BOEM Bureau of Ocean Energy Management

Consideration of Underwater Sound During Offshore Wind Development

DOSITS webinar

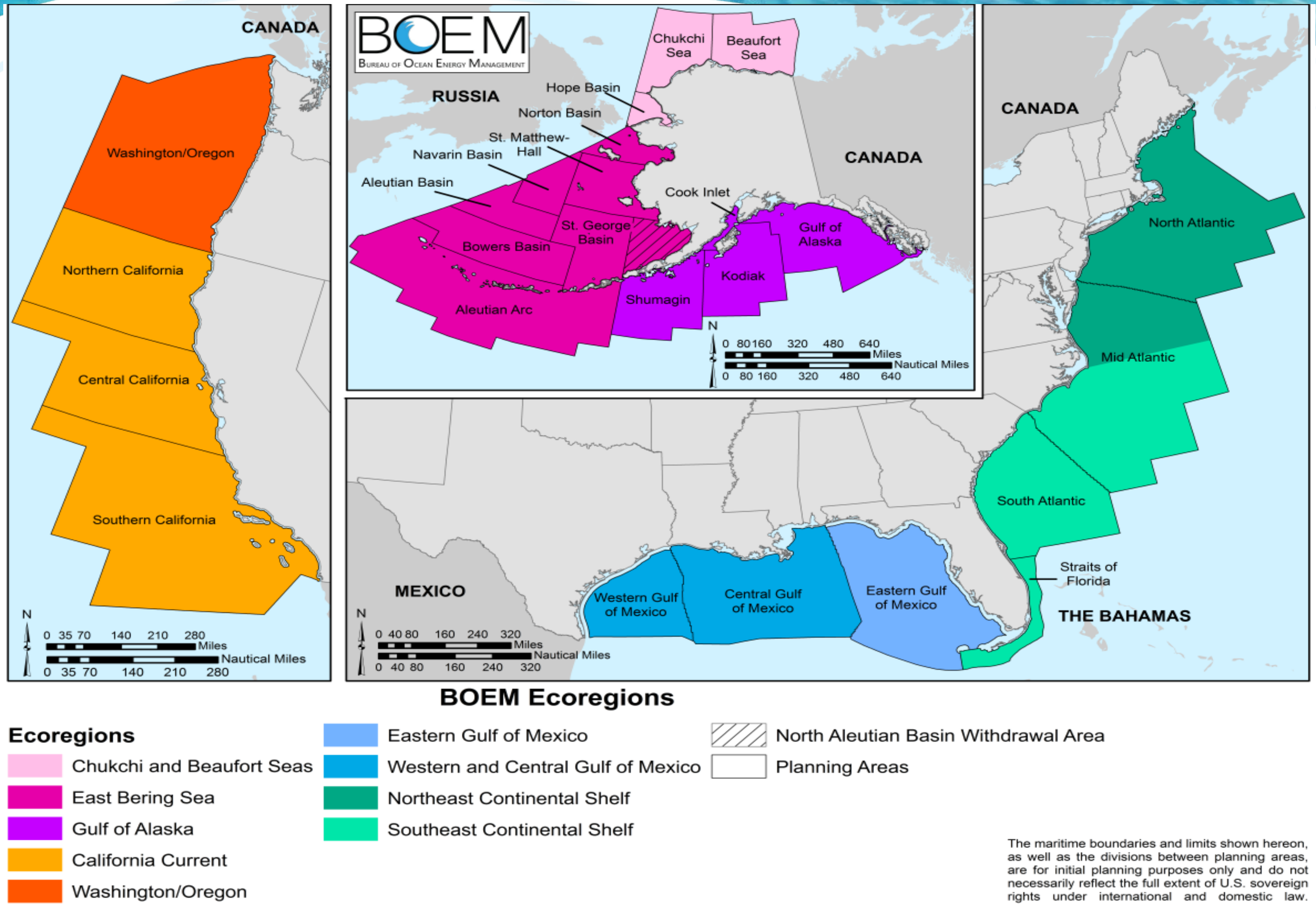
Center for Marine Acoustics

September 14, 2022

BOEM’s mission

The **Mission** of the Bureau of Ocean Energy Management is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.

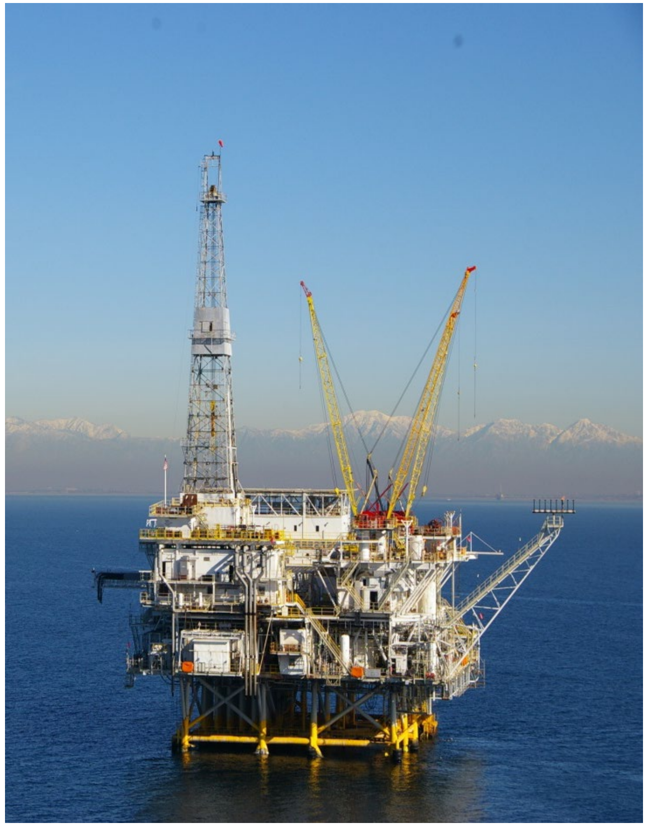
BOEM's geographic scope



Outer Continental Shelf:

- All federal waters out to edge of EEZ (~200 nm)
- Federal waters generally start 3 nm from shore
- In Texas and FL, federal waters start at 9 nm
- The Inflation Reduction Act (2022) gives BOEM jurisdiction over territorial waters too
- ~ 3 billion acres!

BOEM's programs



Oil and Gas

Marine Minerals

Renewable Energy

BOEM’s Center for Marine Acoustics

Be **a trusted voice** on marine acoustic issues.

FUNCTIONS

Modeling. Build models that address current needs and drive improvements in the field.

Knowledge. Track emerging science, fill data gaps, and apply new risk assessment methods.

Policy. Address key policy and management improvements, both internal and external.

Messaging. Improve stakeholder understanding of actual risks.

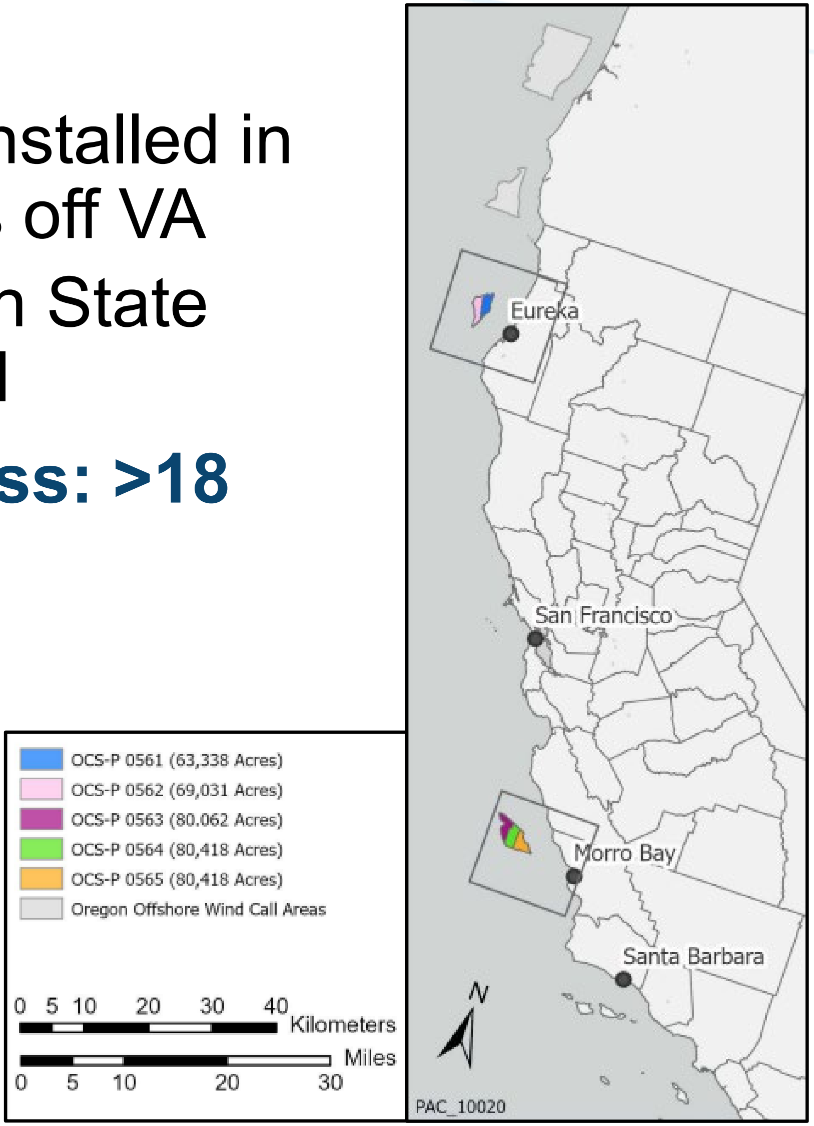
Strategy. Plan in six-year planning horizons. Adapt based on performance and emerging information.

