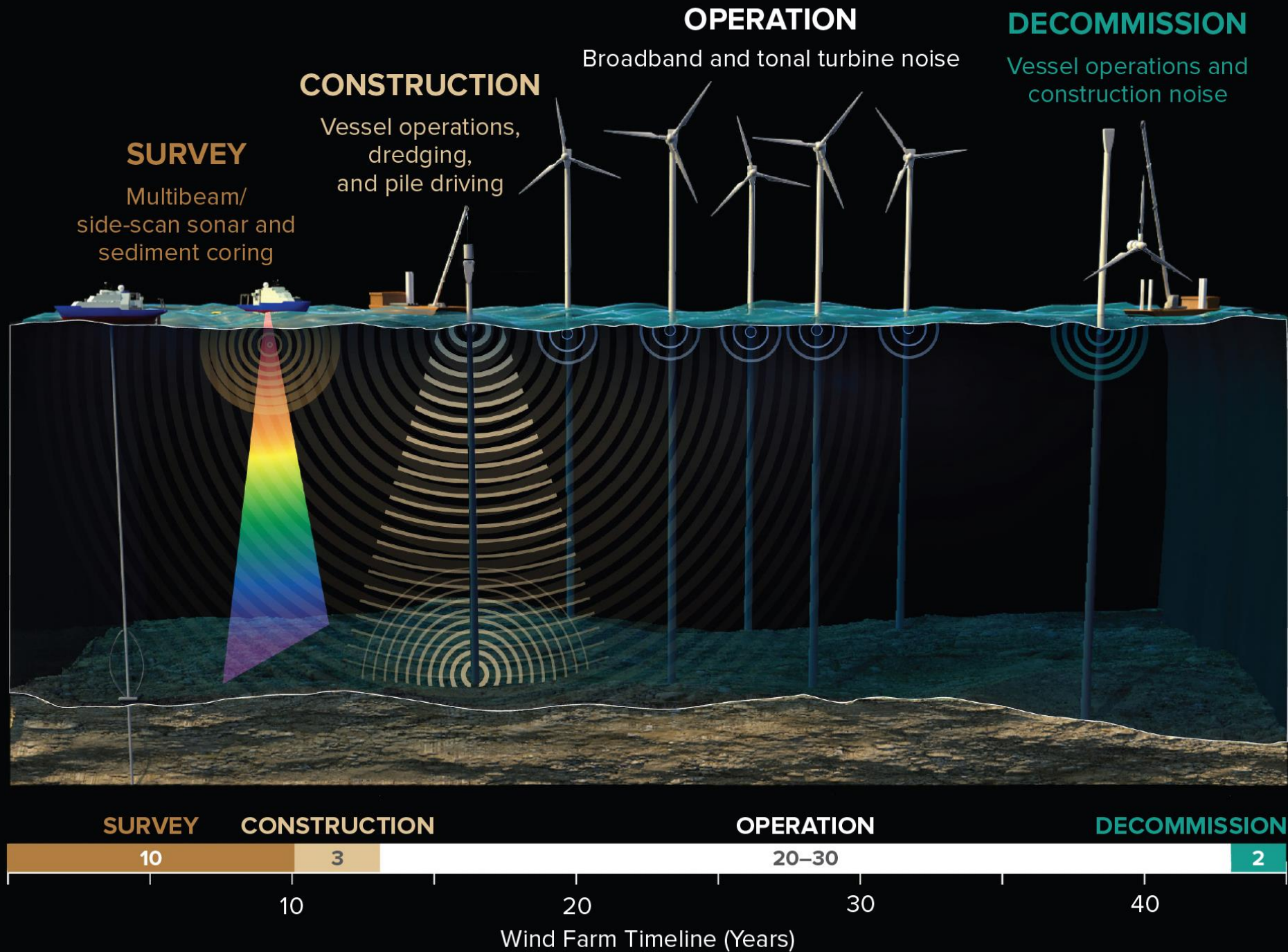


# Marine Mammal Noise Impact -Offshore Wind Energy-

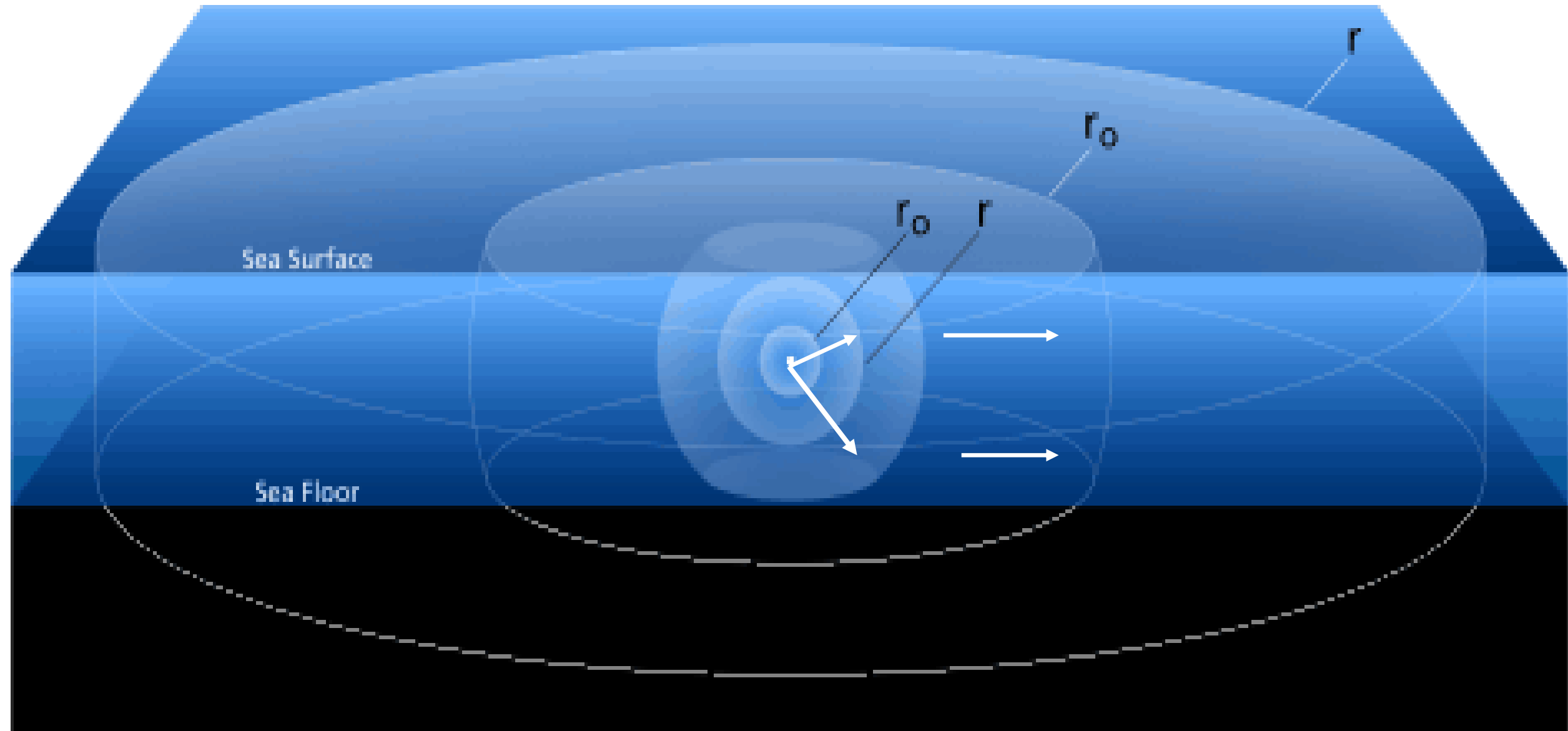
Bob Stern, Ph.D., President, Save LBI,  
Former Director, office of Environmental compliance, U.S. Dept. of  
Energy







