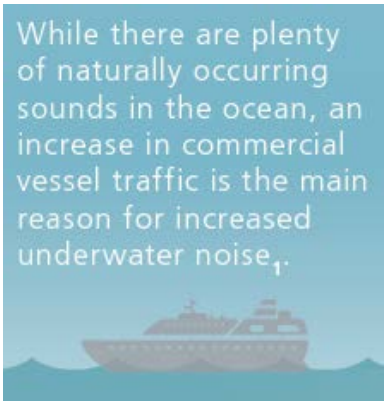
Mariners Underwater Noise Infographic: References List



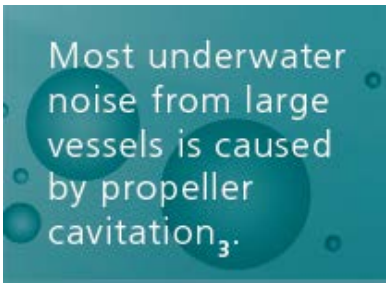
1. An increase in commercial vessel traffic is the main reason for increased underwater noise [at low frequencies].

Ross, D. 1976. "Chapter 8: Propeller cavitation noise." Mechanics of Underwater Noise. Pasadena: Pergamon Press. Pages 253-287. Excerpt from print.

Andrew, R. K., Howe, B. M., and Mercer, J. A. 2011, "Long-time trends in ship traffic noise for four sites off the North American West Coast." *J. Acoust. Soc. Am.* 129, 642–651.

2. In parts of the North Pacific Ocean, [low frequency] underwater noise has been doubling in intensity every decade for the past 60 years.

Hildebrand, J. 2009. Anthropogenic and natural sources of ambient noise in the ocean. *Marine Ecological Progress Series* 395: 5-20.



3. Most underwater noise is caused by propeller cavitation.

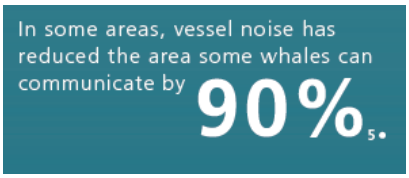
International Marine Organization (IMO). 2013. Noise from Commercial Shipping and its adverse impacts on marine life. Marine Environment Protection Committee, 15 November 2013. 66th session. P.2

Ross, D. 1976. "Chapter 8: Propeller cavitation noise." *Mechanics of Underwater Noise*. Pasadena: Pergamon Press. Pages 253-287. Excerpt in print.

4. Noise increases with speed.

McKenna, M. et al. 2013. Relationship between container ship underwater noise levels and ship design, operational and oceanographic conditions. *Nature Scientific Reports* DOI:10.1038/srep01760.

*Note: Figure 6 shows the relationship between underwater noise levels and ship speed. Cavitation noise begins to dominate at speeds in excess of 8 knots.



5. In some areas, vessel noise has reduced the area some whales can communicate by 90%.

Clark, C. et al. 2009. Acoustic masking in marine ecosystems: intuitions, analysis, and implications. 395: 201-222.

Hatch L. et al. 2012. Quantifying loss of acoustic communication space of right whales in and around a US national marine sanctuary. Conservation Biology 26 (6): 983–994

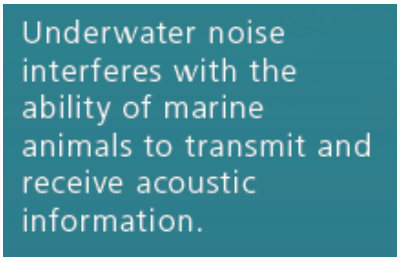
Yvan Simard, Nathalie Roy and Cédric Gervaise. 2008. Masking of Blue and Fin Whales Low-Frequency Vocalizations by Shipping Noise in the Saguenay- St. Lawrence Marine Park. *Bioacoustics* 17(1-3):183-185

6. Listen now

Courtesy of OrcaLab.
This sound clip demonstrates how whale calls can be masked by vessel noise. Listen to the sound of a large vessel passing by a pod of killer whales.

IMO Guidelines for underwater noise from commercial shipping

International Maritime Organization (IMO). 2014. Guidelines for the reduction of underwater noise from commercial shipping to address adverse impacts on marine life. 7 April 2014. MEPC.1/Circ.833.



Additional references for mariners (alphabetical order)

Holt, M.et al. 2009. Speaking up: killer whales (*Orcinus orca*) increase their call amplitude in response to vessel noise. *Journal of the Acoustic Society of America Express Letters*. DOI: 10.1121/1.3040028

Papuc, A. 2014. Underwater Noise. *Raindrops - Robert Allan Ltd. Information & News*. Issue 10.

Slabbekoorn, H., et al. 2010. A noisy spring: the impact of globally rising underwater sound levels on fish. *Trends in Ecology and Evolution* 1243: 9 pages.

Veirs, S., et al. 2015. Ship noise extends to frequencies used for echolocation by endangered killer whales. *PeerJ* 4:e1657