

USA Country Report: Update on 2020 Cruise Plans

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Pacific Arctic Group Meeting

Virtual ASSW 2020 Zoom Meeting

March 30, 2020-0000 UTC

Example input from:

DBO: Distributed Biological Observatory (Jackie Grebmeier, UMCES)

CEO: Chukchi Environmental Observatory (Seth Danielson, UAF)

EcoFOCI: Ecosystems & Fisheries Oceanography Coordinated Investigations

Bering Strait moorings (Rebecca Woodgate, UW)

NOAA activities: Cruises, Saildrones, Gliders (Jessica Cross, NOAA)

NPRB Arctic program: current and future planning (Danielle Dickson, NPRB)

Plus many more...

2020 PAG and DBO Cruise Plan Table-Feb 3, 2020

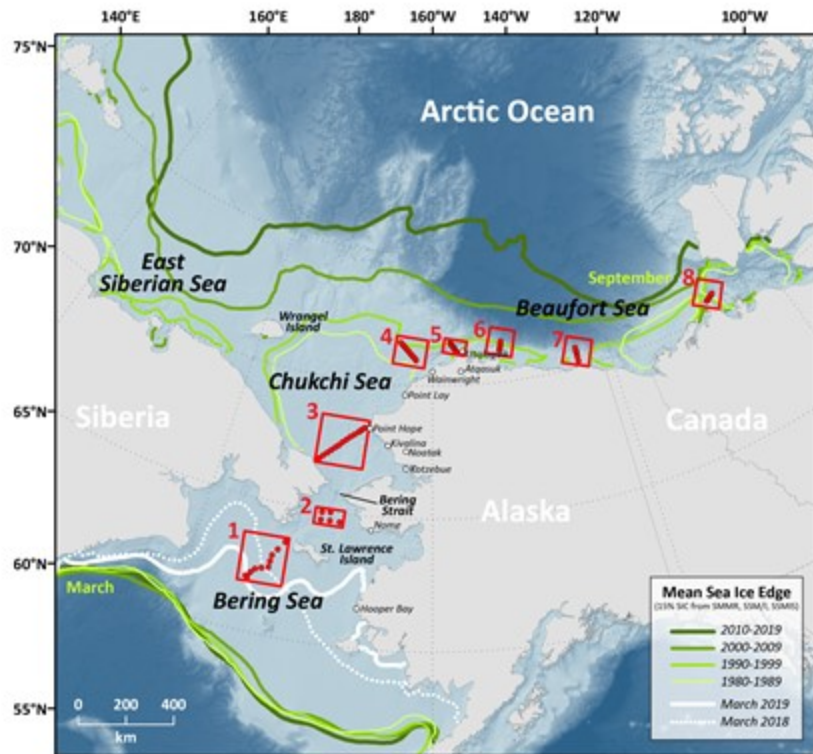
2020 PAG and DBO Field Season (version 2_3_20): Sampling Contributors. Projects Key: AON=US Arctic Observing Network (National Science Foundation); ArCS=Arctic Challenge for Sustainability; ArcticEIS2=Arctic Ecosystem Integrated Survey, C30=Canada's Three Oceans; CHINARE=Chinese Arctic Research Expedition; DBO=Distributed Biological Observatory; EcoFOCI= JAMSTEC= Japan Agency for Marine-Earth Science and Technology; JOIS=KOPRI = Korea Polar Research Institute; MOSAIC= Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAIC);NCIS=Northern Chukchi Integrated Study; NIPR = National Institute of Polar Research; NOAA=National Oceanic and Atmospheric Administration; Office of Naval Research (ONR) Marginal Ice Zone (MIZ) project; PMEL=Pacific Marine Environmental Laboratory. **DBO Region Key:** DBO1=So. St. Lawrence Is., DBO2=Chirikov Basin, DBO3=So Chukchi Sea, DBO4=NE Chukchi Sea, DBO5=Barrow Canyon, DBO6=East Beaufort Sea, DBO7=Beaufort Sea Central, DBO8=Bathurst polynya region.

Dates 2019 (Port calls)	Ship	DBO Region	Projects	PAG contact	Chief Scientist
July 1-24 (Victoria, BC-Utqiagvik)	Sir Wilfrid Laurier	1,2,3,4,5	C30/DBO (AON)	Jackie Grebmeier jgrebmei@umces.edu	John Nelson John.Nelson@dfo-mpo.gc.ca
June-Sept (Shanghai-Shanghai)	Xuelong	-	CHINARE/MOSAIC	Jianfeng He hejianfeng@pric.org.cn	Jianfeng He hejianfeng@pric.org.cn
July 25-August 23 (Dutch Harbor-Utqiagvik)	Araon	3	K-AOOS (Korea-Arctic Ocean Observing System)	Sung-Ho Kang shkang@kopri.re.kr	Eun Jin Yang ejyang@kopri.re.kr
July 23-Aug 17 (Nome-Nome)	Healy	1,2,3,5,6	Harmful Algae Bloom Study	Robert Pickart rpickart@whoi.edu	Robert Pickart rpickart@whoi.edu
Aug 5-28 (Nome-Nome)	Fairweather	1,2,3,4,5	EcoFOCI/DBO-NCIS	Jackie Grebmeier jgrebmei@umces.edu and Phyllis.stabeno@noaa.gov	Jackie Grebmeier jgrebmei@umces.edu
Sept 7-Oct 12 (Nome-Dutch Harbor)	Mirai	3 and 5	Japanese Atmospheric cruise; National Institute of Polar Research (NIPR)	Takashi Kikuchi takashik@jamstec.go.jp	Dr. Kazutoshi Sato stakashik@jamstec.go.jp
Sept (Nome-Nome)	Norseman II	3	Bering Strait Mooring Project/AON	Rebecca Woodgate woodgate@apl.washington.edu	Rebecca Woodgate woodgate@apl.washington.edu
Sept-TBD (Dutch Harbor-Kodiak)	Dyson	1 and M8 mooring	EcoFOCI	Phyllis Stabeno, Phyllis.stabeno@noaa.gov	Geoff Lebon geoffrey.t.lebon@noaa.gov
Sept -Oct	Louis S. St-Laurent	-	JOIS/AON-BGOS	Bill.Williams@dfo-mpo.gc.ca	Bill.Williams@dfo-mpo.gc.ca
Sept-Nov	Healy	-	Glider Program	Craig Lee < craiglee@uw.edu >	Craig Lee < craiglee@uw.edu >
Oct	Sir Wilfrid Laurier	-	C30	Bill.Williams@dfo-mpo.gc.ca	Humfrey.Melling@dfo-mpo.gc.ca
Oct-Nov	Sikuliaq	6	Beaufort mooring/AON	Robert Pickart rpickart@whoi.edu	Robert Pickart rpickart@whoi.edu

NOAA, NSF, USFWS



The Distributed Biological Observatory (DBO): Linking Physics to Biology



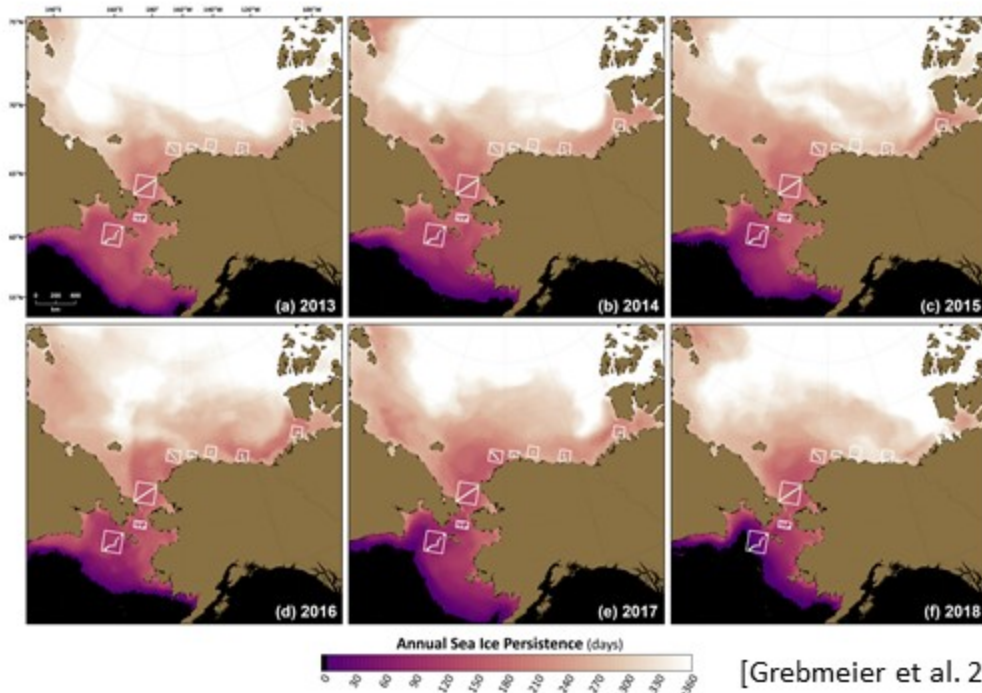
[updated from Grebmeier et al. 2019, DBO DSR Special Issue 162:1-7]

