



← FROM MICROBES TO WHALES →

Arctic marine biodiversity

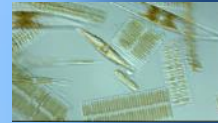
Danielson S¹, Iken K¹, Grebmeier J², Cooper L², Mueter F¹, Hopcroft R¹, Stafford K³, Kuletz K⁴, Collins E¹, Bluhm BA^{1,5}, Moore S⁶, Buckelew S⁷, Bochenek R⁷

(1) University of Alaska Fairbanks; USA; (2) University of Maryland, USA; (3) University of Washington, USA; (4) US Fish and Wildlife Service, USA; (5) University of Tromsø, Norway; (6) National Oceanographic and Atmospheric Administration, USA; (7) Alaska Ocean Observing System/AXIOM, USA

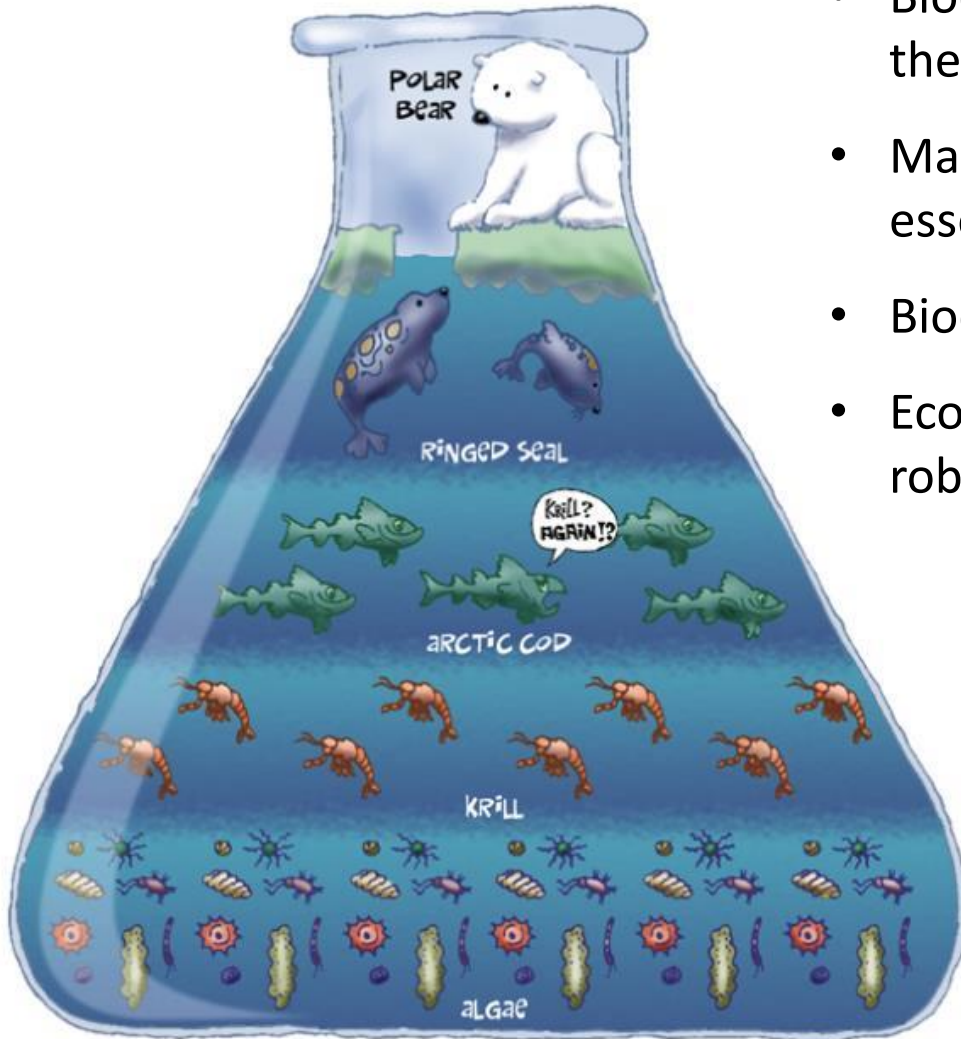


Arctic Marine Biodiversity Monitoring Network: AMBON

- **Measure marine biodiversity (species richness and distribution) in the Chukchi Sea**
- Relate species distributions to the physical environment
- Develop a sustainable model for biodiversity monitoring
- Build on and continue other projects:
 - Chukchi Sea Environmental Studies Program (CSESP)
 - Distributed Biological Observatory (DBO)
 - Russian-American Long-term Census of the Arctic (RUSALCA)
 - Arctic Integrated Ecosystem Research Program (AIERP)

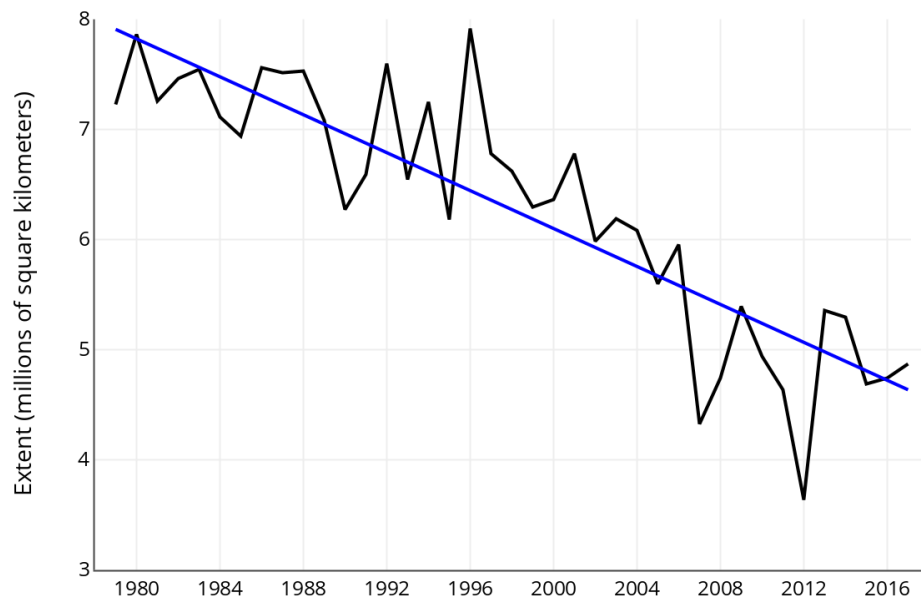


Why do we care about biodiversity ?

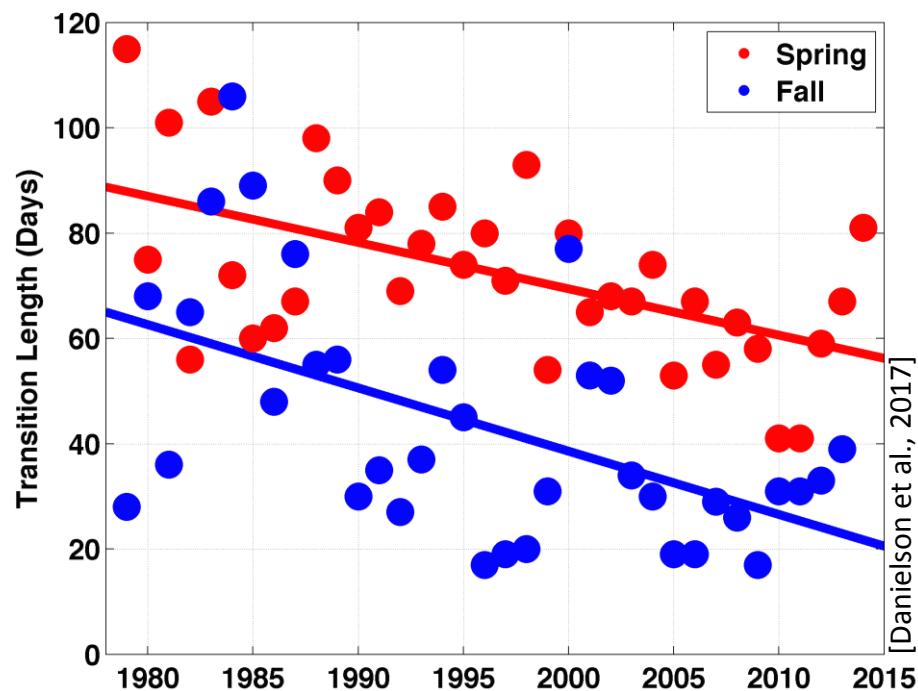


- Biodiversity = number of species and their abundance and distribution
- Marine biological diversity is an essential component of ocean health
- Biodiversity is related to productivity
- Ecosystems with high biodiversity are robust to changes

