

**PAME I-2019: AGENDA 8.4**  
**ICES/PICES/PAME Working Group on Integrated Ecosystem Assessment of the**  
**Central Arctic Ocean (WGICA)**  
**Summary of status and next steps**

**Background**

The working group for the central Arctic Ocean – WGICA – was established by ICES together with PAME in autumn 2015. This followed a recommendation from a scoping workshop held in Bergen, Norway, in May 2015 (ICES/AMAP/CAFF/PAME Workshop on Integrated Ecosystem Assessment (IEA) for the Central Arctic Ocean (WKICA); AMAP and CAFF opted out to be co-sponsors of the new WGICA). PICES (North Pacific Science Organization; the acronym PICES stands for ‘Pacific ICES’) joined ICES and PAME in 2017 to make the group a joint ICES/PICES/PAME working group.

The Terms of reference (ToRs) for WGICA 2016-2018 were:

Term of Reference a – Consider approach and methodology (-ies) for doing an IEA for the CAO (based on the outcome of the 2015 Workshop for the Integrated Ecosystem Assessment of the Central Arctic Ocean).

Term of Reference b – Assemble data and information and carry out appropriate statistical and other types of analyses including mathematical modelling.

Term of Reference c – Prepare an IEA outline for the current status of the CAO ecosystem (CAO LME and adjacent slope waters including Atlantic and Pacific inflows and relevant shelf-basin exchanges) and effects, potential effects, and vulnerability in relation to climate variability and change and human activities such as Arctic shipping and potential future fisheries.

Term of Reference d – Consider requirements and design of monitoring of the CAO to meet the need for repeated IEA in the near future as well as other types of assessments (which can be modular components of IEAs).

Term of Reference e – Identify priority research issues which, when addressed, can improve the knowledge base for the future iterations of the IEA.

WGICA held three meetings in the 2016-2018 period:

- First meeting – 24-26 May 2016, Copenhagen, Denmark (at ICES)
- Second meeting – 19-21 April 2017, Seattle, USA
- Third meeting – 24-26 April 2018, St. John’s, Newfoundland, Canada

Reports from the three WGICA meetings have been presented to PAME (PAME II-2016, PAME II-2017, PAME II-2018).

The main item of the work of WGICA has been ToR c – to prepare a first version Integrated Ecosystem Assessment (IEA) report for the central Arctic Ocean ecosystem. More information on this work is provided in the following.

WGICA has been led by three co-chairs: John Bengtson (NOAA, USA), Sei-Ichi Saitoh (University of Hokkaido, Japan), and Hein Rune Skjoldal (IMR, Norway).

The membership of WGICA is of three types: ICES members, PICES members, and chair-invited members. ICES members are nominated by ICES national delegates. PICES members are appointed by national PICES delegates and constitute a small working group (WG39) in the PICES system. In 2018, there were 40 members in total, from 11 countries: Canada, China, Denmark, Finland, Japan, Korea, the Netherlands, Norway, Russia, Sweden, and the USA. Nine were ICES members, seven were PICES members, and the rest were the co-chairs and chair-invited members.

### **Integrated Ecosystem Assessment report for the central Arctic Ocean**

The title of the report is: 'Integrated Ecosystem Assessment of the Central Arctic Ocean: ecosystem description and vulnerability characterization'.

This is not a full-fledged IEA report, but, as the subtitle suggests, a description of the ecosystem of the basins of the central Arctic Ocean (CAO) with emphasis on spatial aspects and trophic (food-web) connections. The vulnerability section is an initial consideration of both general and specific aspects of vulnerability of the CAO ecosystem to ongoing climate change and human activities such as shipping and potential fisheries.

The report has four main parts:

1. Introduction and background
2. Summary description of key features of the CAO ecosystem
3. A more detailed description of the ecosystem with chapters on physical conditions (bathymetry, oceanography, sea ice), plankton, ice biota, benthos, fish, birds, and marine mammals
4. A vulnerability section including general aspects (concepts, terminology, methodology) and some initial considerations of vulnerability to human activities.

