

Impacts (or lack thereof) of seismic surveys on marine wildlife

Douglas P. Nowacek

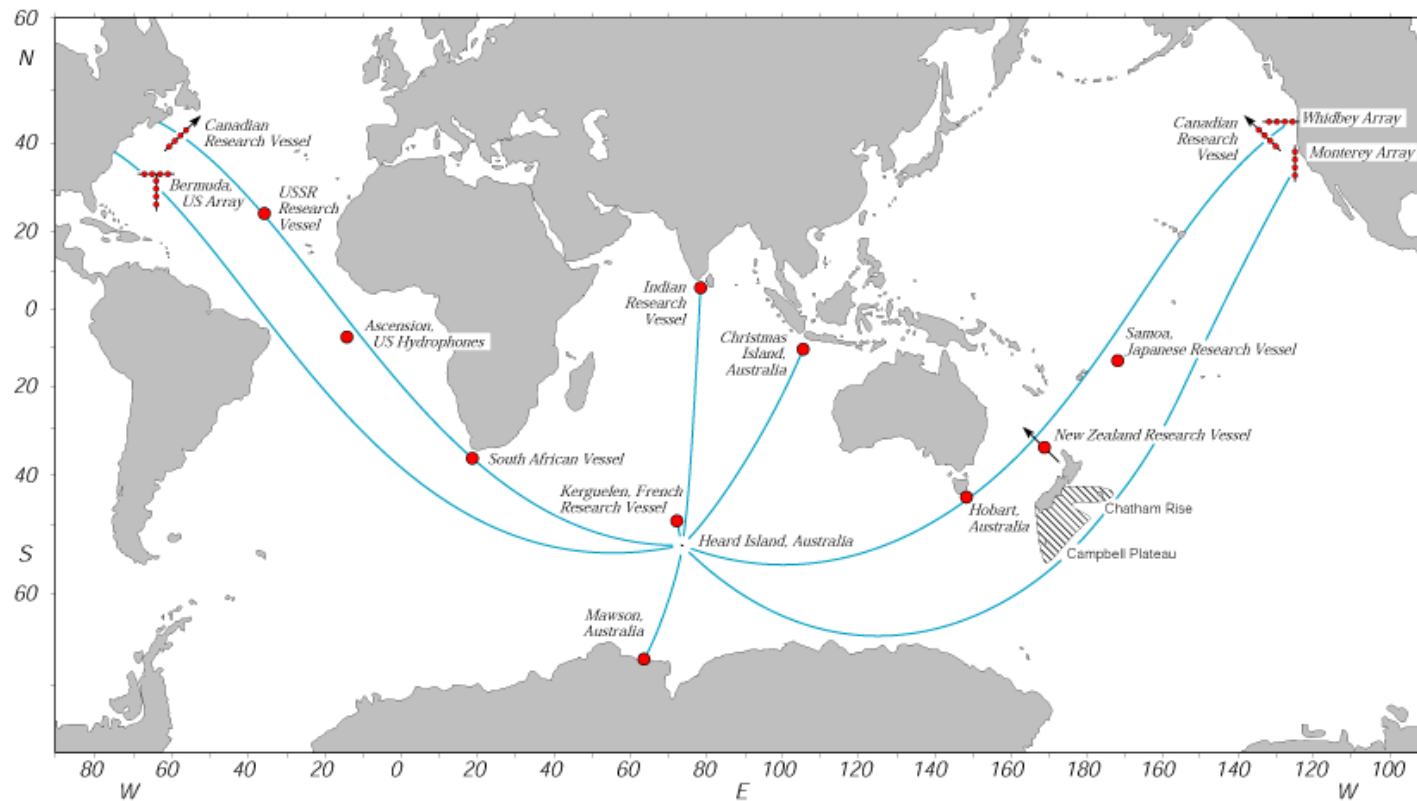
Repass-Rodgers Chair of Marine Conservation Technology

Duke University Marine Laboratory



Heard Island Feasibility Test

Acoustic source transmitted coded signals that were received at hydrophones throughout the world.



Does noise impact wild animals?