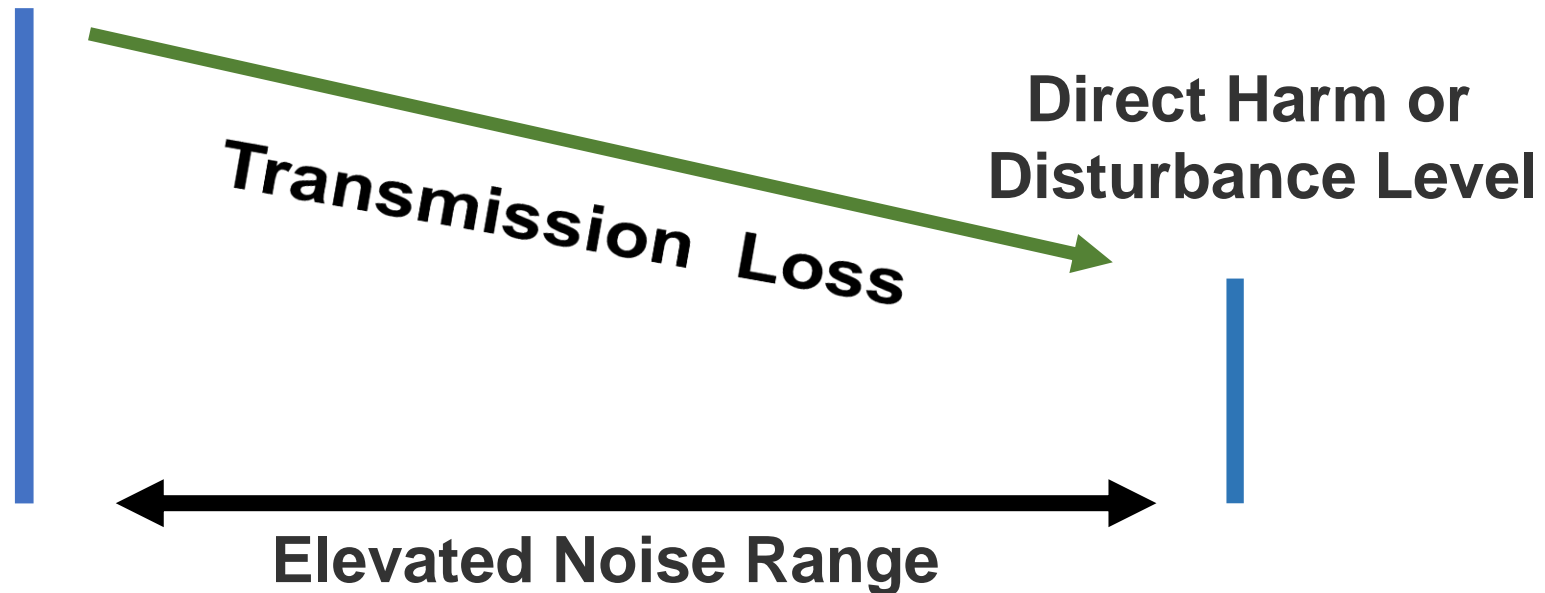
# Noise Spreading and Dissipation





# Source Levels (SL), Transmission Loss (TL), and Range (R) to Accepted Levels (AL)

Source Level





## Source Levels (SL), Transmission Loss (TL), and Range (R) to Accepted Levels (AL)

- Sound is measured in decibels (dB), a logarithmic or exponential scale, to cover wide ranges
- A “plus 10” increase in decibels means the noise intensity experienced is 10 times greater
- The Range at which elevated noise occurs varies exponentially with (Source level minus Accepted level) / Transmission loss, meaning that:
- Small changes in those cause very large changes in Range, and

**Range x Density of the Mammals there = Harm**



## Legal Framework

### **Marine Mammal Protection Act,**

**Level A “Takes”, Fatality, Injury (e.g., hearing loss),**

**Level B, Disturbance**

**Small numbers affected (33% ?)**

**Negligible impact**

### **Endangered Species Act**

**Jeopardize the continuing existence of a species,**

**Adversely impact Critical Habitat**



**However, in the real marine mammal world, Level B disturbance can lead to:**

- **Avoiding the noise or “standing off” from it in an undesirable direction or location, in a migratory setting obstructing or blocking it.**
- **If the mammal is between the shore and the source, being driven towards the shore seeking relief.**
- **Surfacing to seek a lower noise level and becoming more vulnerable to vessel strike.**
- **Separation of mothers and calves due to the “masking” of their normal communications, which can be fatal for the calf.**
- **Loss of its navigational ability, cessation of feeding or mating, loss of energy and the ability to detect predators or oncoming ships.**
- **Finally, because whales use sounds to determine the very nature of their surroundings, the effects may be much more profound than we know.**

**So, behavior disturbance is not as innocuous as the name implies, and the Level A vs. Level B distinction is artificial.**



## Accepted Levels- in Decibels (dB)

	Permanent hearing Loss	Temporary Hearing Loss	Disturbance
Impulsive Noise, NMFS	219 dB Peak, 183 dB Energy	179 dB Energy	<u>160 dB (50 % affected)</u>
Impulsive Noise - for baleen whales, including right & humpback (Wood et al.)			120 dB (10% affected) <u>140 dB (50% affected)</u> 160 dB (90% affected),
Non-Impulsive Noise, NMFS	199 dB		120 dB



# Whales off LBI, October 2022





**Recent, unprecedented number of whale deaths in month-plus period**





## Vessel Surveys –Noise Impact

	National Marine Fisheries Service (NMFS)	More realistic
Source Level	203 decibels (dB)	205-211 dB
Transmission Loss- per tenfold increase in distance	20 dB	15 dB
Criteria- Noise Level to Get Down to	160 dB	140 dB (for baleen whales)
<b>Range to 140 dB</b>	<b>-----</b>	<b>13-34 miles</b>
<b>Range to 160 dB</b>	<b>1/10 mile</b>	<b>1/2-16 miles</b>