We are delayed by a few months with preparation of the report. Draft sections of the report have been prepared and are now being further elaborated by sub-groups of experts within WGICA (physics, lower trophic levels, fish, birds, mammals, vulnerability).

A next step over the coming weeks is to have an internal review by the full working group of the compiled report sections. The co-chairs are also considering bringing in some external reviewers of a final draft version of the report. This could possibly be done through ICES and PICES.

The production of the report with layout and graphics is another step before the report is ready to be released. The US co-chair (John Bengtson) can possibly provide some support from his organization (NOAA) in doing this.

The report was listed as a possible deliverable through PAME to the 2019 Ministerial (Annex II of the RoDs from PAME II-2018 in Vladivostok). With the delay, this may now be difficult. We suggest, however, that this could be kept as an option, and that PAME consider a mechanism for reviewing the

report in the March-April time frame for deciding whether or not the report should be forwarded as a deliverable.

### **Terms of Reference for continuation of WGICA**

The working group (WGICA) discussed and recommended a continuation of the work on IEA of the CAO at its last meeting in St. John's, Canada, in April last year. A draft set of Terms of Reference (ToRs) for the next 3 years of work by the joint WGICA was included in the 2018 WGICA report and reported to PAME II-2018.

The draft ToRs were discussed at a WG39 workshop during the PICES 2018 meeting in Yokohama, Japan, and approved (with one slight amendment of ToR e, adding 'Continue to identify priority research needs') by PICES.

The draft ToRs (including the amendment from PICES) were reviewed by ICES and formally approved by the two committees ACOM and SCICOM on 17 January 2019. ICES added one new ToR g, which was to prepare an Ecosystem Overview for the CAO ecosystem. ICES have produced several Ecosystem Overviews for regional ecosystems (e.g. the Barents Sea and the Norwegian Sea), which are short descriptions of the ecosystems including a diagram showing linkages between pressures and ecosystem components.

The version of the ToRs that were approved by ICES, including supporting information in a format used by ICES, is included as Annex 2.

PAME is invited to review the ToRs for the joint WGICA 2019-2021, and to provide any comments and guidance on the ToRs and the work of WGICA.

The next meeting of WGICA is scheduled for 8-10 May 2019 in Sapporo, Japan, at the premises of the University of Hokkaido.

## Annex 1 – Self-evaluation report to ICES



Revised on 25/October/2018

### Working Group evaluation

- 1) Working Group name. Working Group on Integrated Ecosystem Assessment for the central Arctic Ocean - WGICA
- 2) Year of appointment. 2015
- 3) Current Chairs. John Bengtson, NOAA, USA – Sei-Ichi Saitoh, University of Hokkaido, Japan – Hein Rune Skjoldal, IMR, Norway
- 4) Venues, dates and number of participants per meeting. - First meeting: Copenhagen (ICES), 24-26 May 2016, 18 participants. Second meeting: Seattle, USA, 19-21 April 2017, 23 participants. Third meeting: St. John's, Canada, 24-26 April 2018, 14 participants.

