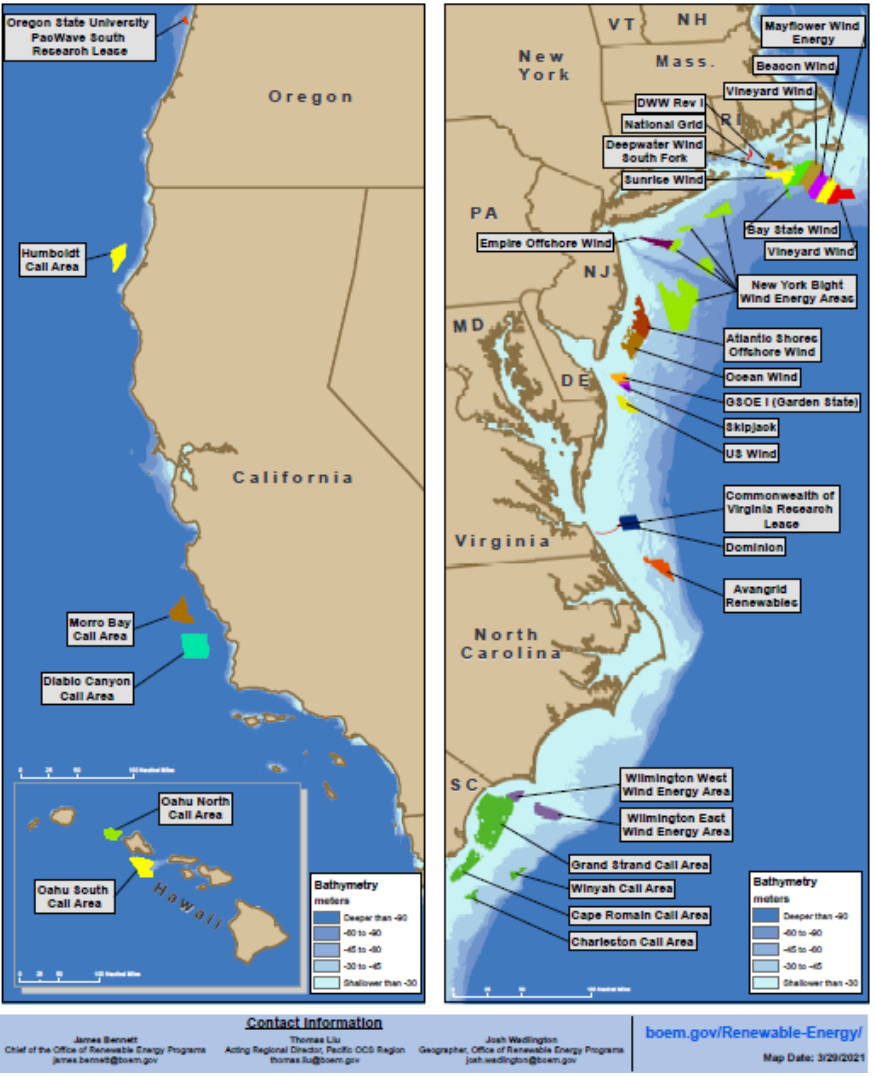
Offshore Wind Energy Update

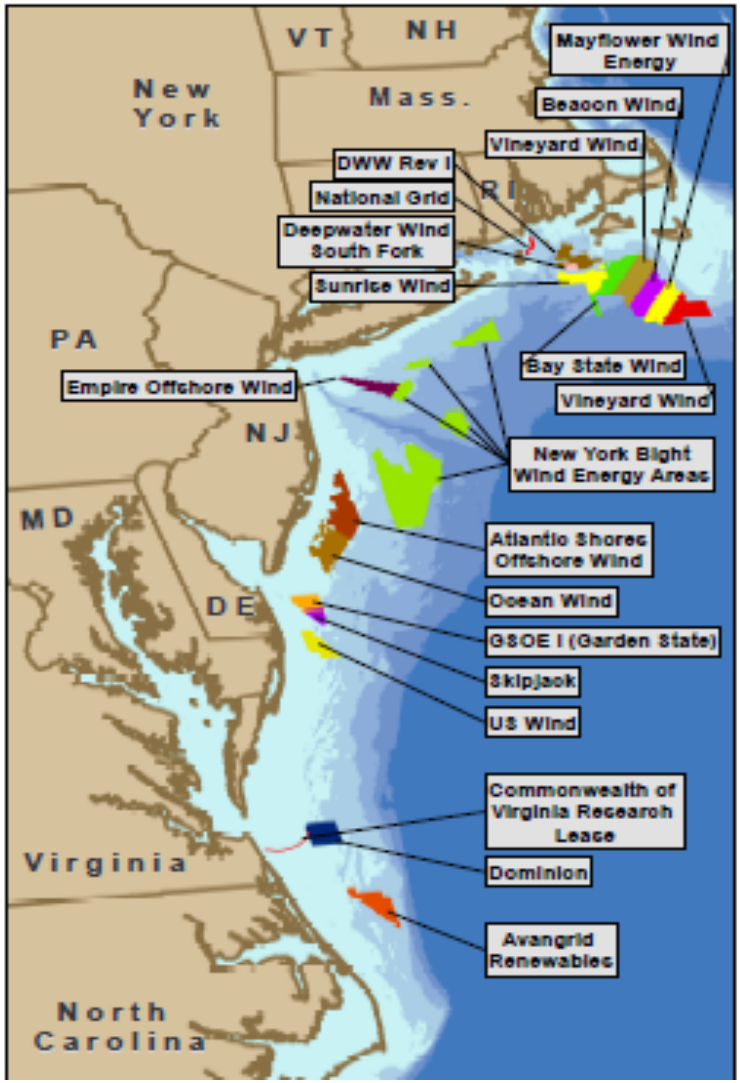
Sam Rauch

May 26, 2021 - MAFAC Meeting



Current Leases and Call Areas

- 17 active commercial & 1 active research leases in the Atlantic
- 1 active research lease off OR
- New Wind Energy Areas identified in NY Bight in March 2021
- Call Areas off SC (2015), HI (2016) and CA (2018)
- Creation of the Gulf of Mexico Intergovernmental Renewable Energy Task Force in 2021



Environmental Review & Workload

- White House goal to approve **at least** 16 Construction & Operations Plans (COPs) by late 2024/early 2025
- 14 submitted COPs
- Site Assessment Plan reviews
- New industry to U.S. waters—unknown impacts

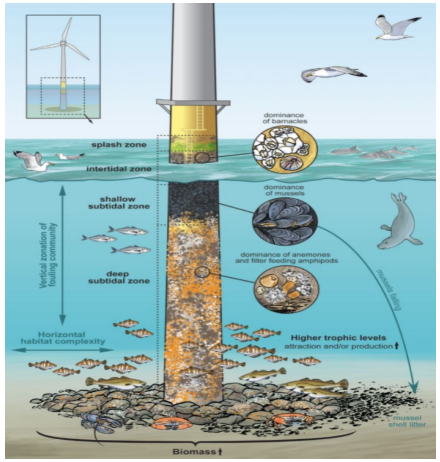

Floating offshore wind turbines

Offshore Wind Energy Science Updates

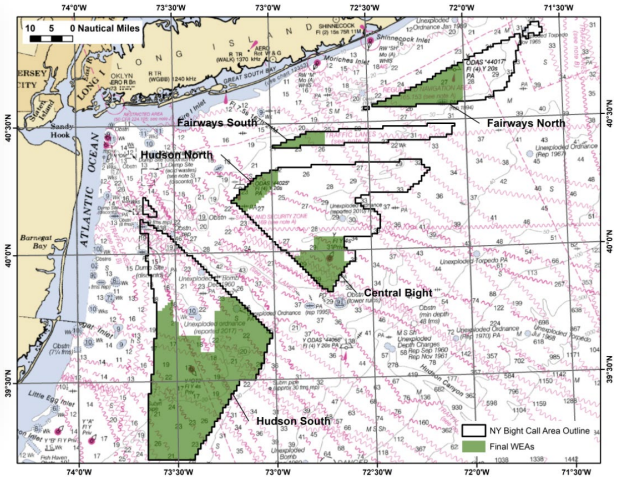
Andy Lipsky, Elizabeth Methratta, Chris Orphanides, Angela Silva, and Jon Hare
NOAA Northeast Fisheries Science Center

NOAA FISHERIES
Northeast Fisheries Science Center

Presentation to the MAFAC
May 26, 2021



Degraer et al., 2020

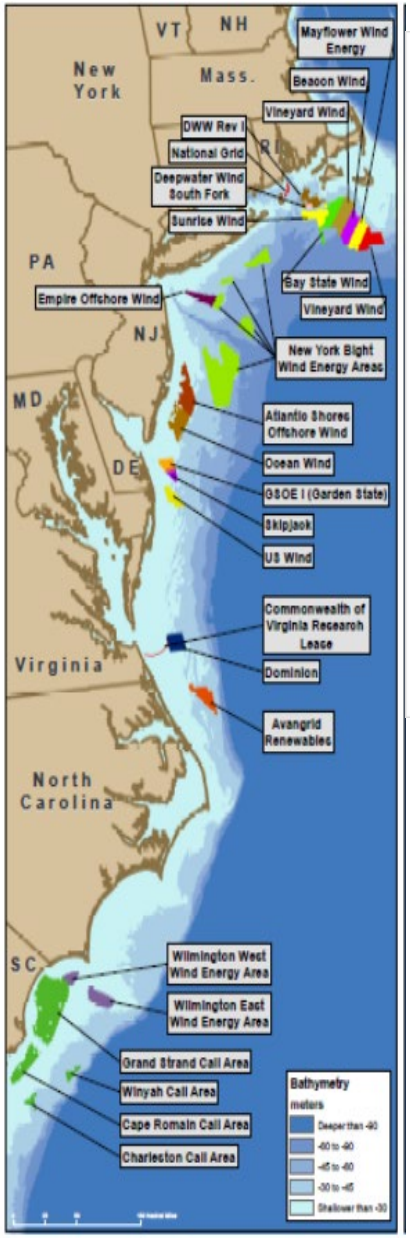


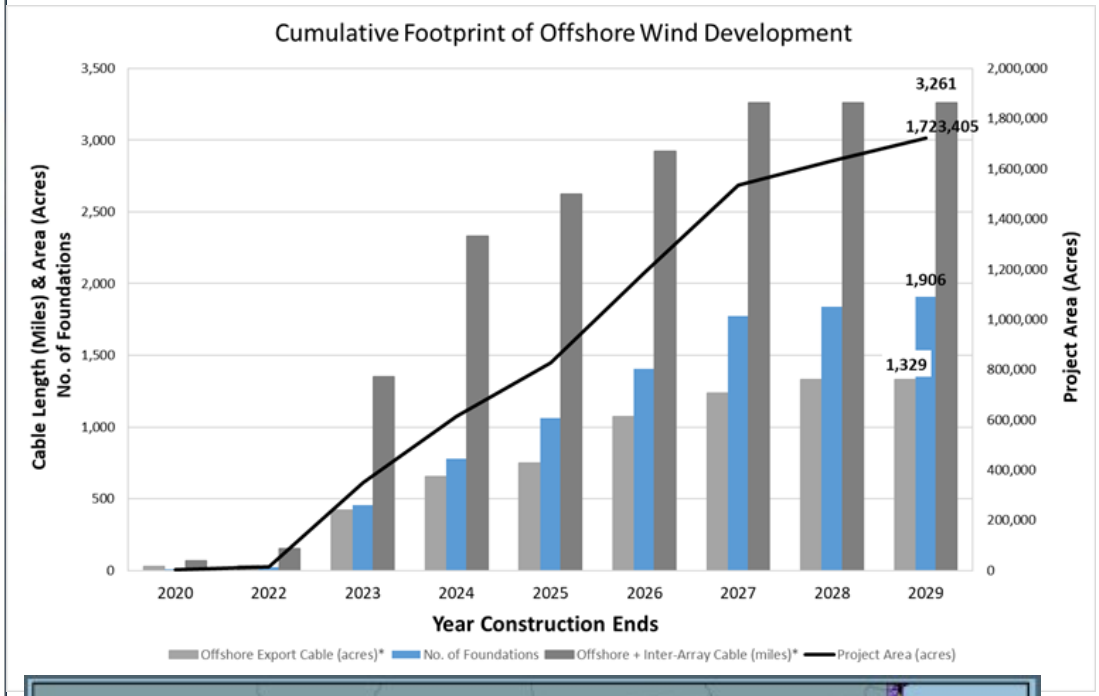
NOAA Fisheries
Offshore Wind Needs

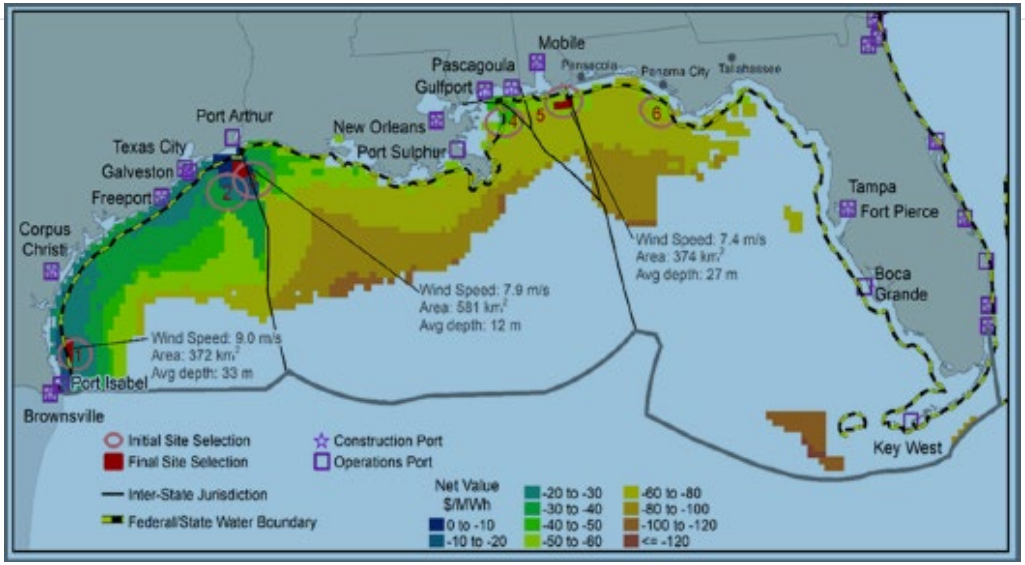
1. Support to Regulatory Process
2. Scientific Support for the Regulatory Process
3. Address impacts of wind on Federal Surveys & Scientific Advice
4. Understanding Interactions with NOAA Trust Resources

