Regional Surveys to Improve Understanding of Ecosystems and Relevance to Offshore Wind Energy Development

SEER webinar #1

31 May 2023

From Surveys to Models: Habitat-Based Species Density Models Informing Offshore Wind Development for the US Atlantic coast

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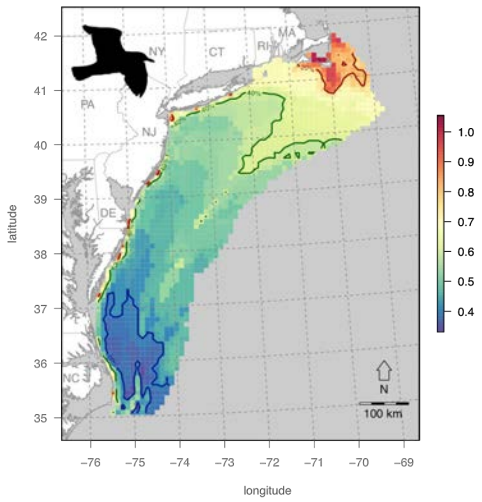
J. Roberts, T. Yack, D. Brill, & J. Cleary

U.S. DEPARTMENT OF ENERGY

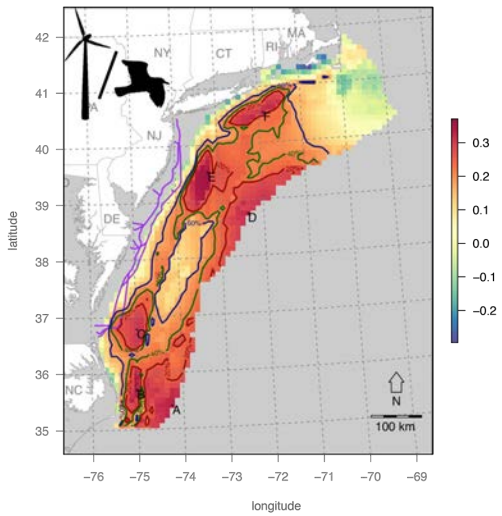
Award DE-EE0010287, Offshore Wind Energy Environmental Research and Instrumentation Validation

BOEM Bureau of Ocean Energy Management

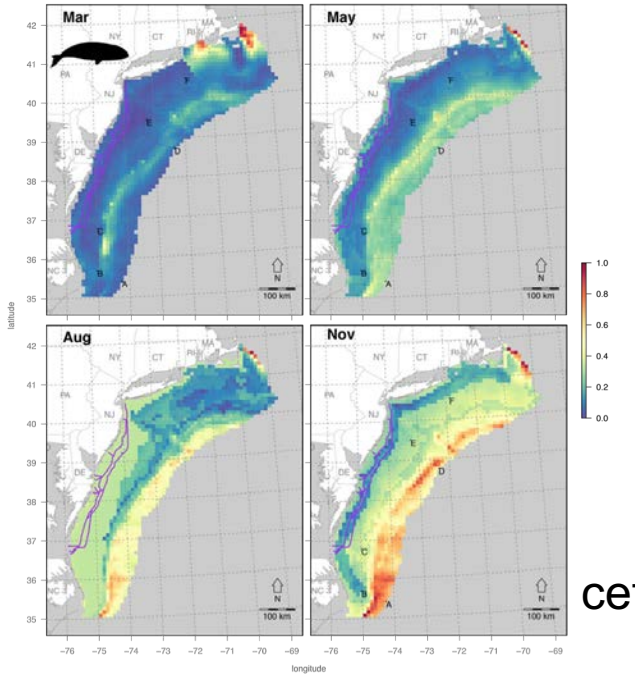
SDM models allow us to estimate species ***occurrence*** within offshore wind development areas



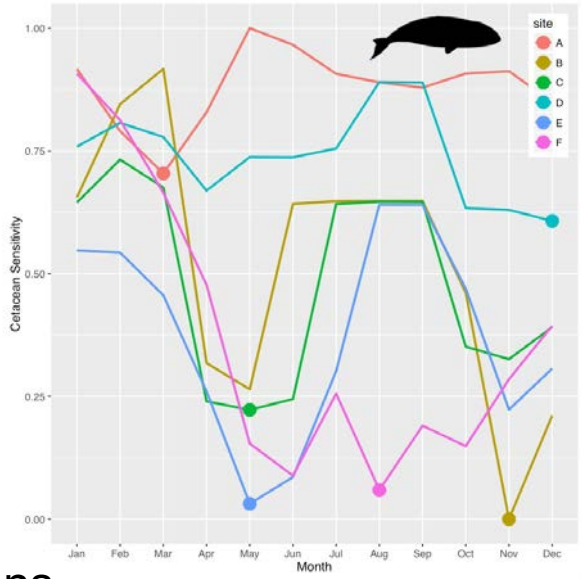
seabirds: year-round interactions



Space
(where)

