

NOAA
FISHERIES

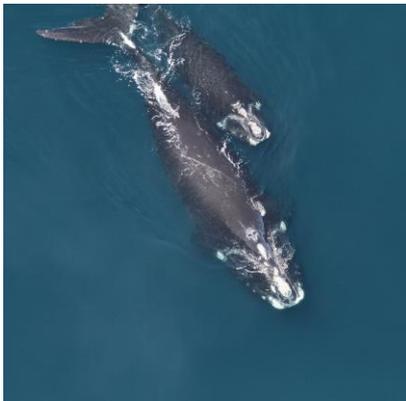
Northeast Fisheries Science Center

Designing monitoring to detect cumulative impacts and address the confounding variable of climate change

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Northeast Fisheries Science Center

Friday, November 20th

State of the Science Workshop on Wildlife and Offshore
Wind Energy 2020: Cumulative Impacts



Introduction

- Work for NOAA since 1998
- Received PhD from SUNY Stony Brook in 1994
- Grew up outside of Rochester, New York



NOAA Fisheries Mission

To support productive and sustainable fisheries, safe sources of seafood, the recovery and conservation of protected resources, and healthy ecosystems—all backed by sound science and an ecosystem-based approach to management.



Magnuson-Stevens Fisheries Management & Conservation Act - 1976



National Aquaculture Act - 1980



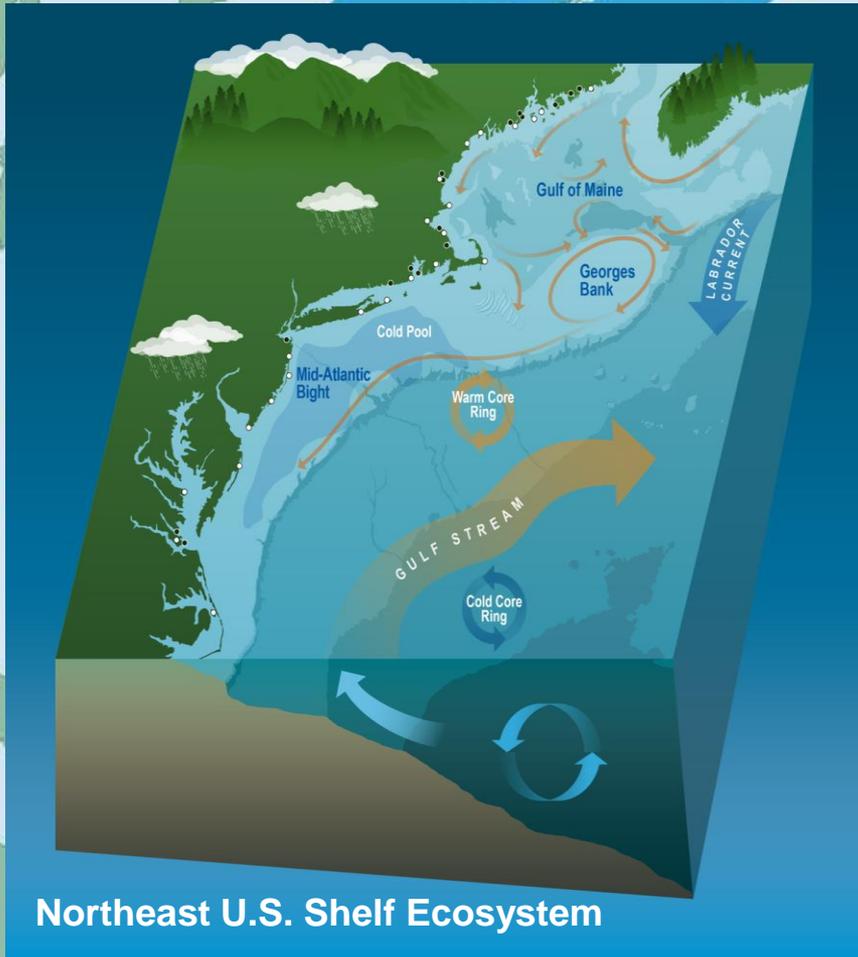
Marine Mammal Protection Act – 1972



Endangered Species Act – 1973



NOAA Fisheries Regions / Ecosystems



Atoll
n Reef



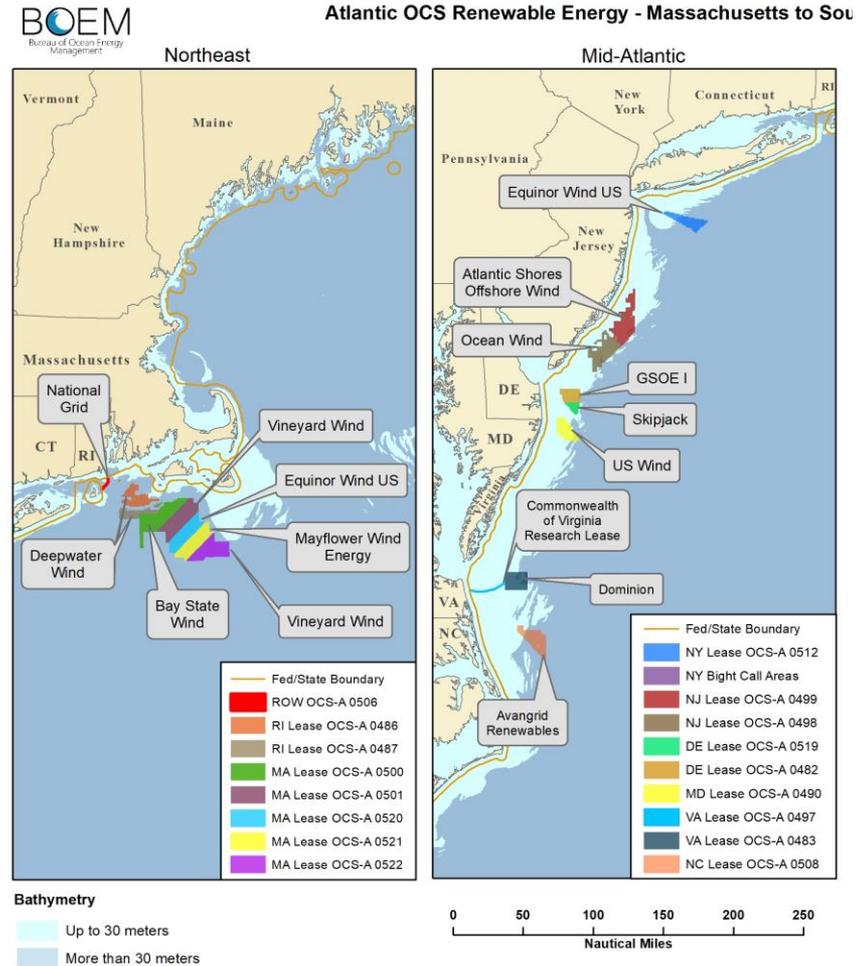
Northeast Fisheries Science Center

- Science and assessments for more than 40 fish and shellfish stocks contributing \$33 billion in sales annually
- Support recovery and protection of more than 30 wildlife species including the highly endangered Right Whale
- Conduct research and development on marine aquaculture
- Research and assessment of regional habitats, ecosystems, and climate
- Understanding of >150 fishing communities



Cumulative Impact of Wind Energy Development on Marine Ecosystems

- Fisheries
- Wildlife (Marine mammals, sea turtles, protected fish species)
- Habitats
- Ecosystem Processes
- Offshore Aquaculture
- Coastal communities
- Surveys & Research (ability to do our science)



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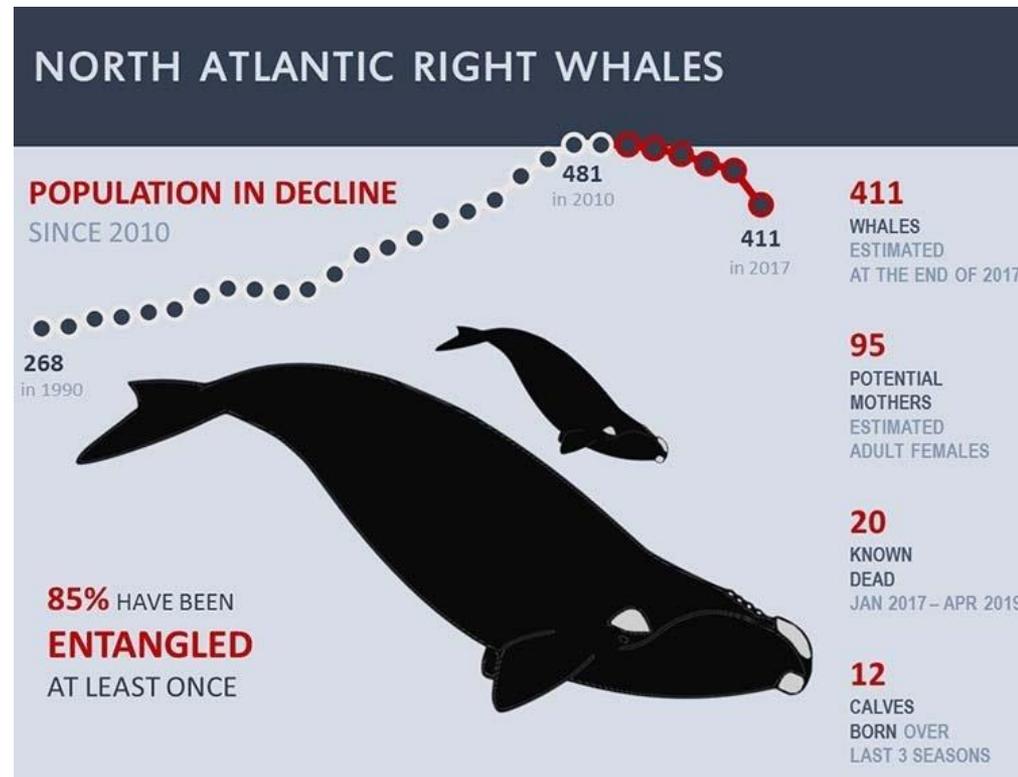
Given scale of the question, my talk is going to be somewhat abstract – identify important elements, not specific plans



Regional “Cumulative Impacts”

NOAA Fisheries Measures Regional Cumulative Impacts

- Conduct surveys
- Conduct assessments
- Provide status and trends of managed populations and of ecosystem components
- Conduct research to understand drivers of status and trends

