CASE STUDY

Reducing the impacts of ocean noise from vessels - Government of Canada support for innovation in the marine transport sector

Propeller and rudder of large ship. Credit: Denys Yelmanov.

The world's ocean covers more than 70 per cent of the Earth's surface and is home to millions of marine species.[1] It also serves as a vital economic link connecting people, countries, and markets. While the transport of consumer goods and industrial materials via commercial shipping is vital to the world economy, underwater ocean noise (hereafter "ocean noise") generated from tens of thousands of vessels each year negatively impacts marine life, including marine mammals.[2,3,4] In addition to the noise generated by large ocean-going vessels, coastal vessels such as tankers, tugboats, ferries, fishing boats, and recreational boats contribute to the overall acoustic noise environment.[5] The number and size of vessels, along with the ocean noise they generate, has been increasing over the last century, jeopardizing the well-being of many marine species.[3]

In the world of commercial shipbuilding and operation, the idea of making vessels quieter using new designs and technologies is a recent development. As a result, there is limited understanding of the most efficient technologies, operational practices, and vessel designs needed to minimize ocean noise in many different vessel categories.[6] To help address this issue, Transport Canada is exploring ways to enhance researchers' and designers' expertise to enable them to build and operate quieter vessels.

Transport Canada's Quiet Vessel Initiative (QVI) was launched in 2019, building on the Oceans Protection Plan, to enhance the protection of Canada's endangered, iconic whale populations. QVI contributes to the Government of Canada's commitment to address ocean noise by providing funding for research, testing, and deployment projects. These projects aim to make vessels quieter by improving their initial design, providing options for retrofitting existing vessels, and developing more efficient operating practices. The overall goal of these research and development projects is to speed up the adoption of vessel improvements in Canada and around the world to reduce the impacts of ocean noise on marine life. These projects are contributing technical evidence needed to support Canada's efforts to manage ocean noise and to influence global quiet vessel design guidelines through the International Maritime Organization.

For information on the sources and impacts of ocean noise, please see the Primer on Ocean Noise and Its Impacts.

The following examples of QVI projects offer additional context regarding the initiative:

- **Underwater Radiated Noise and Greenhouse Gas Reduction Program for Canada's Inshore Fishing Craft.** Canadian company Graphite Innovation and Technologies (GIT) created an innovative graphene-based hull coating and tested its impact on reducing fuel consumption and ocean noise by conducting full-scale trials on fishing vessels. Successful trials led to partnerships with shipping organizations like KOTUG Canada, which are now using the coating to minimize ocean noise and vibrations from the vessel's hull.
- **Propeller Cavitation Monitoring.** Propeller cavitation occurs when a vessel's spinning propeller creates turbulence and low-pressure areas that create small air bubbles in the water. When these bubbles burst, they make loud popping sounds underwater which can disturb many marine species.[7] Allsalt Maritime, a research and development company specializing in minimizing the impact and vibration experienced by humans on vessels, initiated a project with the specific aim of adapting their KINETIX technology to monitor propeller cavitation in real-time. This real-time information can help captains of smaller vessels like fishing boats and ferries change their vessel's speed or other characteristics to reduce cavitation noise, resulting in benefits to marine life.
- **Expertise and Collaboration in Advancing Quiet Vessel Design.** Defence Research and Development Canada (DRDC) serves as the research and development division for the Department of National Defence and the Royal Canadian Navy. As such, the branch has extensive expertise in the design and operation of quiet vessels. In 2019, DRDC and Transport Canada signed an agreement leading to progress in estimating and monitoring ocean noise using onboard sensors, improving propeller design tools, and strengthening the exchange of technical expertise within the federal government.
- **Correlation between Propeller Characteristics and Noise.** With a fleet of 35 vessels, several of which operate within the critical habitat of the Southern Resident killer whale, BC Ferries has a particular interest in mitigating the impact of its vessels' operations. Since 2019, Transport Canada has funded a project led by BC Ferries to explore the design of new propellers to reduce ocean noise emissions. BC Ferries has used results from this study to include noise-reducing characteristics in potential future propeller designs. BC Ferries has also actively participated in several other projects funded by Transport Canada, providing their vessels as platforms for tests and trials that contribute to advancing knowledge on reducing ocean noise.
- **Supporting Vessel Source-Level Measurement Standards for Shallow Water.** Accurately measuring ocean noise from vessels in shallow water is challenging because of the ways sound interacts with the sea floor and sea surface.[8,9] Currently, measurements are taken in deep water to reduce these challenges, but this approach limits the testing locations and conditions leading to notable gaps in understanding. JASCO Applied Sciences has been evaluating different approaches to both help address this issue and contribute to the development of an International Standards Organization (ISO) standard for measuring noise in shallow water. As shipbuilding and shipping are international industries, having such a standard is crucial for ensuring consistent and accurate measurement of vessel noise levels.
- **Alignment of 'Quiet Ship' Classifications.** Marine classification is a safety-promoting system that ensures vessels and marine facilities comply with established technical standards during design, construction, and maintenance. In Canada, various authorized marine classification societies assess and certify new ships by evaluating them against the technical standards and assigning them a designated "class" based on their design.[10] For this project, Transport Canada collaborated with the Vancouver-Fraser Port Authority's Enhancing Cetacean Habitat and Observation program (ECHO). The aim was to improve the coordination of measurement, analysis and reporting techniques used by the different marine classification societies. The project focused specifically on developing consistent methods for the classification of a "quiet ship," facilitating comparisons and encouraging a standardized approach to designing vessels with reduced noise. ECHO conducted workshops with different classification societies to further this goal. A report has been published and is available here.

Transport Canada further promotes innovative solutions through its participation in the development of noise-reducing vessel design standards at the International Maritime Organization (IMO). In 2023, the IMO's Marine Environment Protection Committee (MEPC 80) adopted the *Revised Guidelines for the reduction of underwater radiated noise from shipping to reduce adverse impacts on marine life.* The updated guidelines focus on better understanding the connections between energy efficiency, greenhouse gas (GHG) emissions and ocean noise. In support of this work, Transport Canada commissioned VARD Marine to study technological measures known to increase energy efficiency and reduce GHG, analyzing their effects on vessel ocean noise. The results outline technical

Southern resident killer whales. Credit: Edward Stredulinsky, DFO.

and operational measures that have the potential to increase energy efficiency, decrease greenhouse gas emissions, and/or mitigate ocean noise from vessels. This information can be used by vessel owners, operators, and ship builders to make informed design decisions, leading to the construction of more efficient and quieter vessels.

These efforts, among other projects, collectively represent a substantial commitment to reducing the environmental impact of vessel noise while advancing the science and technology of quiet vessel design and operation. The integration of scientific and technological expertise with the input and participation of a wide range of partners and stakeholders is crucial in developing strategies for reducing ocean noise from vessels. These collaborative efforts support both environmental conservation and technological innovation to enable both the protection of marine species and the sustainable growth of the marine economy.

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Published by:
Fisheries and Oceans Canada, Ottawa, Ontario K1A 0E6
Également disponible en français.

Issue number: 23-2341 Cat. No. Fs23-737/2024E-PDF ISBN 978-0-660-71693-0