Correlating sea ice variables to epibenthic communities on the Alaskan Arctic shelves

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Background

Through tight benthic pelagic coupling, high seasonal primary productivity in the Alaskan Arctic supports large benthic biomass. In the Chukchi Sea epibenthic biomass can amount to 217 g wet wt. m^{-2} and on the western Alaskan Beaufort shelf epibenthic invertebrates made up to 94% of the total benthic standing stock.

Epibenthic organisms are important as prey to higher trophic levels, they play a significant role in organic carbon remineralization and, through bioturbation, contribute to the total benthic energy turnover.

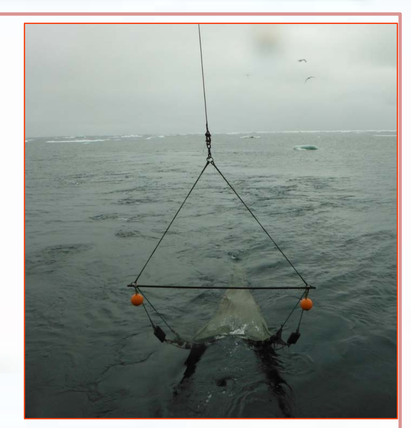
Seasonal melting of sea ice creates a stable water column, with nutrient rich water and increased light penetration enabling a sea-ice-associated phytoplankton bloom. This primary production early in the season falls mostly ungrazed to the seafloor contributing food for benthic organisms.

The spatial reduction of perennial sea ice, along with the early retreat and late formation of annual sea ice on the Arctic shelves affects biological processes and ecosystem functioning; however, the magnitude that epibenthic organisms are affected by sea ice changes is still uncertain.

Objective:

To understand the long term effect of sea ice characteristics on epibenthic community abundance, biomass and species composition.

Methods



Biological data

-The epibenthic community was sampled using a plumb-staff beam trawl at 125 stations during the ice-free seasons of 2009 and 2010 in the Chukchi Sea and 2011 in the Beaufort Sea (Figure 1).

Sea ice data

-Sea ice concentration values were generated using the NASA TEAM algorithm
-Sea ice concentrations were compiled for each station sampled for epibenthos extending 10 years back from the date the samples were collected.

Sea ice variables:

- Date of ice retreat and date of ice return, ice edge was defined by 15% concentration. A 7-day moving average was applied to reduce the weather effect on the ice edge.
- Number of ice free days (0% sea ice concentration days).
- Number of ice covered days (>85% sea ice concentration days).
- Lingering sea ice edge (number of days of ice concentration 15% ± 5 early in the season).

Analyses

-Sea ice variables were correlated to total epibenthic biomass and abundance using R.
-Multivariate correlations between epibenthic community biomass and sea ice variables were performed using BioEnv procedure in PRIMER.

Results

Simple Correlations: In the Beaufort Sea, sea ice variables are significant predictors of total epibenthic biomass and abundance; however R values were very low (R: 0.25) (Fig. 2 & 3). Specifically, **date of sea ice retreat** and **return** had the highest significance values. In the Chukchi Sea there was no significant correlation of sea ice variables with total epibenthic abundance or biomass , and R values were extremely low (R: > 0.1) (Fig. 2 & 3).