- **Core Ship-based sampling:**
 - CTD and ADCP
 - Chlorophyll, nutrients, carbon products
 - Plankton (size, biomass and composition)
 - Benthos (size, biomass and composition)
 - Seabird and marine mammal surveys
 - Fishery acoustics
 - Bottom trawling (every 3-5 years)
- **Autonomous sensor sampling:**
 - Gliders, moorings, saildrone
 - Satellite observations
- **DBO lines also embedded in process cruises**

- DBO sites (red boxes) are regional “hotspot” transect lines and stations, based on high productivity, biodiversity, and/or overall rates of change
- DBO serves as a change detection array for consistent monitoring of biophysical responses
- Sites occupied by national and international entities with shared data plan

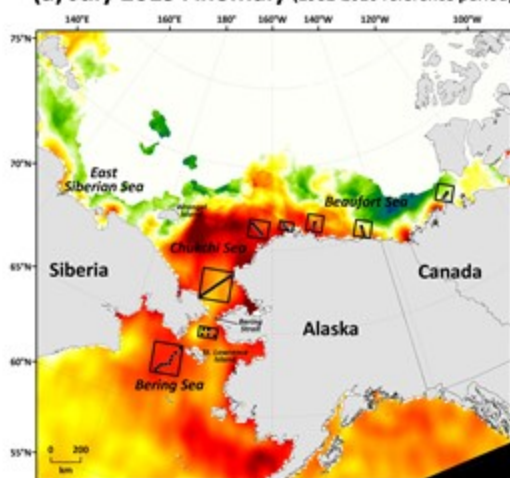


Annual sea ice persistence and sea surface temperature anomalies

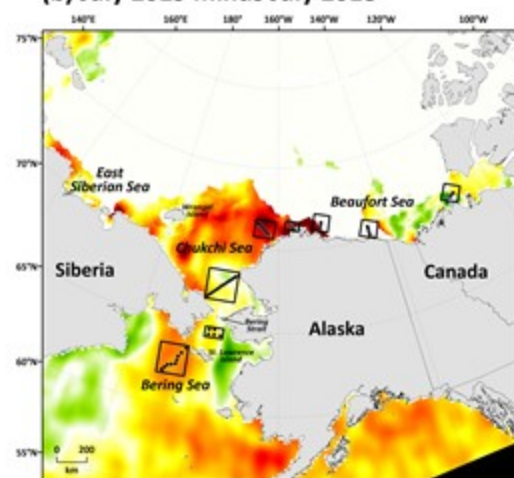


- Annual sea ice persistence (# of days/year of sea ice presence) across the DBO1–8 regions in the Pacific Arctic from 2013–2018
 - Decreasing sea ice cover over time
 - Lowest level sea ice persistence in northern Bering Sea

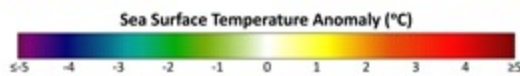
(a) July 2019 Anomaly (1982-2010 reference period)



(b) July 2019 minus July 2018



- **Sea Surface Temperature Anomalies July 2018-2019**
 - $>5^{\circ}\text{C}$ in Bering and Chukchi Sea surface waters
 - Difference 2019-2018 highlights the warm water in DBO1 and DBO4-5



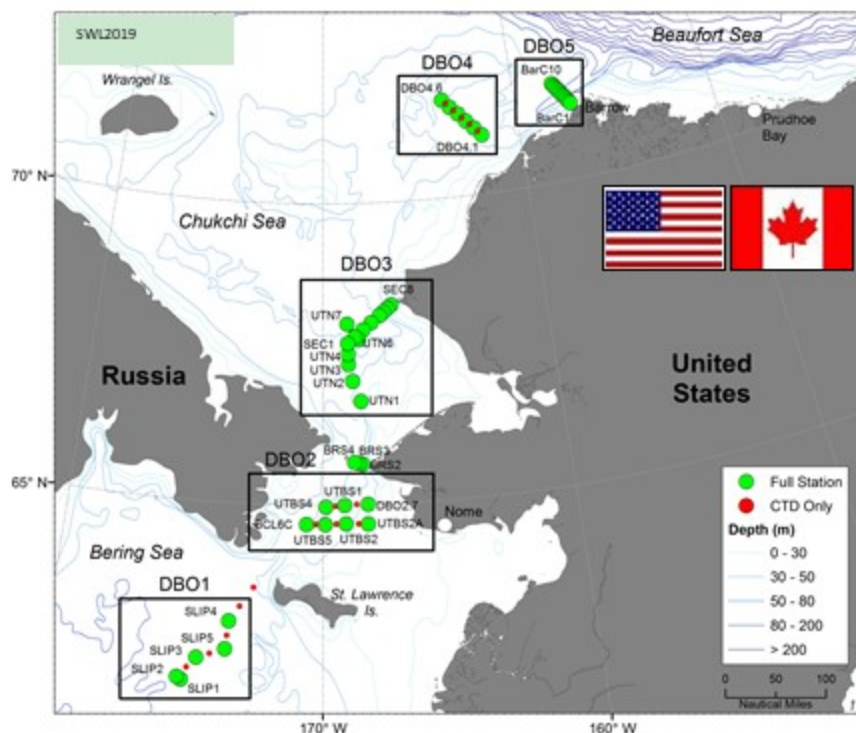
[courtesy Karen Frey, Clark University]



Canada's Three Oceans (C3O) and the DBO: *CCGS Sir Wilfrid Laurier*, July 4-24, 2020; Victoria, BC to Utqiagvik, Alaska



Focus: sampling along latitudinal transect lines developed as a “change detection array” for consistent monitoring of biophysical responses to changing environmental conditions



Date	Location	DBO Line	Distance from Shore (nm)
16-Jul	SW St Lawrence Island	1	60 (CTD only 20)
17-Jul	Chirikov Basin	2	60
19-Jul	SE Chukchi Sea	3	5
20-Jul	NE Chukchi Sea	4	60
23-Jul	W of Utqiagvik	5	5

Contacts: John Nelson
John.Nelson@dfo-mpo.gc.ca and
 Jackie Grebmeier
jgrebmei@umces.edu

DBO data collections

- Seawater temperature and salinity; velocity measurements
- Nutrients, chlorophyll, carbon products, CDOM
- Phytoplankton, zooplankton and macrobenthic abundance, biomass, community structure
- Marine mammal and seabird surveys



DBO Transects: CCGS Sir Wilfrid Laurier (July 11-July 23, 2019)

CTD/Rosette



Bongo nets



Incubation experiments



Laboratory filtrations



Science:

- CTD stations, most with Rosette sampling (chlorophyll, nutrients, phytoplankton)
- Bongo net hauls for zooplankton
- deployments of 150 kHz ADCP
- Benthic sampling stations with up to 5 vanVeen grabs at each station\
- Benthic Video-camera recordings
- stations where water was collected for methane and nitrous oxide analysis
- stations sampled for apparent optical properties
- Subset of stations were used for primary productivity incubation experiments
- Seabird and Marine Mammal observations
- Meteorological and position data from ship sensors

