Plankton and benthic collections coincident with fish, seabird and marine mammal surveys during DBO 2010

Tracking predator-prey interactions as long-term indicators of ecosystem status and trends

Jackie Grebmeier on behalf of the DBO Biology teams

DBO Workshop

Seoul, Korea

27 March 2011

Distributed Biological Observatory-Lower Trophics

Core standardized ship-based sampling:

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

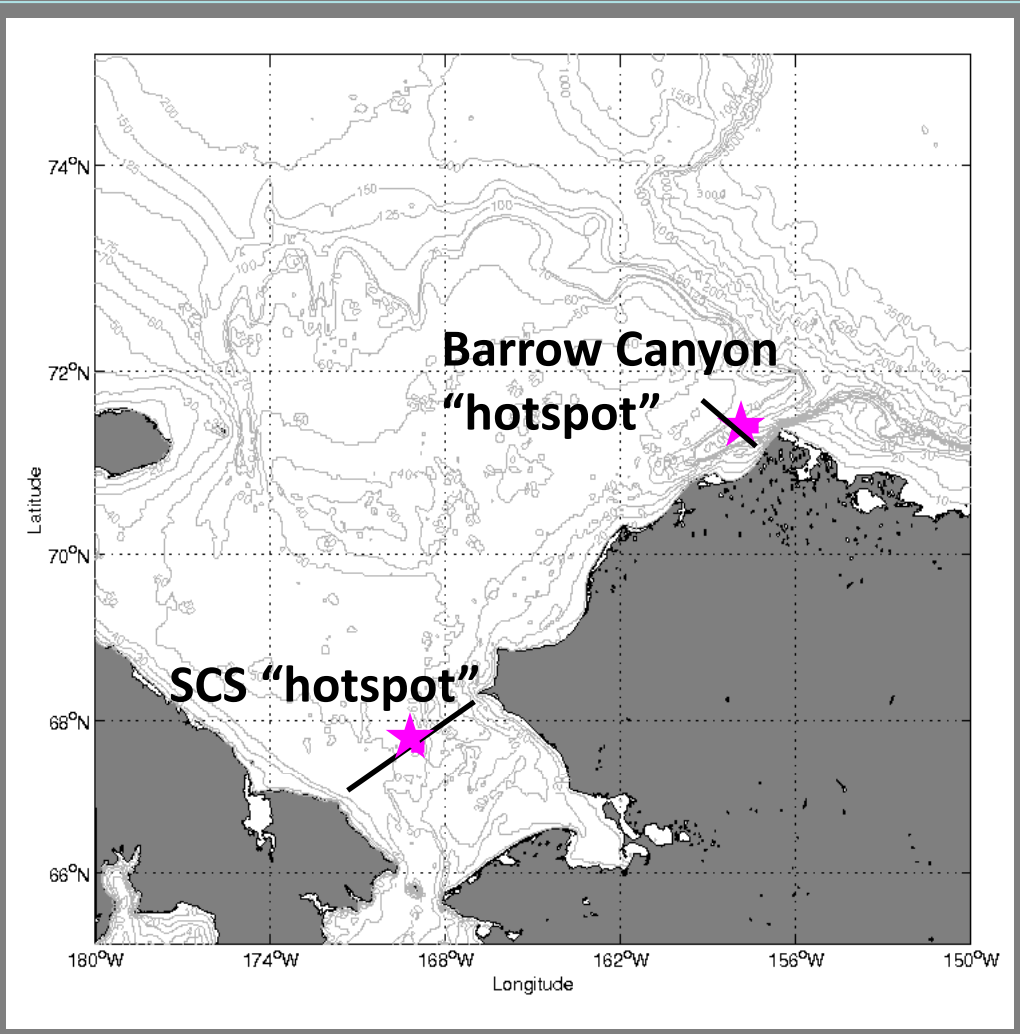
"Change detection array" – same measurements every year, process information in near real time <6 mos; detect regime shifts in rapid changes

Second tier ship-based sampling:

- Fishery acoustics (less effort than bottom trawling)
- Mid-water & bottom trawling (every 3-5 years)

Additional leveraged programs both domestic and international

DBO 2010 "Pilot" Season: International cruises to Pacific Arctic: Lower Trophic Data



Vessel	Country	PI
Moana Wave	USA	Grebmeier
Alaskan Enterprise	USA	Napp*
Xue Long	China	He
Mirai	Japan	Itoh
Laurier	Canada	Nelson, Grebmeier
Healy	USA	Arrigo
Healy	USA	Pickart
Annika Marie	USA	Ashjian
Khromov	Russia & USA	Hopcroft and Kosobokova

http://pag.arcticportal.org

*winch issues 2010

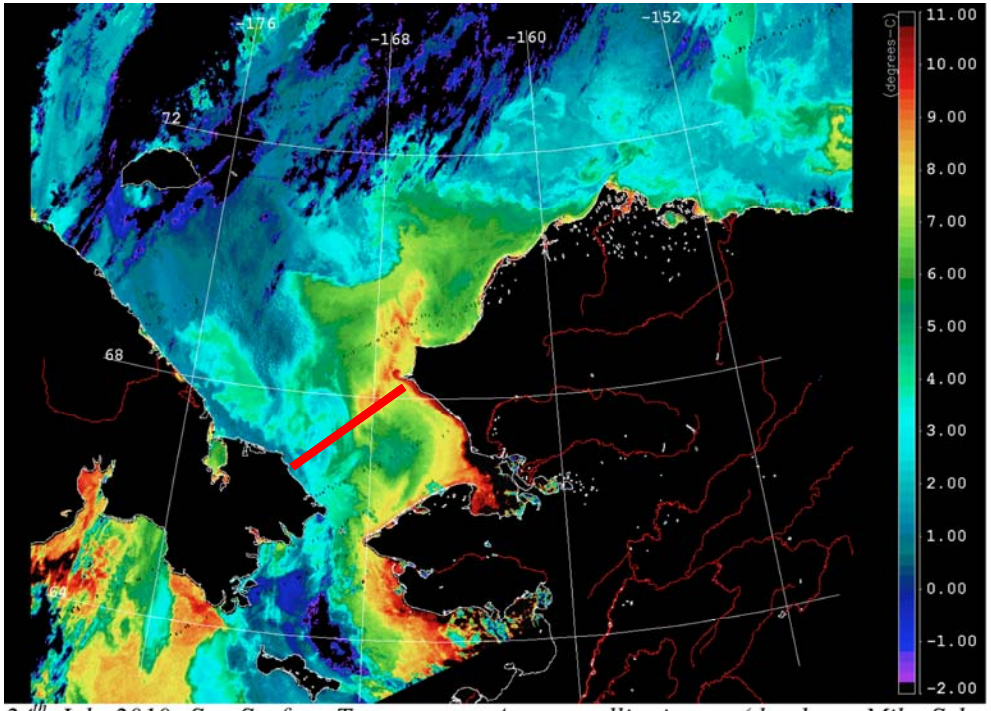
DBO 2010

Biology subgroup leads–Jackie Grebmeier, Carin Ashjian, Russ Hopcroft, Motoyo Itoh, Ksenia Kosobokova, Sue Moore, Jeff Napp, John Nelson, and Jiafeng He

- Biology data collected at Barrow Canyon DBO Line: 5 cruises by 4 nations in 2010: Canada, China, Japan, USA,
- SE Chukchi DBO Line: 4 cruises by 4 nations: Canada, China, Russia and USA
- Type:
  - Phytoplankton IDs: Jackie Grebmeier (limited-BC; COMIDA)
  - Zooplankton IDs: John Nelson (SECS and BC, Canada; C30), Carin Ashjian (BC, USA; AON), Russ Hopcroft and Ksenia Kosobokova (SECS, USA and Russia; RUSALCA), Jeff Napp (BC, USA; CHAOZ)
  - Benthic: Jackie Grebmeier (SECS and B, also NBS), USA; C30, COMIDA, BEST), Jianfeng He (SECS and BC, China; CHINARE)

