

Developing an indicator monitoring and assessment program to support the Mid-Atlantic Regional Ocean Action Plan Health Ocean Ecosystem Action 5

White paper prepared for the Mid-Atlantic Regional Council on the Ocean



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EXECUTIVE SUMMARY

The Mid-Atlantic Regional Ocean Action Plan (OAP) Healthy Ocean Ecosystem Action 5 establishes that a healthy ocean ecosystem indicator monitoring and assessment program is needed to better understand ecosystem changes as they occur, and how those changes impact and are impacted by human activity.

A project to begin to address this need was initiated in February 2017, with the goal of informing the development of a healthy ocean ecosystem indicator monitoring and assessment program for the Mid-Atlantic region that relies on existing data collection and monitoring efforts and is tied to ocean planning goals. This project has completed preliminary work to identify key data and information to inform an indicator monitoring and assessment program, and to engage the Mid-Atlantic RPB and numerous stakeholders in the initial evaluation of potential indicator themes and data.

This white paper was written by the project team to provide background information, potential options, and important considerations for decision-making to advance a healthy ocean ecosystem indicator monitoring and assessment program as described by Mid-Atlantic Regional Ocean Action Plan Healthy Ocean Ecosystem Action 5.

This paper is written with the assumption that the scope of the monitoring and assessment program should still be considered, and is likely the first discussion point at the upcoming July 2017 Healthy Ocean Ecosystem Indicators Workshop.

Specifically, this white paper presents:

- A potential indicator framework, including important themes and potential data categories that likely need to be prioritized in order to identify those data streams and indicators which are most relevant to the OAP
- Options and key decision points for monitoring, assessment, reporting, and display of indicators, including references to example programs
- Feedback integrated from the RPB, numerous stakeholders, the project Steering Committee, and the MARCO Management Board into the background information, options, and key considerations

This white paper is not intended to be a comprehensive inventory of every available option for developing an extensive monitoring and assessment program for the Mid-Atlantic ocean.

The scope of this white paper is relatively narrow and focused on the issues and priorities expressed in the OAP, recognizing that there are extensive programs internationally, nationally, and within the region that have existed for many years with significant financial investments.

Therefore, the intent is to provide enough information to narrow in on those priorities which are most relevant to the OAP and to advance a framework and communication tool that is consistent with likely funding levels.

Target Audience: This white paper serves to create a common understanding of work accomplished to-date to articulate options for a Mid-Atlantic healthy ocean ecosystem indicator monitoring and assessment program for all participants at the July 2017 Healthy Ocean Ecosystem Indicators Workshop, as well as for other interested parties.

Workshop Objectives: consider the scope of a healthy ocean ecosystem indicator monitoring and assessment program; inform the prioritization of potential indicators; identify options for indicator reporting and communication

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1. Introduction

1.1 Project background and objectives

In February 2017, the Mid-Atlantic Regional Council on the Ocean (MARCO) contracted with a team led by the Consensus Building Institute¹ (CBI team) to develop options and recommendations for a healthy ocean ecosystem monitoring and assessment program to support the implementation of Mid-Atlantic Regional Ocean Action Plan (OAP) Healthy Ocean Ecosystem Action 5. The OAP establishes that the project will be informed by the Mid-Atlantic Regional Planning Body (RPB) members, MARCO, technical experts, and OAP stakeholders. In addition, the project leverages the data and other information included in the OAP, the Mid-Atlantic Regional Ocean Assessment (ROA), the MARCO Ocean Data Portal (Portal), the Marine-life Data and Analysis Team (MDAT), and the numerous other data collection, monitoring, and assessment efforts in the region (some of which are discussed below in Section 1.4).

The CBI team is directed by a project Steering Committee that is composed of RPB members and led by representatives from the New York Department of Environmental Conservation. The OAP is serving as the guiding document for this project; in particular, the following key principles from Healthy Ocean Ecosystem Action 5:

Key Principles from Mid-Atlantic OAP Healthy Ocean Ecosystem Action 5:

- “Need to better understand ecosystem changes as they occur, and how those changes impact and are impacted by human activity”
- “Ocean health indicators will focus on the Mid-Atlantic region and, to the extent feasible, be derived from existing data collection and monitoring efforts”
- “Scientists, fishermen, other stakeholders, and Traditional Knowledge holders will be engaged at key points in this action, including during design and evaluation of indicators”

The objective of this phase of the project is to engage the RPB and ocean planning stakeholders to obtain feedback, develop a potential overarching framework for a monitoring and assessment program, and make recommendations for communicating and displaying indicators by the Fall of 2017. A final report will be delivered to the RPB after a public workshop is held to review the contents in this white paper. The RPB will determine next steps based on the feedback received during the workshop and reflected in the final report.

1.2 Geographic scope

This project adopts the geographic focus of the OAP, which includes “the ocean waters of the region...the shoreline seaward to 200 nautical miles...” “northern limit is the New

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York/Connecticut and New York/Rhode Island border; southern limit is the Virginia/North Carolina border”².

The Steering Committee acknowledges the linkages among important coastal habitats, coastal processes, and ocean health, and the numerous existing monitoring and assessment efforts occurring in the coastal region, including within state programs, National Estuary Programs (NEPs), National Estuarine Research Reserves (NERRs), and many others. This project references those existing data collection and reporting streams for topics in the coastal domain that are relevant to the monitoring and assessment of ocean health (e.g., wetland habitats, eutrophication).

1.3 Thematic scope

As noted in the OAP, this project focuses primarily on indicators of healthy ocean ecosystems. However, both the Steering Committee and stakeholders recognized that it may be important to also track aspects of ocean uses that are particularly relevant to the OAP. A number of additional potential data categories that relate to the sustainable ocean uses discussed in OAP section 2.4 were developed for this project given their relevance to healthy ocean ecosystems and OAP goals. Section 2.2 of this white paper (Key Themes) provides more detail on new considerations and recommendations related to these themes that resulted from discussions with Steering Committee members and through project outreach.

1.4 Existing data collection and monitoring efforts

The OAP establishes—and subsequent discussions with the Steering Committee and OAP stakeholders further reinforced—the importance of using existing data and monitoring efforts to the extent feasible to inform the development of a healthy ocean ecosystem monitoring and assessment program. Therefore, the CBI team considered a range of existing data collection and monitoring efforts in the region in order to propose a draft indicator framework for Mid-Atlantic ocean planning – a few of those are described in this section because they are most relevant to this project.

The CBI team and the Steering Committee also relied on the OAP, which included extensive public input from 2013 to 2016, to determine which ocean issues are most relevant for this effort. The OAP identifies several key issues for ocean planning, including climate change (ocean acidification, sea level rise, and warming water temperatures), increases in commercial shipping, commercial-scale renewable energy development, offshore carbon storage, demand for offshore sand and gravel for coastal restoration and shoreline protection, and access to commercial fishing grounds³.

Mid-Atlantic Regional Ocean Action Plan Data Collection and Integration

² Mid-Atlantic Regional Ocean Action Plan, page 24; <https://www.boem.gov/Ocean-Action-Plan/>

³ Mid-Atlantic Regional Ocean Action Plan, pages 10-11; <https://www.boem.gov/Ocean-Action-Plan/>

The Mid-Atlantic ROA and the Portal assembled existing data and information to address the issues identified in the OAP within the broad categories of ocean ecosystem and resources, and ocean uses (Tables 1 and 2, respectively). The Portal also includes datasets developed specifically to support ocean planning, including marine life data products and human use data synthesis products (Table 2). Also through the ocean planning process, Mid-Atlantic tribes identified several categories of information and data that should be considered in future data development, monitoring and assessment (Table 3).

Table 1. Categories of data and information in the Mid-Atlantic Regional Ocean Assessment as of June 2017.
<http://roa.midatlanticocean.org>

Ocean ecosystem and resources	Ocean uses
<ul style="list-style-type: none"> • Oceanographic setting and processes • Important biological, chemical, and physical attributes • Living marine resources • Human settlements relative to the ocean • Ecosystem services • Ecosystem responses to climate change • Important or sensitive species, guilds, and habitats • Ecologically rich areas • Migration corridors and other region-wide features • Ocean acidification • Shifts in species distributions associated with climate change 	<ul style="list-style-type: none"> • Overview of the Mid-Atlantic ocean economy • Tribal uses • Commercial and recreational fishing • Critical undersea infrastructure • Maritime commerce and navigation • National security and military issues • Non-consumptive recreation • Ocean aquaculture • Ocean energy • Offshore sand management • Scientific research • Cumulative impacts

Table 2. Categories and example data layers in the MARCO Ocean Data Portal as of June 2017.
<http://portal.midatlanticocean.org>

Administrative

Includes administrative boundaries and jurisdictions, marine national monument boundaries, Outer Continental Shelf lease blocks, Tribal headquarters

Marine life

Includes individual species, abundance, occurrence, biomass for cetaceans, birds, and fish; marine life summary products; benthic habitats; essential fish habitats; sea turtles; corals habitat

Renewable energy

Includes BOEM active lease areas, wind planning areas; coastal energy facilities; wind resources

Fishing

Includes artificial reefs; Vessel Monitoring Systems (VMS) data; Vessel Trip Reports (VTR) data; management areas; party and charter boat fishing

Security

Includes military training and testing areas; unexploded ordnances

Recreation

Includes results of coastal recreation study, recreational boater survey, and individual state recreation workshops

Maritime

Includes shipping data, port facilities, cable routes, ocean disposal sites, sand and gravel lease areas

Socioeconomic

Includes population density, economics data

Oceanography

Includes bathymetry, oceanographic fronts, primary productivity, seabed forms, sediments, submarine canyons

Human use data synthesis

Includes results of Human Use Data Synthesis (HUDS) Project including maps by use theme (energy, fishing, maritime, recreation security), use type (number of activities, infrastructure, physical infrastructure, regulatory), and use intensity (fishing, maritime)

Table 3. Data topics relevant to Tribal uses (not necessarily for which data currently exist), derived from Tribal Listening Sessions conducted through the Mid-Atlantic Regional Council on the Ocean (MARCO) (Provided by Mid-Atlantic RPB Tribal Co-lead).

Economic data

-
- Protecting burial grounds and archeological sites
 - Charter fishing (large and small vessels)
 - Charter diving/snorkeling
 - Charter party cruises
 - Charter wildlife viewing
 - Charter scenic viewing
 - Charter transport
 - Wampum
 - Energy

Recreational fishing/hunting data

-
- Recreational fishing from non-motorized vessels
 - Recreational fishing from motorized vessels
 - Recreational dive fishing
 - Recreational shore fishing
 - Recreational shellfish harvesting
 - Recreational waterfowl hunting

General recreational data (non-consumptive)

-
- Motorized boating
 - Paddling
 - Sailing
 - Scuba/snorkeling/diving
 - Shore use
 - Surface water sports
 - Swimming
 - Harvesting/fishing from shore

Tribal cultural use

-
- Heritage sites
 - Sacred places
 - Submerged cultural resources
 - Canoe journey routes
 - Traditional routes
 - Whales
 - Climate change
 - Subsistence fishing
 - Customary fishing and gathering from shore
 - Customary fishing and gathering offshore
 - Customary hunting from shore
 - Customary hunting offshore
 - Related to ceremony
 - Related to song
 - Related to story
 - Residence/village
 - Training
 - Place names
 - Burial sites
 - Safe anchorages
 - Stewardship practices and areas of concern

Administrative attributes

- Tribal marine jurisdictions
- Ocean use (geographic description in treaties, deeds, etc.)
- Beach access (current restrictions, parking, permitting)

NOAA Northeast Fisheries Science Center

At the national level, agencies implement ecosystem monitoring and assessment programs that are relevant to Mid-Atlantic ocean planning. The National Oceanic and Atmospheric Administration (NOAA) is implementing Integrated Ecosystem Assessments to understand and monitor changes in ecosystem structure and function with the objective of informing management decisions. For the Northeast U.S. Continental Shelf Large Marine Ecosystem (which includes the Mid-Atlantic ocean planning area), NOAA publishes an Ecosystem Status Report⁴, which provides basic information on fundamental ecosystem properties such as climate forcing, protected species, ecosystem services, and stressors and impacts (Table 4).

Table 4. Sections and contents of the NOAA Ecosystem Status Report for the Northeast U.S. Continental Shelf Large Marine Ecosystem. <http://nefsc.noaa.gov/ecosys>

Climate forcing

Atlantic Multidecadal Oscillation, North Atlantic Oscillation, Gulf Stream path, El Nino, ocean warming, ocean acidification

Physical pressures

Gulf stream, Labrador Current, river flow, winds, temperature, salinity, stratification

Production

⁴ <https://www.nefsc.noaa.gov/ecosys/>

Primary production (phytoplankton), secondary production (zooplankton)

Benthic invertebrates

Temporal trends from bottom trawl surveys, fish diet analysis

Fish communities

Analysis for species groups, biodiversity, size, trophic level, condition, groundfish recruitment

Protected species

Marine mammals, sea turtles, sea birds, fish

Human dimensions

Coastal population, revenue and employment, community vulnerability, communities-at-sea, local ecological knowledge

Ecosystem services

Capture fisheries, recreational fisheries, mariculture, natural products, renewable energy, marine transportation

Stressors and impacts

Contaminants and water quality (heavy metals and pesticides, oil and chemical spills, eutrophication, hypoxia, algal blooms, bacteria); Climate change (sea level rise, ocean warming, ocean acidification, waterway obstruction); Fishing gear impacts (effects on benthic communities, ship strikes, entanglement, incidental catch, underwater noise, shifts in fish distribution)

National Coastal Condition Assessment

The Environmental Protection Agency (EPA) coordinates the National Coastal Condition Assessment (NCCA) among EPA, NOAA, the U.S. Geological Survey, the U.S. Fish and Wildlife Service, coastal states, and the National Estuary Program. The NCCA describes ecological and environmental condition in U.S. estuarine coastal waters using several indicators⁵ (Table 5).

