Report of the 1st meeting of the Provisional Scientific Coordinating Group (PSCG) of the Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean.

11-13 February 2020

Ispra, Italy

Executive summary

The Provisional Scientific Coordinating Group (PSCG) of the Preparatory Conference for the Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean, met for the first time from the 11th to the 13th of February 2020. The meeting was hosted by the European Union in the European Commission Joint Research Centre facilities in Ispra, Italy. The PSCG was attended by 37 experts from all signatories except China due to flight restrictions.

The work carried out allowed the PSCG to address successfully the Terms of Reference (ToR) set by the Meeting of Signatories of May 2019, and provide advice and relevant information to the Preparatory Conference for the Agreement, reflecting the best available scientific information.

TOR 1 Develop Interim Rules of Procedure for the PSCG

The PSCG adopted interim rules of procedures for the current meeting and developed a proposal for future PSCG meetings, or succeeding body, to be submitted to the Preparatory Conference for the Agreement for their review and approval.

TOR 2 Identify processes and mechanisms to incorporate indigenous and local knowledge, through the inclusion of representatives of Arctic communities, including Arctic indigenous peoples, in the work of the PSCG, taking into account the outcomes of the workshop on this topic to be hosted by Canada.

The PSCG suggests delegations for future PSCG meetings to include both scientists and other experts, including Indigenous and local knowledge holders, appointed by each Signatory as each Signatory deems appropriate. The rules of procedures proposal (TOR 1) include options to allow this situation. However, the PSCG observes the importance to ensure some level of continuity within each PSCG delegation from meeting to meeting. Furthermore, the PSCG recognizes the large diversity across Indigenous and Local Knowledge holders' communities and suggests that approaches to include Indigenous and local knowledge holders should be adjusted to each forum. The PSCG supports the continuation and fostering of the dialogue with Indigenous and local knowledge holders and suggests that mechanisms to foster such dialogue need to be considered and established, for example a PSCG working group. Lastly, PSCG participants decided to create a collection of literature related to this subject, which will be made available to all Signatories and their experts.

TOR 3 Update the list in the 5th FiSCAO report[1] of current or upcoming scientific activities and platforms of opportunity for scientific mapping work in the Central Arctic Ocean that could contribute relevant information and data to the Joint Program of Scientific Research and Monitoring and identify the knowledge gaps addressed by each activity or platform.

The PSCG updated information from the 5th FiSCAO report regarding current or upcoming related research programmes. Knowledge gaps covered by each activity were identified, as well as current national data sharing processes.

TOR 4 Prioritize mapping work based on gaps identified in the 5th FiSCAO report, and any updates to these gaps, and coordinate among Signatories opportunities for conducting scientific mapping work in accordance with the Joint Program of Scientific Research and Monitoring, including by using upcoming scheduled scientific activities and platforms of opportunity identified by the Signatories.

The PSCG identified priorities and a number of activities that constitute important opportunities to collect information to support the mapping process. The PSCG suggests signatories and participants to attend and present PSCG's goals and results in future scientific meetings and workshops to raise awareness of PSCG's work and promote collaboration with other international and national bodies. The PSCG acknowledges that having several surveys collecting samples of fish in the Central Arctic Ocean and adjacent areas may create a problem of comparability of results if the sampling devices used are not standardized. Therefore, the PSCG proposes to the Signatories the creation of a working group on the development and standardization of sampling devices to collect fish samples in the Central Arctic Ocean and adjacent areas, to take place late 2020 or early 2021.

TOR 5 Update the Inventory of Monitoring Programs in the High Seas Central Arctic Ocean and adjacent water (appendix B of 5th FiSCAO report)

The list of Central Arctic Ocean monitoring programmes were updated by the signatories attending the PSCG.

Following discussions with the chairperson of the Preparatory Conference for the Agreement, the Korean delegation announced its intent to host the next meeting of the Preparatory Conference for the Agreement (dates and venue to be decided).

1https://archive.fisheries.noaa.gov/Arctic_fish_stocks_fifth_meeting/pdfs/Final_report_of_the_5th_FiSCAO_meeting.pdf

Introduction

The Signatories to the Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean established a Provisional Scientific Coordinating Group (PSCG) to further prepare for the implementation of the Agreement.

The PSCG was established on an interim basis to provide scientific support and advice to the Signatories on matters related to the implementation of the Agreement, develop reports and advice for the biennial Meetings of the Signatories[2] (MoS), and provide support for the scientific work called for under the Agreement.

In detail, the PSCG has the following objectives:

- Develop interim Rules of Procedure for the PSCG.
- Develop the Joint Program of Scientific Research and Monitoring (JPSRM), and, in the interim, coordinate scientific activities by the Signatories in a manner consistent with Article 4 of the Agreement.
- Develop the data sharing protocol as called for in Article 4 in the Agreement.
- Identify processes and mechanisms to incorporate indigenous and local knowledge, through the inclusion of representatives of Arctic communities, including Arctic indigenous peoples, in the work of the PSCG.
- Provide scientific advice for the development of conservation and management measures for exploratory fishing, and other interim measures, as requested by the Signatories.
- Develop quantitative indicators based, *inter alia*, on data collected during the mapping phase.
- Facilitate the possible exchange of samples.
- Promote cooperation by the scientific experts of the Signatories with relevant scientific and technical organizations, bodies, and programs.
- Other functions as may be assigned.

The Provisional Scientific Coordinating Group (PSCG) of the Preparatory Conference for the Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean, met for the first time from the 11th to the 13th of February 2020. The meeting was hosted by the European Union at the European Commission Joint Research Centre facilities in Ispra, Italy.

2 or preparatory conference until MoS is set.

The PSCG was attended by 37 participants from most Signatories as well as from the International Council for the Exploration of the Sea (ICES) and the Northeast Atlantic Fisheries Commission (NEAFC). The Chinese delegation was not able to attend due to COVID19-related flight restrictions, and, due to scheduling conflicts, Indigenous and Local Knowledge holders were also unable to attend.

The PSCG addressed the terms of reference set by the Meeting of Signatories of May 2019, and, with this report, provides advice and relevant information to the Preparatory Conference for the Agreement, reflecting the best available scientific information.

The terms of reference given to the PSCG were:

- TOR 1 Develop Interim Rules of Procedure for the PSCG
- TOR 2 Identify processes and mechanisms to incorporate Indigenous and Local Knowledge, through the inclusion of representatives of Arctic communities, including Arctic indigenous peoples, in the work of the PSCG, taking into account the outcomes of the workshop on this topic to be hosted by Canada.
- TOR 3 Update the list in the 5th FiSCAO report[3] of current or upcoming scientific activities and platforms of opportunity for scientific mapping work in the Central Arctic Ocean that could contribute relevant information and data to the Joint Program of Scientific Research and Monitoring and identify the knowledge gaps addressed by each activity or platform.
- TOR 4 Prioritize mapping work based on gaps identified in the 5th FiSCAO report, and any updates to these gaps, and coordinate among Signatories opportunities for conducting scientific mapping work in accordance with the Joint Program of Scientific Research and Monitoring, including by using upcoming scheduled scientific activities and platforms of opportunity identified by the Signatories.
- TOR 5 Update the Inventory of Monitoring Programs in the High Seas Central Arctic Ocean and adjacent water (appendix B of 5th FiSCAO report).

Following discussions with the chairperson of the Preparatory Conference for the Agreement, the Korean delegation announced its intent to host the next meeting of the Preparatory Conference for the Agreement. PSCG members expressed appreciation for the announcement, and the Korean

[3] https://www.fisheries.noaa.gov/event/fifth-meeting-scientific-experts-fish-stocks-central-arctic-ocean

delegation undertook to provide further information about the meeting to Signatories, including dates and venue.

ToR 01 – Rules of Procedures

A subgroup with representatives from all Signatories present discussed draft rules of procedure (RoP) for the present and future meetings of the PSCG, based on background documentation provided by the chair. A note from the Chinese delegation concerning certain provisions of the proposed ToR was taken into account during the discussions. The group also benefitted from advice from experts from the International Council for the Exploration of the Sea (ICES) and the North East Atlantic Fisheries Commission (NEAFC), as well as the Conference of Signatories' chairperson.

The RoPs adopted for the 1st meeting of the PSCG address decision-making, reporting, subgroups, transparency, and language (see Annex 02 – Rules of Procedures for 1st Provisional Scientific Coordinating Group (PSCG, 2020)).

The recommendations for RoPs for subsequent meetings of the PSCG were discussed in several sessions at the meeting (see Annex 03 – Proposal of Rules of Procedures future PSCG meetings or succeeding body). The PSCG recommends that these interim RoP form the basis for future scientific meetings once the Agreement enters into force. Regarding membership, the PSCG suggests holders of Indigenous and Local Knowledge (ILK) be included among delegation's experts, as each Signatory deems appropriate. For procedural aspects of chairing meetings, the proposal includes discussions of the roles of both a chairperson and vice-chairperson and possible rotation of chairpersons and timing aspects. Duties of the chairpersons are listed as well, including language related to the invitation of external experts. With regards to the provision of advice and recommendations, it's suggested it should be by consensus, but, where agreement cannot be reached, the different views should be made explicit in the meeting report. The Order of Business section specifies that documents have to be made available 20 days prior to any PSCG meeting. Regarding reporting, the PSCG suggests that written reports are prepared within certain time limits and submitted to Signatories before being made public. In addition, the proposal suggests rules on the establishment of sub-groups and working groups, including their chairing, participation and reporting. The RoPs also includes language regarding participation in the PSCG by observers.

ToR 02 – Incorporation of Indigenous and Local Knowledge (ILK)

Through ToR 2, the Signatories charged the PSCG with identifying processes and mechanisms to incorporate Indigenous and Local Knowledge (ILK) in the work of the PSCG, taking into account the outcomes of the workshop on this topic hosted by Canada in Yellowknife, Northwest Territories, in November 2019. Unfortunately, due to scheduling conflicts no indigenous representatives were able to attend the PSCG meeting. They could thus unfortunately not contribute actively to the conversation.

Canada presented a summary of the discussions and outcomes from the Yellowknife workshop, and shared the three options discussed at the workshop:

- Option 1, PSCG membership would include delegations from each Signatory. Those delegations would include both scientists and ILK holders, as appropriate, sending products and advice to the Signatories (i.e., decision-makers) as a single body.
- Option 2 would establish an Indigenous and Local Knowledge Working Group consisting of representatives of ILK holders, which would then provide information to the PSCG. PSCG delegations would be designated in the same manner as described in Option 1. Jointly developed products and advice would then be sent to the Signatories from the PSCG.
- Option 3 would establish two complimentary working groups: the PSCG and an ILK Working Group. Under this option, the PSCG would consist of scientists, with ILK holders as observers, and the ILK Working Group would consist of ILK holders with scientists as observers. Each group would then provide independent products and advice to the Signatories.

PSCG's participants used the summary of these options as the starting point for discussions. It was noted that ILK and science are two complimentary knowledge systems. The Inuit Circumpolar Council considers Indigenous or Inuit Knowledge to be a "systematic way of thinking applied to phenomena across biological, physical, cultural, and spiritual systems. It includes insights based on evidence acquired through direct and long-term experiences and extensive and multigenerational observations, lessons, and skills. It has developed over millennia and is still developing in a living process, including knowledge acquired today and in the future, and it is passed on from generation to

generation[4].” Thus, Indigenous Knowledge “goes beyond observations and ecological knowledge, offering a unique ‘way of knowing’ to identify and apply to research needs which will ultimately inform decision-makers[5].”

