



Western Washington University
Western CEDAR

Salish Sea Ecosystem Conference

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(Seattle, Wash.)

Apr 6th, 8:45 AM - 9:00 AM

Commercial ship versus whale watch boat noise: relative effects on Southern Resident killer whales

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Wood, Jason; Tollit, Dominic; Joy, Ruth; Koshure, Nicole; MacGillivray, Alex; Trounce, Krista; and Robinson, Orla, "Commercial ship versus whale watch boat noise: relative effects on Southern Resident killer whales" (2018). *Salish Sea Ecosystem Conference*. 442.
<https://cedar.wwu.edu/ssec/2018ssec/allsessions/442>

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Speaker

Jason Wood, Dominic Tollit, Ruth Joy, Nicole Koshure, Alex MacGilivray, Krista Trounce, and Orla Robinson

Commercial ship versus whale watch boat noise: relative effects on Southern Resident Killer Whales

Jason Wood¹, Dominic Tollit¹, Ruth Joy¹, Nicole Koshure², Alex MacGilivray³, Krista Trounce⁴, & Orla Robinson⁴

1. SMRU Consulting North America
2. Hemmera Envirochem
3. Jasco Applied Sciences
4. Vancouver Fraser Port Authority.
Enhancing Cetacean Habitat and Observation (ECHO) Program



Noise Effects on Marine Mammals

- Significant progress and evolution on noise effects studies in the last decade
- Assessing chronic (cumulative) noise disturbance (e.g., masking) remains a significant challenge
- Noise exposure models able to integrate temporal – spatial - spectral overlap. Robust, standardized metrics needed **and** linking these to effect key step

Project Background

- Southern Resident Killer Whales (SRKW) critical habitat overlaps inshore waters around Vancouver and Seattle.
- ~10,000 commercial vessel (bulkers, containers, ferries, tugs, tankers) per year ply Salish Sea, significant numbers of whale watching and fishing boats
- 2012: Proposed new container terminal expansion near Vancouver (<260 calls/year)
- 2013-16: Led to development of SRKW-Noise Exposure simulation model (assess baseline, 'delta' effect of increased vessel numbers and mitigation efficacy)

How the SRKW-Noise Exposure Model Works

COLLABORATORS

- **SRKW Sightings (10 yr)**

BCCSN – Van. Aquarium
The Whale Museum
SMRUC + Hemmera

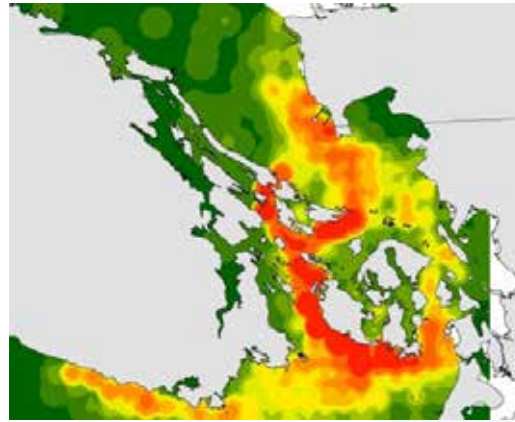
- **Vessel Noise / Ambient**

JASCO
Veirs, Veirs, Wood
SMRUC
University of Dalhousie

- **Dose Response**

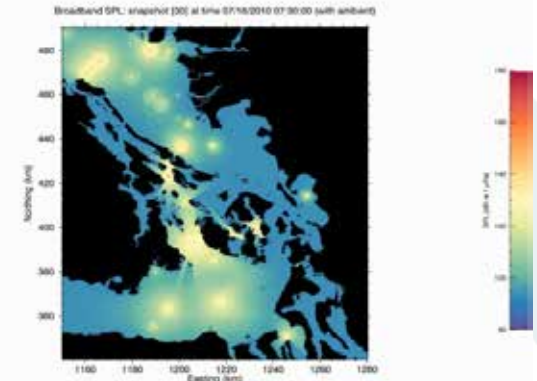
DFO – Deeke (Dtag)
SMRUC (PAM)
Williams et al. 2014 (Obs.)
Univ. of St Andrews
Click Masking: Au (2004)