Table 5. Indicators evaluated for the 2010 National Coastal Condition Assessment (EPA 2015).

Biological	Chemical/toxicity	Physical
<ul style="list-style-type: none"> Benthic macroinvertebrates Chlorophyll a Ecological fish tissue contaminants 	<ul style="list-style-type: none"> Dissolved oxygen Nitrogen Phosphorous Salinity Sediment contaminants Sediment toxicity 	<ul style="list-style-type: none"> Water clarity pH (measured but not evaluated) Temperature (measured but not evaluated)

⁵ U.S. Environmental Protection Agency. Office of Water and Office of Research and Development. (2015). National Coastal Condition Assessment 2010 (EPA 841-R-15-006). Washington, DC. December 2015. <http://www.epa.gov/national-aquatic-resource-surveys/ncca>

Chesapeake Bay Program, the National Estuary Program, and the National Estuarine Research Reserves

Monitoring and assessment at finer spatial scales occurs throughout the Mid-Atlantic region as well. The Chesapeake Bay Program is one of the most well-known long-term ecosystem monitoring and reporting efforts, and has recently been tracking progress according to the Chesapeake Bay Watershed Agreement⁶ (Table 6). Other estuaries in the Mid-Atlantic are assessed as part of the NEPs and NERRs (Table 7).

Table 6. Indicators used by the Chesapeake Bay Program to track progress toward the goals and outcomes of the Chesapeake Bay Watershed Agreement. <http://www.chesapeakeprogress.com>

<p>Abundant life</p> <p><i>Sustainable fisheries (blue crab abundance, blue crab management, fish habitat, forage fish, oysters); Vital habitats (black duck, brook trout, fish passage, forest buffers, stream health, submerged aquatic vegetation, tree canopy, wetlands)</i></p>
<p>Clean water</p> <p><i>Water quality (watershed implementation plans, water quality standards attainment and monitoring); Toxic contaminants (toxic contaminants research, toxic contaminants policy and prevention); Healthy watersheds</i></p>
<p>Conserved lands</p> <p><i>Land conservation (land use methods and metrics development, land use options evaluation, protected lands)</i></p>
<p>Engaged communities</p> <p><i>Public access (public access site development); Environmental literacy (environmental literacy planning, student, sustainable schools); Stewardship (citizen stewardship, diversity, local leadership)</i></p>
<p>Climate change</p> <p><i>Climate resiliency (climate adaptation, climate monitoring and assessment)</i></p>

Table 7. National Estuary Programs and National Estuarine Research Reserves in the Mid-Atlantic Region. See each program's website for information about ecosystem monitoring and assessment.

National Estuary Programs	National Estuarine Research Reserves
Long Island Sound Study http://longislandsoundstudy.net	Hudson River https://coast.noaa.gov/nerrs/reserves/hudson-river.html
Peconic Estuary Program http://www.peconicestuary.org	Jacques Cousteau https://coast.noaa.gov/nerrs/reserves/jacques-cousteau.html
NY-NJ Harbor Estuary Program http://www.harborestuary.org	Delaware https://coast.noaa.gov/nerrs/reserves/delaware.html
Barneгат Bay Partnership http://bbp.ocean.edu/pages/1.asp	Chesapeake Bay Maryland https://coast.noaa.gov/nerrs/reserves/chesapeake-bay-md.html

⁶ Chesapeake Bay Program. 2014. Chesapeake Bay Watershed Agreement. http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hlres.pdf

Partnership for the Delaware Estuary

<http://www.delawareestuary.org>

Chesapeake Bay Virginia

<https://coast.noaa.gov/nerrs/reserves/chesapeake-bay-va.html>

Delaware Center for the Inland Bays

<http://www.inlandbays.org>

Maryland Coastal Bays Program

<http://www.mdcoastalbays.org>

State Programs

Coastal monitoring and assessment occurs at the state level within coastal programs at each Mid-Atlantic state (Table 8).

Table 8. Links to Mid-Atlantic state coastal management or planning programs. See each program's website for information about monitoring and assessment.

New York

<http://www.dec.ny.gov/lands/207.html>; <https://www.dos.ny.gov/opd/>

New Jersey

<http://www.state.nj.us/dep/cmp/>

Delaware

<http://www.dnrec.delaware.gov/coastal/pages/coastalmgt.aspx>

Maryland

<http://dnr.maryland.gov/waters/Pages/default.aspx>

Virginia

<http://www.deq.virginia.gov/Programs/CoastalZoneManagement.aspx>

The State of New York recently began work towards an ocean indicator system for assessing the ecosystem health of the New York Bight as part of the New York Ocean Action Plan⁷. The planning effort identified issues such as fisheries, shipping and transportation, offshore energy development, pathogens and toxic contaminants, habitat, water quality issues, aquatic invasive species, and climate change. Preliminary work toward an indicator system discussed indicators within several potential components and categories (Table 9).

Table 9. Initial draft components (bold headings) and indicator categories from preliminary work on an indicator system for the New York Bight (from material provided by NY-DEC).

Biological components

Species of concern, invasive species, habitat quality, biodiversity, habitats of concern, ecosystem maturity, ecosystem resilience

Physical and chemical components

Ecosystem productivity, oceanographic and atmospheric trends, climate, terrestrial inputs, nutrients, contaminants and pollutants

Socioeconomic components

Public access, resource-based industries and communities, coastal communities, ocean awareness and engagement

⁷ New York Department of Environmental Conservation; <http://www.dec.ny.gov/lands/84428.html>

1.5 Project outreach

In early April 2017, MARCO, in consultation with the Steering Committee, arranged several webinars with ocean planning participants and stakeholders to share a project overview, report on progress to date, and obtain feedback on initial draft indicator themes and data categories for a healthy ocean ecosystems monitoring and assessment program. Over 50 individuals were invited to participate (based on Steering Committee nomination) within the following groups:

- Academic and agency science/research
- Commercial and recreational fishing
- Environmental non-governmental organizations
- Non-consumptive recreation
- Aquaculture
- Tribes
- Maritime commerce
- Energy
- Sand management

The CBI team and MARCO hosted seven 90-minute webinars between April 27 and May 15, 2017. Invitees and participants were asked to provide input, such as whether the proposed indicator themes and data categories were appropriate for ocean planning goals, if there were additional categories or data to consider, and which indicators or metrics should be prioritized. Details about the stakeholder outreach webinars can be found in Appendix A. The input received through these webinars is described and integrated into this white paper.

1.6 Purpose of this white paper

The purpose of this white paper is to support a public workshop to be held on July 19-20, 2017, by providing background information, presenting options, and identifying important considerations and decisions for advancing a healthy ocean ecosystem monitoring and assessment program as described by Mid-Atlantic Regional Ocean Action Plan Healthy Ocean Ecosystem Action 5. This white paper presents a potential indicator framework, including important themes and potential data categories that likely need to be prioritized in order to identify those data streams and indicators which are most relevant to the OAP. It also includes options and key decision points for monitoring, assessment, reporting, and display of indicators, including references to example programs. This white paper also incorporates feedback gathered from the RPB, numerous stakeholders, the project Steering Committee, and the MARCO Management Board to date into the background information, options, and key considerations.

This white paper is not intended to be a comprehensive inventory of every available option for developing an extensive monitoring and assessment program for the Mid-Atlantic ocean. The scope of this white paper is relatively narrow and focused on the issues and priorities expressed in the OAP, recognizing that there are extensive programs internationally, nationally, and within the region that have existed for many years with significant financial investments. Therefore, the intent is to provide enough information to narrow in on those priorities which are most relevant to the OAP and to advance a framework and communication tool that is consistent with likely funding levels.

This paper is also written with the assumption that the scope of the monitoring and assessment program should still be considered, and is likely the first discussion point at the upcoming workshop. Other workshop objectives include obtaining input on what components of the ecosystem should be monitored to support implementation of the OAP by reviewing categories of data and discussing the most relevant metrics or indicators of change, and obtaining feedback on options for assessing and communicating those indicators.

2. Draft Indicator Framework

Recognizing that there are likely hundreds of potential indicators that could be developed to characterize the Mid-Atlantic ocean ecosystem, this project team sought to use an organizing framework that groups similar potential indicators by theme and data category. The framework proposed here borrows elements from other frameworks discussed in Section 1.4, such as the NOAA Integrated Ecosystem Assessments and the draft indicator system for the New York Bight.

2.1 Framework structure

At the highest level of organization in the framework are themes, which represent broad groupings of ecosystem components. Within each theme, there are a number of data categories that represent attributes or processes that could be measured. Data categories were derived from data products developed and assembled as part of the ocean planning process in the OAP, the ROA, and the Portal. Steering Committee members provided feedback on potential data categories to the CBI team during monthly Steering Committee calls. Obtaining input from ocean planning stakeholders on potential themes and data categories was one of the primary goals of the project (see Section 1.5). Initial input was provided via the seven 90-minute webinars in April and May. Participants in the webinars provided input on how data categories were organized within themes, ways to potentially cross-reference data categories across themes, and new potential data categories.

After integrating this feedback into the framework structure, the CBI team listed one or more possible metrics under each data category, based on datasets that

were already assembled as part of the planning process (i.e., were mentioned in the OAP, in the ROA, or available on the Portal). Metrics are values or measures that could become candidate indicators. For example, a sea surface temperature data category could include “mean annual sea surface temperature”, “sea surface temperature anomalies”, and others as potential metrics. To be considered an indicator, a metric must be defined, communicated, and understood in the context of what it is meant to indicate or represent (among other potential indicator criteria; see box in this section). For example, a high incidence of positive “sea surface temperature anomalies” may indicate increased ocean warming. Potential metrics were not presented to the Steering Committee or to others during the webinars, but some metrics and indicators have been suggested and discussed as part of both of these processes. It is expected that further discussion on these details will occur at the July workshop.

Indicator Definition and Criteria

Adapted from U.S. EPA Report on the Environment:
<https://cfpub.epa.gov/roe/about.cfm>

Indicator definition: An indicator is a numerical value derived from actual measurements* of a driver, stressor, state or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.

Indicator criteria:

- The indicator is useful. It answers (or makes an important contribution to answering) a question.
- The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.
- The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.
- The underlying data are characterized by sound collection methodologies, data management systems to protect their integrity, and quality assurance procedures.
- Data are available to describe changes or trends, and the latest available data are timely.
- The data are comparable across time and space, and representative of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

** There is some flexibility in this criterion; for example, some indicators could be based on estimation or partial estimation methodologies applied to the best available data.*

2.2 Key Themes

As described in Section 1.3 of this white paper, the OAP focuses on “healthy ocean ecosystem” indicators for a potential monitoring and assessment program. Throughout discussions with the Steering Committee and through project outreach, the need to track some aspects of ocean uses was also apparent.

The consideration of ocean uses now manifests itself in two ways within the themes of the draft framework, and reflects input from Steering Committee members and feedback received through project outreach. First, while it is recognized that the effects of human activities could be reflected in almost any ecosystem indicator, the “Anthropogenic pressures” theme offers perhaps the most direct way in which these potential effects might be assessed. The data categories in this theme (e.g., marine debris, invasive species) represent inputs and effects that are likely driven by or originate from an array of human activities. As such, causal linkages between indicators and human activities would be difficult or impossible to determine using indicators in these data categories in the absence of additional studies. Second, the “Ocean uses” theme includes a number of data categories specific to aspects of ocean uses identified in the OAP (e.g., wind planning areas, sand resources). This theme would therefore track the incidence of ocean uses themselves, and indicators could potentially reflect economic conditions or the result of management decisions rather than suggesting specific ecosystem effects.

All of the following themes focus on open ocean but include data categories that may relate to datasets collected, maintained, and reported by state coastal programs, NEPs, NERRs, and other coastal and estuarine monitoring efforts.

Potential themes for a Mid-Atlantic healthy ocean ecosystem indicator program:

1. **Oceanographic and atmospheric drivers** – shape the physical environment of marine organisms; affect feeding, migration, reproduction
2. **Anthropogenic pressures** – includes those inputs and effects that likely are driven by or originate from an array of human activities
3. **Habitats** – include benthic vegetated and non-vegetated areas; habitat-forming species; pelagic habitats
4. **Lower trophic levels** – primary and secondary productivity; forage species
5. **Upper trophic levels** – all other marine life not included in Lower trophic levels
6. **Ocean uses** – aspects of ocean uses that are relevant to ocean planning

2.3 Data Categories

The following indicator themes (numbered, bold text) and data categories (each row of the tables) are relevant to the healthy ocean ecosystems and sustainable ocean uses sections of the Mid-Atlantic Regional Ocean Action Plan (OAP sections 2.3 and 2.4).

