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A Study on Effects of Anthropological Noise on Marine Life

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ABSTRACT: Out of all type of pollutions that exist, noise is considered as the most annoying one. Ambient noise has increasingly posed a problem to marine beings over the decades. Modern day humans have infested oceans with noise pollution. Noise can easily blanket a vast area below the surface of water and have underlying effects as a result. Whales and a few other cetacean species use a combination of sounds to create vocalizations. The use of SONAR and seismic guns underwater has caused a major hearing loss issue in cetaceans and altered their unique calls. Invertebrates; that consist of gastropods, annelids, cephalopods, etc.; too are affected by deep sea noise. Marine animals have found it difficult to sense their prey or predator, communicate with their species or even navigate through the oceans due to deep sea noise. The alienating noise creates a bubble around the ecosystem it travels through causing the habitants to experience a sudden parasympathetic surge and force them to flee.

KEYWORDS: Ambient noise, Cetaceans, Deep sea noise, Dolphins, Fishes, Humans, Marine life, Whale.

INTRODUCTION

The ocean is often thought of as a silent wilderness but under the surface is a symphony of sounds. The sounds produced by the organisms underwater help them to navigate across the oceans, commute with the other members of their species, find food or avoid becoming someone else's food. The ocean thrives on sound.

The reach of sunlight rapidly decreases through the twilight or the mesopelagic zone. Due to this photo gradient, the vision is only helpful for a few tens of miles underwater, whereas sound can travel hundreds or even thousands of miles. Consequently, it is not shocking that a lot of marine life uses sound as its main sense.

Due to the mechanical differences between water and air, sound travels through water at a speed of 1500 m/s compared to 340 m/s in air. In some areas of the ocean, temperature has a significant impact on sound speed (sound travels quicker in warm water than in cold water, for example).

Sound is essential for the survival of many marine animals, and these creatures have developed special hearing systems that help them in various ways. They might make sounds and pick up on ambient noise.

Because sounds can be utilized to quickly and effectively transmit large amounts of information over huge distances, they are particularly helpful for communication. Different signals are conveyed through adjustments to sound's pace, pitch, and/or structure. Fish and marine mammals use sound for territorial and reproductive communication in particular. Some marine mammals also use sound to preserve group dynamics.

SOURCES OF UNDERSEA NOISE

A significant portion of the overall auditory background of the ocean is made up of sounds produced by human activity. There are several beneficial uses for underwater sound, including navigation, defense, research, exploration, and fishing. The noise made by ships and by offshore industrial activities, such as oil drilling and production, is an example of a sound that is just a by-product of another activity.

The SONARS used for mapping the ocean floor and also used by the navy of various countries to keep a check on their enemies. The ultrasonic waves generated by humans have a detrimental effect on marine animals. They are often misguided due to it.

Cetaceans and other marine mammals are particularly sensitive to such alien noise and can react negatively to it. They may suffer shock and change their breeding and feeding grounds or sometimes severe and continual exposure has even caused their death.

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A vast range of source levels and frequencies, from a few Hz to several hundred kHz, are covered by the sounds produced by human activity.

Table 1: Underwater Sound Intensity among various ship underway

Ships Underway[1]	Broadband Source Level (underwater dB at 1 m)
Tug and Barge (18 km/hour)	171
Supply Ship (*Kigoriak*)	181
Large Tanker	186
Icebreaking	193

Table 2: Various military sonars producing noise underwater

Military Sonars	Broadband Source Level (underwater dB at 1 m)
AN/SQS-53C (U. S. Navy tactical mid-frequency sonar, centre frequencies 2.6 and 3.3 kHz)[2]	235
AN/SQS-56 (U. S. Navy tactical mid-frequency sonar, centre frequencies 6.8 to 8.2 kHz)[3]	223
SURTASS-LFA (100-500 Hz) [4]	215 underwater dB for a single projector, with up to 18 projectors operating simultaneously in a vertical array

Table 3: Various ocean acoustic studies that produce noise underwater

Ocean Acoustic Studies	Broadband Source Level (underwater dB at 1 m)
Heard Island Feasibility Test[HIFT] (Centre frequency 57 Hz)[5]	206 underwater dB for a single projector, with up to 5 projectors operating simultaneously in a vertical array
Acoustic thermometry of Ocean Climate (ATOC)/North Pacific Acoustic Laboratory (NPAL) (Centre frequency 75 Hz)[6]	195

CONSEQUENCES OF OCEAN NOISE ON CETACEANS

Whales and a few other cetacean species use a combination of sounds to create vocalizations. Whales in particular use a mixture of varied sounds to create songs including clicks, pulses, whistles, groans, boings and cries to name a few. These songs are one of the most sophisticated communication systems in the entire animal kingdom.

