Underwater Sound

Council of BC Yacht Clubs - 13 September 2025

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The importance of sound

- There are several species of vertebrates that have evolved to live without sight (star nosed mole, cave fish, texas blind salamander, naked mole rat, olm)
- There are no vertebrate species without hearing

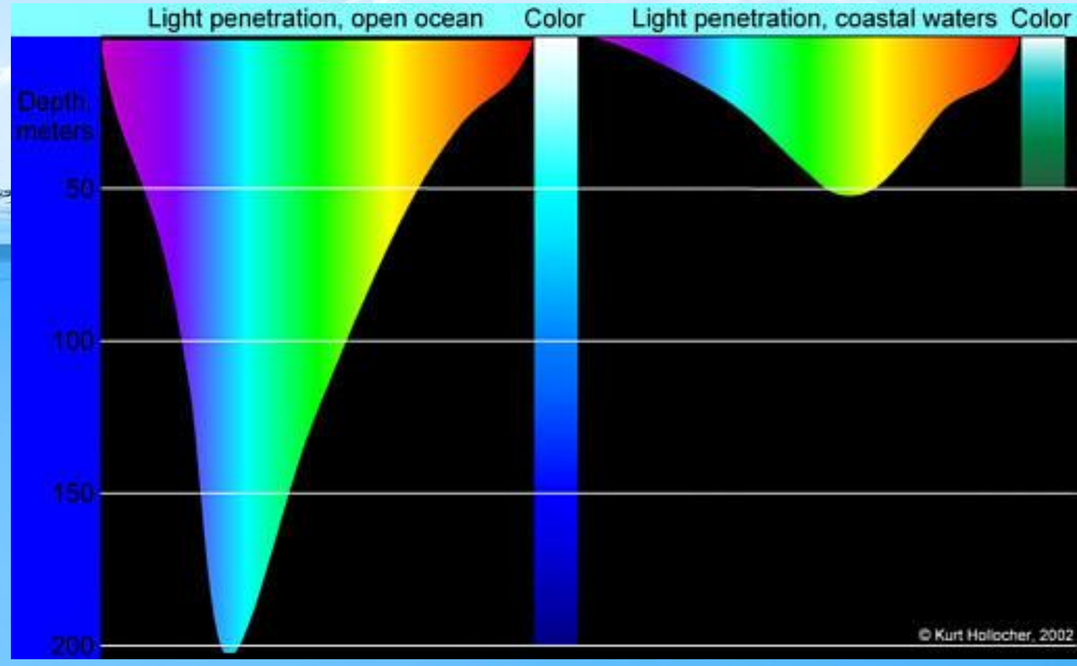
- It’s not just ears used for hearing:
  - Elephants have good ears but also very sensitive feet for listening to other elephants' low frequency sound.
  - Insects have tympana (like membrane microphones) that are exceptional.
  - Spiders have hairs on their legs.
  - Fish are especially gifted; they have both inner ears (otoliths) and lateral lines.
  - Marine invertebrates have sensory hairs, leg sensitivity, and statocysts.

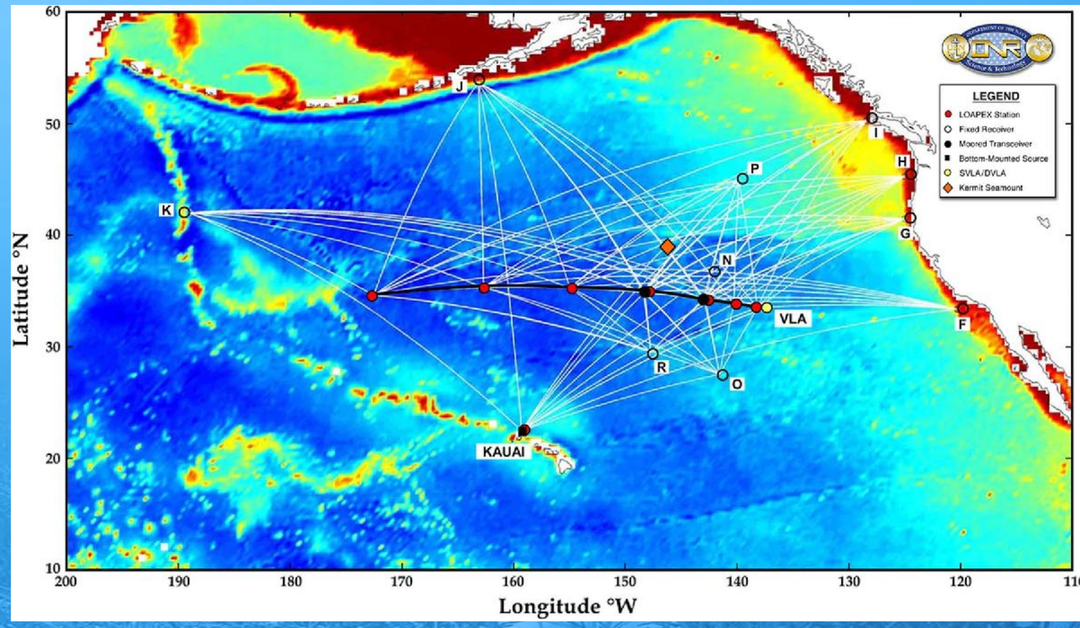
The importance of sound

Energy penetration in the ocean

- Radio, 0.002 km
- Light, 0.2 km
- Electric, 0.5 km
- Sound,10’s to 1000’s of km

Marine life has evolved to take advantage of sound.
For most, is their primary sense!