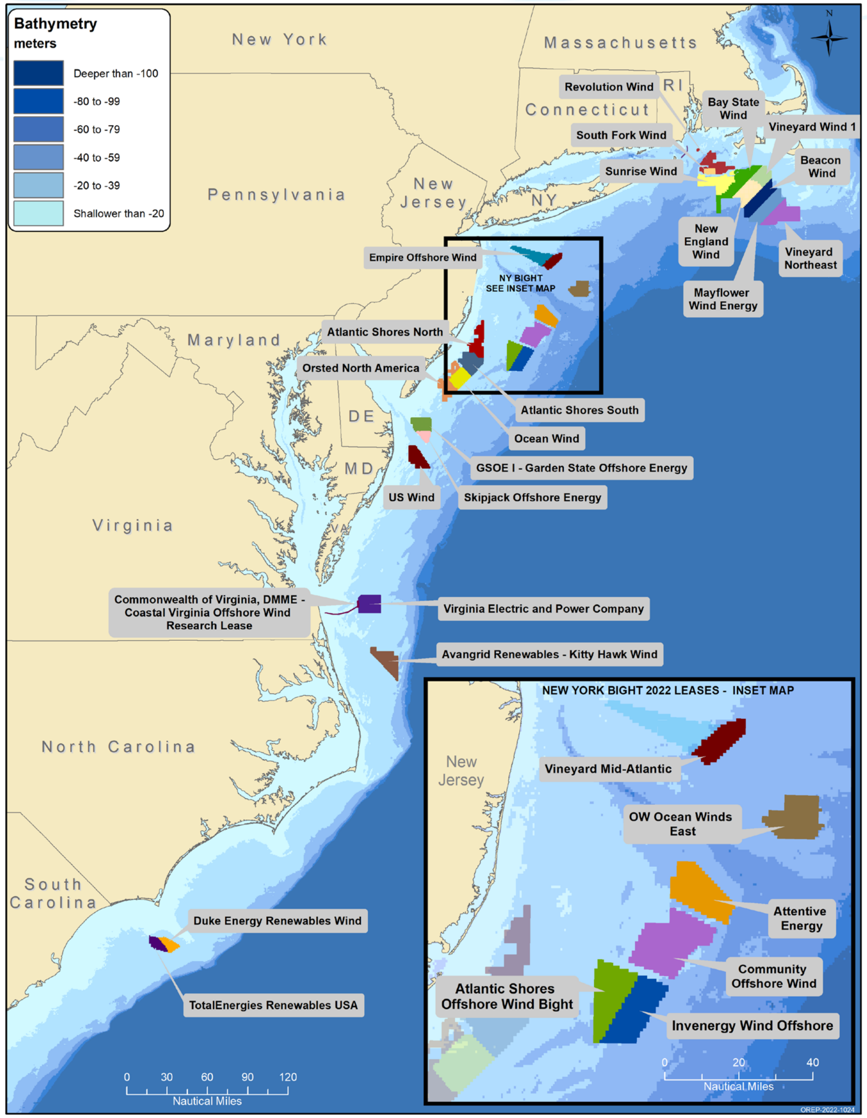
Partnerships. Develop relationships with domestic and international organizations that advance shared goals.

Federal Agencies - Cooperating, Participating, and Consulting

Offshore wind energy projects

- **Approved:**
  - 2 turbines installed in Fed. waters off VA
  - 5 installed in State waters of RI
- **Review process: >18**
  - NY Bight: 6





Planning for offshore wind projects

Planning & Analysis

~ 2 YEARS

- Intergovernmental Task Force
- Request for Information or Call for Information and Nominations
- Area Identification
- Environmental Reviews

Leasing

~ 1-2 YEARS

- Publish Leasing Notices
- Conduct Auction or Negotiate Lease Terms
- Issue Lease(s)

Site Assessment

UP TO 5 YEARS

- Site Characterization
- Site Assessment Plan

*HRG surveys, vessels

Construction & Operations

~ 2 YEARS (+25)

- Construction and Operations Plan
- Facility Design Report and Fabrication and Installation Report
- Decommissioning
- Environmental and Technical Reviews

*Pile-driving, vessels, trenching, possibly explosives

Department of the Interior Briefing and Clearance Points

(CMA Actions in RED)

~ 18 months

2 years or less

COP Submittal
- Completeness and sufficiency review

Public Scoping
- Publish Notice of Intent in *Federal Register*
- 30-day public comment period
- Hold public meetings
- Receive input on issues and alternatives

Draft Environmental Impact Statement
- Prepare with cooperating agencies
- Publish Notice of Availability in *Federal Register*
- 45-day public comment period
- Hold public hearings

Final Environmental Impact Statement
- Address public comments with cooperating agencies
- Publish Notice of Availability in *Federal Register*

Record of Decision
- "One Federal Decision"
- Minimum 30-day wait period

1 Initial Action Notice

2 Notice of Intent

3 Draft EIS Development

4 Draft EIS/ Notice of Availability (NOA)

5 Final EIS/NOA

6 Record of Decision/NOA

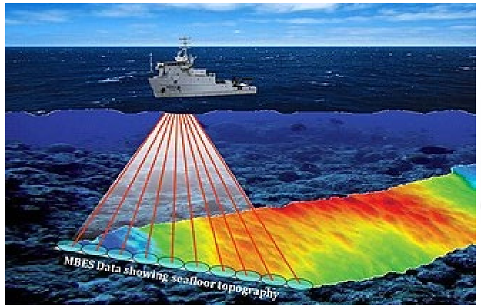
1 COP Review

2 Attend hearings

3 Review DEIS, BA & EFH

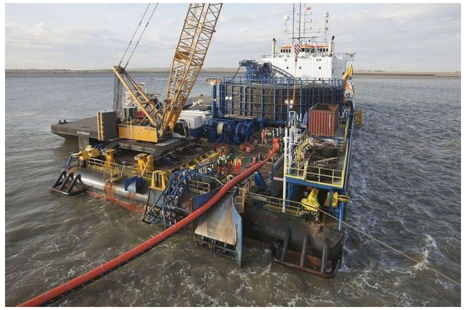
4 Revise DEIS/BA/EFH in response to comments

Sound sources throughout the offshore wind life cycle



High-resolution geophysical surveys


Construction (impact or vibratory pile-driving)



