Preliminary Thoughts on an APNEP 2024 State of the Estuary and Watershed Report and Companion Report Card

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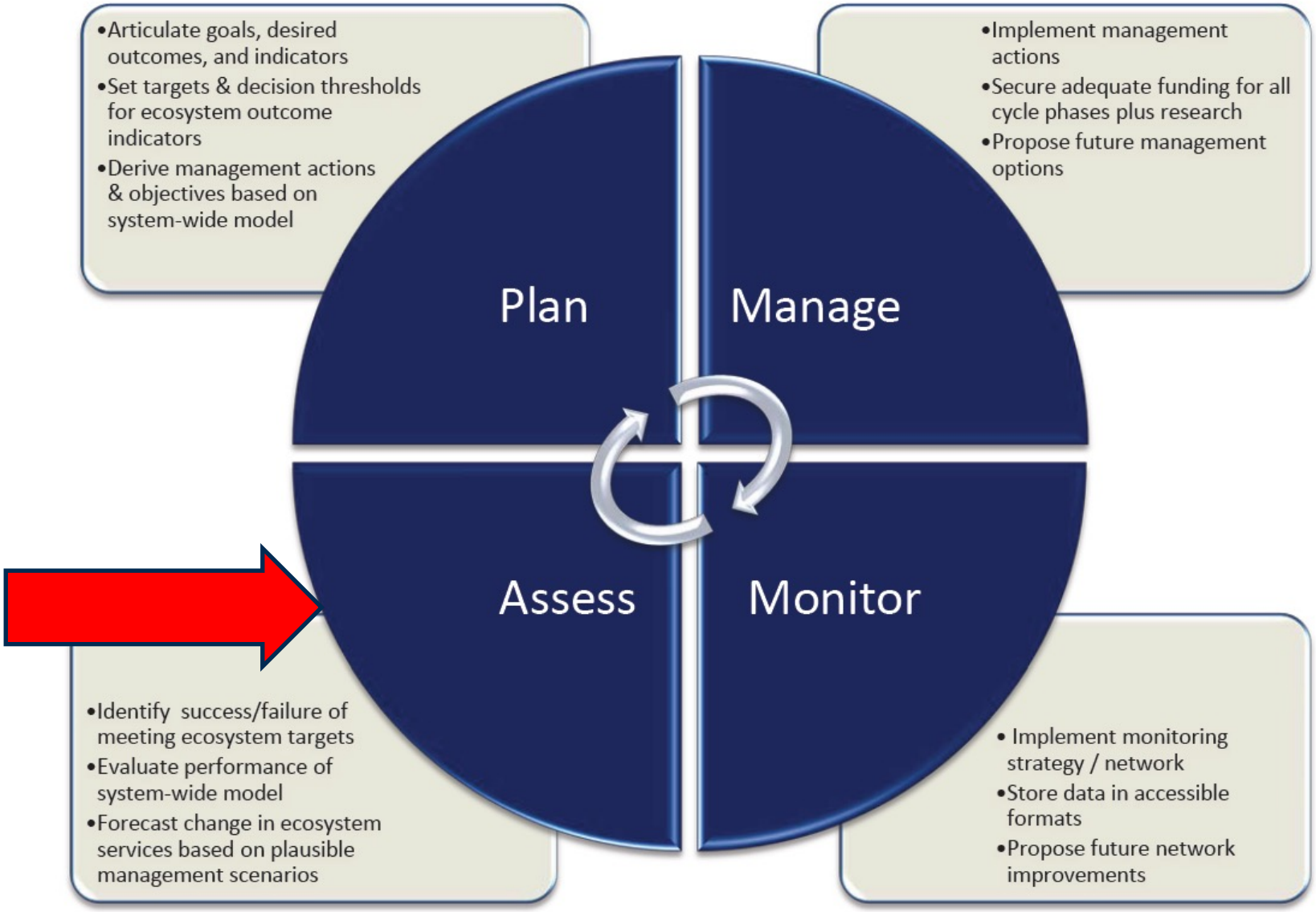
APNEP's Seven Steps to EBM Enlightenment

- Articulate **program goals**
- Develop **system level model** for goal attainment
- Assess current management efforts –identify **gaps**
- Develop **management strategy**
- Develop **monitoring program**
- **Assess** performance
- **Manage adaptively**

Figure 2: APNEP's adaptive management cycle.



