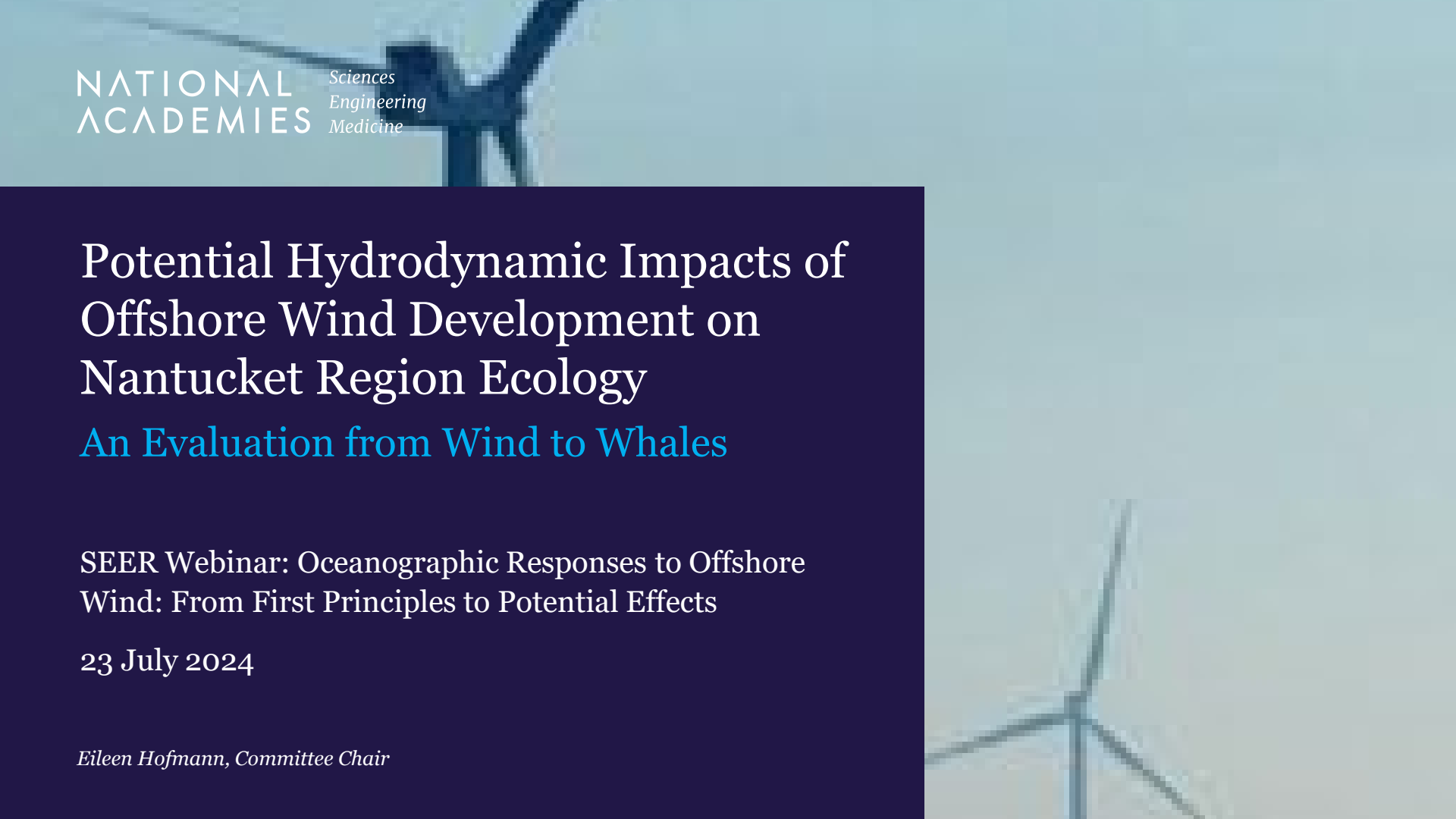


NATIONAL ACADEMIES *Sciences Engineering Medicine*

Potential Hydrodynamic Impacts of Offshore Wind Development on Nantucket Region Ecology

