An Update on the Distributed Biological Observatory (DBO): A Change Detection Array in the Pacific Arctic

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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

















DBO related Cruises 2022; planned for 2023





Sea ice persistence, break-up, formation and annual primary productivity, DBO 1-5





Macrofaunal biomass and dominant taxa type in the DBO1-5 regions, 2010-2019





DBO3:Time Series Benthic faunal biomass (gC/m2), 2010-2019



- High overall benthic biomass dominated by bivalves resulting from decreasing sea ice duration and increasing productivity
- Spatial increase in bivalves, specifically offshore waters in high silt/clay sediments
- Increase in polychaete biomass across many stations nearshore and offshore
 [Grebmeier et al. in prep.]





Research to Management: Potential impacts of ship strikes on baleen whales with increased shipping



- Abundance crustaceans in sediments showing hotspots
- Change in crustacean populations influence feeding location for gray whales



 Provide information relevant to concerns for increased commercial vessel and baleen whale ship strikes in the Bering Strait region ----International Union for Conservation of Nature Cetacean Specialist Group; <u>https://iucn-</u>

csg.org/baleen-whales-in-the-cross-hairs-potential-forincreased-ship-strike-risk-in-and-near-bering-strait/



Harmful Algal Blooms (HABs) as an environmental stressor

- **HABS** are increasing in Pacific Arctic with declining sea ice, more sunlight and warmer seas
- Blooms of *Alexandrium* sp. are dinoflagellates that can cause paralytic shellfish poisoning, clams highest toxin load



[[]Anderson et al. 2021; Lefebvre et al. 2022]

- Overwintering cysts in the mud and hotspot of seasonal blooms
- Climate-change driven reduction of sea ice and continuing ocean warming increase the risk of large and more frequent toxic blooms, thereby escalating the risks to ecosystem and wildlife health due to potentially increasing toxin levels in food webs.

2nd DBO PLOS Special Issue

- 2nd DBO Special Issue: PLOS ONE, 20 articles, **open access**; complete in 2022
- Topics: sea ice, hydrography, microbial & plankton dynamics, export production, benthic populations . sediments, marine mammals and seabirds
- https://journals.plos.org/



walrus)

2nd DBO PLOS Special Issue (cont.)



beluga whale acoustic detections



Moore et al. 2022 (gray whale phenology and benthic prey distribution)





Frey et al. in revision (satellite-based assessment late season warming, sea ice declings and primary productivity)





Cooper et al. 2022 (change on oxygen isotope concentrations with increasing freshwater flux into Arctic)

US Pacific Arctic DBO Data Access

- Data links NSF projects, including DBO project page: <u>https://arcticdata.io/catalog/portals/DBO</u>
- Data links NOAA
 - Alaska Ocean Observing System (AOOS) AXIOM <u>https://search.dataone.org/data</u>
 - National Centers for Environmental Information (NCEI) <u>https://www.ncdc.noaa.gov/data-access</u>
- Data on North Pacific Pelagic Seabird Database (NPPSD)

https://www.usgs.gov/news/40-years-north-pacific-seabird-survey-data-nowonline

• Data link NASA

https://earth.gsfc.nasa.gov/cryo/data/distributed-biological-observatory

• AMBON Data Portal

https://mbon.ioos.us/#search?type_group=all&tag|tag=ambon-projects&page=1

Developing Atlantic sector DBOs

Davis Strait Region DBO



[courtesy Kumiko Azetsu-Scott/DFO, Canada]



[Arild Sundfjord/NPI, Norway]

 International planning to develop Atlantic DBO; workshop held at ASSW2022
planned as part of EU Arctic PASSION (Pan-Arctic Observing System of Systems: Implementing Observations for Societal Need; building on long-term national and multi-national transects

Planning

- Atlantic DBO workshop, Mar 28, 2022, ASSW22 (*hybrid*)-done
- Update at 6th DBO data workshop in December 2022 (*hybrid*); Anna Nikolopoulus
- Community workshop and science sessions Feb 2023, ASSW23 (hybrid)

Davis Strait Region-Oceanography Craig Lee (DBO workshop talk)

- One of two export gateways of the Arctic Water (both sides of Greenland, Davis Strait and Fram Strait)
- It is an ideal location to observe the propagation of changes from the Arctic to the Northwest Atlantic (integration of narrow channels in CAA)
- To monitor the intrusion of the warm and saline Atlantic water into Baffin Bay influence the stability of glacier terminus



Davis Strait Region - Biology



(NASA Earth Observatory)



Continental shelf-break regions are generally areas of

high primary productivity, lipid rich zooplankton communities which are food source of many *commercial fish, seabirds* and *marine mammals* which are not only indicators of ecosystem health, but important sources of food security and culture for Native Greenlanders and Canadian First Peoples. The region also includes biological hotspots of endemic species such as *deep sea corals, sponges* and *sea pens.*



The sites of significant oceanographic (warming, freshwater input, ice cover, ocean acidification) impacts on ecosystem changes (e.g. Increased killer whale use of northern waters \rightarrow increased predation on Baffin Bay bowhead whales, the first migration of Pacific plankton into Baffin Bay in 800,000 years)

DBO in the Laptev/East Siberian seas of the Arctic Ocean

UAF/NABOS KOPRI UMCES ESS DBO Team meeting

Led by Igor Polyakov and Clara Deal Participants: Kyoung-Ho Cho, Jackie Grebmeier, Jinyoung Jung, JeeHoon Kim, Hyoung Sul La, Laura Whitmore, and Eun-Jin Yang

November 28, 2022

Planning for ESS DBO: Clara Deal and Igor Polyakov-DBO workshop presentation



KOPRI ARAON cruises 2016-2020





- Seasonal and annual DBO time series sampling are helping to identify and track environmental and ecosystem changes with climate warming
- Developing pan-Arctic DBOs via Atlantic DBO, Davis Strait/Baffin Bay DBO, and East Siberian Sea DBO

Thank you for your attention and glad to take questions.

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https://dbo.cbl.umces.edu/; https://arcticdata.io/catalog/portals/DBO/Data