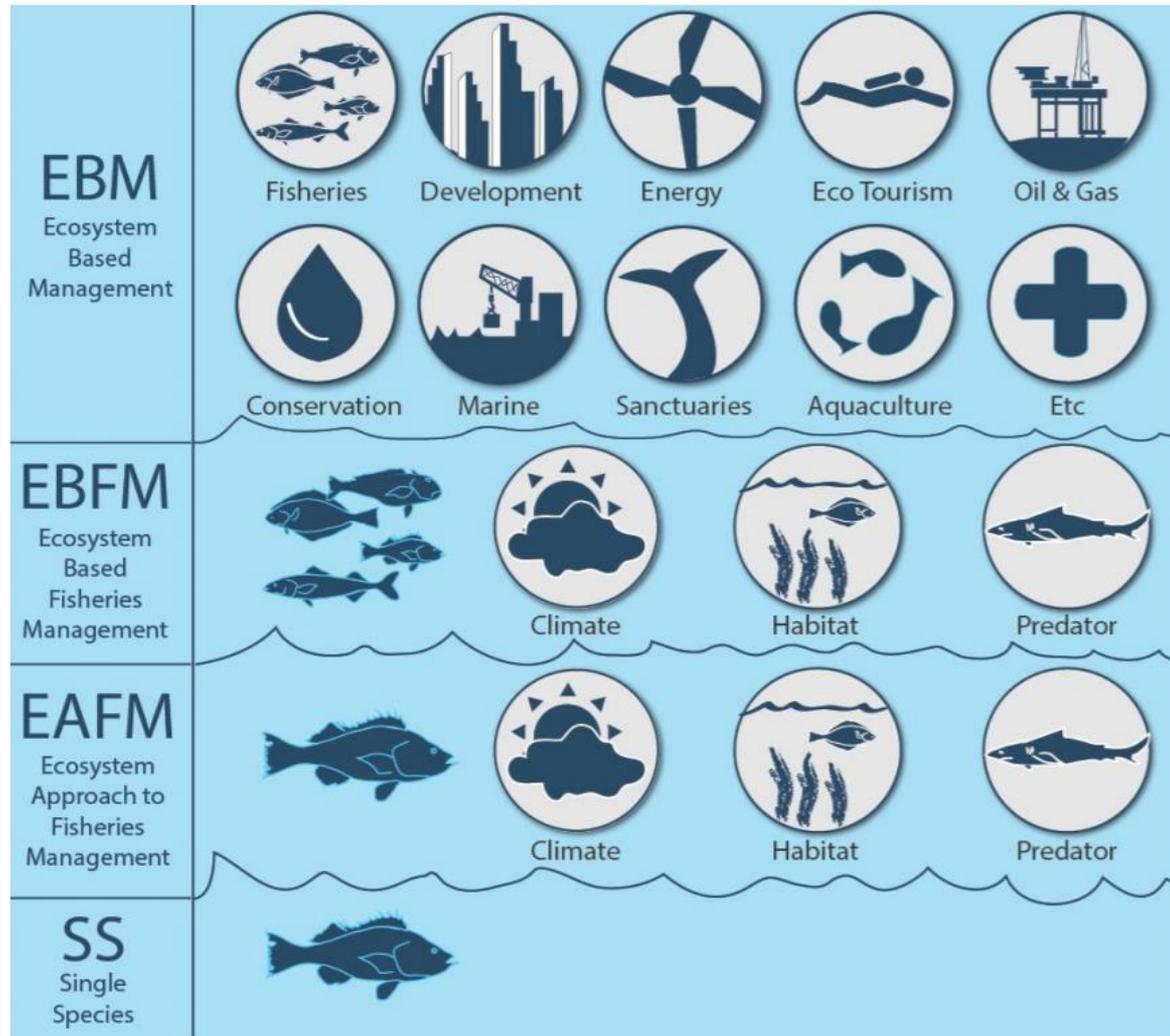


Attribution?



