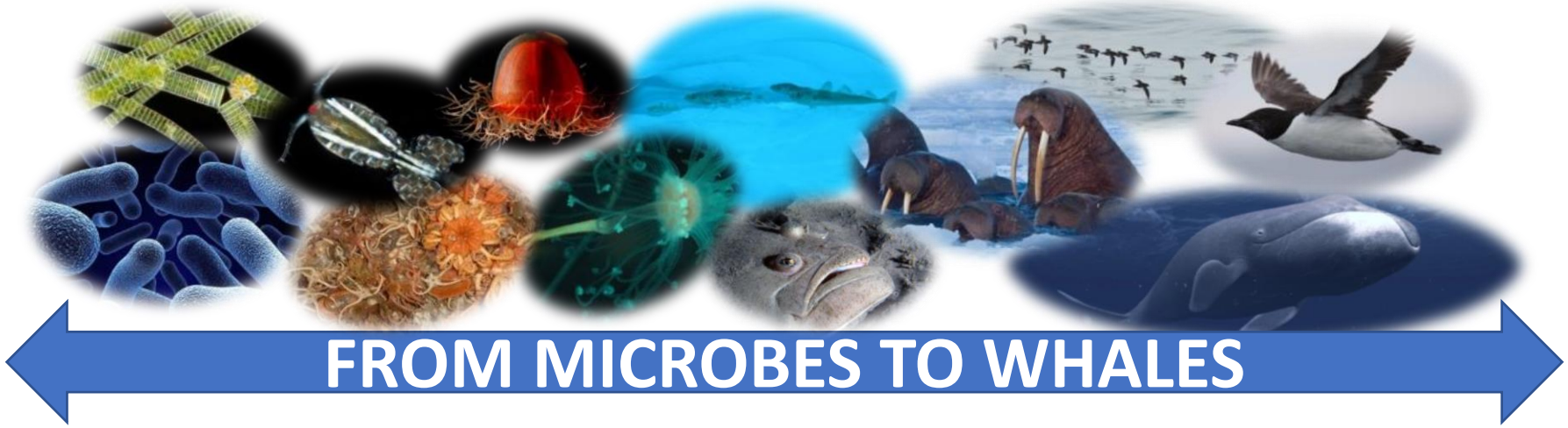


Sustainable AMBON: Arctic Marine Biodiversity Observing Network

Iken K[1], Grebmeier J[2], Danielson S[1], Cooper L[2], Mueter F[1], Galaska M[3], Kuletz K[4], Hopcroft R[1], Stafford K[5], Kavanaugh M[5]

(1) University of Alaska Fairbanks; USA; (2) University of Maryland, USA; (3) University of Washington, USA; (4) US Fish and Wildlife Service, USA; (5) Oregon State University

MBON
Marine Biodiversity Observation Network

IOOS Integrated Ocean Observing System

BOEM Bureau of Ocean Energy Management

NSF

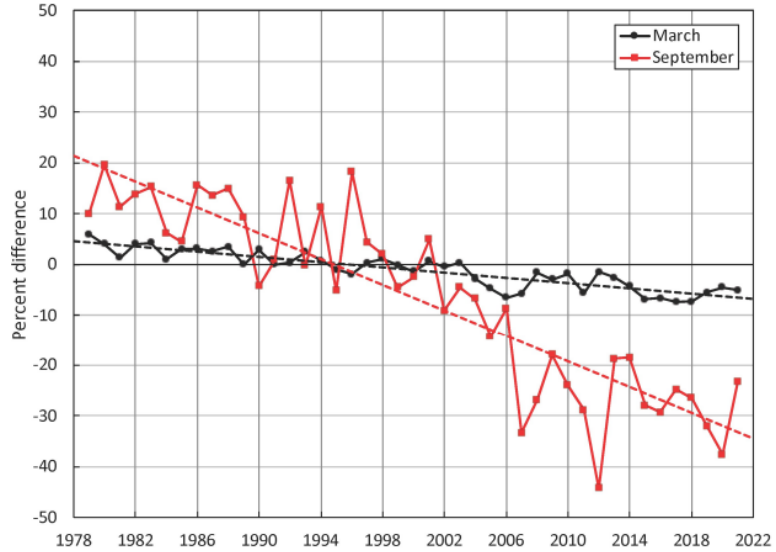
NASA

Office of Naval Research ONR Science & Technology

NOPP

AMBON goals

- **Measure marine biodiversity (species richness and distribution) in the Chukchi Sea**
- AMBON monitors marine diversity from bacteria to whales
- Relate species distribution to the changing Arctic environment
- Collect data to inform stakeholder, esp. management
- Open access data management
- AMBON collaborates with other projects:
  - ➢ Distributed Biological Observatory (DBO)
  - ➢ Chukchi Sea Environmental Studies Program (CSESP)



