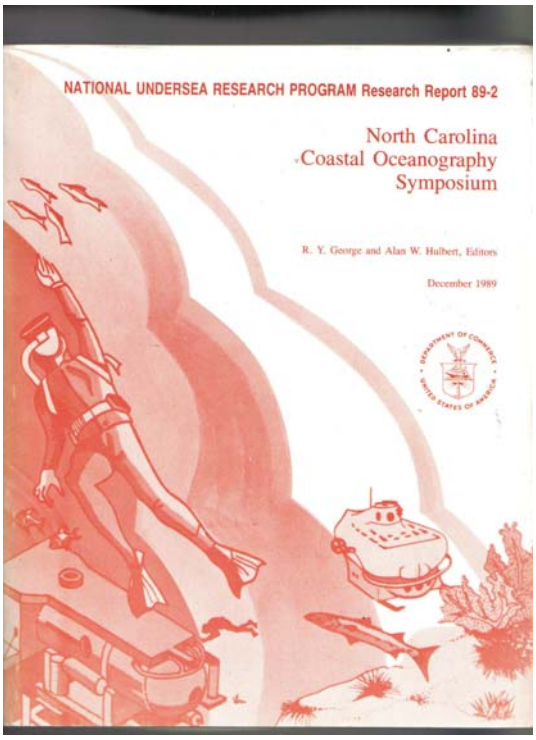
**NORTH CAROLINA COAST SYMPOSIUM: YOU AND YOUR ECOSYSTEMS**
**Carolina Beach, North Carolina**
**Nov. 28- Dec. 1, 2006**

**History**: The first North Carolina Coast Symposium was held in 1987 (September 30 – October 2) at the University of North Carolina at Wilmington. The symposium was organized by Prof. Robert Y. George, Center for Marine Science Research (CMSR) at UNCW. The symposium participants (see photo below) included marine scientists from academia (Duke and UNC), Private and Public Sectors in North Carolina.

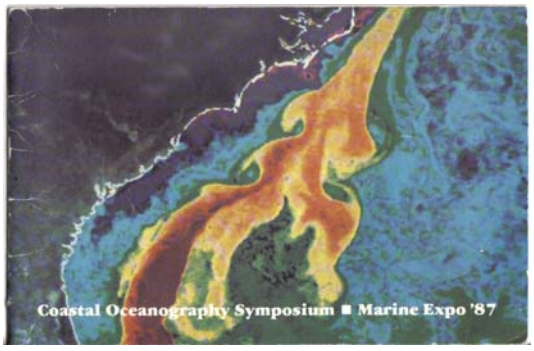
Group Photo

Rita Colwell (Keynote speaker), Dirk Frankenberg, BJ Copeland and Bob George (symposium host)

The first NC Coast symposium was also addressed by the 7th district congressman Hon. Charlie Rose who called for more partnership-research programs between federal and state governments and academia in North Carolina.




The 1987 symposium chose as logo the satellite photograph of North Carolina Coast taken from the orbiting NOAA-6 Satellite, with the Gulf Stream flowing northward with strong eddies westward to the coast and eastward to the Sargasso Sea (See photo below).




The impact of the Gulf Stream to the biological productivity, larval recruitment and coastal fisheries was the emphasis of several papers presented in the symposium. The proceedings of this symposium was published as NOAA-National Undersea Research Program

Research (NURP) Report No. 89-2, edited by Robert Y. George and Alan H. Hulbert. The reason for choosing NOAA-NURP to publish the symposium was to develop a link between state and federal government for future research collaborations even though NOAA did not contribute in either the planning or the conduct of this symposium.

**Planning the 2005 - 2nd NC Coast Symposium:** George Institute for Biodiversity and Sustainability (GIBS) was founded in 2001 by Prof. Robert Y. George with the goal of promoting conservation of nature associated with human dimensions of the coastal and open-ocean (highseas and deep-sea) environment. GIBS board of governors (see photo below) encouraged the need to conduct the 2nd NC Coast symposium in 2005, after a lapse of 18 years since the 1987 symposium.

GIBS's BOARD OF DIRECTORS: (Lt to Rt) 1. Prof. Jarle-Ove Stromberg (Sweden - International) 2. Mrs. Mary-Lee Hawse (Wilmington-Public education) 3. Prof. Robert Y. George (GIBS President) 4. Mrs. Chandra George (Wilmington - Biologist) 5. Dr. Earl MacCormac (Raleigh - Science advisor – ) and 6. Mr. Walter Dietch (Wilmington – Industry Relations).

Based upon the success of GIBS in earlier collaborations with the NGO organization 'Environmental Defense' in conducting the national symposium on 'Global Warming' during the 2003 annual meeting of the American Association of Advancement of Science (AAAS) in Washington DC, Dr. Robert George, GIBS President, approached Dr. Douglas Rader of the Environmental Defense Office in Raleigh, North Carolina to co-sponsor the 2nd NC coast symposium in 2005. Dr. Douglas Rader enthusiastically approved this suggestion and the symposium was, therefore, sponsored by GIBS and Environmental Defense.

The sponsors felt the need to conduct a series of half–day round-tables in both universities in North Carolina and in NGOs and Govertnment centers to plan the symposium with clear definition of vision and mission of the 2005 symposium. Furthermore, the sponsors felt the compelling need to integrate biophysical science with socio-economic science. To achieve this goal, Prof. Michael Orbach, Duke University Marine Laboratories in Beaufort, was requested to play a key role as one of the three organizers (see accompanying photo) of this 2005 symposium along with Dr. George and Dr. Rader. The organizers met thrice as a group to plan the main themes of the symposium and to develop an organizing committee. The three chosen themes are (1) Watershed Ecosystems (2) Beaches and Inlets and (3) Shelf to EEZ boundary off NC Coast.

The symposium organizers felt the need to link the various components of the North Carolina Coastal ecosystems such as microbes, phytoplankton, zooplankton, benthic invertebrates, fish, turtles and marine mammals in relation to the changing environment due to climate change and sea level rise. More importantly the organizers recognized the need for linking the biophysical environment to the society and man's managerial responsibility. Therefore, we chose as symposium logo (see photo),

## Symposium Organizers

Dr. Robert Y. George (GIBS)

Dr. Doug Rader (Environmental Defense)

Dr. Mike Orbach (Duke University)

developed by Alan Joyner of the UNC Institute of Marine Sciences in Morehead City, North Carolina.
A satellite image of the NC coast showing the three capes (Cape Hatteras, Cape Lookout and Cape Fear) and the three bays (Raleigh Bay, Onslow Bay and Long Bay) are shown in the center of the logo. Man's impacts are identified as (1) Storms and Hurricane influences (2) Sea Level changes impacting beach erosions (3) Invasive Species (4) Habitat alterations (5) Water quality in water sheds and (5) Gulf stream impact in the offshore areas off North Carolina Coast.


SYMPOSIUM LOGO

The organizers clearly defined the goal of this symposium as follows:

" To link government (local, state and federal), academia (public institutions including community colleges and UNC system schools and private institutions such as Duke University) and industries or corporations to focus on conservation and prudent management of North Carolina coastal (watersheds and beaches and open ocean ecosystems offshore)."

The organizers also arrived at an anticipated outcome of the 2006 symposium and came up with two ideas:

1. To continue the dialogue and decision-making progress in subsequent symposia on a three year cycles. (Next one planned for 2009).

2. To make recommendation to North Carolina Governor and coastal municipalities and counties what

needs to be done on the basis of synthesizing the existing knowledge of fisheries, water quality issues (sewage problems, hurricane flood impacts) and implemention of ecosystem-based management priorities by integration of governance structure, economics of growth and scope of prudent developmental goals.

The organizers invited scientists and managers from various entities in North Carolina to serve on the symposium planning committee. The names and affliations of these persons who participated in one or more planning meetings are identified below:

Symposium Planning Committee:

1. Robert Y. George, GIBS, Wilmington (Chair)
2. Douglas Rader, Environmental Defense, Raleigh (Co-Chair)
3. Michael Orbach, DUML, Beaufort.(Co-Chair)
4. Richard Barber, DUML. Beaufort
5. Larry Crowder, DUML, Beaufort
6. Anna Hitling, DUML, Beaufort
7. Len Pietrafessa, NCSU, Raleigh
8. Bill Queen, ECU, Greenville
9. Reide Corbett, ECU, Greenville
10. Anthony Overton, ECU, Greenville
11. Joseph Leukovitch, ECU, Greenville
12. Hans Paerl, UNC-Chapel Hill, Morehead City
13. Woody Hall, UNCW
14. Carolyn Mahoney, Provost. ECSU, Elizabeth City
15. Linda Hayden, ECSU, Elizabeth City
16. Jimmy Overton, Division of Water Quality, DENR, Raleigh
17. Lance Farell, Division of Water Quality, DENR, Raleigh
18. Lou Daniel, Division of Marine Fisheries, DENR, Morehead City
19. Mike Street, Division of Marine Fisheries, DENR, Morehead City
20. Heather Wells, Estuaries Program, Center for Marine Science, UNCW, Wilmington
21. Bill Caster, Chair, New Hanover County Commissioners
22. Donna Moffit, North Carolina Aquarium, Fort Fisher
23. Andy Wood, North Carolina Audubon Society
24. Steve Rebach, North Carolina Seagrant Program, NCSU
25. Bill Mansfiled, Carolina Marine Terminal, Wilmington
26.. Todd Miller, North Carolina Coastal Federation, Swansboro
27. Dwight Paeay, GIBS webmaster
28. Dane Herring, GIBS Adviser
29. Julia Berger, GIBS Adviser
30. Mary-Hawse, GIBS Board
31. Chandra George, GIBS Board
32. Walter, Dietch, GIBS Board

A series of four planning committee meetings were organized in the style of workshops in four different locations:

1. Duke University Marine Laboratories in Beaufort.
2. North Carolina Marine Fisheries Headquarters in Morehead City.
3. North Carolina Coastal Federation Head Quarters in Swansboro.
4. North Carolina Aquarium at Fort Fisher.

