Pacific Marine Arctic Regional Synthesis
Themes 2-4: Lower trophics, biodiversity and phenology of biological production

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Themes

Theme 2: Phenology of biological production cycles in relation to physical environment

2a. How will a changing climate affect the timing, magnitude, and duration of production cycles?

2b. Will changes likely result in successful colonization and replacement of arctic endemics by subarctic populations/species?

Theme 3. Benthic-pelagic coupling in relation to physical-chemical environment

3a. Will future climate conditions alter the strength of benthic-pelagic coupling and if so, in which direction?

3b. How will keystone species be affected?

Theme 4: Current state of lower trophic prey-base and higher trophic feeding hot spots

4a. How will migration routes and important feeding hotspots of marine mammals and seabirds change in response to changing climate conditions and increased industrial and commercial activity?

4b. What are the current relationships of biodiversity and productivity?

Approach

- Identify, compile and archive / link to relevant data sets on EOL portal

- Produce maps for Pacific Arctic with relevant variables

- Link functionally related variables

Theme 2: Phenology of biological production cycles in relation to physical environment

Ques. 2a. How will a changing climate affect the timing, magnitude, and duration of production cycles? Ques. 2b. Will changes likely result in successful colonization and replacement of arctic endemics by subarctic populations/species?

Data needs:
Environmental Variables: Climatology, ice cover etc.

Question:
Response of production cycles and community composition to climate change

Data needs:
Prim. Production, zooplankton

Data needs-
Phys., chem. Oceanography: Nutrients, stratification

Data needs:
Time series, seasonal resolution

Data Descriptors:
Plankton, benthos abundance, biomass, taxonomic composition

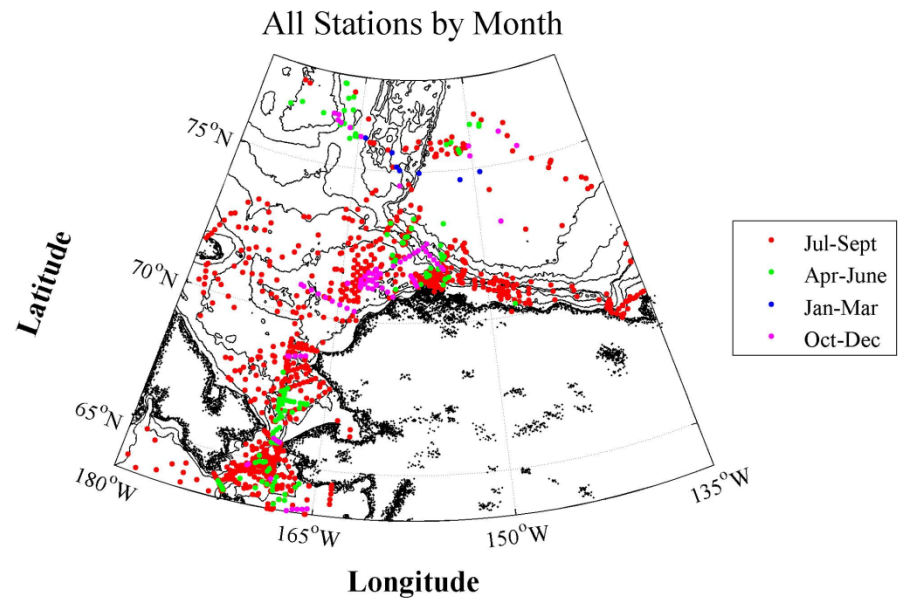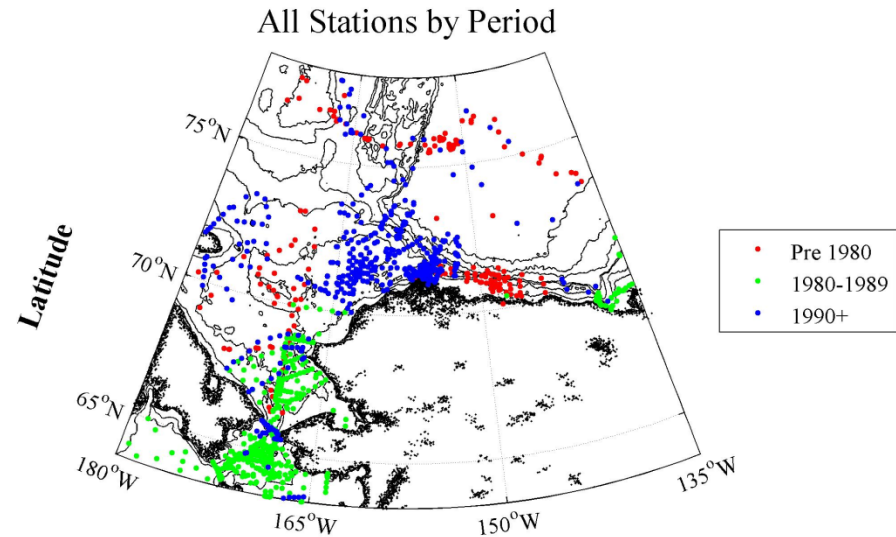# Indicator of food supply: chlorophyll distribution

- *Data sources*: Matrai et al. 2011 (bottle data), will be updated with ICESCAPE, RUSALCA, Canadian Beaufort Sea data

- Chl *a* hot spots in Hope Basin, Barrow Canyon/NE Chukchi

Integrated Chl a (100 m or bottom) (mg m^{-2})

