

Underwater Noise Webinar: Recent Innovations for Reducing URN from Ships

Presented by: Matthew Cooke – Project Officer, Marine RD&D

January 12, 2022



Introduction

- **Transport Canada (TC)'s Innovation Centre is an engineering & science research group.**
- **We support Research, Development & Demonstration (RD&D) to enhance the safety, security, efficiency, and environmental performance of Canada's transportation system.**
- **Our Marine RD&D Program is comprised of engineers, policy analysts, naval architects, and marine biologists**
- **Marine RD&D key research areas include: Clean Marine, Marine Mammal Protection, Quiet Vessel Initiative (QVI)**



Innovation Centre



**Decreasing the
impact of
transportation on
the environment**



**Improving the
safety and
security of
transportation**



**Making our
transportation
systems more
efficient**

Underwater Vessel Noise

- Underwater noise from vessels has been identified as a contributor to adverse effects on the marine environment and vulnerable marine mammals.
- Despite the known impacts of underwater vessel noise on marine ecosystems, significant knowledge gaps exist about the different sources of vessel noise (i.e., engines, propellers, hull design, etc.), their overall contribution to producing noise, and the most effective noise mitigation technologies or designs for different vessel classes.

Ecological Context

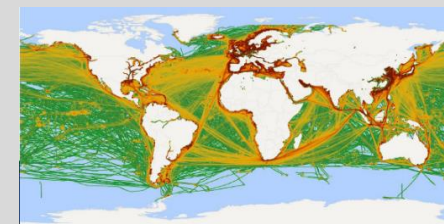
- Marine mammals have evolved over millions of years to use underwater sound for communication (socializing and mating, care and minding offspring), navigation, predator/prey detection.



Human Influence

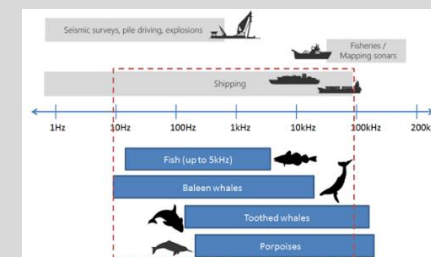
Sources of anthropogenic noise:

- Shipping**
- Seismic surveys
- Sonar
- Explosions
- Pile Driving



Effects of Shipping Noise

- Masking: reduction of communication distance, and echolocation distance (important for foraging).
- Behavioural responses: fleeing from important habitat, and cessation of and reduced foraging.
- Physiological stress: possibly reduced fertility, and reduction of general health.



What is Transport Canada doing?

Building on the Oceans Protection Plan, the Government of Canada is undertaking efforts to enhance the protection of Canada's endangered, iconic whale populations:

- North Atlantic right whales
- Southern Resident killer whale - a vital component of the local marine ecosystem and has cultural significance for the Indigenous and coastal communities of British Columbia
- St. Lawrence Estuary beluga



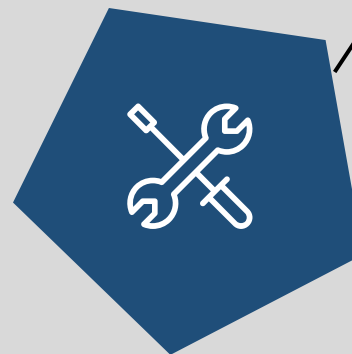
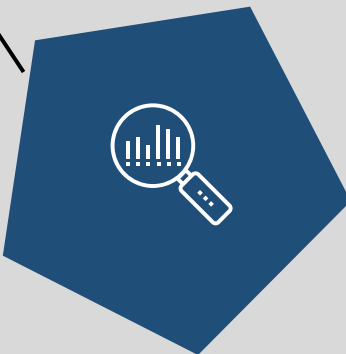
© DFO

Canadian waters are home to several marine mammals, whose critical habitat overlaps with significant commercial shipping routes – as such, the Government of Canada needs to find ways to advance innovative sustainable shipping solutions.

Quiet Vessel Initiative (QVI)

WHAT IS QVI?

QVI is a TC-led initiative that is advancing research, development and deployment of quiet vessel designs, retrofits and operational practices. It is also one of the Trans Mountain Expansion Project Accommodation Measures that have been implemented to help address project-related concerns of Indigenous groups.



