

# Panel 6: Underwater noise from shipping in the Arctic

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Dr Melanie Lancaster  
Senior Specialist – Arctic species  
WWF Arctic Programme  
Melanie.Lancaster@wwf.se

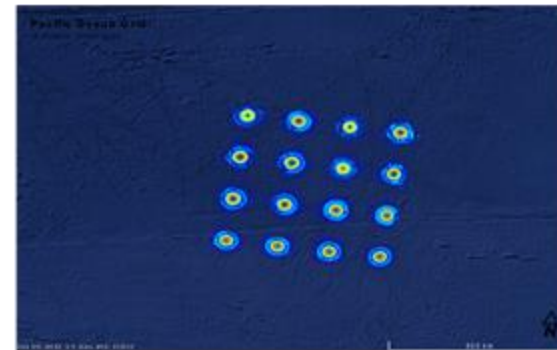
# Sound is essential for many marine species



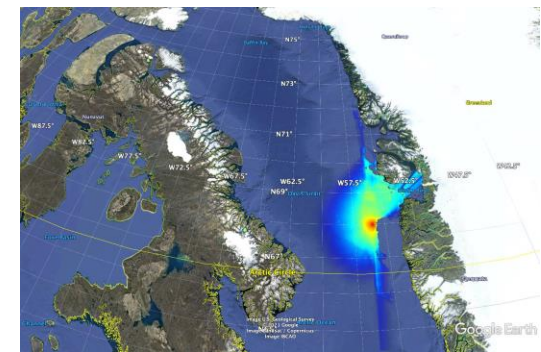
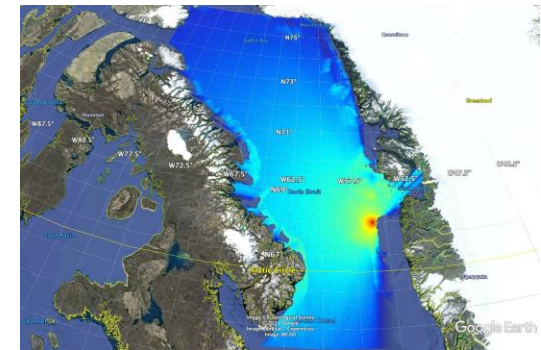
# The Arctic is a special case for underwater sound

- Sound travels differently in the Arctic Ocean
- Ice cover alters the marine soundscape and makes sound propagation complex
- Ships specialised for Arctic operations are a source of additional and different noise
- Marine mammals and ships use the same transit routes.

Tropics vs Arctic



Open water vs sea ice



Source: Underwater Noise Pollution from Shipping in the Arctic, Protection of the Arctic Marine Environment Working Group (PAME), May 2021. <https://www.pame.is/projects/arctic-marine-shipping/underwater-noise-in-the-arctic>

# Underwater noise-producing activities are increasing

Arctic Council shipping status updates  
<https://www.pame.is/projects-new/arctic-shipping/pame-shipping-highlights/411-arctic-shipping-status-reports>

From 2013 – 2019 in the Arctic as defined by the Polar Code, the number of ships increased by 25%. The total distance sailed by all vessels increased by 75%.

The 2021 Arctic Report Card (NOAA) notes *Arctic shipping traffic between the Pacific and Atlantic Oceans continues to increase and with it, ambient **marine noise** levels are increasing in the frequency bands used by marine mammals.*

Projected increases substantial – 3 new trans-Arctic routes possible and all offer shorter distance and time compared to Suez and Panama canals.

