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March 8, 2018

The Honorable Ryan Zinke
Secretary of the Interior
Department of the Interior
1849 C Street, N.W.
Washington, D.C. 20240

Dear Secretary Zinke:

The State of New Jersey strongly opposes the Department of the Interior's ("DOI") proposed plan to open the Atlantic Outer Continental Shelf to oil and gas exploration and drilling. Oil and gas exploration and drilling in the Atlantic would have devastating effects on New Jersey's economy and threaten our critical natural resources.

New Jersey's 130-mile coastline is the pride and joy of our State and has long been vital to New Jersey's economy. The coastal tourism industry generates billions of dollars for New Jersey businesses and supports more than 838,000 jobs – about 20 percent of New Jersey's workforce. The New Jersey coast also hosts a thriving and nationally prominent fishing industry which provides tens of thousands of jobs for the hard-working people of New Jersey.

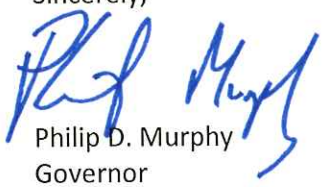
The New Jersey coast is also home to an ecosystem of global importance. New Jersey's marine waters are a key migration corridor for federally endangered marine mammals and turtles. The Delaware Bay estuary provides a critical stopover for threatened and endangered migratory birds and provides spawning grounds for the world's largest population of horseshoe crabs, which are critical to ongoing medical research. The population of Atlantic sturgeon, another endangered species, is growing within New Jersey's coastal waters. The Atlantic Outer Continental Shelf is home to 1,000-year-old deep sea coral communities, which are federally protected by the Deep Sea Corals Amendment. The draft proposed program places these economically and environmentally vital resources at risk.

New Jersey cannot afford to expose its treasured coastal communities to the threats posed by DOI's proposal. Accordingly, I reiterate the State of New Jersey's request that offshore areas adjacent to New Jersey be excluded from the proposed program. In connection with this request, pursuant to 43 U.S.C. 1344(c)(2), I am enclosing my comments on behalf of the State of New Jersey in response to the Bureau of Ocean Energy Management's January 8, 2018, *Federal Register* Notice of Availability for the 2019-2024 Draft Proposed Outer Continental Shelf Oil and Gas Leasing program.

New Jersey is committed to protecting its natural resources and realizing a new clean energy future through support of smart energy policy and renewable energy sources. We will not accept outdated, dangerous approaches that promote reliance on fossil fuels and result in more environmental degradation.

Thank you for your attention to this matter.

Sincerely,



Philip D. Murphy
Governor

Weighing the potential negative impacts to New Jersey's natural resources, coastal communities and economy with the potential for energy generation and current energy needs and our policies and goals, the State of New Jersey strongly opposes any portion of the Mid-Atlantic and North Atlantic region being included in the development of a National Outer Continental Shelf Oil and Gas Leasing Program and requests exclusion from the 2019-2024 Outer Continental Shelf Oil and Gas Leasing Program.

Indeed, the beautiful New Jersey coast and its offshore waters are home to an ecosystem of global importance. The Delaware Bay shoreline – a critical segment of the Atlantic migratory flyway – is one of the most globally important shorebird migration locations and a critical stopover for endangered and threatened species such as the red knot. The Dr. Carl N. Shuster Jr. Horseshoe Crab Sanctuary at the mouth of Delaware Bay was created to protect the world's largest spawning population of horseshoe crabs whose eggs are so critical to migratory shorebirds and medical research.

The waters offshore of New Jersey out to the continental slope break contain spectacular offshore canyons. In fact, the Hudson Canyon is larger and deeper than the Grand Canyon. The slope break and canyons provide important habitat and support essential sectors of New Jersey's economy. The canyons are physically complex with outcrops, steep slopes and diverse sediment with high nutrient flux and biologically important upwellings. These areas are home to unique cold-water corals, with individual colonies likely more than 1,000 years old. These colonies are slow-growing and sensitive to disturbance. In addition, canyon habitats provide refuge for commercially important fish. (See Figure 1) The slope break is known for high concentrations of tunas, billfish, crabs, marine mammals and sea turtles. Data being incorporated into the Mid-Atlantic Data Portal by Duke University's Marine Geospatial Ecology Lab in partnership with the Mid-Atlantic Regional Council on the Ocean and the Mid-Atlantic Regional Planning Body clearly show the importance of this area for protected marine mammals: sei whales and deep-diving species such as sperm and beaked whales. (See Figure 2)

The uniqueness of this region was confirmed in 2016 when President Barack Obama withdrew it under Section 12(a) of the Outer Continental Shelf Lands Act (OCSLA), 43 U.S.C. 1341(a). The OCSLA provides no authority to overturn such a designation. Merely removing the canyons alone from this program does not go far enough. The region's sensitivity to disturbance clearly shows that exploration and development would be detrimental even in proximity to the canyons and reiterate our insistence that the Mid-Atlantic and North Atlantic planning areas be completely removed from consideration.

New Jersey's 130-mile coastline has long been vital to New Jersey's economy. In 2016 the revenue supported more than 838,000 jobs – nearly 20 percent of New Jersey's workforce. The revenue generated by this tourism produced $4.9 billion in state and local taxes and $5.6 billion in federal taxes. New Jersey's recreational and commercial fishing industries are also critical to our economic health. In 2015 New Jersey's seafood industry supported more than 31,000 jobs, and the state is home to one of the nation's largest saltwater recreational fishing industries and some of the most important commercial fishing ports on the Atlantic coast. Figure 3 depicts a compilation of data regarding various recreational uses offshore of New Jersey.

New Jersey fishermen understand the importance of proper stewardship of our ocean resources. As part of the Mid-Atlantic Fisheries Management Council, they worked to create a Deep Sea Corals Amendment to the mackerel, squid and butterfish fishery management plan, aiming to protect corals by restricting fishing in select areas where fishing and prime coral habitat overlap, as well as restricting the expansion of effort into less heavily fished areas where corals are known or highly likely to exist. It consists of a broad zone that starts at a depth contour of approximately 450 meters and extends to the U.S. Exclusive Economic Zone boundary and to the north and south to the boundaries of the Mid-Atlantic waters, as defined in the Magnuson-Stevens Fishery Conservation and Management Act.

In addition, the deep-sea coral protection area includes 15 discrete zones that outline deep-sea canyons on the continental shelf in Mid-Atlantic waters. The deep-sea coral area, including both broad and discrete zones, is one continuous area. The council recommended that the deep-sea coral protection area be named in honor of the late Frank R. Lautenberg, who served New Jersey for more than 28 years in the U.S. Senate. Senator Lautenberg was responsible for several important pieces of ocean conservation legislation and authored several provisions included in the most recent reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act in 2007, including the discretionary provision for corals. The final rule implements the deep-sea coral protection area as the Frank R. Lautenberg Deep-Sea Coral Protection Area." (See Figure 1) Oil and gas exploration and development endangers the protections New Jersey has fought long and hard to establish in the offshore environment and disrespects the legacy of those who have fought to provide a healthy ecosystem for future generations. Given the outsize role of New Jersey's coastal waters in our economy, the national outer continental shelf program would put at risk not only our coastal economy but a significant portion of our statewide economy.

New Jersey's laws, goals and policies have been at the forefront of environmental protection while managing a robust economy with substantial contributions to the national GDP. New Jersey's coastal management program strives to protect, enhance and restore coastal habitats and their living resources to promote biodiversity, water quality, aesthetics, recreation and healthy coastal ecosystems and manage coastal activities to protect natural resources and the environment. To effectively manage ocean resources, New Jersey looks to develop and implement management measures to attain sustainable recreational and commercial fisheries, manage commercial uses to reduce conflict between users and encourage water-dependent uses and administer the safe and environmentally sound use of coastal waters and beaches to protect natural, cultural and aesthetic resources, promote safe navigation and provide recreational opportunities. Opening the Atlantic to oil and gas development runs counter to these policies.

Within days of being sworn into office, Governor Murphy signed executive orders promoting the development of offshore wind energy and directing New Jersey to re-enter the Regional Greenhouse Gas Initiative to combat the real threat of climate change and to establish New Jersey as a leader in developing offshore wind energy and the infrastructure to build an economy around sustainable, clean technologies of the future. The January 31 executive order

directs the New Jersey Board of Public Utilities and Department of Environmental Protection to work together and establish an Offshore Wind Strategic Plan for New Jersey with a goal of

producing 3,500 megawatts of offshore wind energy by 2030, enough energy to power more than 1.5 million homes with clean, renewable offshore energy. The strategic plan will focus on job growth, workforce development, data collection, appropriate determination of facilities and ensuring that our natural resources are protected. Thus, New Jersey is moving toward the cultivation of clean energy technology; opening the Atlantic OCS to oil and gas drilling would significantly hinder this policy.

New Jersey has broad public and bipartisan opposition to development of oil and gas in the Atlantic, which has been clearly articulated by New Jersey governors. In addition, New Jersey's congressional delegation and state legislature oppose this effort as it is not in the interest of New Jersey, with BOEM's analysis grossly undervaluing the importance of New Jersey's coastal environment, our economy and our residents' clear desire to move beyond fossil fuels. Section 18 of the Draft Proposed Program states that BOEM has included planning areas because in 18 of the 26 coastal states at least one adjacent state has expressed desire to be included. This clearly ignores the fact that only one of the 14 Atlantic Coast governors, the governor of Maine, supports inclusion in the program, and even in Maine, the senators strongly oppose inclusion in the program.

Moreover, in light of the Secretary of Interior's recent action apparently exempting the state of Florida from the program, it is requested that the Mid-Atlantic and North Atlantic planning areas be removed from consideration as well. Should Florida be removed from the program, all other states whose economy and environment rely upon coastal resources should also be removed from the program. Further, the lack of an explanation as to why Florida may enjoy an exemption while other states do not render the action arbitrary and capricious.

None of the options outlined in the Draft Proposed Program for the Atlantic region are worthy of consideration. First, there is no articulated basis supporting the buffer zones. The program proposes to include regions of the North-Atlantic OCS which, upon proper application of Section 12(a) of the OCSLA, must be excluded. The Assessment Unit used by BOEM identifies areas offshore New Jersey with the highest-estimates of gas resources, which are located in the most ecologically sensitive areas and thus the risks to our state easily outweigh any marginal benefits. As outlined in previous OCS oil and gas program documents where these regions were removed from consideration, it was noted that the resource potential is poorly understood and out of date. As explained in BOEM documents on the historical background of exploration in this region, the area offshore New Jersey had wells with natural gas shows, but their rates were variable and declining over time and all were abandoned as noncommercial. BOEM concluded then that these regions are questionable for commerciality for a variety of reasons, e.g. reservoir continuity, flow baffles, production rates, and costs. Moreover, the current Draft Proposed Program glosses over the volumes of resources being utilized onshore, casting further doubt upon the need and usefulness of including this region in the program. And as noted in previous program documents, the region lacks the infrastructure necessary to support oil and gas exploration and development, including, crucially, the infrastructure necessary for spill preparedness and response.

Oil and gas exploration and drilling in the Mid-Atlantic or North Atlantic OCS could have devastating effects on these environmentally and economically vital resources, which New

Jersey nearly lost to Superstorm Sandy in 2012. New Jersey cannot afford to expose its treasured coastal communities to the threats posed by the Draft Proposed Program**.** Section 18 of the OCSLA requires consideration of eight factors to determine the timing and location of exploration, development, and production of oil and gas within the OCS. Upon review of the Draft Proposed Program, the state has determined that the assessment contained within the Draft Proposed Program does not adequately identify and consider the potential impacts to New Jersey's coastal uses and resources. It is the state's position that adequate consideration of these factors would require exclusion of the Atlantic region from the program. Following is a compilation of inaccuracies in the Draft Proposed Program, as well as, that must be considered by Secretary Zinke, and which require New Jersey's exclusion from the program.

Economic Impacts

The following statement on page 6-28 of the January 2018 *BOEM Draft Proposed Program* contains several errors:

"The North Atlantic supplies much of the fish and shellfish consumed in the United States, with Maine having the highest landings value (almost $600 million), followed by Massachusetts (more than $500 million) for 2015 (NMFS 2015). The economic impacts of commercial fishing along the entire Mid-Atlantic Planning Area total almost $7 million in total value added (GDP); the industry is especially large in New York and New Jersey, which contribute $2.2 and $2.8 million to the GDP, respectively (NOAA 2012)."

It is important to note that NOAA's fishery management regions are not the same as BOEM's regional planning areas defined in the Draft Proposed Program. For example, New Jersey and New York are part of the NOAA Mid-Atlantic region, but they are in the North Atlantic regional planning area designated in the Draft Proposed Program. The values in the last sentence of the paragraph above, from page 6-28 of the Draft Proposed Program, appear to be taken from a 2014 U.S. Department of Commerce report titled, "Fisheries of the United States 2012" (NOAA Technical Memorandum NMFS-F/SPO-137). In the NOAA Technical Memorandum, the values are billions, not millions as incorrectly shown in the Draft Proposed Program. In fact, the same NOAA memorandum that BOEM references above shows that the seafood industry is an important part of the New Jersey economy and a large part of the total U.S. seafood economy. New Jersey ranks fourth in the nation for total sales generated by the seafood industry ($7.9 billion), fifth in total value-added impacts ($2.9 billion), and seventh in jobs supported by the seafood industry (50,754 jobs in 2012).

In addition to the large economic contribution from the coastal-dependent seafood industry in New Jersey, which includes the commercial fishing industry, there is a large and robust recreational fishery along the entire New Jersey coast. NOAA (2017) reports that among all Atlantic coast states, New Jersey ranks second in direct jobs supported by the recreational fishing industry (16,096), second in annual sales ($1.8 billion), second in total annual income ($786 million) and third in number of recreational fishing trips annually (4.3 million). Figures 4. 5, and 6 depict areas used by the dredge, bottom trawl and long line fishing industry. The

seafood, commercial fishing and recreational fishing industries clearly represent an important contribution to New Jersey's annual GDP. Recreational fishing, along with other recreational coastal activities, also provides a significant quality-of-life opportunity for millions of New

Jersey's residents. The potential risk of both short-term and long-term damage to these industries and activities from OCS gas and oil drilling is a serious threat to the state's well-being if BOEM's proposal to expand leasing off the New Jersey coast is implemented. Figure 7 is a visual depiction of data relating to the gross domestic product of revenue of the business activities in the six economic sectors that are dependent on the resources of the oceans. These include: marine construction, living resources, offshore mineral extraction, ship and boat building, tourism and recreation, and a total of all ocean sectors. This information is harvested from the Economics: National Ocean Watch (ENOW). The ENOW data provides time-series data on the ocean and Great Lakes economy, which includes six economic sectors dependent on the oceans and Great Lakes, and measures four economic indicators: Establishments, Employment, Wages, and Gross Domestic Product (GDP). The annual time-series data are available for about 400 coastal counties, 30 coastal states, 8 regions, and the nation.

