NEW YORK STATE OF OPPORTUNITY

Department of Environmental Conservation

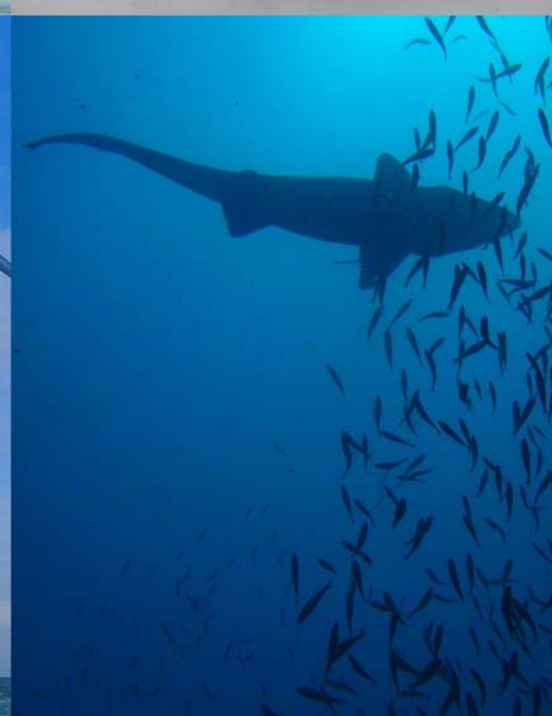
Department of State

NEW YORK OCEAN ACTION PLAN

2016 – 2026







In collaboration with state and federal agencies, municipalities, tribal partners, academic institutions, non-profits, and ocean-based industry and tourism groups.

Acknowledgments

The preparation of the content within this document was developed by Debra Abercrombie and Karen Chytalo from the New York State Department of Environmental Conservation and in cooperation and coordination with staff from the New York State Department of State. Funding was provided by the New York State Environmental Protection Fund's Ocean & Great Lakes Program.

Other New York state agencies, federal agencies, estuary programs, the New York Ocean and Great Lakes Coalition, the Shinnecock Indian Nation and ocean-based industry and user groups provided numerous revisions to draft versions of this document which were invaluable. The New York Marine Sciences Consortium provided vital recommendations concerning data and research needs, as well as detailed revisions to earlier drafts.

Thank you to all of the members of the public and who participated in the stakeholder focal groups and for also providing comments and revisions.

For more information, please contact:

Karen Chytalo
New York State Department of Environmental Conservation
Karen.Chytalo@dec.ny.gov
631-444-0430

Cover Page Photo credits, Top row: E. Burke, SBU SoMAS, M. Gove; Bottom row: Wolcott Henry- 2005/Marine Photo Bank, Eleanor Partridge/Marine Photo Bank, Brandon Puckett/Marine Photo Bank.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

625 Broadway, 14th Floor
Albany, New York 12233-1010
(518) 402-8545
www.dec.ny.gov

NEW YORK STATE DEPARTMENT OF STATE

One Commerce Plaza
99 Washington Avenue
Albany, New York 12231-0001
(518) 474-0500
www.dos.ny.gov

MESSAGE FROM COMMISSIONER AND SECRETARY

The ocean and its significant resources have been at the heart of New York's richness and economic vitality, since our founding in the 17th Century and continues today.

We have known for a long time that human activities have caused significant degradation within the ocean and coastal ecosystems, affecting the economy, communities and livelihoods of those working or living near or on the ocean. Two national ocean commissions in the early 2000s shed light on the fragmentation of ocean management, and recommended a national agenda to protect the ocean ecosystem and to implement coordinated management of ocean resources.

In 2006, New York took the lead at the state-level, with the enactment of the New York Ocean and Great Lakes Ecosystem Conservation Act, which promotes an ecosystem-based management approach. This Ocean Action Plan integrates New York's critical economic and environmental goals for the ocean region, utilizes our best scientific understandings, and draws on the perspectives of a diverse array of public and private stakeholders. New York's Ocean Action Plan represents a shared vision of the priority issues and key actions needed to be undertaken over the next ten years.

Through Governor Cuomo's leadership, significant resources have been provided over the past few years to act on the identified needs. The FY 2016-2017 State Budget enacted the Governor's significant increase in the Ocean and Great Lakes annual appropriation under the Environmental Protection Fund from $6 million to $15 million. This will enable many priority actions in this Plan to get underway. In addition, the Governor took the lead following Hurricane Sandy to provide funding to help coastal communities adapt to climate change and integrate resiliency into planning and infrastructure programs.

We appreciate the renewed federal focus on the ocean as a result of President Obama's leadership. The President's 2010 Executive Order on the stewardship of the Ocean and the establishment of the National Ocean Council and regional ocean planning bodies are supportive actions coming from the federal level. Most of the "New York Bight," our segment of the ocean, falls within federal jurisdiction and responsibility. The New York Ocean Action Plan calls attention to many priorities that will need federal government leadership, participation and resources.

We look forward to working with a host of partners and collaborators to accomplish our ambitious agenda.

Basil Seggos
Commissioner

Rossana Rosado
Secretary of State

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation | Department of State

List of Acronyms

ASMFC	Atlantic States Marine Fisheries Commission
BOEM	Bureau of Ocean Energy Management
BREP	Bycatch Reduction Engineering Program
BRI	Biodiversity Research Institute
CAFO	Concentrated Animal Feeding Operations
CCE	Cornell Cooperative Extension of Suffolk County
CCMP	Comprehensive Conservation and Management Plan
CEHA	Coastal Erosion Hazard Area
CMP	Coastal Management Program
CMSP	Coastal and Marine Spatial Planning
CO2	Carbon Dioxide
CPUE	Catch Per Unit Effort
CRRA	Community Risk and Resiliency Act
CSO	Combined Sewer Overflow
CTDEEP	Connecticut Department of Energy and Environmental Protection
CUNY	The City University of New York
DAM	New York State Department of Agriculture and Markets
DEC	New York State Department of Environmental Conservation
DMMP	Dredged Material Management Plan
DOH	New York State Department of Health
DOS	New York State Department of State
DOT	New York State Department of Transportation
DPS	New York State Department of Public Service
DSP	Diarrhetic Shellfish Poisoning
EBM	Ecosystem-Based Management
ECL	Environmental Conservation Law
ECSGA	East Coast Shellfish Growers Association
EFC	New York State Environmental Facilities Corporation
EFH	Essential Fish Habitat
EPA	Environmental Protection Agency
EPF	Environmental Protection Fund
ESA	US Endangered Species Act
ESD	Empire State Development

FDA	United States Food and Drug Administration
FEMA	Federal Emergency Management Agency
FMP	Fishery Management Plan
G&G	Geological and Geophysical
HABs	Harmful Algal Blooms
HARS	Historic Area Remediation Site
HREP	Hudson River Estuary Program
HRNERR	Hudson River National Estuarine Research Reserve
IAWG	New York State Interagency Working Group
IFQ	Individual Fishing Quota
LNG	Liquefied Natural Gas
LISCMP	Long Island Sound Coastal Management Program
LISS	Long Island Sound Study
LISSER	Long Island South Shore Estuary Reserve
MA DMF	Massachusetts Division of Marine Fisheries
MAFMC	Mid-Atlantic Fishery Management Council
MARACOOS	Mid-Atlantic Regional Association for Coastal Ocean Observing Systems
MARCO	Mid-Atlantic Regional Council on the Ocean
MARUs	Moored Acoustic Recording Units
MCLs	Maximum Contamination Levels
MDP	NOAA Marine Debris Program
MEA	Millennium Ecosystem Assessment
MidA RPB	Mid-Atlantic Regional Planning Body
MMPA	Marine Mammal Protection Act
MSA	Magnuson-Steven Fishery Conservation and Management Reauthorization Act of 2006
MW	Megawatt
MTA	Metropolitan Transportation Authority
NCCOS	National Centers for Coastal Ocean Science
NEFMC	New England Fishery Management Council
NEFOP	Northeast Fishery Observer Program
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NERACOOS	Northeast Regional Association for Coastal Ocean Observing Systems
NGO	Non-Governmental Organization
NHPA	National Historic Preservation Act

NHP	New York Natural Heritage Program
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric and Administration
NOP	National Ocean Policy
NROC	Northeast Regional Ocean Council
NYC DEP	New York City Department of Environmental Protection
NYMSC	New York Marine Science Consortium
NYNJHEP	New York-New Jersey Harbor Estuary Program
NYOGLECC	New York Ocean and Great Lakes Ecosystem Conservation Council
NYS RISE	New York State Resiliency Institute for Storms and Emergencies
NYSERDA	New York State Energy Research and Development Authority
NYSG	New York Sea Grant
OCRM	NOAA's Office of Ocean and Coastal Resource Management
OPRHP	New York State Parks, Recreation and Historic Preservation
OGS	New York State Office of General Services
OA	Ocean Acidification
OAP	Ocean Action Plan
OCS	Outer Continental Shelf
OTC	Over-the-counter
PANYNJ	The Port Authority of New York/New Jersey
PBB	Polybrominated Biphenyls
PBDE	Polybrominated Diphenyl ethers
PCBs	Polychlorinated Biphenyls
PEP	Peconic Estuary Program
PEIS	Programmatic Environmental Impact Statement
PPCP	Pharmaceutical and Personal Care Products
PSC	New York State Public Service Commission
PSP	Paralytic Shellfish Poisoning
RFMRP	Riverhead Foundation for Marine Research and Preservation
RSA	Mid-Atlantic Fishery Management Council's Research Set-Aside Program
SAG	Scientific Advisory Group
SAR	Stock Assessment Report
SAV	Submerged Aquatic Vegetation
SCDHS	Suffolk County of Health Services
SCFWH	Significant Coastal Fish and Wildlife Habitat

SFP	Sustainable Fisheries Plan
SMMP	Site Management and Monitoring Plans
SNE	Southern New England
SPDES	State Pollutant Discharge Elimination System
SSER	South Shore Estuary Reserve
SUNY ESF	State University of New York College of Environmental Science and Forestry
SUNY SB	State University of New York Stony Brook
SWPPP	Stormwater Pollution Prevention Plan
SWCD	Soil and Water Conservation Districts
TMDL	Total Maximum Daily Load
TRAC	Technical Review and Advisory Committee
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USDOI	United States Department of the Interior
USFWS	United States Fish and Wildlife Service
USGCRP	United States Global Change Research Program
USGS	United State Geological Survey
VTR	Vessel Trip Reports
WCS	Wildlife Conservation Society
WHOI	Woods Hole Oceanographic Institution

Contents

Executive Summary

New York relies on the ocean for the many benefits it provides to local communities and the broader state economy, including food, maritime commerce, recreational and educational opportunities, nutrient cycling, climate regulation, storm surge protection and coastal erosion control. Unfortunately, New York's ocean ecosystem—defined here as encompassing all estuarine, coastal and offshore waters off New York out to the Atlantic continental shelf break—has experienced significant degradation. Human development along the coast and the unsustainable use of ocean resources (e.g., sand mining, overharvest of certain fish species, dumping, shoreline modification etc.) have effects that compromise the functioning of that ecosystem and reduces the benefits we enjoy.[1] The purpose of the New York Ocean Action Plan (OAP) is to provide a framework for an integrated, adaptive approach to management that seeks to address the increased man-made stressors that threaten the ecological integrity of the ocean ecosystem, contributing to the destruction of important marine habitat, loss of marine biodiversity and impaired waterways.[2]

In the context of our current level of use of the ocean, the OAP acknowledges the need to understand how new offshore developments (e.g., renewable energy, aquaculture) may impact the ecological integrity of the ocean ecosystem. Inter-jurisdictional offshore planning is needed, in order to minimize conflicts that can arise between diverse ocean user groups for limited space and resources. The OAP framework encourages increased coordination across all levels of government, effective communication of ocean related issues and the technology to address these challenges, and education and engagement of stakeholders to increase capacity to effectively participate in the decision-making process.

Additionally, the OAP recognizes that ocean ecosystems are rapidly being altered as a result of increased greenhouse gas emissions and global climate change—specifically warmer water temperatures, ocean acidification and sea-level rise—and the need to act in order to protect the continued viability of the goods and services the ocean provides.[3] In short, the OAP seeks to promote restoration, conservation, resiliency, and sustainable use of New York's ocean ecosystem and to have the best available information for New York State to make sound management decisions on ocean issues.

Through the leadership of Governor Andrew Cuomo, New York has made increased funding available through the Environmental Protection Fund, providing critical State support to help implement this Plan. Nevertheless, the State cannot tackle the concerns of the ocean on its own. Collaboration with municipal, regional and federal government agencies and with other partners will be important to leverage the necessary resources to accomplish all the Plan's multi-faceted priorities. With a significant portion of the New York Bight and ocean resources extending beyond New York's three mile territorial jurisdiction, New York will seek federal government leadership, participation and resources as a vital component to accomplish this Plan.

Key OAP Elements

- Synthesize what is known about the current status of the ocean ecosystem and identify the multiple human activities, and their potential cumulative impacts, that threaten its integrity and resiliency.
- Clearly identify shared goals, measureable objectives, and detailed short-term and long-term actions steps to help state agencies and public and private partners develop annual work plans, timelines and performance measures intended to produce positive and sustainable outcomes for both human activities and natural systems.
- Improve science-based understanding of how interrelated components of the ocean ecosystem function through dedicated research and long-term monitoring programs. Establish ecological assessment criteria to monitor effectiveness of actions taken, and incorporate new information gained from expanded or new research and monitoring programs into management programs.
- Facilitate better coordination among all levels of government by building strong collaborations needed to address multi-jurisdictional ocean resource issues and maintain consistency with regional and national ocean management organizations.

- Establish an ongoing advisory process for involving key stakeholder interests, as well as outlining a clear pathway for implementation of identified priority action steps.
- Strengthen the ability of partnering agencies, organizations and stakeholders to implement ecosystem-based management principles and effectively communicate research findings and scientific assessments to the general public.

Summary of OAP Priority Goals and Objectives

The four interconnected goals, 11 long-term objectives and 61 specific actions outlined in the OAP were developed holistically, intended to be considered as a whole instead of separate components of this plan. The OAP employs an adaptive management approach to inform decision-making across all levels of government over the next 10 years. Implementation, however, will require multi-jurisdictional partnerships and strong collaborations amongst agencies and stakeholders to effectively promote a healthy ocean ecosystem while sustaining the services they provide to the people and communities depending on them locally, regionally and nationally.

GOAL 1: *Ensure the ecological integrity of the ocean ecosystem.*

- Objective A: Protect and restore sensitive inshore, offshore and estuarine habitats.
- Objective B: Improve the management of ecologically and economically important species.
- Objective C: Evaluate the ecological integrity of the ocean ecosystem off New York.

GOAL 2: *Promote economic growth, coastal development and human use of the ocean in a manner that is sustainable and consistent with maintaining ecosystem integrity.*

- Objective D: Implement and advance offshore planning.
- Objective E: Promote sustainable ocean-based industry and recreation.

GOAL 3: *Increase resilience of ocean resources to impacts associated with climate change.*

- Objective F: Conduct climate change vulnerability assessments.
- Objective G: Adopt long-term climate adaptation and coastal planning strategies.
- Objective H: Implement ecologically sustainable inshore and offshore sediment resource management strategies.

GOAL 4: *Empower the public to actively participate in decision-making and ocean stewardship.*

- Objective I: Increase stakeholder participation in resource management and offshore planning.
- Objective J: Advance ocean outreach and education.
- Objective K: Support local and regional stewardship programs.

Vision Statement

Restoring, strengthening and maintaining the ecological integrity of the state's ocean ecosystem, including estuarine and coastal waters, will benefit all residents and visitors of New York for this generation and those to come. Through an integrated and adaptive approach where management decisions are informed by the best available science, we will be able to promote better understanding, protection, restoration, resiliency and use of New York's ocean resources and the services they provide for the well-being of humans and the natural environment.[4]

1.0 Background

1.1 Ecosystem-based Management

Over the last decade a consensus has emerged within the scientific community and among resource managers that ecosystem-based management (EBM) is a valuable approach that can conserve the ecological integrity of the ocean ecosystem, contribute to economic and social welfare, and provide important research and educational opportunities.[5] [6] EBM is a comprehensive, integrated approach to natural resource management that considers the entire ecosystem, including humans.[7] EBM differs from single-species or single-sector management approaches that attempt to solve environmental problems by treating individual activities or concerns separately. Additionally, EBM accounts for both ecological and socio-economic factors of resource use, as well as the cumulative impacts from human activities on the environment.

EBM's core principles are (1) Recognizing connections within and across ecosystems; (2) Applying an ecosystem services perspective; (3) Understanding and addressing cumulative impacts from multiple stressors; (4) Managing for multi-sector, and often competing, human use; and (5) Acknowledging change, learning from past experiences, and adapting management policies.[8] By taking an EBM approach, people and communities are acknowledged to be an integral part of, and dependent upon, ecosystems. There is also an emphasis on the need to establish strong partnerships and use sound scientific understanding to address complex and often contentious ocean use issues. By recognizing that ecosystems are not defined or constrained by political boundaries, EBM principles promote collaboration among local management agencies and relevant stakeholders, as well as across national and regional jurisdictions.[9] See **Appendix 1** for more information regarding EBM.

In 2006, the State of New York committed to addressing ecological and economic declines associated with its ocean and Great Lakes resources by enacting the New York Ocean and Great Lakes Ecosystem Conservation Act (The Act). The Act established EBM as the foundation to conserve, maintain and restore the health of ocean and coastal ecosystems.[10] In 2009, the New York Ocean and Great Lakes Ecosystem Conservation Council (NYOGLECC) released its report '*Our Waters, Our Communities, Our Future*' to the state legislature and governor. The report outlined research recommendations and identified priority actions critical to implementing EBM as an approach to achieve the state's restoration, resiliency and sustainable management goals.

EBM is not a new concept, and many state agencies or state programs started to incrementally integrate EBM principles into existing strategies for managing human activities well before the OGLEC Act was passed.[11] However, the high costs of gathering scientific information and difficulties obtaining long-term federal funding over the last several years has greatly reduced the capacity to expand and incorporate fundamental science-based research and monitoring programs into management strategies or to move quickly to prevent potential conflicts between various user groups before they arise.[12] Additionally, implementation of EBM of New York's ocean and coastal ecosystems has been inhibited by a lack of guidance for working in a coordinated cost-efficient manner. In order to strengthen the capacity to for successfully implementing EBM principles into existing and proposed ocean management and offshore planning processes, the NYOGLECC report recommended the development of an Action Plan for our ocean ecosystem based upon an extensive public outreach and stakeholder engagement.

1.2 New York Ocean Action Plan (OAP)

The New York Ocean Action Plan (OAP) was created to focus the state's efforts to ensure the long-term health of the ocean and to promote stewardship and sustainable use. Four interconnected goals have been identified that reflect New York's priorities for immediate action. They focus on the most urgent initiatives that should be undertaken that would address the most pressing threats to the ocean ecosystem. These goals, along with the eleven associated objectives, are intended to establish a framework for the 61 strategic actions that should be implemented in the short-term (in the 2 two years), near-term (in the next 5 years) and long-term (in the next 10 years). In the following pages, an overview for each goal is provided, along with the context to help set the stage for each action. For each action, detailed work steps are provided, along with suggested timeframes. Lead agency(ies) and potential partnerships are tentatively identified. These offer a starting point for discussion to help move beyond aspirational goals and objectives for the ocean to concrete action that we can measure over time.

Stakeholder participation was invaluable during the development of the OAP. In 2012, The New York State Department of Environmental Conservation (DEC) and the New York State Department of State (DOS) met with resource management agencies, non-governmental organizations (NGOs), academic institutions and other interested stakeholders during several informal outreach forums to gather information that would be used to develop the goals, objectives and action steps in the OAP.

DEC and DOS also met with the New York Marine Sciences Consortium (NYMSC) in the summer of 2012 to compile a list of research priorities and data needs to support implementation of EBM and promote the development of mechanisms for better coordination of local, state, and regional management of multi-jurisdictional ocean resources found off New York. This collaboration built upon the recommendations compiled by the Ocean Working Group to the NYOGLECC, as well as the research and monitoring priorities put forth by the Scientific Advisory Group (SAG) to the NYOGLECC published in the 2008 document entitled, *Research and Monitoring Priorities for Ecosystem-based Management of New York's Oceans and Great Lakes*. The SAG consisted of experts in biology, ecology, physical oceanography, environmental engineering, social science, and economics.[13]

An important premise of the OAP for improving the health of the ocean ecosystem is the importance of coordination with the goals and objectives of existing state, federal and regional management programs (e.g., New York State Coastal Management Program, Long Island Sound Study, Peconic Estuary Program, Long Island South Shore Estuary Reserve Council, NY/NJ Harbor Estuary Program, and Hudson River Estuary Program, and Federal and Interstate Fishery Management Programs). Several state, regional and national action plans were used to guide OAP priorities, especially the Hudson River Estuary Action Agenda 2010-2014, Long Island Sound Study Comprehensive Conservation and Management Plan (CCMP), Peconic Estuary Program CCMP, Great South Bay Ecosystem-based Management Plan, the New York Comprehensive Wildlife Conservation Strategy (CWCS) Plan, the Mid-Atlantic Regional Council on the Ocean (MARCO) 2011-2012 Work Plan, the National Ocean Policy Implementation Plan (2013) and the National Ocean Council's Marine Planning Handbook (2013).

The OAP is also linked to the offshore planning work being led by DOS through its authority as the state's federally-approved Coastal Management Program. Offshore planning is being used to identify potential sites for offshore wind energy projects to meet energy needs, promote economic development, and to identify areas important to New York's ocean industries.

Disclaimer: The OAP does not change, expand, alter, or amend existing state agency authorities or create new mandates for federal, state, or local agencies. Rather, the OAP builds upon the programs and initiatives already in place and seeks to establish better data collection programs based on ecosystem principles, encourages better integration of management efforts across all levels of government and sets the foundation for future actions. All implementation steps taken will be subject to the appropriate environmental and regulatory review and consultation, including, but not limited to: National Environmental Policy Act (NEPA), Coastal Zone Management Act (CZMA), Clean Water Act, Rivers and Harbors Act, Endangered Species Act (ESA), Lacey Act, Magnuson-Stevens Act (MSA), Marine Mammal Protection Act (MMPA), National Historic Preservation Act (NHPA) and the Public Lands Law.

1.2.1 OAP Geographic Scope

Given the interconnectedness of coastal areas and the offshore environment, the geographic scope of this document encompasses all inshore waters stretching from New York City to Montauk Point on the east end of Long Island, offshore waters of the New York Bight out to the edge of the Outer Continental Shelf (OCS), all connecting estuarine waters—the Peconic Estuary, Hudson River Estuary, and NY/NJ Harbor Estuary, the Long Island Sound—and the lagoonal bays of the south shore of Long Island—Great South Bay, Jamaica Bay, Moriches Bay, Hempstead Bay, and Shinnecock Bay. For a depiction of the areas included within this definition of the ocean ecosystem, see **Figure 1.**

Existing estuary programs have had management plans devised by state and federal agencies, municipalities and other partners for many years, while New York's coastal and offshore waters have not. The primary focus of the OAP will be to gather the same comprehensive information for the ocean—New York's territorial waters (extending out to three nautical miles from shore) and the federal offshore waters (beyond 3 nm)—as is being used to assess the state of the New York's estuaries. While waters beyond three nautical miles are under federal management jurisdiction, New York has the ability to impact decision-making in federal waters through authorities granted under the CZMA, and through participation in interstate and federal fisheries management councils, and other state-federal initiatives, such as those led by MARCO, Northeast Regional Ocean Council (NROC) and the Bureau of Ocean Energy Management (BOEM).

A secondary focus of the OAP will be to support EBM-focused actions needed to address threats within estuaries, tidal rivers, intertidal wetlands and mudflats, and areas of submerged aquatic vegetation because they serve as important ecological areas that provide critical developmental, foraging or spawning habitat for several marine species that also use coastal and offshore areas.

Additionally, the watersheds and coastal communities that immediately surround these aquatic resources are particularly vulnerable to short-term climate variations and long-term coastal ecosystem change. Therefore, land-based actions needed to sustain local waterfront economies and promote more resilient coastal communities in preparation for the prevalence for more frequent and intense storms in the future are also considered within the scope of the OAP, even though they are not the primary focus.

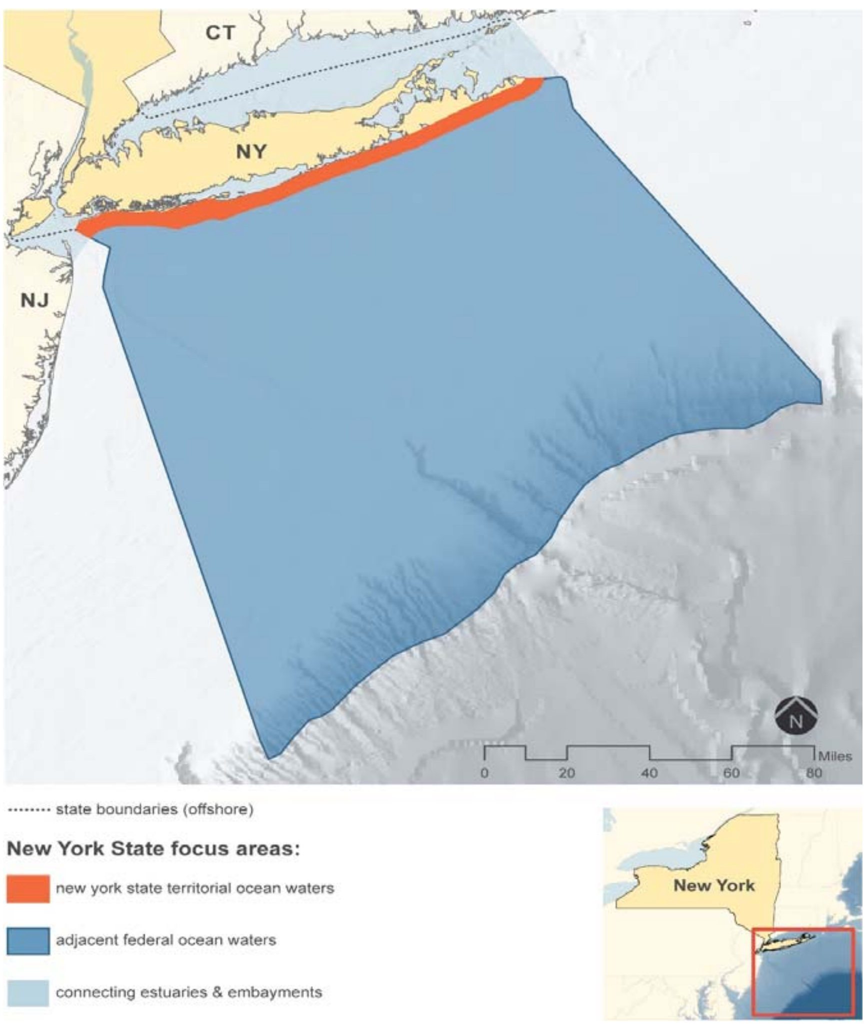


Figure 1. Geographic scope of the OAP. Note: The edge of the continental shelf ranges from 70-100 miles offshore.

1.2.2 Governance

There are multiple state, interstate and federal agencies and partnership agreements in place to address a variety of management concerns, including: the sustainable use of New York's natural and cultural resources, fostering economically and ecological sustainable local communities, drafting adaptation strategies for projecting and mitigating the impacts of climate change, and connecting people to the ocean ecosystem through recreation and tourism. For a detailed description of management authorities pertinent to the OAP, see **Appendix 2.** For a description of the state, interstate, regional and national management programs and cooperative agreements, see **Appendix 3**. These programs often have similar and possibly overlapping responsibilities and program activities already working to achieve some of the identified goals and objective outlined in the OAP.

2.0 New York's Ocean Ecosystem

2.1 Ecological Significance of New York's Ocean Ecosystem

The portion of the western Atlantic Ocean adjacent to New York lies within a broader area called the New York Bight, which stretches from Cape May, NJ, to Montauk, NY, and extends out to the continental shelf. The New York Bight's large area of the relatively shallow continental shelf and the number of adjacent high-quality estuary systems contribute to the area's high productivity and biological diversity. Over 300 marine fish species use the area for reproduction and growth, many of which move between estuarine, inshore and offshore habitats on a daily basis, seasonally, or as a result of ontogenetic shifts in foraging or habitat use to complete critical portions of their life cycle. Other marine species traverse over long distances, seasonally occurring in waters off New York as they move between feeding, breeding and nursery areas.

Several species of diadromous fish—species that migrate between the ocean, estuaries and rivers as part of their life cycle—are found here, including the shortnose sturgeon, Atlantic sturgeon, American shad, hickory shad, river herring (alewife and blueback, collectively), striped bass, rainbow smelt, Atlantic tomcod, American eel, sea lamprey and sea run brook trout. Offshore, the surface waters of the deep subtidal zones are highly productive and home to many species of marine zooplankton and the phytoplankton they feed on. Adult Atlantic mackerel spend winter months offshore, feeding on plankton, before serving as prey themselves for swordfish, tuna, sharks and marine mammals.[14] Species associated with the seafloor include sharks, skates, rays, American lobsters, crabs, horseshoe crabs and demersal finfish, like winter flounder.

The Hudson Shelf Valley and Canyon complex is a dominant feature of the New York Bight, extending from the inner-continental shelf onto the continental slope. Sediments in this area are primarily composed of sand, with isolated patches of coarse-grained gravel, fine-grained silt, rocky outcroppings, and mud deposits.[15] Deep-sea corals, including sea pens, stony corals, true soft corals, and gorgonians, thrive in the deep, cold waters of the shelf and provide habitat for numerous fish and invertebrate species, increase habitat complexity, and contribute to marine biodiversity.[16] Sea pens and stony corals in deeper waters are typically found in soft sediments and substrates on the continental shelf while the true soft corals and gorgonians are typically found on gravel and rocky outcrops around the continental slope.[17] However, several species of deep-sea corals are commercially harvested for jewelry and biological compounds found in deep-sea corals and sponges are currently being investigated for medicinal purposes.[18] We not aware that this is occurring offshore New York though. Fishermen frequent the canyons and seamounts in search of commercially important species like squid, mackerel, butterfish, tilefish, and swordfish, and gamefish such as large tunas, billfish and sharks.

Some of New York's estuaries and bays serve as critical developmental habitat for sea turtles. The majority of sea turtles seen in New York waters are young loggerhead and Kemp's ridley sea turtles which use Long Island Sound estuary and Peconic bays as foraging areas. Adult loggerhead and Kemp's ridley sea turtles have also been observed in New York waters, as have leatherback and green sea turtles.[19] [20]

A migratory corridor for several large whale species extends through the New York Bight, although evidence is emerging that some species like blue, fin, humpback and the right whale occur both inshore and offshore year round.[21] [22] Several species of seals (especially gray and harbor) are commonly seen in New York waters in winter months, resting on rocky shores and sand bars of remote beaches, estuaries and tidal rivers.[23]

Located along the Atlantic Flyway, New York hosts a great diversity of migratory and resident birds and seabirds—including waterfowl, shorebirds, predatory birds, and songbirds. Some species spend the majority of time along coastal shorelines, while others live offshore, coming to land only to breed. Most seabird species are temporary residents gathering food in pelagic and coastal habitats as they overwinter during the non-breeding season or stop over during migration. However, from May to September some species breed along New York's shores.[24] **Appendix 4** has a full list of managed marine species at the state, interstate and/or federal level found in New York.

These same complex coastal and dynamic ocean areas, that are crucial spawning, breeding and foraging habitat for finfish, shellfish and crustaceans and several endangered, threatened, or keystone marine species, also sustain state and regional economies.

2.2 Socio-economic Significance of New York's Ocean Ecosystem

The ocean and its natural resources have always played an important role in New York's diverse economy, and serve as a foundation for its varied traditions and vibrant culture. Over 60% of the state's population resides along the nearly 2,000 miles of tidal coastline. The numerous beaches, bays and estuaries boast ample nature-related recreational activities like fishing, hiking, diving and bird, whale and seal watching.[25] Approximately 65 million people who visit New York state parks and contribute nearly $2 billion in economic activity annually[26] have access to 67 marine facilities and scores of boat launch and fishing access sites.[27] Beyond its beauty and role in recreation and tourism, coastal communities and the broader state economy have a deep intrinsic connection to New York's unique estuarine, coastal and ocean resources due to the many fundamental benefits the ocean ecosystem provides.

Commercial and recreational fishing are major economic drivers in New York. In 2011, commercial fishing industries landed more than 27 million pounds of finfish and shellfish worth $37.6 million, generated $5 billion in sales in local communities, contributed $1.8 billion to the gross state product, and supported 42,000 jobs. That same year, recreational anglers generated $369 million in sales, contributed $212 million to gross state product, and supported 3,000 jobs.[28] Additionally, aquaculture contributes approximately $13 million to the New York's economy, of which $11 million is from shellfish and $2 million is from finfish.[29]

New York's marine waters are also an economically important area for commercial shipping of goods and commodities entering the country and the state. Container and tanker ships move through the New York Bight into New York Harbor, Port Newark, and Port Elizabeth in New Jersey carrying cargo and petrochemicals from around the world. The Port of New York and New Jersey is the third largest port in the nation, processing over $175 billion in cargo and supporting 279,200 jobs in 2011.[30]

Offshore areas hold significant potential as locations for the generation and transmission of renewable energy, especially wind power. Accordingly, industries are rapidly developing specific technologies that can harness these renewable resources, and state and federal government agencies are instituting policies that can promote appropriate development in offshore locations. Because New York is a net importer of energy, each New Yorker spends an average of $1000 each year out-of-state to purchase energy.[31] Promoting sustainable renewable energy generation in the ocean can stimulate in-state economic development, greater energy security, and reduced greenhouse gas emissions. An assessment of a 350 to 700 megawatt (MW) proposed wind project off New York estimated that it would create between 2,300 to 4,700 jobs paying $450-900 million in wages during the construction phase and from 85-170 jobs paying $5-11 million for continued maintenance.[32] Other studies calculated that offshore wind energy production in US waters would create from 14 to 20.7 jobs per MW.[33]

The ocean ecosystem plays a role in the regulation of the Earth's climate by absorbing and storing carbon. Approximately 30% of the carbon released into the atmosphere as a result of human activities has been absorbed into the ocean.[34] On average, salt marshes store 362 to 2,012 metric tons of carbon dioxide equivalents per hectare in their biomass and the soil beneath them.[35] Seagrasses maintain stores of carbon that range from 66 to 1,478 metric tons of carbon dioxide equivalent per hectare.[36] [37] Other ecosystem services include water filtration, nutrient cycling, protection from flooding and storm surge and coastal erosion control.

2.3 Ecological Integrity of the Ocean Ecosystem

Ecological integrity is a term used to refer to the status, or health, of an ecosystem. Healthy ocean ecosystems are characterized by persistent and productive natural habitat, balanced processes (such as nutrient cycling, energy flow, productivity and predator-prey relationships), and high biological diversity with the ability to respond to natural or manmade stresses that cause short-term environmental fluctuations or even long-term disruptions. Consequently, healthy ecosystems are resilient enough to sustainably support the ecosystem services people want and need.[38]

New York's ocean ecosystem is rich in biological diversity at the ecosystem, species and genetic level—referred to collectively as biodiversity—and the state's economic sustainability is directly linked to maintaining the ecological integrity of its ocean ecosystem, including estuarine, coastal and offshore waters. There is also growing scientific evidence that biodiversity plays a crucial role in maintaining ecosystem health and resilience.[39] Unfortunately, as important as they are to New York's future, population growth and the cumulative impacts from multiple human activities are driving unprecedented changes in marine biodiversity and threatening the ecological integrity of the ocean ecosystem and the services it provides.[40] [41] Because we must maintain the ecological integrity of our ocean ecosystem to protect the goods and services it provides, we must act to address the numerous threats to our natural marine resources from human activities.[42]

2.4 Human Caused Stressors that Threaten the Ocean Ecosystem

New York hosts one of the most densely populated and highly industrialized coastal areas in the world. Combined, the five boroughs of New York City and Nassau and Suffolk Counties located on Long Island have a population of approximately 11.2 million, with more than 10,000 and 5,000 people per square mile (6.4 M acres), respectively.[43] With a high population density, particularly along the coast, there has also been an increased demand for the goods and services provided by the ocean ecosystem, and overexploitation and overuse has begun to take a toll on the biodiversity and resilience of the ocean.[44]

Urbanization has increased impervious cover of the landscape, including roads, buildings, parking lots or any other manmade surface incapable of effectively absorbing and infiltrating stormwater. Additionally, aging sewage conveyance and wastewater treatment and stormwater infrastructure supporting heavily developed areas is often overburdened during storms. These factors have contributed to habitat loss, increased nutrient loading and marine debris into our waterways and estuaries, the emergence and expansion of harmful algal blooms, toxic chemicals and pathogens that persist in contaminated sediments and bioaccumulate in marine species, altered food web dynamics, significant declines in several important fisheries species and the emergence and proliferation of aquatic invasive species.[45] Consequently, more than 40 percent of New York's estuarine waters are considered impaired.[46]

There is the uncertainty of how climate change will further stress the aging wastewater and stormwater infrastructure and impact an already vulnerable ocean ecosystem.[47] Superstorm Sandy had an impact of untold magnitude from the debris, gasoline, home heating oil and other hazardous materials that entered coastal and ocean waters. Flood damage to wastewater treatment facilities due to storm surge and heavy rainfall during the storm caused approximately 11 billion gallons of raw and partially treated sewage to spill into waters along the east coast from Washington DC to Connecticut, with 47% of the overflow taking place in New York.[48] To be able to achieve our goals for the ecological integrity of the ocean ecosystem and the goods and services it provides, we must act to address the numerous threats to our natural marine resources from human activities.[49]

2.4.1 Fisheries

Most US fisheries stocks are sustainable and are not overfished. As of 2015, of the 233 commercially landed species where the stock status is known, 84% are not overfished. Of the 313 commercially landed species where the stock status is known, 91% are not subject to overfishing. Thirty nine stocks have been rebuilt since 2000.[50]

Commercial fisheries landings in New York are substantial, but have been declining steadily for the last several decades due to occasional overexploitation, habitat loss and water quality problems.[51] Rigorous management measures put in place to address overfishing and to rebuild the populations of many signature marine species that were once abundant in New York waters have attributed to recent increases in many finfish populations (e.g., striped bass, black sea bass, scup, bluefish) and which are no longer overfished.[52] However, other species simply have not recovered as hoped. Winter flounder, river herring, American shad, American lobster and American eel are all species historically abundant in New York waters that are currently experiencing extreme population lows.[53] Despite recent increases in relative abundance in the Hudson River, the Atlantic sturgeon was added to the federal endangered species list in 2012. As an extra measure of precaution, mitigation strategies for Atlantic sturgeon, as well as Shortnose sturgeon, were employed for the construction of the new New York Bridge project over the Hudson River.

Historically, fishery management strategies have focused on harvest reduction measures, such as setting catch limits or imposing time area closures in directed fisheries. However, managers have begun to see the importance of a more ecosystem-based approach to fisheries management, incorporating the designation and protection of essential fish habitat (EFH) into fishery management plans, as defined in the Magnuson-Steven Fishery Conservation and Management Reauthorization Act of 2006 (MSA). EFH are habitats considered necessary for spawning, breeding, feeding, and growth to maturity, and the MSA also includes regulatory guidelines for identifying other actions that encourage the conservation and enhancement of EFH.[54] However, it is also important that all potentially significant sources of mortality are identified and addressed, if important finfish and crustacean populations are going to fully recover, so as to prevent further impact to the livelihood of fishermen.

Bycatch, defined here as the discarding of any living marine resource due to a direct encounter with fishing gear, has been identified as one of the most significant threats to ocean ecosystem function and biological diversity by potentially depleting populations of commercially and recreationally important species, as well as a number of endangered or threatened resources like marine mammals, sea turtles and sea birds.[55] New York's commercial fishing industry uses a number of gear types that may result in unintentional catch of marine threatened and endangered species. The gears representing the most significant threat are otter trawl, gillnet, fish pot/trap, lobster pot and longline.[56] While species with low reproductive rates and extended life histories, such as marine mammals, seabirds, sharks and rays, and Atlantic sturgeon are likely to be significantly affected even when fisheries bycatch is suspected to be minimal, the extent to which bycatch is occurring in New York state waters and adjacent federal waters is unknown.[57]

The use of destructive fishing practices, such as unnecessarily long soak times of gear like small mesh gillnets, result in unusually high mortality of target and non-target species. Bottom tending gear like trawls and dredges can also be destructive to the sea floor because they are typically used repetitively, sometimes in important spawning and foraging habitat used by several species during various stages throughout their life cycle. These gear types not only can contribute to bycatch mortality of target and non-target species, but also cause unobserved mortality to microorganisms that play important functional roles in biogeochemical cycling in benthic communities. Many of these gear types are becoming highly regulated and fishermen are using newer gear and technologies to mitigate potential impacts to habitat.

2.4.2 Shipping and Transportation

The New York-New Jersey harbor is home to the largest port complex on the US East Coast. The three shipping lanes that enter New York Harbor are busy areas for commercial vessels, and US international container traffic is projected to at least double from 2001 to 2020.[58]

Because this port generates $30 billion in revenues and $620 million in state and local taxes annually, there is a huge economic incentive to dredge to maintain navigation channels and port access. Shinnecock Inlet, Montauk Harbor Inlet and East Rockaway Inlet are just a few examples of channels that routinely undergo maintenance dredging as part of local navigational safety and coastal storm management plans to allow commercial and recreational vessels access to important ports and marinas.

Dredging of inshore and offshore areas for commercial shipping and other ocean uses (e.g., commercial fishing, recreational boating, offshore energy development and sand mining) can adversely affect the ocean and estuarine ecosystems. Impacts include decreased water clarity due to turbidity and siltation, direct removal or burial of benthic fauna, contaminant resuspension, alterations to the hydrodynamic regime and modification, destruction or total loss of submerged aquatic vegetation and important benthic habitat.[59] Dredging and dredged material disposal must be carefully managed to ensure that environmental impacts are minimized through appropriate siting, avoidance of sensitive areas or time periods (use of environmental windows), short and long term monitoring of dredged material disposal sites utilizing Site Management and Monitoring Plans (SMMPs) established by the EPA[60], development of alternatives to in-water disposal, and the use of dredging and disposal techniques that limit the potential for release of contaminants. Due to poor controls and documented impacts, the New York Bight Mud Dump Site was closed in 1997 and the site and surrounding area has been designated the Historic Area Remediation Site (HARS).[61]

Dredging and dredged material disposal are regulated under the federal Clean Water Act and the Marine Protection Research and Sanctuaries Act (Ocean Dumping Act) and by New York regulations through the Water Quality Certification provisions of Protection of Waters and by Tidal Wetlands Regulations if a project occurs in shallow waters (less than 6 feet). New York also has guidance (TOGS 5.1.9) for the “In-water and Riparian Management of Sediment and Dredged Material” which outlines how projects should be evaluated based on the physical and chemical characteristics of the sediment. New York State advocates that all practical disposal alternatives should be evaluated before in-water disposal is used as a management option.

