ATLANTIC NORTHEAST COASTAL MONITORING SUMMIT

The Need for a Regional Monitoring Network for the Atlantic Northeast

Background

As professionals in the marine and estuarine sciences, we recognize the inherent challenges when monitoring these very complex and changing environments. To facilitate our attempts to answer basic questions about system response to human-caused change and temporal trends, we tend to geographically compartmentalize our study areas, usually sizing the scope of a monitoring program to match our abilities to fund and implement. Consequently, artificial limits are often set, most notably along jurisdictional boundaries, but any number of equipment, skill, political, knowledge or funding factors may shape a monitoring program. Despite these constraints, local and state or provincial monitoring programs are often judged successful at meeting their goals and objectives and lead to effective management actions that demonstrably improve water quality and living resources. Nevertheless, there is added value from regional integration of local monitoring efforts or sharing of data from local monitoring efforts with common objectives.

Rationale for Integration

Sometimes a broader perspective is required to fully understand ecosystem response and accurately identify causative agents. This paper presents three reasons for supporting a regional monitoring network in the Atlantic northeast grounded on the region's coastal and marine management and policy needs.

I. REGIONAL-SCALE PROCESSES AFFECT LOCAL ISSUES. Water and organisms move, rendering jurisdictional and geographic boundaries meaningless. Further, anthropogenic effects are increasingly being measured on a global scale, including global warming (Figure 1), sea level rise, and atmospheric deposition of pollutants, expanding management horizons well beyond traditional boundaries. A regional monitoring network could help identify and track these changes in an unprecedented way and aid the development of appropriate management strategies to address issues with regional-scale causes. In addition, coordinated sharing of monitoring data and information within a regional framework may help resolve some "local" problems that don't seem to have a clear, proximate cause and may, in fact, arise over a wide geographic area. For example, lobster shell disease has been observed across several state jurisdictions in the northeastern U.S., but the reason for its increase is unknown. An integrated network might identify the appropriate spatial scale at which a specific signal is most effectively separated from "noise".

II. COMPARATIVE ANALYSES CAN GIVE VALUABLE INSIGHT INTO LOCAL ISSUES THAT OCCUR REGIONALLY. Even with problems that can be traced to a local source, managers throughout a region are often faced with challenges similar to their neighbors'. Sharing information gathered from a broader geographic area can help them. For example, many estuaries are experiencing the effects nutrient over enrichment (Figure 2), which may lower dissolved oxygen levels or impair seagrass bed health. Data collected and reported using standardized methods in an integrated regional network would enable valid comparisons between local areas and facilitate understanding of local processes.

III. INTEGRATED ASSESSMENTS PROVIDE POWERFUL ANALYSIS AND COMMUNICATION TOOLS. A regional monitoring network can improve communication and sharing of successful monitoring and management activities, leading to better mangement of both local and regional problems. Furthermore, regional data can be synthesized to inform residents about the state of the Northeast's water and living resources.

One model that successfully includes all the involved states – the National Coastal Assessment (NCA) – is built upon a five-year effort started in 2000 to survey the condition of the Nation's coastal resources by creating an integrated, comprehensive coastal monitoring program among the coastal states. To answer broad-scale questions on environmental conditions, NCA partners have collected estuarine and coastal data from hundreds of stations along the coasts of the continental United States. Types of data include water column parameters, sediment chemistry and toxicity, benthic communities, demersal fish, and tissue contaminants. Existing monitoring and research programs provided the foundation for the effort for much of the sampling.

The NCA and similar multi-jurisdictional programs in the Gulf of Maine, provide opportunities to institutionalize and enhance a regional monitoring network in concert with local initiatives. Objectives are to identify more productive monitoring approaches and better mechanisms for sharing information and data, and to improve analysis of the causes and appropriate management response to common regional problems, whether the cause is local, regional, or global. Without this effort, and a firm commitment to future collaboration throughout the region, integrated assessments fostered under current programs, like the NCA, and proposed in this summit may be short-lived and opportunities to evolve and innovate will be lost.

