PROGRAM GUIDE

2010 - 2012

Introduction

During the 2010-2012 funding cycle, the Woods Hole Sea Grant Program is supporting 13 concurrent research projects and several smaller new initiative efforts aimed at taking the first steps into promising new areas.

Together, these projects fit into the following theme areas: Environmental Technology, Estuarine and Coastal Processes, and Fisheries and Aquaculture. Many of these projects address local and regional needs, while others have national, or even global, implications.

In addition to research, Woods Hole Sea Grant supports a vibrant marine extension program and a communications, public outreach, and education program. During the 2010-2012 biennium, the program will support additional research efforts funded under peer-reviewed regional and national competitions.

Major by-products of Woods Hole Sea Grant projects include publications, workshops, and presentations. Since 1971, programmatic support has resulted in more then 1,000 publications, including journal articles, theses, books, maps, fact sheets, pamphlets, newsletters, and web-based products.

Research and outreach efforts involve the following academic institutions, as well as private industry: Woods Hole Oceanographic Institution, Marine Biological Laboratory, Boston University Marine Program, Harvard University, University of Massachusetts at Amherst, Roskilde University (Denmark), Northeast Massachusetts Aquaculture Center, Southeast Massachusetts Aquaculture Center, and Martha's Vineyard Shellfish Group, as well as numerous federal, state, and local agencies and partners, and private individuals.

The Woods Hole Sea Grant Program supports research, education, and extension projects that encourage environmental stewardship, long-term economic development, and responsible use of the nation's coastal and ocean resources.

It is part of the National Sea Grant College Program of the National Oceanic and Atmospheric Administration (NOAA), a network of 33 individual programs located in each of the coastal and Great Lakes states, as well as Guam, to foster cooperation among government, academia, industry, scientists, and the private sector.

Sea Grant's affiliation with the Woods Hole Oceanographic Institution began in 1971 with support for a number of individual research projects. In 1973, WHOI was designated a Coherent Sea Grant Program and, in 1985, was elevated to its current status as an Institutional Sea Grant Program.

The Woods Hole Sea Grant Program has made great strides in channeling the expertise of world-renowned ocean scientists toward the goal of meeting the research and information needs of users of the marine environment. Public and private institutions throughout the Commonwealth of Massachusetts and the Northeast participate in the Woods Hole Sea Grant Program.

Woods Hole Sea Grant's Coastal Processes Extension program helps to identify the risks and impacts associated with the region's coastal natural hazards. Partners include the U.S. Geological Survey, Cape Cod Cooperative Extension, the Massachusetts office of Coastal Zone Management, Cape Cod Commission, Federal Emergency Management Agency and coastal communities throughout the commonwealth.

Mapping of Longshore Sediment Transport and Littoral Cells

Longshore sediment transport is one of the most important nearshore processes affecting beach morphology, and directly influences a particular shoreline's potential to accrete, erode, or remain stable. Woods Hole Sea Grant and Cape Cod Cooperative Extension are actively mapping longshore sediment transport and littoral cells across Cape Cod. Products will include presentations and a map booklet showing the results of the study and describing the value of this management approach. The purpose of these maps and report is to provide a qualitative understanding of the motion of water and sediment in the surf zone.

Off-Road Vehicle Corridor Surveys

Beaches, dunes and near-shore areas are the most dynamic areas on the face of the earth, changing constantly in response to winds, waves, tides, storms, relative sea level rise, and human activities. These complex systems are often not well understood or documented, and some of the uses may degrade the resource. Off-Road Vehicles (ORV) are one use that has the potential to cause harm if the designated corridors are not maintained in the proper position. Woods Hole Sea Grant, working with Cape Cod Cooperative Extension, provides direct field assistance to local natural resource managers in order to map ORV corridors for public beaches, as well as follow up surveys. The results show how these dynamic systems need to be monitored during the season in order to reflect the current conditions of the resource. Reports and presentations, along with recommendations to follow an objective scientific methodology, are provided to natural resource departments, conservation commissions, and other stakeholders.

Town and Regional Technical Assistance

Woods Hole Sea Grant's coastal processes outreach focuses on providing the most up-to-date scientific and technical information relating to erosion control, flooding, human impacts on the beneficial functions of coastal landforms, relative sea level rise, and other coastal issues. We routinely work in the field with local officials across Cape Cod, the Islands and southeastern Massachusetts, identifying and suggesting alternatives to minimize potential impacts from proposed shoreline development. We also provide workshops, field trips, training, lectures and one-on-one advisements.