Scientific Support for the Regulatory Process

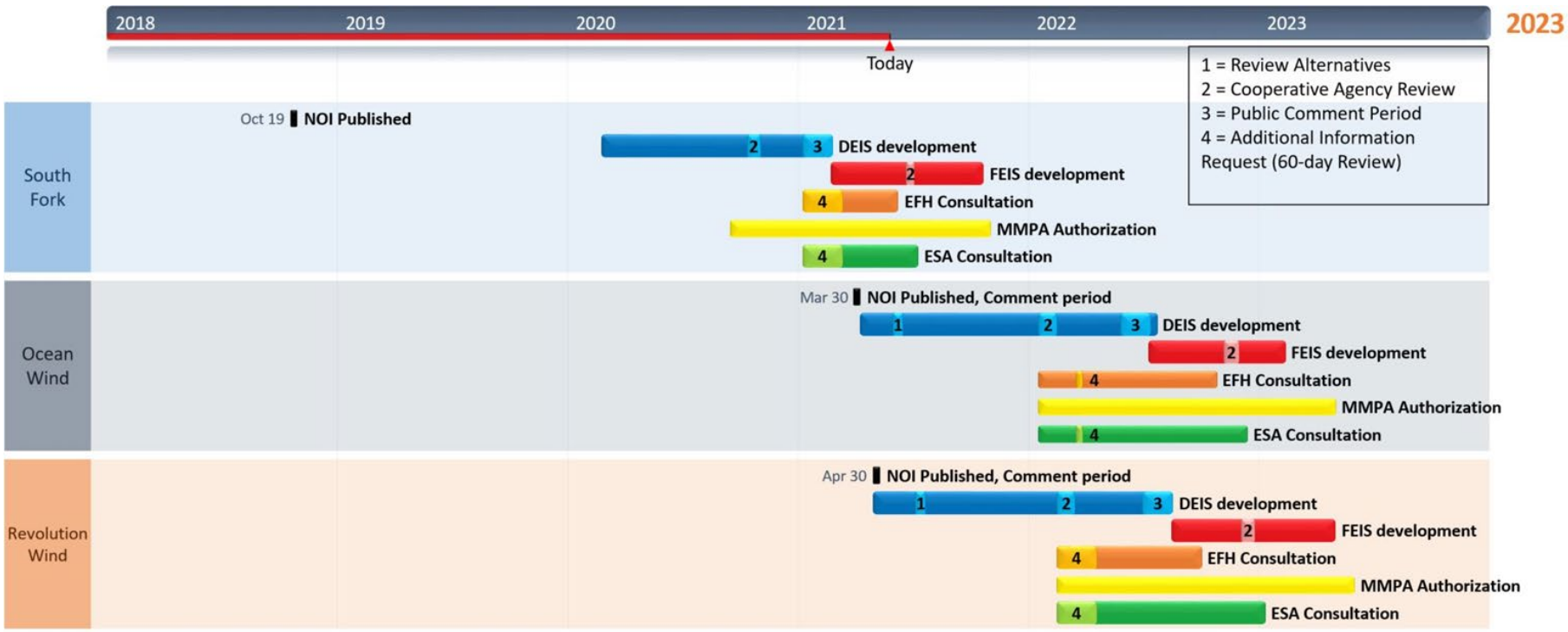
Scientific Support needed for cumulative development







Regulatory Process to Integrate Scientific Advice

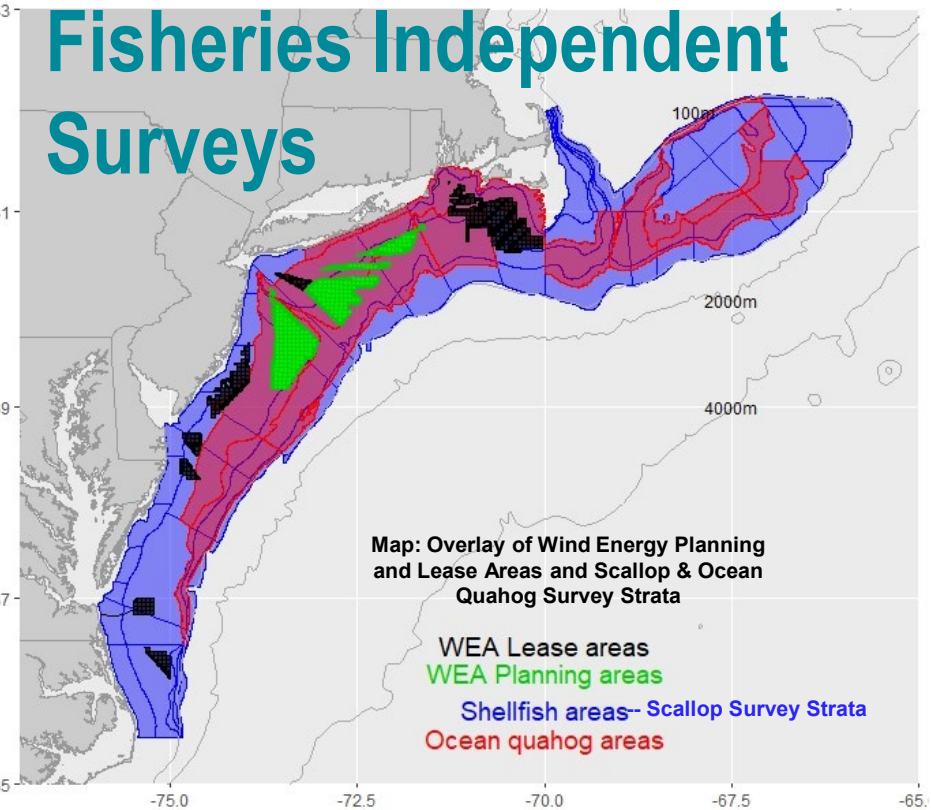


+ **Additional Projects?**

If current NOI release rates by BOEM continue (every 30 days) we would contribute concurrently to an <u>Additional Six EIS's</u> before the end of 2021

Addressing Impacts of Offshore Wind Development on NOAA Scientific Surveys & Advice

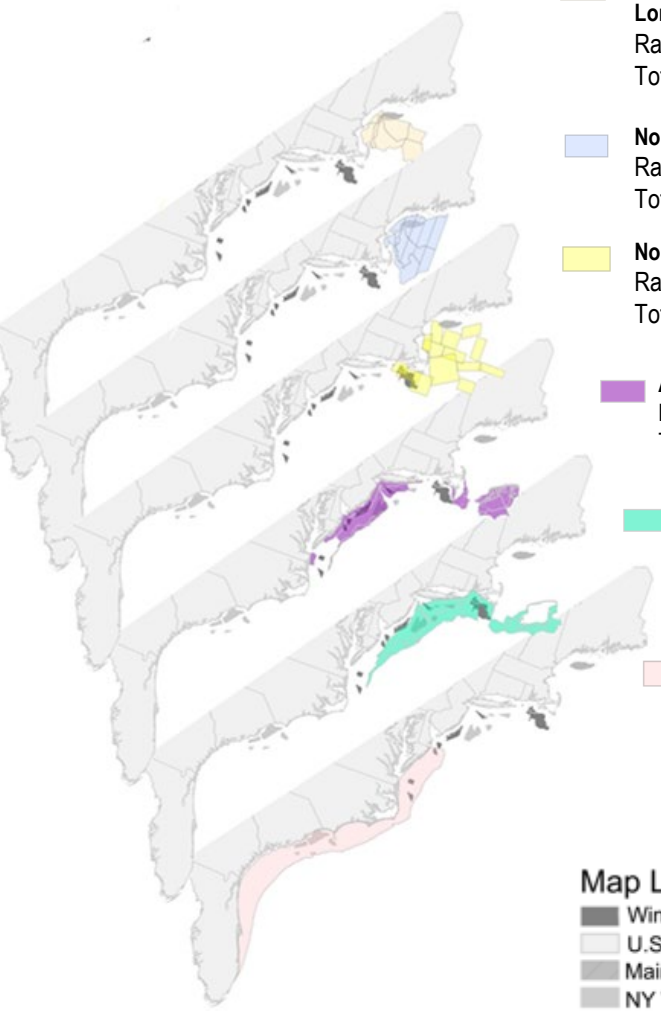
Offshore Wind & Fisheries Independent Surveys



Represents 394 Years of Total Survey Effort
Underpin fisheries valued at $27B/year commercial fisheries & $6.5B recreational fisheries (NMFS, 2018)

Survey	Year Started	Survey Design	Major Applications
Autumn Bottom Trawl Survey	1963	Random Stratified Design - North Carolina to Nova Scotia (bottom trawl)	abundance; length, age, sex, weight, diet, maturity samples, distribution, EcoMon
Spring Bottom Trawl Survey	1968	Random Stratified Design - North Carolina to Nova Scotia (bottom trawl)	abundance; length, age, sex, weight, diet, maturity samples, distribution, components of Ecosystem Monitoring survey
Scallop Survey	1979	Random Stratified Design (dredge); line transect (HabCam)	biomass, abundance, distribution, size and sex of sea scallops and other benthic fauna
Atlantic Surfclam and Ocean Quahog Surveys	1980	Random Stratified Design (hydraulic dredge)	biomass, abundance, distribution, size and sex of Atlantic surfclam and ocean quahog
Northern Shrimp Survey	1983	Random Stratified Design (commercial shrimp trawl)	biomass, abundance, length
Gulf of Maine Cooperative Bottom Longline Survey	2014	Randomly Stratified Design (bottom longline)	abundance, biomass, length, age, sex, weight, maturity samples, distribution, habitat data
Ecosystem Monitoring Survey	1977	Random Stratified Design (linked to Trawl Survey Design); fixed stations embedded in design (plankton and oceanographic sampling)	Phyto/nkton, zooplankton, ichthyoplankton, carbonate chemistry, nutrients, marine mammals, sea birds
North Atlantic Right Whale Aerial Surveys	1998	Aerial line transects	Right Whale population estimates; dynamic area management
Marine mammal and sea turtle ship-based and aerial surveys	1991	Line transects for ship and aerial surveys. biological and physical oceanography sampling	Abundance and spatial distribution of marine mammals, sea turtles, and sea birds
Large Coastal Shark Bottom Long-line Survey	1986	Fixed station design in US continental shelf waters from Fl to DE with stations ~ 30 nm apart	Abund., distribution, migrations (tagging), and bio-sampling for assessment, EFH designations, and life history studies
Coop. Atlantic States Shark Pupping and Nursery Longline/Gillnet Survey	1998	Random stratified and fixed station (longline and gillnet) surveys in estuarine and nearshore waters from Florida to Delaware	Abundance, distribution, migrations (tagging), and bio-sampling for assessment, EFH, and life history studies

Northeast NMFS Survey Interactions with Offshore Wind



Gulf of Maine Cooperative Bottom Longline Survey
Range: 2-7%
Total: 2%

Northern Shrimp Survey
Range: 1-39%
Total: 5%

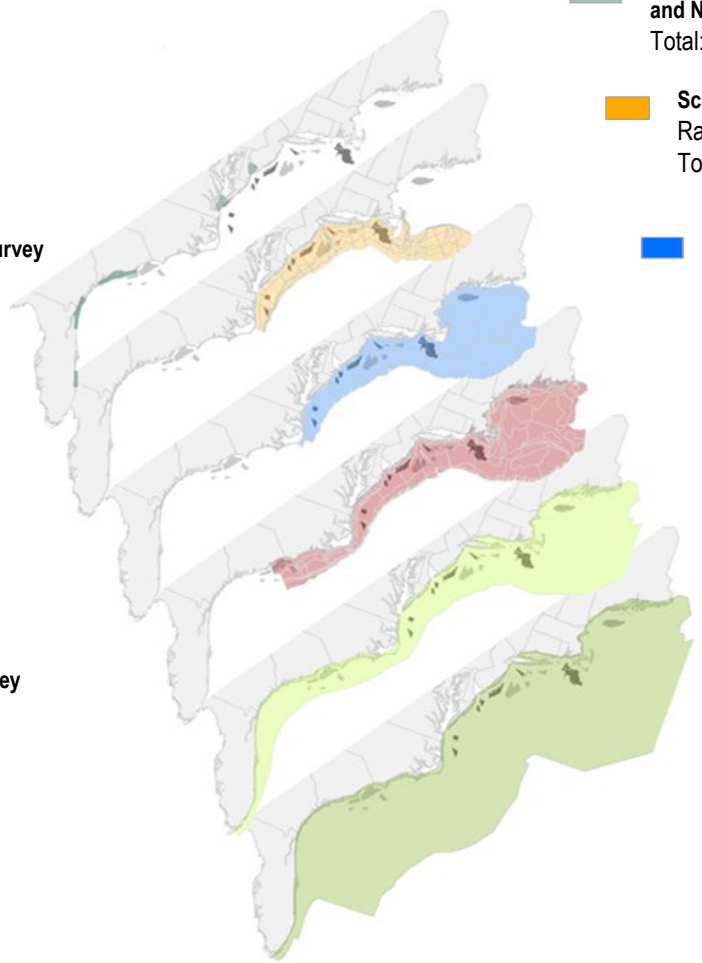
North Atlantic Right Whale Survey
Range: 5-50%
Total: 5%

