

Boundary Pass Underwater Listening Station

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Underwater Listening Station Project

- A multi-year project sponsored by Transport Canada, with Port of Vancouver's ECHO Program as a key collaborator
- Deployed under the Boundary Pass shipping lanes leading to major ports near Vancouver British Columbia
- The project's primary goals are to:
 - Accurately measure the noise emissions of thousands of commercial ships visiting BC Ports
 - Detect and localize calling marine mammals near the shipping lanes
 - Measure and track ocean noise levels over several years
- Autonomous recorders were used from December 2018 to May 2020, when the cabled system was deployed



Why was the Boundary Pass Location Chosen?

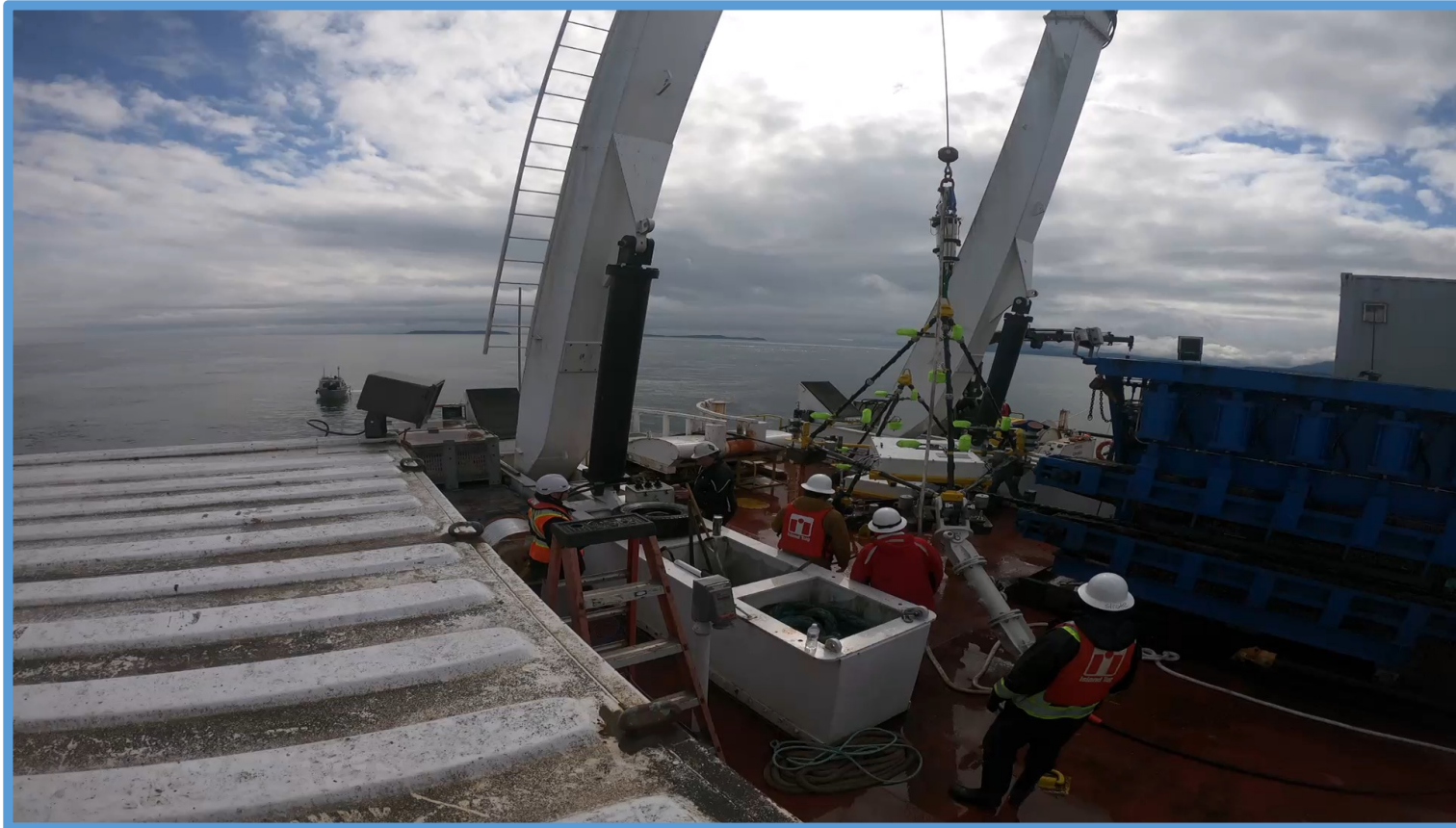
- A 2017 feasibility study by JASCO and Ocean Networks Canada found this location was optimal for a listening station
- The water depth is deep enough to meet international standards for ship underwater radiated noise measurements
- The in-bound and out-bound shipping lanes are adjacent here, so traffic in both directions can be monitored from one site
- Boundary Pass has a relatively high SRKW density, so whale behaviour in the presence of ships can be monitored



