

# **Draft List of Key Questions and Indicators**

# **Northeast Coastal Indicators Workshop Draft List of Key Management Questions and Indicators**

## Management priorities and corresponding indicators<sup>1</sup>

### **Background**

Environmental managers, scientists, citizens, policy and decision-makers from Nova Scotia to Connecticut will convene in New Hampshire on January 6-8, 2004 to arrive at consensus on indicators of environmental, social and economic for the Northwest Atlantic. An information packet is being assembled for the event that builds on the significant work that is available, both within our region and from away, on indicators and environmental reporting.

### **Management priorities and corresponding indicators**

A consensus is emerging that while there are many important region-wide coastal and ocean management themes there are six that seem to be most important and urgent. These include:

- Fisheries
- Contaminants
- Eutrophication
- Land use change
- Aquatic Habitat
- Climate change

Described below for each theme are the driving questions managers have articulated and possible indicators that might be used to characterize them.

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<sup>1</sup> A measurement that provides useful information about the condition of the natural, ecological, cultural or economic environment.

**I. Fisheries**

Management questions	Indicator Categories
a) What is the status of fish stocks?	Population sustainability
b) What is the impact of fish harvesting on non-target species?	Commercial/recreational fisheries Removal of species (Target and non-target)
c) What is the impact of gear types on habitats and species?	Gear impacts Marine protected areas
d) Is the fishery overcapitalized?	Invasive species impacts

Potential Indicators
Commercial fish/shellfish landings—also changes in target trophic level (% top predators, % prey species, etc.), average size/age class of landings
Annual recreational fishing days logged OR Total annual number recreational fish caught
Miles of stream open to fish migration
Condition of anadromous fish habitat (miles of viable vs. silted breeding areas)
Phytoplankton populations???. Specifically what?
Fisheries (fish and shellfish) populations (abundance, biomass, species richness, species evenness) <ul style="list-style-type: none"> <li>• Commercial stocks</li> <li>• Increase/decrease of "different species"—is this referring to increases/decreases due to by-catch of non-target species? What does "different species mean? Non-target?</li> <li>• Any indicators related to non-fisheries related impacts such as disease?</li> <li>• Standing stock of oysters, scallops, m. mercenaria, mussels, etc.?</li> </ul>
At risk native species (number or percent) and current status (increasing/decreasing/stable), how/if known threats are being addressed.
Non-native species (number/extent of invasion)
Effectiveness of existing MPAs in fisheries management: (age/size class inside and outside, habitat status inside/outside, evidence of spillover, area of coverage, type of restrictions, socioeconomic impacts/benefits, compliance, success in meeting stated objectives)

**II. Contaminants**

Management questions	Indicator Categories
<p>a) Is the contaminant source profile changing? Point vs. non-point? Air vs. water?</p> <p>b) Is the source distribution changing?</p> <p>c) What are lethal and sub-lethal effects of contaminants on fisheries and human consumers? (Safe to eat? Safe to swim in?)</p> <p>d) What is the fate and transport of contaminants to the region?</p>	<p>Pathogens</p> <p>Sewage</p> <p>Mercury</p> <p>Nutrient loading</p> <p>Cumulative effects of contamination</p> <p>Transfer through food chain (pathways and sources)</p> <p>PAHs, PCBs, trace metals? Chlorinated pesticides? Endocrine disrupters?</p> <p>Groundwater contaminants</p> <p>Sediment toxicity and benthic community measures</p>

Potential Indicators
<p>Sediment contamination levels (presence of toxic contaminants not specific to sediments)</p> <p>Tissue contamination levels (shellfish, fish, presence of toxic contaminants)</p> <p>Contaminants in predator species (humpback whale biopsies to measure contaminant levels?)</p> <p>Shellfish harvesting (either days of closure, acre days of activity)</p> <p>Bacteria concentrations</p> <p>Bathing beach closures</p> <p>Endocrine-disrupting chemicals in aquatic ecosystems</p> <p>Number of detection of pesticides identified as toxic air contaminants and the percent that exceeds numerical health standards each year (Type III)</p> <p>Pesticide use volumes and acres treated by toxicological and environmental impact categories</p> <p>Air Pollution (are we including air??):</p> <p>Vehicle NOx Emissions vs. Vehicle Miles Traveled</p> <p>Air Quality from Inhalable Particulates</p>

### III. Eutrophication

Management questions	Indicator Categories
a) What is the extent of eutrophication in the region?	Dissolved oxygen Harmful algal blooms
b) How successful are the controls?	Chlorophyll A
c) Where is eutrophication manifested?	Biomass
d) What is the rate of eutrophication in the region?	Productivity/Respiration Dominant plankton species
e) How does eutrophication impinging on human use?	System metabolism Water clarity
f) How is eutrophication changing the regions ecosystem?	Sediment anoxia
g) Are there hot spots with in the region?	
h) What are the sources of high nutrient levels (land, offshore current, effluent, etc.?)	

