Integrated Ecosystem Assessment of the Northern Bering Sea – Chukchi Sea (NBS-CS) (WG 44) Working Group Meeting

April 14, 2021

15:00-18:00 Pacific Daylight Time (UTC-7)

CHAIR: LIBBY LOGERWELL

Agenda

- Welcome, adoption of agenda, appointment of rapporteurs (Chairs)
- Introductions, new members and guests (Chairs)
- Metadata, status and upcoming milestones (Ferguson, Rand and Zuenko)
- Approach and methodology, status and upcoming milestones (Holsman, Daniel, Stram)
- Indigenous knowledge sharing, status and upcoming milestones (Wise)
- Revised timeline due to COVID restrictions (Chairs)
-
- Break
-
- ICES IEA projects, workshops, etc. (Jörn Schmidt)
- NOAA IEA proposal (Holsman)
- NPRB synthesis proposal (Logerwell)
- Arctic Council PAME Ecosystem Approach Expert Group (Logerwell)
- New surveys, IEA projects or other information:

Welcome, adoption of agenda, appointment of rapporteur (Chairs)

- Additions or revisions to the agenda?
- Thank you Kim and Megan for volunteering to be rapporteurs!
- Meeting logistics
  - Please mute your microphone if you are not speaking
  - If bandwidth becomes limited, please turn off your video if you are not speaking
  - Please write in the chat box if you would like to comment or ask a question

Introductions, new members and guests (Chairs)

- Jörn Schmidt (ICES Science Committee SCICOM Chair)
- New member: Lis Jørgensen (co-chair ICES/PICES/PAME WG Integrated Assessment of the Central Arctic Ocean WGICA)
- Guests
  - Marisol Garcia Reyes (Farallon Institute, US)
  - Jamal Moss (NOAA)
  - Lyle Britt (NOAA)
  - Fletcher Sewall (NOAA)
  - Ebett Siddon (NOAA)
  - Henry Huntington
  - Matthew Asplin (ASL Environmental Science, US)
  - Jackie Grebmeier (University of Maryland, US)
  - Carin Ashjian (Woods Hole Oceanographic Institution)
  - Others?

Metadata, status and upcoming milestones (Ferguson, Rand and Zuenko)

WG 44 - Metadata

- Update WG44 on status of metadata compilation (14 April 2021)
  - A spreadsheet has been populated based on responses from WG44 members to the Google Form that was distributed in autumn 2020.
  - We discovered that multiple metadata archives exist online. In some instances, a single database is referenced in multiple archives.
  - Some databases have no metadata or are not archived in a publicly accessible archive.
- **How would WG 44 members like to use and interact with** an inventory of scientific metadata, institutions, and programs (e.g., spreadsheet, app, etc.) (14 April 2021)
- Metadata needs can be further defined as objectives are narrowed.

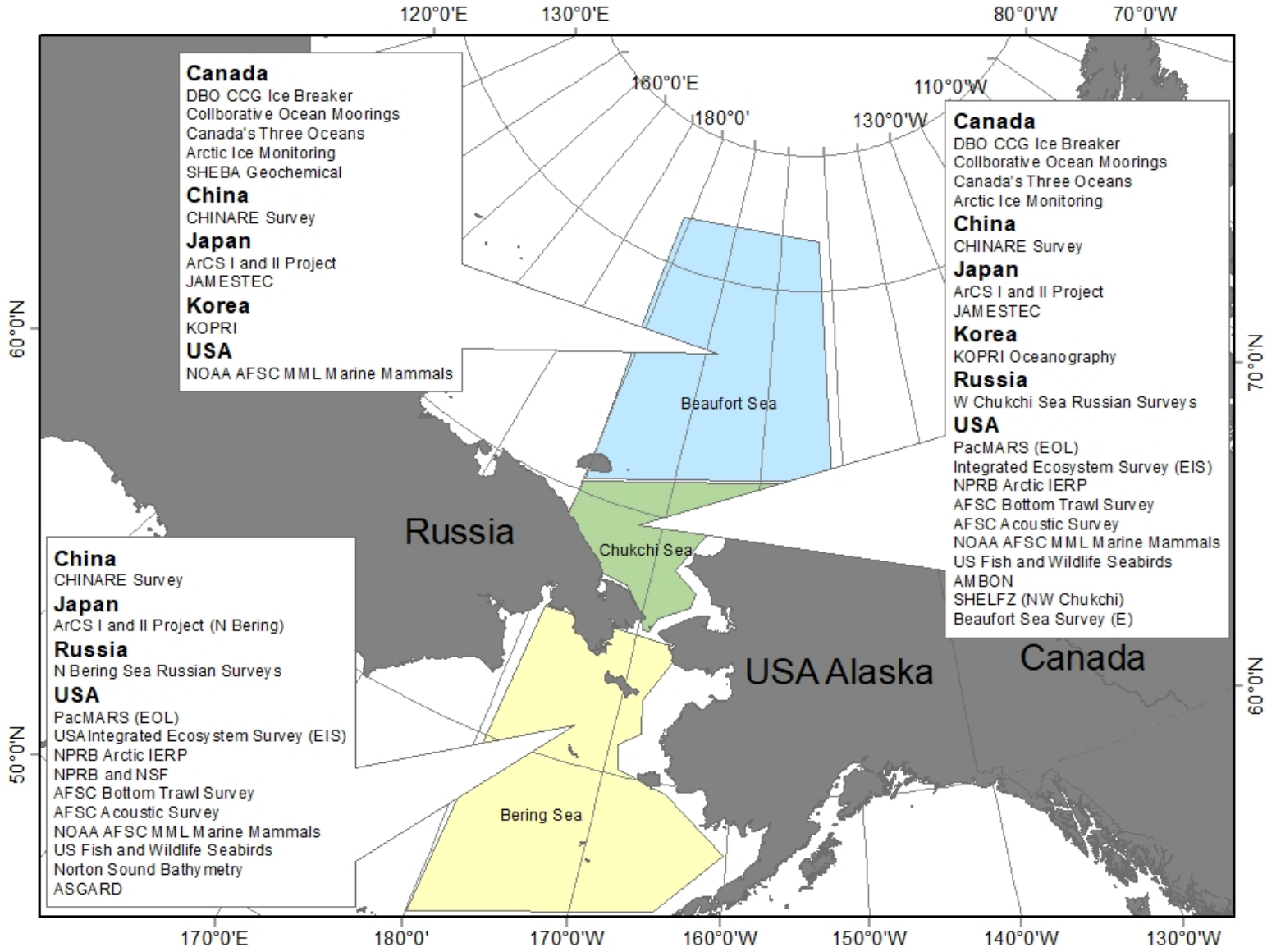
Two types of metadata exist:

1. Metadata that points to all the other data and is fully online accessible with URLs
2. Metadata that lists available data that are NOT available online but rather through contacts

Milestones for 2021 metadata:

- Provide a list and URLs for known, existing, metadata archives where WG44 members can go to conduct searches themselves (Autumn 2021)
- Create a simple compilation of known databases that have no metadata or are not archived in a publicly accessible archive. Include PI contact info and other key features (Autumn 2021)

Updated map of datasets identified in the WG 44 metadata compilation



- Little has changed in regards to the map shown.
- Each source of data identified by nation includes multiple datasets.

Metadada on Russian investigations

The following Russian research institutions potentially are able to investigate the northern Bering and Chukchi Seas:

Federal Hydrometeorological Agency (meteorology, oceanography, chemistry, pollution)

Institutes: Far-Eastern Research Hydrometeorological Institute (Vladivostok)
Arctic and Antarctic Research Institute (Sankt-Peterburg)

Academy of Science (oceanography, chemistry, marine biology)

Institutes: Pacific Oceanological Institute (Vladivostok)
Institute of Marine Biology (Vladivostok)
Institute of Biological Problems of the North (Magadan)

Federal Fisheries Agency (oceanography, chemistry, pollution, marine biology)

Institutes: Russian Research Institute of Fisheries and Oceanography
(Pacific branch (TINRO) in Vladivostok,
Magadan branch in Magadan)

Hydrographic Service of the Russian Navy (meteorology, oceanography)

Expected volumes of the data (% to the total)

Institution	Meteorology	Physical oceanography	Marine chemistry	Pollution	Marine biology
Hydrometeorological Agency	95	5	5	10	-
Academy of Science	-	3	5	-	10
Fisheries Agency	-	90	90	90	90
Hydrographic Service	5	2	-	-	-

About 90% of marine data are collected by Fisheries Agency (mostly by TINRO)

Availability of the metadata

Institution	**Meteorology**	**Physical oceanography**	**Marine chemistry**	**Pollution**	**Marine biology**
Hydrometeorological Agency	WMO data base	WMO data base, partially **available**	**available**	no data base	-
Academy of Science	-	no data base	no data base	-	no data base
Fisheries Agency	-	**available**	**available**	no data base	**available**
Hydrographic Service	not available	not available	-	-	-

Metadata about the main part of data are already collected for WG 44

Russian metadata on oceanography

Northern Bering Sea

		1980s						1990s										2000s										2010s										
Year	1950-1980	early 80s	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TINRO	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+
HMA	+	+	+	+	+	+	+	+			+									+																		

Chukchi Sea

		1980s						1990s										2000s										2010s										
Year	1950-1980	early 80s	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TINRO															+						+				+	+		+								+	+	+
HMA																																						

Russian metadata on marine chemistry

Northern Bering Sea

Year	1950-1980	early 80s	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TINRO								+																		+	+	+	+	+	+	+	+					+
HMA		+		+	+	+														+								+							+		+

Chukchi Sea

Year	1950-1980	early 80s	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TINRO																												+								+		+
HMA																																						

Russian metadata on marine biology

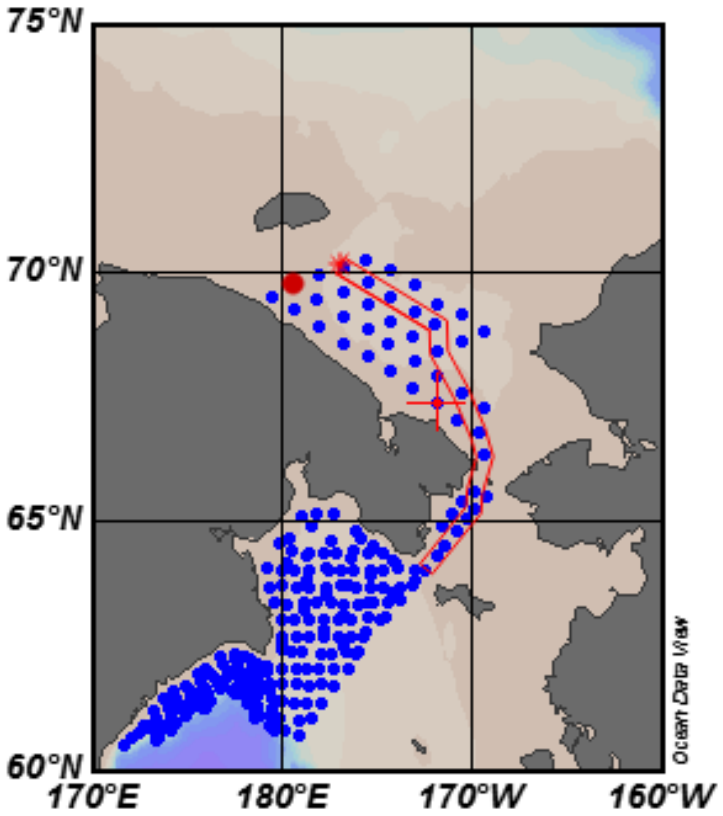
Zooplankton collections

Year	1950-1980	early 80s	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
N.Bering				+	+		+	+								+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+			+		
Chukchi																					+				+	+		+					+			+		

Trawl surveys

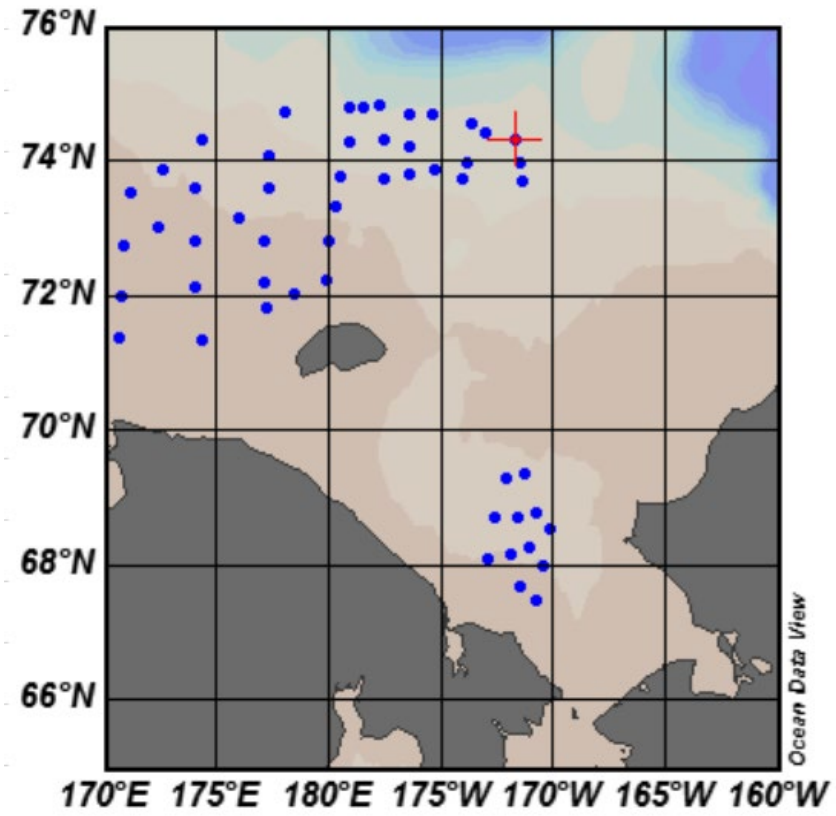
Year	1950-1980	early 80s	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
N.Bering	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+
Chukchi																					+				+	+		+								+	+	+

Typical scheme of TINRO survey



RV TINRO
August-September, 2010

Unusual case of TINRO survey in the Chukchi Sea

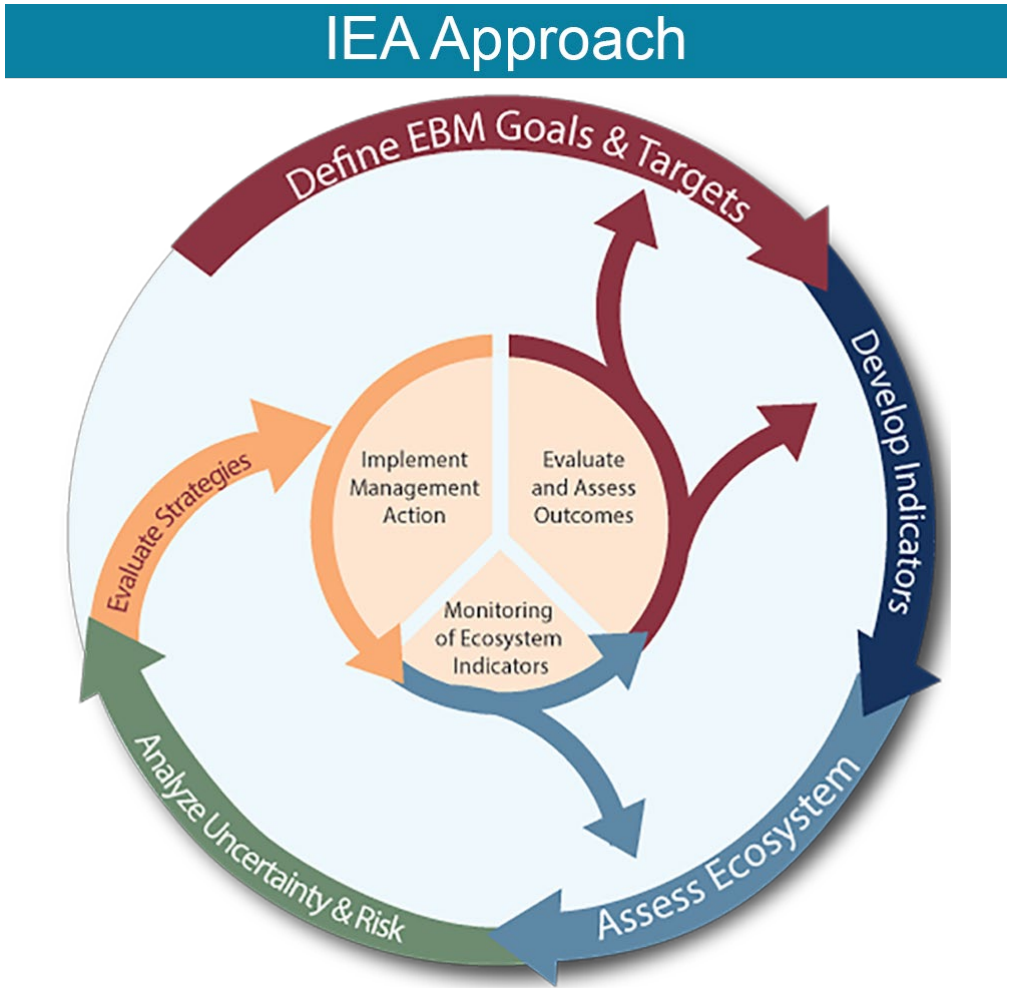


RV TINRO
August-September, 2018

Approach and methodology, status and upcoming milestones (Holsman, Daniel, Stram)

SCOPING

K. Holsman
R. Daniel
D. Stram



SCOPING

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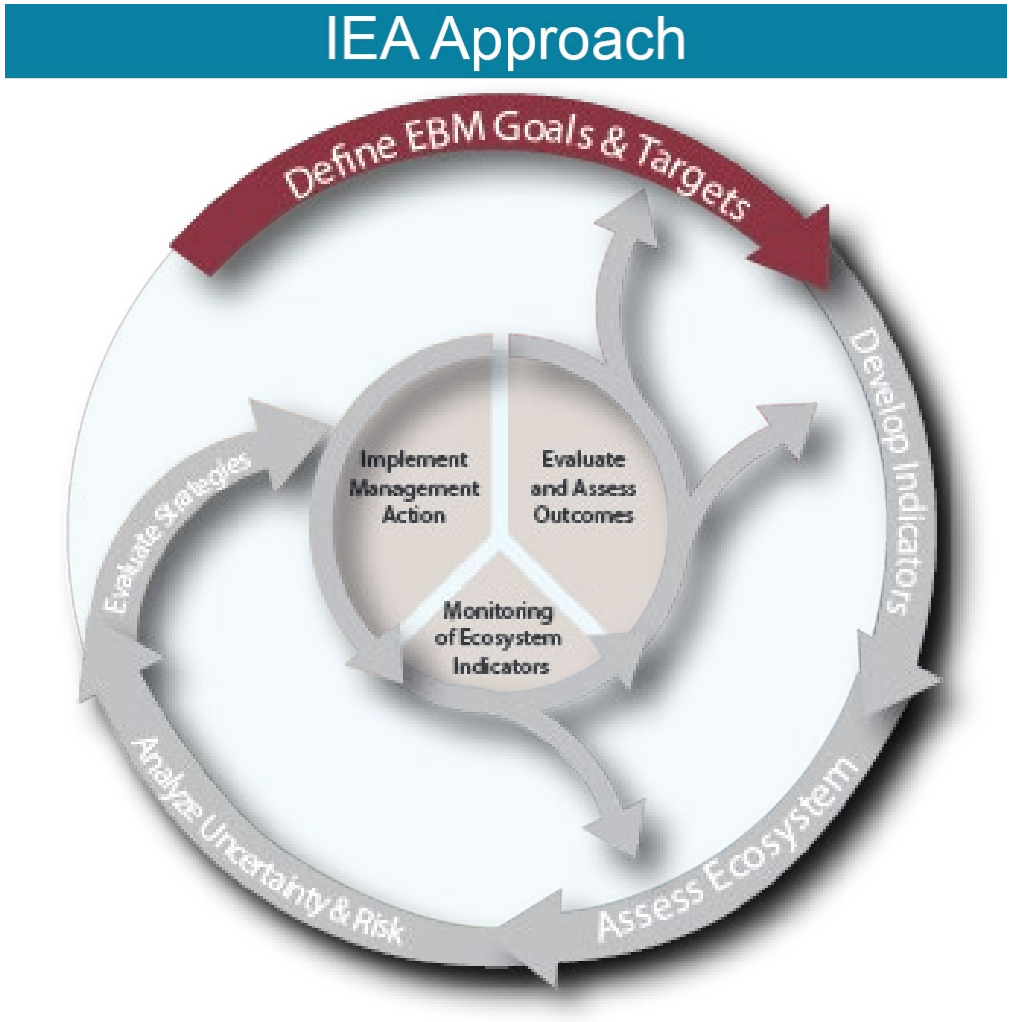


SCOPING

The term "scoping" is often used to describe this first step which includes defining:

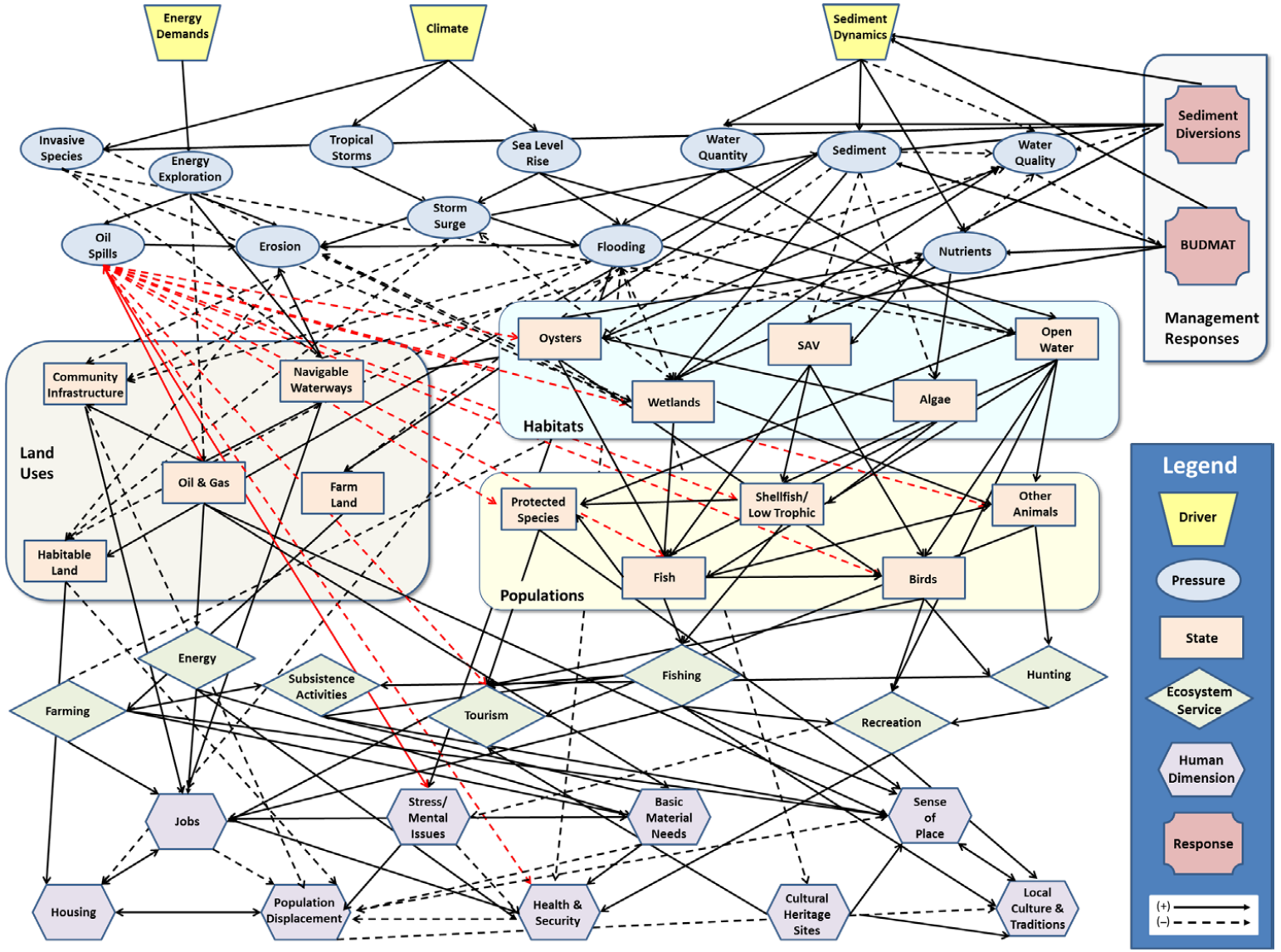
- The system of interest, including relevant ecological, social, economic characteristics, and their relationships with partners and stakeholders
- Management or planning goals and objectives

"For scoping to be effective, ongoing communication and engagement with and between scientists, managers, stakeholders, and other users of the marine ecosystem is critical from the outset. ***Success requires that dialog and trusted relationships between all partners be established and communication and feedback be "early and often" - cultivated and maintained throughout collaborative implementation of the IEA approach."***

Conceptual model

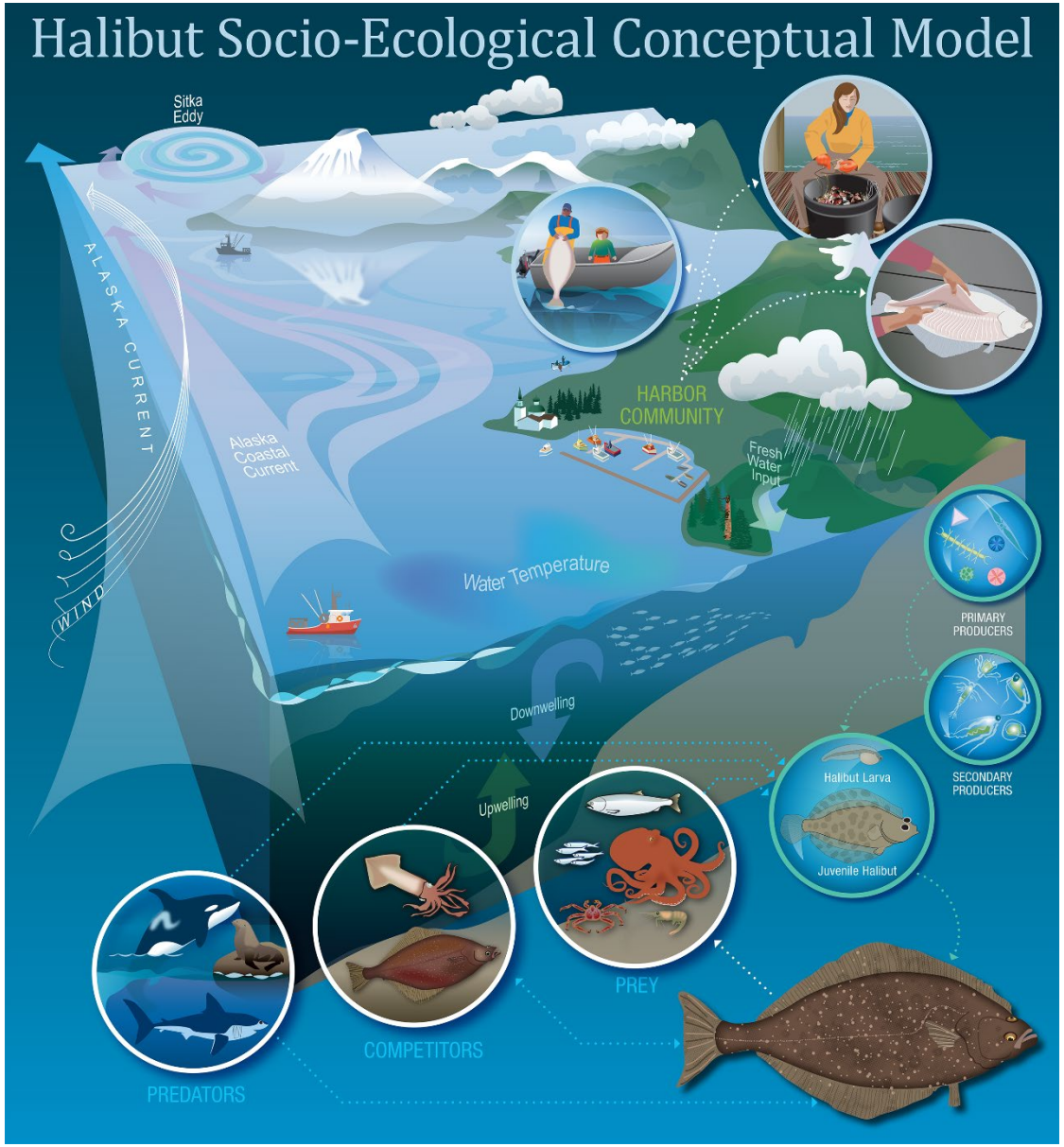
- Are a good communication and engagement tool
- Provide a unifying framework across people and disciplines (i.e. natural and social scientists; managers and policy frameworks; industries and local communities)
- Promote dialog among interested parties
- Increase and visualize understanding of complex system dynamics and relationships
- Link and integrate concepts across ecological and socio-economic components; enable consistent analyses across components
- Help identify and define what indicators are needed for each ecosystem component (e.g. what do we need to measure?)
- Help integrate scientists across ecological and socio-economic components by visually defining what they need to do together
- Help define what needs to be included in ecosystem models
- Show managers with different mandates how they all fit together
- Help anticipate trade-offs of potential management actions across components in a system
- Depict human activities (positive and negative) as a central aspect of the system (Humans as not just "antagonists" in the system, but fully integrated as part of the system)
- Facilitate integration of information and collaboration across disciplines to enable implementation of management in an informed, holistic, ecosystem context

Conceptual model



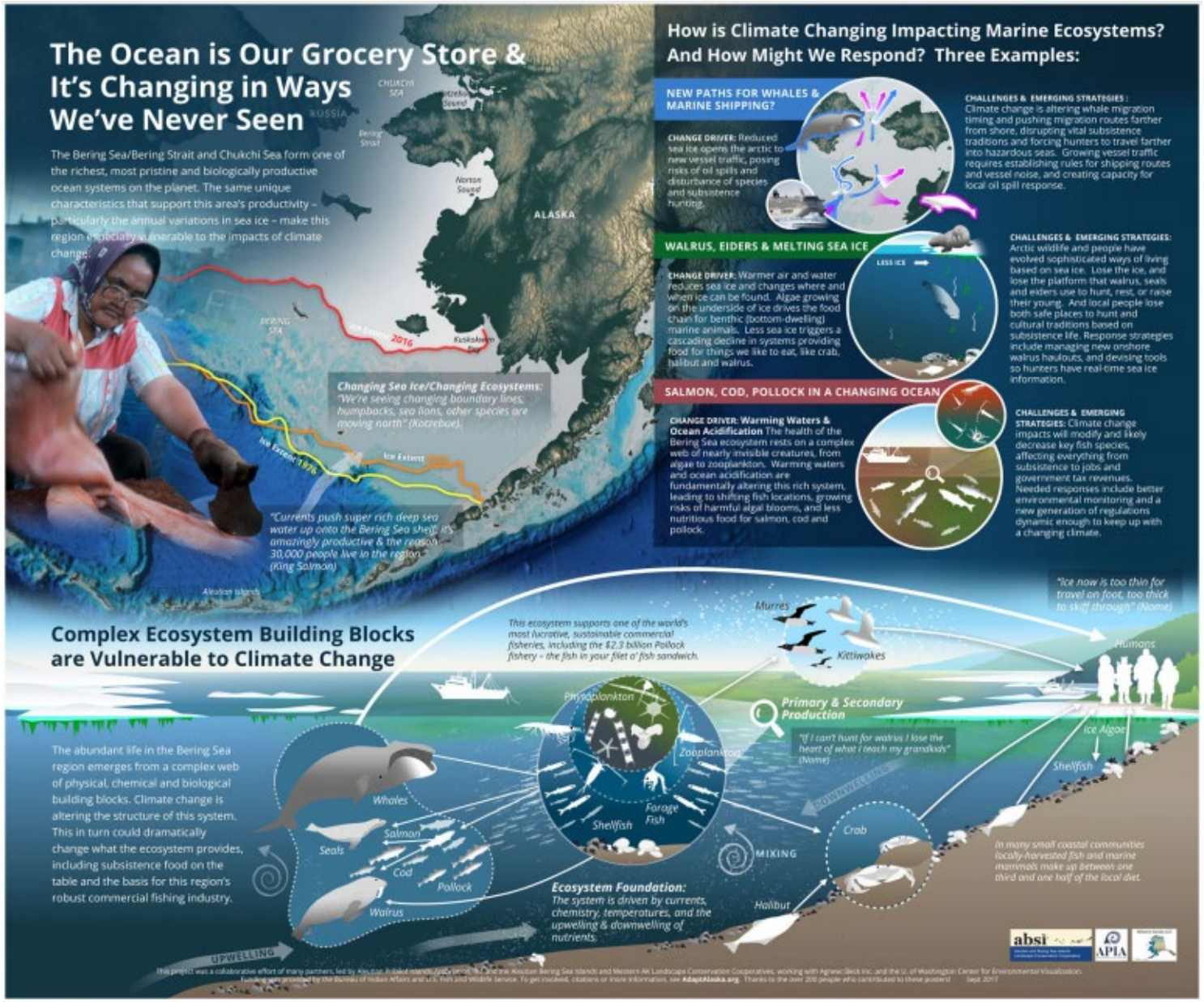
This conceptual model depicts the ecosystem of the Mid-Barataria in the Gulf of Mexico. To learn more about how it is being used go here.