Over the side
150kHz ADCP



C-OPS



vanVeen grabs



Bird observations



Fisheries and Oceans
Canada
Pêches et Océans
Canada



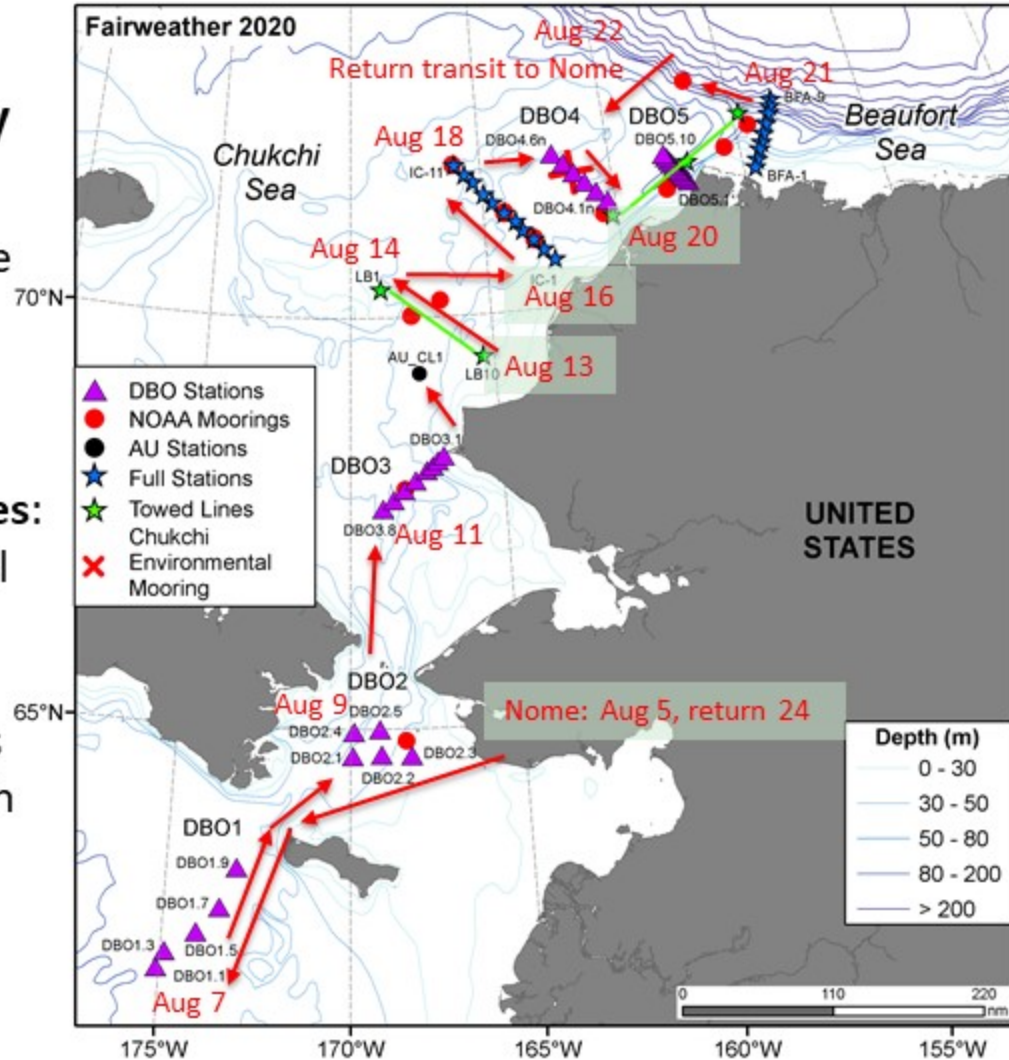
2020 EcoFOCI/DBO-NCIS Cruise

August 5-24, 2020; Nome-to-Nome; RV NOAA Ship Fairweather

Goal: evaluate ecosystem status and change at time series (stations and moorings); turnaround ~20 NOAA moorings & Chukchi Environmental Observatory mooring

Standard measurements and process studies:

- Physical: CTD and ADCP, mooring retrieval and replacement (NOAA and UAF)
- Chemical: nutrients, oxygen-18
- Chlorophyll-a (chl-a), carbon components
- Water column: zooplankton and larval fish abundance and biomass
- Benthos: macrobenthos abundance, biomass and population structure
- Epibenthic trawls: fish and invertebrates
- Sediment: organic carbon/nitrogen content, chl-a content, grain size, harmful algal blooms
- Benthic oxygen uptake and nutrient exchange
- Seabird surveys



Contact: Chief Scientist: Jackie Grebmeier/UMCES:
jgrebmei@umces.edu; DBO-NCIS = Distributed Biological Observatory (DBO) –Northern Chukchi Integrated Study (NCIS)



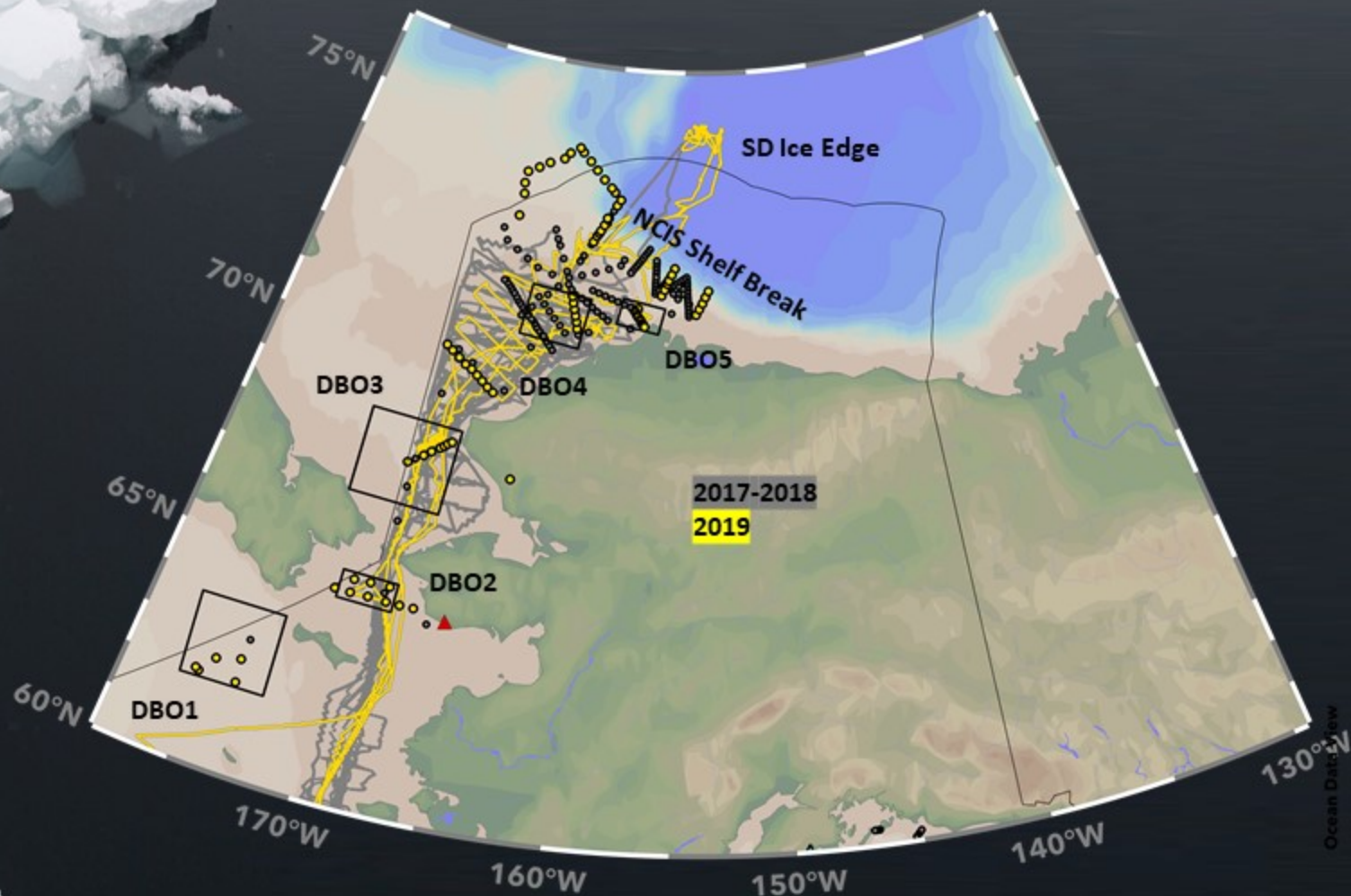
EcoFOCI

Ecosystems & Fisheries-Oceanography Coordinated Investigations

Contact: Phyllis Stabeno/NOAA:
phyllis.stabeno@noaa.gov

ARCTIC DBO-NCIS

[Jessica Cross, PMEL/NOAA]

