Environmental Technical Working Group

A Stakeholder Engagement and Advisory Process to Advance the Environmentally Responsible Development of Offshore Wind Energy for New York State

NEW YORK STATE | NYSERDA

Introductions

> E-TWG Lead: NYSERDA - 518-862-1090

- Kate McClellan Press x3110, Kate.McClellanPress@nyserda.ny.gov

> Technical Support: Biodiversity Research Institute (BRI) - 207- 839-7600

- Kate Williams x108, kate.williams@briwildlife.org
- Julia Gulka x303, Julia.gulka@briwildlife.org

> Facilitation Support: CBI and Cadmus

- Bennett Brooks 212-678-0078, bbrooks@cbi.org
- Stefanie Sganga 617-673-7018, Stefanie.Sganga@cadmusgroup.com

Meeting Agenda

- Welcome
- E-TWG Activities Updates
- Masterplan 2.0
  - Overview
  - Key findings from individual studies
  - Breakout group discussions
  - Environmental sensitivity study
  - Full group discussion
- Next Steps and Wrap Up

Ground Rules

- Contribute – your perspectives are important
- Share time – lots to cover and many people around the table (virtually and in person)
- Integrate ideas and pose questions
- Stay focused on the agenda
- Avoid multitasking and other distractions
- We all have our unique challenges in a hybrid environment – it will take all of us being mindful to make this work

In Person Logistics

- Food/Coffee
- Restrooms
- Name tags and table tents
- Seating organization

Virtual Logistics

- Rename yourself in the participants tab with first & last name, affiliation
- If you don't have optimal internet, join the meeting via computer for video and dial in for audio
- Use the raise hand function if you would like to contribute (and don't forget to put it down afterwards)
- Use the chat sparingly
- Mute yourself when not speaking

If you have tech issues, contact Julia Gulka in the chat or via email at Julia.Gulka@briwildlife.org

E-TWG Activities Updates

NEW YORK STATE | NYSERDA

Whale Communications Committee

> Monthly meetings since May

> Goal: Develop communications materials to aid in the dissemination of current, accurate, and readily understandable information around recent whale mortality events and the level of potential risk to whales from offshore wind energy development activities

> Primary products:

- Working FAQ document that can be used by various groups in their own communications around topics of interest
- Public survey to solicit input on topics and identify experts to support FAQ development

https://www.nyetwg.com/communications-resources

Whale Communications Committee

> Are there non-communications related approaches that the E-TWG is interested in pursuing on this topic?

https://www.nyetwg.com/communications-resources

2024 State of the Science Workshop

- July 16-19, 2024, on Long Island (tentative)
- Addition of a fisheries focus
- 3.5 days total (including half day of side meetings)
  - Day 1: conference
  - Day 2: conference AM, side meetings PM
  - Day 3: conference
  - Day 4: conference AM
- 2-stage call for abstracts planned

2024 State of the Science Workshop

> *Taking an Ecosystem Approach: Integrating Offshore Wind, Wildlife, and Fisheries*

> Sessions will focus on:

- Understanding wildlife and wildlife habitat: populations and distributions
- Offshore wind development effects and species/ecosystem responses
- Offshore wind development effects and fisheries: social/economic responses
- Monitoring, minimization, and mitigation approaches
- Cumulative impacts of offshore wind energy development
- Collaborative processes to improve development and conservation outcomes (including guidance, data sharing, and other collaborative efforts)
- Integration of fisheries data, marine protected species, and wildlife data to identify wind energy areas and planning areas
- Ecosystem interactions: physical and biological interactions and changes in ecosystems across trophic levels in response to offshore wind and other stressors

2024 State of the Science Workshop

Scientific Planning Committee

- NMFS, BOEM, USFWS, Vineyard Offshore, Ørsted, Invenergy, Integral Consulting, TNC, WCS, NOWRDC, ROSA, LIFCA, members of organizing committee

Organizing Committee

- NYSERDA, BRI, Tetra Tech

Regional Synthesis Workgroup

Atlantic Database of Research Needs

Recommendations for Regional Research

> Met from Dec. 2021-Aug 2023

> Goals:

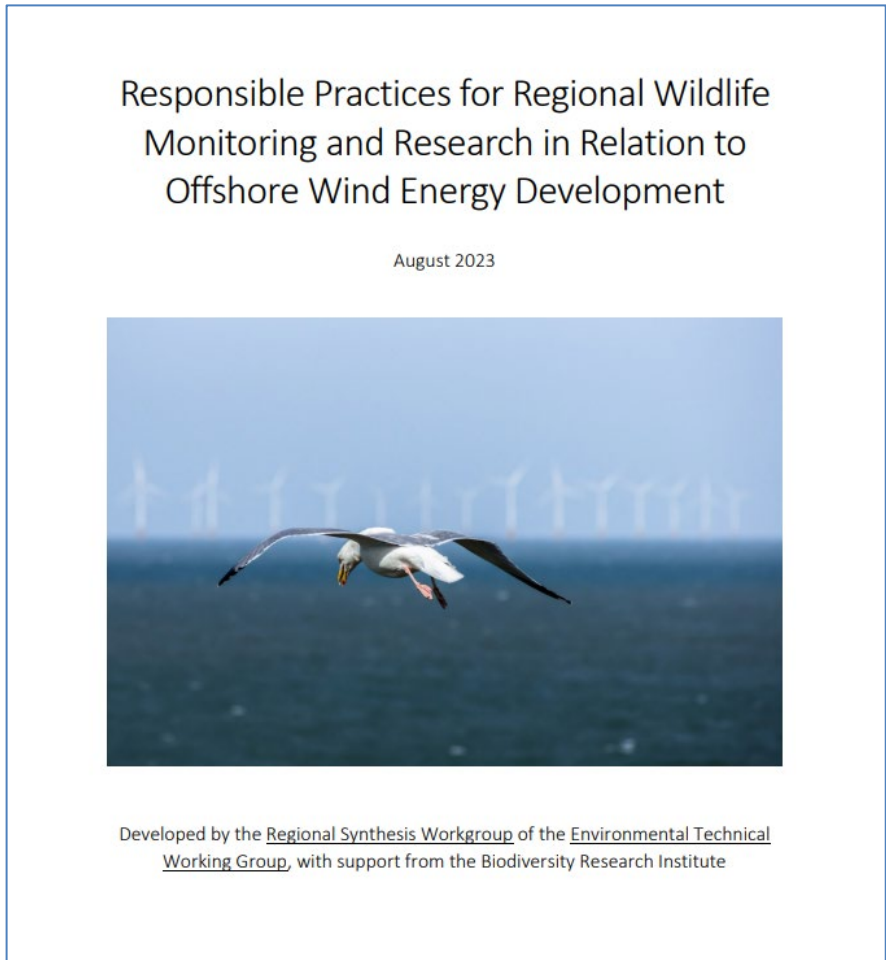
- Inform immediate decision-making by states, developers, and others about regional research activities to fund
- Help feed into Regional Wildlife Science Collaborative efforts

> Primary products:

- Database of research needs and data gaps compiled and synthesized from existing sources
- Guidance for regional-scale research to complement the database

> Many thanks to workgroup members!!

nyetwg.com/regional-synthesis-workgroup



Responsible Practices for Regional Wildlife Monitoring and Research in Relation to Offshore Wind Energy Development

August 2023

Developed by the Regional Synthesis Workgroup of the Environmental Technical Working Group, with support from the Biodiversity Research Institute

Avian Displacement Guidance Committee

> Co-chaired by BOEM and USFWS

> Meeting ~monthly since May 2022

> Goal

- Inform pre- and post-construction monitoring and research approaches for detecting and characterizing displacement, attraction, and macro- to meso-avoidance of marine birds at OSW facilities in U.S. Waters

> Primary products:

- Initial guidance document that includes identification of displacement and attraction-related questions and the appropriate methodologies to address those questions, with a focus on informing study designs for boat/aerial surveys
- Interim recommendations for using existing avian baseline data for site characterization

Avian Displacement Guidance Committee

- Draft recommendations for pre- and post-construction monitoring are available for you to review
- Please provide input by **September 29**
- This is an E-TWG-only review; the public review period will begin in October

Timeline

- September – E-TWG Review
- Oct 4 – Committee meeting to discuss feedback
- Oct 16 – Public webinar
- Oct 16-Nov 3 Opportunity for public input
- November – Committee revise document based on feedback
- December – Finalize document

Questions?

Masterplan 2.0

NEW YORK STATE | NYSERDA

New York State Offshore Wind Master Plan 2.0 Deep Water

11 September 2023

Environmental Technical Working Group

NEW YORK STATE | NYSERDA

New York State Offshore Wind Goals

July 2019, New York State signed into law the Climate Leadership and Community Protection Act (Climate Act)

> Mandates a minimum of 9 GW of offshore wind by 2035

> Requires New York State achieve an 85% reduction in emissions below 1990 levels by 2050 and 100% zero-emissions electricity by 2040

> Created a Climate Action Council (CAC) charged with developing a scoping plan to provide recommendations to meet Climate Act targets and place New York on a path toward carbon neutrality

The CAC scoping plan suggests 16-18 GW of offshore wind energy may be necessary to ensure New York State achieves its Climate Act mandate.

> Planning, analysis, and engagement is critical for responsible development

> Additional lease areas may be needed

BOEM issues Call for Information and Nominations in New York Bight

5 years
BOEM Planning & Analysis to Lease Auction

4-5 years
BOEM Planning & Analysis to Lease Auction

BOEM Bureau of Ocean Energy Management

Lease auction in New York Bight

NY Bight Proposed Sale Notice

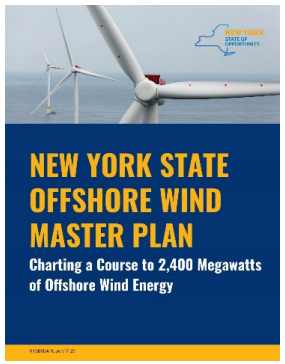
Analysis and engagement

Regional OSW leases per Inflation Reduction Act

Consultations with States and stakeholders

2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2027 ? | 2035

NYS Master Plan + Policy Options Paper



Order from Public Service Commission

NYSERDA Issues Request for Information

New York's 1st OSW solicitation

Climate Act codifies 9GW goal

PSC authorizes OSW procurements to meet Climate Act mandate

New York's 2nd OSW solicitation

New York Power Grid Study

PSC PPTN

PSC Order on Power Grid Study

NYS Climate Action Council Scoping Plan

New York's 3rd OSW solicitation

NYS Master Plan 2.0 Studies

Analysis and engagement

2.0 Areas for Consideration

9GW x 2035 target

NEW YORK STATE | NYSERDA

Master Plan 2.0 Objectives

- Serve as an organizing principle for all offshore wind work ensuring a robust and transparent strategy for achieving New York's 9GW goal

- Foster ongoing and proactive stakeholder engagement

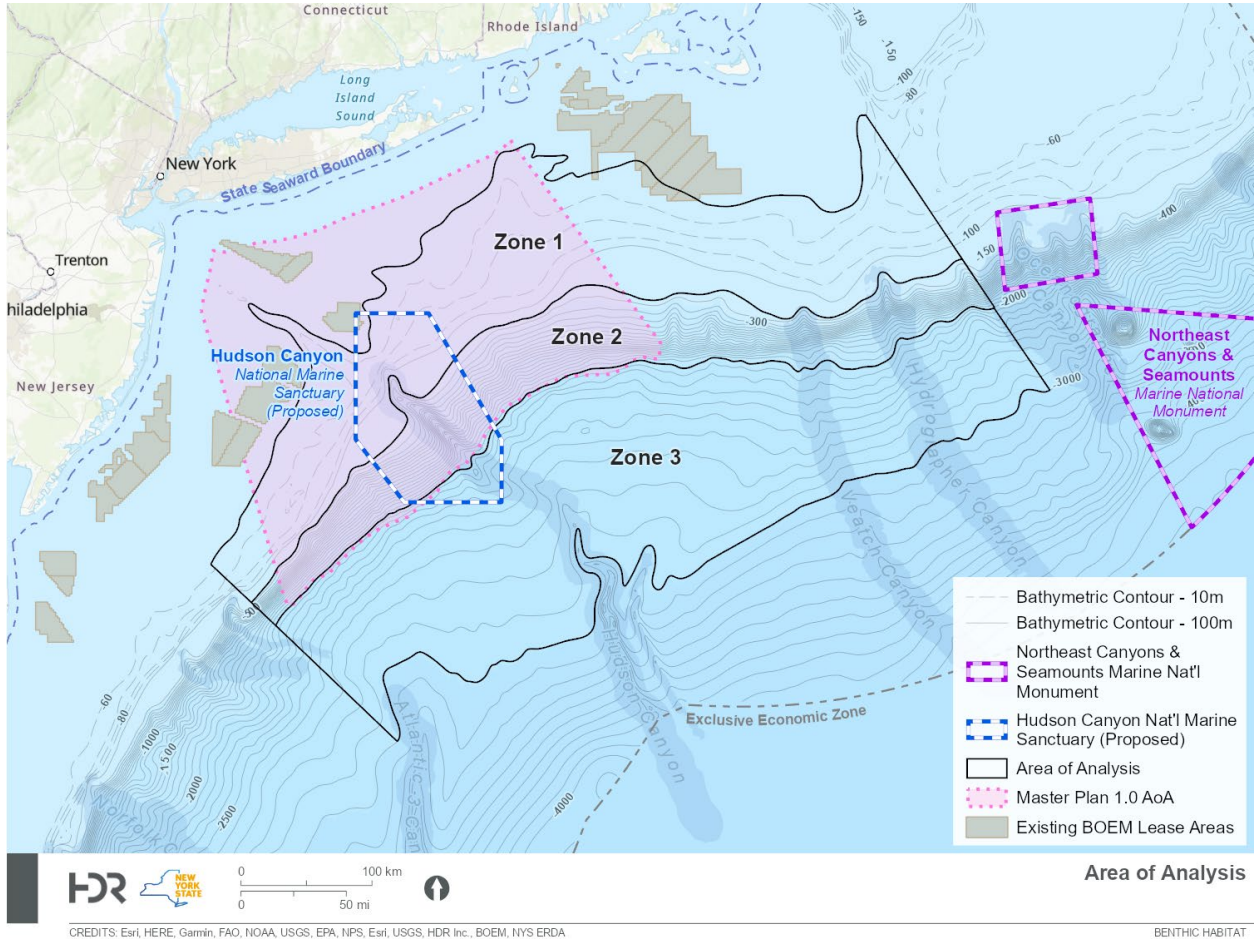
- Enable New York State to assess and characterize the risks and opportunities for offshore wind development in a comprehensive, sequential, and logical approach to achieve 9GW and beyond

Master Plan 2.0 Geographic Scope

Master Plan 2.0 Study Area:

Study area extends east from the 60-meter contour out past the continental shelf break to the edge of the 3,000-meter contour.

- **Zone 1** (remaining shelf) extends from the 60-meter contour to the continental shelf break.
- **Zone 2** spans the steeply sloped continental shelf break (unique canyon habitats).
- **Zone 3** extends from the continental shelf break out to the 3,000-meter contour.



Master Plan 2.0 Track 1 Studies:
To inform "Areas for Consideration"

Credit: NOAA Fisheries

Environment

- Birds and Bats
- Fish and Fisheries
- Marine Mammals and Sea Turtles
- Benthic Habitats
- Environmental Sensitivity Analysis

Maritime Activity

- Maritime Assessment: Commercial and Recreational Uses

Technology

- Offshore Wind Resource Assessment
- Deep Water Wind Technologies: Technical Concepts

Feasibility

- Technology Assessment and Cost Considerations

Master Plan 2.0 2023 Timeline

April - August

- Literature and data request
- TWG Environmental and Fisheries Studies Review

September

- Draft study discussions commence
- **September 11: E-TWG Discussion**
- **September 15: Comments Received**
- September 22: F-TWG Discussion
- Reviewer feedback is incorporated in final studies, as appropriate

October

- **October 31: all studies and TWG feedback finalized**
- Legal Review
- Draft Areas for Consideration Report

November - December

- November 1: Final Areas for Consideration Report
- Areas for Considerations Report
- **Finalize Master Plan 2.0 supporting studies**
  - **Cumulative Impacts Study**
  - Ideas for additional studies welcomed by NYSERDA

Timeline Goal:

Seek to make a formal request of BOEM early in 2024 based upon consideration of studies, support from regional states and stakeholders, and concurrence from State agencies.

Potential Master Plan 2.0 2024-2025 Studies:

Environmental, Fisheries, Maritime

> Cumulative Impacts Study

Transmission

> Transmission planning and interconnection

Supply Chain

> Port Performance Permitting

> Wind Turbine Vessel and Technology Study

> Supply Chain Opportunities Analysis

Workforce

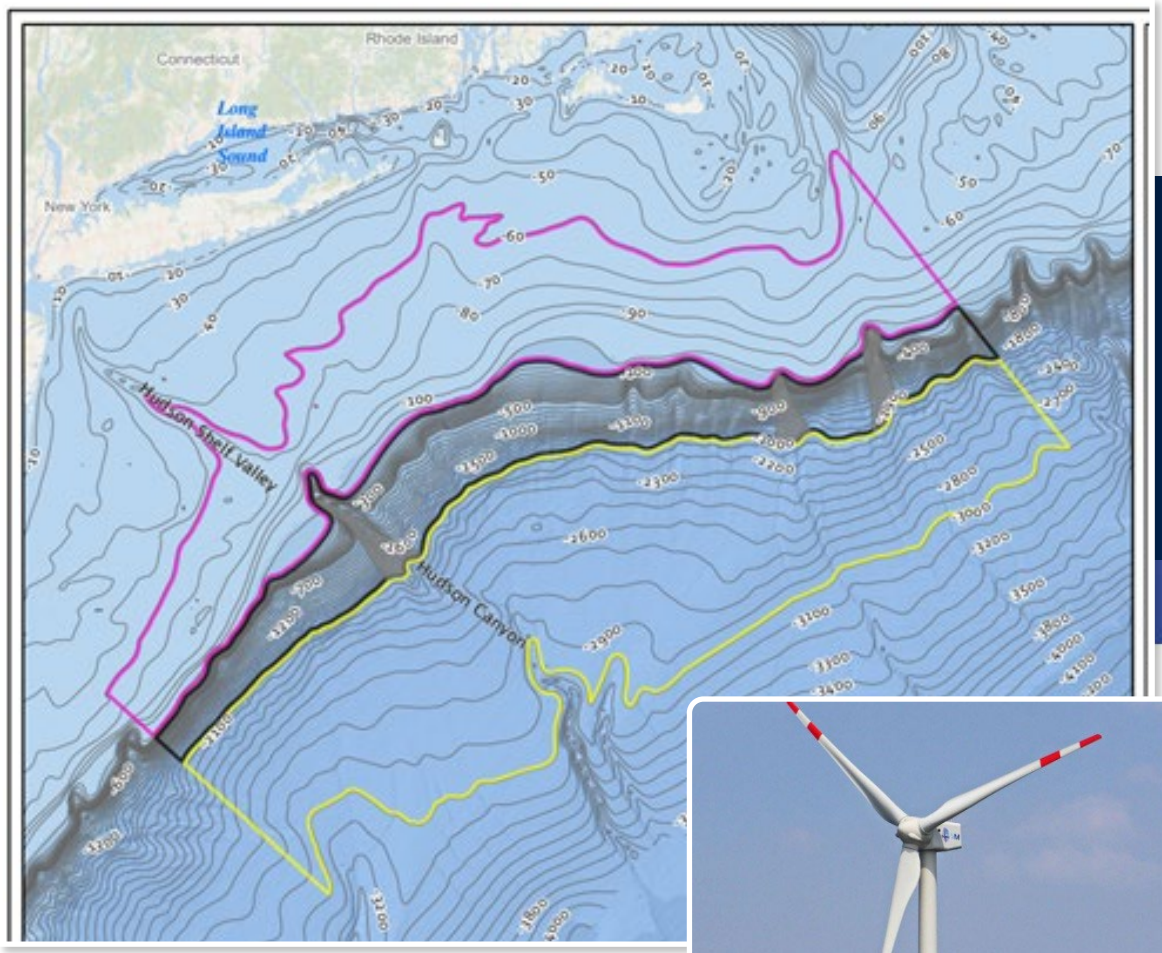
> Workforce Opportunities

Disadvantaged Communities

> Disadvantaged Communities: Cumulative Impacts

> Catalogue of Assets

Credit: Vestas



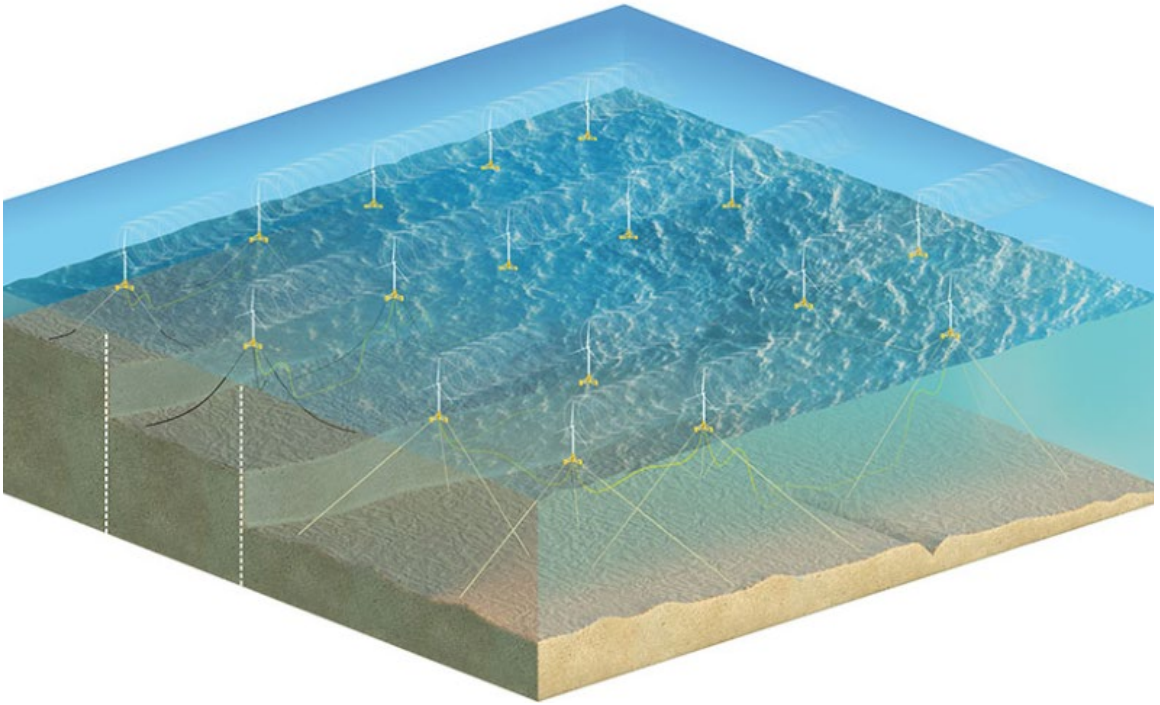
Deep Water Wind: Technical Concepts Study

Brian Dresser

11 Sept 2023

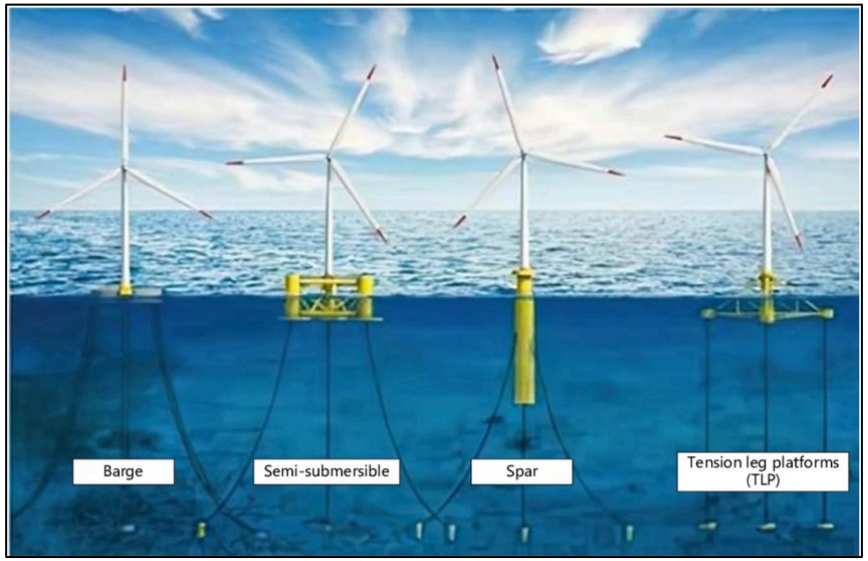
TETRA TECH

Deep Water Wind: Technical Concepts Study

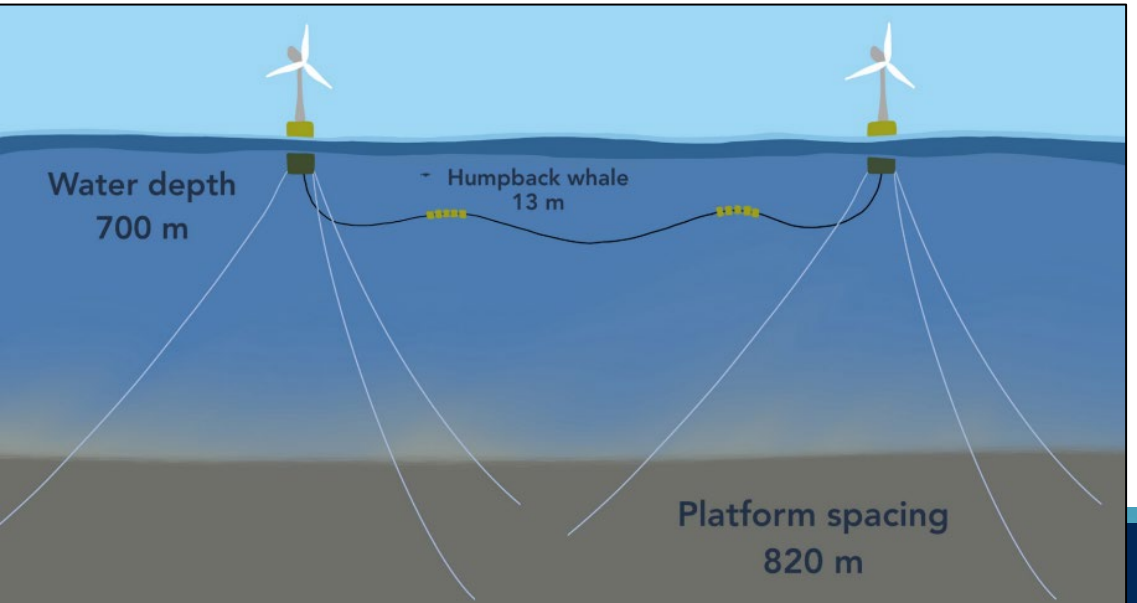


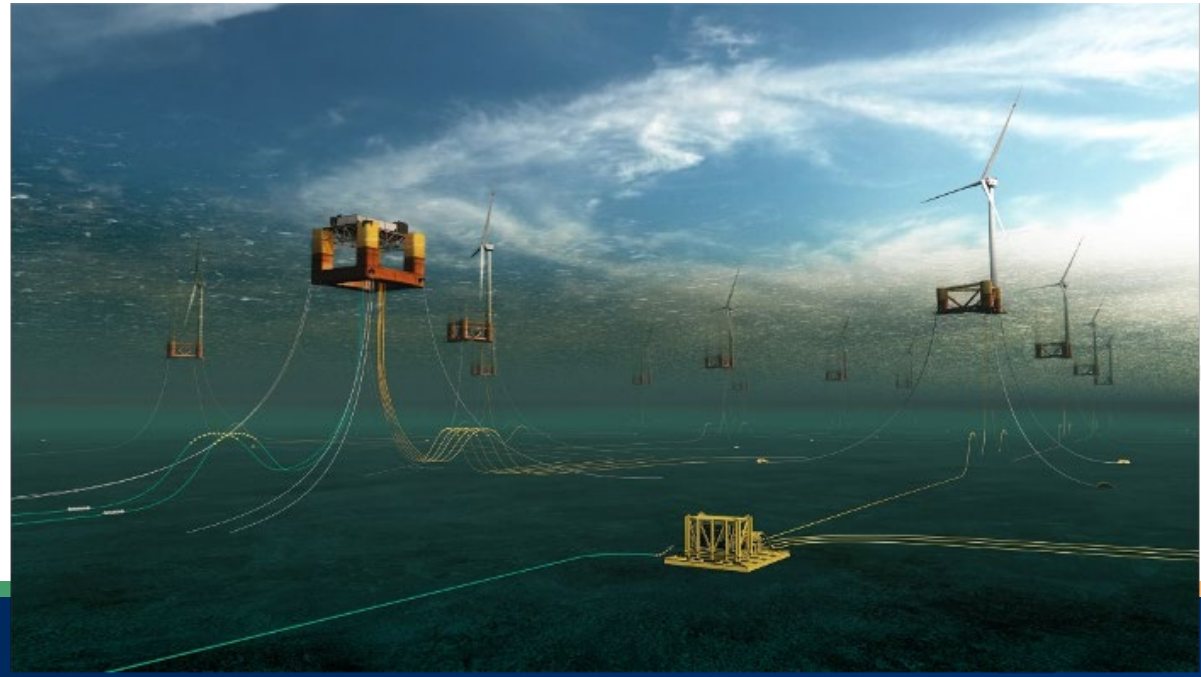
- Goal is to provide an overview of available technology and environmental issues related to wind development in waters > 60 m depth
- Primarily floating wind, but next-gen fixed bottom foundations also investigated

Deep Water Wind: Technical Concepts Study



- Address project technical specifications
  - Turbine types,
  - anchoring mechanisms,
  - mooring designs,
  - export and inter-array cables,
  - offshore substations

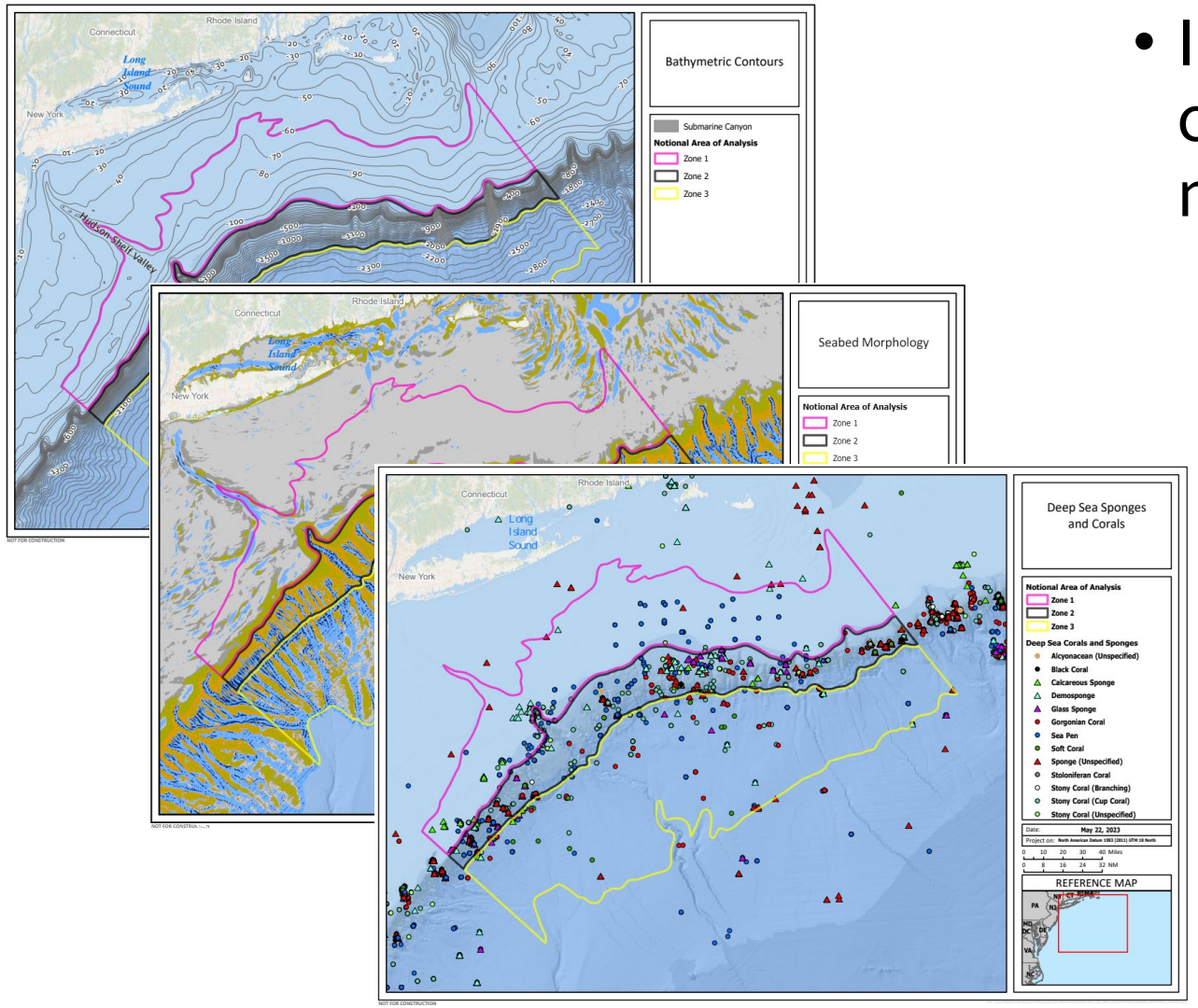




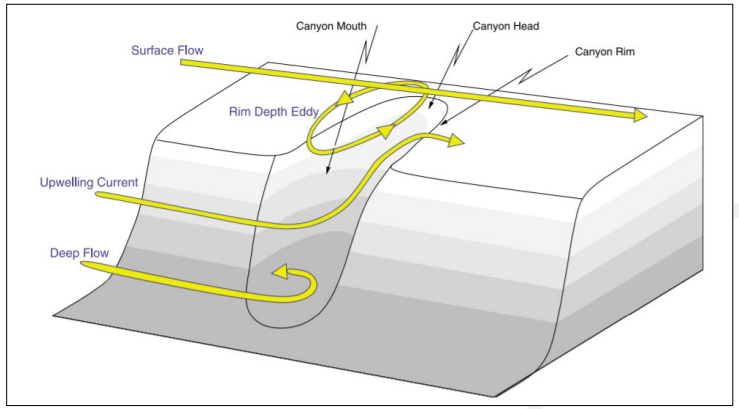
Deep Water Wind: Technical Concepts Study

- Case Studies of Existing Projects:
  - Seagreen Scotland –world's deepest (59 m [194 ft]) fixed-bottom foundation offshore wind farm (operational since April 2023)
  - Hywind Scotland (operational since 2017)
  - Kincardine Scotland (operational since 2021)

Deep Water Wind: Technical Concepts Study



- Identify environmental impacts, considerations, and potential mitigation
  - Broad environmental factors
  - Benthic constraints
  - Risks to fisheries and gear



Deep Water Wind: Technical Concepts Study – Conclusions

TETRA TECH

Deep Water Infrastructure	Technology Options	Zone 1	Zone 2	Zone 3
Anchors	-Suction -Drag Embedment -Pile -Shared	- In mud/clay areas, all anchor designs may be used - In sand areas, best choices are drag embedment or pile anchors	- No anchor is ideal due to steep slopes and canyons; drag embedment could be used, but cannot be sited precisely	- In mud/clay areas, all anchor designs may be used
Mooring Lines	-Catenary -Taught (Tension leg) -Semi-Taught	- Dependent upon type of anchor selected above		
Turbine Platform	-Barge -Semi-Submersible -Spar -Tension Leg Platform	- Dependent upon type of anchor and mooring line selected above		
Cables	-Export -Inter-array	-Export and inter-array cables would occur in, or pass-through, each zone – depending on specific project location		
Substations	-Fixed -Floating -Subsea	-Fixed (potentially) -Floating -Subsea	-Floating	-Floating -Subsea

Deep Water Wind: Technical Concepts Study – Conclusions

TETRA TECH

- Next-generation technologies may push the limits of what is currently deemed feasible in deep water.
- Efforts are being made to produce technology to implement deep water offshore wind in the most cost-effective and environmentally responsible manner to minimize impacts to ocean users and the marine environment.
- Factors such as seabed morphology, water depth, and sediment type dictate the type of structures feasible for use in a specific area.
- Overall design decisions start with anchors – optionality for mooring lines and turbine platforms are highly dependent on anchor choice.
- The physical seabed morphology and sediment type(s) determine the types of anchors feasible, and in turn the layout.

Deep Water Wind: Technical Concepts Study – Future Considerations

- Pilot studies using next-generation fixed bottom technologies in deep water
- Interest in developing shared anchor, mooring, and platform designs to minimize project footprints, and potential impacts to benthic and pelagic environments – as well as ocean users
- Need for optimization of design for turbine arrays that maximize energy output and minimize potential impacts (again, on the environment and ocean users)
- Further examination of the potential for the safe coexistence of ocean users and deep water offshore wind project components
- Assess FOSW infrastructure impacts to upwelling in the Hudson Canyon
- ***What else would the TWGs like to see come out of this effort?***

Environmental and Fisheries Site Assessment Studies Supporting New York's Offshore Wind Master Plan 2.0: Deep Water

11 September 2023

Goals and Objectives (Environmental Studies)

1. Compile and synthesize the best publicly available data for four key resource groups within the AoA.
   - Marine mammals and sea turtles
   - Birds and bats
   - Fish and fisheries
   - Benthic habitats
2. Review and summarize existing literature on the potential stressors associated with each phase of deep water OSW on each resource.
3. Synthesize existing guidance for avoiding, minimizing and mitigating potential impacts from deep water OSW for each resource.
4. Discuss gaps in data and identify opportunities for future studies that may improve the understanding of each resource and their potential interactions with deep water OSW.

Stakeholder and State Agency Engagement

- At study onset, request for data and relevant resources on stressors, receptors, and existing management tools to mitigate risk
- Review draft studies
- Comments received from over 15 stakeholder groups
  - Comments will be addressed and incorporated into the studies, as appropriate, to improve accuracy and completeness of each study
  - Some comments may inform future Master Plan studies
  - Feedback received may inform New York State decision-making as the State works to add value to the BOEM OSW leasing process.

- Environmental Technical Working Group (E-TWG)
- Fisheries Technical Working Group (F-TWG)
- Project Advisory Committees (PAC)
- New York State Agencies


Photo taken by HDR under NMFS research permit 21482


https://www.fisheries.noaa.gov/

Marine Mammal and Sea Turtle Study

AGENDA

1. MM/ST receptor groups
2. Datasets included
3. Key results
4. Data gaps
5. Future considerations
6. Main comment themes

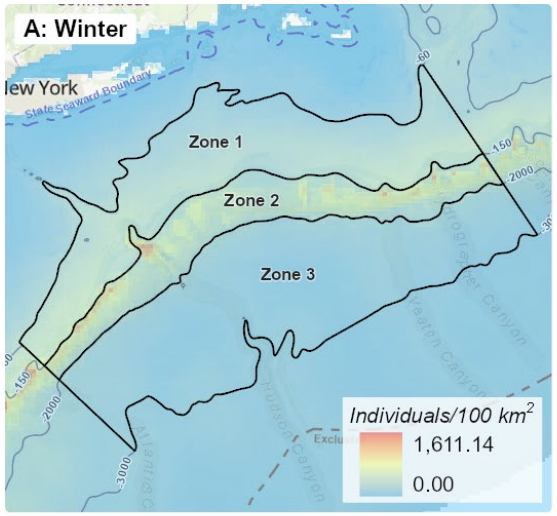
Marine mammal and sea turtle receptor groups

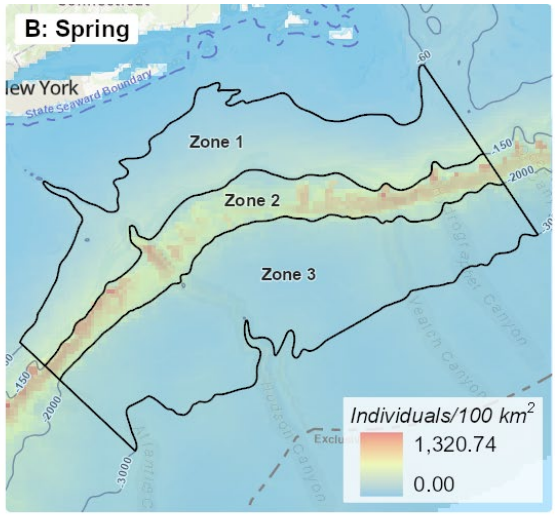
Receptor Group	Members of Receptor Group
High-Frequency Cetaceans	Harbor porpoise, dwarf & pygmy sperm whale
Mid-Frequency Cetaceans	Sperm whale, killer whale, Northern bottlenose whale, beaked whale spp., pilot whale spp., pygmy & false killer whale, melon-headed whale, Risso's, Atlantic white-sided, white-beaked, Atlantic spotted, Pantropical spotted, striped, Fraser's, rough-toothed, Clymene, spinner, common, and common bottlenose dolphin
Low-Frequency Cetaceans	Baleen whales - blue, sei, minke, fin, humpback
North Atlantic Right Whale	North Atlantic right whale
Other Marine Mammals of Special Conservation Status	ESA-listed cetaceans (fin, sei, blue, sperm whale) and any marine mammals under current or recent UME designation (humpback whale, gray and harbor seal, minke whale)
Deep-Diving Cetaceans	Sperm whale, pygmy & dwarf sperm whale, beaked whale spp., pilot whale spp., Northern bottlenose whale
Shallow-Diving Cetaceans	Harbor porpoise, baleen whales (except NARW), killer whale, pygmy & false killer whale, melon-headed whale, dolphins
Seals	Harbor, gray, hooded, ringed, and harp seals
Post-hatchling dispersal stage (all sea turtle species)	Post-hatchling loggerhead, leatherback, Kemp's ridley, and green sea turtles
Juvenile, subadult, and adult hard-shelled sea turtles	Non-hatchling loggerhead, Kemp's ridley, and green sea turtles (may include unidentified hardshell)
Juvenile, subadult, and adult leatherback sea turtles	Non-hatchling leatherback sea turtles

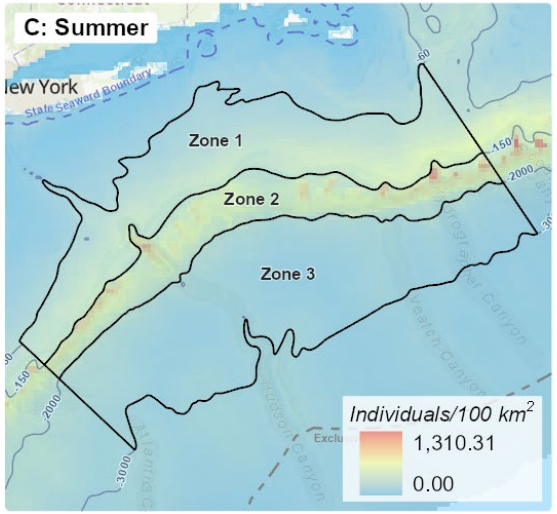
Datasets included

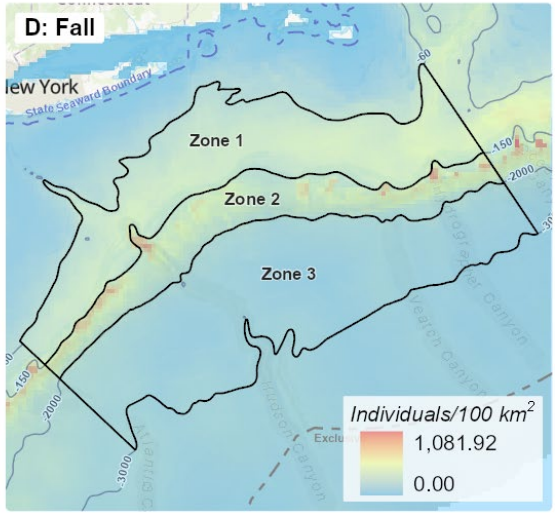
- Geospatial analysis:
  - Marine Mammals
    - Habitat-based Marine Mammal Density Models for the U.S. Atlantic (Roberts et al. 2023)
    - NYSERDA OPA Aerial Surveys (Normandeau Associates Inc. and APEM Ltd. 2021)
    - WCS Vessel Surveys for Baleen Whales in the New York Bight (King et al. 2021)
    - Mid-Atlantic Marine Mammal Tagging Studies (Baird et al. 2015, 2016, 2017, 2018, 2019, Foley et al. 2021; Engelhaupt et al. 2022, Ampela et al. 2023)
  - Sea Turtles
    - East Coast Turtle Density Models (Sparks and DiMatteo 2023)
- General literature review focused on:
  - Information about fixed and floating wind that has become available since MP 1.0
  - Deep water areas off the continental slope and areas further east, roughly to Oceanographer Canyon
  - Refer to Appendix A of MM/ST report for comprehensive list of data sources