Conceptual model



This conceptual model depicts the social and ecological ecosystem around Halibut in the Gulf of Alaska. To learn more about how it was made go here.

Conceptual model



https://www.apiai.org/tribes/

Our draft document

Scoping the NBS & Chukchi Sea Integrated Ecosystem Assessment

Draft

2021

L. Logerwell, R. Daniel, D. Stram, K. Holsman

Contributors:
[add WG44 IEA members here]

Table of Contents:

- https://docs.google.com/document/d/1MHpe1fDfXyhXzOcJVVzrtIibGDNmhgCVo2srU3vHa4c/edit#

AK IEA Priorities

Priorities for regional AK IEA

- Support Ecosystem based decision tools
- Support climate-informed decision tools
- Support equitable & just decision tools
- Continue to develop Alaska IEA Beyond NMFS

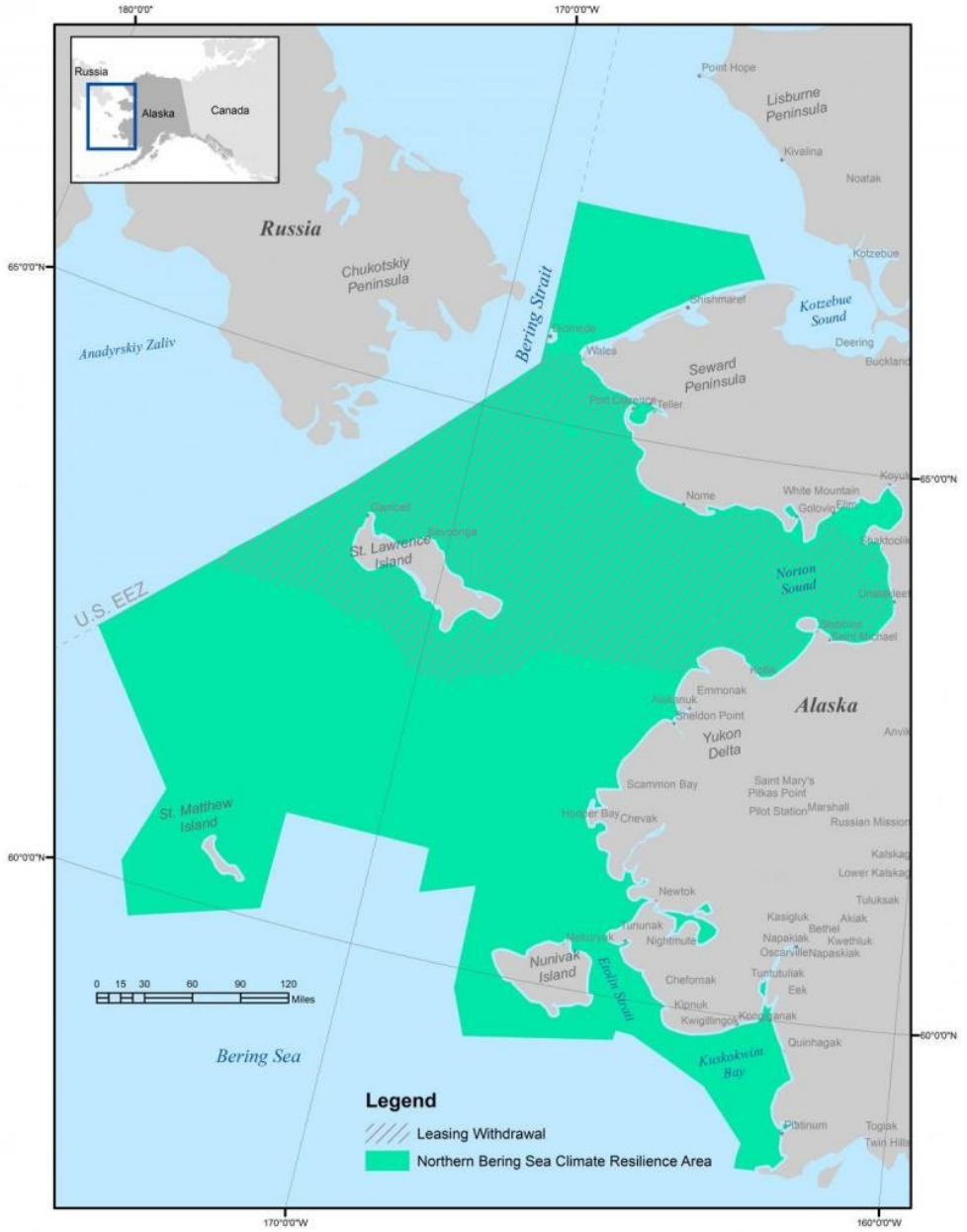
AK IEA Goals

AK IEA Goals (draft):

- **GOAL 1:** Build and maintain operational capacity for EBM across all AK IEA regions
- **GOAL 2:** Continue to build interdisciplinary and diverse partnerships that facilitate a plurality of perspectives in Alaska EBM decision making and support a co-production of knowledge approach.
- **GOAL 3:** Produce actionable science to inform equitable adaptation and response to near-term and long-term threats to Alaska social-ecological systems

N. Bering Sea Climate Resilience Area

[2021 EO]



Next Steps

1. Summer 2021: Finalize goals & objectives
2. Sept 2021: Complete IEA Scoping Doc: Sept 2021 (to align with IERP)
   - Overview & lay of the land
     - Answer: Who is the IEA for? What is the value added?
   - Goals
   - Objectives for each goal
   - Process and products to achieve each goal
   - Scope
3. Activities for year 2 & 3
   - Conceptual model workshop (fund with AK IEA?)
   - Partnership building and knowledge sharing
     - Symposia, workshops, joint proposals

Indigenous knowledge sharing, status and upcoming milestones (Wise)

Determine approach and methodology for conducting an IEA

Objective: *Include Indigenous **perspectives,** Indigenous **knowledge, and** Indigenous **voices in the process and products**—not incorporated into the "science" sections but **standing on their own.***

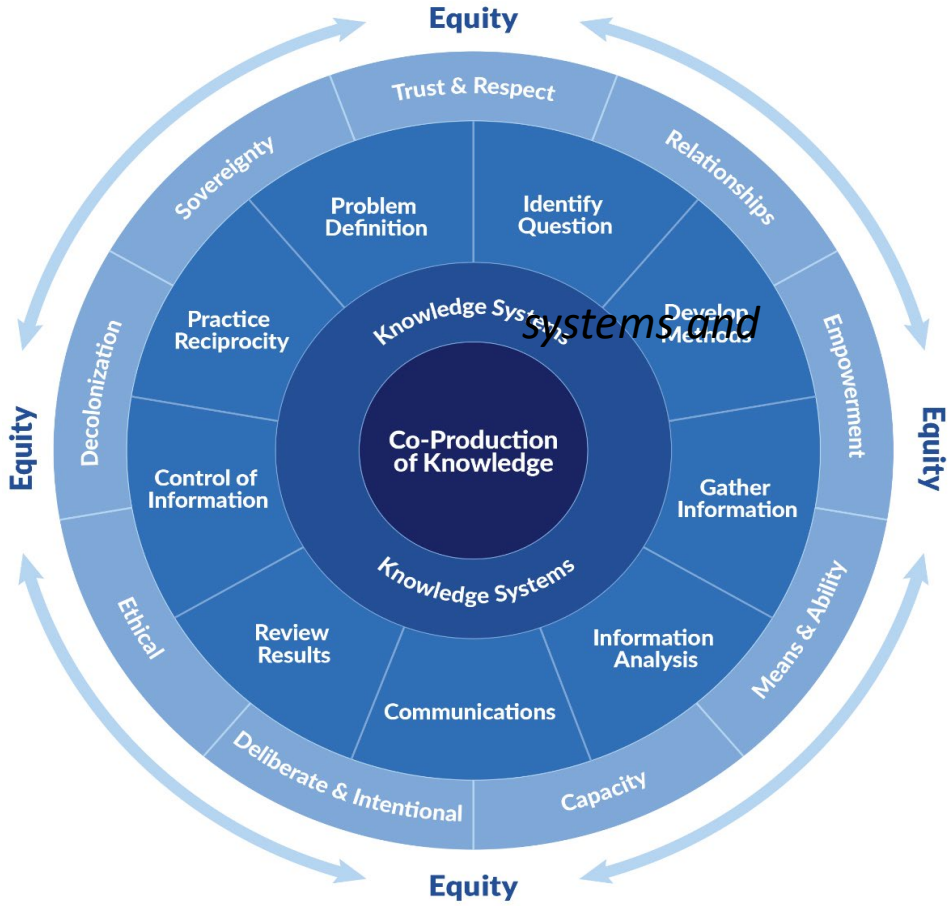
- ***Highlight how** Indigenous Peoples are part of the ecosystem and what that means for guiding human actions.*

  1. **Map Lay of the Land**

- ***Define "Ecosystem" holistically"**—include multiple knowledge perspectives.*

  2. **Indigenous Conceptual Ecosystem Models (ICEM)**

- Do no Harm
- Equity
- Transparency
- Reciprocity
- Continuity
- Flexibility
- Time
- …



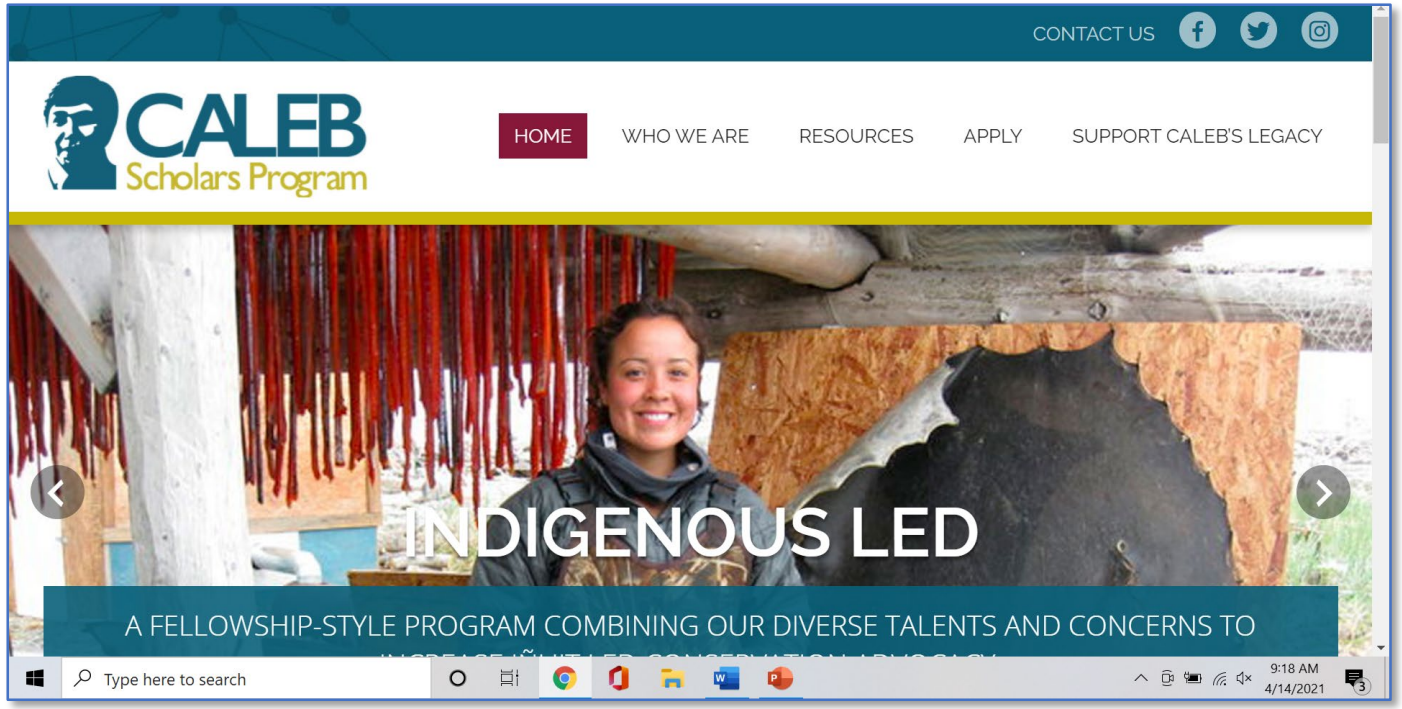
Determine approach and methodology for conducting an IEA

1. Map Lay of the Land

Who is doing work out there? Where and on what?

- Define boundaries and scope
- Map: Institutions, organizations, associations, networks, research efforts, tools, Co-management projects, collaborations, working groups, subject matter.
- Identify gaps and linkages

Initiate broad partnerships



Indigenous Conceptual Ecosystem Models (ICEM)

2. Develop Indigenous Conceptual Ecosystem models (ICEM)

Develop ICEM of the NBS and Chukchi Sea ecosystem using an interdisciplinary methodology, framework, and team (TK holders, scientists, managers).

- Define ecosystem equitably including all ways of knowing
- Promote enduring interdisciplinary partnerships
- Bridge knowledge systems to inform EBM
- ID key issues/concerns for communities

3 phases

Phase I - Facilitate knowledge network

Phase II - Data Collection and ICEM Development Workshop

Phase III – Synthesis into broader IEA

***Continued sensitivity to capacity**
****Covid-19 and uncertainty?**

- **Dutra et al. (2019).** Governance mapping: A framework for assessing the adaptive capacity of marine resource governance to environmental change. *Marine Policy*, *106*, 103392

- **Alexander, S. et. al. (2019).** Bridging Indigenous and science-based knowledge in coastal and marine research, monitoring, and management in Canada. *Environmental Evidence*, *8*(1), 1-24.

- **Raymond-Yakoubian, J. et. al. (2020).** Mapping and indigenous peoples in the Arctic. In *Governing Arctic Seas: Regional Lessons from the Bering Strait and Barents Sea* (pp. 293-319). Springer, Cham.

Revised timeline due to COVID restrictions (Chairs)

Break!

15 MINUTES

IEA-SG news, Ecosystem Overviews, and Workshops

Jörn Schmidt, Chair Science Committee
International Council for the Exploration of the Sea

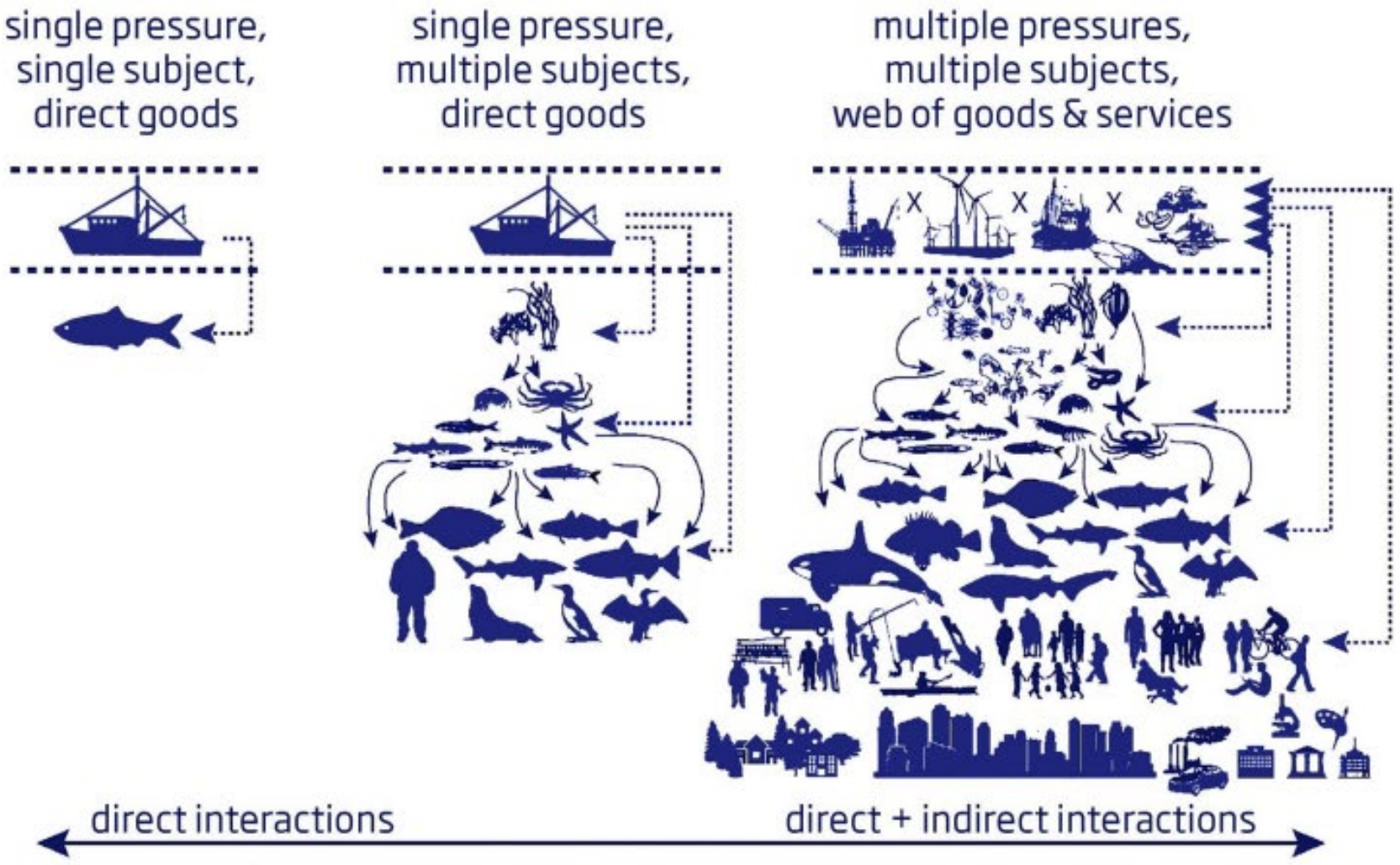
Greetings from Debbi Pedreschi!

- ASC sessions for 2022: Would we like to put together an IEASG session?
  - Title: Integrating Integrated Ecosystem Assessments
- ICES has released its Guidance on 'Ecosystem Services and Effects'

  https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2021/2021/Advice_on_ecosystem_services_and_effects.pdf
- Upcoming Training courses

  https://www.ices.dk/events/Training/Pages/default.aspx
  - Introduction to Management Strategy Evaluation. 23–27 August 2021
  - Introduction to Stock Assessment. 27 September - 1 October 2021.
  - Introduction to large-scale tag-recapture campaigns and their potential role in the management of fisheries resources, 4-8 October 2021

Ways of Working.....



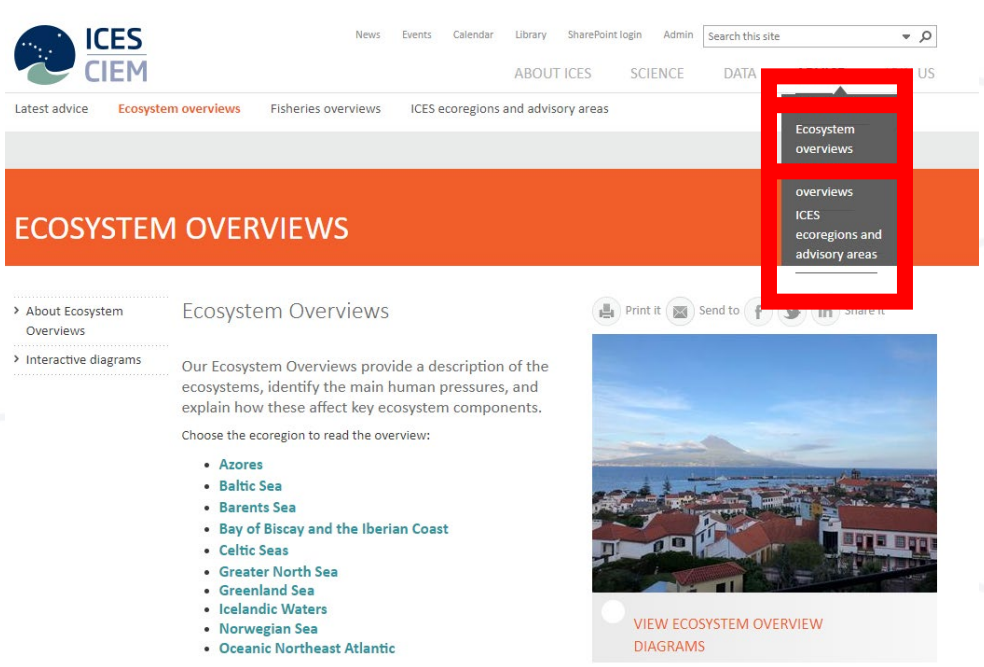
Holsman et al 2017 & ICES 2016

What are the Ecosystem Overviews?

The ICES ecosystem overviews (EOs) are **advice products** that provide a **description of the ecosystems**, identify the **main human pressures**, and explain how these affect **key ecosystem components** (in line with EBM and IEA approaches)

ICES EOs describe the **distribution of human activities and resultant pressures** (in space and time) on the **environment and ecosystem**

ICES 2013 WKECOVER report



10.1 Greenland Sea ecoregion – Ecosystem overview

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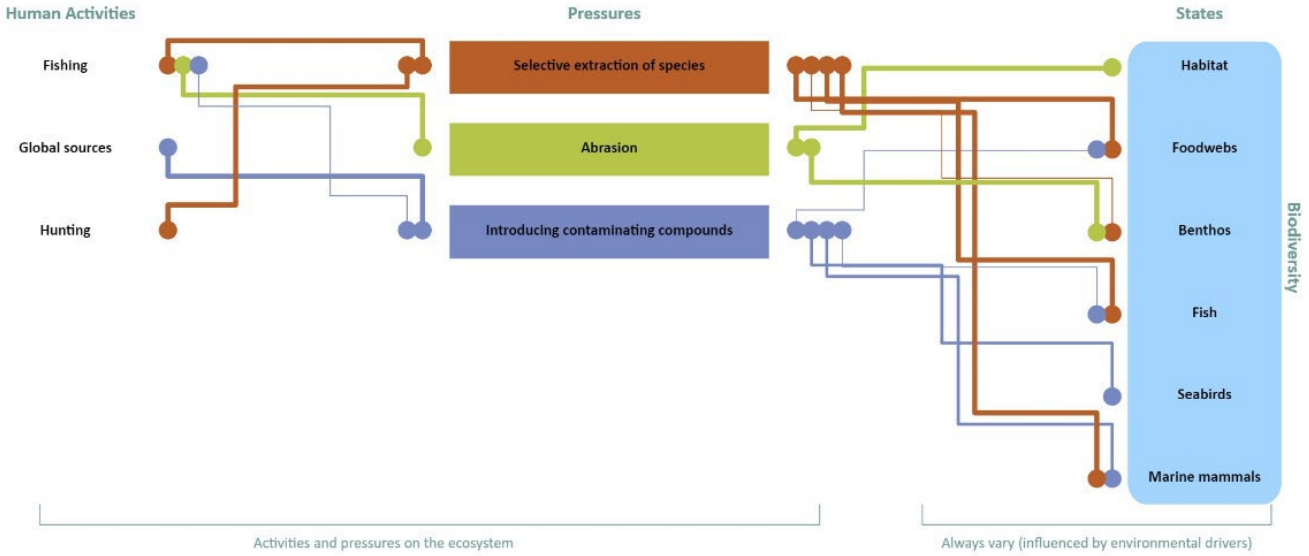
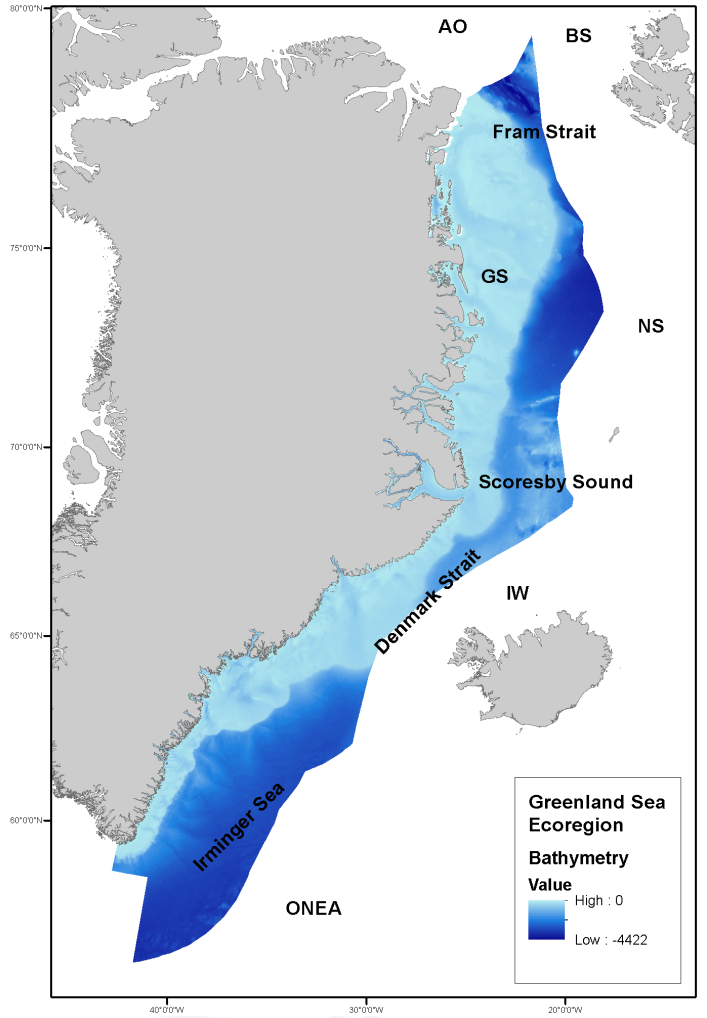
Ecoregion description

The Greenland Sea ecoregion follows the Greenland Exclusive Economic Zone (EEZ) definition and comprises the continental shelf waters and offshore areas. The Denmark Strait between Iceland and Greenland separates the ecoregion into a northern and southern subregion that differ with respect to ice coverage, influence of polar and Atlantic waters, and anthropogenic activity. The ecoregion borders five other ecoregions (Oceanic Northeast Atlantic, Icelandic Waters, Norwegian Sea, Barents Sea, and Arctic Ocean) and also the West Greenland waters (Figure 1).



