Today's Webinar Presentation

- A bit about SLR
- SLR's Ports and Maritime Services
- Understanding the Importance of Marine Systems for Ports
- What Is so Important about Underwater Acoustics?
- Some Recent Projects
- Questions?

Presenters

Anthony Ciriello, Jr. PE

US Sector Leader – Government and Infrastructure

Justin Judge

Senior Marine Ecologist

Dr. Justin Eickmeier

Underwater Acoustics Team Lead

SLR Today

SLR provides a full range of **environmental and engineering services.** Our multi-disciplinary teams address technical and regulatory concerns to **add value, minimize risk,** and **ensure compliance** for the development of port activities.

6 Regions
with **over 10,000** live projects globally

130+
Offices
in **28** countries

4,500+
Staff with a collaborative **'one team'** culture

45+
Technical Services
Environmental, Engineering, Scientific, Advisory

SLR – North America

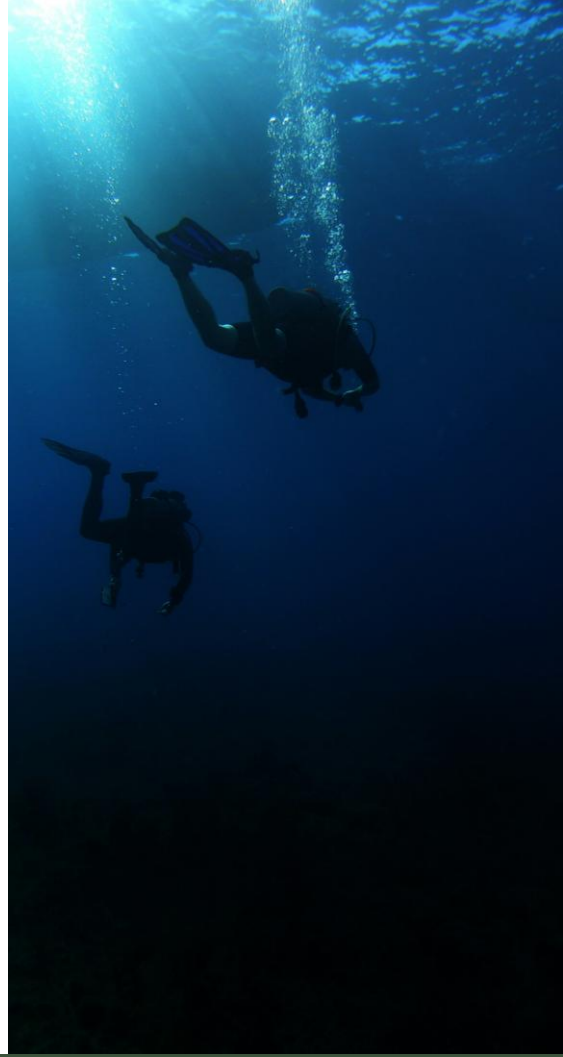
50+ offices in North America

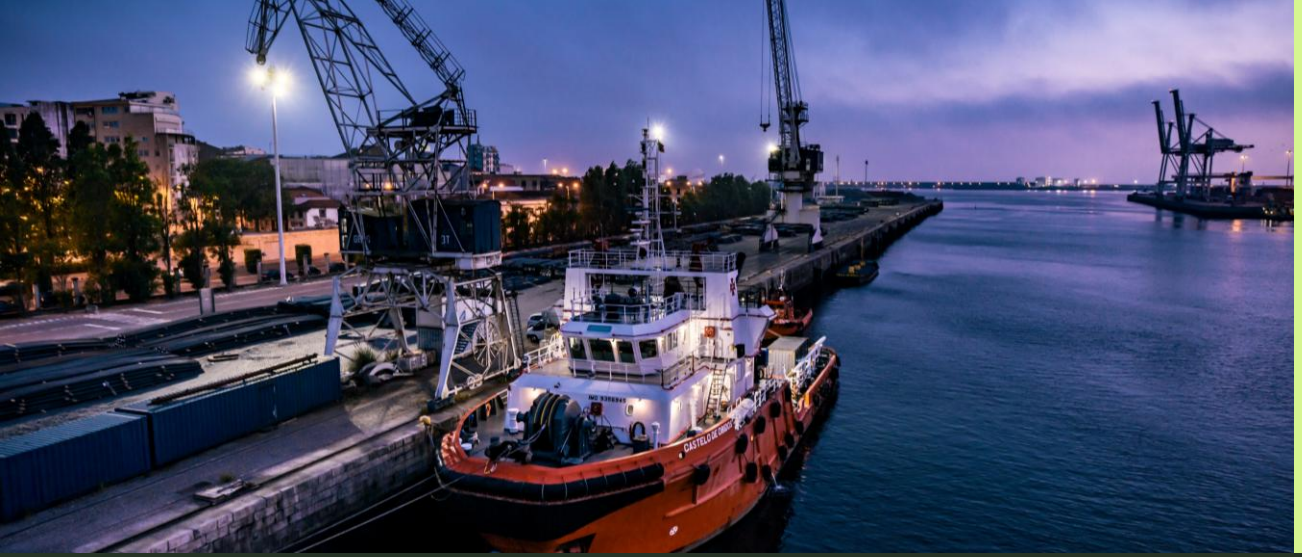
SLR Ports & Maritime Services

- Acoustics, Noise, and Vibration
- Air Quality
- Climate Action Strategy & Planning
- Climate Resilience Risk Assessment & Strategy Implementation
- Decarbonization & GHG Reduction
- Ecology