An Evaluation from Wind to Whales

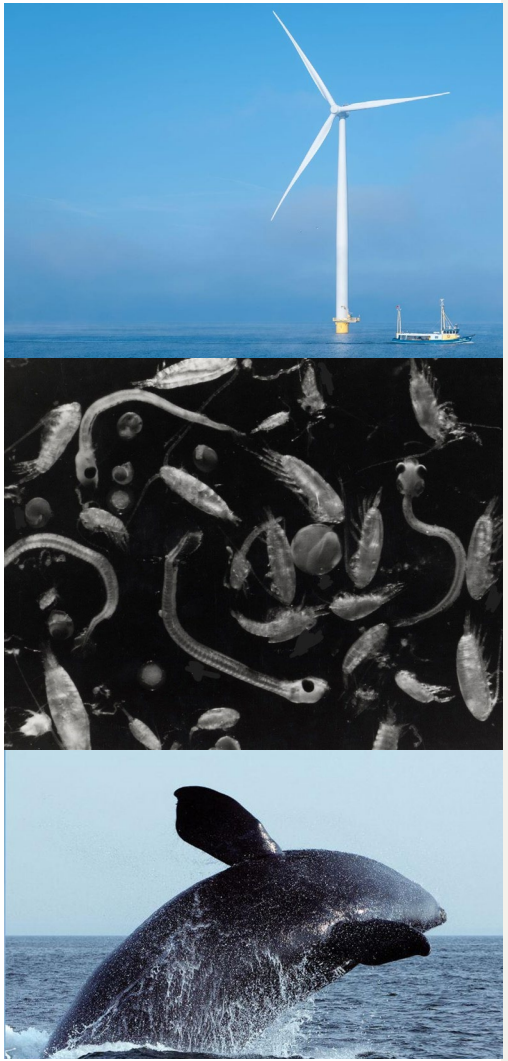
SEER Webinar: Oceanographic Responses to Offshore Wind: From First Principles to Potential Effects

23 July 2024

Eileen Hofmann, Committee Chair

Committee

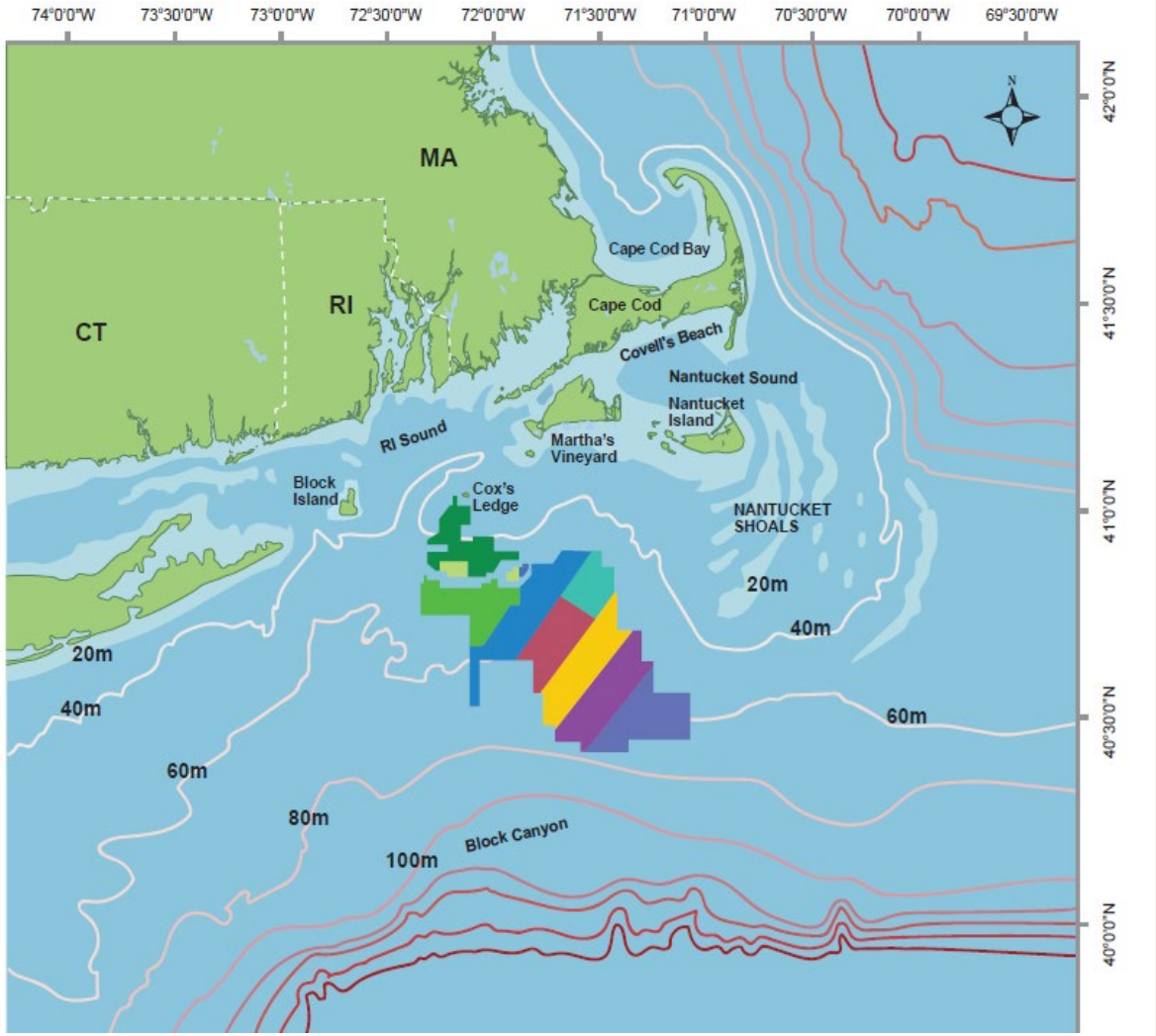
- **Eileen Hofmann**, *Chair*, Old Dominion University
- **Jeffrey Carpenter,** Helmholtz-Zentrum Hereon
- **Qin Jim Chen,** Northeastern University
- **Josh Kohut,** Rutgers University
- **Richard Merrick,** NOAA Fisheries (retired)
- **Erin Meyer-Gutbrod**, University of South Carolina
- **Douglas Nowacek,** Duke University
- **Kaustubha Raghukumar,** Integral Consulting Inc
- **Nicholas Record,** Bigelow Laboratory