GIBS President with some of the GIBS Science Advisory Committee (Julia Berger and Dane Herring) also

conducted planning meeting in the following locations:

1. NCSU Campus with Dr. Steve Rebach of the NC Seagrant program.
2. UNCW-Center for Marine Science with Ms. Heather Wells of the Estuarine Research Program.
3. NC Marine Fisheries Office in Wilmington with Mr. Richard Carpenter and Mr. Andy Wood of the NC Audubon Society.

The symposium dates were firmed up as Nov. 30 to Dec.1, 2007 and the Carolina Beach Marriott Hotel was chosen as the venue with the public event on the opening day at Fort Fisher Aquarium Auditorium.

On Nov. 28 at 8.30 A.M Dr. Robert George made the symposium opening statement and reminded the audience of the famous statement of President John F. Kennedy: "Ask not what the country can do for you, ask what you can do for the country". Dr. George outlined the history of the second NC coast symposium and also discussed the goals of the symposium. He then introduced the mayor of Carolina Beach Hon. William Clarke who welcomed the symposium participants and also invited all for the Friday (Dec. 1) Lunch which he will host at the Marriott Hotel.

Mayor Clarke on the right with bow.

Mayor Bill Saffo of Wilmington City offered his welcoming remarks and outlined the challenges ahead with reference to environmental issues in the Southeast North Carolina. Just on the first day of the symposium the news broke out about a massive sewage spill in the Hewlett Creek in the city of Wilmington. The mayor is currently facing the costly issue of repairing the Northeast Interceptor sewage pipe system and also the "Storm water run-off issues from older neighborhoods". The cost of fixing the Northeast Interceptor is estimated far above 70 million dollars.

L to R: Mayor Clarke, Mr. Reggie Holley from Senator Elizabeth Dole' s office, Mayor Saffo and Bob George.

Mr Reggie Holley, chief of staff in Senator Dole's office presented a statement which clearly emphasized the Senator's position about a strict "No" to any plans for oil-and natural gas drilling or production off North Carolina Coast. This action reaffirms the Congress's moratorium for a ban on oil and gas activities off the entire Us East Coast. Mr. Holley's statement to the 2005 NC Coast symposium is particularly significant in the light of the current controversial discussions in the US

Senate concerning pros and cons of oil drilling off Virginia coast.

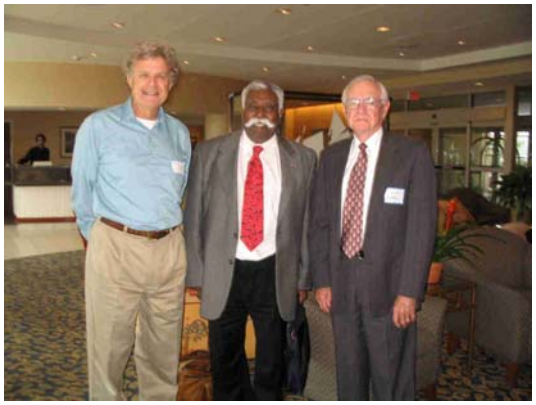
At 9.30 AM on Nov. 28, Prof. Michael Orbach of the Duke University began the science and management part of the symposium with one hour presentation entitled: “Overview of North Carolina Coast –Setting the stage for the conference. The main thrust of his talk is to take into account not just the biophysical science into consideration but also the socio-economic, anthropological and the governance issues for all three components of the symposium, namely (10 Watershed ecosystems (2) Beach, Inlet, Waterways ecosystems and (3) the Offshore blue water ecosystems form 3 miles to 200 miles at the boundary of the EEZ (Exclusive Economic Zone).

Prof. Orbach clearly pointed out that just as there are ecological systems and principles that define the biophysical elements of the coastal and ocean environments, so too are there ecological systems and principles that define the human and institutional elements of coastal and ocean environment. He stated emphatically “ Humans and their cultural values, beliefs, perceptions and behaviors and institutions they form to guide behavior form a core element of the science that needs to be produced and applied to issues of coastal and marine policy and management”.

Dr. Douglas Rader from the ‘Environmental Defenses’ in Raleigh, North Carolina chaired the first symposium session on Northeast Watershed Ecosystems from 11 AM to 1 PM. His past role as director of the Albermarle-Pamlico program and his present role as chair of the Habitat Advisory Panel to the South Atlantic Fisheries Management Council (SAFMC) enabled him to point out the current needs to take steps toward a changing coast with sea-level rise and global warming. Dr. Rader also emphasized the need for establishing ‘Marine Reserves’ in our watershed ecosystems and Marine Protected Areas (MPAs) in our continental shelf and offshore regions off North Carolina.

Prof. George outlined the challenges ahead, particularly in the light of offshore developments and the recent discovery of cold coral ecosystems at the edge of the Blake Plateau between 300 and 800 m and the need to protect these Essential Fish Habitats (EFHs) and take appropriate measures through South Atlantic Fisheries management Council (SAFMC) as deep-water coral HAPCs (Habitat Areas of Particular Concern).

The session keynote speaker Dr.Hans Paerl of UNC-Chapel Hill clearly discussed the impact of recent hurricanes such as *Floyd, Bertha* and *Fran* on the water quality of Pamlico Sound and Bogue Sound. He gave case studies from his recent research publications. Paerl used the Neuse River model and discussed the eutrophication problem inducing severe water quality deterioration in the estuaries with input of phospherus P-limited water from upstreams of freshwater segments and nitrogen N-limited saline downstream segments. He recommended adaptive management with N and P reductions to combat eutrophication problems, especially in the light of climate change and more frequent hurricane in recent years.



L to R: Hans Paerl, Bob George and David Adams.

The watershed ecosystems session included the following two speakers:

1. Dr. Wayne Linker, Beaufort Lab., NOAA – "Biological Studies in the Albermarle-Pamlico Sound"

2. Dr. Reide Corbett, East Carolina University, Greenville, NC – " Hurricane-related sediment transport off Northeast North Carolina Coast"

*The third speaker Dr. Nancy White, Director of the UNC-Coastal Studies Institute in Manteo, NC, was unable to participate because of her automobile accident on her way to the symposium. However, Dr. White sent her abstract of her paper entitled "Comparison of coliform bacteria loading for three different coastal watersheds using storm event monitoring and antibiotic resistence index data", authored by N. White, D. Line and L. Garrigan. The papers covered three watersheds: (1) Jumping Run Creek in Carteret County (2) Pettiford Creek watershed near Croatan National Park and (3) the South River watershed located in the northeastern Carteret county.

The second session of the symposium focused on the "Southeast North Carolina Water-shed Ecosystems from 2 to 3.45 PM on Nov. 30, 2007. This session was chaired by Ms. Julia Berger of the GIBS Science Advisory Committee.

The keynote speaker Dr. Michael Mallin from the Center for Marine Science (CMS), UNCW spoke on the following topic: "Environmental status of Southeastern North Carolina watershed".

Mallin reported results on water quality from 116 stations in the Cape Fear Estuary watershed, Tidal Creeks and New River Estuary. He pointed out that in Lower cape Fear watersheds low oxygen is a major problem along with fecal coliform count, some at point source areas and some in agricultural and CAFO influenced areas. However, he applauded the environmental conditions in New River where there has been "solid improvement" in waste water treatment upgrades and subsequent decreases in nutrients and algal blooms and also increases in dissolved oxygen.

His presentation is germane to ongoing management decisions in the local municipality (Wilmington City council) and the New Hanover County Commissioners' plan to mitigate sewage pollution in recent time, with 7.5 million gallons of sewwage dumpted during early July of past 2 years. Just in Hewlett creek on July 1, 2005 Northeast Interceptor burst, spilling about 3 million gallons of sewage. Mallin's research also revealed the woes behind storm water pollution in older residential areas in Wilmington which lack porous

(pervious) roads and pavements as in the newer residential areas..


The afternoon session (2 – 3.30 PM) included the following two presentations:

1. Mr. Andy Wood of the Audubon Society spoke on: “Balanced Development in Southeastern United States”. He recommended the need for compromise between developers and environmentalists to build new developments taking into account green space and storm water mitigation measures.

2. Dr. William Cleary of UNCW gave a presentation on “ Tidal Inlet Related Erosion Hot-Spots”. He covered in his talks fifteen” highly diverse” inlets between Cape Lookout in the north and Little River Inlet in the south in the North Carolina Coast. He pointed out that the barriers (Bogue Sound to Onslow Beach) are sand-rich and the barriers (Onslow Beach to Sunset Beach are sand-poor. All the chronic erosion zones in the Southeast North Carolina are associated with contemporary or historic inlets that have been artificially closed. All developed shorelines are now experiencing problems related to inlet-induced erosion (erosion hot spots). The hot spots are concerns of the governments (both state and federal) because of the tourist related needs for sand nourishments of NC Beaches despite Orrin Pilkey’s criticisms of state and Core of Engineers’ policies on beach nourishment and inlet dredgings.

Session 3 of the first day of the symposium was dedicated to: “ Governance: Management Perspectives of the Watershed Ecosystems” in North Carolina Coast. This session (3.45 to 5.30 PM) was chaired by Dr. Bill Crowell of the Albermarle -Pamlico program of the DENR.

The keynote speaker was Mr. Michael Street of the Marine Fisheries in Morehead City. His talk was on: “The North Carolina Habitat Protection Plan (CHPP)-Origin, Goals and Actions”. Mike discussed the North Carolina Fisheries Reform Act of 1997 in the light of CHPP. The long-term enhancement of coastal fisheries is the legislative goal of this Act. The plan involves a cooperative effort among state agencies with jurisdiction over marine fisheries, water quality, coastal management, environmental health and wildlife. The organization framework of the plan is based on fish habitat types including the water column, wetlands, submerged aquatic vegetation, shell bottom, soft bottoms and oceanic coast of North Carolina. The geographic area of concern includes all of the river basins that drain to the coast of North Carolina. The plan addresses all of the

six habitats, discussing distribution, ecological functions, status and trends, threats and management needs. CHPP has received legislative support and the plan has 19 recommendations, with implementation on a cooperative basis among many agencies.