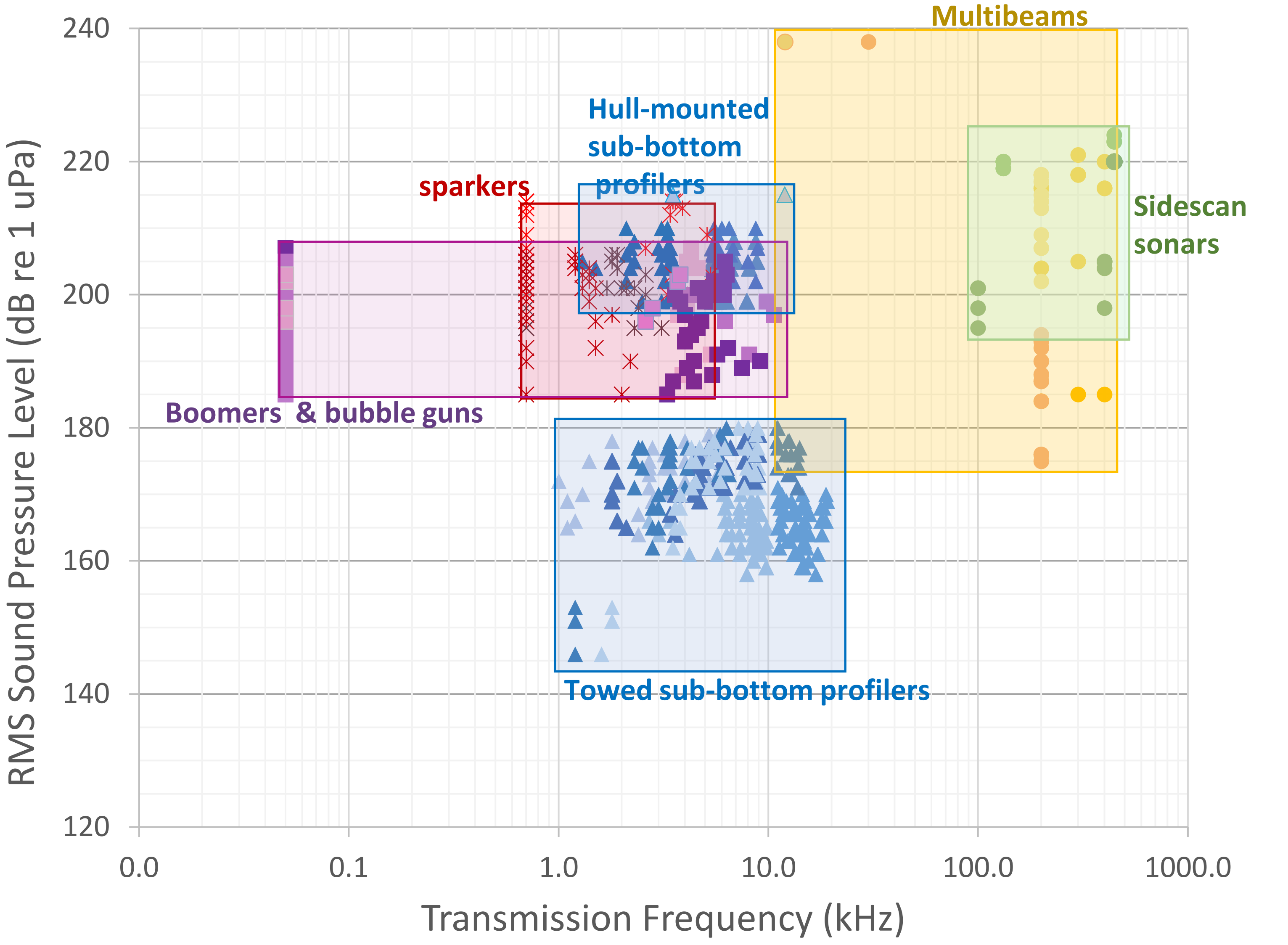
Cable-laying vessels

Operations

Crew and service vessels

High Resolution Geophysical (HRG) sources

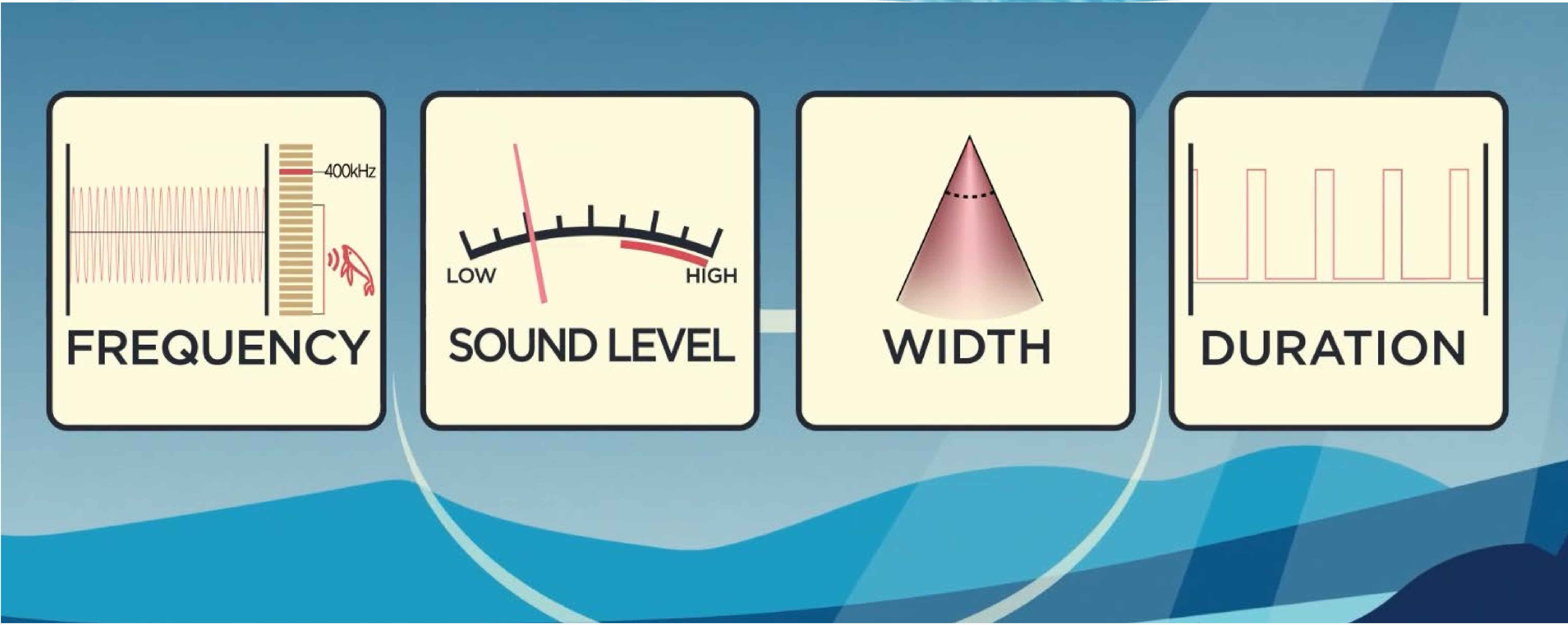
- Regulation of HRG sources is not as simple as with high-intensity sources like airguns
- Sources can be evaluated for *additional* factors
  - Duration
  - Duty cycle
  - Beamwidth
  - Operational parameters
- Recently completed analysis with USGS, NSF, NMFS shows many HRG sources *de minimis* for marine mammals



Data from Cocker and Fratantonio 2016

https://mdpi-res.com/d_attachment/jmse/jmse-10-01278/article_deploy/jmse-10-01278.pdf?version=1662733255

Key Characteristics of HRG Sources



Suggested tiering of active acoustic sources

Tier 1: incidental take likely	Tier 2: incidental take likely	Tier 3: incidental take unlikely with mitigation	Tier 4: incidental take unlikely *(de minimis)*

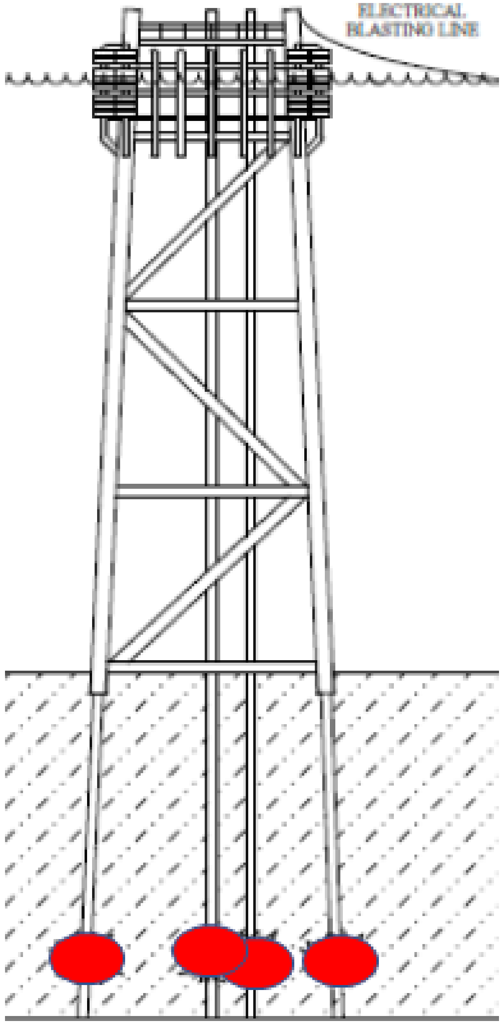
• Airgun surveys with total volume >1500 in^3
 	
• Airgun surveys with > 12 airguns
	• Single airguns
	
	• Arrays with total volume <1500 in^3
		• Highest-powered sparkers
		
		• Other impulsive sources not evaluated fully:
		  ◦ Bubble guns
		  ◦ Some 1- and 2-plate boomers
			• MBES
			• SSS
			• Hull-mounted SBP
			• Towed SBP
			• Parametric SBP
			• SBES
			• Lower-powered sparkers
			• ADCPs
			• Pingers (locators)
			• Acoustic releases
			• Seafloor/tracking devices for ROVs

We are still working with other agencies to determine appropriate levels of mitigation for each source

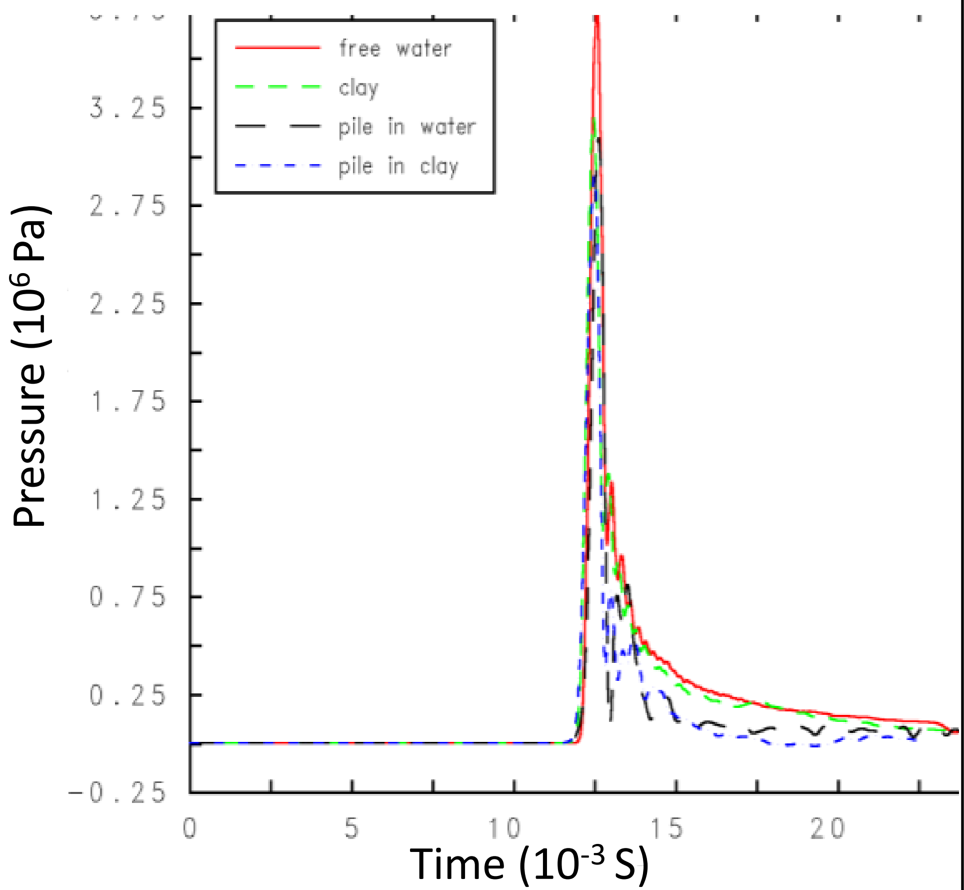
Ruppel et al 2022
https://www.mdpi.com/2077-1312/10/9/1278