2010 DBO International Pilot Project

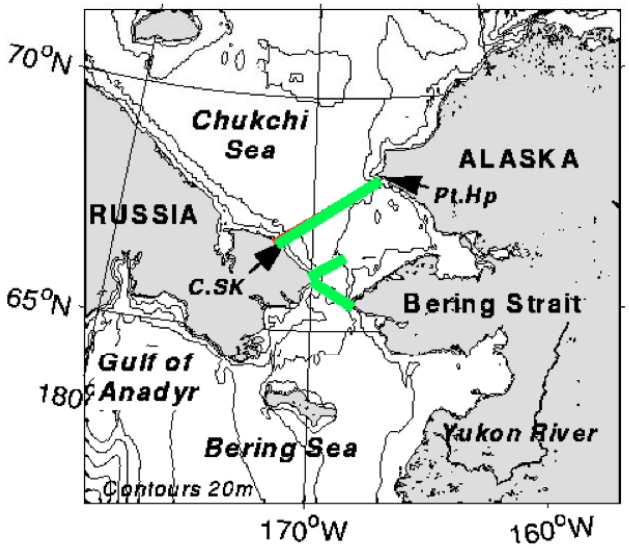
DBO 2010 Data Parameter Matrix (SE Chukchi Sea-SECS) and Barrow Canyon (BC)									
Cruise (DBO PI Lead)	**Period**	**CTD***	**Chlorophyll-extractions**	**Nutrients**	**Algae-Ice/Phyto-plankton: size, biomass, composition**	**Zooplankton: size, biomass, composition**	**Benthos: size, biomass, composition**	**Seabird surveys**	**Marine Mammal surveys**
Healy 1001 (Pickart)	June-July (both)	x	x	x					
Sir Wilfrid Laurier (Vagle)	July (both)	x	x	x		x	x**	x	
Araron (Chung)	July								
Moana Wave (Grebmeier)	July-Aug (both**)	x	x	x	x**	x **	x**	x	x
Xuelong (He)	July-Aug	x	x	x	x	x	x***		
Annika Marie (Ashjian)	August (BC)	x	x	x	Lugols samples for microplankton	x		x	x
Alaskan Enterprise (Napp/CHAOZ)	Aug-Sept (BC)	x				x****			x
Khromov (Woodgate)	Aug (SECS)=CS line	x	x	x		x			x
Healy 1003 (Pickart)	Sept (BC)	x		x					
Mirai (Itoh)	Oct (BC)	x	x	x		x (BC hotspot)			
*=T, S, plus some cruises transmissivity, fluorescence (chlorophyll), CDOM, dissolved oxygen, pH									
**=all water column, plankton and benthic data at "hotspot" sites only; seabird and marine mammal survey throughout									

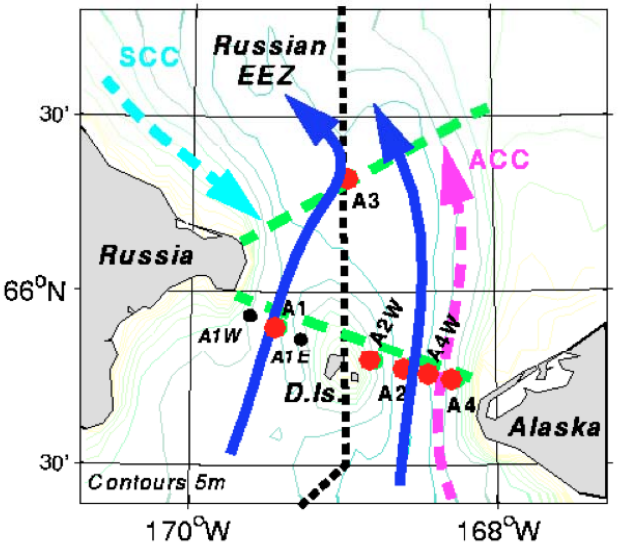


24th July 2010 Sea Surface Temperature Aqua-satellite image (thanks to Mike Schmidt) from
http://mather.sfos.uaf.edu/~mschmidt/ak_chukchi_sea_2010/A2010205230000_AQUA_LAC_sub1_sst_map.png

Rebecca Woodgate: RUSALCA 2010 Cruise report:
…All stations were sampled for nutrients and chlorophyll, BS line for dissolved inorganic carbon (for Nick Bates), organic nitrogen (for Terry Whitledge) and phytoplankton (for the Shirshov Institute). Eighteen zooplankton net tows were taken (for Russ Hopcroft). Marine mammal and bird observations (by Kate Stafford and Carter Esch), with the focus on whales…

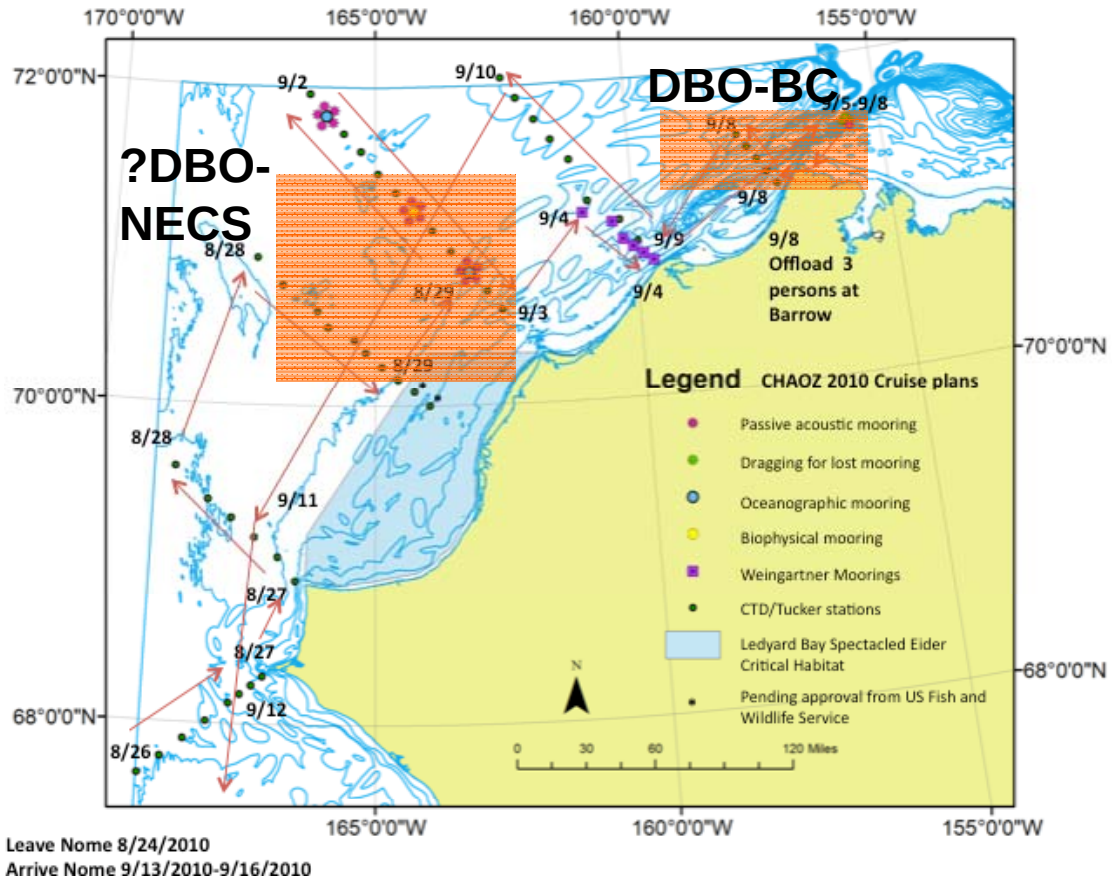
- RUSALCA CS line=SECS DBO line
- zooplankton DBO-SECS processed





Chukchi Acoustics, Oceanography, and Zooplankton Study (CHAOZ)

Principle Investigators:
Catherine Berchok and **Jeffrey Napp**, Alaska Fisheries Science Center, NOAA, Seattle, WA
Phyllis Stabeno and James Overland, Pacific Marine Environmental Lab., NOAA, Seattle, WA Sue Moore, Science & Technology (ST7), NOAA, Seattle, WA

