Memorandum to: Mid-Atlantic Regional Planning Body (MidA RPB)

From: Sarah Cooksey (Delaware) and Kevin Chu (NOAA)
Co-Chairs, Regional Ocean Assessment Work Group

Date: January 12, 2015

Subject: Decisions Requested re: Mid-Atlantic Regional Ocean Assessment

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The Mid-Atlantic Regional Ocean Assessment (ROA) is an ongoing effort to compile the best available information to support development of the Mid-Atlantic Regional Planning Body's (RPB) Ocean Action Plan (OAP). Building upon the goals and objectives in the Mid-Atlantic Regional Ocean Planning Framework, the ROA will provide information about the baseline conditions, resources, and uses of the ocean. The ROA is not envisioned as an encyclopedia of information about the region. Rather, it will provide brief summaries of specific topics of interest, focusing on information that Federal, State and Tribal governments should be aware of when collaborating on ocean management.

Outline

The proposed outline has been modified based on comments received from the RPB and during public listening sessions. This version includes more topics than the one reviewed in November.

The ROA Work Group (WG) seeks RPB approval to use this draft outline as the basis for further development of the ROA. **The adoption of this outline at this stage of drafting does not mean that the outline cannot be modified in the future**. As topics are identified for which the RPB needs information, the outline can be modified and information on new topics compiled and included.

Decisions for the RPB:

1. Is the revised version of the outline sufficient to continue drafting other sections of the ROA?
2. Which topics would the RPB would like to see prioritized for development during the spring of 2015?

Example Sections

To illustrate the information we envision including in the ROA, the WG is providing three example sections on Deep Sea Corals, Renewable Energy, and Panama Canal Expansion. Each example section follows a standardized format to address the complex and varied needs of the RPB in a concise and user-friendly way. These topics have been drafted by

Federal leads and reviewed by the WG, including Federal, State, and Tribal members. Nevertheless, we do not consider the content of these example sections to be complete because there has not yet been formal public, scientific or technical expert review of the contents. The WG recommends seeking input from the scientific community once additional ROA sections have been drafted.

Decisions for the RPB:

Format and Content

3. Is the level of information appropriate? (too detailed? not detailed enough?)
4. Is the scope of the information on each topic sufficient to inform the development of the OAP?

ROA Outline

Major Sections (Goals/Objectives)	Sections	Topics	Sub-Headings/ Content
SECTION I **Goal- Healthy Ocean Ecosystem: Promote ocean ecosystem health, functionality, and integrity through conservation, protection, enhancement, and restoration.**			
I.1 Biology & Ecology	**Introduction**		
	Habitats		
		Benthic (sea floor)	*Biogenic Habitats*
			Hard Bottom
			Soft Bottom
		Pelagic (water column)	*Coastal Bays*
			Continental Shelf
			Deep Water
	Flora		
		Marine Algae	
		Plankton	
		Submerged Aquatic Vegetation	
	Invertebrates		
		Crustaceans	*e.g. Blue Crab, American Lobster, Jonas Crab, Red Crab, other species TBD*
		Jellyfish & Comb Jellies	
		Marine Worms	
		Mollusks	*e.g. Surf Clams & Ocean Quahogs, Oysters, Sea Scallops, Bay Scallops, Squids, other species TBD*
		Sea Stars, Sea Urchins & Sea Cucumbers	
		Sponges, Anemones & Corals	*e.g. Deep Sea Corals, other species TBD*
		Zooplankton Community	
	Vertebrates		
		Bony Fishes	*Demersal: e.g. Sand lance, Summer Flounder, Black Sea Bass, other species TBD*
			Diadromous: e.g. River Herring, Sturgeons, other species TBD
			Large Pelagic Species: e.g. Marlins, Tunas, other species TBD
			Small Pelagic Species: e.g. Menhaden, Butterfish, other species TBD
		Sharks & Rays	*e.g. Spiny Dogfish, White Sharks, other species TBD*
		Birds	*Seabirds, e.g. Gulls, Shearwaters, Gannets, other species TBD*

Major Sections (Goals/Objectives)	Sections	Topics	Sub-Headings/ Content
I.1 Biology & Ecology (cont.)	**Vertebrates (cont.)**	**Birds (cont.)**	*Shorebirds, e.g. Plovers, Sandpipers, Phalaropes, other species TBD*
		Mammals	*Toothed Whales & Dolphins: e.g. Sperm Whales, Bottlenose Dolphins, other species TBD*
			Baleen Whales, e.g. Northern Right Whale, Humpback Whale, other species TBD
			Seals
		Sea Turtles	*e.g. Green, Kemps's Ridley, Loggerhead, other species TBD*
I.2 The Ocean Environment	**Introduction**		
	Natural Conditions and Actions		
		Currents	
		Erosion & Longshore Transport	
		Upwelling	
		Water Chemistry	
		Wind	
	Physical Features		
		Barrier Islands	
		Beaches	
		Harbors	
		Under-sea sand waves	
		Shelf-slope Break, Submarine Canyons	
		Continental Shelf	
		Deep Water	
		Reefs	
I.3 Emerging Issues	**Introduction**		
		Carbon Sequestration & Ocean Acidification	
		Ocean Warming	
		Coastal Inundation	
		Sea Level Change	
		Water Quality	
		Invasive Species	

Major Sections (Goals/Objectives)	*Sections*	*Topics*
SECTION II Goal - Sustainable Ocean Uses: Plan and provide for existing and emerging ocean uses in a sustainable manner that minimizes conflicts, improves effectiveness and regulatory predictability, and supports economic growth.		
II.1 National Security		
II.2 Ocean Energy	Conventional Energy	
	Renewable Energy	
II.3 Fishing	Commercial	
	Fishing for Sustenance	
	Recreational	
II.4 Ocean Aquaculture		
II.5 Marine Commerce & Navigation	Maritime Traffic Analysis	
	Panama Canal Expansion	
	Post-Panamax Port Issues	
	Proposed Anchorage Areas	
	Shipping (Mid-Atlantic Ports)	
	Short-Sea-Shipping and Marine Highways	
	LNG as an Import & Export	
II.6 Offshore Sand Management		
II.7 Non-consumptive Recreation		
II.8 Tribal Uses	Aquaculture	
	Canoe Journey Routes	
	Climate Change	
	Conservation Resource Management	
	Fishing	
	Heritage Sites	
	Submerged Cultural Resources	
	Subsistence Issues	
	Traditional Navigation Routes	
	Whales	
II.9 Undersea Infrastructure	Current Undersea Infrastructure	
	Foreseeable Future Infrastructure	

