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Offshore Wind & Fisheries

Introductory Fisheries Science for Stakeholders
IFSSH 2023
May 2, 2023

Map from
MARCO Mid-Atlantic Ocean Data Portal

Offshore Wind & Fisheries

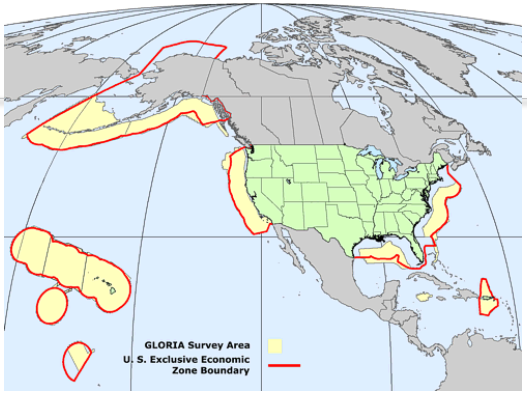
Lecture Outline

Background: Offshore Wind

Background: US Fisheries

How will Offshore Wind and Fisheries interact?

US Fisheries



- For the purposes of the focus of this lecture, focus on commercial and recreational fisheries in federal waters
  - Federal waters are those 3 to 200 miles from coast

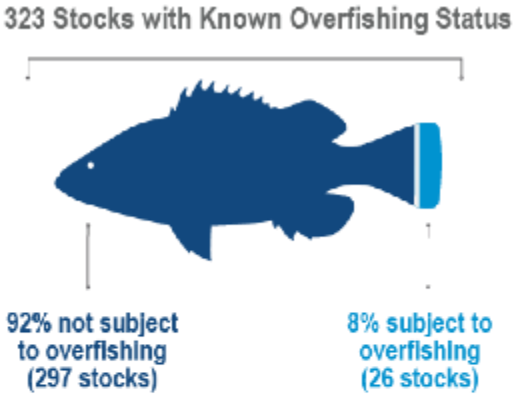
- Managed by NOAA and 8 regional councils
- The Magnuson-Stevens Act
  - Enacted in 1976
  - Law governing US federal marine fisheries
  - Transparent public process of science, management, innovation, and collaboration

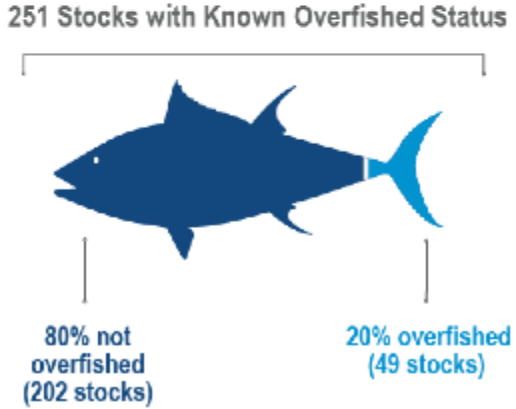
Nationally, NOAA Fisheries assesses the status of:

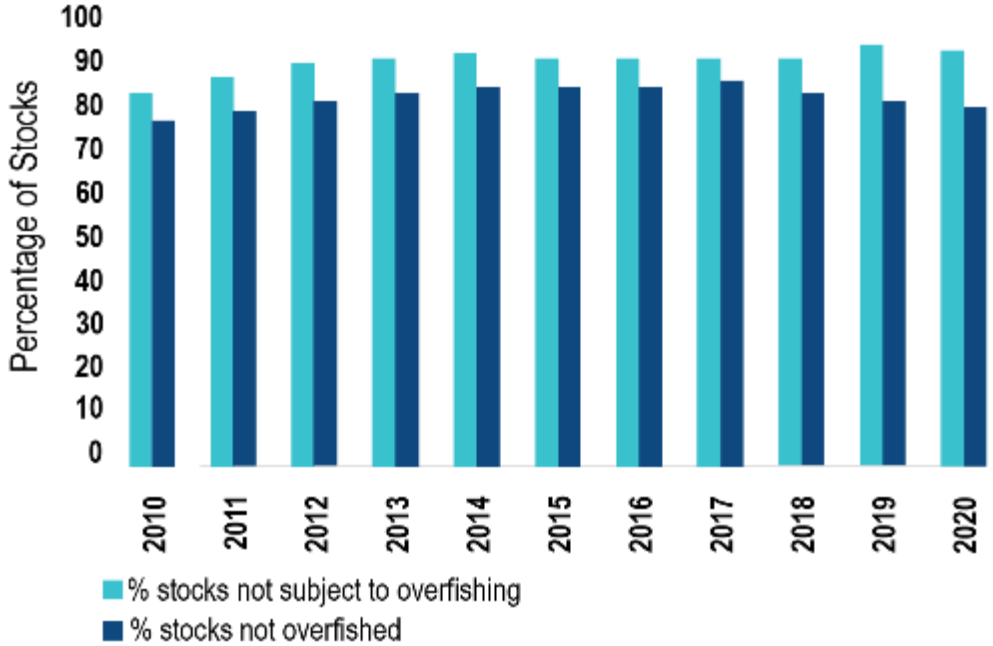
- nearly 500 fish stocks and stock complexes,
- 120 marine mammal species,
- 163 threatened and endangered species

Assessments use >50 long-term, standardized surveys

- many ongoing for more than 30 years







U.S. Commercial Fisheries and the Seafood Industry

Landings and Values, 2020 National Totals

8.4 billion pounds -10% from 2019

$4.8 billion -15% from 2019

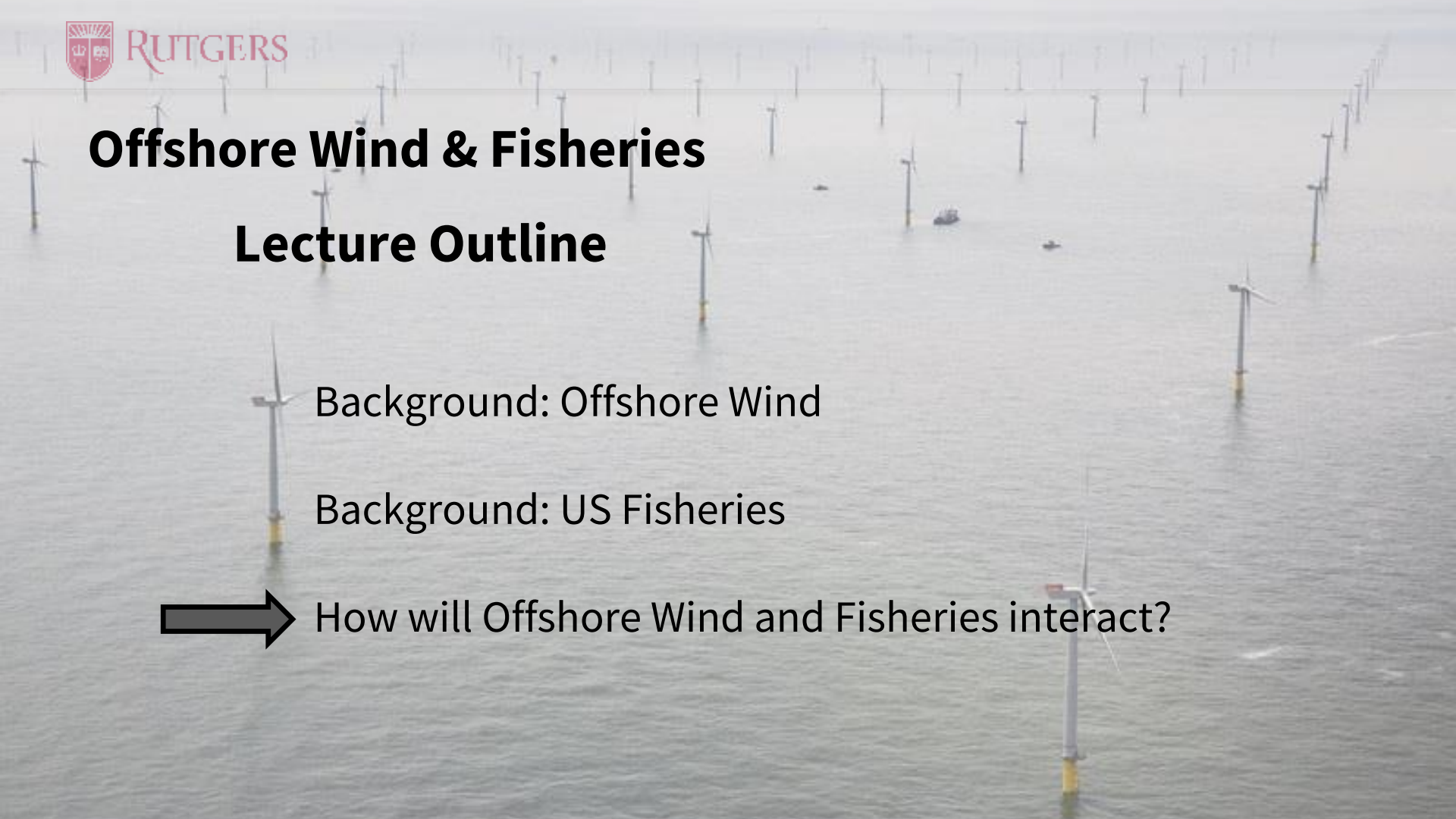
Regional Totals Commercial

PACIFIC
12% of LANDINGS
14% of VALUE

ATLANTIC
14% of LANDINGS
40% of VALUE

ALASKA
60% of LANDINGS
31% of VALUE

GULF OF MEXICO
14% of LANDINGS
15% of VALUE



Offshore Wind & Fisheries

Lecture Outline

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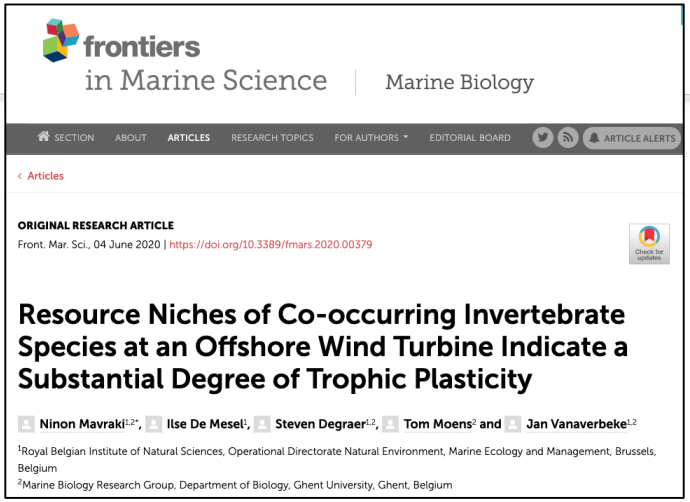
Background: US Fisheries

→ How will Offshore Wind and Fisheries interact?

Offshore Wind & Fisheries

- Alteration of habitat
  - Physical structure and bottom armoring
  - Mixing and wind interactions
  - EMF
- Navigation and safety issues
- Invasive species and dispersal
- Fishery survey access
- Displacement of fishing effort



frontiers in Marine Science | Marine Biology

SECTION ABOUT ARTICLES RESEARCH TOPICS FOR AUTHORS EDITORIAL BOARD ARTICLE ALERTS

‹ Articles

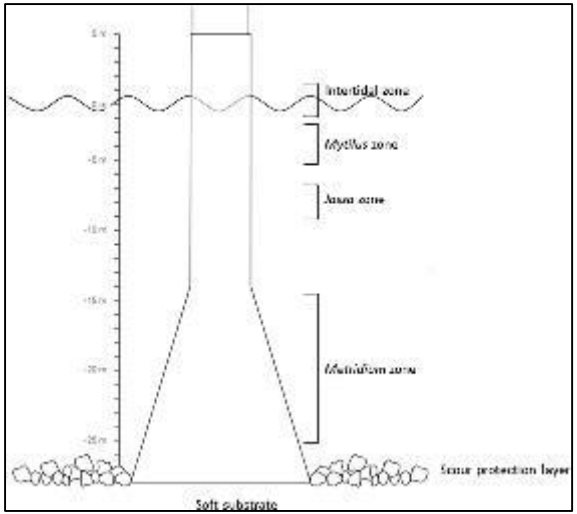
ORIGINAL RESEARCH ARTICLE

Front. Mar. Sci., 04 June 2020 | https://doi.org/10.3389/fmars.2020.00379

Resource Niches of Co-occurring Invertebrate Species at an Offshore Wind Turbine Indicate a Substantial Degree of Trophic Plasticity

Ninon Mavraki[1,2]*, Ilse De Mesel[1], Steven Degraer[1,2], Tom Moens[2] and Jan Vanaverbeke[1,2]

[1]Royal Belgian Institute of Natural Sciences, Operational Directorate Natural Environment, Marine Ecology and Management, Brussels, Belgium
[2]Marine Biology Research Group, Department of Biology, Ghent University, Ghent, Belgium



Offshore Wind & Fisheries

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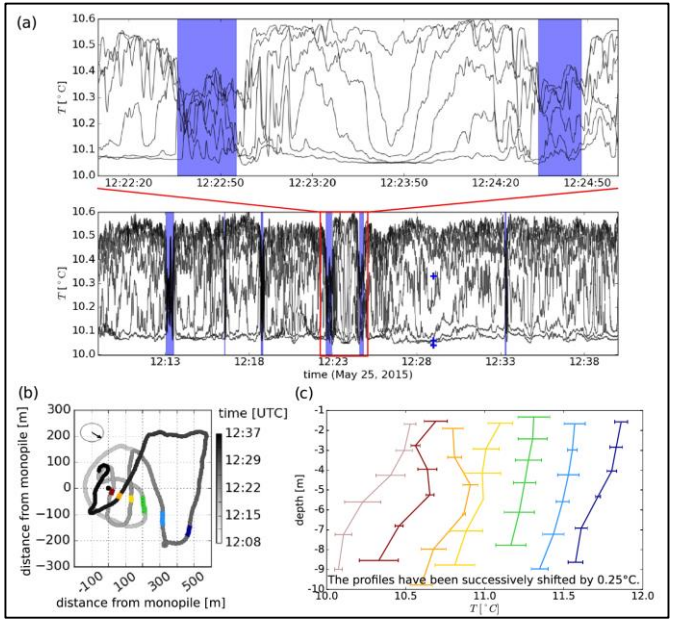


