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## **Marine Noise Pollution and Cetaceans**

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## Marine Noise Pollution and Cetaceans

### Abstract

The purpose of this research is to identify the consequences of anthropogenic noise pollution on cetaceans, specifically along shipping routes. In recent years, more studies have been conducted to identify the effects of anthropogenic noise on marine life. The conclusions of various studies have shown similar patterns of effects, thus increasing the knowledge and understanding that humans have about this topic. Noise pollution, whether in the ocean or on land, has been found to result in harmful effects on foraging, mating, and other critical life processes of animals.

In cetaceans, noise pollution has been found to result in alteration of calls, the development of avoidance behaviors, decreases in foraging behaviors, decreases in hearing capabilities due to acoustic masking, damage to hearing structures, and sometimes death. As more evidence of these negative effects have come to light, the severity and priority of this issue has begun to take hold and initiate discussion about possible solutions.



## Overview of Topic:

Research Question: What impacts does the noise pollution generated by international shipping routes have on cetaceans?

Until the last decade or so, the impacts of noise pollution on cetaceans and other marine life have gone relatively unnoticed. The concerns with the impact of industrialization on wildlife as a whole has gained priority in recent years as the demand for national and international trade has increased drastically; however, the focus of many studies are the impacts of terrestrial roads, rather than their marine counterparts. Now, this topic is beginning to gain some traction and is becoming a higher priority in talks of conservation and management efforts to protect the world's oceans.

# Marine Noise Pollution and Cetaceans

*Alexis Walsh*

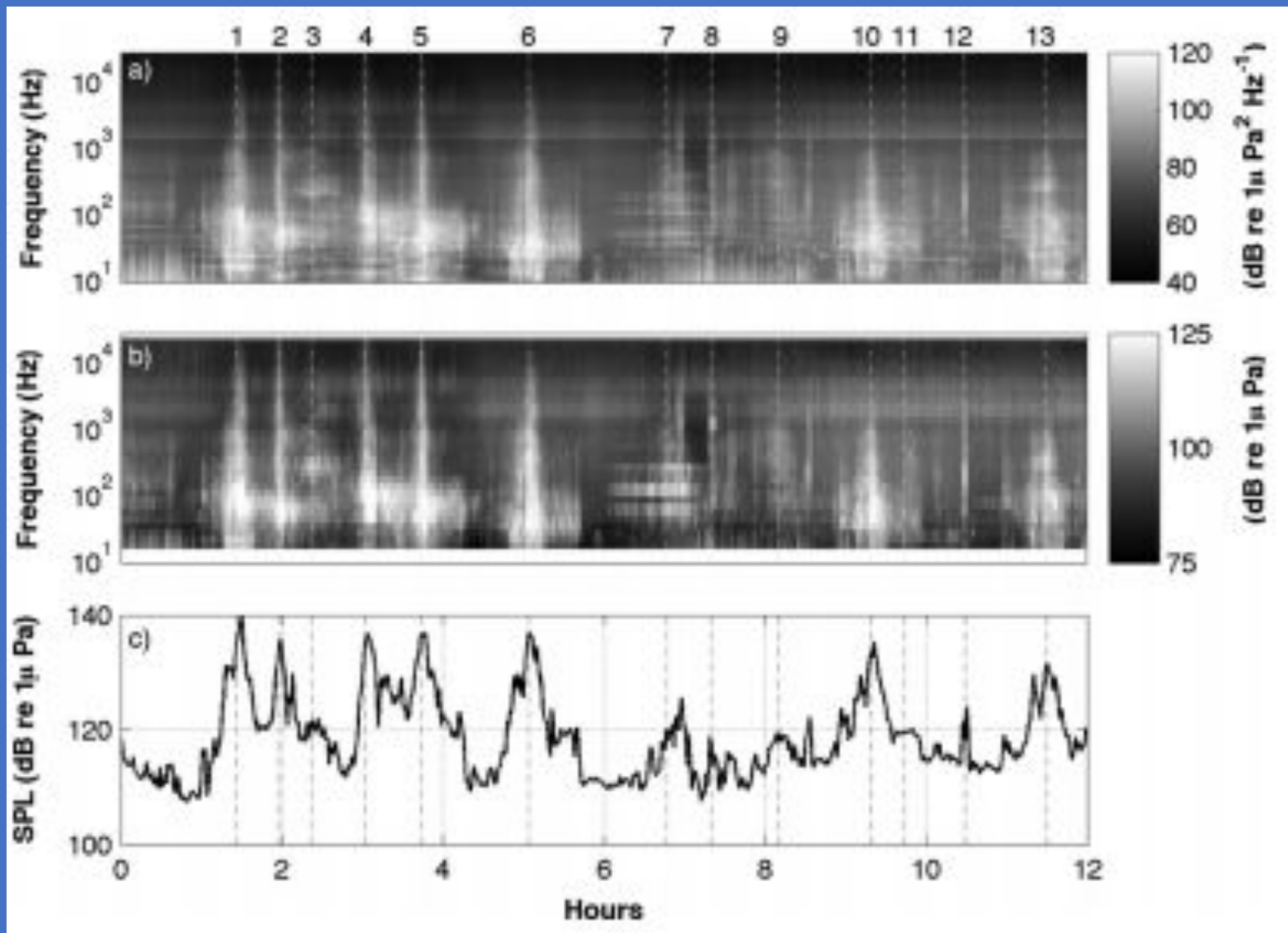
*EnvStd 420 - Debates on Global Climate Change - Dr. Mari Rice*