Arctic changes: diminishing Arctic ice cover



**September Sea Ice Extent
1979-2017**

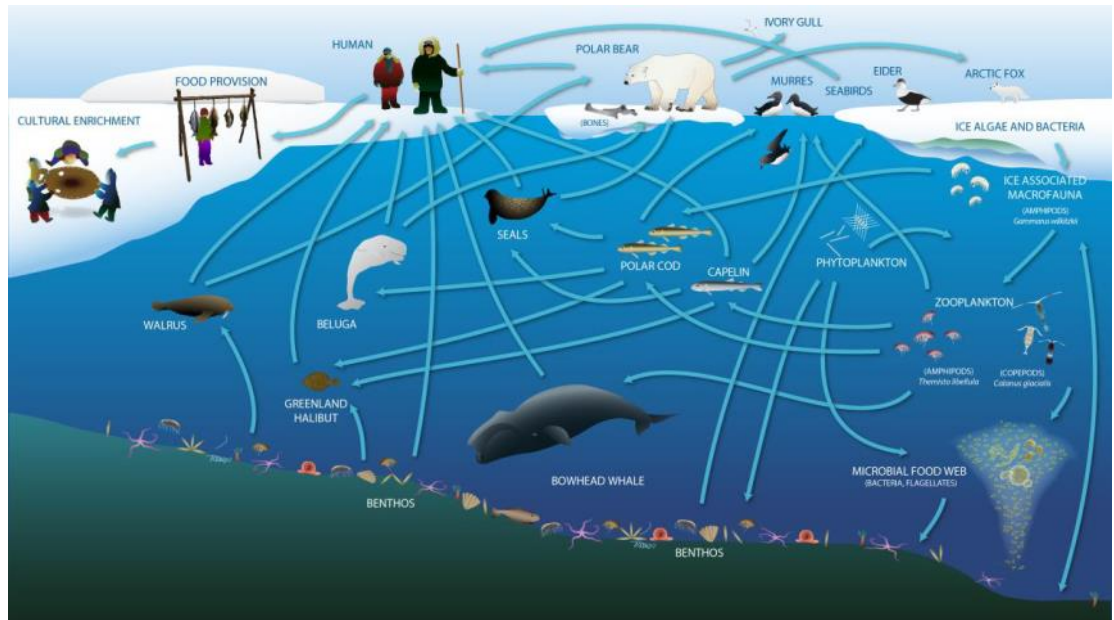


**Duration of ice retreat
1979-2014**

National Snow and Ice Data

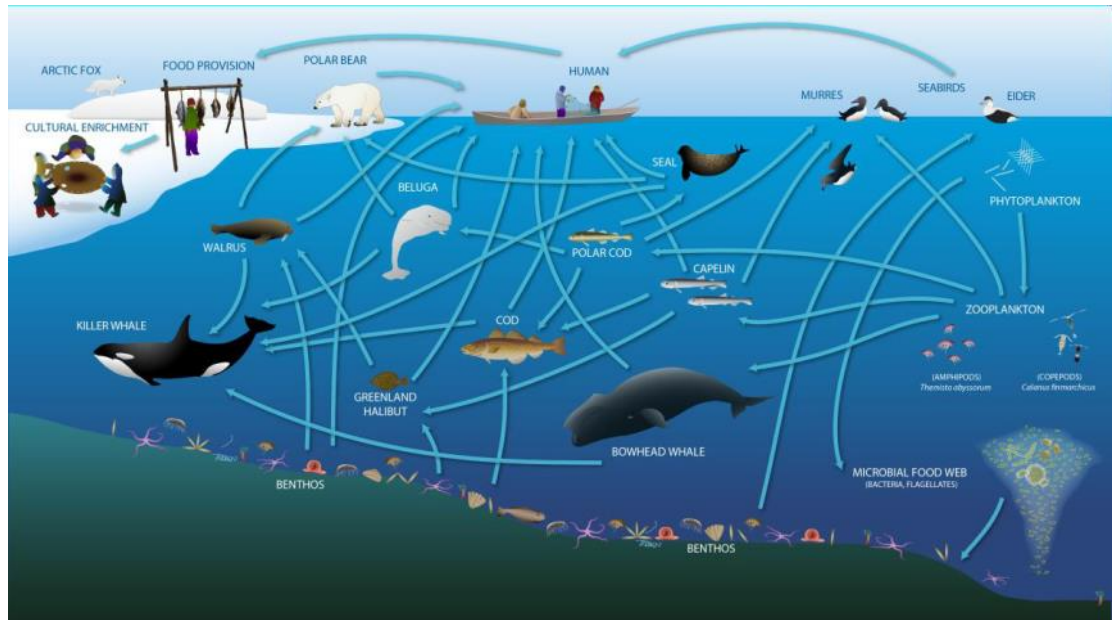
Arctic changes through the Food Web

Arctic food webs with ice cover



Environmental change leads to food web reorganizations

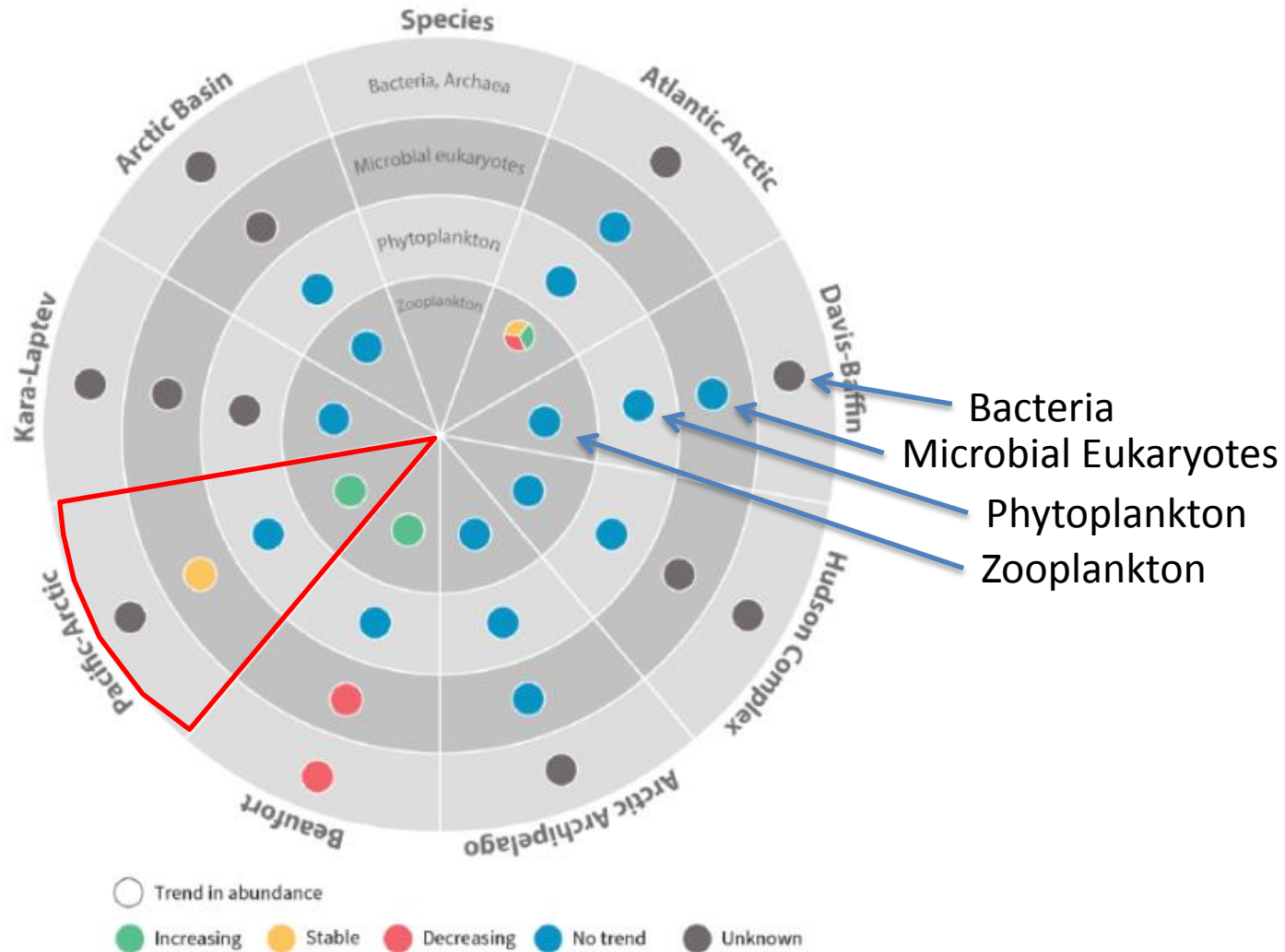
Changing Arctic food webs without ice cover