BOEM acknowledges the importance and value of coastal tourism to the State of New Jersey. On page 6-29 of the Draft Proposed Program, BOEM estimates that ocean-dependent tourism generates $10.8 billion in New Jersey. In fact, the impact of coastal tourism in New Jersey may be even larger. New Jersey's tourism sector, overall, generated $37.3 billion of state GDP in 2015, representing 6.6 percent of the entire state economy (Tourism Economics, 2015). Also in 2015, tourism demand in New Jersey grew by 3.3 percent to reach $43.4 billion. (Tourism Economics, 2015) The coastal counties of Cape May, Atlantic, and Ocean contributed 42 percent of tourism direct sales and 31 percent of direct tourism employment. (Tourism Economics, 2015) Further, New Jersey tourism industry directly supported 318,330 jobs in 2015 and sustained more than 512,000 jobs including indirect (supply chain) impact and induced (spending of tourism generated incomes) impact. (Tourism Economics, 2015) It is important to note that, including all impacts, the tourism industry accounts for 9.9 percent of total employment or nearly 1 in 10 jobs in New Jersey. (Tourism Economics, 2015) Moreover, including indirect and induced impacts, tourism in New Jersey generated $10.2 billion in government revenues in 2014, including $2.7 billion in state and local tax revenues. (Tourism Economics, 2015) Finally, wildlife-related tourism was estimated to generate about $3 billion annually in 2004 (NJDEP, 2007). Much of the wildlife-related tourism in New Jersey is coastal and related to migratory birds.

On page 6-33 of the Draft Proposed Program, BOEM states, "Through November 2017, BOEM has issued 30 agreements for approximately 69 million cubic yards of OCS sand for beach nourishment and coastal restoration projects along the Atlantic coast from New Jersey south to Florida." For the period 1960-2013, New Jersey received 11.7 percent of this beach nourishment volume to buffer against storm damage (NOEP 2014). Beaches, including dunes, provide by far the highest ecoservice value per acre due to their ability to reduce or eliminate damage from flooding and storm surge during storm events (NJDEP 2007). Loss of this resource resulting from reduced accessibility from undersea pipelines or environmental damage from an oil spill would be detrimental to the state's prominent coastal economy.

While BOEM in Chapter 7 discusses the environmental sensitivity and marine productivity of each region's natural capital, it does not clearly define the economic value of the good and services from nature. The total value of New Jersey's natural capital in 2004 dollars is about $20 billion per year (NJDEP 2007). In 2010, the Delaware Estuary watershed across Delaware, New

Jersey and Pennsylvania provided an estimated $12.1 billion in ecosystem services, from wildlife viewing to flood protection, which would equate to $392 billion in net present value over the next 100 years, assuming a three-percent discount rate (NOEP 2014). The annual value of the services provided by New Jersey's natural capital is estimated as high as $19.8 billion in 2004 dollars with wetlands ($9.4 billion for freshwater and $1.2 billion for saltwater) and marine ecosystems ($5.3 billion for estuaries/tidal bays and $390 million for other coastal waters) having the highest ecoservice values (NJDEP 2007). Annual value of goods provided by New Jersey's natural capital is estimated as high as $9.7 billion in 2004 dollars with farmland, marine waters, and quarries providing the highest values of goods (NJDEP 2007).

Moreover, New Jersey questions whether BOEM has adequately considered eventual offshore decommissioning expenses. When the drilling infrastructure is no longer economically viable, the state may be left with a big, expensive problem. In the North Sea, for example, total cost to decommission approximately 2,500 wells, 200 platforms, and thousands of miles of pipelines over the next five years could exceed $5 billion (E&E News, Feb. 2, 2018). Currently, California is seeking over $100 million in public funds to decommission two offshore oil sites abandoned by bankrupt companies (E&E News, Feb. 6, 2018). New Jersey would not burden its residents with decommissioning expenses.

The statement at the top of page 6-32 of the January 2018 *BOEM Draft Proposed Program*, "Renewable energy leasing that could occur during the approximately 40- to 70-year lifespan of producing leases issued during the 2019-2024 Program will need to be coordinated during the later stages of BOEM's oil and gas leasing process, if oil and gas leasing occurs…" could disrupt New Jersey's immediate plan for offshore wind generation. Governor Murphy signed Executive Order No. 8 on January 31, 2018, directing the New Jersey Board of Public Utilities and Department of Environmental Protection to establish an Offshore Wind Strategic Plan for New Jersey with a goal of producing 3,500 megawatts of offshore wind energy by the year 2030. Currently, New Jersey ranks fourth behind North Carolina, South Carolina and Florida for potential 15.8 gigawatts of offshore wind, equivalent to 1.25 BOE (billions of barrels of oil equivalent) from 20 years of offshore wind, compared to 0.19 BOE from offshore oil and gas. (Oceana, 2015). Further, the projected lifetime jobs created from offshore wind in New Jersey is 22,212 compared to 3,476 created from offshore oil and gas. (Oceana, 2015)

Another cost of environmental damage results from emissions of greenhouse gases through leakage and from end-use combustion of oil and gas. Recent court decisions have directed the Federal Energy Regulatory Commission to estimate the greenhouse-gas emissions from projects it reviews as part of the NEPA EIS process and to consider in the approval process. OCS drilling projects should be held to the same standard. Most of the potential damage estimates and analysis in the Draft Proposed Program relate to oil spills. In addition, BOEM should provide a rigorous analysis of the potential damages related to natural-gas exploration and development in the OCS.

Additional Economic Considerations:

- BOEM should require benefit-cost analysis for all offshore drilling actions/projects.
- BOEM should require cradle-to-grave reporting of carbon emissions.
- BOEM should address the possibility of contaminant and oil-spill transport from other planning areas to New Jersey via the Gulf Stream and other ocean currents.
- If fracking is not prohibited outright, BOEM should conduct a rigorous analysis of the possible impacts from spills of fracking fluids, disposal and treatment of fracking wastes and transportation of fracking fluids and wastes to and from OCS facilities.
- The federal government, in partnership with New Jersey, has invested decades tremendous resources in beach nourishment and dune-building projects along much of the New Jersey coast. These investments should not be threatened by leasing the OCS off New Jersey for oil and gas exploration and development.
- New Jersey is concerned with the fate of our wetlands, as thousands of wells drilled and thousands of miles of pipelines laid in Louisiana's wetlands have allowed the Gulf of Mexico's salt water to intrude, killing soil-anchoring plants and trees and allowing coastal land to slip away. The oil and gas industry has acknowledged causing 36 percent of all wetlands loss in southeastern Louisiana. (Facing South, 2015)
- BOEM should address coral protection. The New England Fishery Management Council voted to expand coral protections in the Atlantic Ocean from the Canadian border to Florida about 100,000 square miles of coral habitat. The Commerce Department will implement the changes. (E&E News, Jan. 31, 2018)

The U.S. Energy Information Administration indicates that shale gas production is outpacing regional demand in New Jersey. On November 14, 2016, the New Jersey Division of Rate Counsel challenged the need for a major new natural gas pipeline in New Jersey. This Draft Proposed Program does not provide sufficient information regarding the purpose and need of OCS oil and gas drilling off the coast of New Jersey. Furthermore, any additional supply of oil and gas from a source off of the coast of New Jersey has not been demonstrated, at this time, to specifically benefit New Jersey residents.

Consideration of the foregoing information is required under 43 USCA 1344(a)(2)(A)-(H), and should lead the Secretary to determine that the character of New Jersey's environment and economy do not support allowing lease sales to occur in the Mid-Atlantic and North Atlantic planning areas. These areas must be excluded from the oil and gas leasing program.

Oil Spill Impacts

New Jersey has significant concerns regarding the impacts of potential oil spills. The following statement on page 5-19 (and reiterated on page B-8) of the January 2018 *BOEM Draft Proposed Program* raises significant concern:

"Given the unpredictable nature of catastrophic oil spills, including the many factors that determine severity, efforts to quantify unexpected costs are less meaningful and more uncertain than the other measures considered in the NSV [net social value] analysis. In addition to the difficulty in calculating the cost of the potential impacts of a catastrophic spill, there are similar difficulties in calculating the risk. For these reasons, the risk and impact of catastrophic oil spill are not considered in the NSV analysis."

Similarly, on page 7-31, the draft proposed program reads:

"The decision to lease under the 2019-2024 Program does not alter existing oil and gas activities on the OCS or the possible environmental impacts from those activities." Table 7-4 on page 7-36 is misleading as the probabilities are calculated for large (>=150,000 bbl) spills only. The risk from all sizes of spills should be evaluated, as NOAA states that "Even relatively small oil spills can cause major harm…" (NOAA 2018).

These statements are of particular concern because, depending upon the drilling fluids used, the sediment type, and other environmental factors, drilling fluid contamination has been detected up to 6000m (3.7miles) away from an oil well, contributing to decreased species diversity, assimilation of contaminants in organism tissue, and lower overall biomass (Ellis et al. 2012). Impacts to the benthic environment can have cascading adverse effects throughout the ecosystem and needs to be fully evaluated in any assessment for oil and gas exploration. Table 7-3 on page 7-35 of the Draft Proposed Program indicates that the likelihood of a spill resulting from loss of well control, that is, only a subset of spills that have occurred from all OCS drilling-related activities. Table 7-3 shows the likelihood of a spill from loss of well control is approximately 0.002 per well, which is 40 to 100 times more likely than the large spills shown in Table 7-4. Examples of other catastrophic spills that have occurred within the past 30 years are:

- Exxon Valdez spilled nearly 11 million gallons crude oil (March 1989); cleanup cost $2-3 billion;
- Ixtoc I exploratory oil well spilled 130 million gallons (June 1990); cleanup cost $100 million;
- MV Prestige released more than 20 million gallons heavy fuel oil, crude #4 (November 2002); cost of disaster $2.8 billion;
- Hurricane Ivan (September 2004) triggered an undersea landslide that toppled an oil platform, spilling an estimated 300,000 to 1.4 million gallons of oil over at least 11 years; federal officials have said it will continue for another century until the reservoir is empty
- Katrina (August 29, 2005) caused at least 10 oil spills, resulting in an estimated 8 million gallons of oil spilled onto the ground and into waterways from Louisiana to Alabama;
- Katrina and Hurricane Rita (September 24, 2005) damaged a total of 457 pipelines and destroyed 113 offshore drilling platforms, resulting in about 750,000 gallons of petroleum products spilling from offshore platforms, rigs, and pipelines;
- BP Deepwater Horizon spilled 210 million gallons (April 2010); cleanup cost $42-62 billion; and,
- Hurricane Isaac (August 28, 2012) caused infrastructure failures at fossil fuel transport, storage and refining facilities, allowing contaminated water to spill into surrounding wetlands, waterways, and communities.

In addition to the immediate impacts associated with a spill, a key consideration in oil-spill response is how the oil is removed. Many microbial species are capable of degrading oil under the right environmental conditions. Specific studies on the type of microbial communities that exist to degrade oil have not been conducted in New Jersey, but results from previous studies indicate that biostimulation was successful to aid in degradation of oil in marsh sediments associated with the 1990 Arthur Kill spill (Burger, 1994). Total petroleum hydrocarbon (TPH) concentrations were consistent throughout the summer of 1990 in Arthur Kill sediments.

Measured concentrations were steady at approximately 2 mg/kg TPH in the study area, indicating that no natural degradation was occurring. Specialized fertilizer (a proprietary

compound formulated based on experience gained from the Exxon Valdez oil spill) was applied to marsh sediments 8 months after the initial spill, at which point significant decreases in hydrocarbon concentrations were measured (Nixon and Michel, 2017). These studies indicate that New Jersey's temperate climate may be not suitable for efficient natural degradation of hydrocarbons. The ideal temperature for marine degradation of hydrocarbons is between 15-20 degrees Celsius (Das and Chandran, 2011). The annual average temp for coastal New Jersey waters are 12-13º C, with June-October exceeding 15º C on average. In addition, residual crude oil can be expected to remain in the environment for a long period of time following a spill. For example, some crude oil product (~0.6%) is still present in Prince William Sound sediments following the 1989 Exxon Valdez oil spill, down from the estimated 2% residual that was calculated in 1992 (Nixon and Michel, 2017).

Any future assessments of the impacts associated with oil and gas exploration should take into consideration the environmental impact and economic costs of remediation of a spill.
The Draft Proposed Program also fails to recognize the potential economic losses for the commercial and recreational fishing industries due to oil spills or other chemical contamination. Such impacts are not limited to offshore fisheries. New Jersey has a thriving estuarine shellfish industry, stretching from Delaware Bay north to Raritan Bay. Species of importance include Eastern oysters, hard clams and blue crabs. In Delaware Bay between the years 2012-2014, the expanding shellfish aquaculture industry contributed an annual average of $866,000 in ex-vessel value to the fishery, equating to an added value of $5.1 million annually to the New Jersey economy. In the same region, the ex-vessel value of wild harvest oysters in 2017 alone was approximately $6.2 million ($37.5 million in added value), a record high at a sustainable fishing level since 1998. Since 2004, New Jersey has invested over $6 million in the shell-planting program that augments the total allowable catch for the industry by about 25% each year. An offshore oil spill or pipeline route leak could be devastating to both industries, immediately making shellfish unsuitable for harvest and potentially reducing habitat, spat set and harvest in years to come. It would also render the state's significant investment in the industries worthless. Additionally, while not fully described here, the state's Atlantic Coast estuarine shellfish harvest, including harvest in the Raritan Bay, also contributes significantly to the economy and is equally subject to economic loss as the Delaware Bay fishery. Any future analysis needs to incorporate these facts.

Oil spills, such as the well-known BP Deepwater Horizon disaster, will have detrimental consequences on a variety of marine wildlife species and their habitats. Consumption of and exposure to oil or tar balls, along with direct oiling, will have serious impacts, including mortality, on wildlife such as breeding and migratory shorebirds, ospreys, bald eagles, wading and water birds, waterfowl, loons and gannets, sea turtles, seals, diamondback terrapins, cetaceans, fish and invertebrates. Oils spills occurring off New Jersey will not only eventually impact sensitive coastal zones, but also have serious, long-term consequences on wildlife and habitats of the Delaware Bay. The largest population of spawning horseshoe crabs in the world, whose eggs are a critical source of nourishment to migrating shorebirds, including the federally threatened red knot, exists within Delaware Bay, making its shorelines and ocean waters a

critical link to the migratory path of a wide variety of avian fauna. Furthermore, oil spills from offshore drilling may threaten operation of nuclear and other power plants along the coast and in Delaware Bay by clogging cooling water intakes, thereby risking shutdowns, interruption of

power grids and ultimately economic loss. The Draft Proposed Program failed to take these specific impacts into consideration and any future analysis must address these concerns.

The Draft Proposed Program has also failed to conduct a fulsome analysis of New Jersey's network of prime fishing areas, also known as sport ocean fishing grounds, that are particularly attractive habitats to a variety of fish species. These natural features are complemented with New Jersey's extensive network of artificial reefs. New Jersey demonstrated its commitment to our fishing industries by reinvigorating the Artificial Reef Program in 2016. The investment of taxpayer dollars and private fishing organization contributions to the artificial reefs would be largely negated by an oil spill, either at a well or along a pipeline route. Figure 1 depicts the documented sport ocean fishing grounds and artificial reefs ranging from 30 feet of water with a proximity to the beach of less than a mile and extending offshore to the outer continental shelf and shelf break of the vibrant offshore canyons with depths of 300-6,000 feet. Along with the diverse habitat available in the New York Bight comes diverse species richness that should be conserved with sound management practices excluding development of the ocean floor.

Consideration of the catastrophic effects of oil spills, even small spills, is required under 43 USCA 1344(a)(2)(A)-(H). The information provided above mandates that the North and Mid-Atlantic planning areas be excluded from the oil and gas leasing program; the Secretary must not risk such disastrous impacts to our State's environment and economy.

