# BARRIER ISLAND

## Forum and Workshop

*May, 1980*
*Provincetown, Massachusetts*

18580

*Proceedings of*

# BARRIER ISLAND
## Forum and Workshop

*Provincetown, Massachusetts*
*May 28–30, 1980*

U.S. DEPARTMENT OF COMMERCE NOAA
COASTAL SERVICES CENTER
923A SOUTH HOBSON AVENUE
CHARLESTON, SC 29405-2413

*Barbara S. Mayo and Lester B. Smith, Jr.*
*Editors*

*Sponsor*
NORTH ATLANTIC REGION, NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

*Co-sponsor and Coordinator*
PROVINCETOWN CENTER FOR COASTAL STUDIES

*Host*
CAPE COD NATIONAL SEASHORE

Property of CSC Library

National Park Service
GB473.B35 1980
9825242
FEB 17 1996

*Published by*
NATIONAL PARK SERVICE, NORTH ATLANTIC REGION

Mayo, B. and L. Smith, Eds. 1982. *Proc. Barrier Id. Forum and Workshop, Provincetown, Mass., May 1980.* Boston, U.S. National Park Service. 207 pp.

*Front Cover:* Aerial photograph of storm overwash of Nauset Beach, Cape Cod, Massachusetts during the February 6 and 7, 1978 northeaster (Blizzard of '78). Photo by Richard C. Kelsey of Kelsey Airview, Chatham, Mass. Taken on February 7, 1978.

*Back Cover:* Aerial photograph showing the same barrier beach as shown on the front cover two years later. Photo by Richard C. Kelsey of Kelsey Airview, Chatham, Mass. on September 27, 1980.

# FOREWORD

These *Proceedings* provide a record of the 1980 Barrier Island Forum and Workshop, the second in a series of biennial meetings dealing with the management of barrier islands and other coastal barriers, sponsored by the North Atlantic Region of the National Park Service. The use of "barrier island" in the title is not meant to exclude the other types of barrier beaches or coastal barriers such as barrier spits, bay barriers and tombolos.

The purpose of this conference was to provide the public, managers and decision-makers with an update on research in areas affecting management and an overview of federal policies for protecting coastal barriers. This documentation of the Forum and Workshop has been provided because so many of the oral presentations were exciting, timely, contained much useful information, and appeared to be well received by all involved.

The papers contained in this volume are, for the most part, edited transcriptions of the talks as they were given in the course of this three-day symposium. In most cases only minor changes were necessary to make the papers quite readable. Most of these changes were suggested by the speakers and in all cases speakers had the opportunity to review the manuscript prior to final publication. However, for all subsequent errors, omissions or misinterpretations, contained herein, the editors take full responsibility. In a few cases, the speakers chose to rewrite their presentations, preserving the substance, but changing the format to one they considered more useful for this written record. The papers have been arranged so that they may be copied or reprinted without the contextural remarks which precede each presentation. However, the introductory remarks and question and answer period have been retained for the additional information and completeness they provide.

Barbara S. Mayo
Lester B. Smith, Jr.
Co-editors of *Proceedings*
Provincetown Center for Coastal Studies

# ACKNOWLEDGEMENTS

The idea for this Forum and Workshop originated with Richard L. Stanton, former Regional Director of the National Park Service's North Atlantic Region, and now Superintendent of the C & O Canal. His support, and that of Robert L. Herbst, former Assistant Secretary of the Interior for Fish and Wildlife and Parks, were essential to its coming to fruition in the Year of the Coast.

The actual details of planning the symposium, including preparing the format and list of speakers, fell to the Steering Committee members, who worked long and hard, especially in convincing their colleagues to come and deliver papers on what was exceedingly short notice. The Steering Committee included: P.A. Buckley and Tom Mercer, North Atlantic Regional Office, National Park Service; Paul Godfrey and Steve Leatherman, University of Massachusetts; Jim Killian and Herbert Olsen, Cape Cod National Seashore; and Barbara Mayo, Provincetown Center for Coastal Studies. Marge Burling of Cape Cod National Seashore aided the Committee in coordinating logistics and the many details of setting up the program.

The speakers themselves went out of their way to present timely talks, well illustrated and aimed directly at their audience. Their careful editing of the transcripts taken at the conference, the final versions of which are reproduced in this volume, attest to the time and effort they expended.

Special acknowledgement must be accorded to Harvey Glennon, who transcribed the entire, highly technical symposium and was remarkably able to phoneticize many esoteric terms he probably had never heard before.

Special acknowledgement is given to Jean Kenyon, who, in addition to working closely with the Steering Committee in managing the logistics of the meeting, so competently dealt with the enormous task of retyping edited transcripts, circulating material to speakers, and typesetting most of the final copy.

Credit is given to Gillian Drake of Shank Painter Printing Company who worked closely with the editors in developing the design and layout of the cover and text.

Lester Smith has prepared the source list and update on barrier island legislation which appear in the Appendix.

Finally, the scientists and staff at the Provincetown Center for Coastal Studies, working with Cape Cod National Seashore Superintendent Herbert Olsen, oversaw the details of all arrangements for accommodations, transportation, printing and coordination, including preparation of these *Proceedings.* That the entire operation went so smoothly is to their credit.

# CONTENTS


## PUBLIC FORUM
### Oral Presentations, Wednesday, May 28, 1980

**The Year of the Coast** . . . . . 1
*Robert Herbst, Assistant Secretary for Fish and Wildlife and Parks, Department of the Interior*

**Coastal Zone Management** . . . . . 7
*Michael Glazer, Assistant Administrator for Coastal Zone Management, Department of Commerce*

**Barrier Island Development: What Have We Wrought?** . . . . . 23
*John R. Clark, Senior Associate, The Conservation Foundation*

**Barrier Island Protection Strategies: The Federal Role** . . . . . 33
*Robert W. McIntosh, Northeast Regional Director, Heritage Conservation and Recreation Service*

**Development Alternatives: New Directions** . . . . . 43
*William P. Gregg, Co-Coordinator, MAB-8 Directorate, National Park Service*

**Storm Preparedness: The Potential for Catastrophe** . . . . . 55
*Rodney C. Winslow, Acting Meteorologist in Charge, National Weather Service Forecast, Boston*

**Storm Preparedness: The Aftermath** . . . . . 64
*Edward A. Thomas, Director, Division of Insurance and Mitigation, Federal Emergency Management Agency*

**Public Forum Wrap-Up** . . . . . 75
*Norbert P. Psuty, President, The Coastal Society, and Center for Coastal and Environmental Studies, Rutgers University*

## WORKSHOP: HUMAN IMPACTS
### Oral Presentations, Thursday, May 29, 1980

**Pedestrian Impacts: Assateague Island** . . . . . 84
*Stephen P. Leatherman, Leader, National Park Service Cooperative Research Unit, University of Massachusetts, Amherst*

**Pedestrian Impacts: Padre Island** . . . . . 89
*John T. Baccus and Jack K. Horton, Department of Biology, Southwest Texas State University*

Off-Road Vehicles: Cape Hatteras . . . . . 104
*Paul E. Hosier, Associate Professor of Plant Ecology, University of North Carolina*

Off-Road Vehicles: Cape Cod . . . . . 113
*Paul J. Godfrey, Associate Professor of Botany, University of Massachusetts, Amherst*

Off-Road Vehicles: Fire Island . . . . . 119
*Fred J. Anders, Assistant Leader, National Park Service Cooperative Research Unit, University of Massachusetts, Amherst*

WORKSHOP: ENGINEERING SOLUTIONS TO COASTAL PROBLEMS
Oral Presentations, Friday, May 30, 1980

Structural Approach to Coastal Problems . . . . . 128
*Neill Parker, Chief, Engineering Development Division, U.S. Army Corps of Engineers, Coastal Engineering Research Center, Ft. Belvoir, Virginia*

Non-Structural Approach to Coastal Problems . . . . . 139
*Stephen P. Leatherman, Leader, National Park Service Cooperative Research Unit, University of Massachusetts, Amherst*

Reconciling Structural and Non-structural Solutions to Coastal Erosion Problems . . . . . 148
*P.A. Buckley, Chief Scientist, North Atlantic Region, National Park Service*

Forum and Workshop Closing Remarks . . . . . 169
*Richard L. Stanton, Regional Director, North Atlantic Region, National Park Service*

PROBLEM SOLVING AND BRAINSTORMING SESSION . . . . . 171
*Panel Discussion, Friday, May 30, 1980*

APPENDIX A: LIST OF PARTICIPANTS . . . . . 197

APPENDIX B: LEGISLATIVE UPDATE . . . . . 204

APPENDIX C: NEW PUBLICATIONS AND MATERIALS RELATING TO BARRIER BEACH ISSUES . . . . . 206

# BARRIER ISLAND PUBLIC FORUM

## Oral Presentations
## Wednesday, May 28, 1980

## INTRODUCTORY REMARKS

MR. OLSEN: The purpose of this conference is essentially twofold: to provide the general public, land managers, and decision-makers an update on research in several key areas affecting land management; and, two, how the Department of the Interior and other federal agencies deeply and directly concerned with barrier island management are redirecting, sometimes in striking and unexpected ways, traditional approaches to barrier islands.

With that, I would like to turn the program over to Mr. Richard Stanton, Regional Director, North Atlantic Region, National Park Service.

MR. STANTON: Thank you very, very much, Herb.

I want to welcome you to the Barrier Island Public Forum and Workshop for Managers, the first of what we propose to be a series of such convocations. On behalf of the National Park Service's North Atlantic Region, I am delighted to see all of you this morning and it is standing room only, it appears, shortly.

1980 is the Year of the Coast, and it is also the year that the Department of the Interior has offered its Environmental Impact Statement on alternatives for barrier island management. That document is the theme of the public forum portion of this conference.

The topics that each of the speakers today will address derive their main themes from this document. We hope all of you will leave this portion of the conference with a sense of the new direction that Interior and other federal agencies and departments will be taking in the 1980's relative to barrier island management.

It is my pleasure to introduce to you Bob Herbst, who, as you know, is our Department's chief steward for National Park Service, Fish and Wildlife Service and Heritage Conservation and Recreation Service. One so sensitive to the needs and demands of our nation's natural treasure, Bob Herbst is a professional resource manager in the true sense. He rose through the ranks as Commissioner for Natural Resources for the State of Minnesota before coming to the Department of Interior almost four years ago.

I want to welcome, and indeed it is a very deep pleasure, Bob Herbst, Assistant Secretary of the Interior, who is with us this morning.

# THE YEAR OF THE COAST

**Robert Herbst**
*Assistant Secretary for Fish and Wildlife and Parks, Department of the Interior*

As Dick mentioned, I started my career as a forester and about twenty years ago I left the woods for a desk job and as a kind of outgrowth, I had to accept invitations for public speaking.

Before I took on some of those assignments, I recall visiting one of my professors at the University of Minnesota to get some insight and some special wisdom on public speaking. I asked him to give me some advice and I awaited his profound words.

He said to me, "Bob, never accept an invitation to speak before noon. People just don't seem to hear very well early in the morning. In fact, some of them don't even see you too well "

"Second," he said, "if you slip up and you do accept such an assignment, for Christ sake, don't talk very long. If, for example, they give you forty-five minutes on the program, either they are just trying to make you feel important, or, more likely, they couldn't get the second speaker they wanted or, perhaps, it is the one-for-two concept, something like our hiring practices at the federal government level now."

Then he said, "At the very least, if you must speak early and longer than you should, don't tell any stories."

So, this morning, as your keynote speaker at 9 o'clock in the morning with forty-five minutes on the program, I am going to follow his advice and not tell you any stories.

He would want me to be serious and I know that you are serious about this, the Year of the Coast, and the protection of our barrier islands.

I could not help but think, as I looked out the window of my room this morning, about a scientist, a strong voice for the sea and the coast. No American in our lifetime did more to focus public interest on the sea, on nature, on man's harmful acts, than the late Rachel Carson.

In the introduction to *The Silent Spring* she quoted from Albert Schweitzer, which was an apt quote for her subject—a description of man's tunnel vision, of modern man's blundering forward beyond progress to disaster. I quote them this morning, because they seem far more appropriate for this forum and for us to consider and for us to accept as a real challenge.

Schweitzer said, "Man has lost the capacity to foresee and forestall. He will end by destroying the earth."

Our challenge today and for the future is to prove him wrong. I think we can do it.

This conference and your concern for the barrier islands is a small sign, but at least, I think that you have foreseen that singly and collectively we are trying to forestall the destruction of a very special part of this earth.

This conference and your concern for the coast and for the barrier islands is a sign, if you will, that a few voices crying in the wilderness can turn the power of the tide.

The indifference to the irreplaceable parts of nature's mosaic is not

acceptable. Destruction is not inevitable if we will use our talents for anticipating, for acting, for foreseeing, for forestalling. If the concern for the barrier islands has been sporadic and we have not had a national concern in the past, I believe that that concern has grown. It is more steady than it ever was and it does have the hope of success, because it has enlisted the articulate advocates, as we have in this room, many of you professionals in conservation, and it has also reached a far greater audience, the group of people whose consciousness was raised during the Earth Days in the early '70's.

This decade, beginning as it does with the Year of the Coast, holds out a hope for a better stewardship of our environment and the barrier islands, specifically.

We have, I believe, the components for success. We have professionals and scientists throughout this nation alert and at work. We have traditional leaders and groups concerned as never before. We have a wider public with a voluntary interest. We have government on a local, state and federal level more than ever concerned with conservation, in its complexity, rather than development, in its simplicity. We are getting the kinds of leadership that we need in Washington.

As you know, in the 1979 message on the environment, President Carter said, and I will quote, "America's coastlines are extraordinarily varied, productive and beautiful. The coastal zone is subject to unusual pressure, both from natural causes and from human activities. The opportunity for citizens to enjoy beaches, bays and marshes is often threatened, but working with states, the goals of my policy will include the protection of significant natural resources such as our wetlands, our estuaries, our beaches, our dunes, our barrier islands, our coral reefs and the fish and wildlife of these areas."

We in Interior, and in particular the Fish, Wildlife and Parks end, are carrying out that assignment. Let no one doubt our commitment. It is so strong that it will survive the social and the natural myopia of those that see barrier islands only as vacant land to be developed and to be filled in at whatever cost. It will survive the inevitable austerity pressures of difficult economic conditions that we are all facing. Our commitment will survive and it will, indeed, prosper, because it is right, because it is sensible, and because to do less is to permit greed and ignorance and the children of darkness to prevail.

Why, some may ask, the intensity and the emotion of this commitment? Why does your heart rage for these spits of sand, for these few acres of shifting lands?

I took a stand some years ago and I have had my views reprinted in our Department's publications on barrier islands, and I would say them again, because I want to be on record clearly, concisely and permanently.

I said that barrier islands are different, they contain faceted ecosystems that are not found anywhere else. Because of their inherent beauty, they are places of great attraction, offering not only scenic lands and waterscapes, but also the mystery and allure that seascapes have always had.

Today we see a pervasive disregard of the barrier island nature, of what their proper role ought to be. The balances are fragile, but the forces at work are not. It is clear that we cannot continue to develop barrier islands as if they were mainland sites. Sooner or later we are going to have to pay

for our mistakes.

I believe that today more strongly than the day I wrote it. I believe that not only are we going to pay for our mistakes, we have already and are paying for our mistakes and they are costly. I believe that you and I in this society, in this affluent society and hard economic times have a responsibility that cannot be avoided, that cannot be half-hearted, if we are to protect these precious bits of our universe. They need protection only for one reason–because man will not leave well enough alone.

Listen to what even FEMA, the Federal Emergency Management Agency, which is rarely totally committed to a conservation bias has said, and I quote, "Without human structures there are no barrier island problems. The erosion, the migration, the overwash and the inlet formations that occur on barrier islands are natural processes that can coexist in a state of equilibrium. It is only when structures are placed on barrier islands by man that these natural processes and the equilibrium are threatened and problems develop."

Knowing that, it is mystifying that we nevertheless continue to encourage and promote development.

A Library of Congress study puts it even more clearly: "If developed barrier islands have large potential public costs, undeveloped barrier islands have significant public benefits."

Let me quote it again. "If developed barrier islands have large potential public costs, undeveloped barrier islands have significant public benefits."

The systems help protect areas from the full force of ocean storms. They absorb the energy of the waves and reduce flooding.

During the calmer periods barrier islands protect beaches, wetlands and estuaries from the direct influences of the ocean. Estuaries where the salt and fresh water mix are among the most productive ecosystems in the world. They produce large commercially valuable shellfish, crabs, finfish and wildlife abounds in that habitat.

In short, the barrier islands have unequaled and virtually unparalleled values in this world. They are unique in their animal and in their plant life. They are a favorable habitat not only for fish, but for reptiles, for birds and for mammals.

They provide the protection for our mainlands and recreational activities of a special sort for millions and millions of people whose souls are refreshed and whose spirits soar, like the osprey who nests and feeds nearby.

The figures, by the way, are astounding. Twenty-five million people visited the ten National Park's-administered barrier islands and millions more visited our wildlife refuges.

We must remember that one of every four, and let me put it another way, twenty-five percent of our entire population, lives within one hundred miles of our east and Gulf coast barrier islands. Yet, as many of you know, while the interest in barrier islands has been great for some scientists and some conservationists, it was not until recently that it was articulated as a national concern, when Carter called for a national study and a policy related to barrier islands.

He spoke then of 169 coastal barrier islands, of which 68 were unspoiled. He spoke movingly of the need to protect this special and irreplaceable national treasure of natural resources.

Subsequently, at his direction, we have studied a total of 295 units,

which were part, all, or a group of the islands, totaling 1.6 million acres, which compared to the entire land base of the United States, which is over 2 billion acres, they may not be a large percentage but as I have said, they perform a unique function: they protect one thousand miles of our coasts from storms and the frenzied power of the sea.

Think, if you will, what the coastline would be like without them. Think of the power unleashed on those millions that live so close. Those values question why we are so indifferent and so callous in our regard to the coastline and the barrier islands of our country. Yet, we seem to be so. We ignore or shrug off the sand castles of developers, hardly more permanent than a child's play building at the edge of the sea.

So, in this Year of the Coast, we must recognize the many dangers to the continued existence of these islands. Few of these dangers are natural, as FEMA has pointed out. Of those dangers, most come from acts of development made without apparent thought to the consequences of the inevitable changes that will occur.

The islands are tolerant of the great power of wind and water. They can absorb everything from the gentle shifting of sand to the untold devastation of the most devastating hurricanes.

What they cannot tolerate is wood and concrete where they should never be. We can foresee the consequences, yet we build on dunes which, left alone, would replenish themselves. Then, we see them destroyed and then we build them again, close to the sea, and challenge nature.

When the inevitable destruction occurs again, the remnants of our work, structures of wood and metal, bits and pieces, stand mute like scarecrows in the field ravaged by birds and weather. We are as wise as those scarecrows, monuments to our ignorance.

I say to you that it is preposterous to handle nature this way and I understand that much of the development grows out of the legitimate human urge to savor the sights, the sounds, the joys of the sea and the landscape. But to purchase those temporary pleasures for a few today at the inevitable cost to generations is foolhardy.

How long does it take us to learn? The coastal zone along our continent has enough problems of development as it is, without the mindless scrambling to find even more problems for the islands themselves.

We seem unable, even now, to define a protective system for our entire coastline. We watch, even now, in the Year of the Coast, as they are threatened by refineries, by power plant sitings, by ports for larger tankers.

We fill up our marshland, we pollute our estuaries, we destroy the grasses and the life of the coast as though these were the only protein upon which we build the sinew of the industry of our nation.

It is short-sighted and, for certain, it is not visionary.

I don't hesitate to criticize economic policies of private initiative, since they are so confused. But our federal government policy, which seems to be one that should be more amenable to national order, is just as confused and maybe even more so.

There are at least twenty federal agencies which administer thirty programs which affect the barrier islands. Half of these programs are pro-development. About twenty-five percent of them are protection-oriented and, of course, isn't that our general policy on whatever the issue is? The Government giveth and the Government taketh.

We spend endless millions of dollars to encourage development, while we spend other endless millions of dollars to encourage protection.

When nature proves us fools by throwing away what we have built, then we start all over again, because we have insured ourselves against what was sure to be destroyed and then we spend millions more and perhaps repeat the cycle several times over.

So, if lemmings could write insurance, not one would be unemployed because our policy is like writing insurance on a building that is already on fire. We are bound to lose, yet we persist.

Our barrier island economic policy is part compulsion to build and part local boosterism, I suppose. It is the creature of economic development laws, small business loans, disaster insurance and emergency compassion. All of which makes sense, except on barrier islands where it is built on a foundation of shifting sand.

Our present policy is a cycle. Build, destroy, build. It reminds me of Senator Everett Dirksen who once mused, "A million here, a million there, pretty soon it adds up to real money."

So, then, in this Year of the Coast, we would all do our nation well if we could convey wisely the idea that the best economy is to spend to protect the islands. It is both the most liberal and the most conservative approach in this, a political year. We have the chance to protect. If it costs too much to buy them all, which it does, there are still many other things that can be done, or at least started in what remains in this, the Year of the Coast.

First, while much is known about the barrier islands and how they react to the various forces, we do need a coordinated, system-oriented research program to determine even more precisely how the islands function, so that we can better predict how they will react to future forces.

We need to move to protect the undeveloped and yet unprotected islands.

We need to improve the level of protection of lands which are already under public control. That will take further coordination and consultation between the public and many other local and federal agencies.

It will take firm decisions, many of them controversial, but they must be made.

Where there are undeveloped islands, and where it is appropriate, we must move to restrain or channel development from free growth into development which is compatible with permitting the islands to live on, ever-changing, but in a sense, ever-permanent.

We must do this together. We have not lost our ability to foresee. We have not lost our ability to forestall. Despite that, it remains unresolved whether we will, in the end, destroy the earth, starting with the barrier islands.

We don't have to let it happen. Bob McIntosh of our Office this afternoon will outline to you our proposed alternatives for policy at the national level.

I would hope that we would go from this place preaching a doctrine that will help save our nation's soul, that the barrier island belong to all and forever and that we do, individually, and collectively, see to it that our words become, in fact, deeds, and that the words of Albert Schweitzer will not become fact.

Thank you.

*[Questions to Mr. Herbst and Mr. Glazer follow the next presentation.]*

## INTRODUCTORY REMARKS

MR. STANTON: Our next speaker is Michael Glazer, the National Oceanic and Atmospheric Administration's Assistant Administrator for Coastal Zone Management, Department of Commerce. He has been in that office since January of 1980.

In that office, he is responsible for NOAA's Coastal Zone Management activity, which includes state programs, marine and estuarine sanctuary programs, coastal energy impact programs and closely related programs.

He serves as the primary policy officer with the authority and responsibility for implementing the programs authorized in the Coastal Zone Management Act of 1972, including amendments in 1976 and 1980.

Prior to his present position he was NOAA Assistant Administrator for Policy and Planning during 1978 and 1979.

Mr. Glazer will address us on the topic of Coastal Zone Management, Opportunity for Action.

# COASTAL ZONE MANAGEMENT: OPPORTUNITY FOR ACTION

**Michael Glazer**
*Assistant Administrator for Coastal Zone Management, Department of Commerce*

It is a pleasure to be with you here today to talk about barrier islands. I feel a little bit like somebody trying to follow Billy Graham, but I compliment Assistant Secretary Herbst. I think many times I, myself, have noticed that we sometimes forget why we are involved after all the talk about dollars and cost-benefit ratios, things like that. Sometimes we get so used to talking about that kind of thing that we forget the real, almost spiritual reason why we are doing what we are doing.

My view today is going to be, although unintentionally, complimentary to his.

I want to take the view of the people down in the trenches, so to speak, where the battles to achieve the kind of benefits that Assistant Secretary Herbst was talking about, have to be fought. I want to talk a little bit about some of the tools we currently have available to do that and why those tools can be applied with some promise during the 1980's. I want to finish up with a few ideas about other possible management techniques that might be applied during the 1980's.

Let's not forget, as Mr. Herbst mentioned, that fifteen years ago almost no one outside of the scientific community knew much about the structure or functions of wetlands, dunes systems and other natural features associated with barrier islands.

We are in a difficult and time-consuming process of educating state and local governments, creating state and local institutions that can address and start to grapple with the kinds of problems that have been addressed and educating the public so that when people try to accomplish the kinds of things that we are going to be talking about here, the public is politically receptive to it.

We don't work in any abstracts here, we have to work in a political system where, in order to achieve the kinds of benefits that we are talking about, it takes a great deal of work on the state and local level, as well as at the federal level.

Let me first describe some of the tools that we already have to manage barrier islands effectively, at least through the Coastal Zone Management system—in my view, tools that we have only started to use effectively.

Under the Coastal Zone Management Act an approved State Coastal Management Plan must include policies and procedures that will assure appropriate protection of valuable natural coastal resources, such as wetlands, beaches, dunes, and barrier islands. It must improve management of development in coastal areas in order to avoid or mitigate losses of life and property. It must better coordinate government activities at all levels.

The process of developing State Coastal Management Plans has been a long and difficult one. Since 1974, when funds were first made available to states under the Coastal Zone Management Act, nineteen state programs covering about sixty-eight percent of the nation's coast have been approved

as meeting federal standards. By the end of this year, twenty-five states and territories, covering about eighty-two percent of the coast, likely will be covered. These will include nine states representing seventy percent of the East coast shoreline and four states representing forty-five percent of the Gulf coast, the areas that we are most concerned about here for the next several days.

We are just now in a transitional phase from a time when states were spending most of their efforts trying to put in place institutions and laws to manage the coastal zone, to a time when they are going to be able to use the federal monies that are becoming available to them to actually do management.

Barrier islands have already, however, received significant attention in the development and implementation of state coastal zone management programs and I want to explain a little bit about the various approaches that states have taken, as I said, to fight this battle out at the local and state level—where it has to a great extent been fought.

Four basic types of approaches have been used by states so far.

First of all, most of the states with approved programs administer permitting systems that include consideration of the values of special resource areas, such as barrier islands.

The state that we are in today, Massachusetts, has a Wetlands Protection Act that regulates development so that activities will be forbidden or conditioned if they adversely affect certain vital interests such as storm damage prevention. New Jersey has a state-level permit system that regulates large-scale development. South Carolina has a coastal regulatory program designed to protect barrier islands from development that would adversely affect their natural values. I suppose one of the frustrations and delights of federal coastal management programs is the variety of approaches that states have taken to protect the things that they think are important. The examples that I am to be giving you will illustrate the variety of approaches taken in different states.

Rhode Island has adopted a policy that prohibits development on undeveloped barrier beaches and has specific safety requirements for additional development on beaches that are partially developed. For example, new construction must be elevated six feet above the storm surge height requirements established by FEMA. That is one set of requirements that states have adopted—permitting systems.

A number of states have, secondly, enacted special area protection laws that have beneficial effects on barrier islands.

Massachusetts designates Areas of Critical Environmental Concern and Areas of Preservation or Restoration, whose primary effect is to negate all exemptions to filing under the Massachusetts Environmental Policy Act. This insures that any project proposed in any one of these special areas is fully reviewed in the interest of protecting the conservation, aesthetic and other values of the area. Similar beach and dune protection statutes in state coastal programs in South Carolina, Texas, Alabama, Delaware, Maryland and elsewhere have assisted in protecting barrier islands and in limiting development and subsequent losses in these erosion-prone areas.

A third set of approaches, as a result of program approval, has resulted in a more stringent review of infrastructure decisions under the policies of individual coastal zone management program plans.

For instance, Massachusetts has a policy to, "ensure that state and federally-funded public works projects proposed for location within the 100-year coastal floodplain will not promote growth and development in damage-prone or buffer areas." South Carolina's management program includes innovative policies to discourage new public investments in infrastructure such as roads, bridges and sewers on undeveloped barrier islands. New Jersey has adopted a Shore Protection Master Plan to give special reviews to infrastructure projects that might affect sensitive areas like barrier islands.

Finally, state coastal zone management program funds have also been used for special projects related to barrier island protection. For example, funds are being used or proposed in Alabama, Louisiana and South Carolina to develop management programs for barrier islands and to study special problems such as erosion. Delaware is using funds to map its barrier beaches and will establish a setback line on which new regulations for managing beaches and dunes will be based.

In some cases where barrier islands have already been developed and are experiencing problems, coastal zone management funds have also been used to address these problems.

I would like to give one illustration of what a state coastal management program can do with respect to barrier islands. North Carolina's Currituck Banks have become increasingly threatened by development in the last few years. Perhaps many of you are acquainted with it; it is a twenty-six mile long barrier spit extending southward from the Virginia border with the Atlantic Ocean on one side and Currituck Sound on the other. It consists of beaches, ocean front dunes, maritime forest and marshland, all the pristine and beautiful values that we are trying to maintain on our barrier islands.

By the mid-1970's 8,000 lots had been plotted on this spit. A road into the area was under study and the Currituck County planners, who were designing a land-use plan under the State Coastal Zone Management Program, were becoming concerned about the fate of this unique area.

At about this time, the U.S. Fish and Wildlife Service began to consider acquiring as a wildlife refuge the northern thirteen miles of the barrier spit and other lands farther along Currituck Sound.

However, problems that I think are not unique occurred. The county residents insisted on continuing uses of the area that weren't compatible with the federal plans and the refuge proposal was not supported locally. The result was a standoff, such as we often see when the federal government, with the best of intentions, comes in and tries to work with local people who may have other ideas about what they would like to see.

To develop a compromise and to avoid possible legal battles, the state Office of Coastal Zone Management stepped in as part of its implementation of North Carolina's Coastal Management Program. The county was persuaded to take a comprehensive look at the future of the Banks and to include a Fiscal Impact Study on the relative advantages of development and preservation. The state provided funding for this study through their Coastal Zone Management Program.

The study indicated that acquisition by the Fish and Wildlife Service would be financially better for the county than development.

The state program staff met on many occasions with county officials,

regional Fish and Wildlife people, officials in Washington D.C., both Coastal Zone Management and the Department of Interior, to put together conditions for a refuge acceptable to all sides.

Eventually, a compromise was reached and the governor of the state, a state advisory committee and the Currituck County Board of Commissioners have all endorsed the plan for the refuge.

Under this plan the Fish and Wildlife Service will acquire the northern thirteen miles of barrier beach and portions of wetlands along the Sound. The county will permit only limited development on the rest of the southern portion. That development must meet certain conditions as part of the Coastal Program, including ocean-front setbacks and marshland protection. Over half of the plotted lots will be included in the planned acquisition, with no development permitted on those lots.

The North Carolina Coastal Program served as a catalyst and intermediary in reaching the compromise and I think the acquisition probably wouldn't have been possible without the federal government working with state and local support.

FROM THE FLOOR: I would like to raise a point on that because the fact is that the present plan of the County Commissioners is to triple the density in the lower half. I would like to know what that means in the face of the fact that they are not proposing an extremely high density development.

MR. GLAZER: Well, I am not an expert in this area. I would suggest, from the information I have that possibly more widespread and devastating development was avoided by this; but as you can see, the program, even in compromise, is not one that is totally acceptable. I would be glad to talk with you afterwards. I am not intimately familiar with this example.

FROM THE FLOOR: Why I bring this up is, if you preserve one piece by compromise, it really comes out that you are doubling or tripling or quadrupling whatever may be the development in the remaining area, and the question is, what are you gaining?

MR. STANTON: May I interrupt for a minute and ask out of courtesy to the speaker and the other participants in the audience, that you permit Mr. Glazer to complete his talk. After that I am sure he will be glad to talk to your specific questions and issues that–

MR. GLAZER: I don't particularly mind that interruption because it is an example, a real-world example, of the difficulties we have in trying to deal with local pressures and with various levels of state, federal and local governments, all trying to operate. Whoever wants to speak can say it and then we will go on. What were you going to say?

FROM THE FLOOR: There is no compromise, the whole process is still under study. It will be addressed in a final Department Impact Statement. It will come out very shortly.

MR. GLAZER: Fine.

This is perhaps a good example for a discussion later, because, again, here we are dealing with an area where development has been planned for a substantial number of lots. We are trying to find a way to achieve some of the kind of benefits that the Assistant Secretary was talking about at first in what is at best a very difficult situation.

Let me review another mechanism available under the federal Coastal Zone Management Act: the Coastal Energy Impact Program. This is a

program that is not generally thought of as something aimed at barrier island protection. It is a program that was passed in 1976 to assist states in planning for, accommodating and ameliorating the effects of energy activities off our coast.

However, states have been able, innovatively I think, to use funds under this program for barrier islands protection. To date nine states have used Coastal Energy Impact Program assistance totaling almost $2 million to perform planning studies which directly or indirectly involve barrier islands.

For example, Louisiana has used program funds to investigate the extent of damages to coastal marshes caused by energy activity and to devise strategies to prevent erosion. Texas has used Coastal Energy Impact Program funds to plan for the impacts of energy activities affecting Mustang Island and to perform ecological baseline studies of the biology of marine and estuarine deposits in the vicinity of Corpus Christi. Maine, New Hampshire, New Jersey, Rhode Island and Delaware have all done similar studies with Coastal Energy Program funds. In addition to planning, the states of Massachusetts, Texas and others have used CEIP funds to construct facilities affecting barrier islands.

Massachusetts has two projects for oil spill cleanups, should that be necessary, as the result of the oil exploration activities which may take place off its coast. Texas has constructed beach improvements that have tended to attract people away from sensitive barrier island areas, as Padre Island and Port Aransas.

A third coastal zone management program affecting barrier islands, again not often thought of as directly affecting islands, is the National Estuarine Sanctuary Program, which provides federal matching funds for the planning, acquisition and operation of estuarine sanctuaries.

Areas chosen for this program must be relatively undeveloped so they can be set aside to serve as field laboratories for the study of natural processes within coastal ecosystems. Although the program's principal purposes are estuarine research and education, protection of barrier islands has become an important incidental benefit.

Four barrier islands are included within the seven established sanctuaries. Three in Apalachicola, Florida, and one in the Sapelo Island Sanctuary in Georgia.

I don't want to imply by all this that barrier island problems are solved. It is obvious that they are not; they are not even on the way to being satisfactorily solved.

For example, many state coastal programs do not address barrier islands specifically, but treat them instead only as part of a wetlands or hazardous area.

Other states do not have coastal management programs that meet federal standards, and it is not clear that they ever will.

Nonetheless, there are some signs, I think, that the decade of 1980 will bring some important changes in how we treat barrier islands.

Let me say that as we look ahead to the 1980's, we see a high probability of an escalating level of conflict in barrier island areas. Development pressures are likely to intensify in the years ahead. Already more than fifty percent of the U.S. population lives in coastal areas containing only eight percent of the land area of the nation. People continue to be drawn by the

beauty and diversity of our coastal areas. Much of the development pressure on barrier islands is a function of their location within weekending distance of major metropolitan areas.

At the same time that development pressures are increasing, public awareness of the ecological and public protection values of barrier islands is also on the rise.

As I mentioned, fifteen years ago not many people had heard about the benefits of barrier islands. Now, public knowledge is much more widespread and many states have enacted or are starting to grapple with enforcement of laws designed to protect these natural features.

Another force that will counter development pressures is the increasing taxpayer vigilance. I think taxpayers are simply going to become more reluctant to support public investments in the form of improvements such as roads and water and sewer systems or in the form of insurance for private development in these high-hazard areas.

It was interesting that one of the ads in the *Washington Post* four or five months ago, a Howard Jarvis ad, following up on Proposition 13, talked about barrier islands expenditures as a waste of taxpayer funds.

The probable increase in pressures for both development and preservation suggest that it is important to find ways of preventing barrier islands from simply becoming a battleground in the 1980's. I think there are many signs that the need for a clear national barrier island policy is being recognized.

There are signs at all levels of government. In the Congress we have seen recently a number of new bills aimed at just such a policy. The Burton bill, which many of you have followed, has been extensively debated in Congress. Congressman Ullman has been working on a similar bill.

Recent amendments to the Coastal Zone Management Act, approved by committees in the House and Senate, are likely to pass this year. Perhaps they are a little further on than some of the legislation. Both committee versions refer clearly to barrier islands as features of national significance and both explicitly allow us in the Office of Coastal Zone Management to direct a significant portion of our coastal management awards to states to make improvements in their ability to address significant coastal protection goals–the theory being that a portion of the federal funds provided under the Coastal Zone Management Act should be provided to allow the state permitting and other systems to operate now that they have been put in place, but that up to thirty percent of the funds should be continued to be applied to make improvements in how those states manage significant natural resources, including barrier islands.

We will be able, in effect, to target our funds in the future to ensure that these issues are addressed. In states where barrier island management and protection is a major issue, funds will be targeted for that purpose.

The bills would also re-authorize a portion of the Act concerned with island preservation that has never been funded in the past. If re-authorized and funded, the program would be managed in a manner similar to the Estuarine Sanctuary Program. The funds would be used for the protection of barrier islands through acquisition or purchase of easements, development rights and similar activities.

Benefits from such a program would include leveraging state funds through fifty percent matching grants, state ownership and management

of the land, which thereby reduces local apprehension about federal control, a close link with the State Coastal Management Program and an emphasis on research and education, with multiple uses encouraged to the extent that they don't interfere with the primary purposes.

I think the President's commitment to re-authorization and improvement of the Coastal Zone Management Act is going to have an important consequence in the 1980's. At a time of almost hysteria in Congress about our national budget, the administration has gone on record as supporting over the next five to seven years appropriations of more than $375 million to improve our state coastal and federal coastal zone management activities. This is an important commitment, a commitment that I think follows the language in the President's Environmental Message with some real dollars.

This movement, to clarify our national policy on barrier islands, is also evident in the executive branch. Brief mention was made, and I guess it will be discussed later, about the important role of the Barrier Islands Environmental Impact Statement. That is a pioneering effort very capably being conducted under the leadership of the Department of the Interior in an effort to try to look at the whole range of policies being applied to barrier islands and to try to make some sense out of them and to articulate some policy choices for the future. It is a very important exercise, one I think will give considerable direction to both the executive and legislative branches.

Another area of executive branch activity is the Federal Coastal Program Review now being conducted by NOAA, the National Oceanic and Atmospheric Administration.

The President's 1979 Environmental Message announced a national coastal protection policy, part of which Mr. Herbst quoted, that provides, among other things, for the protection of significant natural resources, including barrier islands.

The President also directed NOAA to conduct a review of federal programs affecting coastal resources, to assess their consistency with each other and with objectives of the National Coastal Protection Policy and to determine whether federal programs contribute to environmentally unsound or uneconomic development in the coastal areas.

Now, the fact that federal programs don't operate consistently is undoubtedly no news to anybody who has followed this area. This is one of a number of efforts going forward to bring the federal house into order. To some extent the state coastal zone management programs are an attempt by the federal government to get states to bring their houses in order, but I think there is a long overdue recognition that the federal government itself doesn't always operate as a smoothly oiled machine. Many of our programs operate at cross purposes, and I think that through the Federal Coastal Program Review and the barrier islands study, we have important ways of getting at this kind of a problem.

One of the specific concerns being addressed by the Review is the charge that government programs have encouraged development of coastal hazard areas such as barrier islands. For example, the President indicated that, "The potential development stimulus of the National Flood Insurance Program in the coastal zone is an often-cited example of the inconsistency of federal program goals."

Perhaps it is no news to anyone, but I think it is worth recounting, some of the unintended effects of programs such as this.

An actual occurrence in Rhode Island provides the basis for much of the criticism that we have often heard about the Flood Insurance Program. In the late '20's and '30's a substantial amount of development occurred on Green Hill Beach, East Beach and Jerusalem Beach in that state. A 1938 hurricane swept these beaches clean of development, killing forty-nine people in the process and creating many millions of dollars in property damage. Because of this hurricane, little development occurred over the next sixteen years and what was left was wiped out in 1954 by a hurricane, again costing one life and almost a half million dollars in property damage.

Soon afterwards, the state acquired a large portion of East Beach, but almost no land was developed on any of the three beaches until the National Flood Insurance Program came into being.

Today there is considerable development on the barrier beaches. In fact, three houses in Charleston have recently fallen into the water due to erosion and their owners were reimbursed by the Flood Insurance Administration. One Rhode Island official indicated that the owners feel that having a house on the beach is worthwhile, as long as they will get their money back from insurance if a hurricane strikes.

This is the kind of issue that the Federal Coastal Program Review is addressing. The kind of remedies that are possible include mapping, ending subsidies for insurance in coastal high-hazard areas and ending insurance coverage altogether in these areas.

Through the Review, and the Barrier Island Environmental Impact Statement, we are looking carefully at federal activities in the coastal zone to assess their effect on coastal hazard protection, public access to the shore and improved coordination through planning and permitting in special areas.

Important activity can also be expected elsewhere.

As I indicated earlier, this decade of the '80's will be a decade in which substantial funds will be devoted to states to improving their management in coastal zones.

The tools and funds will be there, but the effectiveness with which they will be used during this period will depend to a great extent on the vigor and imagination of state and local government officials, private citizens and private organizations.

I should also mention in connection with state programs, that technical assistance will continue to be available through Coastal Zone Management Programs to state and local units of government to improve local plans, zoning ordinances and construction codes, to identify areas for acquisition and to use the federal consistency provisions of the Coastal Zone Management Act to ensure that federal infrastructure actions complement state and local plans.

I also, in passing, do not want to fail to recognize the substantial contributions of private individuals or organizations, such as the Nature Conservancy, in acquiring and protecting barrier islands. Their efforts will also continue to play an important part in what is going on in the 1980's.

Let me briefly mention, in closing, a few relatively new ideas that might also help avoid barrier island conflict in the 1980's.

Recently a Truth in Coastal Development bill was proposed by a North

Carolina real estate broker in testimony before a congressional subcommittee. In his view such a bill would require that developers tell potential buyers which areas have been flooded in the past one hundred years, the rate of island migration or erosion and the possibility of a hurricane or major storm hitting the area. They might also be required to describe the risks to existing development when such an event occurs again.

Similar requirements already exist under the Interstate Land Sales Full Disclosure Act. They are so riddled with exemptions and exceptions that they really are not effective.

Another series of related requirements are included in the Flood Insurance Act, however, there are no penalties for non-compliance.

The ignorance of buyers in these areas is not a hypothetical problem. Most of the current property owners in the Rhode Island example that I mentioned are from out of state. In fact, many of them are from out of the country. They had no idea of the dynamic nature of the barrier beaches when they acquired their land.

While the information stemming from a Truth in Coastal Development bill might not dissuade all potential buyers from acquiring property on such islands, it would help to dissuade me and I think it would dissuade a substantial number of potential buyers. That is not without problems, of course, because there are people there who are trying to sell the land that they own and so we have a very difficult social problem.

Another idea that I would like to discuss is system management in areas such as barrier islands. It is becoming increasingly obvious that habitat protection can no longer be accomplished solely through fee simple acquisition by government agencies. We just cannot afford it. Nor can we rely solely on regulatory frameworks that do not promote system management or provide conflict resolution mechanisms.

We may need to develop new strategies to facilitate the management of barrier island ecosystems that allow for the protection of the naturally functioning system, yet at the same time recognize some of our economic needs.

Some case studies of prototype efforts at multiple agency system management do exist: the New Jersey Pine Barrens Legislation, the Apalachicola Bay and River National Estuarine Sanctuary, and the Grays Harbor Special Area Management Plan in Washington.

Coupled with these cases is the growing use of innovative land acquisition techniques and their application to overall ecosystem management. Examples of pioneer work in this field are the use of land trusts in California, the use of easements to protect riverine watersheds, and the use of creative developments in a process that takes into account the natural resource base, future population needs and community socioeconomic needs to allow ecologically, as well as economically, viable development of land.

In fact, several of the best examples of this trend are located in Massachusetts. One such project was the development of a large parcel of land on Martha's Vineyard that provided community open space, a bike trail easement and subsidized land purchases for residents without cost to the taxpayer.

At Seal Beach, California, the state and local community are working together in planning a unique, self-supporting development with public

recreation facilities, in part financed by funds from the Coastal Energy Impact Program.

We need to explore ways to incorporate innovative less-than-fee acquisition techniques with the multiple-agency system management concept into a national strategy to protect certain unique natural systems such as barrier islands.

Finally, as I indicated, and as I think the Assistant Secretary indicated, most of all what I believe we need right now is a clear national policy on barrier islands. We need a clear signal to federal agencies to guide their actions and direct their funds and to direct their interactions with state and local governments.

The Barrier Island Environmental Impact Statement is the first step towards such a policy.

The Federal Coastal Program Review, I believe, will help in this effort as well.

Perhaps such a policy should be embodied in an Executive Order such as the Flood Plain Management Order. Perhaps legislation is needed. I look forward to hearing your ideas on this subject.

I think all of you here at the symposium will spend the next few days discussing and considering these and other ideas and alternatives for better managing barrier islands in the future. I think in doing so we have to keep firmly in mind the ideals that the Assistant Secretary mentioned. I think that is what we are all after.

We also have to keep in mind what kinds of tools we are going to have to deal with these problems and the fact that in the end the gains that we are going to be able to make are going to come from hard work at the state and local levels and at the federal level as well and that we cannot simply wave our hand and cure all the problems. It is going to take continued vigilance and continued work by many people over the next decade.

I want to assure you that the Office of Coastal Zone Management will continue to work toward responsible management of the nation's barrier islands through improvements in State Coastal Management Programs, through interagency coordination at the national level, through acquisition efforts and through technical assistance in education.

I believe that the 1980's are going to see a vast improvement in our ability to deal with barrier islands, but that it will require all of our time and effort and hard work to achieve those improvements.

Thank you, and I will be glad to talk about the North Carolina situation afterwards.

Thank you very much.

MR. STANTON: Thank you very much, Mr. Glazer.

## QUESTIONS TO MR. HERBST AND MR. GLAZER

FROM THE FLOOR: It seems to me that the collision course that I perceive that we are involved with here is sort of the fundamental American principle that he who owns a piece of property is allowed to do anything he wants to get the maximum benefits and at the same time a public policy which designates certain areas as being critical, such as barriers, and so

forth.

I haven't been able to follow the very latest on it, but it seems to me California took a rather strong position in this when they made their program and said that state interests like this could override this great American tradition and that is being tested in the Courts.

Is this kind of thing yet to be resolved or are all of these programs waiting around and nobody is ready to bite that bullet?

MR. HERBST: I think it is a combination of both.

Let me first answer your basic question about the fundamental right of private ownership.

There is a higher fundamental right which began with the Bible itself, in which no man owns the land. He is custodian of it while he is on the earth. He is to leave it in condition for future generations.

The Bill of Rights of the United States did not give individuals unlimited rights to exploit for the few at the expense of the many. All of us had rights to green space, fresh air, health and a quality of life in those Bill of Rights.

People cannot go hell-bent to destroy, because they believe they have an unlimited right for something that they own for a short period of time.

What we are trying to say and what Mike was trying to say is that the federal policy, state government policy and the private initiative of economic development is a mismatch and there is no overall comprehensive policy as to what ought to be preserved and how much of it ought to be preserved. For that which is already developed there is no policy for what kind of development, where the development should be, how much development and what kind of reconstruction can be allowed in these sensitive areas.

What we are trying to develop jointly between the agencies at the federal level, the executive branch, through Congress and through the State Coastal Zone Programs and through the Coastal Alliance is some kind of a comprehensive approach, land planning, if you will, to see to it that the barrier islands continue for the benefit of the many and that the development at the expense of the many, for the good of the few, is not there.

FROM THE FLOOR: I am with you on that, I am just wondering how this is making its way through the Courts, if this has been litigated yet, as it inevitably will be in my judgment.

MR. HERBST: There are examples at the Court level as well. They speak to just exactly the issue that I spoke of. A good example would be the Boundary Waters Canoe Area of Minnesota in which there was private ownership of mineral rights, but there was a higher right to society as a whole and the Court ruled in that direction and, subsequently, the State Legislature and Congress itself ruled in that direction, that there could be no mining in the BWCA. So there are cases in which the public right has overridden the private right. There are other cases in which the reverse has occurred, so it goes both ways.

MR. GLAZER: Let me just mention on the California example, there was a lawsuit involving the California Coastal Zone Management in which the American Petroleum Industry challenged the federal government's approval of that Coastal Zone Management Act and lost, basically; the Act was upheld. That doesn't end the battle, however. The California Coastal Zone Management, California Coastal Commission, which is a very

progressive Commission in terms of its attempts to protect the coastline, is under constant attack in the Legislature from economic development interests. They had to weather a storm of bills last year, they had to weather a storm of bills this year and they are going to have to weather a storm of amendments next year. So, it is a never-ending battle.

They don't happen to have barrier island problems, but the battle is not won by a longshot, even for some kinds of things that we tend to think of as fundamentally accepted by now in Coastal Zone Management.

MR. HERBST: But there is no question that when the bullets are bit on all of these policies, or even on existing decisions on existing public lands, they will be challenged in Court. I expect we will probably have a lawsuit on our hands in a few days just on the rights that we issued on Back Bay and the access across that beach, which are heading out in final form this week.

I expect that whatever we do on off-road vehicles in a number of public areas up and down, we will be challenged by one side or the other, no matter what we do. We are every week on something or other.

FROM THE FLOOR: I wanted to ask Mr. Glazer, how do you get the politics out of the Coastal Zone, it seems like the politicians seem to be telling you what you want to hear, but they are not listening to the experts, in fact, they won't even when the local people ask to have experts come in, people who know about barrier islands, to talk to us. We aren't getting the information to the administration and that is what we really need.

MR. GLAZER: I don't think that you can really get the politics out of Coastal Zone Management. If there is anything that is evident, from our experience at least, how you use land and regulate land is political. It ought to be. It ought to be in the best sense of the word. I mean, we are talking about people charting their own destinies. I don't think that we should simply turn it over to some kind of a board of experts to make those decisions. But I do think that we have to effectively bring scientific information into that process. It is a very long, difficult procedure. You are talking about educating people, often when we don't even understand ourselves all there is to understand scientifically. I don't know any answer for it, other than to keep plugging away.

FROM THE FLOOR: I think at least the administrators ought to be oriented toward the intent of the coastal zone program instead of letting the local politicians who are supported by the developmental interests run the show. That is what we see happening in Maryland.

MR. GLAZER: You are talking about one of the fundamental issues that is raised by the Coastal Zone Management process that we are engaged in, which is what level of government ought to make decisions about the coastal zone. There is a great strain in American life that says we want to push that down as far as we can, let's let local individuals rule their own futures.

On the other hand, you are right, oftentimes it is much easier for local government not to be the level that has to make the hard decisions, because they are saying no to their neighbor who wants to turn his or her house into a hotel.

So, many have tried to kick that up to the state level and, oftentimes, the state is relying on the federal government to help put pressure on them, so that they can say, oh, gosh, the Feds are making us do this. We don't

really want to do this to you. But, you know, we have to. There is no easy answer to that, either.

It depends, I think, on the political situation in each state and locality. My preference would be, I think, that if it could be done directly, that it be done on the most local level possible. But we are facing very real pressures, as you say, and I don't know a clear answer to that, either, I am afraid.

FROM THE FLOOR: If the local level wants to make the decisions, why don't they have to pay for the mistakes that they make instead of going to the federal government to bail them out? I think if they would see the reality of that, they would have to put up all the money for the beach protection, you would have a lot better government.

MR. GLAZER: Don't forget, when Hurricane Frederick came through, there were a lot of people in need. As the Assistant Secretary mentioned, part of it is the natural human sympathy when a disaster occurs. What can we do for those people. It is very hard to say, "Sorry, but ten years ago we told you so." I'm not saying that is not something we should be doing, but we are generous people in some regards and that works against us on barrier islands. The rules don't apply the same way.

FROM THE FLOOR: I would like to know whether you have had a lot of feedback on the draft Barrier Island Statement to be able to see at all what is the preferred alternative, what is the recommended alternative, whether they can perhaps be expected to take a very strong stand with some teeth in it or anything like that?

MR. HERBST: It is premature for me to tell what alternatives we are going to recommend to the President, because not all of the comments are in yet and, in fact, not all of the analyses and comments are even in from the federal agencies themselves.

We are very hopeful that we can brief the Secretary in July and, perhaps , get the final package of recommendations to the President in August, but my sense is that we will be as tough as we can consistent with scientific facts and public input on an array of tools, as Mike mentioned.

FROM THE FLOOR: There is a problem that arose in the Plum Island, in Newburyport, the Wildlife people wished to put in an auditorium to educate people about barrier beaches and about the ecology, but the auditorium was of such size that we felt it was going to wholly ruin Plum Island by the fact that it was going to put in a big parking area and an enormous concrete building in an area that is right now very narrow and fragile. How do we protect ourselves from those who are supposed to be protecting us?

MR. HERBST: Well, I don't know why everyone keeps bringing that up and writing me letters that we ought to stop that; I stopped that a couple of months ago. There is no construction underway at Parker River. We made a complete analysis of all proposed construction by both Fish and Wildlife Service and National Park Service on the entire coastline and anything in that proposed construction that was inconsistent with even our proposed tightest policy was dropped. That was one of them. That was dropped a couple of months ago.

FROM THE FLOOR: It just seemed to me so inconsistent with the policy of putting up something that was going to ruin our Island.

MR. HERBST: That is why we stopped it. That is why proposals are

made in the first place and, as you know, the master planning of parks and refuges or national forests or scenic rivers include all kinds of proposed development for uses that are compatible with the major mission of whatever it is that you are administering. Not everybody agrees with certain types of development that are proposed and the array of feeling over what kind of facilities and what kind of services and what kind of development ought to be in a national park or in a wildlife refuge varies, depending on who you are talking to from lots of development to zero development. Each one becomes a case in and of itself, but in the one that you referred to, it was stopped.

FROM THE FLOOR: Are there any clear-cut guidelines for the pathway through the Fed that somebody takes when they want to do a development. Is there something that we should speak to, Historical Preservation, Fish and Wildlife, Water Quality, Corps of Engineers, and so forth. Is there any clear-cut path that is charted as to who must be consulted and how that might spread out to the other agencies?

MR. HERBST: It depends on the specifics of what you are talking about. If it is biological in nature, chances are it is NOAA and ourselves. They would be the two principle agencies to talk to. Chances are on most development projects there are those things that cause you concern, if you can get ahold of one or the other, they will normally alert the others that are involved. But as I pointed out on the barrier islands, we have at least twenty federal agencies with at least thirty program areas that are involved. If you get into water projects, you are off and running with another twenty or thirty agencies involved.

You try to consolidate in the federal government and eliminate some of the overlap and duplication. It is like trying to eliminate an office someplace in the country. Everybody is in favor of it, until it happens to be the office in their town and then you just can't seem to close that office because it is there, it has been there and it is important to them; and the same thing is true with restructuring and organizing the government. There are a lot of things that we could do to improve the effectiveness and the efficiency and free up overhead to be more productive in the water area, in the environmental effects area, in the fish management area and so on. When we start suggesting these things, then it's suggested that it is a turf battle and somebody is trying to build their kindgom. You saw what happened when the President suggested the creation of a Department of Natural Resources. He started with a good plan that made eminent sense, except when people reviewed it and then the eminent sense got whittled down and whittled down into nothing and nothing was accomplished because too many turfs were trampled on. It is unfortunate, but it is true.

FROM THE FLOOR: I am troubled by what you say on the ability of legal recourse on some of our more inflammatory issues. I wonder what the federal government's attitude is towards the preliminary exercise of mediation before you come to where the lawyers earn their high fees on both sides.

MR. HERBST: Well, I am in some instances in favor of mediation.I think it is a useful tool and if we can get all parties from opposite ends of the issue to sit down and reach agreement on it, I find that dandy.

But I can tell you that just recently on the burro issue in the Grand Canyon we had the case of lawsuits. Four plaintiffs had suits against us and

three of the four mediated and one didn't and filed a suit after mediation was all over with. So, it is inevitable in our system, just as Mike described in politics, it is inevitable in our system that the courts many times become the determining mechanism on many of these issues. So, for us in many of our decisions regarding threats to our resources and threats to our parks and threats to our refuges, we have got to be on sound legal ground, because we will find ourselves in court on many of these issues.

An administrator's job, you know, is a lonely, panicky, frantic position; but it is also a very lonely position because every decision you make, you don't gain friends, you lose your friends along the way.

I guess President Lincoln said it best when he was caught in the pressures of the freeing of the slaves, when he said, "If when I lay down my reins of power I shall have lost every friend on earth save one, the one deep down inside of me, I will have done my job well."

I think for most administrators, they have to operate in that mode of making the decisions that they think are best for the resources and best for the people in the long run. In the process of doing that, you will be criticized, you will be in court, you will be dragged through the mud and so on. It is inevitable in our system politically and legally.

Most of our decisions, if we can mediate it, reach agreement, good. But many times we cannot. And in order to be prepared for that "cannot" we have to have the scientific facts and legal procedures so that we are on solid ground when we are before that court.

Any further questions?

FROM THE FLOOR: (Inaudible question)

MR. HERBST: It does have a fit, and Mr. McIntosh will be addressing the EIS and alternatives this afternoon. In that document and in the backup to the document we address all of the existing national policies, Executive Orders and laws and the administration of various programs to determine implications and tie-in, including the Water Policy and the use of non-structural alternatives. What we are talking about is in many areas of the barrier islands that are fragile, the non-structural alternative is the only alternative. That will be one of the areas that will be addressed when we finalize that EIS.

Let me just elaborate a little bit more on how powerful nature can be by describing for you the other end of the country and what we have been through with Mt. St. Helens, which most of you have read about. But you are probably not familiar with the total extent of what has happened there with the eruptions that have taken place.

We have a number of parks and refuges in the immediate vicinity of that area, so we have been impacted greatly. To give you some idea of the direct damage from that eruption, from mud slides and the debris of logs and materials there is a direct wipe-out of twenty-five thousand acreas of land. We have closed six of our national parks, three of our wildlife refuges, four fish hatcheries have been completely wiped out, devastated. There are two more that will probably be affected.

The Columbia River went from a channel depth of forty feet to a depth of eighteen feet in a matter of hours. It is presently at twelve feet. We have fifty ships stuck. The two major tributaries of the Columbia River reached, in their upper tributaries, a temperature of 200 degrees in the water, a temperature of 84 degrees at the confluence. The salmon fisheries

of both are completely dead, wiped out.

The ash settling across the country has reached the depth of two inches in Glacier Park, which, as you know, is several tiers of the state away from Mt. St. Helens.

We have had severe problems with road travel, most of the roads east of Seattle being closed.

We have had problems with the ash affecting the operation of all of our vehicles, with oil changes every hundred miles, with the arcing out of our equipment, monitoring of all water supplies, Spirit Lake potentially going out with 50,000 residents down below and there is not a thing that man can do about that force of nature.

Thank you very much.

MR. STANTON: Thank you, Mr. Herbst and Mr. Glazer for a fine start to our three-day conference and workshop.

## INTRODUCTORY REMARKS

MR. STANTON: John R. Clark is a Senior Associate of The Conservation Foundation since 1972. Mr Clark has done extensive research in the barrier islands field including work at Sanibel Island, Florida, resulting in the "Sanibel Report: Formulation of a Comprehensive Plan Based on Natural Systems."

