

Including Underwater Sound in Arctic and Subarctic IEAs

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Management in the Arctic
Bergen, Norway**

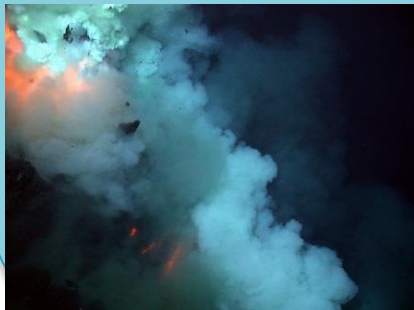
Outline



- ▶ Ocean Soundscapes
- ▶ Long-term recorders in Arctic and Subarctic Seas
- ▶ Anthropogenic Noise: Impacts to Subsistence Hunting; Arctic Shipping
- ▶ Including Sound in IEAs: NOAA Ocean Noise Strategy, Ocean Observing Systems (IOOS, GOOS)

Ocean Soundscapes

Natural - Physical



Earthquakes, Storms, Ice, Volcanoes

Natural - Biological



Invertebrates, Fishes, Mammals

Ocean Soundscapes

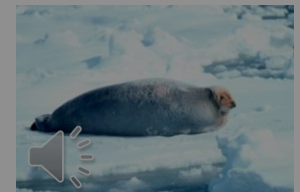
Natural



Man-made sounds



Biological



Shipping, sonars, seismic surveys, offshore energy development



Sound is Critical to Marine Animals

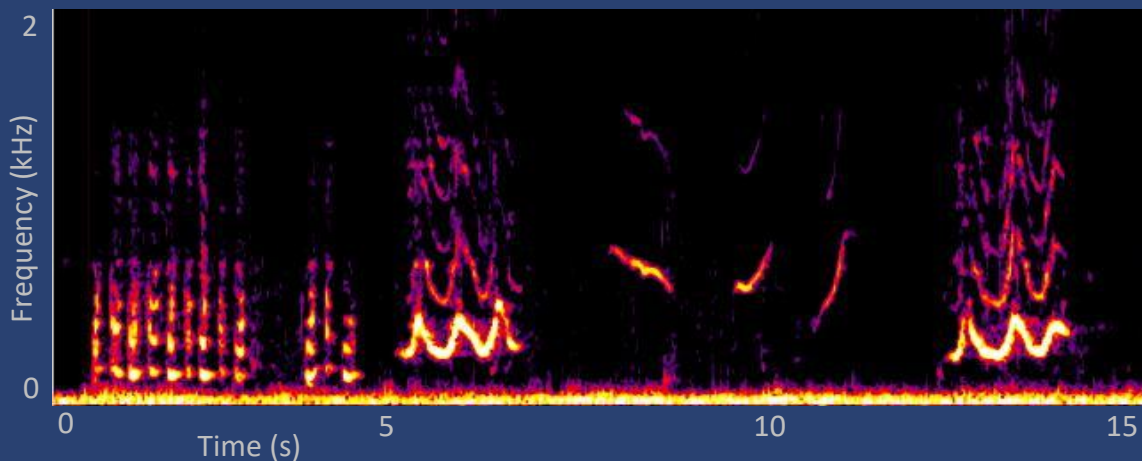
Why?

- Sound travels 4X faster in water than air, so is the most efficient means to communicate underwater
- Hearing is critical to gathering information underwater over a range of distances



Sound is used to:

- Locate mates
- Find food
- Maintain group structure
- Avoid predators
- Navigate



Anthropogenic Noise (unwanted Sound)

Currently:

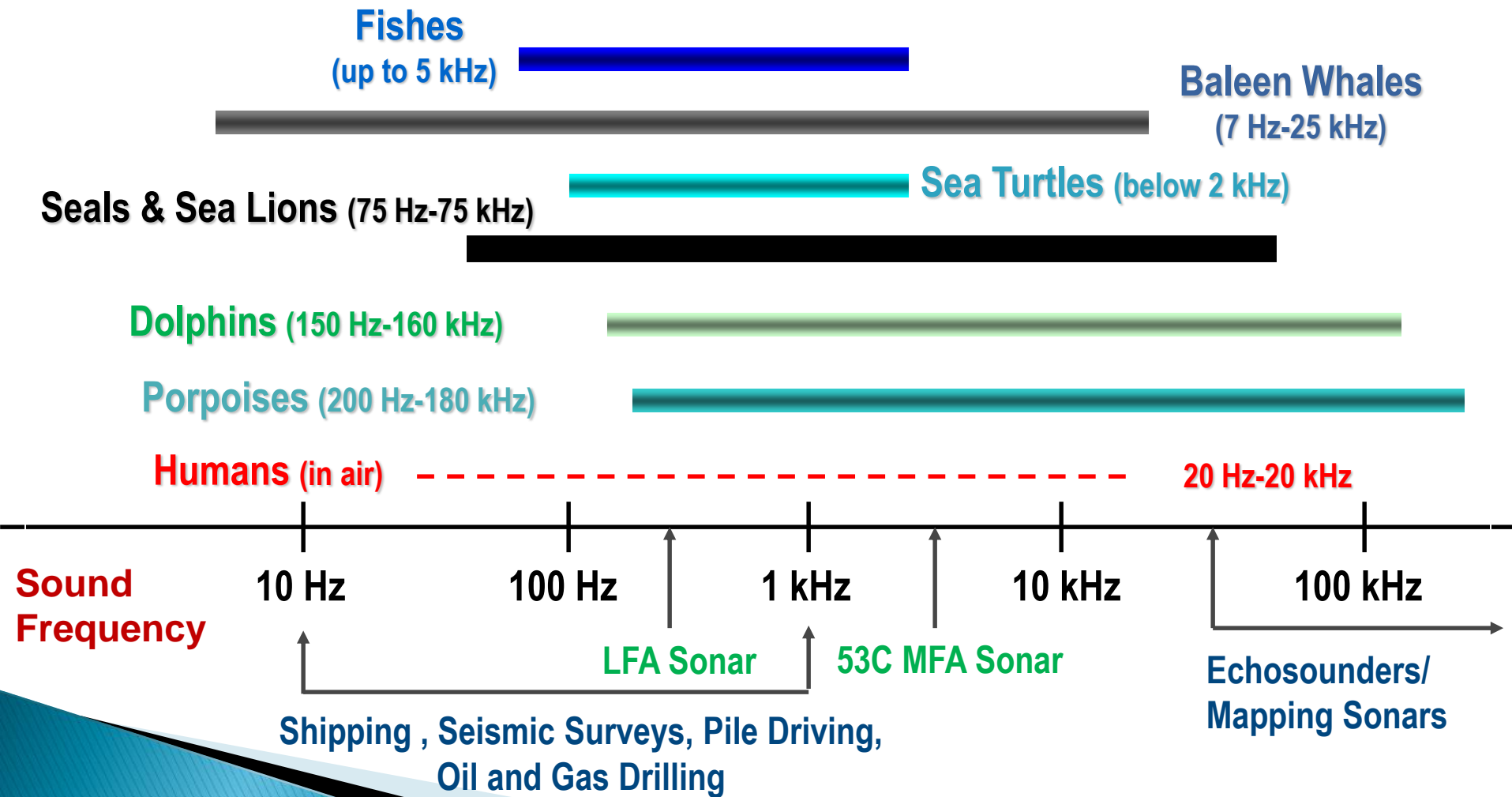
- **Ocean noise is a growing global problem for marine ecosystems**
- Increasing human activities in Arctic seas = a noisier environment
- Anthropogenic noise impacts Arctic subsistence activities



Environmental Impact:

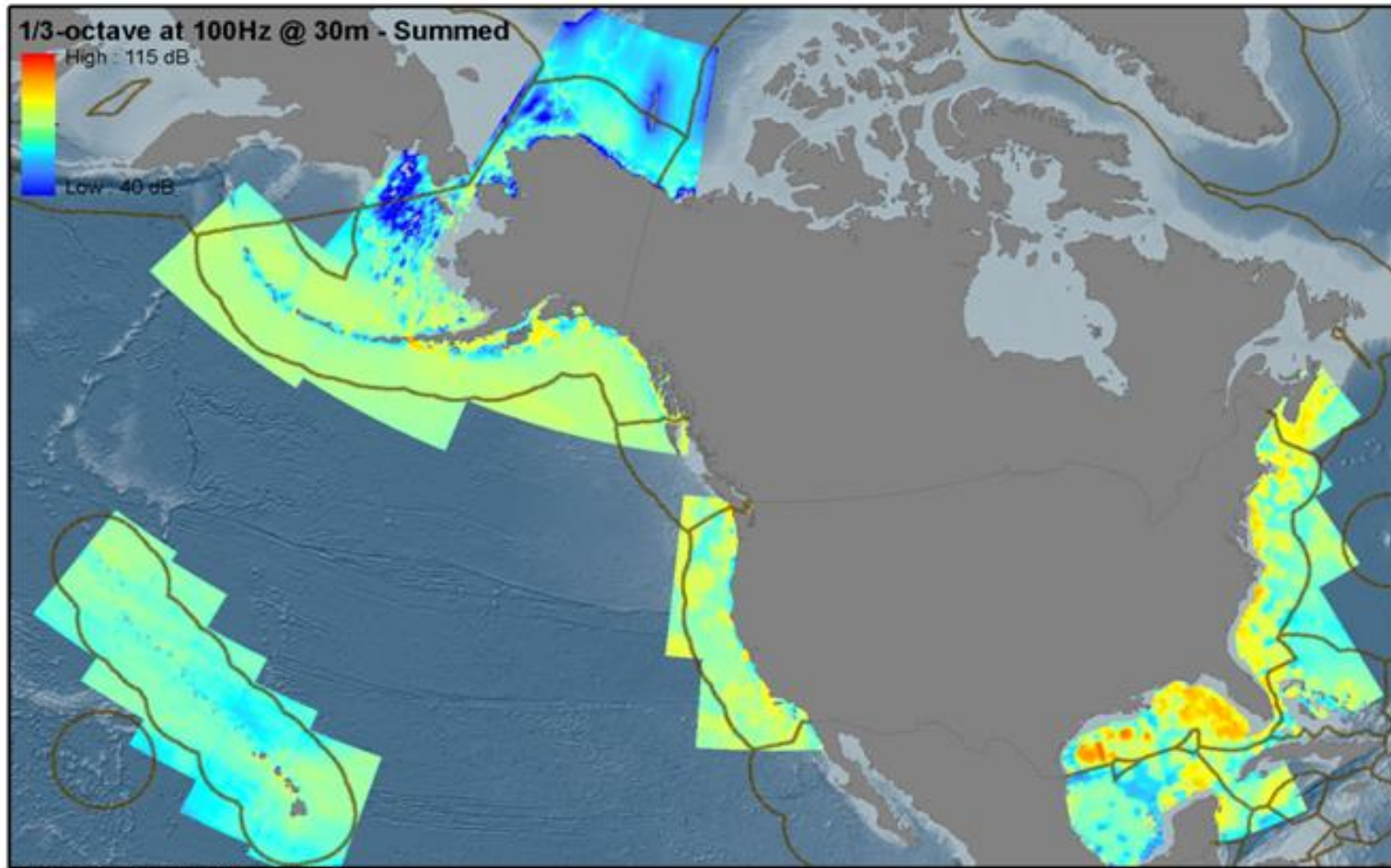
- **Acute:** Intense noise events can have adverse physical and behavioral impacts that affect health and fitness
- **Chronic:** Rising background noise limits marine animals' communication range and ability to sense their environment

Noise Impacts Linked to Species' Hearing Range



Soundscape Mapping: “Quiet” Arctic

<http://cetsound.noaa.gov/ons>



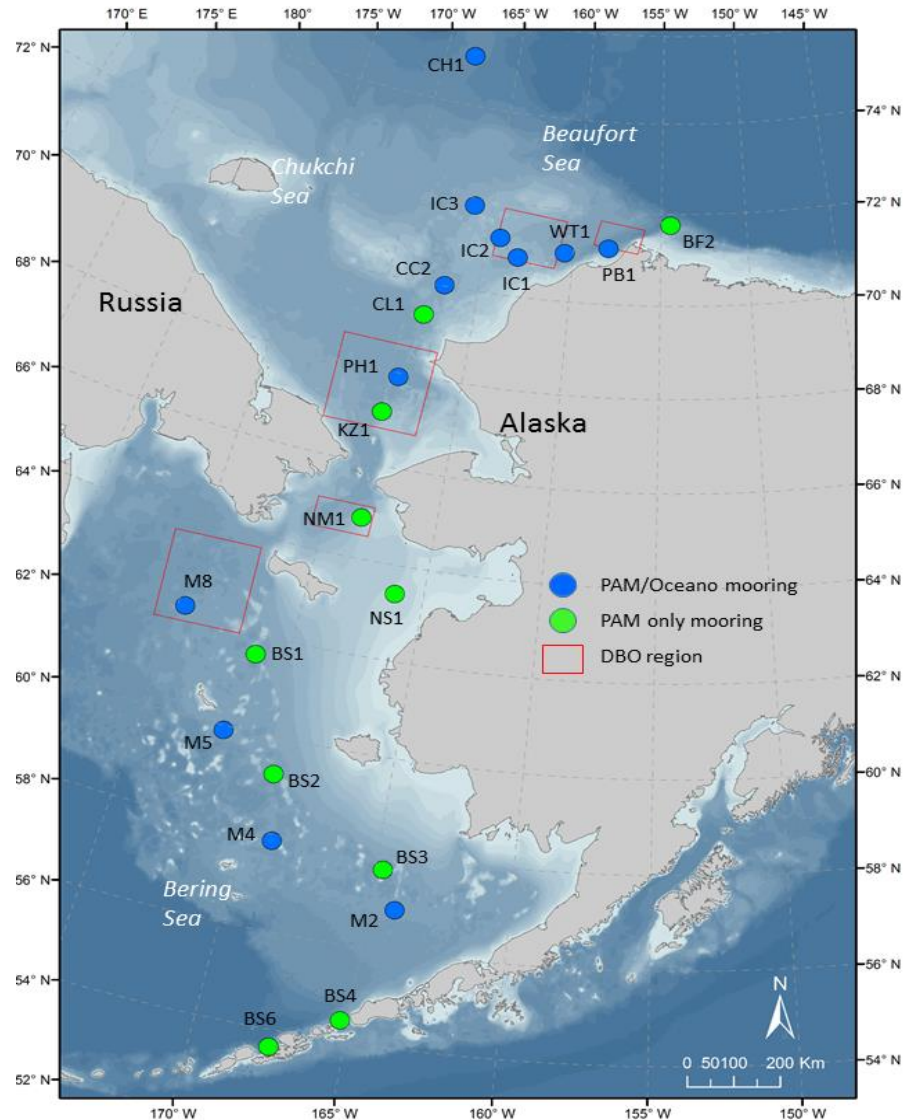
*Arctic is getting **NOISER** with sea ice loss, increased storminess & anthropogenic noise