Potential Indicators
Dissolved oxygen levels; DO Saturation Chlorophyll concentrations Nutrient concentrations --particulate organic nitrogen, particulate organic carbon, TDN, ammonium, nitrate/nitrite, total dissolved phosphorous, phosphate/ortho-phosphate, silicate, total S Dinoflagellate cysts, diatoms, and foraminifera  Seagrass Nutrient Pollution Index Trends in estuarine particulate concentrations Nutrient and Sediment Loads Nitrogen and Phosphorous Trends in Rivers Entering Bays: Monitored Loads Flow Nitrogen Phosphorous Discharges and Population

**IV. Coastal Development (Land Use)**

Management questions	Indicator Categories
<ul style="list-style-type: none"> <li>a) How is land use changing?</li> <li>b) Where is fragmentation occurring?</li> <li>c) What is the ratio of natural areas to man-made development?</li> <li>d) How is land use affecting aquatic marine habitat?</li> <li>e) What land uses are exacerbating issues of contaminants, nutrients, sedimentation?</li> <li>f) How is water quality and hydrology changing?</li> <li>g) Where are land management practices and land use planning being implemented?</li> <li>h) How is the increase in impervious surfaces impacting land use? (Habitat, Water quality)</li> <li>i) To what degree are riparian buffers intact and functionally successful in buffering land-based impacts?</li> <li>j) How has the extent and diversity of riparian buffers changed?</li> </ul>	<ul style="list-style-type: none"> <li>Effects on resident and migratory species</li> <li>Impervious surfaces</li> <li>Alterations to hydrology</li> <li>Land conversion, development, fragmentation &amp; Industrialization</li> <li>Species at risk</li> <li>Loss of coastal wetlands, salt marsh, and riparian buffers</li> <li>Sedimentation/siltation</li> <li>Habitat loss (rate and location)</li> <li>Urbanization/human population shifts</li> </ul>

Potential Indicators
<ul style="list-style-type: none"> <li>Eel grass distribution</li> <li>Extent and distribution of various habitat types (quality of benthic habitat &amp; wetlands, unfragmented forests)</li> <li>Acres of restored salt marsh and tidal wetlands</li> <li>Extent of forest buffers</li> <li>Riparian Forest Buffer Conservation and restoration</li> <li>Areas of lands conserved</li> <li>Terrestrial Protected Areas- the percentage of land protected through legal mechanisms</li> <li>Impervious surfaces (trends or extent)</li> <li>Coastal access (number and type)</li> <li>Human population (by watershed)</li> <li>Rates of coastal development &amp; percent of development within (blank) feet of shore or tributary</li> <li>Siltation of submerged habitats</li>   <li>Percentage of population connected to sewage treatment</li> <li>Vehicles per populated land area OR Vehicles per 100 residents</li> <li>Knowledge of indigenous (archaeological) heritage places</li> <li>Public access to Shore</li> <li>Visits to National, Provincial/State, or Regional Parks + visits to "museums, and natural</li> </ul>

exhibits"

Public open green space

Managed forest area ratio

Annual municipal expenditures on parks, open space, and streetscapes.

Number of interest groups involved in area planning

**V. Aquatic Habitat**

Management questions	Indicator Categories
<p>a) How is aerial extent and quality of SAVs changing over time? What are the causes of change?</p> <p>b) How is aerial extent and quality of coastal and tidal wetlands changing over time? Causes?</p> <p>c) How is coastal armoring and sediment management practices affecting coastal aquatic/marine habitats?</p> <p>d) What is the relative success of restoration Activities?</p> <p>e) Where is sedimentation impinging on human uses?</p> <p>f) Where is sediment impinging on the quality of aquatic habitat?</p> <p>g) How is sediment character and quality changing?</p> <p>h) How healthy and diverse is the population's habitat and biology?</p> <p>i) (Related to fisheries) How are commercial and recreational harvesting practices affecting aquatic habitats?</p>	<p>Community structure and quality</p> <p>Submerged aquatic vegetation</p> <p>Sediment management, siltation, dredging</p> <p>Salt marshes</p> <p>Habitat created by invertebrate communities (deep sea coral, scallop, mussels)</p>

Potential Indicators
<p>Water temperature</p> <p>Eel grass distribution</p> <p>Macroalgae extent /diversity</p> <p>Extent and distribution of various habitat types (quality of benthic habitats)</p> <p>Restored habitats</p> <p>Biodiversity by habitat</p> <p>Stream bioassessment - invertebrate populations</p> <p>Acres and diversity of grasses</p> <p>Designated Oyster Restoration Areas</p> <p>Annual Loss of Wetlands</p> <p>Stream Miles Opened to Migratory Fish</p>



**VI. Climate Change**

Management questions	Indicator Categories
a) How is climate change and changing weather patterns affecting hydrology and fresh water inputs? b) How does the change in water temperatures affect biodiversity? c) Is there evidence of climate-related regime shifts in biota? d) Have weather patterns been altered? e) How does sea level rise and changing weather patterns effect coastal infrastructure? f) How is climate change and sea level rise affecting coastal erosion?	Extreme events Species movement Temperature and sea level rise Weather State variables/Physical variables Abiotic factors Changes in hydrology/salinity Impacts on coastal infrastructure

Potential Indicators
At risk species (number or percent) Non-native species (number/extent of invasion) Water temperature (and air temperature) Sea level rise Number of extreme storm events Documentation of species range expansions or declines  Climate Change: Carbon dioxide emissions Air temperature Annual snowmelt runoff Sea level rise Stratospheric ozone depletion Days with unhealthy levels of ozone pollution