

Distributed Biological Observatory (DBO)

Linking Physics & Biology in the Arctic

The Distributed Biological Observatory (DBO): A Change Detection Array in the Pacific Arctic Region

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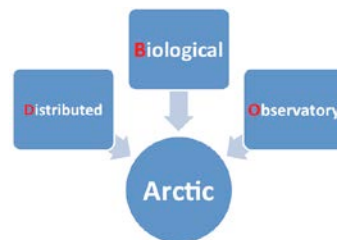
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DBO Data Meeting

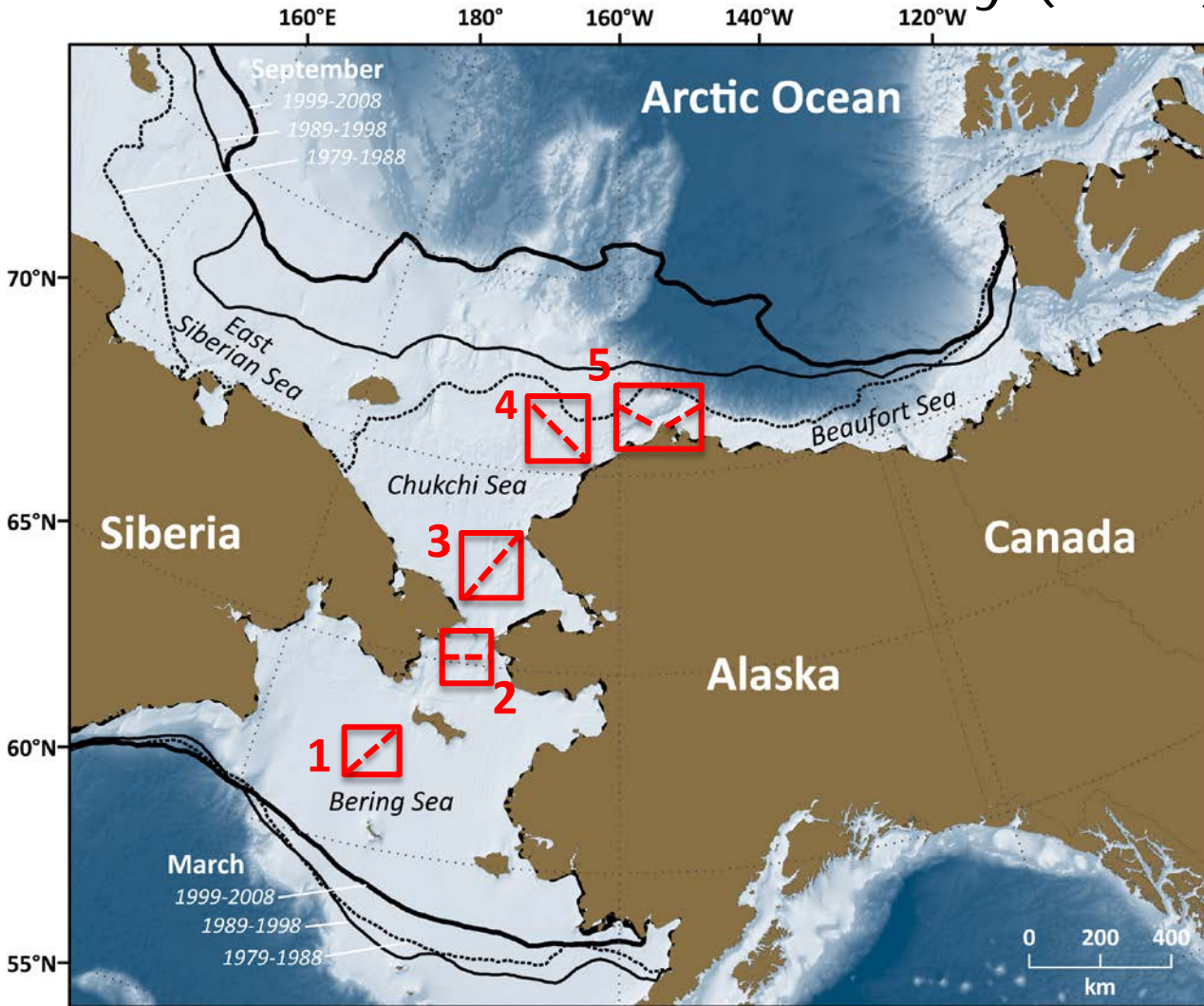
February 27–March 1, 2013

NOAA/PMEL, 7600 Sand Point Way NE, Bldg. 3

Seattle, Washington, USA



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



[modified by Karen Frey from Grebmeier et al. 2010, EOS 91]

- DBO sites (red boxes) are regional “hotspot” transect lines and stations located along a latitudinal gradient
- DBO sites are considered to exhibit high productivity, biodiversity, and overall rates of change
- DBO sites will serve as a change detection array for the identification and consistent monitoring of biophysical responses
- Sites occupied by national and international entities with shared data plan



Distributed Biological Observatory: Linking Physics to Biology

Core standardized ship-based sampling:

- CTD
- Chlorophyll
- Nutrients
- Ice algae/Phytoplankton (size, biomass and composition)
- Zooplankton (size, biomass and composition)
- Benthos (size, biomass and composition)
- Seabird (standard transects, no additional shiptime)
- Marine mammal observations (no additional ship time)