- Electrification Strategies & Implementation
- Engineering & Design, Visualization
- Environmental and Social Impact Assessment
- Environmental Management, Permitting, and Compliance
- Environmental Remediation
- Green Marine Certification Assistance
- Hazardous Materials & Waste Management
- Marine Mammal Protection
- Noise & Underwater Acoustics
- Permitting & NEPA
- Planning & Traffic
- Stakeholder Engagement & Outreach
- Vulnerability & Risk Assessment

Diving a bit deeper...

- Landside Engineering Support
- Underwater Acoustics
- Air Quality Services
- Marine Mammals, Ecology, and Environmental Services
- Social Impact
- Sustainability Services, including
  - reporting
  - decarbonization strategies
  - fleet electrification
  - net zero waste strategies
  - climate risk analysis and resilience planning





Understanding the Importance of Marine Systems for Ports & Terminals

July 2025

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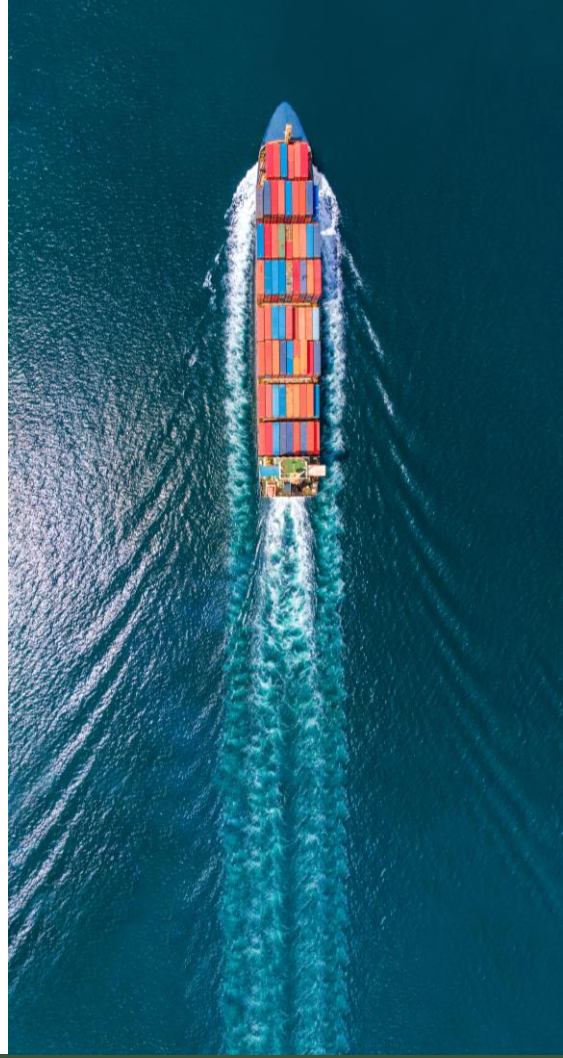
Overview

- Marine Environmental Pressures
- Implications for Ports and Marine Terminals



Marine Environmental Pressures

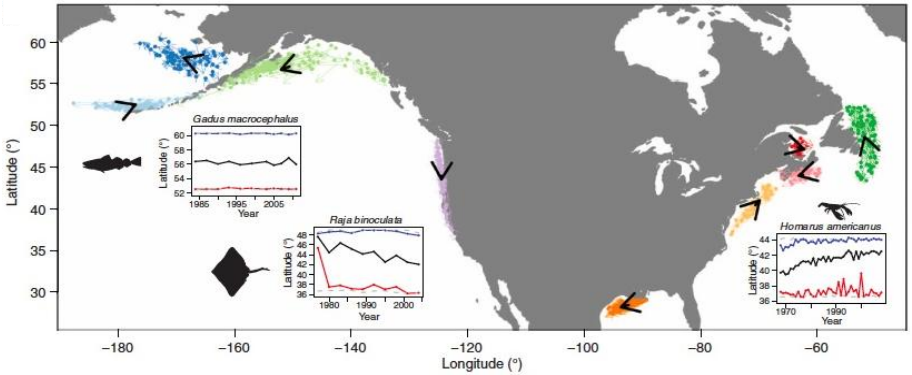
- Climate Change
- Coastal Infrastructure Development
- Shipping
- Cumulative Effects