CCMP's Four Questions

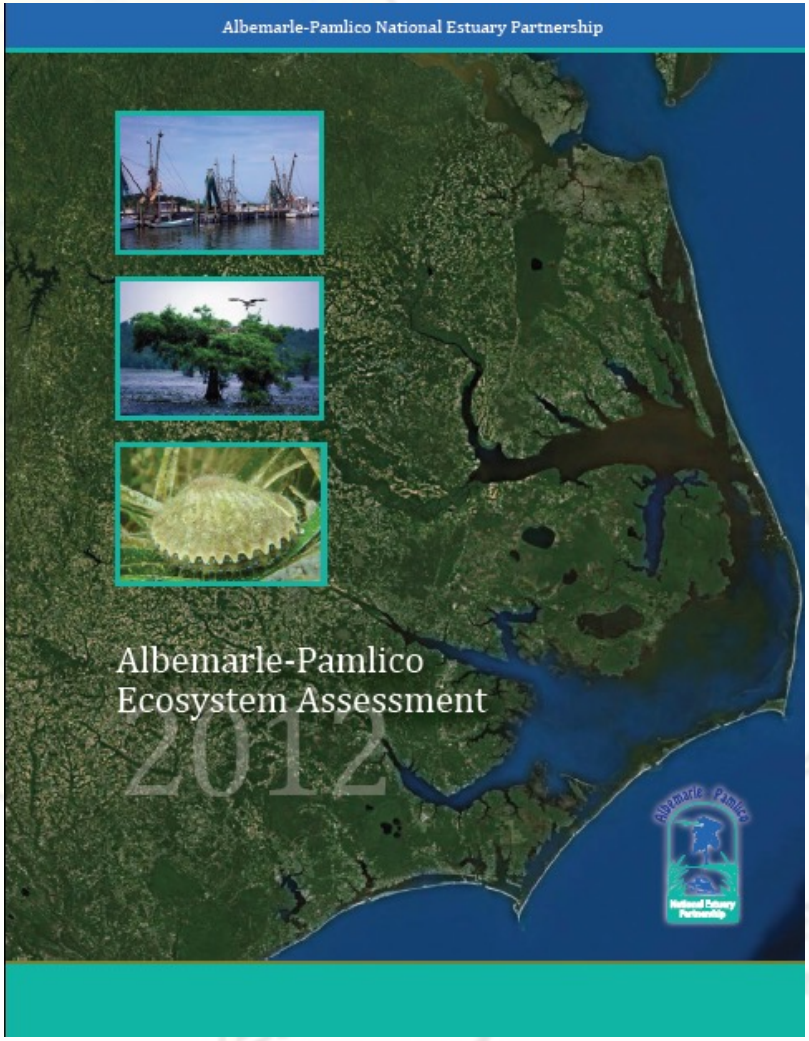
- **What is a healthy Albemarle-Pamlico Estuarine System?**
- **What is the status of Albemarle-Pamlico Estuarine System?**
- **What are the biggest threats to Albemarle-Pamlico Estuarine System?**
- **What actions should be taken that will move us from where we are today to a healthier Albemarle-Pamlico Sounds by 2028?**

Goal	Environmental Outcome	Outcome Type	Provisional Indicator
1: Human Communities	1A: Waters are safe for personal contact.	Swimming	Beach Action Days/Closings by Water Body Type Sounds, Freshwater River, Lake, Brackish River)
	1B: Designated surface and ground water supplies are safe for human consumption.	Potable Surface Waters	WQ Standard Violations (Surface)
		Potable Groundwaters	Drinking Water Standard Violations (Water-supply Aquifers)
			Nutrient Concentrations in Land Use Categories (Shallow Aquifer)
	1C: Surface hydrologic regimes sustain regulated human uses.	Water Supply	Flows, Severity, Frequency, Duration of Droughts & Floods
	1D: Fish and game are safe for human consumption.	Edible Harvest	Fish Consumption Advisories
			Shellfish (& Swimming) Area Closures
	1E: Opportunities for recreation and access to public lands and waters are protected and enhanced.		Access, Water Trails
			Number of Visitations & People Who Use Coastal Areas
			Number of Tourists to Coastal Regions
			Water Access Number & Location