In 1977 he published a book entitled, "Coastal Ecosystems Management: A Technical Manual for the Conservation of Coastal Zone Resources". A report prepared for the Council on Environmental Quality entitled "Coastal Environmental Management: Guidelines for Conservation of Resources and Protection Against Storm Hazards" is soon to be published.

He has done work at Apalachicola Bay and Gasparilla Islands in Florida. He is continuing his work at Apalachicola and doing research at Winyah Bay, South Carolina.

Before going to The Conservation Foundation he spent ten years working as Assistant Laboratory Director and Supervisor of Research Operations at Sandy Hook Marine Laboratory.

Mr. Clark will speak to us on the subject of "Barrier Island Development: What Have We Wrought?"

# BARRIER ISLAND DEVELOPMENT: WHAT HAVE WE WROUGHT?

John R. Clark
*Senior Associate, The Conservation Foundation*

While "Barrier Island Development: What Have We Wrought?" wasn't my title, I think I can work with it. I am a conservationist: I have been in this business full-time for about eight years. I want to tell you a little bit more about it. Since we have forty-five minutes to spend together, I'd like to tell you a bit more about what we are doing at The Conservation Foundation and give you an idea of where I am coming from.

We do a number of things out of The Conservation Foundation. It is all research and demonstration work. We are kind of a think-tank operation and we like to dream up ideas and then go test them out in the field.

We have done a lot of physical planning for communities along the coast–Sanibel was mentioned. We are now working in Apalachicola and Winyah Bay to show that we can pull together the elements of the coastal ecosystem–the watershed, bay, and barrier islands–into a single coordinated plan in which local government takes the major role.

We do a lot of conferences and meetings, including the 1976 Barrier Islands Conference in Annapolis. We do policy studies on barrier islands. We recently finished one on the Coastal Zone Management Program with money from the Flagler Foundation, which we hope may set a new theme and a new course for coastal zone management in the '80's.

We do special-purpose projects in consultations where there are problems that need our treatment. We have done this at Casey Key and Gasparilla Island in Florida.

We have helped the courts many times when they needed to be better informed about natural processes and conservation needs. Right now we are participating in a case involving a bridge that the Department of Transportation wants to rebuild out onto Dauphin Island, which was washed away in a modest-sized hurricane that hit the Alabama coast.

We are becoming involved in trying to use the new discipline of environmental mediation–developed out of labor mediation, neighborhood mediation and minority mediation–on the coast. We are now doing a case on that in Swansboro, White Oak River in North Carolina.

Much of this is published and I should be glad to hand anybody one of my cards so that they might write for a list of our publications.

So, let's go back to the beginning of the 1970's and look at what was happening and what it is that caused us to gather together here today on this subject.

By the end of the first half of the '70's, the "rape" of Marco Island, Florida, had been halted. The "good" guys had taken over at Sanibel Island. Kiawah Island in South Carolina had gotten the message; its owner started a conscientious development program. St. Phillips Island in South Carolina was rescued by intervention over a Coast Guard bridge permit by the Environmental Defense Fund. The destruction of St. George Island had been slowed and the Park Service had occupied Cumberland Island.

At that time islands were in the news, to say the least. The rescue campaign was on, but actions were spotty, ad hoc and uncoordinated. We were beginning to realize that there was a common theme to all of these coastal fights, that we should try to coordinate our efforts and get a centralized campaign going.

We realized that parts of the shorefront were different, they were easily breached by small storms and washed over by large storms. Geologists had a name for this phenomenon that we are observing–barrier islands. They worked out the dynamics of barrier islands in Georgia and other places and they said that these were dangerous and unstable geological features.

The ecologists were beginning to say how productive these barrier islands were and what critical elements they were in nature's plan for the coast.

Well, we were listening and were looking for opportunities for coordinated action and these were arising in various new federal protection programs. The Coastal Zone Management Program, that you heard about this morning, started in October, 1972. The Flood Insurance Program, in its most recent form, got its start in December of '73. The Wetlands Protection Program under the Environmental Protection Agency, and Section 404, with the Courts–all these programs were coming in, rules were being made, things were getting started.

And then we began to react to demands for coordinated action brought on by a whole other set of programs with the Feds–development programs. Sewerage grants from the EPA enabled people to occupy islands that they could never occupy before. Big sewer programs came in. Water systems being provided by loans from the Farmers Home Administration put water on islands that didn't have an aquifer sufficient to supply the needs of a community growing on the island. Bridges were facilitated by DOT, and shore protection programs by the Corps of Engineers. All these supports thwart the natural limitations of living on islands and make it possible at a great cost of tax money for people who had a great deal of money to be able to live on barrier islands.

It was obviously time to organize and to try to work with the tensions that existed between the development and protection programs of the federal government and the counterparts of these that were operating in the states. We had before us the obvious rapid diminishment of barrier island resources and the new conservation consciousness of the nation.

So, we held a strategy conference in Annapolis, Maryland, with the support of private philanthropy and the Office of Coastal Zone Management. That was in 1976–May 17th and 18th. That conference in Annapolis elevated the barrier islands to prominence. It started a movement which got us here today. I have here the report of that meeting. It is out of print, but if anybody wants to borrow a copy we can provide them on loan. But that meeting was the turning point, the kick-off.

Since then we have been able to slow things down on a case-by-case basis, but we still have no central program for barrier islands. There are thousands of houses and condominiums and motels sprouting up each year. Sewers are going in, dunes are being flattened; the good old boys are still running Ocean City and most of the rest of the coast. There is too little money from the Land and Water Conservation Fund to buy our way out of this mess. So, what are we going to do if we can't buy all these islands?

Well, we have looked at other opportunities and we have generated a lot of interest in the federal agencies. Bob Herbst's efforts have been helping a lot since 1977 when President Carter told him to get a study going. Gloria Jiminez at the Federal Insurance Agency is trying to get barrier islands recognized as critical places within her program to justify stronger constraints against development. We need to get the insurance rates up for people that are moving into those high risk areas.

Finally, in Congress this year we got a little attention, because a Congressman from California, Bill Burton, who gave us the "Parks Barrel Bill" in 1977 decided to try his hand at saving barrier islands. So, he has put in a bill, has had hearings on it this year, and has got a certain amount of support for it. The major theme is: It is going to cost $ 11 billion over the next twenty years for federal support for development on these islands, but for $2 billion we can buy them all. That would be the solution and we would save $9 billion dollars in the next twenty years. This would have sounded good in 1964, but it sounded terrible in 1980 with Congress in the mood to spend nothing now, regardless of what the nation might save in the long run.

So, Mr. Burton decided to add onto the acquisition bill another part to prevent the federal government from subsidizing willy-nilly development on these islands. So, he had two parts to his bill, the second part which requires the exercise of strong constraints on federal support and the first part which was acquisition.

The Senate liked the part about the constraints but not the acquisition. So the Senate is sympathetic to federal constraints and that may be all we will get. Right now we don't have a program. We have high background noise level, but no program. Perhaps nothing will happen. The Senate and the House may just not take action on it.

What I think is that we can't wait around to see if Congress fails and then do something different. I think the chances of Congress failing are very high. I think that the hope of making them more serious about it is a counter-threat from the administration. I think it is time that President Carter got back in the driver's seat on this. The last we heard from him was in the spring of 1977. It is time for him to get back into the scene and give the Congress some further motivation and give us some hope that something will happen if Congress doesn't act.

What I am saying is the President should have an Executive Order, all finished, all written, politically tuned, technically sound and ready to go by the 4th of July. An Executive Order to apply those constraints to the federal agencies to force them to stop throwing money into the sea and save these islands.

So, we have got to have this thing ready to go by the 4th of July so that all Jimmy Carter has to do is to just sign it and it becomes law. An Executive Order is something that he has the authority and obligation to use when it comes to coordinating existing authorities in Congress and federal agencies on important public issues. He can write an Order that says to the DOT and the Farmers Home and the EPA and the Corps of Engineers and all the rest of them, you are not going to do this anymore without looking at the total, full-range consequences of each and every federal action on the islands, and with a presumption against anything that will facilitate development.

I think we need that. We need to urge the White House into action on this point. And who you urge is CEQ, because they are part of the White House. Any who you specifically urge is Malcolm Baldwin, who facilitated the original order that President Carter signed in 1977. I say that we have had three years of study. That is long enough, let's get some action going. Let's not wait for Congress to collapse on its initiative. Let it be known to Congress that there is an Executive Order going to come down this summer if they don't act, and that will give us a chance to see these islands protected.

Such an Order has to do four things. It has to establish a high priority for purchase, with the funds that we do have. It has to put a stop to federal subsidies for high-cost, high-risk development on barrier islands. It has to improve the budget situation and the managerial capabilities of federal agencies dealing with the islands. Finally, it has to require state and local conformance to various grant, loan, public works and federal government subsidies.

So much for policy. Let's talk about the islands and some case histories. I have here in the slide tray some rather poor pictures of a very important place, Dauphin Island, in the Gulf of Mexico, off the Alabama coast. Dauphin Island, and its neighboring barrier formation to the east, Gulf Shores, were disabled and dismembered by a hurricane called Frederick. I don't mean to say that I am against the forces of nature; I appreciate the forces of nature and nature has every right to steer a hurricane through the Gulf of Mexico and onto the continent. That happens periodically, as we know from history. Looking at the history of hurricanes for the South Carolina area and south I have found that there were fifteen major hurricanes in the last two hundred years or so that did extensive damage. You will find the same thing for any other part of the coast. They are natural phenomena, unpredictable and ferocious but they are real and they are natural.

Frederick came on September 12th, up through the Gulf of Mexico, after threatening parts of the Caribbean and Florida and hit dead on at the eastern end of Dauphin Island. The hurricane, as it passed over Dauphin Island, was moving almost due north. It had winds of 153 miles per hour.

Dauphin Island is a fourteen-mile long island, shaped like a pollywog, with its head to the east and its tail to the left, that forms the western head of the Harbor of Mobile. Gulf Shores, or Mobile Point, forms the eastern point. Eight miles of that island to the west are undeveloped and it has 3,000 acres of land. It has 1,600 acres of wetlands. It is forty miles south of Mobile. It has alligators, peregrine falcons and eagles, but it particularly has terns. It has the only nesting activity for Common Terns in that part of the Gulf of Louisiana across to Alabama. It also has breeding colonies of Least Terns. It has all of the normal features of a barrier island. It has some water in the middle of it, fresh water. It serves a role for many migratory birds. It protects the coast from hurricanes. And it was connected by a bridge to the mainland.

In the story of Dauphin Island, the land development issue starts in the 1950's when the local Chamber of Commerce took a longshot and decided to become developers themselves. They got hold of some money and bought this island. They started a campaign to sell lots to raise a million dollars, which was to be their share of the three million dollar bridge which was going to go out to the island. They announced lot sales on a particular

day and three days later, they not only sold all the lots they had advertised, but they had sold lots that they didn't have and committed themselves to land filling in order to provide those lots. It was outrageously successful.

There are 1,100 dwelling units on Dauphin Island, 600 year-round residences and 500 temporary residences.

I'm going to show you just quickly what Dauphin Island looks like. The slides are kind of hard to follow but it will give you the idea of the tremendous power of one of these hurricanes and give you a sense of what you can do with an island and what you can't do with an island.

Now, Dauphin Island is, as I said, a kind of a pollywog-shaped island. It is long and skinny. There is another formation called Little Dauphin Island, which is here, and just across over there is Gulf Shores, which was another major disaster because of Hurricane Frederick.

This was a dry hurricane. They say that you can find evidence in the aftermath of at least 200 tornadoes–small tornadoes that were generated and spun off by the hurricane as it moved across. You will find, if you look particularly on the mainland, various spotty lines of incredible devastation where the tornadoes were spun off from the hurricane and cut swaths of one hundred to a hundred and fifty feet wide knocking down trees and houses.

This end of the island is an old Pleistocene lump that has been there for a long time. The rest of it is all sand from the last five to eight thousand years.

This area here is called Class C by the new listing. I don't know how many of you have seen the Catalog of Undeveloped and Unprotected Barrier Islands that the Interior Department recently released, but it is a good collection of information about barrier islands and I recommend it to all of you (get ahold of Bill Gregg of the National Park Service and ask for a copy of it).

The fishermen that occupied this island for a couple of hundred years up until the 1950's had the good sense to live on top of this lump, protected by a very high dune structure here, going up to over thirty feet, where they were also sheltered by another feature called Sand Island here.

Here is the old part and, of course, once the bridge went in, anybody could go out there and throw any kind of junky cottages or trailers, anything they wanted to. People began to occupy this and dredge and fill and put in canals and, generally, urbanize and develop the coast.

Here you see Dauphin Island two days after the storm of September 12th. These were taken on September 14th, 1979. This is the condition of the island. These little things that look like they are on a Monopoly board where somebody spilled their drink, scattered all around, are houses. These are also houses still resting on their original foundations.

As you go along you will see in very graphic fashion the effect of that hurricane on this low part of the island that had very little dune front left to protect it in any way. You see that kind of damage along the whole beach front. You see the Holiday Inn, that is still standing, but it has its lower floor completely taken out.

Then, as we leave the beach and start across the broader part of the island, you see the kind of protection that these houses have that are in the area of the high land. You can see that these have received pretty good protection as you go right across the island.

Now, we are going to come up on the east end, turn around and from here we are heading west back across the island. Here is the fort that has been there forever. Here is the long high dune that protects the part of the island back here. This is the beginning of this sand island feature, right out in this position.

Now, we are going to run down to the west and look at this relatively undeveloped part of the island behind this huge dune, where very little damage was done.

Here is a kind of a series of little round units here, virtually untouched because they are snuggled in behind that dune. You can see the signs of earlier action, the shifting of the sand, and now you can see the point where we are running out of dune here and we are now getting back to that same area that we left a short time ago. The minute you pass that big dune, you see all this sand being carried across the ocean, blown out across the island here into the back side. This part was the road. It is now covered by huge amounts of sand on many parts of it.

You see the canal developments and what happened to them, all filled with sand. The houses are knocked around badly, a lot of damage was done on the back side of the island. The height of the surge, plus the waves over the island was thirteen feet above mean sea level, and back on the mainland reached 20.6 feet in height above mean sea level, which meant that in many parts of the low-lying mobile home community the surge was sixteen to seventeen feet above the ground level where people were living.

You can see the disarray here and the whole collection of houses that have all washed into one place. Here are others scattered around. Some are still standing, very much weakened, but still standing. As you move along the beach you can see the force of the hurricane devastation of sand. This whole thing was virtually a washover and the houses have been scattered around, washed from their beach foundations and beach sites, backwards in many cases.

Some people came to the island after the storm when they could finally get there to look for their houses and they never found the house. They just disappeared off the island.

From this point on, which marks about the end of this development, is the unprotected, undeveloped part of the island that the Burton Bill would try to purchase.

Those of you who know barrier islands can come and tell me afterwards what all this means. There are a lot of details, a lot of important stuff, I think, on the record, like these photographs, that show exactly how an island like this responds to a hurricane.

All of the damage that this island received by overwash, by sand deposition, by water and by wind will repair itself very rapidly. It will take some new form and shape, but barrier islands always have new forms and new shapes if they are let go. This part of the island is fine.

The only part of the island that isn't fine is where people have tried to move in and establish residence without any care or concern. It is going to cost probably $20 to $30 million of tax money to pay off claims on the insurance. These people were in the regular insurance program of FIA.

Here you can see the condition of the road. It was just totally wiped out. You can see all these areas where the sand has moved over. You get a sense of the tremendous force and power of these hurricanes and the fool-

ishness of people building in areas that, obviously, anyone could have told them even back in 1950, would be overwashed by a big hurricane.

Well, what can you do about it? One of the things that the National Flood Insurance Program has come up with is an idea of putting houses up above the waves. It works well in river valleys and places like that, where you put people up on pilings and the elevation is above all of this nasty business and there is no problem. We just stick in pilings, put the house on top of them, make sure the foundation is sound, and strap it down with big bolts. But an engineer told me that carpenters cut notches out of these beams and drill holes in them, and when it comes right down to it, they don't have nearly the strength that they are supposed to.

Designers are still fooling around, trying ways to build buildings strong enough to withstand wind and waves and the surge height on these islands, with the object that you can outwit nature by just elevating the houses above it and once people have done that, you give them cheap insurance, because they are out of danger.

Mobile, Alabama is the first place in the first state where the Federal Insurance Agency is attempting to add wave height onto the surge height and get the houses up above the top of the waves. They want to elevate the houses 20.6 feet above mean high water. Ground level is three or four feet, so you are talking about a house that is seventeen feet from the ground to the first horizontal level. I'm not talking about the floor level, now, I'm talking about the first sill or horizontal member and then you have got to add on some more, so these houses are approaching twenty feet off the ground to the first floor. The standards that go with that, in terms of strength of those pilings, the depth the piling has to go and all, haven't really been worked out yet.

The big issue on Dauphin Island is over the bridge reconstruction. Back in the fall of 1979–the Federal DOT okayed having this bridge rebuilt–three miles of it down to the island. The Chamber of Commerce managed to get it built for $3 million in the '50's; they now have an estimate of $42 million to replace the bridge, which, as we all know, will probably go up to sixty or seventy before it is actually finished, three or four years from now. Also, there is going to be a tremendous number of other costs to put that island back together. The bridge itself is going to cost fourteen times as much as the original bridge and we can expect that the other costs of repair for damage, fixing up the damage, will be equally out of scale to the original costs.

There is absolutely no such benefit to be found from putting that bridge across. I mean, there is not forty or fifty or sixty million dollars worth of benefit to be gained from it. From my calculation, the maximum benefit might be $10 million.

If you turn around the other way, you are looking at total cost of repeated damage of this kind, of $20 to $30 million every time a hurricane comes by and you must add the cost to put in the sewerage facility that they want so badly out there, the beach protection, the bulkheads, jetties and all the things that they will be demanding from now on to protect themselves. They will also want free rein with the water services to be supplied which will come because the aquifer is no longer capable of providing for the water and we can't let things like that stand in our way.

The only option that many of us see to this is just not to rebuild the

bridge. That is a rather painful idea to a community: "Too bad you lost your house, you have got no place to go, your whole life is disrupted, you may never collect back the full damage, you've got a terrible mess to clean up" and then we say, "Oh, incidentally, we are not going to build that bridge back there, you are going to have to go across on the ferry from now on." It doesn't go down too well.

But there are a number of people on Dauphin Island who say, "Fine, we always wanted a solution to all this development that is going on, all these people that come down here." They would like it, many of them, and I think that idea would grow. To be on an island that doesn't have a bridge is sometimes not so bad. There are many happy islands along the coast, barrier islands,that don't have bridges. The minute you connect an island to the mainland by a bridge, it is not an island anymore. It cannot be thought of as an island. It becomes part of the mainland once you make that attachment, and there are a lot of people who realize that. They want to live on an island, and it is no longer an island in any social or psychological context, once it has a bridge to it. There are many places like Sanibel Island which lost itself when it got its bridge in 1962. There are other areas, like St. George Island, where they would never rebuild the bridge if it were destroyed and are trying to figure out anything, short of dynamite, to get rid of the bridge. Many of the communities don't want these bridges, the more aware ones.

So you say, okay, maybe we can figure out how you can get along without a bridge rather than spend $50 million or $60 million to build a bridge, where you gain maybe $10 million worth of economic benefits and make a continuing further mess out of the island.

Well, that doesn't sell to DOT who wants to say, "This is America. When we have a disaster we rebuild it and get ourselves back on the track." DOT went around and persuaded agencies to do quick sign-offs and letters of "no objection" for the Dauphin bridge. There was no EIS on what is one of the most significant federal activities affecting the coast. So, there is a lawsuit going on. It has been filed; there will probably be a hearing for an injunction–a temporary restraining order about building that bridge, probably within the next week or two and probably on trial sometime in July.

The grounds for that lawsuit are, in the first place, that you don't do such a significant thing that affects the environment, such as building a bridge to an island like this, or even rebuild a bridge, without doing an Environmental Impact Statement.

The grounds for argument on the alternative to this are: there is plenty of development potential left, there is no land use planning going on on the island, the lots are going to be cheaper, there's going to be a new bridge, there is lots of insurance. Development on that island could accelerate as a result of the hurricane, rather than be diminished. This must be thought of thoroughly before the bridge goes ahead.

It has, in addition to the things I mentioned earlier, lots of wetland–1,600 acres. It has very critical groundwater resources. The dunes need to be protected. There are oysters in abundance providing a good little industry that needs to be saved from runoff pollution and sewage and septic tanks.

So, we are trying to slow this type of thing and make the agencies

think of the consequences. They don't have to give money to anybody that asks for it and they can use intelligence to decide if the development of these barrier islands is against the public interests.

Also, what we are trying to stress is the tremendous cost to the taxpayers for many of these island developments. It is expensive to put a community out on an island because of the cost of sewerage and water and beach protection, insurance, erosion, and local participation in these things which tend to run the tax base up for the people on the mainland.

I want to point out that there are something on the order of fifty to one hundred situations right now on the barrier islands along the coast where we really need immediate attention to these development problems. They are really going willy-nilly. Maybe the slight depression and the escalation of interest rates will cause things to slow down. It hasn't yet, but I expect it may by mid-summer, and maybe during this lull is a good time to push for the kind of permanent protection of the islands.

My message, if it hasn't gotten through yet, and I want to make sure it does get through and very clearly, to the U.S. Department of Interior, CEQ, Coastal Zone Management Office and others, is that the Executive Order better be ready by the 4th of July, or we are going to lose the battle.

If we lose it in this Congress, the chances of getting it going in the next Congress are not all that good. They certainly aren't good for 1981 and it will be 1982 before we are organized again.

Now is the time for the administration to get in behind this thing, write that Executive Order, have it on Carter's desk, let Congress know what he is doing and get this thing going.

Thank you.

## INTRODUCTORY REMARKS

MR. OLSEN: Our next speaker is Robert M. McIntosh, Jr., Regional Director, Northeast Region, Heritage Conservation and Recreation Service, Department of the Interior.

Mr. McIntosh's region encompasses the six New England states, as well as the states of New York, New Jersey, Delaware, Maryland, Pennsylvania, Virginia, West Virginia and the District of Columbia.

Among his responsibilities are the administration of the Land and Water Conservation Fund, the Urban Park and Recreation Recovery Fund, the state-wide comprehensive Outdoor Recreation Plans and the continuous survey of over 800 national, historic and natural landmarks.

He began his federal career in 1967 with the Northeast Regional Office of the former Bureau of Outdoor Recreation.

# BARRIER ISLAND PROTECTION STRATEGIES: THE FEDERAL ROLE

**Robert W. McIntosh**
*Northeast Regional Director, Heritage Conservation and Recreation Service, Department of Interior*

and comment by
**Robert Kutler**
*Counsel to the Subcommittee for Parks, Recreation and Renewable Resources and Senate Energy and Natural Resources Committee*

Secretary Herbst, I don't know if it is worse to be first in the morning or the first after lunch, especially after we had to corral everybody in from the outside. It's a shame that we don't have the opportunity, especially for a lot of us, who sit in offices, to come to conferences like this more often just to really enjoy it.

Unfortunately, I have to leave this afternoon, so I can't even enjoy the sea and surf and the wind tomorrow afternoon on the field trip.

Nonetheless, my programatic responsibility this afternoon is to talk about the federal role as it relates to barrier island protection. There is no way in an hour or 100 hours, I think, that we can totally cover the impact of the responsibilities, the priorities, some unfortunate aspects–the confusion of the federal policies and programs as they currently and definitely potentially impact the barrier islands.

But the federal role, I guess, is divided into two parts as to responsibility: one in the Executive Branch and the other in the Congressional Branch.

Executive Orders are mandated by the President in the White House, with the assistance from CEQ, various departmental secretaries and so forth down the line, as well as by the statutes that give the general shape of the policy and guidance to the Executive Branch.

I chose for definitional purposes this afternoon to divide the statement of the federal role into two areas.

One is the responsibility of management, in the sense that the majority of the program deals with management techniques, responsibilities and problems. I won't deal at all with that.

I think another important and most often overlooked role in the responsibility of federal government is that of education–the responsibility of continuing education with regard to natural resources or social resources and so on. Certainly in this regard, we can see the importance of education as we learn and disseminate information about the barrier islands.

The educational process you could probably break down into three steps: one, to provide the leadership to identify the issue, to set the priorities as to what is going to be the subject of the debate and discussion; second is obviously the important and necessary collection of appropriate information and the assurance of information dissemination–something that is very difficult and very burdening, given the amount of documentation and diversity of individuals and institutions and organizations that

are involved in investigation and analyses of various problems that deal with our natural resources; third is the policy and direction of the federal government.

I go back to the three points under education, to say that leadership, as far as the conference today is concerned, could be put back to President Carter's Environmental Message of 1977, whereby quite simply he made the statement in the second paragraph, saying that about sixty-eight coastal barrier islands are still unspoiled, "Because I believe these remaining natural islands should be protected from unwise development, I am directing the Secretary of the Interior in consultation with the Secretary of Commerce and Council on Environmental Quality, state and local officials of coastal areas, to develop effective plans for protecting these islands. This report should include recommendations for actions for this purpose." Definitely a statement of leadership. That was followed by the Barrier Island Task Force, a working group that was assembled in the summer of 1977 and has worked diligently over the last couple of years putting together various elements of information and documentation.

I would like to call your attention, first of all, to this small brochure that was mentioned earlier, called "American Barrier Islands". There are a hundred or so copies now available on the back bar. If you don't have this, please stop by and pick it up. If you do have it, and there are some still available, take them and pass them to friends, because I think it is important that in this twenty pages or so you have an opportunity to get, in a nutshell, the essence of what the problems are and what the responsibilities are as far as the barrier islands issue in the future is concerned.

The effort of that work group was obviously more exhaustive and it is not available here, but there is a report of the barrier islands work group. That is a rather detailed statement, an assimilation of information, which basically outlines the impact of development on the barrier islands, provides a documentation as to why the barrier islands should be protected, and speaks in some detail about the government and private protection efforts, as well as the federal programs that influence development on the barrier islands.

As a matter of decision-making, in the process that the Task Force undertook to meet the mandates of President Carter's Environmental Message, the framework of the various decisions and subsequent actions of implementation that the federal government could take to further the protection of the barrier islands have been laid out in the Environmental Impact Statement which is now currently out for review.

The principals in that effort are the work group from the National Park Service, the Fish and Wildlife Service, the Office of Coastal Zone Management and CEQ under the coordinating leadership of HCRS at the national level.

I think what is even more important is the education and information sharing process that took place in the development of this information and the EIS. To name the federal agencies that participated, one would cite the Corps of Engineers, EPA, the Department of Agriculture, SBA, Department of Transportation, Coast Guard, Department of Energy, Council of Environmental Quality, Farmers' Home Administration, Federal Disaster Assistance Administration, Federal Energy Regulatory Commission, GSA, Department of Housing and Urban Development, the Interior agencies, Commerce

represented through the OCZM and EDA, and the various state and local and public and private organizations.

I list those not just to say that we have involved a lot of people in doing the exercise, but to point out that I think one of the most fundamental and important aspects of that exercise was the information sharing and the opportunity for Interior people to learn about the values and priorities and so on of people in HUD and other agencies and, obviously, that information or that opportunity was transferred back to those in Interior.

Consequently, at the highest level, among those people that are in the Washington offices of the various departments, there is existing now, through the individuals who participated in this exercise, a recognition and an appreciation, a consciousness, of what is the mandate of the President's Environmental Message. We have already started, even though there is no clear, definitive statement of policy, even though there is no final statement of legislative action, and the Secretary of Interior has not made his recommendations to the Congress, a very significant and very important action and that is the educational process that is involved at the highest level of government and staff.

I would like to point out, I had the option of reading this 250 page document to you, which I thought, given my dyslexia, would make it ununderstandable, with respect to the bureaucratic jargon that is contained therein, but I will save you from that. I do want to point out that in the format, after considerable background discussion, there are no recommendations in this EIS.

As was mentioned earlier with the multitude of federal programs and federal agencies involved, it is very difficult, given the review process within the administration, within the Department of the Interior, and then through the coordinated activities of the Office of Management and Budget, to finitely and clearly make a statement of policy until the opportunity to review and comment has been fully exercised.

So, in order to move that process along, a decision was made, quite wisely, to put all the options together without recommendations in the Impact Statement and to then use that formal review and comment process to establish a base line of reaction in putting together the final recommendations.

There are within the document three levels of decision-making. One is the low level, the term is somewhat inaccurate, but I would dare to venture there is a little bit of continuation as we are right now recognizing some ongoing activity from the Park Service with respect to their Coastal Management Plan Policy Statement that has just been released, and various activities at the Fish and Wildlife Service and other initiatives that are moving along in their own course, if you will, among the various federal agencies. There is a moderate level, a middle level that might be also described as one in which various points or raised consciousness would be formally recognized administratively and then, finally, there is a high level protection alternative, which clearly speaks to either legislative change or significant or distinct administrative change through the re-writing of regulations, the issuance of a new Executive Order, and so on.

I will not go through all the details of the lower and middle levels, but I think I will point out, or highlight, in concept at least, the high level protection alternatives, so that you will have a sense of the scope and a sense

of the potential impact, should one or all of these high level options be adopted in the Policy Statement by the administration.

There are seven categories: development project evaluation, flood insurance, disaster mitigation and recovery, resource evaluation and planning, Executive Orders 11988 and 11990, permit process and acquisition.

The first is the development project evaluation, with the objective being basically to restrict federal government initiated or assisted development projects on barrier islands. Problematically, then, you would have the opportunity to impact the Fish and Wildlife Coordination Act, the Interstate Land Sales Full Disclosure Act as administered by HUD and prohibit interstate commerce sales on barrier islands. You would also have the opportunity, under all federal development programs, to prohibit approval of federal grants, loans or permits to barrier island projects, unless it meets as a minimum, a three-point test to each requested project. Those three points would be: no feasible or prudent alternative to the action, federal participation is essential in the project, and the proposal assures that harm to the island's resources would be minimal and all possible planning is undertaken to mitigate the adverse impact.

Now, if that was adopted within the Department of Interior, that would include significant actions taken by HCRS, the Fish and Wildlife Service, and the Park Service; within HUD, it would impact community block grant programs, interstate land sales, FDA grants and loans, EDA grants and loans; GSA; Farmers' Home Administration grants and loans; Corps permits; FEMA actions; Department of Energy facility siting permits; Coast Guard bridge permits; and Department of Agriculture.

Obviously, adoption of a policy like that would be far-reaching in its impact. I've had several discussions over the last few days, this morning and last evening, as well as reading some of the mail that comes back in response to this EIS and the magnitude and responsibility of the state and local officials in accepting or recommending or requesting the approval of such an action like that is quite devastating, as they would look individually to their own institution priorities, be they housing, be they labor, be they education or whatever.

We are dealing with what some might call something quite devastating, for an example, if you had invested your life savings in a business enterprise in Ocean City, Maryland.

I think in this decision-making process, we have to be fully cognizant of the fact that we have perpetuated certain values, certain responsibilities with respect to the importance of barrier islands. But over the century, what has not been clearly spoken is that other people have had different desires, interests and investments, and, consequently, there is a question and a responsibility of equity in any federal policy. This we are all going to have to focus on and accept as the decisions are fully itemized.

These categories go down through the Flood Insurance Program, through disaster mitigation and recovery, through resources evaluation and planning and so on for about fifteen pages. This very, very strongly indicates changes in federal regulations that could serve and move towards protecting the barrier islands.

I just passed one here that I would like to highlight, and that is Flood Insurance, particularly because it was mentioned today to give FIA the higher priority on the barrier islands, the flood-prone areas, the implement-

ing authority specifically considered amending the Flood Disaster Protection Act to deny federally subsidized flood insurance to new construction in areas designated by FIA as coastal high hazard areas, or areas to the seaward of the erosion setback lines.

So, clearly, I am trying to set in front of you the facts that in this decision document there is an information base on which some clear and definitive lines can be drawn for barrier islands protection through the management or the administration of federal programs and policies.

The decision-making process, as Assistant Secretary Herbst mentioned this morning, will take place in the summer with the recommendations and decisions made by the administration. We clearly need to, I think, focus on the fact that education is fundamental and probably the most important element, because while we can articulate anything we want, if the understanding isn't taken and accepted at the highest level of government, as well as by those in a day-to-day position of granting permits, reviewing applications, et cetera, then we have not really moved that far down the line.

I think that we have a responsibility in the decision process here to make the decision that would prevent the despoiling of those areas on the barrier islands that are not yet spoiled, not yet developed, and further, to adopt a policy of relocation rather than reconstruction.

Then, finally, where all else fails, to have a very aggressive coordinated federal-state land acquisition priority scheme worked out so that between the federal agencies, the state agencies, the state fish and game department, state park department, as well as the CZM Acquisition Authority, we are not stepping on each other's toes, and so that we know what the priorities are and that we are working effectively towards that end.

I would say that if we adopted those four things and we brought in another factor, that I didn't see mentioned here in the EIS, and that is some weather management by NOAA, over a relatively short period of time, given the example of Mount St. Helens, we would be back to where we wanted to be.

The statement, to reiterate the statement that Assistant Secretary Herbst made this morning with respect to the decision-making process, is awaiting the final responses as far as the review of the EIS.

I know personally, and I have heard others comment, that the EIS is a cumbersome document to review in the sense of the array of the matrix of information. I would urge you, if you have comments, or if you are still planning to comment, or if you have already commented and would like to comment further, not only to comment on the negatives, but comment on the positives. If you see ways of communication, techniques or organization which would help you and, obviously, others, to better understand the hierarchy as well as the priority of federal action, that would be most appropriate.

I have taken the opportunity prior to coming to the podium to ask Robert Kutler, who is counsel to the Subcommittee for Parks, Recreation and Renewable Resources and the Senate Energy and Natural Resources Committee to come up and do the honor of outlining for you and to update in some detail as to what the activities are, both on the House and Senate sides with respect to barrier island legislation.

My final point before turning it over to Rob, and then to answer any questions later, would be to say that the most important thing that I can

leave with you today is the fact that these three documents do exist: the summary document that is available in the back, the Staff Report that lays out the details of information on the impact and potential problems as far as barrier islands are concerned and, then, finally, the obvious decision document which is the EIS.

It is fascinating reading, it requires a lot of patience and understanding, but it is the decision-making process that the Department will undertake to provide a framework of policy for the administration that will be defensible and will, hopefully, as we would all agree and encourage, lead toward the further protection.

With that, I will turn it over to you, Rob.

MR. KUTLER: Thank you, Bob. I appreciate your sharing your time and giving me the opportunity to address the group.

I want to give you a little background. Before I started working for the Senate, my involvement with barrier islands started when I was staff member of the Council on Environmental Quality and worked on the Environmental Impact Statement that HRS put out.

Then, fortunately, by timing, I moved up to the Senate and it was time for Congress to deal with the issue of barrier islands.

Senator Bumpers of Arkansas is the Subcommittee Chairman of Parks, Recreation, and Renewable Resources and he became interested in the issue of barrier islands when Assistant Secretary Herbst briefed him on the EIS. One of his main issues is, and has been for quite a while, before it became so fashionable, fiscal responsibility of the federal government. I think this was the point that interested him the most. He saw the ludicrousness of building on areas that are going to be destroyed at some time or another with the use of federal funds and of re-using federal funds to rebuild the places.

So, we have been working on a bill through the winter and Senator Bumpers introduced a bill on May 9th, S-2686, to provide the protection of the barrier islands system. Senator Tsongas of Massachusetts and Senator Weicker of Connecticut are co-sponsors of that bill and both are members of the Committee.

At this point we have now scheduled hearings on this bill, S-2686, which will be on June 12th at 10 o'clock.

I would like to take a moment and brief you on our bill and then later contrast it with the bill that is in the House.

If I could, I would like to read you the findings and statement of policy.

Section 1 states that "The Congress finds and declares there are resources of extraordinary scientific, recreational, natural, historic, archeological and social value present on barrier islands which are being irretrievably damaged and lost.

Section 2. The barrier islands are generally unsuitable for development because of erosion and sand migratory patterns that undermine permanent and man-made structures.

Section 3. Certain development on barrier islands severely restricts the natural process on which the islands are dependent.

Section 4. Critical to more effective use of conservation and unique values of barrier islands is a program of coordinated action by federal, state and local governments to protect the islands for their natural scenic,

ecological, scientific, cultural, historic, conservation and recreational opportunities."

The reason I read this is to point out the obvious, that there are tremendous values and tremendous national interest in the barrier islands.

The second section of the bill establishes yet another advisory council, but I think that we have high goals for this. It would be the Barrier Islands Advisory Council that will be chaired by the Secretary of Interior.

I think one of the issues that we highlighted most in the development of the EIS was the fact that there is no coordination in federal action; there is no discussion among different agencies using the resources and the priorities of the different agencies. Consequently, the Advisory Council would be composed of the Department of Transportation, HUD, Commerce, Energy, Agriculture, Defense, Small Business Administration, FEMA, the EPA, General Services Administration, CEQ, Advisory Council on Historic Preservation and individually the National Park Service, Heritage Conservation and Recreation Service, and the Fish and Wildlife Service.

This would be quite a large Council. We are also thinking of adding a state and a local government representative to that Council. We will use the hearings to decide that at that point.

The purpose of the Advisory Council would be to conduct studies and also to advise the chairman with respect to, "on-going plans of proposed federal action affecting barrier islands, between preservation of natural, cultural and historic resources, transportation planning, acquisition priorities, economic development, beach restoration and preservation, flood insurance and disaster relief and proposed regulations which would adversely affect the barrier islands."

There are additionally the attempts to improve coordination between the Feds and the states, as I stated.

The real heart of the bill is in Section 3. The application of Section 3 is based on maps which were prepared by the Park Service under the direction of Bill Gray that essentially start at the same point that the House version started in terms of its application.

These areas are areas that have been identified by the Park Service as the undeveloped and unprotected islands. They are not necessarily the same islands that are in the Environmental Impact Statement study, but that is by far the large majority of them.

What Section 3 states is that, based on maps for these areas, no federal expenditures or financial assistance may be made available under any authority of federal law and no federal licenses, permits or other form of approval may be issued by any federal agency for the construction of any structure, facility, road or related infrastructure, any bridge, airport or boat landing facility, to be used for providing access to these specified areas in the barrier island protection system. No flood insurance policies, under the National Flood Insurance Act, can be issued for structures in which construction had not been commenced prior to May 8, 1980, or finally, for any project to prevent erosion or to otherwise stabilize any shoreline or any shore area of a barrier island.

There is a proviso, however, which says that this subsection, the section I just read, shall not apply to any activity related to energy development, navigational safety, public recreation and protection of barrier island ecosystems.

So, that is the heart of this bill. We give the Secretary minor boundary revision authority, because the maps that we have right now are on too large a scale to make individual property determinations.

The bill does not contain any acquisition provisions. There are a couple of reasons.

One, as John Clark said this morning, this is not a good time for new acquisition. The Conservation Fund is being proposed for extremely heavy cuts. There already is some backlog, Congress has already passed some new areas and is considering other new areas.

Secondly, we didn't feel that it would be necessary and Senator Bumpers didn't feel that it was the approach that we wanted to take. He hoped that this will be effective enough to solve the problems, to emphasize the duplication of federal efforts–one trying to work on conservation and the other at another time pushing for development.

I wouldn't say that this will stop all projects, it obviously won't, but that is the approach that we are taking.

Now, the House bill does contain acquisition. It makes the argument that, as John Clark said, it would be more fiscally responsible to buy these islands than to use the subsidies in the future. I think there are other reasons, such as Committee jurisdiction, Subcommittee jurisdiction in the House, why acquisition was excluded.

I think that if the House and Senate do pass different versions of the bill, we will be able to reach a compromise that is agreeable to all.

In terms of the prospects for the bill, that is always a very difficult thing to predict. We are starting a little late in the session, very late in the session. There are members of the Committee who have concern about the bill, but I think with the strong representation of co-sponsors, the prospects for moving out of Committee are good and, from what feedback that I have gotten from other members' offices, it is appealing to them from a fiscal standpoint. We do anticipate problems, of course, with some of the coastal Senators who have problems with the cut-off of all development in these areas. I think at this point we can turn it back to questions.

## QUESTIONS TO MR. KUTLER AND MR. McINTOSH

FROM THE FLOOR: I have a question, concerning the exclusion. You have listed energy and you have also listed public recreation. Now, would that be anybody's public recreation, state and federal?

MR. KUTLER: Well, of course, the bill only applies to federal action or grants or assistance.

The reason for putting that in, of course, is that if it wasn't in, then you would not be able to use conservation fund moneys for the barrier islands at all, including acquisition.

FROM THE FLOOR: Does this mean that money for public recreation at National Seashores would be excluded?

MR. KUTLER: It would be excluded from application of this bill, yes. They would be available, they would not be affected by the bill.

FROM THE FLOOR: Would moneys for state programs that involve structural activities on barrier islands also be excluded?

MR. KUTLER: I think that is one thing that we defined through the hearing process and through the legislative language, or through the legislative report, and possibly specifically through the legislative language.

FROM THE FLOOR: What change is sought in accepting energy?

MR. KUTLER: What sought? It was the consideration of other national priorities, one of which was energy development and that is particularly crucial in the Gulf Coast, that energy development not be hindered by this. We don't anticipate that energy development would actually impact the barrier islands' structural unit itself.

FROM THE FLOOR: I noted that you excluded flood insurance for new construction as of May 8, 1980. Would disaster relief for those homes and higher risk casualty and subsidies also be excluded or will it just be the insurance?

MR. KUTLER: That is a good question. That is another issue that really needs to be defined a little bit further. I think there is mixed feeling on that question.

Some people feel that people who do go in and build without any federal assistance, that if a disaster occurs, it is really not the American way to exclude them from disaster relief. I think it would be a question of the extent of disaster relief in terms of rebuilding and any limitations imposed on reconstruction. The difference is between emergency services, which I really doubt would be excluded, and reconstruction assistance, which I feel probably would be. But that is still to be defined.

FROM THE FLOOR: Would your energy development have to be those of national interest, or if you wanted to put your drill rig on a barrier island, is that kind of thing allowed?

MR. KUTLER: Well, I think under this bill it would not be excluded. There are, of course, many other statutes which evaluate that. This isn't a green light, it's a question of a red light and I think in an issue like that, that this bill would not put a red light to that. We would use the other processes that are existing to evaluate the environmental consequences.

FROM THE FLOOR: It sounds to me as if this bill wouldn't change any *status quo.*

MR. KUTLER: That is your reading of it. Flood insurance policies would be limited as would other development projects, including beach stabilization, wastewater treatment plants, water distribution systems, railroads, bridges, airports, and so forth.

FROM THE FLOOR: Except, as you say, the energy developments.

MR. KUTLER: I don't think that those exceptions will impact those programs.

FROM THE FLOOR: Would the bill make federal projects specifically subject to state and local regulations in terms of the coordination between the federal and the state and the local governments?

MR. McINTOSH: That is a very general question and I think a general answer would be yes.

There is obviously going to be a hierarchy of impact as to federal policy, administration policy or legislative mandate. As long as both vehicles are in the direction of barrier island protection, I think there is going to be basic compatibility. Where a state, hypothetically let's say, a state energy project would be proposed in an area that was incorporated to be protected, let's say, under administrative policy or under federal statute, then there is going to be a conflict as to who, basically, has superceding rights.

I think in the general statement, again, the federal legislation would overrule, unless there is contradicting federal legislation like under the pro-

posed Energy Emergency Review Board.

FROM THE FLOOR: I was particularly thinking of a situation where the state has a statute which might be interpreted stricter than the federal statute which is being proposed here. There are the Clean Water Acts and a few other acts where there are specific provisions making the federal government subject to those procedural and substantive requirements. I'm questioning whether there is such a specific provision in the proposed statute and whether, if not, maybe it ought to be. Someone might consider giving the state the right, otherwise the federal may supercede over the state regulation.

MR. McINTOSH: I understand. Why don't you answer the question specifically as to the legislation and then I will add another comment.

MR. KUTLER: I don't see the two in conflict. I think the example that you cited are regulatory programs, whereas this is not a regulatory program, this is a question of what kind of action is the federal government going to take. It is a federally-initiated project that we are talking about that would be undergoing the evaluation of whether or not this bill applies.

I am really not involved with the actual enforcement of any kind of regulatory program, so I don't see that there is a need for trying to coordinate the federal and state programs. If the state has a more restrictive program, for example, in terms of recreation, then they would not be applying to the federal government for federal assistance for that kind of a project. The state laws would be applying and the same would apply to the local areas.

MR. McINTOSH: For an educational exercise in the sense of a critique, I direct all of your attentions to the Parks and Recreation Act of '78, Section 502, which is the Pinelands National Reserve, then to the Governor's Executive Order and then to the state statute, in which there is compatibility. Number one, the most interesting and important is the fact that, in effect, as far as the teeth, you might say that the state statute is a lot stronger than the federal statute, as far as implementation is concerned.

While we are still doing this on a day-to-day basis, as far as the compatibility of the federal legislation and federal plan and the state plan, we have yet to really identify an area of conflict in which we foresee some major problems in the future.

Consequently, I don't think in the situation that Robert described here, under that type of a federal statute, that you would be in a serious conflict situation.

## INTRODUCTORY REMARKS

MR. OLSEN: Our next speaker is Dr. William Gregg, who is coordinator of Man and Biosphere Program of the National Park Service in Washington, D.C.

He is a plant ecologist and has been coordinator for providing information to the Congress on barrier islands as related to the Burton Protection Bill.

Dr. Gregg will speak to us on Developmental Alternatives, New Directions.

# DEVELOPMENT ALTERNATIVES: NEW DIRECTIONS

William P. Gregg

*Co-Coordinator, MAB-8 Directorate*

*National Park Service*

I am very glad to be here with everyone. I appreciate the organizing Committee's invitation to visit the beaches and lobster houses of Cape Cod during the peak of springtime and I can assure them that I plan to take full advantage of the spiritual and material benefits of both of these special environments.

I am even more appreciative, however, of the opportunity to visit with you, whether you be a manager, scientist, planner, conservationist or just a concerned citizen. I am glad, because I know that you are here because you have a stake in the wise management and use of our coastal resource heritage. I know, too, that you are here because you are alarmed over the skyrocketing loss of this heritage and the need to tell people about the significance of this loss while there is still time to reverse the trend.

By your numbers you attest to the fact that stemming the rising tide of coastal development is an idea whose time has come because it has the force of logic behind it, because it makes ecological sense, economic sense and maybe even political sense.

I know you share my resolve and, hopefully, my optimism, that this milestone Year of the Coast will be long remembered as the year in which, on island after island, the white sands of the dunes are saved from the jaws of the earth mover and given over to the waves and the wind.

I know that there is probably no one here today who fails to appreciate the immense ecological and economic value of the narrow band of coastal barrier spits and islands which fringe our Atlantic and Gulf coastlines. This value is due not so much as to their inherent characteristics, but more to the role they play in the dynamic coastal ecosystem of oceans, sandbars, beaches, dunes, wetlands and bays.

Although a full understanding of its complexity remains for the future, we do know that this ecological machine made of water, sediments, plants and animals, and run by solar energy, is one of the most productive natural systems known and one of the most varied in the beneficial functions it provides to human society. I need not elaborate on the value of wetlands and estuaries in supporting our nation's fish and shellfish industries. I need not elaborate on the wetlands in removing pollutants from estuarine waters and providing habitat for migratory birds. I need not elaborate on the recreational benefits of a clean estuary, ocean or beach. I need not elaborate on the benefits of storm protection provided by a natural barrier. Finally, and most importantly, I need not elaborate on the spiritual benefits of experiencing the sounds and moods of the sea, the sight of the Great Blue Heron sweeping low over an autumn tidal marsh or the silhouette of a solitary lighthouse in the mist. All of these benefits are well documented in the literature, scientific and otherwise.

You already know of these values and the difficulty, if not the futility, of trying to describe them all in economic terms. Suffice it to say that if we were to attempt to provide through technology any one of the benefits

which our coastal ecosystem provides free, the cost in energy alone would be astronomical.

The point I want to make in the foregoing discussion is that if we are to retain the values the ecosystem provides, we must focus our attention on insuring the health of the entire ecosystem. We can do this only by insuring the health of each and every one of its interconnected parts, as well as the flows of energy and materials between them. If any one of the components is disturbed, the whole system reacts by becoming less well-ordered and less productive in one or more of its functions.

Sometimes the reaction is obvious. For example, beach stabilization to shore up the beaches at Ocean City, Maryland, from the onslaught of a rising sea, has caused rapid beach erosion and landward migration of the north end of Assateague Island. This dramatic ecosystem shift is affecting the recreational value of the Assateague Island National Seashore area, current patterns in the bay, the distribution of natural habitats, and the natural processes which operated unimpaired for thousands of years until now.

On the other hand, the ecosystem reaction is sometimes subtle. For example, the upgrading of a power line at Cape Hatteras will stimulate development on a barrier island. However, the effects of this development on the values I discussed will most likely occur very gradually as new structures are incrementally added or expanded here and there, one by one, or several at a time, and the population density slowly increases.

Without comprehensive long-term monitoring of land use, as well as sociological and ecological conditions, the detection of changes and their causes will be difficult. I am not aware of any barrier which has such comprehensive monitoring in place and I believe that this is a major obstacle in dealing effectively with the more subtle long-term threats associated with development.

You may ask, how serious is the development problem on barriers anyway? My best answer to this question would be, extremely serious by whatever measure you may wish to use.

In a recent unpublished inventory, the National Park Service, using data developed by the United States Fish and Wildlife Service, reported that of the 2,643 miles of barriers on the Atlantic and Gulf coasts, and by barriers we mean bay-mouth barriers, spits and true islands, fully 869 miles, or thirty-three percent of their shorelines, are considered developed, and another 191 miles, or seven percent, are considered committed to development because the roads, utilities and other infrastructure for development are either under construction or in place. In other words, about forty percent of the nation's barrier shoreline is either developed or committed to development.

Then there are the presently undeveloped and unprotected, mostly private, islands which make up 679 shoreline miles or about twenty-six percent of the total.

Finally, there are the barriers managed for protection, usually under public ownership, such as the National Seashores, National Wildlife Refuges and State Parks, which account for 906 miles of shoreline or about thirty-four percent of the total.

Acreage data developed by the Geological Survey provide additional perspective. Of the fast-land acreage on the barriers, that is, all lands other

than submerged lands and wetlands, about thirteen percent was considered urban in 1950. By 1974, the figure had more than doubled, to twenty-eight percent. This growth trend involved a net loss of about 137,000 acres of wetlands or about fourteen percent of the wetland acreage on barriers in 1950.

If we extrapolate, using the 1950-1974 growth rate of about five percent per year, the figures show that about thirty-one percent of the fast lands are now developed.

In view of the development boom of recent years, this figure is almost certainly conservative and the true figure may be approaching thirty-five percent. Unfortunately, the cumulative impact of this development boom may not be known for some time because even hazardous barrier island environments are usually kind to human handiworks for some years before the onslaught of nature begins.

We do know, however, that as time passes more development usually brings more interference with natural shoreline processes, more environmental pollution, more draw-down of limited water reserves, more loss of wildlife habitat and more cost to the taxpayer from underwriting the risks of barrier island investments.

Anyone who has studied our coastal barriers or who has lived on a barrier for a long time, knows that barriers are, in general, unstable places. Beaches' dimensions change daily, seasonally and over the long term. Shorelines have been, for the most part, receding as an inevitable consequence of the well-documented rise in sea levels, estimated on the average of about a foot a century, although rates may vary considerably in different parts of the coast.

Were it not for the great mobility of the barriers, they would have drowned long ago. Nature has given these land forms the capability to migrate landward up the coastal incline, normally through the mediation of coastal storms, whose waves and tides relocate tremendous quantities of sediment. Whether this process occurs all at once as overwash or gradually as sediments accumulate in deltas behind storm-caused inlets, the net effect is to move the barriers landward and, at the same time, to perpetuate and revitalize them. Fresh sediments bring in fresh supplies of nutrients, which cause dune and marsh plants to grow vigorously, trapping and holding sediments washed in by the tides and blown in by the wind. These ever-changing conditions perpetuate the ecosystem's productivity, the diversity of its ecological niches and the many public benefits I mentioned earlier.

Scientists may debate the origin of the barriers and the importance of various processes in their evolution, but there now appears to be wide agreement that landward migration is an important process over much, if not all, of the coast, and that this process is significant within a human time frame. Such unstable conditions do not favor the enduring survival of human structures.

To see a living or barely living example of what happens when barrier processes begin to exact their toll on human works, one needs only to compare the wide beaches and elegant resorts of Miami beach twenty years ago with today's lost beaches, seawalls and colossal beach nourishment efforts in what is fast becoming the Venice of the Western Hemisphere. Or to look at Ocean City, Maryland, where high-rise condominiums, with barely cured concrete foundations, are becoming mute testimonials to the validity of

the biblical admonition to avoid construction on unstable sands.

A recent National Park Service report prepared in connection with the pending Burton legislation, indicates that out of 182 presently undeveloped and unprotected barriers, the fast lands of 129 would be more than sixty percent flooded during a 100-year storm and seventy six would have more than ninety percent of their fast lands flooded. Developed barriers would presumably be subject to a somewhat lower amount of fast land flooding because the better sites presumably have already been developed, but the figures are illustrative of the extent of flood hazard on the fast or upland portion of the barriers where today's development is primarily occurring. The figures are particularly alarming because many of those developed barriers have solitary road links with the mainland which are subject to flooding or washout. Some areas have seriously inadequate evacuation plans. Too many are disasters waiting to happen when a severe storm hits during the season of peak occupancy.

The fact that the east coast development boom on the barriers has coincided with an unprecedented lull in the landfall of major hurricanes, magnifies the dimensions of the potential catastrophe. The devastation of Hurricane Frederick last year at Dauphin Island provides a dramatic indication of what could and most likely will happen along many of our recently developed east coast shorelines when more normal hurricane patterns return.

The existence of these conditions tempts one to ask, why has so little effective action been taken before now? I think the answer is simply that we have not yet reached a critical threshhold of knowledge about how these ecosystems operate and, more importantly, a critical threshhold of public awareness that their continued development risks an environmental and human crisis of enormous proportions. I think that the same can be said for other nationally and globally significant environmental problems caused by the increasing and ever more varied demands the human population is placing on the ecological systems that support it.

Our awareness of the potentially awesome implications of the rapid carbon dioxide buildup in the atmosphere, the ecological assault of acid rain, the deforestation of the humid tropics and the expansion of the world's deserts has come about largely in the last five years because the acceleration of change has reached an unprecedented rate. Although the time may not be here when the full measure of the effect is known, the changes themselves, and some of the effects, have become impossible to ignore.

The development on coastal barriers is quite different from any other major national or international environmental problem, in that it is not caused by the need to provide the goods, services and energy necessary to support human civilization. On the barriers, the primary cause of resource degradation is the progressive development of residential housing of an overwhelming single-family variety. In northern areas, most of the recent development is single-family vacation homes occupied primarily during the warmer months of the year. In the south, where the climate is more favorable, the season of occupancy expands until, in Florida, year-round occupancy of vacation and retirement homes is the rule and the barriers often serve as bedroom communities for major urban areas or are themselves major urban areas. In both north and south, however, the loss of barriers

to development is caused primarily by the desire of people to seek the good life, either for vacations or year-round, in the land of the sea and the sun.

This kind of development should not be viewed as a human and economic necessity benefiting society as a whole, but rather as a private use of nationally-important ecological resources with primary benefits accruing to individuals.

Most environmental and ecological problems on our coastal barriers are due directly or indirectly to the development and protection of residential communities. Major industrial projects, development of public recreational facilities and navigational dredging pale in terms of their total impact on barrier islands when considered alongside the inexorible march of homes, condominiums and commercial facilities across the landscape. The former projects tend to have relatively large short-term impacts at the time of construction, followed by fairly predictable longer-term impacts associated with their maintenance or operation. They tend to occur as discrete actions and receive a fairly high degree of public scrutiny, because agencies responsible to the public are usually involved in licensing, subsidizing or implementing them. They are much less likely to be implemented incrementally without some measure of oversight. If a change in *status quo* is planned, it is not very likely to go unnoticed by those who have an interest in it.

The same has not traditionally been true of residential development, which rarely occurs as large-planned projects that attract attention. Instead, the usual pattern is a series of small-scale, seemingly unrelated projects, implemented at different times and in different places, which are individually authorized by local governments, sometimes on the basis of little more than a satisfactory percolation test. The result of this process of incrementalization is a change in reality to which people are continually and largely unconsciously adjusting.

Incrementalization has traditionally been very resistant to effective control. There are several reasons for this. First, the Constitution specifically protects individual property owners from uncompensated losses due to actions by the government. Legal restrictions on the use of private lands must, therefore, be developed in a manner that will not be construed by the courts as a taking of land without just compensation. For agencies of the government to limit an individual's use of his or her land, the public interest to be served has to be clearly established. In practice, the contemporary expression of the public interest is embodied in the various ordinances and zoning regulations of local governments which have broad discretion in land use matters. The local ordinances and regulations normally reflect the community's awareness of what is required to protect people's health, well-being and sometimes quality of life.

Rural areas, where development-related problems are not matters of concern to most people, tend to have very little regulation of land use. Because land use problems are not perceived as important, people view governmental controls as unwarranted infringement of their property rights.

On the other hand, in urbanized areas where conceivable threats to human health, well-being and quality of life often have become actual threats, people tend to view governmental controls in their own best interest with the result that most urban and suburban jurisdictions are subject to diverse and often complex zoning controls. Local regulations, therefore,

tend to be government's reaction, sometimes a much-delayed one, to the public perception of the public interests.

It seems to be a fact of life on many barriers that by the time the protection of environmental quality becomes widely perceived as a desirable local land use control objective, incrementalization has produced so strong a commitment to urbanization that it is all but impossible to restore any semblance of the natural barrier which existed in the unregulated times when people were not very concerned about land use matters.

There are presently no effective federal counterweights to incrementalization. Even the Coastal Zone Management Program, which has had substantial success in encouraging systematic local land use planning, has been ineffective in restraining incrementalization, except in certain environmentally critical areas, such as primary dune fields, wetlands and rapidly eroding areas. Even on barriers where local governments restrict the development in environmentally critical areas, there is almost always plenty of land remaining to accommodate the incrementalization process.

Finally, the incrementalization process resists control, because the federal government effectively promotes it through permitting programs, grant and loan programs, insurance programs, and disaster relief programs which allow, support and underwrite the risk of development on the barriers.

Federal permits are required for dredging and filling, causeway construction, discharging of wastewater effluents and for certain short-term uses of federal land, such as operation of various concessions. Federal rights-of-way are required to authorize use of federal lands on barriers for roads, pipelines and other essentially permanent uses. Federal grants are available to support many kinds of developments and development-related activities and facilities, including water quality management planning; construction of wastewater treatment plants, highways and airports; development of public recreational facilities; implementation and restoration of flood control and erosion control projects; planning and implementing development programs in economically-distressed rural areas, and carrying out a host of urban development and renewal projects. Federal loans, many with a statutory interest ceiling of five percent, are made for water supply and storage systems, power transmission systems, public works and development projects in economically distressed areas and housing for low-income families in rural areas. Federally subsidized flood insurance is available on the majority of barriers to underwrite the risk of private investment in development. The federal government also insures home mortgages and guarantees a variety of commercial loans. Finally, the federal government provides grants and low-interest loans to enable homeowners, businesses and communities to rebuild following natural disasters.

