

GUIDING FUTURE ARCTIC POLICY

Strategic Scientific Support for High Seas Fisheries in the Central Arctic Ocean

EMFAF - European Maritime, Fisheries and Aquaculture Fund projects managed by CINEA (2018 - 2023)

> European Climate, Infrastructure and Environment Executive Agency

European Climate © European Unio	r, Infras n, 2024	tructure and Environment Execut	ive Agency (CINEA)	
PDF		ISBN 978-92-9405-034-2	doi: 10.2926/772512	HZ-02-24-050-EN-N
Reproduction is an regulated by Deci	uthoris sion 20	ed provided the source is acknowl)11/833/EU (OJ L 330, 14.12.201	ledged. The reuse policy of Euro 1, p. 39).	ppean Commission documents is
Neither the Europ made of the follo	ean Co wing in	mmission nor any person acting o formation.	on behalf of the Commission is	responsible for the use that might be
For any use or rep from the respecti	product ve right	ion of elements that are not own t holders.	ed by the European Union, pern	nission may need to be sought directly

Table of Contents

Table of Contents	3
Introduction	4
Projects and achievements	6
Overview of projects between 2018-2023	8
Scoping Supporting the EU in international fora	10
Gap analysis Review of existing research knowledge and identifying gaps	12
Getting ready Defining and planning the expeditions	14
Ready, Steady, Go Hands on, diving into the ice	16
Back on shore Drawing conclusions and future outlooks	20
Contributions to science and society	22
Key recommendations	25
CINEA in Brief	26

Introduction

The Arctic Ocean, ice-bound for 800,000 years, is now witnessing ice-free regions in summers, which will only increase in the next few decades due to rapid climatic changes. This transformation has made the once inaccessible Central Arctic Ocean (CAO) a focus of potential exploitation.

To counteract premature resource exploitation, an international <u>Agreement to Prevent</u> <u>Unregulated High Seas Fisheries in the Central</u> <u>Arctic Ocean</u> (known as the **"CAO Fisheries Agreement"**) was established, following extensive negotiations. Ten signatories are party to the agreement: Canada, the People's Republic of China, the Kingdom of Denmark in respect of Greenland and the Faroe Islands, the European Union (EU), Iceland, Japan, the Republic of Korea, the Kingdom of Norway, the Russian Federation and the United States of America.

Bolstering international ocean governance

This international Agreement, <u>which came into</u> <u>force in June 2021</u>, protects the Arctic's fragile marine ecosystems against unregulated fishing and fills an important gap in the international ocean governance framework. It is rooted in three main principles:

- Prohibiting unregulated commercial fishing in the Central Arctic Ocean;
- Advancing scientific cooperation and research through a Joint Program of Scientific Research and Monitoring (JPSRM);
- Enabling limited, **constrained exploratory fishing.**

Recognising the vulnerability of the Central Arctic Ocean and its resources to climate change, the EU is strongly committed to ensuring its conservation. Scientific understanding and cooperation are crucial to secure a sustainable management of the ecosystems. Implementation of the Common Fisheries Policy (CFP) already relies heavily on science to preserve resources and ensure sustainable and balanced ecosystems. The recently launched Fisheries Policy Package includes a Marine Action Plan that aims at protecting and restoring marine ecosystems for sustainable and resilient fisheries. The objectives of the action plan extend to international waters in line with the EU's commitments in the Joint Communication on International Ocean Governance and with the external dimension of the Common Fisheries Policy.

Strengthening EU scientific research

In 2018, the European Commission's Directorate-General for Maritime Affairs and Fisheries (DG MARE) recognised the need to bolster the EU's contribution to the Agreement, particularly through scientific research. As a result, a call for tenders was launched by CINEA under the European Maritime and Fisheries Fund (EMFF) and the European Fisheries Inventory in the Central Arctic Ocean (EFICA) Consortium was awarded a framework contract to deliver scientific services to the EU. Specifically, the goal was to provide informed, scientific advice to the EU on a range of emerging issues associated with the Central Arctic Ocean. This includes detailed insights into the state of marine ecosystems in the Central Arctic Ocean, along with related technical, social, and economic impacts.