Atlantic Surfclam Survey
Range: 3-21%
Total: 9%

Ocean Quahog Survey
Range:1-21%
Total: 9%

Large Coastal Shark Bottom Longline Survey
Total: 5%

Map Legend
- Wind Lease Areas
- U.S. State Boundaries
- Maine Area of Interest (AOI)
- NY Wind Energy Areas & SC Planning Areas



Cooperative Atlantic States Pupping and Nursery (COASTSPAN)
Total: <1%

Scallop Survey
Range: 1-96%
Total: 7%

Ecosystem Monitoring Survey
Range: 1-37%
Total: 5%

Bottom Trawl Survey
Range: 1-76%
Total: 5%

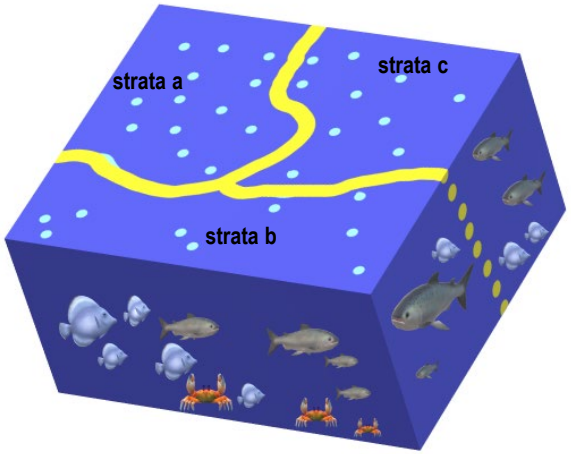
Protected Species Abundance Surveys Aerial
Total: 3%

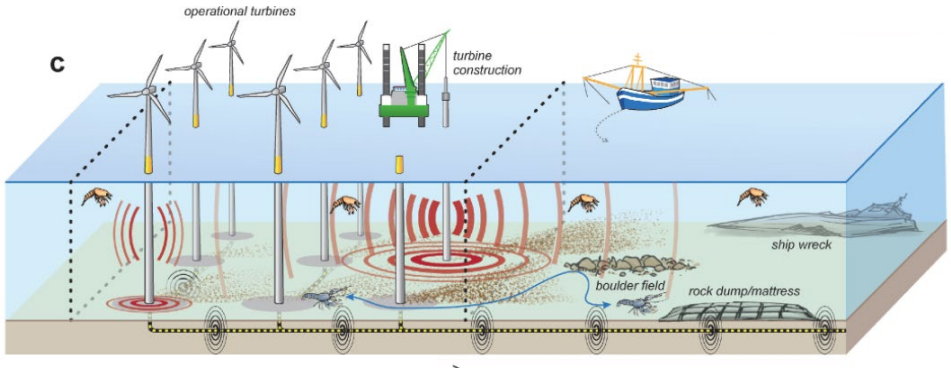
Shipboard + Aerial
Total: 2%

Range= Minimum and maximum overlap with survey strata
Total = Percent overlap of wind development with total survey area

Wind Energy Actuates Impacts to Scientific Surveys in Four Ways:

1. **Preclusion**- displacement by infrastructure
2. **Impacts to Statistical Survey Design**
3. **Habitat Change** that affect species distribution, abundance, and vital rates within and outside wind energy areas
4. **Impacts to sampling** outside of developments by wind energy-induced transit effects that can result in lost sampling time





Gill Methratta al., 2020

Implications of NOAA Fisheries Survey Disruptions

American Public

- Adverse impacts on fishermen and fishing communities and American public who consume seafood and expect recovery and conservation of endangered species and marine mammals

Commercial/Recreational Fishermen & Fishing Communities

- Increase uncertainty in estimates of abundance—through application of the precautionary approach—impacting setting of quotas,
- Increase in more precautionary protected species management measures

Protected Species

- Greater uncertainty in protected species assessments/recovery programs

Non-fishing Sectors-Shipping & Energy

- Uncertainty in protected species information and stock assessments

Federal Agencies

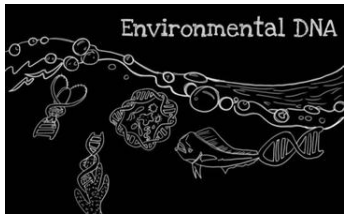
- Harm caused by the need to include more precautionary mitigation measures, e.g., Incidental Take Statements (ITA) through ESA Biological Opinions and MMPA ITAs

Climate Science

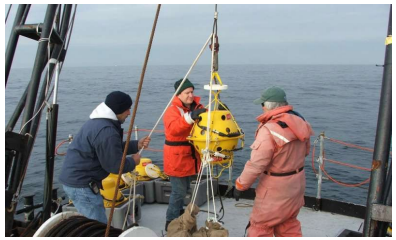
- Disruptions of 60+ year time series decreases ability to understand and mitigate the effects of climate change, impacting American Public

Implementing a Federal Survey Mitigation Program

1. **Evaluate survey designs**: Evaluate and quantify effects and impacts of proposed project-related wind development activities on scientific survey operations and on provision of scientific advice to management.



1. **Identify and develop new survey approaches**: Evaluate or develop appropriate statistical designs, sampling protocols, and methods, while determining if scientific data quality standards for the provision of management advice are maintained.



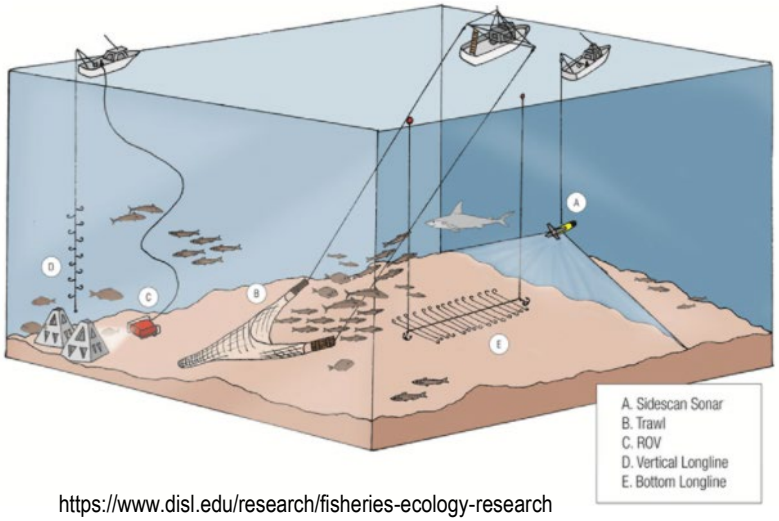
1. **Calibrate new survey approaches**: Design and carry out necessary calibrations and required monitoring standardization to ensure continuity, interoperability, precision, and accuracy of data collections.

Implementing a Federal Survey Mitigation Program

5. **Develop interim provisional survey indices:** Develop interim indices from existing data sets to partially bridge the gap in data quality and availability between pre-construction, and operational periods while new approaches are being identified, tested or calibrated.

6. **Wind energy monitoring to fill regional scientific survey data needs**: Apply new statistical designs and carryout sampling methods to effectively mitigate survey impacts due to offshore wind activities from operations for the 30 year operational life-span of project developments.

5. **Develop and communicate new regional data systems:** New data collections will require new data collection, analysis, management, dissemination and reporting systems. Changes to surveys and new approaches will require substantial collaboration with fishery management, fishing industry, scientific institutions and other partners.



https://www.disl.edu/research/fisheries-ecology-research

Northeast Surveys: Status of Survey Mitigation Steps

NOAA Fisheries Survey Time Series	1.Evaluate designs & impacts	2. Design New methods	3. Calibrate New/Existing Surveys	4.Bridge Solutions	5. Conduct New Surveys	6. Comms. & Data
Fall BTS	Started	Initial	No	No	No	Initial
Spring BTS	Started	Initial	No	No	No	No
EcoMon	No	No	No	No	No	No
Scallop	Started	Grant?	No	No	No	No
Shellfish- (clams)	No	No	No	No	No	No
Right Whale-Air	**Initial**	Pending Grant	Pending Grant	No	No	No
Marine Mammal/sea Turtle Ship/Air	No	No	No	No	No	No
Atlantic Shark Bottom Long-Line	No	No	No	No	No	No
GOM Bottom Long Line	No	No	No	No	No	No
GOM Shrimp Survey	No	No	No	No	No	No
Atlantic Shark COASTPAN	No	No	No	No	No	No

Development of an Adaptation strategy for Multi-Species Bottom Trawl

- **Determine effects of wind development on survey data, stock assessments and management measures.**
  - Evaluate range of impacts (eg. Eliminate all observations from WEAs and recalculate abundance indices)
  - Must look at over 40 assessed stocks for bottom trawl survey

- **Identify potential combination(s) of sampling methodologies and statistical designs for inside WEAs**
  - Results should be able to be incorporated with historical and existing sampling for continuity of time-series

- **Observing System Simulation Experiments (OSSE)** and/or other modeling approaches
  - Interagency Agreement with Bureau of Ocean Energy Management
  - **Stakeholder workshops in 2021**
    - Identify impacts of offshore wind energy development on fisheries
    - Impacts on stock assessment and management advice
    - Define the objectives and questions that OSSE needs to answer
    - Design analytic and empirical framework

- **Build Model, evaluate alternatives, identify survey adaptation actions**

Essay on the use of Observing System Simulation Experiments in the US published in the Bulletin of the American Meteorological Society

SEPTEMBER 11, 2020

BAMS Essay

Use of Observing System Simulation Experiments in the United States

Xubin Zeng, Robert Atlas, Ronald J. Birk, Frederick H. Carr, Matthew J. Carrier, Lidia Cucurull, William H. Hooke, Eugenia Kalnay, Raghu Murtugudde, Derek J. Posselt, Joellen L. Russell, Daniel P. Tyndall, Robert A. Weller, and Fuqing Zhang

CINAR

Cooperative Institute for the North Atlantic Region

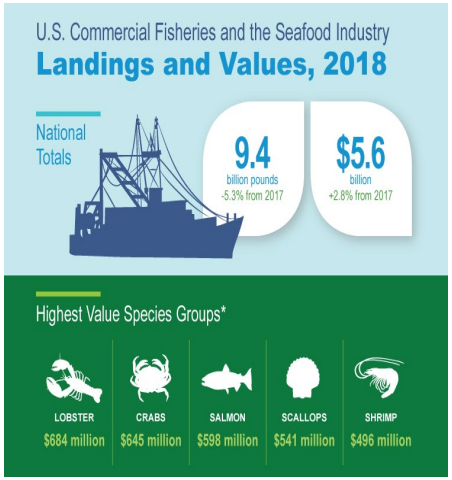
What we know, don't know, & need to know

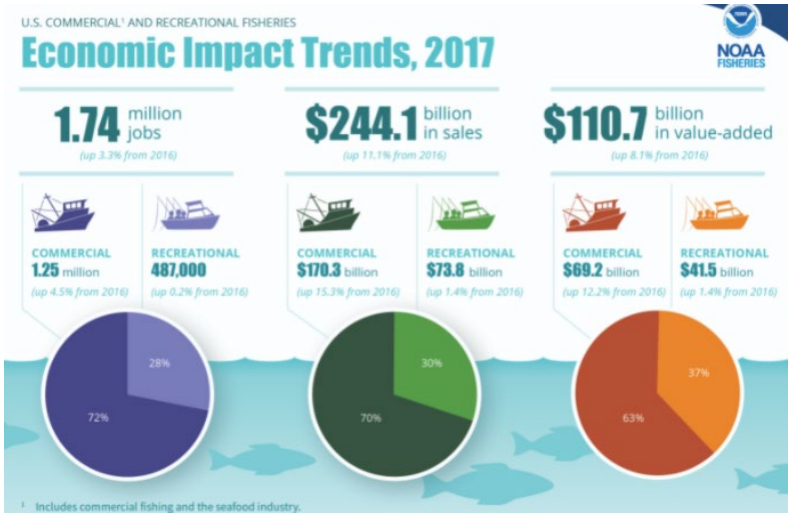
Understanding Interactions of Offshore Wind with NOAA Trust Resources

	Known to U.S. Research	Unknown to U.S. Research
Known to others	Mutually Understood	Unknown by our research but known by others
Unknown to others	Known by our research but unknown by others	? Unknown by all

Johari Window adapted from (Luft and Ingham (1955)

Addressing Human Dimensions Research Needs





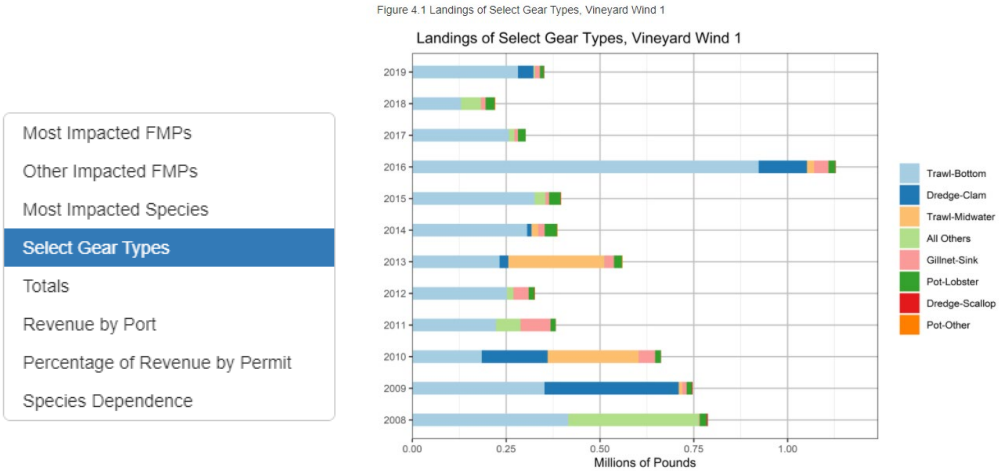
Scallop fishing activity 2015-16 and current wind areas

The scallop fishery is one of the most valuable U.S. fisheries ($500M/year)