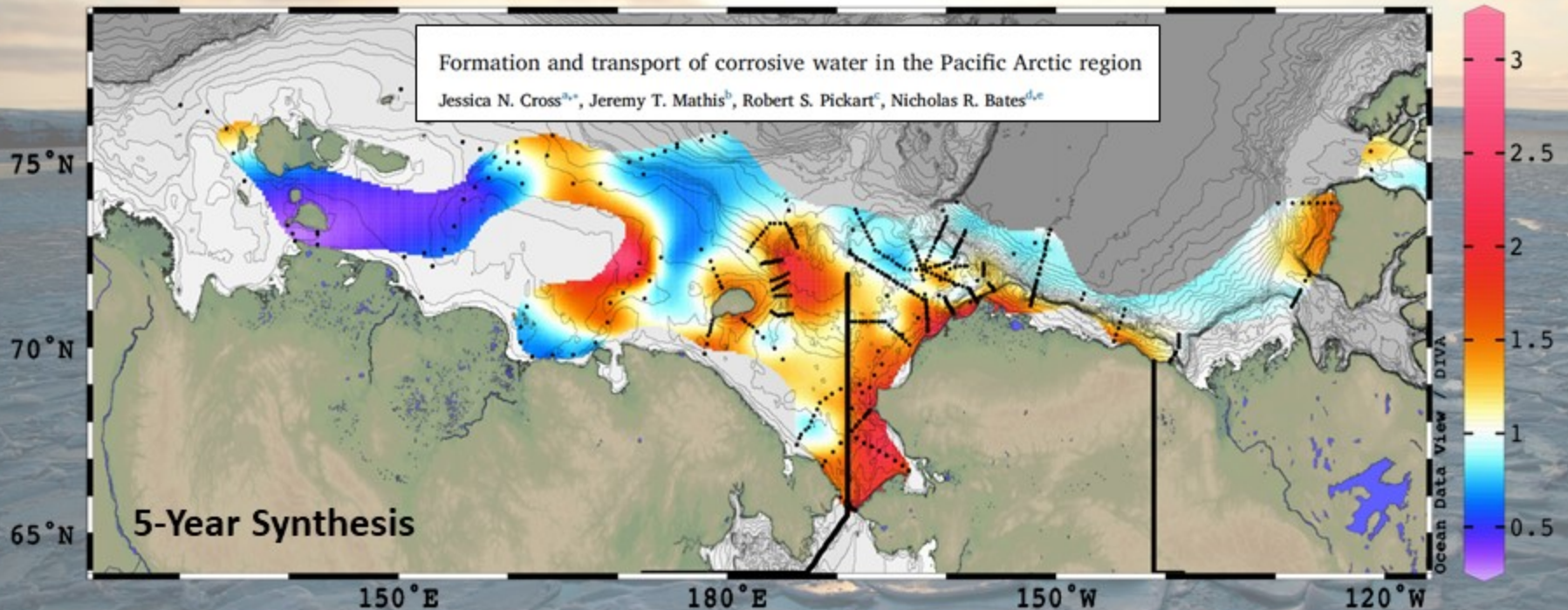


ARCTIC
PROGRAM

ITAE
Innovative Technology for Arctic Exploration



OA in the Pacific Arctic Sub-Surface



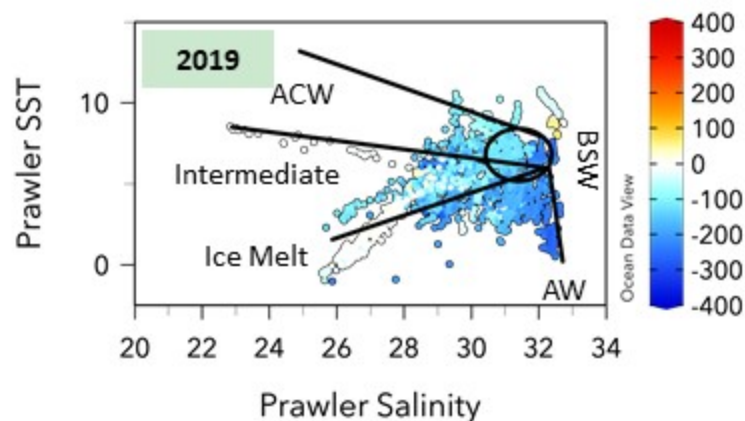
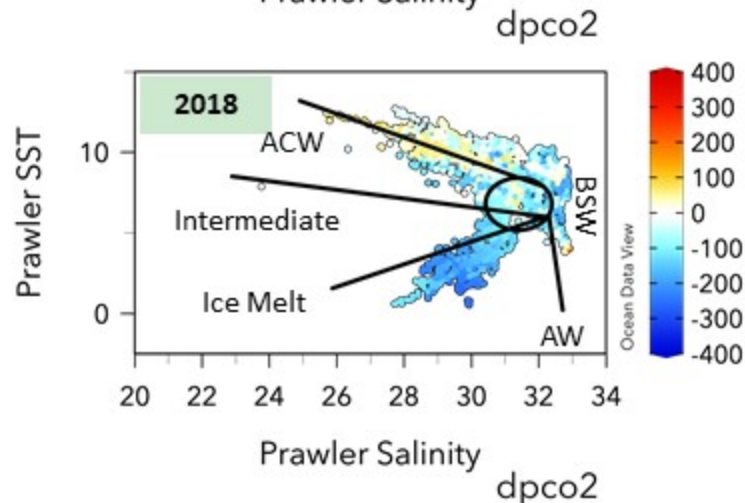
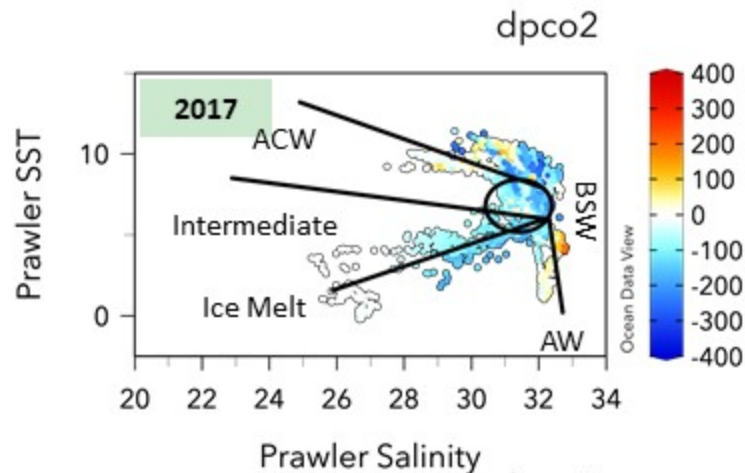
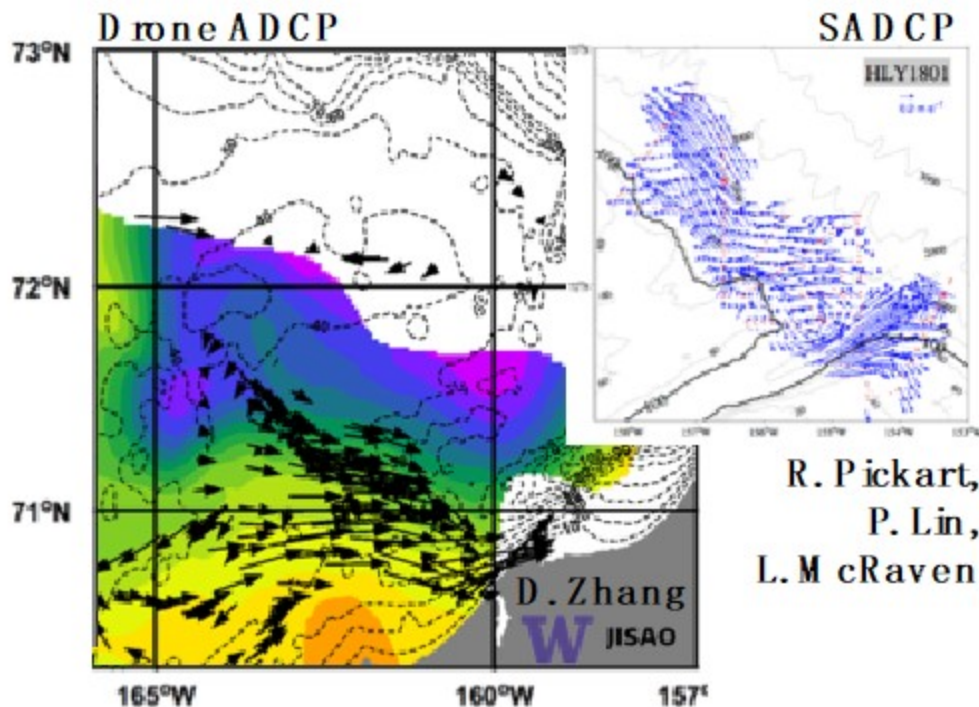
*We don't know much about Arctic ecosystem-level OA impacts, but we do know **exposure is increasing.***