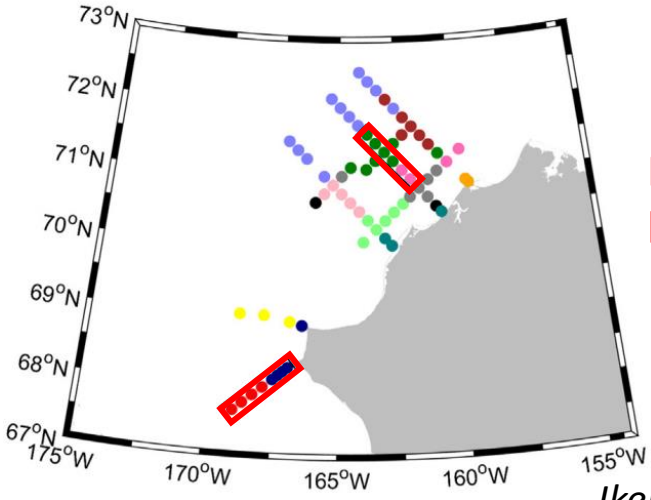
AMBON management applications

Bureau of Ocean Energy Management (BOEM)

- NEPA information needs
- Spatial planning of observing networks

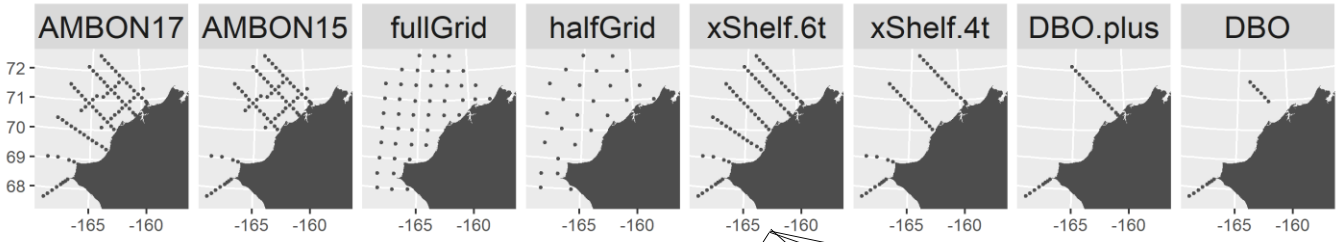
Chukchi Sea OCS

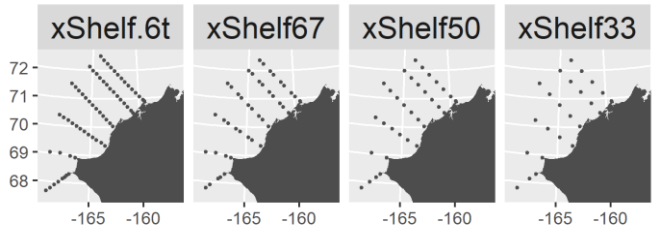
Spatial observation design



Red box=DBO

Iken et al. 2019



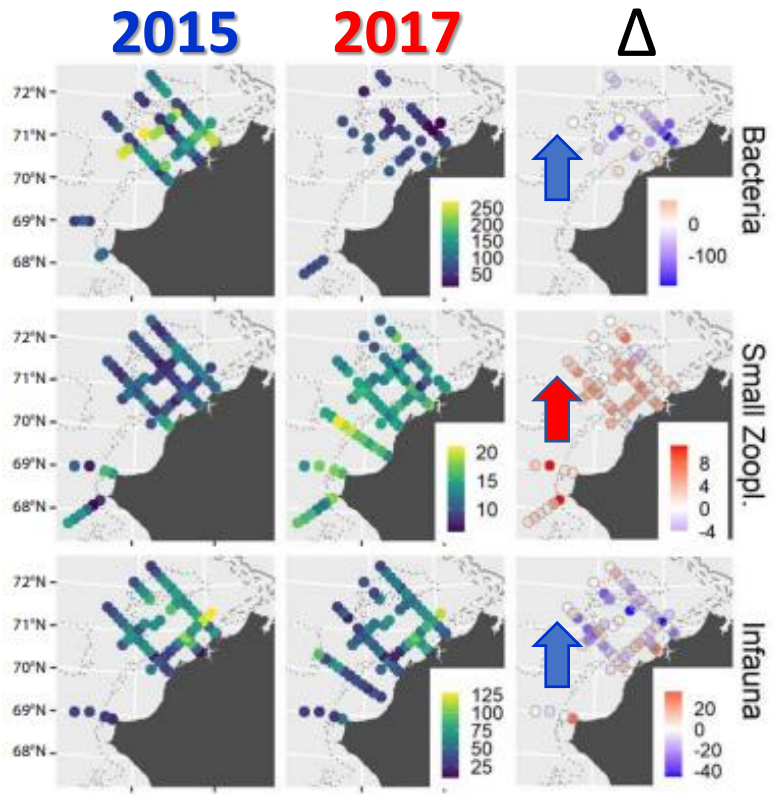