Category	Dimension	Indicator Type	Provisional Indicator
Ecosystem Stressors	**Base Stressors**	**Human Population**	Human Population
		Land Use, Land Cover	Total Area of Impervious Cover
			Land Use/Cover Extent by Type (Urban, Altered, Total)
	Atmospheric Stressors	**Air Chemistry**	Total Inorganic Nitrogen Deposition
			Total Inorganic Sulfur & Nitrogen Deposition
			Ground-Level Ozone Concentrations
			Mercury Deposition
		Air Physics	Ambient Air Temperature
			Precipitation
			Storm Frequency & Severity
	Liquid Stressors	**Liquid Waste Generation**	Wastewater Per Capita
			Number of Open Liquid-Waste Lagoons
			Livestock Waste Production
		Sea Level Rise	Sea Level/Relative Sea Level

Step 6: Assess performance

- "Interim" regional ecosystem assessment (2012)
  - Select provisional indicators
  - Status & trends from 1995 to present
  - Heinz Center format
- Phase 2 assessment
  - Diagnosis
- Phase 3 assessment
  - Forecasting



- Editing team
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- STAC members
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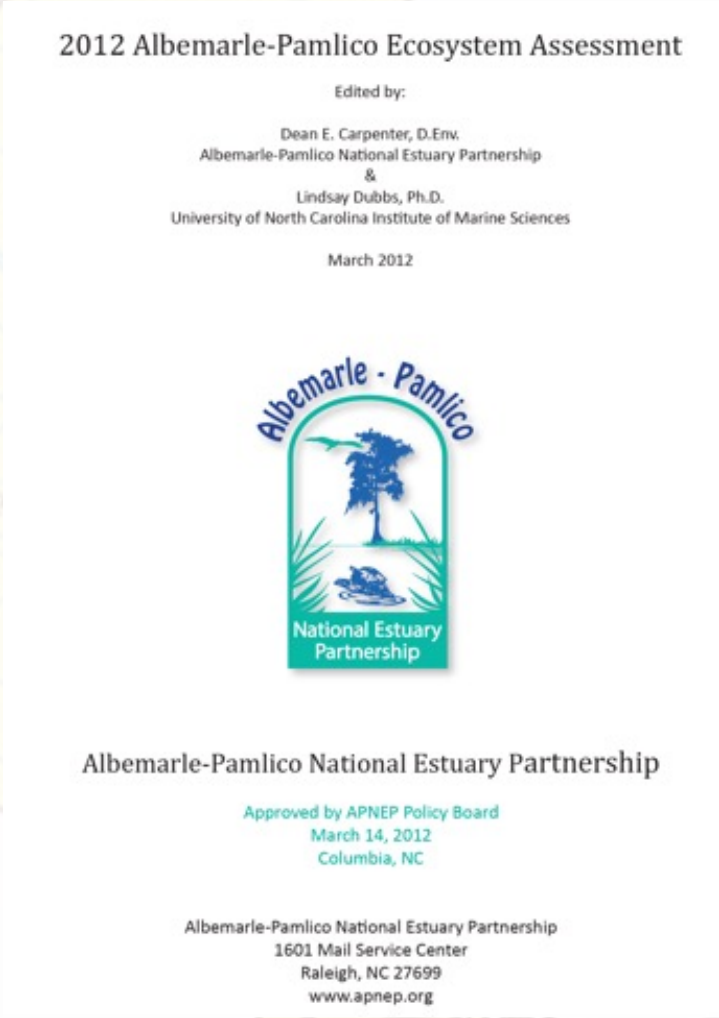