WHAT DOES QVI DO?

QVI is testing safe, environmentally-responsible and effective quiet vessel technologies, retrofits, designs, and operational practices that reduce the impacts of underwater noise on vulnerable marine mammals and the marine environment.



WHY IS QVI DOING THIS WORK?

The program contributes to the Government of Canada's efforts to advance sustainable marine shipping – domestically, and internationally .

WHAT ARE THE FUNDING OPPORTUNITIES?

Indigenous groups, as well as industry and academia, can submit proposals through the program's periodic **Call for RD&D projects (posted on BuyandSell.gc.ca)**. **Targeted Contribution Funding** is also available for Indigenous groups located along the TMX marine shipping corridor to support engagement, e.g. underwater noise monitoring; community capacity building activities, etc. (non-exhaustive). 5

QVI Funding Opportunities

A series of call for proposals for research projects have been launched to:

- provide an opportunity for the sector and Indigenous groups to put forward projects that will help meet research goals; and,
- ensure a transparent and competitive process.

Research Contracts



Planned call for proposals scheduled for Winter 2022

Examples of research requirements (to be finalized):

- Testing and evaluation of URN mitigating technologies
- On-board noise monitoring system development and trials
- Guidelines and procedures to:
 - standardize methodologies to measure effectiveness of URN technologies
 - assist vessel owner/operators develop noise management plans
- Characterization of echosounder use in Canada to inform mitigation approaches



Targeted Industry Call for Contribution Funding



Call for proposals launched May 5th, 2021

- Closed on June 30, 2021
- Over 30 proposals received
- Recipients to be announced in Winter 2022

Targeted Indigenous Call for Contribution Funding



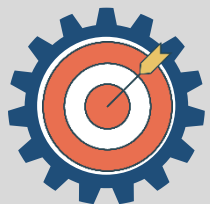
The **second call for proposals** – exclusively available to site-specific rights holding Indigenous groups along the TMX Marine Shipping Route – was **launched on November 8th, 2021**. The deadline to submit a proposal is **February 2nd, 2022**.

QVI Research Projects Funded in FY 2020-2021

						 shaping tomorrow with you					
	Advanced Air Abatement Technology for Canadian Ports	Hull Coating and Propeller Condition Optimization for Emission Reduction	Propeller Cavitation Monitoring	Arctic Marine Natural Gas Supply Chain	Marine-Zero (Hydrogen) Fuel Assessment Tool	Vessel Fuel Optimization	Underwater Radiated Noise and Greenhouse Gas Reduction Program for Canada’s Inshore Fishing Craft	Supporting ISO Vessel Source Level Measurement Standards for Shallow Water	Feasibility of Real-Time Shipboard Cavitation Monitoring and Management	Impact of Underwater Radiated Noise Reduction on Compliance with Energy Efficiency Design Index Criteria	On-The-Go Robotic Ship Hull Cleaner for Ocean Going Vessels
<div>Objective(s)</div> 	To evaluate the feasibility and benefits of implementing advanced exhaust scrubber technology onboard a barge for use at 5 Canadian ports and to develop a concept design.	To establish the most beneficial schedules and methods for hull coating and propeller maintenance that balance the costs of these activities with their fuel savings and environmental benefits.	To develop a cost effective and commercially available propeller cavitation monitoring system.	To explore issues associated with the development of a natural gas marine supply chain for the Canadian Arctic, with a focus on supplying natural gas fuel to vessels, coastal communities, mines and other commercial organizations.	To advance a comprehensive fuel assessment tool for the marine sector (including port vehicles), and to test its usefulness by analyzing a selected marine fleet.	To further develop Fujitsu’s “Vessel Fuel Optimization” system, and to support sea trials on actual ocean-going vessels to validate the technology in operational settings.	To test whether GHG and noise are reduced if a fishing vessel hull is painted with a new graphene-based coating	To provide data to inform the development of an ISO standard for the measurement of vessel source levels in shallow water.	To evaluate the operational feasibility and underwater noise emissions should the Master take measures to minimize cavitation when navigating.	To understand the impacts of implementing technologies to reduce underwater vessel noise on energy efficiency requirements (i.e. Energy Efficiency Design Index).	To complete the detailed engineering design of a robotic hull cleaner in order to progress to build and field test. coating.
<div>Timeline</div> 	May 2020 – April 2021	August 2020 – February 2022	May 2020 – August 2021	2 years	August 2020 – March 2023	May 2020 – March 2021	June 2020 – March 2022	May 2020 – March 2022	May 2020 – March 2022	May 2020 – November 2020	July 2020 – April 2021
<div>Funding</div> 	\$248,440	\$816,202	\$162,220	\$165,925	\$507,059	\$103,488	\$1,186,507	\$991,859	\$301,069	\$70,000	\$150,000
<div>Project Partners</div> 	<ul style="list-style-type: none">Albion Marine Solutions	<ul style="list-style-type: none">Algoma Central CorporationVard Marine	<ul style="list-style-type: none">Allsalt MaritimeT’Sou-ke Nation	<ul style="list-style-type: none">Canadian Natural Gas Vehicle Alliance	<ul style="list-style-type: none">Canadian Nuclear LaboratoriesPotential federal fleet operator	<ul style="list-style-type: none">Fujitsu Intelligence Technologies	<ul style="list-style-type: none">Graphite Innovation & TechnologiesLloyd’s Register Advanced Technology Group	<ul style="list-style-type: none">JASCO Applied SciencesDW Ship ConsultBC Ferries	<ul style="list-style-type: none">JASCO Applied SciencesDW Ship ConsultCanada Steamship Lines	<ul style="list-style-type: none">JASCO Applied SciencesDW Ship Consult	<ul style="list-style-type: none">Offshore Designs Limited
											