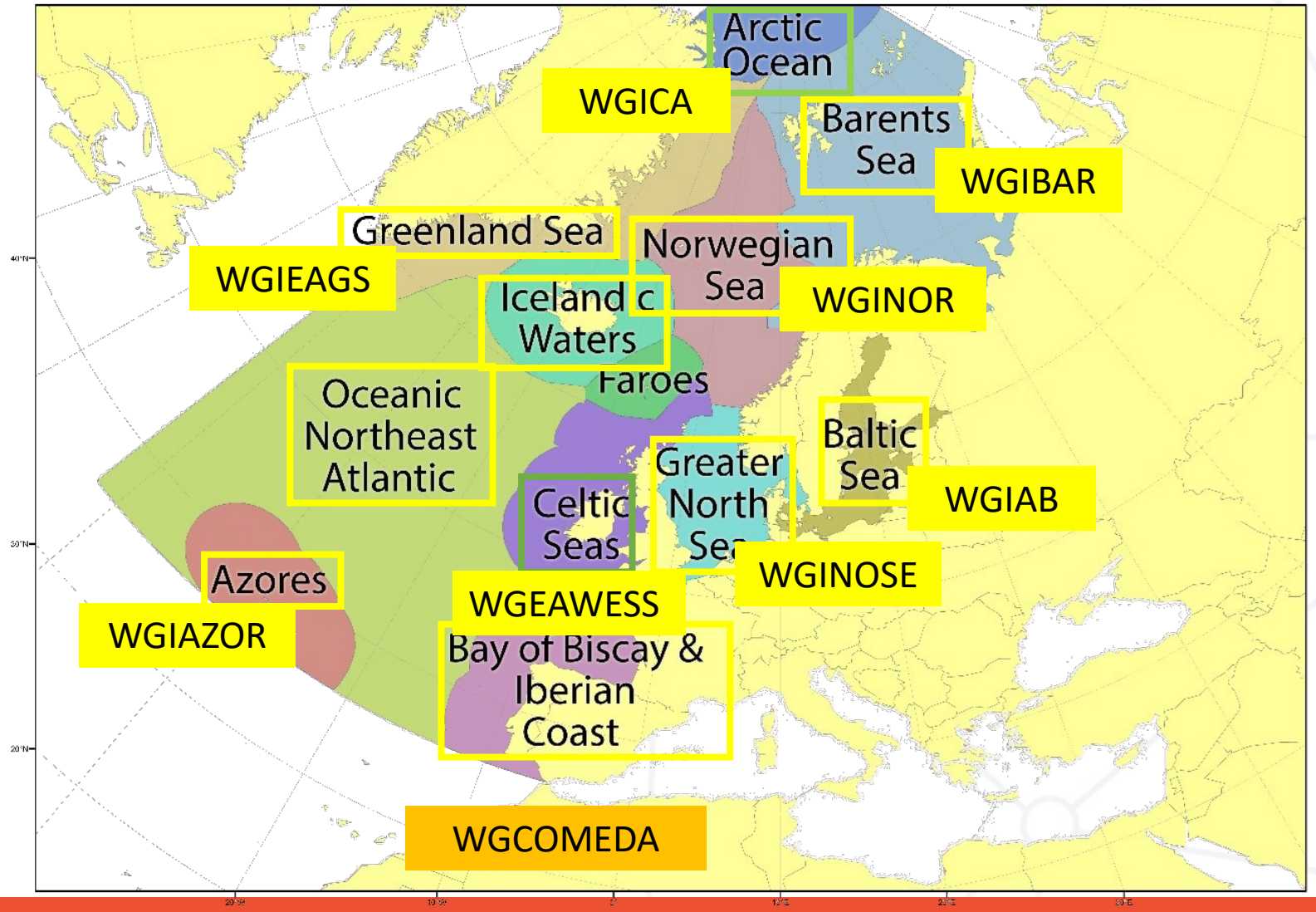


Science for sustainable seas

ICES Ecoregions

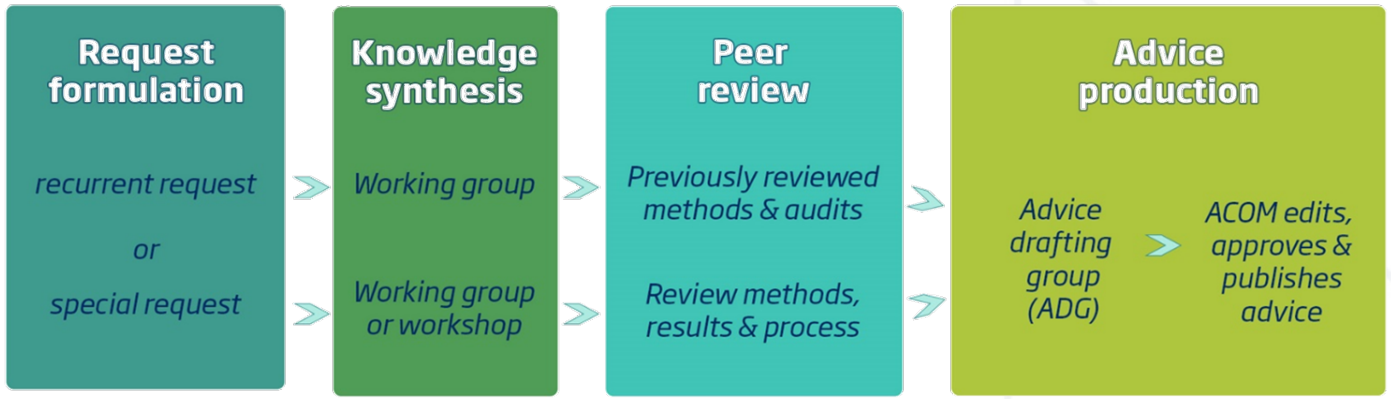
WGIEA
NBS-CS

WGNARS



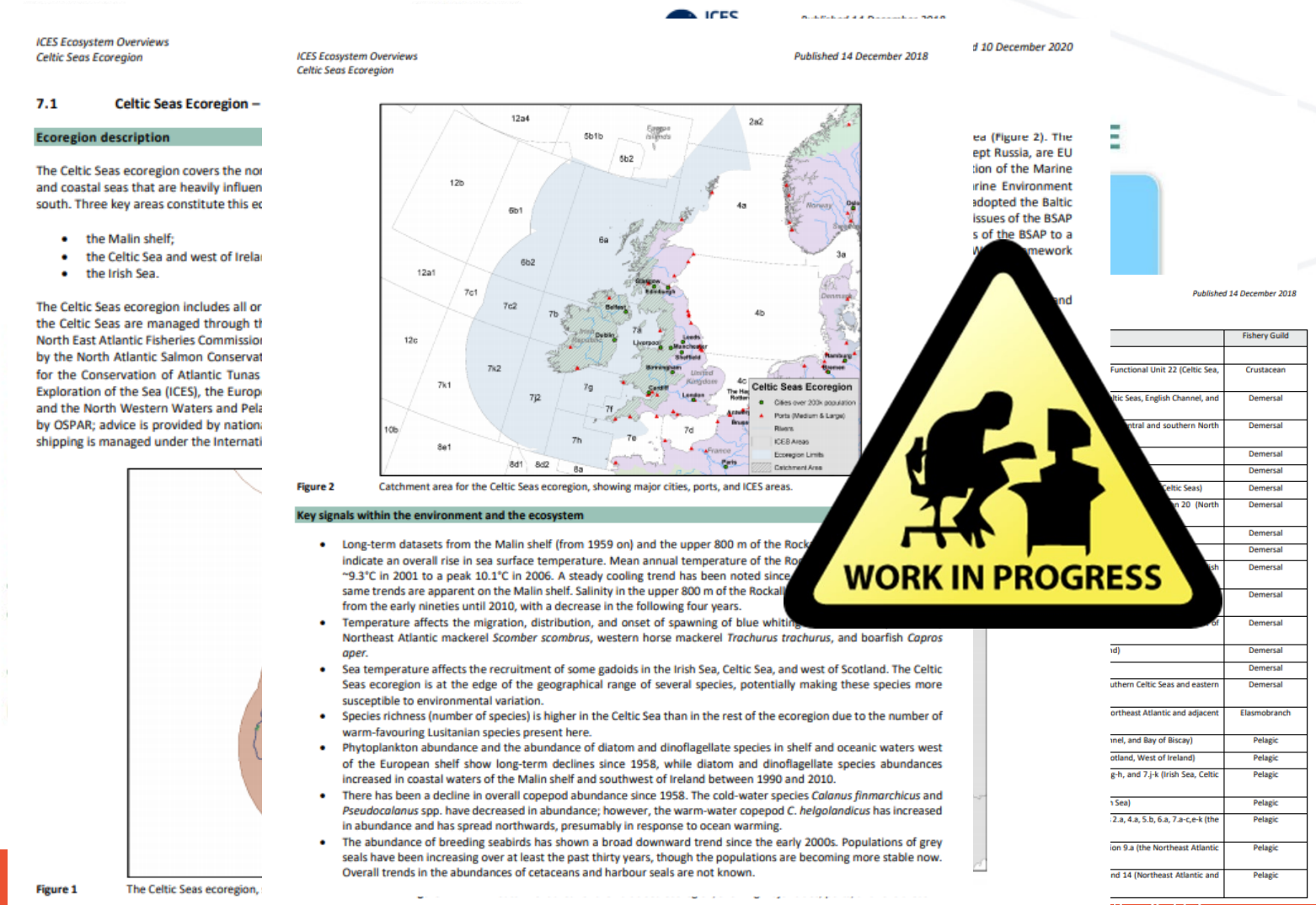
Who makes the Ecosystem Overviews?

- Integrated Ecosystem Assessment (IEA) groups
  - with contributions from many other groups
  - reviewed by advice drafting group (ADGECO)
- The final advice is agreed by Advisory Committee (ACOM), which includes scientists appointed by each ICES member country government



What's in the Ecosystem Overviews?

- Key Messages
- Ecoregion Description
- Management (new!)
- Pressures (impacts)
- Ecosystem State (current status of system and species)
- Climate Change impacts



Upcoming workshops

- Workshop on Stakeholder Engagement Strategy (WKSHOES, 22-24 June 2021)
  https://www.ices.dk/community/groups/Pages/WKSHOES.aspx
- Climate-related advice (September/October 2021)
- Joint ICES/EUROMARINE Workshop on Common Conceptual Mapping Methodologies (1-5 November 2021)
  https://www.ices.dk/community/groups/Pages/WKCCMM.aspx
- Ecosystem Services (later 2021)

Ideas for workshops

- Workshop on Guiding Principles for Community Supported Observations (CSO)
  - data collection and reporting protocols are co-created by communities and researchers, producing linked social and environmental data in interoperable formats that can embed biophysical data in social contexts
- Workshop on knowledge sharing and knowledge co-production approaches
  - Traditional (TEK), local (LEK) or Indigenous ecological knowledge (IEK) from coastal communities is invaluable to understand the development of local social-ecological systems by providing practical experience in living within ecosystems and responding to ecosystem change.

Thank you very much!

ICES
CIEM

Science for sustainable seas

NOAA IEA proposal (Holsman)

National IEA 3 year plan

- **GOAL 1:** Fully implement the IEA process (Figure 1) in each IEA region, resulting in successful science-based decision support (transfer of science to management); demonstrate that the IEA approach is more than the sum of its parts.
- **GOAL 2:** Enhance and expand science and management partnerships (considered as integrated IEA partners as opposed to users) with regionally relevant partners.
- **GOAL 3:** Conduct innovative, leading-edge science to support implementation of stakeholder and manager-driven EBM.
- **GOAL 4:** Strengthen internal and external communication to support effective dissemination of science to policy-makers, managers and stakeholders, exchange between scientists, and for messaging of progress, successes and [management] impact.

IEA Program proposal

K. Holsman

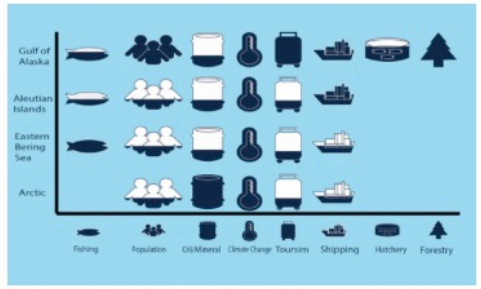
Alaska Integrated Ecosystem Assessments

Integrated Ecosystem Assessments carried out in Alaska provide ecosystem science to management, relevant stakeholders, and community members in the Alaska region to support effective Ecosystem-Based Management. Read more.

Alaska Sub-regions

The Alaska region is made up of 4 distinct ecosystems:

Ecosystem Status Reports



Qualitative depiction of the relative amount of human drivers and pressures on each Alaskan ecosystem

https://www.integratedecosystemassessment.noaa.gov/regions/alaska

National IEA 3 year plan

www.integratedecosystemassessment.noaa.gov/regions/alaska

National IEA 3 year plan: GOAL 1

- **Objective 1:** Identify and develop projects that will advance end-to-end implementation of the IEA process, resulting in transfer of integrated science products for direct and impactful support to managers making management decisions.
- **Objective 2:** Capture best practices, lessons learned (including barriers) to successful implementation and delivery of results.
- **Objective 3**: Establish base capacity and flexibility to be able to predict and respond to emerging and extreme events.
- **Objective 4**: Promote expansion and diversification of the network of NOAA scientists contributing to IEA and EBM efforts in each region in balance with expansion to additional regions.
- **Objective 5**: Develop methodology to define and track IEA success, including consideration of co-development of metrics that measure how IEA addresses milestones in EBM and EBFM related strategies.

AK IEA Base

Additional Methodological Information

1. *How will these outcomes result in a complete iteration of the IEA loop and/or advance IEA activities?*
2. *What scientific advancements are anticipated from this work plan that are likely transferrable to other regions?*
3. *How will human dimensions and climate change be incorporated into the work?*
4. *Will this research transition into or inform actionable management decisions?*
5. *What management entities are engaged or will be engaged by this effort? How do you envision the work informing management decisions in your region? Are there specific pending management decisions that you aim to inform with this work?*
6. *What steps will be taken to increase the probability that relevant management agencies make decisions informed by IEA products?*
7. *Identify and describe external drivers related to EBM and IEA in your region. How are you proposing to work with these external drivers to benefit the IEA?*

End-Users (e.g. recipients/ beneficiaries of regional IEA work and impact): *Identify the management entities you are working with in the IEA project. In addition, if possible, please provide letters of request, support, endorsement, evaluation from pertinent management agencies that are likely to use the IEA products being developed from this regional IEA. Alternatively, provide meeting records that reference and state the need for or request IEA products.*

Long-term Outcome(s): *How will this work contribute to the broader IEA vision in your region and beyond?*

Success: *How will you know and evaluate/ determine that your objectives and activities have been successful at achieving your priority goals? What is the ultimate outcome you are trying to achieve? What are the anticipated impacts and benefits of the IEA work in your region?*

AK IEA Special project

EVALUATION CRITERIA:

- Actionable science/ tie in to management
- cross regional relevance (i.e., proof of concept)
- cross line office? (all NOAA)
- New tools, new partnerships
- Hot topic
- Expansion
- Capacity for sustained long-term (feasibility and identification of who will carry the work forward or indication of how base funds keep it rolling)

AK IEA 3 yr planning

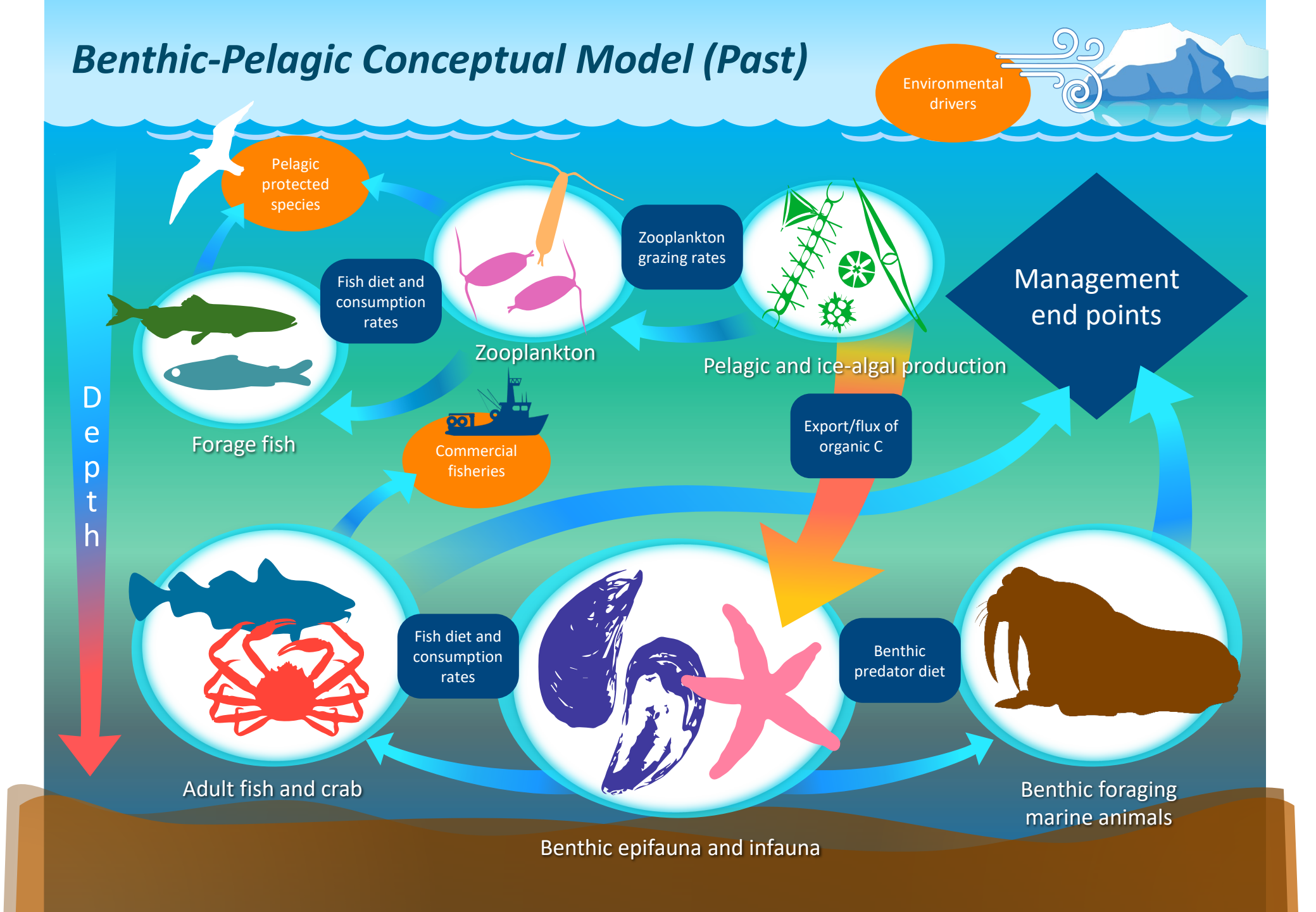
Spring 2021: 3 year plans drafted

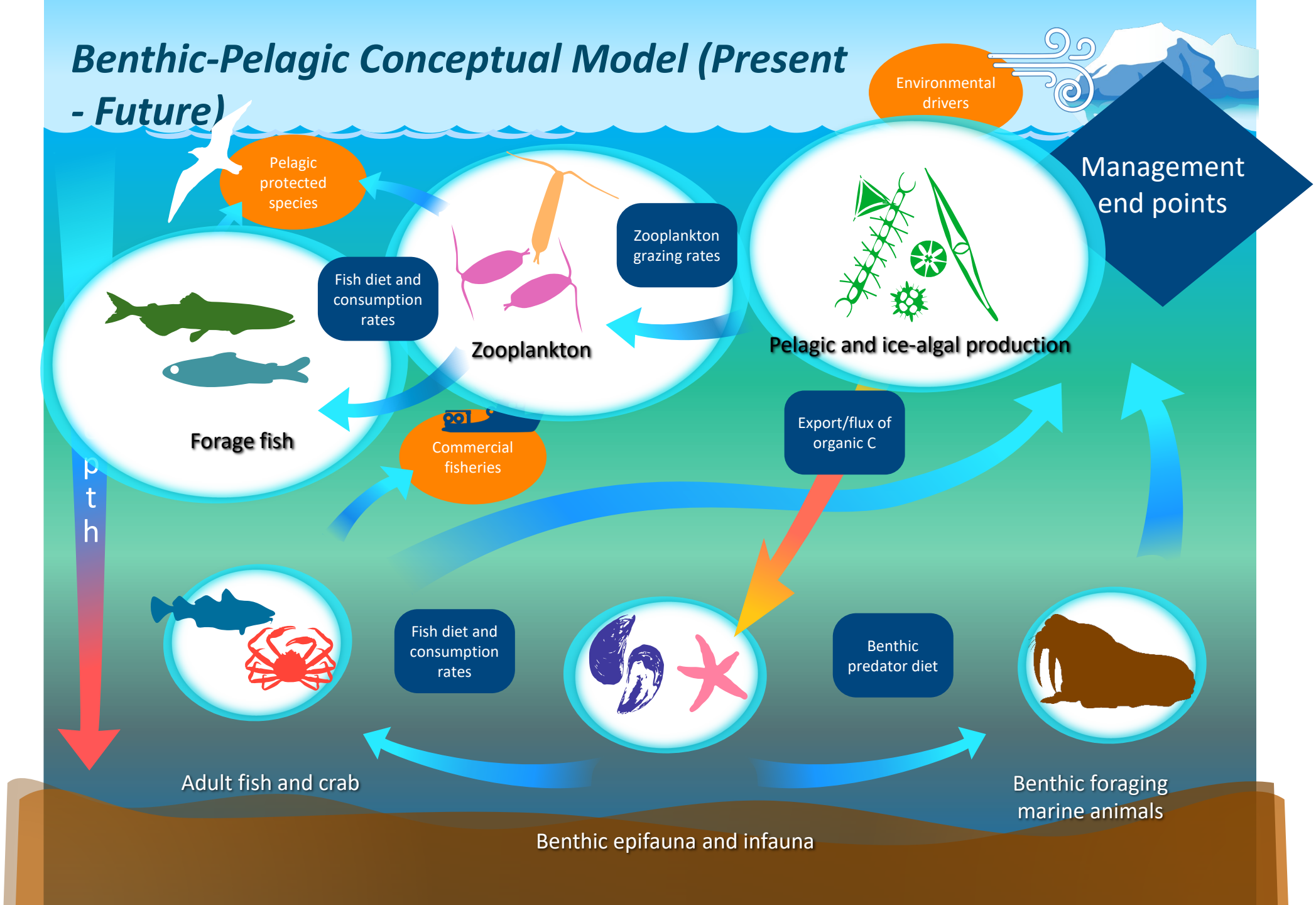
Summer 2021: Cross regional review by SC

Fall 2021: 3 year plans finalized

North Pacfic Research Board Synthesis Proposal (Logerwell)

- Arctic Integrated Ecosystem Research Program
  - Field work 2017-2019
  - Synthesis Request for Proposals September 2021
- Benthic-pelagic coupling or decoupling in the Northern Bering Sea – Chukchi Sea (NBS-CS)?
  - Scoping group: Logerwell, Goldstein, Duffy-Anderson, Thorson, Farley, Rand, Ferguson, Kimmel, Mordy
  - Have there been changes in export of pelagic production to the benthos due to ocean warming and loss of sea ice? What might the future hold?


Benthic-Pelagic Conceptual Model (Past)
Environmental drivers
Pelagic protected species
Zooplankton grazing rates
Fish diet and consumption rates
Zooplankton
Pelagic and ice-algal production
Management end points
Forage fish
Commercial fisheries
Export/flux of organic C
Depth
Fish diet and consumption rates
Benthic predator diet
Adult fish and crab
Benthic foraging marine animals
Benthic epifauna and infauna


Benthic-Pelagic Conceptual Model (Present - Future)
Environmental drivers
Management end points
Pelagic protected species
Zooplankton grazing rates
Fish diet and consumption rates
Zooplankton
Pelagic and ice-algal production
Forage fish
Commercial fisheries
Export/flux of organic C
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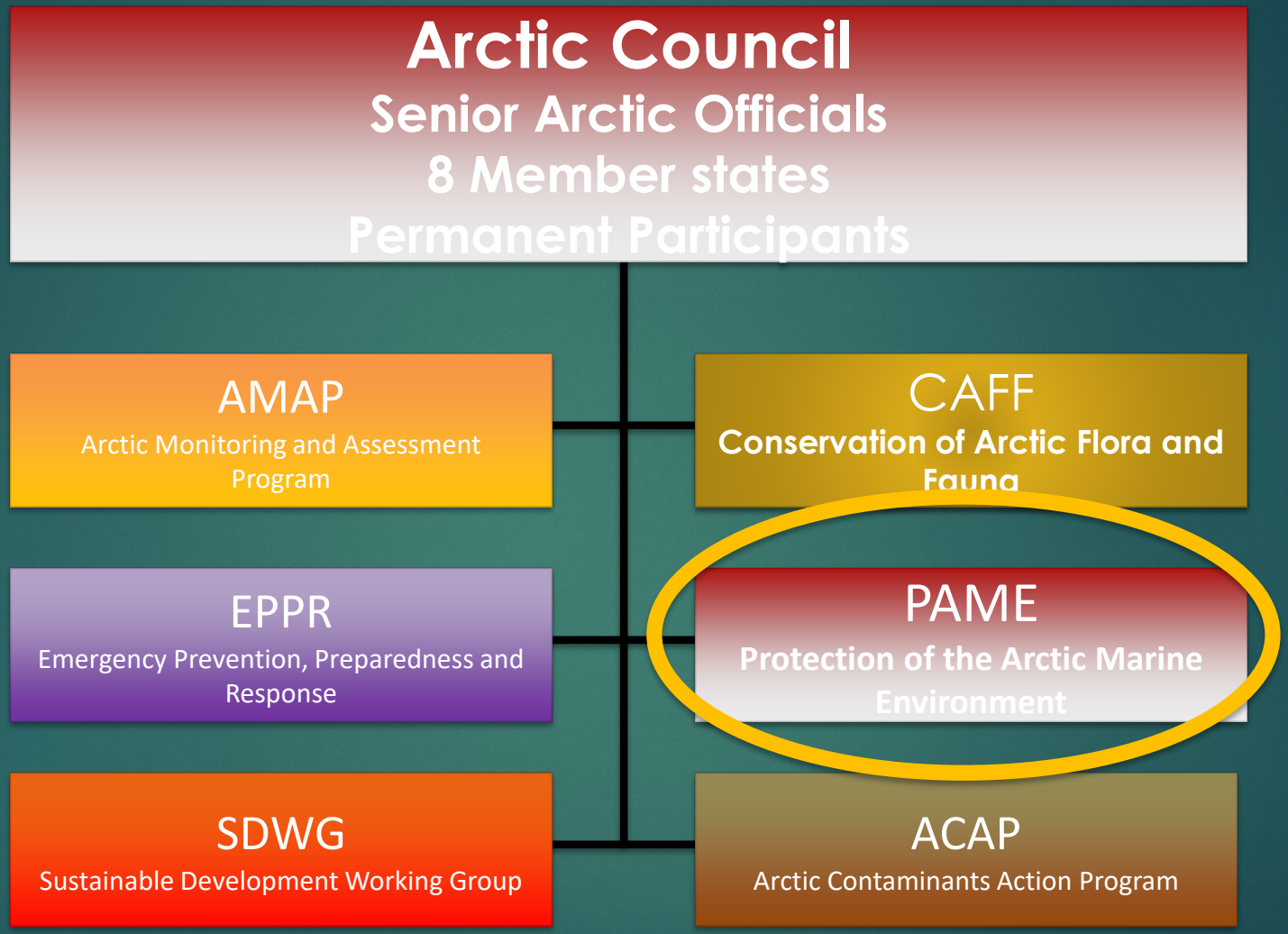
Fish diet and consumption rates
Benthic predator diet
Adult fish and crab
Benthic foraging marine animals
Benthic epifauna and infauna