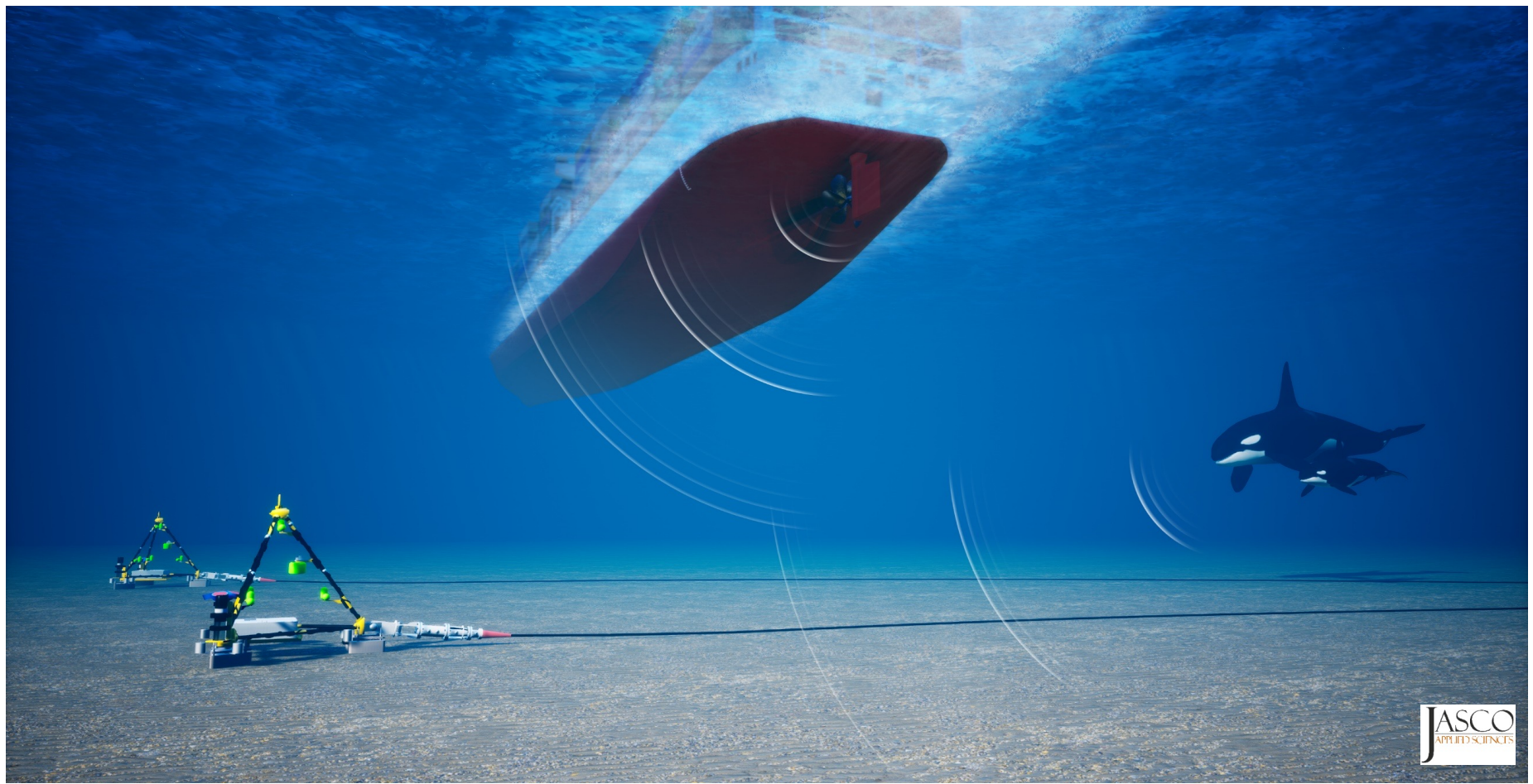
Saturna Island Shore Site

- Two cables run from shore approximately 2.8 kilometers along the seabed to the ULS site
- Acoustic and oceanographic data are fed back to shore in real-time
- The data are processed on-shore and the results