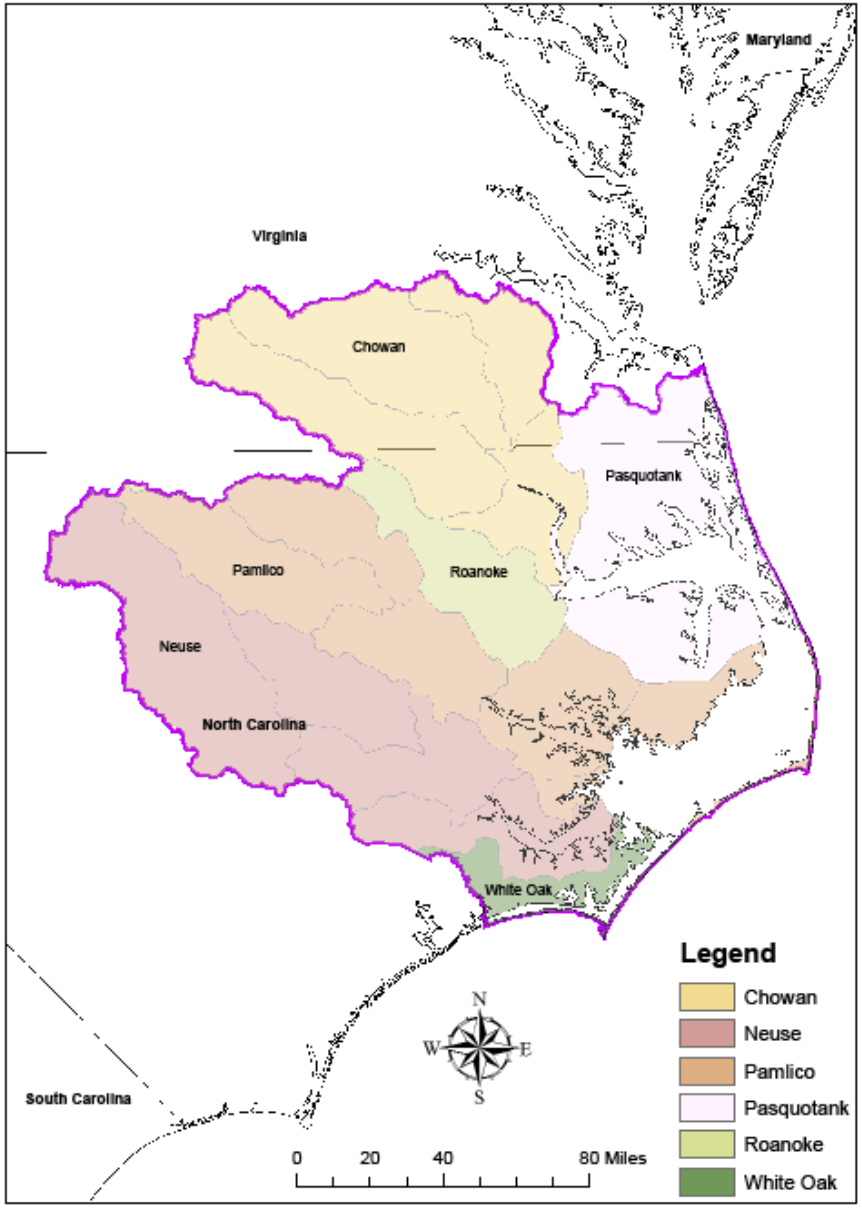
APNEP Terrestrial Resources Monitoring & Assessment

- Develop a monitoring strategy for Terrestrial Resource metrics within the APNEP region
- Metric-specific monitoring proposals
- Indicators to be featured in the 2011 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 surface and ground water supplies are safe for human consumption*
  - *Surface hydrologic regimes sustain regulated human uses*
  - *Fish and game are safe for human consumption*
  - *Opportunities for recreation and access to public lands and waters are protected and enhanced*
  - *The ecosystem sustains uses such as agriculture, aquaculture, fisheries, and forestry, while maintaining diverse natural resources*

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 populations of species in aquatic, wetland, and upland communities are protected, restored, or enhanced*
  - *The extent and quality of upland, freshwater, marine and nearshore habitats fully support biodiversity and ecosystem function*
  - *Non-native species do not significantly impair native species' viability or function, nor impair habitat quality, quantity, and the processes that form and maintain habitats*

APNEP "Water" Goal and Outcomes (Draft)

- **A region where water quantity and quality maintain ecological integrity**
  - *Ecological integrity through preservation or restoration of appropriate hydrologic regimes*
  - *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*
  - *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.