NATIONAL ACADEMIES Sciences Engineering Medicine

Nantucket Shoals Region

Offshore Wind Energy Development



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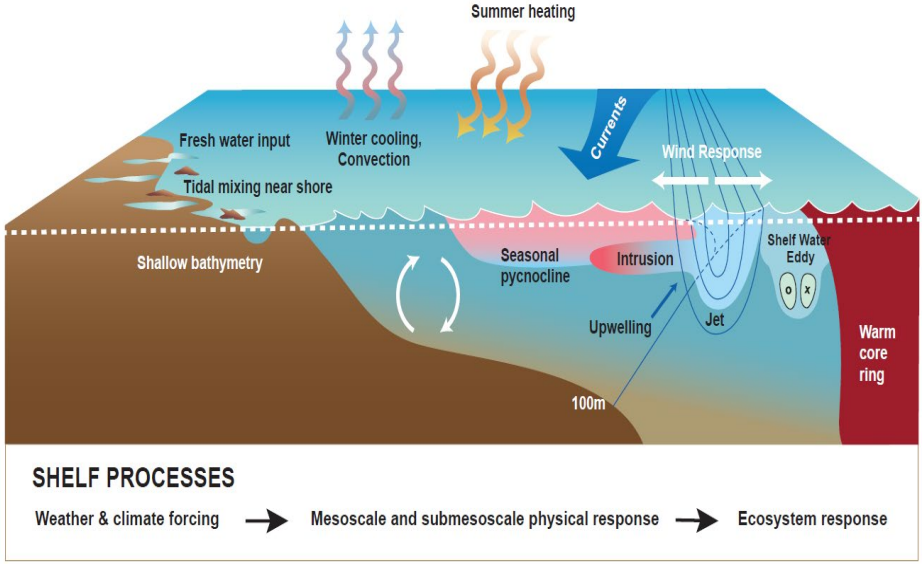
Committee Statement of Task
Abbreviated

- Assess the state of the science about the effects of offshore wind turbine structures – what do we know
- Based on the literature review and public information gathering sessions:
  - Comment on the ability to estimate the extent of perturbations caused by wind turbine generator installation – can effects be observed
  - Evaluate models – can effects be modeled and simulated
  - Suggest approaches for assessing the hydrodynamic impacts of wind turbine generators

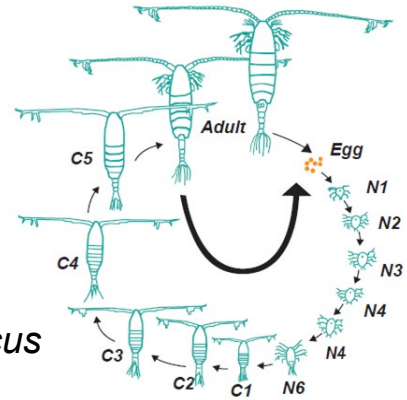
Physical and Biological Oceanography Nantucket Shoals Region



