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ICES / PICES / PAME working-group on the Integrated Assessments of the Central Arctic Ocean (CAO) “WGICA”



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PAME
Protection of the Arctic Marine Environment

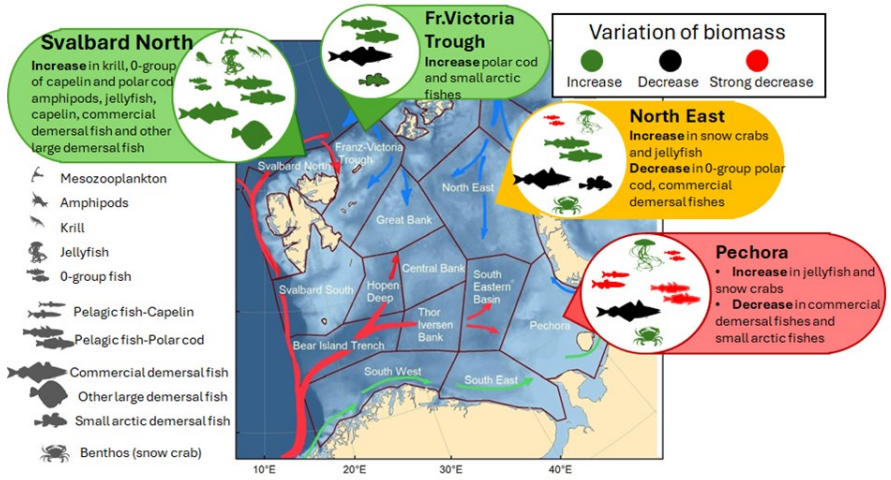
Unofficial on-line fall meeting 6 and 8 October, 2026

WGICA

Background

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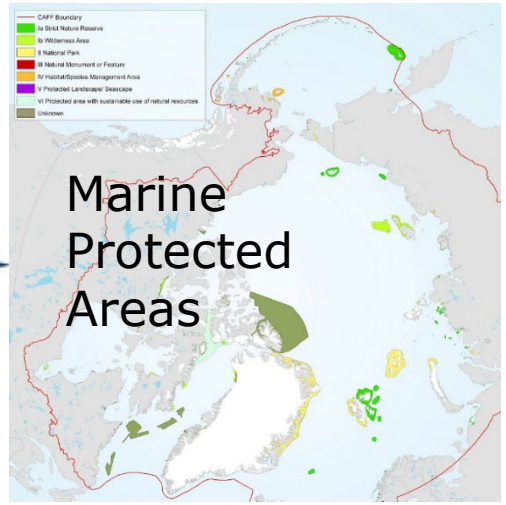
WGINOR, WGIEAGS, WGIBAR



Eriksen, E., Husson, B., Skaret, G., Ingvaldsen, R.B., Dalpadado, P., Johannesen, E., Jørgensen, L.L., Bogstad, B., Dolgov, A.V., Prozorkevich, D.V. and Prokhorova, T.A., 2025. The living Barents Sea response to peak-warming and subsequent cooling. Scientific Reports, 15(1), p.13008. https://doi.org/10.1038/s41598-025-96964-x

PAME

Shipping, MPA, EBM, Marine Litter



PROJECTS



PICES

Climate/anthropogenic drivers in the **Pacific Arctic**

Cooperation with **Northern Bering Sea - Chukchi Sea**

Co-production methods and inclusive of **Indigenous knowledge** systems

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The Central Arctic Ocean ecosystem



Physical changes

Sea ice

Water temperatures

Acidity in seawater

Climate change

The **unique ecosystem** has species adapted to sea ice, the mesopelagic zone, the seabed, and hydrothermal vents on the deep-sea ridges.

The ecosystem is under pressure. The reduction in multiyear ice is **changing the range and abundance of species**, from primary producers to top predators.

Rapid warming and **sea-ice loss** are transforming the Central Arctic Ocean, reshaping the ecosystem and facilitating human activities.