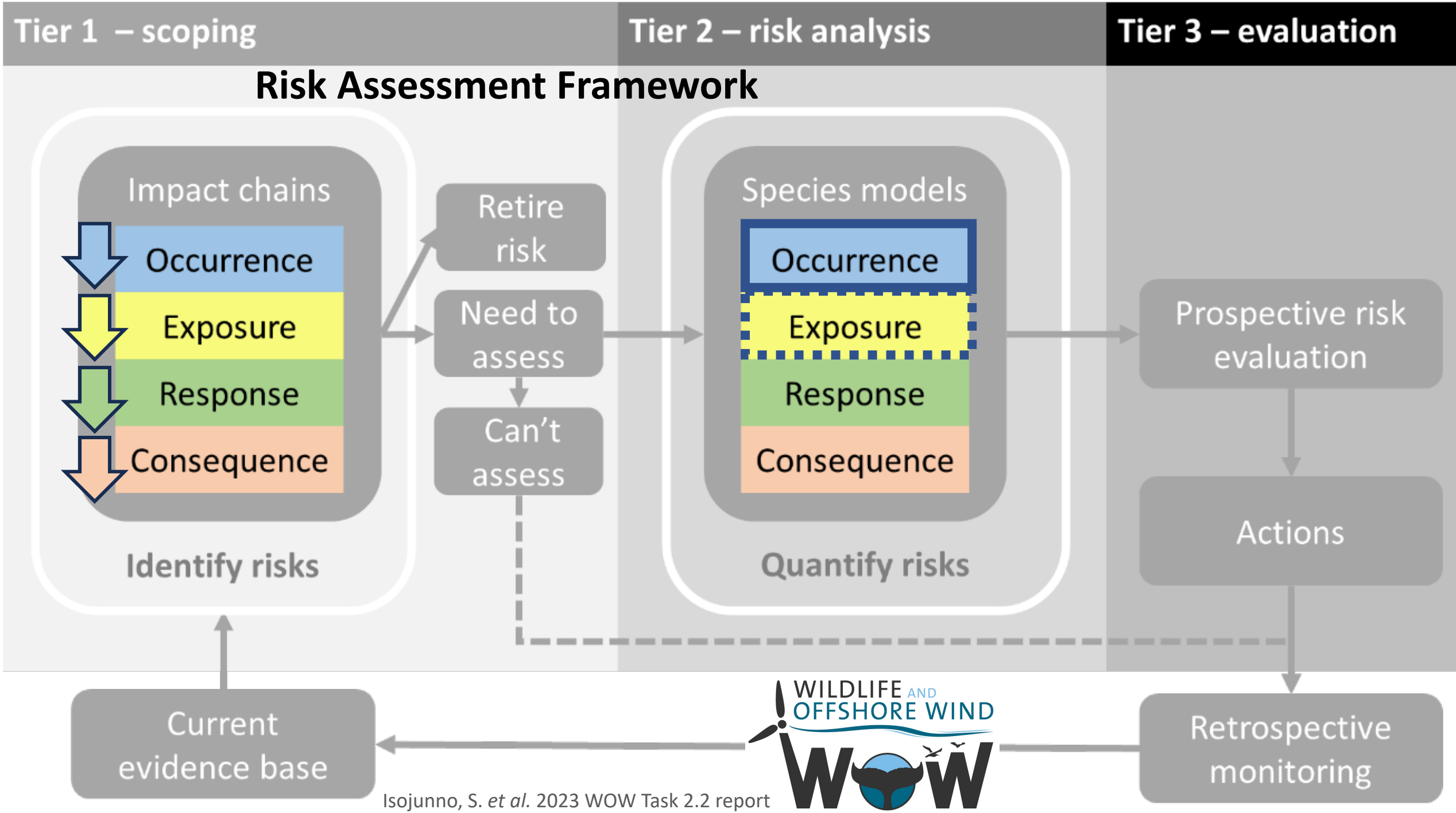


cetaceans: construction interactions

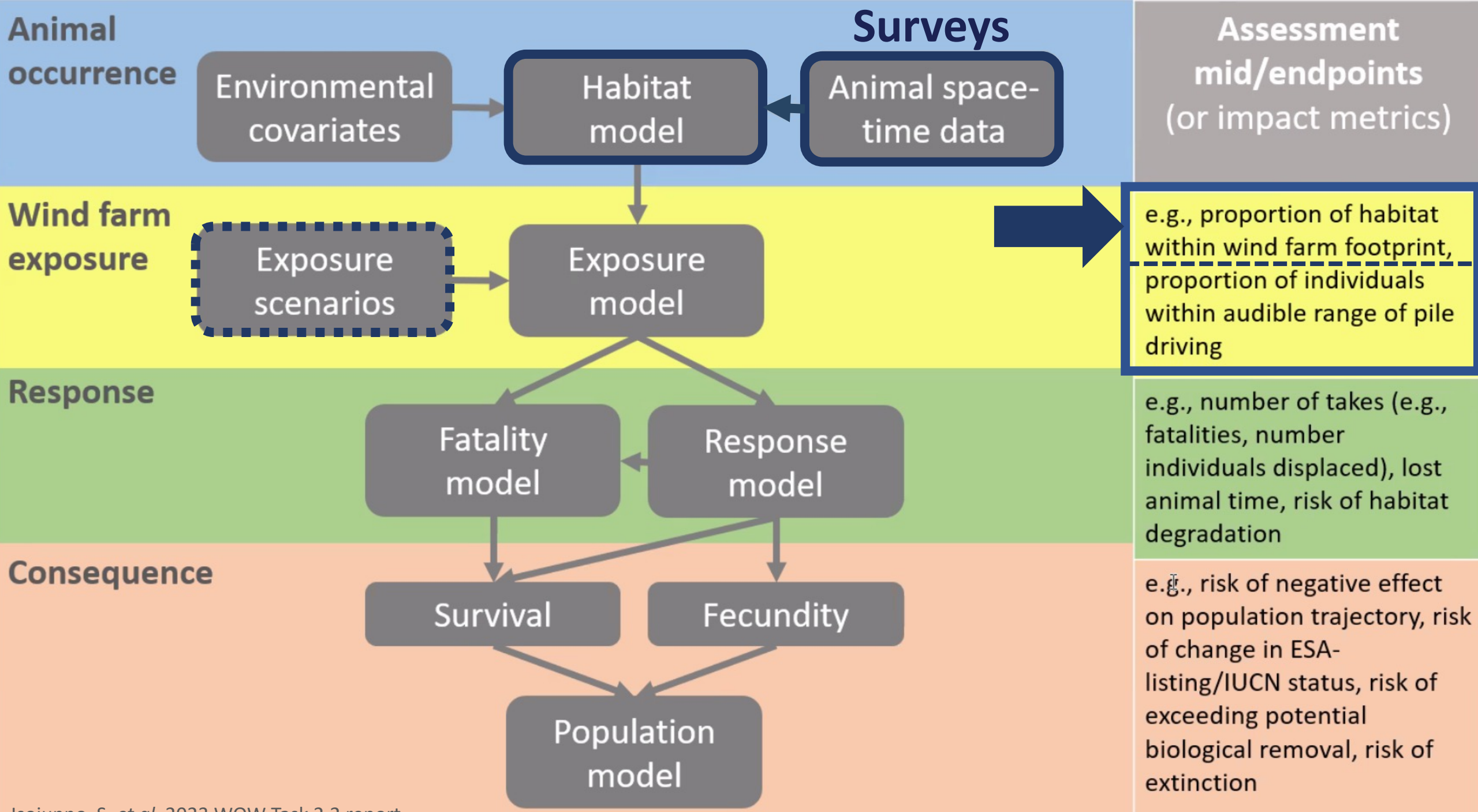


Time
(when)

From Best & Halpin 2018



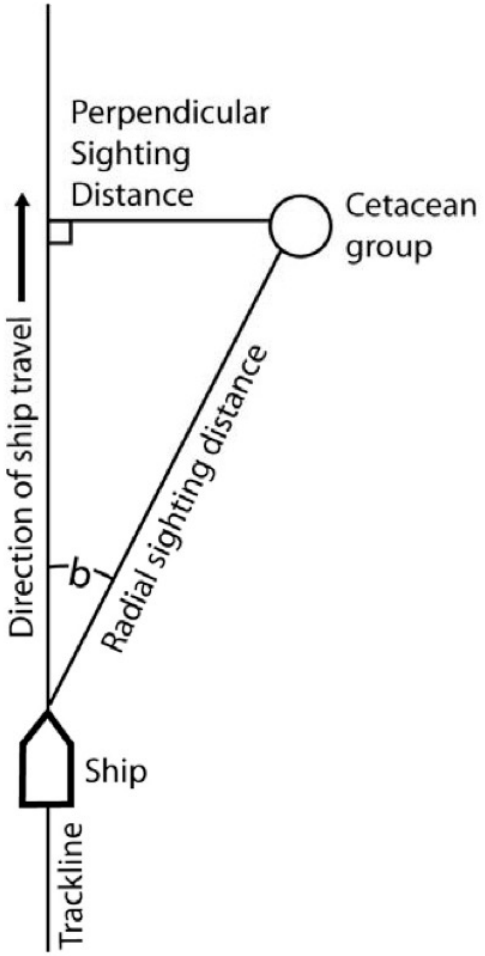
Isojunno, S. *et al.* 2023 WOW Task 2.2 report



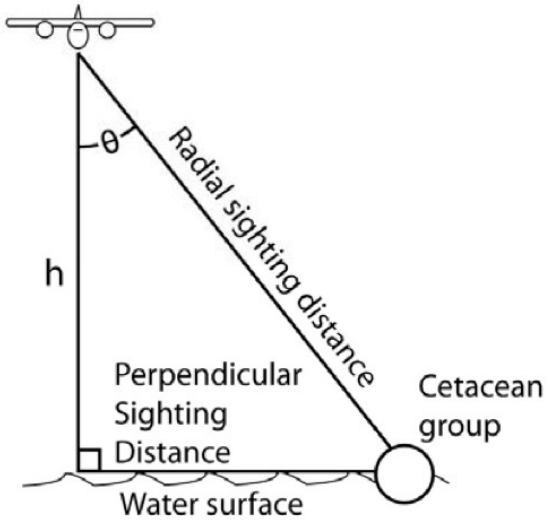
Isojunno, S. *et al.* 2023 WOW Task 2.2 report

Forecasting Process

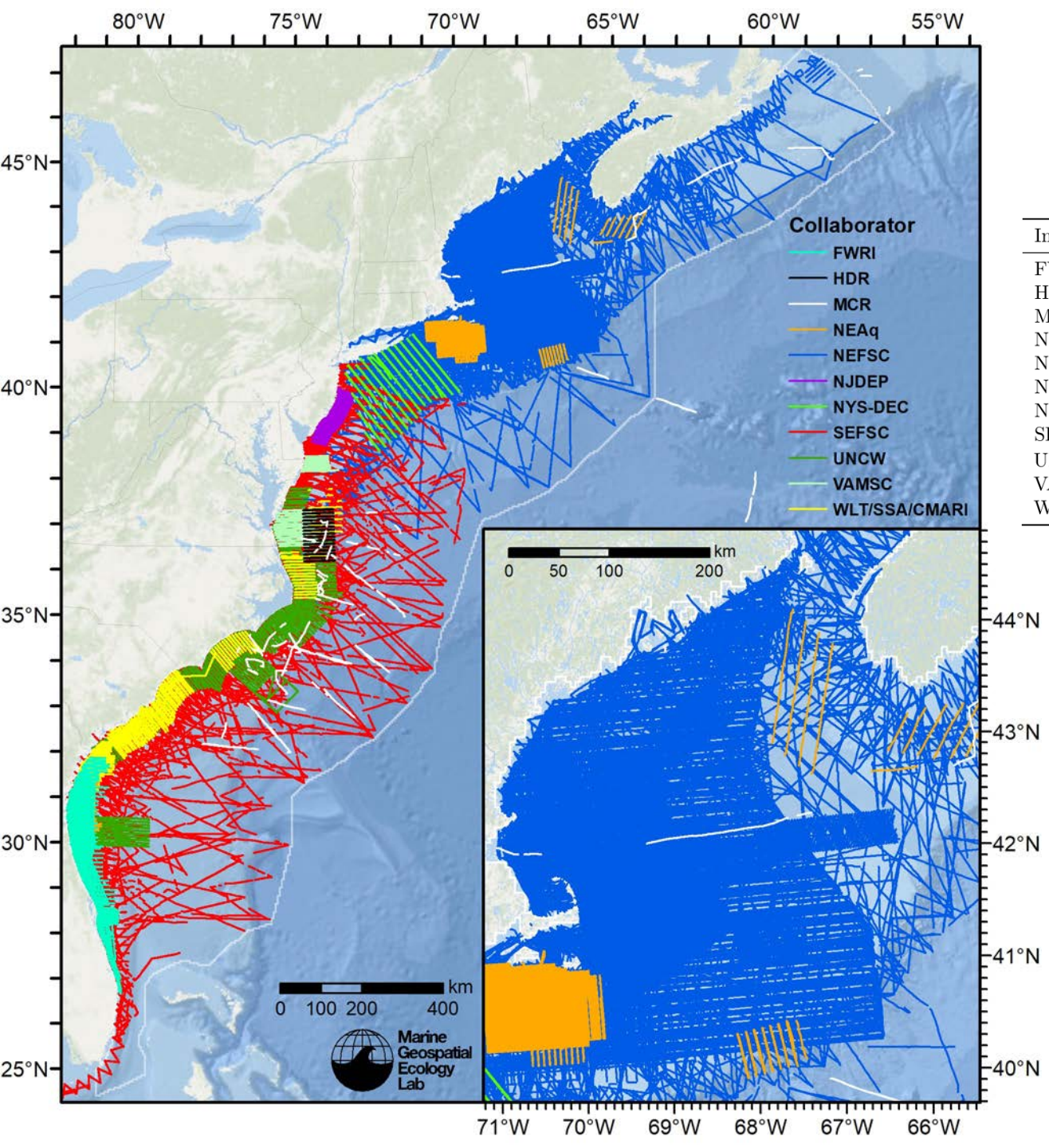
Step 1: Data collection by cetacean observation teams