Marine Species Impacts

The Draft Proposed Program fails to take into consideration the potential for substantial and irreparable harm to New Jersey's commercial and recreational fisheries, unique marine habitats – especially the New York Bight – and coastal resources. As acknowledged by the Draft Proposed Program, the commercial and recreational fishing industries are especially significant in the North Atlantic Planning area, providing fresh seafood to the United States, contributing millions of dollars to New Jersey's economy annually and supporting thousands of jobs. The Murphy Administration is deeply concerned that exploration and development of oil and gas off New Jersey's near shore and outer continental shelf will detrimentally impact the robust and vibrant commercial and recreational fishing industries in the New York Bight. Outer Continental Shelf oil and gas drilling activities would conflict spatially with existing recreational and commercial fishing grounds. Conflicts would also arise with recreational diving, whale watching and the siting of artificial reefs. Spatial conflicts will also arise with nearshore development of ports, pipelines or other infrastructure associated with oil and gas development. In addition to spatial conflicts, the industries and ecosystem are at risk from oil spill events as well as daily influx of minor oil leaks and the use of chemical drilling fluids. Details of the specific impacts of drilling and spills to fish and their habitats are well-described in the Mid-Atlantic Fishery Management Council's (MAFMC) offshore oil policy, available for review at http://www.mafmc.org/actions/offshore-energy. New Jersey's fisheries are managed, in part, by the MAFMC, and the Murphy Administration concurs with their policy and concerns outlined

at the referenced website above and in their August 7, 2017, letter to BOEM. Any future analysis needs to fully assess these impacts to New Jersey's coastal resources.

The Murphy Administration performed a cursory data analysis on the commercial harvest of three representative species of finfish (summer flounder, black sea bass, scup) and three

representative species of shellfish (sea scallops, ocean quahog, surf clam) landed between 2014 and 2017. Although not exhaustive of all species commercially important to New Jersey, the assessment demonstrates the significant fisheries resource off of New Jersey waters that play an important role in providing a healthy economy. If this resource were to be impacted, there would be significant economic and ecological effects. Staff examined data landed only in New Jersey that was harvested in National Marine Fisheries Service (NMFS) statistical areas 611, 612, 614, and 621, all areas heavily utilized by New Jersey vessels as well as vessels from Massachusetts, Rhode Island, Connecticut, New York, Virginia and North Carolina. During reference years 2014 to 2017, New Jersey accepted an annual average of 1.4 million pounds of summer flounder equating to an ex-vessel value of more than $4.8 million, 2.4 million pounds of scup equating to an ex-vessel value of more than $1.3 million, and nearly 600 thousand pounds of black sea bass equating to an ex-vessel value of more than $2 million. In aggregate, these three species alone are worth approximately $8.1 million in ex-vessel value annually. A similar cursory analysis of shellfish harvest was conducted. During the reference years of 2014 to 2016, the annual average landing of ocean quahog was more than 17 million pounds equating to an ex-vessel value of more than $14 million, 8.5 million pounds of sea scallop equating to an ex-vessel value of more than $102 million, and 18 million pounds of surf clams equating to an ex-vessel value of more than $10 million. When aggregated, these three shellfish species provided an average annual ex-vessel value of $126 million to the New Jersey fishery. In addition, while ex-vessel values are useful in understanding the value of the commercial fishery, it does not reflect the full value added to the greater New Jersey economy. Using an economic multiplier of 6 (McCay et al. 1995), the value added to New Jersey's economy on an annual basis from 2014-2017 using the combined average annual landings of scup, summer flounder, and black sea bass was $48.1 million per year. From 2014-2016, the sea scallop, ocean quahog and surf clam fisheries combined contributed approximately $756 million annually to the New Jersey economy. Figures 8 and 9 depict the surf clam, ocean quahog and sea scallop fisheries.

Any future public outreach that BOEM may need to undertake should be coordinated with the fisheries management councils, the National Marine Fisheries Service, and state agencies to assist with outreach to their commercial and recreational fishing interests.

The Draft Proposed Program failed to fully address impacts to the federally endangered Atlantic sturgeon that occurs along the coast of New Jersey, with some individuals spawning in the lower portion of the Delaware River. If impacts from noise and other project activities disturb Atlantic sturgeon migrating into Delaware Bay for spawning in the river, an entire year class could potentially be lost, accelerating the decline of an already diminishing river stock. In addition, Atlantic sturgeon are vulnerable to injury and mortality from ship strikes, especially in the Delaware River. It is possible that increased traffic, coupled with behavioral changes due to survey activities, may place Atlantic sturgeon at increased risk from ship strikes. Activities such as bottom sampling, drilling of test wells and placement of equipment or structures on the sea

floor could significantly impact this demersal species, along with federally endangered Shortnose sturgeon, that occasionally migrate into ocean waters. Oil spills and other chemical contamination would further adversely affect this Federally protected species.

The Draft Proposed Program also failed to adequately address the significant impacts the exploration of OCS oil and gas deposits will have on New Jersey's coastal resources. The

attached memo, "Impacts of Seismic Exploration Activity on Marine Organisms and Response to the Federal Overturn of Inconsistency Determination; Dated: May 29, 2015," describes in greater detail impacts expected with emphasis on marine organisms and fisheries from seismic activities. For example, at least 37 marine species have been shown to be affected by seismic airgun noise. Recent studies support that marine mammals and sea turtles are especially sensitive to high intensity, low frequency sounds, such as those emitted by seismic airgun surveys (Nelms et al., 2016, Weilgart, 2014, Gordon et al., 2004). Further, noise generated from air guns has been shown to alter the behavior of captive fishes, with an increase in alarm response as noise level was increased (Fewtrell and McCauley 2012). In addition, activities such as pile driving have the potential to impact fish survival with effects such as burst swim bladder and massive internal bleeding (Halvorsten et al. 2011). Although pile driving has not been proposed at this time, the construction that must take place to drill and penetrate the ocean floor to expose gas and oil deposits, along with repeated air gun use, will likely result in similar impacts. April through October is a period of high-to-peak population abundance of several fish species off the coast of New Jersey (Bigelow and Collette 2002, Able and Fahay 1998). Future analysis of the noise impact of exploration and development must address these concerns; at a minimum there should be a requirement that these activities be timed during the winter when populations of commercially and recreationally important fish species are lowest off the coast, equating to a cease-and-desist policy for exploration and development between April and October.

New Jersey's ocean waters act as a migration corridor federally endangered marine mammals and sea turtles that transit between habitats farther north and south. Acoustic detections of whale calls by Geo-Marine Inc. confirmed the presence of right whales during all seasons, concluding that some individual right whales occur in the nearshore waters off New Jersey either transiently or regularly. Other listed marine mammals were also found year-round, including humpback and fin whales (GMI, Inc. 2010). These, other marine mammals and sea turtles will be at risk due to vessel strikes associated with geophysical and geotechnical (G&G) surveys/exploration, construction, and operational/transport activities. Drilling and associated piping would adversely impact seafloor habitat and aquatic life, including prey items for many endangered and threatened species, via disturbance and release of toxins due to accidental frac outs. Also, the installation and operation of drilling platforms may fragment marine habitat, altering the migratory pathways of marine mammals, with individuals potentially shifting into less suitable feeding areas or locations with higher vessel traffic. This issue needs to be assessed with more details on the impact of exploration and drilling on these resources.

In addition, marine mammals, especially cetaceans, may be adversely affected by noise created during G&G exploration, construction and extraction activities. Cetaceans' primary means of communication, navigation, locating food, locating mates and avoiding predators and other

threats is through their sense of hearing, which is much more highly developed than that of humans and can detect sounds within a much wider range of frequency. Noise pollution, in the form of repeated or prolonged sounds, as well as less regular but high-decibel noise may adversely impact marine mammals by disrupting otherwise normal behaviors associated with migration, feeding, alluding predators, rest, breeding, etc. Any alterations to these behaviors may jeopardize the survival of an individual simply by increasing efforts directed at avoidance of the noise and the perceived threat. In addition, animals distressed by noise may become more

susceptible to disease or predation by species that are not directly affected themselves. Furthermore, the proposed activities will add to an existing and increasing cacophony of anthropogenic noise pollution that may already be negatively impacting species of conservation concern. House Bill HR 3133, Streamlining Environmental Approvals Act of 2017, proposes to expedite federal permitting and exempts harmful activities like seismic surveys from ESA requirements such as fully minimizing harm to endangered species. If the bill is signed into law, and G&G exploration moves forward, the legislation could have devastating, and perhaps irreparable, consequences to marine mammal populations off our coast.

Sea turtles likely use sound for navigation, predator avoiding, locating prey, and other activities (Piniak et al. 2012). Although information regarding the impacts of anthropogenic noise on sea turtles is somewhat lacking, there is evidence to suggest that observed effects due to airguns may include behavioral changes, as well as temporary or even permanent hearing loss (Moein et al. 1995). In addition, research by Piniak et al. (2012) suggests that sea turtles are able to hear much of the pervasive low frequency and high intensity noise in the ocean, including sonar, shipping, and oil and gas exploration. Marine waters off New Jersey, along with Delaware Bay, provide critical migration and feeding areas for sea turtle species such as Kemp's Ridley, Green, Atlantic Loggerhead and Leatherback turtles. Sea turtles, mostly reported between June and September, are susceptible not only to impacts, such as behavior changes and hearing loss, from seismic activity, but to entanglement in the seismic array gear, and injuring/mortality due to ship strikes. The extent to which sea turtles will exhibit avoidance behavior and show other impacts from seismic exposure remains unclear. Many sea turtles migrating off New Jersey are juveniles. Effects from airgun noise to smaller turtles will undoubtedly be greater than those observed in monitoring studies, while their ability to swim away from or avoid airgun may be reduced due to their smaller size.

Consideration potential damage to the marine life off New Jersey's coast is required under 43 USCA 1344(a)(2)(A)-(H). The above information shows that these crucial and sensitive animals must not be subjected to the harms caused by offshore drilling and exploration. The North and Mid-Atlantic planning areas must be excluded from the oil and gas leasing program.

<u>Historic and Archeological Impacts</u>

The Draft Proposed Program mentions potential archeological sites offshore. During the last ice age, a significant amount of water was tied up in continental glaciers. The result was a much lower sea level. As a rough approximation the ocean was about 300 feet lower than it is today. The attached map shows the estimated 300-feet depth line off New Jersey's coast as a red line. Areas between the current shore and this red line may have been inhabited in the past and

therefore should be included in any assessment of impacts to historic and archeological resources.

In conclusion, Section 18 of the OCSLA requires consideration of eight factors to determine the timing and location of exploration, development and production of oil and gas within the OCS. As discussed in detail previously, the state has determined that the assessment contained within the Draft Proposed Program does not adequately consider the potential impacts to New Jersey's coastal uses and resources. It is the state's position that adequate consideration of these factors would require exclusion of the Atlantic region from the program.

Literature Cited

Able, K.W. and M.P. Fahay. 1998. The First Year in the Life of Estuarine Fishes in the Middle Atlantic Bight. Rutgers University Press. New Brunswick, New Jersey.

Bigelow, H.B. and B.B. Collette. 2002. Fishes of the Gulf of Maine. Smithsonian Institution Press. Washington, D.C.

Burger, J. (Ed.). (1994). Before and after an oil spill: the Arthur Kill. Rutgers University Press.

Center for the Blue Economy at the Monterey Institute of International Studies. (2014). *State of the U.S. Ocean and Coastal Economies*. National Ocean Economics Program. http://centerfortheblueeconomy.org/wp-content/uploads/2015/01/NOEP_National_Report_2014.pdf

Das, N., & Chandran, P. (2011). Microbial Degradation of Petroleum Hydrocarbon Contaminants: An Overview. *Biotechnology Research International*, *2011*, 941810. http://doi.org/10.4061/2011/941810

Ellis, J.I., G. Fraser, and J. Russell. 2012. Discharged drilling waste from oil and gas platform and its effects on benthic communities. *Marine Ecology Progress Series* 456:285-302.

Fewtrell, J.L. and R.D. McCauley. 2012. Impact of air gun noise on the behavior of marine fish and squid. *Marine Pollution Bulletin* 64(5)984-993 (abstract only).

Geo-Marine, Inc. 2010. Ocean/Wind Power Baseline Ecological Studies, Jan. 2008-Dec. 2009, Final Report. Report to NJDEP, Division of Science, Research and Technology. July 2010.

Gordon, J. C. D., D. Gillespie, J. Potter, A. Frantzis, M. P. Simmonds, R. Swift, and D. Thompson (2014). A Review of the Effects of Seismic Surveys on Marine Mammals. Marine Technology Society Journal. Winter 2003-04, 37(4): 14-32.

Gronewold, N. (2018, February 2). Do Big Finds Point to a rebound? Not in the Gulf. *E&E News*. https://www.eenews.net/energywire/stories/1060072695/search?keyword=offshore

Halvorsten, M.B., B. M. Casper, C. M. Woodley, T. J. Carlson, and A. N. Popper. 2011. Predicting and mitigating hydroacoustic impacts on fish from pile installations. NCHRP Research Results Digest 363, Project 25-28, National

Cooperative Highway Research Program, Transportation Research Board, National Academy of Sciences, Washington, D.C.

McCay, B.J., G. Grant, and A. Adelaja. 1995. *The Status and Condition of New Jersey's Marine Fisheries and Seafood Industries.* (Ecopolicy Center for Agriculture, Environment andResource Issues, New Jersey Agricultural Experiment Station/Cook College, Rutgers, the State University

of New Jersey, Report No. AERDI94-7-95-1). Retrieved from https://doi.org/doi:10.7282/T3Z03824.

Menaquale, A. (January 2015). *Offshore Energy by the Numbers: An Economic Analysis of Offshore Drilling and Wind Energy in the Atlantic*. Oceana. http://usa.oceana.org/sites/default/files/offshore_energy_by_the_numbers_report_final.pdf

Moein SE, Musick JA, Keinath JA, Barnard DE, Lenhardt M, George R (1994) Evaluation of seismic sources for repelling sea turtles from hopper dredges. Report for US Army Corps of Engineers, from Virginia Institute of Marine Science, VA, USA

Nelms, S. E., W. E. D. Piniak, C. R. Weir, and B. J. Godley (2016). Seismic surveys and marine turtles: An underestimated global threat? Biological Conservation 193 (2016): 49–65.

Nixon, Z., & Michel, J. (2017). A Review of distribution and quantity of lingering subsurface oil from the Exxon Valdez Oil Spill. Deep Sea Research Part II: Topical Studies in Oceanograph

NJDEP. (April 2007). *Valuing New Jersey's Natural Capital: An Assessment of the Economic Value of the State's Natural Resources*. http://www.nj.gov/dep/dsr/naturalcap/nat-cap-overview.pdf

NOAA Fisheries. (May 2017). *Fisheries Economics of the United States 2015: Economics and Sociocultural Status and Trends Series*. https://repository.library.noaa.gov/view/noaa/11992

Piniak, W.D.; Mann, D.A.; Eckert, S.A. and C.A. Harms. 2012. Amphibious hearing in sea turtles. In: *The Effects of Noise on Aquatic Life*. A.N. Popper and A. Hawkins, Eds. Springer Sciences and Business Media. Pg. 83-87

Rosenhall, L. (2018, February 6). Calif. Officials Seek Funds for Abandoned Drilling Sites. *E&E News*. https://www.eenews.net/energywire/stories/1060072923/search?keyword=decommission

Sturgis, S. (2015, August 28). The Katrina Oil Spill Disaster: A Harbinger for the Atlantic Coast? *Facing South*. https://www.facingsouth.org/2015/08/the-katrina-oil-spill-disaster-a-harbinger-for-the.html

Tourism Economics. (2015). *The Economic Impact of Tourism in New Jersey: Tourism Satellite Account Calendar Year 2015*. http://www.state.nj.us/state/pdf/2015-nj-economic-impact.pdf

Weilgart, L. (2014). A review of the impacts of seismic airgun surveys on marine life. Submitted to the CBD Expert Workshop on Underwater Noise and its Impacts on Marine and Coastal Biodiversity, 25-27 February 2014, London, UK. Available at: http://www.cbd.int/doc/?meeting=MCBEM-2014-01.