are stored immediately in a system database
- Users can access these results using a real-time web interface





Deploying the Hydrophone Arrays

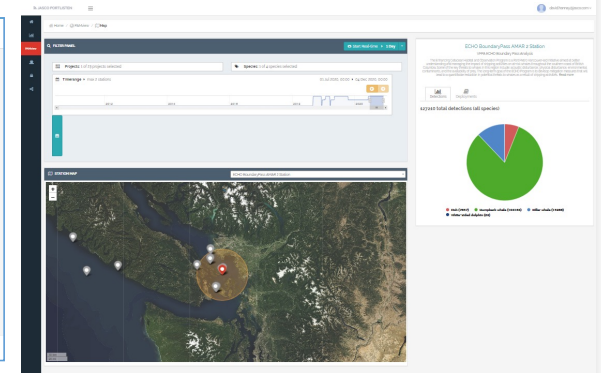
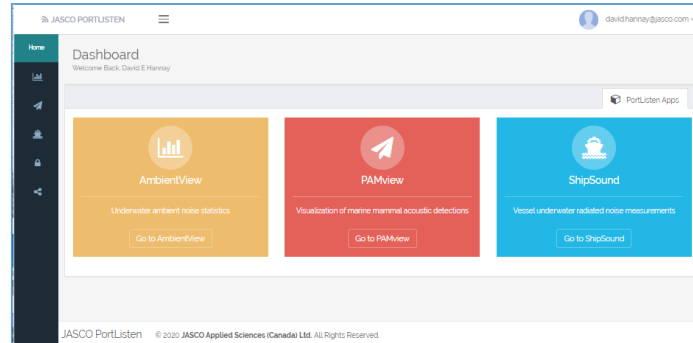
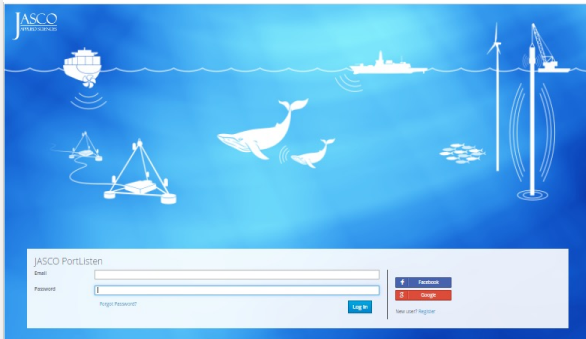