Long-Term Recorders

Recorders in the Bering and Beaufort Sea since 2007; in the Chukchi Sea since 2010.

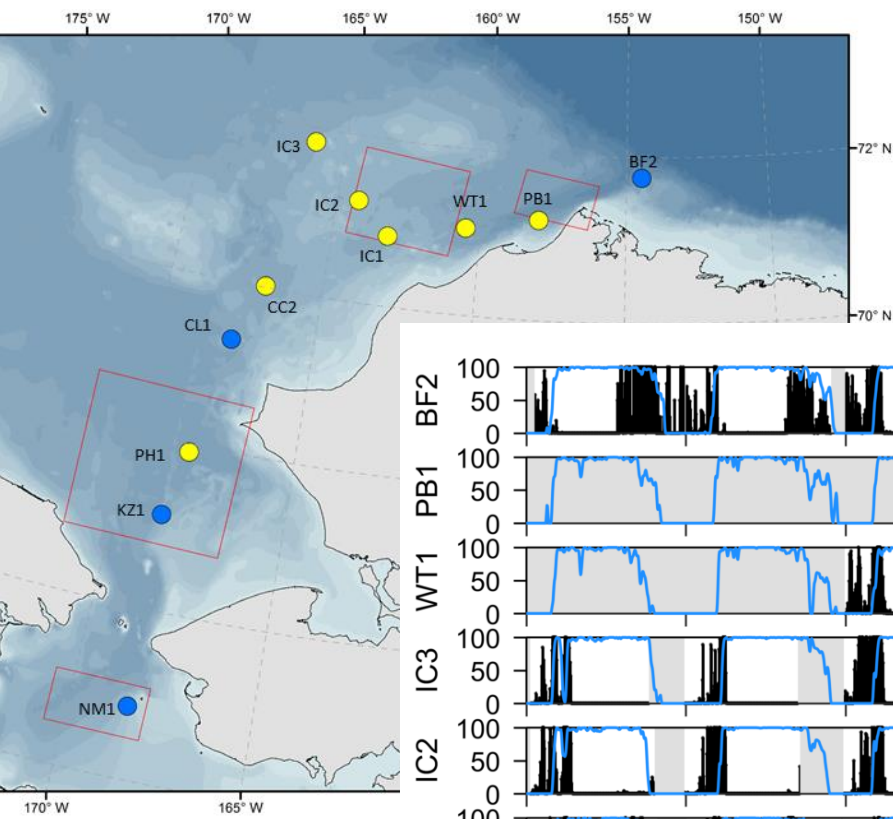
Several co-located with bio-oceanographic moorings.