Knowledge of Arctic biodiversity

Trend in Abundance

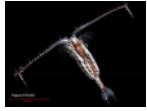
Plankton



Knowledge of Arctic biodiversity



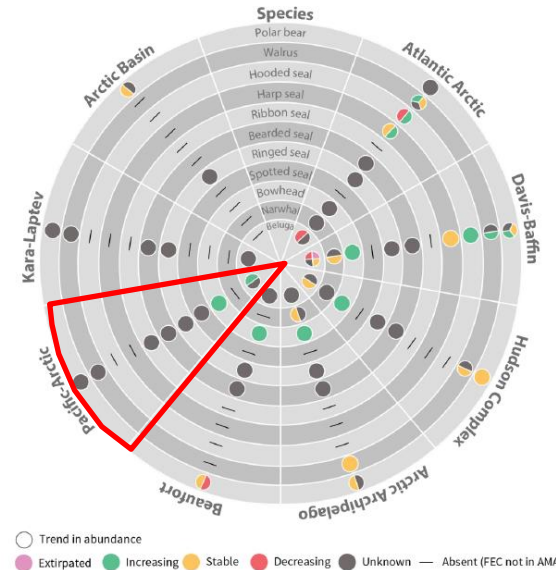
Plankton



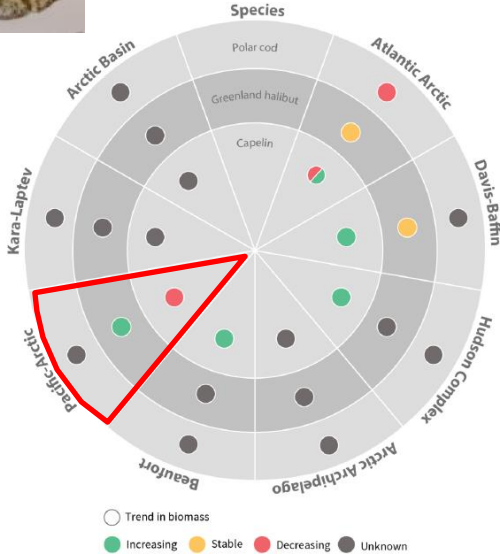
Benthos



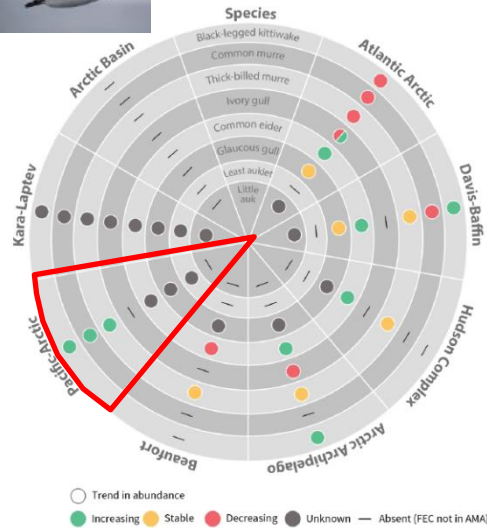
Marine mammals



Fish

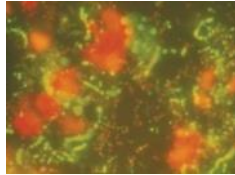
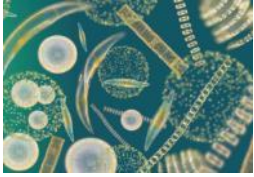


Seabirds



What AMBON measures

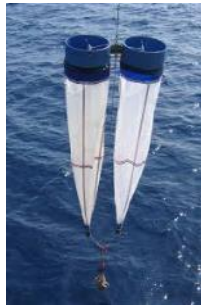
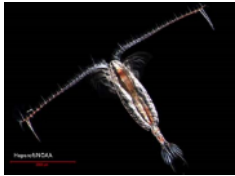
Microbes



Physical & Chemical Environment



Plankton



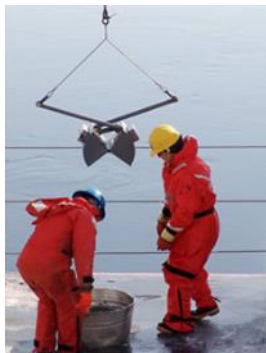
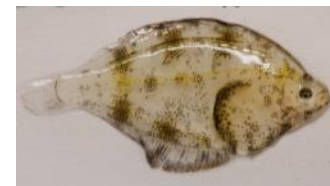
Seabirds & marine mammals