Whittle, P. (2018, January 31). Federal Panel Approves Coral Protections in Atlantic. *E&E News*. https://www.eenews.net/greenwire/stories/1060072493/search?keyword=coral

Figure 1

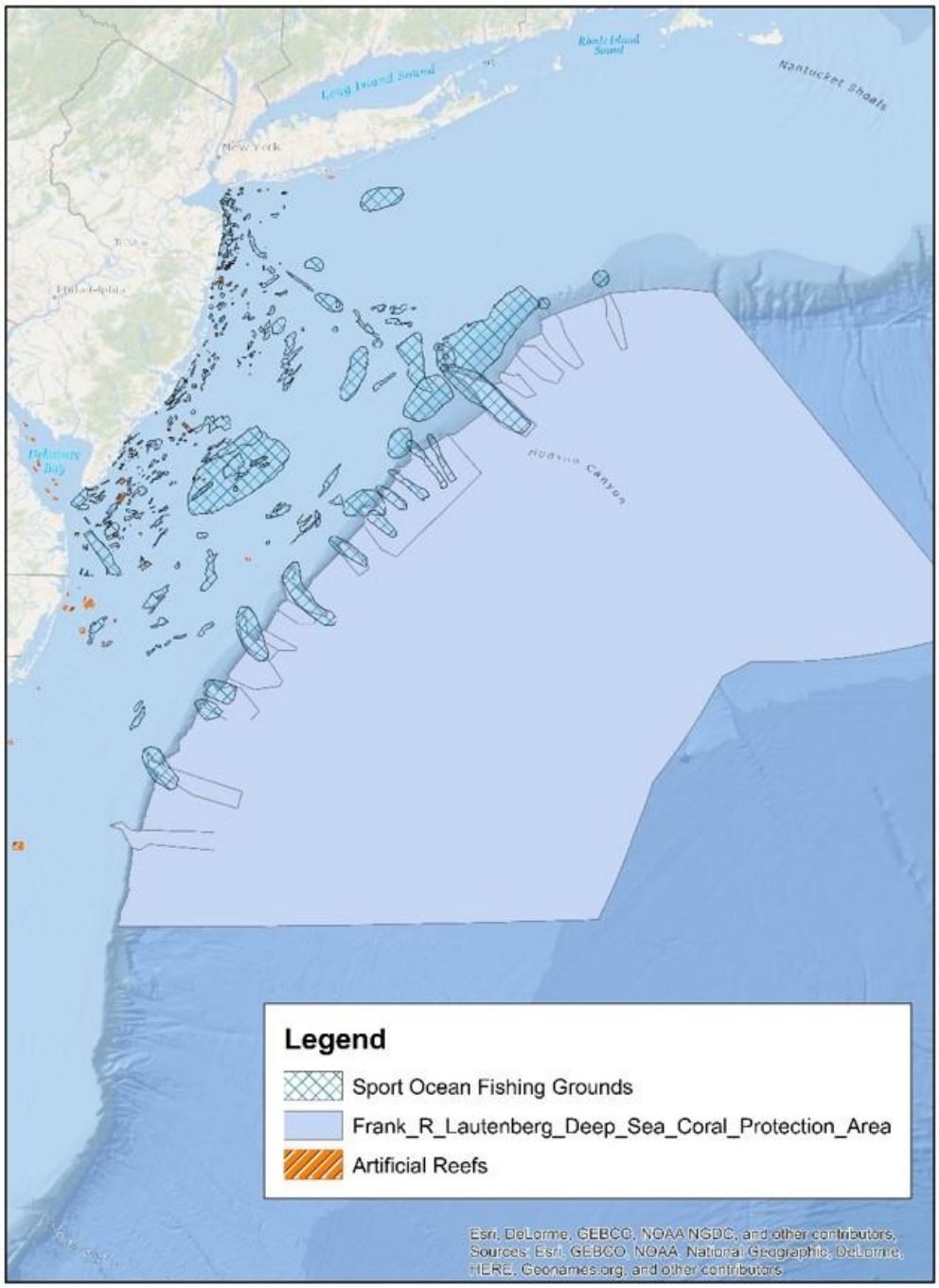

Legend
Sport Ocean Fishing Grounds
Frank_R_Lautenberg_Deep_Sea_Coral_Protection_Area
Artificial Reefs
Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors,
Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme,
HERE, Geonames.org, and other contributors

Figure 2

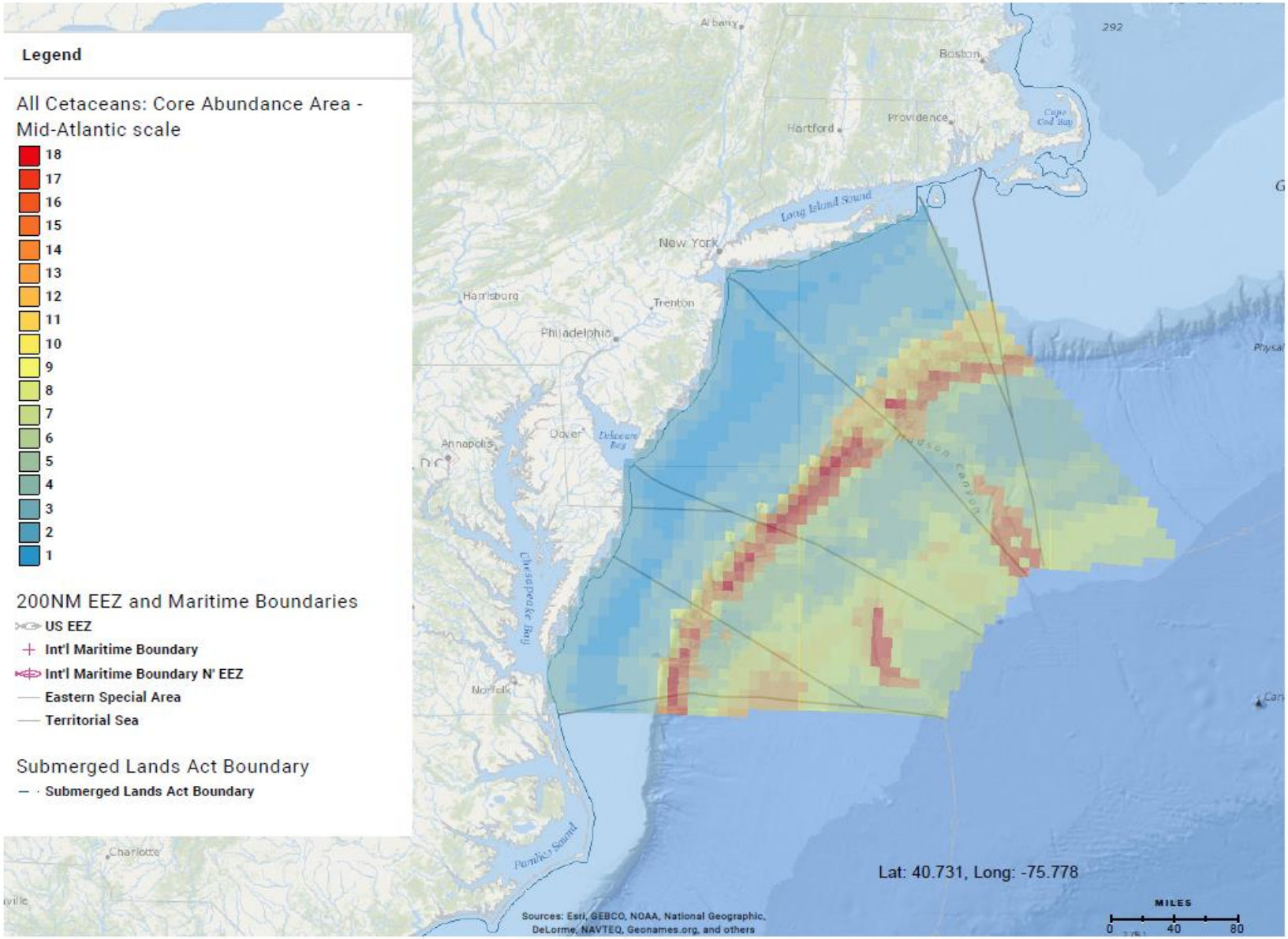

Legend
All Cetaceans: Core Abundance Area - Mid-Atlantic scale
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
200NM EEZ and Maritime Boundaries
US EEZ
Int'l Maritime Boundary
Int'l Maritime Boundary N' EEZ
Eastern Special Area
Territorial Sea
Submerged Lands Act Boundary
Submerged Lands Act Boundary
Albany
Boston
Hartford
Providence
New York
Harrisburg
Trenton
Philadelphia
Annapolis
Dover
Norfolk
Charlotte
Long Island Sound
Hudson Canyon
Chesapeake Bay
Pamlico Sound
Lat: 40.731, Long: -75.778
Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, NAVTEQ, Geonames.org, and others
MILES
0
40
80

Figure 3

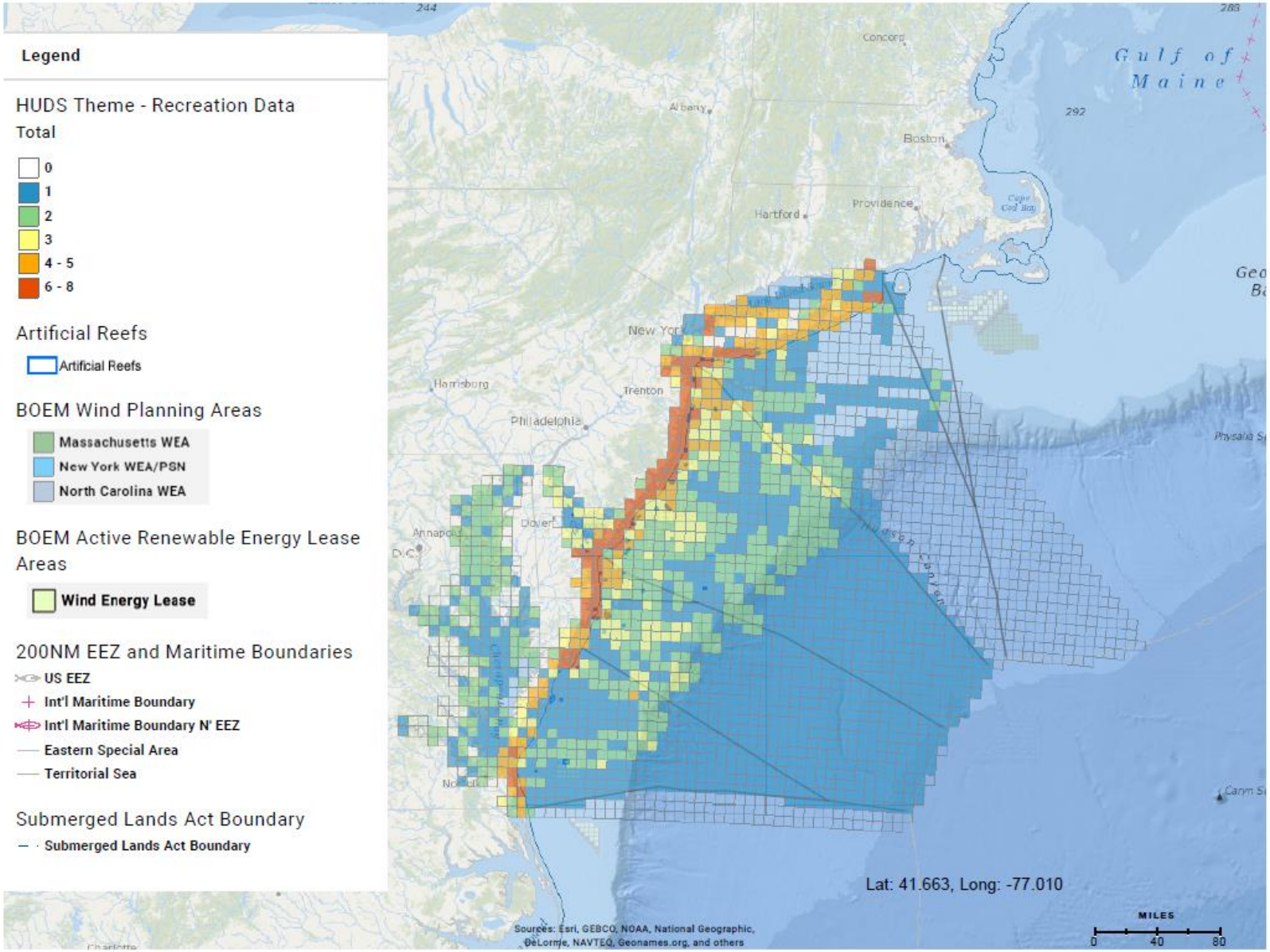

Legend
HUDS Theme - Recreation Data
Total
0
1
2
3
4 - 5
6 - 8
Artificial Reefs
Artificial Reefs
BOEM Wind Planning Areas
Massachusetts WEA
New York WEA/PSN
North Carolina WEA
BOEM Active Renewable Energy Lease Areas
Wind Energy Lease
200NM EEZ and Maritime Boundaries
US EEZ
Int'l Maritime Boundary
Int'l Maritime Boundary N' EEZ
Eastern Special Area
Territorial Sea
Submerged Lands Act Boundary
Submerged Lands Act Boundary
Gulf of Maine
Concord
Albany
Boston
Hartford
Providence
New York
Harrisburg
Trenton
Philadelphia
Annapolis
Dover
Lat: 41.663, Long: -77.010
Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, NAVTEQ, Geonames.org, and others
MILES
0
40
80