Recorders also in Davis Strait, Fram Strait, and Canadian Arctic

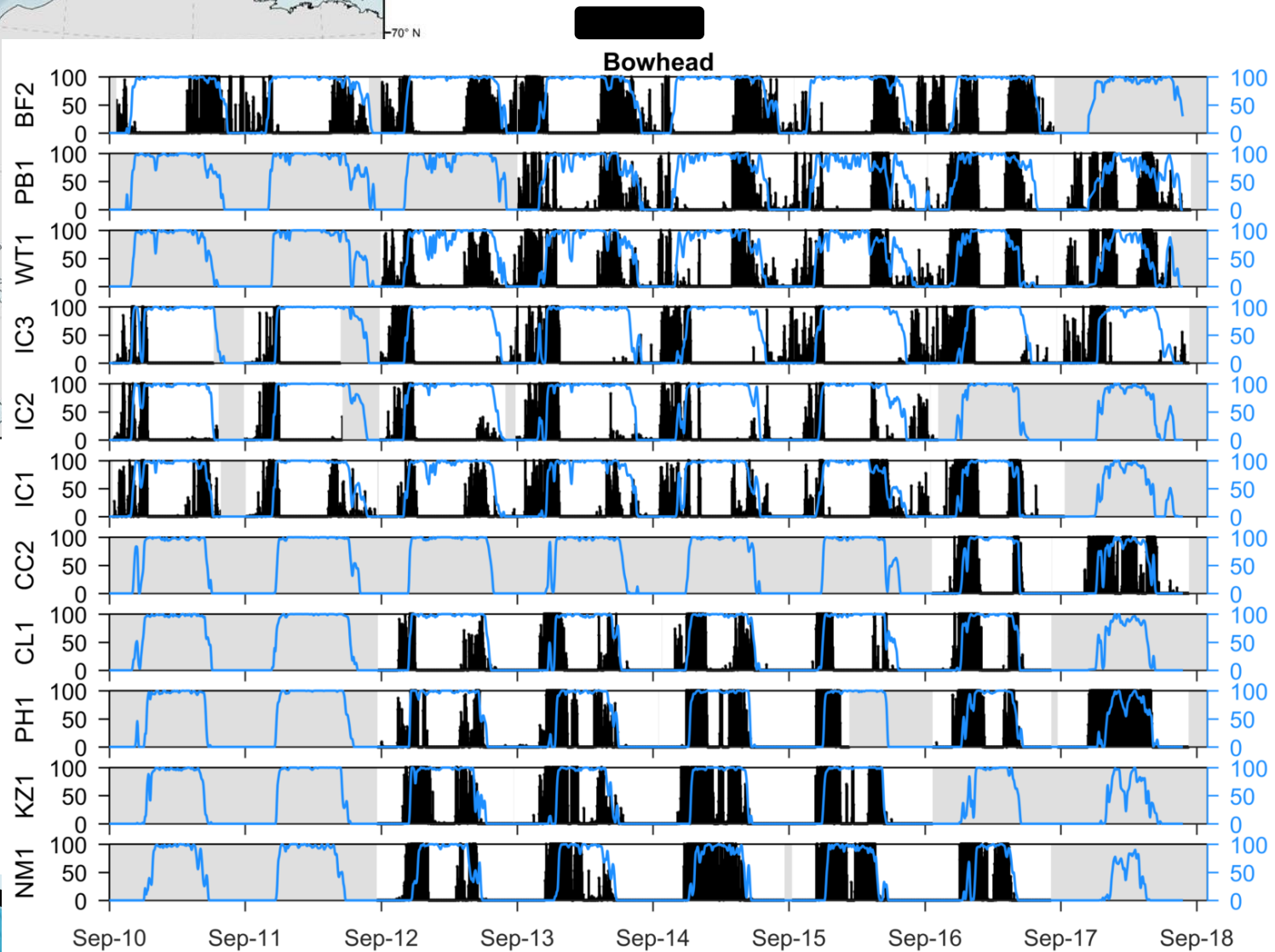


EXAMPLE: NOAA Moorings
Courtesy: C. Berchok, MML

Chukchi Sea: Bowhead whale calls

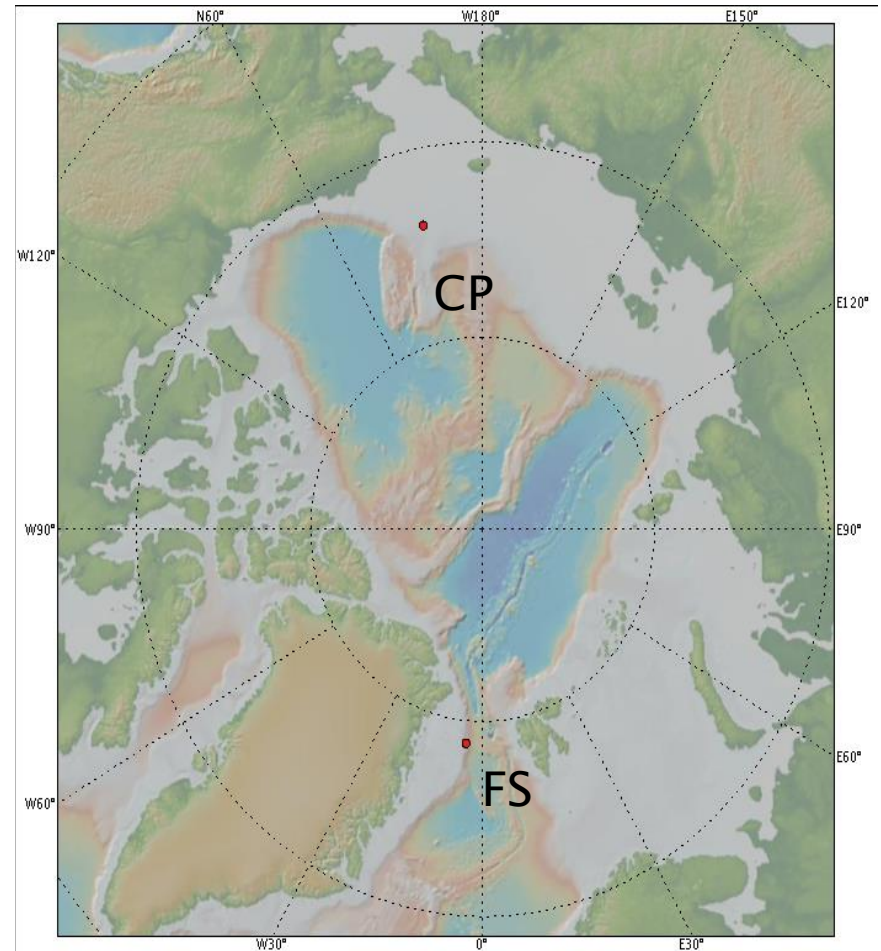
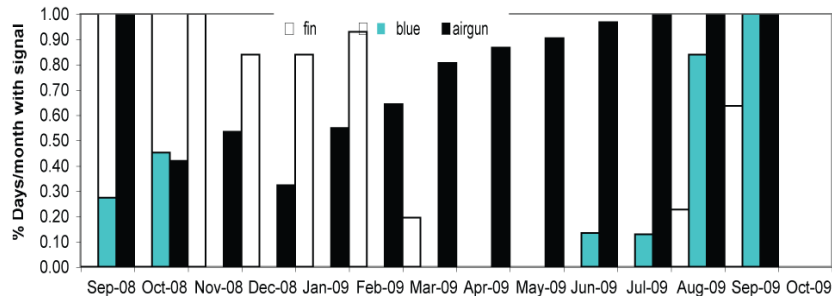