Examples of Management Issues Benefiting from Integration

This section illustrates each of the three reasons for integration through a specific management issue. A more comprehensive list of management issues, their causes, consequences, primary indicators, and local/regional importance, facing the region is presented in the attached matrix.

1. **REGIONAL-SCALE PROCESSES AFFECT LOCAL ISSUES:** TIDAL WETLAND IMPACTS FROM CLIMATE CHANGE/SEA LEVEL RISE

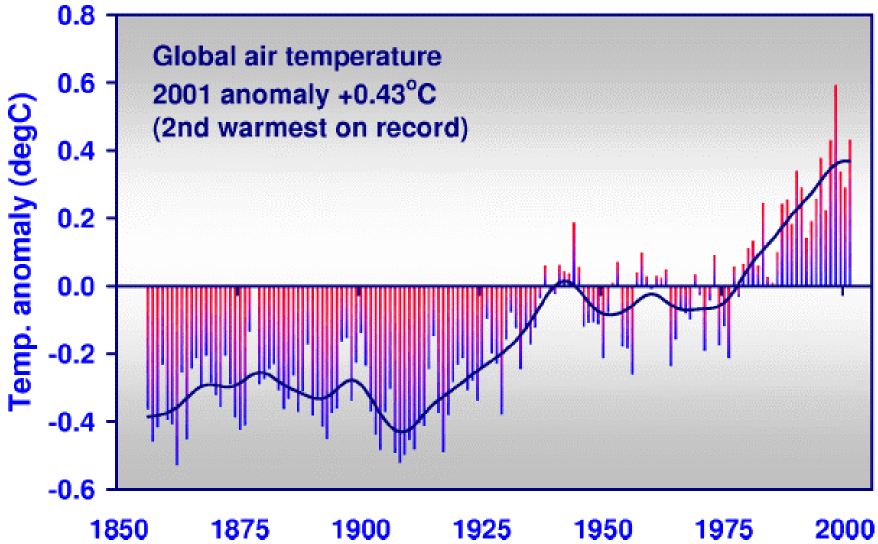
Salt marshes comprise regionally significant coastal habitats that are inherently sensitive to environmental change. Sea-level rise is one of the causes implicated in the loss in salt marshes in recent decades. Sea-level change is part of a complex feedback system that affects salt marsh stability influenced by local, regional, and temporal factors. Understanding how sea level changes affect salt marsh surface elevations and designing appropriate management responses requires some insight into the relative importance of regional versus local forcing factors. A regional monitoring network can provide the data necessary for this understanding.

2. **COMPARATIVE ANALYSES CAN GIVE VALUABLE INSIGHT INTO LOCAL ISSUES THAT OCCUR REGIONALLY:** NUTRIENT ENRICHMENT CAUSING CULTURAL EUTROPHICATION AND HYPOXIA

NOAA's National Eutrophication Assessment identifies estuaries throughout the United States that share common symptoms of nutrient over-enrichment that range from hypoxia to SAV loss. Often, nitrogen is the nutrient of concern but the sources, processes and symptoms may reflect local conditions in composition and degree. While these may be viewed a geographically unique management issues, history has shown broad utility and transference of research and monitoring data that can greatly aid local decision making. The explosion of publications on nitrogen sources, dynamics and effects attests to the potential for local application and value of technology developed in other estuaries.

3. **INTEGRATED ASSESSMENTS PROVIDE POWERFUL ANALYSIS AND COMMUNICATION TOOLS:** BASIC PHYSICAL DATA AND BASE MAPPING

Comparable data interpretation is greatly aided by accurate mapping techniques in a GIS format. Basic layers include shoreline, bathymetry, substrate, etc. These layers provide a common foundation for data storage and interpretation, in particular for attributes such as sediment quality, benthic community structure, fish and shellfish distribution, etc. In addition, communication in a GIS format, where geographic and even temporal features can be simply presented, is an important component of any monitoring program to gain public understanding and support.