Mike Street in Action

This session on governance included the following 3 presentations:

1. Ms. Rebecca Ellin, North Caroina National Coastal Reserves: "Estuarine Reserves in North Carolina-Ecosystem-based Management perspectives.

2. Dr. Bill Crowell, Director, Albermarle-Pamlico Sound Program, DENR: "Citizen-driven Ecosystem-based management"

2. Mr. David Adams, Formerly Assistant Secretary of the Department of Natural Resources (Now DENR): "North Carolina Fisheries –Then and Now".

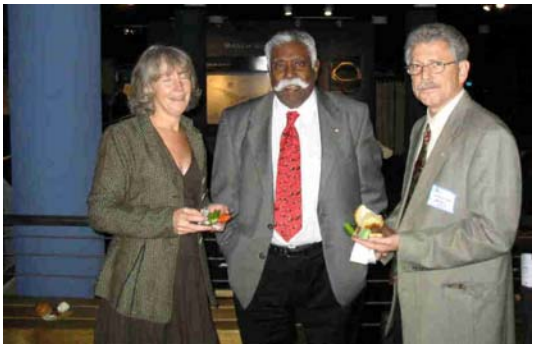
Dr. Doug Rader, symposium co-organizer summarized the outcome of the first day of the symposium (See Symposiun Findings and Recommendations) in this 'GIBS Report' at the end.

FIRST DAY EVENING GALA AT FORT FISHER AQUARIUM
7 to 9 PM, Nov. 28, 2007

At 6.30 GIBS gave a reception for all symposium participants with guitar music, plenty of food and soft drinks and cocktail doe the thirsty souls. The highlight of the evening was the invited public lecture at Fort Fisher Aquarium a fascinating slide presentation by the new director of the Duke University director Dr. Cindy Lee Van Dover.

Ms. Donna Moffitt, director of the Aquarium welcome the audience that included 80 persons, with many local public including the mayor of Carolina Beach Mr.William Clarke.

Prof. Robert George, President of GIBS, introduced Dr. Cindy van Dover as follows:


Cindy Van Dover, Bob George and Paul Sandifer.

In the words of Bob George: "Prof. Cindy van Dover is a world-renowned marine ecologist with a heavy leaning on chemosynthetic ecosystems, as evidenced from her popular book entitled "Deep-Ocean Journeys"

published by Addison-Wesley in 1997 (written for laymen). Cindy also wrote scholarly text book-"The ecology of Deep-Sea Hydrothermal vents", published by Princeton University Press in 2000. Dr. Van Dover recently joined Duke University as Professor and Director of Duke Unversity marine Laboratory in Beaufort, NC.

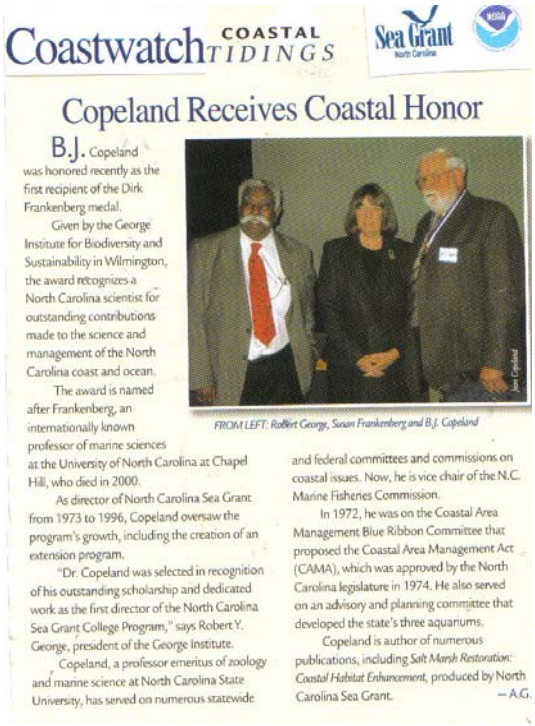
Dr. Cindy Lee van Dover gave a fascinating lecture on her adventures aboard ALVIN in exploring the chemosytnhetic ecosystems in the world oceans, including her work off the Carolinas in the soft-sediment cold seep ecosystem in the Bake Nose area in the Northwestern Atlantic ocean.

Prof. George invited Dr. B. J. Copeland to come forward to receive the Dirk Frankenberg Medal, established by George Institute for Biodiversity and Sustainability (GIBS) in memory and honor of Prof. Dirk Frankenberg who died prematurely when he was the chair of the UNC-Chapel Hill Marine Science Program. The medal was presented by Mrs. Susan Frankenberg who graciously came for this auspicious occasion.

Dr. B. J. Copeland was selected by the GIBS anonymous committee. Dr. Copeland recived his Ph.D. from Oklahaoma Stae University in 1963. He served as director of North Carolina Seagrant College from 1973 to 1996. Dr. George called him one of the architects of marine science in North Carolina and told the audience that he served with BJ as a member of the UNC-marine Science Council for many years along with late Prof. Dirk Frankenberg. Prof. Mike Orbach, who was chair of the NC Marine Science Council and worked closely with Dr. Copeland , praised BJ for his outstanding contribution to North Carolina coastal science.

The following photographs amply tell us who were there in this medal-award ceremony.

BJ thanking GIBS for the recognizing him with the first Frankenberg Medal



Coastwatch COASTAL TIDINGS

Sea Grant North Carolina

## Copeland Receives Coastal Honor

B.J. Copeland was honored recently as the first recipient of the Dirk Frankenberg medal.

Given by the George Institute for Biodiversity and Sustainability in Wilmington, the award recognizes a North Carolina scientist for outstanding contributions made to the science and management of the North Carolina coast and ocean.

The award is named after Frankenberg, an internationally known professor of marine sciences at the University of North Carolina at Chapel Hill, who died in 2000.

As director of North Carolina Sea Grant from 1973 to 1996, Copeland oversaw the program's growth, including the creation of an extension program.

"Dr. Copeland was selected in recognition of his outstanding scholarship and dedicated work as the first director of the North Carolina Sea Grant College Program," says Robert Y. George, president of the George Institute.

Copeland, a professor emeritus of zoology and marine science at North Carolina State University, has served on numerous statewide and federal committees and commissions on coastal issues. Now, he is vice chair of the N.C. Marine Fisheries Commission.

In 1972, he was on the Coastal Area Management Blue Ribbon Committee that proposed the Coastal Area Management Act (CAMA), which was approved by the North Carolina legislature in 1974. He also served on an advisory and planning committee that developed the state's three aquariums.

Copeland is author of numerous publications, including *Salt Marsh Restoration: Coastal Habitat Enhancement*, produced by North Carolina Sea Grant. – A.G.

FROM LEFT: Robert George, Susan Frankenberg and B.J. Copeland

BJ and his beloved family with Susan & Bob

L to R" Mike Orbach, Susan, BJ, Doug Rader and Bob George.

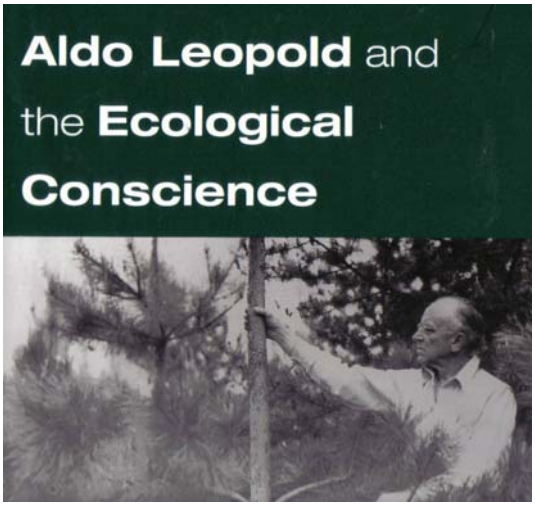
Applause at the end: Susan, Bob and BJ.

The evening function came to an end with a round of applause for the guest speaker Cindy and medallist BJ.

SECOND DAY: November 29, 2006

Symposium shifted gear to the marine theme from estuarine theme on the first day. The morning session, entitled "NC Beaches to the EEZ (200 miles) was chaired by Prof. Mike Orbach.

The keynote speaker for this session was Dr. Robert Y. George and his talk was titled: "North Carolina People and Coastal issues". At the outset, he appealed to the audience to give reverance to the founders of conservation science such as Aldo Leopold who created the ecological conscience on nature and Rachael Carson who saved the birds and wildlife by initiating the government action on banning DDT.




Conservation champion Aldo Leopold

This symposium also emphasized the need for action at the local county and city levels for promoting not only nature conservation goals but also energy conservation issues. Dr. George pointed out an ongoing project in planning stage for a joint venture between Wilmington City and New Hanover County to develop "Eco-Trails" in the Halyburton Park, Dobo Park, Ann McCrary park, Greenfield Park, Cape Fear River Walk and Arlie Garden along the Bradley Creek to install displays for public

education and to promote outreach activities.

A Marine Reserve in the bank of the Taylor Creek in Beaufort is named in honor of the conservation guru Rachael Carson in Beaufort town in North Carolina.

Dr. George spoke about the following three issues that occupy the minds of the North Carolina people and the government. (1) Coastal citizens and their year-after-year battle to fund beach nourishment to maintain the summer economy through tourism, (2) The decline of fisheries and fishing stock in the continental shelf zone from shore to 3 miles in state waters and 3 to 200 miles in the federal waters as a consequence of over-fishing and also climate-change related recent decadal shift and (3) Navy's plan to develop a sonar testing site which may threaten the integrity of the ecosystems, particularly the cold corals reefs which he recently described as "Ben Franklin Reefs" at 30-40 m below the Gulf Stream in the midshelf in Onslow Bay and also the offshore *Lophelia* reefs that he described as "Agassiz Coral Hills" from 400 –800 meters in the western edge of the Blake Plateau off Cape Fear, North Carolina.