Ecosystem changes

Primary productivity

Animals moving north



Socio-economic context

Human activity is limited but is an emerging pressure due to sea ice declining. Activity is increasing in the periphery of the region.

73% of the region lies within the High Seas, an **area beyond national jurisdiction**.

International governance has been strengthened with treaties such as UNCLOS. **Arctic Indigenous Peoples** are increasingly recognized in Arctic governance.

Commercial fishing has been banned through the **CAOFA Agreement** until 2037 to protect the fragile ecosystem.

Underwater noise

Ships and sonar generate underwater noise. Sound can travel **hundreds of kilometers**, and ecologically important sounds can be masked.

With **sea-ice cover declining**, noise is expected to **increase** in extent, intensity, and frequency.

Wildlife impacts can include altered behaviour and adverse physiological effects in **marine mammals**.

Propellers

Engines

Sonar

Contaminants

The ecoregion acts as a **sink for contaminants**, carried into the Arctic from **lower latitudes** through multiple pathways.

Elevated levels of **mercury** and **polychlorinated biphenyls** (PCBs) are found in the Arctic foodweb.

Air

Rivers

Currents

Hg mercury

PCBs

Seabirds and marine mammals carry the highest concentrations

Marine litter

Most marine litter originates from **outside the ecoregion**.

Microplastics have been found in ocean sediments, ice floes, and snow samples.

Marine litter is **ingested by wildlife**.

Explore the Central Arctic Ocean Ecosystem Overview 2025 for more insights

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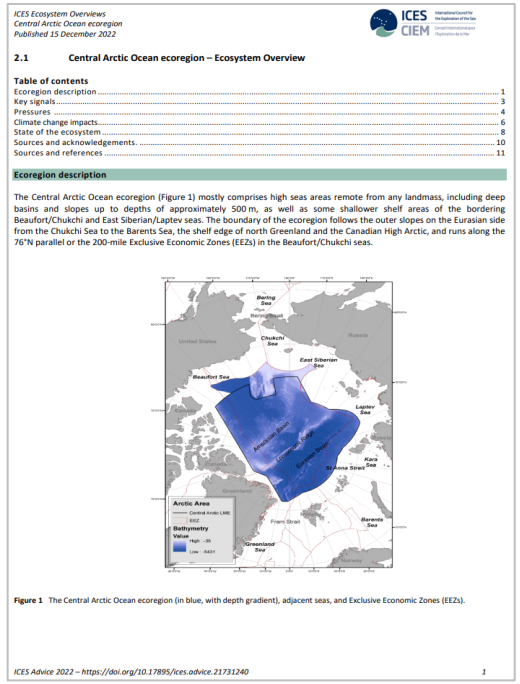
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Products

Updated Ecosystem overview (ICES)



ICES Ecosystem Overviews
Central Arctic Ocean ecoregion
Published 15 December 2022

2.1 Central Arctic Ocean ecoregion – Ecosystem Overview

Table of contents
Ecoregion description 1
Key signals 3
Pressures 4
Climate change impacts 6
State of the ecosystem 8
Sources and acknowledgements 10
Sources and references 11