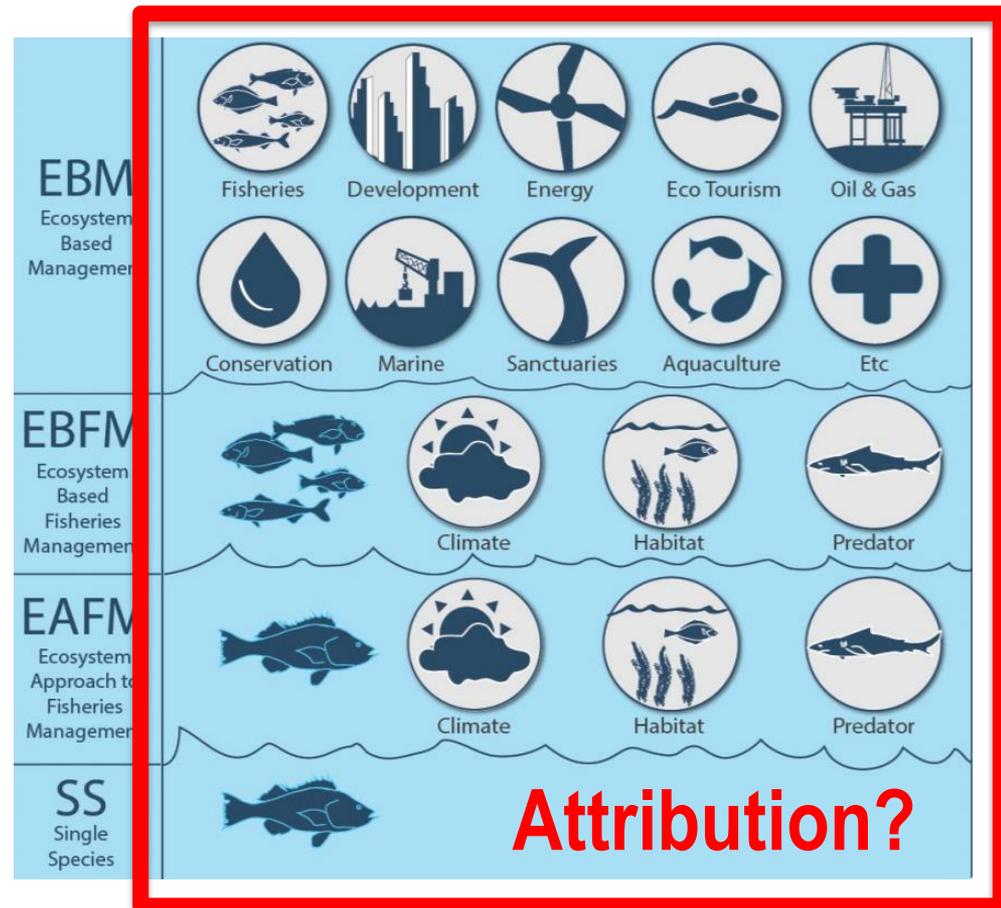
Ecosystem Based Management

NOAA Fisheries
Past 20 years

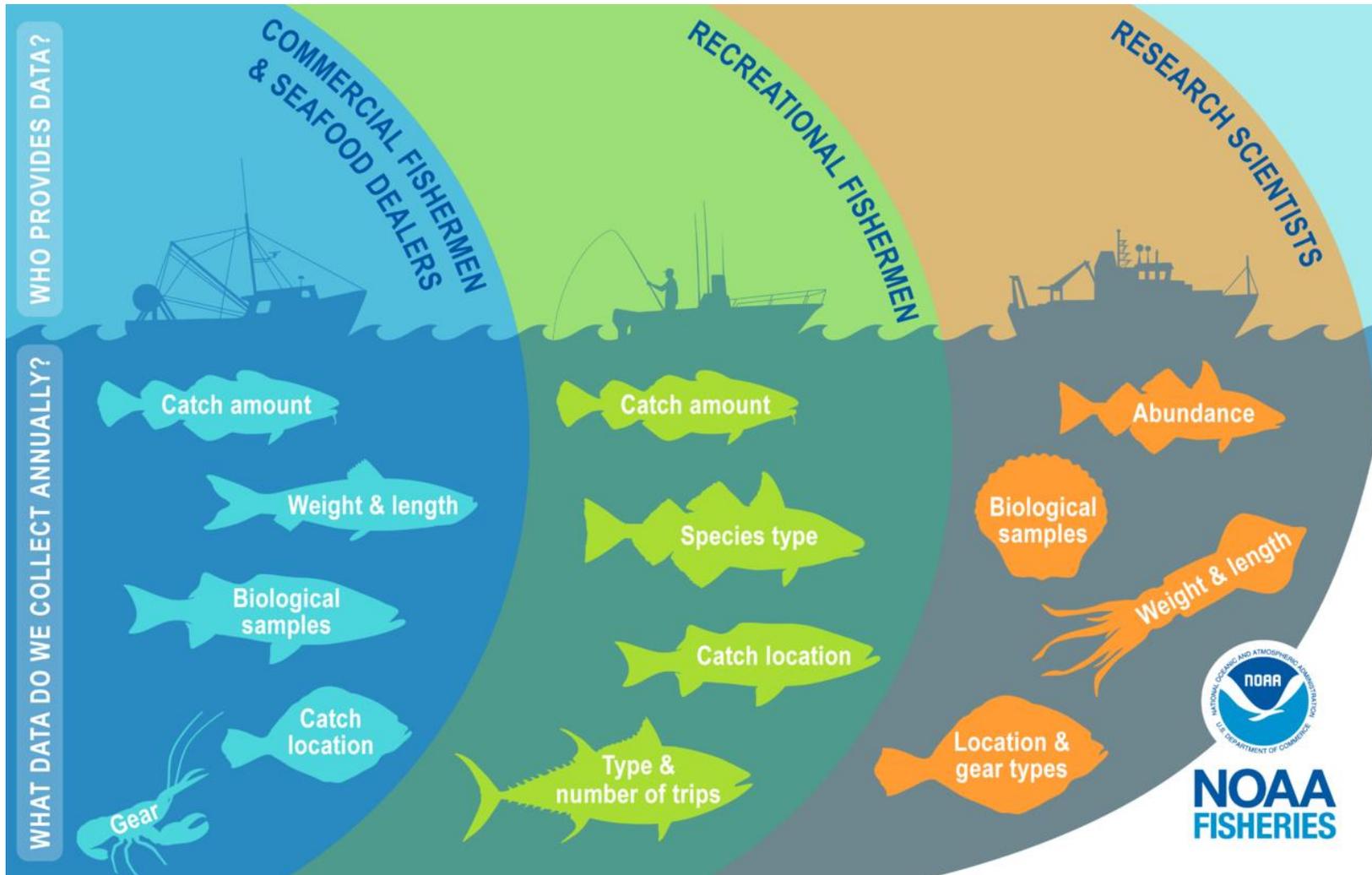


Cumulative Impact of Wind