### WG Evaluation

- 5) *If applicable, please indicate the research priorities (and sub priorities) of the Science Plan to which the WG make a significant contribution.* WGICA is one of several groups in ICES that do integrated ecosystem assessments, which is one of the priority action areas for ICES. Being a WG for the central Arctic Ocean, WGICA also contribute to the Arctic research action area. Jointly sponsored by PICES and the PAME working group of the Arctic Council, WGICA represents a collaborative effort that links ICES' work in the wider Arctic Mediterranean Sea (the Nordic Seas and the central Arctic Ocean) with expertise on the Pacific Arctic through PICES.
- 6) *In bullet form, highlight the main outcomes and achievements of the WG since their last evaluation. Outcomes including publications, advisory products, modelling outputs, methodological developments, etc.* \* ICES. 2016. First Interim Report of the ICES/PAME Working Group on Integrated Ecosystem Assessment for the Central Arctic Ocean (WGICA), 24-26 May 2016, ICES Headquarters, Copenhagen, Denmark. ICES CM 2016/SSGIEA:11. 20 pp. \* ICES. 2017. Interim Report of the ICES/PICES/PAME Working Group on Integrated Ecosystem Assessment (IEA) for the Central Arctic Ocean (WGICA). WGICA 2017 REPORT 19-21 April 2017. Seattle, USA. ICES CM 2017/SSSGIEA:11. 47 pp. \* ICES. 2018. Interim Report of the ICES/PICES/PAME Working Group for Integrated Ecosystem Assessment of the Central Arctic Ocean (WGICA). WGICA 2018 REPORT 24-26 April 2018. St. John's, Newfoundland, Canada. ICES CM 2018/IEASG:11. 12 pp. \* Approach and methods for doing an IEA of the central Arctic Ocean, mainly through literature review of existing information – described in the three interim reports 2016-2018. \* Description of key characteristics of the central Arctic Ocean ecosystem – Annex 2 to 2017 interim report. \* Draft review of primary production in the central Arctic Ocean – Annex 3 to 2017 interim report. \* Compilation of information on fish in the central Arctic Ocean – Annex 4 to 2017 interim report. \* Compilation of information on marine mammals and birds in the central Arctic Ocean – Annex 5 to 2017 interim report.

- \* Outline of IEA report - '*Integrated Ecosystem Assessment of the Central Arctic Ocean: ecosystem description and vulnerability characterization*'- section 5.1 in 2018 interim report.
- 7) *Has the WG contributed to Advisory needs? If so, please list when, to whom, and what was the essence of the advice.* WGICA contributes to preparing the basis for future advice on status and management needs for the central Arctic Ocean ecosystem. One part of the IEA report (under preparation) is consideration of sensitivity of species and habitats to shipping (oil spills and disturbances) to be used by shipping experts in PAME addressing the need for protective measures to future shipping activities in the High Seas portion of the central Arctic Ocean.
  - 8) *Please list any specific outreach activities of the WG outside the ICES network (unless listed in question 6).* For example, EC projects directly emanating from the WG discussions, representation of the WG in meetings of outside organizations, contributions to other agencies' activities. Reports from WGICA have been presented at meetings of PAME and PICES.
  - 9) *Please indicate what difficulties, if any, have been encountered in achieving the workplan.* Much discussion over several meetings has been necessary to achieve consensus in the group of the general approach and scope of the IEA of the central Arctic Ocean. This is an area with limited time series monitoring (except for sea ice and related oceanography), and it represents in many ways an assessment of a data poor area where information is fragmentary from various research activities that have been carried out over the years.

## **Future plans**

- 10) *Does the group think that a continuation of the WG beyond its current term is required? (If yes, please list the reasons).* Yes – the group suggests prolongation of the work of WGICA for three more years (2019-2021). It was noted that IEA is a core component of the Ecosystem Approach to management (EA), and that the work of WGICA is contributing to the basis for developing EA for the central Arctic Ocean ecosystem. A set of new ToRs was developed, including to review and report on ongoing and recent changes and events in the central Arctic Ocean ecosystem, examine effects of climate change on the ecosystem, and review and report on new studies on fish as well as other biological components of the ecosystem.
- 11) *If you are not requesting an extension, does the group consider that a new WG is required to further develop the science previously addressed by the existing WG.*  
*(If you answered YES to question 10 or 11, it is expected that a new Category 2 draft resolution will be submitted through the relevant SSG Chair or Secretariat.)*
- 12) *What additional expertise would improve the ability of the new (or in case of renewal, existing) WG to fulfil its ToR?* The suggested new ToRs include assessment of changes of transport pathways (physical and biological) and potential effects of contaminants in the central Arctic Ocean ecosystem. This would require expertise in contaminants and pollution effects. Cooperation with AMAP is one way to bring in such expertise in the work of WGICA.
- 13) *Which conclusions/or knowledge acquired of the WG do you think should be used in the Advisory process, if not already used? (please be specific).* The IEA report produced by WGICA will provide a synthesis and summary of knowledge about the central Arctic Ocean ecosystem and its current status and trends. While this is not direct management advice, it is information that can form the basis for advice on the need for policy formulations and management considerations in the context of implementing the EA to management.

