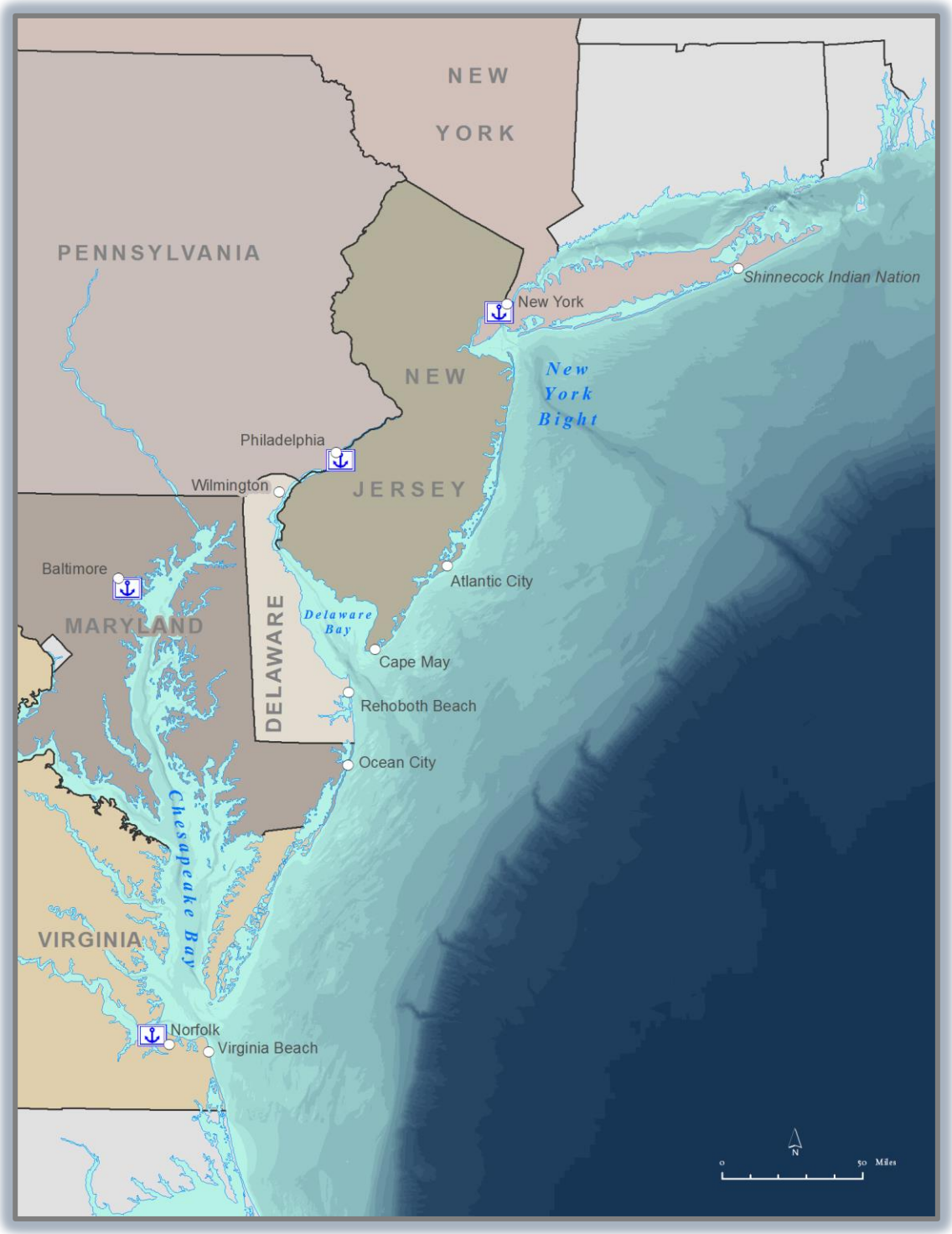
A Brief Overview of the Mid-Atlantic Ocean:
Characteristics, Trends, and Challenges



For the Mid-Atlantic Regional Planning Body

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NOTE: This document was written by the Regional Ocean Assessment Work Group of the Mid-Atlantic Regional Planning Body (MidA RPB) and is intended to stimulate discussion within the planning body. The ideas expressed here should not be taken as indications of RPB direction or decisions.

1. INTRODUCTION

The ocean waters of the Mid-Atlantic, stretching from New York to Virginia, are well used and well loved. Sandy beaches, rich cultural and historical sites, vibrant coastal communities and metropolitan cities help to define the region. The ocean shapes the economy and the culture of the region, providing sand for our beaches, transportation for goods, food for the table and a place for rest, refreshment and recreation. The ocean is changing, and the human population in the region is growing. Planning for these changes will assist us in facing them more effectively.

Over 34 million people call the Mid-Atlantic coastal counties their home, and that population is expected to grow another 8% by 2020.[1] The Mid-Atlantic coastal region serves as an economic engine for the nation, having contributed $2 trillion to the U.S. Gross Domestic Product (GDP) in 2010, which was 14% of the entire U.S. GDP.[2, 3] The region hosts the world's largest naval base (Norfolk, VA), the nation's largest city and the east coast's largest seaport by tonnage (New York, NY),[4, 5] and the fifth largest commercial fishing port by tonnage (Reedville, VA).[6]

The nation currently uses the Mid-Atlantic's dynamic ocean environment for: fishing, transportation, sand and gravel mining, national security activities, telecommunications, scientific research, tourism, recreation and more. Some existing uses are expanding and new uses are emerging that need space in the Mid-Atlantic Ocean (e.g., offshore energy development, aquaculture and new habitat protection measures).

Figure 1. Maritime transportation is increasing. Credit: NOAA

[1] U.S. Census Bureau 2010
[2] Bureau of Labor Statistics Census of Employment and Wages 2010
[3] NOAA Spatial Trends in Coastal Socioeconomics Database 2012
[4] U.S. Census Bureau 2010 Top 20 Cities
[5] U.S. Department of Transportation Top 50 U.S. Water Ports, Ranked by Tons, 2012
[6] NOAA Commercial Fisheries Statistics 2013

The region is likely to experience dramatic changes in the next 20 years, including:

Increasing demands for goods and services

- More ship traffic and substantially larger ships.[7]
- Major changes to harbor infrastructure, including deepening of channels and raising bridges to accommodate the larger ships.[7]
- Increased interest in offshore sand mining.[8]
- Development of offshore terminals to ship and receive Liquefied Natural Gas (LNG).[9]
- Development of offshore wind farms.[10]
- Exploration for oil and gas deposits.[11]
- Increased placement of cables on or under the ocean floor.[12,]
- More recreational use of the ocean, including the expanding tourism & recreation industries.[13]

Physical and biological changes

- More contaminants and marine debris in the ocean.[14, 15]
- Rising sea levels.[16, 17]
- Increasing incidents of extreme weather, including intense precipitation, extra-tropical storms and hurricanes.[18, 19]
- Shifts in the distribution of fish stocks as species move northward and/or offshore in response to oceanic changes. [20, 21]
- Changing food web dynamics.[22, 23]
- Increasing acidity to the ocean, which may particularly affect species that form shells.[24]
- Changing ocean circulation patterns.[25]

Identifying and discussing ocean uses early in the decision-making process can make problems easier to resolve. This white paper identifies key aspects of the Mid-Atlantic Ocean and its multiple uses, in order to help identify those interests. At the conclusion of each section, we include a bulleted list of ideas to spark that discussion.