PSCG noted the importance of understanding how each Signatory works to incorporate and co-produce knowledge. Sharing these experiences is important for all Signatories (especially those without indigenous communities) to understand, to help us establish successful processes and mechanisms to incorporate ILK into the PSCG and ultimately the Joint Program of Scientific Research and Monitoring (JPSRM) called for in Article 4 of the Agreement.

The PSCG participants recommend delegations for future PSCG meetings to include both scientists and other experts, including ILK holders, appointed by each Signatory as they deem appropriate. The PSCG would then establish working groups or sub-groups, as needed, with relevant expertise included in each such group. Participants note this approach is reflected in the draft Rules of Procedure developed under ToR 1. The PSCG also noted the diversity among indigenous communities throughout the Arctic. Indigenous and local representation on the PSCG should reflect this diversity, while ensuring some level of continuity within each PSCG delegation from meeting to meeting.

In order to validate this approach, PSCG participants discussed presenting this proposed process to a meeting of Indigenous Knowledge holders currently proposed for June 2020 in Canada[6]. Complementary, it would also be helpful to discuss with the indigenous representatives, the objective of the Agreement and the key questions identified in the Fourth and Fifth FiSCAO reports, that need to be addressed by the mapping and monitoring phases. If considered relevant, the PSCG recommends Signatories not involved in the June meeting should consider having a similar dialogue with their ILK communities. Lastly, PSCG participants decided to create a collection of literature

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4 Inuit Circumpolar Council-Alaska, Alaskan Inuit Food Security Conceptual Framework: How to Assess the Arctic From an Inuit Perspective. 2015, pp. 1–115.

5 Ibid

6 Note, due to the COVID-19 global pandemic, the proposed face-to-face workshop meeting in Cambridge Bay, Nunvavut, was replaced with three online workshops. The first was held in early July and the others will take place in the fall. The outcomes of the process remain unchanged.

about the integration of ILK in the PSCG and JPSRM, which will be made available to all Signatories and their experts.

A letter from the President of the Inuit Circumpolar Council (Alaska) expressing the views of the Inuit Circumpolar Council (ICC) was circulated to all participants (see Annex 04 - Letter from the President of the Inuit Circumpolar Council (Alaska)). In annex 05 a description of Greenland's approach to deal with Indigenous and Local Knowledge is presented.

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ToR 03 – Update on the planned scientific activities

List of current and upcoming scientific activities

ToR 3 directed the PSCG to update the list of current and upcoming scientific activities in the High Seas of the Central Arctic Ocean, firstly reported in the 5th FiSCAO report. The list was expanded to also include relevant work in waters adjacent to the High Seas CAO. Participants identified upcoming scientific activities, platforms of opportunity, and added online registries of research vessels and facilities to assist in identifying upcoming research opportunities (Table 1). In addition, participants also listed other expert groups conducting syntheses of information that include ecosystems in the High Seas CAO in their scope of work.

Table 1 - Upcoming research vessels and programs collecting relevant data for the JPSRM in the High Seas CAO and in adjacent waters including the basic information on the data gaps addressed.

Vessel or Program	**Data Gap**
Kapitan Dranitsyn - Russian	Hydroacoustics
USA - Healey - heavy icebreaker.	Hydroacoustics, oceanorgraphy, fishing might be possible with a beam trawl via A-frame; Surface and Under-Ice Trawl (SUIT)
USA – R/V Sikuliag	Fishing capable, ice reinforced, could be chartered
JOIS (SAS) - oceanographic - might add hydro acoustics?	Hydroacoustics - likely no but might be able to be added
Whales as data collection platforms.	Oceanography
CBS-MEA - if possible would they continue into the high seas?	Fish, benthic invertebrates, zooplankton, oceanography
USA – Presidential memorandum on Ocean mapping - map entire EEZ, specifically looking at shoreline of Alaska - vessels https://www.whitehouse.gov/presidential-actions/memorandum-ocean-mapping-united-states-exclusive-economic-zone-shoreline-nearshore-alaska/	Oceanographic, can't combine multi-beam with fish hydroacoustic surveys
Seabed 2030	Oceanographic, can't combine multi-beam with fish hydroacoustic surveys
Nansen Legacy	Not fishing - other programs are better for fishing Could they add some fishing
Norway/Russia Barents Sea fish surveys	How far will this be extended into the high seas CAO?
K-AOOS (Korea Arctic Ocean Observing System) - onboard IBRV Araon	Oceanographic and hydroacoustic surveys, ichthyoplankton sampling (no targeted fish sampling as yet)
DBO vessels from any country	
PAME shipping inventory	

Vessel or Program	Data Gap
European Polar Board - catalogue and database	http://europeanpolarboard.org/polar-infrastructure/ http://www.europeanpolarboard.org/polar-infrastructure/european-polar-infrastructure-catalogue/
Eurofleet	https://www.eurofleets.eu/
ARICE	http.arice.eu
EU (Sweden) - Oden	Upcoming expedition: SAS-Oden 2021, including mesopelagic fish sampling under the CAO pack ice. Regular oceanographic expeditions in the Arctic Ocean with focus on the CAO, operated by the Swedish Polar Research Secretariat for scientific research.
EU (Germany) - Polarstern	Regular oceanographic expeditions in the CAO / availability of ship time via secondary user request: https://www.portal-forschungsschiffe.de/index.php?index=53 / fishing capable (benthic, pelagic, Surface and Under-Ice Trawl (SUIT) for ice-associated fauna - including juvenile polar cod)
EU (Italy) - Laura Bassy	Upcoming expedition: SAS 2021
Synoptic Arctic Survey (SAS) An initiative driven by scientists (https://synopticarcticsurvey.w.uib.no). Many of the vessels and projects below participate in SAS in 2020-2022	Synoptic Arctic Ocean ecosystem status Synchronization of methodology
NABOS (USA, Russia, Germany)	Oceanographic expeditions in CAO. Possibility of hydroacoustics?
Mirai (Japan)	Oceanographic

List of other expert groups conducting work relevant to the PSCG

The PSCG recognizes that several expert groups are also conducting work relevant to understand fish dynamics and supporting ecosystems of the High Seas CAO and adjacent waters. To potentially avoid duplication of effort and to leverage existing activities, PSCG's participants highlighted several of these groups and their activities:

- ICES/PICES/PAME Working Group for the Integrated Ecosystem Assessment of the Central Arctic Ocean (WGICA): This WG is developing integrated ecosystem assessments, including ecosystem overviews, for the Central Arctic Ocean using available information. The geographical scope includes the CAO Large Marine Ecosystem developed by PAME.
- CAFF's Circumpolar Biodiversity Monitoring Program – Marine (CBMP-Marine): The CBMP-Marine is a network of partners to harmonize and enhance long-term monitoring efforts on the status and trends of key marine species and their attributes. CBMP-Marine

identifies eight Arctic Marine Regions, the High Seas CAO largely overlaps with the Arctic Basin but also other defined regions such as the Pacific-Arctic.

- Other Arctic Council working groups such as Protection of the Arctic Marine Environment (PAME) and Arctic Monitoring and Assessment Programme (AMAP): Potentially relevant projects and assessments are undertaken by PAME and AMAP on themes related to climate change, marine protected areas, ecosystem approach to management, shipping (underwater noise, biological impacts) and pollution (marine litter).
- International Council for the Exploration of the Sea (ICES) and North Pacific Marine Science Organization (PICES): Organizations that provide scientific coordination, data analysis, communications and advice. ICES, for example, provides advice to the North East Atlantic Fisheries Commission (NEAFC) which includes under its jurisdiction a portion of the Central Arctic Ocean.

ToR 04 – Prioritize mapping activities

Ongoing activities in the CAO

The Research Consortium EFICA (European Fisheries Inventory in the Central Arctic Ocean) presented ongoing field work in the High Seas of the CAO. The Consortium consists of scientific institutes from Sweden, Germany, Belgium, The Netherlands and Denmark, funded by the European Union to collect primary data on fish stocks and ecosystem variables that currently live in the CAO during 2019 and 2020. The field work has started through participation of EFICA scientists in the MOSAiC (Multidisciplinary drifting Observatory for the Study of Arctic Climate) expedition with the German icebreaker Polarstern. This is a transpolar ice-drift expedition in the Amundsen and Nansen Basins from 85^{o} N outside the Laptev Sea (September 2019), over the North Pole area to ca. 80^{o} N in Fram Strait (October 2020). During the MOSAiC expedition, four methods are used for data collection on fish stocks. However, the principal method normally used in fishery research, trawling, is impossible to employ because the ocean is covered by thick sea ice (usually 1-2 m).

The first method is hydroacoustics for estimating stock size and structure of fish and zooplankton. A full year of data will be obtained from MOSAiC during its passive drift with the sea ice. This will be a unique data set, because hydroacoustic data from vessels breaking ice cannot be used due to high noise hindering the hydroacoustic record. During Leg 1 of MOSAiC, the EFICA scientists observed the same mesopelagic deep scattering layer (DSL) in the Atlantic water layer as similar to a previously observed DSL with the Swedish icebreaker Oden (2016), with similar very low abundance of fish-sized organisms (size ca. 15 cm, <500 individuals km^{-2}), which indicates extremely low total stock biomass. The second method consists of visual observations with video cameras to validate echosounder data indicating fish versus large zooplankton, and potentially assess species and behaviour. During Leg 1 of MOSAiC, fish observations were extremely rare and the fish flee the camera lights too fast to be able to identify species. The rarity of fish observed confirms the low biomass recorded by hydroacoustics. The third method comprises fish sampling from holes in the ice with different fishing gears to assess species, diet, population genetics, and migration. During Leg 1 of MOSAiC, the EFICA scientists were able to sample four fish from the pelagic zone (data to be published soon). This low number of fish sampled also confirms the low biomass recorded by hydroacoustics. Sympagic juvenile *Boreogadus* were often observed in holes and leads in the ice and were systematically recorded by surveys with a ROV, but they were very difficult to catch and until now only two juvenile *Boreogadus* were sampled during MOSAiC Leg 1. The fourth and last method is bioinformatics of eDNA as an indirect way to monitor the occurrence of fish and

zooplankton by DNA sequences. For this purpose, weekly water samples are taken with Niskin bottles attached to a CTD during the whole MOSAiC year. EFICA scientists participate in the expedition's Core Parameter sampling, and will therefore have access to environmental and biotic data crucial for interpreting the results.

Updates to knowledge gaps

Since the gap analysis in the Fifth FiSCAO Report (April 2018), the European Union has published the Report "Review of the research knowledge and gaps on fish populations, fisheries and linked ecosystems in the Central Arctic Ocean (CAO)" (https://op.europa.eu/en/publication-detail/-/publication/aae1e59e-46fe-11ea-b81b-01aa75ed71a1) in February 2020, which approaches the issue from a slightly different angle (more ecosystem-focussed). With respect to gap analysis on the CAO fish stocks, both reports arrived at similar conclusions. In spring 2020, another report is expected to be published: the First Report of the ICES/PICES/PAME WGICA with the preliminary title "Integrated Ecosystem Assessment of the Central Arctic Ocean: Ecosystem description and vulnerability characterization". The WGICA report concludes that the CAO is under-sampled and understudied when it comes to the fish fauna in this remote sea area. Based on these three reports, as well as reports from previous FiSCAO meetings (2011–2017) and other scientific work, the PSCG suggests an official start of the mapping phase of the JPSRM as soon as possible.