Woods Hole Sea Grant works with coastal communities to better inform decisions concerning living natural resources, through outreach, education and applied research. With a focus on shellfish (important both commercially and recreationally) and nearshore coastal issues (e.g., eelgrass and water quality), we serve a diverse group, including commercial shellfishermen, aquaculturists, natural resource managers, researchers and members of the general public. The program partners with Cape Cod Cooperative Extension, the Southeastern Massachusetts Aquaculture Center, and the Barnstable County Shellfish Advisory Committee.

Oyster Restoration

In response to dwindling numbers of oysters, Woods Hole Sea Grant has worked in cooperation with Cape Cod Cooperative Extension to restore banks of oysters along the shores of Cape Cod. Juvenile oysters, spawned in a hatchery and attached to pieces of shell, have been deployed in 11 towns. These oysters provide valuable habitat and may improve water quality, and eventually a nice catch for fishermen. Working closely with natural resource managers, 'living shorelines' are also being developed through the use of remote-set oysters, designed to stabilize the shoreline by ameliorating the effects of wind and water currents.

Eelgrass Restoration

To stem the tide of decline of eelgrass beds across the region, the program is exploring several methods of restoration of this valuable habitat. Most recently, 10 potential areas for eelgrass restoration were explored and assessed for suitability. Three sites were chosen for exploring two methods of transplantation — clump vs. horizontal rhizome method. Pending the outcome of the test plantings, one or more of these sites may be chosen for larger scale restoration efforts.

Assessment of Shellfish Habitat

Woods Hole Sea Grant has helped to develop a simple, inexpensive means of assessing and comparing habitats in terms of shellfish survival and growth. This tool, now in its eighth year of use, allows shellfish growers and natural resource managers to identify optimal sites for shellfish; it also provides a comparison within across the region and among years. This tool has been used along the Massachusetts coastline and is now available on a training DVD to interested parties.

Management of Shellfish Diseases

Several diseases affect shellfish within this region. Though these diseases do not affect humans, they pose a significant hurdle to shellfish farmers and to sustainable management of the public shellfisheries. Woods Hole Sea Grant is working with growers, resource managers and scientists to develop reasonable protocols for movement of shellfish as well as improved culture methods to reduce losses. Four embayments are continuously monitored with water quality instrumentation which provide an additional measure of habitat conditions and increased understanding of parameters which may contribute to disease susceptibility.

Assistance to the Massachusetts Shellfish Aquaculture Industry

Woods Hole Sea Grant works closely with shellfish farmers, providing technical advice and information on issues of concern such as predator management, control of diseases and marketing issues. In 2004 a network comprised of more than 10 regional shellfish farmers was established to address these concerns through a unified scientific approach. Each year a new issue is addressed; results are disseminated and made available through bulletins, fact sheets, reports, and presentations.

Woods Hole Sea Grant's Outreach and Education Program (WHSGOEP) works with its target audiences — educators, students, coastal decision makers, citizens and research scientists and engineers — to provide them with the tools they need to make connections between ocean science information and ocean and coastal issues. The program is guided by the following objectives: (1) educators have access to ocean science content, including Sea Grant research results, and understand how to use this information to convey scientific concepts; (2) students have access to ocean science research and information to develop an appreciation for the oceans and an awareness of marine science related opportunities; (3) citizens have access to Sea Grant research applicable to their interests and needs; (4) coastal decision-makers have access to the results of Sea Grant research and other research to increase their ability to design and develop environmentally sound policies; and (5) research scientists and engineers from the ocean science community have access to and participate in educational and outreach opportunities.

WHSGOEP uses a variety of program and products to accomplish our objectives:one-on-one advice, training programs, publications, web sites, workshops, and lectures. In collaboration with the extension program, outreach and demonstration projects in fisheries, aquaculture, and coastal processes are brought to local communities. Collaborative projects include workshops aquaculture issues and shoreline erosion, production of DVDs on extension activities, work with legislators on coastal issues, production of information brochures and workshop proceedings, hosting and facilitation of teacher workshops on a broad range of coastal issues, and publication the program's newsletter, Two If By Sea.