Key results: Importance of continental slope

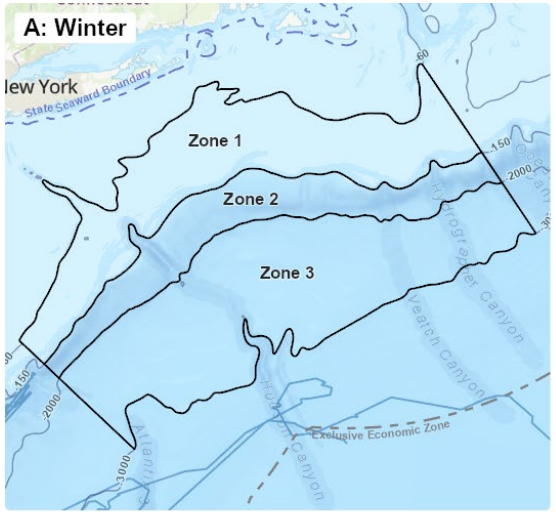


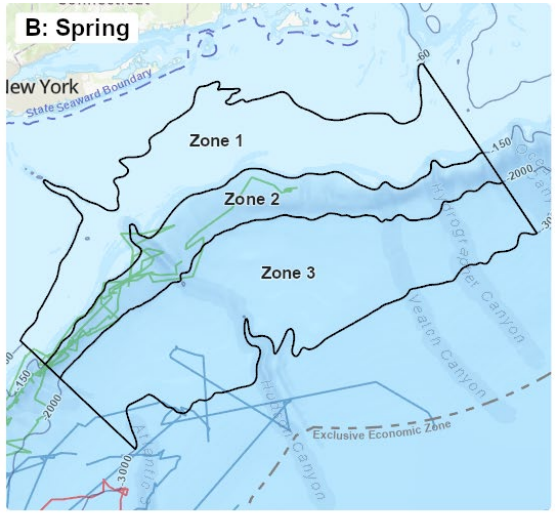


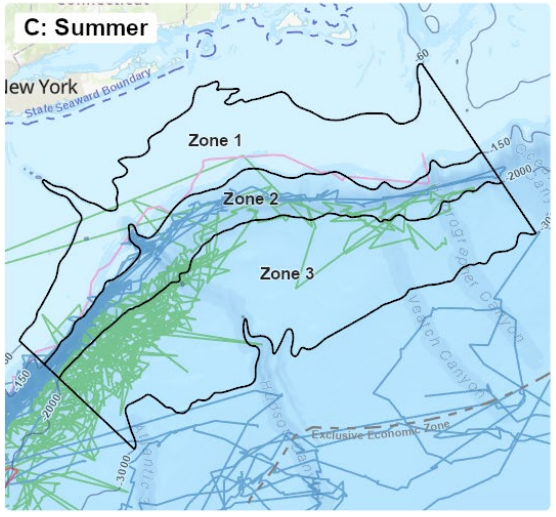


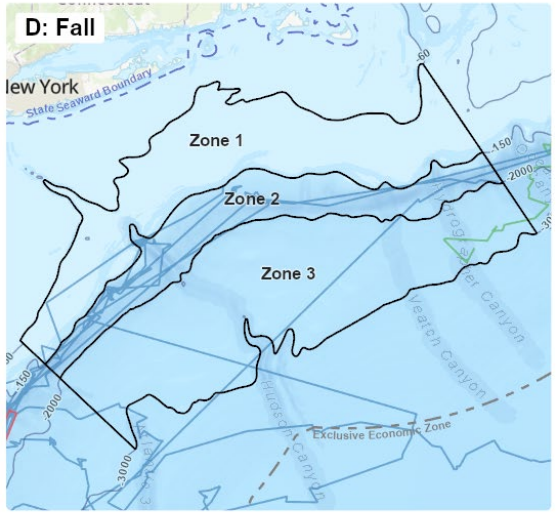


Mid-Frequency Cetaceans: Scaled to Highest Seasonal Predicted Density



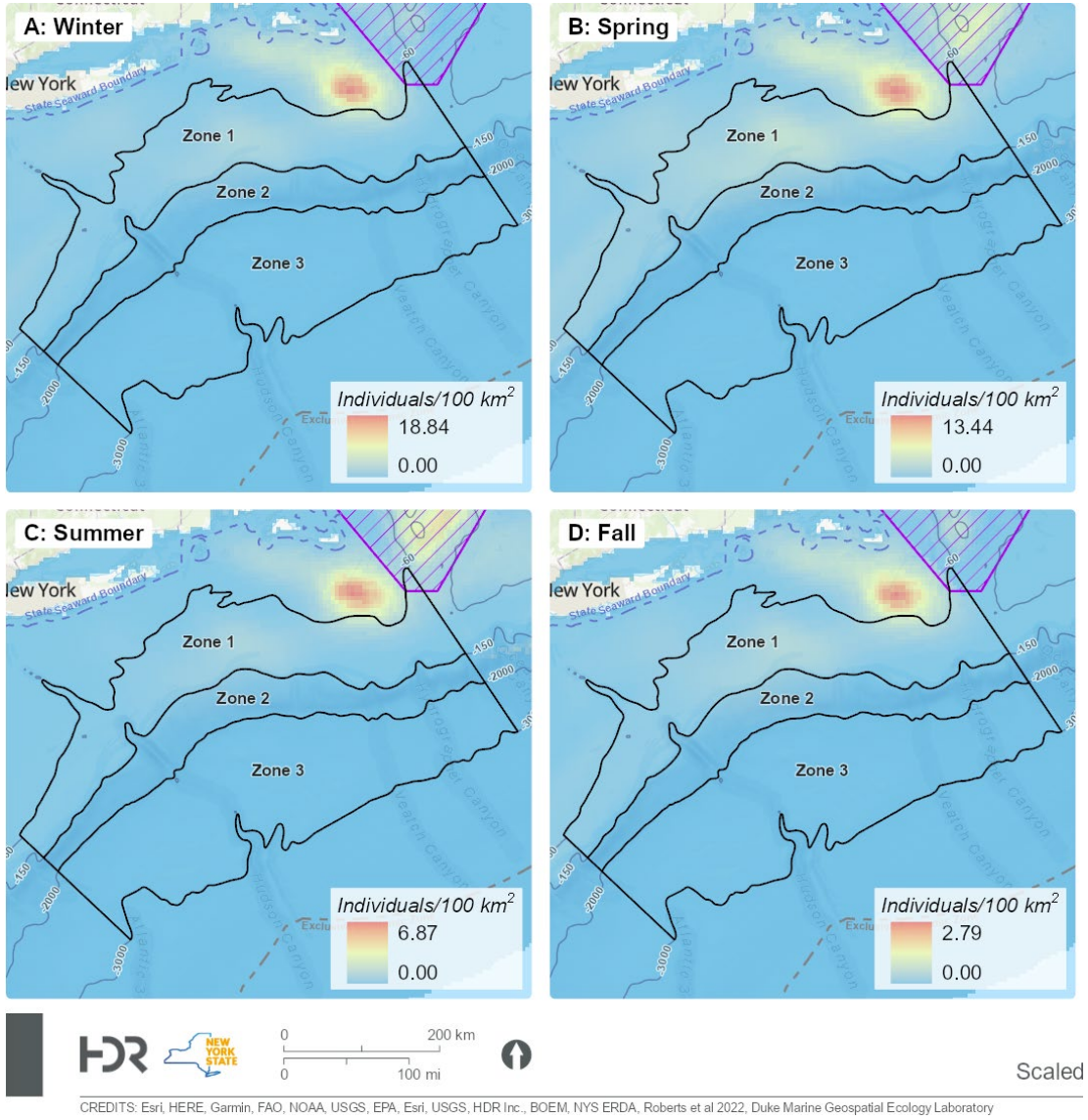




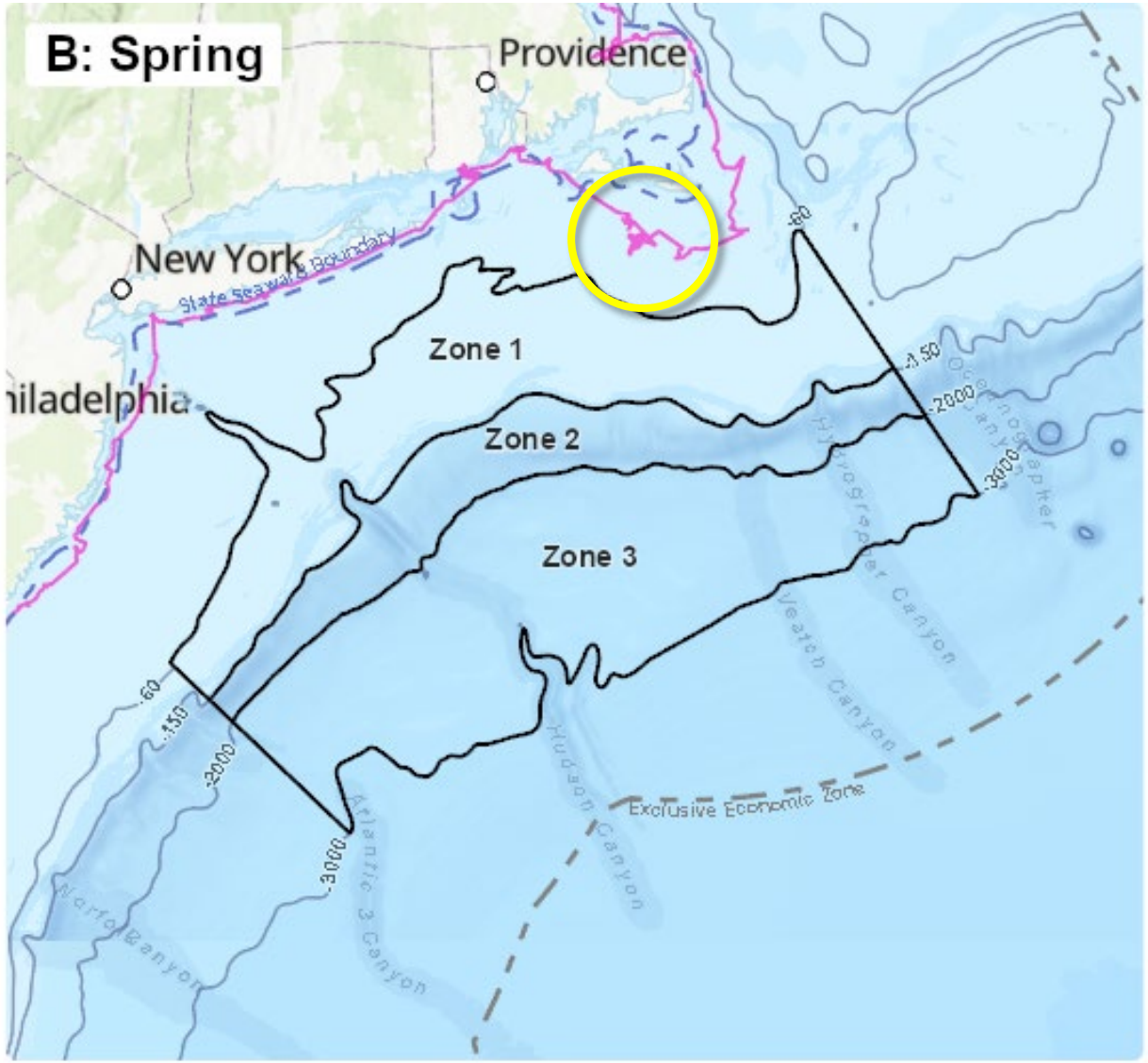


Mid-Frequency Cetaceans: Tag Tracks

Key results: North Atlantic right whale

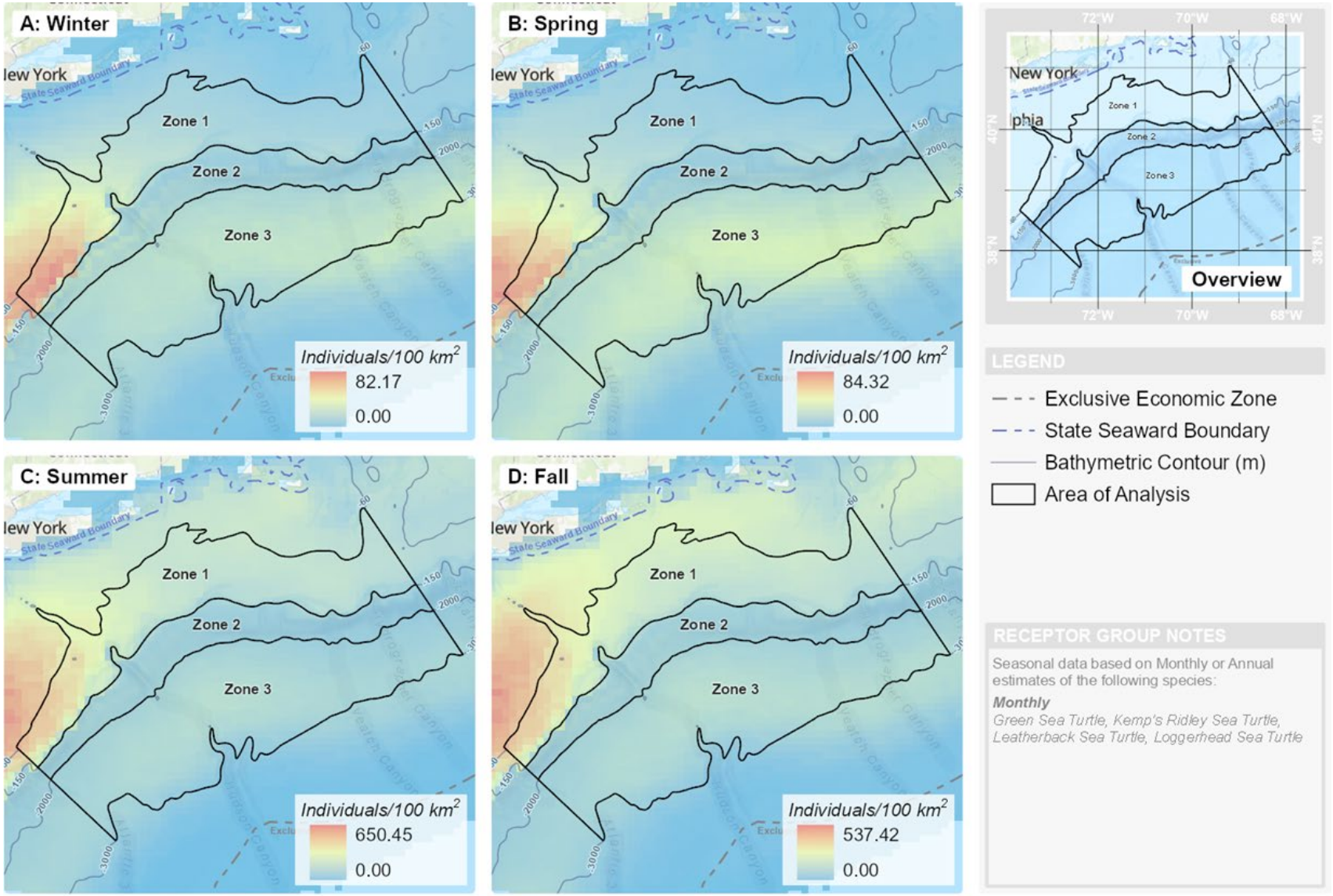


NARW: Scaled to Highest Seasonal Predicted Density

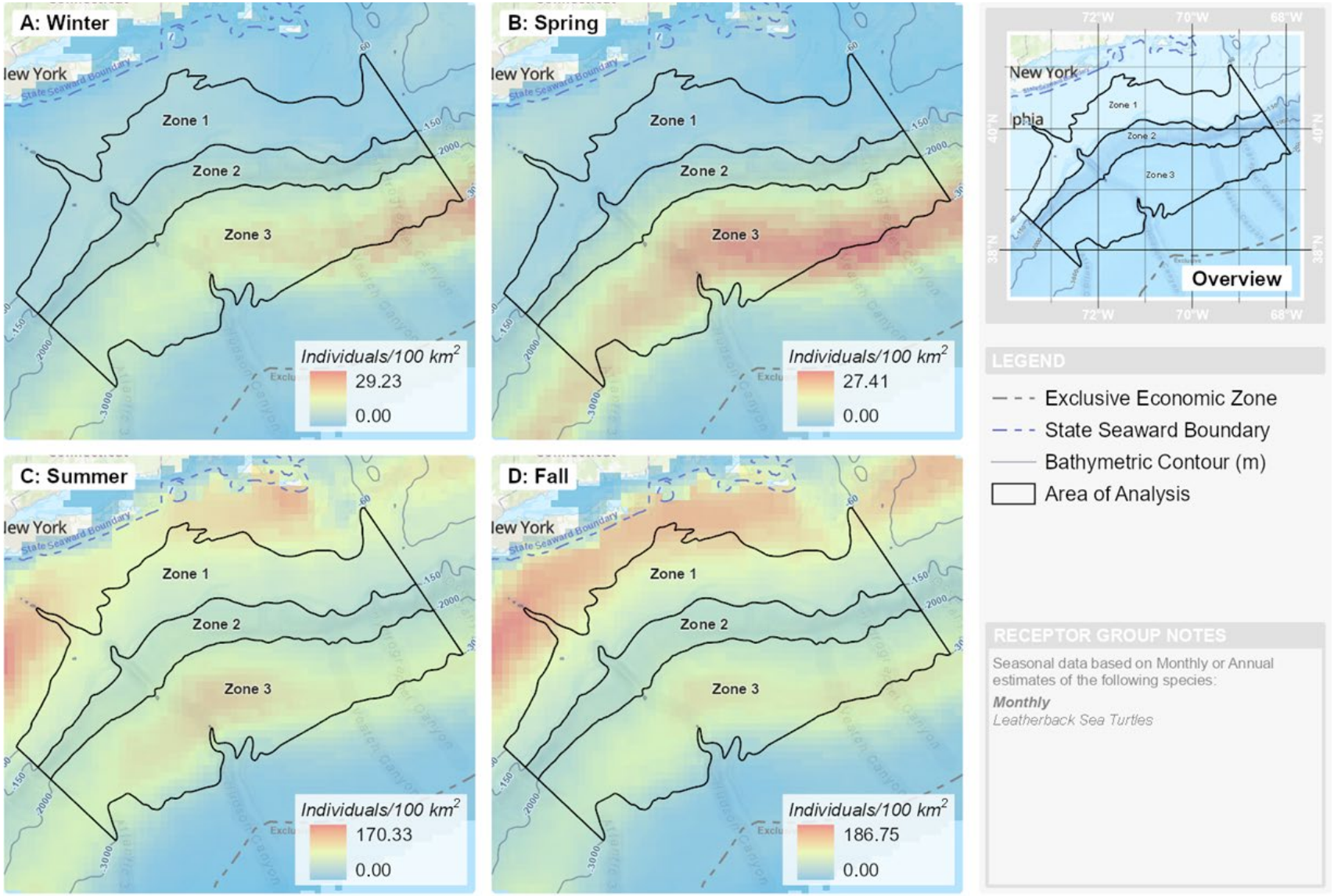


NARW: Tag Track

Key results: Sea turtles



Key results: Leatherback turtles



Data gaps

- Marine mammals
  - Sighting records used for density estimation may be limited due to cryptic surface behavior or lack of ID to species (e.g. seals and pilot whales)
  - Little known about hearing sensitivity of baleen whales and their reactions to pile driving
- Sea turtles
  - Limited information on the distribution and habitat use of different sea turtle age classes, such as post-hatchling versus non-hatching sea turtles
- Stressors (MM and ST)
  - In-water structures on ocean mixing, stratification, and primary productivity
  - Operational noise from the large, 12+ MW turbines currently planned for U.S. OWF
  - Electromagnetic fields (e.g. from undersea power cables)

Future considerations

- Value in conducting visual surveys for density estimation as well as tagging studies
- Continental shelf break and slope habitats, including waters above submarine canyons, are of particular importance to marine mammals
- Potential exists for floating wind tether cables to attract marine debris, could increase entanglement risk

Comments received to date: Main themes

- Include additional references
- Better characterize existing ambient noise in NYB to put noise from OSW development (particularly LF noise) into context
- Better explain uncertainty associated with marine mammal density models
- Include more thorough discussion of operational noise levels, and to what extent these can be inferred from European OSW farms

Birds and Bats Study

1 **Introduction**: Species

2 **Methods**: Data

3 **Methods**: Analysis

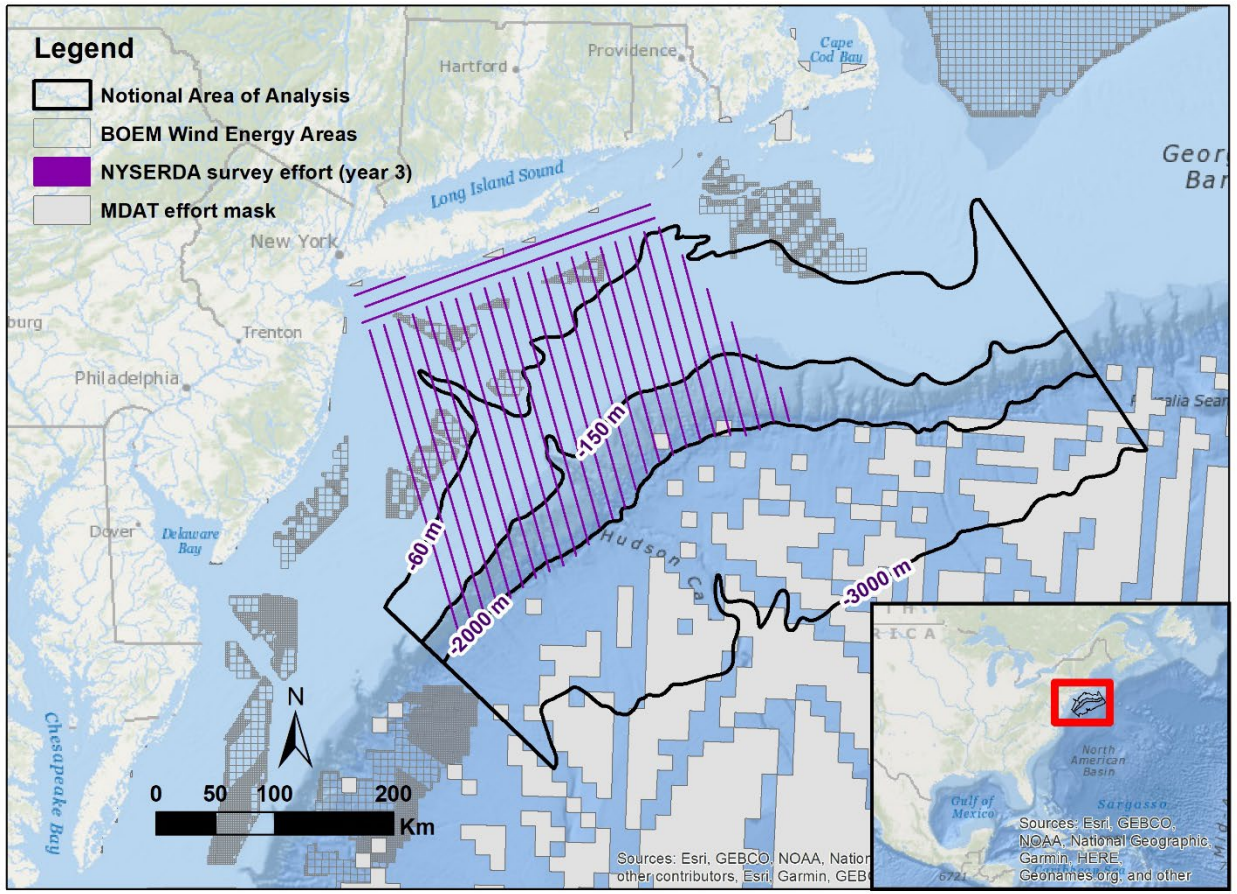
4 **Results**: Risk Assessment

5 **Discussion**: Considerations

6 **Discussion**: Comments

Introduction: Species

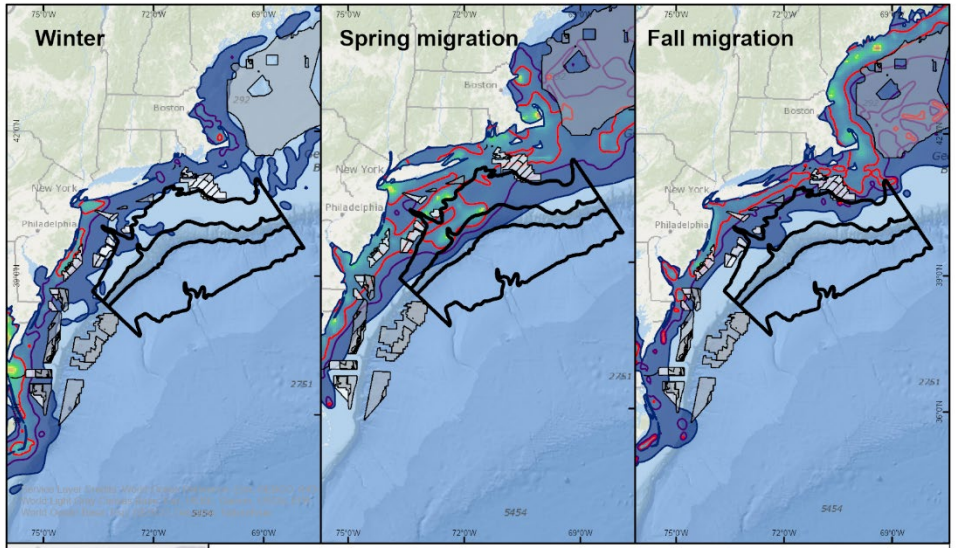
- 4 bat species
  - cave-hibernating & migratory tree bats
- 63 bird species
  - shorebirds, seabirds, wading birds,
  - raptors, songbirds
- Protected species
  - Federal
    - Endangered Species Act
    - Bald and Golden Eagle Protection Act
    - Migratory Bird Treaty Act
  - State
    - Species of Greatest Conservation Need

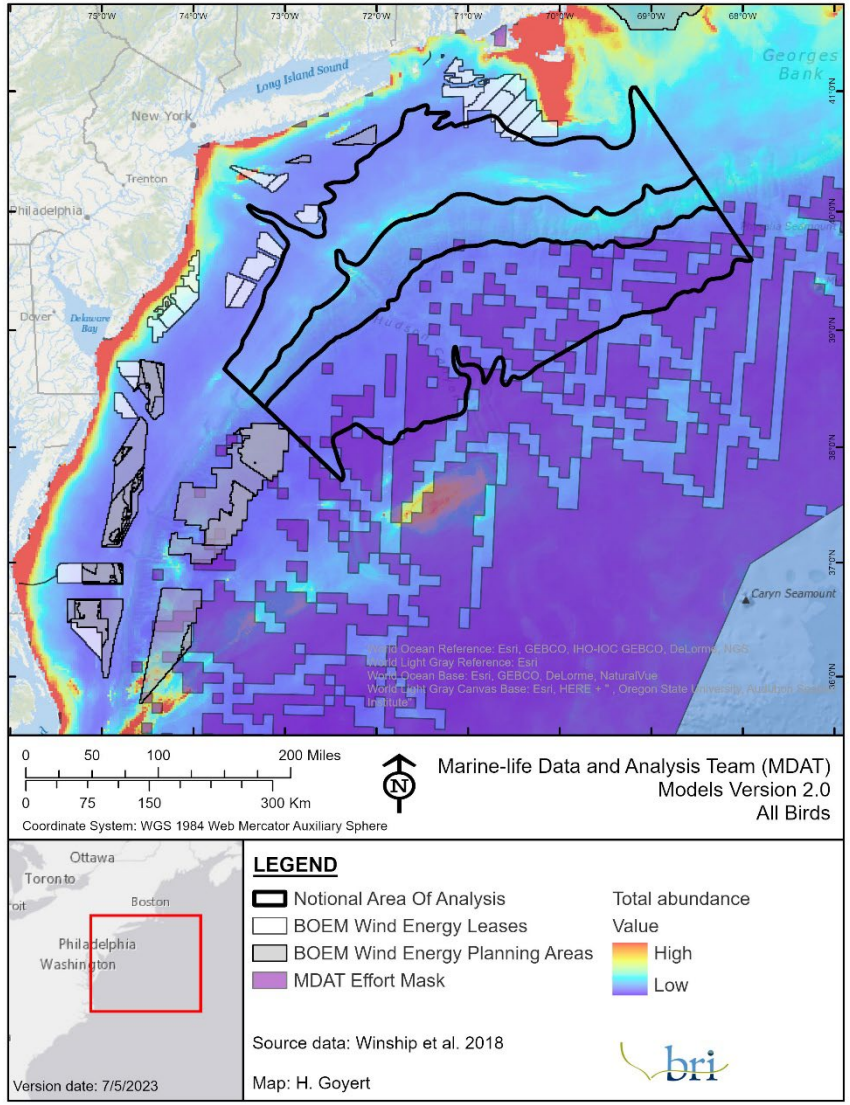


Methods: Data

- Data sources
  - boat-based and aerial surveys,

    including passive acoustics (bats)
  - tagging efforts (tracking data)
- Data gaps or uncertainties and considerations
  - Qualitatively scored by number of data sources available

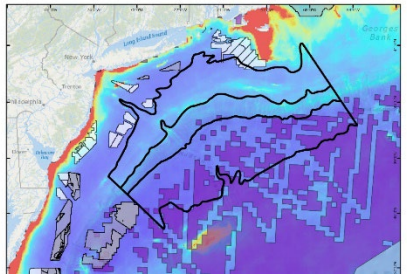




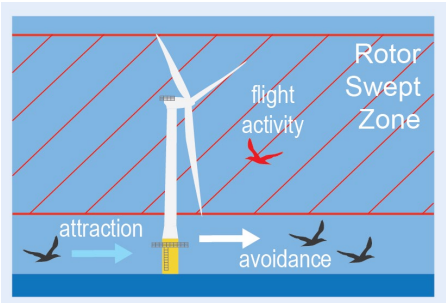
Methods: Analysis

- Spatial risk assessment (quantitative)
  - Exposure & vulnerability assessment
  - Tracking data
- Potential risks from all phases
  - Expected impacts from stressors

Stressors
Vessel Traffic
Noise
Bottom Disturbance
Artificial Lighting
New Structures
Changes in Water Quality
Changes to Atmospheric/ Oceanographic Dynamics



×

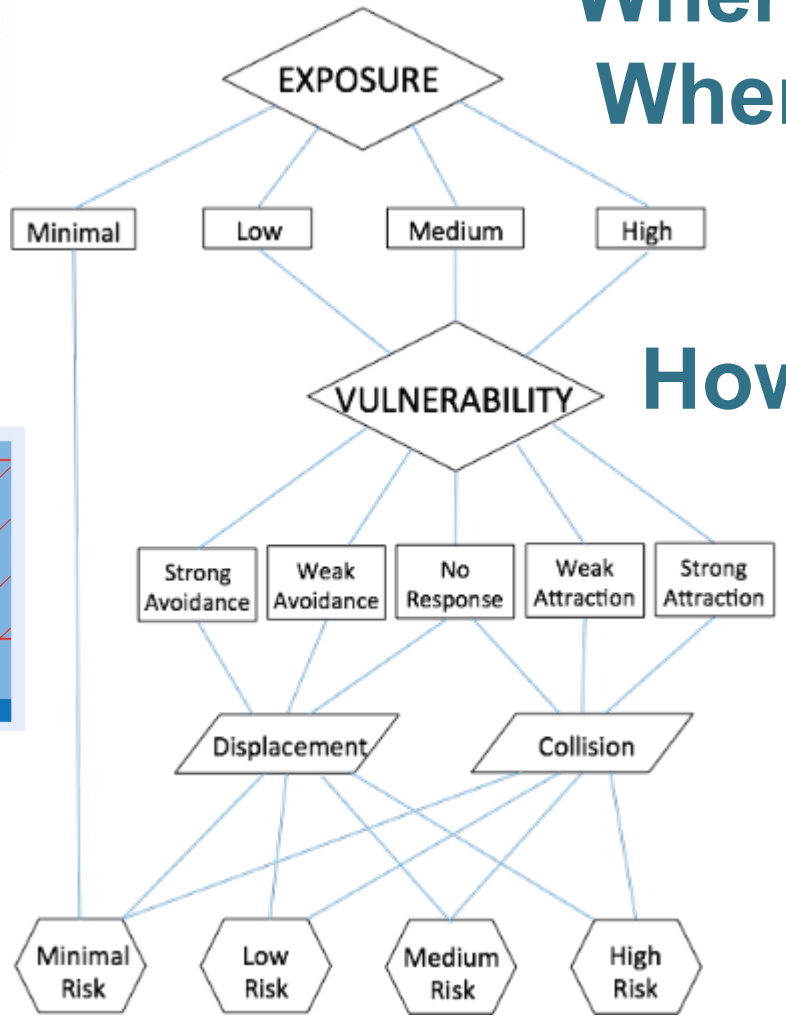


=

RISK

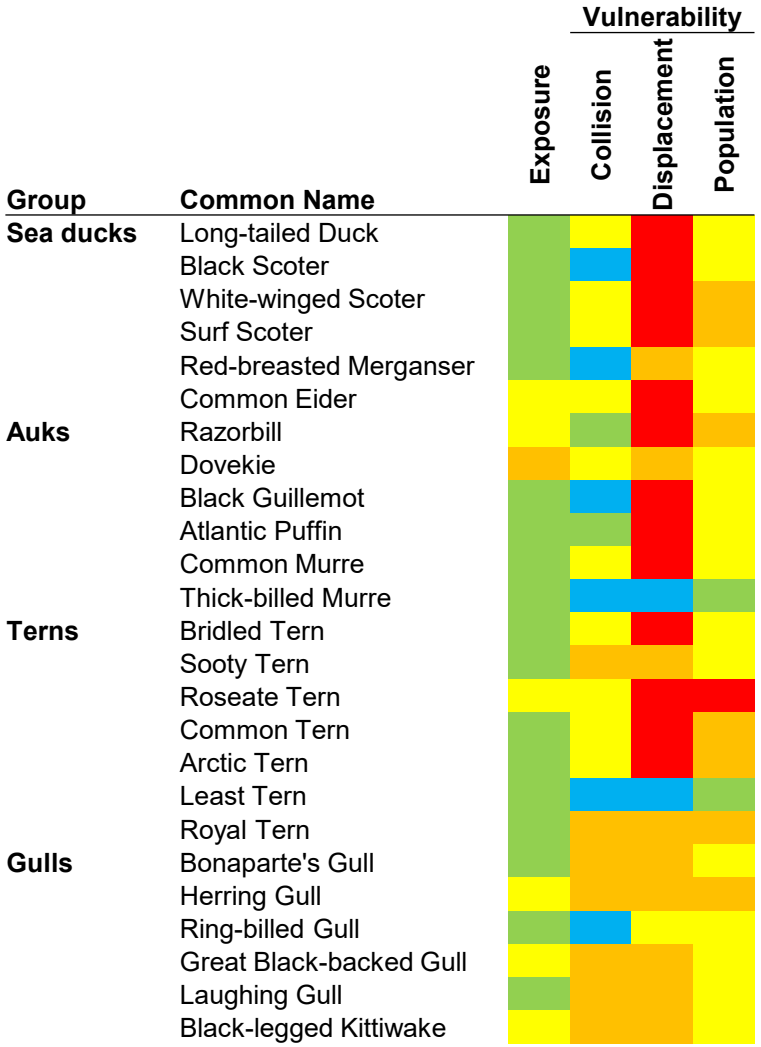
Where?
When?

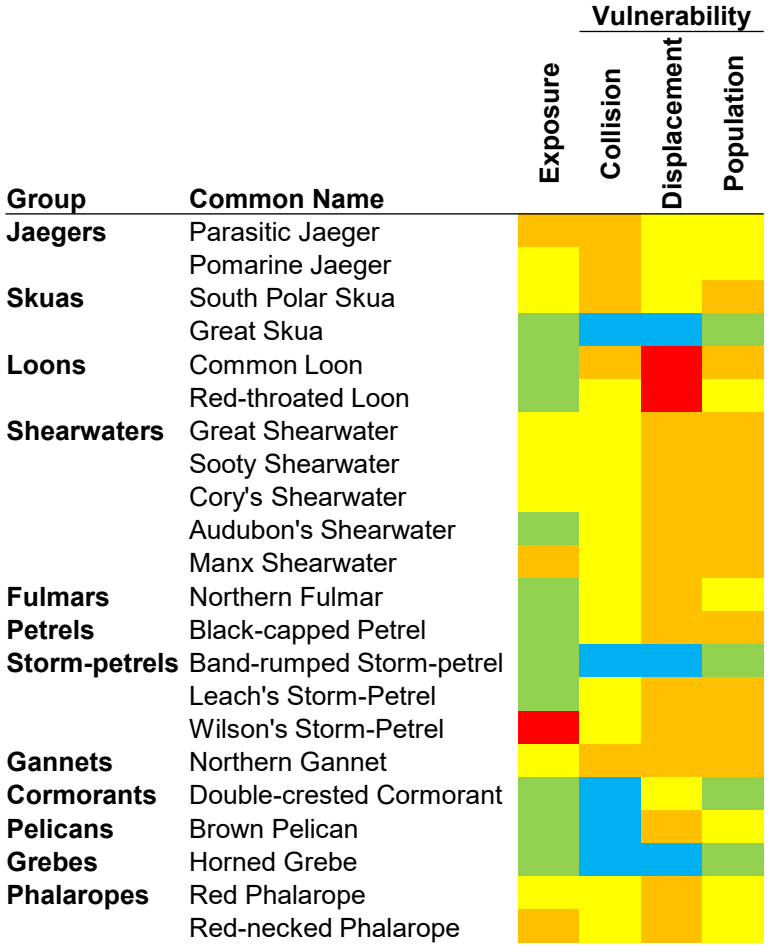
How?



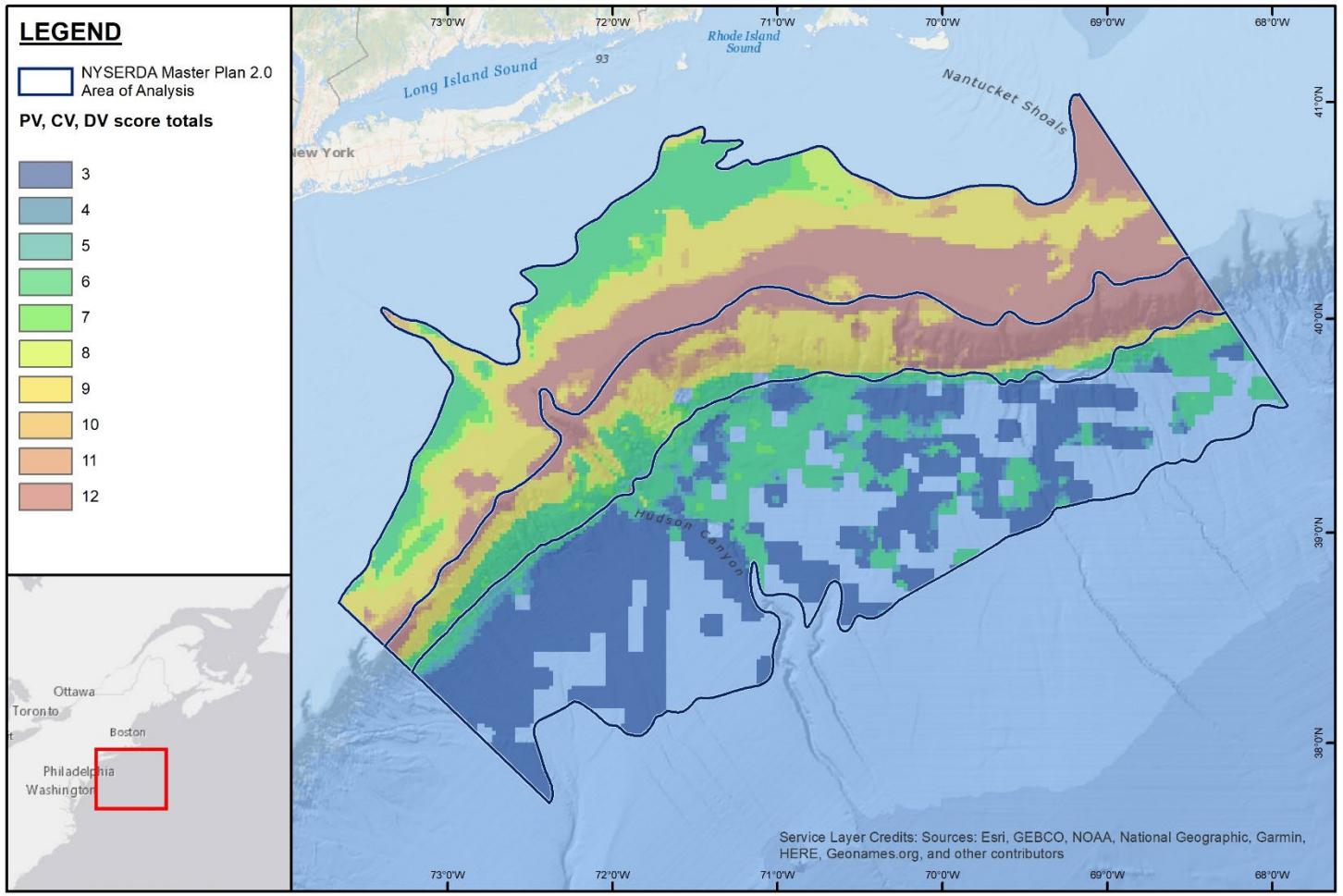
Results: Spatial risk assessment

BIODIVERSITY RESEARCH INSTITUTE
innovative wildlife science





Results: Risk and data gaps



Produced by:
A. Gilbert, H. Goyert

Version date: 6/8/2023
Document: NY_MP_MDAT_PV_CV_DV_total_dBBMM

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere

0 30 60 120 Miles
0 50 100 200 Km

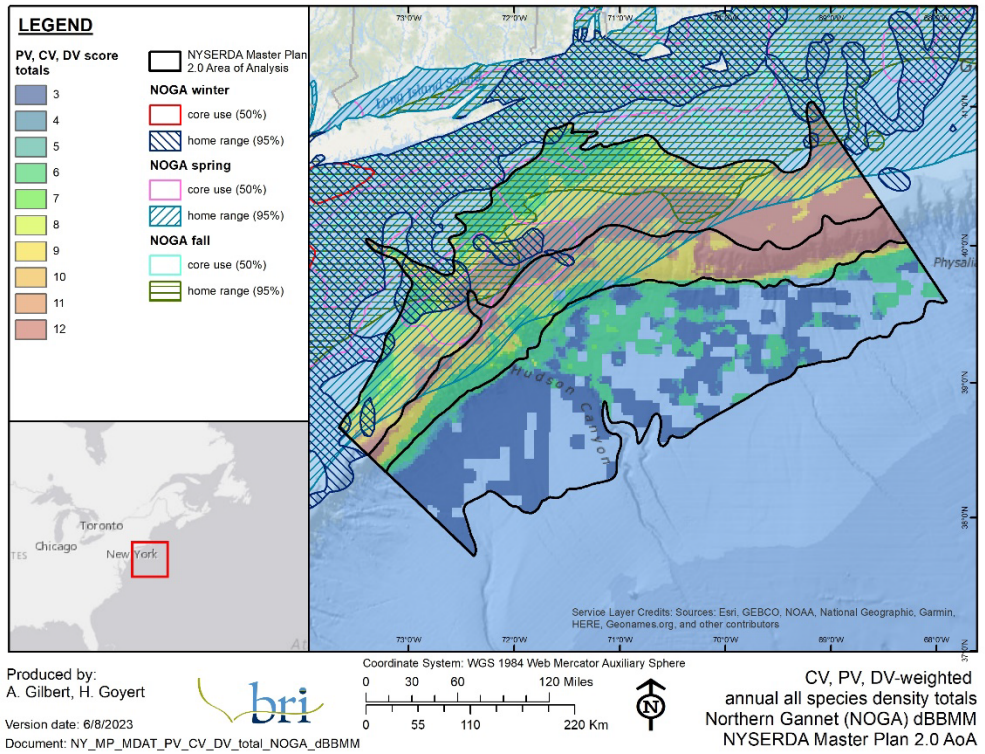
CV, PV, DV-weighted annual all species density totals NYSERDA Master Plan 2.0 Area of Analysis

Marine Birds	Data Gaps
Zone 1	0.0%
Zone 2	3.6%
Zone 3	37.5%
Total	18.30%

Discussion: Future considerations

BIODIVERSITY RESEARCH INSTITUTE
innovative wildlife science

1. Incorporate updated MDAT models
2. Increase coverage of tracking data in AoA
3. Increase survey coverage in AoA
4. Support research on continental shelf break
5. Develop integrated model of survey, track data
6. Improve colony data: foraging range analyses
7. Test and verify mitigation measures offshore



Discussion: Comment themes

From industry and eNGOs:

- Fixed structures not expected in AoA (depth):

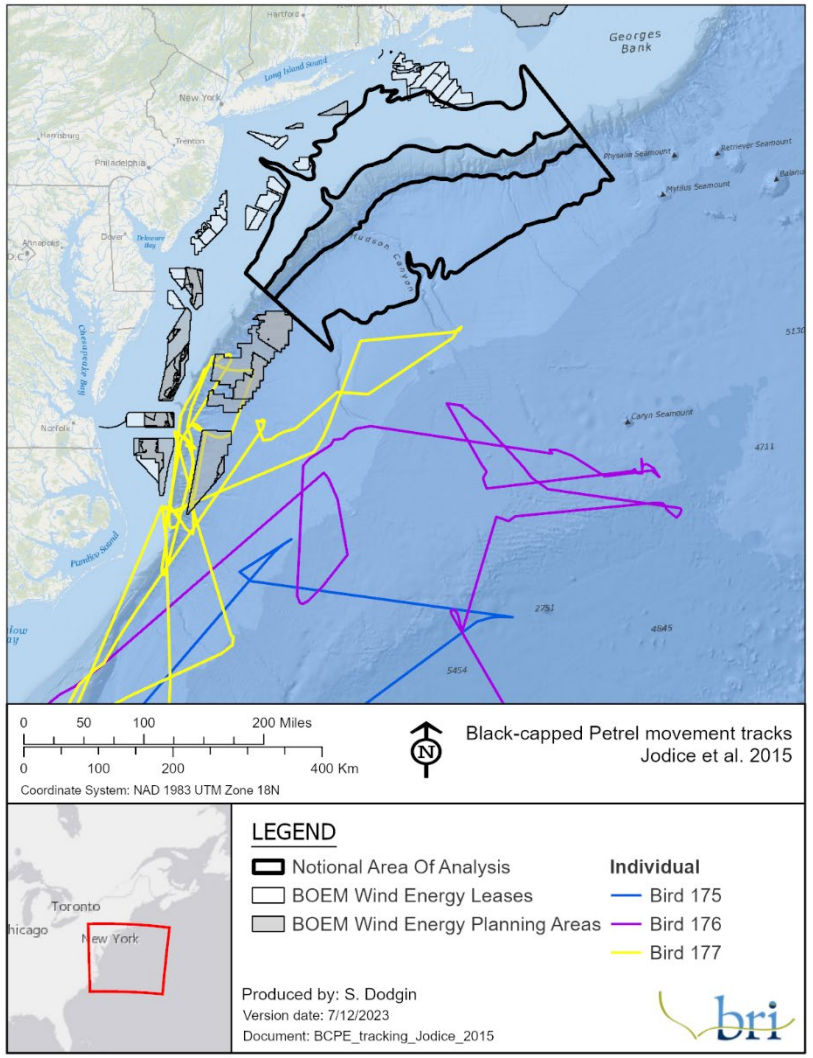
  noise from floating less than pile-driving

- Additional pelagic species expected in region:

  lacking documentation in AoA

- Changes in prey quantity/quality as a stressor:

  bottom disturbance, new structures



Lunch

© Robert Thiemann

Fish and Fisheries Study

1 Study Framework

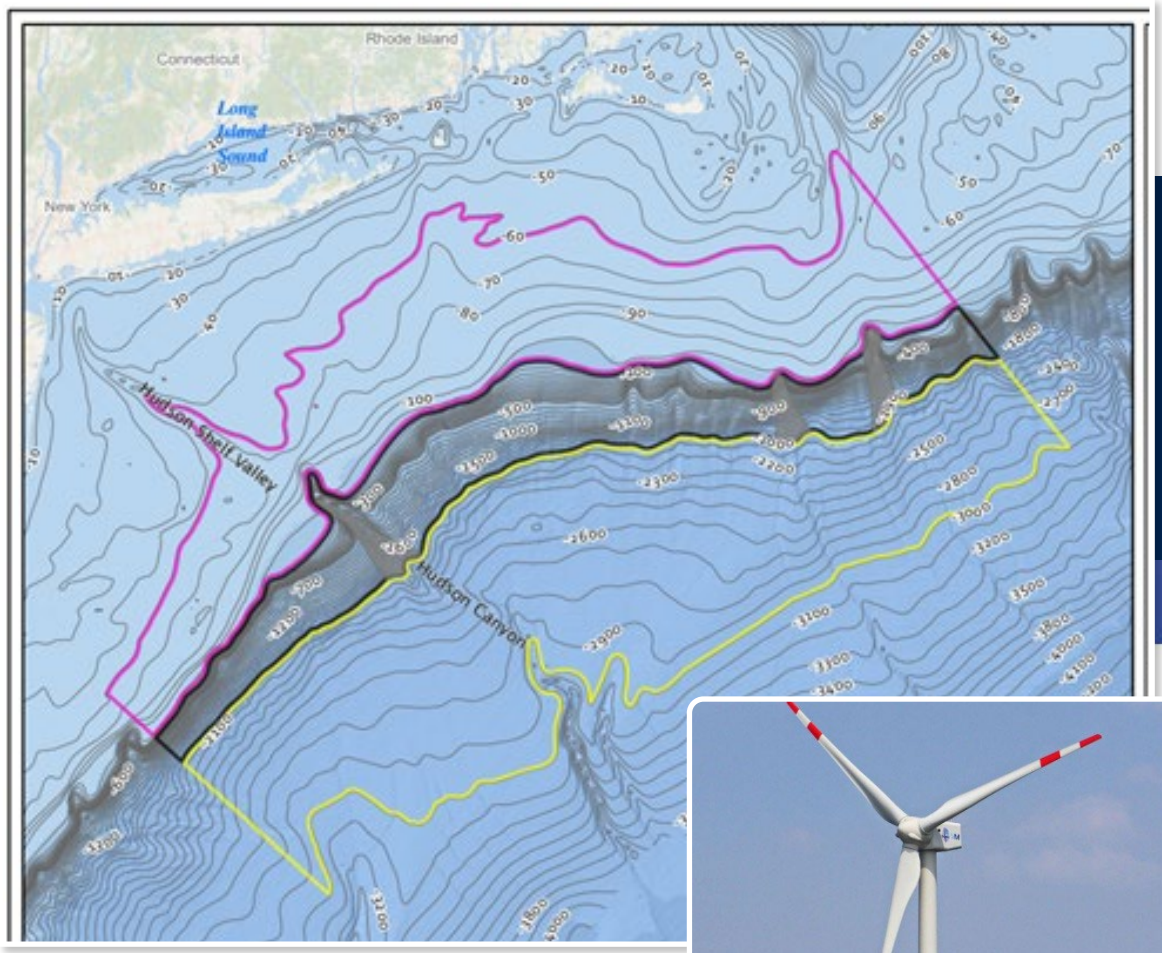
2 Datasets Included

3 Receptor Groups

4 Results

5 Knowledge Uncertainties

6 Future Considerations & Comments



Fisheries Stakeholder Engagement

Brian Dresser

11 Sept 2023

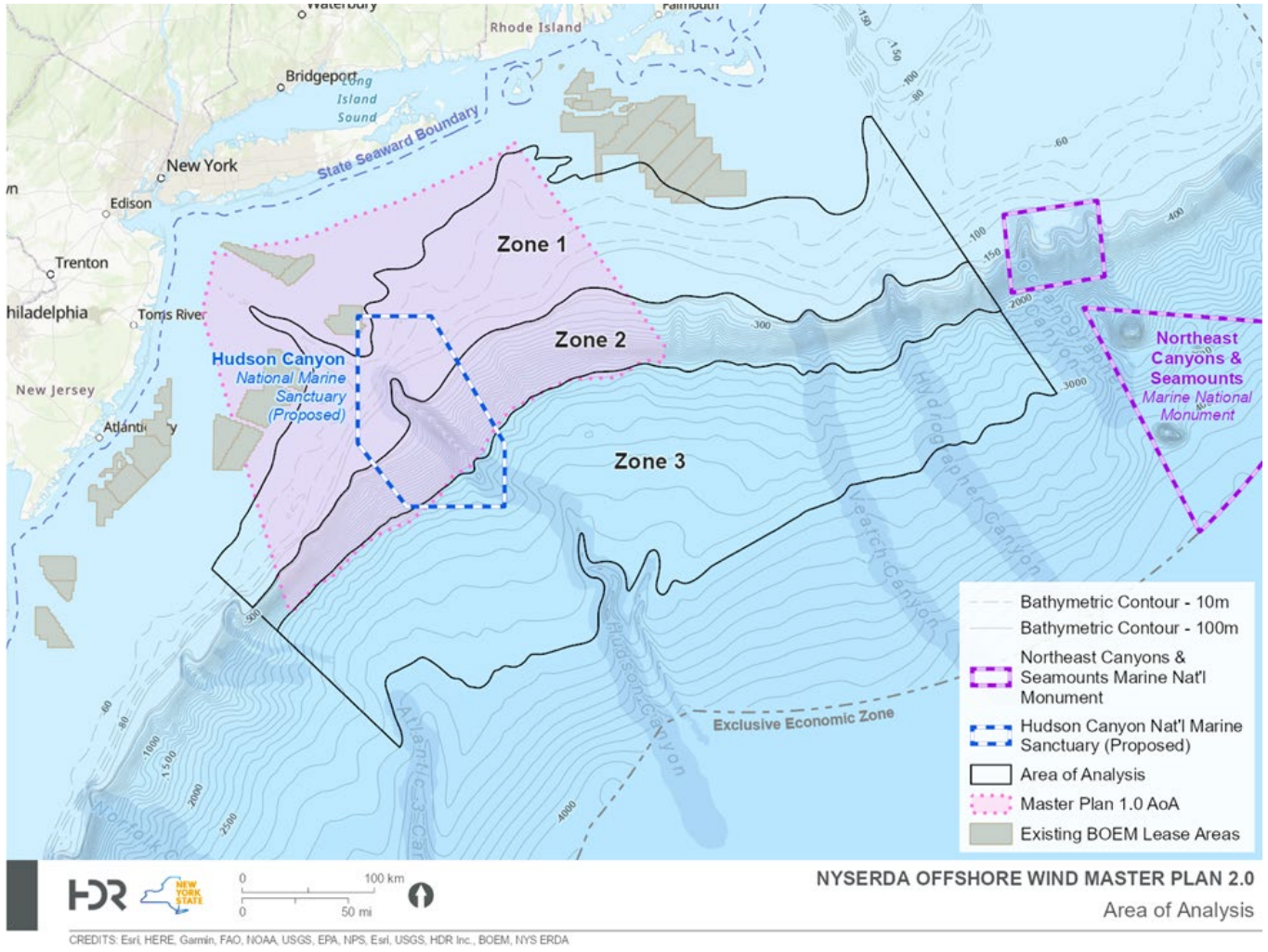
TETRA TECH

Purpose of the Fisheries Office Hours

- Overview of Master Plan 2.0.
- Share/summarize general concerns of the fishing industry; based on prior input, including input on deep water wind in other regions.
- Hear the fishing industry's concerns with deep water wind off New York and New Jersey.
- What is most important to fishermen and how to address through further studies, workshops, etc.?
- Input will be captured in a brief memo as an appendix to the Fish/Fisheries Study of the OSW Master Plan 2.0, which will then be provided as a recommendations document to BOEM.