These songs can travel thousands of miles away in the ocean to either find a mate or to network with other pods. But unfortunately these songs have seen a steep decline due to the intervention of anthropological noises under the surface of water. More specifically saying, the SONAR systems have hampered their calls and made it hard for them to listen to other group members calls.

Songs from humpback whales are produced at frequencies between 300 Hz and 10 kHz, with source levels that can reach up to 174 underwater dB at a distance of 1 m. (Flipper slaps and fluke make significantly louder sounds, with source levels reaching up to roughly 192 underwater dB at 1 m). Although songs have been recorded on the summer feeding grounds in Alaska and during

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migration between the winter and summer grounds, singing is most common on the winter breeding grounds, such as those around the Hawaiian Islands. Males, alone and stationary are the majority of singers. However, it is likely to hear a chorus of whales singing when noises are captured at large distances from any one whale.

Mid-February to mid-March, when the population of humpback whales in Hawaii often peaks, is when recordings made in a broad frequency band (up to 700 Hz) near Lahaina, Maui, during the 1998 humpback whale winter season show a high. Due to humpback whale vocalizations, ambient sound levels are around 15 dB greater than they are in early January or late May. According to aerial studies, the highest sound levels between January and May were coincident with the peak in whale sightings in this area on March 7, 1998[7].

The loudest humpback whale choruses occurred between 315 Hz and 630 Hz, additionally, the results indicated that daytime sound levels were lower than nighttime sound levels.

Sound can travel farther and faster in water because water molecules are more closely packed together than the gases in air. Particularly whales and dolphins employ this characteristic for vocal communication and echolocation. Dolphins use clicks to echolocate their prey. But the SONAR imaging used in ships to map the ocean bed or used by other navy submarines and ships has greatly hampered the natural eco-location of dolphins often misguiding them.

Because noise can cover a very vast area, it may make it difficult for fish or whales to hear their prey or predators, navigate, or establish connections with partners, group members, or their young ones. Unwanted sound, or noise, can have a significant impact on the marine ecosystem. The impact of ocean noise pollution on marine biodiversity could be felt over a region of about 3.9 million square kilometers when the U.S. Navy uses low frequency active sonar to detect submarines (Johnson 2003)[8].

Animals in the neighboring habitats are scared away by the noise made during oil well drilling and the extraction of metals from the sea bed. Sound disturbs vast portions of many ecosystems because it travels through water about four times more quickly than it does via the air. At least occasionally, noise from seismic surveys or naval sonar can be fatal to cetaceans. Even a brief and transient exposure to modest levels of mid-frequency military sonar has been observed to cause whales to strand or perish at sea within hours. (Fernández et al. 2005; NOAA and U.S. Department of the Navy 2001)[9].

More than 40 Cuvier's beaked whale mass strandings have been documented globally since 1960, the year that more potent sonars first became available. About 28 of them took place in conjunction with seismic surveys, sonar-based naval maneuvers, or in close proximity to military bases. In contrast, there was only one large stranding of this species observed between 1914 and 1960. The brain and heart of whales appear to bleed to death, maybe as a result of decompression sickness brought on by an irregular dive pattern brought on by a fear response to the noise.

Beaked whales are more sensitive to noise out of the other whale families. They have been prone to mass stranding due to sonar. Sonar is the primal culprit for most of the harm caused to marine life. Animals experience a strong parasympathetic surge when hearing the sonar, which causes them to either flee or eventually perish.

Whales have altered their migration routes (e.g. Richardson et al. 1995)[10], left their feeding and breeding areas (e.g. Bryant et al. 1984; Morton and Symonds 2002)[11], changed their songs and calls (Lesage et al. 1999)[12], or gone silent as a result of noise (Watkins and Schevill 1975)[13].

CONSEQUENCES OF OCEAN NOISE ON FISHES AND INVERTEBRATES

Commercial shipping has significantly doubled the underwater background noise levels over every passing decade (Andrew et al. 2002; McDonald et al. 2006)[14].