WHSGOEP relies on Marine Outreach Guidance Group for input and advice on communication and educational activities. With participation by several MOGG members, WHSGOEP has developed and implemented educational programs designed to encourage users of our marine and coastal resources to explore, understand, and appreciate the value of these resources. Through Sea Grant's Coastal Community Development Program, Woods Hole Sea Grant also participates in the Massachusetts Coastal Training Program (CTP) a unique, federal-state partnership to provide science-to-management training opportunities that address the challenges facing coastal communities. A partnership of the Waquoit Bay National Estuarine Research Reserve (WBNERR), Massachusetts Coastal Zone Management (CZM) and Woods Hole Sea Grant, CTP provides support, training and technical information to communities, organizations, and agencies so that they can better manage the coastal resources that contribute to the economic and aesthetic vitality of coastal communities in Massachusetts. Additional projects contributing to these efforts are the development of a coastal training course for conservation com-

missions and the development of a model flood plain bylaw.

Beach Cleanups/Marine Debris Workshops

Sea Grant is increasing local data collection efforts on source of regional marine debris through organization of community-based, volunteer-staffed beach cleanups and subsequent workshops. The program is engaging 50 to 75 volunteers at each event and we plan to hold at least one event quarterly, with an increased effort of 3-4 during the final quarter of each year to coincide with Coastsweep, the International Ocean Conservancy efforts each fall.

Teachers' Workshops

WHSG continues to offer its extremely popular workshops for K-12 educators. Teachers are presented with ocean science-related background and examples for science teaching. Educators attending workshops have the ability to contact Sea Grant staff and scientists at WHOI to augment the workshop information and experience.

Boat Shrink Wrap Recycling Collection Initiative

WHSG aims to become the leader in the collection of plastic boat shrink wrap on Cape Cod with a goal of 150 boats, or two dumpsters, collected at three sites over the course of the next two years. Program expansion of one additional town yearly is anticipated.

Woods Hole Osprey Cam

WHSG managed the expansion of extremely popular Woods Hole Osprey Cam in 2010, along with related efforts to highlight effect of marine debris, poor water quality, climate change and other coastal issues on shorebirds. With an improved affiliated website, blog and expanded exposure through partnership with Wildearth.tv network, the reach of the cam is expected to increase.

Extension support

WHSG coordinates media efforts for extension agents, including editing and project management for all brochures, web-based material and bulletins, and will continue to do so.

Full Proposals Funded

Fisheries and Aquaculture

Assessment of Movement Patterns and Spawing Site Fidelity of Female Horseshoe Crabs via Telemetry: Implications for Management of the Fishery

Robert Glenn, Massachusetts Division of Marine Fisheries, Sarah Martinez, Massachusetts Audubon, and Alison Leschen, Waquoit Bay National Estuarine Research Reserve

Horseshoe crabs are a highly contested resource in Massachusetts, playing an important role in the ecosystem and providing valuable biomedical and economic benefits. However, newly examined and gathered data, as well as ample anecdotal reports, have raised concern about the declining horseshoe crab population. Ability to effectively manage a sustainable horseshoe crab fishery has been limited by gaps in knowledge about their behavior, especially in regards to spawning.

In this study, researchers are using telemetry tags to track movement patterns of 75 mature female horseshoe crabs on the southeast corner of Cape Cod to determine what management strategies may or may not be effective in maintaining a sustainable population and fishery.

Study results will determine whether the horseshoe crabs spawn every year and are loyal to spawning sites each year or move from protected areas into other estuaries. The results will directly impact horseshoe crab fishery management, since self-contained populations are more vulnerable to local depletion and must be managed differently than a highly mobile, state- or region-wide population.

Integrating Experiential Field Work with a Marine Ecology Curriculum for Southeastern Massachusetts

John W. Brawley, Duxbury Bay Maritime School

Many scientists live for the moment they can get out of the classroom or lab and into the field. This project allows middle schoolers in Plymouth County and southeastern Massachusetts to get that same exposure, building scientific literacy and environmental stewardship as a result.

The project funds the design and delivery of experiential fieldwork projects, integrated with a full ecology curriculum, at Duxbury Bay Maritime School and Bay Farm Montessori Academy. In their work, students will participate in bacterial monitoring and source-tracking in the Bluefish River and monitor environmental characteristics and fish migration at the Island Creek fish ladder and vicinity. They'll be exposed to a wide-range of components of a research project, including data analysis, writing results and presenting their findings to the public.