## Vessel Surveys

- In a recent five-week period, five whales were washed up on New Jersey shores, plus 3 juveniles, plus another dead whale sighted 12 miles out soon after
- At least six vessels were doing geotechnical surveys off the New Jersey coast during that time frame using high intensity noise devices to characterize the seabed
- The **NMFS** estimates noise levels above its 160 dB criteria exist a **tenth of mile** from the vessel. Using documented measured noise source levels, a generally accepted noise dissipation rate, and more relevant noise disturbance criteria, that distance **increases exponentially to 13 to 34 miles**, depending on noise device settings.
- The noise levels from the surveys are sufficient to create large ranges, where the whale's behavior will be disturbed, potentially leading to other serious outcomes.
- The noise from the vessel survey devices is not likely to cause permanent hearing damage to whales in the vicinity, so that damage would not show up on post-mortem examinations even if it was looked for, which often it is not.
- **The situation calls for a prompt, serious and transparent investigation by those with the skills and independence to reach fact-based conclusions.**



## **Response to Vessel Survey Issue from the federal agencies and wind energy proponents**

- **Hastily concluded there is no “direct” connection between the whale deaths and the vessel surveys, other factors vaguely presented without evidence-climate change, feeding patterns, more vessels, etc. – none of which explains six deaths in a month in NJ .**
- **No presentation of the acoustics math and marine mammal science, noise source levels, large elevated noise range, and whale disturbance.**
- **The issue is with the word “direct”, apparently referring to permanent hearing damage, but that is not expected here, and they fail to say that post-mortems rarely look for that anyway.**
- **The problem is with behavior disturbance leading “indirectly” to serious harm and fatality.**
- **Federal response does not address the real disturbance issue –an investigation is still needed.**



## Pile Driving to Place Foundations in Seabed





## **Pile Driving – Noise Impact Background**

Foundation Diameter, 49 feet (15 meters), Length, 344 feet

Embedded in Seabed, 200 feet

Strike Rate , 30 per minute

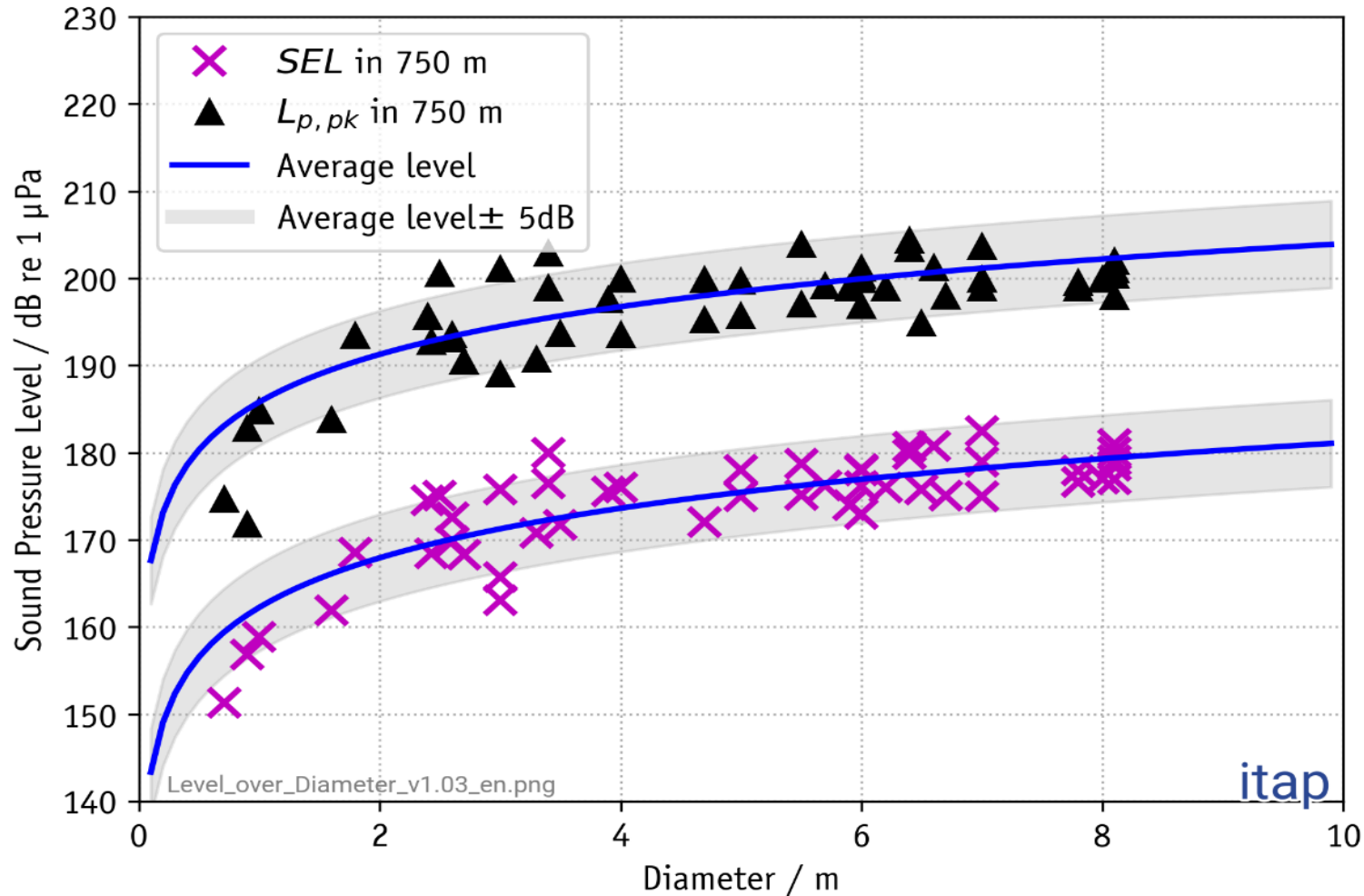
15,387 Strikes to Drive One Pile

Noise Pulse, 15 milli-seconds

Two to three year construction period; Noise Impacts to marine mammals and onshore humans



# Pile Driving – Noise Source Level Increasing with Foundation Diameter



For 12-15m pile diameter, Sound Energy Level (SEL) =182 dB

Adjusted to 1 meter, +43 dB

Adjusted from SEL to SPL ,+18 dB

**SPL at 1 m= 243 dB**



## Pile Driving Impacts -for 15 meter diameter pile-

	Atlantic Shores Application	Other Sources
Sound Energy Level @ 750 meters	165-170 dB <sup>(1a)</sup>	184 dB <sup>(2)</sup>
Sound Pressure Level (SPL), broadband	~ 210 <sup>(1b)</sup>	~220 <sup>(3)</sup> , ~245 <sup>(4)</sup>
<b>Transmission Loss (TL)</b>	<b>40 <sup>(5)</sup></b>	<b>15 dB <sup>(6)</sup></b>
<b>Distance required to 160-140 dB</b> (no source attenuation)	<b>4-9 miles <sup>(7)</sup></b>	<b>6-134 miles <sup>(8)</sup></b>
Broadband Source Attenuation , bubble curtains	10 dB <sup>(7)</sup>	5 dB <sup>(6)</sup>
Low Frequency Attenuation, baleen whales	10 dB <sup>(7)</sup>	0 dB ( reverberates from seabed)