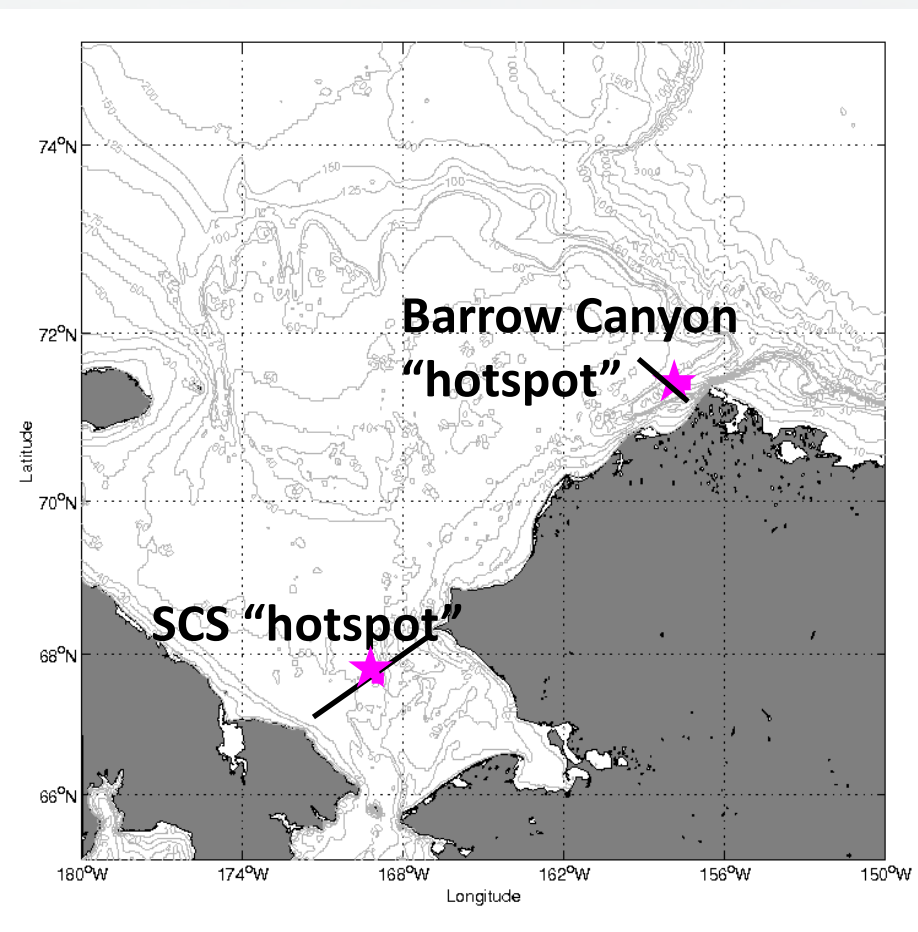
“Change detection array” – same measurements every year, process information in near real time <6 mos; detect regime shifts in rapid changes

Second tier ship-based sampling:

- Fishery acoustics (less effort than standardized bottom trawling)
- Bottom trawling (every 3-5 years)

DBO occupations by national and international science programs

DBO 2010-2012 “Pilot Program”

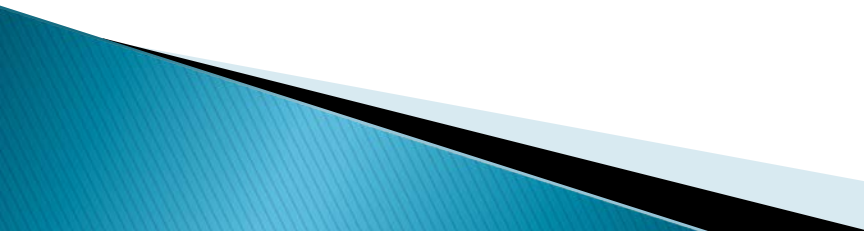


Vessel	Country	PI
<i>Moana Wave, Healy</i>	USA	Grebmeier
<i>Healy</i>	USA	Arrigo
<i>Xuelong</i>	China	He
<i>Mirai</i>	Japan	Itoh (2010) Kikuchi (2012)
<i>Laurier</i>	Canada	Vagle
<i>Araon</i>	Korea	Chung
<i>Khromov</i>	Russia and USA	Woodgate
<i>Alaskan Enterprise</i>	USA	Napp
<i>Annika Marie</i>	USA	Ashjian
<i>Healy</i>	USA	Pickart
<i>Westward Wind</i>	USA	Day