Data categories listed below are the result of Steering Committee and stakeholder input. These lists were not edited with respect to redundancy or continuity. For example, under Anthropogenic Pressures, “Coastal discharges” and “Eutrophication” may address similar or overlapping processes. In addition, some data categories within the same theme relate to drivers, processes, or inputs to the system, whereas others relate to outputs or the status of ecosystem components – e.g., “Eutrophication” and “Harmful algal blooms.” It is expected that these organizational factors will be discussed at the July workshop.

The table columns to the right indicate whether each data category is present in the OAP, the ROA, and the Portal. Data categories in italics were added or revised as a result of feedback during the April-May project outreach webinars.

1. Oceanographic and Atmospheric Drivers – shape the physical environment of marine organisms; affect feeding, migration, reproduction

	OAP	ROA	Portal
Sea surface temperature Δ	X	X	
<i>Bottom temperature Δ</i>			
Sea surface temperature fronts		X	X
Gulf stream path		X	
<i>Dissolved oxygen Δ</i>		X	
<i>pH Δ</i>	X	X	
<i>Carbonate system series</i>		X	
North Atlantic Oscillation/Atlantic Multi-decadal Oscillation			
<i>Water column stratification</i>		X	
El Niño			
Sea level	X	X	
<i>Wave height</i>			
<i>Tides and other currents</i>			

Δ Categories that may be captured and reported by NEPs or other coastal programs

2. Anthropogenic Pressures – includes those inputs and effects that likely are driven by or originate from an array of human activities

	OAP	ROA	Portal
Marine debris	X		
Oil/chemical releases	X		
Contaminants Δ	X		
Harmful algal blooms ¹	X	X	
Coastal discharges (outward flow from embayments, estuaries, lagoons, canals, rivers, other outflows)	X	X	
Eutrophication Δ	X	X	
Sound			
Invasive species			
Shoreline hardening Δ	X	X	
Seabed scour or alteration			
Bycatch			
Ocean disposal sites			
Electromagnetic fields			

1. Consider NOAA definition: colonies of marine algae that grow out of control while producing toxic or harmful effects on people, fish, shellfish, marine mammals, and birds (<http://oceanservice.noaa.gov/hazards/hab/>)

Δ Categories that may be captured and reported by NEPs or other coastal programs

3. Habitats – include benthic vegetated and non-vegetated areas; habitat-forming species; pelagic habitats

	OAP	ROA	Portal
Critical Habitats (ESA)		X	X
Benthic habitats* (includes structural habitats like submarine canyons, sand waves/ridges, and other soft-bottom habitats)	X	X	X
Beaches Δ	X	X	
Benthic infauna Δ	X	X	
Habitat for soft corals	X	X	X
Deep sea corals	X	X	X
Submerged aquatic vegetation Δ	X		
Salt marsh/wetlands Δ	X	X	
Essential fish habitat**	X	X	X
Artificial reefs	X	X	X
Tilefish			
Methane seeps			

**also appears in Sand Management*

***also appears in Commercial and Recreational Fishing*

Δ Categories that may be captured and reported by NEPs or other coastal programs

4. Lower Trophic Levels – primary and secondary productivity, forage species

	OAP	ROA	Portal
Primary productivity		X	
Secondary productivity		X	
<i>Forage species, small pelagic fish, and invertebrates</i>	X	X	X

5. Upper Trophic Levels – all other marine life

	OAP	ROA	Portal
Protected species	X	X	X
Marine biodiversity	X	X	X
Highly migratory species	X		X
Changes in migration and habitat use	X	X	
Sea turtles	X	X	X
Seabirds, shorebirds, <i>passerines</i> , and <i>bats</i>	X	X	X
<i>Fish (suggestion to use MAFMC FMPs as groups)</i>	X	X	X
Large pelagic fish (sharks, billfish, etc.)	X	X	X
Marine mammals	X	X	X
<i>Anadromous fish</i>			X
<i>Shellfish (includes sea scallops, clams, others)</i>	X	X	X
<i>Squid</i>			X
<i>Horseshoe crab</i>		X	

6. Ocean uses

	OAP	ROA	Portal
National Security			
Military installations	X	X	X
Training and testing complexes and ranges	X	X	X
<i>Unexploded ordnance</i>			X
Ocean Energy (OAP focus on wind energy)			
Wind resources	X	X	X
Wind planning areas	X	X	X
Active wind lease and research areas	X	X	X
Electrical cable occurrence*			X

Commercial and Recreational Fishing			
Commercial landings (volume and revenue)	X	X	
Commercial trips		X	X
Commercial fish sales and processing		X	
Recreational landings (volume)		X	
Recreational trips (number and value)		X	X
<i>Commercial and recreational access</i>			
Essential Fish Habitat**	X	X	X
Ocean Aquaculture			
Aquaculture production (volume and value)		X	
Permitted and/or leased areas			
Maritime Commerce and Navigation			
Port cargo (volume and value) and ship calls	X	X	
Vessel trips and traffic patterns	X	X	X
Waterway maintenance and safety (routing measures, anchorages, pilot boarding, channel maintenance and deepening, aids to navigation (AtoN))	X		X
Sand Management			
Sand resources**	X	X	
Federal sand and gravel lease areas (area size, volume, placement area)			
Sand requirements	X		
Non-Consumptive Recreation			
Recreational visits or trips (volume, areas, value)	X	X	X
Recreational access			X
Tribal Interests and Uses			
Submerged cultural areas	X	X	
Tribal ceremonial areas	X	X	
Commercial and sustenance fishing and aquaculture	X	X	
Critical Undersea Infrastructure			
Telecommunication and electrical cable occurrence	X	X	X
Pipeline occurrence	X	X	X
Scientific equipment occurrence	X	X	X

*also appears in Critical Undersea Infrastructure

**also appears in Habitats

2.4 Common themes from stakeholder outreach

After reviewing the objectives of the project, draft indicator framework structure, key themes, and potential data categories with the Steering Committee and with members of the public through project outreach, the CBI team identified the following broad themes of feedback. In general, feedback was supportive of the draft framework structure and process to develop an indicator monitoring and assessment program. Participants offered the following ideas and input relevant to the framework and process:

- There was general agreement that these were the right themes, with some suggestions for modifications, such as establishing “Anthropogenic pressures” as a separate theme.
- There was general agreement that these were the right data categories and there were many recommended additions (see the tables in Section 2.3).
- There were several suggestions for specific metrics within data categories.
- There were also suggestions to consider identifying indicators that integrate across data categories and themes and therefore enable a greater understanding of ecosystem change with fewer metrics.

- There was discussion about whether it’s necessary and practical to define ocean health, given the title of this project, and if so, how to define “ocean health”, what makes the ocean “healthy”, and what purpose a definition would serve.
- There was discussion about whether and how indicators will be prioritized given the extent of the themes and data categories in Section 2.3.
- Participants expressed the need to ensure the framework acknowledges the many scales of natural ecosystem variability.
- Participants expressed concern about the scope of the project and the decision to leave out coastal ecosystem components since they are essential to understanding changes in ocean health⁸.
- There were suggestions to consider ways that the framework can track the effects of ocean activities (e.g., invasive species, sound, seabed disturbance).
- Participants recommended that the program should track indicators that relate to the Ecologically Rich Area Components, which are being developed by the RPB through a related process under the OAP.
- There were suggestions to consider tracking human well-being, ocean engagement, and other social/economic indicators in addition to the measures of ecosystem change.
- There were suggestions to consider tracking higher-order themes of ecosystem maturity, resilience, and vulnerability.

2.5 Potential metrics database

The CBI team assembled information about existing data collection efforts relevant to many draft indicator themes and data categories (full database in Appendix B). The purpose of this

⁸ Note the geographic scope of the OAP “the ocean waters of the region...the shoreline seaward to 200 nautical miles...”; see Section 1.2.

database is to serve as an easily-updated set of information about datasets that could support potential future indicators in the Mid-Atlantic region. This database does not represent all of the data available on each topic. Instead, it is meant to assist the process for identifying which potential indicators are supported by existing data and information. This database could be revised, expanded, and updated over time.

For each data category identified in Section 2.3, the database lists potential metrics, their geographic scope, lead agency, program or source data, reporting interval, and contact information for the data provider. For many data categories, a description of how each metric is reported and/or interpreted by the data providers is included. Some data categories include data sources but a specific metric does not exist or is not suggested.

Additional work and discussion is needed to synthesize the information in this database to determine:

1. How many indicators are desired and practical to monitor?
2. What does a metric indicate (i.e., what is it an indicator of)?
3. How sensitive is it to ecosystem changes that we care about?
4. How representative is it of ecosystem changes that we care about?
5. How understandable is it to a broad audience?
6. What is the sustainability or longevity of the source data or program that supports the metric?

These questions are related to the definition of “indicator” and potential indicator criteria (see box in Section 2.1) that are anticipated to be a topic of discussion at the workshop.

2.6 Data gaps

Data gaps presented in this section are meant to highlight any discrepancies between the themes and data categories that the Steering Committee and stakeholders identified as potentially important to a Mid-Atlantic indicator monitoring and assessment program, and those existing data sources and metrics identified in the Potential metrics database (Appendix B).

In general, almost all of the suggested data categories could be linked to an existing data source. A few notable data gaps include:

- Seabed scour and alteration
- Electromagnetic fields
- Changes in migration and habitat use for some species
- Passerines and bats
- Submerged cultural areas
- Tribal ceremonial areas
- Tribal commercial and subsistence fishing and aquaculture
- Components of Ecologically Rich Areas (ERAs)

Some of these gaps are likely to be filled as information becomes available in the near future. For example, seabed scour and alteration is not currently monitored throughout the region (although perhaps some ocean disposal site monitoring could be relevant), but it is expected that as projects are permitted for seabed uses (e.g., sand resources, offshore wind energy development), new monitoring data may become available. In addition, as this effort begins to focus on specific indicators or metrics, there are likely to be temporal and spatial gaps that may affect the ability to assess and report change. Any gaps related to temporal and spatial resolution must be considered on a case-by-case basis.

3. Indicator monitoring, assessment, reporting, and display

3.1 Monitoring and assessment

Options for monitoring and assessment are important considerations that are specific to each indicator that is ultimately chosen. This entails an understanding of the relevant existing programs that are available to support monitoring and assessment of each indicator, the spatial and temporal resolution of existing data, data gaps, and the range of assessment techniques that could be used to combine multiple data streams (if appropriate). It also includes specific decisions around establishing a baseline for each indicator so that change can be monitored, assessed, and reported. Therefore, it is premature to suggest specific monitoring and assessment options since this project is at the stage of prioritizing data categories, determining what needs to be monitored for each of those priorities, and identifying ways to report on indicators.

Monitoring and Assessment Considerations

- Identify specific indicators based on priorities expressed through this phase of project
- Understand existing data & monitoring efforts, including spatial and temporal resolution, data gaps, etc.
- Communicate and partner with relevant existing programs
- Understand related assessment techniques, including establishing a baseline
- Establish a baseline and techniques for assessing change

Generally, the RPB has expressed an interest in relying on existing programs for monitoring and assessment, while noting there may be some important data gaps. This would require the RPB to communicate and partner with the supporting monitoring and assessment programs once priorities are established. The database of potential metrics provided in Appendix B identifies existing programs, their geographic scope, temporal considerations, and data gaps. This database will be an important supplement to the workshop, and it will be a critical information source for deciding on specific indicators and the monitoring and assessment programs and techniques that will support those indicators.

3.2 Options for reporting tool location

To be widely accessible and easily updated, an indicator reporting tool, display, or dashboard would likely need to be developed in a web-based format. Data and metadata standards would have to be developed since indicators will likely be based on datasets from multiple providers. Those standards would have to be clearly communicated through the website and via data agreements and trainings with each data provider. For each indicator and dataset, the standard should articulate the appropriate maintenance and update schedule. Indicators (and underlying data) could either be updated on a regular schedule (such as every five years) or at a frequency that is relevant to each individual indicator based on the temporal resolution of the underlying data and the appropriate time scale for monitoring change. A web based format with associated data and metadata standards would ensure that the contents of the tool are accessible, usable, searchable, and that the methods and updates are repeatable.

As discussed below with regard to options for indicator display, a web-based tool could be developed with consideration of the need or desire to easily print results or outputs. For example, the Mid-Atlantic Regional Ocean Assessment (<http://roa.midatlanticocean.org>) was developed as a web-based tool, but also one that could be printed and thus converted to a report-based product if desired. The tool itself could appear anywhere on the web (e.g., a unique URL) or be affiliated with any of the current websites that support regional ocean management (such as the Mid-Atlantic Ocean Data Portal). The tool could link to the other Mid-Atlantic ocean planning sites (e.g., Portal, ROA) to connect all of these efforts. The decision about where to host such a tool is informed by the different options for reporting and communicating indicators, including the general scope of the monitoring and assessment program, the intended audience, and relationships with existing and potential data providers.