http://nefsc.noaa.gov



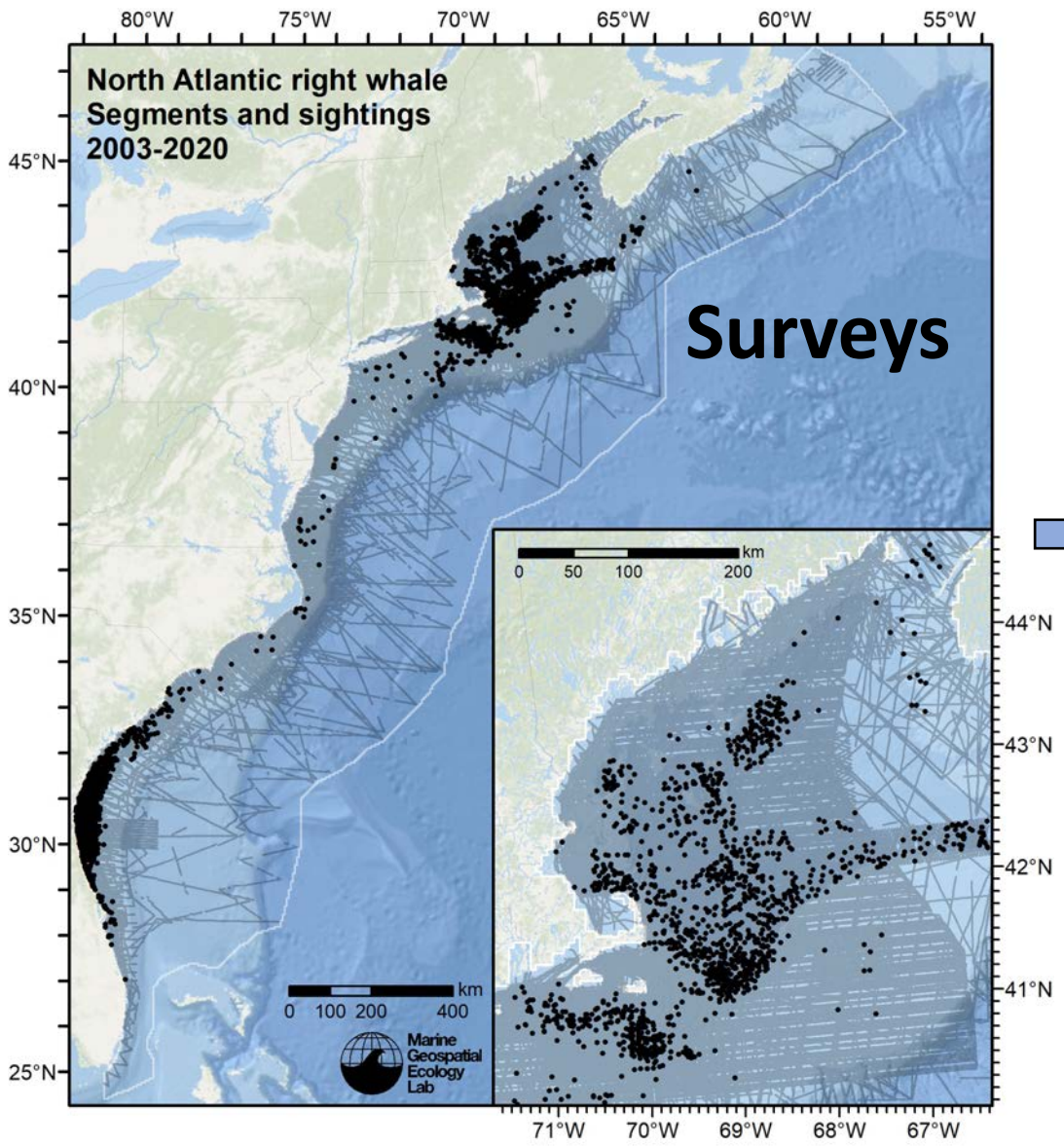
Collaborating survey programs



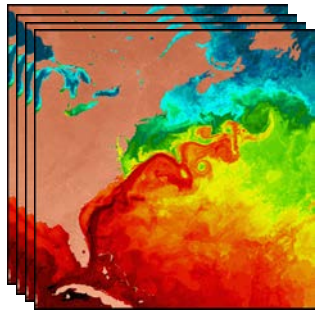
Institution	Full Name
FWRI	FWC Fish and Wildlife Research Institute
HDR	HDR, Inc.
MCR	Marine Conservation Research
NEAq	New England Aquarium
NEFSC	NOAA Northeast Fisheries Science Center
NJDEP	New Jersey Department of Environmental Protection
NYS-DEC/TT	New York State Department of Environmental Conservation and Tetra Tech, Inc.
SEFSC	NOAA Southeast Fisheries Science Center
UNCW	University of North Carolina Wilmington
VAMSC	Virginia Aquarium & Marine Science Center
WLT/SSA/CMARI	Wildlife Trust, Sea to Shore Alliance, and Clearwater Marine Aquarium Research Institute

Thanks again for your collaboration!

Modeling density

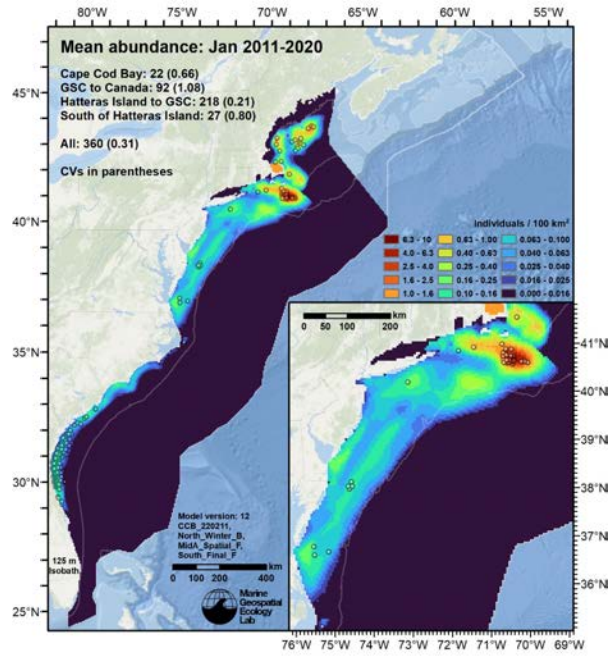


Oceanographic data

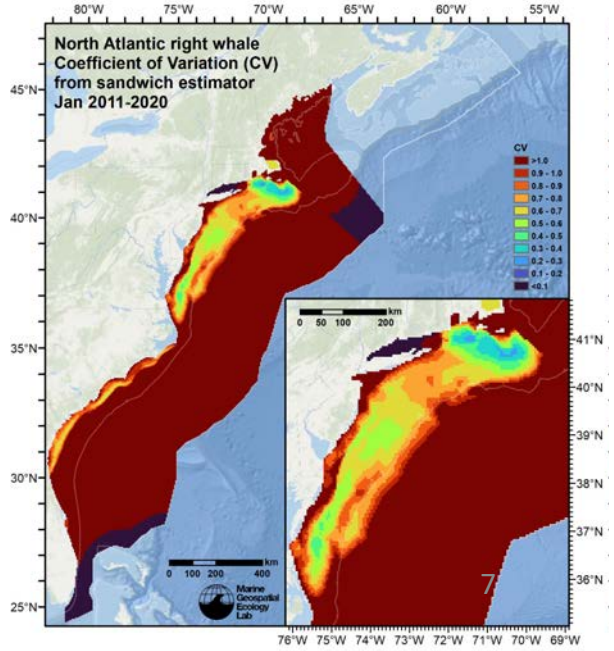


Density Surface Modeling

Density maps (whales / km^2)

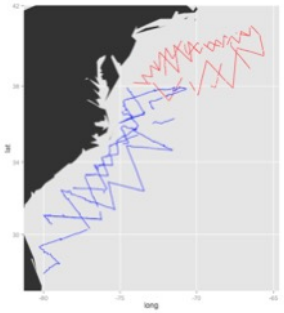


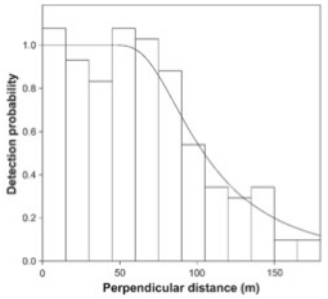
Uncertainty maps

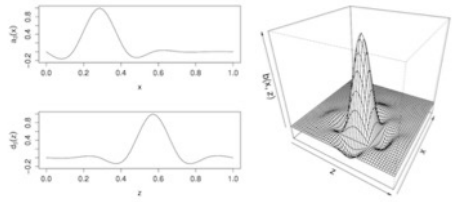


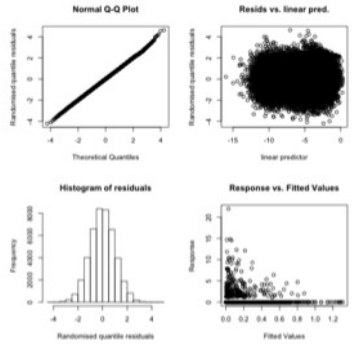
Density surface modeling (DSM)

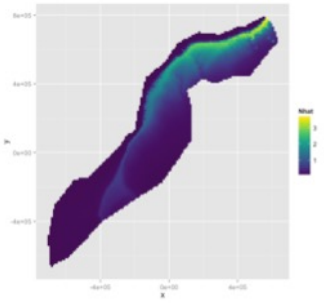
(Hedley and Buckland 2004; Miller et al. 2013)











Line transects

Detectability

Spatial model (GAM)

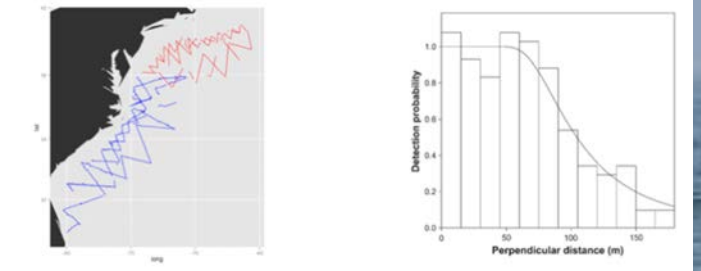
Model checking/ criticism

Predictions

Oceanographic data

Stage 1

Adapted from figure by David L. Miller



Line transects → Detectability

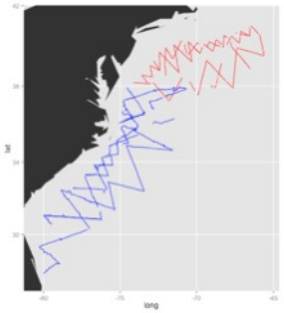
Perception bias: *what was an observing actually able to see?*

