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ANY OTHER BUSINESS

Reducing Underwater Noise Utilizing Ship Design and Operational Measures

Submitted by Canada

SUMMARY

Executive summary:	This document seeks to enhance understanding of ship noise and measures to mitigate it by sharing information from three recent case studies. This submission builds on previous work of the Committee and work of Member States.
Strategic Direction, if applicable:	4
Output:	No related provisions
Action to be taken:	Paragraph 27, 28
Related documents:	MEPC 58/19; MEPC 68/INF.26; MEPC 66/17; MEPC 66/21; MEPC 71/16; MEPC.1/Circ.833

Background

1 This document is submitted in accordance with paragraph 6.12.4 of the Guidelines on the Organization and Method of Work of the Maritime Safety Committee and the Marine Environment Protection Committee and their subsidiary bodies (MSC-MEPC.1/Circ.5).

2 Scientific evidence continues to support previous findings that underwater noise is a stressor for many marine species, especially for those mammals that rely on sound as a means of carrying out key life functions.[1] While the majority of underwater noise from large commercial ships is generated at frequencies below 1,000Hz, these ships emit noise across a wide spectrum of frequencies, and therefore can impact the life functions of a variety of aquatic animal species, including whale and fish species. The level of ambient noise in a

[1] See Redfern, J.V., Hatch, L.T., Caldow, C., et al. (2017) Assessing the risk of chronic shipping noise to baleen whales off Southern California, USA. Endangered Species Research Vol 32, ppl 153-167.

specific area is greatly influenced by anthropogenic activity, including ship traffic. The noise contribution from shipping is likely to continue rising, including in sensitive habitat, as global ship traffic increases.

3 In addition to initiatives being undertaken within individual member states, the issue of underwater noise is increasingly recognized on the international agenda. It has been on the agenda at various multilateral meetings, including the International Maritime Organization (IMO), the Convention on Biological Diversity, the OSPAR Commission,[2] the Arctic Council, the International Whaling Commission, the Baltic Marine Environment Protection Committee (HELCOM), and the United Nations.

4 Canada reaffirms its support for the IMO as the forum for discussion on underwater noise from commercial traffic, while recognizing that other international bodies serve to advance global awareness and action. Canada acknowledges the efforts of this committee in addressing underwater noise through the *Guidelines for the Reduction of Underwater Noise from Commercial Shipping to Address Adverse Impacts on Marine Life* (MEPC.1/Circ. 833) ("the *Guidelines*"). It is Canada's view that mitigation measures can generally be classified into two broad categories:

.1 **Routing and Operations**: applies to those mitigation measures directly affecting the movement, location, or running of the ship. They are normally variable and can be changed relatively quickly in response to local conditions. These measures include, for example, areas to avoid, reducing speed, or limiting the use of unnecessary equipment.

.2 **Ship Design and Maintenance**: applies to those mitigation measures directly affecting the physical structure of a ship. They are normally planned and more difficult to change quickly. They are likely to be implemented during the design stage for new ships or as part of a planned dry dock for those already existing. These measures include propeller optimization and polishing, hulls that minimize drag and uneven wakes, and resilient mounting of machinery.

5 Routing and operations offer important mitigation options that can provide an immediate acoustic benefit but that may result in higher operating costs. Therefore, ship design is likely to provide the best long-term solutions to the challenge of underwater noise but can only be introduced gradually as new ships are built and existing ships refitted. It is important to underscore that mitigation measures will have a different impact on different ships and different classes of ships. As such, not all measures are applicable to all ships.

Current status

6 Canada is actively looking at ways to reduce underwater noise from ships in its coastal waters. Recent work in this regard includes a synthesis report on anthropogenic underwater noise (available by emailing: TDCCDT@tc.gc.ca), support for work to standardize noise impact measurements, workshops and meetings with experts on noise metrics and the scientific underpinning of noise mitigation measures, advanced modelling of operational mitigation

[2] The OSPAR Commission ensures the 16 contracting parties to the Convention for the Protection of the Marine Environment of the North-East Atlantic are able to work together in the North-East Atlantic and to deliver on their collective commitments.

measures, and innovative approaches for monitoring noise from ships and detecting marine mammals.