Ship Traffic 2015 - 2019  
Total Hours of Traffic

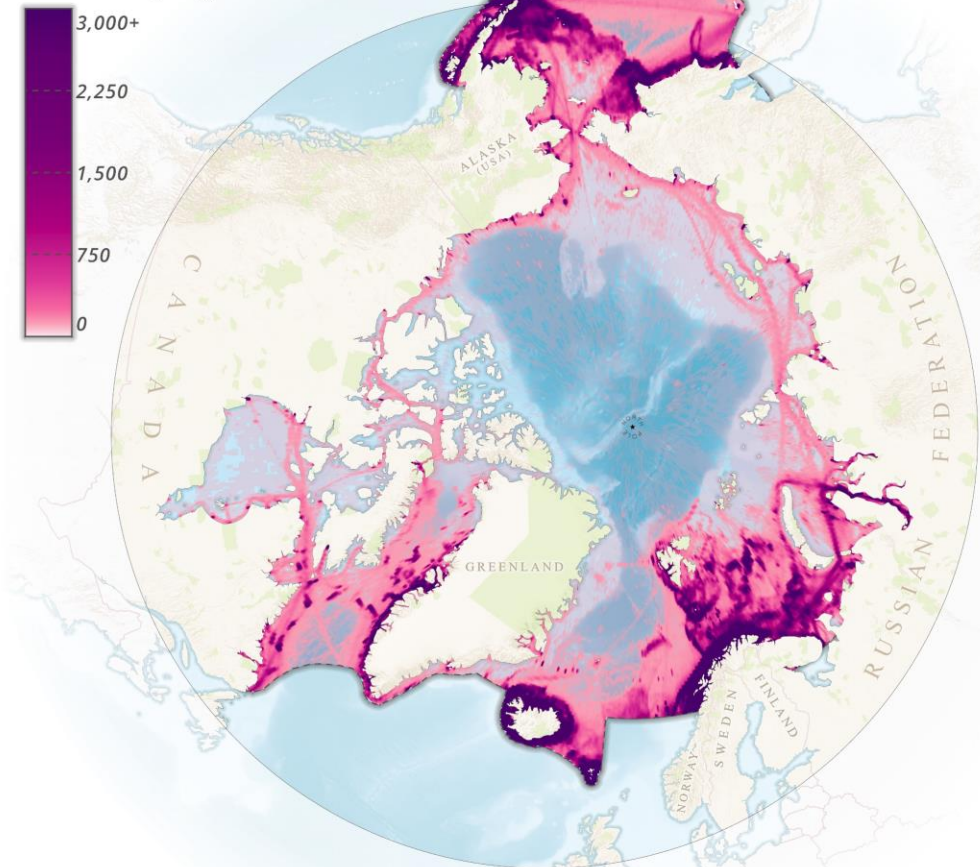


Figure source: WWF Arctic Programme

# Managing underwater noise for a healthy Arctic Ocean

**WWF's goal:**

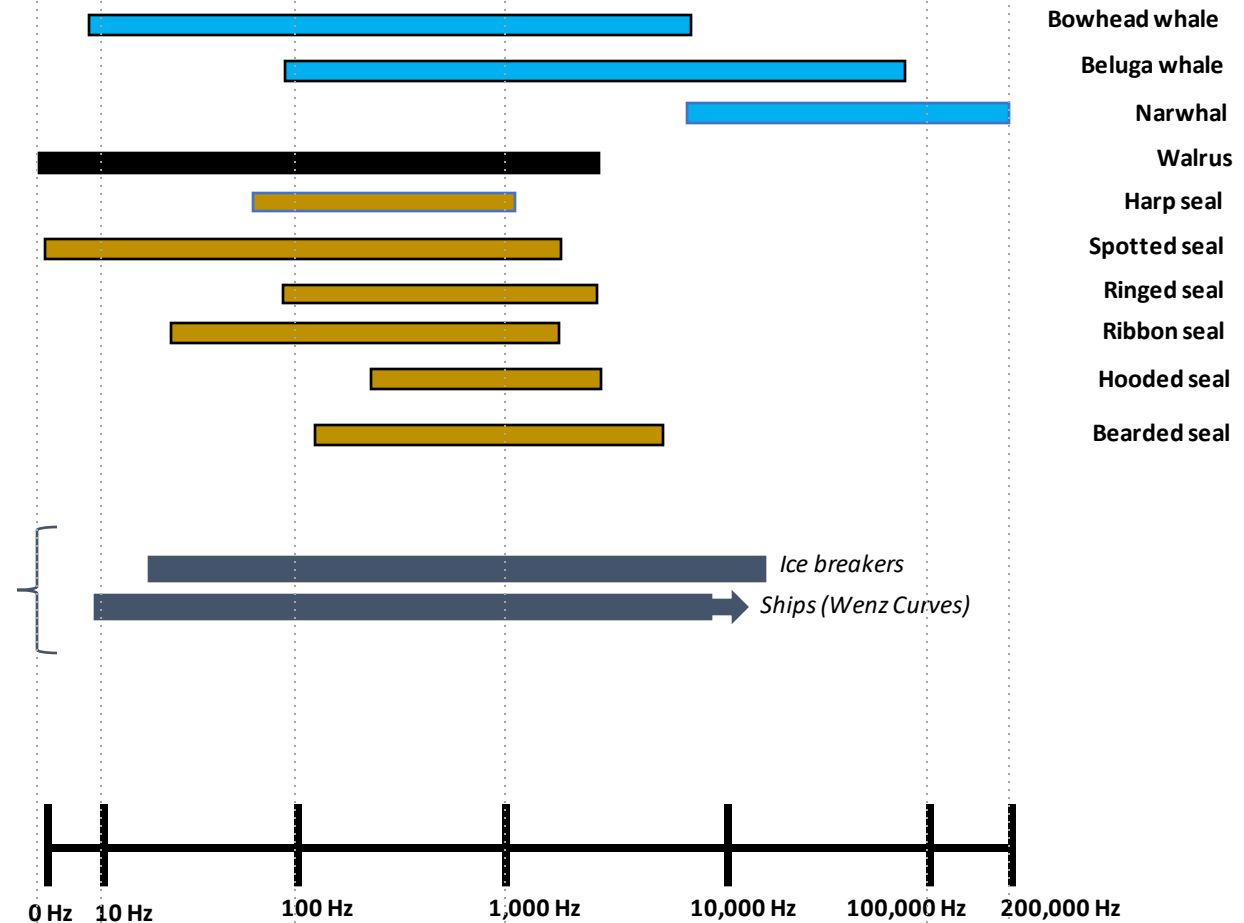
**Underwater noise is managed at safe levels for noise-sensitive species to promote a healthy Arctic Ocean**