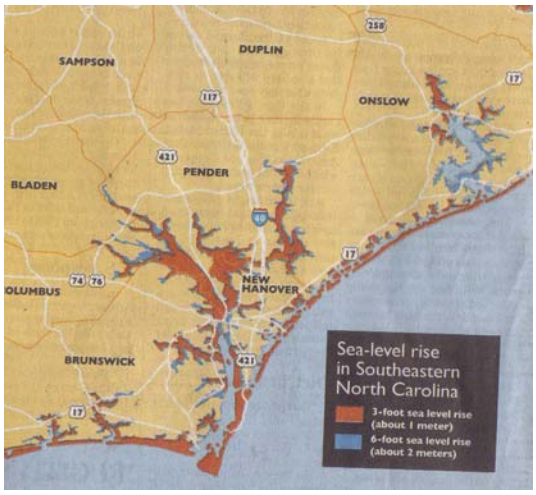
The morning session (8.3- to 10.30 AM) included the following four presentations:

1. Dr. Chris Dumas, UNCW Cameron School of Business: "Value of Beach Recreation".

Chris pointed out that the Beaches in the Southeastern North Carolina are main attraction for tourism, particularly in the spring and fall. This economic benefit needs to be sustained to keep a robust cash flow to the coastal beach towns and the city of Wilmington in the New Hanover County.

NC Beaches are bambarded by erosion problems caused by storms and hurricanes and this process demands need for federal dollars for re-nourishment. The lack of support in recent years and the controversies,

associated with it, have been the subject of local newspapers “Star-News” in the coast of North Carolina. The report on sea-level increase may engulf of beaches is evident from the somewhat blown-up or exaggerated newspaper figure that is shown below.




“Loins” (see the loins in Bald Heads Island Beach)

Loins are favored in land over seawalls and jetties to prevent beach erotion. North Carolina Beaches are often visited by surfers for recreation as seen in photo below.

2. Dr. Paul Sandifer, Hollings Marine Laboratory, Charleston, SC and member of the US Ocean Commission: “Coastal Health-Human health linkages”.

Paul told the audience that evidence is accumulating that health risks to human living, working or recreating in coastal areas and exposed to coastal waters and seafood increase with degradation of the coastal environment. For example, increasing frequency and intensity of harmful algal blooms (HABs), which may occur in response to non-point source runoffs and other pollution, result in greater potential for humans to be exposed to HAB toxins via contact with water, breathing of toxin-laden aerosols on beaches or through consumption of contaminated shellfish.

Paul also pointed out that pollution of estuarine and coastal waters via sewage overflows, leaking septic tanks, and runoff from urbanized, suburban and

agricultural lands may expose beach-goers and recreational fishermen to elevated levels of human pathogens, resulting in gastrointestinal and other illness. The culture at the coast is to abandon our beaches in the winter months and come to beaches in the summer and fall. Large crowds congregate along the beaches in the Southeastern North Carolina. It is thus the obligation of the government to keep the beaches clean and healthy.

Picture above shows the sand-strolling , sun-bathing and fishing folks and "sweating and jostling" humanity behind the symposium venue-Marriott Hotel in the summer of 2007 on Memorial Day week-end in Carolina Brach.

Accumulation of many chemical contaminants, including the well-known PCBs and others of emerging concern such as human and domestic animal use pharmaceuticals, flame retardants, and new pesticides, in marine sentinel species such as marine mammals indicate potential health threats to humans. In conclusion Paul informed the audience that US Commission on Ocean Policy recommended development of an interagency Oceans and Human Health (OHH) research program based on efforts within NOAA, NSF and NIEHS, as mandated by the Oceans and Human health Act of 2004.

3. Mr. Andy Shepard, National Undersea Research Program at UNCW-Monitoring the deep-water ecosystems.

Andy informed the audience that Ocean resource regulatory agencies have imposed a number of marine managed areas (MMA) in the federal waters off North Carolina. Most recently, South Atlantic Fisheries management Council designated Deep-Sea Coral Habitat Areas of Particular Concern and is publicly scooping designation of NC shelf-edge marine protected areas (MPAs) for conservation of reef fish populations.


Mr. Andy Shepard, Director of the Under-Sea Research Center UNCW, addressing the conference.

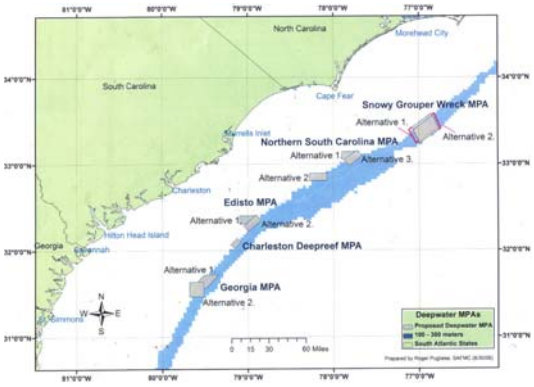
Andy discussed the approach for monitoring these protected areas offshore and also projected cost for research and monitoring.

3. Dan Whittle, Environmental Defense, Raleigh, NC- "The Future of Fishery management in the South Atlantic Region".

Dan discussed the role of the South Atlantic Fisheries Management Council in proposing MPAs in the offshore areas of the Southeaster United States, threats to marine resources and efforts of the SAFMC to address over-fishing and to protect habitats. As a lawyer, he emphasized the need for taking into

account the science, fishermen's interest and management strategies for implementing and maintaining a sustainable fisheries of the coast of the Southeast United States. Between 100 and 300 meters, several Marine Protected Areas (see photo below for MPAs off Carolinas, including the Snowy Grouper MPA off Cape Fear, NC) have been selected by the Amendment 14 of the Snapper-Grouper Protection Plan of the SAFMC. He also explained the Amendment 13 C(over-fishing amendment) and the potential use of IFQ or other dedicated access privilege program (DAP) in the multispecies snapper-grouper fishery

Presently plans are undeway for also establishing deep-sea Cold Coral HAPCs which will include 2 sites off North Carolina coast off Cape Haterras and Cape Fear and several sites off Florida Atlantic coast.




Shelf Break MPAs off Carolinas.

**Climate Change and Weather**

PANAL DISCUSSION
10.30 AM to 12.00 noon
Panel Moderator: Dr. Paul Sandifer

The following two presentations were made:

1. Dr. Machuan Peng, North Carolina State University: "Hurricane Induced Flooding on the NC Coast: An Advanced Methodology for Emergency Management and Local Communities"

2. Dr. Shaowu Bao, North Carolina State University: "Weather Prediction Models"

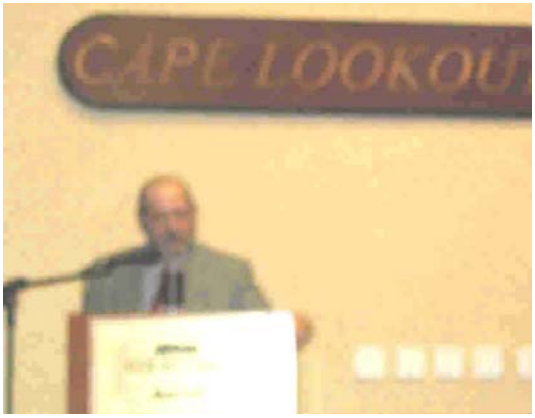

There was a lively discussion for one hour with many questions and comments from the audience.

**Symposium Lunch**
**at Cape Fear Ball Room**

Luncheon Speaker: Dr. Michael Voiland, Executive Director of the North Carolina Seagrant Program (UNC System):

"Update on the work of NC Legislative Water Front Access Committee"

Mike gave an overview on the status of the Committee's recommendation to the General Assembly. In July 2006 the North Carolina General Assembly established, by state statute, a Waterfront Access Study Committee (WASC) charged to "study the loss of diversity of uses along the coastal shoreline of North Carolina and how these losses impact access to the public trust waters of the state". In tasking the committee, the state sought guidance on potential solutions, including "incentive-based techniques and management tools" to preserve waterfront diversity within North Carolina.



Dr. Voiland adressing the audience.

The committee report is now completed successfully and is available in the NC Sea-Grant website.

There are several fishing piers that simply disappeared in North Carolina, making way for large oceanfront private homes. One such example is the Long Beach Pier in Oak Island. Presently, the Carolina Beach Fishing Pier, not too far from the symposium venue, is for sale. The asking price is $ 3 million which is a bargain. These piers provided economic benefits, encouraging tourism in spring and fall seasons. Their disappearance will make angler sad since they came to fish year after year and generation after generation. Ms. Donna Moffitt, director of the NC Aquarium at Fort Fisher appealed to the symposium organizers during this conference to make all these vanishing fishing pier available for North Carolina Aquarium Society to use these unique "windows to our shore marine life" as educational platforms.

**Afternoon Session on Governance and Management (1.30 to 2.30 PM):**

This session was chaired by Mr. Dane Herring of the GIBS Science Advisory Committee.

Speaker: Mr. Rich Carpenter, District Manager, North Carolina Marine Fisheries, Wilmington, NC. He spoke on "External Influences on Local Fisheries Management".

Rich discussed the influences of local land use, habitat alteration and changes in regional, national and international fisheries management on local fisheries management. He concluded that there is significant impact

in the Southeastern North Carolina, particularly on shellfish, shrimp and snapper-grouper fisheries.

**Final Session of the Second Day:**

**Theme 3: Large Scale Issues**
(2-30 to 5 PM)

Moderastor: Dr. Len Pietrafesa (NCSU)

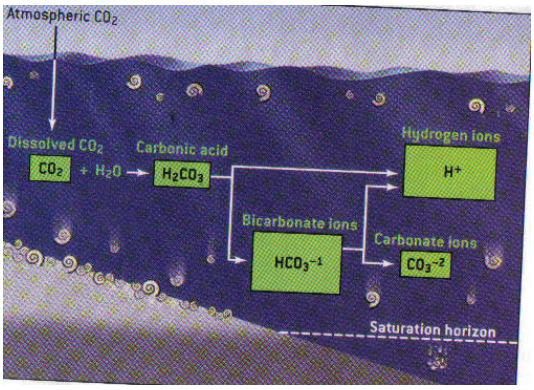
The following 3 presentations were made:

1. Dr. Joe Luczkovich, East Carolina University, Greenville. "Multi-species management: Construction of network Modles of fisheries in NC Coast.