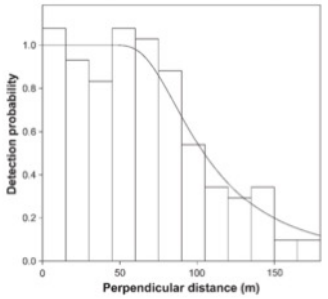
Availability bias: *how long are animals actually at the surface?*

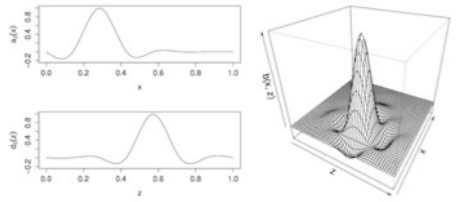
Photo: Scott and Mary Flanders

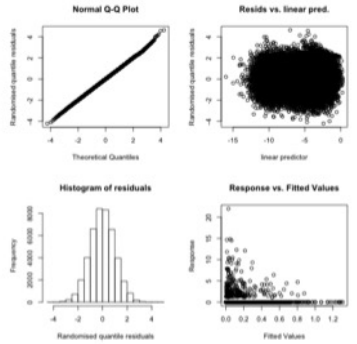
Density surface modeling (DSM)

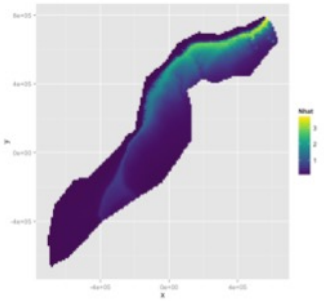
(Hedley and Buckland 2004; Miller et al. 2013)











Line transects → Detectability → Spatial model (GAM) ⇄ Model checking/ criticism → Predictions

Oceanographic data → Spatial model (GAM)