JGR Oceans

RESEARCH ARTICLE
10.1029/2019JC015858

Key Points:

- Enhanced mixing and disturbed stratification in the wake of monopiles is traceable in field and turbulence-resolving numerical experiments
- Elevated turbulent dissipation and mixing are found in a narrow region

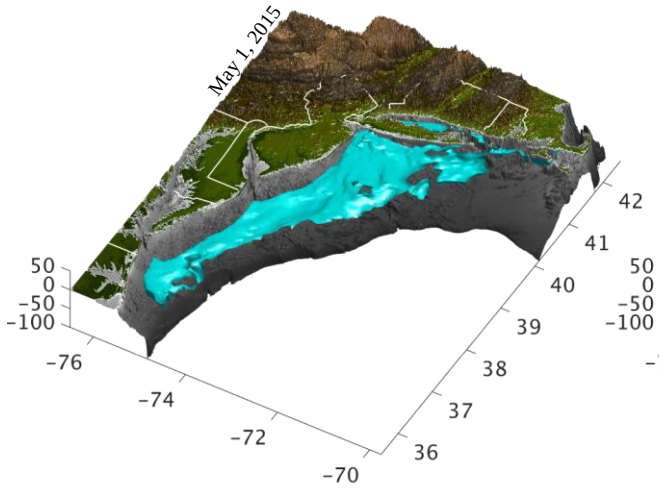
Increased Mixing and Turbulence in the Wake of Offshore Wind Farm Foundations

L. K. P. Schultze[1], L. M. Merckelbach[1], J. Horstmann[1], S. Raasch[2], and J. R. Carpenter[1]

[1]Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, Geesthacht, Germany, [2]Institute of Meteorology and Climatology, Leibniz Universität Hannover, Hannover, Germany

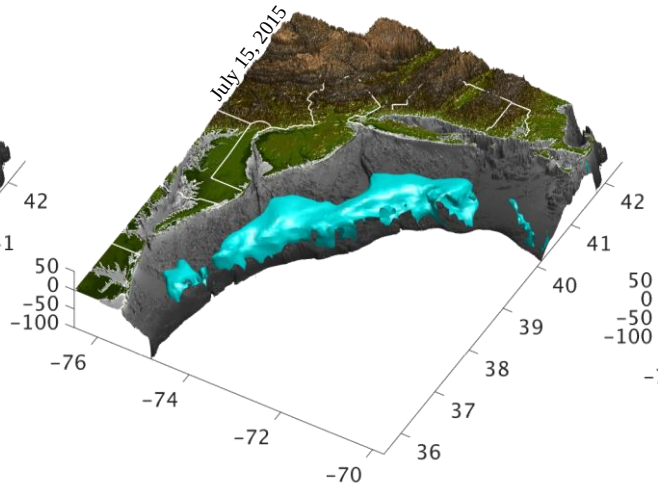
Cold Pool Processes

Spring setup



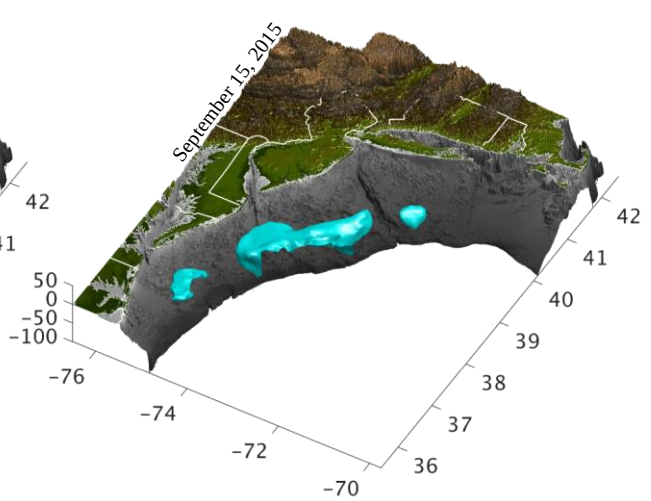
• Maturation • Migration • Spawning

Summer stability



• Migration • Refuge • Feeding

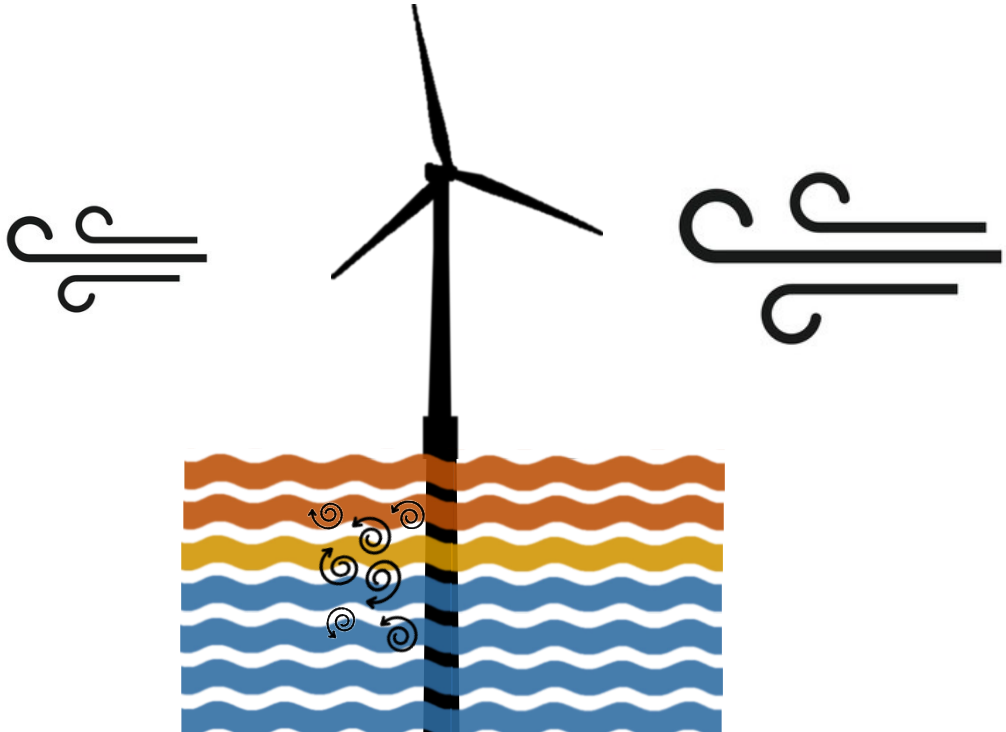
Fall breakdown



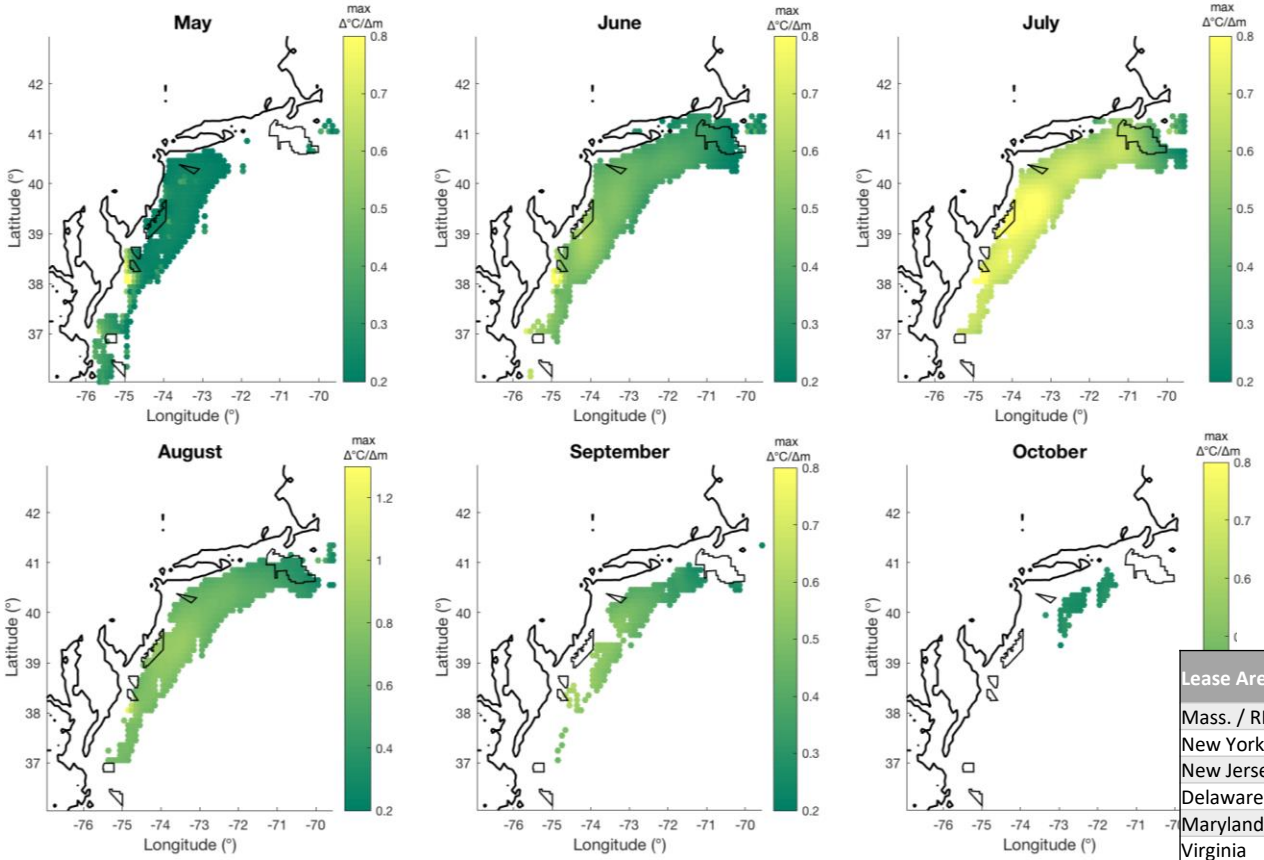
• Spawning • Refuge • Migration

Ecological Processes

Oceanographic Uncertainties
Wind Energy and Cold Pool



Location of Cold Pool



PAPER

Offshore Wind Energy and the Mid-Atlantic Cold Pool: A Review of Potential Interactions

AUTHORS
Travis Miles
Sarah Murphy
Josh Kohut
Sarah Borsetti
Daphne Munroe
Department of Marine and Coastal Sciences, Rutgers, The State University of New Jersey

ABSTRACT
The U.S. East Coast has 1.7 million acres of federal bottom under lease for the development of wind energy installations, with plans for more than 1,500 foundations to be placed. The scale of these wind farms has the potential to alter the unique and delicate oceanographic conditions along the expansive Atlantic continental shelf, a region characterized by a strong seasonal thermocline that overlies cold bottom water, known as the "Cold Pool." Strong seasonal stratification traps cold (typically less than 10°C) water above the ocean bottom sustaining a boreal fauna that represents vast fisheries, including the most lucrative shellfish fisheries in the United States. This paper reviews the existing literature and research per-

Percentage of Lease Area Occupied by Cold Pool

Lease Areas	May	June	July	August	Sept.	October	Total Pixels
Mass. / RI	6.3	**91.7**	**100**	**72.9**	0	0	48
New York	**100**	**100**	**80**	**80**	20	0	5
New Jersey	**89.5**	**73.7**	**63.2**	**68.4**	0	0	17
Delaware	**60**	40	0	0	0	0	5
Maryland	**100**	**66.67**	**50**	16.7	0	0	6
Virginia	11.1	0	0	0	0	0	9
North Carolina	0	0	0	0	0	0	6

total number of ocean pixels in each lease area

* Monthly statistical mean of 2005-2012 Northwest Atlantic Regional Climatology data at 1/10° grid accessed from World Ocean atlas at https://www.nodc.noaa.gov/OC5/regional_climate/nwa-climate/

Offshore Wind & Fisheries

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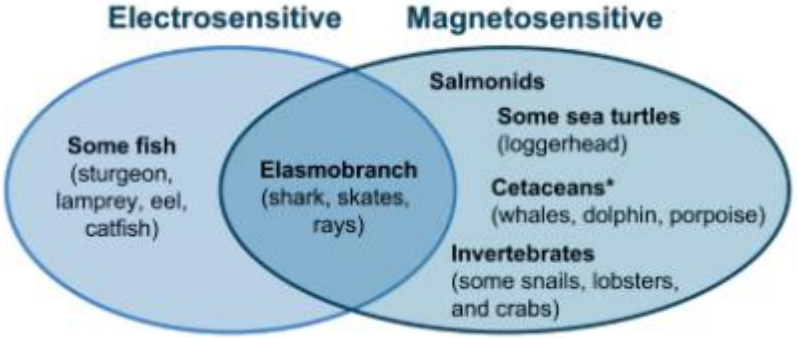
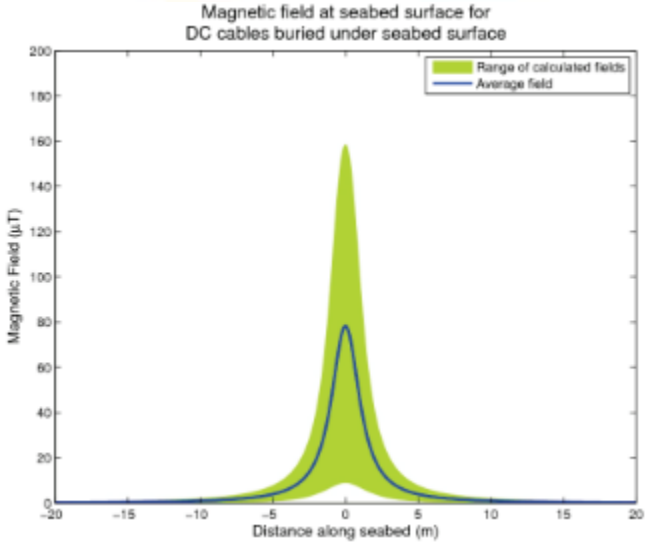
  - Mixing and wind interactions
  - EMF
- Navigation and safety issues
- Invasive species and dispersal
- Fishery survey access
- Displacement of fishing effort