Mid-Atlantic Regional Ocean Assessment Example Sections

Contents

Deep Sea Corals

Authors: *David Stevenson (NOAA) and Kiley Dancy (MAFMC),* ***Contributors:*** *Kevin Chu (NOAA)*

Introduction

As their name implies, deep sea corals are unlike the shallow, reef-forming corals that require warm water and sunlight. Deep sea corals inhabit deep, cold water environments. Although some species also grow in shallower water on the Mid-Atlantic shelf (some as shallow as intertidal), most of them are found on the Outer Continental Shelf (OCS) and slope. Overall, scientists have discovered more species of deep sea corals (also known as cold-water corals) as shallow-water species throughout the world. Most species grow on rocky substrates and are particularly abundant in submarine canyons that cut into the outer shelf and slope.

Deep sea corals grow very slowly and live for hundreds and sometimes thousands of years. They provide refuge for many other species, thereby increasing the productivity of the environment. Due to the depths where these corals occur and the significant resource investment required to study them, there is still much to be discovered regarding the biology, interactions with other species and intersections with natural events and human activities.

One of the objectives of the Mid-Atlantic Regional Council on the Ocean (MARCO) is to coordinate among its members the protection of important marine habitats, including sensitive and unique offshore areas such as corals and canyons (http://midatlanticocean.org/shared-regional-priorities/marine-habitats).

For more information, see the following:

- The NOAA's National Marine Fisheries Service, Habitat Conservation provides an array of information on Deep Sea Corals and their habitat requirements, including sensitive and unique offshore locations such as coral canyons: http://www.habitat.noaa.gov/abouthabitat/deep sea corals.html.
- The Smithsonian Institution's Ocean Portal has a good introduction to deep sea corals at: http://ocean.si.edu/deep-sea-corals.

Economic, Social and/or Cultural Importance Considerations

There is inherent cultural and ecological value in conserving corals in isolated deep sea environments. They are long-lived and grow slowly, making them particularly susceptible to stress or damage since their recovery timeframe is extremely slow. They provide an oasis for marine fish and invertebrates at depths with otherwise limited habitat substrates. They are especially vulnerable to any disturbances that affect the ocean bottom (e.g. contact with fishing gear, oil and gas drilling, cable laying activities, etc.). Conservation of deep sea corals and their habitats is a growing area of international attention as human activities extend into deeper waters.

For more information, see the following:

- For more information about deep sea corals and relevant policy considerations in the United States National Ocean Policy Implementation Plan (2013) http://www.whitehouse.gov/sites/default/files/national_ocean_policy_implementation_plan.pdf

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Current Status and Trends/Indicators

Current Status:
Within the Mid-Atlantic region, research about deep sea corals, including known and predicted (based on scientific models) locations in the Mid-Atlantic, has been conducted and is still ongoing (NOAA, http://oceanexplorer.noaa.gov/okeanos/explorations/ex1404/dailyupdates/dailyupdates.html; BOEM, http://www.boem.gov/Curriculum-Lophelia-II/).

Trends:
Due to the technical and financial challenges to studying the deep ocean, it is difficult to assess trends in deep sea coral populations. What is known is that many deep-sea corals grow extremely slowly and that they are damaged by human activities. Once damaged, the corals and the communities they support may take centuries to recover.

Identification of Gaps and Ongoing Studies

Gaps:
More research is necessary to understand the biology of deep sea corals, ecological connections and their sensitivity to human activities, including:

- Improving scientific knowledge regarding the distribution and abundance of deep-sea corals in the Mid-Atlantic region and the ecosystem services they provide for other organisms,
- Identifying and monitoring activities on the OCS and slope that could potentially be harmful to deep-sea corals and their habitats, and
- Identifying areas and fishing gear restrictions that can improve protection for deep-sea corals and their habitats while having acceptable impacts on existing fishing activities.

Ongoing Studies:
The US Government has funded research on deep sea corals since at least the 1970's and 1980's. Research in the Northeast is continuing through 2015. (NOAA, http://coralreef.noaa.gov/deepseacorals/noaasrole/research_technology/ and http://coastalscience.noaa.gov/research/scem/coral/deep_coral)

For more information, see the following:

- From 2013-2015, NOAA's Deep Sea Coral Research and Technology Program is coordinating field research in the northeast region. NOAA's research activities are being done in partnership with the NOAA's Northeast Fisheries Science Center, its Office of Exploration and Research, NOAA's National Center for Coastal Ocean Science, and a number of academic colleagues:
  http://oceanexplorer.noaa.gov/okeanos/explorations/acumen12/welcome.html
  http://oceanexplorer.noaa.gov/explorations/13midatlantic/background/background.html
  http://oceanexplorer.noaa.gov/okeanos/explorations/ex1404/dailyupdates/dailyupdates.html.

- NOAA has developed a strategic plan for deep sea coral conservation:
  http://static.squarespace.com/static/511cdc7fe4b00307a2628ac6/t/51784380e4b01256f21cc732/1366836096652/noaa_dsc_strategicplan.pdf

- From 2011-2013, BOEM conducted multiple research cruises to the Norfolk and Baltimore canyons. BOEM, Environmental Studies Program: Ongoing Studies; Gregory Boland:

  http://oceanexplorer.noaa.gov/explorations/12midatlantic/welcome.html
  http://oceanexplorer.noaa.gov/explorations/13midatlantic/welcome.html
  http://oceanexplorer.noaa.gov/explorations/13landerrecovery/welcome.html

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Intersections with other ROA Topics

Corals may be impacted by fishing activities, undersea cables, offshore oil drilling, and any other activities that affect the ocean floor on the OCS and slope. They may be affected by sediments from human activities. In addition, coral growth may be compromised by ocean acidification.

At this time, area-based restrictions on bottom trawling are in place in portions of four offshore canyon, three in the area managed by the New England Fishery Management Council (FMC) and one (Norfolk Canyon) in the southern end of the region. These gear restricted areas were created to manage squid trawling on bottom habitats used by federally-managed demersal fish species and to protect hard clay outcrops used by tilefish to make burrows. They also indirectly benefit deep sea corals by protecting their habitats from disturbance.