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[7] Panama Canal Expansion Study
[8] Marine mining technologies and mitigation techniques
[9] Dept. of Energy Liquefied Natural Gas Overview
[10] Dept. of Energy Offshore Wind Research and Development
[11] BOEM Assessment of Undiscovered Technically Recoverable Resources on the Atlantic OCS 2014
[12] Sechrist, M. et al., 2012. The Dynamics of Undersea Cables: Emerging Opportunities and Pitfalls
[13] National Oceanic & Atmospheric Administration: National Ocean Watch Explorer: Mid-Atlantic Region 2012
[14] NOAA Environmental Contaminants Overview
[15] NOAA-EPA Coastal Nonpoint Pollution Control Program
[16] Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region
[17] IPCC Climate Change 2013
[18] NOAA Geophysical Fluid Dynamics Laboratory Global Warming and Hurricanes Overview
[19] U.S. National Climate Assessment Extreme Weather
[20] NOAA: North Atlantic Fish Populations Shifting as Ocean Temperatures Warm
[21] Nye, J.A. et al., 2009
[22] NOAA Food Web Dynamics Program
[23] Link J.S. et al., 2012
[24] NOAA: What is Ocean Acidification?
[25] NOAA Integrated Ocean Observing System Climate Variability and Change

The MidA RPB has adopted two overarching goals: (1) promoting ocean ecosystem health, functionality, and integrity through conservation, protection, enhancement, and restoration; and (2) planning and providing for existing and emerging ocean uses in a sustainable manner that minimizes conflicts, improves effectiveness and regulatory predictability, and supports economic growth. Balancing development with protection of the natural resources is the overarching challenge of the Mid-Atlantic Ocean planning effort. This white paper is organized to provide a brief summary of information and issues relating to these goals, as articulated in the Mid-Atlantic Regional Ocean Planning Framework.[26]

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2. HEALTHY OCEAN ECOSYSTEMS IN THE MID-ATLANTIC REGION

The convergence of cool New England and warm South Atlantic waters shape the Mid-Atlantic Ocean and produce an ecosystem that supports a rich diversity of marine life. A healthy ocean ecosystem is fundamental to the health of our regional economies and communities. One of the RPB's two primary goals focuses on protecting and conserving our ocean and coastal resources. Three objectives support the healthy ecosystems goal, each of which is discussed briefly below, with opportunities for collaboration to achieve the objectives noted in each section.

To maintain a healthy ocean ecosystem, all activities that affect the health of the Mid-Atlantic Ocean must be considered both individually and cumulatively. Balancing competing uses with natural resource protection is a complex task that will benefit from management approaches that analyze multiple factors simultaneously rather than separately. For example, air guns can provide useful information about the geology of the region, but they can also affect marine mammals that rely on sound to communicate. Marine mammals can also be entangled in fishing gear. The cumulative impacts of human activities on marine mammals are difficult to assess, but if we fail to consider them our decisions may fall short of management goals.

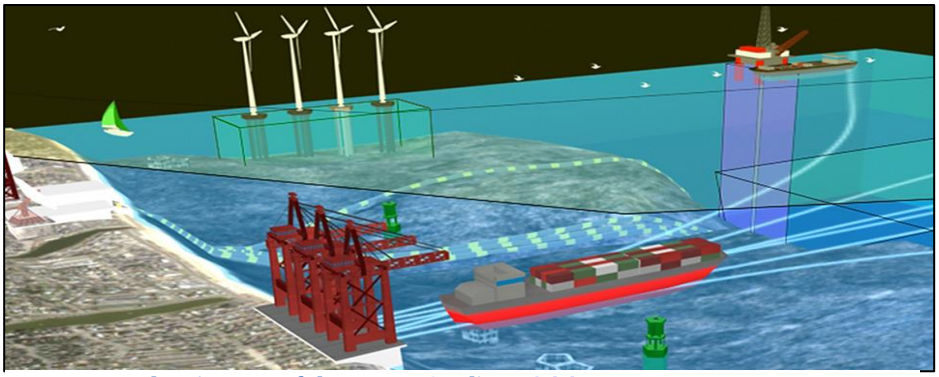

Figure 2. Overlapping uses of the ocean. Credit: NOAA

[26] Mid-Atlantic Regional Ocean Planning Framework

2.1 Discovering, Understanding, Protecting, and Restoring the Ocean Ecosystem:

Figure 3. Photo of Loggerhead sea turtle from the NOAA Teachers at Sea Program. Credit: NOAA

The Mid-Atlantic region, as defined by the RPB, includes ocean waters from Long Island to the Virginia/North Carolina border. It has a vast array of highly diverse habitats and a wide diversity of species, including economically important species (e.g., summer flounder, menhaden, scallops, oysters, clams, blue crabs).[27] The diverse marine life of the Mid-Atlantic Ocean ecosystem supports a robust commercial fishing industry and millions of recreational angling trips every year. It also provides numerous opportunities for non-consumptive enjoyment of species like whales, turtles and seabirds.[28] It is an area with widely varying habitats, from shallow coastal bays with sea grasses to offshore canyons with deep sea corals. Species' ranges overlap in the Mid-Atlantic, which serves as the southern boundary for a number of cold water species and as the northern boundary for warm water species.

Physical Characteristics

Under the waters of the Mid-Atlantic lies a broad continental shelf with a width generally greater than 120 km (75 mi). Steep submarine canyons cut into the edge of the shelf. Based on the canyons explored by NOAA and BOEM to date, there is reason to believe that the Mid-Atlantic canyons contain assemblages of sensitive, long-lived corals and provide feeding and stopover habitats for commercially and recreationally important species.[29]

[27] Fisheries Economics of The U.S. 2012
[28] MARCO Recreation Overview
[29] NOAA Value of Coral Ecosystems

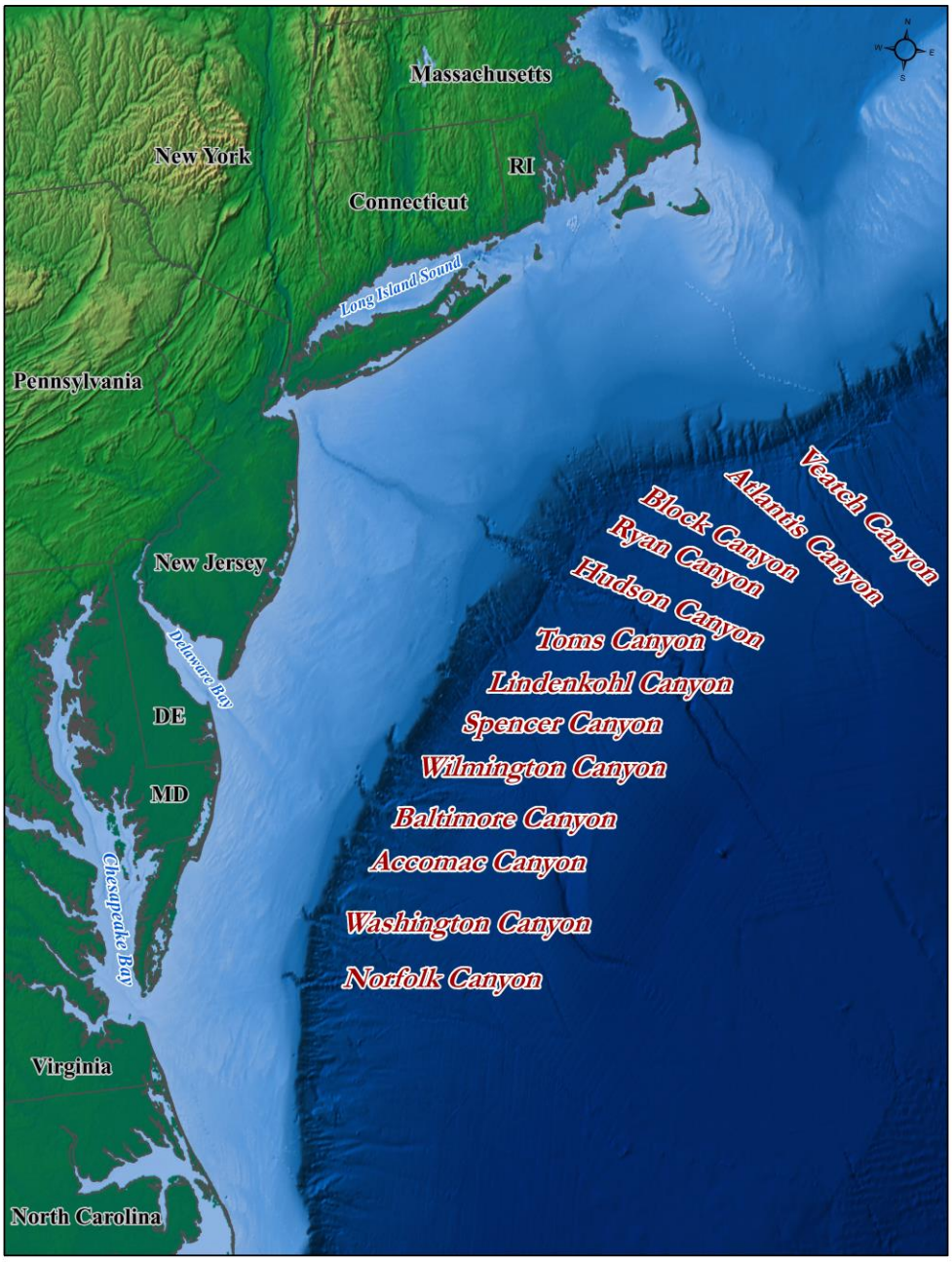

Figure 4. Submarine Canyons offshore of the Mid-Atlantic. Credit: BOEM

The continental shelf itself is a heterogeneous region dominated by a ridge-and-swale (hill-and-valley) topography resulting in a patchy distribution of sediments and varying benthic communities. It contains extensive sandy bottom areas with persistent shoals consisting of medium-grained sand inshore, grading to muddy finer sands at the shelf break. Coarser surficial sediments are often found on ridges and shoals, while generally finer sediments with higher organic carbon content are found in swales, along with greater biomass and species diversity.

