



# Research on Vessel Underwater Radiated Noise & Efficiency and Advancing International Collaboration

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# Outline

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- Vessel Underwater Radiated Noise (URN) in Canada
- Research on Vessel Underwater Radiated Noise (URN)
  - The relationship between URN & Efficiency
  - Case studies that evaluate the benefits associated with hull and/or propeller maintenance
- International Collaboration
  - IMO work output

# Vessel Underwater Radiated Noise in Canada

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In Canada, underwater noise is identified as a high-risk anthropogenic threat in recovery plans for species protected under the Species at Risk Act (SARA) in particular the Southern Resident killer whale (SRKW) and St. Lawrence Estuary beluga

## SRKW

- An endangered species that uses sound extensively for communicating and foraging
  - Population of ~74 (three new calves this summer)
- Spend significant time in Canadian waters in the summer and fall when they feed on Chinook salmon in the southern Salish Sea



Credit: Valerie Shore/Shorelines Photography

# Research

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# Reduction of Emissions and URN

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Canadian projects can be described in 2 categories:

1. Projects that examine the **CORRELATION** between vessel emissions/efficiency and URN
2. Projects that examine the **CO-BENEFITS** – emissions/efficiency and URN – associated with making a change to a vessel or its operation

# Examining Correlation

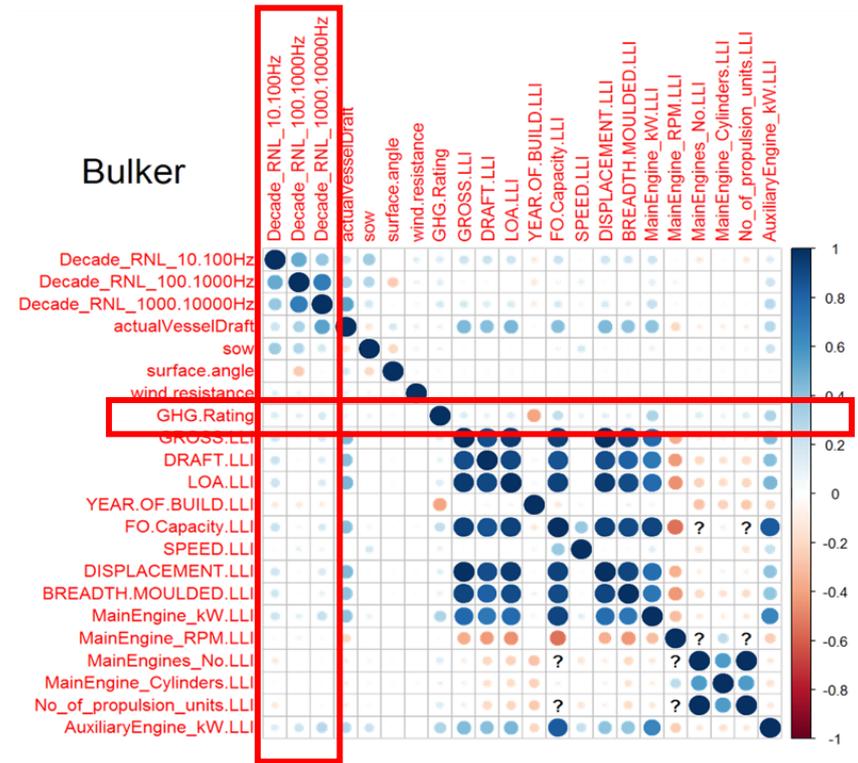
## Vessel Correlations Study

JASCO Applied Sciences (Canada) Ltd, ERM Consultants Canada Ltd, Acentech

**Objective** –to determine which vessel design and operational parameters influence URN

**Method** – statistical analysis of databases of vessel noise measurements and design and operational characteristics

**Key Result** - GHG Emissions Rating exhibited weak correlation with URN



Source: JASCO Applied Sciences and Vancouver Fraser Port Authority

# Examining Correlation

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## URN and Vessel Efficiency