Graph by C. Ashjian
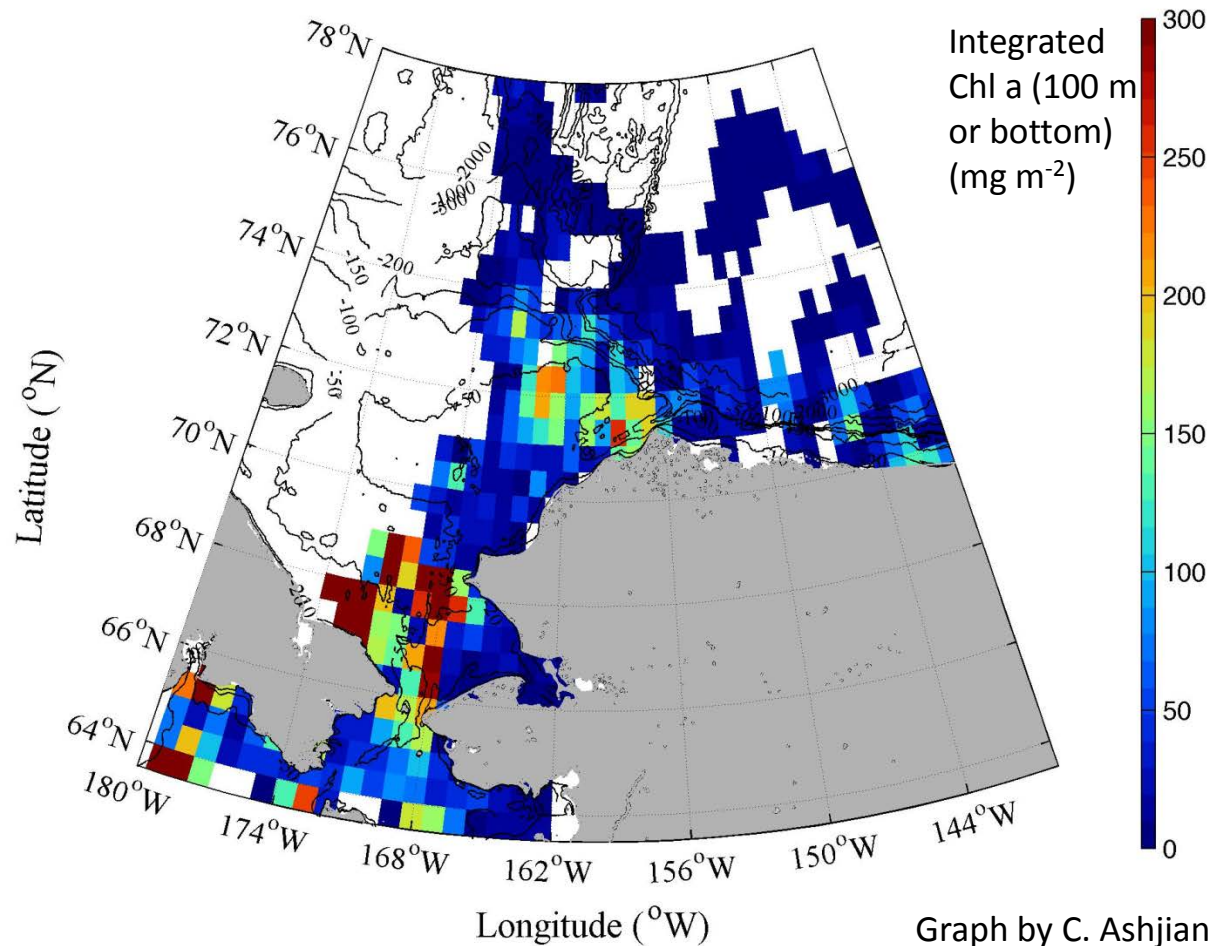
Theme 2: Phenology of biological production cycles in relation to physical environment

Indicator of food supply: zooplankton

- *Data sources*: Ashjian & Campbell, ArcOD/ Hopcroft, EOL, IOS, OBIS, et al.

- Regional foci per decade limit analysis of long-term patterns

- Goals: link with pelagic production, predator distributions and water mass tracers

All Stations by Period

•	Pre 1980
•	1980-1989
•	1990+

All Stations by Month

•	Jul-Sept
•	Apr-June
•	Jan-Mar
•	Oct-Dec

Longitude

Graphs by C. Ashjian, R. Campbell

Theme 3: Benthic-pelagic coupling in relation to physical chemical environment

Ques. 3a. Will future climate conditions alter the strength of benthic-pelagic coupling and if so, in which direction? Ques. 3b. How will keystone species be affected?

Data needs: Environmental Variables: Proxies for larger drivers

Question: Relationship between pelagic production, vertical flux, benthic hotspots, and key species distribution and activity

Data needs: Benthic community structure

Data needs- Oceanography: Current patterns, vertical flux, pelagic production

Benthic Data Descriptors: Abundance, Biomass, dominant infauna and epifauna

Data needs: Marine Mammal and Seabirds observations

Benthic infaunal biomass

- *Data sources*: Grebmeier (4 decades), Stoker, (1970s), Feder (1980s)

- Benthic infauna is indicator of benthic-pelagic coupling

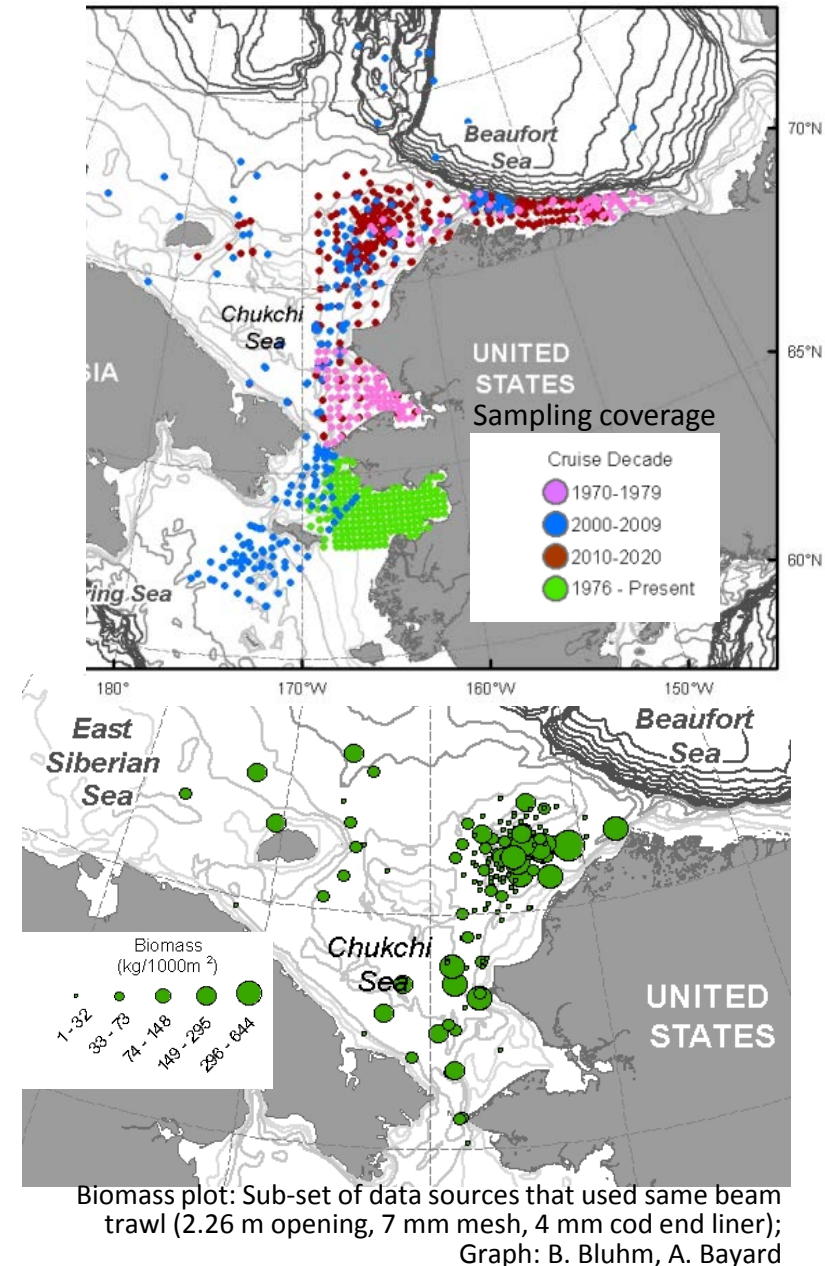- Hot spot: St. Lawrence Island Polynya, Chirikov Basin, Hope Basin, Barrow Canyon