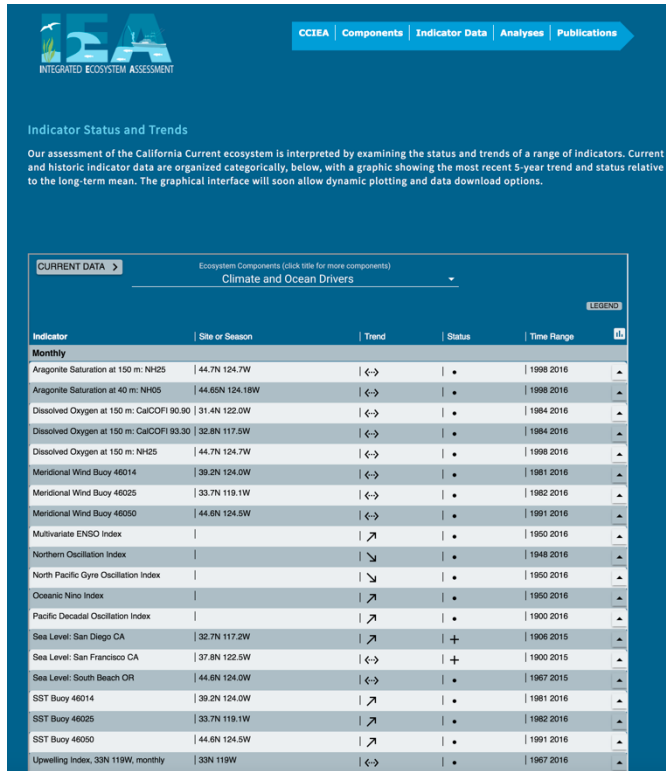
3.3 Indicator display or dashboard tool

There are numerous existing indicator monitoring and assessment programs with web-based display or dashboard tools that can be used to help identify potential options for a Mid-Atlantic indicator display tool. This section presents screenshots and short descriptions of a few particularly relevant existing web-based indicator reporting tools for ocean, coastal, or aquatic indicator programs. It concludes with a few important considerations to be discussed at the July workshop that will help guide the development of a monitoring and assessment program to support the implementation of the OAP.



The NOAA Northeast Fisheries Science Center (NEFSC) Ecosystem Status Report (<http://nefsc.noaa.gov/ecosys>) is an example of a web-based report-style tool. The Executive Summary features expandable sections for major ecosystem components that include explanatory text and graphs showing status and trends. Status is summarized by graphics representing that the indicator is above (+), below (-) or within (.) long-term variability. Trends are summarized by graphics showing increasing (\nearrow), decreasing (\searrow), or no (\leftrightarrow) trend. Inadequate recent data to determine status or trend is indicated by (x).

Several of the datasets summarized in the Ecosystem Status Report are generated by NEFSC, but many others are collected, maintained and summarized by other agencies or groups.



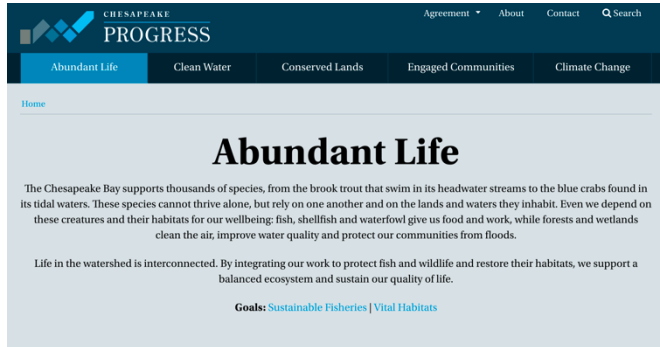
The California Current Integrated Ecosystem Assessment was developed by NOAA with other federal, state, tribal, and non-governmental partners. The website uses a combination of narrative and graphics to explain the importance of focal components and links between and among indicators. Indicator data are presented in large tables organized by ecosystem components such as “Coastal pelagic species”, “Habitat”, and “Climate and Ocean Drivers”. Rows of the tables include the indicator name, location of the observation(s), trend (↗, ↘, ↔) status (+, -, .), and time range of available data. Each row of the tables can be expanded to show trends graphs, citations to the source data, and data downloads. There are hundreds of individual indicators reported on this website.



The Puget Sound Partnership developed the Vital Signs tool (<http://www.psp.wa.gov/vitalsigns>) to display the measures for determining the health of Puget Sound. There are six statutory goals for the recovery of Puget Sound that are identified in the outer ring of the Vital Signs wheel. Each wedge in the wheel is a Vital Sign that relates to one primary goal, and likely others.

The data are compiled from state and federal agencies, tribes, local jurisdictions, and non-governmental organizations under the umbrella of the Puget Sound Ecosystem Monitoring Program. The experts from the source agencies provide the data, oversee the interpretation of the results, and maintain responsibility for

data quality assurance and documentation.



Goals

Sustainable Fisheries

Habitat loss, poor water quality and harvest pressure continue to threaten the sustainability of the Chesapeake Bay's recreational and commercial fisheries. Sustaining fish and shellfish populations supports a maritime culture, a strong economy and a healthy ecosystem.

Goal

Protect, restore and enhance finfish, shellfish and other living resources, their habitats and ecological relationships to sustain all fisheries and provide for a balanced ecosystem in the watershed and Chesapeake Bay.

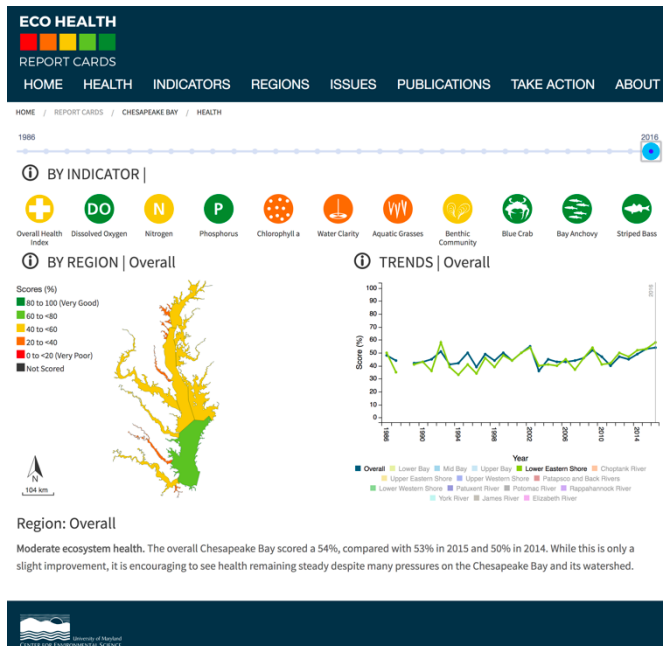
Progress Increased

Outcomes

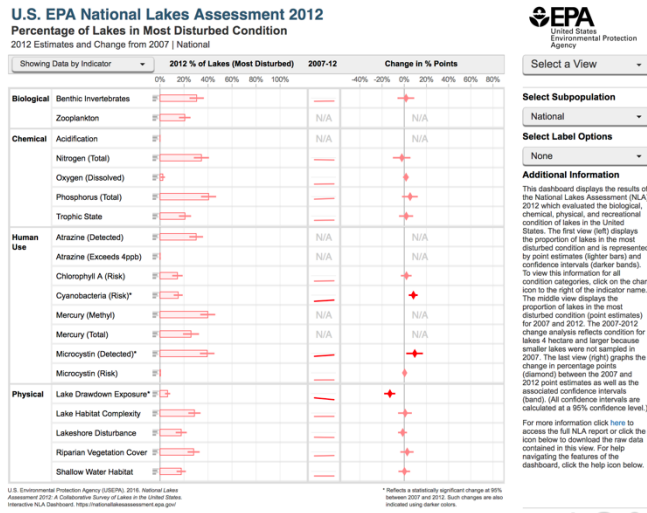
- Blue Crab Abundance →
- Blue Crab Management →
- Fish Habitat →
- Forage Fish →
- Oysters →

The new Chesapeake Bay Project reporting tool is called Chesapeake Progress (<http://www.chesapeakeprogress.com>). This tool displays outcomes for more than two dozen indicators under several goals that relate to five issues: “Abundant life”, “Clean water”, “Conserved lands”, “Engaged communities”, and “Climate change”. The dashboard view shows up/down/static arrows for each indicator. Clicking on an indicator opens a page with narrative, graphs, and links to more information. The issues, goals, and indicators are all derived from the Chesapeake Bay Watershed Agreement that was signed in 2014. Data for each indicator are derived from state and federal agencies, academic institutions, and non-governmental organizations. The status and trends of the same indicators

are also reported in a public-friendly “Bay Barometer” report, issued every few years.

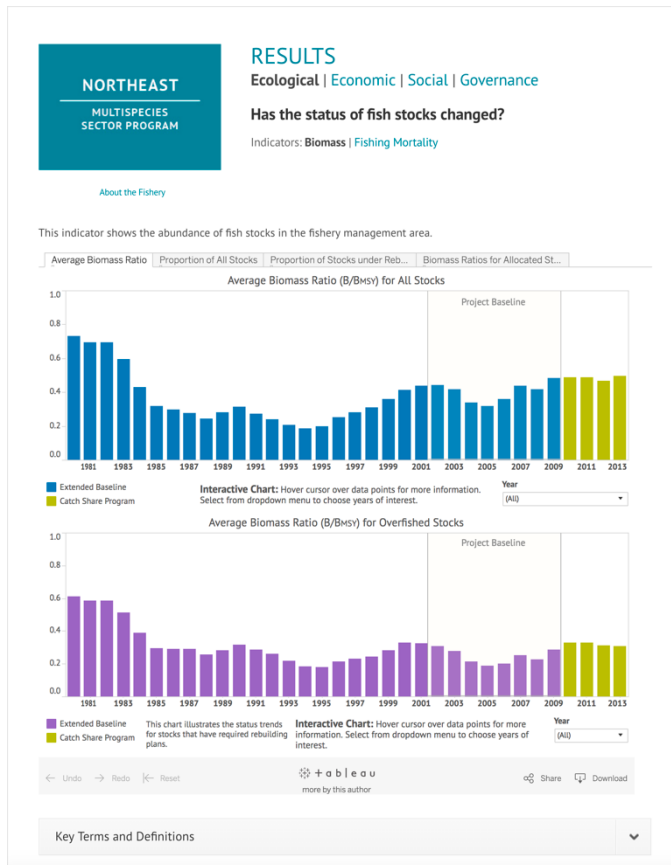


Another tool that reports the health of the Chesapeake Bay ecosystem is the Chesapeake Bay Report Card, developed by the University of Maryland Center for Environmental Science (<https://ecoreportcard.org/report-cards/chesapeake-bay>). This website is centered on a set of interactive panels from which the user can select a year and an indicator. Changing the selection updates the score map and the graph panels. The navigation bar at the top of the page allows the user to read through narrative descriptions of the indicators, geographic profiles, and issues like fisheries and recreation. Individual datasets supporting each indicator are not clearly described within the tool, but an About section credits the Chesapeake Bay Program, and several governmental and academic partners for providing data and interpretation.



The EPA National Lakes Assessment dashboard (<https://nationallakesassessment.epa.gov/>) displays the results of the 2012 assessment of biological, chemical, physical, and recreational condition of US lakes. The National Lakes Assessment is similar to the NCCA in that it is an EPA-led collaboration between multiple federal and state agencies, tribes, and other organizations. Within the display, users can view data by indicator or by EPA region. The dashboard displays status and trends with simple plots that use darker colors to represent

statistically significant results. Hovering over a data point brings up a popup window with a summary and explanation of the data. Users can download the source report, raw data, and a static image of the dashboard.



The Catch Share Indicators Project website (www.catchshareindicators.org) displays quantitative results of several indicators in the form of interactive bar and line graphs and pie charts. The indicators are responsive to a set of questions asked by the research team to measure the effects of catch shares. These questions are separated into ecological, economic, social, and governance categories. Source data are from NOAA National Marine Fisheries Service and Fishery Management Councils. This website combines the interactive graphs (which summarize and report large volumes of data) with extensive narrative sections, links to methodological reports, and lists of references/citations.

Important display or reporting tool considerations

The previous examples provide a range of options for reporting and communicating indicators. They also highlight a few key questions and decisions the RPB will need to make with public and stakeholder input in order to take the next step in developing a monitoring and assessment program to support the OAP. These include:

1. Organization: The reporting tools included in this section, and others reviewed by the team, are all generally organized in one of two ways. Some of these tools are organized by ecosystem component, theme, or data category (similar to the presentation of themes and data categories in Section 2.2). The focus on ecosystem component, theme or data category enables a relatively issue-neutral tracking of change in the ecosystem. Examples of this include the two NOAA assessments and the EPA Lakes Assessment above. Other tools are organized by issue (e.g. climate change, water quality, protected species) with several relevant ecosystem components being categorized within each public policy or planning issue area. Examples of this include the Puget Sound Vital Signs and Chesapeake Bay Progress tools.
2. Format and content: The reporting tools presented in this section and available elsewhere demonstrate a range of approaches to communicating change through their respective monitoring and assessment programs. This range of approaches includes some tools that are more reliant on images, scoring mechanisms, classification, and symbols demonstrating trends. Conversely, it also includes tools that are more reliant on narratives to describe the status and trends associated with any indicator. Many programs utilize both approaches effectively, and while it is not critical to determine at this stage how this effort will ultimately be reported, it will be informative to understand stakeholder and RPB preferences to better understand the potential intent, scope and depth of a monitoring and assessment program to support the OAP. Critically, most of the content in these examples is compiled from many cooperating agencies and groups. Data generators may agree to follow consistent and/or common analysis methods, reporting standards, and delivery formats (see The Water Quality Portal at <https://www.waterqualitydata.us/> as an example of how data can be aggregated over 400 programs into one reporting portal).
3. Total number of indicators: The number of indicators should ultimately be determined through the prioritization process which is a focus of this phase of the project and the July workshop. Nevertheless, initial stakeholder and RPB feedback on the general number of indicators that should be monitored and assessed will help inform the overall scope and intent of the project. Again, the indicator programs identified in this section demonstrate a range of options – some programs report on a small set of specific ecosystem components or issues, while others try to capture the range of issues and ecosystem components.