Energy Development on Marine Ecosystems

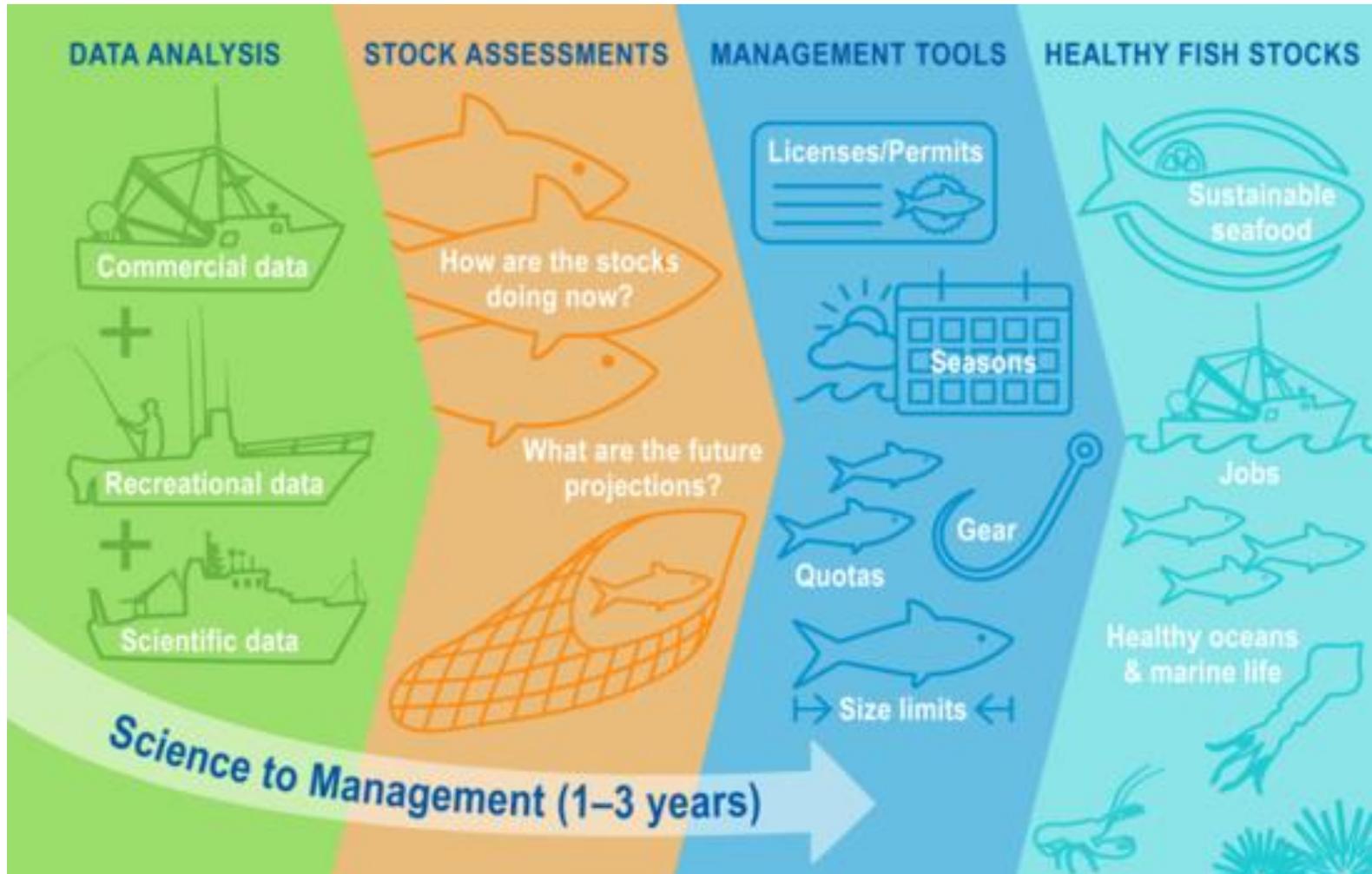
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Stock Assessments – Surveys & Research