Large amount of Information Being Collected and Stored

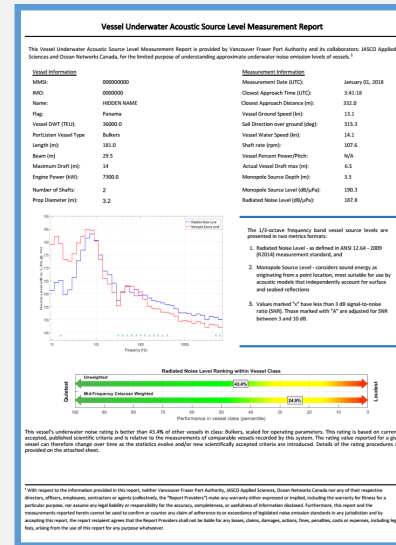
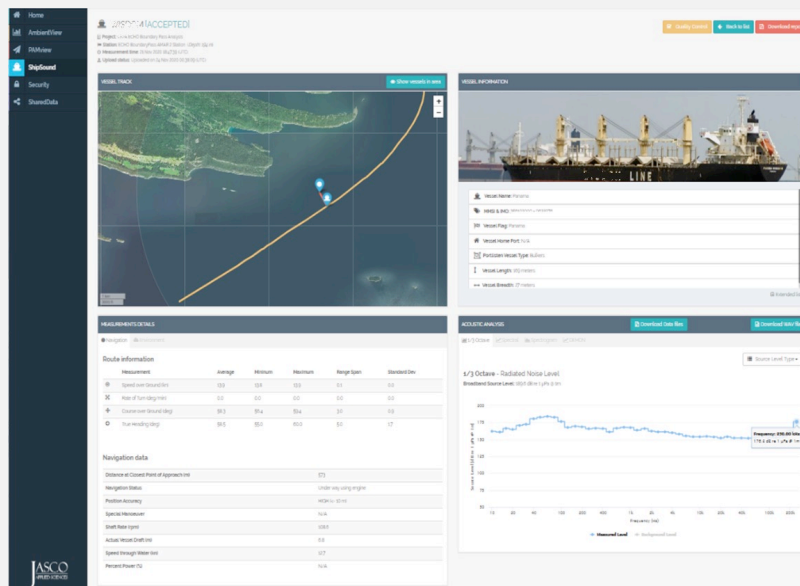
- Acoustic data – 8 hydrophones (4 on each frame) provide calibrated sound measurements
- Water currents: Acoustic Doppler Current Meter (ADCP) measures ocean currents at all depths
- Water Temperature and Salinity: these measurements are relevant because they influence how underwater sound propagates in the ocean
- Video cameras: provide captures of seabed animals and fish
- AIS (vessel position and speed) receiver operated at the shore station
- Weather data from East Point Park weather station, 3 km from the hydrophone arrays



Data Analysis and Reporting



- All data are processed in real-time
- This avoids having to wait for results, and ensures efficient use of all data
- A web-based application makes the results easily available to managers and scientists