Another impact from heavy shipping traffic is the potential of mortality for several marine species due to vessel strikes. Whale vessel strikes have been documented in New York waters, including fin, minke and right whales.[62] Vessel strikes with Atlantic sturgeon are well documented in the Delaware River, and may pose a similar threat in New York waters.[63] Ocean noise, predominantly caused by increased shipping activity, has also changed migratory and foraging behavior of many marine species and can further negatively affect fish and marine mammals by impeding communication or through physical trauma.[64] [65] [66] Other activities such as military training exercises and offshore energy development within the New York Bight are also significant sources of anthropogenic noise pollution. Even recreational motorized watercraft can cause impacts, such as to nearshore seagrass beds through propeller damage or scaring by mooring.

2.4.3 Offshore Energy Development

New York State is the eighth largest energy user in the US. However, only 12% of the total primary energy requirements are generated from in-state resources, including the burning of fossil fuels (oil, natural gas and coal), renewable resources (biomass and biofuels, hydrokinetic, wind and solar energy) and power plants.[67] Over the last few decades, considerable research has gone into developing alternative energy methods using land-based and offshore wind, solar and geothermal sources to replace the traditional practice of burning fossil fuels to meet growing energy demands. Of the alternative methods, the tremendous wind potential located offshore New York in the Bight has shown promise as a significant and steady source of renewable energy for New York City, Long Island, and surrounding areas.[68] As energy needs are expected to increase, New York is looking to take advantage of the abundant renewable offshore energy resources found in the outer continental shelf (OCS) of the New York Bight to help move the state towards a safe, reliable, and clean energy agenda.[69] This shift is consistent with and will help achieve the Governor’s call for 50% of the State’s electrical generation to come from renewable sources by 2030.

On June 2, 2016, Secretary of the Interior Sally Jewell and Bureau of Ocean Energy Management (BOEM) Director Abigail Ross Hopper announced the proposed lease sale and Environmental Assessment for 81,130 acres offshore New York for commercial wind energy leasing. The siting of wind turbines in federal waters will require detailed spatial planning, consultation and robust analysis to understand potential effects. Depending on the type of facility, the analysis may address potential effects on benthic habitats and communities, changes to sand movement, migratory pathways for marine mammals, sea turtles and seabirds, mortality of bats and seabirds, overlap with areas of potential sand borrow areas for beach re-nourishment needs, and existing uses such as commercial fishing, navigation and tourism.

In addition to offshore wind leasing, the U.S. Department of the Interior (USDOI) previously considered authorizing non-renewable energy exploration in the form of oil and gas lease sales in federal waters in its Mid-Atlantic and South Atlantic Planning Regions under its 2017-2022 five-year plan.[70] In 2012, USDOI announced availability of a Draft Programmatic Environmental Impact Statement (PEIS) for Atlantic OCS Proposed Geological and Geophysical Activities in the Mid-Atlantic and South Atlantic Planning Areas, with a final PEIS in 2014 that would have authorized activities including seismic surveys to explore for potential oil and gas deposits in the Atlantic OCS from Florida to Delaware Bay. In January 2015, USDOI had released its Draft Proposed Program for 2017-2022 that included geological and geophysical exploration as one potential aspect of its offshore leasing strategy. However, due to low oil and gas resource potential in the Mid- and South Atlantic Regions, and lack of support for initiating new oil and gas leases, the final USDOI 2017-2022 offshore leasing program, announced in March 2016, excluded oil and gas lease sales in the Mid-Atlantic and South Atlantic Planning Regions. Since there is no permanent moratorium on oil and gas leasing in the Atlantic OCS, USDOI could revisit the possibility of issuing oil and gas leases in the Atlantic OCS in future planning cycles.

2.4.4 Climate Change

The oceans absorb large amounts of carbon dioxide (CO_2) from the atmosphere and as atmospheric CO_2 has increased, so has the concentration of CO_2 in the oceans. As a result, the pH of seawater has decreased an average of 0.1 units less than the estimated pre-industrial value for 1750, over 200 years ago. This represents a 30 percent increase in acidity[71], with ocean pH projected to become more acidic by as much as 0.3 to 0.4 units by the end of the century.[72] Ocean acidification is expected to cause large-scale changes in ecosystem structure, as certain species will have advantages over others that are less capable of adapting to rapid changes in marine conditions. In particular, many shell producing species, like oysters, will be negatively affected, resulting in economic uncertainties for the aquaculture industry and important commercial and recreational fisheries.[73] [74] However, impacts of ocean acidification on marine organisms that occur in the deep ocean remains poorly studied.[75]

Mean annual sea surface temperatures have increased on the continental shelf in the US northeast to the highest levels seen over the 150-year time series due to climate change.[76] As a result, economically valuable marine species may already be changing their behavior. Nye et al. (2009) demonstrated that 24 of the 36 fish stocks examined on the northeast US continental shelf have shifted their distribution northward and/or offshore due to behavioral adaptations associated with large-scale warming.[77] Another study in the mid-Atlantic bight showed that modest increases in water temperatures caused large ecological shifts, in which macrocrustaceans (e.g., crabs, lobster) and southern pelagic fish (e.g., bay anchovy, butterfish) were favored at the expense of boreal demersal fishes (e.g., winter flounder, red hake).[78] Additionally, changes in ocean circulation patterns may change spawning adult spatial distribution, larval dispersal[79] and the geographic distributions of marine species.[80] For example, Atlantic surfclams in the northeast Atlantic have suffered higher mortality in recent warmer than average years and are now found at deeper depths.[81] There is further evidence that as water in coastal and ocean environments becomes warmer, they are also becoming more hospitable to the production of harmful algal bloom events[82] and an increase in the potential for exposure to seafood-borne illnesses through shellfish consumption due to an increase in naturally occurring *Vibrio* bacteria.[83]

Warming and rising ocean waters are also predicted to bring stronger and more destructive coastal storms to New York's densely populated coastline, which will face substantial increases in the extent and frequency of storm surge, coastal flooding, erosion, property damage, disruption to utilities and public services (e.g., power, light, communications, wastewater treatment facilities and transportation) and loss of wetlands. Severe weather events attributable to climate change, including heat waves and extreme precipitation events are forecast to increase in both frequency and intensity.[84] Hurricanes Irene and Sandy, which struck New York in 2011 and 2012 respectively, could be indicative of the widespread destruction expected from future storms, with the most significant impacts expected in communities already facing economic hardships.[85]

New York's shorelines are dynamic and constantly undergoing change due to the complex interactions between natural processes (subsidence, erosion and accretion) and human activities associated with coastal development. While these natural influences and human activities work to alter shorelines, there is now a growing consensus that global climate change will exacerbate the state's vulnerability to sea-level rise. [86] According to the New York City Panel on Climate Change, sea levels in New York City are expected to rise between 4 and 8 inches, with the highest estimate of 10 inches by the 2020s, and between 11 and 24 inches with a high of 30 inches by the 2050s.[87] However, difficult-to-predict rate of melting of land-based ice could double those projections, resulting in almost five feet of sea-level rise in the next 70 years.[88] For comparison, over the past 150 years the New York Harbor has experienced an increase in sea level of 15 inches.[89] Under the Community Risk and Resiliency Act efforts, New York is proposing projections of sea level rise for New York's tidal coast that vary slightly from the panel's projections. http://www.dec.ny.gov/regulations/103877.html

2.4.5 Pathogens and Toxic Contaminants

Vast amounts of urban waste have historically been disposed of at a number of dumpsites located within the New York Bight and Long Island Sound.[90] Pathogens, toxic metals and synthetic organic compounds found in discharge from sewage treatment plants, toxic chemicals from industrial waste and contaminated dredged spoils from harbors were routinely dumped in the ocean or estuaries for decades until this practice was banned by the EPA in 1987.[91] Some pesticides found in sewage sludge and industrial discharge can persist in the ocean ecosystem for years and can remain in sediments at concentrations that are toxic to benthic organisms.[92] Sub-lethal concentrations can be assimilated into food webs, posing health risks to species at higher trophic levels, like marine mammals, seabirds, sea turtles, large predatory fish or even humans.[93]

While much effort has gone into improving the state's estuarine and coastal water quality, beach closures precipitated by factors such as elevated bacteria levels, unknown sources of contamination, storm water runoff, and sewage leakage or spills, cost $60 million in lost revenue for Suffolk and Nassau Counties combined in 2007.[94] When considering beach closures in New York City and Westchester Counties, the impacts to the broader New York economy would have been much higher. Bacteria in stormwater runoff contribute to contamination in many of New York's waters, and the resulting shellfish bed closures in the New York Bight, estuaries of Long Island, and in the NY/NJ Harbor Estuary.[95] In 2010, Suffolk, Nassau and Westchester County beaches on the ocean and southern bays experienced a total of 328 days of closings or advisories due to measured or anticipated increases in bacteria levels, representing an economic blow to local coastal communities.[96] In 2015, Suffolk, Nassau and Westchester Counties and New York City coastal beaches experienced a total of 1457 days of closures or advisories according to the NYSDOH.

DOH issues fish consumption advisories for ocean areas of Long Island and New York City, because some fish contain chemicals at levels that may be harmful to health. Advisories are issued for sportfish (including weakfish, bluefish, American eel, and striped bass) due to PCB concerns, and crab and lobster tomalley due to dioxin, cadmium and PCB concerns.[97] In addition, the US Food and Drug Administration (FDA) recommends that women who are or may become pregnant, nursing mothers, and young children should not eat tilefish, king mackerel, shark, and swordfish due to higher mercury levels in these fishes.[98] Uncertified shellfish areas in state waters located near sewage outfall pipes and dumpsites in federal waters (106-Mile Dumpsite, Mud Dumpsite, etc.) are closed year round for the protection of human health. Unlike estuaries and coastal areas, little water quality monitoring and sediment testing is done in ocean waters. Although pathogens and other toxic contaminates have accumulated in offshore sediments, very little is known regarding the effects these pollutants are having on the structure and function of benthic communities, or to economically and ecologically important fish species that migrate between potentially contaminated inshore and offshore waters during their lifecycle.[99]

2.4.6 Habitat Loss and Degradation

Increased population density and development along New York's coastline over the last century have resulted in fragmentation, alteration or complete destruction of highly productive marine habitat. Shallow estuarine and coastal habitats represent large contributions to ecosystem function that promote abundant ecosystem services. However, dredging, filling, construction of dams and culverts, shoreline hardening, and some fishing and shellfishing practices threaten ecologically sensitive and economically important inshore habitat. These ecosystems support commercial and recreational fisheries and naturally protect coastal communities from flooding and erosion during storms.

Historical records and photos indicate that 197,684 acres of eelgrass may have been present in 1930s New York, but today only 21,802 acres remain. While some of this loss can be attributed to natural events such as disease, the majority of eelgrass loss has been driven by human activities.[100] Excessive nitrogen pollution has been demonstrated to cause a decline in seagrass beds. Impacts associated with certain motorized boating and commercial fishing practices can be especially destructive to submerged aquatic vegetation and benthic habitats that support important finfish species and shellfish beds. Additionally, deep-sea corals are critically important offshore habitat and are particularly vulnerable to bottom trawling and could be further impacted by offshore development for renewable energy, aquaculture and sand extraction.[101] High mortality of marine species typically associated with habitat destruction and alteration, particularly juvenile finfish species, has the potential to not only affect the long-term sustainability of fisheries, but also further degrade the ecosystem.[102]

2.4.7 Eutrophication and Hypoxia

While nutrients occur naturally and support healthy marine ecosystems, excessive nutrients (particularly nitrogen) can severely impair water quality by stimulating excessive growth of algae and contributes to reduced water clarity.[103] Humans have greatly increased nutrient pollution (eutrophication) directly into estuaries and the ocean through agricultural and stormwater runoff, discharges from wastewater treatment plants, atmospheric deposition from the burning of fossil fuels and improper use and/or disposal of residential fertilizer and other household products.[104] Commercial and residential onsite sewage systems (cesspools and septic tanks) and landfills also seep nitrogen and other pollutants into groundwater which can be harmful even at low concentrations to the nearly 3 million residents on Long Island who rely 100% on groundwater as the sole source for drinking water. Many pollutants that make it into the ground water eventually end up in surface waters.[105]

One direct adverse impact of eutrophication attributable to human activities is hypoxia. Hypoxic (low oxygen) conditions occur when dissolved oxygen in water is depleted as excess buildup of organic matter (e.g., plants, phytoplankton blooms) decomposes.[106] Mobile organisms can escape a particular area when dissolved oxygen concentrations become so low that they become physically stressed and ultimately cannot survive. However, immobile or sessile species, such as oysters and mussels, are particularly vulnerable to die-offs during prolonged hypoxic events.[107] Hypoxic areas incapable of supporting aquatic life are referred to as dead zones. Water quality has improved in the Long Island Sound due primarily to upgrades of wastewater treatment plants that discharge to LIS. The extent of the improvement these upgrades will have on the size and duration of the hypoxic zone in LIS is still unknown. Improvements in management practices of stormwater runoff, atmospheric deposition, groundwater discharge and overflows from aging sewage collection systems would further reduce the anthropogenic nutrient load contributing to this hypoxic zone

Hypoxia has also resulted in mortality of benthic organisms in the New York Bight, disrupting oceanic food web dynamics, reduced growth in commercially harvested species and loss of biodiversity.[108] Low oxygen zones in coastal areas and in the open ocean have expanded in recent decades, and new studies are suggesting that eutrophic, low oxygen areas are also experiencing acidification. The effects of hypoxia coupled with low pH on marine organisms are largely unknown, but experiments have shown the co-occurrence of these conditions to be detrimental to the early life stages of two bivalves, bay scallops and hard clams. [109]

2.4.8 Harmful Algal Blooms

The ocean is full of microscopic plankton and algae that form the basis of the marine food web. While most of these microscopic organisms are harmless, there are several species that can grow rapidly under certain environmental conditions, resulting in algal blooms that can have adverse environmental impacts. The US has seen a drastic increase in harmful algal blooms (HABs) since 1972, and in coastal areas, they are now distributed across greater geographic areas, for longer duration, and with more toxic species observed. This increase represents a serious threat to fisheries, public health, and local economies.[110]

There are many possible causes for this increase in HABs, such as species dispersal or introduction of cysts via currents, storm activity, ballast water discharge, shellfish seeding and transport, and improved detection methods and increased monitoring, particularly around shellfish beds and in estuaries. There is also mounting evidence that eutrophication may play an important role in the development, persistence and expansion of many HABs.[111] In New York, DEC is working with scientists to establish to a clear linkage between the form of nitrogen and the toxicity of a HAB in Northport Harbor. Although HABs do occur offshore within the New York Bight, there are currently very few monitoring efforts underway that would allow researchers to quantify the extent of their occurrence or assess any environmental impacts. HABs caused by non-toxic macroalgae can adversely impact aquatic ecosystems by significantly decreasing the amount of sunlight that penetrates through surface waters of impaired systems, thereby reducing the ability of other plants and algae to produce the energy they need to survive. This shading effect has been linked to declining seagrass beds and reduced growth, reproduction and survival in finfish, shellfish, invertebrate and zooplankton.[112]

There are a few primary examples of major HABs that impact coastal areas of New York. HABs commonly called brown tides in the Peconic Estuary and Great South Bay caused by *Aureococcus anophagefferens* are non-toxic to humans but have severely impacted several fisheries species (particularly bay scallop populations in the Peconic Bays) and eelgrass beds.[113] Brown tide blooms were most recently observed in June 2016 in the eastern south shore bays. Red tides are HABs caused by the toxin-producing dinoflagellates *Alexandrium fundyense* and *Cochlodinium polykrikoides,* and are common in Northport, Huntington and Shinnecock bays. *Alexandrium sp*. produce saxitoxin, which is a dangerous neurotoxin that causes paralytic shellfish poisoning (PSP). PSP can destroy, damage, or impair the functioning of nerve tissue in humans upon consumption of contaminated seafood, and can even cause death if consumed in large quantities. The last time DEC closed shellfish beds from red tide was back in May, 2015. There have been no shellfish closures from HABs in 2016.

2.4.9 Aquatic Invasive Species

The National Invasive Species Council defines an invasive species as a non-native species that when introduced (intentionally or unintentionally) into an environment, causes or will likely cause harm to the economy, environment, or human health.[114] Aquatic invasive species (AIS) found within New York's ocean ecosystem include several species of plants (e.g., common reed, water primrose), crustaceans (e.g. Asian shore crab, Chinese mitten crab, green crab), marine invertebrates (e.g., Asian stalked tunicate, orange striped anemone) and fish (e.g., lionfish). AIS can be introduced into waterways and the marine environment along a variety of pathways, or vectors, and can be released intentionally or by accidental means. Such vectors for introducing AIS include the domestic or international trade of live aquatic organisms, the use of live bait during fishing, small craft transport between water bodies (such as kayaks, canoes, or trailered fishing vessel), escape and/or release from aquaculture facilities and retail markets and from hull fouling or the discharge of ballast-water from ocean-going commercial and recreational vessels.[115] AIS can be devastating competitors to native species in the marine environment, causing losses in biodiversity and significant adverse impacts to local economies.

The costs of controlling the spread of aquatic invasive species are not well documented in New York, but prevention, early detection, rapid response and eradication are important management strategies. While aquatic invasive plant and animal species are known to occur in the estuaries of New York, their status in ocean waters is mostly unknown. Given their ability to overwhelm native species, the effects of AIS is most likely being felt in ocean areas where currently little monitoring is underway. In order to address the threat of AIS and prioritize response, it is critical to build the capacity within New York to evaluate and predict potential impacts different AIS are having on the ocean ecosystem, as well as to identify which AIS species may be causing the most environmental damage. Outreach and education will also play a key role in as a cost effective way to combat the spread of AIS and raising awareness of AIS threats and informing the public of local legislation pertaining to AIS and prevention strategies that have already been developed on a state wide and regional basis.

2.5 Challenges to Ocean Resource Management and Offshore Planning

There are numerous human activities that directly or indirectly threaten the ecological integrity of the ocean ecosystem. As a result, New York State resource managers are faced with challenges making it increasingly difficult to restore, protect and sustainably manage valuable ocean resources. Historically, past ocean resource management strategies have been carried out in a piecemeal fashion, based on a fragmented sector-by-sector approach. This results in the failure to consider the cumulative effects that multiple human activities are having on the ecological integrity of the ocean ecosystem.[116] Although considerable federal and state regulatory action has been taken over many years to reverse ecological declines, the effectiveness of these largely single species or single sector management decisions have been uncertain due to the paucity of quantitative data needed to accurately assess the current status of the ocean ecosystem or to detect long-term changes in biodiversity.[117]

While resource managers have recognized the benefits of multispecies or ecosystem-based management approaches, critically important information on the interconnectedness of ocean ecosystem processes, how they function and what actions are required to maintain their ability to provide goods and services are inaccessible, inadequate or completely lacking. [118] The scientific information that could lead to a better understanding of the consequences of biodiversity loss is often not accessible or is collected in an uncoordinated, non-standardized format, making it difficult to incorporate into a larger, publicly available metadatabase. For many commercially important fish and large invertebrates species (e.g., blue crabs), we are only beginning to understand their functional roles in the ocean ecosystem. There is no way of knowing the human impacts on organisms for which no population assessments exist, or how offshore areas that are currently under-sampled are potentially changing due to environmental stresses. Additionally, there are estimated to be scores of plants and animals that remain undescribed. For example, planktonic bacterial assemblages in the ocean ecosystem are crucial components of the marine food web and are extremely important in biogeochemical cycling. Yet, we know very little about the species diversity of complex microbial communities, or how the trophic roles of species within these communities are being affected by human activities or even climate change.[119]

Adding to the complexity of ecosystem dynamics is the uncertainty of how climate change will continue to drive changes in biodiversity (e.g., distribution shifts, ocean acidification, food web dynamics, shifting of currents like the Gulf Stream, etc.) and to the extent that it might impact the economy. The ocean ecosystem and its resources hold cultural and historical significance for many New Yorkers, such as the Shinnecock Indian Nation in Suffolk County, the baymen who harvest shellfish from Long Island's extensive bays and waterways and many other user groups who depend on ocean resources. With coastal development and human use of the ocean generally increasing, continuing to manage each sector, or human activity, in isolation is insufficient to conserve the ocean ecosystem.[120] Although we must continue to gather scientific information to better understand the ocean ecosystem and implement effective management decisions, it is vital that we proceed with the best available science and use ecosystem-based management principles to implement actions in the short-term that can be achieved while factoring new information into management and planning initiatives over time.

3.0 Goals, Objectives, Actions

3.1 Overview

The New York Ocean Acton Plan (OAP) seeks to achieve the state's vision of improved understanding, protection, restoration and resiliency of New York's ocean resources and the goods and services they provide. Specifically, the OAP will help guide the sustainable management of ocean resources and inform a diverse range of human activities and planning for future use. It also is intended to encourage communication and collaboration at all levels of government in order to promote effective decision-making.

The goals, objectives and actions outlined in the OAP were developed through an inclusive, transparent stakeholder process after working with a diverse array of stakeholders. This plan underscores the research priorities necessary to address gaps in knowledge and existing data regarding the ocean, but also highlights specific actions we need take now within the broad range of existing State laws and regulations relating to fish, wildlife, water, public health and community resiliency. For example, the actions listed under Goal 1 are detailed and often state what needs to be done to address the threats to a specific resource, such as a particular habitat or single species. The steps are offered as strategies, that when integrated along with all other actions under this section, and adapted over time based on careful monitoring and lessons learned, will address how to achieve the overall goal—'*Ensure the ecological integrity of the ocean ecosystem'*.

The OAP also seeks to articulate for our federal and interstate partners with inshore and offshore regulatory jurisdiction what is important to New York regarding effective management and conservation of New York's ocean ecosystem. Implementation of this ambitious plan will require the use of multi-jurisdictional partnerships and strong collaborations amongst agencies and stakeholders and will require the leveraging of funding from federal, state and other sources. Only through a collective approach, focused on priority actions, will New York be able to effectively achieve a healthy ocean ecosystem with increasingly scarce public and private resources.

3.2 GOAL 1: Ensure the ecological integrity of the ocean ecosystem.

3.2.1 Overview

New York's ocean ecosystem boasts an array of habitats, ranging from submarine canyons, deep sea corals, artificial reef structures and sandy continental shelves offshore, to tidal wetlands, mud and sandflats, submerged aquatic vegetation beds (SAVs) inshore. The ocean ecosystem is also home to a diversity of living resources that support commercial and recreational opportunities. For example, Long Island's inshore waters, including estuaries and lagoonal bays, not only sustain inshore fish, shellfish and crustaceans, but are used extensively by many ecologically and economically important offshore species throughout various life stages. They also serve as important foraging areas for seasonal migrants, as well as threatened or endangered species. However, human activities are threatening the health of the ocean ecosystem, causing habitat loss, water quality issues and a decline in biodiversity.

Protecting and maintaining marine habitat and living resource biodiversity, thus conserving ocean ecosystem function, will provide long-term direct benefits to several ocean-based user groups, or sectors.[121] A commitment to establishing programs for baseline monitoring of environmental conditions (physical, geological, chemical and biological) is crucial to identify ecosystem threats, increase our understanding of the associated impacts of existing and emerging stressors, make well-informed management decisions and gauge the success or failure of management actions.

3.2.2 Objective A: Protect and restore sensitive inshore, offshore and estuarine habitats.

3.2.3 Actions 1-8

1. **Evaluate, prioritize and remove or modify known impediments to diadromous fish passage.**

   Almost all diadromous fish species that occur in New York waters are currently experiencing historical population declines. The following species are listed as species of greatest conservation need (SGCN) in the state's Comprehensive Wildlife Conservation Strategy: alewife, blueback herring, American eel, American shad, and shortnose sturgeon and Atlantic sturgeon. The New York Bight distinct population segment of Atlantic sturgeon was also listed as endangered under Endangered Species Act (ESA) in 2012. Manmade barriers, such as dams and culverts, account for a significant loss of access to spawning and developmental habitat for diadromous fish species, particularly in the Hudson River and rivers and tributaries throughout Long Island. Downstream passage can be difficult for juveniles because structures like spillways and inefficient turbines pose potential mortality threats during out-migration.[122] Removal of impediments to fish passage, or modification when removal is prohibitive, will help restore migration of diadromous species into several hundred acres of spawning habitat. For example, a permanent fish passage feature called a Rock Ramp was installed in Grangebel Park in Riverhead in 2010. This restoration effort resulted in the reopening of approximately 24 acres of historical spawning habitat used by alewives (*Alosa pseudoharengus*). Monitoring efforts began that same year to provide basic biological data on alewife runs in this particular area of the Peconic River and to access the effectiveness of the restoration efforts. It has been estimated that alewife spawning biomass has increased four-fold in just 3 years (Byron Young, personal communication).

   Step 1) Using current data from successful restoration sites, work closely with all relevant estuary programs to map, evaluate and prioritize actions needed for the removal or modification of a minimum of ten manmade impediments to diadromous fish passage throughout Long Island and along the Hudson and Delaware Rivers. In addition, review The Nature Conservancy's Northeast Aquatic Barrier Assessment for opportunities. See **Appendix 5** for a list of priority fish passage projects identified on Long Island and a list from the Hudson River Estuary Program. The priority will be to remove impediments at first instance from the main waterbody.
   Timeframe: Short term (2 years)

   Step 2) Because many traditional fish passage systems are not effective in allowing American eels to pass, research and develop more effective fish passage technologies for this species for implementation at proposed and existing sites, when applicable.
   Timeframe: Short term (2 years)

   Step 3) Conduct feasibility studies necessary to appropriately design and implement removal or modification of 2 sites based on Step 1.
   Timeframe: Short term (2 years)

   Step 4) Install educational signs at each site and explore other opportunities to inform the public and promote continued stewardship of the ocean ecosystem and its natural resources.
   Timeframe: Short term (2 years)

   Lead Agency: DEC; Potential Partners: ASMFC, NOAA, USFWS, OPRHP, SSER, PEP, LISS, HREP, WCS, MRAC, municipalities and land owners.

2. **Develop a seagrass management program that will implement seagrass management plans for designated seagrass management areas.**

   Seagrasses are important for maintaining healthy bays and estuaries throughout the marine district. They help stabilize shorelines, reduce turbulence and provide spawning, nursery and foraging habitat for fish, shellfish, birds and sea turtles.[123] Additionally, it has been estimated that 2.5 acres of seagrass may sustain up to 125 million small invertebrates[124] and is capable of sequestering carbon in the range from 66 to 1,478 metric tons of carbon dioxide equivalent per

hectare.[125] [126] Despite their ecological role, seagrass beds have been severely reduced in New York waters due to several anthropogenic stressors. Damaging physical disturbances to seagrass beds can result from dredging and commercial fishing gear activities, as well as from alterations in wave attenuation and sedimentation caused by hardened shoreline structures. Water quality issues, caused largely by urban development, is another major contributor to large-scale losses of seagrass meadows. Seagrasses are especially impacted by eutrophication, which promotes algal growth and may be a contributing factor in the persistence of harmful algal blooms during warmer months of the year across Long Island. In fact, substantial loss of eelgrass beds in the Peconic Estuary due to repeated brown tide (*Aureoccus anophageffrens*) events since the 1980's has decimated the New York Atlantic bay scallop fishery. [127] Because the loss of seagrasses leads to declines in commercially and recreationally important fish and shellfish species in both offshore and inshore areas, the economic impacts to local communities who rely on harvesting these marine resources for their livelihoods can also be substantial.

Step 1) Following the guidance of the goals and action recommendations by the New York State Seagrass Task Force, and as mandated by The Seagrass Protection Act of 2012, DEC will work in collaboration with municipalities and other appropriate stakeholders to designate seagrass management areas and to regulate marine and coastal activities to protect at risk areas from further decline.
Timeframe: Short term (2 years)

Step 2) Utilize the seagrass management program to coordinate monitoring, research, and restoration efforts in collaboration with municipalities and other appropriate stakeholders, following the recommendations put forth in the *Final Report of the New York State Seagrass Task Force: Recommendations to the New York State Governor and Legislature* (2009). The state is willing to work collaboratively with municipalities, including New York City, to implement seagrass restoration projects within their jurisdictions.
Timeframe: Short term (2 years)

Step 3) Conduct a SAV mapping survey within Long Island estuaries (SSER, LIS, Peconic), to be repeated every 3 years and coordinate with mapping of submerged aquatic vegetation throughout the marine district.
Timeframe: Short term (2 years)

Step 4) Examine seagrass sites for restoration within subwatersheds that have been identified as having been negatively impacted by excessive nitrogen loading and suspended solids. Evaluate areas first where there is a high likelihood of reducing nitrogen loads and improving habitat for economically important marine species. Use information collected by TNC's Southern New England and New York Seagrass and Restoration Initiative as a guidance document which examined 20 sub-watersheds and linked nitrogen to seagrass decline.
Timeframe: Near term (5 years)

Step 5) Investigate the impacts of toxic groundwater contaminants (e.g., herbicides, pesticides, etc.) on seagrasses as a potential driver of seagrass loss, including the identification of data needs and future research and management priority actions.
Timeframe: Near term (5 years)

Lead Agency: DEC, DOS; Potential Partners: NOAA, NPS, OPRHP, municipalities and the Shinnecock Indian Nation.

3. Monitor tidal wetland loss (trends), water quality and implement restoration in estuaries and embayments

Tidal wetlands, such as salt marshes, improve coastal water quality and provide important spawning, nursery, shelter and foraging habitat for many finfish, shellfish and birds. They also stabilize shorelines, offer protection from flooding and erosion during intense storms and can store 362 to 2,012 metric tons of carbon dioxide equivalent per hectare within their soil.[128] Tidal wetland loss on Long Island and along the lower Hudson River was first documented since 1974 using infrared aerial surveys. However, tidal wetlands loss has accelerated in recent decades, most notably along the south shore of Long Island and particularly within Jamaica Bay.[129] Although wetland loss can occur naturally, human activities such as dredging, filling for land development and shoreline armoring, have drastically reduced the amount of tidal wetlands on Long Island. Additionally excess nutrients, particularly nitrogen, have been shown to negatively impact the ecological integrity of tidal wetlands (e.g., eutrophication can lead to hypoxia, seagrass declines, increased erosion, harmful algal blooms, increased pathogens, and the spread of invasive species) and significantly reduce their resiliency to storm surges and wave action. New York first moved to protect these valuable resources with the passage of the Tidal Wetlands Act in 1973. In 2012, the NY 2100 Commission Report (2013) recognized the importance of tidal wetland protection and restoration as a central part of New York's coastal resilience strategy, and recommended using the Jamaica Bay Wetland Restoration Project as a model for future restoration plans in other areas of Long Island. Detecting trends in salt marsh accretion rates and water quality parameters at tidal wetland sites to identify the causes of loss will help design effective, site specific habitat restoration projects in the future.

Step 1) Continue to monitor temperature, salinity, pH, dissolved oxygen, turbidity, and tidal water elevation at deployed surface elevation tables (SET) in four embayments of western and central LIS 1) East Creek in Sands Point, 2) Frost Creek in Lattingtown, 3) West Pond in Glen Cove and 4) Flax Pond in Old Field. Concurrently, evaluate additional tidal wetland water quality, hydrologic and sediment elevation monitoring needs in the Peconic Estuary and along the south shore of Long Island, as necessary. Coordinate with similar projects in the Hudson River estuary.
Timeframe: Short term (2 years)

Step 2) Integrate water quality and SET data to evaluate marsh loss and assess sea-level rise impacts and restoration potential in these embayments.
Timeframe: Short term (2 years)

Step 3) Complete tidal wetlands mapping and trends analyses through work funded by USEPA.
Timeframe: Short term (2 years)

Step 4) Acquire and map new tidal wetlands data. Then, update Tidal Wetland Trends analysis within 5 years.
Timeframe: Near term (5 years)

Step 5) Investigate the drivers of tidal wetland loss and marsh migration on a site-specific basis. This should include the development of a conceptual model incorporating factors that influence marsh growth/loss, such as accretion rates, groundwater input, dredging, ice scour or other physical alterations, inlet stabilization, coastal development, shoreline hardening, sediment regime alteration, wind/wave action, sea level rise, and nutrient (particularly wastewater-derived nitrogen) enrichment. Ultimately develop a Wetlands Loss Diagnostic Matrix in order to analyze the reasons for wetland losses in these locations.
Timeframe: Near term (5 years)

Step 6) Using information from step 5, develop an inventory of priority tidal wetland conservation and restoration sites, design and implement restoration strategies for these priorities, starting with state owned tidal wetland properties.
Timeframe: Near term (5 years)

Step 7). Create a centralized database for tidal wetland information to serve as a way for stakeholders to disseminate and communicate information regarding tidal wetland issues, monitoring protocols, research results and next steps, funding opportunities and lessons learned as well as to assist the regulators who review Tidal Wetland Permit Applications.
Timeframe: Near term (5 years)

Step 8). Create a regional marsh monitoring framework, including standard monitoring protocols and metrics to be used at all tidal wetland restoration sites before, during and after restoration.
Timeframe: Near term (5 years)

Lead Agency: DEC, USGS; Potential Partners: NPS, OPRHP, SUNY SB, TNC, LISS, EPA, NOAA, USFWS, and NYC Department of Parks and Recreation.

4. **Strengthen criteria for designation of significant coastal fish and wildlife habitats (SCFWH), and designate new areas as SCFWH in state waters (0-3 nm).**

One of the biggest threats to marine biodiversity is habitat loss and degradation. As the pressure for development along New York's heavily populated coast continues to increase, important habitat, such as tidal wetlands, will continue to be degraded or lost. Recreational and commercial fishing industries (along with the coastal communities that support them) will continue to suffer significant losses in revenue as a result. While many fisheries management strategies are aimed at ending overfishing, maintaining sufficient, high quality coastal habitats is an essential objective to support abundant and diverse fish and wildlife populations that our economy depends on. The Waterfront Revitalization and Coastal Resources Act provides a process for DEC to identify habitats of statewide significance that are critical to the maintenance or re-establishment of species of fish and wildlife. DOS's Coastal Management Program and regulations at 19 NYCRR § 602.5(a) define specific criteria used to designate these areas as Significant Fish and Wildlife Habitats (SCFWH). These criteria and the document, *Technical Memorandum: Procedures Used to Identify, Evaluate and Recommend Areas for Designation as "Significant Coastal Fish and Wildlife Habitats"* should include updates to reflect evolving stressors of marine habitats. With uncertainties regarding the impacts of climate change, and increasing interests for energy development in coastal and offshore areas, the impact assessment language of the marine SCFWH narrative that accompanies each habitat designation should include language consistent with current and future management realities.

Step 1) Update supporting data and impact assessment language (19 NYCRR § 602.5(a)) in the *Technical Memorandum: Procedures Used to Identify, Evaluate and Recommend Areas for Designation as "Significant Coastal Fish and Wildlife Habitats"* to identify stressors to marine habitats.
Timeframe: Short term (2 years)

Step 2) Using newly available data, DEC should identify and DOS should designate additional marine areas within state waters (0-3 nm) to be incorporated into the New York Coastal Management Program. Specifically, evaluate habitats considered important for ESA listed species, such as Atlantic sturgeon and sea turtles, and others considered species of greatest conservation need (SGCN) like the American eel and river herring that use both offshore and inshore habitats. Analyze areas projecting future climate change scenarios. Use this information to steer potential projects away from these designated habitats.
Timeframe: Short term (2 years)

Lead Agency: DOS, DEC; Potential Partners: NPS, NYSERDA, OPRHP, NOAA, USFWS, MRAC, WCS and Shinnecock Indian Nation.

5. **Implement the Long Island Pesticide Pollution Prevention Strategy to protect groundwater and surface water resources from pesticide-related contamination.**

According to New York State Environmental Conservation Law 33-0301 (ECL), pesticides are "valuable, important and necessary to the welfare, health, economic well-being and productive and industrial capabilities of the people of this state."[130] However, many chemicals used in pesticides, like organochlorines, can persist in the environment for years and can be toxic to SAV's and lethal to aquatic wildlife.[131] Sub-lethal concentrations of pesticide-related chemicals found in estuaries bioaccumulate in the tissues of fish and other marine species, eventually making it into all levels of the food chain. For this reason, improper use of pesticides can negatively affect public health, property, the groundwater supply and estuarine and ocean resources.[132] Title 12 of Article 33 of the Environmental Conservation Law established a database that compiles information from annual reports of pesticide sales and their use in New York State. The Long Island Pesticide Pollution Prevention Strategy (2014) states that since 1997, 117 pesticide-related chemicals have been detected at various locations in the Long Island federally designated sole source aquifer, which supplies drinking water to 2.8 million people. Approximately half of these are legacy compounds, meaning they are derived from pesticides that have not been in use for several years or even decades and/or have never been registered for use on Long Island or in the state. Fortunately, the New York State Department of Health (DOH) has established water quality standards that require routine monitoring for maximum contaminant levels (MCLs) and DEC recently implemented a comprehensive pest management strategy program for pesticide pollution prevention aimed to protect Long Island's groundwater and surface water resources and protect human health. However, the strategy is primarily focused on pollution prevention measures for pesticides that are registered under the program, and assumes the pesticides that are registered are actually the only ones being used. It also doesn't address the pesticides that make their way into estuaries or the ocean from urban runoff or groundwater discharge.[133]

Step 1) Form a Technical Review and Advisory Committee (TRAC) to assist DEC in the investigation and assessment of active ingredients of potential pesticide-related contaminants detected in Long Island groundwater, evaluation of pesticide use on Long Island and identifying which pesticides have the greatest potential to cause adverse effects to humans living marine resources, effective and lower-risk pest management alternatives to address existing needs for pest management, and potential response actions to prevent further pesticide-related impacts to the Long Island aquifer.
Timeframe: Short term (2 years)

Step 2) Evaluate the toxicity of compounds found in pesticides to finfish and shellfish species throughout each stage of their lifecycle, particularly embryonic and larval stages.
Timeframe: Near term (5 years)

Step 3) Evaluate the potential for synergistic effects of multiple compounds found in pesticides on biodiversity in the ocean ecosystem.
Timeframe: Near term (5 years)

Step 4) Establish a water quality monitoring program to assess the status, trends and potential health impacts to ground and surface waters on Long Island and throughout the state from pesticide contamination.
Timeframe: Near term (5 years)

Step 5) Work with various partners and Long Island stakeholder groups to implement the comprehensive Long Island long-term Pesticide Pollution Prevention Strategy's (2014) pesticide P2 blueprint that will address the agricultural, commercial and residential pest management needs of Long Island, while reducing potential pesticide pollution from stormwater runoff, groundwater discharge and other sources into Long Island's estuaries (including the Peconic Bays, Long Island Sound, and Great South Bay) and in the ocean. The benefits of P2 blueprint measures include: modifying pest management processes, promoting the use of alternative pest management practices, and utilizing effective, less-toxic products when applicable.
Timeframe: Long term (10 years)

Lead Agency: DOH**,** DEC; Potential Partners: Suffolk County Department of Health Services (SCDHS), Suffolk County Soil and Water District, Nassau County Health Department; Cornell Cooperative Extension of Suffolk County (CCE), DAM, EPA, USGS, Long Island Farm Bureau and Shinnecock Indian Nation.

6. **Recommend solutions for reducing contaminants of emerging concern.**

   Contaminants of emerging concern (CEC) are synthetic chemicals or naturally occurring microorganisms recently detected in the marine environment that are not commonly included in water quality monitoring programs, but have the potential to adversely affect human health and negatively impact aquatic wildlife, even at low concentrations. Coastal and estuarine areas receive CECs from highly populated coastal communities and the upland watersheds that drain into them, via urban runoff, wastewater treatment plants, CSOs landfills, industrial waste, and agricultural runoff.[134] Example of CECs include pesticides, components of detergents, pharmaceuticals and personal care products (PPCPs), and flame retardant chemicals such as polybrominated diphenyl ethers (PBDE) and polybrominated biphenyls (PBB).[135] One known effect of certain CECs on marine wildlife include endocrine disruption, and the effects of exposure to endocrine disrupting chemicals to some types of marine animals (e.g., fish) during early developmental stages may not be apparent until much later in life.[136]

   Step 1) Monitor, identify and assess the effects these contaminants are having on marine life (e.g., endocrine disruption, including thresholds) and ecological processes (e.g., food webs, nutrient cycling, primary production) found in the water column and in sediments.
   Timeframe: Short term (2 years)

   Step 2) Working with local, state and federal partners, continue to support prescription drug collection programs for the proper disposal of expired or unused over-the-counter (OTC) and prescription medications, but also investigate the feasibility to establish collection and take back programs. This should include, but not be limited to, Identifying CECs that should potentially be prohibited from sale and use in products (some already are) and developing product stewardship (take back) measures to manage those products already in commerce or to remain in commerce.
   Timeframe: Short term (2 years)

   Step 3) Develop and propose water quality standards to protect aquatic life from CECs.
   Timeframe: Near term (5 years)

   Lead Agency: DEC; Potential Partners: USGS, NPS, DOH, RFMRP, Shinnecock Indian Nation and local municipalities.

