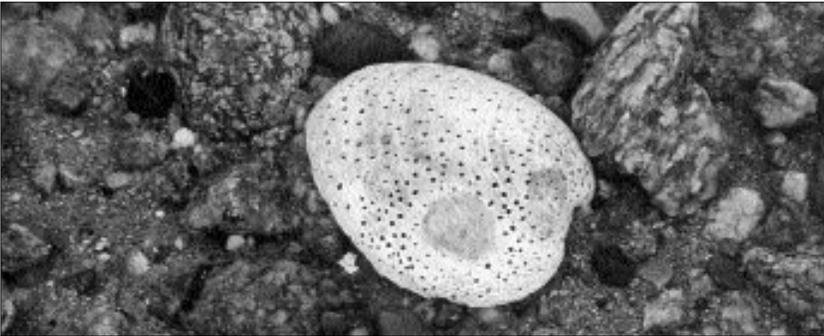


SCIENTIFIC UNDERSTANDING



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Massachusetts is fortunate to have a wide variety of ocean resources, which is largely due to its position at the intersection of two major biogeographic ocean regions, the Virginian and Acadian provinces. Biogeographic regions are identified by distinct differences in biological communities, physical characteristics and weather patterns. Cape Cod forms the boundary between the two provinces with the Acadian province north of Cape Cod and the Virginian province to the south. Although differences exist between the Acadian province (which encompasses the Gulf of Maine ecosystem) and Virginian province (represented by the waters of Massachusetts in the northern Middle Atlantic Bight), there are overlapping characteristics. For example, species and habitats often have broad geographic ranges, inhabiting several biogeographic zones.



Species populations and habitat conditions demonstrate substantial variability in abundance and quality. Natural variability mediates species population status and habitat conditions, but human activities have considerably altered estuarine and marine ecosystems throughout the world. Massachusetts is no exception - habitat loss and degradation, overfishing, and pollution have major impacts to the environment that affect the status of ocean resources in Massachusetts.

As part of the Task Force's efforts to understand these natural and physical phenomena relating to our ocean resources, the Task Force's Data Trends and Needs Work Group, composed of academic and government scientists, resource managers, and advocacy groups, undertook the large and important tasks of describing the diversity of ocean resources in Massachusetts and identifying influences of anthropogenic activities on the abundance and quality of certain resources. The Data Trends and Needs Working Group (1) summarized ocean resources data, key trends, and gaps in data; (2) summarized ecologically and economically important trends; (3) determined whether relevant data were readily available for planning purposes; (4) determined what data are needed to support ocean resource management purposes; and (5) provided recommendations to the Task Force to improve data collection, management, analyses, and interpretation to facilitate ocean resources management.

The following chapters are found in the Technical Report and present a range of resource information and identify limitations to the current knowledge of ocean resources. The data presented are, however, by no means a comprehensive assessment of all ocean resources or a thorough assessment of existing data. These chapters support the Scientific Understanding Recommendations:

Oceanography, Weather Patterns and Climate Change - Major oceanographic features and weather patterns are discussed, and the status and consequences of climate change are described.

Living Marine Resources - The summary includes a description of the monitoring of fishery resources, commercial and recreational fish and shellfish landings, abundance of selected species, and invasive species.

Estuarine and Marine Habitat - Habitats are categorized as wetlands, seagrass, and seafloor habitats, and major datasets are summarized to provide an overview of the status of these resources.

Water and Sediment Quality - Monitoring programs, major discharges, and the general requirements for monitoring activities are identified to provide an overview of the current state of water and sediment quality monitoring programs.

In addition to providing data and information on natural resources, the Technical Reports also describe trends in human population, maritime economics, and alteration of marine habitat and life:

Demographics of Human Population - Thirty (+) years of human population data are summarized for coastal municipalities.

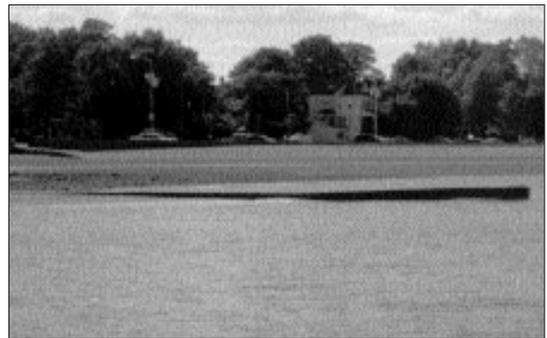
Massachusetts Marine Economy - An overview of maritime industries is presented to demonstrate the status and recent changes in ocean-based economic conditions.