Figure 4

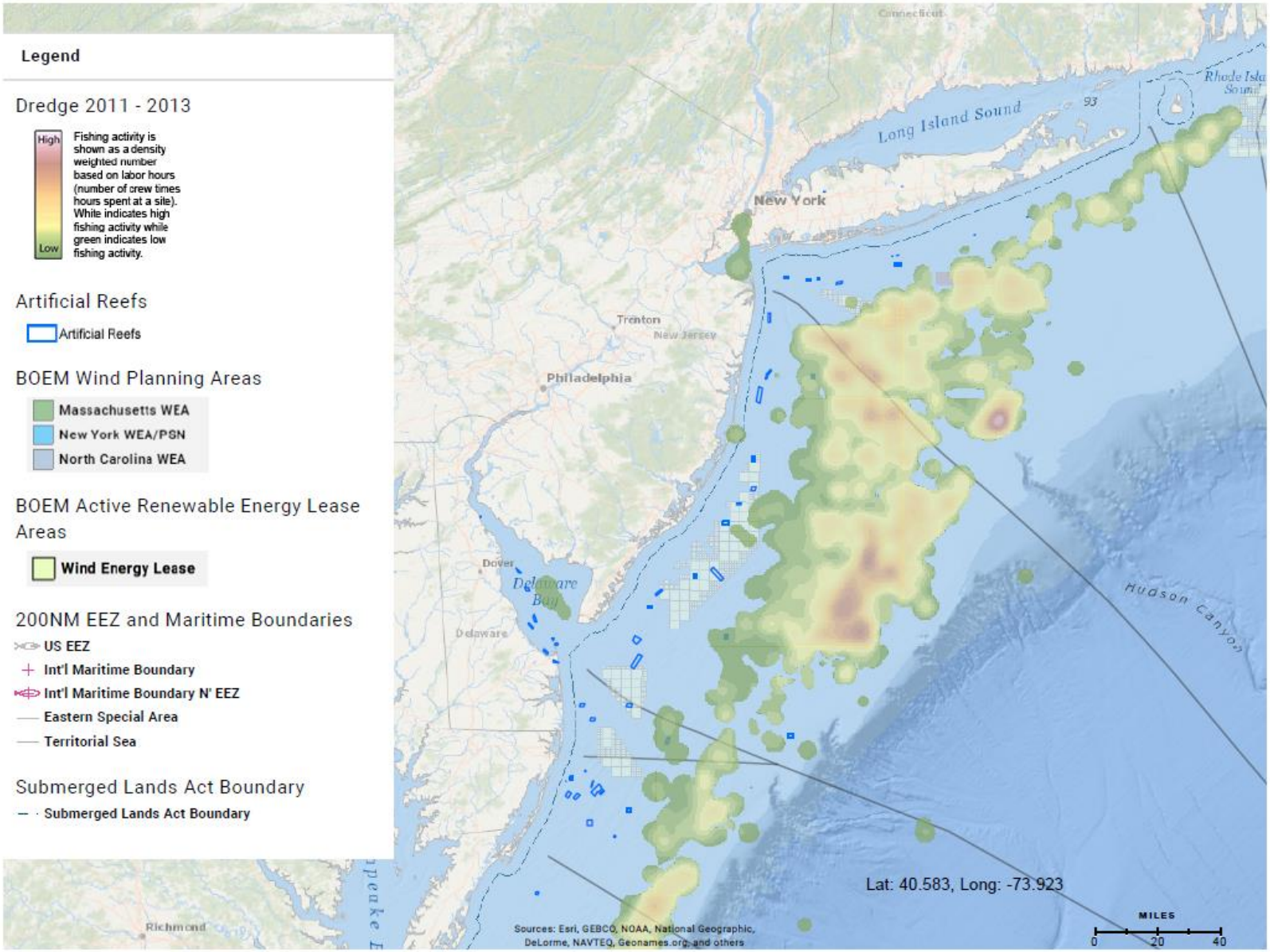

Legend
Dredge 2011 - 2013
High
Low
Fishing activity is shown as a density weighted number based on labor hours (number of crew times hours spent at a site). White indicates high fishing activity while green indicates low fishing activity.
Artificial Reefs
Artificial Reefs
BOEM Wind Planning Areas
Massachusetts WEA
New York WEA/PSN
North Carolina WEA
BOEM Active Renewable Energy Lease Areas
Wind Energy Lease
200NM EEZ and Maritime Boundaries
US EEZ
Int'l Maritime Boundary
Int'l Maritime Boundary N' EEZ
Eastern Special Area
Territorial Sea
Submerged Lands Act Boundary
Submerged Lands Act Boundary
Long Island Sound
New York
Trenton
New Jersey
Philadelphia
Dover
Delaware
Delaware Bay
Hudson Canyon
Richmond
Lat: 40.583, Long: -73.923
Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, NAVTEQ, Geonames.org, and others
MILES
0
20
40

Figure 5

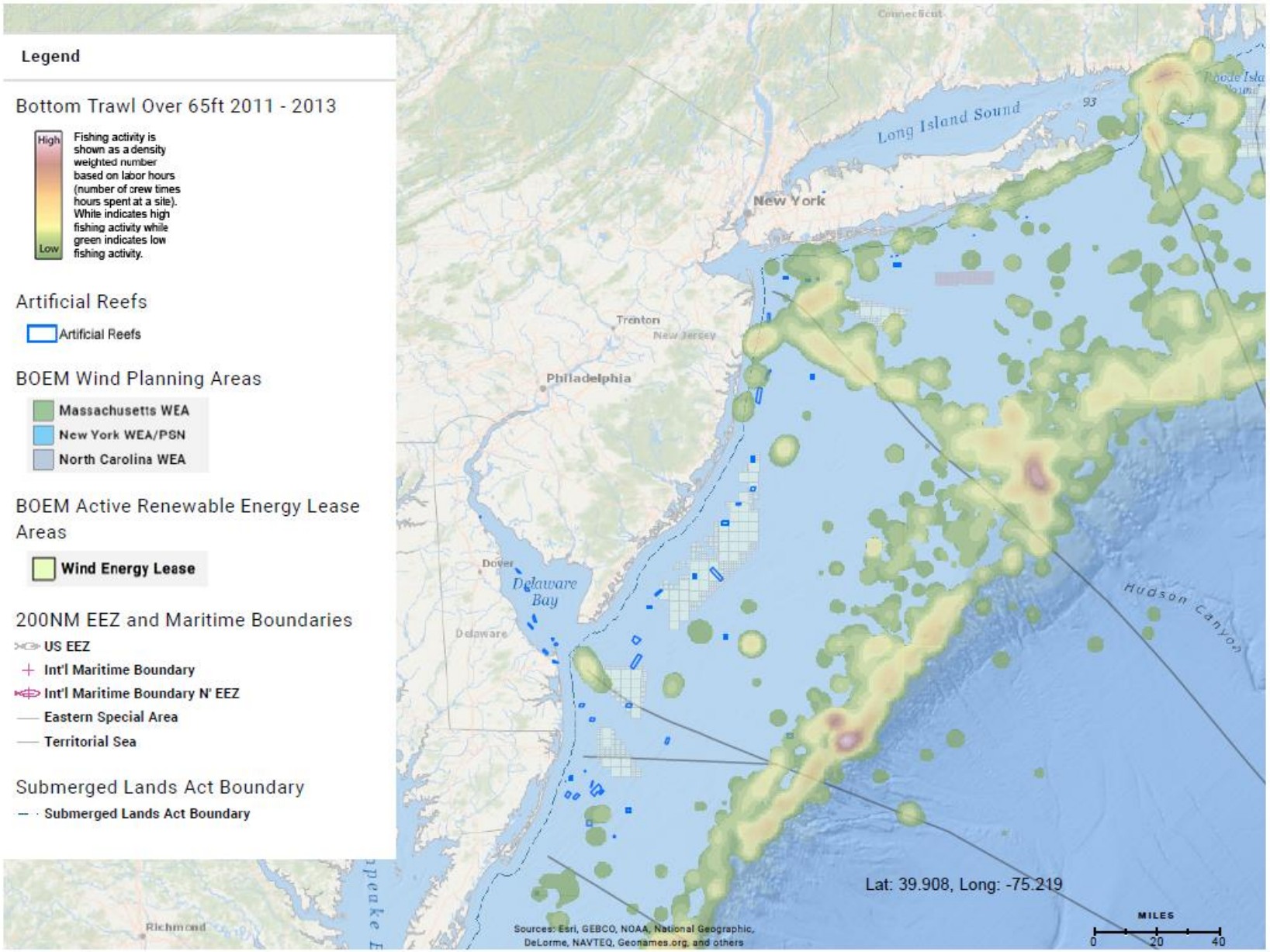

Legend
Bottom Trawl Over 65ft 2011 - 2013
High
Low
Fishing activity is shown as a density weighted number based on labor hours (number of crew times hours spent at a site). White indicates high fishing activity while green indicates low fishing activity.
Artificial Reefs
Artificial Reefs
BOEM Wind Planning Areas
Massachusetts WEA
New York WEA/PSN
North Carolina WEA
BOEM Active Renewable Energy Lease Areas
Wind Energy Lease
200NM EEZ and Maritime Boundaries
US EEZ
Int'l Maritime Boundary
Int'l Maritime Boundary N' EEZ
Eastern Special Area
Territorial Sea
Submerged Lands Act Boundary
Submerged Lands Act Boundary
Connecticut
Long Island Sound
93
New York
Trenton
New Jersey
Philadelphia
Dover
Delaware Bay
Delaware
Hudson Canyon
Richmond
Lat: 39.908, Long: -75.219
Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, NAVTEQ, Geonames.org, and others
MILES
0
20
40

Figure 6

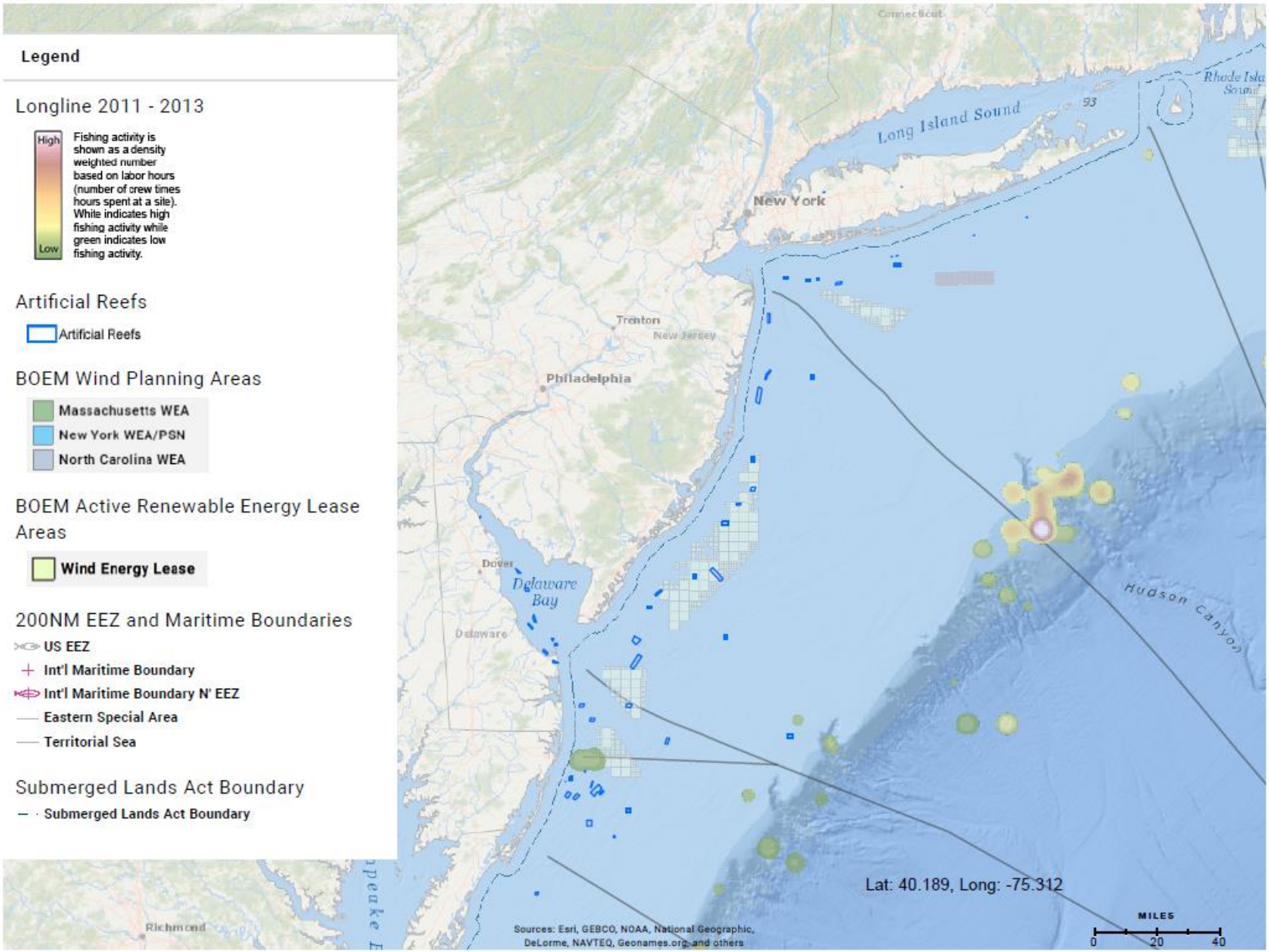

Legend
Longline 2011 - 2013
High
Low
Fishing activity is shown as a density weighted number based on labor hours (number of crew times hours spent at a site). While indicates high fishing activity while green indicates low fishing activity.
Artificial Reefs
Artificial Reefs
BOEM Wind Planning Areas
Massachusetts WEA
New York WEA/PSN
North Carolina WEA
BOEM Active Renewable Energy Lease Areas
Wind Energy Lease
200NM EEZ and Maritime Boundaries
US EEZ
Int'l Maritime Boundary
Int'l Maritime Boundary N' EEZ
Eastern Special Area
Territorial Sea
Submerged Lands Act Boundary
Submerged Lands Act Boundary
Long Island Sound
New York
Trenton
New Jersey
Philadelphia
Dover
Delaware Bay
Delaware
Hudson Canyon
Richmond
Lat: 40.189, Long: -75.312
Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, NAVTEQ, Geonames.org, and others
MILES
0
20
40

Figure 7

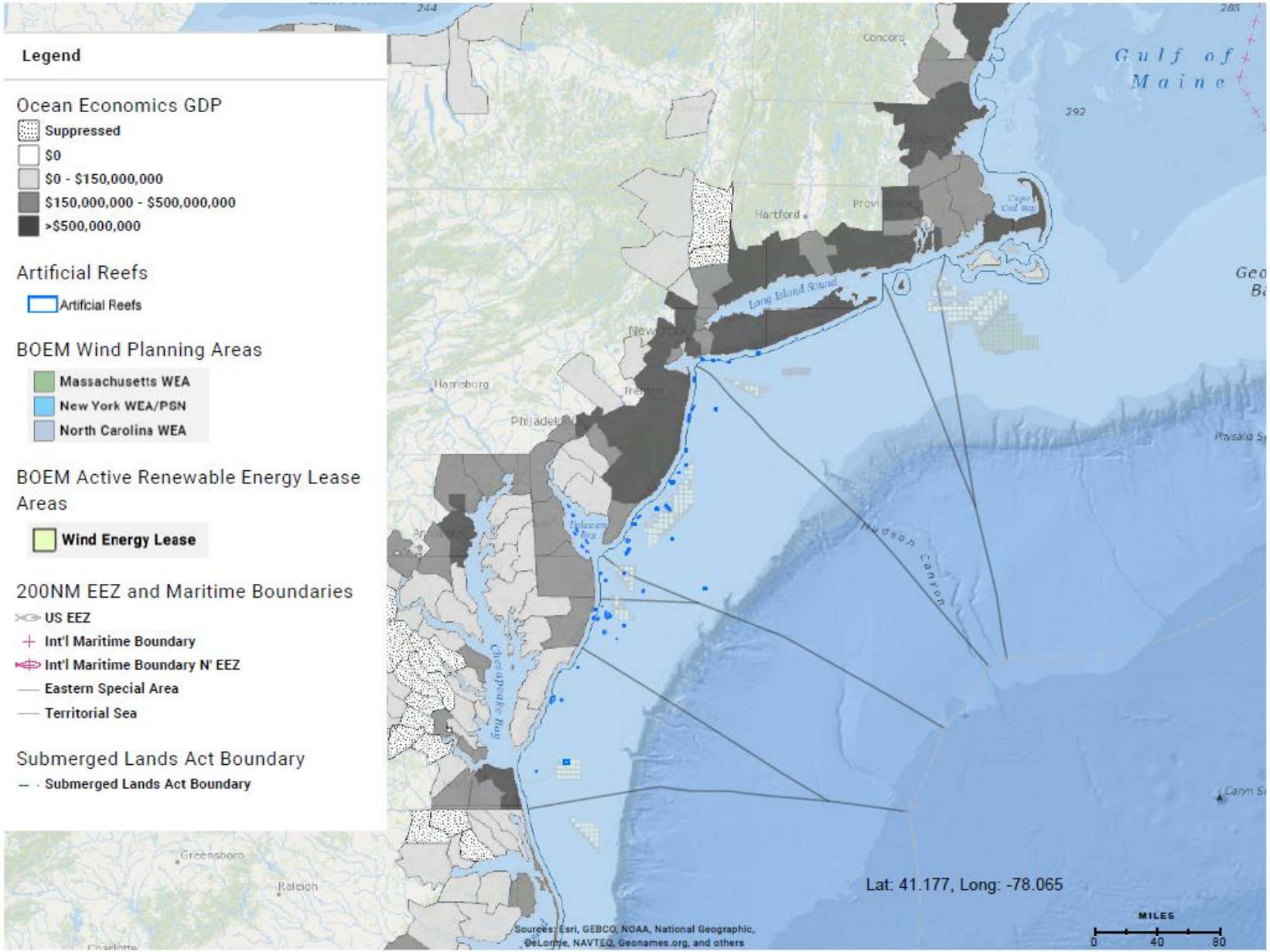

Legend
Ocean Economics GDP
Suppressed
$0
$0 - $150,000,000
$150,000,000 - $500,000,000
>$500,000,000
Artificial Reefs
Artificial Reefs
BOEM Wind Planning Areas
Massachusetts WEA
New York WEA/PSN
North Carolina WEA
BOEM Active Renewable Energy Lease Areas
Wind Energy Lease
200NM EEZ and Maritime Boundaries
US EEZ
Int'l Maritime Boundary
Int'l Maritime Boundary N' EEZ
Eastern Special Area
Territorial Sea
Submerged Lands Act Boundary
Submerged Lands Act Boundary
Gulf of Maine
Concord
Hartford
Long Island Sound
Harrisburg
Philadelphia
Hudson Canyon
Chesapeake Bay
Greensboro
Raleigh
Lat: 41.177, Long: -78.065
Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, NAVTEQ, Geonames.org, and others
MILES
0
40
80

