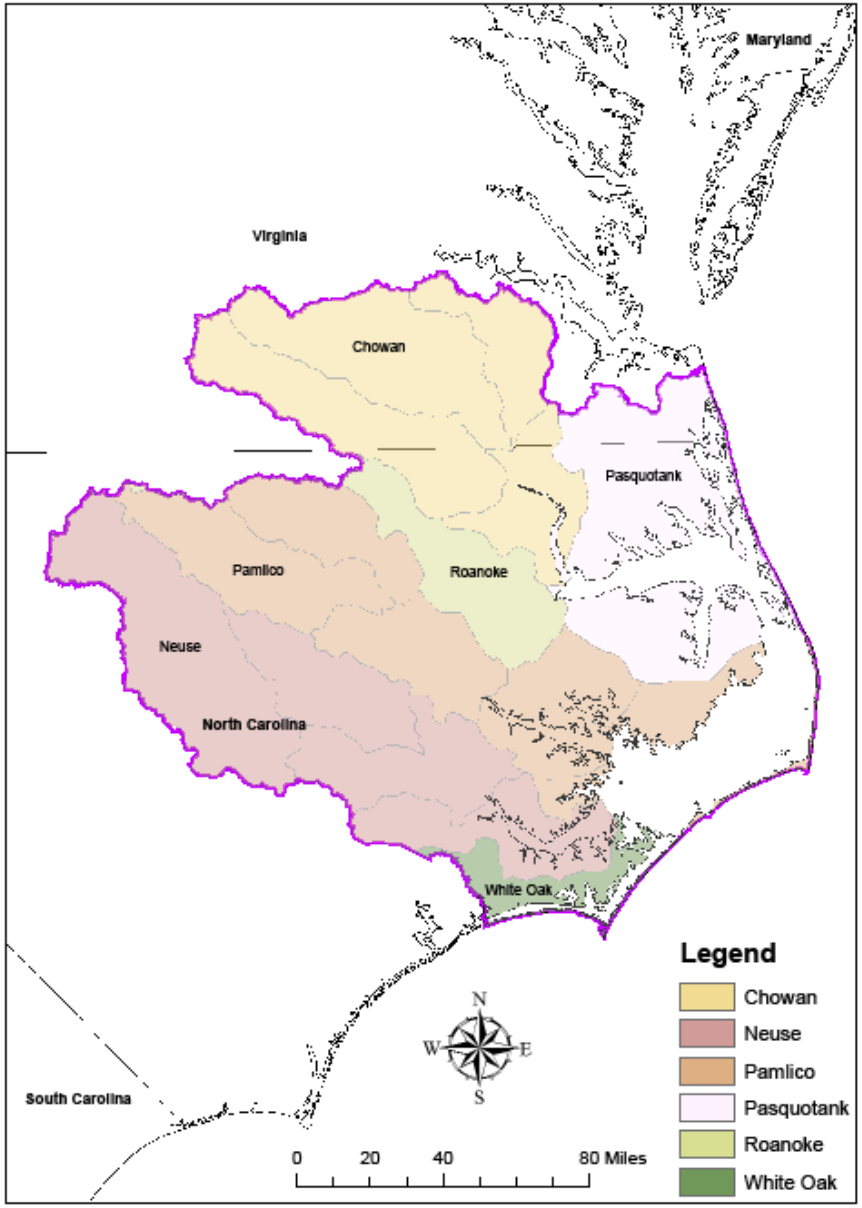
APNEP Living Aquatic Resources Monitoring & Assessment

- Develop a monitoring strategy for Living Aquatic Resource metrics within the APNEP region
- Metric-specific monitoring proposals
- Indicators to be featured in the 2010 APNEP Regional Ecosystem Assessment

River Basins in the APNEP Region



Map Created By Lori Brinn, 2010

APNEP's Transition to Ecosystem-Based Management

- A holistic vision and plan that includes a comprehensive description of the A-P system and articulation of multiple management objectives.
- A community that has effective engagement of policy makers, managers, scientists, & stakeholders.
- A process that includes effective adaptive management to address a changing system.
- A framework that includes appropriate authority, implementation area, management institutions, financial resources, and effective communications.