Fish & Fisheries Study Framework

- Developed Sensitivity Analysis Framework, Risk Ranking and Data Receptors based upon stakeholder and PAC input:
  - Habitat
  - Fish Species
  - Commercial/Recreational Fisheries



Biological Datasets Included

Habitat

- Atlantic Highly Migratory Species (HMS) EFH map (NOAA)
- Mid-Atlantic and NE EFH map (NOAA)
- Habitat Areas of Particular Concern – HAPC map (NOAA)
- Northeast Canyons and Seamounts Nat'l Monument
- ESA-listed species and Critical Habitat – Greater Atlantic Region (Section 7 map)

Fish Species

- NOAA NEFSC Spring & Fall Bottom Trawl (2013-2022)
- NOAA NEFSC/Industry Cooperative Sea Scallop Dredge Survey (2013-2022)
- NOAA NEFSC Atlantic Surfclam & Ocean Quahog Survey (2013-2022)

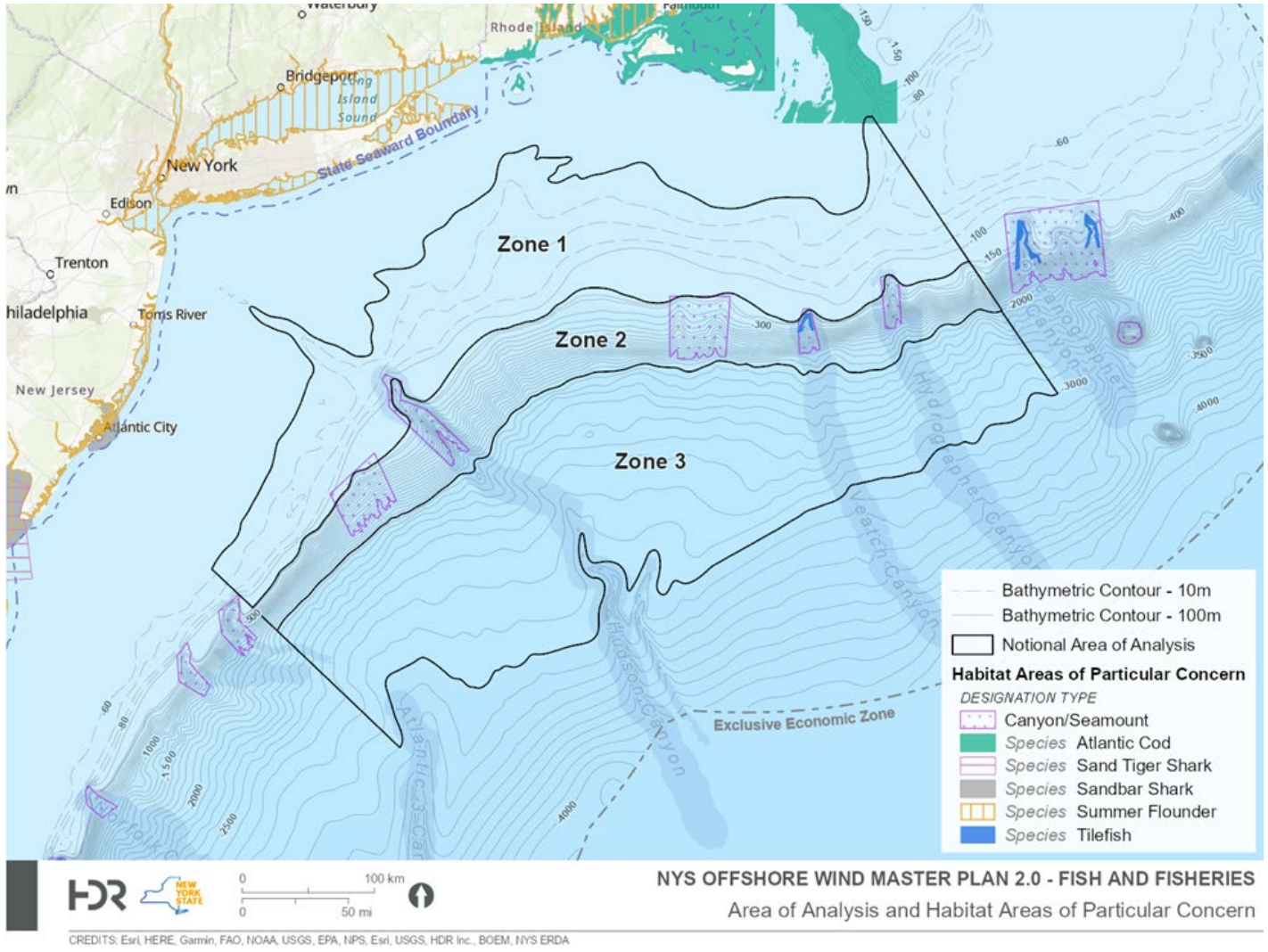
Fisheries

- NOAA Fisheries Observer Data (2013-2022)
- NOAA Fishing Footprints data (2012-2021)
- USCG AIS data (2018-2022)
- NOAA VMS data (2013-2023)
- HabCam Survey (Requested; not yet received)

Other primary sources included scientific literature and research reports relevant to deep water OSW development and species in the northeast.

Habitat Overview

- EFH
  - 63 species identified
  - 39 species with EFH for every life stage
- HAPC
  - Subset of EFH
  - Juvenile Atlantic cod
  - Several submarine canyons
  - Tilefish HAPC within Veatch Canyon HAPC



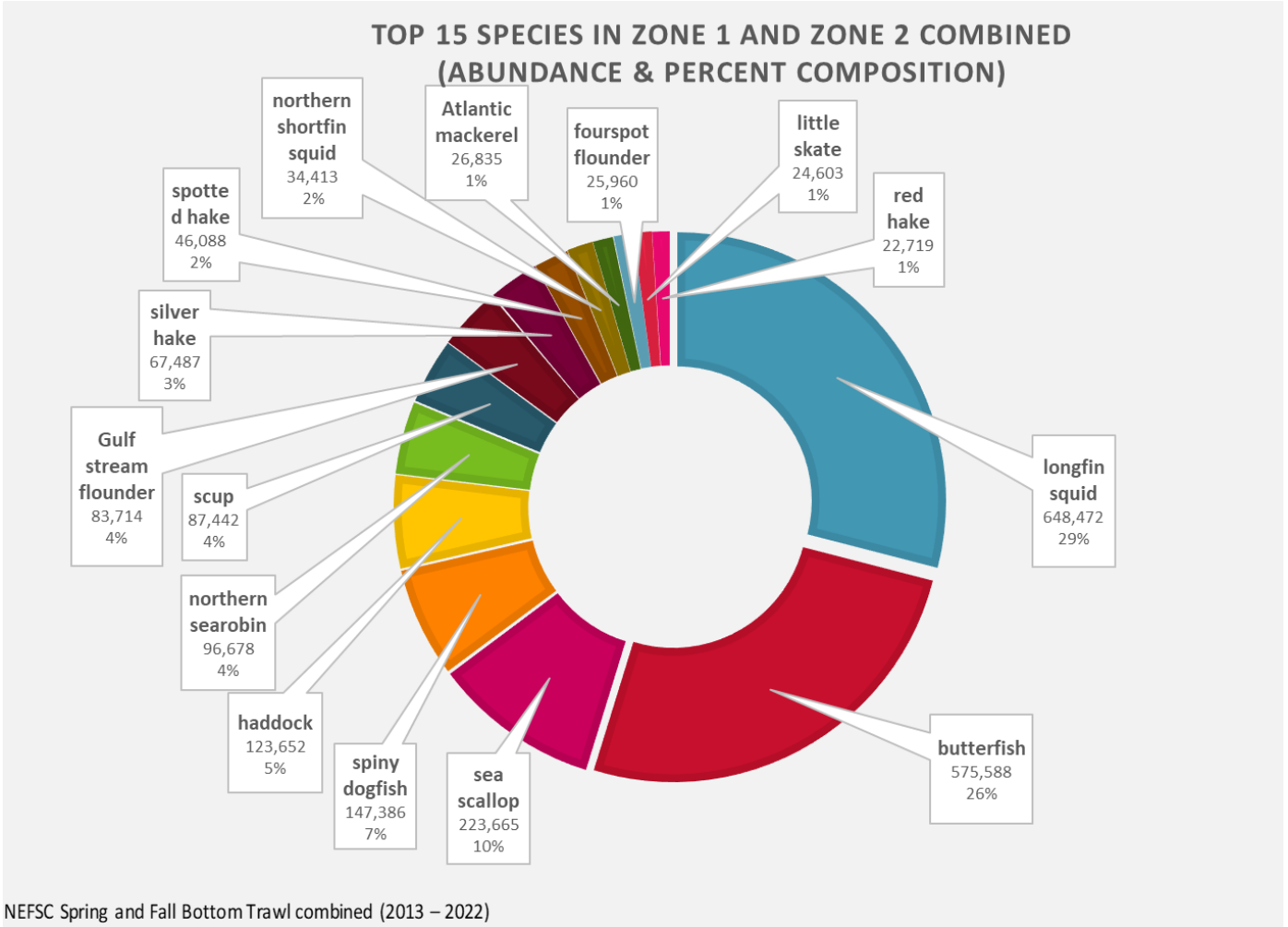
- Marine Sanctuaries & National Monuments
  - Proposed Hudson Canyon Sanctuary
  - Northeast Canyons and Seamounts National Monument

Fish Species Overview

Fish Species in Areas 1 and 2

190+ species identified (NEFSC BT Survey)

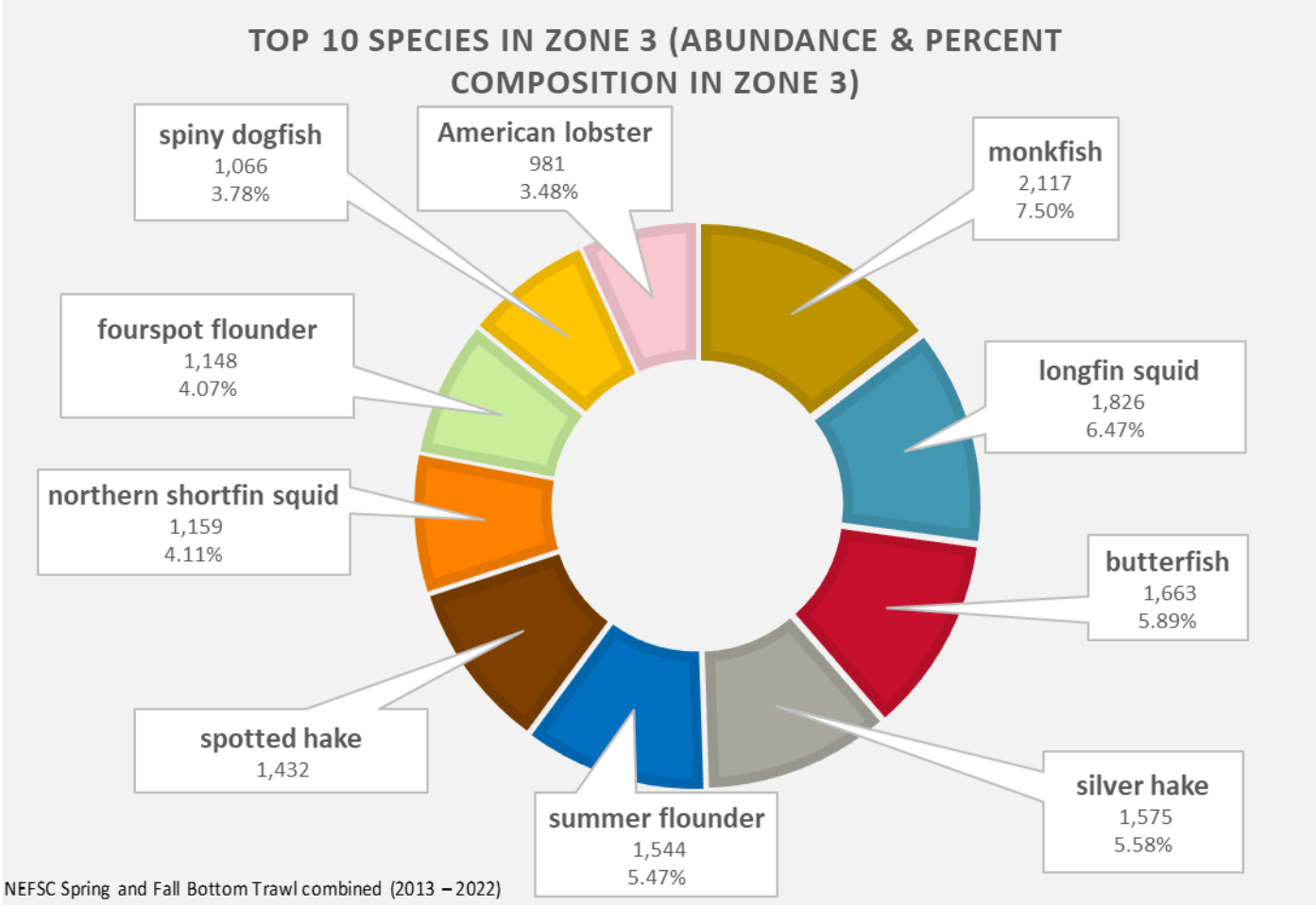
- Most abundant Zones 1 and 2:
  - Longfin squid
  - Butterfish
  - Sea scallop
  - Spiny dogfish
  - Haddock



Fish Species Overview

Fish Species in Area 3

- Most abundant Zone 3 (NOAA Observer):
  - Monkfish
  - Longfin squid
  - Butterfish
  - Hake species
  - Summer flounder
  - American lobster



Fish Species Overview

- ESA-listed Threatened & Endangered
  - Atlantic sturgeon (E)
  - Giant manta (T)
  - Oceanic whitetip shark (T)
- NOAA Trust Resources & Species of Concern
  - Highly Migratory Species (HMS)
  - Diadromous species
  - Forage and Shellfish species

Common Name	Scientific Name	Species Type	Species of Concern
American eel	*Anguilla rostrata*	Catadromous	Y
Striped bass	*Morone saxatillis*	Anadromous	Y
Blueline tilefish	*Caulolatilus microps*	Demersal	Y
Golden tilefish	*Lopholatilus chamaeleonticeps*	Demersal	N
Halibut	*Hippoglossus hippoglossus*	Demersal	Y
Black seabass	*Centropristis striata*	Demersal/hard bottom	N
Cusk	*Brosme brosme*	Demersal/hard bottom	Y
Tautog	*Tautoga onitis*	Demersal/hard bottom	N
Red hake	*Urophycis chuss*	Demersal/semi-pelagic	Y
Silver hake	*Merluccius bilinearis*	Demersal/semi-pelagic	N
Atlantic mackerel	*Scomber scombrus*	Forage species	Y
Atlantic menhaden	*Brevoortia tyrannus*	Forage species	N
Sand lance	*Ammodytidae*	Forage species	Y
American lobster	*Homarus americanus*	Shellfish	Y
Atlantic sea scallop	*Placopecten magellanicus*	Shellfish	N
Atlantic surfclam	*Spisula solidissima*	Shellfish	N
Horseshoe crab	*Limulus polyphemus*	Shellfish	Y
Ocean quahog	*Arctica islandica*	Shellfish	N
Deep-sea red crab	*Chaceon quinquidens*	Shellfish	Y
Northern shortfin squid	*Illex illecebrosus*	Cephalopod	Y

Commercial and Recreational Fisheries Overview

Fourteen Fisheries Management Plans (FMPs) within AoA

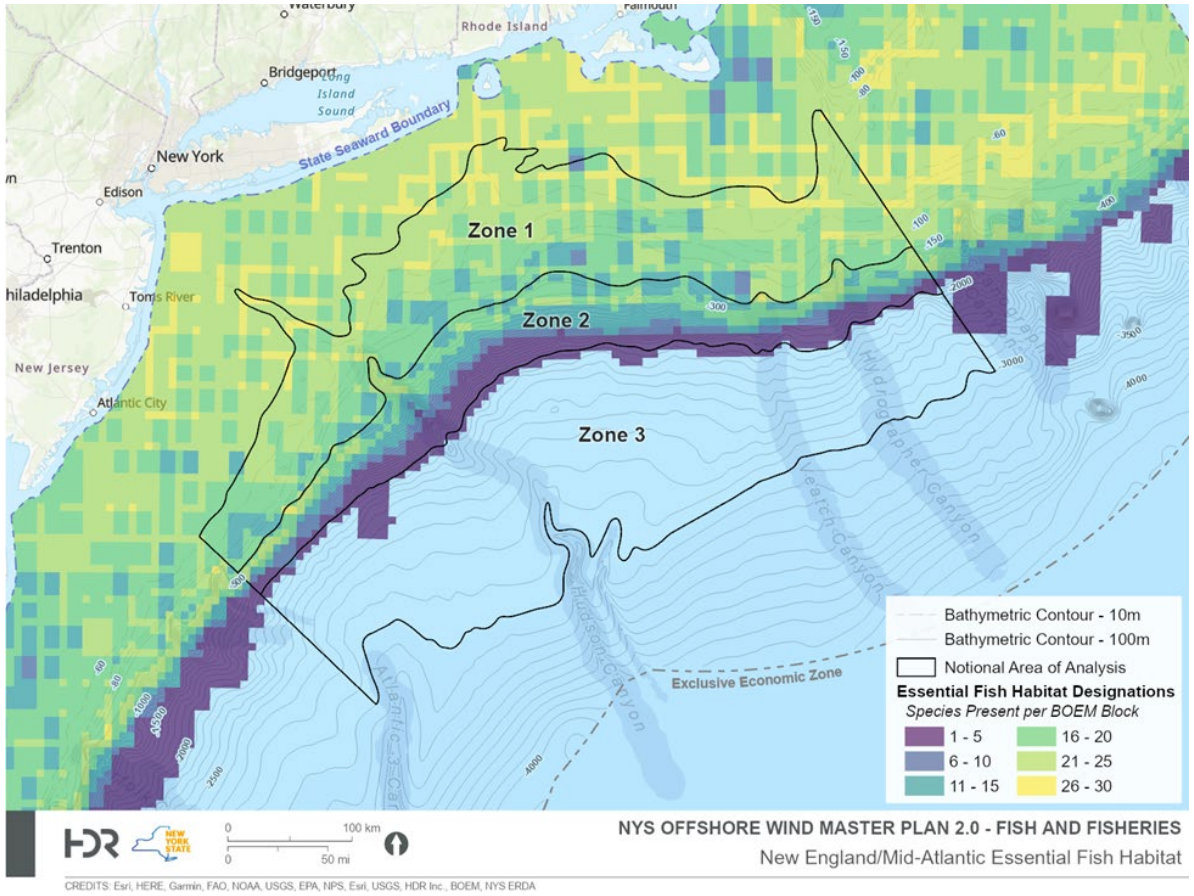
- Prime Recreational Fishing Locations Mapped
- Fishing Vessel Usage: USCG Automatic Identification System (AIS) for vessels >65ft and NOAA)
- Vessel Monitoring System (VMS) Tracking Data
- NOAA Fisheries Observer Data Mapped
- Fishing vessel hauls
- Fishing industry revenue

Fisheries Management Plan	Management Area	Date of Inception
Atlantic Herring	New England, Mid-Atlantic	1999
Atlantic Salmon	New England	1987
Atlantic Sea Scallop	New England	1982
Atlantic Surfclam and Ocean Quahog	New England, Mid-Atlantic	1977
Bluefish	Mid-Atlantic	1990
Consolidated Atlantic Highly Migratory Species	Highly Migratory Species, New England, Mid-Atlantic, South Atlantic	2006
Deep-sea Red Crab	New England	2002
Mackerel, Squid and Butterfish	Mid-Atlantic	1978
Monkfish	New England, Mid-Atlantic	1998
Northeast Multispecies	New England	1985
Northeast Skate Complex	New England	2003
Spiny Dogfish	New England, Mid-Atlantic	1999
Summer Flounder, Scup, and Black Sea Bass	Mid-Atlantic	1988
Tilefish Fishery	Mid-Atlantic	2001

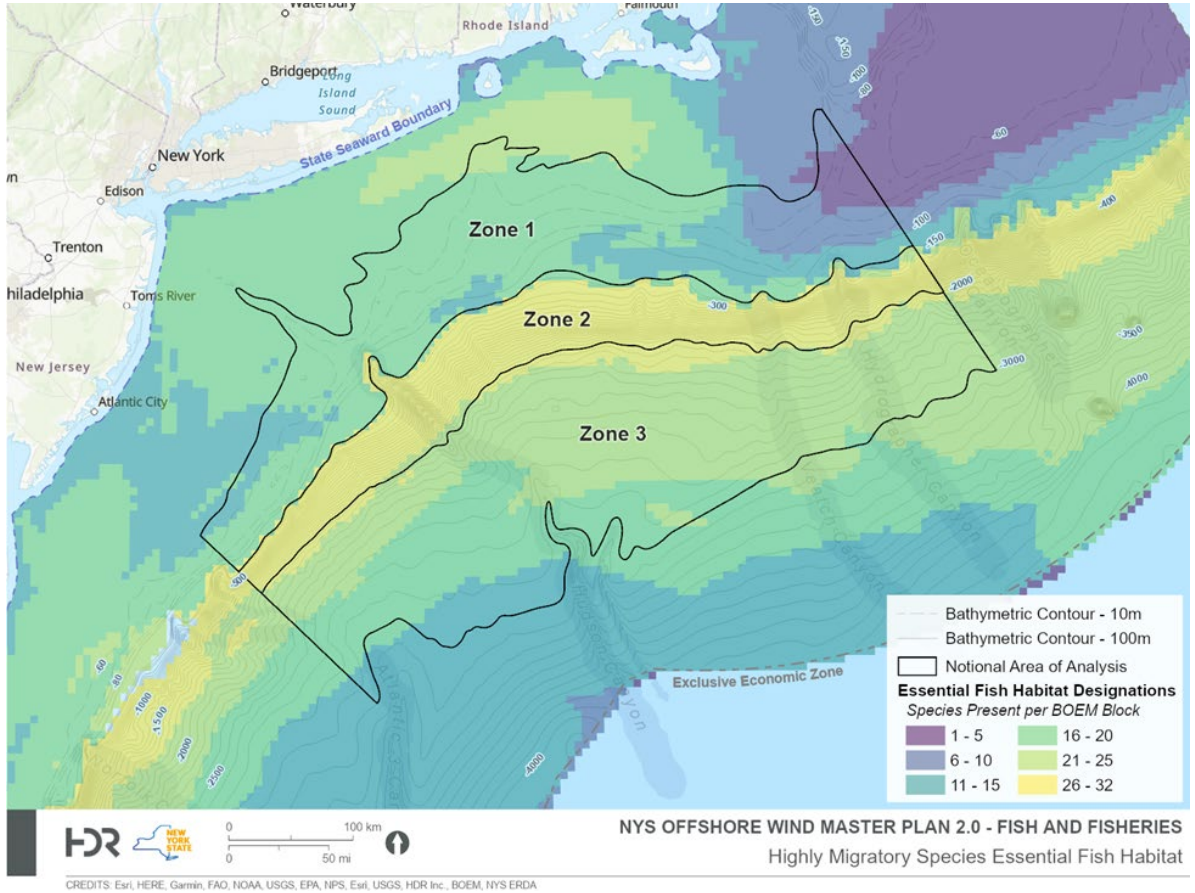
Results Essential Fish Habitat

- EFH widely distributed in Zone 1 and most of Zone 2
- Most HMS EFH occurs along shelf break and seaward in Zones 2 and 3

Mid-Atlantic & NE EFH



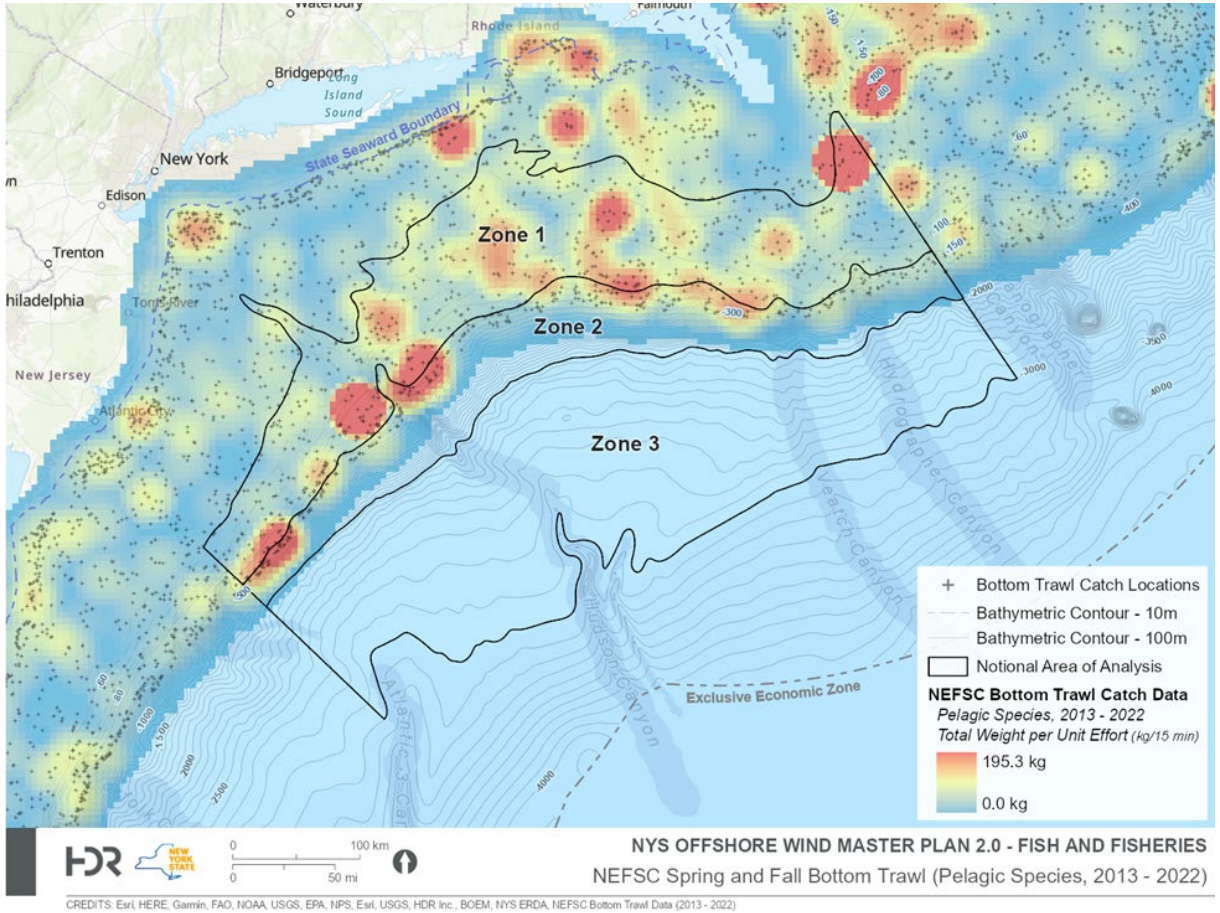
HMS EFH



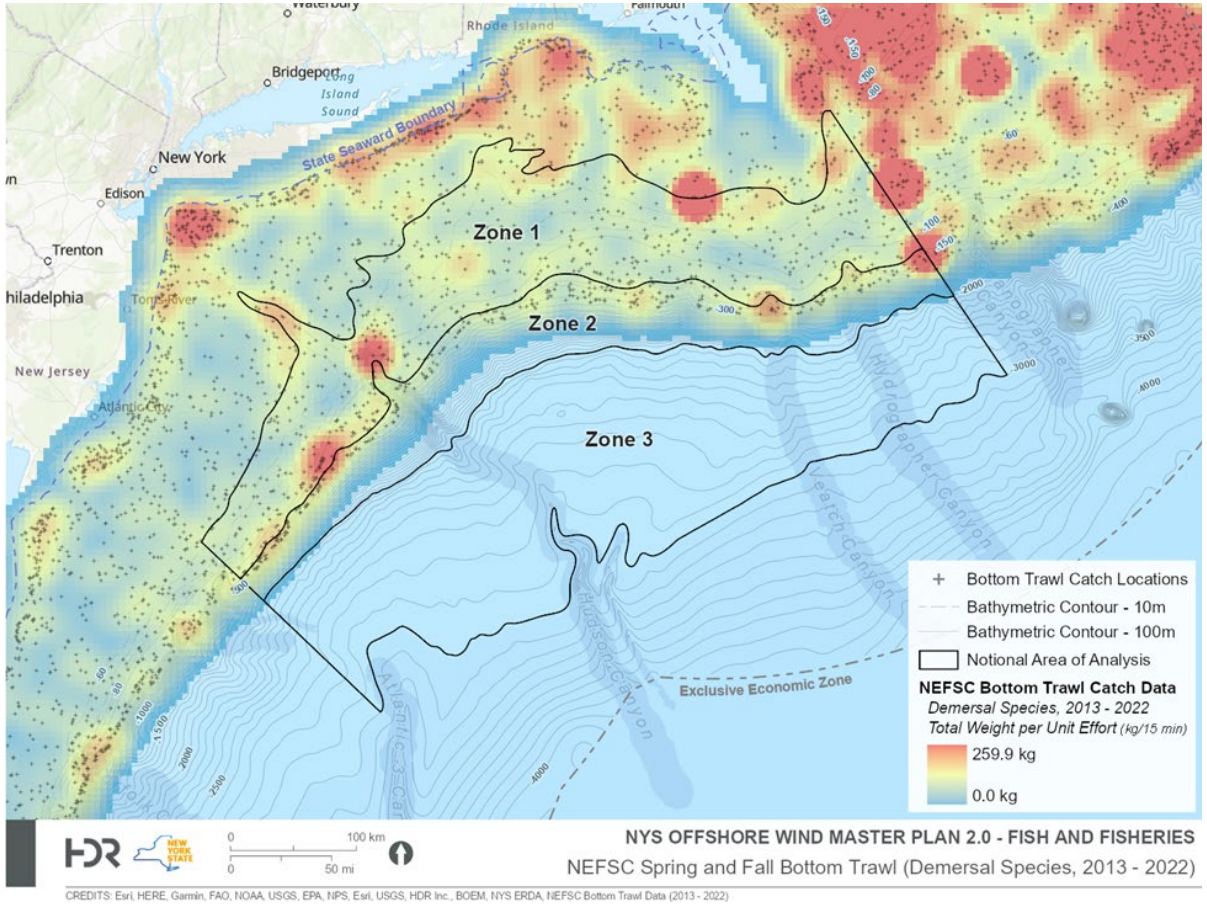
Results Bottom Trawl

- Concentrations of demersal and pelagic species biomass along the shelf break, within and outside of submarine canyons (NEFSC BT Survey).

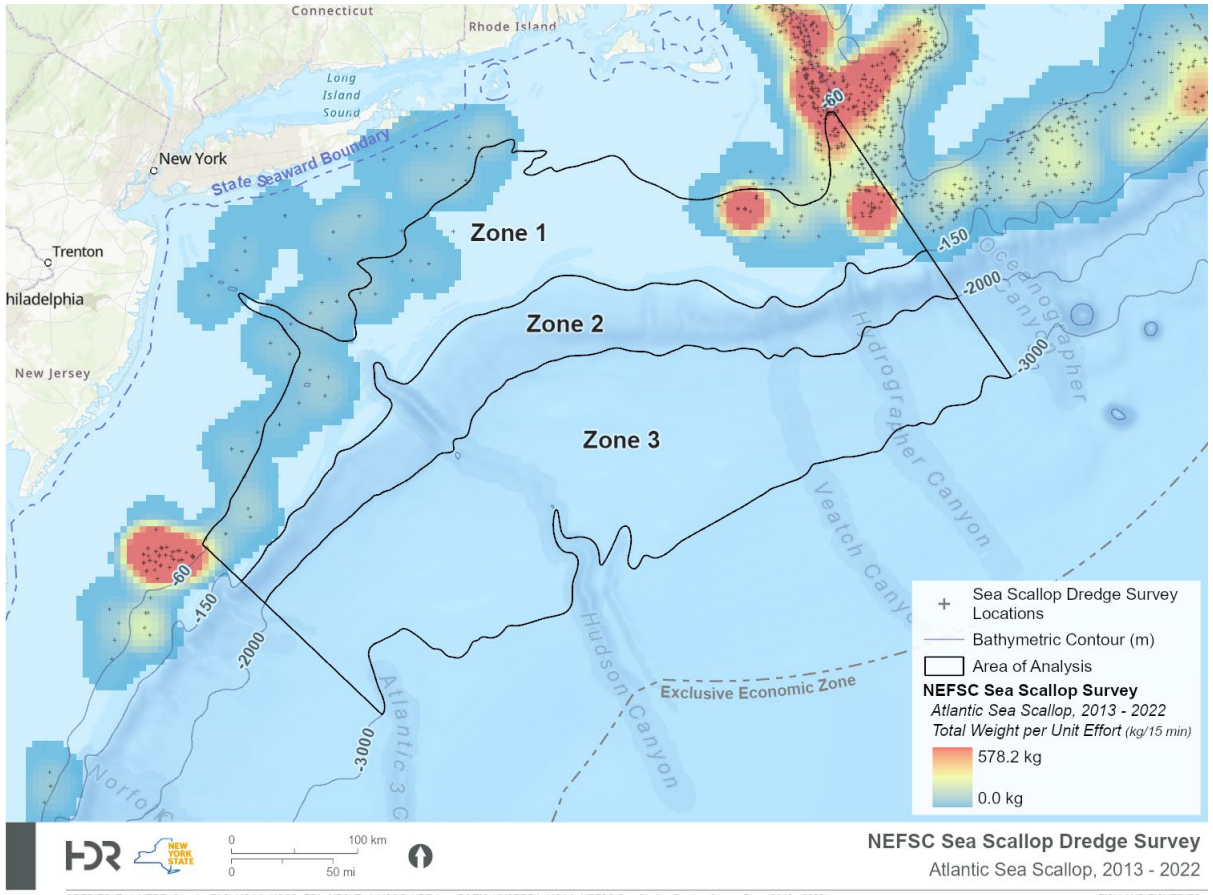
Pelagic Species Biomass

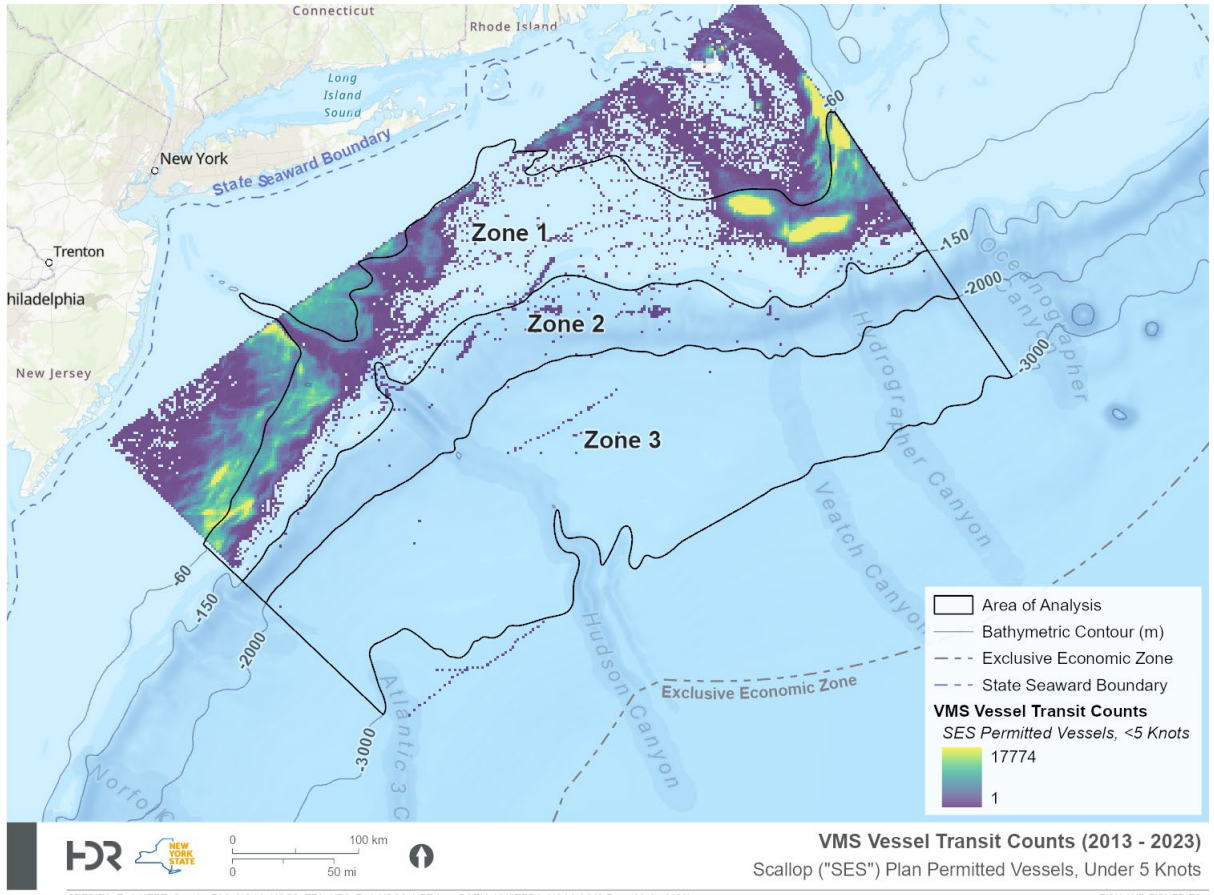


Demersal Species Biomass



Results NEFSC Sea Scallop Dredge Survey and Sea Scallop VMS





Knowledge Uncertainties & Data Gaps

- Future Fisheries Surveys
  - Impact to long-term fisheries studies and future study design/methods
  - Spatial data limited in Zone 2 and 3 for some species (i.e., Highly Migratory Species)
  - Recent research prioritization is expected to enhance knowledge of potential impacts to fisheries
- Hydrodynamic and Oceanographic Changes
  - Impact of deep water floating wind technology
- Vessel Traffic
  - NYSERDA Maritime Reports
- Fisheries Tourism
  - Enhanced opportunities?
- Fishing Industry Employment
  - Long-term impacts unknown/NYSERDA (2021) Study
- Climate Change
  - Fish population changes vs GHG reductions

Future Considerations

- Build off ongoing fishing industry feedback (i.e., office hours) during OSW planning and siting to mitigate impacts to historical fishing and sampling locations
- Preliminary and baseline studies of habitat, species, and fisheries
- Research prioritization (ie., assessing impacts to larval fish, habitat conversion, and EMF)
- Continued biological monitoring to assess impacts as deep water OSW technology develops

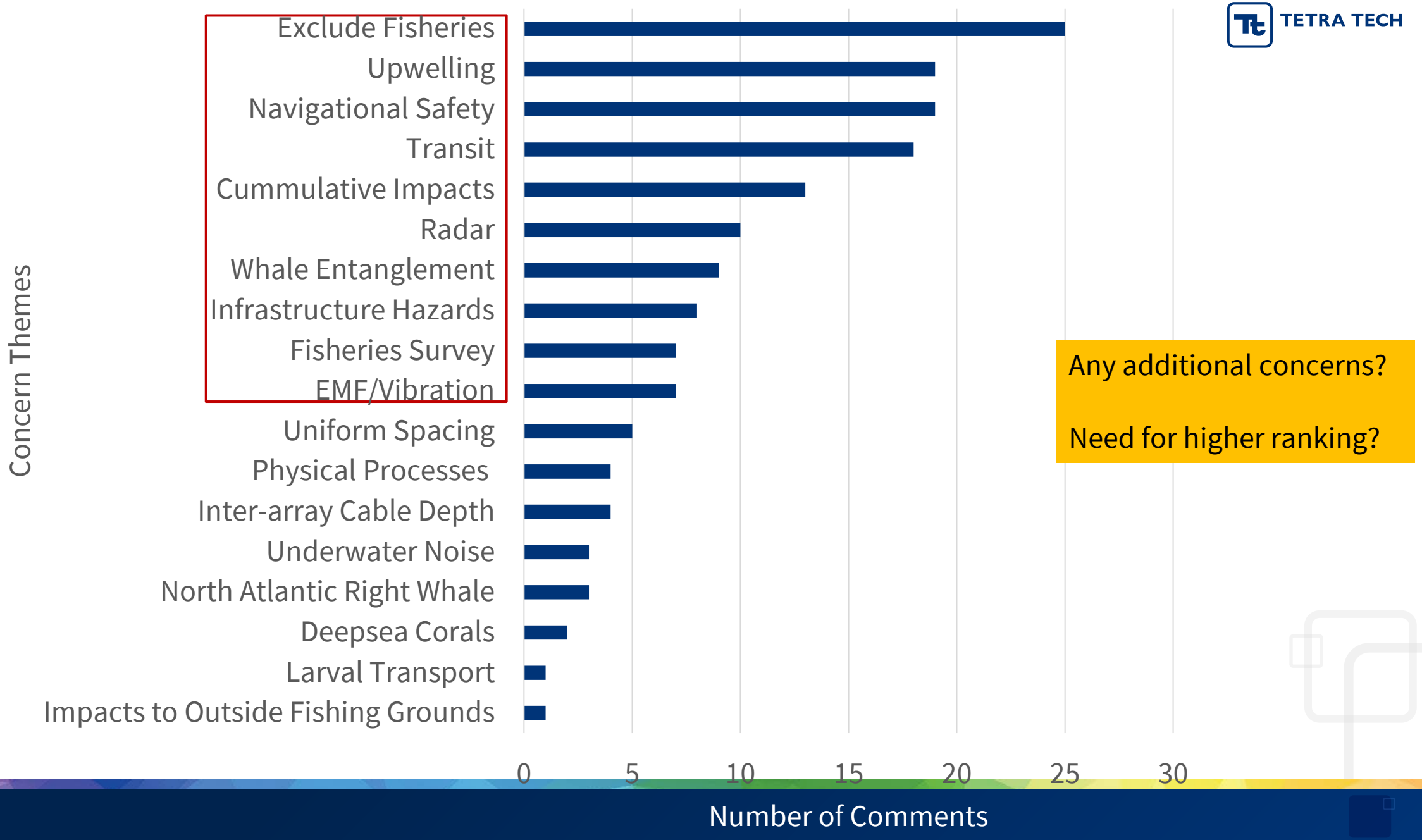
General Comment Themes

- Data availability & usage (i.e., AIS, VMS and Sea Scallop Dredge/HabCam data).

- Data limitations and caveats:
  - sampling gear limitations;
  - survey sampling locations vs. industry fishing locations;
  - limitations of data provided with confidentiality protections.

- Additional information on stressors associated with hard bottom structures and the potential for restoration after decommissioning.
- Additional discussion of impacts to fishing industry, including:
  - Effort displacement
  - Revenue loss
  - Gear loss and damage
  - Compensation fund considerations

Comment Synthesis



Any additional concerns?

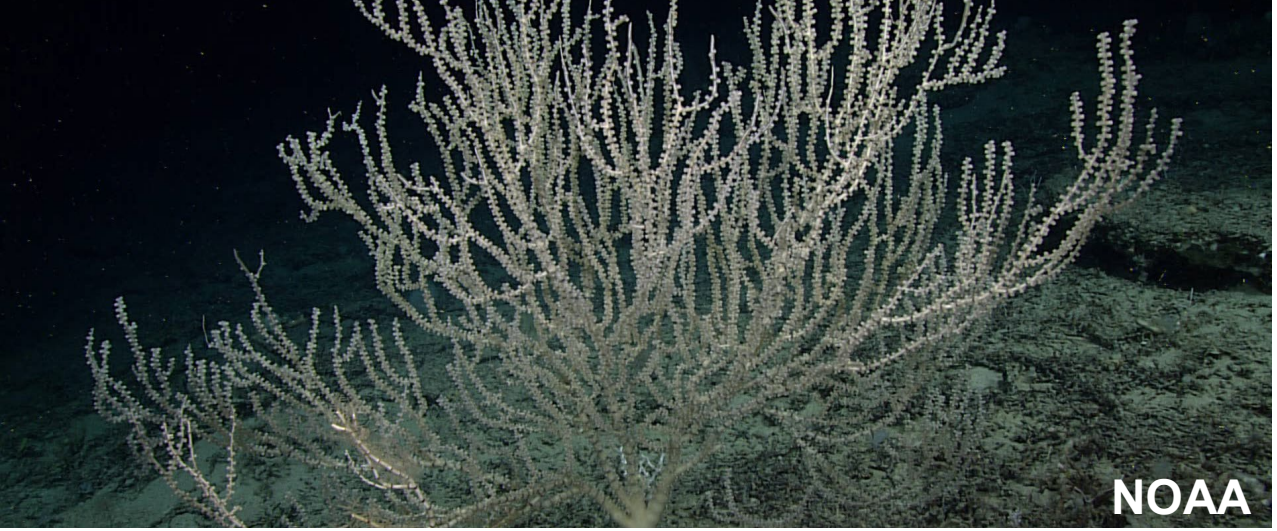
Need for higher ranking?

Feedback from Office Hours – Input & Concerns

- **Comments & Input from Prior Documents:**
  - All prior comments are important, no ranking suggested.
  - Common themes may also be found within comments on the NYB WEA assessments.
  - Concerns with prioritizing the different comment themes against each other and ranking them. The primary concern should be the cumulative impacts of OSW development.
  - Review NOAA Proposed Hudson Canyon Sanctuary comments.
  - Include the FSF letters for the MA RFI and RI/MA Lease Issuance that influenced the communication of information to remove scallop areas from the MA-RI WEAs
  - Agreement with NMFS concern that there is a lack of knowledge and studies around the benthic habitats in Zone 3.
  - Underwater noise is under emphasized in the comment synthesis.
  - Concern about cumulative impacts with deep water AoA and existing lease areas, wind energy areas, and call areas.
- **Oceanographic Processes:**
  - Multiple oceanographic processes and their effects elsewhere.
  - Need to consider disruption to oceanographic/hydrodynamic systems, oxygen depletion, larval transport, and how that might impact fisheries.
- **Important Fisheries:**
  - Scallops in Zone-1 is a major concern. Also, Eastern boundary of the map is fished much deeper than the area south of long island. Scallop fishery gets very deep further east you go.
  - Mid-Atlantic groups seem to be underrepresented – recommend reaching-out to long-liners (> 100 fathom), as well as Bluewater Fishermen's Association; particularly in Zone-2 & Zone-3

Feedback from Office Hours – Input & Concerns

- **Components & Footprint:**
  - Floating will be different footprint than fixed (on the seabed and in the water column).
  - Which platform designs and inter-array cable depths are most commonly used or preferred in other floating OSW installations?
  - The type of mooring system used by deep water OSW could influence constraints with fishing interests (e.g., potential to prevent trawling or bottom dredging).
  - Request to assess floating OSW options with turbines sited as close as possible, in order to minimize the exclusion areas for fisheries.
  - Concern that deep water wind technologies and associated cables/chains across the water column will entirely preclude any mobile gear from fishing within a floating wind farm.
  - Need to consider the potential for whale entanglement (primary & secondary).
  - Compensatory mitigation will be a necessary part of developing the AoA, if mobile gear types are precluded from fishing – potentially up to entire boat/permit buybacks if necessary.
- **Siting & Analysis:**
  - Is New York State considering areas closer to shore, which would have considerably less impacts on fisheries? Concern about New York State leading the charge for potential development of the AoA, located in Federal Waters.
  - Considerable interest in the potential to install cell receivers on OSW infrastructure to extend cell service at sea, continued concerns with radar, and collision with platforms.
  - Ensure that the Fish/Fisheries Study contractor is utilizing all appropriate data sources, particularly for scallop surveys (e.g., NEFSC Scallop Dredge Survey, VIMS Dredge Survey, SMAST drop camera survey, and HABCAM). Also, ensure NYSERDA's contractors are coordinating on inputs from these office hour sessions, for incorporation into the Fish/Fisheries Study.
  - During NYSERDA's original Master Planning effort, the goal was least risk (to fishermen) and greatest opportunity (for wind development); concern that this new 2.0 effort does not have that same approach in mind.
  - Need a cost-benefit study for the overall economics of developing the AoA.
  - Concern about stakeholder burnout from all of the engagement efforts, with little avoidance of impacts.