2012 Albemarle-Pamlico Ecosystem Assessment

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  - History of assessments in A-P Region
  - Protocol & format
- Chapter 2: Region's Ecosystems
- Chapter 3: System-Wide
  - Extent & Pattern
  - Chemical & Physical Characteristics
  - Biological Components

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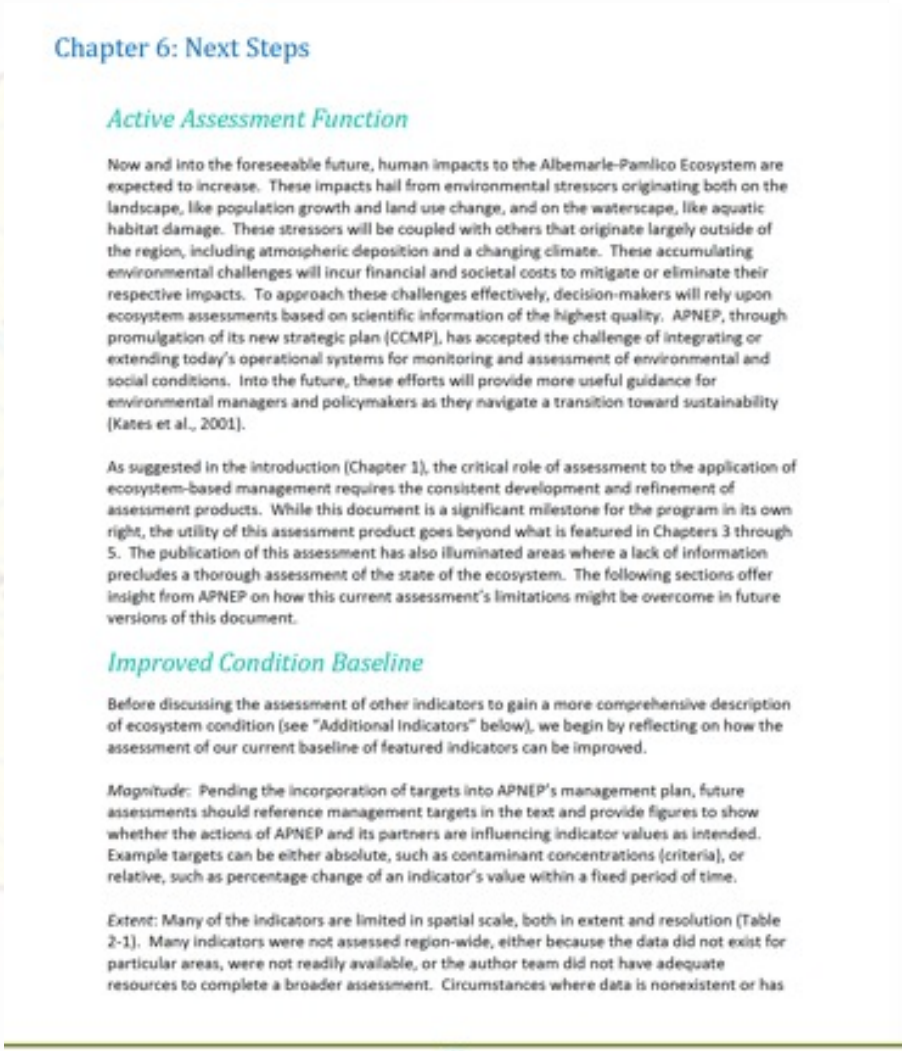

Chapter 6: Next Steps

Active Assessment Function

Now and into the foreseeable future, human impacts to the Albemarle-Pamlico Ecosystem are expected to increase. These impacts hail from environmental stressors originating both on the landscape, like population growth and land use change, and on the waterscape, like aquatic habitat damage. These stressors will be coupled with others that originate largely outside of the region, including atmospheric deposition and a changing climate. These accumulating environmental challenges will incur financial and societal costs to mitigate or eliminate their respective impacts. To approach these challenges effectively, decision-makers will rely upon ecosystem assessments based on scientific information of the highest quality. APNEP, through promulgation of its new strategic plan (CCMP), has accepted the challenge of integrating or extending today's operational systems for monitoring and assessment of environmental and social conditions. Into the future, these efforts will provide more useful guidance for environmental managers and policymakers as they navigate a transition toward sustainability (Kates et al., 2001).