Within the soft sediment matrix found in the Mid-Atlantic region, natural and man-made reef habitats occur in estuaries, along the coast, across the continental shelf, and in deeper waters. Natural reef habitats are found in some areas and consist of biogenic material or rock, typically

rock outcrops or boulders. Off coastal Delaware and farther south, there are reports of cobbles and loose rock patches associated with "live bottom," i.e., where the rocks are colonized by sea whips, stony coral, and other habitat-forming organisms. Man-made reefs include shipwrecks, which are one of the most abundant types of man-made reef habitat in the area,[30] and reefs that have been deliberately constructed to provide fish habitat.

The coastal region is low-lying and has a variety of features, including mainland shores, delta plains, estuaries and bays, lagoons, barrier islands and capes, and tidal inlets. The central coastal region is characterized by continuous barrier islands and capes (spits) interrupted by inlets and large bays (e.g., Delaware Bay and Chesapeake Bay). Extensive wetlands and marshes occur in the estuaries and in areas where sediment and marsh vegetation have partially filled the lagoons behind barrier islands. The shoreline is constantly changing as a result of wind-driven waves and tidal currents that cause sediment transport. The primary sources of the sand that maintains the beaches and barriers along the Atlantic Coast are eroding up-current beaches and sand shoals on the inner continental shelf.

Estuaries are the transitional zones along the coastline where ocean saltwater mixes with freshwater from the land. There are three prominent and highly productive estuaries in the Mid-Atlantic region, Chesapeake Bay, Delaware Bay and the New York/New Jersey Harbor Estuary. The Chesapeake Bay is the largest estuary in the United States, with a total surface area of about 11,500 km^2 (4,500 mi^2).[31] Because of the large size of the Chesapeake Bay, its conditions heavily influence the conditions of Mid-Atlantic waters. In addition, there are numerous coastal bays including those in Maryland, Delaware, and New Jersey, and at the northernmost range of the region, Long Island Sound.

Biological Characteristics

The rich diversity of species in the Mid-Atlantic is under increasing pressure from uses occurring onshore and in the water column. Fish, mammals, sea turtles, corals and other animals are affected by: shipping, fishing, dredging, recreation, military activities, habitat loss and alteration, pollutants that run off the land, and other activities. Some of the notable species and major threats are outlined below.

Figure 5. Deep Sea Corals. Credit: NOAA

[30] Steimle, F.W. and C. Zetlin, 2000
[31] NOAA Chesapeake Bay Fact Sheet

Deep sea corals are of special concern in the Mid-Atlantic, because they grow very slowly and live for hundreds of years, and because they provide refuge for many other species.[32] In the Mid-Atlantic, most deep sea corals are found on the Outer Continental Shelf and slope, although some species also grow in shallower water. They can be impacted by commercial fishing activities, energy development and possibly other human uses.[33, 34]

Figure 6. Piping plover chick. Credit: US Fish and Wildlife Service

There is an array of endangered and threatened species, including birds, sea turtles, marine mammals, and fish that rely upon the habitats of the Mid-Atlantic Ocean.[35, 36] For example, piping plovers nest on its beaches.[37] Rufa red knots use the region as a much needed rest stop on their migrations from South America to the Arctic.[38] Two species of sturgeon ("shortnose" and "Atlantic") forage in the Mid-Atlantic and return to the rivers that flow into it to spawn.[39, 40] Human activities and changes in the ocean and coastline can affect these and other endangered species.

When water temperatures are warm enough, Mid-Atlantic waters serve as important foraging and developmental areas for sea turtles. The sea turtles most likely to be found in the Mid-Atlantic include the endangered leatherback and Kemp's ridley turtles and the threatened loggerhead and green turtles.[41]

The highly endangered North Atlantic right whale is a winter resident in Mid-Atlantic waters, and mothers and calves migrate through our waters from the breeding area off Florida to summer feeding grounds in the north. There are only about 450 North Atlantic right whales in the world. They can be killed or injured when they are entangled in fishing gear or struck by ships.[42, 43]

Figure 7. Entangled North Atlantic right whale. Credit: NOAA

Collaboration Opportunities

[32] NOAA Deep Sea Corals Habitat Protection
[33] NOAA Strategic Plan for Deep Sea Corals
[34] Mid-Atlantic Fishery Management Council Deep Sea Corals Amendment
[35] NOAA Greater Atlantic Region Protected Resources
[36] MD Dept. of Natural Resources Rare, Threatened & Endangered Animals
[37] NY Dept. of Environmental Conservation Piping Plover Fact Sheet
[38] U.S. Fish & Wildlife Service Rufa Red Knot
[39] NOAA Atlantic Sturgeon Fact Sheets
[40] NOAA Shortnose Sturgeon Fact Sheets
[41] NOAA Turtle Status Information
[42] NOAA Fisheries: North Atlantic Right Whales
[43] NOAA Northeast Fisheries Science Center North Atlantic Right Whale: Western Atlantic Stock Report 2014

- Continue mapping and characterizing submarine canyon habitats in the Mid-Atlantic region.
- Identify Federal, State, and Tribal habitat protection and restoration initiatives (e.g., oceanic canyons and deep sea corals).
- Coordinate efforts to improve understanding of natural cycles of key fish stocks.
- Monitor and improve understanding of threatened and endangered species distribution and relative abundance in the Mid-Atlantic region, and develop new and enhanced strategies to manage protected species.
- Identify areas of high fish productivity and high usage to inform management of ocean uses and habitat areas.
- Coordinate and integrate research on invasive species and coordinate management strategies to control invasive species.
- Research the cumulative impacts of increasing human activities (e.g. shipping and energy development) on Mid-Atlantic wildlife and habitats.

2.2 Accounting for Ocean Ecosystem Changes and Increased Risks

The Mid-Atlantic region is experiencing large-scale changes in both its physical and its biological conditions. In 2012, water temperatures reached the highest level in over 150 years of recorded observations on the Northeast U.S. Continental Shelf, and climate projections indicate that the Mid-Atlantic will experience some of the highest absolute levels of change in water temperatures along the eastern seaboard.[44, 45] Between 1895 and 2011, temperatures in the Northeast increased by almost 2℉ (1.1°C) or 0.16℉ per decade. Precipitation increased by approximately five inches (12.7 cm), or more than 10% during the same time period.[46] Coastal flooding has increased due to a rise in sea level of approximately 1 foot (~0.3 m) since 1900.[47] As these historic changes continue, they will have profound impacts on coastal communities. In fact, recent evidence suggests the primary ocean current, the Gulf Stream, may be weakening (affected in part by the melting of the Greenland ice sheet).[48,49] A slowing of the Gulf Stream could lead to sea level rise in the Mid-Atlantic.[16 above]

Figure 8. Winter flounder in eelgrass habitat. Credit: NOAA

Mid-Atlantic waters are becoming more acidic.[50] This is primarily a result of increasing atmospheric CO_2 levels, which in turn cause an increase in CO_2 in the oceans, where it forms

[44] NOAA Science: Sea Surface Temperatures Reach Highest Level in 150 Years on Northeast Continental Shelf
[45] EPA Climate Change Indicators: Sea Surface Temperature
[46] EPA Climate Change Indicators: Heavy Precipitation
[47] EPA: The Impact of Climate Change on the Mid-Atlantic Region
[48] IPCC Climate Change 2007: Working Group 1: The Physical Science Basis
[49] S. Rahmstorf et al., 2015
[50] EPA Climate Impacts on Coastal Areas

carbonic acid. [51] The greater acidity decreases the supply of carbonate ions, which provide the chemical building blocks for marine organisms' shells and skeletons.[52, 53]

Coastal and marine habitats provide fish, invertebrates, and marine mammals with food and shelter.[54] Nearshore beach, dune, and coastal wetland habitats are critically important as spawning, nursery, and feeding areas and have been extensively altered or lost throughout the region. Habitat conservation is vital for the species that depend on these environments – fish and humans alike. Loss of habitat results in fewer places for fish and other wildlife to live, less filtration to improve water quality, and less protection during strong storms. Pollution, sea level rise, increased nutrient levels, and other contaminants (e.g., from agriculture, erosion, and pharmaceuticals) affect the health of rivers, bays, and oceans.[55] In turn, the health of these water bodies affects the health and abundance of the species that live in them.