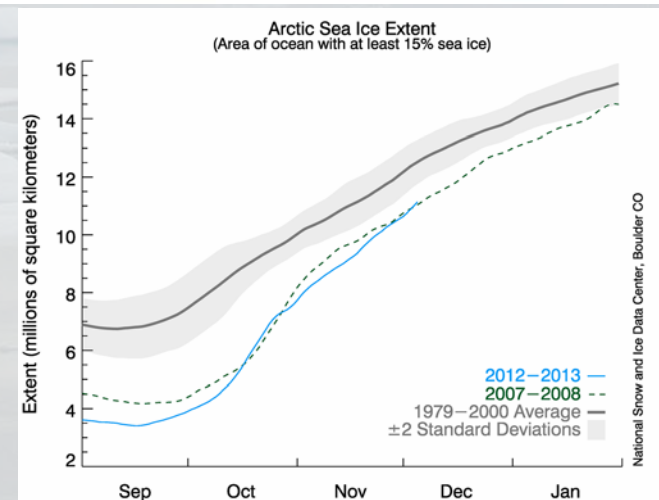
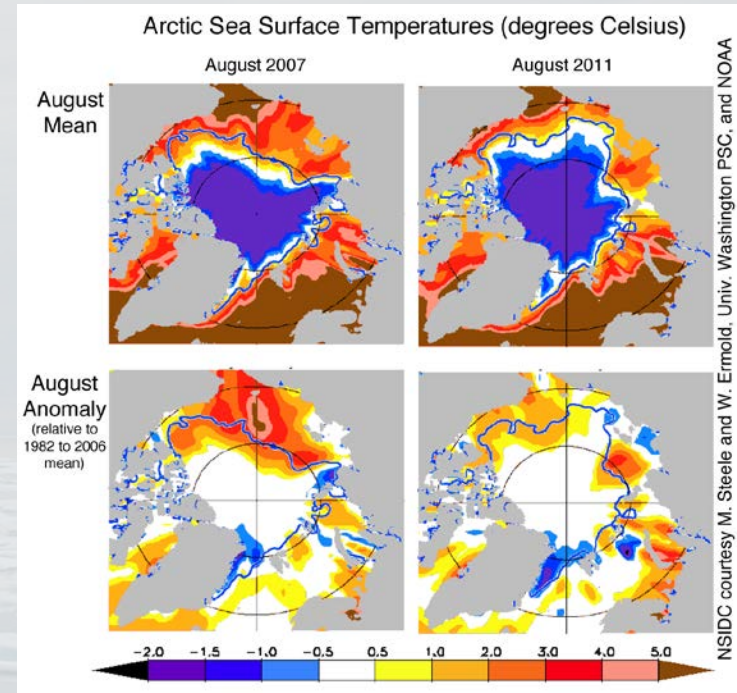
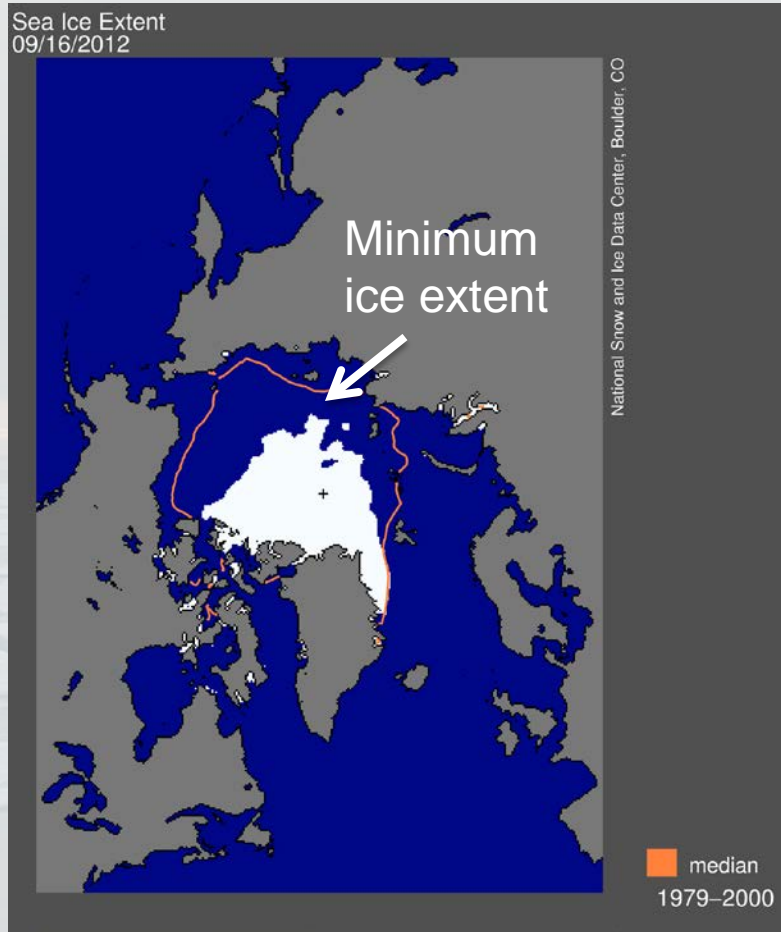
<http://www.arctic.noaa.gov/dbo/>