Benthic Habitat Study

1 Receptor Groups

2 Datasets Included and Methodology

3 Key Results

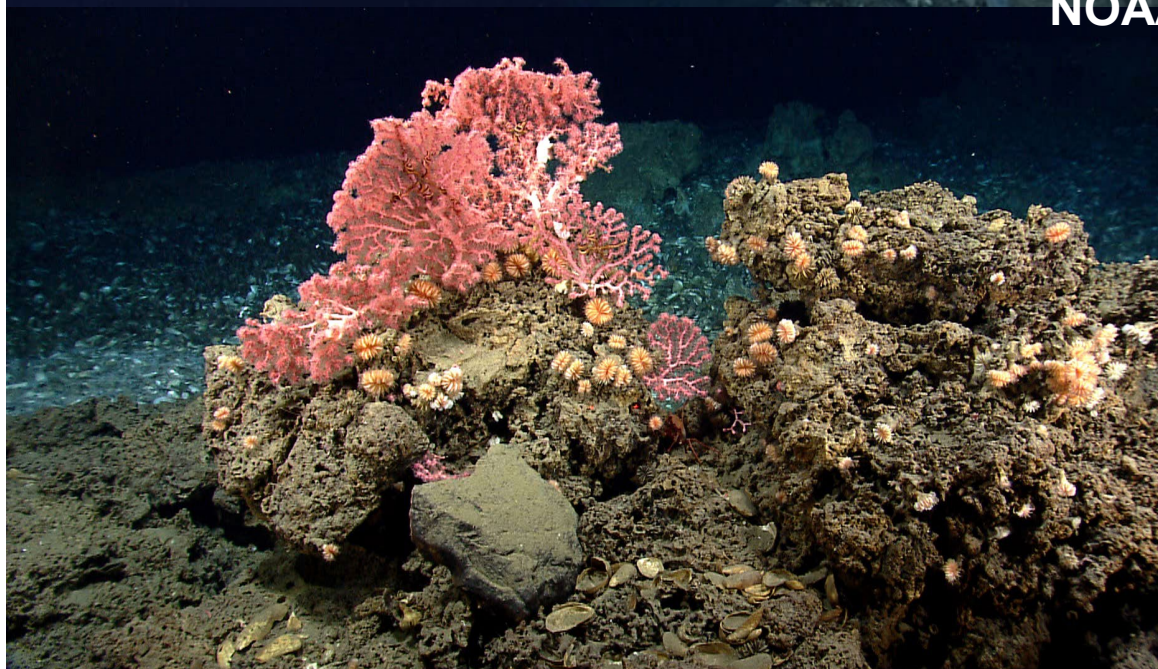
4 Knowledge and Data Gaps

5 Future Considerations

6 Main comment themes

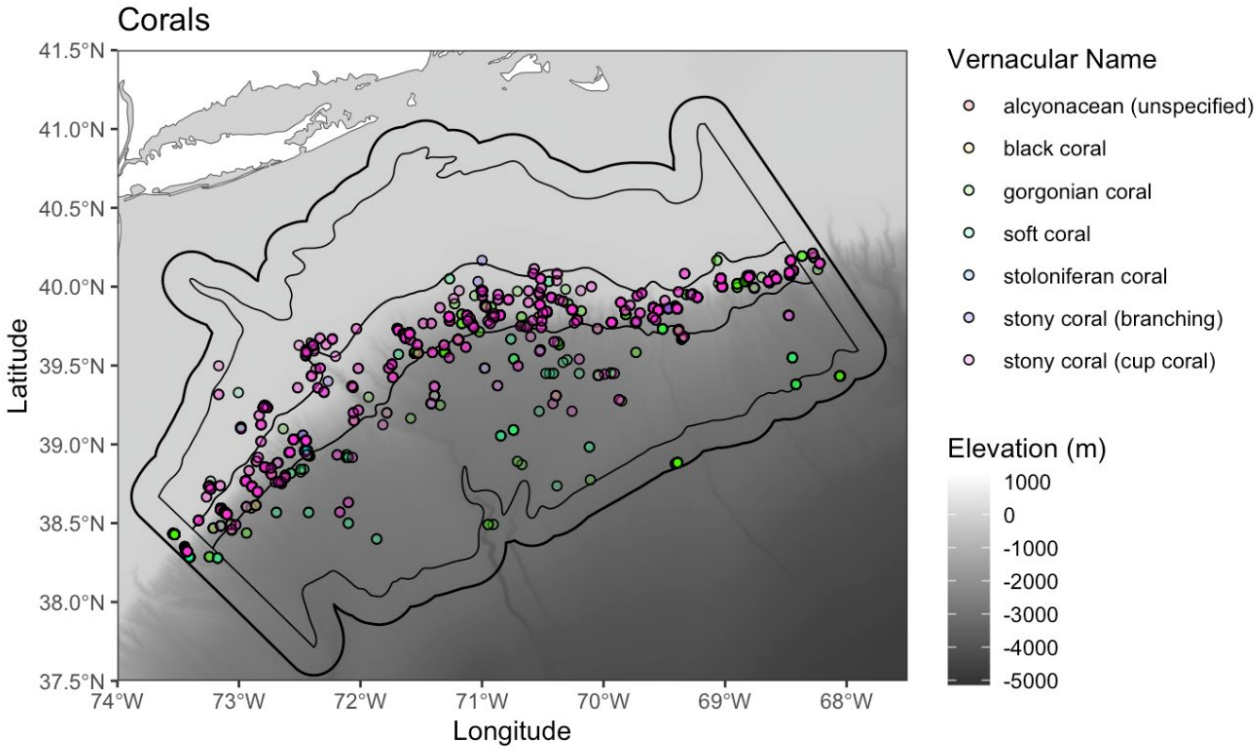
1 Receptor groups

- Focused on structurally complex and foundational habitat groups present within the AoA.
- Selected based on the provision of habitat that generally enhances local diversity and have strong functional roles in the local ecosystem.
- Additionally, these receptor groups (particularly biological) have high conservation and management value (e.g., Essential Fish Habitat).
- Biological Receptor Groups
  - Deep-sea corals
  - Sponges
  - Sea pens
- Physical Habitat Receptor Groups
  - Hard substrate



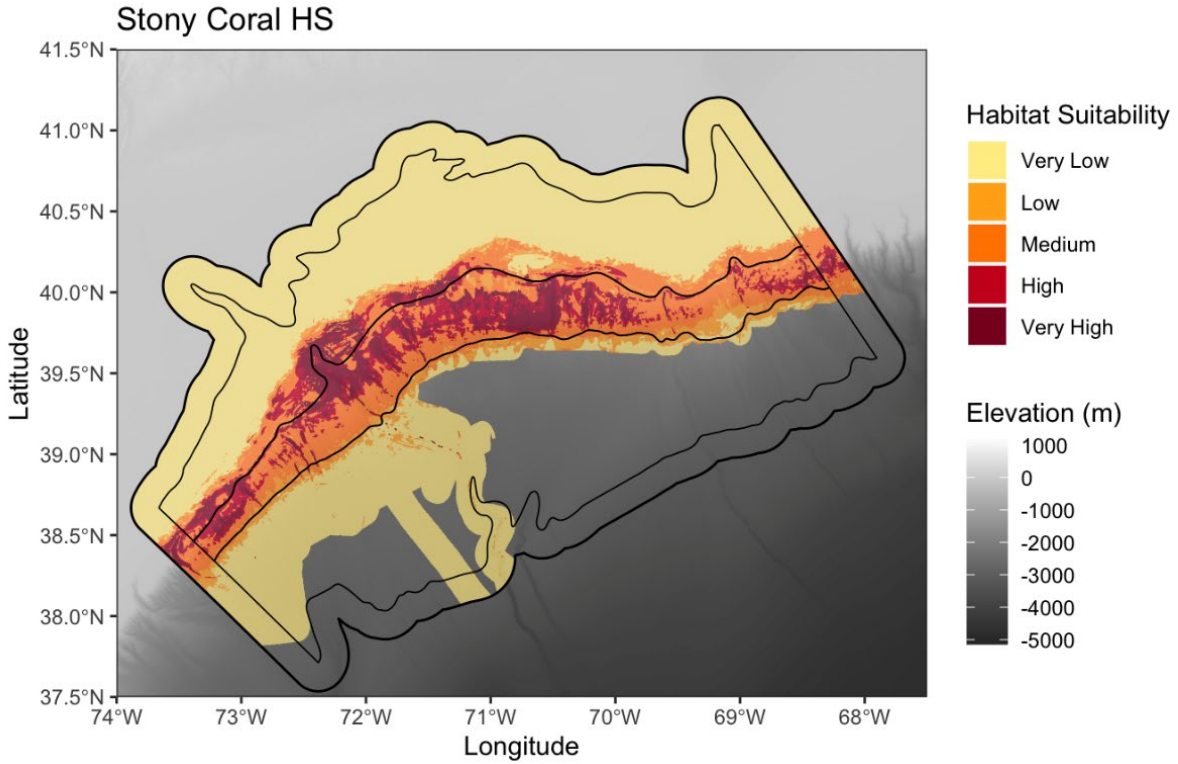
2 Datasets included and methods

- Explored multiple datasets that were available within the AoA:
  - Biological
    - **Occurrence records** for the distribution of deep-sea corals, sea pens and sponges obtained from publicly available databases including the NOAA Deep-sea Coral Data Portal and the Ocean Biodiversity Information System.
    - Show where species occurrences have been found but not necessarily the best representation of species distributions due to incomplete effort data in much of the AoA for these receptors.



2 Datasets included and methods

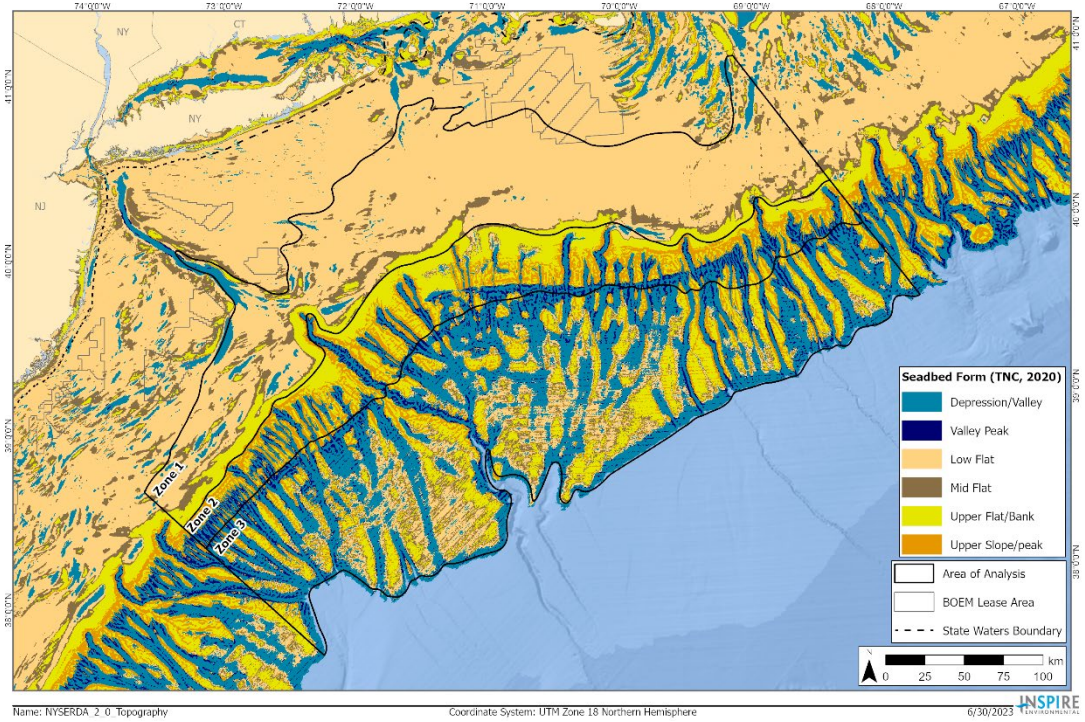
- Explored multiple datasets that were available within the AoA:
  - Biological
    - **Species distribution models** for the receptor groups were obtained from peer-reviewed regional model outputs developed by NOAA for the US continental shelf area (Kinlan et al., 2020).
    - Statistically extrapolates potential species distributions from known occurrences and the calculation of species niches. Provides an estimation of potential distribution patterns in areas that have not yet been sampled.
  - Also undertook **systematic literature review** to determine potential impacts from anthropogenic activities that may occur during OSW development.



2 Datasets included and methods

- Explored multiple datasets that were available within the AoA:
  - Physical Habitat Data
    - **Geophysical:**
      - Bathymetry (compiled by TNC 2010, updated 2020)
      - Backscatter (limited coverage, USGS; Butman et al. 2017)
    - **Geomorphology:**
      - TNC updated seabed topographic forms (TNC, 2010, updated 2020)
      - Derived from bathymetry and backscatter (limited coverage, USGS; Butman et al. 2017)
    - **Sediment types:**
      - TNC interpolated soft sediment type (TNC, 2010, updated 2020)
      - Modeled hard bottom likelihood (limited coverage, Battista 2019)

Topographic Seabed Forms (TNC 2010, updated 2020)



3 Key results

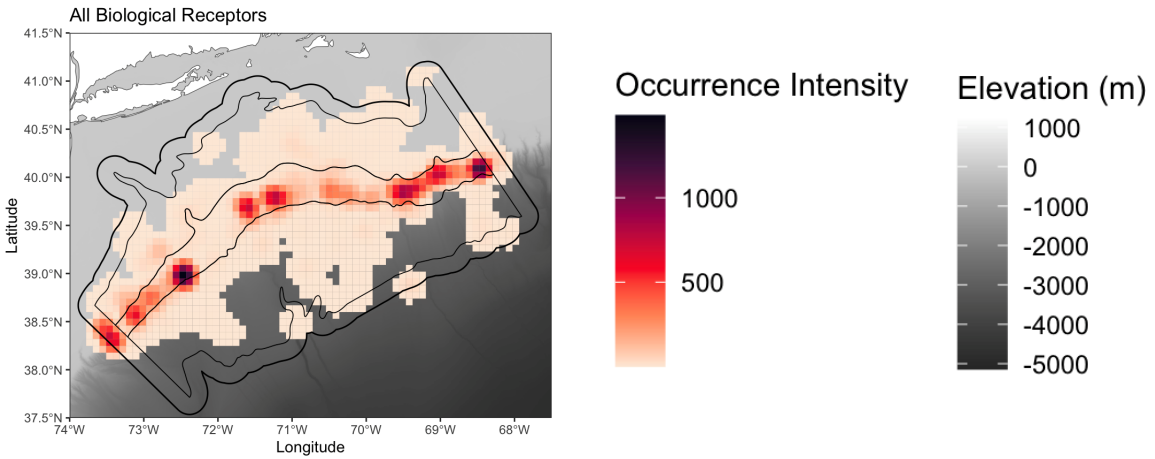
- Biological
  - **Occurrence records**
    - **Zone 1** did not contain as many observations of the selected benthic receptors than other zones, with relatively low recorded species richness.
    - **Zone 2** contained the most observations of all receptors and harbored the greatest species richness across all zones. Likely due to substantial habitat heterogeneity, with highly rugose terrain and the presence of several submarine canyons.
    - **Zone 3** is the least studied region of the AoA, however, still contained multiple observations of benthic receptors.

Number of records

Zone	Corals	Sponges	Sea Pens	All Receptors
Zone 1	194	63	294	551
Zone 2	8,493	939	1,004	10,436
Zone 3	597	56	415	1,068
All Zones (AoA)	9,284	1,058	1,713	12,055
All Zones + 25 km buffer	9,844	1,377	2,188	13,409

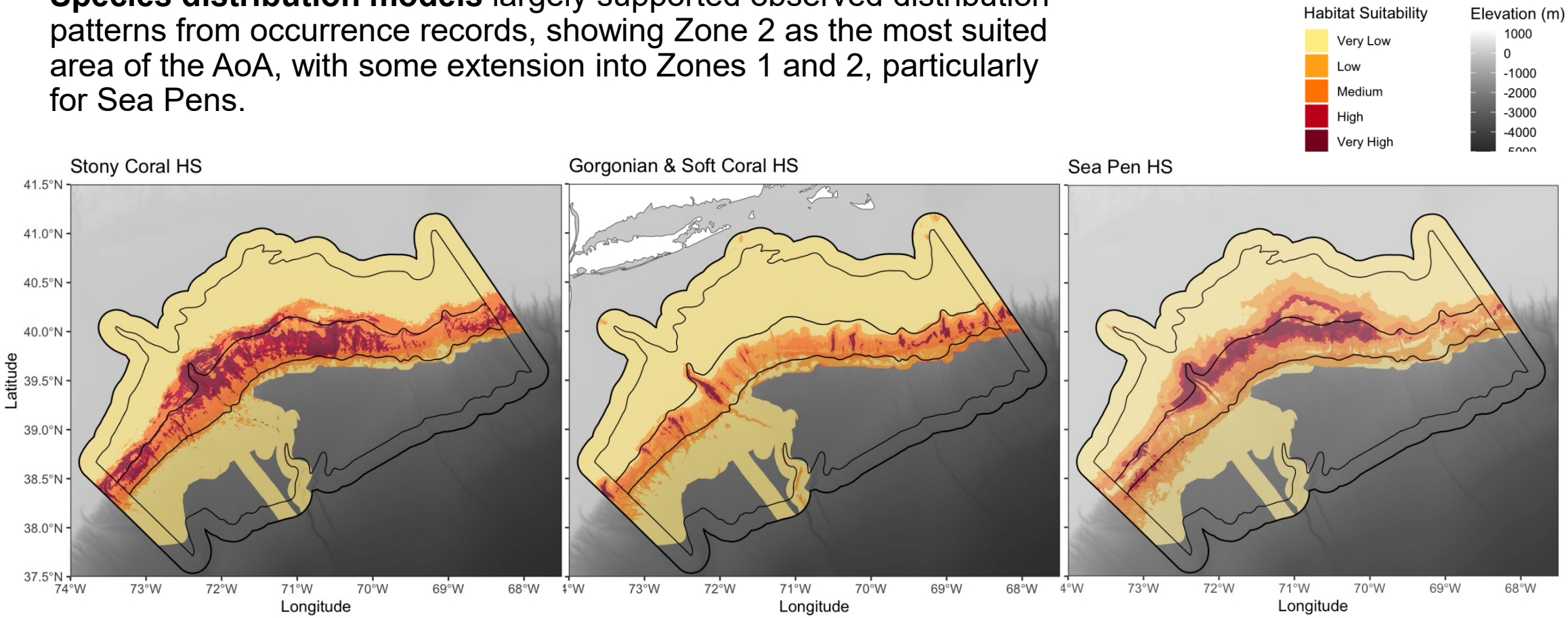
Species richness

Zone	Corals	Sponges	Sea Pens	All Receptors
Zone 1	4	7	16	27
Zone 2	36	21	73	130
Zone 3	21	3	36	60
All Zones (AoA)	43	27	87	157
All Zones + 25 km buffer	44	30	92	166



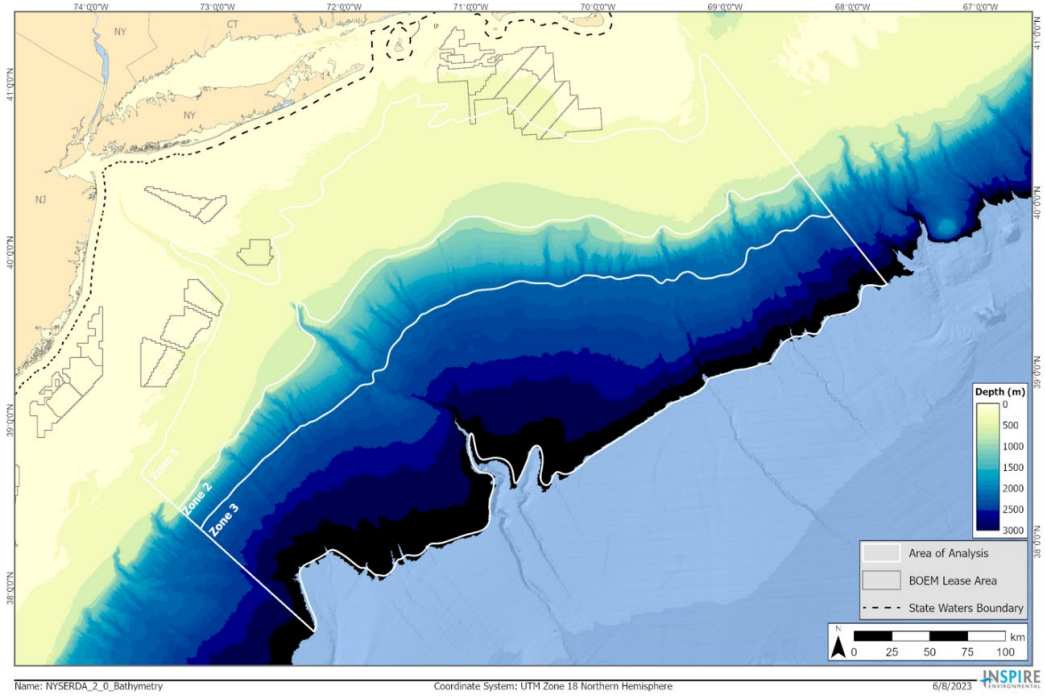
3 Key results

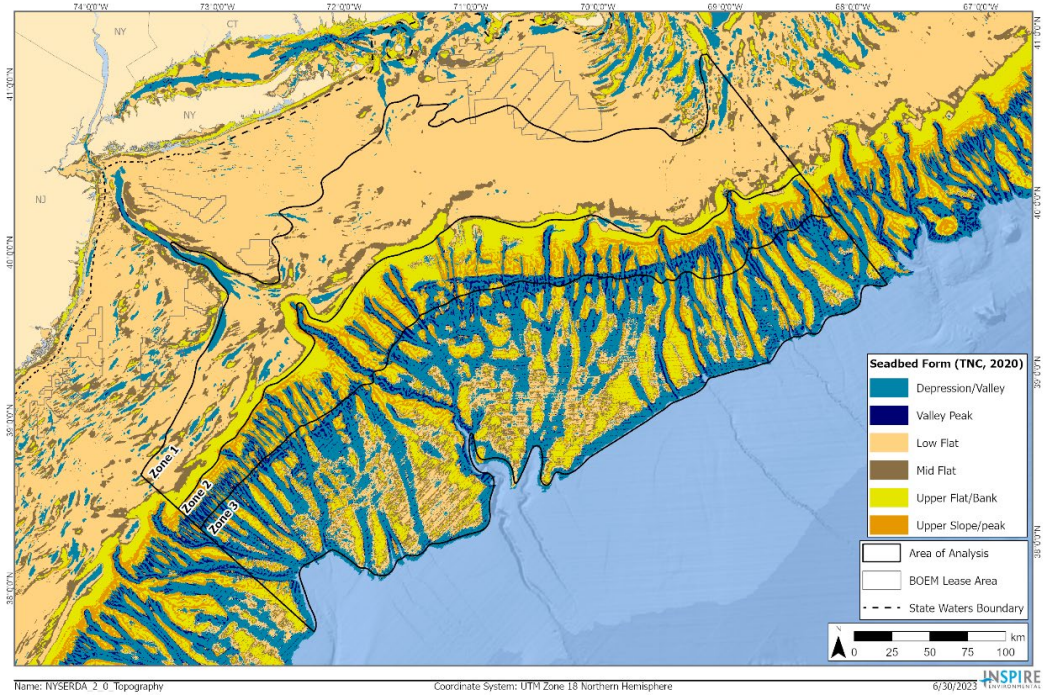
- Biological Data
  - **Species distribution models** largely supported observed distribution patterns from occurrence records, showing Zone 2 as the most suited area of the AoA, with some extension into Zones 1 and 2, particularly for Sea Pens.



3 Key results

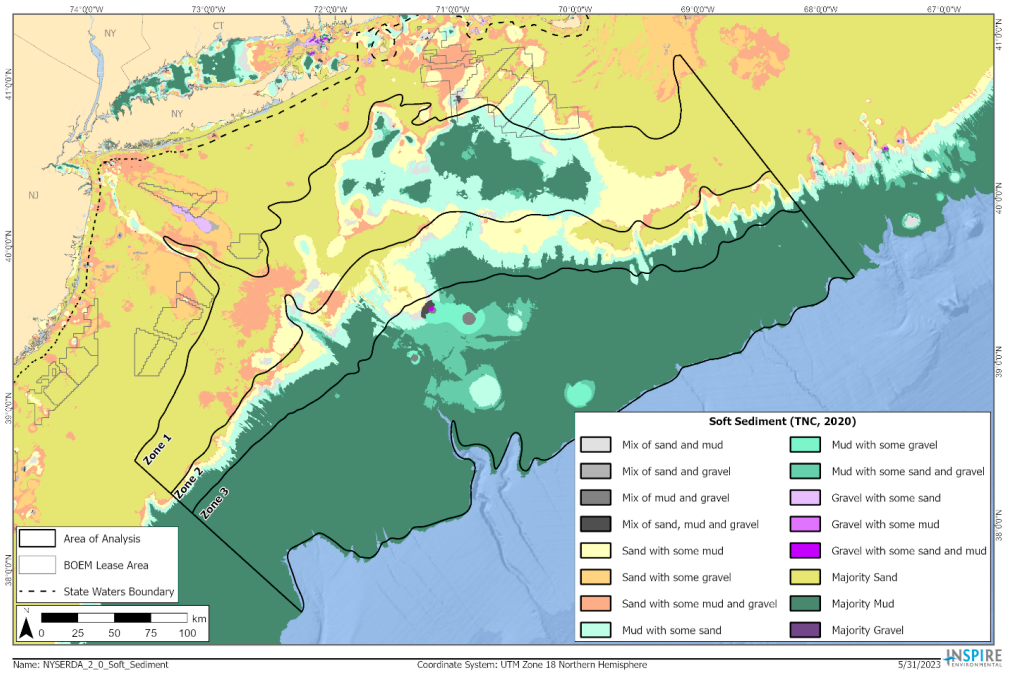
- Physical Habitat Data
  - **Bathymetry**
    - Prominent differences in the overall depth and large-scale bathymetric features of the seafloor are evident in regional bathymetric data.
    - Nearly complete coverage for the AoA.
  - **Geomorphology**
    - TNC's 2020 dataset that covered the AoA showed Zone 1 to be primarily a low flat, consistent with its position on the continental shelf.
    - Geomorphology present in regular patterns highlighted several canyons along the shelf break in Zone 2, with those patterns continuing to the edge of Zone 3.

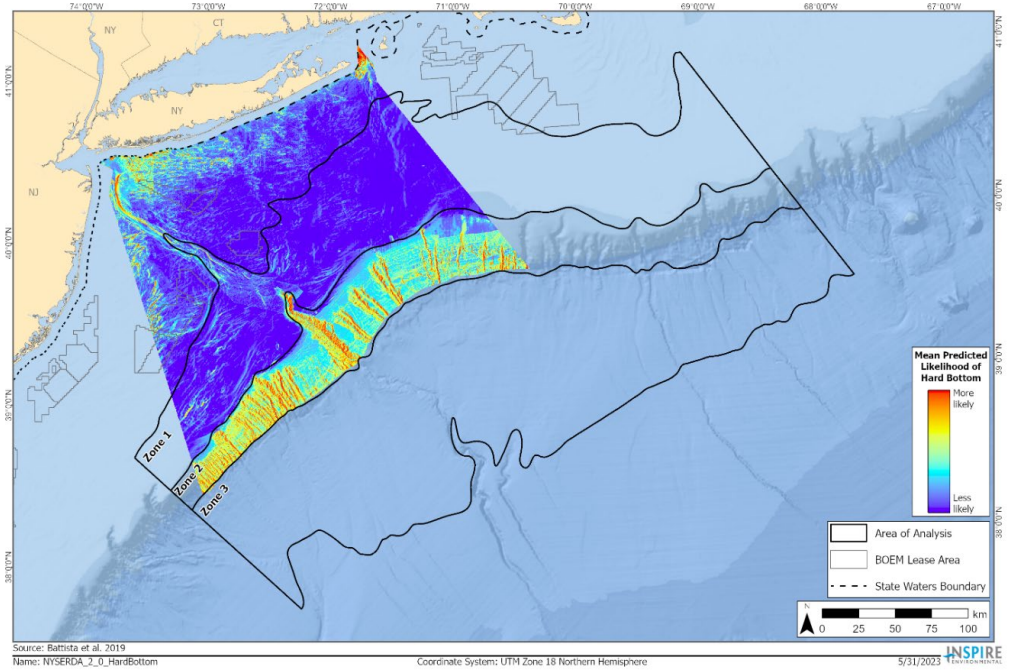




3 Key results

- Physical Habitat Data
  - **Sediments and hard bottom**
  - TNC's (2020) dataset showed the outer continental shelf is primarily sandy with patchy distributions of gravel and mud in some locations.
  - The continental slope marks a transition from predominant sand to predominant mud, and offshore of the slope, muds dominant the deep abyssal plain.
  - Patchy areas of gravel are generally associated with the Hudson Canyon and Hudson Shelf Valley and areas with higher rugosity, particularly along the continental slope.
  - Hard bottom habitat is found largely in Zone 2, where canyons incise the slope. However, areas of hard bottom can be difficult to detect in regional analyses.



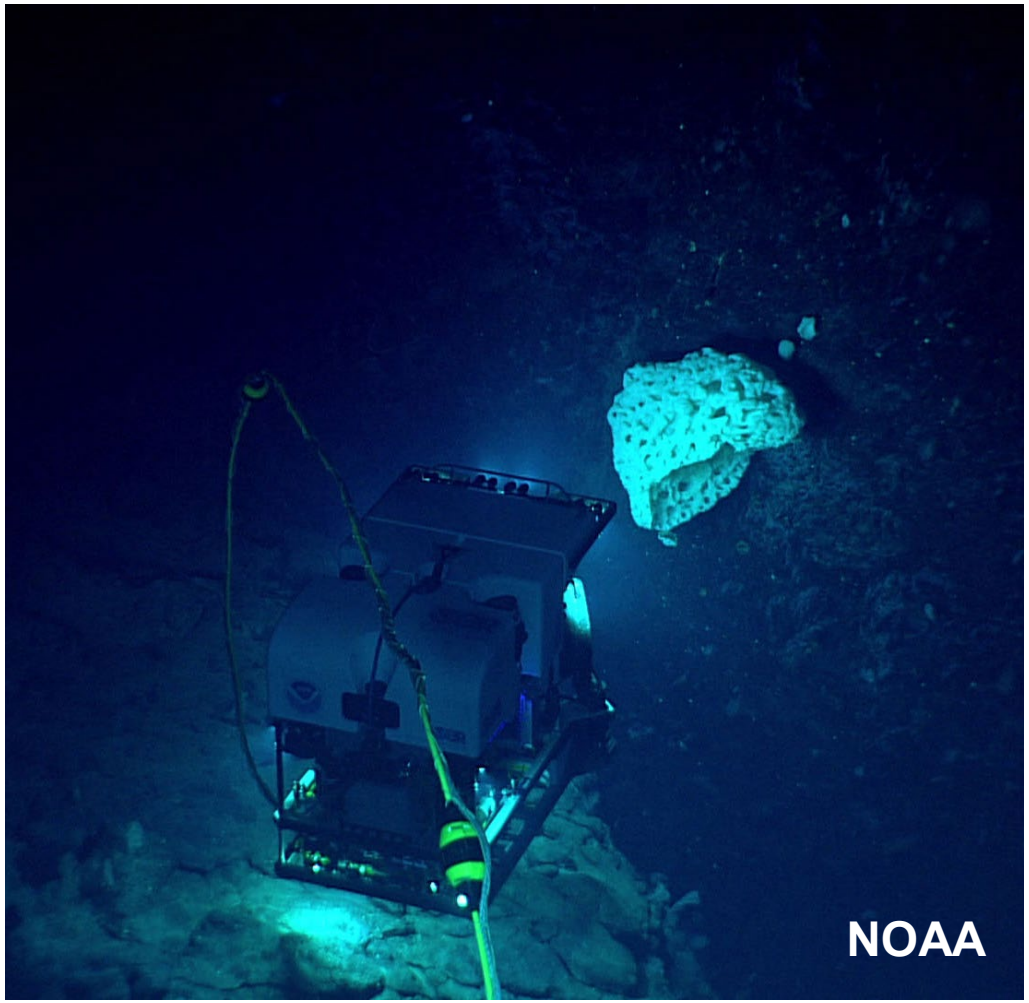


4 Knowledge and data gaps

- Biological Data Gaps
  - Our understanding of most biological processes diminishes offshore and within deeper waters.
    - Generally, an incomplete understanding of species distributions within the AoA, however, most occurrences are concentrated in Zone 2.
    - We have an incomplete of taxonomic information for many deep-sea species and we do not understand genetic connectivity patterns for most species and regions.
    - Environmental characterization in many locations is also lacking, leading to poor understanding of species responses to natural environmental variability and anthropogenic change.
- Physical Habitat Data Gaps
  - Comprehensive and high-resolution data on seafloor structure and composition is paramount to proper siting for offshore energy development and protection of biological resources and ecosystem services.
    - While regional scale bathymetric information exists, higher resolution products (including derived backscatter metrics) are generally lacking from public access.
    - Standardized terminology is lacking for geomorphological characterization.
    - Sediment and seabed form data are available but lack high precision. Quantitative hard bottom likelihood data are limited to only a portion of the AoA.

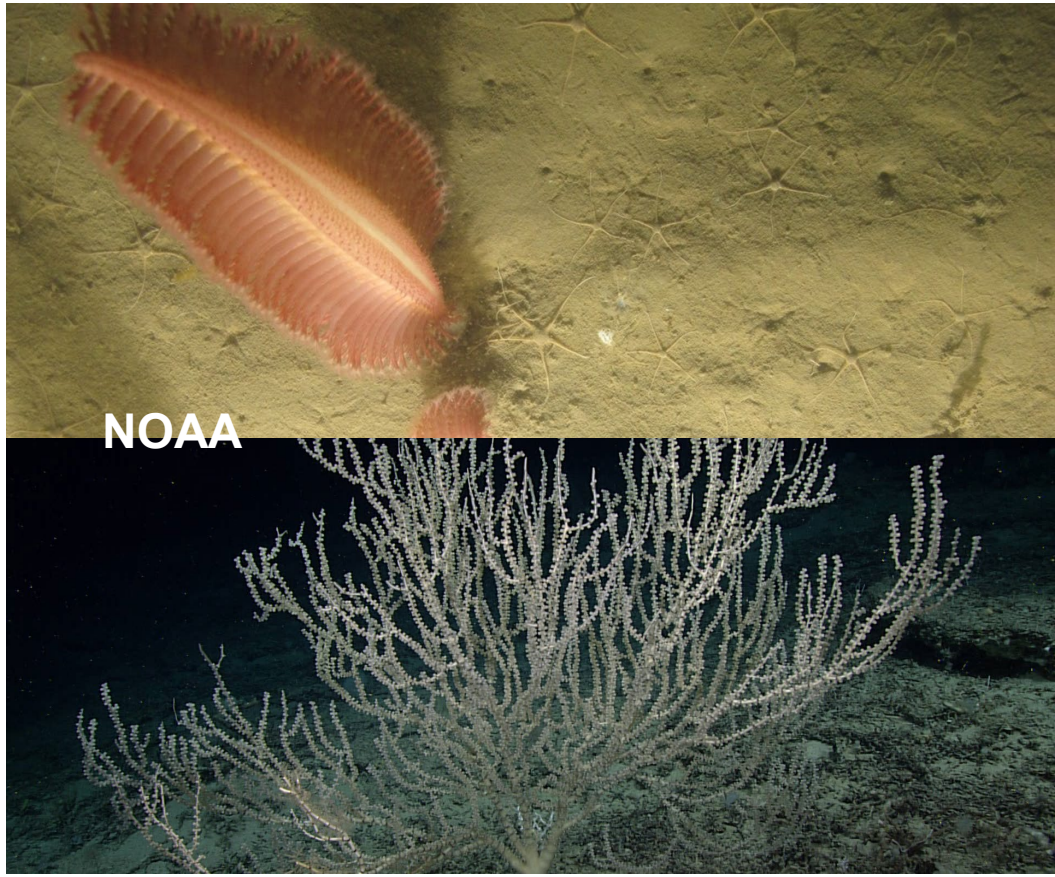
5 Future considerations

- Improve understanding of the distribution of benthic species and physical habitat within the AoA, particularly for zones 1 and 3 and develop finer scale habitat maps for zone 2.
- Establish environmental and ecological baselines for benthic receptor groups in areas where activities may be conducted. Particularly in Zone 2 where the highest abundances of receptors are found.
- Explore experimental assessment of the response of benthic receptors at different life stages. Particularly addressing little known impacts such as sound, changes in water quality, atmospheric and current dynamics, and EMF.
- Explore the implications of changing climate on cumulative impacts from OSW energy development, if any.
- Conduct sustained monitoring to establish ongoing ecosystem impacts, if any.



6 Main comment themes received to date

- Include more detailed information about stressors such as:
  - Cable protection/armoring.
  - Removal and relocation of boulders.
  - HVDC – larval entrainment and discharge of heated water.
  - Construction noise.
  - Pre-construction survey and site preparation impacts.
- Explore potential indirect and direct impacts to EFH and fish communities.
- Several comments requesting removal of spatial locations such as designated protection areas from consideration in the AoA.



Breakout Groups 35 min

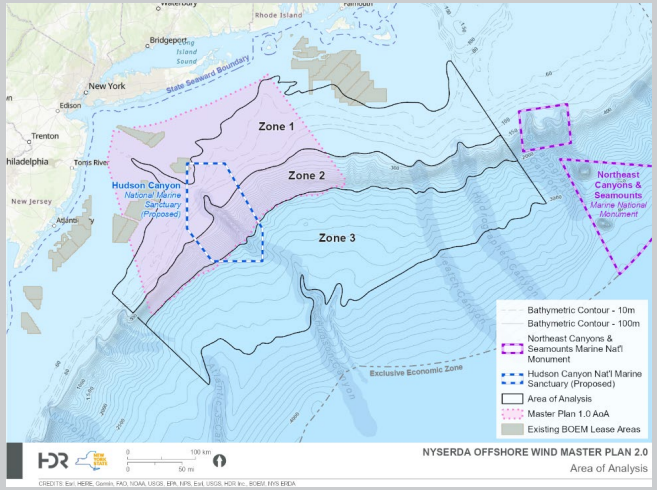
Topics for discussion

- **Completeness**
  - *What information/data is available that wasn't included?*
- **Key data gaps and information needs**
  - *What gaps should be filled in the future and/or taken into consideration in interpreting results?*
- **Geographic areas of particularly high risk**
- **Key messages for NYSERDA**

In person: Please take a handout
Virtual: Please use virtual board (link in chat) for brainstorming – will keep open until Sept 15

©Gatis Marcinkevics

© Anastasia Taioglou



Environmental Sensitivity Analysis Study

AGENDA

1 Background & Literature Review

2 Spatial ES Analysis Framework

3 Data Sets and Processing

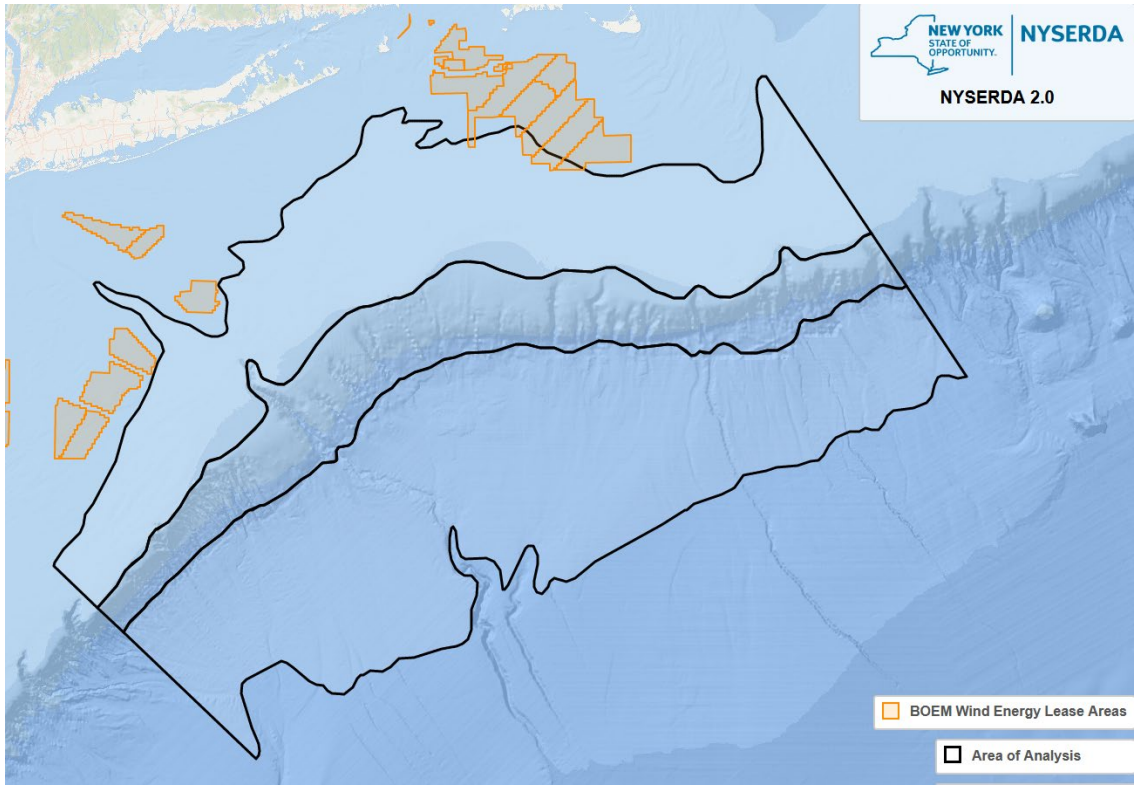
4 Weighting & Overlay Methodology

5 Data Gaps

6 Results

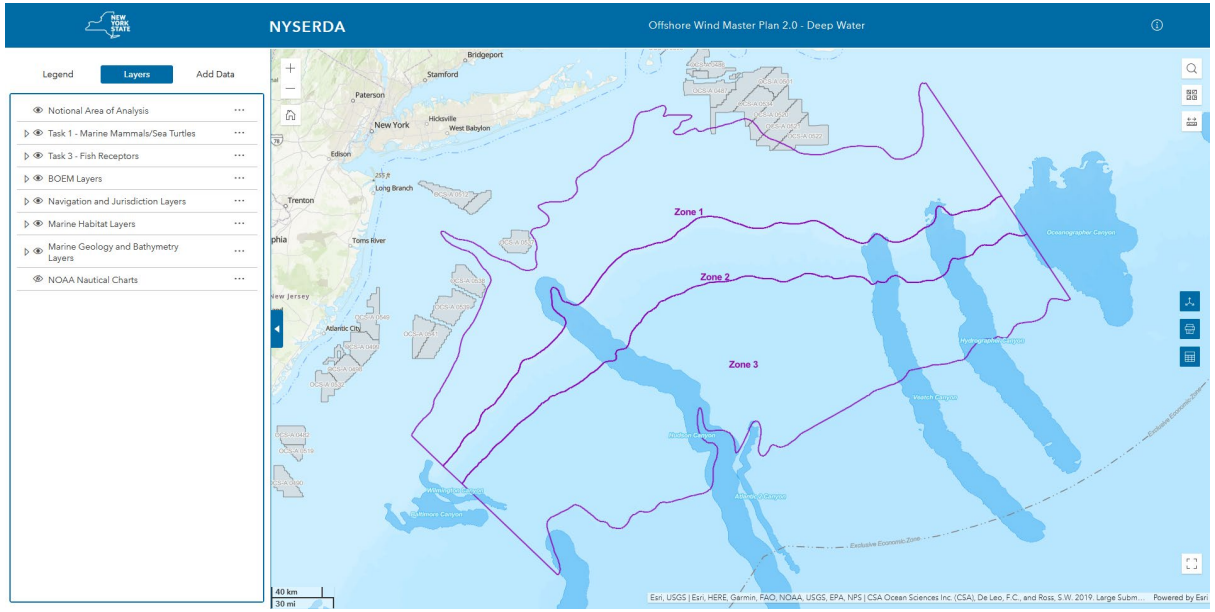
General Methods (March 2023)

- Review stressors, risk weighting, and overall methodology in Master Plan (2017) and other relevant risk assessment models
- Develop a model to incorporate the temporal and spatial risks identified in the individual studies on the marine resources from potential stressors and the level of risk associated with the stressors on a particular receptor during each phase of OSW development
- Provide geographic depictions of relative high and low areas of potential conflict for OSW development and associated stressors with respect to biota



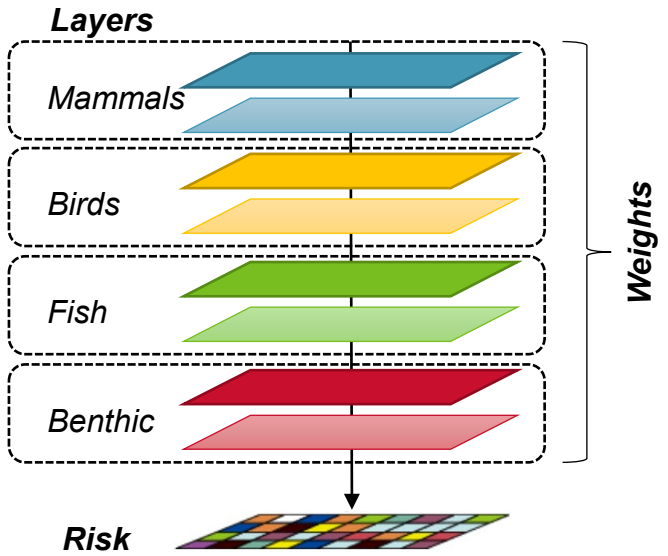
Literature Review

- Reviewed overall methodology in similar risk assessment models:
  - NYSERDA Master Plan 1.0
  - NJ Offshore Wind Strategic Plan
  - NCCOS Central Atlantic Wind Energy
  - NCCOS Gulf of Mexico
  - Gulf of Maine (Birds)
  - Primary academic literature
- Spatial Multi-Criteria Decision Analysis
- Typically, follow a common workflow, but details of each step may differ



Spatial Environmental Sensitivity Analysis

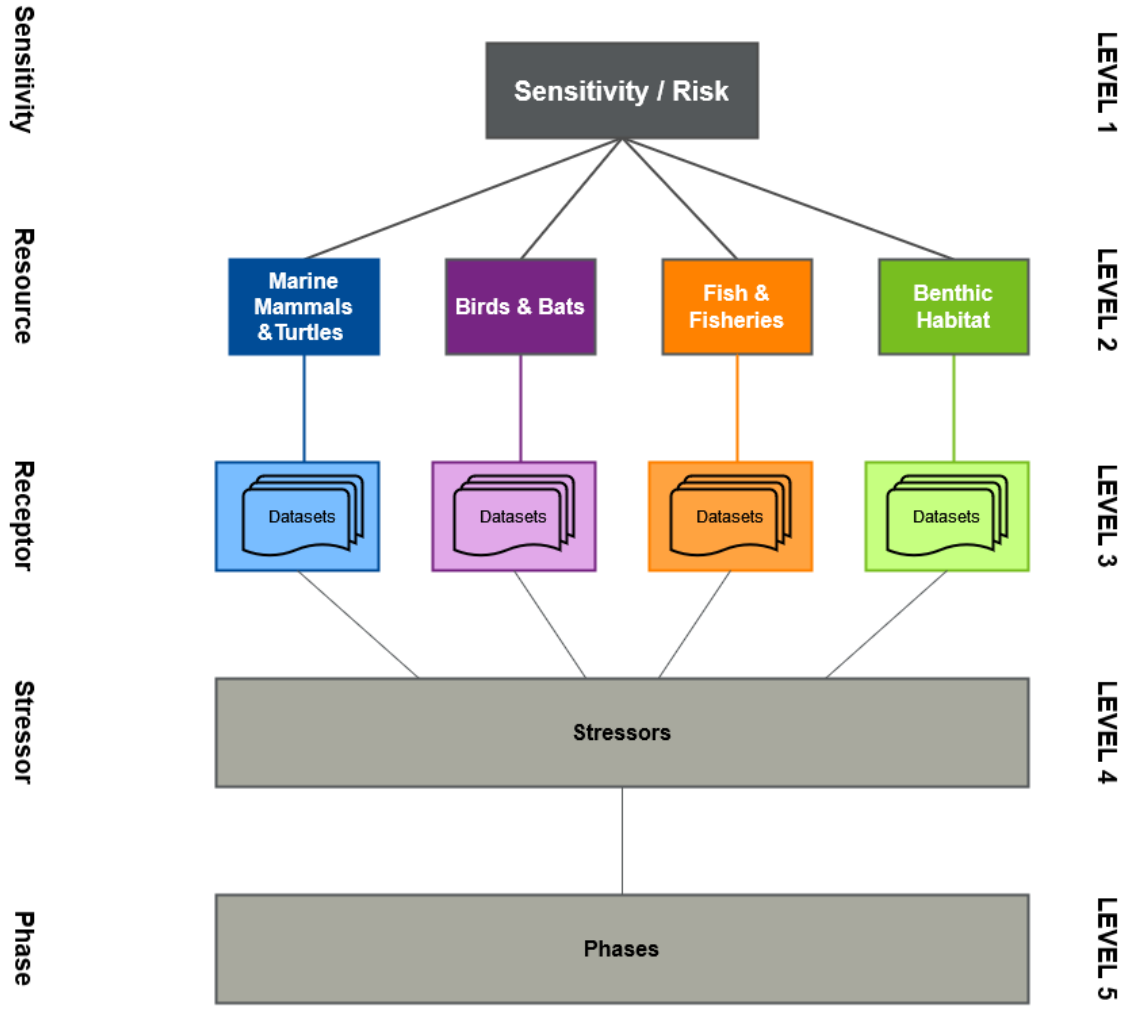
1. Framework: Establish an overall conceptual framework
    1. What is scope, intended use/audience etc.
    2. Define an Area of Analysis (spatial)
    3. What Input Data to include/exclude
    4. Sub-models / pre-processing (groupings, classes etc.)
2. Goal: Define the “goal” or metric (“Risk” or “Suitability”)
    1. Risk $\propto$ Suitability^{-1} (High Risk $\Leftrightarrow$ Low Suitability)
3. Data: Obtain and Evaluate Input Data
    1. Identify individual components
    2. How/if to group components
    3. Address Data Gaps, Uncertainty
4. Rescale: Rescale Input Data to common scale
5. Weight: How/if layers will be differentially weighted
6. Combine: Define how layers will be combined to overall score