Hehe, J. (2019, January 11). Cetacean Consciousness. Retrieved from <https://joshuashawnmichaelhehe.medium.com/cetacean-consciousness-e061ec779782>

## Summary of Literature

- Global industrialization has threatened biodiversity in various regions. The specific impacts from various forms of pollution, in this case, noise pollution, on wildlife is not well known (Pirotta et al., 2019).
- There are many studies on road ecology to assess the direct and indirect impacts of roads on wildlife; however, few have considered the impacts of noise pollution from shipping routes, terrestrial roads' marine counterparts (Pirotta et al., 2019).
- Marine mammals use sound to hunt prey, find a mate, communicate with conspecifics, and gather information about their surrounding environment (Holt and Noren, 2009).
- The low frequency noise produced along shipping routes is problematic. Low frequencies travel further distances than higher frequencies and in general, noise travels much further underwater than in air, thus increasing the negative effects of noise pollution (Pirotta et al., 2019).
- One study divided their findings into four categories – physical disturbances, modification to behavior, chemical pollution, and fragmentation as a result of marine roads. The results were rather alarming (Pirotta et al., 2019).
- A study placed hydrophones along shipping routes to collect data of the noise produced by various vessels. The researchers found that when ships emit noise frequencies at a level below 1 kHz, the increase in noise level (loudness) increases by 25 dB (Bassett et al., 2012).
- Sounds produced by vessels often overlap hearing ranges and frequencies of sound production in cetaceans (Duarte, et al., 2021).
  - Results in acoustic masking, interference of bioacoustics over long distances, reduced communication space, reduced calving rate, and decreased survival rates (Gordon, 2018).
  - Study on orcas found that for every 1 dB increase in background noise level as a result of vessels travelling along shipping routes, they will alter their call by increasing it by 1 dB. Orcas will also increase the duration of their call in response to vessel noise (Holt and Noren, 2009).
- The noise from vessels has contributed a 32-fold increase along major shipping routes.
- Odontocetes (toothed whales), dolphins, and porpoises use echolocation to localize and pursue prey. When shipping lane sounds overlap and overpower hearing ranges, it makes this task nearly impossible (Duarte et al., 2021).
- Important to note is when marine organisms are exposed to constant high intensity sound, it results in hearing loss or damage. Some organisms, like fish, can regenerate the hair cells in their ears and regain hearing function. Cetaceans, on the other hand, more than likely do not have the ability to regenerate these cells (Duarte et al., 2021).



(The graph above depicts the sound frequencies (Hz) compared to the "loudness" of sound (dB) collected along the major shipping lane in Admiralty Inlet, Puget, Washington.)