<http://pag.arcticportal.org>

Rationale of the DBO

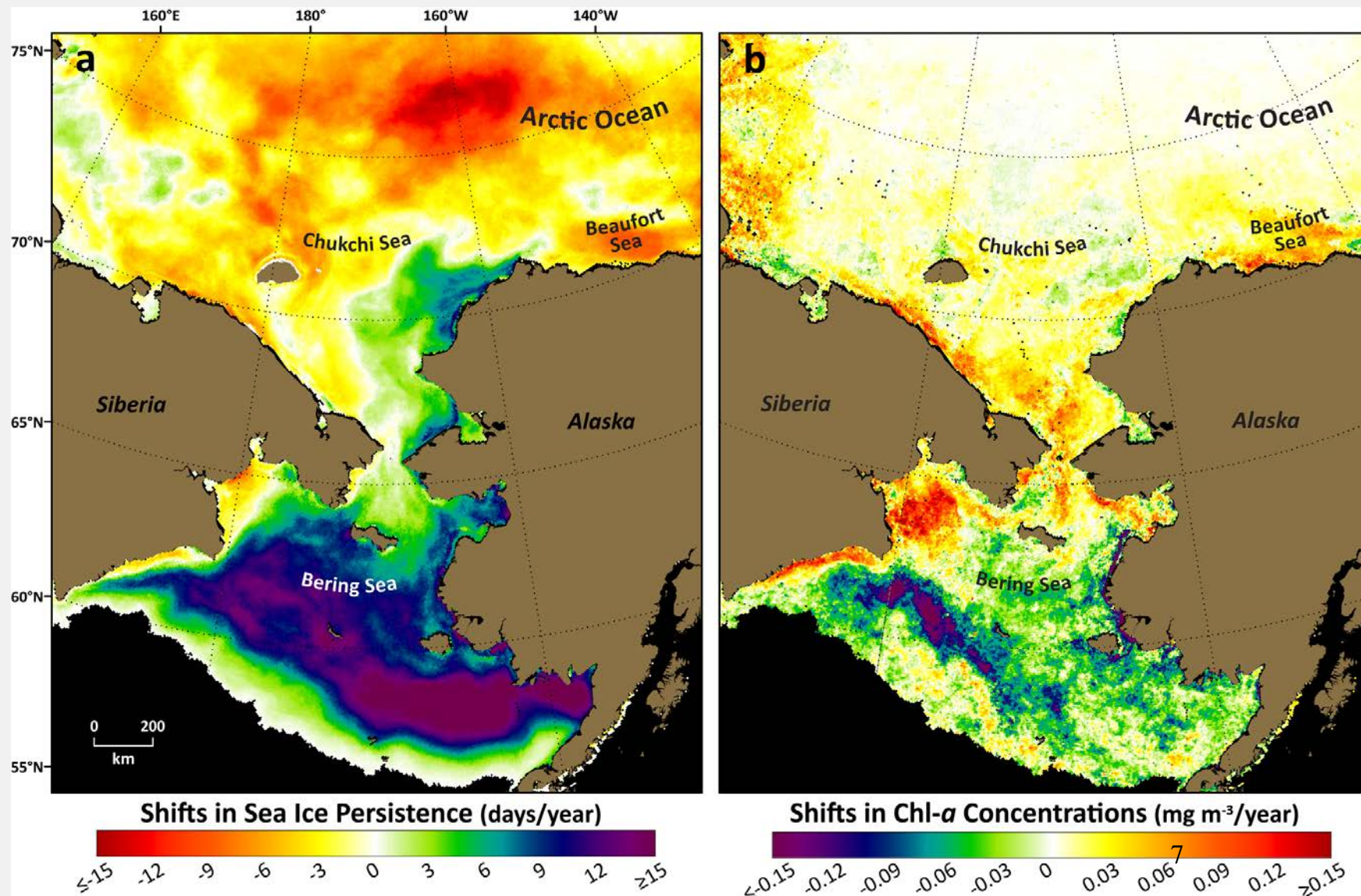
- Biological response and shifts in ecosystems are ecologically significant, requiring multidisciplinary field collections in time and space
 - Many developing observation systems in the Arctic are focused on physical sensors, but biological sampling at different scales are required to detect biological changes in response to environmental forcing
 - Coordinated ship-based observations on a regular basis, coincident with satellite and moorings could provide an early detection system for biological systems in the Arctic
- 

Sea ice extent (2012) and surface sea water temperatures (2007-2011) in Pacific region



- 2012 lowest sea ice retreat on record; ~7% decline per decade

Shifts in sea ice persistence and Chl-a concentration from 2003-2009



Based on SSM/I Sea Ice Concentrations and the GlobColour (SeaWiFS, MODIS, MERIS) satellite time series, courtesy Karen Frey

Observed Changes in the Pacific Arctic Region - a few examples

- Pacific zooplankton in Beaufort Sea and benthic species in the Chukchi Sea
- Commercially fished 'Bering species' & snow crab in the western Beaufort Sea
- Seabird declines with drop in clam biomass [eiders] & access to ice-associated cod [guillemots]
- Gray whale feeding-focus shift from N. Bering to Chukchi
- Walrus hauling out on land in unprecedented numbers
- Polar bears reported drowned at sea, scavenging & denning on land



Benthic Foragers: respond to changes in sea ice

Gray whales = shifts in distribution reflects sea-ice related prey decline (amphipods: time and space) & overwintering opportunity feed euphausiids; staying longer north to feed



Walrus = loss of sea ice platform for riding, resting, nursing calves & access to Chukchi shelf feeding areas

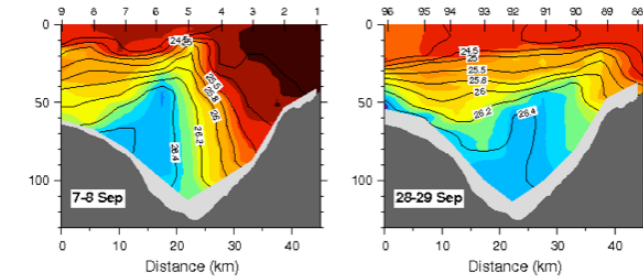
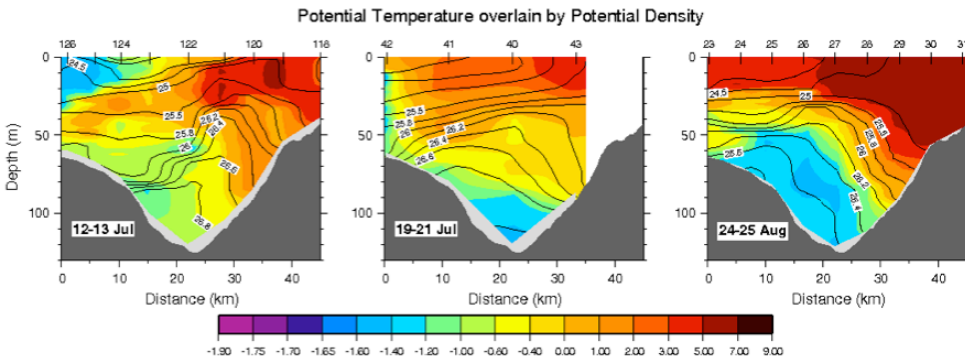
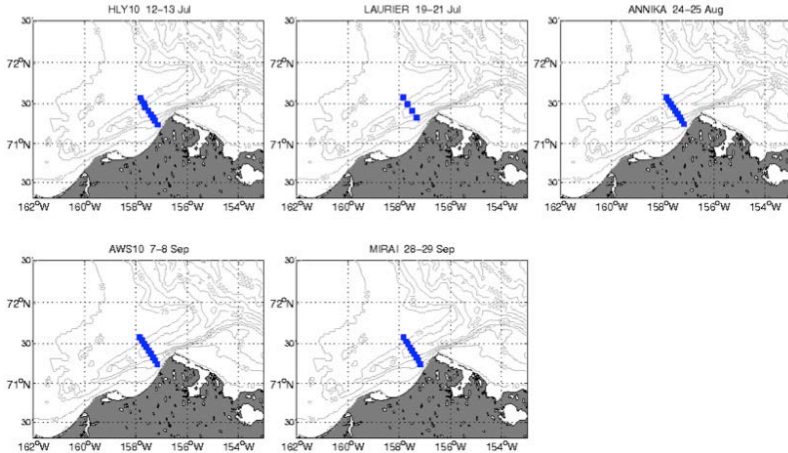