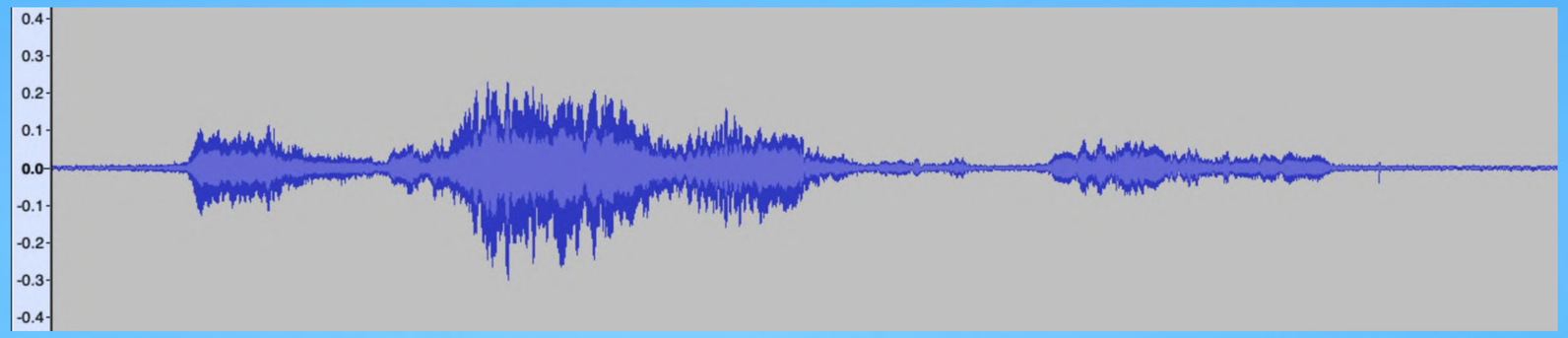


Long-range Ocean Acoustic Propagation Experiment
Mercer, Colosi, Howe, Dzieciuch, Stephen, Worcester, 2009, IEEE Journal of Oceanic Engineering