# The North Atlantic right whale

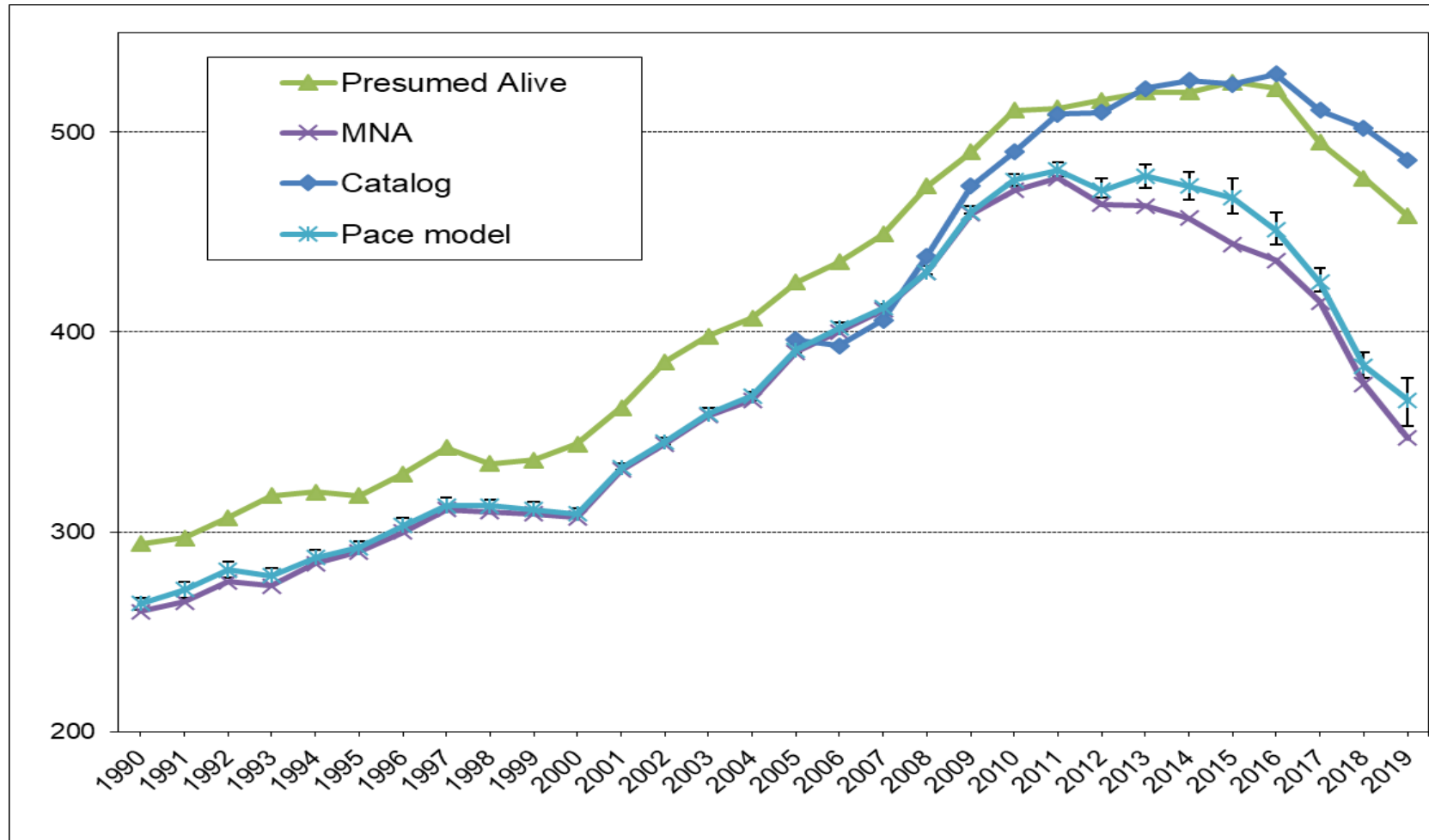
- **Critically endangered North Atlantic right whale, slaughtered for oils, struggling to survive.**
- **Current population ~350 and declining, 70 breeding age females**
- **\*Recent study indicates human induced stressors are stunting their growth.**
  - **Scientists have observed 5–10-year-old whales about the size of 2-year-old whales**
  - **An 11-year-old whale observed was the same size as 1.5-year-old whales**
- **Current risks include net entanglement, vessel strike.**



- **New risks: noise from vessel surveys, turbine installation (pile driving), and now from larger turbine operation.**
- **If human-induced stressors, including noise, are not lowered - the right whales' chances of survival are dim.**