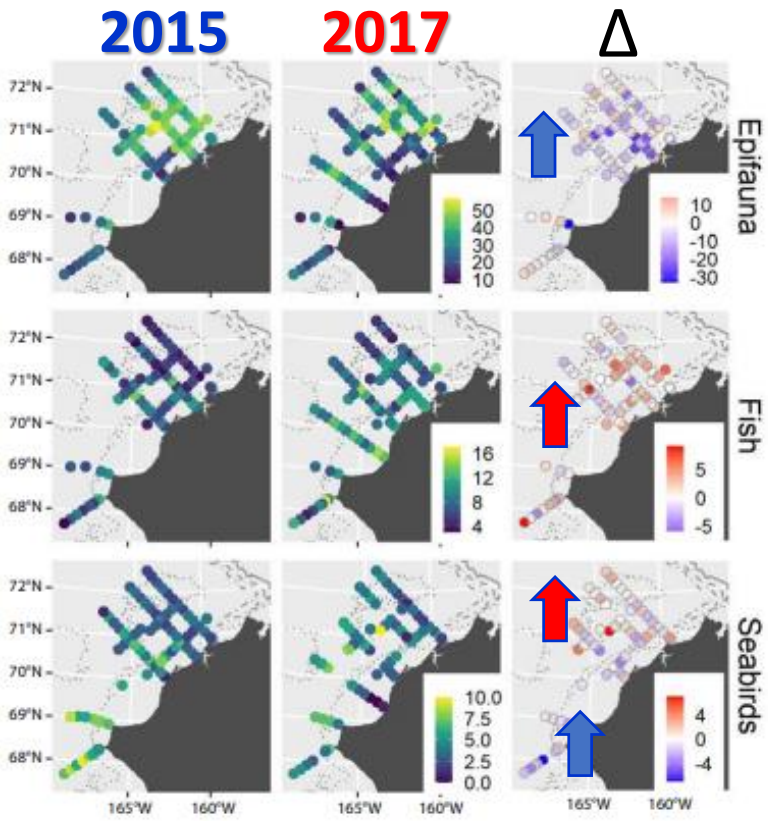
Mueter et al. in prep

AMBON management applications

Bureau of Ocean Energy Management (BOEM)

- Species distributions, food web stability, and ecosystem resilience
- Borealization/invasive species potential = ecosystem functioning





Effects of **cold (2015)** versus **warm (2017)** regimes on biodiversity across ecosystem components