BIOLOGICAL
REVIEWS

Cambridge
Philosophical Society

Biol. Rev. (2015), pp. 000–000.
doi: 10.1111/brv.12207

1

A synthesis of two decades of research documenting the effects of noise on wildlife

Graeme Shannon^{1,†*}, Megan F. McKenna^{2,†}, Lisa M. Angeloni³, Kevin R. Crooks¹, Kurt M. Fristrup², Emma Brown², Katy A. Warner¹, Misty D. Nelson¹, Cecilia White¹, Jessica Briggs¹, Scott McFarland¹ and George Wittemyer¹

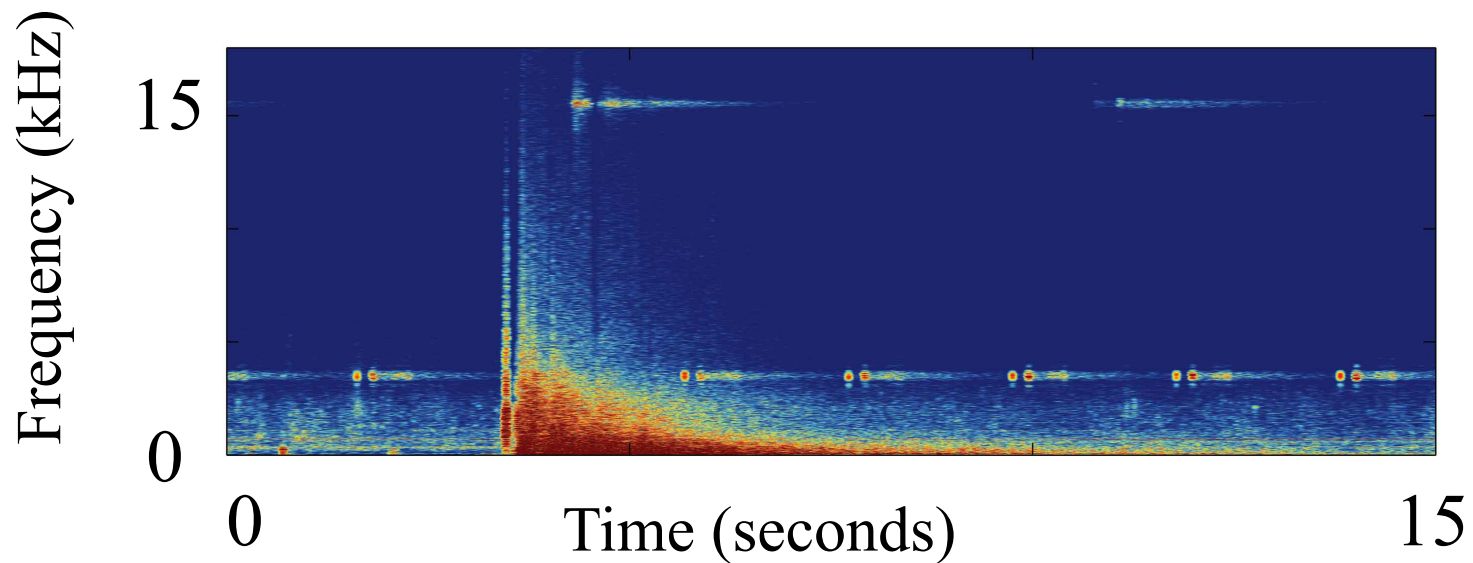
¹*Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins, CO 80523, U.S.A.*

