

Acoustic Noise Levels in the Earth's Oceans

The ambient acoustic noise levels in the earth's oceans have been rapidly rising, in lock-step with growth of global trade – shipping manufactured goods, food, *etc.* from one continent to another. Why should the rising tide of acoustic noise pollution in the earth's oceans be of any concern to us?

We're not the only living creatures on this planet – we share it with all other life forms. It is very important – for our own survival – not to unduly perturb the natural environment and/or upset the {delicate} balance of nature – otherwise, if we do, we may suffer the consequences...

Acoustic noise sources are many – propeller & motor noise associated with the sum total of fleets of cargo, passenger & military ships, commercial fishing boats/tractors, private boats, *etc.* as well as military use of sonar/sonar blasts, and also {very loud} booms from seismic air guns that are used in off-shore oil & natural gas exploration. These noises are often louder than a jet engine! The sound waves radiated from seismic air gun booms are oriented downward, reflecting off of, and penetrating deep into the sea bed, in order to locate pockets of hydrocarbons...

Noise from rotating ship propellers arises from cavitation – the violent collapse of bubbles/voids of water vapor – which, over time the acoustic energy associated with cavitation is such that it can in fact cause damage to a ship's propeller(s).

The sound pressure levels from these noise sources are not small – peak levels in fact can be incredibly high. The peak SPL's, measured using a calibrated hydrophone at a distance of 1 meter from such sound sources are: Seismic Air Gun: 250 *dB*, Oil Tanker: 200 *dB*, Tug Boat: 170 *dB*. Note that the threshold for pain – for human hearing – is 120 *dB*!

Marine experts are increasingly becoming concerned about the rapidly rising clamor in the earth's oceans – especially so for whales, which locate and communicate with each other via sound(s) over long distances, as well as use sound for locating/finding source(s) of food for them to eat/survive. Sound waves can travel hundreds of miles in the earth's oceans – because the absorption of sound in water is quite small. Essentially, living in the ocean is ~ like living in a reverb tank, sound wise!

Due to the physical environment in which they live, marine mammals have evolved a sharp sense of hearing in order to compensate for poor visibility and/or lack of light in the earth's oceans – especially important for finding food and locating/finding each other in the depths of the earth's oceans... The heads of *e.g.* whales and dolphins contain complex resonant chambers and acoustic lenses (!) that give these animals not only extraordinary hearing capabilities but also the complex voices that they use to communicate with members of their species.

Marine biologists have established a link between the rapid increase in ocean noise levels due to human activity and reductions in vocalizations of marine mammals, implying a decline in their foraging and breeding abilities.

The US Navy has estimated that its own use of sonar/sonar blasts – as used in training exercises and also in surveillance/tracking of other country's submarines – results in permanent (temporary) hearing losses for hundreds (thousands) of sea mammals each year, respectively.

There has also been a significant increase in the beaching of so-injured mammals, showing clear evidence of acoustic trauma – massive internal bleeding/internal injury – due to naval training exercises in the past decade. The total number of injured marine mammals due to such activities is estimated to be more than a quarter million!