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Offshore Wind & Fisheries

- Alteration of habitat
  - Physical structure and bottom armoring
  - Mixing and wind interactions
  - EMF
- Fish aggregation, artificial reef effects
- Navigation and safety issues
- Invasive species and dispersal
- Fishery survey access
- Displacement of fishing effort

Hydrobiologia (2014) 727:121–136
DOI 10.1007/s10750-013-1793-1

PRIMARY RESEARCH PAPER

The ecology of benthopelagic fishes at offshore wind farms: a synthesis of 4 years of research

J. T. Reubens · S. Degraer · M. Vincx

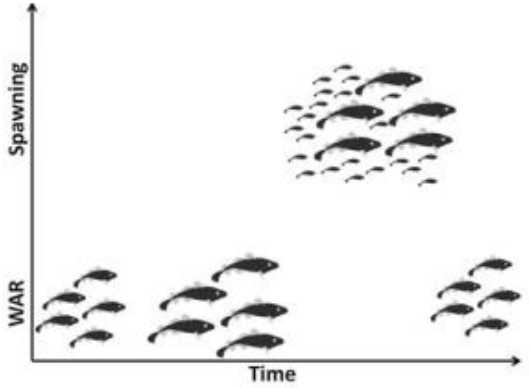

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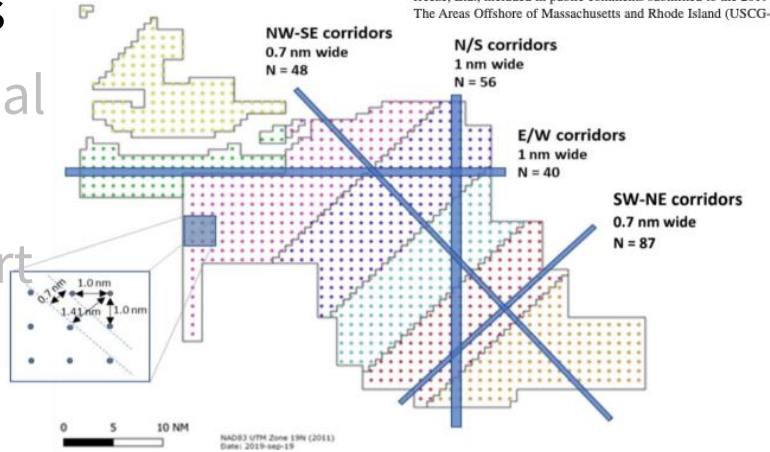
FIGURE 1.3 Photograph of the display of a shipboard radar operated in a U.K. wind farm. SOURCE: Seafreeze, Ltd., included in public comments submitted to the 2019 U.S. Coast Guard Port Access Route Study: The Areas Offshore of Massachusetts and Rhode Island (USCG-2019-0131-0026).



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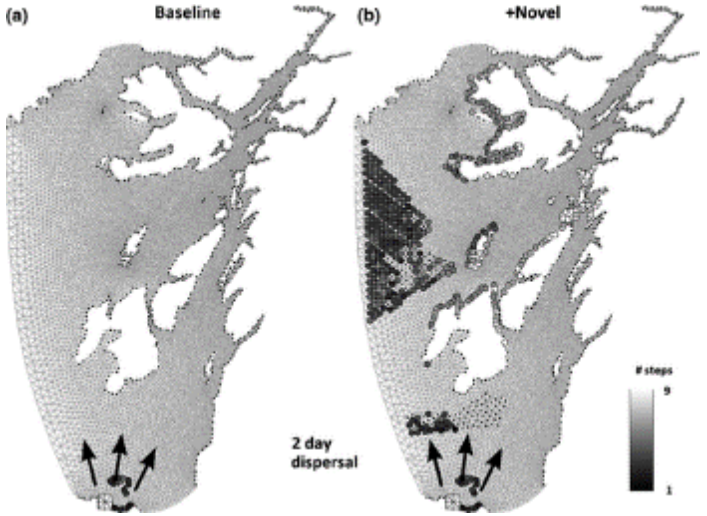

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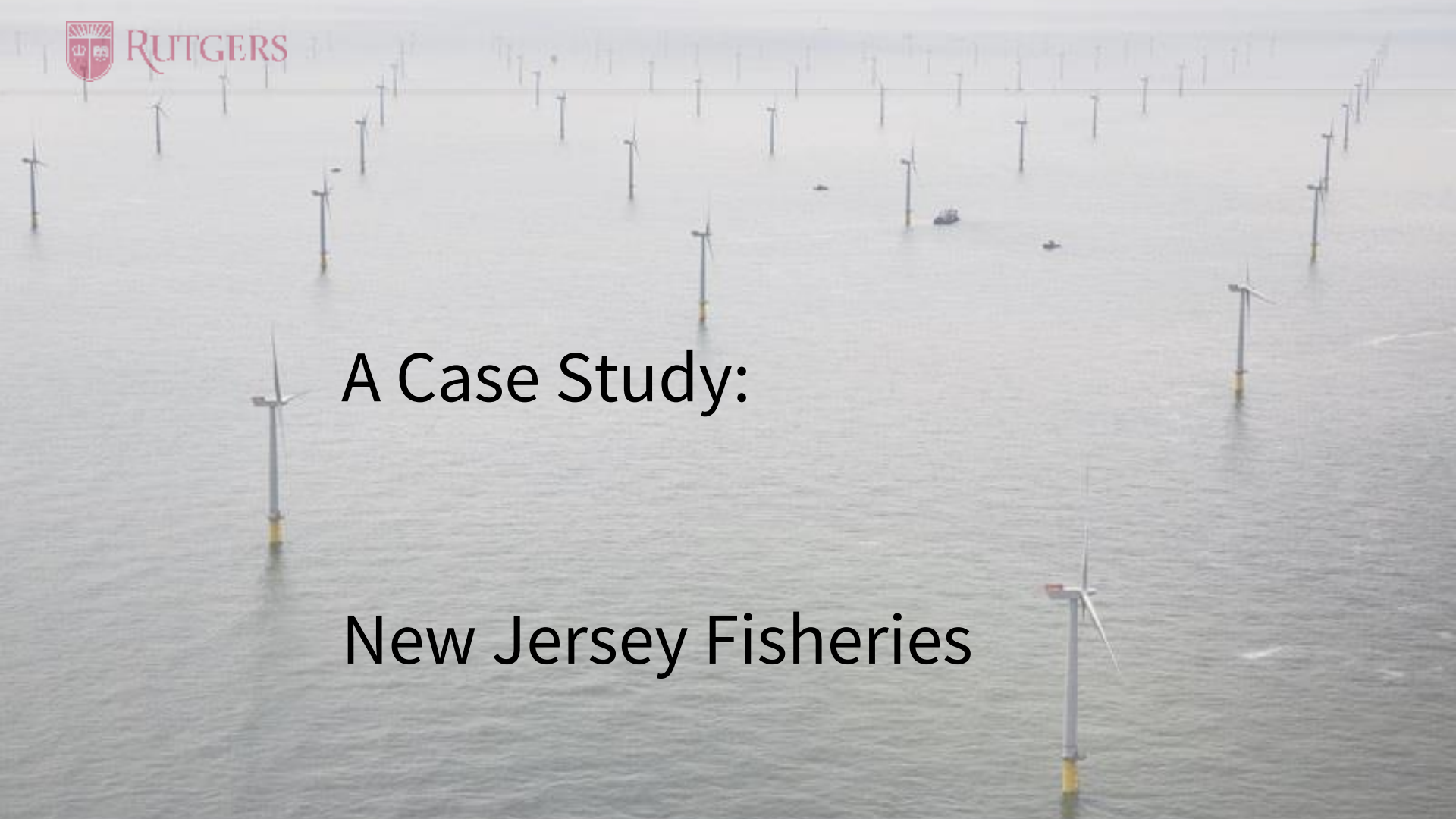
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A Case Study:
New Jersey Fisheries

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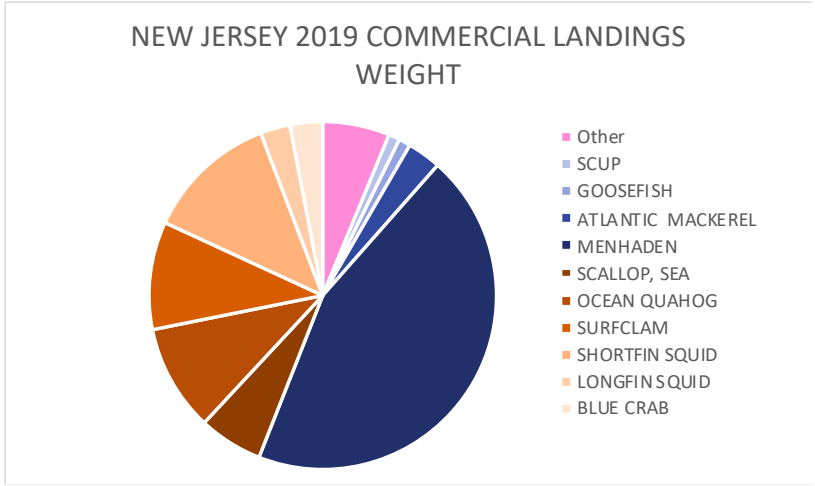
NEW JERSEY 2019 COMMERCIAL LANDINGS
WEIGHT
Other
SCUP
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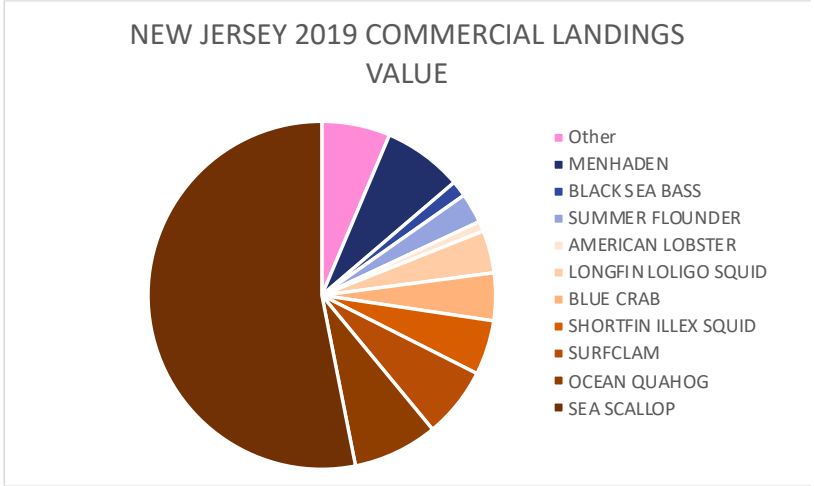
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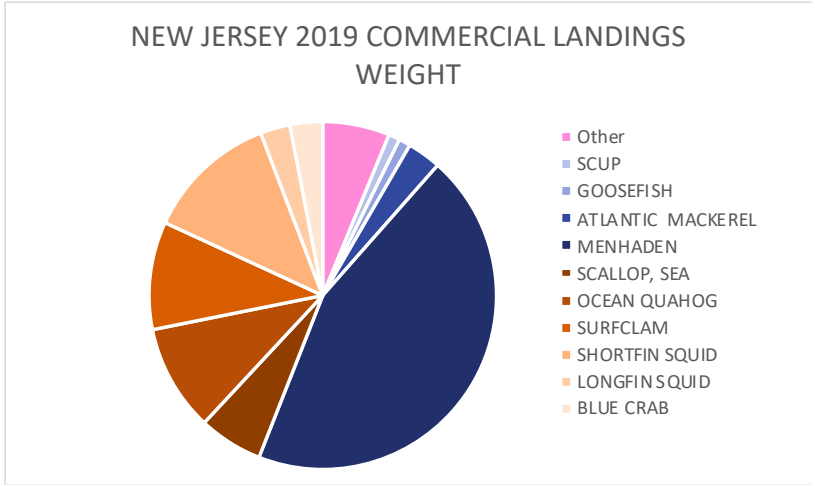
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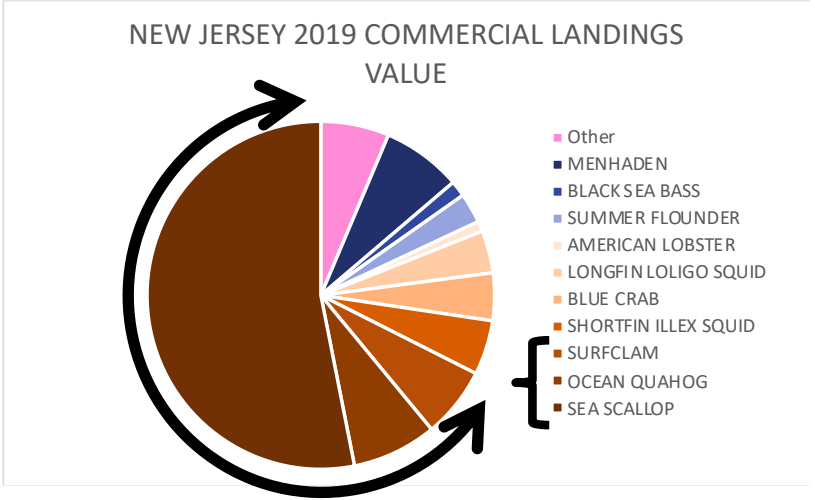
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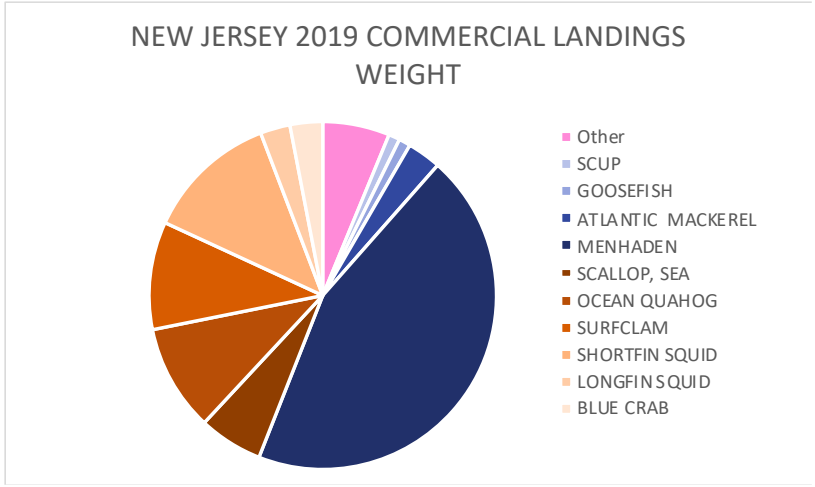
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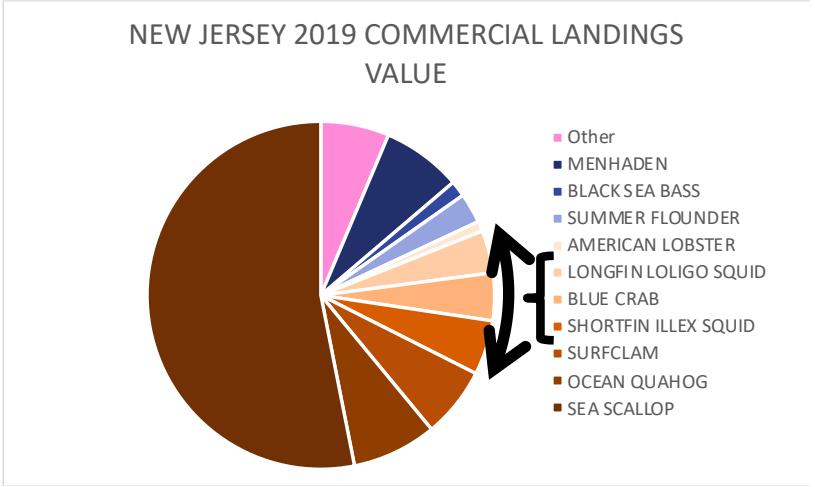
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Blue Crabs