Opportunities for data collection in the CAO

Although scientific knowledge about the CAO and adjacent waters is increasing, it does not necessarily refer to potential commercial fish species in the CAO. Expeditions to the CAO are very expensive, and the best way forward is to use opportunities of adding fish studies to already planned scientific expeditions and routine monitoring programmes by the Signatories. In 2019-2021, several expeditions for collecting new primary data in the CAO are ongoing or will take place, e.g. the MOSAiC Expedition (see above), and the various expeditions within the Synoptic Arctic Survey (SAS). These scientific expeditions include programs for basic physical, chemical and biological oceanography onboard (i.e., data necessary for interpreting and modelling fish distributions).

The Signatories to the Agreement could execute the mapping phase of the JPSRM[7] in the next three years in the High Seas of the CAO in two principal ways (**Error! Reference source not found.**): (1) by funding participation of fish scientists on scientific expeditions organized by the respective Signatories' countries, and (2) by extending routine monitoring programmes in the shelf seas into the CAO as far as possible when the ice cover reaches its yearly minimum in September. A third possibility is the deployment of buoys with sensors, such as acoustics and cameras, but this would need method development and is quite expensive and risky (such buoys are easily lost by ice movements), and would therefore be more appropriate for the Monitoring Program that will succeed the mapping phase of the JPSRM.

Table 2 - Possibilities for the Signatories of the Agreement to execute the mapping phase of the JPSRM by connecting fish studies to already planned expeditions, by extending already ongoing monitoring programmes into the CAO and by automated measurements on buoys.

Type of expedition	Possibilities for the Signatories	Extra costs for the Signatories
Icebreaker equipped for research in the CAO	Connect to scientific oceanographic expeditions Access to environmental and biological data	For adding fishery research (acoustics, lines, ring nets, but no trawling is possible) SAS 2020-2022, ARICE
Ice-going vessels normally working in the Arctic shelf seas	Connect to scientific oceanographic expeditions Access to environmental and biological data Connect to standard monitoring programs	For adding fishery research (acoustics, lines, ring nets, but no trawling is possible) For going into areas of the CAO in late summer when the ice cover is the lowest
Fishery vessels normally working in the Arctic shelf seas	Connect to standard monitoring programs	For going into areas of the CAO in late summer when the ice cover is the lowest
Buoys to be deployed by icebreakers	Connect to scientific oceanographic expeditions for deployment	Development of buoys with hydroacoustic measurements and visual observations (cameras)

Of particular note, the Synoptic Arctic Survey is currently (2020-2022) collecting oceanographic data throughout the Central Arctic Ocean and in adjacent waters (Figure 1). The goals of the mapping phase of the JPSRM could be largely achieved in the near term by partnering with contributors of the SAS. To achieve as complete a level of spatial coverage as possible, the PSCG suggests that Signatories consider engaging with the SAS to collect fish and invertebrate data in conjunction with SAS's oceanographic surveys (which are primarily using icebreaker vessels). At a minimum, vessels undertaking oceanographic data collection under the SAS framework should make

[7] As noted in the FiSCAO reports, mapping here refers to delineation of the spatial extent of species, irrespective of abundance and habitat characteristics, including physical and biological oceanographic conditions and trophic interactions.

efforts to add feasible fish data collection methods (e.g., hydroacoustic surveys) to the suite of parameters collected.

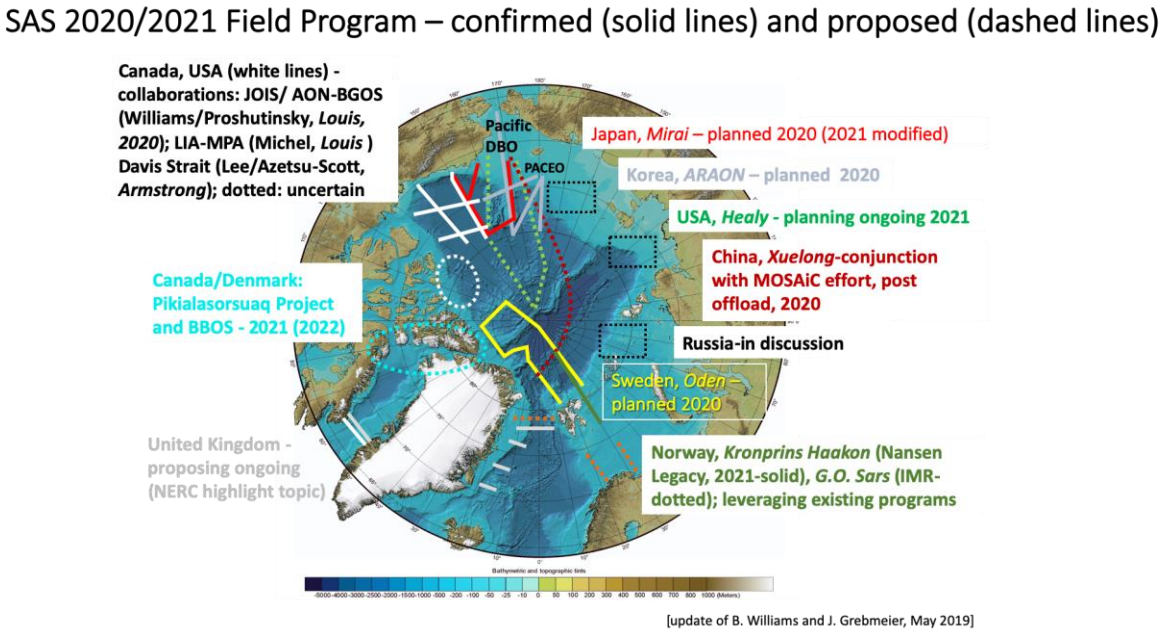

Figure 1 - Status of planning for the Synoptic Arctic Survey (SAS). The map shows the proposed routes for the expeditions that are in different stages of planning. This is a bottom-up initiative driven by scientists to study all parts of the Arctic Ocean from as many vessels as possible in 2020-2021, synchronize sampling methods and modelling the Arctic marine ecosystems. Fish studies are not part of the planning of most of these expeditions but could be added by the Signatories through funding fish studies on their own vessels. Please note that all Signatories, except Iceland, are involved in SAS. Figure source: Jacqueline Grebmeier (SAS, USA, https://synopticarcticsurvey.w.uib.no/)

Proposal to establish a Fish Sampling Device Working Group

Since a large part of the High Seas portion of the CAO is covered by thick sea ice (usually 1-2 m) the most common method to sample fish, trawling, cannot be used. However, as stated repeatedly in reports from the FiSCAO meetings since 2013, it is of paramount importance to collect fish samples from the Atlantic water layer (200-600 m of depth) from all parts of the CAO to estimate abundances and ground truth acoustic signals recorded in previous surveys.

A series of research updates given by the Signatories highlighted that several research programs are attempting to document fish biomass and abundance via direct capture techniques (Surface and Under Ice Trawl (SUIT), long line fishing, etc) or using indirect measures (hydroacoustics, eDNA, camera, etc). During these presentations it became clear that the techniques currently used are not standardized, while new ones are being developed or modified for work in ice-covered conditions.

Given the difficulty in conducting fish stock assessments with data collected by non-calibrated sampling devices and using multiple methodologies, the PSCG discussed the need for coordination

of methods development with an eventual goal to adopt/recommend a set of protocols for data collection methods (For example, metadata, data formats, entry time, vetting, etc.) and configurations of sampling devices.

Therefore, the PSCG proposes to establish a Sampling Device Working Group within the PSGC, to provide advice on the standardization and calibration of under-ice sampling devices for fish species in the CAO. The WG should propose, test and agree to the extent possible: (i) the number and size of hooks, bait type and bait size used on long lines, (ii) standards for gill net size and mesh sizes, (iii) standards for ring nets, and (iv) other relevant advice; to be used by research vessels in the CAO, while taking into account the diversity of habitats and the impact of such operations on ecosystems may have. This guidance will allow the Signatories to collect comparable fish samples across expeditions and areas, fostering the creation of a robust dataset for future scientific work. PSCG's participants agreed to develop terms of reference for this Working Group via e-mail, which are then to be submitted to the Meeting of Signatories for consideration.

Identify priorities and assess implementation

Table 3 summarizes the scientific rationale, gaps and opportunities to address the questions outlined in Section 2.1 of the 5th FiSCAO meeting report (FiSCAO 2018), of which the participants noted the importance of prioritizing knowledge collection for the first three:

(1) What are the distributions of species with a potential for future commercial harvests in the High Seas CAO?

(2) What fish species are currently present in the High Seas CAO?

(3) What are the trophic linkages among fishes and between fishes and other taxonomic groups (i.e., quantify food webs) in the CAO?

(4): What are the likely key ecological linkages between potentially harvestable fish stocks of the High Seas CAO and adjacent shelf ecosystems?

It should be kept in mind that the overall goal of the mapping phase is to define a set of indicators, devices and methods to be used during the monitoring phase of the JPSRM. An additional high priority of major concern to the PSCG is the need to establish, as soon as possible, metadata standards for the data to be collected within both the mapping and monitoring phases of the JPSRM. This is usually a major problem in multinational surveys. During the meeting, participants heard a presentation from ICES about the organizations capabilities in this area and ICES' willingness to provide advice on this matter.

Table 3 Questions (1)-(4) were posed by the 2013 Meeting of Governments and discussed and analysed at the subsequent FiSCAO Meetings (2013, 2015, 2016, 2017). For each question, the PSCG undertook to identify the current knowledge gaps while taking into account recent scientific work and particularly those activities since the 5th FiSCAO meeting in 2017 and included recommendations for possible actions by Signatories and scientists. Knowledge gaps entries are assessed on the basis of findings in the EU Report from February 2020 (ref): 0 = no knowledge, 1 = serious lack of knowledge, 2 = insufficient knowledge, 3 = sufficient knowledge for fish stock modelling, assessments and to evaluate possibilities for future fishing. Future research should continue to prioritize activities that would address Questions (1) and (2). When possible, these research activities should also undertake work that would contribute to Question (3). Question (4) is a highly important issue but this is not a priority for action until knowledge is improved on Questions (1), (2) and (3).