The three primary decisions expressed here – the organization by issue or component, formatting and content, and total number of indicators – will likely need to be considered together as they are linked. In addition, while initial feedback on the design and depth of a final

product will be helpful, ultimately the prioritization of themes and data categories will have greater influence on the structure of the communication and reporting tool.

4. Conclusion

The objective of this phase of the project is to engage the RPB and ocean planning stakeholders to obtain feedback, develop a potential overarching framework for a monitoring and assessment program, and make recommendations for communicating and displaying indicators by the Fall of 2017. This white paper presents the context and background information necessary to frame major discussion points to inform these objectives at the July workshop.

While the objectives and discussions do not necessarily need to occur in a linear, step-wise fashion, it is helpful to bin discussion topics and understand the dependencies of each potential decision (Figure 1).

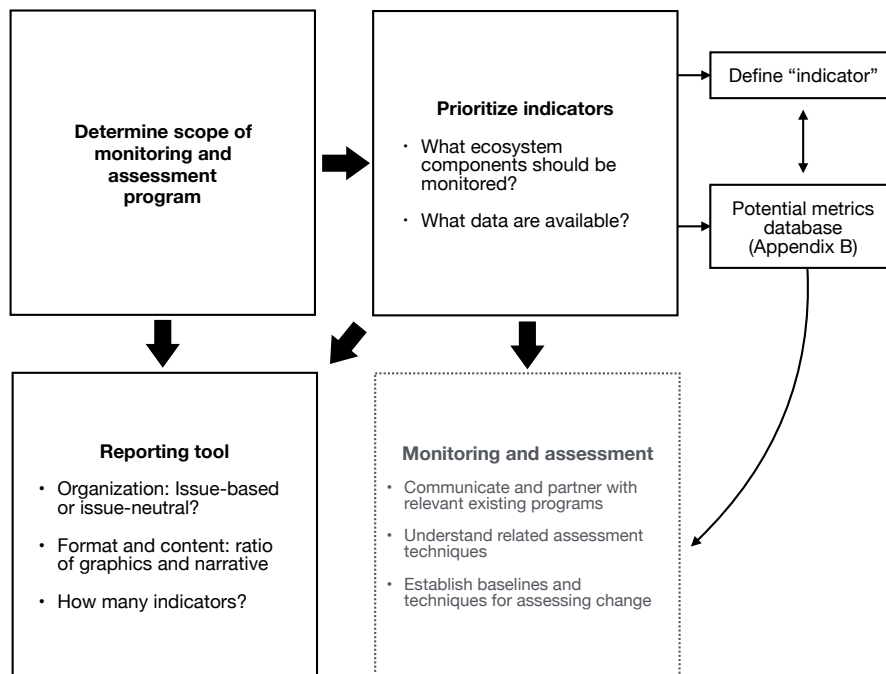


Figure 1. General discussion topics (boxes) for a Mid-Atlantic ocean ecosystem indicator workshop in July 2017. Relationships among topics are shown with arrows. The “Monitoring and assessment” topic box is grey because potential actions within that topic depend on the prioritization of indicators.

From this suite of topics, the CBI team proposes the following goals for the July workshop:

- Discuss the scope of a future Mid-Atlantic ocean ecosystem monitoring and assessment program, considering imagined funding level and possibilities, potential partnerships, desired output(s) and communication product(s)
- Obtain input on what ecosystem components and indicators should be monitored, considering intended definition and/or criteria for indicators
- Obtain feedback on options for assessing and communicating indicators, including reporting tool organization, format and content, total number of indicators

Appendix A: Project outreach webinars

Purpose

The purpose of the outreach component of this project was to obtain feedback from ocean planning stakeholders about the project itself and draft indicator themes and data categories to support a Mid-Atlantic healthy ocean ecosystem indicator monitoring and assessment program. This component of the project addressed a key principle described in the Mid-Atlantic Regional Ocean Action Plan (OAP):

“Scientists, fishermen, other stakeholders, and Traditional Knowledge holders will be engaged at key points in this action, including during design and evaluation of indicators”

Outreach plan

The CBI team proposed to hold a number of 90-minute webinars based on the following criteria:

- Guidance from the project Steering Committee
- Greater focus on indicators of a healthy ocean ecosystem
- A suggestion to include a few calls to cover indicators related to sustainable ocean uses, while recognizing the focus of this project is on healthy ocean ecosystem indicators
- Grouping of individuals with similar expertise (see listing below) in order to use time efficiently (the workshop will provide opportunities for cross-sectoral discussions)

The project Steering Committee provided the CBI team with a list of potential participants across the following sectors and interest groups: the RPB, tribes, academic and agency scientists, environmental groups, commercial and recreational fishing, aquaculture, non-consumptive recreation, maritime commerce, energy and infrastructure, and offshore sand mining. The CBI team worked with MARCO staff to invite participants and schedule webinars.

General webinar agenda

The following information was provided to webinar participants to guide the discussion:

Materials provided to call participants: Project overview read-ahead (7-page pdf)

Objective:

- Introduce RPB members and stakeholders to the project and its intended goals and products
- Obtain detailed and robust feedback on proposed indicator themes and the data categories, and especially the types of metrics that are most relevant for each theme given the ocean planning context
- Include, connect with, and involve key ocean users and stakeholders

Agenda (90 minutes):

- :05 Introductions
- :10 Project overview
- Overview of Mid-Atlantic Regional Ocean Action Plan (OAP) and Healthy Ocean Ecosystem Action 5
 - Project objectives, products, key principles and schedule
 - Role of contract team
 - Questions
- :20 Proposed indicator themes
- Share initial themes - are these the right themes for measuring ecosystem health as it pertains to the OAP?
 - Share the proposed structure for identifying potential indicators, etc.
- :45 Data categories
- What aspects of this theme and the data categories are most relevant to ocean planning?
 - Which metrics (if any) should be prioritized? What would those metrics indicate?
- 1:30 Conclude
- Feedback captured during webinars will be incorporated into draft white paper
 - Discussion will be continued and advanced at July indicators workshop

Outreach results

From April 27 to May 4, the CBI team held seven outreach webinars with members of the following groups (total number of participants in parentheses):

- Scientists (9 total over two separate webinars)
- Commercial and recreational fishing (6)
- Tribes (5)
- eNGOs (3)
- Energy, sand (1 – representing BOEM Marine Minerals Program)
- Non-consumptive recreation (1 – representing Surfrider Foundation)

In general, feedback obtained through the webinars was supportive of the draft framework structure and process to develop an indicator monitoring and assessment program. Participants offered numerous ideas relevant to the framework structure, process, and specific indicators, metrics, and data streams (see Section 2.4). The CBI team incorporated all of this feedback into the draft white paper. Participants were encouraged to continue engaging with this project by attending the July workshop.

Appendix B: Potential metrics database

Potential metric	Lead agency	Source data/Program	Geographic Extent	Reporting Interval	Notes	Contact	Link
1. Oceanography and atmospheric drivers: shape the physical environment of marine organisms; affect feeding, migration, reproduction							
Sea surface temperature	NOAA	National Climatic Data Center; Northeast Fisheries Science Center	Mid-Atlantic Bight	Monthly since JBS4. Presents anomalies compared to 1971-2000 monthly climatology		Mike Fogarty, Boyu Huang, boyu.huang@noaa.gov	NOAA NESFC summarizes these data in the Ecosystem Status Report
Trends in mean annual SST	NOAA	National Climatic Data Center; Northeast Fisheries Science Center	Mid-Atlantic Bight	2000 monthly climatology		Mike Fogarty, Boyu Huang, boyu.huang@noaa.gov	NOAA NESFC summarizes these data in the Ecosystem Status Report
Trends in mean annual SST anomaly	NOAA	Northeast Fisheries Science Center	Mid-Atlantic Bight	Spring/Fall		Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nefsc.noaa.gov/ecosys/current-conditions/
Trends in seasonal variability in SST	NOAA	Northeast Fisheries Science Center	Mid-Atlantic Bight	Spring/Fall		High Sullivan, National Coastal Condition Assessment Program Lead, 202-564-1763	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Trends in SST and water column T profiles	EPA	National Coastal Condition Assessment/Office of Water	Northeast/Mid-Atlantic	Every 5 years; probabilistic sampling	From surface to 0.5m from the bottom; collected using probabilistic sampling design	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Trends in seasonal bottom	NOAA	Northeast Fisheries Science Center	Mid-Atlantic Bight	Spring/fall	The index measures the probability of sea surface temperature front formation; currently an experimental dataset	Need to call to find out further info	
Trends in CoastWatch Oceanic Front	NOAA	CoastWatch	?	?		Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Probability Index	NOAA		?	?		Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Change in Frontal Strength	NOAA	Northeast Fisheries Science Center	Mid-Atlantic Bight	Annual	Shifts in the position of the north wall of the Gulf Stream are a leading indicator of conditions on the shelf and indirectly related to the distribution of some commercially important fish species as well as changes in plankton community composition.	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Index of the position of the North Wall of the Gulf Stream	NOAA	Ecosystem Status Reports/Integrated Ecosystem Assessment Program	Basin-wide	?	Status (good/poor) assigned based on most recent 3-year period. CANT FIND EVIDENCE THAT NOAA MONITORS DOZ, BUT THAT SEEMS STRANGE	eyesonshay@dm.maryland.gov, 877-820-8DNR	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Dissolved oxygen status in Chesapeake Bay	Maryland Department of Natural Resources		Chesapeake Bay	?		Ben Sherman, NOAA, 202-253-5356, ben.sherman@noaa.gov; lead biologist, USGS, 443-488-5560, bsherm@usgs.gov	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Trends in extent of hypoxia in Chesapeake Bay	NOAA	Ecological Forecasting Site/National Ocean Service	Chesapeake Bay	Annual/?	Partnership between NOAA/USGS/Maryland DNR and VA DEQ.	admsdata@bmk.biarabch.zo.edu	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Dissolved oxygen status in Mid-Atlantic estuaries	NOAA	National Estuarine Research Reserve System	Estuaries located in Mid-Atlantic	?	Water Quality Monitoring Data available on Digital Coast	High Sullivan, National Coastal Condition Assessment Program Lead, 202-564-1763	
Trends in water column DO concentration	EPA	National Coastal Condition Assessment/Office of Water	Northeast/Mid-Atlantic	Every 5 years; probabilistic sampling	From surface to 0.5m from the bottom; collected using probabilistic sampling design	High Sullivan, National Coastal Condition Assessment Program Lead, 202-564-1763	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
pH					Needs to call Rk to determine if pH is routinely monitored. I believe Observing Network East Coast, 305-361-8370, rk.wanninkhof@noaa.gov	Rk Wanninkhof, Lead Investigator, OA Observing Network East Coast, 305-361-8370, rk.wanninkhof@noaa.gov	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Surface and sub-surface trends in arginine saturation rate	NOAA	NOAA Ocean Acidification Program	Mid-Atlantic region	Surface trends: reported seasonally; sub-surface trends: reported every 2-3 years	Surface trends will be reported as seasonally starting in 2016; sub-surface trends will be available on 2.5 year intervals	High Sullivan, National Coastal Condition Assessment Program Lead, 202-564-1763	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Trends in water column pH	EPA	National Coastal Condition Assessment/Office of Water	Northeast/Mid-Atlantic	Every 5 years; probabilistic sampling	From surface to 0.5m from the bottom; collected using probabilistic sampling design	High Sullivan, National Coastal Condition Assessment Program Lead, 202-564-1763	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
North Atlantic Oscillation/Atlantic Multi-decadal Oscillation	NOAA	Ecosystem Status Reports/Integrated Ecosystem Assessment Program	Basin-wide	?	Considered to be correlated with Gulf Stream position: The Mid-Atlantic Bight is the most strongly stratified in the Northeast, so there is less scope for further increases in this area."	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Annual mean density stratification (0-50 meters)	NOAA	Ecosystem Status Reports/Integrated Ecosystem Assessment Program	Mid-Atlantic Bight	Annual	Multivariate ENSO index is used to discern between El Niño and La Niña phases in the eastern tropical Pacific Ocean.	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Predicted El Niño Southern Oscillation phase for current year	NOAA	Climate Prediction Center/National Weather Service	Nation-wide	Monthly	Trends were calculated using monthly data up to the end of 2006, and all stations had data spanning a period of 20 yrs or more.	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Mean Sea Level Trends	NOAA National Ocean Service	Tides & Currents/National Ocean Service	North Atlantic stations	"As needed"		Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Rates of sea level change	NOAA	Ecosystem Status Reports/Integrated Ecosystem Assessment Program	Northeast, but reporting can be done by states	Annual?	Part of Ecosystem Status Reports	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
	NOAA National Ocean Service	National Water Level Observation Network/Center for Operational Oceanographic Products and Services	NOAA National Ocean Service		Collects and provides real-time tide and other water level measurements, which inform NOAA's tide predictions	CO-OPS Resilience Program, 240-533-0548	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Tides and other currents	NOAA National Ocean Service	National Water Level Observation Network/Center for Operational Oceanographic Products and Services	NOAA National Ocean Service		Collects and provides real-time tide and other water level measurements, which inform NOAA's tide predictions	CO-OPS Resilience Program, 240-533-0548	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
2. Anthropogenic Pressures: includes those inputs and effects that likely are driven by or originate from an array of human activities							
Cumulative abundance of marine debris by type	NOAA	Marine Debris Program	Mid-Atlantic Region	N/A	NOAA hosts an online database populated from groups conducting marine debris surveys. The database is public, and can support reporting of this metric, but NOAA does not publish reports	Jason Rolfe - 301-713-2989 x111	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Trends in cumulative abundance of marine debris by type	NOAA	Marine Debris Program	Mid-Atlantic Region	N/A	NOAA hosts an online database populated from groups conducting marine debris surveys. The database is public, and can support reporting of this metric, but NOAA does not publish reports	Jason Rolfe - 301-713-2989 x111	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Number and cause of incidents	NOAA/USGS	Office of Response and Restoration - Marine	Mid-Atlantic Region	Annual	Casualty and Pollution Database that involves marine pollution incidents investigated by the Coast Guard. Not sure the extent of overlap.	Online databases	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Cumulative amount of oil or chemicals that entered the environment	NOAA/USGS	Office of Response and Restoration - Marine	Mid-Atlantic Region	Annual	OPR tracks and publishes (through Incident News) spills and releases that NOAA respond to. The USGS maintains the Marine Casualty and Pollution Database that involves marine pollution incidents investigated by the Coast Guard. Not sure the extent of overlap.	Online databases	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Trends in heavy metal and DDT concentration anomalies	NOAA	Northeast Fisheries Science Center	Mid-Atlantic Bight	Annual	Field crews are sent out every five years to do sampling. High believes there are enough samples in the Mid-Atlantic region to have a high confidence level in reporting on these indices for the Mid-A. Note that offshore sediment samples are no longer collected	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Trend in Sediment Quality Index	EPA	National Coastal Condition Assessment/Office of Water	Northeast/Mid-Atlantic	Every 5 years; probabilistic sampling	Field crews are sent out every five years to do sampling. High believes there are enough samples in the Mid-Atlantic region to have a high confidence level in reporting on these indices for the Mid-A. Note that offshore sediment samples are no longer collected	High Sullivan, National Coastal Condition Assessment Program Lead, 202-564-1763	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/
Trend in Sediment Toxicity	EPA	National Coastal Condition Assessment/Office of Water	Northeast/Mid-Atlantic	Every 5 years; probabilistic sampling	Field crews are sent out every five years to do sampling. High believes there are enough samples in the Mid-Atlantic region to have a high confidence level in reporting on these indices for the Mid-A. Note that offshore sediment samples are no longer collected	High Sullivan, National Coastal Condition Assessment Program Lead, 202-564-1763	https://www.nefsc.noaa.gov/ecosys/current-conditions/seasonal/