Bassett, C., Polagye, B., Holt, M., Thomson, J. (2012). A vessel noise budget for Admiralty Inlet, Puget, Washington (USA). *The Journal of the Acoustical Society of America*, 132(6), <http://dx.doi.org/10.1121/1.4763548>

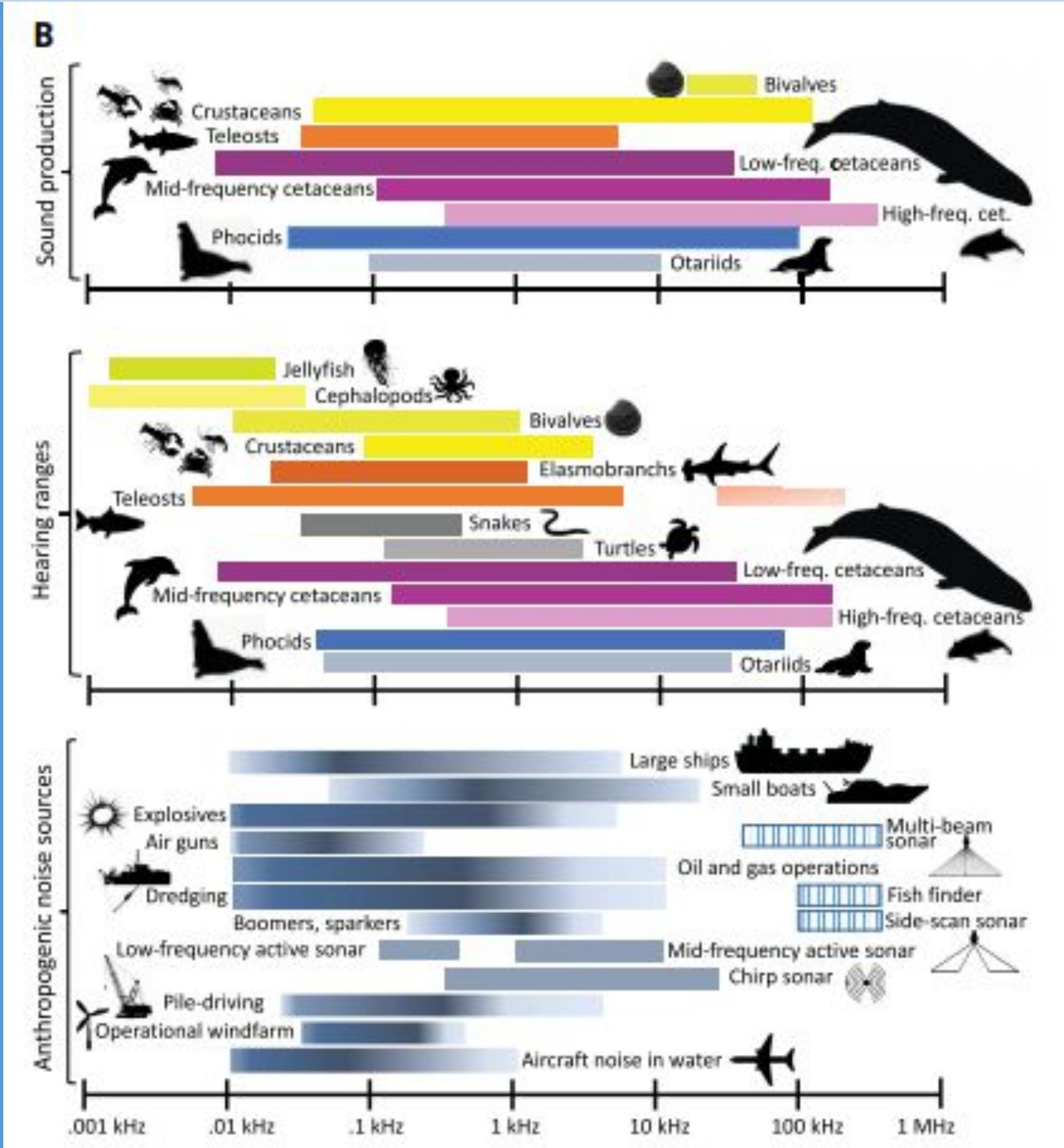
## Findings/Discussion

- Every study emphasized that shipping lane noise has been steadily increasing since the industrial revolution and is still increasing at drastic rates as the human population continues to grow, resulting in an increased desire to trade and distribute goods across the globe.
- Study and synthesis by Duarte et al., discovered that more than half and up to 95% of studies found significant evidence and agreed that noise pollution has an effect on marine organisms and the environment (2021).
- All the studies used in this project agreed that vessel noise along national and international shipping lanes had significant effects on cetacean communication, foraging and avoidance behaviors, calving rates, and overall survival.
- All mentioned the term “acoustic masking” which indicates shipping lane noise interferes with life processes of cetaceans and many other marine animals alike.
- During the COVID-19 pandemic, when about 58% of the human population was in confinement, sharks and whales returned to previously noisy areas near harbors and urban coastlines.
  - Gave ample evidence that shipping lanes have impacted marine life and caused many of them to leave the area to avoid exposure to constant low frequency, high intensity sound (Duarte et al., 2021).

## Conclusions/Solutions

There is information available that shows where cetaceans frequently travel and feed. If shipping companies coupled with marine biologists, there is a potential for less disruptive shipping lanes to be used and produced. Pirotta et al note that this information is an important tool for the development of mitigation efforts.

Duarte et al mentions the development of new technological features of propellers, shape of the hull, and on-board machinery could reduce noise propagation. Another potential solution is using advanced materials, such as “fiber-reinforced polymer composites” which have the capability to dampen noise, in addition to being lighter in weight. A lighter boat means the engines and propellers exert less energy, therefore reducing source levels of sound propagation (2021).



Duarte, C. M., Chapuis L., Collin, S. P., Costa, D. P., Devassy, R. P., Eguiluz, V. M., ... Juanes, F. (2021). The soundscape of the Anthropocene ocean. *Science*, 371(6529), <https://doi.org/10.1126/science.aba4658>

