State of Knowledge Report on Underwater Noise in the Arctic

Co-Leads: Canada, WWF, OSPAR Commission

OBJECTIVE: To bring together a baseline understanding of the current state of knowledge on the issue of anthropogenic underwater noise in the Arctic, and identification of knowledge gaps.

Scope of the literature review

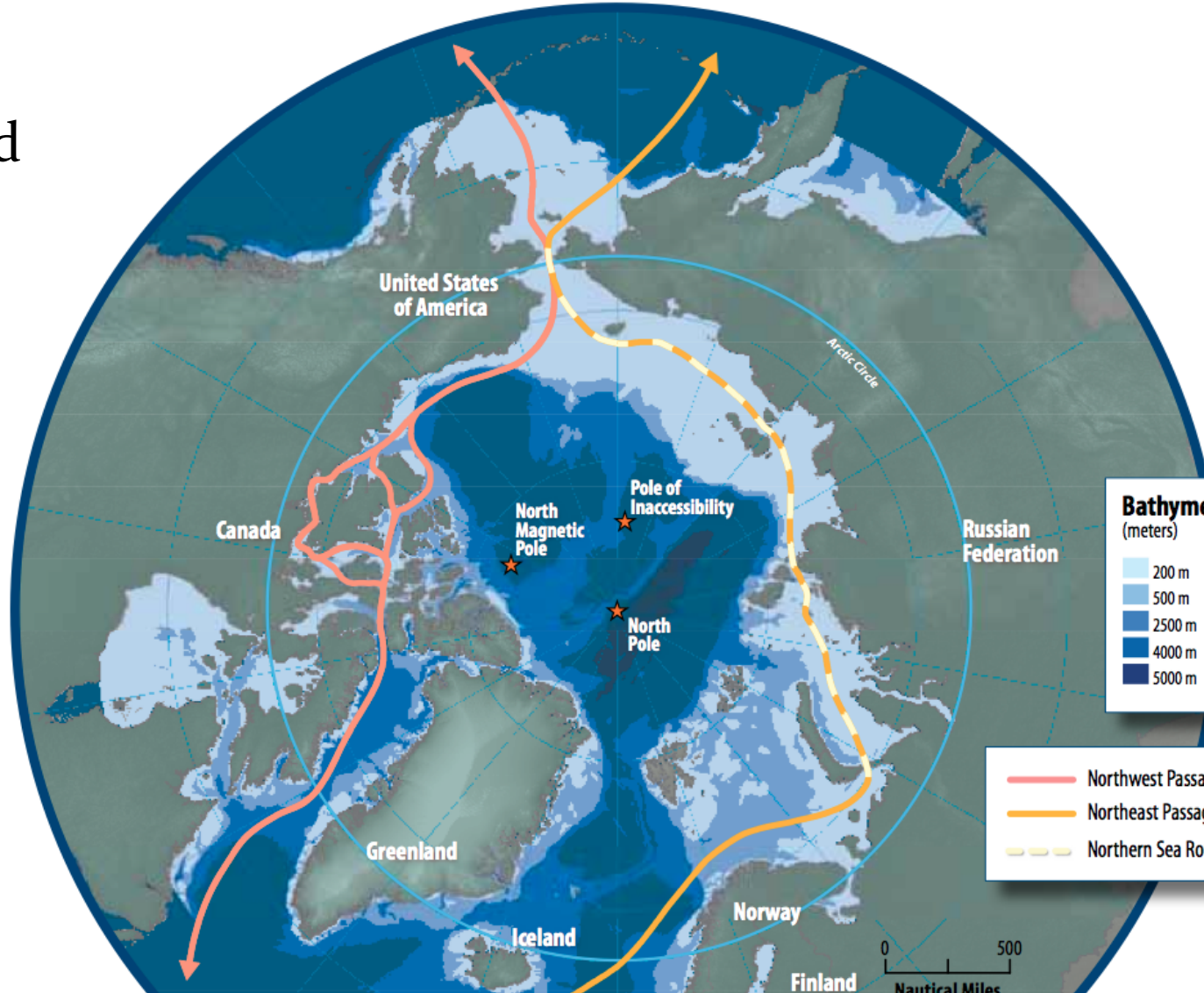
- Arctic defined as north of the Arctic Circle, adjacent seas if relevant to Arctic animals (AMSA boundary)
- Literature found through scholarly search engines and provided by PAME members
- English literature only