Based on van Veen grabs, 1 mm mesh
Graph: J. Grebmeier, EOL Map Server

EOL PacMARS Map Server
Scale: 13198117
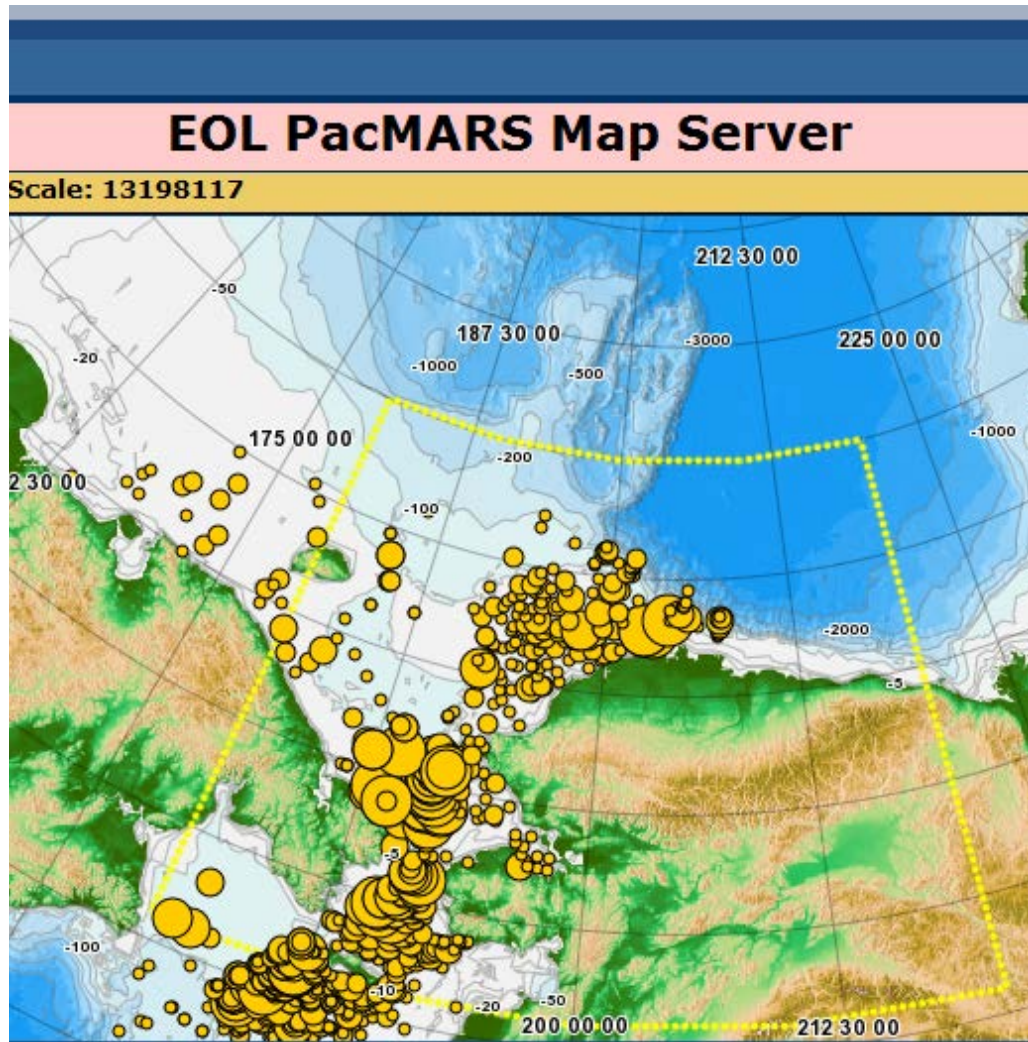
Theme 3: Benthic-pelagic coupling in relation to physical-chemical environment
Benthic epifauna biomass

- *Data sources*: WEBSEC, OCSEAP, CSESP, Feder (2005), Hidden Ocean, Norton Sound survey, RUSALCA, Oshoru Maru, COMIDA, others

- Epifauna biomass influenced by bottom T/S, sediment features, carbon supply/prey field; contribute to remineralization; mobility distributes carbon

Sampling coverage

Biomass plot: Sub-set of data sources that used same beam trawl (2.26 m opening, 7 mm mesh, 4 mm cod end liner); Graph: B. Bluhm, A. Bayard

Theme 4: Current state of lower trophic prey-base and higher trophic feeding hot spots

Ques. 4a. How will migration routes and important feeding hotspots of marine mammals and seabirds change in response to changing climate conditions and increased industrial and commercial activity? Ques. 4b. What are the current relationships of biodiversity and productivity?

Data needs: Environmental Variables: Proxies for larger drivers

Question: Responses of mammal and seabird activity to changing climate and human foot print? Biodiversity-productiviy relationships?