About this brochure

EFICA CONSORTIUM MEMBERS:

Stockholm University, Sweden – Polar science studies (leader)

DTU Aqua, Denmark - Aquatic research Alfred Wegener Institute, Germany - Arctic and Antarctic research

Wageningen Marine Research, the Netherlands - Marine ecosystem studies Catholic University Leuven, Belgium -Environmental research European Polar Board, the Netherlands - Polar region collaboration

Swedish University of Agricultural Sciences, Department of Aquatic Resources, Sweden Royal Swedish Academy of Sciences, Sweden

The aim of this brochure is to provide an overview of the work performed by the EFICA consortium between 2018 and 2023 in support of the EU's contribution to the Joint Program of Scientific Research and Monitoring in the Central Arctic Ocean.

The consortium carried out a total of six projects, funded under the European Maritime and Fisheries Fund (EMFF) and the European Maritime, Fisheries and Aquaculture Fund (EMFAF).

Each of the projects covered different steps – from identifying the research needs and data gaps, to analysing the outcomes of two scientific expeditions in the Central Arctic Ocean. The publication is targeted at fisheries scientists, policymakers and all stakeholders with an interest in Arctic policy and international governance.

PROJECTS AND ACHIEVEMENTS



The projects were managed by CINEA and were funded under the European Maritime and Fisheries Fund (EMFF), and the new European Maritime, Fisheries and Aquaculture Fund (EMFAF).



Scoping

Supporting the EU in international fora) Gan

Gap analysis

Review of existing research knowledge and identifying gaps



Getting ready

Defining and planning the expeditions





Hands on, diving into the ice



i Aj

Drawing conclusions and future outlooks



Overview of projects between 2018-2023

|--|

Supporting the EU in international fora

Advice, coordination and participation of scientists in international meetings relevant to High Seas Fisheries in the Central Arctic Ocean (CAO)

Review of research knowledge and gaps on fish populations, fisheries and linked ecosystems in the CAO 05/2019 to 10/2023

05/2019 to 09/2019



Gap analysis: Review of existing research knowledge and identifying gaps

<u>Getting ready:</u>

Defining and planning

the expeditions

Scientific workshop to prepare for the Arctic MOSAiC and SAS expeditions

Exploratory fishing and ecosystem research in the CAO during the 2019 MOSAiC expedition

Ecosystem mapping in the CAO during the SAS-Oden 2021 expedition

07/2019 to 12/2021

04/2021 to 02/2022

06/2019 to 12/2019

<u>Ready</u>, <u>S</u>teady, Go: Hands on, diving into the ice

Analyses, results and conclusions from the expeditions in the CAO

02/2022 to 04/2023



Back on shore: Drawing conclusions and future outlooks





Scoping: Supporting the EU in international fora

Advice, coordination and participation of scientists in international meetings relevant to High Seas Fisheries in the Central Arctic Ocean

PERIOD: 05/2019 TO 10/2023

BUDGET: €210,000

Main activities

A key task of the EFICA consortium was to coordinate the contributions of scientists from EU Member States, participate in international scientific meetings, provide technical support and advice on scientific subjects (such as fish stock status, fisheries developments and management) and report back to the European Commission.

From May 2019 to May 2023, a total of 15 meetings and events were prepared, attended and reported by EFICA, including some directly related to the Central Arctic Ocean Fisheries Agreement (CAOFA), such as the Central Arctic Ocean Agreement Signatories' meetings, the Inuit Circumpolar Council's meeting on integrating Indigenous Knowledge into the Central Arctic Ocean Agreement, meetings on the Joint Program of Scientific Research and Monitoring (JPSRM) and Arctic Council meetings.

EFICA scientists were participating in the provisional groups before CAOFA was set up, its Conference of Parties (COP) and Scientific Coordinating Group were established, and a JPSRM Framework was on the table for approval by the COP in May 2023.

Ice view - Copyright Pauline Snoeijs-Leijonmalm

- Production of the "Framework of the Central Arctic Ocean Fisheries Agreement (CAOFA) Joint Program of Scientific Research and Monitoring (JPSRM)" draft. This will form the basis for the "JPSRM Implementation Plan" as part of the Agreement (e.g. listing the ecosystem parameters to be measured within the JPSRM).
- The way forward towards an operational JPSRM includes recommendations from the EFICA Consortium on how to make the JPSRM operational.
- Specialised sampling procedures underscoring the EU's leadership in setting scientific protocols and standards in the marine environment.