7 The marine industry in Canada is taking a leading role in the piloting of ship noise mitigation measures. Two particularly important studies were undertaken in 2017 that assessed the impact of key operational measures on underwater noise from different ships. Both of these studies were conducted in the Salish Sea region, which is home to the Port of Vancouver, Canada's largest port, and to the endangered Southern Resident killer whale (SRKW), for which underwater noise has been identified as one of three main threats to survival of the population. One study examined the acoustic benefit achieved by slowing ships down through an important SRKW feeding area, while the second looked at underwater noise profiles for ferries under different operating scenarios and for different fuel types (i.e. liquefied natural gas (LNG).

8 In the first study, piloted commercial ships transiting a 16 nautical mile corridor in Haro Strait in the Salish Sea, were requested to voluntarily reduce their speed to 11 knots (through the water), between August 7 and October 6, 2017. This voluntary ship slowdown trial was led by the Vancouver Fraser Port Authority's Enhancing Cetacean Habitat and Observation (ECHO) Program and had the broad support of shipping associations, commercial ship owners and operators, marine pilots, as well as other ECHO Program collaborators including government departments, conservation and environmental groups and several First Nations.

9 Important questions that were to be answered through this study included:

.1 How does reduced speed change the underwater noise generated by specific ships (ship source level) and by class of ships?

.2 How does reduced speed change the total underwater ambient noise received at specific locations within the critical habitat of the Southern Resident Killer Whale?

.3 What are the predicted resultant effects on killer whale behaviour and foraging given the changes in noise as answered by questions .1 and .2?

10 Hydrophones were placed in the slowdown zone to systematically measure the change in underwater source radiated noise levels (RNL) resulting from slower ship speeds. At the time of submission of this paper, hydrophone recordings were still being cross-referenced with AIS data and undergoing further fine-scale multivariate analysis to draw conclusions about the overall effects of the slowdown and its predicted impact on SRKW behaviour, however, some positive preliminary results have already been released.

11 Approximately 61% of piloted ships participated in the trial. Containerships reduced speed by approximately 7 knots during the trial, which resulted in an average ship source noise reduction of 9 decibels (dB), while bulk cargo ships reduced speed by approximately 2 knots and experienced an average ship RNL reduction of 5 dB. Comparison of ambient noise data for pre-trial control versus trial months, and corrected for ship presence, wind and current, indicated a median reduction in the 10 Hz – 100 kHz frequency range of 2.5 dB re 1 µPa

received at a specific location, roughly equivalent to a 44% reduction in sound intensity. Preliminary results also show that slowing ships down means that they are generating less noise but are in a given area for a longer period of time. This in turn means that the quieter times experienced between ship transits under normal ship speed conditions are reduced in duration and are less quiet during slowdown conditions. These preliminary results are available here: https://www.portvancouver.com/wp-content/uploads/2017/05/2017-11-09-Preliminary-results-of-slowdown-trial-Summary.pdf. Final study conclusions will only be available once the data has been fully analyzed.

12 The second study was conducted by BC Ferries, which is a regulated private Canadian company that operates one of the world's largest ferry services. In support of its commitment to the ECHO program and to environmental stewardship, it commissioned JASCO Applied Sciences to accurately measure noise profiles for key parts of its fleet, including recently acquired LNG-fueled ferries. The selected ferries were each measured in five operating scenarios in order to determine the effects of speed and other propulsion system settings on the ships' underwater noise emissions. This information can lead to the optimization of the settings to produce quiet ship operations.

13 Results from the testing reaffirmed that the same operational mitigation measures, such as speed reduction, can have different results across a variety of ship types, however, trends can be observed.

14 Generally, ferries 10 years of age or less, including both the LNG- and non-LNG-fueled ferries, were the quietest in the study when operating at service speed. The RNL was higher at reduced speeds for ships with controllable pitch propellers rotating at constant speed. Frequency spectrum analysis showed that ships of identical construction had very similar noise emission characteristics, both in level and spectral shape. At service speed across all tested ships, the emitted noise with frequency above 500 Hz was almost the same sound level despite significant variations in ferry size, power, age and configuration.

15 The more than 500 measured transits of eight ferries while in route service required detailed planning, communications and real time feedback between ship and shore to acquire the high quality ANSI Grade C source RNL. The initial conclusions from this work are that:

.1 An overall RNL of 185 dB in the frequency range 1 Hz – 64 kHz is a typical value for ferries that are designed for cost effective short sea operation (multiple daily crossings of less than 2 hours).

.2 Although the speed-sound relationship is variable for different ferry types, reduced speed will increase noise for some ferries and thus should be applied only as mitigation for marine mammal strike risk, unless the ferry has a measured RNL reduction with speed reduction.

.3 Spectral analysis may prove to be a useful post-construction or maintenance methodology to identify ship specific sources of noise peaks.