Structure of the Report

- General overview of the issue- underwater noise in the Arctic region
- Arctic Ocean ambient sound levels
- Arctic underwater noise created by anthropogenic activities
- Impacts of underwater noise on:
  - Marine mammals
  - Marine fish
  - Invertebrates
- Summary of Findings
- A special case for underwater noise in the Arctic

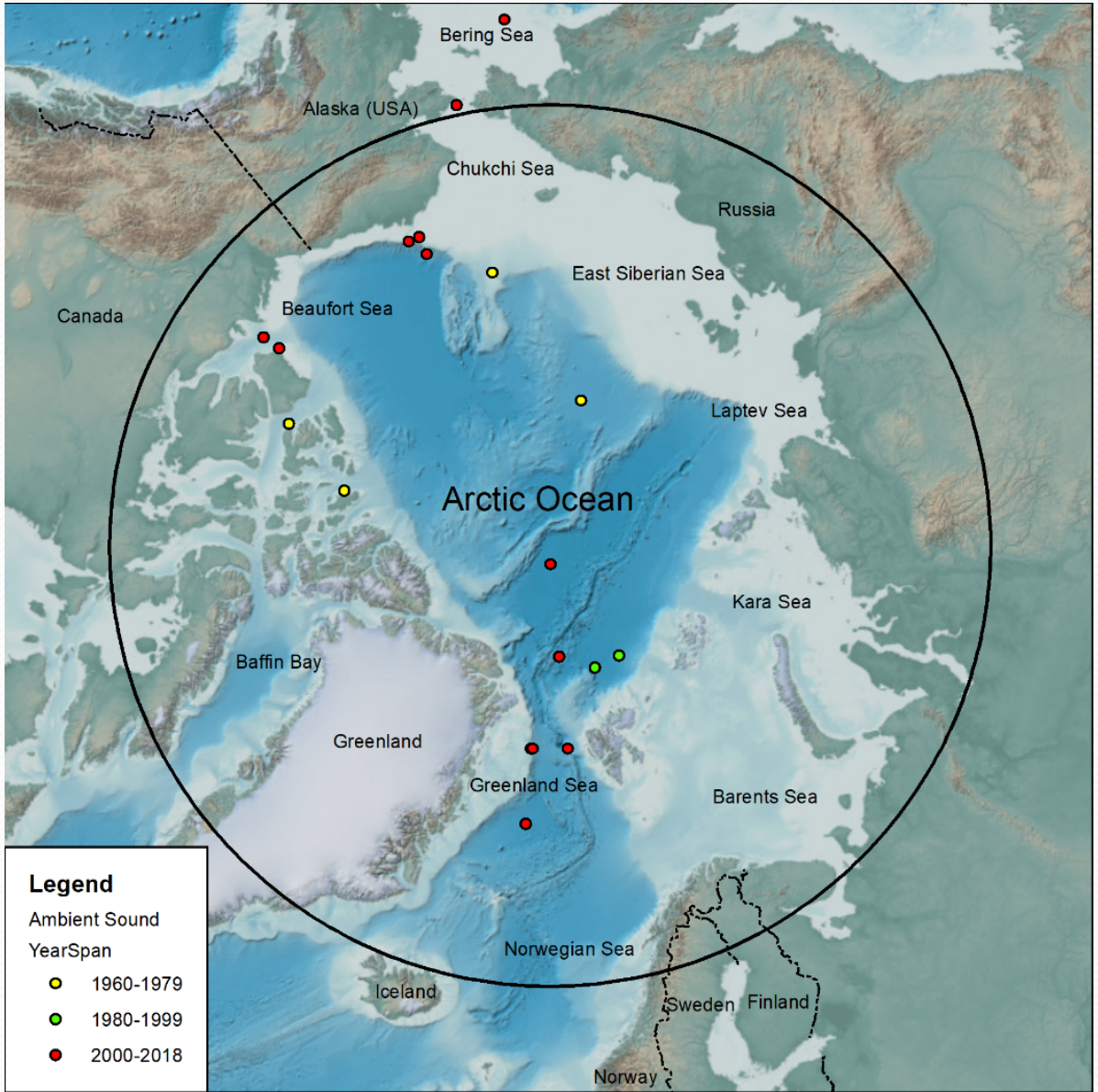
The Arctic – A Special Case

- Indigenous people in the Arctic, more than in other regions, depend on the continued health of marine mammals
- Sound travels greater distances in the Arctic
- There are unique noise sources in the Arctic
- Noise has a potentially greater impact when noise levels start out low