- 4.5 million lbs landed commercially in 2021
  - Worth over $10 million
  - Recreational harvest ~40% of commercial harvest
- Commercial harvest by dredge or pot/trot line

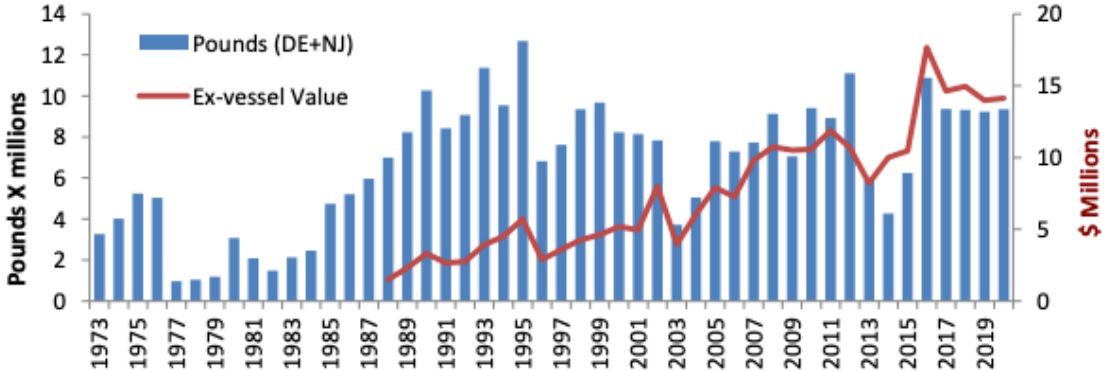
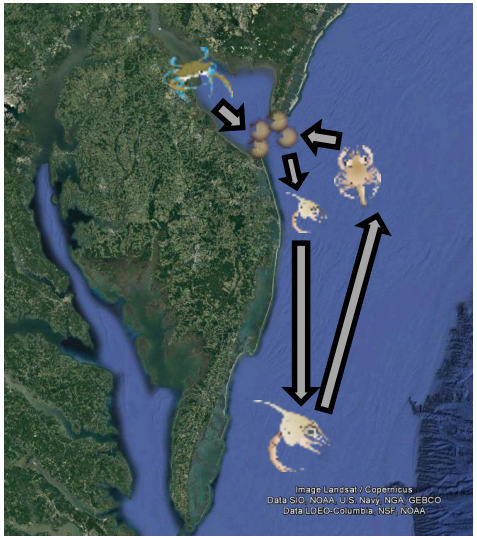


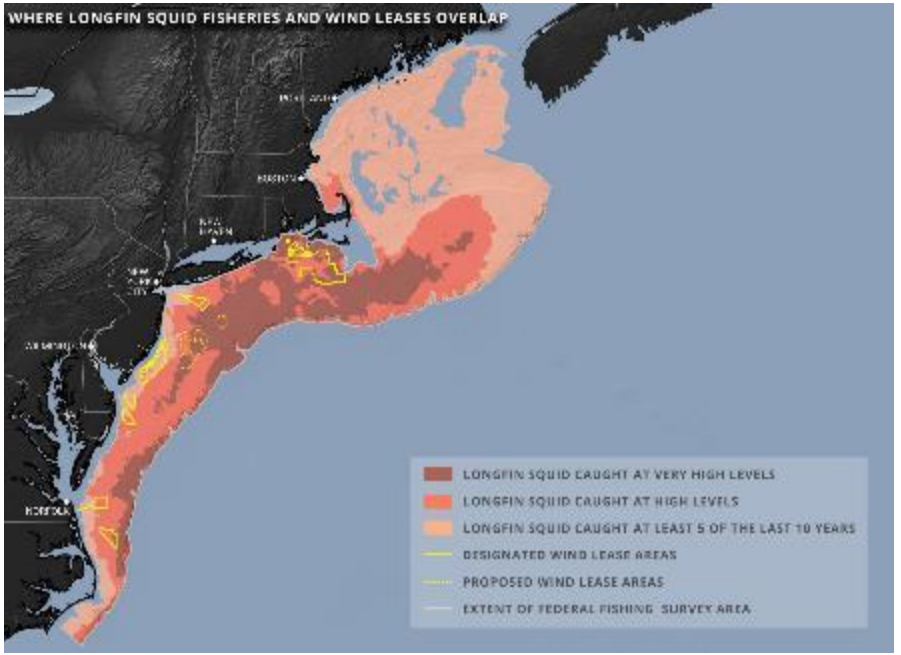
Figure 2: Combined NJ and DE Delaware Bay blue crab landings (combined commercial and recreational) and commercial fishery ex-vessel value (denoted by red line).



Squid

- Northern shortfin (*Illex illecebrosus*)
  - 20.5 million lbs worth >$6 million (2020)
- Longfin inshore (*Doryteuthis pealeii*)
  - 1.4 million lbs worth >$1.7 million (2021)
- Both species:
  - Live less than 1 year
  - Are highly mobile
  - Fishery is by trawl
  - Reproduce year round

CERTIFIED SUSTAINABLE SEAFOOD MSC www.msc.org



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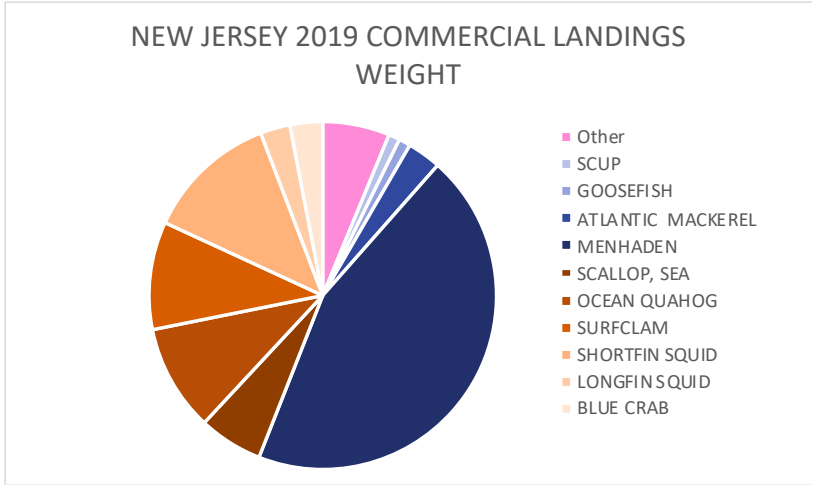
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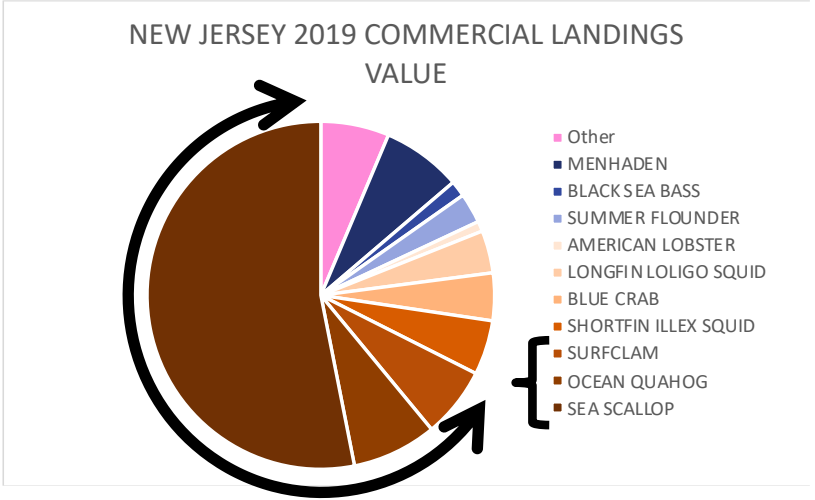
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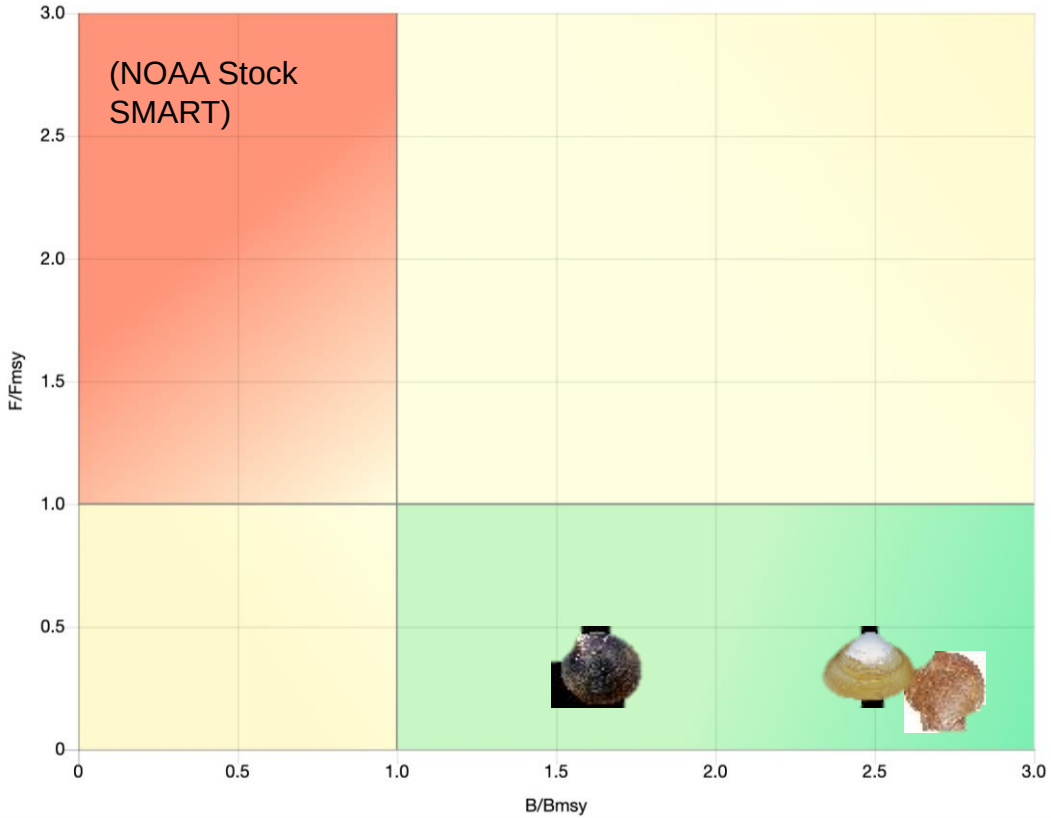
Three important Northeast commercial shellfish species