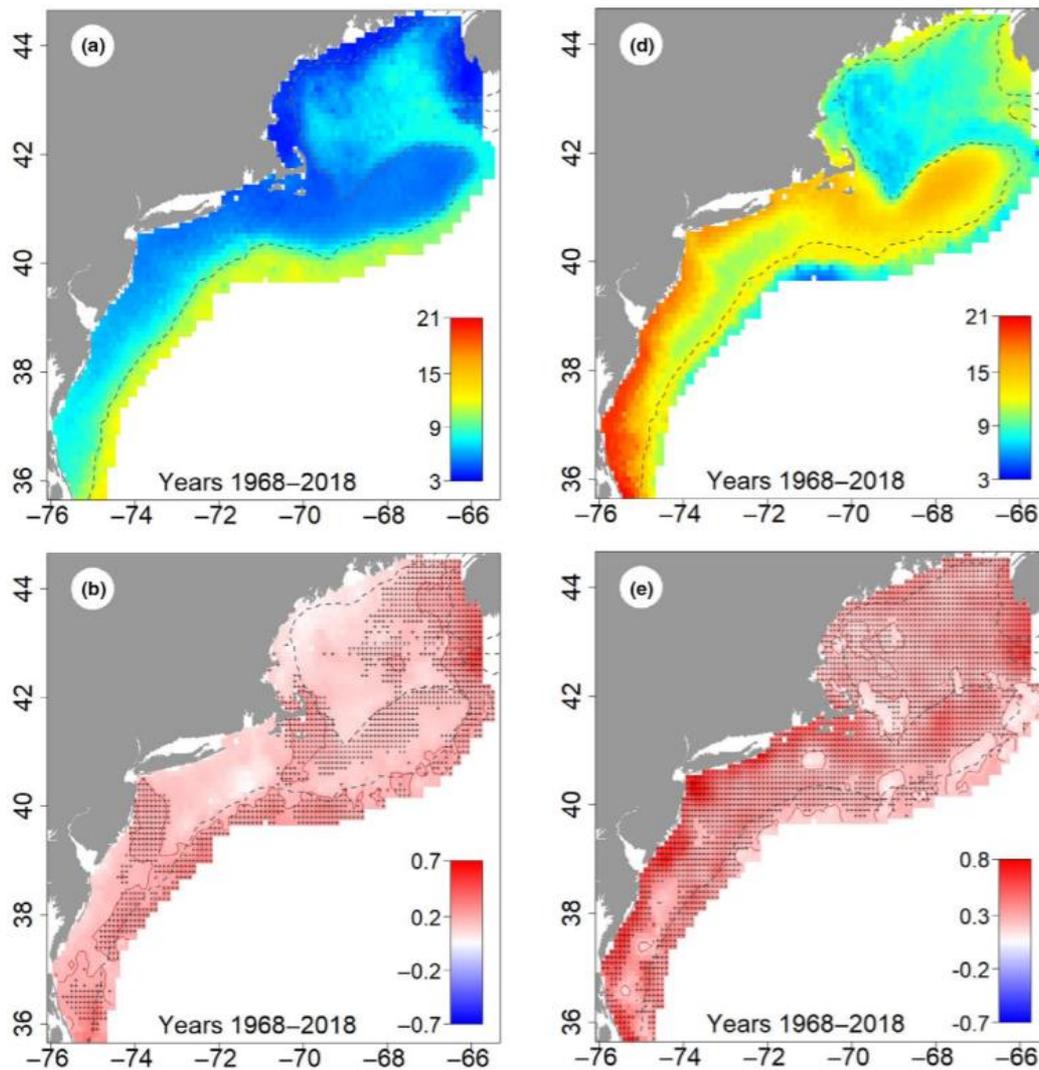


Stock Assessments – Modeling & Decisions



Changing Climate Conditions

- Northeast U.S. Shelf Ecosystem is changing
- Temperature, carbonate chemistry, precipitation, currents
- Decadal trend in spring and fall bottom temperature
- What are the impacts of these changes