SOURCE: Adapted from Gawarkiewicz and Plueddemann, 2020

North Atlantic Right Whale

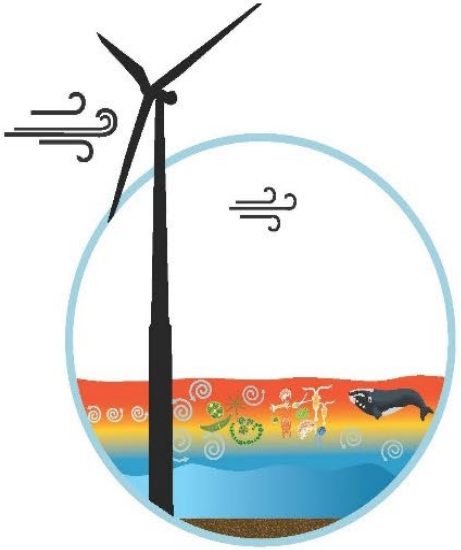
SOURCE: Dawn Witherington; NOAA

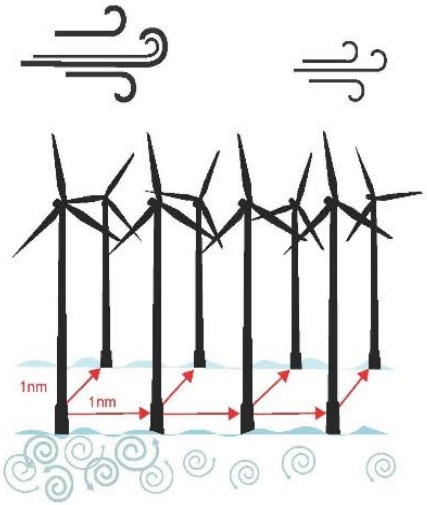


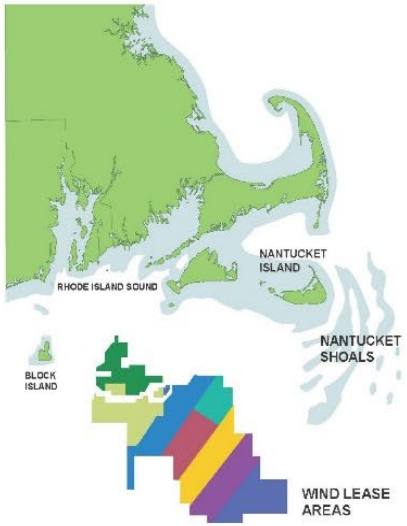
Calanus finmarchicus
Copepod prey

SOURCE: Adapted from Ji et al., 2017

Scale of Effects

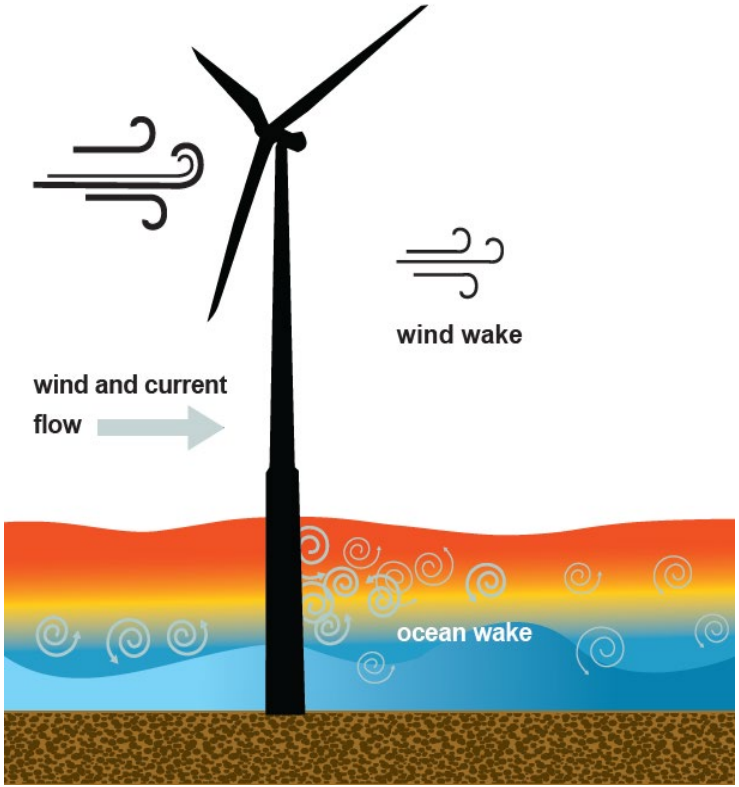




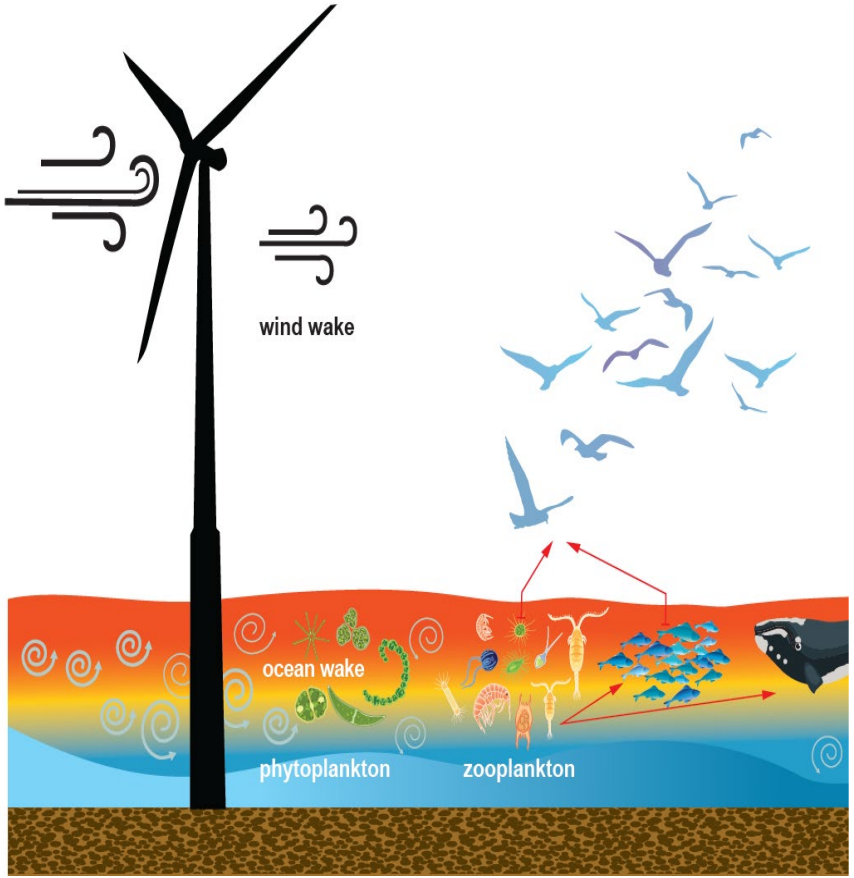


SPATIAL SCALE	TURBINE	WIND FARM	REGION
	~1m–1km	1km–100s km	> 100s km

Wind Turbine Effects

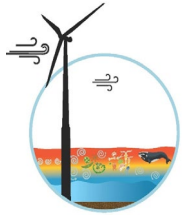


Hydrodynamics

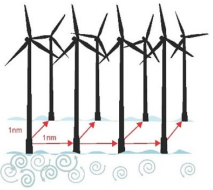


Biology/Ecology

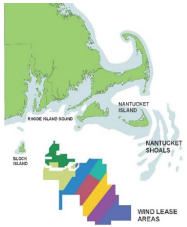
Ability to Estimate Perturbations



Turbine scale: few observations for verification of wake behavior



Wind farm scale: changes in ocean current speeds, stratification, ocean surface wind speed, and deflection of the pycnocline



Regional scale: difficult to quantify due to natural variability

Applicability of Hydrodynamic Models to the Region

Scale of Effects	Resolution	Idealized	LES	Non-hydrostatic Models	RANS Models
Turbine O(1)m – O(1)km	Millimeters to meters	●	●	◗	◗
WEA O(1) km – O(10-100)km	Meters to 10s of meters	●	●	●	●
Region >O(100)km	10s-1000s of meters	●	●	●	●