Munitions and Explosives of Concern (MEC)

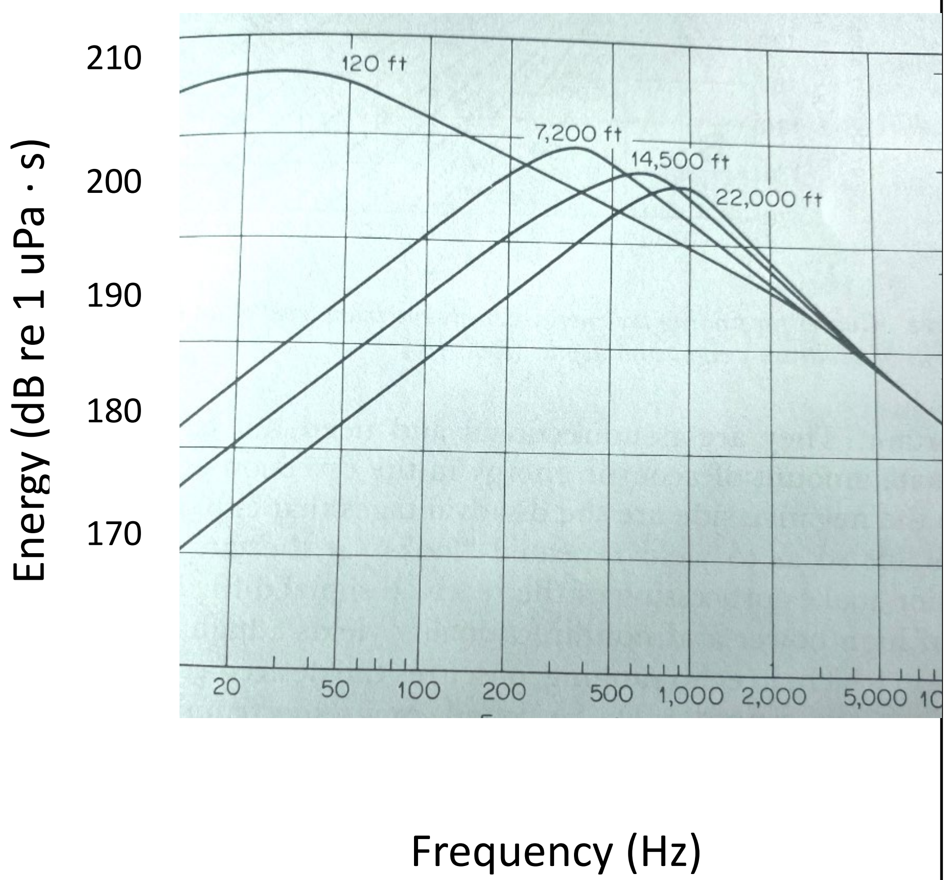
Unexploded Ordnance (UXO)



Time series of sounds produced
50 lb charge, 20m distance, different sediments



Frequency spectra of sounds produced
1-lb explosives at different depths

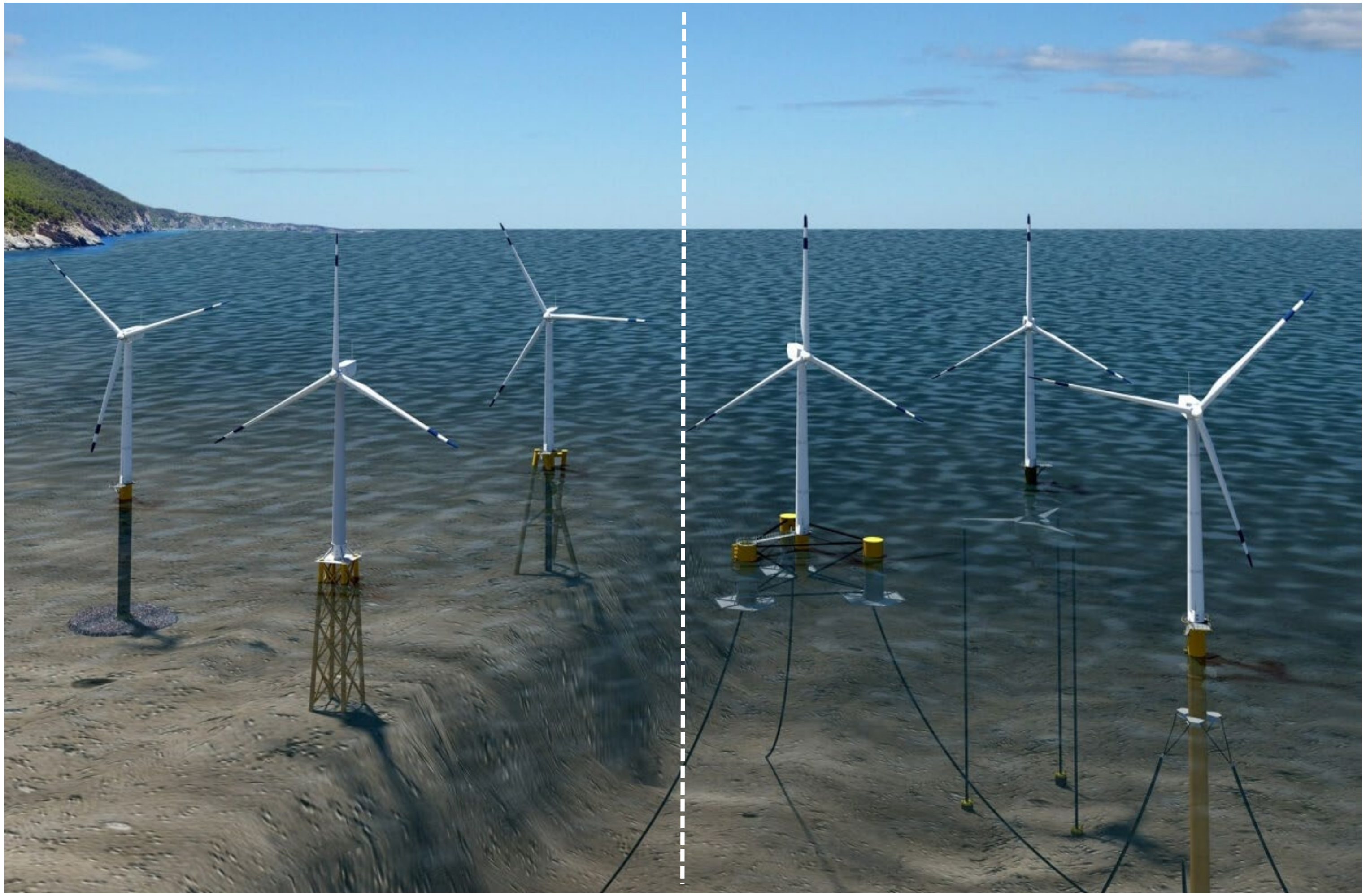


From BOEM PEIS (2005) Structure removal operations on the GOM OCS

Foundation types

Fixed foundations:

- North Sea, U.S. East Coast
- Depth < 60 m
- Impact or vibratory pile-driving of foundations is required

