USA Country Report: Update on 2020 Cruise Plans

Jacqueline M. Grebmeier,
Chesapeake Biological Laboratory
University of Maryland Center for Environmental Science, Solomons, MD, USA

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. 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.

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

**NOAA, NSF, USFWS**
The Distributed Biological Observatory (DBO): Linking Physics to Biology

- **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

- Sea Surface Temperature Anomalies July 2018-2019
  - >5°C in Bering and Chukchi Sea surface waters
  - Difference 2019-2018 highlights the warm water in DBO1 and DBO4-5
Canada’s Three Oceans (C30) and the DBO: *CCGS Sir Wilfrid Laurier*, July 4-24, 2020; Victoria, BC to Utqiaġvik, Alaska

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

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>DBO Line</th>
<th>Distance from Shore (nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-Jul</td>
<td>SW St Lawrence Island</td>
<td>1</td>
<td>60 (CTD only 20)</td>
</tr>
<tr>
<td>17-Jul</td>
<td>Chirikov Basin</td>
<td>2</td>
<td>60</td>
</tr>
<tr>
<td>19-Jul</td>
<td>SE Chukchi Sea</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>20-Jul</td>
<td>NE Chukchi Sea</td>
<td>4</td>
<td>60</td>
</tr>
<tr>
<td>23-Jul</td>
<td>W of Utqiaġvik</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

**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

Contacts: John Nelson [John.Nelson@dfo-mpo.gc.ca](mailto:John.Nelson@dfo-mpo.gc.ca) and Jackie Grebmeier [jgrebmei@umces.edu](mailto:jgrebmei@umces.edu)
DBO Transects: CCGS Sir Wilfrid Laurier (July 11-July 23, 2019)

**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
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: JackieGrebmeier/UMCES: igrebmei@umces.edu; DBO-NCIS = Distributed Biological Observatory (DBO) – Northern Chukchi Integrated Study (NCIS)

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

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
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

Pacific Winter Waters less dense than in 1990s
- ~ 50-100m shallower?
- not ventilating cold halocline?
Aerial Surveys of Arctic Marine Mammals, 2010-2019

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; DSRII)

Six ‘clusters’ of species
Appear to align with
- Shelf domains
- Major currents
- Regional features

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

Dead gray whale in northern California. Photo by M. Flannery, California Academy of Sciences

NOAA Declares Unusual Mortality Event for Ice Seals

- 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

UME for Seabirds 2019

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

[courtesy Kaler & Kuletz, USFWS]
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:
1: **Synthesize existing data** from Arctic Integrated Ecosystem Research Program (IERP) ([www.nprb.org/arctic-program](http://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](mailto: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/
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://pag.arcticportal.org
https://arcticdata.io/catalog/portals/DBO
http://ambon-us.org/, https://mbon.ioos.us/
http://www.ChukchiEcosystemObservatory