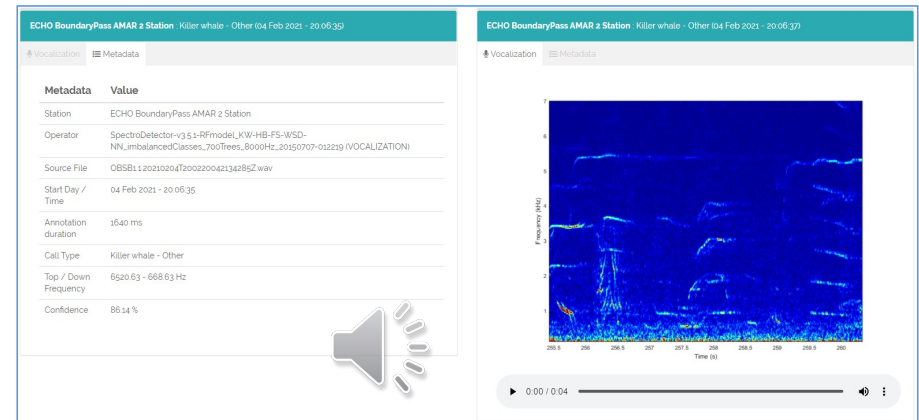
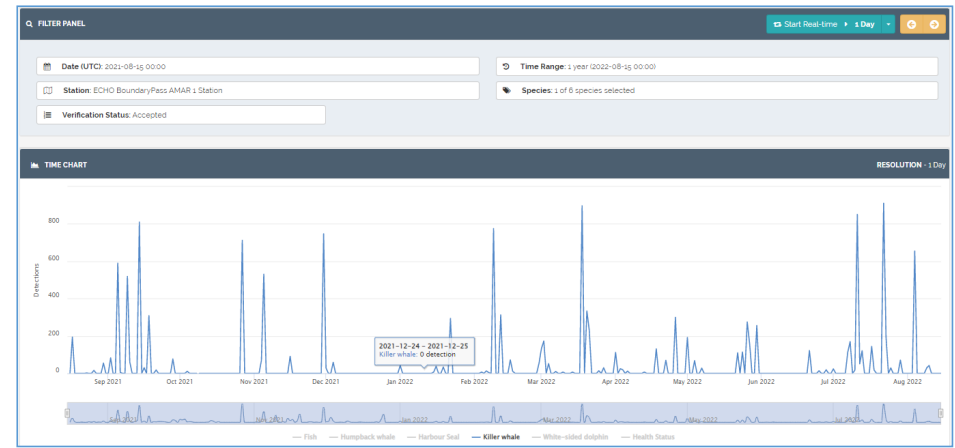


Ship Noise Measurements

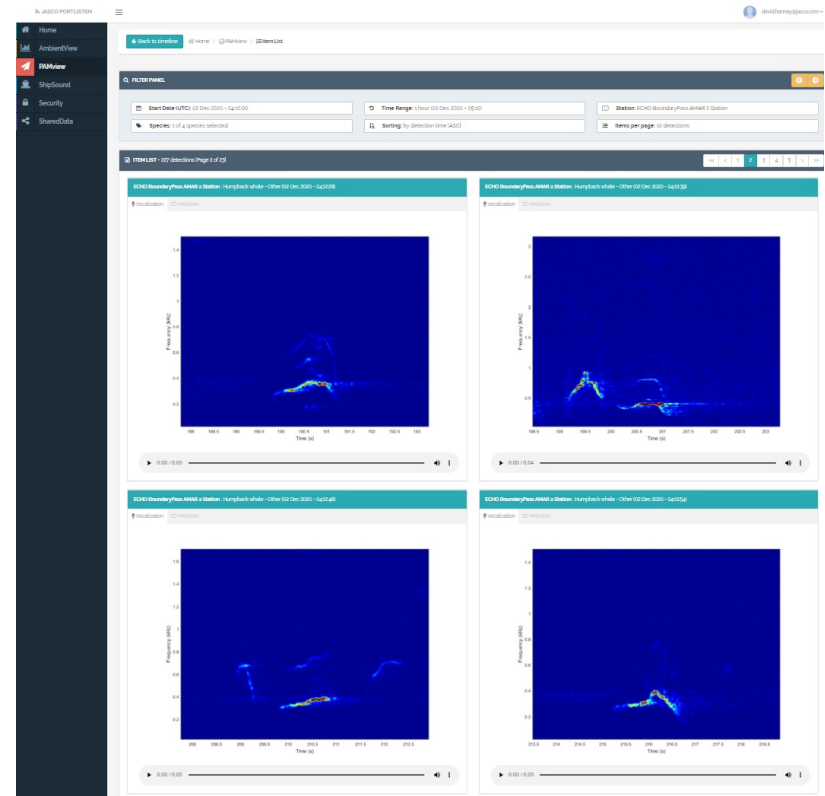
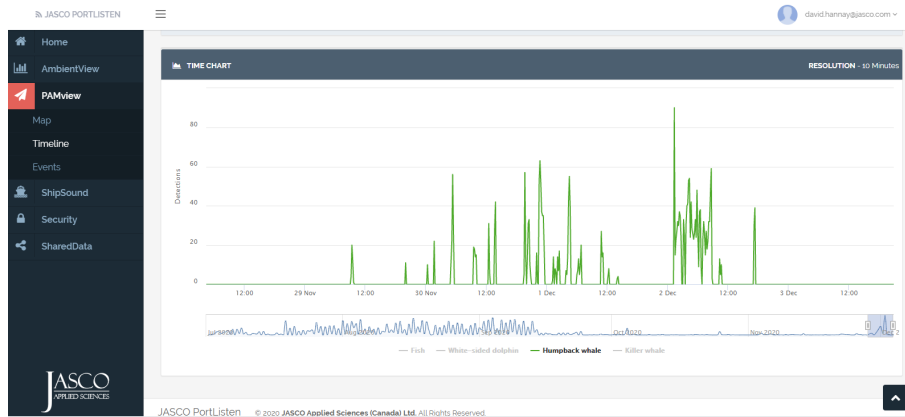
- Noise emissions measurements from over 20,000 vessel passes through August 2022. Approximately 17 new measurements are added each day
- This is now the largest scientific-quality ship noise database worldwide.
- The database is being used in Canada and worldwide for decisions related to ship underwater noise management policy