Thus, it should be obvious that the government is an accomplice in the development of the barriers from the cradle to the grave. The amount of this involvement is increasing daily, but quantification of the amount of the total involvement has proven quite elusive. A major reason for this is that very few agencies at any level of government collect information specifically for barrier structures. The importance of doing so has not yet been recognized. Yet, if we are to effectively monitor these resources and objectively assess the effects of our policies and actions, the boundaries of the barriers must be agreed upon and both resource and program data collected

for these areas to the greatest extent possible.

Another problem is that the limited program data that we do have are probably unrepresentative because of the unusual lull in hurricane landfalls along the Atlantic coast during the development boom of the last fifteen years. These figures could easily lead to the conclusion that the level of certain federal subsidies on barriers is too small to warrant serious concern.

For example, in recent Congressional hearings, the Corps of Engineers estimated that from 1975 through 1980, those fiscal years, it will have spent only about $50 million on the barriers: for beach erosion control, $28.2 million; flood control, $14.7 million; and restoration of Corps projects, $6.5 million. Obviously, these figures could increase dramatically if a series of major hurricanes were to strike densely populated barriers.

An estimate of the level of federal subsidy of barrier development was recently made by Crane Miller in a Congressional hearing on legislation to authorize federal acquisition of the remaining 480,000 acres of undeveloped barriers. Miller estimated that the federal expenditures for utilities, subsidized insurance, disaster relief and other development-related assistance during the next twenty years would amount to $11.7 billion or about 5.8 times the $2 billion estimate for acquiring them at a per-acre cost of $4,200. The estimate required making a number of assumptions about storm frequencies and intensities, rate of development and the extent of federal participation in a variety of projects.

If this estimate is correct, then federal acquisition of the remaining undeveloped barriers would seem to be a very cost-effective way to solve the problems of incremental development on these barriers. Its major disadvantage appears to be its $2 billion price tag. Expenditures of much lesser magnitude to conserve natural resources are increasingly being viewed as the method of last resort, when conservation simply cannot be achieved by any other means. Acquisition of the undeveloped barriers is certainly a key policy option, but it certainly is not a complete solution to the full range of complex issues associated with development of the barriers.

The nation critically needs a balanced federal policy which promotes protection and enhancement of the significant public benefits that natural barrier ecosystems provide, minimizes human interference with the natural processes responsible for maintaining them, reduces the hazard to life and property associated with the development and minimizes the federal taxpayers' role in underwriting the risk of private investment on them.

Such a balanced policy is required to respond effectively to the President's 1977 directive requiring federal agencies to prepare an effective plan for protecting undeveloped barriers and to his stated goals of getting the federal government out of the business of subsidizing development in hazardous barrier locations.

Although it is impossible at the present time to predict the policy recommendations the federal agencies will soon be making to the President, or what the outcome of pending legislation on barrier islands and the Coastal Zone Management Program will be, a consensus on the attributes of a balanced federal policy seems to be emerging.

Such a policy must be firm in requiring agencies to consider and document for public review the consequences of their proposals for actions involving barrier ecosystems.

It must be firm in keeping agencies from taking actions that would

adversely affect these ecosystems, unless an overriding national interest has been conclusively demonstrated. Yet, it must be flexible in allowing agencies to consider the suitability of barriers for development, which may vary considerably from place to place, and not impose across-the-board prohibitions on agency actions.

It must be forthright in its redirection of future construction away from hazardous and ecologically valuable areas; yet it must be fair to existing residents and commercial interests on the barriers and avoid retroactive penalties.

In reviewing the eighty-eight policy options presented in the Department of Interior's draft Environmental Statement on Barrier Islands Policy Alternatives, National Park Service planners, managers and scientists gave strong support to a number of actions the government could take to achieve a balanced policy on the barriers. Some of these actions could be implemented by the agencies themselves, but most would require either new legislation or executive direction by the President.

I want to take a few minutes to discuss the actions which received the strongest support from my Bureau, because I believe they provide the framework for reasonable redirection and strengthening of the agencies' programs.

First, high priority went to a legislative amendment on existing agency authorities to prohibit issuance of federal permits, rights of way, grants and loans that either enable or subsidize development on barrier islands, unless the responsible agency demonstrates in a public document that there is no feasible and prudent alternative, that federal participation is clearly in the national interest and that all possible measures to mitigate impacts on natural ecosystems and human welfare have been or will be taken as part of the project. This measure would require agencies to assess the long-term impacts of the enabled development and to give full weight to these impacts in making decisions.

I want to note in this context that the same kinds of benefits could be incorporated, but perhaps to a less effective degree, through executive direction of federal agency programs within the context of the existing procedures and processes under the National Environmental Policy Act. As a cornerstone of the government's policy,the requirements would apply to all federal programs. It would place severe restrictions on the operation of federal programs on the barriers, yet would still allow agencies to take well-planned actions which they could justify on the basis of overriding national interest. It would also allow agencies to consider differences in levels of existing development; differences in flood hazards, storm vulnerability and the significance of natural, cultural and recreational resources; as well as other factors, in reaching decisions.

A provision of this type is included in the Senate Resolution 2686 on which public hearings are scheduled for June 12th, 1980. The authority would provide the basis for denial of numerous development-related permits and subsidies and would slow down, but not stop, the incrementalization process. It would certainly make barrier development more costly by forcing the private sector to bear more of the costs and the risks than it does today.

There was also strong support for a major new emphasis on public education, beginning during the Year of the Coast, by all agencies and

organizations influencing the use of coastal barriers. This would include more interpretation of the relationship between human activities and barrier ecosystems in the National Park Service and Fish and Wildlife Service interpretative programs, a strong effort by the Federal Emergency Management Agency to inform the public about the hazards of living on a barrier, and the establishment of a central information system within the Department of Interior for acquiring, archiving and disseminating information on coastal barriers.

Accompanying the new efforts to maintain the flow of up-to-date information and improve the public's awareness of the issues there must be a redoubled emphasis on barrier inventory, monitoring and research, particularly process-oriented ecological research. Existing programs of the Department of Interior, the Corps of Engineers and the Department of Commerce need to be expanded in order to give us an understanding of how different barrier systems operate and the tools to do a first-class job of predicting the consequences of human activities.

Although the agencies could undertake these initiatives themselves, their mention in an Executive Order would certainly help insure agency and OMB support in the budgeting process.

There was general support for doing development of a barrier protection priority list by the Departments of the Interior and Commerce to give a focus for coordinating various bureaus' work in identifying and protecting the barriers having the most significant resources and the greatest degree of threat. The bureaus would use this listing in allocating funds for protecting the barriers through acquisition or other means.

Finally, the NPS reviewers focused on two agencies whose programs are considered to be particularly in need of major redirection, the Federal Insurance Administration, regarding flood insurance programs, and the Corps of Engineers, with regard to hurricane protection, erosion control and navigation projects.

Although the Federal Insurance Administration plans this year to raise its premiums for properties in areas subject to velocity flooding, to increase the required first-floor building elevations to take wave heights into account and to issue a building code manual for construction in flood-prone areas, these measures will not substantially make development pay its own way or cause a great redirection of new development away from hazardous areas. For this reason, there was general support of a legislative amendment of the Flood Disaster Protection Act of 1973 to deny federally-subsidized flood insurance for new construction and reconstruction of destroyed buildings in FIA-designated coastal high-hazard areas. This would act as a major restraint to development in the most unsuitable areas of the barriers, regardless of their development status, and would force property owners planning new development or reconstruction in these areas to assume the full financial and human risks involved.

NPS' concern about Corps projects is due to the severe, long-term impacts projects can have on the natural sand-sharing systems responsible for the ecological health of the barriers. In an October 1977 survey, eighty percent of National Park Service barrier island managers reported substantial conflicts with the Corps over the need for projects, the design of projects, alternatives requiring analysis and other matters such as the management of spoil areas. Corps projects in the vicinity of protected barriers can and do

have significant long-term impacts on these resources. In order to encourage planning coordination, assessment of long-term impacts, and mitigation of project impacts, NPS reviewers gave their strongest support to a legislative amendment of Corps authorities to require concurrence by the Secretary of Interior in any Corps project which may adversely affect a barrier administered by the Department. In practice this would involve projects within about five miles of an Interior area. This new authority would make a substantial contribution to the protection of some of the nation's most significant barrier resources. Expansion of the amendment to include natural landmarks, state parks or other protected areas could be done to increase the number of areas covered. The amendment would invigorate the Corps in evaluating non-structural alternatives, assessing and considering hard-to-quantify long-term and indirect impacts, and developing new mitigation technology.

Although these measures received the greatest support from NPS reviewers, federal policymakers will be considering a myriad of new authorities and program directions which will contribute directly to the national policy objectives or provide incentives for states, localities, and the private sector to do so.

The major challenge will be to keep the process of incrementalization from invading most of the remaining undeveloped barriers and to channel it into the least hazardous, most environmentally suitable locations on the developed barriers, all the while holding the line against any and all assaults on the barriers we have been able to protect as a public trust.

Charting a new direction for development on the barriers will not be easy. Yet, I believe we have reached that threshhold of knowledge and awareness that I spoke about earlier, and that the Year of the Coast will be the year when the scales are tipped away from the wild exploitations for short-term private gain in the direction of fair and reasonable restraint for the long-term public good.

Thank you very much.

MR. OLSEN: Questions anyone?

## QUESTIONS TO DR. GREGG

FROM THE FLOOR: I would just like to say, I'm glad to hear you talk about barriers, coastal barriers rather than barrier islands. I think we have to got to get away from talking about barrier islands and talk about the more general term barrier beach or coastal barrier. A lot of the barriers up here in Massachusetts are barrier beaches. They wouldn't be classified in the barrier island classification. I think that we are going to end up omitting some of those barriers because we are talking about islands.

DR. GREGG: Certainly in the National Park Service inventory of undeveloped and unprotected barrier structures, this is what we tried to do. I believe there are forty-seven units in Massachusetts and most of these are bay mouth barriers as opposed to true islands.

Certainly from the standpoint of the functions that the various structures perform, there is very little distinction between the three land forms.

FROM THE FLOOR: Is there any way in your recommendation to also include provisions that if Corps projects are determined to be necessary to protect the already-developed islands, that this will be great enough to

support the enforcement of responsibility?

DR. GREGG: This would certainly be an option which could be considered. We did not specifically recommend that, but it is certainly a potentially viable possibility.

MR. OLSEN: Thank you very much. Could you comment on the progress of the Burton bill in your opinion?

DR. GREGG: We have not yet begun the intensive evaluation of comments from other agencies on the areas which the National Park Service included in that report. During the weeks immediately ahead, those areas will be evaluated from a variety of standpoints. There is no doubt we will be subtracting some areas and perhaps adding others, with the objective of reaching a general consensus on which areas should be included by the middle of the summer.

I can't predict at the present time exactly what the future of the legislation is going to be. Things at the present time seem to be unusually quiet, and when things are as quiet as they have been over the last two months, one tends to get a little bit suspicious. So, I hope that the lack of detailed comment that we have gotten so far with reference to the bill's provisions is indicative of a fair measure of support, both within the Congress as well as outside.

MR. OLSEN: Thank you, Dr. Gregg.

## INTRODUCTORY REMARKS

MR. OLSEN: Rodney C. Winslow is Acting Meteorologist in Charge of the National Weather Service Forecast in Boston, Massachusetts. He has had twenty-six years with the meteorological service, has been stationed in Philadelphia, Duluth, Worcester, Cleveland and, for the past ten years, in Boston.

He will speak to us on the subject of Storm Preparedness: The Potential for Catastrophe.

Mr. Winslow.

# STORM PREPAREDNESS: THE POTENTIAL FOR CATASTROPHE

Rodney C. Winslow

*Acting Meteorologist in Charge*
*National Weather Service, Boston*

It is a pleasure for a meteorologist to come out and speak to a group on a day like this. At least on this type of day, our past mistakes are quickly forgotten.

My talk is entitled "Storm Preparedness: The Potential for Catastrophe". I think a better title is, storm *un*preparedness or storm *lack* of preparedness, the potential for catastrophe.

Being prepared, whether it is in respect to winter storms or tornadoes or severe thunder storms or hurricanes, being prepared is the answer; it is the prevention of the catastrophe as far as individuals are concerned. There is a lot that we can do to protect property, but our aim is to protect lives as much as possible.

You may note that the hurricane season starts on June 1; it extends through October or November.

The last I heard, there were no hurricanes threatening any land area at this present time, but it is good to be prepared well ahead of time, to know what to do, to know where to go and what to do to save your life and, as I said before, this is really what our warning service is for.

I have some slides that I will show this afternoon of Cape Cod and the southern Massachusetts coast over to the Rhode Island border.

Here in the northeast, the hurricanes come up at generally a very fast pace. When they pass Hatteras, they are moving probably on the order of thirty-five or forty knots, accelerating as they come up. The Hurricane of 1938, notorious in our history during which 600 people died, was moving forward at between sixty and sixty-five knots through the area.

Possibly the worst thing that ever happened to our warning system was Hurricane Belle several years ago. It fizzled out, didn't do a doggone thing. So, people who lived here on the southern coasts of Massachusetts, Rhode Island, and Connecticut said, "Heck, I lived through that hurricane, it was nothing."

They didn't live through the 1938 hurricane–nor '54, '44 and so on. We have had some very destructive storms. In fact, one of the greatest natural disasters in the United States was the Galveston Hurricane of 1900, where 6,000 people died.

Here on Cape Cod, 600 people died in the '38 hurricane. One of the reasons for the high death toll at that time was the lack of warning, lack of preparedness. Nobody saw the thing coming. The Weather Service passed it off as a small storm moving up the coast, lost it and the next thing they knew, there was a lot of death and destruction in this particular area.

It is almost inconceivable for us as meteorologists today to think that a hurricane or other storm can hit the coast of the United States without prior warning. We have satellites, we have reconnaissance aircraft, we have

radar. Hopefully, no hurricane or no tropical storm will hit the States without warning.

As I said, when a storm is moving up this direction, generally it is moving quite rapidly. That gives us very little time between the issuance of a watch and the issuance of a warning. When it passes Hatteras, it has a little over four hundred miles to come to hit Cape Cod, or to hit southern New England. If it is moving forward at fifty miles an hour, that is eight hours preparation time. The storm surge is out ahead of the storm itself and lessens the lead time for warnings.

So we here in New England actually have to be prepared during the watch situation, rather than during the warning situation. On the south coast, where a hurricane meanders around the Caribbean and Gulf of Mexico for a while, preparation time is much greater than it is here in New England. So, if you have boats in the water and a hurricane watch is issued, put them in safe harbor or get them out of the water. Don't wait for the hurricane warning or you will probably be sitting there in six or eight feet of water; it is too late during the warning situation. We try to give as much lead time as possible, but it is diminished greatly in this particular area just because of the speed of the storm.

We are talking about the hurricane situation here, and as I say, most of my slides will be on hurricanes. But probably of more interest or of equal interest to the seashore areas are the winter storms, where a storm can come up, as it did in 1978, and stay with us over several successive high tides. This is one of the major problems of a winter storm. The winds are almost hurricane force in many instances, and when they work over several high tides you have beach erosion, surf battery and so on.

Other storms that we are interested in as far as the southern New England area is concerned, are tornadoes and severe thunder storms. Massachusetts has the highest incidence of tornadoes per square mile of any state in the eastern United States, with the exception of Illinois and Indiana. I suppose one of the reasons for that is that many of our tornadoes are small; but we do have larger ones, such as the 1953 tornado in Worcester, the 1973 tornado in Stockbridge and western Massachusetts.

Our problem here is that we go from winter storms to severe storms, thunder storms and tornadoes, to hurricanes, back to winter storms and so as meteorologists we are always preparing ourselves from one season to another.

Another thing that worries me is that we have gone so many years without a hurricane. We have gone now several years in Massachusetts, almost ten years, without a major tornado. We have now gone several years without a major winter storm. The weather and nature has its ways of evening things up, and it probably will in the next several years. We must just hope, keep our fingers crossed, and push for this preparedness.

As you see, what I am going to show here are some slides taken from an old book on the 1938 hurricane. This is before and after in many instances. And then what we are faced with at the present time along the southern New England coast.

This is the Buzzards Bay area where a tide, a surge of about fifteen to eighteen feet, entered the upper end of the Bay. The parking meters in downtown Bourne were under water and there was general destruction throughout the area.

This is Providence and the Yacht Club at Providence at that time. The photographer took the pictures and the whole thing washed away eventually.

Watch Hill Beach before and after.

Now, I'll go back to Watch Hill once more. I think this is indicative of the destruction that can be caused by hurricanes.

This is Crescent Beach over by Mattapoisett. It was a nice beachfront community. There it was after the hurricane, the arrow showing where the homes ended up. Look how far back from the ocean much of the destruction took place. We visited there several years ago and one of the old timers told us there were still refrigerators and stoves back up in the woods from that hurricane.

Somebody has made some plans in case the water comes up again. The house in this photograph would be a hundred thousand dollar house at least. This man built his house up on the sand. The Bible says to build your house upon a rock. He has taken some precautions, the stilts that he has built it on are circular and it has been found that during a storm, a house built on circular stilts will withstand the force of water much more than one built on square stilts. He was using some foresight.

These homes are comparatively new. This area was destroyed back beyond this point in the '38 hurricane.

Here you are in an area perhaps less than ten feet above high water. This is certain to be destroyed during the next hurricane. I use that phrase, the next hurricane, because there will be one. Only nature will say whether it is this year or next year, but the odds are getting larger each time.

Here is another building right on the coast, not more than ten feet above water. It is certain to be destroyed. Again, more homes built right near the water, almost certain to be destroyed.

This is another photograph of an area before and after a beach clearer—in Boston we call an easterly wind a beach clearer.

This is Horse Neck Beach, completely destroyed.

Certainly the person who owned this building didn't have a whole lot to lose, but if he were riding out Hurricane Camille, as the movies tonight will show, he would have had a party on that.

This is Horse Neck Beach today, the State Park, and the way that type of land should be used.

Now we get into East Horse Neck Beach and you can see the houses being rebuilt, right along the water again, certain to be destroyed in a hurricane the size of the 1938 or even the '44 or '54 hurricane.

FROM THE FLOOR: What is the interval for expecting a hurricane?

MR. WINSLOW: It is hard to say. Probably once every twenty, twenty-five years it's possible. Should we prepare for one every twenty-five years or one every hundred years or, as Neal Frank, the Director of the National Hurricane Center would say, once every five hundred, once every thousand years.

Somebody that has his home and trailer or his summer home and trailer built like that doesn't have a whole lot to lose. Incidentally, this trailer is still here. This picture was taken three years ago. We flew over several weeks ago and I could identify that trailer in the air. It is still there. It could be completely wiped out.

This is Woods Hole during the '38 hurricane. That is Woods Hole Bay

showing a lot of valuable property built right on the water.

This is over at the Falmouth Maravista area. This is the bridge at Maravista and here is the Inn at Maravista today. This would be an ideal place to have a hurricane party. If you survived, you could tell first-hand what happened.

This is over in the Falmouth area. They have made some protection for it but I'm not sure how it could withstand the forces of fifteen or eighteen feet of water. It is likely that many of them would survive; the trouble is they would have a lot of water damage and wind damage.

This is just east of Chatham and there are certain motels and condominiums built very, very close to the water. I emphasize again that with a storm surge of ten feet or so, most of them would be well under water, washed out.

In the western part of the Cape many motels are built right on the water. These housing developments, in all probability would be completely wiped out during a hurricane the size of the '38 or even the '54 hurricane.

There is much destruction here, probably going back to the second or third streets away from the water. There is probably a lot of water damage even further back.

This is Falmouth Inner Harbor. This was taken in the spring and comparatively few boats were in the water at that time. There are houses built right on the water.

There is a reason for this slide, and this is my last slide, I think. This is over at Crescent Beach, over in the Mattapoisett area. This is the wall of water, the surge, that takes place. We talk about surges as high as fourteen to sixteen feet, perhaps even higher in the upper end of Buzzards Bay.

How many people know what fourteen feet looks like? You don't think much of it, but that fourteen feet at the base of that bridge, that is a lot of water, and the force of that water, tons and tons of water, will take anything in its path.

I would like to emphasize a fact. We talk about several factors in hurricanes. Ninety percent of the deaths in hurricanes occur from drowning. That is because of the large surge associated with it. A few die because of wind-blown debris and a few pick up live wires. They don't think.

One of our problems is to get the people to think what to do during a hurricane situation. We have preparedness meetings, we come down to the Cape Cod area at least once every year for several days. We feel that most of the Civil Defense officials are prepared, with some idea of what to do, but the general public doesn't really know what to do.

We had several such conferences a year ago, we advertised and we had posters made and put in post offices and stores on the south side of the Cape. We had a meeting in Wareham one day from 11 o'clock to 6 o'clock and the next day at the Cape Cod Community College. As I say, we put it in the newspaper, on radio stations and in Wareham six people showed up. At the Cape Cod Community College, ten people. That was a success.

So, we really try; our hands are tied sometimes with the amount of money we have to spend, and our ability to get out.

But shortly after Labor Day last year we came down to the Cape and set up at the Cape Cod Mall in Hyannis. We passed out over 1,500 pieces of literature to people. And, this is what we will be doing in the future, coming to shopping centers and so on, to try to make the people aware of

how simple it is to save their lives.

We do not advocate clearing Cape Cod, evacuating Cape Cod. Can you imagine what would happen? We would have more people die on the highways than die in all the hurricanes put together probably.

All we ask is that anybody residing or living in an area less than ten feet above sea level, go back a couple of hundred yards. The storm surge won't go much further than that in many cases, but people will get wet as they move back. Schools and churches and public buildings are not always located on the immediate beach and there is plenty of area to move back.

So, when we talk about evacuation, we talk about evacuating only the low-lying areas along the immediate coast. Cape Cod is unlike the Gulf Coast or much of Florida where evacuation is measured in miles rather than yards. So, it is very simple to be prepared for a hurricane which might strike this area.

Deaths might occur; we can never foresee the person that lifts up a live wire or gets hit. We say, I suppose, that is luck, but it is not luck to move back from the shore.

I don't know how much time I have consumed here, but I would like to cut this off pretty quickly and answer any questions that you might have regarding the storms that hit the area.

## QUESTIONS TO MR. WINSLOW

FROM THE FLOOR: It is not a question so much as a comment. If you're collecting interesting signs, there is one down in Delaware, the South Bethany Beach. A house was built right on stilts and stands right on the water and it is prophetically named Richard's Folly.

Come down and get that one and add it to your collection.

MR. WINSLOW: One of the hurricanes, I can't remember exactly which one it was, 1815 or 1850, where the ocean met the Delaware Bay. All of southern Delaware was inundated by that particular hurricane.

Most of the hurricanes that come up the coast parallel the coast. Southern New England juts out from the New York City area all the way out to the outer tip of Cape Cod and so it lies in the path of the storms which move up this way.

As the coastline comes up, it goes perpendicular to the path of the storm. Much more destruction will be wrought in the area of southern New England than along the Atlantic Coast. That is not to say that the Atlantic Coast south of New York City is free and clear of hurricanes. That is not true, because they can come up and meander around and actually move westward into the coast itself and, as you all know, during Agnes of a few years ago, a lot of deaths and a tremendous amount of destruction took place from the flood situation.

Here we are confronted with both the hurricane itself and the flood-producing rains in the western and central parts of Massachusetts and northwestern areas of Connecticut. It is a little bit more complex up here in Massachusetts and the southern New England area.

FROM THE FLOOR: Are you planning to set up just once or twice in the Mall during the summer or what kind of coverage are you contemplating?

MR. WINSLOW: We will probably not set up during the summer at all. We will probably wait until after Labor Day so that we can talk to more of the natives, so to speak.

I suppose many people don't care about the tourists; we do, because they are statistics.

The Cape Cod Chamber of Commerce doesn't like us to say much about hurricanes, but we might as well face facts—they do occur. We have to prepare. I remember Don Kent years ago saying something about a rainy weekend that turned out clear and he was chastized severely by the Cape Cod Chamber of Commerce. It is bad when we have to sort of make our forecasts for what the Chamber wants.

FROM THE FLOOR: Doesn't that only perpetuate the problem of the local summer resident not understanding what really happens out here during storm periods?

MR. WINSLOW: It may, but one of the problems with us, I suppose, is that the season for hurricanes in southern New England is more likely to be late in the season rather than during the summer months when tourism is at its peak. Most of our hurricanes occur in September, even early October. There certainly have been those in August and a little bit earlier than that.

My major fear is to have a hurricane come up on a Labor Day weekend, especially one following a very hot summer and there are thousands, literally hundreds of thousands of people down here on the Cape. I don't know what we would do.

The only thing we can do is give adequate warning and for people to listen to it at that particular time: get back from the beach, don't get out in the highway. There is no way that you can handle, let's say, twenty thousand cars across the one bridge that we have remaining at the present time. I don't know what the capacity of the Bourne Bridge is, probably less than a thousand cars an hour. To accommodate all of the Bostonians down here on the Cape would take probably forty-eight to seventy-two hours or more to get them all off the Cape itself.

FROM THE FLOOR: You talk about the lack of response to your education sessions until you went to the Mall. Could those type of public awareness sessions be made mandatory for people who are going to receive aid after a hurricane, or if not mandatory, certainly encouraged?

MR. WINSLOW: Well, it is too late. Actually what we are trying to do is educate the younger people, through the high schools and grade schools, and we have prepared several plans for the State to put severe weather in the curriculum. This would apply, not only to hurricanes, but to winter storms and to the severe summer storms, the tornadoes and thunderstorms.

This is the only educational process that I think we can make any progress in at all. For other direct forms of education we don't have the manpower; we don't have the time to come down and speak to everybody on the Cape, whether it is getting a thousand people to the Cape Cod Mall for three days or whatever it might be. We just don't have the resources.

FROM THE FLOOR: Have you prepared such things as inundation maps and such saying that this place will be covered by X rise in sea level or that a surge from a certain direction will make this area uninhabitable, but yet this other area is safe?

MR. WINSLOW: That type of map is being prepared. However, in the

office at Boston we have prepared our own maps and delineated areas of less than ten feet elevation. This is one of the selling features of our trips to the Mall and so on and we take these maps with us and ask people, "Where do you live?", and most people will point out a little dot on the map. Quite a few of them said, "Gee, I had no idea I live that close to the coast."

We feel that those people now will be better prepared for the next storm that comes along.

The Kennedys, and people living in that type of area, won't have to worry; they are right on the coast, but they are twenty or thirty feet above sea level. They will suffer wind damage and possibly some water, but those houses will remain.

It is the person who built his house right on the beach that we are concerned about. He may not have put a whole lot of money into it, so we are not worried about that house being destroyed, except as taxpayers, we are paying for him to rebuild it; but we are interested for him to get out, to get off those little islands along there that are very shallow or very low in elevation.

FROM THE FLOOR: Does your office compile historical data and photographs of the different areas in the past storms?

MR. WINSLOW: Prior to the 1978 blizzard we had done very little of that, except for the hurricanes. Now, after that storm, we flew up and down the coast and took a lot of pictures, compiled a lot of data.

One of the problems, and I don't want to get into it here, is that there are so many federal agencies involved in the aftermath of storms. We are more or less involved in the forecasting of storms and how that applies to the people, the residents of the area.

But, yes, we are now more actively involved in that.

I took a three and a half hour ride with Neal Frank and three of his forecasters from the Hurricane Center in the Coast Guard helicopter from Otis. We took countless pictures to show how it looks now. He wants to put them into a book to show how it is now and after the next hurricane, to show what destruction took place.

FROM THE FLOOR: I wonder if you are saying that perhaps the Cape is hit so hard, all seventy miles, because it is going out east?

MR. WINSLOW: The most destructive hurricanes that we can have hit the coast at right angles to the coast. Those that parallel the coast will, in general, be less destructive. They are headed out to sea. The land would then be on the western side, which is, historically, the side of least destruction.

But those that come up from the south and, let's say, go up Narragansett Bay or Buzzards Bay, will be the most destructive.

The zone of maximum destruction will probably be from the center of the storm out to about fifty miles to the east of the storm. So, no, not all of the Cape will be affected by such a storm.

Let's say a storm crosses Long Island and goes up the Thames River area. The hardest hit will probably be the area around Providence. I don't think the eastern end of the Cape would be affected too much, except in increased winds and waves and so forth, but it would not be a destroying storm.

FROM THE FLOOR: Did you take a look at this building when you

walked into it today?

MR. WINSLOW: I look at a lot of buildings. Provincetown probably isn't too bad off. The one area that we are concerned with in Provincetown is the Route 6 area south of the town where there are a lot of motels built right on the water. With a southerly wind there, a lot of waves and a lot of wave battering could occur; a lot of flooding could occur, but for the most part, Provincetown has no problem, I should not say that it hasn't any cause for concern, I would hate to come out here after a storm. But we are not particularly concerned with the Provincetown area, with several exceptions.

You take a ride along a certain area of the Cape and there are a lot of little houses that are built right on the ocean itself.

FROM THE FLOOR: I would think that a well-prepared TV show, a documentary, would be very effective in talking to people in this area, rather than talking around in the towns.

MR. WINSLOW: A channel in Providence put together a film, a documentary on the '38 hurricane. It has been shown in Boston, I don't know whether it has been seen down here, but you cannot expect people to watch that sort of thing, especially when "Laverne and Shirley" or some other program is on.

It is difficult to make people weather-prepared, extremely difficult.

FROM THE FLOOR: Do you hold out any hope that weather modification techniques will be able to reduce the force of these storms in the next few decades?

MR. WINSLOW: We haven't done a whole lot of experimentation on that. One of the things new, that Neal Frank was looking forward to, was trying to find a hurricane out far enough away from land and also within range of reconnaissance aircraft so that we could seed it. The last two years I think they were unable to seed any of them, they were just not in the right position.

The question arises, I suppose, perhaps not so much for us here, but do we want to destroy hurricanes–whether they are called hurricanes or typhoons or whatever they may be called around the world. Mexico, in a conference, said no way will you seed any hurricane in the Pacific, because this was their main source of water.

Japan and China are the same way. Although a lot of people die, this is one of their main sources of precipitation. So the question arises, should hurricanes, should tropical storms be seeded, should they be modified. It is a question which has political, economical, and other aspects.

FROM THE FLOOR: Is there any reason given for the lack of hurricanes in the last twenty years in this general area?

MR. WINSLOW: I don't think so, not a rational reason at least.

I had a series of slides that I didn't put in here today, but it shows the various decades since the twenties, showing how during a particular decade the storms would hit the Caribbean or the Gulf of Mexico; then the next series would hit more into the Florida area, and the next decade, the decade of the '50's was the New England decade, and so on.

But no, I really don't know that we can give any good rationalization on that.

## INTRODUCTORY REMARKS

MR. OLSEN: We will remain on the subject of hurricanes. Our next speaker is Edward Thomas, Director of the Insurance and Mitigation Division, Federal Emergency Management Agency.

Mr. Thomas started with HUD as an Urban Intern in New York in 1969. Later he was transferred to Senior Flood Insurance Specialist for New England by HUD. In this position, he was responsible for the Flood Insurance Program in the area.

In 1976 he was appointed to his present position. During the past six years he has addressed over 1,000 groups on the subject of Flood Insurance Programs and Flood Plain Management.

# STORM PREPAREDNESS: THE AFTERMATH

**Edward A. Thomas**
*Director, Division of Insurance and Mitigation*
*Federal Emergency Management Agency*

I am delighted to be with you here today. This is a very suitable place to have a conference, in that it was flooded twice in 1978. Right where we are standing, you would have been very wet in January of 1978, by winter storms. As it has been pointed out, Provincetown in this area is pretty well protected from hurricanes, but quite well set up for winter storms. The whole Inn was very severely damaged in 1974.

I am with the Federal Emergency Management Agency whose name has been mentioned once or twice here today. Far worse than that, I suppose, I am in charge of the National Flood Insurance Program in New England and have been since 1974.

It is always a little difficult to figure out how to sort of introduce Flood Insurance Programs to a group. There are no jokes about flood insurance that can be told. The leading one is generally considered to be a very, very serious ethnic slur and most of the disaster jokes that I know are a little bit too sick to be told so early in the afternoon.

But perhaps it can be best introduced by relating to you an experience I had speaking at the University of Connecticut when I was introduced by one of the professors who ended his introduction by smiling at me and said, "What the hell is the government doing in insurance?" He meant it. He didn't think it was a good idea at all.

So, very briefly, I would like to explain to you how it is that the federal government has become involved in a Flood Insurance Program, what it is we are trying to do, and we will sort of take it from there.

Basically, the Program was established in response to the enormous toll of disaster relief which was being spewed out in this country. Ever since the 1950's we have had a tremendous wave of development in flood plains, barrier islands, any flood plain anywhere, nice, flat, pretty land, next to the water, for a subdivision, for a motel, whatever it was. Unfortunately, all of us absorb the costs of those unwise planning decisions through disaster relief.

Congress thought, let us instead go to a program which will provide an organized form of disaster relief–insurance, but most importantly, not be a giveaway. It will be a program that will require proper and safe construction when there is development in flood plains.

The program will require, once we establish flood elevation and know, as we do here, that this is a coastal high-hazard area, that new construction, number one, will be elevated. We will talk about the merits of that a little bit further on. In addition, the development will pay its own fair share of that development cost, and it will pay what we call actuarial insurance.

Contrary to what you may have heard here today, once we figure out how high the water comes, subsidized flood insurance is no longer available to new construction in the community. The new construction has to pay its

own freight. But that, perhaps, is not really the issue that we are here to talk about.

The program needs improvement. It will not heal cripples, thus far has not raised anybody from the dead, will not do everything to protect the environment, but, nevertheless, is frequently criticized as being "one of the most outrageous examples of government intervention in history". That is a direct quote. "A Communist plot to take over land and communities." There are others, innumerable. Called a confiscatory program, we have been sued in Federal District Court all over this country for running a program which violates the fifth amendment--protection of individuals from having their land taken without compensation.

On the other hand, others say that we are a program that promotes development. I am sure that if you were to go to the Falmouth or the Cape Cod Chamber of Commerce and ask them if they can list a program that promotes development, flood insurance would not be one of them. In fact, the Town of Falmouth (and we saw some slides of the devastation in Woods Hole, which is near Falmouth, and some other areas of Falmouth) , sued the Federal Insurance Administration over flood heights--that they were too high, that the regulations that required proper building were too onerous.

So we kind of tread a very, very straight and narrow path between developers who regularly sue us, communities who regularly threaten to sue us or do sue us, and others, such as we have here today, that say that we encourage development and heaven knows what else. I suppose the fact that both sides criticize the program is perhaps an indication that we are walking a middle path. We can do better and we are going to need support from people like you to do better.

For example, we will see some slides from Gulf Shores, Alabama--massive destruction. We decided that, coupled with some scientific breakthroughs, we would change the way we calculated the flood height. We used to use what was known as the surge height elevation, which was something that could be legally, scientifically backed up, and, now, we have gone to surge height plus the running wave that is on top of that in calculating our flood insurance premiums and in calculating our requirements for building properly. The Mobile County Board of Commissioners apparently has voted to petition the Attorney General of Alabama to sue us over this new outrage that we have perpetrated.

We need the help of people like you in order to sustain the program, to strengthen the regulations, to make sure that when we do have development in coastal areas it is done at least safely and that is one of the predominent messages that we want to get across today.

I would like to run through some slides. As part of FEMA, our office has been very fortunate to assist in recovery operations from two of the most recent massive floodings on the barrier beaches: the New England flood of 1978, which affected several barrier beaches; and also, Hurricane Frederick, which slammed into a number of very delicate barrier islands on the Gulf Coast.

Scituate, Massachusetts, contains barrier beaches; homes were tossed around like matchsticks. This was the largest flood that has hit that area since 1919 or so. The area is regularly flooded, had been flooded in 1972, before that in 1968, twice in the 1950's, three times in the 1930's, twice in

the 1920's and several times before that. I don't have the whole list. Everybody was very surprised when it was flooded again in 1978.

You can see the protection that is afforded your home by seawalls. There is a seawall there, just about dead center, and you can see the home has survived completely behind it. There was some minor damage; the home was moved somewhat off the foundation. The roof is intact and if they can figure out how to move the four walls back up again, they might be able to get the roof back in place.

Here is a little bit better close-up. These homes all had seawalls in front of them. Some of them were fortunate enough to have the seawall remain. The house didn't, but at least the seawall is there so when they want to rebuild the house again, they can.

Now, in this particular area that we are talking about, we have changed our standards and, in cooperation with the Commonwealth of Massachusetts and the locality, have required very different and much stronger, safer construction down there. The municipality originally tried to ban construction in the area and it was not upheld by the Courts: So, we went, instead, to strengthening the type of construction there.

Recently we have been trying to work with the Town to acquire the property, using funds under Section 1362 of the National Flood Insurance Act. I, honestly, in my foolishness, expected to be greeted something more like a messiah, going down there to offer money to buy these properties and turn them over, as parks, to the community. We are hoping that, perhaps, the riot will die down and that reason will prevail, but at this point that idea is not overwhelmingly popular.

This is another shot of the destruction on the ground. You can see this kind of thing happens regularly: people go in, they are comparatively affluent, they claim an IRS casualty loss, they can get SBA money, they can get flood insurance and they can rebuild quite nicely.

All we have been able to do thus far is require that the construction be built safely, which is more difficult. It has slowed the pace of construction quite considerably down there, but we still have mobile homes back where they were before.

I listened to one of the most heart-rending stories of my life concerning the evacuation of these mobile homes at the height of the blizzard that dumped about thirty-two inches of snow on the ground. Winds of approximately seventy to eighty miles per hour, gusts up to 110, 120 miles an hour in the black of night and firemen and policemen went down to these mobile homes and risked their lives as the mobile homes were bobbing around in the water to pull people out.

Here we are down in Gulf Shores. We have already talked about Hurricane Frederick slamming into Mobile. This is Gulf Shores, Alabama, just across from Dauphin Island, that Dr. Clark described.

This was a condominium built in a horseshoe. What they forgot is that if you build at a parallel to the shore, the waves are going to come right in. As the horseshoe turned around, the walls that were built upon became more and more at right angles to the shore and then parallel to the flow of the water and the middle part of the condominium was saved. The middle part of the condominium suffered no water damage at all. It was built safely. If the walls of that thing had been built completely at right angles to the shoreline, it probably would have suffered no damage.

FROM THE FLOOR: Isn't orientation one of the things that you have listed in your recommendations for building on a flood plain?

MR. THOMAS: Yes, but I think the architect missed on that one, though.

FROM THE FLOOR: Do you still insure him?

MR. THOMAS: I'm not sure if that was insured or not. We would have, and we will be talking a little bit about that. That is one of the changes that we are making. We learn, it takes us a while, but we learn.

This used to be wall-to-wall houses. I don't have any really good "before" shots. At the top of all those posts there, used to be buildings with human beings living in them. The main thing is that very few people lost their lives down there. That is really a magnificent tribute to the Civil Defense workers and to the fact that the media had been giving very lurid accounts of the flooding in Santa Domingo, in Cuba and in Puerto Rico, which apparently scared people. That flooding had taken place only the week before.

This building is on Dauphin Island. It is interesting predominently because it is one of the three homes on Dauphin Island that had been built to the standards of the Flood Insurance Program that suffered any damage. Dauphin Island was spared the real brunt of the storm, the eye of the hurricane passed through Gulf Shores. What we found on Dauphin Island was that the homes that were built properly came through safely. The homes that weren't, didn't. You can see in the background here, the number of homes left. On the other hand, some didn't make it.

This is just miles and miles of places where they have what the insurance adjustors called slicks. There wasn't even a post left to tell where the house had been. People were down with surveyors trying to figure out where their land was. Sometimes the posts were left.

On the other hand, we had homes that rode through almost completely intact. These were built to the standards of the Flood Insurance Program and the Southern Florida Building Code.

This was built to the standards of the Flood Program, it suffered some minor damage, it had windows blown out, but it was back in business again fairly soon. It was part of the Alabama State Park down there.

This is a shot of Dauphin Island, the homes that rode right through the storm. The Building Inspector down there was very proud of them because they had been built properly.

This is the aftermath of Scituate, Massachusetts. This was the best that we were able to manage. Homes are built up a lot higher, a lot stronger. They will resist all but the very largest storms. And possibly it is one solution to our problem.

But on the other hand, when you have the kind of erosion that took place, this is Gulf Shores again, you can see that there is about four feet of erosion, up to here. It took place over the entire island or over the barrier spit. It is really doubtful that in any larger storm, this home here would have survived, because the whole underpinnings, the underlying foundation was almost eroded away. When you have erosion like this, I don't know what you could design to prevent destruction. You do have areas that you can't quite build properly. We have to face that.

There is a barrier beach, that is what we are talking about. You have developed barrier beaches and undeveloped barrier beaches. The question is,

what can you do to make all our barrier beaches look a lot like that? It is a very complex problem. So, despite all this destruction, there is some possibility that at least in some parts of barrier islands you can build safely.

Why develop it? That has been asked a couple of times. I guess I have found one thing out in my life, and that is that people aren't stupid. I've traveled all over New England and south on disaster relief and one thing I have learned is that people develop because it makes economic sense. There are enormous benefits to the developer; to the occupants–(God! wouldn't you love to live in one of those houses?); to the locality, in the form of sales taxes, tax revenue; and to the state. All those groups of individuals are receiving tremendous benefits from barrier island development.

The costs on the other hand are borne by you and me in the form of federal taxes. Some costs are borne by the state and some costs are borne by the localities and individuals when they get killed in these areas. Due to the tremendous competence of the National Weather Service, and local Civil Defense officers, comparatively few people are killed in storms, perhaps deceptively few; perhaps we are very, very lucky.

But by and large, the costs go to the federal government; benefits to to others. I think that that is a fairly clear indication of why we have development. The Town of Hull, Massachusetts, predominently barrier island, turned a profit in the 1978 flood. It didn't cost them a dime, they turned a profit of $300,000. We wonder why localities allow development on barrier islands? That is why, because it makes economic sense.

Dauphin Island Causeway has been mentioned today. That is a very good example. Dauphin Island is reached by a broad causeway. Governor Bob James of Alabama said that that causeway rebuilding was a top priority for his state following Hurricane Frederick, other than life protection and getting people back into some kind of shelter. The reason for that was economic. Tourism is the second largest industry in the State of Alabama. The tourists go down to motels and hotels and summer homes, to Alabama beaches, not only injecting that enormous amount of money that they spend in the Alabama economy there, but all the way as they come down through Alabama, stopping off at motels, hotels, spending money.

We suggested that perhaps it was time to implement some purchase programs on Gulf Shores and Dauphin Island. I could be a comedian for the laughs. No, not interested. They may allow us to buy some small area of Gulf Shores, but by and large the towns are not interested in that.

If you see a home on a barrier island in many ways it is best to look at that as an industry, look at it as a smokestack with smoke coming out of it. For many of these communities it is the industrial strength and basis that they have. They are certainly very anxious for the federal government to protect that base and that strength. I don't know how anxious they would be to pay it out of their own local revenue, but that is just the sheer fact of it.

So, what is the federal interest? Certainly it is to protect lives and save money. I am not really quite sure what the order there is nowadays, but certainly those two things.

I think that as the result of Flood Insurance Programs, the result of some changes in the disaster relief laws–the way they are administered, and the way they are interpreted–we are going to see a tremendous turnaround in the amount of federal dollars that they will pump into an area after a

flood. That is going to happen.

Executive Order on Flood Plains 11988, and Executive Order on Wetlands, 11990, which have been mentioned today, will also make a very significant difference in how federal dollars are spent. Certainly any type of legislation or Executive Order on the barrier islands themselves would be helpful.

I think that we can get a handle on the dollars lost, possibly, even on the lives. But the real question is, will that protect the environment? Will it really protect the environment, just because we build safely and properly?

Do we instead then go and end all subsidies by the federal government for development in barrier areas? That is a thought. Certainly we talked a lot today about the Flood Insurance Program, Disaster Relief. Dr. Jack Schaeffer did a study and calculated about eight percent, e-i-g-h-t, eight percent of the federal subsidy for barrier islands, could be attributed to flood insurance and disaster relief. Quickly subtracting, that means ninety-two percent, ninety-two percent of the federal subsidy went for highways, sewers, water, sewerage treatment plants, all of those lovely things that go into an area. Do we end them, do we abolish them? If we do, will that, in fact, make for better development?

We have tried that one out already in some areas of the country. The EPA has said that they would not build a sewerage treatment plant and we found that the developers were able to make up the cost of their own sewerage treatment plant by simply increasing the density. That is not terribly functional.

We have found that ending the federal subsidies does not necessarily end development. The barrier islands in Massachusetts were developed long before there were federal subsidies. I think we have to keep that in mind. We can't just expect, because we end all federal subsidies, that there will be no development. I don't think that is going to happen.

Barrier islands are tremendously fragile and a completely unique area. The best protection for them, of course, would be park land. Now that we have had our little joke, I think that we have to realize that we are not going to have that. We are going to have to find another way.

The Federal Emergency Management Agency will be spending about $5.4 million this year buying up property that was damaged by floods. It is a step in the right direction. We hope that a lot of that is going to be spent on barrier islands. But, considering the reception that we have had with preliminary discussions with barrier islands in New England communities, I wonder if that will be the case.

We have to see that whatever federal assistance is made available, it is made available so that we get safe development that protects the environment. But I urge you to seriously consider what might happen if we had the federal government step out of the barrier islands completely. We may have development that will be far worse than what we have now.

What we need is a comprehensive federal policy that, at a minimum, says: "All right, we can't absolutely forbid you from building on this land, we don't have a legal basis; we can't afford to buy it, that seems to be the feeling; these will be the standards that we will use for development." I suggest that that can be considered as an alternate means.

Okay, I guess I have about seven minutes left and I would love to have some questions.

## QUESTIONS TO MR. THOMAS

FROM THE FLOOR: What kind of enforcement have you got for your policy? If somebody ignores you and goes ahead and builds, whatever he feels like, what can you do about it?

MR. THOMAS: Well, three things. First of all, as of about September or October when we issued our new Agent's Manual, all construction on what we call coastal high-hazard areas, the areas subject to waves during a hundred-year's flood, will be individually rated by us based upon the actual construction that is to take place. So, if someone wants to build four feet below storm level, we will be happy to charge them the appropriate premium. At this time, we have the beginning of that in our regular Agent's Rating Book. The premium should be calculated that would be actuarial if someone built four feet or two feet or one foot below flood level. Their premium would be very, very high.

In addition, if the community gives the kind of variances which would allow such building, it is subject to being suspended from the Flood Insurance Program and enormous sanctions would take place, which would essentially mean a cut-off of all federal funds for any type of mortgaging development, construction, grants, within the flood hazard areas. So, we have a pretty good stake there and a fairly decent handle that we are getting better and better at all the time.

There is, for example, a lady in Florida whom, I personally feel very, very sorry for, who managed to get a variance from her local or her county government to build some six feet below flood level. Her flood insurance premium is $7,500.00 a year. That certainly should calm down people from building completely incompetently. We hope to tighten up on that considerably.

FROM THE FLOOR: Are you going to be recalculating your rate maps for the new interpretation on storm surge in the zones by wave height?

MR. THOMAS: Yes.

FROM THE FLOOR: How long is that going to take?

MR. THOMAS: Probably in the vicinity of two to three years. However, as of September or October, as I mentioned, we will be including wave height in our calculations of the premiums for new construction in the area that we call coastal high-hazard areas. We should be starting to charge the dollars reflecting the risk by September or October. Then, hopefully, shortly thereafter, we will be requiring elevations to wave height as part of our standards.

FROM THE FLOOR: You started out with a question, why is the government in the insurance business? I am not clear that you have answered that question. And, secondly, what would that individual that is paying $7,500.00 a year, what would it cost her if she wanted to go to private insurance companies?

MR. THOMAS: Okay. One of the problems of having a half hour, having an assigned topic, I can't describe the whole Flood Insurance Program.

Flood Insurance Programs exist because private insurance companies, with three very minor exceptions, do not write flood insurance at all. They did not write it because of what we call negative risk selection, that is,

that only those most near the ocean or most near the river would be likely to buy the policies. In addition, they didn't write it because they had no means to enforce the loss prevention standards, which we call flood plain management or hazard mitigation, which would be a condition of writing the insurance in the first place. Flood insurance is cheaper on a dollar-per-dollar basis to give out by the government than disaster relief; the insurance program makes economic sense for the federal government, because we prevent future losses by requiring safe construction. We have a ready means at hand, through private industry, to pay off on claims of people as they are flooded out. It flows a lot easier.

FROM THE FLOOR: Okay, but are these rates fitting for the costs? In other words, is this individual paying the proper proportion of the premium?

MR. THOMAS: The individual in Florida?

FROM THE FLOOR: Well, any individual with flood insurance.

MR. THOMAS: In the first phase of our program, before we established credit levels, people received a subsidized rate. The same blanket throughout the country for single-family houses would be twenty-five cents per hundred dollars coverage.

The second phase of our program they are charged the actual cost of the insurance.

FROM THE FLOOR: No longer subsidized?

MR. THOMAS: That's right. The way it works is that, according to our actuarial computations and formulae, we expect that by the year 2000, or 2020, that the annual savings due to the Flood Insurance Program to the federal taxpayer, constant 1972 dollar, over disaster relief with no flood insurance program which is the system that we had before our insurance came into being, would be a three to five billion dollar a year annual savings because we have the requirements for proper and safe construction.

FROM THE FLOOR: It seems to my oceanographic background that in order to do what you propose to do about adding wave height to surge height, you are going to have a very, very sophisticated program that does wave refraction on a three-dimensional basis and evaluates different breaking criteria and the reformation of—I don't want to snow you with things—secondary waves forming after the first one breaks and such, you are preparing to enter into that sort of a thing?

MR. THOMAS: Yes sir. The reason we haven't done it before is that we did not have the means at hand to do it. We have worked with the Academy of Sciences, with NOAA, with the Corps and a number of private firms and we have computerized to give you a sufficient estimate of wave height. It is not going to be completely site-specific, as you obviously well know, there are small minor changes. It will be sufficient to sustain.

FROM THE FLOOR: Some sort of an actuarial approach to a design wave or something like that?

MR. THOMAS: It will be an approach by doing it, having the wave split up, probably about every half mile or so along the coast we would have a different elevation. If you would like to sit down and talk about it, I will be happy to.

I think that it will be, number one, legally defensible, and number two, it will be correct and accurate.

FROM THE FLOOR: Can you tell me whether the communities in-

volved in the Flood Insurance Program still in the emergency or first stage of it, is there any kind of a time limit on those communities to get their flood insurance, flood programs made and zoning regulations in place?

MR. THOMAS: To answer your first question, at this time, in terms of the number of policies written, about sixty-five percent of them are written in communities that are in the regular phase of our program.

In terms of gross numbers of communities, that includes a lot of very, very small communities with very slight flood hazard, we have less than twenty-five percent in the regular program. But we have to have them all in the regular program by 1985 and we expect to make that as our target date.

FROM THE FLOOR: You showed us some slides of houses that were intact and others that were destroyed. Those ones that were intact were built to certain specifications. What were the major, specific specifications that made the difference in most of those cases?

MR. THOMAS: Elevation. The homes that had been built on stilts to elevations below ten feet mean sea level really got nailed by the waves.

On Dauphin Island the flood insurance requirement was to raise the home up sufficiently so they escaped major wave damage. It was just a basic question of elevation.

There were other nuances which we can talk about. We have a number of slides that really get into construction techniques, what works and what doesn't, round poles, notched poles, concrete piers and that kind of thing, but the main differential there was that before the Flood Insurance Program on Dauphin Island, they had not raised the homes up high enough.

FROM THE FLOOR: Are these design standards something that is going to discourage people from building in these areas or is it something that simply is going to encourage them to put their houses up on sticks?

MR. THOMAS: They will be more than sticks, first of all.

FROM THE FLOOR: Well, you were talking about these buildings in resort areas being industries. Is the cost differential between the standard construction and this stick construction going to be so different that it is going to discourage them from abandoning their industry?

MR. THOMAS: There will be some discouragement that we have seen thus far on the coast. In Scituate and Hull, Massachusetts, two of the barrier beach communities most severly hit, and where we are enforcing the wave height criteria right now, due to a combination of local and state laws, there are a number of lots that have not been rebuilt. So, it may have dampened it a little bit. But your basic laws of supply and demand will take precedence here. The demand is enormous for beachfront property. I don't think you can look at that to prevent development over a long period of time.

FROM THE FLOOR: You said ten feet was the number you were using for height on the poles. Now, what would happen if Hurricane Camille had hit that community, I think the surge was around twenty or twenty-plus?

MR. THOMAS: We wouldn't have had the houses left on the posts.

I am not suggesting that they are going to be able to resist every hurricane. I am not suggesting that it is necessarily totally good, but they did come through. A larger storm would have wiped out even houses built to the standards which we are proposing right now. You will always have a larger storm that could wipe these areas out. I think that that really skirts

the issue, though.

The question that we have is preventing loss to the federal government. We can achieve a reasonable degree of loss prevention. You are not going to have a Hurricane Camille come along, even every hundred years. It was a very unusual, very severe storm. We can absorb some risks in this economy.

The question is, in barrier islands should we look beyond the question of loss prevention to the question of environmental protection. That is the issue. You can come to a satisfactory and reasonable degree of loss prevention. We haven't come to it yet, but we can. That can be done. The issue, though, is, is that really enough? We talk about barrier islands, do we just want to protect them from the point of view of economics and saving the federal taxpayer or do we want to protect them because of what they are?

The normal way of doing that is to buy them. If you want to have nice open beach, you buy it. That is really the horns of the dilemma that we are on.

FROM THE FLOOR: What kind of relief is available to an uninsured community if it turns out to be hit by a very severe storm?

MR. THOMAS: We will be happy to supply tents, medical supplies, some other stuff like that. The Red Cross will step in, if the community is not a member of the Flood Insurance Program. By the way, very few communities that have a real flood risk are not members of the program now.

FROM THE FLOOR: What kind of relief does your office give to communities that have adopted flood insurance programs, but don't have a building code and don't have the zoning regulations that reflect the high hazard areas?

MR. THOMAS: They would. I guess I am somewhat notorious for saying that I don't care how they adopt the ordinances, so long as they work. If they have an ordinance that protects their coastal flooding area or their inland flooding area as part of their dog ordinance and it works,we don't care.

If, on the other hand, it is not working, then they can and should be suspended from the Flood Insurance Program. They have to demonstrate some type of ordinance or code in order to join the Flood Insurance Program in the first place, or they would not have gotten in, or they would have been suspended when they moved from the emergency phase of the program to the regular phase. They had to have something on the books. If it is not working, or if they repeal it, they are subject to immediate suspension.

FROM THE FLOOR: Who would you write to to get further information on that?

MR. THOMAS: From your voice I perceive you would write to our Atlanta office. Where are you from?

FROM THE FLOOR: Maryland.

MR. THOMAS: You would write to our Philadelphia office, I beg your pardon. I would be happy to give you the address after I am finished here.

We very much want to know about that kind of stuff, because it is illegal. We can't sell Flood Insurance policies unless they have adopted the ordinance. There is no point, or almost no point in having a Flood Insurance Program unless we get the *quid pro quo* of proper and safe construction.

FROM THE FLOOR: We have adopted an ordinance, but we don't have any regulations, there is no building code and no zoning to protect that area.

MR. THOMAS: Is the ordinance being enforced, though? By some means?

FROM THE FLOOR: Not that I know of.

MR. THOMAS: That is something that we can look into. The community has to issue building permits, they have to have documentation that buildings are built to certain heights or flood proof, et cetera, and if they can't do that, they are subject to suspension.

FROM THE FLOOR: How high do those buildings have to be built above the mean high tide?

MR. THOMAS: How about mean sea level instead? It varied in Scituate from seventeen to twenty-one feet above mean sea level. It will vary tremendously according to how close to the ocean the area is. The waves, obviously, are going to be dropping down as they get further inland. In Hull it was about the same.

FROM THE FLOOR: Now, all the other houses around that do remain, are they going to have a much higher insurance premium starting next year when your new regulations come in?

MR. THOMAS: The way it works is if they are substantially improved they are treated as if they were new construction, both with respect to elevation and insurance rating purposes.

Thank you. I'm going to be around and I will be happy to chat with you.

MR. OLSEN: That is a job well done. Obviously, you generated a lot of interest.

## INTRODUCTORY REMARKS

MR. OLSEN: Now it is time for our "clean-up hitter", Dr. Norbert Psuty, who is Director of the Center for Coastal and Environmental Studies at Rutgers University and also President of the Coastal Society. Professionally, he is a coastal geomorphologist, a professor of geography and geology at Rutgers University. He has worked on coastal management issues for about twenty years, especially on beach erosion and dune processes in Latin America, on the Gulf Coast and the Atlantic Coast.

Dr. Norbert Psuty.

# PUBLIC FORUM WRAP-UP

Norbert P. Psuty
*President, The Coastal Society*
*and*
*Center for Coastal and Environmental Studies, Rutgers University*

I have found today very, very interesting. I have learned a lot and I am sure you did as well. I am going to try to make a little presentation this afternoon that is going to touch on a number of the points that were raised today and maybe raise a few more issues about them.

Before I do that, I want to give a little publicity to the unit that I am associated with--the Coastal Society. I am its President this year and we have an organization that contains membership from amongst scientists, managers, technicians, from different agencies of all sorts, some local, state and federal levels. We share a common interest that those of you have here– interest in issues and problems associated with coastal zones. I hasten to add that this is an international unit; we have memberships from around the world.

This October, October 13th through 15th, we are going to hold our annual meeting in San Diego. We have a theme for our meeting, basically the information transfer process, how does information flow from the scientists, from the technicians into the decision-making process, into the forum. How does it get into public policy. Our presentations this October are going to be on that particular mechanism, that flow. We will have a variety of topics. Barrier islands happens to be one of them. We will try to show the flow of information from the scientists, let's say, on one hand, to the establishment of policy on the other hand in terms of the processes that are involved.

You are certainly invited to attend. There are announcements of this meeting on the back counter over there as you walk out. There are also membership applications to the Society. You are certainly invited to this Society as well as to the annual meeting.

Now, in terms of this wrap-up, you have heard a number of views on many different issues that pertain to barrier islands. I think that you have heard from people that have to deal with them on a continuing basis. This is first-hand information.

We have heard that there are initiatives for preservation, we have also heard that there are programs for incentives. That tends to leave us in a kind of conflict situation. I like to think of it in terms of a coastal paradox, or paradoxes, because there are many, many points. We seem to have people coming from both sides and there may not be an actual resolution to the problem or a solution to the problem, rather, a continuing conflict. I think for us that means that there are opportunities, challenges, and, of course, many, many headaches.