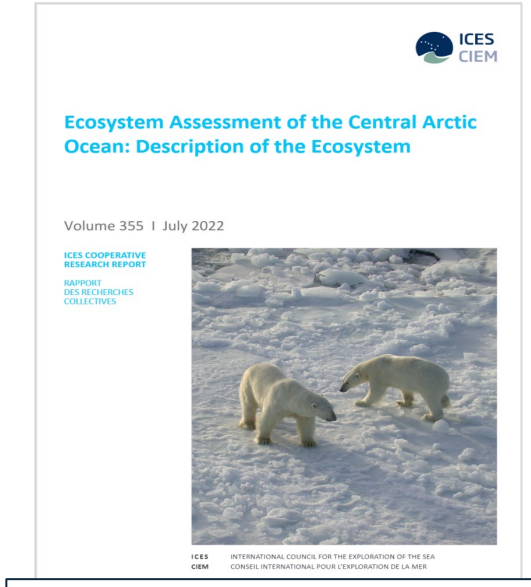
Ecoregion description

The Central Arctic Ocean ecoregion (Figure 1) mostly comprises high seas areas remote from any landmass, including deep basins and slopes up to depths of approximately 500 m, as well as some shallower shelf areas of the bordering Beaufort/Chukchi and East Siberian/Laptev seas. The boundary of the ecoregion follows the outer slopes on the Eurasian side from the Chukchi Sea to the Barents Sea, the shelf edge of north Greenland and the Canadian High Arctic, and runs along the 76°N parallel or the 200-mile Exclusive Economic Zones (EEZs) in the Beaufort/Chukchi seas.

Figure 1 The Central Arctic Ocean ecoregion (in blue, with depth gradient), adjacent seas, and Exclusive Economic Zones (EEZs).

ICES Advice 2022 – https://doi.org/10.17895/ices.advice.21731240 1

Scientific Report 1



ICES CIEM

Ecosystem Assessment of the Central Arctic Ocean: Description of the Ecosystem

Volume 355 I July 2022

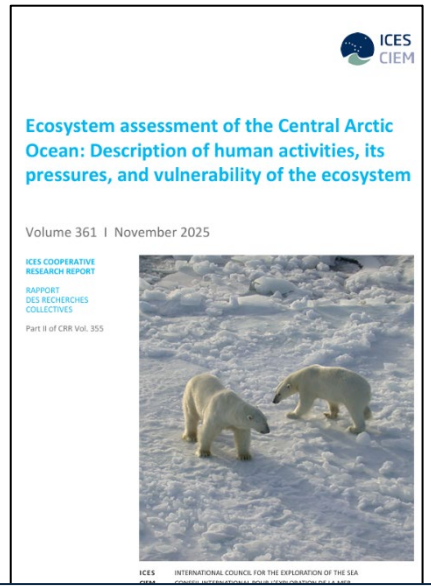
ICES COOPERATIVE RESEARCH REPORT

RAPPORT DES RECHERCHES COLLECTIVES

ICES INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA
CIEM CONSEIL INTERNATIONAL POUR L'EXPLORATION DE LA MER

Skjoldal, H. R. (Ed.). **2022**. Ecosystem assessment of the Central Arctic Ocean: Description of the ecosystem. ICES Cooperative Research Reports Vol. 355. 341 pp. https://doi.org/10.17895/ices.pub.20191787

Scientific Report 2



ICES CIEM

Ecosystem assessment of the Central Arctic Ocean: Description of human activities, its pressures, and vulnerability of the ecosystem