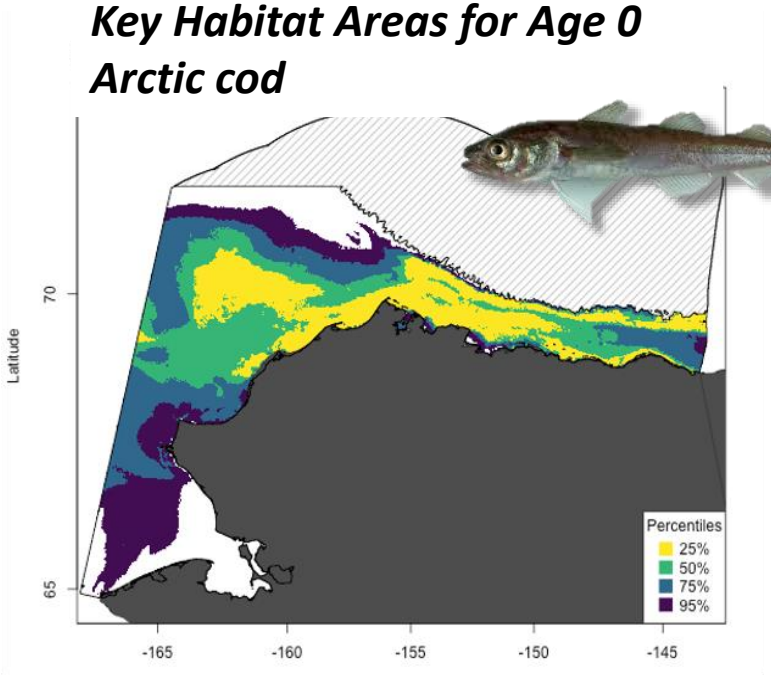
Mueter et al. 2021

AMBON management applications

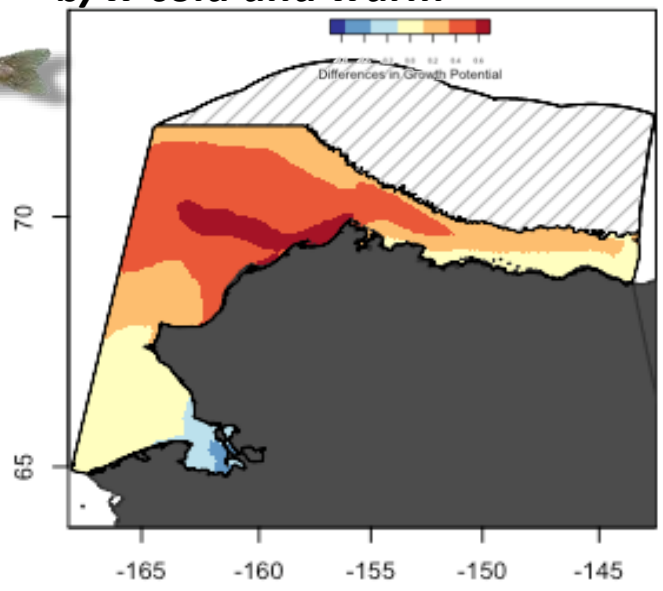
North Pacific Fishery Management Council (NPFMC)

- Manages AFMP-specified target species
- AMBON advises on Scientific and Statistical Subcommittee
- Development of of Essential Fish Habitat (EFH) models for each AFMP target species

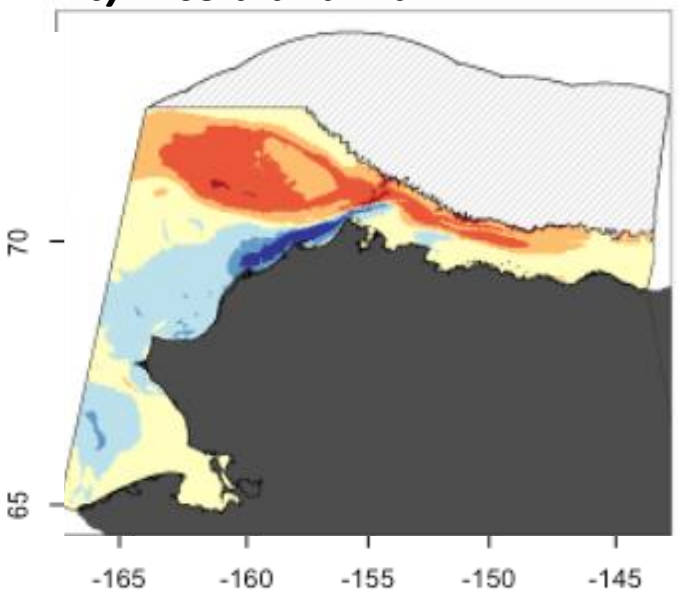
Key Habitat Areas for Age 0 Arctic cod



Difference in pot. growth b/w cold and warm



Difference in habitat suitability b/w cold and warm



Marsh, Mueter & Pirtle 2021, BOEM Report M19AC00009

AMBON management applications

Arctic Integrated Ecosystem Assessment (IEA)

- Organized by the North Pacific Marine Science Organization (PICES) as WG44
- Led by NOAA