For more information, see the following:

- The Mid-Atlantic and New England FMC's are currently developing measures to protect deep sea corals from fishing gear that could damage corals or their habitats on the OCS and slope between North Carolina and Georges Bank: http://www.mafmc.org/actions/msb/am16.
- Observations of deep sea corals and their habitats made during these cruises are being used by the Mid-Atlantic FMC to develop area-specific deep-sea coral management measures. Area-based management proposals are also based on the results of a predictive model and bathymetric data that highlight areas of high habitat suitability (http://www.habitat.noaa.gov/pdf/blueprintinitiatives.pdf).

Maps relevant to the Activities & Resources

a. Societal Uses and Activities: current & planned

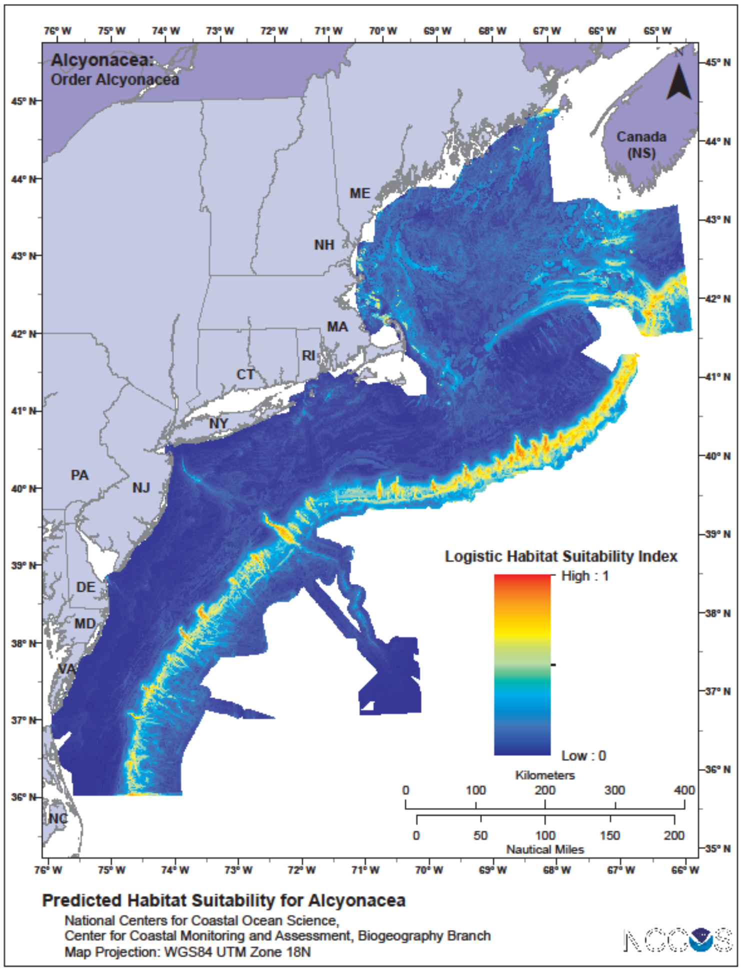
TBD, if applicable

b. Resource distribution and abundance

- The Mid-Atlantic Ocean Data Portal includes coral point data linked to detailed survey records and the Alcyonacea coral family predictive model illustrated below: http://portal.midatlanticocean.org/learn/conservation
- A summary of research and an extensive collection of maps showing known and modeled coral distribution along the Mid-Atlantic shelf slope break and within submarine canyons is found within this document: Mid-Atlantic Fishery Management Council (Aug 2014): Measures to Protect Deep Sea Corals from Impacts of Fishing Gear (DRAFT) http://static.squarespace.com/static/511cdc7fe4b00307a2628ac6/t/53e4cacde4b09a46dcc9aafb/1407503053985/Corals%20PID_August%202014.pdf

c. Areas of Interest

TBD, if applicable



Predicted areas in the Mid-Atlantic and northeast where species of the coral family Alcyonacea may be found. (Source: NOAA)

References

a. Peer reviewed or government documents

Under Construction

b. Other sources of information, including grey literature

Under Construction

Key Words

Deep sea corals, outer continental shelf, fishing, submarine canyons, undersea cables, ocean acidification

Renewable Energy

Authors: *Michelle Morin (BOEM) and Mary Boatman (BOEM)*

Introduction

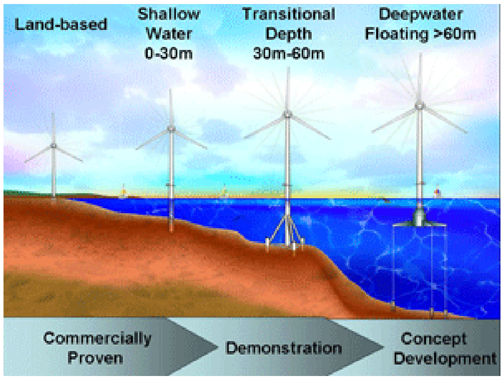
Ocean renewables could play a significant role diversifying our nation's energy portfolio. There is the potential to harness energy from offshore wind, waves, tides and currents.

Offshore Wind Energy

Wind energy has been used by humans for more than two thousand years. For example, windmills were often used by farmers and ranchers for pumping water or grinding grain. In modern times, wind energy is mainly used to generate electricity, primarily through the use of wind turbines. All wind turbines operate in the same basic manner. As the wind blows, it flows over the airfoil-shaped blades of wind turbines, causing the turbine blades to spin. The blades are connected to a drive shaft that turns an electric generator to produce electricity.

The nacelle is a shell that encloses the gearbox, generator, and blade hub (generally a three-bladed rotor connected through the drive train to the generator) and the remaining electronic components. Once the turbine is operational, wind sensors connected to a yaw drive system turn the nacelle to face into the wind, maximizing the amount of electricity produced.

While the tower, turbine, and blades of offshore turbines are generally similar to onshore turbines, the substructure and foundation systems that support the tower and nacelle differ considerably (see figure below). Their foundations must be designed to withstand the harsh environment of the ocean, including storm waves and hurricane-force winds. The most common substructure type is the monopile—a large steel tube with a diameter of up to 20 feet. Monopiles are typically used in water depths up to 100 feet (30 meters). The piles are driven into the seabed at depths of 80 to 100 feet below the mud line, ensuring the structure is stable. A transition piece protrudes above the waterline, which provides a level flange to fasten the tower. In even shallower environments with firm seabed substrates, gravity-based systems can be used, which avoids the need to use a large pile-driving hammer. Tripods and jackets foundations have been deployed in areas where the water depth starts to exceed the practical limit for monopiles.