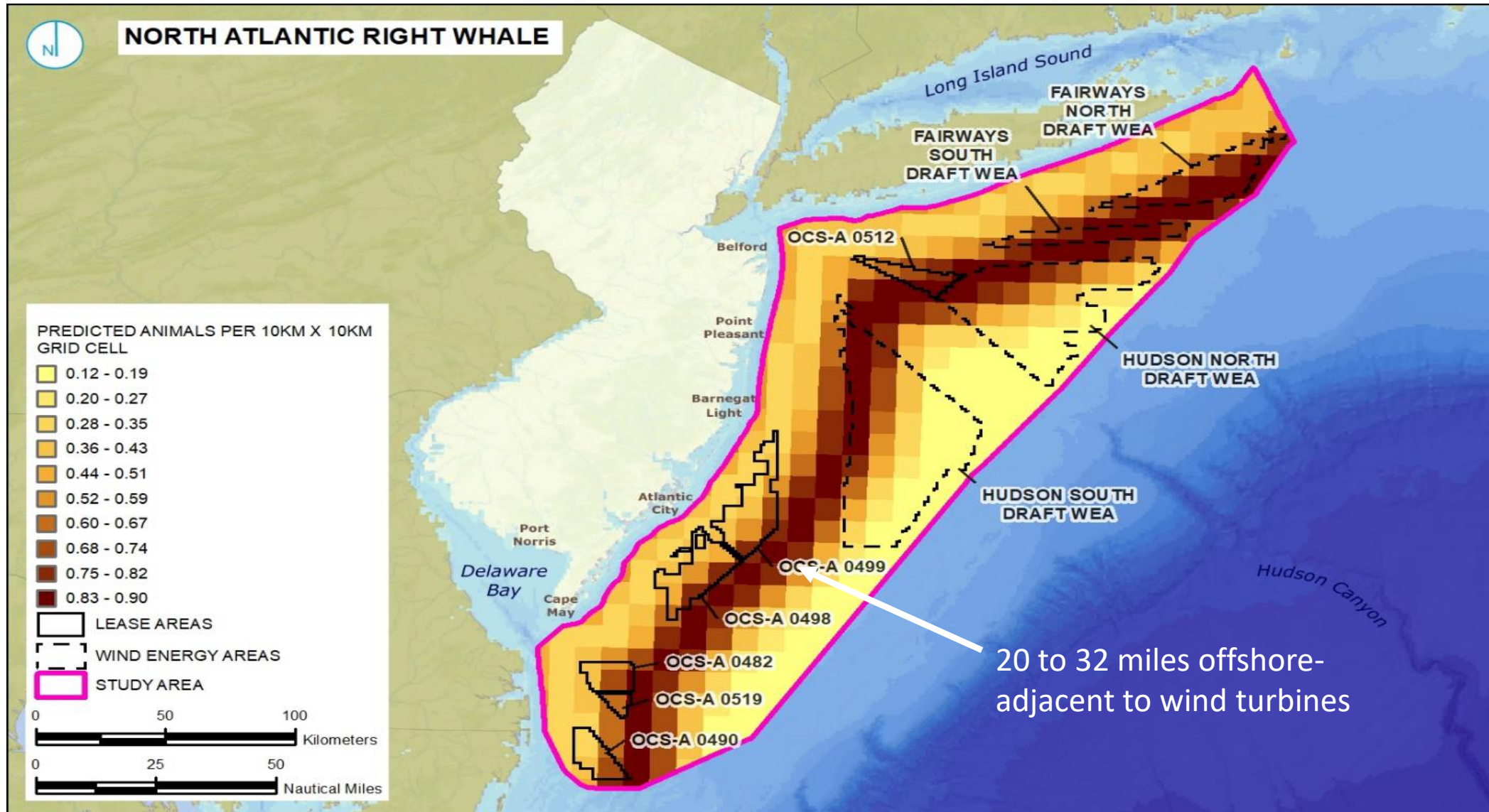


# Population Decline of the North Atlantic Right Whale





# Close-in Migration Corridor-North Atlantic right whale



Source, NJ Offshore Wind Strategic Plan, Natural Resource Technical Appendix, Figure 21.



Right Whale Migration- from the Atlantic Shores Incidental Take Application for Construction –Figure 9.

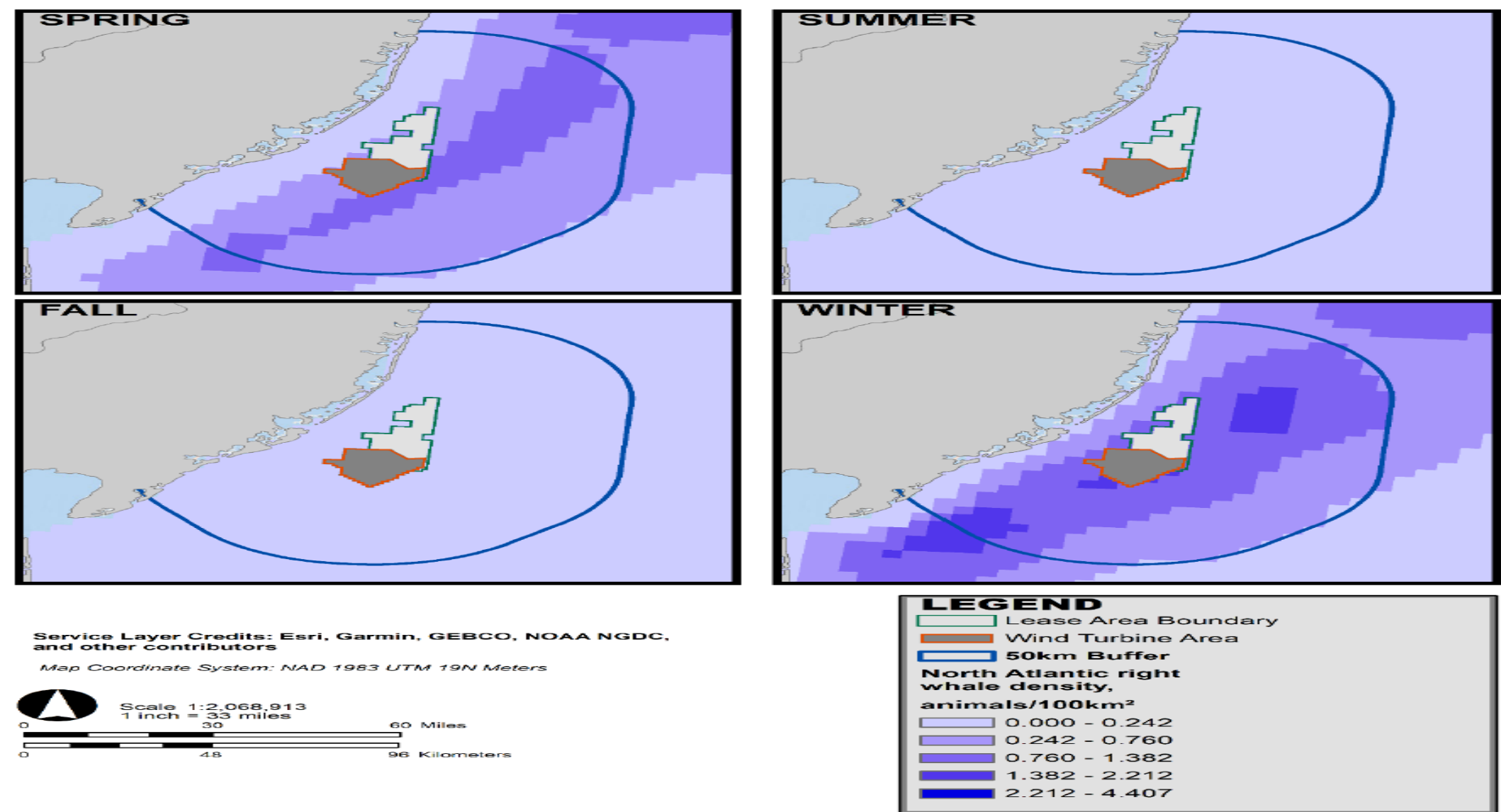
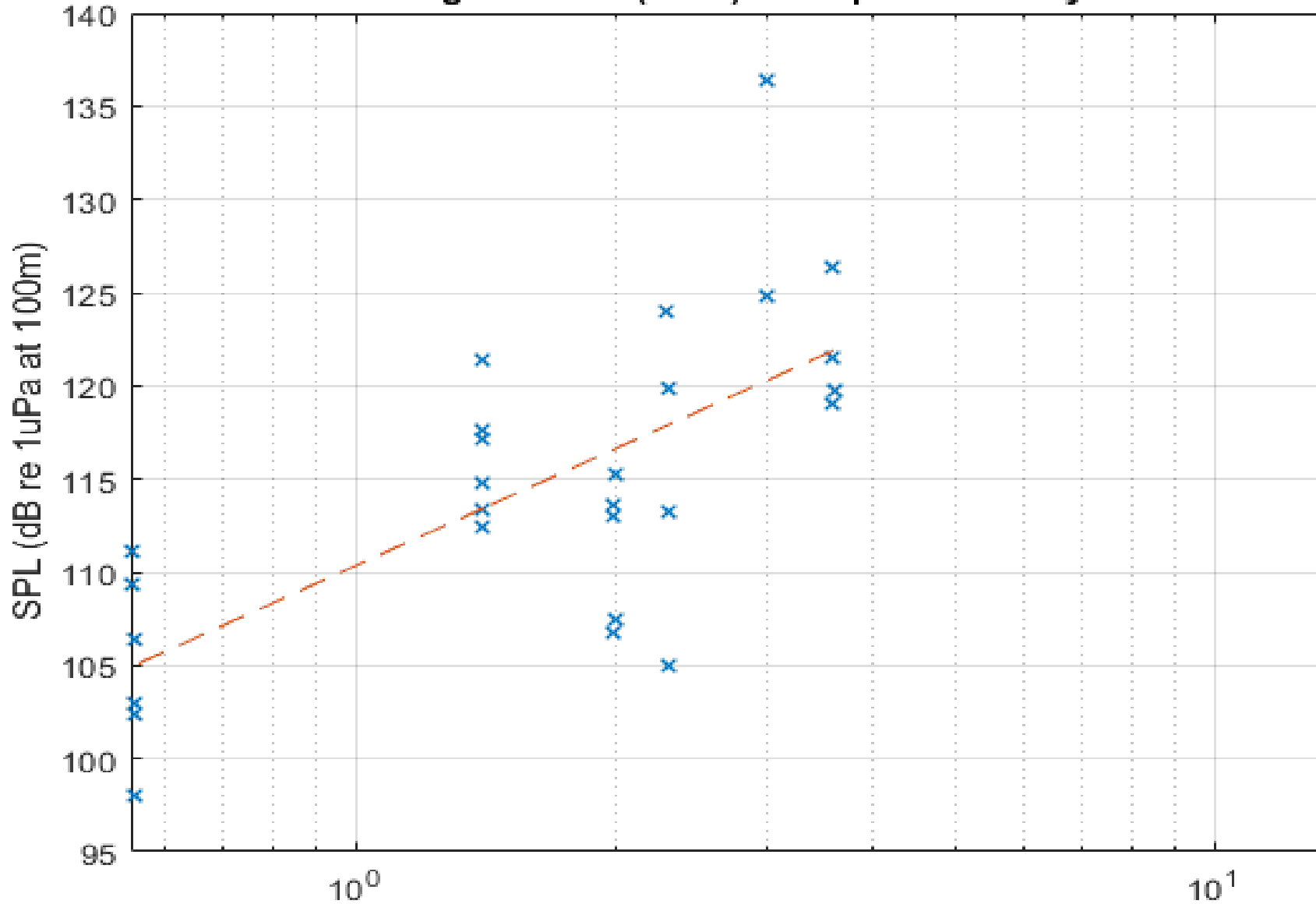