DBO 5: Barrow Canyon Section

-5 reoccupation of sections by international partners from June-October 2010

-observed seasonal warming of Alaska Coastal Water (ACW)

-high nitrate and silicate in the western Bering Sea water compared to eastern ACW



[R. Pickart]

[see Grebmeier et al. 2012, Arctic Report Card 2012, available at http://www.arctic.noaa.gov/reportcard/barrow_canyon.

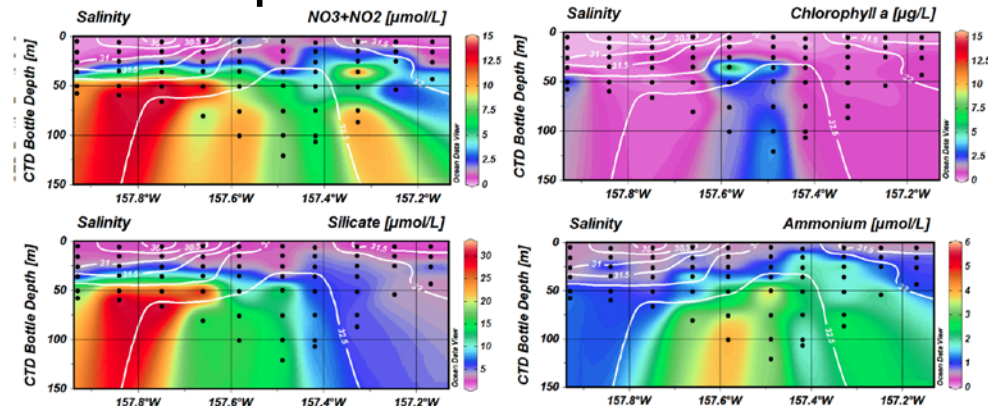
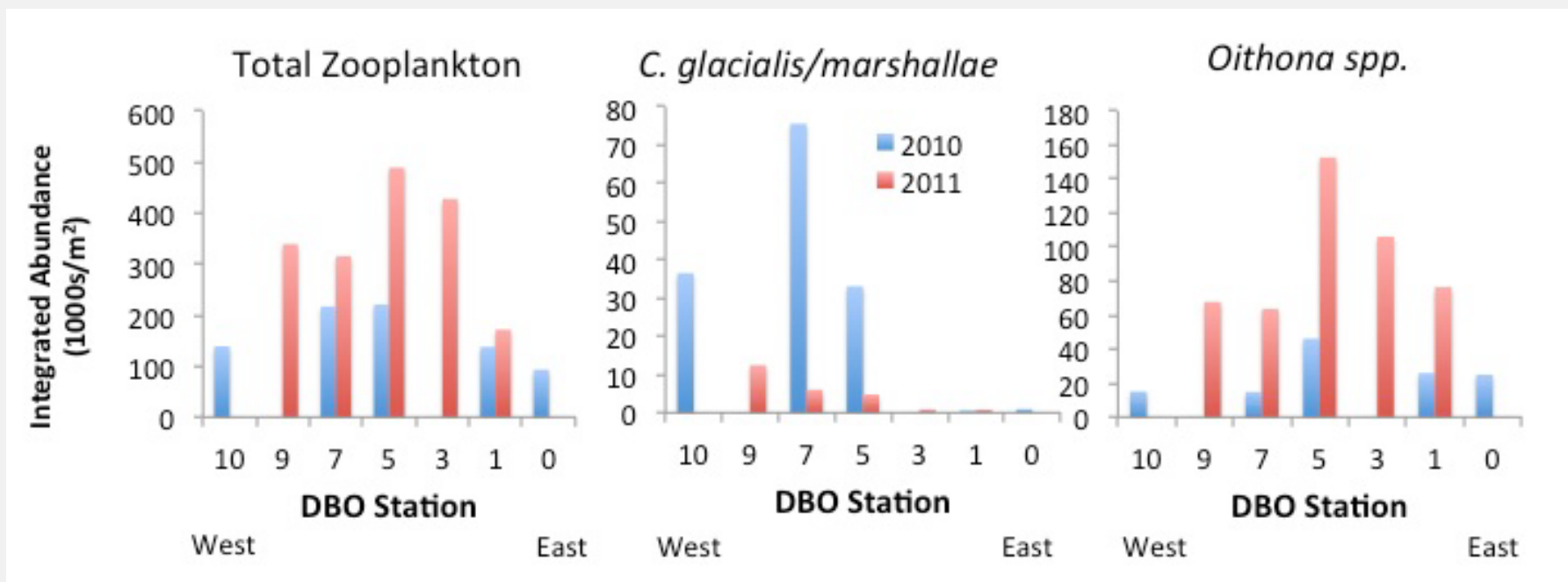


Figure 3. Nutrient data (nitrate, silicate and ammonium) and chlorophyll a (ug/L) over salinity in Barrow Canyon during the CCGS Sir Wilfrid Laurier cruise July 2011.