Animals prefer to flee from noisy environments because they cannot stand them. This results in a particular species—or potentially a number of species—falling from that particular area of the ocean. The ecosystem's natural balance gets upset as a result of this. When there is no prey, the predator species dies off from famine, or lack of a predator to keep them in check, the prey species increase their population to the point that they are eventually wiped out either by intra-specific or inter-specific competition.

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According to reports, seismic air weapons have even caused a mass stranding of giant squid (Guerra et al. 2004)[15]. Nine of them stranded between 2001 and 2003. All of them experienced internal injuries, some of them serious, including internal organ damage. Other invertebrates have shown to have good hearing. When assessing the possible effects of ocean noise on the marine ecosystem, invertebrates must be taken into account. Prawns are as sensitive to sound as many fish (Lovell et al. 2005)[16].

There were hints that lobster consumed more food and underwent histo-chemical alterations for weeks or months following low-level seismic noise exposure. Following exposure to seismic noise, codfish displayed altered gene expression in their brains as well as increased food consumption for more than a month.

Additionally, fish can respond to noise by diving to greater depths, stopping moving, becoming more active, or grouping together more tightly. Fish schools can die out, creating large amounts of undersea detritus. Reduced catches are a result of the marine fish population declining.

Due to an inability to hear approaching ships or detect fishing gear, the effects of noise may compound with other environmental risks to increase by-catch (net entanglements) or ship hits. Animals that are already under stress for food, and those affected by chemical pollution or overfishing, will face an untimely decline. Like when seismic noise is added to shipping noise; many diverse noise sources can produce an amplified effect that may be more powerful than the total of the individual noise sources.

EFFECT OF CARBON DIOXIDE ON OCEAN NOISE

Since the middle of the 19th century, the start of the Industrial Age, there is more carbon dioxide in the atmosphere. Carbon dioxide gas is produced by the burning of wood and fossil fuels (such as oil, coal, and natural gas). Carbon dioxide levels in the atmosphere have increased as a result of increased usage of fossil fuels. Due to the rise in dissolved carbon dioxide as a result, the ocean is now more acidic due to the formation of carbonic acid.

Low frequency sound absorption decreases as ocean acidity increases. Concerns have been raised concerning potential effects on ocean background noise levels as a result. However, the overall transmission loss in the ocean at low frequencies is largely not due to sound absorption. Spreading loss is the reason why sound rapidly deteriorates as it moves away from a source even in the absence of absorption. As sound waves move over the ocean, they are reflected, refracted, and scattered in addition to spreading and absorbing. These mechanisms all have an impact on how far sound can travel.

WAYS TO CONTROL OCEAN NOISE POLLUTION

Humans are shying-off from accepting that noise is causing a slow and painful death of our oceans. Ocean is the womb of earth, life was born there. If we continue to poison them with plastics and noise, it will eventually cause direct and severe harm to us.

We cannot revert back to making the oceans completely noise-less but there is always a window to control the harm we have been doing over the past centuries. There can be humungous amounts of solutions to the problem.

These proposed fixes include rebuilding ship propellers, altering shipping lanes, using seismic vibrations of lesser intensity, and deploying acoustic bubble curtains in power plants.

CONCLUSION

One of Earth's greatest gifts to humans is the oceans, which are stunning and priceless ecosystems rich with life and offer everything from fresh food to livelihoods for millions of people who would otherwise be unemployed. These waters, on which we are so dependent, may appear to be in excellent condition, but not all is as it seems. The oceans resemble a flower that has been battered through time and is now losing the last of its petals as it slowly wilts. It will be too late to conserve some of the priceless species that make life simpler every day, if something is not done soon to clean up the mess that humanity has produced.

This pollution is entirely within our control to manage. We can absolutely bring them back to life if we can obliterate it. To achieve a better future once and for all, humanity must unite.