North Pacfic Research Board Synthesis Proposal

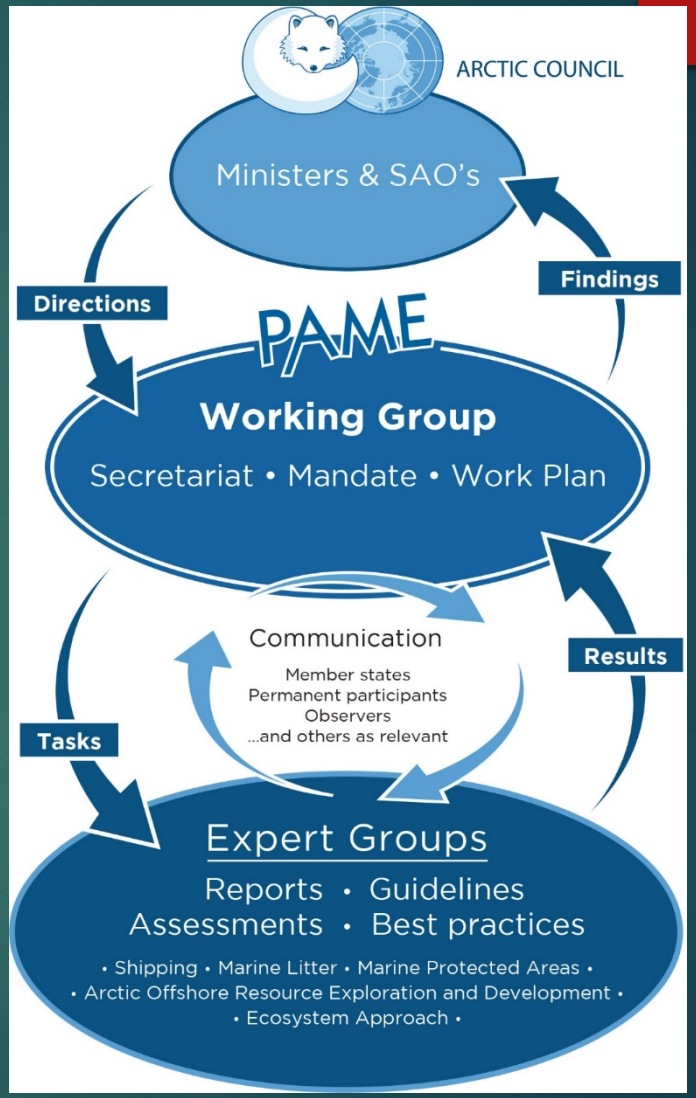
- Synergies with WG44 activities
  - Management Endpoints and local Community concerns
  - Indigenous Knowledge sharing
  - Metadata
- Interested in being a PI? Please talk to Libby ☺

Arctic Council PAME Ecosystem Approach Expert Group (Logerwell)


Arctic Council
Senior Arctic Officials
8 Member states
Permanent Participants
AMAP
Arctic Monitoring and Assessment Program
CAFF
Conservation of Arctic Flora and Fauna
EPPR
Emergency Prevention, Preparedness and Response
PAME
Protection of the Arctic Marine Environment
SDWG
Sustainable Development Working Group
ACAP
Arctic Contaminants Action Program

Protection of the Arctic Marine Environment (PAME)

- Arctic Council Working Group since 1996.
- **Focal point of Arctic Council's policy-related initiatives for the conservation and sustainable use of the Arctic marine environment.**
- Has a Chair, a Secretariat based in Iceland and five expert groups
- Not a science body, relies on expertise through its expert groups



Ecosystem Approach Expert Group (EA-EG)

- Current chairs:

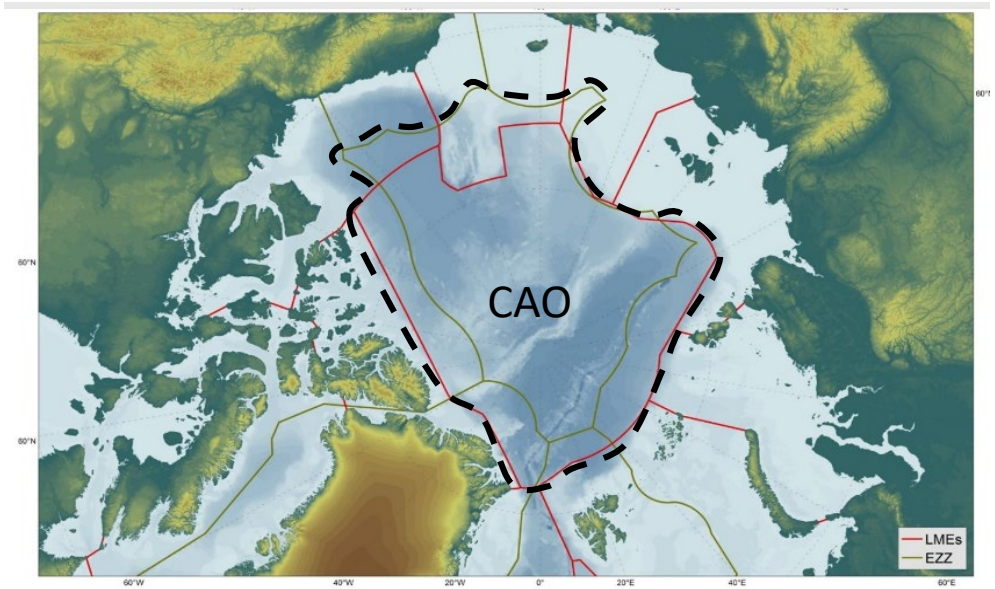
  Lis Lindal Jørgensen (Norway) and
  Libby Logerwell (USA)

- Goals
  - Integration of EA implementation into work of the Arctic Council
  - Facilitate exchange and review of information and experiences
  - Support development of a common and coordinated approach to EA implementation by Arctic states

PAME
Protection of the Arctic Marine Environment

Current EA-EG projects

- WG Integrated Ecosystem Assessment of the Central Arctic Ocean (WGICA)
- Workshop on Value and Valuation
- Report on Ecological Objectives
- Ecosystem Approach Framework Revision



High Sea

LME

PAME

Protection of the Arctic Marine Environment

Lis Lindal Jørgensen (Norway)

PICES

Sai-Ichi Saito (Japan)

ICES

CIEM

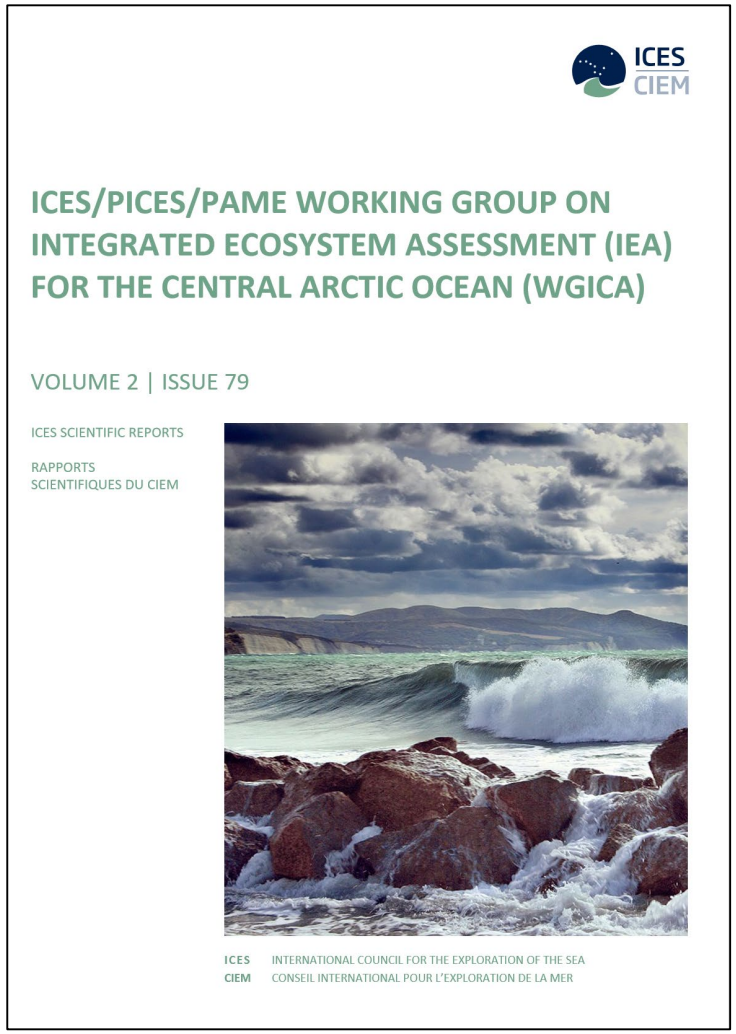
Martine van den Heuvel-Greve (Netherland)

18 national-appointed permanent members from Norway, Denmark, Finland, Netherlands, Canada (ICES) Japan, Korea and China (PICES)

40 chair-invited scientists which also includes USA, Germany, Russia and Sweden.

https://www.ices.dk/community/groups/Pages/WGICA.aspx

Annual Report 2020



ToR (2019-2021)

1. Methods for Integrated Assessment
2. Sea ice, oceanographic circulation, and hydrographic properties.
3. The CAO biological ecosystem
4. Contaminants in the CAO ecosystem.
5. New studies on fish
6. Priority research needs and monitoring
7. Ecosystem Overview (EO)

ICES Scientific Reports. 2:79. 144 pp. http://doi.org/10.17895/ices.pub.7454

Plan 2021 WGICA

- ICES to refine the **EO** report into a management product

- **Spring meeting** **12-13 April**: *Report 2, part 1: Human activities, management organizations (IMO etc) and ecosystem impact of the CAO*

- **Fall meeting** **12-14 October**:
  - Defining ToR for next period 2022-2024
  - Finishing Annual Report 2019-2021
  - Defining *Report 2, part 2: Integrated Climate and Vulnerability Assessment of the CAO* (during 2022-2024)

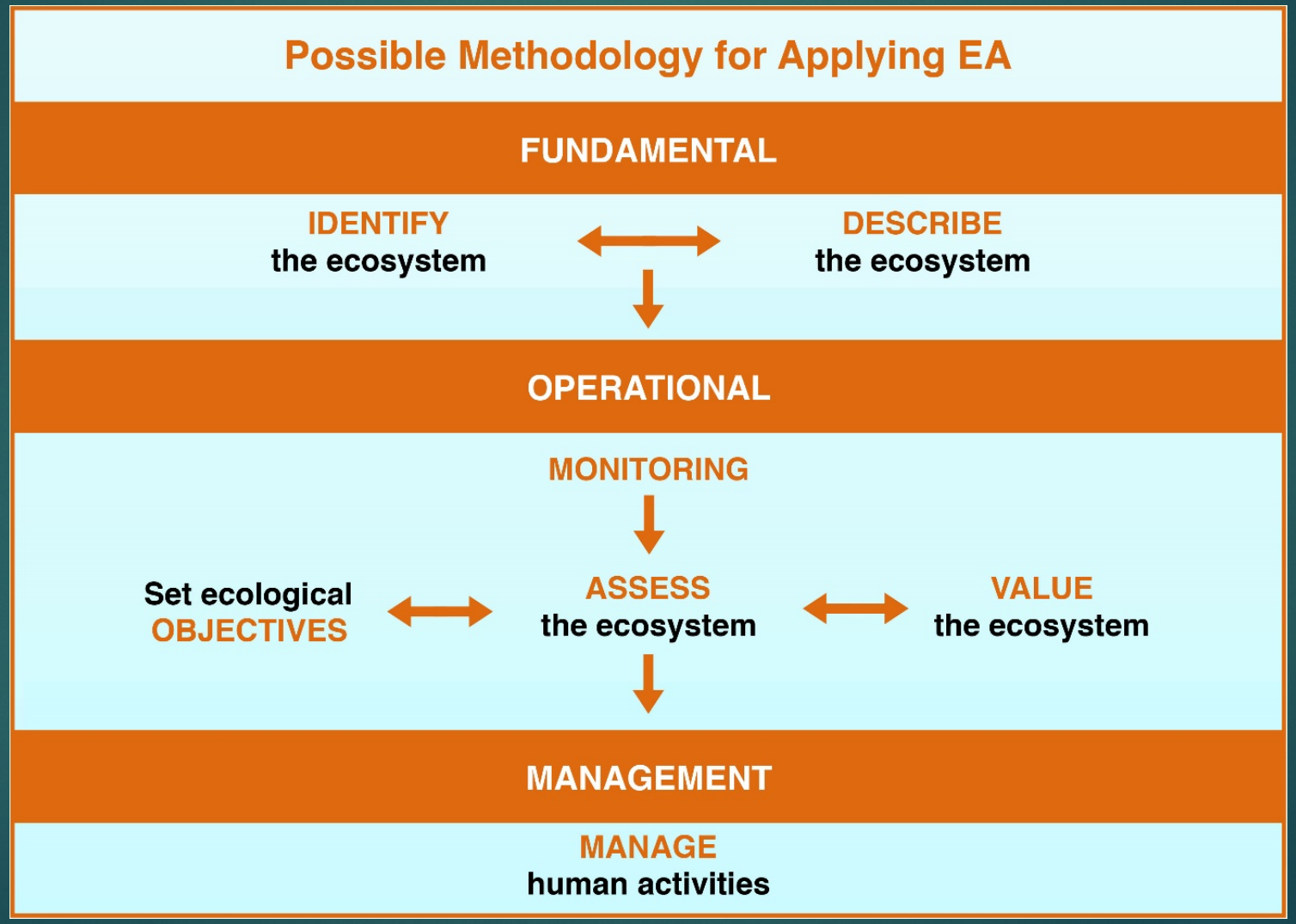
Workshop on Value and Valuation

- February 2022, Sweden (TBD)
- Overall goal: To identify, understand and find ways to benefit from the diverse systems of values and valuation of nature in the shared ecosystems of an increasingly connected Arctic.
- What is valuation?: How a culture qualifies and quantifies the values it attaches to things. It entails identifying the relationships between the individual and/or community and the different parts of "nature", "social relations" and "economy" that surround the individual.
- New perspective: Embrace HUMAN-diversity. Accept that there isn't a single "right", "optimal" or "best" choice that encapsulates the HUMAN-diversity.
- New path forward: Seek ways for different cultures to successfully share the same ecosystems and allow a diversity of human cultures to survive.

Report on development in defining or setting Ecological Objectives

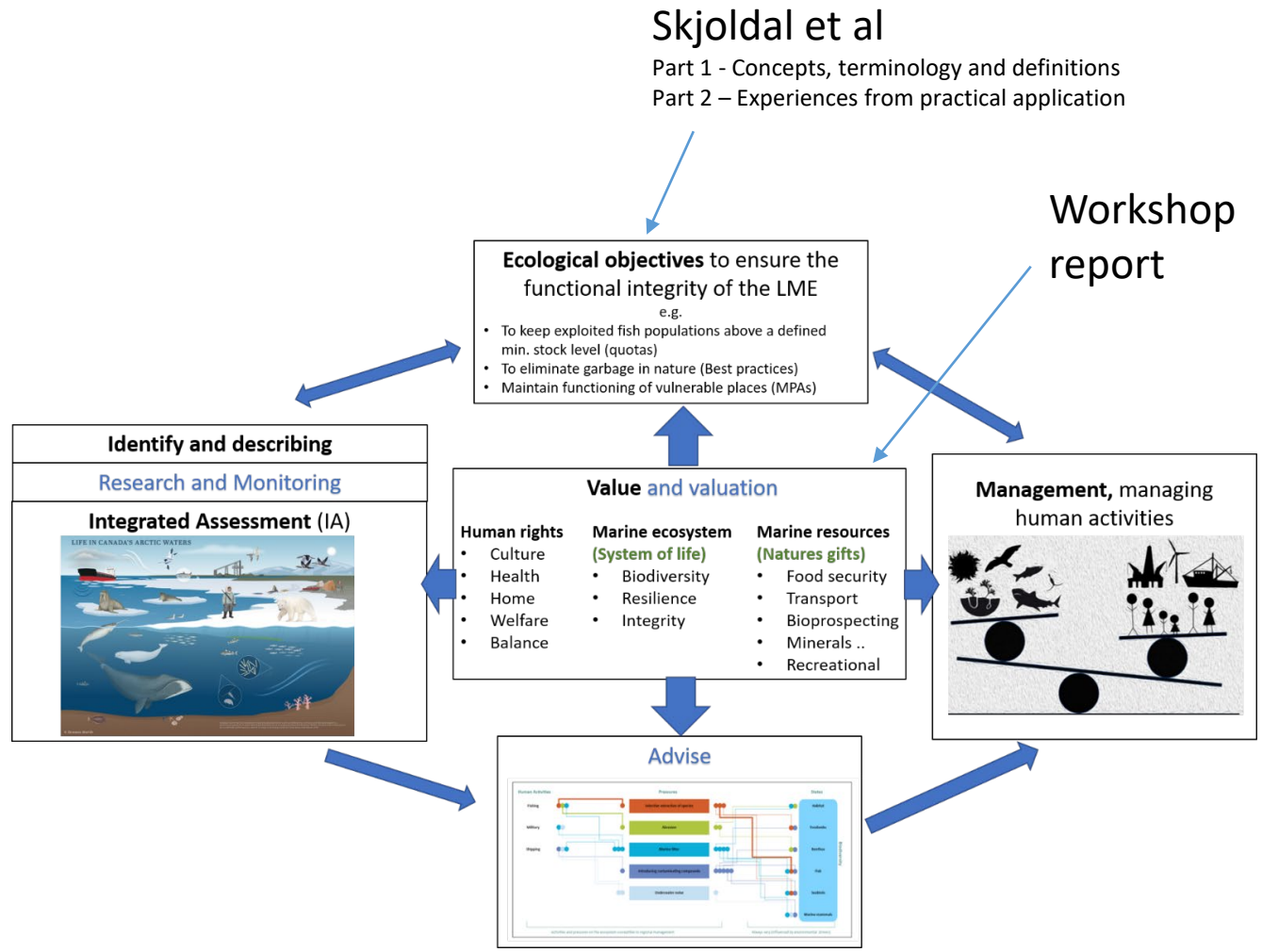
- Skjoldal et al - originally a work plan item 2019-2021
- Outline presented at PAME I- February 2020
  - Two parts
    - Part 1 - Concepts, terminology and definitions
    - Part 2 – Experiences from practical application (EU MSFD, UN, countries)
- Status – DELAYED, and will continue

EA Framework Revision



EA Framework revision

- **Review and synthesize existing EA literature on the existing 6-point framework.**
- **Adding new elements to the EA framework**
- **Develop from linear to circular EA framework**
- **Compilation of relevant EA information within Arctic Council**
- **Produce a communication strategy to reach out on digital platforms for the use of the nations**



New surveys, IEA projects or other information

Canada (Andrea Niemi)

Canadian Sector: Beaufort Sea Amundsen Gulf

- 2021 Continuation/return of offshore programs

-Beaufort Shelf Monitoring program (long-term moorings)

-Joint Ocean Ice Study (JOIS)

-Canadian Beaufort Sea Marine Ecosystem Assessment (CBS-MEA)

- 2021 start of new funding cycle (results TBD)

-Ocean-climate model downscaling for community priorities

-Climate-change responses in anadromous, coastal, and marine fishes

-Connecting coastal and marine ecosystems (knowledge systems/biodiversity/drivers of change)

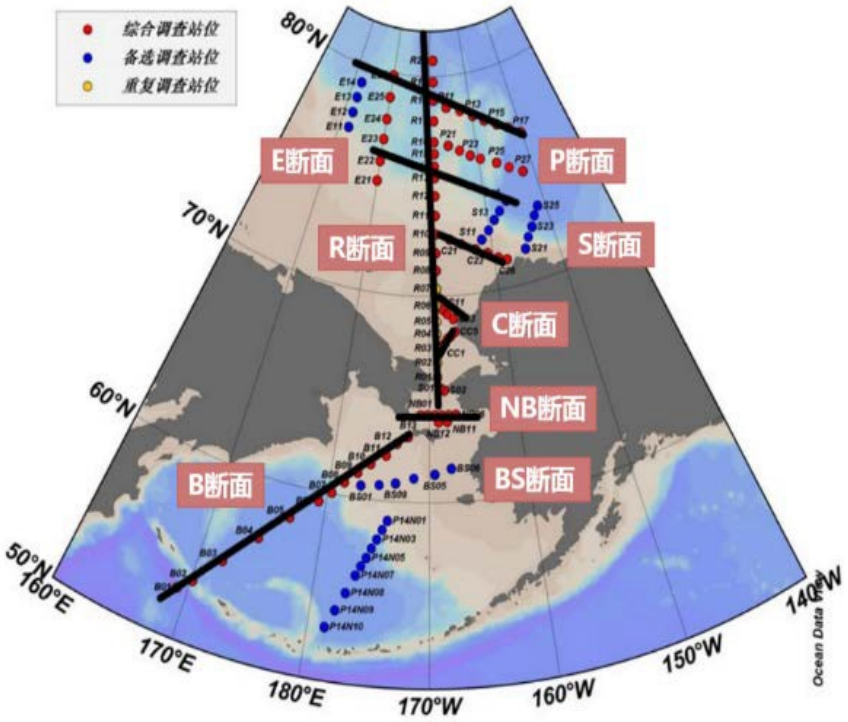
China (Zhongyon Gao)

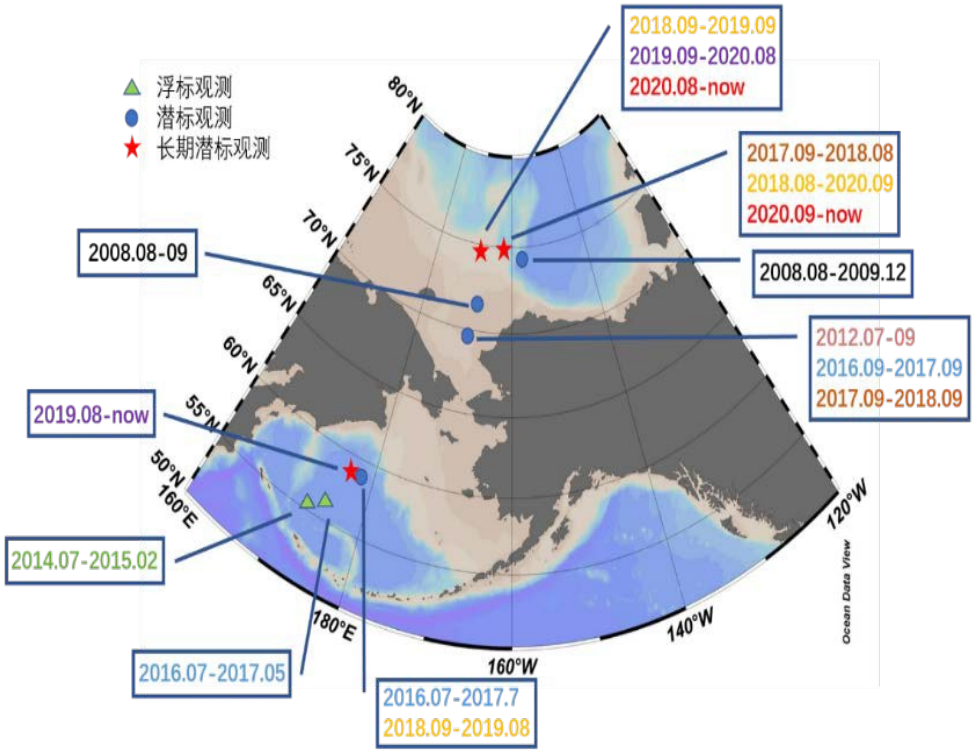
China's Work
in the North Bering Sea and the Chukchi Sea

Zhongyong GAO[1], Chang-An Xu[1], Qi SU[2]

[1]Third Institute of Oceanography,
Ministry of Natural Resources (MNR)
[2]First Institute of Oceanography, MNR

Physical oceanography observations in the Arctic Ocean by China

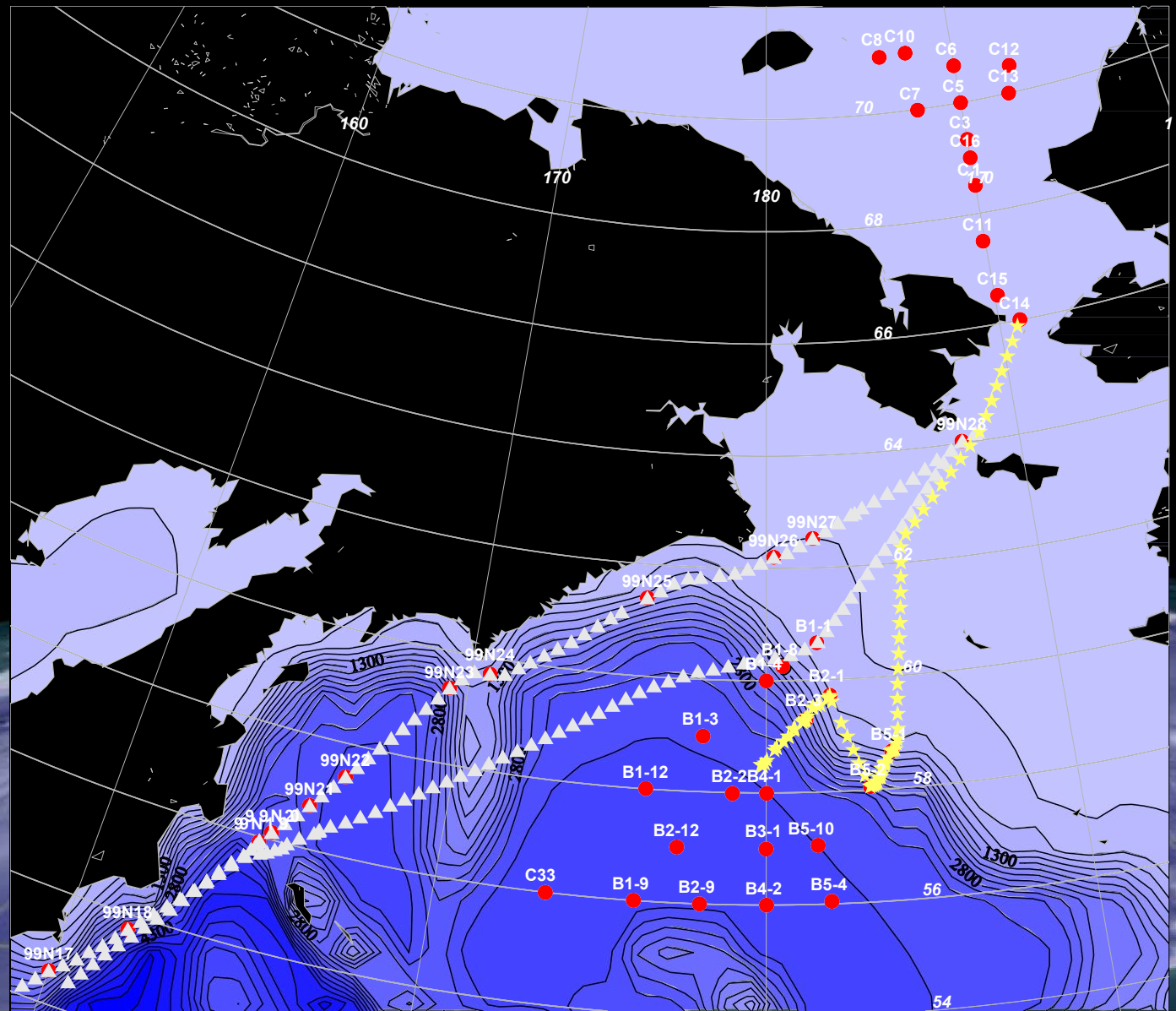


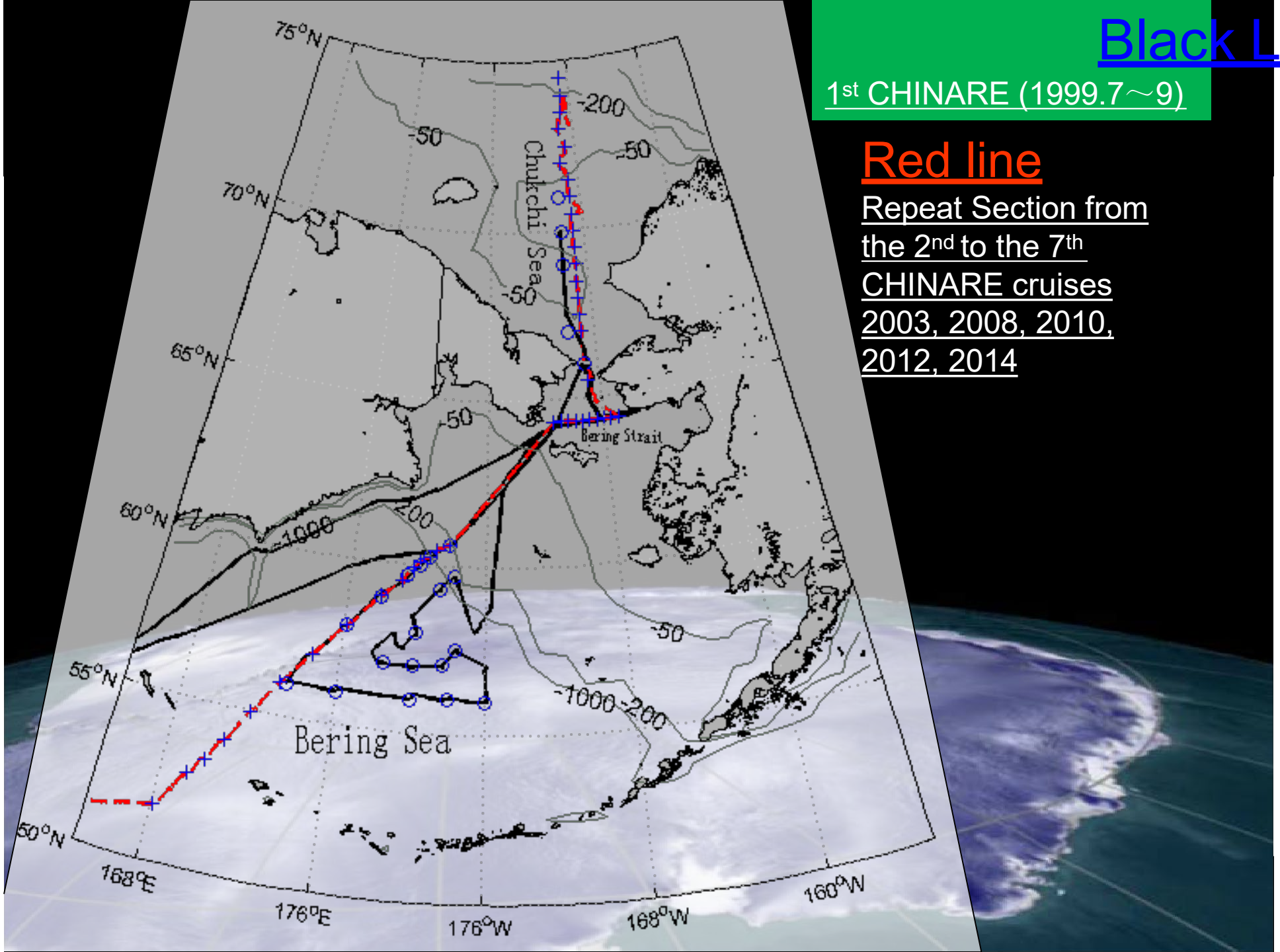


7 cruises during 2012-2020 with 721 stations

13 mooring observations in total

CHINARE Sampling Sattions in the Bering Sea & Chukchi Sea (1999)