Questions	Size of the knowledge gaps	What is (being) done to date	Possible actions by Signatories	Possible actions by scientists
(1) What are the distributions of species with a potential for future commercial harvests in the High Seas CAO?	Fish stock structure in the Arctic shelf seas: 3 Barents Sea 3 Bering Sea 2 Beaufort, Chukchi Sea 2 Fram Strait 1 Kara, Laptev, East Siberian Sea 1 North of Canada and Greenland 0 Central Arctic Ocean	Fourth FiSCAO Report, including Appendix B: Synthesis of knowledge on fisheries science in the CAO and Adjacent Waters Fifth FiSCAO Report EU Gap Analysis Report (Chapter 6) First WGICA Report (spring 2020) Scientific and monitoring data from shelf seas exist for most shelf seas, but not all are internationally available	Provide funding for studies on fishes and fisheries to planned and upcoming scientific expeditions in the shelf seas (trawling), e.g. SAS (national level) Through international political agreements create possibilities for scientists to share pan-Arctic fish-stock data for the shelf seas for scientific cooperation on fish-stock structure and dynamics (international level) Provide funding for joint data analyses between the Signatories, including all shelf seas (international level)	Model traits, habitat suitability, step-stone (= on the verge of entering the CAO) of species that might occur in the CAO, including IPCC scenario modelling
(2) What fish species are currently present in the High Seas CAO?	Data from the CAO: 0-1 Pelagic (water column) fishes 0-1 Benthic (bottom) fishes 1 Sympagic (ice-associated) fishes 0-1 Fish stock structure 1 Primary productivity 1 Secondary productivity 2-3 Physical oceanography and ice dynamics 0 Fish ecology 0 Horizontal and vertical migrations 0 Winter survival	Fourth FiSCAO Report, including Appendix B: Synthesis of knowledge on fisheries science in the CAO and Adjacent Waters Fifth FiSCAO Report EU Gap Analysis Report (Chapters 3 and 4) First WGICA Report (spring 2020) EU project EFICA with sampling on MOSAiC and SAS-Oden in the CAO	Provide funding for studies on fishes and fisheries to scientific expeditions in the CAO (under-ice fishing), and where possible, open water fishing), e.g. SAS (national level) Reserve funding and anticipatory agreement and logistic/sampling plan for ad-hoc surveys in years of extremely low sea-ice extent for extending on-going national fish-stock monitoring programs into the CAO when the sea ice cover is absent or thin enough to enable trawling (national level) Provide funding for joint method development between the Signatories for under-ice fishing (international level)	Participate in the proposed PSCG's Device Working Group on developing fish sampling devices. - Collect hydroacoustic data in the CAO (EK60/80, 38 kHz) - Collect fish samples, determine species, length, weight, age, stomach contents, stable isotopes in the CAO - Collect eDNA samples, identify fish genes in the CAO with Model the current fish stocks in the CAO (first attempts could be made in 2-3 years)

Questions	Size of the knowledge gaps	What is (being) done to date	Possible actions by Signatories	Possible actions by scientists
(3) What are the trophic linkages among fishes and between fishes and other taxonomic groups (i.e., quantify food webs) in the CAO?	Data from the CAO: 2 Abundance and distribution of phytoplankton and ice-algae 1 Abundance and distributions of zooplankton and sympagic fauna 0 Abundance and distributions of fishes 0 Abundance and distributions of birds and mammals	Fourth FiSCAO Report, including Appendix B: Synthesis of knowledge on fisheries science in the CAO and Adjacent Waters Fifth FiSCAO Report EU Gap Analysis Report (Chapter 5) First WGICA Report (spring 2020) EU project EFICA with sampling on MOSAiC and SAS-Oden in the CAO Stomach analyses of sympagic fishes (juvenile *Boreogadus*) Biomarker analyses (fatty acids and stable isotopes) of sympagic fishes (juvenile *Boreogadus*)	Provide funding for food-web studies, including biomarkers to scientific expeditions in the CAO (under-ice fishing), e.g. SAS (national level) Reserve funding and anticipatory agreement and logistic/sampling plan for ad-hoc surveys in years of extremely low sea-ice extent for extending on-going national fish-stock monitoring programs into the CAO when the sea ice cover is absent or thin enough to enable trawling and data collection for primary production, prey and predator studies (national level) Provide funding for sample and data analysis for the CAO (national level)	Collect hydroacoustic and/or video-optical data in the CAO (EK60/80, 38 kHz, 70 kHz, 120 kHz, 200 kHz, AZFPs, LOKI) to study spatial interactions of fishes and prey in the CAO - Collect biogeochemical, physical, and associated food-web parameters (CAO) - Collect phytoplankton and ice-algal samples, analyse stable isotopes, fatty acids (CAO) - Collect invertebrate samples, analyse stomach contents, stable isotopes, fatty acids and other biomarkers (CAO) - Collect fish samples, analyse stomach contents, stable isotopes, fatty acids, otoliths for trophic fluxes and other biomarkers (CAO) - Collect data on marine mammal and seabird distributions and movement patterns and when possible, any associated environmental parameters (e.g, tagging studies, ship-based or aerial surveys) (CAO) - Collect eDNA samples, identify fish and invertebrate genes (CAO) Model the food webs of the CAO (first attempts could be made in 2-3 years)
(4) What are the likely key ecological linkages between potentially harvestable fish stocks of the High Seas CAO and adjacent shelf ecosystems?	Likely key linkages: 1 Knowledge of spawning areas 0-1 Migration patterns 2 Gene flow 1-2 Trophic linkages (predation, invertebrate prey advection) 1-2 Competition Dynamics of the Arctic ecosystems with climate change: 2-3 Physical (ice, water currents) 1-2 Chemical (nutrients, acidification) 0-1 Biological	Fourth FiSCAO Report, including Appendix B: Synthesis of knowledge on fisheries science in the CAO and Adjacent Waters Fifth FiSCAO Report EU Gap Analysis Report (especially Chapter 9) Publications on borealisation and species interaction in the shelf seas (e.g. EU project BIOACID)	Provide funding for studies on shelf-ocean processes (national level) Through international political agreements create possibilities for scientists to share pan-Arctic fish data and samples for scientific cooperation on spawning areas and migration patterns, including population genetics and gene flow (international level) Provide funding for joint data analysis and modelling for CAO and shelf seas interactions (national and international levels) or establish formal agreement for other scientific bodies to conduct relevant analyses (e.g. WGICA)	Observe changes in primary productivity, zooplankton and fish distribution over the shelf-deep ocean transition zones Collect data on ontogenetic migrations, advection of food sources, immigration of predators and competitors Model connectivity (including genetics) between the CAO and the adjacent shelf ecosystems for the key species that occur in the CAO. For this data from (1), (2), (3), (4) are necessary Model changes in the fish stocks of the CAO fish species and their conspecifics in the adjacent shelf ecosystems with climate change. For this data from (1), (2), (3), (4) are necessary

List of meetings in 2020/21 where PSCG attendance would be useful

The PSCG made a list of coming meetings relevant for the progress of the PSCG and where the PSCG could present its achievements:

- UArctic Congress, Reykjavik (Iceland), 5-8 October 2020
- Arctic Circle Assembly, Reykjavik (Iceland), 8-11 October 2020
- PICES annual meeting, Qingdao (China), 22 October - 1 November 2020
- Arctic Science Summit Week 2021, Lisboa (Portugal), 19-21 March 2021
- The large kick-off event of the United Nations Decade of Ocean Science for Sustainable Development will take place in Berlin (Germany), 31 May - 2 June 2021. See Web Site
- 3rd Arctic Science Ministerial Co-hosted by Iceland and Japan (ASM-3). 3-2-2 Kasumigaseki Chiyoda-ku, Tokyo 100-8959. Nov 21-22 2020. http://asm3.org/

ToR 05 – Update inventory of monitoring programmes

A subgroup of meeting participants met to identify current and upcoming monitoring programmes in the High Seas of the CAO and adjacent LMEs. The table below identifies the programmes mentioned or submitted by the meeting participants.

Table 4 Inventory of monitoring programmes update

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
maybe	Canada	Fisheries and Oceans Canada	Humfrey Melling	Canadian High Arctic, Arctic Basin	Arctic Ice Monitoring (AIM) Thickness & movement of multi-year ice, sea ice features (ridges, leads, floes, etc.), ocean circulation, ocean temperature & stratification	2003 and present	Very low	In DFO data archive, Pacific Region, at IOS
maybe	Canada	Fisheries and Oceans Canada	Humfrey Melling	Eastern Beaufort Sea	"Beaufort Marine Hazards (BMH)" Thickness & movement of sea ice at the periphery of the Beaufort Gyre, sea ice features (ridges, leads, floes, etc.), ocean circulation, ocean temperature & stratification	1990 and ongoing	Low	In DFO data archive, Pacific Region, at IOS
yes	Canada	Fisheries and Oceans Canada	Andrea Niemi, Andrew Majewski	Eastern Beaufort Sea	Canadian Beaufort Sea-Marine Ecosystem Assessment (CBS-MEA) Benthic/pelagic fish and invertebrate community structure, ship and mooring-based oceanography and hydroacoustics, marine productivity, trophic interactions The Canadian Beaufort Sea – Marine Ecosystem Assessment (CBS-MEA) is a multi-year (2017-2019) research program to study the offshore Beaufort Sea ecosystem, and builds on work conducted by Fisheries and Oceans Canada (DFO) under the Beaufort Regional Environmental Assessment – Marine Fishes Project (BREA-MFP, 2012-2014). A multi-disciplinary science team works aboard the fishing vessel (F/V) Frosti to sample the biological communities of the Beaufort Sea to learn about their physical and chemical habitats and relationships between predators and prey. An important goal of the CBS-MEA is to understand how ocean conditions are affected by environmental stressors (e.g., acidification, climate change) and to understand potential impacts to species and habitats that support subsistence animals like whales, seals, and char.	Ship - 2012-2014, 2017 and ongoing (year over year funding) Moorings - 2017 and ongoing	Ship - medium Moorings - high	Metadata via Polar Data Catalogue Subset of datasets via published reports

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
yes	Canada	Fisheries and Oceans Canada	Lisa Loseto	Eastern Beaufort Sea	Arctic coastal ecosystem studies Long-term (2010 - present) community-based monitoring program for coastal fishes and their habitats at Shingle Point, YT.	2010 and ongoing	high	
yes	Canada	Fisheries and Oceans Canada	Lisa Loseto	Eastern Beaufort Sea	Eastern Beaufort Sea Beluga health research and monitoring Long-term (1970s - present) harvest monitoring and harvest-based monitoring (1980-present) for stock status indicators and assessing beluga health (condition, disease, diet), in partnership with the Fisheries Joint Management Committee. Tissue collections for dietary biomarkers, TLK indicators of health, metabolomics, multi-hormone, contaminants, disease, parasites.	1980 and ongoing	high	
yes	Canada	Fisheries and Oceans Canada	Lisa Loseto	Eastern Beaufort Sea	Eastern Beaufort Sea Beluga Habitat Study Study to assess beluga use of habitat and relationship to environmental drivers in the Tarium Niryutait Marine Protected Area (TN MPA).	2011 and ongoing	high	
no	Canada	Fisheries and Oceans Canada	Lisa Loseto	Eastern Beaufort Sea	Eastern Beaufort Sea beluga telemetry Collection of high-resolution movement (location) and behavioral (dive) data using satellite transmitters, to support environmental assessment, marine conservation, and population abundance estimate for Eastern Beaufort Sea beluga. High resolution movement (location) and behavioral (dive) data, with temperature and some CTD; methods development for single-attachment point harpoon-deployed tag	2018, 2019		