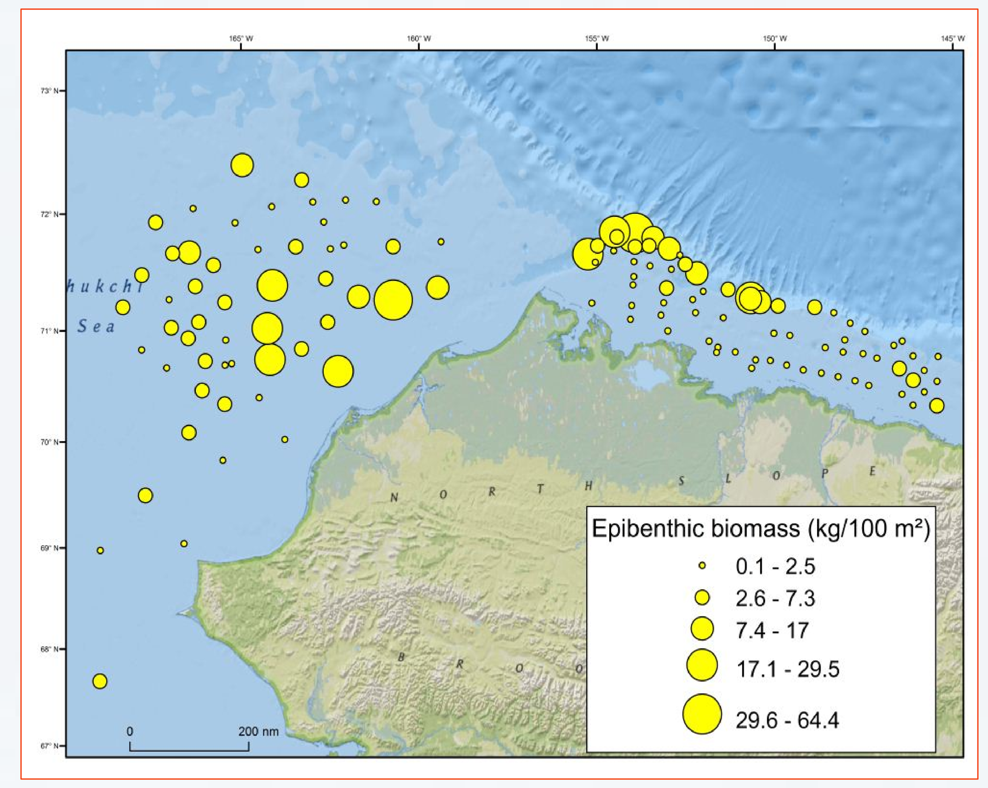


Fig. 2: Total epibenthic biomass

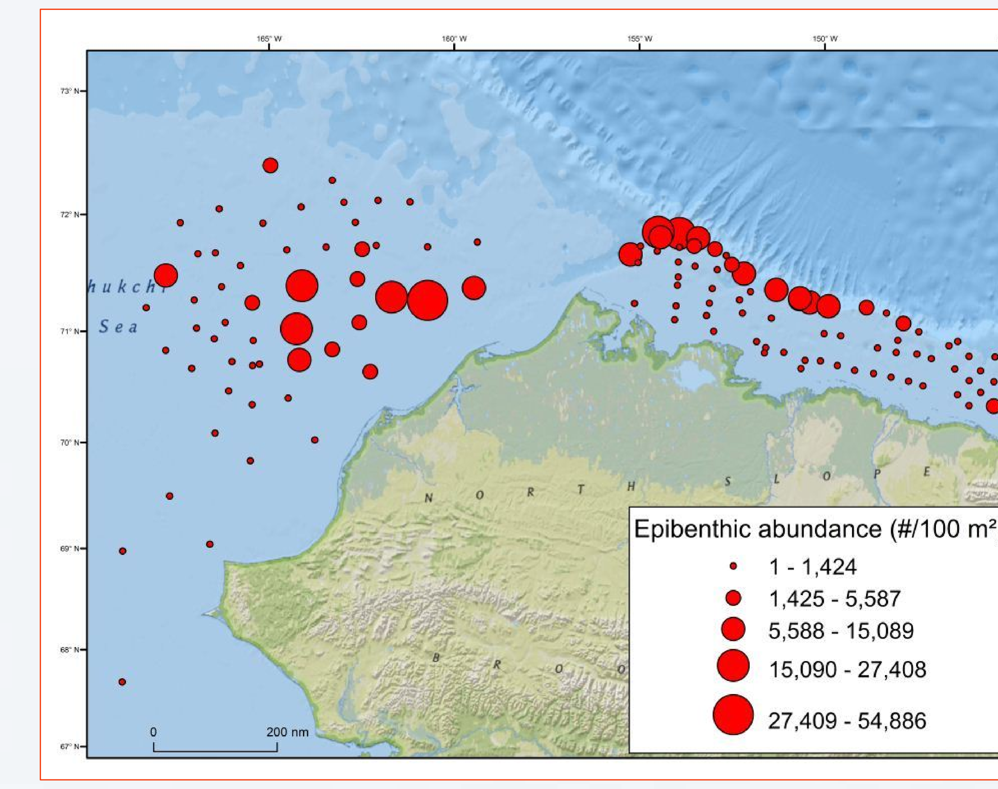


Fig. 3: Total epibenthic abundance

Multivariate Analysis: In the Beaufort Sea the two variables **date of sea ice retreat** and **date of sea ice return** were selected as important drivers of epibenthic community biomass (R: 0.493) (Fig. 4). In the Chukchi Sea, the variables **number of ice covered days**, **date of sea ice return** and **days of lingering ice edge** were selected as important drivers of community biomass (R: 0.435) (Fig. 4).