1. Understand more about the Arctic Ocean soundscape and underwater noise and its impacts.
2. Take a precautionary approach and “hold the noise” in Arctic waters at current levels until safe noise levels can be determined for this unique marine environment.
3. Bring underwater noise to safe levels and promote a healthy Arctic Ocean, in accordance with Sustainable Development Goal 14.1.



# Underwater noise affects marine life in the Arctic

- Fish, invertebrates – no direct studies
- Arctic cod and shorthorn sculpin changed behaviour and home ranges
- Pacific walrus changed diving, course and speed when vessels were within 500 m
- Beluga whales and narwhal show stress responses. Aware of icebreaker at 80 km away, at 35 – 50 km had strong flee response up to 80 km away and avoidance of the area for days afterwards
- Narwhal increase swim speed and change feeding behaviour and vocalisations
- Bowhead whales have strong responses to approaching vessels at 4 km or more. Try to outswim ship, but then flee kilometres away.



# Arctic Council work on underwater noise from shipping

## Underwater Noise in the Arctic

A State of Knowledge Report

**PAME**  
Protection of the Arctic Marine Environment



2019 report

## UNDERWATER NOISE POLLUTION FROM SHIPPING IN THE ARCTIC

MAY 2021



**PAME**  
Protection of the Arctic Marine Environment



**DW**  
SHIPCONSULT  
Your Noise and Vibration Experts

2021 report

- Arctic Council Protection of the Arctic Marine Environment (PAME) working group 2017 – current.
- 2017 – 2019: State of Knowledge Report.
- 2019 – 2021: Phase I: understanding impacts and defining management solutions.
- 2021 – 2023: Phase II: understanding impacts and defining management solutions (current).



# Phase I: Predicting shipping noise status and trends in the Arctic

PAME modelled underwater noise from shipping from 2013 – 2019 across the Arctic Ocean.

In some Arctic regions where shipping levels are on the rise, the models predicted that average noise levels more than doubled over the past decade (e.g., parts of the Barents Sea and Baffin Bay), with increases of 5 – 15 dB at some frequencies. Multiple of these areas have high densities of marine mammals.

The models suggest this increase has taken place over a much shorter time period than has occurred at lower latitudes with high vessel traffic – same magnitude took 30 – 40 years in the North Pacific Ocean.