SRKW – Pod spatial use



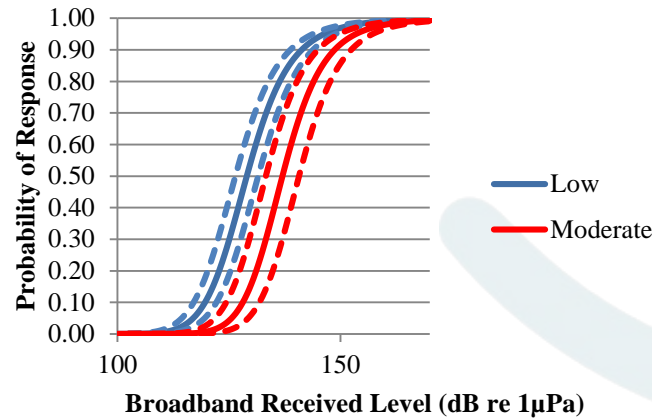
Effort corrected

Vessel noise (AIS)



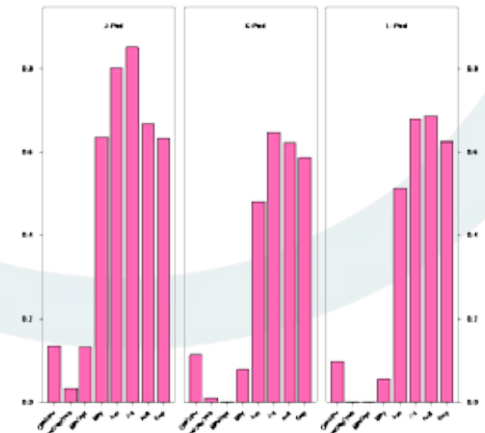
24 Hour – Fine scale
(200m, 1 min interval)

Dual severity dose response



50% Moderate BR 137 dB, Low BR 129 dB. If NO response –
Click masking within 50 kHz band

Marginal Probability of Occurrence Per Day by Month in Winter/Summer



SRKW – temporal (month)

SRKW-Noise Exposure: Study Implications

1. Key conclusions:

Baseline regional levels high – cumulative noise effect ‘significant’

Local project area ‘delta’ effect relatively ‘small’ (e.g., PCOD lite)

2. Vancouver Fraser Port Authority: Next Steps

Underwater Noise Management and Mitigation plan

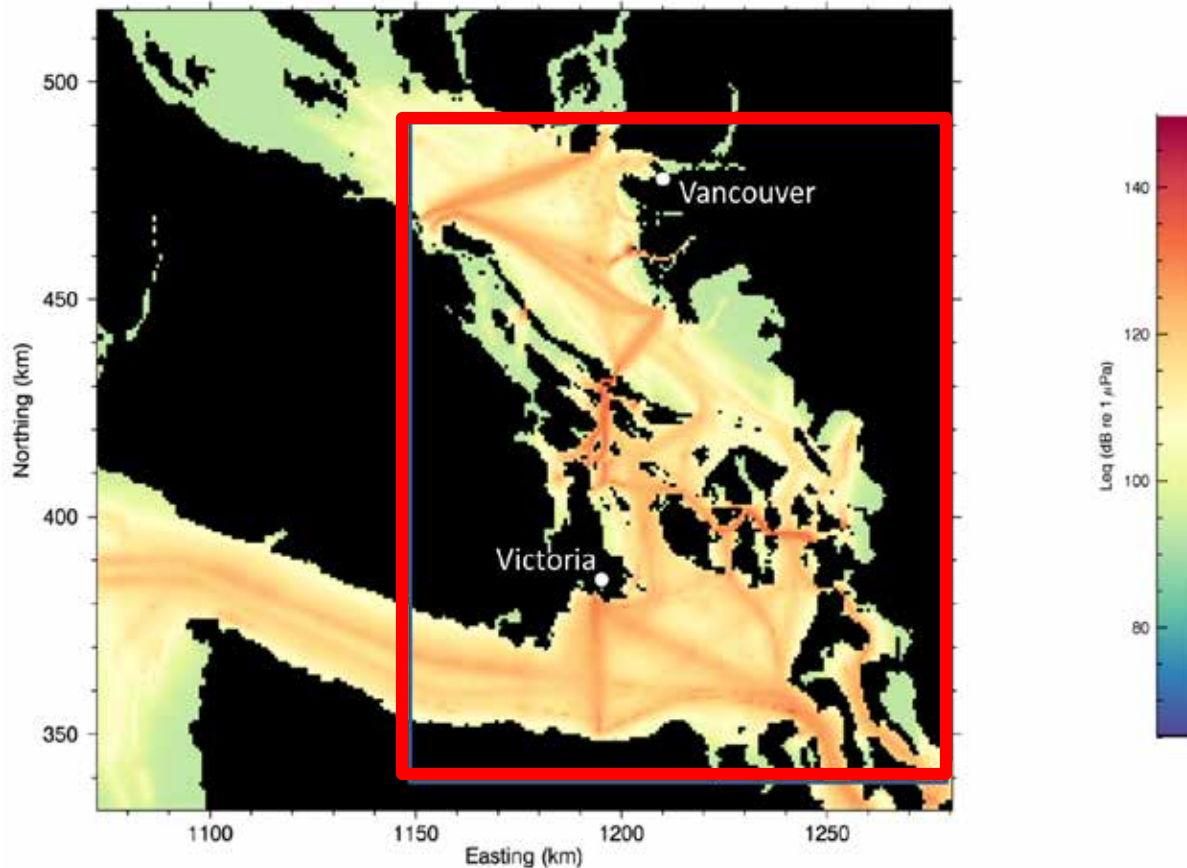
Recognised noise baseline was a multi-stakeholder issue– created new Enhancing Cetacean Habitat and Observation (ECHO) Program (2014) to address cumulative vessel issues.