Figure 8

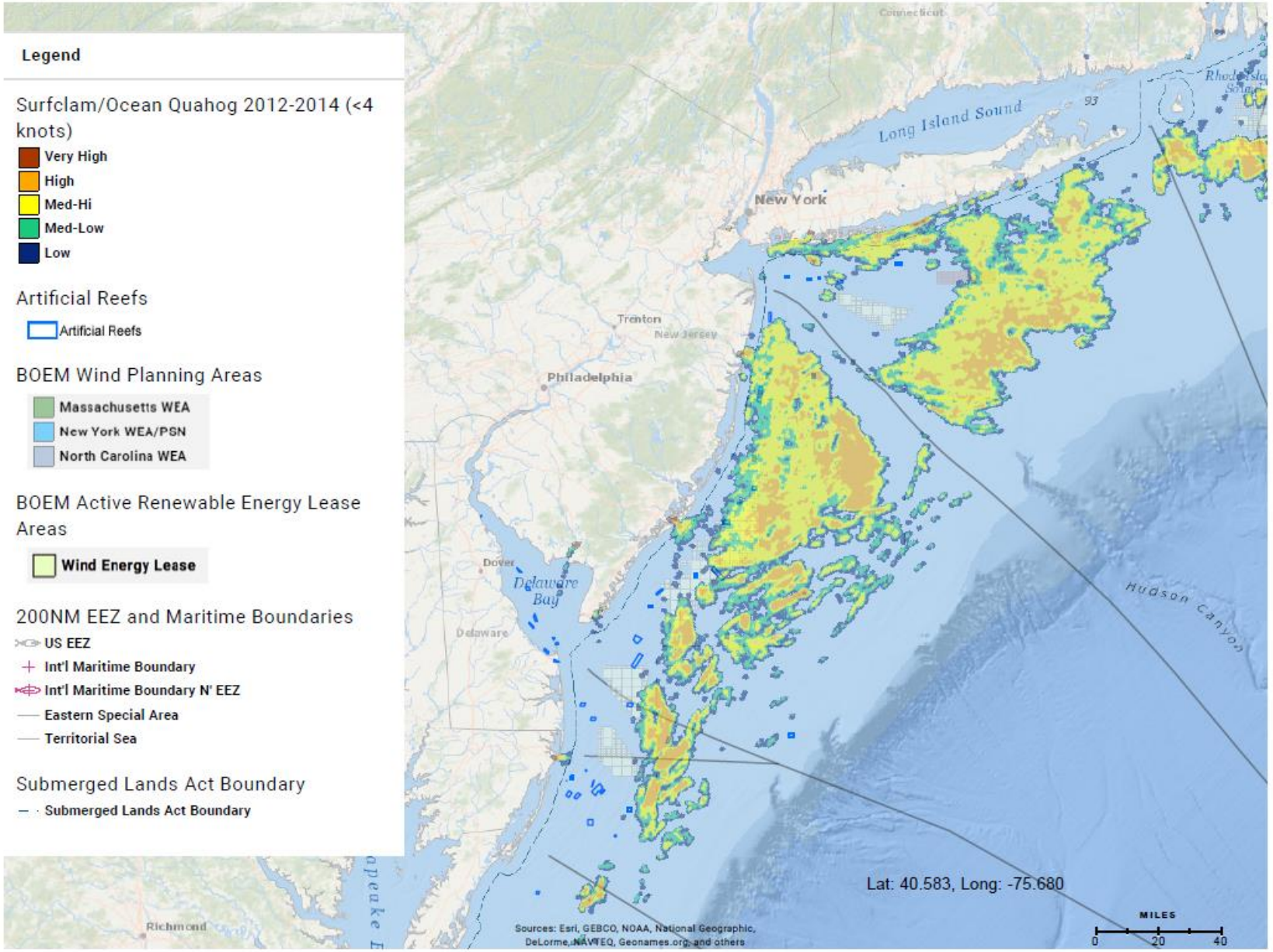
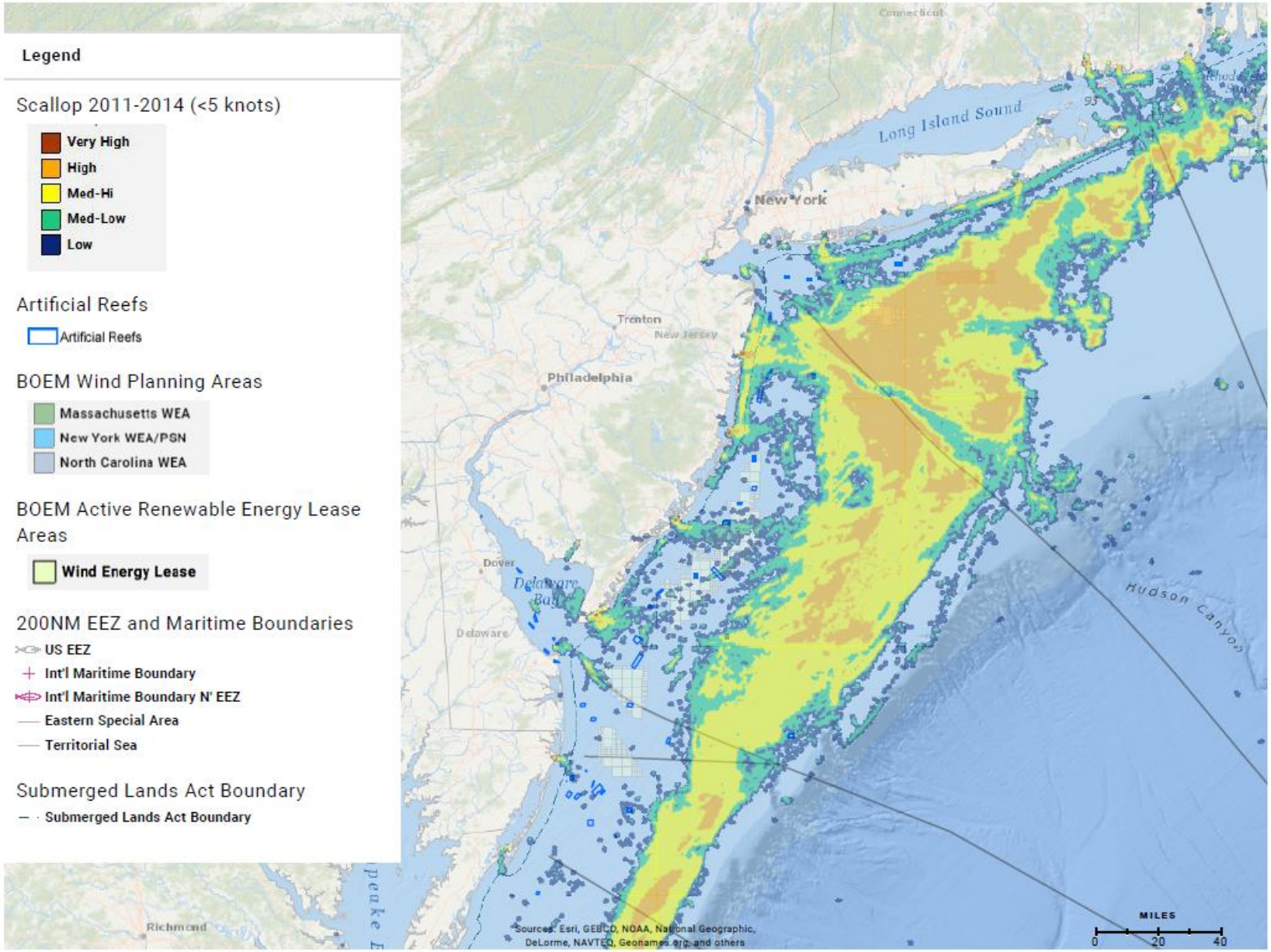

Legend
Surfclam/Ocean Quahog 2012-2014 (<4 knots)
Very High
High
Med-Hi
Med-Low
Low
Artificial Reefs
Artificial Reefs
BOEM Wind Planning Areas
Massachusetts WEA
New York WEA/PSN
North Carolina WEA
BOEM Active Renewable Energy Lease Areas
Wind Energy Lease
200NM EEZ and Maritime Boundaries
US EEZ
Int'l Maritime Boundary
Int'l Maritime Boundary N' EEZ
Eastern Special Area
Territorial Sea
Submerged Lands Act Boundary
Submerged Lands Act Boundary
Connecticut
Long Island Sound
New York
Trenton
New Jersey
Philadelphia
Dover
Delaware Bay
Delaware
Hudson Canyon
Richmond
Lat: 40.583, Long: -75.680
Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, NAVTEQ, Geonames.org, and others
MILES
0
20
40

Figure 9


Legend
Scallop 2011-2014 (<5 knots)
Very High
High
Med-Hi
Med-Low
Low
Artificial Reefs
Artificial Reefs
BOEM Wind Planning Areas
Massachusetts WEA
New York WEA/PSN
North Carolina WEA
BOEM Active Renewable Energy Lease Areas
Wind Energy Lease
200NM EEZ and Maritime Boundaries
US EEZ
Int'l Maritime Boundary
Int'l Maritime Boundary N' EEZ
Eastern Special Area
Territorial Sea
Submerged Lands Act Boundary
Submerged Lands Act Boundary
Long Island Sound
New York
Trenton
New Jersey
Philadelphia
Dover
Delaware Bay
Delaware
Hudson Canyon
Richmond
Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, NAVTEQ, Geonames.org, and others
MILES
0
20
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Summary of Impacts to Marine Fauna from Oil/gas Exploration Activities (Seismic Airgun Bursts) and Oil Spills in New Jersey Coastal and Offshore Waters
February 8, 2018

The Division of Science, Research and Environmental Health has prepared the following comments in response to the Bureau of Ocean Energy Management's (BOEM) recent announcement of potential OCS oil and gas exploration in federal waters off NJ's coast.

Background:
In 2014, BOEM prepared a Draft Programmatic Environmental Impact Statement (PEIS) to evaluate the potential environmental impacts that could occur from multiple geologic and geophysical (G&G) investigations for oil and gas exploration and production, renewable energy projects, and marine minerals extraction. The purpose of the PEIS was to provide information and analyses to BOEM and other agencies for use in evaluating the effects of G&G investigations that may be proposed in future applications. The PEIS covered potential G&G activities in the Mid- and South Atlantic planning areas during 2012 to 2017. It was designed to serve as a reference document for a tiered approach to NEPA, whereby future site-specific EA or EIS's may reference sections of the report to reduce reiteration of issues. In 2015, the State of New Jersey through the NJDEP expressed concern about these activities, and later voiced opposition to oil and gas exploration and development in New Jersey waters. BOEM has now (2018) released a Notice of Availability (NOA) (2019 – 2024) for the Draft Proposed Outer Continental Shelf Oil and Gas Leasing Program.

Comments:

A. Exploration - With regard to the potential impacts to living marine sources, the PEIS identified varying impacts that could occur during the exploration phase along the OCS, specifically impacts caused by seismic testing employing airgun arrays. The PEIS states that the "overall impacts from airgun surveys on marine mammals are expected to be moderate", moderate defined as "impacts are detectable, short-term, extensive, and severe; or impacts are detectable, short-term or long-lasting, localized, and severe; or impacts are detectable, long-lasting, extensive or localized, but less than severe" (DOI-BOEM, 2014). With respect to fisheries and avian resources, the PEIS states that the anticipated impacts are expected to be "minor or negligible". Although, recent studies support that marine mammals and sea turtles are especially sensitive to high intensity, low frequency sounds such as those emitted by seismic airgun surveys (Nelms et al., 2016, Weilgart, 2014, Gordon et al., 2004).

Summary of Impacts and Effects:
The attached memo dated (Appendix A – "Impacts of Seismic Exploration Activity on Marine Organisms and Response to the Federal Overturn of Inconsistency Determination; Dated: May 29, 2015") describes in greater detail impacts expected with emphasis on marine organisms and fisheries from seismic activities. The following is a summary of some of the impacts and effects:

- At least 37 marine species have been shown to be affected by seismic airgun noise.
- Sound from seismic airgun arrays (3.9 x 1013 J) can extend across distances of 4 km or greater from the noise source. Typical survey intensities range from 10 to 300 Hz.
- Impacts range from behavioral changes such as decreased foraging, avoidance of the noise, and changes in vocalizations through displacement from important habitat, stress, decreased egg viability and growth, and decreased catch rates, to hearing impairment, and possible strandings.
- Marine mammals: Whales and small cetaceans (e.g. dolphins) are the most affected group, an important issue since the Atlantic Ocean offshore New Jersey acts as a migration corridor for several endangered marine mammals (and sea turtles) which transit between habitats farther north and south.
- Sea turtles: Marine turtles show a strong initial avoidance response to airgun arrays at a strength of 175 dB or greater.
- A typical airgun array operating in 100–120 m water depth could impact behavior at a distance of about 2 km and cause avoidance at around 1 km for marine turtles.
- Fish: Behavioral reactions of fish to anthropogenic noise (i.e. seismic airgun activity) include dropping to deeper depths, milling in compact schools, ‘‘freezing’’, or becoming more active.

References:
Carroll, A. G., R. Przeslawski, A. Duncan, M. Gunning, and B. Bruce (2017). A critical review of the potential impacts of marine seismic surveys on fish & invertebrates. Marine Pollution Prevention 114 (2017): 9-24.