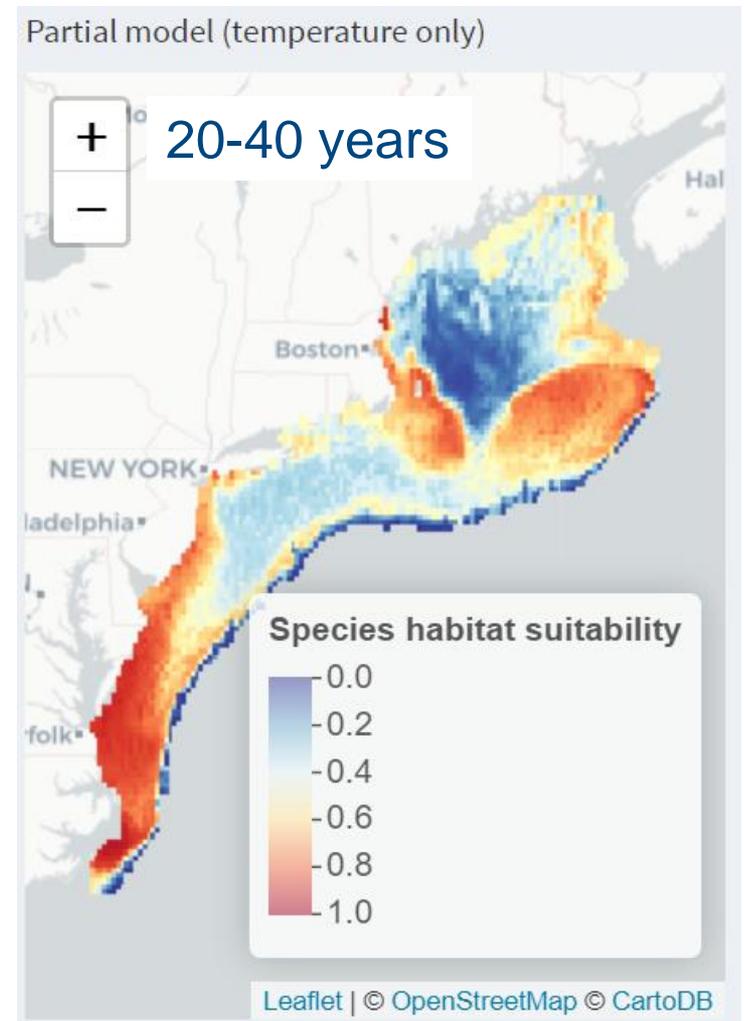


<https://onlinelibrary.wiley.com/doi/abs/10.1111/fog.12485>



Species Distribution Modeling

- A conceptual model (ecological niche)
- Process understanding of climate effects (temperature metabolism relationships)
- Survey and regional-scale data to support modeling
- A model to evaluate effects (species distribution models)