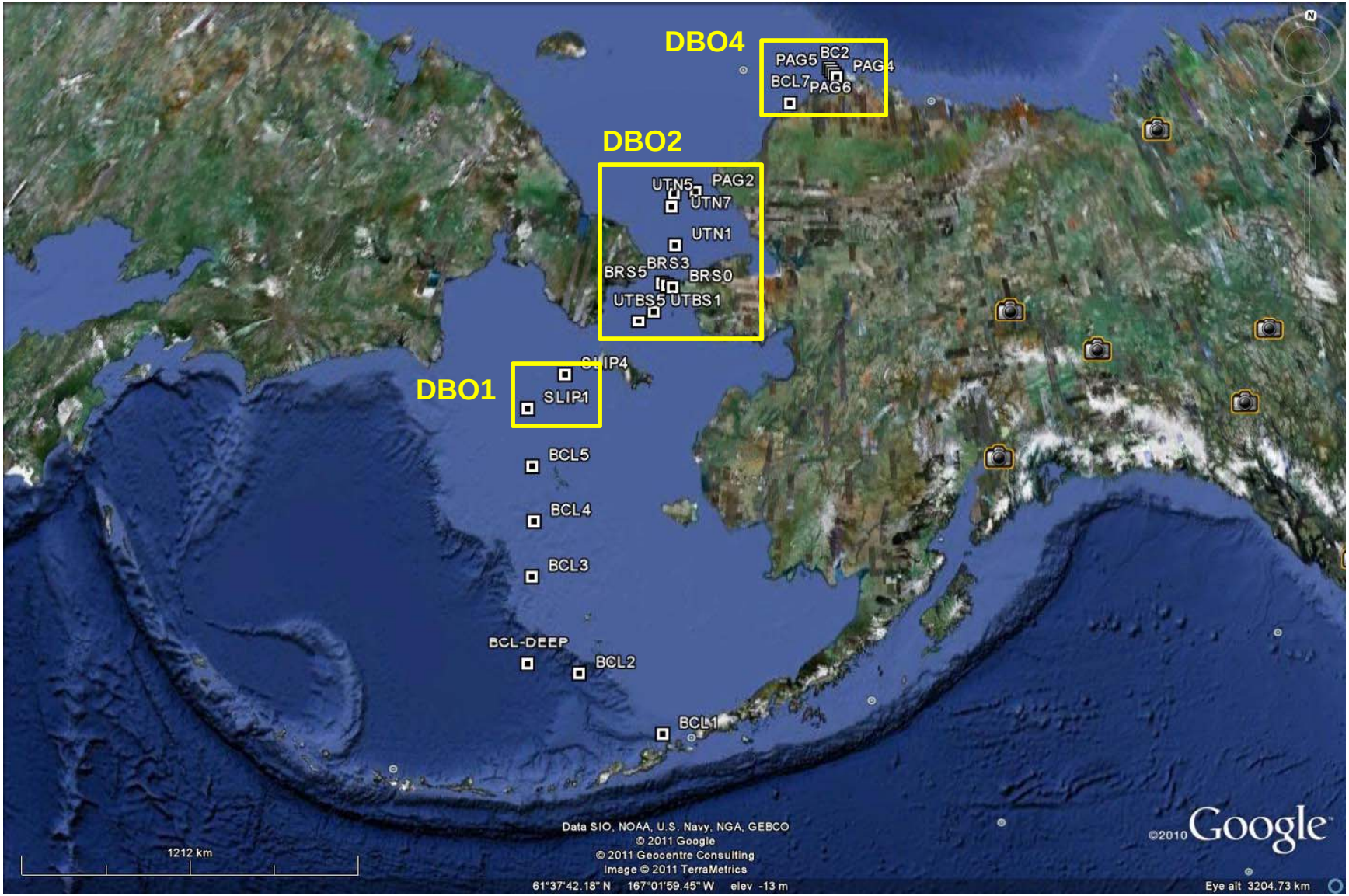


Research Goals:

- Determine general presence and detailed movements of bowhead, fin, gray, and humpback whales in oil and gas lease areas using long-term passive acoustic recorder arrays, sonobuoys, shipboard visual observations, and opportunistic satellite tracking.
- Monitor ecosystem change through the use of long-term biophysical moorings, shipboard observations and climate numerical models
- Assess the response of the whales to environmental changes (including climate and anthropogenic use of the area) by integrating the biophysical, passive acoustic, and large whale biology data sets.

2010 Integrated C3O and DBO Zooplankton Analysis

John Nelson IOS/DFO, Canada



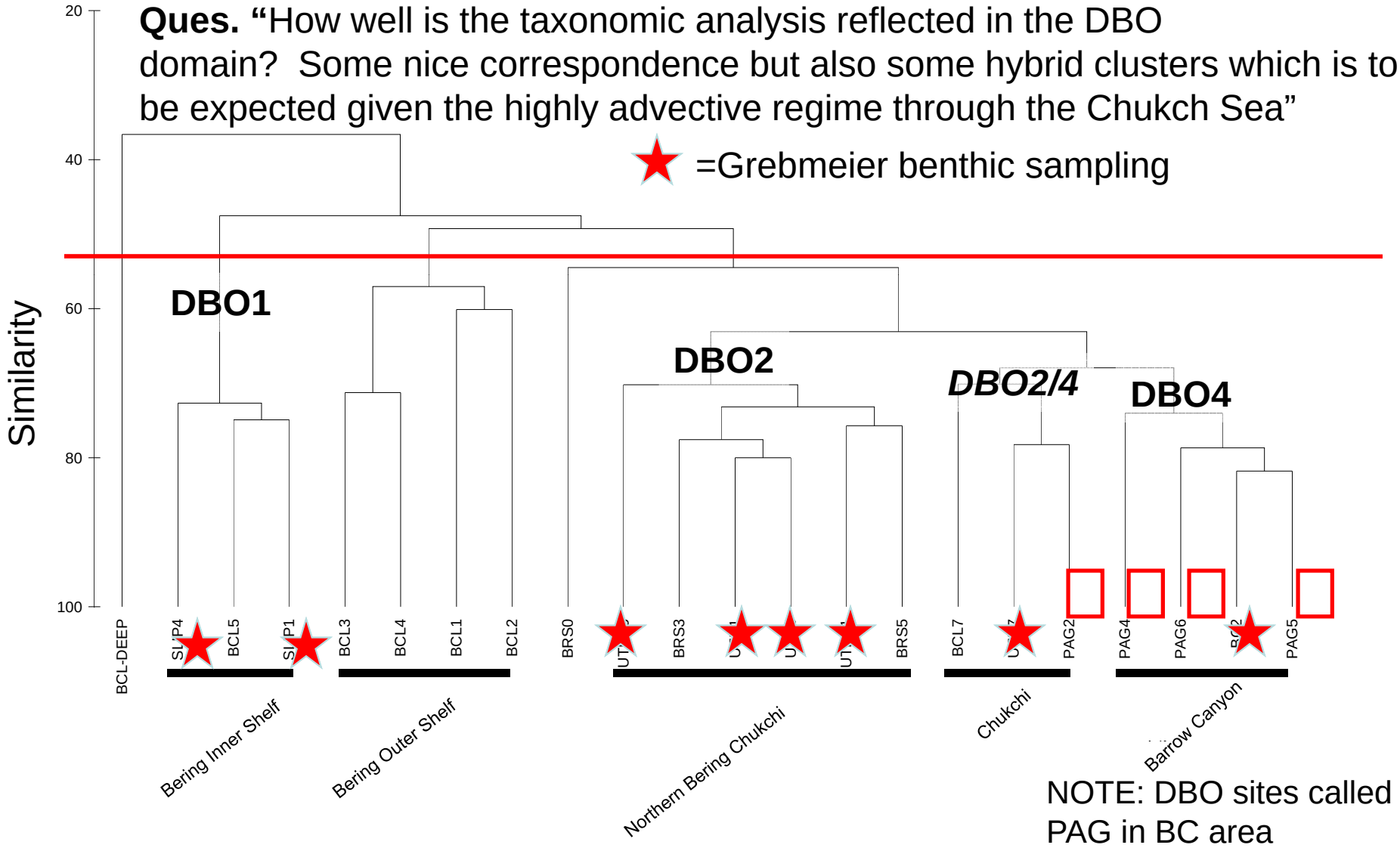
JG1

2010 Integrated C3O and DBO Zooplankton Analysis-John Nelson IOS/DFO, Canada

– 4th root transformed Bray-Curtis similarity based on abundance

Ques. "How well is the taxonomic analysis reflected in the DBO domain? Some nice correspondence but also some hybrid clusters which is to be expected given the highly advective regime through the Chukch Sea"

★ =Grebmeier benthic sampling



NOTE: DBO sites called PAG in BC area

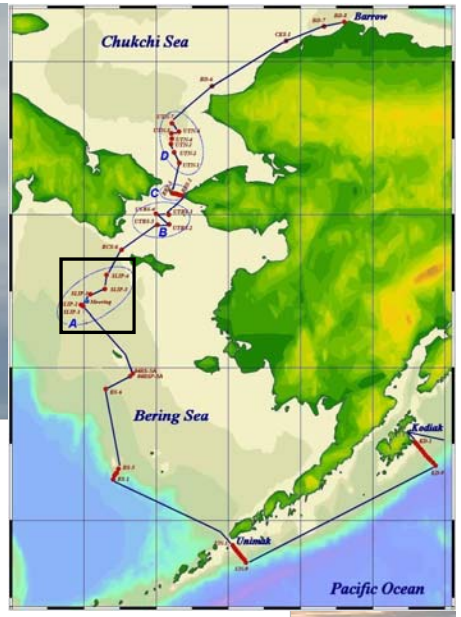
Latitude (° S to °N in Pacific Sector)