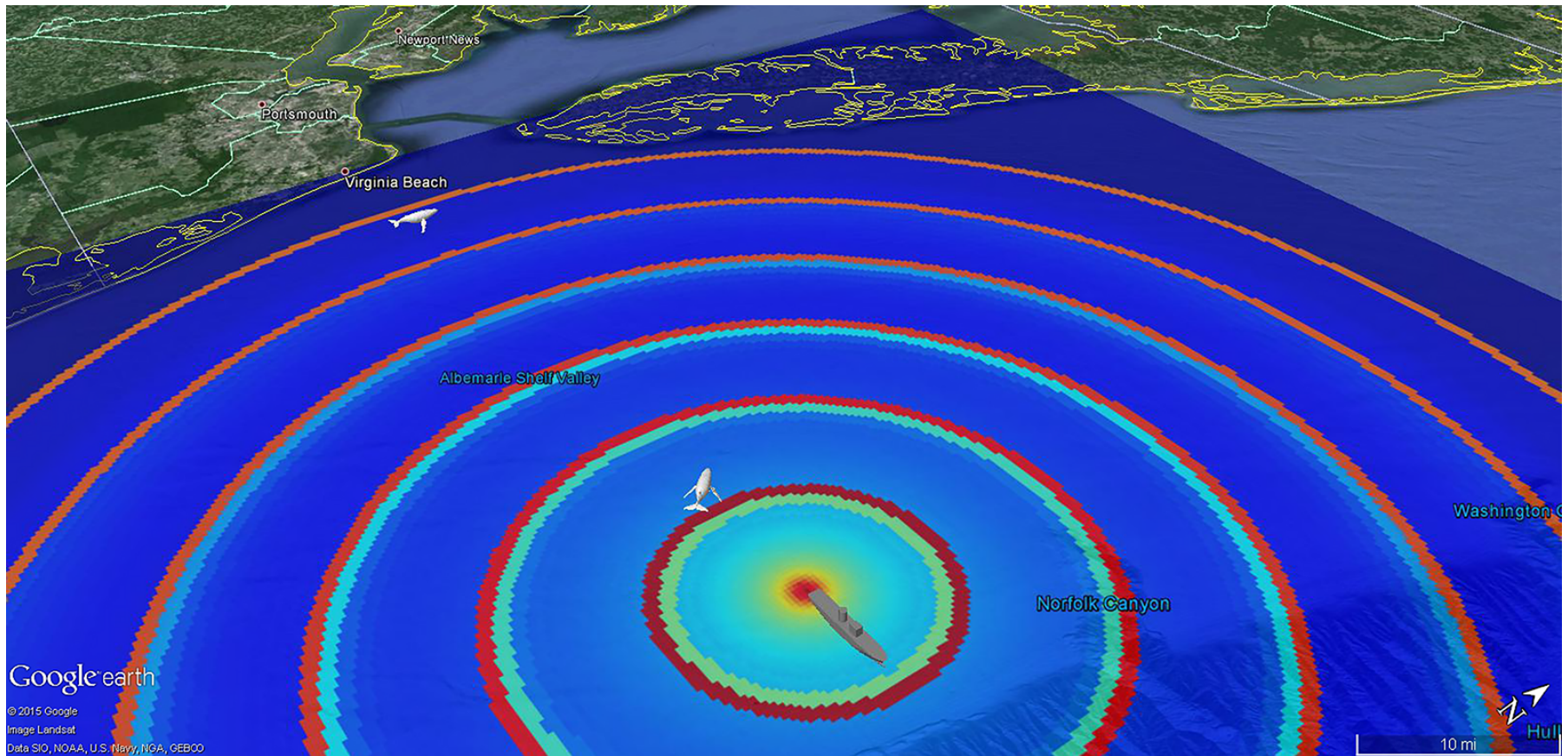
²*Natural Sounds and Night Skies Division, National Park Service, Fort Collins, CO 80525, U.S.A.*

³*Department of Biology, Colorado State University, Fort Collins, CO 80523, U.S.A.*