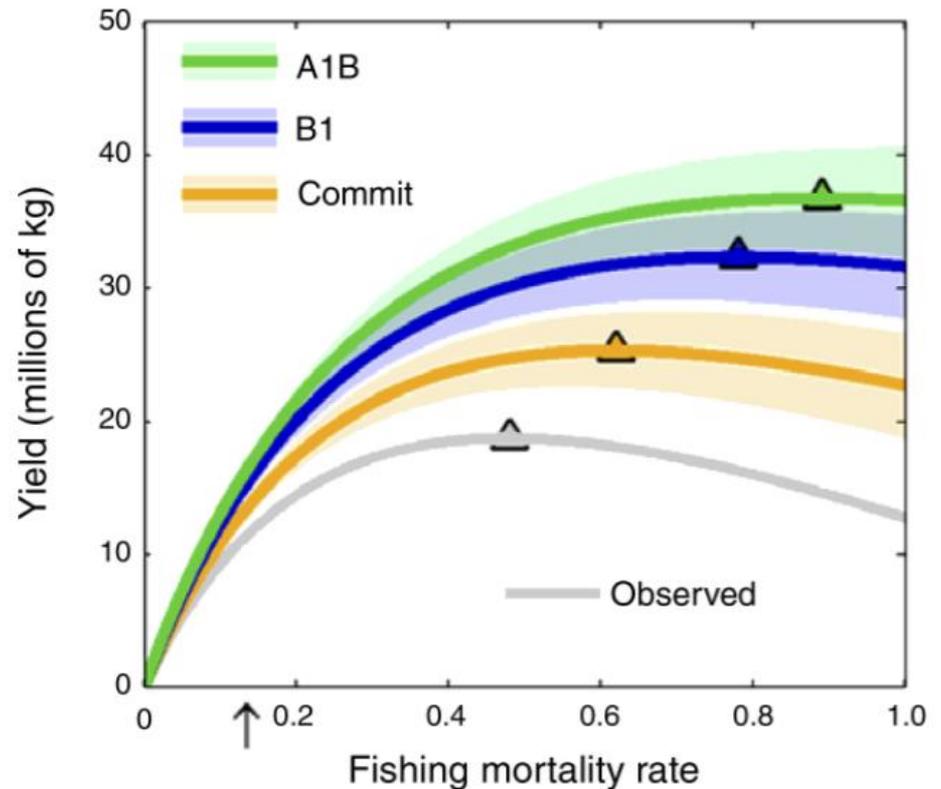


https://heatherwelch.shinyapps.io/beyond_temperature/



Population Productivity

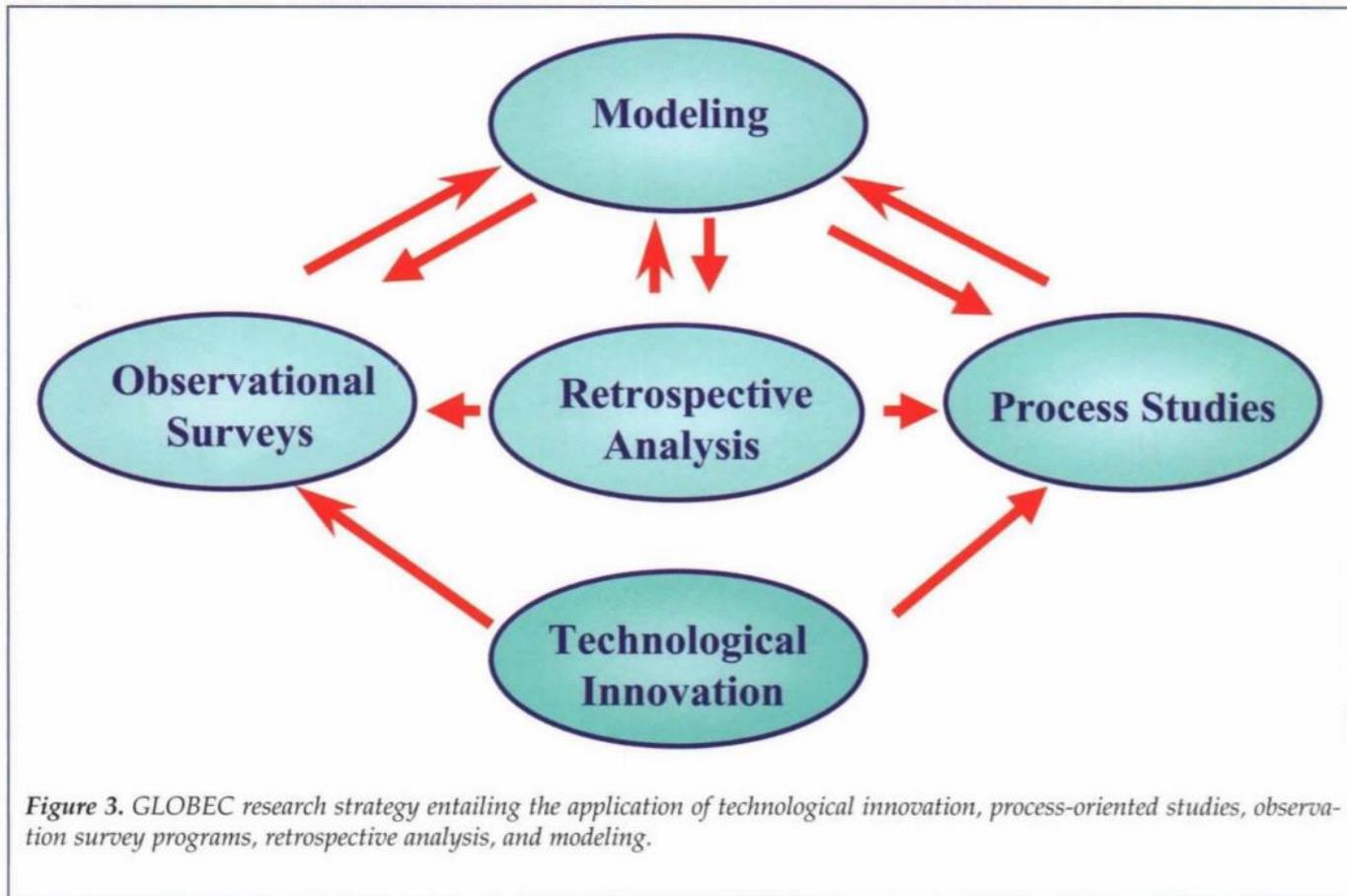
- A conceptual model (overwinter mortality)
- Process understanding of climate effects (winter temperature and recruitment)
- Survey and regional-scale data to support modeling
- A model to evaluate effects (environmentally explicit population model)



<https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1890/08-1863.1?sid=nlm%3Apubmed>



Components of Cumulative Impacts (Understanding)



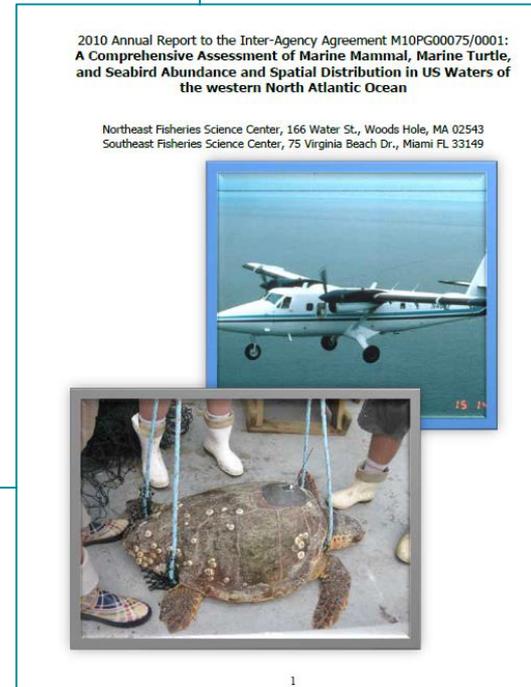
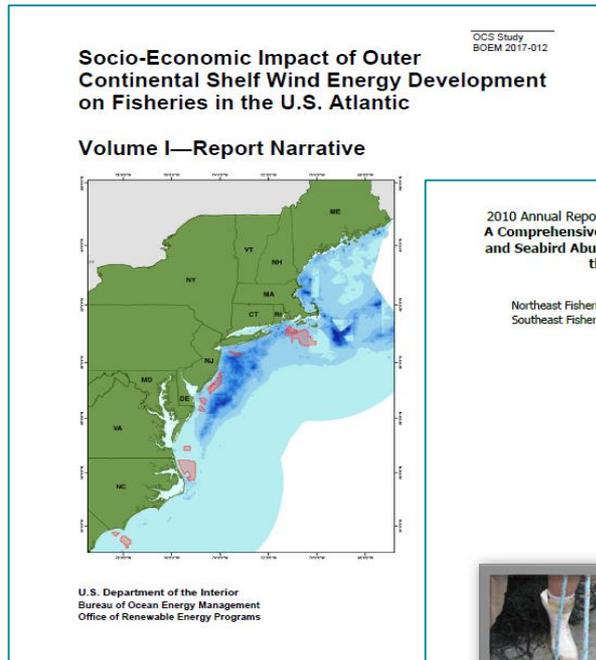
<https://tos.org/oceanography/article/an-overview-of-the-u.s.-globec-program>



Cumulative Impact of Wind Energy Development on Marine Ecosystems

Baseline Studies (BOEM, NMFS, VW 1)

- Fishing revenue studies
- Habitat characterization
- Marine mammal, seabird, fisheries and ecosystem surveys
- Sound studies
- Site specific monitoring studies



Cumulative Impact of Wind Energy Development on Marine Ecosystems

Wind Development

1. Pre-construction (now)
2. Construction (soon)
3. Operation (20-30 yrs)
4. Decommissioning (after operation)

- Acoustic survey and construction noise
- Vessel traffic
- Seafloor, water column, and surface air disturbance
- Sediment Suspension and Deposition
- Cabling & Electro-magnetic fields
- Lighting / Navigation
- Habitat Conversion



Cumulative Impact of Wind Energy Development on Marine Ecosystems

Trust Resources

1. Fisheries

2. Wildlife

3. Ecosystems & Habitats

4. Coastal Communities

- Exclusion of some fishing activity
- Creation new habitat
- Biological effects of noise and electromagnetic fields
- Exclusion / attraction of species
- Changes in behavior - feeding, socializing, nursing
- Ecosystem changes: oceanography, prey, habitat
- Impacts on surveys and assessments