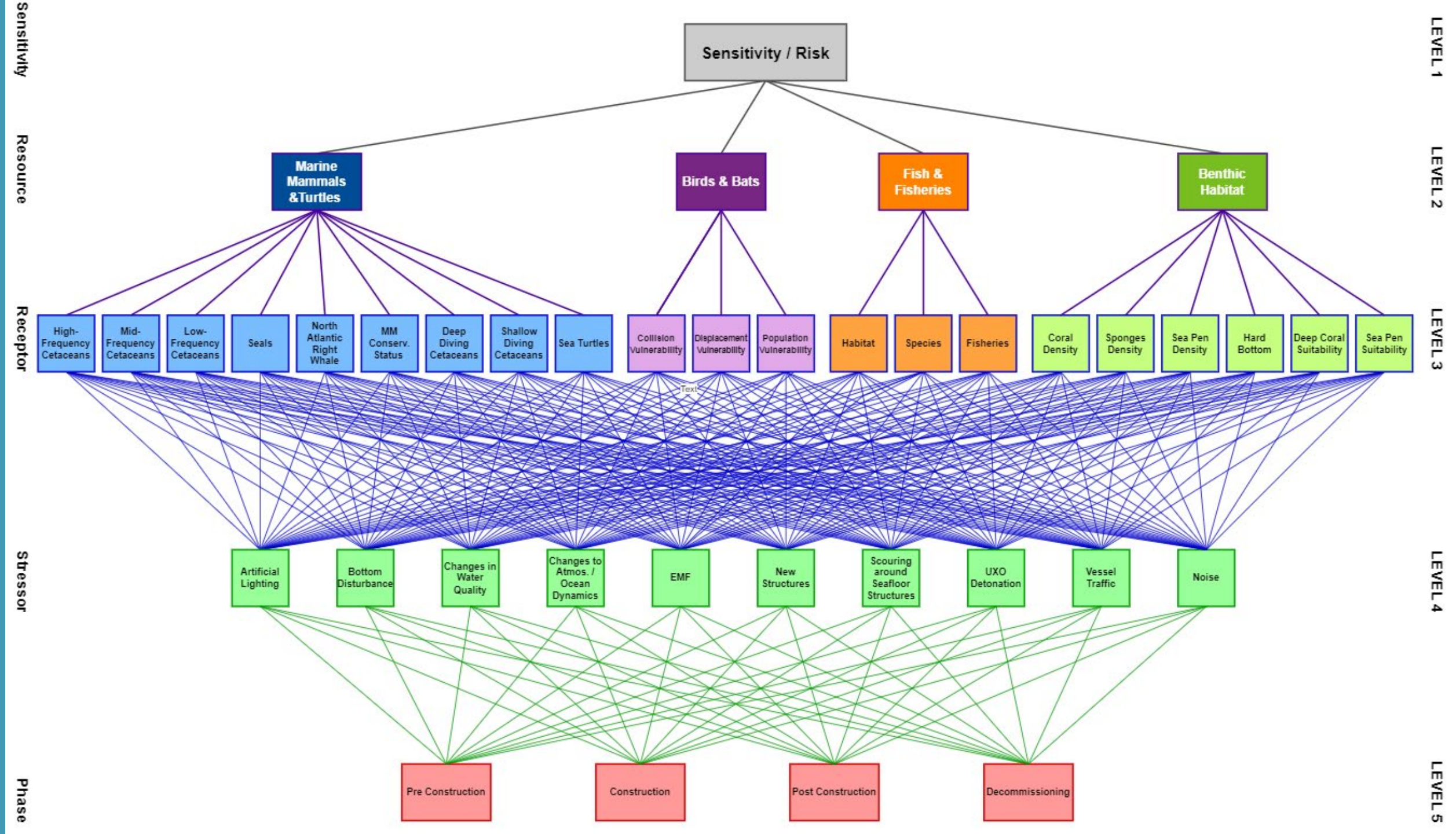


Framework

Subdivided into 5 Organizational Levels:

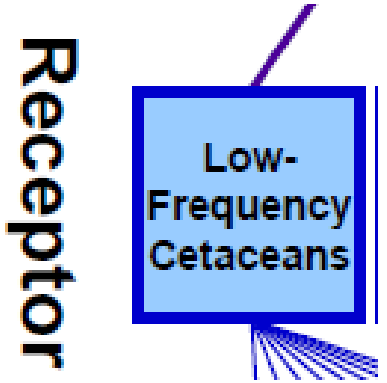
- Overall Sensitivity:
  - Relative environmental sensitivity on a common scale (e.g. 0 to 1 or High/Med/Low)
- Resources
  - Four primary marine resource groups
- Receptors:
  - An individual or group of like individuals that could be stressed by OSW development. *These are our data!*
- Stressors:
  - For any receptor, what are the possible stressors that could impact it
- Phase
  - Relative prevalence of each stressor during OSW Phases

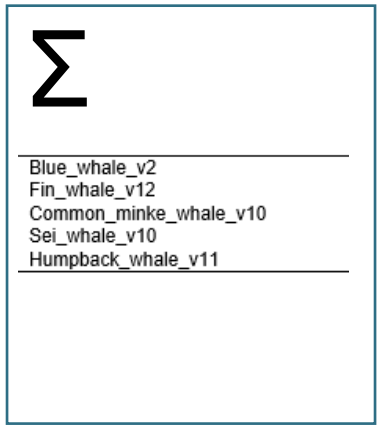



Sensitivity / Risk
Marine Mammals &Turtles
Birds & Bats
Fish & Fisheries
Benthic Habitat
High-Frequency Cetaceans
Mid-Frequency Cetaceans
Low-Frequency Cetaceans
Seals
North Atlantic Right Whale
MM Conserv. Status
Deep Diving Cetaceans
Shallow Diving Cetaceans
Sea Turtles
Collision Vulnerability
Displacement Vulnerability
Population Vulnerability
Habitat
Species
Fisheries
Coral Density
Sponges Density
Sea Pen Density
Hard Bottom
Deep Coral Suitability
Sea Pen Suitability
Artificial Lighting
Bottom Disturbance
Changes in Water Quality
Changes to Atmos. / Ocean Dynamics
EMF
New Structures
Scouring around Seafloor Structures
UXO Detonation
Vessel Traffic
Noise
Pre Construction
Construction
Post Construction
Decommissioning
Sensitivity
Resource
Receptor
Stressor
Phase
LEVEL 1
LEVEL 2
LEVEL 3
LEVEL 4
LEVEL 5

Data

- Identify source data layers
- Individual Study Leads and SMEs identify the datasets to be incorporated into the SA
- Not all data evaluated and reviewed from studies necessarily must be included in SA
- Candidate datasets should be:
  - Spatial
  - Represent some quantity that correlates with “sensitivity” (positively or negatively)
  - Identify areas with gaps
- Decide how/if individual receptors should be:
  - Grouped/split (e.g., Hearing Groups)
  - Aggregated (e.g., across time)
  - Pre-processed
- 21 Receptor Datasets in total
  - 9 Marine Mammal & Sea Turtles
  - 3 Birds & Bats
  - 3 Fish & Fisheries
  - 6 Benthic Habitat

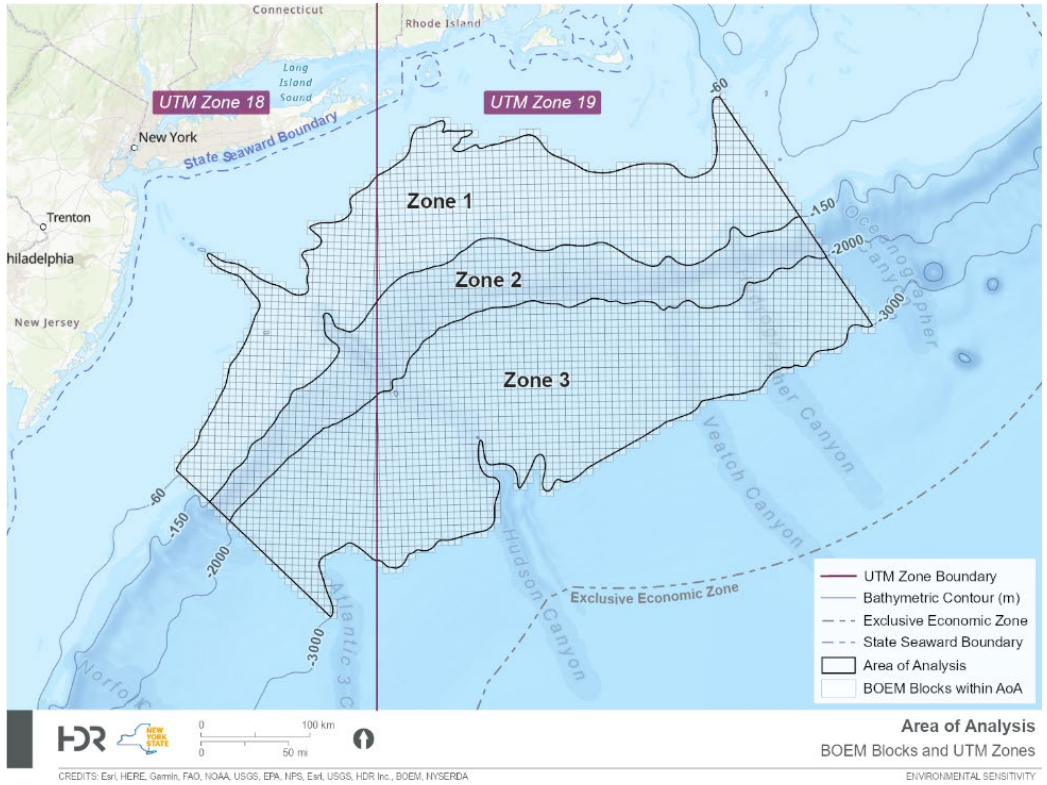


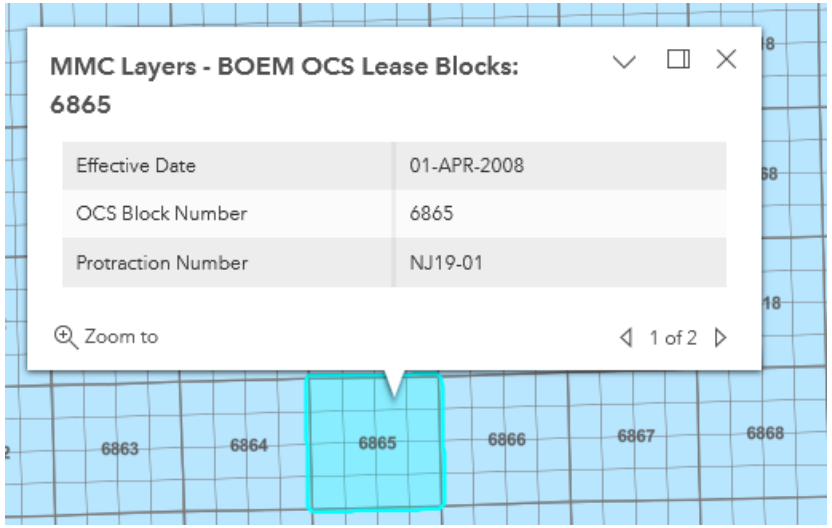


Resource Group	Receptor	Species Members/Description	Source(s)	Processing Summary	Notes
Marine Mammals & Turtles	High Frequency Cetaceans	Harbor porpoise, dwarf and pygmy sperm whales	Curtice et al. 2019;	Sum of predicted abundance per 100 km^2 grid	
	Mid-Frequency Cetaceans	Sperm whales, beaked whales, dolphins: common dolphin, Killer whale, Northern bottlenose whale, Pygmy killer whale, false killer whale, Melon-headed whale, Risso's, Atlantic white-sided dolphin, white-beaked, Atlantic spotted dolphin, Pantropical spotted dolphin, striped dolphin, Fraser's dolphin, Rough-toothed, Clymene dolphin, spinner dolphin			
	Low-Frequency Cetaceans	Baleen whales -blue, sei, minke, fin, humpback			
	Seals	Harbor, gray, hooded, and harp seals			
	North Atlantic Right Whale (NARW)	North Atlantic right whale			Critically Endangered
	Other Marine Mammals of Special Conservatio	ESA-listed cetaceans (fin, sei, blue, sperm whales) and any marine mammals under UME designation (humpback whales, gray and harbor seals, minke whales)			
	Deep-Diving Cetaceans	Sperm whale, pygmy and dwarf sperm whale, beaked whales, pilot whales (both species), Northern bottlenose whale			Shallow versus deep diving cetaceans were defined as Coastal (<200 m depth) and Oceanic (>200 m depth). Source: Table 12 from https://www.federalregister.gov/documents/2021/10/21/2021-22858/takes-of-marine-mammals-incidental-to-specified-activities-taking-marine-mammals-incidental-to
	Shallow-Diving Cetaceans	Dolphins not listed in "Deep-Diving Cetaceans," harbor porpoise, baleen whales (except NARW), common dolphin, Killer whale, Pygmy killer whale, false killer whale, Melon-headed whale, Risso's, Atlantic white-sided dolphin, white-beaked, Atlantic spotted dolphin, Pantropical spotted dolphin, striped dolphin, Fraser's dolphin, Rough-toothed, Clymene dolphin, spinner dolphin			
	Sea Turtles	Green Sea Turtle, Kemp's Ridley Sea Turtle, Leatherback Sea Turtle, Loggerhead Sea Turtle	DiMatteo, Andrew D. and Sparks, Laura M. 2023; DiMatteo, Andrew D. et al. 2023		

Rescale

- Rescale input data sets to a common spatial scale (location and geometry)
- BOEM Lease Block
  - Block = 4x4 grid of aliquots
  - Full coverage of AoA
  - 4,300 blocks in AoA
- Area weighted average



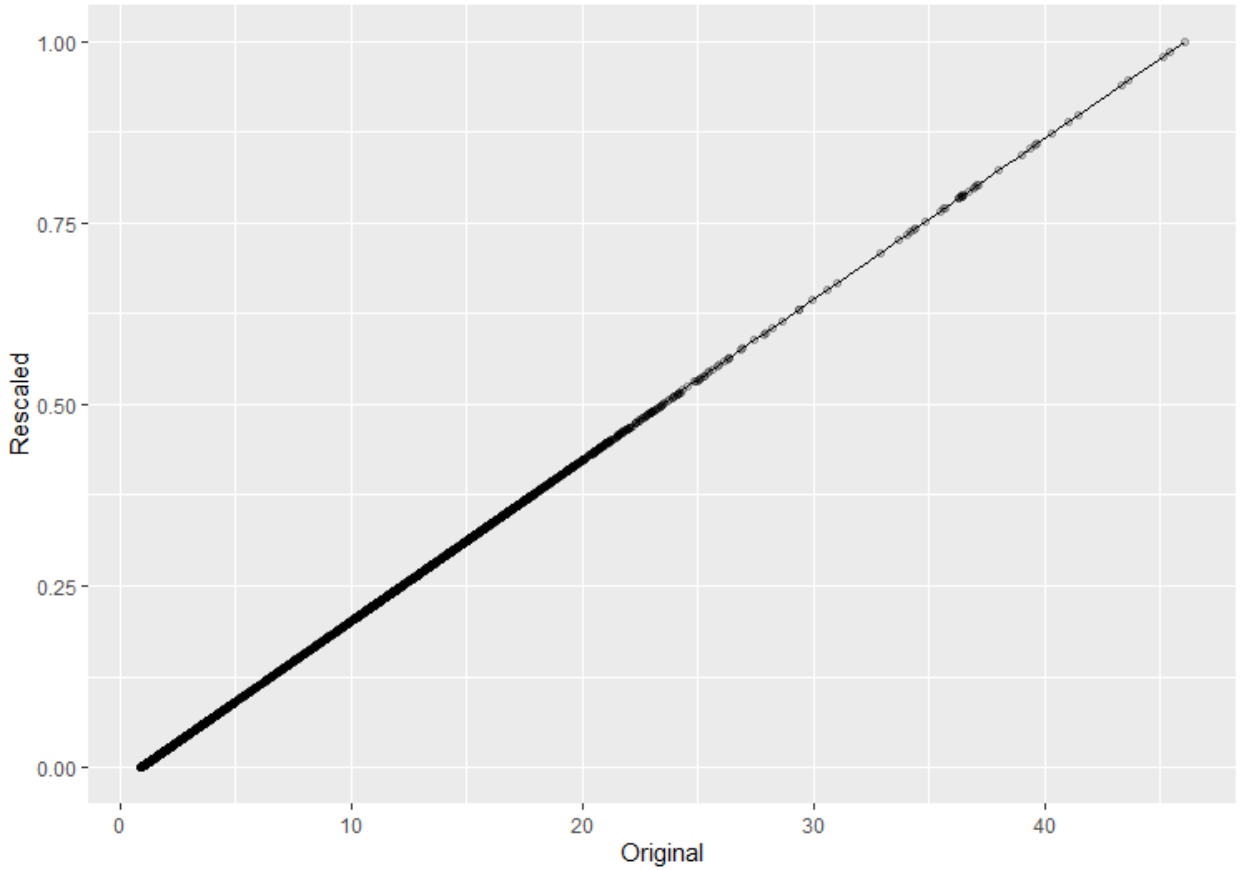


Rescale

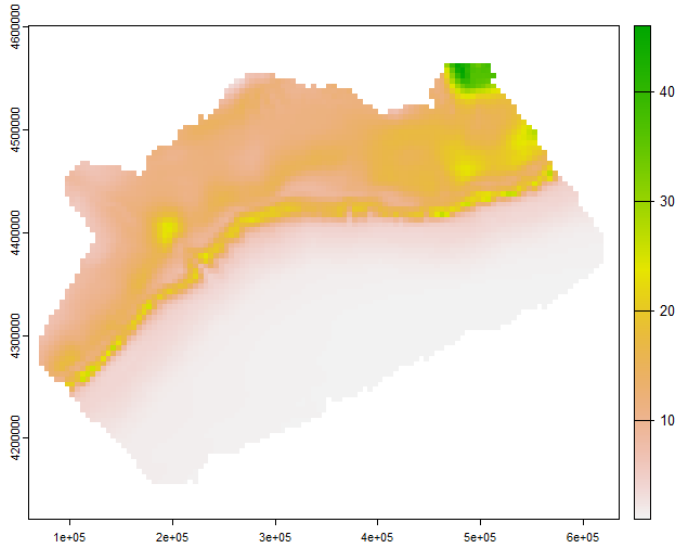
- Rescale input data sets (receptors) to a common “sensitivity” scale
- Necessary to combine data in an “apples:apples” way
- Common practice in multivariate statistics / data science
- Data rescaled on a continuous 0-1 scale (Low Sensitivity – High Sensitivity) using linear rescale function

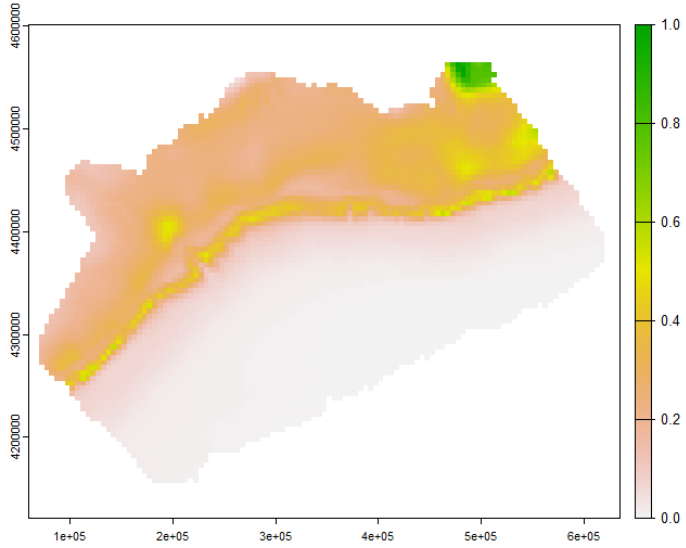
$$V_i' = \frac{v_i - \min(v)}{max(v) - \min(v)}$$

$$V' \in [0,1]$$

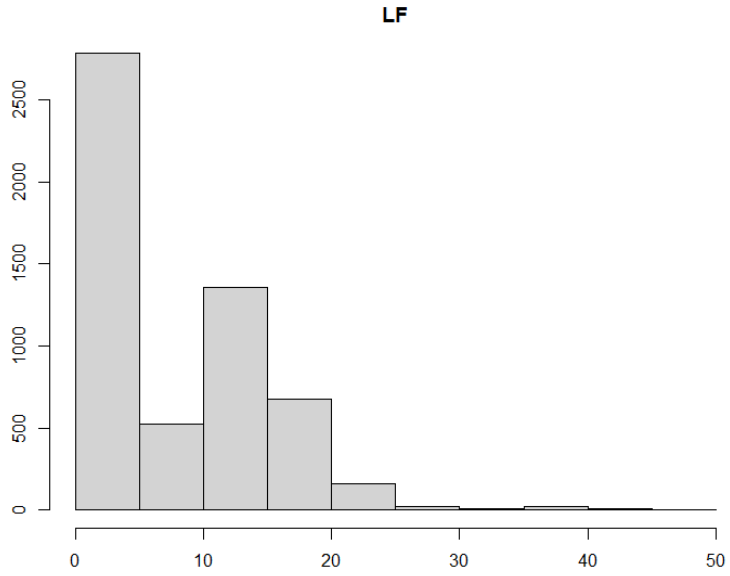


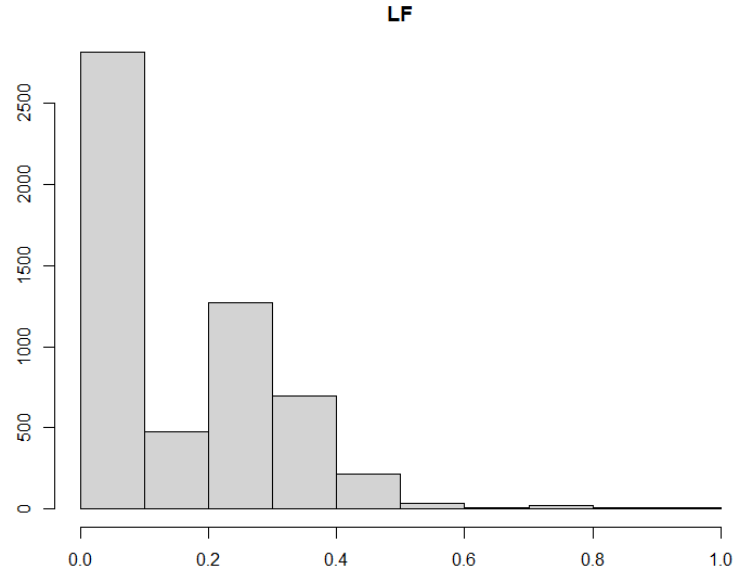
Rescale





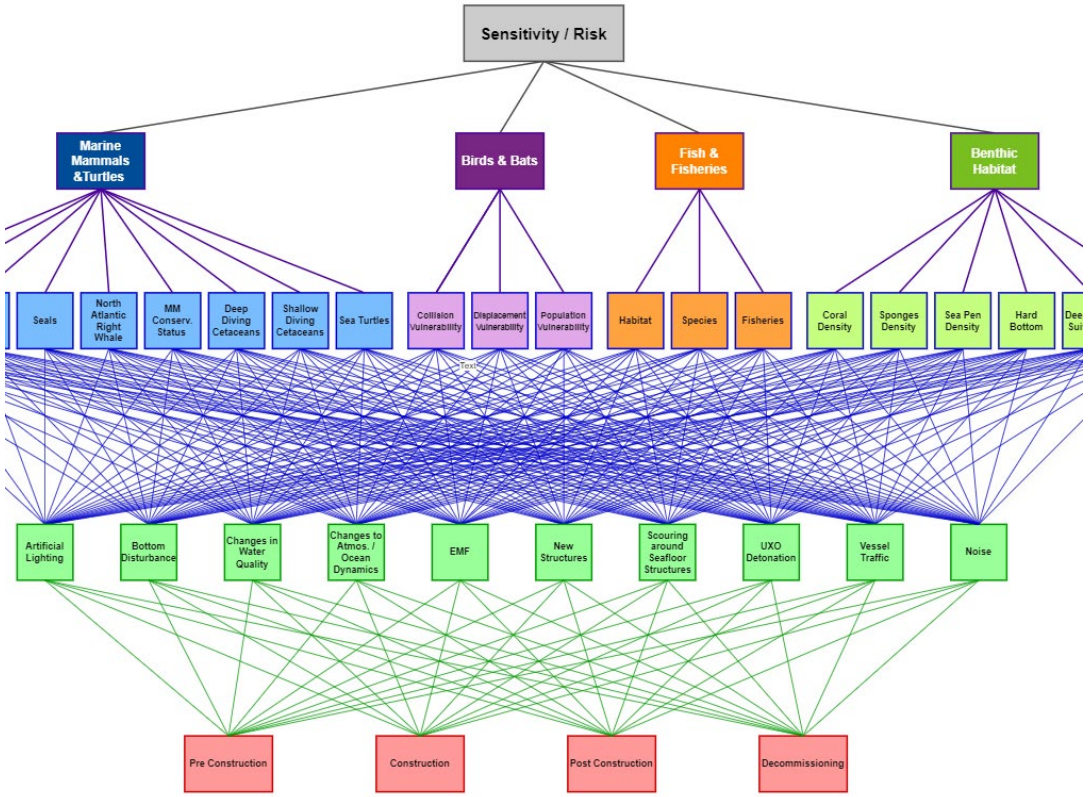
Original → Rescaled





Weighting

- Define Weightings
- How to determine weights?
- Weights are inherently **subjective**
- Analytic Hierarchy Process:
  - Expert elicitation
  - Series of SME questionnaire's that make pairwise comparisons between things
  - Used to calculate the Weights
  - Operations Research / Decision Theory



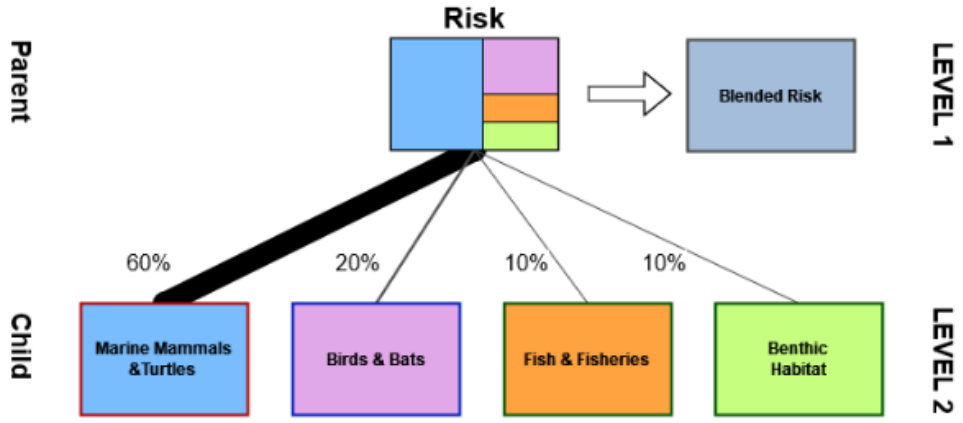
Mathl Modelling, Vol. 9, No. 3–5, pp. 161–176, 1987
Printed in Great Britain. All rights reserved

0270-0255/87 $3.00 + 0.00
Copyright © 1987 Pergamon Journals Ltd

THE ANALYTIC HIERARCHY PROCESS—WHAT IT IS AND HOW IT IS USED

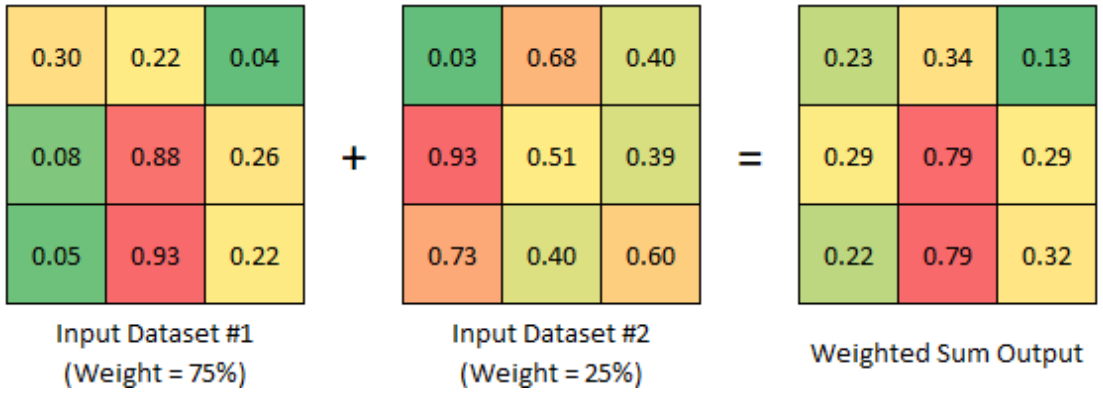
R. W. SAATY
4922 Ellsworth Avenue, Pittsburgh, PA 15213, U.S.A.

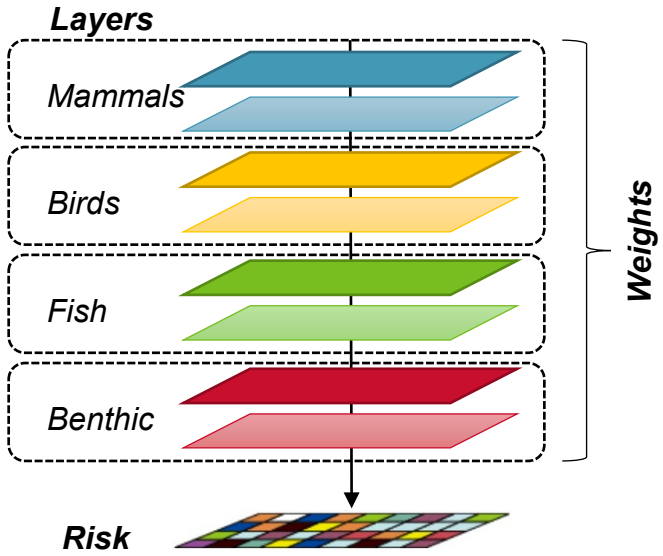
Abstract—Here we introduce the Analytic Hierarchy Process as a method of measurement with ratio scales and illustrate it with two examples. We then give the axioms and some of the central theoretical underpinnings of the theory. Finally, we discuss some of the ideas relating to this process and its ramifications. In this paper we give special emphasis to departure from consistency and its measurement and to the use of absolute and relative measurement, providing examples and justification for rank preservation and reversal in relative measurement.



Combine

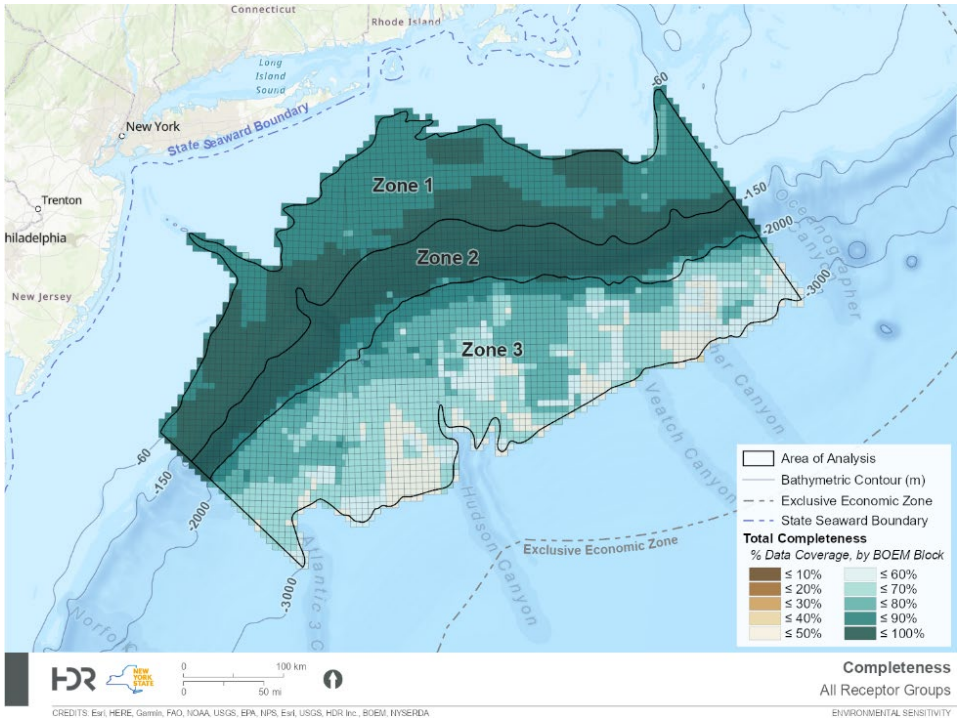
- Each data layer has been:
  - Rescaled
  - Mapped to BOEM blocks
  - Weights computed
- Weighted Sum Overlay





Data Gaps

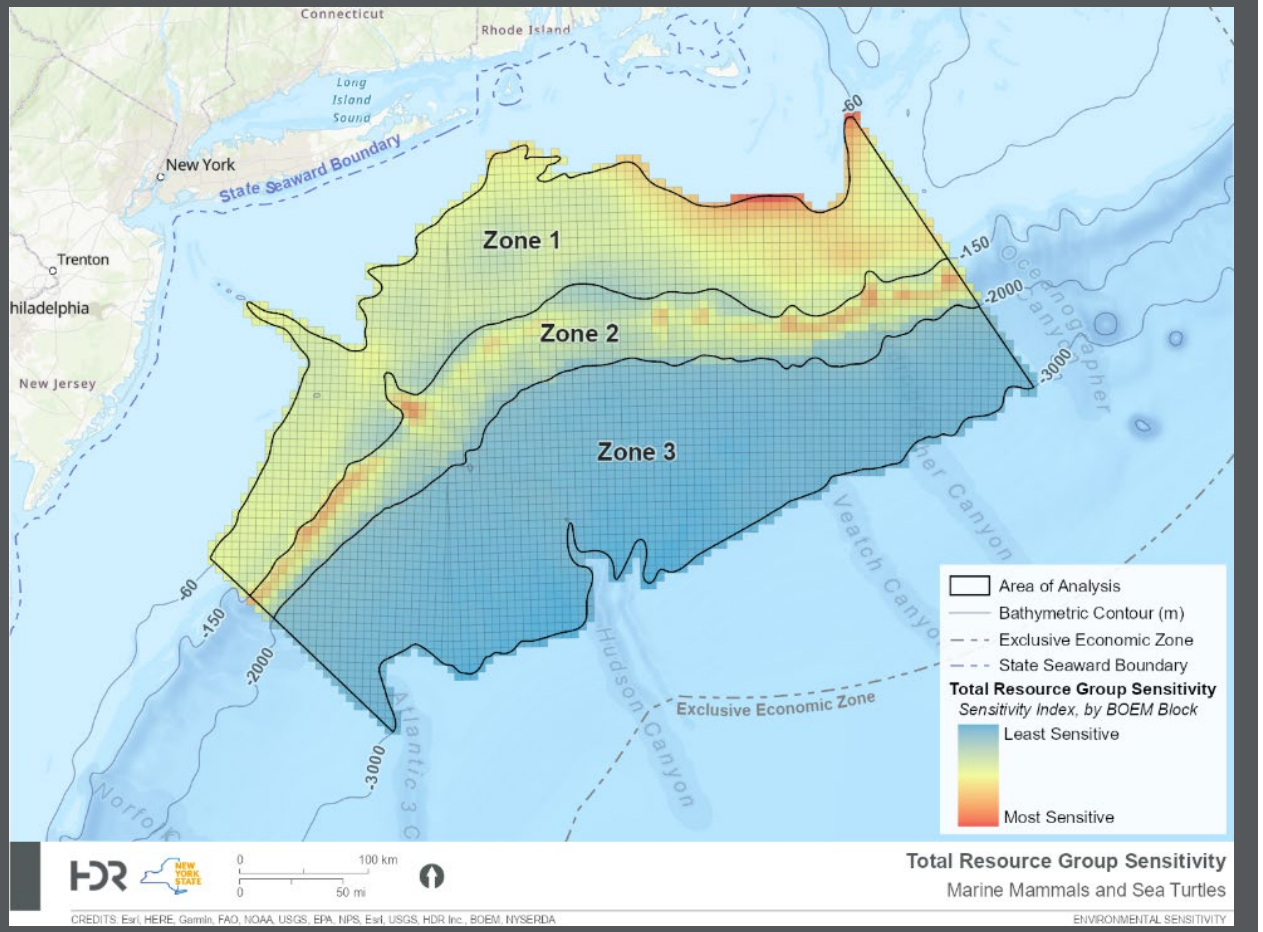
- Define and quantify Uncertainty based on 2 components:
  - **Completeness**: % of the AoA that has data for a particular receptor
  - **Confidence**: Degree to which data accurately reflect the receptor
- Individual study reports address and discuss data availability and confidence
- Important to interpret sensitivity results in context of data gaps

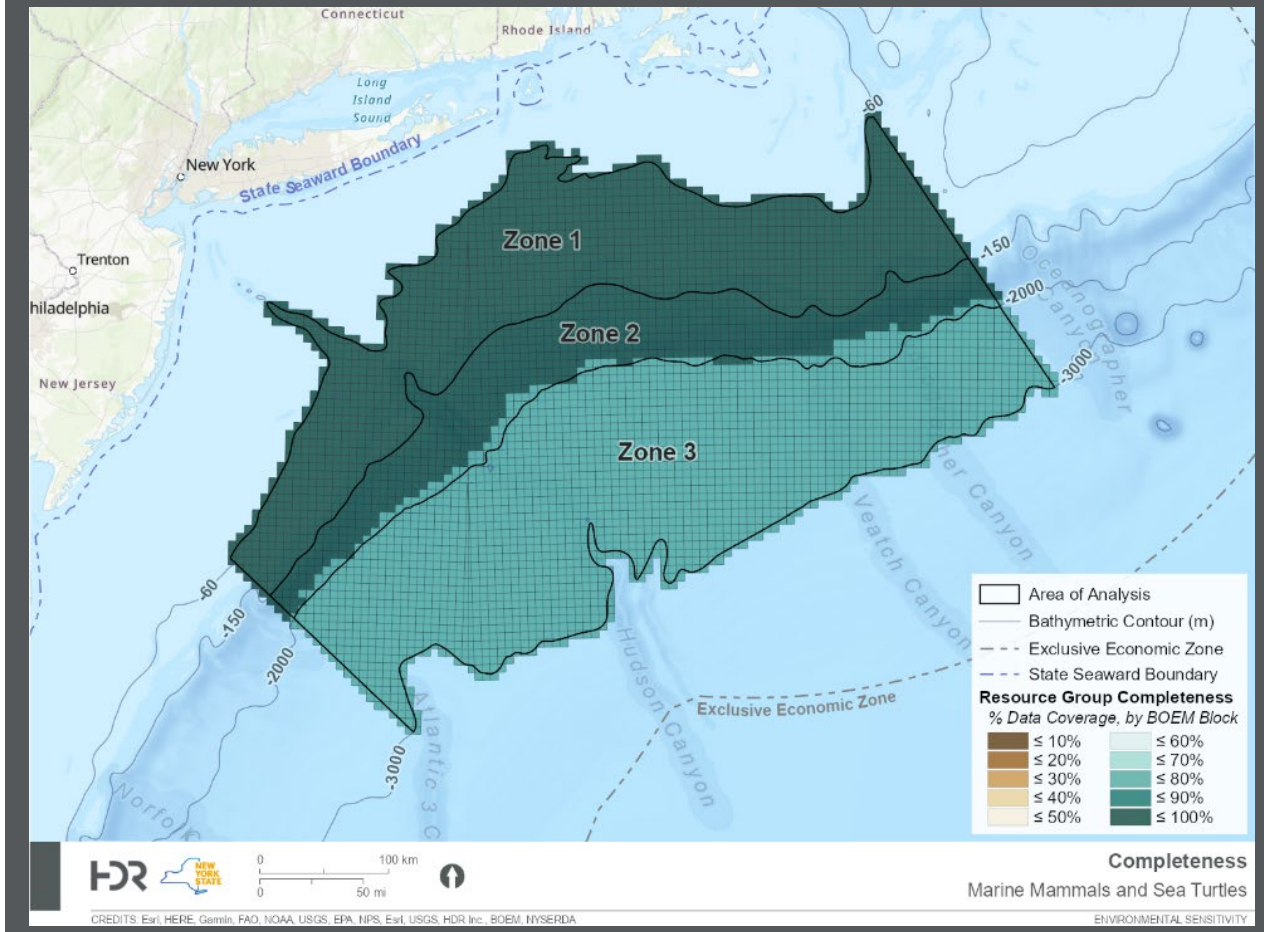


Resource	Receptor	Zone 1	Zone 2	Zone 3	Total	Average by Resource
Marine Mammals & Turtles	Deep-Diving Cetaceans	100%	100%	100%	100%	89%
	High-Frequency Cetaceans	100%	77%	0%	51%	
	Low-Frequency Cetaceans	100%	100%	100%	100%	
	Mid-Frequency Cetaceans	100%	100%	100%	100%	
	Marine Mammals Conservation Status	100%	100%	100%	100%	
	North Atlantic Right Whale	100%	100%	100%	100%	
	Shallow-Diving Cetaceans	100%	77%	0%	51%	
	Seals	100%	100%	100%	100%	
	Turtles	100%	100%	100%	100%	
Birds & Bats	Collision Vulnerability	100%	99%	79%	90%	90%
	Displacement Vulnerability	100%	99%	79%	90%	
	Population Vulnerability	100%	99%	79%	90%	
Fish & Fisheries	Fisheries	93%	49%	26%	55%	68%
	Habitat	100%	100%	100%	100%	
	Species	100%	70%	0%	49%	
Benthic	Coral Density	41%	99%	67%	63%	62%
	Deep Coral Suitability	29%	95%	8%	31%	
	Hard Bottom	100%	100%	99%	100%	
	Sea Pen Density	62%	98%	47%	62%	
	Sea Pen Suitability	100%	100%	42%	74%	
	Sponge Density	46%	85%	22%	42%	

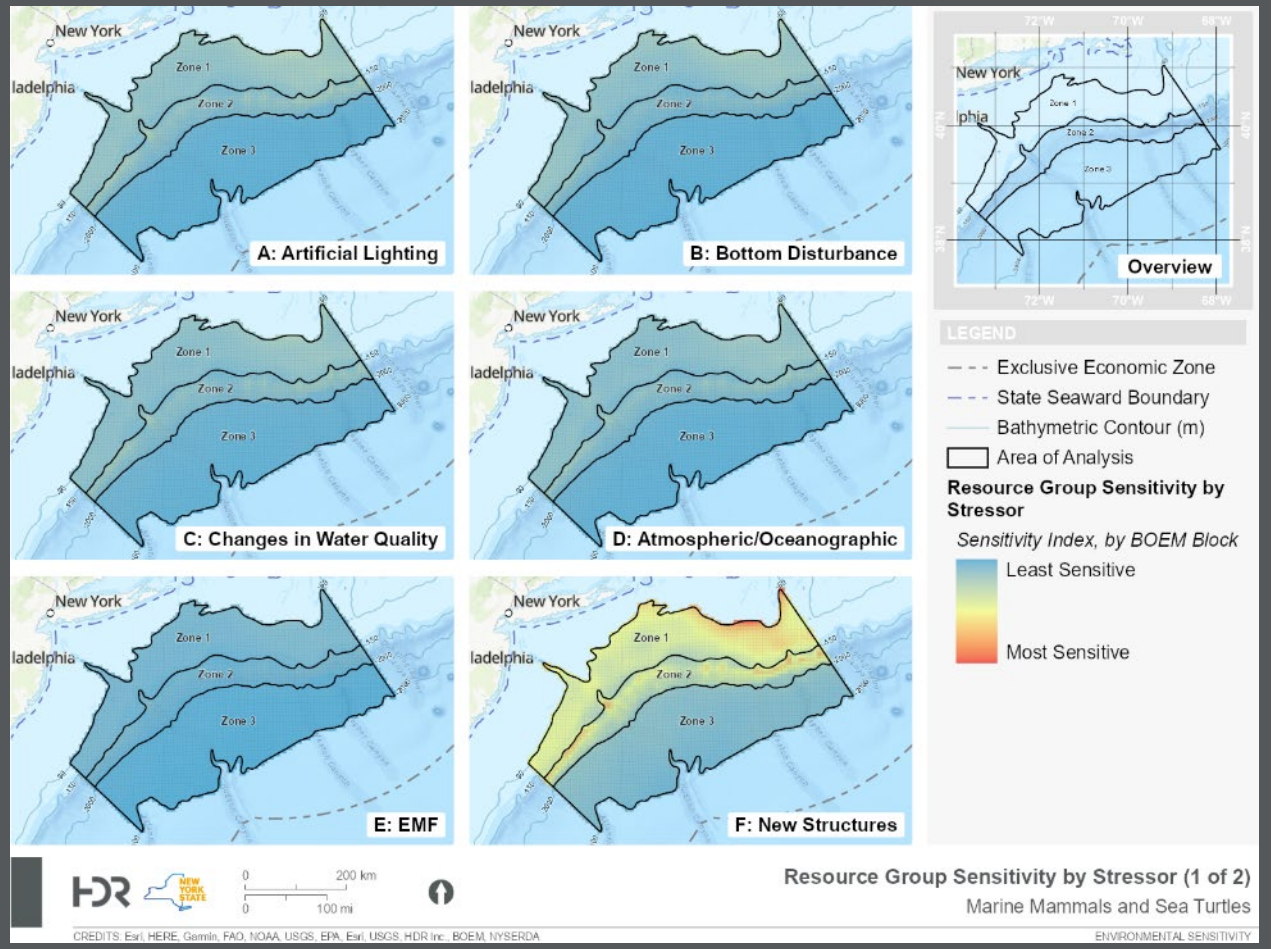
Results

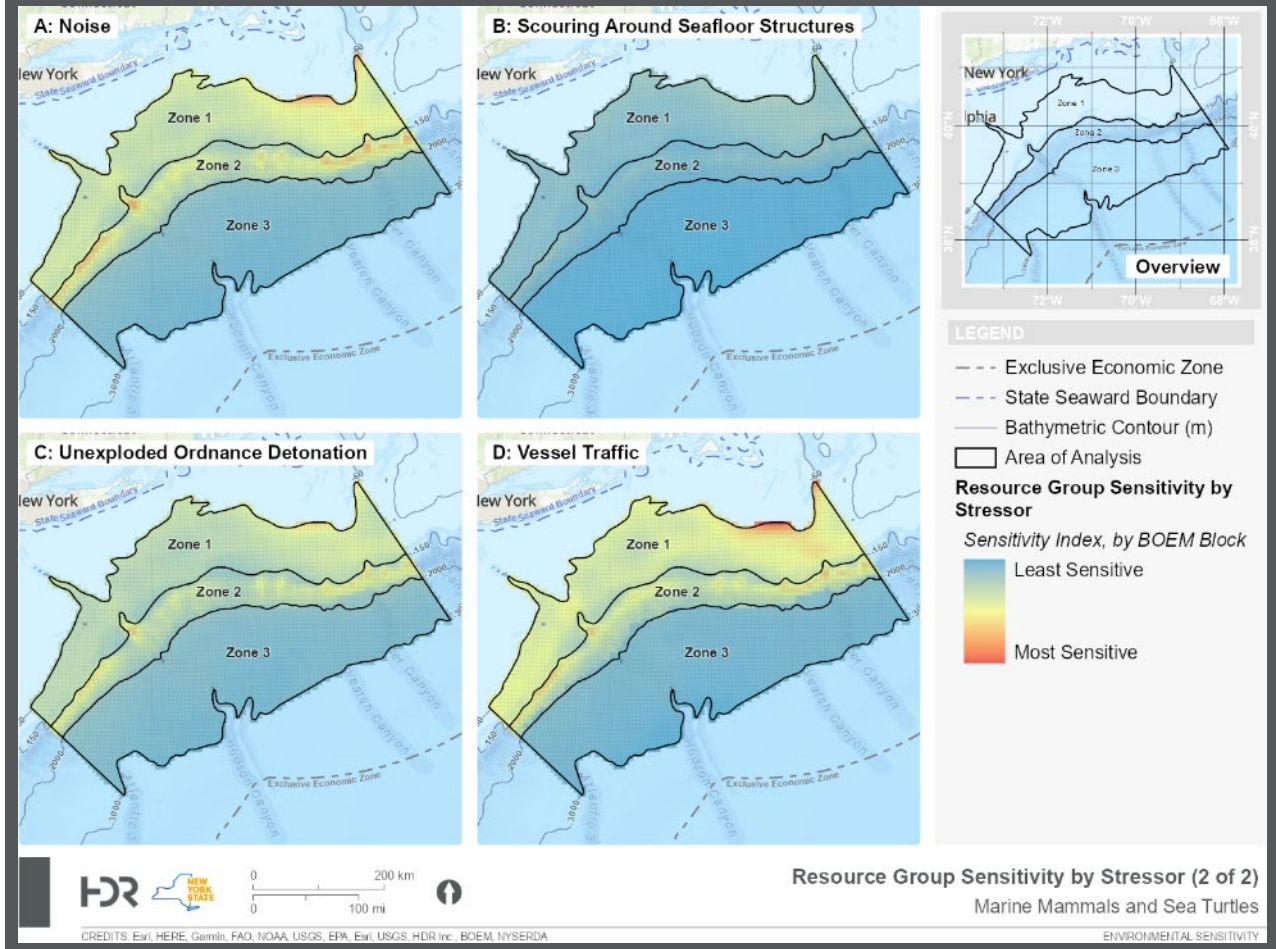
Sensitivity Results: Marine Mammals & Sea Turtles
Overall Sensitivity and Data Gaps