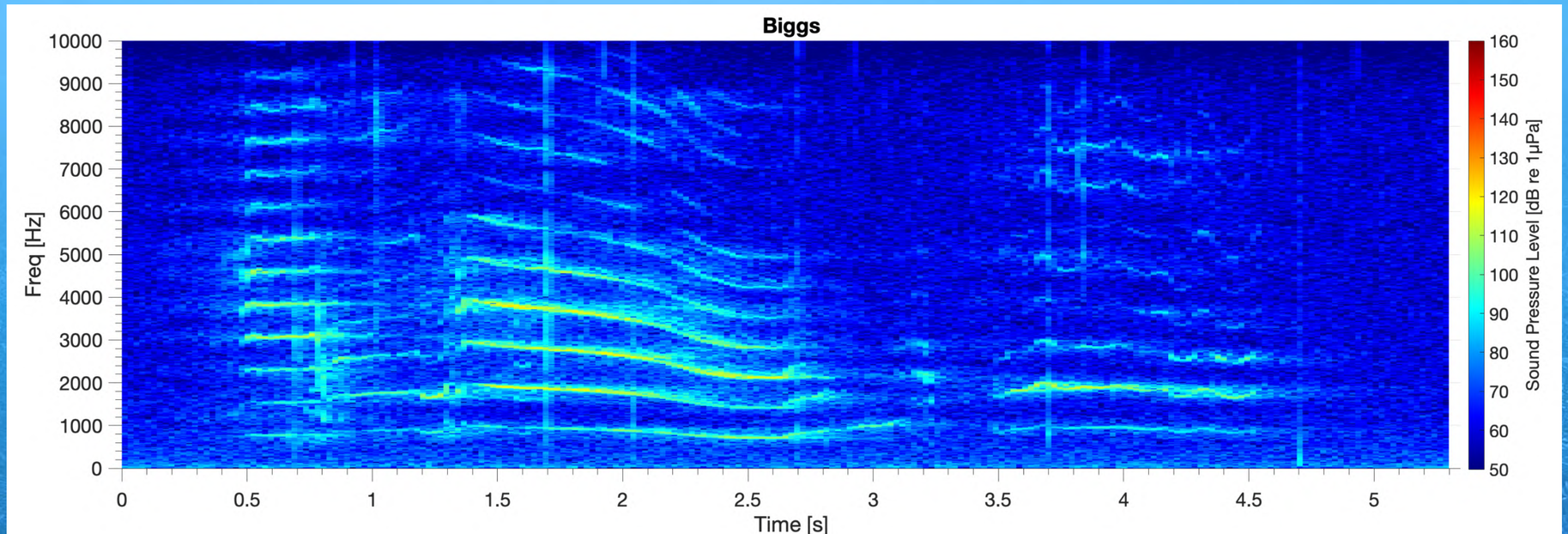
Spectrogram

- **Listening**

- **Looking at the waveform (time domain)**



- **Looking at the spectrogram (frequency domain)**



The importance of sound

Uses

- Communicate

The importance of sound

Uses

- Communicate
- Navigate

Passive: Listening

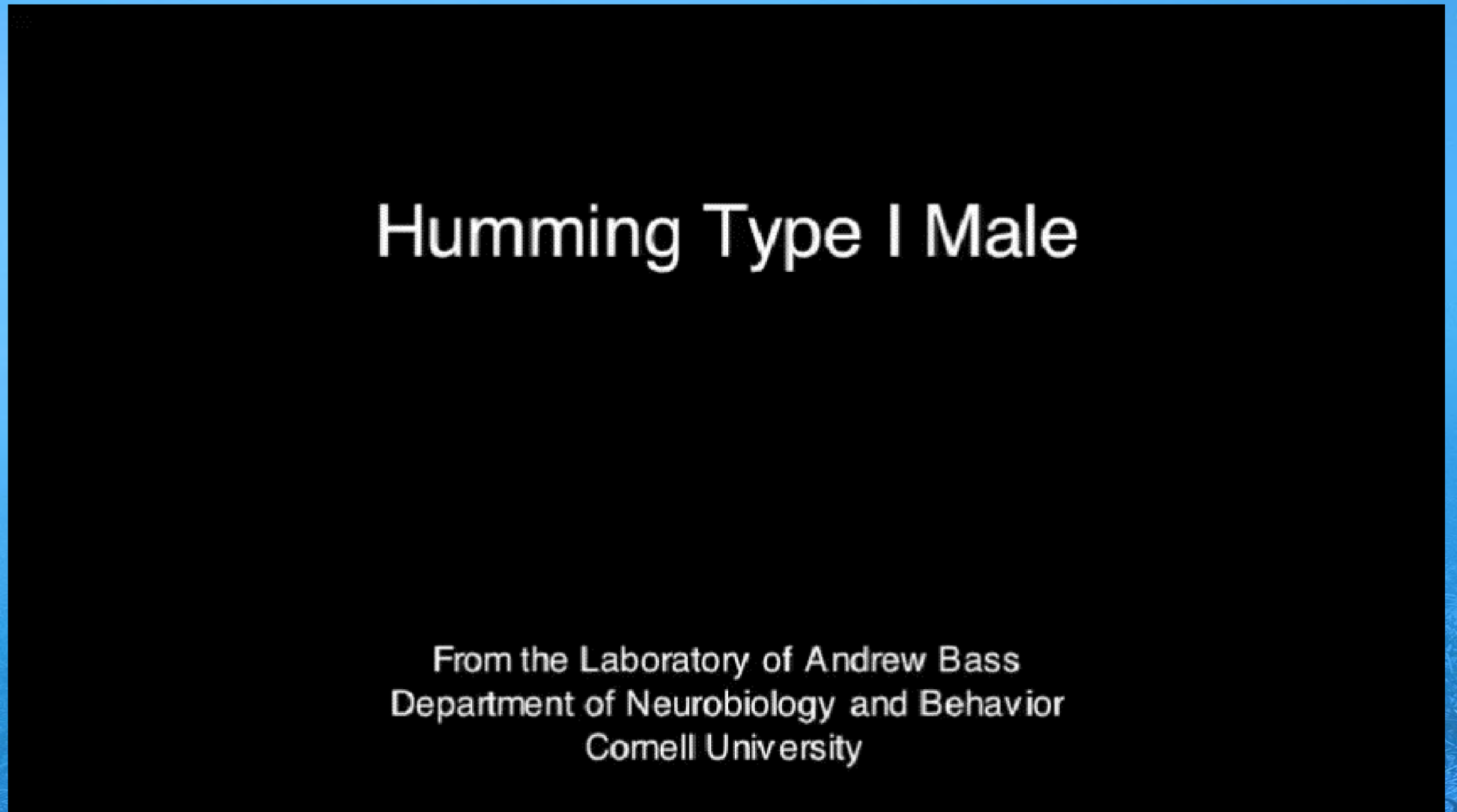
Active: Echolocation

The importance of sound

Uses

- Communicate
- Navigate
- Attract mates

Plainfin Midshipman



The importance of sound

Uses

- Communicate
- Navigate
- Attract mates
- Defend territory

Toadfish (Roaten)

The importance of sound

Uses

- Communicate
- Navigate
- Attract mates
- Defend territory
- Find food

Active: Echolocation

Passive: Listening

Sperm whale echo location

Pieter Folkens

The importance of sound

Uses

- Communicate
- Navigate
- Attract mates
- Defend territory
- Find food
- Stun prey (shrimp)