7. **Evaluate impacts from two sewage treatment outfalls located in ocean waters.**

   Hempstead Bay, located in the Western Bays of the Long Island South Shore Estuary Reserve (SSER), has been listed by DEC as an 'impaired waterbody' as a result of nitrogen loadings from municipal and urban stormwater sources since 2006 and pathogens from urban stormwater sources since 1998. According to researchers at Stony Brook University, 95% of the total nitrogen found in the Western Bays of the SSER is from WWTP discharges, and that the Bay Park WWTP contributes 85% of that total.[137]

   The Bay Park WWTP serves roughly 40% of Nassau County, and discharges approximately 50 million gallons of wastewater per day (MGD) into Reynolds Channel, which then discharges into Hempstead Bay. Consequently, the Western Bays experience shellfish and finfish declines, loss of eelgrass, tidal wetlands loss and beach use impairments due to pathogen loadings and explosive macroalgae growth (i.e., *Ulva lactuca*) that emits hydrogen sulfide gas as it decomposes. Due to modification of the State Pollutant Discharge Elimination System (SPDES) in 2006, and vulnerability to malfunction during intense storms like Hurricanes Irene (2011) and Superstorm Sandy (2012), Nassau County is currently evaluating options for improving the existing outfall for Bay Park WWTP, or extending the existing outflow pipe across the SSER so that it would eventually discharge into the Atlantic Ocean. The relocation of the outfall to the ocean, in compliance with the Ocean Dumping Act requirements, would allow the treated wastewater to discharge into an open system as opposed to the current site within the estuary where little flushing occurs.

Step 1) Evaluate the current environmental impacts from the two existing WWTP ocean outfalls (Cedar Creek WWTP, Nassau County, ocean outfall site, and the Bergen Point WWTP, Suffolk County, ocean outfall site) affecting water quality, sediments and benthic habitats, including nutrients, marine debris, toxins and pathogens.
Timeframe: Short term (2 years)

Step 2) Evaluate any potential environmental impacts to the ocean by moving the Bay Park WWTP outfall into the ocean. While locating the outfall to the ocean is supported by New York, we must ensure that any potential impacts to the ocean will be minimized.
Timeframe: Short term (2 years)

Step 3) Based upon assessments of current outfall sites from Step 1, and historic research conducted on impacts of the 112 mile sewage ocean dumpsite, predict future environmental impacts to ocean water quality, sediments and benthic habitat while distinguishing between sewage sludge dumping and treated sewage effluent discharges.
Timeframe: Near term (5 years)

Step 4) Implement a baseline monitoring program at any proposed ocean outfall site to evaluate physical, chemical, and biological characteristics in the vicinity of proposed new ocean discharge site (to begin pre-construction), to document spatial and temporal changes at the site over time, and as a way to measure compliance with state and federal regulations.
Timeframe: Short term (2 years)

Step 5) Based on Steps 1-3, Develop a state policy to guide decisions on the placement of future outfall sites in ocean locations.
Timeframe: Near term (5 years)

Lead Agency: DEC, DOS; Potential Partners: NYC DEP, SUNY SB, Shinnecock Indian Nation and municipalities.

8. **Develop strategies to reduce pathogen and nutrient loads from onsite wastewater treatment systems (OWTS) into the Long Island South Shore Estuary Reserve (SSER).**

There is a need to reduce nitrogen to New York's ocean ecosystem as well as traditional pollutants such as pathogens that impair shellfish growing waters and water quality at bathing beaches. A priority is to develop a NYS marine water quality criteria for nitrogen. In addition, there are some priority watersheds that need to reduce nitrogen specifically from OWTS that are either nonconforming or do not reduce nitrogen sufficiently. The SSER, with its beaches, shallow bays and tidal marshes, provides ecologically productive habitat for finfish, shellfish, waterfowl, sea turtles and other marine life, and supports the highest concentration of water related industries in the state. The livelihood of tourism, recreation and commercial and recreational fishing and shellfishing businesses are greatly impacted when water quality within the SSER is degraded. Since 2008, DEC has declared most of the South Shore Estuary Reserve (SSER) waters as 'impaired waterbodies', citing excessive nitrogen loads.[138] Onsite wastewater treatment systems (OWTS) are one of the most significant sources under local control responsible for declining water quality in portions of the SSER located in Suffolk County.[139] Inadequate OWTS and cesspools are leaching nitrogen into groundwater that ultimately makes its way into surface waters of the SSER. Seventy five percent of residences located in Suffolk County are served by OWTS, with the vast majority installed prior to amendments to the Suffolk County sanitary codes in the late 1970s requiring that OWTS reduce pollutant and nutrient loads be discharged to groundwater. In addition, because the current County design standards do not contain performance criteria for nutrient removal, even systems that conform to the updated sanitary codes do not significantly reduce nutrient loadings. Updating New York state regulatory requirements for OWTS and investing in centralized wastewater treatment and sewer infrastructure has been identified as priorities by resource managers and stakeholder groups. These updates have also garnered strong public support because current measures are insufficient for protecting surface waters such as Great

South Bay, Moriches Bay, Quantuck Bay and Shinnecock Bay, all known to experience brown tides, fish kills, eelgrass declines, excessive growth of invasive aquatic plants (e.g., *Ulva lactuca*), impairments to shellfish growing waters and bathing beaches.

Step 1) Develop numeric performance criteria for nutrient removal in state design standards as part of the NYS Nutrient Criteria Plan. This should include individual residential OWTS.
Timeframe: Short term (2 years)

Step 2) Identify onsite wastewater treatment systems (septic tanks and cesspools) that do not conform to the rules and regulation contained within the Suffolk County Title 5 Sanitary Code.
Timeframe: Short term (2 years)

Step 3) Conduct a feasibility study to determine the economic and ecological viability of requiring Innovative and Alternative (IA) upgrades to all OWTS in Suffolk County to reduce nutrient loading into estuaries and actively seek funding for these upgrades.
Timeframe: Near term (5 years)

Step 4) Develop and implement strategies that would build upon existing SSER watershed management plans, local initiatives, and through the developing Long Island Nitrogen Action Plan to reduce pathogen and nutrient loads to the SSER and development of TMDL along the South Shore Estuary. This should include the implementation of appropriate actions for other sources of pollutant loads, such as agricultural runoff, stormwater runoff (residential fertilizer, pesticides, pet wastes), wastewater treatment plants and atmospheric deposition.
Timeframe: Near term (5 years)

Lead Agency: DEC, DOS, DOH, EFC, municipalities; Potential Partners: NPS, EPA, NYC DEP, local watershed Groups and DAM.

3.2.4 Objective B: Improve the management of ecologically and economically important species.

3.2.5 Actions 9-31

9. Reduce bycatch in New York fisheries.

As a result of the 2006 Amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSA), annual catch limits to end overfishing have been implemented for all federally managed fisheries. They have proven to be effective, with more than 30 commercially valuable stocks in the Atlantic considered rebuilt. However, annual catch limit allocations for a particular species are based on total catch, meaning fish that are landed plus the fish that are discarded. Because discard rates for unintended catch, referred to here as bycatch, during commercial fishing operations in New York fisheries is uncertain[140], developing effective management strategies becomes complex. Additionally, bycatch has been identified as a significant source of mortality for several marine species prohibited from commercial landings, including regulatory discards of target species and protected species like Atlantic sturgeon, sea turtles, sea birds and marine mammals.

A reoccurring recommendation by the Atlantic States Marine Fisheries Commission (ASMFC) and the Mid-Atlantic Fishery Management Council (MAFMC) and NOAA's National Marine Fisheries Service (NMFS) for improving stock assessments for several managed species, as well as species federally listed under the ESA (Atlantic sturgeon, sea turtles, whales) and protected under the Marine Mammal Protection Act (MMPA; e.g., whales, dolphins, harbor porpoises, seals) is to increase at-sea observer coverage. In particular, concerns have been expressed by governmental and non-governmental groups regarding the declines documented in such species as Atlantic sturgeon, river herring, American shad, scup, winter flounder and butterfish by vessels fishing in both state and federal areas. Observer data, widely considered the most reliable fishery dependent source of data, will lead to more accurate bycatch and bycatch mortality estimates that are vital for fishery managers to set effective regulatory measures (including accurate estimates for required annual catch limits for managed fisheries) needed to preserve the State's valuable marine resources and keep our fishermen fishing.

Step 1) Support NOAA's Northeast Fishery Observer Program (NEFOP) to extend at-sea observer coverage to fishing vessels operating in state waters (where there is no at-sea observer coverage currently) and increase at-sea observer coverage on fishing vessels operating in adjacent federal areas off New York. The goal is to better quantify and characterize bycatch and bycatch mortality associated with commercial fishing operations using otter trawl, gillnet and pot/trap gear. These gear types typically represent significant fishing effort, the highest landings and discard rates when compared to other fishing gears used in state and federal waters off New York, and are most likely to have incidental takes of marine mammals, sea turtles and Atlantic sturgeon.[141]
Timeframe: Short term (2 years)

Step 2) Continue to evaluate the development of electronic monitoring tools and technology as it is being developed, as a potential cost-effective alternative to at-sea observers.
Timeframe: Long term (10 years)

Step 3) Review at-sea observer data, vessel trip reports (VTRs) and fishery characterization work prepared by Cornell Cooperative Extension (CCE) of Suffolk County and DEC to inform the State's fishery management decisions. Integrate this information to create a comprehensive document that provides a detailed characterization of all of the fisheries in New York state waters. This information will be critical for efficiently and effectively assigning observer coverage in fisheries with documented bycatch, to identify which fisheries may potentially have incidental takes of Atlantic sturgeon, sea turtles, marine mammals and other endangered or protected species, and to determine if any fishery(ies) warrant further management actions to reduce incidental takes (e.g., implementation of bycatch reduction gear technology).
Timeframe: Long term (10 years)

Lead Agency: DEC, NOAA; Potential Partners: ASMFC, MAFMC, SUNY SB, and CCE.

10. Create an inshore trawl survey and monitoring program.

Establishing baseline information and long-term data series from monitoring programs are essential for fishery managers to be able to understand distribution, abundance and basic demographic parameters for many important fish species. These data are crucial for delineation of stock structure, evaluating residency or home range patterns, documenting site fidelity (an animal or species that returns to a specific location repeatedly), determining habitat preferences and seasonal migration patterns. The Northeast Fisheries Science Center multispecies bottom trawl survey is an example of a long time-series data collection program that generates fishery data currently used in stock assessments for several commercially and recreationally important species. However, this survey is conducted from a large vessel that cannot sample coastal waters less than 18 meters deep. It generally covers areas outside of New York's three mile boundary, leaving inshore areas without sufficient data coverage for sound management.

In 2006, a state-federal cooperative inshore trawl survey was begun to cover some of area not covered by the federal trawl from Cape Hatteras to Cape Cod. This Southern New England/Mid Atlantic Inshore Trawl Survey is part of the North East Area Monitoring and Assessment Program (NEAMAP), an integrated, cooperative state-federal data collection program that also includes inshore trawl surveys conducted by Massachusetts, Maine and New Hampshire. Spring and fall surveys targeting adult and subadult fish are conducted in inshore areas where sampling is inadequate or absent entirely. These data are an extremely important source of information for fishery resource managers tasked with generating abundance indices, reliably estimating annual catch limits for managed fisheries and developing accurate single and multispecies stock assessments. Given the migratory nature of many key species that support interstate fisheries, the data is currently used on a local and regional basis.

Additional benefits include 1) biological sampling and environmental monitoring, 2) ability to assess life history demographics for important fishery species, and 3) increased tagging opportunities for such species as Atlantic sturgeon, striped bass and horseshoe crabs. Fortunately, NOAA Fisheries has recently announced dedicated, long-term funding for the NEAMAP beginning in FY 2015. New York has contributed support for NEAMAP in the form of annual funding in the past. However, the implementation of an inshore trawl survey that samples more stations throughout New York State waters with more sampling opportunities throughout the year (not limited to spring and fall) has been suggested as a more cost effective and complementary way for New York to obtain comprehensive data that could then be used by state fishery resource managers to effectively monitor local fisheries.

Step 1) Collaborating with appropriate state and federal partners, and in conjunction with advocacy for the continued financial support for NEAMAP into the future, create a standardized inshore trawl survey and monitoring program that will supplement current NEAMAP (spring and fall) survey effort in New York State waters. Secure the necessary resources (vessel services, personnel) to conduct such a survey.
Timeframe: Short term (2 years)

Step 2) Evaluate the need to expand inshore monitoring surveys (including the use of additional gear types in areas not accessible via trawl-capable vessels) to encompass several Long Island embayments, including but not limited to, Great South Bay, Moriches Bay, Shinnecock Bay, Napeague Bay, Gardiners Bay, Great Peconic Bay, Little Peconic Bay, and Block Island Sound. This type of survey would allow the state to assess potential impacts to the population dynamics due to natural and anthropogenic stressors, and the overall significance of these embayments' contribution of several important species to the New York Bight and larger regional seascape. Again, this should include securing the necessary resources.
Timeframe: Near term (5 years)

Lead Agency: DEC; Potential Partners: NOAA, ASMFC, NPS, and SUNY SB.

11. Develop and implement a cooperative fisheries research program for state waters.

Cooperative research programs have been used as a fisheries management tool throughout the northeast, and are expected to expand elsewhere in the US as a result of the MSA Reauthorization in 2007.[142] The goal of developing and implementing a program for New York will be to build partnerships among commercial and recreational fishermen and scientists from academia and state and federal management agencies. Partners will collect fundamental fisheries information that can be used to develop effective regulatory options and enhance management decisions. This will include, but not be limited to: 1) studying the movement of contaminants, such as, mercury and other heavy metals, as well as PCBs, PAHs, dioxins/furans and similar organic contaminants, through trophic levels, 2) collecting biological samples and build the capacity to assess fish health, including the prevalence of fish diseases and viruses, 3) assessing the impacts of mobile fishing gear on benthic communities and ecosystem productivity, 4) testing and validating effective gear modifications to reduce and mitigate bycatch of non-targeted species or protected resources, 5) identifying aquatic invasive species and documenting potential impacts, 6) collecting data to aid in recovering, maintaining, or improving the status of stocks, and 7) improving our understanding of the factors potentially affecting recruitment success and long-term sustainability of fisheries (e.g., changes in water temperature, circulation patterns, ocean acidification). Such a cooperative program will facilitate timely responses to existing and emerging challenges to resource management by improving communication and collaboration among commercial and recreational fishing industries, scientists and fishery managers.

Step 1) Partner with local commercial and recreational fishermen to design, implement and secure dedicated funding for a cooperative fisheries research program.
Timeframe: Short term (2 years)

Step 2) Develop a transparent process to share results with the fishing industry and foster improved communication between scientists, managers and fishing industry members.
Timeframe: Near term (5 years)

Lead Agency: DEC; Potential Partners: NOAA, MAFMC, ASMFC, USFWS, Mid-Atlantic Panel on Aquatic Invasive Species, New York Sea Grant, SUNY SB, CCE, NY Marine Science Research Consortium and Shinnecock Indian Nation.

12. Monitor abundances for both species of river herring, alewife (*Alosa pseudoharengus*) and blueback (*Alosa aestivalis*), in the Hudson River estuary.

River herring are an economically important resource for both recreational and commercial fisheries in New York. Ecologically, river herring serve as an important forage base for many of New York's fish species. The current commercial fishery in the Hudson River exploits the spawning migration of both river herring species. The primary use of commercially caught river herring in recent years has been for bait in the important recreational striped bass fishery. This fishery occurs from March into early June annually, although some commercial fishers report catching river herring as late as July. Over the last 30 years, the Hudson River stocks of alewife and blueback herring have both shown inconsistent signs in stock status trends. The upsurge in river herring used as bait for striped bass has placed both species in a tenuous position. With this continuing demand, declining size, and increasing mortality, careful management is needed despite variable but stable recruitment. To address declines in coast-wide stocks, Amendment 2 to the ASMFC Shad and River Herring Interstate Fishery Management Plan (FMP) was adopted in 2009. It requires member states to demonstrate that fisheries for river herring within state waters are sustainable.

A sustainable fishery is defined as one that will not diminish potential future reproduction and recruitment of herring stocks. If states cannot demonstrate sustainability to ASMFC, they must close their river herring fisheries. In response to Amendment 2, New York proposed and ASMFC accepted a Sustainable Fisheries Plan (SFP) for river herring in 2011. The SFP included a five year restricted fishery in the main-stem Hudson River, a closure of the commercial fishery in tributaries, and annual stock monitoring. Required monitoring includes young of year abundance indices, age and length characteristics, mortality estimators, and commercial fishing catch per unit effort (CPUE) for adult fish. Data from this monitoring are needed to continue the New York river herring fishery beyond the initial five year trial period and to provide the basis for future management adjustments.

Step 1) Develop optimum fisheries independent methodology to capture river herring with a haul seine and characterize by species, size, and age composition of Hudson River Estuary river herring spawning populations. Develop contacts and expertise needed to monitor the fisheries dependent commercial fishery and characterize species composition, catch rates, and size and age composition of the river herring catch by species. Develop ageing methodology to calculate mortality rates for adult river herring in the Hudson River Estuary.
Timeframe: Short term (2 years)

Step 2) Based on results of the baseline study from 2012-17 described in Step 1, establish continuous long-term, fishery dependent and independent monitoring programs to characterize age and size composition, annual mortality rates, and estimates of relative abundance (CPUE) of the spawning stocks of both species of river herring to monitor long-term population trends.
Timeframe: Near term (5 years)

Step 3) Using data from long-term monitoring efforts, evaluate the effectiveness of the regulation changes implemented in 2012 to the commercial and recreational fisheries in the Hudson River Estuary.
Timeframe: Near term (5 years)

Lead Agency: DEC; Potential Partners: SUNY ESF, ASMFC, WCS and Massachusetts Division of Marine Fisheries (MA DMF).

13. Monitor distribution and habitat requirements of Atlantic surfclams, (*Spisula solidissima)*, in New York State waters.

The Fishery Management Plan for the Mechanical Harvest of the Atlantic Surfclam (*Spisula solidissima)* in New York State waters of the Atlantic Ocean, and its subsequent amendment which established an Individual Fishing Quota (IFQ) system, recommend that the DEC conduct routine surfclam population surveys and collect scientific information on surfclam growth and recruitment.[143] [144] Results of the 2012 Atlantic Ocean Surfclam Survey illustrate a continued decline in biomass, total number of individual clams, population density for almost all survey strata, and low recruitment in New York State waters (out to 3 nm) as compared to previous surveys since 2002. Although the reason for the decline in surfclam abundance in our area is unknown, large declines have been documented in areas further south. There are data which suggest that physiological impairment from environmental stress and increases in water temperatures may be affecting the distribution, reproductive potential and recruitment of surfclams along the northeastern region of the Atlantic Ocean.[145]

DEC establishes annual harvest limits for the Atlantic Ocean surfclam fishery (6 NYCRR Part 43) for the harvest that may be taken by mechanical means from the New York State waters of the Atlantic Ocean. Based on results from the 2012 Atlantic Ocean Surfclam Survey, the annual harvest limit for 2013 was set at 225,000 industry standard bushels, representing a 25% decrease from the 2012 limit. Although the surfclam is a commercially important bivalve species, little is known about the ecological role they play in the ecosystem or the biological processes that might affect their productivity. It is not known if climate change will contribute to further declines or bathymetric shifts northward or offshore, as suggested in the literature.[146] [147] Other commercially important shellfish species in the marine district include hard clams, oysters, soft clams, and bay scallops and many of the estuary programs have restoration goals for these species.

Step 1) Building upon existing data, monitor bottom temperature, dissolved oxygen, phytoplankton assemblages, predator abundance, reproductive condition (gonadal development), overall population health (histopathology), and pH and salinity in surfclam habitat from Rockaway Point to Montauk Point for a minimum of three seasons. Collect Atlantic surfclam data as necessary (potentially including size classes that are smaller than current survey methods are capable of sampling) to assess population condition based on demographic characteristics, to better understand their role in the ocean ecosystem, and to predict changes to the population that may be influenced due to climate change. This monitoring work should be conducted across all Atlantic Ocean surfclam survey strata to better understand any observed differences from west to east and inshore to offshore variability.
Timeframe: Short term (2 years)

Step 2) Monitor and assess the population status and diseases (e.g., Quahog Parasite Unknown, Juvenile Oyster Disease) of other commercially important shellfish resources, such as oysters, hard clams, soft clams and bay scallops.
Timeframe: Short term (2 years)

Step 3) Secure needed resources (staff, boats, equipment) to provide monitoring and screening of shellfish populations for parasitism and pathogens.
Timeframe: Near term (5 years)

Step 4) Evaluate the feasibility of restoration of oysters and hard clams in shellfish growing waters and learn from existing pilot projects.
Timeframe: Near term (5 years)

Lead Agency: DEC; Potential Partners: SUNY SB.

14. Investigate population declines of American lobster (*Homarus americanus*) inshore, offshore and in estuaries.

During the 1990's the American lobster, (*Homarus americanus***)** was the state's most valuable marine commercial fishery. New York's lobster landings peaked in 1997, and during the fall of 1999 there was a large mortality event in Long Island Sound that affected both lobsters and crabs. The population has continued to decline, and is currently at very low abundance levels. High water temperatures have been implicated in the mortality events. American lobsters are managed via the ASMFC. The 2006 and 2009 American lobster stock assessments determined that the Southern New England (SNE) stock was depleted. During 2010, the ASMFC Lobster Technical Committee reviewed updated information and contends the stock is experiencing recruitment failure due to environmental drivers and overfishing. The SNE lobster stock is at the southern end of its range, and may also be impacted by climate change.

Step 1) Establish a pilot monitoring survey to be conducted for a minimum of three years, to determine trends of adult and/or recruit lobster stocks within New York's oceanic, inshore and estuarine waters. Coordinate with ongoing coastwide lobster monitoring. Collect lobster biological data and environmental data.
Timeframe: Short term (2 years)

Step 2) Integrate monitoring data collected in Step 1 with coastwide lobster and environmental data to identify and designate important areas as critical habitats that should be protected.
Timeframe: Near term (5 years)

Lead Agency: DEC; Potential Partners: ASMFC, CCE, SUNY SB and Connecticut Department of Energy and Environmental Protection (CT DEEP).

15. Monitor Ocean Acidification and investigate the impacts of ocean acidification on shellfish and crustaceans.

Ocean acidification (OA) resulting from increased anthropogenic CO_2 emissions over the last several decades is expected to have profound adverse effects on marine organisms and disrupt entire ocean ecosystems. Eutrophication exacerbates OA in nearshore areas like Long Island Sound, Jamaica Bay and Great South Bay, which have a history of nutrient pollution and algae blooms fueled by excessive nitrogen loading.[148] When these algal blooms die they sink to the bottom and undergo decay by bacteria, which is a process that simultaneously reduces dissolved oxygen (hypoxia) and releases metabolic carbon dioxide**.**[149] Although OA will not affect all marine organisms the same way, researchers at Stony Brook University's School of Marine and Atmospheric Sciences have discovered that even minor increases in ocean acidity appears to have significant detrimental effects on larval growth, development, and survival of three commercially and economically important shellfish species: hard clams, bay scallops, and oysters. [150] American lobsters, at the southern edge of their inshore range in New York, have shown declines that may also be linked to warming waters and OA.[151] Because higher latitudes feel the effects more dramatically, the northeast is more susceptible to increased effects of ocean acidification, and it is expected that the impacts will eventually be felt by Long Island's shellfish fisheries (aquaculture and both commercial and recreational).

Step 1) Utilizing currently available data, develop methods to assess current impacts and predict future responses of commercially important shellfish (e.g., surfclam, ocean quahogs) and crustacean (e.g., blue crabs, lobster, horseshoe crabs) species to increased OA (decreased pH), decreased carbonate concentration and carbonate saturation state, and an increase in gaseous CO_2 in seawater. Work with federal and regional partners to monitor ocean acidification in the NY Bight and NY's estuaries. Also monitor inshore species, such as oysters, hard clams and bay scallops which may be predictive indicators of impacts associated with climate change. Note that monitoring and assessments should be consistent with the New York State *Consolidated Assessment and Listing Methodology (CALM)*.
Timeframe: Short term (2 years)

Step 2) Evaluate the potential for physiological stress and increased susceptibility of shellfish and crustaceans to predation, pathogens and disease due to synergistic effects of OA and multiple other human induced stressors (e.g., eutrophication, increased water temperatures, habitat degradation and exposure to toxic contaminants).
Timeframe: Near term (5 years)

Step 3) Review and evaluate federal and state strategies developed to minimize OA.
Timeframe: Near term (5 years)

Step 4) In addition to the implementation steps in Action #8, work with local municipalities to assess existing technology and potential for upgrading wastewater infrastructure in order to reduce the flow of reactive nitrogen into surface waters across Long Island.
Timeframe: Near term (5 years)

Step 5) Collaborate on an ocean acidification monitoring network through the Mid Atlantic Regional Planning Body and develop mitigation strategies for New York.
Timeframe: Short term (2years)

Lead Agency: DEC; Potential Partners: NOAA, Mid Atlantic Regional Planning Body, MARACOOS, NPS, SUNY SB, Shinnecock Indian Nation, and municipalities.

16. Assess blue crab (*Callinectes sapidus*) abundance and life history characteristics and predict future population trends in Great South Bay and other marine waters.

Blue crab abundance in Great South Bay and in other marine waters have experienced a dramatic increase since the 1990's. Although the mechanisms behind regional population dynamics and the role of blue crabs in the local ecosystem are unknown, it has been suggested that they are important consumers of winter flounder (*Pseudopleuronectes americanus*) and hard clams (*Mercenaria mercenaria*) in the bays of Long Island, and may compete with other fish and shellfish species for resources. Blue crab populations in the northern extent of their range are typically restricted by winter mortality. However, blue crab distribution and abundance could be altered by the effects of climate change, leading to increased abundance in our area, thereby adversely impacting some commercially and recreationally important species that currently inhabit our waters. To better understand potential increases in blue crab abundance and any associated ecosystem impacts, it is essential to better understand basic demographics, winter survival, abundance, distribution, movement patterns and, through modeling, predict how climate change may further alter population dynamics and status of this species in marine waters.

Step 1) Conduct an intensive spring, summer, fall trawl survey in Great South Bay to characterize seasonal trends in abundance, distribution movement patterns and demographic parameters. Conduct a winter dredge survey to estimate winter mortality.
Note: the trawl survey recommended in this step should be standardized according to sampling protocols established in Action #15 (Create an inshore trawl survey and monitoring program). Coordinate with monitoring of blue crab in all marine waters.
Timeframe: Short term (2 years)

Step 2) Using acoustic transmitters and other conventional tagging methods, track movement patterns of blue crabs and detect possible survivorship within the study site.

Step 3) Using data collected during this and other projects on Long Island, develop models to predict future blue crab population status.
Timeframe: Near term (5 years)

Step 4) Develop a Blue Crab Management Plan for New York State waters.
Timeframe: Long term (10 years)

Lead Agency: DEC; Potential Partners: NPS, SUNY SB, and University of Maryland-Chesapeake Biological Laboratory.

17. Monitor whelk (sp.) abundance and movements inshore, offshore and in estuaries.

New York and the Mid-Atlantic have active fisheries of several whelk species. Due to declines in the Southern New England lobster stock and increased market price, fishing effort on whelk has increased. Long life span, late maturation and limited larval dispersal make these species particularly vulnerable to overexploitation due to increased harvest. On the other hand, these species prey upon local shellfish, which are important resources. While food fish, lobster and crab permit holders are required to report all species harvested on their state or federal harvest reporting form, there are currently no mandatory state reporting requirements for permit holders who have whelk licenses and there are no implemented regulatory measures to manage New York's whelk fishery. Little information is available on whelk population status and trends in New York, and there is a gap in understanding of basic life history for channeled (*Busycotypus canaliculatus*) and knobbed whelk (*Busycon carica*) found in New York's Marine District. This information is essential for implementing effective management strategies.

Step 1) Establish a pilot monitoring survey to be conducted for a minimum of three years, to determine trends of whelk relative abundance within NY's oceanic, inshore and estuarine waters. Coordinate with any ongoing coastwide whelk monitoring. Collect whelk biological data and environmental data.
Timeframe: Near term (5 years)

Step 2) Investigate the effectiveness of various tagging methods to track whelk movements and migrations.
Timeframe: Near term (5 years)

Step 3) Assess the need for a long-term, coordinated tagging and/or monitoring program within NY State waters.
Timeframe: Near term (5 years)

Lead Agency: DEC; Potential Partners: SUNY SB and CCE.

18. Investigate Atlantic sturgeon (*Acipenser oxyrhynchus*) habitat association in the Hudson River, inshore, offshore and in estuaries.

Atlantic sturgeon are anadromous fish that use riverine, coastal and oceanic habitats throughout their life cycle. While previous work has found this species associated with site-specific locations in rivers, estuaries and the ocean, there is a gap in understanding the physical and biological drivers for habitat specificity, such as substrate type, water temperature, depth, salinity, current speed and direction, dissolved oxygen and prey availability. Recent research indicates that individual adult and juvenile sturgeon return to sites in the Hudson River and ocean on a routine basis, suggesting some level of site fidelity (Fox and Dunton, Personal Communication).There are large areas, particularly in the New York Bight, that are heavily fished with trawl gear, meaning this species is vulnerable to bycatch mortality.[152] Research is needed to quantify which habitats Atlantic sturgeon are associating with and why in the different systems, as well as gaining a better understanding of how Atlantic sturgeon are influencing the structure and function of these systems. This information will be used when developing the Atlantic sturgeon state conservation plan by identifying and designating important habitat, which is considered essential for the continued survival of the species. This type of information is being used by federal managers as part of the process of designating critical habitat for Atlantic sturgeon. NMFS has recently proposed in regulations in June, 2016 the Hudson River from Troy to the Battery as a critical habitat for Atlantic sturgeon.

Step 1) Identify data gaps in existing studies and conduct additional research such as using a combination of multi-beam sonar, side-scan sonar, and acoustic tagging to determine Atlantic sturgeon site fidelity, habitat specificity and use. Incorporate additional research such as benthic sampling and stomach content analysis to determine habitat use.
Timeframe: Near term (5 years)

Step 2) Using information acquired in Step 1, develop important habitat maps for Atlantic sturgeon in the Hudson River and in the inshore ocean.
Timeframe: Near term (5 years)

Step 3*)* Monitor adult and juvenile populations of sturgeon offshore and in estuarine waters for relative abundance and biological characteristics, including reproduction when possible, and use this information to inform state, federal and coastal management decisions.
Timeframe: Near term (5 years)

Lead Agency: DEC; Potential Partners: NOAA, USFWS, USGS, SUNY SB, and Delaware State University.

19. Design and implement a monitoring survey to determine baseline trends for large whales in the New York Bight.

Although several species of cetaceans occur within the New York Bight, very little is known about seasonal occurrence, residency, abundance and distribution of the six large whales designated as species of greatest conservation need (SGCN) in New York's Comprehensive Wildlife Conservation Strategy. These species are: the North Atlantic right whale (*Eubalaena glacialis*), sperm whale (*Physeter macrocephalus*), sei whale (*Balaenoptera borealis*), fin whale (*Balaenoptera physalus)*, blue whale (*Balaenoptera musculus)* and humpback whale (*Megaptera novaeangliae*). This lack of information is concerning given New York's increasingly pressing need to balance whale conservation needs with human activities such as shipping traffic, fishing and offshore wind energy development.

A workshop was held on January 16, 2014, with experts in the field from federal and state governments, academia and NGOs. The purpose of the workshop was to identify feasible methodologies for monitoring and conserving large whales in the NY Bight. Expert consensus was that an integrated monitoring approach should be utilized and that the State should start by collecting a minimum of three years of baseline data in order to determine basic trends. Data collection priorities will include seasonality- annual timing (arrival and departure), distribution, and abundance within the New York Bight and New York/New Jersey Harbor. Data, such as duration of stay and behavior while in the NY Bight, are also of interest but are not logistically feasible to determine at this time. Data from this pilot study will serve as the foundation for a more focused, long-term monitoring (see Action 20) and be used to help inform management decisions to mitigate the impacts of human activities on whales, particularly to reduce mortality of whales by ship strikes, fishing gear interactions and entanglements and for the siting of offshore wind development areas.

Step 1) Design the most appropriate survey methods (e.g., aerial surveys, ship or land based surveys, passive acoustic monitoring, Pop-up satellite archival tags) and analysis method(s) to establish baseline trends for each SGCN designated whales, identify areas of conservation importance if warranted by the data, and provide a basis for long-term monitoring. The work plan should include a schedule for the implementation of the field survey and subsequent monitoring, with thorough documentation of available options and reasons for selecting the preferred option. It should also include methods for integration of analyses from the preferred approaches, as well as opportunities for cost-sharing and building from existing efforts.
Timeframe: Short term (2 years)

Step 2) Establish an integrated whale monitoring survey to be conducted for a minimum of three years, to determine baseline trends associated with the distribution, abundance, seasonal occurrence and potential migratory corridors of whale species within NY's oceanic and inshore waters (see Figure 1).
Timeframe: Near term (5 years)

Step 3) Establish a state-federal partnership to repeat the integrated whale monitoring survey as described in step 2 every 5 years to continue to collect baseline date for SGCN designated whales and to ensure that baseline data has not shifted due to climate change, human activities or other stressors. Use methods from Step 2 to ensure comparability of data.
Timeframe: Long term (10 years)

Lead Agency: DEC; Potential Partners: NOAA, US NAVY, USFWS, AMAPPS, BOEM, DOS, NY Natural Heritage Program, Cornell University, RFMRP, SUNY SB, WCS, and other NGOs.

20. Design and implement focused, long-term monitoring surveys for large whales to investigate the impacts of human activities and for effective conservation planning.

The New York/New Jersey Harbor is home to the third largest port in the US in terms of containerized cargo, and the three shipping lanes that enter New York Harbor are busy areas for various types of commercial vessels. Whale mortality from ship strikes has been documented in New York waters, including fin, minke, and North Atlantic Right whale.[153] The North Atlantic right whale is one of the world's most critically endangered large whale species, with the most recent peer-reviewed minimum population size estimated at 444 whales known to be alive in 2009.[154] Because vessel strikes is one of the primary causes for the continued slow recovery of the species, NOAA initiated vessel speed restrictions in 2008 for certain areas, including Montauk Point and the entrance to the Harbor of NY/NJ where speed limits are in place seasonally. This conservation measure has successfully reduced lethal vessel strikes of North Atlantic Right and other species of large whales.[155] A better understanding of whale occurrence and behavior is necessary since even one single right whale mortality can have a large impact on population viability in such a highly endangered population. Additionally, serious injury or mortality can also occur from human activities such as fishing gear interactions and entanglements.

Long-term passive acoustic monitoring—using a combination of moored acoustic recording units (MARUs) to detect whale vocalizations and archival tagging—of whales has been used in other areas for studying a variety of ecological and biological factors, including detecting fine scale movement patterns of several cetacean species.[156] For example, NOAA uses this information for the development of techniques to reduce mortality from ship strikes using real-time alert networks. Other applications of long-term passive acoustic monitoring data include improving scientific understanding of large whale behavioral patterns in relation to human activities and identifying areas of sustained and/or recurrent large whale activity (e.g., important habitat areas).

Step 1) Based on results of the baseline monitoring study (Action #19), establish a long term whale monitoring program with refined study areas of concentrated human activity. This would be performed in conjunction with the baseline monitoring survey. Data collection priorities will include seasonality (i.e., annual timing of arrival and departure), distribution, abundance, duration of stay and behavior.
Timeframe: Near term (5 years)

Step 2) Based on the results of the baseline monitoring study, collaborate with federal agencies and other appropriate authorities to identify and pursue actions that seek to reduce serious injury or mortality to whales due to human activities. Examples could include further reducing vessel speeds and/or additional speed restriction areas, implementing real-time alert networks, increased enforcement of current regulations, and promoting educational outreach programs.
Timeframe: Long term (10 years)

Step 3) Support marine mammal and turtle stranding efforts in NY's waters and use information to help focus the long-term monitoring effort.
Timeframe: Short term (2 years)

Lead Agency: DEC; Potential Partners: NOAA, BOEM, US NAVY, USFWS, ASMFC, MAFMC, DOS, NYSERDA, PANYNJ, USCG, NOAA, Harbor Ops Committee, New York Shipping Association, Pilots Associations, Riverhead Foundation, New York Aquariums, WHOI, Cornell University, SUNY SB, WCS and other NGOs.

21. Design and Implement a Monitoring Survey for Sea Turtles in the New York Bight.

Several ESA listed sea turtle species frequent New York waters, including the endangered leatherback and Kemp's ridley, and the threatened loggerhead and green.[157 158] Studies suggest that some of New York's coastal and estuarine systems serve as important developmental habitat for juvenile loggerheads and Kemp's ridleys[159 160] and in recent years more juvenile green turtles are being seen (Robert DiGiovanni, personal communication). However, little is known about the abundance, distribution and behavior of sea turtles in the New York Bight. This baseline data is needed in order to mitigate growing threats to sea turtles such as cold stunning and fishery interactions (entanglements and incidental catch).

Step 1) Design and implement the most appropriate monitoring survey for sea turtles. Monitoring will include a variety of elements, such as maintaining the current stranding network, mark-recapture, morphometrics, health assessment, aerial surveys, and tagging (see Action# 22). Data collection priorities will include seasonal occurrence, distribution, behavior, health and identification of areas or habitats of importance. Host a workshop to design monitoring program. Collect initial information through the proposed whale monitoring effort.
Timeframe: Short term (2 years)

Step 2) Based on data collected during monitoring, identify and implement appropriate conservation actions for sea turtles in the New York Bight.
Timeframe: Near term (5 years)

Lead Agency: DEC; Potential Partners: RFMRP, NOAA and SUNY SB.

22. Monitor distribution and relative abundance of finfish, large pelagics, and endangered and threatened marine species inshore, offshore and in estuaries.

The New York Bight, with its large area of relatively shallow continental shelf and numerous adjacent high-quality estuary systems, is high in biological diversity and productivity. Dunton et al., (2010)[161] identified the New York Bight as an important seasonal aggregation area for Atlantic sturgeon, which were recently listed as endangered under the federal Endangered Species Act (ESA). The New York Bight is also important to a number of endangered or threatened sea turtles species (see Action #21 above). The use of acoustic telemetry (acoustic receivers used to detect signals emitted from tagged marine species) to monitor the movements of threatened or endangered species facilitates a better understanding of migratory behavior, both temporally and spatially, which can help with developing appropriate conservation measures. These include mitigation for fisheries interactions, vessel strikes and dredging activities. Establishing baseline data collection is also crucial for delineation of stock structure, evaluating residency or home range patterns, documenting site fidelity (an animal or species that returns to a specific location repeatedly) and habitat preferences of exploited or imperiled species. These data can also be used to delineate state or federally mandated critical habitat for endangered species. Lastly, opportunities for long-term data collection from passive acoustic telemetry studies (local and regional in scope) will provide insight into how and when marine species respond to impacts due to climate change (warmer temps, ocean acidification, etc.)[162] and will be essential in shaping sound management strategies, particularly for sites of future anthropogenic disturbance such as offshore wind energy production, shipping and fishing. This action should be coordinated with action #10 and other traditional sampling techniques.

Step 1) Maintain the current coastal passive acoustic telemetry receiver array along the south shore of Long Island and in the Hudson estuary as part of a broader, regional monitoring network and long-term data collection associated with the seasonal occurrence of Atlantic sturgeon. Implement acoustic tagging and satellite telemetry for sea turtles, sharks, and other species (large pelagics and finfish species) residing within or migrating into New York's coastal waters.
Timeframe: Near term (5 years)

Step 2) Extend the passive acoustic telemetry receiver array to cover areas in federal waters within the New York Bight. Potential sites should include those identified for possible offshore development (e.g., wind energy, OCS sand borrow areas, aquaculture) and along hydrographic features where marine species are known to aggregate. This would yield important species distribution information that could be used in conjunction with satellite imagery of oceanographic data to develop mapping tools and improve models used to identify areas of high biodiversity or predict biological 'hot spots' (e.g., areas to avoid by military, shipping, fishing). Also explore the use of gliders or other non-traditional sampling techniques. Use information to inform management decisions.
Timeframe: Near term (5 years)

Step 3) Identify and protect important habitat within New York State waters. Investigate other appropriate conservation measures (e.g., SEQR, NYS Significant Coastal Fish and Wildlife Habitat Program), and implement if warranted by the data.
Timeframe: Long term (10 years)

Lead Agency: DEC, DOS; Potential Partners: BOEM, NOAA, SUNY SB, RFMRP, and WCS.

23. Expand the New York Natural Heritage Program to include additional marine species and offshore habitats.

The New York Natural Heritage Program (NHP) is a partnership between DEC and the State University of New York College of Environmental Science and Forestry (SUNY ESF). The mission of the Natural Heritage Program is to work collaboratively with partners inside and outside New York to support stewardship of New York's rare plants, rare animals, and significant ecological communities throughout the state, and to reduce the threat of invasive species to native ecosystems. The ***NHP*** works with NatureServe, an international non-profit organization network that collects and maintains extensive biodiversity data that focus on the taxonomy, natural history, distribution, and conservation status of terrestrial plants, vertebrates and a selection of invertebrates. NatureServe also maintains compatible standards for data management, and provides comprehensive information and scientific expertise to resource managers and other conservation partners. Information compiled by the NHP is used by public agencies, the environmental conservation community, developers, and others to aid in permitting decisions and is essential for prioritizing species and communities in need of protection. However, the NHP currently does not collect this same information for endangered or threatened marine species, which would provide a better understanding of the diversity of marine life in New York Bight, assess the status of these species and aid resource managers in the designation of new SCFWHs.

Step 1) Expand the New York Natural Heritage Program to include marine species and marine areas of ecological significance.
Timeframe: Short term (2 years)

Step 2) Recommend the NatureServe biodiversity data management software adds detailed local information on marine species and marine habitat into current database to help local, national and global conservation needs.
Timeframe: Short term (2 years)

Step 3) Expand the iMapInvasives on-line, GIS-based data management system to include data on invasive marine taxa.
Timeframe: Near term (5 years)

Lead Agency: NHP; Potential Partners: DEC, SUNY ESF and WCS.

24. Evaluate horseshoe crab (*Limulus polyphemus*) abundance and connectivity inshore, offshore and in estuaries.

Horseshoe crabs (HSC) play an important ecological role in the marine food web, as their eggs serve as a food source for a number of migratory shorebirds, finfish and the ESA listed loggerhead sea turtle. They are also harvested as bait for important coastal eel pot and whelk pot fisheries,

and the biomedical industry uses HSC blood to detect bacterial endotoxins in medical equipment.[163] Due to concerns about increasing exploitation of HSC and apparent declines in shorebird abundance, ASMFC developed a Horseshoe Crab Fishery Management Plan (FMP) in 1998. Although HSCs are managed as a single stock coast wide (from ME to FL) the ASMFC 2009 Stock Assessment Report (SAR) indicated evidence for abundance declines in the New York area.[164] The NYS DEC uses a variety of survey information to monitor the population status of HSC in NY waters. Several long-term monitoring programs are used to track the relative abundance of adult male and female HSC, including a HSC spawning survey initiated in 2005 in collaboration with Cornell Cooperative Extension (CCE), based on the recommendation in the 2009 SAR.[165] This spawning survey is currently used to monitor and manage HSCs along the north and south shore of Long Island, as well as in the Peconic Estuary. Monitoring the migratory behavior of horseshoe crabs both temporally and spatially, in addition to monitoring relative abundance off New York, can help with developing additional conservation measures for horseshoe crabs. This would include mitigation measures for illegal or over-harvesting in fisheries, shoreline hardening and dredging activities.