Gap analysis: Review of existing research knowledge

and identifying gaps

Review of research knowledge and gaps on fish populations, fisheries and linked ecosystems in the Central Arctic Ocean

READ THE PUBLICATION HERE

PERIOD: 05/2019 TO 09/2019

BUDGET: **€30,000**



Main activities

As a preliminary step, the EFICA consortium carried out a thorough review of the existing knowledge and performed a gap analysis to improve understanding of the Central Arctic Ocean. Although this ocean is becoming more accessible due to the melting of summer sea-ice, its remote location and harsh ice conditions have historically limited our understanding and made scientific research in the area challenging. This has resulted in significant data and knowledge gaps in relation to the Central Arctic Ocean's marine ecosystems.

The work comprised desk research, using scientific research databases as well as any available research. The gap analyses involved comparisons of actual knowledge with desired knowledge on the ecosystems of the Central Arctic Ocean to be able to evaluate the potential of future sustainable fisheries in the area.

The review underlined the necessity to intensify efforts for extensive data collection and analysis in the region. It revealed a significant lack of biological and ecological data in the region.

Data for the physical environment in the Central Arctic Ocean (oceanography, bottom topography and ice cover dynamics) could support fish stock modelling and assessment. Data from other shelf seas is limited or inaccessible, though some fish stock data is available from scientific projects and monitoring programmes for some of the shelf seas. However, more data from all shelf seas may be contained in reports that are not publicly accessible.

Overall, the critical gap analysis revealed significant knowledge gaps in the Central Arctic Ocean's fish stocks, hindering quantitative analyses.

- IDENTIFIED DATA/KNOWLEDGE GAPS ON
 - Climate change impacts
 - Ecosystem data
 - Food web data
 - Fish ecology
 - Fish stock assessment data
 - Fish data



<u>Getting ready:</u> Defining and planning the expeditions

Scientific workshop in preparation to the Arctic Polarstern and Oden expeditions

PERIOD: 06/2019 TO 12/2019

BUDGET: **€**50,000

Main activities

After identifying knowledge gaps, the next step was to bring experts together in a scientific workshop to prepare the scientific data collection for the research expeditions to the Central Arctic Ocean: the Arctic <u>MOSAiC</u> and <u>SAS-</u> <u>Oden</u> expeditions.

The event took place in June 2019 and focused on defining the data collection methods and the programme for the expeditions, as well as planning future scientific work. Key discussions at the workshop revolved around standardising fish sample collection, validating acoustic data, and the relevance of incorporating traditional knowledge (e.g. input from local communities) into policy recommendations. This approach aimed to ensure a comprehensive and holistic strategy for managing the Central Arctic Ocean.



- Importance of interdisciplinary collaboration and the integration of local community insights into the scientific process
- Establishment of the **Provisional Scientific Coordination Group** (PSCG) with the EFICA Consortium set to play a significant role in the Mapping and Monitoring Program.
- EFICA's commitment to developing standardised protocols for fish sampling in the Central Arctic Ocean, ensuring consistency across the MOSAiC and SAS-Oden expeditions.
- Recognition of acoustics as a key method for quantifying mesopelagic fish to overcome the challenges posed by ice.
- Endorsement of **sample-sharing within the Mapping and Monitoring Program** of the Agreement, enhancing EFICA's capacity for genetic analysis and contribute to the modelling of the Central Arctic Ocean's food web.





<u>Ready, Steady, Go:</u>

Hands on, diving into the ice

Exploratory fishing and ecosystem research in the Central Arctic Ocean during the MOSAiC expedition

READ THE PUBLICATION HERE

PERIOD: 07/2019 TO 12/2021

BUDGET: <u>€</u>817,000

Main activities

The next phase involved participation in the MOSAiC and SAS Arctic expeditions from 2019 to 2022. The international Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) expedition, a transpolar drift expedition with the German Polarstern research icebreaker anchored to the sea ice, took place between 20 September 2019 to 12 October 2020. MOSAiC was the **largest Arctic research expedition to date**, including more than 500 scientists and 300 support staff from 20 countries.