The time series shows the combined global land and marine surface temperature record from 1856 to 2001. The year 2001 was the second warmest on record. This time series is being compiled jointly by the Climatic Research Unit and the UK Met. Office Hadley Centre. The record is being continually up-dated and improved. The principal reason is to detect climate change due to *global warming* through an increase in temperature in the instrumental record. Increased concentrations of greenhouse gases in the atmosphere due to human activities are most likely the underlying cause of warming in the 20th century.

The key reference for this time series is:

Jones, P.D., New, M., Parker, D.E., Martin, S. and Rigor, I.G., 1999:
Surface air temperature and its changes over the past 150 years.
Reviews of Geophysics, **37**, 173-199.

The 1990s were the warmest decade in the series. The warmest two years of the entire series were 2001 and 1998, with the latter the warmest at 0.59°C above the 1961-90 mean. The eight warmest years globally have now occurred in the 1990s and 2000s. They are, in descending order, 1998, 2001, 1997, 1995, 1990 & 1999 (joint), 1991 & 2000 (joint).

Analyses of over 400 proxy climate series (from trees, corals, ice cores and historical records) show that the 1990s is the warmest decade of the millennium and the 20th century the warmest century. The warmest year of the millennium was 1998, and the coldest was probably 1601.

The Inter-governmental Panel on Climate Change in its most recent report stated:

'most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations.'

There is also a long record of temperature for Central England. This is based on a paper by Gordon Manley:

Manley, G., 1974:
Central England temperatures: monthly means 1659 to 1973.
Quarterly Journal of the Royal Meteorological Society, **100**, 389-405.

This is being continually up-dated. It shows that 1999 was +1.16°C above the 1961-90 average, the warmest year recorded in 341 years. The year 2000 was 0.85°C above the 1961-90 average. The year 2001 was cooler at only 0.47°C above the 1961-90 average, although October 2001 was the warmest October on record.

Links

- Global temperature anomaly datasets
- CET data
- Latest IPCC report from Working Group 1

Figure 1. Global temperature record, 1850-2001 (Jones, P.D., M. New, D.E. Parker, S. Martin and I.G. Rigor. 1999). From the Climatic Research Unit, permission for use granted (see above).

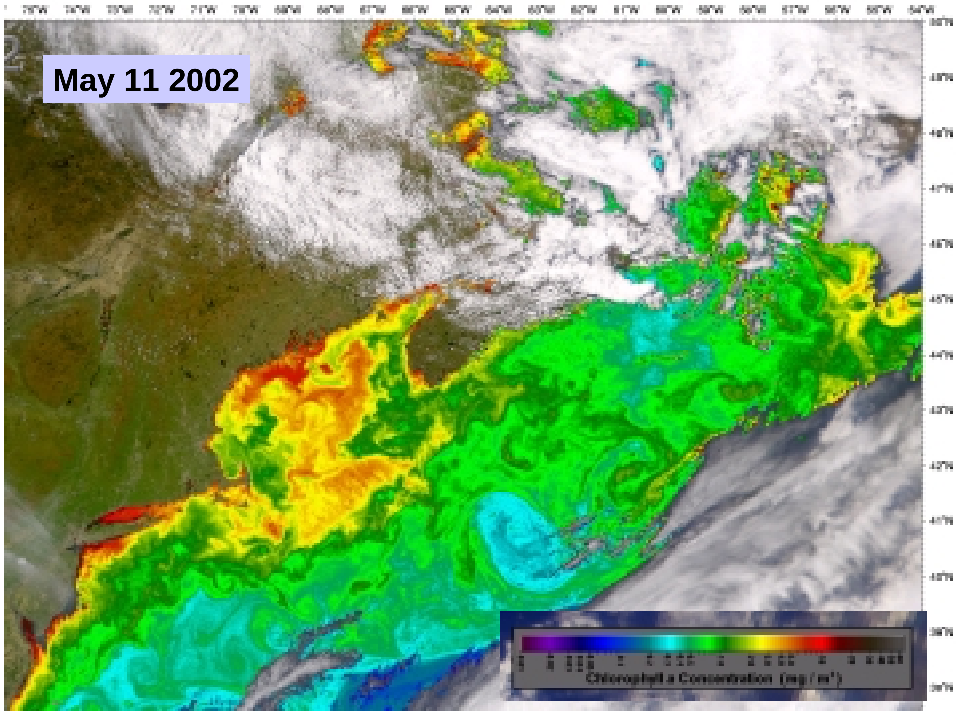


Figure 2. SEAWIFS chlorophyll a concentration imagery, May 2002.