Alteration by Human Activity: Cumulative Impacts - General human-induced and natural impacts to habitat are identified and described for Massachusetts.

Although ocean resources in Massachusetts are diverse and issues related to the understanding and management of these resources are complex, a common theme is apparent: the lack of data limits our collective understanding of trends in ocean resource abundance and quality and anthropogenic impacts to ocean resources. This lack of data is not just one that has affected the Task Force's work, but is a condition in the current environment in which public decisions are made about the use and protection of our ocean resources creating a hindrance to the long-term management of ocean resources. This lack of understanding does not imply that resource agencies in Massachusetts are uninformed, but many resources, ecological functions, and environmental impacts caused by humans remain to be discovered and explained in the ocean environment.

Ocean resources are not fully understood, and monitoring supplemented with targeted research is warranted to improve the management of the ocean environment. Seafloor habitat is a particular resource that affects many aspects of the environment. The types, quality, and extent of seafloor habitats are largely undocumented in Massachusetts. Fundamental to a comprehensive monitoring and research plan is the identification of seafloor habitats. Seafloor habitat is among a long list of resources that require further examination, and a coordinated, comprehensive ocean resource monitoring and research plan is needed to elucidate the ecology of the ocean and advance the management of ocean resources.

Government agencies, academic institutions, environmental consultants, and non-profit organizations study and monitor a variety of ocean resources in Massachusetts. Monitoring techniques are at times as varied as the resources monitored, limiting the comparability of distinct data sets on similar resources. Studying the ocean environment requires flexibility; however, guidance on standard data collection protocols assists the development of monitoring plans, especially monitoring for permit requirements. Current and future monitoring and research generates substantial volumes of data, and access to and dissemination of certain data, collected by monitoring programs, research, or part of permitting requirements, is imperative to applying data to resource management and planning.



Related to existing and future monitoring and research, an estimation of baseline species population levels, habitat conditions, and contaminant levels provides the foundation for a long-term perspective of environmental change. Many aspects of the ocean environment are well-described, but these accounts are often from recent decades. Ocean resources have been exploited throughout human history and continue to be affected by human activities. Current population levels and habitat conditions are a result of centuries of human exploitation and degradation interacting with natural variability, and our understanding of changes in population and habitat status is incomplete. Contemporary monitoring does not truly assess baseline conditions, potentially misinforming interpretations of the current character of the environment.



We believe that effective management and stewardship of the ocean environment requires a scientific understanding of ocean resources. The public agencies responsible for managing ocean resources, however, often lack the resources to collect fundamental data to support management decisions. The Technical Report takes a closer look at our data needs and gives a basis for our scientific understanding recommendations.

The Task Force makes the following recommendations to improve the scientific understanding of the Massachusetts ocean environment:

1. establish an advisory group of marine and fishery scientists to advise the Commonwealth;
2. develop a comprehensive ocean resources monitoring plan;
3. acquire and/or develop seafloor maps; and,
4. develop standards for monitoring data submitted by project proponents.

SCIENTIFIC UNDERSTANDING RECOMMENDATIONS

Scientific Understanding Recommendation #1: Marine and Ocean Resource Trends Advisory Group

Recommendation

An advisory group of state, federal, academic and other marine and fishery scientists and other experts should be appointed to evaluate and estimate baseline marine species population levels, habitat conditions, and contaminant levels to evaluate changes in ocean resources through time, identify emerging threats to ocean resources, and determine appropriate management goals. Conditions relating to the effects of global climate change, including sea-level rise and salinity of the ocean, could be included in these data collection efforts. The group should compile historic data and periodically study trends in these resources relative to the estimated historic conditions to assess improvements or degradation in the character of the resources.

The goal of this recommendation is not to set conservation or restoration goals to achieve minimally disturbed environmental conditions, but rather to fully leverage existing historic data to contribute to our understanding of estuarine and marine ecosystems, thereby leading to improved resource management. The estimation of minimally-disturbed population levels and habitat conditions can also assist in the assessment of cumulative impacts and contribute to the recommended comprehensive ocean resources monitoring and research plan. This advisory group should advise state official(s) responsible for stewardship and management of the state's ocean resources.