The expedition focused on the Eurasian Basin (Amundsen and Nansen) of the Arctic Ocean and the Fram Strait gateway, mainly located in the High Seas of the Central Arctic Ocean (CAO) (See map on page 17). The EFICA Consortium, along with onboard scientists, carried out sampling and data collection to address identified knowledge gaps in the CAO's ecosystem. This expedition investigated the marine ecosystem, fish stocks, and ecological connections, capturing data across different seasons to understand seasonal shifts and potential impacts of climate change.

The EFICA scientists collected hydroacoustic data (over 90,000 files), made video recordings (over 4,000 files), took samples of both fish (57 haddock, Atlantic and Polar cod, redfish) and eDNA (approximately 1,400). However, the expedition faced challenges in sampling due to thick ice and noise interference. Notably, deep-layer observations (around 500 metres) revealed unusual fish concentrations, including Atlantic cod, typically nonnative to the Arctic, further north than expected. These findings suggest that sustainable commercial fisheries might not be viable due to low fish biomass and expected continuous low productivity, despite the potential effects of reduced ice cover and increased Atlantic water inflow from global warming.

PROJECT HIGHLIGHTS

- Generally low abundances of zooplankton and small fish (<15 cm) confirmed.
- Apparent higher fish abundance in some areas receiving inflow of Atlantic water.
- Fish (Atlantic cod) and squid (armhook squid) observed between 200-500 metres depth, further north than anticipated. Results were published in Science Advances Journal "Unexpected fish and squid in the central Arctic deep scattering layer".
- Observation of few larger fish (up to ~60 cm long).
- Effective Sampling Methods: longlines and fishing rods are effective for targeting larger fish species (e.g. Atlantic and Arctic cod).

Note: These results and conclusions are preliminary and not quantitative.



Cartography: CINEA, February 2024 © EuroGeographics for the administrative boundaries Flanders Marine Institute (2024): MarineRegions.org. Available online at www.marineregions.org. Consulted on 2024-02-06.





<u>Ready, Steady, Go:</u>

Hands on, diving into the ice

Ecosystem mapping in the Central Arctic Ocean during the SAS-Oden expedition

READ THE PUBLICATION HERE free free

PERIOD: 04/2021 TO 02/2022

BUDGET: €1,300,000

Main activities

In the summer of 2021, 12 scientists from the EFICA Consortium joined the SAS-Oden icebreaker expedition, aiming to fill knowledge gaps of the ecosystems. They employed various sampling techniques across multiple Arctic regions (see map on page 17) to study spatial changes throughout the Central Arctic Ocean.

The expedition encountered similar challenges as the previous ones, with thick ice and noise interference limiting the collection of samples. The EFICA scientists performed field work using techniques such as hydroacoustics 49 WBAT (Wideband Autonomous Transceiver). Acoustic profiles were recorded across 19 stations and deep-sea videos (178 files) were filmed. They took samplings of 315 otoliths from 85 sediment samples, as well as 1,084 organism samples and 1,546 of eDNA, targeting the collection of information on fish, squid and zooplankton. Further ecosystem data (physical, chemical, biological) was collected in collaboration with other scientists on-board.

Notably, a deep scattering layer (200-500 metres of depth) with zooplankton and small fish was documented along the entire expedition route. Initial findings showed very low abundances of fish from certain basins, alongside variable presence of Atlantic fish in some areas, reinforcing the idea that **future sustainable commercial fisheries do not seem feasible in the region.** In addition, results suggest that the **Central Arctic Ocean is an extremely vulnerable ecosystem** with very few higher-trophic level species of nekton occurring in very low abundances. The mesopelagic fish and squid that do occur can probably barely feed the few marine mammals that also occur in very low abundances in the region (seals, walrus, polar bear).



Polarnstern -Copyright Markus Rex

SAS-Oden Western Euroasian | Lomonosov Ridge | Atlantic inflow

Oden - Copyright Larry Larsson



- The results of the expedition indicate that **future sustainable commercial fisheries do not seem feasible** in the Central Arctic Ocean.
- **Fish sampling outcome**: small abundances of fish and zooplankton normally found between 200-500 metres of depth. Only four specimens of polar cod (Boreogadus saida) were collected from the ice habitat.
- **Quality of hydroacoustic data**: the sound of ice-breaking heavily disturbs hydroacoustic data. The solution was to turn off the engines between sample stations, which resulted in good quality data.
- Comparison with the MOSAiC expedition: no high abundances of Atlantic fish species detected at the inflow of Atlantic water.
- First ever comprehensive macrozooplankton dataset for the Central Arctic Ocean using a beam net.
- More than 300 well-preserved fish otoliths of polar cod and ice cod, with potential to reveal historical information.