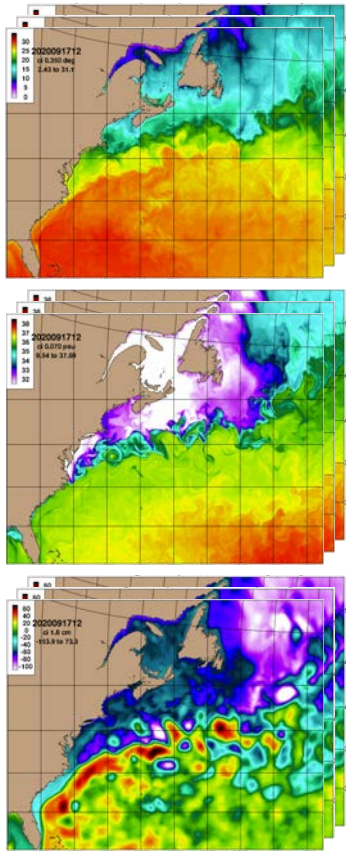
Oceanographic data → Predictions

Stage 1

Stage 2

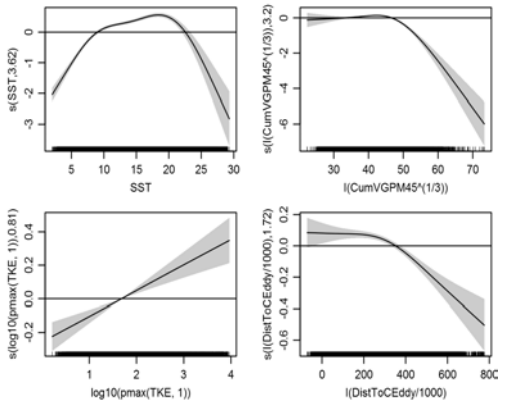
Adapted from figure by David L. Miller

Predicting and summarizing across time

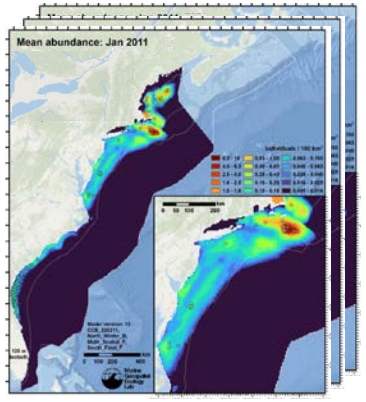


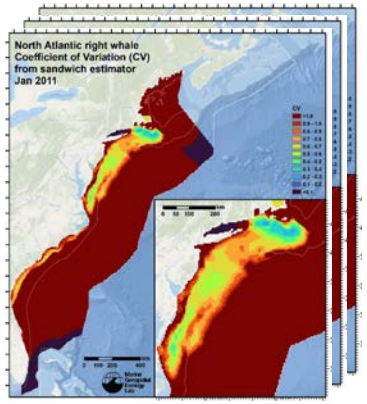
Time series of maps of covariates

$$\mathbb{E}(\hat{N}_j) = A_j \exp\left[\beta_0 + \sum_k f_k(z_{jk})\right]$$

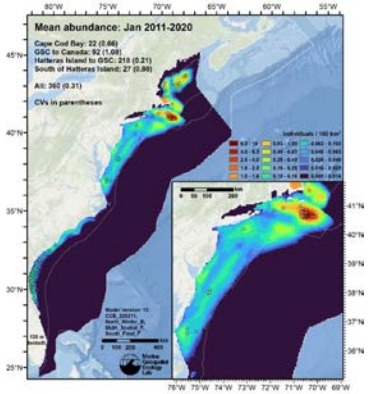


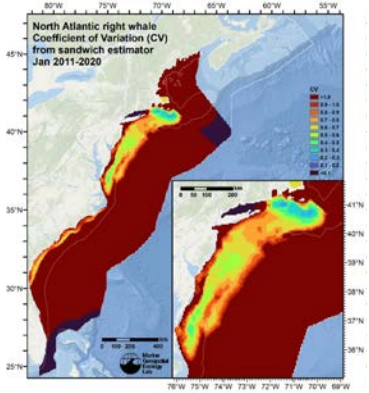
Spatial model





Time series of maps of predicted density and uncertainty

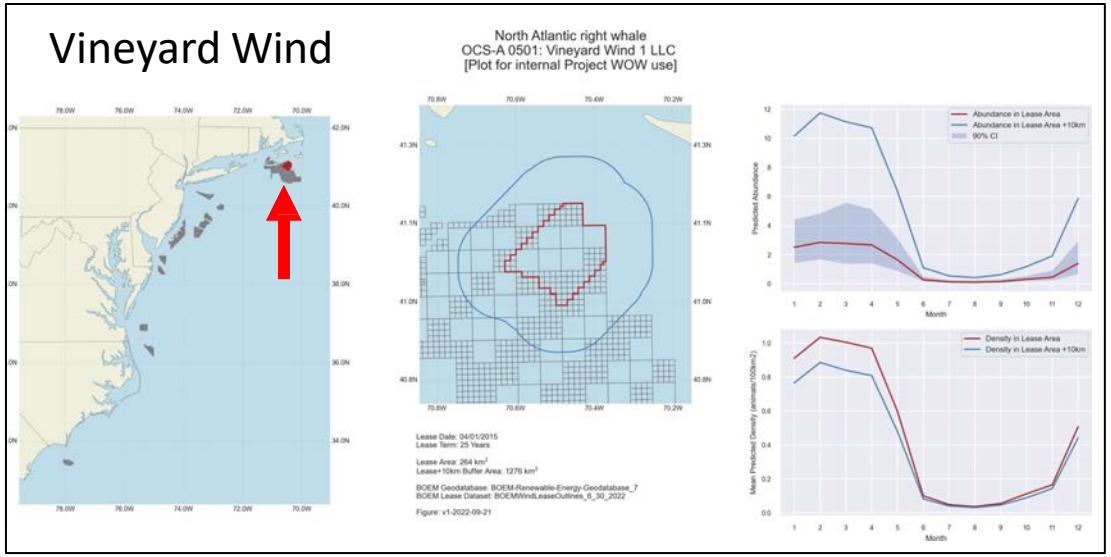




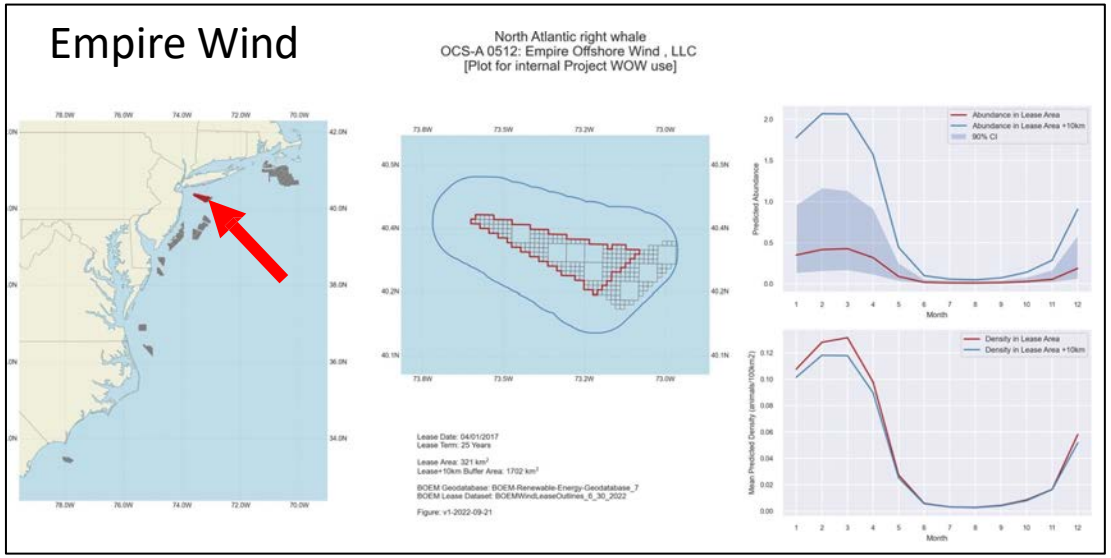
Summaries for decision making

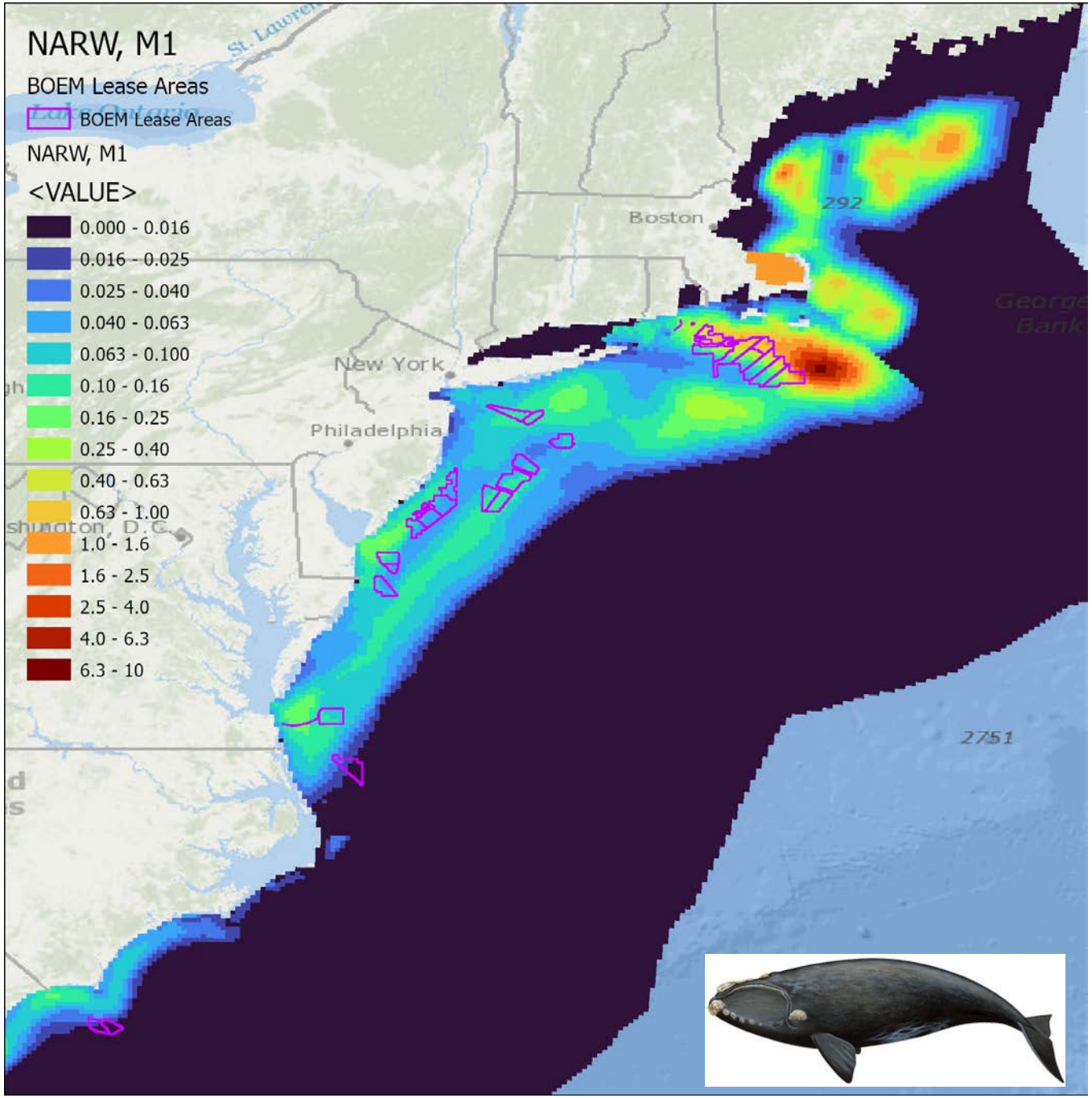
North Atlantic Right Whale

Vineyard Wind

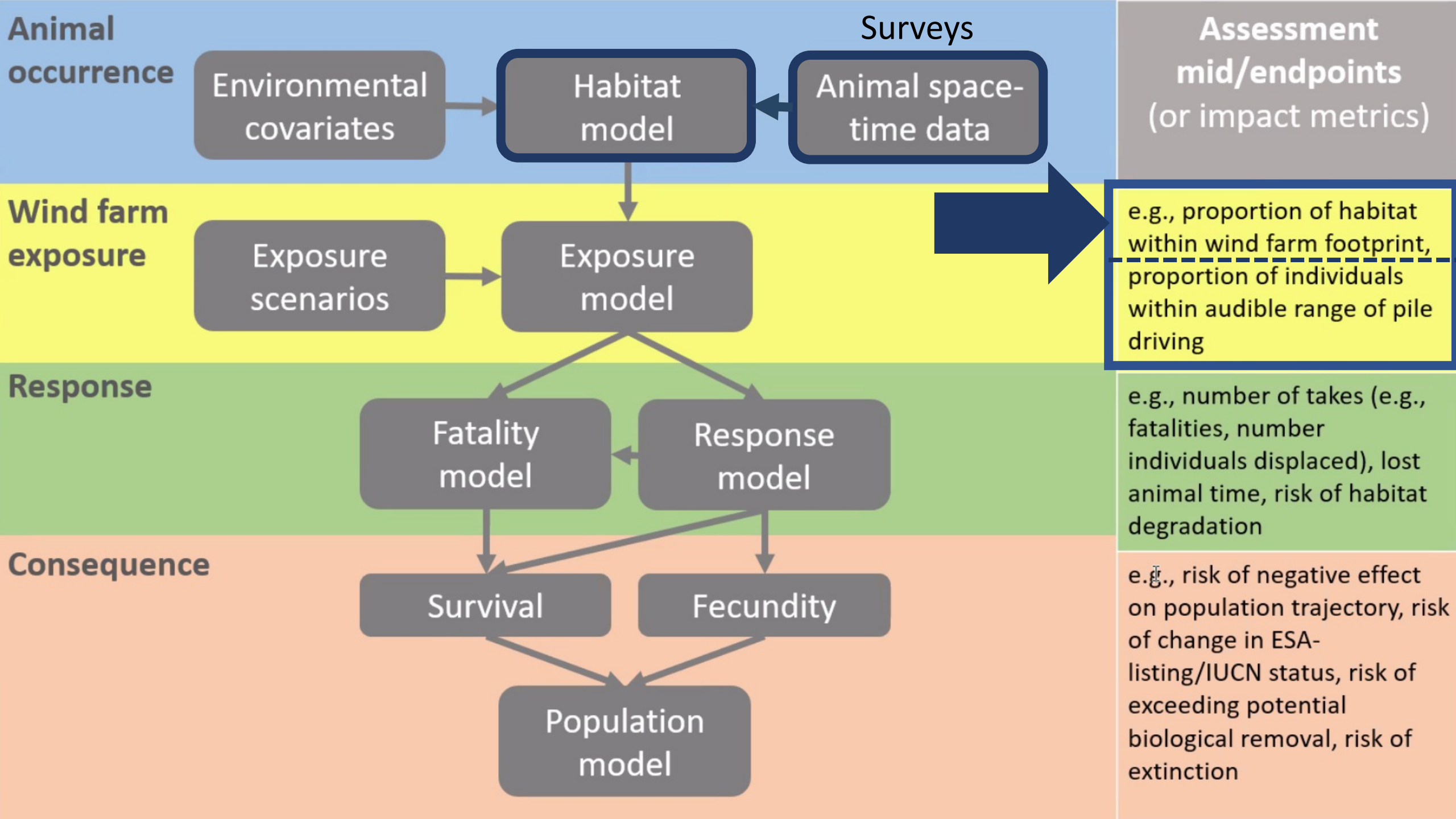


Empire Wind

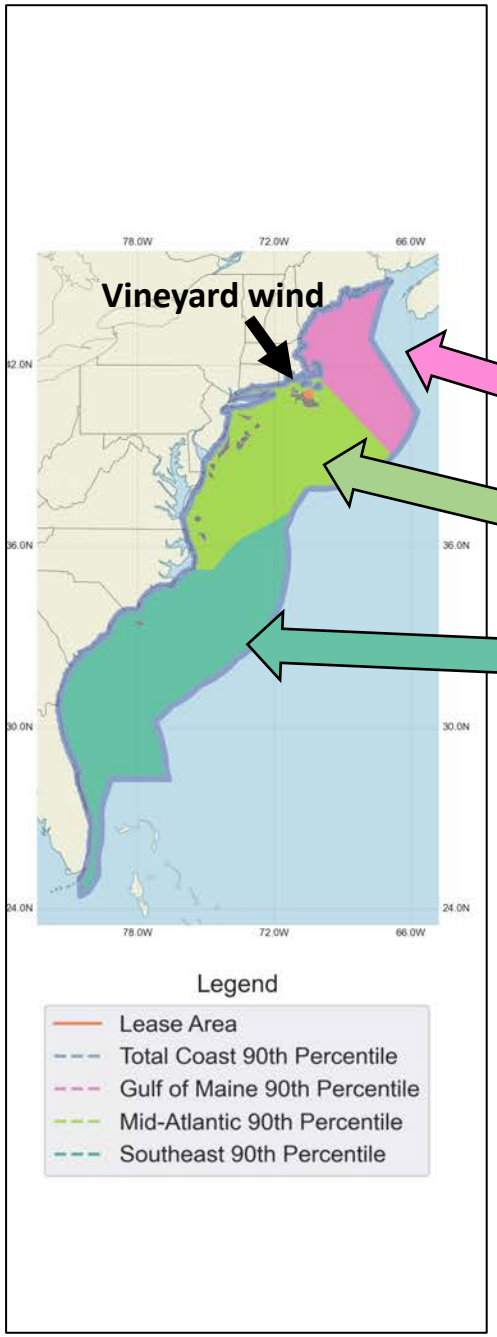


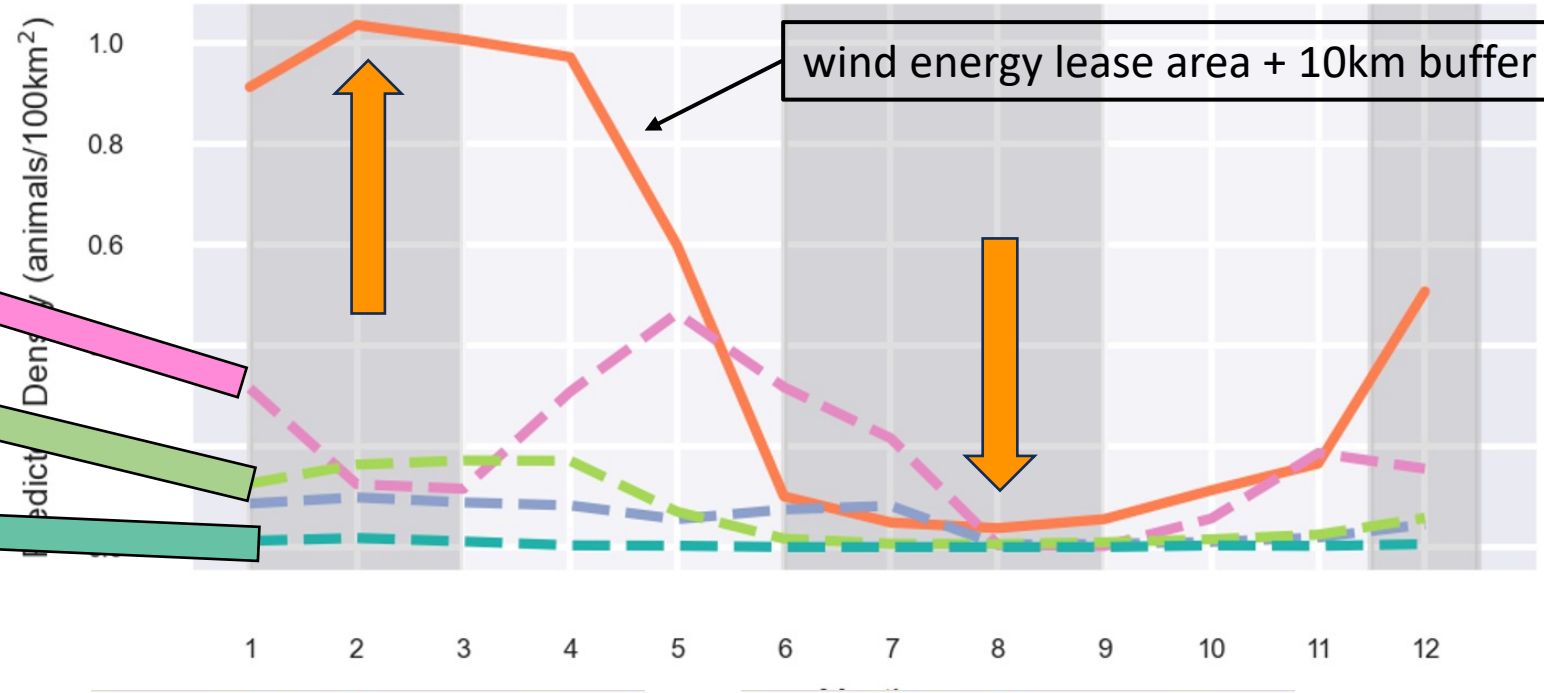


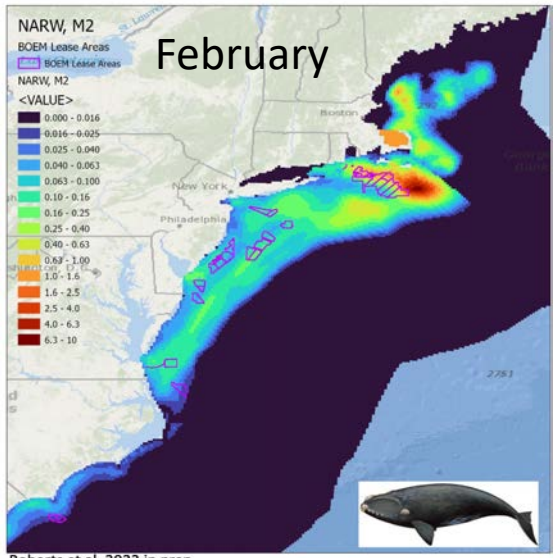
Roberts et al. 2022 in prep


Animal occurrence
Surveys
Environmental covariates
Habitat model