ECHO Noise Study: Effect of Shipping vs. Whale Watch Noise on SRKW

- SMRU Consulting to revisit SRKW noise exposure simulation model
- Focus on summer (May-Sept) when most whale watch effort occurs.
- First cut assessment
- Identify key sensitivities of the model
- Make recommendations

Study Assessment Area

- Study confined to inshore study area (red box) where SRKW habitat use best understood



Average Leq noise level for AIS-enabled vessels in July (JASCO)

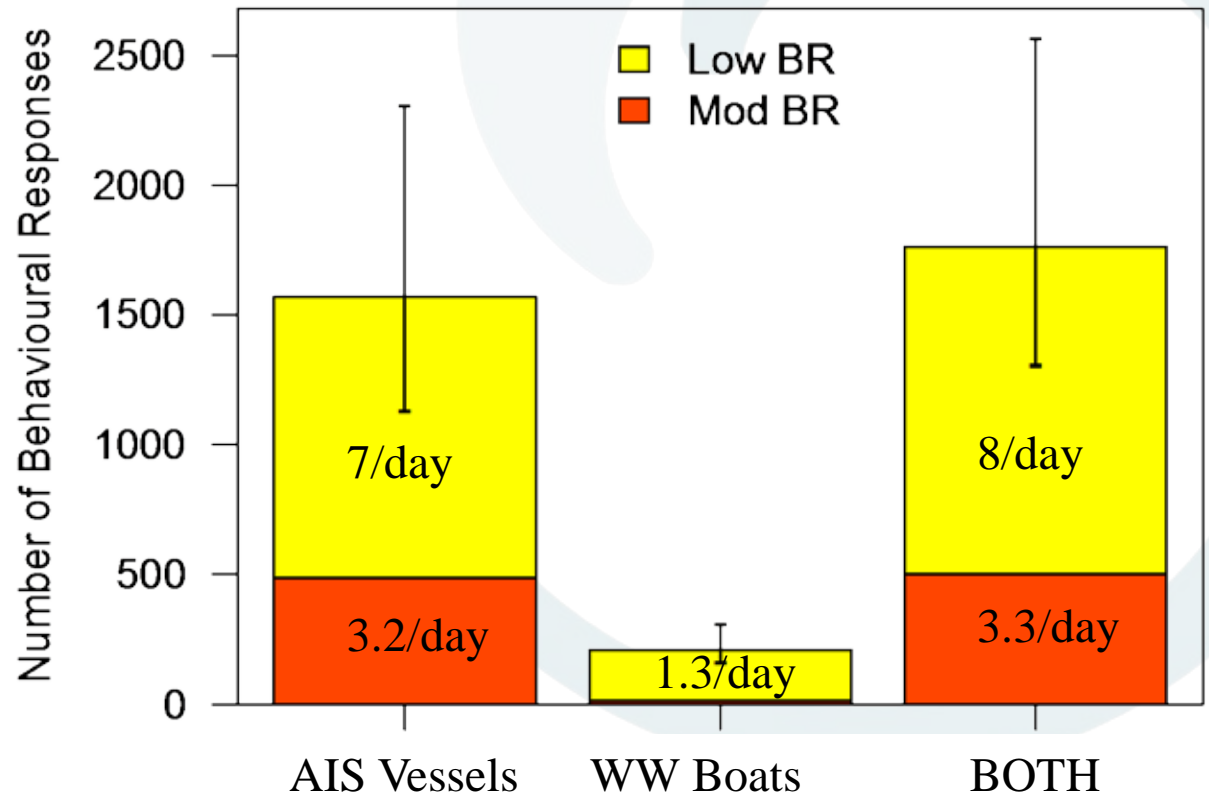
Incorporating Whale Watch Boat Noise

Multi-step, back-calculation approach

1. “With whale” probability combines sightings and effort (Hemmera 2014, Soundwatch 2012)
2. Number of boats per hour (Soundwatch 2012)
3. Boat noise (SPL – Holt et al. 2009, PSD – Hunt 2007, Jensen 2009)