Potential metric	Lead agency	Source data/Program	Geographic Extent	Reporting Interval	Notes	Contact	Link
Fish Contamination	EPA	National Coastal Condition Assessment/Office of Water	Northeast/Mid-Atlantic	Every 5 years; probabilistic sampling	Field crews are sent out every five years to do sampling. High believes there are enough samples in the Mid-Atlantic region to have a high confidence level in reporting on these indices for the Mid-A. Note that offshore sediment samples are no longer collected	High Sullivan, National Coastal Condition Assessment Program Lead, 202-561-763	
Harmful algal blooms	NOAA	National Ocean Service/National Centers for Coastal Ocean Science	Northeast/Mid-Atlantic	Every 5 years; probabilistic sampling	An experimental forecasting system has been developed for the Chesapeake Bay. The Northeast Fisheries Science Center includes HAB monitoring, but it is not clear if monitoring is occurring in the Mid-Atlantic.	Robert Magnien, NOAA Center for Environmental and Estuarine Science, 301-713-3380/rob.magnien@noaa.gov https://www.ncefc.noaa.gov/ceos/4048/4048-hab.html	
Coastal discharges (outward flow from embayments, estuaries, lagoons, canals, rivers, other outflows)	NOAA	Ecosystem Status Reports/Integrated Ecosystem Assessment Program	Mid-Atlantic Bight		Most freshwater enters marine systems through rivers, rather than direct precipitation or runoff.	Michael Fogarty, @noaa.gov 508-495-2000 x2386	https://www.ncefc.noaa.gov/ceos/ceosystems-status-report/physical-resources.html
Trends in annual river flow	NOAA	Ecosystem Status Reports/Integrated Ecosystem Assessment Program	Mid-Atlantic Bight		Precipitation affects a wide range of ocean processes such as salinity, water column stratification, coastal circulation, and nutrient supply.	Michael Fogarty, @noaa.gov 508-495-2000 x2386	https://www.ncefc.noaa.gov/ceos/ceosystems-status-report/physical-resources.html
Trends in annual freshwater input via precipitation	NOAA	Ecosystem Status Reports/Integrated Ecosystem Assessment Program	Mid-Atlantic Bight		Offshore discharge flow locations and precipitation flow values (million gallons/day)	Don Evans, EPA, 215-814-5370, don.evans@epamail.epa.gov	https://portal.mda.fiantiocean.gov/cdz/data_manager/metadata.html#offshore-discharge-locations_MARCOE.htm
Eutrophication status	NOAA	Northeast Fisheries Science Center	Northeast	7?	Reported in Ecosystem Status Report	Michael Fogarty, @noaa.gov 508-495-2000 x2386	
Nutrients and chlorophyll a concentrations in estuaries	EPA	National Coastal Condition Assessment/Office of Water	Northeast/Mid-Atlantic	Every 5 years; probabilistic sampling	Field crews are sent out every five years to do sampling. High believes there are enough samples in the Mid-Atlantic region to have a high confidence level in reporting on these indices for the Mid-A. Note that offshore sediment samples are no longer collected	High Sullivan, National Coastal Condition Assessment Program Lead, 202-5641763	
Sound/Underwater Noise	NOAA	CetSound Program	Mid-Atlantic	7?	Reported in Ecosystem Status Report; CetSound	Michael Fogarty, @noaa.gov 508-495-2000 x2386	https://www.ncefc.noaa.gov/ceos/ceosystems-status-report/cet-sound-impacts.html
Trends in underwater ambient noise	NOAA	Ocean Noise Reference Station Network/Office of Science and Technology	Northeast region	TBD	New program initiated in 2015 - will redeploy sensors every 2 years, and being reporting trends within the next 5-6 years	Jason Gedamke, NOAA Fisheries Biologist, 301-427-8133	https://www.ncefc.noaa.gov/ceos/ceosystems-status-report/cet-sound-impacts.html
Total number and taxonomy of invasive species	USGS	Nonindigenous Aquatic Species Program	Can report by state	Ongoing/real-time	Online database	Pam Fuller, NMS Program Leader, fullerp@usgs.gov, 352-264-3481	http://nas.erdc.usgs.gov/about/dmf.html.aspx
Source of introductions	USGS	Nonindigenous Aquatic Species Program	Can report by state	Ongoing/real-time	Online database	Pam Fuller, NMS Program Leader, fullerp@usgs.gov, 352-264-3481	http://nas.erdc.usgs.gov/about/dmf.html.aspx
Percentage of active dredged material ocean dumping sites that have achieved "environmentally acceptable" status	EPA	Office of Water	EPA Regions 2 & 3	Annual	Annual monitoring of active ocean dumping sites is required under the Marine Protection, Research, and Sanctuaries Act	Region 2 Charles Jones, 212-657-3798; Region 3 Sheldon Lau, 215-814-2786, lausheldon@epa.gov	https://www.epa.gov/ceos/ceos-dumping-forms/regional-contacts-ecm-dumping-management-system
Area of restored shoreline and change from previous year	NOAA	Habitat Conservation Restoration Center/Office of Habitat Conservation	7?	7?	NOAA Habitat Blueprint Living Shorelines Project Map tracks shoreline restoration projects	Office of Habitat Conservation, 301-713-0174	https://www.habitatblueprint.noaa.gov/home-how-we-use-it/about-ecm/
Total extent of hardened shoreline and change from previous year	Virginia Institute of Marine Science	Shoreline Inventories/Center for Coastal Resources Management	Chesapeake Bay	7?	Shoreline inventories exist for Chesapeake Bay	VA Institute of Marine Science, 804-684-7380	http://cem.vims.edu/gis_data_mngt/shoreline_inventories/
Fishery bycatch ratio trends in Mid-Atlantic fisheries	NOAA National Marine Fisheries Service	National Bycatch Reporting/National Observer Program	Northeast region	Every 2 years	Fishery bycatch ratios are based on landings for the entire northeast region and can't be broken out for just the Mid-Atlantic, although those fisheries that are predominantly prosecuted in the Mid-Atlantic can be the focus of the reporting	Lee Banika, National Observer Program Lead, 301-427-8554	http://www.st.nmfs.gov/observer-home/lims-edition-update.html
Bycatch estimates and trends of marine mammals, sea turtles and seabirds by Mid-Atlantic fishery	NOAA National Marine Fisheries Service	National Bycatch Reporting/National Observer Program	Northeast region	Every 2 years	Fishery bycatch ratios are based on landings for the entire northeast region and can't be broken out for just the Mid-Atlantic, although those fisheries that are predominantly prosecuted in the Mid-Atlantic can be the focus of the reporting	Lee Banika, National Observer Program Lead, 301-427-8554	http://www.st.nmfs.gov/observer-home/lims-edition-update.html
Electromagnetic fields							
3. Habitats: includes vegetated and non-vegetated areas; habitat-forming species; pelagic habitats							
HABITATS DELINEATED FOR MANAGEMENT PURPOSES							
North Atlantic Right Whale Seasonal Management Areas	NOAA	NMFS Protected Species Program	Atlantic	Updated "as needed"	Data bases is stored in Mid-Atlantic Data Portal, and represents Spatial Management Areas where NMFS will implement speed restrictions in shipping areas at certain time of the year to reduce the likelihood of vessel collisions with North Atlantic right whales	Barbara Zwickers, Southeast U.S. Right Whale Recovery Program Coordinator, nmfs.erdc.coordinator@noaa.gov, 727-824-5312	https://portal.mda.fiantiocean.gov/cdz/data_manager/metadata.html#SMA_all_no.html
Critical Habitats (ESA)	NOAA	Digital Coast/Office for Coastal Management	Spatial data covers Mid-Atlantic	Updated "as needed"	Digital Coast maintains current and proposed Coastal Critical Habitat Designations	Marine Cadastre Data Steward, 843-740-1202	https://portal.mda.fiantiocean.gov/cdz/data_manager/metadata.html#SMA_all_no.html
Deep-Sea Coral Protection Areas	NOAA	NOAA Fisheries Greater Atlantic Regional Fisheries Office	Mid-Atlantic region	Upon request	This can be calculated from Frank Lautenberg Deep-Sea Coral Protection Area databases on MDA Portal. Re-calculation would only be needed in the event that boundaries change or new areas are protected.	Doug Potts, GARFO, dougpotts@noaa.gov, 978-282-3941	https://portal.mda.fiantiocean.gov/cdz/data_manager/metadata.html#SMA_all_no.html
Essential fish habitat	NOAA	NMFS	Mid-Atlantic	Updated based on Council actions	Essential fish habitat Mapper displays EHF areas protected from fishing	Marine Cadastre Data Steward, 843-740-1202	http://www.habitat.noaa.gov/essential-fish-habitat-mapper.html
Artificial reefs	NOAA	Artificial Reefs Dataset/Office for Coastal Management	Mid-Atlantic	Update frequency: "as needed"	Data Portal dataset built by TNC, with no updates planned. Artificial Reefs dataset on Digital Coast is set to update "as needed"	Marine Cadastre Data Steward, 843-740-1202	https://www.habitat.noaa.gov/essential-fish-habitat-mapper.html
Spatial locations of existing and proposed coastal critical habitat designations	NOAA	NOAA Fisheries Greater Atlantic Regional Fisheries Office	Mid-Atlantic	Update frequency: "as needed"	The Mid-Atlantic Data Portal contains spatial datasets showing the location of soft-sediment bottom habitats (from TNC NAMEBA), and including major submarine canyons	Marine Cadastre Data Steward, 843-740-1202	https://portal.mda.fiantiocean.gov/cdz/data_manager/metadata.html#SMA_all_no.html
Number and total area of Deep-Sea Coral Protection Areas	NOAA	NOAA Fisheries Greater Atlantic Regional Fisheries Office	Mid-Atlantic region	Upon request	This can be calculated from Frank Lautenberg Deep-Sea Coral Protection Area databases on MDA Portal. Re-calculation would only be needed in the event that boundaries change or new areas are protected.	Doug Potts, GARFO, dougpotts@noaa.gov, 978-282-3941	https://portal.mda.fiantiocean.gov/cdz/data_manager/metadata.html#SMA_all_no.html
EHF areas protected from fishing	NOAA	NMFS	Mid-Atlantic	Updated based on Council actions	Essential fish habitat Mapper displays EHF areas protected from fishing	Marine Cadastre Data Steward, 843-740-1202	http://www.habitat.noaa.gov/essential-fish-habitat-mapper.html
Number of artificial reefs in the Mid-Atlantic region	NOAA	Artificial Reefs Dataset/Office for Coastal Management	Mid-Atlantic	Update frequency: "as needed"	Data Portal dataset built by TNC, with no updates planned. Artificial Reefs dataset on Digital Coast is set to update "as needed"	Marine Cadastre Data Steward, 843-740-1202	https://www.habitat.noaa.gov/essential-fish-habitat-mapper.html
SPATIAL LOCATIONS OF HABITATS							
Benthic habitats (includes structural habitats like submarine canyons, sand waves/ridges, and other soft-bottom habitats)	EPA	Beaches, Environmental Assessment, Closure and Health (BEACH) program	Mid-Atlantic	Annual	Percentage of days of beach season that coastal beaches monitored by state beach safety programs are open and safe for swimming	Samantha Fontenelle, 202-566-2083; Lisa Larimer, Team Lead BEACH Program	https://portal.mda.fiantiocean.gov/cdz/data_manager/metadata.html#dicton_Shapellef_Metabath.html
Beaches	EPA	Beaches, Environmental Assessment, Closure and Health (BEACH) program	By State	Annual	Percentage of days of beach season that coastal beaches monitored by state beach safety programs are open and safe for swimming	Samantha Fontenelle, 202-566-2083; Lisa Larimer, Team Lead BEACH Program	https://www.epa.gov/beach-tech
Benthic community condition in Chesapeake Bay	EPA	Chesapeake Bay Benthic Monitoring Program	Chesapeake Bay	Annual	http://www.bayhenthos.vesnar.com/dmf.html	High Sullivan, National Coastal Condition Assessment Program Lead, 202-5641763	http://www.bayhenthos.vesnar.com/dmf.html
Annual trends in Benthic Index	EPA	National Coastal Condition Assessment/Office of Water	Northeast/Mid-Atlantic	Every 5 years; probabilistic sampling	Field crews are sent out every five years to do sampling. High believes there are enough samples in the Mid-Atlantic region to have a high confidence level in reporting on these indices for the Mid-A. Note that offshore sediment samples are no longer collected	High Sullivan, National Coastal Condition Assessment Program Lead, 202-5641763	
Spatial distribution of predicted habitat for soft corals	NOAA	National Centers for Coastal Ocean Science	Mid-Atlantic	Update frequency: "None planned"	Spatial dataset included in Mid-Atlantic Data Portal	NOS Biogeography Branch, 301-713-3028	https://portal.mda.fiantiocean.gov/cdz/data_manager/metadata.html#dicton_Shapellef_Metabath.html
Percentage of observed and predicted deep sea coral habitats protected from bottom-tending gear	NOAA	National Geodatabase of Deep Sea Coral Observations/Deep Sea Coral Research and Technology Program	Mid-Atlantic region	Upon request	This indicator is not currently tracked or reported, but the data is available to calculate it. Reporting could be updated when new gear restrictions or closures are enacted.	Fan Tsao, Deep Sea Coral Research and Technology Program, 301-427-8650	https://deepseacoral.noaa.gov/