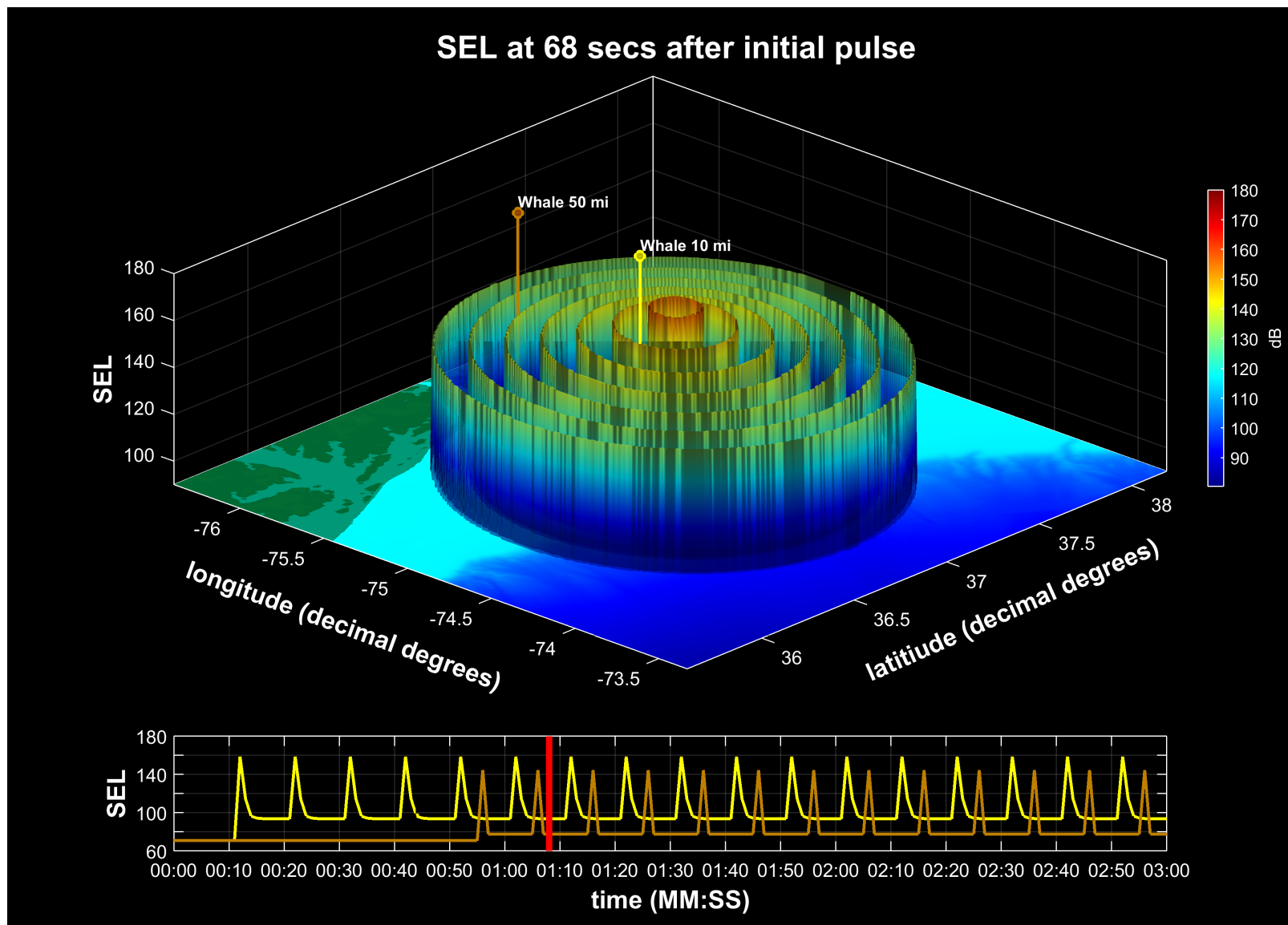
“The **majority** of studies documented effects from noise, including altered vocal behaviour to mitigate masking, reduced abundance in noisy habitats, changes in vigilance and foraging behaviour, and impacts on **individual fitness** and the **structure of ecological communities**.” Shannon et al. 2015