Slide 9

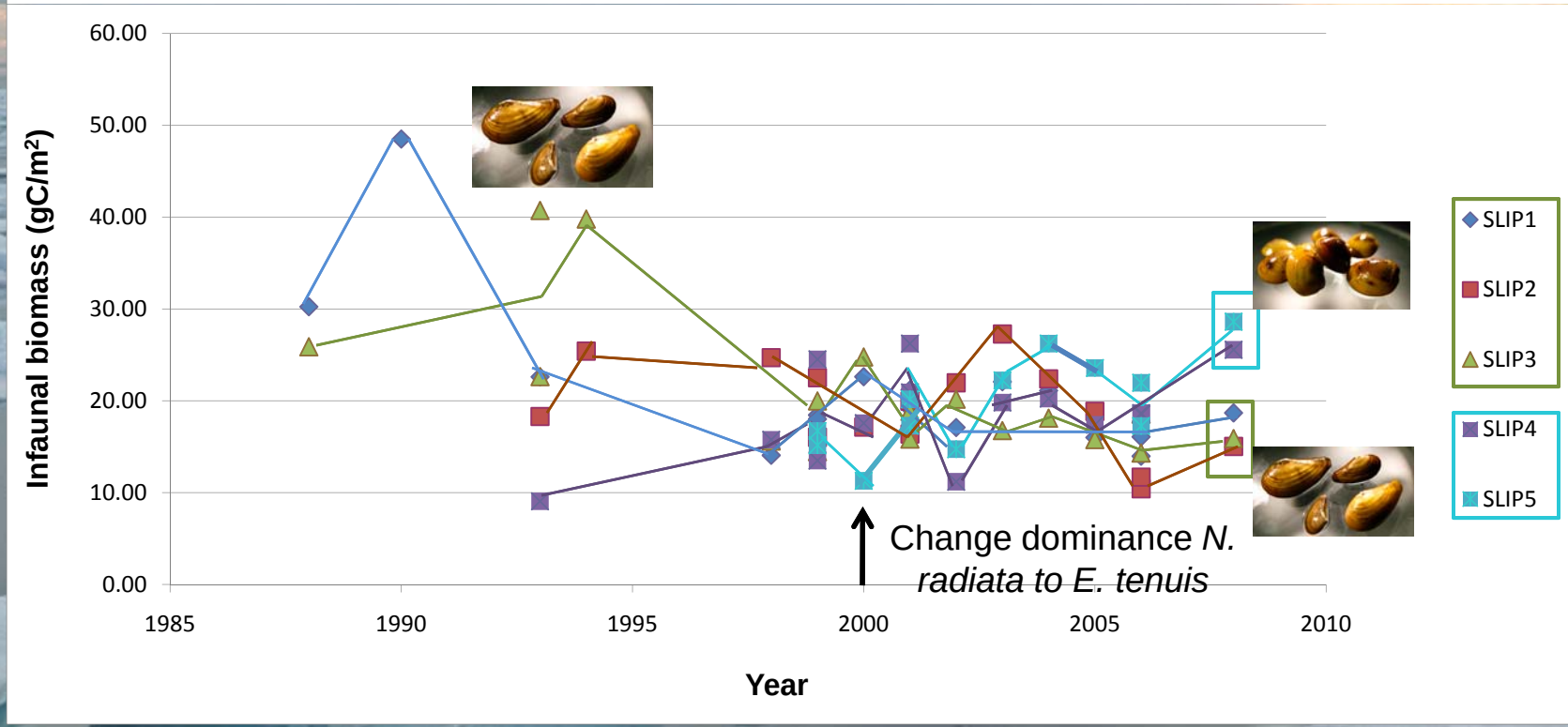
JG1 Jackie Grebmeier, 3/26/2011

DBO1 (NBS-S) site: Decline in dominant nuculanid bivalve biomass 1990-2000, with increase nuculid bivalves since 2000

- time series essential
- species composition necessary understand prey food value, nuculid bivalves less caloric content, thicker shells for threatened seabirds
- changing hydrography impacts sediment grain size (fining recently)

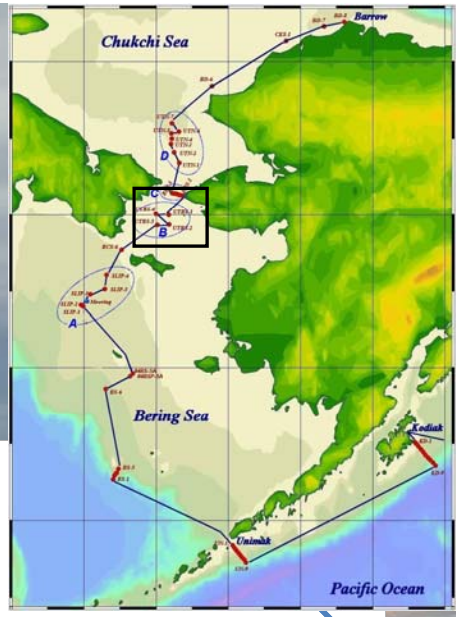


St. Lawrence Is. Polynya Biomass by Station (gC/m2)



DBO 2(NBS-N): Chirikov Basin

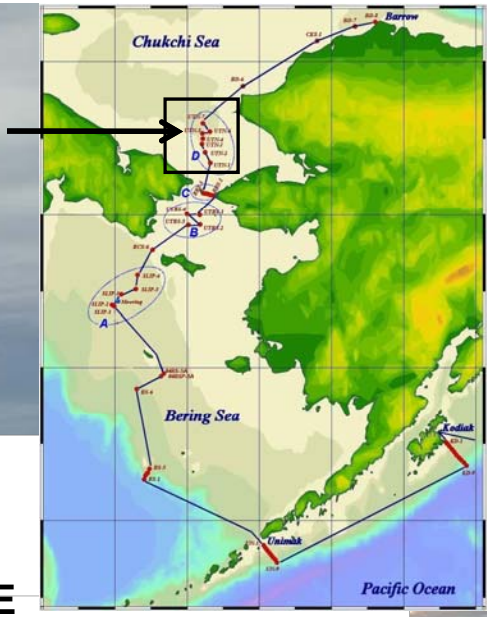
- decline ampeliscid amphipods to 2000, with some rebound, although “footprint” declining
- note that one site changed from ampelisid amphipods to ampharetid polychaetes

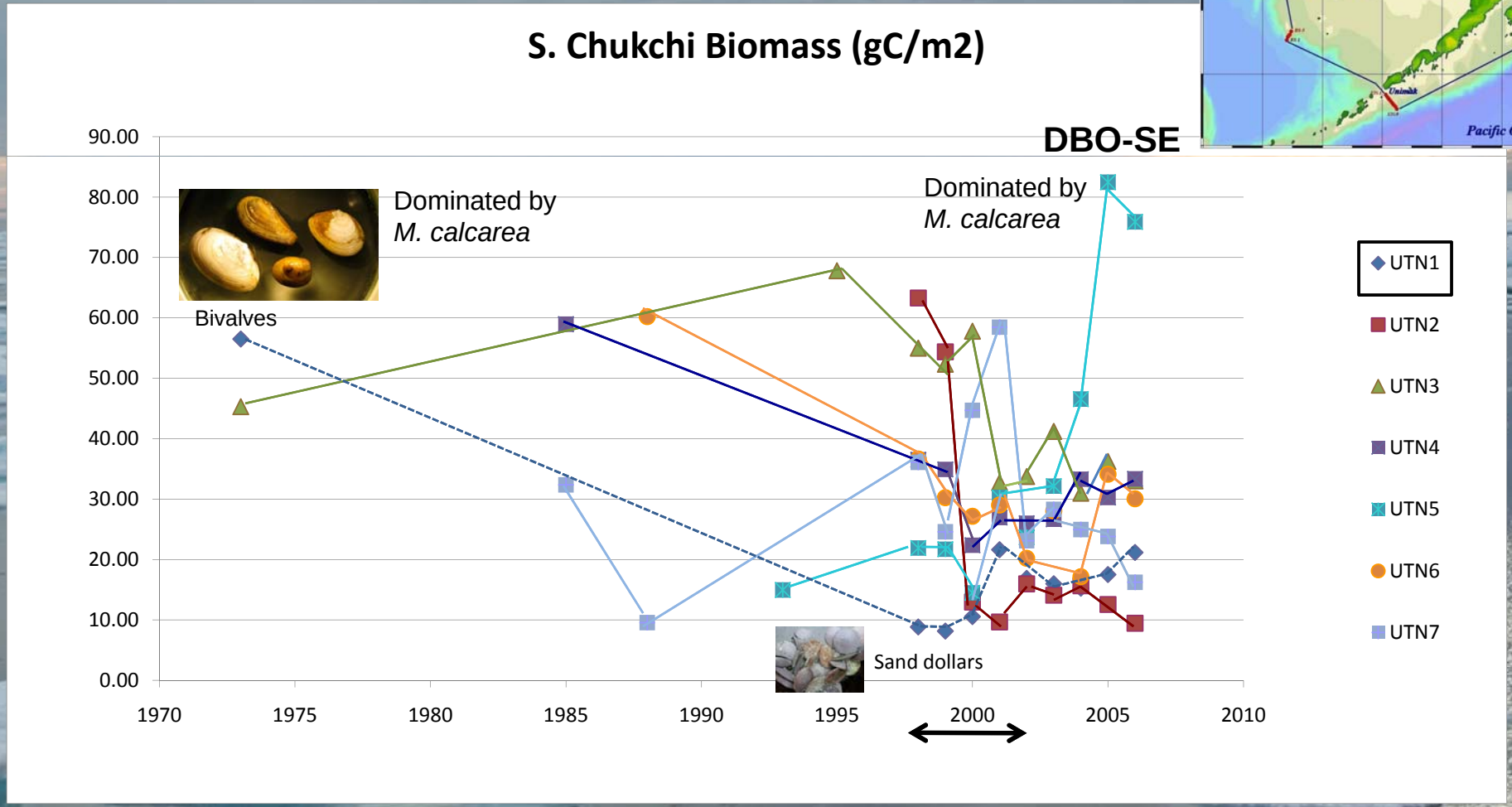


Chirikov Basin Biomass by Station (gC/m2)