Northern Bering Sea Climate Resilience Area (Bering Task Force)

- Bering Task Force coordinates Federal activities in the region
  - Regulation of shipping lanes, ban on bottom trawling, oil & gas development

The White House
Executive Order

Interagency Arctic Research Policy Committee (IARPC)

- Coordination of Arctic activities across US federal agencies
- Marine Ecosystem Collaboration Team under the new US 5 yr Arctic Research Plan 2022-2026

IARPC COLLABORATIONS

Expanding seascape applications to the Arctic

- Regionally-scaled seascapes from satellite imagery as a monitoring tool

NASA

AOOS
Alaska Ocean Observing System

AMBON local management links

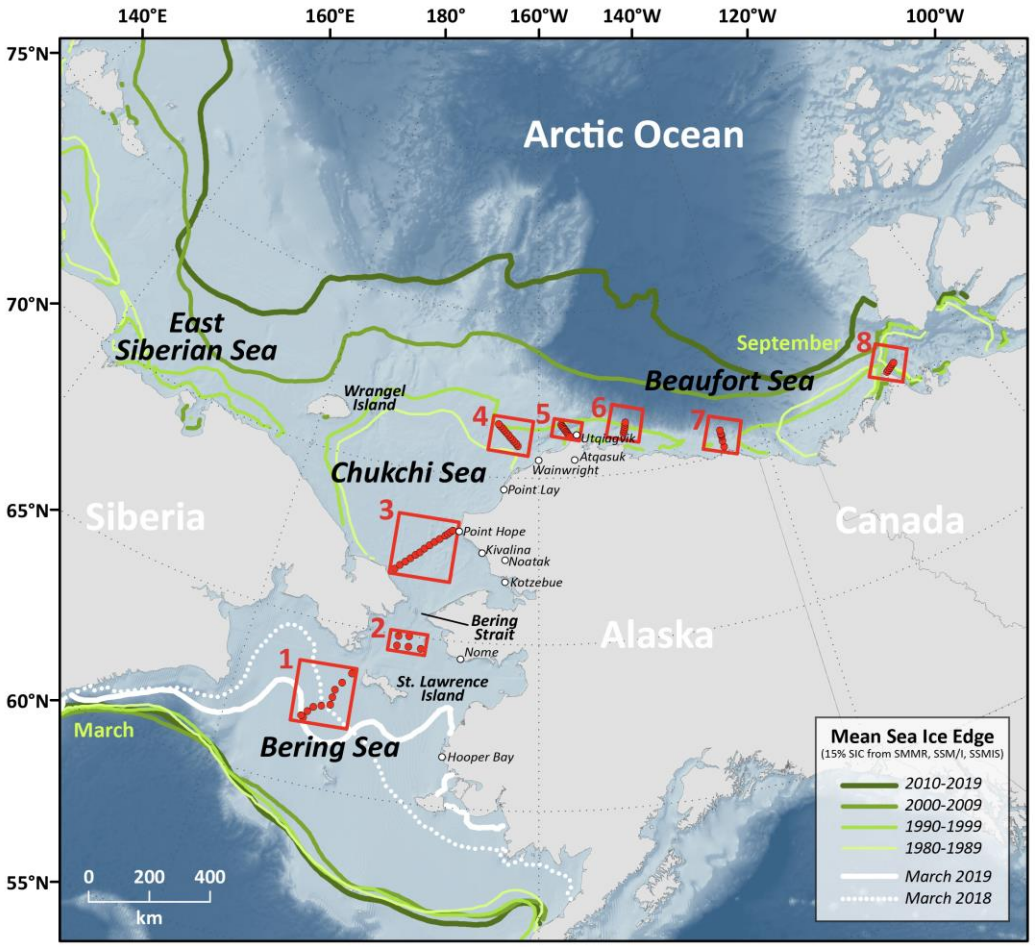
Food security: subsistence food and commercial fisheries

- **Subsistence users of local foods**
  - Marine mammals, seabirds, tunicates, clams, crabs, fish
  - Negative impact of toxic algae (Harmful Algal Blooms) and ocean acidification on key food organisms
  - Involvement of local observers

- **Commercial fisheries**
  - Pollock and Pacific cod in the Bering Sea, large US fisheries
  - Expanding northward with warming seawater
  - Contaminants magnified up the food chain

AMBON – collaborations are key to success

- Collaboration to maximize scientific information
- Capitalize on joint logistics