BBC slow motion video of pistol shrimp bubble formation

The importance of sound

Uses

- Communicate
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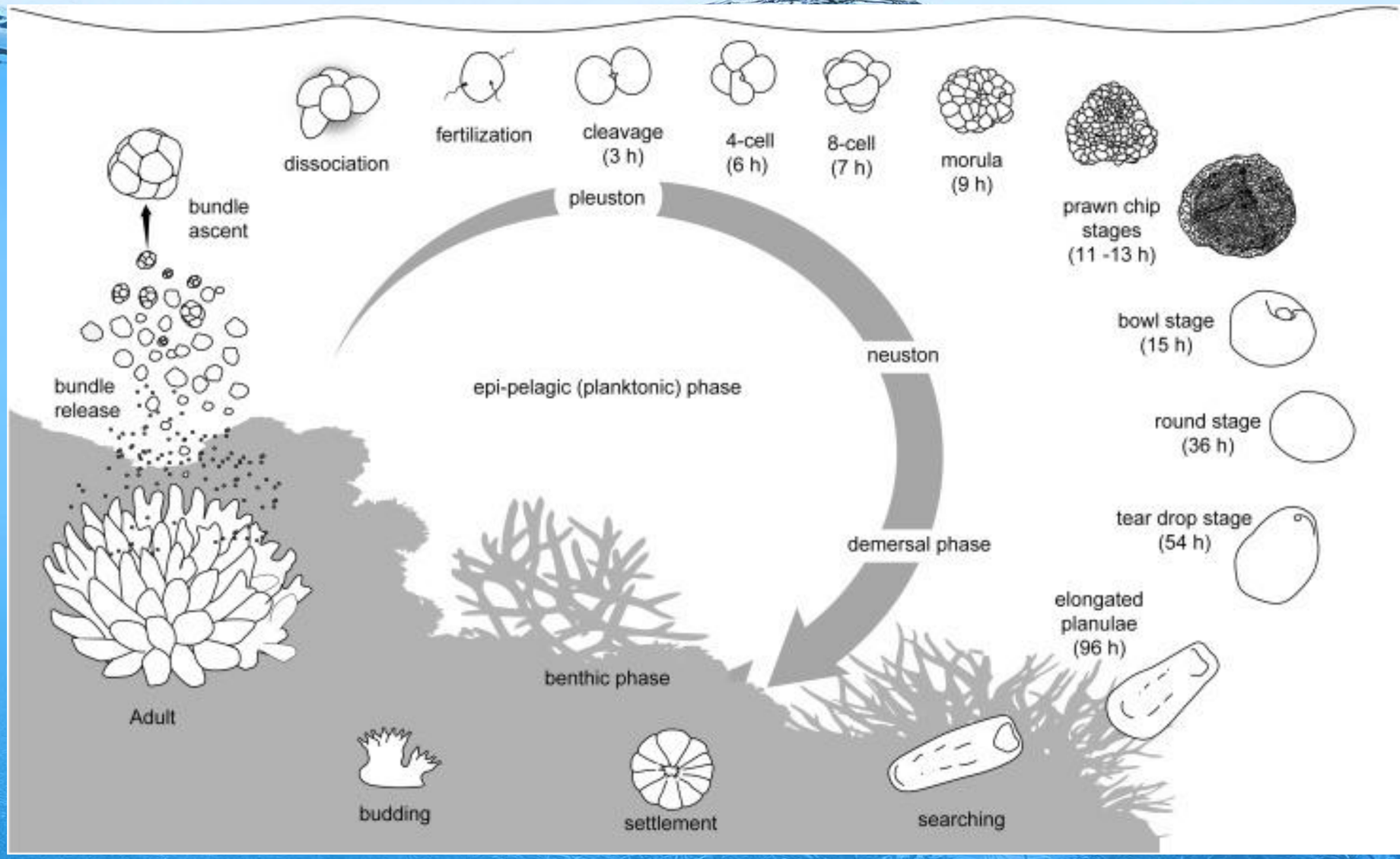
- Defend territory
- Find food
- Stun prey
- Find places to live (coral reefs)



Jones, Ricardo and Negri, 2015, Effects of sediments on the reproductive cycle of corals, Marine Pollution Bulletin Volume 100, Issue 1, 15 November 2015, Pages 13-33

The importance of sound

Uses

- Communicate
- Navigate
- Attract mates
- Defend territory
- Find food
- Stun prey
- Find places to live
- Advertise (cleaner shrimp)

The importance of sound

Uses

- Communicate
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- Attract mates
- Defend territory
- Find food
- Stun prey
- Find places to live
- Advertise
- **Warnings!**

Local Examples

Uses

- Communicate
- Navigate
- Attract mates
- Defend territory
- Find food
- Stun prey
- Find places to live
- Advertise
- Warnings!