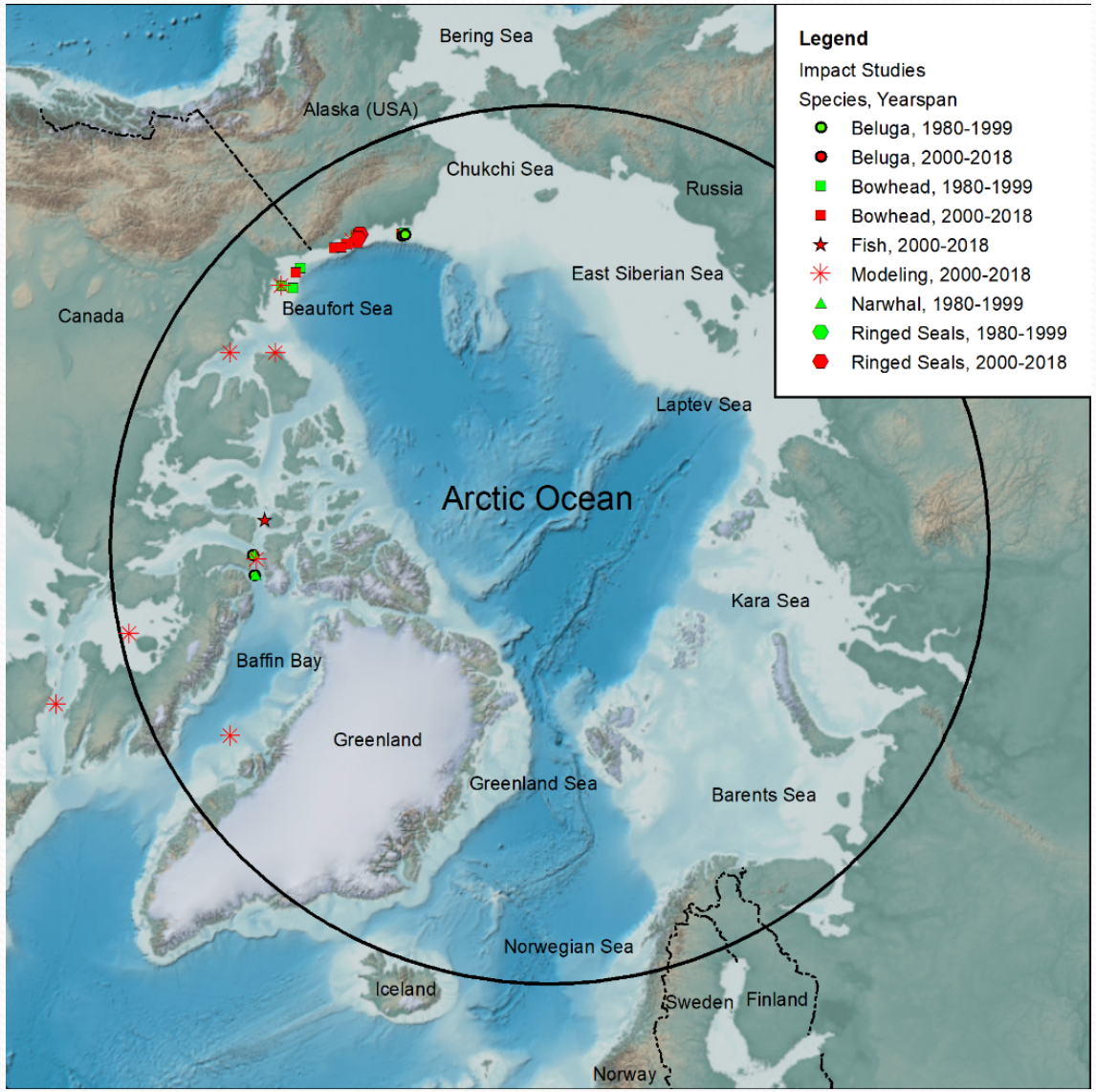


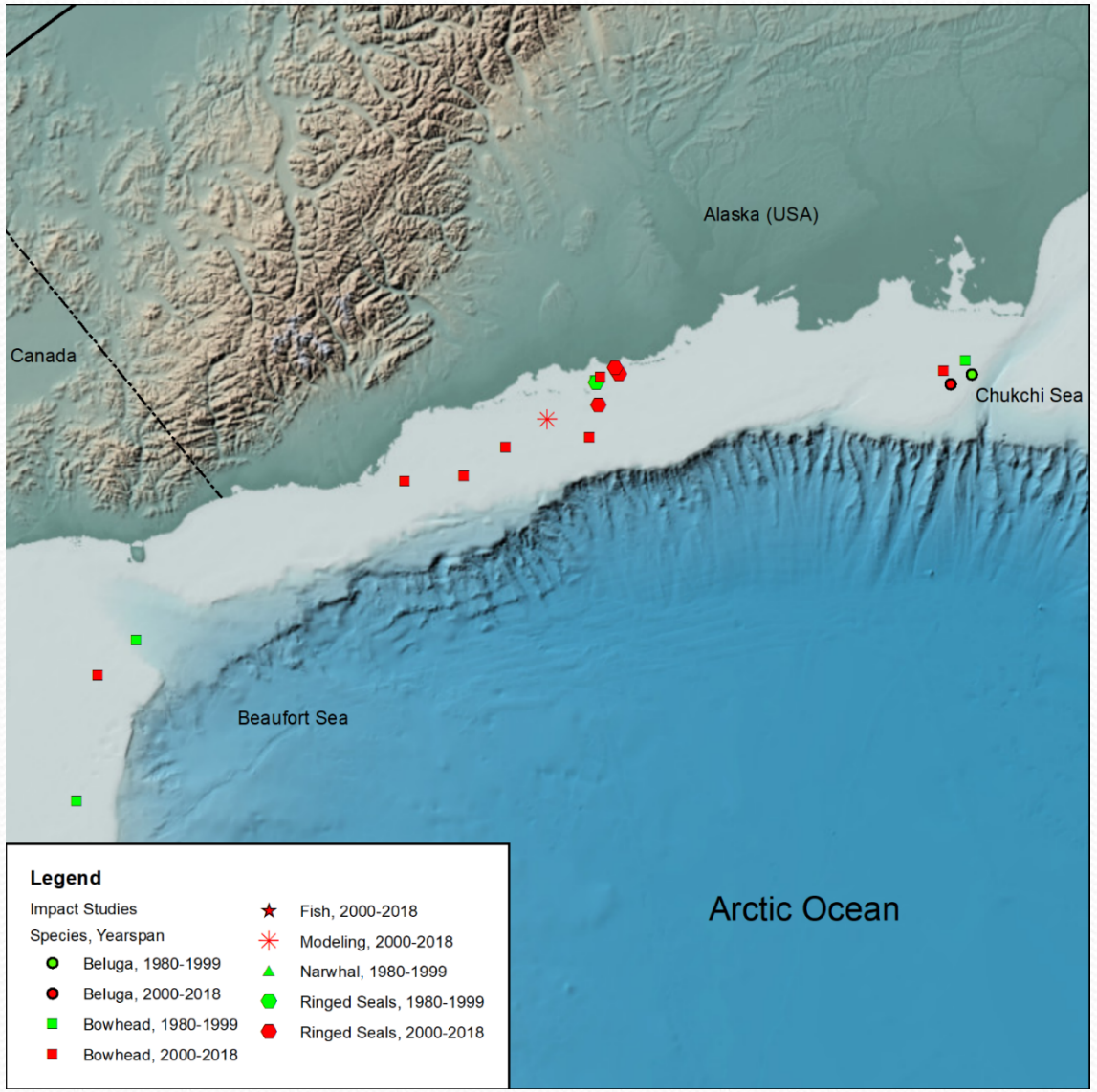
Findings: Arctic Ambient Sound Levels

- The map indicates the geographic location for studies measuring ambient noise in the Arctic Ocean
- Note that this was based on publicly available, peer reviewed data, and any studies provided by PAME members
- Coverage is lacking for the eastern side of this area