Justification

Current population levels and habitat conditions are a result of centuries of human exploitation and degradation interacting with natural variability. Baseline population levels and habitat conditions, spatial and temporal trends in resource character, and changes in natural processes and anthropogenic effects through time (cumulative impacts) are largely undocumented. The estimation of appropriate baselines, such as the period and status of a resource at an undisturbed state (or a status deemed appropriate by the advisory group) is needed for management and stewardship of ocean resources. The analysis of historic population levels will inform managers of potential population levels that can be sustained by marine ecosystems, which will help them determine appropriate management goals. Historic data on population levels is available for commercially valuable species but is difficult to incorporate because of the format of historic resource publications, which are not in electronic form. A thorough review of historic data will enable resource managers to determine baseline environmental conditions. These historic population levels and habitat conditions, supplemented with contemporary data collection, will inform the development of sustainable management goals, restoration plans, and assessment of changes in ocean resources through time.

Implementation Plan

An advisory group should be appointed to outline the scope of this recommendation, including identifying priority species and habitats and appropriate temporal baseline levels. The advisory group can define baseline, evaluate the feasibility of estimating baseline populations and conditions for select species and/or habitats, and recommend a strategy to assess population levels and habitat conditions for resources with scant data. Existing frameworks for analyzing and describing populations and habitats, such as stock assessment approaches for commercially exploited species, should be evaluated and incorporated into this process. At the completion of each historical trends analysis, the advisory group should prepare a report that explains the trends analysis process and provides guidance for how marine resource managers should use the information.

Legislation Required: Not applicable.

Next Step: We recommend that the Secretary appoint the chair and members of an advisory group to initiate the estimation of baseline populations and habitat conditions. The advisory group should directly or indirectly make use of the expertise, skills, and resources at the Massachusetts Marine Fisheries Institute.

Timing: The chair and advisory group should be appointed by September 2004.

Funding Required: Additional resources may be required to manage the Working Group process.

Potential Sources of Funding: State capital funds, NOAA (through CZM grant), DMF, and/or EPA. Collaboration with federal and state agencies, academic institutions, fishery groups, municipalities, local environmental stewards, and NEFMC should also be sought.



Scientific Understanding Recommendation #2: Ocean Monitoring and Research

Recommendation

As a basis for sound management of ocean resources - with or without new state authorities to develop comprehensive ocean resource management plans - a comprehensive ocean resources monitoring and research plan should be developed. This monitoring and research plan should encompass living and non-living estuarine and marine resources, as well as studies of the economic and other uses of these resources. The plan could serve as an important "roadmap" for work to be carried out by state resource agencies and others (e.g., academic institutions, permit applicants, public agencies), and should be periodically reviewed and adjusted to reflect improved understanding of resources and their patterns of use, integrate new management approaches, and incorporate innovative survey techniques. The plan should provide guidelines on standardized protocols for conducting surveys to enhance data consistency.

The monitoring and research plan should be ecologically driven and cover both environmental features of the ocean (living marine resources, such as commercial, recreational and non-target species; benthic communities; invasive species; estuarine and marine habitat; water and sediment quality; and physical oceanographic, wind, and weather patterns), as well as social and economic uses and characteristics of these ocean resources (including uses of the water column, the lands under the water, and the water sheet) and submerged cultural resources. The plan should lay out a complete scope to evaluate cumulative impacts from activities, such as coastal alteration projects, fisheries, and implications of resource management approaches (e.g., fishery and watershed planning), while distinguishing changes due to natural processes.

National and regional efforts to develop monitoring and research plans recently garnered support, and Massachusetts is an active participant. One such effort is the Gulf of Maine Ocean Observing System (GoMOOS) with its array of oceanographic buoys collecting realtime data in the Gulf of Maine, including in Massachusetts Bay. These larger efforts should guide specific monitoring and research needed to improve the understanding and management of the Commonwealth's ocean resources. The comprehensive plan for Massachusetts should be developed by Massachusetts resource agencies, but rely on an integrated approach that includes municipalities, neighboring states, federal agencies, collaborative efforts between fishermen and government agencies, and provide flexibility for innovative approaches and the identification of research needs.

Justification

Appropriate and effective management of ocean resources, including marine habitat and life and human uses of the ocean, requires sufficient understanding of the resources achieved through a comprehensive monitoring and research plan. Ocean resources are influenced by global phenomena (e.g., global warming and sea level rise), regional exploitation, and local perturbation, and, without long-term, systematic monitoring it is difficult to detect and understand the cause of spatial and temporal changes in the resources. The monitoring and research plan will guide the development of new information needed to explain trends in resources, thus informing resource managers. Many state and federal monitoring and research programs, non-government organizations, and private researchers



effectively monitor and study particular resources, such as exploited species or geographically restricted areas (e.g., harbors). These monitoring efforts achieve program goals and are a good foundation for a comprehensive monitoring and research plan. At the same time, however, there are a variety of ocean resources that are not monitored or are inadequately monitored, leading to a limited understanding (including type, distribution and abundance) of these resources. Indeed, in the recent past, certain monitoring programs carried out historically by state and other public agencies have had to terminate or severely limit their data collection and monitoring activities, in part because of budgetary imperatives.