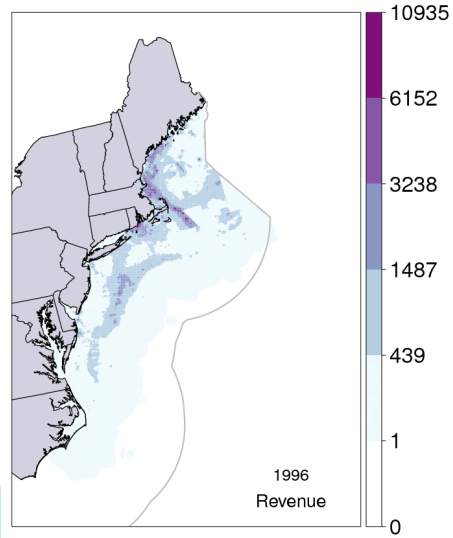
Socio-economic Data Tools: Impacts of Offshore Wind Development

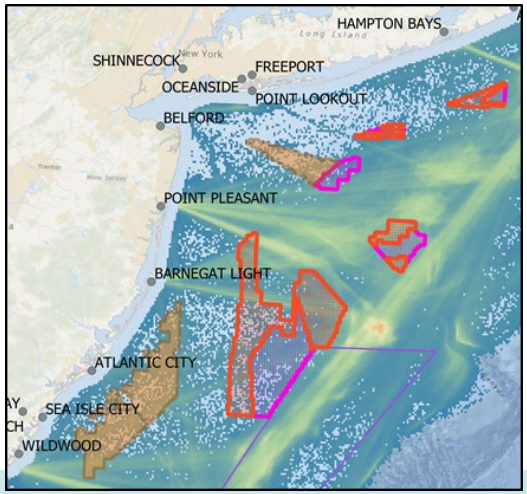
- NOAA Fisheries developed reports summarizing previous fishing activity within wind energy areas https://www.fisheries.noaa.gov/resource/data/socioeconomic-impacts-atlantic-offshore-wind-development
- Highlights annualized landings and revenue by species, gear type, ports and fishery management plan
- Can be used to prepare fisheries monitoring plans and socio-economic impact analysis
- Next steps: Developing a predictive displacement model for the Atlantic sea scallop fishery

Vineyard Wind Project Area Reports for Landings by Gear Type:



Fishing Footprint





ICES Workshop on the Socio-economic Implications of Offshore Wind on Fishing Communities (WKSEIOWFC)

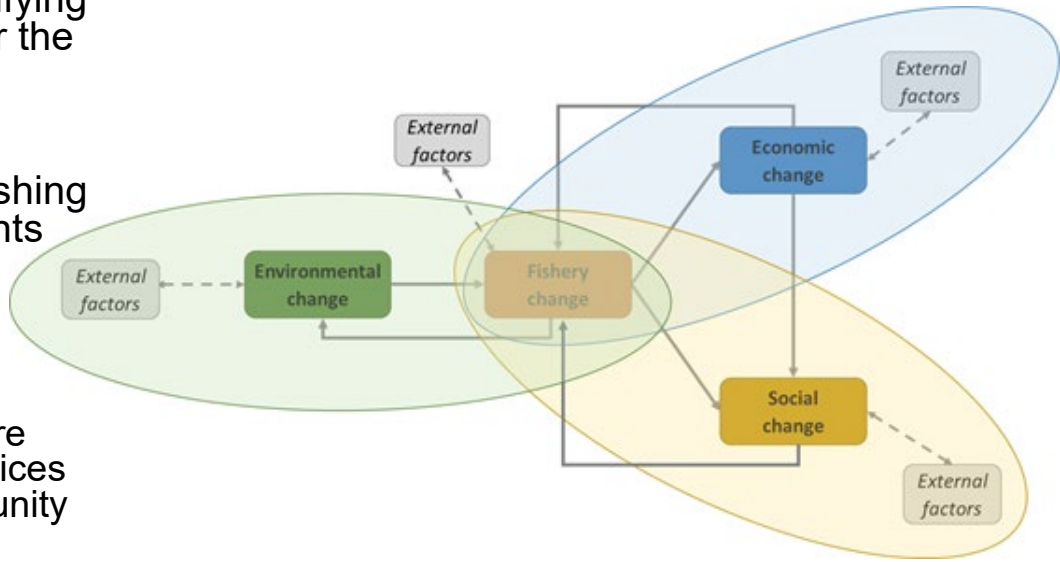
1. ICES Wind&Fisheries Working Group determined that no common, consistent, and accepted framework for defining and quantifying socio-economic impacts exist in Europe nor the United States.

1. Workshop attended by participants from **9 countries** representing policy/regulation, fishing industry, offshore wind industries, consultants and academia

1. **Objectives of the Workshop:**

   - To determine the routes by which offshore wind could cause change in fishing practices and the implications at individual, community and societal levels

   - Determine existing evidence, identify methods to fill data gaps, and develop recommendations for generating evidence



ICES CIEM

Offshore Wind in the NE U.S. Shelf Ecosystem

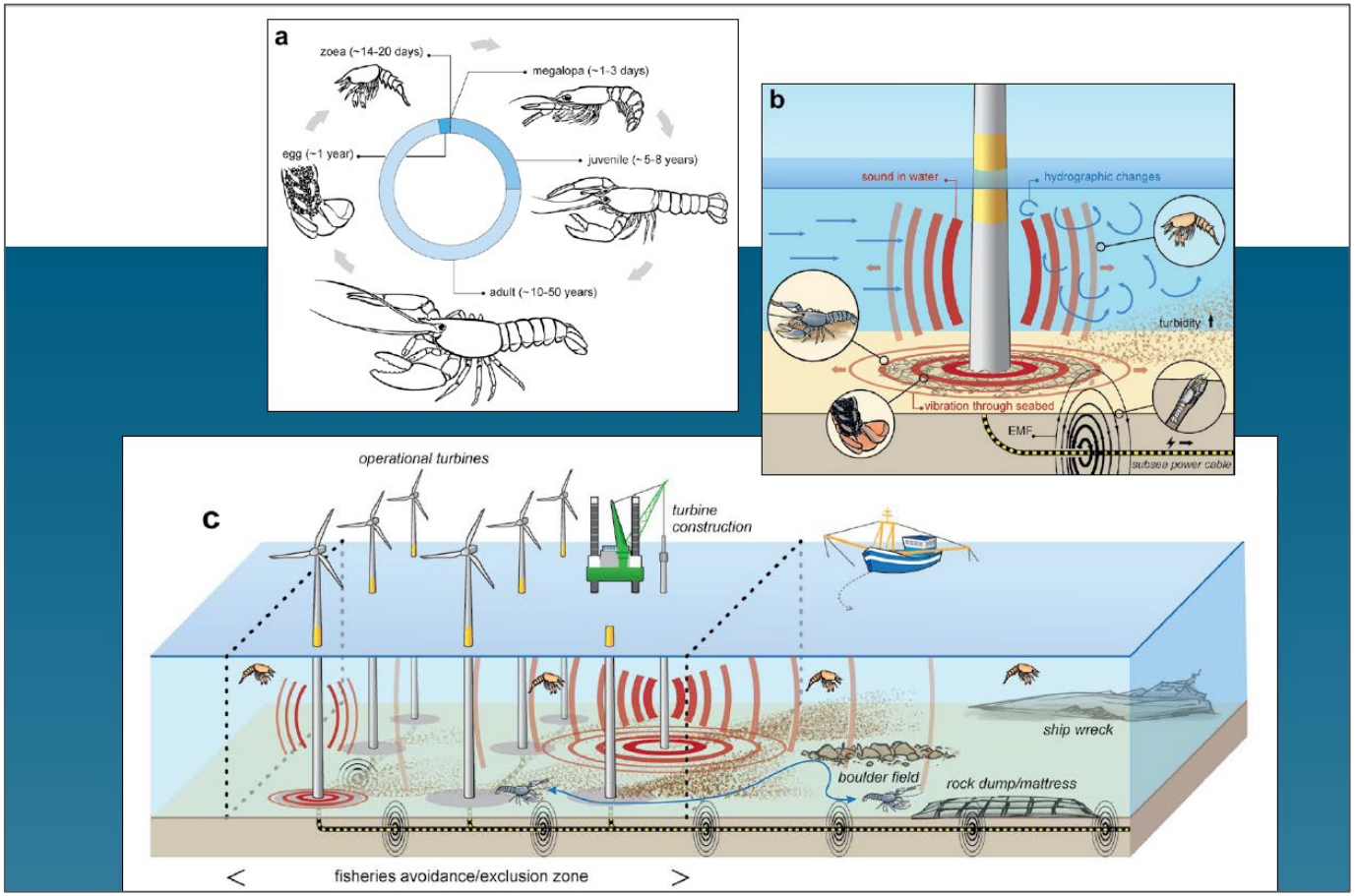
Methratta et al. 2020 *Oceanography* 33: 16-27.

- Regional scientific surveys and the scientific advice that they underpin will be impacted
- Fisheries resources will be affected via impact producing factors (sound, EMFs, artificial reef effects, hydrodynamics)
- Fisheries may be affected through changes in fishing effort distribution, navigation, collision potential, gear switching, etc.
- Socio-economic impacts include changes in CPUE, landings revenue, and shoreside communities

Setting the Context

Gill et al. 2020 *Oceanography* 33: 118-127

- Interactions vary among impact producing factor, development phase, space, time, and life stage
- Need to improve understanding of economic and societal impacts of OWFs & linkages to ecosystem services that support fisheries
- Survey and monitoring data at OWFs are needed by fisheries managers



Sound

Mooney et al. 2020 *Oceanography* 33: 82 – 95.

- Activities during all phases of wind farm lifetimes produce underwater sound
- Data on acoustic impacts of OWFs are very limited for most species' populations, life stages, and other phases
- Much more research is needed

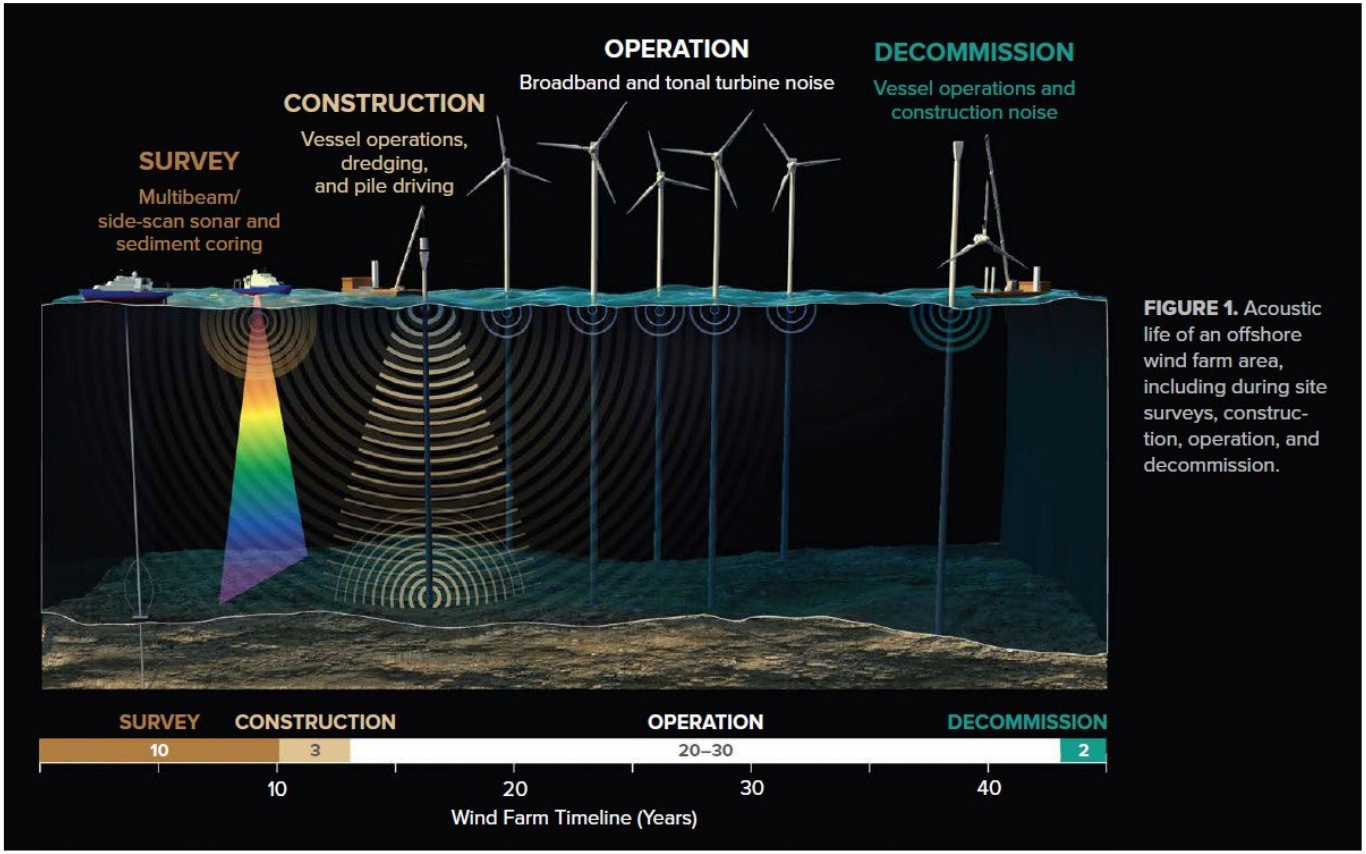
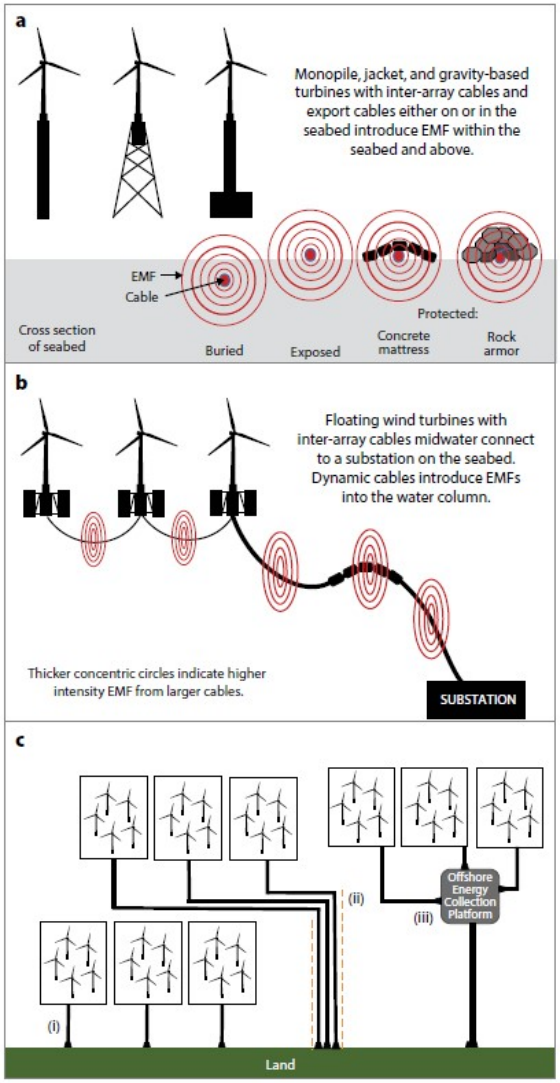


FIGURE 1. Acoustic life of an offshore wind farm area, including during site surveys, construction, operation, and decommission.