Pacific white sided dolphin

Local Examples

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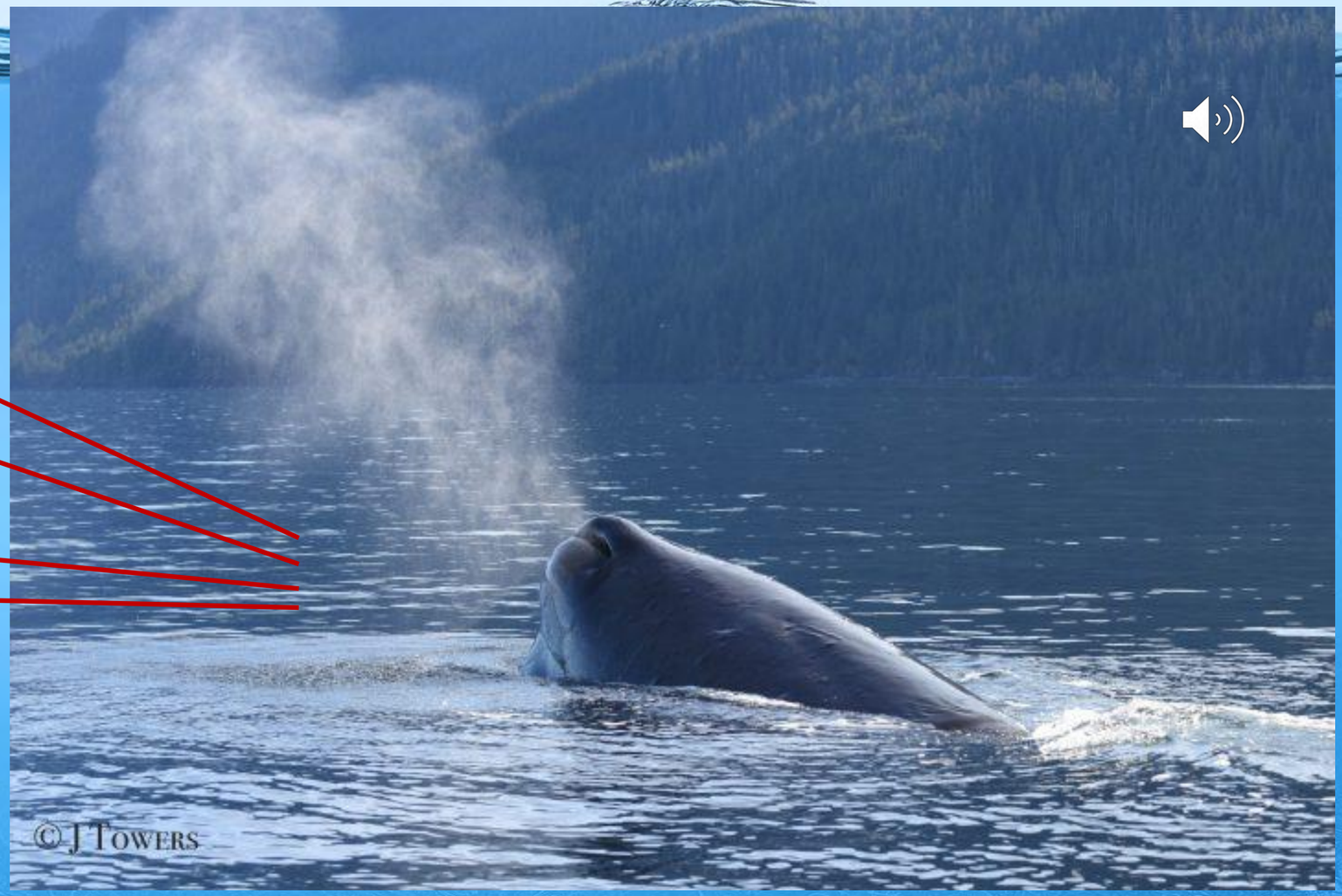
- Warnings!



Sperm whale (Yukusam) in Johnstone strait

Local Examples

Humpback whales

Uses

- Communicate
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- Stun prey
- Find places to live
- Advertise
- Warnings!

Local Examples

Uses

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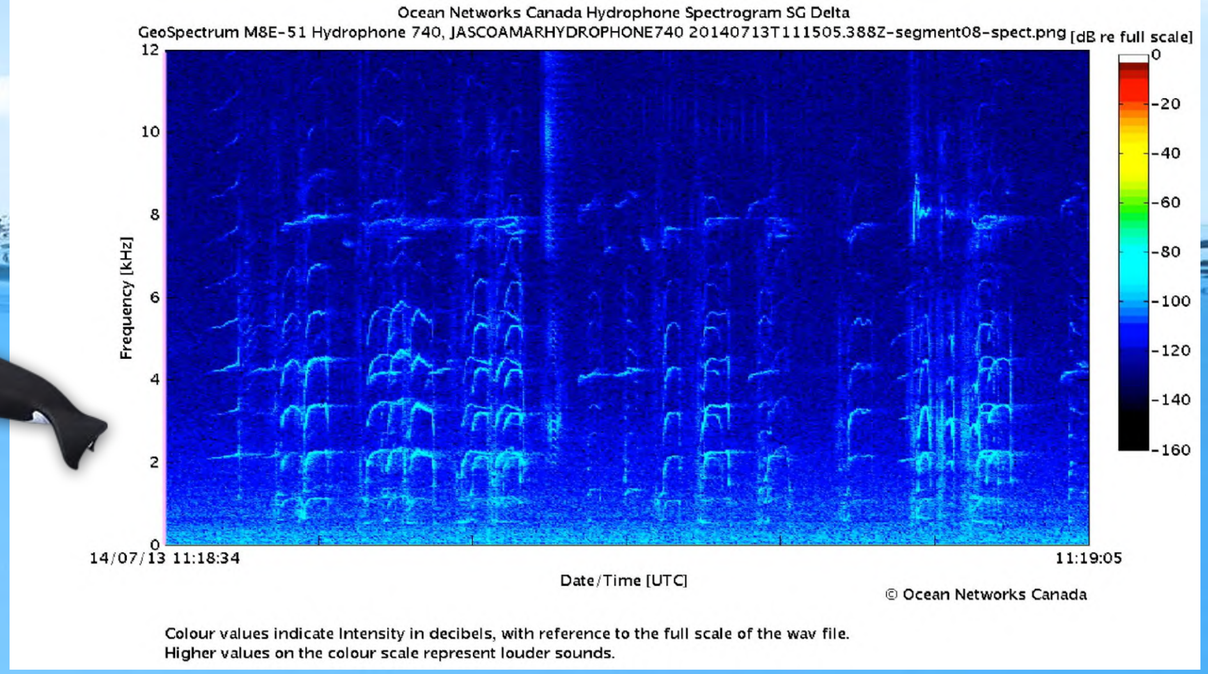