Step 1) Maintain the long-term spawning stock monitoring and tagging of horseshoe crabs (US Fish and Wildlife Service) to track the seasonal and annual occurrence and relative abundance of horseshoe crabs migrating into New York's estuarine and offshore waters.
Timeframe: Short term (2 years)

Step 2) Explore the effectiveness of tagging and recapture methods to estimate abundance and mortality in addition to movements and implement a long-term, coordinated tagging and monitoring program within New York State waters.
Timeframe: Near term (5 years)

Step 3) Identify beaches along Long Island considered optimal spawning habitat for HSCs and assess the need for increased law enforcement presence on these spawning beaches during the new moon during the height of the summer spawning season.
Timeframe: Near term (5 years)

Step 4) Assess the potential adverse impacts of beach renourishment projects on areas of optimal spawning habitat on HSC populations and develop strategies to reduce those impacts.
Timeframe: Long term (10 years)

Lead Agency: DEC; Potential Partners: NPS, SUNY SB and CCE.

25. Reduce the incidental catch of marine mammals, sea turtles, seabirds and Atlantic sturgeon (*Acipenser oxyrinchus*).

Bycatch and bycatch mortality of protected resources, especially sea turtles, Atlantic sturgeon and marine mammals, are an unintended consequence of commercial fisheries. However, there is insufficient data to recommend solutions to reduce mortality associated with incidental takes. Areas of focus should include: a) developing more selective fishing gear, b) gathering information on fish, marine mammal, sea turtle, seabird and Atlantic sturgeon distribution patterns and environmental conditions, c) facilitating real-time exchange of information to identify areas where catches of non-target species are highest (bycatch hot spots) based on previous research and on distribution and d) assessing bycatch trends using data collected during pilot fishery observer coverage (Action #9) and acoustic telemetry monitoring efforts (Action #22) for these species.

Step 1) Participate in a project lead by a partner at Delaware State University, in collaboration with NMFS and members of the commercial fishing industry, to conduct gear modification research for modification of gillnets to reduce bycatch and bycatch mortality. Also as a part of this project conduct satellite and acoustic tagging of Atlantic sturgeon to calculate bycatch survival rates. In the longer term collaborate on gear modification research for trawls; looking at Atlantic sturgeon bycatch rates and bycatch survival rates.
Timeframe: Near term (5 years)

Step 2) Using increased data collection through newly expanded observer coverage within the New York Bight (see Action #9), or through existing or new fishery independent and fishery dependent surveys (see Action #10), develop and recommend solutions to reducing incidental catch (and mortality) of protected resources (marine mammals, sea turtles and Atlantic sturgeon) in New York fisheries. Utilize existing research and data sets to examine possible solutions such as modifying hooks, pot lines and other gear associate with incidental takes of protected resources; use of gear technology advancements such as pingers and turtle excluder devices (TEDs); and gear placement.
Timeframe: Near term (5 years)

Step 3) Update current state statute to require vessels fishing in New York State waters to implement gear modification requirements. Provide data access to regional and federal regulators for potential use in regulatory actions. Work with federal managers to coordinate these activities.
Timeframe: Long term (10 years)

Lead Agency: DEC; Potential Partners: Delaware State University, SUNY SB, NOAA, ASMFC, The Nature Conservancy, CCE, RFMRP, WCS and other NGOs.

26. Establish an aquatic invasive species monitoring network for the ocean.

Most scientists regard aquatic invasive species (AIS) as a major threat to biodiversity in the ocean ecosystem, second only to habitat loss.[166] Many species of non-indigenous, marine invasive species can be devastating competitors to native species in the marine and estuarine environment and can negatively affect species diversity, impair ecosystem function by disrupting important food web interactions and cause public health concerns.[167] More than 50 non-native and 40 cryptogenic (uncertain if native or non-native) species have been identified in Long Island Sound.[168] The rusty crayfish, the Asian shore crab, the Chinese mitten crab, and the Asian clam are examples of non-native species that have established populations along the mid-Atlantic coast.[169] While environmental stress, aquarium trade, shipping and transportation, port facilities, aquaculture and climate change are factors that will likely continue to facilitate the spread of AIS, there also seems to be a general lack of awareness about the potential presence of AIS and any associated adverse impacts to the marine environment during seemingly harmless activities. For example, anglers using imported live bait (worms and crabs) may not be aware of the potential for the presence of invasive species in the packing material (typically algae) and may discard it at sea.[170] To impede the introduction and spread of invasive species, New York law regulates the sale, purchase, possession, introduction, importation and transport of invasive species and establishes penalties for those who violate such regulations. However, there is still much to learn about prevention and control of invasive species that cause harm to the marine environment or to human health. Early detection, rapid response, a better understanding of the AIS pathways into the marine environment, evaluation of ecosystem and economic impacts, and education of the general public about the potential for hitchhikers during boating and fishing activities can contribute to effective management strategies.[171]

Step 1) Work with the State Invasive Species Council and other appropriate partners to establish an aquatic invasive species (AIS) monitoring network for the ocean ecosystem and early detection alert system to better track the statewide or interstate spread of AIS.
Timeframe: Near term (5 years)

Step 2) Establish a notification system to alert neighboring states of new detections, and develop rapid response protocols. The Partnerships for Regional Invasive Species Management (PRISMs) program should be expanded to include marine aquatic invasive species and should be used to respond to early detection of invasive species and manage invasive species that have become established.
Timeframe: Near term (5 years)

Step 3) Assess the need for, and then propose new regulations to prevent the introduction and spread of aquatic invasive species from boats, trailers and other equipment that typically transfers from one waterbody to the next.
Timeframe: Near term (5 years)

Step 4) Establish an Invasive Species Contingency Fund to be used for rapid response assistance aimed at minimizing or preventing the spread of newly introduced aquatic invasive species (plants, animals or pathogens) to state watersheds, including the ocean ecosystem.
Timeframe: Near term (5 years)

Lead Agency: DEC; Potential Partners: USFWS, Mid-Atlantic Panel on Aquatic Invasive Species, OPRHP, WCS, Other state wildlife agencies, EPA, NOAA, NPS, Shinnecock Indian Nation and municipalities.

27. Examine predator-prey dynamics within foraging hotspots located in estuaries, inshore, and offshore.

Federal and interstate fishery management plans (FMPs) have been successfully implemented to rebuild and recover several depleted fish stocks and protected species along the US northeast and mid-Atlantic. While fisheries collapses have occurred due to overfishing practices of the past, recovery of certain species have been hindered due to a lack of critical information not yet fully considered in current FMPs and stock assessments, such as top down, ecosystem and food web processes.[172] There is also widespread concern that the structure and function of marine ecosystems are still being adversely impacted by human activities. The repetitive harvesting of targeted species can leave other non-targeted species disproportionally abundant. For example, overabundance of certain predatory fish (e.g., striped bass) may adversely impact the already depleted populations of important fisheries species such as juvenile river herring, winter flounder, weakfish, and American lobster. Additionally, climate change is likely making it harder for depleted species to recover from overfishing due to a fluctuation on timing of prey availability. For instance, a shift in the distribution of zooplankton may lower the reproductive success for fish species in the Gulf of Maine, like the once abundant Atlantic cod.[173] Gaining a better understanding of the different trophic linkages and trends in biomass flow throughout the food web in New York's ocean ecosystem is essential for evaluating the stability of ecological community structure and can be used to assess how certain marine species respond to environmental change (warmer ocean temperatures, eutrophication and hypoxia, habitat degradation) due to natural or human disturbances. Incorporating this type of data into ecosystem models will be important for ultimately developing and implementing sustainable fishery management strategies and an efficient ocean planning process to potentially mitigate adverse impacts to the ocean ecosystem due to human activities.[174] [175]

Step 1) Compile and integrate existing information gathered in identified important foraging areas within the ocean ecosystem (e.g., estuaries, embayments, inshore habitats and offshore submarine canyons). *Important foraging areas can be identified using oceanographic and bathymetric conditions that typify areas of high productivity, at-sea survey data gathered at important fishing grounds, and data gathered from acoustically or passively tracked individual animals (e.g., sturgeon, sea turtles, whales, and seabirds).
Timeframe: Near term (5 years)

Step 2) Assess research priorities to fill data gaps on understanding ecosystem function and the uncertainties associated with climate change (e.g., OA, sea-level rise, and spatial-temporal shifts in predators and coupled prey availability due to warming water temperatures). This should include, but not be limited to, 1) the use of chemical tracers, PCR methods and gut content analyses to characterize the importance of juvenile fish (e.g., winter flounder, American lobster) and other prey species occupying lower trophic groups (e.g., shrimp, sand lance, jellyfish) in the diets of predatory species (e.g., striped bass, spiny dogfish, large sharks, billfish, marine mammals, sea turtles and seabirds) for at least three field seasons, 2) evaluating the effects of

fishing on predators, and 3) assessing the availability of alternative prey items for a variety of predatory species.
Time Frame: Near term (5 years)

Step 3) Assess forage fish availability as prey to predators in state waters, and increase our understanding of the role of forage fish in New York's ocean ecosystem.
Timeframe: Near term (5 years)

Lead Agency: NOAA, DEC; Potential Partners: SUNY SB, SUNY ESF, ASMFC, MAFMC, WCS and other NGOs.

28. Investigate natural and anthropogenic factors that are potentially contributing to winter flounder (*Pseudopleuronectes americanus*) declines within New York embayments.

Winter flounder (*Pseudopleuronectes americanus*) is an estuarine flatfish species that once supported a historically valuable commercial and recreational fishery throughout New England and the Mid-Atlantic. However, local stock abundance is at record lows despite interstate and federal management efforts to end overfishing and rebuild the stock. Research conducted along the south shore of Long Island indicated that winter flounder maintain local population structure[176] and likely display behavioral diversity.[177] However, the relationship to offshore winter flounder remains poorly understood. While overfishing likely contributed to declines in abundance and the extremely low effective (breeding) population sizes currently seen[178] in Long Island Bays, natural and anthropogenic stressors may be contributing to the failure of the winter flounder stock to rebuild in the shallow coastal estuaries of Long Island due to high rates of mortality in the first year of life, leading to reduced recruitment into older life history stages.[179] Because young of the year (YOY) winter flounder have a limited home range, they are especially sensitive to the natural and human caused factors that can lead to high mortality, such as predation, high water temperatures, seasonal hypoxia and exposure to contaminants that accumulate in coastal sediments. Additionally, YOY winter flounder may have experienced increased predation in recent years with increased populations of predatory species known to feed on winter flounder, such as striped bass (*Morone saxatilis*), summer flounder (*Paralichthys dentatus*) and blue crab (*Callinectes sapidus*).[180] [181] Inshore populations of winter flounder around Long Island, New York are poorly studied, despite evidence suggesting that there is an even greater reduction of winter flounder abundance in Long Island Bays than estimated for New Jersey, Rhode Island and Connecticut. [182]

Step 1) Evaluate the effects of predation, and determine the individual and combined impacts of temperature, dissolved oxygen, contaminated sediments and other environmental stressors on YOY winter flounder growth and condition. This should be done using field studies at sites within the four Long Island Bays where two years of data have already been collected (Jamaica Bay, Shinnecock Bay, Moriches Bay and Great South Bay), expanding field studies into additional sites in the east end of Long Island and along the north shore, and by conducting laboratory based experiments.
Timeframe: Near term (5 years)

Step 2) Improve water and sediment quality in targeted, existing winter flounder habitat to reduce environmental stressors on winter flounder.

Lead Agency: SUNY SB, DEC; Potential Partners: NOAA, ASMFC and MAMFC.

29. Increase New York's participation at regional and interstate fisheries management meetings.

The Atlantic Coastal Fisheries Cooperative Management Act of 1993 was established to support interstate and state-federal partnerships for improved management of commercially and recreationally important fishery resources that migrate, or are widely distributed, across the multi-jurisdictional boundaries in federal waters and of the waters of the 15 Atlantic coast states: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia and Florida. Under this Act, The Atlantic States Marine Fisheries Commission's Interstate Fishery Management

Program (ISFMP) is responsible for developing fishery management plans (FMPs) that are then implemented by the states through regulations. The ASMFC also works with the Department of Commerce and the three regional fishery management councils who have the authority to develop, revise and implement fishery management plans and data collection programs for domestic and foreign fishing conducted within the 200-mile U.S. Exclusive Economic Zone (EEZ) to complement the Commission's FMPs. DEC Division of Marine Resources staff are active representatives of ASMFC and the MAFMC, and also serve on several committees under each. The Division Director also participates at the Marine Resources Advisory Council (MRAC) meetings which was established to advise DEC on marine resources issues, such as proposed regulations and the protection and utilization of New York's valuable marine resources. Additionally, the same DMR staff participates in several NOAA Fisheries (NMFS) Take Reduction Teams (TRTs) that have been established to develop and implement Take Reduction Plans for reducing incidental mortality and serious injury to strategic stocks of marine mammals that interact with commercial fisheries. With increased complexity of fishing issues, degraded water quality, habitat loss and alteration, and the uncertainty of climate change related impacts on the ocean ecosystem, increased participation in state-federal management is a management priority.

Step 1) Develop and implement a *Fishery Management and Policy Advisory Program* within DEC. The responsibility of the program would be to attend and consult during interstate and federal fisheries management processes. This should include increasing staff at DEC (DMR) to building the capacity for evaluating policy issues, working towards fishery ecosystem based management and to represent NY's priorities at meetings (ASMFC, MAFMC, NEFMC, TRT) meetings.
Timeframe: Short term (2 years)

Step 2) Support timely reporting of state commercial and recreational harvest data and dealer reports through VTRs and ACCSP efforts to better inform fishery management decisions.
Timeframe: Short term (2 years)

Step 3) Enhance MRAC to improve fishery community engagement in decision making.
Timeframe: Short term (2 years)

Step 4) Design and develop a new Marine Permit System to improve customer service.

Timeframe: Short term (2 years)

Lead Agency: DEC; Potential Partners: ASMFC, NOAA, US FWS, MAFMC, NEFMC, MRAC and CCE.

30. Promote improved management of deep-sea corals and sponges within the New York Bight.

Deep-sea corals and sponges provide important habitat for marine life, increase habitat complexity, and contribute to marine biodiversity. Because deep-sea corals and sponges are fragile and slow-growing, they are particularly vulnerable to disturbance from certain human activities; particularly bottom-tending fishing gears (e.g., bottom trawling). Other threats include oil and gas exploration, renewable offshore (wind) energy development and production, aquatic invasive species (tunicate, *Didemnum sp.*) and ocean acidification. DOS (Ocean and Great Lakes Program) and NOAA's National Centers for Coastal Ocean Science (NCCOS) collaborated to compile and interpret existing ecological information the state needed for offshore renewable energy planning that resulted in the compilation of 5,619 locations of deep-sea corals and sponges based on data obtained from historical surveys. However, there are questions remaining regarding the taxonomy of samples collected and the full extent of the distributions for deep-sea coral and sponge species remains unknown.[183] Currently, there are no management measures in place in the New York Bight that are designed specifically for the protection of deep-sea corals and sponges.

Step 1) Encourage implementation of and potentially collaborate on certain elements of NOAAs strategic plan for deep-sea coral and sponge ecosystems, to include: a) increased benthic survey and mapping efforts by federal partners to quantify the distribution and abundance of deep-sea

corals and sponges within the New York Bight, b) increased biological assessments and biodiversity of deep-sea corals and sponges, c) increased understanding of the extent of degradation to deep-sea coral and sponge ecosystems caused by fishing and other human activities.
Timeframe: Short term (2 years)

Step 2) Characterize the susceptibility of deep corals to perturbations caused by invasive species and anthropogenic impacts (from fishing and non-fishing activities).
Timeframe: Short term (2 years)

Step 3) Assess, develop and implement mitigation measures to minimize adverse impacts of fishing and non-fishing activities on deep-sea coral and sponge ecosystems, as recommended in Amendment 16 to the Atlantic Mackerel, Squid and Butterfish FMP: Protections for Deep Sea Corals.
Timeframe: Near term (5 years)

Lead Agency: NOAA**;** Potential Partners: MAFMC, BOEM, DOS, DEC, WCS and other NGOs.

31. Integrate avian conservation into research, management and offshore planning.

Seabirds are key components of marine ecosystems and are considered to be indicators of ocean health. However, coastal development, fishing, and other ocean-based human activities, in addition to climate change, are impacting global seabird populations.[184] Investigating seabird abundance and distribution is currently underway in New York to inform decisions regarding offshore planning and to guide the development of mitigation measures for minimizing the impacts of ocean-based activities on seabirds. Additionally, the New York State Bird Conservation Area (BCA) Program was established in 1997 and seeks to provide a comprehensive, ecosystem approach to conserving birds and their habitats on state lands and waters to protect and enhance populations of hundreds of different species of resident and migratory birds and the habitats they are dependent upon for foraging, breeding, migration, and shelter. The BCA Program provides a physical description and a map of each of the 52 designated sites, lists important species and habitat types within the state, and provides guidance relative to bird conservation not only for management purposes, but for research, education and outreach. Integrating the BCA Program with the data compiled from various ongoing seabird surveys in a statewide effort to incorporate seabird conservation into research project design and to inform offshore planning would be useful, but it would require the designation of additional BCAs within the marine district, as well as the expansion of BCA program to include areas offshore. Integrating BCA data with seabird surveys currently used in offshore planning.

Step 1) Designate new BCAs in coastal areas and expand the BCA Program to include offshore areas considered hotspots for seabird diversity and abundance. Use any newly collected avian monitoring data from USFWS or NYSERDA efforts to support offshore designations.
Time Frame: Short term (2 years)

Step 2) Integrate BCA Program information with abundance and distribution data from various seabird survey (e.g., aerial, ship-board, shore-based and telemetry) sources, to document and predict important coastal and offshore seabird relative abundance hotspots, meaning common aggregation sites or areas of frequent use for foraging, breeding or nesting. Create mapping products to be used for offshore planning purposes, including the siting of offshore wind development. Note: coastal areas should also include adjacent uplands identified as important habitat for coastal nesting species, such as piping plover (*Charadrius melodus*), Roseate tern (*Sterna dougallii*), least tern (*Sterna antillarum*), common tern (*Sterna hirundo*), American oystercatcher (*Haematopus palliatus*) and black skimmer (*Rynchops niger*).
Timeframe: Near term (5 years)

Step 3) Assess the relative risk to seabirds within New York's coastal and offshore areas to help inform decisions about current and future offshore planning efforts, particularly the siting offshore wind facilities.
Timeframe: Near term (5 years)

Lead Agency: DEC, NALCC, NYSERDA**;** Potential Partners: BRI, USFWS, BOEM**,** NOAA, USGS, NPS, DOS, OPRHP, CUNY, Audubon New York, NHP, WCS and other NGOs.

3.2.5 Objective C: Evaluate the ecological integrity of the ocean ecosystem off New York.

3.2.6 Actions 32-34

32. Establish a baseline ocean monitoring system for the New York Bight.

Although New York is moving toward EBM approaches, we are only just beginning to understand the interactions among complex ocean ecosystem components, including humans and how we influence environmental change. It is imperative that we create a comprehensive ocean monitoring system for the New York Bight. Establishing ecological and socio-economic benchmarks for direct biotic and abiotic parameters through baseline and ongoing long-term monitoring efforts are crucial for detecting shifts in ecosystem status, being able to accurately predict future changes, and implementing effective adaptive management necessary to meet OAP goals in a changing ocean environment. Ocean observing systems are already in place, such as the Mid-Atlantic Regional Association for Coastal and Ocean Observing Systems (MARACOOS) and Northeast Regional Association for Coastal and Ocean Observing Systems (NERACOOS), and typically focus data collection on physical ecosystem parameters (e.g., temperature, salinity, nutrients (nitrogen, phosphorous and silica series) pH, carbon dioxide, dissolved oxygen turbidity, current and wind speed) and other water quality issues (e.g., HAB's and their toxins, marine debris, and pathogens) in the marine environment. These observing systems are becoming increasingly valuable for providing information on marine condition patterns that can be used to model and predict coastal flooding hazards, how best to protect sensitive coastal and estuarine habitat, for public safety, emergency and disaster response in evacuation zones, improve marine forecasts for maritime safety, predict harmful algal bloom (HAB) occurrence and shellfish closure areas, and improve fishery survey data used for management purposes. Increasingly, these observing systems are also being used to evaluate the ecological effects of wind turbine foundations (e.g. sediment transport).

Step 1) Establish and convene a working group consisting of experts from appropriate governmental and non-governmental organizations, educational institutions and local partners to compile a list of current and past research projects and analyze any currently available datasets.
Timeframe: Short term (2 years)

Step 2) Create a centralized public data repository to help identify information gaps. Evaluate and improve current data collection programs.
Timeframe: Short term (2 years)

Step 3) With partners from the research and scientific community and representatives of offshore ocean use groups, identify and prioritize ongoing needs for ocean observing platforms and develop a potential observing platform to achieve multiple state objectives related to ocean monitoring data.
Timeframe: Short term (2 years)

Step 4) Collaborating with key federal agencies and appropriate partners, and using existing data from ocean observing systems like MARACOOS and NERACOOS, create a system for monitoring physical (e.g., temperature, surface currents, waves, currents at depth), meteorological (e.g., wind speed and direction, precipitation, barometric pressure), chemical (e.g., nutrients, dissolved oxygen, contaminants, acidity) and biological (e.g., dissolved organic matter, pathogens, species distribution and abundance using acoustic telemetry) components of the ocean ecosystem. In particular, long-term time series from existing and expanded studies monitoring coastal and open ocean ecosystems are crucial to monitoring the potential threat of climate change (sea-level rise, ocean acidification) and place it in context with historical data.
Timeframe: Near term (5 years)

Lead Agency: DEC, DOS; Potential Partners: NOAA, BOEM, USGS, USEPA, USACE, NYSERDA, NYSG, Academia, USGCRP, CCE, Shinnecock Indian Nation, WCS and other NGOs.

33. Develop an ocean indicators system for the New York Bight.

Establishing ecological and socioeconomic benchmarks through baseline and ongoing long-term monitoring efforts (see Action # 32) will not only help define current conditions within the ocean, but also to fill much needed data gaps currently used to predict and to minimize impacts of adverse changes caused by natural events or human activities. The development of a suite of ocean indicators to be used as a metric of ecosystem health, including ecosystem services, will be crucial for assessing and understanding the current state of the ocean, as well as identifying short-term variations or long-term trends in ocean conditions due to natural and anthropogenic drivers that impact ecosystem integrity. A suite of ocean indicators, once properly identified, will lead to a better understanding of the relationship between water quality, marine habitats, marine wildlife and human use of the ocean. Additionally, this will give resource managers the ability to evaluate the risk posed by human activities and natural processes, to track the effectiveness of EBM actions taken to maintain ecosystems in a healthy, productive and resilient condition, and better inform future decision-making. The information collected will be complimentary to many of the OAP actions, and will be especially invaluable for improving fisheries stock assessments and guiding offshore energy development and mitigation protocols.

Step 1) Analyze available data from existing ocean observing systems like MARACOOS to establish effective ocean indicators representative of overall ocean health, including biological, physical, chemical and socio-economic indices.
Timeframe: Short term (2 years)

Step 2) Integrate the system with federal and regional monitoring and indicator frameworks and include guidance on monitoring protocols and training.
Timeframe: Short term (2 years)

Step 3) Use existing and newly available data (from Action #32), develop an "Ocean Health Index' for identifying actions or adapting existing management strategies to ensure ecological integrity of the ocean ecosystem, and consistent with regional initiatives in the Mid-Atlantic.
Timeframe: Near term (5 years)

Lead Agency: DEC; Potential Partners: DOS, NYSERDA, NYSG, Academia, USGCRP, NOAA, USGS, USACE, EPA, BOEM, Shinnecock Indian Nation, NGOs, and estuary programs.

34. Publish a State of the Ocean report.

Evaluate the status of the ocean (NY Bight) and prepare a "State of the Ocean" report periodically and as data are available, preferably every 5 years. The report will emphasize knowledge gained from the expanded monitoring programs undertaken by the State and other organizations. It will also assess which implementation efforts have been successful or have not worked as anticipated and why, which actions were implemented or delayed and reasons why, and what we need to improve upon to reach our long-term goals. To this end, it is critical that an initial baseline monitoring and ocean indicator program initiative is developed to track ecological and socio-economic benchmarks and assess ocean health (Actions #32 and # 33). This "State of" report will be crucial in conveying to all stakeholders (e.g., resource managers, policy makers and the public) where New York stands in terms of the health of the NY Bight. The information will be used to regularly update the OAP. The updated OAP will identify where we need to go, the future proposed steps that are needed to fully realize the environmental and economic value of a healthy New York ocean ecosystem, and the priority tasks that state, federal, regional and local municipality partnerships must undertake over the next five to ten year period to reach long-term goals and advance ocean health.

Step 1) A "State of" report will be released to assess progress thus far. Based upon this report, update OAP.
Time Frame: Near term (5 years)

Lead Agency: DEC, DOS; Potential Partners: NOAA, USEPA, USGS, BOEM, USACE, New Jersey, NYSERDA, NYMSC, NYSG, SUNY SB, WCS and other NGOs.

3.3 GOAL 2: Promote economic growth, coastal development and human use of the ocean in a manner that is sustainable and consistent with maintaining ecosystem integrity.

3.3.1 Overview

As New York's ocean resources face increased and sometimes competing uses, management decisions on those uses often fail to take into account the interconnections within ecosystems or the cultural significance of the ocean to many coastal communities. Coastal and marine spatial planning (CMSP) is an EBM tool used by coastal resource managers to minimize the potential for conflicts that can arise between ocean–based user groups while balancing the need to promote sustainable development and protecting the environment. New York's approach to incorporating CMSP principles into ocean management, is currently being used in the New York Bight to site offshore renewable wind energy development, and can also be used to site other emerging economic opportunities, such as offshore aquaculture. Bringing stakeholders together to develop a shared vision for managing current and future ocean activities is an important aspect of CMSP, as collaboration with stakeholders often leads to the development of more effective strategies to achieve sustainable use of the ocean while minimizing adverse environmental impacts. This will include comprehensive data collection efforts for benthic mapping to identify critical habitats that support fisheries and natural ecological functions, species distributions within the area, and for performing vulnerability assessments to determine how the cumulative impacts of multiple human activities are changing the ocean ecosystem.

New York should continue to encourage natural resource-based tourism opportunities that capitalize on the state's rich collection of parks, state and national heritage areas, public lands and waters, and historic, cultural and agricultural resources. Approaches should integrate economic development opportunities (including development of heritage assets) with resource protection goals, and planning that acknowledge climate change as well as improved access for visitors in coastal areas. For example, diving and whale and seal watching activities, while not a large part of the economy, are popular in New York waters. DEC has deployed artificial reef structures as part of a fishery management strategy that not only enhances marine habitats, but also provides human use opportunities.[185]

3.3.2 Objective D: Implement and advance offshore planning.

3.3.3 Actions 35-40

35. **Assemble and analyze resource and use data for offshore planning.**

    New York relies on the ocean and its resources for a wide range of commercial and recreational activities. Commercial shipping and navigation, commercial and recreational fishing, diving, recreational boating, surfing, tribal uses, tourism and wildlife viewing all are uses occurring offshore New York with intrinsic, cultural, and economic importance. The continued growth and vitality of New York's ocean economy and Atlantic coastal communities depends upon healthy and productive ecosystems. In addition, new opportunities are emerging to develop ocean industries that make use of New York's offshore resources and advancing technologies, such as offshore wind and other renewable energy industries that can provide environmental benefits from offsetting traditional energy sources. Improving understanding of New York's existing human uses and offshore resources, including the natural resources and environments which they inhabit, is a critical first step for offshore planning and informing the siting of potential future activities.

    The New York Department of State's (DOS) Ocean and Great Lakes Program assembled the most comprehensive dataset possible of physical, biological, geographic, and socioeconomic information on New York's offshore uses and resources and released its *New York Offshore Atlantic Ocean Study* in July 2013.[186] DOS collaborated with federal, state, and non-governmental partners to assemble and analyze these data on known or predicted locations of resources and uses. Data collection and modeling efforts for natural resources found in New York's offshore waters involved development of the most comprehensive datasets possible for groundfish, large pelagic fish, marine mammals, sea turtles, deep-sea coral and sponges, and seabirds. The study and four technical reports that were developed as supporting documents are available for download from http://www.dos.ny.gov/opd/programs/offshoreResources/index.html. DOS is continuing to collaborate with partners to obtain additional data, refine its analyses, and address offshore planning issues relevant to existing uses and emerging technologies.

Step 1) Implement and enhance the "Geographic Information Gateway" to provide data and information from the *New York Offshore Atlantic Ocean Study* and supporting reports, plus additional data as they become available.
Timeframe: Short term (2 years)

Step 2) Continue collaboration with federal, state, and non-governmental partners to obtain additional data and information, conduct geospatial analyses, discuss questions and obtain expert feedback to refine existing information relevant to offshore planning efforts. Do gap analysis to assess if data is sufficient to answer questions and monitor to fill in gaps. Appropriate new data should be incorporated into the Gateway and made available for public use.
Timeframe: Near term (5 years)

Step 3) Conduct geospatial analyses to identify ocean habitats of particular importance to marine and keystone species (e.g., spawning, breeding and feeding habitat; migration pathways), and that support New York's resources and uses. Discuss findings with the New York State ad-hoc Offshore Habitat Work Group, stakeholders – including ocean user groups – the science community, and other interstate partners and coordinate with the efforts of the Mid Atlantic Regional Planning Body. Provide information to federal agencies and recommend potential management measures.
Timeframe: Near term (5 years)

Step 4) Integrate available data and information on existing uses and resources into assessments of compatibility with offshore wind development, to identify areas suitable for potential wind energy development. Discuss findings with the New York state ad-hoc Offshore Renewable Energy Work Group. Provide recommendations to the BOEM–New York Outer Continental Shelf Renewable Energy Task Force.
Timeframe: Near term (5 years)

Lead Agency: DOS; Potential Partners: DEC, NYSERDA, New York State Public Service Commission (PSC), OPRHP, PANYNJ, NY Natural Heritage Program, Harbor Ops, Shinnecock Indian Nation, BOEM, NOAA, USFWS, NAVY, USCG, EPA, USACE, ASMFC, MAFMC, municipalities, Cornell Cooperative Extension, NGOs, Stone Environmental Inc., New England Aquarium and University of Rhode Island, NROC, MARCO.

36. Identify essential ecosystem services in the New York Bight and assess their vulnerability to impacts from human activities and climate change.

An integral part of implementing EBM is the understanding that the ocean provides a range of ecosystem services that benefit human well-being, and that unsustainable human activities often disrupt the ecosystems ability to deliver those services. CMSP is an EBM tool that can be used to address specific challenges to ocean management aimed at advancing both economic development and conservation of ecosystem services over the long term.[187] It is also critical to understand the values people place on the various ecosystem services to implement the best management strategies. Yet all too frequently we lack the ability to assess the value(s) of an ecosystem and therefore neglect this critical consideration when making decisions regarding development along our coasts or in the ocean for human use. The Scientific Advisory Group of the NYOGLECC identified incorporating the value of ecosystem services into decision-making and offshore planning processes as a pressing research need for New York, and the top research priority for the New York Bight identified by the New York Marine Science Consortium at the Fifth Annual Research Symposium in September, 2012, was 'Identify and define measurements and indicators of current and future ecosystem services' (see NYMSC survey results in **Appendix 6**, and more on ecosystem services in **Appendix 7**).

Step 1) Incorporate ecosystem structure, interactions among components (functioning) and key processes into ecosystem models, such as Ecopath (using data gathered from actions under Goal 1).
Timeframe: Near term (5 years)

Step 2) Couple socioeconomic information into ecosystem models to evaluate the impacts of human uses (existing and emerging) and assess costs and benefits to resources, Examples of ecosystem model output should include, but not be limited to, different nutrient loading scenarios, shellfish population assessments, eelgrass restoration and various dredging schemes to examine the effects on other parts of the ecosystem and the services they provide.
Timeframe: Near term (5 years)

Step 3) Use ecosystem service valuation (ESV) to determine the economic value of ecosystem goods and services provide by estuaries, wetlands, beaches, and other aspects of the ocean ecosystem relative to other marketed and non-marketed goods and services. EVS is important to identify which ecosystem services are important (for the natural environment and people), and to help set priorities and justify action need to protect, restore and maintain ocean ecosystem integrity.
Timeframe: Near term (5 years)

Lead Agency: Academia; Potential Partners: DEC, DOS, BOEM, NOAA, USGS, EPA, other federal agencies, MAFMC, WCS, other NGOs and Shinnecock Indian Nation.

37. Develop and evaluate alternative future use scenarios and tradeoffs between ecosystem services and ocean use.

Over the past decade, ecologists and social scientists have developed the concept of identifying and assessing the attributes of certain ecosystem services as an approach to better communicate the non-monetary value of certain ecosystems that benefit humans (including ecosystem processes and functions, and the linkages between the ecosystem and human well-being) to policymakers, the public, and other stakeholders. Ecosystem services valuation also serves as the foundation for CMSP efforts that attempt to minimize the impacts of human activities and promote better protection and management of important ocean resources. However, existing CMSP efforts are frequently single-objective, and fail to consider the tradeoffs of alternative management strategies or proposed and emerging opportunities for human uses. Additionally, many CMSP efforts are constructed around ocean development projects such as wind farms, significantly limiting their ability to meet comprehensive EBM goals. To be most effective, CMSP should have a substantial integrated approach to assessing tradeoffs between all human uses and ecosystem services in marine systems from the start, including commercial interests, environmental stewardship, and community values. Ecosystem-based CMSP grounded in core ecological principles and responsive to multiple objectives and all ecosystem service categories is therefore an essential tool for managers to implement EBM.

Step 1) Identify a range of potential future use scenarios based upon information regarding the impacts of current, emerging, and proposed human uses, ecosystem conditions (including baseline monitoring and ocean indicators), and ecosystem services to assess, forecast, and analyze the tradeoffs associated with alternative policy and management options.
Timeframe: Near term (5 years)

Lead Agency: Academia; Potential Partners: DEC, DOS, BOEM, NOAA, USGS, EPA, other federal agencies, MAFMC, and Shinnecock Indian Nation.

38. Identify goals for environmental assessments to better understand effects of offshore renewable energy development on wildlife.

The negative impacts to the ocean ecosystem associated with traditional methods of energy production (oil, LNG, nuclear power plants) on land are well understood. For example, deposition of air pollutants from the burning of fossil fuels is responsible for adverse environmental and economic impacts including degradation of lakes, streams and forests from acid deposition; elevated levels of mercury in fish and other wildlife; human morbidity and mortality from poor air quality related to ozone and particulate matter. Climatic changes resulting from extraction and combustion of fossil fuels are acidifying the ocean. Up to 17 billion gallons of water per day are used in New York by steam electric generating power plants, which leads to entrainment and impingement of fish and fish larvae, many of which spend part of their life cycle in the ocean.[188] However, while renewable energy resources such as offshore wind have substantial environmental benefits over traditional methods of energy production the impacts of proposed offshore energy generation and transmission facilities on marine wildlife, and the critical habitats they depend on, must be further studied. A variety of environmental concerns have arisen regarding construction and operation of large wind turbines that could result in both direct and indirect effects, including underwater noise pollution and discharges of toxic pollutants, disruption of whale migratory patterns, mortality of bats and birds, conflicts with fishing grounds, navigational hazards to fishing vessels, changes to sand movement, and effects of electromagnetic field generated from transmission cables. Targeted research and monitoring will enable better ocean resource management decisions and potentially expedited permitting of offshore development projects.

Step 1) Define site-specific wildlife and marine wind energy assessment goals for a better understanding of information needed to guide the permitting process for marine wind energy projects off New York, with an emphasis on fish, marine mammals, sea turtles, seabirds and bats. In addition, perform an analysis of nearshore and shoreline impacts, such as energy point of connections (to onshore utility grid/supply network), impacts to living shorelines and shoreline habitat, existing recreation assets (boating, kayaking, etc.)
Timeframe: Short term (2 years)

Step 2) Building on current projects and traditional knowledge, identify data gaps and research, survey and monitoring needs to better understand how offshore wind energy infrastructure installation, transmission, maintenance and decommission are likely to affect wildlife, including benefits to wildlife through the replacement of traditional fossil fuel energy sources. This will include the development and Implementation of the Preliminary New York State Marine Wind and Wildlife Environmental Research Plan that will prioritize areas of future research, baseline surveys and long-term monitoring related to marine wind energy and wildlife. These environmental assessments will be used to inform regulators, developers and stakeholders of the potential benefits and impacts (direct and indirect) of offshore wind development on wildlife, including birds, bats, sea turtles, fish, and marine mammals.
Timeframe: Short term (2 years)

Lead Agency: NYSERDA; Potential Partners: DEC, DOS, USFWS, NOAA, BOEM, USGS, CCE, Biodiversity Research Institute, WCS and other NGOs.

39. Assess the effectiveness of BMPs and other measures used to mitigate adverse effects of anthropogenic sources of underwater noise.

Noise pollution from ocean-based human activities, such as shipping, military training and seismic surveys for oil and gas exploration, is considered a serious threat to marine mammals. Noise pollution can mask the natural underwater soundscape, impeding communication, orientation, predator avoidance, foraging and, depending on the levels of sound exposure, can cause injury or death. [189] [190] Although much work has been done to reliably establish levels of sound exposure that could negatively impact marine mammals, there is not sufficient data at this time to fully assess and understand the extent of the exposures.[191] U.S. and international maritime commerce is projected to at least double from 2001 to 2020, with an attendant increase in the amount of noise entering the ocean from commercial shipping.[192] However, no non-military standards exist for measuring the underwater background noise generated by these vessels.[193] Additionally, the development of offshore renewable energy facilities will impart noises in offshore marine waters different from boat traffic. As such, there is a strong need to evaluate the cumulative environmental impacts of underwater noise pollution from all potential noise producing human activities on marine mammals, as well as a range of other taxonomically diverse marine animals (e.g., sea turtles, fish, crabs, other invertebrates).

Step 1) Identify and review and synthesize all available literature describing the effects of potential sources of noise producing activities on marine mammals and commercially-important fish such as squid, including but not limited to, commercial shipping, military training (sonar activity, explosions), oil and gas exploration (seismic surveys), fishing (depth sounders, sound emitted by vessels and gear during deployment, fishing and retrieval), acoustic seafloor mapping surveys (side scan and multibeam sonar), dredging, coastal development, offshore wind energy development and production, pile driving, recreational boating, whale watching and other commercial and recreational activities.
Timeframe: Short term (2 years)

Step 2) Identify and assess the effectiveness of mitigation measures, best management practices and alternative technologies (e.g., ship quieting technologies, alternatives to airguns and other instruments used during seismic surveys, air curtains) and mitigation approaches (e.g., timing of activities) currently used regionally, nationally and internationally to minimize adverse impacts of noise pollution on marine mammals and other marine species.
Timeframe: Short term (2 years)

Step 3) Deploy passive acoustic sensors strategically within the New York Bight (e.g., for whale monitoring purposes (Actions 19 and 20) and at existing and future ocean observing stations, and work with federal, state, tribal and local partners to a) establish baseline acoustic conditions for natural and anthropogenic sound sources (ambient noise budget) off of New York, and; b) use this information to develop and validate effective strategies that can be implemented to mitigate the effects of noise pollution caused by human activities, particularly for the construction, operation and maintenance of offshore wind turbines in the New York Bight.
Timeframe: Near term (5 years)

Lead Agency: NOAA; Potential Partners: BOEM, USACE, PANYNJ, DEC, DOS, NYSERDA, WCS and other NGOs.

40. Represent New York's interests in the Mid-Atlantic Regional Planning Body (MidA RPB) ocean planning process and other ocean planning processes.

Since ocean-based human activities likely have impacts that span a range of spatial scales and multiple regulatory jurisdictions, there is a need for federal and state agencies to coordinate to establish regional management and ocean planning frameworks. The Mid-Atlantic Regional Planning Body (MidA RPB), established in April, 2013, is a non-regulatory group comprised of voluntary representatives from federal and state, tribal and local governments throughout the Mid-Atlantic region (NY, NJ, PA, MD, DE, VA) and the Mid-Atlantic Fishery Management Council. Its purpose is to develop a Mid-Atlantic Regional Ocean Action Plan (ROAP) that will improve our understanding of how the Mid-Atlantic ocean and its resources are being used, managed, and conserved; address potential for conflicts that arise as a result of current activities, and guide planning for emerging economic opportunities, such as renewable offshore wind development. Central to the success of the MidA RPB offshore planning process was to coordinate with stakeholders, scientific, business, and technical experts, and members of the public to identify issues of importance to the region and how federal agencies can assist in addressing those regional priorities. New York has already begun the offshore planning process by releasing an Atlantic Ocean Study, identifying data needs and research priorities, and conducting outreach with relevant stakeholders and the public. Participation in the MidA RPB offshore planning process ensured that New York's voice was heard as the ROAP was developed. A similar planning body has been proceeding in New England and an effort in Long Island Sound was just initiated through CT legislation.

Step 1) Use knowledge gained from offshore and estuarine spatial planning efforts to inform the MidA RPB ocean planning process and ROAP implementation to support sustainable management and protection of Mid-Atlantic ocean resources, minimize user conflicts and improve regional policy decision-making. Continue to remain engaged in this process regardless of what forum is created after completion of the ROAP.
Timeframe: Short term (2 years)

Step 2) Engage as appropriate for New York in CT's Long Island Sound Blue Plan to support sustainable management and protection of Sound resources.
Timeframe: Short term (2 years)

Lead Agency: DOS, DEC; Potential Partners: Mid Atlantic Regional Planning Body, New England Regional Planning Body, and the Long Island Sound Blue Plan Advisory Committee.

3.3.4 Objective E: Promote sustainable ocean-based industry and recreation.

3.3.5 Actions 41-43

41. Develop a New York aquaculture policy and improve the regulatory framework to promote sustainable best management practices.