Marine Mammal Detections

- Four AI-based automated call detectors are presently running in real-time
 - Humpback Whales
 - Killer Whales
 - Pacific white-sided dolphin
 - Fish-like sounds
- Detections are manually reviewed for acceptance
- The system has the capability to localize all calling animals, but this is not yet automated
- The result set is being used for developing systems that will be able to track southern resident killer whales over large distances

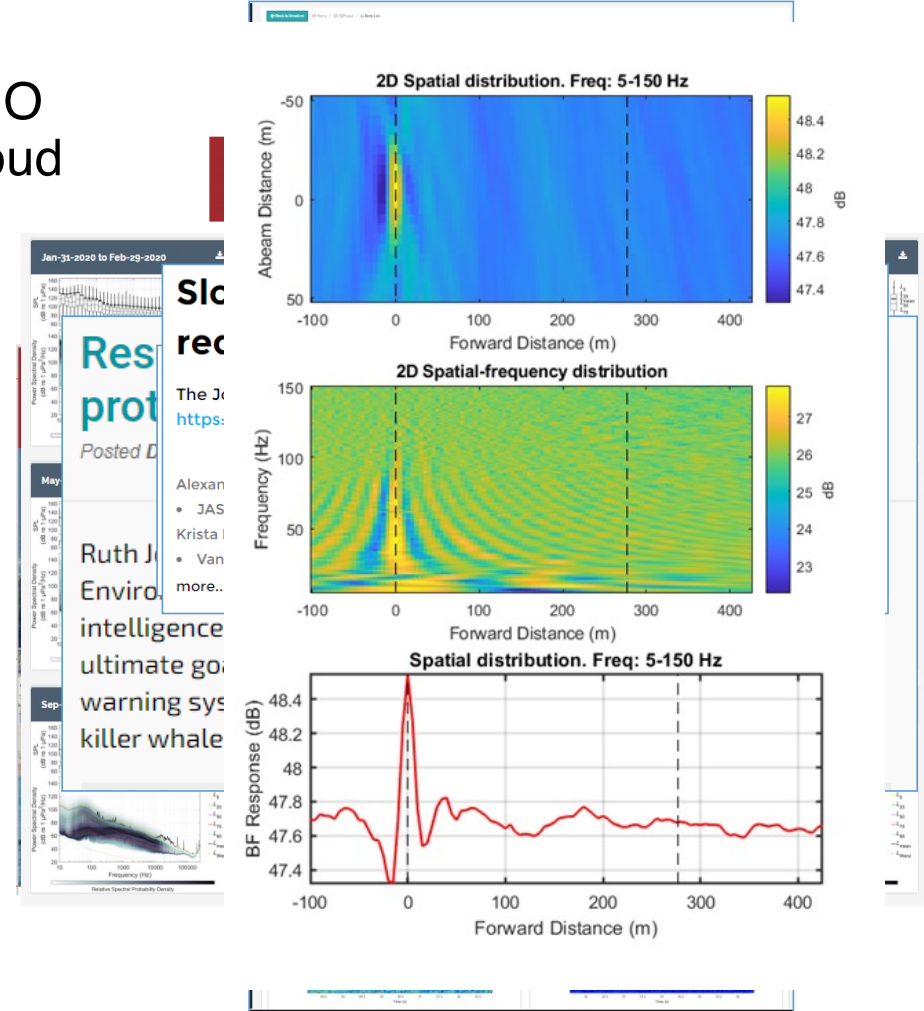


November 29 – December 3, 2021 Humpback Visit