Animal space-time data
Assessment mid/endpoints (or impact metrics)
Wind farm exposure
Exposure scenarios
Exposure model
e.g., proportion of habitat within wind farm footprint,
proportion of individuals within audible range of pile driving
Response
Fatality model
Response model
e.g., number of takes (e.g., fatalities, number individuals displaced), lost animal time, risk of habitat degradation
Consequence
Survival
Fecundity
Population model
e.g., risk of negative effect on population trajectory, risk of change in ESA-listing/IUCN status, risk of exceeding potential biological removal, risk of extinction

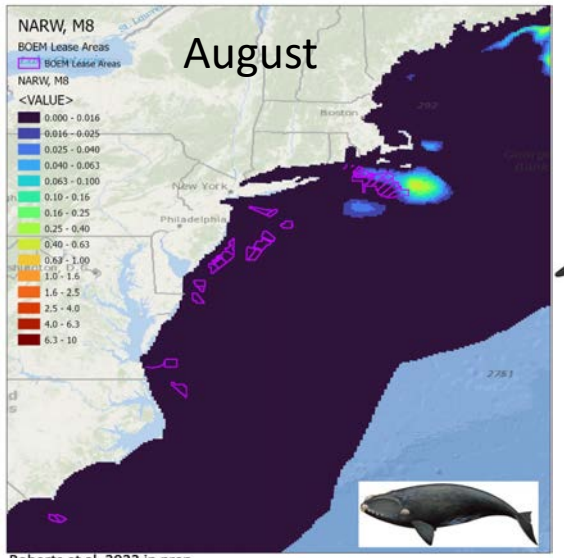
North Atlantic right whale (version 12)







Roberts et al. 2022 in prep

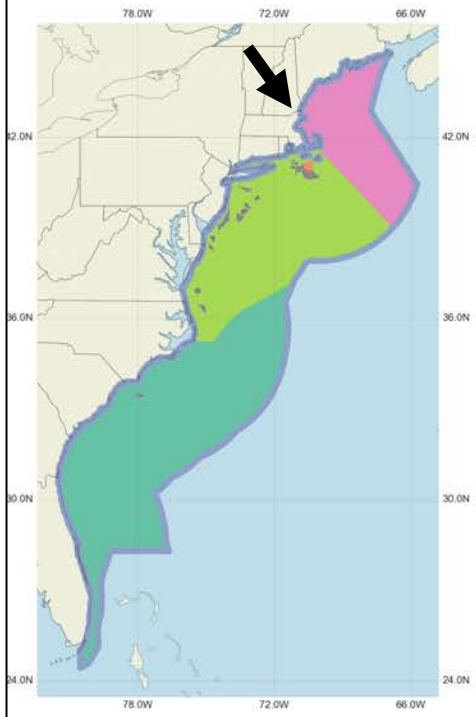


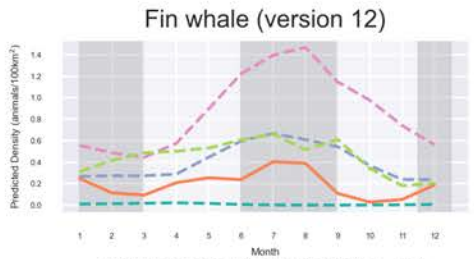
Roberts et al. 2022 in prep

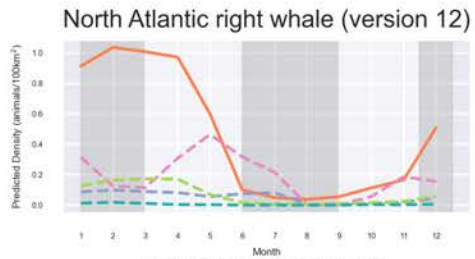
WILDLIFE AND OFFSHORE WIND
WOW

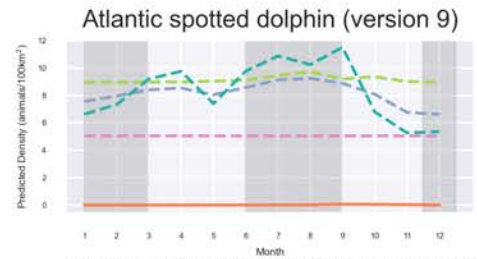
Occurrence analysis for marine mammal (Duke-MGEL models) and seabird distributions (NOAA-NCOS models)