Approximately 91 percent of the seafood consumed in the United States is imported, with about half of that produced from aquaculture facilities. However, domestic aquaculture provides only about five percent of the seafood consumed in the United States.[194] The aquaculture industry contributes $17 million to New York's economy, and when implemented sustainably, aquaculture has the potential to create between 20 and 50 direct farming jobs per thousand metric tons of production.[195] In 2011, NOAA released its National Aquaculture Policy which was designed to increase domestic seafood production, create sustainable jobs and restore marine habitat. The National Aquaculture Policy outlines goals, objectives and actions necessary to encourage and foster sustainable aquaculture development.[196] Although the technology exists for the potential of sustainable farming of finfish, shellfish and seaweed in New York State waters and offshore, there currently is no clearly stated regulatory framework (permitting, siting, approval processes) or established environmental standards for monitoring to guide ocean aquaculture development in the region, which has discouraged investment in the industry. [197] Additionally, as human population and development continue to increase along the coast, less inshore areas will be hospitable to aquaculture development due to human health concerns. Development in offshore areas will be problematic without consideration of a comprehensive planning process, as competition for space with other ocean user groups grows. [198] Other issues to consider when promoting the expansion of this industry are the spread of disease, pollutant discharges, adequate state and/or federal funding assistance, current wetland, waterway and CZMA restrictions, and conflicts that could arise from allowing exclusive private use of public waters or existing state laws that may discourage aquaculture development. Development of a Best Management Practices (BMPs) guidance document for the New York Aquaculture Industry would be useful to minimize negative environmental impacts and develop consistent culture practices amongst aquaculturists.

Step 1) Through an appointed interagency task force, create a New York marine aquaculture policy and planning framework to promote economically and ecologically sustainable ocean aquaculture industry operating within state waters. Additionally, develop and implement environmental standards and monitoring protocols for water quality, benthic biogeochemical processes and marine life to protect the ocean ecosystem from potential adverse environmental impacts. NOAA Technical Memorandum NOAA NOS 164 and the BMPs developed by the East Coast Shellfish Growers Association (ECSGA) should be used as templates.[199] [200]
Timeframe: Short term (2 years)

Step 2) Working with federal partners, identify natural resource and industry concerns associated with offshore aquaculture development (beyond the 3 nm state jurisdiction) and recommended measures to address those concerns. Of particular concern, investigate how climate change will affect development opportunities inshore and offshore, consistent with the NOP and NOAA's National Aquaculture Policy.
Timeframe: Near term (5 years)

Lead Agency: DAM, DEC; Potential Partners: NOAA, DOS, DOH, OGS, ESD, NYSG, CCE, NY Aquaculture Industry, Long Island Farm Bureau, East Coast Shellfish Growers Association (ECSGA), Shinnecock Indian Nation and municipalities.

42. Support the New York artificial reef program and identify suitable sites for future reef placement.

DEC has had a program for marine artificial reef construction since 1962, utilizing suitable material available to build artificial reefs to enhance and increase shelter and foraging habitat for important finfish species and provide recreational fishing and diving opportunities. The program currently has 11 artificial reef sites (2 in Long Island Sound, 2 in Great South Bay, and 7 in the ocean within 3.3 nm of the south shore of Long Island) that support several forage and predatory fish species, as well as lobster, crabs, sponges, anemones, and even temperate corals. The programs goals are: to provide recreational angling and diving opportunities; to enhance and/or restore fishery resources and associated habitat; and, to manage artificial reef habitat as part of a fishery management program. Although a limited amount of monitoring has been conducted in the past, the data was not collected at all existing sites and is not comprehensive enough to be used for quantitative assessment purposes.

Step 1) Establish a pilot study using a variety of techniques to determine the most cost effective, repeatable survey methods and sampling procedures for biological assessment of reef associated species. The pilot study will also quantify species diversity and population abundance of fish, crustaceans, and other epibenthic organisms at two artificial reef sites: Atlantic Beach [AB] and Hempstead [HS]).
Timeframe: Short term (2 years)

Step 2) Establish a comprehensive, long-term biological monitoring program on existing reef sites to evaluate fish and crustacean populations and assess the effectiveness of existing artificial reefs in achieving programs goals (e.g., bathymetry surveys to assess functionality of the artificial reef sites).
Timeframe: Short term (2 years)

Step 3) Conduct a programmatic supplemental environmental impact (SEIS) for NY's Artificial Reef Program. This analysis should incorporate all relevant new data on areas historically used and all 11 of the currently used artificial reef sites. Additionally, identify suitable future artificial reef sites, including an assessment of possible direct and indirect ecosystem effects, and potential benefits for recreational fishing and diving interests. Develop a Supplemental Environmental Impact Statement.
Timeframe: Short term (2 years)

Step 4) Construct additional artificial reefs in compliance with federal and state regulations, permitting requirements, and regional management strategies for reef-associated stocks.

Step 5) Study the benefits of offshore wind turbine foundations that act as artificial reefs.
Timeframe: Near term (5 years)

Lead Agency: DEC; Potential Partners: SBU, USACE, NOAA, OGS, DOS, NYSG.

43. Promote and develop New York's existing ocean economy and identify new opportunities for growth in New York's working waterfronts.

New York's ocean economy is supported by existing and long-standing activities that have contributed to the economic vitality of coastal communities for decades - particularly commercial navigation, fishing, and recreation. Offshore wind development has the potential to add a new

component to New York's ocean economy. Greater attention is needed to the long-standing pressures on New York's ocean economy from land-use needs and increased competition for ocean space. As a complement to state efforts at offshore planning and coastal resilience, agencies should look for opportunities to strengthen the ocean economy through strategic partnerships, marketing opportunities, and the continued waterfront access for recreation and maritime uses. For example, market NY wild caught fish.

Step 1) Develop collaborations with existing and new industries that emphasize sustainable use of the ocean ecosystem. Promote New York's ocean economy through partnerships with industry, state and federal agencies, and NGO's to draw public attention to the value of the ocean economy. *Time frame: Short term (2 years)*

Step 2) Identify existing, underutilized infrastructure and new opportunities for access to the water to enhance the viability of New York's coastal economy and recreational opportunities. Integrate ocean data collection and resiliency into coastal community planning activities.
Timeframe: Near term (5 years)

Lead Agency: DOS; Potential Partners: NOAA, OPRHP, GOSR, NYS REDCs, PANYNJ, ESD, DEC, NYSERDA, NYS DOT, USACE, New York City Department of City Planning (NYC DCP) and CCE.

3.4 GOAL 3: Increase resilience of ocean resources to impacts associated with climate change.

3.4.1 Overview

Climate change, in conjunction with current environmental stressors caused by coastal population density, development and land use and waste disposal practices, is expected to pose a significant threat to New York's coastal communities and ocean ecosystem. The combination of natural variability and human-caused stressors proved to be a devastating mixture during Superstorm Sandy. Future storms will pose additional challenges to coastal communities, as well as the federal, state and local governments responsible for preserving the ecological integrity of coastal and estuarine habitats, while also maintaining public infrastructure, economic stability, and public welfare. Building the capacity to understand and respond to natural processes and vulnerabilities to the impacts of climate change (e.g., warmer temperatures, ocean acidification, sea-level rise, changes in precipitation patterns and the higher frequency of extreme weather events) in light of the uncertainties associated with long-term future climate projections is our current and most-pressing challenge.[201]

Although our knowledge of how the Earth's climate is changing has grown over the last several decades, our understanding of the magnitude of current and potential impacts of climate change on our ocean and coastal ecosystems is incomplete.[202] The cumulative effects of climate change are often difficult to predict, but all coastal communities will be directly impacted by rise in sea level, coastal erosion and storm surge from more frequent intense weather conditions.[203] There is a critical need for a better understanding of the physical characteristics of ecosystems and their supporting natural processes, their exposure to stressors and climate change effects, and their ability to adapt to climate change. Vulnerability assessments will provide the information needed to develop tools and services for coastal communities and resource managers to prepare for and adapt to the impacts associated with climate change.

3.4.2 Objective F: Conduct vulnerability assessments to inform climate change adaptation and coastal planning strategies.

3.4.3 Actions 44-48

44. Assess and predict the vulnerability of the coastal areas to climate change.

New York's densely populated and heavily developed coastal areas have introduced added complexity to resource management within New York's already dynamic ocean ecosystem. The impacts associated with climate change (e.g., sea-level rise, changes in precipitation patterns, and increasing water temperatures, and an increased frequency of extreme weather events) will pose additional challenges to people living in coastal communities, as well as to the state and municipalities responsible for preserving the ecological integrity of coastal and estuarine resources, while also maintaining public infrastructure, economic stability, and public welfare. Vulnerable coastal areas, such as wetlands, are important foraging and nursery habitat for many inshore and offshore species. Because they also act as natural buffers during intense storms, protecting and restoring these natural areas can and should be an effective resilience strategy used by coastal communities to minimize the effects of sea-level rise and extreme weather events. Significant amounts of shoreline and wetlands have already been transformed by measures such as armoring, bulkheads, dredging, fill and replacement of native vegetation. In most cases these actions reduce or eliminate natural habitat, disrupt sediment transport processes, and they may contribute to increased impacts in adjacent areas. Coastal development and physical alteration of shorelines, including shoreline hardening to protect against storms, erosion and sea-level rise are among the factors contributing to significant tidal wetlands loss in Jamaica Bay and other areas. However, the full extent of impairments to the environment caused by manipulated shorelines in conjunction with sea-level rise has not been tracked. Continuing development and shoreline hardening will further diminish natural protective features and biological communities of the coasts and oceans, with uncertain outcomes for long-term human community risks. Implementation of more beneficial shoreline treatments could partially offset losses and create more sustainable adaptation, provided existing losses, potential benefits, and the effects of various approaches are understood. It will also be increasingly important to understand the role of climate change on already vulnerable species, and identifying changes in population dynamics will be critical for effective management and climate adaptation.

Step 1) Integrate water and ecosystem observing systems currently used to monitor coastal zones and the offshore environment to better understand and assess the effects of the threats of coastal flooding, storm surge and sea-level rise to coastal ecosystems under a changing climate. This should include a gap analysis of what types of monitoring are needed but not currently conducted (e.g., identifying the best indicators of biodiversity and trophic function, developing a minimum set of indicators that will track ecosystem health and the effects of stressors including climate change), and recommendations on how to implement this step.
Timeframe: Short term (2 years)

Step 2) Create a database to compile integrated water and coastal ecosystem monitoring data (from Step 1) and develop software and web interface to facilitate data entry and public access to continuous coastal ecosystem monitoring data on the NYS RISE website.
Timeframe: Short term (2 years)

Step 3) Use coastal ecosystem monitoring data in Step 2 to evaluate baseline conditions within the region, as well as within local basin areas: New York Harbor and lower Hudson, New York Bight, Coastal Atlantic, Jamaica Bay, South Shore Estuaries, Long Island Sound, and north shore bays. These base-line data not only help the state track system health (e.g., assessing the impacts of HABs on human health and the environment, and a better understanding of the conditions that trigger HABs), it would also form an essential information background for any EIS in the covered area.

Step 4) Extend land-based vulnerability assessments for habitat[204] and at-risk species[205] that have been conducted for New York to ocean resources not yet included in such analyses and identify which resources (estuarine, coastal and oceanic species and habitats) in the marine environment are at risk of decline. Many nearshore species and communities are dependent on natural sediment transport processes, periodic water level change or inundation and ephemeral conditions. In fact, physical alteration of coastal areas, coupled with sea-level rise, can inhibit inland wetland migration, leaving the tidal wetlands to drown in place and eliminating their protective value. In order to support the health and value of these species and communities it is essential to recognize these needs and the potentially negative effects of climate change and various shoreline management measures. A component of the vulnerability assessment should examine the value of natural periodic or ephemeral habitat conditions, how they are impaired by active management measures and how climate change may lead to future impacts. The results of these new vulnerability assessments should be incorporated into the revision of the New York State Wildlife Action Plan (SWAP).

Step 5) Identify which ecosystem services and natural communities are most susceptible to climate change and recommend adaptation strategies.
Timeframe: Near term (5 years)

Step 6) Develop and implement adaptation strategies to respond to the impacts of a changing climate to barrier islands, beaches, inlets, estuaries, other vulnerable coastal habitats, fish and wildlife. This should include, but not be limited to, restoring wetlands and other natural areas that serve as buffers during intense storms, adopting resilient shoreline management techniques, improvements to natural hydrology in coastal areas, better management of stormwater, and upgrading vulnerable WWTP infrastructures.
Timeframe: Near term (5 years)

Lead Agency: DEC; Potential Partners: EPA, NYS RISE, NOAA, USFWS, NPS, DOS, Hudson River Environmental Conditions Observing System, HRNERR, NYSERDA, OPRHP, NYCDEP, LISS, New York City Department of Parks and Recreation (NYC DPR), NYC DCP, Shinnecock Indian Nation and municipalities.

45. Identify, assess and prioritize flood-prone areas at risk due to climate change.

Climate change will lead to stronger coastal storms and increase frequency and severity of coastal flooding, resulting in greater impacts to the ocean ecosystem and the communities that rely on them for the goods and services they provide. Coastal flooding results in increased coastal erosion and reduced water quality and has the potential to disrupt public services and infrastructure, destroy property and put lives in jeopardy. Consistent with the requirements of the State Community Risk and Resiliency Act (CRRA), long-term climate change adaptation strategies recommended in the ClimAID Report (2011) for coastal zones should be developed and integrated into the decision-making process for policy and management initiatives based on local vulnerability and scientific knowledge of the risks associated with climate change. For instance, updating local sea-level rise information based on climate change projections for NY coastal zones can help identify areas most at risk of inundation and coastal erosion after a storm. Based on this information, hazard avoidance or mitigation (e.g., minimizing or relocating commercial or residential development out of these flood-prone areas) can be implemented to reduce loss of life and minimize the destruction of property during coastal storms. NOAA's *Roadmap for Adapting to Coastal Risk*, a similar program or other available tools should be used by municipalities to characterize their exposure to current and future coastal hazards and climate change related threats and incorporate this information into planning and decision-making.

Step 1) Undertake mapping, modeling and analysis to identify and prioritize the effects of sea-level rise and severe weather scenarios, then use this information to predict the potential impacts of weather and climate change (e.g., flooding, erosion, and altered precipitation return periods) on coastal ecosystems, communities and infrastructure and to guide conservation of areas such as floodplains, wetlands and other natural areas which are likely to be subject to future inundation.
Timeframe: Near term (5 years)

Step 2) Monitor how climate change drives increased storm frequency and severity and investigate resource and water quality impacts associated with storm events, such as shoreline erosion, nutrient export from watersheds, impacts from stormwater drainage systems, and changes in pathogen levels.
Timeframe: Long term (10 years)

Lead Agency: DOS, DEC; Potential Partners: NYSERDA, NYS RISE, USGS, NOAA, EPA, OPRHP, NYSERDA, SUNY SB, NYSG, NYC DCP, Shinnecock Indian Nation and municipalities.

46. Examine the impacts of increased coastal flooding and sea-level rise on wastewater, stormwater and other vulnerable infrastructure in New York City and Long Island.

Future extreme storm events, characterized by storm surge and coastal flooding, can result in increased vulnerability of aging public works infrastructure due to effluent discharge and stormwater runoff, which adds pathogens, contaminants and turbidity to coastal ecosystems and potentially to groundwater reservoirs currently used as drinking supplies. In 2012, Bay Park Sewage Treatment Plant in Nassau County was out of service for 56 hours as a result of Superstorm Sandy, due mostly to storm surge and heavy rainfall. From November 1 through December 13, roughly 2.8 billion gallons of partially treated sewage was discharged into West Bay before the facility wastewater flow was restored.[206] Shallow aquifers in flooded areas were also contaminated by saltwater intrusion, sewage effluent, and oil from public storage facilities and private tanks. These issues resulted in unsubstantiated claims about the unsafe quality of drinking water after Sandy. Given coastal population densities and aging wastewater and stormwater infrastructure along the coast, water quality concerns persist that threaten coastal and ocean resources (species and habitats).There are a number of construction projects underway in New York City and Long Island that will help to minimize climate change related impacts to water quality, ranging from WWTP upgrades to installing green infrastructure for stormwater management. These projects are meant to increase coastal resilience, but they can come at great expense to the state and municipalities. The cost of repairing Sandy's damage to sewage treatment plants in New York alone is estimated at nearly $2 billion. NYS set up a Hurricane Emergency Loan Program (HELP) to provide financial assistance to municipalities with storm-damaged drinking water, storm water and wastewater infrastructure in counties eligible for public and/or private assistance by the Federal Emergency Management Agency pursuant to Disaster Declarations DR-4020 and DR-4031. Consistent with the requirements of the CRRA, applicants to state programs responsible for funding and permitting infrastructure projects soon will be required to demonstrate they have considered future physical climate risk due to sea-level rise, storm surge and flooding. These factors will also be incorporated into certain facility-siting regulations.

Step 1) Investigate reported damage to WWTPs infrastructure (publicly owned treatment works and private sewage treatment plants) in NYS coastal waters caused by Superstorm Sandy and other storms, including tropical storms, nor'easters and severe winter weather that caused storm surge and flash flooding. This should include, but not be limited to, 1) examining environmental impacts of the Bay Park WWTP effluent discharge into Reynolds Channel and Mills River caused by Superstorm Sandy, 2) identifying potential vulnerabilities of WWTP infrastructure in Nassau, Suffolk and Westchester counties to severe storm events and other climate change related impacts, such as sea-level rise, 3) analyzing existing WWTP design, operation and facility capacity to respond to emergencies during extreme storm events (e.g., storm surge, coastal flooding and high wind conditions), 4) identifying which WWTP infrastructure components are most vulnerable during extreme storm events, and evaluate any facility limitations, operational deficiencies and potential for improvement (upgrades, expansion), 5) identifying and reporting on deficiencies of existing systems during normal operations, scheduled upgrades and outcomes with respect to projected climate change effects, and 6) coordinate with similar efforts along the Hudson estuary.
Timeframe: Near term (5 years)

Step 2) Study the impacts of sewage discharge from Bay Park on water quality and sediments in the Western Bays and nearby tributaries.
Timeframe: Near term (5 years)

Step 3) Assess the impacts of sewage discharge from WWTPs on drinking water supplies that serve the state's coastal areas. This should include identifying municipal water supply sites in flood prone areas and collection and distribution system infrastructure prone to flooding and potential delivery disruptions, and developing and implementing water supply resiliency strategies in flood prone areas.
Timeframe: Near term (5 years)

Step 4) Investigate the potential for highway and rail system vulnerabilities on Long Island. Incorporate New York State Department of Transportation (DOT) assessments and information from partnerships with other infrastructure owners or operators such as the MTA and the Port Authority of New York and New Jersey (PANYNJ), when available. Utilize GIS technology to determine areas that may be prone to flooding due to storm surge or under future conditions due to sea-level rise alone and storm surge with sea-level rise. Rank location vulnerability based on the likelihood of flooding and share information with appropriate partner owners and agencies for planning purposes. This work should be coordinated with Action # 44.
Timeframe: Near term (5 years)

Step 5) Investigate the impacts of oil and chemical spills on fisheries, water quality and habitat as a result of Superstorm Sandy, and assess the vulnerability of public and private storage facilities to future weather events.
Timeframe: Near term (5 years)

Lead Agency: DEC, DOH; Potential Partners: NYS RISE, USGS, EPA, OPRHP, DOT, DOS, NYSERDA, EFC, PANYNJ, MTA, NYSG, NYC DCP, Shinnecock Indian Nation, municipalities, WCS and other NGOs.

47. Support the use of living shorelines as a tool to reduce coastal erosion and flooding while providing better environmental services.

Coastal erosion is largely driven by wave action, currents, tides, stormwater runoff and groundwater seepage, all which transport sediment along the coast. These natural processes lead to long-term shoreline changes and create important foraging, breeding and nursery habitat that coastal and offshore species depend on. However, human development and shoreline hardening structures (e.g., bulkheads, seawalls, revetments) along the coasts have altered inshore hydrodynamics, preventing natural processes from supplying sediment. This results in increased coastal erosion in adjacent areas and wetland loss. In addition, climate change consequences (e.g., sea-level rise and severe weather events) are likely to intensify erosion and increase coastal flooding. This will have significant financial implications for residential and commercial properties and considerably impact associated infrastructure. A shoreline stabilization approach called living shorelines uses techniques that range from non-structural, engineered habitat (e.g., beach nourishment, wetlands and shellfish bags) to hybrid approaches that include limited manmade structural components enhanced with natural habitat characteristics (e.g., oysters in reef balls). This approach reduces erosion while preserving natural processes in low to moderate wave energy areas of the coast (fetch less than one mile). Living shorelines are being considered by coastal managers as an alternative to shoreline armoring because they not only reduce erosion but can be cost effective, preserve land-water connections, mimic the natural landscape, and provide better environmental services in comparison with structural measures. New York is acknowledging national and state trends that emphasize the importance and the value of natural and nature-based features such as living shorelines to reduce risk from erosion and are ecologically sustainable.

The NYS 2100 Commission Report (2013) recommended the use of living shorelines as one method to help mitigate present and future coastal erosion. The Community Risk and Resiliency Act (CRRA) also encourages the use of living shoreline approaches (referred to as “natural resources and natural processes”) by requiring guidance to be developed by DEC and DOS. However, development of living shoreline projects across New York’s marine district has been slow because the science and techniques involved are still relatively new concepts and private owners are reluctant to build installations into the upland. Currently, engineering standards for living shorelines structure designs are not standardized, and challenges arise during the permitting process due to statutory requirements that discourage development in tidal wetlands and other important coastal habitats. Additionally, there is a lack of awareness among the public and the engineering and construction communities regarding the benefits gained by using living shorelines versus armored shorelines, such as erosion protection with improved water quality, improved habitat function, adaptive capacity, land-water access, and resilience. It is also important to note that not all “soft” shoreline stabilization solutions are of equal value and, if not properly assess on a site by site basis, some designs can unintentionally disrupt natural processes and degrade critical habitat. This is particularly true for early successional beach habitat that is critical to two federally listed species in New York, the Piping Plover and Seabeach Amaranth. A guidance document for navigating the permitting process (and effectively defining what constitutes a living shoreline in NYS) is currently under development, but there is still a need for guidance for identifying appropriate site-specific living shoreline solutions, comprehensive engineering guidelines, more publically visible demonstration sites, and monitoring programs that demonstrate performance.

Step 1) As per CRRA Section 16, develop guidance on the use of resiliency measures that utilize natural resources and natural processes to reduce risk. This includes siting, design criteria and guidelines for living shoreline projects located within the marine and coastal district (as defined in Environmental Conservation Law (ECL) section 13-0103) and the Estuarine District (ECL 11-0306).
Timeframe: Near term (5 years)

Step 2) Revise current laws, regulations and permitting policies for tidal wetlands and other coastal habitats, as necessary, to make the permitting process more timely and efficient. These revisions should be consistent with existing federal regulations and policies and mitigation actions.
Timeframe: Near term (5 years)

Step 3) Conduct feasibility, design and implementation of living shoreline projects. Implement various living shoreline designs that are appropriate for use along New York’s coastline as demonstration projects. Monitor installed projects so as to evaluate and develop standardized monitoring protocols (step 5).
Timeframe: Near term (5 years)

Step 4) Use results of climate change habitat vulnerability assessments (Action # 43) to identify areas prone to erosion that require new or enhanced shoreline protections where living shoreline development might be used as an alternative to conventional shoreline stabilization techniques.
Timeframe: Long term (10 years)

Step 5) Develop standard monitoring protocols and implement at completed living shoreline sites (preferably both pre- and post-construction) and at control sites with traditional shoreline hardening to assess how effective these projects have been at 1) reducing erosion, 2) creating satisfactory habitat for local ecological communities, 3) protecting water quality, and 4) providing human use, access and other environmental services. This information will be critical for developing appropriate siting and structural designs for future erosion management goals and for getting regulators and the general public “on board” with this new technique.
Timeframe: Long term (10 years)

Lead Agency: DEC, DOS; Potential Partners: USACE, EPA, OPRHP, SUNY SB, NYSG, NYC, HRNERR, NOAA, DCP, municipalities, Shinnecock Indian Nation.

48. Evaluate and periodically revise the breach contingency plan.

When Superstorm Sandy hit Long Island in the fall of 2012, three breaches occurred along barrier islands in Suffolk County, and led to the first ever activation of the New York Breach Contingency Plan to begin closure procedures. Once a breach occurs following intense storm activity, the likelihood of future damage from coastal erosion and flooding could potentially increase. Some breaches eventually close due to natural processes, but public safety is the main reason breaches to barrier islands are closed by mechanical means. Breaches also might affect coastal economies due to the potential for significant damage to property and infrastructure and negative impacts to local fisheries. Ultimately, two of the three breaches opened by Sandy were closed by mechanical means. The third breach in Fire Islands National Seashore, “wilderness breach”, has not been filled but has been and continues to be closely monitored. The NYS 2100 Commission Report (2013) recommended that because our coastline is undergoing natural changes over time, our preparation for closing breaches to barrier islands must also be regularly reviewed and adapted as new, cost-effective approaches to closing breaches by mechanical means are developed. The Contingency Plan was created by New York, the Army Corp of Engineers (USACE) and federal partners in 1994 in response to the perceived need to close breaches upon occurrence so as to prevent or minimize costs associated with further storm damage. It has not been updated since January 1996. We now know that new inlets can actually improve water quality in the bays and we are beginning to understand the important role breaches play in the transport of sand into the bays. This natural process allows new wetlands and eelgrass beds to form and provides a platform for the barrier islands to roll onto as sea-level rises. Absent this platform, the barrier islands may drown in place.

Step 1) Monitor breach conditions (breach position, depth, tidal exchange and sediment movement), ecosystem response, water levels and water quality in Great South Bay caused by the breach that remains open at Old Inlet in the Fire Island National Seashore.
Timeframe: Near term (5 years)

Step 2) Compare data collected in 2007 (pre-Sandy), with current trends in biological, physical and chemical changes within Great South Bay and adjacent areas to evaluate the potential benefits and/or impacts the breach could be having on biological communities within the Fire Island National Seashore Wilderness Area and assess subsequent consequences to ecosystem integrity of Great South Bay. This assessment should include (but not be limited to) how environmental factors influence species diversity and population dynamics and how changes in hydrodynamics due to the breach will effect coastal ecosystems.
Timeframe: Near term (5 years)

Step 3) Use knowledge gained from monitoring of barrier island breaches (for example, the ongoing efforts to monitor the 2012 breach at Old Inlet) to develop criteria for determining whether breaches should be closed by mechanical means, monitored for potential closure, or left unmanaged to evolve through natural processes.
Timeframe: Near term (5 years)

Step 4) New York, USACE and partners should establish a regular cycle of review for the Breach Contingency Plan. This would include a) evaluation of current approaches to closure of breaches in the barrier islands along Long Island, b) the environmental, public safety, and property effects of non-action including potential sea-level rise effects on coastal barrier reefs, c) the development of new breach management plans that reflect emerging science or may be specific to particular locations or basins, and d) the means to share information on breach benefits, risks and management plans with neighboring communities.
Timeframe: Near term (5 years)

Lead Agency: USACE, DEC, DOS; Potential Partners: SUNY SB, OPRHP, NPS, USGS, EPA and OGS.

3.4.4 Objective G: Adopt long-term climate adaptation and coastal planning strategies.

3.4.5 Actions 49-50

49. Update current community planning practices to include coastal resiliency strategies that effectively minimize the impacts of extreme weather events and sea-level rise.

As a result of recent severe weather events, including Superstorm Sandy (2012), Hurricane Irene (2011) and Tropical Storm Lee (2011), resource managers and local planners are looking for science-based solutions to make waterfronts and coastal areas more resilient to flooding and storm impacts expected as a result of climate change. Several organizations in New York are working to compile and coordinate environmental data, perform new research relevant to climate change in the coastal areas of New York, and to integrate coastal hazard resilience and climate change planning into existing strategies and decision-making. For example, NYSERDA is completing a research plan to support climate change adaptation, including the coast, based on input from state agencies and organizations. The NYS RISE (Resiliency Institute for Storms and Emergencies) is a consortium of universities and other research organizations focused on building greater resiliency to extreme weather events by translating research into actionable information to inform critical decisions before, during and after such events. These and other statewide efforts should allow managers to identify emerging challenges, set and adopt a course of action, and measure relative progress in achieving management, conservation and planning objectives.

Step 1) Examine current funding sources and programs available to local governments for completing and implementing climate change adaptation and coastal resilience plans. Identify pathways to facilitate and/or improve county and local government climate change adaptation and coastal resilience plans. Identify any obstacles or gaps in existing resources and programs. Prepare and distribute outreach to counties and local governments on available resources. If appropriate, prepare recommendations on how existing programs and support could be improved.
Timeframe: Short term (2 years)

Step 2) In compliance with the CRRA, develop guidance and model laws that local governments can use to select optimal administrative, regulatory and adaption measures to improve resilience to climate risk, sea level rise, storm surge and/or flooding. Appropriate content will include projections of future conditions and integration of that information in decision making, guidance on resiliency measures that utilize natural resources and natural processes to reduce risk, and utilization of state programs and resources to facilitate adaptation.
Timeframe: Short term (2 years)

Step 3) Develop guidance for local governments and state agencies on resiliency measures that utilize natural resources and natural processes to reduce risk, in compliance with the CRRA. Identify environmental co-benefits and services provided by natural protective features, and means to incorporate those values into decision making procedures at the state and local level. Where appropriate incorporate the guidance into updates of policies, regulations, programs, agency practices, planning and implementation actions.

Step 4) Establish a review process to a) facilitate communication between scientists, state coastal managers, county and town planners and local planners and policy makers and b) support regular incorporation of new information into municipal comprehensive plans and associated local land-use regulations, policies and local laws. The New York Climate Change Science Clearinghouse (NYCCSC) is being developed as an open access, web-based system to compile and coordinate scientific data and literature related to climate change science relevant to New York. The NYCCSC can help communicate climate change research and management activities of state agencies, authorities, municipalities, private business and the insurance industry.
Timeframe: Short term (2 years)

Step 5) Provide assistance to municipalities for the evaluation of existing policies, plans and local laws (on a community specific basis) with the intent of identifying potential barriers that inhibit adaptation and resilience to climate change within these communities. For example, NYSERDA has provided funding for regional coordinators to assist with adaptation planning training and to facilitate the use of the *Climate Smart Resiliency Planning Self-assessment Tool for* Climate Smart Communities.
Timeframe: Short term (2 years)

Step 6) Utilize existing state technical assistance, planning expertise and legal authorities to foster regional and local government completion of coastal resilience and climate change adaptation plans. These plans may build from or be completed through resilience strategies specific to – and appropriate for – each section of shoreline, or “reach”. Emphasize partnerships between federal and state agencies and local governments and community involvement to address projected costs for infrastructure maintenance, adaptation, and restoration of natural protective features and/or natural processes. Include environmental quality and services in planning and prioritization of implementation actions.
Timeframe: Short term (2 years)

Step 7) Develop and provide projections for anticipated changes in climate variables (at a regional and watershed or basin level), with adequate detail to support regional and local planning. Use predictive modeling to adopt statewide sea-level rise projections as called for by the CRRA, and guidance for potential storm surge heights, inundation areas and depths and other elements that contribute to future coastal hazards caused by extreme weather events. This baseline planning information should include, at minimum, estimates of future seasonal and flood water levels, estimates of future storm surge inundation zones, changes in precipitation type and intensity and changes in seasonal temperature patterns. The projections should extend through a planning time frame of at least 100 years, with longer term trends reported. As required by CRRA, the sea-level rise projections should be updated no less than every 5 years as the scientific basis for forecasting is improved. Include updated program administration or regulatory mapping every five years as (feasible and appropriate) in response to changes due to sea-level rise and subsequent impacts, especially in relation to CEHA and Tidal Wetlands programs.
Timeframe: Near term (5 years)

Step 8) Convene an expert panel to examine current and alternative coastal hazard mitigation measures and assess performance outcomes under various climate change scenarios. Examine both structural protection and non-structural adaptation and report outcomes. Evaluate socio-cultural benefits, environmental benefits, and economic benefits of the alternative approaches. Use comprehensive cost-benefit analyses to estimate relative implementation costs and direct damage reduction benefits. Examine the equity of assuming the responsibility of paying for damages caused by severe weather and implementing coastal adaptation strategies. Review short comings of traditional cost-benefit techniques with respect to non-market goods and beneficial environmental outcomes and recommend improved methodologies for state and local decision making. Obtain expert assistance on long-term coastal land form evolution, including projections of future conditions with accelerated sea-level rise and climate change, and interpret the relative performance of alternative management strategies under the projected conditions.
Timeframe: Near term (5 years)

Lead Agency: DOS, DEC; Potential Partners: EPA, NYSERDA, NYS RISE, OPRHP, NYSG, Consortium for Climate Risk in the Urban Northeast, NOAA, USGS, EPA, Shinnecock Indian Nation, municipalities, WCS and other NGOs.

50. Encourage coastal municipalities to participate in the Climate Smart Communities Program.

The Climate Smart Communities (CSC) Program is a partnership between municipalities and six state agencies: NYSERDA, DEC, DOS, DOT, DOH, PSC. As part of the CSC Program, each participating community pledges to take action locally to mitigate and adapt to climate change. At least 130 communities have taken the Climate Smart Communities Pledge, and the CSC Program provides the technical support and guidance framework necessary to help them succeed. Communities benefit through cost savings for local taxpayers, reduced energy costs, increased opportunities for green energy job growth, and improving existing and designing new infrastructure to withstand the effects of climate change. The CSC Certification Program, launched in 2014, provides an organizational framework for local action. The CSC Certification Manual lists more than 120 local actions for which CSC can receive points toward certification or a higher award level (bronze, silver or gold). Thirteen priority actions, all of which must be completed to achieve silver, include formation of a local CSC task force, adoption of both municipal and community climate action plans, and completion of the *Climate Smart Resiliency Planning* self-assessment and a separate vulnerability assessment.

Step 1) Encourage all coastal communities to take the Climate Smart Communities Pledge and begin work toward certification.
Timeframe: Short term (2 years)

Step 2) Encourage coastal communities to participate in additional programs developed to promote resilience planning, green infrastructure, and improving water quality.

Lead Agency: DEC, municipalities; Potential Partners: DOS, NYSERDA, DOT, DOH, and PSC.

3.4.6 Objective H: Implement ecologically sustainable inshore and offshore sediment resource management strategies.

3.4.7 Actions 51-52

51. Improve policies for sediment resource management, particularly for dredging and use of clean dredged sand from state waters.

In an effort to keep New York's ports, harbors, and water-dependent business and recreational facilities viable, statewide sediment and dredged material management plans need to be developed, using the USACE Dredged Material Management Plan-Port of New York & New Jersey (DMMP) and the NYNJHEP Regional Sediment Management Plan as guidance. Such a plan would 1) establish ways to coordinate efforts of the diverse agencies with jurisdictions related to dredging, 2) develop improvements in permitting to streamline the process, 3) encourage the public/private partnerships necessary to establish dredged material processing facilities for the beneficial re-use of dredged material, or when re-use is not feasible, establish facilities for upland disposal of dredged material and 4) develop standards and guidelines for the beneficial re-use of such material, including beach and marsh habitat restoration. Coordinate on management of watershed inputs of sediment to assure that both marine ecosystems and economic uses are sustained through careful data collection, analysis and management of sediment. The management plan should also consider the effects of climate change and minimize future damage to highly vulnerable coastal communities. Specifically, the current dredging schedule to replenish beaches and dunes along barrier islands is inadequate given the increased frequency of intense storms New York has experienced in the past few years.

Step 1) Improve state policies, then develop a schedule and management plan for the extraction, dredging, and use of clean dredged sand from state waters (within 3 nm of shore) for beach engineering, wetland restoration, and other erosion and storm protection projects.
Timeframe: Short term (2 years)

Step 2) Create a catalog of existing and potential future sand extraction areas.
Timeframe: Near term (5 years)

Step 3) Synthesize existing information on dredge borrow areas, including sediment type and biological data (from monitoring pre- and post-dredge events if possible), and assess impacts of borrow area use on environmental quality (e.g., water quality, sediment transport) and human use activities (e.g., fishing, diving).
Timeframe: Near term (5 years)

Step 4) Evaluate the use of sand that naturally accumulates around jetties and other hard structures of dredged inlets for potential use as backfill in sand borrow areas (see Action 51 below), to address chronic erosion of beaches and dunes, or as a preventative measure to build up areas on barrier islands prone to breaches.
Timeframe: Near term (5 years)

Step 5) Evaluate the use of clean dredged material as a tool to develop effective natural infrastructure in coastal areas along Long Island. Use the restored marsh islands in Jamaica Bay as a model to promote coastal resilience.
Timeframe: Near term (5 years)

Step 6) Identify possible beneficial re-uses for treated navigation dredged material. Evaluate regional opportunities for management of dredged material.
Timeframe: Near term (5 years)

Lead Agency: DEC, DOS, USACE; Potential Partners: BOEM, NPS, OPRHP, OGS, NYC DCP, NGOs, Shinnecock Indian Nation and municipalities.

52. Identify and assess sand resources within state and federal waters.

Sand resources from the ocean floor are used to help protect and restore important coastal habitat, renourish beaches, and construct public infrastructure. Currently, much of the sand resources used for these types of projects in New York are being extracted from "sand borrow areas" located within state waters. However, not all sand resources will naturally replenish if extracted from a site, leading to resource depletion. If sand resources are depleted or extraction is done incorrectly, it can impair the ecological function of the site[207] and result in negative effects to benthic resources and the larger species that depend on them.[208] The USACE is continuing to characterize and assess existing borrow areas in NY's waters and is conducting associated post-monitoring so as to assess the potential for long-term ecological impacts to these areas. However, the availability of sand resources will become even more essential with the expected rises in sea level and increases in storm strength and frequency associated with climate change. Efforts are now underway to plan for the continued and possibly increasing need for sand, and to better understand the geophysical relationship between sand resources in state waters and federal waters. Developing baseline information on these resources will enable more sustainable use of sand resources within state waters and can lead to identification of potential future borrow areas in federal waters, should the sites in state waters become degraded or depleted.

Step 1) Through the Disaster Relief Appropriations Act of 2013, BOEM and DOS have signed a 2 year Cooperative Agreement to review data from existing geophysical and geological surveys to identify sand resources between 3-8 nm offshore Nassau and Suffolk Counties that could potentially be used for coastal resilience and restoration planning. Researchers will also evaluate the effects of sand dredging on the wave environment**,** with support from SUNY SB School of Marine and Atmospheric Sciences.
Timeframe: Short-term (2 years)

Step 2) Building from the current Cooperative Agreement, assess the physical features of existing and future sand borrow areas in federal waters. Analytical needs that may be addressed through future Cooperative Agreements or other mechanisms include, but are not limited to, geophysical surveys and analysis, sediment composition and grain size, hydrology, and biological and chemical assessments. Integrate any new information to inform the siting of possible new sand borrow areas.
Timeframe: Near term (5 years)

Step 3) Create an inventory of all existing sand borrow areas in state waters and assess the physical features of existing and future sand borrow areas. Analytical needs that may be addressed through future Cooperative Agreements or other mechanisms include, but are not limited to, geophysical surveys, sediment composition and grain size, hydrology, and biological and chemical assessments. Integrate any new information to inform the siting of possible new sand borrow areas.
Timeframe: Near term (5 years)

Step 4) Establish monitoring protocols to evaluate the potential for adverse ecological and geophysical impacts associated with existing sand borrow areas located in state waters. Develop recommendations for managing offshore sand resources in a sustainable manner to minimize adverse ecological impacts. Advocate for the use of these protocols in federal waters and compile all data in a comprehensive, centralized database. Develop recommendations to conduct dredging and management of borrow areas in a sustainable manner to avoid morphological impacts as much as possible.
Timeframe: Near term (5 years)

Lead Agency: BOEM, USACE, DOS, DEC, SUNY SB; Potential Partners: NPS, OGS and OPRHP.

3.5 GOAL 4: Empower the public to actively participate in decision-making and ocean stewardship.

3.5.1 Overview

Active and ongoing stakeholder engagement is essential for effective local, state and federal EBM and offshore planning initiatives. For the purpose of the OAP, we consider our stakeholders to be those who have an interest in, or are affected by, any decisions made regarding how the ocean is used and how its resources are managed. During outreach forums and planning workshops that were held to create this Ocean Action Plan, we learned that stakeholders are interested in ocean stewardship and would like to be involved in management decisions. They understand that when the health of the ocean ecosystem is compromised, the economy, safety and overall well-being of surrounding communities are diminished. To encourage stakeholder participation, however, requires providing outreach and education material through pathways most easily accessible to the public. These opportunities should raise awareness of ocean issues and threats to its ecological integrity, and provide examples of how changes in the ocean ecosystem impact the stakeholders. Outreach and education to key audiences will help increase communication, transparency and build support for the identified action steps outlined in this report.

While many of the actions identified in this plan fall within the purview of state, federal or interstate agencies, there are also opportunities to engage local government, business, recreational visitors, coastal landowners and the public at-large in decision-making. Greater visibility of issues affecting the ocean, the status of the ocean ecosystem, and ways that we can better protect valued ocean natural resources will provide support for ecosystem goals. Readily accessible information about the health of the ocean ecosystem, trends, emerging challenges and progress made, presented in a compelling and relevant way, will be essential in increasing public understanding of the issues, encouraging the public to participate in decision-making processes, and earning public support for needed actions. Uncertainty is always a factor when dealing with a dynamic and complex ocean ecosystem. Establishing recurring mechanisms that clearly communicate the challenges faced, and the scientific advances being made to address them, will also be extremely important for promoting EBM principles.

3.5.2 Objective I: Increase stakeholder participation in decision-making and offshore planning.

3.5.3 Actions 53-55

53. Develop a formal stakeholder engagement process for promoting the ocean action plan's long-term agenda.

The OAP outlines the many threats to the ocean ecosystem (e.g., habitat destruction, water quality issues, biodiversity loss, offshore energy exploration and development, climate change) and its interdependent coastal watershed community (the social system). The OAP strives to highlight pressing research and management needs to effectively address these threats. The need to gather a wealth of scientific information for the ocean may be compelling, but the value of this information will not be realized if research results are not widely known, understood and put to good use. In fact, a broad disconnect sometimes occurs between what scientists know and what policy makers and the general public understands about the ocean. Another broad disconnect exists between what behavioral social scientists know about human perception, knowledge processing, and behavior change process, and what policy makers and resource managers assume will result in changed ocean conservation behaviors by people living in coastal communities. Presenting and exchanging information in clear, non-technical lay terms is vital for stakeholder understanding. A stakeholder engagement process should ensure that all stakeholders (including fishermen, environmental groups, shipping, etc.) have a shared understanding of the science of key ocean issues along with the social science of behavioral change processes needed for meaningful and effective participation in developing, implementing and evaluating the actions identified in this plan.