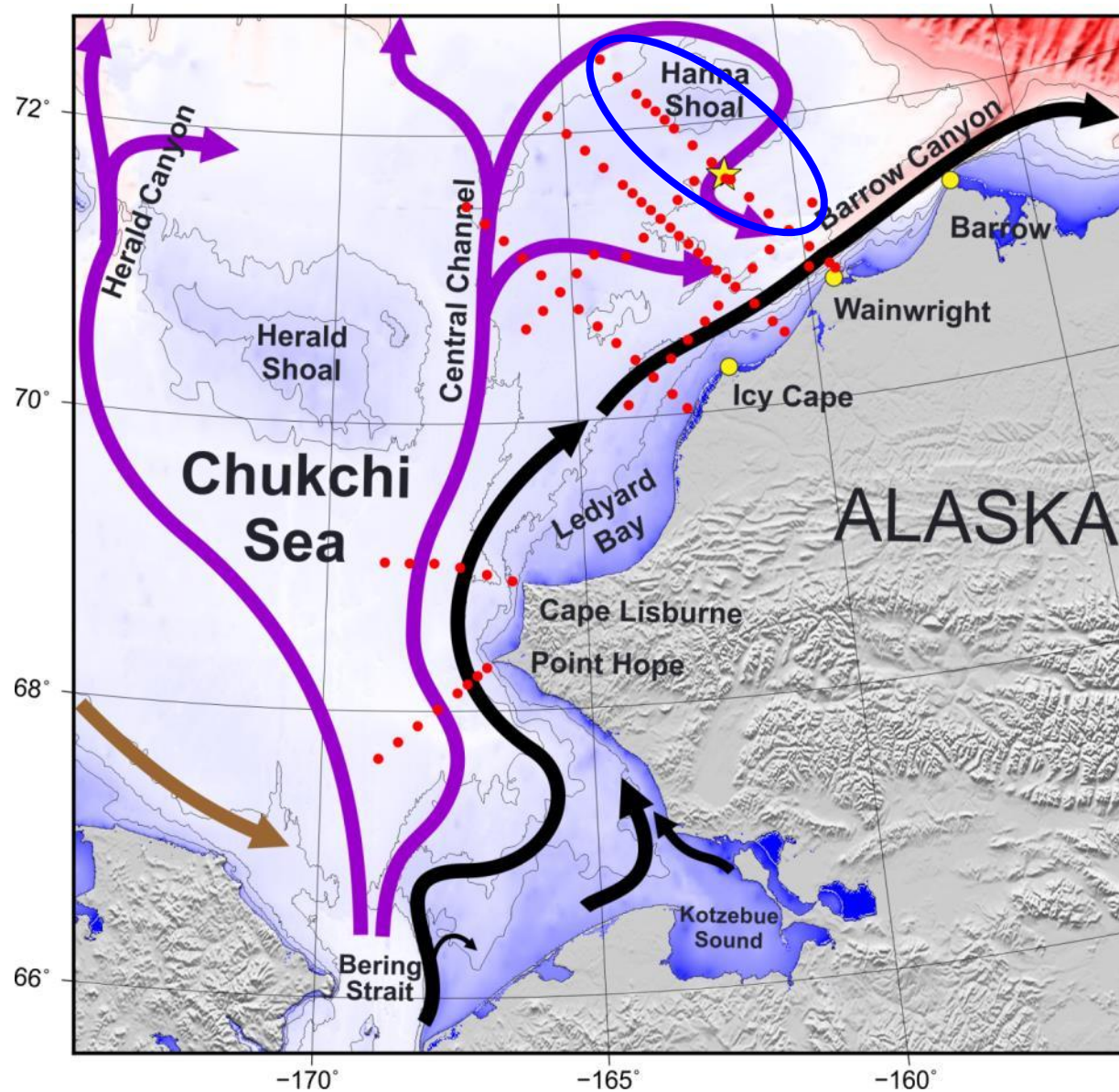
Seafloor organisms



Fish



Hydrography in AMBON region

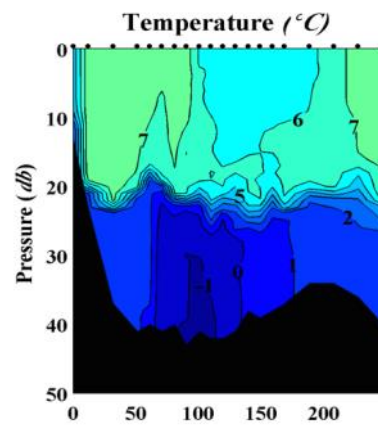
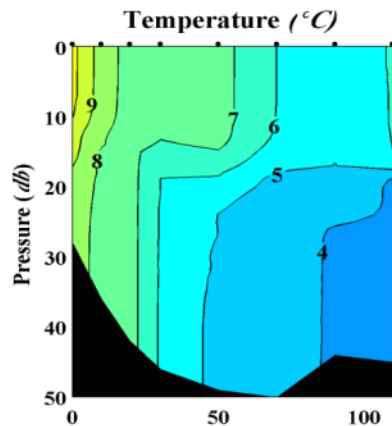
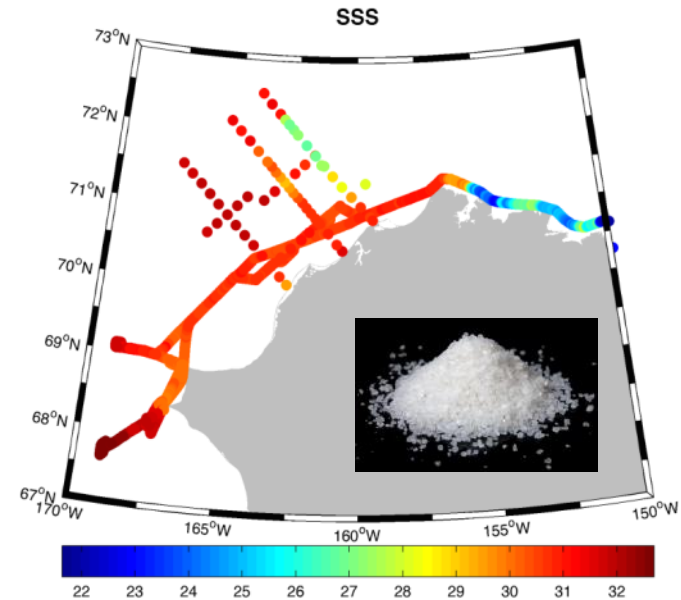
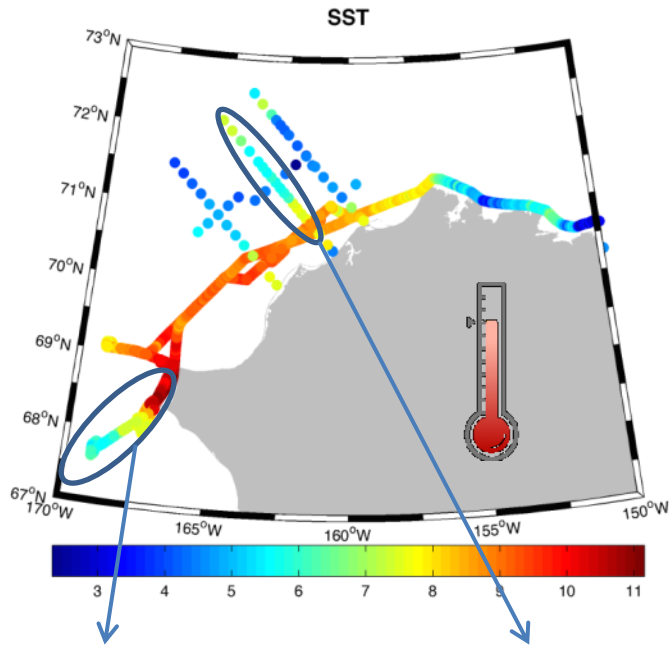


Arctic Water
Very Cold

BSW
Salty
Colder
Nutrient rich

ACW
Less salty
Warmer
Less nutrients

AMBON 2015

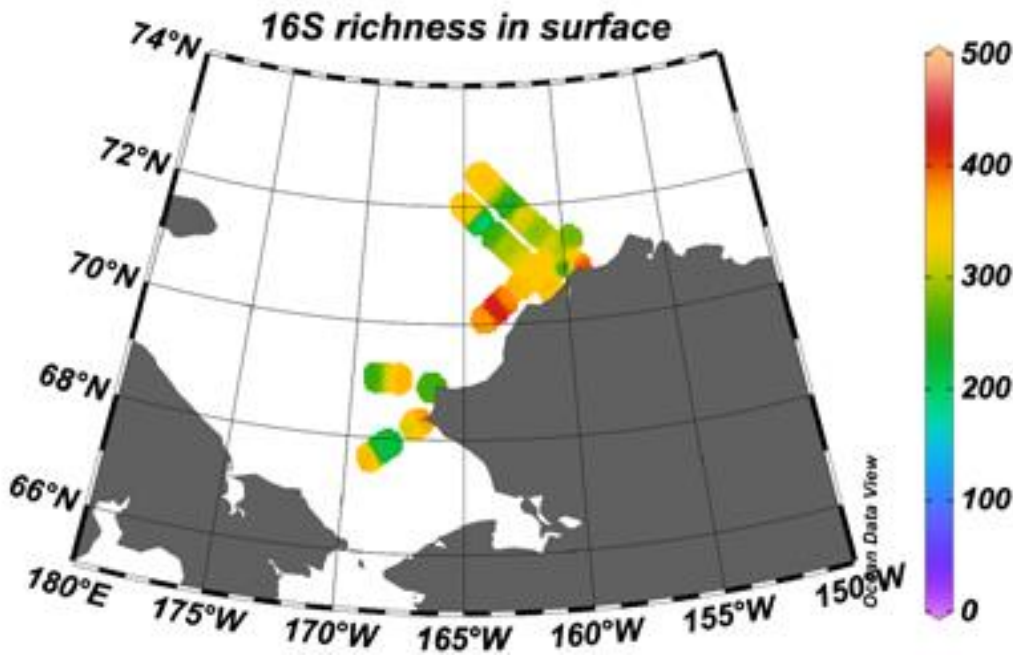


Temperature & salinity structure determined by ocean currents and annual cycles of heating and cooling.

Inshore-offshore gradients

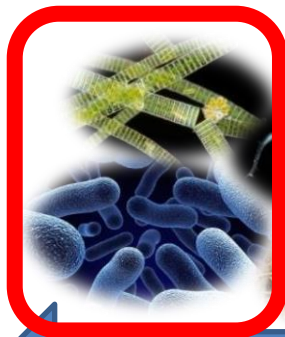
Vertical stratification

Microbe diversity



- Orders of magnitude higher bacterial diversity than other single-celled taxa such as phytoplankton
- Strong association of many species to water mass characteristics (depth, nutrients)

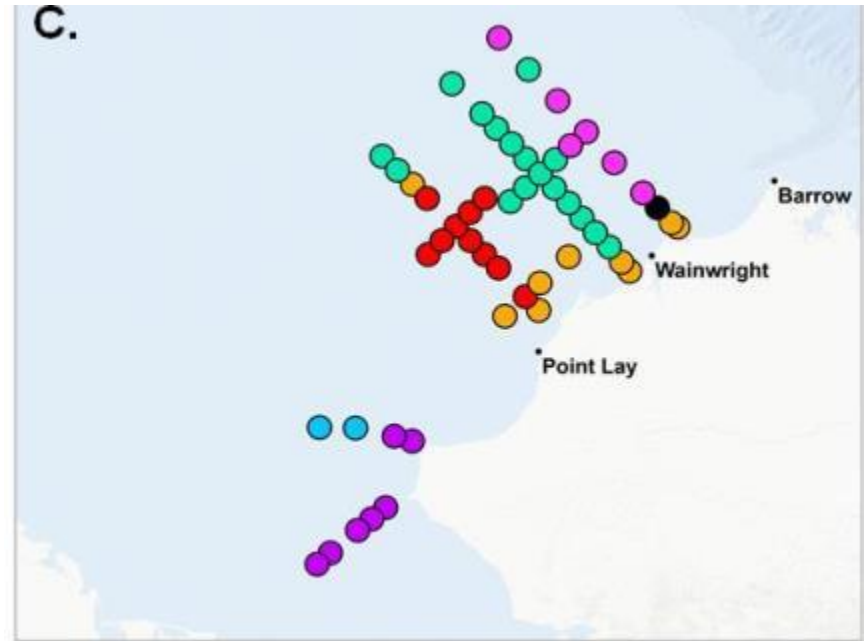
Microbes



FROM MICROBES TO WHALES

Zooplankton communities

- Zooplankton strongly structured by water mass characteristics
- AMBON adds to 10-year time series on zooplankton = understanding of what is the “normal range”