## Why I Chose This Topic

*I chose this topic because I have done research prior to this semester regarding the stress cetaceans experience in captivity and the resulting behaviors. I have also done research on plastic pollution, climate change, and coral bleaching a handful of times. Until now, I had never thought to look into what issues marine organisms face as a result of noise pollution.*

*Cetaceans have evolved in a unique way. Their origin was marine environments and over time they evolved to live on land, before making their final return to the ocean, becoming fully aquatic mammals. This pattern of evolution has resulted in unique ways of hearing, as well as the structures that enable them to hear at specified frequencies (Mourlam & Orliac, 2017).*

*I think doing this research was highly beneficial to me personally because I am now more aware of this issue. Additionally, this has resulted in an interest of potentially attempting to pursue a career in this field of research and conservation.*

## Sources

- Bassett, C., Polagye, B., Holt, M., Thomson, J. (2012). A vessel noise budget for Admiralty Inlet, Puget, Washington (USA). *The Journal of the Acoustical Society of America*, 132(6), <http://dx.doi.org/10.1121/1.4763548>
- Duarte, C. M., Chapuis L., Collin, S. P., Costa, D. P., Devassy, R. P., Eguiluz, V. M., ... Juanes, F. (2021). The soundscape of the Anthropocene ocean. *Science*, 371(6529), <https://doi.org/10.1126/science.aba4658>
- Gordon, C. (2018). Anthropogenic Noise and Cetacean Interactions in the 21st Century: a Contemporary Review of the Impacts of Environmental Noise Pollution on Cetacean Ecologies. *University Honors Theses*, 625, <https://doi.org/10.15760/honors.636>
- Hehe, J. (2019, January 11). Cetacean Consciousness. Retrieved from <https://joshuashawnmichaelhehe.medium.com/cetacean-consciousness-e061ec779782>
- Holt, M. M. and Noren, D. P. (2009). Speaking up: Killer whales (Orcinus orca) increase their call amplitude in response to vessel noise. *The Journal of the Acoustical Society of America*, 125(1), <https://doi.org/10.1121/1.3040028>
- Mourlam, M. J., and Orliac, M. J. (2017). Infrasonic and Ultrasonic Hearing Evolved after the Emergence of Modern Whales. *Current Biology*, 27(12), <https://doi.org/10.1016/j.cub.2017.04.061>
- Pirotta, V., Grech, A., Jonsen, I. D., Laurance, W. F., and Harcourt, R. G. (2019). Consequences of global shipping traffic for marine giants. *Frontiers in Ecology and the Environment*, 17(1), <https://doi.org/10.1002/fee.1987>