Step 1) Hire an ocean and marine outreach coordinator to form an interagency group to: 1) identify stakeholders, 2) develop a strategy to promote effective stakeholder involvement, and 3) coordinate communication between agencies and stakeholders. A component of effective stakeholder involvement will include, but not be limited to, the development and implementation of public education programs to support specific objectives and strategic actions outlined in the OAP.
Timeframe: Short term (2 years)

Step 2) Train agency staff and stakeholders in effective outreach, engagement, communication, and participation processes based on the latest behavioral science research and BMPs.
Timeframe: Short term (2 years)

Step 3) Evaluate stakeholder participation and identify barriers to stakeholder engagement (e.g., hard-to-reach constituents) and behavioral science-based solutions.
Timeframe: Short term (2 years)

Step 4) Dedicate web pages on the DEC website regarding the 'Ocean'. Post relevant OAP activities, including scientific publications, other information resulting from the implementation of actions and OAP status updates, as necessary and in compliance with web guidance.
Timeframe: Short term (2 years)

Step 5) The ocean and marine outreach coordinator will facilitate brief two-way updates and printed materials on ongoing projects at formal and informal meetings, such as the Marine Resources Advisory Council MRAC meetings, public engagement meetings, estuary citizen advisory committee meetings and other organized events. Solicit input for the appropriate media to use to communicate with them, and their family and friends.
Timeframe: Near term (5 years)

Step 6) Use social media (FB page or Twitter feed) as a tool for two-way communication (e.g., scientific findings, technological advances, educational opportunities, decision-making, feedback and upcoming opportunities for participation) with OAP stakeholders, use the NY Gateway to communicate information, and submit articles to popular publications, such as sportfishing magazines, for broader constituent engagement.
Timeframe: Near term (5 years)

Lead Agency: DEC, DOS; Potential Partners: NYMSC, NYSG, SUNY SB, WCS, USACE, and other NGOs.

54. Establish an ocean advisory committee.

The multi-sector, multi-jurisdictional governance structure of the ocean off New York can at times be as complex as the many challenges that threaten the health of the ocean ecosystem and sustainable use of natural ocean resources. To ensure that EBM principles based on applied research are integrated into the activities of the state agencies, and to assist the state in effectively implementing the actions outlined in the OAP in an efficient manner, an Ocean Advisory Committee should be created. This committee should work to improve coordination and collaboration between local, regional and federal governance entities, identifying potential conflicts between sectors and stakeholder interests when addressing ocean-related issues. Members of the Ocean Advisory Committee should also be able to assist in the comprehensive review of current laws, regulations and policies to identify potential updates and/or changes at the state, federal and regional levels necessary to support the goals and objectives of the OAP.

Step 1) Appoint individuals (approximately 10) from local, state, regional, and federal agencies, tribes, or other interested stakeholders who are considered experts in the marine sciences, a human use of the ocean or social sciences (human dimensions) to make recommendations to the state regarding implementing (short term, near term and long term) OAP action steps.
Timeframe: Short term (2 years)

Step 2) Convene regular Ocean Advisory Committee meetings with members to establish a guidance framework for the state, to include (but not limited to) assistance with identifying research priorities, assessing tradeoffs among ocean users and resource management options, how to modify and/or integrate existing programs, to prioritize funding needs, and recommendations for responding to unforeseen circumstances not accounted for in current annual work plans of various state agencies or municipalities (e.g., natural disaster response).
Timeframe: Short term (2 years)

Lead Agency: DEC, DOS; Potential Partners: NYMSC, NYSG, SUNY SB, Shinnecock Indian Nation, WCS and other NGOs.

55. Establish a biannual OAP stakeholder workshop.

The NYMSC is an association formed between academic institutions with expertise in marine and/or coastal science, and is a platform that can be used to facilitate increased collaboration, promote and effectively communicate science, and advocate for dedicated funding for the marine sciences within New York. The NYMSC will play an important role in assisting the state with the implementation of the OAP, and a biannual stakeholder workshop as part of their annual meeting agenda will provide an opportunity for OAP stakeholders, including local, state, regional, and federal governments, academic institutions, tribes, NGOs, all user groups, and any other interested parties to 1) go over the results of completed research projects that help promote the management of ocean ecosystems, 2) review the current state of the biological, chemical, physical and social sciences for the New York Bight focal area, 3) get an update on new data from specific action steps that have been implemented and how that information is being used to inform decision-making, 4) learn about new (and more efficient) technology or survey methods and 5) identify ways to adapt current management strategies and solicit stakeholder input regarding potential new management strategies. See **Appendix 6** for the results of the 2012 New York Marine Science Consortium Data and Research Needs for the Ocean Ecosystem survey.

Step 1) To promote effective, transparent management of ocean ecosystem, evaluate the status of the OAP every two years during a stakeholder inclusive workshop convened during the New York Marine Sciences Consortium (NYMSC) annual meeting.
Timeframe: Short term (2 years)

Lead Agency: DEC, DOS; Possible Partners: NYMSC, NYSG, SUNY SB, WCS and other NGOs.

3.5.4 Objective J: Advance outreach and education.

3.5.5 Actions 56-59

56. Develop a statewide campaign to increase ocean literacy.

Ocean literacy and education promotes the understanding of the human-nature relationship: the ocean influence on humans and human influence on the ocean. This involves 1) a basic understanding of essential principles and fundamental concepts of ocean science, 2) a basic understanding of essential social science of behavior change processes, policy making processes, the sustainable ocean economy, and the dynamics of a sustainable social-ecological coastal-ocean system, 3) effectively communicating knowledge of the ocean ecosystem to others, 4) facilitating active ocean knowledge acquisition by learners, 4) applying knowledge to informed and responsible decision-making regarding ocean use and responsible management of ocean resources.[209] However, many New York residents are unaware of their diverse ocean resources, or how everyday human activities on land and at sea can impact the ecological integrity of the ocean ecosystem, and eventually come back to impact the human community. An effort for promoting effective communication of ocean science and social science aimed at increasing the public's awareness of the importance of the ocean on human wellbeing is important for resolving the complex and serious threats facing the ocean (e.g., pollution, habitat loss, ocean acidification and other effects of climate change) and coastal communities.

There is an abundance of ocean literacy resources available, particularly online, that can be used effectively to educate the public on the ocean sciences and social sciences.[210] Our ability to effectively provide clear, sufficient information regarding environmental issues such as coastal hazards and the effects of human activities on marine species, and use the insights from behavioral social sciences to guide policy making and behavior change,[211] is also necessary to promote the importance of sound resource management and the role that individuals and communities can play to keep the ocean healthy and productive into the future. A comprehensive educational campaign that expands ocean literacy, environmental stewardship, coastal sustainability and resilience knowledge and skills, and spatial knowledge among New York residents will increase the public's awareness that New York is indeed an 'ocean state' and should strive to promote EBM focused approaches to natural resource management and community resilience and sustainability. No amount of management will ever fully restore and protect the ocean ecosystem and the future of our ocean resources without the understanding by the general public that a change in our behavior is warranted to reverse ecological declines due to human activities.[212] (*"In the end we will conserve only what we love. We love only what we understand. We will understand only what we are taught." – Baba Dioum)*

Step 1) Compile a list of currently available awareness campaigns that promote ocean literacy.
Time Frame: Short term (2 years)

Step 2) Assess the ocean literacy levels of stakeholders and the general public who would be targeted in the ocean literacy campaign. Audiences may include local government officials, recreational anglers, local coastal businesses, teachers, boaters, traditionally underserved populations and students (grades K-12 as well as enrollees at higher learning institutions).
Timeframe: Near term (5 years)

Step 3) Develop an educational plan (based on the findings of step 1) that outlines a comprehensive, collaborative process for learning about the ocean through schools, museums, aquariums, environmental education centers, parks and other informal venues. The emphasis of the campaign should be to build an understanding of and appreciation for ocean ecosystems (function, processes), environmental stewardship, local and cultural knowledge, the ocean economy, sustainable and resilient coastal communities, the impact of individual and cumulative human behavior on ecosystem health, and best management practices. The plan should promote technology and innovations that address specific ocean-related issues, such as green infrastructure for improving water quality, living shorelines for habitat restoration and erosion control, and best management practices for siting offshore energy development. Create Web-based applications and public events that bring diverse partners and stakeholders together to update progress, share best practices, celebrate exemplar cases, and help individuals understand the crucial connection between a healthy ocean and human wellbeing. This may also include developing and distributing print and web-based multilingual outreach and educational materials to engage diverse cultural audiences.
Timeframe: Near term (5 years)

Step 4) Collaborate with formal K-12 educators willing to engage classrooms in ocean literacy and explore the integration of ocean sciences into the high school standard Science, Technology, Engineering and Mathematics (STEM) curricula (e.g. developing lesson plans that include the ocean sciences as they relate to the Crosscutting Concepts of the Next Generation Science Standards). This may also include the creation of ocean stewardship projects for the classroom. Use the Ocean Literacy Network as guidance and online resources for educators.[213]
Timeframe: Near term (5 years)

Step 5) Encourage academic institutions to promote ocean literacy by engaging in professional development opportunities for K-12 high school science teachers through the use of online resources (PowerPoint presentations, podcasts, webinars), workshops, seminars, certification courses, and other learning experiences that teach the principles of ocean literacy and focus on specific ocean issues.
Timeframe: Near term (5 years)

Step 6) Encourage the development of summer marine science education camps that engage students (typically aged 11-17) in ocean science concepts and principles, including field and laboratory research techniques (biological and chemical oceanography) and other opportunities that promote research, education and outreach.
Timeframe: Near term (5 years)

Step 7) Promote stewardship programs for teachers (grades K-12) designed to inform citizens in coastal communities and help prepare the next generation of professionals involved with our nation's ocean resources, coastal communities and economies.
Timeframe: Long term (10 years)

Step 8) Work with coastal post-secondary institutions (universities, colleges, and community colleges) to provide ocean courses, workshops, and symposia.
Timeframe: Long term (10 years)

Step 9) Work with non-formal community extension education services like Cornell Cooperative Extension, Sea Grant, and Soil and Water Conservation Districts to teach community members about oceans, coasts, sustainability and resilience, with a special emphasis on skills that lead to ocean conservation and sustainable and resilient coastal lifestyles and homes.
Timeframe: Long term (10 years)

Lead Agency: DEC; Potential Partners: DOS, OPRHP, New York State Museum, NOAA, NPS, Local School Districts, RFMRP, NYSG, NYMSC, NYSMEA, WCS and other NGOs.

57. Promote diverse stakeholder participation in ocean outreach and advance awareness of environmental issues in underserved communities.

There have been tremendous education and outreach efforts at the federal, state and local levels in recent years to help raise awareness regarding the many benefits the ocean ecosystem provides to local economies, along with the many management challenges facing ocean resource managers and policy makers. However, there are concerns that social and economic factors may be limiting participation by individuals in minority and/or low income communities. Environmental justice efforts focus on developing, implementing, and enforcing environmental laws, regulations, and policies in communities—specifically minority and low-income communities—and addressing disproportionate adverse environmental impacts that may exist in those communities. This includes identifying the current level of understanding in these communities of how human activities can negatively impact the ocean, as well as implementing local projects, such as the use of green infrastructure to minimize the impacts from severe weather events, that improve environmental quality within these communities. New York is committed to achieving equitable treatment and meaningful involvement of citizens, regardless of race, ethnicity or income, with respect to the development, implementation and enforcement of environmental laws, regulations, policies and programs. Environmental Justice (EJ) Community Impact Grants assist minority and low-income communities facing disproportionate environmental burdens, such as pollution and water quality issues. EJ communities in coastal areas are also highly vulnerable to flooding during extreme weather events. These grants also serve to enhance public safety and community resiliency during severe storms and other climate related events.

Step 1) Promote community awareness and outreach regarding environmental issues and the practical solutions that can be implemented to address these issues in minority and low-income communities located within ‘potential environmental justice areas’ that are currently facing disproportionate adverse environmental impacts.
Timeframe: Short term (2 years)

Step 2) Continue to support state funding for awarding Environmental Justice (EJ) Community Impact Grants and Green Gems Grants (a subset of the EJ Community Impact Grants) for implementing community-based projects that address environmental and/or public health concerns. This support should include funding and other resources needed for hosting public information meetings and Grant Outreach Workshops to continue to provide community organizations, representatives and other interested members of the public with an overview of the grant application process and useful information for potential applicants.
Timeframe: Near term (5 years)

Lead Agency: DEC; Potential Partners: NPS, DOS, Shinnecock Indian Nation, NYSG, DOH, WCS and other NGOs.

58. Create an updated recreational marine fishing guide.

New York’s marine district and offshore waters provide exciting fishing opportunities for recreational saltwater anglers. Currently, New York has an informative freshwater guide for recreational fishing, but has not updated the marine equivalent since the 2009/2010 fishing season. To promote compliance with state, interstate and federal fishing regulations, DEC should continue to provide a marine recreational fishing guide designed to serve the interests of all saltwater fishermen–novices and seasoned professionals–and strive to enhance recreational fishing experiences. It should also encourage recreational anglers to be responsible while out on the water. The guide should be made publically available online (including in the form of a free, downloadable smartphone app), as well as in printed form to be disbursed at tackle shops, marine supply stores, town halls, chambers of commerce, and other locations throughout the state.

Step 1) Compile a New York Recreational Fishing Guide that includes current state, interstate and federal recreational fishing regulations, permit, license and recreational marine fishing registry information (including federal, state and out of state registry requirements), species ID of commonly caught and prohibited species, consumption advisories, local fishing and boating access facilities (including DEC boat ramps), artificial reef locations, safe handling and release protocols for protected marine resources, invasive species awareness, pump-out facility locations, no-discharge zones, and contact information for DEC’s BMR, Environmental Conservation Police and the state’s marine mammal and sea turtle stranding network.
Timeframe: Short term (2 years)

Lead Agency: DEC; Potential Partners: NYSG, DOH, WCS and other NGOs.

59. Install 20 informational kiosks at major public recreational fishing access sites.

The Fish and Wildlife Law (ECL Section 11-0303(1)) requires DEC to efficiently manage fish and wildlife resources of the state, as well as to develop and administer measures for making them accessible to all visitors and residents of the state. Other state statutes authorize the management of public fishing areas (ECL Section 11-0305(9)), implementation of regulations for the use of state-owned boat launching sites and access sites (ECL Section 11-2101), and guaranteed beneficial use of the environment without risk to health and safety (ECL Section 1-0101(3)(b)). While New York is encouraging environmentally sound ocean-based recreation and tourism that would allow anyone to take advantage of the natural beauty and resources of the Marine District, many recreational boaters and fishermen are unaware of the various state and federal regulations that apply to them, or may not be alerted to specific state laws and local mandates that are currently in place to protect natural resources and the marine environment. There are often misunderstandings regarding current regulations for recreational fisheries, as they are constantly being updated and are often not consistent with requirements in bordering states. Additionally, many recreational enthusiasts, residents and visitors, are unaware of time sensitive regulatory actions, such as emergency temporary shellfish closures and seafood consumption advisories, or even the many threats to the ocean ecosystem (e.g., marine debris, aquatic invasive species). To promote enhanced recreational boating opportunities, while also protecting public health and ocean resources, informational kiosks should be provided at state-owned boat launching and access sites. The kiosks should be specifically designed to provide pertinent, updated information to recreational users. Placement of kiosks should be chosen using criteria to identify the most used and geographically diverse launching and access sites, and should aim to eliminate or minimize barriers that lead to access inequality among users.

Step 1) Evaluate the different kiosk types currently being used in wildlife areas, field stations, state parks and other sites to identify cost-effective designs appropriate for outdoor use and ease of updating the material being displayed.
Timeframe: Short term (2 years)

Step 2) Install 20 kiosks at major public recreational fishing access sites that display recreational fishing regulations, laws that promotes boater safety and protects natural resources (habitat, species), and other outreach and educational information that informs a diverse public audience of the threats to the ocean ecosystem, to include (but not limited to) eliminating or minimizing marine debris and the prevention and spread of aquatic invasive species.
Timeframe: Near term (5 years)

Step 3) Develop a partnership with local ocean-based user groups, NGOs and other interested stakeholders to provide maintenance of the kiosks. Provide information in multiple languages. Use similar organization and symbols as the DEC website.
Timeframe: Near term (5 years)

Lead Agency: DEC; Potential Partners: OPRHP, NYSG, Shinnecock Indian Nation, municipalities and NGOs.

3.5.6 Objective K: Support local and regional stewardship programs.

3.5.7 Actions 60-61

60. Implement best management practices to reduce, mitigate or remove marine debris.

Marine debris is natural and manmade materials that find their way into marine waters, either accidentally or intentionally, that can severely damage sensitive habitat, reduce water quality and pose significant health and safety risks to humans and wildlife.[214] Marine debris can either be from land-based or ocean sources, and intense storm activity contributes significantly to the problem. Submerged or floatable debris in navigable channels can cause damage to commercial and recreational vessels and can interfere with fishing activities. Serious injury and mortality can occur to sea birds, whales, seals, sea turtles or other wildlife that ingest marine debris or become entangled in plastic or derelict fishing gear.[215] In fact, UNEP estimates that 100,000 marine mammals and 1 million seabirds are killed by marine debris annually.[216] Beach litter (e.g., cigarette butts) and other debris that wash onto beaches can actually deter tourism and potentially be dangerous to beach goers.[217] Implementation of regulations aimed at reducing or eliminating marine debris requires dedicated resources for monitoring and enforcement efforts to be effective, and removal after natural disasters such as Superstorm Sandy can also be time consuming and expensive. In order to reduce the amount of trash that ends up in our coastal waters, the EPA has begun the New York-New Jersey Trash Free Waters Initiative. The initiative focuses on source reduction in five major categories: plastic bags, microbeads, single-use plastic beverages bottles, food service boxes (made of plastic and polystyrene) and cigarette butts. In addition, an attempt at educating the public who may not be aware of the issues is one cost-effective way of reducing marine debris. The American Littoral Society organizes the New York State Beach Cleanup, which is a 100%

volunteer effort to not only remove marine debris, but also document the types of debris found at certain sites. Using programs like beach cleanups that actively engages the public is important to increase awareness of persistent environmental issues resulting from marine debris, encourage behavioral changes that translate into solutions to reduce, mitigate or eliminate the problem.

Step 1) Develop BMPs for commercial and recreational vessels or facilities (e.g., marinas, ferry terminals, private docks, inshore and offshore construction sites) that focuses on guidelines for proper refuse disposal plans in coastal areas and the ocean.
Timeframe: Short term (2 years)

Step 2) Encourage beach cleanup programs and other initiatives that seek to assess and monitor marine debris to standardize methodologies and adhere to guidelines consistent with NOAAs Marine Debris Program (MDP). This will facilitate development of effective policies to mitigate, minimize or prevent marine debris.
Timeframe: Short term (2 years)

Step 3) Support the EPA's Trash Free Waters Initiative to identify strategies for preventing marine debris and reducing coastal pollution, particularly via combined sewer overflow discharge and storm water runoff. This should include promoting the development of innovative upland source control solutions.
Timeframe: Short term (2 years)

Step 4) Encourage municipalities, state agencies, and NGOs to seeking funding necessary to continue to promote initiatives to remove and recycle derelict fishing gear (e.g., installing disposal bins in convenient locations, establishing buy-back programs to promote retrieval) from estuaries, inshore and offshore areas.
Timeframe: Short term (2 years)

Step 5) Encourage municipalities, state agencies, and NGOs to develop and distribute multilingual outreach materials (including public service announcements, informational brochures, educational tools, and promotional items) to the public on the harmful impacts of marine debris from land-based and ocean sources to the marine ecosystem and guidance on how to minimize or eliminate the problem.
Timeframe: Near term (5 years)

Step 6) Implement best management practices for marinas, as part of the EPA's Clean Marina Program, at two New York marinas per year. In addition to addressing issues with marine debris, this will highlight various practices that can greatly improve the environmental performance of marinas in reducing the amount of toxic pollutants that enter New York's waterways. For more information regarding Marina Environmental Best Management Practices, also visit the New York Sea Grant's Web Site: http://www.seagrant.sunysb.edu/marinabmp/. Include recommendations for non-toxic fouling solutions for vessels.
Timeframe: Near term (5 years)

Lead Agency: NGOs, DEC; Potential Partners**:** NOAA (MDP), OPRHP, NYSG, NYMSC, DOS, EPA, CCE, American Littoral Society, Shinnecock Indian Nation and municipalities.

61. Promote responsible wildlife viewing activities for marine mammals within the New York Bight.

Commercial seal and whale watching tours are not currently considered a large part of the state's economy, but the number of marine mammals that can be found in close proximity to shore has prompted growing interest that could lead to the expansion of the industry within New York waters. While socioeconomic data are not available for evaluating the importance of seasonal seal and whale watching tours (guided walks and cruises) to local communities in New York, the Stellwagen Bank National Marine Sanctuary off Massachusetts estimated that whale watching associated with the marine park was worth $440 million annually.[218] Seal watching, a nascent economic contributor in New York, supports five organizations near Montauk, where grey and harbor seals haul out from

December through mid-April.[219] Commercial marine mammal watching activities can be a positive way to encourage responsible stewardship of marine animals in their natural environment. However, irresponsible human behavior and operating practices can have an adverse impact on marine mammal behavior that can potentially result in uncertain long-term consequences on entire populations.[220] Also, increased vessel activity in areas where certain marine mammals are known to occur can cause a disturbance or displacement from noise or potentially lead to serious injury or mortality due to vessel strike.

Step 1) Work with NOAA and other stakeholder groups to promote regional responsible viewing guidelines, operational procedures and regulations already developed that minimize the negative impacts of these activities on marine mammals (e.g. behavioral changes, vessel strikes) and facilitate adherence to federal regulations. For a list of federal marine mammal viewing guidelines, please visit NOAA's Responsible Marine Wildlife Viewing website (http://www.nmfs.noaa.gov/pr/education/viewing.htm).
Timeframe: Short term (2 years)

Step 2) Continue to develop new local, regional and national guidelines for responsible marine wildlife viewing to effectively promote ocean stewardship using a process that includes scientists, resource managers and business representatives.
Timeframe: Near term (5 years)

Step 3) Encourage businesses that promote viewing and interacting with wild marine mammals to participate in voluntary initiatives that endorse responsible viewing practices while supporting educational experiences, such as NOAAs Whale SENSE Program.
Timeframe: Near term (5 years)

Lead Agency: NYSG, DEC; Potential Partners: NGOs, DOS, NOAA, OPRHP, OGS, ESD, Shinnecock Indian Nation, municipalities, WCS and other NGOs.

4.0 Implementation

The OAP will help guide the sustainable management of ocean resources and the benefits they provide in the long term as well as the diverse range of human activities and planning for future use. All the action steps listed in this Plan have been scrutinized for what can feasibly be accomplished in the short term (over the next 2 years), the near term (over the next five years) and the long term (over the next 10 years) considering management jurisdictions, research needs to address data gaps, budget constraints and available staffing. Each action step recommends which agency or partner is responsible for taking the lead to implement that action, along with a list of potential collaborators and a general timeframe for completion. This is important so that it is clear who is responsible for each action step and time sensitive actions can be implemented before others. An annual state ocean work plan will be developed to ensure timely, coordinated and leveraged implementation of the actions.

A common theme throughout the OAP is the impetus for an engaged, collaborative governance structure between local, state and federal agencies, regional and tribal partnerships, researchers and academia institutions, and ocean-based user groups and other important stakeholders to improve policy and management decisions. Continued active stakeholder engagement will be needed to continually update and refine this action plan, and that process may identify additional priority actions that should be included. Implementation of the actions within this plan address a broad range of ecological and socio-economic issues and will require strong collaborative efforts at all levels of government, including focused workgroups, to establish timelines, work plans, budgets and funding needs. This multi-disciplinary management approach can also aid in identifying legislative and policy issues that may hinder realizing actions as outlined in this document. While prioritization of many actions was necessary based on research needs to achieve a shared vision, priorities may change. The ocean is dynamic and the State may have to focus its future priorities on the progress achieved and natural disaster emergencies or other unexpected circumstances (e.g., HABs, fishery closures, etc.).

4.1 The Need for Adaptive Management

EBM is premised using adaptive management, which is a process for managing the ocean using the best scientific information available, while being flexible enough to adjust management decisions as we improve our understanding of how the ocean ecosystem works and our knowledge of how human activities continue to adversely impact the ecological integrity of the ocean ecosystem and the goods and services it provides. Establishing comprehensive monitoring programs are urgently needed, if we are to address the many ecological or economic issues highlighted in this plan, and to detect, predict and adapt to long-term ecosystem changes. The data collected from such programs will improve the information used in modeling efforts to predict future changes in biodiversity, as well as provide a means for managers to evaluate the effectiveness of policy measures.[221]

With the need for obtaining high quality data, especially in the context of limited funding, we must be more efficient in the way we make decisions and manage our natural resources. It is vital that we are able to distinguish variations in ecosystem conditions from fundamental changes in trends due to the cumulative impacts of environmental stresses (e.g., human use, climate change). Currently, we lack a set of consistent measures or guidelines for doing so. Fundamentally, there is a deficiency in the physical and biological baseline information being collected for the ocean, in comparison to the depth of information collected for estuarine and terrestrial ecosystems.

Technology now exists for continuous monitoring of a variety of aquatic factors that can track the shifting baseline of ocean ecosystem health. We are in the beginning stages of the planning process for incorporating this technology into routine assessments of ecosystem status and establishing ecological and socio-economical benchmarks for current oceanic conditions to be used for tracking the effectiveness of new practices and future change. A workshop is planned for June 2016 to discuss the design of a long-term, integrated, baseline monitoring and ocean indicators program (Action 33) compatible with regional and federal efforts, including periodic trend analysis.

4.2 Funding to Support the Actions

New York State's Environmental Protection Fund (EPF) can help support some of the actions and strategies outlined in this plan. However, the ambitious goals, objectives and actions highlighted in the OAP will require the commitment of more extensive resources at the federal, state and local municipal levels. A significant portion of the New York Bight and ocean resources extends beyond New York's three mile territorial jurisdiction. Successful implementation of the OAP will rely on strong leadership and firm commitments by a combination of existing state and federal funding programs, as well as the capacity of non-profit organizations, academic institutions, municipalities, and other stakeholders.

5.0 Appendices 1-7

5.1 Appendix 1: "Scientific Consensus Statement on Marine Ecosystem-Based Management" (2005)

"Ecosystem-based management means an integrated approach to management that considers the entire ecosystem, including humans, to achieve improved environmental conditions and sustained ecosystem services that support human needs and social goals. Ecosystem-based management differs from current approaches that usually focus on a single species, sector, activity or concern; it considers the cumulative impacts of different sectors, including human, social and economic activities."

Ecosystem-Based Management Guiding Principles:

- Place-based focus
- Protection of ecosystem structure, function and key processes
- Interconnectedness within and among systems
- Integration of ecological, social, economic and institutional perspectives

- Sustainable human use of the ecosystem
- Stakeholder involvement
- Collaboration
- Scientific foundation for decision-making
- Adaptive management

5.2 Appendix 2: Management Authority

New York State Department of Environmental Conservation (DEC)

Through the Division of Marine Resources (DMR), DEC is responsible for the management of living marine resources and their habitats within the Marine and Coastal District of New York State located within 3 nm of shore. Because many commercially important marine species undergo seasonal migrations and can occur in the waters of several states and/or in waters further offshore than 3 nm, data collection and management responsibilities are shared between the states and the federal government. Representatives from DEC participate in the Atlantic States Marine Fisheries Commission (ASMFC) and the Mid-Atlantic Fishery Management Council (MAFMC) to establish fishery management plans (FMPs) and achieve interstate and federal cooperative management objectives.

DEC manages important marine habitats by administering the state's Tidal Wetland Act and the federal Clean Water Act Section 401 Water Quality Certification permit programs, which both typically involves building construction and dredging and filling activities. DEC also participates in the National Estuary Program through cooperative efforts to assess adverse environmental impacts and to develop and implement management plans to restore and enhance estuarine water quality and ecosystem health.

New York State Department of State (DOS)

DOS is responsible for administering the Coastal Management Program (CMP), which is broadly responsible for encouraging development in the coastal area while protecting natural coastal resources and maintaining ecosystem health. The Waterfront Revitalization of Coastal Areas and Inland Waterways Act (Executive Law, Article 4*2)* is the basis for coordinating all state and local government actions affecting the coastal area. Through the federal consistency authority provided to the DOS, as the designated state agency pursuant to the federal Coastal Zone Management Act (CZMA) of 1972, as amended, 16 U.S.C. § 1451 et seq., DOS can review any direct federal agency action, federal agency approvals for private actions, or the issuance of federal agency financial assistance that occurs within or outside of the state coastal area that affects New York's coastal resources— including those actions occur outside the 3 nm jurisdictional state ocean boundary.

Office of General Services (OGS)

The OGS Bureau of Land Management's Submerged Lands and Natural Resources Unit is responsible for administering the Submerged Lands Act of 1953 (NY Public Lands Law, Article 6), which grants the state authority over natural resources within its marine and coastal district jurisdiction (out to 3 nm in the Atlantic Ocean and Long Island Sound), including oil, gas, minerals, artificial reefs and marine animal and plant species. OGS Real Estate Development Program works cooperatively with DEC, DOS and other state agencies to review and approve leases, easements, and permits for the construction of underwater structures in state-owned lands, such as docks, but can also include other issues related to dredge disposal and borrow pit areas, power cables, gas lines, wind and tidal turbines, and emerging submerged infrastructure.

Local Governments

Through the "Home Rule" Article of the state Constitution, local governments may have jurisdiction and/or regulatory authority over activities occurring within coastal areas and state waters that could potentially threaten ecosystem health. Interagency coordination and information sharing will be crucial for implementation of several actions outlined in this document, particularly those actions pertinent to dredging and dredged material placement, planning and land-use regulation, stormwater management, water quality monitoring, commercial and recreational fishery harvesting methods and the development or modification of recreation sites and structures.

Tribal Governments

The Shinnecock Indian Nation (the Nation) is the only federally recognized tribe within the geographic scope of the OAP. Recently granted federal status in 2010, the Nation is currently developing unilateral natural resource protection goals and recognizes that it is critical to coordinate with state, regional and local OAP partners to protect, maintain and conserve natural resources and cultural ideals, while promoting environmentally sound economic development and exploring the expansion of renewable offshore energy opportunities. Located on the east end of Long Island, the Nation's land base is somewhat limited. Environmental impacts, particularly to water quality due to improper land use or increase erosion from increased storm activity resulting from climate change, will greatly affect the Nation. Engaging the tribal leaders of the Nation's Board of Trustees and Tribal Council Members helps provide a wealth of information on the existing cultural uses of the marine ecosystem, identification of culturally sensitive sites located within the scope of the OAP, and dissemination of historical knowledge important for preserving traditional methods for protecting natural resources.

5.3 Appendix 3: Local, Regional and National Management Coordination

Collaboration is a basic tenant of EBM, and therefore essential for successfully implementing the action steps outlined in the OAP. This plan is meant to work with existing marine management programs in New York, as well as regional and national initiatives. Numerous organizations will also be invited to the annual workshop to give feedback on the OAP work plan and to coordinate on achieving shared goals and more effectively implement identified actions. Given the many interconnections between the estuarine and ocean environments, collaboration among these programs is paramount.

Local management programs include the: Hudson River Estuary Program, Hudson River National Estuarine Research Reserve, Long Island Sound Coastal Management Program, Long Island Sound Study, Long Island South Shore Estuary Reserve, New York-New Jersey Harbor and Estuary Program, New York Coastal Management Program, Jamaica Bay Wildlife Refuge, Fire Island National Seashore, Peconic Estuary Program,

Regional management programs include: Mid-Atlantic Fishery Management Council, Mid-Atlantic Regional Council on the Ocean (MARCO), and National Ocean Council Mid-Atlantic Regional Planning Body.

Collaborative Management Programs

New York's local programs- Long Island Sound Study, Long Island Sound Coastal Management Program, Peconic Estuary Program, Long Island South Shore Estuary Reserve, Hudson River National Estuary Research Reserve, Hudson River Estuary Program, NY/NJ Harbor Estuary Program, Jamaica Bay Wildlife Refuge-Gateway National Recreation Area and Fire Island National Seashore - are managed through comprehensive management plans developed for each program by various collaborative partnerships consisting of federal, state, and local agencies, universities, scientific institutions, non-governmental organizations, local businesses, and community groups including landowners and dedicated volunteers. Program initiatives include: natural resource conservation and restoration projects, research development, outreach and community planning assistance.

Long Island Sound Study (LISS)

The Long Island Sound (LIS or Sound) is a 3,419 square km (844,853 acres) estuary bounded by Connecticut to the north, Long Island to the south, and New York City to the west. It has two narrow connections to the ocean, and distinctive two-layered estuarine circulation. The Sound provides critical habitat for marine plant, bird, and fish species—including fish species that utilize both estuary and the ocean waters such as alewives, American eel, striped bass, blue fish, menhaden, and winter flounder. LIS also serves as stop-over grounds for many migratory birds in the Atlantic flyway. Least terns, a federally endangered species, and piping plovers, a federally threatened species, use LIS as breeding grounds in the late spring/early summer.

LIS coastal areas offer important horseshoe crab breeding grounds. Horseshoe crabs are commercially important, although their numbers have declined in recent years. Harbor and gray seals and sea turtles, including the endangered Kemp's Ridley sea turtle, are known to migrate into these waters. In the summers of 2009 and 2011, two pods of dolphins passed through harbors on the north shore of Long Island, most likely following prey species.

The Long Island Sound Study (LISS), sponsored by the US Environmental Protection Agency (EPA) and the states of Connecticut and New York, is a partnership of federal, state, and local agencies, universities, national and local environmental groups, businesses, and community groups whose mission is to restore and protect this great resource. The LISS is staffed by EPA Region 1 in Stamford Connecticut, NYSG at SUNY and New York DEC's Bureau of Marine Resources.

The LISS has many goals that affect ocean resources: Protect and improve the water quality of Long Island Sound and its coves and embayments to ensure that a healthy and diverse living resource community is maintained; Ensure that social and economic benefits associated with the use of the Sound are realized to the fullest extent possible, consistent with social and economic costs; Preserve and enhance the physical, chemical, and biological integrity of the Sound and the interdependence of its ecosystems and; Establish a water quality policy that supports both the health and habitats of the living resources of the Sound and the active and passive recreational and commercial activities of people.

Long Island Sound Coastal Management Program (LISCMP)

The Long Island Sound Coastal Management Program's (LISCMP) geographic reach includes the LIS embayments and watersheds of Westchester, Nassau, and Suffolk Counties, plus the shoreline from New York City to the Throgs Neck Bridge. The LISCMP is the state's first regional Coastal Management Program (CMP) with specific coastal policies that are tailored to regional attributes and needs. In 1999, the LISCMP was approved by NOAA's Office of Ocean and Coastal Resource Management (OCRM) and incorporated into the state's federally approved CMP. The LISCMP serves as the state CMP for the region. It draws its authority from the Federal CZMA and Article 42 of the NYS Executive Law and is a federally approved component of the CMP. The program sets forth regionally refined 13 coastal policies that address specific regional issues for LIS and its communities. DOS uses the 13 LISCMP coastal policies in its federal consistency decision-making. State agency actions are also to be reviewed for state agency consistency review using the 13 regionalized coastal policies pursuant to Article 42 of the Executive Law and State Environmental Quality Review Act (SEQRA). The LISCMP focuses on appropriate economic development, natural resource protection and promoting access and use of the Sounds recreational resources. It complements the LISS CCMP, which focuses on water quality in the deep waters of the Sound, by addressing the upland watershed and harbor and inshore waters.

Many of the LISCMP policies address ocean resources which move into and out of the Sound, including: Protect and improve water quality and supply in the LIS coastal area; Protect and restore the quality and function of the Sound ecosystem; Minimize environmental degradation in the Sound coastal area from solid waste and hazardous substances and wastes; Promote sustainable use of living marine resources in the Sound; and, Promote appropriate use and development of energy and mineral resources.

Peconic Estuary Program (PEP)

The Peconic Estuary Program (PEP), one of 28 National Estuary Programs in the country, is bounded by the North and South forks of Long Island and is designated by the EPA as an estuary of national significance. The watershed begins at Brookhaven National Lab with the headwaters of the Peconic River, spans the several bays from Flanders to Gardiners, and ends in Block Island Sound between Plum Island and Montauk Point, where it connects with ocean waters. The program's Management Committee consists of representatives from Suffolk County, EPA Region 2, DEC's Bureau of Marine Resources, the Local Government Committee, Citizens Advisory Committee, and Technical Advisory Committee.

The Peconic Estuary is an important spawning and nursery area for many species of ocean fish, including weakfish, scup, northern puffer and others, and supports an economically important commercial shellfish industry. However, as increasing levels of nutrients have entered the estuary from sources including runoff, groundwater inflow, atmospheric deposition, and sewage treatment plants, excess algae production can occur. The increased production of algae results not only in low dissolved oxygen conditions, but also discolors the water, decreases water clarity and diminishes the amount of light received by beneficial rooted aquatic plants, such as eelgrass.

Many of the Peconic Estuary Program's goals affect ocean resources: Establish a comprehensive water quality policy, which ensures the integrity of marine resources, habitat, and terrestrial ecosystems while supporting human activities in the Peconic Estuary study area; Achieve zero discharge (from point and nonpoint sources) of toxic pollutants, and particularly of bioaccumulative chemicals and; Promote an understanding and, thus, appreciation of the value of the Peconic Estuary as an ecosystem and as a mainstay to the East End economy so that it is preserved and restored as one of the last great places in the Western Hemisphere.

Long Island South Shore Estuary Reserve (LISSER)

The Long Island South Shore Estuary Reserve (LISSER) encompasses one of New York State's unique estuaries and its 326 square mile watershed in Nassau and Suffolk counties. The LISSER stretches from the western boundary of the Town of Hempstead to the middle of the Town of Southampton. South to North, the Reserve extends from the mean high tide line on the ocean side of the barrier islands to the inland limits of the mainland watersheds that drain into Hempstead, South Oyster, Great South, Moriches, and Shinnecock Bays. The bays act as spawning and nursery areas for fish and provide important recreational and commercial opportunities for boating, fishing, and shellfish harvesting.

The New York Legislature created the South Shore Estuary Reserve Council, which is comprised of representatives from South Shore towns and villages, Nassau and Suffolk counties and the City of Long Beach, recreation, business, academic, environmental and citizen's interests. The Long Island South Shore Estuary Reserve Comprehensive Management Plan was implemented on April 12, 2001. The LISSER is managed by DOS, with technical support occasionally provided by DEC.

Many of the actions taken by the LISSER also support stewardship of ocean resources: Reduced nonpoint source pollution; Reduced point source pollution; Coastal habitats protected and restored to support shellfish, finfish and coastal birds; Open space preserved to sustain community character and protect water quality and habitat; Improved knowledge for ecosystem management; Heightened public awareness of the estuary.

Hudson River National Estuarine Research Reserve (HRNERR)

The Hudson River Estuarine Research Reserve (HRNERR) extends from the Federal Dam in Troy south to the Verrazano Narrows outside New York City. The Hudson River Reserve encompasses about 5,000 acres of freshwater and brackish tidal wetlands and uplands distributed at four sites that span the middle 100 miles of the Hudson River Estuary. From north to south the sites are: Stockport Flats (Columbia County), Tivoli Bays (Dutchess County), Iona Island and Piermont Marsh (Rockland County).

The National Estuarine Research Reserve System (NERRS) was created by the CZMA16 U.S.C. § 1461, to augment the Federal Coastal Zone Management (CZM) Program. The HRNERR is staffed by DEC, in close collaboration with the NYS Office of Parks, Recreation, and Historic Preservation, DOS, NYS Office of General Services, and the Palisades Interstate Park Commission.

Many of the goals of the HRNERR affect ocean resources: Increase scientific understanding of HR Estuary habitats; Increase estuarine literacy to promote active stewardship and environmentally sustainable behaviors and decisions; Increase informed decision-making to protect and enhance Hudson River habitats and; Enhance stewardship of the land and water ecosystems within the Reserve.

Hudson River Estuary Program (HREP)

The Hudson River Estuary Program (HREP) manages the area from the Troy dam south to the Verrazano Narrows and the surrounding watershed. This geographic area includes the 153-mile-long, tidal, main stem of the Hudson River, as well as upper New York harbor, the Hudson's tributaries and the upland areas of the Hudson Valley, encompassing 5,200 square miles (3.3 M acres) of the river's overall 13,400-square-mile (8.6 M acres) watershed.

In 1987, the New York Legislature passed the Hudson River Estuary Management Act (Section 11-0306 of the Environmental Conservation Law). This law directs DEC to develop a management program for the Hudson River Estuarine District and its associated shores. The program is staffed by DEC.

Key elements of the ocean ecosystem depend on the health and vitality of the adjoining Hudson River and Hudson Estuary ecosystem. Nearly half of the Hudson is an estuary, where tides progress over 150 miles from New York City past Albany to Troy, providing a unique and vast spawning habitat for ocean fishes. Within the estuary, salinity fluctuates with the flows of water from the upland watersheds. The salinity regime of the estuary may be a factor in the reproduction of ocean fishes. Saltwater is rarely detected north of Newburgh Bay, and the remainder of the estuary is freshwater tidal. The freshwater estuary and the tributaries which flow to it provide spawning and nursery habitat for ocean fish, including striped bass, American shad, river herring, and Atlantic sturgeon. It is also a nursery for American eel, which migrate into the river and its tributaries as young elvers and grow to maturity in the estuary ecosystem before returning to the Sargasso Sea to reproduce.

The Hudson contains nearly its full complement of historic fish species, making it unusual along the East Coast. The estuary supports a robust striped bass recreational fishery and at one time supported significant commercial fisheries for shad, striped bass, sturgeon and herring. The state's Estuary Management plan calls for restoration of these species to levels where commercial and sport fishing can be sustained. Managing these restoration programs in concert with ocean fishery management is crucial.