The principal investigator anticipates this work will provide a model for integrating coastal use and stewardship organizations with local and regional school systems, leading to a greater

number of students becoming informed advocates of coastal natural resources and engaged in its protection.

Essential Fish Habitat: Quantifying the Roles of Euphausiid Behavior and Physical Aggregation Mechanisms in the Canyons of the New England Continental Shelf Break Using Broadband Acoustic Techniques

Gareth Lawson, Andone Lavery and Peter Wiebe, Woods Hole Oceanographic Institution

Euphausiids are common crustacean members of North Atlantic pelagic ecosystems, but their ecological role in the waters off of New England is only poorly understood. Previous studies in the Gulf of Maine have suggested that euphausiids can be locally abundant and a key prey item for a variety of higher predators, including commercially exploited fish and squid. Euphausiids are also notable among zooplankton for their strong swimming capabilities and occurrence in dense aggregations. These aggregations are an important factor in making the euphausiids available to higher predators. Little is known, however, regarding the biological and physical processes that lead to the formation of aggregations, the interaction of euphausiids with their predators, and the overall significance of euphausiids to the New England Shelf/Slope ecosystem.

By addressing the bio-physical factors that lead to the aggregation of euphausiids and that determine their availability higher predators in submarine canyons, the proposed work will take a necessary first step towards defining the essential habitat of fish predators that target euphausiids and quantifying their interaction for the development of ecosystem-based management models.

The field program using acoustic broadband surveys will coordinate the NOAA/NMFS Northeast Fisheries Science Center's bottom trawl survey. Thus estimates of abundance using acoustic surveys will be calibrated against collections made in the trawl surveys. During analysis, measurements of the characteristics, movements, and distribution of euphausiid aggregations will be related to measurements of the biological and physical environment. Benefits of the project will include the use of broadband acoustic scattering techniques for monitoring pelagic environments and providing data to scientists, managers, the fishing industry and society of the importance of euphausiids in pelagic ecosystems.

Modeling as a Tool to Better Understand Bay Scallop Recruitment and to Manage Bay Scallop Populations

James Churchill, Woods Hole Oceanographic Institution, and Geoffrey Cowles, University of Massachusetts-Dartmouth (To be started in Year 2)

In Massachusetts, bay scallops constitute a major resource for the fishing economy but the value of the harvest varies significantly from year to year, specifically in local embayments. Those variations have led to efforts to enhance populations in specific areas through seeding – with varying degrees of success.

Churchill and Cowles are interested in developing and applying a modeling system for examining sources of recruitment variability of bay scallops in the region to understand the factors that influence juvenile scallop recruitment. They will model transport and recruitment of juvenile scallop in three critical scallop habitats: Buzzards Bay, Waquoit Bay and Menemsha Pond.

Among their goals are determining the relative extent to which the local population is self-sustaining through retention of the spawned population, and nourished through delivery of larvae from remote sources. It's believed that developing a system to predict the impact of management decision on population will benefit those charged with regulating and safeguarding the resource.

Giardia and Cryptosporidium in Cape Cod Seals and Their Flounder Prey: Issues of Fish, Seal, Fisherman and Consumer Health

Rebecca Gast and Michael Moore, Woods Hole Oceanographic Institution (To be started in Year 2)

Gast and Moore will be looking into the ecology of zoonotic diseases in marine vertebrates and the potential human health risk associated with them, specifically determining the prevalence of Giardia and Cryptosporidium in local seal populations, their fish prey, shellfish, water and sediment. In addition, they propose to determine the potential for transmission between marine animals and humans by examining the genetic types present, their prevalence in the population and their persistence over time.

There are several relatively distinct seal populations around Cape Cod and researchers have a general idea of their foraging locations while the animals are in the region. The principal investigators will sample the different populations for both seal, fish (including flounder), shellfish, water and sediment in order to assess whether there are local differences in pathogen prevalence. Increased prevalence may be associated with areas of human environmental impact, or may simply be associated with increased prevalence of infected individual seals in a population.

Ocean Acidification Impacts on Larval Shell Formation by Commercial Shellfish Species of New England: An Experimental Investigation

Anne Cohen and Daniel McCorkle, Woods Hole Oceanographic Institution

The principal investigators are investigating the effect on bivalves of ocean acidification. Rising atmospheric CO_2 levels are changing the ocean's carbonate chemistry: the increased CO_2 in seawater changes the saturation state of seawater with respect to aragonite, a form of calcium carbonate found in shell.