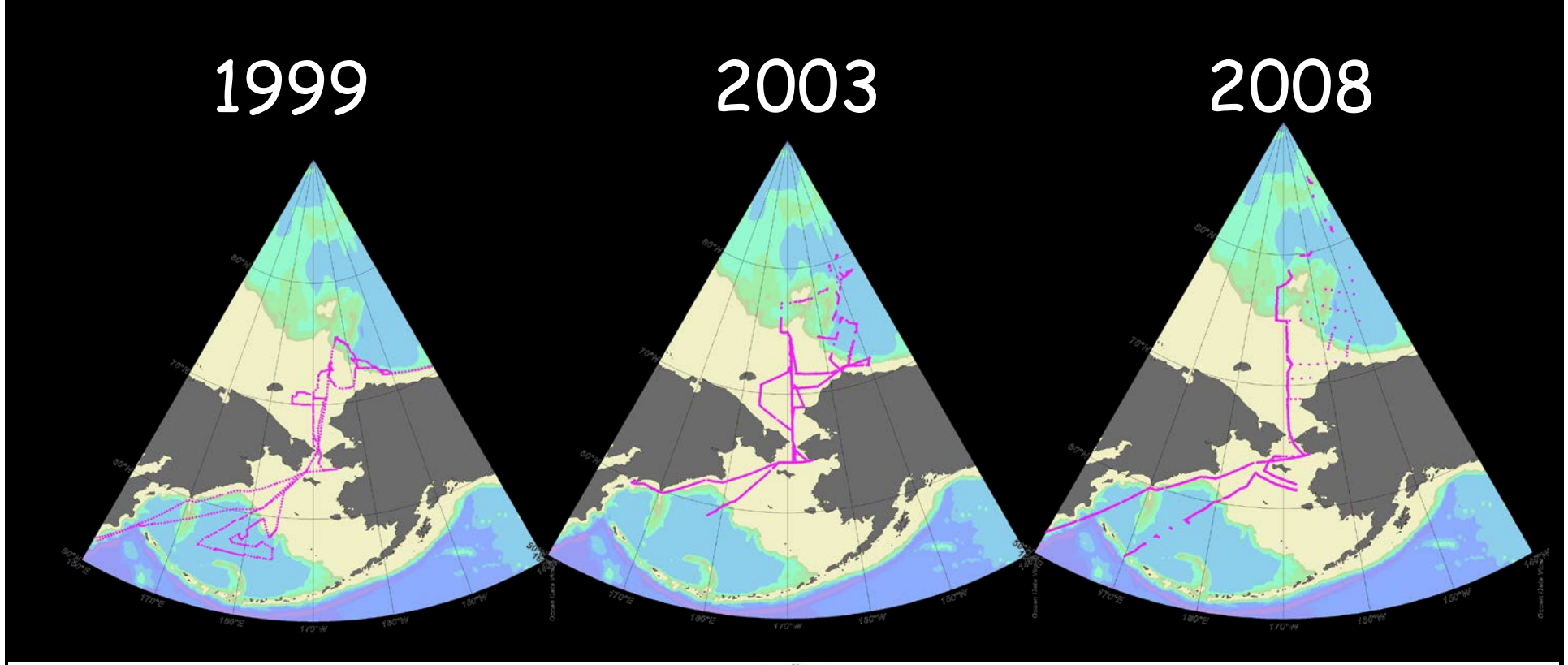


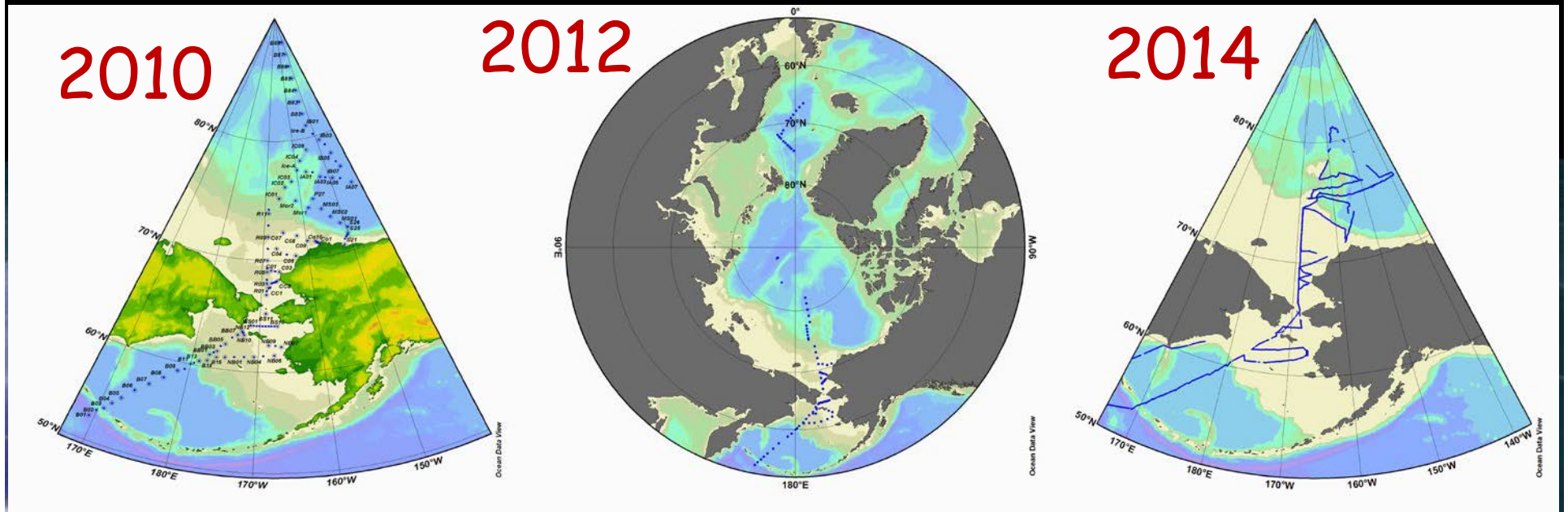
Black Line

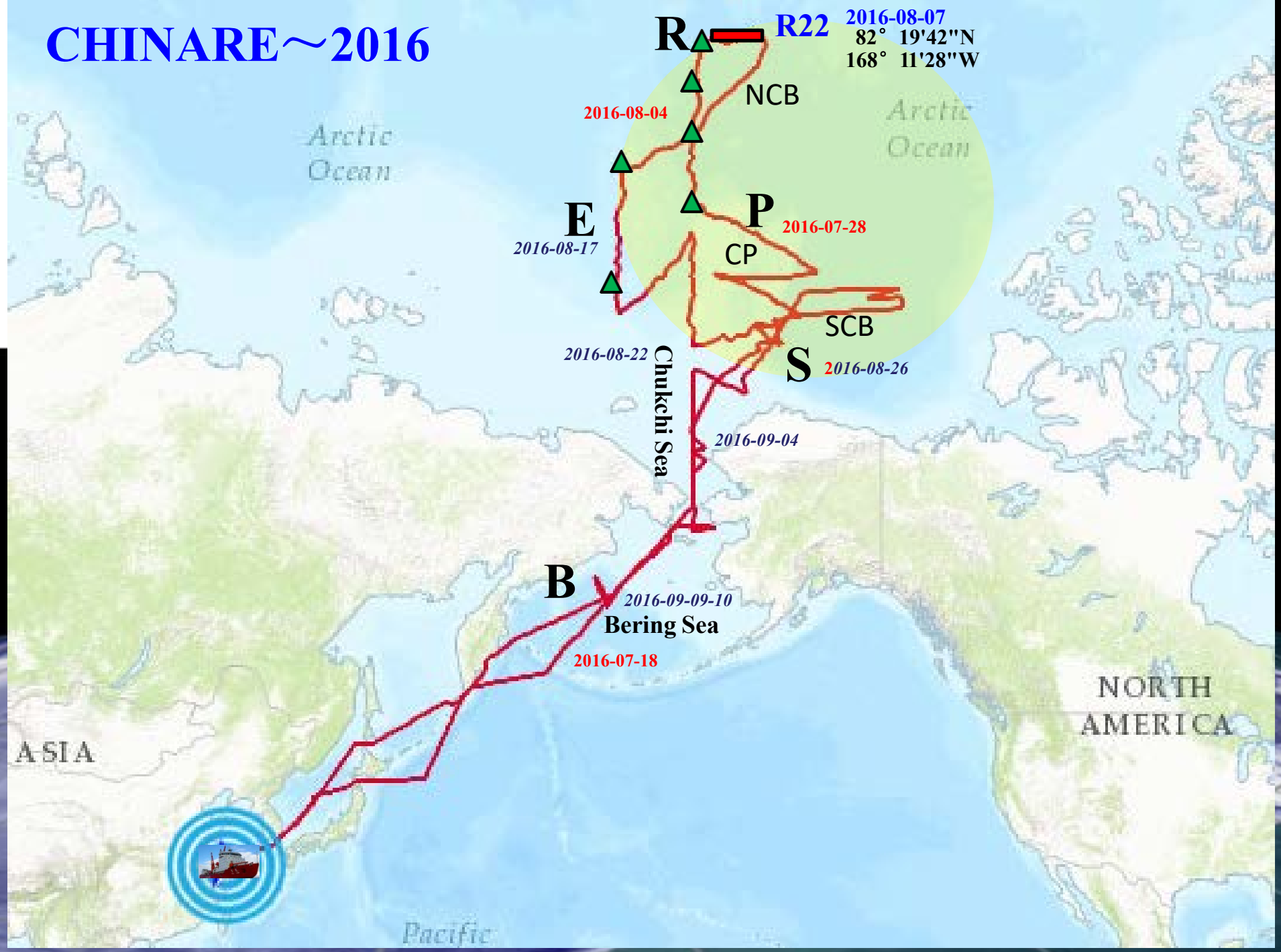
1st CHINARE (1999.7～9)

Red line

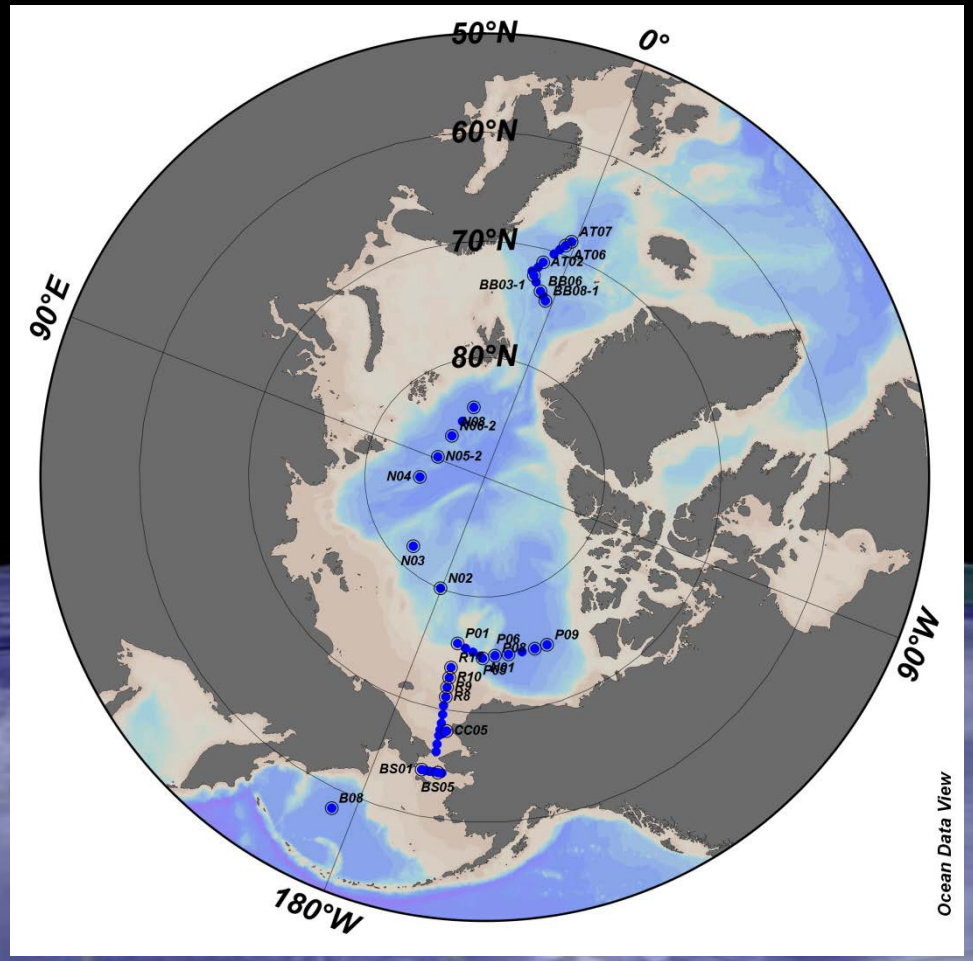
Repeat Section from the 2nd to the 7th CHINARE cruises 2003, 2008, 2010, 2012, 2014


1999
2003
2008

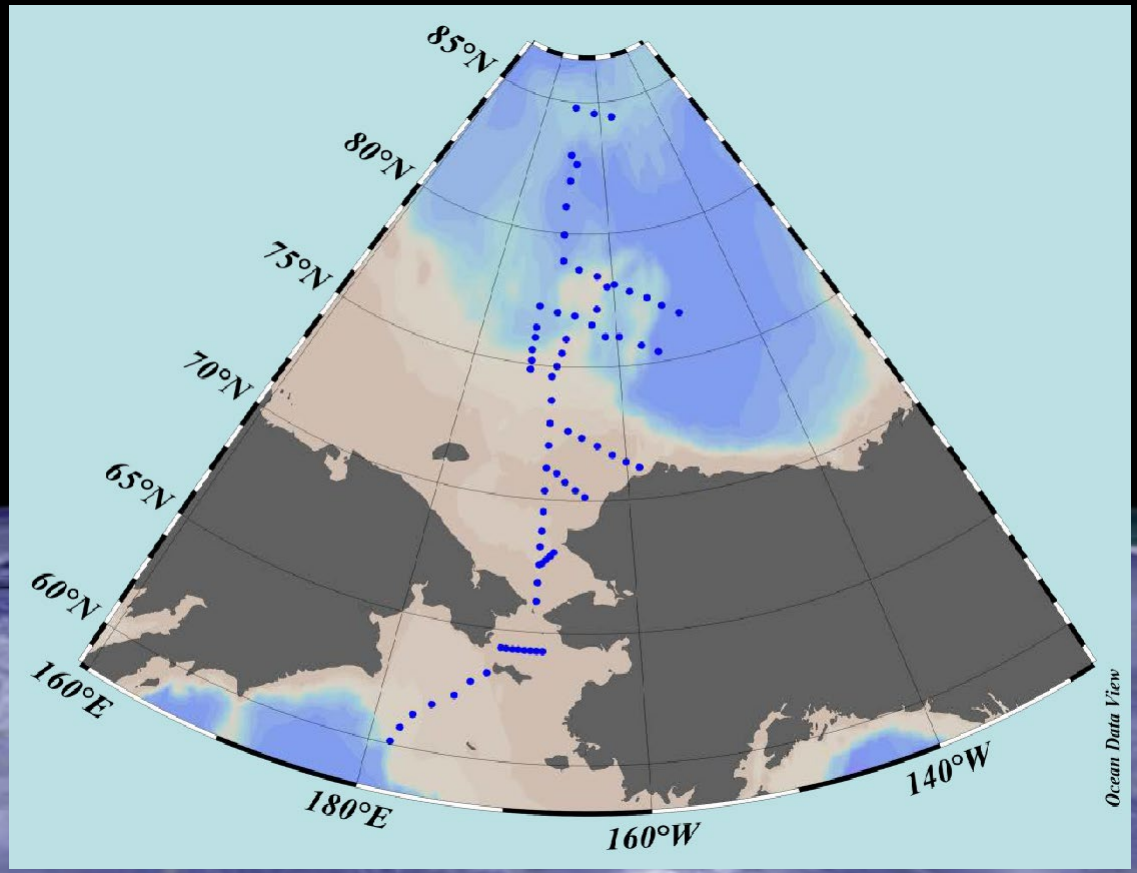

2010
2012
2014


CHINARE～2016
R
R22
2016-08-07
82° 19'42"N
168° 11'28"W
NCB
2016-08-04
Arctic Ocean
Arctic Ocean
E
2016-08-17
P
2016-07-28
CP
SCB
2016-08-22
Chukchi Sea
S
2016-08-26
2016-09-04
B
2016-09-09-10
Bering Sea
2016-07-18
NORTH AMERICA
ASIA
Pacific

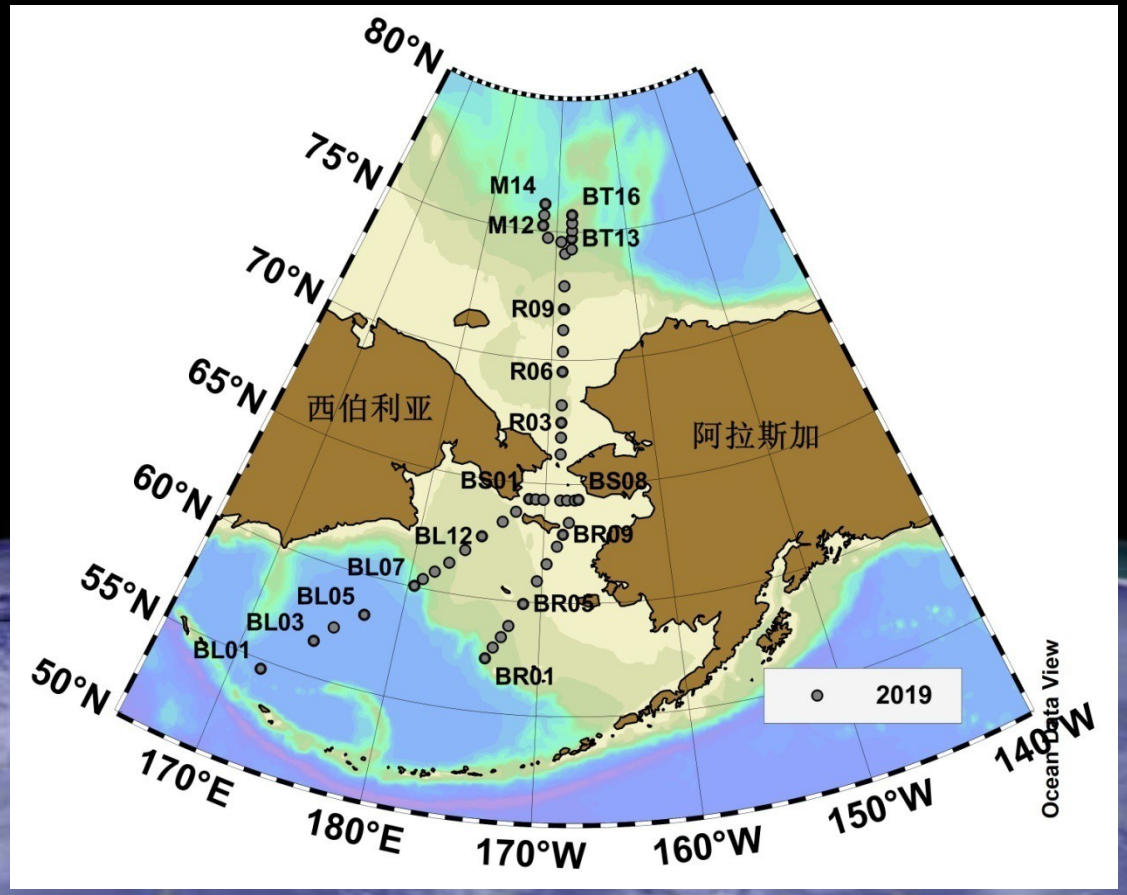
CHINARE 2017



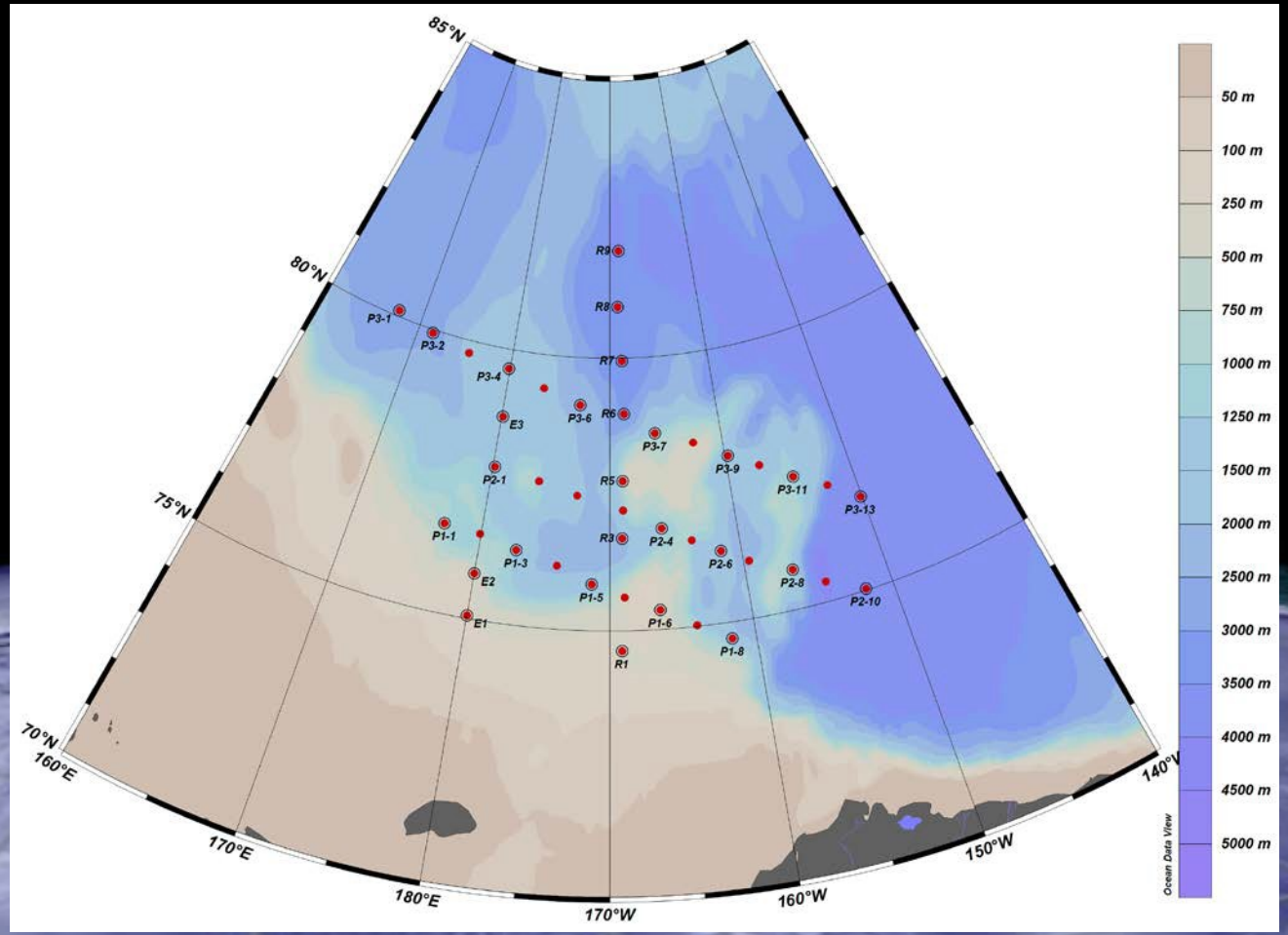
2018



2019


80°N
75°N
70°N
65°N
60°N
55°N
50°N
170°E
180°E
170°W
160°W
150°W
140°W
M14
BT16
M12
BT13
R09
R06
R03
西伯利亚
阿拉斯加
BS01
BS08
BL12
BR09
BL07
BL05
BR05
BL03
BL01
BR01
2019
Ocean Data View

2020

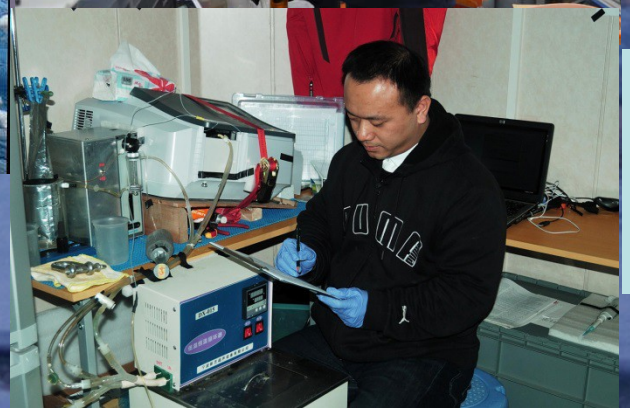

85°N
80°N
75°N
70°N
160°E
170°E
180°E
170°W
160°W
150°W
140°W
R9
R8
R7
R6
R5
R3
R1
P3-1
P3-2
P3-4
P3-6
P3-7
P3-9
P3-11
P3-13
P2-1
P2-4
P2-6
P2-8
P2-10
P1-1
P1-3
P1-5
P1-6
P1-8
E3
E2
E1
50 m
100 m
250 m
500 m
750 m
1000 m
1250 m
1500 m
2000 m
2500 m
3000 m
3500 m
4000 m
4500 m
5000 m
Ocean Data View

CHINARE cruises

R/V Xuelong

CTD sampling

TA, DIC, pH measurements



High precision pH measurements

Underway pCO_2 observation

CO_2 system (TA, DIC, pH) Measurements in situ

Research Approaches & data

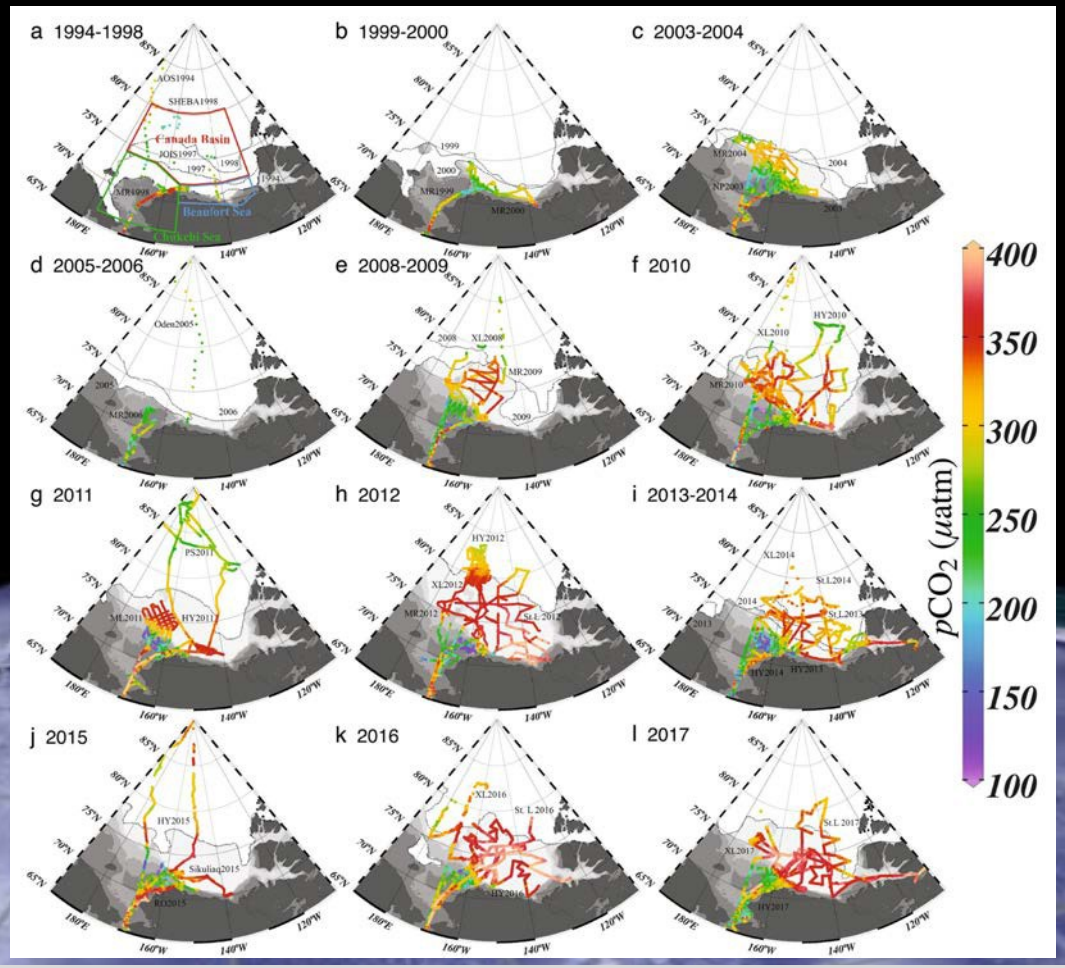
high resolution **underway pCO_2** , O_2 *and* underway *TAlk data (for underway* *Ωaragonite data, underway* O_2/Ar *ratio data (for NCP),*

and discrete water column ***DIC, TAlk, δ^{13}C-DIC, PIC , and Ca^{2+} data***

(as well as hydrographic data and ***dissolved oxygen*** *and* ***nutrients*** *data by ou collaborators)*

during the Chinese National Arctic Research Expedition (CHINARE) in summer .