DOI-BOEM (2014). Atlantic OCS - Proposed Geological and Geophysical Activities: Mid-Atlantic and South Atlantic Planning Areas. Final Programmatic Environmental Impact Statement. OCS EIS/EA BOEM Report 2014-001.

Gordon, J. C. D., D. Gillespie, J. Potter, A. Frantzis, M. P. Simmonds, R. Swift, and D. Thompson (2014). A Review of the Effects of Seismic Surveys on Marine Mammals. Marine Technology Society Journal. Winter 2003-04, 37(4): 14-32.

Nelms, S. E., W. E. D. Piniak, C. R. Weir, and B. J. Godley (2016). Seismic surveys and marine turtles: An underestimated global threat? Biological Conservation 193 (2016): 49–65.

Weilgart, L. (2013). A review of the impacts of seismic airgun surveys on marine life. Submitted to the CBD Expert Workshop on Underwater Noise and its Impacts on Marine and Coastal Biodiversity, 25-27 February 2014, London, UK. Available at: http://www.cbd.int/doc/?meeting=MCBEM-2014-01.

B. Oil Spills/Operation - Oil spills are a primary concern associated with the proposed oil and gas exploration activities. Increased oil and gas activity off the coast of New Jersey will undoubtedly increase the risks associated with oil spills and the resultant impacts to the State’s abundant natural resources and economy (e.g., tourism). The occurrence of oil spills in US coastal waters has decreased substantially since the early 1970s, but rates

associated with platform spills over 1,000 barrels (bbl) have remained consistent over the past 20 years (ABS Consulting Inc., 2016). Spills from tanker operation and pipelines have decreased in recent history (20 years) according to same report.

New Jersey is already home to several large refinery and storage facilities, and has experienced ongoing oil contamination (Stratus Consulting Inc. and Toxicological & Environmental Associates, Inc., 2006) as well as several large spills due to oil related activities. Previous major spills in the state are listed below. International oil spills of note are included in Appendix B – "Table of selected major oil spill characteristics, effects, and concerns" for comparison.

- Arthur Kill Storage tank (Concurrent with Superstorm Sandy)
  - October 29th, 2012
  - Approximately 7,500 barrels.
- Athos 1
  - November 26th, 2004
  - Approximately 6,200 barrels.
- Arthur kill pipeline
  - January 1st, 1990
  - Approximately 13,200 barrels.

Research conducted after the 1990 Arthur kill pipeline spill was compiled and published by Joanna Burger (editor) and others (Burger, 1994). Many negative impacts to wildlife were reported, including acute mortality of saltmarsh cordgrass, benthic fauna such as fiddler crabs and ribbed mussels, diamondback terrapins, birds, and mammals that visited the shores foraging for food and water. It was noted that due to the spill occurring in January, many resident species were hibernating or less abundant while migratory species were not present. The researchers speculated that a spill during the spring or summer may have had different, more severe or longer lasting effects. It is important to consider the significant impact that the timing of an oil spill will have. Seasonal differences in wildlife behavior will drastically impact the resource damage associated with an oil spill scenario.

In addition to the immediate impacts associated with a spill, a key consideration in oil spill response is how the oil is removed. Many microbial species are capable of degrading oil under the right environmental conditions. Specific studies on the type of microbial communities that exist to degrade oil have not been conducted in New Jersey, but results from previous studies indicate that biostimulation was successful to aid in degradation of oil in marsh sediments associated with the 1990 Arthur Kill spill (Burger, 1994). Total petroleum hydrocarbon (TPH) concentrations were consistent throughout the summer of 1990 in Arthur Kill sediments. Measured concentrations were steady at approximately 2 mg/kg TPH in the study area, indicating that no natural degradation was occurring. Specialized fertilizer (a proprietary compound formulated based on experience gained from the Exxon Valdez oil spill) was applied to marsh sediments 8 months after the initial spill, at which point significant decreases in hydrocarbon concentrations were measured (Nixon and Michel, 2017). These studies indicate that New Jersey's temperate climate may be not suitable for efficient natural degradation of hydrocarbons, but

application of fertilizers is possible to assist in bioremediation during a spill scenario. The ideal temperature for marine degradation of hydrocarbons is between 15-20 degrees Celsius (Das and Chandran, 2011). The annual average temp for coastal New Jersey waters are 12-13º C, with June-October exceeding 15º C on average.

Residual crude oil can be expected to remain in the environment for a long period of time following a spill. For example, some crude oil product (~0.6%) is still present in Prince William Sound sediments following the 1989 Exxon Valdez oil spill, down from the estimated 2% residual that was calculated in 1992 (Nixon and Michel, 2017).

Additional research on microbial communities and oil degradation in New Jerseys temperate climate would be needed to fully assess the effectiveness of natural degradation in New Jersey as compared to the Gulf of Mexico, where natural degradation was effective after the Deepwater Horizon event without nutrient augmentation in open waters (Edwards et al., 2011) and beach communities (Kappell et al., 2014).

An additional resource of interest is the "Tidal inlet protection strategies for oil spill response" published by the Bureau of Emergency Response in 1997, in which they reviewed protection strategies for 12 inlets south of Shark River and named 3 inlets (Beach Haven, Little Egg, and Brigantine) as being especially difficult to protect due to their large size and energetic wave conditions (NJDEP, 1997). This classification also considered the costs associated with each inlet based on its size and the magnitude of resources that would need to be protected. It has been approximately 20 years since these studies were conducted and if there is continued interest in offshore oil and gas exploration the Division of Science and Research would recommend re-evaluating and updating these strategies as necessary.

References:

ABS Consulting Inc. (2016) 2016 Update of Occurrence Rates for Offshore Oil Spills. Arlington, VA. Submitted to BOEM and BEMM

Burger, J. (Ed.). (1994). Before and after an oil spill: the Arthur Kill. Rutgers University Press.

Das, N., & Chandran, P. (2011). Microbial Degradation of Petroleum Hydrocarbon Contaminants: An Overview. *Biotechnology Research International*, *2011*, 941810. http://doi.org/10.4061/2011/941810

Edwards, B. R., Reddy, C. M., Camilli, R., Carmichael, C. A., Longnecker, K., & Van Mooy, B. A. (2011). Rapid microbial respiration of oil from the Deepwater Horizon spill in offshore surface waters of the Gulf of Mexico. Environmental Research Letters, 6(3), 035301.

Kappell, A. D., Wei, Y., Newton, R. J., Van Nostrand, J. D., Zhou, J., McLellan, S. L., & Hristova, K. R. (2014). The polycyclic aromatic hydrocarbon degradation potential of

Gulf of Mexico native coastal microbial communities after the Deepwater Horizon oil spill. *Frontiers in microbiology*, *5*, 205.

Miles O. Hayes, Todd M. Montello, Robert J. Schrader, and Edwin A. Levine (*1999*) Tidal Inlets—A Major Hurdle to Effectively Protecting Sensitive Coastal Resources. International Oil Spill Conference Proceedings: March 1999, Vol. 1999, No. 1, pp. 1239-1243.

Nixon, Z., & Michel, J. (2017). A Review of distribution and quantity of lingering subsurface oil from the Exxon Valdez Oil Spill. Deep Sea Research Part II: Topical Studies in Oceanography.

NJDEP. (1997). Tidal Inlet Protection Strategies for Coastal New Jersey: Shark River Inlet to Cape May Inlet. Bureau of Emergency Response. Trenton, NJ.

Stratus Consulting Inc. and Toxicological & Environmental Associates, Inc. (2006). Natural Resource Damages at the ExxonMobil Bayway and Bayonne Sites. Prepared for State of New Jersey, Department of Environmental Protection.

APPENDIX A:
MEMO – "IMPACTS OF SEISMIC EXPLORATION ACTIVITY ON MARINE ORGANISMS AND RESPONSE TO THE FEDERAL OVERTURN OF INCONSISTENCY DETERMINATION" (5/29/15)

State of New Jersey

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KIM GUADAGNO
Lt. Governor

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BOB MARTIN
Commissioner

May 29, 2015

MEMORANDUM

TO: Bob Martin, Commissioner

FROM: Gary Buchanan, Ph.D., Manager, Office of Science

SUBJECT: IMPACTS OF SEISMIC EXPLORATION ACTIVITY ON MARINE ORGANISMS AND RESPONSE TO THE FEDERAL OVERTURN OF INCONSISTENCY DETERMINATION

The Office of Science has examined existing and the most recent literature available concerning the impacts of seismic exploration activities on marine organisms with an emphasis on fish and fisheries. The general conclusions are that marine organisms have been found to be temporarily affected by the emissions of seismic exploration activity (i.e. a seismic airgun array) immediately within and to a varying spatial extent away (up to 18 km or more) from the source of seismic impulses. Given that the proposed study will be conducted in a 230 square mi. area considered to be a highly productive and viable fishery and during the peak season for both commercial and recreational fishing activity, adverse impacts to human interests and to species inhabiting this area and beyond are anticipated. An important component of this area are fish species that prey upon the unique benthic communities found here, of which many are of important recreational and commercial value (NJDEP - OS 2010). A NJDEP commercial harvest analysis from May through August 2013 showed that 20% of black sea bass (*Centropristis striata*) and 22% of summer flounder (*Paralichthys dentatus*) are harvested within the proposed study area, roughly representing revenues of fish worth $250,000 and $1,360,000, respectively (NJDEP DLUR 2015). Temporary impacts to other organisms such as marine mammals, sea turtles, and to a lesser degree invertebrates are also expected. The following information is a synopsis of the known effects of seismic exploration surveys on marine organisms, with the impacts to fish species highlighted below.

Although mostly temporary in nature, impacts to marine life *in situ* (in the natural environment) generally include area avoidance and behavioral modifications that can affect normal day to day activities, or can disrupt important periods critical to the life cycles/history of these organisms. During airgun surveys, impulses are typically discharged every 10-15 seconds (although we note that the subject study will be firing at a greater frequency every ~5-6 seconds indicating additional impacts) and can emit a sound impulse at levels up to 250 decibels (db) re μPa (Lokkeborg et al. 2012). To bring this sound level into perspective, human threshold for extreme discomfort/pain is in the magnitude of 202 db re μPa, with damage occurring at or approaching 222 db re μPa (Gausland 2000). With respect to "normal activities", which include foraging or general presence in the area in question, seismic airgun emissions have been shown in some cases to illicit an initial stress or alarm response, with the ultimate result being that the species chooses to leave the area (Weilgart 2013; Lokkeborg et al. 2012; Piniak et al. 2012; Lucke et al. 2009). This area of avoidance can be in excess of several km. In some cases, such as with some whale species and fish, individuals may be initially attracted to the sound and change course in order to investigate its source (Weilgart 2013; Gordon et al. 2004; McCauley et al. 2000). This could potentially increase the likelihood of an accidental vessel strike. Additionally, in both whales and dolphins, cessation of vocalization between individuals can occur and impede the exchange of information, for example, on an individual's location or available food resources (Weilgart 2013; Lucke et al. 2009).

Studies have shown that seismic airgun activity can have a negative impact on fish catch rates during the initial phases of impulse emission and for up to 2 weeks after cessation of activity (NSW DPI 2014). It is important to note that the effects of seismic airgun activity on fish and other species can be highly variable depending on the specific survey method and local conditions including water depth, temperature profile, and bottom type. The overall effect due to seismic activity is disruption of normal fish behavior and area avoidance. Auditory fatigue, or temporary threshold shift (TTS), has been documented as a consequence when marine organisms are within 1 – 2 km of seismic activity (Weilgart 2013). Airgun activity can influence commercial catch rates (which also infers recreational catch rates) based on whether a fish is a pelagic or benthic species (i.e. whether it dwells in open waters or near the bottom, respectively). Several references (e.g., NSW DPI 2014; Vold et al., 2012; Skalski et al. 1992) discuss the impacts to commercial fishing and species, where benthic species such as *Lophius piscatorius* and *Sebastes* spp. increase their swimming activity when startled by airgun sounds, while pelagic species swim away from the source of the seismic emission. Contrary to NSF's position, disturbance of benthic species may make them less vulnerable to commercial fishing efforts in New Jersey waters due to the extensive bottom trawl fishery (i.e., disturbed fish may avoid the trawls). The pelagic fishery is also very large in the study area and the seismic activity of this project would result in reduced commercial and recreational catch due to the avoidance behavior and/or flight from the area by these species.

While some may argue the impacts of seismic emissions are relatively short term and temporary, the immediate effects on commercial fisheries can result in significant economic hardship (e.g., reduction in catch for up to two months). Lokkeborg et al. (2012) demonstrated that seismic air gun emissions negatively affected commercial fish catch rates, with pronounced reductions in local abundance and catch (from 45-85%) depending on the fish species caught. This effect lasted for up to 5 days for cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*)

within an area of 18 nmi, and up to two weeks for other species (NSW DPI 2014). Skalski et al. (1992) observed significant reductions in rockfish (*Sebastes* spp.) on catch per unit effort in hook and line fisheries following a single airgun source emission (source level of 223 db re μPa), which could be translated to an average economic loss of 49.8%. In some cases, declines in catch can be even more extreme following seismic surveys when combined with seasonal or other natural variation (NSW DPI 2014). Steffe and Murphy (1992) reported a four month decline of commercial trawl catches of prawns off Sydney following seismic exploration the year before, although seasonal declines had been observed for the last 15 years. In New Jersey, over 35 fish species (not including decapods and other invertebrates) are known to be harvested within and adjacent to the proposed study area, which include but are not limited to: Albacore (*Thunnus alalunga*), bluefish (*Pomatomus saltatrix*), bigeye tuna (*Thunnus obesus*), bluefin tuna (*Thunnus thynnus*), butter fish (*Peprilus triacanthus*), Bonita (*Sarda sarda*), Black Sea bass (*Centropristis striata*), cobia (*Rachycentron canadum*), Atlantic cod (*Gadus morhua*), smooth dogfish (*Mustelus canis*), spiny dogfish (*Squalus acanthias*), summer flounder (*Paralichthys dentatus*), Atlantic menhaden (*Brevoortia tyrannus*), monkish (*Lophius americanus,* and other spp.), red hake (*Urophycis chuss*), tilefish (*Lopholatilus chamaeleonticeps*), swordfish (*Xiphias gladius*), yellow fin tuna (*Thunnus albacares*), skipjack tuna (*Katsuwonus pelamis*), and others.

The Office of Science modeled the potential impact area of seismic surveys on fish based on the literature, which reports various values for impact distances ranging from up to 5 km, 12 km, 18 km and more than 30 km (e.g., Weilgart 2013; Lokkeborg et al. 2012; Engås et al., 1996). While NSF has argued that the Engås et al. (1996) paper is based on a larger airgun array, there are no other similar data for the size array planned for this project, and therefore the horizontal extent of impact to fish is unknown. In addition, Engås et al. (1996) reported that fish are capable of detecting seismic sound at distances of 30 to 100 km. Therefore, a conservative value of 18 km was used as the limit of impact to fish behavior. Based on these data and assumptions impact distances for three distances (5, 12 and 18 km) were plotted (Figure 1). This figure indicates that in addition to the entire study area, a larger adjacent area will be impacted, resulting in a potential enormous impact on commercial and recreational fishing during the peak periods of June through August off the New Jersey coast. An estimate of the extent of the impact area and volume of water affected for each of the three distances is shown in Table 1.