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
yes	Canada	Fisheries and Oceans Canada	Bill Williams	Beaufort Sea, Beaufort Gyre	Joint Ocean Ice Studies (JOIS) Joint Ocean Ice Studies (JOIS) is a collaboration between DFO-IOS and Woods Hole Oceanographic Institution and the National Science Foundation in the USA to monitor the Beaufort Gyre in the Canada Basin of the Arctic Ocean. Fieldwork consists of an annual, 25-day, interdisciplinary joint expedition aboard the CCGS Louis S. St-Laurent to the Beaufort Gyre Region. We collect the highest quality CTD/Rosette profiles and collect a wide range of water samples for geochemistry and biology casts. These expeditions are recognized by the Go-Ship program as line ARC-02. Long-term time series of oceanographic conditions in the Beaufort Gyre including freshwater content, water masses, ocean acidification, geochemistry, sea-ice, zooplankton.	2003 to present	medium to high	
yes	Canada	Fisheries and Oceans Canada	Bill Williams (PAC)	Bering Sea, Chukchi Sea, Beaufort Sea	Distributed Biological Observatory (DBO) The Distributed Biological Observatory (DBO) is a set of prescribed oceanographic sampling lines and protocols at biological hotspots distributed across the Bering and Chukchi Sea Shelves and extending into the Beaufort Sea Shelf. The DBO sites are intended to be occupied, as possible, by oceanographic research vessels that operate in the region. In collaboration with Dr Jackie Grebmeier (University of Maryland, USA) we conduct extensive physical, biological, geochemical and benthic sampling of the DBO sites in the Bering and Chukchi during the annual C3O expedition aboard the CCGS Sir Wilfrid Laurier.	2003 to present		
yes	Canada	Fisheries and Oceans Canada	Bill Williams (PAC)	Canadian Beaufort Shelf	Canadian Beaufort shelf upwelling hotspots Cape Bathurst and Herschel Island are two sites of localized, topographically enhanced upwelling on the Canadian Beaufort shelf. A monitoring mooring is placed in the center of each upwelling site to measure the upwelling flows, their velocity, temperature and salinity.	2010 to present		

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
no	Canada	Fisheries and Oceans Canada	Christine Michel	High Arctic	Multidisciplinary Arctic Program (MAP) - Last Ice The MAP-Last Ice program studies the so-called Last Ice Area of the Lincoln Sea, a considerably under sampled region home to the last remaining really thick, old Arctic sea ice. This region is one of the most remote and inaccessible regions in the world, which makes it very difficult to access the sea ice to collect ice and ecosystem component (e.g. zooplankton, benthos) samples and obtain baseline in situ measurements required to understand the role of multiyear ice in Arctic marine ecosystem processes and food webs. Fish observations/collection planned for 2020.	2018 to 2021	low	
yes	Canada	Fisheries and Oceans Canada	Karen Dunmall	Eastern Beaufort Sea, CAA, Baffin Bay/Davis Strait	Arctic salmon: community-based monitoring of finfish biodiversity shifts in a rapidly changing Arctic The Arctic Salmon program is a very successful community-based project that monitors changing fish biodiversity in the Canadian Arctic. Through voluntary community-based reporting, the relative abundance and geographic distribution of rare or unusual fishes, including vagrant salmon and also native Arctic fishes found outside known distributions, is monitored throughout the entire Canadian Arctic. This program began in 2000 due to increased harvests of vagrant salmon in the Northwest Territories (NWT), and has expanded to now monitor all "unusual fishes" in the NWT and Nunavut (NU).	2000 to present	high	
no	Canada	Fisheries and Oceans Canada	Karen Dunmall	Eastern Beaufort Sea	Traditional knowledge of salmon in the Canadian Arctic The goal of the Salmon TK study is to gather, summarize, and distribute local and traditional knowledge about salmon and the changing environmental conditions that may be influencing changes in their distribution across the Inuvialuit Settlement Region (ISR). Local and traditional knowledge about historical salmon presence, abundances, species, distributions, and subsistence use, as well as observed changes in marine and freshwater environments and species, will be collected through interviews in each community in the ISR over a two to three-year period.	2018 to 2021	low (study)	

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
ytyes	Canada	Fisheries and Oceans Canada	Clark Richards	Barrow Strait/Lancaster Sound	Barrow Strait monitoring program and real-time observatory The Barrow Strait Monitoring program provides year-round measurements of currents, water properties, ice, and biological parameters across the eastern end of the Northwest Passage, near Lancaster Sound. The real-time observatory component (on the north side of the strait) transmits ocean and ice data via iridium satellite in near real-time (hourly) that is accessible to the public and used for weather and sea-ice forecasts, and aids in navigation through this increasingly unpredictable (yet increasingly used) waterway. Physical oceanography, including: moored temperature, salinity, oxygen, water currents, ice draft, ice velocity, hip-based CTD surveys, under-ice profiles (Icycler): CTD plus oxygen, fluorescence. Data available for 2003-2004 and 2007-2008, with plans for future deployments, opportunistic chemical/biological in situ samples	1998 and ongoing	High	Publicly available through ODIS/MEDS
yes	Canada	Fisheries and Oceans Canada	Les N. Harris	Cambridge Bay region on Southern Victoria Island (commercial Arctic Char stocks)	Monitoring of commercial catch since the 1960s, fishery-dependent sampling (collection of biological data) of commercially harvest Arctic char since the 1970s, periodic fishery-independent sampling (on and off since the 1970s). More frequent monitoring as of late, effort (CPUE) data has been monitored/collected since 2011	1970s and ongoing	high	CPUE data are publicly available through the Nunavut General Monitoring Plan (annual uploads) All other data are summarized in reports but data are not publicly available
yes	Canada	Fisheries and Oceans Canada	Bill Williams (PAC)	Pacific Ocean, Arctic Ocean, Atlantic Ocean	Canada's Three Oceans (C3O) Canada's Three Oceans (C3O) takes advantage of the long summertime transits of the CCGS Sir Wilfrid Laurier and CCGS Louis S. St-Laurent from their home ports of Victoria and St John's to the Northwest Passage. Together they enable sampling along a long line through the Pacific, Arctic and Atlantic Oceans surrounding Canada. The sampling is currently limited to underway (XCTDs, seawater loop) and opportunistic ship time (CTD/Rosette).	2006 to present		

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
no	Canada	Fisheries and Oceans Canada	Bill Williams (PAC)	Kitikmeot Sea: Coronation Gulf, Queen Maud Gulf, Bathurst Inlet, Chantry Inlet	Kitikmeot Sea Science Study (K3S) The Kitikmeot Sea Science Study (K3S) explores the physical and geochemical drivers of the ecosystem in the Kitikmeot Sea within the CHARS-ERA (Canadian High Arctic Research Station - Ecological Research Area). We collaborate with the Arctic Research Foundation and use their R/V Martin Bergmann, a 62ft fishing vessel that has been converted for oceanographic research. This interdisciplinary program conducts regional oceanographic surveys of Coronation Gulf, Bathurst Inlet, Queen Maud Gulf and Chantrey Inlet to evaluates the general circulation of the region, the fate of the massive river inflow and the significance of tidal mixing straits as biological hotspots in this low productivity region. K3S will provide a first oceanographic description of the Kitikmeot Sea, including its seasonal cycle, estuarine-like circulation, benthic communities, tides, tidal mixing straits, nutrient fluxes, ocean acidification and primary production.	2015 to present		
yes	Canada	Fisheries and Oceans Canada	Bill Williams (PAC)	Northwest Passage	Canadian Rangers Ocean Watch (CROW) CROW is a collaboration between DFO and DND in which DND Rangers groups in northern communities collect CTD profiles, snow depth and ice thickness measurements during their wintertime snowmobile patrols. DFO provides the CTD kits and training in their use to the DND Rangers. These wintertime data are hard to obtain otherwise, and rely on the unmatched skills of the Rangers in wintertime travel over the ice. CROW is currently active in Cambridge Bay, Kugluktuk and Paulatuk and the sampling is being extended to zooplankton nets and water sampling for nutrients and inorganic carbon geochemistry.	2009 to present (winter)		
yes	Canada	Fisheries and Oceans Canada	Kevin Hedges	Baffin Bay	NAFO Subarea 0 Multispecies Survey · Benthic fish and invertebrate community structure, · physical oceanography, · trophic interactions	1999 and ongoing	high	Publicly available via OBIS (annual data uploads)

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
yes	Canada	Environment and Climate Change Canada	Carina Gjerdrum	Eastern Arctic	Opportunistic (ships of opportunity) observational surveys for seabirds (and other marine wildlife)	Since 2007 and ongoing	Medium – based on year to year funding	Publicly available via OBIS (annual data uploads)
no	Canada	Fisheries and Oceans Canada	Marianne Marcoux	Eclipse Sound	Narwhal passive ecosystem monitoring in Tremblay Sound, passive acoustic monitoring of marine mammals	2017-ongoing	medium	Available on request
	Canada/USA	Fisheries and Oceans Canada (DFO) & NSF	John Nelson (john.nelson@dfo-mpo.gc.ca)Jackie Grebmeier(jgrebmei@umces.edu)	Bering Sea, Bering Strait, Chukchi Sea, Beaufort Sea	Benthic fish and invertebrate community structure, physical oceanography, trophic interactions	July - ongoing since X	high?	
	China	PRIC	Jianfeng He (hejien@pric.org.cn)	Bering Strait, Chukchi Sea, East Siberian Sea, CAO				
	Korea	KOPRI	Eun Jin Yang (ejyang@kopri.re.kr)	Bering Strait, Chukchi Sea, Beaufort, CAO				
	USA	WHOI/NSF	Robert Pickart (rpickart@whoi.edu)	Bering Strait, Chukchi Sea	HAB sampling, physical oceanography, others?	One-off: Aug 1-23, 2020	low	Arctic Data Center
	USA	NOAA	David Allen (david.allen@noaa.gov)	Bering Sea, Bering Strait, Chukchi Sea	Benthic fish and invertebrate community structure, physical oceanography, trophic interactions	August - ongoing since 2011	neutral	NCEI

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
	USA	NSF	Jackie Grebmeier (jgrebmei@umces.edu)	Bering Sea, Bering Strait, Chukchi Sea, CAO	Benthic fish and invertebrate community structure, physical oceanography, trophic interactions	One-off: August 2021	low	Arctic Data Center
	USA	NSF	Rebecca Woodgate (woodgate@apl.washington.edu)	Bering Strait	Physical oceanography,	September - ongoing since X	neutral	Arctic Data Center
	USA	NOAA	Phyllis Stabeno (phyllis.stabeno@noaa.gov)	Bering Sea; Dutch Harbor - Kodiak	Physical oceanography, trophic interactions	September - ongoing since X	neutral	NCEI
	USA	NOAA	Geoff Lebon (geoffrey.t.lebon@noaa.gov)		Physical oceanography, trophic interactions	September - ongoing since X	neutral	NCEI
	Canada	DFO	Bill Williams (bill.williams@dfo-mpo.gc.ca)	Beaufort Sea	Benthic fish and invertebrate community structure, physical oceanography, trophic interactions	September - October	neutral	

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
	Japan	JAMSTEC	Takashi Kikuchi (takashik@jampstec.go.jp)	Bering Strait, Chukchi Sea, Beaufort Sea, CAO		September - November		
	USA	Office of Naval Research	Craig Lee (craigleee@uw.edu)	Bering Strait, Chukchi Sea, Beaufort Sea	Physical oceanography	September - November	high	
	Greenland	Greenland Institute of Natural Resources	Helle Siegstad - hesi@natur.gl	Disco Bay up to Upernavik	Net survey targeting Greenland halibut (inshore)	(2011)2014 - present	High	Data can be found in yearly reports from NAFO and ICES
	Greenland	Greenland Institute of Natural Resources	Helle Siegstad - hesi@natur.gl	Greenland west coast up to Upernavik	West Greenland shallow water trawl survey targeting fish and shrimp	1992 - present		Data can be requested by contacting Greenland Institute of Natural Resources
	Greenland	Greenland Institute of Natural Resources	Helle Siegstad - hesi@natur.gl		West Greenland deep water trawl survey targeting Greenland halibut	1997 - present		