Little is known about the impact that altered saturation state will have on marine calcifying organisms. Cohen and McCorkle are conducting a two-year study with controlled culture experiments to quantify the impact of changes in saturation state on early shell formation in commercially valuable shellfish. Starting with bay scallop (Argopecten irradians), and quahog (Mercenaria mercenaria) in year one, they will add sea scallop (Placopecten magellanicus) and eastern oyster (Crassostrea virginica) in year two.

Full Proposals Funded

Assessing the Impact of Hypoxia/Anoxia on Sediment Denitrification and the Production of Nitrous Oxide in Waquoit Bay

Robinson W. Fulweiler, Boston University

Anthropogenic nutrient loading impacts the nitrogen cycle both directly with the addition of excess nitrogen, and indirectly by promoting low oxygen conditions that alter sediment denitrification and the production of nitrous oxide (N_2O). Denitrification is an important component of estuarine nitrogen budgets and it helps remove anthropogenic nitrogen from coastal waters.

Understanding how low oxygen concentrations affects this process is critical to both scientists and managers. Recent research has shown that low oxygen conditions may promote the formation of nitrous oxide, an important greenhouse gas with global warming potential two hundred and fifty times greater than carbon dioxide. Up to 50 percent of the global flux of nitrous oxide may occur in estuarine and coastal habitats.

Two objectives will be addressed in this field bay to be conducted in collaboration with staff at the Waquoit Bay Estuarine Research Reserve: (1) to determine the spatial variability of sediment denitrification and nitrous oxide production in Waquoit Bay and (2) to determine how hypoxia affects the production of nitrogen gas and nitrous oxide. By examining these parameters in the context of other environmental changes in Waquoit Bay, we will gain a better understanding of how the nitrogen cycle is impacted by hypoxia/anoxia.

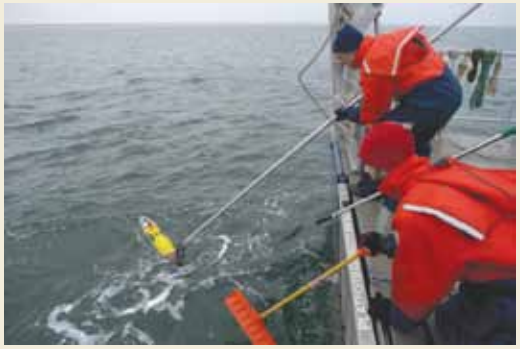
Does Epiphytic Nitrogen Fixation Lead to a Spiral of Increasing Eutrophication in Shallow Estuaries?

Robert W. Howarth and Roxanne Marino, Cornell University

West Falmouth Harbor has received a five-fold increase in nitrogen loading over the past decade due to groundwater inputs of a high nitrogen plume from the local wastewater treatment plant. What is the effect of this increased nitrogen loading on the sea grass community?

To answer this question, the investigators will evaluate the importance of nitrogen fixation on the process of eutrophication in West Falmouth Harbor by comparing two areas — one that has become quite eutrophic from increased nitrogen loading and one that is less affected because of greater flushing and dilution of nutrient inputs.

Since nitrogen fixation is an energetically expensive process, the expectation would be that nitrogen fixation rates would decrease as nitrogen loading increased, thus serving as a partial mitigation for the increased external input of nitrogen. Results to date, however, suggest that this is not the case. In shallow lagoons such as West Falmouth Harbor, nitrogen fixation by epiphytes on eelgrass may increase rather than decrease as external nitrogen loading increases. If this happens, there is the potential for sea grass dieback to accelerate and for coastal habitats to degrade. Understanding this balance between nitrogen fixation and external nitrogen loading will help managers maintain the correct balance of nitrogen inputs to the ecosystem and help them understand nitrogen dynamics in coastal habitats.



Characterizing the Variability of the Outer Cape Coastal Current

Glen G. Gawarkiewicz and Anthony Kirincich, Woods Hole Oceanographic Institution

This project continues Gawarkiewicz' study of the strong current that flows along Cape Cod's eastern shore called the Outer Cape Coastal Current (OCCC), which influences circulation in the Gulf of Maine and affects local and regional ecosystems. The OCCC is an important avenue of interchange between the Gulf of Maine to the north and Georges Bank and the mid-Atlantic Bight to the south through areas with complex topography.