APNEP "Human" Goal and Outcomes (Draft)

- **A region where human communities are sustained by a functioning regional ecosystem**
  - *Waters are safe for personal contact*
  - *Designated waters are safe for consumption*
  - *Hydrologic regimes support human activities*
  - *Fish and game are safe for human consumption*
  - *Opportunities for recreation and access to public lands and waters are protected and enhanced*
  - *An ecosystem that provides natural resource uses such as agriculture, aquaculture, fisheries, forestry, and mining*

APNEP "Flora & Fauna" Goal and Outcomes (Draft)

- **A region where aquatic, wetland, and upland habitats are protected, enhanced, or restored and support viable populations of native species**
  - *The biodiversity, function and species populations of aquatic communities are protected, restored, or enhanced*
  - *The biodiversity, function and species populations of wetland communities are protected, restored, or enhanced*
  - *The biodiversity, function and species populations of upland communities are protected, restored, or enhanced*

APNEP "Flora & Fauna" Goal and Outcomes (Draft)

- **A region where aquatic, wetland, and upland habitats are protected, enhanced, or restored and support viable populations of native species**
  - *Extent and quality of marine and nearshore habitats maintain, restore, or enhance biodiversity and ecosystem function*
  - *Extent and quality of freshwater habitats maintain, restore, or enhance biodiversity and ecosystem function*
  - *Extent and quality of upland habitats maintain, restore, or enhance biodiversity and ecosystem function*
  - *Non-native species do not significantly reduce native species' viability or function, or impair habitat quality, quantity, or the processes that form and maintain habitats*

APNEP "Water" Goal and Outcomes (Draft)

- **A region where water quantity and quality maintain ecological integrity**
  - *Hydrologic regimes support ecological integrity*
  - *Nutrients and pathogens do not harm the species that depend on the waters*
  - *Toxics in waters and sediments do not harm the species that depend on the waters*

Source: US Clean Water Action Plan Partners. 2000. Clean Water Action Plan: Coastal Research and Monitoring Strategy.