[updated from Grebmeier et al. 2019, DBO DSR 162:1-7]

The Distributed Biological Observatory (DBO)

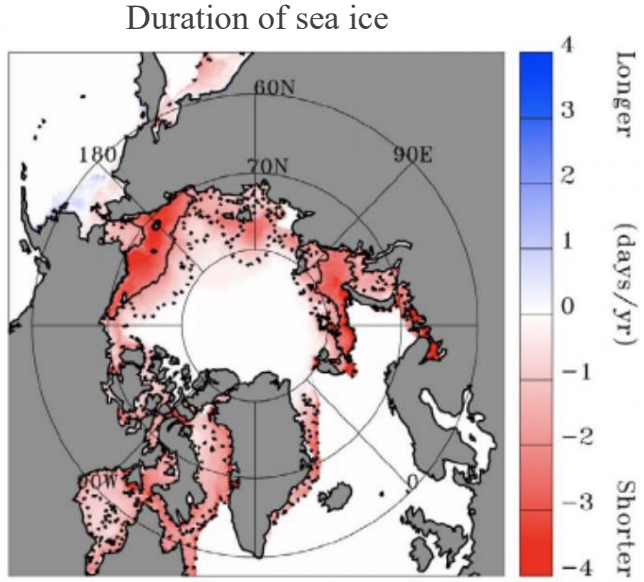
- Serves as a change detection array for consistent monitoring of biophysical components of the ecosystem
- Focus on biological hotspots defined by high **biomass and rate of change**
- DBO collaborates with AMBON, Chukchi Ecosystem Observatory (CEO), and Ecosystems & Fisheries -Oceanography Coordinated Investigations (EcoFOCI) programs
- Shipboard sampling of DBO lines and collaborative deployment of moorings

AMBON – collaborations are key to success

DBO regions with scientific focus on:

- Northward range extension of gray whales with reduced sea ice duration
- Contraction of benthic amphipods northward with warming seawater; also northward advection of krill
- Impact on biodiversity and ecosystem function

- Threatened diving seaducks in northern Bering Sea
- Sea ice reduction limits habitat for winter feeding
- Northward contraction of clam food