Within the Mid-Atlantic, a significant number of marine species have moved poleward and/or to deeper water.[56,57] These changes have often been connected to increasing water temperatures, but in some cases, (e.g., summer flounder) have also been linked to changes in the age and size composition of the stock. There is evidence that some commercially important shellfish species (e.g., surf clams) have shifted farther offshore into deeper (cooler) waters as bottom temperature has increased. These changes in distribution make fishing more uncertain and complicate fishery management, including the allocation of fish quotas among states.

Facilitating enhanced understanding of current and anticipated ocean ecosystem changes in the Mid-Atlantic is necessary to plan for future uses in ways that are compatible and accommodating. These include risks and vulnerabilities associated with ocean warming (including sea level rise, coastal flooding/inundation), ocean acidification (including effects on living marine resources), and changes in ocean wildlife migration and habitat use.

Figure 9. Annapolis, Maryland, pictured here in 2012, saw the greatest increase in nuisance flooding, according to a recent NOAA study. (Credit: NOAA, with permission from Amy McGovern.)

[51] NOAA Ocean Acidification Overview
[52] NOAA Climate Change, Carbon, and Cold-water Corals
[53] NOAA What is Ocean Acidification
[54] NOAA Habitat Key Fact Sheet
[55] United Nations Environment Programme Clearing the Waters: A focus on Water Quality Solutions Report 2010
[56] NOAA: North Atlantic Fish Populations Shifting as Ocean Temperatures Warm
[57] Nye J.A. et al., 2009

Collaboration Opportunities

- Coordinate the collection of data and information and improve understanding needed to adjust human activities in response to changing migratory pathways of marine life (e.g., right whales).
- Coordinate information sharing regarding sea level rise and ocean acidification to guide management of living marine resources, improve the resilience of coastal communities, and inform ocean-dependent industries.
- Develop the means to track surface and sub-surface ocean temperatures across the Mid-Atlantic Ocean to better understand species migrations and distribution, coastal storm development, and other impacts.
- Integrate assessments of climate change impacts to commercially and recreationally important species.

2.3 Valuing Traditional Knowledge

Figure 10. Embarking on a traditional Canoe Journey. Credit: Shinnecock Indian Nation

The MidA RPB recognizes that the ocean is not merely a collection of physical and biological resources to be managed for safe and productive human uses. The Mid-Atlantic Ocean and coastal waters have provided sustenance, spirituality, and solace for generations of human inhabitants, and continue to offer immensely valuable attributes to millions of Mid-Atlantic residents and visitors. From the first Native Americans to the coastal residents of today to the generations seventh hence, our connection to the ocean is deeper than the sand, water, wind, and waves that can be experienced with our five senses. The connection ties together our cultures, our stories, and our consciousness. The MidA RPB acknowledges the importance of these traditional values, including the sovereignty of American Indian Tribes to exercise their hunting and fishing rights. [58] The MidA RPB will strive to improve our understanding and use of traditional knowledge, along with other cultural resources and values, and incorporate such knowledge and values in the ocean planning process.

Collaboration Opportunities

- Include traditional ecological knowledge and consideration of local cultural values in regional ocean planning.
- Develop and use non-market valuations for non-consumptive uses of the ocean inclusive of intrinsic value.

[58] See for example: Native American Rights Overview - Hunting And Fishing

3. SUSTAINABLE USES IN THE MID-ATLANTIC

The MidA RPB has recognized that the region needs to plan and provide for existing and emerging ocean uses in a sustainable manner that minimizes conflicts, improves effectiveness, regulatory predictability, and supports economic growth. It has identified nine specific objectives. Information about each is discussed briefly below. At the end of each section is a list of examples on how that objective may intersect with other MidA RPB topics. The lists are meant to illustrate some of the complexities of management issues in the Mid-Atlantic. They are not comprehensive and are not intended to be prescriptive.

3.1 National Security

The Department of Defense (DoD) and Department of Homeland Security carry out a variety of activities in Navy at-sea training ranges to be able to protect and defend the United States against its adversaries, to protect and defend the rights of the United States and its allies to move freely on the oceans, and to provide humanitarian assistance when called upon. Issues such as location, encroachment, and the continuity of operations of the DoD Operating Areas are critical considerations throughout the ocean planning process.

The Mid-Atlantic hosts the world's largest naval base (Norfolk, VA), as well as numerous other military installations and training grounds. The Hampton Roads area of Virginia is home to one of the largest concentration of military bases and facilities of any metropolitan area in the world. Overall, DoD activities in at-sea training ranges have remained steady over the past 10 years despite ongoing and emerging challenges and competing interests. [59] Conflicting and competing uses, highlighted below, can limit fleet tactical maneuverability and training quality.

Key Issues and Intersections

- The placement of offshore conventional and renewable energy development projects could affect Navy training, testing and preparedness.
- Increasing maritime commercial traffic, as well as an increase in large, deep draft (Post-Panamax) shipping may affect maneuverability at sea.
- The potential impact of offshore structures on the electro-magnetic spectrum

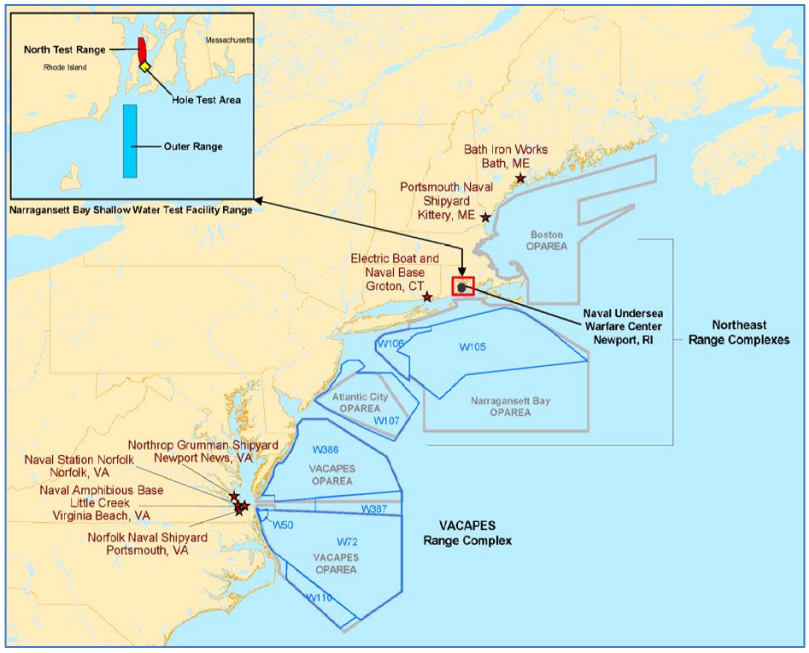

Figure 11. Figure 11. Testing and Training Areas in the Mid-Atlantic Region. Source: U.S. Navy

[59] Secretary of Defense Report to Congress on Sustainable Ranges 2012

must also be considered. Electro-magnetic interference from some structures effect both military and commercial radar and radio frequencies. Electro-magnetic interference increases navigation and national security risks.[60]

- At-sea Navy range complexes may be encroached on by seemingly innocuous ocean observing systems' data collections, thus putting the Navy and national security interests at risk. [59 above]

3.2 Ocean Energy

Renewable and conventional energy production on the Mid-Atlantic Ocean offers the opportunity to: support economic growth and job creation, enhance energy security through energy independence, and support a diversified energy supply. Renewable energy projects are typically close to shore while oil and gas activities on the Mid-Atlantic would be offshore. This would reduce the potential for conflict between the two operations.