JASCO Applied Sciences (Canada) Ltd, DW ShipConsult

**Objective** – to determine whether a vessel's URN can be reduced without compromising efficiency

**Method** – analysis of tanker & containership designs, EEDI and URN; propeller design, efficiency and cavitation; market factors

**Key Result** – achieving EEDI by speed reduction is favoured and URN reduction may result, but overall impact may be limited if propellers are re-designed for efficiency at the reduced speed



Source: DW Ship Consult

# Examining Co-Benefits – Hull Cleaning

## M/V Cygnus Trials

National Research Council Canada and JASCO Applied Sciences (Canada) Ltd

**Objective** – to evaluate the effects of hull and propeller cleaning on efficiency and URN of a Canadian Coast Guard patrol vessel

**Method** – full scale trials to measure performance and URN before and after hull and propeller cleaning

**Key Result** – Average 5% reduction in required propulsion power; no impact on URN; recommendations to improve experimental controls and improve confidence in results



Source: MarineTraffic.com



Source: National Research Council Canada

# Examining Co-Benefits – Hull Coating

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## Queen of Oak Bay Trials

National Research Council Canada and  
JASCO Applied Sciences (Canada) Ltd

**Objective** – to evaluate the effects of new hull coating on efficiency and URN of a BC Ferry vessel

**Method** – full scale trials to measure performance and URN before and after application of a new hull coating

**Key Result** – data is being analyzed; preliminary results indicate modest reductions in required power and URN at service speeds



Source: BC Ferries

# Examining Co-Benefits – Hull Coating

## URN and GHG Reduction for Fishing Vessels

Graphite Innovation and Technologies and Lloyd's Register Advanced Technology Group

**Objective** – to develop a new graphene-based coating and evaluate its impact on efficiency and URN of small fishing vessels

**Method** – full scale trials to measure performance and URN before and after application of a new hull coating on 6 vessels

**Key Result** – project is underway; baseline data has been collected and is being analyzed



Source: Graphite Innovation and Technologies

# Examining Co-Benefits – Electric Propulsion

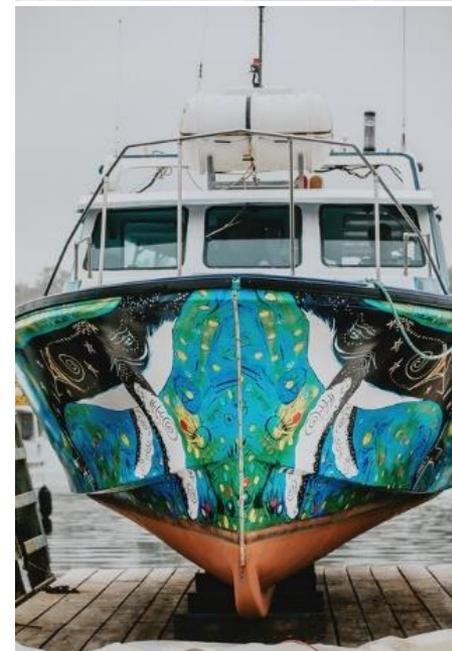
## Electric Propulsion for Small Vessels

Glas Ocean Electric

**Objective** – to demonstrate emissions and URN benefits of a side-by-side diesel and battery-electric propulsion system

**Method** – full scale trials to measure emissions and URN; analysis of impact from using electric system for low speed operations typical for small fishing vessel fleet