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REFERENCES

1. Richardson, W. J., Green, C. R., Malme, C. I. J., & Thomson, D. H. (1995). *Marine Mammals and Noise*. San Diego: Academic Press.
2. NOAA/NMFS and U. S. Navy. (2001). Joint Interim Report Bahamas Marine Mammal Stranding Event of 15-16 March 2000. https://repository.library.noaa.gov/view/noaa/16198
3. NOAA/NMFS and U. S. Navy. (2001). Joint Interim Report Bahamas Marine Mammal Stranding Event of 15-16 March 2000. https://repository.library.noaa.gov/view/noaa/16198
4. U. S. Navy. (2001). Final Overseas Environmental Impact Statement and Environmental Impact Statement for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar. https://www.nepa.navy.mil/Portals/20/Documents/surtass-lfa/2018/02/FEIS-Vol-I.pdf
5. Munk, W. H., Spindel, R. C., Baggeroer, A., & Birdsall, T. G. (1994). The Heard Island feasibility test. *The Journal of the Acoustical Society of America*, *96*(4), 2330–2342. https://doi.org/10.1121/1.410105
6. Richardson, W. J., Green, C. R., Malme, C. I. J., & Thomson, D. H. (1995). *Marine Mammals and Noise*. San Diego: Academic Press.
7. Daily means and standard deviations of sound levels off Lahaina, Maui, Hawaii, during the 1998 humpback whale winter season. [Reprinted with permission from Au, W. W. L., Mobley, J., Burgess, W. C., Lammers, M. O., and Nachtigall, P. E. 2000. "Seasonal and diurnal trends of chorusing humpback whales wintering in waters off western Maui," Marine Mammal Science 16, 530–544. Copyright 2000, John Wiley and Sons).
8. Johnson, J.S. 2003. SURTASS LFA environmental compliance experience. Presentation at ECOUS (Environmental Consequences of Underwater Sound), May 12-16, San Antonio, Texas.
9. (i)NOAA (National Oceanographic and Atmospheric Administration) and U.S. Department of the Navy. 2001. Joint Interim Report: Bahamas Marine Mammal Stranding Event of 15-16 March 2000. U.S. Department of Commerce, Washington, D.C.. 59 pp.
   (ii)Fernández, A., Edwards, J.F., Rodríguez, F., Espinosa de los Monteros, A., Herráez, P., Castro, P., Jaber, J.R., Martín, V., and Arbelo, M. 2005. 'Gas and fat embolic syndrome' involving a mass stranding of beaked whales (family *Ziphiidae*) exposed to anthropogenic sonar signals. Vet. Pathol. 42: 446-57.
10. Richardson, W.J., Greene, C.R., Jr., Malme, C.I., and Thomson, D.H. 1995. Marine mammals and noise. Academic Press, New York, 576 pp.
11. (i)Bryant, P.J., Lafferty, C.M., and Lafferty, S.K. 1984. Reoccupation of Guerrero Negro, Baja California, Mexico, by gray whales. *In* The gray whale, *Eschrichtius robustus*. *Edited by* M.L. Jones, S.L. Swartz, and S.Leatherwood. Academic Press, Orlando, Florida. pp. 375-87.
    (ii)Morton, A.B., and Symonds, H.K. 2002. Displacement of *Orcinus orca* (L.) by high amplitude sound in British Columbia. ICES J. Mar. Sci. 59: 71-80.
12. Lesage, V., Barrette, C., Kingsley, M.C.S., and Sjare, B. 1999. The effect of vessel noise on the vocal behavior of belugas in the St. Lawrence River Estuary, Canada. Mar. Mamm. Sci. 15(1): 65-84.
13. Watkins, W.A., and Schevill, W.E. 1975. Sperm whales (*Physeter catodon*) react to pingers. Deep-Sea Res. 22: 123-129.

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14. (i) Andrew, R.K., Howe, B.M., Mercer, J.A., and Dzieciuch, M.A. 2002. Ocean ambient sound: comparing the 1960s with the 1990s for a receiver off the California coast. Acoust. Res. Lett. Online 3(2): 65-70.
(ii) McDonald, M.A., Hildebrand, J.A., and Wiggins, S.M. 2006. Increases in deep ocean ambient noise in the Northeast Pacific west of San Nicolas Island, California. J. Acoust. Soc. Am. 120(2): 711-718.
15. Guerra, A., González, A.F., Rocha, F., Gracia, J., and Verrhione, M. 2004. Calamares gigantes varados: Victimas de exploraciones acústicas. Investigacion y Ciencia (Spanish edition of Scientific American), July 2004: 35-37.
16. Lovell, J.M., Findlay, M.M., Moate, R.M., and Yan, H.Y. 2005. The hearing abilities of the prawn *Palaemon serratus*. Comp. Biochem. Physiol. A 140(1): 89-100.