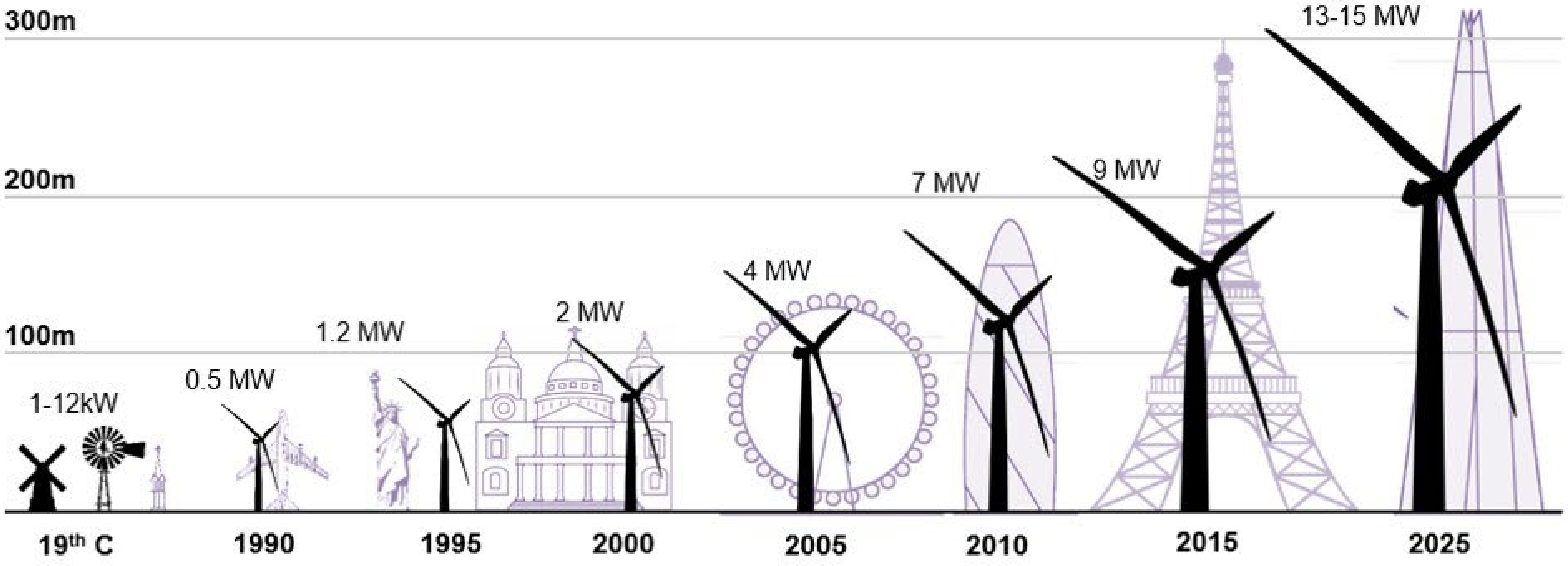


Floating foundations:

- Gulf of Maine, U.S. West Coast, Hawaii, Territories
- Depth > 60 m
- Anchoring systems need to be attached, likely using tugboats and drag anchors

Turbines are growing in size

Evolution of wind turbine heights and output

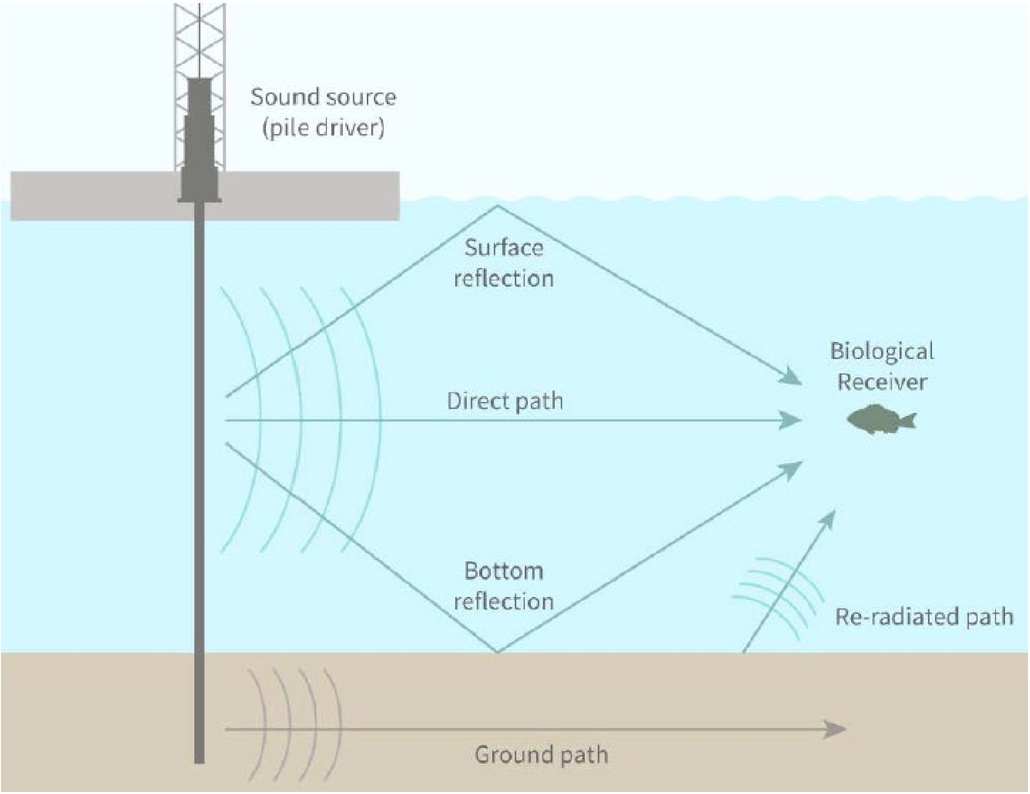


Sources: Various; Bloomberg New Energy Finance

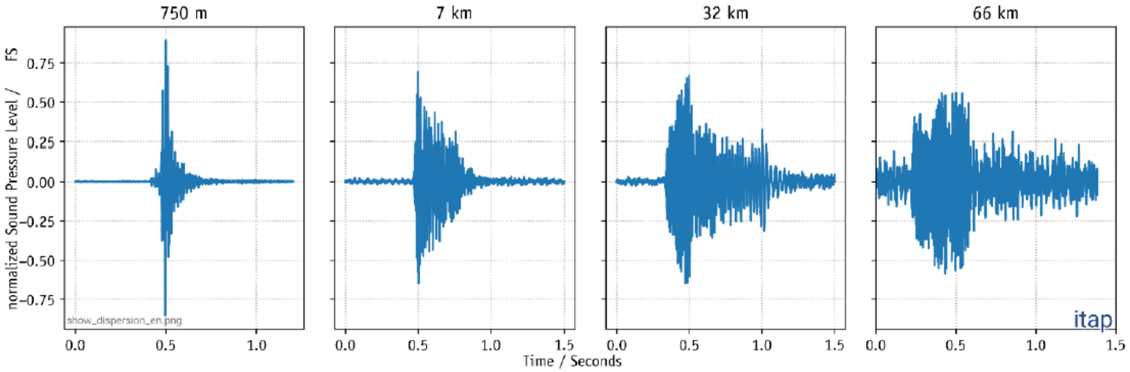
Impact pile-driving sound

Underwater noise produced during pile-driving

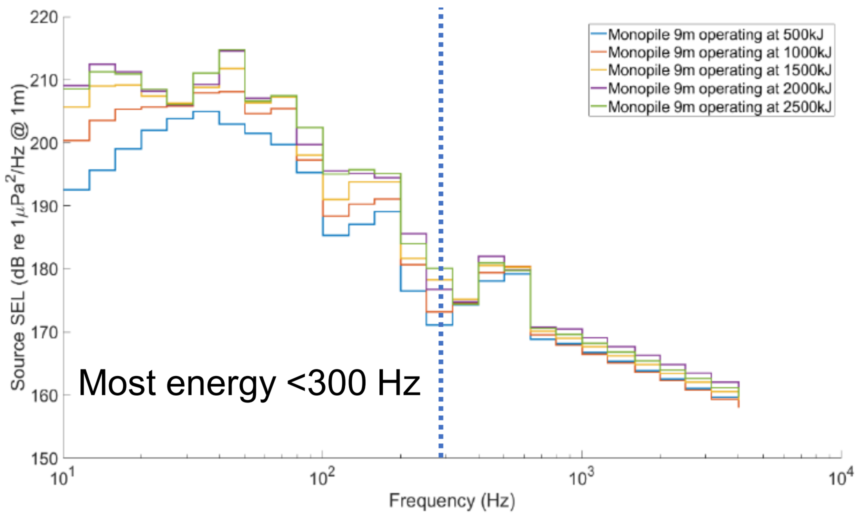
From Vineyard Wind Draft EIS 2018



Time series of pile-driving with distance



Impact-pile Driving Acoustic Spectra

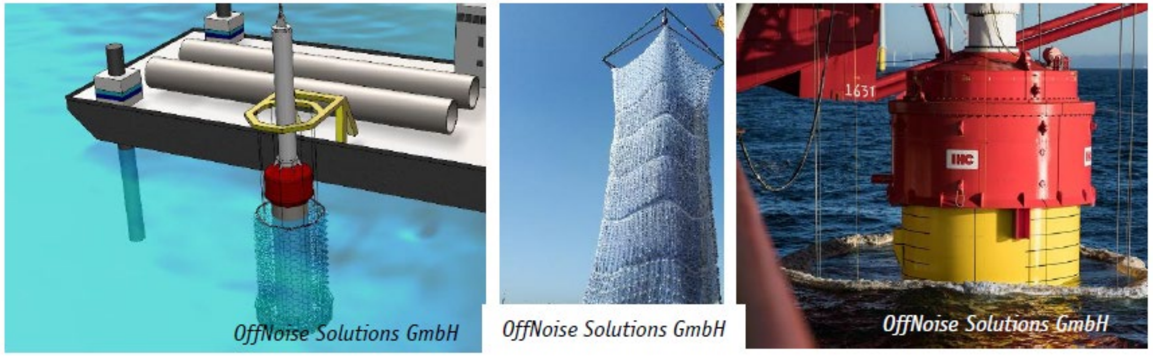


Pile-driving noise depends on:

- Foundation type
- Sediment type
- Water depth
- Abatement system used

Noise abatement methods for pile-driving

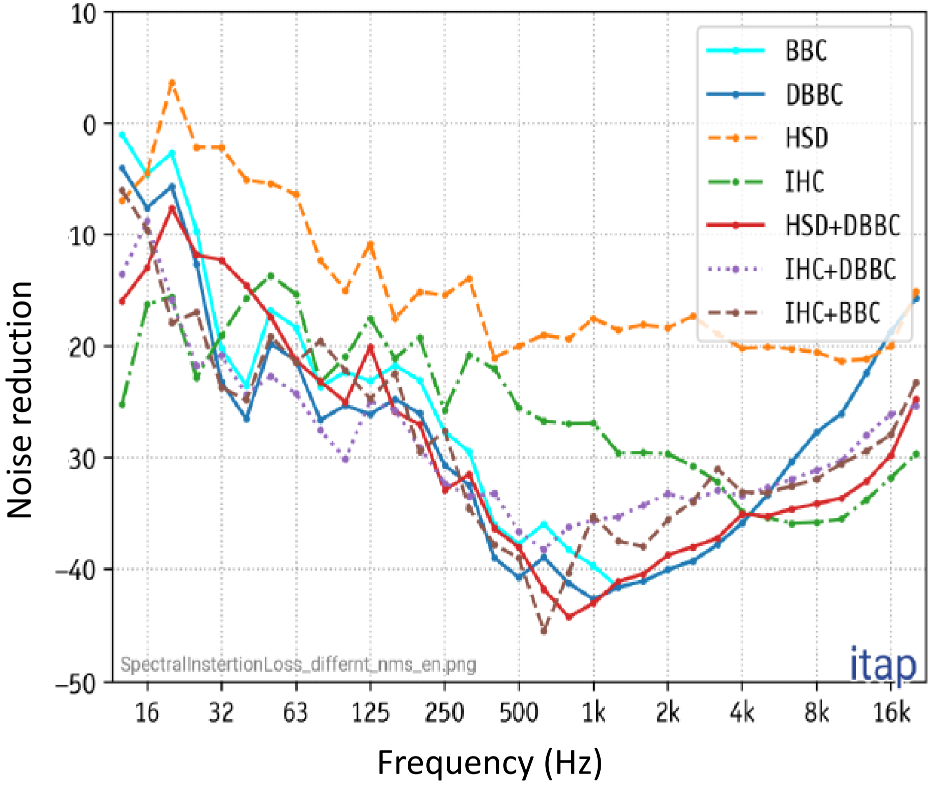
Hydro Sound Damper (HSD) — System



Double Big Bubble Curtain (DBBC)

Low Current High Current

Measured noise reduction from different abatement technologies

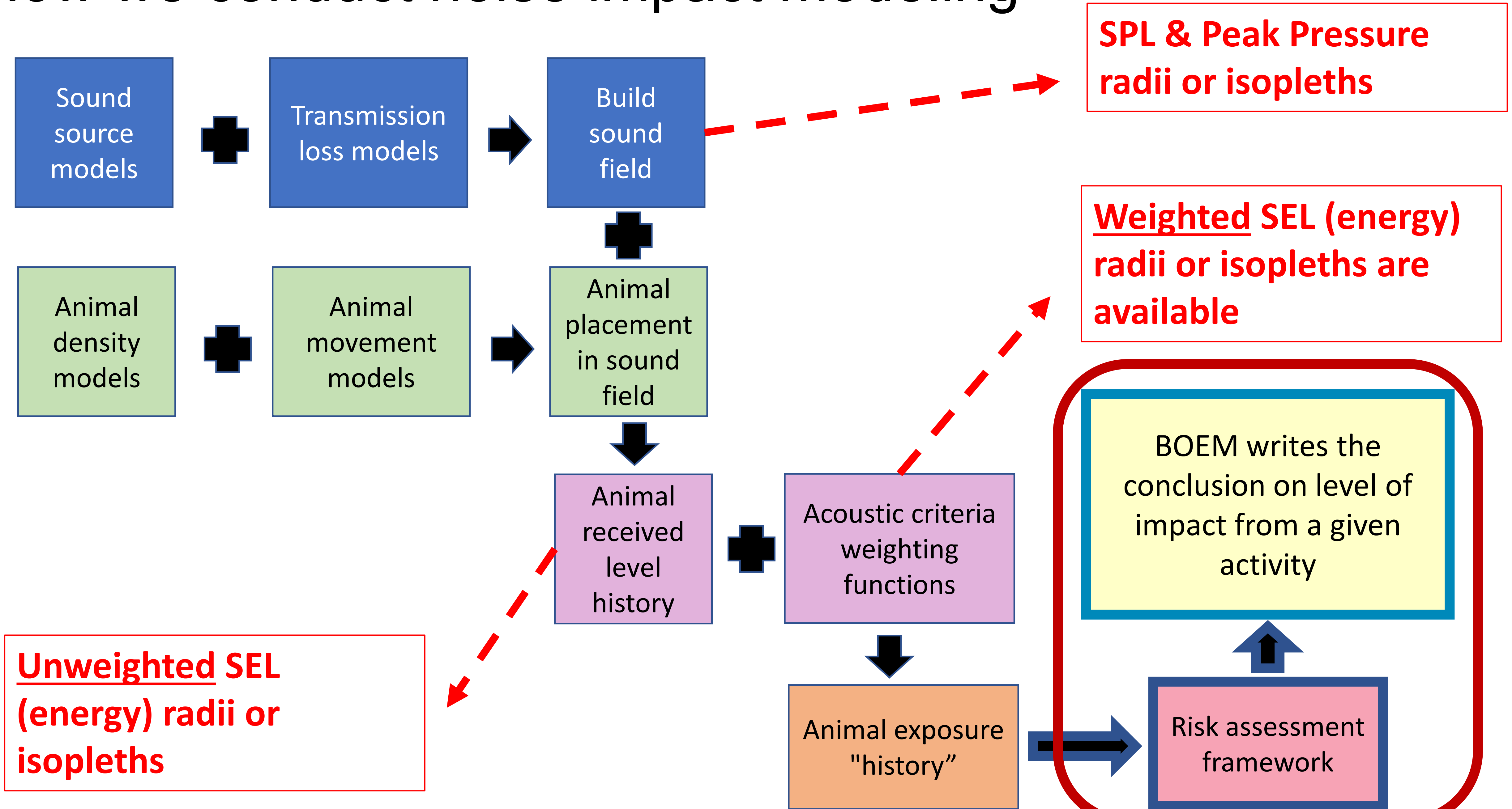


Bellmann 2020

Sounds produced during operations

- **Predicted broadband source levels: 150–180 dB re 1 µPa-m**
  - Based installations smaller < 6.5 MW (Tougaard, 2020)
  - Statistical fit based on:
    - Turbine power rating
    - Range
    - Windspeed
- **Block Island and CVOW measurements in US waters fall with this range**
  - Direct-drive systems quieter than gearbox

How we conduct noise impact modeling



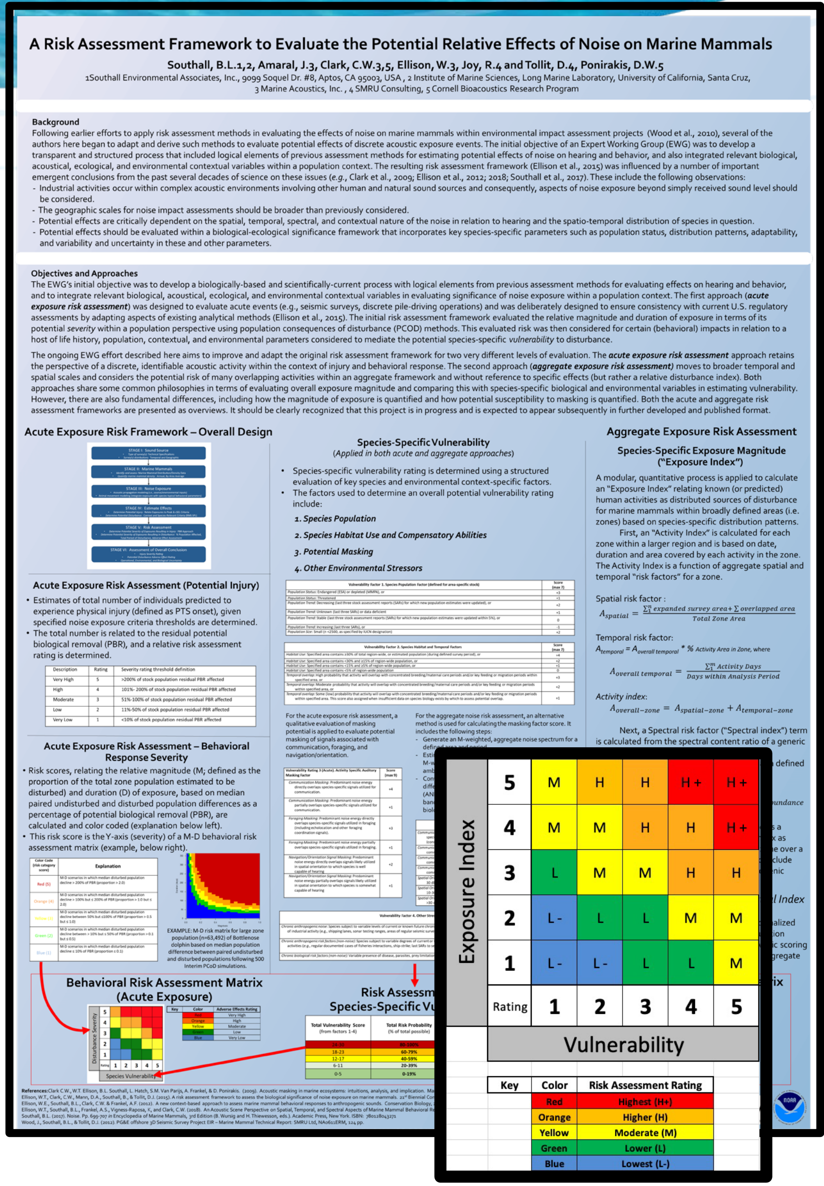
Center for Marine Acoustics Workbench Vision

The Center for Marine Acoustic (CMA) Workbench will be a well-understood, respected, and dynamic tool for predicting acoustic and biological effects of anthropogenic sound on the outer continental shelf (OCS) — a "useful" model answering current needs, while driving next-generation regulatory approaches.