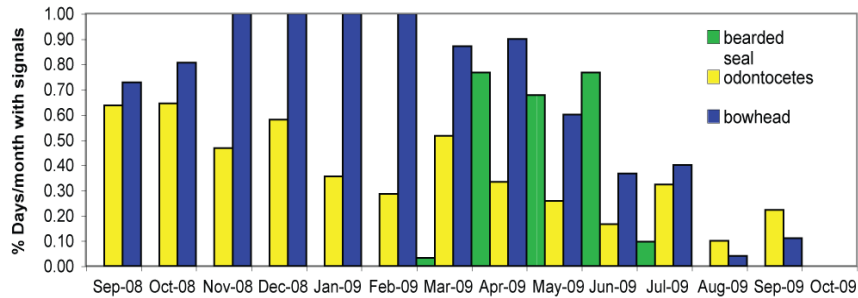
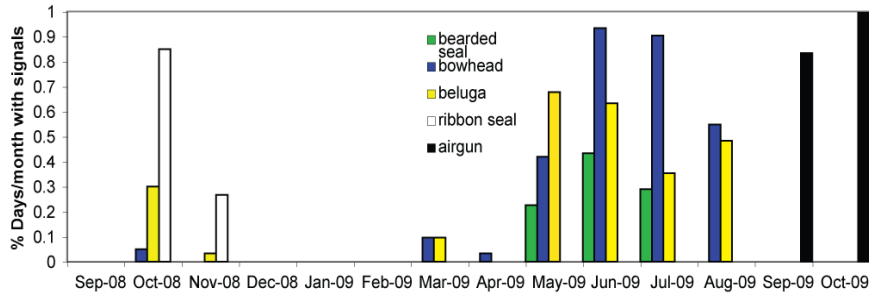


**Broadscale
Time Series**
courtesy:
C. Berchok,
NOAA/MML



Arctic: International Deployments

Chukchi Plateau (CP) and Fram Strait (FS)



Species detected

(re. CAFF/CBMP)

Chukchi Plateau

Bowhead (simple calls)