pCO2 (1994～2017)



The distribution of sea surface pCO_2 at in situ temperature in the western Arctic Ocean

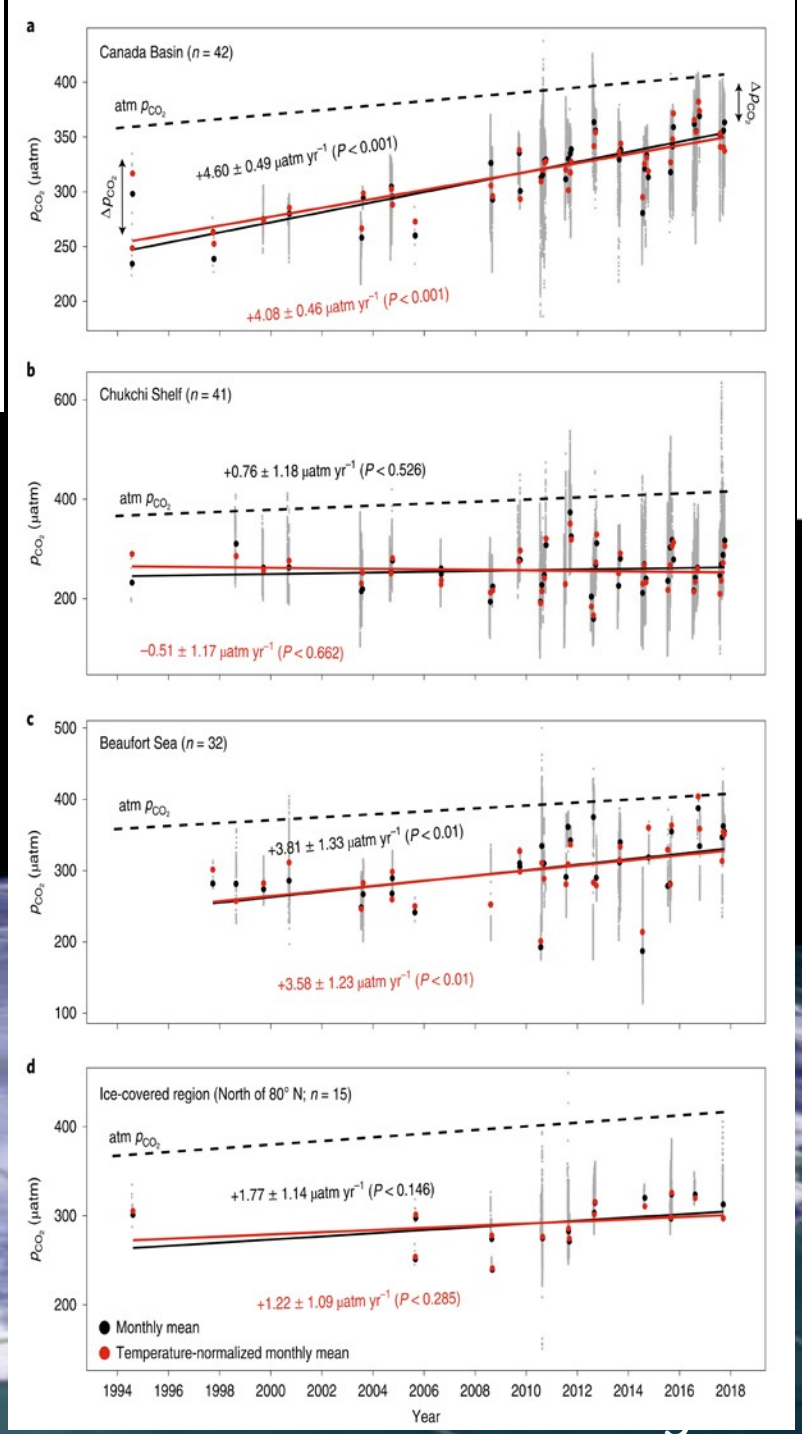
Global Biogeochemical Cycles

Research Article

Summertime Evolution of Net Community Production and CO_2 Flux in the Western Arctic Ocean

Zhangxian Ouyang, Di Qi, Wenli Zhong, Liqi Chen, Zhongyong Gao, Hongmei Lin, Heng Sun, Tao Li, Wei-Jun Cai ✉

First published: 17 January 2021 | https://doi.org/10.1029/2020GB006651



Decadal change trends of sea surface pCO_2 in the western Arctic Ocean.

a–**d**, The grey dots represent the raw observations of pCO_2 in the Canada Basin (**a**), the Chukchi Shelf (b), the Beaufort Sea (c)and the high latitudes (north of 80° N) (**d**). The black and red dots indicate the monthly means based on the gridded-average pCO_2 (0.1° latitude × 0.25° longitude) at in situ SST and the long-term means of SST, respectively (Ouyang et al. 2020).


北極
The Arctic
作品 张弦
雪龙
XUE LONG
Thank you

Japan (Shigeto Nishino)

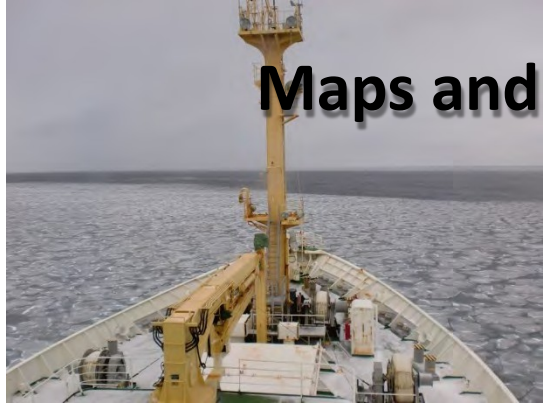
Arctic Challenge for Sustainability II

NBS-CS WG44: 2021 1st WG Meeting

April 14, 2021

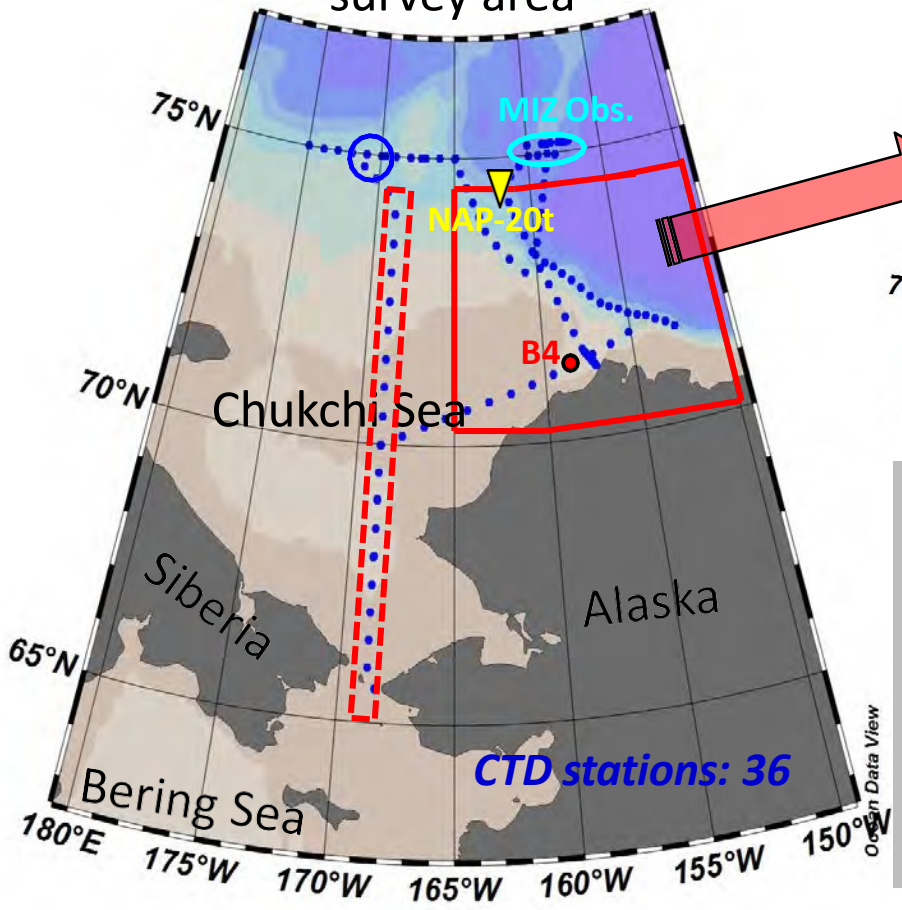
- R/V Mirai Arctic cruise 2020
- Collaboration between social and natural scientists on Arctic marine plastic wastes
- Recent publications

Shigeto Nishino (JAMSTEC)

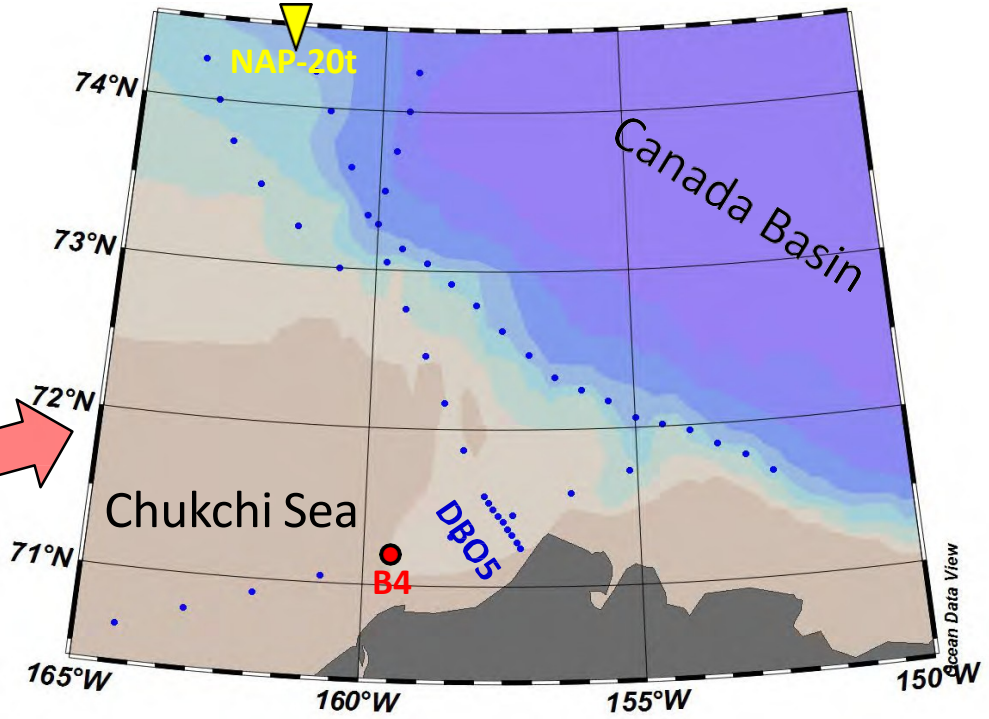


Maps and stations of the R/V Mirai cruise in 2020

Map of the whole survey area



Enlarged map of the slope area

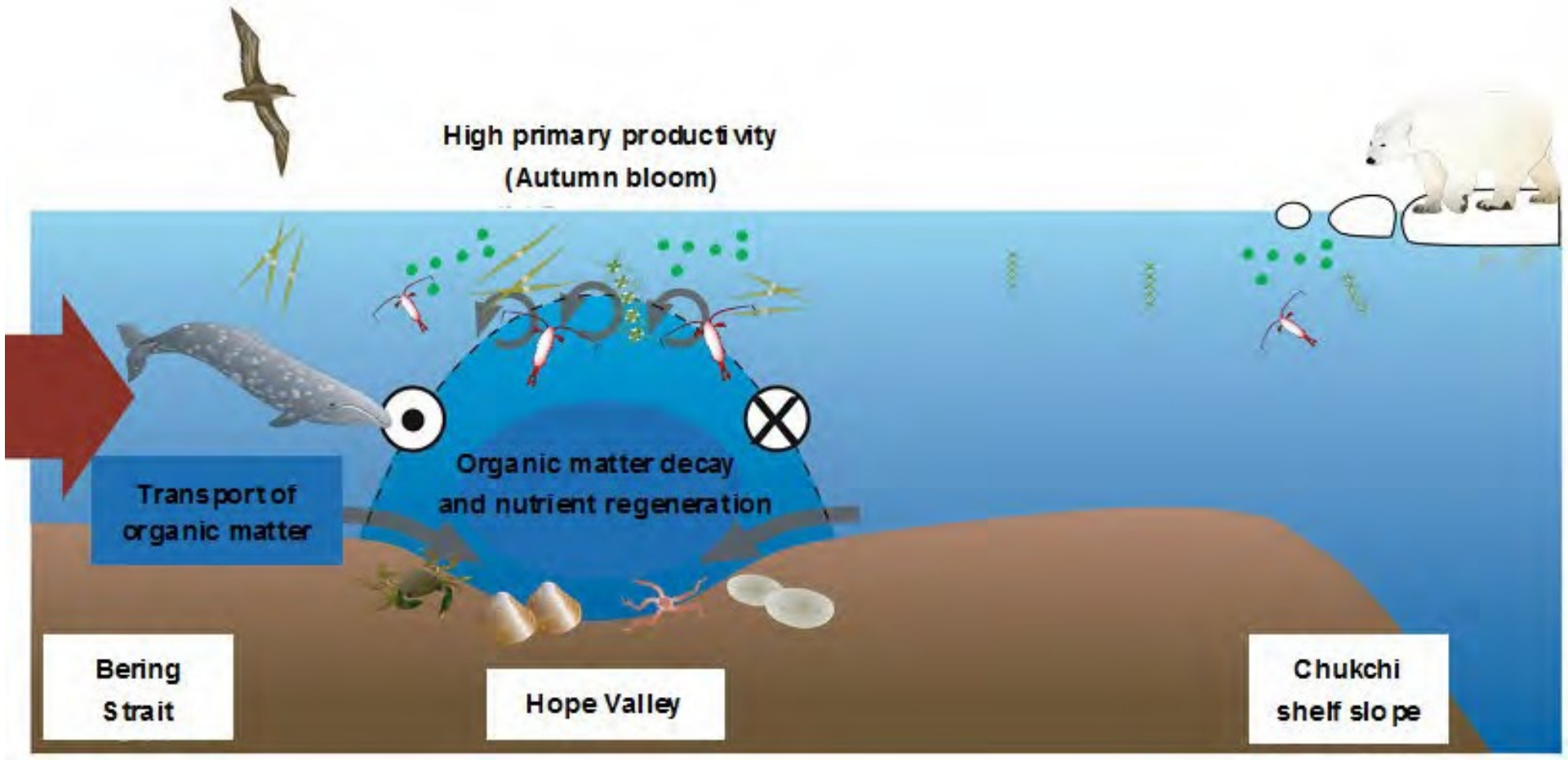


Activities

- ● : CTD/XCTD, TurboMAP, Plankton net, S&M grab, Bio-optics observation
- ● : Mooring
- ▼ : Sediment trap
- ⬭ : Marginal Ice Zone observation

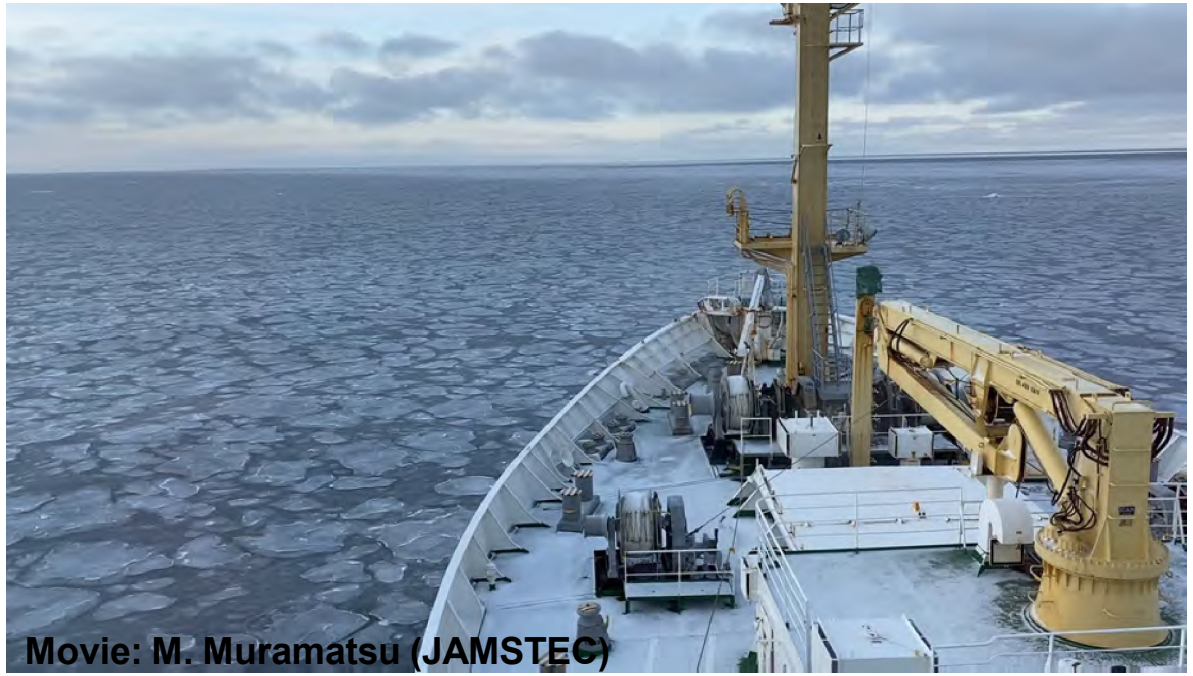
DBO: Distributed Biological Observatory

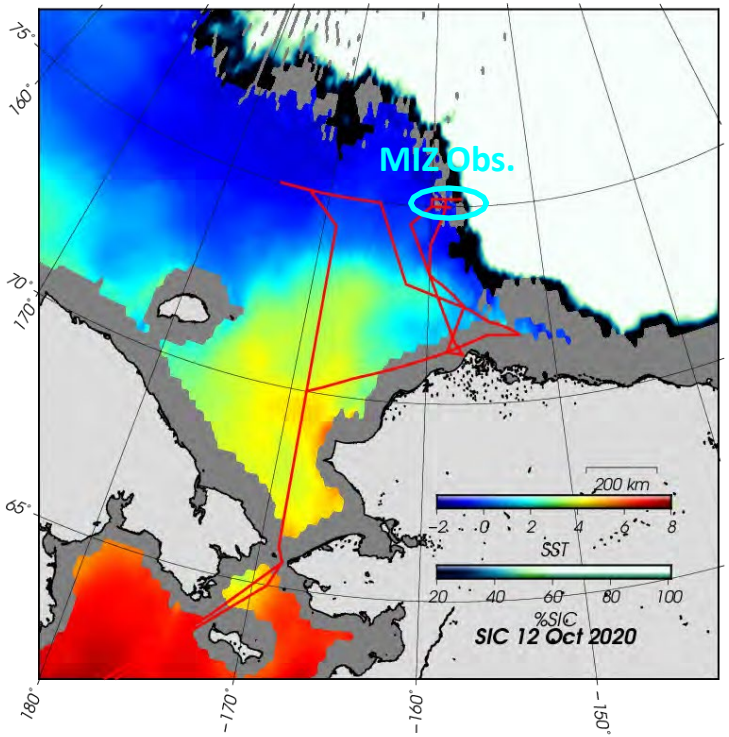
Schematic of fall bloom in Hope Valley in the southern Chukchi Sea



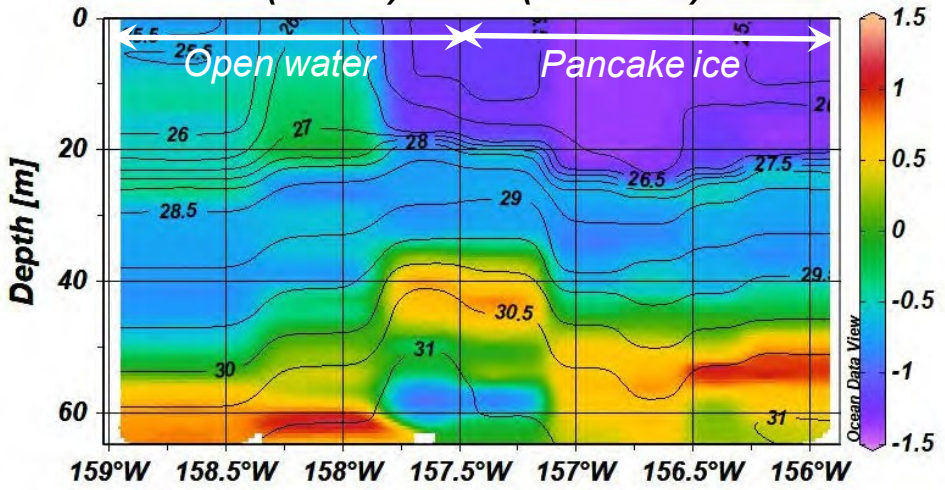
[Nishino *et al.*, 2016]

Marginal ice zone observation

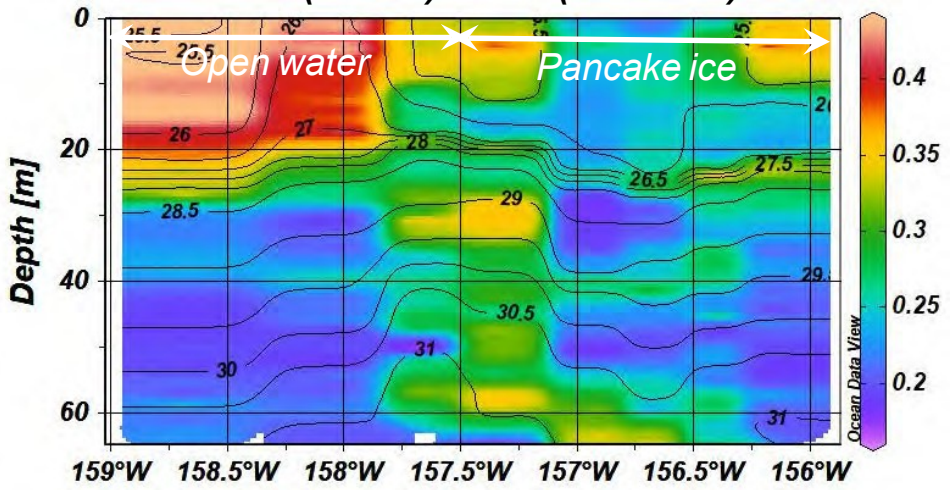




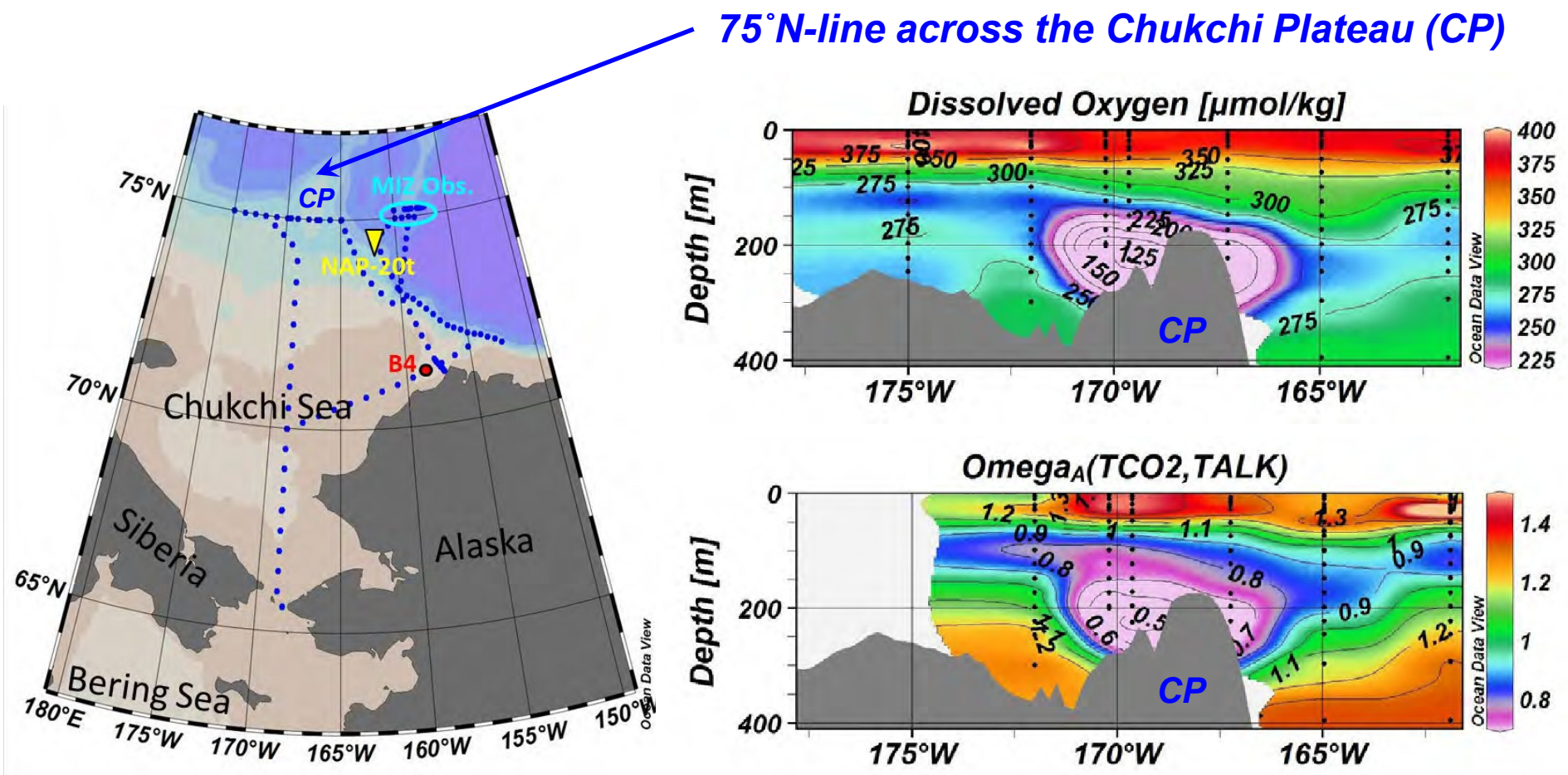
T (colors) and S (contours)



Chl-a (colors) and S (contours)

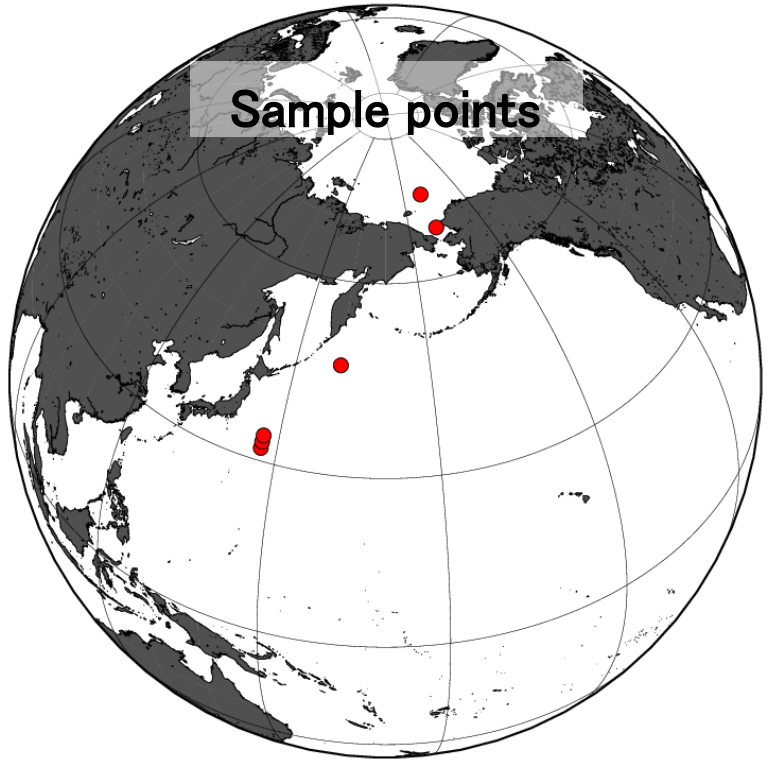


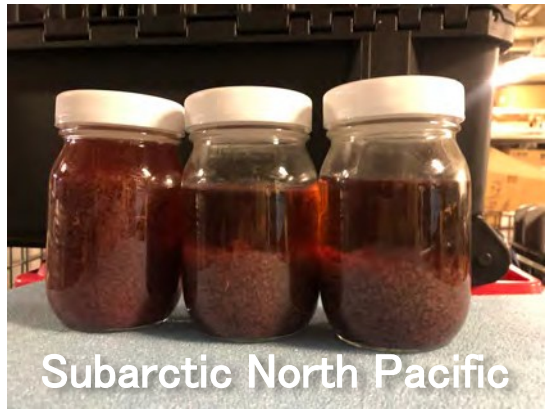
Aragonite super-corrosive water on the Chukchi Plateau (CP)

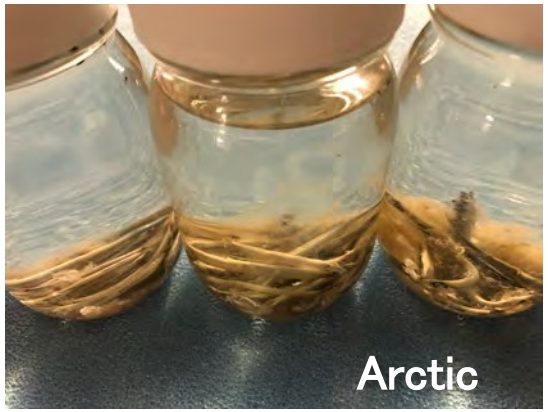


Plastic sampling

Neuston net and whale shark







Provided by A. Fujiwara (JAMSTEC)

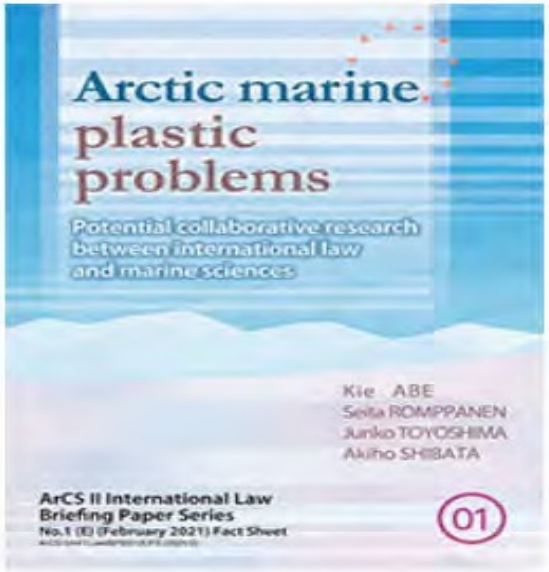
Arctic Challenge for Sustainability II

ArCS II Research Program on International Law

PCRC Home

March 24, 2021 Press Release

ArCS II International Law Research Program published its first Briefing Paper Series on Arctic marine plastic problems.