- **Related to underwater acoustic issues: To improve the CMA's:**
  - Flexibility and timeliness
  - Self reliance and support BOEM decision-makers
  - Ability to verify external modeling and results
  - Internally examine and explore acoustic technical issues and ideas
- **BOEM's need for this capability is based on decades of experience addressing the issues/needs of OSCLA, NEPA, MMPA, ESA, etc.**
- **Initially, the Workbench will address BOEM's underwater acoustic needs, but other agency needs will potentially eventually be included.**

Development of a Risk Assessment Framework

- **How modeling results inform the alternatives and mitigation in NEPA**
  - During the Draft EIS to ROD portion of the process
- **Risk Assessment Framework Approach**
  - Uses expert elicitation and acoustic impact analysis to quantify species exposure & vulnerability
  - One for each scenario identified for examination
    - Geometries, seasons, proposed timing, etc.
  - Currently provides a relative assessment of risk for each species and scenario
- **Some results from Proof of Concept work**
- **Future Efforts**
  - Aggregate noise exposure for multiple acoustic sources
  - Cumulative look across all stressors (acoustic and non)
  - Case studies and ways it's been applied so far



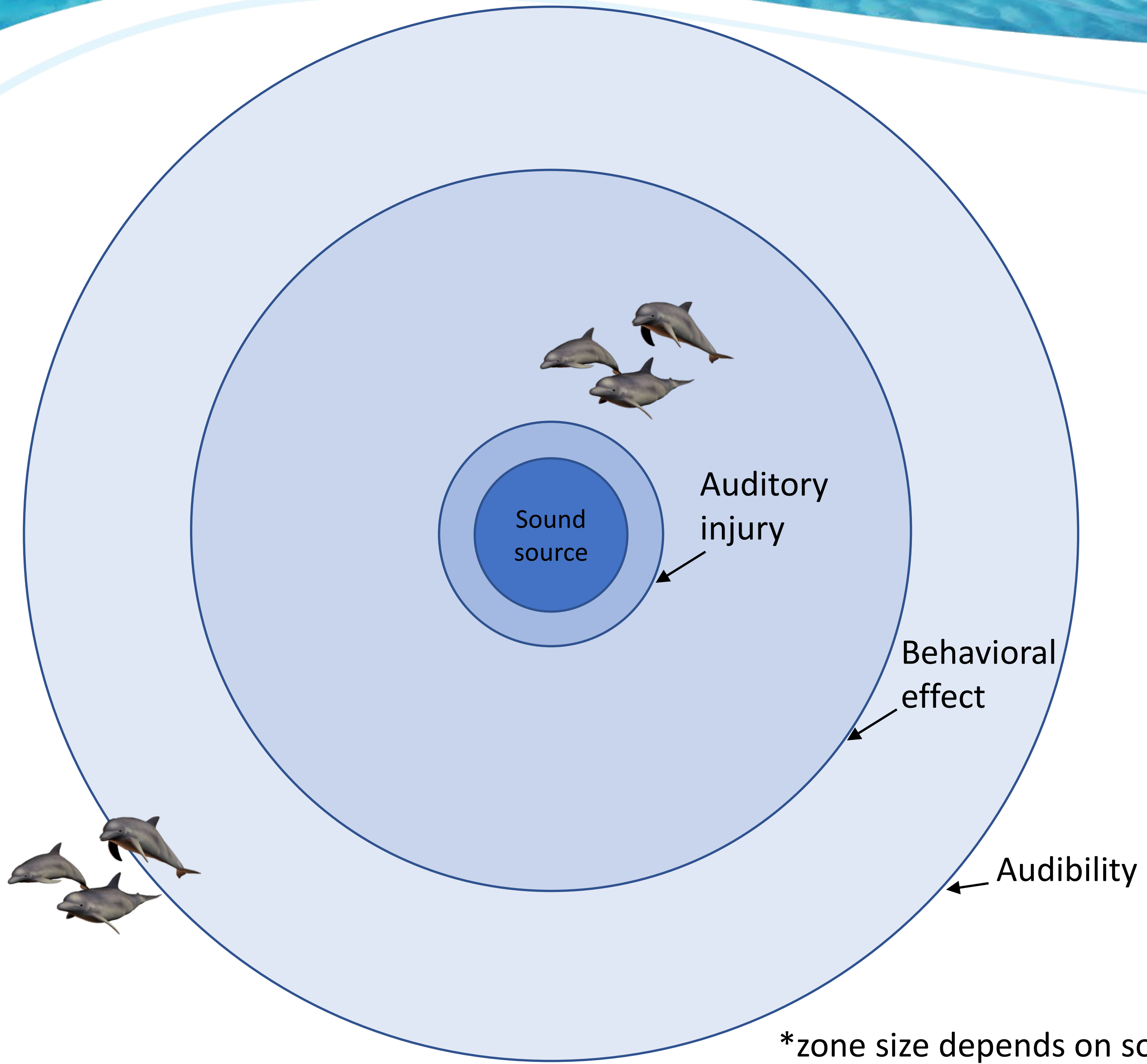
BOEM's Environmental Studies Program (ESP)

- BOEM has been funding underwater acoustics research since the 1980s
- We have an annual cycle of study development, prioritization, and then funding
- More and more topics of concern related to offshore wind

If you have ideas for research, submit to BOEM in Nov-Dec timeframe
Please do not send unsolicited proposals! Only high-level ideas

Request stakeholder input	→	Study profile development	→	Internal profile review and revision	→	Study Development Plan release	→	NASEM review	→	National Studies List release	→	Begin procurement of NSL studies
November		December		February		June		July		October		November

Range of effects at distance, and ways to mitigate



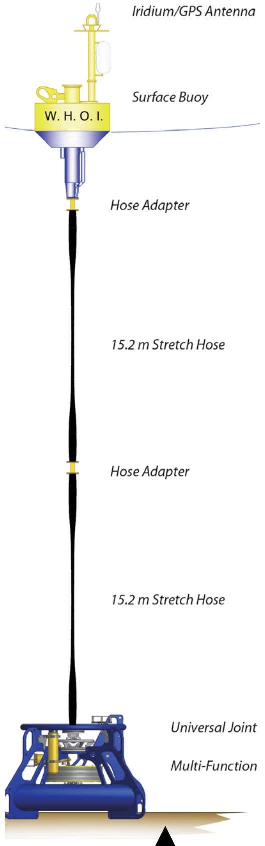
- Injury
  - Most acute effects occur close to source
  - Exclusion zones help mitigate
- Behavioral effect
  - Usually occur over larger scales
  - Difficult to quantify biological significance of behavioral impacts - area of research
  - Not practical to monitor such large zones
- Audibility
  - Largest
  - Audible but not bothersome?
  - Chronic and aggregate noise exposure may be an issue – area of research
- Quieting the source has benefits for all effects

*zone size depends on sound source, physical environment, and hearing capabilities of species!