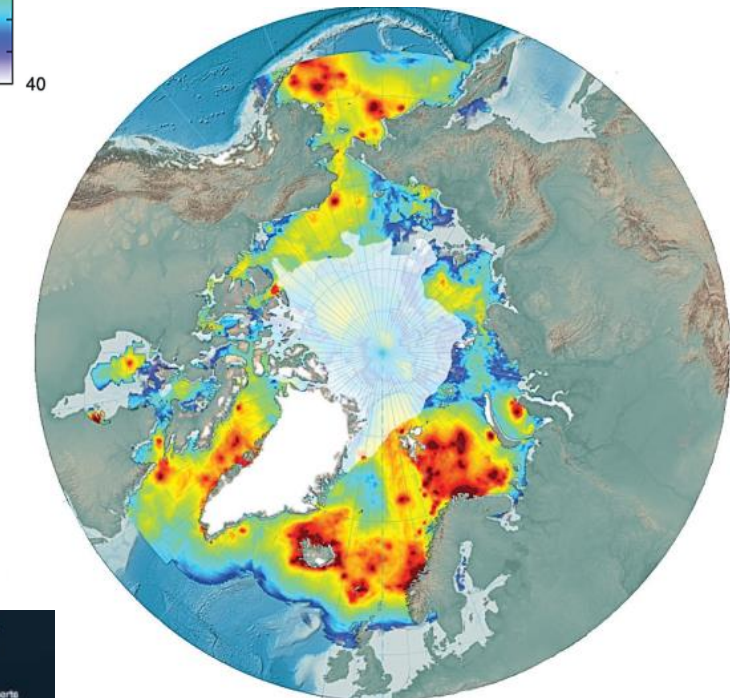
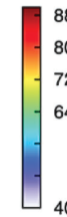
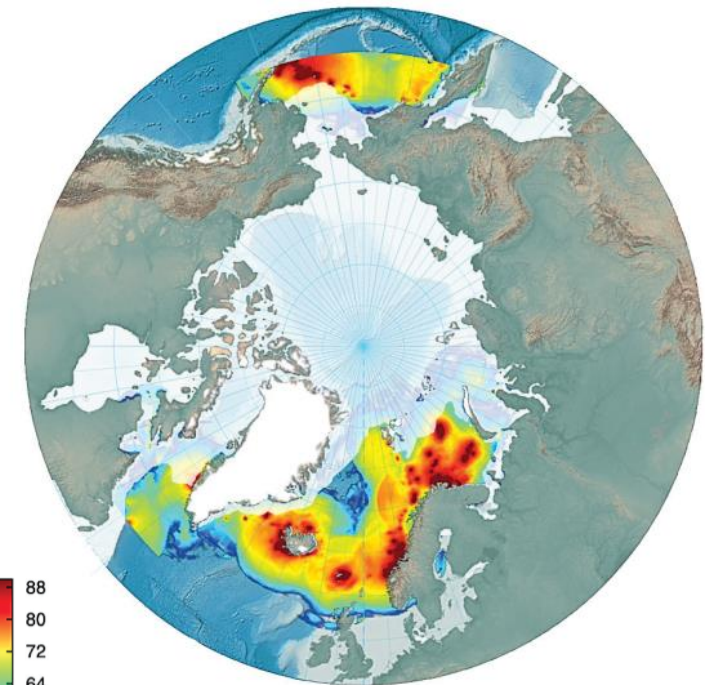


Fig. 1. Pan-Arctic 25Hz decade band weekly median SEL for a) March 2015 and b) September 2015 (SEL is in units of dB/ $\mu$ Pa<sup>2</sup>).

Source: Underwater Noise Pollution from Shipping in the Arctic, Protection of the Arctic Marine Environment Working Group (PAME), May 2021. <https://www.pame.is/projects/arctic-marine-shipment/underwater-noise-in-the-arctic>