Data needs: Zooplankton and Benthic community structure

Data needs- Phys. & biol. Oceanography: Productivity, temperature

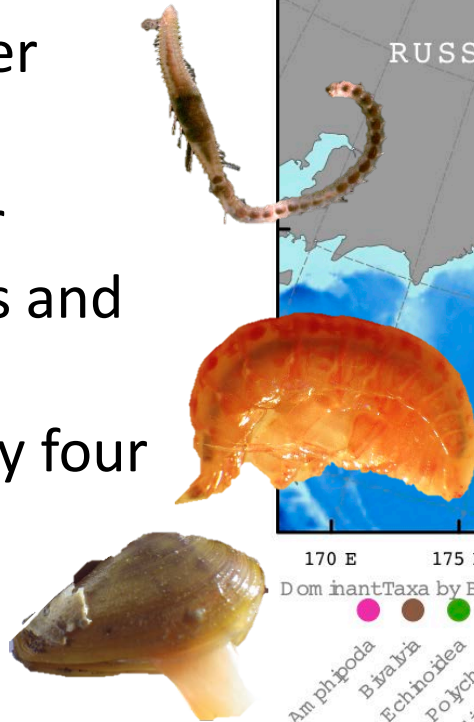**Data needs:** Marine Mammal and Seabirds observations

Data Descriptors: Abundance, Biomass, Biodiversity

Benthic community structure (infauna)

- *Data sources*: Grebmeier (1980s-present), Stoker (1970s), Feder (1980s)

- Prey base for invertebrates and vertebrates dominated by four taxon groups
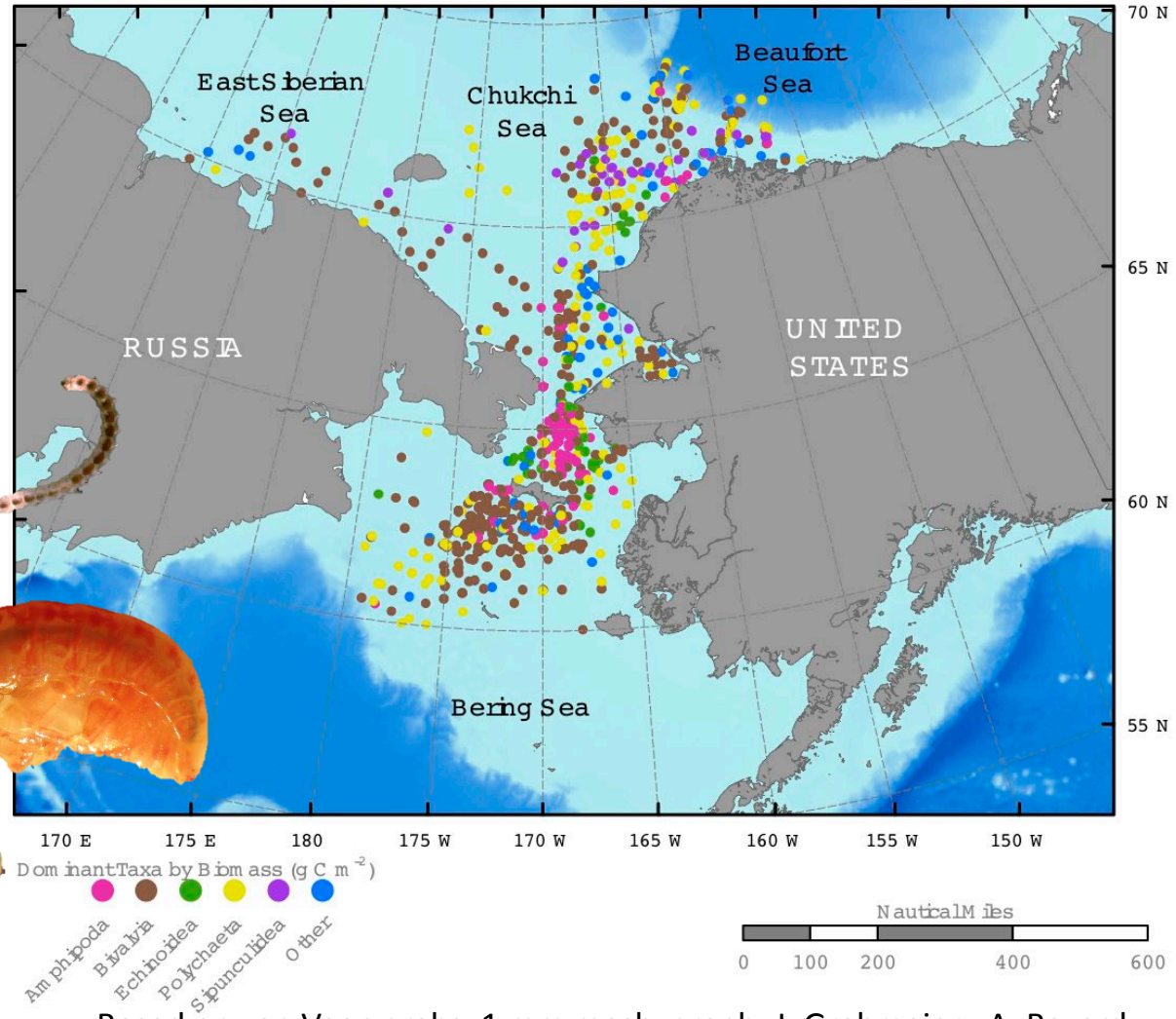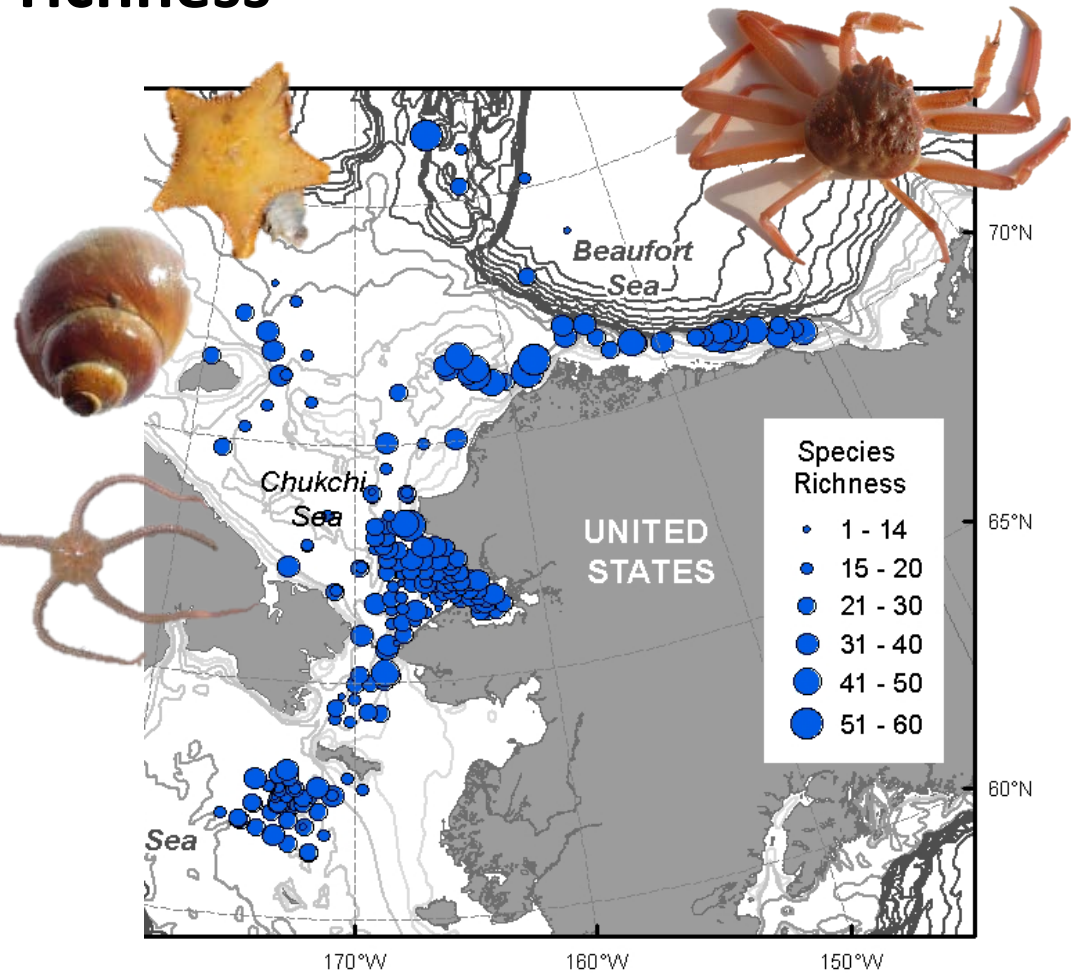