Gawarkiewicz and Kirincich will characterize the current's variability over time scales across seasons and spatial scales along the continental shelf, using a combination of shipboard surveys and moored observations. They are measuring the structure and variations of the OCCC hydrography and current structure, over two complete seasons of monthly field studies using two vehicles: a REMUS autonomous underwater vehicle and a "Minibat" towed-undulating vehicle. Moored observations during spring and fall seasonal transitions will give more detail on across-shelf temperature and salinity structure of the current, and full water column velocity profiles, all from the mooring's central location.

This detailed description, across yearly cycles, of an important New England coastal current will build a better understanding of water exchange, fresh water transport, and circulation from the Gulf of Maine to areas southward within the region. In turn, it will provide a basis for a better understanding of current and future climate and

Alternative Nitrogen Cycling Pathways: When Does Nitrate Disappearance Alleviate Eutrophication?

Anne Giblin and Joseph Vallino, Marine Biological Laboratory (to be completed in Year 1)

Giblin and colleagues are developing an understanding of nitrogen dynamics in a New England estuarine system. The goal is to be able to predict how changes in salinity and the amount of available nitrogen — both related to tidal and seasonal cycles and terrestrial freshwater inputs — alter the exchange and loss of nitrogen between sediments and the open water. In particular, they are investigating how salinity and nitrogen change the partitioning between three bacterial nitrogen-cycling processes.

Their hypothesis is that changing freshwater inputs from land alter nitrogen cycling in an estuary by changing the salinity, which in turn determines which microbial pathways dominate under different conditions.

This project examines the importance of two novel nitrogen-using processes, anaerobic ammonium oxidation (ANAMMOX) and dissimilatory nitrate reduction to ammonium (DRNA), in comparison to denitrification, a well-understood bacterial process. The investigators are using state-of-the-art isotopic techniques (including isotope pairing) to measure the three processes in sediments taken from regions of varied salinity regimes at the study site, Plum Island Sound in northern Massachusetts. Controlled laboratory experiments are also being conducted.

ecosystem dynamics, including transport of algal cysts that originate in the Gulf of Maine and can produce harmful algal blooms (HABs) in the region.

Controls on Calcification by Shellfish: Carbonate Chemistry of Bays and Estuaries in Southeastern Massachusetts

Daniel McCorkle, Woods Hole Oceanographic Institution

Much is made of the impact on rising CO_2 levels in the ocean and many researchers are looking into its effect on shellfish calcification. Dan McCorkle is interested in what's going on a little closer to home – and he's intrigued by what he's finding in our backyard.

McCorkle is leading a project looking into the carbonate chemistry of Cape Cod coastal waters. The ultimate goal, he says, is to see if increasing CO_2 and the subsequent lowering of the pH level of the water, is going to impact shellfish growth and the multi-million dollar industry it spawns.

In the project, McCorkle will look at the water chemistry in three locations on Cape Cod: Chase Garden Creek, which runs into Barnstable Harbor in Dennis; the Herring River in Harwich; and Waquoit Bay in East Falmouth. All three are known hotspots for shellfish.

Full Proposals Funded

Mitigating Risk to Whales from Lobster Fishing

Hauke Kite-Powell, Woods Hole Oceanographic Institution

Entanglement in fishing gear is, along with ship strikes, the dominant source of direct human injury and mortality for the North Atlantic Right Whale. Lobster gear has been implicated in a number of entanglement cases and recent management decisions seek to address the risk of entanglement by requiring the use of sinking ground lines between traps in lobster trap trawls and weak links in trawl buoy lines, among others.

Kite-Powell seeks in this project to develop an improved, comprehensive entanglement risk index for the waters off Maine, which account for the majority of lobster fishing off the East Coast. In order to do so, researchers will get a better sense of how lobstermen fish through interviews and a web-based survey and improve the characterization of right whale activity through analysis and synthesis of sightings data and habitat information.

Once they achieve a model of risk that takes into account habitat conditions and trap string configuration, as well as the overlap and density of whales and fishing gears, they plan to do an analysis of potential risk reduction measures and conduct outreach with the Maine lobster fishing community.