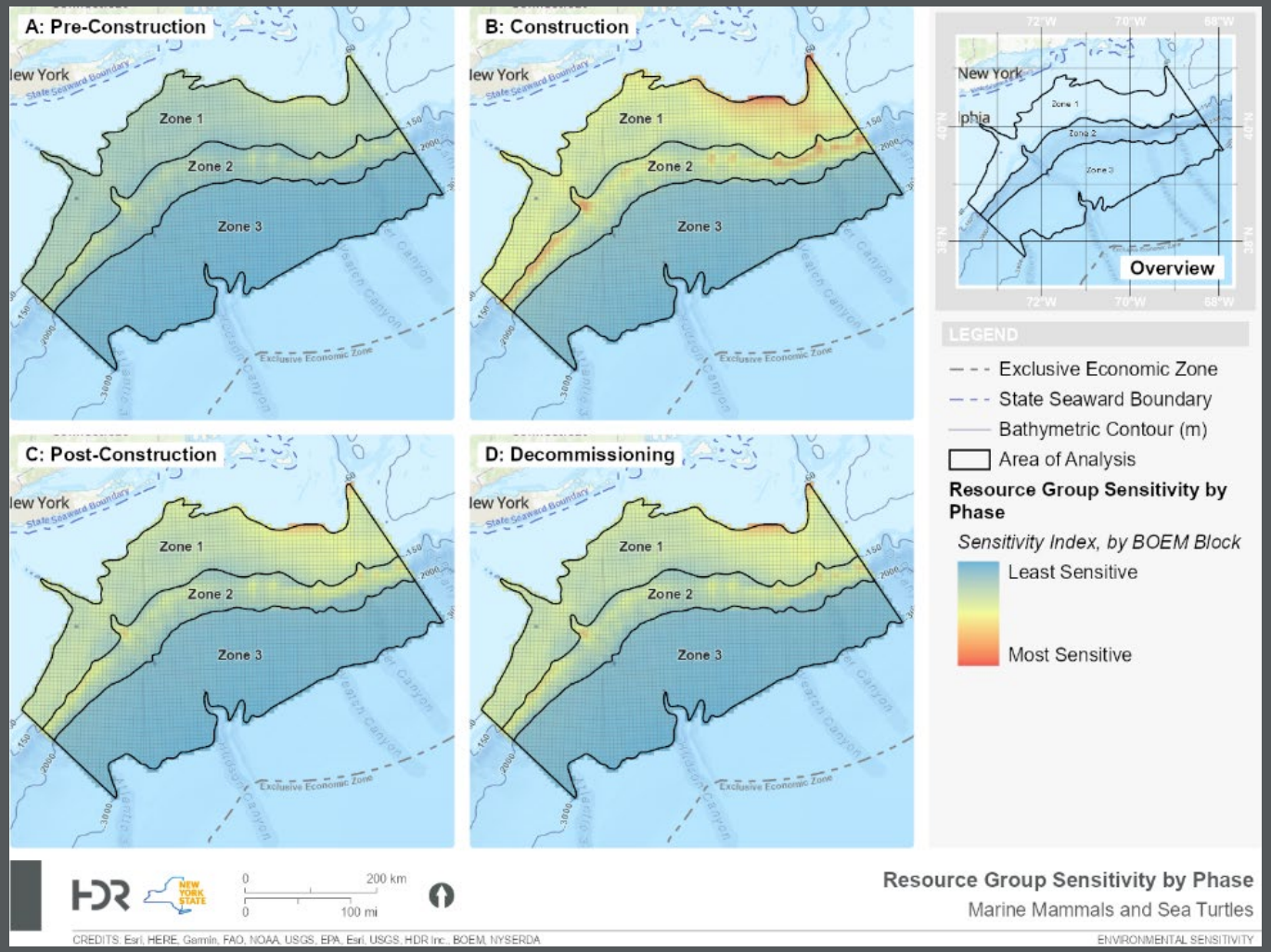


Sensitivity Results: Marine Mammals & Sea Turtles by Stressor

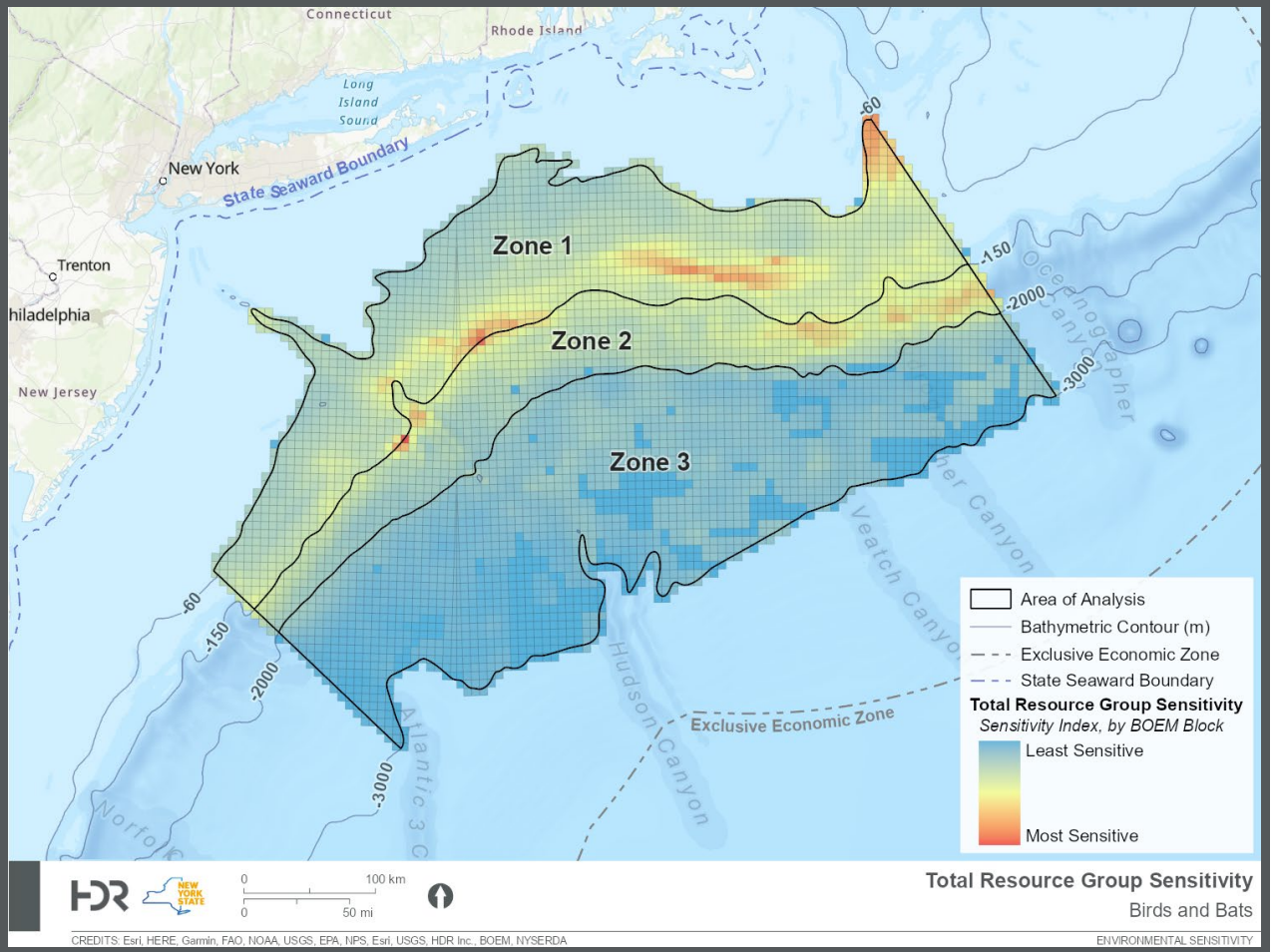


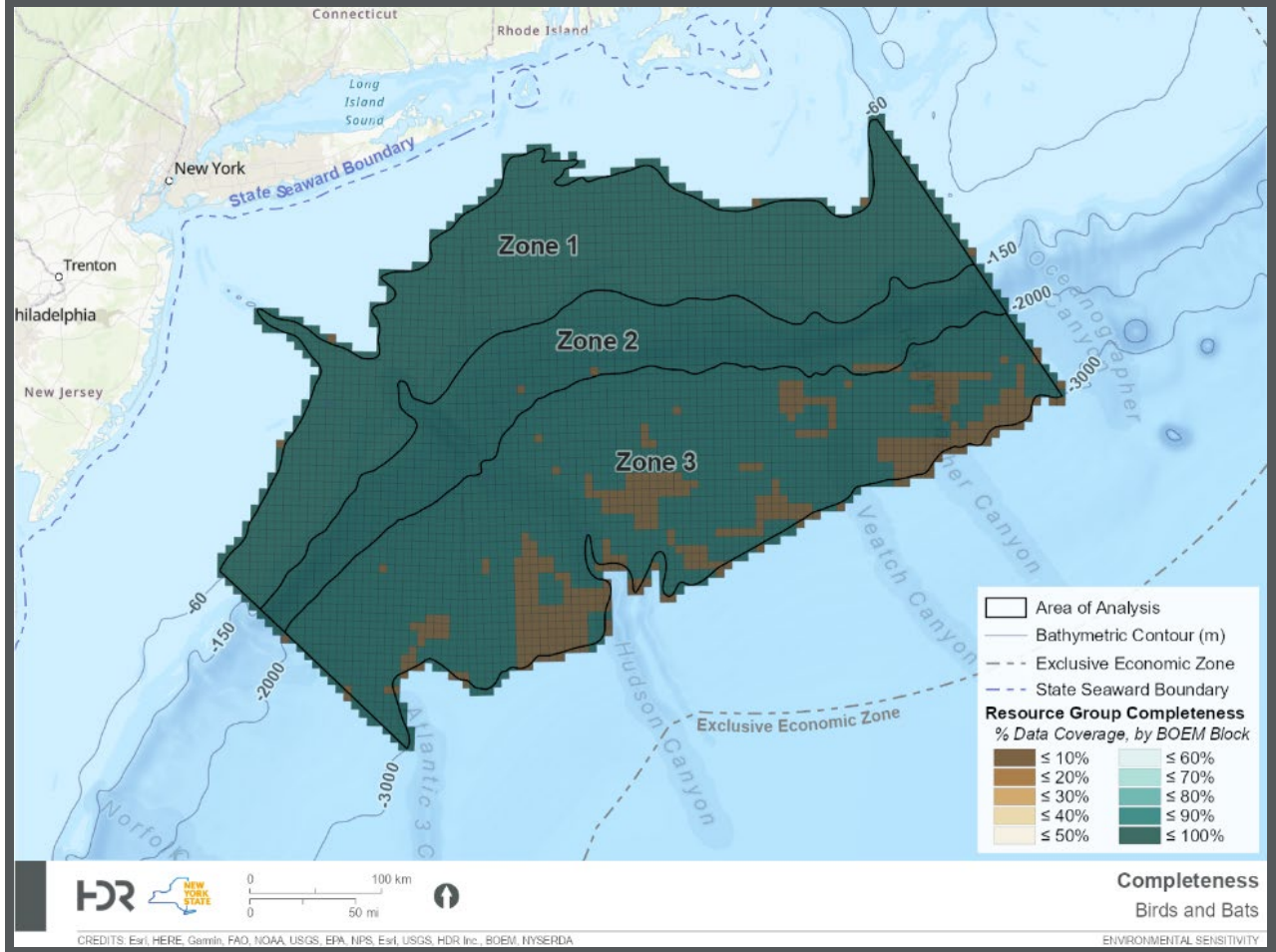


Sensitivity Results: Marine Mammals & Sea Turtles by Phase

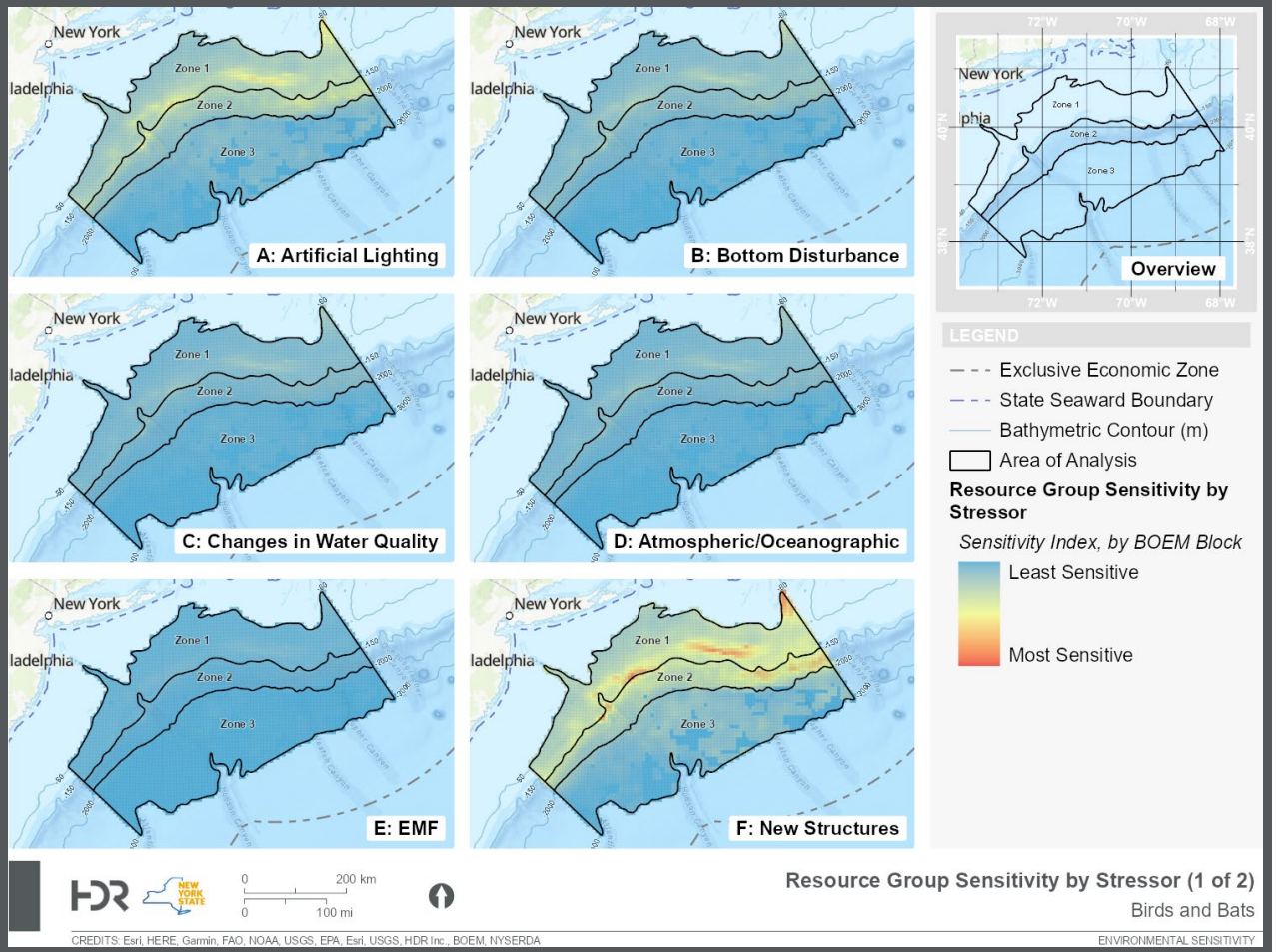


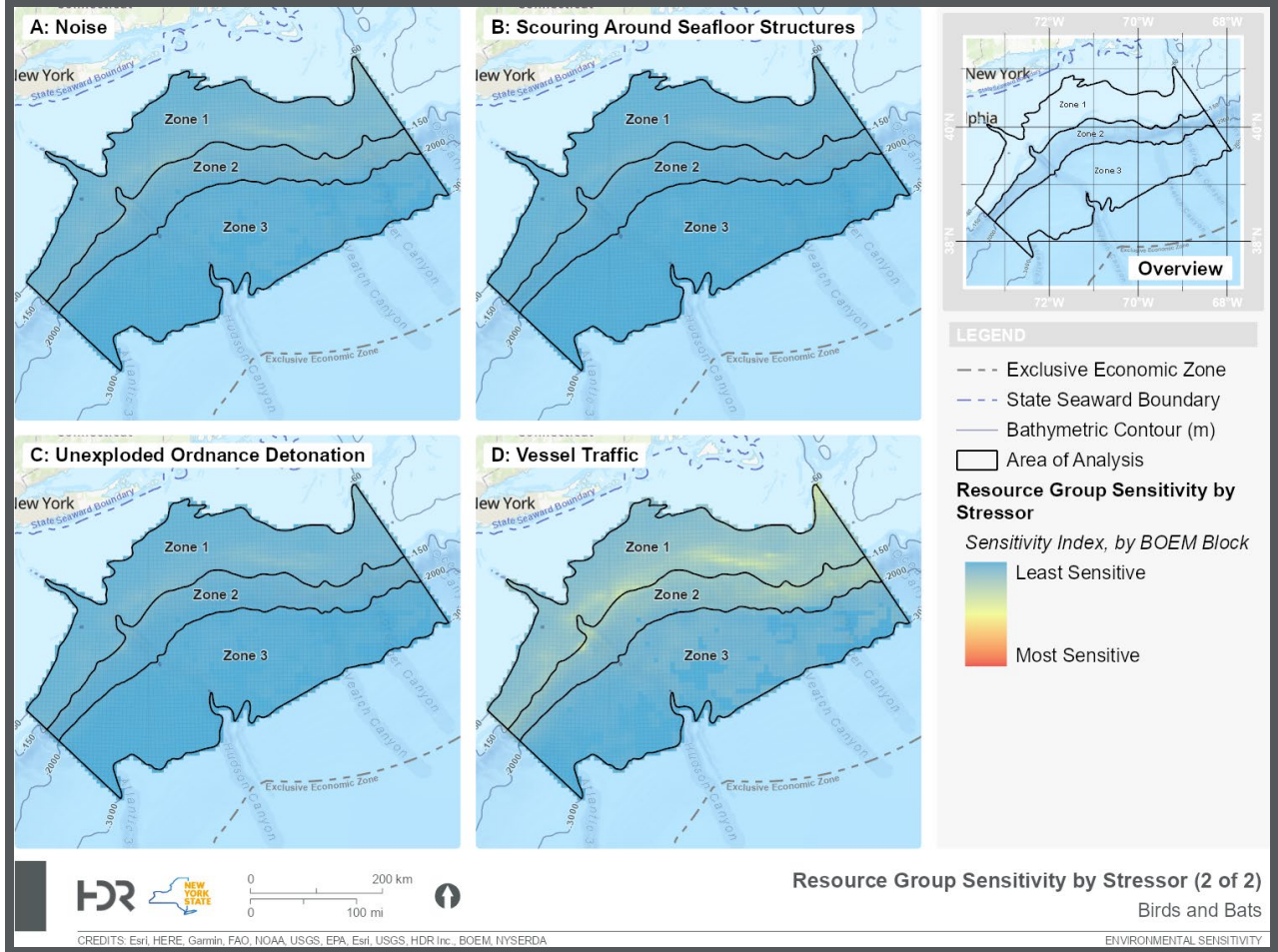
Sensitivity Results: Birds & Bats
Overall Sensitivity and Data Gaps



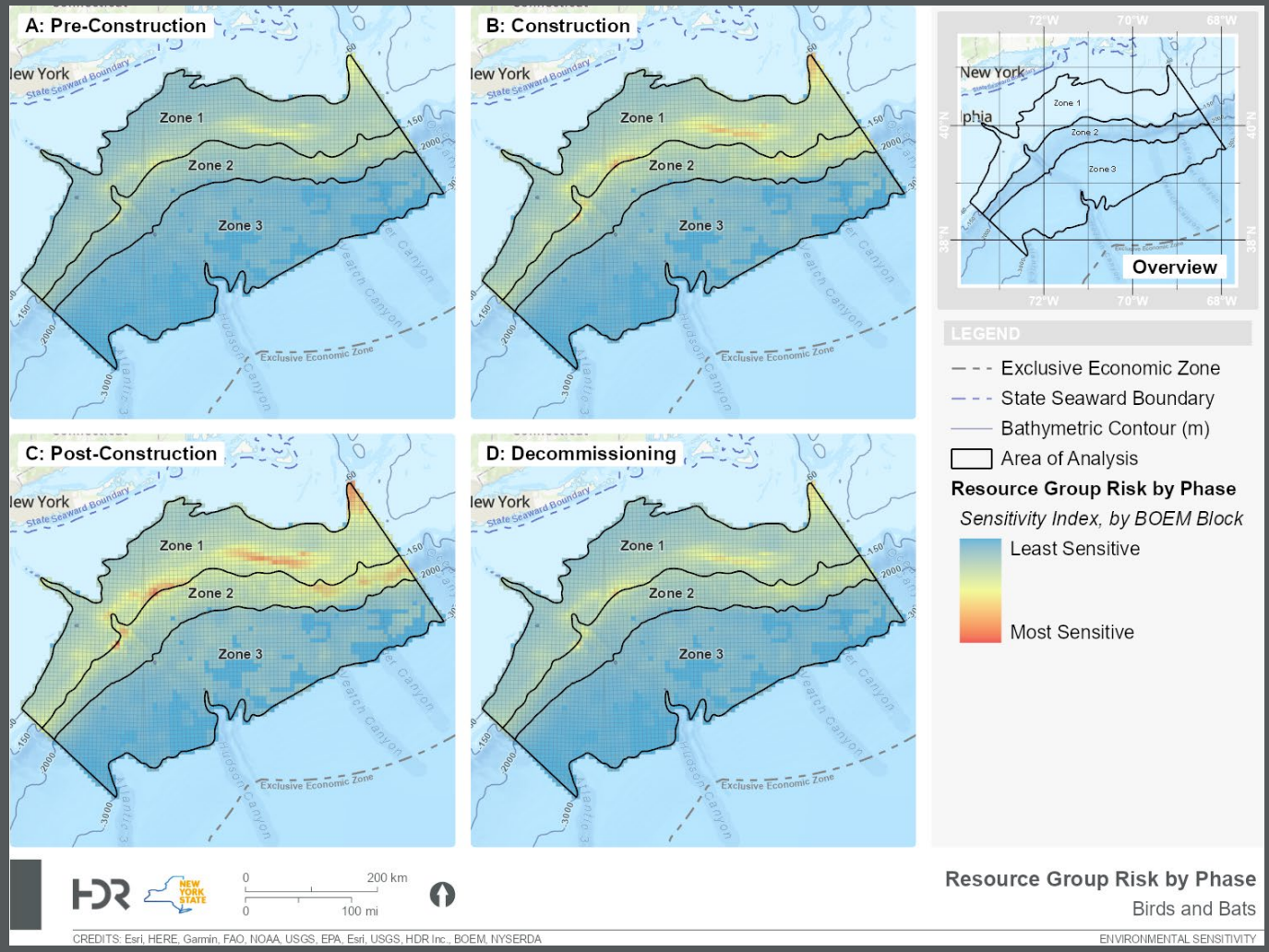


Sensitivity Results: Birds & Bats by Stressor

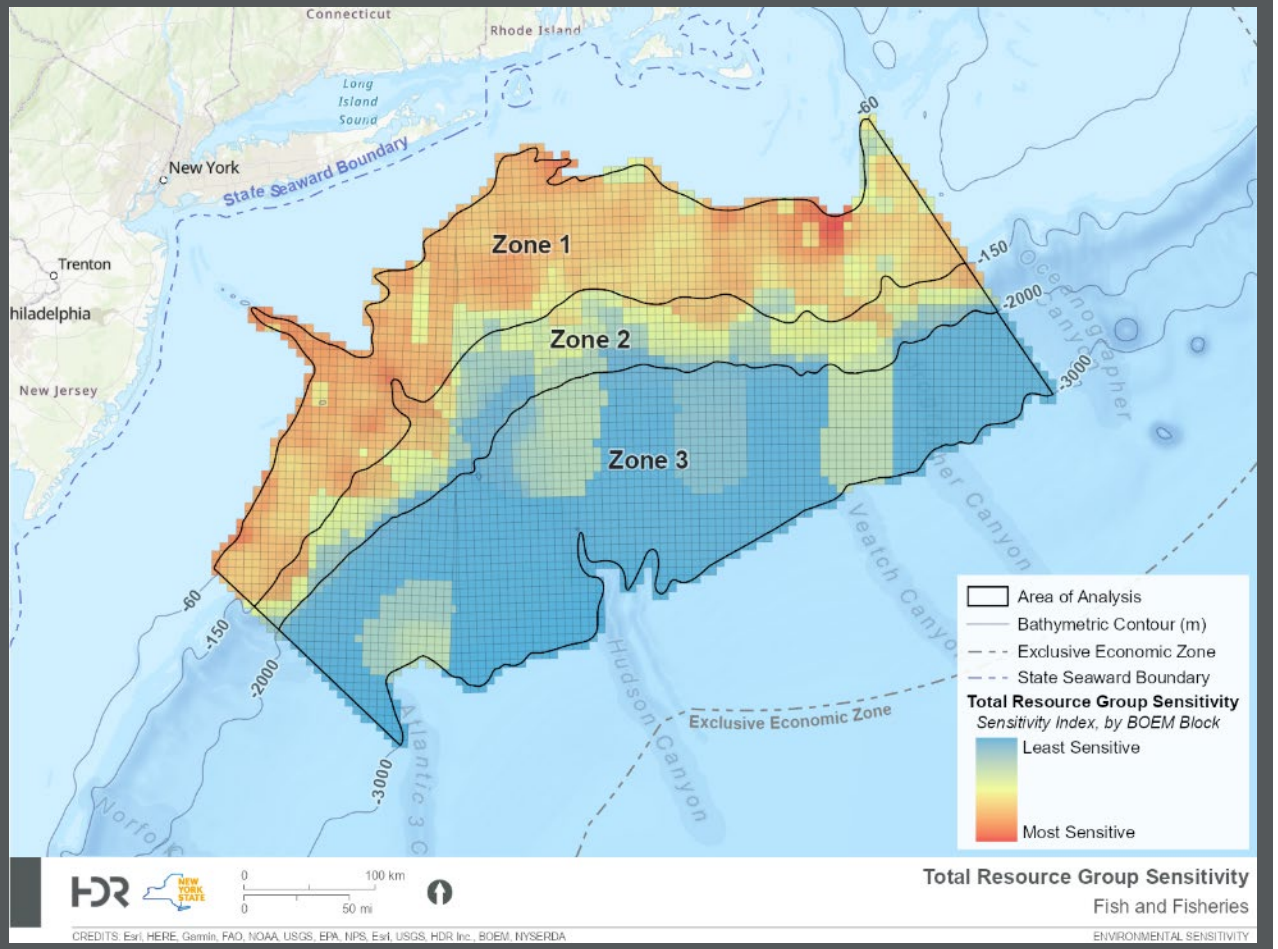


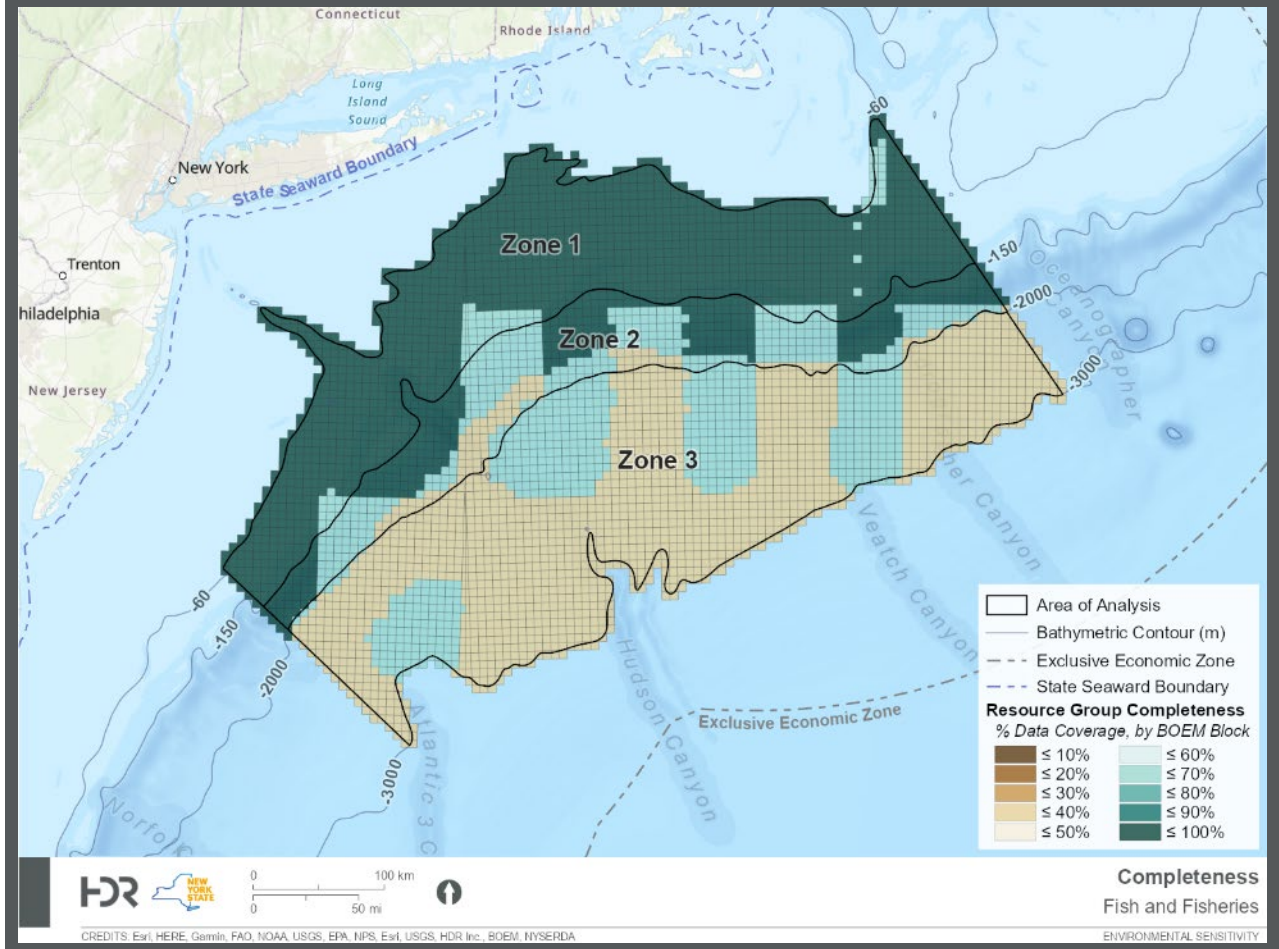


Sensitivity Results: Birds & Bats by Phase

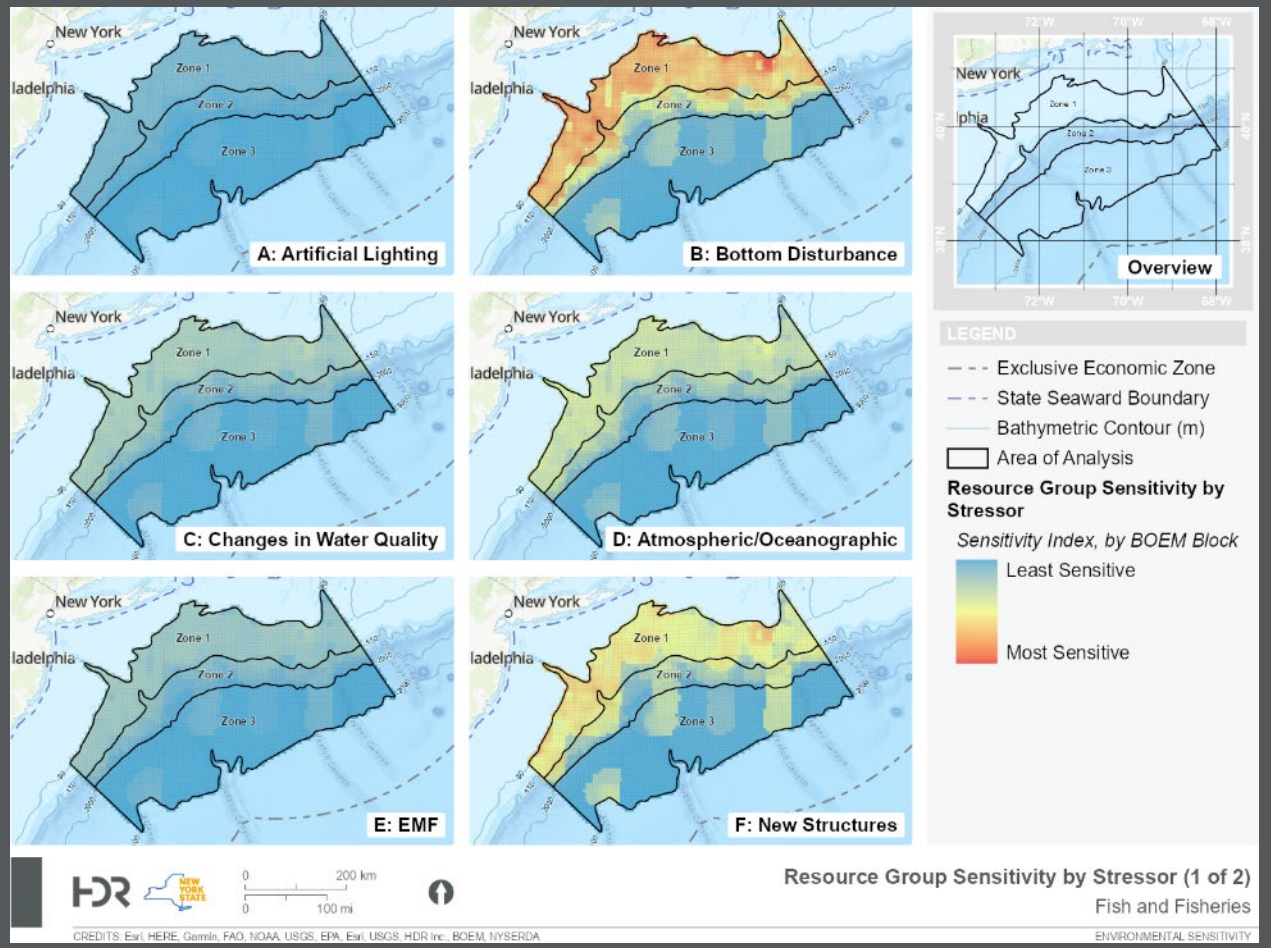


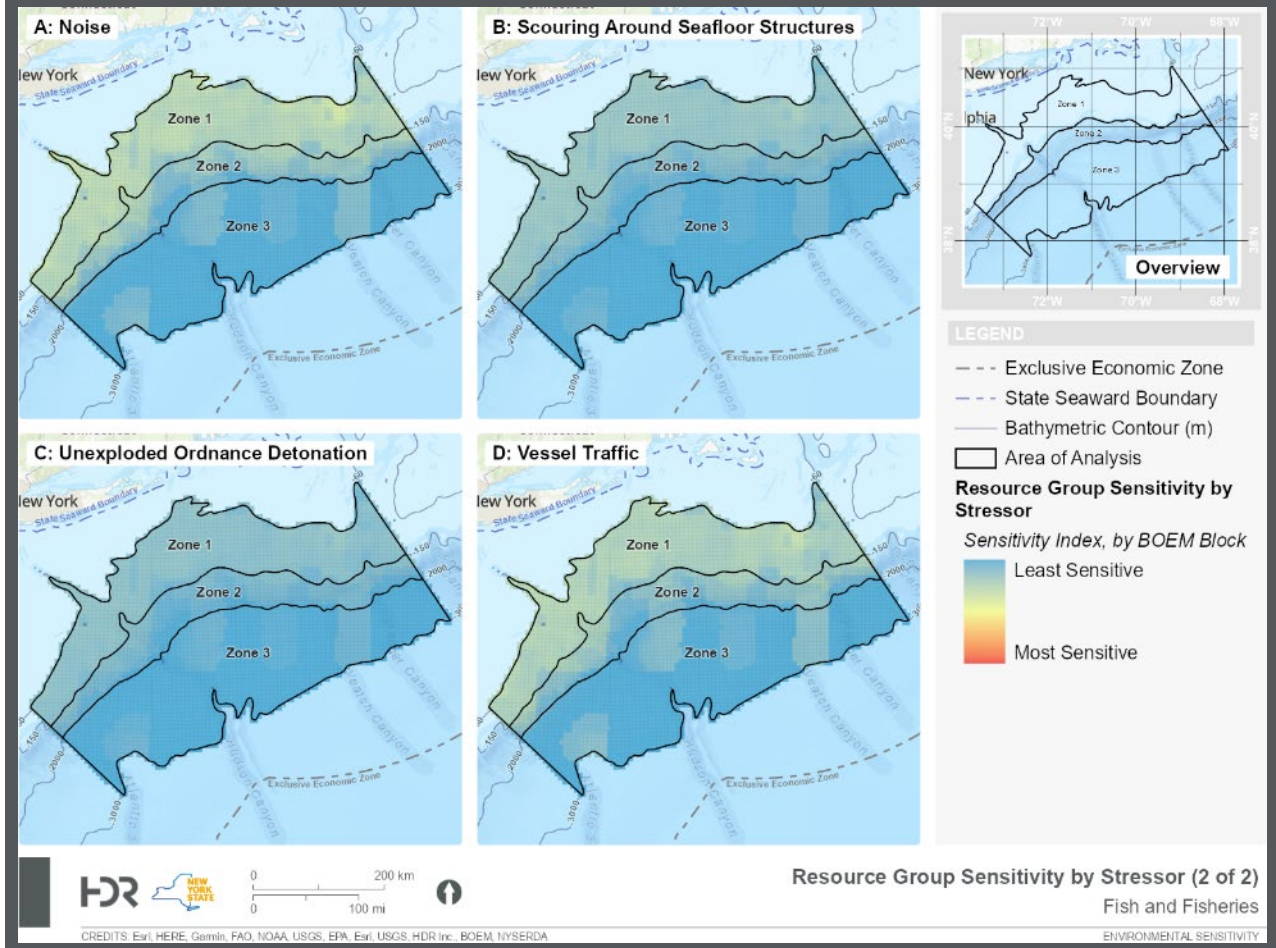
Sensitivity Results: Fish & Fisheries
Overall Sensitivity and Data Gaps



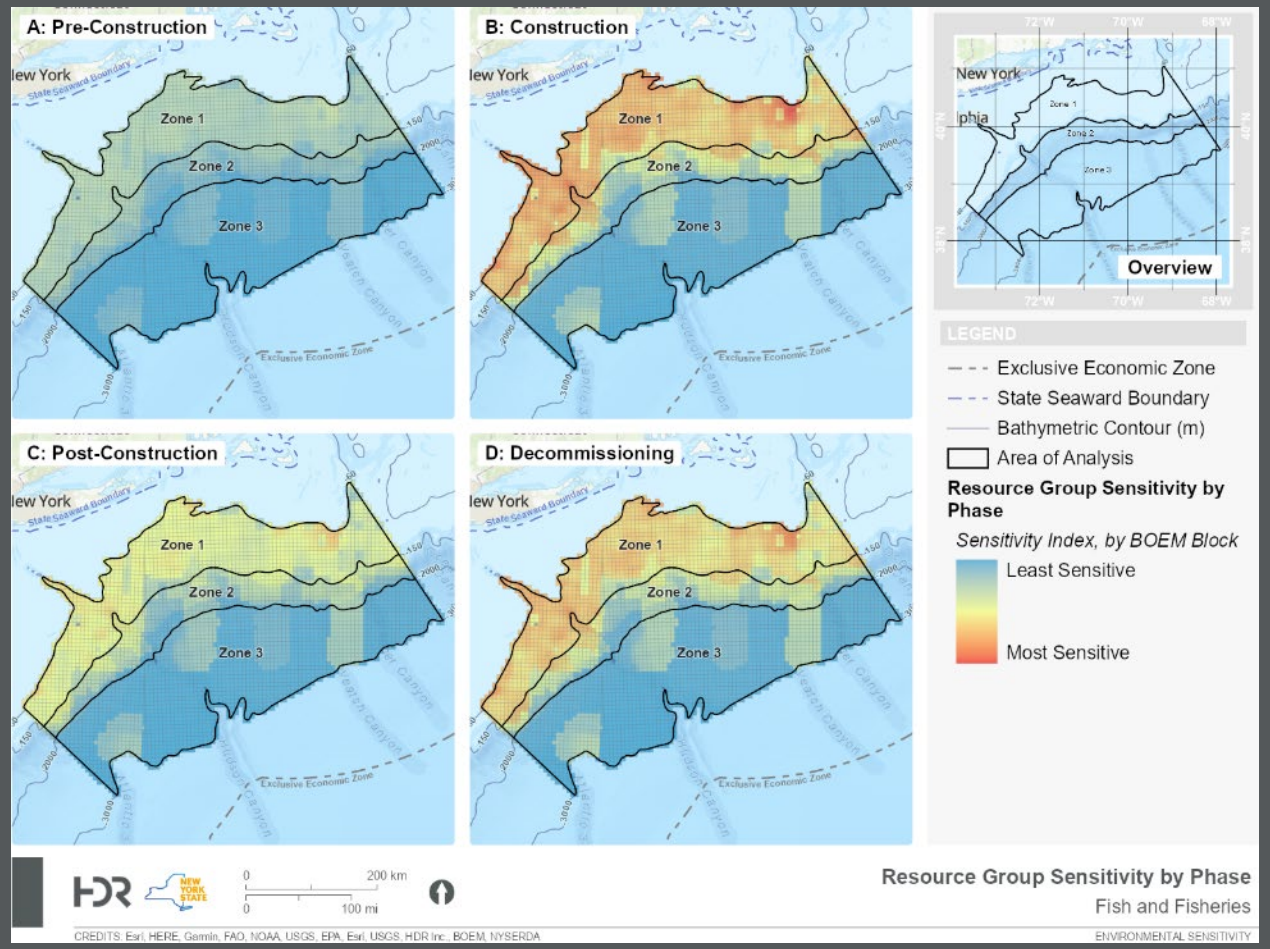


Sensitivity Results: Fish & Fisheries by Stressor

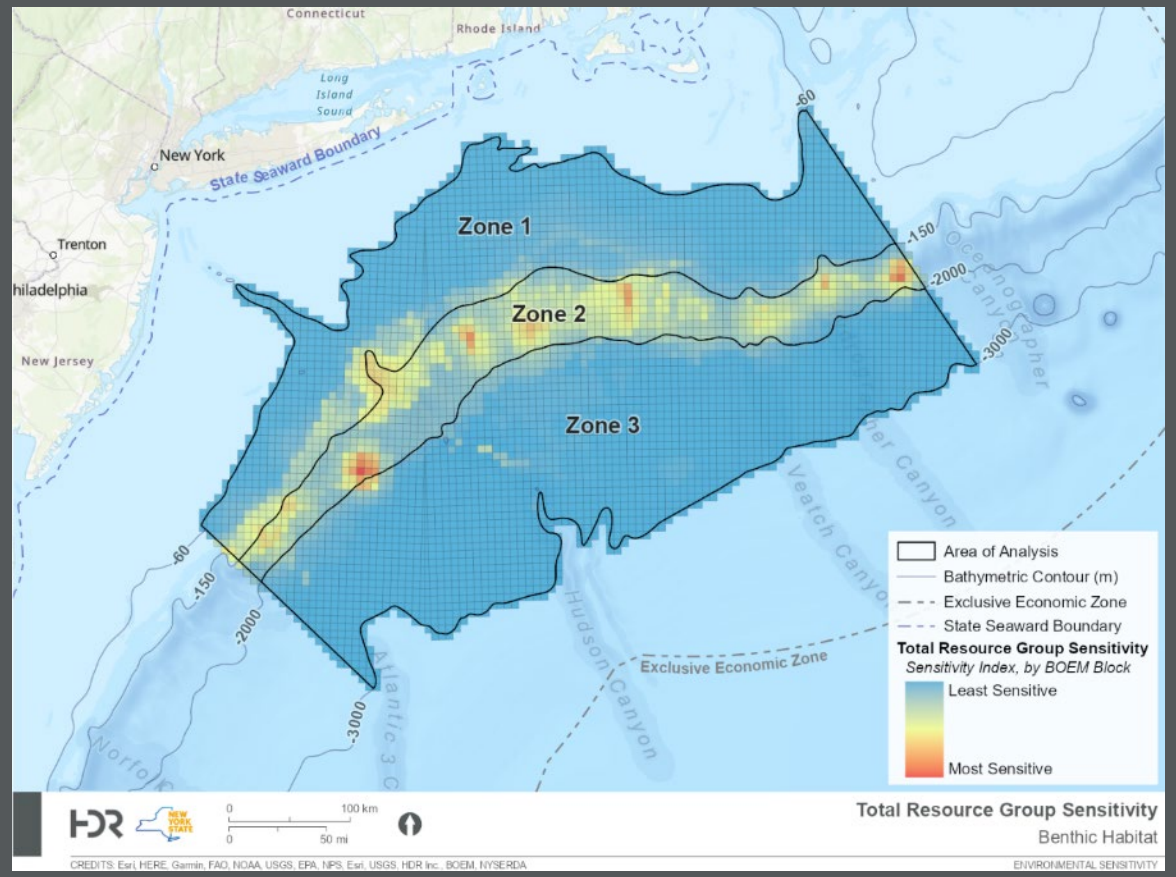


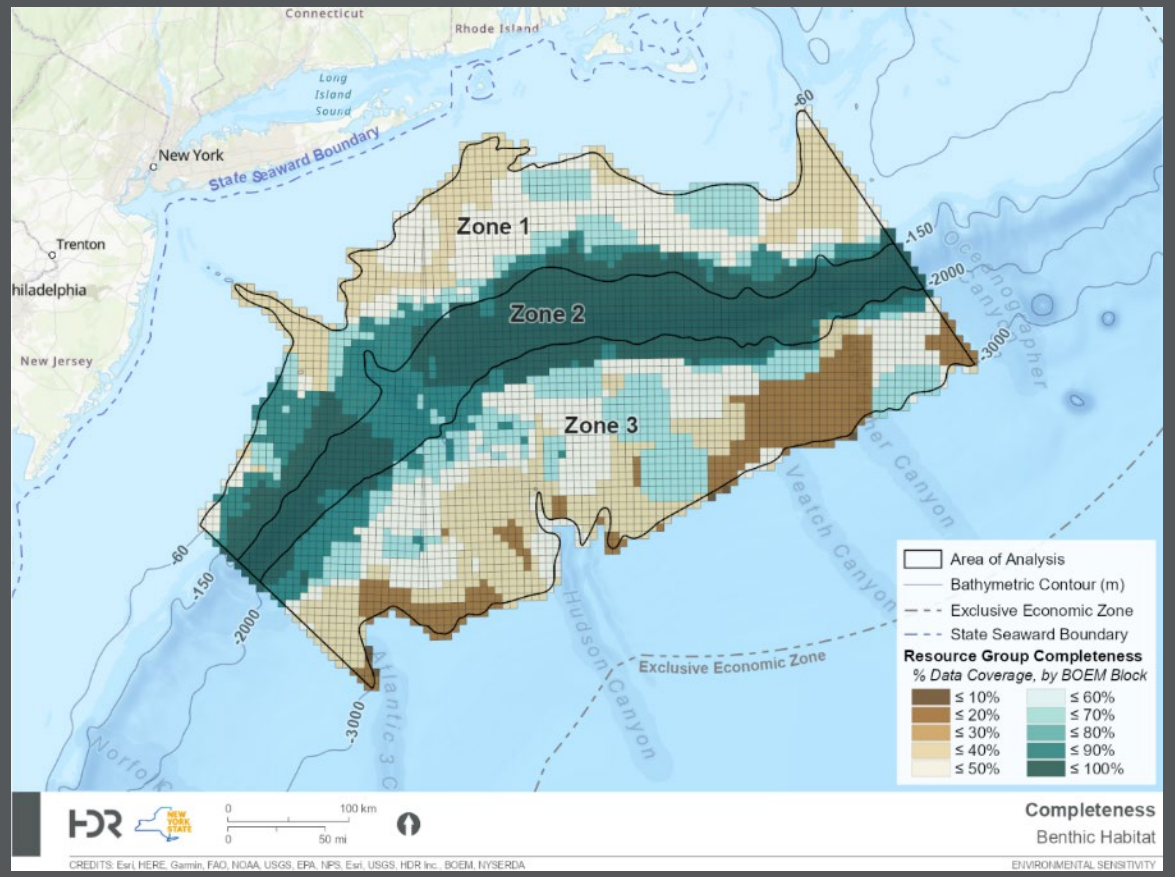


Sensitivity Results: Fish & Fisheries by Phase

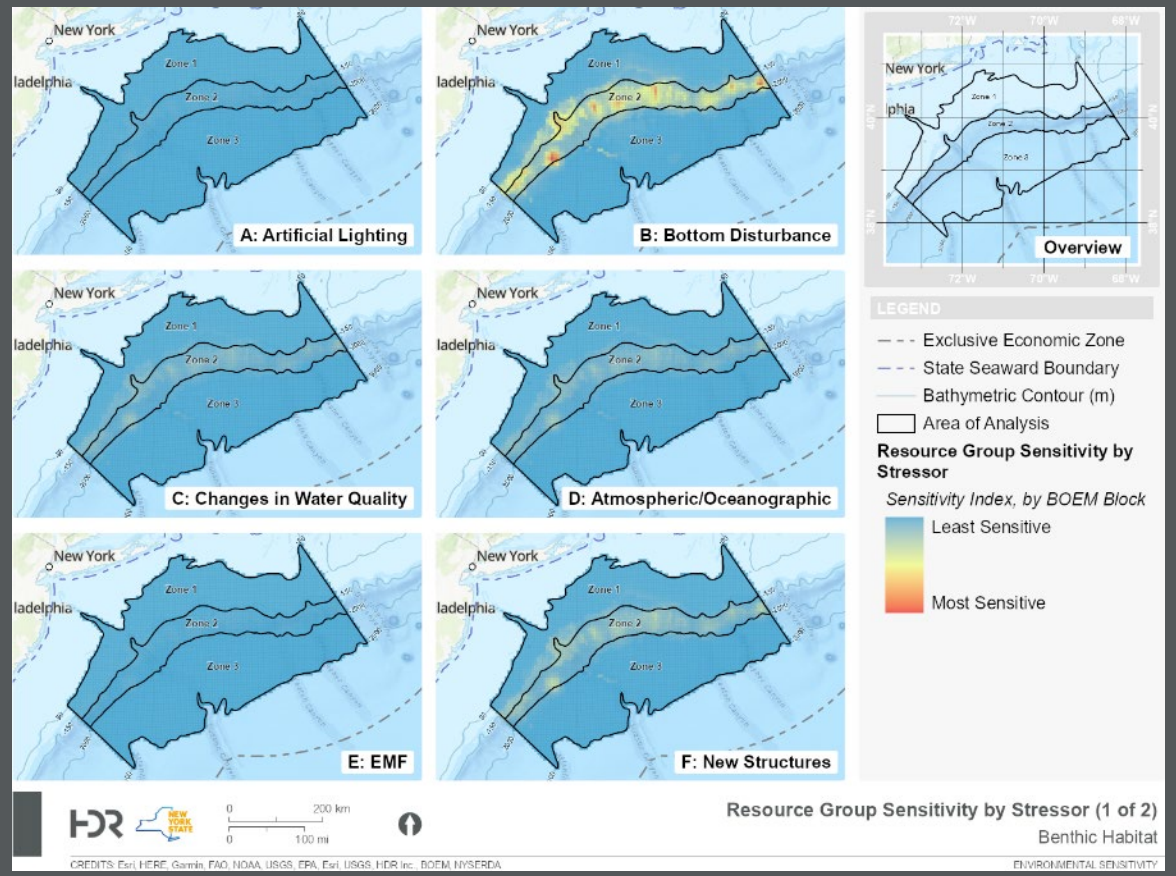


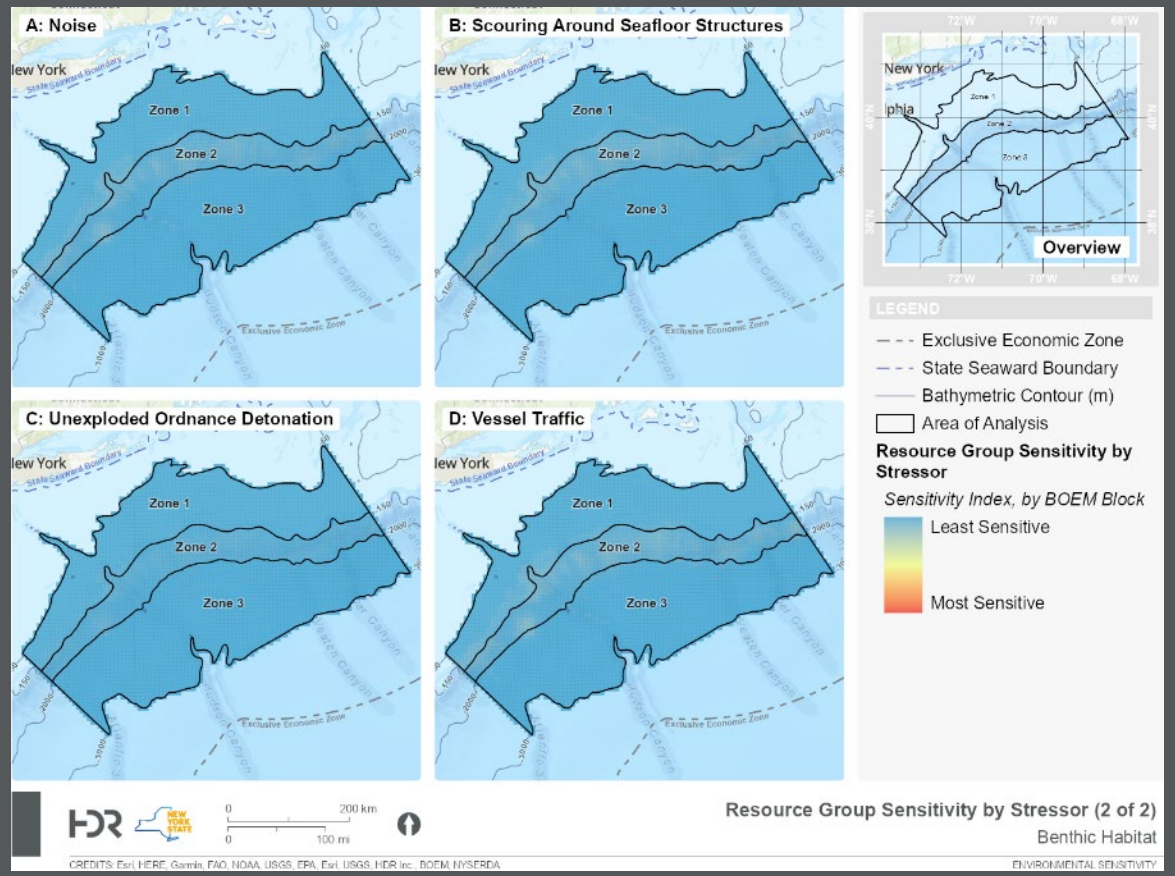
Sensitivity Results: Benthic Habitat
Overall Sensitivity and Data Gaps