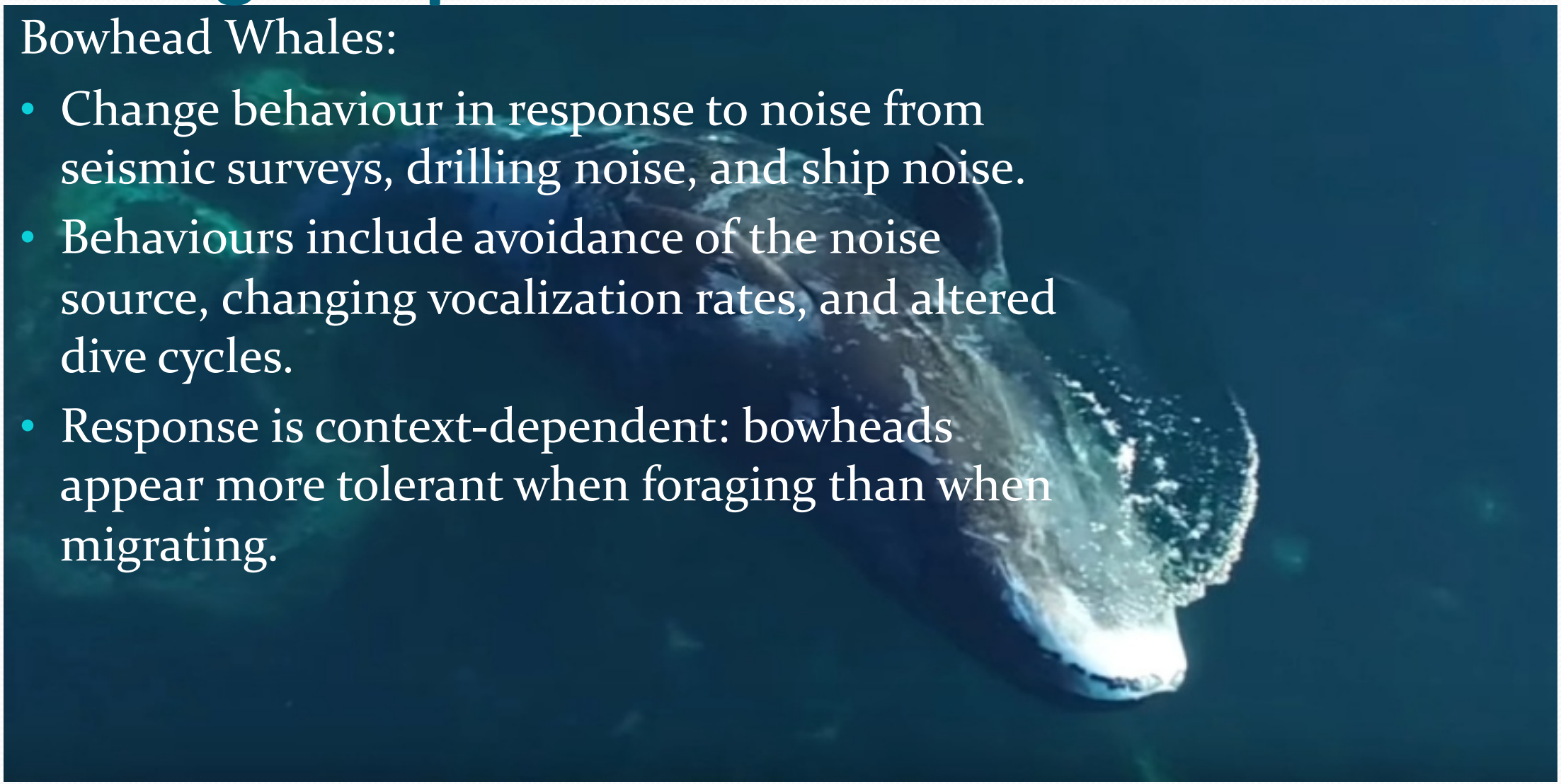


Studies: Impacts on Arctic Marine Mammals



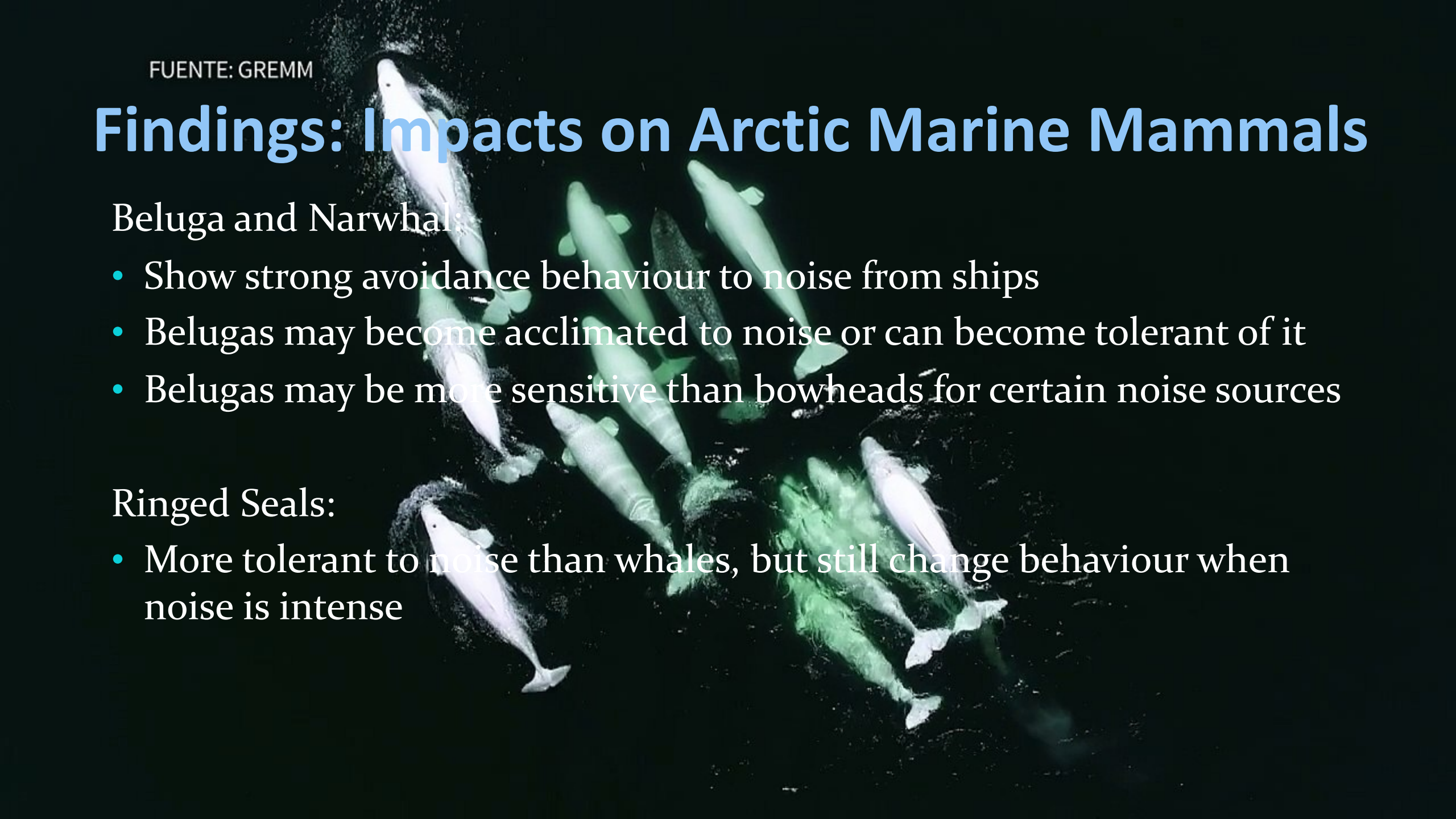


Findings: Impacts on Arctic Marine Mammals



Bowhead Whales:

- Change behaviour in response to noise from seismic surveys, drilling noise, and ship noise.
- Behaviours include avoidance of the noise source, changing vocalization rates, and altered dive cycles.
- Response is context-dependent: bowheads appear more tolerant when foraging than when migrating.



Findings: Impacts on Arctic Marine Mammals

Beluga and Narwhal:

- Show strong avoidance behaviour to noise from ships
- Belugas may become acclimated to noise or can become tolerant of it
- Belugas may be more sensitive than bowheads for certain noise sources

Ringed Seals:

- More tolerant to noise than whales, but still change behaviour when noise is intense

Findings: Impacts on Arctic Marine Fish

- Only two studies on marine fish were identified, both at Resolute in the Canadian Arctic, both by the same authors (Ivanova et al).