Potential metric	Lead agency	Source data/Program	Geographic Extent	Reporting Interval	Notes	Contact	Link
Submerged Aquatic Vegetation	NOAA/EPA (?)	Virginia Institute of Marine Science	Chesapeake Bay	Annually	The VA Institute of Marine Science maps and measures SAV beds in the Chesapeake Bay annually and has produced reports most years since 1984.	Rich Barko, EPA, 410-267-5731 http://web.vims.edu/barko/	
Soft marsh/wetlands	NOAA	Coastal Change Analysis Program	Mid-Atlantic	Change analysis conducted every 5 years; the CCM program could report on Mid-Atlantic region upon request	Status and trends of coastal wetlands habitats are analyzed every five years; the CCM program could report on Mid-Atlantic region upon request	Nate Herold 843-740-1183 - EPA/NWI 843-235-282-286-9233 nate.herold@epa.gov alison.castellan@noaa.gov 301-563-1125	https://oost.noaa.gov/digitaldata/softmarsh.html
Coastal Habitats	NOAA	Coastal Zone Management Program	Mid-Atlantic states	Annual	The CZM program can provide monitoring results for the Mid-Atlantic states upon request	Allison Castellan alison.castellan@noaa.gov 301-563-1125	
Annual number of acres of degraded coastal habitat under restoration	NOAA	Coastal Zone Management Program	Mid-Atlantic states	Annual	The CZM program can provide monitoring results for the Mid-Atlantic states upon request	Allison Castellan alison.castellan@noaa.gov 301-563-1125	
Tilfish	NOAA	Stock Assessment/Northeast Fisheries Science Center	Mid-Atlantic	~3-5 years	Habitat forming species. Stock assessment sustainability = stock is not overfished and not subject to overfishing	Words Hole MA Lab, USFWS 495-2000 https://www.nefsc.noaa.gov/publications/cfm/093/	
Methane seeps	NOAA	Office of Ocean Exploration and Research	Atlantic		USFS created a map of methane seeps discovered in 2012, also is building a database of "Worldwide Gas Hydrates" although I'm uncertain if that includes methane seeps: http://worldwide-energy.gov/project-pages/methane-seeps-database.html	http://oceanexplorer.noaa.gov/explorations/17Zebra/090417Zebra.html	
4. Lower trophic levels: primary and secondary productivity; forage fish							
Primary productivity	NOAA	Ecosystem Status Reports/integrated Ecosystem Assessment Program	Northeast shelf (not sure if they can report on Mid-A Bight?)	Every 2 years (with twice-annual updates for some metrics)	Ecosystem Status Report indicator	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nfsc.noaa.gov/ecosys/ecosystem-status-report.html
Annual trends in small phytoplankton (nanoplankton)	NOAA	Ecosystem Status Reports/integrated Ecosystem Assessment Program	Northeast shelf (not sure if they can report on Mid-A Bight?)	Every 2 years (with twice-annual updates for some metrics)	Ecosystem Status Report indicator	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nfsc.noaa.gov/ecosys/ecosystem-status-report.html
Annual trends in large phytoplankton (microplankton)	NOAA	Ecosystem Status Reports/integrated Ecosystem Assessment Program	Northeast shelf (not sure if they can report on Mid-A Bight?)	Every 2 years (with twice-annual updates for some metrics)	Ecosystem Status Report indicator	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nfsc.noaa.gov/ecosys/ecosystem-status-report.html
Annual trends in zooplankton abundance	NOAA	Ecosystem Status Reports/integrated Ecosystem Assessment Program	Mid-Atlantic Bight	Every 2 years (with twice-annual updates for some metrics)	Ecosystem Status Report indicator	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nfsc.noaa.gov/ecosys/ecosystem-status-report.html
Annual trends in copepod species composition	NOAA	Ecosystem Status Reports/integrated Ecosystem Assessment Program	Mid-Atlantic Bight	Every 2 years (with twice-annual updates for some metrics)	Ecosystem Status Report indicator	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nfsc.noaa.gov/ecosys/ecosystem-status-report.html
Forage species, small pelagic fish, and invertebrates	NOAA	Ecosystem Status Reports/integrated Ecosystem Assessment Program	Northeast shelf (not sure if they can report on Mid-A Bight?)	Every 2 years (with twice-annual updates for some metrics)	Ecosystem Status Report indicator	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nfsc.noaa.gov/ecosys/ecosystem-status-report.html
Trends in biomass for small pelagic fish (herring, mackerel, others)	NOAA	Ecosystem Status Reports/integrated Ecosystem Assessment Program	Northeast shelf (not sure if they can report on Mid-A Bight?)	Every 2 years (with twice-annual updates for some metrics)	Ecosystem Status Report indicator	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nfsc.noaa.gov/ecosys/ecosystem-status-report.html
Estimated forage fish species biomass	NOAA	Ecosystem Status Reports/integrated Ecosystem Assessment Program	Northeast shelf (not sure if they can report on Mid-A Bight?)	Every 2 years (with twice-annual updates for some metrics)	Ecosystem Status Report indicator	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nfsc.noaa.gov/ecosys/ecosystem-status-report.html
Trends in biomass of benthic invertebrates	NOAA	Ecosystem Status Reports/integrated Ecosystem Assessment Program	Mid-Atlantic Bight	Every 2 years (with twice-annual updates for some metrics)	Ecosystem Status Report indicator	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nfsc.noaa.gov/ecosys/ecosystem-status-report.html
Annual trends in mean trophic level of fish communities	NOAA	Ecosystem Status Reports/integrated Ecosystem Assessment Program	Mid-Atlantic Bight	Every 2 years (with twice-annual updates for some metrics)	Ecosystem Status Report indicator	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nfsc.noaa.gov/ecosys/ecosystem-status-report.html
Trends in average position for a group of 48 species resident on the Northeast US Continental Shelf	NOAA	Ecosystem Status Reports/integrated Ecosystem Assessment Program	Northeast shelf (not sure if they can report on Mid-A Bight?)	Every 2 years (with twice-annual updates for some metrics)	Ecosystem Status Report indicator	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nfsc.noaa.gov/ecosys/ecosystem-status-report.html
5. Upper trophic levels: marine life							
Protected species	Navy, NOAA	MDAT	Mid-Atlantic	Update frequency: "Irregular"	Synthetic base layer developed by MDAT	Jesse Cleary, jesse.cleary@duke.edu Report v.1.pdf http://seemap.emu.duke.edu/models/mdat/MDAT-1-technical-report-v.1.pdf	
Total relative abundance of marine terns	BOEM, NOAA	MDAT	Mid-Atlantic	Update frequency: "Irregular"	Synthetic base layer developed by MDAT	Jesse Cleary, jesse.cleary@duke.edu Report v.1.pdf http://seemap.emu.duke.edu/models/mdat/MDAT-1-technical-report-v.1.pdf	
Relative status (Recovery Factor) of marine mammals	NOAA	Ecosystem Status Reports/integrated Ecosystem Assessment Program	Northeast shelf (not sure if they can report on Mid-A Bight?)	?	Ecosystem Status Report indicator	Michael Fogarty, michael.fogarty@noaa.gov 508-495-2000 X2386	https://www.nfsc.noaa.gov/ecosys/ecosystem-status-report.html
Marine biodiversity		MDAT	Mid-Atlantic	Update frequency: "Irregular"	MarineLife Data and Analysis Team (MDAT) developed multiple spatial data layers showing abundance and distribution of marine species. All spatial data layers are stored in the Mid-Atlantic Data Portal	Jesse Cleary, jesse.cleary@duke.edu Report v.1.pdf http://seemap.emu.duke.edu/models/mdat/MDAT-1-technical-report-v.1.pdf	
Changes in migration and habitat use		NOAA NEFSC, AMAPPS					
Sea turtles	NOAA	NMFS Sea Turtle Stranding and Salvage Network	Mid-Atlantic/global	Update frequency: "As needed"	Data summaries of number of strandings by species and cause can be produced annually upon request	Windy Teas, STSN Program Lead, Southeast Fisheries Science Center 305-361-4595; Kate Sampson, Greater Atlantic Stranding Network Program Lead, 978-282-8670 teas@stsn.org 617-853-1819 http://stsn.org/atlantic/atlantic_data_maintainer/metadata/ http://seemap.emu.duke.edu/	
Sea turtle observations	N/A - multiple	OBIS-SEAMAP	Mid-Atlantic/global	Update frequency: "As needed"	Data set included in Mid-Atlantic Data Portal		
Number of sea turtle strandings by species and cause	NOAA	NMFS Sea Turtle Stranding and Salvage Network	Mid-Atlantic/global	Update frequency: "As needed"	SEANET staff confirmed they could theoretically publish annual reports on Mid-Atlantic bird mortality counts by species and location; however, current coverage of Mid-Atlantic beaches by citizen scientists is extremely low. New recruitment through trainings would be required to kick-start this effort in earnest in the Mid-Atlantic	Julie Ellis, SEANET Director, 508-887-4933 https://seanet.us.wednet.edu/about/	
Mortality by focal species and location; year-to-year trends	SEANET	Citizen science beach bird surveys	East Coast Atlantic states	Annual	The red-tailed loon (<i>Gavia stellaris</i>), red-necked grebe (<i>Podiceps griseigularis</i>), greater shearwater (<i>Puffinus gravis</i>), northern gannet (<i>Morus bassanus</i>), thick billed murre (<i>Uria lomvia</i>), rosebill (<i>Alca torda</i>), black guillemot (<i>Lophopus griseus</i>) and the Atlantic puffin (<i>Fregata aeterea</i>) have been identified as species at risk due to inter-species competition	Lee Banka, National Observer Program Lead, 301-827-8524 http://www.fishbase.org/species/obs/atlantic/atlantic_data_maintainer/metadata/	
Trends in catch bycatch by fishery	NOAA	National Bycatch Reporting/National Observer Program	?	Annual	Species at risk include Atlantic pellics, Audubon's shearwater, Black-capped petrel, Common noddie, Cory's shearwater, Dovekie, Great shearwater, Leach's storm-petrel, Manx shearwater, Northern fulmar, Pomarine jaeger, Razorbill, Red phalarope, Red-necked phalarope, Sooty shearwater, and Wilson's storm-petrel	Jesse Cleary, jesse.cleary@duke.edu Report v.1.pdf http://seemap.emu.duke.edu/models/mdat/MDAT-1-technical-report-v.1.pdf	
Offshore/Pelagic Avian Abundance, Species Richness and Core Areas	MDAT	MDAT modeling	Mid-Atlantic	Update frequency: "Irregular"			