**Key Result** – project is underway; data has been collected and is being analyzed



Source: Glas Ocean Electric

# Examining Co-Benefits – Propeller Design

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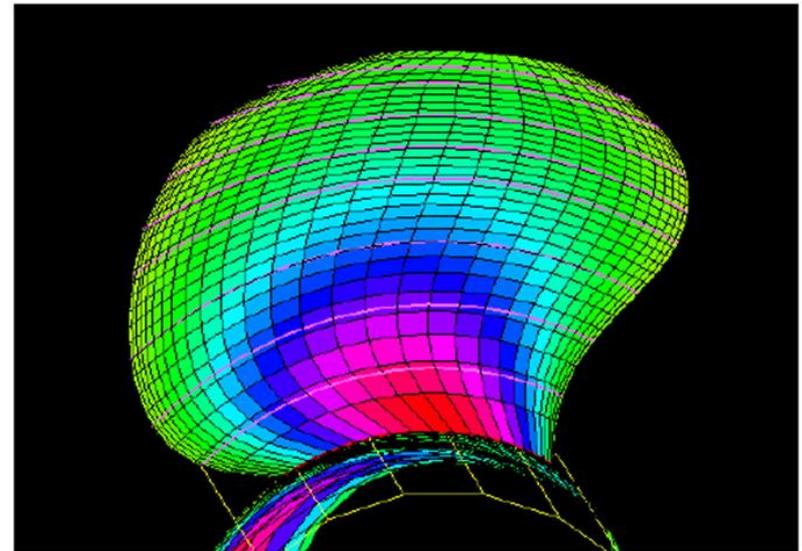
## Parametric Propeller Noise Study

BC Ferries and DNV

**Objective** – to evaluate the effect of varying propeller design parameters and operational conditions on URN and efficiency

**Method** – numerical simulations of existing BC Ferry hull forms and propeller designs and operating points, and comparison with predictions for modified propeller geometries and off-design conditions

**Key Result** – project is underway; preliminary results indicate that tip-offloading improves URN, but with efficiency loss



Source: BC Ferries

# Examining Co-Benefits – Propeller Design

## Propeller Re-design and Optimization

Defence Research and Development Canada,  
Lloyd's Register Applied Technology Group,  
MARIN

**Objective** – to re-design the propeller, optimizing for improved cavitation inception and efficiency

**Method** – computation and model tests of existing and newly designed and optimized propeller

**Key Result** – improvements in cavitation inception without loss of efficiency; improvements being made to computational methods



Source: DRDC

# Underwater Radiated Noise Monitoring

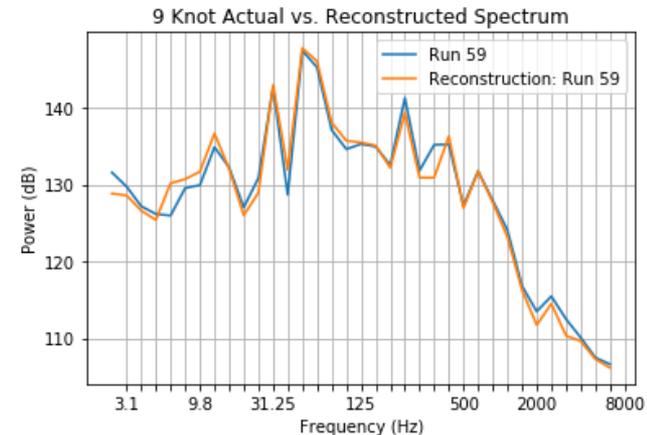
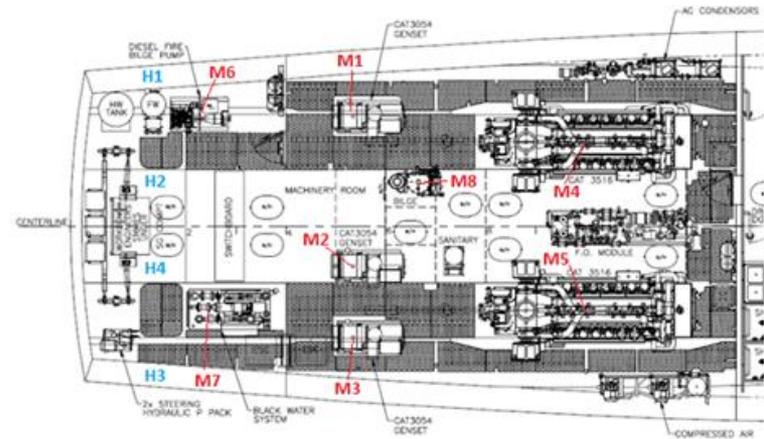
## On-board/Off-board Noise Correlation