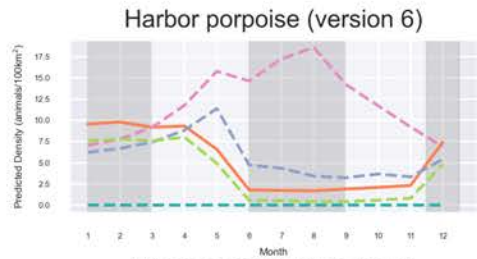
Vineyard wind

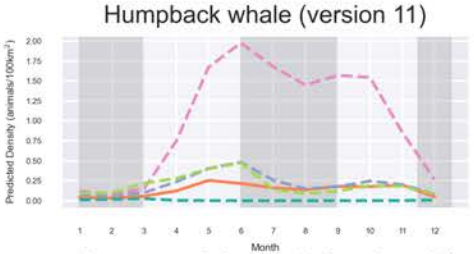


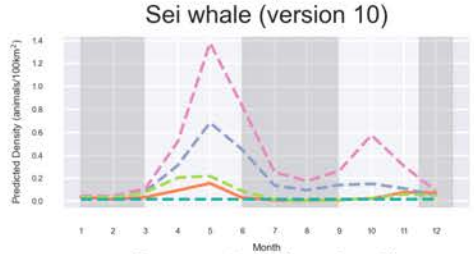


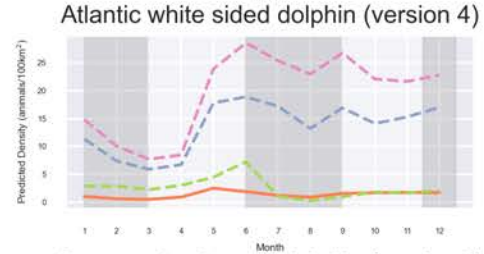


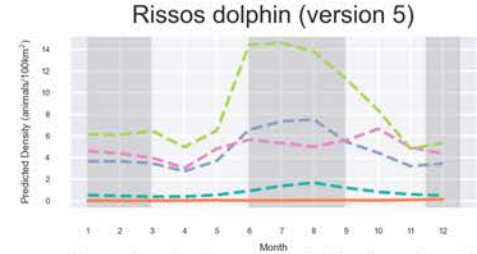


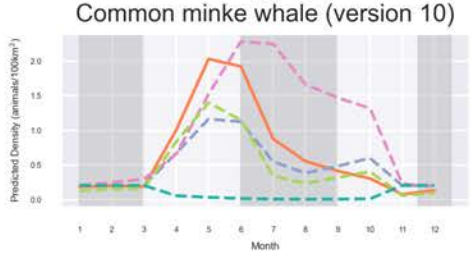


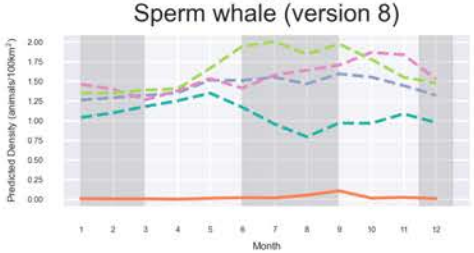


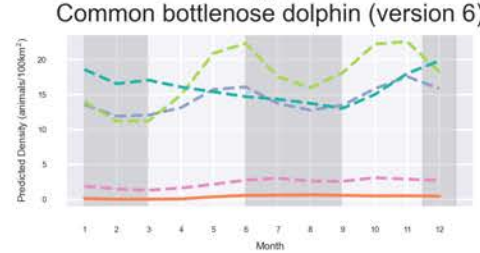


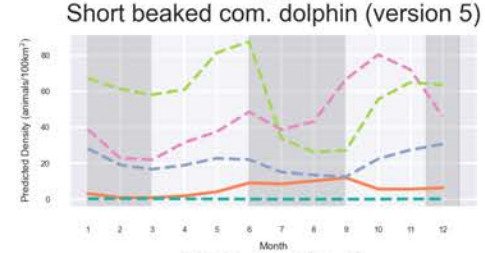


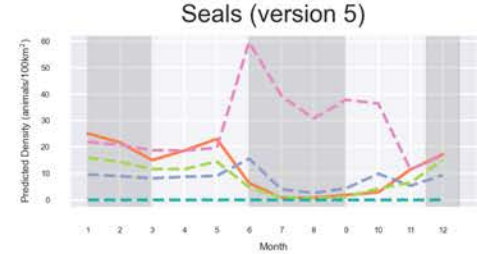












Legend

- Lease Area
- Total Coast 90th Percentile
- Gulf of Maine 90th Percentile
- Mid-Atlantic 90th Percentile
- Southeast 90th Percentile

Lease Date: 04/01/2015
Lease Term: 25 Years
Lease Area: 264 km^2

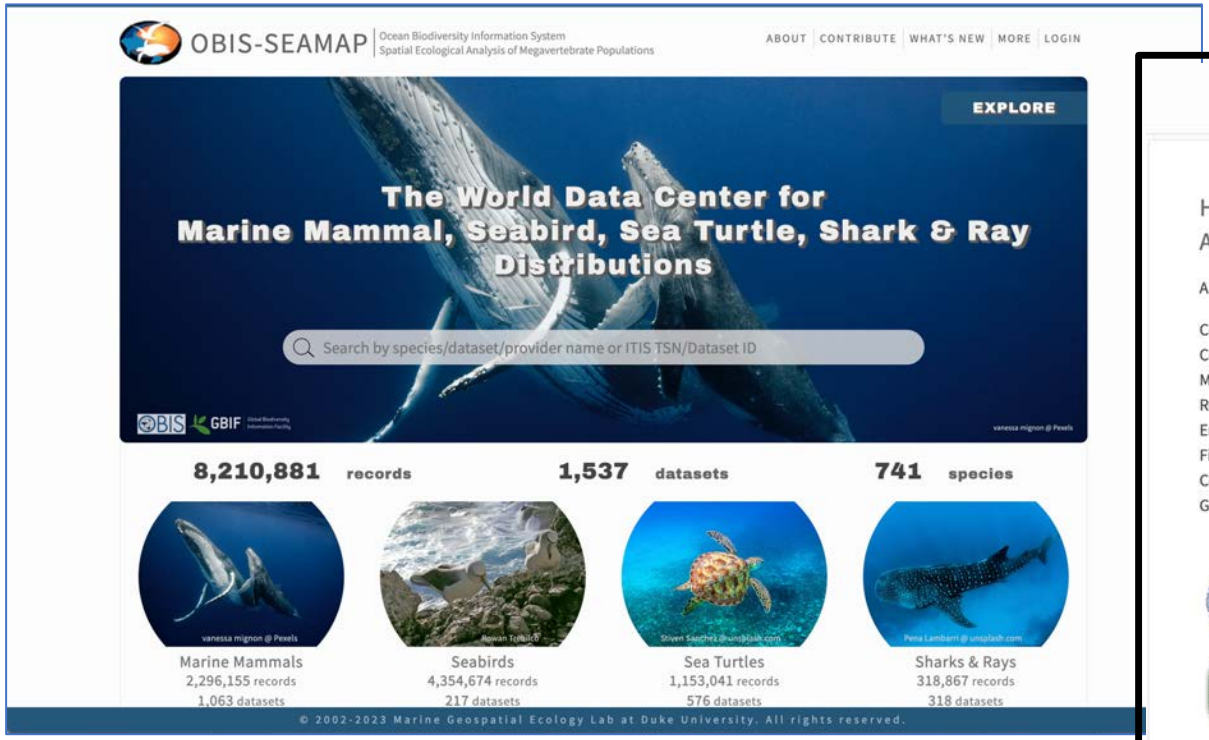
BOEM Geodatabase: BOEM-Renewable-Energy-Geodatabase_7
BOEM Lease Dataset: BOEMWindLeaseOutlines_11_2_2022

Marine mammal density & abundance data: Duke-MGEL habitat based models
Roberts, J., Best, B., Mannocci, L. et al. Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico. Sci Rep6, 22615 (2016). https://doi.org/10.1038/srep22615

Version # refers to Roberts et al. release version. https://seamap.env.duke.edu/models/Duke/EC/

The boundaries used were provided by J. Roberts and reflect the same partitions used in those models.