Corrosive conditions emerged 1975-1985

ARCTIC SAILDRONE SURVEYS

OVERALL:

- 2018 was warmer than 2017
- Sampled much colder waters in 2019
 - Targeted ice edge
 - Sensors off for return transit
- Now including ADCP!



Examples of environmental stressors occurring in the Pacific Arctic

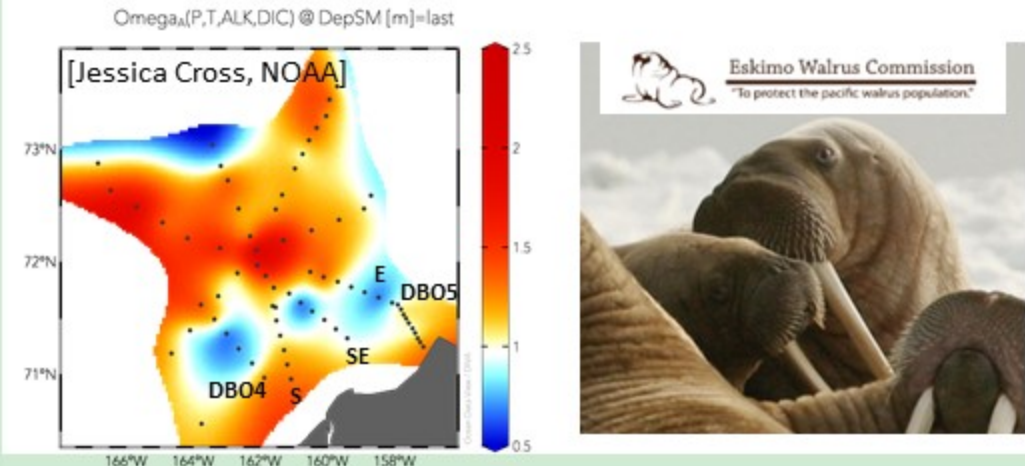
- Ocean acidification could impact ecosystem services in the Arctic region



[2017, DSR 133:112-124]

Implications of ocean acidification in the Pacific Arctic: Experimental responses of three Arctic bivalves to decreased pH and food availability

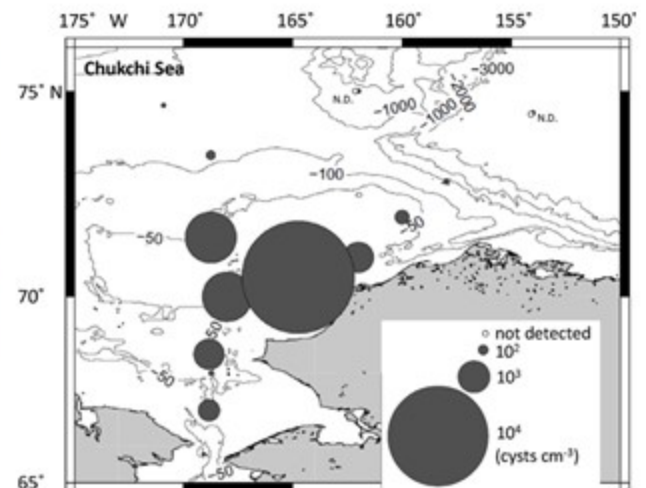
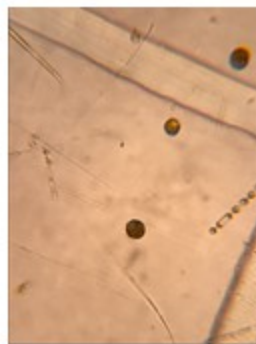
Christina L. Goethel, Jacqueline M. Grebmeier, Lee W. Cooper, Thomas J. Miller



- Corrosive waters (blue) prevalent on SE side of Hanna Shoal, area of focused carbon deposition and high bivalve biomass; food security issue

Harmful Algal Blooms (HABs) are increasing in Pacific Arctic with declining sea ice, more sunlight and warmer seas

- Blooms of *Alexandrium* sp. that are dinoflagellates that cause paralytic shellfish poisoning.
- Don Anderson (WHOI) has found overwintering cysts in the mud and hotspot of seasonal blooms (DBO-NCIS cruises 2018-2019)



(Anderson et al. 2018, figure modified from Natsuike et al. (2013))

HAB 2020 Healy cruise

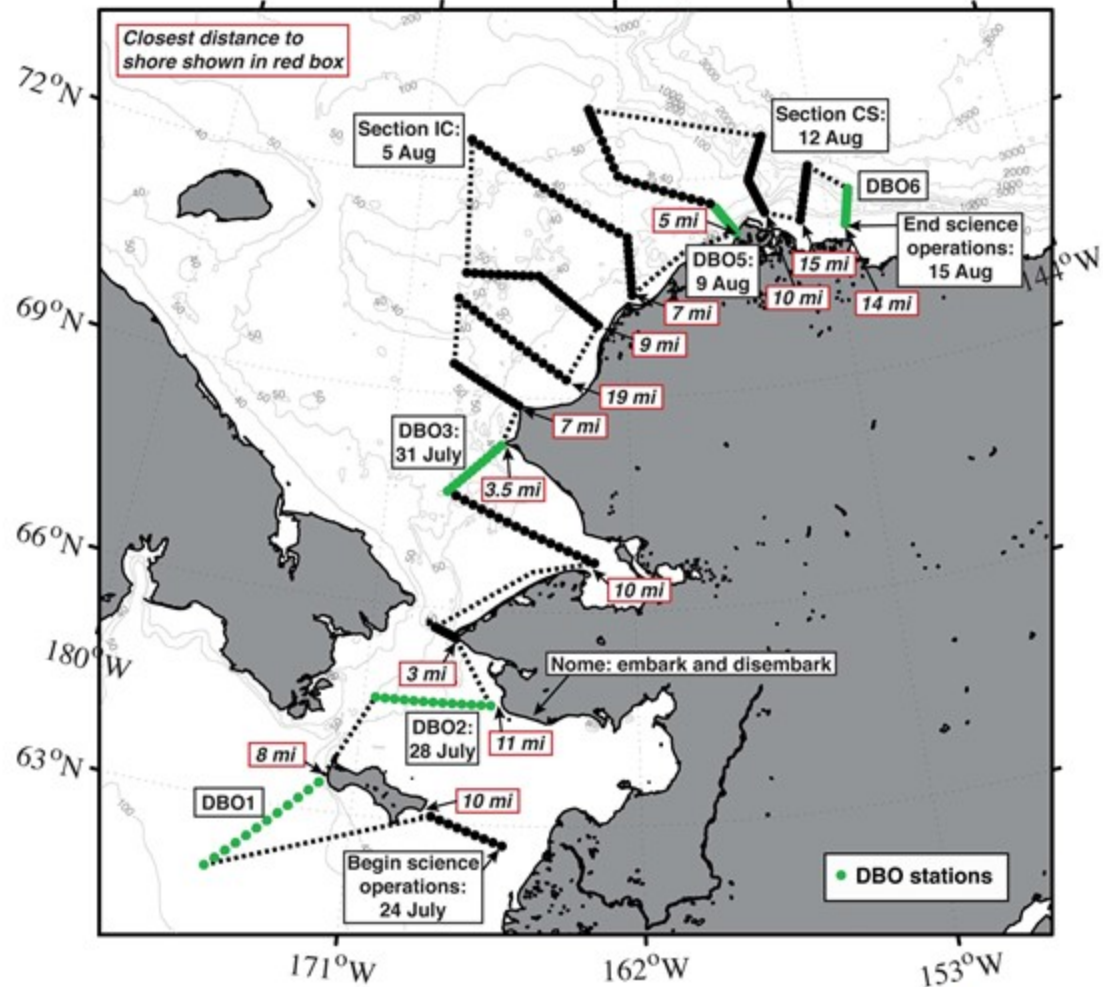
Chief Scientist: Robert Pickart/
WHOI; co-PI, Donald
Anderson/WHOI