DBO2-SE Chukchi Sea

- changes and some decline in benthic infaunal biomass
- except UTN5 (DBO “hotspot” station at head of Herald Valley
- also UTN1 shift bivalves to sand dollars





Benefits:

- Lower trophic taxa data (phytoplankton, zooplankton and benthos) shared amongst DBO cruises can be analyzed first-order via simple cluster analysis
- can be used to look at temporal variation, latitudinal variation (time and space scales)
- variation between labs

Challenge:

- post-cruise analysis sorting time
- standardization of gear and analytical capability
- collection of standard parameters sites on a regular basis
- national funding support

Including Fish, Seabirds and Marine Mammals in the DBO

Integration of visual and acoustic surveys, satellite tagging and tissue sampling via Research Partnerships

Sue Moore
DBO Workshop
Seoul, Korea
27 March 2011

“Vision” for Distributed Biological Observatory-High Trophics

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 protocols, no additional ship time) = Kuletz**
- **Marine mammal observations (no additional ship time) = NMML?**

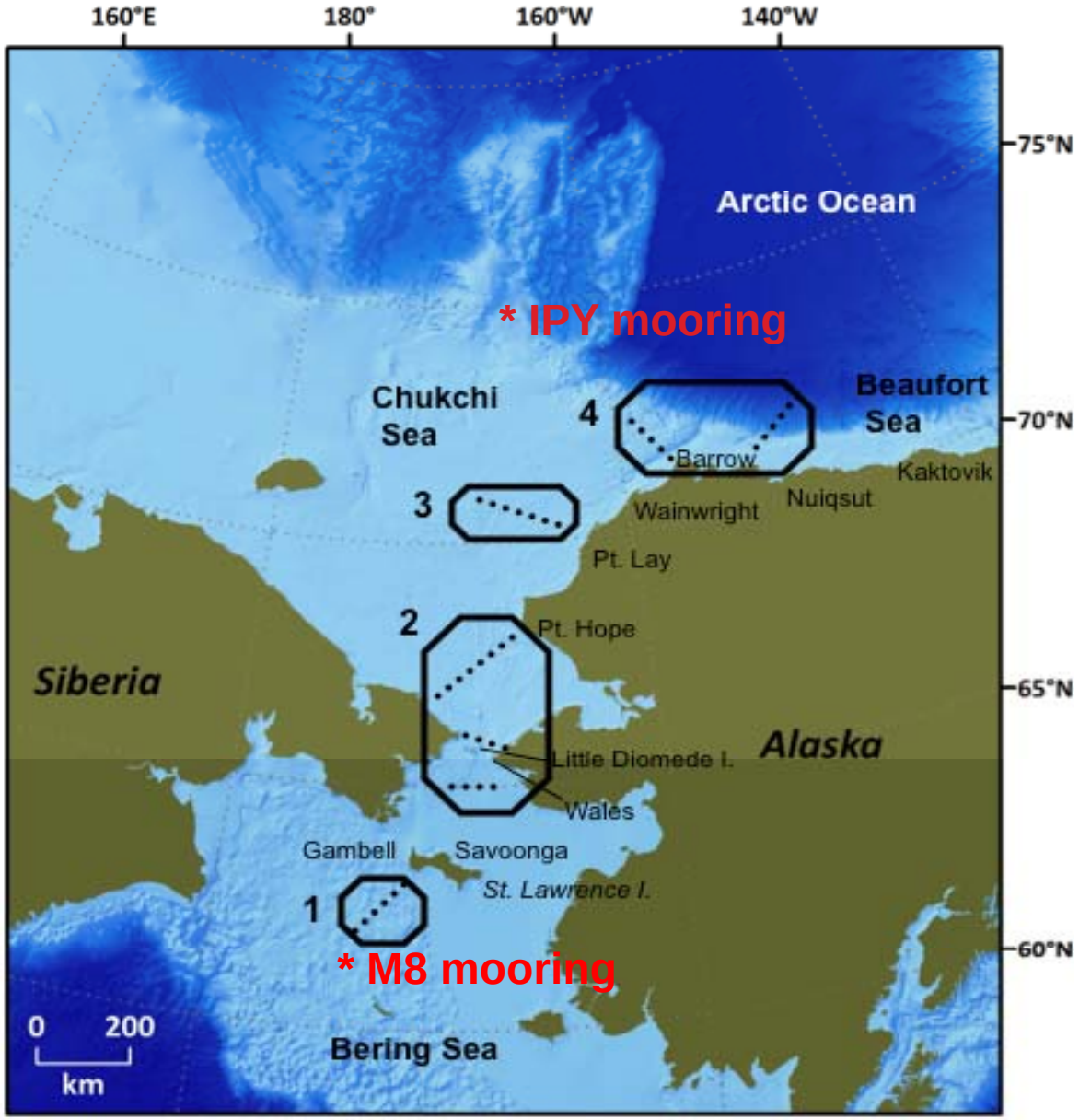
“Change detection array” – same measurements every year, process information in near real time <6 mos; detect regime shifts in rapid changes

Second tier ship-based sampling:

- **Fishery acoustics (less effort than bottom trawling) = AFSC & UAF**
- **Mid-water & bottom trawling (every 3-5 years) = AFSC & UAF/ RUSALCA**

Additional leveraged programs both domestic and international

DBO- Repeated Oceanographic Sampling with Links to Community-based Research Partnerships

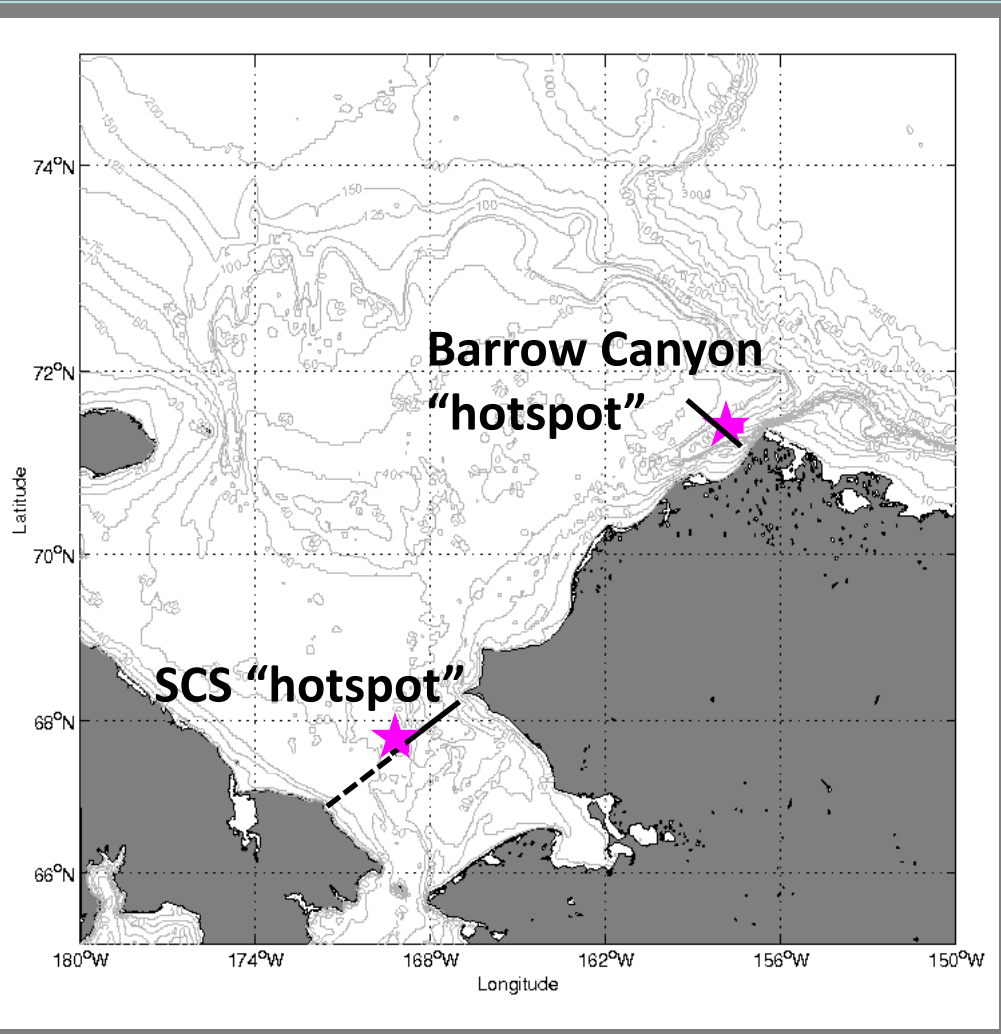


- Stations from prior & existing research programs: SBI, RUSALCA, SNACS, BOWFEST

Framework for integration of IPY * and many other research programs

Links to prior & existing Community-based Research @ SLI/Diomede Kotzebue, Pt. Lay, Barrow