With respect to fish species, studies (Hastings and Miksis-Olds 2012; Slabberkoorn et al. 2010; Song et al. 2008; McCauley et al. 2000) have shown that anthropogenic sound sources of varying intensities might have anywhere from slight effects to temporary shifts in behavior, and even mortality in some extreme cases. Fish species may alter schooling behavior, which may make the group more susceptible to predation (Fewtrell and McCauley 2012), or again choose area avoidance which may disrupt normal foraging behavior and other species activities.

In the case of a "life cycle impact", given that species tend to breed or migrate during discrete windows of time, avoidance of breeding grounds or migratory pathways during seismic exploration activity could result in decreased populations long term (e.g. missed breeding opportunities, etc.), decreased energy reserves if foraging cannot occur in prime feeding areas, or increase mortality in the case of altered migration around an avoidance area into less favorable and/or predatory waters. The waters of the Mid-Atlantic Bight (MAB) are one of the most productive fishing areas on the east coast, with approximately 250 fish species using these waters

(NJDEP –OS 2010). With the abundance of prey (i.e. fish and invertebrates), the MAB is important as a foraging area for resident and transient species, and has been shown to contain overlapping essential fish habitats (EFHs) for numerous fish species.

Empirically, studies have reported wide ranging impacts that can affect fish and invertebrate species either temporarily or permanently. Santulli et al. (1999) demonstrated that European sea bass (*Dicentrarchus labrax*) exhibit primary and secondary stress responses via varied release of cortisol, glucose, lactate, and other biochemical constituents in various tissues when in close confines of airgun impulses, effects of which can last up to 72 hours. TTS has been observed for numerous taxa at distances within 1-2 km of operating single airgun or multiple airgun arrays (Weilgart 2013; Jorgensen and Gyselman 2009; Song et al. 2008). In laboratory studies, tissue damage or other physiological damages have been shown where the species are confined and were unable to avoid the direct impacts from the airgun/seismic impulse (NSW-DPI 2014; Weilgart 2013; Song et al 2008). In a confined, laboratory setting, these effects tend to be more pronounced, however it is important to note that in the natural environment not all of the impacts are still known.

Please let me know if you need any additional information. References and cited studies are listed below.

c: David Glass, Deputy Commissioner
Magdalena Padilla, Chief of Staff
Ray Cantor, Chief Advisor
John Gray, Deputy Chief of Staff
Angelene Taccini, Communications
Bob Considine, Press Office
Bob Bostock, Communications

References and Literature Cited

Engås, A., S. Løkkeborg, E. Ona, and A. Vold Soldal (1996). Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*). Can. J. Fish. Aquat. Sci. 53: 2238-2249.

Fewtrell, J.L., and R.D. McCauley (2012). Impact of air gun noise on the behavior of marine fish and squid. Marine Pollution Bulletin. 64(2012): 984-993.

Jorgensen, J. K. and E. C. Gyselman (2009). Hydroacoustic measurements of arctic riverine fishes to seismic airguns. J. Acoust. Soc. Am. 126(3): 1598-1606.

Gausland, I. (2000). Impact of Seismic Surveys on Marine Life. The Leading Edge (2000). 4 pp. http://www.dcenr.gov.ie/nr/rdonlyres/ead7daf5-ae1e-4a78-8234-9cfa28fd86ee/0/seasubmapp2.pdf.

Gordon, J., D. Gillespie, J. Potter, A. Frantzis, M. P. Simmonds, R. Swift, and D. Thompson (2004). A review of the effects of seismic surveys on marine mammals. Marine Technology Society Journal. Winter 2003/04, 37(4): 16-34.

Hastings, M. C. and J. Miksis-Olds (2012). Shipboard assessment of hearing sensitivity of tropical fishes immediately after exposure to seismic air gun emissions at Scott Reef. In: The Effects of Noise on Aquatic Life, Advances in Experimental Medicine and Biology, Eds.: A. N. Popper and A. Hawkins. 239-243.

Lokkeborg, S., E. Ona, A. Vold, and A. Salthaug (2012). Effects of sound from seismic air guns on fish behavior and catch rates. Advances in Experimental Medicine and Biology, 730: 415-419.

Lucke, K., U. Siebert, P. A. Lepper, and M-A Blanchett (2009). Temporary shift in masked hearing thresholds in a habor porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli. J. Acous. Soc. Am. 125(6): 4060-4070.

McCauley, R. D., J. Fewtrell, A. J. Duncan, C. Jenner, M-N. Jenner, J. D. Penrose, R. I. T. Prince, A. Adhitya, J. Murdoch, and K. McCabe (2000). Marine seismic surveys - a study of environmental implications. Appea Journal 2000: 692 -708.

New Jersey Department of Environmental Protection, Office of Science - NJDEP-OS (2010). New Jersey Offshore Wind Power Ecological Baseline Studies: Final Report. Prepared by Geo-Marine, Inc., Vol IV: Fish and Fish Studies.

New Jersey Department of Environmental Protection, Division of Land Use Regulation – NJDEP-DLUR (2015, Mar. 6). Federal Consistency Determination for Marine Geological Survey by the R/V *Marcus G. Langseth* in Atlantic Ocean off New Jersey, Summer 2015 – Inconsistent. DLUR File No. 000-14-0030.1 CDT 150001. 11 pp.

New South Wales, Department of Primary Industries, NSW-DPI (2014). Information paper: potential effects of seismic surveys on fish and fishing activities, August 2014. Source: www.dpi.nsw.gov.au. 15 pp.

Pena, H., N.O. Handegard, and E. Ona (2013). Feeding herring schools do not react to seismic air gun surveys. ICES Journal of Marine Science; doi:10.1093/icesjms/fst079. 7 pp.

Piniak, W. E., S. A. Eckert, C. A. Harms, and E. M. Stringer (2012). Underwater hearing sensitivity of the leatherback sea turtle (*Dermochelys coriacea*): assessing the potential effect of anthropogenic noise. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Headquarters, Herndon, VA. OCS Study, BOEM 2012-01156 Report. 35 pp.

Slabbekoorn, H., N. Bouton, I. van Opzeeland, A. Coers, C. ten Cate, and A.N. Popper (2010). A noisy spring: the impact of globally rising underwater sound levels on fish. Cell Press. Doi:10.1016/j.tree.2010.04.005. 9 pp.

Santulli, A., A. Modica, C. Messina, L. Ceffa, A. Curatolo, G. Rivas, G. Fabi, and V. D'Amelio (1999). Biochemical responses of European sea bass (*Dicentrarchus labrax* L.) to the stress induce by off shore experimental seismic prospecting. Marine Pollution Bulletin, 38(12): 1105-1114.

Skalski, J.R., W.H. Pearson, and C.I. Malme (1992). Effects of sound from a geophysical survey device on catch-per-unit-effort in a hook-and-line fishery for rockfish (*Sebastes* spp.). Can. J. Fish. Aquat. Sci. 49(1992): 1357-1365.

Song, J., D. A. Mann, P. A. Cott, B. W. Hanna, and A. N. Popper (2008). The inner ears of Northern Canadian freshwater fishes following exposure to seismic air gun sounds. J. Acoust. Soc. Am. 124(2): 1360-1366.

Steffe, A.S., and J.J.Murphy (1992). Offshore prawn catches in the Newcastle region, May to November 1991. Fisheries Research Institute, NSW DPI (As cited by NSW DPI 2014).

Vold, A., S. Lokkeborg, and M.M. Tenningen (2012). Using catch statistics to investigate effects of seismic activity on fish catch rates. In: The Effects of Noise on Aquatic Life, Advances in Experimental Medicine and Biology 730, DOI 10.1007/978-1-4419-7311-5_94. Pp. 411-413.

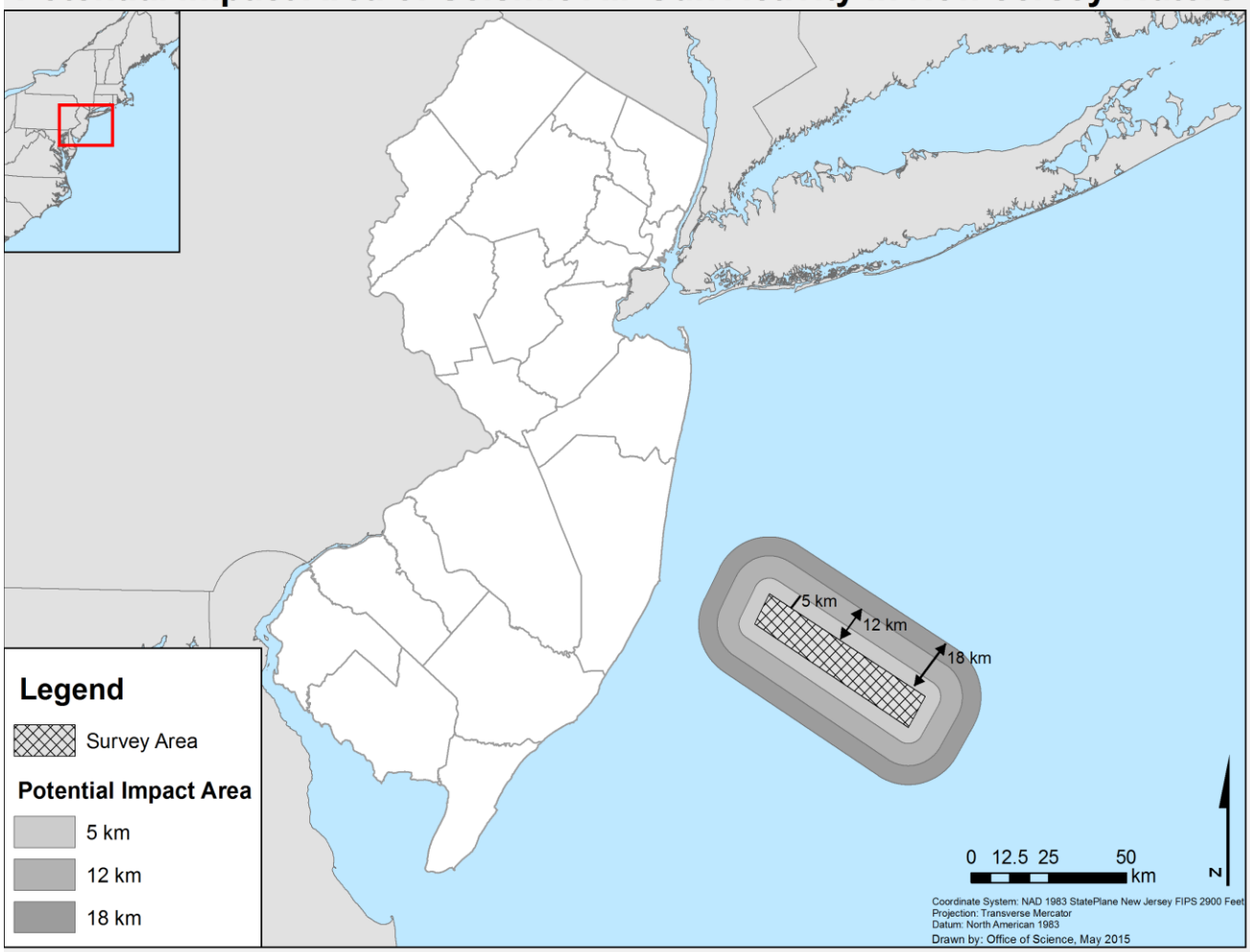
Weilgart, L. (2013). A review of the impacts of seismic airgun surveys on marine life. Marine and Coastal Biodiversity, Feb. 2014. 10 pp.

Table 1. Potential impact area and volume determined for varying distance of influence around the survey area.

Distance from Seismic Area (km)	Impact area (Survey area + buffer) km^2	Impact volume (Survey area + buffer) km^3 (1)
5	1,432	64
12	2,793	126
18	4,205	189
(1) assumes average depth of 45 meters		

Next page: Figure 1. Potential Impact Area of Seismic Airgun Activity in New Jersey Waters.

Potential Impact Area of Seismic Air Gun Activity in New Jersey Waters



APPENDIX B:
TABLE OF SELECTED MAJOR OIL SPILL CHARACTERISTICS, EFFECTS, AND CONCERNS

Table 1. Selected major oil spill characteristics ranked by volume of oil discharged into the environment (in millions of barrels).

Major Oil Spill	Date	Volume (millions of bbl)	Type of Oil (API*) Spill characteristics	Effects Observed	Concerns	Citation
Arabian Gulf/Kuwait	January 23, 1991	6.3	Kuwait crude oil (30) Terrestrial and marine spill from multiple sources; intertidal species and near shore benthic communities in the western Arabian Gulf were most affected.	Dense mats of oil covered biota and accumulated in coastal sediments. Loss of species diversity was persistent for decades.	Contamination is still present in the most recent studies evaluating coastal habitat. Low flushing rates increase retention of pollutants in sediment and tidal zones.	Al-Awadhi et al., 2012; Jones et al., 2008; Randolph et al., 1998
Deepwater Horizon	April 22, 2010	4.9	Light Louisiana, Macondo 252 (35.2) Drill rig explosion caused deep sea (1500m) release of oil creating subsurface and surface plumes. Significant shore oiling occurred in coastal regions of the northern Gulf of Mexico.	Acute mortality of exposed organisms and loss of significant marsh habitat after shore oiling. Fishing was closed in most of the Gulf for months. Unique partitioning of oil into the subsurface and marine snow.	Persistence of oil in benthos may be significant due to cold temperatures and anoxic sediments. Pelagic fish and mammals may have been more affected than initially reported.	Atlas and Hazen, 2011; Peterson et al., 2012
Ixtoc 1	June 3, 1979	3.5	Light Louisiana (32) Drill rig explosion caused shallow sea (50m) release of oil into southern Gulf of Mexico. Affected much of Mexico and Southern Texas.	Fishing limitations were put into effect; benthic communities were disrupted by oil and detrital matter. Coastal bird species and marshes were impaired.	First spill of its kind making preparation and remediation efforts difficult to implement. The need for baseline monitoring became apparent.	Jernelov and Linden, 1981; Teal and Howarth, 1984
Amoco Cadiz	March 16, 1978	1.6	Light Arabian and Iranian crude oil (35) Tanker grounded near Brittany, France. Wave action from storms naturally dispersed oil in the coastal area. Concentrations of crude oil up to 500 µg/l were detected.	Significant deposition of oil into sensitive habitats with low flushing rates. Oyster mariculture was most heavily affected. Mechanical cleanup and biodegradation played key remedial roles.	Abundant low energy environments were affected and rely on biodegradation for remediation. Anoxic sediments and heavier crude oil constituents decrease biodegradation.	Gundlach et al., 1983
Exxon Valdez	March 24, 1989	0.26	Alaska North Slope Heavy Crude (29) Tanker spill on Bligh Reef in Prince William Sound, Alaska. Nearly 2000 km of pristine coastal habitat was oiled.	Significant declines in bird, fish, invertebrate populations. Oil persisted in sediments and evidence of exposure lasted for decades.	Pristine habitat and abundant wildlife severely contaminated and affected by spill. Development of a shift from acute toxic exposures to possible chronic effects as well as increased appreciation for seasonal variation during exposure assessments.	Peterson et al., 2003; Atlas and Hazen, 2011

API: American petroleum institute gravity. Table adapted from Millemann, 2016.

Citation: Millemann, D. R. (2016). *The presence of particulate material and comparative toxicity of crude oil in finfish from the northern Gulf of Mexico* (Doctoral dissertation, Rutgers University-Graduate School-New Brunswick).