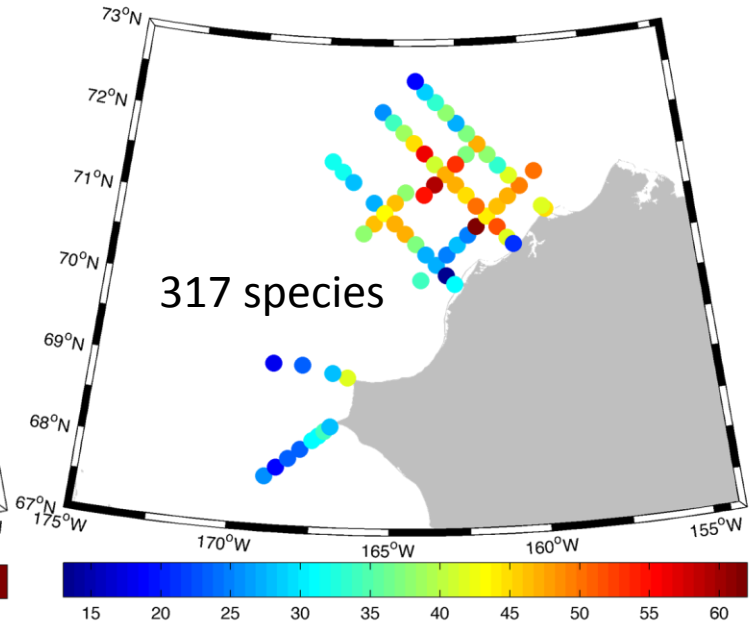
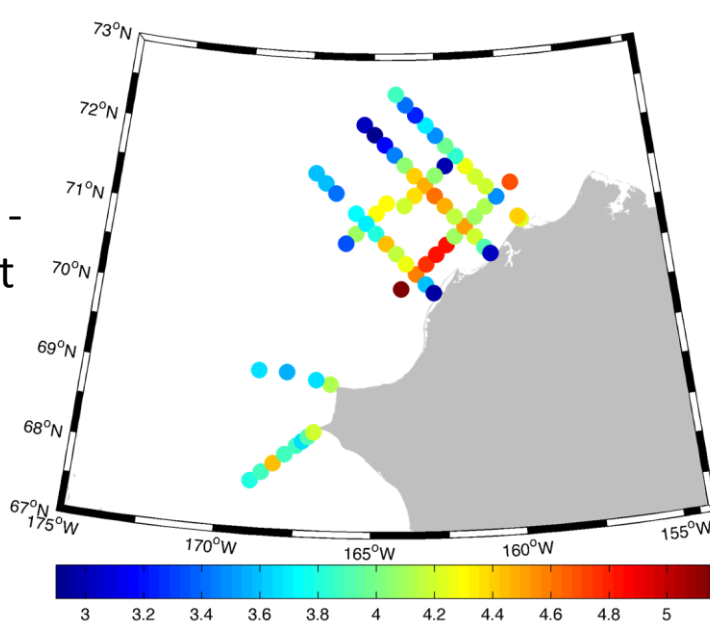


Zooplankton



Seafloor communities

- Spatially variable
- Biomass from 0.8 - 153 kg wet weight 1000 m⁻²



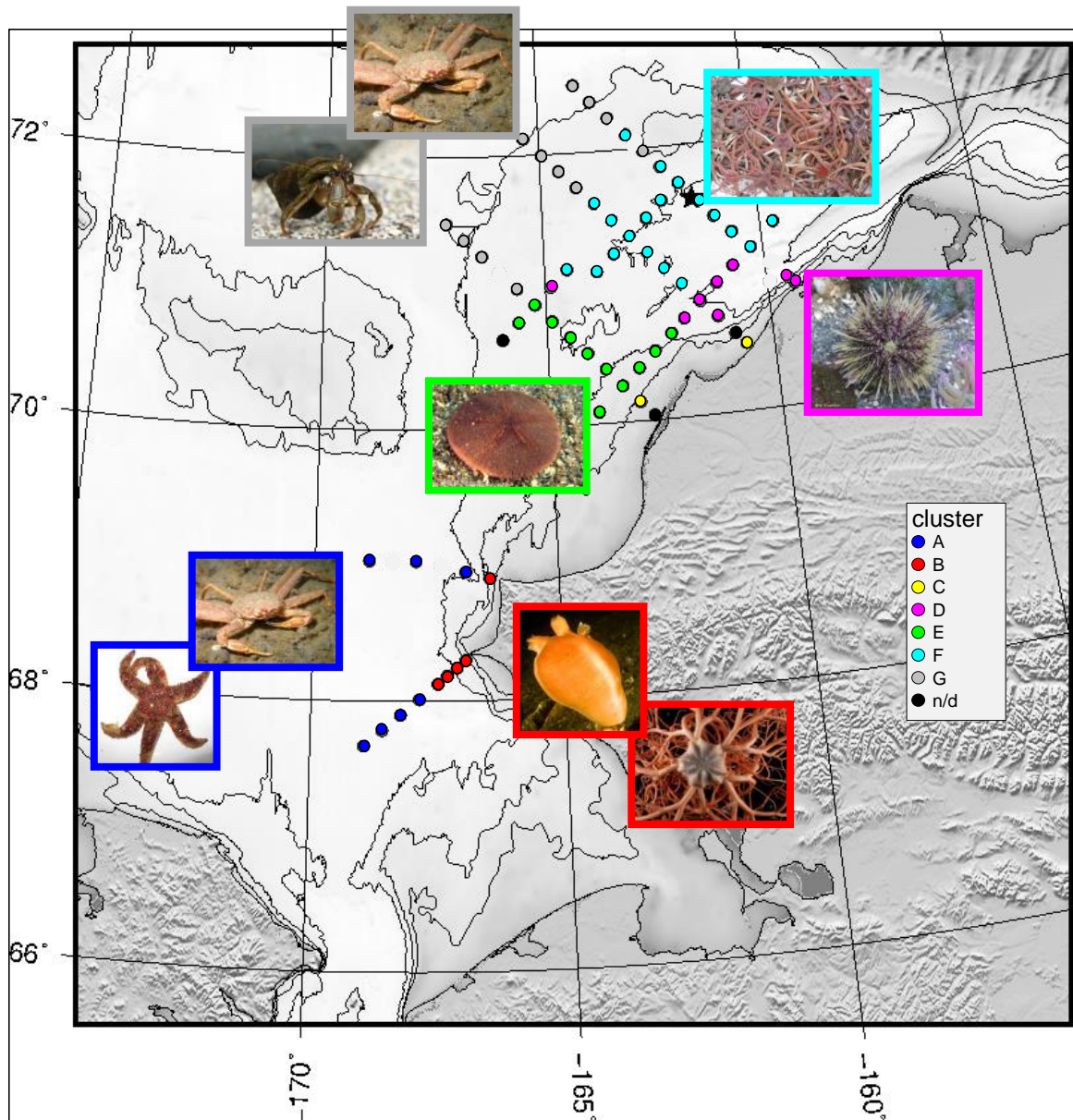
Biomass
(log₁₀ g wet weight 1000 m⁻²)

Species richness per station

Seafloor benthos



Seafloor communities

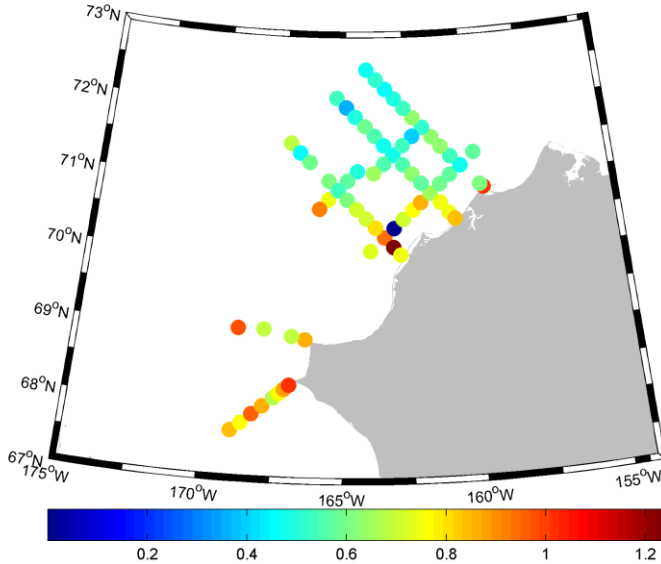


Distinct community groupings:

- by water mass (inshore – offshore, south-north)
- by sediment characteristics (inshore – offshore)

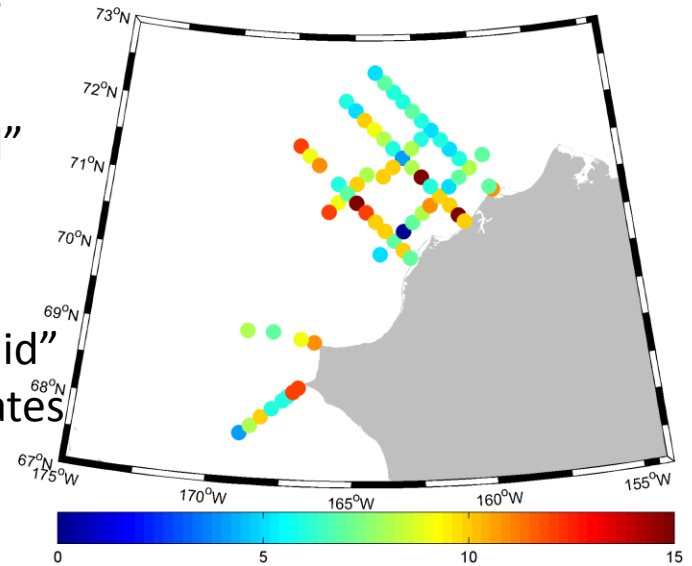
Fish communities

Biomass



- More biomass and species at the southern stations
- More “arctic” species in the north, more “boreal” species in the south
- Distinct community groupings but more “fluid” than seafloor invertebrates