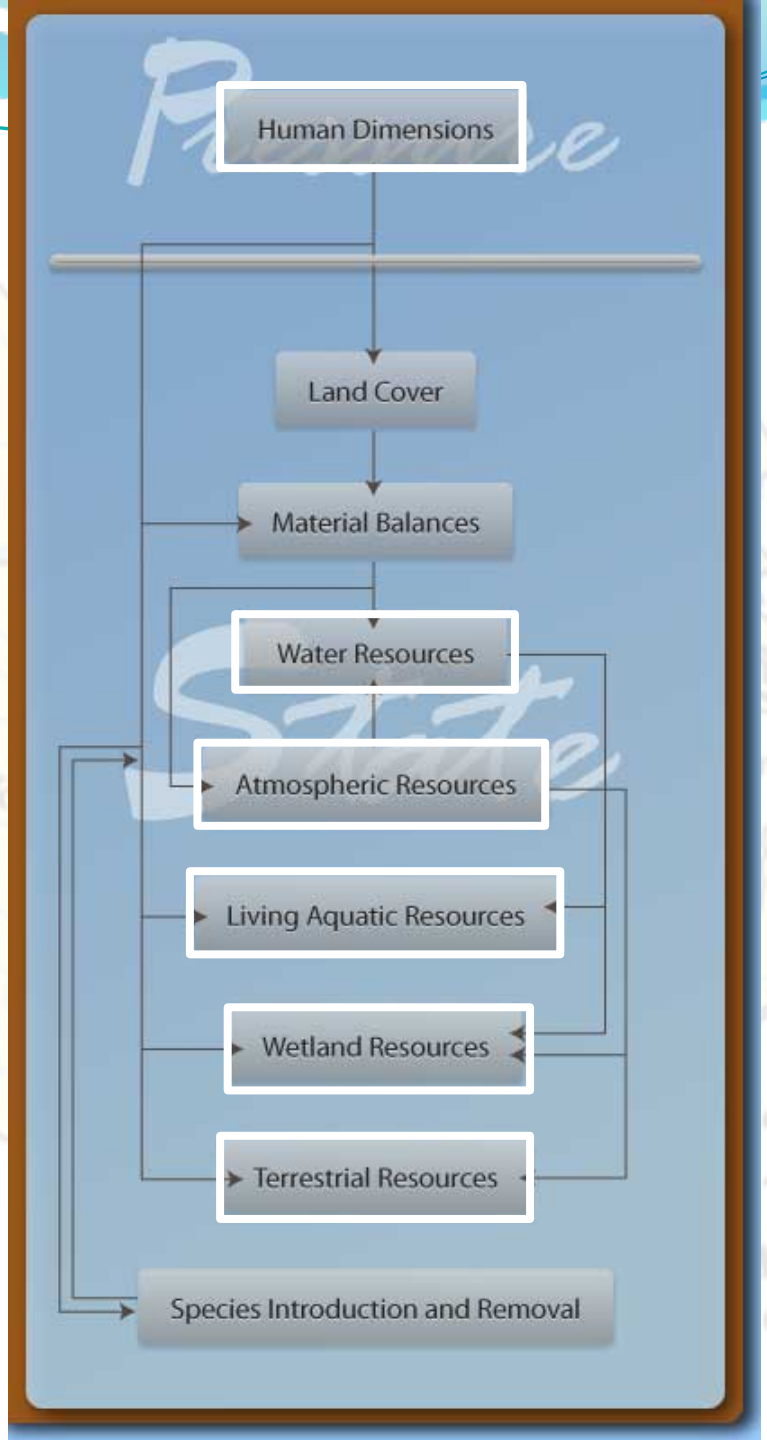
APNEP Targets 2010-2011

- 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



Terrestrial Resources Monitoring & Assessment Team Representation

- APNEP
- NC-DENR
  - DCM
  - DFR
  - DLR
  - DPR
  - DSWC
  - EEP
  - MNS
  - NHP
- NC-WRC
- NC-DOT
- VA-SNR
  - *DCR*
  - *DF*
- EPA
- FS
- FWS
- GS
- NPS
- NRCS
- STAC/ Ex-STAC
- Ex-DENR

EPA Indicator Development for Estuaries

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

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 Terrestrial Resource Indicators