Based on van Veen grabs, 1 mm mesh; graph: J. Grebmeier , A. Bayard

Benthic community structure: epifaunal species richness

- *Data sources:* Blanchard, Bluhm/Iken, Feder, Frost & Llowry, Lovvorn

- Goal: link benthic biodiversity data to productivity gradients to anticipate future diversity changes
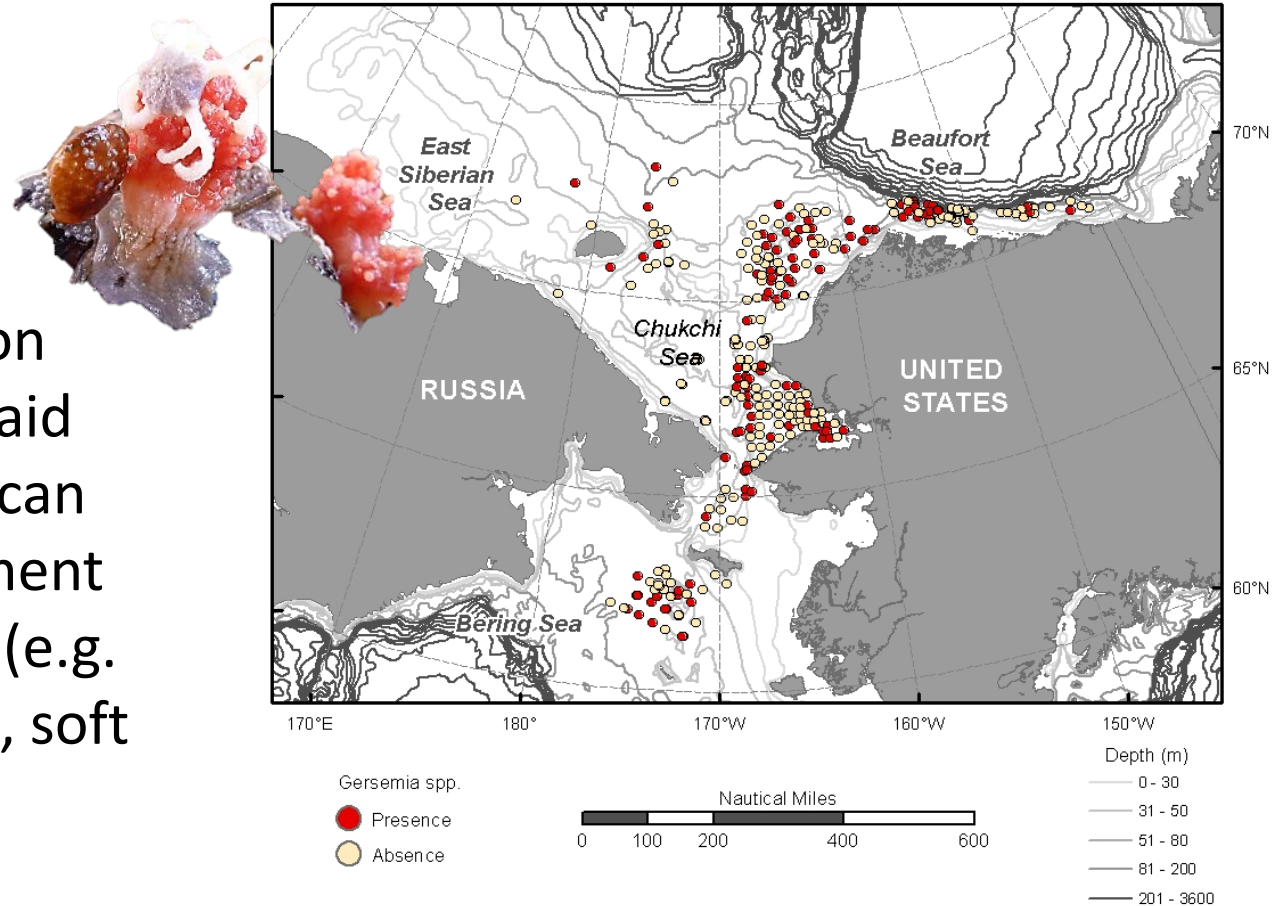

