Annotated Bibliography

**Chen F, Shapiro GI, Ingram SN, Thompson D, Vincent C, Russel DJF, Embling CB. 2016. Shipping noise in a dynamic sea: a case study of grey seals in the Celtic Sea. Marine Pollution Bulletin. 114(1): 372-383**

This article investigated the role oceanographic conditions play in grey seal exposure to shipping noise in the Celtic Sea. Sound can vary by season, depth and location on the continental shelf and is thus an essential concept to keep in mind when researching noise pollution. The results of this study concluded that during the summer sound exposure varied vertically, with areas of high noise exposure situated at depths. This occurs due to increased stratification during the summer. However, in the winter sound propagated farther and noise exposure was more uniform throughout the water column. This source demonstrated the importance of including oceanographic variability when modeling noise pollution in the marine environment.

Dr. Chen is an oceanographer at the School of Marine Science and Engineering at the University of Plymouth. While the primary author seems to be in the process of establishing himself having published only three papers, one of his co-authors, Dr. Shapiro, provides significant credibility having published over fifty papers on related topics in marine science.

The paper was very well-written and had clear empirical data demonstrating the conclusions of the study. The methods section was extensive, yet concise. The details added were important for the audience’s understanding of the study. In addition, the discussion section included information on the importance of modeling noise pollution using multiple variables and even compared the results with a more basic model to further prove the point. This point is further discussed in the article’s summary in which the authors explained why a more realistic model is needed for understanding to the exposure of animals to anthropogenic noise. The addition of model comparison and need for a more realistic model added to the value of the article and demonstrated why the results of this study is important to future research. This research study is intended for scientists with an interest in oceanography since the article discusses the seasonality of physical processes in the ocean with respect to noise. This article is worthwhile to read and digest before delving into further research in the marine acoustics and noise pollution.

This research study is a valuable source to include in my literature review on how commercial shipping contributes to noise pollution. Furthermore, it discusses how oceanographic seasonality can affect noise in the marine environment and introduces the importance of using models with multiple variables in this field since this issue is not unidimensional.

**Kaplan MB, Mooney TA. 2015. Ambient noise and temporal patterns of boat activity in the US Virgin Islands national park. Marine Pollution Bulletin. 98(2):221-228**

This study investigated the role small boat traffic has on marine noise pollution. Many studies have previously reported the impacts large vessels have on the marine environment, however few have looked at how small vessels impact their local environment. In order to determine the spatial and temporal variability of small boat noise pollution, three different reefs were set up with acoustic recording devices that detect sound inputs into the environment. The authors found evidence of anthropogenic boat noise in all three reefs. In addition, boat noise and the frequencies fish use for communication and hearing intersect, which can greatly impact fish.

Maxwell Kaplan and T. Aran Mooney are both scientists at Woods Hole Oceanographic Institution. Maxwell Kaplan is a post-doctoral fellow who has published 11 peer-reviewed publications to date. T. Aran Mooney is an associate scientist in the biology department of Woods Hole who has published around fifty peer-reviewed publications to date. Since both of these scientists published multiple times and work at a world-renowned marine research institute, the authors have the necessary background to present research on noise pollution in the marine ecosystem.

This article was intended for the scientific community in order to begin the discussion on how small vessel traffic can impact the ocean ecosystem. The methods were concise even though additional information was added discussing why the author’s chose this procedure. In addition, the results section was short yet effective due to the use and explanation of figures to help visualize and analyze the data. Through the information provided in the methods and the results sections, the coherent argument was formed that small boats do indeed affect the marine soundscape. This demonstrates that even areas thought to be unharmed by human activity and noise pollution, such as marine protected areas, still face the harmful impacts of human actions.

This paper will be a useful resource for my literature review because it offers information on recreational vessel contribution to ocean noise. This is important since it introduces the role noise emitted from small boat traffic has on the marine environment rather than commercial traffic.

**Li S, Wu H, Xu Y, Peng C, Fang L, Lin M, Xing L, Zhang P. 2015. Mid- to high-frequency noise from high-speed boats and its potential impacts on humpback dolphins. The Journal of the Acoustical Society of America. 132(2): 942-951**

This study examined how noise emitted into the marine environment by small speed boats effect humpback dolphins in China. Data was collected from boats traveling at various speeds and distances using a hydrophone. This study found that small speed boats emit mid- to high-frequency sounds in the form of clicks that can contribute to ambient noise level in the marine environment. Since humpback dolphins use mid-frequency sounds for communication and echolocation, mid- to high-frequency sounds are of greater concern when researching the impacts of nose pollution on this species of cetacean. The frequencies recorded were loud enough to impact the dolphins in the bay at all observed speeds and distances in this study, which can cause a variety of impacts including auditory masking, hearing threshold shifts, behavioral responses, and physiological responses.

The primary author of this article, Songhai Li, is a marine biologist at the Chinese Academy of Sciences with an interest in bioacoustics. Dr. Li has published over sixty articles in his field thus establishing his credibility.