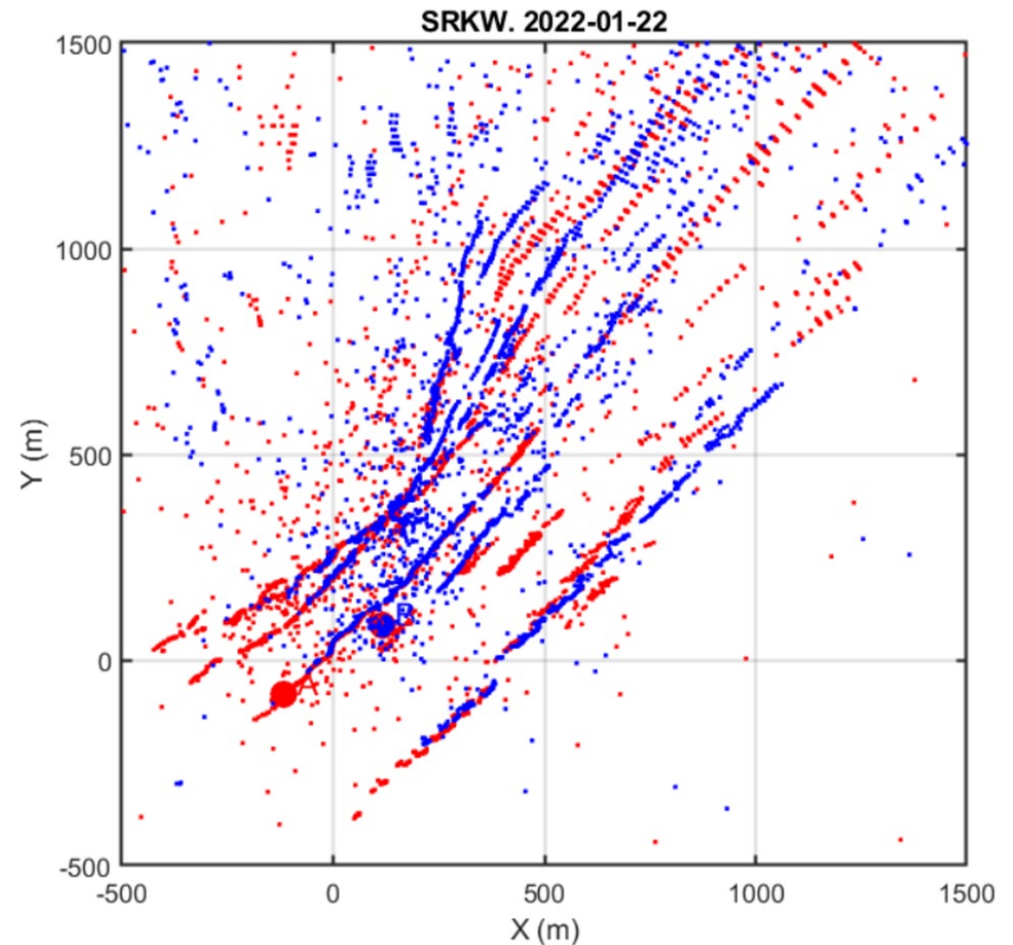
How the Station and its Data are Used

- Ship measurements are reviewed by ECHO Program managers to identify unusually loud vessels
- Several studies/initiatives are already in progress using the station's data:
 1. Several ship noise emissions studies
 2. Ship slow-down noise savings studies
 3. Ship noise localization study
 4. SRKW detection distance study
 5. Development of killer whale detectors
 6. Ambient Noise studies
 7. Alignment of ship certification society quiet-vessel notations