- Studied Arctic Cod (*Boreogadus saida*) and Shorthorn Sculpin (*Myoxocephalus scorpius*)
- Both species changed their movement patterns and home range size in response to noise from ships

Non-Arctic studies have documented the following impacts:

- Auditory masking
- Behavioural changes
- Temporary hearing loss
- Death

Impacts on Arctic Marine Invertebrates?

No studies on noise impacts on Arctic marine invertebrates were found.

From non-Arctic studies:

Underwater noise can have many impacts on invertebrates:

- Hearing loss
- Physiological changes
- Behavioural changes
- Reduced fitness
- Mortality

Knowledge Gaps

- Geography: Gaps in noise data in many regions of the Arctic including Russia and most of the Canadian Arctic. Relatively more data exists for the Beaufort and Chukchi Seas (driven by oil and gas interests) and Fram Strait (noise monitoring).
- Many species have not been studied, especially invertebrates and fish
- No information on chronic/cumulative effects of underwater noise
- Need more information on hearing ability of marine life
- Standardization of methods- lacking
- Specific measures of anthropogenic noise in the Arctic

Next Steps

- Seeking further input from PAME members to fill the geographic gaps in the study, where possible.
- Intersessional revision of the report- submit to PAME I 2019 for approval.
- Draft report also submitted to CAFF board for review

Future PAME/AC work?

- Explore the potential for specific spatial or temporal mitigation measures for underwater noise impacts (i.e. speed restrictions, 'quiet zones', routing to avoid sensitive areas)
- Understand the potential applicability and relevance of existing measures aimed at mitigating underwater noise impacts (noise quieting technology, propeller cleaning, slow steaming)
- Promote expansion of noise monitoring throughout the Arctic
- Address knowledge gaps – work to focus and prioritize efforts to address them, or to provide a repository for information of specific relevance to Arctic states