This article is important to read and understand not only for the scientific community, but for politicians interested in implementing policy that reduces noise pollution in the marine environment as well. The introduction had a clear narrative that detailed the problem of noise pollution and prefaced potential noise impacts on the humpback dolphin population used in this study. The methods, however, were almost too detailed and could have been more concise. The audience does not need to know every insignificant step the researchers took to record the data, but rather needs an overview of the methods so that the study can be reproduced. This also applies to the results, which could have been more concise and easier to follow were a table used to summarize the data collected. The discussion and conclusion not only discussed potential impacts, but also suggested policy that could be implemented to decrease noise pollution impacts on humpback dolphins. Overall, the information obtained in this study is extremely important and should be taken into account when researching noise pollution and its impacts on the marine environment.

The information from this source is important for my literature review because it discusses biological impacts small vessel noise can have on the marine environment and recommends mitigation strategies to reduce these impacts. While the authors concentrate on noise pollution impacts on humpback dolphins, the results of this study can be broadened to include other marine mammals that use echolocation.

**Mckenna MF, Wiggins SM, Hildbrand JA. 2013. Relationship between container ship underwater noise levels and ship design, operational and oceanographic conditions. Scientific Reports. 3(1): 1760**

This paper introduces how varying factors influence noise level output of commercial ships in Santa Barbara. Although it is generally accepted by the scientific community that container ships contribute significantly to noise pollution in the ocean, little research has been focused on how design, operational elements and oceanographic conditions contribute to noise pollution from these large ships. This study used models that included many variables to understand what factors need to be taken into account when working to decrease shipping noise. Not only do increased ship speed and size affect noise levels, but month of ship passage, surface currents, and ship tones must all be taken to account as well. In addition to demonstrating the complexity of noise pollution in the ocean, this article also reveals numerous opportunities to delve into further research to reducing noise input into the ocean from container ships.

Megan F. McKenna is currently an oceanographer for the National Parks Services. She focuses on ocean acoustics, especially those pertaining to anthropogenic input into the oceans. Dr. McKenna has over forty-five published articles with her latest scientific paper regarding noise pollution in marine protected areas having been published in Science in 2017. Due to Dr. Mckenna’s extensive research on ocean acoustics, she is qualified to delve into how noise pollution is influenced by other factors both on ships themselves and in the ocean.

Since the information discussed in this article was complex, the intended audience of this article was the scientific community, especially graduate students and professors interested in understanding and perhaps researching noise pollution. Since the article was written at such a high level of thinking, the author skipped over explanations of terminology and mathematical calculations involved in this research. Although this oversight may seem as though the author demonstrated bias when writing this article, many articles written with an audience of higher thinkers in mind omit this type of information. The author effectively explained the conclusions made in this article through the addition of figures and examples. This article is critical to the scientific understanding of noise pollution in the ocean since it establishes not only how variable the issue is, but also factors that can be further explored through additional research.

This paper is a valuable source for my literature review because it provides information on different variables that can affect vessel noise in the marine environment. The research presented in this article goes hand in hand with the research presented by Dr. Chen regarding the dynamics of shipping noise in the Celtic Sea. Both articles discuss oceanographic conditions and seasonality that can affect marine acoustics. Dr. McKenna’s article discusses how surface currents and month of ship passage impact noise input into the marine environment, whereas Dr. Chen’s article examines how the oceanographic conditions in summer versus winter impact noise intensity and exposure for marine animals. Although both papers discussed different oceanographic variables, the combination of their conclusions can help researchers further understand how ocean conditions can affect the marine soundscape.

**Pine MK, Jeffs AG, Want D, Radford CA. 2016. The potential for vessel noise to mask biologically important sounds within ecologically significant embayments. Ocean & Coastal Management. 127: 63-73**

This study explored the extent to which small and large vessels contribute to background sound and mask biological noise in coastal embayments. Masking refers to when vessel sound input inhibits organisms from hearing/receiving a biological signal. This study recorded sound emissions from a combination of eight shipping and recreational vessels using a hydrophone. A statistical analysis was preformed to determine whether these vessels contributed enough to ambient noise to mask biological noise and how far the noise travels. The authors found that both recreational and commercial vessels do indeed contribute enough sound to mask biological communication in many species. However, due to increased interactions small vessels have with the marine environment, recreational vehicles and ferries have larger potential masking impacts than commercial vessels. This is an important finding since it demonstrates that smaller vessels introduce a significant amount of noise pollution into the marine environment as well.

The main author of this article, Dr. Matthew Pine, is a marine scientist at the University of Victoria in New Zealand. He is an underwater noise specialist and has contributed to fourteen scientific publications. Dr. Pine’s work on underwater noise and human sound input into the marine environment makes him qualified to research and comment on the state of the marine environment pertaining to noise pollution.

This article is a worthwhile read for the general scientific community and policy makers due to the clear narrative of the paper and the effective way the authors explained their results and conclusions. The paper was very well organized in the way the information was presented. The introduction included a thorough explanation of problems associated with noise pollution and the purpose of the study altogether. The methods included enough detail of use of the hydrophones and mathematical analysis for another scientist to recreate the experiment in other locations. In addition, the discussion section did not simply reiterate the results, but rather explained the impacts of the results on the marine ecosystem and where additional research is needed. The authors present ample opportunities for policy implementation to reduce the amount of human noise input into the ocean. The information learned in this article is critical to scientists understanding of noise pollution in the marine environment and should be thoroughly studied and recreated to demonstrate the impacts vessel noise has in other marine ecosystems.

This paper provides detail on how commercial and recreational vessels can affect organisms in the marine environment, which will be useful for my literature review. This complements the other articles to provide a comprehensive view of noise pollution and its impact on marine organisms.