Preliminary!   Graph by B. Bluhm, A. Bayard

Species of particular concern

- Data sources: as previous slide & Logerwell, Konar

➡ Geo-referenced species distribution maps (to be overlaid on habitat maps) can support management and conservation (e.g. crabs, sea urchins, soft corals, fishes)
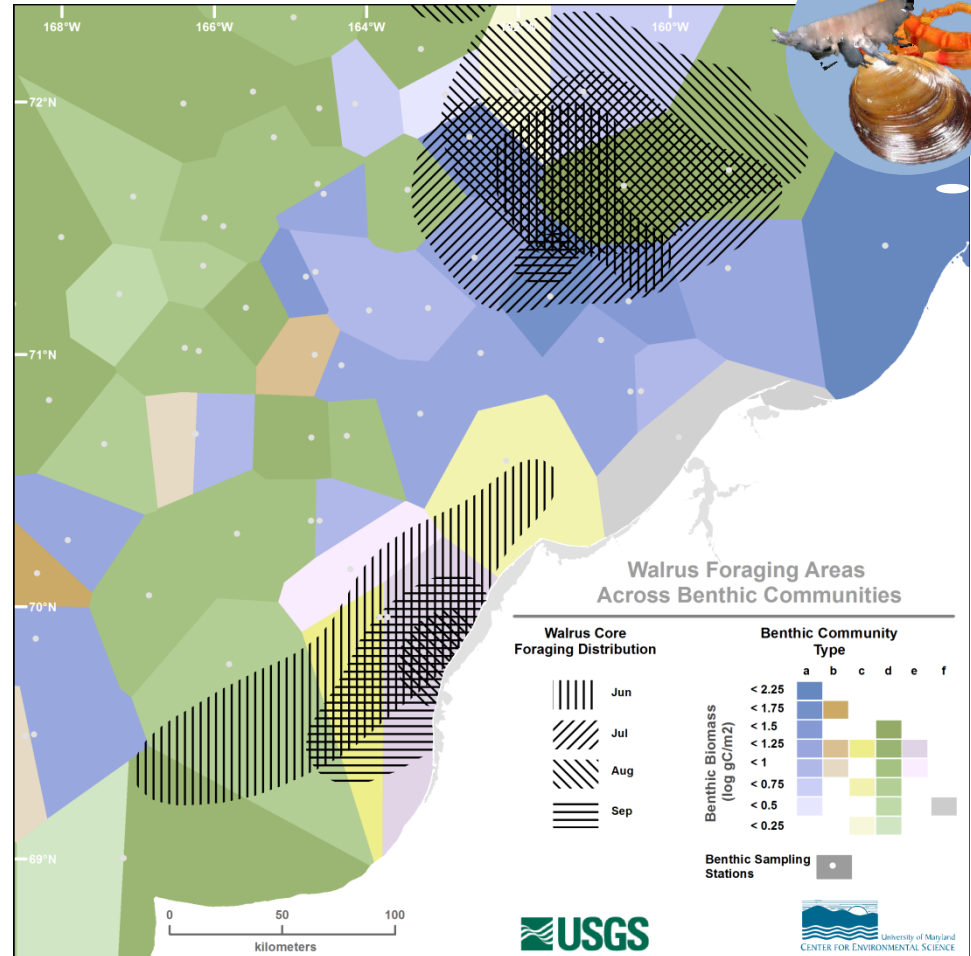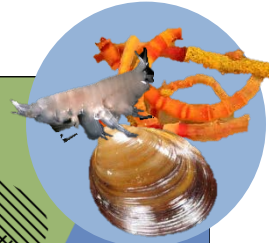

Graph by Bluhm and Bayard

Feeding hot spots: Walrus habitat use 1

- *Data sources*: Grebmeier (4 decades); Jay, Fischbach (USGS)

- Satellite-tagged walrus movements over benthic communities identifies feeding sites in different benthic community types
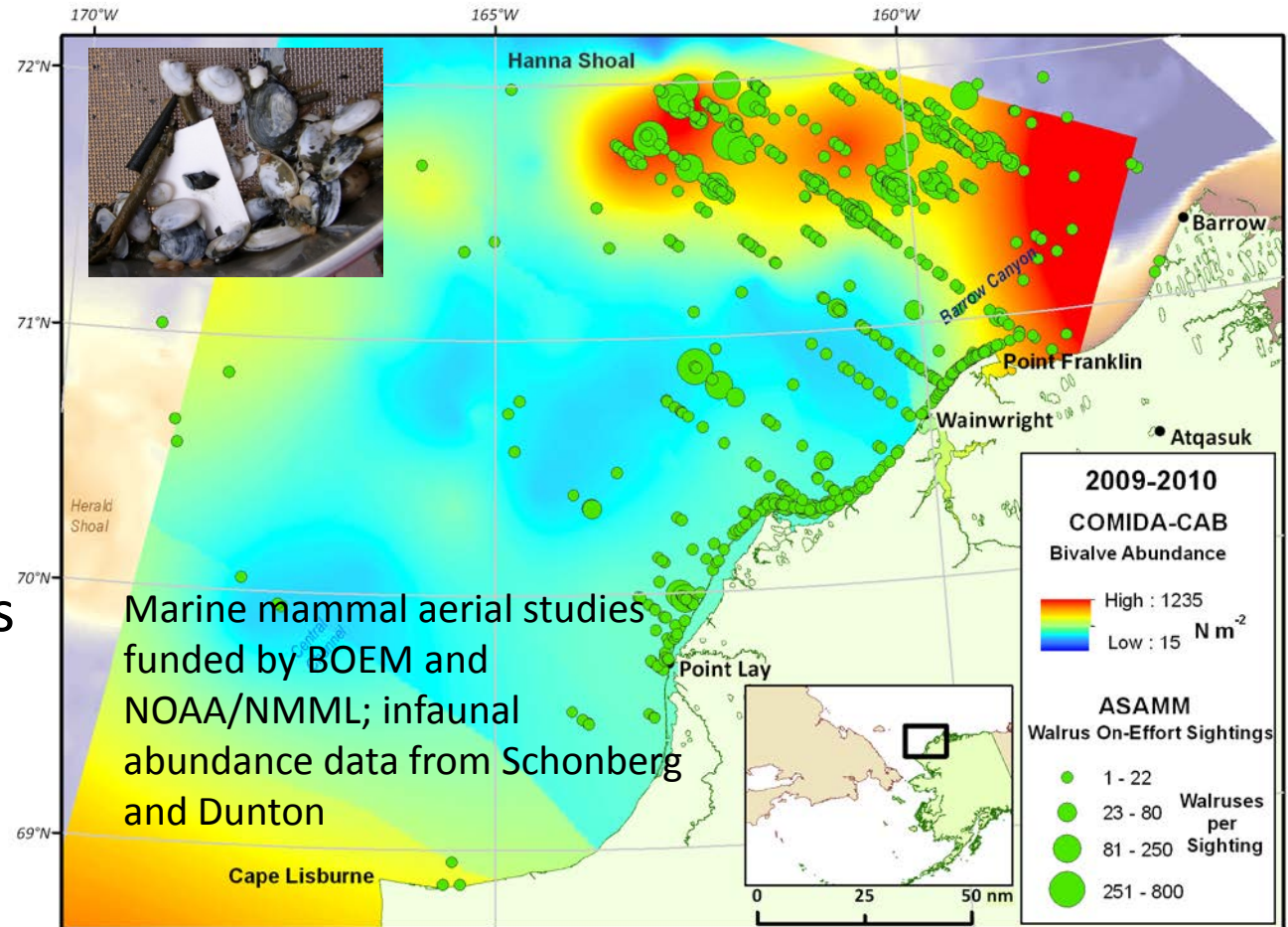
Graph by Jay, Fischbach, Grebmeier
Photos: Bluhm, Iken, Voronkov, www.alaska-in-pictures.com, www.invertebrates.si.edu