4. Whale – boat proximity (Giles 2014, Pod dispersed/clustered)
5. Noise levels input into SRKW-Noise Exposure simulation model in isolation (only WW boats) and combined with AIS vessel noise

Number of Behavioral Responses (BR) per Whale

- Overall BRs dominated (>90%) by AIS vessel noise
- WW boats infrequently trigger dose response thresholds



Legend:

AIS: Automatic Information System (Commercial vessels > 60 feet)

WW: Whale watch boats

Error bars: 95% confidence intervals – 500 simulations

Total number of behavioral responses per whale (May-Sept.)

Residual Click Masking (50 kHz): Range Reduction

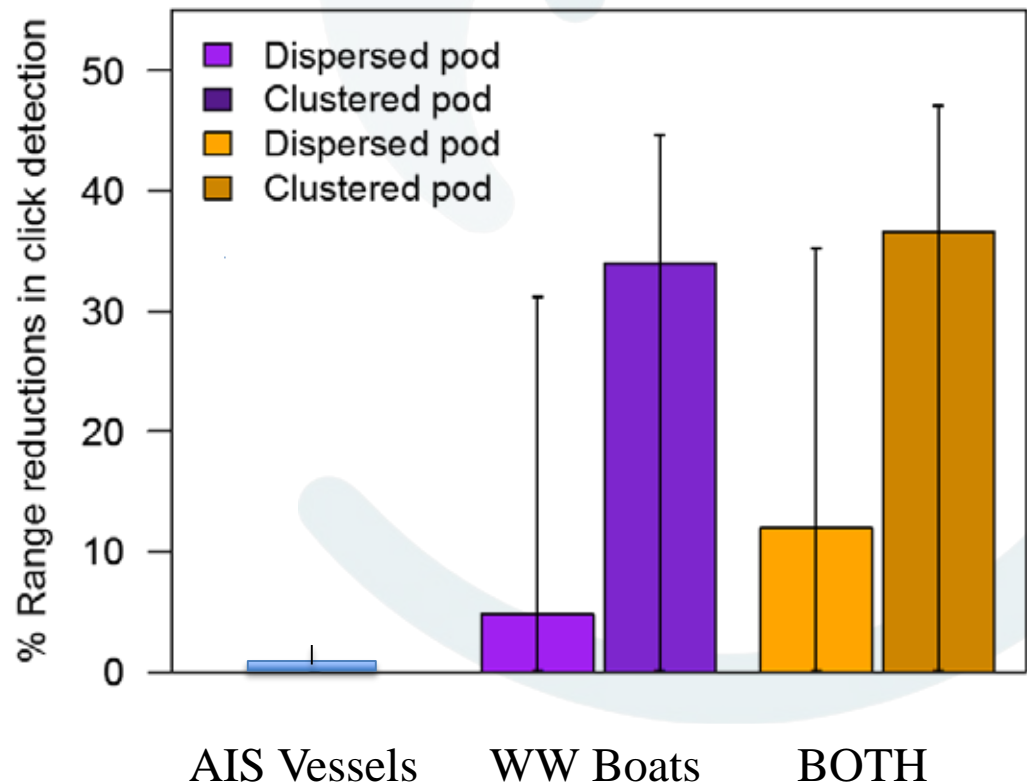
- Whale Watch (WW) boats dominate click masking
- Highly sensitive to input PSD parameters (esp. whale-boat proximity, vessel SL-speed selection)