Resident Orca

Local Examples

Sealions

Uses

- Communicate
- Navigate
- Attract mates
- Defend territory
- Find food
- Stun prey
- Find places to live
- Advertise
- Warnings!

Harbour porpoise

Biggs orca (transients)

Environmental Noise Sources

- Wind, wave and surf
- Earthquakes
- Flow noise from currents
- Rain and Snow
- Methane bubbles from the seafloor

Human sound in the sea

Industry

Navigation

- Navigation sonars (submarines, autonomous & remotely operated vehicles)
- Echo sounders (to measure water depth)
- Multibeam sonars (map the ocean bottom for charts)
- Speed logs (vessel speed through the water)

Finding objects

- Side scan sonars (shipwrecks)

Fishing

- Fish finders (detection, depth, numbers, type)

Communications

- Underwater telephone (voice)
- Acoustic modems (transmitting data)

National defense

- Sonar (finding vessels and mines)
- Hydrophones (finding submarines, nuclear testing, divers) and the Identifying vessels

Resource exploration

- Seismic surveys (oil, gas, gas hydrates, minerals and metals)

Research

Marine animal research

- Hydrophones (marine animal distribution, abundance and tracking)
- Zooplankton and fish profilers (estimate abundance and type)

Weather

- Hydrophones (rainfall, wind)
- Ice profilers (ice thickness)

Ocean physics

- Acoustic thermometry (measure temperature in the ocean)
- Acoustic tomography (currents, temperature profiles, climate change)
- Current meters (currents and current profiles)

Geophysics

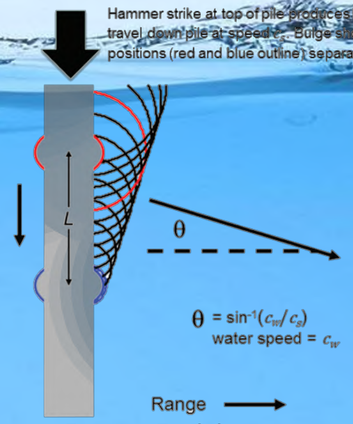
- Seismic surveys (Earth's geologic makeup & history)
- Passive acoustics (earthquakes, volcanic eruptions)

Vessel noise

- Hydrophones (vessel radiated noise levels)

Human Unintentional Sound

- Construction
  - Pile driving
  - Dredging

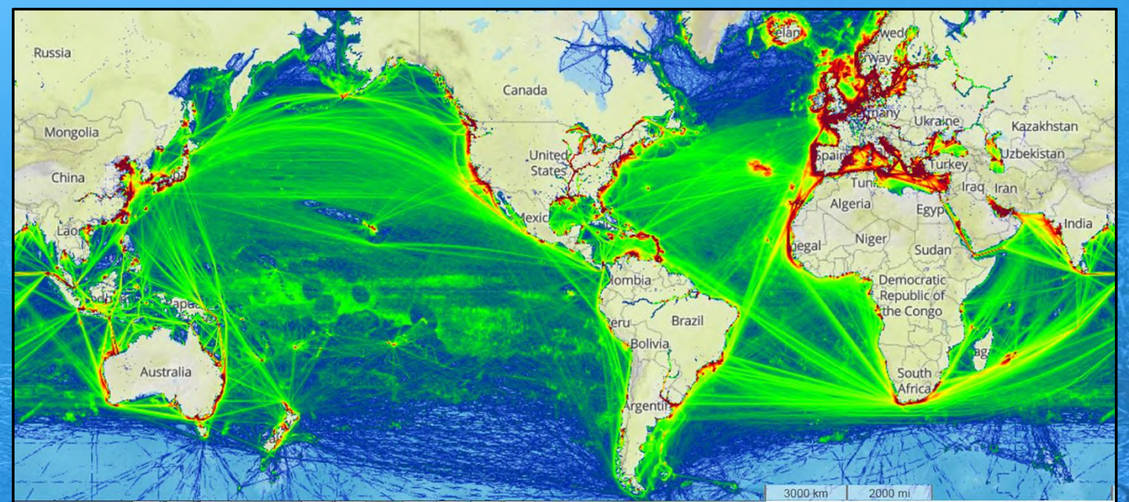


Peter Dahl

- Recreational boating
  - Motors
  - Cavitation
  - Echosounders
  - Fishfinders