Source: National Renewable Energy Laboratory (NREL) 2014

All of the power generated by the wind turbines needs to be transmitted to shore and connected to the power grid. Each turbine is connected to an electric service platform (ESP) by a power cable (BOEM, 2014a). The ESP is typically located somewhere within the turbine array, and it serves as a common electrical collection point for all the wind turbines and as a substation. In addition, ESP's can be outfitted to function as a central service facility, and may include a helicopter landing pad, communications station, crew quarters, and emergency backup equipment. After collecting the power from the wind turbines, high voltage cables running from the ESP transmit the power to an onshore substation, where the power is integrated into the grid. The cables used for these projects are typically buried beneath the seabed. Cables are buried to avoid or minimize impacts from anchoring and fishing gear, and also for heat dissipation. The typical burial depths are 1 to 2 meters. Where minimal burial depth isn't possible, cable protection measures would be used, such as concrete mattresses, rock armoring, and articulated pipe or ducting. Cables could become exposed with time, especially in areas with mobile sediments.

Offshore wind turbines are being used by a number of countries to harness the energy of strong, consistent winds that are found over the oceans. The first offshore wind project was installed off the coast of Denmark in 1991, and wind turbines have been installed offshore a number of countries, mostly in Europe, to harness the energy of the moving air over the oceans and convert it to electricity. Wind resource potential is typically given in gigawatts (GW), and 1 GW of wind power could supply between 225,000 to 300,000 average U.S. homes with power annually (BOEM, 2014a). The Department of Energy (DOE) estimates a gross wind power resource of over 4,000 GW off the coast of the United States (Lopez et al., 2012, Table 7). For comparison, 4,000 GW is over four times the generating capacity of the current U.S. electric grid (EIA, 2013).

For more information, see the following:

- DOE's "How does a wind turbine work?" http://energy.gov/eere/wind/how-does-wind-turbine-work
- NREL's "Wind Energy Basics: How Wind Turbines Work" http://www.nrel.gov/learning/re_wind.html

- DOE's "Wind Resource Assessment and Characterization" http://energy.gov/eere/wind/wind-resource-assessment-and-characterization.

Offshore Hydrokinetic

Marine hydrokinetic (MHK) energy technologies convert the energy of waves, tides, and currents into electricity. This is an emerging industry with hundreds of potentially viable technologies (DOE, 2015). Test and pilot projects are being planned and deployed to evaluate the technical and economic viability of MHK energy production. A commercial-scale facility on the Mid Atlantic Outer Continental Shelf (OCS) is not anticipated in the foreseeable future and therefore, not discussed further in this document.

For more information, see the following:

- DOE: http://energy.gov/eere/water/marine-and-hydrokinetic-energy-research-development;
- BOEM: http://www.boem.gov/Renewable-Energy/; and
- Open Energy Information: http://en.openei.org/wiki/Marine_and_Hydrokinetic_Technology_Database

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Economic, Social and/or Cultural Importance Considerations

Renewable energy development has cross-cutting economic, social and cultural implications for the Mid-Atlantic region. Renewable energy projects would also support three goals of the President's All-of-the-Above energy strategy: 1) to support economic growth and job creation; 2) enhance energy security; and 3) deploy low-carbon energy technologies and lay the foundation for a clean energy future (Executive Office of the President of the United States, 2014).

For more information, see the following:

- U.S. Report- The All-of-the-Above Energy Strategy as a Path to Sustainable Economic Growth: http://www.whitehouse.gov/blog/2014/05/29/new-report-all-above-energy-strategy-path-sustainable-economic-growth.

Current Status and Trends/Indicators

Offshore Wind Energy

Current Status:

Wind speeds off the Atlantic Coast are lower than wind speeds off the Pacific Coast. However, the presence of shallower waters in the Atlantic could potentially make development and siting more economically feasible. Offshore winds also tend to blow harder and more uniformly than on land. The DOE provides a number of maps showing average wind speed data through its

Resource Assessment and Characterization studies (DOE, 2014; http://energy.gov/eere/wind/wind-resource-assessment-and-characterization). The NREL estimates a gross wind power resource of 4,200 GW off the coast of the United States (Lopez et al., 2012).

While the United States does not have any operational offshore projects, there are multiple projects in the planning and leasing stages. Within Federal waters, BOEM has the authority to issue leases, easements, and rights-of-way on the outer coastal shelf for the purpose of renewable energy development (BOEM, 2014b; http://www.boem.gov/Renewable-Energy). Currently, within the Mid-Atlantic and beyond, BOEM has leased areas for commercial development of wind energy off the shores of Delaware, Maryland, Virginia, North Carolina, Rhode Island, and Massachusetts. BOEM is in the process of leasing areas offshore New Jersey New York, North Carolina, and additional areas offshore Massachusetts, and is considering research lease requests and proposals off the shores of Virginia and Oregon (BOEM, 2014c; http://www.boem.gov/Renewable-Energy-State-Activities).

After execution of a commercial lease, the lessee has five years to conduct site assessment activities (install and operate meteorological towers and buoys) and submit a Construction and Operations Plan (COP). To date, no plans for commercial-scale development have been submitted for the Mid-Atlantic.

Within state waters, the U.S. Army Corps of Engineers (USACE) has the lead for permitting renewable energy facilities. Along the Mid-Atlantic coast, one small-scale wind project is fully permitted in state waters. On June 14, 2012, the USACE issued a permit to Fishermen's Energy of New Jersey, LLC to install five 5-megawatt wind turbines approximately three miles off the coast of Atlantic City, New Jersey (Fishermen, 2014; http://www.fishermensenergy.com/atlantic-city-windfarm.php).