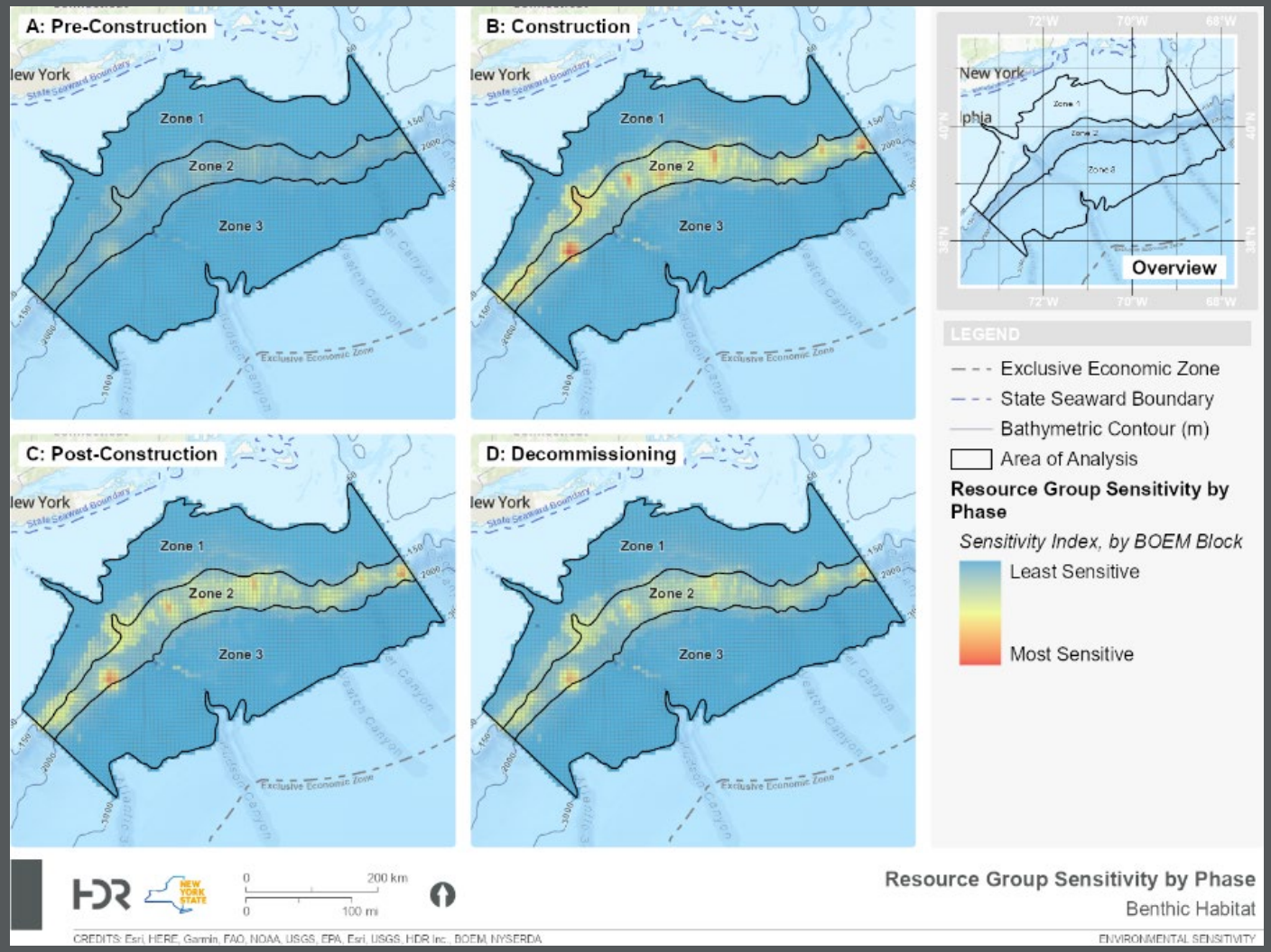


Sensitivity Results: Benthic Habitat by Stressor





Sensitivity Results: Benthic Habitat by Phase



Conclusions

- The high-level sensitivity mapping analysis identified regions of relatively higher or lower sensitivity within the three zones of the AoA
- In general, Zones 1 and 2 had the highest sensitivity overall and lowest in Zone 3, but this should be considered carefully as the data gaps were greater in Zone 3 due to lack of readily available data for many receptors
- Consult the Data Gap figures in conjunction with Sensitivity figures to place sensitivity in proper context
- Bottom disturbance was the most impactful stressor for fish and benthic habitat, and new structures were most impactful for birds and mammals
- Benthic habitat sensitivity is almost exclusively focused in Zone 2 along the continental shelf area as this area is most likely to contain suitable habitat for benthic species
- In general, sensitivity was greater during the construction phase for marine mammals, sea turtles, fish and fisheries, and benthic habitat, and during post-construction for birds and bats.

Main Comments to Date

Comment themes

- Uncertainty
  - Include more detail / context about uncertainty
  - Describe earlier in the report to provide adequate context to the reader
- Datasets
  - Inclusion of additional fisheries data
  - More detail about how datasets were used
- Stressors
  - Selection of stressors and reasons
  - Additional stressors to consider

Thank You

Reminders

- **E-TWG Specialist Committees**
  - **Avian Displacement Guidance: Draft for E-TWG review until September 29**
  - **Whale communications: Survey for input on topics to address in the FAQ**

If you have not done so already, we encourage you to review the written updates we sent via email for additional details on NYSERDA and E-TWG activities

Wrap Up & Next Steps

E-TWG Lead: NYSERDA - 518-862-1090

- Kate McClellan Press x3110, Kate.McClellanPress@nyserda.ny.gov

Technical Support: Biodiversity Research Institute (BRI) - 207- 839-7600

- Kate Williams x108, kate.williams@briwildlife.org
- Julia Gulka x303, Julia.gulka@briwildlife.org

Facilitation Support: CBI and Cadmus

- Bennett Brooks 212-678-0078, bbrooks@cbi.org
- Stefanie Sganga 617-673-7018, Stefanie.Sganga@cadmusgroup.com

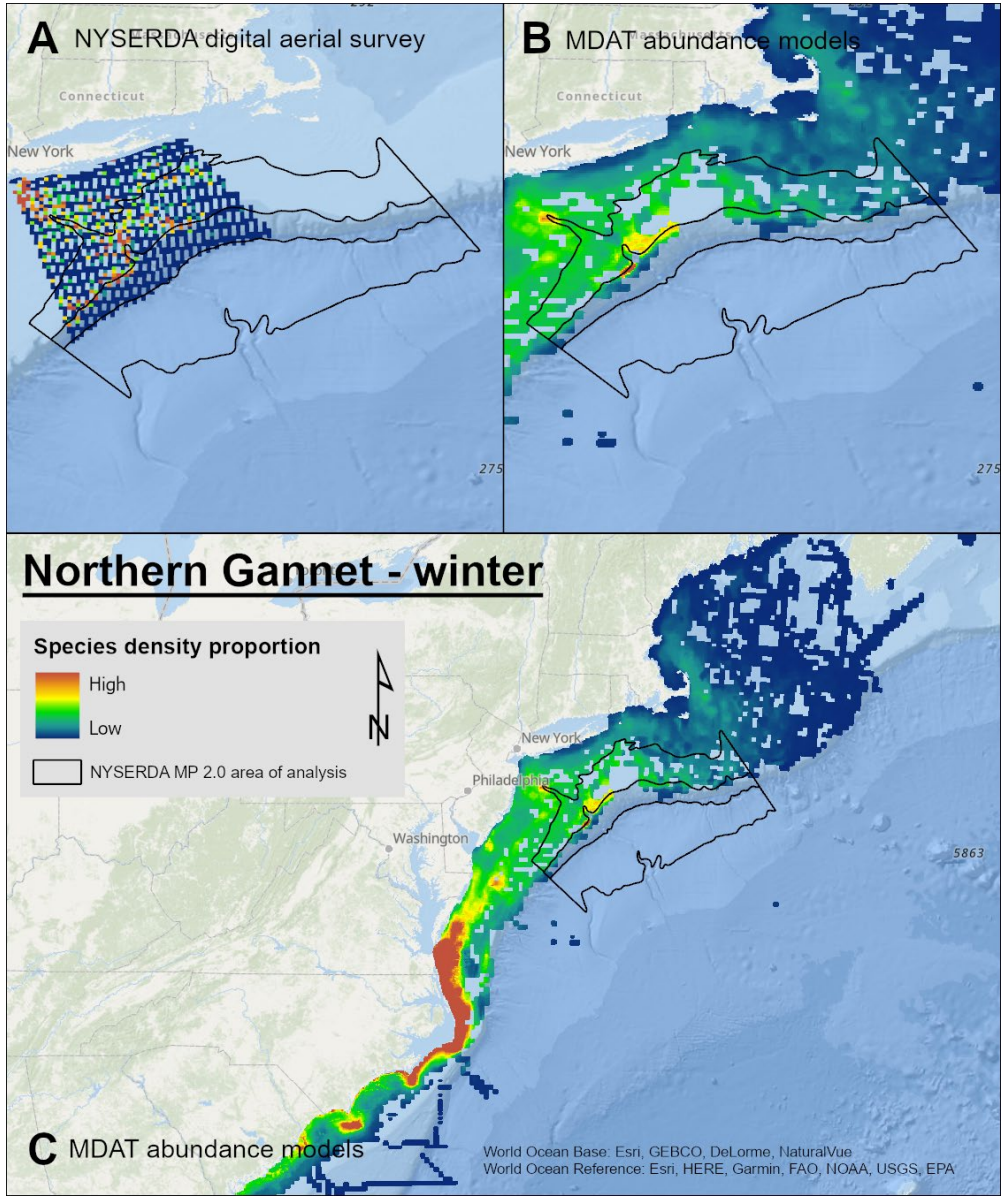
> **Questions? Comments?**

> **Thank you!**

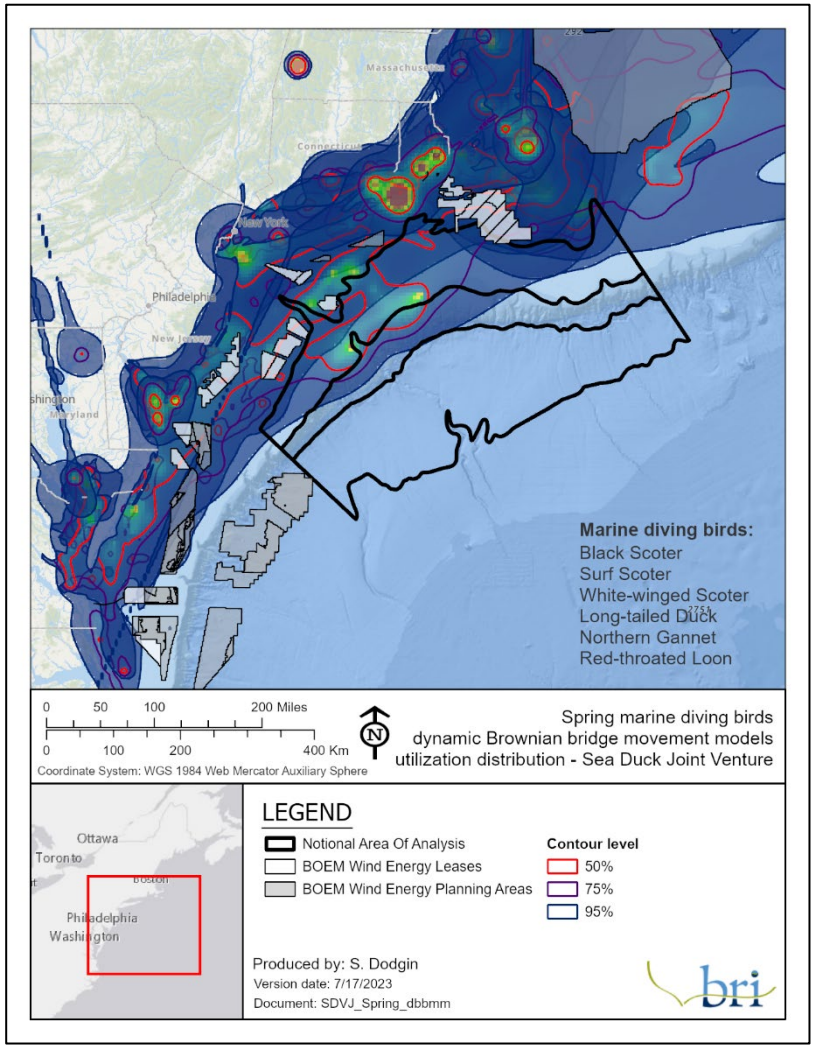
Birds and Bats Study

Extra Slides

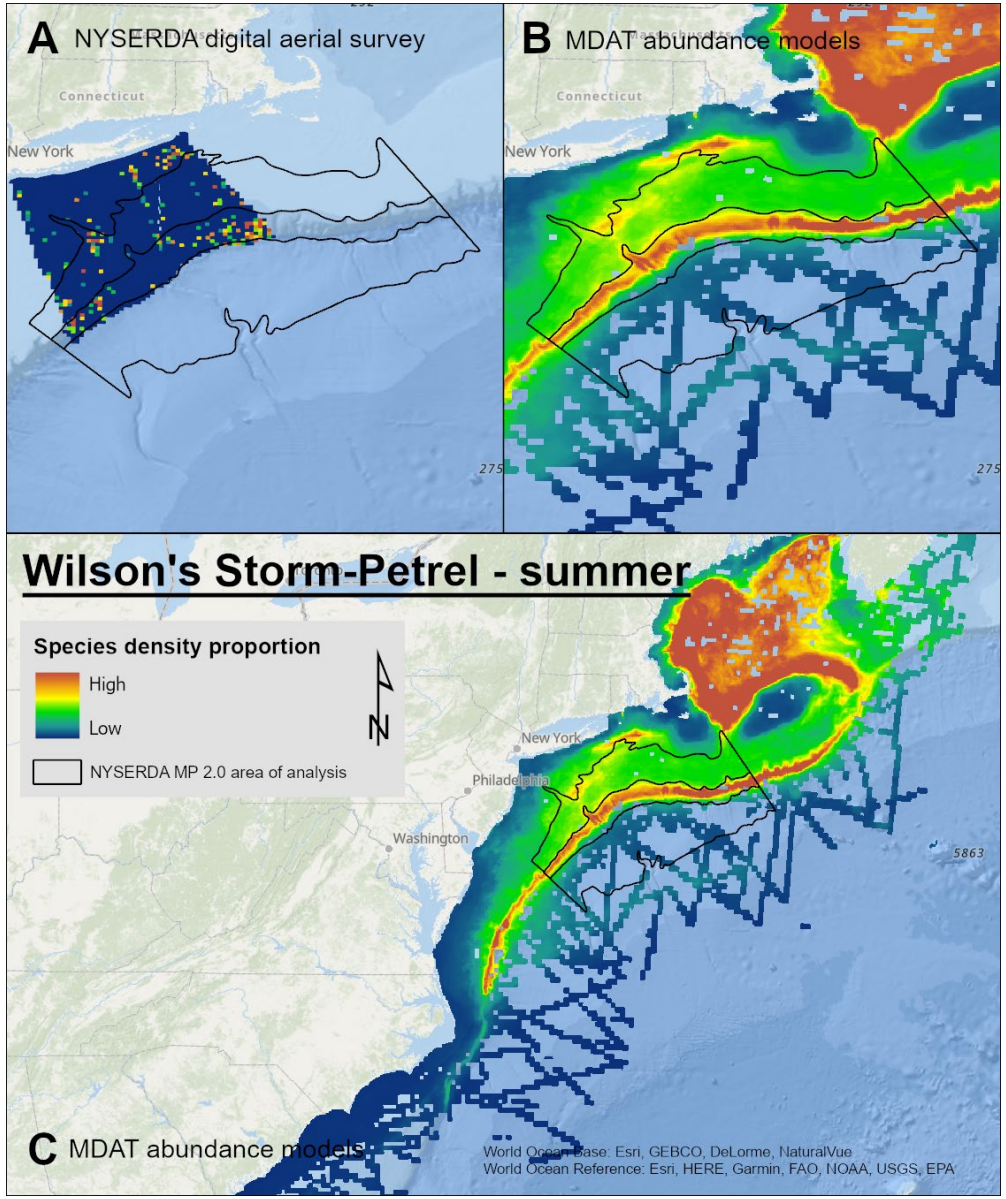
Results: Marine diving birds



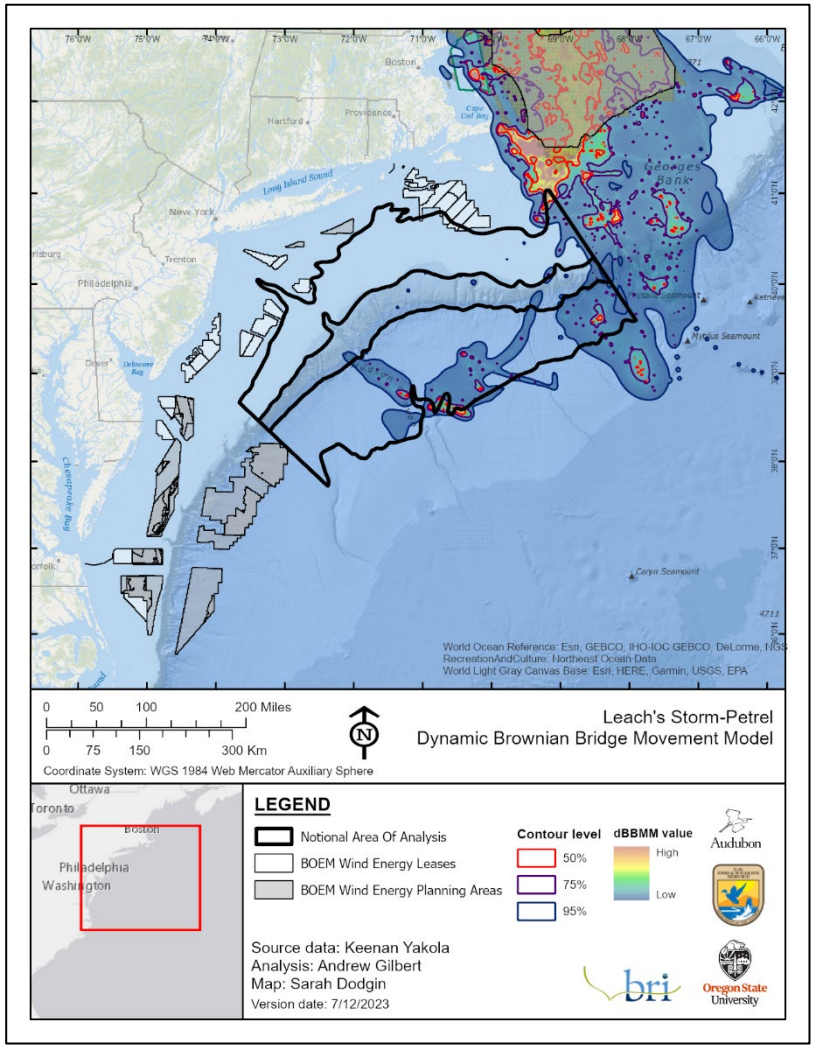
BIODIVERSITY RESEARCH INSTITUTE
innovative wildlife science



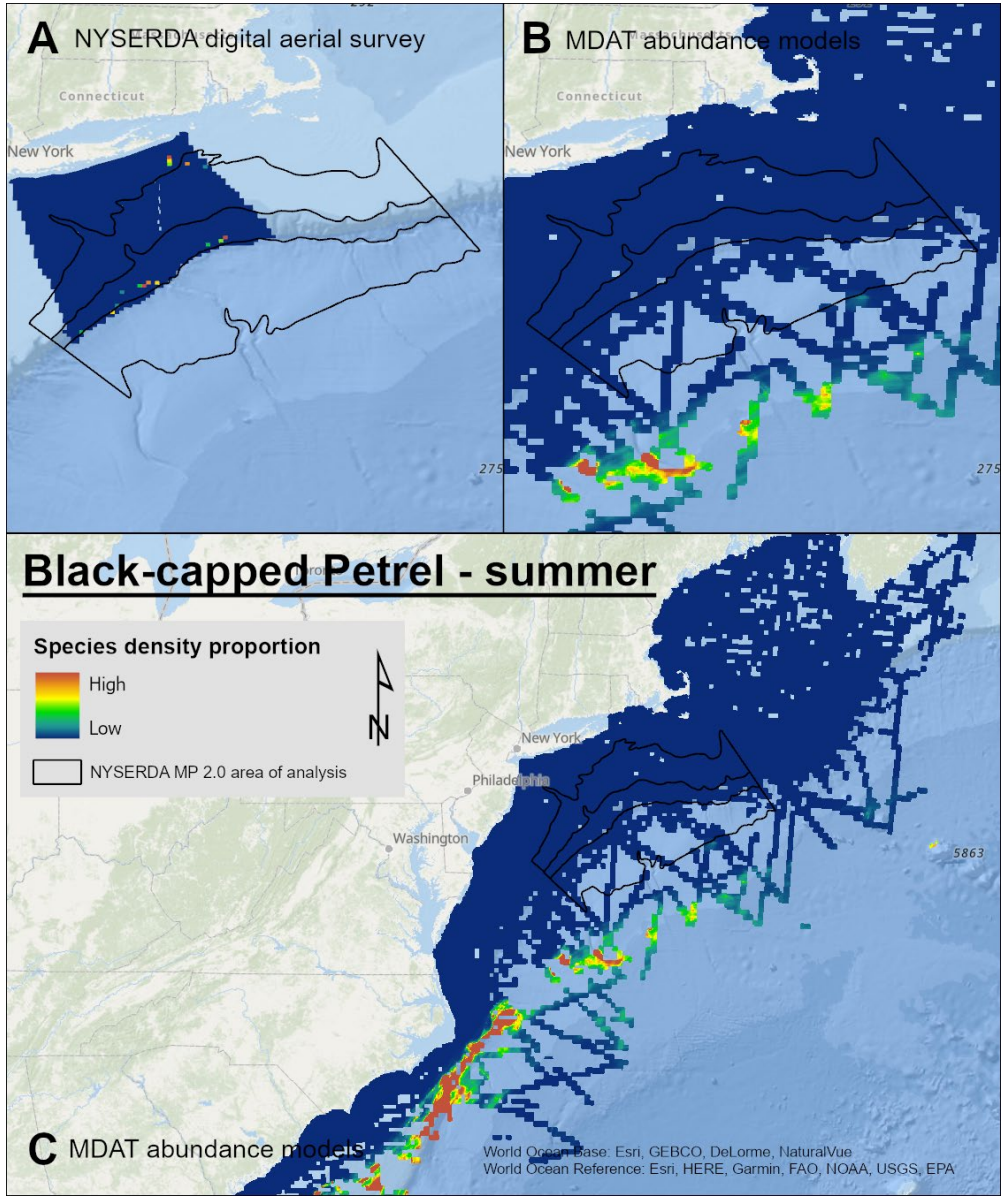
Results: Storm-petrels



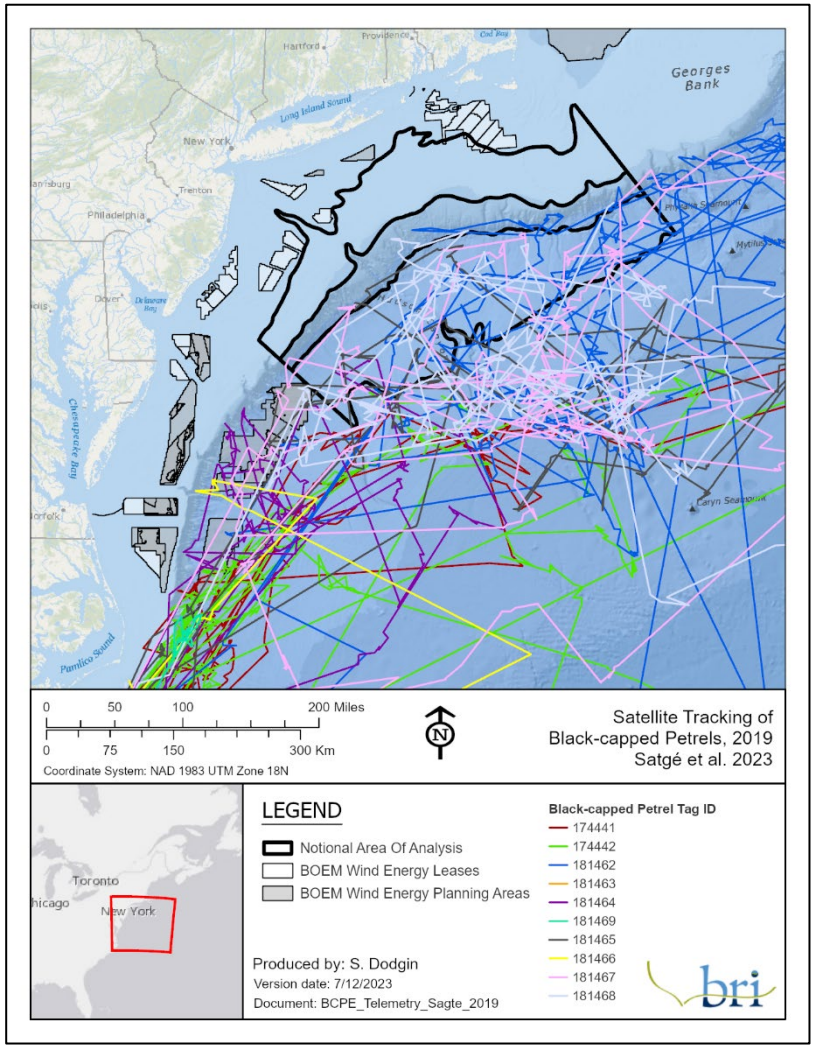
BIODIVERSITY RESEARCH INSTITUTE
innovative wildlife science



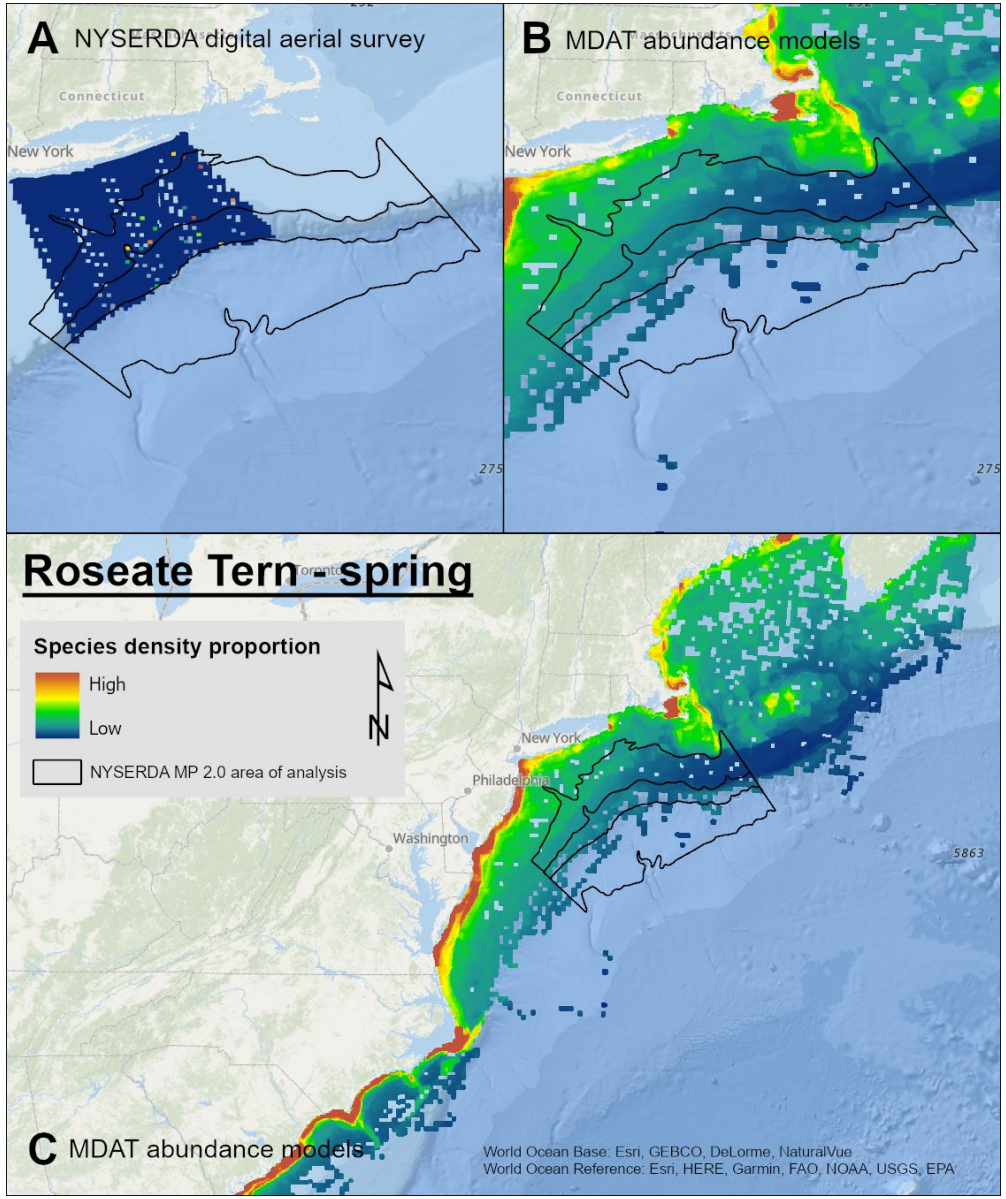
Results: Black-capped petrel



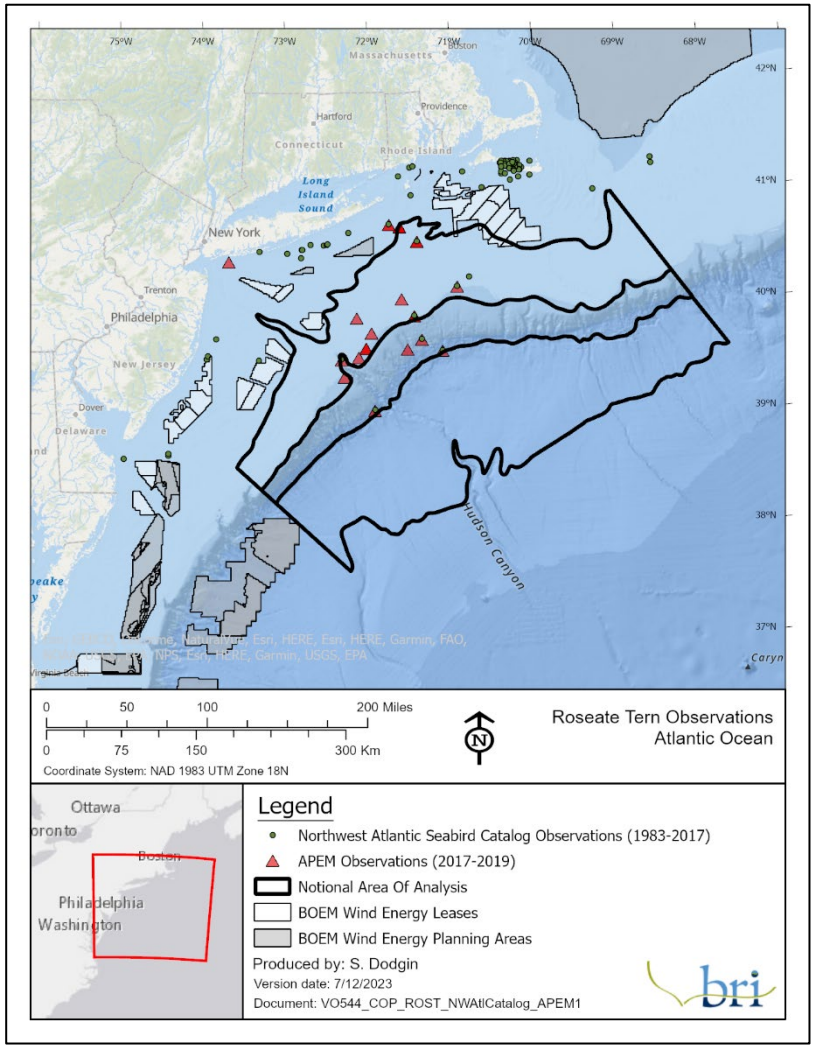
BIODIVERSITY RESEARCH INSTITUTE
innovative wildlife science



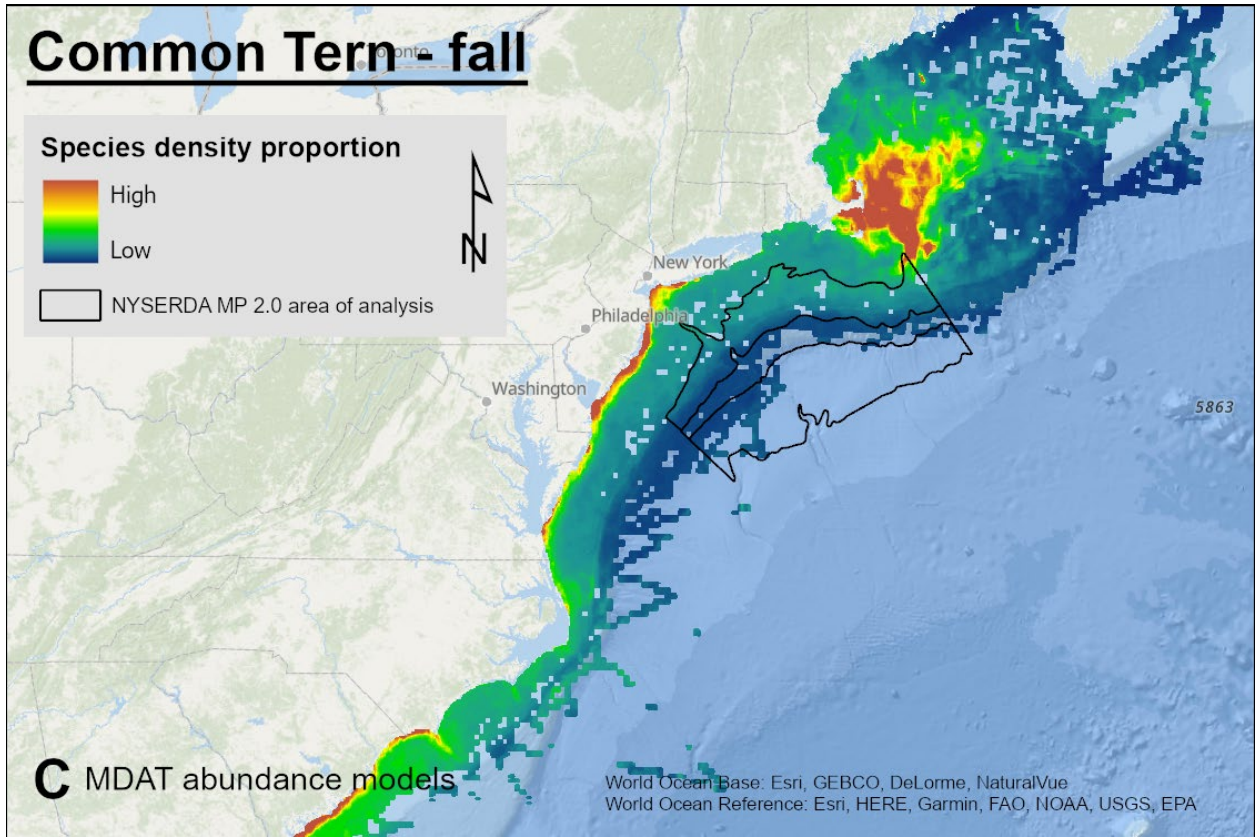
Results: Terns

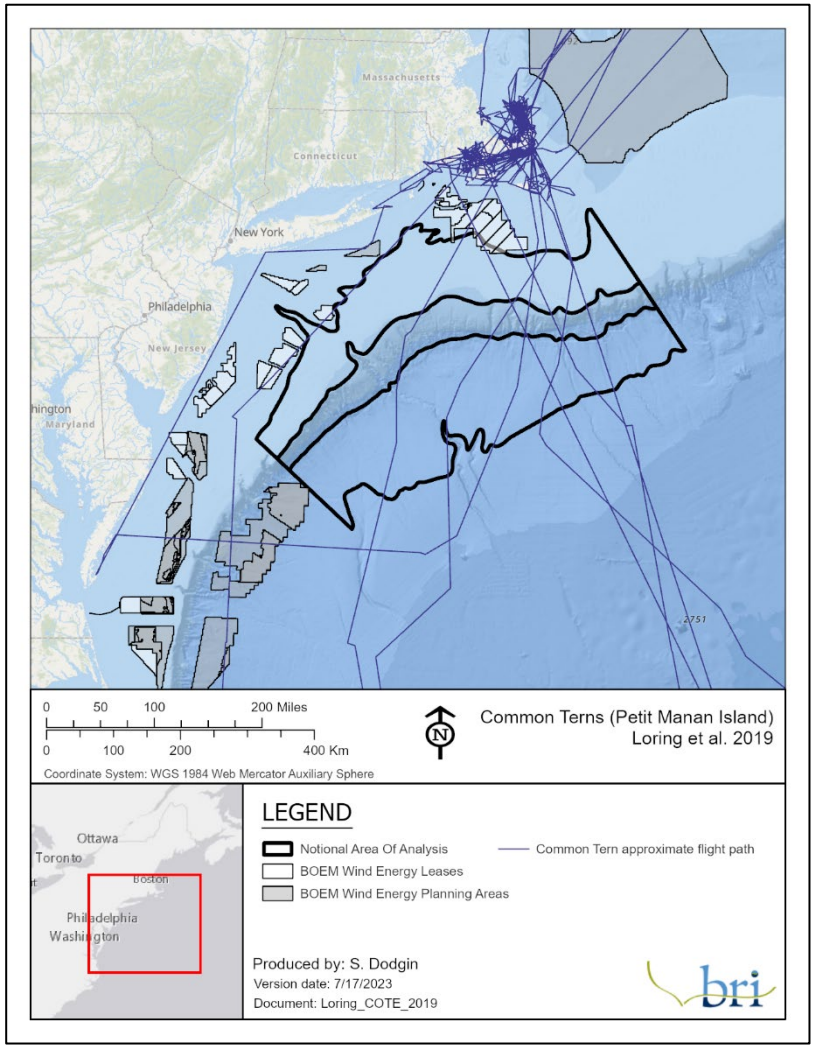


BIODIVERSITY RESEARCH INSTITUTE
innovative wildlife science



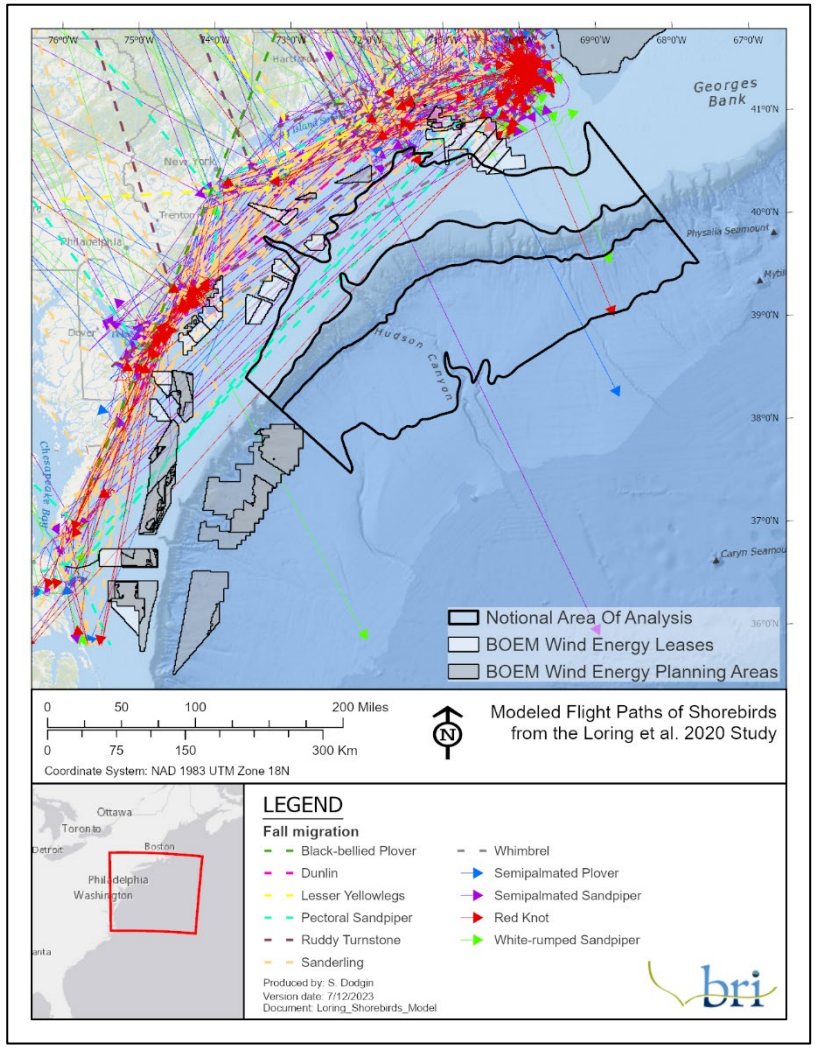
Results: Terns

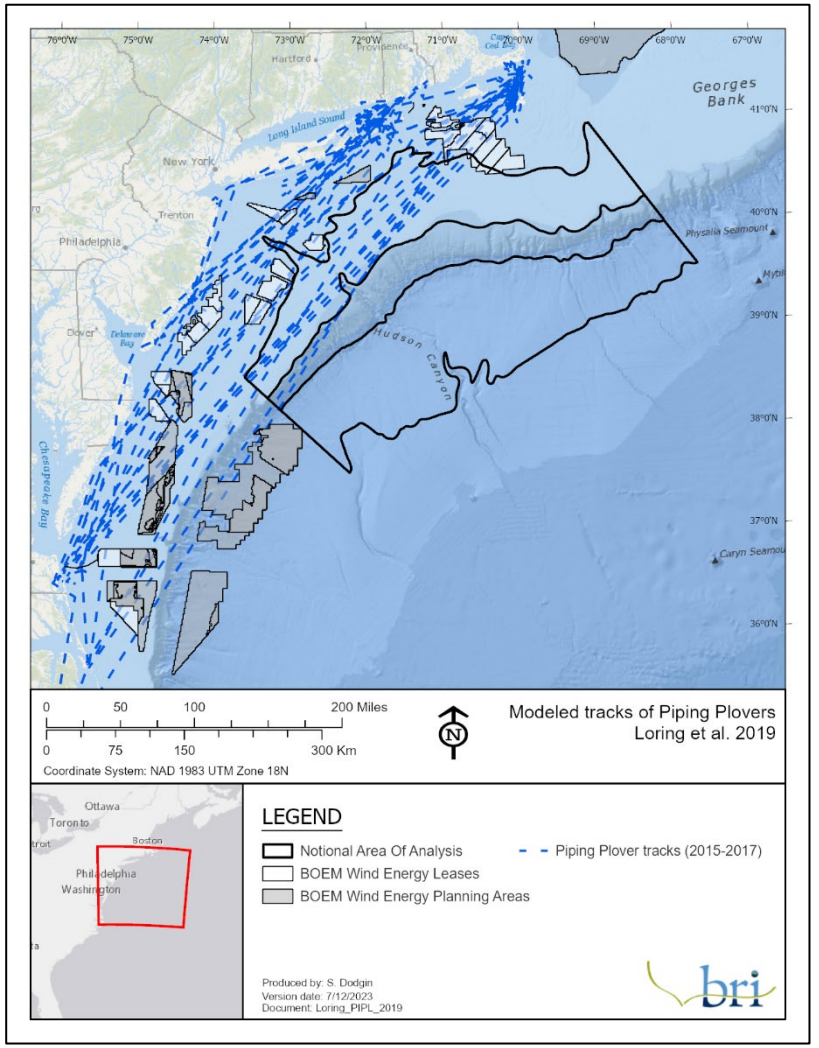




Results: Shorebirds

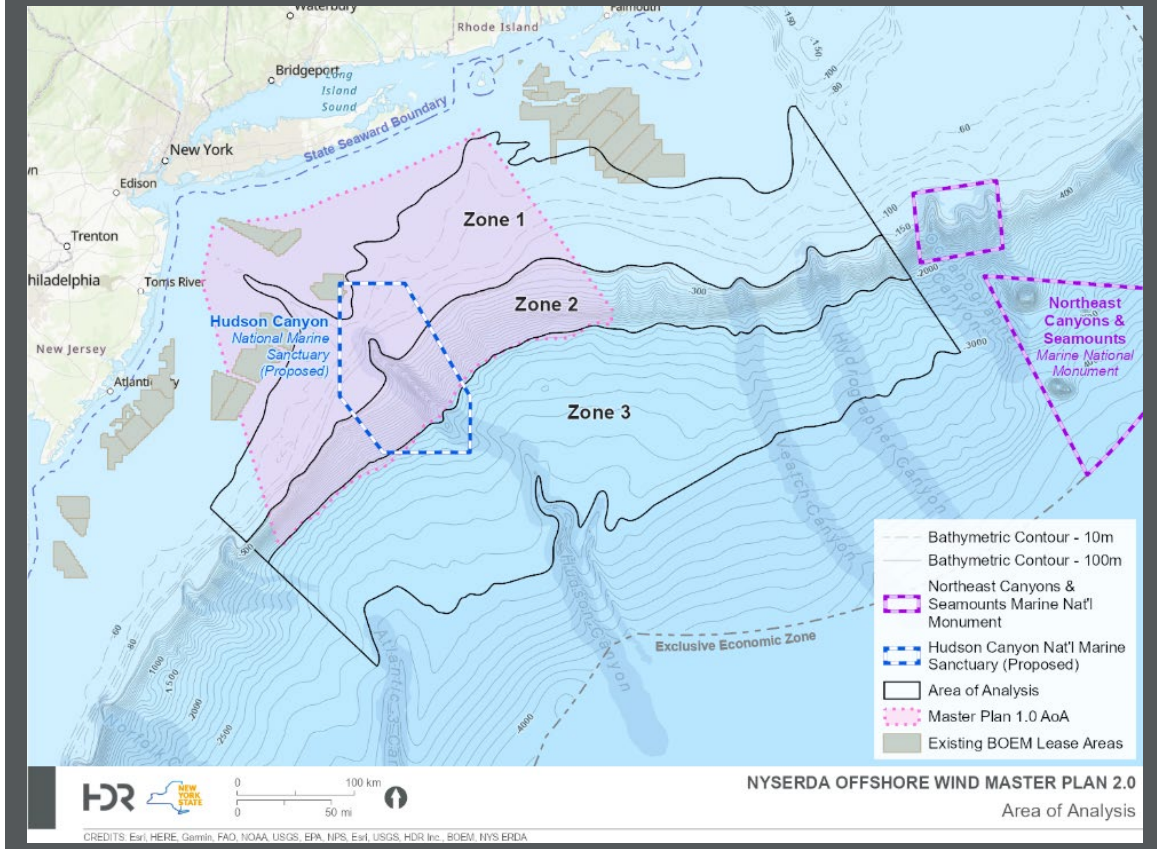
BIODIVERSITY RESEARCH INSTITUTE
innovative wildlife science