DBO 2010 "Pilot" Season: International cruises to Pacific Arctic (dedicated seabird/marine mammal observations)



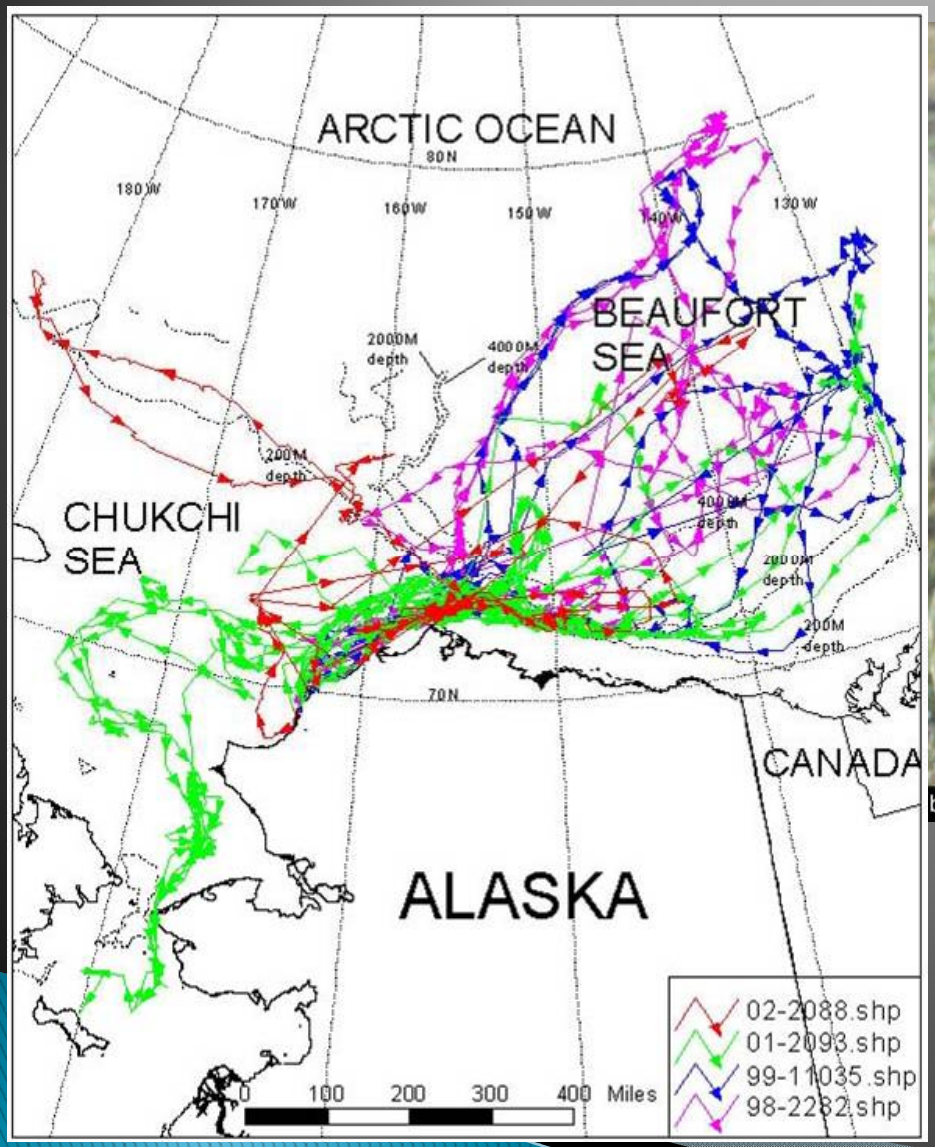
Vessel	Country	PI
Moana Wave	USA	Grebmeier
Alaskan Enterprise	USA	Napp
Xue Long	China	Zhao
Mirai	Japan	Itoh
*Laurier**	Canada	Vagle
Healy	USA	Arrigo
Healy	USA	Pickart
Annika Marie	USA	Ashjian
Khromov	Russia & USA	Stafford

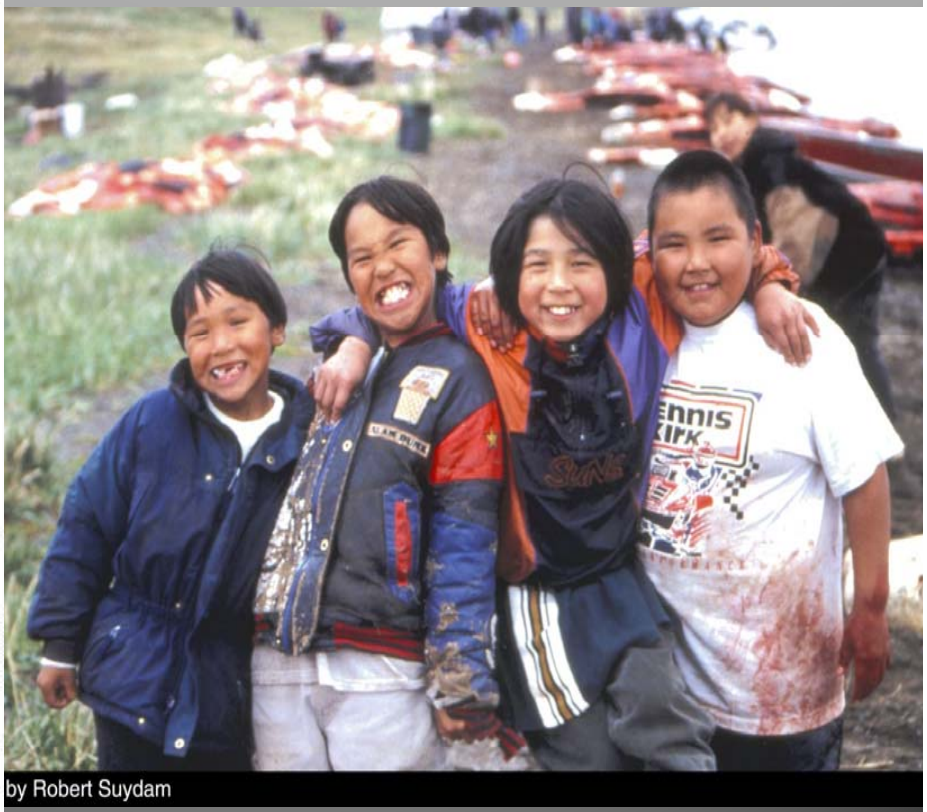
[*seabirds only]

http://pag.arcticportal.org

EXAMPLE: Research Partnerships

Beluga tagging in partnership with hunters at Pt. Lay, AK





Other Examples:

Bowhead – SNACS/BOWFEST/Barrow

Ice Seal Tagging – NOAA/ADF&G

Walrus – SIWO/ Gambell & Savoonga

Links to Co-Management Committees

DBO Partnerships: Villages, subsistence activities, marine mammal research, oceanographic moorings and associated long-term passive acoustics projects. BH=bowhead whales; BE = beluga whale; WS = walrus; ice seals = ringed, bearded, spotted, ribbon

No.	DBO Region	Villages	Subsistence Activity*	MM Research**	Moorings/Acoustics
1	N. Bering	Gambell Savoonga	BH whaling; WS & ice seal hunting; seabird & duck hunting; local fishing	BH, WS & ice seal tagging, stomach & tissue samples	Stabeno/Berchok
2	Bering Strait & SE Chukchi	Wales L. Diomede Kotzebue Pt. Hope	BH whaling; WS & ice seal hunting; seabird &duck hunting; local fishing	BH, WS & ice seal tagging, stomach & tissue samples; COMIDA aerial surveys	Woodgate & Weingartner/ Stafford
3	Central Chukchi	Pt. Lay	BH and BE whaling, ice seal hunting; seabird &duck hunting; local fishing	BE, BH & ice seal tagging, stomach & tissue samples; COMIDA aerial & benthic surveys; O&G-related surveys & benthic sampling	Stabeno/Berchok Shell, Statoil & CP: MMO & acoustics (LGL/JASCO); also lease-site- scale ecosystem sampling
4	Barrow Arc	Wainwright Barrow	BH and BE whaling; WS & ice seal hunting; seabird & duck hunting; local fishing	BE, BH, WS & ice seal tagging, stomach & tissue samples; COMIDA BWASP aerial surveys; BOWFEST oceanographic sampling + aerial surveys	Okkonen & Weingartner/ Stafford & Berchok Hildebrand (HARPs) Shell/CP/Statoil (hydrophone array off Barrow)