July 23 – August 17, 2020

Dutch-Dutch

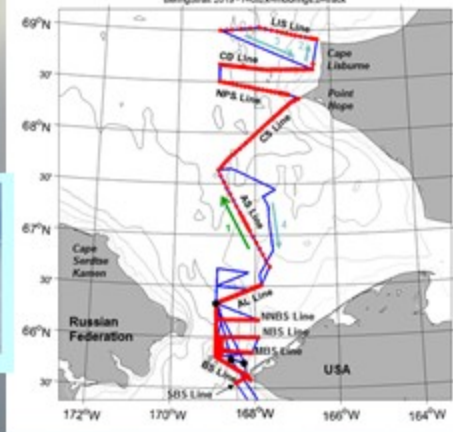
- Repeat *Alexandrium* and *Pseudo-nitzschia* sampling during HLY1901 (August 2019)
- Compare of 2018 and 2019 cyst and cell distributions
- Comprehensive toxin and microsatellite analysis of Chukchi, Beaufort and Bering Sea *Alexandrium* cultures – determine origin and connectivity of HAB populations
- NSF-funded HAB cruise planned for 2020

USCGC Healy cruise 2001
23 July - 17 August, 2020
Draft as of October 27, 2019

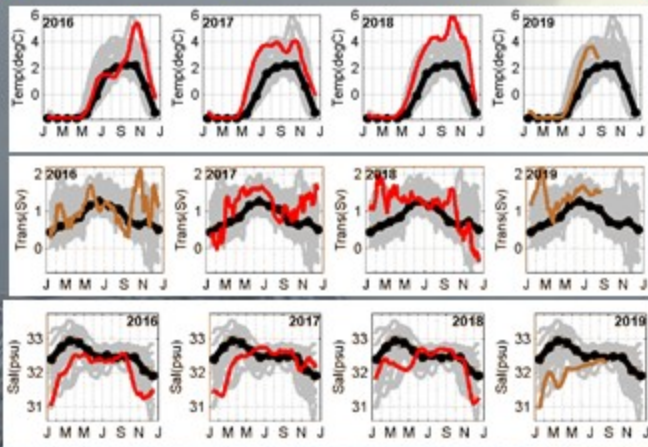


Bering Strait Moorings: Trends and September 2020

Field Plan [Chief Scientist: Rebecca Woodgate, University of Washington, Seattle]



Change in recent years



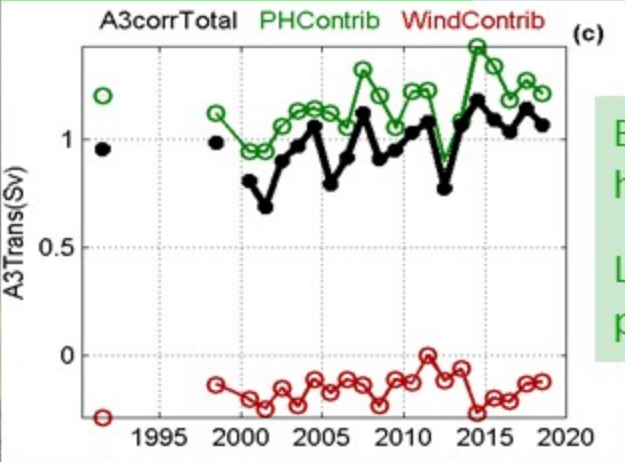
Earlier warming, later cooling, longer open water season.

Significant trends in
 - temperature (warming)
 - transport (increasing)
 - salinity (freshening)
Almost doubling heat and freshwater fluxes

No Trend in the Alaskan Coastal Current

psc.apl.washington.edu/BeringStrait.html

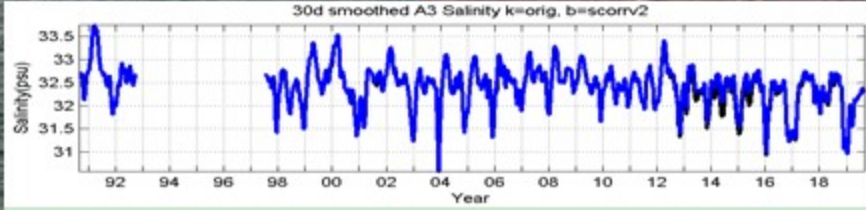
Transport increase



Both wind and pressure head changes important.

Long term trend only in pressure head, not wind

Winter freshening

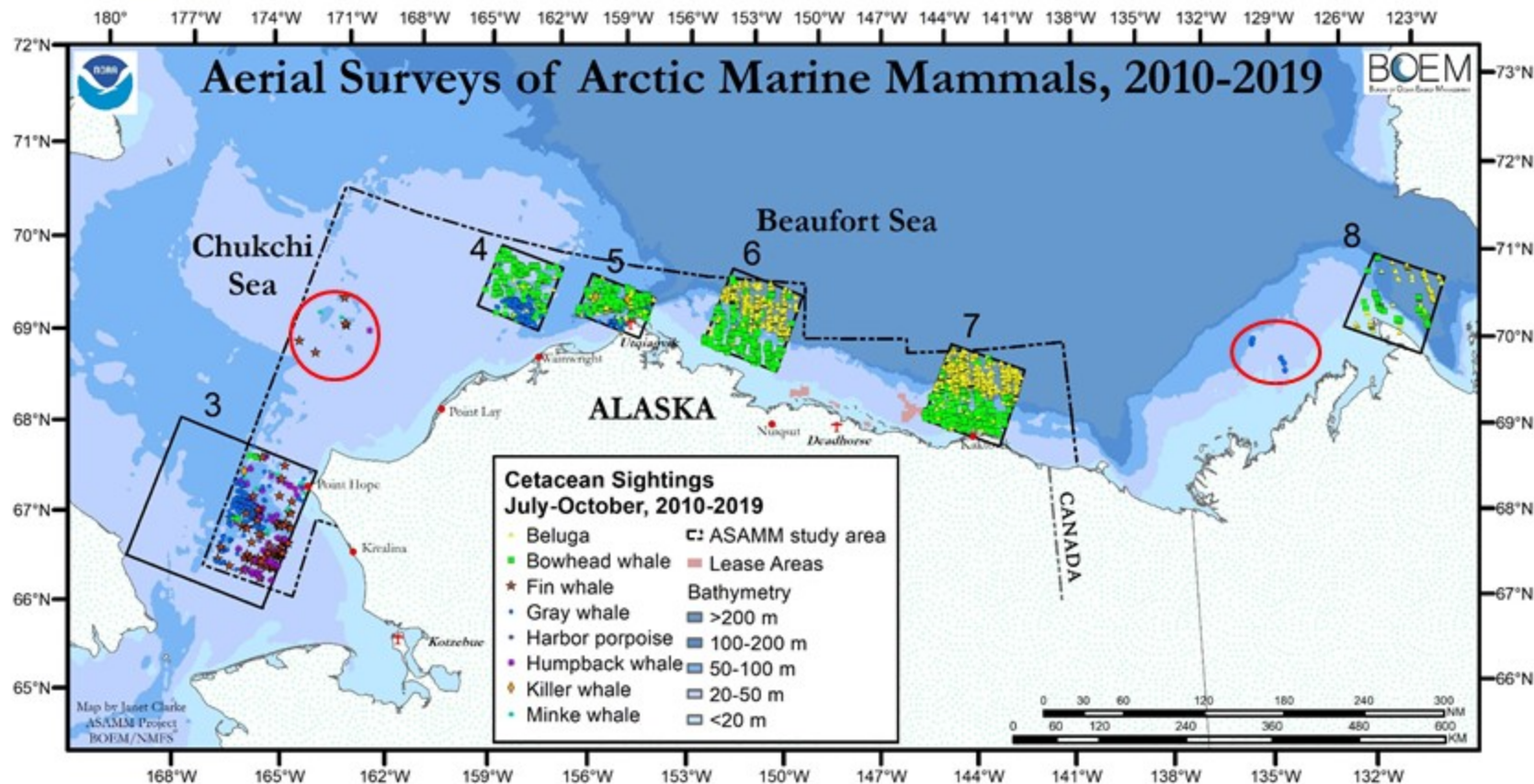


Pacific Winter Waters less dense than in 1990s

~ 50-100m shallower?
 - not ventilating cold halocline?