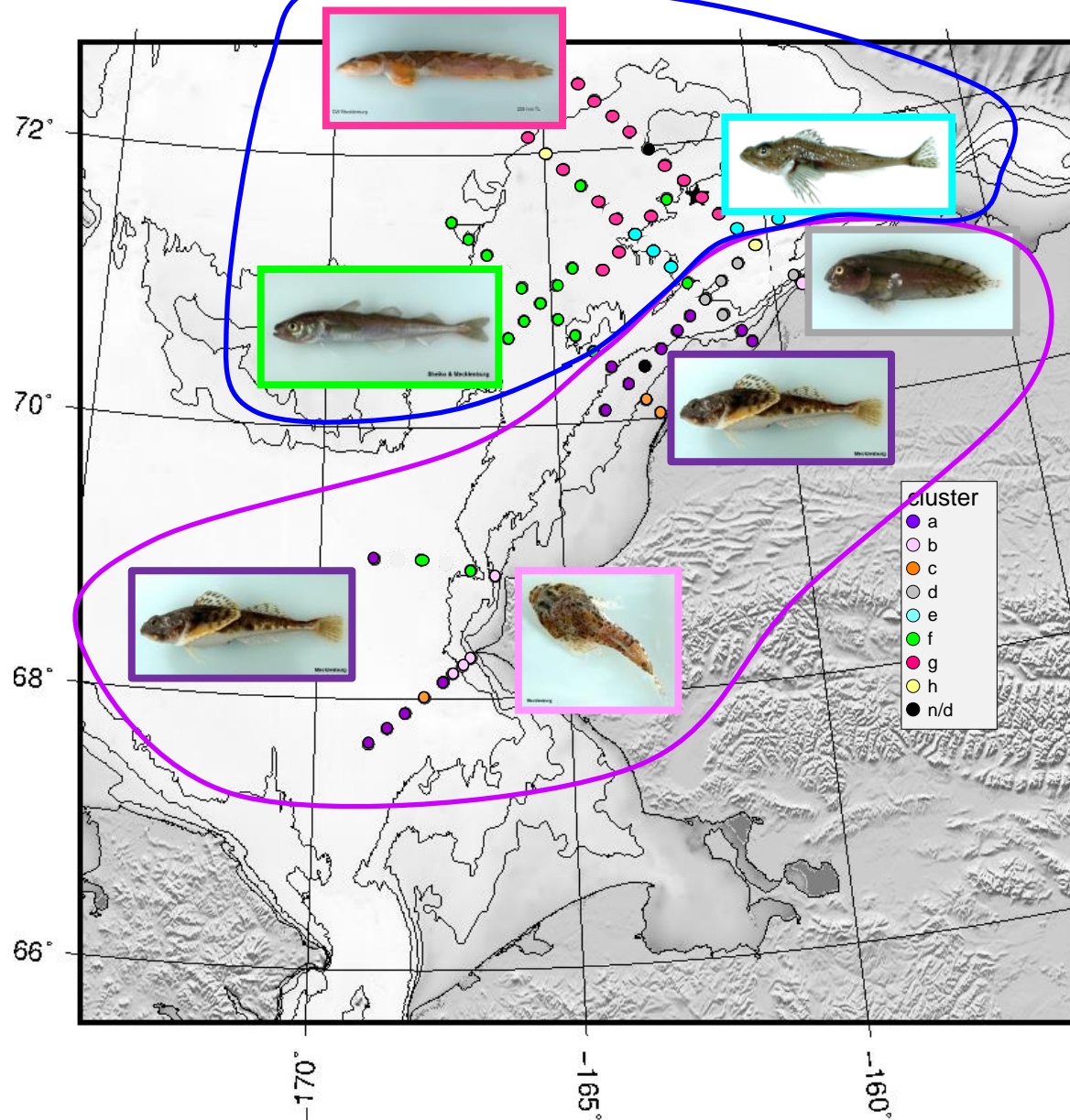
Species Richness



Fishes



Fish communities



Arctic species

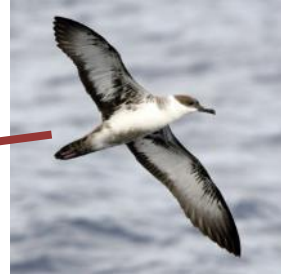
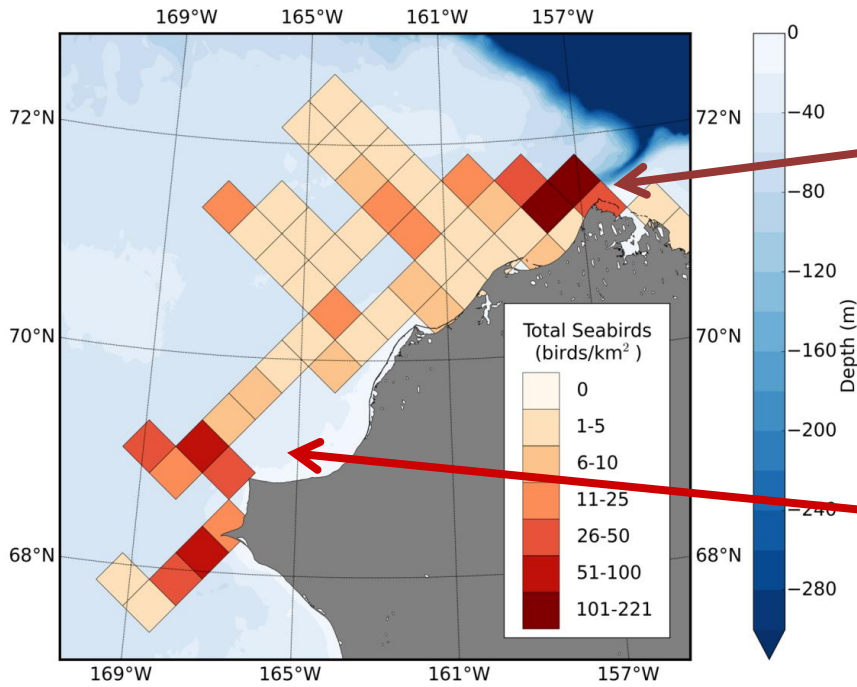
North and offshore