Examples of Research Projects

Ship Underwater Radiated Noise Backgrounder and Tech Matrix



Objective:

- ▶ To produce a technology scan of mature and near commercial technologies for reducing underwater vessel noise addressing vessel class, expected cost, ancillary benefits, expected payback, and noise reduction potential.



Key Outcome(s):

A matrix of underwater radiated noise mitigation measures categorized in four main areas covering:

- ▶
 - propeller noise reduction;
 - machinery noise reduction;
 - flow noise reduction; and,
 - other, where the first three categories are not easily applied.



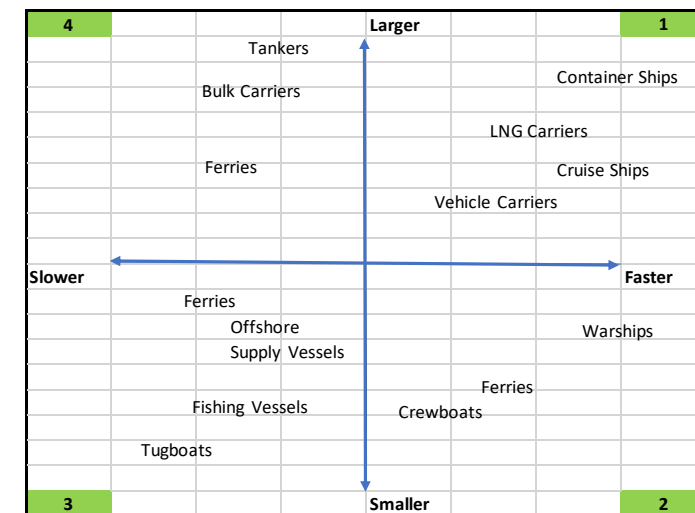
Timeline:

Published in 2019



Partners:

- ▶ Vard Marine Inc.

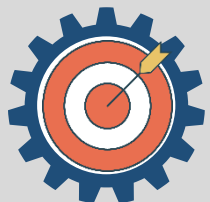


Link to VARD Report
"Ship Underwater Radiated
Noise"



Link to MEPC 74/INF.28
MARINE ENVIRONMENT
PROTECTION COMMITTEE 74th
session Agenda item 17

Supporting ISO Vessel Source Level Measurement Standards for Shallow Water



Objective:

To provide data to inform the development of an ISO standard for the measurement of vessel source levels in shallow water.