Localization Abilities

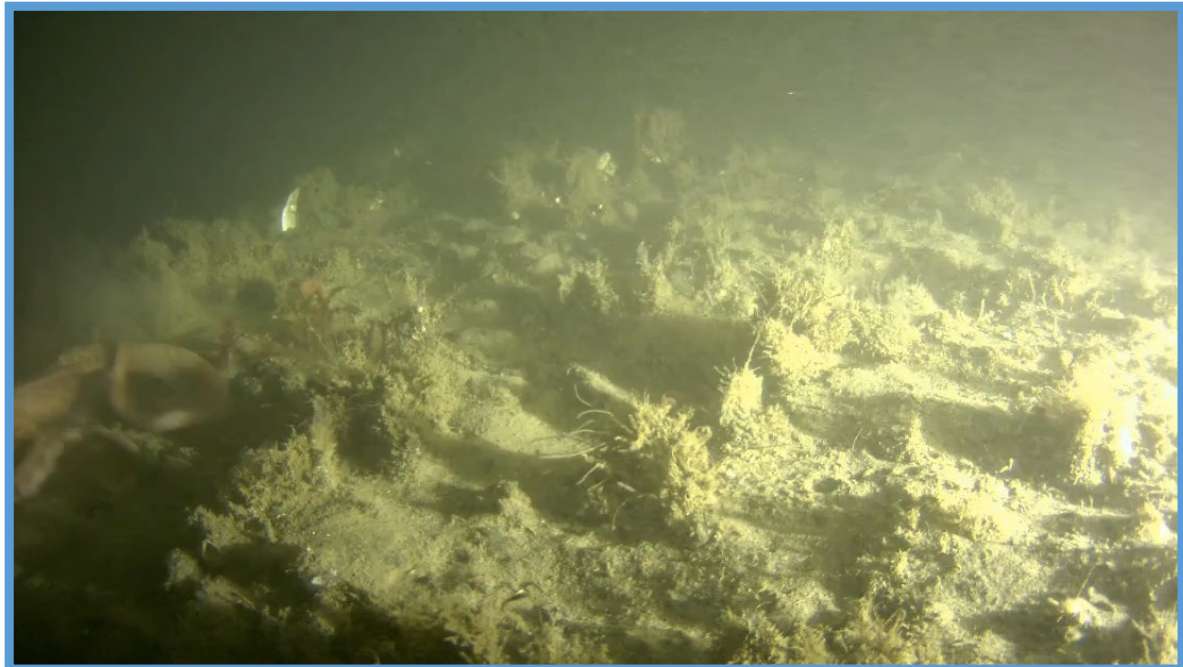
- The two arrays of 4 hydrophones each allow for accurate localization of received sounds
- Individual animals in groups/pods can be localized and tracked
- SRKW are excellent candidates for tracking due to high vocalization and echolocation rates
- Group distribution, swim speed, dive depths and other movement parameters can be measured



Video Cameras

- Each frame has a video camera and lights
- Video recordings are made for 3 minutes each hour
- Many fish and benthic animals pass through the field of view
- Can be used for correlating animal sounds with their presence and location
- We have not yet reviewed the video in detail. Our hope is to engage students to help

Giant Pacific Octopus Visit June 6, 2020



Acknowledgements

- Transport Canada, Innovation Centre
- Vancouver Fraser Port Authority, ECHO Program
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- Fisheries and Oceans Canada
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- Island Tug and Barge
- Hemmera
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- Terra Remote Sensing Inc.
- MacArtney Canada