Figure 9. North Atlantic right whale maximum seasonal density from Roberts et al. (2016a, 2021a, 2021b).



# Turbine Operation-Increasing Source Noise with Turbine Power-Monopile Foundations (Xi Engineering)

Tougaard et al (2020) Monopile data only

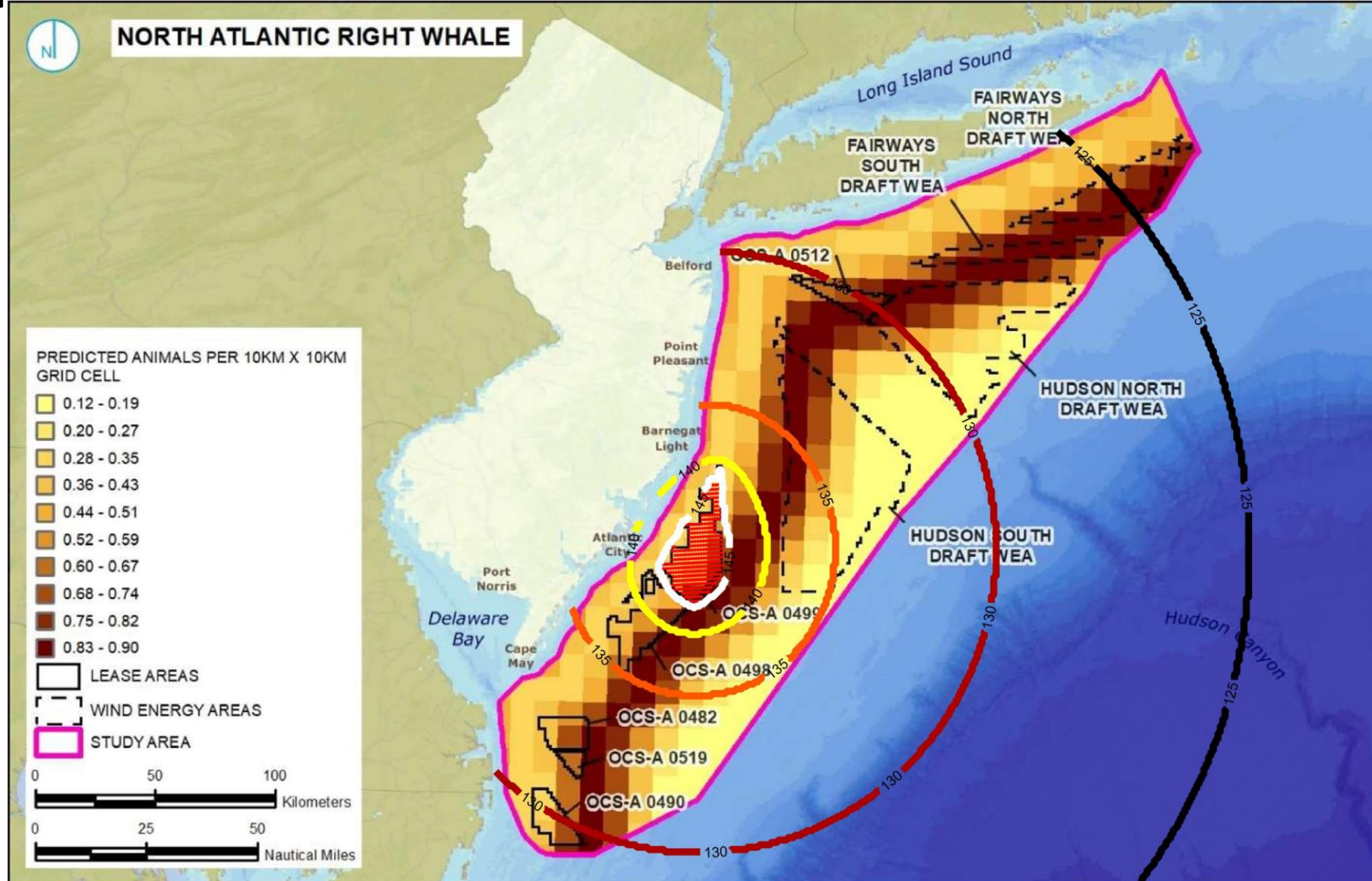


- Data were taken from Tougaard et al (2020) for the monopile foundation only, and the line extended to give source level of a 13.6 MW turbine on monopile foundations.
- A level of 137 dB re 1 μPa at 100m was extrapolated, and then back propagated to get a source level of **181 dB re 1 μPa at 1m.**
- Both broadband and spectral models were updated with this value and plotted on contour plots.