Key Outcome(s):

- Recommendations on Shallow Water Vessel Source Level Measurements approaches for ISO TC 43/SC 3
- A comparison of the benefits and disadvantages of using a shallow water hydrophone array versus a deep-water array, including a comparison of the quality of that data



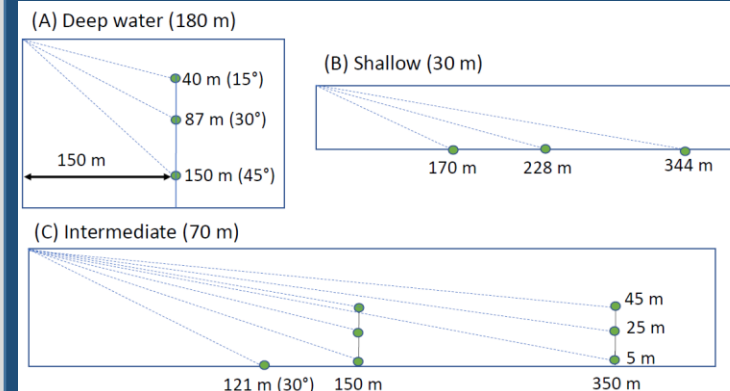
Timeline:

May 2020 – March 2022



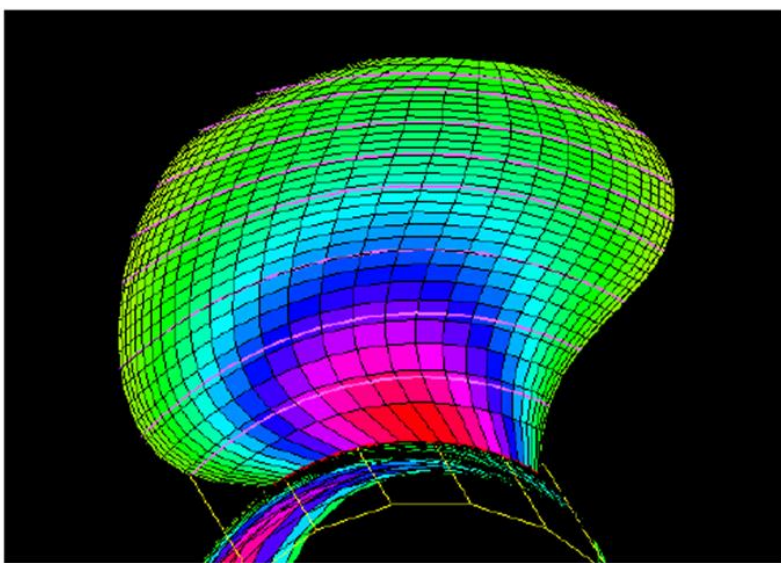
Partners:

- JASCO Applied Sciences
- DW Ship Consult
- BC Ferries

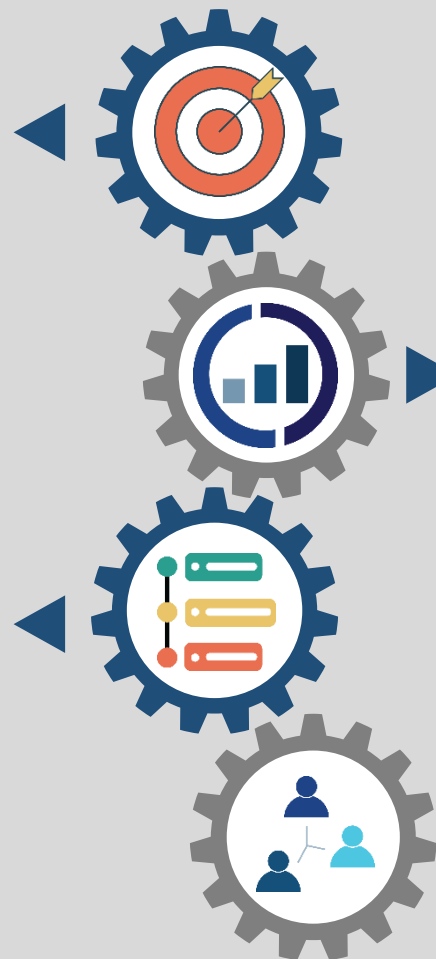


Designing a New Propeller to Reduce Underwater Noise

Objective:
To better understand the relation between propeller cavitation and propulsion system design through numerical evaluations of varied propeller parameters. The relation between CO2 emissions and URN levels was also investigated



Timeline:
October 2019 -
July 2021



Key Outcome(s):

- Recommendation for a new propeller design
- Found that in general, optimizing for reduced noise comes at the cost of reduced efficiency

Partners:

- BC Ferries
- DnV-GL

Feasibility of Real-Time Shipboard Cavitation Monitoring and Management

Objective:

To evaluate the operational feasibility and underwater noise emissions should the Master take measures to minimize cavitation when navigating.