Boreal species

South and nearshore

Seabirds



Surface feeder:
e.g., shearwaters

**Separation by habitat
and feeding type, even
within the same genus**

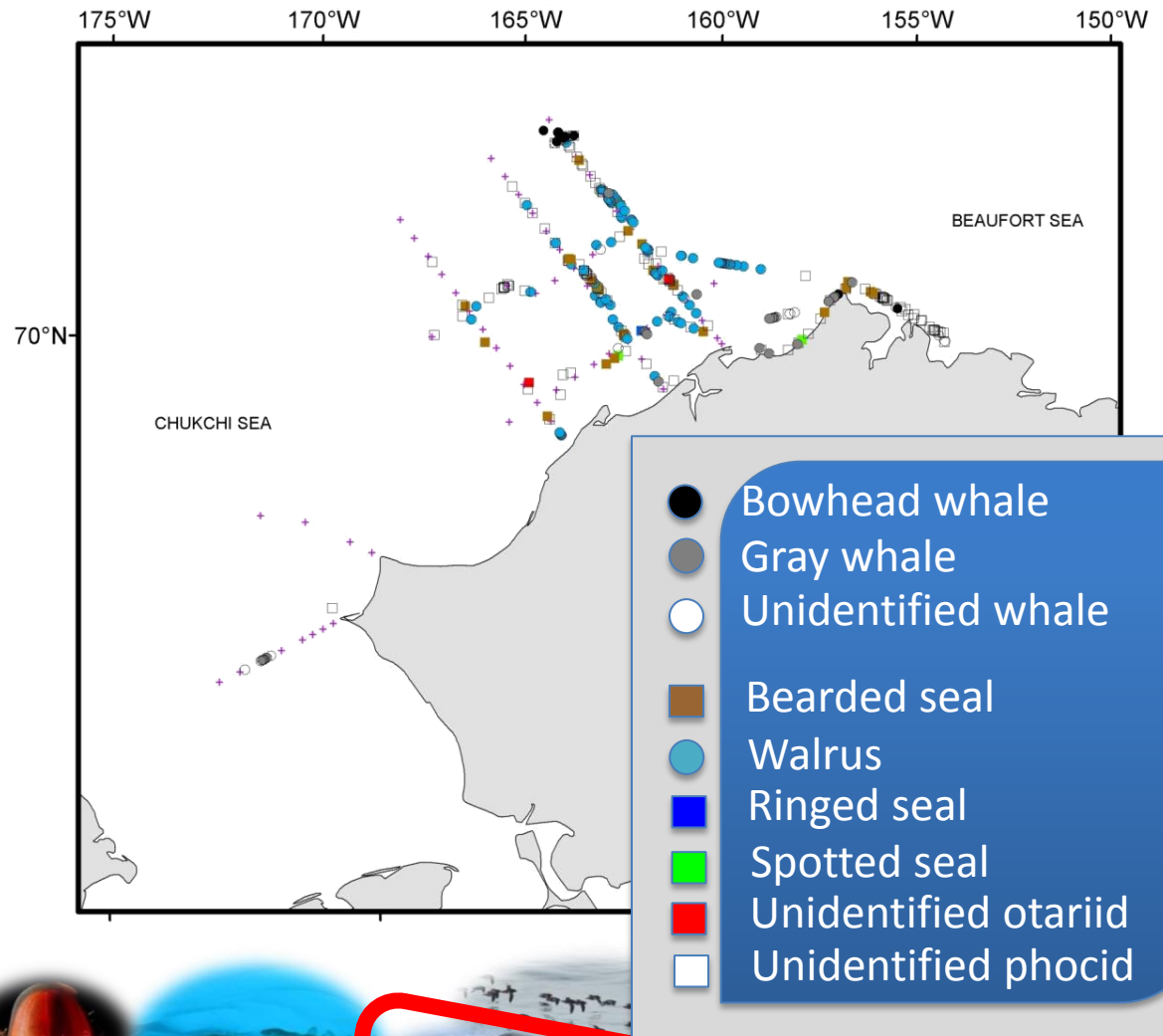


Sub-surface feeder:
e.g., least auklets



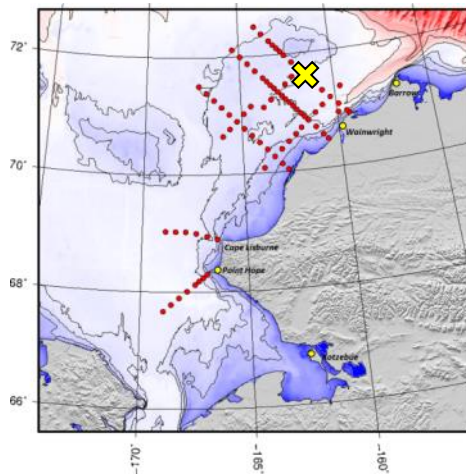
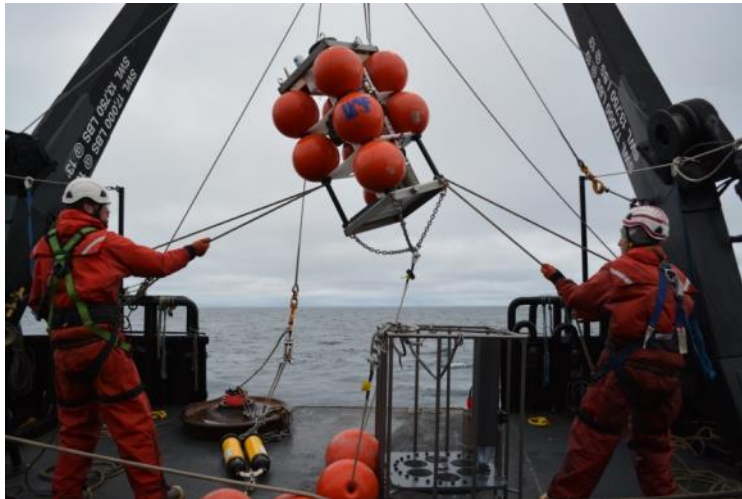
Marine mammals

- Very few mammals in southern region
- Walrus most common mammal, especially in north
- Gray whales and bowhead whales most common whales



Connecting Biodiversity to the Environment

Connecting short-term (cruise) observations with long-term (mooring) observations



Chukchi Ecosystem Observatory, CEM2-16

Latitude 71° 35.976' N Longitude 161° 31.621' W

Deployment DateGMT 4 August, 2016 Deployment TimeGMT 04:33:14

Height (Top)
-11.97 m



36 meters below surface

Xeos Locator Beacon	SN 300234063212650
SUNA V2:NO3	SN 801
Acoustic Zooplankton Fish Profiler	SN 55063
SeaCAT (P/T/S)	SN 4604
(PAR 70612 /Triplet 1417)	
SeapHOx (P/T/S/pH/Ox)	SN 1340
HydroC (pCO2)	SN BAT-7S12P-0416-001
LISST	SN 1557

2.54 meters 3/8" line
2 14" Vinny floats

S-L-S

-7.615 m



Sediment Trap SN 1140315

S-L-S

1.74 meters 3/8" line
2 14" Vinny floats

S-L-S

-3.065 m



Acoustic Releases:

Dual Push-Off Release Transponders

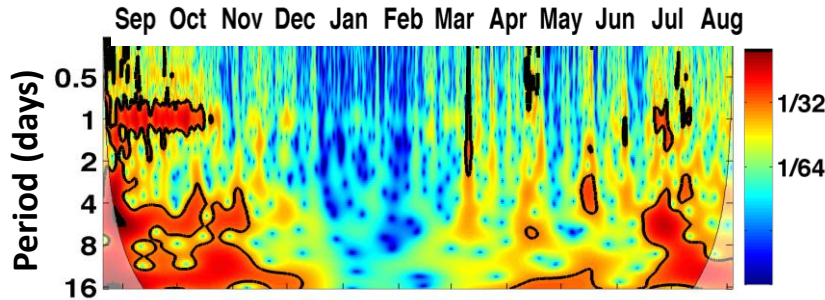
SN#1	36429	SN#2	36430
Enable	414254	Enable	414306
Disable	414277	Disable	414325
Release	431712	Release	431731

Anchor at depth of 48 meters

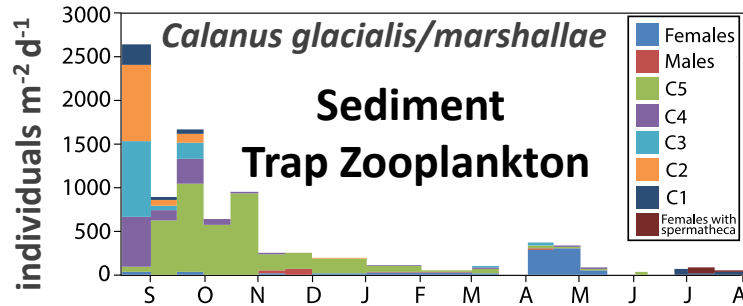
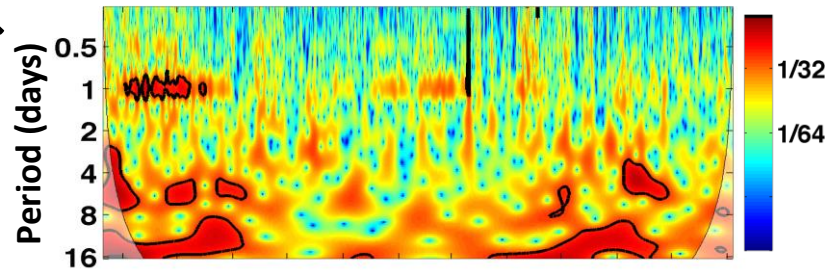
www.chukchiecosystemobservatory.org