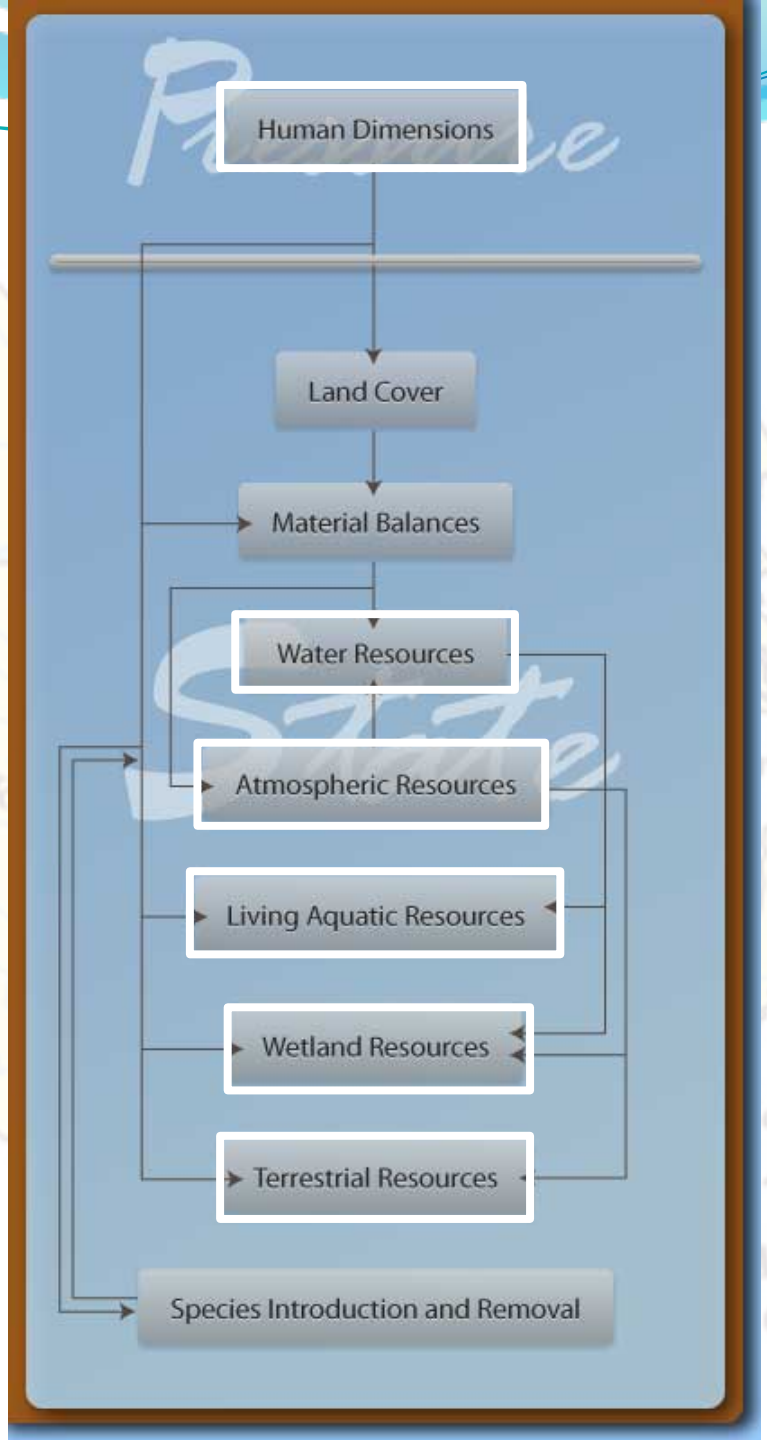
APNEP Targets 2010-2011

- Regional Ecosystem Assessment 1.0
  - Indicator Specification 1.1
- Comprehensive Conservation & Management Plan (CCMP) 2.0
  - Ecosystem-Based Management (EBM) Plan 1.0
- Integrated Monitoring Strategy 1.0
  - Indicator Specification 1.1

APNEP Monitoring & Assessment

- APNEP staff adopt indicators/metrics in 2007
- Plan in 2008 to develop an integrated monitoring strategy for those indicators
- In concert with APNEP revising its Comprehensive Conservation & Management Plan (CCMP)
- Six APNEP resource monitoring & assessment teams

Regional Ecosystem Model



Living Aquatic Resources Monitoring & Assessment Team Representation

- APNEP
- NC-DENR
  - DMF
  - DWQ
  - DWR
  - NHP
- NC-WRC
- VA-SNR
  - NHP
  - DGIF
  - DEQ
  - MRC
- ACE
- EPA
- FWS
- NOAA
- NPS
- USGS
- STAC/ Ex-STAC

EPA Indicator Development for Estuaries

- Program Planning
- Conceptual Model Development
- Indicator Specification
- Monitoring Program Development
- Implementation
- Reassessment