Scale of the Issue

Climate Change

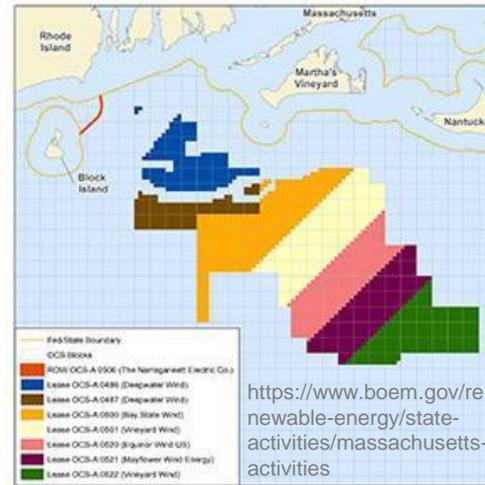
Turbines



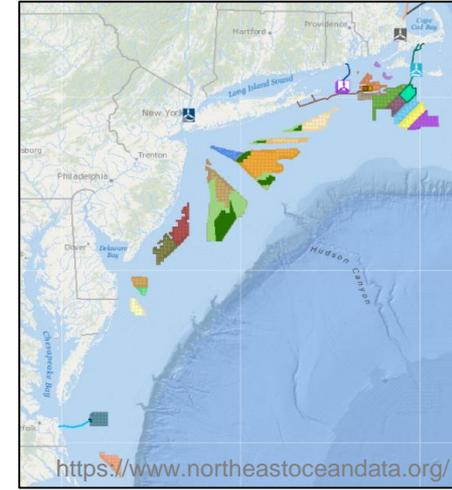
Wind Farm



Region



Ecosystem



Turbine and Wind Development:

Site specific monitoring

Process-scale studies

Small-scale models

Sub-regional to Ecosystem:

Regional monitoring

Retrospective studies

Large-scale models

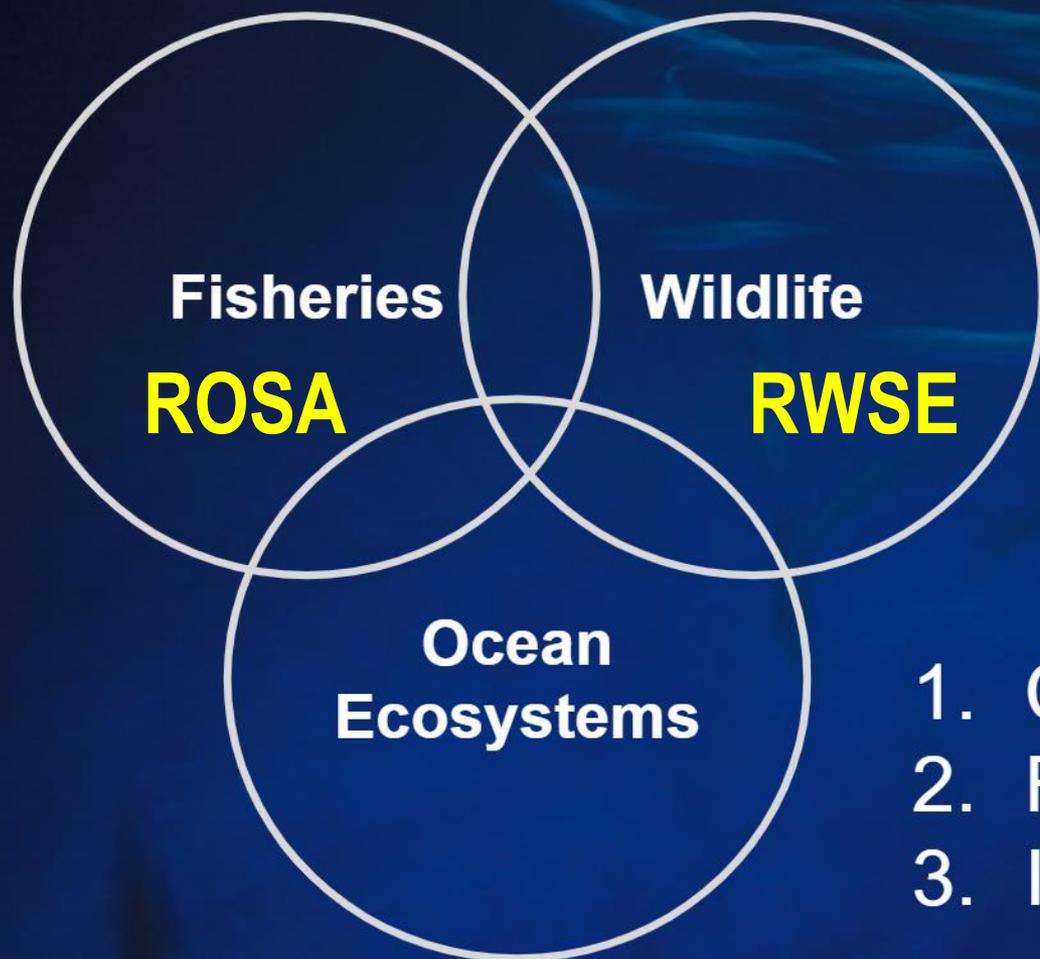


Designing monitoring to detect cumulative impacts of wind development and climate change

- Understand and work in current “regional” landscape (science, assessment and management)
- Conceptualize impacts (impact type, “*impactee*”)
- Consider scale of impact and “*impactee*” to be quantified; consider how to scale up to sub-regional / ecosystem scale
- Conduct process studies to evaluate and quantify impact
- Continue regional surveys and assessments (measure regional cumulative impacts)
- Design, calibrate and execute surveys in wind energy areas (link site specific activities to regional surveys and assessments)
- Develop models to evaluate “attribution” of different impacts



Regional Collaboration



Wind Development

Rest of our careers

1. Collaboration
2. Regional approach
3. Innovation

