7. Conclusions and Considerations for Monitoring, Research, and Management

IMPROVING MANAGEMENT, MONITORING, AND RESEARCH

The update of the National Estuarine Eutrophication Assessment provides a picture of nutrient-related water quality conditions in the Nation's estuaries and coastal waters, and changes that have occurred in the decade since the early 1990s. These results are based on data and information provided by regional and national experts about water quality conditions, the influence of natural and anthropogenic factors, living resource and use impairments, and expected future conditions for the systems assessed. The results were reviewed and synthesized by experts at a national assessment workshop and provide a comprehensive assessment of the location, magnitude, and consequences of eutrophication in the Nation's coastal water bodies. The results also point to needs for monitoring and research to better characterize and understand the complexities of this pervasive problem.

The following are a list of conclusions used by the participants to make recommendations for targeted monitoring, research, and management in order to better protect these resources in the future.

Monitoring

Conclusions

There are many more data gaps now than a decade ago, when the first NEEA was completed. Some of this difference is a result of methodological differences, a site visit and regional workshop approach for the 1999 report and self-reporting through the online survey for this report. This led to overall eutrophic conditions being ascertained in 88% of systems in the early 1990s compared with only 70% of systems in 2004. In addition, many systems in the 2004 assessment had incomplete data leading to low confidence in the ratings provided. Similar to the 1999 survey, the Pacific Coast region had the least robust data and the lowest assessment certainty.

Considerations for Monitoring

Survey participants recommended that a eutrophication monitoring program be institutionalized on regional and national bases so that the same indicators are monitored in a comprehensive and coordinated fashion. This includes reevaluation of the indicators that provide the most accurate assessment and the thresholds for indicators by type of system once the type classification is completed. Some of the indicators needing reevaluation are submerged aquatic vegetation (SAV), and macroalgae, as discussed in Chapter 6, including refining the monitoring of both indicators and development of standards for measurement and assessment metrics. For these indicators, it might be best to analyze multi-year data (moving averages) and the metric should include spatial coverage and biomass. Monitoring of C:N:P ratios of SAV were suggested as an early warning indicator of distress, though this would require additional research.

Tim Carruthers, University of Maryland Center for Environmental Science

Submerged aquatic vegetation, an important habitat, is a resource which needs to be monitored more consistently.

Participants recommended that the low data certainty and reliability be corrected by establishing consistent, standard indicators and quality assurance (QA) mechanisms. These standards should include minimal frequencies of sampling for specific indicators by type of estuary both in terms of the spatial coverage and time frame of sampling. These practices would be much more efficient given limited resources than the development of a stand-alone, new monitoring program. There are many real-time and continuous monitoring programs in place already that could be united to provide national, comprehensive sampling coverage such as the Integrated Ocean Observing System (IOOS) and the National Water Quality Monitoring Network (NWQMN).

Concurrent with the coordination of these programs is the development of a mechanism to easily capture summary data and disseminate to States/stakeholders and researchers. There should be data transfer standards and web-based data entry/dissemination. The possibility of automatic processing of real-time data and automatic entry of the processed data into the online survey is being explored.

Some of the specific data needs identified by participants are characterization of nutrient loads,

better quantification of total nutrient inputs, estimators of nutrient pressure (e.g., population, land use), and atmospheric and groundwater inputs.

Research

Conclusions

For some systems, the assessment is inaccurate because the boundaries of the system were mis-identified and some indicators were not applicable. This was the case with SAV, because it is not naturally occurring in some systems and with macroalgae, which naturally occurs at high levels in some systems. Additionally, some of the indicator thresholds that have been applied universally, such as chlorophyll *a*, are inappropriate and should potentially be adjusted according to the system's sensitivity or susceptibility.

Considerations for Research

The first recommendation is to develop a type classification based upon physical and hydrologic characteristics that influence a system's susceptibility to developing problems. This has already begun (see *Chapter 6*), and the results are promising. The type classification will be used to reevaluate indicators used and thresholds for indicators (particularly SAV and macroalgae, since they are absent in many South Atlantic systems). For further refinement of the SAV indicator, key indicator taxa and threshold problem levels should be identified for different types of systems. Standard monitoring protocols should be developed so that indicator results are nationally comparable.