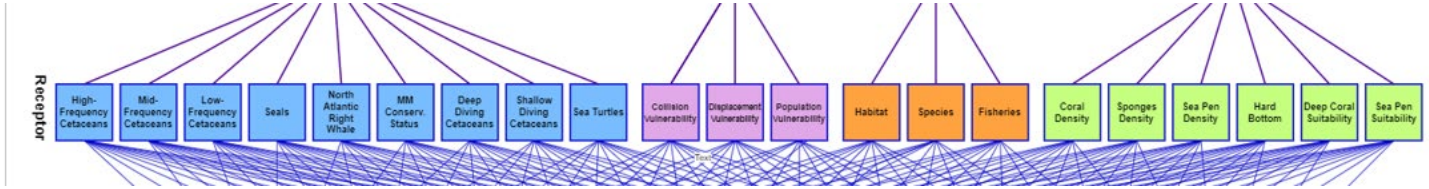


NYSERDA Master Plan 2.0

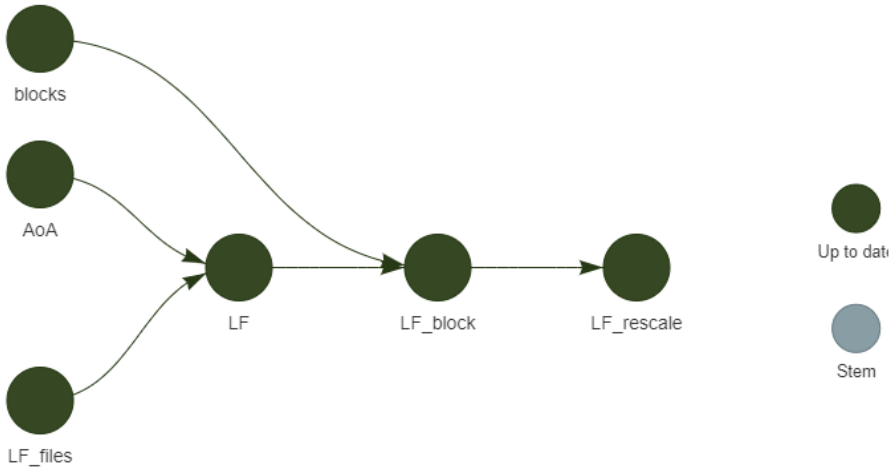
- Framework:
  - Planning Level Analysis
  - Broad-scale focus on relevant environmental issues
  - Identify OSW Stressors and impacts on Receptors
  - Incorporate different construction phases
- Goal: Environmental Sensitivity Analysis (SA)
- Input Data:
  - Marine Mammals & Sea Turtles, Birds & Bats, Fish & Fisheries, Benthic Habitats
- Rescale: rescale to 0-1 interval
- Weights: Analytic Hierarchy Process to determine weights from SME elicitation
- Combined: Weighted Sum Overlay
- Address Uncertainty
- Modular & Adaptable

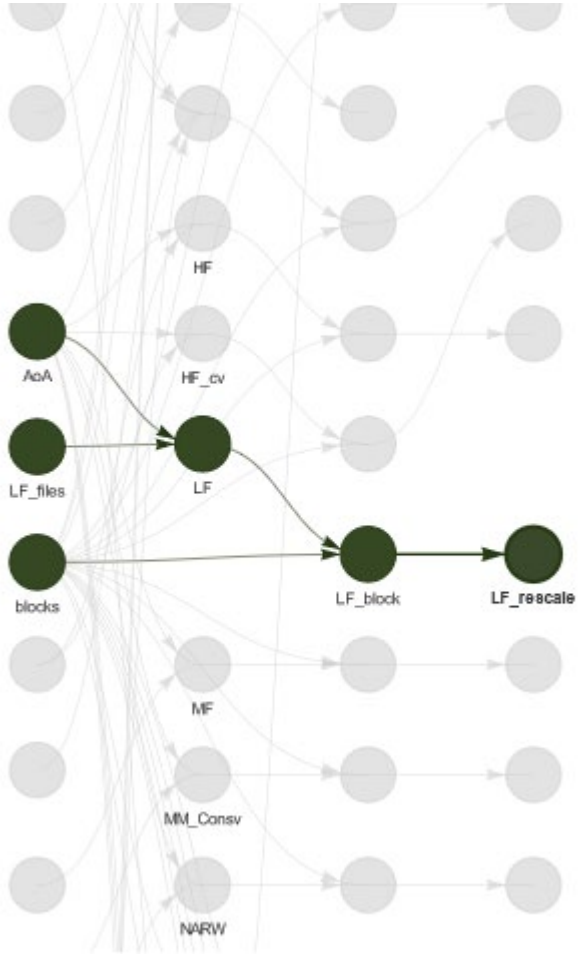


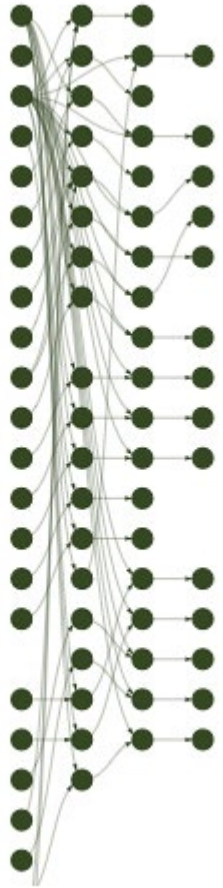
Data Processing



- Overall approach:
  - Collect all source files
  - Clip source files (rasters) to AoA area (w/small buffer)
  - Combine data files (sum)
  - Intersect (merge) the data with the BOEM blocks layer (area weighted average)
  - Rescale the data to 0-1 range
- Geoprocessing done in R, coordinated using `targets` package







Weighting

- **Analytical Hierarchy Process**
  - Expert Elicitation
  - Operations Research / Theory of Decision making
  - *Structured technique for organizing and analyzing complex decisions, based on mathematics and psychology*
  - Developed by Saaty in the 1980s
  - Pairwise Comparisons
  - Series of questionnaire's that ask to make pairwise comparisons between things and rank them

- Benefits of AHP:
  - Quantitative rigor
  - Breaks down the problem into small parts
  - Forces rationale and supporting evidence
  - Consistency Ratio
  - Multiple respondents
  - "Unbiased"

Mathl Modelling, Vol. 9, No. 3–5, pp. 161–176, 1987
Printed in Great Britain. All rights reserved

0270-0255/87 $3.00 + 0.00
Copyright © 1987 Pergamon Journals Ltd

THE ANALYTIC HIERARCHY PROCESS—WHAT IT IS AND HOW IT IS USED

R. W. SAATY
4922 Ellsworth Avenue, Pittsburgh, PA 15213, U.S.A.

Abstract—Here we introduce the Analytic Hierarchy Process as a method of measurement with ratio scales and illustrate it with two examples. We then give the axioms and some of the central theoretical underpinnings of the theory. Finally, we discuss some of the ideas relating to this process and its ramifications. In this paper we give special emphasis to departure from consistency and its measurement and to the use of absolute and relative measurement, providing examples and justification for rank preservation and reversal in relative measurement.

Weighting

- Compare each Child against another with respect to the Parent and score 1-9
- *How <u>much more important</u> is <LEFT SIDE> vs. <RIGHT SIDE> with respect to the Parent*
- PROVIDE RATIONAL!

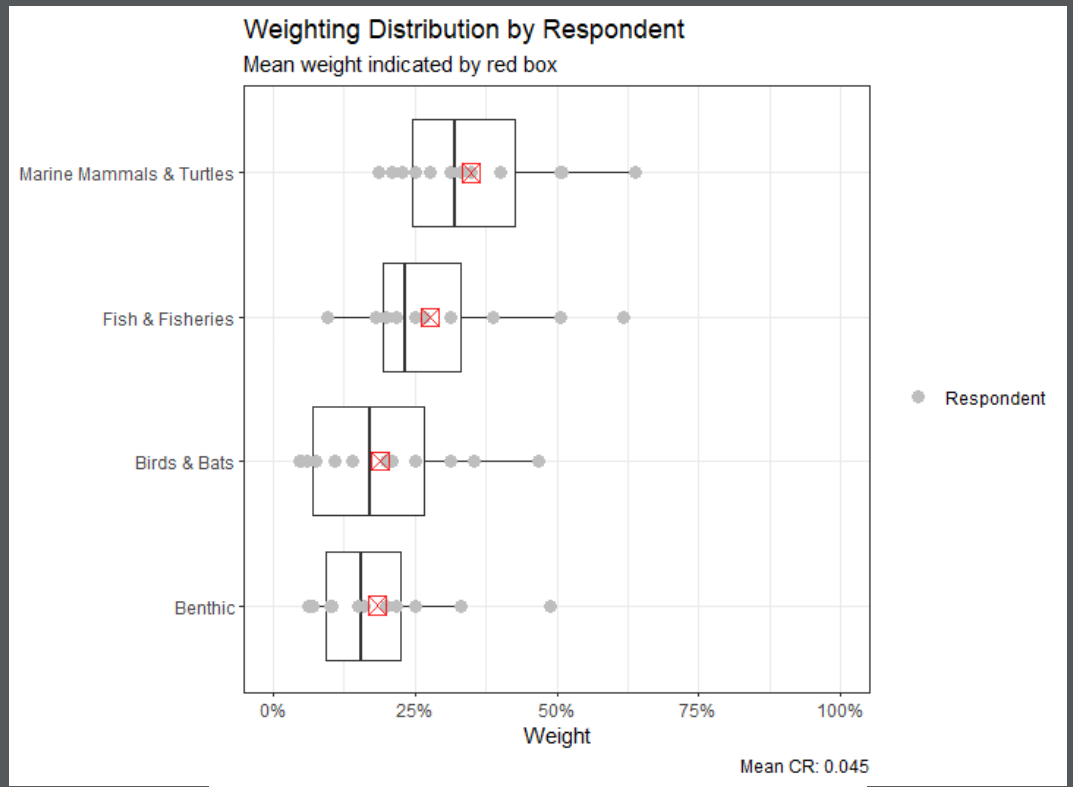
The Fundamental Scale of Pairwise Comparisons		
Intensity of Importance	**Definition**	**Explanation**
1	Equal Risk	The two elements have equal risk relative to the parent
3	Moderate Risk	Experience and judgement determine that one element is moderately more risk than another
5	Strong Risk	Experience and judgement determine that one element is strongly more risky than another
7	Very Strong Risk	One element is very strongly more risky over another; its dominance is demonstrated in practice
9	Extreme Risk	The evidence for one element being more risky than the other is of the highest possible order of affirmation
Risks of 2, 4, 5, and 8 can be used to express intermediate values.		

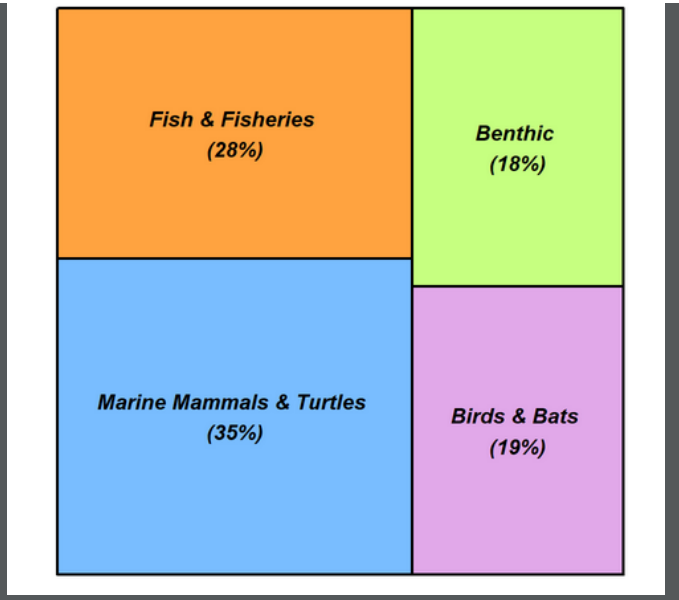
*Adapted from Saaty, R. W. (1987). The analytic hierarchy process—What it is and how it is used. Mathematical Modelling, 9(3–5), 161–176. https://doi.org/10.1016/0270-0255(87)90473-8

What is the risk contribution	Between:	Extreme		Very Strong		Strong		Moderate		Equal Risk		Moderate		Strong		Very Strong		Extreme	And:	Required
										=										Why?
Parent	**Receptor_1**	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	**Receptor_2**	**Rationale**
Sensitivity	Marine Mammals & Turtles								✔										Birds & Bats	I think there is **slightly more** risk to **Mammals** than **Birds** due to OSW development because…
Sensitivity	Marine Mammals & Turtles							✔											Fish & Fisheries	I think there is **moderately** more risk to **Mammals** than **Fish/Fisheries** due to OSW dev. Because…
Sensitivity	Marine Mammals & Turtles					✔													Benthic	I think there is **strongly** more risk to **Mammals** than **Benthic** due to OSW dev. Because…
Sensitivity	Birds & Bats								✔										Fish & Fisheries	I think there is **slightly more** risk to **Mammals** than **Fish** due to OSW development because…
Sensitivity	Birds & Bats									✔									Benthic	I think that there is **equal** risk to **Birds** as there is to **Benthic** due to OSW dev. Because…
Sensitivity	Fish & Fisheries											✔							Benthic	I think that there is **moderately** more risk to **Benthic** as there is to **Fish** due to OSW dev. Because…

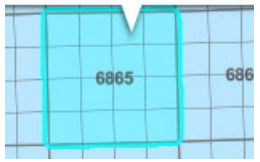
Weighting – Level 1 Results

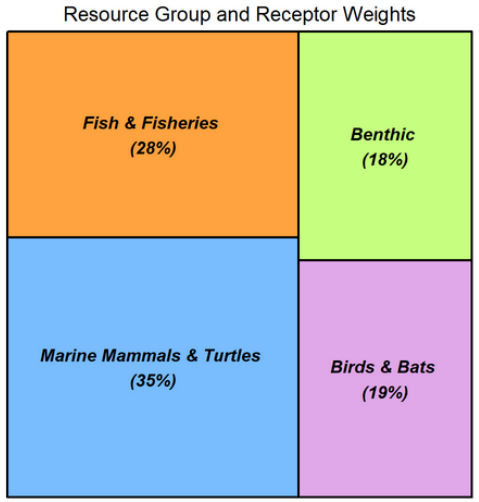
Respondent	Marine Mammals & Turtles	Birds & Bats	Fish & Fisheries	Benthic	CR
Sr. Fisheries and Aquatic Scientist	25%	25%	25%	25%	0.000
Sr. Fisheries and Aquatic Scientist	35%	5%	51%	10%	0.042
Sr. Quantitative Ecologist/Avian Scientist	28%	47%	10%	16%	0.012
Sr. Avian Scientist	31%	31%	31%	6%	0.000
Sr. Marine Mammal Biologist	40%	20%	20%	20%	0.000
Sr. Marine Mammal Biologist	19%	35%	39%	7%	0.100
Sr. Benthic Scientist	51%	6%	22%	22%	0.058
Sr. Benthic Scientist	33%	14%	20%	33%	0.023
Research Scientist and Regulatory Specialist	23%	5%	62%	10%	0.055
Sr. Offshore Wind Development Consultant	51%	8%	27%	15%	0.075
Ocean and Lakes Policy Analyst	21%	21%	10%	49%	0.058
Sr. Offshore Wind Development Consultant	64%	11%	18%	7%	0.114
Mean	35%	19%	28%	18%	0.045

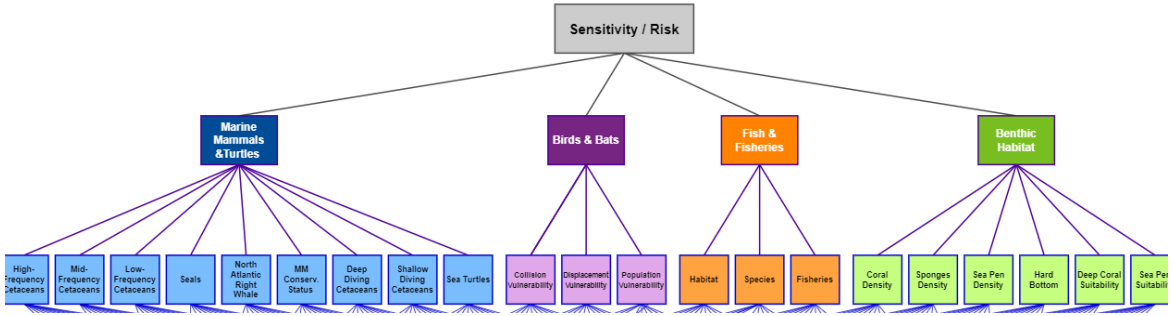


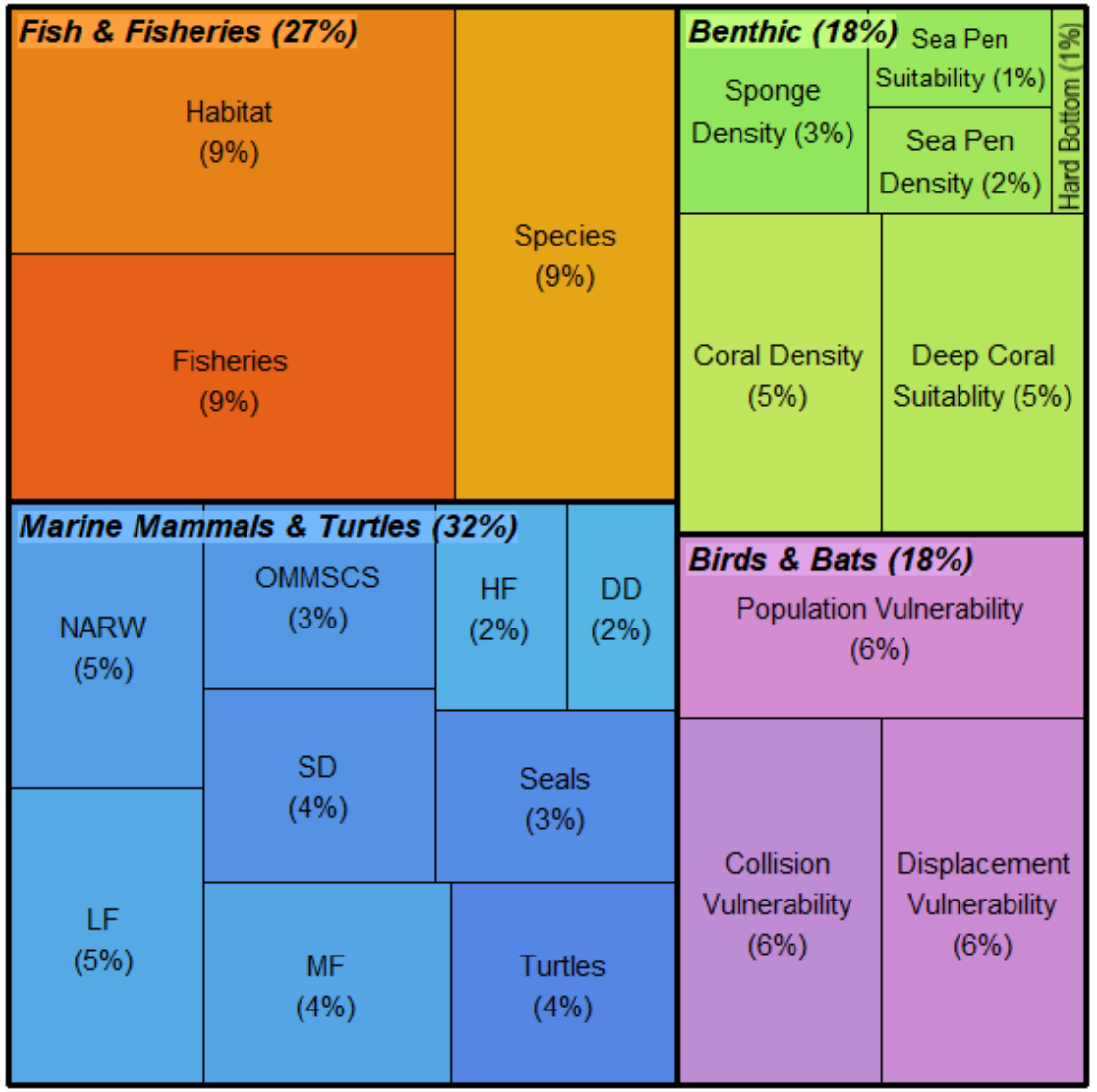


Weighting – Level 1 Results



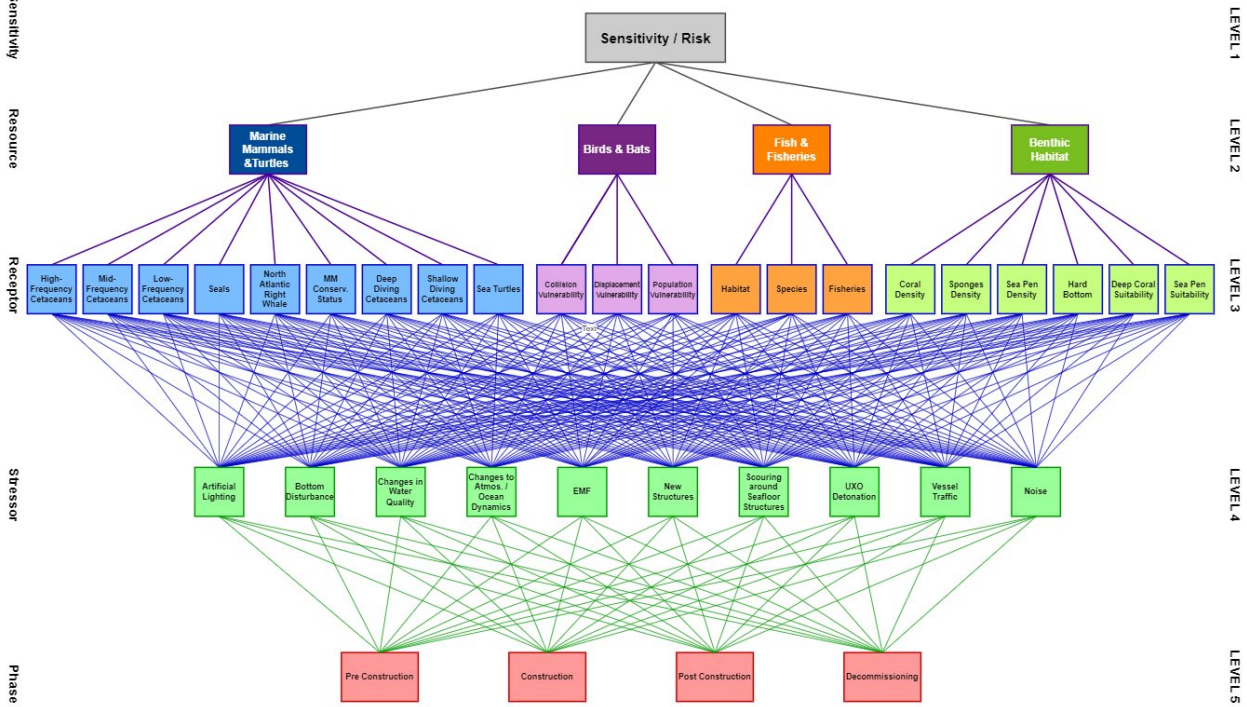




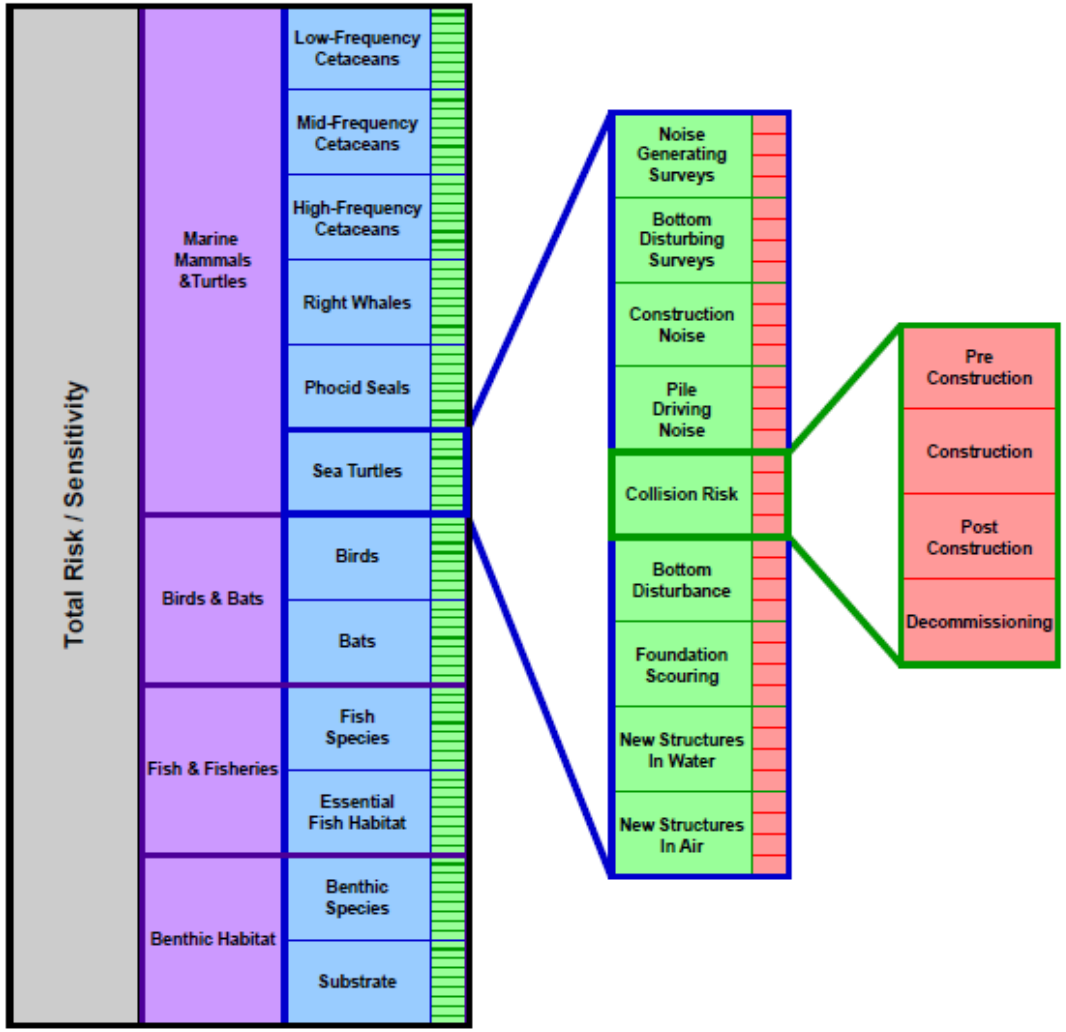


Weighting

- Repeat this process for all parent-child
- Can compute each risk partition

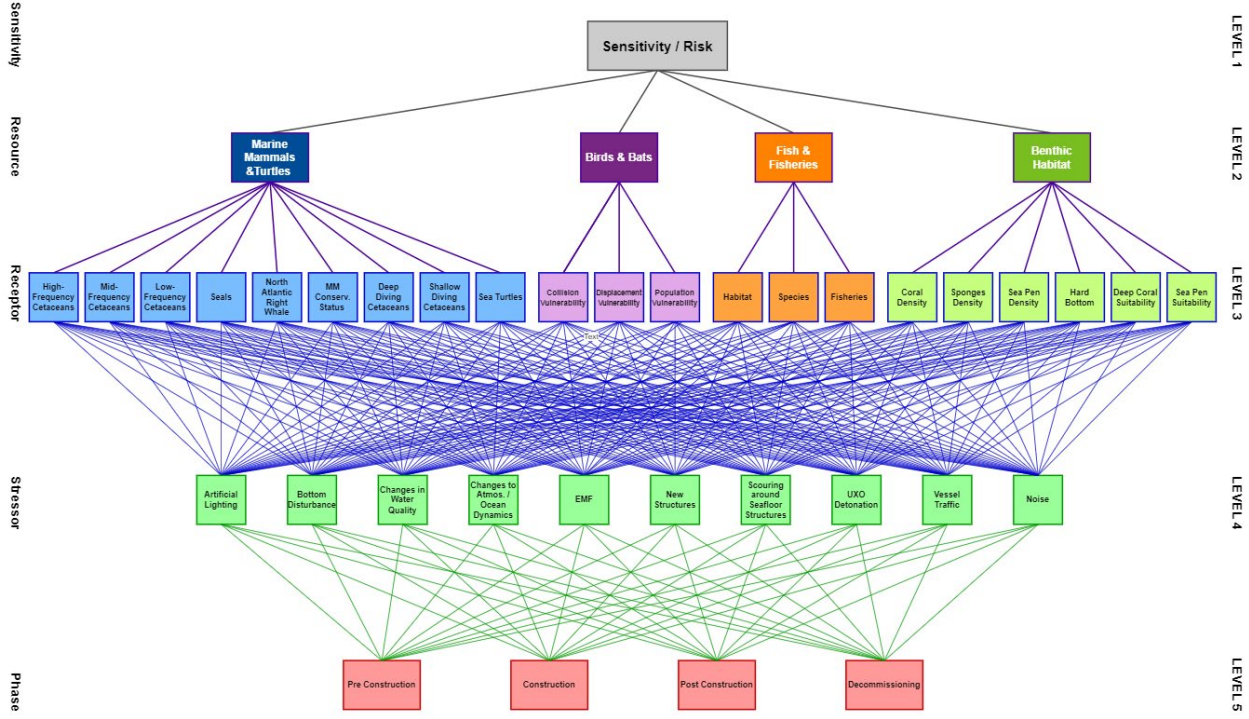


Level 1 Sensitivity	Level 2 Resource	Level 3 Receptor	Level 4 Stressor	Level 5 Phase
Total Risk	Resource Risk	Receptor Risk	Collision Risk	Phase Risk
Sum of Resources	*Sum of Receptors by Resource*	*Sum of Stressors for Each Receptor*	*Sum of Phases for Each Stressor*	*Fractional Risk for Each Phase*



Weighting

- Repeat this process for all parent-child
- Can compute each risk partition
- Receptor x Stressor



Row Labels	Deep Diving Cetaceans	High-Frequency Cetaceans	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	NARW	Other MM of Special Conservation Status	Seals	Shallow Diving Cetaceans	Turtles
Artificial Lighting	4%	10%	6%	8%	4%	4%	8%	7%	6%
Bottom Disturbance	4%	4%	5%	4%	2%	5%	10%	5%	9%
Changes in Water Quality	9%	7%	4%	7%	5%	6%	4%	6%	5%
Changes to Atmospheric/ Oceanographic Dynamics	7%	4%	8%	6%	3%	4%	4%	5%	4%
EMF	3%	3%	2%	3%	2%	2%	4%	3%	3%
New Structures	19%	21%	19%	17%	21%	19%	24%	16%	20%
Noise	19%	19%	17%	26%	18%	14%	16%	13%	15%
Scouring around Seafloor Structures	4%	4%	6%	5%	2%	5%	9%	5%	4%
UXO Detonation	25%	16%	11%	19%	12%	12%	15%	13%	12%
Vessel Traffic	5%	12%	22%	4%	31%	30%	5%	28%	23%
Grand Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

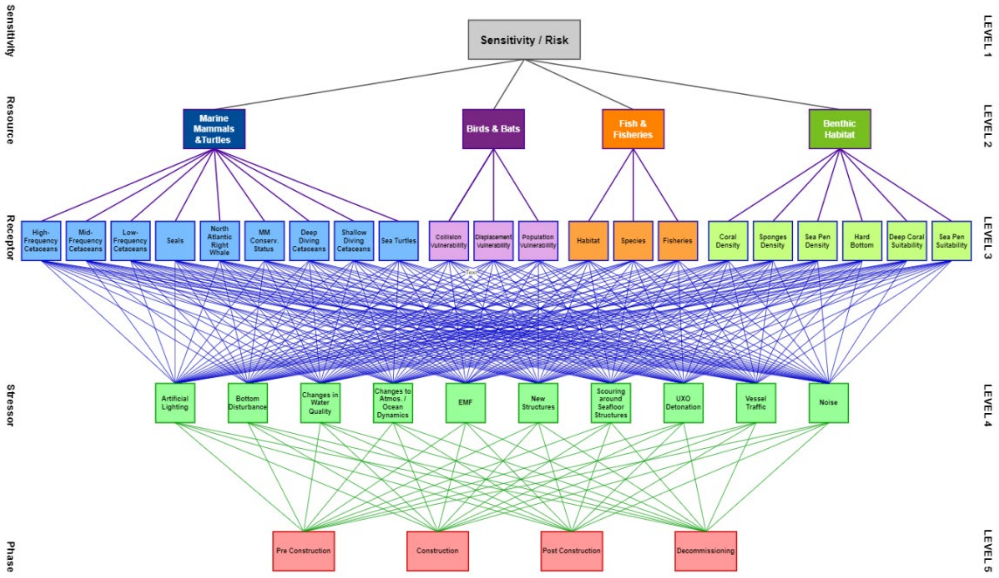
Row Labels	Birds - CV	Birds - DV	Birds - PV
Artificial Lighting	24%	17%	19%
Bottom Disturbance	6%	11%	12%
Changes in Water Quality	5%	7%	8%
Changes to Atmospheric/ Oceanographic Dynamics	5%	7%	8%
EMF	4%	2%	2%
New Structures	28%	33%	27%
Noise	5%	5%	5%
Scouring around Seafloor Structures	4%	2%	2%
UXO Detonation	5%	3%	3%
Vessel Traffic	14%	11%	12%
Grand Total	100%	100%	100%

Row Labels	Fisheries	Habitat	Species
Artificial Lighting	2%	2%	3%
Bottom Disturbance	19%	28%	28%
Changes in Water Quality	7%	8%	8%
Changes to Atmospheric/ Oceanographic Dynamics	12%	13%	13%
EMF	5%	7%	6%
New Structures	29%	14%	11%
Noise	8%	10%	13%
Scouring around Seafloor Structures	4%	6%	6%
UXO Detonation	4%	5%	4%
Vessel Traffic	10%	8%	8%
Grand Total	100%	100%	100%

Stressor	Coral Density	Sponge Density	Sea Pen Density	Hard Bottom	Deep Coral Suitability	Sea Pen Habitat Suitability
Artificial Lighting	2%	2%	2%	3%	2%	2%
Bottom Disturbance	43%	43%	43%	39%	43%	43%
Changes in Water Quality	10%	10%	9%	5%	10%	9%
Changes to Atmospheric/ Oceanographic Dynamics	11%	11%	10%	6%	11%	10%
EMF	2%	2%	2%	2%	2%	2%
New Structures	16%	16%	16%	14%	16%	16%
Noise	5%	5%	4%	2%	5%	4%
Scouring around Seafloor Structures	4%	4%	8%	14%	4%	8%
UXO Detonation	2%	2%	2%	11%	2%	2%
Vessel Traffic	6%	6%	5%	5%	6%	5%
Total	100%	100%	100%	100%	100%	100%

Weighting

- Repeat this process for all parent-child
- Can compute each risk partition
- Stressor x Phase



resource: Marine Mammals & Turtle

Sum of MeanPref / Row Labels	Artificial Lighting	Bottom Disturbance	Changes in Water Quality	Changes to Atmospheric/ C	EMF	New Structures	Noise	Scouring around Se	UXO Detonation	Vessel Traffic
Pre-Construction	11%	7%	7%	14%	17%	8%	5%	12%	70%	11%
Construction	35%	46%	39%	14%	17%	21%	58%	19%	10%	38%
Post-Constructior	19%	13%	15%	46%	50%	49%	11%	42%	10%	17%
Decommissionin	35%	33%	39%	26%	17%	23%	26%	27%	10%	34%
Grand Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

resource: Birds & Bats

Sum of MeanPref / Row Labels	Artificial Lighting	Bottom Disturbance	Changes in Water Quality	Changes to Atmospheric/ C	EMF	New Structures	Noise	Scouring around Se	UXO Detonation	Vessel Traffic
Pre-Construction	12%	17%	20%	42%	25%	16%	16%	25%	47%	20%
Construction	23%	33%	22%	23%	25%	28%	47%	25%	28%	22%
Post-Constructior	42%	17%	23%	12%	25%	47%	10%	25%	16%	23%
Decommissionin	23%	33%	35%	23%	25%	10%	28%	25%	10%	35%
Grand Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

resource: Fish & Fisheries

Sum of MeanPref / Row Labels	Artificial Lighting	Bottom Disturbance	Changes in Water Quality	Changes to Atmospheric/ C	EMF	New Structures	Noise	Scouring around Se	UXO Detonation	Vessel Traffic
Pre-Construction	8%	10%	12%	12%	11%	13%	10%	11%	45%	12%
Construction	56%	52%	52%	11%	11%	16%	52%	11%	17%	51%
Post-Constructior	14%	15%	12%	36%	53%	30%	13%	39%	17%	13%
Decommissionin	23%	24%	24%	41%	24%	42%	26%	39%	20%	24%
Grand Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

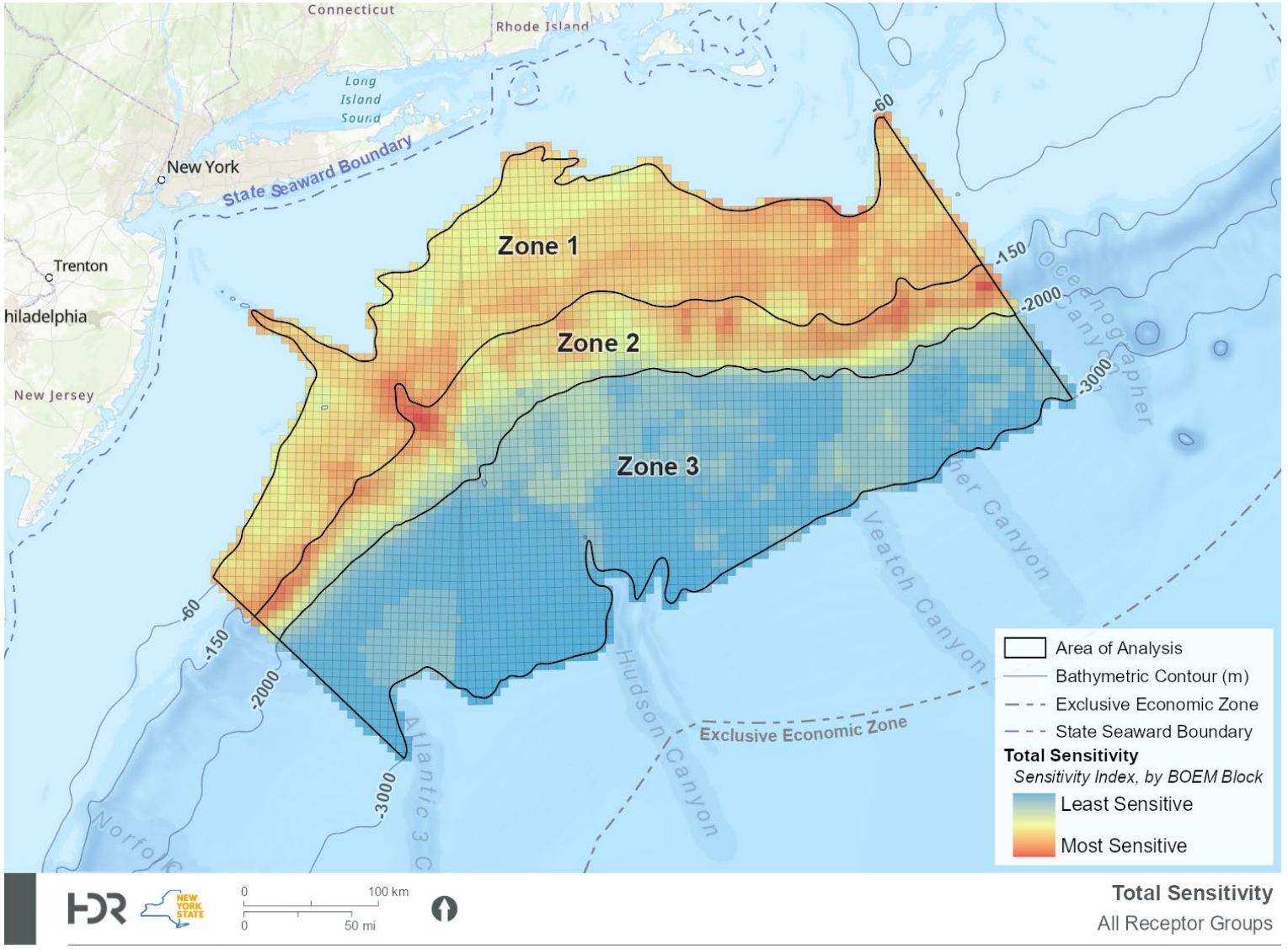
resource: Benthic

Sum of MeanPref / Row Labels	Artificial Lighting	Bottom Disturbance	Changes in Water Quality	Changes to Atmospheric/ C	EMF	New Structures	Noise	Scouring around Se	UXO Detonation	Vessel Traffic
Pre-Construction	25%	7%	16%	6%	18%	6%	9%	7%	17%	8%
Construction	25%	49%	25%	15%	18%	18%	44%	10%	50%	41%
Post-Constructior	25%	9%	34%	61%	48%	66%	11%	66%	17%	10%
Decommissionin	25%	35%	25%	17%	18%	10%	36%	17%	17%	41%
Grand Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

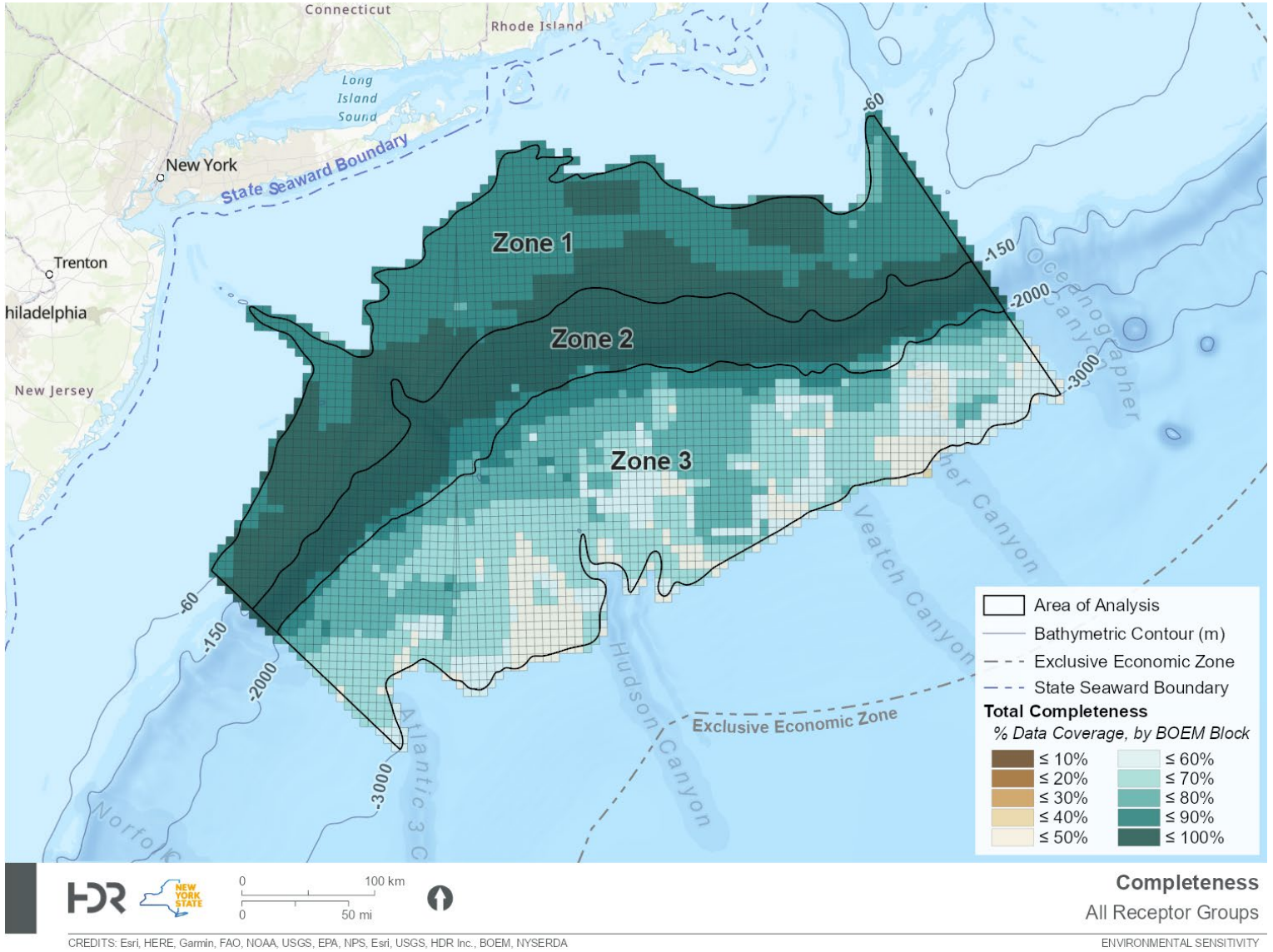
level: L4_Stressor

Sum of MeanPref / Row Labels	Artificial Lighting	Bottom Disturbance	Changes in Water Quality	Changes to Atmospheric/ Oceanographic Dynamics	EMF	New Structures	Noise	Scouring around Seafloor Structures	UXO Detonation	Vessel Traffic
Pre-Construction	15%	10%	14%	15%	17%	10%	10%	12%	40%	12%
Construction	36%	47%	36%	15%	17%	20%	49%	15%	29%	41%
Post-Constructior	23%	13%	22%	42%	46%	51%	11%	46%	16%	15%
Decommissionin	26%	31%	29%	27%	21%	19%	30%	27%	16%	33%
Grand Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Overall Sensitivity



Overall Completeness



Sensitivity by Phase