Defence Research and Development  
Canada

**Objective** – to test a methodology for real-time estimation of vessel underwater radiated noise

**Method** – full scale trials to measure on-board vibrations and off-board noise; application of transfer function to re-construct off-board noise spectrum

**Key Result** – it is possible to re-construct the URN spectrum and cavitation state of the propeller using a few hull and machine-mounted accelerometers



Source: DRDC

# Report Status and Links

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## **Vessel Correlations Study**

Phase 1 report: <https://www.portvancouver.com/wp-content/uploads/2020/05/2020-05-26-ECHO-Program-Vessel-Noise-Correlations-Study.pdf>

Phase 2 report: [https://www.portvancouver.com/wp-content/uploads/2021/01/2021-01-29-Vessel-Noise-Correlations\\_Phase-2\\_Final.pdf](https://www.portvancouver.com/wp-content/uploads/2021/01/2021-01-29-Vessel-Noise-Correlations_Phase-2_Final.pdf)

## **URN and Vessel Efficiency**

Report complete; link not yet available

## **M/V Cygnus – URN and Efficiency after Hull Cleaning**

Efficiency report: <https://nrc-publications.canada.ca/eng/view/object/?id=1c84eae1-f574-4330-b0bc-771e280030d3>

URN report: [https://tcdocs.ingeniumcanada.org/sites/default/files/2020-01/COAST\\_GUARD\\_CYGNUS\\_NOISE\\_ANALYSIS\\_TRANSPORT.pdf](https://tcdocs.ingeniumcanada.org/sites/default/files/2020-01/COAST_GUARD_CYGNUS_NOISE_ANALYSIS_TRANSPORT.pdf)