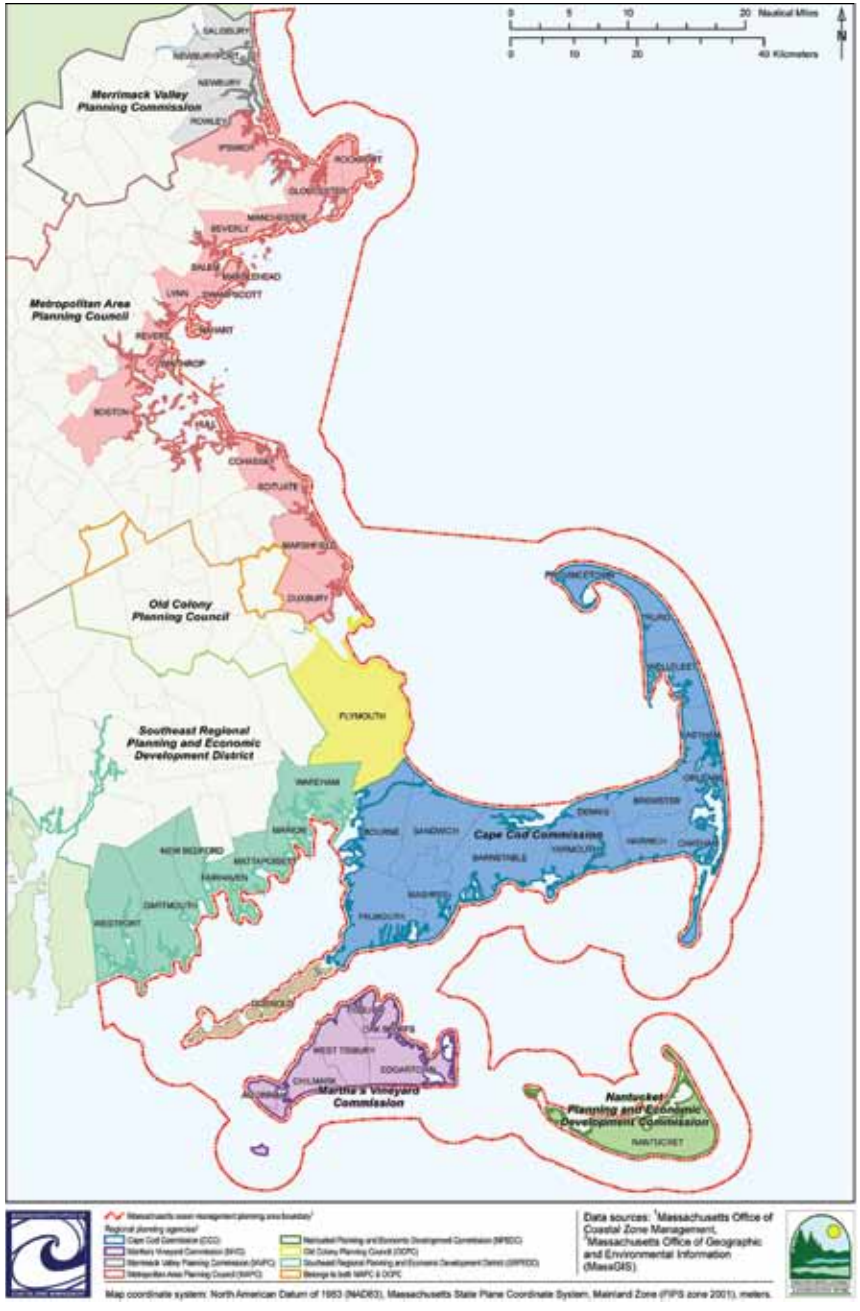
Developing New Institutions for Managing Ocean Zoning

Porter Hoagland and Hauke Kite-Powell, Woods Hole Oceanographic Institution

The uses of the coastal ocean are growing more numerous and becoming more closely packed, leading to the need for institutions that can allocate ocean space efficiently. Ocean zoning now is being promoted as one of the main ways in which the uses are to be managed and its resources are to be developed or conserved.

In this project, Hoagland and Kite-Powell will focus on the Massachusetts coastal ocean, with the goal of widening the intellectual and pragmatic discussions about the most appropriate institutional structures and processes for managing ocean zoning.

Drawing upon the data and literature emerging from the state ocean planning process, the researchers plan to develop three to four comprehensive case studies of ocean zoning in specific areas and for specific categories of use.



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