Legend:

AIS: Automatic Information System (Commercial vessels > 60 feet)

WW: Whale watch boats

Error bars: 95% confidence intervals – 500 simulations

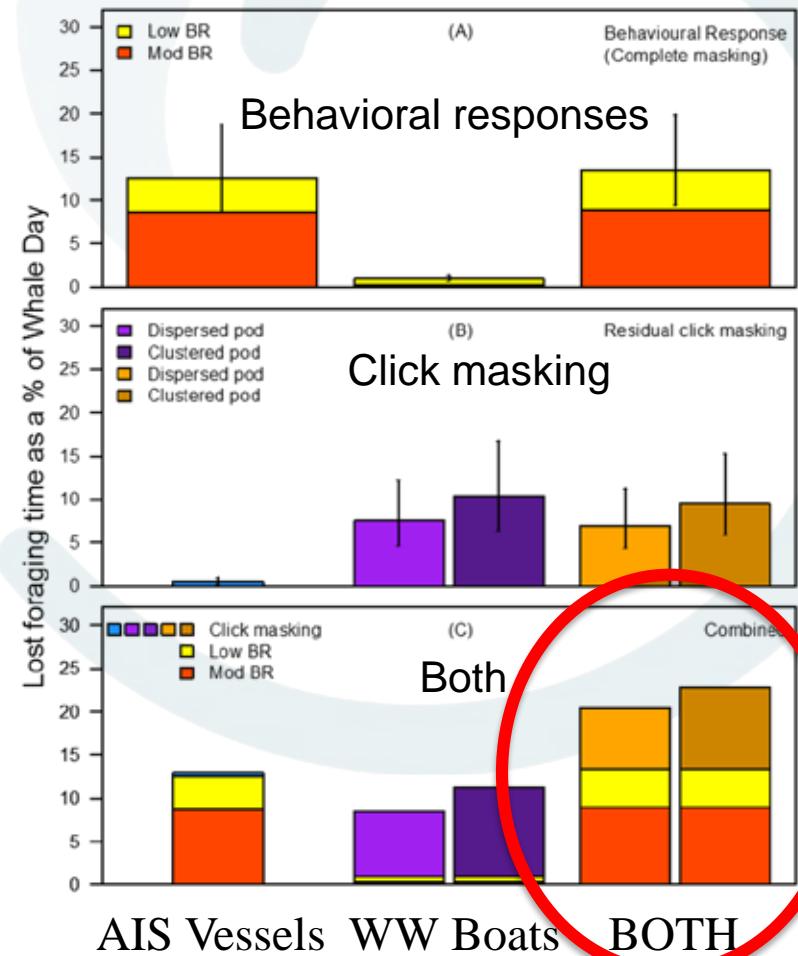


Masking of foraging clicks: % range reduction from 250m

Link to Effect: Need for a Common Metric

- Challenged to find a common “effect” metric
- Used Dtag data and simple assumptions to relate both BRs and masking to **time**

1. AIS-Vessels contributed ~60% and whale watch boats ~40%
2. Total time equated to 13-14.5% of each study day or 20-23% of each “whale present” day



SMRU Consulting Thoughts in Implications / Mitigation

- Large vessels and whale watch boats trigger different noise effects, both have notable potential effects.
- **Mitigation measures:**
 - Whale watch boats (distance, boat speed or number regulations).
 - Large vessels (slow downs (when KW present?), lane shifts from hotspots, targeting “gross polluters”, and clustering vessels. Incentives to design quiet vessels or adopting noise quietening management procedures important as a long-term solution
- For SRKW – increasing **salmon availability key**

SMRU Consulting Thoughts on Model Improvements

- Recommend refining click masking model
 - Masking range, masking frequency
 - Noise inputs and assumptions
- Improve/expand habitat use layer
- Include assessment of quiet periods

Thanks for listening

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Full report can be found on the
ECHO website