Feeding hot spots: Walrus habitat use 2

- *Data sources*: NOAA/NMML, Schonberg and Dunton

- Habitat utilization: High density of walrus sightings in area of high bivalve density


Marine mammal aerial studies funded by BOEM and NOAA/NMML; infaunal abundance data from Schonberg and Dunton

Graph by Schonberg and Dunton

Gray whale habitat use

- *Data sources*: NOAA/NMML, Schonberg and Dunton

- Habitat utilization: High density of gray whale sightings in area of high amphipod density

Marine mammal aerial studies funded by BOEM and NOAA/NMML; amphipod abundance data from Schonberg and Dunton
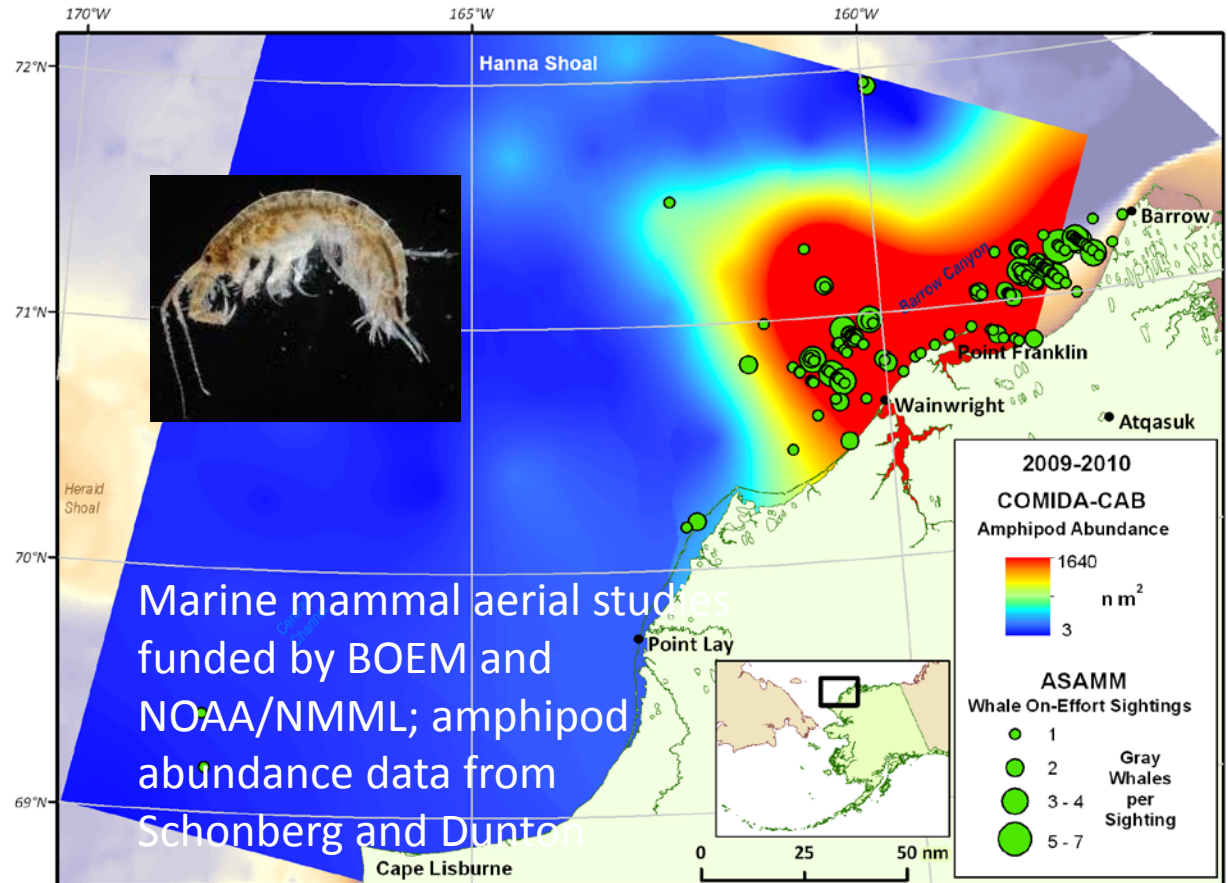
Graph by Schonberg and Dunton

Food web: Stable isotopic data coverage

- *Data sources*: Schell, Saupe, Dunton, Cooper, Iken/Bluhm, Naidu et al.