CERTIFIED SUSTAINABLE SEAFOOD MSC www.msc.org

Surfclam

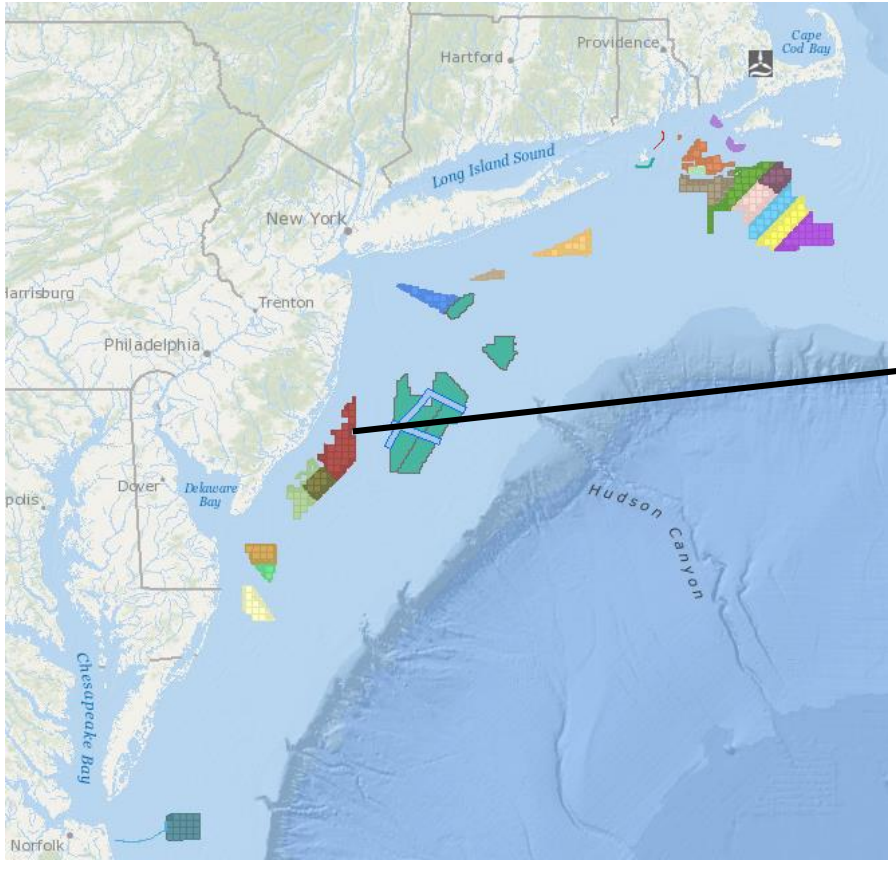
~20,000 metric tonnes
$28 million USD

Ocean Quahog

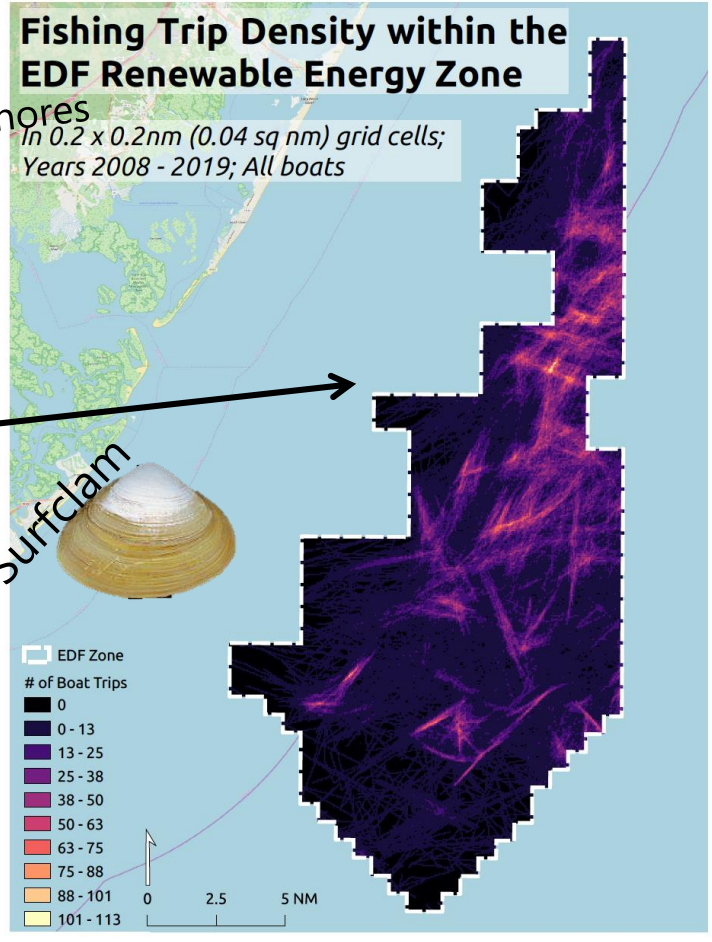
~9,500 metric tonnes
$19 million USD

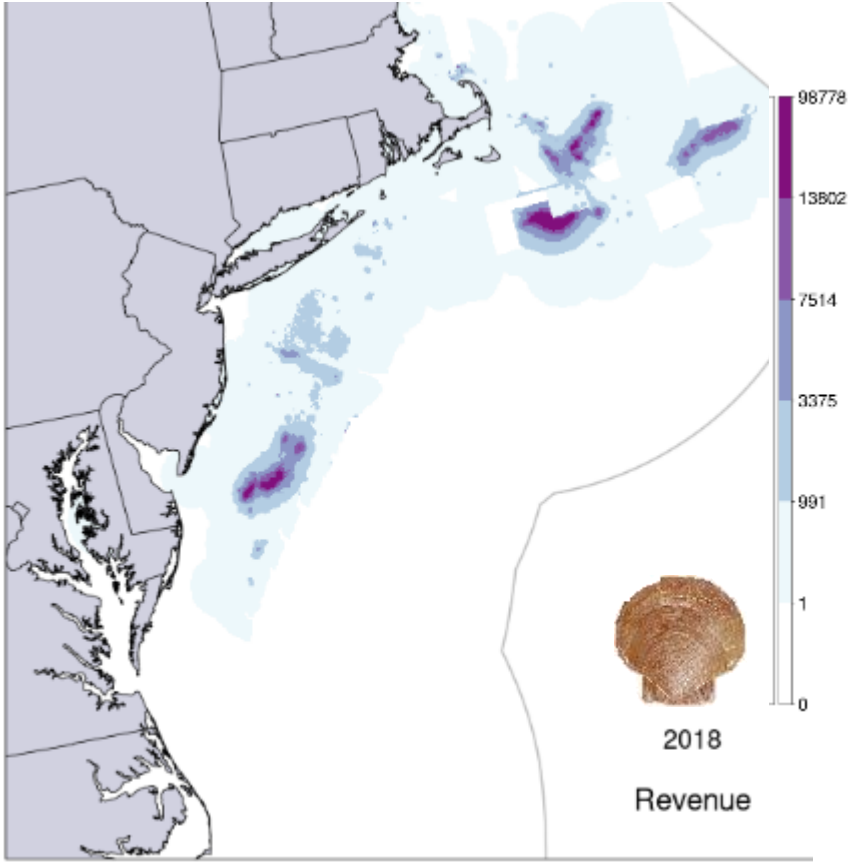
Sea Scallop

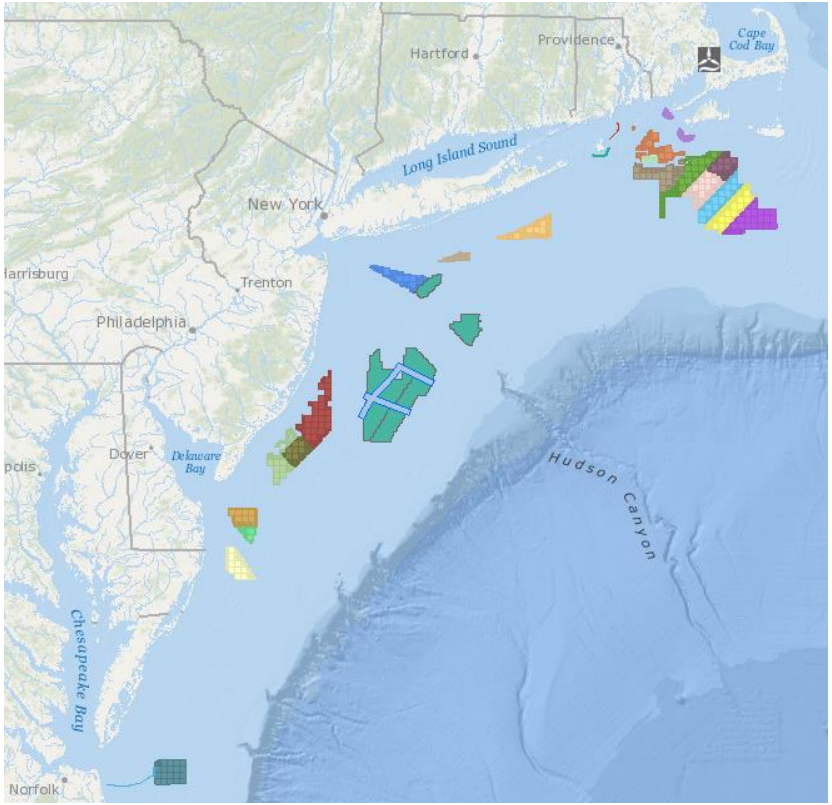
~60,000 metric tonnes
$560 million USD



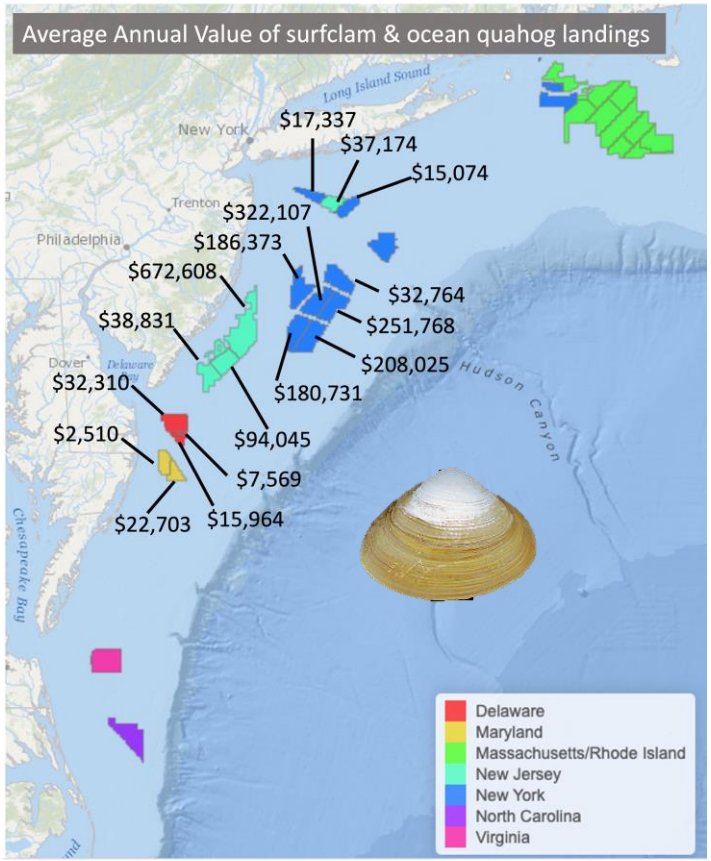
Atlantic Shores



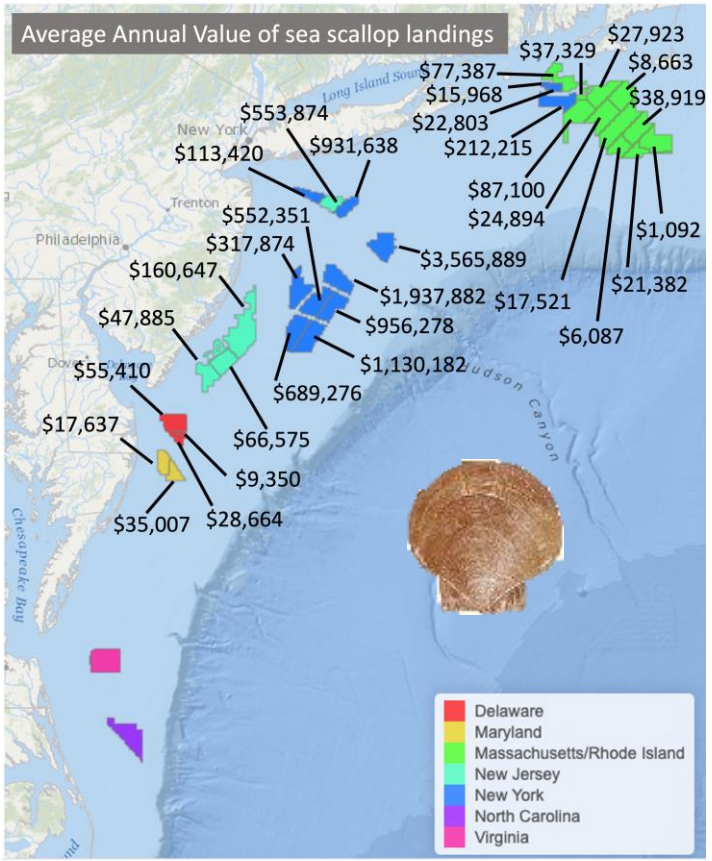




NOAA Fishing Footprints



Annual average values from each lease area over 2015-2019. Data from NOAA Socioeconomic Impacts of Atlantic Offshore Wind Development, GARFO online data resource. Accessed June 30, 2022.
https://www.fisheries.noaa.gov/resource/data/socioeconomic-impacts-atlantic-offshore-wind-development