As suggested in the introduction (Chapter 1), the critical role of assessment to the application of ecosystem-based management requires the consistent development and refinement of assessment products. While this document is a significant milestone for the program in its own right, the utility of this assessment product goes beyond what is featured in Chapters 3 through 5. The publication of this assessment has also illuminated areas where a lack of information precludes a thorough assessment of the state of the ecosystem. The following sections offer insight from APNEP on how this current assessment's limitations might be overcome in future versions of this document.

Improved Condition Baseline

Before discussing the assessment of other indicators to gain a more comprehensive description of ecosystem condition (see "Additional Indicators" below), we begin by reflecting on how the assessment of our current baseline of featured indicators can be improved.

Magnitude: Pending the incorporation of targets into APNEP's management plan, future assessments should reference management targets in the text and provide figures to show whether the actions of APNEP and its partners are influencing indicator values as intended. Example targets can be either absolute, such as contaminant concentrations (criteria), or relative, such as percentage change of an indicator's value within a fixed period of time.

Extent: Many of the indicators are limited in spatial scale, both in extent and resolution (Table 2-1). Many indicators were not assessed region-wide, either because the data did not exist for particular areas, were not readily available, or the author team did not have adequate resources to complete a broader assessment. Circumstances where data is nonexistent or has

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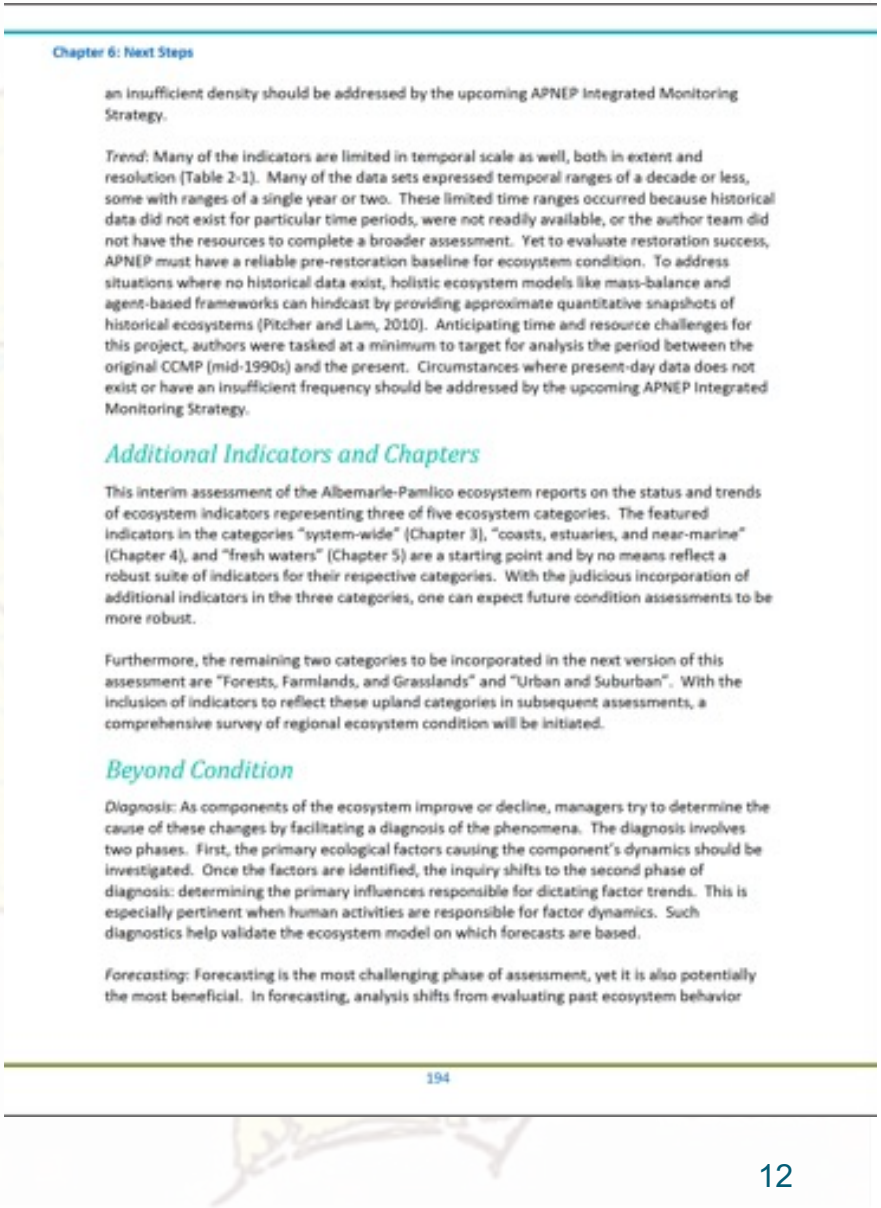
- Additional indicators & chapters
  - Forests, Farmlands, & Grasslands
  - Urban & Suburban
- Beyond Condition
  - Diagnosis
  - Forecasting