Regional Monitoring Issues Matrix. The matrix builds from seven general problem areas that may be of common concern and interest throughout the region. The sources/causes, consequences, primary indicators and local/regional importance notes provide many examples, but should not be considered comprehensive. This list could and likely will be expanded in the monitoring proposal and during summit deliberations.

Problem	Sources/Cause	Consequences	Primary Indicators	Local/Regional Importance
Accelerated Eutrophication (Nutrient Enrichment)	Nutrient and carbon enrichment from point and nonpoint sources and atmospheric deposition	Hypoxia, SAV decline, overly productive, harmful algal blooms, increases in benthic and sheet algae	Water: DO, nutrients, PAR, Secchi depth Biota: SAV, benthic and sheet algae, phytoplankton, benthic infauna, fish, shellfish, crustaceans	Causes and effects are both local and regional. Local understanding is highly transferable throughout the region.
Habitat Modification and Change	Land use, development, dredging, filling, armoring, storms, accelerated sea level rise, hydromodification and altered hydrology, nutrients, invasive species	Loss or degradation of habitat functions and values	Water: Clarity, nutrients, contaminants, temperature Sediment/Soils: Diversity, grain size, acid sulphate soils, low DO in drained wetlands, resuspension, drift Habitat: Trends mapping, wetland subsidence Biota: General biodiversity, SAV, invasive species, benthic infauna, shellfish, crustaceans, fish, avifauna	Primarily local causes and effects. Understanding is highly transferable throughout the region. Regional implications for sea level rise and possibly from population declines of species with widely dispersing larvae.

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Toxic Contamination	Contaminant loads from point and nonpoint sources and atmospheric deposition, spills, historical sediment burdens, redistribution of solids suspended in rivers and from dredging and storms	Toxic water and sediments, habitat quality decline, reduced system productivity, endocrine disruption and pathological effects, human health effects	Water: Chemistry Sediment: Chemistry Biota: Toxicity testing, bioaccumulation or magnification, pathology and productivity of all levels	Primarily local causes and effects, but technology is highly transferable throughout the region. Regional implications for atmospheric deposition and some contaminants (e.g., Hg).
Pathogens and Toxins	Point and nonpoint sources, epizootics, secondary effect of degraded water and habitat quality, nuisance wildlife populations	Diseases, reproductive failure, and kills of higher fish and wildlife groups, beach closures, shellfish closures, harmful algal blooms, human health effects	Water: Pathogen indicators, toxin assessments Biota: HAB, shellfish, fish, crustacean, avifauna	Primarily local causes and effects, but understanding is transferable and of value regionally.
Resource Exploitation	Commercial and recreational harvests, mining, development	Population decline of commercial and recreational species, habitat destruction, altered hydrology and hydromodification, water quality (e.g., DO dead zones)	Sediment: Diversity, grain size, resuspension, drift Biota: Shellfish, crustaceans, fish, birds	Local impact but transferable. Regional impacts likely for species that travel widely through larval or adult dispersal.

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Invasive and Exotic Species Nonindigenous haplotypes	Shipping, transplanting, pet trade, storms, currents	Replacement of indigenous species, loss of biodiversity, rare and endangered species decline, boating access, low DO	Water: Low DO Biota: Invasive species, abundance, biodiversity, community structure	May start locally but often a regional effect
Climate Change	Greenhouse gases, natural trends, air contaminants	Exacerbates many of the above problems, range shifts of indigenous species, community imbalances, disease, global warming, storms, accelerated sea level rise, current anomalies, freshwater inflow change, submergence of tidal wetlands	Water: Temperature, hydrodynamics, hydrology Habitat: Tidal wetland loss Biota: Community structure surveys, pathology, changes in productivity	Largely regional in nature though consequences may vary at the local level.