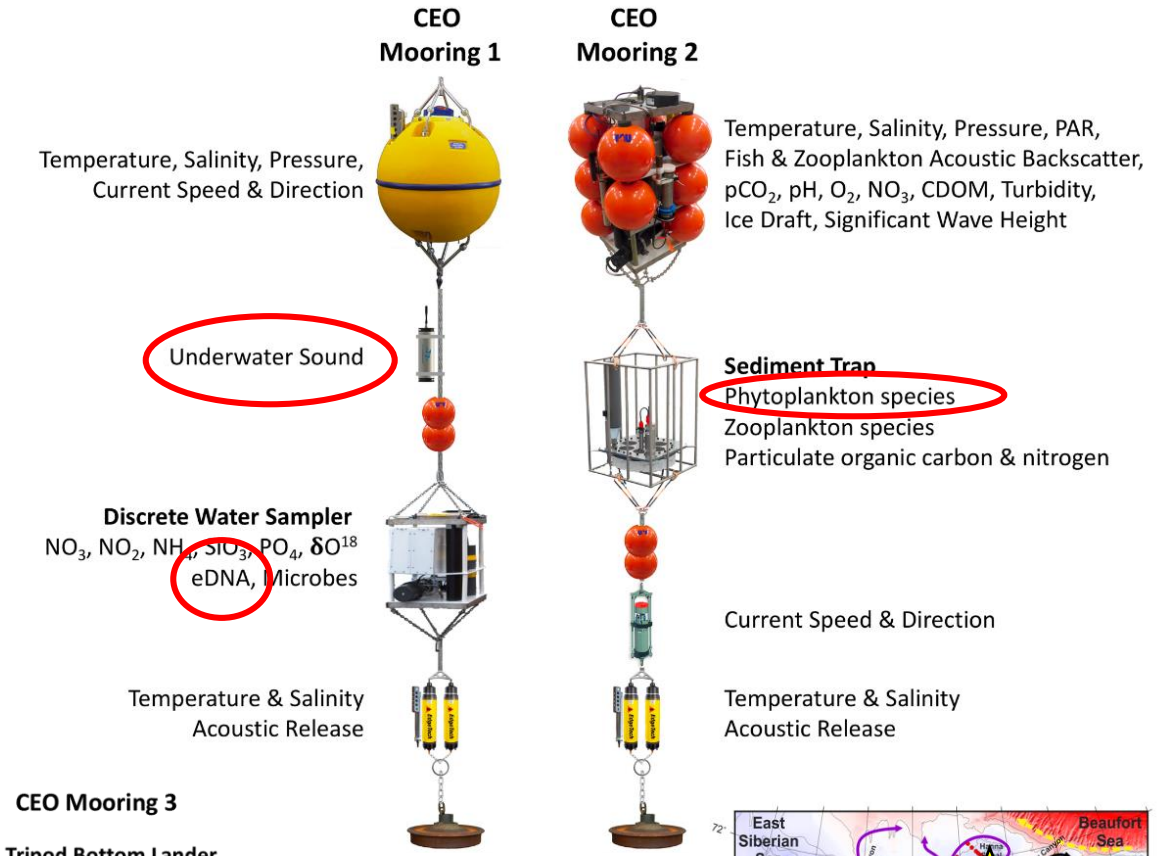


[Credit Fraser et al. 2020]

AMBON – collaborations are key to success

Chukchi Ecosystem Observatory

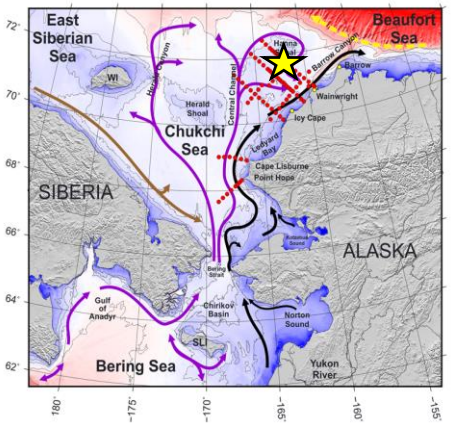
- **Year-round data collection in one location**
- Long-term environmental context
- AMBON-supported instrumentation:
  - Marine mammal sound
  - eDNA water collections
  - Phytoplankton species (sediment traps)
- **New AMBON-leveraged instrumentation from AOOS**: Benthic time-lapse camera
  - Year-round benthic biodiversity
  - Migration patterns of benthic fisheries species, e.g., snow crab