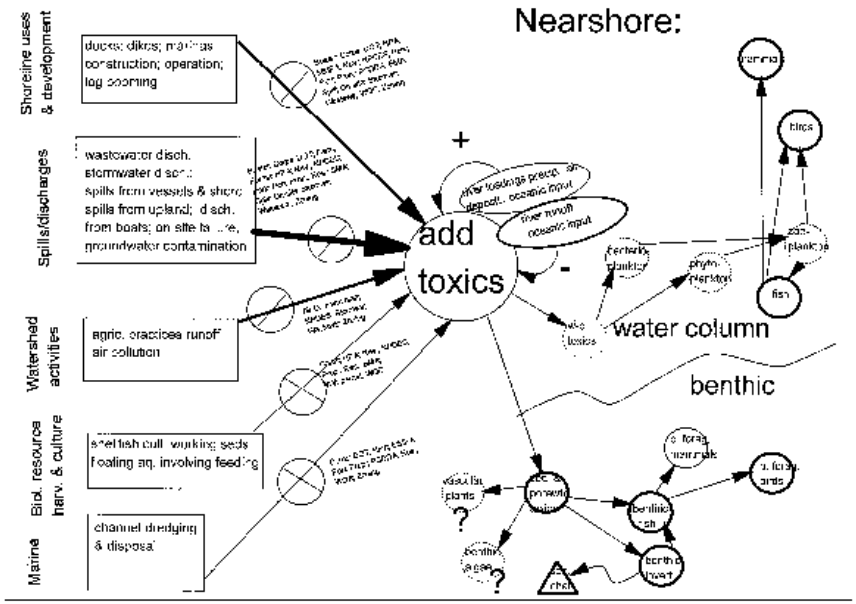


Figure 3. Stressor-based conceptual sub-model for toxics in the nearshore environment. Weighting of line around ecosystem component circles indicates amount of monitoring data available.

APNEP Indicator Definition

"A numerical value derived from actual measurements of a pressure, state or ambient condition, exposure, ecological condition, or measure of human health or wellbeing over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment in the A-P region."

APNEP Indicator Criteria

- Utilization: Address a key process or property, and answers (or makes an important contribution toward answering) an important question about conditions in the A-P region
- Objectivity: Developed and presented in an accurate, clear, complete, and unbiased manner
- Integrity: Underlying data should be characterized by sound collection methodologies and data management systems adequate to protect its integrity, and to comply with quality assurance procedures
- Availability: Data should be available and timely, or will likely be available in the future, to maintain the indicator's utility
- Representation: Trends should accurately represent the underlying trends in the target population
- Clarity: The indicator should be clearly defined and reproducible. The specific data used and the specific assumptions, analytical methods, and statistical procedures employed are clearly stated