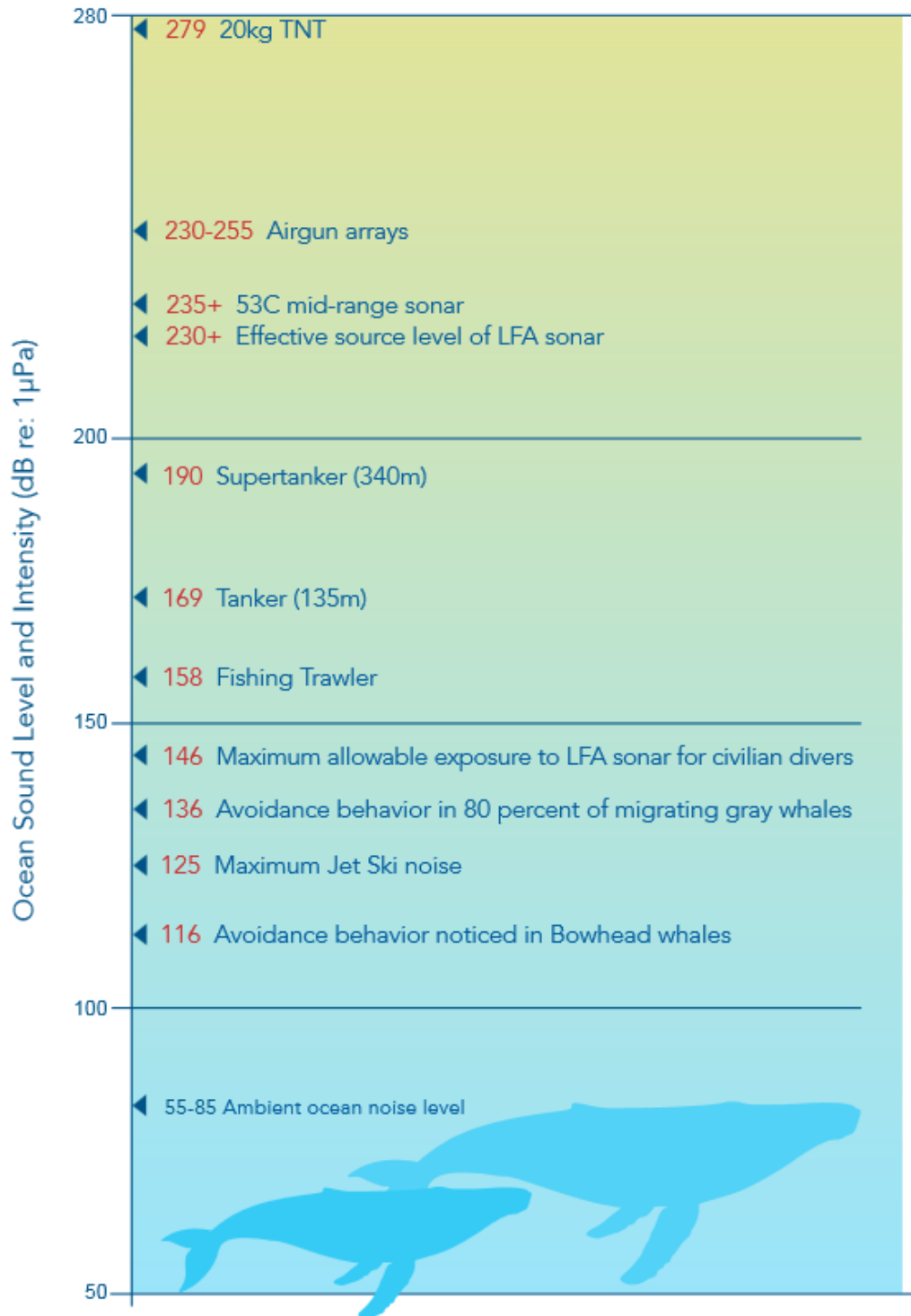
Example:



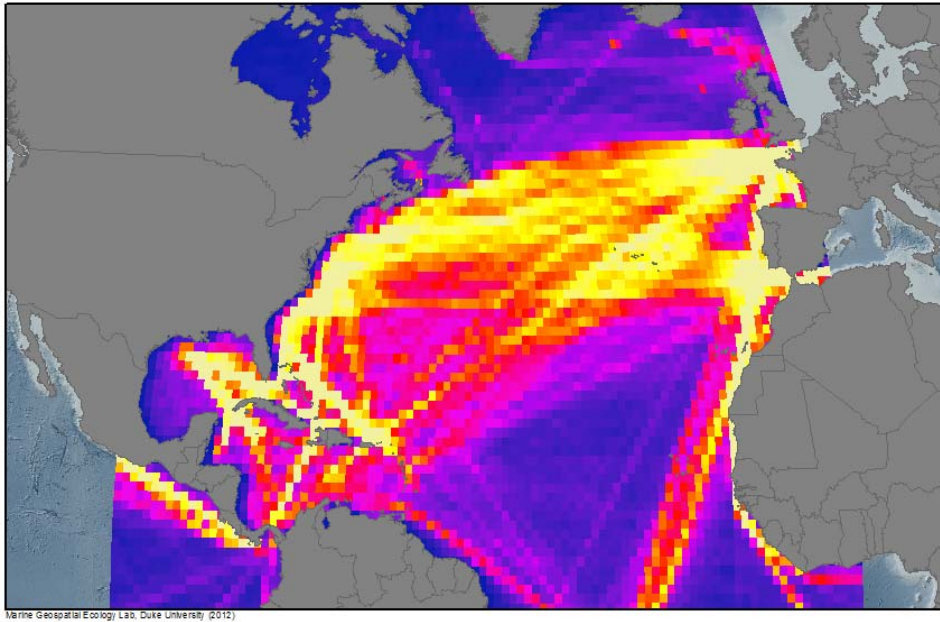
This Cuvier's beaked whale (*Ziphius cavirostris*) was a victim of the 2000 Bahamas stranding event (@ location G in pix below), in which 17 individuals from several whale species stranded after naval exercises involving the use of active sonar.



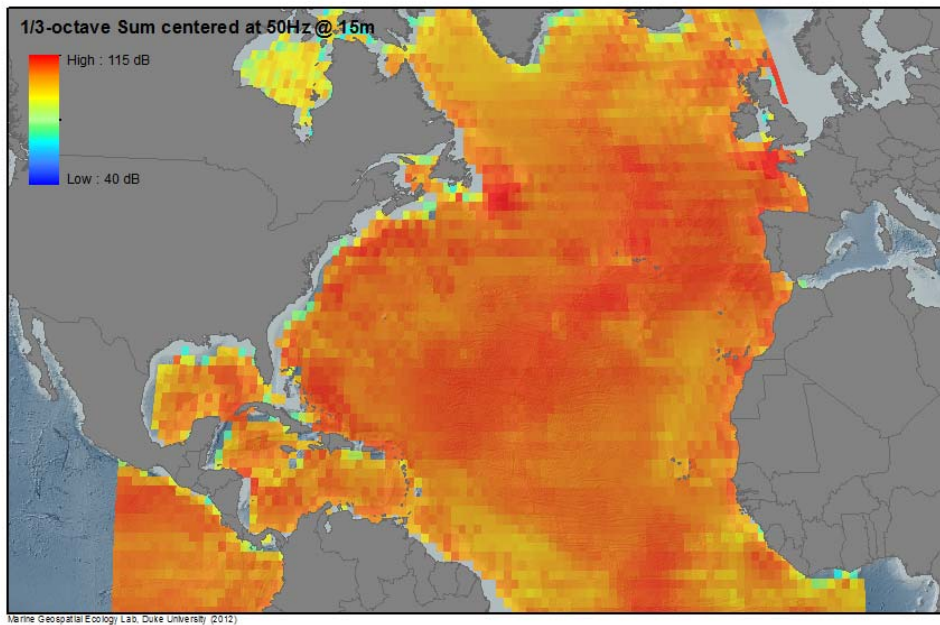
Comparative Scale of Known Ocean Noises and their Noise Levels