an insufficient density should be addressed by the upcoming APNEP Integrated Monitoring Strategy.

Trend: Many of the indicators are limited in temporal scale as well, both in extent and resolution (Table 2-1). Many of the data sets expressed temporal ranges of a decade or less, some with ranges of a single year or two. These limited time ranges occurred because historical data did not exist for particular time periods, were not readily available, or the author team did not have the resources to complete a broader assessment. Yet to evaluate restoration success, APNEP must have a reliable pre-restoration baseline for ecosystem condition. To address situations where no historical data exist, holistic ecosystem models like mass-balance and agent-based frameworks can hindcast by providing approximate quantitative snapshots of historical ecosystems (Pitcher and Lam, 2010). Anticipating time and resource challenges for this project, authors were tasked at a minimum to target for analysis the period between the original CCMP (mid-1990s) and the present. Circumstances where present-day data does not exist or have an insufficient frequency should be addressed by the upcoming APNEP Integrated Monitoring Strategy.

Additional Indicators and Chapters

This interim assessment of the Albemarle-Pamlico ecosystem reports on the status and trends of ecosystem indicators representing three of five ecosystem categories. The featured indicators in the categories "system-wide" (Chapter 3), "coasts, estuaries, and near-marine" (Chapter 4), and "fresh waters" (Chapter 5) are a starting point and by no means reflect a robust suite of indicators for their respective categories. With the judicious incorporation of additional indicators in the three categories, one can expect future condition assessments to be more robust.

Furthermore, the remaining two categories to be incorporated in the next version of this assessment are "Forests, Farmlands, and Grasslands" and "Urban and Suburban". With the inclusion of indicators to reflect these upland categories in subsequent assessments, a comprehensive survey of regional ecosystem condition will be initiated.

Beyond Condition

Diagnosis: As components of the ecosystem improve or decline, managers try to determine the cause of these changes by facilitating a diagnosis of the phenomena. The diagnosis involves two phases. First, the primary ecological factors causing the component's dynamics should be investigated. Once the factors are identified, the inquiry shifts to the second phase of diagnosis: determining the primary influences responsible for dictating factor trends. This is especially pertinent when human activities are responsible for factor dynamics. Such diagnostics help validate the ecosystem model on which forecasts are based.

Forecasting: Forecasting is the most challenging phase of assessment, yet it is also potentially the most beneficial. In forecasting, analysis shifts from evaluating past ecosystem behavior

- Beyond Ecosystem Outcomes
  - Management actions
  - Stakeholder understanding

(retrospective) to modeling future ecosystem behavior (prospective). Projections are useful exercises to help plan for future uncertainty in a dynamic system (Pandolfi et al., 2011:421). The complexity of ecosystem behavior, like that of the global economic system, dictates that ecosystem models rather than simple linear extrapolation are often the most prudent course. Furthermore, because of ecosystem momentum operating at regional scales, traditional experimental protocols are often infeasible. Varied treatments and multiple replicates necessary for these approaches would require huge area and time commitments, which as a practical matter excludes them from consideration. Environmental managers should strive to have a decision support system whereby the influence of various human activities can be effectively modeled. In return, the decision support system would provide increasingly accurate estimates of the ecosystem services and economic value gained and lost in the region. Ultimately, this ability to forecast future events based on current management decisions seeks to provide optimal solutions that reduce societal vulnerability to ecosystem degradation at an efficient cost.