The HREP also calls for restoration and enhancement of shallow water habitats that could increase the available habitat area for spawning and nursery functions for ocean fishes. Habitat loss on the Hudson River is extensive due to past dredging and filling practices for navigation and for railroad construction. As previously described for Long Island's lagoonal bays, bulkheading of sections of the Hudson River shoreline has also degraded habitats in this portion of New York's coastal ecosystem. Restoration of estuarine habitats could provide significant long-term benefits for the ocean ecosystem.

Coastal development, invasive species, nitrogen pollution, and legacy contaminants are some of the major threats that affect the ocean. For example, the Hudson River and its major tributary, the Mohawk, serve as an integral passageway for shipping and transportation between the Atlantic Ocean and the Great Lakes. This provides a major pathway for movement of invasive and exotic species between both ecosystems. PCBs and other legacy contaminants discharged into the Hudson River move through the food chain into the flesh of migratory fish, such as striped bass, affecting fish caught by ocean fishers. Large quantities of nitrogen entering the estuary from the urban areas around Upper and Lower New York Bay flow into New York Bight, where they accumulate. Similarly, sediment from the Hudson and its tributaries flows down into the Bight during hurricanes and storms.

New York–New Jersey Harbor and Estuary Program (NY/NJ HEP)

The New York-New Jersey Harbor and Estuary Program's (NY/NJ HEP) core area of focus includes the entire Hudson River estuary up to the Troy dam as well as the entire Raritan River watershed out to an imaginary line connecting Sandy Hook, New Jersey, and Rockaway Point, New York, at the mouth of the Harbor. In New York, the area includes the East and Harlem Rivers and Jamaica Bay, and in New Jersey it includes the Hackensack, Passaic, Raritan, Shrewsbury, Navesink, and Rahway Rivers, and Newark and Sandy Hook Bays. The Program was designated an Estuary of National Significance in 1988 by the EPA under the Clean Water Act and is administrated by EPA Region 2.

Many of the program's goals affect ocean resources: All of the Harbor waters will meet the Fishable/Swimmable goal of the Clean Water Act, where attainable; Eliminate toxicity or bioaccumulation impacts on living resources by reducing contaminant inputs and cleaning up contaminated sites, and manage risk to humans from seafood consumption; Eliminate the adverse impacts of hypoxia and nutrient enrichment that result from human activities; All of the Harbor will be essentially free from floatable debris; Preserve, manage, and enhance the Estuary's vital habitat, ecological function, and biodiversity so that the Harbor is a system of diverse natural communities; Reduce sediment hot spots and point and non-point sources of contaminants entering the Harbor, such that levels of toxics in newly deposited sediments do not inhibit a healthy thriving ecosystem and can be dredged and beneficially reused; Promote an informed and educated constituency involved in decisions affecting the ecological health of the Harbor and its living resources.

There have been a couple of organizational changes that have taken place over the last few years. In 2011, NY/NJ HEP reaffirmed the program's watershed basis by re-iterating that its geographic scope includes the tidally influenced portions of the rivers that empty into the harbor, including the Raritan and Hudson Estuary systems. NY/NJ HEP noted at the time it would continue to focus on a "core area" in and around NY-NJ Harbor. At the same time, it endorsed the Hudson River Estuary Program Action Agenda as the appropriate path for the restoration and protection of water quality in the Hudson Estuary. This action reaffirms both the larger whole-watershed scope of the program—for action planning purposes—as well as recognizing the value of the "core area" concept, particularly as it pertains to National Estuary Program (NEP) funding. Presently, the Hudson River Foundation (HRF) has taken over the coordinating role for NY/NJ HEP from USEPA.

Science and Resilience Institute at Jamaica Bay

The Science and Resilience Institute, or the *Institute,* is a cooperative effort initiated by the City of New York and the National Park Service. The *Institute* is a consortium of top-tier research institutions, led by the City University of New York (CUNY), with the broad mission of understanding resiliency within coastal urban ecosystems. The *Institute*, with representation from federal, state and city agencies, provides an ideal forum to facilitate the translation of research findings to implementation of management and policy actions. National Park Service post-Hurricane Sandy funds are providing an excellent boost to the recently created Institute, supporting research projects to guide habitat restoration, adaptation and resilience efforts throughout Gateway National Recreation Area's Jamaica Bay and with relevance to other urban coastal systems. The research projects are varied, focusing on habitat response and resiliency to sea-level rise and storms. Advanced numerical models will evaluate how coastal adaptation and restoration efforts will influence coastal flooding. Long-term monitoring is being implemented to better evaluate responses to future storms and climate change. A social science project is soliciting information from local communities, agencies, scientists and managers on visions of resilience.

Interstate and Regional Management Agreements

Atlantic States Marine Fisheries Commission (ASMFC)

The 15 Atlantic coast states of Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida formed The Atlantic States Marine Fisheries Commission (ASMFC) in 1942. Each state is represented by three Commissioners: the director for the state's marine fisheries management agency, a state legislator, and an individual appointed by the governor.

The Commission focuses on responsible stewardship of marine fisheries resources, serving as a forum for the states to collectively address regional fisheries issues. Many of ASMFC's goals affect ocean resources: Rebuild and restore depleted Atlantic coastal fisheries, and maintain and fairly allocate recovered fisheries through cooperative regulatory planning; Strengthen cooperative research, data collection capabilities, and the scientific basis for stock assessments and fisheries management actions; Protect, restore, and enhance fish habitat and ecosystem health through partnerships, policy development, and education.

Mid-Atlantic Fishery Management Council (MAFMC)

The Mid-Atlantic Fishery Management Council (MAFMC) is one of eight councils formed under the authority of the Magnuson-Stevens Fishery Conservation and Management Act of 1976 to manage federal fisheries located from 3-200 nm offshore. The MAFMC consists of representatives from New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina. The voting members are the Regional Administrator of the National Marine Fisheries Service (NMFS), a state fisheries official from each state, and thirteen public members nominated by the state governors and selected by the Secretary of Commerce. A permanent staff, a Scientific and Statistical Committee, and an Advisory Panel support and advise the Council.

Interstate Environmental Commission (IEC)

The Interstate Environmental Commission (IEC) is an interstate air and water pollution control agency serving the states of New York, New Jersey, and Connecticut. The IEC was established in 1936 under a Compact between New York and New Jersey, with the consent of Congress. The state of Connecticut ratified in 1941. The IECs overall responsibility is to protect the environment and assure compliance with and enforcement of its water quality regulations. The IECs vision is an ecosystem plentiful of diversified inhabitants, waters that are litter free, easily reached and capable of supporting a wide spectrum of commercial and recreational activities, and a balance between the needs of the ecosystem and the demands of citizens which may, at times, be in conflict.

New England Interstate Water Pollution Control Commission (NEIWPCC)

The New England Interstate Water Pollution Control Commission (NEIWPCC) is an interstate organization established by Congress in 1947 to serve and assist environmental agencies in New England states (ME, VT, NH, MA, RI, CT) and New York with water and wastewater issues. NEIWPCC strives to coordinate activities and forums that encourage cooperation among the states, educate the public about key water quality issues, support collaborative research projects, represent the region in matters of federal policy, train environmental professionals, and provide overall leadership in the management and protection of. For more information, visit the NEIWPCC website: http://www.neiwpcc.org/aboutus.asp.

Mid-Atlantic Regional Council on the Ocean (MARCO)

In 2009, the Governors of five Mid-Atlantic States (New York, New Jersey, Delaware, Maryland, and Virginia) signed an historic agreement to coordinate and work together on shared regional ocean priorities, creating MARCO. The five states created MARCO to address four initial priorities: habitat protection, water quality, sustainable renewable energy development, and climate change. DOS leads New York's participation in the MARCO. In June 2012, MARCO launched its regional ocean planning initiative through the release of the MARCO Data Portal. MARCO partner states are currently developing human use maps in their offshore waters building on New York's methods to engage ocean interests and locate and characterize offshore uses.

Mid-Atlantic Regional Planning Body (MidA RPB)

The Mid-Atlantic RPB, established in 2013 by the National Ocean Council (NOC) in response to President Obama's 2010 Executive Order 13547 on Ocean Protection and Stewardship, brings together federal agencies, federally recognized tribes, the six mid-Atlantic States, and the Mid Atlantic Fishery Management Council to take action to implement the national ocean policy. The national ocean policy is centered on ocean protection and wise use of the ocean. The Mid-Atlantic RPB will consider MARCO priorities of appropriately siting offshore wind energy development and protecting important offshore habitats. This work will inform and serve as models for the Mid-Atlantic region, and New York will benefit from the resources that will be dedicated to this ongoing federal initiative to generate important and much needed data. In particular, New York's offshore planning approach can serve as a model for organizing and implementing a regional ocean plan. Transferable planning components include federal partnerships that emphasize sharing existing information, issue-specific work groups focused on priorities such as habitat protection and energy siting, data collection and analysis protocols, and methods of engaging stakeholders such as the participatory geographic information system approach. Additionally, the OAP can serve as New York's position to the RPB on other ocean resource management issues and research needs.

National Management Programs

The Bureau of Ocean Energy Management (BOEM) is the agency of the Department of the Interior responsible for coordinating the exploration and development of offshore energy on the Outer Continental Shelf (OCS). BOEM works with its federal, state, local, and tribal government partners through the Intergovernmental Renewable Energy Task Force to achieve a balance between economic development, energy independence and environmental protection. Their Office of Environmental Programs prepares environmental impact statements (EIS), consistent with the National Environmental Policy Act (NEPA), for each of the planning stages of energy development.

BOEM is also responsible for managing the extraction of "non-energy minerals" (primarily sand and gravel) from the OCS. While this largely entails exploration for and development of oil and gas resources, New York is currently exploring the option to use sand resources offshore for future beach renourishment projects. The state will work with BOEM to ensure that the removal of any mineral resources is done in a safe and environmentally responsible manner, and that any potential adverse impacts to the marine or coastal environment are avoided or minimized.

BOEM's scientists work with federal and state agencies, academia, ocean-based industries, NGO's and other stakeholders to identify and prioritize research needs, conduct and oversee environmental studies and to inform policy decisions relating to the management of energy and marine mineral resources on the OCS using the best science available.

National Park Service (NPS)

The NPS manages and protects the natural and cultural resources of several units within the coastal region of New York, including Fire Island National Seashore, Gateway National Recreation Area, Sagamore Hill National Historic Site, and National Parks of NY Harbor (Statue of Liberty National Monument and Ellis Island, Governors Island National Monument, and others). The NPS is responsible for managing these units in accordance with the National Park Service Organic Act of 1916, which states that, "the fundamental purpose of the said parks…is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The NPS carries out this mandate through application of regulations to activities in park lands and waters, science-informed decision-making, consistency with NPS and Department of the Interior policies, and collaboration with partners.

Gateway National Recreation Area

The Jamaica Bay Unit of Gateway National Recreation Area includes salt marsh, dune and barrier spit, freshwater wetlands, maritime forests and grasslands, and ocean habitats. Included within the Jamaica Bay Unit is the Jamaica Bay Wildlife Refuge, a former New York City bird sanctuary that since 1972 is managed by the National Park Service. The Refuge is an important bird migration route, and is used by 326 bird species as a stopover or year-round residence. About 8 miles to the west of Jamaica Bay lies the 2,064-acre Staten Island Unit. At least 106 fish species are recorded from the waters in and around Gateway NRA.

Fire Island National Seashore

Fire Island National Seashore includes a 32 mile long coastal barrier island on the south shore of Long Island. A 7-mile portion of the barrier island is the federally-designated Otis Pike Fire Island High Dunes Wilderness Area. The Seashore includes beaches, dunes, salt marshes, maritime forests (e.g., Sunken Forest) and extensive submerged marine resources (e.g., seagrass beds, tidal flats, shellfish beds) extending into Great South Bay and the Atlantic Ocean.

National Ocean Policy

The NOP was laid out in President Obama's 2010 Executive Order 13547, which set overarching guiding principles for management decisions and actions toward achieving the vision of "an America whose stewardship ensures that the ocean, our coasts, and the Great Lakes are healthy and resilient, safe and productive, and understood and treasured so as to promote the well-being, prosperity, and security of present and future generations."[222]

The National Ocean Policy (NOP) encourages a comprehensive, adaptive, integrated, ecosystem-based, and transparent spatial planning process based on sound science, for analyzing current and anticipated uses of ocean and coastal areas.

Coastal and marine spatial planning (CMSP), recommended by the National Ocean Council[223], is an applied tool of EBM that holistically focuses on a discrete geographic area used to reduce current and future human use conflicts, investigate cumulative and interactive impacts between resource uses to improve marine ecosystem function,[224] and to facilitate long-term strategic governance.

5.4 Appendix 4: Managed Species (State/Interstate/Federal)

Endangered Under New York Law 182.2(g) of 6NYCRR Part 182	
Atlantic Sturgeon	*Acipenser oxyrinchus**
Shortnose Sturgeon	*Acipenser brevirostrum**
Atlantic Hawksbill Sea Turtle	*Eretmochelys imbricate**
Atlantic Ridley Sea Turtle	*Lepidochelys kempii**
Leatherback Sea Turtle	*Dermochelys coriacea**
Black Rail	*Laterallus jamaicensis*
Piping Plover	*Charadrius melodus***
Eskimo Curlew	*Numenius borealis**
Roseate Tern	*Sterna dougallii dougallii**
Black Tern	*Chlidonias niger*
Sperm Whale	*Physeter catodon**
Sei Whale	*Balaenoptera borealis**
Blue Whale	*Balaenoptera musculus**
Finback Whale	*Balaenoptera physalus**
Humpback Whale	*Megaptera novaeangliae**
Right Whale	*Eubalaena glacialis**

Threatened Under New York Law 182.2(h) of 6NYCRR Part 182	
Green Sea Turtle	*Chelonia mydas***
Loggerhead Sea Turtle	*Caretta caretta***
Common Tern	*Sterna hirundo*
Least Tern	*Sterna antillarum*

Special Concern Under New York Law Section 182.2(i) of 6NYCRR Part 182	
American Bittern	*Botaurus lentiginosus*
Osprey	*Pandion haliaetus*
Black Skimmer	*Rynchops niger*
Harbor Porpoise	*Phocoena phocoena*

* Also listed as endangered under the federal Endangered Species Act

** Also listed as threatened under the federal Endangered Species Act

New York Comprehensive Wildlife Conservation Strategy Species of Greatest Conservation Need (SGCN)	
FISH	
Alewife	*Alosa pseudoharengus*
American shad	*Alosa sapidissima*
American eel	*Anguillla rostrata*
Atlantic tomcod	*Microgadus tomcod*
Atlantic silverside	*Menidia*
Atlantic sturgeon	*Acipenser oxyrinchus**
Bay anchovy	*Anchoa mitchilli*
Blueback herring	*Alosa aestivalis*
Common pipefish	*Syngnathus fuscus*
Cunner	*Tautogolabrus adspersus*
Killifish - 3 other spp	*Fundulus* spp.
Menhaden	*Brevoortia tyrannus*
Northern puffer	*Sphoeroides maculatus*
Oyster toadfish	*Opsanus tau*
Seahorses and pipefish	*Syngnathus* spp.
Sharks, skates and rays	*Elasmobranchiomorphi*
Shortnose sturgeon	*Acipenser brevirostrum**
Spotfin killifish	*Fundulus luciae*
Tautog	*Tautoga onitis*
Winter flounder	*Pseudopleuronectes americanus*
CRUSTACEA	
American lobster	*Homarus americanus*
Blue crab	*Callinectes sapidus*
Horseshoe crab	*Limulus polyphemus*
Marine zooplankton	*Crustacea* - various spp.
MOLLUSKS	
Hard clam	*Mercenaria mercenaria*
Bay scallop	*Argopecten irradians*
Oyster	*Crassostrea virginica*
Ribbed mussel	*Geukensia demissa*

New York Comprehensive Wildlife Conservation Strategy Species of Greatest Conservation Need (SGCN)	
MAMMALS	
Sperm whale	*Physeter catodon**
Sei whale	*Balaenoptera borealis**
Blue whale	*Balaenoptera musculus**
Finback whale	*Balaenoptera physalus**
Humpback whale	*Megaptera novaeangliae**
Right whale	*Eubalaena glacialis**
Harbor porpoise	*Phocoena phocoena*
REPTILES	
Atlantic hawksbill sea turtle	*Eretmochelys imbricate**
Kemp's ridley sea turtle	*Lepidochelys kempii**
Leatherback sea turtle	*Dermochelys coriacea**
Green sea turtle	*Chelonia mydas***
Loggerhead sea turtle	*Caretta caretta***
BIRDS	
American bittern	*Botaurus lentiginosus*
American oystercatcher	*Haematopus palliates*
Atlantic brant	*Branta bernicla*
Black-bellied plover	*Pluvialis squatarola*
Black-crowned night-heron	*Nycticorax nycticorax*
Black rail	*Laterallus jamaicensis*
Black scoter	*Melanitta nigra*
Black skimmer	*Rynchops niger*
Black tern	*Chlidonias niger*
Blue-winged tea	*Anas discors*
Bonaparte's gull	*Larus Philadelphia*
Buff-breasted sandpiper	*Tryngites subruficollis*
Caspian tern	*Sterna caspia*
Cattle egret	*Bubulcus ibis*
Common eider	*Somateria mollissima*
Common goldeneye	*Bucephala clangula*
Common loon	*Gavia immer*
Common tern	*Sterna hirundo*

New York Comprehensive Wildlife Conservation Strategy Species of Greatest Conservation Need (SGCN)	
Cory's shearwater	*Calonectris diomedea*
Dunlin	*Calidris alpina*
Eskimo curlew	*Numenius borealis**
Forster's tern	*Sterna forsteri*
Glossy ibis	*Plegadis falcinellus*
Great egret	*Ardea alba*
Greater scaup	*Aythya marila*
Greater shearwater	*Puffinis gravis*
Greater yellowlegs	*Tringa melanoleuca*
Gull-billed tern	*Sterna nilotica*
Harlequin duck	*Histrionicus*
Horned grebe	*Podiceps auritus*
Hudsonian godwit	*Limosa haemastica*
King rail	*Rallus elegans*
Laughing gull	*Larus atricilla*
Least tern	*Sterna antillarum*
Least bittern	*Ixobrychus exilis*
Lesser scaup	*Aythya affinis*
Little gull	*larus minutes*
Little blue heron	*Egretta caerulea*
Long-tailed duck	*Clangula hyemalis*
Marbled godwit	*Limosa fedoa*
Northern pintail	*Anas acuta*
Osprey	*Pandion haliaetus*
Piping plover	*Charadrius melodus***
Purple sandpiper	*Calidris maritime*
Razorbill	*Alca torda*
Red knot	*Calidris canutus*
Red-necked phalarope	*Phalaropus lobatus*
Red-throated loon	*Gavia stellata*
Roseate tern	*Sterna dougallii dougallii**
Ruddy duck	*Oxyura jamaicensis*
Ruddy turnstone	*Arenaria interpres*

New York Comprehensive Wildlife Conservation Strategy Species of Greatest Conservation Need (SGCN)	
Sanderling	*Calidris alba*
Semipalmated sandpiper	*Calidris pusilla*
Short-billed dowitcher	*Limnodromus griseus*
Snowy egret	*Egretta thula*
Surf scoter	*Melanitta perspicillata*
Thayer's gull	*Larus thayeri*
Tricolored heron	*Egretta tricolor*
Upland sandpiper	*Bartramia longicauda*
Whimbrel	*Numenius phaeopus*
White-winged scoter	*Melanitta fusca*
Willet	*Catoptrophorus semipalmatus*
Yellow-crowned night-heron	*Nyctanassa violacea*
Yellow rail	*Coturnicops noveboracensis*

* Also listed as endangered under the federal Endangered Species Act

** Also listed as threatened under the federal Endangered Species Act

5.5 Appendix 5: Priority Fish Passage Projects in Southern New York.

Information provided by Byron Young, New York's Citizen Advisor to the Atlantic States Marine Fisheries Commission's Shad and River Herring Advisory Panel and the Hudson River Estuary Program

There are a number of diadromous fish passage projects that are currently in various stages of development, as well as additional sites that have been identified for potential diadromous fish passage projects on Long Island. Below is a list of sites that should be considered priorities for the implementation of fish passage projects located on Long Island. This list was put together based upon my perspective working with diadromous fish passage on Long Island.

There are often major hurdles in completing fish passage projects at the identified sites. In particular, securing funding for completing conceptual and engineering designs on a site by site basis, long-term commitments for funding to finalize construction, resolving political issues or agreeing to work together for the benefit of rebuilding diadromous fish migratory routes throughout Long Island, securing necessary permits in a timely fashion, months versus years, procurement of contracts for work in a timely fashion.

The Peconic River

The first barrier on the Peconic River was passed with the completion of a Rock Ramp fish passage project at Grangebel Park, Riverhead, in February 2010. This allowed access to approximately 1.5 miles of Peconic River and 24 acres of historical spawning habitat, particularly for alewives. Three barriers to fish passage remain on the main stem of the Peconic River and one barrier on the Wildwood Lake tributary to the Peconic River. Fish passage plans are in various stages of development for each of these barriers and will require securing additional funding to complete engineering design and final construction. It is my opinion that if all of these barriers were passed the Peconic River alewife run would become the largest on Long Island at well over 100,000 adults. The current run is estimated to be between 50,000 and 80,000 adults conservatively with only a small portion of the potential spawning habitat available. The projects under consideration at this point in time are:

On the Main Stem of the Peconic River:

Upper Mills Dam, Riverhead – is an old mill dam and a long past local power generation facility. Currently, this structure is the first upstream barrier on the Peconic River with the completion of the fish passage project at Grangebel Park in 2010. Current conceptual plans call for a bypass channel with either step pools or an Alaska Steep Pass. There are a couple of major technical hurdles with this project, the main one being the presence of Long Island Power Authority (LIPA) utility cables that pass over the pool below the dam. Additionally, there is a buried gas line and a USGS stream gauging weir located immediately downstream of the dam. Based upon earlier surveys, a detailed engineering design will be required in order to bypass the LIPA utility cables and gas line. Any fish passage project proposed at Upper Mills Dam will also require input from the USGS on an acceptable fish passage design that does not disrupt the water flow data string from this station. Conceptual engineering designs have been developed by the Town of Riverhead, and limited funding has been secured to support design and final construction. Fish passage here would open 2 miles of the Peconic River and 40 acres of potential spawning, feeding and developmental habitat for alewives and American eels.

Forge Road/Peconic Lake Dam, Brookhaven – is a dam that impounds Forge Road/Peconic Lake. It is believed that this dam may have been constructed to support local duck farms and cranberries bogs which no longer exist. The Peconic Estuary Program has provided money to support the development of a conceptual design for fish passage at this dam. Funding is still needed to finalize the engineering design and final construction. This project would open up access to the expansive Peconic Lake, 2 miles of the Peconic River and approximately 107 acres of potential spawning, feeding and developmental habitat for alewives and American eels.

Edwards Avenue Dam, Brookhaven –This dam is owned by the state of New York. Funding was appropriated by DEC to replace the dam and add both fish and eel passages. This completed project has opened 2 miles of the Peconic River and approximately 107 acres of potential spawning, feeding and developmental habitat for alewives and American eels.

Little River, Peconic River Tributary:

Woodhulls Pond/Wildwood Lake, Southampton- Woodhull dam is a Suffolk County owned dam of historic value, as it impounds water for the Cranberry Bog Preserve. Suffolk County has secured funding to develop conceptual fish passage project designs for this dam but with current budget issues has not released the monies. Early discussions have called for a bypass channel at this facility. Bypassing this dam would allow alewives to gain access to Wildwood Lake which is an approximately 86 acres Kettle Hole Lake. In my opinion, opening access to this lake would provide a large boost to restoring alewives in the Peconic River System.

The Carmans River

The first barrier to diadromous fish passage on the Carmans River was modified with the installation of an Alaska steep pass fish ladder at the Hards Lake Dam by the Department of Transportation in March 2008. Alewives, blueback herring, American eel and brook trout have successfully used this fish passage to access freshwater habitat within the Carmans, according to recent research efforts by DEC, SUNY SB and Cornell Cooperative Extensions Marine Program.

The Carman's River is receiving a great deal of attention recently with the development of a Draft Watershed Management Plan by the town of Brookhaven. The Watershed Management Plan has not been accepted by the Town Board and is currently being modified for resubmission. The primary issues in the Watershed are how to control development, combat invasive aquatic plants and preserve the rural character of the watershed. Fish passage was a component of the plan that, unfortunately, did not generate much support from the local community.

The main stem of the Carman's River:

Lower Lake Dam- is a 12 foot high earthen dam at the south end of Lower Lake that was originally constructed in 1762 and reconstructed in 1940. Suffolk County is in the process of developing the conceptual designs for fish passage at this facility. A consultant has been brought onboard to develop the designs. Preliminary designs would have an Alaska steep pass fish ladder placed in the current spillway of the dam. There would need to be some reconfiguration of the spillway to accommodate the fish ladder. Completion of this fish passage project would allow access to an additional 37 to 50 acres of spawning habitat.

Upper Lake Dam- is an 8 foot high earthen mill dam located 6 miles north of the mouth of the river that was originally constructed in the 1740s and reconstructed in 1932. The Town of Brookhaven has begun the development of a conceptual engineering design for modifying this dam in order to create a bypass channel around the east side of the spillway which current does not accommodate fish passage. Completion of this fish passage project would open an additional 50 to 60 acres of habitat plus the headwaters of the Carman's River.

South Shore Streams or Barrier Ponds from East to West:

- **Big Reed Pond, East Hampton** - This system has supported alewife spawning and still may to a limited degree. The main issue here is a culvert leading from tide water into the fresh water system and vegetation, primarily common reed (*Phragmites sp.)* blocking access to Big Reed Pond.
- **Georgica Pond, East Hampton** - Barrier Pond which is breached each spring and fall. Alewives have been known to enter the pond on the spring breach, spawn and exit when the sand barrier is breached in the summer of fall.
- **Mecox, Southampton** - Barrier Pond with the same history as Georgica Pond. This is a much large system with a greater potential.
- **Swan Lake, Patchogue and Brookhaven Town** - Fish passage into this lake is being developed. Alewives have been observed in the tidal water of this system, though not in large numbers.
- **Argyle Lake, Babylon** - There is a dam on the Carl's river at the head of tide water that blocks fish passage. An effort has been undertaken to provide for fish passage at this facility. I am not familiar enough with the project to provide a complete description at this time.
- **Massapequa Lake, Massapequa** - An Alaska Steep pass fish ladder has been placed in the first barrier allowing access into Massapequa Lake. Alewives have been observed at the fish ladder and adults have been captured in the lake. Additional barriers to passage further upstream exist and discussions have begun on how best to pass these barriers.

There are numerous streams along the South Shore of Long Island that potentially do or could support alewife runs. The ones listed above either support alewife runs or have had fish passage projects initiated on them.

North Shore of Long Island from East to West:

Due to the geology of Long Island the North Shore does not have as many streams with the capacity to support alewife runs.

- **Baiting Hollow Boy Scout Camp, Riverhead** - This small barrier pond and impounded pond supports a small run of alewives annually. There is potential to enhance this run by providing access to the small pond at the head of the system and by providing for sufficient water behind the barrier beach to allow for alewife spawning and nursery space. The biggest issue here is that with elevate water levels several homes in the area experience flooding of their septic systems.

- **Sunken Meadow Creek Complex, Kings Park**- Alewives do utilize this complex but there is limited information relative to the size of the run and the potential for increasing this run. Plans that were being considered for Sunken Meadow were derailed by Superstorm Sandy which breached the dam thus opening approximately 1 mile upstream of the dam to tidal influence. Alewives were observed in the upper reaches of the now tidal system in 2013 and efforts are underway to understand the implications of these changes brought on by the Hurricane. There are currently five impediments located within the Creek.
- **Nissequogue River, Smithtown** -
  - **Willow Pond Dam** - NY Parks, Recreation & Historic Preservation is currently working with a contractor to prepare a design for the upgrade to the dam. This will include the replacement of the existing spillway as well as installing a fish ladder.
  - **Phillips Mill Pond Dam** - NY Parks, Recreation & Historic Preservation currently has a contractor evaluating three different options for upgrading. The options included breaching the dam, building a new dam in front of the existing dam that would eliminate the need for Parks to acquire easements from the adjoining property, or the third option was to replace the dam and its existing location and to enlarge the spillway. The installation of a fish passage will be incorporated in whatever option Parks decides to advance.
- **Fresh Pond, Fort Salonga**- Potential fish passage at this location. The dam is located on private property and the underwater stretch that flows into Long Island Sound is jointly owned by the Seagull Point Community Association. This project will need a feasibility study and design.
- **Beaver Lake, Oyster Bay** - There is a rudimentary fish passage device at dam between tide water and Beaver Lake. This system could benefit greatly from an improved fish passage facility. It is suspected that some alewives do gain access to Beaver Lake at times of full moon and new moon high tides. The dam is owned by the Village of Mill Neck. Funding was secured by The Nature Conservancy through the Long Island Sound (LIS) Futures Fund in October 2013 for feasibility and design work. NYS Bond Act funding is also in place and allocated to fund construction of the fish passage.
- **Betty Allen Twin Ponds, Centerport** – A fish ladder was installed at this location in 2011 with the intention of attracting and moving alewives to spawning grounds above the ladder. The project includes the repair of a platform and spillway structure, slope and stream channel stabilization and the addition of the ladder.
- **Harrison's Pond Dam Removal, Smithtown**-- Harrison Pond was a manmade pond constructed over 200 years ago. This project removed the pieces and rubble of the failed concrete dam, clearing the site for regarding, and removal of sediment in the culvert.

New York City and Westchester County:

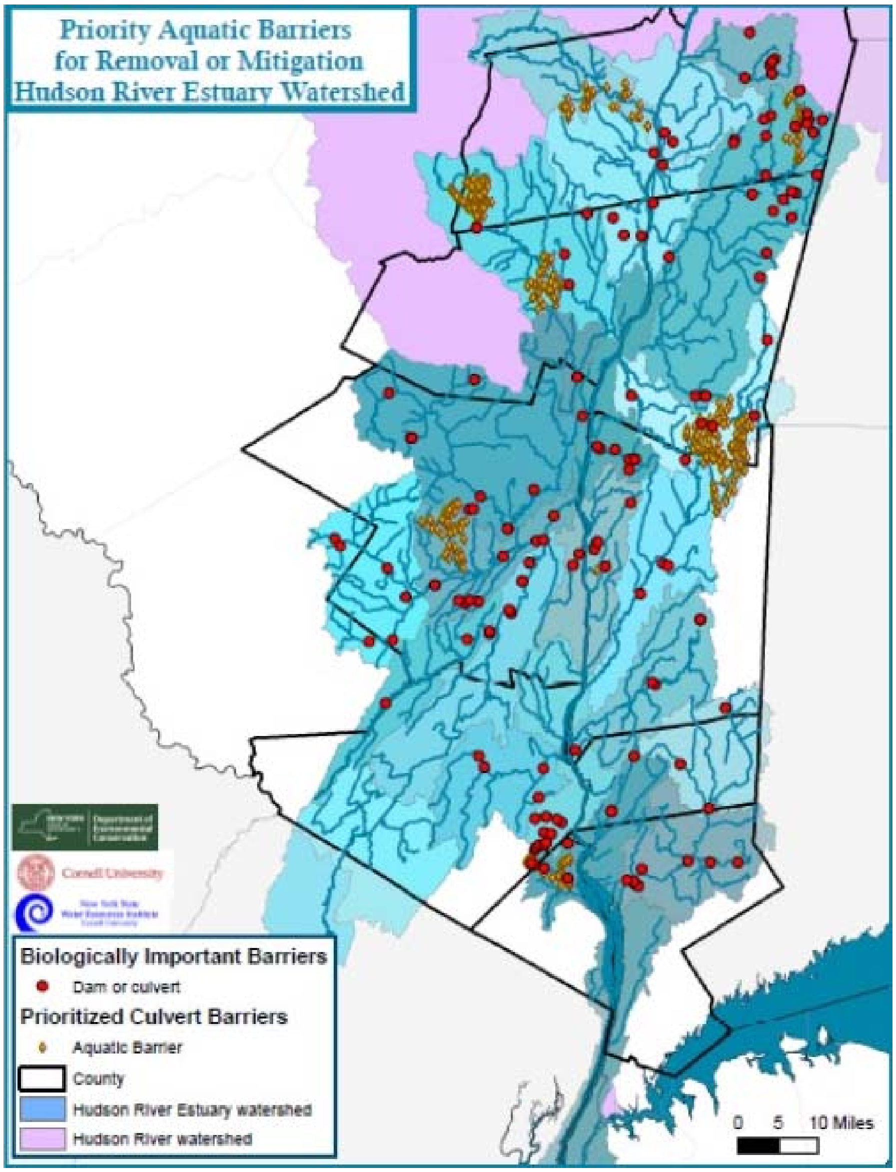
- **Bronx River, New York City** – The Bronx County portion of the Bronx River contains three dams: East 182nd Street Dam, The Bronx Zoo Double Dam, and the Stone Mill Dam. The fish passage project at the East 182nd Street Dam was completed in December 2014 with funding from NYS DOS, NFWF, WCS-NOAA and Bronx Borough President Ruben Diaz, Jr. Final Designs have been completed for fish passages at both the Stone Mill and Bronx Zoo Double Dam. NYSDEC has awarded NYC Parks $500,000 through WQIF to fund construction of the Bronx Zoo Double Dam Fish Passage, the more downstream of the two aforementioned dams. The Bronx Zoo Double Dam and the Stone Mill Dam have fish passage feasibility and designs but no scheduled construction date. These projects are led by the City of New York Department of Parks & Recreation with support of local. State, regional and federal partners. Alewives were stocked in the river in 2006 and 2007. Alewives were found below the dam attempting spawning runs during spring monitoring efforts from 2009-2013.
- **Hutchinson River, New York City -** There may be some potential here, however, numerous environmental impacts require correction and evaluation of the system are necessary before a great deal of effort is expanded on fish passage for this system.

- **Westchester County shoreline** - There are a couple of small lakes that may hold some potential (Playland Lake/Manursing Lake and Kirby Pond). However, I do not have any further information regarding these two systems.

Hudson River Estuary:

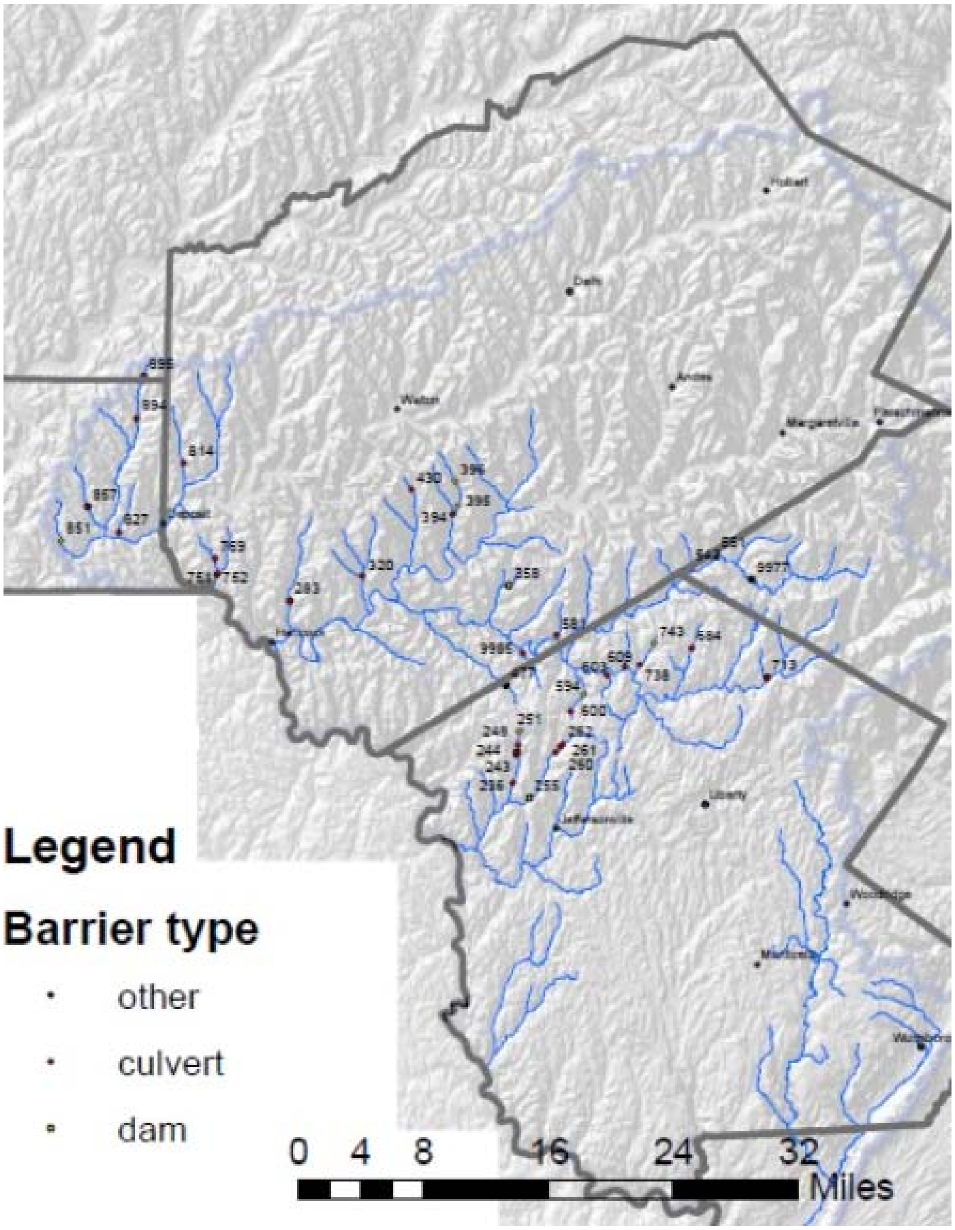
Information provided by Andrew Meyer, Shoreline Conservation Specialist, Hudson River Estuary Program/NYS Water Resource Institute at Cornell University, NYSDEC.

Two projects are underway in the Hudson River Estuary watershed to prioritize dams and culverts as barriers to aquatic organisms. The Nature Conservancy, in partnership with the NYSDEC Hudson River Estuary Program, identified Biologically Important Barriers--field-verified dams and culverts disconnecting habitat for Species of Greatest Conservation Need. In addition, the Hudson River Estuary Program is prioritizing culverts in focal subwatersheds as being undersized and barriers to aquatic organisms. For information on either of these projects, please contact Andrew Meyer (andrew.meyer@dec.ny.gov).



Information provided by Andrew Meyer, Shoreline Conservation Specialist, Hudson River Estuary Program/NYS Water Resource Institute at Cornell University, NYSDEC.

Aquatic barriers that negatively impact New York's Species of Greatest Conservation Need were evaluated by a State Wildlife Grants project in some tributaries of the Delaware watershed in 2010. Priority stream segments were identified based on known and potential distribution of SGCN in the basin. Potential barriers on priority stream segments were identified using orthoimagery. Stream segments were then visited in the field and evaluated to see if they were an actual barrier. Potential barriers are shown in the attached map. Contact Gregg Kenney (gregg.kenney@dec.ny.gov) for more information on the project.



5.6 Appendix 6: New York Marine Science Consortium Fifth Annual Research Symposium: Data and Research Needs for New York's Ocean Ecosystem

September 22, 2012, Wang Center, Stony Brook University, Stony Brook, NY 11790

As part of the OAP developmental process, attendees of the New York Marine Science Consortium (NYMSC) Fifth Annual Research Symposium in the summer of 2012 compiled a list of research and data needs in support of improved management of ocean resources and implement EBM in the New York Bight. This built upon the ideas laid out in the 2008 document entitled, *Research and Monitoring Priorities for Ecosystem-based Management of New York's Ocean and Great Lakes*, written by the Scientific Advisory Group to the New York Ocean and Great Lakes Ecosystem Conservation Council.

A small group of marine scientists gathered for two, one-day workshops to create a preliminary document in preparation for NYMSC's Fifth Annual Research Symposium on September 22, 2012. During that meeting participants broke into three topical groups and reviewed, edited, and voted on the list of research and data needs created by the small group. The ideas with the most votes were then organized and placed into an online survey for a second round of voting. DEC and DOS then considered and included research and data needs highlighted by the NYMSC for inclusion as action steps in this document.