ASAMM July-October 2010-2019 Cetacean Sightings DBO 3, 4, 5, 6, 7, and 8



DBO-3 – gray whale hot spot, subarctic cetaceans
DBO-4 and DBO-5 – bowhead whales, gray whales, belugas
DBO-6, DBO-7, and DBO-8 – bowhead whales, belugas

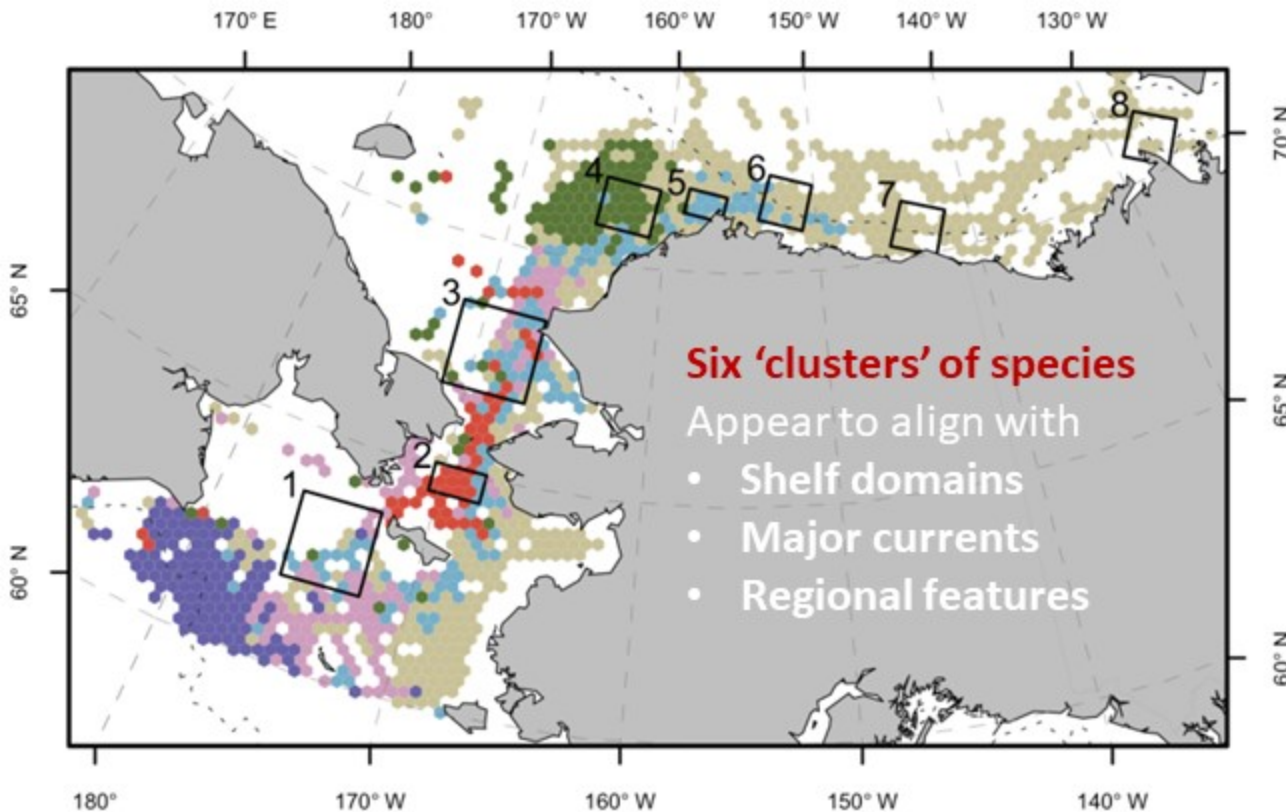
**Special appearance by subarctics near Herald Shoal
and gray whales in the eastern Beaufort Sea**

[courtesy Janet Clark,
Jan 2020 5th DBO data
meeting]

Seabird Communities in Pacific Arctic

Cluster Analysis, using at-sea survey data, 2007-2015

(Kuletz et al. 2019; DSR11)



At-sea surveys (USFWS)

- Identified six major communities
- Five had a dominant species
- One characterized by very low seabird densities (no dominant)
- Most captured well by DBOs (exception – Fulmar community)
- Need all DBOs to capture full seabird community for LMEs
- Beaufort effort too low to fully track low seabird densities offshore

Fulmars

Shearwater

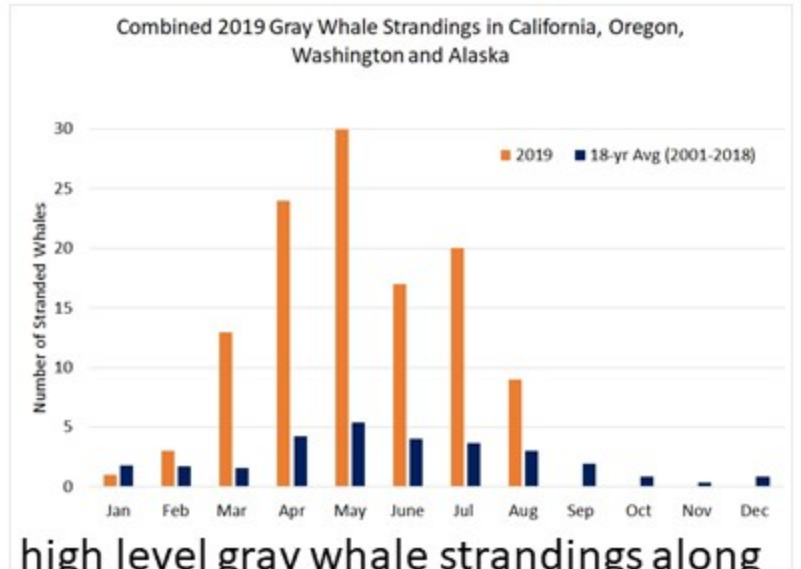
Thick-billed murre

Least Auklets

Crested auklets

Low densities

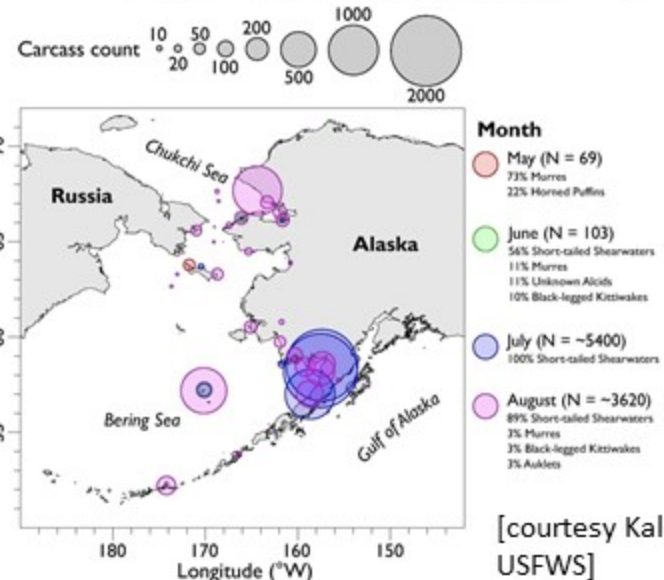
2019 Gray Whale Die-Offs along Pacific Coast- Mexico to Alaska



- high level gray whale strandings along west coast from Mexico to Alaska; NOAA declared it as an Unusual Mortality Event (UME)

NOAA Declares Unusual Mortality Event for Ice Seals)