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
	Greenland	Greenland Institute of Natural Resources	Helle Siegstad - hesi@natur.gl	Greenland west coast up to Melville Bay	West Greenland deep and water beam trawl survey targeting benthos	2016, 2017, 2019 (Melville Bay was only covered in 2016)	Occasionally	
	Greenland	Greenland Institute of Natural Resources	Helle Siegstad - hesi@natur.gl	Southern part of the Greenland East coast up to 66°N	East Greenland shallow water trawl survey targeting fish and shrimp	Present time series 2008 and ongoing (Earlier time series targeting shrimp 1989-1992 and 1994-1996)		
	Greenland	Greenland Institute of Natural Resources	Helle Siegstad - hesi@natur.gl		Deep water trawl survey targeting Greenland halibut	1998 - present	High	
	Greenland	Greenland Institute of Natural Resources	Helle Sigestad hesi@natur.gl	South East Greenland in Irminger current	Pelagic trawl survey targeting Mackerel	2013 - present	High	Data can be found in yearly reports from ICES; Data can be requested by contacting Greenland Institute of Natural Resources
	Greenland	Greenland Institute of Natural Resources	Helle Sigestad hesi@natur.gl	East Greenland in East Greenland current	Acoustic survey targeting capelin	2019 - ongoing	High	Data can be found in reports from ICES; Data can be requested by contacting Greenland Institute of Natural Resources

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
	Greenland	Greenland Institute of Natural Resources	Helle Sigestad hesi@natur.gl	Greenland East coast north of 67°N	Experimental fishery with commercial vessels	2019	Only planned in 2019	Data can be requested by contacting Greenland Institute of Natural Resources
	Greenland	Greenland Institute of Natural Resources	Mie Winding; miwi@natur.gl	Greenland East, Young Sund	Pelagic sampling: Light, temperature, salinity, nutrients (NO3-, PO43- & SiO4), DIC, alkalinity, O2, plankton composition, chlorophyll concentration and pCO2, sedimentation; benthic flora; monitoring of marine mammals: acoustic monitoring of marine mammals (acoustic sound recorders), walrus; sea ice cover	2005-present	High	http://data.g-e-m.dk/
	Greenland	Greenland Institute of Natural Resources	Malene Simon - masi@natur.gl	Melville Bay	Acoustic Monitoring of Marine Mammals, acoustic sound recorders and camera system	2017- present	High	
	Greenland	Greenland Institute of Natural Resources	Mie Winding; miwi@natur.gl	Disko Bay	Melt water flux; pelagic sampling: light, temperature, salinity, nutrients (NO_3^-, PO_4^{3-}, SiO_4), DIC, alkalinity, O_2, plankton composition, chlorophyll concentration	2019	Only planned in 2019	
	Faroe Islands	Faroe Marine Research Institute	Karin M. H. Larsen	Shelf and oceanic waters around Faroes	Physical oceanography, plankton, alkalinity, pH	1976, 1990, 2015 and ongoing	High	At request from FARMI and on www.envofar.fo

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
	Faroe Islands	Faroe Marine Research Institute	Karin M. H. Larsen	North of Faroes	Volume flux of Atlantic water, temperature and salinity	1993 and ongoing	High	Available at www.envofar.fo
	Faroe Islands	Faroe Marine Research Institute	Karin M. H. Larsen	Faroe Bank Channel	Volume flux of Faroe Bank Channel overflow	1995 and ongoing	High	Available at www.envofar.fo
	Iceland	Marine and Freshwater Research Institute	Guðmundur Óskarsson	Shelf and oceanic water around Iceland	Physical oceanography, plankton, carbon	1960 and ongoing (carbon since 1983)	high	At request from MFRI, partly also from ICES
	Iceland	Marine and Freshwater Research Institute	Guðmundur Óskarsson	Shelf and oceanic waters north of Iceland (to ca 70 N)	Capelin	1980 and ongoing (plankton since 1965)	high	At request from MFRI, partly also from ICES
	Iceland	Marine and Freshwater Research Institute	Guðmundur Óskarsson	Icelandic shelf area to 500 m	Demersal fish and invertebrates	1985 and ongoing	high	At request from MFRI

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
	Japan	Japan Agency for Marine Earth Science and Technology	Takashi Kikuchi Shigeto Nishino	Pacific sector of the Arctic Ocean	Physical, chemical, and biological (lower trophic levels) oceanography, meteorology, physical and chemical moorings and sediment traps	1998 and ongoing	high	Publicly available via DARWIN
	Japan	Faculty of Fisheries Sciences, Hokkaido University	Toru Hirawake	Bering Sea, Chukchi Sea	Physical, chemical, and biological oceanography, bottom trawl survey, gill net survey	Since 1957 and ongoing	middle	Data Record of Oceanographic Observations and Exploratory Fishing (Hokkaido University)
yes	Korea	Korea Polar Research Insitute	Eun Jin Yang (ejyang@kopri.re.kr)	Bering Strait, Chukchi Sea, East Siberia	Physical, chemical, biological (lower trophic level) oceanography, hydroacoustics, physical-chemical-biological mooring (ADCP, AZFP, CTD, Fluorometer, SUNA, and Sediment trap) Physical, Chemical, biological (lower trophic level) oceanography, ship-based CTD surveys and chemical/biological in situ samples, hydroacoustics, physical-Chemical-biological mooring (ADCP, AZFP, CTD, Fluorometer, SUNA, Sediment trap)	2015 - 2021	high	metadata available (detailed data upon request and consultation; http://kaos.kopri.re.kr)metadata available (detailed data upon quest and consultation)
yes	Korea	Korea Polar Research Institute	Eun Jin Yang (ejyang@kopri.re.kr)	Bering Strait, Chukchi Sea, East Siberia Sea	Physical and chemical oceanography, phyto-, proto- and meso-zooplankton abundance, biomass, community structure, ichthyoplankton abundance and composition, fish eDNA, ship-based CTD surveys and chemical/biological *in situ* samples, hydroacoustics, physical-chemical-biological mooring (ADCP, AZFP, CTD, Fluorometer, SUNA, and Sediment trap)	2022 - 2026	high	metadata available (detailed data upon quest and consultation; http://kaos.kopri.re.kr)

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
yes	Korea	Korea Polar Research Institute	Hyung Sul La (shla@kopri.re.kr)	Bering Sea Subarctic	Physical oceanography, phyto-, proto- and meso-zooplankton abundance, biomass, community structure, fish eDNA, hydroacoustics	2019 - 2024	high	metadata available
	Norway	Institute of Marine Research	Geir Odd Johansen (Randi Ingvaldsen) geir.odd.johansen@imr.no (randi.ingvaldsen@imr.no)	Barents Sea and adjacent Arctic Ocean	Physical and chemical oceanography, phyto- and zooplankton, pelagic and demersal fish abundance, biomass, community structure, benthos abundance, biomass, community structure, marine mammal observations (absence/presence), acoustic registrations, trophic interactions	Annual (August-September) since 2004. Ongoing.	High	Available at Norwegian Marine Data Centre
	Norway	Institute of Marine Research	Elvar Hallfredsson elvar.hallfredsson@imr.no	Eastern slope of Norwegian Sea/Fram Strait (68-80°N - 400-1500 m depth)	Greenland halibut and other deep-sea fish species, physical oceanography and acoustic registrations (from 2009), trophic interactions	Autumn Annual 1994-2009 Biennial since 2009	High	Available at Norwegian Marine Data Centre
	Norway	Institute of Marine Research	Jørgen Schou Christiansen jorgen.s.christiansen@uit.no TUNU-Programme	Northeast Greenland fjords and shelf (70°N - 79°N)	Biodiversity and food webs – fishes (2002–2017), biodiversity and food webs – plankton & benthos (2015 & 2017), acoustics (2017) and seabed mapping (2010-2017), physical and chemical oceanography (2002–2017)	2002–2017	2019	Oceanography – data partly available at Norwegian Marine Data Centre. Biodiversity and food webs – data need “quality checks” before released

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
	Norway	Institute of Marine Research	Thomas Wenneck Thomas.wenneck@hi.no	Barents Sea south of ice edge	Demersal fish abundance, biomass, community structure, physical oceanography	Annual (February-March) since 1981	High	Available at Norwegian Marine Data Centre
	Norway	Institute of Marine Research	Randi Ingvaldsen Espen Bagøien randi.ingvaldsen@hi.no espen.bagoien@hi.no	Barents Sea – standard sections	Physical, chemical and biological oceanography, zooplankton biomass and abundance	4-6 times each year, since 1977	High	Available at Norwegian Marine Data Centre
	Norway	Institute of Marine Research	Randi Ingvaldsen randi.ingvaldsen@hi.no	Southern Barents Sea	Volume flux of Atlantic Water - moorings	1997 (continuous – replaced once a year)	High	Available at Norwegian Marine Data Centre
	Norway	SIOS Infranor project (Institute of Marine Research/Norwegian Polar Institute/SIOS)	Randi Ingvaldsen randi.ingvaldsen@hi.no Arild Sundfjord arild.sundfjord@npolar.no	North of Svalbard	Volume flux of Atlantic water and bio-acoustic moorings	2011 (continuous – replaced every second year)	High	Available at Norwegian Marine Data Centre
	Norway	Institute of Marine Research	Nils Øien nils@hi.no	West and north of Svalbard	Sighting surveys of common minke whales and other whales	Summer, every 6 year	High	

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
	Norway	Institute of Marine Research	Tore Haug tore.haug@hi.no	West Ice and East Ice	Aerial surveys to assess the abundance of harp seals	March/April, every five year	High	
	Norway	Norwegian Polar Institute		Barents Sea and north of Svalbard	Surveys to assess endemic seal and whale species			
	Norway	The Nansen Legacy project (UIT/The Arctic University of Norway/Institute of Marine Research/Norwegian Polar Institute)	Marit Reigstad marit.reigstad@uit.no	Barents Sea and adjacent regions in the Nansen Basin	Physical and chemical oceanography, phyto- and zooplankton, pelagic and demersal fish abundance, biomass, community structure, benthos abundance, biomass, community structure, acoustic registrations trophic interactions	Mapping observations (not monitoring). Survey in 2018. Seasons in 2019-2020. Survey into the CAO in 2021.	Low (mapping, not monitoring)	Available at SIOS
	Norway	Arctic ABC programme (UIT/The Arctic University of Norway)	Jørgen Berge jorgen.berge@uit.no	Central Arctic Ocean	Drifting ice buoys including weather observations, light observations, temperature/salinity measurements and acoustic registrations of zooplankton and fish	Mapping and monitoring		
	Norway	Argo (Institute of Marine Research)	Kjell Arne Mork kjell.arne.mork@hi.no	Barents Sea and adjacent regions in the Nansen Basin	Drifting buoys in the Arctic that monitor, in near real-time, essential physical and ecosystem variables (like pressure, temperature, salinity, oxygen, pH, nitrate, etc.) using drifting buoys	Mapping and monitoring		https://fleetmonitoring.euro-argo.eu/dashboard