Module	Category	Dimension	Indicator	
VIII: Upland Resources	VIII-A: Upland Incidents of Concern	VIII-A-1: Altered Fire Regime	VIII-A-1-a	Fire Severity, Frequency, and Extent
		VIII-A-2: Insects, Diseases and Parasites	VIII-A-2-a	Disease Outbreak Severity, Frequency, and Extent
		VIII-A-3: Storms Damage	VIII-A-3-a	Frequency and Extent of Vegetation and Soil Loss
		VIII-A-4: Bioaccumulation	VIII-A-4-a	Bird Egg Contamination
	VIII-B: UplandHabitat Adequacy	VIII-B-1: Overall Habitat Adequacy	VIII-B-1-a	Rare Organism Presence
			VIII-B-1-b	Rare Community Presence
	VIII-C: Living Resource Status	VIII-C-1: Forest Type Extent and Location	VIII-C-1-a	Longleaf/Natural Upland Pine Extent, Location (LC)
			VIII-C-1-b	Natural Upland/Mesic Hardwood Extent, Location (LC)
			VIII-C-1-c	Maritime Forests Extent, Location (LC)
		VIII-C-2: Forest Age-Structure	VIII-C-2-a	Longleaf/Natural Upland Pine Age-Structure
			VIII-C-2-b	Natural Upland/Mesic Hardwood Age-Structure
			VIII-C-2-c	Maritime Forests Age-Structure
	VIII-D: Upland Species of Particular Concern	VIII-D-1: Upland Mammals	VIII-D-1-a	Black Bear Population in Wetlands & Uplands
			VIII-D-1-b	Deer Population
			VIII-D-1-c	Bat Population
		VIII-D-2: Upland Birds	VIII-D-2-a	Turkey Population
			VIII-D-2-b	Raptor (Eagles/Ospreys) Population
			VIII-D-2-c	Land Bird Population
		VIII-D-3: Upland Herptofauna	VIII-D-3-a	Reptile Species TBD Population
		VIII-D-4: Upland Flora	VIII-D-4-a	Leopard Frog Population
			VIII-D-5-a	Ephemeral Pool Breeders
	VIII-E: Soil Quality	VIII-E-1: Soil Condition	VIII-E-1-a	Extent of Highly Eroded Soils
			VIII-E-1-b	Soil Organic Matter
		VIII-E-2: Soil Toxicity	VIII-E-2-a	Brownfield Extent
			VIII-E-2-b	Toxicant Body Burdens in Soil Fauna Species (TBD)
II: Land Cover	II-A: Cover Type Extent	II-A-1: Regional Coverage	II-A-1-a	Area by Land Cover Class
		II-A-2:Coastal Margin	II-A-II-a	Natural Coast Buffer: Undeveloped Dunes and Shorelines
	II-B: Spatial Relationships	II-B-1: Connectivity	II-B-1-a	Landscape Connectivity Index
		II-B-2: Patchiness	II-B-2-a	Landscape Complexity Index
		II-B-3: Proximity	II-B-3-a	Landscape Proximity Index
III: Material Balances	III-B: Terrestrial Element of Carbon Cycle	III-B-2: Sequestered Carbon	III-B-2-a	Stored Carbon in Terrestrial Biota
	III-C: Terrestrial Element of Nutrient Cycle	III-C-1: Nitrogen	III-C-1-a	Nitrogen Cycle Condition
		III-C-2: Phosphorus	III-C-2-a	Phosphorus Cycle Condition
		III-C-3: Sulfur	III-C-3-a	Sulfur Cycle Condition
	III-D: Terrestrial Element of Sediment Cycle	III-D-1: Soil	III-D-1-a	Prevalence of Highly Eroded Lands
		III-D-2: Sedimentation	III-D-2-a	TBD
	III-E: Terrestrial Element of Toxicants Cycle	III-D-1: Metals Contaminants	III-D-1-b	Mercury Prevalence in Biota
		III-D-2: Non-Metals Contaminants	III-D-2-a	Toxicant (TBD) Prevalence in Biota
IX: Species Introduction & Removal	IX-A: Invasive Upland Species	IV-A-1: Invase Upland Mammals	IV-A-1-a	Wild Hog Population Estimates, Notable Local Populations
		IV-A-2: Invasive Upland Birds	IV-A-2-a	TBD Species Population Status/Occurrences
		IV-A-3: Invasive Upland Herptofauna	IV-A-3-a	TBD Species Population Status/Occurrences
		IV-A-9: Invasive Upland Invertebrates	IV-A-9-a	TBD Arachnid Species Population Status/Occurrences
			IV-A-11-a	TBD Insect Species Population Status/Occurrences
		IV-A-13: Invasive Upland Flora	IV-A-13-a	Privet Population Status/Occurrences
			IV-A-13-b	Microstegium Population Status/Occurrences
			IV-A-13-c	Kudzu Population Status/Occurrences
	IX-B: Vulnerable Upland Species	IV-B-1: Vulnerable Upland Mammals	IV-B-1-a	Red Wolf, Population Status/Occurrences
		IV-B-2: Vulnerable Upland Birds	IV-B-2-a	Quail, Grassland bird Community Status
		IV-B-3: Vulnerable Upland Herpofauna	IV-B-3-a	TBD Reptile Species Population Status/Occurrences
			IV-B-4-a	TBD Amphibian Species Population Status/Occurrences
		IV-B-9: Vulnerable Upland Invertebrates	IV-B-9-a	TBD Arachnid Species Population Status/Occurrences
			IV-B-11-a	TBD Insect Species Population Status/Occurrences
		IV-B-13: Vulnerable Upland Flora	IV-B-13-a	TBD Species Population Status/Occurrences

Albemarle-Pamlico National Estuary Program North Carolina

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 2011 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 2011 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 2011 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)