## **Queen of Oak Bay Trials**

Report not yet complete

## **URN and GHG Reduction for Fishing Vessels**

Report not yet complete

## **Electric Propulsion for Small Vessels**

Report not yet complete

## **Parametric Propeller Noise Study**

Report not yet complete

## **Propeller Re-design and Optimization**

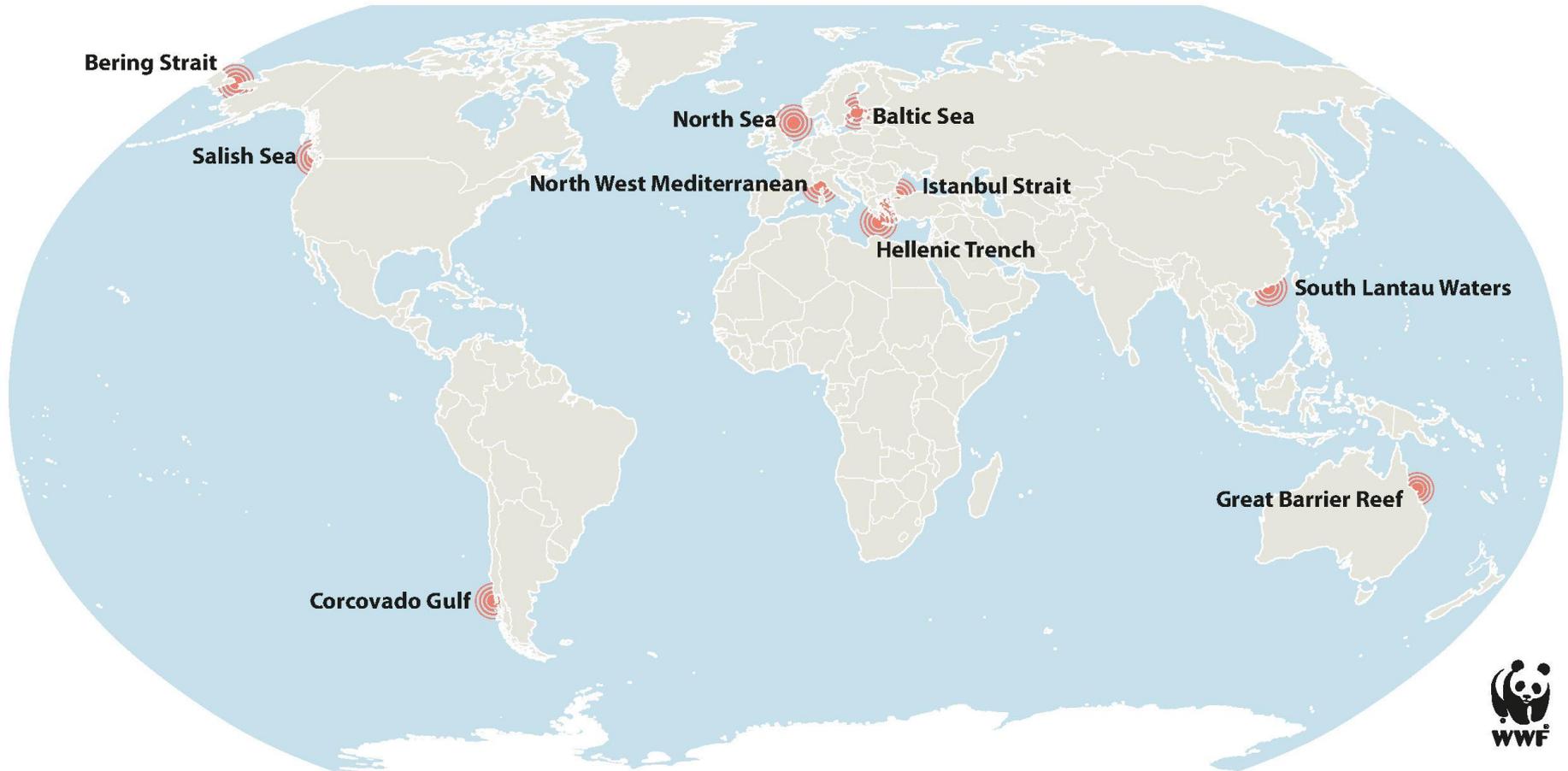
Report complete; link not yet available

## **On-board/Off-board Noise Correlation**

[https://cradpdf.drdc-rddc.gc.ca/PDFS/unc351/p812595\\_A1b.pdf](https://cradpdf.drdc-rddc.gc.ca/PDFS/unc351/p812595_A1b.pdf)

# Underwater Noise is a Global Issue

## Global case studies of marine life and underwater noise from shipping



# International Collaboration

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- Advancing discussions at the International Maritime Organization's Marine Environment Protection Committee (MEPC) Meetings since 2017
- Canada supported an international survey to identify barriers that exist in implementation of the *2014 IMO Guidelines* through World Maritime University (WMU)
- Co-hosted/hosted two Technical Workshops on quiet vessel design and retrofits (Halifax, Canada and London, UK)
- The ECHO Program (led by the Vancouver Fraser Port Authority), supported by Transport Canada, initiated a project focused on improved alignment of classification society quiet ship notations.



# Work Output Proposal

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- Canada has proposed, along with co-sponsors Australia and the U.S., a new work output on underwater noise to MEPC.
- The proposal is set to be considered at MEPC 76 in June 2021.
- Proposal seeks a review of the current IMO Guidelines with a view to:
  - identifying barriers to implementation of the current Guidelines;
  - promoting uptake and identification of new technologies and innovations;
  - raising awareness of the scientific evidence of impacts;
  - considering the work underway on EEDI and GHGs;
  - recommending measures to further prevent and reduce noise and encourage action.





**SAVE THE DATE!**

# UNDERWATER NOISE WEBINAR

**WHEN:** Monday, May 17<sup>th</sup>, 2021 10 AM (EST)  
and 8 PM (EST)

**WHERE:** Hosted through the ZOOM Platform

The Government of Canada, with support from WWF-Canada, is inviting all interested Member States and Policy and Technical experts to join this webinar that will review recent work on underwater noise and the new work output proposal submitted to MEPC 76 on underwater

*For more information please consult **MEPC 75/14** or contact  
Transport Canada ([TC.QuietShips-Naviresilencieux.TC@tc.gc.ca](mailto:TC.QuietShips-Naviresilencieux.TC@tc.gc.ca))*



# QUESTIONS