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
yes	USA / Russia	NOAA	Igor Polyakov	Nansen and Amundsen Basin	Physical oceanography, plankton, sea ice physics, buoys and moorings	August / September every other year	High	user registration; https://nabos.iarc.uaf.edu/NABOS2/data/registered/main.php
maybe	USA/Russia /EU (Germany)	NABOS Consortium	ivpolyakov@alaska.edu	CAO and Siberian shelf	Autonomous buoys and moorings: physical Oceanography, chemical oceanography, vertical fluxes, biological oceanography	2022 -	High	IARC data archive http://climate.iarc.uaf.edu/geonetwork/srv/en/main.home
maybe	EU (Germany)	Portal German Research Vessels	Ingo Schewe: Ingo.schewe@awi.de	Arctic Ocean	Oceanography, sea ice, plankton, fish (if requested), hydroacoustics, autonomous buoys and moorings	season flexible, yearly expeditions with varying focus	High	pangaea.de
yes	EU (Germany)	Alfred Wegener Institute (AWI)	thomas.soltwedel@awi.de	Fram Strait	Physical oceanography, chemical oceanography, biological oceanography (chlorophyll, PP, plankton community structure, benthic fauna), vertical fluxes	1999 - (annually)	High	pangaea.de
yes	EU (Germany)	Alfred Wegener Institute (AWI)	martina.loebl@awi.de	Eurasian Arctic	Autonomous buoys and moorings: physical oceanography, chemical oceanography, vertical fluxes	2014 - (permanent)	High	pangaea.de Fram data portal

Monitoring	Country	Organization	Contact person	Geographic location of monitoring	Type of monitoring (physical/chemical/biological/ trophic level, etc.)	Temporal span of monitoring (range of seasons, years or ongoing)	Likelihood of continuing	Availability of data
no	EU (Germany)	Alfred Wegener Institute (AWI)	hauke.flores@awi.de	CAO	Autonomous buoys and moorings, physical oceanography, chemical oceanography, vertical fluxes, biological oceanography, fisheries	2012 -	High	pangaea.de
no	EU (Germany)	Alfred Wegener Institute (AWI)	hauke.flores@awi.de	CAO	Autonomous buoys and moorings, physical oceanography, chemical oceanography, vertical fluxes, biological oceanography, fisheries	2012 -	High	pangaea.de
no	EU (Sweden)	Swedish Polar Research Secretariat (SPRS) polar.se	asa.lindgren@polar.se, maria.samuelsson@polar.se	Arctic Ocean, mainly CAO	Seafloor mapping, physical oceanography, chemical oceanography, vertical fluxes, biological oceanography	1990 -	High	Different Swedish national data bases
no	EU	Arctic Research Icebreaker Consortium (ARICE)	nicole.biebow@awi.de veronica.willmott@awi.de	Pan-Arctic	An international collaboration strategy for meeting the needs of marine based research in the Arctic	2018 -		ARICE data portal
no	EU	EU POLARNET	nicole.biebow@awi.de	Pan-Arctic	Autonomous buoys and moorings: physical oceanography, chemical oceanography, biological oceanography, vertical fluxes,	2020 -		ARICE data portal

List of participants

Table 5 List of participants, roles and affiliations

Last Name	First Name	Email	Affiliation	Role	Representation
BOUFFARD	Nadia	nadiabouffard55@gmail.com		Chairperson	Preparatory Conference (PrepCon) for the Agreement
BURMEISTER	Anndorte	anbu@natur.gl	Greenland Institute of Natural Resources	Senior Advisor & Research scientist	Delegation of the Kingdom of Denmark on behalf of Faroe Islands and Greenland
BURNS	Adam	adam.burns@dfo-mpo.gc.ca	Fisheries and Oceans Canada	Director General, Fisheries Resource Management	Canada (Head of Delegation)
CHRISTENSEN	Steen	stch@nanoq.gl	Ministry of Fisheries, Hunting and Agriculture	Chief Advisor	Delegation of the Kingdom of Denmark on behalf of Faroe Islands and Greenland (HoD)
CHUNG	Sangdeok	agapesd@naver.com	National Institute of Fisheries Science		Korea
CRUMP	John	jpcrump@inuitcircumpolar.com	Inuit Circumpolar Council	Senior Policy Officer	Canada
DICKEY-COLLAS	Mark	mark.dickey-collas@ices.dk	International Council for the Exploration of the Sea (ICES)	Chairpearson of Advisory Committee	ICES
DUPUIS	Alain	alain.dupuis@dfo-mpo.gc.ca	Fisheries and Oceans Canada	Science Advisor, Environment and Biodiversity Science	Canada
FLORES	Hauke	hauke.flores@awi.de	Alfred Wegener Institut Helmholtz-Institut für Polar- und Meeresforschung	Researcher	EU
FOSSHEIM	Maria	maria.fossheim@hi.no	Institute of Marine Research	Programme Director Barents Sea and Arctic Ocean	Norway
FOY	Robert	robert.foy@noaa.gov	National Oceanic and Atmospheric Administration	Director, Alaska Fisheries Science Center, National Marine Fisheries Service	USA
HEDGES	Kevin	kevin.hedges@dfo-mpo.gc.ca	Fisheries and Oceans Canada	Research scientist, Arctic Aquatic Research Division	Canada
HOEL	Alf Hakon	alf.hakon.hoel@uit.no	Institute of Marine Research / UiT The Arctic Unversity of Norway	Professor	Norway

Last Name	First Name	Email	Affiliation	Role	Representation
HURRELMANN	Annette	Annette.HURRELMANN@ec.europa.eu	European Commission, Directorate-General for Maritime Affairs and Fisheries (DGMARE)	Deputy Head of Unit, Scientific Advice and Data Collection	EU
JEONG	Jihoon	jj@kopri.re.kr	Korea Polar Research Institute	Senior Administrative Associate	Korea
JARDIM	Ernesto	ernesto.jardim@ec.europa.eu, ernesto.jardim@msc.org	European Commission, Joint Research Centre	Senior Research Fellow/chairperson	EU/PSCG
JONUSAS	Stanislovas	Stanislovas.JONUSAS@ec.europa.eu	European Commission, Directorate-General for Maritime Affairs and Fisheries (DGMARE)	Policy officer, Unit Scientific Advice and Data Collection	EU
KIVVA	Kirill	kivva@vniro.ru	Russian Federal "Research Insitute of Fisheries and Oceanography" (VNIRO)	Head of Division: Climate and Aquatic Ecosystem Dynamics	Russia
Konrad	Christoph	christoph.konrad@ec.europa.eu	European Commission, Joint Research Centre	Research fellow	EU
LA	Hyoung Sul	hyoungsulla@gmail.com	Korea Polar Research Institute	Senior Scientist	Korea
MORISHITA	Joji	jmoris0@kaiyodai.ac.jp	Tokyo University of Marine Science and Technology	Professor	Japan
NACHMAN	Candace	Candace.Nachman@noaa.gov	National Oceanic and Atmospheric Administration	Senior Policy Advisor, Office of Policy, National Marine Fisheries Service	USA
NIIRANEN	Susa	susa.niiranen@su.se	EFICA-project / Stockholm University	Researcher	EU
PARK	Kyum Joon	mogas@hanmail.net	National Institute of Fisheries Science		Korea
PERAMAKI	Liisa	liisa.peramaki@dfo-mpo.gc.ca	Fisheries and Oceans Canada	Director, Environment and Biodiversity Science	Canada
PINTO	Cecilia	cecilia.pinto@ec.europa.eu	European Commission, Joint Research Centre	Research fellow	EU
RASMUSSEN	Elisabeth	elisabethfrasmussen@gmail.com	Ministry of Foregin Affairs and Culture of the Faroe Islands	Advisor	Delegation of the Kingdom of Denmark on behalf of Faroe Islands and Greenland
SHINOHARA	Shogo	shogo.shinohara@mofa.go.jp	Ministry of Foreign Affairs of Japan	Assistant Director	Japan
SNOEIJS-LEIJONMALM	Pauline	pauline.snoeijs-leijonmalm@su.se	Stockholm University	Professor	EU

Last Name	First Name	Email	Affiliation	Role	Representation
STAMOULIS	Antonios	Antonios.STAMOULIS@ec.europa.eu	European Commission, Executive Agency for Small and Medium Sized Enterprises	Project Adviser	EU
SUAREZ JIMENEZ	Rocio	Rocio.SUAREZ-JIMENEZ@ec.europa.eu	European Commission, Executive Agency for Small and Medium Sized Enterprises	Project Adviser and Framework Contract Manager for the Arctic	EU
SWEETING-WOODS	Matt	matthew.sweeting-woods@dfo-mpo.gc.ca	Fisheries and Oceans Canada	Senior Policy Advisor, International and Intergovernmental Affairs	Canada
TAKI	Kenji	takisan@affrc.go.jp	National Research Institute of Far Seas Fisheries	Research Coordinator for Oceanography and Resources	Japan
VERBORGH	Jacques	Jacques@neafc.org	North-East Atlantic Fisheries Commission (NEAFC)	President	NEAFC
YANG	Eun-Jin	ejyang@kopri.re.kr	Korea Polar Research Institute	Division Director, Polar Ocean Sciences	Korea
IIOKA	Mako	mako_iioka540@maff.go.jp	Fisheries Agency, Government of Japan	Subsection Chief	Japan
ÓLAFSDÓTTIR	Anna	anna.olafsdottir@hafogvatn.is	Marine and Freshwater Research Institute	Research scientist	Iceland

ANNEXES

Annex 01- Agenda

- Day 01
  - Morning:
    - Open meeting by chair
    - Welcome by Charlina Vitcheva (JRC Director-general)
    - Opening statements by each delegation (2' max, alphabetic order).
    - Opening statement by Nadia Bouffard (Chair for the Preparatory Conference for the Agreement)
    - Presentations:
      - *Report of the Workshop on the Co-Development of Indigenous Knowledge for the Central Arctic Ocean Agreement* by Matt Sweeting-Woods (Canada) (15')
      - *Accountability in knowledge production - ensuring transparency and traceability of the evidence base for fisheries management* by Marck Dickey-Collas (ICES) (10')
    - Discussion and clarification about how to address ToRs (30')
    - Sub-group ToR 01
    - Sub-group ToR 02
  - Afternoon:
    - Sub-group ToR 01
    - Sub-group ToR 02
    - Plenary (quick report back from sub-groups, organize following day work)
- Day 02
  - Morning:
    - Sub-group ToR 01 (if needed)
    - Sub-group ToR 02 (if needed)
    - Presentations (max 10' each):
      - Gap analysis of knowledge on ecosystem, fish populations and fisheries in the CAO by Hauke Flores (EU)
      - Korean Arctic Research by Eun Jin Yang (Korea)
      - An early start of scientific mapping of fish stocks in the High Seas of the CAO by the EU by Pauline Snoeijs Leijonmalm (EU)
      - Possibilities for executing the Mapping Program of the Agreement: SAS and ARICE by Pauline Snoeijs Leijonmalm (EU)
      - Canadian Arctic Research Summary by Kevin Hedges (Canada)
      - Japanese Arctic Research by Kenji Taki (Japan)
      - Update on Norwegian current and ongoing scientific activities by Randi Ingvaldsen (Norway)
    - Sub-group ToR 3 & 5
    - Sub-group ToR 4
  - Afternoon
    - Sub-group ToR 3 & 5

        - Sub-group ToR 4
        - Plenary (quick report back from sub-groups, organize following day work)
- Day 03
    - Morning
        - Sub-groups (if needed)
        - Plenary (discussion)
    - Afternoon
        - Plenary (draft report)
        - Goodbye

Annex 02 – Rules of Procedures for 1st Provisional Scientific Coordinating Group (PSCG, 2020)

1 - Provision of advice

1. The PSCG shall make all efforts to adopt its advice and recommendations to the PrepCon by consensus.
2. If all efforts to reach agreement by consensus have been exhausted, the different views of the members shall be set out in its report.