As Herb mentioned, I am a coastal geomorphologist and I can point to a couple of issues now that have developed from my background of coastal geomorphology. I have been trained to work in areas of investigation of sand movement, of form development, different processes that take place along the shoreline.

I can look to the literature that I deal with and I can see that quite a while ago, in fact, around the turn of the century, there is in the literature, a lot of information from observations by scientists at the time, that recognize the concept of barrier islands, recognize the fact that they migrate, that they are dynamic. So, we have on the order of eighty or ninety years worth of information, of scientists pointing out some of the potential for change along the shoreline.

In the 1930's we had another series of developments that pointed to theoretical and laboratory experiments that provided more information about the dynamics of the shifting of barrier islands. I would have to say that since about the 1930's to the present, there is nothing that has really changed from the scientific point of view. We have added some additional information, we have filled in the gaps, but the theories that were presented around that time continue to hold. That means that there is on the order of fifty years of information which seems to be accurate, since it has not been contradicted at the present time; it seems to hold up against the additional information.

The scientists, on the other hand, were apparently interested in talking to themselves, the "ivory tower" type of scientists, so this information didn't really get into the hands of management. The scientists weren't interested in making management decisions and developing management plans. So, we find that the scientists had not been terribly involved in this process.

In the last decade, however, the scientists have been involved. I think there has been both a clamour for bringing scientific information into the decision-making process, as well as interest on the part of the scientists.

I happen to be a member of the group that really likes to see the kind of information we produce being used in decision-making. We take a certain pride in having the information that we generate showing up somewhere to back up the law, to back up an ordinance or to allow for a certain direction on the part of a management agency.

Now, there are many scientists like that and I think we will hear from a number of them tomorrow when we talk about various environmental matters that have to do with the coastal zone, because you will see that they are really gearing toward how to make use of this information, how to protect the environment, how to direct development.

We like to draw upon the background that we have; it is a good scientific background, and establishes a firm foundation for policy. I'm going to draw from some of the points made earlier today that illustrate the applications of scientists, the use of some basic information and some facts that apply.

Certainly we all realize at this time that the barrier islands are a dynamic system, constantly changing. The system is constantly migrating. I think that one concept, migration, is probably one of the key concepts that has to be applied to any kind of management of barrier islands systems. Now, I will bring forth a number of examples about this one concept of migration.

We have researchers who have been working in this area for some time. Some are funded through state CZM programs, and a variety of state agencies; some are funded by the Department of Interior, National Park Service, by a variety of units that have put money into understanding the way in which things are changing along the shoreline. There are a lot of reports

that come out that show maps and say that this portion of the shoreline is migrating at X feet per year. You can fill in the number.

There is one place in the southern part of New Jersey, in a community called Strathmere, where there is a marsh outcropping in the beach. A number of places around the Atlantic and Gulf seaboards have this kind of situation with marsh popping up on the beach. Basically this outcropping is some of the marsh that was originally behind the barrier island, that is now being exposed as the barrier island migrates inland. However, in this marsh in Strathmere, we found some artifacts. These artifacts give testimony to the fact that during pastoral times the colonists were herding cattle in the area. This means that within a span of about two hundred years, the barrier island has migrated the width of the barrier island.

We know as geomorphologists, as geologists, barrier island have been around several thousand years, but not in one place. They are constantly shifting. This one place, this island, has no antiquity whatsoever. This resembles a lot of other islands along our shoreline. We are talking about a couple hundred years. Anything that was there before that time doesn't exist anymore, because the island doesn't exist in the same place anymore. That change, that rate of change is still going on today, perhaps a little faster or a little slower. A few groins going in there will slow it down, perhaps a little bit in this one location, but accelerates the rate of displacement downcurrent a bit, so overall the trend has not really changed very much. Again, there may be some fluctuations in the trend, but the overall trend has not changed very much and, basically, these coastal areas that we are trying to work with and protect have no antiquity. That is very, very important.

When we apply this information we see that it certainly can be utilized to get handles on the things that occur along the Atlantic and Gulf seaboards. But to people who sponsor the Senate bills, those who are in favor of the bill that is in the House of Representatives on barrier islands, let me point out as a geomorphologist, we also realize that similar features of barrier islands, barrier spits, barrier beaches, whatever you call them, exist along the west coast of this country and along the Great Lakes. The east and Gulf coasts are not unique in the fact that they have barrier islands. They may be unique in that there are so few relative to the extent of the great length of the shoreline, but they do exist elsewhere, in these other portions of the coast.

The fact that this island is moving, as I mentioned before, is a key element. What good is it to go to construction standards that cause a house to survive in a particular place for a hundred years, when a hundred years from now that barrier island is not going to exist there. Now the structures are going to be on stilts, standing on the beach. I am aware of places like that on Fire Island, parts of the Mississippi shoreline and parts of the New Jersey shoreline. They have survived the storms, have withstood some erosion and are now perched, essentially, on the beach.

Presumably we can build houses that last and last and last; they can even be in the water after a span of time. I see no great benefit to that whatsoever. I point to one of the potential conflicts that occurs with the insurance program and that is the establishment of some risks that are based upon storm surge; but are they also taking into account the fact that the shoreline is retreating? It may not be a storm that eventually wipes out the

building, it may be the undermining of the structure which, to my way of thinking, is different than just the flooding of the structure. I would venture to say, as I saw on the slides, that this may be one of the variables that helps explain why some of the structures survive where others are demolished, it may be their proximity to the old shoreline. Some of those were eroded or undermined a bit more easily than others. Basically there was less sediment in front of them to help act as a buffer.

So, to come back to the question, given information about rates at which these islands are changing, should we even allow dwellings? There is information that is known about the rates at which these islands are changing. I think there could be further information generated about how to construct dwellings that will not outlive the space that they are occupying.

This morning Michael Glazer raised a point about alternatives to fee simple purchases. Managers should take note, because last Friday the State of New Jersey unveiled a piece of draft legislation which essentially is a zoning program; it is indeed an alternative to fee simple purchase. The legislation basically says that there will now be some zones along the shoreline wherein certain permits will not be required. In a sense, it goes somewhat after the concept that we have had of riparian law, which basically said that one shall not interfere with certain areas of water, because of the rights of navigation, of movement. We are now suggesting in the State of New Jersey that beaches and dunes are important to the people of the State and this is a public resource. We are suggesting that there are some things that can be done in the area of public resources and some things that cannot be done in the area of public resources.

As was pointed out this morning by Dr. Clark, the dunes are very important. On Dauphin Island, the area where the dunes were well developed seemed to suffer less destruction. But within the State of New Jersey we are also taking an approach that says that the dunes are very important. The dunes, their form, their dimension and their interaction with the beach is a dune-beach system. Our draft legislation recognizes that as a system, not protecting the beach or the dune, but essentially both.

We are suggesting that if we can maintain the dunes, maintain the character of the dunes, maintain the environment of the dunes, we can go a long way toward maintaining some of the integrity of the barrier islands. This comes back to the point that was made by Mr. Thomas, that this approach is environmental as well as good management.

We have mapped the dunes that exist within the State of New Jersey along our shoreline. We have mapped the areas where the dunes would be had they been allowed to be maintained, those places where they have been bulldozed to permit development, and where they have been removed to allow access to the sea or vistas of the sea.

We have mapped those places and we have found two zones, essentially. One is the dune beach zone, which is essentially where the dunes would be if man had not terribly interferred. Then there are a series of lines drawn inland from the dunes. Since this area is changing and migrating, we have a series of time lines drawn behind the dunes. These time lines show the location the dunes will be five years from now, ten years from now, twenty years from now, if conditions continue the way we have seen in the past hundred years. For each of these zones there are state guidelines to be implemented at the local level as to what may or may not be permitted.

The general objective is basically to say that structures should not outlive the space that they are occupying on the barrier islands.

If we get too close to the dunes or in the dunes, there are also some recommendations about the availability or non-availability of Federal Flood Insurance. Regulation of the opportunity to construct or not construct or to reconstruct in these areas may in fact be taking place at the state level rather than at the federal level.

This is a strategy to deal with the dynamic system and I think that is one of the most important parts. We are recognizing the fact that this particular barrier island is migrating; it is shifting and we have to take into account not only what it looks like today, but what it is going to look like twenty years from now when the shoreline has receded thirty-five feet or fifty years from now when it has receded much more than that.

Yet, if we are aware of the thing, we can maintain the environmental quality that exists on the barrier islands through strict control of development, not totally limited. I think those of you who are aware in New Jersey realize that it is kind of difficult to totally eliminate development along barrier islands, but there are opportunities to restrict it. There are opportunities to keep certain areas that remain relatively pristine, state parks, many natural recreational areas that we have, in their current kind of environment. But in places where development has already occurred, there are opportunities to try to reconstruct some of the elements of the barrier islands, while allowing the migration of the barrier island to occur.

Now, there are principles involved here, obviously there is a lot of science involved here. Rather than going into detail on the science, let me just point out the fact that there is a publication that the state is utilizing to support the bill that has just been unveiled. You can see me afterwards and I can direct you to write to the Division of Coastal Resources of the State of New Jersey in Trenton and get a copy of this publication; but we do have a few copies ourselves that will be available to you.

The point is that this is the application of scientific information for both the preservation of certain environmental values and where practical, the establishment of guidelines for continuing utilization of the barrier islands and the residential kind of format.

Thank you.

## QUESTIONS TO DR. PSUTY

FROM THE FLOOR: Doctor, on the west coast there are beaches that are completely removed during the wintertime and completely replaced in the summer. Along the Gulf coast there is not all the erosion and migration, but there is accretion as well as erosion.

DR. PSUTY: Very little accretion. Go ahead.

FROM THE FLOOR: On the east coast do you have any evidence that barrier islands are moving only in one direction over time, geologically or–

DR. PSUTY: Geological time, if you want to say five thousand years, a thousand years– well, they have existed at their present level only about four thousand years, some period on that order, three thousand, five thousand, somewhere in that range.

At that point, at that time, the barrier islands attained a kind of stability, an equilibrium to expand and contract. But from what we can gather

in certain areas, sediment balance, that is how the materials are being made available, in the last five hundred years, sediment balance has been such that there is only one direction for the migration of these islands, and that is inland.

Most of the sediment that was available on shore has already been used. It has found its way up the coast or it is not going to be moved up anymore.

All the rivers that you can think of tend not to come directly to the shore and thereby take sediments and provide them to the beaches on the shoreline. Almost all the rivers along our eastern and Gulf seaboards empty into embayments, and in the embayments the sediment sinks. A lot of it is therefore not available to the beaches.

We don't have any sediment entering the system along most of the eastern and Gulf seaboards. There is not much sediment coming through that water-land contact. It is going to the bays and filling up the bays and it is going offshore in some places. But on the west coast and in some other rivers it is coming down to the waterline, there could be sediments accreting there.

Even so, barrier islands tend to have a retreating pattern.

Also, let me add that they do tend to migrate downdrift, so that you might find an island being displaced laterally along the shoreline. So that along parts of the mid-Atlantic region, the islands tend to be moving from north to south. They are elongating on the southern end. Some people look at that as accretion, whereas, in fact, it is just the relocation of some of the sediment and the net effect is the sediment loss over a period of time; there is less material there.

FROM THE FLOOR: Hasn't there been a lot of offshore dredging to get sand for island construction and what does this do?

DR. PSUTY: There is some offshore dredging, I don't know about a lot. I would hesitate to say that it has much effect upon the sediment balance. I know there are millions of cubic yards that move here and there, but millions of cubic yards are really a small amount of material.

FROM THE FLOOR: You said that legislation was introduced in New Jersey that you have talked about?

DR. PSUTY: Draft legislation was introduced last Friday, yes.

FROM THE FLOOR: What is the prognosis of the outcome of this? Do you think it will ever get passed?

DR. PSUTY: In the last two Environmental Messages from the Governor he has referred to this on both occasions. He has said this is his highest priority in terms of environmental matters and preservation of the coastal zone of the State of New Jersey and a large number of legislators are supporting this bill. There is going to be opposition, obviously. It seems, from my perspective, and I don't have all of the inside information, it has a fairly decent chance. Even the Shore Developers Association is giving it somewhat guarded support at the present time, because they found out recently it wasn't as bad as they thought it was going to be.

FROM THE FLOOR: That sounds downright inspirational to me.

DR. PSUTY: Atlantic City is excluded, by the way.

MR. OLSEN: As the official scorer for this meeting, I will give you a home run for a fine job of wrapping up today's discussion.

Thank you.

# BARRIER ISLAND WORKSHOP: HUMAN IMPACTS

Oral Presentations

Thursday, May 29, 1980

Pedestrian Impacts: Assateague Island ..... 84
*Stephen P. Leatherman, Leader, National Park Service Cooperative Research Unit, University of Massachusetts*

Pedestrian Impacts: Padre Island ..... 89
*John T. Baccus and Jack K. Horton, Department of Biology, Southwest Texas State University*

Off-Road Vehicles: Cape Hatteras ..... 104
*Paul E. Hosier, Associate Professor of Plant Ecology, University of North Carolina*

Off-Road Vehicles: Cape Cod ..... 113
*Paul J. Godfrey, Associate Professor of Botany, University of Massachusetts*

Off-Road Vehicles: Fire Island ..... 119
*Fred J. Anders, Assistant Leader, National Park Service Cooperative Research Unit, University of Massachusetts*

## INTRODUCTORY REMARKS

MR. OLSEN: I trust that you enjoyed the field trip this morning. It certainly was a beautiful day, and I am sure that both Paul and Steve did an excellent job. Our moderator this afternoon is Dr. P.A. Buckley, Chief Scientist at the North Atlantic Regional Office of the National Park Service.

DR. BUCKLEY: This morning's field trip was a very useful excuse to doff tie and jacket, and I hope that everyone will do the same this afternoon. The second half of this meeting was designed as a workshop so that those of us who are federal employees could come; we can travel to places for workshops that we cannot go for meetings, symposiums, and conferences. Furthermore, we intend it to be a realistic workshop; one that really gets across more substantive information on a few topics. Human impacts on barrier island ecosystems is a simple question, but not simple at all in its content. This afternoon we are going to look at human impacts, which we have divided into two parts: pedestrian and off-road vehicle impacts. As most of you know, the National Park Service, directly or indirectly, has pioneered the research in these areas. So we are pleased to be able to present some of these results.

Our first speaker today is Dr. Stephen Leatherman who is going to speak about "Pedestrian Impact on Assateague Island." Steve is presently Director of the National Park Service Cooperative Research Unit at the University of Massachusetts in Amherst. He is a coastal geomorphologist by training, who has focused on barrier island research from Cape Hatteras to Cape Cod, particularly storm-generated processes such as overwash. He did the pioneering work on overwash at Assateague Island National Seashore. He has also worked extensively on the problems of recreational impacts of ORVs and pedestrians on coastal ecosystems in general.

# PEDESTRIAN IMPACTS: ASSATEAGUE ISLAND

Stephen P. Leatherman
*Leader, National Park Service Cooperative Research Unit*
*University of Massachusetts, Amherst*

I am going to describe the research undertaken at Assateague Island by Al Steiner and myself. Assateague Island is located along the mid-Atlantic coast in the states of Virginia and Maryland. This barrier island is thirty-three miles long, and is jointly managed by the National Park Service and the Fish and Wildlife Service.

We divided the island into five major land use management zones. Basically, there is the north tip, Section A, which at one time was owned privately by Atlantic Ocean Estates and is now controlled by the National Park Service. Section B is the State Park area; it is operated in a different mode than the National Seashore or the Fish and Wildlife Service areas. Section C is the major part of the National Seashore, including the North Beach Camping Area. The Fish and Wildlife Service manages the Wild Beach (Section D); no vehicles are allowed here. Finally, at the very southern tip of Assateague is an area called Fishing Point (Section E). This area is open to off-road vehicles and pedestrians.

In Section A there is no off-road vehicle traffic. Some people come across by boat, but it is minimal. The State Park (Section B) is serviced by hard-surfaced roads, and there is extensive usage of this area. In Section C, there is off-road vehicle traffic with pedestrian impacts at the campground. In Section D there are no vehicles, only backpackers are allowed. In Section E there are both vehicle and pedestrian impacts. The island is further divided into subsections according to land uses and management regulations.

The objective of this study was to look at the type and location of impacts at Assateague Island, using various indicator species. This was a preliminary study, and we were trying to provide some baseline data and determine the research needs.

For indicator species, *Ammophila*, American beach grass, was chosen; it is common to dunes and is a major dune-building species. *Ammophila* is not nearly as vigorous in the Assateague area as it is on Cape Cod since it is close to the southern extent of its range. Another indicator species, Least Terns, were found to be nesting on the beach backshore. We did some work with Ed Britton of the Fish and Wildlife Service on nesting shore birds.

Today I want to talk about the pedestrian part of the study. In the Tom's Cove area, we chose three areas to study pedestrian impacts. In one area near Tom's Cove, there is high recreational usage by pedestrians. There are a number of parking lots where people have access to the beach. One of the problems is that, although there are designated dune crossovers, not everyone uses them.

In Pedestrian Impact Area A, there is a new developing dune in front of the established foredune. The major foredune was artificially established in 1962 following that large-scale northeaster. Since that time, a more natural dune system has formed in front of this older dune line. Impact Area A is one of the more popular areas. It is near one of the crossovers where people are traversing the dune, trampling down the vegetation and cutting the

newly-developing dune into many separate pieces.

This map of the area was made in 1978. It was compiled by surveying the area with transit and rod on a two-meter square interval. We also measured the vegetative biomass. The contour lines indicate the elevation of the dune, and the shaded areas show the vegetation. People walking across the dune crest created this trail, which has dissected the dune.

There are other, larger blowouts developing in the major dune field; this area was used by vehicles at one time. There was considerably less vegetation in 1979. With devegetation, there is a corresponding loss of elevation, and a dune blowout results.

Now I want to examine the Maryland area of Assateague Island. This is one of the most popular camping areas, called North Beach. Holes in the barrier dune are evident due to foot traffic through the area. Major gaps are being created by people walking from the campgrounds across the dunes to the beach since there are no designated crossovers. People either choose their own path or follow pre-established trails through the dunes. In some cases dune destruction has progressed so that there is very little left of the original structure. The sand can now be blown freely by the prevailing northwest winds.

This map shows the 1978 and 1979 dune vegetation and topography of the area. Again, we used the same technique of surveying the elevation and determining the vegetative biomass. We named these pathways A,B,C, and the major one D. It is evident that they have enlarged during only one year. Of course, we are looking at a very short time frame; what is really needed is long-term data.

It is rather interesting to note that this particular area (Pathway D), which is the largest blowout, is actually becoming quite deep. Pathways A, B, and C in 1978 were just starting to form. These devegetated pathways initially appear as small, V-shaped notches in the dune line. Only one year later, these notches look like valleys or canyons. These pathways across the dune crest have lost as much as a half meter of sand in a single year. In terms of the larger area (Pathway D), we are looking at a different profile. Pathway D is much deeper and enlarged after a single year. These changes have occurred in just one year, which should be emphasized. We are obviously looking at part of the trend that is occurring—the rapid devegetation of the area and deepening of the pathway.

One additional area of pedestrian impact was established in the Tom's Cove area. This is an area where the beach and dune field are quite narrow in contrast with the other two areas previously discussed. There is only one dune here; it is quite high, but very narrow.

This block diagram shows that the gap has become quite large during one year. There is little elevation at the crest of the barrier at this point. In other words, the elevation of the beach backshore is nearly the same as the elevation of this breach in the dune line. Thus, there is little prevention of overwash, and during a storm it can be expected because the beach is so narrow in this location. Snow fencing has been erected to prevent people from coming across the dune. It took very little impact, in terms of the amount of normal pedestrian traffic, to cause this type of devegetation and, eventually, the blow-out which follows.

This map of the area shows very low areas. The beach backshore exhibits very little relief so that storm water can freely flow through. In

fact, in the winter of 1978 this area became an "artificial" overwash. Sand was bulldozed from the beach to build this big mound to form a plug of sand. This sand is not going to be nearly as stable as a normal dune, because it is just a pile of sand. It has no structure as a true dune would have, and it lacks the vegetation which makes the dune more resistant to erosion. This is just a pile of sand pushed up by a bulldozer. We can expect problems in this same area relative to the rest of the shoreline.

It is interesting that at Assateague some of the first things that people would say is, "Let's find ourselves a dune." I could not understand this at first, but on days when there is a bit of wind or chill, dunes provide protection. Also, people like to lie up against the surface of the dune, and it puts them at an angle with the sun. It is difficult to persuade people to stay off the dunes, and stay on the beach. There seems to be some preference by people to use dunes in this manner.

The amount of pedestrian impact at Assateague far exceeds the ability of the vegetation to withstand it–it is well over the threshhold.

What can we do about this situation? I will give you some examples of management practices that could be utilized. In some areas, particularly in the Netherlands, barbed wire is used in the dunes to prevent trepass. Reportedly there are actually armed guards patrolling the dunes to keep people off of them, but I would not suggest protection of the U.S. coastal dunes in this manner.

One approach that has been successful at Assateague Island is using hard-packed dirt at the dune crossovers. The sand itself is not useful in that regard since it can be easily blown away by the wind. Loamy-type of material from the mainland can be packed densely over the sand surface. This hard-packed clay is resistant to wind erosion, but not to runoff from a torrential downpour. Rivulets quickly develop into gullies, and the material can be moved down the dune slopes. Trail maintenance is required on a continuing basis. In fact, it will probably be a yearly maintenance project.

The other approach is to utilize hard structures–boardwalks, in particular. Dune walkover structures have been used very successfully in Florida. At Fire Island National Seashore, wooden dune ramps and boardwalks are used to much advantage. The boardwalks at Watch Hill extend from the bayside across the barrier and dunes to the beach face.

In an eroding situation in terms of the beach, you can anticipate some problems with the steps and the front of the boardwalk. Boardwalks have been very successful, and often provide the best pedestrian corridor when a large number of people are using the area. Some people have objected to hard structures on an aesthetic basis, but in this situation it is needed to protect the island morphology.

Finally, I would like to talk about public education. Placing signs in appropriate places, particularly areas where people first enter a park, can be quite helpful. This slide shows one of the signs being used at Fire Island National Seashore to inform people of dune fragility to pedestrian impact.

In fact, we often talk about the word "fragile", but *Ammophila*, American beach grass, can survive many of the environmental stresses–salt spray, sand burial, and salt water flooding–that inland vegetation cannot withstand. Therefore, beach grass is not fragile in the environment in which it is living, but in terms of mechanized pressures, or a large amount of foot traffic, it is fragile. These plants cannot take that kind of treatment and

soon die.

Signs can be used to inform people that dunes are fragile areas, particularly the stabilizing beach grass. Some people ask what a dune is, but if people stay off the vegetative part, at least they will avoid harming most of the dune feature.

A number of general recommendations are given in the technical report. If crossovers are required, then you should designate and maintain trails across the dunes. Hard-packed material, if available, can be used to keep the trail in a more natural condition than wooden structures. Where there are a large number of pedestrians and maintenance might be a real problem then you should probably use boardwalks as walkover structures across dunes, because the hard-packed dirt can be eroded, as previously mentioned, by torrential downpours.

Designated pathways across the dunes should be provided; other paths of an unrestricted nature should not be allowed to develop. This is a problem that we have seen in the camping areas. Once the dunes are devegetated, blowing sand becomes a significant problem, not only in terms of lowering the dune itself, but also affecting the campers during times of high winds with sand blowing right through the tenting area.

Finally, signs or instructions to pedestrians using these critical areas can be quite helpful. Most people will respond to this type of information. There can be vandalism if you place these signs in remote areas. If placed in access areas, where people are first entering the seashore, good control can be maintained and people can be made aware of the situation.

Thank you.

I will entertain your questions now.

## QUESTIONS TO DR. LEATHERMAN

FROM THE FLOOR: Can you tell me, have you established a threshhold for pedestrian traffic across the grass?

DR. LEATHERMAN: We did not address this question directly. Dr. Norton Nickerson and associates have looked at the levels of impact that *Ammophila* can take. I don't remember the exact figures, but at Cape Cod National Seashore, it far exceeds the threshhold. In our studies it was not really a consideration, because there are so many more people using these areas above the minimum threshhold.

There is a different philosophy of management on areas which experience very low levels of pedestrian impact. By low-level, we are talking about maybe less than ten people or so a day, perhaps even less than that. In this particular case, you might be much better off by not establishing designated trails. People walking, for instance, in the wild beach area, will result in little impact since there are few backpackers. One or two passes in a week dispersed across a dune surface probably does not make much difference. This would represent really low level pedestrian impact.

Nickerson, at Cape Cod National Seashore, set up pathways through the dunes in order to walk along the same path. It took less than a few hundred passes before significant deterioration of the dune vegetation occurred. Of course, in a normal Park situation, you would soon exceed those threshholds on a good day. There is no such thing as a real carrying capacity in areas of high or moderate usage.

FROM THE FLOOR: A comment on some of the dunes here on Cape Cod, both in the Provincelands and on Great Island–there are stabilized dunes that you should not walk on at all, particularly during dry weather. These dunes are stabilized with reindeer lichen. When dry, and even when wet, they will be crushed by a single pedestrian impact. If one person walks across it, you eventually get a blowout. If you walk on it when it's dry, you break down the plants; each step punches a hole in the cover and the first breeze that comes along starts the blowout. So, you cannot walk on these dunes at all. They are that fragile. In this case you have a cover that is so fragile that you can look at it and that is about all.

DR. LEATHERMAN: Any other comments or questions? I went through this rather rapidly, but I think you can get the gist of exactly how little impact it takes to create a bad situation. Some Park administrators are somewhat reluctant to put in structures since there are maintenance costs, but I think that if you have any level of impact at all, you are probably going to have to at least consider them.

FROM THE FLOOR: One of Nort Nickerson's points was that if you can do so, encourage people to take their shoes off when they walk in dune areas, because the impact significantly diminishes, something like sevenfold. People don't like to step on beach grass with bare feet.

DR. LEATHERMAN: That's right, beach grass can hurt your feet if you are not used to it. If you are going to walk through the dunes in an area where it is allowed, I think that is a good point. It would be better to take your shoes off because you try to avoid the shoots of *Ammophila* which can be quite painful to your feet.

FROM THE FLOOR: Can you speak to the impact of the so-called wild ponies?

DR. LEATHERMAN: You are speaking now of Assateague Island and the pony situation there?

FROM THE FLOOR: Yes.

DR. LEATHERMAN: Well, that is an interesting issue. I think Dr. Keiper at Penn State is looking at this situation. The ponies do crop vegetation pretty closely on the dunes, and it is a point of consideration. I don't know if anyone has decided if there is actually a problem or not at the present level, but I have taken a number of pictures and have observed where the vegetation was cropped within about an inch of the surface at Assateague. They are going a pretty good job in some areas of cropping back the *Ammophila*, which is a preferred vegetation. Hopefully Dr. Keiper of Penn State is going to get some data on exactly what the effect of these animals are on the dunes. I don't think we can ask the ponies to take their shoes off.

# PEDESTRIAN IMPACTS: PADRE ISLAND

John T. Baccus and Jack K. Horton

*Department of Biology*
*Southwest Texas State University*

Along the south Texas coast, an almost continuous barrier island extends from Corpus Christi Bay southward approximately 110 miles to Brazos Santiago Pass. This island, Padre Island, is one of the longest barrier islands in the world. It exists in a fragile state of dynamic equilibrium between the opposing natural forces of erosion and deposition. Padre Island is primarily composed of alluvial sand and shell remains of marine invertebrates. The island sand, approximately 24 m thick, rests on a Pleistocene shell, clay, and sand layer about 30,000 years old (Hunter and Dickinson, 1970). Bernard, LeBlanc and Major (1962) theorized the island formed during a sea level rise which resulted from the melting of the last continental glaciers. Hoyt (1970) suggested the island was once attached to the mainland, but as the island built upward and seaward in response to the sea level rise, it left behind the remnants of previous dunes and beaches. These were flooded by the rising sea and formed the Laguna Madre, thus the separation of the barrier from the mainland resulted.

During the past century, Padre Island has undergone tremendous changes due to the effects of overgrazing and drought (Hunter and Dickinson, 1970). Prevailing winds blew huge masses of devegetated sand landward. This destabilized condition permitted hurricane surges to wash through the southern section of the island to form washover channels and fans. These channels served as pathways for erosion by minor hurricanes which, otherwise, would not have breached the barrier. Hurricane surges did not breach the northern island, but severe wind erosion changed the elevational profile of the northern portion of the island and caused the ecological composition to change dramatically. Among other things, the oak forests were almost destroyed.

Adverse effects of human impact on vegetation and substrate conditions of the coastal environment have been described by several authors (Bur. Econ. Geol., 1972; Sudia, 1973; Suter, 1973; Kenneth, 1973; McAtee, 1975; Baccus et al, 1977). The pattern of devegetation and erosion initiated a century ago is active today. The alteration of the natural dynamic state of this ecosystem by recreational usage has resulted in a diminished environment and increased erosion. Many of the popular visitor attractions of the seashore are located within or near the fragile beach-dune ecosystem. There are marked changes in beach and dune structure and vegetative patterns as a result of recreational impact.

Because of the environmental problems associated with the barrier island, the National Park Service initiated an ecological assessment of the actual and potential recreational impact upon the seashore ecosystem. The purpose of this research has been to develop and analyze an ecological data base to assist the National Park Service in the development of management policies which will protect the environment and promote aesthetically pleasing experiences for generations of seashore visitors.

## STUDY SITES

Since only the extreme northern section of the seashore is accessible by a single paved road, the concentration of visitors into a limited area is a major contributing factor influencing impact upon the biotic and physical environment. Within this area there is a variety of degrees of beach utilization and associated vehicular and pedestrian traffic. In order to estimate the extent of impact, four study sites were selected.

One study site was selected on a section of beach where vehicle traffic was prohibited, and only light pedestrian traffic occurred. This site was designated Notraf. The beach and dunes were stabilized in this area. Dominant beach vegetation was *Cassia fasciculata* (prairie senna), *Uniola paniculata* (sea oats), *Ipomoea stolonifera* (beach morning-glory), *Oenothera drummondii* (beach evening-primrose), *Spartina patens* (marsh cordgrass), and *Paspalum monostachyum* (gulfdune paspalum). The major dune plant was *Uniola paniculata*.

A second study area was located adjacent to the Malaquite Pavilion. Pedestrian traffic was the major source of impaction at this site (Pedtraf). The beach was characterized by having areas of light to moderate disturbance. The absence of *Uniola paniculata* as a dominant species indicated the disturbance in this area. *Croton punctatus* (Gulf croton), *Cassia fasciculata*, *Oenothera drummondii*, and *Ipomoea stolonifera* were dominant beach species at the Pedtraf site. The dunes were characterized by *Physalis viscosa* (beach groundcherry), *Cassia fasciculata*, and *Oenothera drummondii*.

A third site was designated in an area of open beach. The main paved road terminated at this beach and tended to funnel vehicle traffic onto the beach. This area, Vetraf, was an unrestricted usage beach and received heavy conventional and off-road vehicle traffic as well as pedestrian traffic. Beach vegetation was dominated by *Ipomoea stolonifera*, *Cassia fasciculata*, and *Croton punctatus*. *Uniola paniculata* and *Oenothera drummondii* were dune dominants.

A remote beach (Shell) limited to four-wheel vehicle traffic was selected as a fourth study site. This area was characterized by extensive shell deposits on the beach which resulted in a different soil composition in comparison to the other three sites. Vegetation was limited in diversity because of the soil type. Dominant beach species were *Uniola paniculata*, *Cassia fasciculata*, *Croton punctatus*, and *Oenothera drummondii*. The dune vegetation was composed primarily of *Uniola paniculata* and *Heterotheca subaxillaris* (camphor weed).

## METHODS

Since we were interested in impacts on both the biotic and physical components of the beach, sampling methods were utilized which would demonstrate changes in the floral composition and community structure as the beach changed physiographically. A total of 36 transects extended perpendicular to the shoreline from the water's edge across the beach and into the foredunes. Twelve transects were located in Notraf and Vetraf, whereas, six transects were located in Shell and Pedtraf. Each of the four sites had one long transect which extended over the foredunes and onto the vege-

tated barrier flats. Data collection for each transect line was semiannual.

Sampling stations were positioned every 3 m (10 ft was the precise distance) along each transect line. Topography was surveyed with a rod and level. The elevation for each sampling station was determined by using three reference elevations for each transect line. The surveys were usually precise to 0.1 ft (approx. 3 cm), but in windy weather the surveys were precise to 0.2 ft. The data acquired was used to generate elevational profiles for each transect line.

Vegetation was sampled using two methods – point frame and quadrat. The point frame technique involved the passage of a rod from ten positions on a frame at each station on a transect line. The frame guided the rod from above the vegetation to ground level, and a record was made of each contact the tip of the rod made with plants, litter, or ground. Most contacts were foliar hits (leaf or stem portions of viable plants) and identified to species, while basal hits (surface living grass culms, herbaceous stems or stoloniferous runners) of all species were lumped. Aerial litter (nonliving stems, leaves or blades in an aerial position) was tabulated as the total number of hits at each station.

Due to the sparse dispersion of beach vegetation, sampling by the quadrat method was conducted to ensure an accurate species representation of the beach portions of the transects. Quadrat samples were taken only on beach portions of transect lines. An oblong one-quarter meter squared frame (100 cm X 25 cm) was positioned at each station with the long axis perpendicular to the line. The sampling station was located in the middle of the rectangle. Stems greater than 5 cm long from species within the boundary of the frame were counted. If the entire plant was less than 5 cm long, it was still counted. Buried stolons were counted as single stems if they could be easily picked from the sand. Otherwise, each protruding leaf cluster was counted as a stem. Plants with a grass-like growth form were counted only if rooted in the quadrat. The culms (not individual leaves) were counted. The stems of other plants within the boundary of the quadrat were counted regardless of where they were rooted.

Programs which calculated Shannon's index of diversity, Simpson's index of diversity, evenness, species richness, plant ranks by abundance, percentages of floral composition for each plant, slopes, mean elevations, and other parameters were used in the analysis of data. Data were analyzed with the aid of a Dec System 10 digital computer.

## RESULTS AND DISCUSSION

Pedestrian impacts upon the beach environment were based on observations of cause and effect by comparing areas of different vehicle and human usage. Community composition and beach structure of the three beach study sites were analyzed. The beach was defined as an area seaward of the foredune base. In the following discussion pedestrian impacts at the Pedtraf sites will be contrasted with the Notraf and Vetraf sites.

The sedimentary processes influenced by different levels of pedestrian impacts can be realized by comparing computer generated beach profiles. Pedtraf 60 (Fig. 1), adjacent to the Notraf site, can be characterized as an area with minimal pedestrian influence above the berm of the beach. Numerous embryo dunes dotted the beach above the berm and were a major

surface feature of the beach being in some instances greater than one meter in height. Vegetation formed a mat of growth which connected the embryo dunes with one another. The embryo dunes coalesced with the foredune structure.

If you were to walk southward from the Pedtraf 60 site, you might observe a subtle change in the beach structure. Certainly you would realize a greater degree of foot traffic. At Pedtraf 1.6 (Fig. 2), a stark contrast with Pedtraf 60 can be observed. This is a beach visited by approximately 100,000 people yearly. The beach is characterized by few embryo dunes and very patchy vegetation. The embryo dunes demonstrated the impact of foot traffic by their rounded profile with extensive areas devoid of vegetation. The abundance of the beach morning glory at this transect evidenced the high degree of disturbance to the environment. This particular invader species filled the gaps created by the destruction of the more fragile species which previously occupied the embryo dunes.

For comparison purposes a typical profile of Notraf, a beach with no foot or vehicle traffic (Fig. 3), and a typical profile of Vetraf (Fig. 4) with heavy foot and vehicle traffic are presented.

For an overall impression of the influences of pedestrian and vehicle traffic upon the beach, aerial photographs of the study sites were used to document the degree of disturbance to the environment. No signs of massive changes in beach or dune structures were seen in the Notraf area. In Pedtraf, the portion of the beach with heavy foot traffic evidenced the genesis of three major blowouts. The potential for active migrating sand fields exists at these three sites. If no preventive counteraction is taken, these fields will produce huge gaps in the dunes. The Vetraf site evidenced large areas of destabilized sand. The blowouts were huge and extended across the island.

Over three and one-half years between fall 1975 and fall 1978, there was considerable forebeach accretion at Notraf and almost no forebeach accretion elsewhere. This forebeach accretion was a short-lived phenomenon because the accreted sediment was carried downstream by longshore currents. The back beach at Notraf decreased least in elevation in comparison to the other two beaches. At Pedtraf there was localized forebeach accretion but general forebeach erosion. The backbeach at Pedtraf decreased in elevation only slightly more than Notraf. At Vetraf, however, there was a large amount of erosion over the forebeach and backbeach. The elevation of the trafficked portion of Vetraf beach has decreased at an average of 0.6 m per year the last three and one-half years. Half of the beach at Vetraf was blown back against the foredune base, and half was lost to the sea. At Pedtraf and Notraf minimal amounts of sand were blown back to the foredune base. This sand was trapped on the beach by plants and their associated coppice dunes. At Vetraf, however, there were no coppice dunes and few other structures to trap sand, so the sand was easily carried by wind and water.

The largest number of species and the highest percent of flora occurred at the Notraf beach sites. There was a marked contrast between the number of grass species growing on the Notraf beach and Vetraf beach. The Vetraf beaches had approximately one-half as many species. There was an even greater contrast between the Notraf beach and Vetraf beach in the percent of the flora composed by grass species. Less than 15% of the flora at

Vetraf were grass species, whereas the Notraf beach had over 30% of the flora composed of grass species. The Pedtraf beach floral composition was intermediate in species number and percent composition (Table 1).

Table 1. Number of grass species for each study site and the percent of the flora represented by grass species.

| SITE | NUMBER OF SPECIES | PERCENT OF FLORA |
|---|---|---|
| Pedtraf | 5 | 20 |
| Notraf | 7 | 34 |
| Vetraf | 3 | 13 |

The floral composition of the Pedtraf site was diverse, but the disturbance by foot traffic is demonstrated by the four most abundant species (Table 2). *Ipomoea stolonifera*, beach morning glory, was dispersed over much of the area between the small embryo dunes. It is a typical invader species, and its presence is indicative of unstabilized conditions. At Vetraf this species had a first place ranking, whereas, its rank at Notraf was fifth. Please note the different ranking for the three sites. Based on plant community structure, the floral composition of Pedtraf reflected the influence of invader species and a greater instability than Notraf but less than Vetraf.

The extent of vegetative growth on the beach for Notraf, Vetraf and Pedtraf data indicated a seasonal trend. In each case the distance of the vegetated beach was more extensive in the fall than spring. The longest beach distance during the three sampling periods was at Notraf, and the shortest was Vetraf. The vegetative distance at Notraf averaged 49 feet more than the Vetraf distance. The difference would be even more pronounced if the sparse stands of *Tidestromia lanuginosa* were deleted from the Vetraf sample. The distance at Pedtraf was similar to Notraf.

The vegetated beach at Vetraf was atypical in that its elevation and proximity to the foredune caused it to attain some characteristics of the foredune. The increased elevation of the vegetated portion of the Vetraf beach was not due to the sand binding capacity of its flora but rather to the backstop effect of the foredune. Its elevation and distance from the sea caused the vegetated portion of the Vetraf beach to be protected from innundation, wind, and salt spray and resulted in an apparent higher plant density. This density, however, was concentrated in a very narrow zone of vegetation about half the width of the Notraf vegetated beach. A large portion of the plant composition of the Vetraf beach consisted primarily of colonizers. These pioneer species thrived on the blown sand entering the system due to a lack of stability over the major portion of the beach. Most of the Vetraf beach was devoid of vegetation.

The Notraf vegetated beach was the widest because of a lack of physical trauma on beach plants by automobiles. Pedtraf beach width was intermediate between Notraf and Vetraf. Notraf consistently had a higher plant density than Pedtraf because of the lack of stress from foot traffic. The difference in plant density, however, was not great and the two beaches

fluctuated in the same manner, thus indicating ecological processes were very similar on the two beaches. This similarity suggested pedestrian traffic had a minimal effect due to the type of plants inhabiting the Pedtraf beach.

Table 2. Species ranks by abundance for each study site and the percent of the total flora represented by each species.

| SPECIES | PEDTRAF | NOTRAF | VETRAF |
|---|---|---|---|
| *Croton punctatus* | 1 (25.8) | 7 (3.61) | 3 (19.1) |
| *Cassia fasciculata* | 2 (16.9) | 1 (19.0) | 2 (20.7) |
| *Oenothera drummondii* | 3 (16.0) | 4 (13.8) | 5 (7.21) |
| *Ipomoea stolonifera* | 4 (11.8) | 5 (11.0) | 1 (34.2) |
| *Uniola paniculata* | 5 (10.2) | 3 (14.2) | 4 (11.4) |
| *Paspalum monostachyum* | 6 (4.10) | 16 (1.02) | 11 (0.19) |
| *Spartina patens* | 7 (4.06) | 2 (15.7) | 7 (1.38) |
| *Ipomoea pes-caprae* | 8 (3.49) | 9 (3.20) | 6 (3.06) |
| *Sesuvium portulacastrum* | 9 (2.06) | 18 (0.58) | |
| *Sabatia arenicola* | 10 (1.48) | 14 (1.13) | |
| *Leptoloma cognatum* | 11 (1.13) | 15 (1.12) | |
| *Physalis viscosa* | 12 (0.89) | | 10 (0.63) |
| *Euphorbia ammannioides* | 13 (0.80) | 17 (0.61) | |
| *Erigeron myrionactis* | 14 (0.54) | 8 (3.53) | |
| *Amaranthus greggii* | 15 (0.33) | | |
| *Helianthus debilis* | 16 (0.33) | | |
| *Schizachyrium scoparium* | 17 (0.14) | | |
| *Ambrosia psilostachya* | | 10 (1.78) | 12 (0.19) |
| *Tidestromia lanuginosa* | | 6 (4.70) | 8 (1.14) |
| *Panicium amarum* | | 11 (1.65) | |
| *Sporobolus virginicus* | | 12 (1.42) | |
| *Senecio riddellii* | | 13 (1.37) | |
| *Eragrostris oxylepis* | | 19 (0.25) | |
| *Fimbristylis castanea* | | 20 (0.25) | |
| *Cyperus esculentus* | | 21 (0.11) | 9 (0.80) |

There was a tendency toward decreasing vegetated beach width at all sites before fall 1977, but the tendency has stopped or reversed since that time. Storm activity between fall 1976 and fall 1977 was a possible cause for this trend. The Vetraf vegetated beach width fluctuated the least of all the beaches. The cause for this phenomenon was the greater elevation and distance from the sea of the Vetraf beach vegetation. The physiographic location of the Vetraf vegetated beach caused that area of the beach to be protected from minor storm surge, but at the same time, the vegetation was not resisting aqueous erosion of the beach. As a result, the Vetraf beach eroded more than its less trafficked counterparts. In addition, each meter

of vegetated beach width at Vetraf contained more sand than its less trafficked counterparts.

In ecological studies emphasis is placed on the importance of the dominant species of a community and their contribution to diversity and habitat utilization. Additional information about the composition of the community can be acquired by studying the rare species of a community.

Another difference between the Notraf sites and Vetraf sites was the absence of the rarer or low ranked grass species at Vetraf. *Uniola paniculata*, *Spartina patens* and *Paspalum monostachyum* were ranked high at both Vetraf and Notraf sites, but three or four rarer species not only occurred at Notraf, but contributed substantially to the overall composition of plant species.

Notraf was the only beach site with rare plant occurrence during fall 1976 sampling. *Phyla nodiflora*, *Chloris patrea* and *Bacopa monniori* were recorded on the beach and *Eustomia glabriflora* at the foredune base. Occurrences at Vetraf and Pedtraf were over 100 feet back of the foredune base in the dune complex. Notraf had approximately three times as many rare species present as the other two sites combined.

The spring 1977 data demonstrated an increase in the rare species inhabiting the Notraf beach. One species, *Cakile fusiformis*, extended almost to the berm, while *Fimbristylis carrolinea* and *Erogonium multiflorum* occurred near the foredune base. *Erogonium multiflorum* was listed as a beach species at Vetraf. The absence of rare species at Pedtraf was possibly associated with the overall detrimental effects of habitat change and the crushing effect of foot traffic.

Species diversity is an excellent measure of the stability of a community. Higher diversity reduces oscillations and increases community stability (Odum, 1971). Evenness indicates how the individuals are apportioned among species in a community. Richness indicates variety in community composition. Simpson's index is a measure of dominance (i.e., it is the inverse of the probability of randomly drawing two individuals of the same species from a population). Lower diversity is associated with evenness. The dominance of major species will depress the evenness value. Table 3 presents a summary of indices values for the major study sites.

Table 3. Major indices values for the flora of the major study sites.

| SITES | NO. OF SPECIES | DIVERSITY | EVENNESS | RICHNESS | SIMPSON'S |
|---|---|---|---|---|---|
| Pedtraf | 17 | 2.16 | 0.76 | 2.47 | 0.85 |
| Notraf | 21 | 2.40 | 0.79 | 2.88 | 0.88 |
| Vetraf | 12 | 1.76 | 0.70 | 1.66 | 0.78 |

The Vetraf beach was atypical in that every aspect of its diversity was low and, thus far, subjected to no fluctuations other than seasonal ones. The diversity of Vetraf beach was low because of the environmental con-

straints placed upon it. Its elevation was too great to support lowland species, and foredune species were thwarted by the large quantity of new sand being constantly deposited on the vegetated pile of sand at the base of the foredune. This vegetated pile of sand represented the Vetraf vegetated beach. Due to high elevation the vegetated portion of this beach did not receive the brunt of storm surge attack, but instead the barren beach bore the full impact. Vegetative diversity was, therefore, relatively unaffected by small storms. Simpson's index and evenness demonstrated the most radical fluctuations at Vetraf. The explanation for this phenomenon was related to the population dynamics of one species, *Cassia fasciculata*. It dominated fall samples. The number of species was high in the fall 1977 and 1978 samples due to the influx of annuals, but the dominance of *Cassia fasciculata* overshadowed the increase in diversity caused by the addition of new species. This species also filled niche spaces which would have otherwise been available for other plants.

Vegetation of the other beaches, Notraf and Pedtraf, was influenced more by long-term effects than by seasonal effects. The vegetation of these sites was not insulated from the ravages of the sea and, therefore, the sea influenced erosional dynamics of these beaches. Notraf was consistently the most diverse and stable beach. It was occasionally surpassed in evenness by Pedtraf because of its high species richness. The number of individuals of each species was not as even at Notraf as at Pedtraf because Notraf supported a larger number of minor species.

The evolution of the beach and dunes is related to plant succession. The pioneer species stabilize an otherwise tenuous environment. Additional microhabitats are invaded by species with wind baffling and soil arrestor and binding properties. Protected landward areas of the embryo dunes are inhabited by species requiring protection from the wind and salt spray. Eventually a large dune forms with a coverage of stabilizing plants. The availability of diverse microhabitats results in higher beach biotic diversity and a more stable ecosystem.

If we assume that under natural conditions, Vetraf beaches would be similar to Notraf in species number and abundance of individual plants, then how can we explain the vast differences between the two sites? Since Vetraf has intensive vehicle traffic and Notraf does not, past research (McAtee, 1975; Behrens et al, 1976) and the data of this study suggest a cause and effect relationship. Although correlation and especially correlations in the absence of numbers of people does not prove causation, several mechanisms exist for traffic and concentration of individuals at Vetraf to effect vegetational and sedimentary changes.

The open beach at Vetraf provides visitors an opportunity to drive on the beach. Vehicle wheels lift the sand and expose the sand to a greater wind action than would be operative at ground level. McAtee (1975) noted the different wind velocities on the beach and demonstrated a decrease in wind velocity near the ground surface. Sand lifted into the air is exposed to greater wind action, thus, a tire throwing sand into the air results in sand being carried greater distances than under normal wind stress.

Vehicles as well as foot traffic tend to crush and dislodge beach vegetation. Beach vegetation functions in sand entrapment and as a wind baffle. Not only are vehicles a destructive force on beach vegetation at Vetraf, in addition grading of the beach is detrimental to pioneer and colonizing

species and embryo dune formation. The crushing of vegetation decreases aerial projections that baffle the wind velocities. Instead of remaining a part of the beach, sand is wind transported onto the vegetated beach, even onto the dunes. Decreased beach vegetation also is related to additional salt spray due to a greater wind velocity and thus, a harsher environment results.

An attempt of natural ecological processes was observed at Vetraf where colonizing plants tried to vegetate the bare beach, but the combination of vehicles, foot traffic and grading thwarted the process. These forces were not active at Notraf. Therefore Notraf, in comparison to Vetraf, exhibited a wider vegetated beach, greater plant diversity, greater evenness of plant species, less bare beach, more grass species, a greater abundance of ranking grass species, a higher Simpson's index, a greater richness, and more rare plant species in the absence of vehicle and pedestrian traffic.

The Pedtraf site quantitatively proved intermediate in several characteristics to values obtained for Notraf and Vetraf. With high values for Notraf and lower values for Vetraf, mid scores at Pedtraf beach were the number of species, floral species diversity, number of grass species, percent abundance of the grass species in relation to total floral abundance, Simpson's index, richness, evenness, rare plant species, and vegetated beach distance.

Pedtraf was viewed as a site that has not experienced as much impact as Vetraf, but light impact is beginning to alter floristic patterns and influence the environment. Effectively no vehicle traffic occurs, therefore, foot traffic can result in sand lifting, plant crushing and damage to the beach. Certainly the damage to the beach does not approach the degradation at Vetraf, but the potential for the lowering of beach quality is an immediate problem. Pedtraf is seen as a site presently demonstrating some of the initial signs of impact. This is evidenced in the decrease in numbers and abundance of grass species, more forms as dominant species and decreased aerial litter.

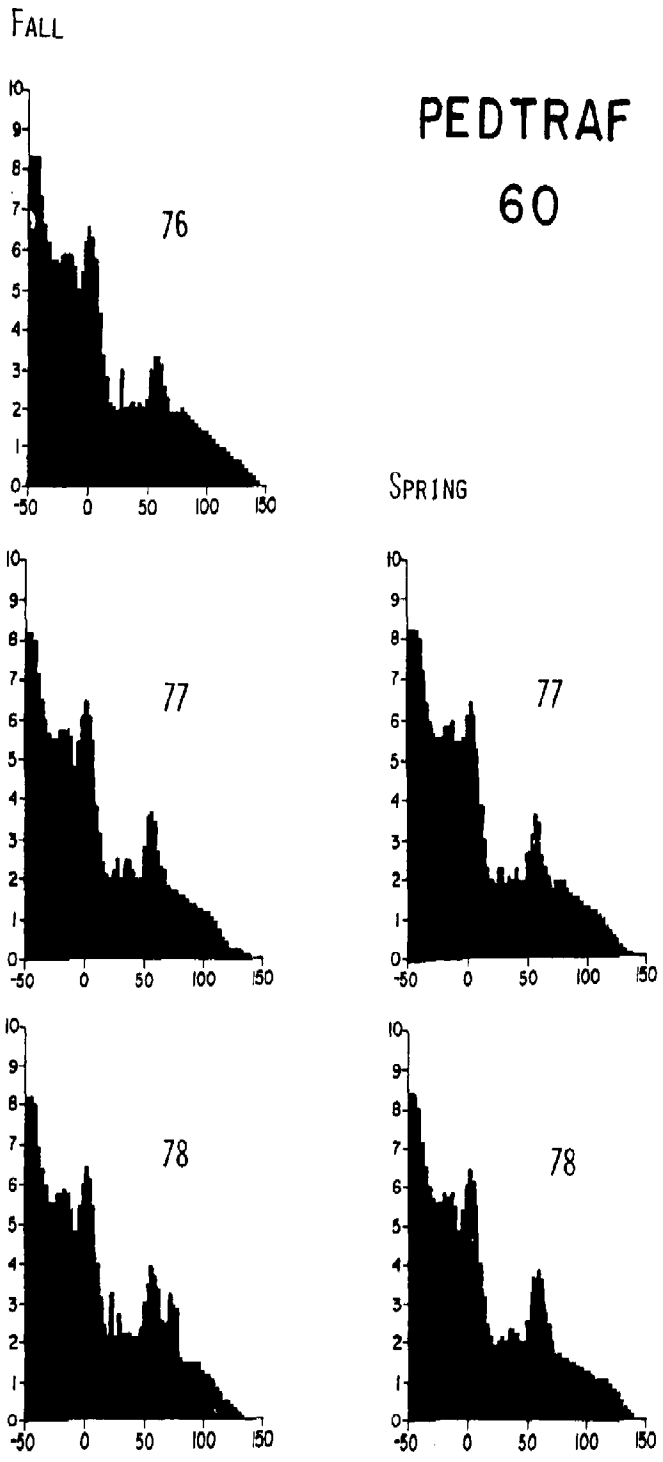


Figure 1. A computer-generated composite beach profile of Pedtraf 60. Numbers on the vertical axis are meters above mean sea level. Positive numbers on the horizontal axis are meters seaward from the foredune base (0).

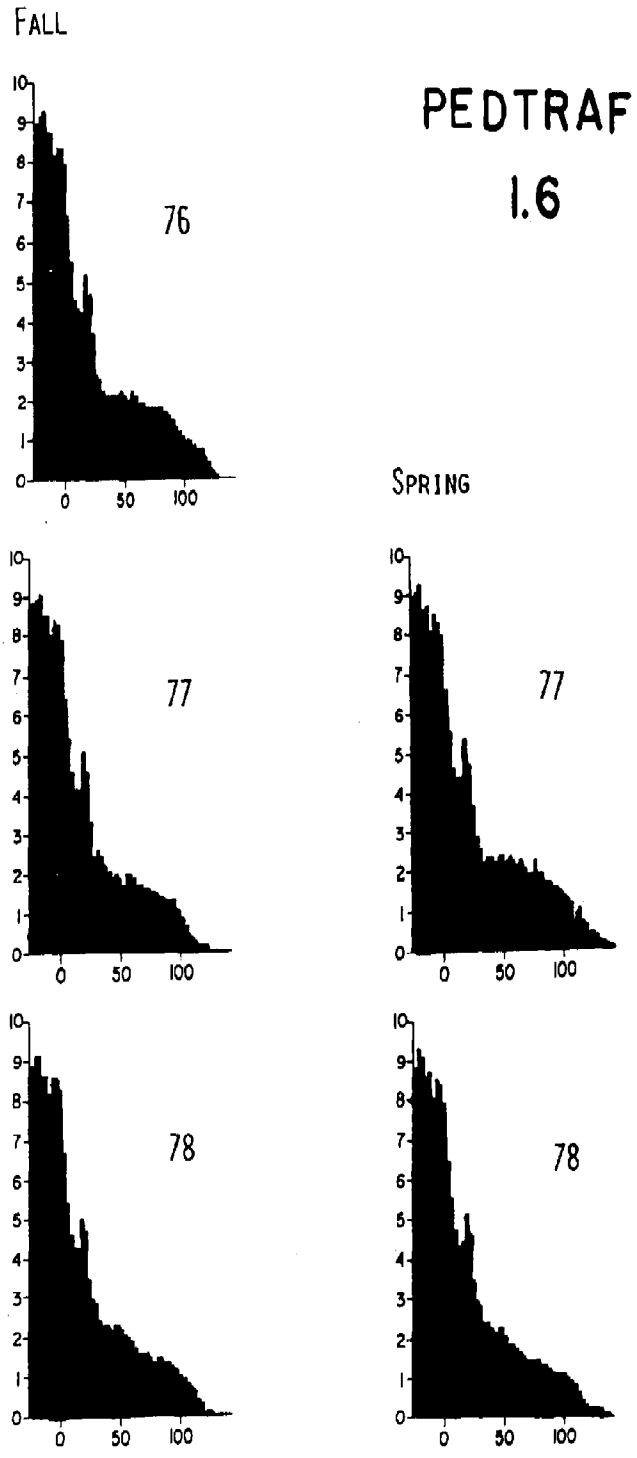


Figure 2. A computer-generated composite beach profile of Pedtraf 1.6. Numbers on the vertical axis are meters above mean sea level. Positive numbers on the horizontal axis are meters seaward from the foredune base (o).

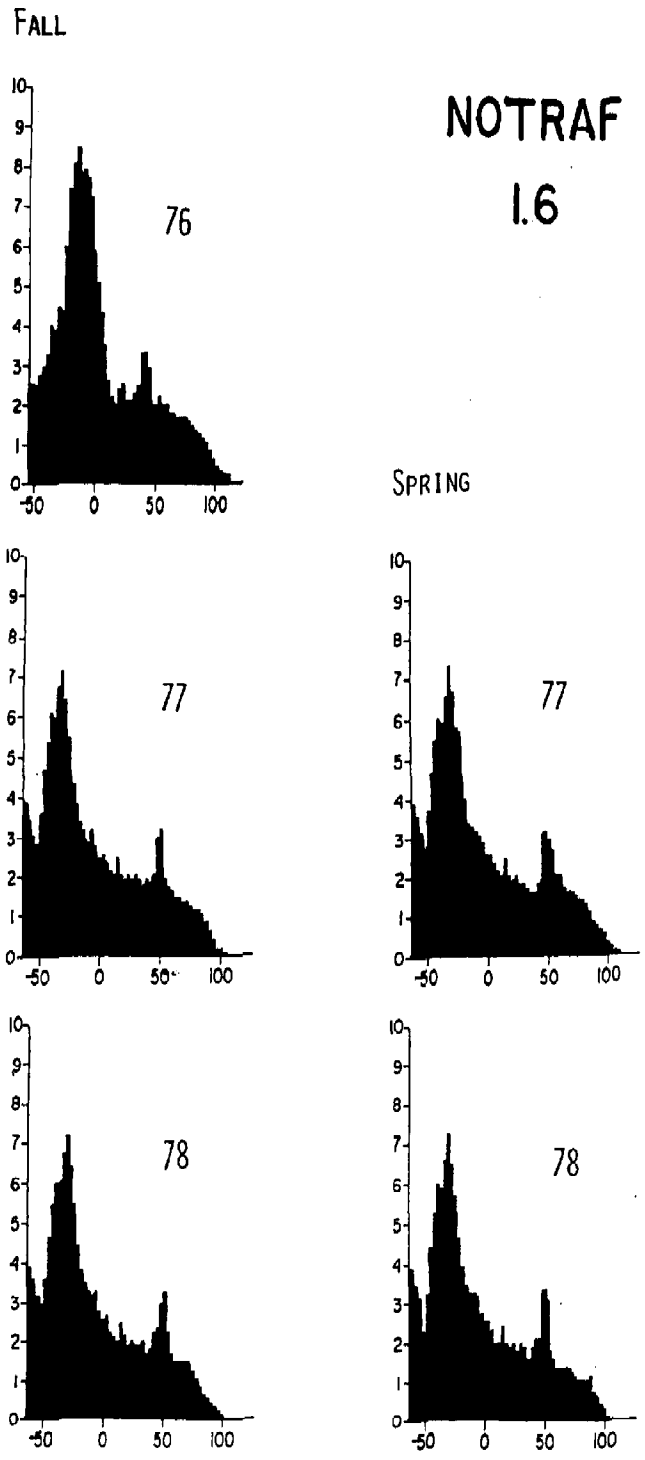


Figure 3. A computer-generated composite beach profile of Notraf 1.6. Numbers on the vertical axis are meters above mean sea level. Positive numbers on the horizontal axis are meters seaward from the foredune base (o).