Electromagnetic Fields (EMFs)

Hutchison et al. 2020 *Oceanography* 33: 96-107

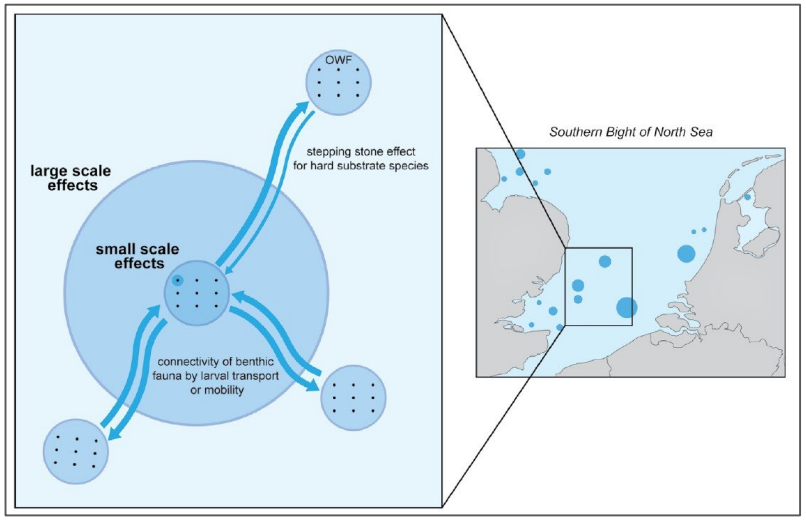
- Existing evidence from field and laboratory studies indicates the potential for EMFs from cables to affect navigation, predator detection, communication, and finding mates for finfish and shellfish
- Electrosensory species and those that use a magnetic map sense are particularly vulnerable.
- More research is needed to understand individual to population level effects

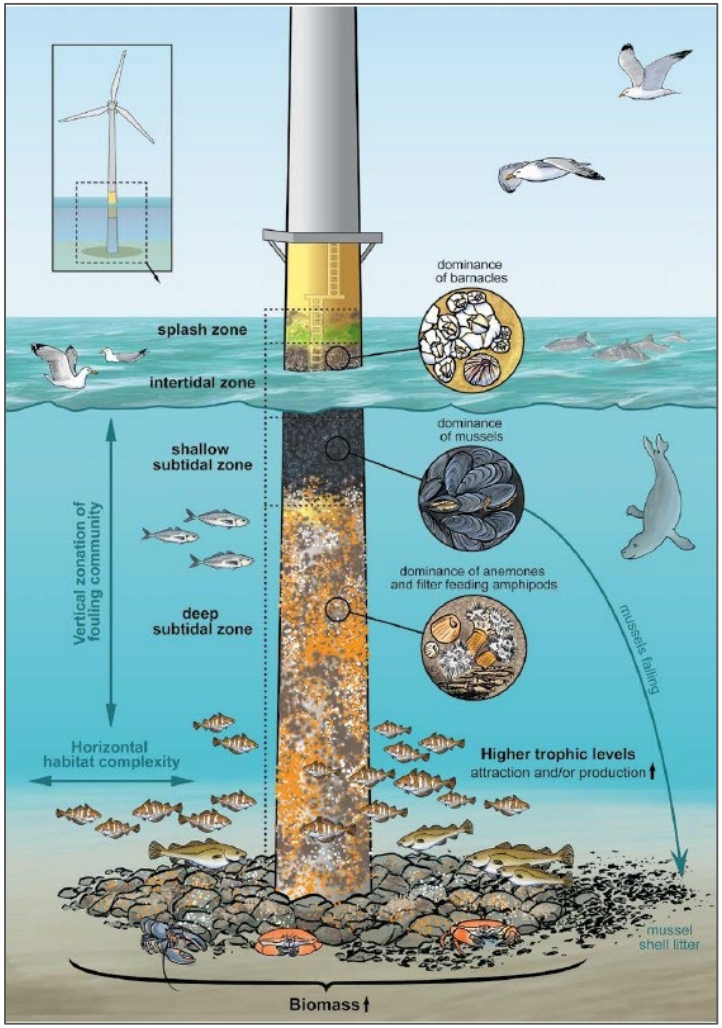


Artificial Reef Effect

Degraer et al. 2020 *Oceanography* 33: 48-57

- Turbines support a diverse and abundant artificial reef community that includes epibiota, mobile shellfish, and finfish
- Finfish and shellfish as well as birds and marine mammals also profit from locally increased food availability and/or shelter
- Understanding the artificial reef effect requires study at broad spatial and temporal scales



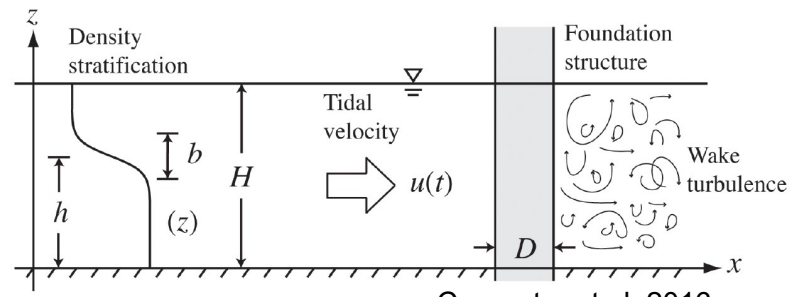


Effects of Altered Hydrodynamics

Van Berkel et al. 2020 *Oceanography* 33: 108-117.

- OWFs may alter local or regional hydrodynamics through modification of (1) the wind fields, and (2) oceanographic parameters including turbulence, mixing, and vertical stratification.
- Existing studies focus on how altered hydrodynamics affect **local** processes: sediment resuspension or sedimentation, temperature change, nutrient transport, and substrate availability
- **Regional** affects are possible via spillover effects on surrounding ecosystems and natural oceanographic connectivity

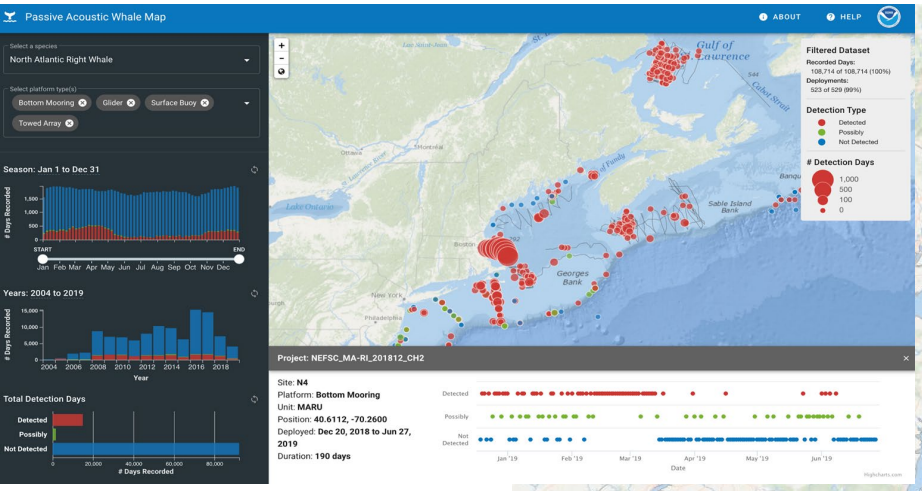
Local Effects

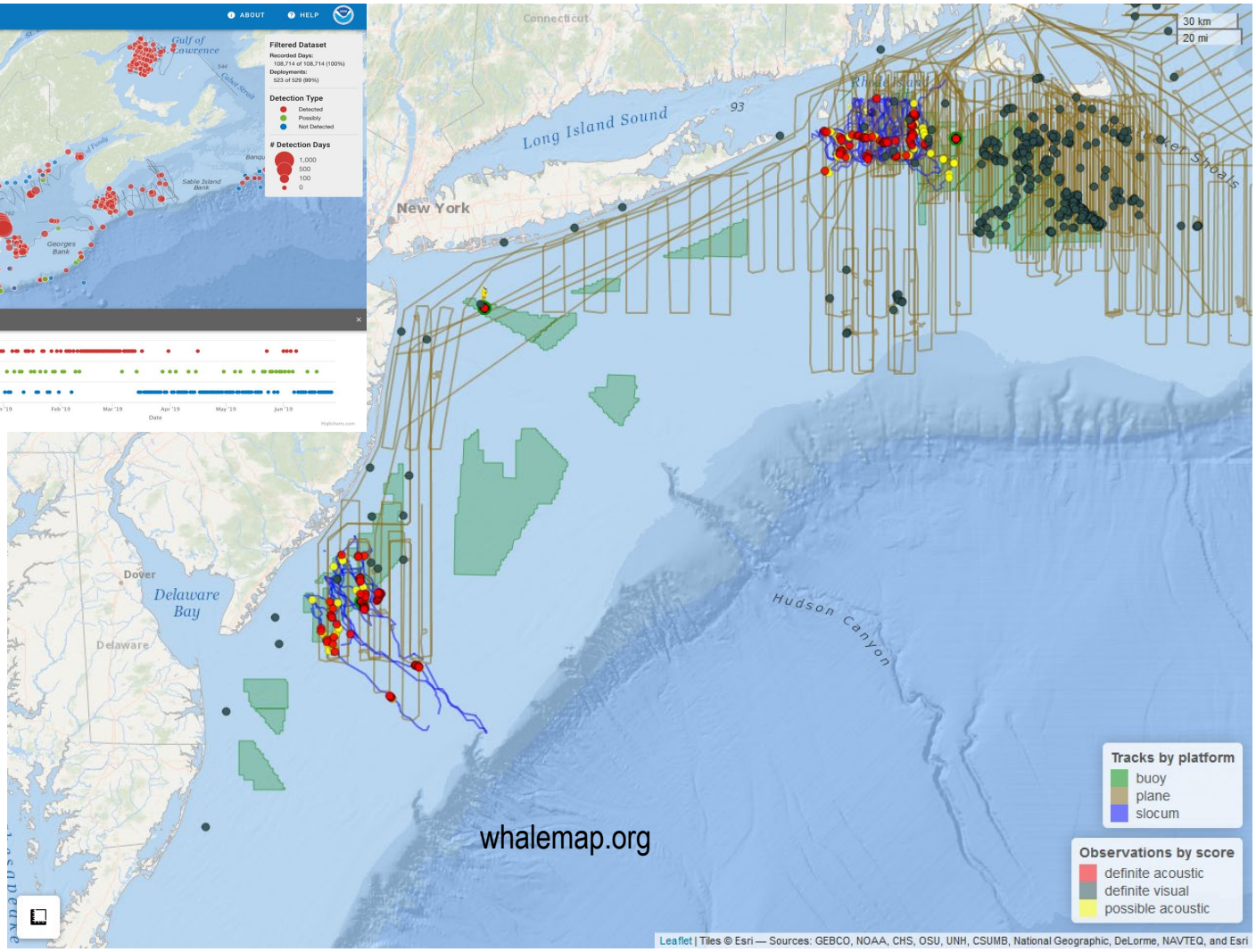


Carpenter et al. 2016

https://www.windpowerengineering.com/optimizing-energy-production-addressing-rotor-wakes-wind-farms/

Protected Species Research & Monitoring





Aerial Surveys & Passive Acoustic Monitoring

North Atlantic Right Whales Research & Monitoring

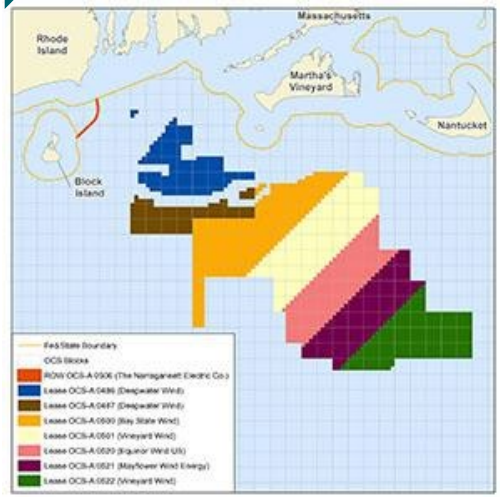
1. NOAA/USGS right whale expert elicitation to develop a population viability assessment examining the potential impact of offshore wind on right whale population
2. Collecting data on zooplankton energy density, species, and concentrations to better understand right whale habitat use in MA/RI WEA
3. Future field work to assess right whale health and demographics in the MA/RI WEA region