.4 More design guidance should be developed for ferries, especially for noise mitigation above the 500 Hz frequency range, where there is minimal ship to ship difference in averaged frequency dependent RNL values.

16 Canada is also encouraged by the recent results from testing delivered jointly by the container shipping company Maersk and the Marine Physical Laboratory at the Scripps Institution of Oceanography. A hydrophone in the Santa Barbara Channel shipping lane off the

coast of California has been monitored by Scripps since 2008. The device is used to make opportunistic recordings of ship transits, which are then linked to AIS in order to produce a noise profile specific to a ship and further develop the general catalogue of noise profiles by ship-type.

17 Maersk has invested in ship design retrofits for 11 of its New Panamax-size container ships for the purpose of improving fuel economy. Many of the retrofits were undertaken on the same areas of the ship known to be prominent sources of underwater noise, namely the propeller and hull. More specifically, the retrofits included a modification of the bulbous bow to reduce drag, a new propeller with four fins, and propeller boss cap fins to reduce cavitation.

18 The Scripps-monitored hydrophone was able to capture sufficient pre- and post-retrofit data for five of the Maersk container ships. The analysis of the data found that ship-source noise levels for the same ships after being retrofitted were typically 6 dB lower in the low frequency-band (8 – 100 Hz) and 8 dB lower in the high frequency-band (100 – 1000 Hz). These significant noise reductions have been observed at lower operational speeds (< 16 knots) and are largely attributed to these retrofits. The evidence suggests that widespread adoption of these mitigation measures by marine shipping has the potential to reduce noise ocean-basin-wide.

19 The Maersk retrofits led to a 10 per cent improvement in fuel efficiency per containership, demonstrating the co-benefits of undertaking such changes. This improved efficiency supports air emissions reduction targets, including greenhouse gas emissions, and reduces operating costs. It is increasingly evident that, in general terms, optimal ship designs and operations can deliver a dual benefit of improved fuel efficiency and reduced environmental impact.

20 Importantly, these three studies are examples of how government, the private sector, and non-governmental organizations can work collaboratively to identify and implement innovative solutions that both benefit the private sector and help governments meet our collective environmental objectives[3]. In doing so, risk is reduced, resources are maximized, and positive relationships between all parties are fostered.

Future Work

21 Canada remains interested in advancing national and international scientific research and actions that can lead to underwater noise reductions through ship design and operations. To help advance this work, Canada is currently co-leading the development of a state of knowledge report on underwater noise in the Arctic through the Protection of the Arctic Marine Environment (PAME) working group of the Arctic Council. Canada also encourages Member States to take advantage of existing bilateral, regional and international opportunities to

[3] Member States interested in learning more about Canada's research efforts on underwater noise from ships, or that are interested in collaborating on new projects are encouraged to send an email to Transport Canada's Mrs. Michelle Sanders at: michelle.sanders@tc.gc.ca. Additional information and the final results of the Haro Strait ship slowdown trial are available by contacting Ms. Orla Robinson of Vancouver Fraser Port Authority at: orla.robinson@portvancouver.com. Enquiries relating to the BC Ferries fleet testing can be sent to Mr. Greg Peterson of BC Ferries at: Greg.Peterson@bcferries.com. An overview of the Maersk retrofits and the Scripps findings are available by contacting Dr. Martin Gassmann of the Scripps Institution of Oceanography at: martin.gassmann044@gmail.com.

discuss anthropogenic underwater noise, including at the United Nations' Informal Consultative Process on Oceans and the Law of the Sea in June 2018.

22 Despite advances in understanding of underwater noise and how the design and operation of a ship can contribute to it, knowledge gaps remain in our collective understanding of underwater noise from ships and how to effectively reduce or mitigate it. This challenge is made more complex by the various sources of noise in the marine environment and the wide variety of ship types, sizes, speeds and operational characteristics. Nevertheless, these gaps can be narrowed through research such as examining the noise benefits delivered by specific retrofits, including the ship characteristics that optimize its adoption, or undertaking a detailed examination of the relationship between ship noise and speed.

23 To help fill these gaps in knowledge and solutions, Canada will be seeking an output for this Committee at a later meeting that returns underwater noise to its agenda and which considers economically feasible actions that build off the *Guidelines*. At this time, Canada welcomes comments from Member States on this future request and invites Member States to collaborate with Canada in the development of this submission.

Action requested of the Committee

24 The Committee is invited to note the information in this document and take action as appropriate.

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