Trends:

The DOE's report *'2014 Offshore Wind Market and Economic Analysis'* states "Globally, offshore wind projects continue to trend farther from shore into increasingly deeper waters; parallel increases in turbine sizes and hub heights are contributing to higher reported capacity factors" (Navigant Consulting, Inc. 2014). Approximately 90% of the U.S. outer continental shelf wind energy occurs in waters that are too deep for current turbine technology. New technologies, such as innovative foundations and floating wind turbines, will help transition wind power development into the harsher conditions associated with deeper waters. The trend toward taller towers and larger blades is likely to resume, as the newly announced 7 megawatt turbines and larger machines reach commercial deployment in the next few years (Navigant Consulting, Inc., 2014).

To take advantage of steadier winds, offshore turbines are bigger than onshore turbines. More recently constructed offshore wind facilities globally have hub heights up to approximately 100 meters (328 feet) and rotor diameters of up to approximately 130 meters (427 feet) (Navigant

Consulting, Inc., 2014). The average turbine size for projects in the United States is expected to utilize larger offshore turbines (between 5.0 and 5.3 megawatts) compared to the turbines that have previously been installed in European waters (Navigant Consulting, Inc., 2014). The USACE recently approved the construction of five 6-MW turbines off the coast of Block Island, Rhode Island (http://www.army.mil/article/133452/Deepwater_Wind_s_permit_signed_to_construct_five_wind_turbines_off_Block_Island_coast/) while BOEM is currently considering a plan for two test 6 MW turbines offshore Virginia (http://www.boem.gov/VOWTAP/). The maximum height of structures offshore the United States, at the very tips of the blades, would easily surpass 500 feet (150 m.).

Identification of Gaps and Ongoing Studies

Offshore Wind Energy

Gaps:
Since no wind turbines are installed in U.S. waters, there is a shortage of critical data on the environmental and siting effects of turbines and on the installation, operations, and maintenance of these turbines. This lack of data drives up the costs of financing offshore wind projects to the point where financing charges account for approximately half of the cost of offshore wind energy (DOE, 2011).

Ongoing Studies:
To address information gaps, research is occurring nationwide to develop and deploy offshore wind technologies that can capture wind resources off the coasts of the United States and convert wind into electricity (DOE's Offshore Wind Research and Development Program; http://energy.gov/eere/wind/offshore-wind-research-and-development). In a July 2012 Technical Report (Lopez et al., 2012), NREL estimates a gross wind power resource of 4,200 GW off the coast of the United States. One GW of wind power will supply between 225,000 to 300,000 (on average) U.S. homes with power annually (BOEM, 2014a).

In addition, multiple studies have been conducted and more are ongoing to evaluate the potential impacts of renewable energy development (BOEM 2014d: http://www.boem.gov/Renewable-Energy-Environmental-Studies). Workshops have been conducted to identify data gaps and to evaluate other European renewable energy projects and marine spatial planning methodologies (Michel and Burkhard, 2007, CSA International, Inc., 2011; http://www.boem.gov/Renewable-Energy-Completed-Studies/#Synthesis).

With stakeholder input, national and regional guidelines are being developed for site characterization studies (BOEM, 2014e; http://www.boem.gov/National-and-Regional-Guidelines-for-Renewable-Energy-Activities). These studies will be used to evaluate the impact of proposed renewable energy activities on physical, biological, and socioeconomic resources, in addition to evaluating the seafloor and sub-seafloor conditions potentially affected by the construction, installation, and operation of meteorological towers, buoys, cables, wind turbines, and supporting structures. Information submitted will be used by Federal and State agencies for consultations, the preparation of National Environmental Policy Act (NEPA) documents, and other regulatory requirements.

For more information, see the following:

- BOEM hosted two workshops to identify data needs related to offshore renewable energy development.
    - *'Workshop to Identify Alternative Energy Environmental Information Needs'* (Michel and Burkhard, 2007),
    - *'Atlantic Wind Energy Workshop'* (CSA International, Inc., 2011) and,
    - '*Offshore Wind Energy Development Site Assessment and Characterization: Evaluation of the Current Status of European Experience*' (Rein et al., 2013).

Intersections with other ROA Topics

A primary concern in the Mid-Atlantic region is multiple use conflicts: for example, between renewable energy projects and marine transportation, fishing, and military activities. BOEM works with interested and affected Federal, State, local and Tribal governments through Intergovernmental Task Forces. Task Forces have been initiated in the following Mid-Atlantic region states: New York, New Jersey, Delaware, Maryland, and Virginia (http://www.boem.gov/BOEM-Stakeholder-Engagement/). The role of each Task Force is to collect and share relevant information, identify areas of significant promise for offshore development, and provide early identification of, and steps toward resolving, potential conflicts.

With respect to offshore wind energy, BOEM has sought input from the fishing industries and management agencies, in order to identify issues, foster dialogue and develop recommendations for best management practices (Farrell et al., 2014; http://www.boem.gov/Fishing-Offshore-Wind-Mitigation-Measures-Development-Workshops). For example, after collecting the power from the wind turbines, high voltage cables running from the ESP transmit the power to an onshore substation, where the power is integrated into the grid. The cables used for these projects are typically buried beneath the seabed, to protect the cables from ocean bottom disturbance activities (such as fishing gear, anchors, etc.) and to reduce their exposure to the marine environment. These types of cables are expensive and the amount of cable used depends on many factors, including how far offshore the project is located, the spacing between turbines, the presence of obstacles that require cables to be routed in certain directions, and other considerations.

Environmental considerations are also a key component in siting and assessing renewable energy activities. In 2007, BOEM published the Final Programmatic Environmental Impact

Statement (EIS) for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf (Programmatic EIS, MMS 2007, http://www.boem.gov/Renewable-Energy-Program/Regulatory-Information/Guide-To-EIS.aspx). This document examines the potential environmental impacts related to renewable energy development on the OCS for each phase of development (technology testing, site characterization, construction, operation, and decommissioning). Actual proposals will include project-specific analyses under the National Environmental Policy Act.

Offshore Wind Energy

For example, Chapter 7.6.2 of the Programmatic EIS discusses generic cumulative impacts associated with offshore renewable energy on environmental and socioeconomic resources (MMS, 2007). In general, most impacts would be negligible to moderate for all phases of wind energy development assuming that proper siting and mitigation measures are followed.

Vessel activity on the outer continental shelf related to a wind facility is relatively low, with only a few support vessels in operation at any one time during the highest activity period (construction). Potential impacts during the construction phase are the highest, because this phase involves the highest amount of vessel traffic, noise generation, and air emissions. There is a potential for major impacts to some threatened and endangered species of marine mammals, birds, or sea turtles 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, because population-level impacts are possible from injury or death of individual females if population numbers are critically low.