Volume 361 I November 2025

ICES COOPERATIVE RESEARCH REPORT

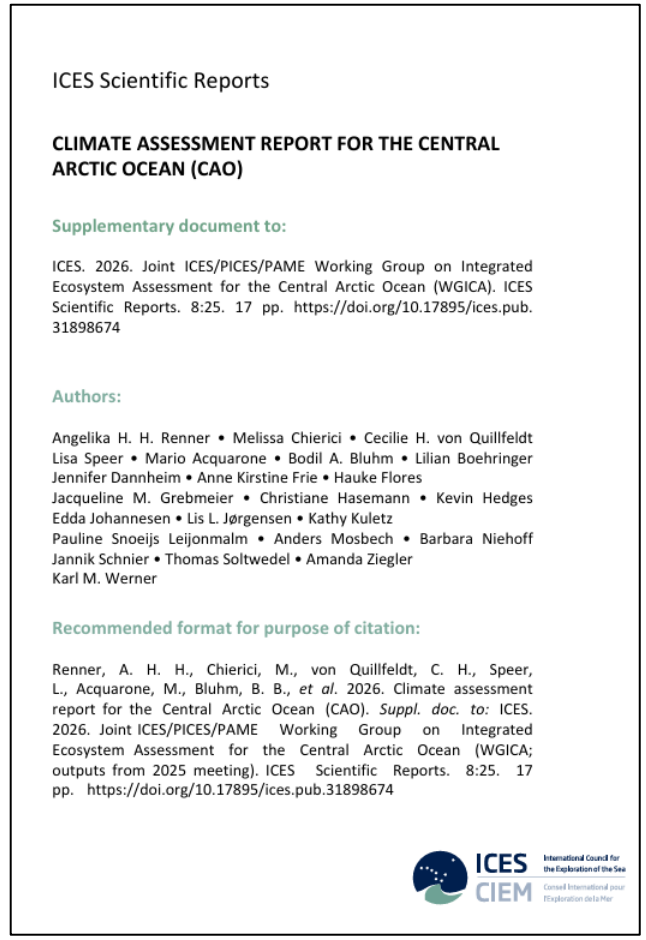
RAPPORT DES RECHERCHES COLLECTIVES

Part II of CRR Vol. 355

ICES INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA

Jørgensen, L. L. (ed.). **2025**. Ecosystem assessment of the Central Arctic Ocean: Description of human activities, its pressures, and vulnerability of the ecosystem. ICES Cooperative Research Reports Vol. 361. 223 pp. https://doi.org/10.17895/ices.pub.30540437

Brief Climate Assessment Report



ICES Scientific Reports

CLIMATE ASSESSMENT REPORT FOR THE CENTRAL ARCTIC OCEAN (CAO)

Supplementary document to:

ICES. 2026. Joint ICES/PICES/PAME Working Group on Integrated Ecosystem Assessment for the Central Arctic Ocean (WGICA). ICES Scientific Reports. 8:25. 17 pp. https://doi.org/10.17895/ices.pub.31898674

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Scientific paper (*submitted and in review*)

Ecosystem risks from human activities in the fast-changing Central Arctic Ocean (CAO)

Lis Lindal Jørgensen(*)[1], Bodil A. Bluhm[2], J. Dawson[3], Haakon Hop[4], Alf Håkon Hoel[5], Randi B. Ingvaldsen[1], Katherine J. Kuletz [6], Hauke Flores[7], Martine van den Heuvel-Greve[8,9], Amanda F. Ziegler[1,2], J.J. Solski[10], Mario Acquarone[11], Kevin J. Hedges[12], Cecilie H. von Quillfeldt[4], Sei-Ichi Saitoh[13], Anders Mosbech[14], Bjørn E. Grøsvik[15], Jessica A. Nilsson[16], David Fluharty[17], Paul Arthur. Berkman[18,19,20], Lisa Speer[21], Ida, M. Hassellöv[22], Hyoung Chul Shin[23], Jacqueline M. Grebmeier[24], John L. Bengtson[25], Anne K. Frie[1]

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What we will do the next 3 years - 2026-2028

Mapping vulnerable and fragile species, communities and habitats in the ice and on the seabed.

Mapping climate and environmental change in the Central Arctic Ocean in context with the evaluation of commercial fisheries potential.



Mapping pressures from human activities

Investigate cumulative or otherwise interacting effects of pressures on VMEs

Mapping vulnerable and fragile species, communities and habitats in the ice and on the seabed