*= web links available to AEWC, ABWC, EWC, ice seal co-mgt sites

** = research/primary PoC: BH tagging/Lori Quakenbush; BE tagging/Robert Suydam; WS tagging/Chad Jay; ice seal tagging/Peter Boveng & Jason Herreman; BH tissues & stomachs/Craig George; BE tissues/ Robert Suydam; ice seal tissues & stomachs/ Lori Quakenbush ; in Region 3 ref. AOOS assets map (http://www.aoos.org) for all research activities ongoing in the NE Chukchi Sea

Seabirds and marine mammals on COMIDA/Shell RV Moana Wave 2010 cruises

Marine Mammals Observed, R/V Moana Wave, July 24-August 12, 2010

Species	# adult	# juvenile	Total
Fin Whale (*Balaenoptera physalus*)	11	0	11
Gray Whale (*Eschrichtius robustus*)	73	1	74
Humpback Whale (*Megaptera novaeangliae*)	8	0	8
Minke Whale (*Balaenoptera acutorostrata*)	3	0	3
Beluga (*Delphinapterus leucas*)	3	2	5
Harbor porpoise (*Phoca vitulina*)	23	2	25
Pacific Walrus (*Odobenus rosmarus*)	259	51	310
Bearded seal (*Erignathus barbatus*)	7	2	9
Spotted seal (*Phoca largha*)	24	0	24
Ribbon seal (*Phoca fasciata*)	4	0	4
Ringed seal (*Phoca hispida*)	11	0	11
Polar Bear (*Ursus maritimus*)	1	0	1
Unidentified Mysticete Whale	13	0	13
Unidentified Whale	11	0	11
Unidentified Pinniped	8	0	8
Unidentified Seal	57	0	57
Total	516	58	574

[courtesy Paula von Weller, LGL]

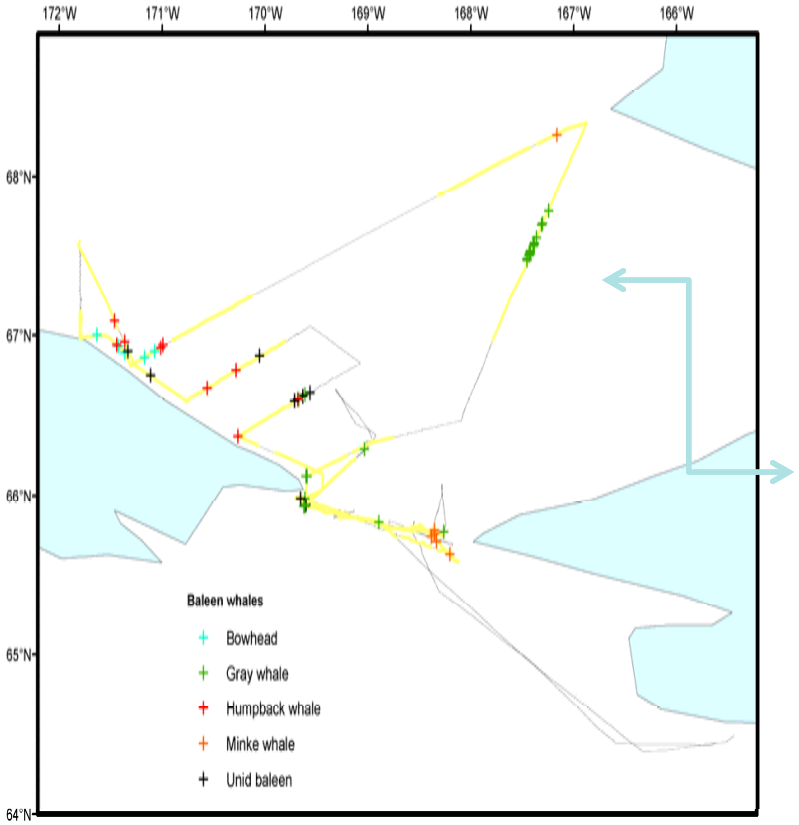
Seabirds: Observations were made during a total of 49 observation periods during transits between sampling stations. Observation periods ranged from 0.5 to 7.5 hrs with a total of 114.3 hr of watch time over ~2100 km of vessel trackline.

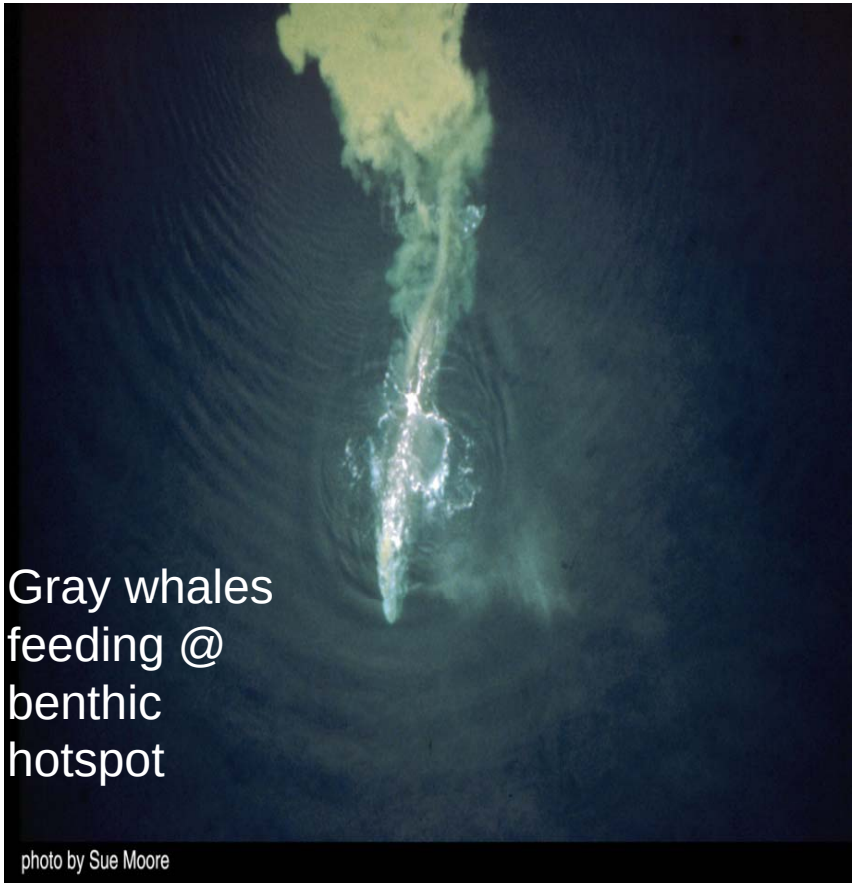
In total, 25 bird species were recorded during transit periods. The most abundant species were murres, least auklets, northern fulmars, crested auklets and black-legged kittiwakes.

[courtesy Bob Rodriquez, 2010]