Climate Change

Environmental Pressures

Commercial species range changes

Changes in species assemblages and tolerances / risks)



Coastal Infrastructure Development

Habitat loss, degradation

Effects on water quality

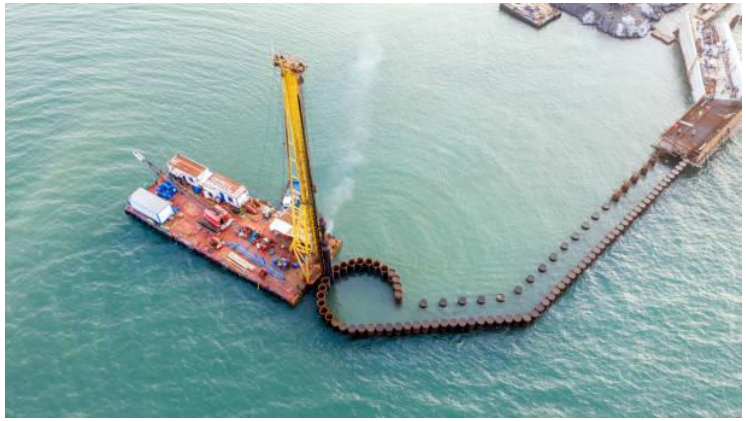
Effects on marine/aquatic fauna

Shipping

Underwater noise

Ship strike

Habitat degradation



Cumulative Effects

Emerging consideration

Considers a combination of factors (both natural and anthropogenic) e.g.:

- Underwater noise
- Effluent discharge
- Replacement of native species with non-native species (niche replacement)

Investigations can be higher level e.g., combined contributions to sedimentation, or

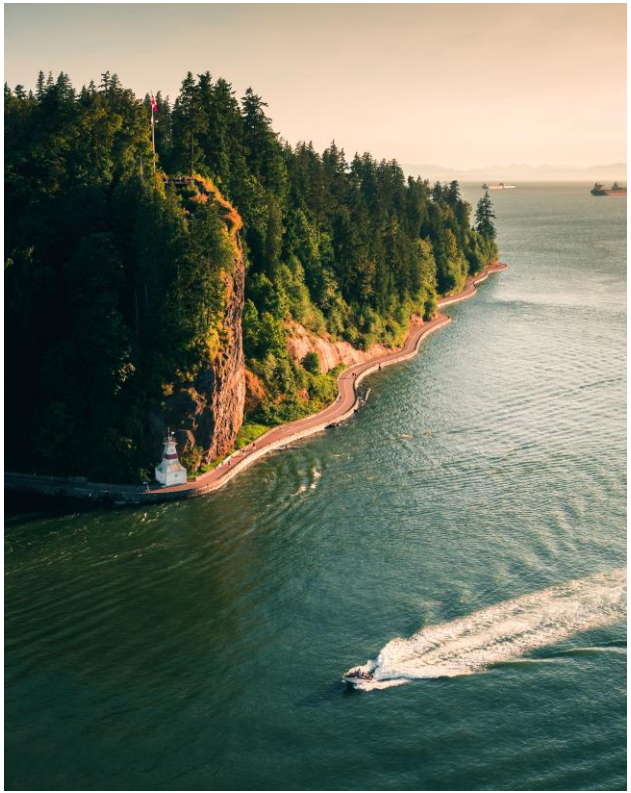
Greater resolution – effects on strengths of species interactions