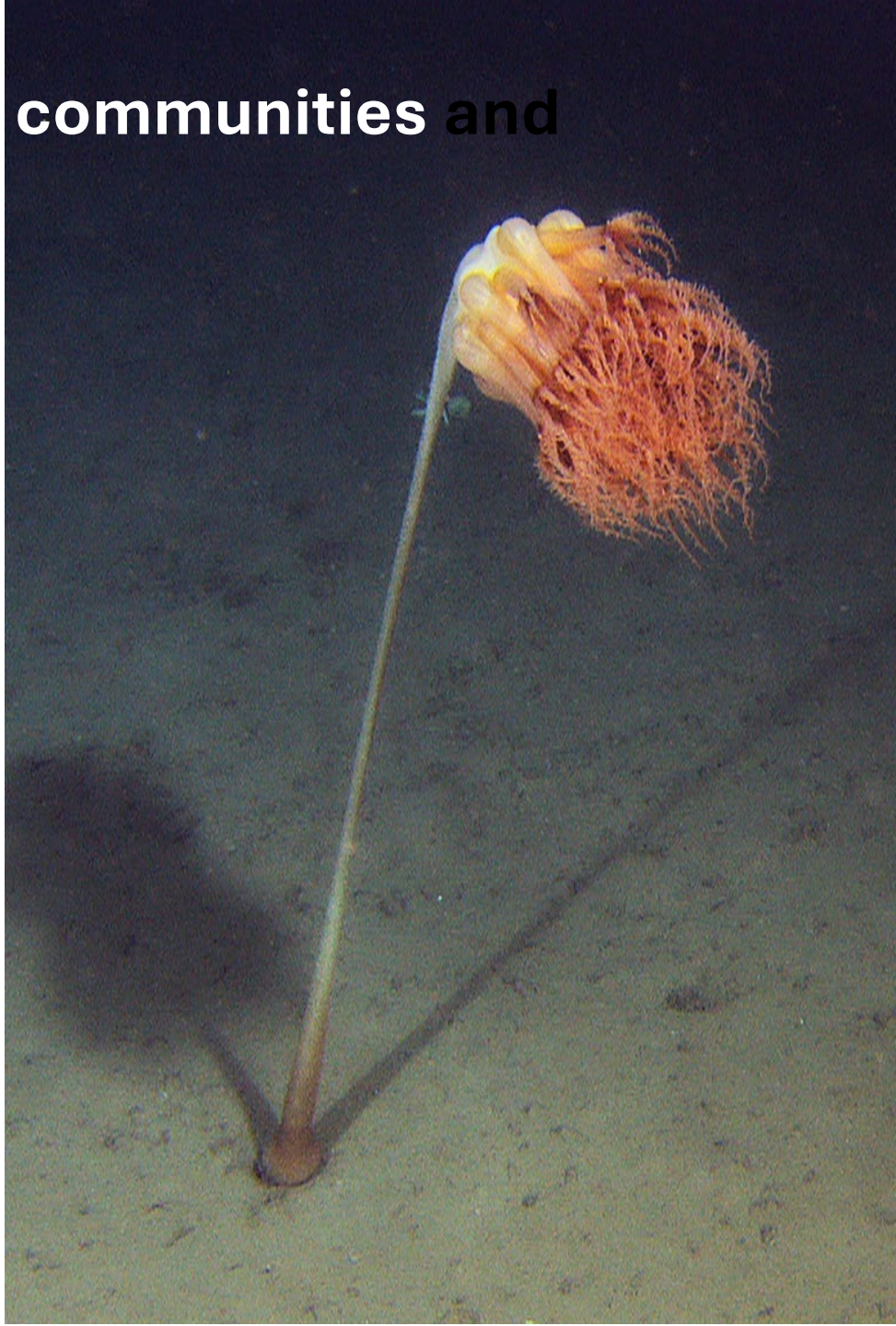
To investigate and take advantages of work done in CBMP_benthos on:

- **Sea-Ice** (Last Ice Area): **Stine Frie** (lead),
  Unique Sea mammals, Fish, Birds, Zooplankton, Algae

- **Benthos**: **Lis Jørgensen** (lead),
  Benthos, geological features, Demersal fish

Action points:
”What is a VME”,
” human activities: who are they and why”,
”What is the Habitat”,
”What do we mean by *expansion*”?

How to produce a **product that can be used in the Mapping Tool** developed in the Arctic Council by PAME/CAFF.



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Mapping climate and environmental change in the Central Arctic Ocean and Establishment of Commercial fish.

1. **Stepwise Niche/habitat-modelling**: with preferences on commercial species.