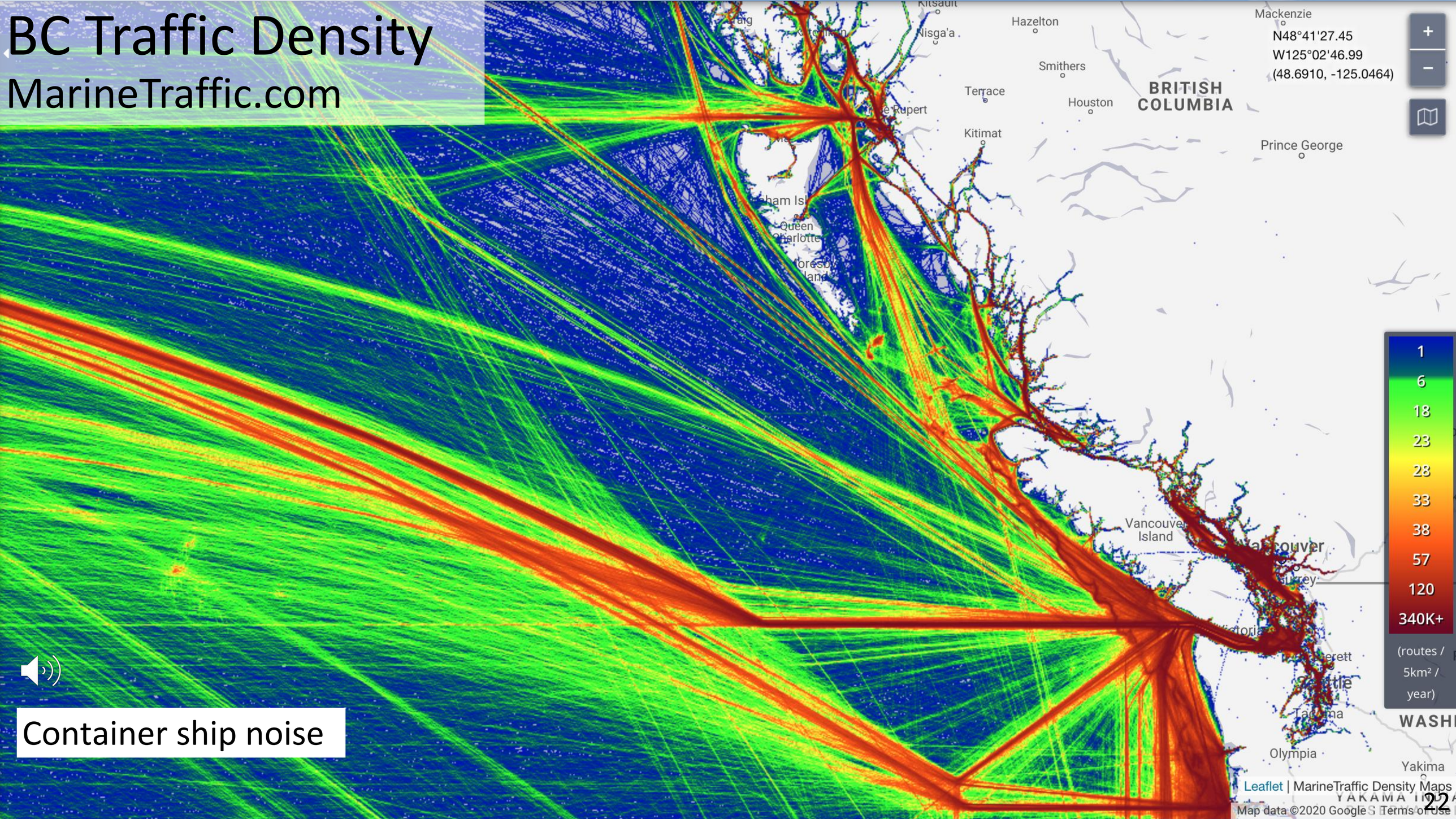
- Shipping noise

MarineTraffic.com



BC Traffic Density

MarineTraffic.com



Container ship noise

Cavitation

- If the propeller turns fast enough the low pressure areas of the propeller can drop below the vapour pressure and the seawater can ‘boil’ at ambient temperature.
- When the bubbles reach ambient pressure behind the propeller they implode.