Figure 12. Wind Turbine. Source: BOEM

Renewable Energy

Ocean renewables could play a significant role diversifying our nation's energy portfolio. There is the potential to harness energy from offshore wind, waves, tides and currents, although only commercial-scale facilities powered by wind are anticipated in the foreseeable future. Offshore winds tend to blow harder and more uniformly than on land making offshore wind turbines appealing. The gross wind power resource off the coast from New York to Virginia is estimated to be over 400 gigawatts (GWs), which is over 1/4 the generating capacity of the entire current U.S. electric grid.[61,62]

While the United States does not have any operational offshore projects, there are multiple projects in the planning and leasing stages.[63, 64] Currently, within the Mid-Atlantic, areas off the shores of Delaware, Maryland, and Virginia have been leased for commercial development of wind energy. Areas offshore New Jersey, New York,

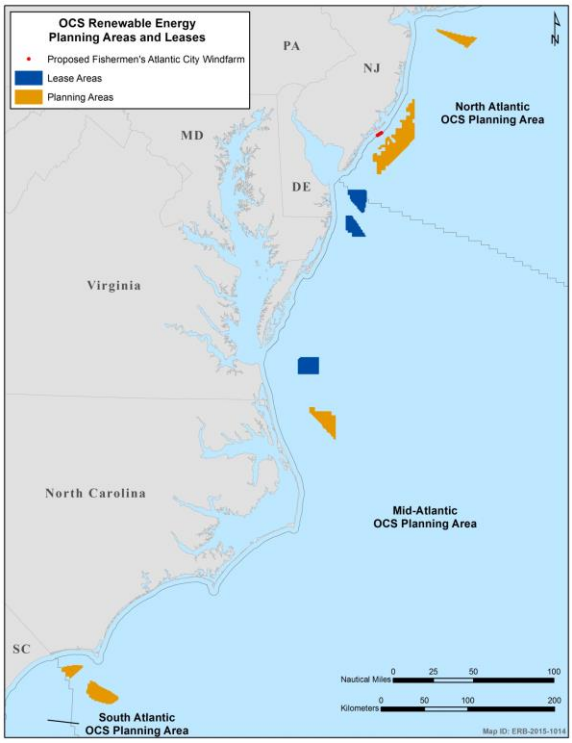

Figure 13. Outer Continental Shelf Renewable Energy Planning Areas and Leases. Source: BOEM

[60] Secretary of Defense Report, 2014
[61] Lopez, A. et al., 2012
[62] U.S. Energy Information Administration 2013
[63] BOEM Renewable Energy
[64] BOEM State Activities

and North Carolina are also being considered for leasing, while a proposed demonstration project offshore Virginia is being reviewed.[65] A single offshore wind energy facility could consist of 100 or more turbines. Smaller wind projects may be seen in state waters, such as the five 5-megawatt wind turbine facility which was approved last year, to be sited approximately three miles off the coast of Atlantic City, New Jersey. The maximum height of structures offshore the United States, at the very tips of the blades, can be upwards of 500 feet (150 m).[66]

Conventional Energy

There are is an increased interest in oil and gas leasing in some parts of the Mid-Atlantic. This could expand domestic production as a means to support economic growth and to enhance energy security.

Eight companies have active requests for nine Geological and Geophysical permits on the Atlantic Outer Continental Shelf.[67] If approved, the permits would allow the collection of information about the geology under the ocean floor to better inform decisions on future oil and gas activities, including the identification of oil and gas resources.

While there are no existing oil and gas leases in the Atlantic, a Draft Proposed Program, the second stage of a five-stage process, was published on January 19, 2015 that proposed an oil and gas lease sale in 2021.[68] The proposed lease area would be located at least 50 miles offshore the coasts of Virginia, North Carolina, South Carolina, and Georgia.[69] However, this proposed area could still be removed or reduced either before the 5-year Program is finalized in 2017 or later during the lease sale process. If a lease sale were to be held and leases issued, lessees would then begin the process for exploration for oil and gas accumulations by conducting additional seismic surveys and drilling exploration wells. If a lessee discovers a resource in quantities appearing to be economically favorable, one or more follow-up delineation wells may be drilled to help define the amount of resource or the extent of the reservoir. If hydrocarbons are discovered and successfully delineated, a production facility may be installed at the site. The number of wells per structure varies according to the type of production facility used, the prospect site, and the drilling and production strategy deployed. Oil and gas are brought to market via a system of pipelines and processing facilities or through production into a floating system.

Figure 14: Seismic vessel acquiring 3D data. Source BOEM

[65] BOEM Lease and Grant Information
[66] Navigant Consulting, Inc. 2014. Offshore Wind Market and Economic Analysis
[67] BOEM Atlantic Geological and Geophysical Permitting
[68] BOEM Five-Year Outer Continental Shelf Oil and Gas Leasing Program
[69] BOEM Programmatic Environmental Impact Statement

Key Issues and Intersections

- A primary concern in the Mid-Atlantic region is multiple use conflicts between wind energy projects and marine transportation, fishing, and military activities. Environmental considerations are also a key component in siting and assessing renewable energy activities.
- There is a potential for impacts to marine mammals, birds, or sea turtles and other species from vessel or turbine strikes, disturbance of nesting areas, alteration of key habitat, or low-probability large spills of fuel or lubricating oil or dielectric fluids.
- There are concerns about the visual impacts of wind facilities. Siting facilities farther offshore and/or away from important scenic resources could mitigate potential visual impacts.
- Similar to wind energy facilities, there is concern over conflicts between oil and gas activities and military operations, training and testing, and impacts to marine life due to noise from surveys and pile driving, increased vessel traffic, and the presence of structures.
- There is concern over potential oil spills that could threaten environmental and socioeconomic resources along the coast and offshore. Because oil and gas structures in the Mid-Atlantic would be located 50 or more miles from shore, visual impacts are not as much of a concern as those for wind energy facilities.

3.3 Commercial and Recreational Fishing

Fishing is managed by each state in waters out to 3 nautical miles. The Atlantic States Marine Fisheries Commission coordinates regulations among the states and with the Federal government for species that are primarily caught within state waters.[70] From 3 to 200 miles, fishing is regulated by NOAA's National Marine Fisheries Service, based on recommendations from the Mid-Atlantic Fishery Management Council. The Council's recommendations have been particularly successful in rebuilding the fish stocks under its purview. The Mid-Atlantic is the only region in the country that

Commercial Fishing in the Mid-Atlantic

- In 2012, commercial fishermen in the Mid-Atlantic region landed 751 million pounds of finfish and shellfish, earning $488 million in landings revenue.
- Landings revenue was dominated by sea scallop ($169 million) and blue crab ($100 million).
- More menhaden is landed than any other species. On average, 439 million pounds of menhaden were landed each year from 2003 to 2012. Menhaden has averaged 7 cents per pound over the last ten years.
- $188 million of seafood was landed in New Jersey in 2012. $176 million was landed in Virginia. $78 Million was landed in Maryland.
- Overall, in 2012 the Mid-Atlantic region's seafood industry generated 137,477 jobs, $18 billion in sales, $4 billion in income, and $6.5 billion in value added impacts across all five

Figure 15. NOAA Fisheries Economics of the U.S. 2012 Report

[70] Atlantic States Marine Fisheries Commission Overview

has no stocks that are considered overfished or upon which overfishing is taking place.[71, 72]

Commercial fishing is an important industry in the Mid-Atlantic. Fish landed in the region were worth almost $500 million in 2012 (the most recent year for which data are available), when 751 million pounds of seafood were landed commercially. Virginia earned the most from finfish landings ($62 million), followed by New Jersey ($29 million), and New York ($24 million). Shellfish landings revenue was dominated by New Jersey ($159 million), followed by Virginia ($114 million), and Maryland ($63 million).[73]

Commercial fishing is a way of life for many who pursue it, not just a way of making a living. Fishing techniques have evolved, but much knowledge gets passed down from one generation to the next.

Figure 17. Overall, total recreational fishing trip and durable equipment expenditures across the Mid-Atlantic Region in 2012 were $3.5 billion. Source: NOAA Fisheries Economics of the United States 2012

Recreational fishing is a treasured pastime and a significant economic driver in the Mid-Atlantic region. In 2012, over 2.3 million anglers took 14 million fishing trips in the Mid-Atlantic region. This supports an estimated 31,000 jobs (including bait and tackle shops, boat dealers, for hire vessels, etc.). Private or rental boat and shore-based fishing trips accounted for 7.7 million and 5.8 million fishing trips, respectively, in 2012. Together these made up 93% of the fishing trips taken in that year. Summer flounder was the most commonly caught species, averaging 20 million fish per year from 2003 to 2012. Of these, 88% were released rather than harvested.[73]

Saltwater fishing offers residents and visitors to the Mid-Atlantic coast an opportunity for close contact with the ocean and the complex web of life it supports. These experiences can foster an appreciation for conservation of sea life and the need for programs to maintain and protect fisheries and the habitat that supports them. Recreational fishing is an activity that can build strong family bonds and provides an avenue for cultural learning and an important food source for families.