The Chukchi Sea experiences much greater spatial variability in sea ice concentration than the Beaufort Sea shelf (Fig. 5 & 6). This greater variability was also observed in the temporal time frame of this analysis.

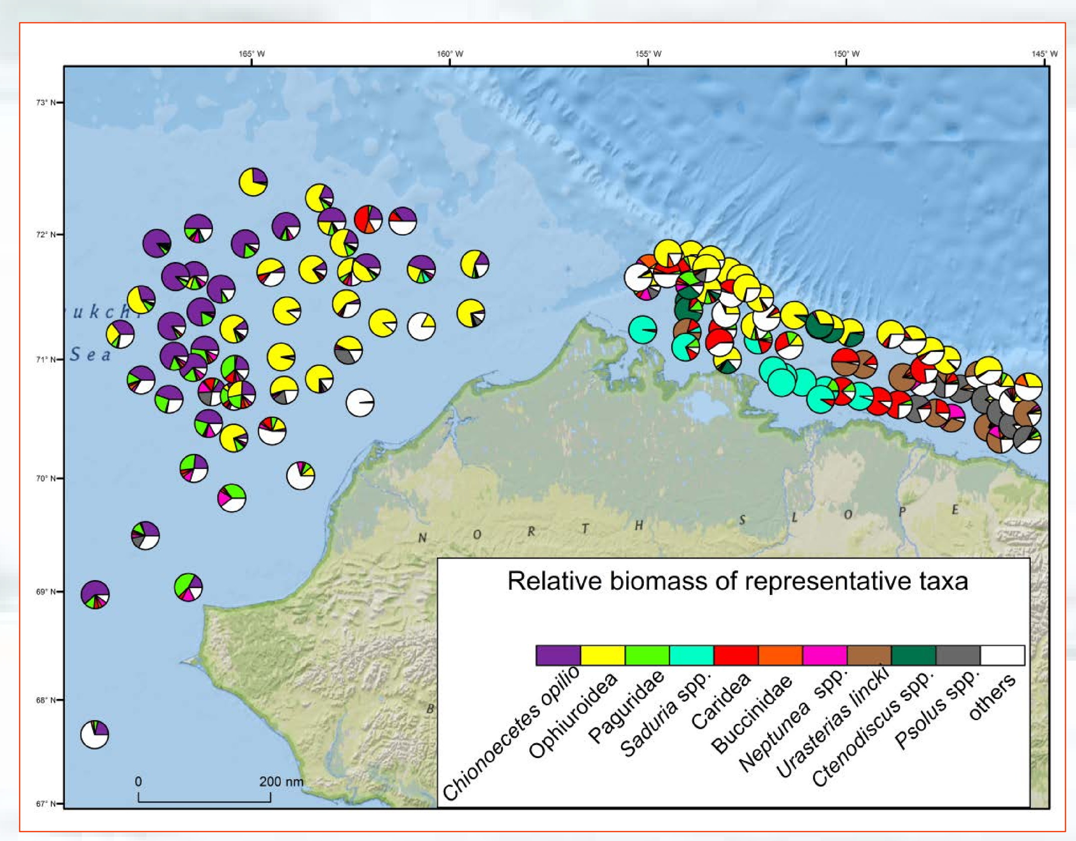


Fig. 4: Relative biomass of mayor epibenthic taxa

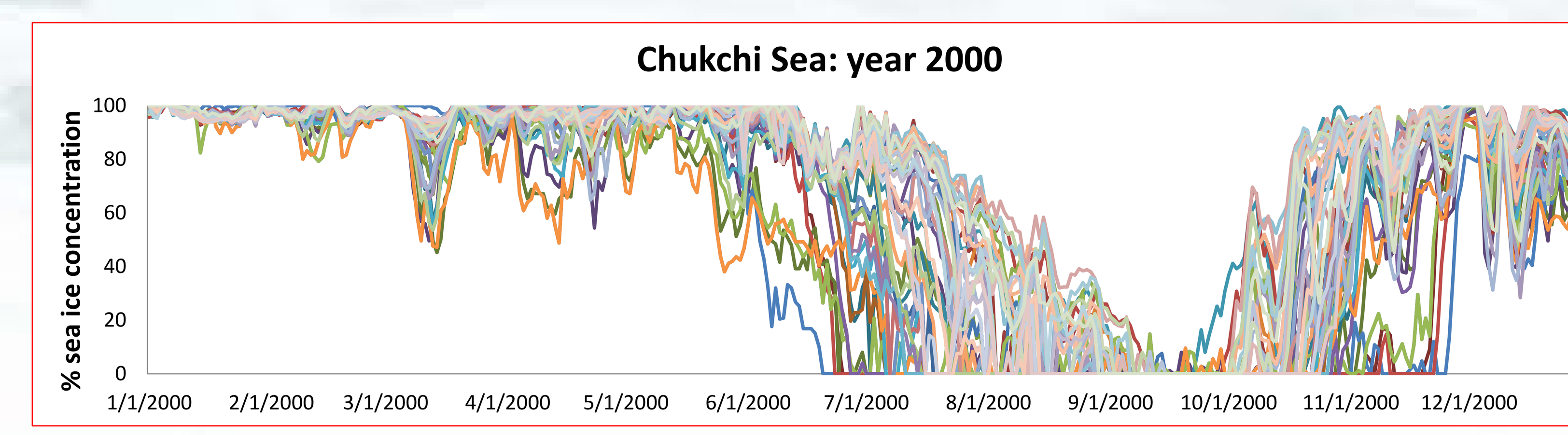


Fig. 5: Sea ice concentration during the year 2000 for each station in the Chukchi Sea

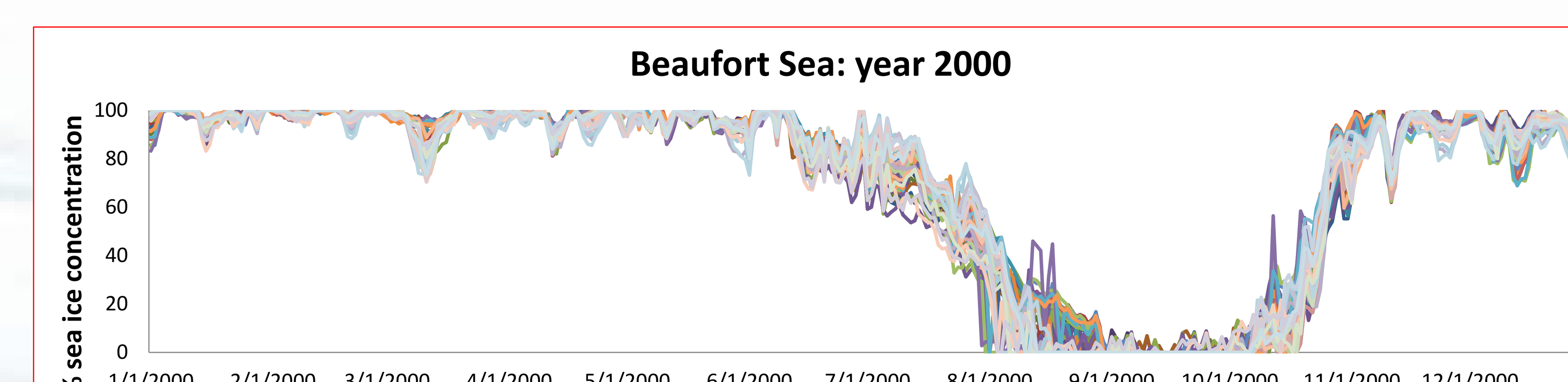


Fig. 6: Sea ice concentration during the year 2000 for each station in the Beaufort Sea

Next Steps

-We have currently focused on the mean value of each variable over the course of 10 years. Next we will include the magnitude of variance that each variable has shown in that time to assess the level of change.

- We will explore the relation of each sea ice variable with the different taxonomic groups, feeding guilds, mobility and other biological traits.

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