Implications for Ports and Marine Terminals

Regulations

Planning

Mitigation and Monitoring



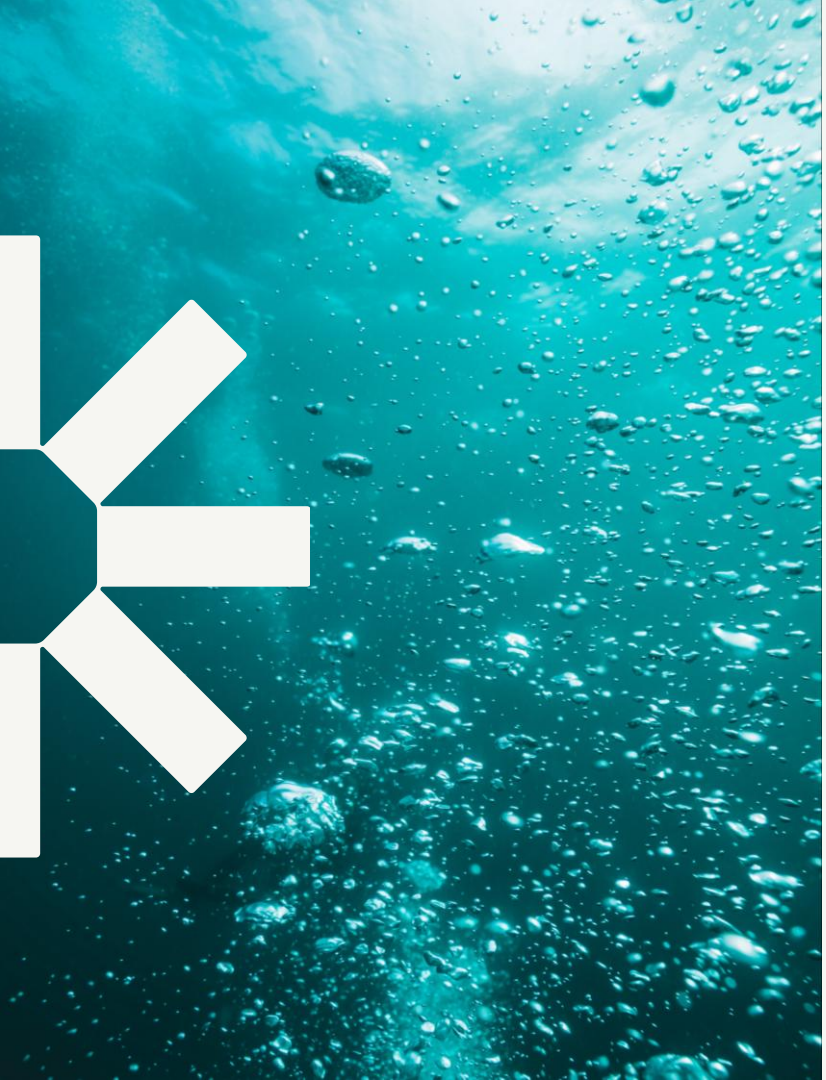
PROJECT PROFILE

Aquatic Ecosystems

Client:	Government of Canada
Location:	British Columbia, Canada

SLR was contracted by the Government of Canada to provide environmental planning, monitoring, and support for operational and remedial dredging programs at a naval facility in coastal British Columbia. This involved sediment impact delineation, remedial planning, and regulatory permitting. During construction, SLR monitored water quality, marine life, noise levels, air quality, waste management, and confirmed compliance with performance criteria and permit conditions.

Early and ongoing collaboration with the SLR team ensured environmental protection and facilitated the implementation of corrective actions and adaptive management techniques, resulting in successful project completion and alignment with Green Marine Aquatic Ecosystems performance indicators.



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How Loud is too Loud?