Back on shore: Drawing conclusions and future outlooks

Analyses, results and conclusions from the expeditions in the Central Arctic Ocean

READ THE PUBLICATION HERE

PERIOD: 02/2022 TO 04/2023

BUDGET: €1,200,000

Main activities

Following the extensive data collection during the MOSAiC and SAS-Oden icebreaker expeditions, it was time for the scientists of EFICA to analyse the data. The MOSAiC expedition collected data throughout the year, including the polar winter, thereby providing **unique insights into seasonal changes**. However, climate change impacts were not directly suggested. Meanwhile, the Oden expedition concentrated on collecting marine ecosystem data across a vast expanse of the western High Arctic Ocean, notable for its large area.

These expeditions shed new light on the distributions of sympagic (under-ice) and pelagic (living in the water column) fish, along with their zooplankton prey, including a first investigation on their seasonality during the MOSAiC expedition. The increase of knowledge for pelagic fish was mostly due to the new hydroacoustic data obtained in addition to the direct data from eDNA and sediment otoliths, particularly via the SAS expedition.

Both expeditions were interdisciplinary meaning that many measurements and samples were taken within the framework of other programmes. These samples were also accessible to EFICA scientists for interpretation of the results obtained through their own sample analysis. The EFICA team's efforts contributed to a significant metadata database containing lists of all collected samples and relevant data, that was delivered to the European Commission at the end of the project, thus providing valuable insights for future fishery assessments and shaping policy recommendations.

The main contribution of the project consists of **providing** – **for the first time** – **a realistic range of species, size and biomass distribution over a large geographical area of the Central Arctic Ocean**, thereby constituting a strong reference point for future studies. This research represents the pinnacle of the EFICA's work and a major EU contribution to the Joint Program of Scientific Research and Monitoring in the Central Arctic Ocean.

> Oden in sampling position 2021 -Copyright Julia Muchowski - SU



- The pelagic food web system of the Central Arctic Ocean is more complex than previously thought, particularly at the level of predatory fish which are found to have different origins.
- Atlantic fish species (e.g. Atlantic cod, haddock) appear to enter the Central Arctic Ocean from adjacent European shelf seas (Norwegian Sea, Barents Sea).
- **High fish abundances** assumed during MOSAiC, especially close to the inflow of Atlantic water, was **not confirmed** during the SAS-Oden expedition.
- Fish abundance and zooplankton abundance show variations that are in sync and the distribution of fish generally mirrors that of the zooplankton prey.
- Atlantic cod, haddock, and beaked redfish were actively feeding (mainly zooplankton, but also some fish and squid) and in good condition. Polar cod is dependent on the availability of zooplankton.
- Initial assumptions indicated that the zooplankton community could support 4,000 kg fish per KM² at most. However, fish biomass derived from hydroacoustic measurements was well below this figure (between 20 and 230 kg fish per KM²).
- Findings indicate that Atlantic cod can survive long periods of exposure to cold water, and the properties in its diet indicate its adaptation to the Central Arctic Ocean food web.



Contributions to science and society

The research initiatives in the Central Arctic Ocean have bolstered the EU's pivotal role in the negotiations and implementation of the Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean, solidifying the EU's leading role in the implementation of the scientific aspects under the Agreement. The extensive work carried out via the various projects by the EFICA consortium have propelled the Agreement's objectives forward, enhancing the EU's influence and fulfilling aspects of the EU Arctic strategy. The systematic approach to data collection developed and implemented has expanded global scientific understanding of the Central Arctic Ocean and introduced innovative sampling procedures that have caught international attention.

These efforts have been instrumental in progressing the Joint Program of Scientific Research and Monitoring (JPSRM), with the contribution to expeditions completing a detailed mapping phase for the first time. The resulting data, a comprehensive catalogue of species, sizes, and biomass distributions across the Central Arctic Ocean, is a robust baseline for future assessments. It enables at least partial modelling of habitats, food webs, and fish distribution, informing policy and management strategies.