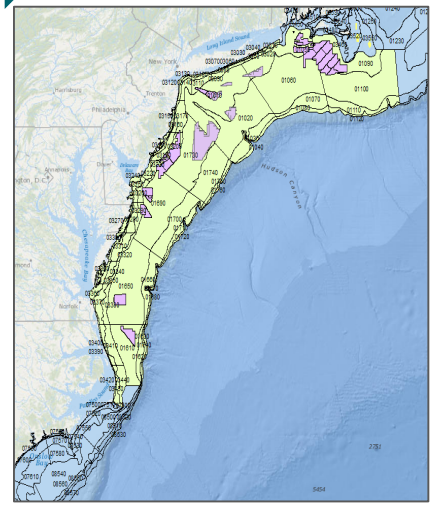
Leiter et al. 2017. *Endangered Species Research 34:45-59/*
Habitat use by North Atlantic right whale in wind energy areas

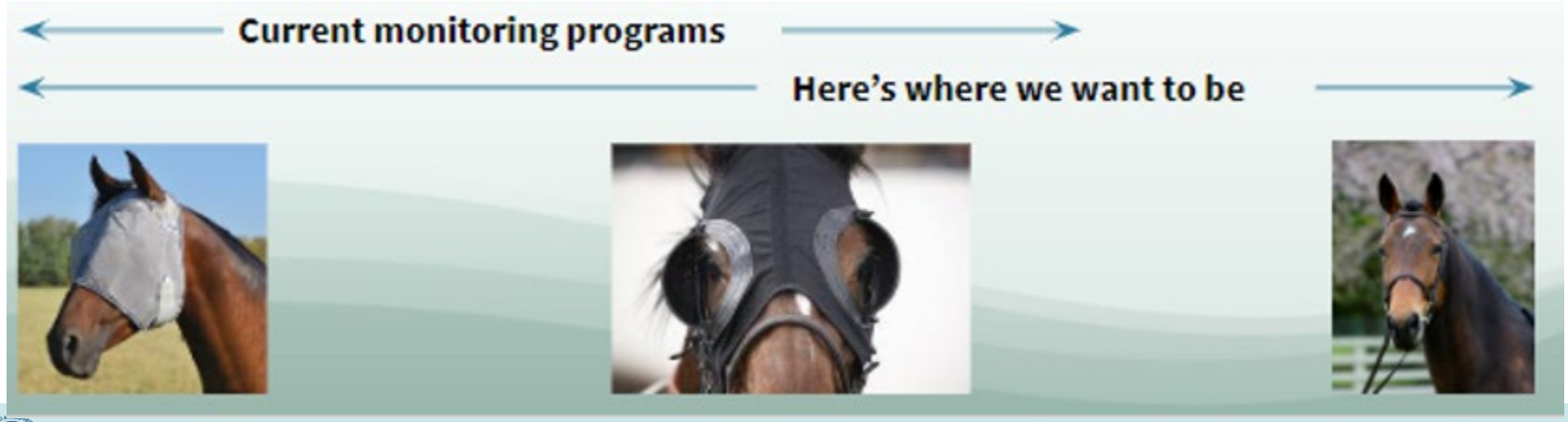
Quintana et al. *in press*. *Endangered Species Research*
Residency, demographics, and movement patterns of North Atlantic right whales in wind energy areas

Offshore Wind Effects Occur across Multiple Spatial Scales

Turbines → Wind Farm → Region → Ecosystem



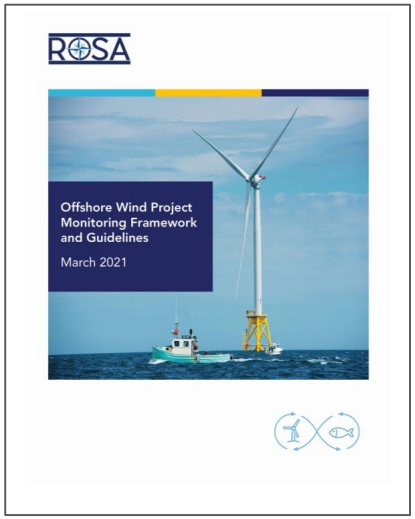




courtesy of Steven Degraer

Regional Science Collaborations

- **RODA, BOEM, and NOAA Synthesis of the Science Workshop and White Paper**
  - Synthesize existing science, identify gaps and research priorities (Oct. 2020-present)
  - *Upcoming* **State of the Science-Fisheries and Floating Wind Technology**
- **ROSA Guidelines for research and monitoring**
  - Establish guiding principles for study design, methods, data collection, analysis, scale (July 2020-March 2021)
- **Establishing Regional Wildlife Science Entity** collaborating with DOI, developers, states, and eNGOs
- **NOAA SeaGrant/Fisheries & DOE-Research Funding Opportunity**

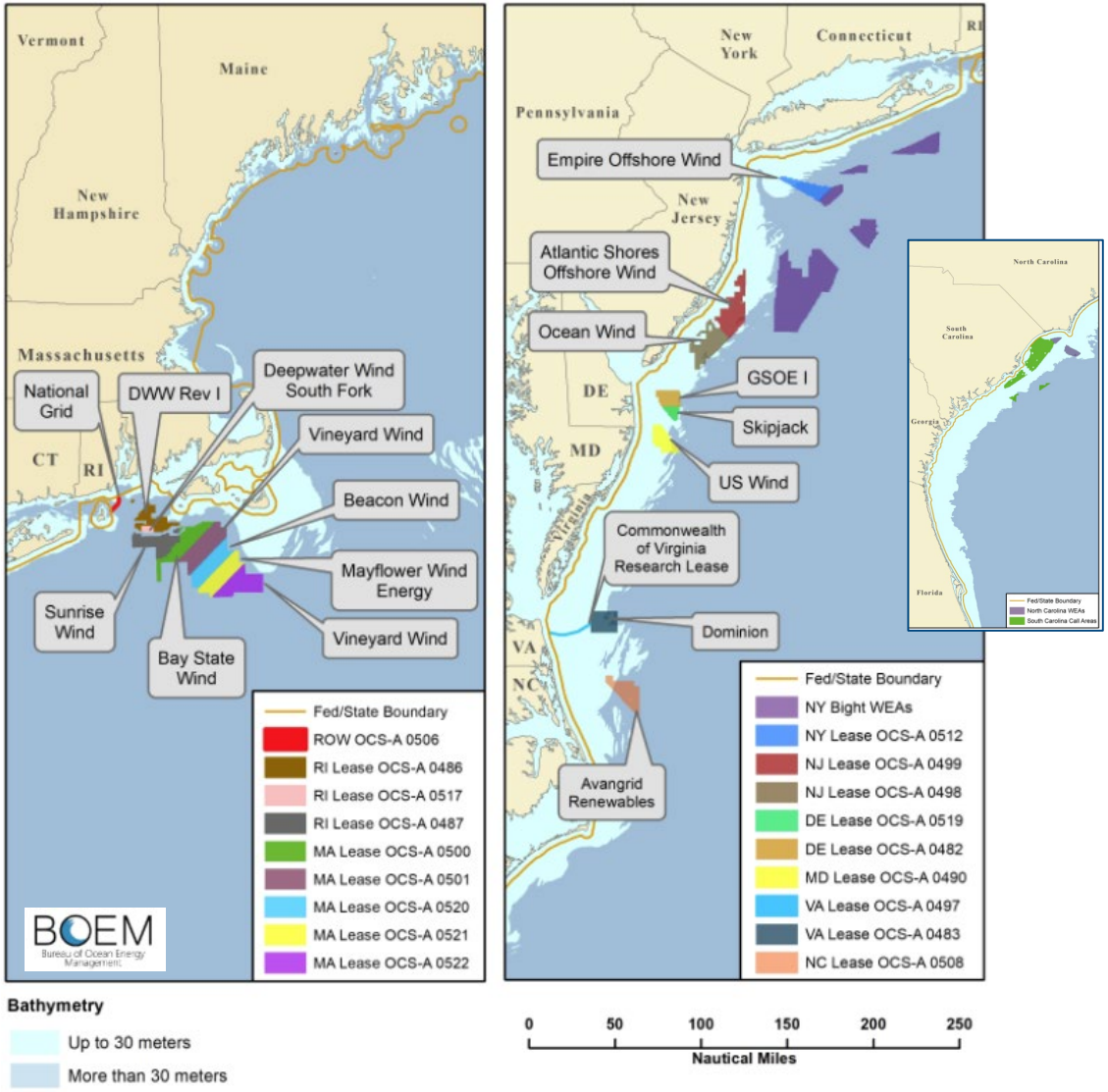


Questions

Additional Information

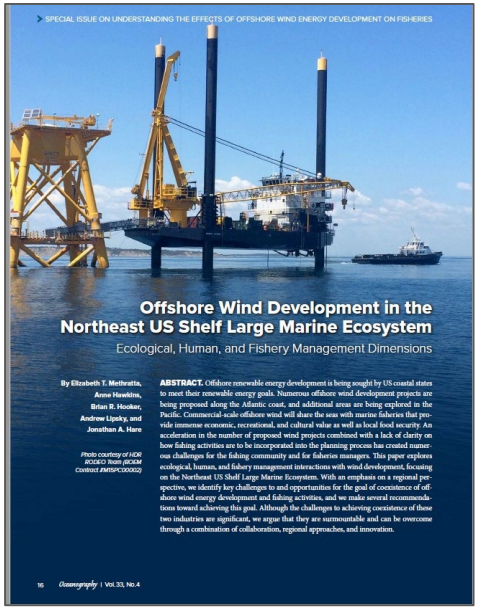
Regulatory scientific demands

- **U.S. Goal Set for 30 GW of offshore wind power by 2030**
- **U.S. Goal Set for 110 GW of offshore wind power by 2050**
- **New Wind Energy Areas** now established in NY Bight- Adds **800,000 acres** to existing **1.7M** acres of leases
- **Notice of Intent to proceed with 16 Construction and Operations Plans/EISs by 2025**
- **16 Record of Decisions by the end of 2024**



https://www.boem.gov/renewable-energy/mapping-and-data/renewable-energy-gis-data

Peer-Reviewed Papers on Offshore Wind - Fisheries Science Topics


SPECIAL ISSUE ON UNDERSTANDING THE EFFECTS OF OFFSHORE WIND ENERGY DEVELOPMENT ON FISHERIES

Offshore Wind Development in the Northeast US Shelf Large Marine Ecosystem

Ecological, Human, and Fishery Management Dimensions

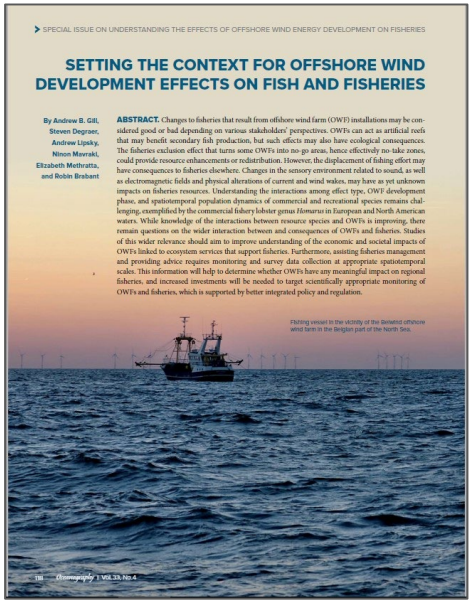
By Elizabeth T. Methratta, Anne Hawkins, Brian R. Hooker, Andrew Lipsky, and Jonathan A. Hare

ABSTRACT. Offshore renewable energy development is being sought by US coastal states to meet their renewable energy goals. Numerous offshore wind development projects are being proposed along the Atlantic coast, and additional areas are being explored in the Pacific. Commercial-scale offshore wind will share the seas with marine fisheries that provide immense economic, recreational, and cultural value as well as local food security. An acceleration in the number of proposed wind projects combined with a lack of clarity on how fishing activities are to be incorporated into the planning process has created numerous challenges for the fishing community and for fisheries managers. This paper explores ecological, human, and fishery management interactions with wind development, focusing on the Northeast US Shelf Large Marine Ecosystem. With an emphasis on a regional perspective, we identify key challenges to and opportunities for the goal of coexistence of offshore wind energy development and fishing activities, and we make several recommendations toward achieving this goal. Although the challenges to achieving coexistence of these two industries are significant, we argue that they are surmountable and can be overcome through a combination of collaboration, regional approaches, and innovation.

16 Oceanography | Vol.33, No.4

Methratta et al. 2020. *Oceanography* 33:16–27.

Ecological, human, and management dimensions of OW in the NE U.S.