WILDLIFE AND OFFSHORE WIND
WOW


OBIS-SEAMAP
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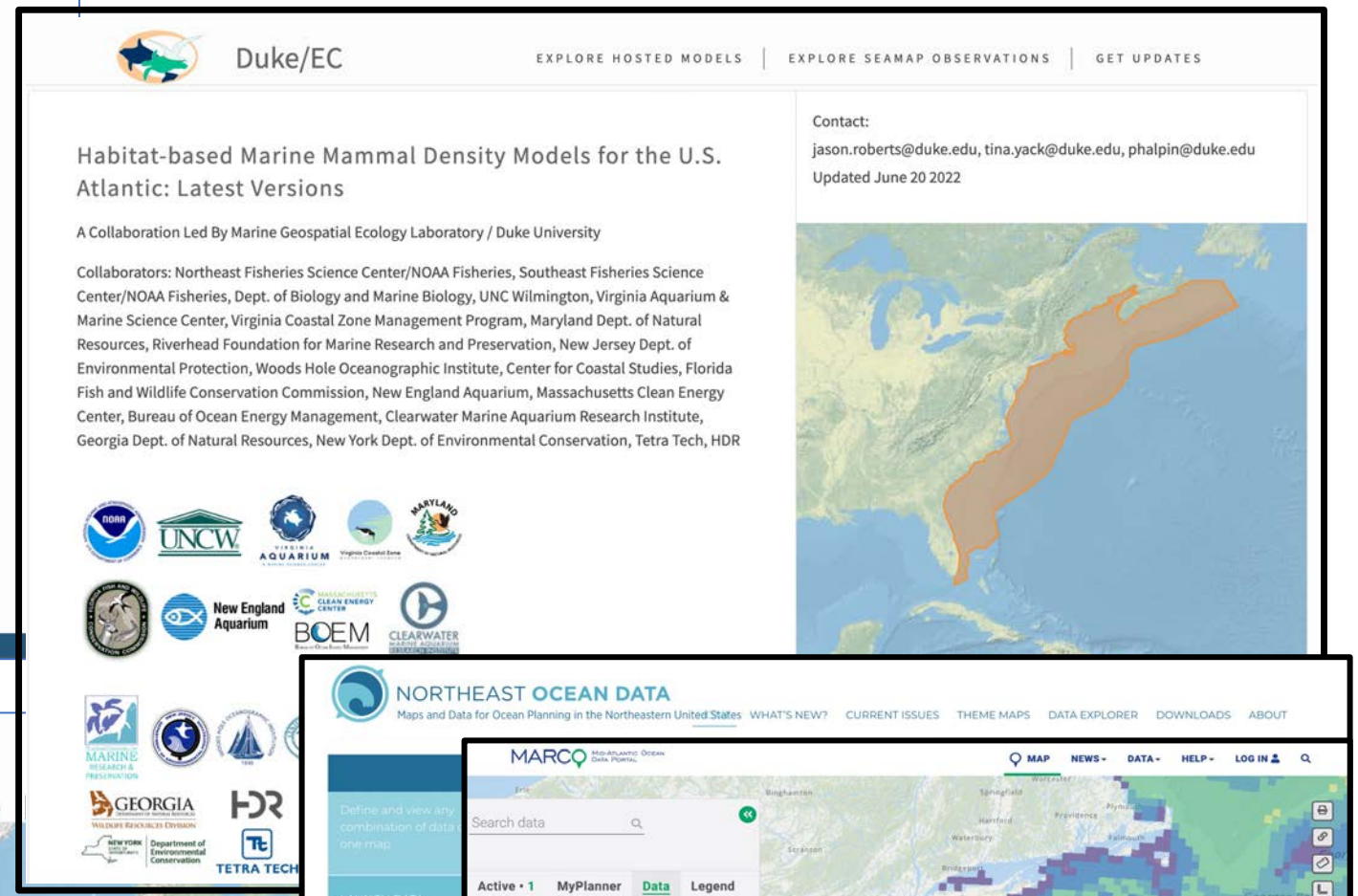
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Habitat-based Marine Mammal Density Models for the U.S. Atlantic: Latest Versions
A Collaboration Led By Marine Geospatial Ecology Laboratory / Duke University
Collaborators: Northeast Fisheries Science Center/NOAA Fisheries, Southeast Fisheries Science Center/NOAA Fisheries, Dept. of Biology and Marine Biology, UNC Wilmington, Virginia Aquarium & Marine Science Center, Virginia Coastal Zone Management Program, Maryland Dept. of Natural Resources, Riverhead Foundation for Marine Research and Preservation, New Jersey Dept. of Environmental Protection, Woods Hole Oceanographic Institute, Center for Coastal Studies, Florida Fish and Wildlife Conservation Commission, New England Aquarium, Massachusetts Clean Energy Center, Bureau of Ocean Energy Management, Clearwater Marine Aquarium Research Institute, Georgia Dept. of Natural Resources, New York Dept. of Environmental Conservation, Tetra Tech, HDR
Contact:
jason.roberts@duke.edu, tina.yack@duke.edu, phalpin@duke.edu
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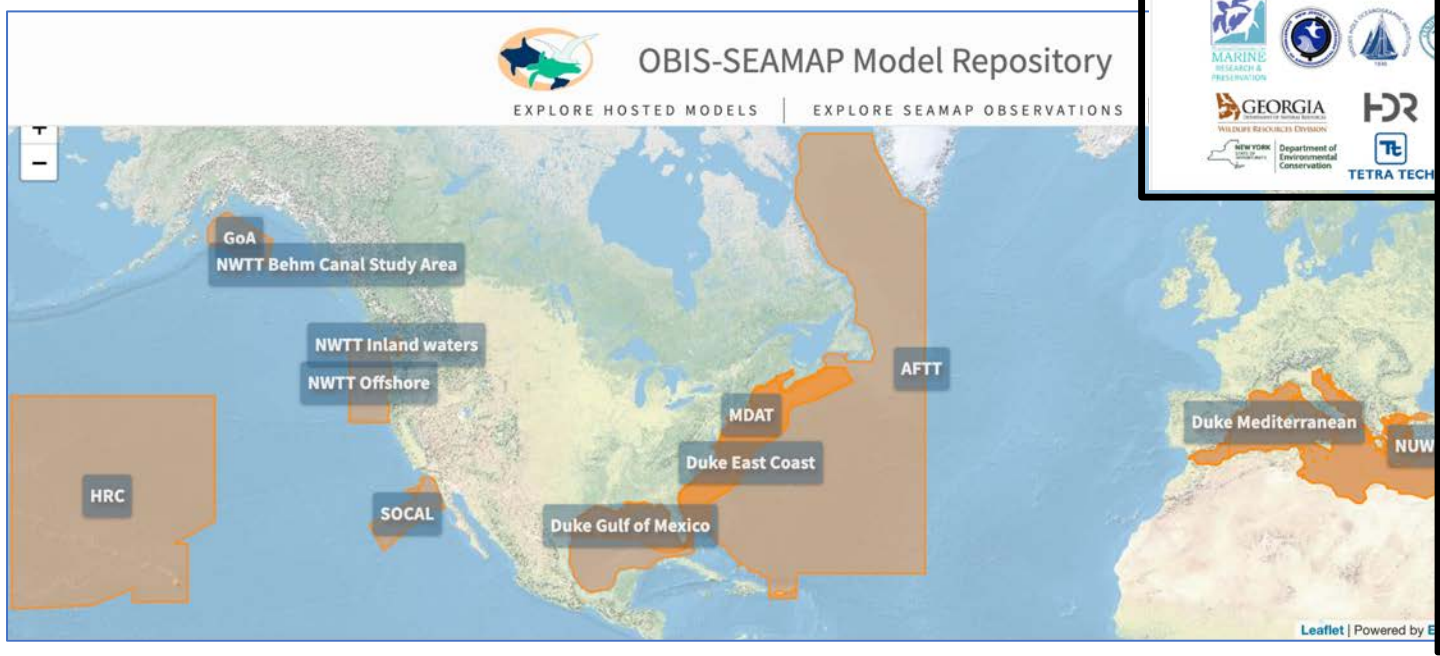
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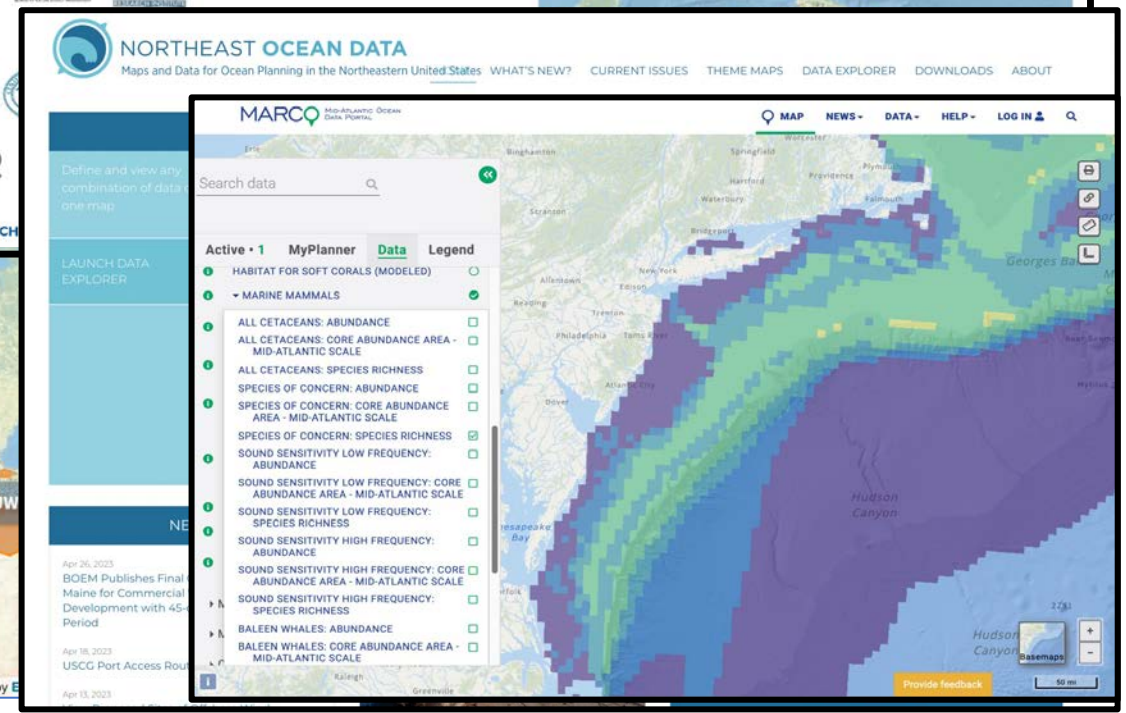
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Maps and Data for Ocean Planning in the Northeastern United States
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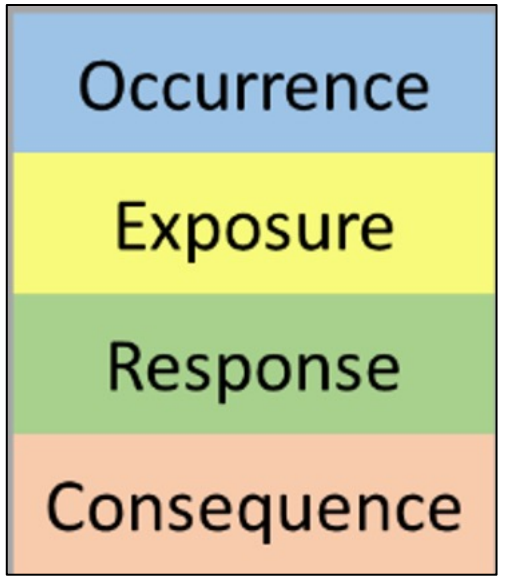
Basemaps
Provide feedback

From Surveys to Models: Habitat-Based Species Density Models Informing Offshore Wind Development for the US Atlantic coast

- Habitat-Based Species Density Models allow us to combine survey data and estimate the expected occurrence of species in wind energy areas;
- These models can directly provide information that is useful for both planning the timing of construction activities as well as expected baselines for monitoring;
- These models allow us to estimate the type and intensity of monitoring (e.g. through power analysis) that would be required to observe an effect;
- Ongoing work is underway to increase the spatial and temporal resolution of these models to better forecast sub-regional distributions.



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Wildlife & Offshore Wind funding

U.S. DEPARTMENT OF ENERGY

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