Timeline:

May 2020 –
March 2022



Key Outcome(s):

- Full scale trials data
- Evaluation of impact (safety, cost, fuel consumption) of managing cavitation.
- Evaluation of effectiveness of a cavitation monitoring system when used to reduce underwater vessel noise

Partners:

- JASCO Applied Sciences
- DW Ship Consult
- Canada Steamship Lines



Vessel Noise Correlations Study

Objective:
To use the Underwater Listening Station (ULS) data to investigate statistical correlations between vessel operational and design characteristics and vessel underwater radiated noise levels.

Timeline:
Phase 1 complete May 2020.
Phase 2 complete January 2021.
Phase 3 results expected in 2022.



Key Outcome(s):

- **Design characteristics:** Vessel length had the strongest correlation with increased URN
- **Operational characteristics:** Speed through water and actual draft had the strongest correlation with increased URN
- **Statistical model equations:** Statistical model developed to predict underwater noise using 9 design and operational characteristics

Partners:

Vancouver Fraser Port Authority
JASCO Applied Sciences

Open Science Portal

To view our published reports, please visit our open science portal:

<https://tcdocs.ingeniumcanada.org/>



<https://tcdocs.ingeniumcanada.org/fr>



Contact Information

Matthew Cooke

Project Officer

Innovation Centre, Transport Canada

Matthew.Cooke@tc.gc.ca

www.canada.ca/innovation-centre

Marine-RDD-Maritime@tc.gc.ca

Krista Trounce

Research Manager

ECHO Program



David Hannay

Chief Science Officer



Thank you

Annex

Underwater Listening Station in Boundary Pass

Objective:

Design, manufacture and deployment of a cabled underwater tetrahedral listening station 190m deep between the shipping lanes in Boundary Pass.

Timeline:

FY 2018-19 to
2022-23



[Link to JASCO ULS Project Page](#)



Key Outcome(s):

- **Vessel Noise Profiles** - measurements of noise emissions of vessels entering and exiting the Port of Vancouver, while adhering to international noise measurement standards.
- **Tracking Whales in Boundary Pass** - Detecting and localizing/tracking vocalizing cetaceans in Boundary Pass.

Partners:

- JASCO Applied Sciences
- Vancouver Fraser Port Authority ECHO Program



Study of Quiet Ship Certifications



► Objective:

To use the Underwater Listening Station (ULS) data to investigate how recorded vessel traffic noise signatures compare to various classification societies' quiet notation thresholds, and to improve alignment of measurement and analysis techniques to provide clarity to ship owners and operators.



► Key Outcome(s):

- Classification societies' URN measurement methods are well designed, but lack of harmonization precludes direct comparison
- Single thresholds make it more difficult for some vessel categories to meet quiet notations than others
- Collaboration with ship classification societies underway working towards alignment of measurement and analysis for quiet vessel notations



► Timeline:

2015-2023+



► Partners:

Vancouver Fraser Port Authority
JASCO Applied Sciences



TP 15478E

Study of Quiet-Ship Certifications

Analysis using the ECHO Ship Noise Database

By:

David Hannay

Alex MacGillivray

Héloïse Frouin-Mouy

Zizheng Li

Federica Pace

Jennifer Wladichuk

Zahra Alavizadeh

JASCO Report: 01737

Final Report Version 1.0:

JASCO Applied Sciences (Canada) Ltd.

29 March 2019

Underwater Radiated Noise Technical Bibliography

Objective:

Develop a technical bibliography compiling references related to hydrodynamic aspects of URN

Timeline:

Completed March 2020

Key Outcome(s):

Technical Bibliography references include:

- Noise limit criteria
- Parametric wake field descriptors and wake field data
- Full-scale and model-scale propeller noise test data
- Prediction of propeller tip vortex, non-cavitating flow, and cavitation noise
- Zotero bibliography files available on our Open Science Portal

Partners:

HydroComp Inc.



HYDROCOMP
INC