SPECIAL ISSUE ON UNDERSTANDING THE EFFECTS OF OFFSHORE WIND ENERGY DEVELOPMENT ON FISHERIES

SETTING THE CONTEXT FOR OFFSHORE WIND DEVELOPMENT EFFECTS ON FISH AND FISHERIES

By Andrew B. Gill, Steven Degraer, Andrew Lipsky, Ninon Mavraki, Elizabeth Methratta, and Robin Brabant

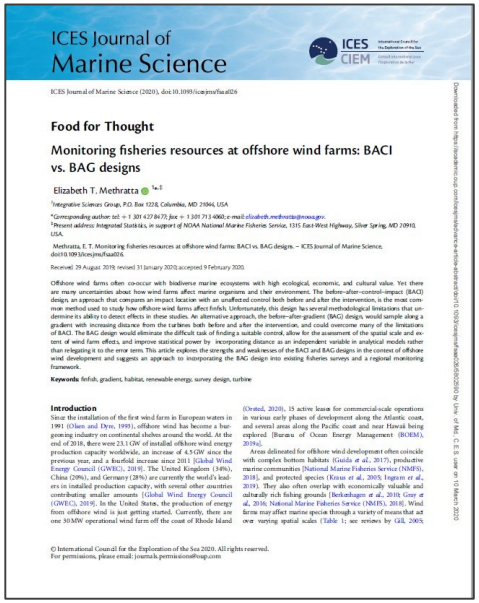
ABSTRACT. Changes to fisheries that result from offshore wind farm (OWF) installations may be considered good or bad depending on various stakeholders' perspectives. OWFs can act as artificial reefs that may benefit secondary fish production, but such effects may also have ecological consequences. The fisheries exclusion effect that turns some OWFs into no-go areas, hence effectively no-take zones, could provide resource enhancements or redistribution. However, the displacement of fishing effort may have consequences to fisheries elsewhere. Changes in the sensory environment related to sound, as well as electromagnetic fields and physical alterations of current and wind wakes, may have as yet unknown impacts on fisheries resources. Understanding the interactions among effect type, OWF development phase, and spatiotemporal population dynamics of commercial and recreational species remains challenging, exemplified by the commercial fishery lobster genus *Homarus* in European and North American waters. While knowledge of the interactions between resource species and OWFs is improving, there remain questions on the wider interaction between and consequences of OWFs and fisheries. Studies of this wider relevance should aim to improve understanding of the economic and societal impacts of OWFs linked to ecosystem services that support fisheries. Furthermore, assisting fisheries management and providing advice requires monitoring and survey data collection at appropriate spatiotemporal scales. This information will help to determine whether OWFs have any meaningful impact on regional fisheries, and increased investments will be needed to target scientifically appropriate monitoring of OWFs and fisheries, which is supported by better integrated policy and regulation.

Fishing vessel in the vicinity of the Belwind offshore wind farm in the Belgian part of the North Sea.

118 Oceanography | Vol.33, No.4

Gill et al. 2020. *Oceanography* 33:118–127.

Ecological, societal, management, and regulatory dimensions of OW with European and U.S. perspectives


ICES Journal of Marine Science

ICES CIEM

ICES Journal of Marine Science (2020), doi:10.1093/icesjms/fsaa026

Food for Thought

Monitoring fisheries resources at offshore wind farms: BACI vs. BAG designs

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Methratta, E. T. Monitoring fisheries resources at offshore wind farms: BACI vs. BAG designs. – ICES Journal of Marine Science, doi:10.1093/icesjms/fsaa026.

Received: 29 August 2019; revised: 31 January 2020; accepted: 9 February 2020.

Offshore wind farms often co-occur with biodiverse marine ecosystems with high ecological, economic, and cultural value. Yet there are many uncertainties about how wind farms affect marine organisms and their environment. The before–after–control–impact (BACI) design, an approach that compares an impact location with an unaffected control both before and after the intervention, is the most common method used to study how offshore wind farms affect finfish. Unfortunately, this design has several methodological limitations that undermine its ability to detect effects in these studies. An alternative approach, the before–after-gradient (BAG) design, would sample along a gradient with increasing distance from the turbines both before and after the intervention, and could overcome many of the limitations of BACI. The BAG design would eliminate the difficult task of finding a suitable control, allow for the assessment of the spatial scale and extent of wind farm effects, and improve statistical power by incorporating distance as an independent variable in analytical models rather than relegating it to the error term. This article explores the strengths and weaknesses of the BACI and BAG designs in the context of offshore wind development and suggests an approach to interpreting the BAG design into existing fisheries surveys and a regional monitoring framework.

Keywords: finfish, gradient, habitat, renewable energy, survey design, turbine

Introduction

Since the installation of the first wind farm in European waters in 1991 (Olsen and Dyre, 1993), offshore wind has become a burgeoning industry on continental shelves around the world. At the end of 2018, there were 23.1 GW of installed offshore wind energy production capacity worldwide, an increase of 4.5 GW since the previous year, and a fourfold increase since 2011 (Global Wind Energy Council (GWEC), 2019). The United Kingdom (34%), China (29%), and Germany (28%) are currently the world's leaders in installed production capacity, with several other countries contributing smaller amounts (Global Wind Energy Council (GWEC), 2019). In the United States, the production of energy from offshore wind is just getting started. Currently, there are one 30 MW operational wind farm off the coast of Rhode Island (Ørsted, 2020), 15 active leases for commercial-scale operations in various early phases of development along the Atlantic coast, and several areas along the Pacific coast and near Hawaii being explored (Bureau of Ocean Energy Management (BOEM), 2019a).

Areas delineated for offshore wind development often coincide with complex bottom habitats (Guisla et al., 2017), productive marine communities (National Marine Fisheries Service (NMFS), 2018), and protected species (Kraus et al., 2005; Ingram et al., 2019). They also often overlap with economically valuable and culturally rich fishing grounds (Beekenhagen et al., 2018; Gray et al., 2016; National Marine Fisheries Service (NMFS), 2018). Wind farms may affect marine species through a variety of means that act over varying spatial scales (Table 1; see reviews by Gill, 2005;

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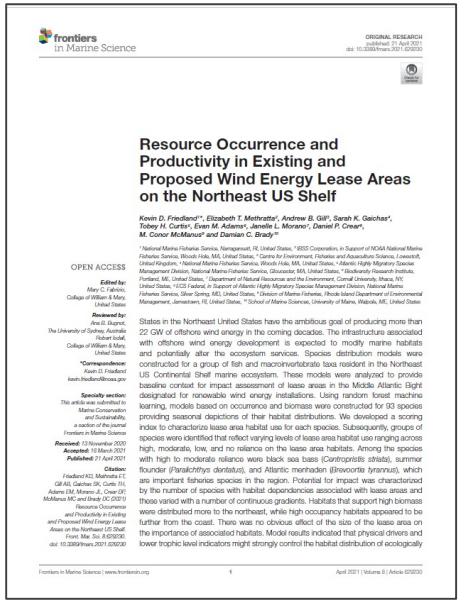
Methratta 2020. *ICES Journal of Marine Science* 77: 890–900.

Exploring the pros and cons of BACI and BAG experimental designs in the context of OW


frontiers in Marine Science

ORIGINAL RESEARCH

Resource Occurrence and Productivity in Existing and Proposed Wind Energy Lease Areas on the Northeast US Shelf

Kevin D. Friedland[1*], Elizabeth T. Methratta[2], Andrew B. Gill[3], Sarah K. Gaichas[4], Tobey H. Curtis[5], Evan M. Adams[6], Janelle L. Morano[7], Daniel P. Crear[8], M. Conor McManus[9] and Damian C. Brady[10]

OPEN ACCESS

States in the Northeast United States have the ambitious goal of producing more than 22 GW of offshore wind energy in the coming decades. The infrastructure associated with offshore wind energy development is expected to modify marine habitats and potentially alter the ecosystem services. Species distribution models were constructed for a group of fish and macroinvertebrate taxa resident in the Northeast US Continental Shelf marine ecosystem. These models were analyzed to provide baseline context for impact assessment of lease areas in the Middle Atlantic Bight designated for renewable wind energy installations. Using random forest machine learning, models based on occurrence and biomass were constructed for 93 species providing seasonal depictions of their habitat distributions. We developed a scoring index to characterize lease area habitat use for each species. Subsequently, groups of species were identified that reflect varying levels of lease area habitat use ranging across high, moderate, low, and no reliance on the lease area habitats. Among the species with high to moderate reliance were black sea bass (*Centropristis striata*), summer flounder (*Paralichthys dentatus*), and Atlantic menhaden (*Brevoortia tyrannus*), which are important fisheries species in the region. Potential for impact was characterized by the number of species with habitat dependencies associated with lease areas and those varied with a number of continuous gradients. Habitats that support high biomass were distributed more to the northeast, while high occupancy habitats appeared to be further from the coast. There was no obvious effect of the size of the lease area on the importance of associated habitats. Model results indicated that physical drivers and lower trophic level indicators might strongly control the habitat distribution of ecologically

Frontiers in Marine Science | www.frontiersin.org 1 April 2021 | Volume 8 | Article 629230

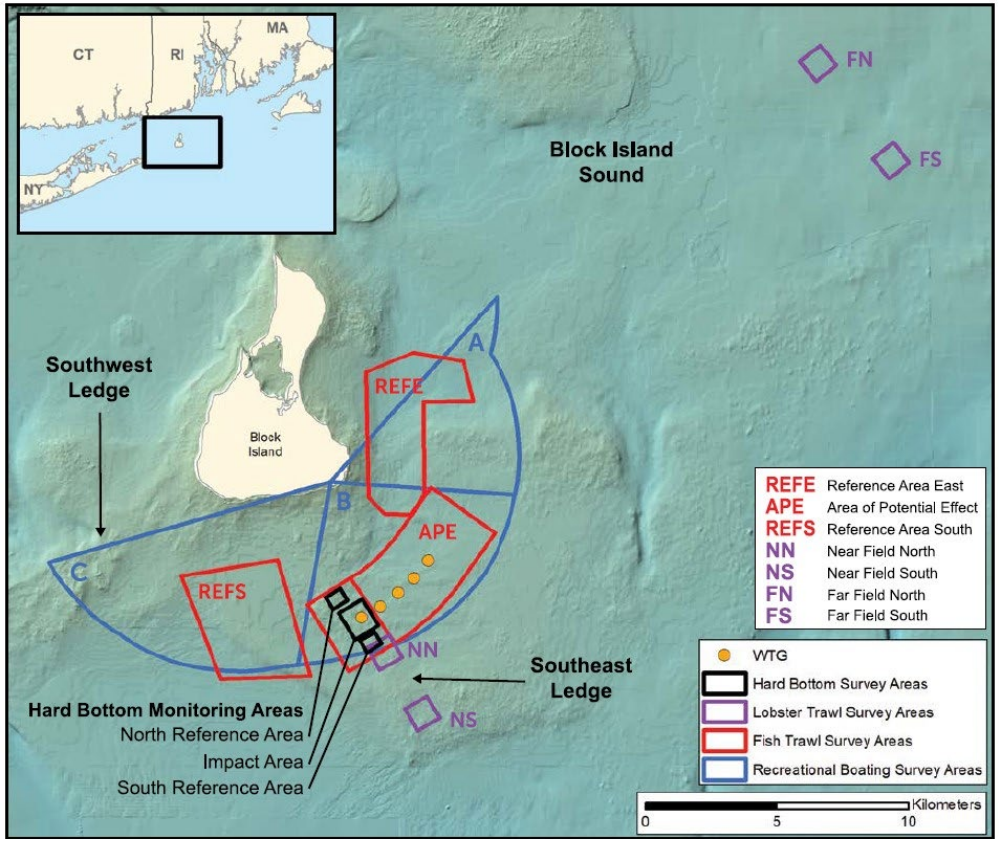
Friedland et al. 2021. *Frontiers in Marine Science* 8:629230.

Fisheries resource occurrence in the NE U.S. Shelf wind energy areas

Block Island Wind Farm: Coastal Resources

Carey et al. 2020 *Oceanography* 33: 70-81

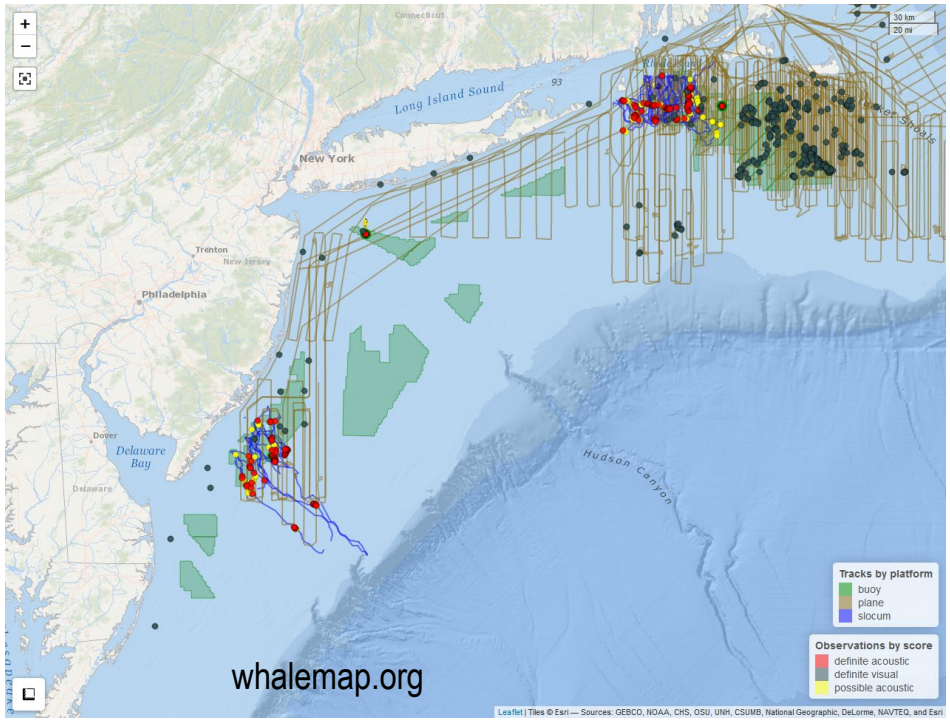
- Designed studies to investigate the effects of construction and operation on hard bottom habitats, demersal fish, lobster and crabs, and recreational boating
- Important study elements included early engagement with fishermen and boaters, adaptive monitoring based on data and stakeholder feedback, and cooperative research
- Use methods that are consistent with regional surveys