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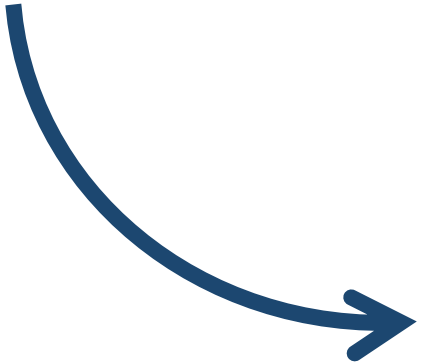
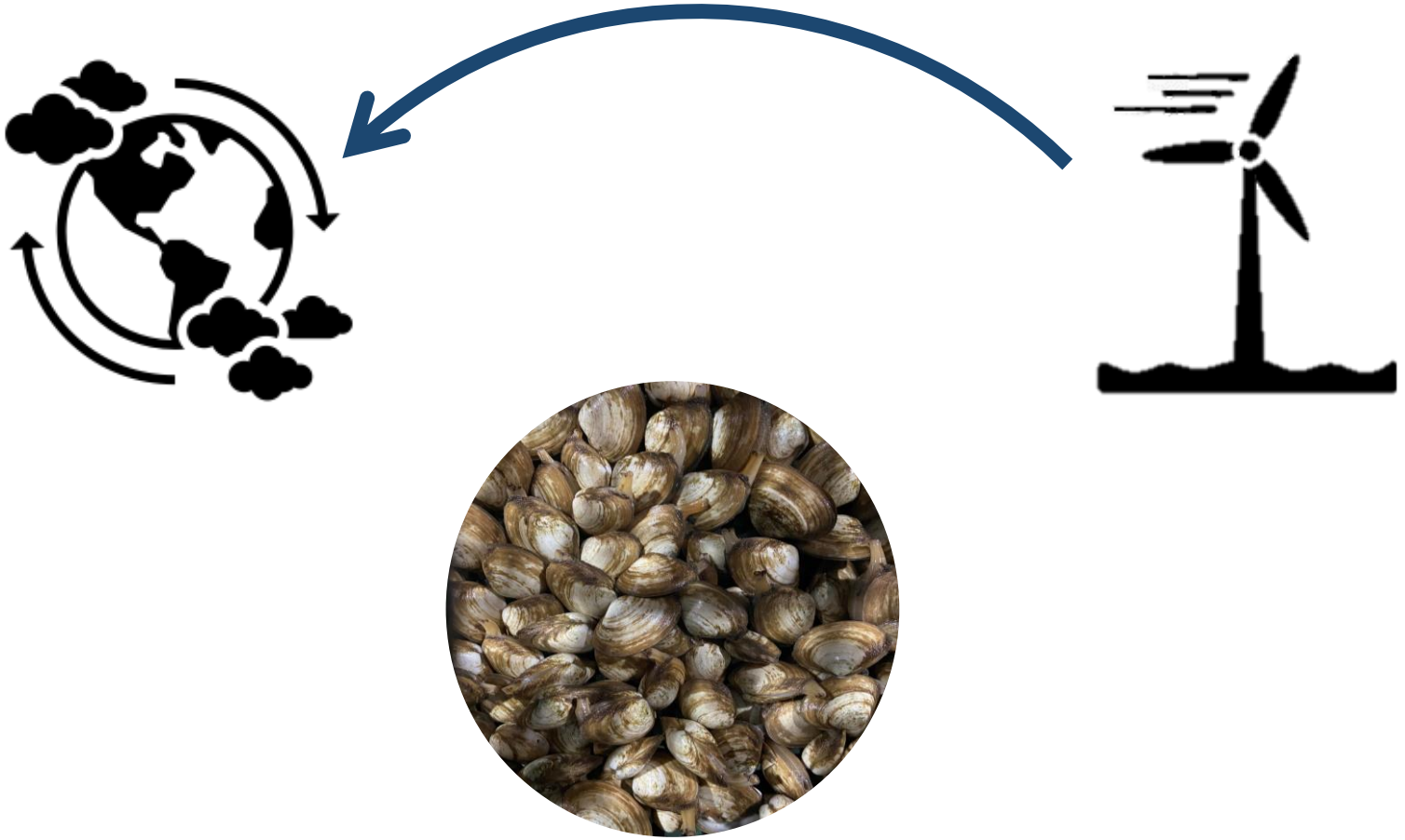
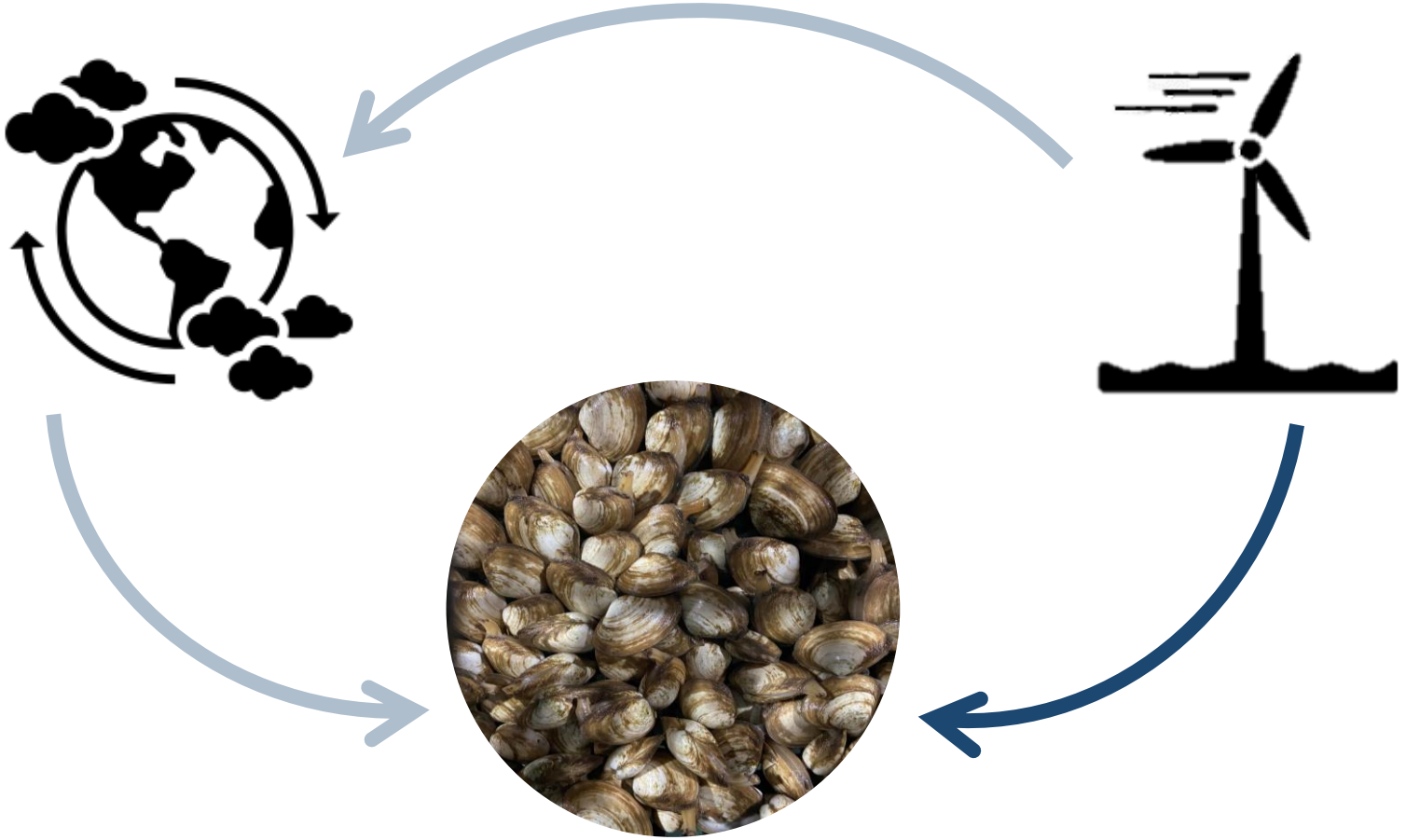
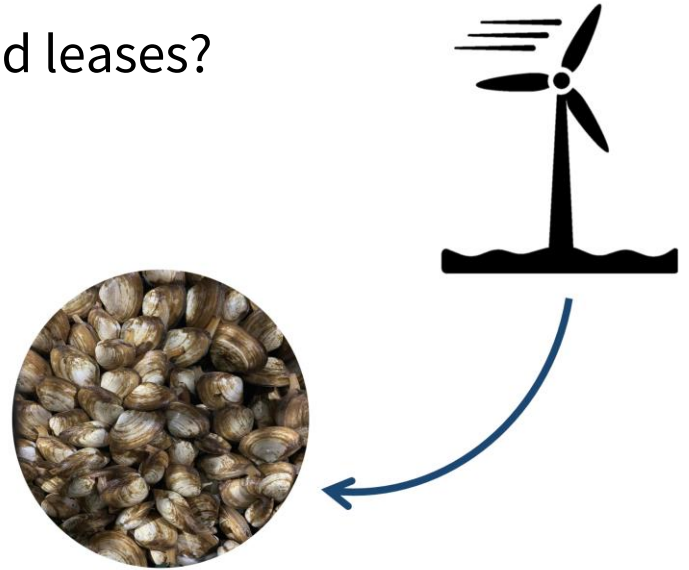






Offshore Wind and the Surfclam Fishery:

- What are the economic consequences of fleet displacement?
- What are the surfclam populations within wind leases?



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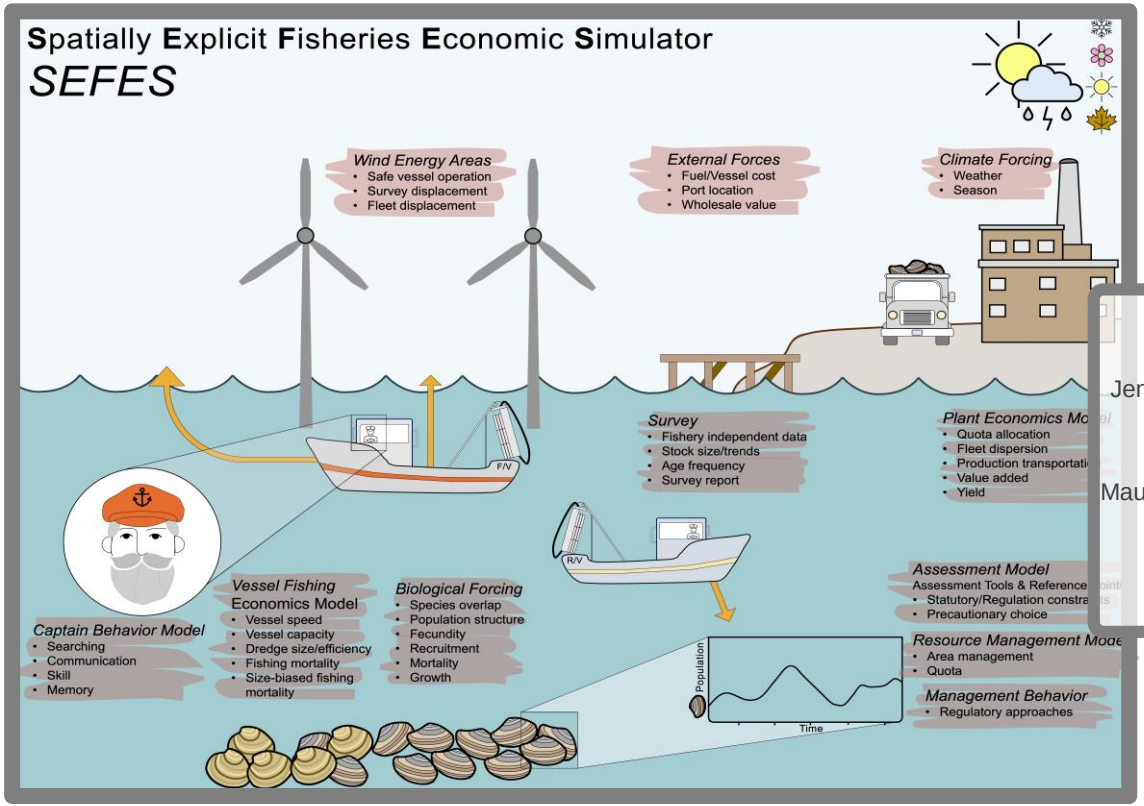

Andrew Scheld
Sarah Borsetti
Jennifer Beckensteiner

John Klinck
Eileen Hofmann
Mauricio González Díaz

Eric Powell
Stephanie Stromp
Molly Spencer

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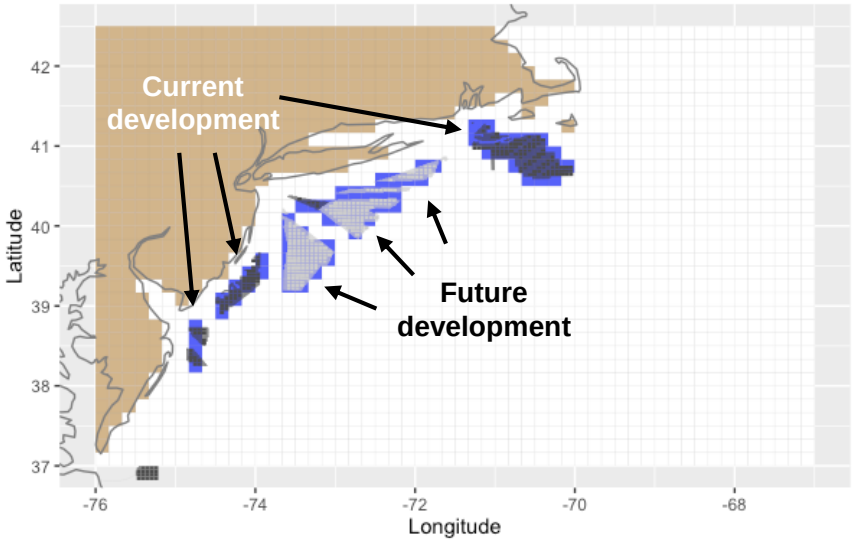

Wind energy scenario	*Description*
Status Quo	Status quo; no wind farms
	Current wind farms; Transit allowed — CURRENT LEASES
	Current wind farms; No transit allowed — CURRENT LEASES
	Current & future wind farms; Transit allowed — CURRENT LEASES, FUTURE LEASES
	Current & future wind farms; No transit allowed — CURRENT LEASES, FUTURE LEASES

Simulation strategy: evaluate changes in revenues and costs for fishing fleet and processors across different wind energy development scenarios

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ICES Journal of Marine Science, 2022, **79**, 1787–1800
DOI: 10.1093/icesjms/fsac108
Advance access publication date: 20 June 2022
Original Article

The Atlantic surfclam fishery and offshore wind energy development: 1. Model development and verification