The MOSAiC expedition, in particular, has generated significant media and academic interest, leading to a documentary ("A Year in the Ice: The Arctic Drift") and many scientific publications, including a notable paper in "Science Advances" (Unexpected fish and squid in the central Arctic deep scattering layer).

The EU's contribution to the scientific world is complemented by its election as vice-chair of the scientific committee and co-chair of a subgroup preparing the JPSRM. The EU's active participation has not only driven the work of the JPSRM but also contributed to data sharing and fisheries management measures, emphasising its commitment to marine ecosystem research. With its influential positions within the scientific community, the EU continues to contribute constructively to JPSRM's ongoing development and the broader goals of the Agreement.

Oden in sampling position 2021 - Copyright Julia Muchowski - SU

215

6.25 16



Key recommendations

Over the past five years, the EU has been a key player in advancing scientific research in the Central Arctic Ocean. This has placed the EU in a strategic position to influence both the negotiations and the implementation of the international Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean (the Agreement). The EU's attention is now focussed on promoting the full implementation of the Joint Program of Scientific Research and Monitoring (JPSRM) and ensuring that the deadlines of the Agreement are met, notably regarding the adoption of a conservation measure on exploratory fisheries.

Key recommendations arising from EFICA's work:

1. Develop a clear Implementation Plan that integrates scientific and indigenous knowledge, has a Standard Operational Protocol, ensures efficient collaboration, and secures robust financial support from the Parties for mapping, monitoring and ecosystem modelling.

2. Conduct more acoustic mapping and pelagic food web surveys to collect basic data on climate change impact, fish ecology, food webs and fish stocks, and better understand species migration linked to climate change.

3. Maintain an ecosystem approach that utilises the best scientific, indigenous, and local knowledge, develop targeted trawling techniques for sampling fish inbetween ice floes, and enables focus on specific areas of interest.

4. Advance the JPSRM by advocating for the standardisation of sampling methods and reinforcing international cooperation to generate valuable data for guiding policy and management in the Central Arctic Ocean.

5. Establish an international collaboration network that includes all Parties, coordinated by a central organisational body, to facilitate daily operations and streamline communication.

CINEA in Brief

The European Climate, Infrastructure and Environment Executive Agency (CINEA) has been established by the European Commission to implement parts of EU funding programmes for transport, energy, climate action, environment and maritime fisheries and aquaculture.

CINEA has a multinational team, including specialists in project management, financial management, legal affairs and communication.

Seven European Commission's Directorates-General oversee CINEA's activities:

- » DG Mobility & Transport (MOVE)
- » DG Energy (ENER)
- » DG Research & Innovation (RTD)
- » DG Climate Action (CLIMA)
- » DG Environment (ENV)
- » DG Maritime Affairs and Fisheries (MARE)
- » DG Regional and Urban Policy (REGIO)

Providing added value to beneficiaries

CINEA's long-standing experience in programme management provides the beneficiaries with:

» Simplified access to EU funding opportunities

» Promotion of project results and achievements for increased visibility of EU actions and promotion of the programmes

» Guidance and technical support in project management, financial engineering, public procurement, and environmental legislation in close collaboration with beneficiaries

» Streamlined and harmonised procedures for a better use of EU funds and maximised programme efficiency, such as shorter payment times and faster response rate

» Efficient evaluation procedures, user friendly and transparent call documentation, and customised IT tools to support applicants.

Supporting the European Commission

CINEA is also supporting the policymakers and the European Commission with:

- » Relevant feedback on programme implementation as input to policymaking
- » Developing synergies between programmes to bridge the gap between R&I results and infrastructure development
- » Bringing innovative ideas, concepts and products to implementation
- » Building significant economies of scale

CINEA IN NUMBERS

BY 2027 MANAGING

4 000 PROJECTS BUDGET 2021 - 2027

65 BILLION



600 STAFF



European Climate, Infrastructure and Environment Executive Agency

European Commission

W910

B-1049 Brussels, Belgium

+32 (0)2 299 5252



https://cinea.ec.europa.eu





X @cine



<u>CINEA - European Commission Executive</u> Agency



ISBN 978-92-9405-034-2 doi: 10.2926/772512