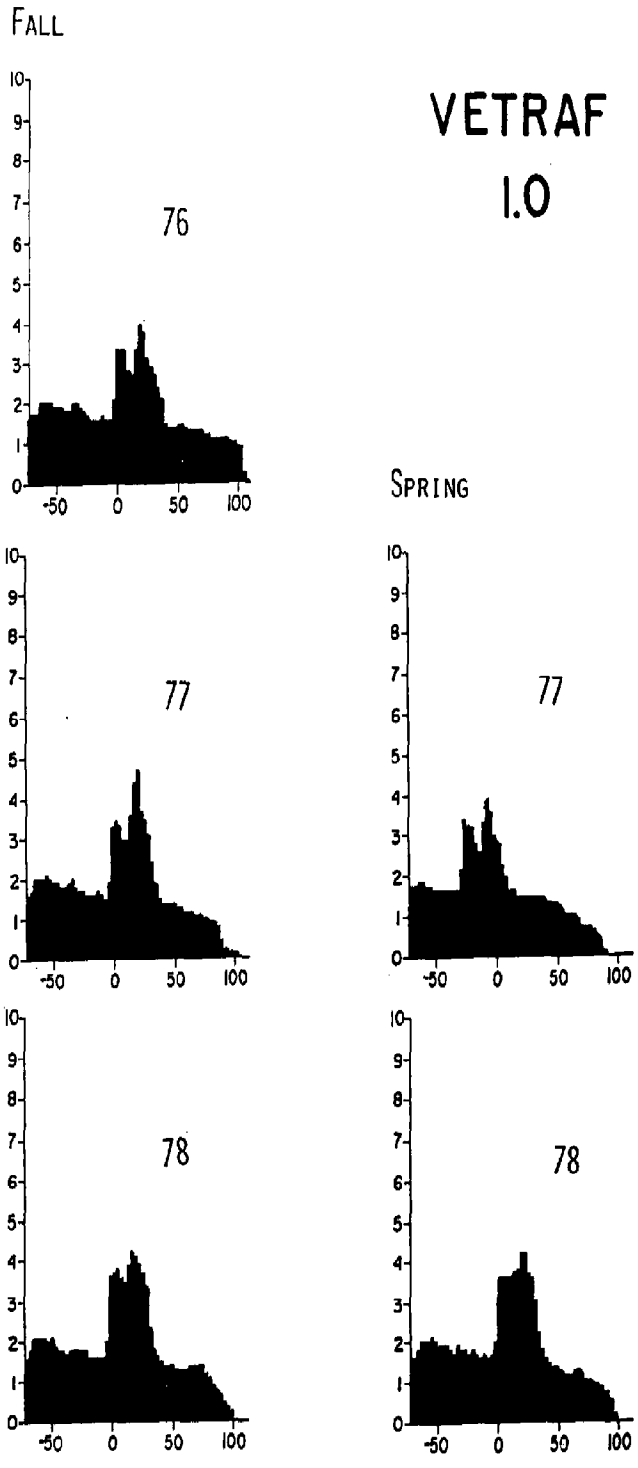


Figure 4. A computer-generated composite beach profile of Vetraf 1.0. Numbers on the vertical axis are meters above mean sea level. Positive numbers on the horizontal axis are meters seaward from the foredune base (o).

## LITERATURE CITED

Baccus, J. T., J. K. Horton, and P. D. Carangelo. 1977. A study of beach and dunes floral and faunal interrelations as influenced by recreational and user impact on Padre Island National Seashore. Final report prepared for Office of Natural Science, Southwest Region, National Park Service.

Behrens, E. W., P. D. Carangelo, and H. S. Finkelstein. 1976. Effects of vehicular and pedestrian traffic on backshore vegetation and beach development. Final report prepared for Office of Natural Science, Southwest Region, National Park Service.

Bernard, H. A., R. J. LeBlanc, and C. F. Major. 1962. Recent Pleistocene geology of southwest Texas. *Field excursion No. 3. Geology of the Gulf Coast and Central Texas.* Houston Geol. Soc., 175-224.

Bureau of Economic Geology. 1972. Interim Coastal Zone Study Committee of the Texas Senate. University of Texas Press, Austin. 11p.

Hoyt, J. H. 1970. Development and migration of barrier islands, northern Gulf of Mexico: Discussion. *Geol. Soc. Amer. Bull.*, 81: 3779-3782.

Hunter, R. B. and K. A. Dickinson. 1970. South Bird Island Quadrangle, Texas. U. S. Geol. Survey Misc. Geol. Inventory Map I-659.

Kenneth, C. G. 1972. Recreational parks and beaches; peak demand, quality, and management. *J. Leisure Res.*, 2: 83.

McAtee, J. W. 1975. Human impact on the vegetation and microclimate on the beach and foredunes of Padre Island National Seashore. Master's Thesis, Texas A & I University, Kingsville, Texas.

Odum, E. P. 1971. *Fundamentals of Ecology.* Saunders, Philadelphia, Pennsylvania.

Sudia, T. W. 1973. Receational carrying capacity of the National Parks, U.S. Dept. Int. National Park Service Rept. Washington, D.C. 11p.

Suter, H. 1973. Natural beaches and protection from tides. Corpus Christi. *Caller-Times*, 1 July: 48.

## INTRODUCTORY REMARKS

DR. BUCKLEY: In this second half of the session, we will look at human impacts by off-road vehicles.

We are going to look at the ecological and environmental effects of off-road vehicles with three different speakers in three areas: Cape Hatteras, Cape Cod and Fire Island.

The first presentation will concern off-road vehicle research done at Cape Hatteras National Seashore. The speaker is Paul E. Hosier, Associate Professor of Marine Science at the University of North Carolina, Wilmington.

He has done research on the vegetation affected by hurricanes at Cape Lookout, the oceanic overwash at North and South Carolina and the subject of today's talk, the effects of off-road vehicles on coastal ecosystems at Cape Hatteras and Cape Lookout National Seashore.

DR. HOSIER: Thank you, Paul.

I have one housekeeping duty that I must take care of initially. I worked at Cape Hatteras for the past year and will be working at Cape Lookout for the next year and a half or two years. Also, I rode up with the Superintendents from those two Seashores; I must say they have been extremely helpful during the past times we worked together and I anticipate that will continue. I would also like to thank the steering committee for inviting me to the forum and allowing me to participate.

# OFF-ROAD VEHICLE IMPACTS: CAPE HATTERAS

**Paul E. Hosier**
*Associate Professor of Plant Ecology*
*University of North Carolina*

Today I would like to share some of my research results, which we obtained during approximately two years of study along the North Carolina coast. I actually broadened my topic, at my own discretion, to include not only Cape Hatteras, but other parts of North Carolina.

North Carolina is one of a number of states which has received significant impacts from off-road vehicles along its beaches. This is indicated by the type of news articles and the level of controversy that has developed in the coastal area in respect to off-road vehicle use.

I would like to begin my discussion by surveying several island localities within North Carolina, describing the type of recreational use and also citing the vehicle impact that each area receives. I will continue discussion with some of our research results on North Carolina beaches and, finally, I would like to show a couple of slides indicating some of the management concepts we might consider in off-road vehicle management.

I anticipate also that Paul Godfrey will give us sort of a litany of "do's" and "don'ts" on vehicles, so I haven't included that.

North Carolina possesses approximately 320 miles of barrier islands and many of these are influenced by off-road vehicles. What I would like to do is survey these areas. In the northern portions of the state of North Carolina on Currituck Bank, which was mentioned yesterday, is an area which has been a mecca for off-road vehicle users. The area is similar to the nationally famous Jockey Ridge area in North Carolina, physiographically and geomorphologically, in that it has very large mobile sand dunes, similar to some of those we saw today during our field trip.

These very large sand dunes are or were the past sites of Holiday Hill Climbs and various other meetings, like the Fourth of July. These areas have received vehicle impacts from hill climbs and also general partying in the area. You can see the extent of the innundation in the area. Lots of other people have other uses for off-road vehicles in the area, and, generally, this type of activity has been stopped in this particular section of the state. But that first slide I showed you showing the large sand dunes, did have extensive tracks on it and that was taken last August. So, you can see there is some considerable illegal off-road vehicle use in this area.

South of Currituck Bank lies the extensive barrier of Cape Hatteras National Seashore. Cape Hatteras is an area where the vehicles are now pretty much confined to beach strand and most of the other areas within the park, excepting the areas near inlets, such as the Oregon Inlet and Hatteras Inlet, where vehicles can come right down to the edge of the water near the inlet to fish. The vehicles are pretty much restricted to the beach strand itself. This is the area on Hatteras itself, showing the impact of the vehicles along the crossover area along the beach strand.

South of Cape Hatteras National Seashore is Cape Lookout National Seashore. Cape Lookout has had a very long history of off-road vehicle

use. Fishing camps established many years ago have carried literally thousands of vehicles out to the island during the past forty or so years. You can see in the vicinity of the lighthouse the extensive road networks which have developed in response to people using these vehicles and wanting to see the vehicles.

In fact, my first real look at an off-road vehicle was in 1970 when I came down to Cape Hatteras. I had seen many of what we call off-road vehicles, or what we didn't call off-road vehicles at Cape Lookout. They were '49 Chevies and '54 Fords and '38 Chevies and that sort of thing. But I saw my first real off-road vehicle, a nice red and white Jeep at Cape Lookout. Many of us looked at each other and said, "My gosh,somebody bringing a vehicle down into this salty air, a brand-new one like that and carrying it out onto the beaches, it is pure folly." So much for that. Years later you can see that there have been thousands on the beaches.

For many years on Cape Lookout the vehicles have had free use of the areas, have run up and down the island unimpeded, primarily because of the very wide flat berm that existed on the island. This was a temporary phenomenon, very likely due to the influence of grazing animals and a series of severe storms in the '50's and '60's. Since the early '70's, the area has recovered considerably; extensive dunes now exist in this area and the vehicles are now confined to sand roads and various other paths that they have created along the backside of the island and also on the beach face itself.

In another area down near Wilmington, Fort Fisher Beach, North Carolina, the off-road vehicles have invaded in force. Unlike the National Seashore where vehicles are used primarily for transportation to fishing sites, recreational use by dune buggies is predominent. Roads criss-cross the area; they cut through and over the dunes, through the grasslands and along the edge of the salt marsh, creating a severe impact in this area.

Presently there is confusion and controversy over law enforcement responsibilities in the area and there is also administrative resistence to remove the last dune buggy recreational beach area in North Carolina. So, as a result, many of these off-road vehicle users, not fishermen, but just recreationists, have created considerable impact in this particular area.

These few slides that I have shown you represent an overview of some of the impacted areas along North Carolina beaches.

Our research areas now include the Cape Hatteras National Seashore, more recently the Cape Lookout National Seashore and also Fort Fisher State Historic Site.

We just initiated the field portion of our study at Cape Lookout, so I don't have anything but observational data to share with you. Let me briefly review some of the ORV effects that we have seen.

Since off-road vehicles are generally restricted to beach running at Cape Hatteras National Seashore, the concern for beach organisms is very high. Studies along the nearby Virginia coast, such as Assateague, by Goldsmith, by Steiner and Leatherman, as Steve mentioned earlier, have indicated that lower ghost crab populations occur in the vicinity of off-road vehicle use. At Cape Hatteras our data tended to support this conclusion.

We compared driven and undriven portions of the beach. We compared dunes, berm and intertidal areas and have skeleton data showing the number of active crab holes. We would get up at five o'clock in the morning, run out

to the beach and locate active holes, rather than simply getting total hole counts. We measured the size of the hole and also whether it was active or not and its location with respect to these three areas.

You can see by the control and experimental aspects of it, the experimental being the off-road vehicle driven section, that with the exception of Ramp 14 on the dunes area, there is a considerable difference. There are statistically confirmed differences between off-road vehicle impacted and unimpacted areas.

More importantly, I think, are data supporting the findings of Leggett concerning the size of the ghost crab holes in comparative areas and the size of the ghost crabs which we were using in a straight line relationship, which has been developed.

The proportion of smaller crabs in the ORV-driven population is larger than in the undriven sections; that is to say where off-road vehicles operate, the crabs tend to be smaller. We want to take a careful look at this again, especially at Cape Hatteras, to determine the cause of this. It may be a differential mortality in relation to the off-road vehicle use, possibly a differential tolerance to the vehicle traffic or vehicle presence or, possibly, a change in recruitment patterns within the ghost crab population.

We are presently working on that right now. In fact, the troops are down there in Cape Hatteras during this week; while I am up here having a good time, they are out there counting ghost crabs at five o'clock in the morning.

At Fort Fisher, North Carolina, which I showed you in the picture earlier, we conducted a study comparing two areas: one driven by off-road vehicles and the other undriven. Two sites were selected: A and B in this particular photograph, A for the northeast and B for the southwest. You can see the physical set-up here—it shows the Fort Fisher Beach to the north. Area A is accessible by a hard-surfaced road to the north. Area B, Bald Head Beach to the southwest, is very similar geomorphologically and vegetationally to the Fort Fisher Beach; however, you can see access to the area is lost by the presence of a new inlet in the center of the photograph.

So, we compared these two areas. This is an aerial photograph facing north showing the northern end in the upper part of the photograph, Fort Fisher Beach. In the center is the new inlet area and to the south is Bald Head Beach with which we made the comparison.

This is an aerial photograph of the Fort Fisher Beach. This is the one beach where they have not closed or changed it in any way. You can see the extent of road activity in the area. People have no regard for limiting their use to the road and so they create their own trails throughout the area.

This is the experimental area, not the exact area, but very similar to it; I didn't have a photograph at the time of the exact area, but this is very similar to the control area. It is an overwash dominated environment. The last overwash occurred in 1962. Areas A and B were selected very carefully to reflect similar physiography following the '62 storm, to try and reduce the variability due to original differences in geomorphology.

Here is a transect across the natural beach area, the area to the south, unaffected by off-road vehicles. I want you to look at the number of species on the right-hand side and also the black lines that appear there showing the large change in species composition and the well-developed zonation that you see across the island itself. You can also see a cartoon-o-gram of

the physiography relating to those low areas.

We took four transects in each area. When we compare the vehicle-free area to the off-road vehicle driven beach, we immediately see a much smaller number of species in the off-road vehicle driven area. You can also see that the major pattern of dunes, grasslands, marsh are completely disrupted by off-road vehicle use.

If we look at some of the numbers that are associated with this, we can see that species differences are significant in the dunes and grasslands. There are significant changes in numbers of species, especially in the grasslands. You can see a sixty percent reduction in the number of species in the grasslands area influenced by off-road vehicles.

Aerial extent of dunes and grasses are changing also. If you look at the aerial extent of grasslands at Fort Fisher and Bald Head and compare them, you see much smaller grassland areas at Fort Fisher. That is where the vehicles operate; the grasslands appear to be disturbed.

We do have an increase in the aerial extent of the dunes. Generally you might ask, isn't this a positive effect of off-road vehicles in increasing the extent of dunes in the area? We now have driven into our heads that dunes are very helpful in terms of lowering the impact of storms; however, this is not a positive change.

Oceanic overwash, as I mentioned, is a dominant process on Fort Fisher Beach. Without the breaking effect of the grasslands vegetation, washovers would be more severe. Probably equally important, if not more important, without the grasslands, the washover sediment will not be retained on the island. So the washover material will come across the island at a greater velocity and it will not be trapped by the vegetation. Much of it will go into the sound side, as you saw on the early morning portion of our field trip. This may, in turn, result in a lowering or narrowing of the island during a severe storm. This is due primarily to the effect of off-road vehicles.

Following the observation of large tunnels created through the sand dunes at Fort Fisher, we attempted to recreate some of these large cuts or tunnels. We put our most sadistic driver behind the wheel and went for the dunes. We had plenty of volunteers. "I'll come down and help, I know how to drive." So we put our drivers behind the wheels, and impacted the dunes to recreate the tunnels which we saw at Fort Fisher Beach.

We impacted two dunes, one with twenty impacts and one with a hundred vehicle passes. Surprisingly enough, or not so surprisingly, we were unable to duplicate the kind of tunnels or troughs we saw with a number of vehicle passes at a given time. So it is apparent that although we can cause elevational changes of up to a foot or so with a hundred vehicle passes as shown by these two transects across one of the areas which we impacted, we can not create large changes.

It appears that there is a situation where we need chronic off-road vehicle use accompanied by the winds that are common in the coastal area to work in concert, so to speak, much like building the dunes. The wind and vehicle activity can contribute to breaking up the dunes. So it looks like deflation and chronic vehicle use will be required for us to show how these vehicle passes can blow out these dunes and create these large tunnels. We just can't do it individually with a large number of vehicle passes at one time. I think that is an important fact.

Grassland areas at Cape Hatteras have been used to determine the effect

of a known number of passes on these well-vegetated flats. Four areas have been impacted seasonally at ten, twenty-five, and fifty passes, using our Ford Bronco.

Our data show initial vegetation removal, as we see in this particular slide, varying from sixty to ninety percent. We find that ten vehicle passes reduce vegetation biomass by at least sixty percent; fifty vehicle impacts have in certain of our biomass samples reduced the original biomass by ninety-five percent. So, you can see that vehicle impacts, no matter how few, can have a rather large impact on a grassland.

Little recovery of vegetation occurred during our season last year; however, beginning this spring, there is considerable recovery in the area. Here we are beginning to see the green stretches through the area, as well as the different colored plants in these vehicle tracks. There is, however, a noticeable shift in species composition. Our annual plants, including horseweed, sorrel and also the deep-rooted perennials, such as the day flowers and ground cherries, recover very rapidly in the impacted tracks.

The dominant perennial plant species, American beachgrass and sea oats, also have exhibited slower recovery. By the fall we hope to have a fairly complete set of numerical data relating the amount of impact for one particular year with our various experimental impacts and also our natural seasonal impacts included.

One of the major ramps to the beach at Cape Hatteras crosses a very wet grassland area. The Park Service personnel closed this area for us last year and we have been continuing to monitor its recovery in terms of vegetation. This particular slide shows the area as it existed late last summer. You can see that the fence in the background closed the road. Vegetation was essentially zero within the roadway itself, although there is a sharp line between the edge of the roadway and the adjacent vegetation.

We set up a number of small transects. We also set up large transects. This is one particular transect across the road area. The middle section of the graph shows a cartoon-o-gram of the vegetation, the physiography and the location of the road. You can see the vegetation on either side and the roadway at that particular time last fall. Along the lower portion of the graph, you see the penetration resistance as measured by a penetrometer. The isolines of penetration resistance on the slide indicate areas of equal resistance. The lines closer to the surface, that is, in the center of the road, show that there is a very hard surface, very difficult to penetrate with the penetrometer. You can see very sharp differences on the road and adjacent to the road where, on either the left or right-hand sides, you can drive the penetrometer into the soil to a considerable depth before you run off the scale of the machine.

In the roadway within, as you can see on the axis, on the wide scale, in less than ten centimeters we reach the maximum measurement on our machine. So, the vehicles have compacted the surface significantly in the area. The upper portion of the graph shows the differences in biomass across the area. This is total biomass, irrespective of species composition.

Now, interestingly enough, we began this study last summer. We monitored the change in penetration resistance last fall and found no change. Early this spring we again found very little change in penetration resistance, although the roadway seems to be softening up a bit. The isolines have moved down about two or three centimeters in the roadway.

There has been virtually no change on either side, which is lucky and nice.

Here is the area last fall and again when we came up here last May. The amount of recovery has been astounding over the winter. Obviously, the winter here is different than the winter in North Carolina, but even so, the amount of vegetation recovery in this area was rather startling. We are now checking data on these plants. We believe that by the end of the summer or early fall we will have nearly 100% cover of vegetation in the area, although it will be a considerable time before more biomass is reached at this particular site. We probably will have nearly 100% coverage in this off-road vehicle affected area, which has now been closed to traffic.

Thus, to date, our study indicates a number of impacts of off-road vehicles on barrier islands. I would like to just summarize these very quickly.

First of all, we have indicated that there are, in support of other studies, ghost crab population changes in structure and also in number.

We have indicated that there is dune destruction and that is usually accompanied or followed by deflation. Once you break the vegetation cover, deflation will follow and the vehicles will impact the area in that respect.

Also, we found changes in plant species diversity, biomass, et cetera. A number of factors have been influenced by off-road vehicles.

Finally, we have seen alteration in the small mammal population in the area.

So, I would like to conclude by enumerating three basic management concepts that we consider applicable to both Cape Hatteras and Fort Fisher, which are based on the data that we have collected to date.

First, I would like to suggest that management plans in these areas consider minimizing the number of vehicular access points to the beach. The vehicles often use the areas in the vicinity of a crossover, rather than running the length of the beach from one crossover to another. The general pattern is for vehicles to come from the main highway crossover areas and fish close to the vehicle access area, so their impact is right in the vicinity of the crossovers. So, if there are changes in ghost crab populations, if there are changes in the small mammals associated with vehicle use in these areas, by localizing these impacts and decreasing the number of these impacts, we probably can leave large spaces in between the off-road vehicle use areas and these will essentially be undisturbed by the vehicles.

Second, I would like to anticipate a recovery rate based upon our data and on observational data from Cape Lookout where resource management personnel have closed vehicle trails for two years now. Looking at these areas and also based upon our data on the artificially impacted areas, it appears that there is probably at least a two-year minimum biomass recovery for these impacted areas. This would be especially true in the grasslands areas. Once you get into the dunes, it's probably a considerably longer delay than that. However, there will be species composition differences that persist for longer than two years. I am sure our data will indicate, as we collect it, that species differences will remain for a number of years, probably five or six.

Also, our Fort Fisher area has demonstrated that we should not allow vehicles anywhere in the dunes without some sort of engineered crossover. Cape Hatteras has a number of vehicular crossovers that are well engineered;

they are constructed out of two by four materials. Also there are other kinds of tracking materials that you can use like aluminum, that would also serve the purpose of preventing deflation or preventing the change in the beach profile and the dune profile as a result of vehicle use.

Basically, we find that overall ORV impact analysis is a very long-term project and we will continue to monitor changes for several years to come. Our studies will continue to focus on the rate and pattern of change produced by vehicle operation in the grasslands and dunes and on sand flats. In fact, we are now planning to begin a study to determine methods to aid natural regeneration and vegetation affected by off-road vehicles.

It is evident that with development of a sound data base concerning the effect of off-road vehicles, resource management personnel charged with the responsibility of providing recreational outlets and/or preserving our natural coastal resources will be able to develop appropriate and justifiable plans for the management of our coastal environments.

Thank you.

## QUESTIONS TO DR. HOSIER

FROM THE FLOOR: Would you repeat that recovery sequence again, please?

DR. HOSIER: This is fall, 1979, this is spring 1980. The exact time I believe was October and May. So, in approximately seven months, which include the winter, this difference in vegetation has been created. Similarly to what we found in our artificially-impacted tracks, the vegetation which recovers is different from the adjacent vegetation. Here again, we are finding creeping plants such as *Libia*. We are also finding annual plants moving in to the crossover area.

Using the same study areas at Fort Fisher described earlier, we analyzed changes in small mammal populations. I was very surprised to see our earlier speaker discussing small animal populations also. We analyzed these in December and also in March, 1980, using our A and B study areas. The upper two sets of data are from the off-road vehicle impacted areas. You can see total animals and also trap nights there on the right, which reflected only two species of small mammals–the house mouse and the rat. Those two organisms made up our complete survey on small animals.

We anticipated when we went out into the areas and impacted, we would wipe out small animal populations. The amount of impact at Fort Fisher was very severe. Our data indicated that the number of animals on the impacted beach at Fort Fisher is higher than that on the unimpacted beach. So, right now we have sampled twice; we are going to sample again in June and in September to see if we have consistent data throughout the year. The first two sets of data from Fort Fisher show total number of animals 30 and 23, differences in trapped mice, 30 and 23, for December and March, 12 in the impacted area, and 6 in the unimpacted area. So, we actually show an increase in small animal populations in the affected areas.

Why? Well, that is the next step.

We essentially believe that the observed change in the population is the result of decreased predation at Fort Fisher. We consider that it is possible that predators are reduced by persistent ORV activity. Constant, chronic ORV activity in the area reduced the predators and in turn, the prey populations of small animals increased in response to the decreased predators.

In support of this we have made foot surveys in the area and found grey fox and coach whip snakes present in the unimpacted area; we were unable to locate any of these in the impacted area. So, it may well be that predators are reduced in ORV-impacted areas.

FROM THE FLOOR: How about the garbage in the impacted areas? Does that act as food for these small animals?

DR. HOSIER: We thought about that. We have talked to a number of people about that possibility and there just doesn't seem to be enough garbage. These animals really don't turn to garbage as a source of food. There is plenty of natural food around, so they will prefer that to cookies and crackers and things like chicken bones.

FROM THE FLOOR: Could you speak a little more about what an engineered crossover really is?

DR. HOSIER: By engineered crossover, I mean having some sort of structural aspect to it, rather than just allowing vehicles to cross the dunes. I have been told that in one particular town they think they are fine by just taking an area and saying, "Here is a crossover, now, folks, use it," and they expect to have no change in the physiography of the area resulting from off-road vehicle use.

I think we need some sort of structure. In the case of Cape Hatteras, for example, most of their crossovers have two by fours that are strapped together with steel cable. They are laid end-wise in a network pattern, so that they have a space between, and the vehicles run up over that, just like a track. That maintains the integrity of the dune structure and yet doesn't allow the vehicle to eat in or to dig into that dune.

Also, I mentioned earlier aluminum tracking–things like the Army or Navy would use in coming ashore in a beach area, or in a swamp or sandy area. Using these kinds of structures would also prevent digging into the dune and changing it.

## INTRODUCTORY REMARKS

DR. BUCKLEY: The next and second of the three presentations on off-road vehicles takes us back to the scene of the crime. The first major effort in an experimental approach to the environmental effects of off-road vehicles was done at the Cape Cod National Seashore by Paul Godfrey and later on by Steve Leatherman.

Paul Godfrey will talk to us today on the studies. He is Associate Professor of Botany at the University of Massachusetts, Amherst. Dr. Godfrey has been working on barrier islands and beaches since 1968, with his wife Melinda, a zoologist, mainly in North Carolina, at Cape Lookout National Seashore and in Massachusetts at Cape Cod.

Formerly leader of the National Park Service Cooperative Research Group at the University of Massachusetts, he started the off-road vehicle project here and in the last couple of years has been on the Department of Interior Barrier Islands Study Group and as a part-time research biologist for the National Park Service in Washington.

Paul Godfrey.

DR. GODFREY: Thank you, Paul.

Those of you who have seen this talk before, if you want to sneak out, it is perfectly okay with me. I won't mind a bit.

# OFF-ROAD VEHICLE IMPACTS: CAPE COD

**Paul J. Godfrey**
*Associate Professor of Botany*
*University of Massachusetts, Amherst*

This work was begun in 1974 in cooperation with the National Park Service, continuing on a project that we started a long time ago on Cape Cod. Every year we go back and take some more pictures. So those of you who have seen this talk before, you will see a few more pictures.

There are quite a few reports out now, which are available to you through the National Park Service. This is a stack of the official reports of the ORV project here. There are some reprints available and also there are some black and white pictures of the study site out in the poster display.

What I think I should do with the time available is just go zipping through these pictures. I want to show you very briefly how the study was done and what the impact of our experimental research was, which is very similar to what Paul Hosier talked about at Cape Lookout.

If we could start with the first slide. On a nice July day or September day, this is the kind of use you will see in the Park. There is a great deal of ORV use of different kinds: people who fish on the beach; people who recreate by taking tours over the dunes; those who joy-ride around the dunes and go all over the place in dune buggies and that sort of thing; also research and Ranger use as well. So, vehicles have long been in use here.

What I want to show is a cross-section of the beaches which we saw yesterday and this morning. If you look very briefly at the sites that we have impacted, they range from the beach through the foredune system, the stabilized dunes, and into the salt marsh and mud flats.

This is the beach where a great deal of our work was initially done. We tried to look at all the different systems and to determine where on this barrier beach system the greatest impact occurred.

The stakes mark the place where we drove around, back and forth, with a vehicle, looking at the effects on bacteria and other things that live on the beach. On northern beaches there aren't as many organisms in the system as Paul mentioned for the southern beaches, where there are ghost crabs and other beasts. In fact, in this area we found the least measurable impact. For one thing it is very, very variable, in terms of the environment. There was some impact in terms of reduction of bacterial numbers and the rate of decay of organic matter.

On the beaches we saw earlier this morning, there is a great deal of drift material that washes up, and it is a primary means from which dunes start building. This is a drift line area at the end of Race Point. Most of this work was done at Race Point. This is an area where the sand is moving around, developing a dune and beach system. It is the area that has the least natural oceanic impacts; in other words, dunes are building at an optimum rate. Out at the end of the spit dunes are starting from drift lines, as we saw, and they also begin down on Nauset Beach.

As you drive through a drift line, you can kill whatever plants are in that particular site very quickly. So, we did that and, sure enough, if you

drive back and forth across these drift lines, you do kill the plants that are in it—they just don't do very well. So that is an area we found to be very sensitive. The young plants that are starting in the drift line are important sources for new dune systems.

Along the edge of the dune is where beachgrass sends out runners which go out into the sand and colonize new beach systems. As you can see here (this is a standard graduate student length, about 5'10") this is one season's worth of beachgrass growth out into the open sand. Here is the tip of the growing shoot. These run under the sand, about six inches down and out onto the new surface. They grow very, very fast, about two centimeters a day under good conditions.

Now, that means that if you drive a vehicle back and forth across either the drift line or the edge of the dune, the effect of the vehicle going across that sandy dune edge is quite severe. It doesn't take a great deal to break down the runners and prevent the dune from expanding seaward. We did this experiment and found, indeed, that you can prevent the dune from expanding seaward onto the beach by driving back and forth in front of it.

When protected, it took about a year or so before the dune started getting back to its normal rate of growth.

This is what happens when a vehicle drives over the sand surface—the effect of the tires is sent down six or seven inches into the sand and causes breakage of the runners and prevents the grass from expanding outward, as it really wants to do. This is very, very critical.

We also had an experimental "racetrack" on Race Point in 1974. As Dr. Hosier mentioned, students do like to drive around and we have certain drivers that are really expert at it. They drove around and around on the Race Point track at different levels of impact. That site is still visible. Probably those of you who flew into Provincetown may have seen that funny little figure eight out there on the sand: that is the study site. This is a photo of our standard off-road vehicle, a Korean War-type jeep, refitted and built up. It was driven around up to 675 times.

Once that was done, we started following the rate at which this area would recover. These pictures were taken in 1974, '76 and '78. Once the pressure of our vehicle use was taken off, the beachgrass began expanding out into the beach system very quickly. Here the new sand is blowing in and the new dune system is growing after the vehicle impact stopped.

We moved further up the dune to the backdune area, and again drove around. This is what it looked like before the site had been driven on and what it was like after 675 passes with the vehicle. We certainly killed the grass. In this particular zone the rate of recovery was very fast and the vegetation reached pre-impact level within about two to three years. It recovered very rapidly.

Then, moving up to the top of the dune, this is what it looked like before impact. You drive on it and again kill the beachgrass: this is the way it looked in 1974, and then recovery by 1976 and 1978. You can still see the impact today. The vegetation is approaching the pre-impact level, but not quite. It still hasn't completely recovered, because growth here is much slower than it is further down on the dune, and will take a while before the biomass returns to the normal level. There is very little new sand coming in here and it is just not a place for vigorous beachgrass growth.

By the way, much of the work that I'm talking about was done by a

whole series of students at U. Mass. One of the persons who did the greatest share of the work was John Brodhead, whose name you will see on all the reports, and I must acknowledge all of these people that have been helpful over the years, a tremendous number, including the Park Service and various organizations like off-road vehicle clubs which provided help on occasion.

One of the things that happens when you drive back and forth over the dunes is that the effect of the tires goes down into the sand. You can see depression areas here. This is where the rhizomes go across and you will recall what we talked about with regard to the boundary between wet and dry sand; this is a very important place for beachgrass to grow—the rhizomes follow that boundary.

These are the only two bits of data that I am going to show you: it doesn't take a whole lot of impact to knock the biomass down very quickly, which is the same result that Paul Hosier found in North Carolina.

This graph shows that something like only fifty to a hundred passes of a vehicle can knock biomass down to a very low level. When you keep adding on impacts—one hundred, two hundred, six hundred— it really doesn't make any more difference if you go over the same tracks. Once you take the impact off, then the rate of recovery depends on whether you are on a back dune or on a fore dune. But it does recover.

The point here is that, as has been seen in many other studies, a very low level of impact can cause the maximum amount of damage. One vehicle pass can cause severe damage.

Other sites were tested, such as the bearberry community. Some fifty or so passes after impact, it appears to be completely killed, but the vehicle did not kill the plants as you will see in a minute, because bearberry has runners that go across the ground surface, almost like corduroy, and these survived. After a few years, 1976, 1978, the whole place is completely recovered. The runners were not broken, new leaves were produced and the ground cover came back.

But if this sort of impact were done on a hill, then the period of time when there was little leaf cover could cause severe erosion just from rain runoff down those tracks. We have seen that in many places on Cape Cod.

The other community that was very, very sensitive was beach heather. It is now blooming, with beautiful yellow flowers, which many of you have seen. This is the site before being driven on, after about fifty passes in 1974, then in '76, and in '78. There was a bit of a storm problem here in 1978 with some salt water flooding, and part of the area was damaged. The reason for lack of recovery is that beach heather doesn't expand very quickly or rapidly by rhizomes or other means. It is one of the most sensitive types of vegetation when impacted by feet or vehicle tires; it takes a long time to come back.

So, in summary, with regard to the dunes, the location of roads is important as well as their orientation relative to prevailing winds. For instance, if a road goes over the dunes, without any protection whatsoever, and is oriented in such a way that the winds, northwest in this case, can blow the sand away, a severe blowout can develop such as the one shown in this picture. But up on the ridge, with grass along both sides of a road, we find very little loss of sand. It is on those turns and corners and places where the wind can start blowing sand away that a real problem exists.

There is also a problem with people who refuse to follow any rules and regulations and have no sensitivity whatsoever to the environment. That

approach produces destructive actions which ads for 4-wheel drive trucks and CJ-5 jeeps encourage. You can see people up there bouncing their vehicle over dunes and doing wheelies on open slopes which face northwest winds—a perfect place for dune erosion to start.

It turns out that this kind of thing causes the greatest problems because, as we said, it doesn't take much to cause the breakdown of vegetation. Only a few passes of people driving around in these spots can cause some long-lasting trouble. As an example, here is a photograph of a place where somebody drove up a dune a few years ago, couldn't make it, slid back down, and left his tracks behind. Those tracks are still visible: if you go out on a whale watch sometime, as you come back into Provincetown on the boat, look at hills across Hatches Harbor and you will see the tracks. That is the kind of thing that causes very severe difficulties.

We know that human beings have had an impact here for a long time, particularly since colonial days. The Provincelands forest was first described by the Pilgrims: much of the dune area was covered with a woodland such as the beech forest up the road here a little ways. The forest was cleared early for wood and pasture.

In recent years this area was and continues to be disturbed by vehicles which, if they stayed on designated paths, would probably cause little damage. But when drivers spread out all over the place, as you can see here, their activity simply does not allow the vegetation to come back into these open dunes. So, this problem will persist for as long as that kind of activity continues.

Here is a picture of the migrating dunes that we saw today. Vehicles travel all along the top of these dunes and if they stayed on trails there would be minimal damage; but what happens is that people go off the trails and start doing wheelies all around the open dune slopes. That activity maintains the system of the migrating dunes.

On beaches that are retreating (we will hear more about that from Fred Anders next) such as Nauset Beach, dunes are often broken by storm overwashes, and vehicles run back and forth through the overwashes. That creates and maintains a large open area because, as we saw on Coast Guard Beach, the driftlines simply can't get started and they are very important in establishing dunes. So, anyone who drives around in such areas stops the potential buildup of new dunes.

Now, that applies to places like Coast Guard Beach which have been closed to vehicles. Occasionally someone sneaks down there, as in this picture, and drives right through a driftline. That kind of impact will simply prevent or retard the natural development of dunes on an overwashed beach. I think this is a very severe problem.

Another problem case: there used to be two roads on Coast Guard Beach, the high road and the low road. After the Beach was closed in 1978, very rapid vegetation recovery occurred in both roads. This photo shows the high dune road, one year after closure, with the grass taking over. That is the kind of dune edge we really should have; not the eroding side of a road.

One of the current problems is use of places like Wood End where there is now an inlet. You can see the level of impact that we have there with trails all around the spit as vehicles go out and move back and forth. There is no way in the world that an actual dune system can get started again with that type of heavy impact. So, it is really a management problem.

First of all you can cut down the use of vehicles in some places. Then you can go out and plant beachgrass where there are breaks, like the ones in this photo, which was done by the Massachusetts Beach Buggy Association. The Cape Cod Four-Wheel Drive Club has also been out planting grass in places for experimental work. You can build ramps over the top of the dunes. This is the ramp at Cape Hatteras that Paul Hosier was describing. It is very well made. You have to maintain it, of course, and that takes money. This is very important because otherwise vehicles will tear the dune down and start opening it up to erosion.

Very quickly, for just a couple of minutes, we will go quickly through our salt marsh studies. Out here at Hatches Harbor, you can see the impact that vehicles have. People do drive through the water and round the edges.

Here you see the salt marsh impact site in 1974. It includes a high marsh, with low marsh further out.

After ninety passes of a jeep, the low marsh was completely torn up, and a number of years were required for it to start coming back. Finally much of the site had recovered after about three or four years, but back out in the marsh there was still a hole. This picture shows the hole in 1976, and in 1978 the tracks were still there. The vegetation had still not filled in the area by any means. In fact the tracks are still there today. The salt marsh also is very sensitive, and traffic there is a problem that must be controlled.

This picture shows the way a vehicle cut can get started–just a few passes were made on the marsh adjacent to an old trail on the left. Within a few years time the site we impacted was still visible and getting even a little wider. It had taken a long time for the other side to begin to recover and it really hasn't fully recovered yet. Once started, these trails in the marsh can last for a while.

You can close off a barren mud flat from vehicle traffic and within a few years that mud flat, if protected, will turn into a salt marsh. Everywhere we have done that, barren flats are now turning into salt marsh.

When people drive along the edge of the marsh, as you can see here down at Wood End, it creates problems. If you drive all over a mud flat, salt marsh plants cannot survive. The area in this photo looks like a parking lot but it is really an intertidal mud flat. If you run along the edges of the marsh and the dunes, there is no way that the two communities can meet and protect the system from eroding–the whole system starts breaking down. So, the transition zone between dunes and marsh, where most people tend to drive, can break down very quickly with too much use.

The study involved a lot of other aspects that I can't go into right now because of time, but there were studies done by Nancy Wheeler on the effects of vehicle traffic on soft shell clams that live in the mud flats. They have soft shells which are easily crushed if you drive over them, even when they are buried. The impact of vehicles does affect the survival of these clams.

Then, finally, one of the favorite topics of many people here are the terns, which I'm not even going to get into very much. That was part of the study as well. The Least Terns were also impacted, but not quite the same way, by Brad Blodget who didn't really drive over the nests, but came close. It pained him greatly to do this, but it had to be done, and he found some interesting results. If the beach is wide enough, birds and vehicles can

coexist if drivers stay out of colonies and watch for chicks. But oftentimes that doesn't happen; terns make their nests out on the beach and when people drive over them, well, that is the end.

What does all this mean? It means that, based on all the areas we have studied so far, we should stay as far out on the open beach as we can get without getting into the water (this picture shows the 4-wheel drive truck my wife and I own). On northern beaches this appears to be the area that is least damaged of the many places that are affected by ORV use.

Finally, as shown in this picture, there are other things that happen when one drives too close to the edge of dunes, such as preventing the dune from expanding seaward. You have to stay out on the berm. If you drive back and forth across the driftlines that prevents new dunes from forming.

If you have to have a trail, you can manage it in such a way that the overall damage can be minimized. I think that is really what it comes down to, finally. We have to decide what level of impact we are going to accept and then learn how to manage it.

Thank you.

DR. BUCKLEY: Thank you, Paul, we appreciate it. Twenty-three minutes is a new track record for Paul Godfrey.

## INTRODUCTORY REMARKS

DR. BUCKLEY: The last speaker for today is Fred Anders, Assistant Director of the National Park Service Cooperative Research Unit, University of Massachusetts at Amherst. He is a research geologist who has been at the Cooperative Unit since 1977 and he has worked previously at the Smithsonian Institute as a geologist.

He is going to speak about research on off-road vehicles done by him and by Steve Leatherman at Fire Island National Seashore.

# OFF-ROAD VEHICLE IMPACTS: FIRE ISLAND

Fred J. Anders
*Assistant Leader, National Park Service Cooperative Research Unit*
*University of Massachusetts*

Fire Island is a retreating barrier along the south shore of Long Island, New York. It is oriented in roughly an east-west direction and is approximately thirty-three miles in length.

Within the boundaries of the National Seashore on Fire Island are a number of communities composed primarily of summer residences, but there are a significant number of year-round dwellings as well. Access to homes is limited to ferries during the summer months, but driving along the beaches is permitted at other times of the year. During the past three years there have been well over 40,000 vehicle trips per year along the beach.

Our study on Fire Island is concerned primarily with the beach and in that respect differs from the two studies on off-road vehicles described previously.

Estimates for Fire Island suggest that there is an oceanside erosion rate of two to three feet per year. Park officials have been gradually reducing the amount of traffic along the beach at Fire Island in the belief that vehicle impact is helping to accelerate the natural erosion rate.

Right now we are involved in a study which is examining the role of ORV traffic on the beach. This study is made up of three major parts. The first is looking at the direct effect of the vehicles on the beach, that is, what actually happens when you drive on the sand. The second part is looking more at the long-term effect of these vehicles on the beach profile. The third portion of the study is looking at what effect the vehicles have when they drive in the vicinity of the foredune.

To examine the role of vehicles in the direct displacement of sand on the beach, we first looked at the major variables related to displacement of sand. These are : vehicle weight, tire size and pressure, the orientation that the vehicle takes to the slope, the speed at which the vehicle is traveling, how many passes the vehicle makes through the same track, the moisture content of the sand, the degree of sand compaction, and the natural slope angle of the beach.

All of these variables are divisible into two categories. The latter variables are basically environmental ones that we measured in the field. The other variables, such as vehicle weight and orientation to the slope, were held constant for all of the experiments or were controlled for each particular test. We conducted the experiments in four different zones on the beach: the dune, the backshore near the dune, the backshore near the berm, and the foreshore.

To measure exactly how much displacement occurred when a vehicle travels along the beach, we devised an instrument which we call a microtopography profiler, which is actually a pretty simple device modeled after a tool that carpenters use in laying floor tiles. It is simply a series of plastic rods held together by a clamp. When the clamp is loosened, the rods lower to the surface and the upper portion of the rods duplicate the profile. We

then place a sheet of paper behind the rods and trace off the duplicate profile of the surface in the vicinity of the vehicle tracks.

The result of vehicle passage over the sand is that we get a depressed area in the vehicle track, as you would expect, which deepens with increasing number of passes in the same track, and on each side of the track we get mounds of sand which also increase with the number of passes. These mounds are composed of loose material that was displaced out of the original track.

In addition to measuring the displacement of sand, we also recorded each of the environmental variables. They were measured prior to testing, during the test and after each experiment. Up to 50 passes were completed in the same track at the designated speed for each test.

From the direct displacement tests, there were two conclusions that were very obvious. First, the downslope mound was generally larger than the upslope mound. You would expect this because of the action of gravity. We found more material moving downslope, which means that there was a net downslope movement of sand and, since the beach tends to slope towards the sea, we had a net seaward movement of sand as vehicles passed along the beach. The second conclusion that we reached was that the volume of sand displaced into each of the mounds was generally less than the amount which was missing from the track, which would indicate a net compaction of the sand below the track.

Several field tests were conducted which confirmed that compaction of sand below vehicle tracks does occur. Compaction effects were visible up to depths of fourteen centimeters. Additional tests show that, while immediately below the track we had compaction, on each side of the track the mounds of sand were extremely loose and the sand right at the surface of the track was also loosened. This means that the net effect of vehicles was to loosen the surface sediment, which easily becomes entrained by wind and water, and to compact sand at depth.

Examining the net downslope displacement of sand relative to the number of passes within the same vehicle track, we found two important results. One was that the dune environment is by far the most sensitive to ORV's. Fewer number of passes were required in the dune environment to move a large amount of sand. Whereas on the backshore areas, backshore near the dune and backshore near the berm, the amount of sand moved downslope was relatively small compared to that moved on the dune. Total disruption was least on the foreshore.

The other point noticed on the graph was the slope of the curves, which in each case started out initially very steep (exponential increase), but then as the number of passes increased above ten, the slope tended to decrease dramatically toward zero. This means that each pass by a vehicle in the same track moved progressively less and less sand than the previous pass. So, in other words, if you had fifty passes in the same track you would move a lot less sand than if you had fifty passes spread out over the entire beach with each driver making his own trail.

We performed a stepwise linear regression analysis of some of the field data and found that of the different environmental variables measured, slope, number of passes within the same track, and the vertical compaction of the sand were the most important ones in controlling displacement. The steeper the natural slope, as near the dune, the greater the displacement.

Vertical compaction, on the other hand, was negatively correlated with displacement. The number of passes in the same track was important initially, but as the number of passes increased, the detrimental effect of each one tended to decrease.

An extension of the direct displacement experiment was the examination of the interaction between the swash processes and the sand that was loosened and delivered downslope by vehicles. It is generally acknowledged that along the south shore of Long Island, including Fire Island, the longshore drift is undernourished. Therefore, if vehicles are able to deliver additional sand into the swash zone and this additional sand is carried off by the backwash, this sand could be entrained by the drift and lost from the beach, thus contributing to the erosion of Fire Island.

Presently we are conducting two indirect experiments to look at the interaction of the swash and the sand in impacted areas.

The first test involves the use of two swash sampling devices. These simple instruments consist of a one-foot length of 3-inch diameter PVC pipe attached perpendicular to a lever handle. A trigger releases two balls which block the ends of the pipe and thus trap a volume of water and sediment which can be emptied and returned to the laboratory for measurement. A section of the beach is impacted experimentally with a test vehicle. Adjacent to the impact site is a control area in each case. The two samplers are held in the swash zone of the beach, one in the impact site and one in the control site. As the swash runs up into both areas, the samplers are made ready and then simultaneous samples are collected of the return flow. This procedure is repeated numerous times for each experiment.

Preliminary analysis of this data suggests that, in fact, the impacted site generally does contain more sand per unit volume of water than does the control site on the return flow of the swash.

The second experiment that we are conducting involves putting dye tracer sand onto the beach in an impacted site and in an adjacent controlled site. As the tide rises this dye material is moved along with the regular beach sediment. Samples are collected 20 meters downdrift of the injection sites. These samples are returned to the laboratory, where we extract a uniform volume from each one and count the number of tracer grains within that sample.

The preliminary results of this particular test have been mixed; but in several cases we have found more sediment tracer grains in the impacted area. This means the impacted area had more tracer grains arriving to our sampling site sooner and in larger volumes, indicating that the sand within the impacted site is much more mobile than the sand in the control site. If this increased mobility of sand on the impacted site is indeed occurring, it could lead to accelerated erosion of the beach, since the longshore drift in this region is undernourished.

Another active phase of the study is investigating the long-term effects of daily movement of vehicles along the beach. All the traffic that enters or exits the western end of Fire Island comes through one dune cut which is just west of the Town of Kismet. Due to the traffic flow pattern we have a natural control site, in which there is almost no vehicle impact, adjacent to a site which receives a large amount of vehicle impact. The proximity of these two sites means that any variation which we observe between the two areas can be attributable only to the difference in impact levels.

The beach on both sides of the Kismet Cut is surveyed periodically along the same lines, perpendicular to the trend of the beach. Beach profiles are computer-plotted and can be overlaid to examine changes that occur through time.

Short-term variations along the beach are quite evident. A particularly good example was after the February '78 northeaster, which caused radical changes in both the control and impact sites. However, comparison of the profiles from the control and impact site shows that the impact site was more severely eroded than the control site. Despite the storm erosion and the difference between the control and impact after the storm the beach on the impact side fully recovered. Comparing the beach profile of August '77 with the beach profile of August '78 you see, in fact, that the beach in August '78 is wider than it was in August '77 and the berm is slightly higher, indicating that the beach has recovered, despite the storm. The littoral drift along Fire Island filled in the impact deficit in this case, eliminating any evidence of the storm event over the long term.

A third phase of this study investigated the effects of ORV traffic in the vicinity of the dune. Storms, and even spring tides, often force ORV users to drive fairly close to the toe of the dune.

To investigate the impact of ORV's in this area of the beach, we closed off a section of the dune using a series of posts and cables. On each side of the exclosure we established two experimental impact sites. Once we established our sites, we located several survey lines through the whole area, which we monitor periodically. The experiment began by producing a map which showed the seaward front of the vegetation, or in other words, the plants which were most seaward. We also used standard vegetational quadrat techniques to determine cover, density, and frequency along each of the survey lines.

After we collected the initial data, we impacted each of the two impact sites on an experimental basis, starting off at the rate of one pass per half meter wide strip per week. To state that another way, our impact sites were eight meters wide and each week we would run eight passes through that eight-meter wide area to see what the effect was on the vegetation. We purposely selected a low level of impact.

We compared the vegetation front maps showing the seaward position of the vegetation from July of 1977, prior to any impacting, to one year later, July of 1978. It was evident that the vegetation front was pushed back on the order of four meters in each of the two impacted sites, while during the same period of time, the vegetation in the control area actually advanced on the order of a meter to a meter and a half.

We halted impacting temporarily in January of 1979 and the result was that the vegetation in the impacted area began to advance seaward. Impacting was resumed in mid-June 1979. This time, however, we reduced the level of impacting to half the previous number; one passs per half-meter wide strip every two weeks. Over the eight-meter wide area, we impacted eight times every two weeks.

Even at that reduced level of impact it didn't take long to completely eliminate the vegetation in the impact sites. In fact, if we look at the vegetation front maps again, comparing July of '77 with October of '79, you can see that once again the vegetation has been pushed almost completely out of the impact area; it had retreated a distance of over four meters.

Whereas over the two year period, the vegetation advanced in the control area by as much as two meters. In some areas the vegetation had grown right up to the seaward boundary of the exclosure site.

Our purpose was not simply to look at the vegetation; we also wanted to find out what effect a loss of vegetation might have on the topography of the foredune. We periodically surveyed the area to monitor the profile changes which might have occurred. We compared two profiles: the control profile as it looked in July of '77, and the control profile as it looked two years later in July of '79. It is evident that within the control area we had a fair amount of sand accumulation, up to a half meter of vertical accumulation over the two year period, as a result of sand being trapped by the vegetation.

Over the same period of time, if we look at the impacted sites, we can see that there was a difference. Comparing the impact zone, July of '77 profile, with July of '79 profile, it is evident that there was no accumulation of sand where impacting had occurred. There was no vegetation; there was no trapping of sand. In fact, a slight loss of sand was evident in this area.

Comparing the same impact profiles it was obvious that there was a large accumulation of sand just landward of the actual zone of impact. We found that in this area the density of vegetation increased greatly, probably due to the fact there was less competition since the seaward-most plants were eliminated. Therefore the unimpacted plants adjacent to the impact zone increased in density. With the increased density, these plants were able to trap more sand, resulting in a profile which is greatly steepened over the original profile of the beach. A steepened foredune profile along Fire Island could lead to accelerated scarp formation, which in fact could lead to accelerated erosion.

In summary let me say that the direct displacement tests have shown that there is a net movement of sand downslope and seaward as a result of vehicle movement on the beach. The natural slope of the beach, compaction of the sand, and the number of vehicle trips through the same tracks, are the critical factors controlling the amount of sand displaced by ORV's. The initial passes are the most critical in displacing sand.

The ideal place for a driver to be traveling along the beach is just landward of the berm during the summer months, where the slope is actually toward the dune. ORV impact would be minimized if each driver would follow in the same track, rather than making his own track along the beach.

In the event that no berm is present, which is often the case during the winter, the ideal place to drive would be where the slope is at a minimum and the vertical compaction is at a maximum. These criteria are best met on the winter foreshore. Again, following a pre-established track each time would be best.

The preliminary swash tests show that under certain conditions ORV impact can result in more sediment in the return flow of the swash and hence can establish the potential for accelerated erosion.

It is evident from the periodic surveys that short-term fluctuations are more pronounced in profiles of impacted sites, but that longshore processes tend to act such that they smooth out the beach and prevent observation of long-term effects.

Finally, from the exclosure studies we are able to show that even low levels of vehicle traffic in the vicinity of the foredune can severly damage

the vegetation and that once the vegetation has been damaged by ORV impacts, natural sand accumulation is halted. As a result, foredune profile changes can occur such that erosion could be accelerated.

Thank you.

DR. BUCKLEY: The amount of time remaining for questions is limited only by your patience, the speaker's endurance, and your desire to get out for whatever stuff is available to eat and drink, but Fred will entertain some questions if you have time.

FROM THE FLOOR: You said that you would recommend having the vehicles drive on the landward side of the berm; that seems to conflict with what Dr. Godfrey said.

MR. ANDERS: How so? I don't see the conflict right offhand.

FROM THE FLOOR: I thought the drift line, et cetera, was in that region and that a minimum amount of impact, especially on the organisms was lower in the area seaward of the berm.

MR. ANDERS: I think the driftline material is usually up higher on the beach in the vicinity of the dune toe. If you look at a profile of the beach, there is a point where the backshore slopes down to a minimum from the berm, where there is zero slope, and then the backshore starts to gradually go up toward the dune. I think that many of the important driftline deposits are located on the backshore slope leading up to the dune and not adjacent to the berm crest.

Where I say driving would be least damaging is just landward of the berm. I am talking about the zone where the slope is still in the direction of the dune line. Driving in the vicinity of the dune toe, where the viable driftlines are located, should be avoided.

DR. GODFREY: May I add something to that. I anticipated that question, and it doesn't conflict at all.

One thing you must remember is that when we began our first studies in '74, there was no indication as to what environmental areas were the most sensitive to vehicle impact.

What we found from a biological point of view, in terms of organisms, is that that area seaward of the driftline was variable, but also had less damage from ORV impact, but it was thought there would be probably what we are seeing now. That area seaward of the driftline might be considered as an acceptable driving area, particularly from the findings on the work that Fred and Steve have been doing.

# BARRIER ISLAND WORKSHOP: ENGINEERING SOLUTIONS TO COASTAL PROBLEMS

Oral Presentations

Friday, May 30, 1980

**Structural Approach to Coastal Problems** . . . . . 128
*Neill Parker, Chief, Engineering Development Division, U.S. Army Corps of Engineers, Coastal Engineering Research Center, Ft. Belvoir, Virginia*

**Non-Structural Approach to Coastal Problems** . . . . . 139
*Stephen P. Leatherman, Leader, National Park Service Cooperative Research Unit, University of Massachusetts*

**Reconciling Structural and Non-structural Solutions to Coastal Erosion Problems** . . . . . 148
*P.A. Buckley, Chief Scientist, North Atlantic Region, National Park Service*

**Forum and Workshop Closing Remarks** . . . . . 169
*Richard L. Stanton, Regional Director, North Atlantic Region, National Park Service*

**PROBLEM SOLVING AND BRAINSTORMING SESSION** . . . . . 171
*Panel Discussion, Friday, May 30, 1980*

## INTRODUCTORY REMARKS

MR. OLSEN: This morning's presentation is devoted to the subject of engineering solutions to coastal problems. Here to present the structural approach is Mr. Neill Parker, Chief, Engineering Development Division, Coastal Engineering Research Center, U.S. Army Corps of Engineers, Fort Belvoir, Virginia.

Mr. Parker joined the Corps on Engineers in 1950 in the Los Angeles District, where he remained until 1969. In the early years of his professional career there, he was involved in planning design of flood control works as a soil mechanics specialist and as a general project manager. In later years Mr. Parker turned his attention to coastal engineering.

In 1969 he transferred to the Office of the Chief of Engineers as a specialist in coastal engineering. As a member of the OCE staff, he had primary responsibility for development and application of design criteria for Corps coastal projects, for the technical review of feasibility and design reports, was technical monitor for all coastal engineering research, and represented the Chief of Engineers on matters pertaining to the planning and design of coastal projects.

In 1978 he moved to his present position, where he directs a program designed to advance the state of the art of coastal engineering through research, evaluation of the performance of coastal projects, translation of research findings into engineering technology, and the application of that technology.

Mr. Parker.

# STRUCTURAL APPROACH TO COASTAL PROBLEMS

**Neill Parker**

*Chief, Engineering Development Division*
*U.S. Army Corps of Engineers, Coastal Engineering Research Center*
*Ft. Belvoir, Virginia*

It is certainly a pleasure to be here and I appreciate being invited to such a beautiful place to spend a lovely day. When I came down yesterday I was struck by the beauty of Provincetown and the beauty of this great natural phenomena and, as I listened to yesterday's presentations, I was equally impressed by the deep concerns and the deep dedication I am finding in this audience. It is certainly a privilege to talk to you.

As I read through the program for this meeting, I turned first to the list of speakers. When I did, I was struck by two things. The credentials of the participants are as imposing as the purpose of the meeting. They are certainly tough acts to follow and equally tough acts to precede.

Second, I appear to be the only engineer on the list.

At first I was inclined to panic and sort of steel myself for my impending doom but then I remembered that Americans traditionally go overboard for underdogs. That tradition is my source of strength today.

The next thing I noticed were the titles, "Barrier Island Forum and Coastal Engineering Workshop." A great deal of attention is being focused on our coast and rightly so. By Presidential Proclamation, 1980 is the Year of the Coast.

By my proclamation, the Year of the Coast began five thousand years ago, when man first started using it.

Considerable legislative attention at all government levels is now focusing on the coast in general and on barrier islands in particular. Yet, there is really no universally-agreed-to determination of what is or is not a barrier island. I am sure that Steve Leatherman and Paul Buckley, who follow me, and both of them are certainly authorities, can and perhaps will define barrier islands. They may very well agree, but I am equally sure that other authorities will differ.

The term "coastal engineering" isn't any better defined. To us at the Coastal Engineering Research Center, coastal engineering is the art and science by which the interaction and functions of structures of sediments and hydraulics and the effects of the ecology of the coastal zone are made useful to man. Some would more narrowly define it as pertaining only to shore protection work. I rather suspect this more narrow definition was in mind when this workshop was conceived.