Beluga

Bearded seals

Ribbon seals

+ Seasonal Airguns



Fram Strait

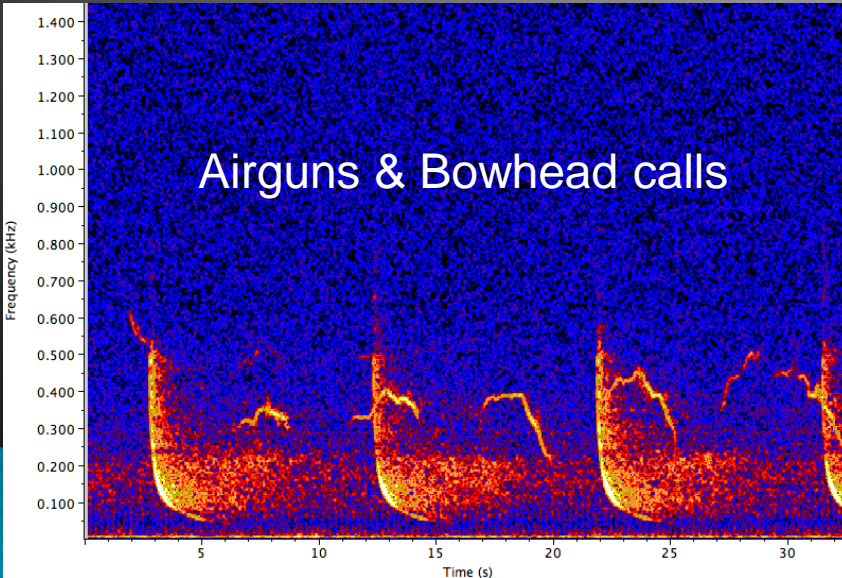
- ▶ Bowhead (calls & song)
- ▶ Beluga
- ▶ Bearded seals
- ▶ Narwhal
- ▶ Blue whales
- ▶ Fin whales
- ▶ Unid. Odontocete
- ▶ + Year-round Airguns



Expanding Anthropogenic Footprint

Shipping, Tourism O&G Development

- > Ship Strikes
- > Increased Underwater Noise
- > Exposure to Contaminants
- > New Vectors for Disease



Anthropogenic Noise

Impact to Subsistence Hunting

- ▶ Noise from oil & gas seismic surveys and ships = **primary concern**
- ▶ Impacts to bowhead whale hunting– **primary focus** (since late 1970s)
- ▶ Bowhead whale harvest co-managed by NOAA & AEWC, under international authority of the IWC



PAME WG: Arctic Marine Shipping Assessment (AMSA, 2009 + biannual updates)

- ▶ **THEME I – Enhancing Marine Safety**

- ▶ **THEME II — Protecting Arctic People and the Environment**
- ▶ (A). Survey of Arctic Indigenous Marine Use
- ▶ (B). **Engagement with Arctic Communities**
- ▶ (C). Areas of Heightened Ecological and Cultural Significance
- ▶ (D). Specially Designated Arctic Marine Areas
- ▶ (E). Protection from Invasive Species
- ▶ (F). Oil Spill Prevention
- ▶ (G). **Addressing Impacts on Marine Mammals**
- ▶ (H). Reducing Air Emissions