Mecholic

Masking

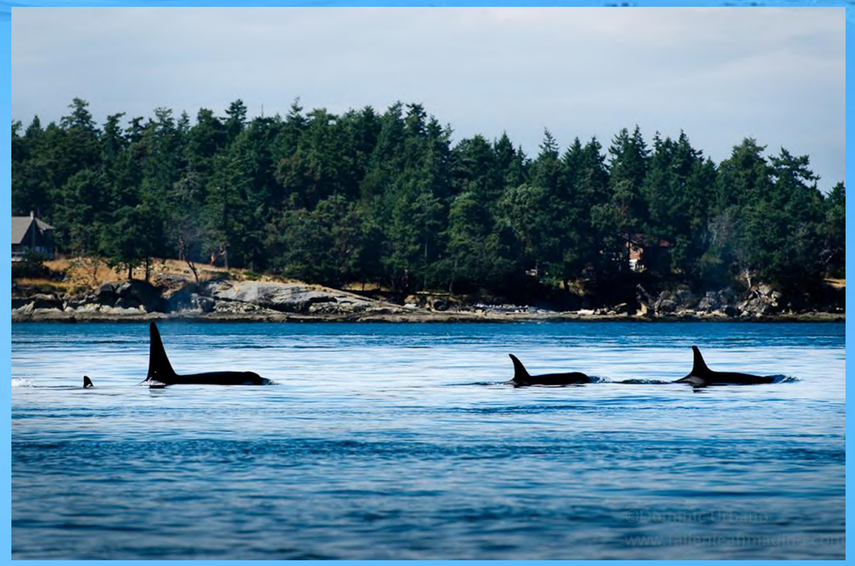
Container ship: 2 km

Cetacean: 1 km

Masking

Container ship: 2 km
Cetacean: 1 km

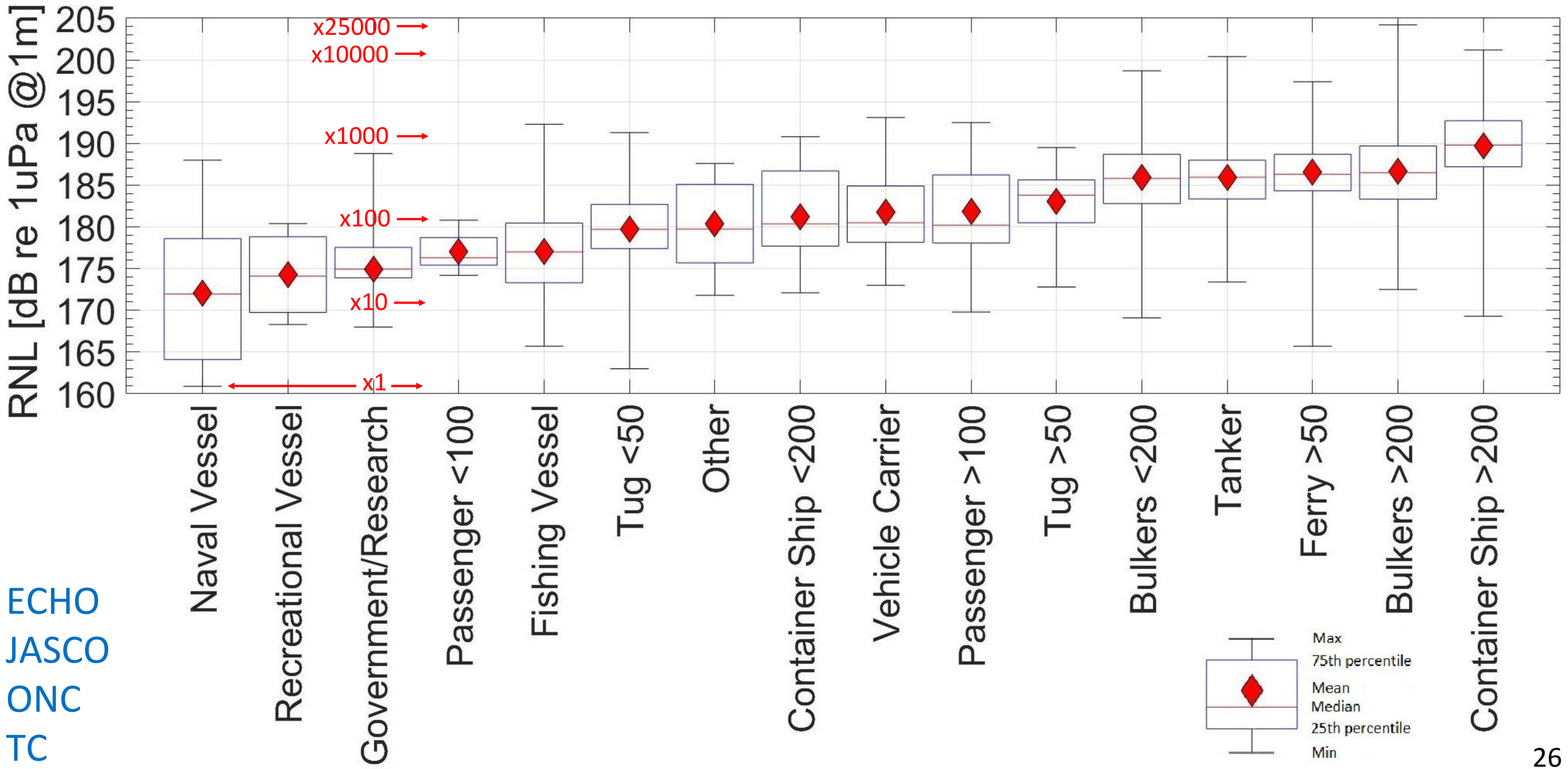
Raw



Filtered

Southern Resident Killer Whales – J pod

Vessel Noise By Class 5000 vessel measurements



ECHO
JASCO
ONC
TC

Thanks!

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