2. Dr. Len Pietrafesa. North Carolina State University, Raleigh.
" Oceanographic Processes off Cape Haterras, North Carolina Coast"

2. Dr. Bob George, George Institute for Biodivesity and Sustainability, Wilmington.
"Ocean acidification and global warming"

This paper particularly focused on the risk imposed by ocean acidification, in the long run, to shell-baring animals in the seas, particularly tropical and cold corals reefs, including the recently discovered *Lophelia* reefs off NC Coast. The slight decrease of 0.4 pH can bring about "osteoporosis syndrome" to corals and mollusks, due to Carbon Dioxide flux, as elucidated in the following diagram.




Len Pietrafesa summarized all the presentations in the day in the following manner.

1. Ecosystem management is the best approach but it must include human alterations and impacts as part of the total ecosystem.
2. Fisheries is more about managing people than about managing fish.
3. The $ value of recreational fishing must be considered in any economic assessment, estimate or forecast of societal or community impacts of fisheries management as part of a decision-making process.
4. Economic network assessment models reveal much of the detail of the end to end network and tradeoffs involving fisheries and thus have value as management tools.
5. Fishing practices can be highly destructive to the environment and to living marine resources; but there are relative trade-off that can be estimated.
6. Cape Hatteras is a zone of confluence for both oceanic provinces and atmospheric provinces where physical and biological processes organized and couples.

7. Cape Hatteras is a zone for terrestrial and marine carbon sequestration.
8. There are strong, well defined couplings between the year class strength of estuarine dependent finfish and environmental factors in the Cape Hatteras region.
9. Cold coral communities are degrading and diminishing in NC continental margin waters and these effects may be related to climate change and ocean acidification.
10. Bottom trawling is very deleterious to the structural integrity of coral reefs not only in tropical waters but also in the deep-sea.

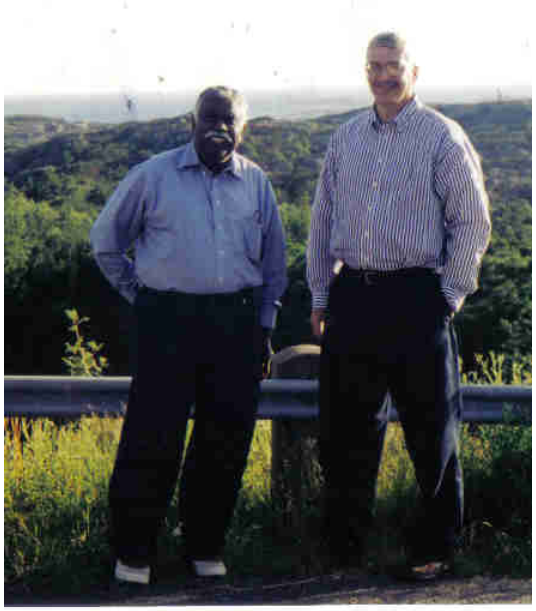
**Concluding Remarks**: Dr. William Schlesinger, Dean, Nicholas School of Environmental Studies, Duke University.

Dr, Schlesinger observed that the session today brought to focus diverse multidisciplinary approach to the assessment and management of North Carolina Coastal ecosystems. He also shared his research on acidification field experiments in a none-on-one discussion with the symposium co-organizer Bob George after the symposium in a meeting in Research Triangle Park. He recommended that NC Coastal ecosystem symposium should continue.


Dean William Schelisnger speaking to the symposium participants.

**Evening Banquett at 7 PM**

At the out set, Prof. Mike Orbach proposed a toast to Prof. George for hosting the second NC Coastal Ecosystems symposium. Bob George thanked both .Doug Rader and Mike Orbach for their immense help in joining him to co-organize the symposium. He then introduced the Provost of UNCW Dr. Paul Hosier to speak to the participants with warm greetings from UNCW Chancellor Rosemarie Depaolo. Dr. George recalled in his introduction his experiences in Sweden not only meeting the King of Sweden but also provost Paul who came all the way to witness the marine biology summer course with a dozen UNCW students.



Bob and Paul in Sweden.

Provost Hosier congratulated the symposium organizers for the success of this event in bringing together scientists and managers from academia, government and corporations in North Carolina. He also reminisced his memories of driving with Bob under the "rain-bow" in Sweden ad ending up in the wrong airport to catch a return-flight to the United States. Then Mrs. Mary-Lee Hawse, member of the board of governors of GIBS thanked all symposium participants for making contributions to the success of this symposium. Subsequently Mr. Andy Wood of the North Carolina Audobon Society presented a fascinating lecture on the "Conservation of Wildlife along North Carolina Coast".

Andy Wood, author of the 2006 book "Backyard Carolina: Two decades of public radio commentary", also explained the plants and animals (small and big) that we commonly encounter in the plains and along the shore. He described the beauty and uniqueness of the so called "Carolina Bays".

Andy Wood of NC Audobon Society at work in the field!

THIRD DAY: Nov. 30, 2006

WORKSHOP: Future of NC Coast with emphasis on watersheds, beach and offshore to EEZ at 200 miles.

The watershed issues were discussed by Todd Miller (Executive Director of the Coastal Federation of North Carolina for watersheds). Doug Rader addressed large scale issues (sea-level rise hurricanes etc) and Bob George addressed offshore reefs including MPAs for mid-shelf, shelf-edge and deep-sea *Lophelia* reefs.

At the end of the workshop, the symposium organizers (George, Orbach and Rader) spent 2 hours to generate recommendations that are presented below as 'Symposium Findings and Recommendations" a part of the 'GIBS Report on 2006 symposium on North Carolina Watershed, Beach and Marine Ecosystems'.

FOURH DAY; December 1, 2006.

The day was devoted to emerging issues in North Carolina. The following five presentations were made:

1. "Beach Nourishment and Inlet Dredging Issues in New Hanover County" by Capt. William Caster, Chairman of the New Hanover County Commissioners.

2. "Bottle Necks for Progress: Conservation of Living Resources off NC Coast" by Mr. William Mansfield of Wrightsville Beach.

3."OLF site in the Pocosin Wildlife Researve Area in the Outerbanks" by Dr. Clarence Styron, Director, Outerbank Center for Wildlife Education, Corolla.

4."Impact of Navy Sonar Installations on Deep-water coral Habitats: Midshelf Ben Franklin Reefs and *Lophelia* reefs off NC coast" by Dr. Robert Y. George, Presidet, GIBS, Wilmington, NC.

5. "Southport Superport: Pros and Cons" by Prof. William (Woody) Hall, Senior Economist at Cameron School of Business at UNCW.

The lunch was hosted by the mayor of Carolina Beach Hon. William Clarke. The luncheon speaker was Dr. Ronald Baird, Adjunct Professor at UNCW (former director of NOAA National Seagrant Programs).

See photo above, Dr. Baird in action! The title of his talk: "Ecosystem Based Fisheries management: MPAs as Tools for fisheries management".

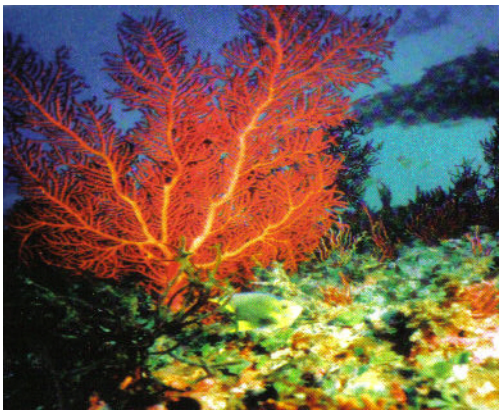
The pinnacle (highlight of the day was the presentation by Dr. Robert George of the second GIBS's "AVENT MEDAL" to Dr. William Hogarth, NOAA Assistant Administrator for Fisheries. Dr. Hogarth, while receiving the medal. Discussed in response to questions the following national and international emerging issues: 1. Possible development of offshore fish-farms in the future and 2 Issues concerning scientific whaling by Japan. Dr. Hogarth is currently the chair of the International Commission for Whaling (ICW).


Dr. George awarding Avent Medal.

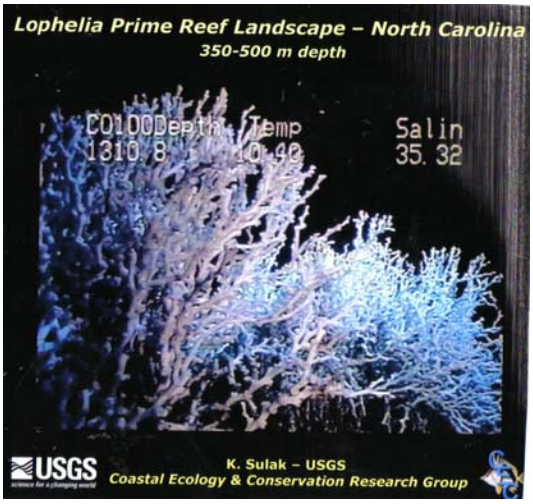

Dr. Hogarth givng the 'medal acceptance speech' at Marriott Hotel, Carolina Beach.

Dr. George congratulating Dr. Hogarth who served as a the Director of North Carolina Marine Fisheries in Morehead City , North Carolina prior to becoming the head of the fisheries for the entire nation as Director of NOAA Fisheries.

Dr. Hogarth was fondly applauded by the audience (standing) for (1) his dedicated service to North Carolina and (2) the promotion the US Fisheries, (3) also for his leading role in the conservation of the fisheries of the world oceans and (4) his work in the helm of the Atlantic Tuna Commission which he now chairs.



Ben-Franklin Reef-GIBS – Proposed SPA (Science Priority Area A) off Cape Hatteras off North Carolina Central Coast.




GIBS REEF at 400 m off North Carolina (photo from Navy Sub. NE-1, courtesy of Dr. Ken Sulak, USGS). GIBS has propsed that this reef be made a Science Priority Area B (SPA).

"TAKE PRIDE IN NORTH CAROLINA COAST" –Symposium motto.