# Results Monopile

## Noise Level versus Distance from 357 Turbine Complex (Xi-Engineering)





## **Noise Extent Study Results**

- **Noise levels in the 12-mile-wide migration corridor between the Atlantic Shores and NY Bight areas ,140 to 145 dB, well above the 120 dB NMFS continuous noise disturbance level- more than 100 times the accepted sound intensity level.**
- **Noise levels above 130 dB extend out 93 miles from the shore**
- **From experiments, probability of another baleen whale, the gray whale, avoidance of 140 dB is 95%, of 130 dB, 80%.**
- **Migration not seen beyond 86 miles**
- **Operation noise from the Atlantic Shores project alone potentially blocks the migration.**



# North Atlantic right whale density v12 model January 2011-2020

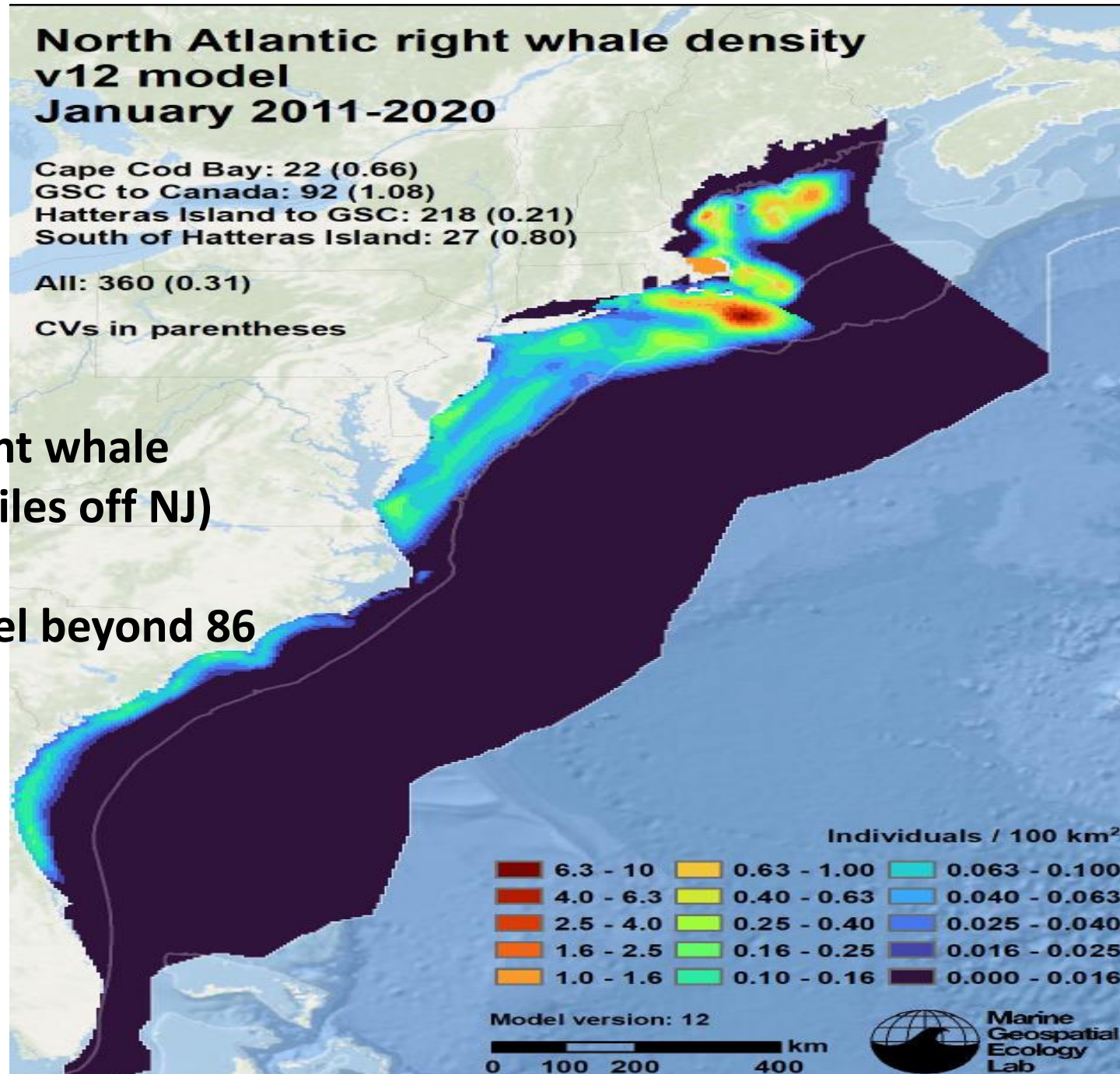
Cape Cod Bay: 22 (0.66)  
GSC to Canada: 92 (1.08)  
Hatteras Island to GSC: 218 (0.21)  
South of Hatteras Island: 27 (0.80)

All: 360 (0.31)

CVs in parentheses

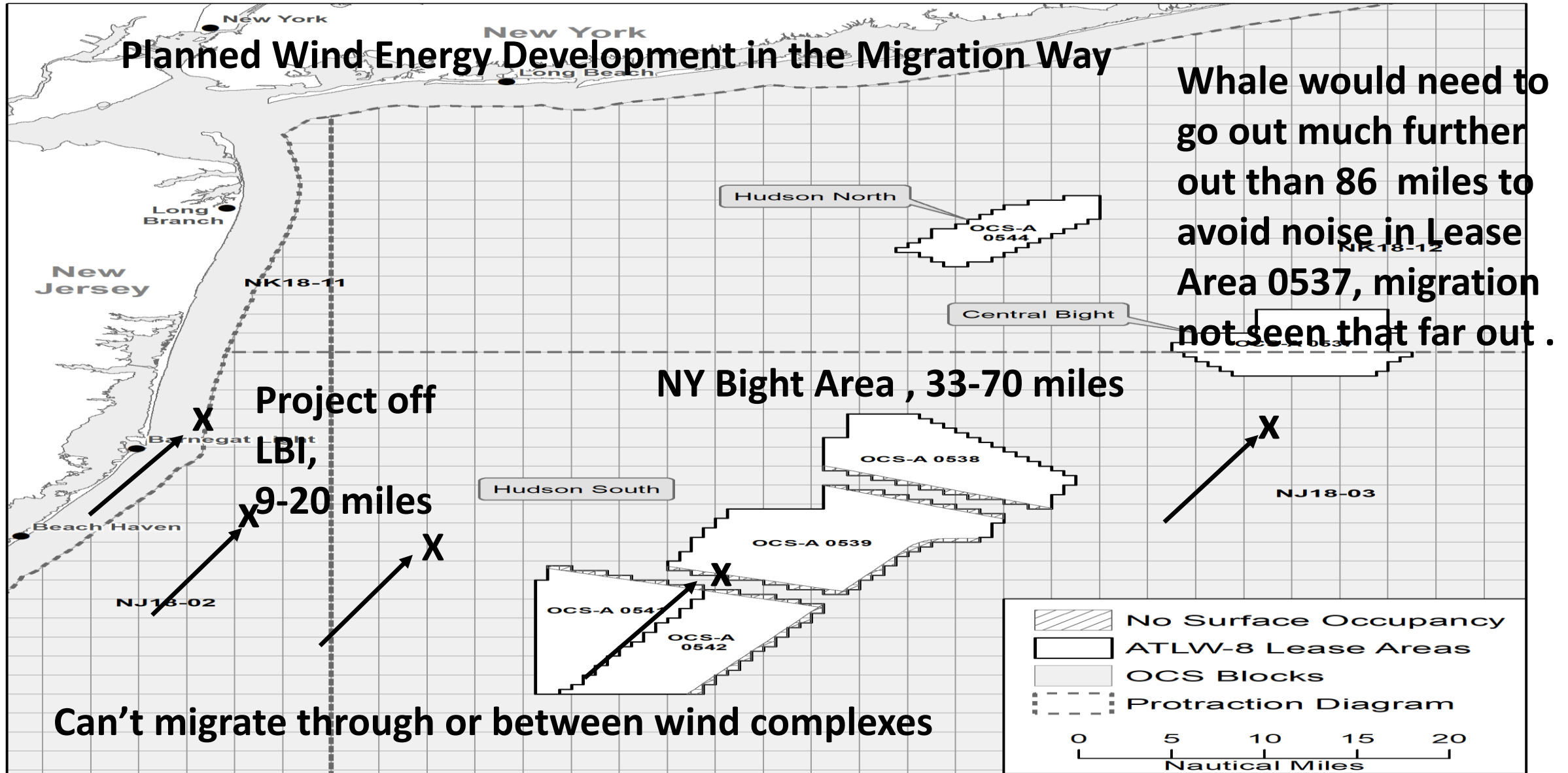
Further look at right whale  
migration ( 6-86 miles off NJ)