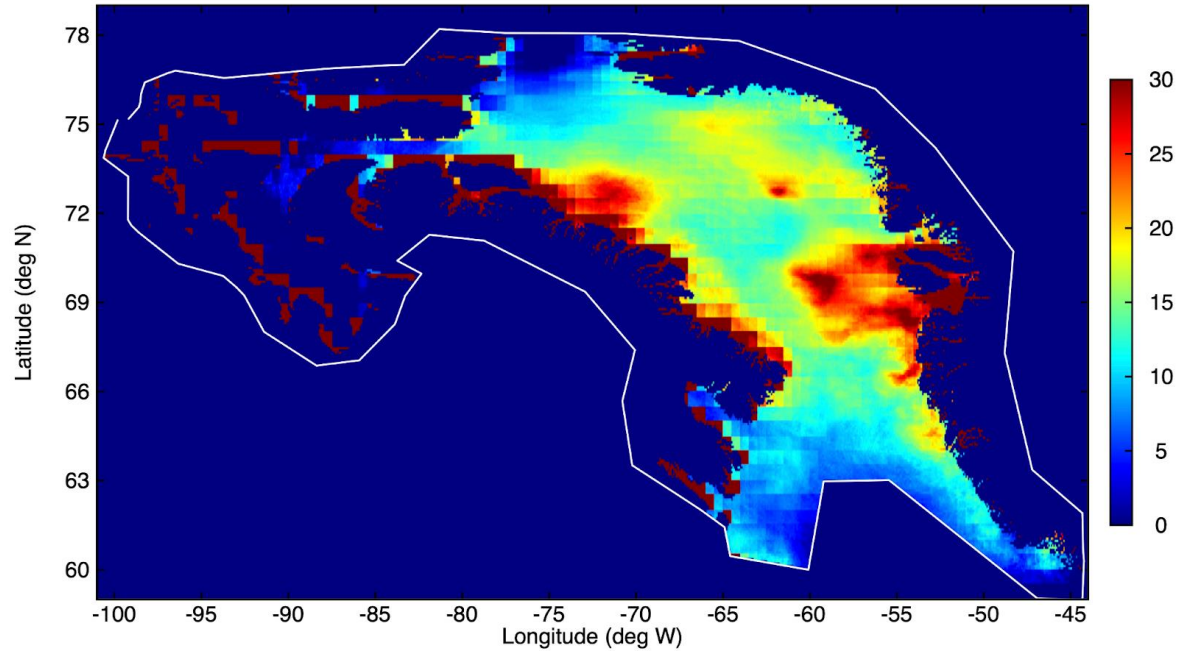
# Phase II: understanding impacts, defining management solutions

1. Predict underwater noise levels in 2030, based on projected shipping and ice conditions.
2. Ground-truth acoustic modelling using hydrophone information.
3. Estimate noise exposure levels to marine life.
4. Model operational and technological scenarios to mitigate underwater noise impacts.