Figure 16. Mackerel. Credit: Mid-Atlantic Fishery Management Council

[71] NOAA 15th Annual Report to Congress on the Status of U.S. Fisheries 2011
[72] Mid-Atlantic Fishery Management Council Status of the Stocks
[73] NOAA Fisheries Economics of The U.S. 2012 Report – Mid Atlantic

Key Issues and Intersections

- Fishermen are concerned that wind farm development might exclude them from key fishing grounds or might modify the habitat of target species.
- Some fish species appear to be shifting their population centers farther north. This trend could disadvantage fleets farther south and the shore-based facilities that maintain them.
- Fishing gear is known to entangle marine mammals and endangered species.
- As the fishing industry shrinks, shore-based infrastructure such as ice suppliers, boat yards and seafood dealers are becoming rarer. Without this infrastructure, ports may completely lose their fishing fleets.
- Working waterfronts are being diminished by the development of marinas for recreational vessels and other non-fishing uses.
- Fishermen are concerned that the sounds used for seismic surveys may harm fish or cause them to move from their usual grounds.
- Undersea cables are sometimes snagged in trawl or dredge gear, and the laying of undersea cables may disrupt fish habitat or harm deep water corals species.
- Sand and gravel mining could affect essential fish habitat, thereby diminishing the productivity of fish populations.[74]

3.4 Ocean Aquaculture

Most consider aquaculture a relatively new addition to the Mid-Atlantic. In fact, it has a long history in the region. In the 1860s salmonid culture methodology was perfected in upstate New York. Virginia has leased shellfish beds since the 1800s. Aquaculture in its various guises plays a major role in the region's history and today plays an increasingly important role in maintaining the economic viability of many rural communities.

Figure 18. Oyster Spat. Photo credit: VA Dept. of Environmental Quality

Aquaculture in the Mid-Atlantic is primarily shellfish (oysters and clams). There is some culture of finfish; black sea bass are being cultured in Virginia on land, for example. Aquaculture is predominantly occurring nearshore in bays and estuaries. There is no aquaculture being conducted in Federal waters at this time, but there is interest in offshore culture in conjunction with an energy project off of Southern New Jersey.

[74] Comprehensive Wildlife Conservation Strategy for New York, Atlantic Basin Conservation Recommendations.

Aquaculture is the third most valuable fishery in the northeast region, behind only scallops and lobster. [75] In some areas of the Mid-Atlantic area, aquaculture is a major employer. For example, in 2013, the industry was worth $45 million and employed an estimated 170+ people in Virginia.[76]

The industry is established in every state in the region, with the exception of Delaware, which has just passed legislation allowing in-water culture of shellfish in their inland bays.[77] There is a growing industry on the Mid-Atlantic with growth in both the bay and sea sides. Shellfish in Maryland has grown from essentially nothing to having more than 4,000 acres under lease in the past five years. The industry is also growing in other states in the Mid-Atlantic region. New Jersey has a long tradition of shellfish culture both in Delaware Bay and the ocean side bays.[78] Long Island, NY, has a burgeoning shellfish industry, a county leasing program for shellfish in Peconic Bay, and one in-water finfish operation growing striped bass.[79]

Key Issues and Intersections

- Aquaculture equipment is another user in already crowded waterways.
- Shellfish aquaculture can have an added benefit of filtering algae from the water, thereby increasing water clarity.
- Aquaculture is a growing part of the region's seafood supply, providing jobs, seafood and helping keep working waterfronts viable.

Top 10 U.S. East Coast Container Ports

1. ***New York/New Jersey***
2. Savannah
3. ***Port of Virginia***
4. Charleston
5. Port Everglades
6. Jacksonville
7. Miami
8. ***Baltimore***
9. ***Philadelphia***
10. Palm Beach

Mid-Atlantic Port Distinctions

Port of New York and New Jersey:
- Largest port on the East Coast and third largest in the U.S.
- Supports over 296,000 jobs with $18.3 billion in wages.

Port of Philadelphia:
- Five consecutive years of double digit cargo growth.
- Supports 130,000 jobs with $7.8 billion in wages.

Port of Wilmington:
- Ranked #1 for the import of fresh fruit, bananas, and juice.
- Largest dock side cold storage facility.

Port of Baltimore:
- A leader in auto exports (public terminals); fourth year for record export cars.
- Handles more than 30 million tons of cargo annually and generates over 50,000 jobs.

Port of Virginia:
- Second largest port on the East Coast and largest ship building and repair complex.
- 1 in 10 jobs and over $41 billion in business revenue is connected to the port.

Figure 19. Sources: NY/NJ Port's Regional Economic Benefits; Philadelphia Regional Port Authority; American Association of Port Authorities; Port of Wilmington; Maryland Port Authority; Virginia Maritime Association.

3.5 Maritime Commerce and Transportation

The Marine Transportation System (MTS) is one of the most prominent, visible, and important human uses of our ocean and coastal waters, providing jobs and economic security. The Mid-Atlantic region hosts

[75] NOAA Greater Atlantic Regional Fisheries Office Strategic Plan FY 2015-2019
[76] William & Mary: Value of Virginia Aquaculture Reaches All Time High 2014
[77] Delaware's Secretary's Order No.: 2014-F-0013
[78] New Jersey Fishing and Aquaculture: Harvesting the Garden State's Waters
[79] Gillibrand Announces New Legislation 2013

some of the nation's busiest ports, including New York/New Jersey, Philadelphia, Wilmington, Baltimore, and Norfolk. [80] These ports are crucial links in the Nation's MTS and constitute a key element of the U.S. economy. Maritime commerce employs many thousands of people. As such, ports are powerful drivers of regional economic growth, creating jobs not only at the ports, but also in the cities and states beyond the port boundaries.[7 above]

The U.S. seaport network unloads $3.8 billion in goods each day and the Mid-Atlantic ports are a huge contributor, maintaining several national distinctions. Products that go through Baltimore's ports reach over a third of the country within a day and can handle all types of cargo that enter the U.S. on wheels (from cars to giant tractors), making it the Nation's top roll on-roll off (Ro-Ro) port. Philadelphia is the nation's fourth busiest tanker port. In 2011, almost one million people vacationed on ocean cruises that originated in New York and Baltimore.[81]

The world's largest natural deep water harbor is located in Hampton Roads, VA, which also stays ice-free throughout the year. This makes it suitable for a conglomeration of military facilities, coal piers, shipyards, plus miles of waterfront property and beaches, adding to the diversity and stability of our Nation.

Significant changes are coming soon for the Mid-Atlantic ports. The Panama Canal is about to open a third, much larger lane for ship traffic (Figure 20). Expected to open in 2016, the new lane will double the waterway's capacity. The existing locks allow the passage of vessels that can carry up to 5,000 twenty-foot equivalent units (TEUs). Once the project is complete, Post-Panamax vessels will be able to transit through the Canal carrying up to 13,000 TEUs.

The use of the much larger Post-Panamax ships will increase the volume of containers that must be moved at each port call and may require ports to deepen harbors and/or raise bridges to provide access to the Post-Panamax vessels. This will likely lead to fewer and more concentrated ship calls at larger ports for any given service, especially for ports in the U.S. East Coast and in the Gulf of Mexico. Fewer calls by larger ships would lead to higher peak loads and tend to favor ports that have greater capacity in container handling, storage, and movement to inland destinations. [7 above]

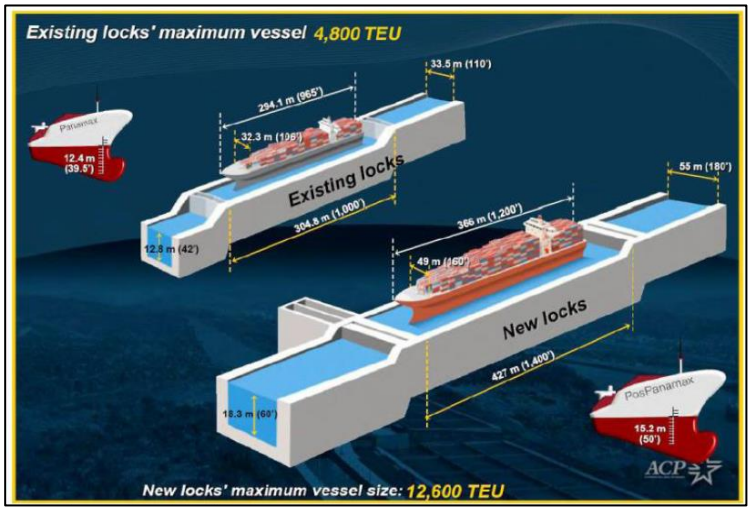

Figure 20. Illustration of Post-Panamax Locks Project. Source: Panama Canal Authority 2011.