Survey Results

1. Design and sustain a long-term, integrated, monitoring program compatible with regional and federal efforts, including periodic trend analysis. (95 points)
2. Identify and define measurements/indicators of current and future ecosystem services. (91 points)
3. Identify status and trends of offshore water quality indicators such as pollutants, nutrients, bacteria, acidification and salinity. (76 points)
4. Compile and analyze past research projects, data, and data repositories (filtering for usefulness), and identify data gaps and adequacy. (67 points)
5. Identify which components of the ecosystem are most susceptible to major perturbations (i.e., storm events). (65 points)
6. Determine ecosystem services that will be most affected by climate change and identify mitigation possibilities. (60 points)
7. Identify/define indicators to best measure ocean ecosystem health. (59 points)
8. Monitor and understand effects of emerging pollutants (e.g. pharmaceuticals, household chemicals, and endocrine disrupters). (59 points)
9. Determine the effects of sea-level rise and storm surges on barrier islands and inlets, estuaries, and other vulnerable coastal waterways. (53 points)
10. Examine the effects of climate change on biodiversity and keystone species. (48 points)
11. Quantify the frequency, duration, and drivers of hypoxic events on the continental shelf. (47 points)
12. Create uniform data management and distribution standards for research. (45 points)
13. Study the movement of contaminants through trophic levels. (43 points)
14. Determine criteria for identifying key species based on ecological and socio-economic values. (39 points)
15. Complete high resolution mapping of habitat (1970s update). (35 points)
16. Gain a better understanding of how construction, spacing, and operation of offshore wind turbines may affect marine ecological resources and processes. (35 points)

17. Identify spatial and temporal patterns of microbial communities in the sediment and water column. (34 points)

18. Investigate how residents interact with environmental information, what that information consists of, and how that information affects their views. (34 points)

19. Identify the timing and magnitude of phytoplankton blooms (including HABs) and their effects on primary productivity. (31 points)

20. Model the cumulative effects on ecosystem services from existing and proposed industrial projects (especially energy). (31 points)

21. Analyze the recovery status of dumpsite ecosystems and habitats. (28 points)

22. Identify relative societal values for ecosystem services. (26 points)

23. Analyze lifecycle habitat needs, and habitat vulnerability, for commercially important fish stocks that utilize both inshore and shelf habitats. (25 points)

24. Analyze and model (Ecopath, Marxan) long-term fall and spring fish data regarding species complexity, trophic links, and connectivity to other regions. (25 points)

25. Design a monitoring program for invasive species that includes identifying vectors and remediation possibilities. (24 points)

26. Model possible tradeoffs between ecosystem services on both local and regional levels. (21 points)

27. Analyze impacts and threats to forage fish. (21 points)

28. Assess mobile fishing gear impacts to benthic communities and ecosystem productivity. (19 points)

29. Investigate how to foster marine species and habitats that promote marine biofiltration. (19 points)

30. Quantify and identify new sources, types, and effects of marine debris. (18 points)

31. Analyze what data could and should be collected through available platforms and programs such as fishing and shipping vessels, ferries, and wind turbines. (18 points)

32. Examine the patterns and drivers of fish migration and its sensitivity to anthropogenic threats including climate change. (17 points)

33. Evaluate whether species are adapting to different pH levels inshore versus offshore (look into long-term monitoring data). (16 points)

34. Develop monitoring standards for new ocean industries that are compatible with ocean indicators. (14 points)

35. Better quantify fishery bycatch, especially for species of concern. (14 points)

36. Complete high resolution maps of bathymetry. (14 points)

37. Examine and monitor regional submarine groundwater discharge. (7 points)

38. Complete a retrospective analysis on impacts to fish stocks from past fisheries management decisions. (2 points)

Total Respondents: 25

5.7 Appendix 7: Ecosystem Services Summary

The concept of ecosystem services—the direct and indirect benefits people obtain from ecosystems—has received a tremendous amount of attention since the release of the United Nation's Millennium Ecosystem Assessment (MEA): Ecosystem and Human Well Being, A Framework for Assessment in 2005. This framework provides a correlation between ecosystem health and human well-being, and assessing and mapping ecosystem services is a descriptive way to help policy makers implement sustainable and efficient management strategies.

Maintaining and conserving ecosystem services is at the core of ecosystem based management (EBM) and coastal and marine spatial planning (CMSP).

The MEA classified ecosystem services into four categories: provisioning, regulating, cultural, and supporting.

SUPPORTING SERVICES

Services necessary for the production of all other ecosystem services

- Soil Formation
- Nutrient Cycling
- Primary Production
- Storm and Flood Protection

PROVISIONING SERVICES

Benefits obtained from ecosystems

- Food
- Fresh Water
- Energy Supply
- Transportation
- Waste Disposal
- Genetic Resources

REGULATING SERVICES

Benefits obtained from regulation of ecosystem processes

- Climate Regulation
- Water Regulation
- Water Purification
- Disease Regulation
- Pest Regulation

CULTURAL SERVICES

Non-material benefits obtained from ecosystems

- Spiritual/Religious
- Recreation/Tourism
- Aesthetic
- Educational
- Cultural Heritage

A key finding of the MA is that many ecosystem services are declining due to human activities. The ecosystem services concept is one way of demonstrating the relevance of the EBM and CMSP to policy makers and non-scientists.

6.0 End Notes

---

[1] Research and Monitoring Priorities for Ecosystem-based management of New York's Oceans and Great Lakes. A report prepared by the Scientific Advisory Group of the New York Oceans and Great Lakes Ecosystem Conservation Council. Version 2: August 2008.

[2] Ocean Working Group Report to the New York Ocean and Great Lakes Ecosystem Conservation Council. 2008.

[3] Climate change and its Effects on Ecosystems, Habitats and Biota: State of the Gulf of Maine Report http://www.gulfofmaine.org/state-of-the-gulf/docs/climate-change-and-its-effects-on-ecosystems-habitats-and-biota.pdf.

[4] Environmental Conservation Law, Article 14. New York Ocean and Great Lakes Ecosystem Conservation Act

[5] Christensen NL, et al. (1996). The report of the Ecological Society of America Committee on the scientific basis for ecosystem management. Ecological Applications; 6: 665-691.

[6] U.S. Commission on Ocean Policy. 2004. An ocean blueprint for the 21st Century: final report of the U.S. Commission on Ocean Policy to the President and Congress.

[7] McLeod KL, et al., (2005). Scientific consensus statement on marine ecosystem-based management. Communication Partnership for Science and the Sea.

[8] UNEP 2011: 'Taking Steps Toward Marine and Coastal Ecosystem-Based Management – An Introductory Guide' http://www.unep.org/pdf/EBM_Manual_r15_Final_high.pdf

[9] McLeod KL, et al., (2005). Scientific consensus statement on marine ecosystem-based management. Communication Partnership for Science and the Sea.

[10] Environmental Conservation Law, Article 14. New York Ocean and Great Lakes Ecosystem Conservation Act.

[11] New York Ocean and Great Lakes Report. 2009. *Our Waters, Our Communities, Our Future http://www.oglecc.ny.gov/media/Final_New_York_Ocean_and_Great_Lakes_Report_April_2009.pdf*

[12] Ibid.

[13] New York Ocean and Great Lakes Report. 2009. Our Waters, Our Communities, Our Future *http://www.oglecc.ny.gov/media/Final_New_York_Ocean_and_Great_Lakes_Report_April_2009.pdf*

[14] Studholme, AL, et al., (1999). Essential fish habitat document: Atlantic mackerel, *Scomber scomberus*, life history and habitat characteristics. NOAA Tech. Memo. NMFS-NE-141; www.nefsc.noaa.gov/publications/tm/tm141/tm141.pdf.

[15] Stevenson DK, et al. 2004. Characterization of the fishing practices and the marine benthic ecosystems of the northeast U.S. shelf. NOAA Tech. Memo. NMFS-NE-181.

[16] Lumsden SE, et al. 2007. The state of deep coral ecosystems of the United States. NOAA Tech. Memo. CRCP-3.

[17] Menza C, et al. 2012. A biogeographic assessment of seabirds, deep sea corals and ocean habitats of the New York Bight: science to support offshore spatial planning. NOAA Tech. Memo. NOS NCCOS 141.

[18] NOAA Habitat Conservation, Deep-sea corals: http://www.habitat.noaa.gov/abouthabitat/deepseacorals.html

[19] Morreale SJ and Standora EA (1998). Early life stage ecology of sea turtles in northeastern U.S. waters. U.S. Dep. Commer. NOAA Tech. Mem. NMFS-SEFSC-413.

[20] Morreale SJ, Standora EA. (2005). Western North Atlantic waters: Critical developmental habitat for Kemp's ridley and loggerhead sea turtles. Chelonian Conservation and Biology; 4(4)872-882.

[21]Cornell Lab of Ornithology Bioacoustics Research program. 2010. Determining the Seasonal Occurrence of Cetaceans in New York Coastal Waters using Passive Acoustic Monitoring. Technical Report 09-07, Albany, NY: New York State Department of Environmental Conservation.

[22] Whit AD, et al. (2013). North Atlantic right whale distribution and seasonal occurrence in nearshore waters off New Jersey, USA, and implications for management. Endangered Species Research**;** 20: 59–69**.**

[23] New York State Division of Fish, Wildlife and Marine Resources. 2005. Comprehensive Wildlife Conservation Strategy for New York.

[24] Ibid.

[25] New York Ocean and Great Lakes Report. 2009. Our Waters, Our Communities, Our Future *http://www.oglecc.ny.gov/media/Final_New_York_Ocean_and_Great_Lakes_Report_April_2009.pdf*

[26] The Trust for Public Land. 2012. The economic benefits of New York's environmental protection fund.

[27] New York State Office of Parks, Recreation and Historic Preservation. 2014. The Statewide Comprehensive Outdoor Recreation Plan and Generic Environmental Impact Statement 2014-2019.

[28] Regional Impact Evaluation: An initial Assessment of the Economic Impacts of Sandy on New Jersey and New York Commercial and Recreational Fishing Sectors, March 15, 2013. NOAA Fisheries, Office of Science and Technology, NEFSC.
http://www.st.nmfs.noaa.gov/Assets/economics/documents/sandy/Final_Report_Sandy_Regional_Impact_Evaluation_MSA.pdf

[29] Timmons, M et al., (2004). New York aquaculture industry: status, constraints and opportunity. A white paper. http://www.organicity.org/food/urbaqua/NewYorkAquaculture.pdf

[30] Port Authority of New York and New Jersey. 2011 Trade Statistics.

[31] National Renewable Energy Laboratory for the U.S. Department of Energy. Dollars from sense: The economic benefits of renewable energy. 1997.

[32] AWS Truepower LLC. for the New York Power Authority. Economic impact assessment: Long Island – New York City offshore wind project. 2010.

[33] Musial W and Ram B (2010). Large-scale offshore wind energy for the United States: Assessment of opportunities and barriers. National Renewable Energy Laboratory.

[34] Feeley et al., (2004). Impact of anthropogenic CO_2 on the $CaCO_3$ system in the oceans. Science, 305: 362-366. http://www.pmel.noaa.gov/pubs/outstand/feel2633/feel2633.shtml

[35] Chmura GL, et al., (2003). Global carbon sequestration in tidal, saline wetland soils. Global Biogeochemical Cycles, 17(4): 1-12.

[36] Mateo MA, et al., (1997). Dynamics of millenary organic deposits resulting from the growth of the Mediterranean seagrass *Posidonia oceanica*. Estuarine Coastal and Shelf Science; 44: 103–110.

[37] Vichkovitten T and Holmer M (2005). Dissolved and particulate organic matter in contrasting *Zostera marina* (eelgrass) sediments. Journal of Experimental Marine Biology and Ecology; 316(2):183–201.

[38] Palumbi SR, et al., (2009). Managing for ocean biodiversity to sustain marine ecosystem services. Frontiers in Ecology and the Environment; 7: 204–211.

[39] Duffy, JE et al., (2013). Envisioning a marine biodiversity observation network. BioScience, 63: 350-361.

[40] Our Waters, Our Communities, Our Future: Taking Action Now to Achieve Long-term sustainability of New York's Ocean and Great Lakes. 2009. New York Ocean and Great Lakes Ecosystem Conservation Council Report.

[41] Millennium Ecosystem Assessment, Ecosystems and Human Well-being: Biodiversity Synthesis. 2005. http://www.millenniumassessment.org/en/index.html

[42] Ocean Working Group. Report to the New York Ocean and Great Lakes Ecosystem Conservation Council. 2008.

[43] U.S Census Bureau. 2010 Census Population Profile Maps. New York. http://www.census.gov/geo/www/maps/2010_census_profile_maps/census_profile_2010_main.html

[44] Research and Monitoring Priorities for Ecosystem-based Management of New York's Oceans and Great Lakes: A report prepared by the Scientific Advisory Group of the New York Oceans and Great Lakes Ecosystem Conservation Council; Version 2: August 2008.

[45] Ibid.

[46] New York State Department of Environmental Conservation. 2010. Section 305(b) Water Quality Report.

[47] Ocean Working Group. 2008. Report to the New York Ocean and Great Lakes Ecosystem Conservation Council. 30 pg.

[48] Kenward, A, D. Yawitz and U. Raja. 2013. Sewage Overflows from Hurricane Sandy. Climate Central http://www.climatecentral.org/news/11-billion-gallons-of-sewage-overflow-from-hurricane-sandy-15924

[49] Ocean Working Group. Report to the New York Ocean and Great Lakes Ecosystem Conservation Council. 2008.

[50] NOAA Fisheries. 2015. Status of Stocks 2015. http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/archive/2015/2015_status_of_stocks_updated.pdf

[51] Ocean Working Group. Report to the New York Ocean and Great Lakes Ecosystem Conservation Council. 2008.

[52] Framework Adjustment 6 to the Atlantic Mackerel, Squid and Butterfish Fishery Management Plan. 2012. Mid-Atlantic Fishery Management Council in cooperation with National Marine Fisheries Service.

[53] Status of Fishery Resources off the Northeastern US. 2006. NOAA/NMFS/NEFSC - Resource Evaluation and Assessment Division. http://www.nefsc.noaa.gov/sos/

[54] 2012 Stock Assessment and Fishery Evaluation (SAFE) Report for Atlantic Highly Migratory Species. Highly Migratory Species Management Division, NOAA Fisheries, 1315 East-West Highway, Silver Spring, MD.

[55] Atlantic States Marine Fisheries Commission. 2009. Excerpts from Fisheries Focus, vol. 18, issue 5, July 2009. (available from http:/www.sdmgc.org)

[56] Abercrombie, D and E Pikitch. 2010. Proposal for the Design of a New York State Marine Fishery Observer Program.

[57] Ibid.

[58]U.S. Department of Transportation Maritime Administration. 2005. Report to congress on the performance of ports and the intermodal system.

[59] Chytalo, K. 1996. Summary of Long Island Sound dredging windows strategy workshop. In Management of Atlantic Coastal Marine Fish Habitat; Proceedings for a Workshop for Habitat Managers. ASMFC Habitat Management Series #2.

[60] Ibid.

[61] EPA Region 2. Dredged Material Management Program.

[62] Jensen AS and GK Silber (2003). Large Whale Ship Strike Database. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-OPR.

[63] Brown JJ, Murphy GW. (2010). Atlantic sturgeon vessel strike mortalities in the Delaware River. Fisheries; 3; 5(2):72-83.

[64] National Research Council of the National Academies. 2003. Ocean noise and marine mammals.

[65] Hatch L, et al. (2008). Characterizing the relative contributions of large vessels to total ocean noise fields: A case study using the Gerry E. Studds Stellwagen Bank National Marine Sanctuary. Environmental Management; 42(5): 735-752.

[66] Southall BL. (2007). Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals; 33(4).

[67] New York State Energy Research and Development Authority. Patterns and trends, New York State Energy Profiles: 1997–2011. 2013 https://www.nyserda.ny.gov/-/media/Files/Publications/Energy-Analysis/1997-2011-patterns-and-trends-report.pdf.

[68] MARCO. 2013. A guide to state management of offshore wind energy in the Mid-Atlantic region. Prepared by Environmental Law Institute®, Washington, D.C. (electronic copy available on the MARCO website: http://www.midatlanticocean.org/

[69] New York Energy Highway Blueprint. 2012. New York Energy Highway Task Force.

http://www.nyenergyhighway.com/Blueprint.html

[70] Hagerty, CL. 2011. Outer continental shelf moratoria on oil and gas development. Congressional Research Service Report for Congress. https://www.fas.org/sgp/crs/misc/R41132.pdf

[71] Orr JC, et al., (2005) Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms. Nature; 437(7059): 681-686.

[72] Ibid.

[73] Intergovernmental Panel on Climate Change (IPCC). Climate Change 2007: Synthesis Report.

[74] Cooley, SR and SC Doney (2009). Anticipating ocean acidification's economic consequences for commercial fisheries.

[75] IGBP, IOC, SCOR (2013). Ocean acidification summary for policymakers – third symposium on the ocean in a high-CO_2 world. International Geosphere-Biosphere. Programme, Stockholm, Sweden.

[76] Friedland KD and JA Hare, (2007). Long-term trends and regime shifts in sea surface temperature on the continental shelf of the northeast United States. Continental Shelf Research; 27: 2313–2328.

[77] Nye J, et al. (2009). Changing spatial distribution of Northeast USA fish stocks. Marine Ecology Progress Series; 393: 111–129.

[78] Oviatt C. The changing ecology of temperate coastal waters during a warming trend. Estuaries 2004;27:895-904.

[79] Cowen RK and S Sponaugle (2009). Larval Dispersal and Marine Population Connectivity. Annual Review of Marine Science; 1: 443-466.

[80] Block BA, et al. (2011). Tracking apex marine predator movements in a dynamic ocean. Nature; 475: 86-90.

[81] Weinberg JR. (2005). Bathymetric shift in the distribution of Atlantic surfclams: response to warmer ocean temperature. ICES Journal of Marine Science; 62(7): 1444-1453.

[82] EPA. 2013. Impacts of Climate Change on the Occurrence of Harmful Algal Blooms. http://www2.epa.gov/sites/production/files/documents/climatehabs.pdf

[83] Martinez-Urtaza, J, JC Bowers, J Trinanes, A DePaola. (2010). Climate anomalies and the increasing risk of Vibrio parahaemolyticus and Vibrio vulnificus illnesses. Food Research International, vol. 43: 1780-1790.

[84] NYS 2100 Commission: Recommendations to improve the Strength and Resilience of the Empire State's Infrastructure. 2013. http://www.governor.ny.gov/NYS2100Commission

[85] EPA Region 2 Climate Change Workgroup. 2013. Draft EPA Region 2 Climate Adaptation Implementation Plan. USEPA Region 2 New York, NY. http://epa.gov/climatechange/Downloads/impacts-adaptation/region-2-plan.pdf

[86]Tanski, J. 2012. Long Island's Dynamic South Shore- A Primer on the Forces and Trends Shaping our Coast. New York Sea Grant. 27 pages.

[87] NPCC2. Climate Risk Information 2013: Climate Methods Memorandum http://www.nyc.gov/html/planyc/downloads/pdf/publications/NPCC2_Climate%20Methods%20Memorandum_2013.pdf

[88] Rosenzweig CW, et al., 2011. Responding to climate change in New York State: The ClimAID integrated assessment for effective climate change adaptation. New York State Energy Research and Development Authority.

[89] New York State Sea-level rise Task Force. Report to the legislature. 2010.

[90] USGS Information Handout. 1998. Offshore Industrial Minerals Studies Using Induced-Polarization Streamer System.

[91] Swanson et al., (2004). Science, policy and the management of sewage materials. The New York City Experience. Marine Pollution Bulletin, 49: 679–687

[92] Ecological Stress and the New York Bight: Science and Management. 1982. G.F. Mayer (ed.). NOAA office of Marine Pollution Assessment, Stony Brook, New York. 715 pg.

[93] Mull CG, et al. (2013). Evidence of maternal offloading of organic contaminants in white sharks (*Carcharodon carcharias*). PLoS ONE 8(4): e62886.doi:10.1371/journal.pone.0062886

[94] Cantor, M (2007). Economic impacts of regional beach closings on the Long Island economy. Long Island Economic and Social Policy Institute at Dowling College.

[95] New York State Department of Environmental Conservation. 2010. New York State Stormwater Management Design Manual. www.dec.ny.gov/docs/water_pdf/swdm2010entire.pdf

[96] Natural Resources Defense Council. Testing the Waters 2011: A Guide to Water Quality at Vacation Beaches.

[97] New York State Department of Health. Health advice on eating sportfish and game 2011-2012.

[98] US Food and Drug Administration. What you need to know about mercury in fish and shellfish.

[99] NOAA's Undersea Research Program. 2000. Deep-Sea Biodiversity and the Impact of Ocean Dumping. http://www.nurp.noaa.gov/Spotlight/OceanDumping.htm

[100] New York State Seagrass Task Force. 2009. Recommendations to the New York State Governor and legislature.

[101] ASMFC…

[102] Francis MP (2013).Temporal and Spatial Patterns of Habitat Use by Juveniles of a Small Coastal Shark (Mustelus lenticulatus) in an Estuarine Nursery. PLoS ONE 8(2): e57021. doi:10.1371/journal.pone.0057021

[103] NYS DEC. Nutrient Loadings and Eutrophication Factsheet. www.dec.ny.gov/docs/water_pdf/305btopten.pdf

[104] Bricker, SB, et al., (1999). National estuarine eutrophication assessment: effects of nutrient enrichment in the nation's estuaries. NOAA, National Ocean Service, Special Projects Office and the National Centers for Coastal Ocean Science. Silver Spring, MD: 71 pp.

[105] Greenaway AM and Gordon-Smith DA (2006). The effects of rainfall on the distribution of inorganic nitrogen and phosphorus in Discovery Bay, Jamaica. Limnology and Oceanography; 51: 2206−2220.

[106] Committee on Environment and Natural Resources. 2010. Scientific Assessment of Hypoxia in U.S. Coastal Waters. Interagency Working Group on Harmful Algal Blooms, Hypoxia, and Human Health of the Joint Subcommittee on Ocean Science and Technology. Washington, DC.

[107] Long Island Sound Study. Sound health 2012: Status and trends in the health of Long Island Sound.

[108] Committee on Environment and Natural Resources. 2010. Scientific Assessment of Hypoxia in U.S. Coastal Waters. Interagency Working Group on Harmful Algal Blooms, Hypoxia, and Human Health of the Joint Subcommittee on Ocean Science and Technology. Washington, DC.

[109] Gobler et al., (2014). Hypoxia and acidification have additive and synergistic negative effects on the growth, survival and metamorphosis of early life stage bivalves. PLoS ONE 9(1): e83648. Doi: 101371/journal.pone.0083648

[110] Heisler, J., et al., (2008). Eutrophication and harmful algal blooms: A scientific consensus. Harmful Algae http://www.whoi.edu/science/cohh/whcohh/publications/WHCOHH_publications/Heisler_etal_2008_HA-inpress.pdf

[111] Ibid.

[112] Long Island Sound Study. Sound health 2010: Status and trends in the health of Long Island Sound.

[113] Gobler et al., (2011). Niche of harmful algae *Aureococcus anophagefferens* revealed through ecogenomics. Proceedings of the National Academy of Sciences of the United States of America, 108: 4352-4357. http://www.pnas.org/content/108/11/4352

[114] EPA. 2008. Effects of Climate Change on Aquatic Invasive Species and Implications for Management and Research. National Center for Environmental Assessment, Office of Research and Development, Washington, DC.

[115] New York State Invasive Species Management Strategy. 2011. http://www.dec.ny.gov/docs/wildlife_pdf/istfreport1105.pdf

[116] Ocean Working Group. 2008. Report to the New York Ocean and Great Lakes Ecosystem Conservation Council. 30 pg.

[117] Duffy, JE et al., (2013). Envisioning a marine biodiversity observation network. BioScience, 63: 350-361.

[118] Palumbi SR, et al. (2009). Managing for ocean biodiversity to sustain marine ecosystem services. Frontiers in Ecology and the Environment, 7: 204–211.

[119] Friedline, CJ et al. (2012). Bacterial assemblages of the Eastern Atlantic Ocean Reveal Both Vertical and Longitudinal Biogeographic Signatures. Biogeosciences, 9: 2177–2193. www.biogeosciences.net/9/2177/2012/

[120] Ban, NC, HM Alidina and JA Arden (2010). Cumulative impact mapping: advances, relevance, and limitations to marine management and conservation, using Canada's Pacific waters as a case study. Marine Policy 34, 876–886.

[121]Palumbi et al., (2009). Managing for ocean biodiversity to sustain marine ecosystem services. Frontiers in Ecology and the Environment; 7: 204–211.

[122]Greene et al., (2009). Fish habitat: A review of utilization, threats, recommendations for conservation, and research needs. Atlantic States Marine Fisheries Commission Habitat Management Series No. 9, Washington, D.C.

[123] Final Report of the New York State Seagrass Task Force. 2009. Recommendations to the New York Legislature www.dec.**ny**.gov/docs/fish_marine_pdf/final**seagrass**report.pdf

[124] Hill K. 2002. Seagrass habitats. Smithsonian Marine Station.

[125] Mateo MA, et al., (1997). Dynamics of millenary organic deposits resulting from the growth of the Mediterranean seagrass *Posidonia oceanica*. Estuarine Coastal and Shelf Science; 44: 103–110.

[126] Vichkovitten T and M Holmer (2005). Dissolved and particulate organic matter in contrasting *Zostera marina* (eelgrass) sediments. Journal of Experimental Marine Biology and Ecology; 316(2): 183–201.

[127] Final Report of the New York State Seagrass Task Force. 2009. Recommendations to the New York Legislature www.dec.ny.gov/docs/fish_marine_pdf/finalseagrassreport.pdf

[128] Chmura GL, et al., (2003). Global carbon sequestration in tidal, saline wetland soils. Global Biogeochemical Cycles; 17(4): 1-12.

[129] Nitrogen Pollution and Adverse Impacts on Resilient Tidal Marshlands: NYS DEC Technical Briefing Summary, April 22, 2014. 7 pg. http://www.dec.ny.gov/docs/water_pdf/impairmarshland.pdf

[130] Environmental Conservation Law 33-0301.

[131] Final Report of the New York State Seagrass Task Force. 2009. Recommendations to the New York Legislature www.dec.ny.gov/docs/fish_marine_pdf/finalseagrassreport.pdf

[132] NYS Department of Environmental Conservation. 201. Long Island Pesticide Pollution Prevention Strategy. http://www.dec.ny.gov/docs/materials_minerals_pdf/fullstrategy.pdf

[133]ibid.

[134] EPA. 2010. Treating Contaminants of Emerging Concern: A literature Database http://water.epa.gov/scitech/swguidance/ppcp/upload/cecliterature.pdf

[135] EPA. 2009. Occurrence of Contaminants of Emerging Concern in Wastewater of Nine Publicly Owned Treatment Works
http://water.epa.gov/scitech/swguidance/ppcp/upload/2009_08_07_ppcp_studies_9potwstudy.pdf

[136] US EPA Scientific Advisory Board Ecological Process and Effects Committee Advisory on Aquatic Life Water Quality Criteria for Contaminants of Emerging Concern. 2008.
http://yosemite.epa.gov/sab/SABPRODUCT.NSF/b5d8a1ce9b07293485257375007012b7/E37FB6980DCDD9B585257532005F6F2C/$File/EPA-SAB-09-007-unsigned.pdf

[137] Swanson, RL, R. Wilson, B Brownawell, K Willig, P Ng and T Moore. (2014). Draft Consequences of the Bay Park Sewage Treatment Plant on Water and Sediment Quality Following Superstorm Sandy.

[138] New York State Department of Environmental Conservation, “DRAFT 2014 303 (d) List.” Available online at http://www.dec.ny.gov/chemical/31290.html#The_2014_CWA

[139] Kinney, EL and I Valiela (*2011*) Nitrogen Loading to Great South Bay: Land Use, Sources, Retention, and Transport from Land to Bay. Journal of Coastal Research: Volume 27, Issue 4: pp. 672 – 686.

[140] NYS Department of Environmental Conservation. 2011. Sustainable Fishing Plan for New York River Herring Stocks.

[141]Abercrombie, D and E Pikitch. 2010. Proposal for the Design of a New York State Marine Fishery Observer Program.

[142] Hartley, TW and RA Robertson (2008). Cooperative research program goals in New England: perceptions of active commercial fishermen. Fisheries 33 (11): 551-559.

[143] New York State Department of Environmental Conservation. 2010. 2008 Atlantic Ocean Surf Clam Population Assessment. Division of Fish, Wildlife and Marine Resources, Bureau of Marine Resources.

[144] New York State Department of Environmental Conservation. 2012 Atlantic Ocean Surfclam Survey Overview. Division of Fish, Wildlife and Marine Resources, Bureau of Marine Resources.

[145] Mid-Atlantic Fishery Management Council. 2010. Overview of the surfclam and ocean quahog fisheries and quota considerations for 2011, 2012 and 2013. Mid-Atlantic Fishery Management Council in cooperation with the National Marine Fisheries Service. Mid-Atlantic Fishery Management Council, Dover, DE.

[146] Ibid.

[147] McKay, BJ et al., (2011). Human dimensions of climate change and fisheries in a coupled system: the Atlantic surfclam case. ICES Journal of Marine Science, 68(6), 1354–1367. *icesjms.oxfordjournals.org/content/68/6/1354.full.pdf*

[148] Wallace et al. (2014). Coastal Ocean acidification: The other eutrophication problem. Estuarine, Coastal and Shelf Science, 148: 1-13.

[149] Gobler et al., (2014). Hypoxia and acidification have additive and synergistic negative effects on the growth, survival and metamorphosis of early life stage bivalves. PLoS ONE 9(1): e83648. Doi: 101371/journal.pone.0083648

[150] Talmage SC, CJ Gobler (2009). The effects of elevated carbon dioxide concentrations on the metamorphosis, size, and survival of larval hard clams (*Mercenaria mercenaria*), bay scallops (*Argopecten irradians*), and Eastern oysters (*Crassostrea virginica*). Limnology and Oceanography; 54(6): 2072-2080.

[151] Howell P, et al. (2005). Long-term population trends in American lobster (*Homarus americanus*) and their relation to temperature in Long Island Sound. Journal of Shellfish Research; 24: 849-857.

[152] Dunton, K. J., Jordaan, A., McKown, K. A., Conover, D. O. & Frisk, M. G. (2010). Abundance and distribution of Atlantic sturgeon (*Acipenser oxyrinchus*) within the Northwest Atlantic Ocean determined from five fishery-independent surveys. *Fisheries Bulletin* 108, 450–464.

[153] Jensen AS, Silber GK. 2003. Large Whale Ship Strike Database. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-OPR.

[154] Waring, GT, et al., (eds). 2012. Draft U.S. Atlantic and Gulf of Mexico marine mammal stock assessments 2011. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NE-221.

[155] Federal Register 78 FR 34024 https://federalregister.gov/a/2013-13442

[156]Stanistreet JE, et al. (2013) Passive acoustic tracking of singing humpback whales (Megaptera novaeangliae) on a Northwest Atlantic feeding ground. PLoS ONE 8(4): e61263. doi:10.1371/journal.pone.0061263

[157] Morreale SJ, Standora EA (1998). Early life stage ecology of sea turtles in northeastern U.S. waters. U.S. Dep. Commer. NOAA Tech. Mem. NMFS-SEFSC-413.

[158] Morreale SJ, Standora EA (2005). Western North Atlantic waters: critical developmental habitat for Kemp's ridley and loggerhead sea turtles. Chelonian Conservation and Biology; 4(4): 872-882.

[159] Morreale SJ, Standora EA. (1998). Early life stage ecology of sea turtles in northeastern U.S. waters. U.S. Dep. Commer. NOAA Tech. Mem. NMFS-SEFSC-413.

[160] Morreale SJ, Standora EA (2005). Western North Atlantic waters: critical developmental habitat for Kemp's ridley and loggerhead sea turtles. Chelonian Conservation and Biology 2005; 4(4)872-882.

[161] Dunton KJ, et al. (2010). Abundance and distribution of Atlantic sturgeon (*Acipenser oxyrinchus*) within the northwest Atlantic Ocean, determined from five fishery9independent surveys. Fish. Bull. 108: 450-465.

[162] Moustahfid et al. (2011). Toward a national animal telemetry observing network (ATN) for our oceans, coasts and Great Lakes: workshop synthesis report (U.S. IOOS workshop, March 2011, Santa Cruz, California). U.S. Department of Commerce, NOAA Tech Memo, NMFS, NOAA-NMFS-SWFSC- 482, 15 p.

[163] USFWS. The Horseshoe Crab (*Limulus polyphemus*): A living Fossil Fact Sheet. www.fws.gov/northeast/pdf/horseshoe.fs.pdf

164 Stock Assessment Report No. 09-02 (Supplement A) of the ASMFC horseshoe crab stock assessment for peer review 2009. http://www.asmfc.org/horseshoeCrab.htm

165 T-3-1 Study 5: Horseshoe Crab Spawning Activity Survey-Final Report (2009).

166 Final Report of the New York State Invasive Species Task Force. 2005. www.nyis.info/pdf/NYS_ISTF_Final_Report.pdf

167 Marine Invasive Species State of the Gulf of Maine Report. 2010. http://www.gulfofmaine.org/state-of-the-gulf/docs/marine-invasive-species.pdf

168 Long Island Sound Interstate Aquatic Invasive Species Management Plan. 2007. Connecticut Sea Grant College Program.

169 Danko, M et al., (2012). On the trail of a nuisance: tracking aquatic invasive species in the Mid-Atlantic. The Jersey Shoreline: A publication of the New Jersey Sea Grant Consortium. http://www.njseagrant.org/jersey-shoreline/vol28_no2/articles/invasive-species-live-bait.html

170 Ibid.

171 Marine Invasive Species State of the Gulf of Maine Report. 2010. http://www.gulfofmaine.org/state-of-the-gulf/docs/marine-invasive-species.pdf

172 Ainley, D., P. Adams, and J. Jahncke. 2014. Towards ecosystem based-fishery management in the California Current System – Predators and the preyscape: a workshop. Unpublished report to the National Fish and Wildlife Foundation. Point Blue Conservation Science, Petaluma, California. Point Blue contribution number 1979. http://www.pointblue.org/uploads/assets/calcurrent/REPORT_Forage_Fish_Workshop_FINAL.pdf

173 NOAA Fisheries. Two takes on climate change in the ocean. http://www.nmfs.noaa.gov/stories/2013/09/9_30_13two_takes_on_climate_change_in_ocean.html

174 Bascompte J et al. (2005). Interaction strength combinations and the overfishing of a marine food web. Proceedings of the National Academy of Sciences, 102(15): 5443-5447.

175 Hunsicker et al. (2011). Functional responses and scaling in predator-prey interactions of marine fishes: contemporary issues and emerging concepts. Ecology Letters, 14: 1288-1299.

176 O'Leary SJ, Hice LA, Feldheim KA, Frisk MG, McElroy AE, et al. (2013) Severe Inbreeding and Small Effective Number of Breeders in a Formerly Abundant Marine Fish. PLoS ONE 8(6): e66126. doi:10.1371/journal.pone.0066126

177 Sagarese, S.R. and M.G. Frisk (2011). Movements and residence of adult winter flounder, Pseudopleuronectes americanus, within a Long Island (NY) Estuary. Marine and Coastal Fisheries 3:295-306.

178 O'Leary SJ, Hice LA, Feldheim KA, Frisk MG, McElroy AE, et al. (2013) Severe Inbreeding and Small Effective Number of Breeders in a Formerly Abundant Marine Fish. PLoS ONE 8(6): e66126. doi:10.1371/journal.pone.0066126
http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0066126

179 Frisk et al. 2013. Restoring Long Island's winter flounder fishery: Influence of natural and anthropogenic factors on health, fitness and recruitment success. Final report to the Saltonstall-Kennedy Grant Program of the National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration, Department of Commerce.

180 Sagarese, S. R., R. M. Cerrato, and M. G. Frisk. 2011. Diet Composition and Feeding Habits of

Common Fishes in Long Island Bays, New York. Northeastern Naturalist 18:291-314.

181 Collier JL, Fitzgerald SP, Hice LA, Frisk MG, McElroy AE (2014) A New PCR-Based Method Shows That Blue Crabs (Callinectes sapidus (Rathbun)) Consume Winter Flounder (Pseudopleuronectes americanus (Walbaum)). PLoS ONE 9(1): e85101. doi:10.1371/journal.pone.0085101
http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0085101

[182] Frisk et al. 2013. Restoring Long Island's winter flounder fishery: Influence of natural and anthropogenic factors on health, fitness and recruitment success. Final report to the Saltonstall-Kennedy Grant Program of the National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration, Department of Commerce.

[183] Packer, D and DS Dorfman. 2012. Chapter 5: Deep Sea Corals. 00 69-86. In C. Menza, BP Kinlan, DS Dorfman, M Pott and C Caldow (eds.). A Biogeographic Assessment of Seabirds, Deep Sea Corals and Ocean Habitats of the New York Bight: Science to Support Offshore Spatial Planning. NOAA Technical Memorandum NOS NCCOS 141. Silver Spring, MD. 224 pp.

[184] Sydeman et al. (2013). Hotspots of Seabird Abundance in the California Current: Implications for Important Bird Areas http://www.audubon.org/sites/default/files/documents/report_audubon_marine_ibas_011813.pdf

[185] New York State Division of Fish, Wildlife and Marine Resources. 2005. Comprehensive Wildlife Conservation Strategy for New York.

[186] New York State Department of State. 2013. Offshore Atlantic Ocean Study. http://docs.dos.ny.gov/communitieswaterfronts/ocean_docs/NYSDOS_Offshore_Atlantic_Ocean_Study.pdf

[187] National Ocean Council. 2013. National Ocean Policy Implementation Plan. Executive Office of the President, Washington, DC. 32 p.

[188] Nieder W. 2010. The relationship between cooling water capacity utilization, electric generating capacity utilization, and impingement and entrainment at New York state steam electric generating facilities. New York State Department of Environmental Conservation.

[189] Madsen et al., (2006). Wind turbine underwater noise and marine mammals: implications of current knowledge and data needs. Marine Ecology Progressive Series, 309: 279-295.

[190] NOAA. 2013. Draft guidance for assessing the impacts of anthropogenic sound on marine mammals: acoustic threshold levels for onset of permanent and temporary threshold shifts. www.nmfs.noaa.gov/pr/acoustics/draft_acoustic_guidance_2013.pdf

[191] ibid.

[192]U.S. Department of Transportation Maritime Administration. 2005. Report to congress on the performance of ports and the intermodal system.

[193] Ibid.

[194] National Oceanic and Atmospheric Administration. 2011. Marine aquaculture policy.

[195] Cornell Cooperative Extension. 2004. New York aquaculture industry: Status, constraints, and opportunities.

[196] National Oceanic and Atmospheric Administration. 2011. Marine aquaculture policy.

[197]National Oceanic and Atmospheric Administration. 2008. Offshore aquaculture in the United States: Economic considerations, implications and opportunities.

[198] Report of the Marine Aquaculture Task Force. 2007. Sustainable Marine Aquaculture: Fulfilling the Promise; Managing the Risks. Pg 128.

[199] Price, C.S. and J.A. Morris, Jr. 2013. Marine cage culture and the environment: twenty-first century science informing a sustainable industry. NOAA Technical Memorandum NOS NCCOS 164. 158 pp. http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CC4QFjAA&url=http%3A%2F%2Fwww.noaanews.noaa.gov%2Fstories2013%2Fpdfs%2F2013_PriceandMorris_MarineCageCultureandTheEnvironment(5).pdf&ei=gXPNUtjoIrKH2AWKuYDICg&usg=AFQjCNFNC6Sp6cH66ZKGR2pDisG-T2Gihw&sig2=ENFhDIVmWZ3cnYx4ih6kVA&bvm=bv.58187178,d.b2I&cad=rja

[200] Flimlin, G et al. (2010). Best management practices for the east coast shellfish aquaculture industry. East Coast Shellfish Growers Association http://www.ecsga.org/Pages/Resources/BMP.html

[201] U.S. EPA (Environmental Protection Agency). (2013) Watershed modeling to assess the sensitivity of streamflow, nutrient, and sediment loads to potential climate change and urban development in 20 U.S. watersheds. National Center for Environmental Assessment, Washington, DC; EPA/600/R-12/058F. Available from the National Technical Information Service, Alexandria, VA, and online at http://www.epa.gov/ncea.

[202] New York State Sea-level rise Task Force. 2010. Report to the Legislature.

[203] National Wildlife Federation. 2011. Practical guidance for coastal climate-smart conservation projects in the northeast: case examples for coastal impoundments and living shorelines.

[204] Hilke, C. and Galbraith, H. 2013. Assessing the Vulnerability of Key Habitats in New York: A Foundation for Climate Adaptation Planning. National Wildlife Federation, Northeast Regional Center. Montpelier, VT.

[205] Schlesinger, M.D., J.D. Corser, K.A. Perkins, and E.L. White. 2011. Vulnerability of at-risk species to climate change in New York. New York Natural Heritage Program, Albany, NY.

[206] Swanson, RL, R. Wilson, B Brownawell, K Willig, P Ng and T Moore. (2014). Draft Consequences of the Bay Park Sewage Treatment Plant on Water and Sediment Quality Following Superstorm Sandy.

[207] Rhoads J. Norton (2001). Basin/Little Bay restoration project: historical and environmental background report.

[208] Diaz R, et al. (2004). Potential impacts of sand mining offshore of Maryland and Delaware: Part 2—biological considerations. Journal of Coastal Research; 20(1): 61-69.

[209] Ocean Literacy: The Essential Principles and Fundamental Concepts of Ocean Sciences for Learners of All Ages. Version 2: March 2013. http://oceanliteracy.wp2.coexploration.org/

[210] COSEE OCEAN Inquiry Group. "COSEE OCEAN Inquiry Group Report: Opportunities for Creating Lifelong Ocean Science Literacy." Boston, MA: School for the Environment, University of Massachusetts, Boston. 124 pp. http://scholarworks.umb.edu/environment_pubs/1/

[211] Shafir, Eldar (ed.) (2013). The behavioral foundations of public policy. Princeton: Princeton University Press.

[212] Shifting baselines: The Past and the Future of Ocean Fisheries. 2011. Jackson, J.B.C, K.E Alexander and E. Sala (eds.), Island Press, Washington. 296 pg.

[213] http://oceanliteracy.wp2.coexploration.org/

[214] Ocean Conservancy. 2007. National Marine Debris Monitoring Program: Final Program Report, Data Analysis & Summary. http://www.unep.org/regionalseas/marinelitter/publications/docs/NMDMP_REPORT_Ocean_Conservancy_2_.pdf

[215] Barnea, N et al. (2009). Marine debris response planning in the North-Central Gulf of Mexico. June 2009. NOAA Technical Memorandum NOS-OR&R-31.

[216] UNEP. 2009. Marine Litter: A Global Challenge http://www.unep.org/pdf/UNEP_Marine_Litter-A_Global_Challenge.pdf

[217] Chen, C and Liu, T. (2013). Fill the gap: developing management strategies to control garbage pollution from fishing vessels. Marine Policy, 40: 34-40.

[218] Hoagland P, Meeks AE. The demand for whale watching at Stellwagen Bank National Marine Sanctuary. National Oceanic and Atmospheric Administration. 2000.

[219]DiGiovanni RA, Sabrosky AM (2010). A note on seal watching in the Northeast United States. NAMMCO Scientific Publication; 8: 373-377.

[220] Parsons, ECM (2012). The negative impacts of whale-watching. Journal of Marine Biology, vol. 2012, Article ID 807294, 9 pages. http://www.hindawi.com/journals/jmb/2012/807294/cta/

[221] Palumbi SR, et al., (2009). Managing for ocean biodiversity to sustain marine ecosystem services. Frontiers in Ecology and the Environment; 7: 204–211.

[222] The White House: Office of the Press Secretary. Executive Order 13547: Stewardship of the ocean, our coasts, and the great lakes. 2010.

[223] Draft National Ocean policy Implementation Plan. National Ocean Council. 2012.

[224] Halpern BS, et al. Managing for cumulative impacts in ecosystem-based management through ocean zoning. Ocean & Coastal Management 2008;51(3):203–211.

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation | Department of State