Finally, I notice the subject assigned to me, Steve Leatherman, and Paul Buckley. Structural approach, non-structural approach, reconciling the structural and non-structural approaches. Again, definition is hard to come by. From previous discussions with Steve and Paul, I know that they tend to consider only hard structures under the structural approach umbrella. By "hard structures", I mean things like seawalls, bulkheads, groins, and other things of that sort. My structural umbrella covers a much larger area. It shelters structures such as beach fill, beach nourishment and engineered vegetative plants. I tend to think of non-structural approaches as those

things done to limit and regulate the actions of man and society in coastal areas, things that are passive protective measures.

Being the lead speaker for the workshop gives me, or at least it lets me take, certain freedoms in organizing and directing my remarks, and I intend to do that. I will use those freedoms to at least touch on certain points and concerns, some of which really flow from my introductory remarks about definitions, before I talk about the specific structural approaches.

Because I represent the coastal engineering community, I feel compelled to tell you a little bit about coastal engineering.

Because I represent the Corps of Engineers, I feel compelled to outline the responsibilities and the activities of the Corps that directly affect coastal areas.

Because I represent the research community, although others here do, too, I feel it important to talk about the state of knowledge.

Because I have had and do have considerable involvement in planning and designing shore protection, I feel it important to identify some of the factors that are essential to decision-making about shore protection.

I listed these as though they are separate items of content, but that is not really the case. My remarks will address all of them, but they will undoubtedly be intertwined, because relationships in many cases are quite intimate.

Engineering has always been a mixture of science, art and applied science. Engineering specialties always begin at the art end of the spectrum and move toward the science end. Coastal engineering is no exception. In fact, few engineering specialties have been so long evolving. The civil engineering community has generally recognized coastal engineering as a legitimate specialty only recently. Yet, man has probably been building harbors for forty or fifty centuries and has been fortifying coasts for probably twenty centuries. Throughout this long involvement, problems arising from the sea's stubborn insistence on rearranging the world's shorelines have frustrated us. Harbors have filled up and had to be abandoned. Fortifications have been undermined and collapsed. Advances in physical sciences and the associated movement of engineering specialties toward the science end of the spectrum normally comes from man's observation and experience. This general rule simply did not apply at the coast for many centuries, and it didn't apply because the complexities of the surf zone and the specificity of the experiences defied rational organization.

Only recently has an ever-growing body of engineering science begun to supplant engineering experience. Only recently has the physics of the surf zone begun to emerge and be understood. Only recently has an understanding of coastal geology and geomorphology started to appear. Today we build, work, play and live in the surf zone with a keen awareness of the forces and processes which that environment marshals to oppose our efforts. But even today, our understanding of those forces and processes is not complete. Any profession to the contrary simply must be regarded with extreme caution, if not actual suspicion.

Sudden leaps forward in knowledge are almost always explained. Coastal engineering has surged forward in two happenings which profoundly shaped our lives in this century. World War II brought amphibious warfare on an unprecedented scale and at an unprecedented level of sophistication. The demands of survival gave tremendous impetus to the study of

physical oceanography and to the study of physical oceanography of the surf zone in particular. After the war, Americans, in huge numbers, almost like lemmings, returned to the coast where the nation had its beginnings. This rediscovery of the coastal zone brought a growing recognition of its importance, and this added impetus in maintaining the momentum of the scientific movement.

With this recognition of the importance of the coastal zone came concern about the effect of man's activities on the coast. We still build harbors; we build them to gain access to the rich foods the sea offers; we build them to satisfy our passion for sailing. But we build them with a consciousness of the impact the structures essential to the harbors will have on the coast itself. Today's coastal engineering incorporates features that preserve and protect the coast, as well as features that make it safe. We no longer fortify coasts, but we build recreational facilities for everyone on them. Today's society uses the coast as no other society ever has. Beaches are an irresistable magnet to vast numbers. Today's coastal engineering is hard put to satisfy the demands of this society. You must use and must have a variety of tools to enable the equally legitimate claims of preservationists and recreationists to co-exist and to respond to society's demand for protection of its lives and property from the excesses of nature. Society, in turn, must see to it that research to advance science and engineering science continues.

The Corps of Engineers is responsible for several activities on and near the coast. Before I describe them, I think it would be well to briefly describe the authorities and the legislative environment in which the Corps does things. First, let me make it clear that I am speaking only of the civil works activity of the Corps, not its military activities as a part of the United States Army. The staff engaged in civil work activities is almost entirely comprised of civilians. For purposes of the civil work the United States is divided into Districts and Divisions. Each District is usually headed by a Corps of Engineer's Colonel and each Division by a Corps Brigidier or Major General. The Corps' civil works policy and direction is nationally established in the Director of Civil Works' Office of the Chief of Engineers. The civil works budget is also put together there. The Director of Civil Works is a Major General. A handful of other Corps officers are scattered through this system, but the vast majority of people in the offices at all levels are civilians like me.

The civil works activities are not programmatic as are the activities of most federal agencies. The Corps is task-oriented and acts on a project basis. The civil works projects are individually and specifically authorized and funded by the Congress. The feasibility studies on which the Congress usually bases its decisions to authorize or not to authorize are themselves similarly authorized and funded by the Congress. Having said that we are not on a programmatic basis, permit me now to organize activities in groupings that for convenience I will call programs.

We do several things that affect coastal areas. We regulate, we construct, we operate, we maintain and we research. We do these things with careful attention to their impact on the physical, biological, economic and social environments. In 1899 the Congress moved to protect navigation when it made construction in or impinging upon any navigable waters of the United States subject to permit by the Secretary of the Army. In subsequent years various Acts broadened this permitting authority and now it includes the

protection of the overall public interest, which, of course, includes impact on the biological community and the physical environment. Discharges into waters of the United States are similarly subject to permit. Projects are constructed by the Corps on the coast for navigation, shore protection and protection against hurricane-induced flooding. The Corps also operates and maintains the projects in the navigation program.

The bottom line factors that probably weigh heaviest in the decision-making process that leads to project authorization are economic justification and environmental impact. American society, acting through its elected national government has already found and declared there is a national interest in the purposes served by the programs.

During my remaining time, I will focus on two phenomena and the programs that react to them. The phenomena are shore or beach erosion and hurricane and storm surges. They are obviously not totally separate. Hurricanes and storms do cause erosion. However, erosion also goes on day after day in the absence of storms.

Much erosion is unquestionably the result of stresses imposed by society's use and demands. But not all erosion can be blamed on society. Beaches doubtlessly eroded before society made demands or imposed stresses. Many near-shore islands, be they called barrier islands or whatever, are undergoing steady day-to-day erosion. Some of these islands are clearly developed areas. Some are clearly undeveloped. Some are not so easily classified.

Various elements of society hold various views on what ought to be done about erosion. At one extreme spokesmen demand that nothing be done. At the opposite extreme, spokesmen demand that all shores be stabilized. These attitudes have focused attention and have produced constructive dialogue and it is well underway and both needed and helpful. From that dialogue should emerge meaningful compromise and sound public policies that will properly serve the national interests.

Much of the current dialogue is centered on preservation of natural values of undeveloped barrier islands. Few persons would oppose this objective, but its disarmingly simplistic appearance masks some sophisticated and complex relationships. Hardly anything comes without cost and in this day of inflation, we are certainly aware of that. The means of preserving these values need to be carefully examined for possible negative impact. For example, if dredging of inlets or navigational channels that carry substantial commerce is restricted, trade and recreation are apt to be adversely impacted. If materials dredged from these inlets and channels cannot be placed on barrier islands maintenance costs are apt to rise sharply and trade and recreation will probably suffer those costs. Also, alternative disposal might have adverse impact on other biological or physical environments. Finally, an undeveloped island could front a mainland area occupied by a mainland community vulnerable to hurricane flood. Preservation of the natural values in that case could result in the destruction of that community. I cite these matters not as arguments against preservation of naturalism on barrier islands, I cite them as expressions of concern with possible unintended effects. At the bottom line a very real problem exists today, and that problem is the tendency to generalize about barrier islands from inadequate or site-specific information. Such generalizations may very well deter the accumulation of knowledge and understanding on which

effective objective reasoning depends.

A good many structural and non-structural approaches to shoreline stabilization are available. Each is important. Each has its place. Each solves a problem or problems. None is best, none is applicable everywhere and none solves everything or every problem. It is unlikely that any approach or any combination of approaches will solve all of the problems present or be responsive to all the legitimate concerns that may be raised. In most cases, the aim must be to insure that balance that serves the present and protects the future. Before an approach can rationally be selected, the problem must be identified and described. Its cause must be determined and an objective must be established. For example, if a shoreline is retreating, the reason for regression must be determined. Assuming it to be a sandy shore, is sand being lost to longshore transport, is it being lost offshore, or are both happening? Will offshore losses be returned by subsequent events or are longshore losses caused by an interruption updrift? Are significant parts of the losses due to wind transport? Are the losses a temporary aberration or a continuing process? How much regression are we willing to accept? What do we want to protect? A recreational beach, a development, a highway? Do we want to establish a buffer zone within which the shoreline will be allowed to advance and retreat?Do we want to oppose wave energy? Do we want to absorb it? Only when these and other similar questions have been examined can we begin to look for solutions. Other problems will raise other questions.

Now, I would like to show you some of the features that we incorporate in coastal navigation, shore protection and hurricane-induced flood protection projects and tell you a bit about them. Before I do that, let me say that these slides that I show are not selected as case studies or histories. They are merely illustrative examples and I don't really intend to individually discuss them. Some of them are Corps construction, some of them are not. Some of them are on barrier islands, some are not. Some of these are on the Great Lakes. My purpose is merely to expose those of you who are not familiar with such structures to what they look like.

For the purpose of discussion, I have grouped structural approaches to shore stabilization according to their physical characteristics. This kind of grouping may sometimes mask functional identity, where no grouping will serve all purposes.

The first grouping I have elected might be called and is called by our European friends, rigid sea defense lines. They are structures designed to establish and hold the line that limits the sea's approach. This group includes seawalls, bulkheads, and revetments. They oppose and reflect the energy that the sea delivers to them. They are relatively inflexible.

Lately it has become somewhat popular, almost chic, to dismiss seawalls as totally unwelcome and totally undesirable. Certainly they do reflect energy almost directly downward with little dimunition. Certainly this redirected energy does erode the beach in front of the seawall. In many instances dry beach will disappear in a relatively short time. It is equally certain that a properly constructed seawall will do exactly what it is intended to do. It will resist and redirect the energy. It will hold the line and absolutely limit the sea's encroachment. It will make the area behind it safe and secure.

I can think of nowhere that this point is better illustrated than in

Galveston, Texas. This slide is a picture taken in Galveston, Texas, September 8, 1900. At that time, or at least the day before, Galveston was Texas' fourth largest city, with a population of 37,000 people. The first floor of residences and businesses were elevated several feet above the ground level as a safeguard against storm-induced overflows that the city occasionally suffered. Many of its residents knew that a storm put eight feet of water in Galveston's streets only twenty-five years before.

On September 8th, after the hurricane had passed, Galveston was a heap of rubble. Six thousand to eight thousand persons were dead or missing and North America had experienced what is still its worst recorded natural disaster.

Galveston rebuilt and fronted itself with the famous seawall, seventeen feet above mean low tide. In 1915 a hurricane again struck Galveston. This one brought a fourteen foot tide. It was just a little more than a foot lower than the September 1900 one, but this time only twelve died.

Seawalls, bulkheads and revetments can be and are built of many things. Often they are not as well built or as carefully designed as they should be. As a result, they fail both structurally and functionally. Whether they be of natural rock, reinforced concrete, concrete blocks, timber, filled nylon bags or whatever, they must be capable of withstanding the design wave. The foundation must be safe against undermining. The structure must be safe against overtopping by the design wave and the ends of the structure must be secured against the flank.

[Series of slides showing revetments in many locations, constructed of various materials, with various degrees of effectiveness, and in all states of disrepair.]

The second group includes structures designed to capture or retain sand in compartments. The most familiar of these are groins. Groins come in all sorts of configurations. Some are T-shaped, some are straight, some are curved. They also come in various lengths. I might parenthetically add, they also come in good and bad design. They are constructed of about the same variety of materials as are seawalls, bulkheads and revetments.

Groins, if they are to be successful, simply cannot be casually planned or constructed. To survive the rigors of the hostile environment in which they are usually sited, they must be well-designed, sound and competent structures. To perform the functions for which they are intended, they must be carefully designed with a solid understanding of the natural forces and processes that work in the area. I hope it goes without saying that they must be suited to the purpose to be served and to the objective envisioned.

Groins cannot create sand; a supply must come to them either by natural process or by man's mechanical intervention. Groins cannot readily prevent offshore movements of sand. Groins can generate rip currents, which encourage offshore losses and, of course, groins can be a barrier to natural sand movement and create problems downdrift of them. Properly designed and constructed groins can and do stabilize beaches without these undesirable side effects.

[There follows a series of slides showing a random assortment of groins constructed of all sorts of materials: nylon bags filled with sand, which may or may not contain some cement (they are extremely vulnerable to vandalism and they are highly visible targets); a groin constructed in this case of a gabion (this is called a dog bone groin because it is pre-cast and has

some resemblance to a dog bone); a cellular sheet pile groin filled with rocks and sand, cement, gravel (a construction method used greatly on the Great Lakes); a groin built of natural rocks; a steel sheet pile (this groin has certain impact upon the shore downdrift of it); a groin field, which has been quite effective in retaining the sand between the groins.]

Another group of structures found in the surf zone are intended to provide protection for navigation. One member of this group is the jetty inlet or harbor entrance.

Jetties attenuate waves and thereby provide calm waters for vessels entering restricted waterways approaching the terminal area. They block sediments that would otherwise shoal the channel and make them unnavigable. They define the harbor entrance and they fix the entrance channel. Because they block sediments moving along the shore, they often induce erosion on adjacent shores. In earlier times society paid little or limited attention to this side effect, but beginning in 1935 the U.S. Congress evidenced its increasing concern by a series of legislative acts. These began with one requiring the study of the coast for ten miles on either side of a federal navigation project and concluded with one authorizing the Corps of Engineers to mitigate damages attributable to federal navigation projects.

Because of concern about jetty-induced erosion, the Corps has developed and is continuing to develop means of by-passing sand around jetty entrances. One such device is the weir jetty. Another sand by-passing system uses an offshore breakwater to trap sand for easy by-pass.

[A series of slides showing various types of jetties and the problems associated with sand accumulation and transport, including weir jetties, parallel jetties and sand by-passing systems.]

This is another kind of sand by-passing system in California, at Channel Island Harbor, a commercial port, and the Navy Base of Fort Wannit. The breakwater, as you see here, serves two purposes: it shelters the entrance from wave action; but equally important, it shelters this shoreline area against wave action. The sand moving along the shore comes into the lee of the breakwater and since there is no longer energy to transport it, drops it there. We trap approximately one million cubic yards per year in that trap. It is then dredged, passed through a pipeline which runs under this harbor and deposited on the beach on the other side where it is distributed on southerly by natural processes. That is a very effective by-pass, but again, expensive.

A fourth group of structures are wave attenuators. Although they occasionally serve other purposes as well, their primary function is stilling wave action, either to protect the shore behind them or to provide sheltered waters for navigation.

The most recent addition to the tools used by the Corps to insure a supply of sand to beach downdrift of navigation entrances is a shallow draft split-hull barge—I'll show you one.

These three breakwaters are on Lake Erie, Lake Viewpar, Ohio, and there are a couple of things I would like you to note. The breakwaters are separated. That separation is carefully designed and engineered. I visited this site before the breakwater was built. That shoreline was rapidly moving this way and there was no sand out here at all. The sand has gathered since those three breakwaters were constructed.

FROM THE FLOOR: Over what period of time did that sand accumulate, please?

MR. PARKER: I have a terrible memory for time. One or two, three years, perhaps less than that.

It might be worth running overtime to describe this area. As you move in this direction, the shoreline becomes increasingly a low bluff. It has a very small percentage of coarse-grained sediments, unlike most of the lake bluffs, but it does have some coarse-grained sediments.

Most of the shores of the Great Lakes are eroding because the lake levels have been high for several years, which means that lake water is attacking areas that are normally above the waterline. That is causing sloughing of those banks and, of course, the materials do get picked up on longshore transport and are moving in this direction.

Groins have been constructed there; those groins, however, were very poorly done. They are buried in what you see now. A breakwater was built not for the purpose it is now serving, but it was built as a protective feature for, I think, a sewer outfall, I am not sure. But note the development behind it.

This is what happens when energy is interrupted at the shoreline. This is one all coastal engineers show with pride and fondness. This is where it all began, Santa Barbara, California. This is a famous example of what happens when we don't understand what is going on. This harbor is perfectly designed and this breakwater was a supplement. This breakwater is aesthetically pleasing but was constructed without understanding the shore processes. The only trouble is the sand was moving in one direction and it used to move in the other. There is a solution to these problems of erosion and accumulation in this area, however: that is dredging 365 days a year, right here, and putting sand right there, where it is needed. In defense, let me mention that I think the construction date on that was about 1927.

I call this one our advertiser. This is one of our small-craft harbors in California that didn't quite work out. That is Santa Cruz, California. I have a reason for showing this slide. That much sand can move into that harbor in two or three days.

I have another slide that I didn't bring, because it is a black and white photograph, it shows a local yacht club where they have a wheeled vehicle with a sail on it and a cocktail table and a cocktail flag flying and they have the cocktail party right there on the sand bar.

I mentioned our newest development. This is at Currituck, and the machine is technically described as a split-hull, self-propelled, self-loading barge. It would be much simpler if we simply called it a mini-hopper dredge. That is what it really is. The great and exciting virtue of this vessel is that when it is empty, it draws about three feet; when loaded, it draws about eight or ten feet. It holds 300 cubic yards. That means that this vessel can go into a shallow inlet, one in need of dredging and not protected. This shows it filling from the drag hopper. It can navigate through a shallow inlet, because it can enter very shallow depths and then sail out of the inlet, move down the shore and actually sail right into the shore, normal to the shore into eight feet of water. It can then split the hull, as you see here, and deposit the 300 cubic yards in water depths of eight to twelve feet. What we have found is that sand deposited in those depths does move by natural means on down the coast.

The shore stabilization methods most often used by the Corps today are beach restoration and periodic beach nourishment. These are the methods which most closely approximate natural processes. Although sand must be brought to the area by mechanical means, its subsequent distribution along the shore uses the energy of the sea itself and requires no importation of energy. Restoration and periodic nourishment are not really well understood by the using public. Restoration is exactly that, no more. A beach is restored by placement of fill to some pre-selected form or dimension. This action does not stop erosion. Periodic nourishment supplies sand to replace erosion losses. It does not stop erosion, either. Needless to say, a very comprehensive and detailed understanding and definition of the natural sand transport mechanisms active in the area are absolutely essential to the planning, design and operation of nourishment projects.

The concluding slides in the series I am about to show on restoration and nourishment show Honey Island, South Carolina, after Hurricane David last year. Responsible naturalists were extremely concerned when David tore away the beach here, because the island is a sea turtle nesting ground. The Corps used emergency procedures to expedite nourishment, because of the concerns about the survival of those turtles.

This is a restored beach which is periodically nourished to keep it that way.

This is another.

I might add that this is a completed park. This is Dade County and there is a lot more to come.

That looks to me to be Wrightville Beach, North Carolina; there is somebody here from North Carolina, I think, who can correct me if I am wrong.

Another slide. This is Honey Island after David. To refresh your memory, this is not where David made landfall. David made landfall at Savannah, Georgia, quite a bit south of that. This resulted from wave action that David had. That island is a State Park; that is a breakthrough. We did a major restoration or nourishment here, because this island had previously been destroyed.

One of our research programs deals with the use of engineered vegetative planning to stabilize and protect shores. Dune formation may be successfully induced by planting vegetation where there are no dunes.

In conclusion, I repeat that there are many structural and non-structural approaches to the solution of the problems. Each has a place, each solves a problem or problems. None is best, none is applicable everywhere, none solves every problem.

Thank you.

## QUESTIONS TO MR. PARKER

FROM THE FLOOR: I notice in all the different kinds of structures that you showed, you didn't have any of what are called gabions. Is there any work going on in that subject?

MR. PARKER: We haven't used it anywhere. I have to confess to not knowing a great deal about them. I know they exist and I know that they are using them. My general impression is that they are maintenance intensive. In our system, maintenance intensive things don't do well.

FROM THE FLOOR: Do you have a working definition for the term "barrier island" or "coastal barrier"?

MR. PARKER: Do I?

FROM THE FLOOR: Yes.

MR. PARKER: No. That is the easiest question I will get all day. It doesn't become a serious problem until you enact legislation containing the word "barrier island", and then definitions become important.

FROM THE FLOOR: Your engineered plantings, are those all hand-planted, or are there other techniques used to get vegetation in?

MR. PARKER: They are hand-planted in the sense that some action of man is necessary. There are machines that can be used, but they are not volunteer plantings, if that's what you mean. By engineered plantings, I mean the plantings are planned and designed and located for the purpose of producing a precise result.

FROM THE FLOOR: Is the technique anything similar to what is used along highways where you can actually spray a combination of mulch and seed?

MR. PARKER: No. I am sure people in the audience could answer that better than I, but you are talking about sprayed seeds and what we are talking about is vegetative planting. It differs in exactly that. These plantings are sprigs, not seeds.

FROM THE FLOOR: It seems that in using a mitigating structure, such as a weir, jetty or offshore breakwater, the only difference in what happens is that it costs more money to move the sand from the uphill to the downhill side. Did I miss something?

MR. PARKER: The difference with what?

FROM THE FLOOR: Well, in the traditional parallel jetty, on one side we have a drift side and on the other side we have erosion. You are still transporting sand across the inlet.

MR. PARKER: Without the weir jetty the sand is not transported across the inlet, it stays against the updrift jetty.

FROM THE FLOOR: My point is that at most parallel jetties, at some point a dredge is out there doing just that and the weir jetty just seems to be a little bit more expensive.

MR. PARKER: No, I'm sorry. There are occasions when a dredge is dredging the fill against the upstream jetty. They are extremely rare, because dredges can't operate in that water. It takes a very special dredge. I don't know of any in this country.

FROM THE FLOOR: I wanted to ask about, I don't know if it was a law but you said after 1935 the Corps of Engineers would have to take a look at ten miles on either side before putting the jetties out?

MR. PARKER: That's correct.

FROM THE FLOOR: Is that a grandfathered thing? Suppose it was constructed before 1935, could a town ask the Corps of Engineers to look at ten miles on either side? I'm thinking of the Cape Cod Canal.

MR. PARKER: There are two laws that affect your question. To respond to your question, first, the 1935 law really doesn't do anything. That law directs the Corps in studying any navigational project to examine the impacts of that project on the shore for ten miles in either direction and report them. It does not mitigate them.

A much more recent law authorized the Corps of Engineers to mitigate

damages attributable to federal navigation works. If you have such a problem involving federal navigation works, all it takes is a letter from the governor of the state asking the District or Divison Engineer to examine the problem.

FROM THE FLOOR: Did I understand you to say at the very beginning when you were talking about seawalls and showed the Galveston construction, that although the beach in front of the seawall will erode, will be scooped out, the seawall will still hold. I would think that eventually it would be undermined and just fall over.

MR. PARKER: It is a matter of design and if the design is not proper, it will be undermined; but if properly designed, it will not. The Galveston Seawall is founded on pilings that go very deep.

FROM THE FLOOR: How long has it been there?

MR. PARKER: Since 1904.

FROM THE FLOOR: Sir, when we look into the things that we have seen promised, the high tech things like floating breakwaters and submerged breakwaters, were those just things that artists drew up?

MR. PARKER: The feasibility of floating breakwaters, whether they are high tech or not, is perhaps debatable. We are examining them; there are two problems with floating breakwaters. One has to do with the fact that (this is a personal opinion at this point) floating breakwaters are probably not going to ever make it in high energy climates, because there is a relationship between the dimensions of the floating breakwater and the length the wave might attain. Waves can get enormous.

Alternatively, they can be built in tune, so to speak, to a specific wave length. All you have to do is stand out here any day and look at the ocean and become aware quickly that there are thousands of wave lengths out there. So, you can't design a structure like this which will be appropriate for all sea conditions.

FROM THE FLOOR: Are broad-frequency responses very poor?

MR. PARKER: Broad-frequency responses at present technology and limit of theory is to make the structure broader, to simply make the structure wider and the costs get out of hand.

The second problem is addressable and it is being addressed and that is anchorage problems. That means that most floating breakwaters that you see around the country now are made of tires that Goodyear is pushing, an excellent idea, most of those are failures or anchorage failures, not breakwater failures, but the floating theory, that is another one. We are researching it and so are many people.

FROM THE FLOOR: If the breakwaters or jetties are causing broadcast problems, that means you have to then go back and construct by-pass systems. Why don't you just do the by-pass system without the jetties?

MR. PARKER: You raise a very good question, a serious question and an excellent one. Again, in my judgment, that will happen. But the technology is not now available.

Let's talk about it afterwards.

# NON-STRUCTURAL APPROACH TO COASTAL PROBLEMS

**Stephen P. Leatherman**
*Leader, National Park Service Cooperative Research Unit*
*University of Massachusetts, Amherst*

Neill did a very good job of showing us the different types of rigid coastal structures that can be employed in various environments. I want to take a different tack and look at barriers as a naturally dynamic system, and show why engineering structures often do not meet their stated objectives.

While we cannot give a simple, precise definition to include all barrier structures, it is certain that along the east and Gulf coasts we have a very long and magnificent chain of barrier islands which we can, for all intents and purposes, identify. Assateague Island is an excellent example of a barrier island. At Assateague there is a very narrow bay between the island and the mainland on the north end as shown on this slide.

I will briefly discuss where we can probably use some engineering structures, be they structural or non-structural. By and large, however, barrier islands are so dynamic and changeable, that the cost associated with their manipulation is quite high. Also, environmental impacts can be quite significant, depending upon the type of structural approach.

One thing that we tend to focus on is the shoreline–how it can be manipulated. We really have not looked at the island from a holistic viewpoint. In other words, how does shoreline manipulation affect the rest of the island–dunes, barrier flats, marsh, and bay. If we only consider the shore itself, then it is a simpler situation than to talk about the island in total.

First, I want to discuss barrier evolution. Next, I will talk about Cape Hatteras as a case history of shoreline stabilization attempts. Finally, the Ocean City, Maryland, problem as it presently exists will be discussed.

The first factor is sea level rise; this may be the single most important forcing function in barrier island migration. Sea level is continuing to rise resulting in beach erosion and ultimately island migration. In this situation, structures designed to prevent this process, will necessarily have to be short-lived and, of course, quite costly to maintain.

The second factor is storms. Storms accomplish in short steps basically what sea level rise sets up. In other words, sea level slowly rises and there may not be detectable shoreline change. However, the water level relative to the island is deeper and during a storm much sediment must be transferred offshore to compensate for the rise in sea level. Barrier beaches migrate landward by the following processes: littoral drift, inlet dynamics, overwash, and dune migration.

This sea level rise curve shows that there was an ice age about 15,000 years ago. About 15,000 years ago the water level was approximately 400 feet lower. If you wanted to go to the shoreline in the Massachusetts area at this time, you would have found it seaward of Georges Bank.

Since that time, the water level has been rising as the glaciers retreated northward and continued to melt. Approximately 2,000 to 3,000 years ago,

the rate of sea level rise declined. At this scale, it appears that there has been a period of standstill. Other scientists maintain that in the last several thousand years, sea level has risen from a half to about a foot per century. This rate, of course, varies considerably with location along the coast.

Recent sea level curves are based on tide gauge data. The record extends back to about 1860 for the earliest gauges. I just want to point out the trends of these curves, showing a general upward rise from the mid 1800's to present. These curves were compiled by Stacey Hicks of the National Weather Service. He has taken the tide gauge data and looked at all the variables that affect sea level and concluded that the general trend is an upward rise. There are some wiggles on the curves, but the overall trend along the east coast has been upward.

We do not know the nature of these curves prior to our tidal gauge data, whether there were similar high levels or the sea level was actually quite lower in the past. Perhaps we are just looking at a recent rise (upward wiggle) along a rather flat curve. This is an important issue and a matter of contention. What is clear, however, is that since about the 1850's or 60's we know from tide gauge records that sea level has been rising.

Even though man has interfered with barrier beaches in many ways in recent times, Dr. Bird of Australia has compiled data showing that sandy coasts around the world are eroding, except where there are large sources of sediment, such as near rivers or extensive sandy shoals. Areas totally unaffected by man, such as along the African coast and many other coasts in remote areas, are eroding. The only thing we can conclude is that sea level rise is a world-wide phenomenon. It is not just occurring along the east or Gulf coasts.

If you look at the Pacific coast, there are other variables to consider. This area is subject to earthquakes and volcanic activity. There is a tendency, particularly in Alaska, for the land mass to be actually rising out of the water. During the Alaskan earthquake of 1964, some parts of the land actually rose by as much as ten feet. Bay bottom areas were exposed in some shallow embayments. Each area is somewhat unique in this regard. The local sea level rise results from a combination of factors; the land can be rising or sinking irrespective of the absolute sea level change.Along the Texas and Louisiana coasts there is a tremendous amount of withdrawal of fluids. In this case, there is a much higher relative rate of sea level rise, because not only does this area have to contend with the world-wide rise of sea level, but there is also subsidence of the land due to withdrawing oil and water.

In terms of sea level rise, we must plan for the worst case. That worst case is that this trend will continue upwards. It can be shown that much of the current beach erosion can be accounted for simply by sea level rise, submerging the land and driving these barriers landward. If the trend continues, rigid coastal structures will be of a short-term nature and quite costly to maintain.

This diagram shows the response of barrier islands to sea level rise. Along most of the coast, particularly south of New York, we have a very wide coastal plain. This plain has a very low slope, amounting to only a few feet to perhaps four feet per mile. The coastal plain is quite wide in North Carolina. Richmond, Virginia, for instance, is built on the landward edge of the coastal plain. Baltimore, Washington, many of our major cities

are also built along the fall line.

As sea level rises, barrier islands must migrate up the coastal plain to accommodate this change of water level. Otherwise, it is possible that barriers could be drowned without migration.

Dr. Sanders has speculated that approximately seven thousand years ago, an ancestral Fire Island, New York, actually did drown. During the last three or four thousand years, his data show that a new Fire Island migrated landward by continuous shoreface retreat up the coastal plain. In this case, Fire Island has moved up the outwash plain of Long Island in its landward displacement.

The process which transports the most sand is littoral drift. This movement of sand is caused by waves striking the shore at an angle. Wave-driven currents move a considerable amount of sand along the shoreline. This is the sand which groins, jetties, and other structures normal to the shoreline are designed to stop or trap. At Cape Hatteras the littoral drift is as high as a million cubic yards per year along the shoreline. To imagine the huge amount of sand in a million cubic yards, think about a dumptruck which holds three to five cubic yards. This will give you an idea of scale. Cape Hatteras is a very high energy area with an appreciable amount of sand movement. There are many shorelines with a drift rate of at least three to four hundred thousand cubic yards per year.

The second process in order of importance is the role of tidal inlets. With a breach in the barrier, flood and ebb shoals are formed by the tidal currents. These shoals often cause problems for navigation and must be dredged and jettied for this purpose. Inlets have to be frequently dredged if you want to maintain a deep channel. The flood tidal delta is composed of sediment which is washed into the bay behind the barrier island. When the inlet finally closes this large sedimentary deposit becomes an excellent substrate for salt marsh colonization.

Alfred Redfield did a landmark study of the evolution of Sandy Neck on Cape Cod Bay. This is a good example of how many of the barriers in the northeast part of the country have developed, growing from the erosion of headlands. Nauset Beach and the Province Lands have both evolved in this manner. Redfield was able to date the buried peat deposits and determine when and how far this spit had grown through time. He also determined the rate of sea level change with his core data. He shows sea level in 1300 B.C. to be 18 feet below the present level. At that point in time the spit was quite small in size and still in the process of development.

Spits can form anywhere there is a concavity in the shoreline. The tendency is for the littoral drift to move sediment along the shoreline in a straight line and deposit sand into deep water, causing a filling and straightening of the shoreline. This is the process which starts building the spit.

Redfield shows the shoreline in 700 B.C. at 12 feet below mean high water. A small amount of marsh is shown to be present. As barrier beaches develop, salt marsh forms behind them. In fact, Redfield was able to determine the growth and development of the spit by dating the salt marsh sediments encountered with depth. By taking cores and determining the sediments' age, he could relate sea level at that time to the old high salt marsh surface. This correlation is possible since *Spartina patens* grows near mean high tide level. Development of the barrier and associated salt marsh system provides good evidence that sea level has been rising over the last two to

three thousand years, at least in the Cape Cod area. Coast Guard Beach on Cape Cod is an example of another barrier beach that developed in a similar fashion. Sediment has moved from the eroding shore at Eastham, forming Coast Guard Beach—the upper part of Nauset Spit.

Inlet formation is a process which is probably second in order of importnace in moving sand across many barriers. While the processes for barrier migration are the same, the relative roles of these processes can be quite different in different environmental settings.

Some islands are very wide, and inlets may not be nearly as important. For instance, Mansfield's Channel on Padre Island has to be dredged to remain open. It is very difficult to maintain a permanent inlet across some of these islands because they are two to four miles wide.

This aerial photograph shows Drum Inlet, North Carolina, shortly after opening. It had a fairly deep channel, and the flood tidal delta had just started to develop. The net drift is to the west, deflecting the channel in this direction. The channel was in a location farther to the east when it first opened; it moved downdrift because of the accumulation of sand delivered by the littoral drift. At the same time there is a tendency for the channel to maintain its dimension, resulting in concurrent shoreline erosion on the downdrift side. Hence, there is a migration of the channel. The inlet migrates until the channel becomes so long and sinuous that it becomes inefficient. Many inlets naturally evolve in this manner if not jettied or stabilized by some means. Most inlets become inefficient and are eventually closed. Behind them is left a large lobe of sediment, which then becomes prime substrate for new, highly productive marshes.

Inlets are usually formed during a storm, primarily hurricanes, because the storm surge is much higher on the average than during winter northeast storms. However, the 1978 blizzard breached Monomoy Island on Cape Cod and created the two islands of Monomoy. Shortly after the storm, the breach had a deep channel, but a large load of sediment had been deposited in the characteristic pattern. This inlet is not yet closed. It may be some time before this inlet through Monomoy closes due to the size of the inlet breach and the large tidal prism.

It is clear that as sea level rises, islands must move landward. Littoral drift basically creates the barrier feature in the Northeast with the aid of activity and overwash processes. Overwash in the last ten years has really captured our imagination. It is a phenomenon that we can go out and study since it is a common occurrence on some barriers. By comparison, inlets have a frequency of occurring only once in fifty to seventy-five years along some shorelines, whereas overwash is much more prevalent, happening during most major storms.

The north end of Assateague Island was overwashed by the 1974 storm. The overwash surges proceed through breaks in the dune line. Here the water is funneled through this breach in the dune line back towards the island interior. This surge is transporting not only water, but sediment as well. As the surge moves back towards the bay, the water slows down and drops the sediment load. This new sediment is deposited in the area behind the barrier dune.

During a large storm surge, a high barrier dune or sections thereof can be overwhelmed and completely destroyed. This is what happened during the '78 storm at Coast Guard Beach, when flow depths were six feet or

greater as they passed the threshhold of the island. Of course, human development in the path of these surges was destroyed.

Washovers on Assateague Island can be quite large. The dimensions of this feature are 200 feet across and 800 feet landward, extending to the bay shore. On the north end of the island there are almost no dunes since overwash is so prevalent here. In this particular area there has been quite rapid erosion, largely due to the Ocean City jetties. This northern section is eroding thirty to forty feet per year because of sand starvation due to sand entrapment on the updrift side of the jetty.

This picture of the Coast Guard Beach area shows overwash in a maximum transport mode. The point here is that dunes can be an effective barrier for a period of time, but on a retreating shoreline these breaches will eventually occur. We are now seeing new dunes forming, albeit slow, on these washover fans, and dunes will eventually redevelop. Dunes are a part of the natural system, but there is a time and place for dunes. Along a rapidly eroding shoreline, such as Coast Guard Beach, you cannot really maintain a solid dune line indefinitely.

The last process for landward transport is windblown sand or aeolian transport. In thirty or forty knot winds, the amount of sand moving by saltation and bouncing along the ground is substantial. Some people minimize the importance of this process. A well-known coastal geographer once said that there is not enough sand being blown around on barrier islands to fill up your shoes. I totally disagree with this statement; obviously these armchair scientists have not been out during the blustery days with thirty or forty knot winds.

During fair-weather conditions in the winter, the prevailing winds are from the northwest. These are the winds which move considerable sand offshore from washovers at Assateague Island. This redistribution of the overwash sand by aeolian processes is a very important process at Assateague Island and Nauset Spit.

At Fire Island parabolic dunes are slowly migrating across the landscape, driven by the prevailing northwest winds. Some parabolic dunes have already reached the beach. Some of these other dune forms, which look like blowouts, actually do have form and are migrating roughly in a southeast direction.

Some of the most spectacular examples are the dunes in the Province Lands–huge parabolic dunes, in some cases up to 100 feet high. Parabolic dunes generally result from some previous disturbance. These dunes are migrating across the beech forest in the Province Lands. As the dunes move, trees in their path often die. Also, there are considerable problems with road maintenance. As much as 10,000 cubic yards of sand have to be moved off of Route 6 each year due to dune migration. This problem which resulted from previous misuses of the land, is aggravated by pedestrian traffic and off-road vehicles.

I want to present a case history of the National Park Service's experience at Cape Hatteras. The area that I want to discuss is Cape Hatteras Lighthouse at the Point and the Buxton Motels. Behind the Outer Banks are large sounds, extending tens of miles. The lighthouse at Cape Hatteras is one of the most distinctive features along the shoreline, but it is now very close to the beach.

The story goes back to the 1930's when there was a CCC project to

plant beach grass along the Seashore to build dunes. There are two schools of thought about the natural vegetation of Cape Hatteras. Some people believe that Cape Hatteras was originally a completely vegetated area. European man with his animals and woodcutting needs altered the vegetation and landscape. Obviously this occurred, but it is not clear to what extent. Other people believe that Cape Hatteras National Seashore was largely a barren washover area, characterized by open sand and low areas. Our best records come from learned travelers who describe the area in their writings. We may never know the actual situation; most likely the conditions were somewhere between these two extremes. There were forests and shrublands along the Outer Banks, but there were also washovers and areas of inlet activity. One of the reasons this replanting was undertaken was to restore the area to its presumed original condition.

The dunes were originally established two to three hundred yards back from the shoreline. During the forty year period, from the 1930's to the 1970's, that wide beach was eroded away. Dunes can only be effective when they are fronted by a wide beachfront. We are not quite sure what the total effect of these dunes has been. We are sure that building dunes has caused ecological changes on the island interior. With the prevention of salt water flooding and limitation of salt spray, the grasslands behind the dunes have evolved to more woody-type vegetation. Thickets have replaced the former grasslands.

In terms of the geomorphic implications, some coastal scientists have argued that dunes actually act like seawalls and cause erosion of the beach. The data to date indicate that this is probably not an important factor.

With an eroding shoreline and a static dune line, the two are eventually going to be in conflict. This happens primarily during severe storms when the dunes are cut back.

This well-vegetated dune was fertilized by helicopters; *Ammophila* is near its southern extent at Cape Hatteras. The dune is not a static feature since it must respond to natural stresses. In some critical locations, particularly the Buxton Motel area, the dunes were finally overtopped and overwash occurred. Dunes were the first type of so-called non-rigid structural solution to be used for shoreline stabilization, but their failure was eventually insured with an eroding beach. Another attempt involved beach fill, and material was dredged from the sounds behind the barrier islands and placed on the beach. There were two major problems with this approach. Unfortunately, the material in the sound consisted of a lot of silts and clays, so that less than about fifty percent of the material actually stayed on the beach within a few years. The silt and clay particles were too small to be stable on the beach, and this fine-grained material moved offshore into deep water. There was little real beach width added. Also, these dredge holes in the bay are stagnant areas. They are quite deep relative to their width, and the bay circulation does not reach the bottom of these borrow pits. The word borrow is a misnomer since the material is never returned. After the fine materials were flushed offshore, the beach became quite narrow again and overwash began anew.

The next type of non-rigid approach was to place sandbags on the beach. The NPS first experimented with 100 pound sandbags and finally 2,000 pound bags, with the idea that these larger ones would be able to withstand the waves. This was a poor engineering design since there was

very little beach in front of these buildings, and hence the sandbags had to be placed very close to the present shoreline. Unless you want to pile sandbags behind the houses, which would not be very helpful, the only other place the sandbags could be placed is right on the beach. This is the problem that can occur when development is already established. Once development has taken place, we cannot properly locate engineering structures, if deemed necessary. The wall of sandbags could not withstand the onslaught of the storm waves. Some were found but most were never recovered. We know the bags were not vandalized because they were still in place just as the storm arrived. Many bags were swept offshore; others were buried in the sand. Obviously, this sand bagging approach was not successful. The storm produced tremendous flooding, erosion, and destruction of the Buxton Motels.

At first, the residents had a problem of sand being deposited upon their lawns and the accreted sand had to be carted away. With time, the beach has moved landward, and accreting areas were placed in an eroding situation. No longer did we have a problem of getting rid of sand; now there was not enough sand. Groins, employed by the Navy, have also been used along this shoreline. The three groins caused a bulge in the shoreline at this location. I will not dwell on this subject since groins are a form of rigid shoreline engineering. The employment of groins did not help the Buxton Motels as they were located too far downdrift of this area since during northeast storms, you can actually drop anchor at the Drop Anchor Motel. The road actually appears to be river with two feet of water over the surface.

During the past few decades there has been a lull in hurricane activity. We really have not seen a major hurricane since the 1960's, and the east coast is well overdue. During a hurricane, the water levels associated with the storm surge is much higher, sometimes ten or fifteen feet higher than the flooding in the smaller northeast storms. It is hard to envision what a full-blown hurricane would do to this area.

The final technique that was used at Cape Hatteras was dredging sand from the Cape Point area for beach nourishment. In terms of the quality of material, this time it was the right sand size. The Cape has been accreting largely from sand moving southward along the shoreline by littoral drift, accumulating at the Point. The dredging operation involved pumping sand northward through a pipeline for discharge in front of the Buxton Motels. The area just north of the motels was breached by an inlet in 1962 and has had a long history of chronic erosion and overwash activity. This area has been particularly dynamic, but the NPS persisted in trying to hold the shoreline largely due to the demands of the residents. This slide shows a new house being built on the active washover.

This slide shows the large borrow area at Cape Point, where the sediment was pumped out at a cost of about $4 million. It is a large pit, nearly twenty feet deep. Presumably, this area will fill in by sand moving southward, but this pit is still clearly evident today.

Beach nourishment is effective if you find the right type of sand, and if you consider it to be only a temporary solution. It is not a long-term solution. You are not really addressing the disease but merely treating the symptoms. The problem is not solved, but valuable time can be bought.

These shoreline stabilization approaches at Cape Hatteras cost the National Park Service about $20 million over the time period discussed.

Some people have argued that the value of this development (Buxton Motels) and maybe even the cost of moving the lighthouse landward would not total $20 million. I am not an economist, but the figures seem to indicate that the cost being expended in trying to hold this shoreline in one position is much higher than would be the cost of buying out the people or moving the lighthouse landward. That is the situation in which the National Park Service got its feet wet in managing dynamic barrier islands. National Park Service managers were formerly only familiar with the large inland parks, which are essentially stable land forms. The National Park Service learned about barrier dynamics the hard way at Cape Hatteras.

I want to briefly discuss the Cape Cod area. The Coast Guard Beach facility was under construction in the mid-1960's. This slide shows the onslaught of waves during the February 7, 1978 storm. We have a tendency to underestimate the energy of the sea. We try to build structures which will withstand the pounding of the surf. During the 1978 blizzard, waves crashed upon the building and over the parking lot area. It was just like an explosion, as if a charge of dynamite went off, just ripping things apart. This slide shows the sediment in the water, and gives an idea of the energy involved in this process. This structure had to be removed because the concrete foundation was cracked and the sewage tank was threatened.

Finally, I want to discuss the type of development that is now occurring along our barrier shorelines. There are many different types of barrier beaches. The Sea Islands along the Georgia coast are quite stable by and large; some of these islands have not really moved much in the last thousand years. Other areas, such as Core Banks, are very unstable and shifting quite rapidly.

Ocean City, Maryland, is representative of the type of development that is presently occurring. We are actually transplanting our cities onto barrier islands from mainland areas with the idea that these areas are just as stable as any other landforms. With this type of urbanized development, the island cannot migrate landward in a normal fashion. Everything is covered with asphalt and buildings. Obviously, overwash must be prevented, and windblown sand has been minimized. Inlets, if they occur, can be catastrophic in terms of loss of property and life.

Since beachfront property is becoming more valuable, as in the city environment, the development must proceed upwards instead of outwards, when the land is not available. This high rise construction is the type of development seen all too often along the barrier shorelines. The idea at Ocean City, Maryland, was to build the Miami of the North—hotels and large condominiums were built right on the shoreline. The dune line was bulldozed down so that people could have a vista to the sea. The developers built right on the beach, defying the rules and regulations. Development has also had an impact on the marshland. The barrier island interior is characterized by finger canals, dredged out to offer the maximum amount of area for mariners. That is good for recreation, but the canals are areas of dead water. During a large hurricane, these dredged canals make an ideal location for an inlet to form. The sea water could cross the bulldozed dune line, joining one of these channels unimpeded.

With developed barriers, some processes, i.e., longshore transport, will still occur, but others, such as overwash and inlet dynamics, really cannot operate. Where there is extensive development along an eroding shoreline,

engineering works are eventually required. One basic question needs to be addressed. How many more Miami Beaches should be allowed? In these areas we are locked into some form of shoreline engineering due to the cost and value of the development. Why should we allow other barriers to follow this kind of trend and put us in the situation of trying to bail out these people with taxpayers' money?

At Ocean City, Maryland, the condominiums are already being undermined by the sea. Tie rods are being exposed and pieces of concrete are hanging down. This building has deep pilings, but eventually this area will be in deep water as the shoreline erodes, and this structure will be in danger during future storms. The Corps has been asked to look into the problem. They have recommended beach nourishment and some bulkheads at an initial cost of around $30 million. The long-range costs for stabilizing this barrier will probably prove to be very expensive. I believe that the present situation at Ocean City, Maryland, graphically illustrates the present problems inherent in barrier development, and the short-term, costly nature of any stabilizing attempts.

Thank you.

## INTRODUCTORY REMARKS

MR. OLSEN: I would like to introduce Dr. P.A. Buckley, Chief Scientist of the National Park Service's North Atlantic Region.

Paul asked that I point out that he is an ornithologist and ecologist by training and that his geomorphic knowledge, such as it is, has only been gained by a combination of on-the-job training and osmosis.

He was a member of the Master Plan Team for Fire Island National Seashore and is Park Service Representative on the Inter-Agency Team for the Corps of Engineers' Fire Island-to-Montauk Hurricane Protection and Beach Erosion Control Plan and has provided advice on coastal erosion and management, for better or worse, to barrier beach parks and refuges from the Outer Banks of North Carolina to Cape Cod.

# RECONCILING STRUCTURAL AND NON-STRUCTURAL SOLUTIONS TO COASTAL EROSION PROBLEMS

P.A. Buckley
*Chief Scientist, North Atlantic Regional Office*
*National Park Service*
*and*
*Research Professor of Ecology*
*Center for Coastal and Environmental Studies*
*Rutgers University*

## INTRODUCTION

By way of preamble, please note first that I have taken the approach of defining structural solutions as *hard* structural solutions. That is, I am not going to talk about any of the various forms of sand emplacement or sand nourishment–which I term non-structural solutions–for the reasons that they are not so controversial (assuming one can find an adequate source of sediment), and that their environmental impacts are usually far less. Secondly I want to stress that I'm not going to address the design needs or design adequacy of the various kinds of hard structures now in use. That is an engineering question and I am not an engineer. What I am going to talk about are the times and the places where I think hard structural solutions might be used or might not be used on barrier islands.* So please bear that narrow approach in mind.

We have heard a reasoned approach to the use of structural solutions from Neill Parker, one of the Corps' most articulate and experienced spokesmen. This was followed by an equally well thought out argument stressing non-structural alternatives by Stephen Leatherman, a geologist who is also a coastal geomorphologist. One might assume that the two positions are diametrically opposed, and yet they are not, no more so than the two sides of a coin.

I will confess at the outset that my bent, if left to my own devices, is to favor strongly the non-structural approach. Many of you already know that. Perhaps many of you do not know, however, that I do believe that there are times and places for even the hardest of structural devices. What I would hope to do now is point out instances where there is potential conflict over the two approaches, or where indecision is understandable. After all, it is not for the easy, obvious cases that a land manager turns to his technical experts for advice.

I hope I will be able to set out some solid ground rules for when it is advisable, and when it is not, to use hard structures if one is confronted with erosion on barrier islands, and also to get you thinking about the whole question. I would also hope that in most if not all of my recommendations, both Neill Parker and Steve Leatherman would concur but they have not been consulted.

*Throughout this talk, my use of the term *barrier islands* is meant to include barrier beaches and barrier spits, even though such use is technically incorrect.

## CONFLICTING MANDATES FOR MANAGEMENT

I believe the reason the question of structural versus non-structural solutions most often arises is that the proponents of each approach probably tend–and I stress *tend*–to be associated with agencies or groups with different and sometimes mutually exclusive mandates.

I will, for purposes of today's argument, polarize such mandates intentionally into preservation and development, two ends of what I *insist* is a spectrum. For traditional, technical, and philosophical reasons, the proponents of development *tend* to be engineers, architects, landscape architects, or planners, whereas proponents of preservation *tend* to be natural or physical scientists or geographers. The former groups are trained to change their environment or to prevent its change, the latter to understand its natural workings. Viewed in this light, their different approaches to resource management are not difficult to appreciate.

Now, while there are doubtless many pairs of potentially or actually conflicting directions to the management of barrier islands, for our purposes today let us briefly consider only six.

A first conflicting use might be that of *navigation* vs. *preservation*, for example in inlets, bays, harbors, waterways. With one hand Congress directs the Corps of Engineers to dredge and maintain an intra-coastal waterway cut through back-bay marshes; with the other, it directs the National Marine Fisheries Service to severely limit and regulate such dredging in terms of the bay's shellfish resources. This is an intrinsically conflicting pair of directions.

A second kind of conflict pair might be that of *waterfowl management* vs. *preservation*. Barrier islands and their back bay marshes are areas where Congress has often directed the Fish and Wildlife Service to establish new refuges with dikes to retain fresh water in otherwise salt marshes, while at the same time also directing the Fish and Wildlife Service to prevent diking of salt marshes.

Another potential conflict is that of *public recreation* vs. *preservation*, where for example Congress would direct the National Park Service to implement a new National Seashore with visitor centers, interpretive trails, and campgrounds, while at the same time directing the National Park Service to preserve and protect its undeveloped barrier islands.

One more source of legitimate conflict is *development* vs. *preservation*. Barrier islands as a group provide many examples, where Congress might direct FEMA to underwrite flood insurance or EPA to pay for sewage treatment plants and sewer lines–thereby subsidizing island development–while at the same time directing the Fish and Wildlife Service to buy and protect undisturbed parts of the same island. In New Jersey, the southern end of Long Beach Island (called Holgate) is natural and undeveloped, a part of the Wilderness portion of Brigantine National Wildlife Refuge. Immediately to its north, the remainder of the island is heavily developed with a sewerage infrastructure and many oceanside groins. The net direction of longshore sediment transport is south towards the Refuge, which is thus placed immediately in the erosional shadow downdrift of the last groin (Fig. 1). But even though thus offset westward, Holgate is still behaving as a classic overwash beach, with many fresh overwash fans and a

readily shifting inlet.

Yet another kind of conflict pair is that of *inholders' access* vs. *preservation.* This situation can readily occur when a series of alternating preservation areas–bay to ocean on barrier islands–are interspersed with developed communities to which access is legally guaranteed. Property owners in the communities often also anticipate, rightly or wrongly, some degree of structural protection against storms and tides, while preservation zones often cannot tolerate any interference with such natural processes. There are 20 developed communities within the 25 miles of Fire Island National Seashore (Fig. 2), and 8 in the 75 miles of Cape Hatteras National Seashore; intercalated among the communities is a series of federally owned natural areas with strict mandates for preservation and protection.

The last kind of conflict is that of *hurricane protection and beach erosion control* vs. *preservation.* Congress has directed the Corps of Engineers, among other agencies, to assist local governments in protecting barrier islands and back-bay communities against hurricane storm surges and ordinary erosion, while at the same time directing, for example, the Park Service or the Fish and Wildlife Service to protect barrier islands and adjacent back bay lagoons and marshes, including the natural overwash and inlet formation/migration processes maintaining them.

These are the kinds of opposing pressures we all face daily in planning for and managing barrier islands. They are one of the reasons why we are having this particular meeting and this session today. I should point out that I could have prepared a similar list where each use was contrasted with navigation, to show how the Corps of Engineers views its problems. The point is, that in each case both mandates in the pair are legitimate and often both are embodied in federal legislation directing that the conflicting actions be undertaken.

## RESOLVING CONFLICTING MANAGEMENT MANDATES

The reason for the recently-issued *Draft Assessment of Alternatives for Management of Barrier Islands* was that no one group had ever set about deciding what is the best economic and environmental approach to barrier islands as a class, and to set national policies so situations of mutually opposing directives would not occur in the future. In such cases hard decisions have to be made. It is my contention that, *as a general philosophy of barrier island management, the most conservative, least damaging solution meeting both objectives should be chosen.* That is, as a general rule the balance should be tilted toward preservation.

For example, when there is a situation with inadequate scientific data, or with conflicting interests where it is certain that one type of approach is going to have severely damaging and long-lasting environmental effects, then by taking the more conservative action, many future options will not be precluded. But life is rarely that simple and often complex negotiations will fail to find common grounds and sometimes end with irreconcilable differences. When this happens between two federal agencies, the court of last resort is the Council on Environmental Quality. CEQ is not insensitive to the public moods nor to the wishes of the President, and some recent referral decisions relative to barrier islands have strongly preferred solutions favoring environmental preservation at the expense of

development.

More often than not, what appear to be irreconcilable differences and philosophies are resolvable, and by applying some consistent practices, solutions will more readily come to hand. Gone are the days, though, when planners could sit down with maps and aerial photos and make quick decisions. Hard data are needed in every case, data of several sorts: (1) site-specific geomorphic analyses of barrier island dynamics; (2) careful cost estimates–authentic cost estimates–of the various alternatives identified as feasible following the geomorphic analyses; (3) sensible analysis of the actual impacts (environmental and economic) of the feasible alternatives; (4) realistic comparison of the economic and environmental benefits and costs over both the short-term (one to twenty years) and the long-term (twenty to one hundred years). The reason for the long-term/short-term distinction is the inexorable rise of sea level. Sea level in the northeast is apparently rising a foot a century, and one hundred years is not beyond the design lifetime of many coastal engineering structures.

It is not feasible in the short time I have here to present a series of examples of such a systematic, objective approach; that would require a lecture in its own right. I do call your attention, though, to the complex case of Long Island's Fire Island-to-Montauk Hurricane Protection and Beach Erosion Control Plan. All three speakers in this particular section, as well as several persons in the audience, are closely involved with this project, which provides the best example to the kind of approach I am advocating.

Fire Island Inlet is at the west end of Fire Island. As the net longshore transport of sediment is east to west, with an estimated 600,000 cubic yards of sediment carried each year, Fire Island has grown westward some five miles in the last 150 years while at the same time migrating several hundred feet landward by "erosion," overwash, and inlet formation/migration/closure. The entire spit, now cut into barrier islands by Shinnecock and Moriches Inlets (more discussion follows further) extends some 52 miles west from its base at Southampton. Much of the sediment in transport is derived from erosion of the mainland of L.I. from Southampton east some 30 miles to Montauk Point. Considerable residential development has occurred at Westhampton Beach, in the 20 Fire Island communities, and on the mainland in the Hamptons. The original intent of the plan, conceived in 1955 following the devastation from Hurricanes Carol, Edna, Connie and Diane, was to erect a sand-and-groin barrier to prevent hurricane storm surge or overwash from getting into the back bays. Subsequent legislation, including that establishing Fire Island National Seashore, as well as great strides in our knowledge of natural coastal processes, came four-square up against the plan's legislative mandate for hard structural solutions. The deadlock seemed hopeless only four years ago, but after extensive, persistent, and exhausting negotiations, the extent of agreement among the Corps of Engineers, Fish and Wildlife Service, National Park Service, National Marine Fisheries Service and EPA for project reformulation following preparation of an adequate scientific base is now what many of us would have once termed utopian. The completely reformulated final project will be designed only after completion of extensive scientific studies being done specifically for this enormous undertaking (Table 1), studies whose extent will, in my opinion, be the template against which those for all future

massive coastal engineering projects will be measured.

## ENVIRONMENTAL GUIDELINES FOR BARRIER ISLAND PLANNING

The Fire Island-to-Montauk project has helped generate environmental guidelines to which all coastal planners and managers would do well to adhere in order to derive optimum plans for any area, plans which might indeed include hard structures. Such guidelines would include the following:

(1) perform intensive, site-specific geomorphic research to learn the peculiarities and limitations of the area under study;

(2) understand that erosion is a natural process, inimical only to man's activities. The sea does not recognize erosion, only the constant reworking of unconsolidated, and therefore extremely malleable, sediments. Monomoy Inlet (Fig. 3) on Cape Cod (now separating North Monomoy Island from South Monomoy Island) was created by the Blizzard of '78. Extensive overwash took place here and the Inlet is still running. This change, while extreme in the sense of catastrophic, nonetheless is just one of the routine processes which have shaped the evolution of barrier islands on the east and Gulf coasts. Having occurred here in a Wilderness portion of a National Wildlife Refuge, it has barely caused any impact or comment;

(3) comprehend that the plants of barrier islands have evolved numerous structural and physiological adaptations to enable them to thrive under harsh and constantly changing conditions. Don't replace them with exotic species unable to cope with an alien environment;

(4) appreciate that the animals of the waters and sediments of the inlets and back bays evolved under conditions of storms, overwash, inlet formation, burial by sand and mud, and drastic changes in salinity, both seasonally and cataclysmically in severe storms. These creatures are used to such events, and almost certainly need them in order to maintain healthy populations;

(5) recognize that sea level is rising. Over much of the northern Atlantic, and the entire Gulf Coasts (where the land may also be subsiding), sea level is rising at a rate of about a foot per hundred years, in some places even higher. In a few mid-Atlantic locations the land appears to be rising faster than sea-level, but that is anomalous;

(6) accept the fact that transport of sediment to back-bay lagoons by opening, closing and migrating inlets or to varying degrees by overwash, is the main means by which barrier islands and their associated plants and animals remain healthy;

(7) know the length of the geomorphic system you are considering managing. Know the sources of your sediment, know where it goes downdrift and include this information in your analyses of impacts, costs and benefits;

(8) recognize that groins and jetties are designed to pirate sand from longshore transport systems. That deficit must be made up somehow, usually by severe erosion just downdrift of the last groin or jetty. Artificial compensation for disruptions in barrier island natural processes is possible by sand nourishment or by-passing schemes, but is very expensive and the need never diminishes.