## Annex 2 – Terms of Reference for ICES/PICES/PAME Working Group on Integrated Ecosystem Assessment for the Central Arctic Ocean (WGICA)

### ICES/PICES/PAME Working Group on Integrated Ecosystem Assessment of the Central Arctic Ocean (WGICA)

A Joint ICES/PICES/PAME Working Group on Integrated Ecosystem Assessment of the Central Arctic Ocean (WGICA), chaired by John Bengtson (USA), Sei-Ichi Saitoh (Japan), and Hein Rune Skjoldal (Norway) will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2019	8-10 May 2019	Sapporo, Japan	Interim report by 1 September 2019 to IEASG	
Year 2020	To be decided	To be decided	Interim report by 1 September 2020 to IEASG	
Year 2021	To be decided	To be decided	Final report by 31 December 2021 to IEASG	Change of chairs

### ToR descriptors

ToR	Description	Background	<a href="#">Science Plan codes</a>	Duration	Expected Deliverables
a	Review and consider approaches and methodologies for conducting an IEA of the CAO ecosystem.	WGICA has produced a first version IEA report for the CAO. Before producing an updated and extended version, the basic approach and methodologies should again be considered.	2.2, 6.1, 6.5	Year 1	Report outcome in the 2019 interim report.
b	Review and report on ongoing and recent changes and events in the CAO ecosystem associated with changes such as in sea ice, oceanographic circulation, and hydrographic properties.	There is a need to follow developments in the CAO resulting from the predicted further loss of sea ice and other physical changes associated with global climate change.	1.1, 2.2, 6.5	Years 1-3	New information will be reported in interim reports in 2019 and 2020. A more full account will be given as part of a second version IEA report for the CAO in 2021.

c	Continue to examine effects of climate change on the CAO ecosystem by compiling and reviewing information on changes in response to the ongoing 'Great melt', and assess likely consequences to the CAO ecosystem of projected future changes associated with further loss of sea ice and other climate-related changes (i.e. a climate impact assessment).	This activity was started in the first 3-year period, and some information is included in the 2018 IEA report. There is a need to continue and carry out a more detailed assessment of the documented and/or inferred biological and ecological changes associated with the large physical changes that have already taken place (e.g. loss of half the area and ¾ of volume of summer sea ice).	1.1, 1.3, 6.1, 6.5	Years 1-3	Progress will be reported in interim reports in 2019 and 2020. A more full account will be given as part of the new version of the IEA report for the CAO in 2021.
d	Assess the consequences of recent and ongoing climatic and oceanographic changes on transport pathways (physical and biological) and potential effects of contaminants in the CAO ecosystem.	This is a new activity which relates to assessment of pollution in the CAO. Pollution can be expected to be one of the more serious threat to the CAO ecosystem and should be included in an IEA.	2.1, 2.5, 6.1	Years 2, 3	Progress will be reported in interim report in 2020. Aspects of pollution will be included in the new IEA report for the CAO in 2021.
e	Review and report on new studies on fish as well as other biological components of the CAO ecosystem.	The information on many parts of the CAO ecosystem is still limited. New information is expected to come over the next few years as research ice-breakers pay more attention and use scientific echosounders and other observation techniques to record fish and other organisms in the water column and at the seafloor.	5.2, 6.1, 6.5, 6.6	Years 1-3	Progress will be reported in interim reports in 2019 and 2020. A more full account will be given as part of the new version of the IEA report for the CAO in 2021.
f	Continue to identify priority research needs and monitor how identified knowledge gaps (needed to improve IEA and management effectiveness) are being addressed and filled.	A by-product of doing the first version IEA of the CAO is a priority list of research needs. It is necessary to monitor how knowledge gaps are filled that will improve new versions of IEA.	1.3, 2.2, 3.1, 6.1, 6.5	Years 2, 3	Progress will be reported in the interim report in 2020 and outcome reported in 2021.