Appendix B: Potential metrics database

	Potential metric	Lead agency	Source data/Program	Geographic Extent	Reporting Interval	Notes	Contact	Link
Shorebirds	Trends in annual counts of endangered shorebirds (Piping plover, Red knot, Roseate tern)	US Fish and Wildlife Service	Endangered Species monitoring	Varies by species	Annual	Little nesting, molting, or incubation occur. Coastal waterfowl species include Black scoter, Common loon, Long-billed duck, Red-throated loon, Surf scoter, and White-winged scoter.	Jesse Cleary, jesse.cleary@duke.edu	http://semaag.zoo.duke.edu/models/moat/MDAT.Ltechnical-report-v.1.1.pdf
Passerines and bats	Coastal Waterfowl Abundance, Species Richness and Core Areas	MDAT	MDAT modeling	Mid-Atlantic	Update frequency: "Irregular"		Jesse Cleary, jesse.cleary@duke.edu	http://semaag.zoo.duke.edu/models/moat/MDAT.Ltechnical-report-v.1.1.pdf
Fish (suggestion to use MAFMC FMPs as groups)	Total biomass, core areas and species richness	MDAT	MDAT modeling	Mid-Atlantic	Update frequency: "Irregular"	MDAT modeled 82 fish species including summer flounder, scup, black sea bass, spiny dogfish, Atlantic mackerel, longfin squid, northern shortfin squid, butterfish, bluefish, and golden flounder.	Jesse Cleary, jesse.cleary@duke.edu	http://semaag.zoo.duke.edu/models/moat/MDAT.Ltechnical-report-v.1.1.pdf
	Biomass of species under a MAFMC Fisheries Management Plan	MDAT	MDAT modeling	Mid-Atlantic	Update frequency: "Irregular"		Jesse Cleary, jesse.cleary@duke.edu	http://semaag.zoo.duke.edu/models/moat/MDAT.Ltechnical-report-v.1.1.pdf
Groundfish	Trends in biomass	NOAA	Ecosystem Assessment Program/ Northeast Shelf Ecosystem Status Report	Mid-Atlantic Bight region	Every 2 years	Ecosystem Status Report indicator	Michael Fogarty, michael.fogarty@noaa.gov	http://semaag.zoo.duke.edu/models/moat/MDAT.Ltechnical-report-v.1.1.pdf
	Recruitment Index Anomaly	NOAA	Integrated Ecosystem Assessment Program, Ecosystem Status Reports	Northwest shelf (not sure if they can report on Mid-Atlantic Bight?)	Every 2 years (with twice-annual updates for some metrics)		Michael Fogarty, michael.fogarty@noaa.gov	http://semaag.zoo.duke.edu/models/moat/MDAT.Ltechnical-report-v.1.1.pdf
Atlantic Highly Migratory Species	Status of Atlantic Highly Migratory Species	NOAA	Stock Assessment and Fisheries Evaluation Report/NMFS	Atlantic Ocean	Annual	NOAA Fisheries produces an annual Stock Assessment and Fisheries Evolution SAFE Report that reviews the current status of Atlantic HMS fish stocks (tuna, swordfish, billfish, and sharks). The reports—which are required under the Magnuson-Stevens Fishery Conservation and Management Act—provide the status of each HMS stock (e.g., overfished, overfishing, rebuilding).	Highly Migratory Species Management Division, 301-427-5503	http://www.nmfs.noaa.gov/fishery/documents/safe_reports/index.html and http://www.fisheries.noaa.gov/fisheries_sco/status_of_fisheries/index.html
Marine mammals (Cetaceans)	Population estimates and trends	NOAA NMFS/Northeast Fisheries Science Center	Annual Stock Assessments	Atlantic Ocean	Annual	Stock assessments include information on mortalities and causes when known.	Allison Henry, Protected Species Branch, 508-492-0248	http://www.nmfs.noaa.gov/fishery/
	Reported mortalities and causes	NOAA NMFS/Northeast Fisheries Science Center	Annual Stock Assessments	Atlantic Ocean	Annual	When known, fish in the mid-Atlantic are managed either by the MAFMC, the ASMFC, or in the case of listed species, NMFS. "Our Living Ocean" reports include a chapter summarizing the status of Atlantic Anadromous Fisheries, and these reports are released on a multi-year cycle. In the interim, status reports could be compiled separately for each Mid-Atlantic species.	Allison Henry, Protected Species Branch, 508-492-0248	http://www.nmfs.noaa.gov/fishery/
Anadromous fish	Status of anadromous fish species in the Mid-Atlantic	NOAA NMFS/Northeast Fisheries Science Center	Atlantic Anadromous Fisheries	Mid-Atlantic	Varies	Dadromous species include alewife, American eel, American shad, Atlantic sturgeon, blueback herring, hickory shad, and shortnose sturgeon.	Jesse Cleary, jesse.cleary@duke.edu	http://semaag.zoo.duke.edu/models/moat/MDAT.Ltechnical-report-v.1.1.pdf
	Species richness of anadromous fish	MDAT	MDAT modeling	Mid-Atlantic	Update frequency: "Irregular"		Jesse Cleary, jesse.cleary@duke.edu	http://semaag.zoo.duke.edu/models/moat/MDAT.Ltechnical-report-v.1.1.pdf
Shellfish (sea scallops, clams, oysters)	Biomass trends of sea scallops, ocean quahogs, and Atlantic surfclams	NOAA	Ecosystem Status Reports/integrated Ecosystem Assessment Program	Mid-Atlantic Bight	Every 2 years (with twice-annual updates for some metrics)	Ecosystem Status Report indicator	Michael Fogarty, michael.fogarty@noaa.gov	http://semaag.zoo.duke.edu/models/moat/MDAT.Ltechnical-report-v.1.1.pdf
	Relative abundance and biomass of soft-shell clam and longfin inshore squid	NOAA	Landings and Science Data/Northeast Fisheries Science Center	Northeast	Annual?	Landings and survey data are used to inform quotas. Last stock assessment was from 2005, and status cannot be determined.	Jason Diddens, 302-536-5254	http://www.oaonline.org/oaonline/show%20crab.html
Squid	Horseshoe crab population	USFWS, with Maryland Fishery Resources, Office and Delaware Bay Estuary Project	Horseshoe Crab Tagging Program	Delaware Bay area	Annual		1-888-1MILLIUS	http://www.fws.gov/northatl/ma/land/shelley/projects/hoose
Horseshoe crab	Horseshoe crab harvest levels	ASMFC	Horseshoe Crab Management Board	Delaware Bay area	Annual		Mike Schmittke, PMP Coordinator, mschmittke@asmfc.org	http://www.asmfc.org/species/hoosecrab
6. Ocean Uses								
NATIONAL SECURITY								
Military installations	Spatial locations of military range complexes	Navy	Naval Facilities Engineering Command Atlantic	Mid-Atlantic	?	A range complex is a designated set of specifically bounded geographic areas and encompasses a water component (above and below the surface), airspace, and may encompass a land component where training and testing of military platforms, tactics, munitions, explosives, and electronic warfare systems occur.	Fleet Area Control and Surveillance Facility-FRACEC@navy.mil, 257-433-1211	https://portal.mil.fleetareacontrol.com/data_manager/metadata/NavalFacilitiesMilitaryRangeComplex.pdf
Training and testing complexes and ranges	Spatial locations of Danger Zones and Restricted Areas	Department of Defense	?	Mid-Atlantic	Update frequency of data layer is annual	Danger zones are a defined water area used for hazardous operations, normally for the armed forces. Danger zones may be closed to the public on a full-time or intermittent basis.	Marine Cadastre Data Steward, 843-740-1202, coastal.jrf@noaa.gov	https://www.noaa.gov/our-work/operations-and-maintenance/operations/2019/02/2019-noaa-marine-cadastre-data-steward/
Unexploded ordnance	Spatial locations of unexploded ordnances	NOAA	Office for Coastal Management	Mid-Atlantic	Update frequency: "as needed"	Explosive weapons on the seafloor that still pose a risk of detonation.	Marine Cadastre Data Steward, 843-740-1202, coastal.jrf@noaa.gov	https://www.noaa.gov/our-work/operations-and-maintenance/operations/2019/02/2019-noaa-marine-cadastre-data-steward/
Wind resources	Area leased for wind energy development	BOEM	Office of Renewable Energy	Mid-Atlantic	"As needed"	"Active wind lease and research areas" dataset	Branch Chief, BOEM, 703-787-1315	https://www.boem.gov/active-wind-lease-research-areas
Wind planning areas	Number of wind planning areas by state	BOEM	Office of Renewable Energy	Mid-Atlantic	"As needed"	Mid-Atlantic Wind Planning Areas in this dataset represent up to seven different types of announcements within the US Federal Register (e.g. Call Area, Wind Energy Area, Request for Interest, Proposed Sale Notice Area) that can be used to show the current status of an area that is being considered for Wind Power Development.	Stephen Creel, stephen.creel@boem.gov, 703-787-1305	https://www.boem.gov/active-wind-lease-research-areas
	Total area of wind planning areas in Mid-Atlantic and change in total area from previous year	BOEM	Office of Renewable Energy	Mid-Atlantic	"As needed"	Wind planning areas are reported in acres and hectares.	Stephen Creel, stephen.creel@boem.gov, 703-787-1305	https://www.boem.gov/active-wind-lease-research-areas
	Number of active wind leases and research areas and change from previous year	BOEM	Office of Renewable Energy	Mid-Atlantic	"As needed"	These areas blocks which have been leased to a company with the intent to build a wind energy facility. No projects are in the development stage at this time; permits may be issued for development provided further site assessment for each leased area.	Branch Chief, BOEM, 703-787-1315	https://www.boem.gov/active-wind-lease-research-areas
Active wind lease and research areas	Locations of coastal energy facilities	EPA	Emissions & Generation Resource Integrated Database (eGRID)	Mid-Atlantic	"As needed"	Locations of facilities that generate electricity. The presence of a facility may indicate that certain power transmission infrastructure exists nearby.	NOAA Office for Coastal Mgr., 843-740-1202	https://www.epa.gov/energy/active-wind-lease-research-areas
COMMERCIAL AND RECREATIONAL FISHING								

Potential metric	Lead agency	Source data/Program	Geographic Extent	Reporting Interval	Notes	Contact	Link
Total cubic yards of sand annually authorized for renewal	BOEM	Offshore Sand and Gravel Leasing Program/Marine Mincro Program	Mid-Atlantic	Annual upon request	BOEM can report on this indicator annually upon request	Jeff Beckwaer, Leasing Division Chief, 703-797-1851	https://www.boem.gov/MMP/Current-Statistics/
Sand requirements	Western Carolina University	Beach Nourishment Database/Program for the Study of Developed Shorelines	Mid-Atlantic	Continuous updates	This spatial database is maintained by the PSDs, and contains attribute information on the general location of sand placement, primary funding source and funding type, volume of sediment emplacement (in cubic yards), length of beach nourished in feet, and cost and inflated cost beach nourishment episodes dating back to 1923.	Andy Coburn, acoburn@wcu.edu, 828-227-3027	https://pdf.wcu.edu/current-research/beach-nourishment/
NON-CONSUMPTIVE RECREATION							
Recreational visits or trips (volume, areas, value)	MARCO	Human Use Data Synthesis - Recreation Theme	Mid-Atlantic	??	Spatial dataset shows number of various types of recreation types occurring across the Mid-Atlantic, and is stored in Mid-Atlantic Data Portal	info@midatlanticceam.org	http://portal.midsatlanticceam.gov/data/data_manager/metadata/ItemHUDS-Summary_Data_Presentation.html
Trends in Tourism and Recreation Sector economics	NOAA	Economics: National Ocean Watch (NOW)/Office for Coastal Management	Mid-Atlantic states	Annual	Recreational economic data is made available by state on an annual basis. Data includes restaurants/bars, hotels, marinas, boat dealers, charters, campsites, RV parks, scenic water tours, recreational fishing, zoos and aquariums.	Allison Castellon, allison.castellon@noaa.gov, 301-563-1125	https://coast.noaa.gov/digitalcoast/tools/nowow.html
Number of new and enhanced coastal public access sites	NOAA	Coastal Zone Management Program	Mid-Atlantic states	Annual	The CZM program annually tracks several metrics related to the program's public access goals, and can provide results from the Mid-Atlantic states upon request.		https://coast.noaa.gov/ocm/performance/
TRIBAL INTERESTS AND USES							
Submerged cultural areas							
Tribal ceremonial areas							
Commercial and sustenance fishing and aquaculture							
CRITICAL UNDERSEA INFRASTRUCTURE							
Telecommunication and electrical cable occurrence	N/A	North American Submarine Cable Association (NASSA)		Update frequency: "none planned"	Data portal dataset shows the locations of in-service and out-of-service submarine cables that are owned by members of NASSA. Didn't see in Data Portal?	MASCA Secretariat, 973-615-2430	https://coast.noaa.gov/dataset/ocseas/ocseas.html http://coast.noaa.gov/data/ocseas/ocseas.html https://coast.noaa.gov/dataset/ocseas/ocseas.html
Pipeline occurrence							
Scientific equipment occurrence					MARCOOS perhaps could be a proxy for identifying location of buoys		