Underwater Noise Impacts at Ports

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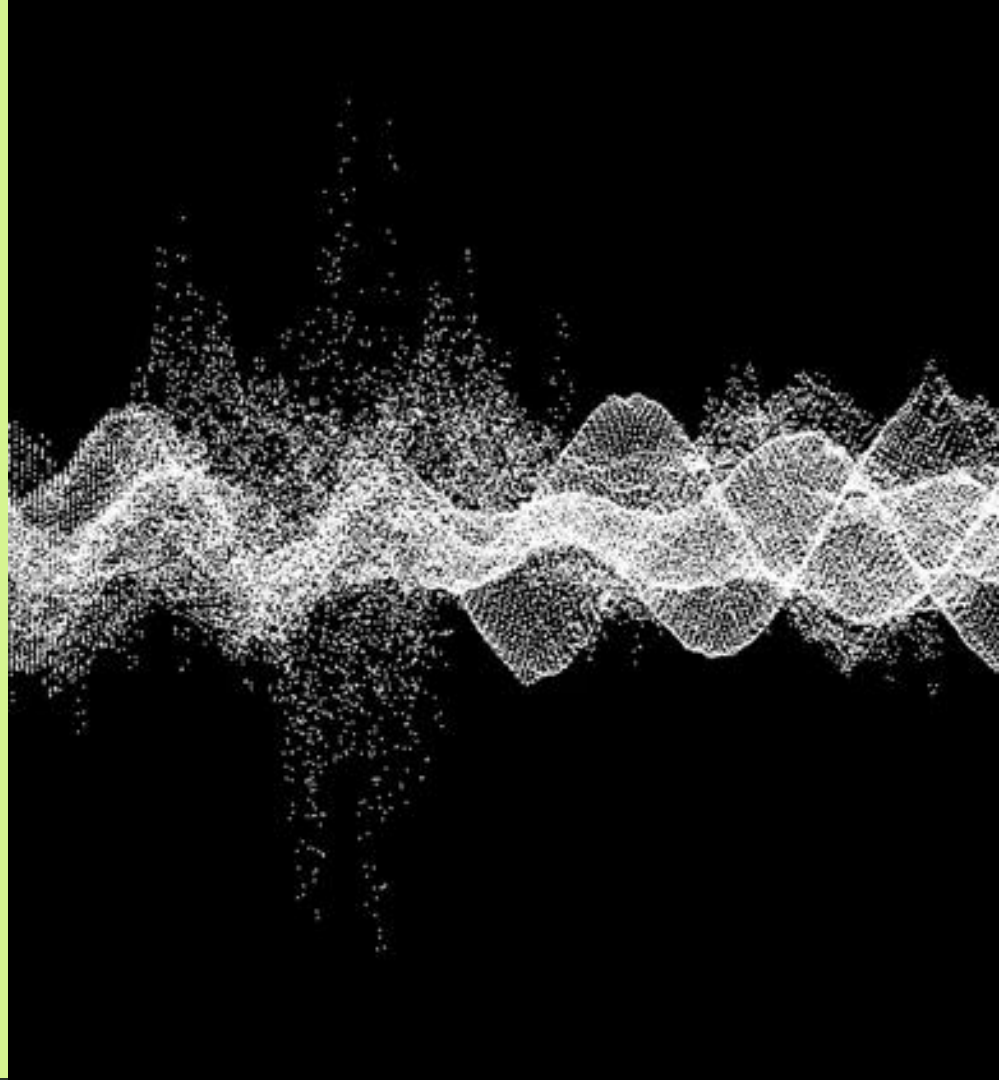
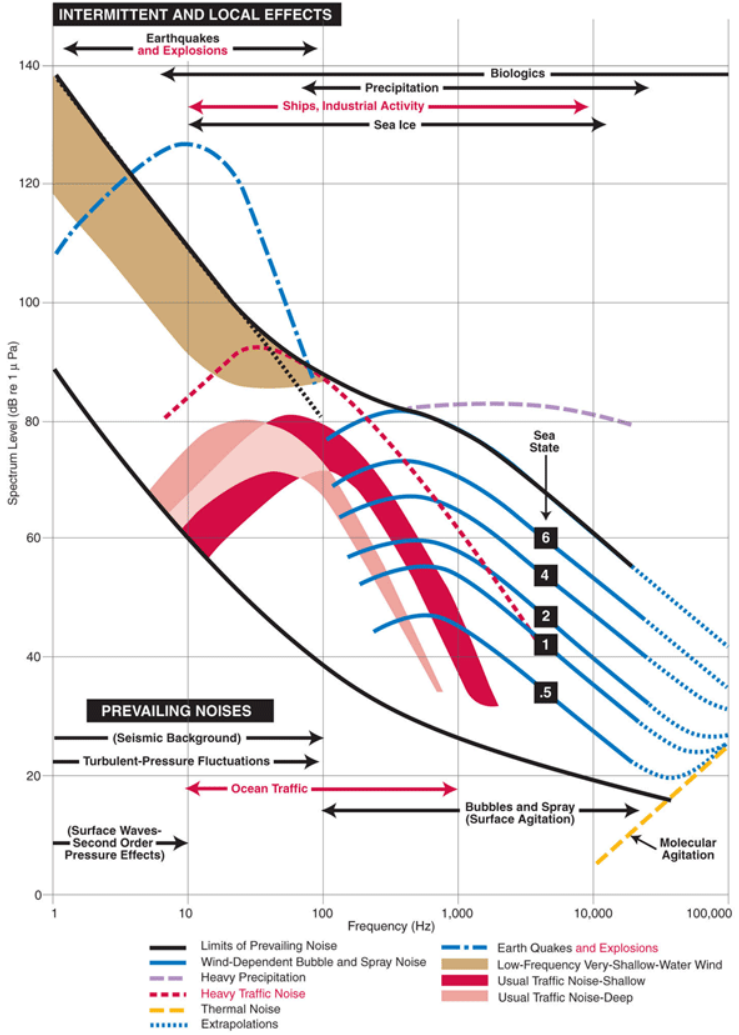
Sound vs. Noise