## WHEN TO CONSIDER HARD-STRUCTURE SOLUTIONS

Having perhaps turned most of you away from structural solutions, let me turn around and say that there are instances where one should consider hard structural solutions to erosion problems on barrier islands. I will list a series of conditions which, when met, suggest that serious consideration be given to hard structures. Obviously, the greater the number of these conditions which obtain in a given case, the stronger the argument for hard structures:

(1) the situation involves extremely great financial investment in development or some unmovable physical feature, or concerns general public safety. Atlantic City, N.J. or Miami Beach, Fla. with their concentrated development, meet these conditions;

(2) vast sums of money are available, tens or perhaps hundreds of millions of dollars. And don't be misled: that is the order of magnitude of the cost of extensive hard structures;

(3) the beach is accreting, or at least is in some sort of sediment equilibrium;

(4) there is no special need for a wide beach between the ocean and the body of the developed area. Under these conditions a hard structure such as a seawall may be practical, because what little beach remains after construction will be quickly removed by storms unless constantly renourished. The seawalls at Virginia Beach, Va., Cape May, N.J. and Galveston, Texas are examples;

(5) the entire geomorphic unit is amenable to a structural solution. That is, there will be no problems caused downdrift, or if so, they are minor and easily and cheaply mitigated. The effects of hard structures can rarely be localized to the site of construction;

(6) the beachfront in question is in an especially low energy situation. With a low energy beach, one can do with structures things impossible on a high energy beach;

(7) an inlet must be stabilized for navigational purposes and some sort of sediment by-passing system, which will allow the net longshore transport volume to pass through to the downdrift side, is feasible.

## SOME SUCCESSFUL HARD-STRUCTURE SOLUTIONS

*Rockaway Beach, Long Island,* has a groin about every block (Fig. 4); intensive development is the investment they are protecting. And while there is not much natural beach left in front of the boardwalk there are sufficient amounts of clean sediment directly offshore, which is regularly used to nourish the beach. Structural devices are working here in the sense that the sea's transgressions have so far been held to acceptable limits, but at great expense. When one is dealing with a Borough of the City of New York, there may be reason to pay that cost.

Another example is *Long Beach, Long Island,* which is much the same as the previous situation. There is probably less of a beach nourishment problem here than in the Rockaways (which are close to the East Rockaway Inlet jetty at Atlantic Beach and downdrift of all the Long Beach groins) because the Long Beach groins are further west of the jetties at Jones

Inlet and because Jones Beach (updrift of Long Beach) has no groins.

The third example of a solution that has worked is at *Virginia Beach, Virginia,* in a location just south of the seawall mentioned earlier. There is a small inlet (Rudee Inlet) which may have been artificially opened initially, or just existed as a small creek. At any rate, for navigational purposes (to provide a recreational sports fishery out to the Atlantic Ocean) this inlet was dredged and has been maintained open by a weir jetty system which seems to be working quite effectively in maintaining longshore transportation of sand. Most sediment reaches a deposition basin at the updrift (southern) jetty by crossing an open area at its base and is then transported by pipe to the downdrift (northern) jetty (Fig. 5). This is a small inlet but it certainly is on a high-energy beach exposed directly to wave energies of the Atlantic Ocean. And there really is no downdrift erosional shadow at Rudee Inlet, so these systems can work if installed with thought and care.

## WHEN TO AVOID HARD-STRUCTURE SOLUTIONS

It might seem obvious that the conditions under which one should *not* consider structural alternatives might only be the reverse of those when one should, but I believe it important to stress each set of conditions in its own right. Thus, contraindictions to structural solutions would include:

(1) an undeveloped or relatively undeveloped portion of a barrier island on which there are yet no structural devices. A classic example is the area around Oregon Inlet near the north end of the Outer Banks of North Carolina. Here, the net direction of longshore transport is north to south, and it is in this direction that Oregon Inlet is migrating, with some considerable speed. The long spit now under the bulk of the bridge, even up to the center span (Fig. 6) has extended that far in less than 20 years. While there must thus be a large amount of sediment entrained here, most of it is being deposited on the updrift side or in the inlet itself. Thus the inlet is migrating rapidly, eroding on the downdrift (south) side to make up the deficit of sediment in transport. Unfortunately the inlet is removing the Coast Guard station at the south side, to say nothing of moving out from its own bridge. Before the bridge was built, a ferry system was more than adequate and easily adapted to changing inlet locations. Now, the Corps of Engineers is seriously considering emplacement of jetties on either side of the inlet location. Unless an adequate, complex and exceedingly expensive sand bypass system were simultaneously installed here, the erosion downdrift of the inlet–the location of Pea Island National Wildlife Refuge with its large freshwater impoundments for waterfowl–will become even greater than it is now, and the formation of one or more new inlets there will have a high probability. In addition, the Outer Banks are also a classic overwash barrier, one that normally would be migrating landward at a slightly faster rate than man's roads and communities now allow. Establishment of structures such as inlet jetties at this location is thus contraindicated for many reasons;

(2) any stretch of barrier island with a demonstrable deficiency of sediment in longshore transport. Such a condition would only be intensified by any hard structures designed to entrap sediment;

(3) any situation where long-term commitment to mitigation of any

adverse downdrift impacts is unavailable. Many structural solutions have failed because mitigation of adverse impacts, by, for example, sand bypassing, was never provided for or if provided for, was never implemented when local cooperators decided it was "unnecessary" or "too expensive";

(4) a compelling need for a long and wide oceanfront beach. Seawalls usually preclude a wide beach, especially in high energy situations, and even inter-groin beaches can be emptied of sand overnight under the proper conditions of wave attack;

(5) mixed-management jurisdictions on the same stretch of island, with preservation and natural conditions mandated on one part, and development on the other;

(6) any location with a long history of known sites of repeated overwashing, or of inlet formation, migration and closure. Such areas typically have very low topographic relief and are often quite bare of vegetation;

(7) any barrier island with a demonstrable history of landward migration in the last two hundred years (i.e. by "erosion");

(8) any locale where structural solutions would induce development on an otherwise undeveloped or lightly developed barrier island.

## SOME UNSUCCESSFUL HARD-STRUCTURE SOLUTIONS

Perhaps owing to failure to recognize these structural use contraindications – most of which would be obvious after but a few moments' thought – structural solutions have probably failed more often than they have worked. Frequently this has happened because they should not have been used in the first place, or because the wrong ones were used, or because mitigation did not follow. Neill Parker has quite rightly also pointed out that the benefits accruing from a particular project are often believed by the general public to be far more extensive than those the constructing agency took pains to outline. Nonetheless, in order to counterbalance the examples of successful structural solutions I gave earlier, we should consider, and possibly learn from, a few examples of what I consider unsuccessful structural solutions.

(1) *Westhampton Beach, Long Island,* the full story of which would be another lecture in its own right, and about which at least one book has already been written. Westhampton Beach is part of the barrier spit extending westward from the Southampton "headlands" some 52 miles to Fire Island Inlet. Over the last 300 years a series of inlets has perforated this spit, but in the 20th century it was intact until 1931 when Moriches Inlet broke through about 19 miles west of Southampton, and then in the 1938 Hurricane, Shinnecock Inlet was born 15 miles east, only 4 miles west of Southampton. Shinnecock was hydraulically stable and un-jettied until the early 1950s. Moriches, however, migrated westward and had closed by the early 1950s when it was artificially reopened; then it too was jettied. Soon after the jettying of Shinnecock Inlet, a major erosion problem appeared, predictably, on the beach west (downdrift) of that Inlet. As development was generally light until one reached Westhampton Beach some 10 miles west, there was no great concern expressed. But here many homes of great price had been built, especially in the hurricane-free period after 1954-55, so that by the early 1960s a considerable investment in

developed real estate was in place on a barrier island sometimes only 500 feet wide. Then the devastating Ash Wednesday Storm of 6–8 March 1962 struck, hitting Westhampton Beach almost as hard as the 1938 hurricane, which essentially planed it smooth. Structural protection for Westhampton had been finally authorized in 1960 following studies after the 1954-55 hurricanes and demand for its implementation became strident after 1962. Thus in January 1965 construction of a set of 11 groins began at Westhampton Beach, being completed in October 1966.

It was then that troubles began. On schedule, extreme erosional scouring was quickly noticed immediately past (downdrift of) the 11th groin. Soon the shorefront jogged in at that point, those few low dunes remaining after house construction having been quickly removed by the sea. Equally predictably, pressure was mounted for extension of the groin field to the west, and in August 1969 work was begun on an additional four groins which were completed in November 1970. And of course the erosional shadow was, again, only shifted westward (Fig. 7).

All 15 groins have failed to act in the manner intended, that is, stabilizing the beach with inter-groin compartments filled to overflowing with sand, thereby allowing some sand to naturally by-pass the entire groin field. The system failed from several causes: (a) for complex reasons, local cost-sharing agencies were unable to provide enough money to fill the inter-groin compartments with sand, so the groins began pirating sediment from the longshore transport system immediately; (b) permeable groins which would by-pass some sediment under most conditions were not installed; (c) groins and jetties should not have been installed in the first place on a barrier beach that was known to be migrating landward at the time of construction at a rate of about 7 feet per year. In some places Westhampton Beach had retreated 500 feet between about 1850 and 1950. And sea level on Long Island was rising about 1 foot every 100 years–not insignificant for structures with a design life of 50 years.

As of May 1980, pressure to extend the groin field the additional 9000 feet to Moriches Inlet (see immediately following discussion) has diminished, and plans are underway for emergency sand nourishment in the entire stretch. There is even some serious talk of removing all 15 groins.

(2) *Moriches Inlet,* whose position in the barrier island complex on eastern Long Island was described above. The problem here is failure of jetties to stabilize an inlet with a history of migration, opening, and closing. In the present case, ill-advised channel dredging and spoil emplacement in the bay behind the inlet created a hydraulically unstable situation, which, when coupled to the severely sediment-starved longshore transport system just downdrift of the Westhampton groin field, led to gradual narrowing of a neck of sand immediately to the east of the eastern inlet jetty (Fig. 8), and finally breakthrough in a mild winter storm in January 1980 (Fig. 9). Moriches Inlet thus bears the distinction of having the only mid-inlet jetty of which I am aware. The hydraulically natural channel seems to be the new one, even though the old one is far deeper (maintained by dredging). Yet plans are underway to fill in the new channel with sand, leaving essentially the same condition to recur in the future. The shoreline at this point is moving so fast landward that any fillet of sand will itself be soon forward of the new shorefront line. As with any such promontory of unconsolidated sediment, wave action will attempt to attain linear equilibrium, and when

coupled with hydraulic pressure from the scour side of the meander on the bay side, will cause breach again with certainty. That the entire system of inlet jetties is now dysfunctional can be clearly seen also by the fact that the base of the eastern jetty is now almost at the normal beach line to its east. It will soon become "untied" from the very structure it was designed to stabilize.

(3) *Gilgo State Park Pavilion*, Jones Beach, Long Island, N.Y., an example of the failure of both barrier island stabilization by road emplacement, and of site-specific revetments. By the late 1950s the pavilion for Gilgo State Park, a large brick structure between the Ocean Highway and the ocean, was in imminent danger of loss from a retreating shoreline along most of Jones Beach. When Robert Moses constructed his Ocean Parkway in the late 1920s, it was envisioned as the ultimate in protection of barrier islands against erosion and transgression by the sea. At that time, the updrift jetty at Fire Island Inlet (at Democrat Point on Fire Island's western tip) had not been built, and normal amounts of sediment were passing the inlet to Jones Beach. Moreover, jetties at Shinnecock and Moriches Inlets were unbuilt; in fact, there were no artificial sand-entrapping structures on Long Island east of Long Beach. But between 1939 and 1941 a jetty was built at Democrat Point, beginning an inexorable process leading up to present conditions at Gilgo.

By the late 1960s erosion all along Jones Beach (from Oak Island Beach to approximately parking field No. 6) was causing some concern. Too late, a massive sand-bypassing operation was begun at Democrat Point with the combined goal of nourishing Jones Beach and improving navigation in badly shoaled Fire Island Inlet. 725,000 cubic yards of sand were hydraulically emplaced as far west as just past Gilgo (Fig. 10), but after slightly more than two years most of the sand had been removed, exposing the rubble riprap emplaced in the 1950s and 1960s. This created a promontory, and the wave energy focusing on this point soon endangered the structure (Fig. 11) to the point where in 1978 it had to be completely removed. (Only 5 miles west, Jones Beach State Park's parking field No. 9 was finally closed down and removed, all but for the remains of the macadam, in 1977.) The rubble in front of Gilgo Pavilion was removed with the structure, and now the sea licks at the Ocean Highway (Fig. 12).

## ORDER OF ACCEPTABILITY OF HARD STRUCTURES

There are degrees of acceptability of hard structures in terms of their environmental and geomorphic consequences, subject to the desirability of emplacement of such structures in the first place, as I discussed earlier. Proceeding in only a general direction from least damaging (or most acceptable) to most damaging (or least acceptable), I would list the following kinds of structures:

(1) *mainland bayside bulkheading*, but only if wetland filling is not involved;

(2) *localized revetments*, provided they do not protrude so as to function as wave-refracting promontories or as sediment traps;

(3) *inlet jetties*, but only if of the weir-type and only when tied to mandatory sediment bypassing;

(4) *offshore seawall*, provided any sediment-passage or -deposition effects are mitigated;

(5) *groin fields*, but only if of the weir-type, if initial and subsequent compartment filling with sediment is provided for, and if down-drift erosional effects are mitigated or acceptable;

(6) *onshore seawalls*, but only if initial and subsequent sand nourishment is programmed;

(7) *bulkheading on barrier island baysides*, but only where wetland filling is not involved, and where island migration has been foresworn because of extensive economic investment and development.

Now, while these seven are in roughly decreasing order of environmental acceptability, I believe they clearly fall into two large groups: the first and second kinds of structures are in almost all cases far less environmentally damaging than the last five–even when each is used under conditions appropriate for hard structures, such as I enumerated earlier. Use of the last five should always be as a last resort. Moreover, while weir-jetties and sand bypassing systems show great promise because they mimic natural systems, they are not problem-free. For example, their use interferes with the establishment of flood-tide deltas and new marshes developing on them, and with inlets' normal migration, closure, revegetation, and formation of recurved spits with dunes and swales, etc. Mitigation of these important aspects of barrier beach geomorphic and ecological processes has to my knowledge rarely been considered.

And even where use of hard structures seems to meet the strictest of conditions I have laid down, such structures will inevitably fall victim to rising sea levels in areas where this is occurring. If we are working in areas where rise is of the order of the northeast's one foot per century, then sea level rise must be taken into consideration in calculating structures' useful lives and their cost-benefit ratios. This too has rarely if ever been done.

## CONCLUDING RECOMMENDATIONS

To summarize, let me offer some general recommendations on the use of hard structures on barrier islands. These should be read *only* in conjunction with more detailed comments offered earlier in this talk, but they are useful principles nonetheless:

(1) never put hard structures on a coastal section where none already exists;

(2) always consider NO ACTION as the first serious alternative;

(3) then consider non-manipulative strategies such as zoning changes, condemnation and buyout; improved emergency access/escape routes and procedures; relocation of development;

(4) next examine soft structural alternatives such as the various kinds of non-reinforced sand emplacement;

(5) only last consider hard structural alternatives, and then only if they meet the conditions, and have the accompanying mitigating measures, described in this paper and elsewhere;

(6) long-term (20-100 years) and short-term (1-20 years) costs and benefits must always be identified and contrasted;

(7) perhaps most important of all, no coastal engineering or development or management project involving geomorphic manipulation of barrier

islands should begin without intensive, site-specific studies to determine critical factors such as: rate of island migration; history and significance of inlet formation, direction and rate of movement and closure; rate of local sea level rise; gross and net littoral transport volumes, with seasonal changes in volume and direction, if any; location and changes, if any, in longshore current nodal points; and sources and relative volumes of sediment in transport.

Is obtaining these kinds of data difficult? time-consuming? costly? The answer is yes to all three questions. But only these data will allow intelligent identification and choice of alternatives, to say nothing of accurate evaluation of costs and benefits, especially of long-term project maintenance.

Thank you for your patience and attention.

---

Table 1. Components of the planning process for the *Fire Island-to Montauk Hurricane Protection and Erosion Control Plan*, NY District, Corps of Engineers.

BASIC DATA STUDIES

1. Geomorphic history of area
2. Metric mapping update of all past area maps
3. Storm surge mathematical modeling
4. Inlet dynamics
5. Littoral transport and sediment budget
6. ICON data analysis (Inner Continental Shelf Sediments & Structures)
7. Aeolian contribution to sediment transport
8. Historical effects of groins and jetties
9. Establishment of baseline monumentation
10. Current aerial mapping survey
11. Cross-island survey transects
12. Bathymetric surveys
13. Storm damage quantification
14. Marine resource studies
15. Estuarine resource studies
16. Terrestrial resource studies
17. Borrow area site studies
18. Surface water quality analysis
19. Ground water quality analysis
20. Cultural resource survey
21. Land use and development patterns
22. Physical effects of past development
23. Current real estate evaluation
24. Utilities analysis

## ALTERNATIVE IDENTIFICATION, IMPACT ANALYSIS, AND DESIGN STUDIES

1. Dune and berm construction
2. Offshore breakwater
3. Limited revetments
4. Seawalls
5. Removal of existing groins
6. Sediment bypassing at inlets
7. Ring-levee enclaves
8. Inlet gates
9. Drainage structures for small enclosed bays
10. Review of previous physical and mathematical models
11. Structure elevation
12. Structure floodproofing
13. Relocation plans
14. Engineering development of mitigating measures
15. Impact analysis of alternatives
16. Cost-benefit analysis of alternatives
17. Preparation of Environmental Statement
18. Development of mitigating measures
19. Preparation of final General Design Memorandum

Figure 1. Long Beach Island, New Jersey, looking south towards Holgate Wilderness portion of Brigantine National Wildlife Refuge. Note westerly offset to barrier beach past groin field (arrow). Photo taken May 1977.

Figure 2. Fire Island National Seashore, Long Island, New York, looking east over Cherry Grove (foreground) towards Fire Island Pines (background). Note federally-owned bay-to-ocean tract between the two developed communities. Photo taken June 1978.

Figure 3. Monomoy Inlet, Monomoy Island National Wildlife Refuge, Cape Cod, Massachusetts, looking north towards Chatham. Photo taken February 1978.

Figure 4. Rockaway Beach, Queens County, New York City, looking westwards towards Jacob Riis Park (far arrow). Photo taken February 1975, not long after beach nourishment covered most groins (near arrows).

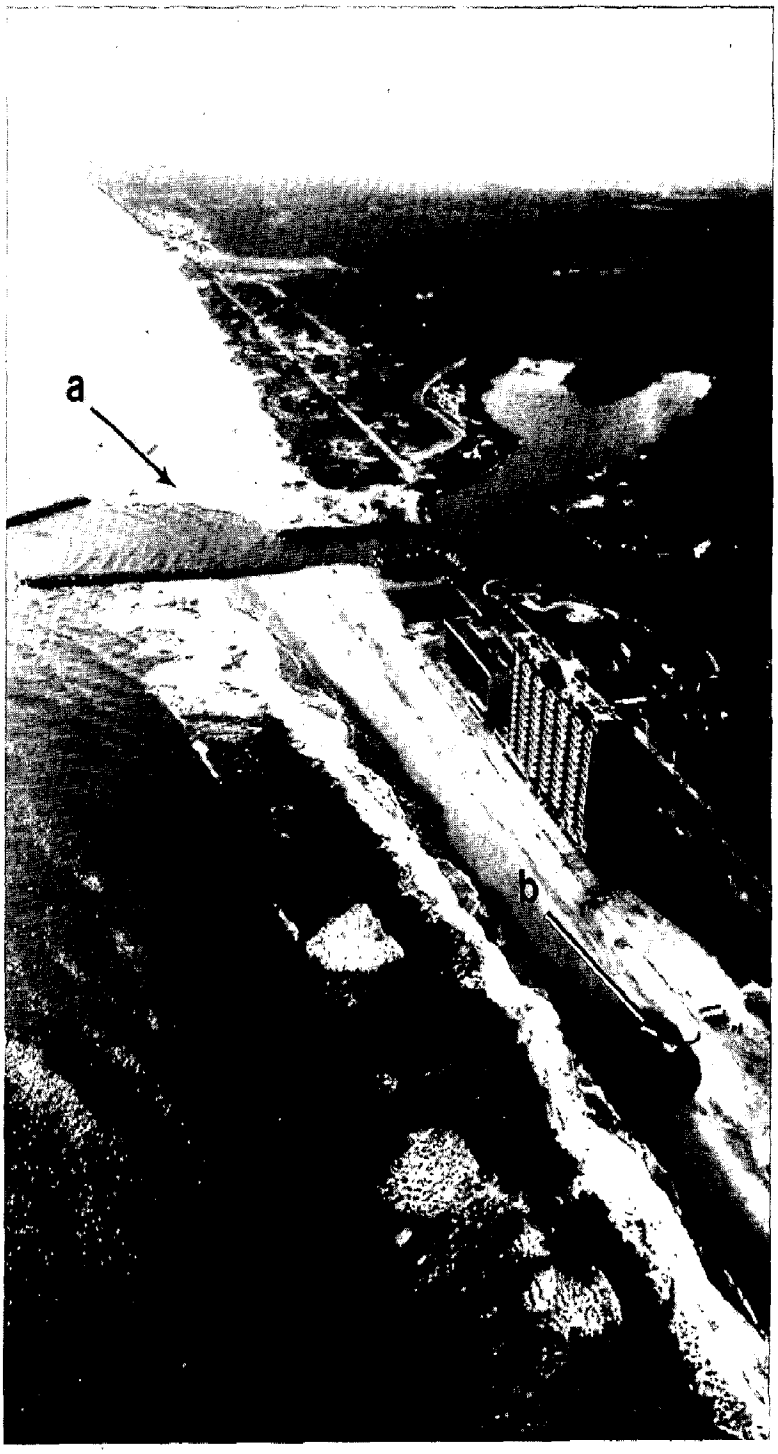


Figure 5. Rudee Inlet jetties, Virginia Beach, Virginia, looking south December 1979. Longshore transport is south to north, sediment dropping into the weir-jetty basin (arrow at "a") is then transported across the inlet by pipe and released downdrift (arrow at "b").

Figure 6. Oregon Inlet, Outer Banks of North Carolina, December 1979, (a) looking south and (b) looking north. Arrow marks Coast Guard station threatened by erosion as inlet migrates southward.

Figure 7. Westhampton Beach, Long Island, New York, looking west-southwest in June 1978. Note erosional shadow downdrift of last groin (near arrow), and new inlet breach at Moriches Inlet (far arrow). See also Figures 8 and 9.

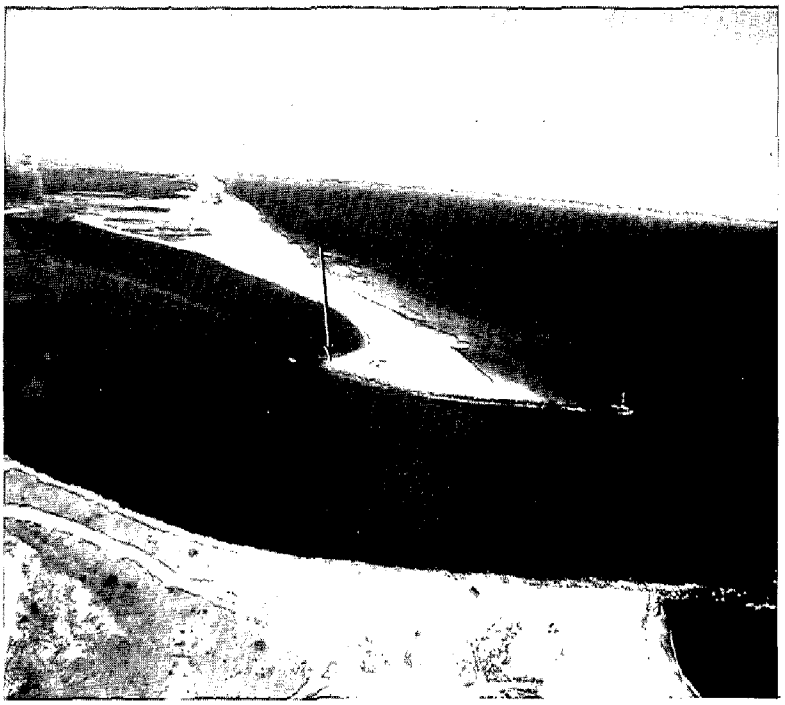

Figure 8. Moriches Inlet, Long Island, New York, looking east June 1978. Note relative position of oceanfront shorelines in this figure and Figure 9. The base of the eastern jetty is marked with an arrow in each figure.

Figure 9. Moriches Inlet after inlet breach of February 1980. Photo taken June 1980. In this and in Figure 8, the eastern end of Fire Island is in the foreground, and Westhampton Beach is across the inlet.

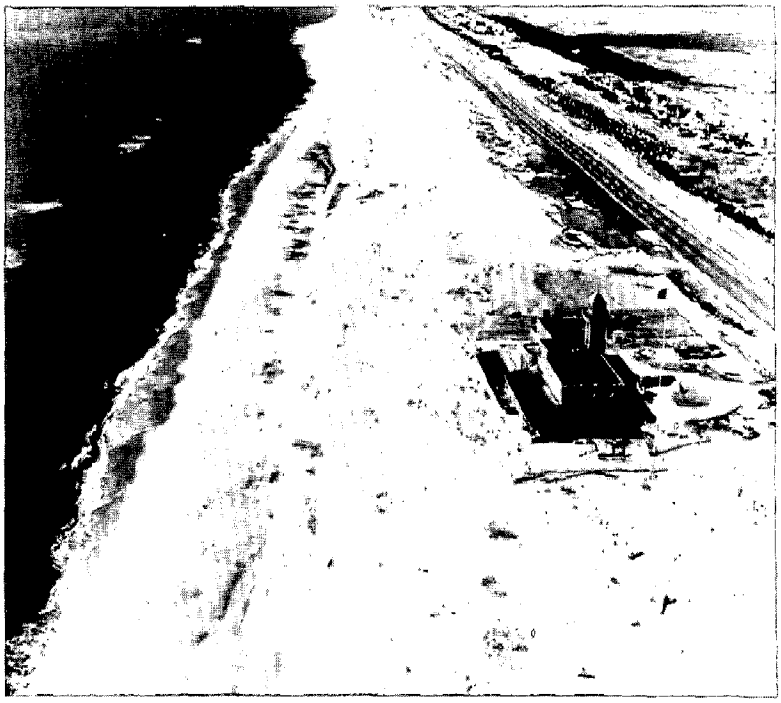

Figure 10. Gilgo State Park Pavilion, Jones Beach, Long Island, New York, looking west March 1969, after extensive beach replenishment with sand bypassed from Democrat Point, Fire Island, across Fire Island Inlet. Photo courtesy New York District, U.S. Army Corps of Engineers.

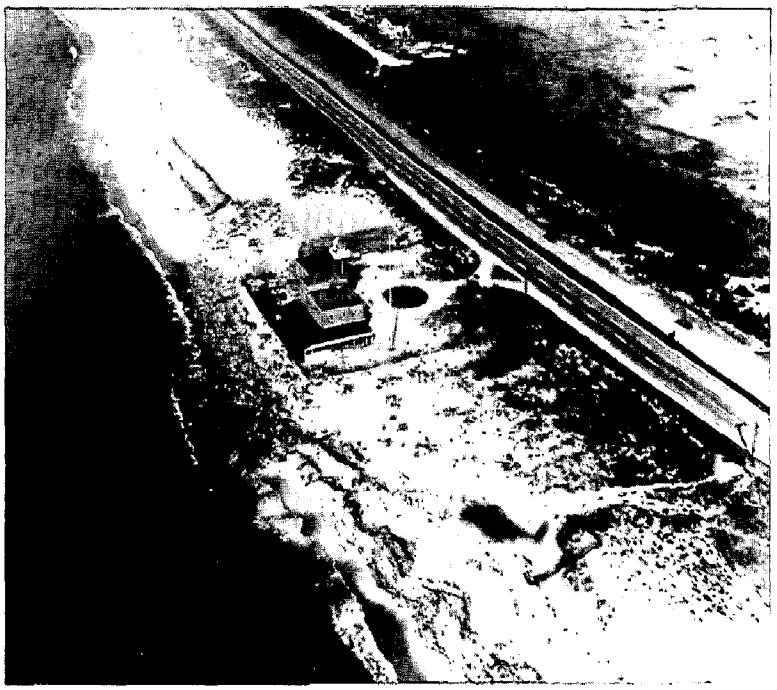

Figure 11. Gilgo Pavilion looking west August 1971. This photo taken when sediment loss had reached its maximum, only 17 months after emplacement (cf. Figures 10, 12). Note rubble riprap immediately in front of structure. Photo courtesy New York District, U.S. Army Corps of Engineers.

Figure 12. Gilgo State Park after removal of pavilion and riprap; remains of foundation visible in foreground. Note narrowing of barrier island at arrows due to oceanfront erosion and bayside boat channel dredged (in part) through salt marshes-likely site of a new inlet. Photo taken June 1978.

# FORUM AND WORKSHOP CLOSING REMARKS

Richard L. Stanton
*Regional Director, North Atlantic Region, National Park Service*

I have the uneasy feeling that I am the speaker you have all been waiting for. Since I have been continuously hearing the alarming news all morning that the shoreline is rising, I have cut this speech down to about six minutes.

We have seen and heard some remarkable things these last two and a half days: the awesome fury of Camille, the sobering statistics on barrier island evacuation problems, and the forgetfulness of east coast residents who have not experienced a cataclismic storm in the last forty years or even a major one in twenty. We have become aware of new directions, new initiatives, and the re-thinking of traditional and often dearly-held notions about coastal management.

We have heard about preparedness, how we can save lives and money while protecting our barrier island resources.

We have seen first-hand the instinctively known but only recently quantified impacts of vehicles and even of pedestrians on fragile barrier island ecosystems from Cape Cod to Padre Island.

Most important, our managers are talking to the scientists.

We have heard exponents of potentially opposed philosophies on structural solutions to coastal erosion problems saying strikingly some more things. We have heard the National Park Service, the Fish and Wildlife Service and the Corps of Engineers start to talk a common language, which, in itself, is worth the cost of the meeting.

The direction we must all go seems clear: toward wise use of our barrier islands with some preserved essentially intact.

In all cases, speakers have stressed conservative management and philosophies and that sensible decisions cannot be made unless sound site-specific research data bases are made intelligible and understood to the non-specialist manager, and to the layman, so that all may be involved in the decision-making process in the clear light of day.

Most of us are involved in a variety of professional and important conservation organizations. Some specialize in the coast.

There is even Coastal Zone '80, this year's version of the Bi-Annual Conference addressing all problems in the greater coastal zone. But there are very few programs or opportunities allowing the barrier island decision-makers to come together, to share ideas and problems and solutions.

The meat of this conference came from the extraordinary work on various aspects of barrier island ecology, geomorphology and resource management done by the National Park Service, the Fish and Wildlife Service, and many others in the last ten years.

We are privileged that the North Atlantic Region of the National Park Service, in particular, has become a center for such research and while we plan to keep it that way, we would not mind getting into the exporting business as well.

We do earnestly hope other agencies will start or expand their own

active programs on barrier island research and we stand ready to provide our assistance if that may be necessary.

But this particular convocation could never have happened had it not been for twenty-one individuals from four federal agencies, several private conservation organizations and state agencies and four universities who selflessly agreed to devote considerable time to preparing contributions of great substance, which I must admit was done on rather short notice. They deserve our very special thanks, and thanks, also, to Assistant Secretary Bob Herbst for his support and enthusiasm.

I must single out for particular commendation the Steering Committee for this meeting. We should also recognize the immense support facilities and staff of the Provincetown Center for Coastal Studies, our co-sponsor, whose work is hardly over. They will be putting together the proceedings of this conference for you, which you will receive in due course as part of your registration fee.

The Cape Cod National Seashore's logistical role was important, and a special note of thanks to one of our great superintendents, Herb Olsen, for his leadership.

We all owe a large debt of gratitude to Steve Leatherman and Paul Godfrey for their partial revision of the Barrier Island Handbook in time for this meeting, and to the Eastern National Parks and Monuments Association for assisting with its reprinting. I am pleased to announce that a full-scale revision of the Handbook will be undertaken shortly and the book will be completely rewritten, including a number of new chapters on barrier island ecology to be jointly authored by Steve Leatherman and Paul Godfrey. This new edition will be available before the end of the year. Its reception promises to be even more enthusiastic than that accorded the first version.

As you know, the conference is not yet over. Possibly the most exciting part is yet to come this afternoon. Two panels, one of barrier island land managers and one of coastal experts, will field real problems from audience participation and point out, if not some tentative solutions, at least directions for examination. We wish all of you to stay.

We thank you for attending and for such active participation and for caring for and loving our great barrier islands.

Thank you.

# PROBLEM SOLVING AND BRAIN STORMING SESSION

## Panel Discussion, Friday, May 30, 1980

**Moderators:**

*Barbara Mayo*
*Associate Scientist, Provincetown Center for Coastal Studies*
*Herbert Olsen*
*Superintendent, Cape Cod National Seashore*

**Panelists:**

*Graham S. Giese*
*Associate Scientist, Provincetown Center for Coastal Studies*

*William A. Harris*
*Superintendent, Cape Hatteras National Seashore*

*Karl Nordstrom*
*Associate Professor, Center for Coastal & Environmental Studies*
*Rutgers University*

*Preston D. Riddel*
*Superintendent, Cape Lookout National Seashore*

*Lester B. Smith, Jr.*
*Chief of Scientific & Engineering Staff*
*Massachusetts Office of Coastal Zone Management*

DR. MAYO: Our real workshop, really rolling-up-your-sleeves type session, will culminate this forum and workshop.

I would like to introduce the panel of experts that we have on hand this afternoon to help you come up with approaches to problems that you have, if not actual solutions to situations that are difficult for you back home.

The panelists are of two general types, those with scientific expertise and those with land management experience.

You already know Mr. Olsen, who is the Superintendent of the Cape Cod National Seashore. He will be moderating this afternoon's workshop.

Those of you who went on the field trip have already met Graham Giese, who is the Director of the Provincetown Center for Coastal Studies. Graham spent five years at the University of Puerto Rico in the Department of Marine Sciences, as Associate Professor of Physical Oceanography. Prior to that he was at Woods Hole Oceanographic Institution from 1956 to 1967 where he was a Field Party Chief for the Coastal Studies Group. He was responsible for the re-survey of the outer coast of Cape Cod, Provincetown to Nauset Inlet, to determine the rate of shoreline change. He is probably the foremost expert on the coastal processes of Cape Cod.

Karl Nordstrom is an Associate Research Professor at the Center for Coastal and Environmental Studies, Rutgers University in New Jersey. Professor Nordstrom has done work on coastal erosion and dune management problems. He has conducted dune research in conjunction with the State of New Jersey, dune and beach change studies on federal flood man-

agement and he has worked with the National Park Service on management studies for coastal development.

Lester Smith is Chief of the Scientific and Engineering Staff, Massachusetts Office of Coastal Zone Management. He has been there for the last four years. Les's chief role is to translate science into management applications. I think he is sitting in an appropriate central place here on the panel. He helped develop the state's coastal wetlands regulations; he helps coordinate the funding for the wetlands Protection and Restriction Programs. He and his staff provide scientific support for the various state management agencies with regard to coastal zone management. In addition his office also funds community grants, of which the Cape has received its fair share.

Preston Riddel is Superintendent of the Cape Lookout National Seashore. Mr. Riddel has been with the National Park Service since 1954. He was formerly Superintendent of Cape Hatteras National Seashore. He is a civil engineer professionally, so there was more than one engineer present this morning.

William Harris is presently Superintendent of Cape Hatteras National Seashore. He has served the Park Service as Historian at Cape Hatteras, at Fort McKinley and Mount Rushmore and has been Superintendent of three parks before coming to Cape Hatteras in 1975.

So, I will turn you over to them and them to you and I hope that you will be very aggressive in your pursuit of their input to your problems. I will also turn the moderation over to Herb Olsen.

FROM THE FLOOR: I don't know if my request fits this session, but I would like to ask the help of the panel and the members of the group sitting here. I am Simon Baker from East Carolina University and I am engaged in a land use study on the barrier islands of North Carolina. I have some worksheets on which people might make some suggestions about the kinds of detailed land use classifications which might be useful to have at fairly large scales, like one to twenty-four thousand or so, the scales of the geological survey quadrangle maps.

I have several of these worksheets. I don't know if it would be appropriate for me to hand out some of these to the people and ask them to think about it and if they have any suggestions mail them back to me. I have already done it, but is it appropriate?

MR. SMITH: I think that this is what this forum is really all about.

MR. HARRIS: One of the things that we wanted to say to you also is if, during the course of the afternoon, you have a problem that cannot be solved here, or if some thoughts come to you after you get back home, we would be very glad to have you put them down on paper and send them to Dr. Barbara Mayo at the Center for Coastal Studies for inclusion in an appendix to the proceedings so that we might all benefit from your additional thoughts.

DR. MAYO: I might add to that, that any general comments that you have about things that go on this afternoon that you think would be an addition to the proceedings, there will also be an opportunity for inclusion of those in the proceedings coming after the meeting.

MR. BAKER: If there is anybody who has, in the course of work or concerns dealing with barrier islands, any thoughts about the types of land use details they might find useful on maps at any particular time for any

particular reason, I would like to give these sheets to them. My address is there and I would appreciate it if you would look these over and write down your comments and mail them back to me.

FROM THE FLOOR: Changing the subject, I would like to ask the panel how they feel as decision-makers, managers in one case and scientists in the other, of the trade-offs that are made in rationalizing preservation of the cultural resources that happen to occur on a barrier island, which oftentimes require manipulation or stabilization of the natural environment. Where do you draw the line when too much preservation of a cultural resource ends in too much damage or manipulation to a natural resource?

MR. HARRIS: I probably have the situation that we are referring to: a lighthouse that is in danger and threatened by waters. The lighthouse is not the National Park Service's lighthouse. It belongs to the United States Coast Guard; but between the lighthouse and the eroding sound side, we have some other structures: keeper's quarters, sheds and a summer kitchen. We would like to believe that, although they are on the register, these structures are not one of a kind type of situation, that they are, if you will, expendable. Maybe somewhere along the line someone may change their mind, but most attention is given to the lighthouse per se, the great navigational aid and something that everyone has a great love for.

But I believe in answer to the question, that each structure will have to be examined on its own merits: what is its role, what is its function and how important is it historically, significantly, nationally or whatever.

FROM THE FLOOR: What about the situation, one that has been resolved, but was proposed for a time for the Chincoteague National Wildlife Refuge. There were remnants of an old fish factory on the bay side and there was a proposal to restore it and create an interpretive facility. From the perspective of some it was damn the natural resource, full speed ahead.

The lighthouse on Montauk Point is a resource that in some minds has great interpretive or historical significance. Even in the case of Portsmith Village, although I doubt that it is threatened as such at this point, if it were threatened, would it be worth manipulating the barrier island, stabilizing the natural dynamics, to retain over a long-term or on a permanent basis, essentially, that kind of a cultural resource or any kind of a cultural resource? Where do you draw the line? Is there any cultural resource on a barrier island that is worth permanent expenditures of large sums of money to maintain it?

MR. HARRIS: Those are hard to answer, but I say to you in sincerity that each unit would have to be examined individually.

Let's look at the lighthouse that we were talking about. You would have to go through the process of 106 Statement, which is a federal cultural compliance requirement. You can call it demolition by neglect, if you will; you can call it something else if you want to, but that kind of statement initiated by the agency must be processed. It has to go through the State Historic Preservation officer and the rest of the Council on up. Somewhere along the line everyone will have their opportunities to make their input into this.

Now, I guess if I were sitting in the role of a State Historical Preservation officer, I would be gung-ho to save anything that's out there—an outhouse, if it was on the list or the register of historic places. I would say that each structure, whatever it may be, will have to go on its own merits.

You referred to Portsmouth Village, that is a 250-acre village on the north end of the Island. As of right now, it is not threatened, but it could be someday. I would say that if it were, all right. You have a church; there are a number of churches in this country. You have a Coast Guard Station, a lifesaving station, a number of those. So, the answer would be each unit would have to be examined on its own merit to find out what is the significance of the thing. Do you want to spend that kind of money and know that it may last one month, six months, six years? Or that it's a gamble?

MR. SMITH: I would like to comment on that briefly. I certainly agree with what was said. I think one of the things that we looked at, and have looked at in a lot of cases, is removal of cultural features to an off-island location. That was what was done here in the Cape Cod National Seashore. The lifesaving station out on North Beach barrier beach was moved to Race Point. I think that is probably the first thing you should look at.

MR. HARRIS: May I comment on this?

We had a similar situation with a lighthouse at Cape Hatteras, a very famous lighthouse which everybody knows about. We anticipate that if the shoreline processes continue as they have been going in the last hundreds of years, that someday soon we are going to be faced with loss of that lighthouse. So, we have already commissioned, through contracts, a look at alternatives for that lighthouse. The major alternatives are: stabilize the shoreline, nourish the shoreline in front of the lighthouse, do nothing and let the lighthouse fall in, or relocate the lighthouse. Then there are variables within the alternatives. So we do have a study underway right now to look at the alternatives and to cost them out.

I suspect somebody in this country could care less about the lighthouse and Cape Hatteras, but in North Carolina they would be terribly upset if they lost that.

FROM THE FLOOR: Are these working lighthouses?

MR. HARRIS: Yes, the Park Service owns the Cape Hatteras Lighthouse structure. The Coast Guard maintains the light inside and they are operating lighthouses.

FROM THE FLOOR: In that case, can they be classified as necessary aids to navigation which would have to be replaced somehow if they were moved or if they fell into the sea?

MR. HARRIS: Well, at one time the Cape Hatteras Lighthouse, for example, was threatened and they built a steel tower lighthouse inland. When the shoreline eroded in that general area then the Coast Guard gave the lighthouse to the Park Service and moved the light to the steel tower. The shoreline was either stabilized or accretion occurred and then they moved it back to the lighthouse with just the signal light. So, whether or not the lighthouse is necessary as an aid to navigation, the Coast Guard would be the one to make that judgment.

MR. RIDDEL: For the Cape Lookout Lighthouse, the Coast Guard has viable alternatives that they look to: one is to move it; another is to let the lighthouse go and put up a tower. The Cape Lookout Lighthouse not only is a light, but is also a visual aid to navigation and, I think that it costs something like $500,000. The Coast Guard owns this lighthouse.

FROM THE FLOOR: It sounds like this is a pretty common problem, because a lot of other ones are on the list, such as the Great Point Light-

house at Nantucket, which is probably one of the ones that an earlier speaker was talking about; it is one of the most seriously threatened. The State Historic Preservation officers are now addressing the problem. The Coast Guard apparently is trying to find the funding to do a feasibility study. They can't come up with the scratch to do it. In the meantime, Great Point Light is almost at the top of the berm of the beach now and getting pretty close.

If somebody comes up with a solution, I wish they would bang out a couple of extra copies and send it out to Nantucket. The Coast Guard has considered the steel tower alternative on Nantucket to replace the existing structure, because it is an essential aid to navigation. A much smaller tower is being considered, one that they feel can be maintained at much less cost. That is beginning to look like an attractive alternative to them. The emotional part of the Great Point Light, being one of the older lighthouses in the United States, is a factor and people are wondering what is going to be done about it.

DR. GIESE: I might mention that there have been several solutions to the lighthouse problem mentioned. When we think about these, the cost, for example, of protecting it as opposed to the cost of moving it back, we are talking about the initial costs. The long-term costs become much, much greater if you try to protect it in its original place, simply because the shoreline becomes more and more out of equilibrium as time goes on.

If the shoreline is almost in equilibrium, then it is not very difficult to maintain a seawall or some other kind of structure. As time goes on and the shoreline becomes more and more in disequilibrium, as the result of erosion to areas that are not protected, then the cost not only continues, but becomes greater and continually greater and greater, which means that, eventually, the protection solution is no longer an affordable solution. You just can't afford that much money, eventually. So the lighthouse would have to be given up anyhow.

Recognizing this fact, and I think this relates to the earlier question about a permanent solution, there is obviously no permanent solution on a retreating shoreline. There is none.

Since there is no permanent solution, it means that taking the temporary solution is not only delaying through time the movement of the structure, but is also putting the community in the position of having to make a greater outlay through time.

We often deceive ourselves about the cost of a structural solution, because we are only looking at the temporary costs and not the long-term ones.

FROM THE FLOOR: Has anybody had any experience with the actual movement of a structure of that type and the related costs, either by way of a feasibility study or actual work?

MR. RIDDEL: For one of the alternatives with respect to the Cape Lookout Lighthouse, we contracted with a consultant in Raleigh to analyze moving the lighthouse one mile north of its present location. This is quite complex because it's a double-walled lighthouse with a cavity. They suggested cutting the lighthouse into seven sections, using a gantry train, taking them off to a railroad bed and with another gantry train, setting it all back up again to the tune of one and three-quarter million dollars.

FROM THE FLOOR: And the cost of a new structure?

MR. RIDDEL: A new structure that would replace it would be nothing more than some sort of a tower with a small navigational visual aid, $500,000.

FROM THE FLOOR: How about the environmental cost and putting the necessary equipment on the ground to move the thing?

MR. RIDDEL: We never really got into assessing the impact of that roadway. There were other alternatives to this, that my friends in the Corps worked out, such as dredging, groin fields, or revetments. The Corps had five options and the Coast Guard came up with a couple of other options. One was sheet-piling and abandoning it or putting up a tower.

FROM THE FLOOR: As an effective teaching aid and as a way to save money, wouldn't a quite dramatic way to inform people about the dramatic movement of the beach ecologies be to leave the lighthouse there, not touch it, let it fall into the sea and have lighthouses all up and down the coast left there just to inform people about the way these barriers move? It would be very dramatic, a very effective way to get a point across.

MR. RIDDEL: That might be, but I am sure that there is a community of commercial fishermen at Harper's Island that would disagree with you a great deal when they had to use that inlet to go fishing and come home.

The worry is that it will change the whole dynamics of that inlet. This is a maintained inlet through the Rivers and Harbors Act by the Corps. What would happen is that you would have a break, a new inlet, from the sound side to the ocean three miles north of the Point.

MR. HARRIS: In Charleston, South Carolina, there is a lighthouse that the Coast Guard protected with interlocking steel sheets and bulkheads. They made a complete circle around the lighthouse. The shoreline retreated away and today it's a quarter of a mile inland and the lighthouse sits out on a little island. That has been done, but it leans a little bit because it doesn't have as much structure to the foundation.

MR. RIDDEL: I guess there is something else to say about the structure of a lighthouse. If you go back to the lighthouse service, I won't say it was corrupt, but they built pretty much on sand; it was like a real flotation foundation. Remember the old houses, if you will, fell down because they weren't structurally sound, not because of the ocean. So, many times when the structure was built in the mid to late 1800's, you are not really sure what is down there. You are going to have to do some subsurface investigation to find out what you have for a foundation.

FROM THE FLOOR: My question has to do more with land un-use, and I will address it to anyone on the panel or anyone in the room who may have the information.

I wonder if in cases where barrier beaches which have been developed and are now having problems with erosion, and structural solutions are inadvisable or not affordable, are there any relocation programs that have taken place and, if so, how were they done and how are they working?

MR. RIDDEL: The only way that I could answer your question would be to say: if there was a development that was now within the boundaries of an area controlled by enabling legislation and thus subject to take over fee simple by the United States, the people in the developed zone would probably be given such things as a life estate or a twenty-five year lease and relocation money, if they wanted to give up their land and go someplace else. If it was a highly vulnerable area, you want them out, and if you can't

negotiate, you could go in by condemnation. They would be given money up to something like $15,000.00 for the land and improvements to relocate someplace else plus the cost of the facility they had there. This is the only way I know of, if you went in to buy it for government use.

FROM THE FLOOR: Do you know of instances where that has really taken place?

MR. SMITH: I think earlier in the conference Ed Thomas from FEMA mentioned that there was a section in the Flood Insurance Act, Section 1362, for which I think $5 million is available. If Ed is here he can correct me. This money is used to look at the purchase of storm damaged properties in several areas. I think Scituate is one, Alabama may be another.

MR. THOMAS: There is an area in Alabama, I'm not sure what the community is, they are just getting going on it.

UNIDENTIFIED SPEAKER: One thing that has happened with federal flood insurance, people recently moved about six cottages at Nags Head that would have been, were supposed to be threatened. These were not yet damaged but they knew the next storm would probably damage them, so they went ahead and moved them in advance. I know they moved some cottages at Nags Head in North Carolina and also Rodan, but that is not the relocation that you are talking about, is it? You are talking about taking it away and relocating the people inland or something?

MR. THOMAS: I was talking about helping people to move their homes and their businesses to some other place.

FROM THE FLOOR: As in the case of a dam project, where a whole community has been relocated to another section of the country, are there barrier beach situations where relocation occurred because the processes were so interfered with by development that the land behind, or the features behind barrier beaches that would normally be protected by a barrier beach were so endangered?

MR. RIDDEL: I am not aware of any personally.

MR. SMITH: I think that for those who live in a place where a storm event happens, the money is available to offer to them in lieu of rebuilding in the same area.

I think if it is tied in with the Flood Insurance Program, it is a good way of taking care of it, so instead of rebuilding, when they get their flood insurance money for their house, they could then take that money, in addition perhaps the money for the land, and go elsewhere.

I feel it would have to be tied in with some type of a disaster. I know the Commonwealth of Massachusetts has been working on acquisition down in the Westport area, but it is very clearly a difficult thing to do, if the house is still standing there. It is much easier if it is wiped out by a storm and then you come in afterwards and provide the money to buy the land.

FROM THE FLOOR: I have a suggestion. When we were planning for Fire Island National Seashore, you saw the slides today showing the series of interpolated communities and federal area and communities and so forth. The communities are all considered in the Development Zone and the other areas are called the Seashore District. We proposed, initially, that if fifty percent of the community were destroyed in a catastrophic storm, that the owners would be reimbursed under the Federal Flood Insurance Program; thus, the community would have to be wiped out to become part of the Seashore District.

Following several years of public hearings, it was not greeted with wholesale enthusiasm. That portion of the plan which was ultimately approved said that if ninety-five percent of the houses in a community were fifty percent destroyed, then such a condition would come to pass. So we tried and it didn't work.

FROM THE FLOOR: This comes into my field, which is education, and I want to know how the panel feels about government agencies allocating certain amounts of their funding to make sure that the education gets, not to just the general public, but to the people who are the most important and influential citizens of the future. We prejudice the future citizens and like to call them children. This means allocating money to teach these children and even having programs that can go into the schools. Some agencies are very good at this and some agencies are really dragging their feet.

I mean things like weather stations, visiting facilities where children could actually come out and visit and see what is done. That is the type of thing I have the most trouble doing, because there just doesn't seem to be interest from the top down. A lot of people at the facilities would like to work with children at schools, but up at the top they say you can't spend your time or your money doing that.

In favor of CZM, we just received a $15,000.00 community grant to develop a slide program on the general issues on Cape Cod for the Year of the Coast. I give CZM a big hand for doing that. If anybody here would like more information on this slide program when it is done, my name is Barbara Waters. If you give me your name and address, I will keep you informed.

MR. RIDDEL: I'd like to answer the first part of your question. We have an avenue within the National Park Service to do just what you are saying, and we do it. I will give you a for instance, because we are in our fourth year of working with children–handicapped children and the senior citizens, if you will. We have to request to spend money out of our operating fund. That means we don't buy boards, nails, gasoline, paint, things like that, because we want to do something else with it: we want to take the kids out.

You can't drive to our Park, you have to go by boat, so what we do is spend the money to put the kids on the ferryboat to bring them to the Park. It takes about an hour and a half each way and they bring their lunches with them. The kids come on the boat about 9 o'clock and they are back home for the school buses about 2:30. They walk with the Rangers, touch a horseshoe crab, whatever; they have about five and a half hours.

Now, I'm speaking for Bill, too, we also go to the school with programs. We try to work generally with fifth and sixth graders. We also have programs in environmental education for junior high school classes. We work it out with the school Superintendent and the Principal. In our county, we have twenty fifth-grade classes. So, we generally get to these kids.

MR. OLSEN: May I interject a remark, because you are from Cape Cod, Mrs. Waters. You ought to get together with Glen Kaye, our Chief of Interpretation.

MRS. WATERS: I've already made other contacts here.

DR. GIESE: I would like to mention the other side of that question, and one I think that you had mentioned which has to do with teaching the

teachers, rather than direct teaching of the children.

We do that at the Center for Coastal Studies and find it to be a very important part of our total program. Of course our educational program is not really for the children, but for the teachers of the children. It seems to have been fairly successful.

Programs such as ours might expect some kind of funding from federal environmental education programs. It is unfortunate that environmental education has not received any funding for either the past fiscal year or, I believe, the present fiscal year. That is a wrong that probably should be righted.

MR. RIDDEL: I am not sure, has the Sea Grant Program come up this far?

MR. SMITH: Yes.

MR. RIDDEL: Down in the Carolinas there are Sea Grant facilities that bring teachers in, usually twenty to forty at a time, into that area. They try to get them into different environments, and then to go back to the kids with that experience. Working through Duke University or UNC, Sea Grant also tries to get the material and tools the teachers need to take back with them.

FROM THE FLOOR: It seems to me that in answer to your question, almost every federal agency will do exactly what you are asking for children, teachers or anyone else. The Corps of Engineers does. We work with children.

MRS. WATERS: The Cape Cod National Seashore has a wonderful new program and it does a really good job. I just wanted this type of thing out in the open, because I think it is very important. If we don't want people building on our barrier beaches, we have to educate them before they are prejudiced about the whole thing.

MR. SMITH: I think some educational booklets are starting to come out, too, and will help educate the general population.

I know Steve's book "Barrier Islands Handbook" is very good, although I feel the title should be changed to "Barrier Beach Handbook"– I want to keep putting that plug in there.

In Massachusetts we have a Coastal Hazard Mapping program and we are finishing up right now a draft of the shoreline between Manomet Point and Sandy Neck in Barnstable. The purpose of this handbook is to describe the coastal hazards, including the barrier beaches, and it will be made available to the general public.

DR. MAYO: I have a question that could be addressed to the panel and perhaps also to Mr. Parker who is still with us.

We have seen some pretty dramatic examples of some coastal structures that haven't worked and no longer function. In fact, some of these structures look pretty hazardous and out of place, and were put in either by the Army Corps of Engineers or others before the knowledge about coastal processes was there.

I'm wondering if there are any precedents for taking such structures away? Is there a mechanism or procedure for getting this done?

MR. PARKER: If you are asking if there is a way for it to be done, yes. Jetties can be removed, there is no questions about that.

DR. NORDSTROM: Structures have been removed in New Jersey that were placed there by the State of New Jersey. It was simply a matter of

altering the groin field to make it more effective; that is, there were too many groins per stretch of beach and they removed every other groin, for example.

The Park Service has also studied through CCS, where I work, the effects of removal of the small groin fields at Sandy Hook. We have been looking at it.

So far as I can see, no groins have been removed. I guess Neill is of the same opinion, no groins have been removed to change the beach back to the natural situation. Structures have been removed because they were no longer effective, they were an eyesore, they were a navigational hazard or they were ineffectively placed and some of the groins in the groin field were removed.

MR. PARKER: I think you have to be a little bit careful in what doesn't work. What doesn't work in one use, may be working in another use. This is a rather single purpose group. It is difficult to define it any other way. You have a certain unity of purpose and unity of interest, but there is a larger society that has some other interests. Jetties, for example, serve oftentimes navigational purposes, essential navigation purposes. The fish that you eat comes from fishing fleets that use those inlets. Now, to say that those jetties don't work because they don't serve some other purpose, is really a misstatement.

Now, there are projects where the project purpose is not being served. That is another category. That is what I am addressing when I say yes, projects can be abandoned, can be removed.

FROM THE FLOOR: That slide showing an inlet that was cut in two and the jetty was in the middle, that is the kind of thing I think would be a candidate for removal and replacement of that jetty. I don't know whether that kind of thing can be done.

MR. PARKER: I would suspect, without having real knowledge, that the Congress would impose a requirement that the benefits of removal exceed the cost of removal. In the case you are talking about, in Paul Godfrey's slide, where from the limited evidence that I have seen, it indicates that the extra inlet is closing–therefore removal of the jetty would be unnecessary.

MR. SMITH: I would like to speak very briefly about this. Groins that are perhaps causing problems, that is, if it can be shown that they are causing problems to adjacent beaches, can be dealt with. In the case of a private groin, the owner would have to be taken to Court and you would need evidence showing adverse effects. There would have to be a thorough process of review.

Often what happens though is that after storms, groins begin to sink and deteriorate. If they can be looked at through the permit process for a reapplication to either restore or put in a new groin, in the Commonwealth of Massachusetts, they could be denied.

We do have a very strong policy in Massachusetts with regard to proposed structures that could interfere with longshore sediment transport: even though they may benefit one person, if they are decreasing the size of the downdrift beaches, we wouldn't allow them. It is a pretty strong policy in Massachusetts anyway.

MR. PARKER: With regard to some of these projects where we saw slides showing apparently ineffective, or incorrectly designed projects,

oftentimes the project's purpose there and the project as originally designed and conceived have not been implemented. However, in cases where federal projects have been constructed and the construction is complete, as it was originally intended and their function is not as was originally envisioned, there are methods, mechanisms to modify those projects to eliminate the problems which they are causing, or to mitigate the damages which may be caused. So, rather than necessarily eliminating the structures, there may be a more readily available means of modifying the project to make it compatible with the other purposes.

I would like to add that in the case of some of the Long Island projects, there is a very detailed history about the projects and in defense of the Corps of Engineers, the things that you have seen depicted in the slides were really all predicted by the Corps, you know, if certain things were not done, which they weren't. So what we are seeing is the results predicted by the Engineers based on the state of the art.

FROM THE FLOOR: I would like to ask if you know of any communities that have adopted zoning restrictions for their beachfront areas in response to requests to the Corps to fill and replenish or renourish their beach. I am thinking, in particular, of the case now coming up with Ocean City where they are asking the Corps to put in jetties or groins and fill in sand, but yet Ocean City continues to build and will really use that as an incentive to encourage more people to come to Ocean City and build more and denser structures. Have any communities pulled back and said that they would have conditional zoning or restrictions on beachfront property so that when they fell down, they would not allow it to be rebuilt?

MR. RIDDEL: I know in North Carolina, they welcome all the beach nourishment they can get.

FROM THE FLOOR: But it just encourages more building doesn't it?