- Data provide information on the relative importance of marine versus terrestrial carbon sources, water mass influences, food webs and benthic-pelagic coupling
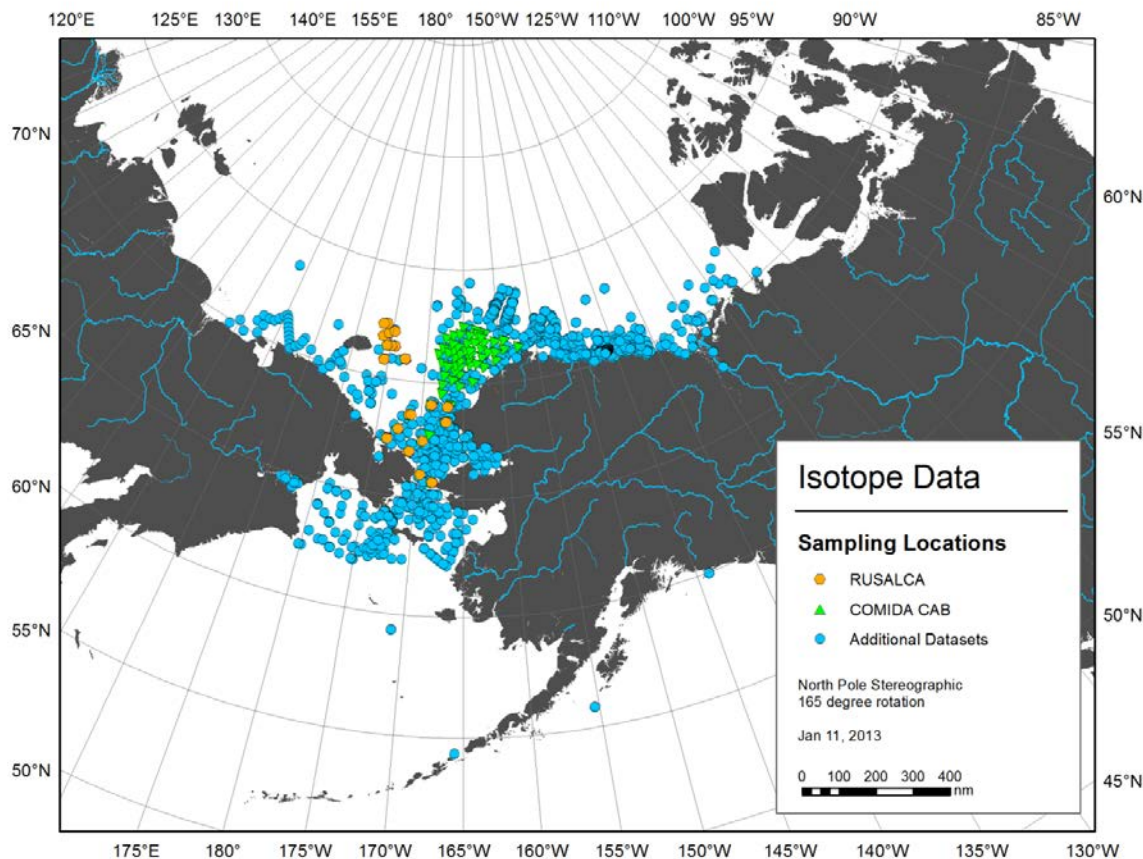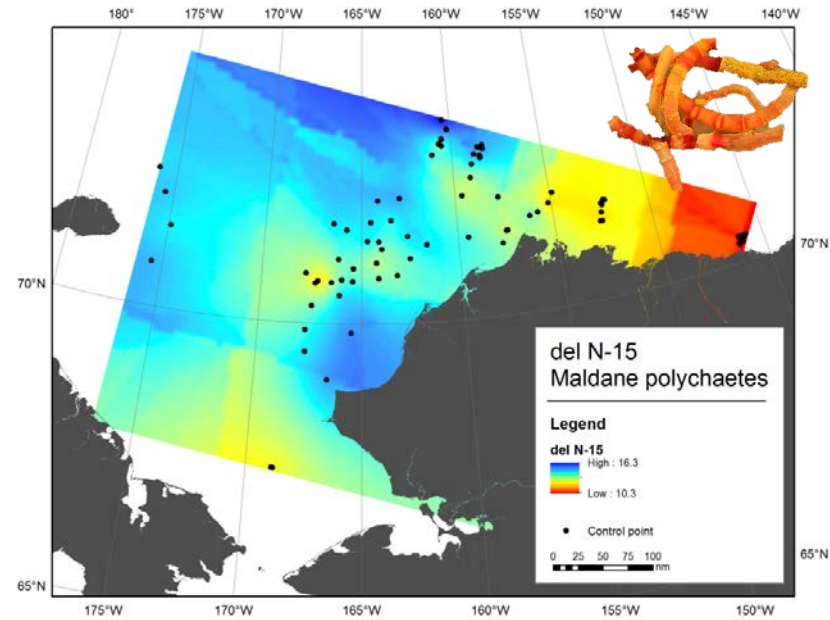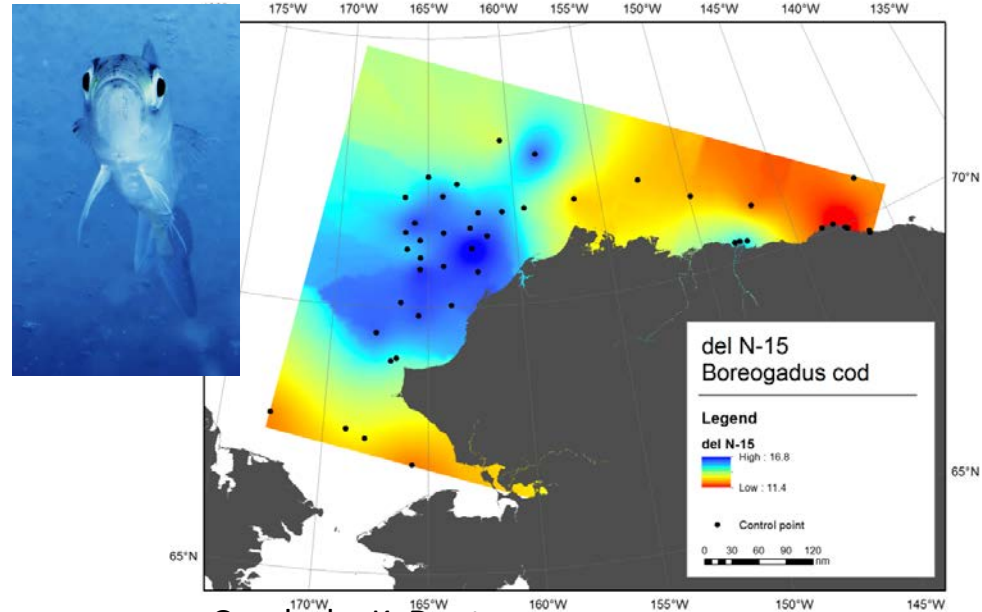

Graph by K. Dunton, T. Whiteaker

Longitudinal trends in consumer isotopic values

- *Data sources*: Dunton

- Increasing dependence of both lower (benthic polychaetes) and upper trophic (pelagic carnivorous arctic cod) level consumers on terrestrial organic matter based on decreased N isotopic values.

del N-15
Maldane polychaetes

Legend
del N-15
High : 16.3
Low : 10.3
• Control point
0 25 50 75 100
nm

Photograph by S. Harper

del N-15
Boreogadus cod

Legend
del N-15
High : 16.8
Low : 11.4
• Control point
0 30 60 90 120
nm

Graphs by K. Dunton

What's coming?

- Continue data compilation through late Feb

- Synthetic analysis Mar-May

- Describe gaps and research needs

- Interim report June

- Publications thereafter

Your data can contribute to this effort! Email us!
jgrebmei@umces.edu, cooper@umces.edu

Thanks

- NPRB, F Wiese, D Dickson, Advisory Committee, E Carmack, R Ulanowicz

- EOL Team J Moore, J Scannell, D Scott et al.

- GIS wizards A Bayard, T Whiteaker et al.

- Contributors, data providers!