2. **Modelling Arctic Oceanographic Connectivity** (PAME work)

    a. **Biology**: Fish group (Elena Eriksen et al) established

    b. **Oceanographic-Chemistry**: Angelika Renner (IMR)/Nadja Steiner (Canada) to lead

Understanding species niches and predict potential ecosystem shifts:

1. Key Physical & Chemical Parameters Needed for fish and oceanography

- **Temperature & Salinity**: Identifying critical temperature ranges and salinity bounds for species establishment and movement into the CAO (particularly in surface, mid-water, and deep benthic zones).
- **Sea Ice & Light Availability**: Determining sea ice coverage thresholds that affect solar radiation penetration, primary productivity, and food web support.
- **Nutrients & Acidification**: Evaluating whether nutrient limits or ocean acidification parameters constrain species expansion, though primary productivity in the CAO may not be strictly nutrient-limited.
- **Hydrodynamics & Turbulence**: High currents and turbulence (e.g., observed at Lofoten coral reefs) are critical for certain species, though current speeds in the deep CAO remain generally low.

2. Analytical Scope & Constraints

Timeframe & Depth Ranges: Clarifying target projections (e.g., 2050 vs. 2100) and depth horizons (top 30 m vs. mesopelagic vs. seafloor down to 1,000+ m).

Data & Resolution Challenges: Existing ocean models at IMR and partner institutions lack the fine spatial resolution required to model complex shelf-to-basin connectivity, eddy dynamics, or inflows through key gateways (Fram Strait and Bering Strait).

3. Action Items & Next Steps

Literature Review & Species Habitats: **Elena Eriksen and Angelika Renner** will conduct a joint literature review mapping physical habitat bounds for key fish and zooplankton species to present at the next meeting.

Model Integration & Climate Data: Explore using CMIP model outputs and linking ocean circulation/particle-tracking models (including PAME's connectivity model and plastic transport studies highlighted by Bjørn Einar Grøsvik) to trace transport pathways into the CAO.

Expertise Expansion: Engage specialized climate modelers (e.g., Norwegian Polar Institute) to support CMIP projection evaluations and high-resolution model integration.

Studies on pressures from human activities

Team:

Exploratory fishing: Kevin Hedges (Canadian lead), Igor

Task: Provide maps of 1) fishable areas of the CAO (<1200m for trawling and <1500m for fixed gear), and 2) areas in the CAO that may need sub-surface cable laying (under sediment, <2000 m) – accompanied w/ text on published max depth for trawling & fixed gear

Noise: Taka Hirata (Japanese lead), *Stine/Kevin/Nadja (help identify experts), Martine (help set up work plan), Tom/Stine/Nadja (help identify relevant experts for migrating marine mammals), WWF?*

Task: Provide maps of ship tracks (ASTD data – LME CAO), sound propagation and marine mammal distribution

Contaminants: Martine van den Heuvel-Greve (Netherland lead), Bjørn Einar, Hauke/Kevin/Edda/Igor (help identify data/samples in freezer/options for sample collection), *Tom/Stine/Nadja (help identify relevant experts for migrating marine mammals/birds)*

Task: Provide maps for contaminants - spatial and temporal (?) trends

Action points (summer '26):

“Draft maps for the CAO of 1) fishable areas, and 2) areas that may need sub-surface cable laying”

“Development of a team for the task on noise”

“Overview of available data/samples for contaminants and what can be collected in the near future”

Investigate cumulative or otherwise interacting effects of pressures on VMEs

Based on outcomes from ToR a-c above and including Indigenous Knowledge, the group will:

- **d.1) Summarize expected interactions of pressures on the ecosystem**
  WGICA will prepare an Infobrief or other concise summary material on:
    - The cumulative effects of all human pressures on VMEs in the CAO
    - Impact on communities along high Arctic coasts surrounding the CAO

- **d.2) Increase inclusion of Indigenous Knowledge/promote the co-production of knowledge**
  WGICA will develop a recommendation on how to include Indigenous Knowledge in WG activities