The paper identifies relevant international legal instruments, concepts, tools, and precedents that will assist the design of future legal governance to address the emerging threat of marine plastic pollutions in the Arctic Ocean.

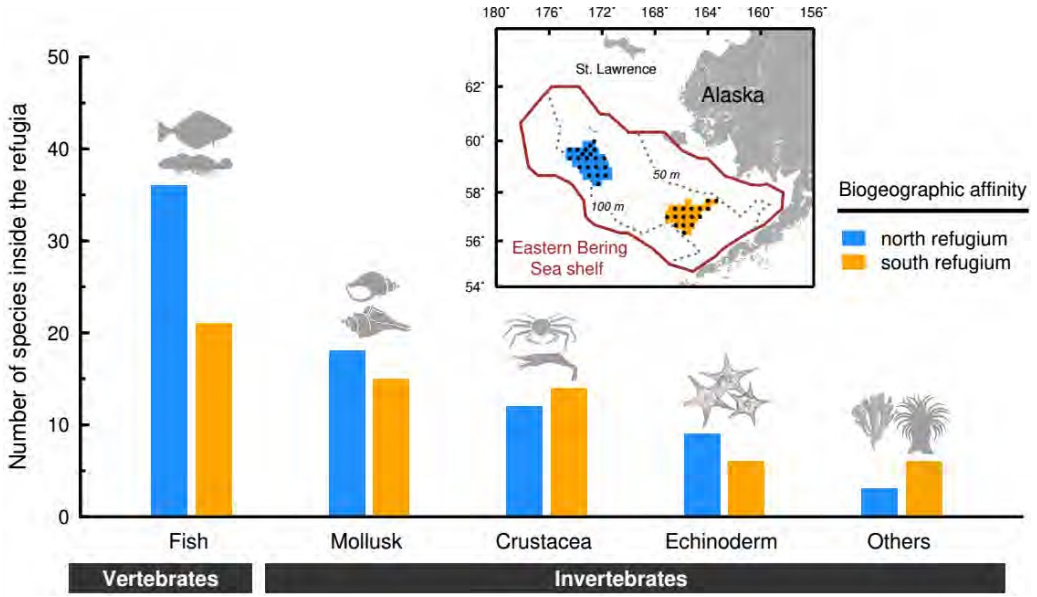
Addressing the problem of Arctic plastic pollutions is a science-based quest that requires the mingling of scientific and regulatory processes. Therefore, the regulatory processes for handling the threat of plastic pollutions necessitate an active and inclusive dialogue between the scientific and relevant regulatory communities, as well as other stakeholders.

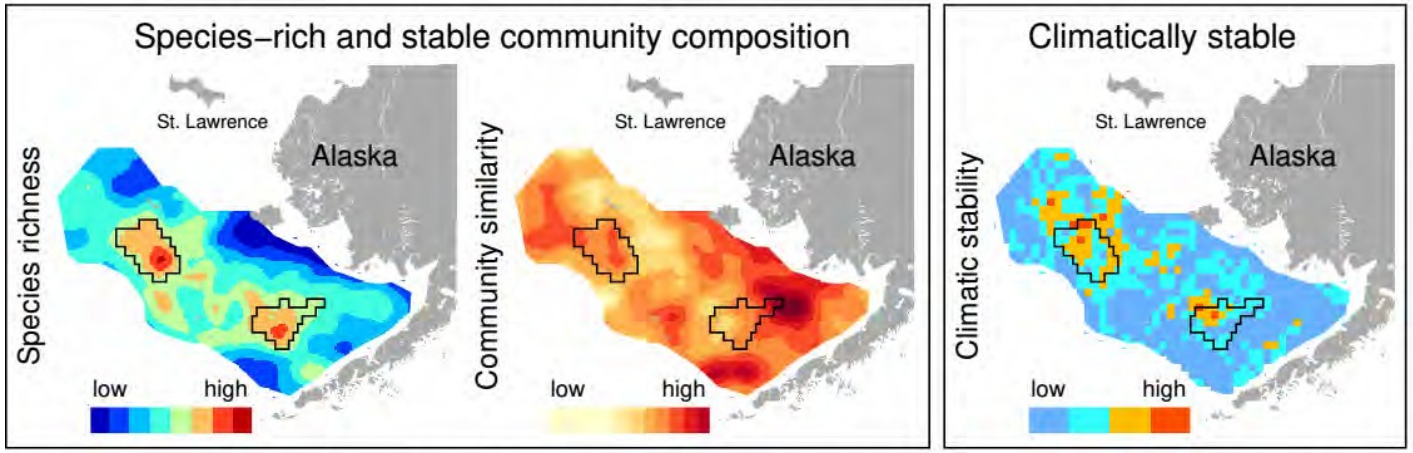
http://www.research.kobe-u.ac.jp/gsics-pcrc/arctic/press_release/e_20210324.html

Marine biodiversity refugia in a climate-sensitive subarctic shelf

Alabia *et al*. [2021, Global Change Biology, accepted]

- Two distinct refugia were identified in the Eastern Bering Sea using actual observations of 159 marine taxa, 1990-2018
- Prevalence of commercially-important species (e.g. walleye Pollock, Pacific cod, snow and tanner crabs) were higher inside than outside the refugia



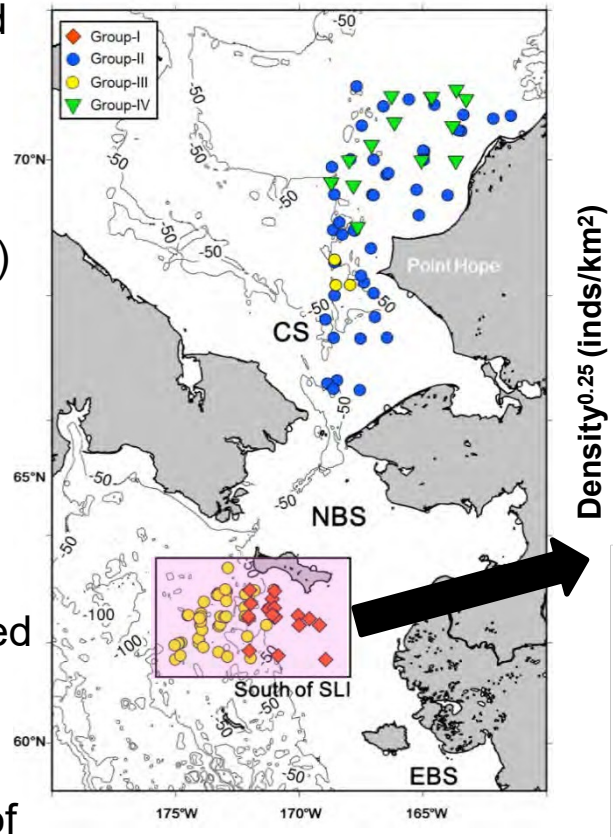


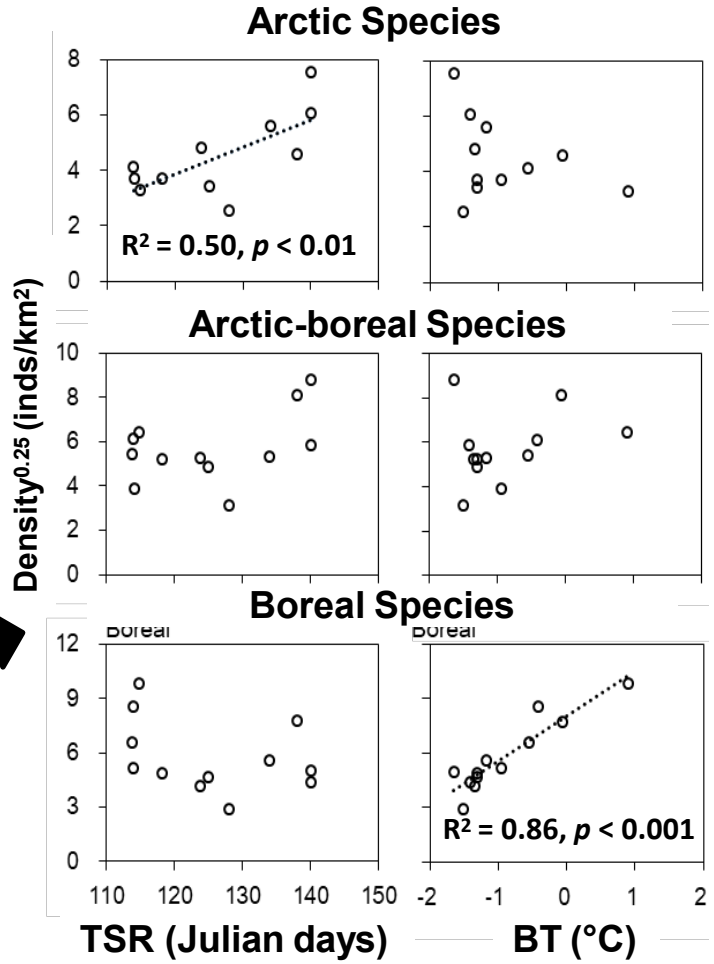
Climate buffering & protracted productivity likely support the persistence of high biodiversity & stable community.

Effects of the timing of sea ice retreat (TSR) on demersal fish assemblages in the northern Bering and Chukchi Seas

Nishio *et al*. [2020, DSR II 181-182, 104910]

- The structure of demersal fish assemblages was investigated using a total of 134 trawling data collected during 12 summers in 1990-2013.
- Timing of sea ice retreat (TSR) was the most important physical factor explaining ca. 20% of the overall variance.
- In the south of St. Lawrence Island (pink square),
  - ✓ late sea ice retreat increased Arctic species density,
  - ✓ higher bottom temperature (BT) increased the density of boreal species.





Mechanisms associated with sea-ice conditions (e.g. prey production) may exist in determining the structure of demersal fish assemblage.

The lack of sea-ice cover and the northern Bering Sea marine ecosystem

Deep Sea Research II, *Volumes 181–182*, December 2020, 104908.
Edited by George L. Hunt Jr, Toru Hirawake

- Impacts of unusually light sea-ice cover in winter 2017-2018 on the northern Bering Sea marine ecosystem – An introduction. Toru Hirawake, George L. Hunt
- Stratification in the northern Bering Sea in early summer of 2017 and 2018. Hiromichi Ueno, Mizuki Komatsu, Zhaoqianyi Ji, Ryo Dobashi, ... Toru Hirawake
- Spatial changes in the summer diatom community of the northern Bering Sea in 2017 and 2018. Yuri Fukai, Yoshiyuki Abe, Kohei Matsuno, Atsushi Yamaguchi
- Distinctive spring phytoplankton bloom in the Bering Strait in 2018: A year of historically minimum sea ice extent. Gennosuke Kikuchi, Hiroto Abe, Toru Hirawake, Makoto Sampei
- Seasonal changes in the zooplankton community and population structure in the northern Bering Sea from June to September, 2017. Fumihiko Kimura, Yoshiyuki Abe, Kohei Matsuno, Russell R. Hopcroft, Atsushi Yamaguchi
- Abundance, horizontal and vertical distribution of epipelagic ctenophores and scyphomedusae in the northern Bering Sea in summer 2017 and 2018: Quantification by underwater video imaging analysis. Marie Maekakuchi, Kohei Matsuno, Jun Yamamoto, Yoshiyuki Abe, Atsushi Yamaguchi
- Effects of the timing of sea ice retreat on demersal fish assemblages in the northern bering and Chukchi Seas. Sango Nishio, Hiroko Sasaki, Hisatomo Waga, Orio Yamamura
- Timing of spring sea-ice retreat and summer seabird-prey associations in the northern Bering Sea. Bungo Nishizawa, Nodoka Yamada, Haruka Hayashi, Charlie Wright, ... Yutaka Watanuki

Russia (Yury Zuenko)

Project: LME of the Arctic Seas and forecasting of their changes under climate change

Initiated by TINRO in 2020 and approved by Fishery Agency for 2021-2024

Postponed in 2021 to indefinite term
(possibly for better understanding of its prospects for fishery industry)

New trawl survey in the Chukchi Sea is recommended in 2021

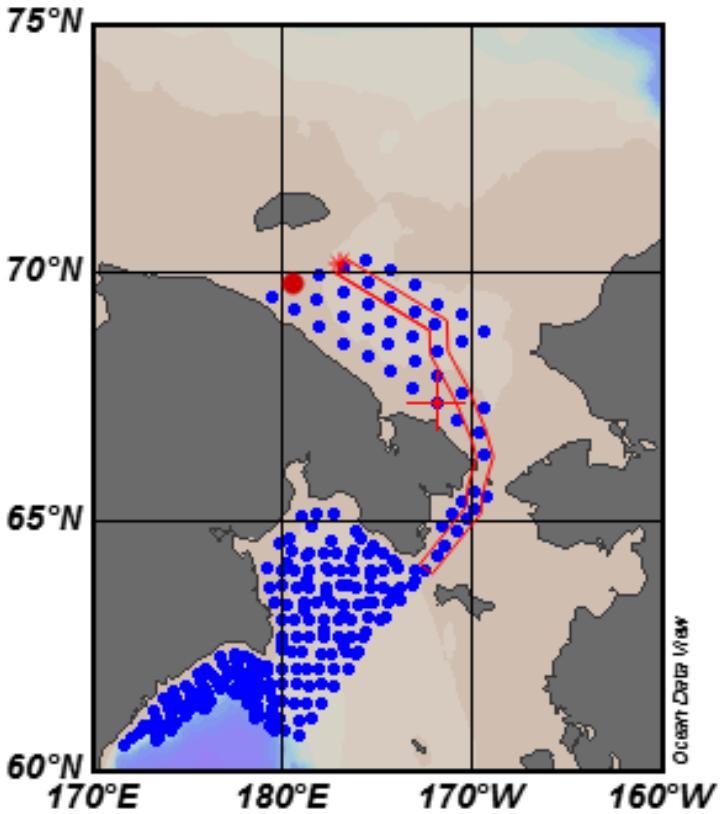
RV TINRO survey in the Chukchi Sea planned for 2021

Midwater trawl survey (instead of annual survey in the western Bering Sea)

Main goal: walleye pollock stock assessment

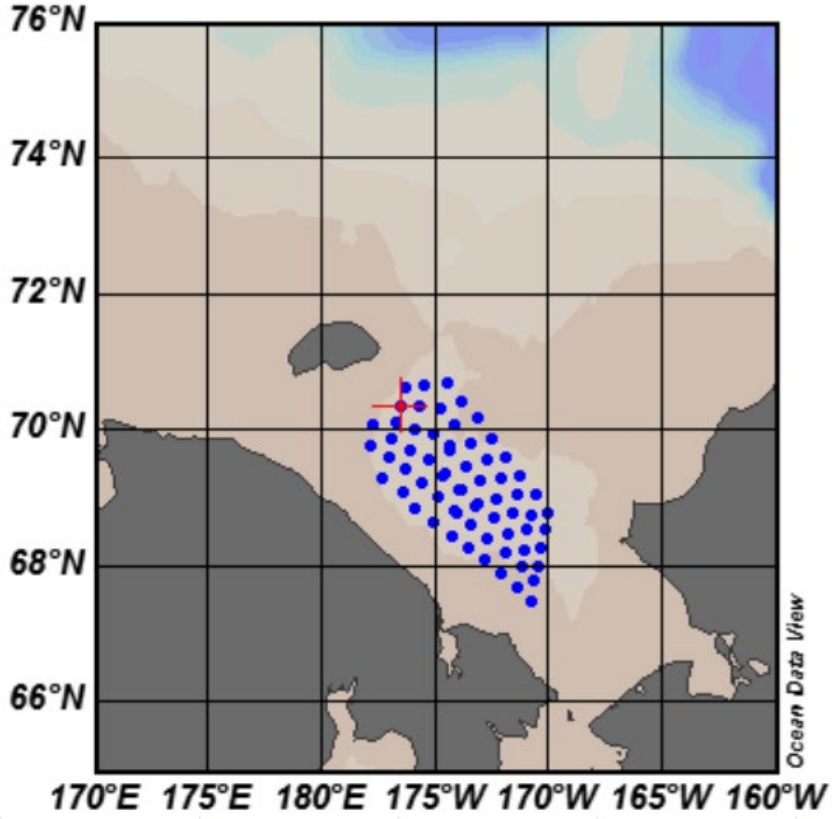
Other goals:
- monitoring on oceanographic conditions (physical and chemical)
- monitoring on zooplankton abundance and species composition
- monitoring on nekton abundance, species composition and biological state
- monitoring on macrobenthos abundance and species composition

Typical scheme of TINRO survey



RV TINRO
August-September, 2010

Scheme of survey planned for 2021



RV TINRO, September, 2021
(instead of annual survey in the western Bering Sea)

Korea (Hyoung Sul La)

Korean Arctic and Subarctic Research Survey

Integrated Ecosystem Assessment of the Northern Bering Sea – Chukchi Sea (WG 44)

Hyoung Sul La, Eun Jin Yang, Taewook Park,Kyung-Ho Cho
Young-Gyu Park, Hyoung Chul Shin, Sung-Ho Kang

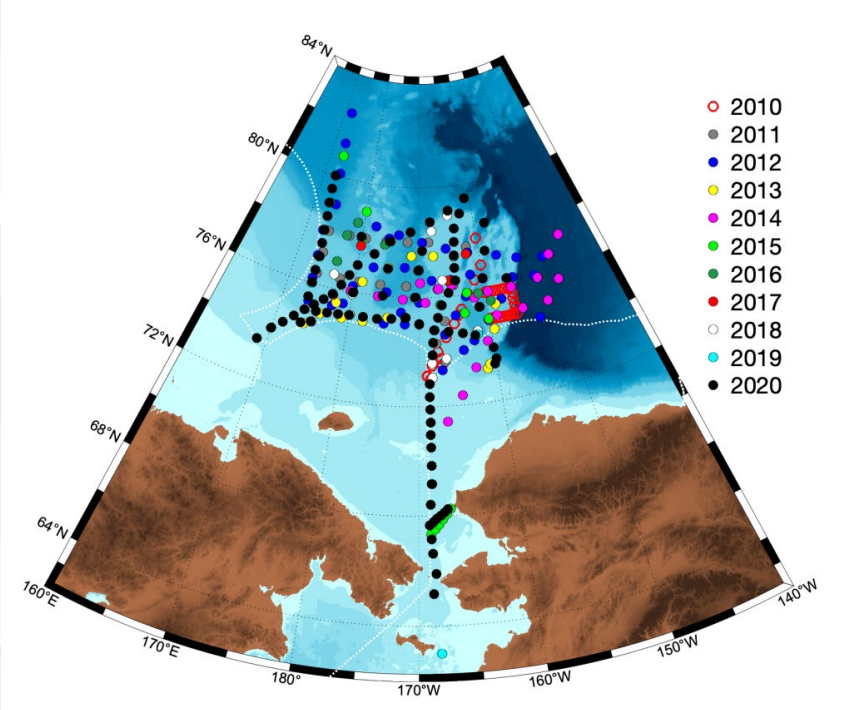
WG-44 First Working Group Meeting

April 14 , 2021

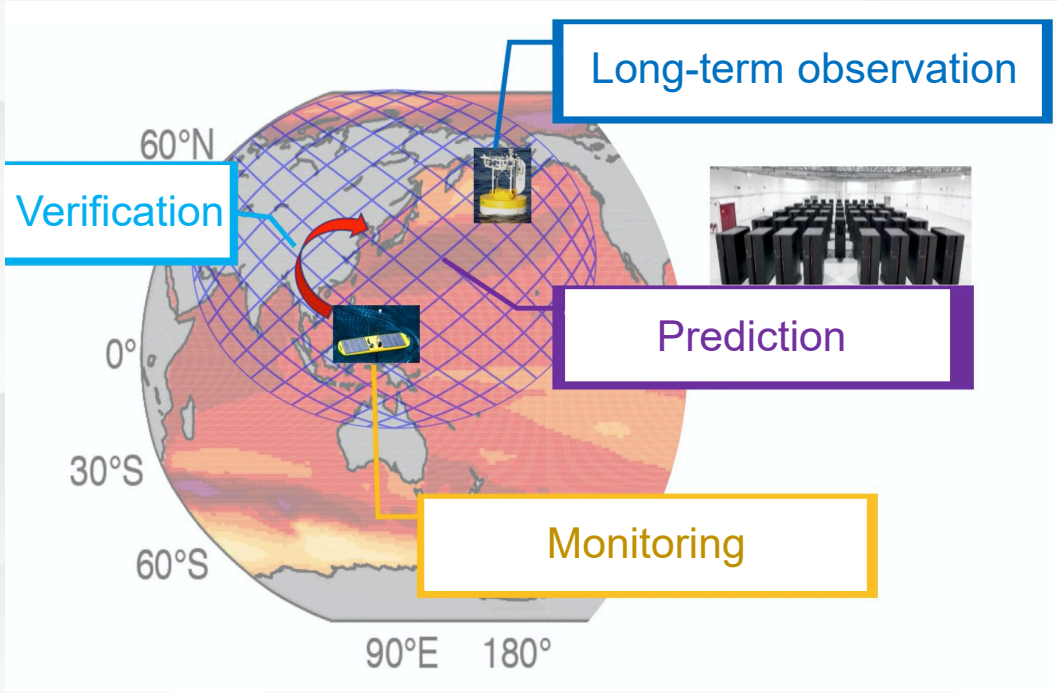
KOPRI and KIOST research collaboration

- **KOPRI** : **K**orea - **A**rctic **O**cean **O**bserving **S**ystem (2016 – 2021)
  - **K-AOOS** will be renewed for **K**orea - **A**rctic **WA**rming and **R**esponse of **E**cosystem (2021 – 2026)
  - Understand the interactions of air - sea-ice – ocean –marine ecosystem in the rapid transition and prospect future **Arctic Ocean**
- **KIOST-KOPRI** : Integration and prediction system development of marine heatwave around the Korean Peninsula originated from **subarctic and western pacific**. (2019 – 2023)

*KIOST: Korea Institute of Ocean Science and Technology



<KOPRI K-AOOS program>

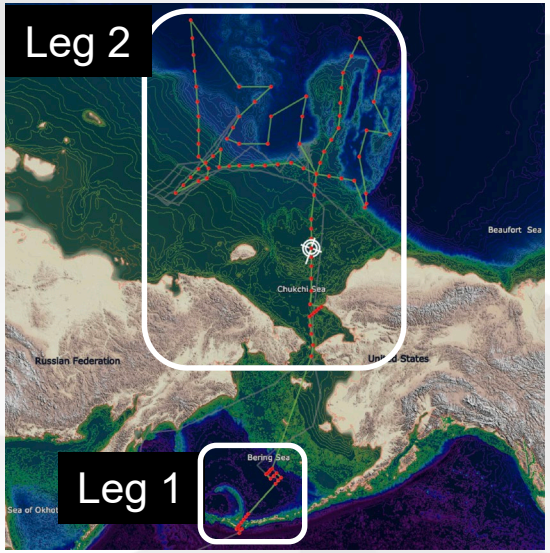


<KIOST-KOPRI program>

2020 IBRV *Araon* Research Cruise

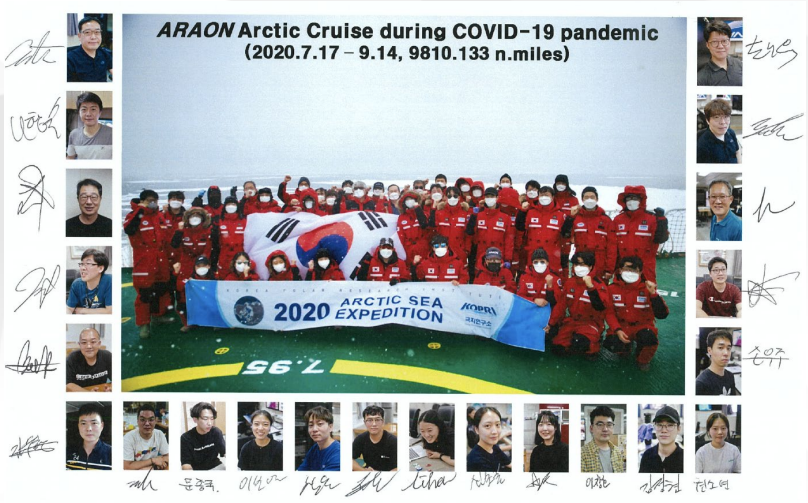
(July 17 – September 15, 2020)

- **Leg 1** : Bering Sea (Jul. 26 – Aug. 2, 2020) (CS, Dr. Taewook Park)
- **Leg 2** : Bering Strait - Chukchi Sea - Arctic Ocean (Aug.4 – Aug. 31, 2020) (CS, Dr. Kyoung Ho Cho)



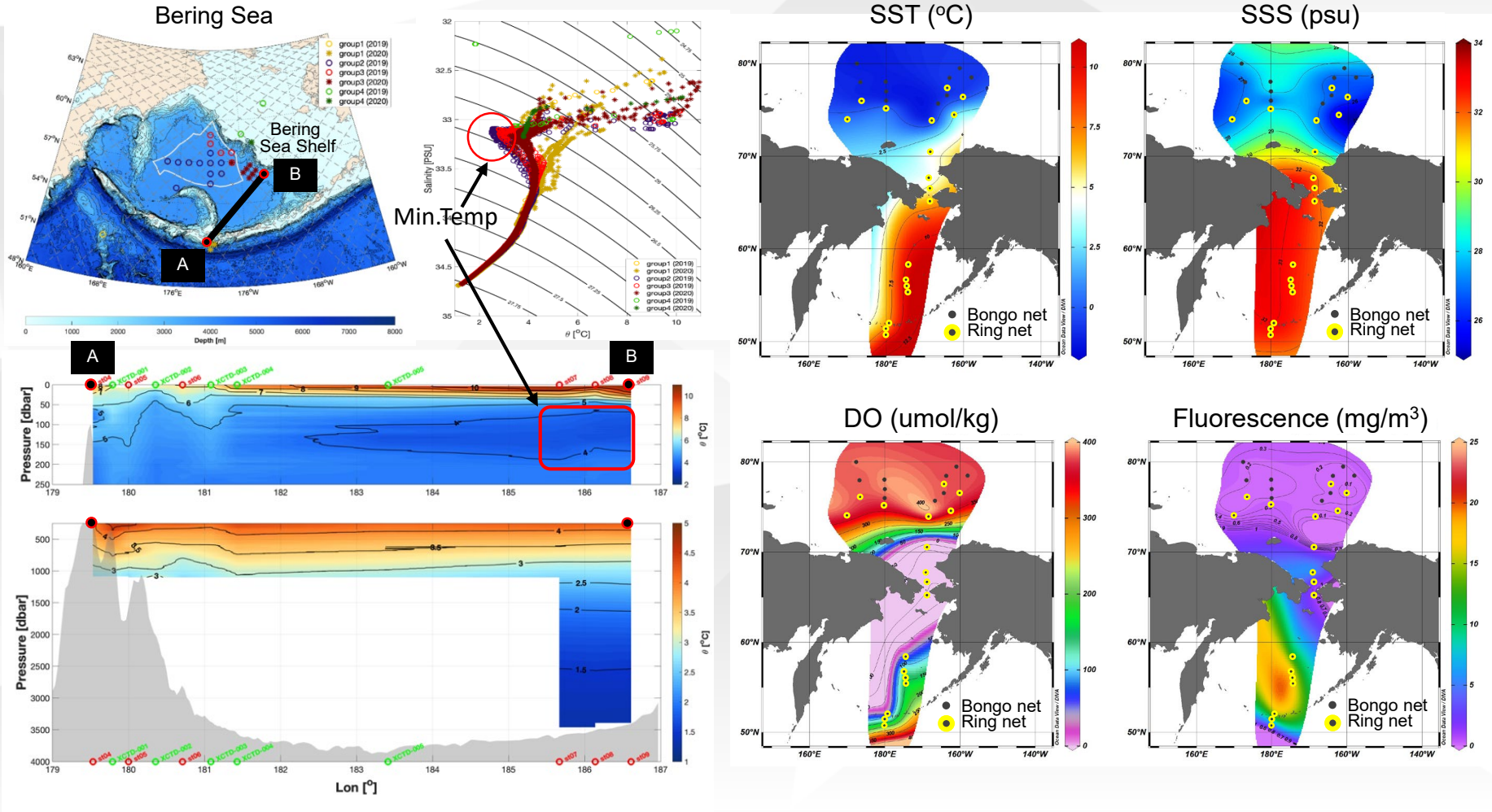
Major research components

- **Physics:** heat/mass balance heat/mass balance air-sea-ice change, current & circulation, remote sensing
- **Chemistry– biogeo:** air/gas chemistry (trace gases, greenhouse gases, air-sea interaction), seawater chemistry (dissolved gases, C, N, nutrients, pigments), biogeochemistry (C flow & flux from sediment trap)
- **Ecosystem – components & functions:** photosynthesis & parameters, processes & rates, producers, consumers, energy and material flow in the food web



