

## LARGE MARINE ECOSYSTEMS: ASSESSMENT AND MANAGEMENT FROM DRAINAGE BASIN TO OCEAN

KENNETH SHERMAN *Chief, Oceanography Branch, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Northeast Fisheries Science Center, Narragansett Laboratory, 28 Tarzwell Drive, Narragansett, RI 02882*  
*Adjunct Professor of Oceanography, Graduate School of Oceanography, University of Rhode Island, Narragansett, RI 02882.*

### ABSTRACT

#### COASTAL ECOSYSTEM STRESS

The long term sustainability of coastal ecosystems as a resource for healthy economies in coastal nations appears to be diminishing. A growing awareness that the quality of the coastal ecosystems is being adversely impacted by multiple driving forces has accelerated efforts by scientists and program managers to assess, monitor, and mitigate coastal stressors from an ecosystem perspective. The Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific, and Cultural Organization (UNESCO) is encouraging coastal nations to establish national programs for assessing and monitoring coastal ecosystems so as to enhance the ability of national and regional management organizations to develop and implement effective remedial programs for improving the quality of degraded ecosystems. This encouragement follows from the significant milestone achieved in June, 1992, with the adoption by a majority of coastal countries of follow-on actions to the UNCED declarations on the ocean for the nations of the globe to: (1) *prevent, reduce, and control degradation of the marine environment so as to maintain and improve its life-support and productive capacities;* (2) *develop and increase the potential of marine living resources to meet human nutritional needs, as well as social, economic, and development goals;* and (3) *promote the integrated management and sustainable development of coastal areas and the marine environment.*

Post-UNCED concern has been expressed over the deteriorating condition of the world's coastal ecosystems that produce most of the world's living marine resources. Within the nearshore areas and extending seaward around the margins of the global land masses, coastal ecosystems are being subjected to increased stress from toxic effluents, habitat degradation, excessive nutrient loadings, harmful algal blooms, emergent diseases, fallout from aerosol contaminants, and episodic losses of living marine resources from pollution effects and over-exploitation. Coastal pollution, changes in biodiversity, the degraded states of fish stocks, and the loss of coastal habitat generally are limiting achievement of the full economic potential of coastal ecosystems. Present efforts to address these problems by local, regional, national, and international institutions responsible for resource stewardship has been less than successful. Informed decisions for ensuring the long term development and sustainability of coastal marine resources can best be made when based on sound scientifically-derived options. For most coastal ecosystems, existing environmental data pertinent to studies of perturbations to habitats and populations at the species,

population, community, and ecosystem level is difficult to synthesize because of spatially and temporally fragmented character, lack of comparability, and inaccessibility. To overcome these shortcomings, there is a need for a more coherent and integrative assessment of the changing states of coastal ecosystems from drainage basins to the adjacent marine ecosystems that is directly linked to institutions responsible for the governance of the ecosystems. An essential component of an ecosystem management regime is the inclusion of a scientifically-based strategy to monitor and assess the changing states and health of the ecosystem by tracking key biological and environmental parameters.

### THE LARGE MARINE ECOSYSTEM ASSESSMENT STRATEGY

An ecological framework that can serve as a basis for achieving the UNCED objectives is the large marine ecosystem (LME) concept. LMEs are increasingly being subjected to stress from growing exploitation of fish and other renewable resources, coastal zone damage, habitat losses, river basin runoff, dumping of urban wastes, and fallout from aerosol contaminants. These are regions of ocean space encompassing coastal areas from river drainage basins and estuaries on out to the seaward boundary of continental shelves and the seaward margins of coastal current systems. LMEs are relatively large regions on the order of 200,000 km<sup>2</sup> or larger, characterized by distinct bathymetry, hydrography, productivity, and trophically dependent populations.

These LME's produce 95 percent of the annual global fisheries biomass yields; reports on the changing states of biomass yields and health have been published for 29 of the LMEs. The assessments of the changing states of LMEs are based on information obtained from five operational modules that link science-based information to socioeconomic benefits for countries bordering on LMEs. The modules are focused on ecosystem (1) **Productivity**, (2) **Fish and Fisheries**, (3) **Pollution and Health**, (4) **Socioeconomic Conditions**, and (5) **Governance Protocols**.

### FAST TRACK LME AND INTEGRATED COASTAL MANAGEMENT (FTICM-LME) PROJECTS

A framework for linking science-based assessments of the changing states of coastal ecosystems to support the long-term sustainability of environmental quality and renewable resources while also guiding environmentally sound economic development of ecosystem resources and management practices is now emerging from a series of regional efforts aimed at cross-sectoral integration of assessments of coastal productivity, fish and fisheries, and pollution and ecosystem health, with socioeconomics and governance modules. The application of the modules is being supported, in part, by grants from the World Bank and the Global Environmental Facility (GEF) in collaboration with national governments of countries bordering large marine ecosystems in Asia, Africa, Central and South America, and eastern Europe.

The GEF Operational Strategy calls for the development and implementation of

projects in the International Waters Program that can achieve global benefits through the implementation by countries of more comprehensive approaches for restoring and protecting the "International Waters" (IW) environment. The GEF has placed priority on *changing sectoral policies and activities responsible for the most serious root causes of transboundary environmental concerns and determining the expected baseline and additional actions needed to resolve each priority concern. Based on the countries' commitments to change sectoral policies or activities and to find baseline investments, the GEF may fund the agreed incremental cost of additional measures.*" One of the focal areas for funding by the GEF is to mitigate stressors on Large Marine Ecosystems, and promote priority actions for improving environmental quality and the sustainable development of resources within LMEs important to the economic growth and food security of developing countries in Asia, Africa, Central and South America and eastern Europe.

It is important to strengthen the linkages between science and management for the drainage basins and near coastal and geographic extent of the LMEs, and also to improve on the methodologies for ensuring that near coastal and drainage basin effects on the LME proper are included in the overarching strategy for a systems approach to a management strategy that includes: (1) drainage basin, (2) near coastal, and (3) offshore coastal components of the LME.

Two model systems can be used to fill this pressing need for improved assessment strategies: The Batangas Bay model in the Philippines and the Xiamen Municipality model in China. Both were developed as demonstration projects in Integrated Coastal Management (ICM). The projects are part of the Global Environmental Facility/UNDP/International Maritime Organization's Regional Programs for the Prevention and Management of Marine Pollution in the East Asian Seas. The approach provides a framework for ICM management and includes guidelines for the implementation of a core program of: (1) integrated waste management, (2) water pollution abatement, (3) conservation of stressed mangrove and coral reef areas, (4) coastal tourism development, and (5) improvements of the municipal fisheries. Special support programs for stakeholders in both systems have been developed for (1) legal and institutional mechanisms for ICM, (2) strengthening of provincial resource management, (3) improvement of policy support (4) upgrading of monitoring and enforcement (5) capacity building, (6) community outreach, (7) multisectoral information, education, and communication, (8) expansion of extension activities, (9) establishment of a management information system, and (10) development of sustainable financing mechanisms.

The objective of these LME projects is in keeping with the GEF Operational Strategy for International Waters aimed at changing narrow national sectoral policies into broader drainage-basin-ecosystem-wide Fast Track ICM-LME projects for improving and promoting the development and use of marine resources in a manner that promotes their long-term sustainability.