Compliance with the regulations and coordination with appropriate wildlife protection agencies would ensure that project activities would be conducted in a manner that would greatly minimize or avoid impacting these species or their habitats. Moderate impacts to fish and fisheries could occur due to the establishment of exclusion zones within wind energy facilities. Potential visual impacts can be mitigated through several means, especially siting facilities away from sensitive areas.

Maps relevant to the Activities & Resources

a. Societal Uses and Activities: current & planned

TBD, if applicable

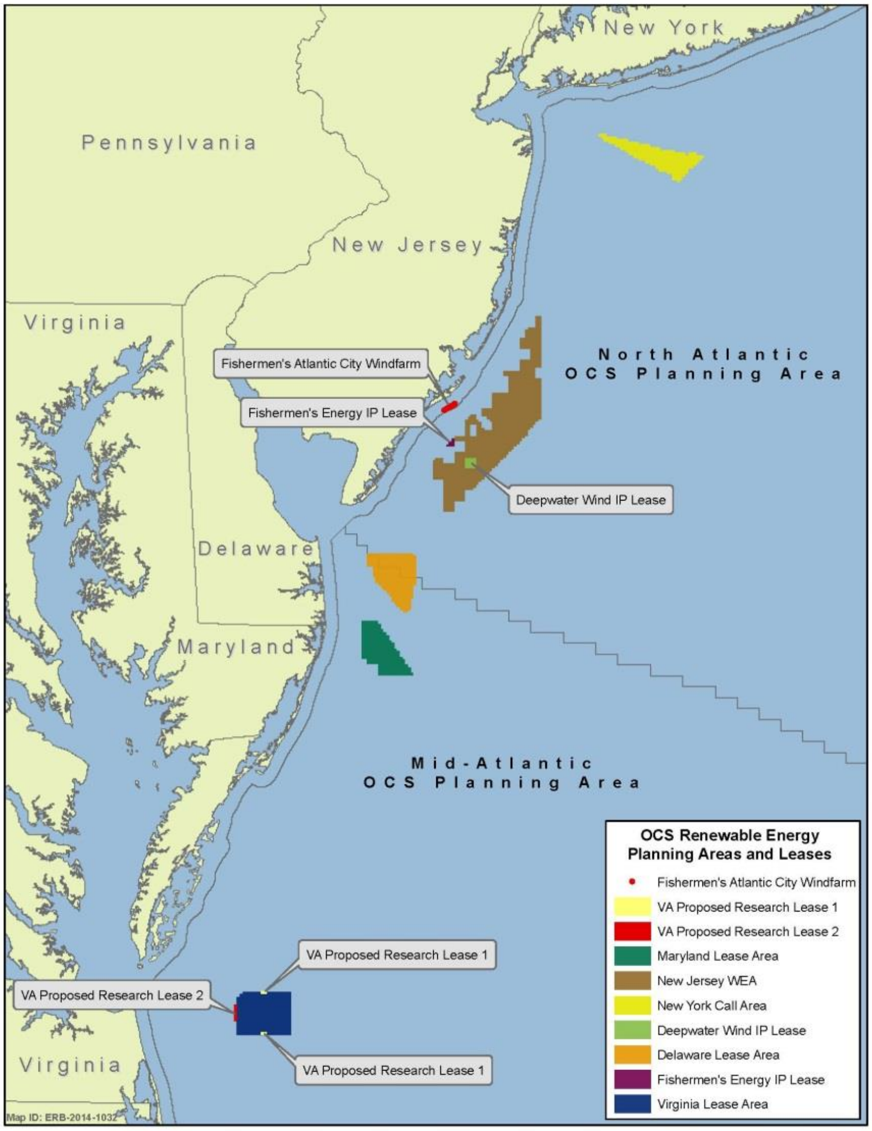
b. Resource distribution and abundance

- The Mid-Atlantic Ocean Data Portal includes a map layer showing annual estimated average wind speeds categorized by their value at a height of 90 meters above the surface. The data were created by the National Renewable Energy Laboratory (NREL) and AWS Truepower. http://portal.midatlanticocean.org/learn/energy

c. Areas of Interest

- The Mid-Atlantic Ocean Data Portal includes map layers showing BOEM wind power planning and lease areas and additional map layers including a Department of Defense compatibility layer with site specific stipulations. http://portal.midatlanticocean.org/learn/energy

By State, maps of offshore renewable energy activities:



Source: BOEM

- New York: http://www.boem.gov/uploadedImages/BOEM/Renewable_Energy_Program/State_Activities/ny_mapL.jpg
- New Jersey: http://www.boem.gov/uploadedImages/BOEM/Renewable_Energy_Program/State_Activities/nj_web_graphicL.jpg?n=825

- Delaware: http://www.boem.gov/uploadedImages/BOEM/Renewable_Energy_Program/State_Activities/de_web_graphicL.jpg?n=1257
- Maryland: http://www.boem.gov/uploadedImages/BOEM/Renewable_Energy_Program/State_Activities/md_web_graphicL.jpg?n=8570
- Virginia: http://www.boem.gov/assets/0/79/101/209/bd103579-7570-4a9c-bc1e-6b973d2ca5a0.jpg?n=6836

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Key Words

Renewable energy, wind, transmission, offshore wind, offshore wind energy, wind farms, and wind turbines, BOEM, offshore wind leases

Panama Canal Expansion

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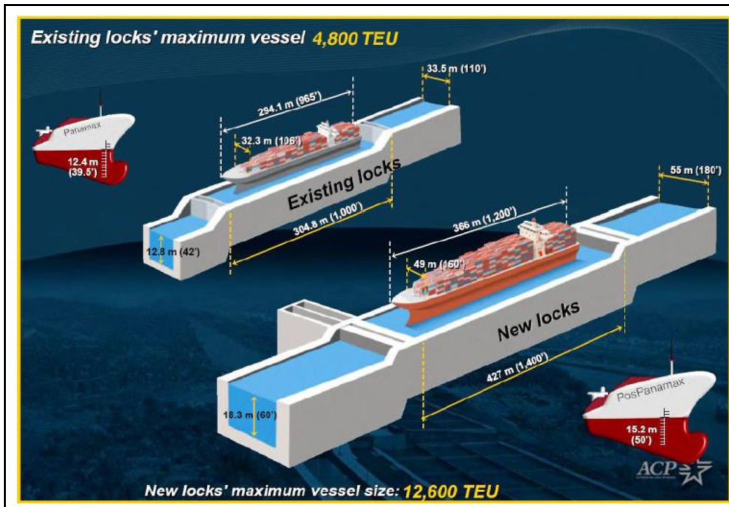
Introduction

Since opening in 1914, the Panama Canal has been a critical element of the global transportation network. It now serves over 140 maritime trade routes to over 80 countries; an estimated five percent of global maritime cargo transits the Panama Canal every year (Panama Canal Authority, 2009). Providing an all-water passage between the Atlantic and Pacific Oceans, the Canal facilitates trade between Northeast Asia, Europe, the Caribbean, and the Americas, which are some of the heaviest cargo flows in the world.