APNEP Objectives-Metrics Hierarchy

- Modules
- Categories
- Dimensions
- Metrics

Candidate Living Aquatic Resource Indicators

Module	Category	Dimension	Indicator	
VI: Living Aquatic Resources	VI-A: Living Aquatic Incidents of Concern	VI-A-1: Community Simplification	VI-A-1-a	Fish Fauna Integrity
			VI-A-1-b	Low Diversity Benthic Macroinvertebrate Faunas
		VI-A-2: Acute Events	VI-A-2-a	Fish Kills
		VI-A-3: Fish and Shellfish Diseases/Parasites	VI-A-3-a	Acute Fish Disease Incidence
			VI-A-3-b	Chronic Fish Disease/Parasite Incidence
			VI-A-3-c	Incidence of Dermo (*Perkinsus marinus*) in Oysters
	VI-B: Aquatic Habitat	VI-B-1: General Habitat Condition	VI-B-1-a	Rare Taxa Presence
			VI-B-1-b	Rare Community Representation
			VI-B-1-c	Freshwater Hard Bottom
			VI-B-1-d	SAV Area/Zone/Density/Potential/Pheology by Species
		VI-B-2: Anadromous Fish Habitat	VI-B-2-a	Quality & Extent of Anadromous Fish Spawning/Nursery Areas
			VI-B-2-b	Inaccessible Fish Spawning Area by Obstruction Type
		VI-B-3: Aquatic Protected Areas	VI-B-3-a	Oyster Sanctuaries & Shellfish Harvest Closure Areas
	VI-C: Living Resource Populations	VI-C-1: Marine Mammals	VI-C-1-a	Bottlenose Dolphin Range and Population Condition
		VI-C-2: Fish	VI-C-2-a	Fish Stock Condition (SSB and Age Structure) by Commercial and Recreational Species
			VI-C-2-b	Fish Population Condition by Ecologically Important Species
			VI-C-2-c	Atlantic Sturgeon and Carolina Madtom Occurrences
		VI-C-3: Reptiles	VI-C-3-a	Diamondback Terrapin Range and Population Condition
			VI-C-3-b	Freshwater Turtles Range and Population Condition
			VI-C-3-c	American Alligator Range and Population Condition
			VI-C-3-d	Sea Turtles Range and Population Condition
		VI-C-4: Crustaceans	VI-C-4-a	Blue Crab Spawning Stock Biomass
			VI-C-4-b	Penaeid Shrimp Stock Condition
			VI-C-4-c	Spiny Crayfish Occurrence
		VI-C-5: Bivalve Molluscs	VI-C-5-a	Eastern Oyster Bed Extent and Densities
			VI-C-5-b	Hard Clam Bed Extent and Densities
			VI-C-5-c	Freshwater Mussels Range and Population Condition
		VI-C-6: Freshwater Invertebrates	VI-C-6-a	EPT Index
			VI-C-6-b	Invertebrate IBI Index
		VI-C-7: Microbes	VI-C-7-a	Zooplankton Community Structure
		VI-C-8: Algae	VI-C-8-a	Algal Community Structure
	VI-D: Toxicant Burdens	VI-D-1: Toxicants in Tissue	VI-D-1-a	Total Toxicant Body Burdens in Species (TBD)
			VI-D-1-b	Mercury in Species (TBD) Tissues
			VI-D-1-c	Dioxin in Fish Tissue
			VI-D-1-d	Fish Consumption Advisories
			VI-D-1-e	Marine Mammal Tissue Contaminants
IX: Species Introductions & Removals	IX-A: Invasive Aquatic Species	IX-A-4: Invasive Aquatic Herptofauna	IX-A-4-a	TBD Amphibian Species Population Status/Occurrences
		IX-A-5: Invasive Fish	IX-A-5-a	TBD Estuarine Marine Fish Species Population Status/Occurrences
			IX-A-5-b	TBD Freshwater Fish Species Population Status/Occurrences
		IX-A-7: Invasives Invertebrates	IX-A-7-a	TBD Mollusc Species Population Status/Occurrences
			IX-A-7-b	TBD Crustacean Species Population Status/Occurrences
			IX-A-7-c	TBD Insect Species Population Status/Occurrences
		IX-A-11: Invasive Aquatic Macrophytes	IX-A-11-a	Eurasian Watermilfoil Population Status/Occurrences
			IX-A-11-b	Hydrilla Population Status/Occurrences
	IX-B: Vulnerable Aquatic Species	IX-B-3: Vulnerable Aquatic Herptofauna	IX-B-3-a	Diamondback Terrapin Range & Population Condition
			IX-B-4-a	Neuse River Waterdog Range & Population Condition
		IX-B-5: Vulnerable Estuarine Fish	IX-B-5-a	Estuarine, Atlantic Sturgeon Population Status
			IX-B-6-a	Freshwater, Carolina Madtom Population Status
		IX-B-7: Vulnerable Invertebrates	IX-B-7-a	Triangle Floater Occurrences
			IX-B-7-b	Roanoke Slabshell Occurrences
			IX-B-7-c	Tar Spiny Mussel Occurrences
			IX-B-7-d	Dwarf Wedge Mussel Occurrences
			IX-B-7-e	North Carolina Spiny Crayfish Occurrences
			IX-B-10-a	TBD Aquatic Insect Species Population Status/Occurrences

A-P Ambient Monitoring Program

- Precise goals and specific measures for monitoring policy effectiveness should be designed and tested at the time that a policy is implemented
- Status Quo: APNEP 2000 monitoring survey update