Daphne M. Munroe[1,*], Eric N. Powell[2], John M. Klinck[3], Andrew M. Scheld[4], Sarah Borsetti[1,4], Jennifer Beckensteiner[4,5] and Eileen E. Hofmann[3]

ICES Journal of Marine Science, 2022, **79**, 1801–1814
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Original Article

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School of Environmental and Biological Sciences

VIMS | William & Mary
Virginia Institute of Marine Science

Old Dominion University

The University of Southern Mississippi

SCAN
PROJECT WEBSITE

- The number of trips reduces and average time at sea increases
- Decreases in fishing activity lead to decreases in revenues ~3-15%
- Costs increase by 10% and revenues decline by 25% for Atlantic City fleet

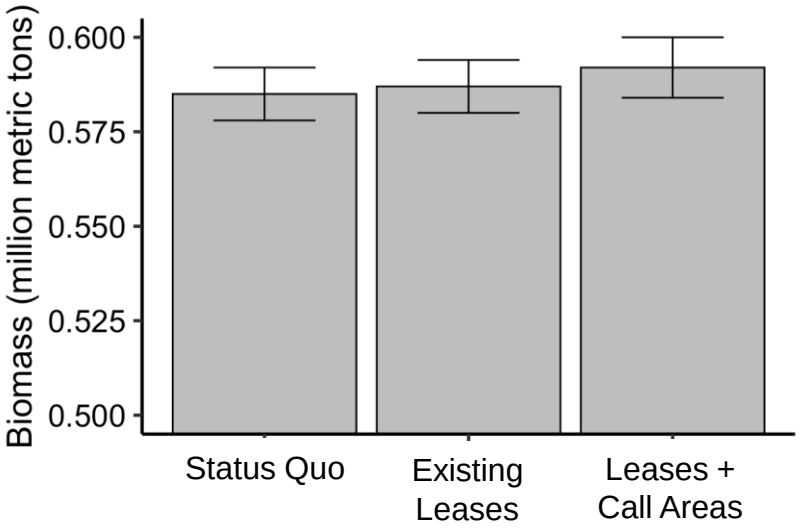
Stock Assessment Impacts

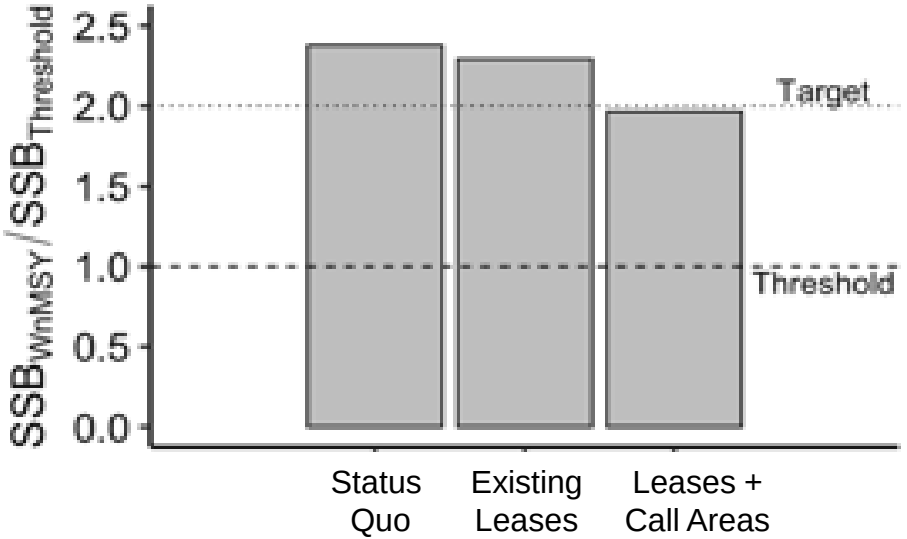
Marine and Coastal Fisheries
Dynamics, Management, and Ecosystem Science

Themed Issue: Offshore Wind Interactions With Fish And Fisheries | Open Access

Potential Repercussions of Offshore Wind Energy Development in the Northeast United States for the Atlantic Surfclam Survey and Population Assessment

Sarah Borsetti, Daphne M. Munroe, Andrew M. Scheld, Eric N. Powell, John M. Klinck, Eileen E. Hofmann





What are the surfclam populations within wind leases?

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Research and Monitoring Initiative (RMI)

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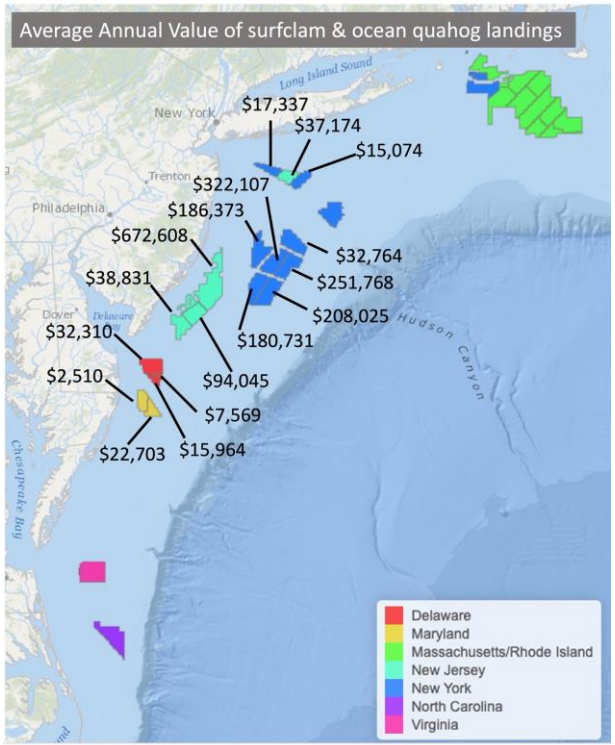

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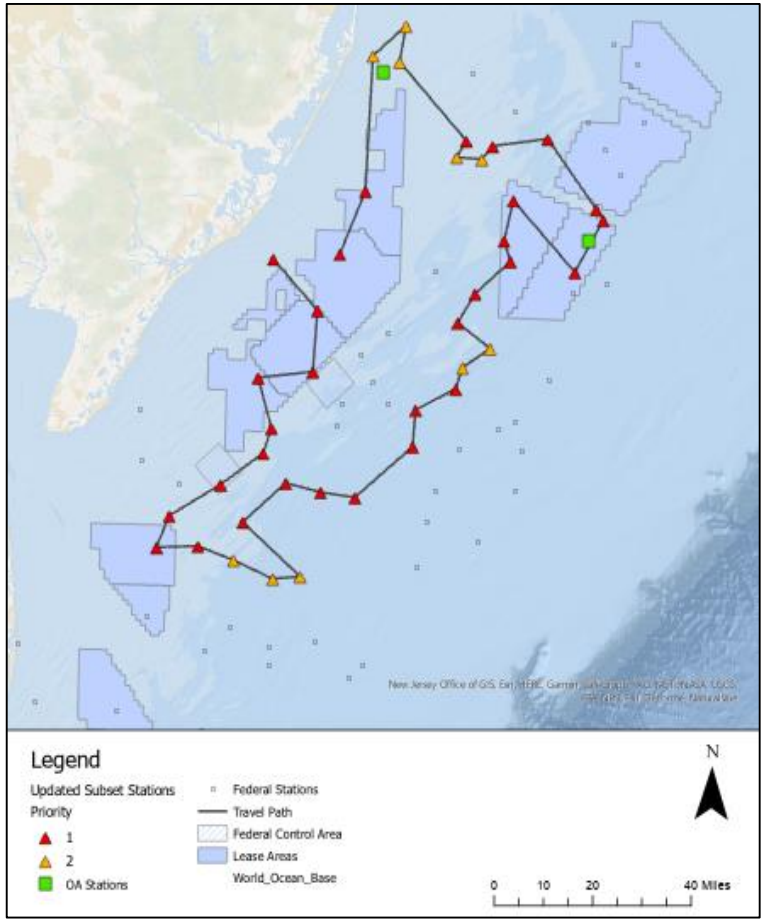

Dredge calibration

- Federal Survey Stations

At each station:

- Standardized dredge tow
  - Clam abundance, size & age frequency, shell strength
- Benthic grab
  - Links with long-term state survey
- CTD & pCO2 sensor cast
  - Oceanographic profile & bottom water chemistry

Department of Environmental Protection
Research and Monitoring Initiative (RMI)

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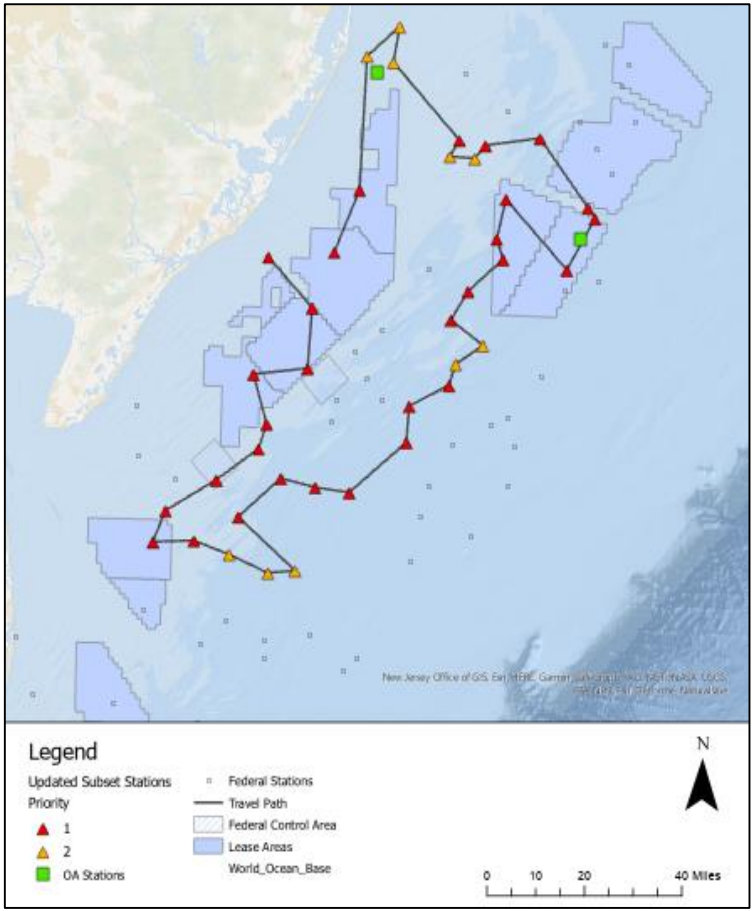