In particular, cumulative impacts are difficult to investigate and describe because of inadequate data, patchy data collection and incomplete understanding of natural variation and human-induced effects on marine habitat and life. Ecosystem effects include, but are not limited to, changes in the type and quality of estuarine and marine habitats and species assemblages, and are also difficult to describe because of inadequate data. Without guidance on approaches to evaluate cumulative impacts, targeted studies to investigate human-induced perturbations and coordinated, long-term monitoring of a wide range of resources, an analysis of cumulative impacts will be unattainable, and cumulative impacts will remain unknown in Massachusetts.

National and regional programs, such as the EPA's National Coastal Assessment and Gulf of Maine Council on the Marine Environment, are currently outlining a coordinated monitoring network that includes northeastern United States and southeastern Canada. These efforts, in addition to other regional and state programs (e.g., monitoring done by the Massachusetts Water Resource Authority, (MWRA)), can facilitate the development of Massachusetts' plan and provide a means to integrate Massachusetts into regional projects.

The Task Force believes that such a "monitoring and research roadmap" - along with the actual resources to carry out critical monitoring activities - is essential to form a basis for sound management and use of the Commonwealth's ocean resources.

Implementation Plan

We recommend that a working group, comprised of state and federal agencies, non-governmental organizations, fishery representatives, and public interest groups, be established and tasked with outlining the components of a comprehensive monitoring and research plan for the Commonwealth of Massachusetts. The work group should summarize existing monitoring programs, evaluate effectiveness of current monitoring, and recommend improvements to statewide monitoring.

Legislation Required: The Working Group should investigate the need for new legislation or changes to existing legislation to fund the development and implementation of the monitoring and research plan.

Next Step: The Secretary should appoint a chair to outline a work plan for the Working Group. An Advisory Committee should be appointed at the same time.

Timing: The Chair and Working Group should be appointed and meet by October 2004.

Funding Required: Additional resources may be required to manage the Working Group process. Long-term, dedicated funding will be required to prepare the monitoring and research plan. This effort will be a multi-million dollar investment.

Potential Sources of Funding: State capital funds. NOAA (through CZM grant), and/or EPA. Collaboration with academic institutions, fishery groups, municipalities, local environmental stewards and NEFMC should also be sought.

Scientific Understanding Recommendation #3: Seafloor Mapping

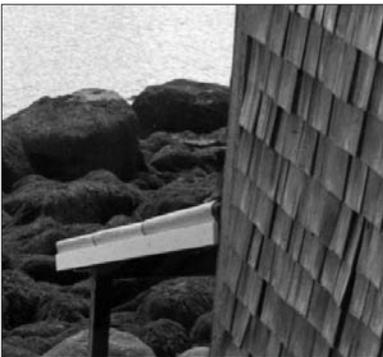
Recommendation

In support of comprehensive management and monitoring of ocean resources, the Commonwealth should acquire high-resolution seafloor habitat maps. Existing and emerging technology, such as aerial photography and multibeam sonar, collects spatially explicit information on vegetation characteristics, topography and surficial geology of the seafloor and provides the foundation for seafloor habitat mapping. Habitat is a term that encompasses physical, chemical and biological attributes, and the creation of seafloor habitat maps, showing the distribution and abundance of seafloor habitats, requires the collection and interpretation of a variety of environmental data to delineate and describe characteristics of the seafloor environment. Seafloor mapping should be done in coordination with the Natural Heritage Program's terrestrial Biomapping Project and the Gulf of Maine Data Partnership Program, which is facilitating data sharing among regional groups.

Justification

The distribution, types, and quality of seafloor habitats are largely undocumented in Massachusetts' marine environment. Terrestrial resource managers have highly detailed maps that show surficial geology, topography, infrastructure, and vegetation communities for the entire Commonwealth. Marine resource managers generally lack this type of information, unless the site has been scrutinized for a previously proposed project. For example, the Massachusetts DEP mapped the distribution of seagrass throughout state waters, and this data is invaluable to environmental impact assessments and monitoring programs. There are few data that identify the distribution of any other seafloor habitats. In the absence of spatially explicit information, marine resource managers must rely on site-specific resource characterizations provided by project proponents to make management decisions. The lack of thorough information regarding the distribution and extent of seafloor habitats hinders long-term ocean resource planning.