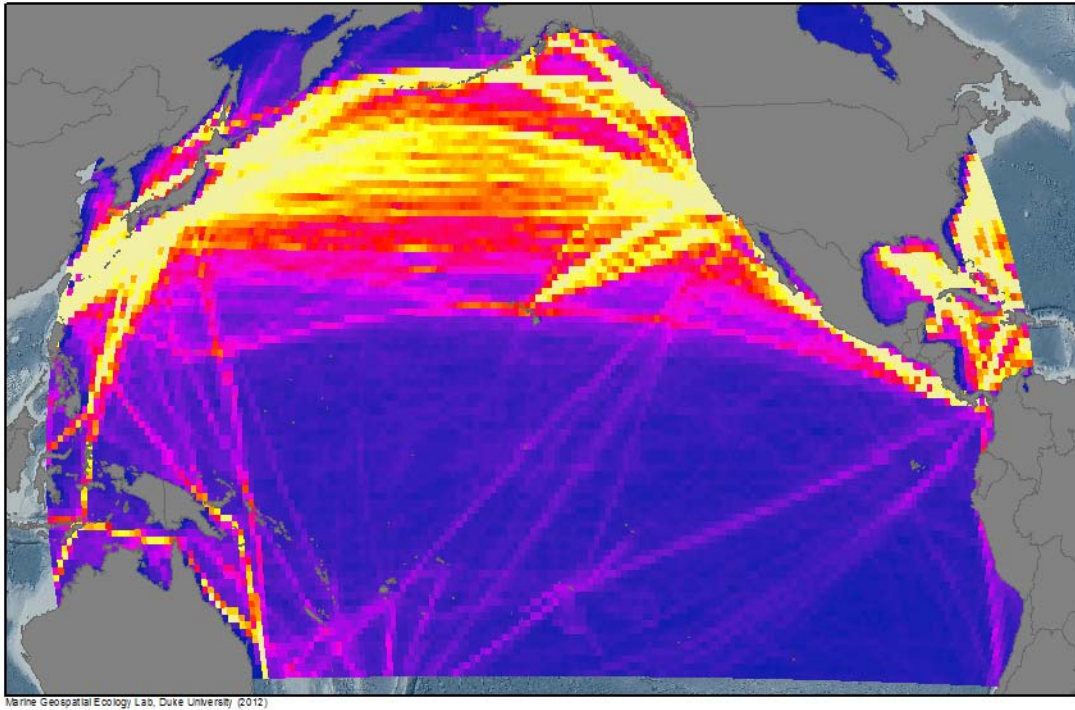
50 Hz Acoustic Noise – Shipping – Atlantic Ocean:



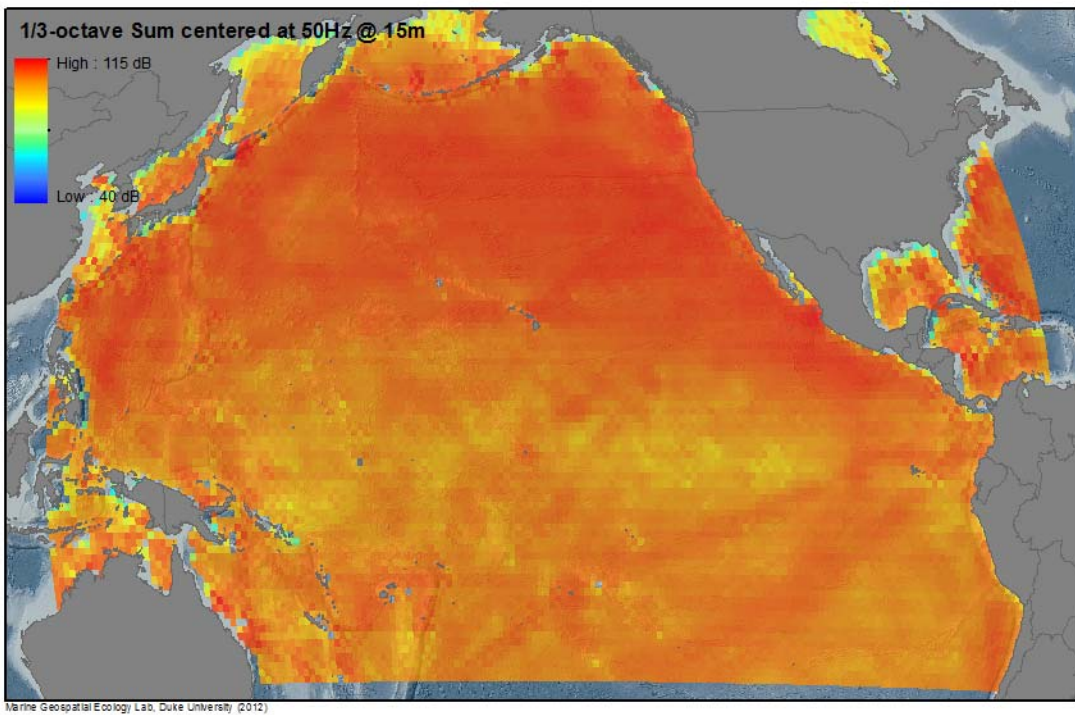
50 Hz Acoustic Noise – All Sources – Atlantic Ocean:



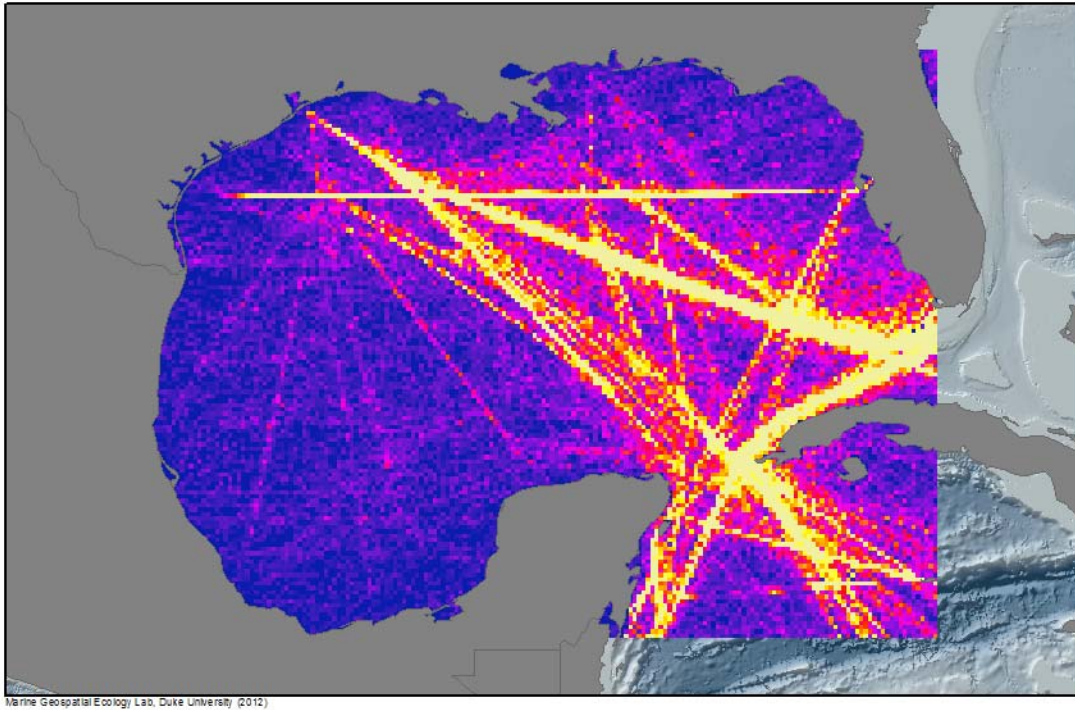
50 Hz Acoustic Noise – Shipping – Pacific Ocean:



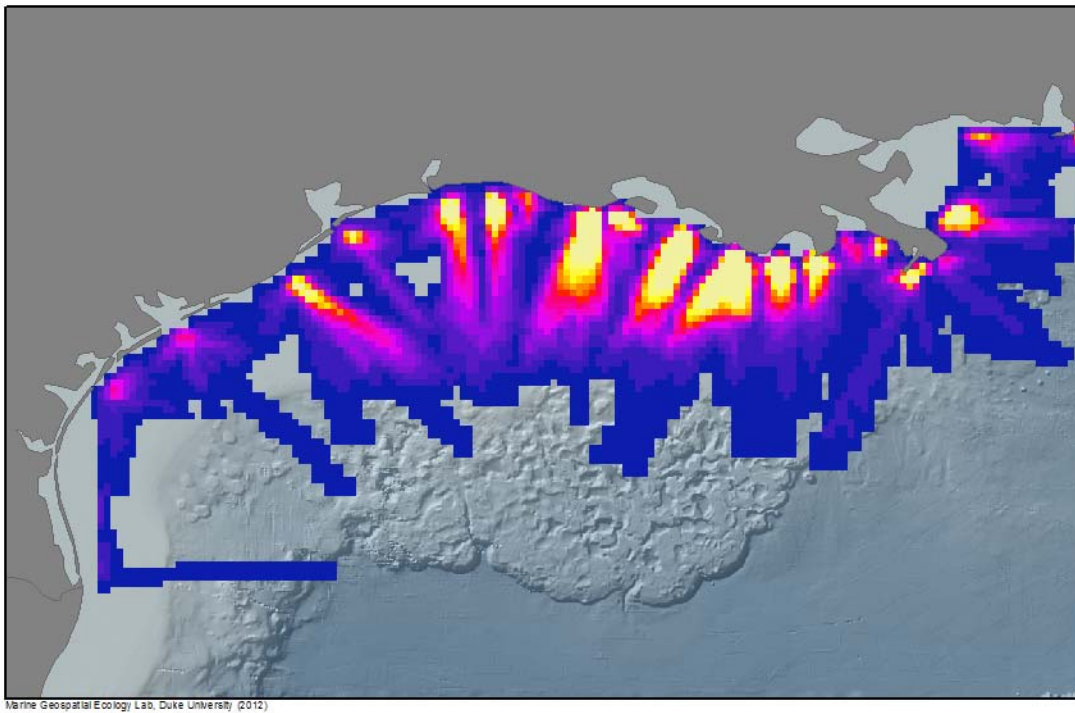
50 Hz Acoustic Noise – All Sources – Pacific Ocean:



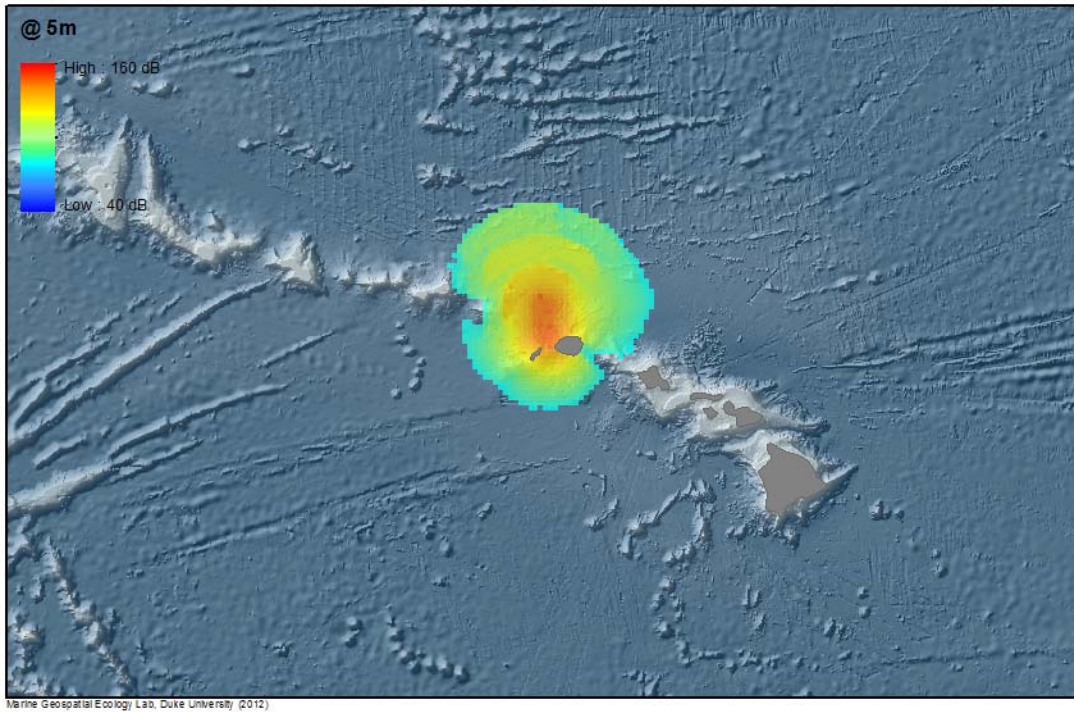
50 Hz Acoustic Noise from Shipping – Gulf of Mexico:



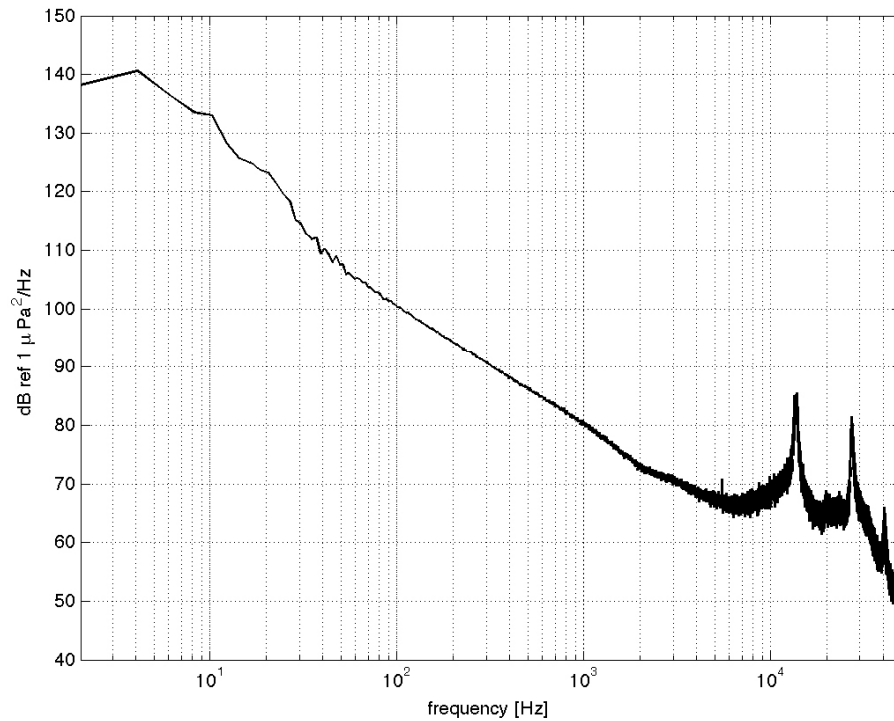
50 Hz Acoustic Noise Associated With Oil & Gas Production – Gulf of Mexico:



US Navy Sonar Training Exercise – Hawaii:



Acoustic Noise Spectral Density – in the Mariana Trench @ Depth of 8413 m:



Much additional information is available at the NOAA website (see below) – *e.g.* maps of shipping-related and summed (all noise sources) sound pressure levels by ocean region as a function of 1/3 octave band and depth.

Further Reading:

[1] NY Times Article, December 11, 2012: “A Rising Tide of Noise Is Now Easy To See”

<http://www.nytimes.com/2012/12/11/science/project-seeks-to-map-and-reduce-ocean-noise-pollution.html>

[2] NOAA Cetacean and Sound Mapping Website: <http://www.st.nmfs.noaa.gov/cetsound/>

and also: http://www.st.nmfs.noaa.gov/cetsound/sound_data.html, see also:

[http://www.st.nmfs.noaa.gov/cetsound/pdf/CetSound Symposium Report Final.pdf](http://www.st.nmfs.noaa.gov/cetsound/pdf/CetSound_Symposium_Report_Final.pdf)

[3] Barclay, D. R., Simonet, F. and Buckingham, M. J., (2009), *Deep Sound: A Free-Falling Sensor Platform for Depth-Profiling Ambient Noise in the Deep Ocean*, Marine Technology Society Journal, 43, 144. See also: Deep Ocean Ambient Noise in the Mariana Trench, Second Pan-American/Iberian Meeting on Acoustics, Nov. 15-19, 2010, Cancun, Mexico, Paper 2aAO2: <http://www.acoustics.org/press/160th/barclay.html>

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