**Symposium Findings and Recommendations**
**(Prepared at the close of the symposium by George, Rader and Orbach)**

**"North Carolina Coast: You and Your Ecosystems"**

**28 November – 1 December 2006**
**Carolina Beach, North Carolina**

## I. General Findings

1. Ecosystem-based Management and the "Total Ecology" of the North Carolina Coast and Ocean

Two companion concepts should guide North Carolina's approach to coastal and ocean management: 1) Ecosystem-based management; and 2) the concept of the "total ecology" of an ecosystem.

a. Ecosystem-based Management

Ecosystem-based management is defined as [insert your favorite definition] the management of human behaviors that affect, or are affected by, a specific biophysical environment, through a specified set of governance institutions.

b. The "Total Ecology" of North Carolina's Coastal and Ocean Environments

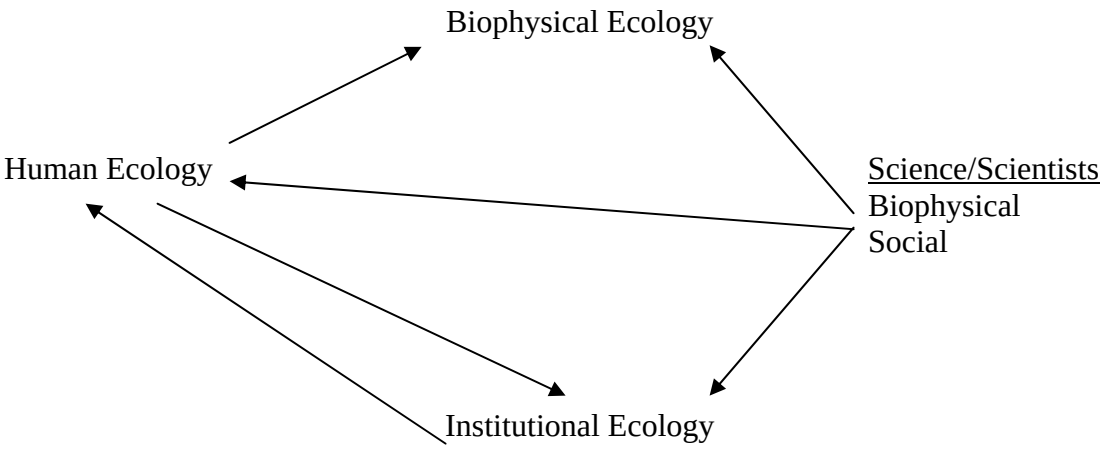
Just as there are ecological systems and principles that define the biophysical elements of coastal and ocean environments, so too are there ecological systems and principles that define the human and institutional elements of coastal and ocean environments. Humans and their cultural values, beliefs, perceptions and behaviors and the institutions they form to guide behavior form a core element of the science that needs to be produced and applied to issues of coastal and marine policy and management. If we do not proceed with a 'mirror image' of social science to match the biophysical science, we will not have the understanding, information and tools that we need to effectively sustain and manage our coastal and ocean environments and resources.

Our general perspective is that of the "total ecology" of coastal and marine systems – biophysical, human and institutional. Figure 1 displays this general relationship. For any defined biophysical coastal or marine ecological system (the EEZ of a country; a particular watershed and its nearshore contiguous area; an LME; a biophysical system defined by a migratory fish pathway) there are associated human and institutional ecological systems.[1] We define the human ecology as those humans and human

[1] Every situation of marine conservation presents the need to set boundary conditions on the biophysical, human and institutional ecological systems to be discussed. To avoid dissolving into a "butterfly effect" (where everything affects everything else), these boundary conditions must be specified. So, for example, in the case of conservation of a stripped bass fishery the number of links up and down the stripped bass trophic web must be specified, as must the habitats of principal concern to the stripped bass. The particular

behaviors that affect, are affected by, or are otherwise concerned with the defined biophysical ecology. We define the institutional ecology as those governance institutions that govern or affect the behavior of those in the human ecological system.[2] So, for example, if we are considering the stripped bass that spawn in the tributaries of the Albemarle Sound, the biophysical ecology is defined by that stripped bass populations and their habitats throughout their migratory range. The human ecology consists of those humans and their behaviors that affect the stripped bass directly (fishing) or the stripped bass habitats (development, impoundments), or even the biophysical trophic linkages with stripped bass (predators, prey). The institutional ecology consists of those policy and management institutions (state, regional, national, international) whose policies and rule-making affect the defined human ecology. There are, of course, feedback loops among all of the elements of this "total ecology", including the relationship between the role of "civil society" and our formal public trust institutions.

Figure 1: The Ecology of Marine Conservation




Notes:

1) Human Ecology (behavior) affects Biophysical Ecology (and, actually, vice versa)
2) Institutional Ecology (laws, policies, regulations) affects Human Ecology (behavior)

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set of humans and their behavior most associated with the stripped bass and stripped bass habitat must be defined. And, the institutions associated with the governance of the behavior of those humans must also be specified.

[2] Since all governance institutions are composed of people, in a sense the institutional ecology is a subset of the broader human ecology. We separate them to emphasize the public trust aspects of authority and responsibility that are attendant on these institutions. In particular, the assignment of authority over the behavior of others is a unique characteristic of public trust governance institutions. In addition, the assigned structure of authority and responsibility exhibits defined interconnections among these institutions, and between those institution and the people whose behavior they govern.

3) Human Ecology affects Institutional Ecology (voting, participatory governance)
4) Science studies the Biophysical Ecology (biophysical science) and the Human and Institutional Ecology (social science)
5) Science provides input to the governance process (Institutional Ecology)

2. Observing/Monitoring

North Carolina should have a comprehensive, integrated, essential, real-time environmental monitoring system for biophysical and socio-economic variables extending from the head of the watersheds to the Gulf Stream, including both the currently-proposed IOOS (**Integrated Ocean Observing System)** integrated with companion terrestrial and estuarine systems **as well as world-wide links (GOOS-Global Ocean Observation Systems).**

3. Research

Following the recommendation of the USCOP (US Commission on Ocean Policy), the federal budget for coastal and ocean research should be doubled. **However, it is important to identify to the US Congress the gaps or added needs of dollars (funding) for the substantial uplift to current levels of budget for various ocean-coast oriented federal agencies**. Sources for comparable increases in resources available to state and local governments for environmental protection should be developed.

4. Climate Variability and Change, and Storms

Ecosystem-based management planning at all levels must take into account the current clear evidence of climate variability and change such as:

A) sea level rise
B) increased frequency of occurrence and size of tropical and extra-tropical storms
C) altered precipitation and river discharge

The role of high-intensity events such as hurricanes and extra-tropical cyclones ("northeasters") in shaping coastal processes cannot be overstated, but is often poorly understood and is rarely integrated effectively into environmental planning **as well as budgetary considerations at local (county, municipal), state and federal levels.**

5. Comprehensive Coastal and Ocean Planning

Following the recommendations of the Pew Ocean Commission and the USCOP, a regional ocean governance structure should be established that:

A) creates an "ocean stewardship area" including the EEZ off North Carolina (see Oregon example) that, when combined with the existing state responsibility and authority for terrestrial and nearshore areas, results in a

'watershed to the limits of the EEZ' planning zone centered on North Carolina; and

**B)** Works towards a regional governance system that includes the authorities and responsibilities of North Carolina's state and local governments and those of adjacent states, and relevant federal agencies. **This approach may imply a departure from the existing "geopolitical boundaries established for the 8 fisheries management councils (Fig. 2) and should also take into account the boundaries and subzones of the established Large Marine Ecosystems (LMEs) adjacent to the U.S. (Fig. 3).**