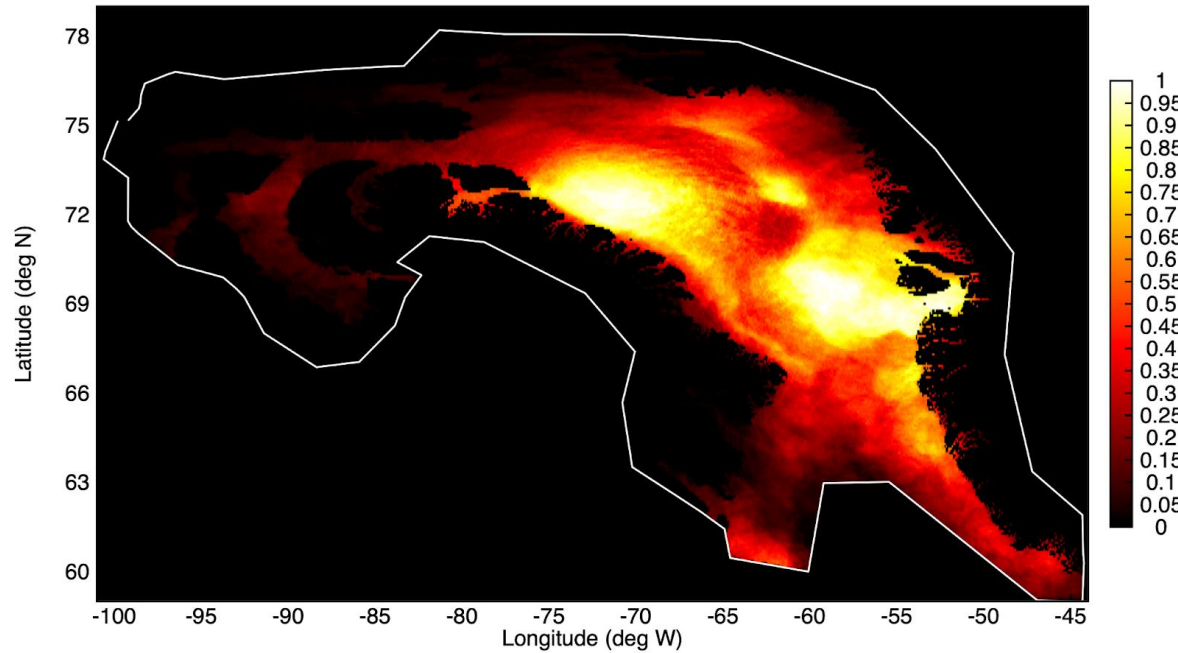


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Baffin LME(16) 125Hz 2019 Median Exceedance



Baffin LME(16) 125Hz 2019 Temporal Exceedance



## Phase II: Canada / Greenland example

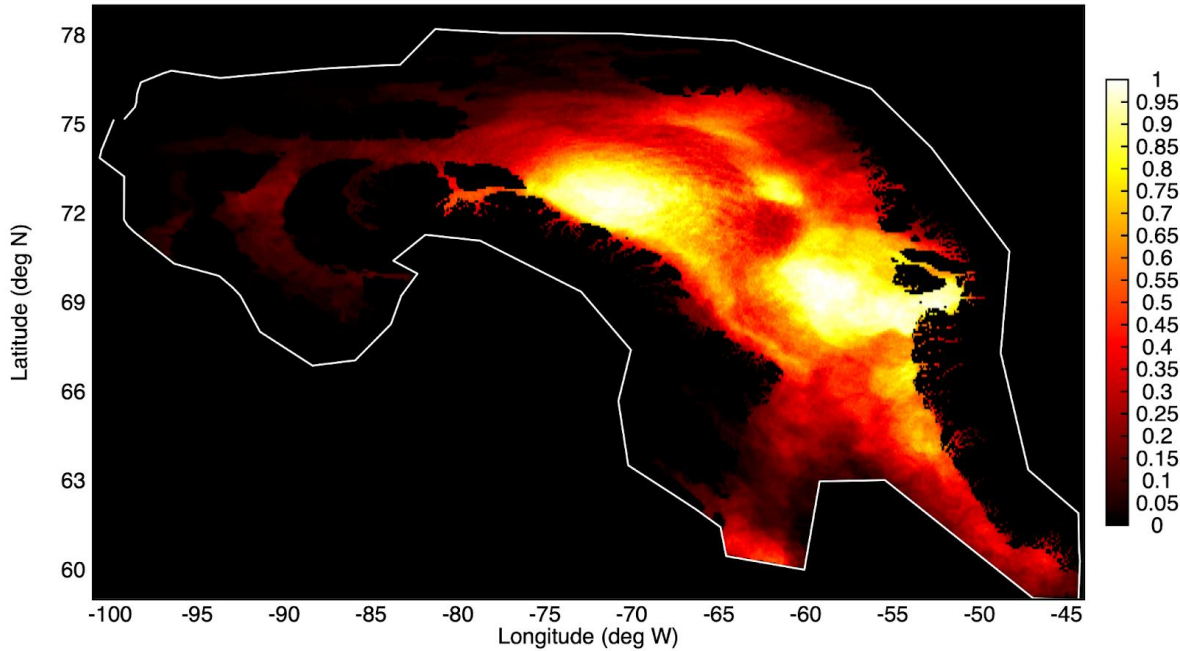
1. Wind-driven levels of underwater sound across the Arctic Ocean were modelled. These levels were used to represent an important element of the natural **ambient underwater soundscape**.

2. Shipping noise was modelled for three subregions in the Arctic for 2019 and 2030 based on existing ship databases and projection models.