Comprehensive seafloor habitat mapping will facilitate the detection of unique or sensitive habitat types and the design and implementation of habitat and indicator species monitoring programs. Additionally, seafloor habitat maps will provide a spatial reference for assessing changes in the distribution and abundance of biological communities (e.g., commercially exploited or protected species), evaluating the potential impacts of human seafloor alterations, locating important cultural resources (e.g., shipwrecks) and proactively identifying ocean resource management approaches.



Implementation Plan

Development of a strategic plan to obtain seafloor habitat maps should be led by the existing (informal) Interagency Marine Habitat Working Group organized by CZM, with involvement from federal and state agencies, non-governmental organizations, researchers, and fishermen. The Working Group will coordinate with existing work groups and programs, such as the Gulf of Maine Mapping Initiative (GOMMI) and the University of



New Hampshire - NOAA Center for Coastal and Ocean Mapping, to guide the development of the strategic plan. The Working Group should consider utilizing DMF's recently acquired multibeam mapping equipment to advance this recommendation. Because creation of seafloor habitat maps is an evolving science, the strategic plan should be implemented in stages, with input from map users helping to guide the data collection and interpretation process.

Legislation Required: Not applicable

Next Step: The Marine Habitat Working Group should coordinate with the monitoring and research plan Working Group to develop a strategic plan for obtaining seafloor habitat maps.

Timing: The Working Group should draft a strategic plan by October 2004.

Funding Required: Additional resources may be needed to manage the Working Group process. This effort requires a multi-million dollar investment over several years. Biological, chemical and physical data are needed to identify habitats, and the collection of these data will require a systematic methodology to create seafloor habitat maps for the entire state.



Potential Sources of Funding: State capital funds. USGS, NOAA, and/or EPA. Collaboration with academic institutions, fishery groups, municipalities, local environmental stewards and NEFMC should also be sought.



Scientific Understanding Recommendation #4: Standardized Protocols for Data Collection

Recommendation

As a corollary to our recommendations relating to Ocean Monitoring and Research and the Dissemination of Ocean Resource Data, we also recommend that when state permits require that environmental monitoring be carried out by the project applicant as part of publicly permitted activities, such monitoring should use more standardized protocols for data collection. The standardized monitoring protocols should be designed to aid managers in assessing environmental suitability and impacts of proposed and permitted activities and gain understanding of individual and cumulative impact of projects and uses. These standards should be flexible to allow project proponents achieve specific goals and evaluate effectiveness of new technologies designed to assess resources and, wherever possible, be consistent with federal data standards.

Justification

Many permitted activities require that the developer carry out studies on an on-going basis to monitor the impacts of their activities on resources in the area. In recognition of the extent of existing permitted activities and the increasing number of large coastal alteration projects in Massachusetts (and projects located in the Commonwealth's ocean), monitoring requirements,

including pre- and post-construction monitoring, should be standardized. This approach could mean additional monitoring requirements for existing and future permitted activities. The extent of data collected for permitted activities can provide substantial insight into quality and function of ocean resources, the duration of environmental impacts and ultimate success of environmental recovery, within and adjacent to the footprint of a particular project. The monitoring data should be provided to state agencies and indexed to allow efficient access to monitoring results, as referenced in the Dissemination of Ocean Resource Data Recommendation. Standardized monitoring protocols and improved access to permit-related data can assist in the assessment of potential impacts of future projects, enhance the ability of state environmental agencies to evaluate future proposals and develop monitoring programs, and set the foundation for evaluating cumulative impacts.

Implementation Plan

An interagency group composed of environmental agencies should be tasked with determining the process of adding permit requirements to implement standardized data collection protocols, to the maximum extent possible. Additionally, an interagency work group should evaluate on-going monitoring programs and periodically make needed changes to these programs. The MWRA, for example, reviews its monitoring program and can guide the evaluation of permitted activities throughout Massachusetts that are required to conduct monitoring. Implementation of this recommendation should not impede ongoing monitoring efforts, but should supplement existing monitoring efforts.

Legislation Required: The interagency Working Group should investigate regulatory requirements for monitoring, including standardized protocols and data management, and identify changes needed to improve monitoring programs.

Next Step: An interagency work group should be appointed to guide the process of investigating permit requirements and changing requirements to standardize methodology.

Timing: The work group should be appointed by September 2004.

Funding Required: Additional resources may be required to guide the Working Group process.

Potential Sources of Funding: State capital funds. NOAA and/or EPA. Collaboration between state and federal agencies, municipalities and environmental stewards should also be sought.