2 - Reporting

1. The PSCG reports to the PrepCon.
2. The PSCG reports should be based on and reflect the best scientific information and evidence available, and indigenous/local knowledge.
3. When relevant, PSCG reports should include diverse points of view and/or trade-offs.
4. Reports of each meeting shall be drafted and distributed as soon as possible to the participants by the chairperson.
5. Before PrepCon, the preliminary report from PSCG should be available at least one month prior to the PrepCon.
6. After PrepCon approval, it shall make the report public within one month after the date of approval.

3 - Sub-groups

1. Sub-groups can be set-up for the duration of the meeting to deal efficiently with the ToR.
2. Sub-groups and rapporteurs are set-up by the chairperson with agreement of the participants.
3. Attendance to sub-groups is decided by each participant based on her/his interests and expertise.
4. Sub-groups report to the PSCG plenary sessions and provide information for the PSCG meeting report.

4 - Transparency

1. All participants have to report their affiliation, institutional role and representation, to be included in the PSCG report.
2. All participants have to provide a short biographic note[8] to be included in the PSCG report.

8 25 lines with font 10 maximum ...

5 - Language

1. English is the official and working language of the PSCG.

Annex 03 – Proposal of Rules of Procedures future PSCG meetings or succeeding body

1 - Membership

a. The PSCG is to consist of delegations appointed by each Signatory, including scientists and holders of indigenous and local knowledge as the respective Signatory deems appropriate.
b. Each Signatory shall formally notify the chairpersons of the MoS and PSCG of the names of its delegates as far in advance of PSCG meeting as possible.

2 - Terms of Reference

a. The PSCG ToRs are set by the Signatories taking into account:
   i. Articles 4 and 5 of the Agreement;
   ii. PSCG's functions;
   iii. Previous PSCG proposals;
   iv. Signatories' requests;

3 - Chairpersons

a. The Chairperson and Vice-chairperson are appointed[9] at the MoS from among the Signatories for a term of two years. The chairpersons should preferably rotate among the Signatories and the two should reflect a geographical balance.
b. The Chairperson and Vice-chairperson shall be eligible for re-appointment but shall not serve for more than two successive terms in the same capacity.
c. The Chairperson and Vice-chairperson shall take office at the conclusion of the biennial meeting at which they are elected, with the exception of the first meeting, where they will take office from the moment of their appointment, which shall take place at the opening of the second PSCG meeting.
d. The duties of the Chairperson shall be:
   i. to preside over meetings;
   ii. to draft and distribute the preliminary agenda;
   iii. to establish sub-groups as deemed necessary;
   iv. to oversee the production of a report of the proceedings of each meeting;
   v. to represent the PSCG during her/his mandate;

9 The appointment process should be described in the Signatories' RoPs for the sake of transparency.

vi. to invite external experts to PSCG meetings and its subsidiary bodies. The external experts would not represent a Signatory or organization and would have no status at the meeting other than to provide specific advice and guidance to the PSCG on particular issues.

e. Whenever the Chairperson is unable to act, the Vice-chairperson shall exercise the power and duties prescribed for the Chairperson.
f. If the office of the Chairperson is vacated, the Vice-chairperson shall become Chairperson for the balance of the term.
g. The Chairperson shall cease to act as a representative of a Signatory.

4 - Provision of advice and recommendations

a. The PSCG shall make all efforts to adopt its advice and recommendations to the MoS by consensus of its members.
b. If all efforts to reach agreement by consensus have been exhausted, the different views of the PSCG members shall be set out in its report.

5 - Order of Business

a. An invitation and a provisional agenda for the meeting shall be made available to all delegations and observers, together with any relevant documents, 45 days before the meeting.

b. Any Signatory may, at least 30 days before the date of the meeting request the inclusion of items in the provisional agenda. Such requests shall be accompanied by a memorandum and any relevant documents on the proposed item.

c. All documents for the PSCG meeting shall be made available to all delegations and observers 20 days in advance of the meeting.

6 - Reporting

a. Each time the PSCG meets, the PSCG shall prepare a written report to be submitted to the Chairperson of the MoS for circulation to Signatories.
b. The PSCG reports shall be based on and reflect the best available scientific information and take into account the work of national scientific programs, relevant scientific and technical organizations, bodies and programs, as well as indigenous and local knowledge.
c. Reports of each meeting shall be drafted and distributed among PSCG members within 30 days by the Chairperson and be finished and submitted within 60 days.
d. The reports shall be made publicly available within 10 days after the submission to the Chairperson of the MoS.

e. All participants must report their affiliation, institutional role and representation, to be included in the PSCG report.

7 - Sub-groups

a. Sub-groups can be set-up for the duration of the meeting to deal efficiently with the ToR.

b. Sub-groups and rapporteurs are set-up by the Chairperson with agreement of the participants.

c. Attendance to sub-groups is decided by each participant based on her/his interests and expertise.

d. Sub-groups report to the PSCG plenary sessions and provide information for the PSCG meeting report.

8 - Working groups

a. The PSCG, with the Signatories' approval, may establish working groups, their ToR and appoint chairpersons for defined periods to deal with tasks that cannot be accomplished by a single PSCG meeting, *e.g.* tasks that require participation of external experts, including scientists and indigenous and local knowledge holders, not present in a PSCG meeting, or tasks that require intersessional work.

b. Participation on any working groups is decided by Signatories and communicated to the MoS and PSCG chairpersons.

c. Working groups report to the PSCG meetings.

d. Working groups follow these RoP except if stated otherwise by the Signatories.

9 - Observers

The text below was adjusted from SPRFMO RoPs.

a. Observers may apply to the MoS Chairperson to participate in PSCG meetings for a defined period. The observer should allow at least 60 days for approval, and the application shall include their affiliation, institutional role and representation.

b. The following institutions may participate as observers in PSCG's meetings and its working groups:

i. other States with an interest in the work of the Agreement that are not Signatories;

ii. the FAO, other specialised agencies of the United Nations, other regional fisheries management organisations and other relevant intergovernmental organisations;

iii. non-governmental organisations, Arctic regional organisations, Arctic communities, Arctic indigenous peoples organisations, environmental organisations and fishing industry;

c. Upon approval by the Signatories, observers may participate in PSCG plenary sessions, meetings of sub-groups and meetings of working groups.
d. Observers may participate in the discussions when given the floor by the Chairperson.
e. Observers may submit relevant documents to the PSCG and its sub-groups and working groups as information documents.
f. Observers shall be given access to meeting documents, subject to the terms of the confidentiality rules determined by the Signatories.

10 - Language

a. English shall be the official and working language of the PSCG and its subsidiary bodies. Other languages may be used, on condition that persons doing so will provide interpreters.
b. All official publications and communications of the PSCG shall be in English.

Annex 04 - Letter from the President of the Inuit Circumpolar Council (Alaska)

INUIT

7 February 2020

Dear Delegates to the CAO meeting,

I'm writing to you in my capacity as President of the Inuit Circumpolar Council (ICC -Alaska) and as a member of the Executive Council of ICC International which represents Inuit in Alaska, Canada, Greenland and Chukotka, Russia. In this capacity, and as a member of the United States delegation, I participated in the negotiations that led to the signing of the CAO Agreement in 2018.

Since ICC has interest in any and all developments within the Arctic Ocean both the United States and the Canadian governments were receptive to including Inuit in their national delegations. Later on, the Danish government included an ICC Greenland representative on their national delegation. It's important to stress that the three ICC representatives were there as members of our respective national delegations, not as ICC.

As delegation members, we were involved at both the policy and scientific meetings in the lead-up to the signing of the Agreement. The notion of having Inuit participate in the scientific meetings is not new. As we have said for a long time, using Indigenous Knowledge (IK) and science together will result in better decisions and outcomes. This is what we mean by co-production of knowledge.

Inuit are completely supportive of the effort underway to gain the broadest and most complete understanding of this unique marine region of the Central Arctic Ocean, and recognize the importance of this initiative globally. Unfortunately, due to scheduling conflicts I am unable to join you in Ispra this week. But if you allow me, I would like to make a couple of observations and suggestions on how to move the agenda forward at the first meeting of the Provisional Scientific Coordinating Group (PSCG). At your meeting, one of the tasks is to identify processes and mechanisms to use Indigenous Knowledge in the work of the Joint Program of Scientific Research and Monitoring (JPSRM) of the Central Arctic Ocean.

I would like to make the following suggestions on ways forward, towards true co-production of knowledge, using both IK and science:

1. Given Inuit reliance on a healthy Arctic ecosystem, we want to ensure that Inuit perspectives are included in deliberations about future fisheries in the CAO. We are here to make sure IK gets considered and included in any decisions made. We need to start the process of using IK together with science, nothing more.

2. We have worked closely with several countries in this process, especially the USA, Canada and Denmark and they have been respectful and supportive. We will continue to work in the same cooperative spirit with all the signatories of the CAO.

3. It is important that the PSCG operate as a single, coherent body. The connection between IK and science is one of the innovative principles of this agreement. Splitting up into an Indigenous group

and a science group would not advance our joint goals. I'm convinced that by sitting down and working the issues together we will build trust and good will. And we will achieve better results.

Good luck in your discussions.

Sincerely yours,

James Stotts
President
Inuit Circumpolar Council (Alaska)

Annex 05 - Indigenous and Local Knowledge in the Greenland context

In Greenland a clear and official division of indigenous peoples and non-indigenous peoples does not exist, given that ethnic Greenlanders are a natural part of the decision making procedure, as both the Government and Parliament are led by the Greenlandic people and thus have full responsibility of natural resource management.

For this reason, the Government of Greenland has decided to use both the terms Indigenous Knowledge and Local Knowledge, which most adequately reflects the abovementioned structures. The term 'Indigenous Knowledge and Local Knowledge' acknowledges indigenous peoples' right to development, as the term reflects both the backward and forward looking aspects of indigenous peoples' knowledge.

In Greenland, use of local knowledge is mandatory and stipulated in the relevant legislation regarding fishing and hunting. Accordingly, resource management is founded on close collaboration with, for example, The Association of Fishers and Hunters in Greenland (KNAPK), local committees of fishers and hunters, municipalities, ICC Greenland, and through regular convening's of the Fisheries Council and the Hunting Council, ensuring that Indigenous Knowledge and local knowledge is included in the knowledge base and decision processes to the extent possible.

Examples of collaboration between scientists, fishermen, hunters, the industry and the inclusion of local knowledge are diverse and include a broad spectrum such as: exchange of knowledge with local communities; participation in questionnaires related to use of living resources; collecting valuable knowledge from hunting and fishery through mandatory logbooks; technical support from hunters and fishers (e.g., with regards to development of satellite transmitters when tagging whales); conducting samples of shellfish, finfish and sharks; colleting biopsies from marine mammals and polar bears; and, monitoring reindeers, counting eider nests, and observations of colonies of breeding birds. A recent survey indicates that, over the past five years, the Department of Birds and Mammals, Greenland Institute of Natural Resources, has included local knowledge in 73% of their projects.

In the context of the JPSRM, the approach taken in Greenland is ensuring that the knowledge represented in the national delegation (DFG) has been thoroughly processed and considered prior to presentation and potential inclusion into the knowledge base being established by the JPSRM.

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