Beyond Ecosystem Outcomes

The sections above have suggested improvements to this type of environmental assessment. APNEP must also produce other types of assessments, including assessments of management actions in the region and assessments of stakeholder understanding of the ecosystem's dynamics. Management assessments are essential to resolve whether undesirable ecosystem trends are due to inadequate implementation of management actions or an inadequate understanding of the ecosystem itself.

In conclusion, APNEP staff and volunteer authors have invested substantial time and resources to generate this interim assessment. This partnership is hopeful that information provided in the preceding chapters will spark partner investment in higher quality and more diverse decision support products as discussed above. If successful, this region's citizens, managers, and policymakers will benefit greatly by more fully understanding the ramifications of their current and future actions. Because the culture and economy of the region are so intimately intertwined with the Albemarle-Pamlico ecosystem, APNEP aspires for its work in this area to substantially improve the well-being of the citizens of the region.

References

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APNEP Ecosystem Assessment

Coasts, Sounds, Near Marine: Extent & Pattern

- Extent of Submerged Aquatic Vegetation in High-Salinity Waters
  - Why Is the Extent of Submerged Aquatic Vegetation Important Within the Albemarle-Pamlico Estuarine System?
  - What Does This Indicator Report?
  - What Do the Data Show?
  - *Why Are These Changes Happening?*
  - What is Not Shown by This Metric?
  - *What are the Implications for Management?*
  - *What are the Proposed Ultimate and Interim Targets for this Indicator?*
  - Technical Notes

APNEP Ecosystem Assessment
System-Wide: Physical & Chemical

- Atmospheric Nitrogen Deposition
  - Why Is Atmospheric Nitrogen Deposition Important Within the Albemarle-Pamlico Estuarine System?
  - What Does This Metric Report?
  - What Do the Data Show?
  - What Is Not Shown by This Metric?
  - *Why Is This Happening?*
  - *What are the Implications for Management?*
  - *What are the Proposed Ultimate and Interim Targets for this Indicator?*
  - Technical Notes

APNEP Ecosystem Assessment
Other Ecosystem Assessment Formats

- Technical Assessments
  - State of Naragansett Bay & Watershed (NEP 2017)
  - Papahānaumokuākea Marine National Monument Status & Trends (NOAA + FWS + State of Hawaii, 2020)
  - Puget Sound State of the Sound (NEP 2021)
  - State of the Ecosystem: Mid-Atlantic (NMFS 2023)
  - National Nature Assessment (US-DEQ *In Progress*)
- Non-Technical Assessments / Report Cards
  - Chesapeake Bay Program

Bioregional Assessment Questions

- What were historic ecological, social, and economic conditions, trends, and variability?
- What are current ecological, social, and economic conditions?
- What are trends and risks under current policies and management?
- What policy choices will achieve ecological sustainability consistent with social well-being?
- What are the implications of these choices?

Source: Erman (1999)

Assessment Planning

- "The greatest challenge in developing a large-scale biogeographic assessment is the synthesis and subsequent analysis of spatial data collected at different scales for varied objectives."

  Source: NOAA 2003, citing Gotway and Young 2002

Scientific Assessment for Environmental Policy

- Assessments are not just summaries
- Assessors define objectivity as policy neutrality and a balance of bias
- Institutional arrangements affect epistemic outcomes
- Assessors strive to separate science and policy
- Assessments generally aim for consensus
- Uncertainty

Source: Oppenheimer et al. (2019)

Step 7: Manage adaptively

- Most difficult step?
- Senior management engagement
- Trigger levels in plan