-marine mammals dominated by gray whales and walrus, both benthic feeders

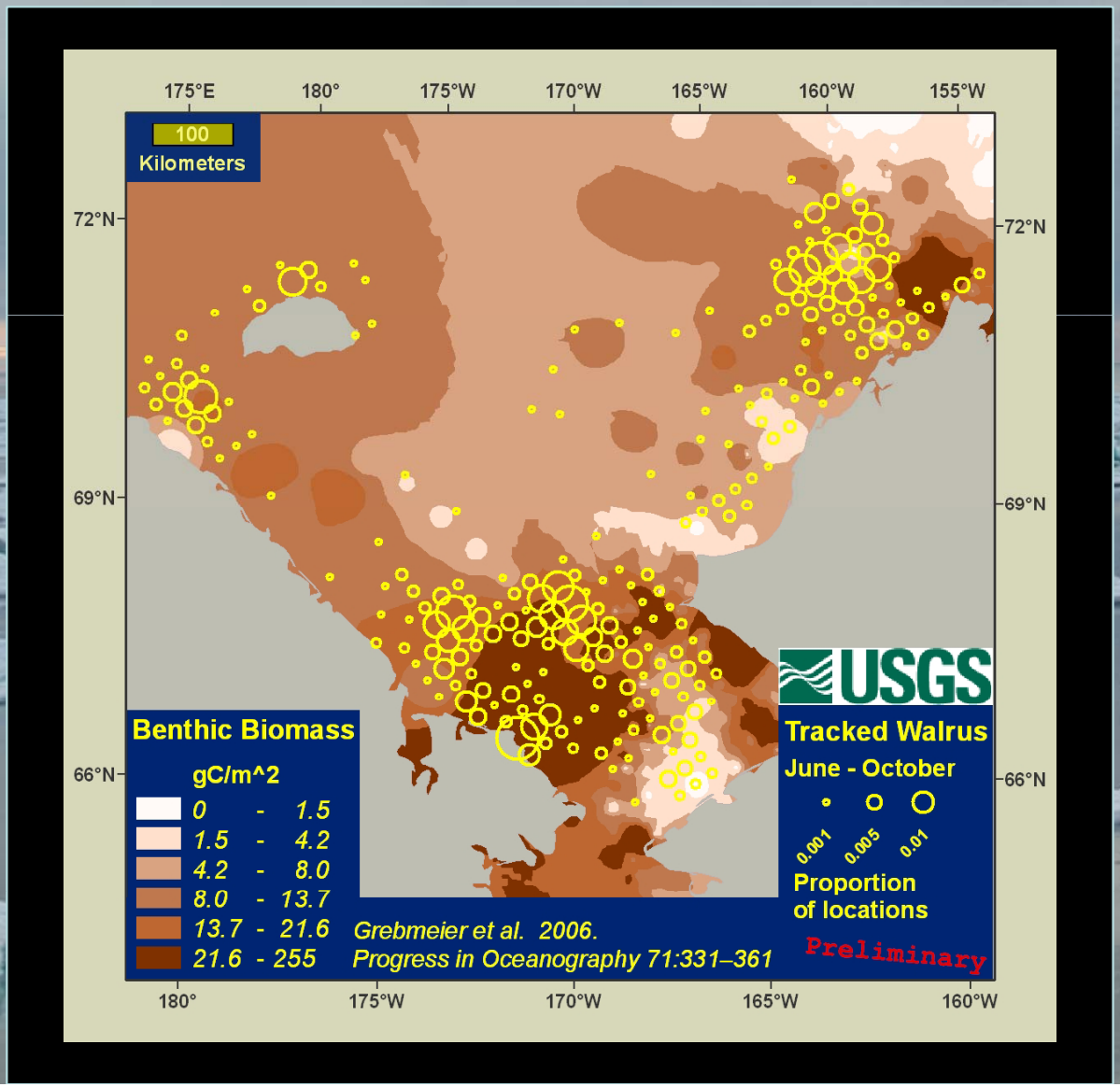
RUSALCA 2010: Baleen Whales





Data courtesy Kate Stafford

Walrus location and benthic infaunal prey biomass

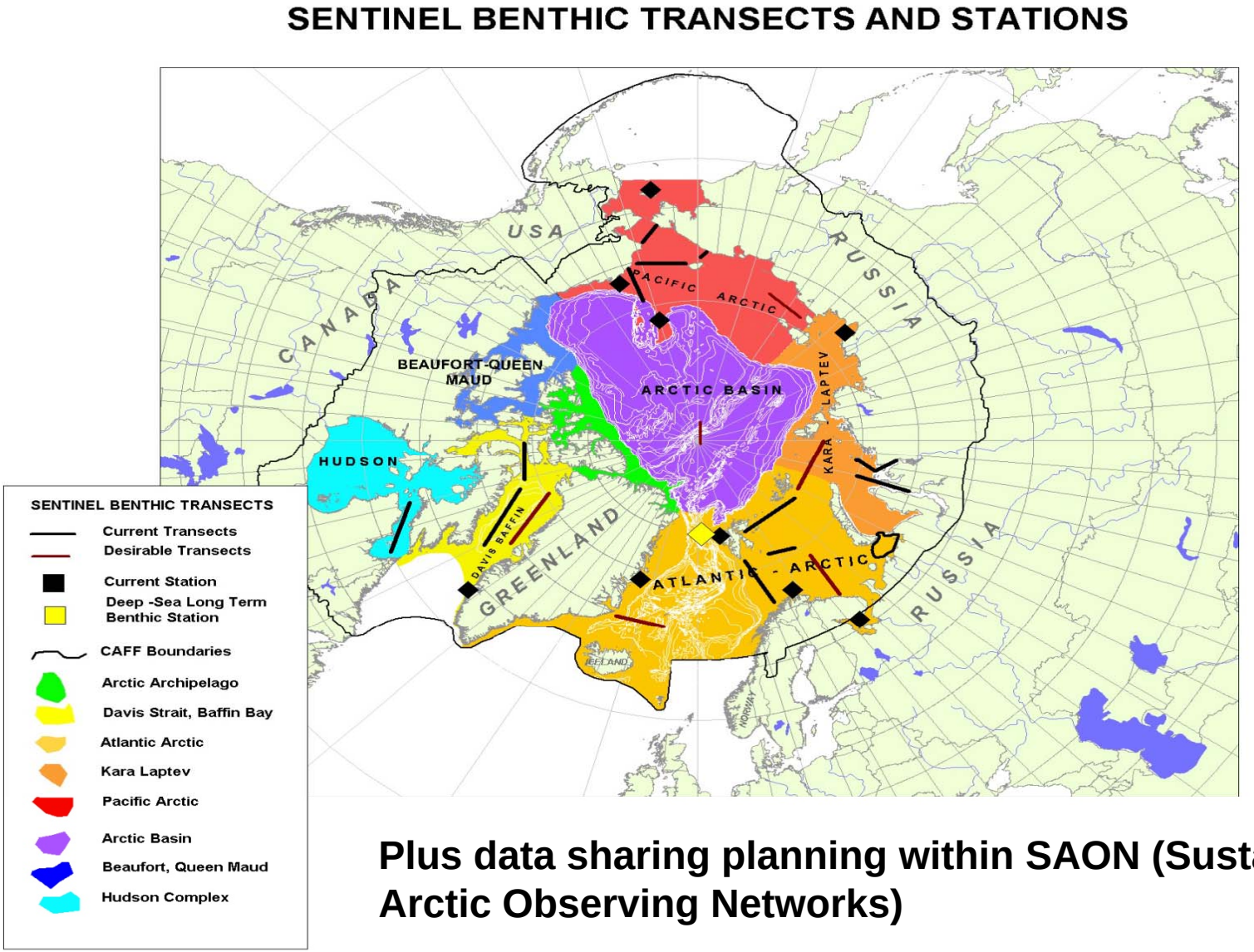


- walrus feeding in areas of ice and rich underlying benthic infauna
- issue of higher energy expenditure by walrus if have to haul-out on land as occurring since 2007

[courtesy Chad Jay and Tony Fischbach.]

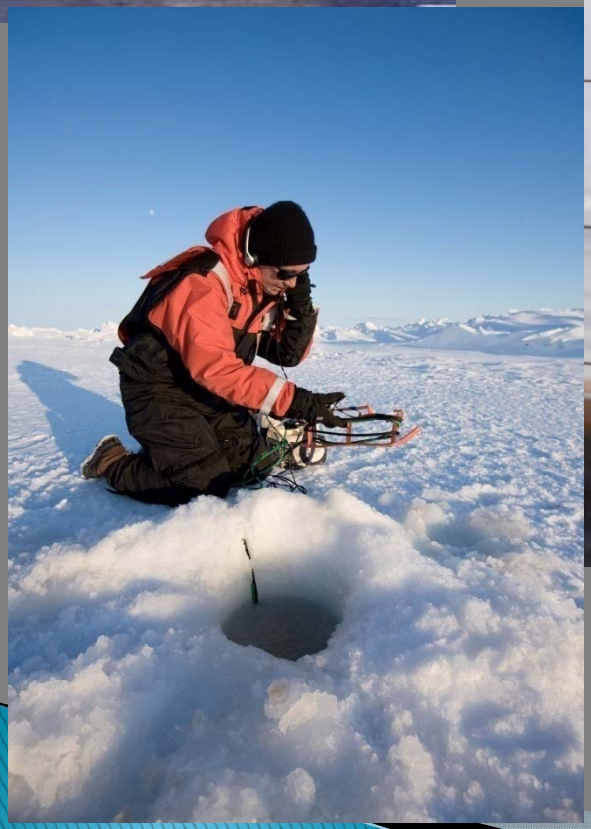
From Pacific Arctic –to- Pan Arctic

Circumpolar Biodiversity Monitoring Program (CBMP)
CAFF/Arctic Council international effort (draft 2010)



Plus data sharing planning within SAON (Sustaining Arctic Observing Networks)

DBO 2011: Time series Visual & acoustic surveys; establish HT Partnership Framework; continued biological sampling at DBO sites



Financial support from the US National Oceanic and Atmospheric Administration and the National Science Foundation; international science partners in the Pacific Arctic Group (PAG). DBO 2010 data courtesy of Carin Ashjian, Russ Hopcroft, (USA), Motoyo Itoh (Japan), Robert Pickart (USA), John Nelson and Svein Vagle (Canada)