Integrated water column abundances of total zooplankton, *C. glacialis/marshallae*, and *Oithona* spp. from across the transect in August/September 2010 and 2011



(Ashjian, Campbell, Okkonen, unpub. data).

Each graph is oriented with the offshore/western station to the left and the eastern station to the right. An additional station (“0”) was sampled in 2010 inshore of the standard DBO station 1. Zooplankton were collected using a 60 cm diameter ring net equipped with 150 μ m mesh net. No samples were collected at station 10 in 2011.

Barrow Canyon

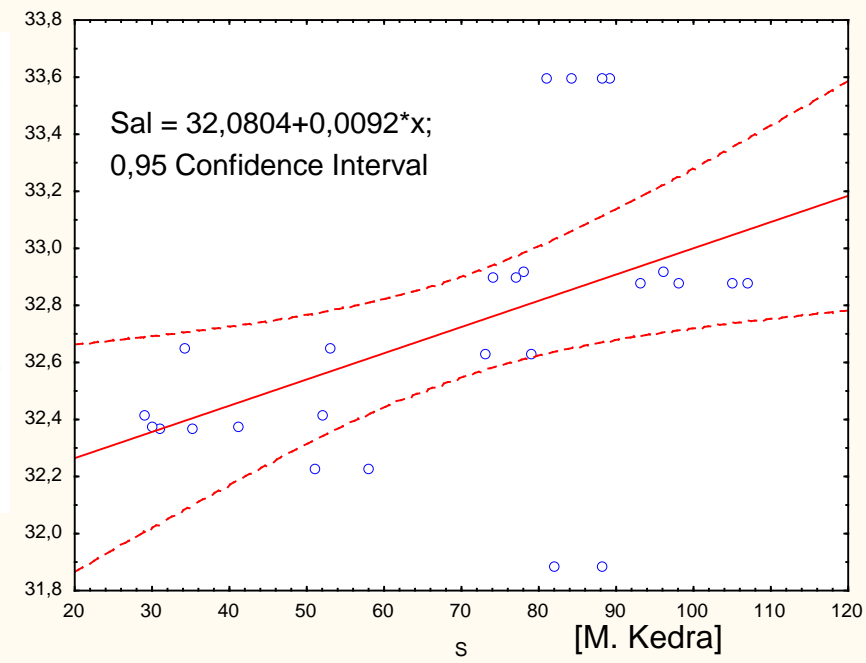
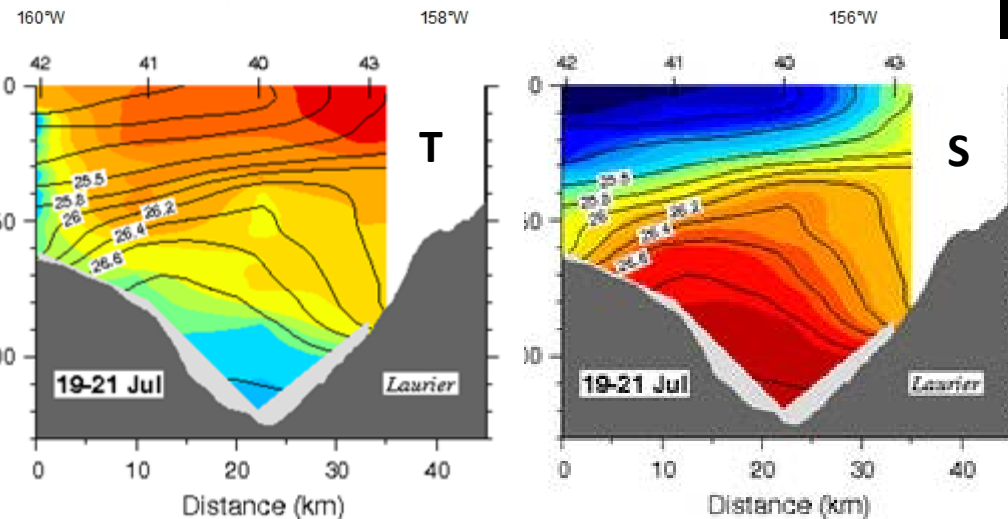
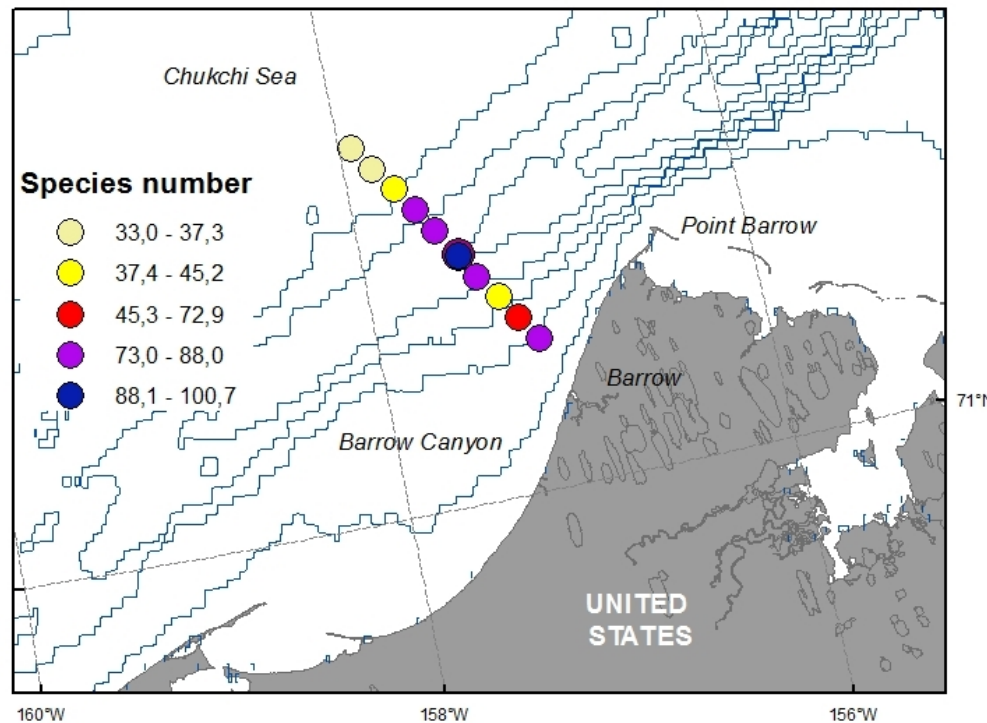
Spearman correlations:

Species richness & bot. sal.: 0.55*

Species richness & chl a: 0.59*

Species richness & TOC : 0.4*

Similar correlations found
for abundance and biomass



http://www.arctic.noaa.gov/dbo/cruise_data_2010_pilot_study.html C30)

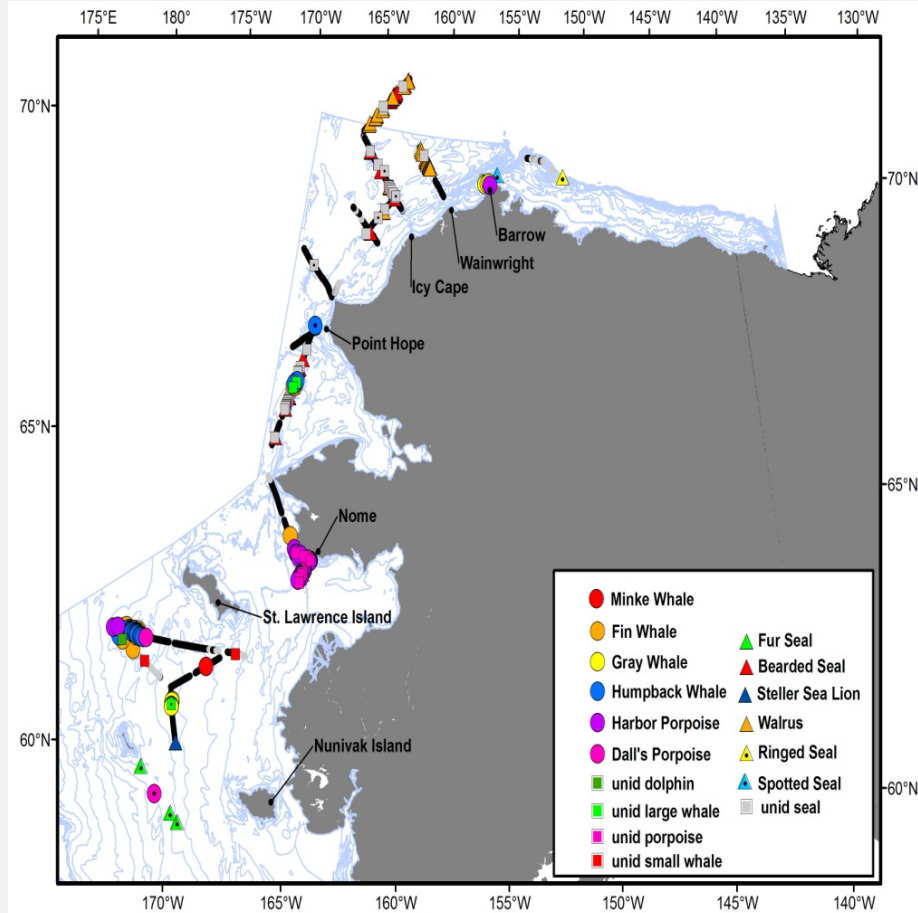
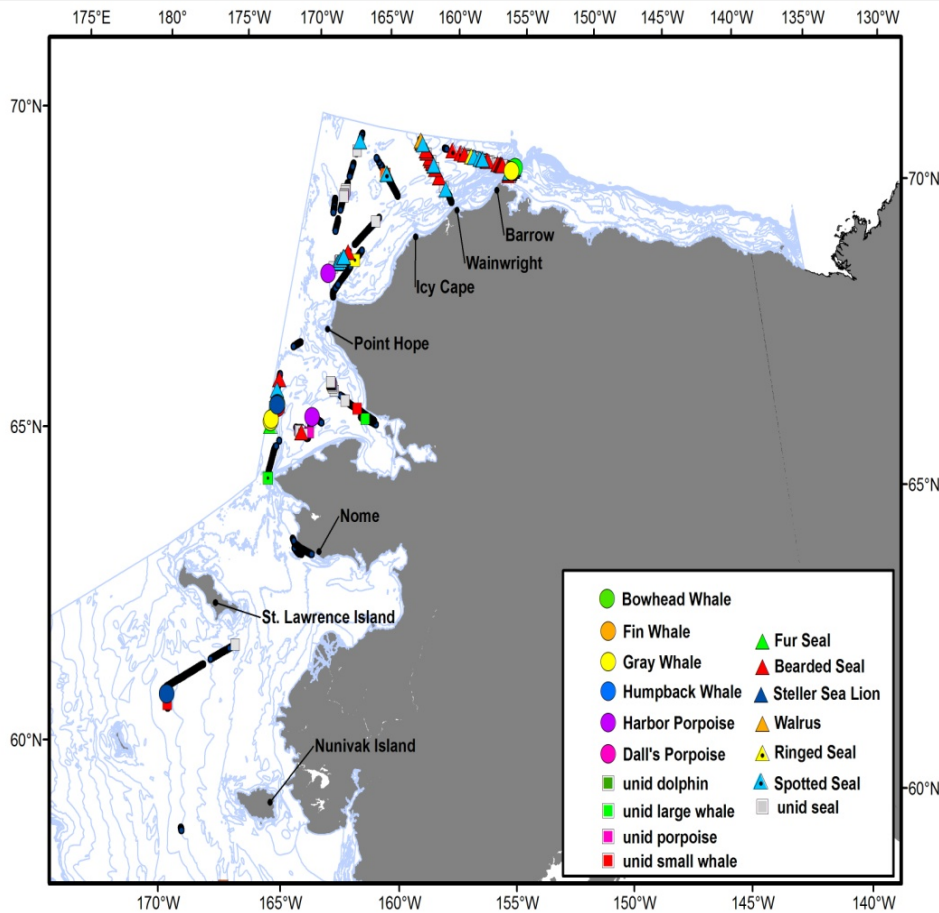