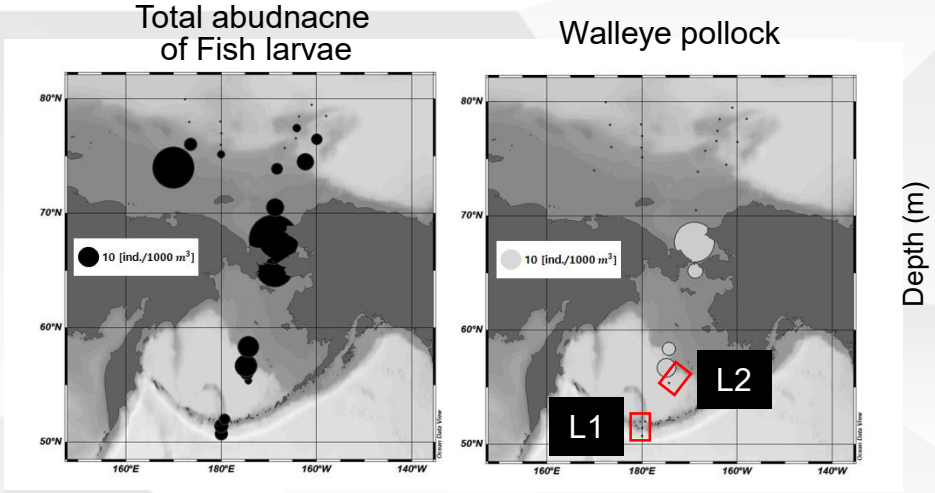
Hydrographic structure of water masses in the Arctic and Subarctic (2020)

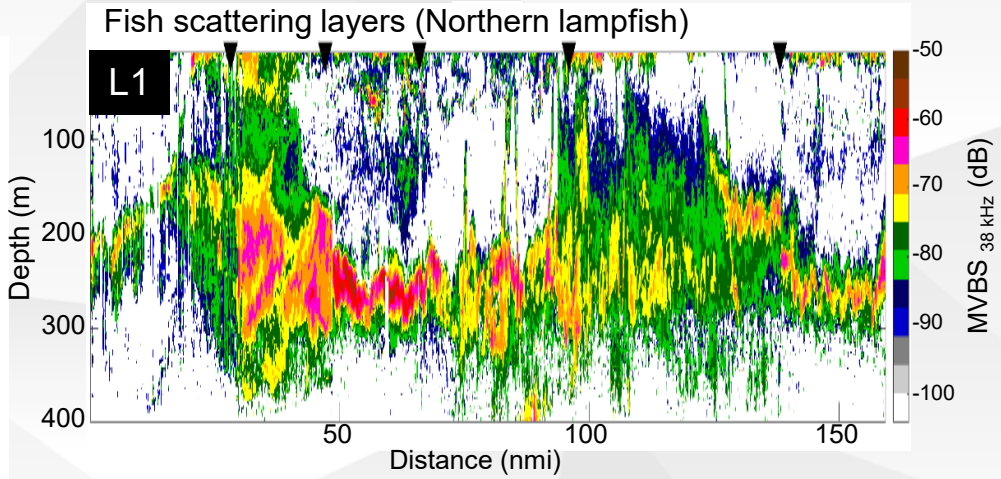
- Thermal stratification becomes stronger at the continental slope and a cold water was observed between 50 and 150 depth (Leg 1).
- The spatial variation in the SST and SSS was generally higher in the northern Bering Strait and lower in the Bering Sea and Arctic Ocean (Leg1 and Leg 2).

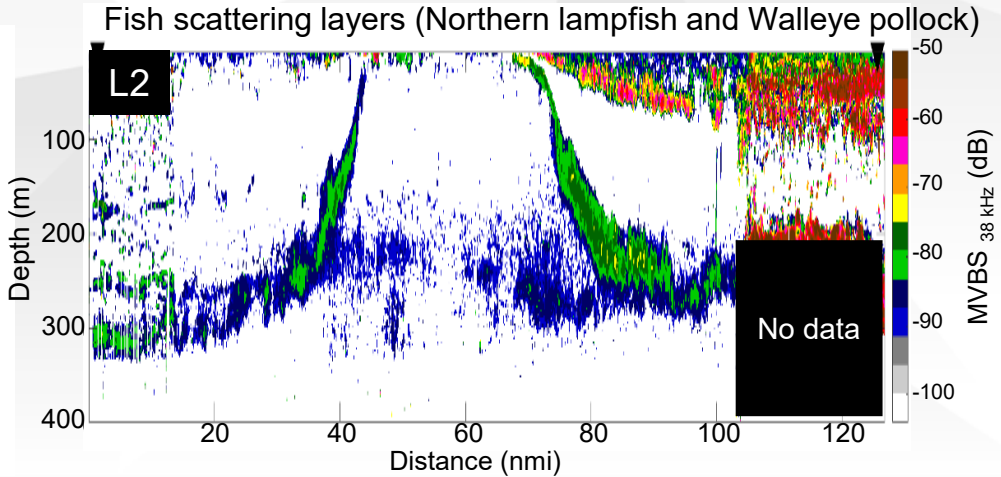


Distribution of Fish eggs and larvae (2020)

- Fish larvae (65 ea.): *Gadus chalcogrammus* (Walleye pollock), *Stenobrachius leucopsarus* (Northern lampfish), and *Boreogadus saida* (Polar cod) were three dominant species
- Fish eggs (59 ea.): *Mallotus villosus* (Capelin) and *Clupea harengus* (COI 0.1 %) or *C. pallasi* (COI 1.5 %) were dominant and only found in the Bering Sea.



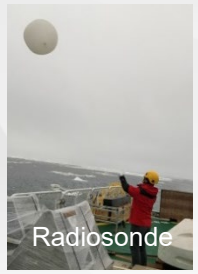




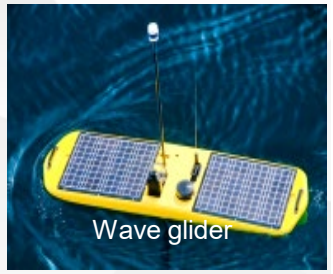
2021 IBRV *Araon* Research Cruise

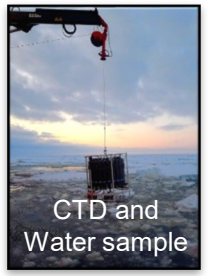
(July 1 – September 30, 2021)

- **Leg 1**: **Ocean – Atmosphere** long-term observation system for the North Pacific Climate Watch (CS: Dr. Taewook Park, twpark@kopri.re.kr , 20201 7.15 – 7.24)
- **Leg 2**: **Ocean – Sea ice – Atmosphere** Integrated Observations in the Pacific Arctic regions (CS: Dr. Kyung-Ho Cho, kcho@kopri.re.kr, 20201 7.25 – 8.28)
- **Leg 3**: **Geological features** and **methane**-related microbiology in the Arctic Ocean (CS: Dr. Young-Keun Jin, ykjin@kopri.re.kr , 20201 7.29 – 9.15)

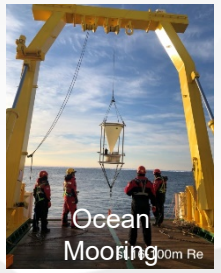

Radiosonde


Surface Buoy

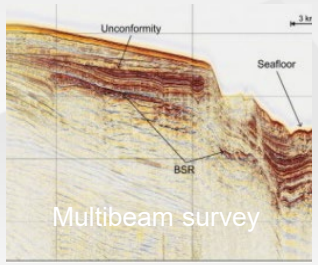

Wave glider


CTD and Water sample

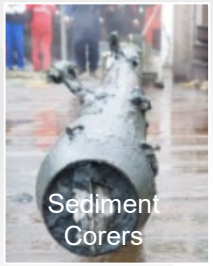

Nets


Ocean Mooring


Fisheries echosounder



Multibeam survey


Sediment Corers

Thank you

US (Kathy Kuletz)

New Projects relevant to North Bering-Chukchi Sea IEA- U.S.A.

Contributors (along with all their colleagues):

- Janet Duffy-Anderson (AFSC/NOAA)
- Elizabeth Siddon (AFSC/NOAA)
- Lisa Eisner (AFSC/NOAA)
- Megan Ferguson (NMFS/ NOAA)
- Lee Cooper (U. Maryland)
- Kathy Kuletz (USFWS)

Partial list of on-going projects relevant to WG44:

AIERP (Arctic Integrated Ecosystem Research Project; Synthesis Phase; N. Pacific Research Board, Bureau of Ocean Energy Management, and other collaborators)

Chukchi Ecosystem Observatory (year-round monitoring mooring system near Hanna Shoal; U. Alaska, Fairbanks lead, with multiple institutions)

AMBON – Arctic Marine Biodiversity Observing Network (U. Alaska, Fairbanks)

DBO – Distributed Biological Observatory (8 international sampling grids)

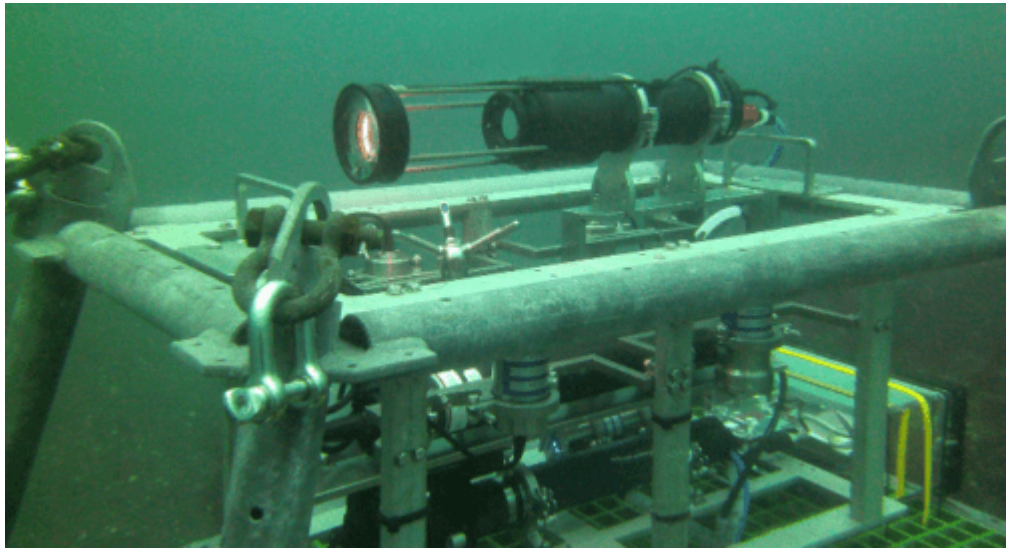
National Science Foundation grants, to complete 2021-2025; physics to humans

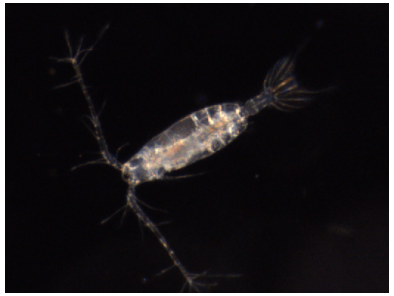
Bering Sea: 5 specifically marine projects + 6 other regional projects

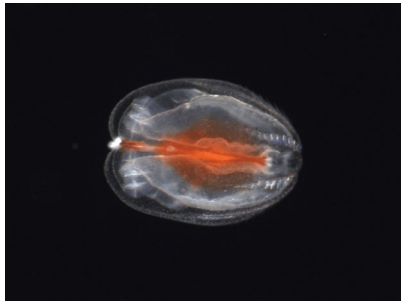
Chukchi Sea: 6 marine projects, comprised of 14 individual projects

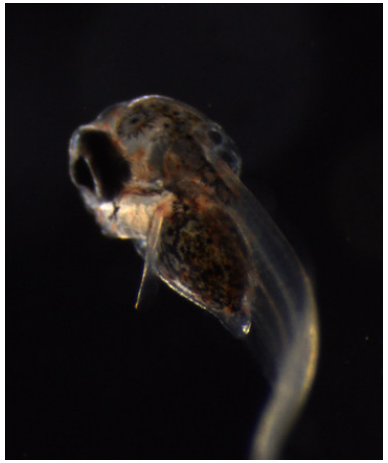
Zooplankton Imaging Project – Bering/Chukchi Sea

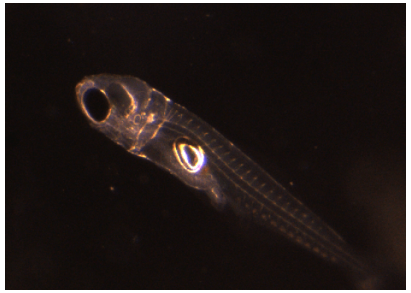
- Team
  - PMEL/ITAE – Calvin Mordy, Heather Tabisola, Christian Meinig
  - AFSC – David Kimmel, Deana Crouser
  - PPSIC – Piotr Margoński
- Goals
  - Deploy CPICS imaging system
  - Use machine learning algorithms to classify zooplankton images
  - Expand temporal and spatial coverage of zooplankton population estimates
  - Eventual deployment on moored or unmanned systems

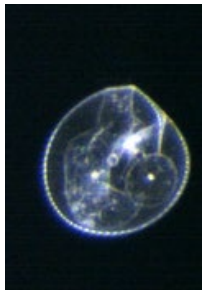












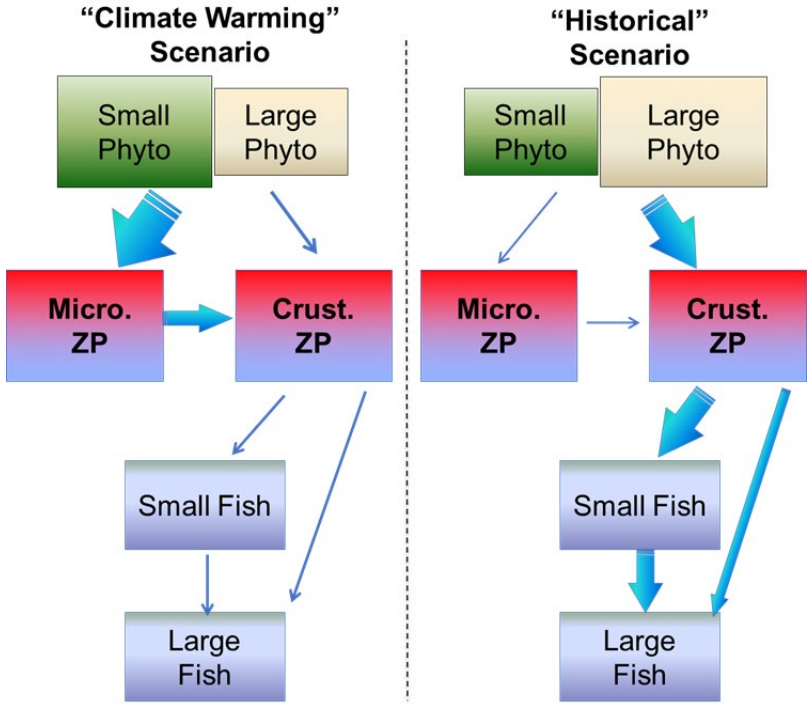
Satellite analysis of shifts in phytoplankton community composition and energy flow in the new Arctic

Eisner, Nielsen (NOAA AFSC); Lange, Lomas (Bigelow Lab); Mordy, Stabeno (NOAA PMEL)

Funded by NOAA Joint Polar Satellite System (JPSS) Proving Ground and Risk Reduction (PGRR) initiatives (3 years, June 2021- 2024)

Use satellite ocean color data for N. Bering & Chukchi seas:

1) analyze variability of phytoplankton community size structure based on spectral slopes of absorption, backscattering, remote-sensing reflectance ($R_{rs}(\lambda)$), and empirical chlorophyll*a* -based algorithms;
2) modify existing algorithms to exploit the unique $R_{rs}(\lambda)$ properties of *Synechococcus* (small photosynthetic bacteria) to determine changes in this picoplankton group;
3) estimate diatom abundances from chlorophyll*a*-specific absorption;
4) explore correlative methods to assess the probability of occurrence of harmful algae such as *Pseudo-nitzschia* spp. and *Alexandrium* spp. using satellite products to improve HAB predictions.



Schematic of hypothesized change with phytoplankton size structure

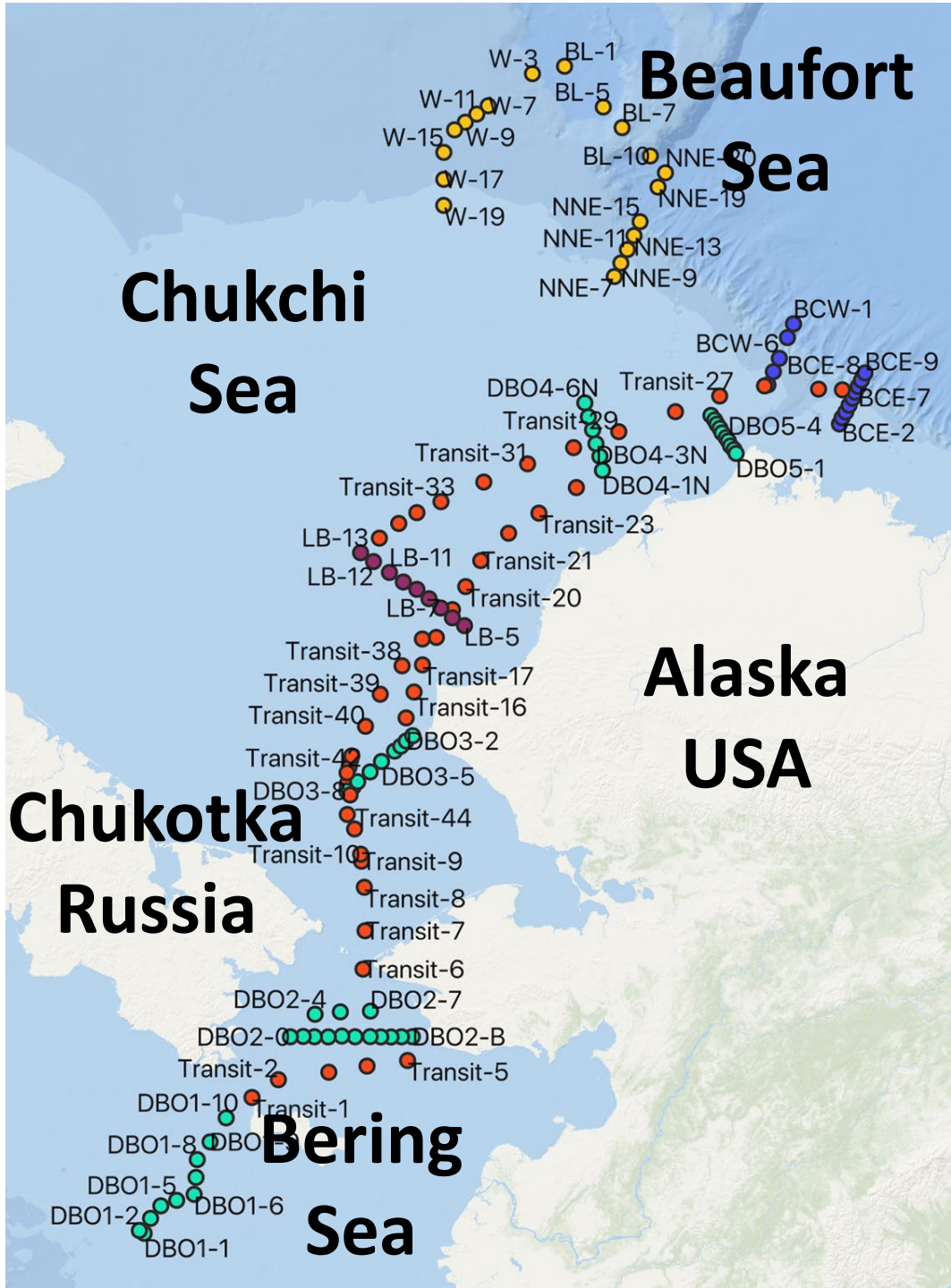
ECOHAB Project Goal: Model for the transfer of algal toxins in food webs & health impacts in wildlife

Kathi Lefebvre NOAA/NWFSC & Don Anderson WHOI

2020 to 2025

Our team will accomplish this goal using multiple Arctic cruises to sample over the next 5 years & answer the following:

1. **Where are harmful algae & how big are the blooms?**
2. **What are the toxin concentrations in food webs?**
3. **What are the health impacts to wildlife?**

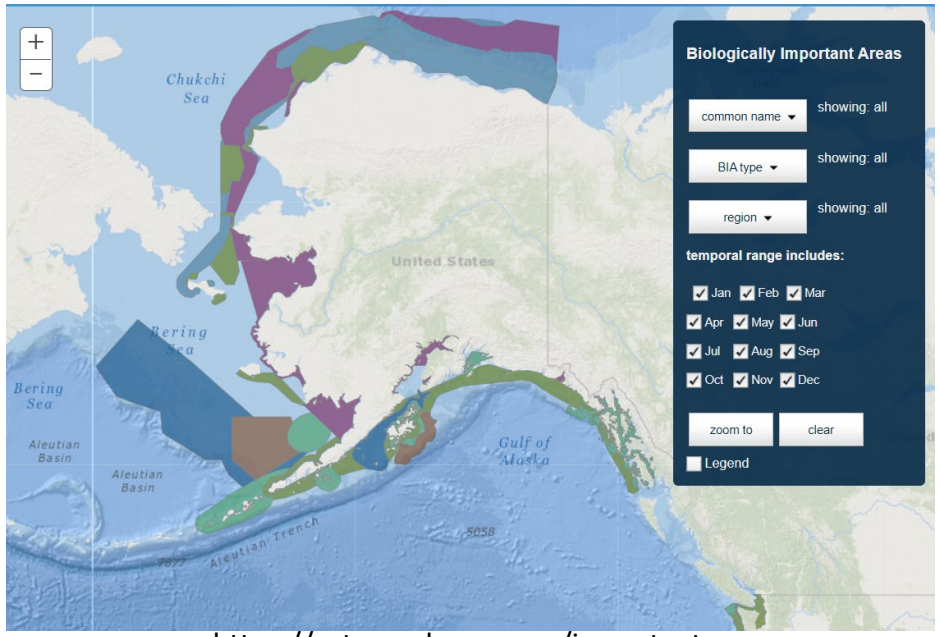


NMFS Biologically Important Areas for Cetaceans v.2

- Delineate areas and times important for migration, feeding, reproduction, and small resident populations
- Purely knowledge-based; no social, economic, or political considerations
- Expert elicitation
- ***No inherent or direct regulatory power***

7 Regions

Arctic
Aleutians & Bering
Gulf of Alaska
Hawaii
West Coast
Gulf of Mexico
East Coast



https://cetsound.noaa.gov/important

Products

Scored BIAs
Peer-reviewed papers
Maps & shapefiles
Metadata tables
Interactive online access
Expected completion in 2022

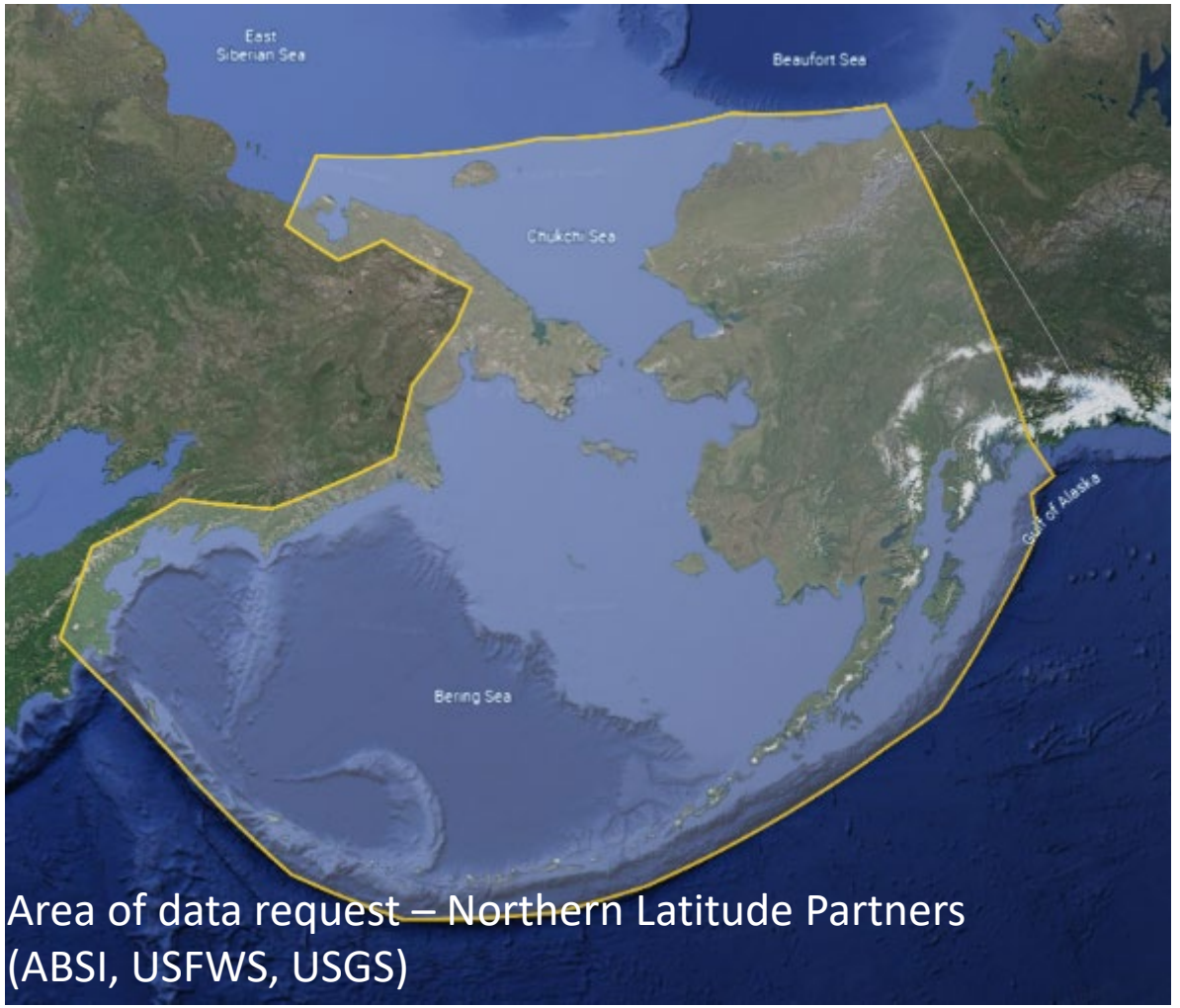
Megan.ferguson@noaa.gov
Sofie.VanParijs@noaa.gov
Jolie.Harrison@noaa.gov

Van Parijs, S. M., Curtice, C., & Ferguson, M. C. (Eds.). (2015). Biologically Important Areas for cetaceans within U.S. waters. *Aquatic Mammals* (Special Issue), *41*(1). 128 pp. http://dx.doi.org/10.1578/AM.41.1.2015.1

Risk Assessment for Seabirds from Vessel Traffic (& Marine Mammals)

- Funded by USFWS, started 2021
- Analysis by fall 2021, publication by winter 2022
- Use Automatic Identification System (AIS)
- Overlay Vessel & seabird distribution
  - Evaluate species or areas at risk
  - Assist planning of shipping lanes
  - Assist avoidance of high-risk areas
- **Will request NBS-CS IEA area as a focus**

Any Tribe, state, federal or local government can use www.AlaskaGeofence.org to customize real time monitoring effort



Area of data request – Northern Latitude Partners (ABSI, USFWS, USGS)

For more information contact: Aaron Poe
907-433-8202
apoe@alaskaconservation.org