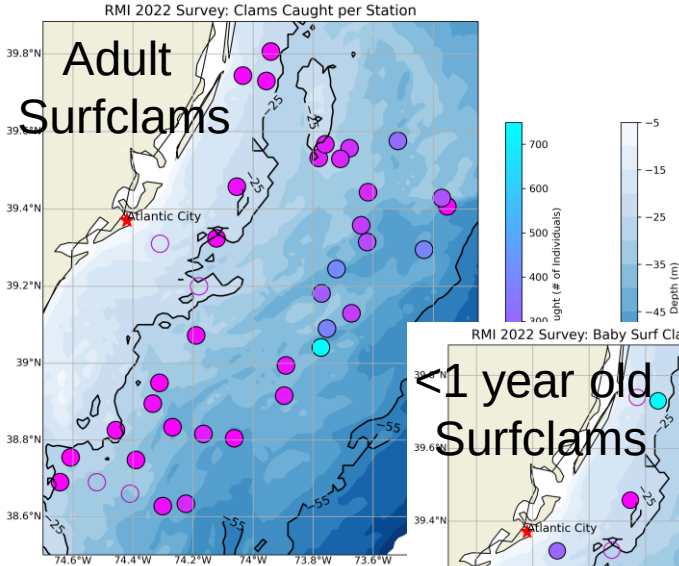

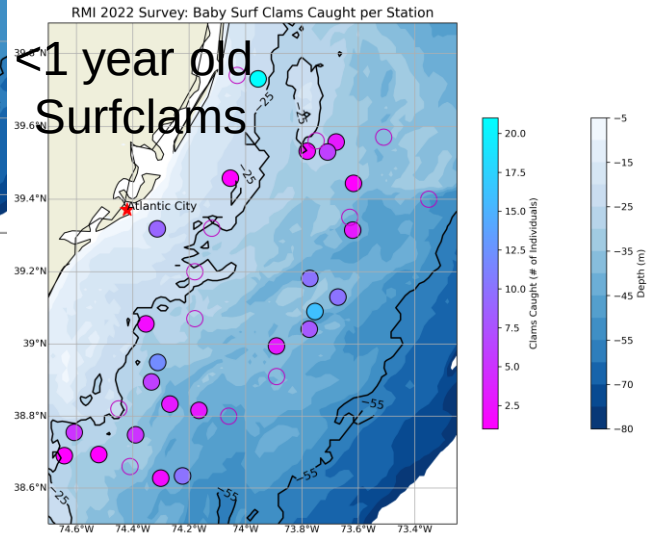

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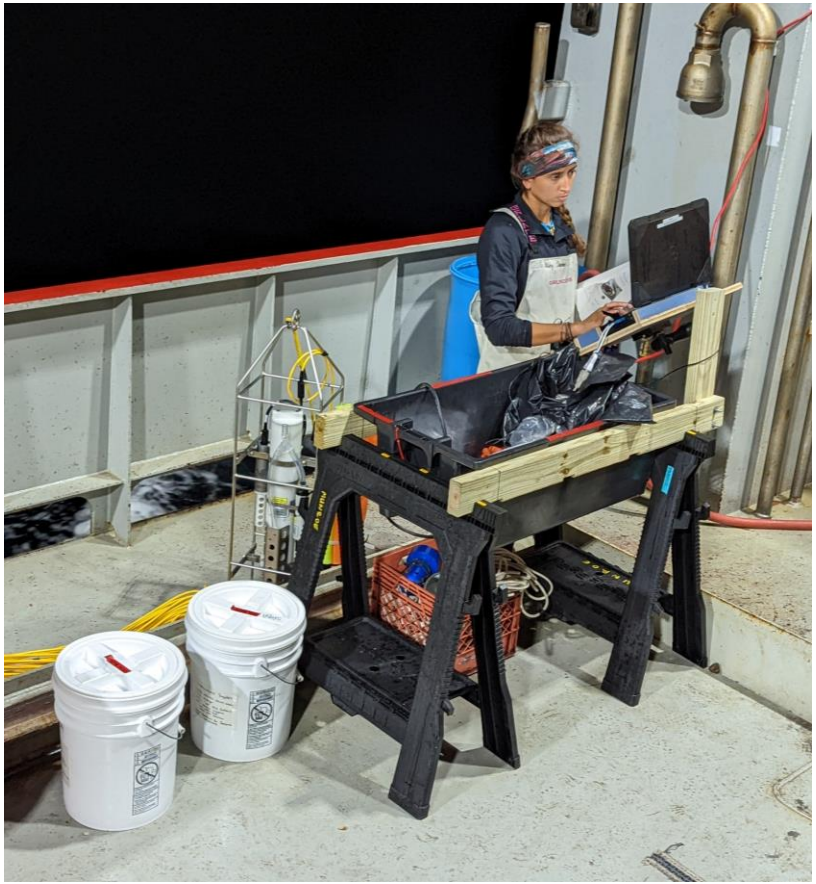
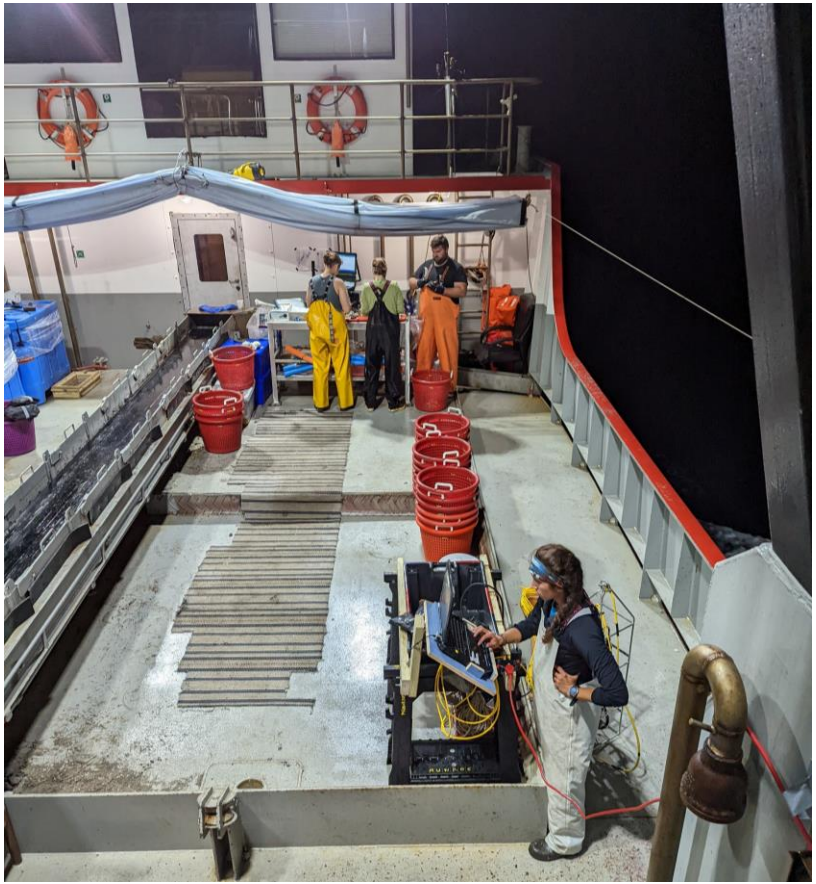
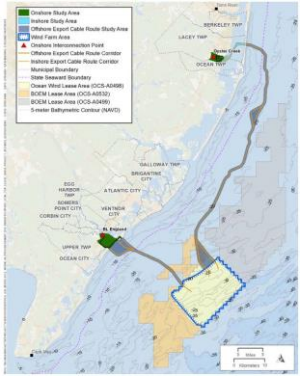
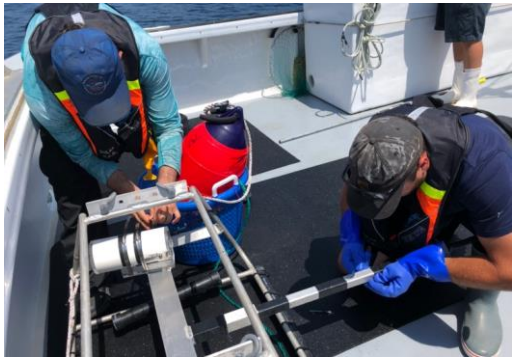




Fisheries Monitoring Of An Offshore Windfarm Ocean Wind 1

https://rowlrs.marine.rutg[illegible]u/





Thomas Grothues, Jason Morson, Jason Adolf, Kaycee Coleman, Gregory Decelles, Keith Dunton, Josh Kohut, Daphne Munroe, Grace Saba, Kevin Wark, and Douglas Zemeckis

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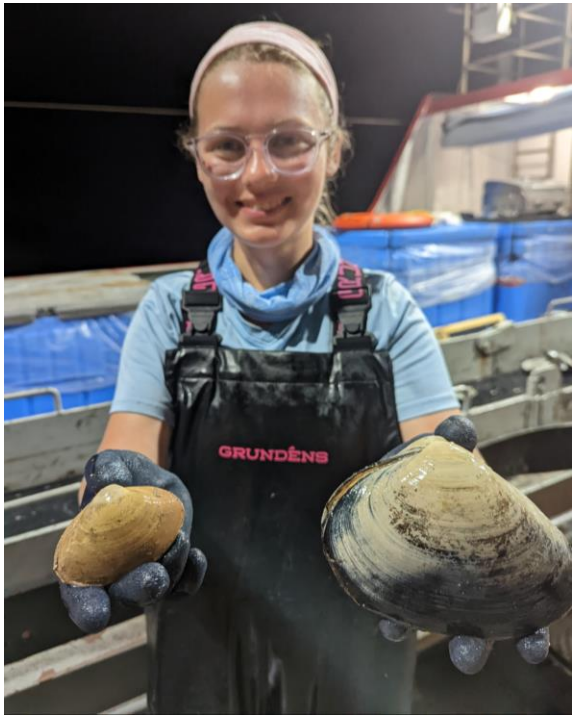
MONMOUTH UNIVERSITY

Ørsted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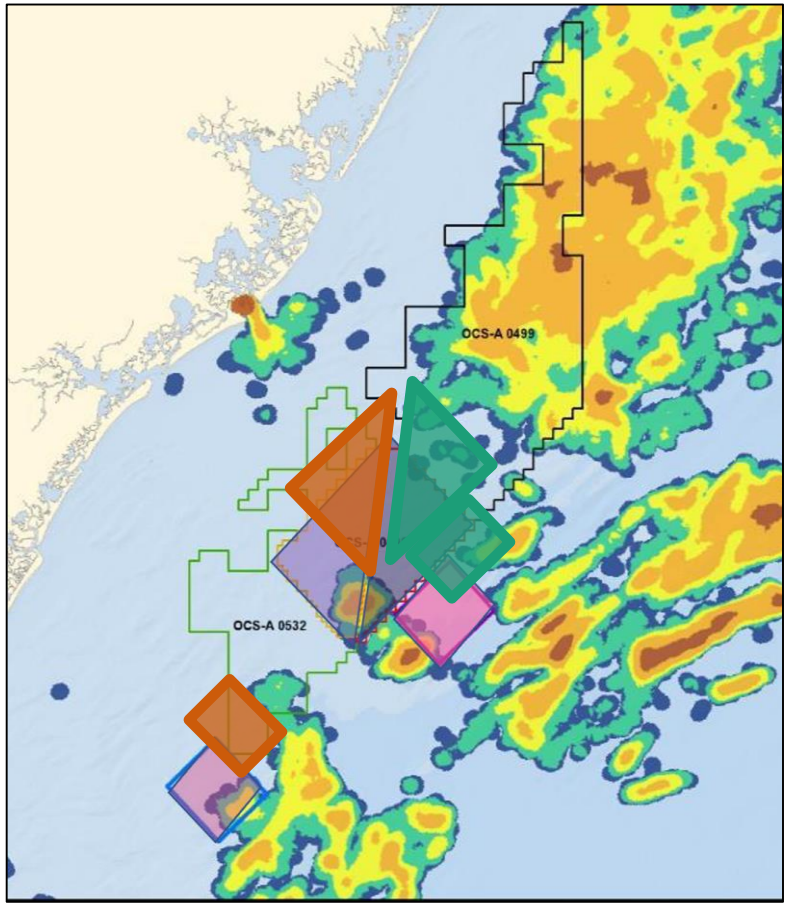
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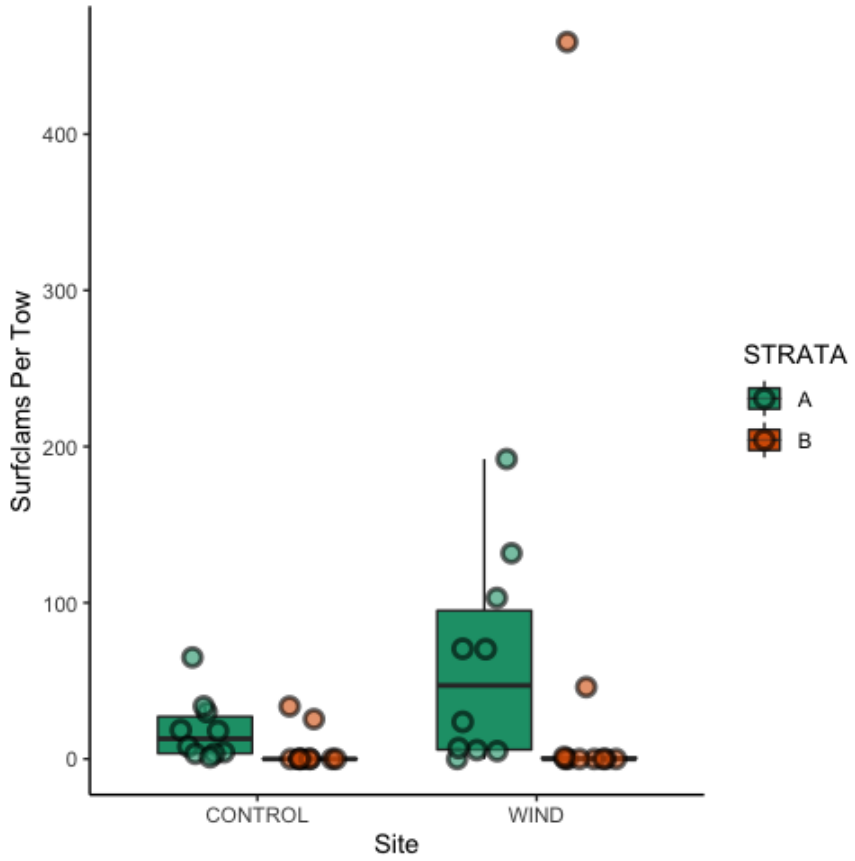
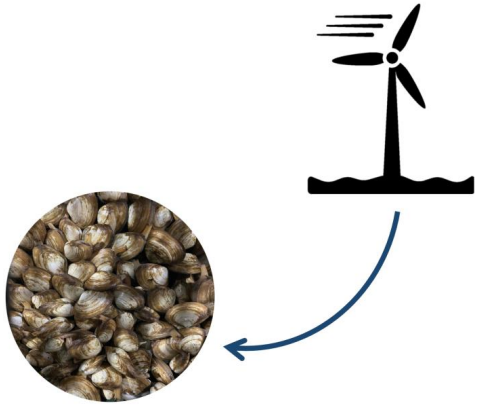

Surfclams Per Tow
400
300
200
100
0
CONTROL
WIND
Site
STRATA
A
B

Offshore Wind and the Surfclam Fishery:

- What are the economic consequences of fleet displacement?
  - Revenue losses (3-15%).
- How might overlap among fishing grounds and offshore wind change over wind project lifetime?
  - Possible biomass ↑ and expansion.
- What are the surfclam populations within wind leases?
  - Young clams in lease areas.

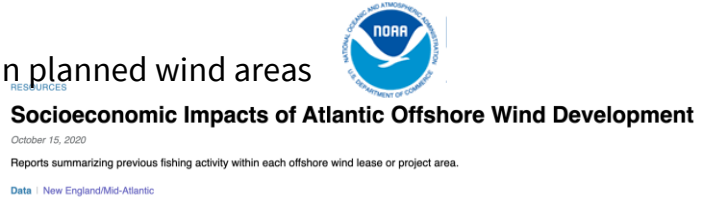


Resources:

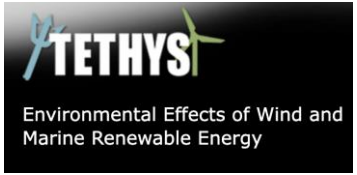
- Oceanography Volume
  - This journal volume has papers on the topic of Offshore Wind & Fisheries
  - December Vol 33(4) – Offshore Wind & Fisheries

- RI Sea Grant Baird Symposium
  - This symposium has recorded talks on Offshore Wind & Fisheries
  - https://seagrant.gso.uri.edu/special-programs/baird/

- NOAA Data Portal for fisheries economic data from WEA
  - This data resource serves information about commercial fishing within planned wind areas
  - https://www.fisheries.noaa.gov/resource/data/socioeconomic-impacts-atlantic-offshore-wind-development



- Tethys
  - This portal contains papers and reports about offshore wind and marine resources
  - https://tethys.pnnl.gov/



- Marco
  - This data portal allows mapping of ocean, wind, and fisheries data
  - https://portal.midatlanticocean.org/

MARCO Mid-Atlantic Ocean Data Portal