Much of the material in this topic is excerpted from a study by the Maritime Administration, which has reviewed the impacts of the expansion of the Panama Canal on U.S. ports. For a more thorough treatment of this subject, see the Maritime Administration's Panama Canal Expansion Study, Phase 1 Report: Developments in Trade and National and Global Economies, November 2013. (http://www.marad.dot.gov/documents/Panama_Canal_Phase_I_Report_-_20Nov2013.pdf)

From the perspective of the U.S. economy, the Panama Canal is an alternative to West Coast routing of Asian trade and serves as a critical link to Central and South American economies. With respect to the Mid-Atlantic region (e.g. east coast ports, along with gulf ports), the Canal is the most economical shipping option for many U.S./Asian commodity exchanges, as alternative water routes are too long and costly (Panama Canal Expansion Study, Phase I, Maritime Administration (MARAD), 2013).

The Panama Canal Expansion Project objectives are to increase the capacity of the Canal to allow the transit of large vessels that are currently restricted by the dimensions of the existing Canal locks, and to maximize the Canal's total possible cargo transport and traffic. Panamax and Post-Panamax are terms used to delineate the size limits for ships traveling through the Panama Canal (see picture below).



Source: Panama Canal Authority, February 2011

The project will essentially create a third lane of traffic through the Canal for the passage of increasingly prevalent Post-Panamax vessels. The major components of the Panama Canal Expansion Project include: deepening and widening the Canal entrances; construction of two new Post-Panamax complexes, one at the Atlantic (north) and another at the Pacific (south) ends of the Canal; excavation of a new north access channel for the Pacific Post-Panamax locks; elevation of Gatun Lake's maximum operation level; and deepening and widening of the Gatun Lake and Culebra Cut navigational channels (Panama Canal Expansion Study, Phase I, MARAD, 2013).

The project creates a new lane of traffic along the Canal through the construction of a new set of locks, thus doubling 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 completed, Post-Panamax vessels will be able to transit through the Canal carrying up to 13,000 TEUs. As of January 2015, the project is at 83% completion (Canal De Panama: http://micanaldepanama.com/expansion/).

Economic, Social and/or Cultural Importance Considerations

The Panama Canal is an important link in global trade, accommodating an estimated five percent of the world's total cargo volume (Panama Canal Authority, 2009). The Panama Canal Expansion Project is currently one of the largest construction projects in the world and is expected by many in the logistics industry to have significant impacts on global trade and on U.S. ports and inland infrastructure. Expansion of the Canal will allow for the passage of larger container vessels, potentially reducing the cost of trans-ocean shipping. This is especially applicable to the East-West trade routes, i.e. between the Far East and U.S. East and Gulf Coast ports.

Over the past half-century, container shipping services have evolved and trade between Asia and Western economies consume the majority of Panama Canal's transport capacity. The Panama Canal Authority (PCA) estimates that the combined effect of allowing between 12 and 14 larger vessels per day through the new locks and using the existing locks for smaller vessels will double the Canal's capacity. The increased size of the vessels, particularly container ships of up to 13,000 TEUs (twenty-foot equivalent units), will play a critical role in increasing Canal throughput capacity, which is estimated to increase from 300 million Panama Canal Universal Measurement System (PCUMS) Tons to 600 million PCUMS Tons. PCUMS also determine what vessels are charged for use of the Canal. (Panama Canal Expansion Study, Phase I, MARAD, 2013).

Current Status and Trends/Indicators

Current Status:
Without increases to container terminal capacity, the number and geographic configuration of Far East all-water services that can be effectively operated to the East and Gulf Coasts could become constrained over the long term (beyond 2025).

Draft is a significant factor limiting navigable waterways, as it determines the minimum depth of water a ship or boat can safely navigate. Air draft, the distance from the surface of the water to the highest point on a vessel, also determines whether a ship can pass safely under a bridge or other obstruction, such as power lines. The largest Post-Panamax vessels require 47.6 feet of draft without tidal restrictions; therefore Mid-Atlantic ports would require channels and water depths alongside berths that are at least 50 feet deep.

Four major ports on the East Coast can handle such large ships already (Baltimore, MD and Norfolk, VA) or will be able to do so by the time the expanded Panama Canal opens (New York/New Jersey). Other East Coast ports are making preparations for dredging to channel depths of 45 feet or more, depths that can accommodate many of the Post-Panamax ships.

The Port of New York and New Jersey has 50-foot water depths in portions of its harbor. U.S. Army Corps of Engineers (USACE) is completing a series of dredging contracts that will provide 50-foot water depth to three of the port's major container terminals. The New York/New Jersey harbor deepening project includes 17 dredging contracts, 11 of which have already been completed.

The 50-foot access to the Newark Bay and Global Marine terminals was completed in December 2012 and deepening the channel to the New York Container Terminal was to be completed by December 2013. Since Global Marine Terminal is situated ahead of the entrance to the Kill Van Kull, ships calling at the terminal do not transit under the Bayonne Bridge. With no air draft limitations and 50 feet of water depth at its berths, Global Marine Terminal will be able to handle the largest container vessels transiting the expanded Panama Canal, as well as Post-Panamax vessels arriving from the east via the Suez Canal. Global Terminal is also scheduled to open an expanded facility in 2014 with a throughput capacity of 1.7 million TEUs. In New York Harbor, Port Newark Container Terminal can be enlarged and the New York Container Terminal on Staten Island could also add an adjacent berth.