MR. RIDDEL: We are going through a process now down in Long Beach, Southport, where all of the cottages are almost in the surf zone; they want material badly.

DR. NORDSTROM: The Corps in implementing such a project can get assurances from communities that they will make it illegal for anyone to encroach upon the beach further or move out from the existing building line and it is then up to the communities to hold up those ordinances. Yes, they can, before implementing a beach fill project, get these assurances from the communities. That is not saying that the communities will not allow variances to happen. Where we can end up in real trouble is if the State has granted some recurring rights to shorefront residents, so that when you do create beach fill in front of the property, it reverts to the property owner. That has happened in some cases in New Jersey. There even could be some tricky court cases. Once deposition occurs, the deposition, or the accreted sand, is then targeted or earmarked for downdrift replenishment elsewhere. The communities or the local property owners can then say "No, this is our property, you can't touch it", despite the fact that a construction project was set up specifically to create that accretion.

MR. RIDDEL: There is another situation that may serve as an example. Steve had a slide this morning of pumping the sand at Hatteras from the borrow pit. At that time I was the Project Supervisor of that job and the situation was such that we had so much erosion caused by the motel that

our property line, public property, was in the ocean. Legally I could not put a grain of sand on private property, so we had to fight the ocean with our pump lines and we had to go into the ocean with our sand. We could not put sand on private property.

That is not to say that once we pumped it into the ocean, through the natural processes, that sediment fell out back on private property. I don't know if the Corps has anything different or not, but we could not put material on private property. We had to stay on public property with our nourishment.

FROM THE FLOOR: To go another step further, in the case of Ocean City the Town Fathers want to continue to improve and expand their sewerage facilities to accommodate the increased growth of the town.

Now, does the federal government have any restrictions or consistency that they could say we don't want any more development on barrier islands, you can't expand your sewer system any further?

MR. SMITH: The states have that power through the Coastal Zone Management Program in a provision called Federal Consistency. If the state has a policy that does not allow infrastructure which promotes development in hazard-prone areas, then in reviewing the federal projects, federal funding, or whatever, the state can deny it. In fact, we have that policy in Massachusetts.

FROM THE FLOOR: What do you do in a state that has an approved Coastal Zone Management Plan, but isn't doing or using that function? The state itself wants the continued growth of Ocean City.

MR. SMITH: I think the point is that environmental impact statements could be required on projects like that. If the state is not doing anything on the Coastal Zone Management Program, you can talk to Washington about it.

FROM THE FLOOR: I am anxious to get figures on how much local areas put into beach nourishment programs that are done by the Corps– not just the state contribution, but the funds from actual local areas, the county or the city itself. This, again, is in relation to Ocean City. I know Virginia Beach paid out itself $1,300,000 last year.

Ocean City wants a big Corps program done without paying a cent of it. It also wants an interim plan prepared by a private engineering firm and it wants the state to assume the whole burden.

I am very anxious to get figures on what has been done in other areas, hopefully being able to prove that the local share has been quite sizeable.

MR. PARKER: I suppose I should respond to that one. I said earlier that the Corps is not a programmatic agency. By that I meant, it does not have a program which seeks its own projects, but it is on a project basis and each project is authorized.

In the case of beach erosion, there is an actual statute which does define cost-sharing responsibilities for all beach nourishment and beach restoration projects. That is, Congress has already decided that is the way it is going to be, you have no problem. They did this a long time ago. I will be happy to send you a copy of that.

Now, that will not answer your question totally, because that merely divides how much is federal, how much is non-federal. How the people of North Carolina decide to split up the paying of non-federal share is the decision made by the people of North Carolina. How the people of Mary-

land do it is a decision by the people of Maryland. I know just from contacts that various states have various approaches to this. The State of California will pay one-half of the non-federal share and the local community pays the other half. There is no consistency.

FROM THE FLOOR: Do you have the figures on who is paying?

MR. PARKER: No.

FROM THE FLOOR: Do you know where I could get that?

MR. PARKER: Not really.

MR. RIDDEL: I don't think that information would be available until you make a contract, because if you say Virginia Beach, you refer to that as the one percent Sand Tax, or three percent. Some of the other communities in North Carolina derive their money from taxation. Maybe some of it is derived from the Alcohol Beverage Control. I think that the dollars would vacillate as tourism did.

MR. PARKER: However, in the case of Ocean City, it will be governed by the Federal Statute. Congress might have passed a new law, but I could not envision Congress doing that.

FROM THE FLOOR: Well, I think the state is perfectly willing to pay; it breaks down practically seventy percent federal, thirty percent state. Our Secretary of the Department of Natural Resources says that since the state pays for bridges and highways to reach Ocean City, therefore it should be the state's responsibility and not Ocean City's responsibility to build up the beaches.

DR. GODFREY: I wonder if I might raise a question which has been sort of gnawing at me for a long time. It's something that came out of the past two years when we were working on the barrier islands study with regard to the problems of certain coastal islands. It really comes down to this. We have seen our barrier islands move; we know the shoreline is receding; we saw a good example on Coast Guard Beach where that barrier beach system moved back and took a bathhouse out. What really do we do about a place like Cape Hatteras or other sections of the coastline where there are developments now? The inevitable storm is going to come along and smash those developments down, knock down the dunes that are remaining, if there are any remaining, and affect the public access to these extensive areas, such as Cape Hatteras. Are the federal agencies, by that I mean us, the Park Service, the Corps of Engineers, everyone involved, are we ready yet to deal with that problem? Can we find a way of moving back with the shoreline, or do we have to wait until a major disaster comes along and gives a *fait accompli?*

I know Mr. Harris is probably closely involved in this problem right now, and I wonder if he would care to comment on this. If this is a case of dealing with policy, and he doesn't want to comment, it is perfectly okay. But it seems to me we are in a state now where we have to consider that problem. How do you get millions of people off of Cape Hatteras when the hurricane is threatening, where do they go, what happens after the hurricane?

MR. HARRIS: That is a complex question, Dr. Godfrey.

As you know, because of the work that you and many others have done, we have come full circle in the way that we manage the shoreline at Cape Hatteras. We are no longer building dunes and we have no plans for stabilization of the shoreline itself. If an inlet were to occur tomorrow, we

don't have an advance strategy to close it. We are going to examine each inlet as it opens and closes on its own merits. At least that is what the policy book for Cape Hatteras is. It has not been tested yet.

The other problem we have is in front of some of the villages; we have acquired the property, the five hundred feet of land between the low water mark and the private property. In places such as Rodan and Buxton, we no longer have five hundred feet; the high water occurs on private property. So, we have a real problem. We have a road--just one road in and out. That could slide easily.

We have worked with the State of North Carolina in developing a hurricane evacuation plan. Our strategy is to close our public facilities very early and not give the people an opportunity to stay within the Park. That doesn't get them out of the community. We do not have plans to require people to leave and I am very much concerned that they will make that decision late in the game. Again, that hasn't been tested. I don't think there is a real answer to your question relative to what we are doing. What we are trying to do is to lead the county and the state into these areas to make these early decisions.

One of the things that has happened in North Carolina: the Coastal Zone Management Program has setback lines--they will not allow buildings to occur within certain setback from the vegetational line. That regulation has just gone into effect. I think it might be effective in keeping the development right off the beach base itself. But when the hurricane comes, we have a real problem.

I would like to say that we have not tested whether or not we can stand by what we have said.

DR. GODFREY: Well, that is the feeling I have. That is the problem. I can see that you are in a very difficult position, really, between one side and the other.

The managing of something like Coast Guard Beach or Cape Lookout National Seashore or other natural areas is quite different than managing Cape Hatteras. When the dune is gone, and the road is flooded by every storm tide, what can you do? What kind of pressure goes beyond you? This is a realistic approach. Can we say, well, let's let nature take its course? Is that really realistic?

MR. HARRIS: Well, we say that is what we are going to do. We have not really made any effort to go out and build dunes and some of the slides I saw,well, Mr. Buckley's and others, show that when we have two to three fields of dunes between public facilities or roads and erosion occurs, eventually you are back to one-half of a dune. So, we are right at the biting edge of finding out, what to do about building dunes. I hate to say it, but that is the realism of it. It will probably happen about the next major storm. One more storm will probably do it.

DR. GODFREY: How do we improve that situation? How do you think science or conservation organizations, the Corps of Engineers, or any other interested group of people can help us avoid the real problem that we are going to face? Is there a way of avoiding it or do we let the storm do it and deal with it later? Can we somehow plan ahead for that, can we change a policy, or do we need to change a policy? It is a real dilemma.

MR. HARRIS: Well, one of the things that we do not have is a constituency of people interested in the management of the Cape Hatteras

Seashore. That may sound strange, but we do not have a Cape Hatteras Preservation Association.

We are just now getting a chapter of the Audubon Society operating in that county. The Sierra Club never comes to see us. So, we really do not have a constituency of people who are concerned about the problems at Cape Hatteras. I don't know if that is good or bad from a management point of view. If they would agree with me, I would be happy to have them. That is not a realistic approach.

I don't know how to answer the question. I wish I could, because we are, as I said, on the brink of having to make some hard decisions, bite the bullets, so to speak.

MR. RIDDEL: We had slides, pictures of the overwash, that is when the local people said, "Hey, look, our kids can't go to school, they are not getting an education." Now, they have got to get down the road to Buxton and to Hatteras; we can't get the buses down the road. That is not the National Park Service's road; that happens to be North Carolina's Route 12. So what do we do?

The people from the state agencies came and saw a little bit of water and a little bit of sand on the road, but nobody in the District Engineer's office or the Chief Engineer or anyplace else said, "Well, to get there, we are going to have to do the same thing they did in Key West, Florida, we have to go up in the air and let the overwash come through." So, until the next storm comes nothing will be done; and when the water comes over, then everybody is going to scream.

FROM THE FLOOR: What would you predict will happen when the next storm comes?

MR. HARRIS: I imagine we will make the same management decisions we have made in the past. Realistically, you are going to have to have transportation. That is the key issue.

I don't think that we are going to go back and build a dune just to protect the village enclaves themselves. I do think that the public transportation and utility system will be put back in place. We are working with the State of North Carolina now on NC-12, which is the state road that serves the Cape Hatteras Seashore and the villages that are interspersed within the area. We are trying to get them to crank into their design for upgrading that road (and when I way upgrading, I am not talking about making it four-lane, just resurfacing and making it a little safer), a bridge causeway across those very thin areas that we know will flood, such as at Buxton.

I don't see us going back to the Congress and asking for money to reestablish a dune-building project. I think we are going to have to come to some other way of doing it. I am sure that we are going to replace that road to provide some type of transportation. We are going to put in those utility corridors that are necessary to serve those communities and the Park and the people that come to the Park.

FROM THE FLOOR: I know this is probably a naive approach, but it just seems to me that if you live in a low-lying area, or too close to where shores are eroding and you know that a bad storm is coming, I think it is up to you, if you want your kids to go to school, to get out and go either to a public building where it is safer before, not to wait until after and expect the Feds or the local governments to take care of everything.

I just don't even understand such talk.

MR. HARRIS: Unfortunately, there are a lot of people who come to the shore to have a hurricane party, rather than turn to go inland away from it.

FROM THE FLOOR: That is their problem, that is my whole point.

MR. HARRIS: I would agree, except that I don't think that you can allow it, I don't think that–

FROM THE FLOOR: What I am saying is, I don't think that you can stop the storms. I don't think dunes are forever, I think you can use Nauset Spit as an illustration. Henry Beston's shack or cottage was there fifty years, through countless storms, but two years ago it was wiped out, period. I think everbody agreed that there was no point in making an effort to take it from the marsh and put it back. That was a historic building.

I think everybody has to be terribly realistic. How can people in Scituate say,"We have the insurance, this is where we want to be." I don't think you can do that *ad nauseum.*

FROM THE FLOOR: It seems to me that the proper context for the kind of policy change that Dr. Godfrey was speaking about is the legislation pending in Congress right now, particularly the approach that the Senate bill is taking–the non-acquisition approach. Rather than just looking at future situations, control of future permits for bridges and shoreline structures, that legislation should also address existing conditions. I mean, looking at the cost estimates that have gone in to Phil Burton's acquisition bill, which we discussed the other day: the tune of $11 billion to be spent on shoreline restoration and protection over the next years that could be alleviated by $2 billion land acquisition.

That same $2 billion perhaps, or quite a bit less, I would suspect, could, in the same legislation, be made available for the kind of relocation prior to storm damage that the lady in the back was talking about.

Those people living on barrier beaches may benefit from the educational efforts, or from the scientist's material translated by the interpreters of the Park Service. Also the Park Superintendents could approach these people to inform them that they are in a bad situation. They could be compensated or in some way assisted in relocating prior to the damage of the storm.

It seems to me that the barrier islands legislation that is going through Congress is the opportunity where the broad range of barrier island issues ought to be addressed. Unfortunately, Congress reacts best when there is a crisis and there isn't a particular crisis right now on barrier islands. When an inlet forms at Sandy Hook, they are probably going to react in a week and a half, but it is going to take the rest of this Congress, if not longer, to get any comprehensive policy change for barrier island management. But that, to me, is the context in which to do it.

I don't think that addressing a prescription for Cape Hatteras this year and addressing a prescription for Point Lookout next year and so on down the line every time a crisis arises is really the best way to go.

FROM THE FLOOR: My name is Slocum, I am an industrial forester. I just have two things to say. The first one is going to shock you, I guess. We should not be, I am saying we, being the public, we should not be spending public funds to protect people from losses incurred because they choose to build and live in areas proven to be dangerous from the power

of the sea. Does anyone of the panel members want to comment on that?

DR. NORDSTROM: I think we pretty much all agree on that.

MR. SLOCUM: The other thing, as a forester, I have always been interested in vegetation, and the barrier islands for some time. I know lots of things that we can plant and try to encourage in growth, but I would like to talk a little more about the type of vegetation that really holds. For instance, there is a tree that grows in Florida, an Australian pine. It is an imported tree, but it has taken over the whole coast there. It grows to be eighty or ninety feet tall, it is prolific, it grows everywhere in the sand. It seems to be a great tree in holding back the movement of sand. But I would like a comment or two about the types of vegetation in this latitude, five degrees south or north, that has real opportunity for us to encourage to hold back the movement of sand.

Dr. Giese, maybe, would like to mention certain types of vegetation that would be very beneficial.

DR. GIESE: I would be glad to, to the extent of my knowledge. I am not a botanist, I am not even a biologist, I am a physical scientist. On the other hand, that is not a way out in coastal science, because the processes are so intertwined that we can't really take them apart.

Yes, vegetation is a very important part of the coastal system, the barrier beach system. The system has the stability, the natural stability in large part because of vegetation. The natural types of vegetation, I think, have been pointed out quite well in the last few days: *Ammophila* on top of the dunes and the marsh grasses are the the kinds of vegetation that we see a great deal of here, right on the small barrier beaches and on the primary dunes. Behind those we do get a lot of other types of vegetation. A few that come to mind are bayberry, *Rosa rugosa* (the wild rose), and beach pea is another one.

I see a hand going up behind you, Barbara has some suggestions.

DR. MAYO: Poison ivy. I know it sounds funny, but it would solve a lot of problems.

DR. GIESE: Those are some of the plants that come to my mind that play such an important role in the stability of the system. It is quite true, without those, without the vegetation, we don't have a system; the dunes don't remain, the marsh doesn't remain.

MR. SLOCUM: Those things are the species, but the encouragement of their growth to cover areas which are wide open is important. A very heavy percentage of the barrier beaches are wide open.

DR. GIESE: Of course, the problem, as we have learned over the last several days, is not so much of spreading the plants artificially, but rather to keep them from being damaged so that they can spread naturally. If we can protect them, the processes are such that they will, indeed, cover the habitat and thrive and provide the stability that we would like to see.

I'm not sure I am answering your question, I'm not quite sure that I understood your question.

MR. SLOCUM: Fertilization.

DR. GIESE: Oh, fertilization of these, I don't know about that. I think that Les Smith might know a little more. I do know that on Cape Cod the Town of Barnstable has been fertilizing the plants on Sandy Neck. I believe that has been done from an airplane and I don't know what the fertilizer mix is; maybe Barbara Waters knows that, too. But, yes, they have

fertilized and it is my understanding that it has been relatively successful.

Does someone know any more about that particular question?

FROM THE FLOOR: Yes, my name is Ed Leary, I am a forester and also a conservationist in the Town of Duxbury.

As far as the fertilization, Duxbury Beach is about 265 acres, privately owned by the Duxbury Beach Reservation, which in turn leases the beach to the Town of Duxbury and my Department, Natural Resources, has been in charge of managing the beach.

Every spring we plant forty to fifty thousand culms of American beachgrass, which is followed up immediately with a fertilization, Triple 15 in granular form.

In the past we have used fixed-wing aircraft, but with the cost and the Reservation being a non-profit trust, we have gone to hand spreading. We don't have that much money to buy lots of fertilizer, so what we do buy, we can ensure that it is placed on the newly planted grass.

I agree with Barbara Mayo about the poison ivy. We have vast expanses of poison ivy on Duxbury Beach. Fellows were kidding around in the past about putting up signs indicating some of the vegetation was poison ivy. We have a big problem at Duxbury Beach with people. On a busy day our 265 acres can have close to six to eight thousand people. They don't read signs, they go anywhere they want to go. Poison ivy is a plant, once they walk through it, they won't walk through it again.

*Rosa rugosa* is another. In one of the protected areas we have got wild cherry. We have red cedar, in the more protected areas. I wouldn't recommend planting it out in the open, because I think the natural succession process is something you should watch. Start with beach grass and see what evolves.

F.G. BUCKLEY: Francine Buckley, I am a biologist and I would like to say something in defense of bare sand; I feel that bare sand is a very important part of a barrier island. There are other organisms that depend on barrier islands to exist and very often people just stay out and leave the bare sand–very often the mere fact of planting vegetation will keep the birds out of there.

In a case that comes to mind on the north shore of Long Island, there was a 3,000 pair Least Tern colony, an almost unheard-of size for a Least Tern colony. The Town of Huntington, being very progressive and conservation minded, decided to help these terns. They put up a fence and got the local high school students to come out and plant beach grass on the tern colony, not realizing that Least Terns need fresh sand. The Least Terns did not come back in any great numbers because of the beach grass planted there.

Now, if they had left the thing alone, the terns probably would have used the area for a while, fertilized it through their droppings and beach grass would have come in naturally. But as a result they lost the Least Terns and they had to go to the expense of putting the fence up.

MR. LEARY: One thing we are proud of, we do have a Least Tern colony on Duxbury Beach that was posted Monday. An Audubon Society representative spent six hours on the beach and let us know that we have the most productive Least Tern colony in Massachusetts as of that date.

Our Least Terns, I would say ninety-nine percent of them, are nesting in the stones. We don't plant in the stones, so the beach grass planting goes on in the bare sand and the Least Terns have their stones.

FROM THE FLOOR: I am very curious about the response from the panel concerning the question of whether or not the American public should pay for damages done in the coastal zone and whether or not we can look to a consistent policy for disaster relief in general? Is the panel agreeing to no disaster relief to areas in the flood plain? Can you distinguish between the coastal zone and other areas that are prone to such natural disasters?

MR. SMITH: I think we are pretty much in agreement that we should not be subsidizing development in those areas, but my feeling is that we should be taking disaster relief moneys and using it to help the people, but help them get out of the hazard prone area. Use the disaster fund money to help people relocate and we will have less hazards in the future.

I think hazard mitigation has got to be multi-faceted. I think barrier beaches are one of the most hazard-prone areas. There are areas that were referred to in the last couple of days that are going to continue to retreat and we know that they are going to be areas of problem in the future. I think it makes more sense to get people out of those areas if we can. For other areas, other than the dynamic barrier beach areas, that is, we have to look at other solutions. The Flood Insurance Program is very useful in some areas to get people up on stilts. There are other mechanisms to reduce the hazards. I think we have to look at it from a multi-faceted approach, but on barrier beaches most of the evidence thus far that we have seen points in the direction of getting people off of them.

DR. BUCKLEY: I think Neill's point is well taken and one that I tried to make this morning. We can't make a categorical decision between Miami Beach and Atlantic City and Rockaway and Hatteras. That would be foolish. You have got to make the decision that what you are going to do in one place, you are not going to be able to do in the other. But what you have to realize is that what you are going to do in Miami Beach and Atlantic City is going to cost you. You have to know exactly what the costs are, have it all laid out and amortize those costs.

If your economic analysis indicates that you can't or are unwilling to amortize those costs, then on cost-benefit ratio you agree to relocate. It has been suggested that you can treat Miami Beach like an onion, if you start peeling off the front layer and moving it to the back. That is not a preposterous solution; it is one that deserves an analysis, but you cannot categorically treat a major investment like that the way you would a Cape Lookout or Cape Hatteras.

MR. PARKER: I really didn't intend to be sarcastic or facetious. I was really intending to make a point, which Paul made very well. It is very easy to single out something and say I am against it, but the truth is that there are an awful lot of natural disasters, an awful lot of natural hazards. There are an awful lot of places that are dangerous to live. Barrier islands aren't the only ones.

It is dangerous to live in the Mississippi Valley. It is dangerous to live in the mid-West because of tornadoes. Where can you stop? Once you make that statement you—

MR. SMITH: I think some hazards are inevitable. Tornado areas are less predictable, so I would distinguish between those type of hazards.

DR. NORDSTROM: I think we can get a good handle on shorefront migration, landward migration, erosion, and then gear the land use policy

MR. PARKER: Let me make a statement if I may, about this question. Most of the projects that this young lady was talking about, for example, are not for the purpose of protecting communities against the ravages of the sea.

I am talking now about shore protection and beach restoration projects. Those projects are supported and are justified almost entirely on recreational benefits. That is what they are for. They are not to protect the houses and Ocean City or in Buxton or wherever. The simple plain truth of it is that only in the case of commercial or highly-developed industrial property will property value support protection. Congress will not authorize projects for protection, where the cost of protection seems to exceed the benefit. This just doesn't happen.

So, beach projects in particular are not for the purpose of protecting the communities. Since they are not for that purpose, an alternative is not evacuation of the community, the alternative is to not have the recreational facilities within the project purpose.

FROM THE FLOOR: I would like to kind of rebut that a little bit. In Maryland, we have Assateague and we have Ocean City. Now, Assateague has a tremendous recreational potential and people can go there and enjoy themselves with no permanent adverse effect on the barrier island. Yet, in Ocean City you are protecting the buildings by doing the beach restoration work. That is the sole reason for the hurricane protection work. Otherwise, I can't see why they aren't pushing to do something at Assateague? People could go to Assateague if all they wanted was recreation, but the only reason the Corps is being called in is to protect the people's property in Ocean City.

There is also the problem with the extreme erosion at the northern end of Assateague; this is a recreational area. The Corps says the cost ratio is such that they can't ask for funds to take care of that. But when you get to Ocean City, they feel that the cost ratio is there.

FROM THE FLOOR: I just wondered if there was any precedent for protecting barrier islands to save the mainland communities that they protect and I am thinking again in terms of the north end of Assateague that is migrating backward very fast. There is a very distinct possibility that it can overwash and there will be a blowout, so to speak, at the north end of Assateague. There being the West Ocean community and the West Ocean airport on the mainland side, some of the local politicians are talking about putting a lot of money and protective devices in to preserve it or to try to save the north end of Assateague, simply to protect the mainland community. Has this happened or is this happening anywhere else?

DR. NORDSTROM: The rationale of using barrier islands to protect the mainland from flooding has, in fact, been put into Corps documents as justification for the hurricane projects. Yes, it has in other areas.

FROM THE FLOOR: What other areas, particularly?

DR. NORDSTROM: The south shore of Long Island, for example.

MR. HARRIS: Cape Hatteras Seashore and Cape Lookout, I think, were sold to the State with that as part of the justification by which to have a National Seashore.

MR. SMITH: Our wetlands regulations in Massachusetts for beaches and dunes and barrier beaches are based on their value for storm damage prevention and flood control.

FROM THE FLOOR: How can you do a cost benefit of that when you have to think that what Ocean City is doing to protect its beaches is directly responsible for the loss of sand and nourishment to the north end of Assateague? I mean, would that have to be cranked into the cost of protecting the north end of Assateague then?

DR. NORDSTROM: You mean if it weren't for that particular project there would be sand by-passing the inlet creating a wider island and higher dunes?

FROM THE FLOOR: Very definitely.

DR. NORDSTROM: With the result of less overwash and less flooding in the interior portion?

FROM THE FLOOR: Yes. It is the jetties that are responsible for starving the north end of Assateague. They are maintaining the harbor for pleasure boats and fishing boats on the west side of Ocean City.

DR. GIESE: Yes, there's no question about that. It is doing that and it seems to me that the responses have indicated that there are a lot of places that recognize the role of barrier beaches in protecting the land behind them and in the management decisions that protection is often taken into consideration. I am not sure whether a cost benefit, actual cost benefit analysis has been made of such a role.

However, the protective value was considered on Cape Cod in Chatham when a project was proposed for North Beach, which is the barrier beach on the outside of Pleasant Bay. At one time recommendations were made to make an inlet through the barrier beach to replace an inlet which had migrated south and had become very shallow. One of the reasons, not the only one, but still one of the reasons for not doing that was, I think, because making a new inlet would endanger the mainland behind that inlet in North Chatham. There is no question that once that new inlet formed, the main shore behind the inlet would be affected.

On the other hand, I don't think that a detailed cost-benefit analysis was made; consideration of the protection value was simply one of many inputs into the decision-making process.

MR. RIDDEL: With regard to cost benefit of beach nourishment at Assateague for protection of the mainland, there may be a problem with the source of material. From my limited knowledge of that area, I would think that there is no material available that is native to the area which could be used for nourishment. In all probability the existing blowout area that has been identified contained an alien material that was much finer granule than the native dune sand so that the retention factor was probably below fifty-percent. To retain dunes X number of yards on the barrier beach, you may have to dredge twice to three times as much material as you need to put on the nourishing area. It's like putting flour someplace that you should have gravel.

FROM THE FLOOR: Could the State use the back bay as a source of sand for nourishment of Assateague?

MR. RIDDEL: In creating protection for the mainland, if you go behind the barrier beach and in front of the mainland, there may be shellfish areas affected by the dredging. For all of these areas that you refer to, an environmental impact statement may be required.

FROM THE FLOOR: There is also the fact that the north end, plus the wash flats and the refuge area on Assateague are the most important

areas along the whole coast for peregrine falcons. More falcons are seen there in the migration period than anywhere else along the east coast. I should think that would be an argument against doing anything to the north end of Assateague, too.

MR. RIDDEL: I wonder if you shouldn't talk about effects on the mainland as well, because if you generate a deep hole in your barrier chain and then you, at some point in time, subject that area to an incident, be it hurricane or anything else, you have not only an erosion problem on the barrier, but you have also generated an erosion problem on the mainland.

MR. SMITH: We have that problem in one of our barriers in Massachusetts in Plymouth where a dredged channel is maintained behind the barrier, very close to the barrier, so now the sand overwashes into the channel. So the barrier is going to have trouble in the future in maintaining its volume. We really should have moved the channel landward. It's kind of the onionskin approach that Paul mentioned.

FROM THE FLOOR: We have problems with barrier beaches here on the Cape. One that I am addressing particularly now is the situation in Brewster, the development of condominiums, a hundred and fifty units. I would like to ask a question of the panel: what should we look for in sewerage problems in the area of barrier beaches and how can we rely on predictions of effluent flow and how reliable are these engineering predictions? What effect can we look for in the ecosystem with extensive leaching fields in the area immediately behind the barrier beach system?

DR. GIESE: One of the problems, of course, is the depth of the water table beneath the surface. I don't know, do you have an idea of what that is in the area that you are talking about, how deep?

FROM THE FLOOR: It's about a foot below the surface.

DR. GIESE: I don't think that if it is only a foot that the building regulations in your Town would permit a waste treatment facility. I don't think it would, I don't think you have the proper depth for drainage.

FROM THE FLOOR: What was originally proposed in the Zoning By-Law was a sewerage treatment plant. The builder has decided to get around the requirement of the sewerage treatment plant by breaking the development up into four separate pieces, thereby skirting the law requiring a sewerage treatment plant for over a hundred units. A number of leaching fields are proposed behind the marsh system. One of them is up on a bluff, highly elevated.

One of the other problems is that immediately in the beach area, in the shoreline area, is the Town shellfish area. There are many complications in this particular property.

DR. GIESE: Well, I think you have identified that one problem with the drainage and it looks as though there are some means being taken to handle that. If it can be made to fit the state regulations, it probably would be acceptable. The problem with the shellfish has never been one, in my experience, to hold up a project. I remember a case in Chatham where there was one property that was a problem or a concern for the Chatham Conservation Commission and after a considerable amount of testimony at a hearing in Boston, it was determined finally that that particular problem was not one that could hold up a project according to the state regulations.

Les may have more on that.

MR. SMITH: I think what you are referring to is State Title V Sanitary Code that applies to subsurface disposal of sanitary waste. Generally, if a project meets Title V, then it is determined that that is enough to take care of the problem, unless sufficient evidence can be brought to bear to show that a given proposal is not going to be adequate. That is very difficult to do, usually.

In most cases, the Title V really doesn't help you in the situation that you are talking about, unless you have some pretty good hydrological information.

MR. RIDDEL: I don't know about the State of Massachusetts, but in North Carolina there are very stringent regulations on that. That is not to say that we don't have contamination, but if they can identify beforehand the construction of the land that would endanger shellfish beds, they usually have the ability to get a Court injunction and make the guy come forward and make him prove that it will not be harmful. I think one in question is a large acreage of open ground that was bought by a foreign interest which put 50,000 head of cattle on it. The runoff went directly into the shellfish beds and they held him up from putting cattle in there.

I don't know if that is an avenue, if your Division of Fisheries is powerful enough that you can show that the runoff is going to be in that area. It is certainly going to contaminate, super-saturate the fresh water limits.

MR. SMITH: I don't think you are saying that a particular discharge was going to be a foot underground, that wouldn't be allowed by any regulations. Are you saying that it was going to be behind the barrier, small barrier and draining down into a small marsh, then perhaps out into the estuary or flat seaward of the barrier, is that right?

DR. GIESE: I think you would have to have some highly technical information to analyze that one.

FROM THE FLOOR: Is it a dune on the inside, I realize it's a dune on the outside and marsh in behind, but is it sandy material?

FROM THE FLOOR: I don't have too many details on it, it's more sandy behind it.

DR. GIESE: But is the building planned to be on the primary or secondary dune on the seaward side of the marsh or is it going to be on the landward side of the marsh?

FROM THE FLOOR: It's going on the seaward side of the marsh. Just at the edge of the primary dune or secondary dune system.

DR. GIESE: Then it would be on a barrier beach?

FROM THE FLOOR: Yes.

DR. GIESE: Well, then one of the concerns in the new Coastal Wetlands Regulations is about building on barrier beaches. There are a lot of concerns which would be directed toward the affect on vegetation and the natural movement of that barrier beach landward. So there would be a lot of concerns about those matters, and also, about the eventual protection of the building from wave action.

FROM THE FLOOR: These buildings are proposed to be on piers.

DR. GIESE: Still, I might like to go over that with you after the session is over. I know you mentioned that to me before and if you have any information on that that I could look at, I would be glad to talk to you about it afterwards.

FROM THE FLOOR: Doesn't the Wetlands Protection Act specify how close you can be to some kind of a sensitive area like that?

Does it not have any footage, Les?

MR. SMITH: No, it doesn't. What the Wetlands Protection Act does is talk about protecting public interests that are provided by the wetland area, in this case, the barrier beach area. The public interests that are provided by the barrier beach system or dune system are storm damage prevention and flood control. So the characteristics of that barrier system that provide storm damage protection and flood control for landward areas are protectable characteristics, such as the dune volume, dune form, vegetation on the dune, and the ability of the dunes to continue the overwash process.

FROM THE FLOOR: He is also talking about septic systems and leaching pits. I just wonder, isn't there something in the regulations about that?

MR. SMITH: That would be covered under prevention of pollution.

FROM THE FLOOR: Isn't there something in the Wetlands Protection Act that says you may not build as close as, say, so many feet?

MR. SMITH: The Wetlands Protection Act relies on the sanitary code I mentioned earlier providing for building septic systems so those are the standards that they have. If you meet that sanitary code, that would be deemed sufficient. In some cases the Town Zoning Ordinances go beyond the State Sanitary Code and have further setback distances from bodies of water.

FROM THE FLOOR: Doesn't that seem sort of like bad regulations, when you are talking about a shellfish bed, shouldn't there be some kind of footage?

MR. SMITH: There is a footage; fifty feet from a leaching facility to a body of water is the standard of the State Sanitary Code. You might argue that is not enough, but you have to go to the Court to argue that.

DR. GIESE: The points are, there are local zoning regulations which might come into play.

FROM THE FLOOR: To get away from some technical questions for just a moment, I would like to comment on some impressions of this meeting. I think that there is very broad agreement of the many aspects of the barrier islands, within the group, and while we may not agree exactly with each other, we understand them to be hazardous areas. There are many of us who are appalled by too much construction too close to the shore. There are many other points of agreement.

Somewhere off in the background are "they", and they are moving onto the barrier islands and they are moving into condominiums and they are building cottages and I would like to suggest that part of the problem with them is perception. It is a perception problem: we use the term "land" to mean a rock outcrop in the Rocky Mountains or a firm hill in the Piedmonts of North Carolina or a sand bar off the coast of the Gulf or the Atlantic, or elsewhere.

I would like to suggest that possibly the use of "land" in connection with barrier islands is an improper use of the word. We might help in the long run, perhaps, not in the near term, but we might help ourselves if we could somehow come up with a word which implies that it isn't really land at all in the usual sense of the word, but that it is ephemeral and that somehow it is in motion. If such a word or some proper modifier to the word

"land" in connection with barrier islands could be introduced into the language that they and we use, there might be a bit more reluctance on the part of people to think in terms of building cottages and handing them down to their children in some of these places. I see a problem with perception of barrier islands here on the part of the general public which we, I don't believe, are suffering from particularly.

DR. GIESE: I appreciate your comment very much, I think it is very important and a very good one. Mr. Parker knew what he was talking about when he began his talk and said that he was not able to define a barrier beach. He decided that, perhaps, Dr. Leatherman and Dr. Buckley might be able to define it, they might agree with each other, but find some third person who would not agree with them. He was right.

There really is a problem; we are not able to define a barrier beach among ourselves. Those of us together in the room have a pretty good idea of what we are talking about, but when geologists look at the types of barrier beaches that we have along the east coast and the Gulf coasts of the United States, there are some very really important differences between them. There are certain classes of them. Steve Leatherman did a good job in his Barrier Beach Handbook of pointing some of these differences out.

One example of the type of barrier beach which really isn't the moving sand bar feature that you are talking about, for example, are the Sea Islands in Georgia. These are probably Pleistocene dunes which have been submerged by rising sea level – problems such as that make it very, very difficult.

All land surfaces are evolving in some way or anotner. There is no question that the outer bar type barrier beaches or barrier islands are extremely mobile, as we have seen. I think that you are right. I think that we really feel the way we do about them, because we perceive the mobility that you are talking about. But it certainly is difficult to find a word in the language, because we don't really yet have such a word in our technical vocabulary for the different types of barrier beaches. We have the concept, but I don't think that we have done it technically yet. So, I think it is going to be a while before we are able to get that far.

DR. BUCKLEY: There is a term in the legal statutes throughout the country that is appropriate, fast land. I suggest that is perhaps just the wrong interpretation of the word "fast", because relative to other kinds of land, these are moving quite fast. It would probably be easier to change the interpretation if we change the law.

MR. OLSEN: Are we ready to call it a day and a week? I must say that it has been a pleasure to serve as your host this week and I am sure that my good friends in the Provincetown Center for Coastal Studies would agree with me, that it has been a productive three days. We have enjoyed some extremely fine weather and I think we must all be grateful for that.

I hope that you will go home, think about the things that you have heard, heard said here in the past three days, do as we suggested earlier, if you have any particular thoughts on issues and problems, possible solutions for some of those, that you wish to share with us and with your fellow participants, we will be very happy to include those in the proceedings.

Thank you very much for being part of this conference. We hope that the next one might be down a little further south in the area of Cape Hatteras and Cape Lookout.

Thank you.

# APPENDIX A: PARTICIPANTS
## Speakers, Panelists and Attendees

Helen Aaron, President
League of Women Voters
of Lower Cape Cod
Box 595 Griffen Island Road
Wellfleet, MA 02667

Ralph Abele
U.S. Fish & Wildlife Service
One Gateway Center
Newton Corner, MA 02158

Edie Adair
North Atlantic Region
National Park Service
15 State St.
Boston, MA 02109

John Aldrich, Asst. Conservation
Officer
Dept. of Lands & Natural Resources
Town of Duxbury, MA
900 Tremont St.
Duxbury, MA 02332

Fred J. Anders, Assistant Unit Leader
National Park Service
Cooperative Research Unit
University of Massachusetts
Amherst, MA 01003

William C. Ashe, Deputy Regional
Director
U.S. Fish & Wildlife Service
One Gateway Center
Newton Corner, MA 02158

Gerry Atwell, Staff Wildlife Specialist
U.S. Fish & Wildlife Service
P.O. Box 1518
Concord, NH 03301

Abigail Avery
Sierra Club
Box 246
Lincoln Center, MA 01773

John Baccus
Associate Professor of Biology
Southwest Texas State University
San Marcos, Texas 78666

Dr. Simon Baker
Institute for Coastal & Marine Resources
East Carolina University
Greenville, NC 27834

Andrew Ball, Hydrologist
Insurance & Mitigation Division
Federal Emergency Management Agency
J.W. McCormack Post Office & Court-
house Building
15 New Chardon St. Room 462
Boston, MA 02109

Richard J. Bellevue, Manager
Coskata-Coatue-Great Point Wildlife
Refuges
The Trustees of Reservations
59 Eel Point Rd. P.O. Box 172
Nantucket, MA 02554

Jeffrey Benoit, Coastal Geologist
Massachusetts Dept. of Environmental
Quality Engineering–Wetlands
Protection
D.E.Q.E. Lakeville Hospital
Lakeville, MA 02346

Brenda J. Boleyn
Association for the Preservation
of Cape Cod
P.O. Box 198
Truro, MA 02666

Glen W. Bond, Jr., Project Leader
Back Bay National Wildlife Refuge
Pembroke Office Park, Bldg. 2,
Suite 218
Virginia Beach, VA 23462

Dave Brown
Massachusetts Dept. of Environmental
Management
100 Cambridge St.
Boston, MA 02202

Francine G. Buckley
Colonial Waterbird Group
372 South St.
Carlisle, MA 01741

P. A. Buckley, Chief Scientist
North Atlantic Region
National Park Service
15 State St.
Boston, MA 02109

Marjorie Burling, Executive Secretary
to the Superintendent
Cape Cod National Seashore
South Wellfleet, MA 02663

Natalia Buttner, Professor of Geology
Physics Dept.
Hudson Valley College
Troy, NY 12180

Dr. Peter Buttner, Director of Environmental Management
New York State Park System
Agency One, Empire State Plaza
Albany, NY 12238

Curtis Carleton, Emergency Management Specialist
Federal Emergency Management Agency
90 Church St. Rm. 801B
New York, NY 10007

W. Drew Chick, Jr., Park Planner
Denver Service Center
National Park Service
655 Parfet St., P.O. Box 25287
Denver, CO 80225

John R. Clark, Senior Associate
The Conservation Foundation
1717 Massachusetts Ave. NW
Washington, DC 20036

William Clark, Community Resource Development Specialist
Cape Cod Extension Service
Railroad Ave.
Barnstable, MA 02630

Thomas Cobb
National Parks and Conservation Assn.
1701 18th St. NW
Washington, DC 20009

Peggy Collins, Chairman
Eastham Conservation Commission
RR 1 Box 106
Eastham, MA 02642

Steven Colman, Coastal Zone Liason
New England River Basins Commission
53 State St.
Boston, MA 02109

Suzanne Contos, Associate Editor
Nautilus Press, Inc.
1056 National Press Bldg.
Washington, DC 20045

Patrick Cudmore
Duxbury Beach Reservation
Box 1243
Duxbury, MA 02332

Robert Cunningham
National Park Service
Bldg. 69 Floyd Bennett Field
Brooklyn, NY 11234

Tina Stonorov Daly
Box 276
South Orleans, MA 02662

Dr. Charles Davidson, MD
Box 197
Truro, MA 02666

Richard Delaney
Cape Cod Planning & Economic Development Commission
Barnstable, MA 02630

Frank Deluise
U.S. Fish & Wildlife Service
Division of Ecological Services
Brookhaven National Lab Bldg. 134
Upton, NY 11973

Ed Devlin, Cape Cod Director
Fisher Junior College
Route 132
Hyannis, MA 02601

Carl Dierker, Deputy General Counsel
Massachusetts Dept. of Environmental Quality Engineering
100 Cambridge St.
Boston, MA 02202

Dr. Anthony Del Prete
Dept. of Earth Sciences
State University of New York
Oswego, NY 13126

Ajax Eastman, Vice President
Maryland Conservation Council
112 E. Lake Ave.
Baltimore, MD 21212

Dr. Lionel Eleuterius
Gulf Coast Research Lab
East Beach
Ocean Spring, MS 39564

Frederic Eustis II
Planning Board, Isle au Haut, ME
P.O. Box 1422
Boston, MA 02104

Ilia Fehrer
Worcester Environmental Trust
110 W. Federal St.
Snow Hill, MD 21863

Marie Ferland
National Park Service Cooperative Research Unit
University of Massachusetts
Amherst, MA 01003

Jane Ferrigno, Research Geologist
U.S. Geological Survey, MS 730
1925 Newton Sq. East Rm. 134
Reston, VA 22090

Ann Fisk
8 Pasture Rd.
Rockport, MA 01966

Laurie Frost
South Carolina Sea Grant Consortium
221 Fort Johnson Rd. James Island
Charleston, SC 29412

George Gavutis, Jr.
U.S. Fish & Wildlife Service
Parker River National Wildlife Refuge
Northern Blvd.
Newburyport, MA 01950

Rachel Giese
Box 154
Provincetown, MA 02657

Graham S. Giese, Associate Scientist
Provincetown Center for Coastal Studies
Box 826
Provincetown, MA 02657

Michael Glazer, Assistant Administrator
For Coastal Zone Management
U.S. Department of Commerce
3300 Whitehaven St. N.W.
Washington, DC 20036

Paul J. Godfrey
Associate Professor of Botany
University of Massachusetts
Amherst, MA 01003

William P. Gregg, Co-coordinator
MAB-8 Directorate
National Park Service
19th & C Streets N.W.
Washington, DC 20046

John Hanlon, Fishery Biologist
U.S. Fish & Wildlife Service
Division of Ecological Services
Brookhaven National Lab Bldg. 134
Upton, NY 11973

William A. Harris, Superintendent
Cape Hatteras National Seashore
Rte. 1, Box 675
Manteo, NC 28516

Mike Harris-Warren
Association for the Preservation
of Cape Cod
Box 636
Orleans, MA 02653

John Hayes III
South Carolina Coastal Council
306 College Ave.
Rock Hill, SC 29730

Martha Hayes
Dept. of Geology/Geography
University of Massachusetts
Amherst, MA 01003

Robert Herbst
Assistant Secretary for
Fish and Wildlife and Parks
U.S. Department of the Interior
Washington, DC 20240

William Hoyt
Dept. of Geology
University of Delaware
101 Penny Hall
Newark, DE 19711

Stan Humphries
Massachusetts Dept. of Environmental
Management
100 Cambridge St.
Boston, MA 02202

Albert Ike, Associate Director
Institute of Community and Area
Development
307 Old College
University of Georgia
Athens, GA 30602

J.R. Jackson, Jr., Manager,
Exploration Regulatory Affairs
EXXON Company, USA
P.O. Box 2180
Houston, TX 77001

T. Destry Jarvis
National Parks and Conservation Assn.
1701 18th St. NW
Washington, DC 20009

Danielle Joneja, Graduate Research Asst.
National Park Service Cooperative
Research Unit
University of Massachusetts
Amherst, MA 01003

Cheryl Johnson
National Park Service Cooperative
ResearchUnit
University of Massachusetts
Amherst, MA 01003

Judith Johnson, Chairman
Committee to Preserve Assateague Island
616 Piccadilly Rd.
Towson, MD 21204

Glen Kaye, Chief of Interpretation
Cape Cod National Seashore
South Wellfleet, MA 02663

R.H. Kendall, Chief
Natural Resource Conservation,
Atlantic Region
Parks Canada
Historic Properties, Upper Water St.
Halifax, Nova Scotia
Canada

Jean Kenyon, Assistant Scientist
Provincetown Center for Coastal Studies
Box 826
Provincetown, MA 02657

Dr. John Kermond
Coastal Zone Studies Program
University of West Florida
Pensacola, Florida 32504

James Killian, Chief of Environmental
Planning
Cape Cod National Seashore
South Wellfleet, MA 02663

Harriet Knight
South Carolina Coastal Council
19 Hagood St.
Summerrall Center Suite 802
Charleston, SC 29403

Robert Kutler, Counsel
U.S. Senate Energy and Natural
Resources Committee
Rm. 3106 Dirksen Bldg.
U.S. Senate
Washington, DC 20510

Howard Larsen, Regional Director
U.S. Fish & Wildlife Service
One Gateway Center
Newton Corner, MA 02159

Dr. Anthony Laska
New Orleans City Planning Commission
9W City Hall
New Orleans, LA 70112

Ed Leary, Conservation Officer
Dept. of Lands & Natural Resources
Town of Duxbury, MA
878 Tremont St.
Duxbury, MA 02332

Stephen P. Leatherman, Leader
National Park Service Cooperative
Research Unit
University of Massachusetts
Amherst, MA 01003

James Lentowski, Executive Secretary
Nantucket Conservation Foundation
P. O. Box 13
Nantucket, MA 02554

Mike Ludwig
National Marine Fisheries Service
Milford Lab
212 Rogers Avenue
Milford, CT 06460

Catherine Madore
National Park Service Cooperative
Research Unit
University of Massachusetts
Amherst, MA 01003

David Malchman
441 Commercial St.
Provincetown, MA 02657

Audrey Massa
Dept. of Geological Sciences
Columbia University
New York, NY 10027

Barbara Mayo, Associate Scientist
Provincetown Center for Coastal Studies
Box 826
Provincetown, MA 02657

John McClellan
Outer Cape Environmental Association
173 Bradford St.
Provincetown, MA 02657

Robert W. McIntosh
Northeast Regional Director
Heritage Conservation and
Recreation Service
600 March Street, Room 9310
Philadelphia, PA 19106

Robert McLean, Asst. Chief
of Recreation
Massachusetts Dept. of Environmental
Management
Division of Forests & Parks
100 Cambridge St.
Boston MA 02202

Irving Mendelssohn, Assistant Professor
Center for Wetland Resources
Louisiana State University
Baton Rouge, LA 70803

Thomas Mercer, Publicity Relations
North Atlantic Region
National Park Service
15 State St.
Boston, MA 02109

Wayne Mitton, Regional Supervisor
The Trustees of Reservations
224 Adams St.
Milton, MA 02186

Frank Monteferrante, Research Associate
Center for Wetland Resources
Louisiana State University
Baton Rouge, LA 70803

Kenneth Morgan, Asst. Superintendent
Sandy Hook Unit
Gateway National Recreational Area
Floyd Bennett Field Headquarters Bldg.
Brooklyn, NY 11234

Edward Moses, Senior Staff Specialist
U.S. Fish & Wildlife Service
One Gateway Center
Newton Corner, MA 02158

P. Suzanne Nair, General Biologist
U.S. Fish & Wildlife Service
Division of Ecological Services
1825B Virginia St.
Annapolis, MD 21401

Gilbert Nersesian, Chief, Coastal Engineering Branch
New York District, Corps of Engineers
143 David Place
Hillsdale, NJ 07642

Karl Nordstrom, Associate Professor
Center for Coastal and Environmental Studies
Rutgers University
New Brunswick, NJ 08903

Richard O'Connor
Office of Coastal Zone Management
3300 Whitehaven St., NW
Washington, DC 20235

James Oland, Acting Refuge Manager
U.S. Fish & Wildlife Service
Chincoteague National Wildlife Refuge
P.O. Box 62
Chincoteague, VA 23336

Herbert Olsen, Superintendent
Cape Cod National Seashore
South Wellfleet, MA 02663

Neill Parker, Chief
Engineering Development Division
U.S. Army Corps of Engineers
Coastal Engineering Research Center
Ft. Belvoir, VA 22060

Ken Pecci
Mashpee Conservation Commission
Box 92
Mashpee, MA 02649

Sheila Gay Pelczarski, Research Asst.
National Park Service Cooperative Research Unit
University of Massachusetts
Amherst, MA 01003

Naomi Pena, Planner
Ecolsciences Environmental Group
133 Park St. NE
Vienna, VA 22180

Jeffrey Pike, Professional Staff
U.S. House of Representatives
Committee on Merchant Marine & Fisheries
Subcommittee on Oceanography
3577 No. 2 H.O.B.
Washington, DC 22205

Dr. John Place
U.S. Geological Survey
National Center, Mail Stop 710
Reston, VA 22092

Ann Platt
Barrier Islands Coalition
10 Freeman Lane
Orleans, MA 02653

Larry Points, Chief of Interpretation
Assateague Island National Seashore
Rt. 2 Box 294
Berlin, MD 21811

Mark Primack
Box 510
Provincetown, MA 02657

Norbert P. Psuty, President,
The Coastal Society, and Director,
Center for Coastal and Environmental Studies
Rutgers University
New Brunswick, NJ 08903

Preston D. Riddel, Superintendent
Cape Lookout National Seashore
P.O. Box 690
Beaufort, NC 28516

JoAnn Marie Roesler, Conservation Easement Negotiator
Maryland Environmental Trust
501 St. Paul Place Suite 1401
Baltimore, MD 21202

John Sanders
Dept. of Geology
Barnard College
Columbia University
New York, NY 10027

Bill Schenk
National Park Service
120 Laurel
Patchogue, NY 11772

Valerie Scopaz
47-11 193rd St.
Flushing, NY 11358

Stephen Selwyn
The Projects Group, Inc.
47-20 40th St.
Queens, New York, NY 11104

Jay Silberman, Environmental Protection Specialist
U.S. Coast Guard
Third Coast Guard District
Governors Island
Bldg. 125 Rm. 107
New York, NY 10004

Judith Skinner
9 Harding Lane
Marblehead, MA 01945

Barbara Sloane
Mashpee Conservation Commission
Box 92
Mashpee, MA 02649

Jack Slocome
Barnstable Conservation Commission
Town Hall
Hyannis, MA 02601

Lester B. Smith, Jr., Chief Scientific and Engineering Staff
Massachusetts Coastal Zone Management Office
100 Cambridge Street
Boston, MA 02202

Henry Stevens, Superintendent
Roosevelt Campobello International Park
P.O. Box 97
Lubec, ME 04652

Jim St. Pierre
Natural Resources Council of Maine
57 Loring Ave.
Auburn, ME 04210

Richard L. Stanton, Regional Director
North Atlantic Region
National Park Service
15 State St.
Boston, MA 02109

Peter Strugatz
Tetra Tech, Inc.
734 Walt Whitman Rd. No. 209
Melville, NY 11747

John Tanacredi, Natural Resources Management Specialist
Gateway National Recreation Area
Floyd Bennett Field Headquarters Bldg.
Brooklyn, NY 11234

Bob Taylor
Southeast Regional Office
National Park Service
Atlanta, GA 30303

Edward A. Thomas, Director
Division of Insurance and Mitigation
Federal Emergency Management Agency
15 New Chardon Street, Room 462
Boston, MA 02109

Charles Thomsen, Chairman
Orleans Waterways Improvement and Shellfish Advisory Committee
Orleans Town Hall
Orleans, MA 02653

David Thulin, P.E., Supervisory Project Engineer
Town of Barnstable
367 Main St.
Hyannis, MA 02601

Barbara Tufty, Freelance Writer
National Science Foundation
3812 Livingston St. NW
Washington, DC 20015

Garret VanWart, Deputy Director for Environmental Services
The Trustees of Reservations
224 Adams St.
Milton, MA 02186

Sterling Wall, Coastal Geologist
Massachusetts Dept. of Environmental Quality Engineering
100 Cambridge St.
Boston, MA 02202

Barbara Walmsley, Special Assistant to the Assistant Secretary for Fish & Wildlife & Parks
Department of the Interior
Washington, DC 20240

John Peter Wargo
School of Forestry and Environmental Studies
Yale University
205 Prospect St.
New Haven, CT 06520

Paul Wasilewski
Cape Cod 4-Wheel Drive Club
42 Point Lane
Hyannis, MA 02601

W. Lowell White, Superintendent
Acadia National Park
RFD 1 Box 1
Bar Harbor, ME 04609

Arlene Wilson, Chairman
Barnstable Conservation Commission
367 Main St.
Hyannis, MA 02601

Rodney C. Winslow
Acting Meteorologist in Charge
National Weather Service Forecast
Boston, MA 02128

Chris Zabawa, Geologist
Maryland Coastal Zone Management
Program
Maryland Dept. of Natural Resources
Tawes State Office Bldg.
Annapolis, MD 21401

Donald Zinn, Professor Emeritus
of Zoology
National Wildlife Federation
P.O. Box 589
Falmouth, MA 02541

# APPENDIX B
## Legislative Update

I. Federal

### Coastal Barrier Resources Bills

House Bill (H.R. 3252) and Senate Bill (S. 1018) seek to establish a Coastal Barrier Resources System. The affected barriers are 125 of the undeveloped barrier beaches along the Atlantic and Gulf coasts of the United States. The intent of these bills is to get the federal government out of the business of assisting and subsidizing the cost of residential and commercial growth on barrier beaches (including barrier islands, spits, tombolos, and bay barriers). The bills would not prohibit development of these areas, nor would they prohibit the expenditure of disaster assistance funds for the protection of property and public health and safety. Reports would be prepared which would inventory fish and wildlife and natural hazards and would provide recommendations for the conservation of the natural resources of these land forms.

These compromise bills would not provide for the acquisition of undeveloped barriers for inclusion in the national park system as earlier proposals had sought.

Congress has recently cut off issuance of new flood insurance policies for all undeveloped barrier beaches identified by the Department of the Interior.

II. State

### Coastal States Organization

The Coastal States Organization, composed of Governor-appointed representatives of coastal states who are often affiliated with State Coastal Zone Management Programs, passed a resolution on barrier islands and barrier beaches that stated the following:

– undeveloped barrier islands and barrier beaches should be provided with the maximum protection to maintain their integrity as natural systems;

– the Department of the Interior with the participation of the state CZM programs, or appropriate agencies where there is no approved CZM program, should conduct a thorough and complete mapping inventory of all barrier islands and barrier beaches on the ocean and Great Lake shores;

– a program of coordinated action by federal, state and local governments should be established for the more effective use and conservation of these unique areas;

– federal funding assistance that supports and stimulates the development of undeveloped barrier islands and barrier beaches should be eliminated;

– issuance of federal flood insurance policies for new structures in developed barrier islands and barrier beaches should be eliminated and federal funding assistance should be used primarily for non-structural hazard mitigation;

– NOAA, through OCZM, should take a leadership role in the coordination of the various federal programs that impact the coast;

– and that Congress should expedite passage of a strong barrier islands and barrier beaches protection act that reflects the above provisions.

Massachusetts adopted policies to discourage development and encourage acquisition of barrier beaches through the signing of a Barrier Beach Executive Order by Governor Edward J. King. The thrust of the order was to redirect redevelopment away from barrier beaches because of the history of storm damage to these dynamic areas.

To implement this order, Massachusetts is identifying and delineating all of its barrier beach areas and developing a public education program to guide barrier beach management.

# APPENDIX C

## Post-Workshop Selected Publications and Materials Related to Barrier Beach Issues, Fall 1981.


1. The Conservation Foundation. 1980. *Coastal Environmental Management.* Clark, J., Project Director. Superintendent of Documents, U.S. Government Printing Office, Washington, DC.

2. Dolan, R., H. Lins, and J. Stewart. 1980. Geographical Analysis of Fenwick Island, Maryland, A Middle Atlantic Coast Barrier Island. U.S. Geological Survey Professional Paper 1177-A, 24p., Superintendent of Documents, U.S. Government Printing Office, Washington, DC.

3. Federal Emergency Management Agency. 1981. *Design and Construction Manual for Residential Buildings in Coastal High Hazard Areas.* 189p., Superintendent of Documents, U.S. Government Printing Office, Washington, DC.

4. Gabriel, J. 1981. *Portrait of a Coast.* 30 minute 35 mm color film. This film shows the dynamic changes and resultant coastal hazards on the barrier beaches of the Massachusetts coast, expecially Cape Cod. Jim Gabriel Productions, Wellfleet, MA.

5. Gabriel, S. 1980. Implementing a Beachwatch and Sand Dune Development Program. 31p. New Jersey Dept. of Environmental Protection, Division of Coastal Resources, Bureau of Coastal Planning and Development, Trenton, NJ.

6. Leatherman, S.P. 1981. Barrier Beach Development: A Perspective on the Problem. *Shore and Beach,* April 1981, p. 3–9.

7. Lewis, J.C. and E.W. Bunce (eds.). 1980. Rehabilitation and Creation of Selected Coastal Habitats: Proceedings of a Workshop. 162 p. Office of Biological Services, Fish and Wildlife Service, Dept. of the Interior, Washington, DC. FWS/OBS-80/27.

8. Madore, C.A. and S.P. Leatherman. 1981. Dune Stabilization of the Provincelands, Cape Cod National Seashore, Massachuetts. University of Massachusetts -- National Park Service Cooperative Research Unit Report No. 52/59, Amherst, MA.

9. Massachusetts Coastal Zone Management Office. 1981. A Report to Governor Edward J. King: Executive Office of Environmental Affairs, Implementation of Executive Order No. 181 for Barrier Beaches. 27p.

10. Myers, J.C. 1980. America's Coasts in the '80's: Policies and Issues. Published by Coast Alliance, Washington, DC, as part of observance of 1980: Year of the Coast. 159p.

11. National Park Service, North Atlantic Region. 1980. Analysis of Management Alternatives (including Environmetal Assessment) for Off-Road Vehicle Use, Cape Cod National Seashore, MA. 48p.

12. Primack, M. 1980. ORV's in Our National Seashores. *National Parks and Conservation Magazine*, Vol. 54, No. 11, p. 4–7.

13. Ralph M. Fields Associates. 1981. Preparing for Hurricanes and Coastal Flooding: A Handbook for Local Officials. Review draft prepared for Office of Coastal Zone Management, NOAA, Washington, DC.

14. Shaefer and Roland, Inc. 1981. Evaluation of the Economic, Social, and Environmental Effects of Floodplain Regulations. 168 p. Federal Emergency Management Agency Report.

15. Waters, B. 1981. *Edge of the Land.* Slide-tape cassette program depicting coastal processes of Cape Cod. Barnstable County Cooperative Extension Service, Barnstable, MA.

NOAA COASTAL SERVICES CENTER LIBRARY
3 6668 00002 0745