- ▶ **Theme III – Building Arctic Marine Infrastructure**

Including Sound in IEAs

links to existing & developing tools

- ▶ NOAA Ocean Noise Strategy

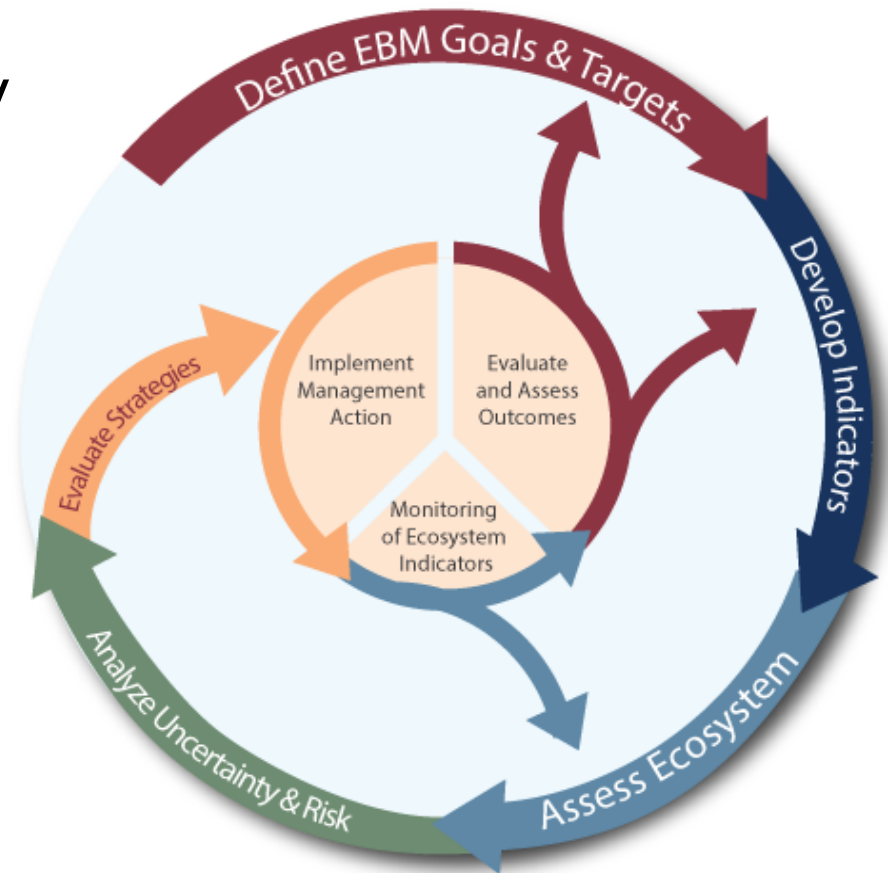
<http://cetsound.noaa.gov/ons>

- ▶ US IOOS – Regional Ocean Observatories = Alaska

OOS <http://aoots.org>

- ▶ GOOS – Global Ocean Observing System

<http://goosocean.org/>

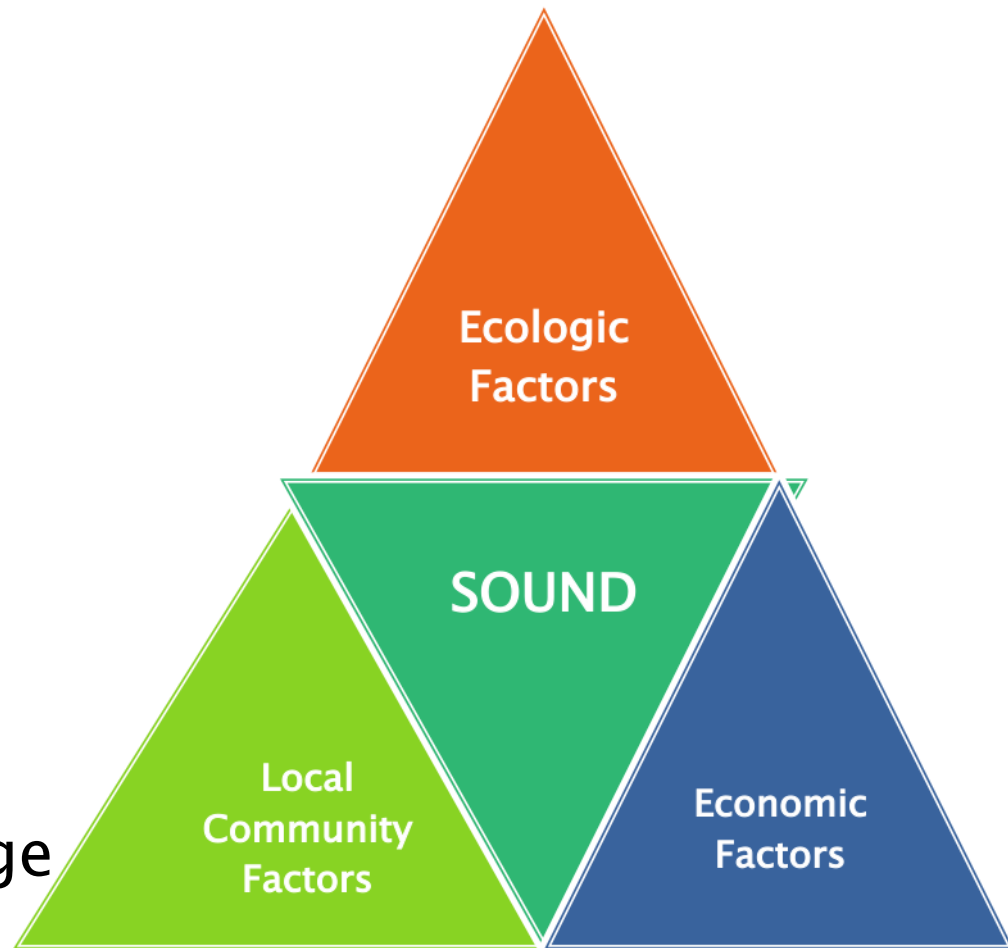


NOAA's IEA Cycle

Including Sound in IEAs

connects three key environmental factors

- ▶ Ecologic – abiotic and biologic ecosystem variability
- ▶ Economic – shipping, resource extraction, tourism
- ▶ Local Community – food security & Inuit Knowledge



It's time to include **SOUND** in the IEA cycle