[80] U.S. Department of Commerce, Bureau of Census, Virginia Maritime Association, American Association of Port Authorities, Virginia Port Authority

[81] Mid Atlantic Regional Council on the Ocean (MARCO) Data Portal

Baltimore, New York/New Jersey, and Virginia have or will soon have channels dredged to 50 feet (15 m).[82] Other, competing East Coast ports are preparing for dredging to channel depths of 45 feet (~14 m) or more, which are depths that can accommodate many of the Post-Panamax ships. Port capacity constraints and more concentrated port calls could lead to greater use of the Marine Highway routes to move containers via water between larger and smaller U.S. ports.[7 above]

Another trend emerging in maritime commerce is the development of offshore Liquefied Natural Gas (LNG) terminals. Over the last several years, domestic natural gas production has increased significantly. Production has outpaced consumption, resulting in declining imports of natural gas. Today, domestic natural gas prices are lower than international prices of delivered LNG to overseas markets. The Department of Energy (DOE) has received a growing number of applications to export domestically produced natural gas to overseas markets in the form of LNG.[83]

Key Issues and Intersections

- The Panama Canal expansion could have multiple impacts: produce an increase in ship traffic through the transit of substantially larger ships, dredge disposal, offshore wind, offshore oil and gas, and military/DoD activities.
- Larger (Post-Panamax) vessels, increased Canal traffic, and doubled annual throughput capacity will affect the size of vessels and requiring changes in infrastructure (such as dredging and raising bridges) to handle larger vessels and to move cargo to inland markets. For example, these changes may affect shipping patterns and the routing, e.g., resulting in a different cargo and traffic transport mix on the Eastern seaboard. In addition, barge traffic may increase as a cost effective means to transport goods to ports that cannot handle Post-Panamax vessels.
- LNG fueling stations could complicate traffic patterns, although the need and the potential for deep water ports for loading exports of petroleum or LNG remains uncertain at this time.
- The development of offshore wind farms, the exploration for oil and gas deposits, and the potential construction of offshore drilling platforms could affect vessel traffic patterns and impact maritime safety and navigation.
- Climate change could impact port facilities and infrastructure through rising sea levels, increased storms, and potential coastal flooding.

[82] U.S. Army Corps of Engineers 2012. U.S. Port and Inland Waterways Modernization: Preparing for Post-Panamax Vessels Report

[83] Department of Energy's Role in Liquefied Natural Gas Export Applications

3.6 Offshore Sand Management

Barrier islands are valuable natural resources that provide recreational areas, sensitive coastal habitats and ecosystems, protect the marshes and coastal estuaries during storms, and are home to energy, defense, and public infrastructure.[84] Such islands characterize most of the Mid-Atlantic Coast. Some barrier islands have become densely developed, especially in New Jersey.[85] In Virginia, however, all of the 80 mile string of barrier islands south of Wallops Island is undeveloped and in conservation ownership.

Figure 21. Aerial image of the 80 mile string of barrier islands south of Wallops Island, VA.

Erosion of barrier island beaches can affect local, state, regional, and national interests. Preservation and enhancement of barrier island beaches protects these interests and is the major impetus for beach nourishment. Frequently, the source of sand for beach nourishment is the nearby offshore sand from the ocean bottom.

Near shore sand ridges are often targeted as "borrow sites" for sand to be dredged and placed on beaches. However, these underwater ridges may provide essential habitat for fish or other marine life[86], [87] and are themselves useful in dissipating the energy of storm waves that can cause destruction of the beaches.[84 above] Dredging submerged sand resources to place on beaches can generate noise and suspend sediment in the water column, which can affect the behavior of marine mammals, fish, and other marine life.[88] There is also the potential to disturb submerged cultural resources such as shipwrecks.[89]

Figure 22. Coastal town of Mantoloking, NJ before and after Hurricane Sandy. Credit: **BOEM**

[84] U.S. Fish & Wildlife Service Coastal Barrier Resources Act
[85] New Jersey Department of Environmental Protection 1982
[86] Vasslides J.M. and K.W. Able, 2008.
[87] Auster, P.J. 1998.
[88] NOAA Technical Memorandum NMFS-NE-209. Impacts to Marine Fisheries Habitat from Nonfishing Activities in the U.S. NE
[89] Bureau of Safety and Environmental Enforcement Archaeological Cultural Resources Program

Offshore sand provides material for storm damage reduction projects designed to protect coastal areas from future storms and rising sea levels. In the wake of Hurricane Sandy, there has been great interest in identifying additional sources of sand for coastal restoration projects.

Key Issues and Intersections

- Restoration of barrier island beaches will become increasingly challenging if development expands and as sea level continues to rise.
- Removal of sand from offshore sand ridges may affect important habitats for fish and fisheries and can decrease the benefits of offshore sand ridges in reducing the energy of waves during storms.
- Sand replenishment is critical to maintain beach access and the tourism and recreation that depend on the beaches.
- There may be opportunities for beneficial reuse of materials dredged to maintain safe navigation throughout the region.

3.7. Non-Consumptive Recreation

Non-consumptive recreation refers to activities through which one person's enjoyment does not preclude others from enjoying the same resource. Popular coastal non-consumptive activities include beach going, sightseeing, biking and hiking, photography, surfing, scuba diving and beachcombing. Coastal tourism and recreational economies are dependent on the natural setting and resources, on public perception of the area and, ultimately, on the value people place on the use of these resources.

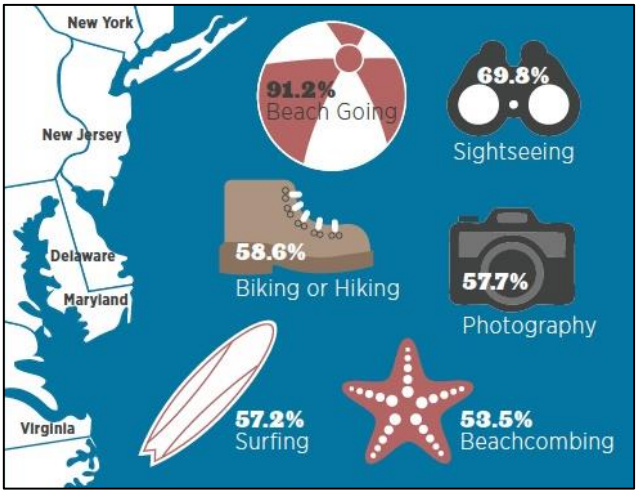

Figure 23. Most popular activities in the Mid-Atlantic region. Source: MARCO, Mid Atlantic Coastal and Recreation Study, 2014

In 2011, the Mid-Atlantic coastal counties' tourism and recreation sector supported more than half a million jobs and produced $27.5 billion in GDP.[90] This sector's employment increased by more than 36,000 jobs between 2009 and 2011, and is projected to grow with a strengthening economy.

It is difficult for economic analyses of non-consumptive recreation to account for another key benefit of the activity-the cultural and social values that people hold for coastal areas. One of the reasons tourists are drawn to coastal communities is the sense of well-being achieved when listening to waves or watching a beautiful sunrise. For example, some Tribes have indicated that

[90] NOAA Economics: National Ocean Watch (ENOW) explorer: Mid-Atlantic Region 2014

their cultural practices require an unobstructed view of the eastern sun rising. Gaining an understanding of "place-based" values, (i.e., what does the existence of a coastal area mean to people from a social or cultural perspective) is an important issue in ocean use planning.

Key Issues and Intersections

- Given the nature of the less monitored public recreational activities, additional data are needed to better understand potential conflicts between non-consumptive recreation and other uses (e.g., offshore energy, transportation, etc.).
- Participants in non-consumptive resource activities are concerned with how multiple ocean uses will impact their ability to enjoy the marine environment. Examples of concerns include potential environmental degradation and reduced access to the resources.
- Recreationalists are concerned about aesthetic changes caused by other ocean uses (e.g., increased vessel traffic, a view of a wind energy facility or an offshore oil rig on horizon).

3.8 Tribal Uses

Since time immemorial, the Mid-Atlantic Ocean has sustained the Indigenous Peoples of the region. The Ocean is a sacred being for which the region's Tribal Nations are the ancestral stewards. Today, tribal and non-tribal communities are working together to assure the health and vitality of this rich environment and to conserve resources for future generations.

