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Environmental Biology
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# Final Bibliography

## Research:

## Primary Literature

Cholewiak D, Clark CW, Ponirakis D, Frankel A, Hatch LT, Risch D, Stanistreet JE, Thompson M, Vu E, Van Pariks SM, 2018. Communicating amidst the noise: modeling the aggregate influence of ambient and vessel noise on baleen whale communication space in a national marine sanctuary. Endangered Species Research 36 59-75.

An important study conducted in the Stellwagen Bank National Marine Sanctuary in Massachusetts Bay. The study used advanced sound tracking techniques to record the ability of five different species of whales to communicate, as well as any and all ambient noises created by man made vessels. The study found that in some whale species, the space they had in the soundscape with which to communicate was reduced by up to 80% due to noises created by boats.

This study is another solid example of the negative impact of whales that boats tend to have. The inability of whales to communicate can make it very difficult for them to survive, and its important to have quality data that can be cited in our presentation in order to convince people of the severity of this situation.

Clark CW, Ellison WT, Southall BL, Hatch L, Van Parijs SM, Frankel A, Ponirakis D. 2009. Acoustic Masking in Marine Ecosystems: Intuitions, Analysis, and Implication. Marine Ecology Progress Series **395**: 201-222.

The recent introduction of ships into marine environments has resulted in a significant increase of communication masking in whale populations. Communication masking is a process through which the ability of animals to communicate across any distance is reduced by the introduction of natural or manmade noises into the soundscape. In the case of whales, they rely on long distance communication across vast stretches of ocean to congregate in order to form social colonies for the purpose of feeding and mating. The loss of the ability to form these colonies comes with obvious population risks.

This article was selected for the project because it presents more evidence of the prevalence of the problem that noise pollution creates for whales. The article also

postulates that this noise pollution threatens the fitness of the species, as the noise pollution makes it harder for whales to communicate, which makes it harder for them to form social groups. In these social groups they not only feed together, but also mate, making the formation of these groups a critical element to the survival of whale populations. This information demonstrates not only that the problem exists, but that it has grave consequences.

Hatch L, Clark CW, Van Parijs SM, Frankel AS, Ponirakis DW. 2012. Quantifying Loss of Acoustic Communication Space For Right Whales in and around a U.S. National Marine Sanctuary. Conservation Biology **26.6**: 983-994.

This study was conducted in the Stellwagen Bank National Marine Sanctuary, located at the mouth of Massachusetts Bay, with the goal of determining the impact of marine vessels on right whales' ability to communicate. Using a complex array of sound measuring instruments and data on ship activity, the study found that it's possible that right whales have lost an average of 63-67% of their "communication space". Communication space can be understood as the surplus potential of noise allowed for by natural oceanic sound levels that right whales are accustomed to.

This was selected for the projects because it presents hard statistical evidence that the ability of whales to communicate is generally hindered by human vessels. This data can be used in our presentation as proof of the existence of the problem we're trying to address. This data is also significant because it resonates on two levels of emotional significance. First, it occurred right outside the city of Boston in Massachusetts Bay, and second, it is based on an endangered species: the North Atlantic right whale.

Kaplan MB, Solomon S. 2016. A coming boom in commercial shipping? The potential for rapid growth of noise from commercial ships by 2030. Marine Policy **73**: 119-121.

This study quantifies ocean noise levels by examining the current and future noise capacity of the global shipping fleet. Examining historical trends in the size of the global commercial shipping fleet and factors contributing to current growth, the researchers estimate that the global fleet's noise capacity could nearly double by 2030. The study attributes this rapid growth to increased shipping, larger and noisier ships, and increased shipping distances. The researchers also mention possible methods to mitigate noise

levels from ships such as regulations pushing shipping companies to purchase quieter ships and standardized ship noise measurement procedures for ports.

This study was selected for our project because it shows that marine noise pollution is currently increasing rapidly and predicts that this rapid growth will continue. The study communicates the urgency with which substantial regulatory action must be taken in order to protect the health of marine ecosystems and populations.

Rolland RM, Parks SE, Hunt KE, Castellote M, Corkeron PJ, Nowacek PE, Wasser SK, Kraus SD. 2012. Evidence That Ship Noise Increases Stress in Right Whales. Proceedings of the Royal Society B: Biological Sciences **279**: 2363–2368.