Marine Mammal Sightings (CHAOZ)

Standard Survey Protocol

2010 – DBO Region 3 – ‘hotspot’

2011: DBO Region 1 – ‘hotspot’



DBO Data Management Considerations

(as part of UCAR/EOL/ACADIS-AON effort)

- Develop an International DBO data policy and exchange protocol (including priority measurements) to facilitate:
 - Dataset exchange and access
 - Preparation of datasets for data integration, inter-comparison and modeling studies
- Encourage broad access to data and metadata beyond national restrictions through scientific collaboration/cooperation
- Coordinate with other National and International Projects
- Consider data format and documentation guidelines to enhance international data exchange and analysis
- Document and standardize (if possible) data collection protocols (time, sensors, processing, parameters, units)



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Summary

- Freshening and warming seasonally as Pacific seawater transits northward from spring to fall, with potential impacts on plankton and benthic prey bases for larger marine mammals and seabirds
- Observations of changes in benthic dominant macrofauna and biomass at benthic hotspots in the region
- Repeat collections of hydrography, plankton, benthic and higher trophic level parameters over the seasons through international coordination
- Latitudinal “change detection array” to track biological response to sea ice retreat and environmental change organized through the Pacific Arctic Group (PAG) & endorsed by the International Arctic Science Committee (IASC) marine working group; designated as SAON (Sustaining Arctic Observing Networks); with US National Ocean Policy
- Ongoing effort to develop coordinated data management, access, and publications

Four Objectives for the DBO Data Meeting

- Present results from the 2010-2012 pilot study and determine a basis for multidisciplinary paper(s) to showcase the DBO international effort;
- Archive metadata, either with a link to data set in a national archive or by submitting the DBO data to common data archive;
- Discuss DBO site criteria and identify NE Chukchi Sea DBO4 line and other DBO lines, and
- Determine how to plan for full implementation for the DBO.

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Thursday-28 February

- 0745 Meet in hotel lobby, van to PMEL
- 0830 Highlights of Day 1 and outline Day 2 activities
- 0845 Summary of DBO Questionnaire Results, EOL Mapserver, data policy and use issues:
Steve Williams
- 1000 Break
- 1020 Breakout into two groups: Physical/hydrography (leads: Pickart/Cooper) and biology (leads: Grebmeier/Moore) for discussion of available data sets for physical/chemical data and biological data, with specific questions related to data collection, needs, standardization of data collection, gaps, etc.
- 1200 Lunch in PMEL cafeteria
- 1330 Meet as full group for discussion of breakout group activities - summary presentations and discussions
- 1430 Second breakout wave (cross-fertilization) to begin data exchange discussion, metadata and data submissions, publication plans
- 1530 Break
- 1550 Return to plenary session, summary presentations and discussions, possible high-level publication?
- 1700 Summary of day's activities and plans for Day 3
- 1700 End Day 2 and shuttle to hotel
- 1730 Dinner on your own

Friday-1 March

- 0745 Meet in hotel lobby, van to PMEL
- 0830 Highlights of Day 2 and objectives for morning session
- 0845 Discussion of criteria for DBO sites, location for DBO 4 in northern Chukchi Sea, and location of other DBO international lines
- 1000 Coffee break
- 1020 Plans for future DBO activities (5-10 min)
- US IARPC DBO Interagency Team milestones-Sue Moore
 - US Industry activities
 - Japan, Canada, Korea, other foreign activities
 - Others?
- 1200 Lunch in PMEL cafeteria
- 1330 DBO data issues, central data link at EOL and links to international data portals for direct access for DBO data products (Steve Williams, others)
- 1500 Break
- 1520 Open discussion of workshop action items, plans for publications, field plan, future activities
- 1700 Close of workshop and shuttle to hotel
- 1830 Meeting reception at local restaurant, then dinner as group or on own (TBD)

Thank you for your attention.

Questions and comments?

Financial support from the international science partners in the Pacific Arctic Group (PAG), the US National Oceanic and Atmospheric Administration and the National Science Foundation

Further information at <http://www.arctic.noaa.gov/dbo/> and <http://pag.arcticportal.org>