APNEP Monitoring Proposal

- Justification for indictor
- Goal of sampling/monitoring program
  - What the optimum sampling/monitoring program will achieve and why that is important
- Existing sampling/monitoring program
  - Objectives - What the existing program is designed to measure.
    - Example: *Conduct periodic aerial mapping to monitor dramatic change of SAV presence over 5-year increments in four of six APES regions*
  - Methods
  - Costs
  - Data quality control (data quality objective)
  - Data analysis, statistical methods and hypotheses

APNEP Monitoring Proposal

- Enhanced sampling/monitoring program
  - Objectives - what the enhanced sampling/monitoring program is designed to measure.
    - Example: *Estimate the areal distribution and abundance of SAV along the western shorelines of APES and be capable of detecting significant change in SAV distribution and abundance*
  - Methods
  - Costs
  - Data quality control (data quality objective)
  - Data analysis, statistical methods and hypotheses
- Reference(s)
- Contact Person

Monitoring Integration Continuum

- Independence: Knowledge of partners monitoring strategies
- Cooperation: Taking advantage of common geography, timing
- Collaboration: Opportunities to leverage partners' monitoring networks
- Integration: Working toward a common set of regional ecosystem objectives

Heinz Center's State of the Ecosystem Assessment Format

- Summation Table: What do the most recent data show? Have data values changed over time?
- Part 1: Why is the indicator important?
- Part 2: What does this indicator report?
- Part 3: What do the data show?
- Part 4: Understanding the data (or discussion)
- Part 5: Why can't the entire indicator be reported at this time?
- Technical note (appendix)

System-Wide Indicators Proposed for 2010 APNEP Assessment

- Climate change
  - *Metrics*: relative sea level, storm frequency**, storm intensity**, average salinity across the estuarine system*
- Air quality
  - *Metrics*: wet nitrate deposition, wet ammonia deposition, tropospheric ozone concentration (secondary standard), total nitrate air concentration
- Unusual mortalities/disease*
  - *Metrics*: instances of mass, or otherwise unusual, deaths of marine mammals**, fishes*, birds, and turtles**; instances of disease in marine mammals**, fishes*, birds, and turtles
- Economic productivity*
  - *Metrics:* major yields and monetary value of agricultural, silvicultural, and fisheries* products
- Species diversity*
  - *Metrics:* areal extent of high biological diversity (natural heritage index)**, number of threatened and endangered species (aquatic and terrestrial)

Land-Based Indicators Proposed for 2010 APNEP Assessment

- Land cover*
  - *Metrics*: areal extent of wetlands*, urban areas*, agricultural land*, forests*, and silvicultural land; number of controlled animal feeding operations (CAFOs)
- Population**
  - *Metrics*: human population by county**, river basin**, and entire AP system**

Water-Based Indicators Proposed for 2010 APNEP Assessment

- Water quality*
  - *Metrics*: instances of violations of Clean Water Act 303(d) criteria including chemical and dissolved metal concentrations*, bacterial counts*, dissolved oxygen*, total phosphorus*, total nitrogen*, chlorophyll *a**, suspended solids* and turbidity*
- Extent of living habitat*
  - *Metrics*: areal extent of submerged aquatic vegetation* and areal extent of oyster beds*
- Fish populations*
  - *Metrics*: stock statuses of choice species* (these were commercial species in the last assessment)
- Economic productivity*
  - *Metrics:* major yields and monetary value of agricultural, silvicultural, and fisheries* products
- Riverine Inputs*
  - *Metrics:* freshwater flow rates*, number and type of point source polluters*, nutrients*, total suspended solids*

Regional Ecosystem Services

- Provisioning (e.g., food, water, timber, fiber)
- Regulating (climate, floods, disease, wastes)
- Cultural (recreational, asethetic, spiritual)
- Supporting (e.g., soil formation, photosynthesis, nutrient cycling)