Comparative Noise Levels

PRESSURE (Pa)	PRESSURE (dB re 1µPa)	COMMON UNDERWATER SOUNDS
1,000,000	240	maximum level / seismic air gun (1m)
100,000	220	typical active sonar (transmission level) /beluga vocalization (1m)
10,000	200	impact pile driving (1m)
1,000	180	large tanker (1m)
100	160	humpback whale song (1m)
10	140	orca vocalization (1m), small vessel traffic
1	120	bottlenose dolphin whistles (1m)
0.1	100	underwater earthquakes
0.01	80	heavy rain falling
0.001	60	ambient noise, sea state 4 (moderate)
0.0001	40	ambient noise, sea state 0 (in calm)
0.00001	20	bubbles (surface agitation)
0.000001	0	acoustic reference (re 1µPa)

Ambient Noise



Environmental Noise – Geography





Biological Noise - Biophony





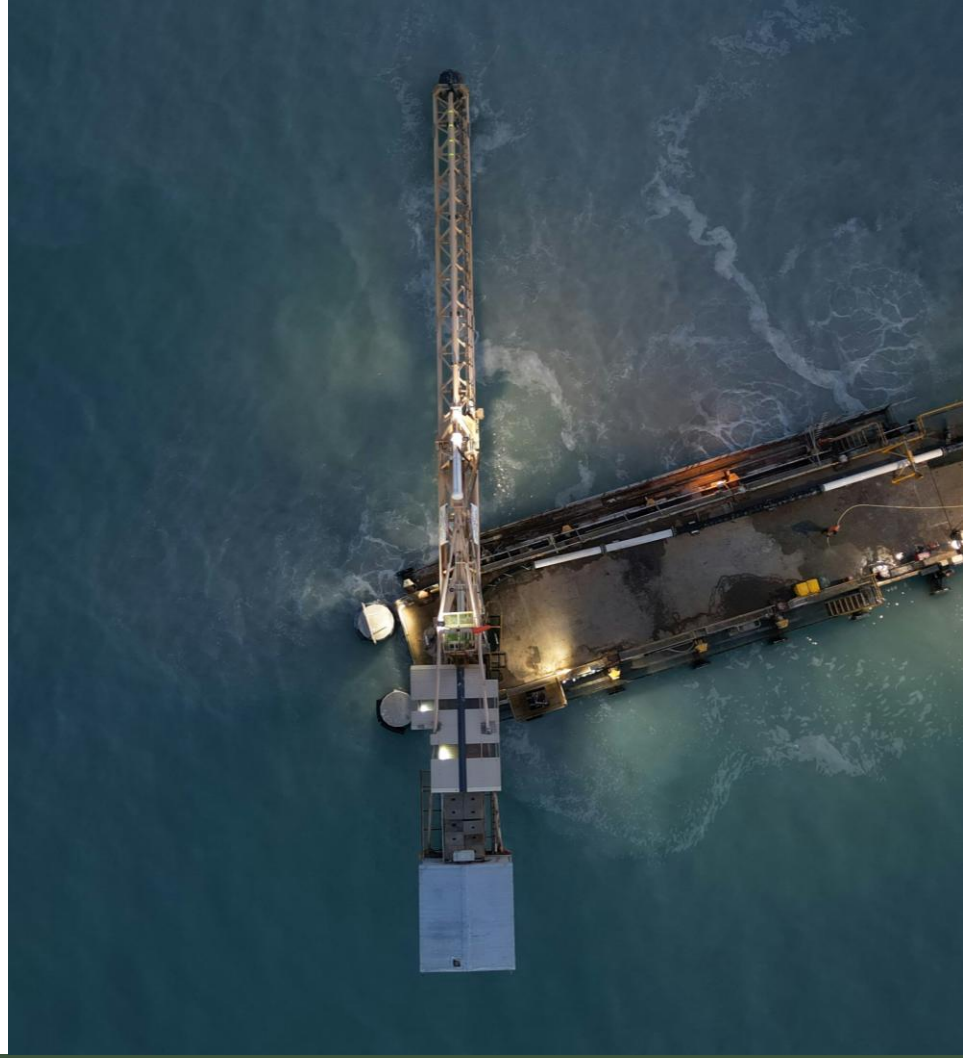


Anthropogenic Noise - Anthrophony

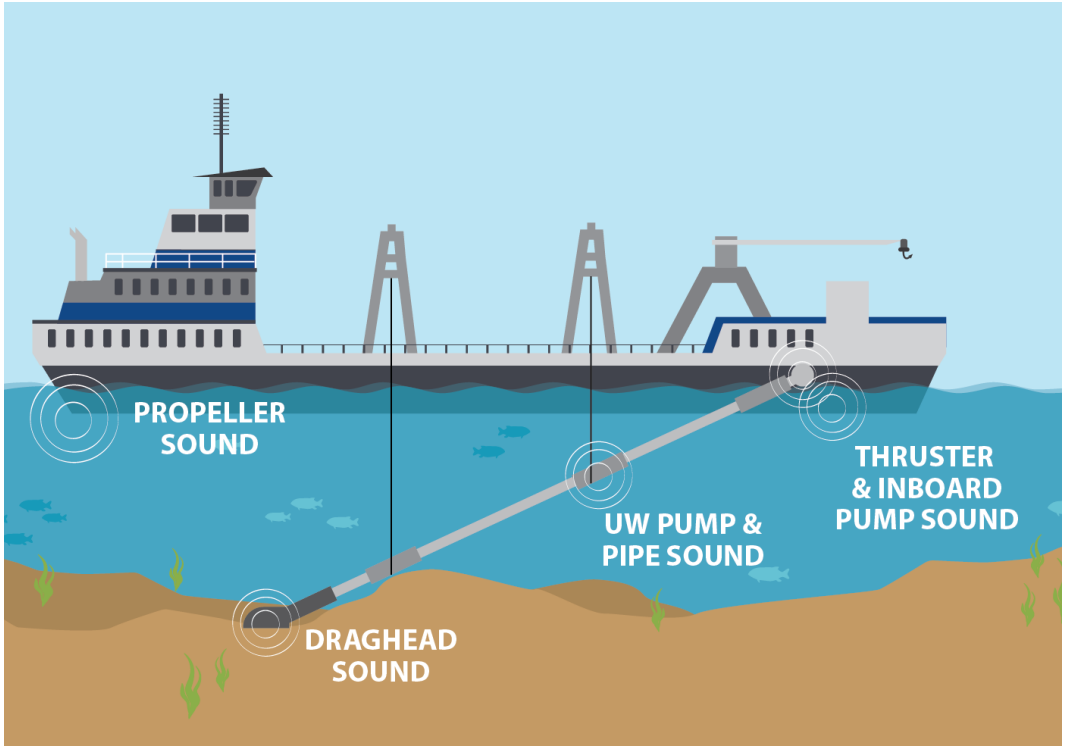
Image by Hannes Grobe File:Airgun-array hg.jpg - Wikimedia Commons

Dredging

- There is increasing concern about adverse biological effects associated with anthropogenic input of sounds to the underwater soundscape.
- Dredging activities generate underwater sound by extraction, transit, and placement of bottom sediments.
- Dredges are separated into four different classes:
  - Trailing Suction Hopper Dredge (TSHD)
  - Cutter Suction Dredge (CSD)
  - Grab Dredge (GD)
  - Backhoe dredge (BHD)