2015-2016

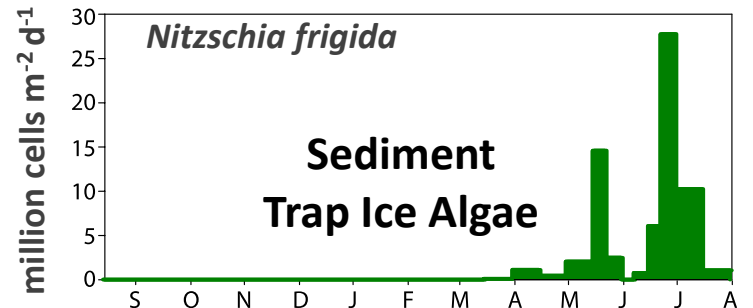
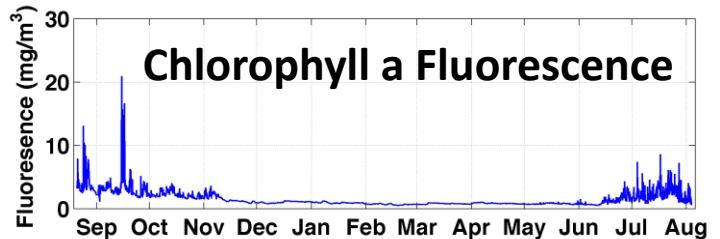
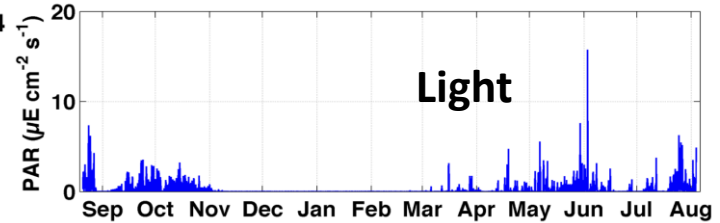
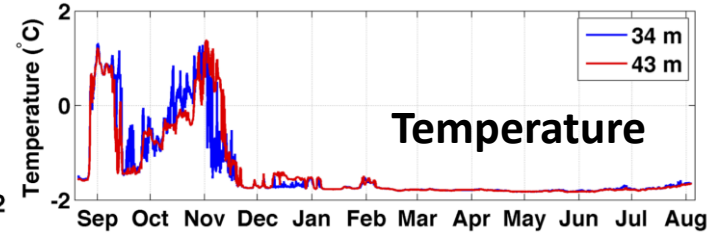
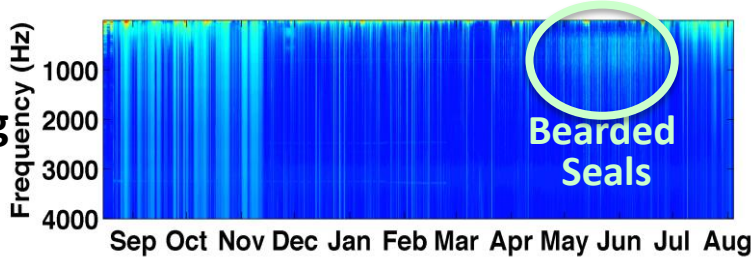
Fish



Zooplankton

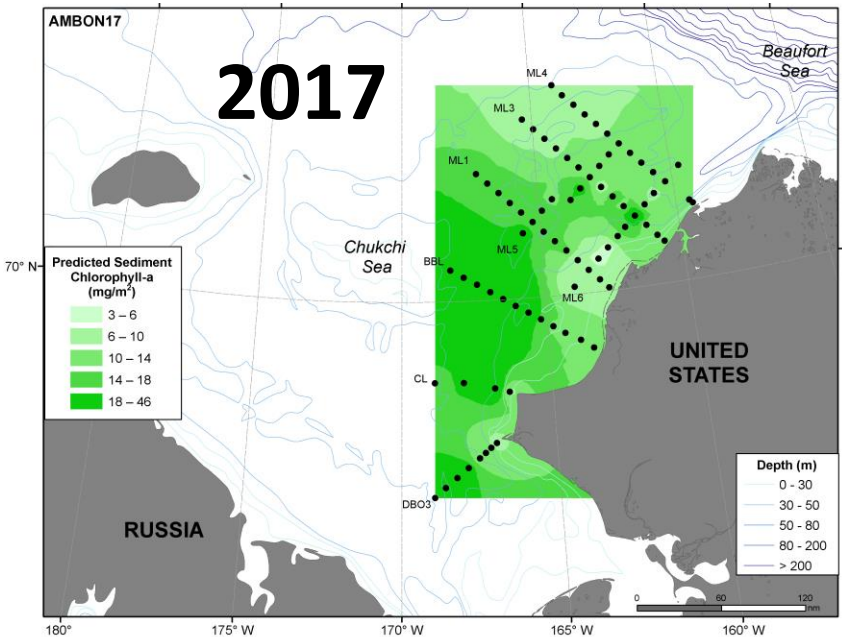
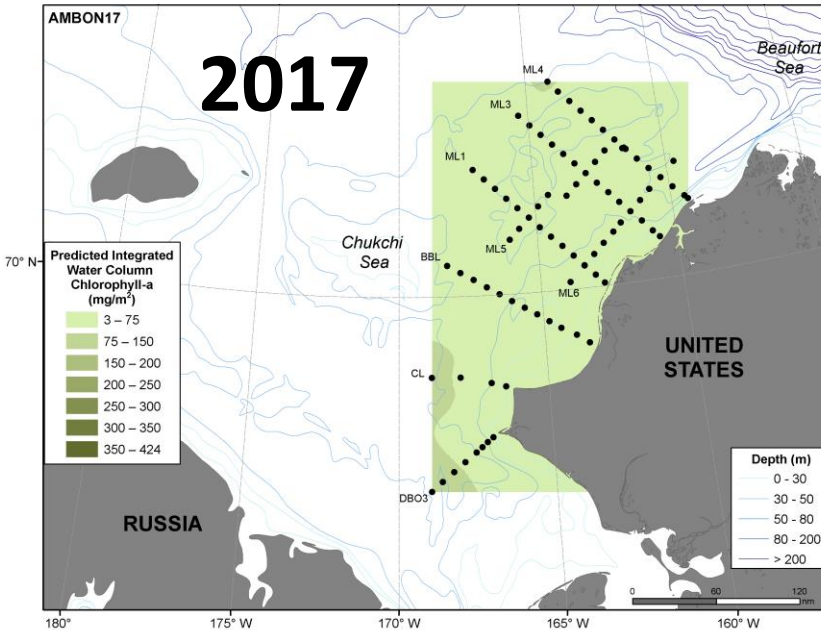
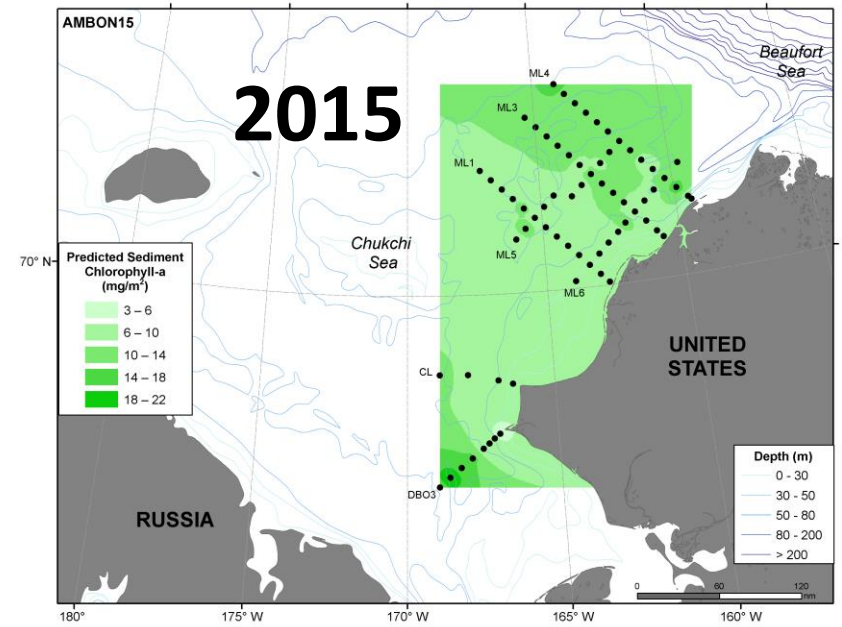
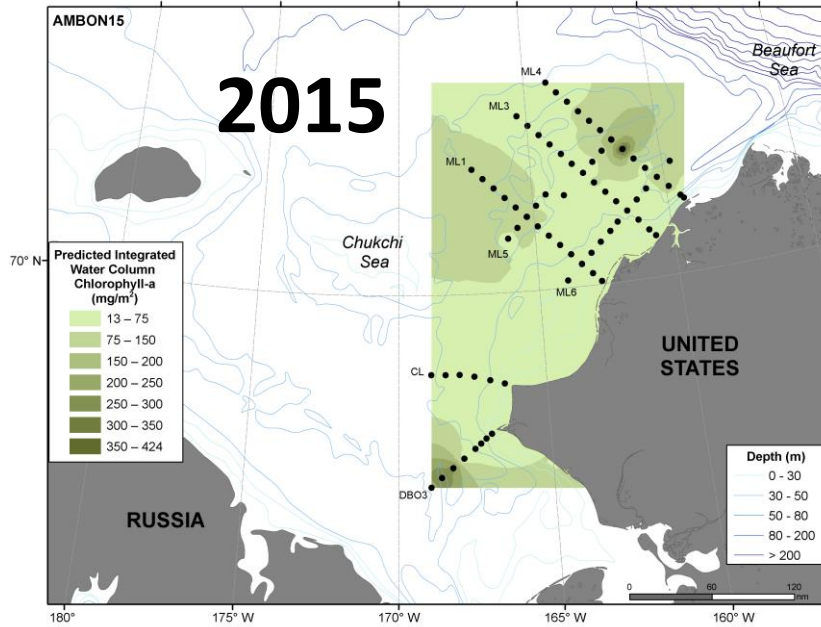


Acoustic Recording Spectra



Water Column Chlorophyll

Sediment Chlorophyll



Data management



- Data management through AOOS – data publicly available
- Website for information: www.ambon-us.org