CEO Mooring 3

Tripod Bottom Lander
Benthic Camera

AOOS
Alaska Ocean Observing System



AMBON international links

PAG

PACIFIC ARCTIC GROUP

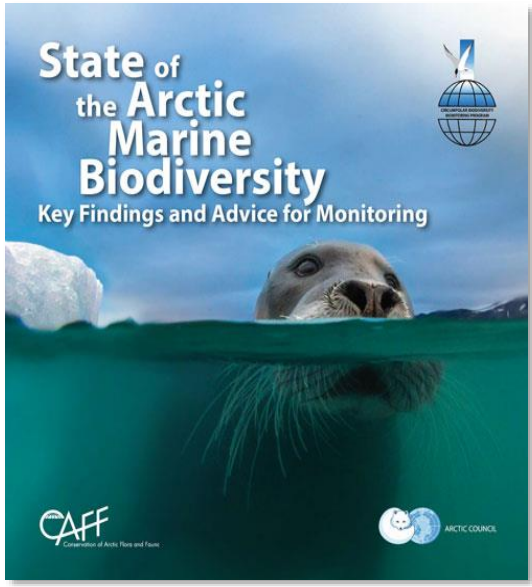
BOEM

Bureau of Ocean Energy Management

ARCTIC COUNCIL

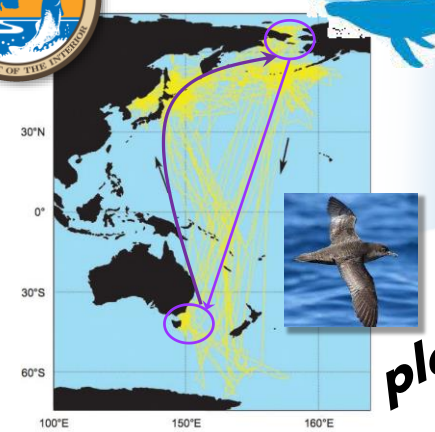
CAFF

CIRCUMPOLAR BIODIVERSITY MONITORING PROGRAM



U.S. FISH & WILDLIFE SERVICE

ATN ANIMAL TELEMETRY NETWORK



planned

MBON

Marine Biodiversity Observation Network

GEO BON

Group on Earth Observations Biodiversity Observation Network

Marine Life 2030

GOOS

The Global Ocean Observing System

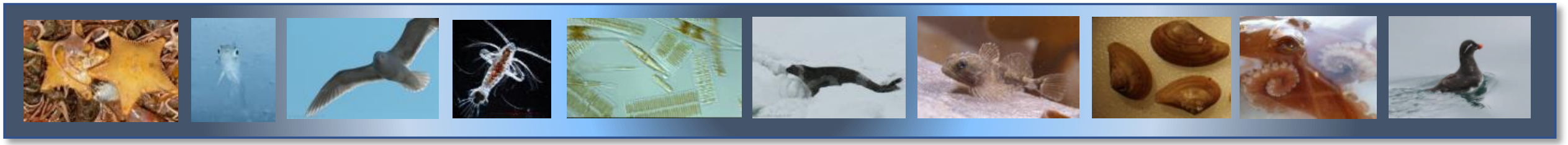
AMBON – concluding remarks

- Climate-induced stressors (reduced sea ice, warming temperatures), along with increasing ship traffic and northward movement of commercial fisheries all influence ecosystem structure, biodiversity, and food security

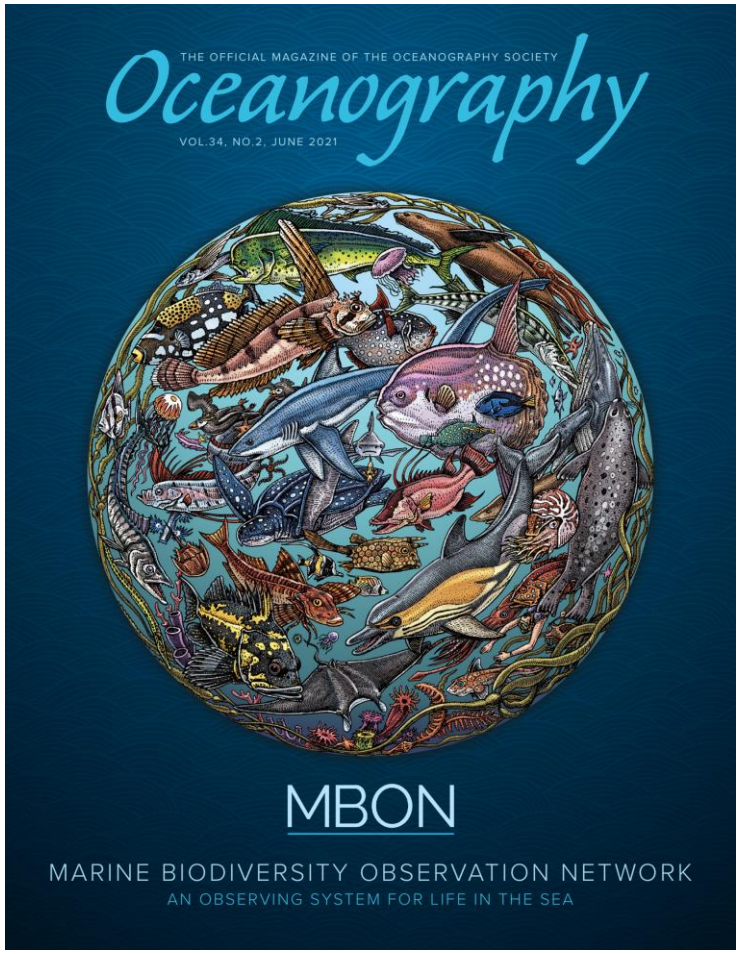
- Ocean acidification, invasive species, harmful algal blooms in the Arctic induced by climate warming can impact ecosystem productivity and function

- Northward migration of commercial fishes has potential to shift ecosystem structure and national and international resource extraction policy decisions

- Opening of new shipping routes in the Arctic have national security implications for the United States coincident with biodiversity and ecosystem services aspects



AMBON – Acknowledgements



Thank you for your attention.

Questions and comments welcome.

MBON
Marine Biodiversity Observation Network

NOAA · IOOS Integrated Ocean Observing System · BOEM Bureau of Ocean Energy Management · NSF · NASA · Office of Naval Research ONR Science & Technology · NOPP