A landmark study in the field of marine noise pollution, this study presents compelling evidence that exposure to low-frequency ship noise is associated with chronic stress in baleen whales. The researchers found that when ship traffic greatly decreased after the events of September 11, 2001, stress hormones in the feces of right whales in the Bay of Fundy in Canada dropped significantly. This was the first study to document disruptive physiological changes in baleen whales caused by exposure to noise.

This article was selected for the project because it quantifies the physiological effects of acoustic pollution levels on baleen whales. The findings of the study are key for building our case about the harmful effects of anthropogenic noise pollution on whale populations.

**Secondary Literature**

Jones N. 2019. Ocean Uproar: Saving Marine Life from a Barrage of Noise. Nature **568:** 158–161.

This news feature from the journal *Nature* gives an overview of current research on the threats of underwater noise pollution and describes ongoing efforts to study the issue further and address uncertainties and unanswered questions using new methods. The author then describes outcomes from areas where solutions such as rerouting shipping lanes, regulating ship speeds, and creating financial incentives for quieter ships have been implemented. She also interviews a Canadian scientist about alternatives to air guns and pile driving, as well as methods of quieting ships and propellers.

This article was selected for our project because it provides a succinct description of the threats of marine noise pollution and an overview of many concrete solutions to the

problem. It will be especially helpful in informing our discussion of possible policy solutions.

Kunc HP, McLaughlin KE, Schmidt R. 2016. Aquatic Noise Pollution: Implications for Individuals, Populations, and Ecosystems. Proceedings of the Royal Society B: Biological Sciences **283**: 20160839.

In this study, researchers examined how noise pollution affects an organism's development, behavior and physiology. This article does not focus on whales but rather on many types of marine life and how the issue affects them all similarly.

This article was selected because it gives information that is crucial to understanding why noise pollution is a problem for marine animals in the first place. It concisely defines terms that we will be using frequently, such as noise pollution, and gives many specific examples of negative effects on marine life such as hormonal imbalances and hearing damage. This information will be useful in convincing our audience that this is an important issue.

Nordtvedt Reeve LL. 2012. Of Whales and Ships: Impacts on the Great Whales of Underwater Noise Pollution from Commercial Shipping and Proposals for Regulation Under International Law. Ocean and Coastal Law Journal **18.1**: 127-166.

This article gives an overview of how noise pollution, especially from cargo ships and other vessels, negatively impacts whales in the northeastern United States. It discusses several international organizations that deal with ocean pollution, such as the IMO, MARPOL, and UNCLOS. The main purpose of the paper is to propose how policy changes could save these whales. One potential solution is to amend these policies to regulate noise pollution in a similar way that they regulate oil and hazardous substances.

This article was selected for our project because it not only addresses the problem of noise pollution, but it presents specific solutions to the issue. These solutions almost entirely relate to international policy, something that is often difficult to tackle because it requires so much cooperation. However, it is still important to consider that although commercial transport is essential to many humans, there are potential ways to make it more sustainable.

Robbins J. 2019. Oceans Are Getting Louder, Posing Potential Threats to Marine Life. The New York Times, New York. Available at www.nytimes.com/2019/01/22/science/oceans-whales-noise-offshore-drilling.html (accessed February 10, 2020).

This news article explores current issues around seismic surveying by the U.S. oil and gas industry and gives an overview of research on noise pollution and marine conservation. It summarizes findings about the consequences of anthropogenic noise pollution for marine ecosystems, including disruptive effects on zooplankton, invertebrates, and marine mammals. It also discusses how the Trump administration's policies have affected the issue and gives a nod to debates between environmental groups and companies with an interest in seismic surveys of the ocean floor.

This article was selected for the project because it not only summarizes research on anthropogenic marine noise pollution, but draws connections between marine conservation, energy policy, and human interest groups, putting the issue into current political context. It will serve as a strong starting point for our efforts to incorporate a political perspective into our project.

Winter A, 2009. NOAA Shifts Mass. Shipping Lanes to Aid Right Whales. New York Times

This New York Times article describes the recent implementation of new shipping lanes into and out of Massachusetts Bay, as recommended by NOAA. The changes were made in order to prevent both obstruction of right whale communication and the rate of collisions between vessels and right whales. Boats coming from a southern direction now have to take a slightly more circuitous route once they've passed the cape, in order to avoid areas of higher right whale concentration.

This article was chosen because it is an extremely valuable example of a policy implementation taken in order to prevent communication masking of right whales. It will serve as an indicator that scientific research propped with advocacy can lead to important institutional changes that aid not only the endangered right whales, but all whale species in general.

**Media:**
**Images**

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