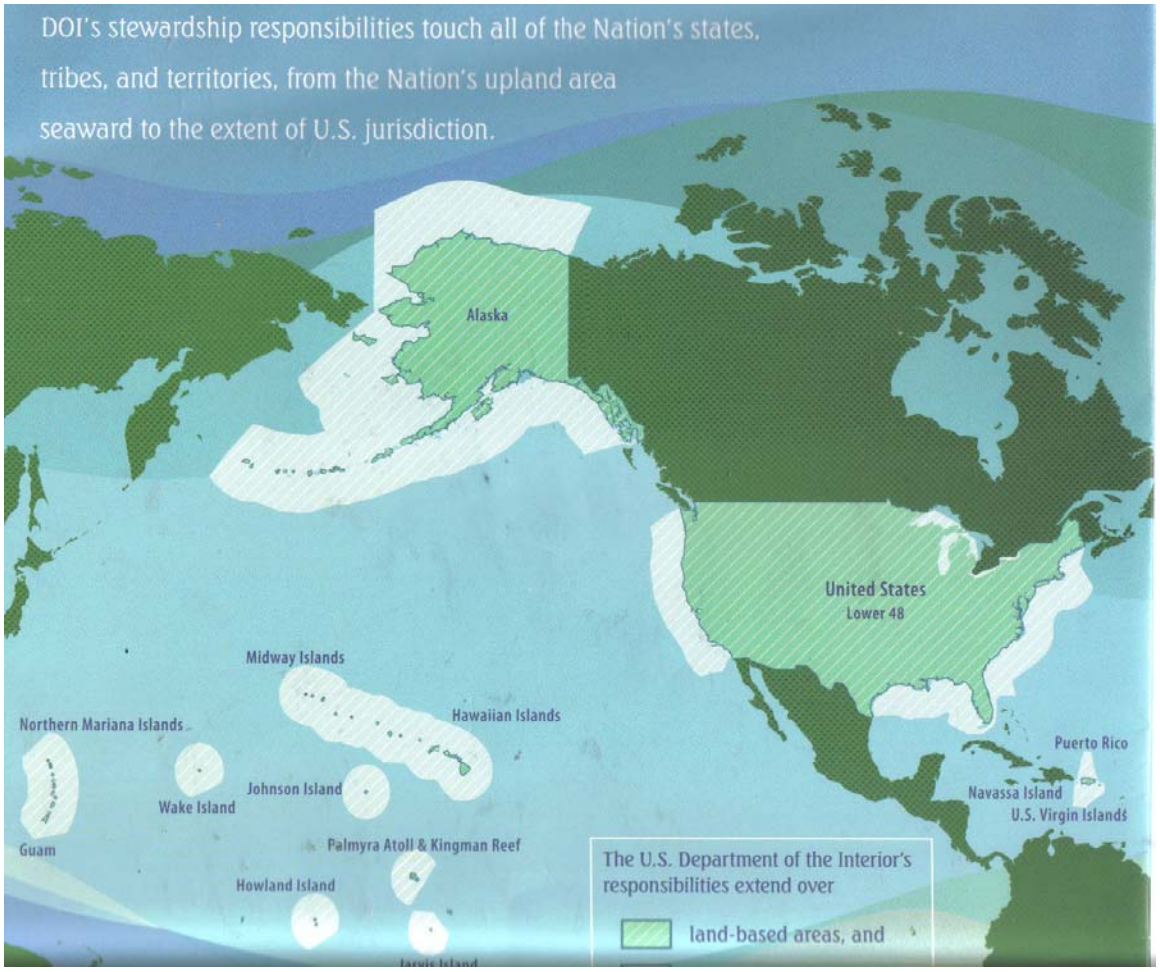


**Fig. 2. Areas marked by the white patch represent the EEZ boundaries around the United States.**

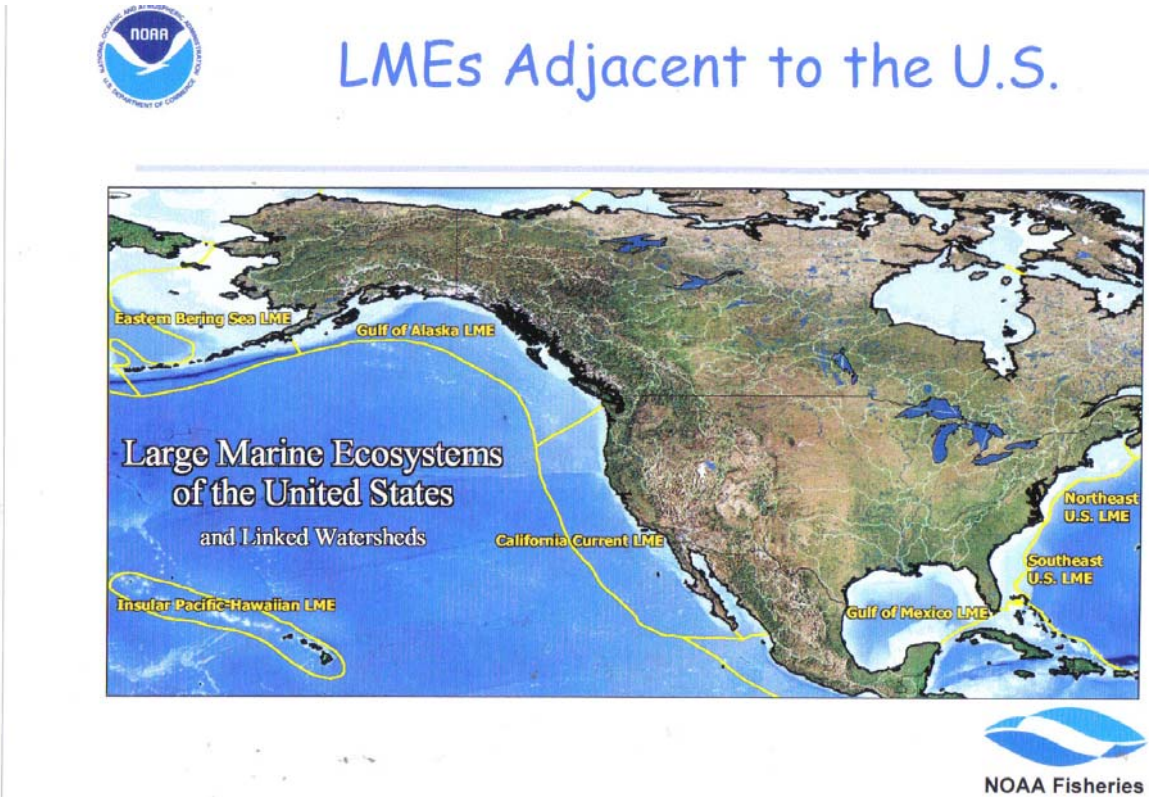


**Fig. 3. The 7 LMEs around the United States are indicated by the yeelow line.**

C) Ocean Policy Report DCM **(Orbach to expand**)

6. Education and Outreach

Significant additional resources should be devoted to education and outreach concerning ecosystem-based coastal and ocean policy and management for all sectors of the public and government officials at all levels. Logical conduits for this education and outreach might be:

A) The North Carolina Sea Grant College Program
B) The DENR Office of Environmental Education
C) The North Carolina Aquariums
D) The North Carolina Partnership for the Sounds (Estuarium, etc.)

7. Enforcement

Management programs are in place that, if effectively implemented could address many of coastal North Carolina's most compelling environmental problems. Adequate enforcement programs and the resources necessary to achieve effective enforcement of existing laws and regulations must be developed and committed to this essential task..

8. Longer Term Policy and Planning

Over and above the other specific recommendations for policy and planning under current mandates and the two Ocean Commissions' recommendations, active consideration should be given to the development of forward-thinking and innovative concepts such as total carbon and nitrogen budgets on state- and region-wide scales, and the means to implement those budgets such as carbon or nitrogen trading systems.

9. North Carolina in the Regional Sea and Global Ocean

North Carolina's location at the conjunction of several large-scale ecological systems, and keystone role as a nursery ground for each, means that what happens here affects living marine systems and human users far beyond our borders. Conversely, we are also profoundly affected by things that happen both up-current and down-current. Planning for sustainable ecological futures must address important processes at all appropriate scales, from individual backyards and small, local watershed to large watersheds, the state's coast, the regional sea, and the global ocean.

10. Partnerships

Success depends upon extensive and diverse partnerships including all stakeholders and institutions, and based on commonly held understanding of each other's needs, and expressed in commonly held language.

## II. Watersheds

The North Carolina coastal ocean is unusual in its degree of connection to both inshore, watershed-based processes and offshore and long-shore physicochemical and biological processes. Complex organism life-histories that utilize rivers and sounds, inlets and long-shore currents, and larger-order oceanic processes are the norm rather than the exception, including diadromous fishes (upstream/downstream spawners) and many others. Human cultures and societies have taken advantage of this unusual bounty throughout history.

Findings and Recommendations

1. Watershed Integrity. Ecological functions of the coastal zone are degraded by alterations of water flows, materials loads (especially for nutrients, sediment, oxygen-demanding substances, toxicants and pathogens), and habitat degradation for both terrestrial and aquatic organisms. While the impacts of greatest concern vary with location and scale, stormwater flows and drainage systems are major contributors to ecological problems throughout the coastal zone. In addition, accumulating direct and indirect impacts of piecemeal change remain among the greatest challenges to existing management programs. Management programs are in place that if effectively designed and implemented could address most watershed problems in coastal North Carolina.

Recommendation: All existing watershed-related management plans (e.g. the NC Coastal Habitat Protection Plan [CHPP], basinwide management plans, wetland restoration plans) should be fully implemented, including adequate resources for enforcement, outreach and education, and research and monitoring.

Recommendation 3: Specific goals should be developed for every coastal watershed for i) the hydrologic regime, ii) materials loads, and iii) habitat condition (type and extent). Programs adequate to achieve those targets should be developed and implemented, taking cumulative and indirect impacts into account.

Recommendation 4: Monitoring programs adequate to track changes in coastal condition (water quality, habitat integrity, living resource condition, and human well-being) should be implemented throughout the coastal zone. The Albemarle-Pamlico National Estuary Program environmental indicator and monitoring program should become an effective pilot.

Recommendation: All new and existing watershed management plans should adequately consider accumulating impacts, both direct and indirect, of piecemeal change. Where basic science limits this application, then funds must be found to address this key need.

Recommendation: All new and existing watershed management plans should take into account the likelihood of more frequent and more intensive storms and rising seas.

2. High-Value Habitats: Many of the most valuable habitat types in the estuaries are either already severely degraded (e.g. shellfish beds and reefs), or are at increasingly serious risk (e.g. primary and secondary nursery areas and diadromous nursery areas). The recent movement to develop the "inner banks" constitutes a serious threat to important and incremental estuarine habitats.

Recommendation: The most valuable fish habitats (including spawning and nursery areas, submerged plans beds and shellfish beds, and other Strategic Habitat Areas) and wetland habitats (e.g. marshes, bottomland swamps and pocosins) in the region should receive elevated protection, and should be restored wherever possible. Oyster reefs are a specific example of particularly valuable habitats that have been nearly extirpated from the system, and that could be relatively easily restored with adequate funding.

Recommendation: Existing public funding mechanisms (e.g. the Clean Water Management Trust Fund, the Natural Heritage Trust Fund, and others) should be used as aggressively as possible to help meet not only the specific goals of those programs, but other downstream habitat goals as well.

3. Publicly-Owned Infrastructure: Public investments (and the lack thereof) have a very strong impact on the condition of North Carolina watersheds and living resources, and the value of those resources to the people of the state. Infrastructure investments can

stimulate damaging development; failure to properly operate and manage public and publicly-licensed utilities and other infrastructure may pose serious threats to all kinds of important resources.

Recommendation: Publicly-owned infrastructure (e.g. roads, sewage collection systems, stormwater utilities, etc.) should be developed and operated to minimize direct and indirect effects on coastal resources (including induced development).

Recommendation: Subsidies supporting human uses of low-lying and flood-prone areas that require structures or other persistent alteration should be eliminated; existing structures should be removed whenever possible (e.g. after storm events).

Recommendation: Canals and other drainage system elements that threaten coastal habitat quality or are likely to exacerbate the effects of flooding associated with rising seas or more frequent or intense storm events should be managed to minimize or eliminate "upstream" risks.

Recommendation: The implications of more powerful storms, rising seas and other effects associated with changing world climate should be fully integrated into all public and publicly-licensed infrastructure planning.