UME for Seabirds 2019

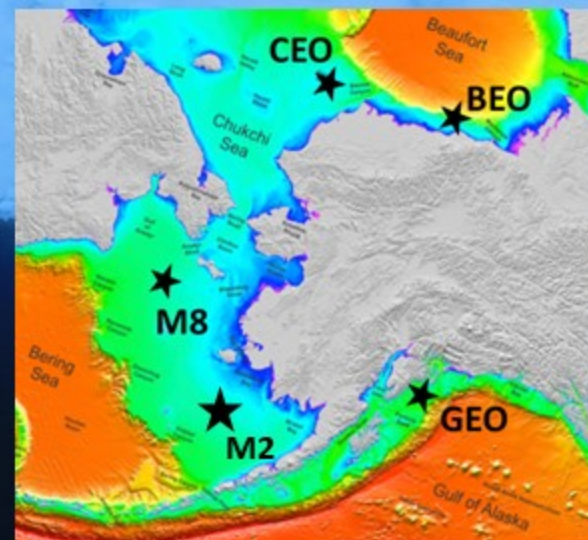


- NOAA declares UME for bearded, ringed, and spotted seals in the Bering and Chukchi seas in September 2019
- The increase in ice seal mortality is nearly 5 times the average number



Alaska Region Moored Ecosystem Observatories

- For improved mechanistic understanding of the marine ecosystem.
- Fostering coordination and cooperation among research programs.
- Enhancing information availability with scientific data, analyses, and products



Vision: A network of moored observatories that monitor Alaska's continental shelves with year-round, high-resolution, multi-disciplinary measurements.

Moored Ecosystem Observatories

2020 Updates

- New NPRB support for CEO Phase II for operations over 2020 to 2024
- New AMBON support: passive acoustics & discrete water sampler: 2020-2022
- New GEO (Gulf of Alaska) observatory deployed 2019
- 2020/2021: Instrumentation upgrades coming to NOAA moorings M2 and M8
- August 2019 turn-around from R/V Ocean Starr (NOAA IES/AIERP)
- November 2019 CTD cast from R/V Sikuliaq (Thomson/Mueter)



Recent CEO publication:

Lalande, C., Grebmeier, J.M., Hopcroft, R.R., Danielson, S.L., 2020. Annual cycle of export fluxes of biogenic matter near Hanna Shoal in the northeast Chukchi Sea. *Deep Sea Research Part II: Topical Studies in Oceanography*, p.104730.



1: Synthesize existing data
from Arctic Integrated Ecosystem Research Program (IERP)
(www.nprb.org/arctic-program)

Fall 2021: RFP to synthesize data collected 2017-2019
during Arctic IERP studies in the northern Bering and Chukchi Seas
Encourage co-produced proposals

Oceanography – Fisheries/Marine Birds and Mammals – Communities
All three categories broadly understood

Contact: Danielle Dickson, Senior Program Manager/Chief Officer for Collaboration and Synthesis Danielle.Dickson@nprb.org



**2: Prepare for NEW Integrated Ecosystem Research Program (IERP)
centered in the Northern Bering Sea**

2026 First Field Year for NBS-centered IERP:

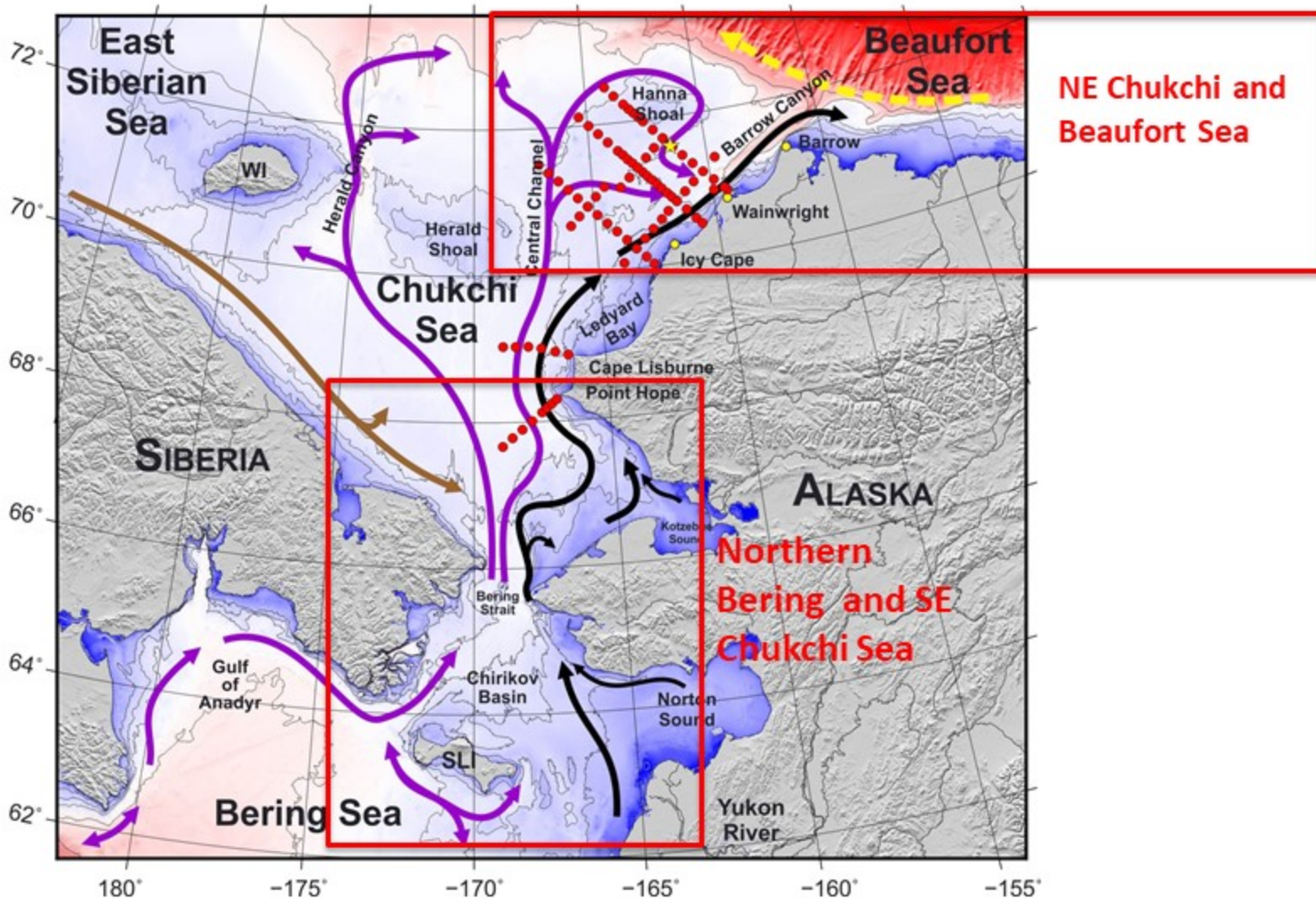
How shifts in environmental conditions & processes may influence species of

- commercial,
 - ecological and
 - subsistence importance,
- Implications for
- state and federal fisheries management and
 - communities that depend on these resources.
 - Encourage co-produced proposals
-

Contact: Danielle Dickson, Senior Program Manager/Chief Officer for Collaboration and Synthesis Danielle.Dickson@nprb.org; +1-907-644-6716

Science access during subsistence whaling: April-May and Sept-Oct periods

-need to interface with coastal communities through new Arctic Waterways Safety Committee to interface with Alaska Eskimo Whaling Commission, Eskimo Walrus Commission, and other parties; see <http://www.arcticwaterways.org/>



[modified from S. Danielsen map 2015]

Thank you for your attention.

Questions and comments?

Thank you to all Pacific Arctic Region science colleagues and DBO collaborators, field and laboratory technicians over the years for the time series efforts. Financial support for the science provided by the US NOAA, NSF, BOEM, NASA, and ongoing national and international science partners in the Pacific Arctic Group.

<http://arctic.cbl.umces.edu>, <http://www.arctic.noaa.gov/dbo>

<http://pag.arcticportal.org>

<https://arcticdata.io/catalog/portals/DBO>

<http://neptune.gsfc.nasa.gov/csb/index.php?section=270>

<http://ambon-us.org/>, <https://mbon.ioos.us/>

<http://www.ChukchiEcosystemObservatory>