Protected Species Research & Monitoring

Aerial Surveys

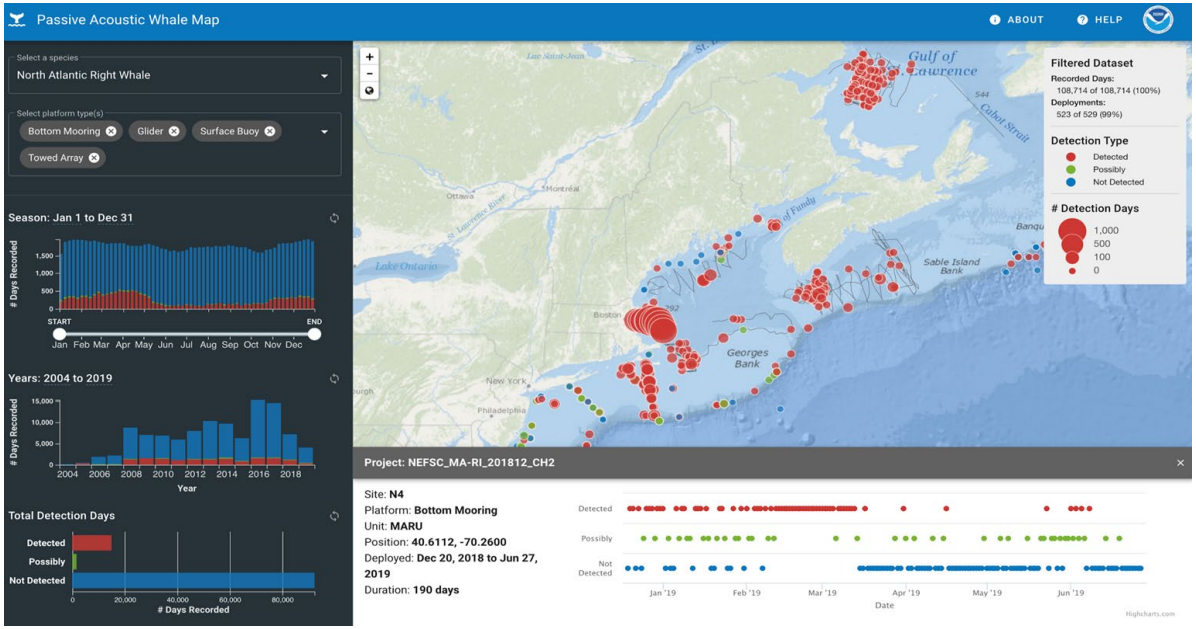
1. Extensive aerial survey effort by NOAA and partners to establish baseline protected species distribution and habitat use
2. Investing in a camera system to for adaptation and calibration of surveys to take into account higher survey heights with the presence of wind farms



Protected Species Research & Monitoring

Passive Acoustic Monitoring (PAM)

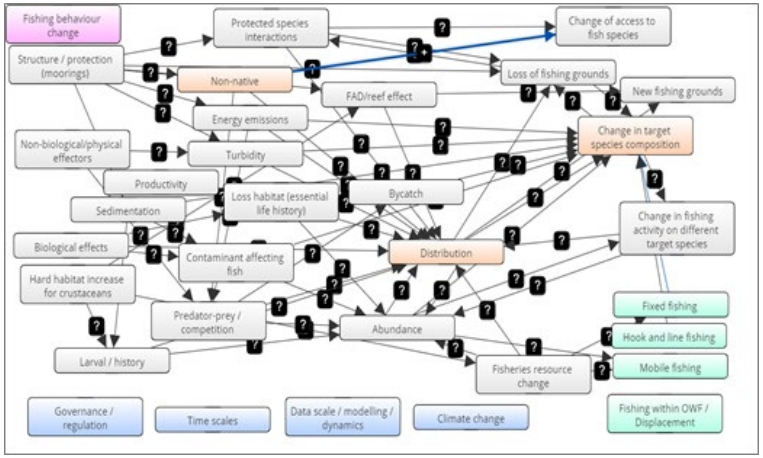
- Developing guidelines for energy developer deployment, dissemination, and storage of PAM data
- Building repository and website for PAM data collection and dissemination
- Deployed PAM devices in WEAs
- Extensive collaboration with partners for baseline data collection



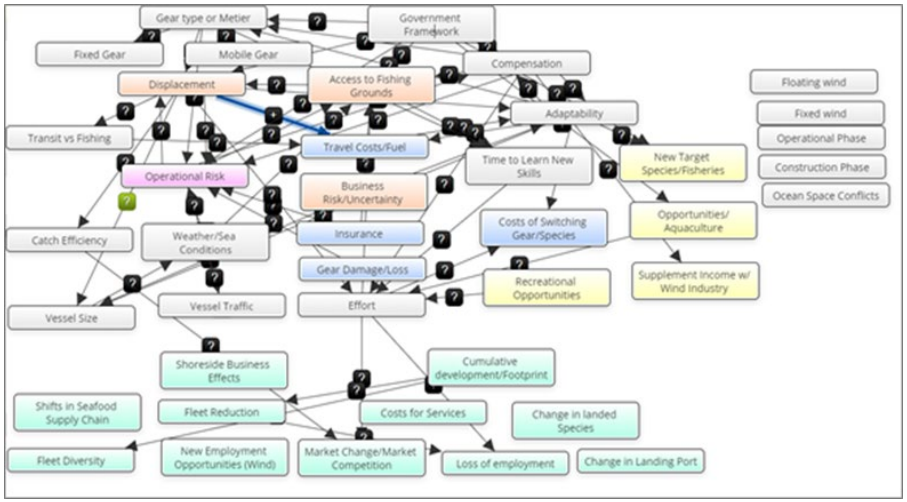
ICES Workshop on the Socio-economic Implications of Offshore Wind on Fishing Communities (WKSEIOWFC)

Workshop Outcomes:

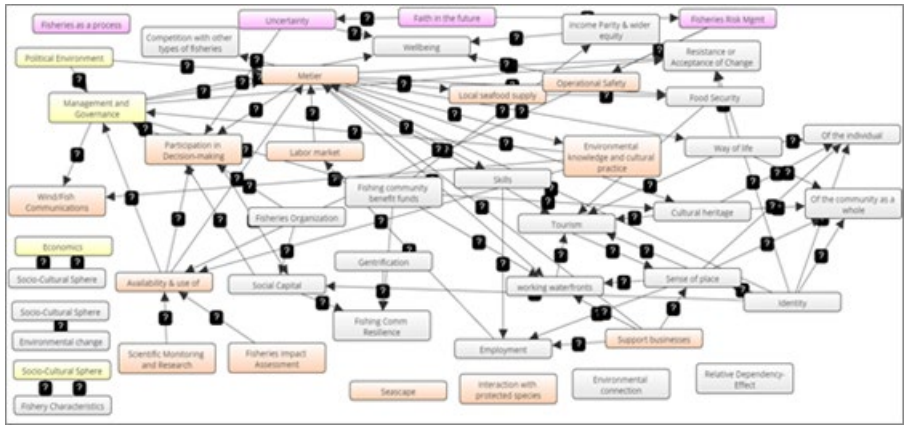
- Sub-group conceptual models on three themes
- Supportive narrative behind ‘nodes’ and the connections was key information collected for identifying gaps and existing evidence
- Identified common issues and differences between the U.S. and Europe



Environmental Model



Economic Model



Cultural Model

Block Island Wind Farm: Benthic Habitat

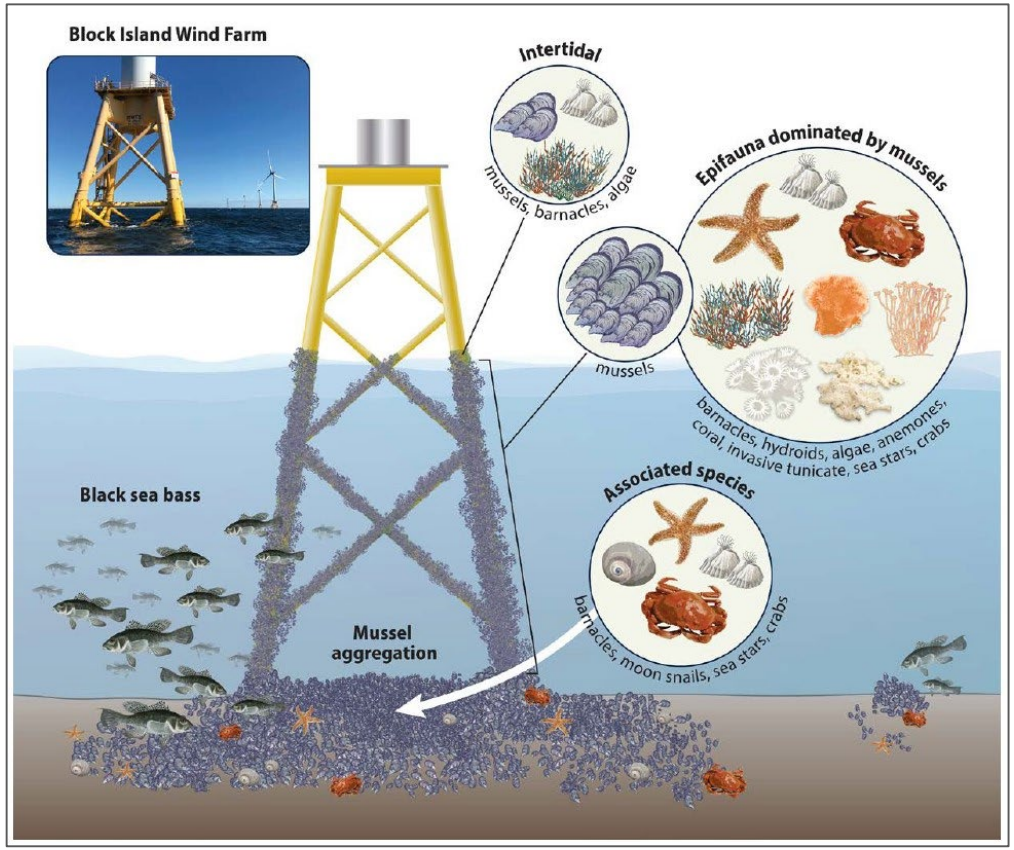
Hutchison et al. 2020 *Oceanography* 33: 58-69

- Monitoring has included sediment grain size, organic enrichment, and macrofauna, as well as the colonization of
- the jacket structures, up to four years post-installation

- After four years, mussel aggregations established within the footprint of the turbines

- Biotypes within 90 m of the turbines were linked to mussel aggregations and included several non-indigenous species

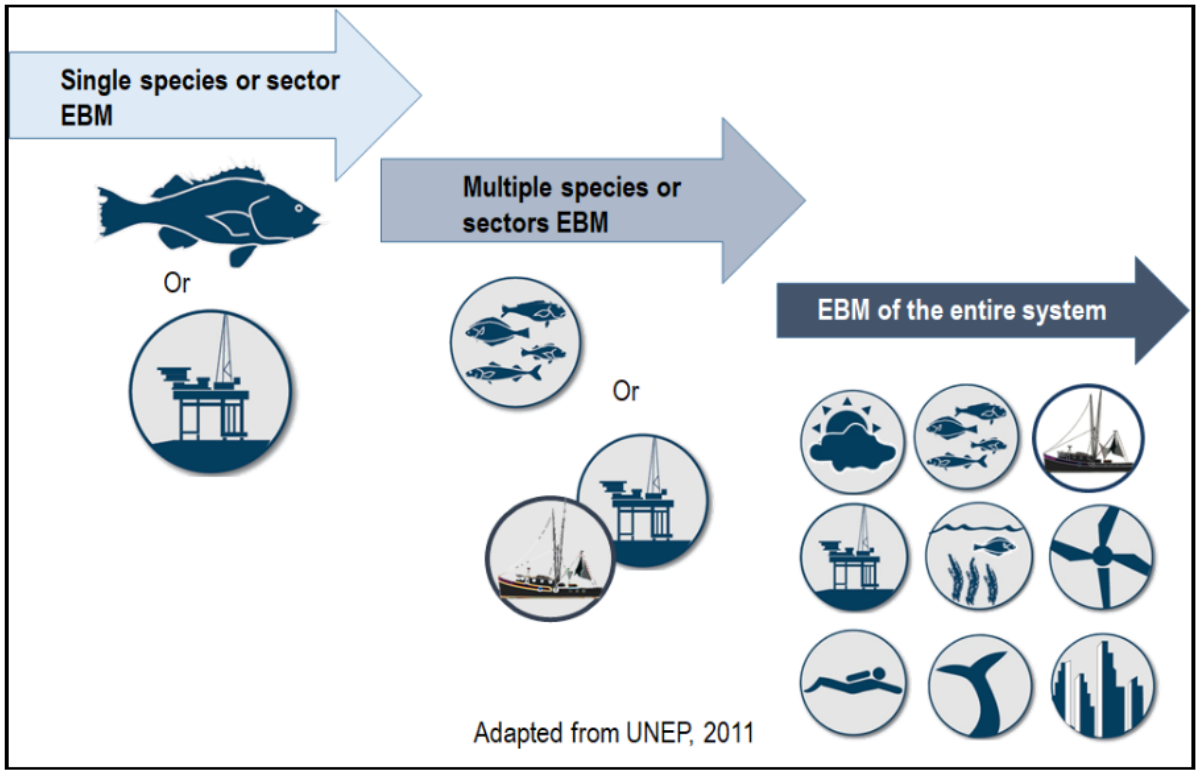
- Coordinated monitoring is needed



Human Dimensions Research Partnership

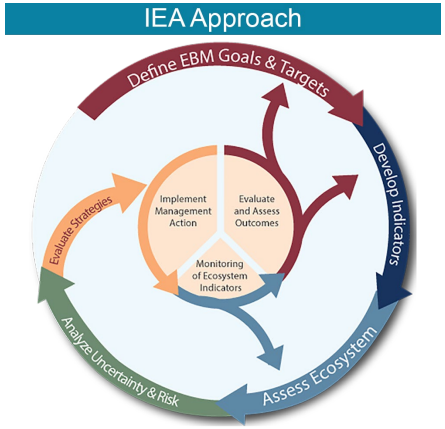
- "Advancing Research for Co-existence of Fishing, Coastal Communities, and Regional Ocean Renewable Energies"
- Sea Grant, NEFSC, DOE
- Research Priority Areas:
  - (1) Fisheries and Fishing Community Resilience
  - (2) Coastal Community and Economic Resilience
  - (3) Multi-use Maritime Activities

Hanging it all together



Continuum of Ecosystem-Based Management

Do we want to push or do we want to be pulled along the continuum to Ecosystem-Based Management?



https://www.integratedecosystemassessment.noaa.gov/national/EBM