4. Valuable Fisheries: Many of North Carolina's most important and valuable fisheries are in poor condition, as a result of overfishing, habitat loss and other factors (e.g. river herrings, many reef fishes). Both recreational anglers and commercial fishermen, and the communities that depend upon them, suffer as a result.

Recommendation: All existing natural resource management plans (e.g. fisheries management plans of North Carolina, the Atlantic States Marine Fisheries Commission, and the Department of Commerce advised by the South Atlantic and Mid-Atlantic Fishery Management Councils, and the NC Wildlife Action Plan) should be fully implemented, including adequate resources for enforcement, outreach and education, and research and monitoring. Where such plans do not yet exist to identify and emplace measures to meet natural resource goals, they should be developed and fully implemented (e.g. fishery management plans currently under development; the SAFMC Fishery Ecosystem Plan; the National Fish Habitat Plan).

Recommendation: Public policies and investments should be designed to support the development and maintenance of infrastructure needed to harvest sustainable fisheries yields. Capacity of North Carolina-based fisheries should be linked to those yields. Infrastructure needed to land those yielded should be developed and sustained.

## III. Beaches and Barrier Islands

North Carolina beaches and barrier islands constitute a world-class resource in their own regard, essential both to both the human and biophysical ecology**. Add a factoid**.

Findings and Recommendations

1. Valuable Beaches: North Carolina's beaches and barrier islands form a system whose characteristics cross the boundaries of watersheds and political jurisdictions, and constitute a system of great natural and human-use value, and with unique issues and challenges.

Recommendation: North Carolina should proceed with and complete the Beach Management Plan mandated by the General Assembly and currently assigned to the Division of Coastal Management.

2. Perverse Incentives: Federal state and local governments have over time created 'perverse incentives' for inappropriate development in hazardous and environmentally sensitive areas. Certain public policy processes such as beach nourishment may provide incentives for inappropriate and unsustainable development on barrier islands.

Recommendation: Both the state of North Carolina and the federal government should work to reduce subsidies and incentives for development on barrier islands and in hazardous, flood-prone and critical habitat areas.

Recommendation: Just as permits for beach nourishment are tied to the provision of adequate public access by both the state and federal governments, consideration should be given to tying beach nourishment permits to barrier island development controls such as growth and density limits.

## IV. Offshore Waters of the Exclusive Economic Zone (EEZ)

In addition to its better-known sounds and beaches, North Carolina also boasts highly diverse and ecologically important offshore waters, at the convergence of the Gulf Stream and the south-bound Virginia Current, with significant rocky "live-bottom" ledges and reefs, and impressive deepwater coral reefs and mounds. The area off Cape Hatteras, known as "the Point," captures a very highly dynamic and nationally important mixing zone and center of productivity for a wide array of marine organisms, and a special place to bird and whale-watchers, and fishermen.

Findings and Recommendations

1. Marine Protected Areas (MPAs) on the Continental Shelf. Highly-diverse reefs and other live-bottoms are both ecologically important as spawning and nursery habitats and vulnerable to both commercial and recreational overfishing. In addition, North Carolina and the Southeast boast unrivalled deepwater coral reefs, both *Oculina arbuscula* (not *Oculina varicosa* reefs as in the Atlantic side of the Florida coast) and *Lophelia pertusa* reefs, the former described as the Ben Franklin Reefs (with Lindquist Massifs) and the latter described as Agassiz Coral

Hills (See George, 2002) and other high-diversity live bottoms (e.g. methane seep communities on the Blake Ridge).

George, R. Y. 2002. Ben Franklin temperate reef and deep-sea 'Agassiz Coral Hills' in the Blake Plateau off North Carolina'. *Hydobiologia* 471: 71-81.

Recommendation: North Carolina citizens and officials should work with federal waters fishery managers (NMFS, same as NOAA Fisheries) to develop and implement a network of Marine Protected Areas (MPAs) located on appropriately high-value habitats that includes the midshelf, and the outer shelf. The guidelines and mechanisms developed by the South Atlantic Fishery Management Council (SAFMC) should steer this process. Highest priorities should be established using the best available scientific information; selections should factor in human uses and user preferences. These sites should be protected against all threats, including new private-sector investments in marine aquaculture, wind and tidal energy extraction, and others.

Recommendation: All known and expected deepwater coral reefs created by Lophelia and similar organisms on the upper slope and Blake Plateau and all known methane seep-related live-bottom communities should be protected against both bottom-disturbing fishing and non-fishing activities (including oil, gas and methane hydrate exploration and development, and other minerals extraction). The SAFMC Coral Habitat Area of Particular Concern (HAPC) process should be used initially to protect these sites.

Recommendation: Management plans for these protected places should be fully implemented and funded, including the as-yet-to-be-drafted SAFMC MPA Evaluation Plan and the SAFMC Oculina Banks Evaluation Plan.

2. The Point: Discussions amongst scientists in the 2nd NC Coast symposium in Carolina Beach clearly established that the Cape Hatteras offshore zone ("the Point") is extremely important from biophysical, biogeographic, biodiversity and human-use parameters, and must be identified as a focus area with special protection off the North Carolina coast. The area also has special importance both in generating and steering larger-scale spawning and nursery processes for Mid-Atlantic fishes and crustaceans, and is also the spawning area for extra-cyclonic storms of the North Atlantic.

Recommendation: The Point area should be protected through all available mechanisms, both state and federal, against all threats. It should be established as essential fish habitat (EFH), and as a Habitat Area of Particular Concern (HAPC) in all relevant fishery management plans, both council-advised and secretarial (where that has not already been done).

Recommendation: Investments should be made to continue the excellent work already completed to characterize oceanographic and ecological processes driven by the Point area, as a key driver for ecosystem-based management in this region.

3. Federal-Waters Fisheries: Many of the most important and valuable fisheries of the US Southeast are in poor condition, as a result of overfishing, habitat loss and other factors (e.g. many reef fishes). Both recreational anglers and commercial fishermen, and the communities that depend upon them, suffer as a result. One key deficiency is the lack of vessel monitoring systems (VMS) and other mechanisms to track vessel usage and achieve enforcement and compliance goals.

Recommendation: All existing natural resource management plans (e.g. fisheries management plans of the Department of Commerce advised by the South Atlantic and Mid-Atlantic Fishery Management Councils) should be fully implemented, including adequate resources for enforcement, outreach and education, and research and monitoring. Where such plans do not yet exist to identify and emplace measures to meet natural resource goals, they should be developed and fully implemented (e.g. fishery management plans currently under development; fishery management planning for deepwater species; the SAFMC Fishery Ecosystem Plan; the National Fish Habitat Plan).

Recommendation: Public policies and investments should be designed to support the development and maintenance of infrastructure needed to harvest sustainable fisheries yields. Capacity of regional fisheries should be linked to those yields. Infrastructure needed to land those yields should be sustained.

Recommendation: VMS for both commercial and sports-fishing boats should be implemented at the regional scale to keep track of fishing activities in and near vulnerable midshelf and cold coral ecosystems off the North Carolina coast and elsewhere in the region. The NC Division of Marine Fisheries and the SAFMC should obtain cost estimates for implementation of VMS in both commercial and sports-fishing vessels.

4. Destructive Fishing Gears: Destructive gears, such as bottom-trawls often have damaging impacts on habitat-forming coral beds, and can cause considerable scars on the sea floor.

Recommendation: Bottom-disturbing fishing gears should be frozen in place until "allowable gear zones" that match sustainable harvest needs with appropriate and non-damaging gear usage are completed, under the SAFMC FEP, and under NC fishery management plans.

Recommendation: A moratorium on new bottom trawling and other destructive fishing practices should be implemented unless and until we get data that demonstrate that those practices are consistent with habitat and biodiversity goals in those places. This is especially important in deeper waters and in developing fisheries.

5. Education about Deep-Sea Resources: Most North Carolinians remain ignorant of the spectacular deepwater coral reefs and related resources off North Carolina and the Southeast.

Recommendation: North Carolina should commit adequate resources to raise the awareness of its citizens to these priceless resources. We recommend that the DENR Office of Environmental Education should encourage public and K-12 level education to create an awareness of the rich natural resources in the NC coast offshore ecosystems directly dealing with such habitats within the territorial waters and within the EEZ to the 200-mile limit.

6. Ocean Observing Systems: Recent investments in developing new and synoptic ocean observing systems provide an important window on oceanic processes in the US Southeast, as well as a key need in understanding the implications of large-scale oceanic processes for North Carolina.

Recommendation: North Carolina and the federal government **(eg OEOS or Ocean Ecology Observation Systems of NMFS or NOAA**) should commit resources adequate to ensure the development, implementation and continuation of an adequate ocean observing system in the Southeast, including elements linking sounds and estuaries to the coastal ocean.

7. Carbon Fluxes and Global Climate Change: There is a compelling need to more fully evaluate the potential influence of increasing carbon fluxes into the ocean and to assess how the increasing acidity of the sea impact calcification of shell and exoskeleton-forming animals such as cold corals in the deepwater areas off North Carolina EEZ. In addition, there is an important opportunity to assess and reduce North Carolina's contribution to the emissions that drive these relationships.

Recommendation: Adequate federal resources should be developed to more fully understand the influences of large-scale phenomena like global warming and ocean acidification on the deepwater systems off the US Southeast. **This proposed scenario calls for recommendations to the newly founded "Federal Interagency Deep-Sea Coral Board for protection of deep-sea coral habitats and 'Deep-Sea Vulnerable Ecosystems' (DVEs). The GIBS (George Institute for Biodiversity and Sustainability) initiatives taken at the Harvard Declaration Conference in October 2006 (which resulted in the creation of the Deep-Sea Coral Board) needs t be followed by the 2009 Harvard Summit II (now in the planning stage). Also, it is important that funding for the SAFMC Deepwater Coral Research and Monitoring Plan, and the SAFMC Oculina Banks Evaluation Plan should receive high priority.**

Recommendation: The North Carolina Legislative Commission on Climate Change should include in its recommendations measures and investments adequate to reduce the state's contributions to global climate change, and measures to induce resilience to simplification in structure and function of our key coastal ecosystems and the human systems which depend upon them.