g	Prepare an Ecosystem Overview for the CAO ecosystem	This will be an addition to the series of Ecosystem Overviews prepared by ICES.	6.5, 6.6	Years 2, 3	Draft version will be reported in the interim report in 2020 and final version reported in 2021.
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### Summary of the Work Plan

<b>Year 1</b>	Review IEA methodologies for IEA of the CAO. Review and report new information and changes in the CAO ecosystem.
<b>Year 2</b>	Review and report new information and changes in the CAO ecosystem. Address pathways and effects of contaminants, make an initial list of research needs, and prepare draft Ecosystem Overview.
<b>Year 3</b>	Prepare a second version IEA report for the CAO with information on status and trends, including impacts of climate change, pollution, and other relevant human pressures. Report on research needs and prepare final draft of Ecosystem Overview.



## Supporting information

<b>Priority</b>	<p>WGICA is one of several groups in ICES that do integrated ecosystem assessments, which is one of the priority action areas for ICES. Being a WG for the central Arctic Ocean, WGICA also contributes to the Arctic research action area. Jointly sponsored by PICES and the PAME working group of the Arctic Council, WGICA represents a collaborative effort that links ICES work in the wider Arctic Mediterranean Sea (the Nordic Seas and the central Arctic Ocean) with expertise on the Pacific Arctic through PICES.</p> <p>The work planned in WGICA will directly address ICES science priority area 6 Developing tools, knowledge and evidence of effective conservation and management and some elements of priority area 2 (Understanding ecosystems) and 3 (Impacts of human activities).</p>
<b>Scientific justification</b>	<p>ICES IEA EGs provide science based assessments of ecosystem status, trends and vulnerabilities to support implementation of the ecosystem approach to management.</p> <p>ToR a – The CAO is a data-deficient system where much of the data and knowledge comes from research activities, while monitoring is a more limited source of information. Based on the first version IEA report for the CAO, as well as experiences from the other IEA WGs in ICES, the approach and methods for IEA for the CAO will be considered prior to producing a second version IEA report in 2021.</p> <p>ToR b – The CAO is on a trajectory of reduction of sea ice with considerable interannual variability. Trends and events will be reported to draw attention to the ongoing changes in the CAO.</p> <p>ToR c – The purpose and aim of this item is to provide a careful evaluation and summary of what we can say about the biological and ecological effects of climate change over the recent decades up to present. This can in turn be used for projections of likely effects of continued warming and loss of sea ice over next decades.</p> <p>ToR d – This item addresses pollution with focus on contaminant pathways (physical and biological) and potential effects in foodwebs of the CAO. The scale of activity will depend on the expertise available in the WG.</p> <p>ToR e – It is expected that new information will be forthcoming on occurrence of fish and other biota in the CAO from planned research activities. There is for instance increased awareness that scientific echosounders on research ice-breakers can provide valuable information. We will report on developments and include new information in the next IEA report.</p> <p>ToR d – This is an item meant to provide guidance to the research community at large on priority research issues to improve the knowledge base for continued IEA work.</p> <p>ToR e – This will add to the suit of Ecosystem Overviews prepared and published by ICES.</p>
<b>Resource requirements</b>	No major resourcing.
<b>Participants</b>	Experts from ICES, PICES, and PAME
<b>Secretariat facilities</b>	Support for meetings at ICES HQ, when appropriate.
<b>Financial</b>	No financial implications for ICES.
<b>Linkages to ACOM and groups under ACOM</b>	Link to ACOM through the development of Ecosystem Overviews and advice.
<b>Linkages to other committees or groups</b>	Within ICES links across all ICES IEA working groups and to HAPISG EGs on human pressures on marine ecosystems, such as pollution.
<b>Linkages to other organizations</b>	This is a joint ICES, PICES, and PAME WG.