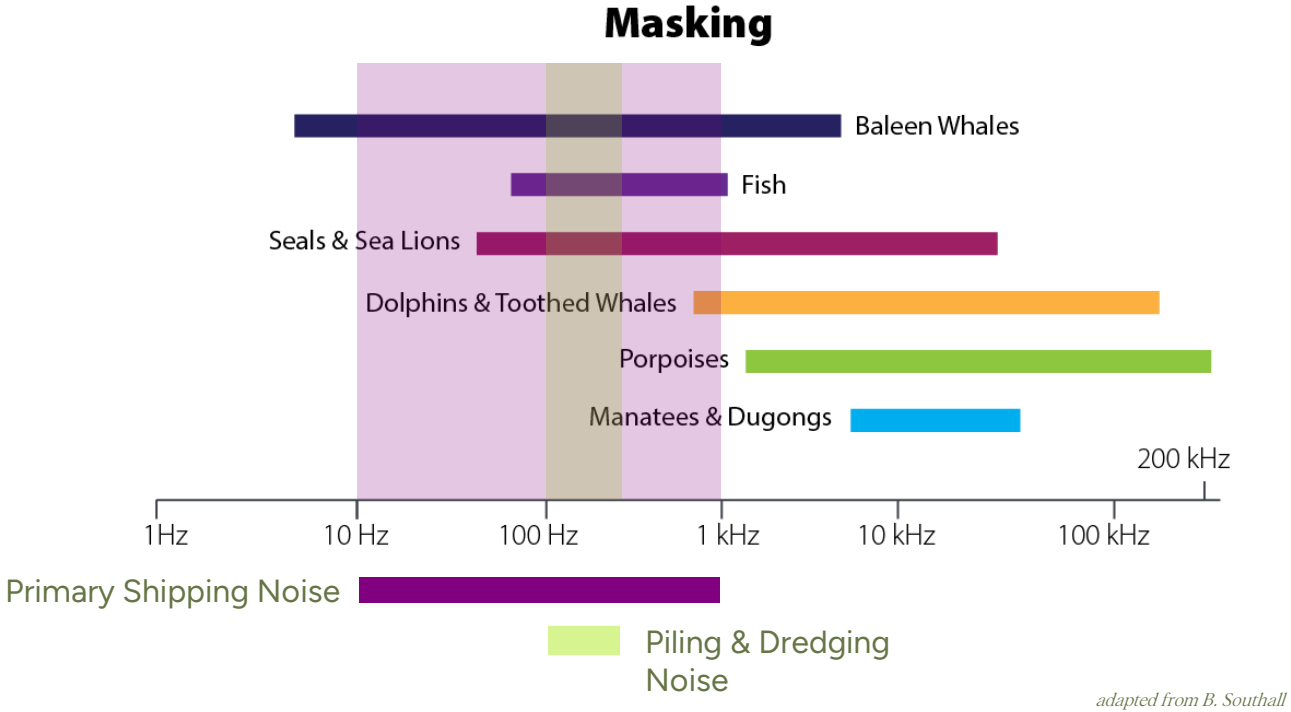


Trailing Suction Hopper Dredge (TSHD)



- Trailing suction hopper dredges (TSHD) are ships with propulsion and large hoppers for containing dredged material.
- Long intake pipes, termed drag arms, extend from the ship and drag along the bottom during dredging.
- Erosion, teeth and water jets loosen the material, and pumps are used to suck the material from the bottom into the hopper.

Masking Noise

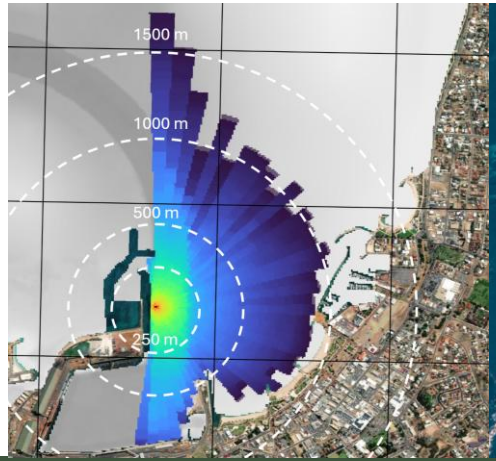


adapted from B. Southall

Validation & Compliance with Regulatory Authorities

To accurately assess the impact of high levels of anthropogenic noise on fish and marine mammals:

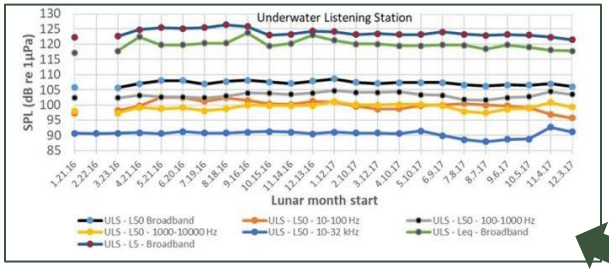
- Modeling (desktop)
  - Detailed modelling considers frequency and range dependent variables (e.g., bathymetry, sound speed profile, etc.) .
- Monitoring (baseline)
  - Real-time monitoring using hydrophones
  - Long-term recording using moored stations
  - Sound source verification
- Mitigation (measures)
  - Reduction of noise generated at the source
  - Reduction of noise propagated through the water
  - Exclusion zones



PROJECT PROFILE

Underwater Acoustics

Client:	Port of Seattle
Location:	Washington, USA



SLR has been selected to support the Port of Seattle Underwater Noise Assessment Program. SLR will collect, analyze, and report on acoustic data to establish a baseline for ambient underwater noise, assess the impact of various maritime activities, and develop noise reduction targets.

As part of this initiative, SLR is facilitating the Port of Seattle in addressing increased concern over underwater noise pollution and its impact on marine life, as well as promoting sustainable maritime operations, enhancing environmental stewardship, and ensuring compliance with environmental regulations.

Port of Seattle Underwater Acoustics Baseline Study is currently underway!

Our Clients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EVERETT


Port
OF
KALAMA


pct


TOTAL


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nationale
National
Defence


PORT of
ANCHORAGE


CONNECTICUT
Port Authority


KINDER MORGAN
INC.


Hilcorp


PORT of
vancouver


PORT OF
NANAIMO


CROSS SOUND FERRY
SINCE 1975


Weyerhaeuser


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VANCOUVER SHIPYARDS


Port
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HAMILTON
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THUNDER BAY


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Tacoma


Connecticut
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Making Sustainability Happen

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Q&A

Thanks