● Only assess key processes at these scales

● Support predictions at specified resolution

◗ Some versions can support an unstructured grid

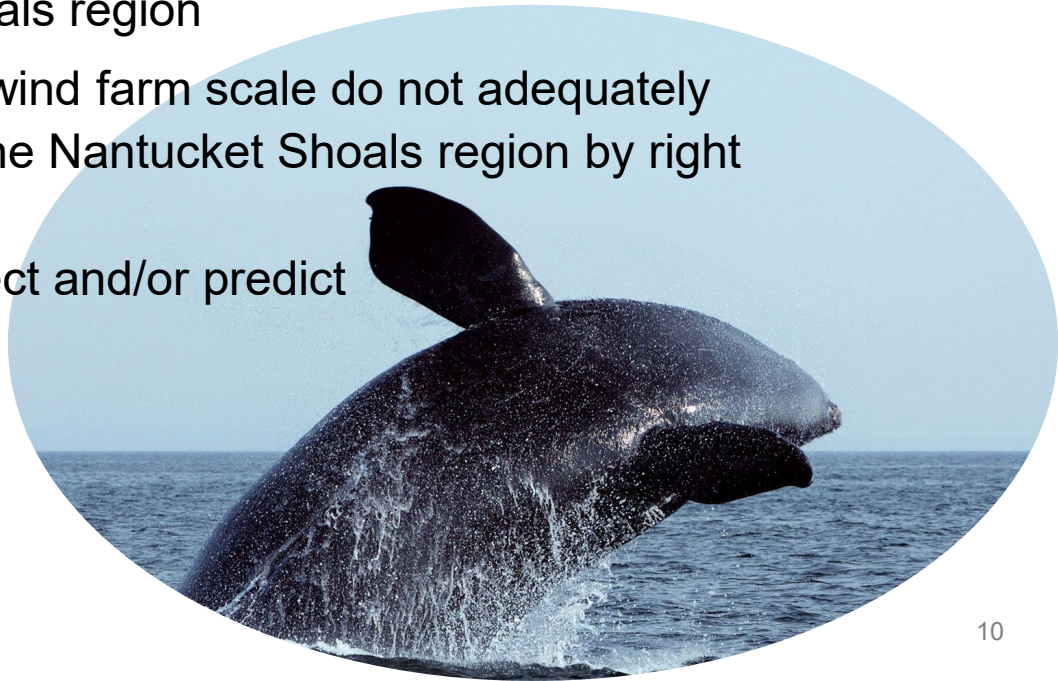
● Full range of process at these scales is constrained by computational capacity

◗ Can assess specific processes at these scales and requires parameterization

LES - Large Eddy Simulation
RANS - Reynolds-averaged Navier-Stokes Models

Effects on Right Whale

- The hydrodynamic impacts on zooplankton are currently difficult to isolate
- There is a gap in understanding of foraging by North Atlantic right whales in the Nantucket Shoals region
- Studies concentrated at the wind farm scale do not adequately capture broad-scale use of the Nantucket Shoals region by right whales
- Effects will be difficult to detect and/or predict



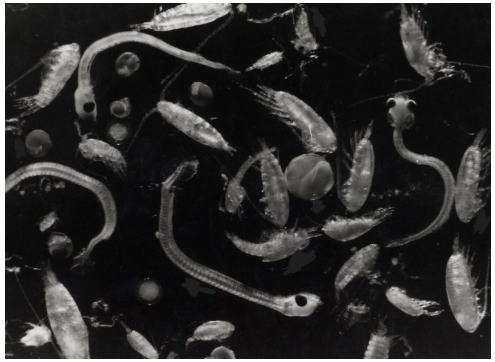
Summary of Conclusions

- The significant natural and anthropogenic variability in the Nantucket Shoals oceanography and ecology suggests:
  - Perturbations in hydrodynamics due to wind farm development are likely to be difficult to isolate
  - Effects on the zooplankton are likely to be difficult to distinguish
- Significant uncertainties exist in assessing the hydrodynamic impacts associated with:
  - Wind wake and ocean wake effects at local, farm, and regional scales
  - Abundance and aggregation of zooplankton including right whale prey
  - Current and future foraging patterns of North Atlantic right whales

- *UPDATE*: Workshop convened 2 weeks ago to design a field monitoring program that would respond to observational and modeling recommendations from the National Academies study

Thank you!

Any questions?


To learn more about the study or process:

https://www.nationalacademies.org/our-work/evaluation-of-hydrodynamic-modeling-and-implications-for-offshore-wind-development-nantucket-shoals