Also in New York/New Jersey, plans are advancing rapidly to raise the deck of the Bayonne Bridge, above the Kill Van Kull Channel by 64 feet, for increased air draft. It is presently too low for larger Post-Panamax ships, limiting access to four of the port's five container terminals. The $1.3 billion construction project is scheduled to be complete by 2017, with navigational obstructions removed in time for the Panama Canal expansion opening.

Within the Mid-Atlantic region, there are multiple ports evaluating their terminal infrastructure and capacity for future development. At Hampton Roads, both the Norfolk International Terminal and the APM-Portsmouth Terminal can be physically expanded, and the port has already secured an additional site, Craney Island, for a massive new container terminal.
In Baltimore, the primary container terminal, Seagirt, has a modest amount of land available for expansion. The other container terminal, Dundalk, could handle significantly more container traffic than is presently moving through it, but this would require both a major investment and the displacement of some non-container traffic.

The primary container terminals of the Ports of Philadelphia and Wilmington cannot easily expand their footprints, given the land uses on the bordering parcels; however, they may have ample space for growth on additional acreage elsewhere in the region, (e.g. Philadelphia's Southport Marine Terminal).

Trends:
The geographic extent of the impacts of Panama Canal expansion will depend on a number factors, including: the capacity of individual U.S. ports and their related infrastructure to handle shifting trade flows, the response of shipping companies to port and inland infrastructure capacity development, the adaptation of supply-chain management methods that take advantage of the scale economies offered by Canal expansion, and the allocation of cost savings among the various domestic and foreign players.

Larger (Post-Panamax) vessels, increased Canal traffic and doubled annual throughput capacity (as measured in PCUMS Tons) will affect the size of vessels calling at some U.S. ports. This will require changes in some port and landside infrastructure to handle larger vessels and move cargoes to inland markets. These changes are also likely to affect shipping patterns and routing of cargo for major U.S. trade lanes, e.g. resulting in a different traffic mix on the Eastern seaboard. After the opening of the Panama Canal expansion, liner companies will likely begin to deploy larger container vessels on long distance, high-volume trade routes in order to benefit from economies of scale.

Although some container traffic from Hong Kong/Yantian and other Chinese ports to the U.S. East Coast (particularly to New York) will move through the Suez Canal after 2015, most of that traffic segment will continue to move via Panama, which offers shorter transits to the South Florida, South Atlantic, and Mid-Atlantic markets. For carriers currently running Suez services from Hong Kong/Yantian to the U.S. East Coast with intermediate stops at hubs in the Strait of Malacca, the Indian Ocean, and the Mediterranean, switching to the Panama route can offer faster transits to the New York market as well.

Identification of Gaps and Ongoing Studies

Gaps:
TBD, if applicable

Ongoing Studies:
Panama Canal Expansion Study Phase I Report: Developments in Trade and National and Global Economies, Department of Transportation, Maritime Administration (MARAD), dated November 2013 identified and explained the pending developments in world ocean trade routes and national and global economies that are likely to affect global and U.S. freight corridors relevant to the Panama Canal expansion.

- The second phase (Phase II) of the study (not yet published) will provide a detailed assessment of the physical attributes of U.S. ports and inland infrastructure and the markets they serve. Phase II will also include the results of a shippers survey and an assessment of infrastructure conditions at key U.S. ports most likely to be affected by the Canal expansion.
- The third phase (Phase III) will assess potential opportunities for applying investment funding towards future development of port capacity.
- The fourth and final phase (Phase IV) of the study will revisit the issues identified in Phase I, in light of feedback received from listening sessions and other stakeholder outreach efforts, and will review the infrastructure needs and funding issues assessed during Phases II and III.

Additional research is nearing completion for the next report of this study (expected to be published May/June 2015) to refine these initial assessments. The research will provide more in-depth information about how transportation service providers are planning to respond to new opportunities to deploy vessels, as well as how shippers and cargo owners are likely to respond to a range of options they may face in the future as their costs change and potential new markets become available to them.

Intersections with other ROA Topics

The geographic extent of the impacts of Panama Canal expansion will depend largely on how U.S. ports and inland transportation providers invest in improvements to their infrastructure, the response of shipping companies to this port and inland infrastructure development, and the adaptation of supply-chain management methods that take advantage of the scale economies offered by Canal expansion.

The use of larger ships will increase the volume of containers that must be moved at each port call for those larger vessels. This will likely lead to fewer and more concentrated ship calls at larger ports for any given service, especially for vessel deployments serving the Northeast Asia

– U.S. East/Gulf Coast trade. 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.

Port readiness and infrastructure will be impacted by the Panama Canal expansion. Readiness is determined by navigational channel depth and height (air draft) restrictions, terminal handling and storage capabilities, rail connectivity and capacity, and inland transportation systems (specifically, intermodal rail and "last mile" port and terminal connections).

The extent to which U.S. ports and others invest to improve vessel handling capacity and more concentrated cargo volumes, and move the cargo inland, could influence whether shipping companies decide to make greater use of the Caribbean or Panamanian container transshipment ports.

Port capacity constraints and more concentrated port calls could lead to greater use of marine highway services to move containers via water between larger and smaller U.S. ports. As with foreign transshipment, the handling and transport costs, as well as the externalities, (e.g. landside traffic congestion) of competing modes are a significant factor in determining the viability of a marine highway as a competitive option.

Panama Canal expansion could also potentially impact the following areas/activities, although currently, there are no published reports that detail the perceived potential impacts: dredge disposal, offshore wind, offshore oil and gas, and military/Department of Defense (DoD) activities.

Maps relevant to the Activities & Resources

a. Societal Uses and Activities: current & planned

- For maps, charts, and graphics, refer to the Panama Canal Expansion Study Phase I Report: Developments in Trade and National and Global Economies, DOT, MARAD, dated November: 2013: http://www.marad.dot.gov/documents/Panama_Canal_Phase_I_Report_-_20Nov2013.pdf.

b. Resource distribution and abundance

- The Mid-Atlantic Ocean Data Portal has nautical charts that provide basic bathymetry information as a basemap option (http://portal.midatlanticocean.org/visualize).

c. Areas of Interest

TBD, if applicable

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b. Other sources of information, including grey literature

TBD, if applicable

Key Words

Panama Canal Expansion Project, Panama Canal, MARAD, DOT, Marine Highway, Short Sea Shipping, Post-Panamax