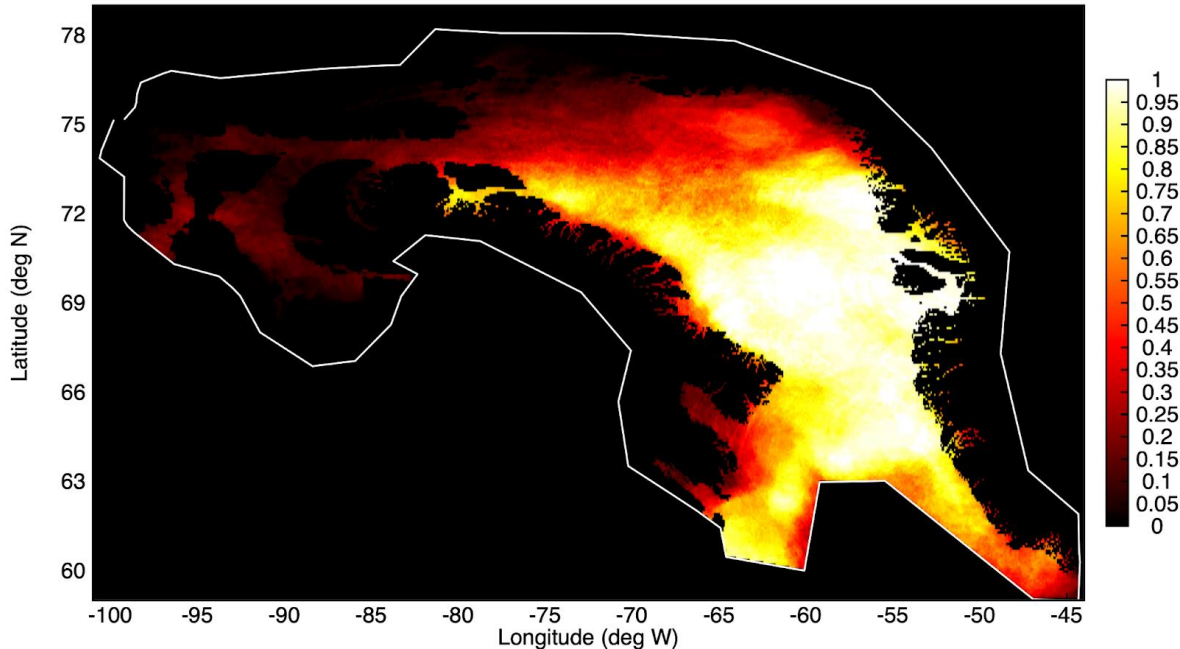
3. Noise from ships and wind were compared to estimate **excess noise**. This metric estimates human addition of noise experienced by whales, seals, and other noise-sensitive species.

In 2019, across three Arctic regions, median excess noise levels from ships ranged from 0 to 30 dB (around 125 Hz) in September. In a few parts of Baffin Bay / Davis Strait, shipping noise was higher than wind noise 100% of the time in September.

Baffin LME(16) 125Hz 2019 Temporal Exceedance



Baffin LME(16) 125Hz 2030 Temporal Exceedance



## Phase II: Canada / Greenland example

When 2019 shipping was compared with 2030 projected shipping scenarios, under current regulation:

The percentage of time that modelled excess ship noise was higher than the background soundscape increased to 100% for much of Baffin Bay / Davis Strait.

Take home: these models predict that assuming current economic projections and without additional mitigation, underwater noise from shipping will become a **more widespread and serious problem** in places that are important to the Arctic's noise-sensitive species, marine ecosystems and Indigenous Peoples, who depend on a healthy Arctic Ocean.

*Baffin Bay, situated between Canada and Greenland. Top: 2019, bottom: 2030. The colour scale indicates the percentage of time ship noise exceeds ambient sound levels. A measure of 1 (bright white) indicates that ship noise exceeds ambient sound levels 100% of the time over the month of September.*

# Phase II: modelling mitigation scenarios

- Prioritise regions with high concentrations of noise-sensitive species and ship traffic:
  - Bering Strait, Baffin Bay / Davis Strait, Barents Sea
- Assess noise risk reduction potential of operational and technological scenarios including:
  - Reducing vessel mechanical noise (e.g., quieter design)
  - Reducing ship speed (e.g., quieter operation)
  - Routing adjustment (e.g., lanes, fairways, corridors)
- Showcase these decision-support tools for managing underwater noise from shipping to Arctic States and other stakeholders.

# Managing underwater noise for a healthy Arctic Ocean

**WWF's goal:**

**Underwater noise is managed at safe levels for noise-sensitive species to promote a healthy Arctic Ocean**

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# Thank you

## For more information:

Melanie Lancaster  
[melanie.lancaster@wwf.se](mailto:melanie.lancaster@wwf.se)