Monitoring for mitigation

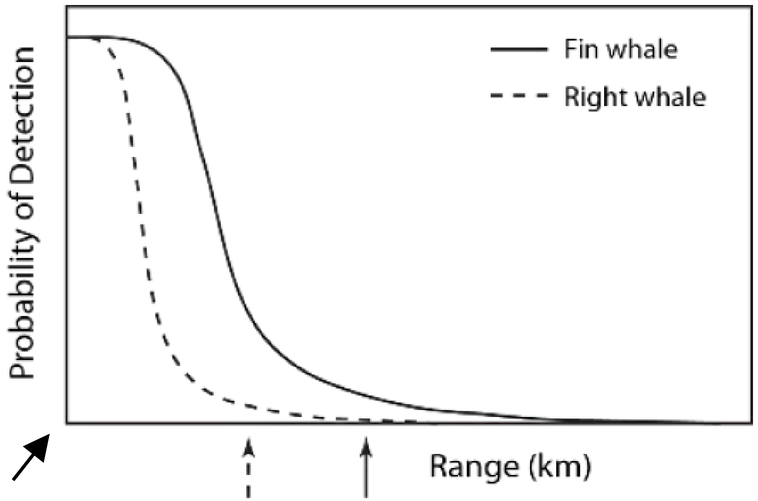
- Mitigation monitoring is only as effective as its detection capabilities
- Each method has pros/cons:
  - Visual observers: daytime, good weather conditions, limited distance
  - Drones: daytime, good weather, limited time
  - PAM: unknown # of individuals and difficult to localize without an array
  - Thermal cameras: short detection range
- Larger zones are not necessarily more effective

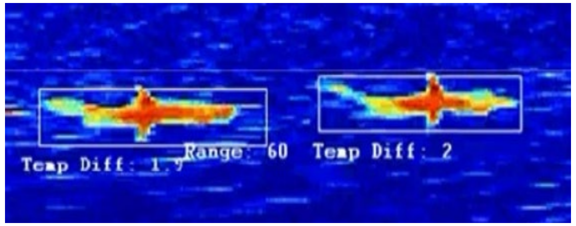
NOAA



Dr. Mark Baumgartner, WHOI

JASCO Applied Sciences





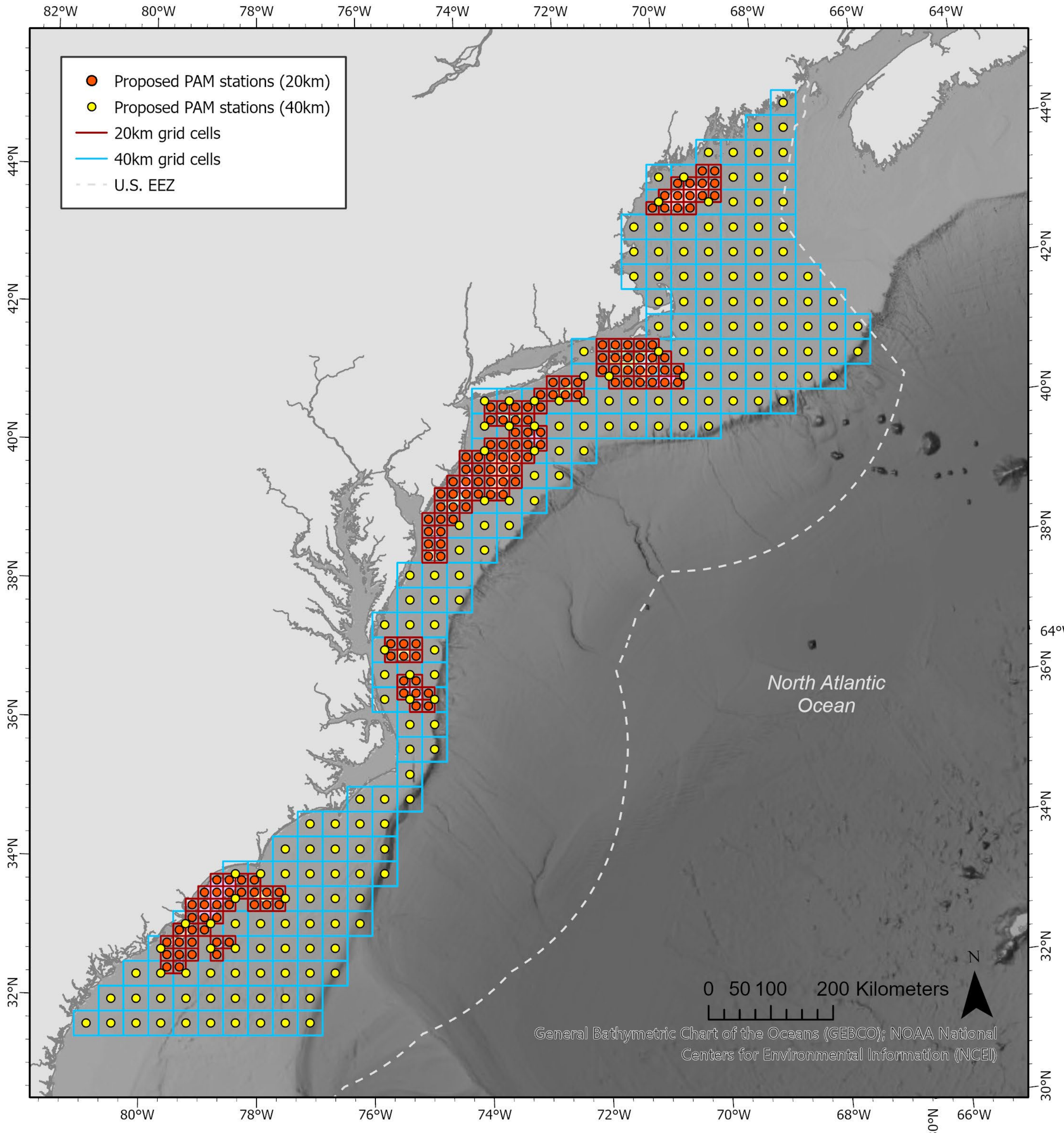
Graber, 2011

Long-term monitoring

- Atlantic Regional PAM Network

- **Driving question:** Is the distribution, abundance, or behavior of baleen whales changing?
  - If so, how?
  - Why?

- Disentangling the potential effects of offshore wind vs. other ongoing stressors will be a major challenge!
  - Need for multiple data streams, not just PAM



Existing knowledge gaps and ongoing research

- Developed BOEM's first-ever Acoustics Science Strategy (summer 2022) – currently looking for funding partners for high-priority topics.

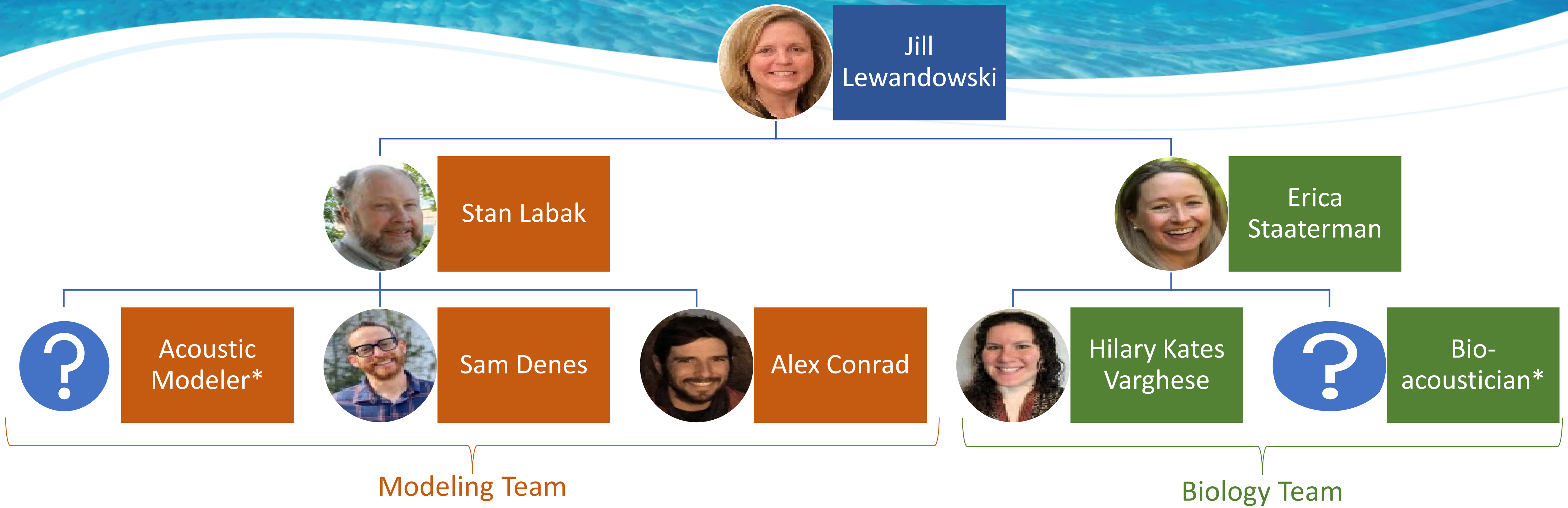
- Ongoing and upcoming research highlights:
  - Hearing in LF cetaceans (ongoing, partnered with other agencies)
  - Behavioral effects of offshore construction sources on seabass and squid: field study (ongoing)
  - Understanding cue rates of North Atlantic Right Whales in the mid-Atlantic (in development)
  - Measurements of substrate vibration from pile-driving (in development)
  - Behavioral responses of fish and inverts to substrate vibration (in development)

ESPIS: https://marinecadastre.gov/espis/#!/

Other projects of note…

1) Exploring quieting performance targets for impact pile-driving
   - differences from Europe to U.S. waters – high-frequency vs. low-frequency cetaceans, size of turbines, etc.
   - addition of quieting technology to new construction vessels
2) Working with NOAA to develop a 'living' strategy "*to protect and promote the recovery of North Atlantic right whales while responsibly developing offshore wind energy*"
3) BOEM recommendations for offshore wind project pile driving sound exposure modeling and sound field measurements

Center for Marine Acoustics



*Could be you! WE ARE HIRING! - deadline Sept 20th 2022

https://www.usajobs.gov/job/675417700 and https://www.usajobs.gov/job/675417300

https://www.boem.gov/center-marine-acoustics
https://www.boem.gov/renewable-energy

Questions? boemacoustics@boem.gov