No significant travel beyond 86  
miles



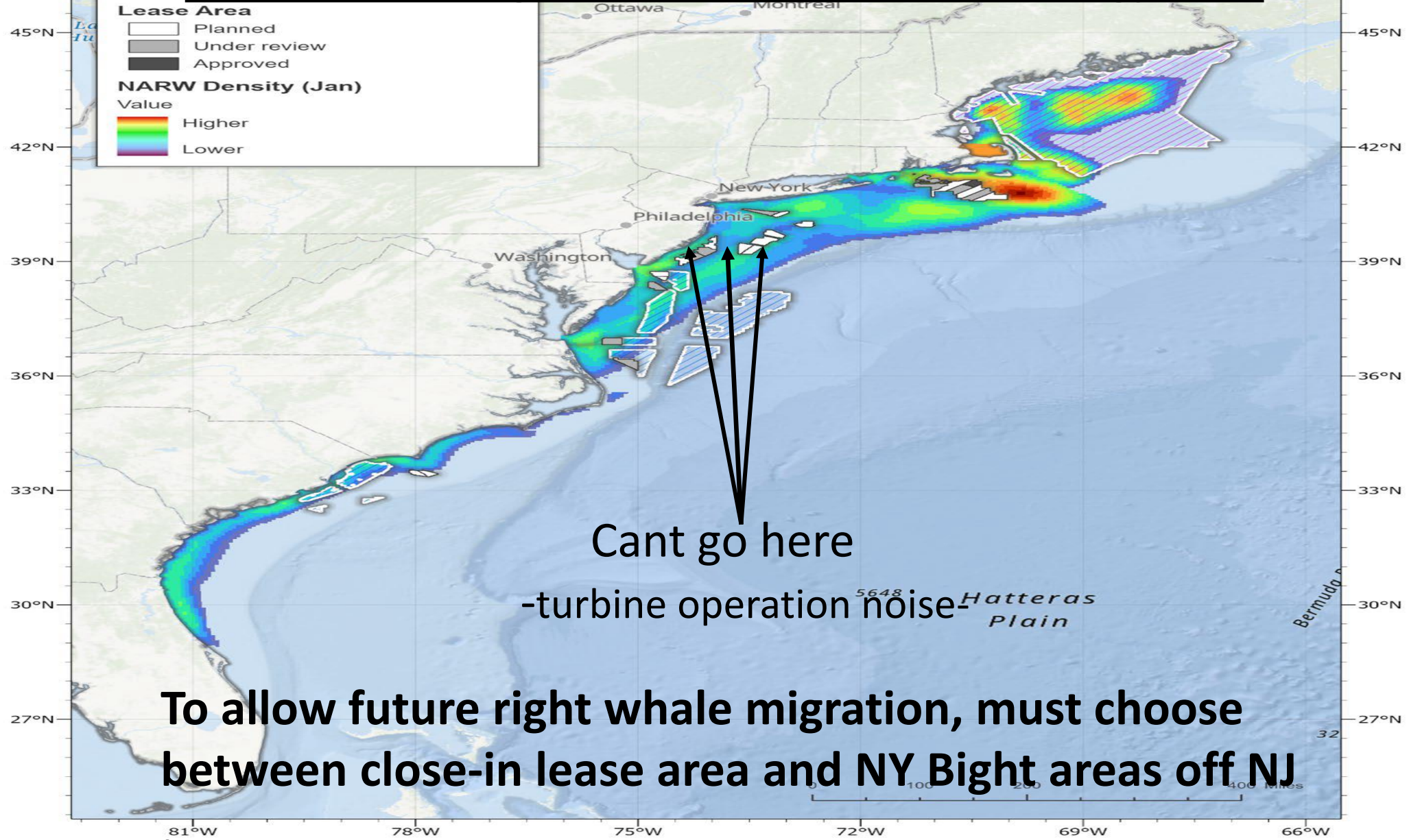


## ATLW-8 Lease Areas





# Intersection of Migration Corridors with Wind Energy Areas





## **Conclusions - NJ Project Specific**

- **To avoid disturbance noise from turbine operation in lease area 0537, whales have to go much farther out than 86 miles to migrate, never seen before. The noise from turbines at 9 miles would block a close to shore path.**
- **The corridor between the Atlantic Shores project and the Hudson South area will also be blocked by elevated noise levels.**
- **Even higher noise levels exist within the wind complexes.**
- **Wind energy development in both the close-in and farther out areas effectively blocks the migration. A choice must be made between the two to leave a path for the whale.**
- **That choice is evident- there is more wind energy in the further out NY Bight area, and development there does not cause the shore impacts that the closer in area does.**



## **Conclusions – General**

- **Major issues regarding NOAA “take” authorizations: noise impact estimates, transparency, criteria used.**
- **Turbine operational noise is crucial, but not being addressed.**
- **Conflict between right whale migration path and selected turbine areas. Was no public input to selected areas.**
- **Excessive reliance on acoustic companies paid by applicants, little on independent experts.**
- **Major risk to marine mammals from the current offshore wind program.**
- **Congress should hold oversight hearings.**



## **Pile Driving – References**

- (1a) Atlantic Shores, ITA Application, Appendix B, Tables F1-F12
- (1b) Atlantic Shores, ITA Application, Appendix B, Figure 13
- (2) Bellman, Underwater noise during percussive pile driving, ITAP report, Figure 12, August 2020
- (3) Thompson, Effects of offshore wind farm noise on Marine Mammals and fish, August 2006, Figure 10, 1 meter from source
- (4) Adjusted from ITAP, 184 dB, +43 dB to 1 meter, + 18 dB to SPL = 245 dB
- (5) ITA Application, Appendix B, Figures F1-F12, and Table 20 in Application
- (6) ITA Application, Save LBI comments, November, 2022
- (7) ITA Application, Table 20
- (8) Using the 220 SPL number and the 15 dB loss factor.