A recommendation was made to establish the link between eutrophication indicators and loss of beneficial uses/aquatic life use. This is already underway through the development of the socioeconomic/human use indicator (see *Chapter 6*) but more research is needed. Some specific research needs that were identified by participants were:

- better characterization of physical factors, including basic circulation patterns;
- effects of weather patterns, climate change; and
- changing land use, and the resulting effects on nutrient delivery, circulation, and eutrophic conditions.

Also needed is a refinement of estuarine boundaries, in combination with circulation patterns in order to support conceptual and predictive models. The reliability of these models depends on the improvements of nutrient load and source estimates described above.

Other research needs include defining the relationship between nutrient inputs and nuisance/toxic blooms and using these blooms as an eutrophication response relative to the total phytoplankton population. Shifts in phytoplankton community composition should be explored as an early warning indicator of eutrophic problems. Better characterization of assimilative capacity, and of the effects of seasonal population (tourism) are also needed.

Finally, in order to support data collection for assessments of eutrophication, remote sensing tools should be developed and refined. The refinement of remote sensing tools (satellite and aerial photography) should focus on increasing the spatial and temporal resolution/validity.

Erin Markin, University of Maryland Center for Environmental Science

Low dissolved oxygen levels and loss of habitat due to eutrophication affect valuable uses of estuaries such as tourism and recreational and commercial fishing.

Management

Conclusions

The majority of systems assessed were highly influenced by human-related activities. With the exception of the northern Pacific Coast and northern North Atlantic regions, eutrophication is a widespread problem: the majority of systems for which data were available were moderately high or highly eutrophic and were expected to become worse in the future. Management measures should be developed and applied now to prevent degradation.

Many of the systems reporting moderate and high level eutrophic impacts are the same systems that exhibit human use and living resource impairments. The top use impairments reported were to fishing, fish consumption, swimming, and aesthetics. The top

four causes of impairments were agriculture (crops and animal operations), wastewater treatment plants, urban runoff, and atmospheric deposition. These and other typical point and non-point sources were identified at the workshop as important management targets. However, there are some important regional differences in nutrient sources, such as combined sewer overflows in the North Atlantic and animal operations and crop agriculture in the mid-Atlantic, South Atlantic, and some Gulf of Mexico systems.

Considerations for Management

Implement more effective action to achieve nutrient reductions and widespread reduction in eutrophication. Convey the status of estuarine and coastal eutrophication to decision makers and the public through a communication strategy that provides frequent updates at local, regional, and national levels. This public relations effort should include environmental report cards which clearly describe the condition of local estuaries and the efforts being undertaken to restore and/or protect the estuary. These should be accessible and easy to understand, and include illustrative graphics, photos, and maps.

Management would also benefit from developing consistency between NEEA, EPA National Coastal Assessment (NCA) and National Park Service (NPS) indicators (i.e., macroalgae (used in the NEEA) vs. water column nutrient concentrations (used by EPA and NPS)). These federal programs should be encouraged to coordinate for maximum use of data and thus maximum benefit with efficient resource use. This includes working with EPA on establishment of nutrient criteria for these indicators in estuaries, particularly the inclusion of biocriteria.

The Total Maximum Daily Load (TMDL) and Non-Point Source (NPS) programs should continue efforts to reduce land-based non-point sources of nutrients. Estuaries should be monitored so that the success of these reductions can be tracked and used to develop models for translation to successful implementation of management measures in estuaries of the same type. This should include public outreach and education on best management practices. Additionally, the linkage between air and water regulatory programs should be pursued.

Adrian Jones, University of Maryland Center for Environmental Science

Non-point sources such as agriculture were noted as a target for management. Incentives for Best Management Practices are one way to reduce nutrient and sediment inputs.