Figure 24. Whales that beach onshore have great spiritual, ceremonial and material value. Credit: Shinnecock Indian Nation

Each Mid-Atlantic Tribe is unique in terms of its cultural, economic, geographic, jurisdictional, social, and political identity. Currently, there are 27 state or federally recognized Tribal Nations in the Mid-Atlantic.[91] Tribes in the region have always relied on the ocean since time immemorial, and marine resources are integral to the survival of Indigenous Peoples.

[91] This does not include those state or federally recognized Tribes with historical ties to the region. It also does not account for those indigenous communities in the Mid-Atlantic who are not recognized by state or federal governments.

The MidA RPB recognizes and respects the right of Tribal Nations to free, prior, and informed consent, while taking into account important Tribal uses and submerged cultural resources in the planning process. Tribal Nations with current and historical ties to the Mid-Atlantic region work in collaboration with the Federal government to ensure that industries developing resources in the Mid-Atlantic do not inadvertently disturb Tribal ceremonial sites and burial grounds that may be submerged under the waters of the Atlantic. The ocean floor should be examined for ancient archaeological sites prior to moving forward with development projects. Ocean survey processes for identifying submerged sites should be standardized and carried out in collaboration with Tribes. Techniques should be refined to ensure the least destructive means is used to identify cultural places of significance rather than conventional excavation practices.

Mid-Atlantic Tribes have inherent sovereign rights to marine subsistence, ceremonial, and customary uses in the Atlantic. Historically, whales provided Mid-Atlantic Tribal people, such as the Shinnecocks, with food, raw materials, a source of spiritual and ceremonial strength, and valuable trade goods. Whales that beach on shore have great spiritual value. Every whale life given by hunt or drift is ceremonially thanked and blessed, then processed for food and raw materials, like bone. Today, many Mid-Atlantic Tribes face challenges in offering ceremonial blessings and caring for whales beached near their territories – an issue that requires greater interjurisdictional coordination.

Another aspect of tribal ceremonial and customary use in the region includes traditional navigation and trade routes for ocean travel by dugout canoe. Today, many Tribes in the region participate in a practice known as the "Canoe Journey" whereby knowledge of these traditional navigation routes may be maintained and transferred to future generations, while fostering relations among neighboring coastal Tribes in the region. Along the canoe journey route tribal ceremonies are held and blessings offered for the bounty and protection of the sea. This is an opportunity for learning and healing for indigenous people across the region.

Mid-Atlantic Tribes' Traditional Ecological Knowledge (TEK), knowledge built over generations, can help the Mid-Atlantic region adapt to climate change. Today's tribal members who work as fishermen have thousands of years of ocean stewardship tools that can assist regional ocean planning in the Mid-Atlantic. Tribal fishermen include

Federally Recognized Tribes

New York

- Cayuga Nation of New York
- Oneida Nation of New York
- Onondaga Nation of New York
- Saint Regis Mohawk Tribe
- Seneca Nation of New York
- Shinnecock Indian Nation
- Tonawanda Band of Seneca Indians of New York
- Tuscarora Nation of New York

State Recognized Tribes

Delaware

- Lenape Indian Tribe of Delaware
- Nanticoke Indian Association, Inc.

Maryland

- Piscataway Indian Nation
- Piscataway Conoy Tribe

New Jersey

- Nanticoke Lenni-Lenape Tribal Nation
- Powhatan Renape Nation
- Ramapough Lenape Nation

New York

- Unkechaug Nation

Virginia

- Cheroenhaka (Nottoway)
- Chickahominy Tribe
- Eastern Chickahominy Tribe
- Mattaponi
- Monacan Nation
- Nansemond
- Nottoway of Virginia
- Pamunkey
- Pattawomeck
- Rappahannock
- Upper Mattaponi Tribe

Figure 25. List of Tribes in the Mid-Atlantic Region.[91] Source: Shinnecock Indian Nation

subsistence as well as commercial fishers. Tribes in the region have developed Fisheries Management Plans in collaboration with state and Federal entities for co-management of resources and commercial industry regulation.

Tribes throughout the region continue to harvest shellfish in tribal waters. Some tribes have shellfish hatcheries where increased ocean acidification poses a threat to the ability of shellfish to produce a hard shell, which is vital to its survival and the viability of tribal harvesting practices. Potential impacts of climate change on shellfish-resources on which several Mid-Atlantic coastal tribes depend remains unclear; however, what is clear is the need to conserve and protect such critical cultural resources for the survival of Tribes. Additionally, Tribes in the region face substantial shoreline erosion as a result of climate change and increased severe storm activity. In response to a changing climate, Mid-Atlantic Tribes are partnering with other regional entities to assess potential coastal flooding vulnerabilities and coastal engineering adaptations for consideration in planning for future sea level rise and storm events affecting their territories.

Mid-Atlantic Tribes are seeking to promote energy independence among their Nations, creating diverse economic portfolios that include off-shore energy options, such as wind and hydrokinetic projects. Generally, Tribes are concerned with how ocean uses of shared resources will impact their ability to maintain tribal marine uses for subsistence, cultural, and ceremonial purposes.

Key Issues and Intersections

- Ensure that ocean related industries do not inadvertently disturb Tribal ceremonial sites and burial grounds that may be submerged under the waters of the Atlantic.
- Maintain inherent sovereign rights, TEK, marine subsistence, ceremonial, and customary uses in the Atlantic.
- Preserve historic navigational and trade routes for ocean travel by dugout canoe, such as the "Canoe Journey" practice in place today.
- Continue to collaborate with and educate commercial and recreational fishermen and natural resource agencies on sustainable fisheries and climate change observations, in order to enhance sustainable ocean uses and prevent destructive consequences from human related activities, such as climate change or coastal engineering.
- Increase tribal independence through alternative energy and sustainable economic portfolios through nation to nation consultations and collaborative partnerships with industry, Federal and state entities.

3.9 Undersea Infrastructure

Undersea infrastructure refers to equipment and technology placed on the ocean floor.[92] Currently, the primary concern is the placement and protection of communication cables, which facilitate global communications, national defense and economic transactions .[93, 94] It is difficult to know the full extent of these cables undersea, as the location of many is confidential. Other existing infrastructure includes stationary equipment for marine research (e.g., acoustic Doppler current profilers and passive acoustic monitoring networks).

A future concern is undersea infrastructure to provide support to energy production, such as renewable energy electricity transmission cables and offshore oil and gas platforms and pipelines. In addition to meeting the demands for energy and expanding the global communications network, construction of subsea infrastructure provides for industry growth and jobs.

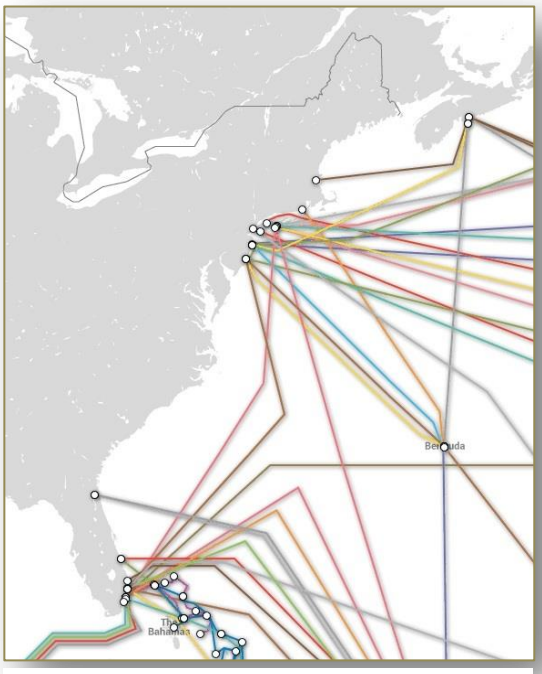

Figure 26. Global long-haul undersea cable networks originating on the U.S. Atlantic coast. Source: TeleGeography Submarine Cable Map 2015

Key Issues and Intersections

- Disturbance of benthic habitat and cultural resources from the placement of future undersea infrastructure.
- Interference with, or relocation of, commercial fishing activities due to new undersea infrastructure.
- Conflicts with existing undersea infrastructure, such as subsea cables as new energy development proceeds.
- Interference of species migration due to electromagnetic fields from electricity transmission cables.[95, 96]

[92] NOAA Submarine Cables Overview
[93] Fredickson, B. & Creese, C., 2007
[94] Sechrist, M. et al., 2012
[95] International Association of Geophysical Contractors Environmental Impact Statement
[96] BOEM OCS Study BOEMRE 2011-09

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