Seismic Airguns



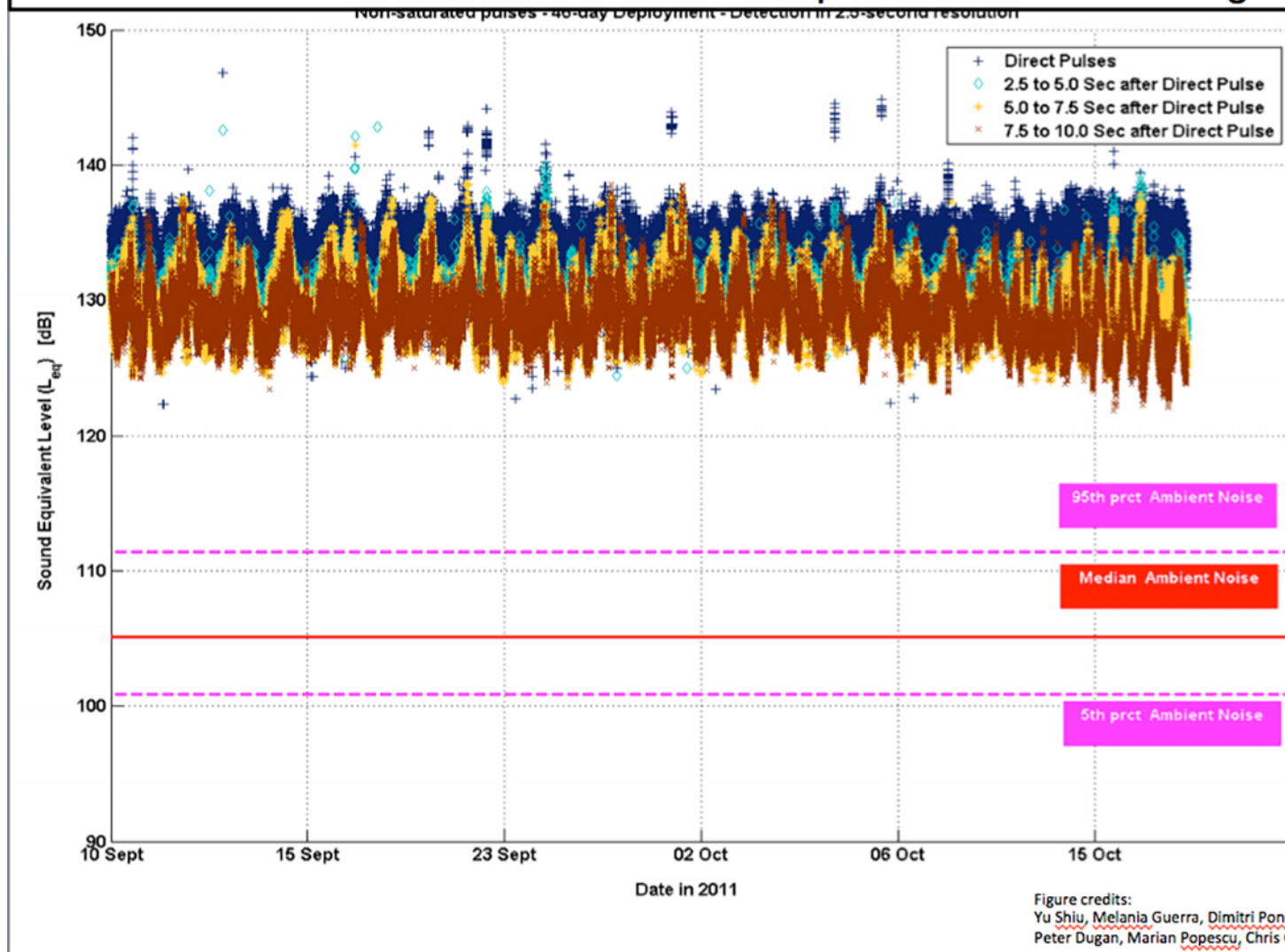


The sound field 60 seconds after the initial seismic survey pulse produced by the vessel near the Norfolk Canyon off the coast of Virginia. The levels experienced by the close whale are almost continuously at or above levels known to impact baleen whales, and the distant whale experiences these levels for the ~10 seconds around the time of the pulse. The dark red color maps to approximately 175 dB, the light green to 125 dB, and the light blue to 100 dB.



Another perspective on Figure 1. This plot shows the levels (bottom) of sound reaching the two whales in the sound field.

Slide 4: Noise levels 7.5 sec after the impulse at 30-100km range.



Noise levels at the time of, 2.5-5, 5-7.5 and 7.5-10 seconds after a seismic survey pulse. Note the significantly elevated noise levels even many seconds after the pulse. Ambient noise levels are shown with red and pink lines. It is important to remember that every increase of 10 dB represents an order of magnitude increase in sound intensity; so even between pulses the ambient noise is elevated by 1-2 orders of magnitude. This result is corroborated by published studies (Guerra et al., 2011).

Effects on cetaceans, fish and turtles(?)

Species	Location	Response/ Effect	Received Level	Reference
Bowhead whale	Arctic	Change surface-respiration; Avoidance	120-130 dB re 1 μ Pa RMS	Richardson et al. 1999; Robertson et al. 2013
Sperm whale	Gulf of Mexico	Buzz (feeding) rate decline	135-147 dB re 1 μ Pa RMS	Miller et al. 2009
Harbor porpoise	North Sea	Temporary displacement	145–151 dB re 1 μ Pa ² s ⁻¹	Thompson et al. 2013
Humpback whale	Angola	Singing and singers declined	120-150 dB re 1 μ Pa peak	Cerchio et al. 2014
Fin whale	Mediterranean	Altered singing and abandon habitat	ca. 15 dB 1 μ Pa above background	Castellote et al. 2012
Fish (herring, blue whiting)	Norway	Displacement, horizontal and vertical	Unknown	Slotte et al. 2004
Fish (Cod, Pollock)	Scotland	Short-term startle, no long term effects	variable	Wardle et al. 2001
Fish (Pink snapper)	Captive	Hearing system damage	Variable 150-180 dB re 1 μ Pa RMS	McCauley et al. 2003

Some concluding thoughts

1. Sound can and does impact wildlife, including numerous published reports of effects on marine mammals and fish; some studies find no impact, but impacts on individual fitness and ecological communities of most concern
2. Seismic airguns are the loudest sound source humans use in the ocean, and noise continues between pulses.
 1. Also...once seismic always seismic
3. There is a fundamental mismatch between the BOEM analysis and the potential area of impact – naïve species and areas of highest species diversity and richness in the NW Atlantic
4. There are many mitigation measures that have not been brought into the discussion