Interannual variation of epibenthic communities in the Chukchi Sea, Alaska

Kimberly Powell (kkpowell2@alaska.edu), Brenda Konar
School of Fisheries and Ocean Sciences, University of Alaska Fairbanks

OBJECTIVES

- **Determine interannual variability of Chukchi Sea epibenthic community biomass**
- **Determine which taxa are responsible for biomass variability**
- **Determine which environmental drivers, if any, influence this variability**

Introduction

Over the past decade, interest in the Chukchi Sea has increased due to climate change and oil and gas development. The Chukchi Sea has one of the highest areas of benthic production in the world (Feder et al. 1994), with tight benthic-pelagic coupling supporting large epibenthic communities (Piepenburg et al. 1996, Grebmeier et al. 2006). The epibenthos not only contributes to overall system production and turnover, but also supports a wide variety of higher trophic level predators. It is important to determine how these productive communities vary from year to year and the amount of natural variation in the ecosystem. Knowledge of short term variability will help interpret future changes.

Methods

- Epibenthic communities in the Chukchi Sea were sampled during August/September of 2009 and 2010, and in June/July of 2012 and 2013 using a plumb staff beam trawl (Fig 1).
- Analyses (in Primer-e) were run on relative biomass to determine interannual variability in the proportions of major taxa.
- A SIMPER analysis determined which specific taxa contributed most to biomass variation in all years.
- CLUSTER analyses by year determined which stations grouped together based on community biomass.
- BIOENV determined which environmental drivers best described epibenthic community variability over time.

Fig 1: Plumb staff beam trawl deployed from the USCGC Healy.

Results

2009: Communities grouped into 2 clusters at 80% similarity with Ophiuroidea, *C. opilio*, and *Pagurus spp*. contributing most to species biomass similarity among stations (Fig 1).

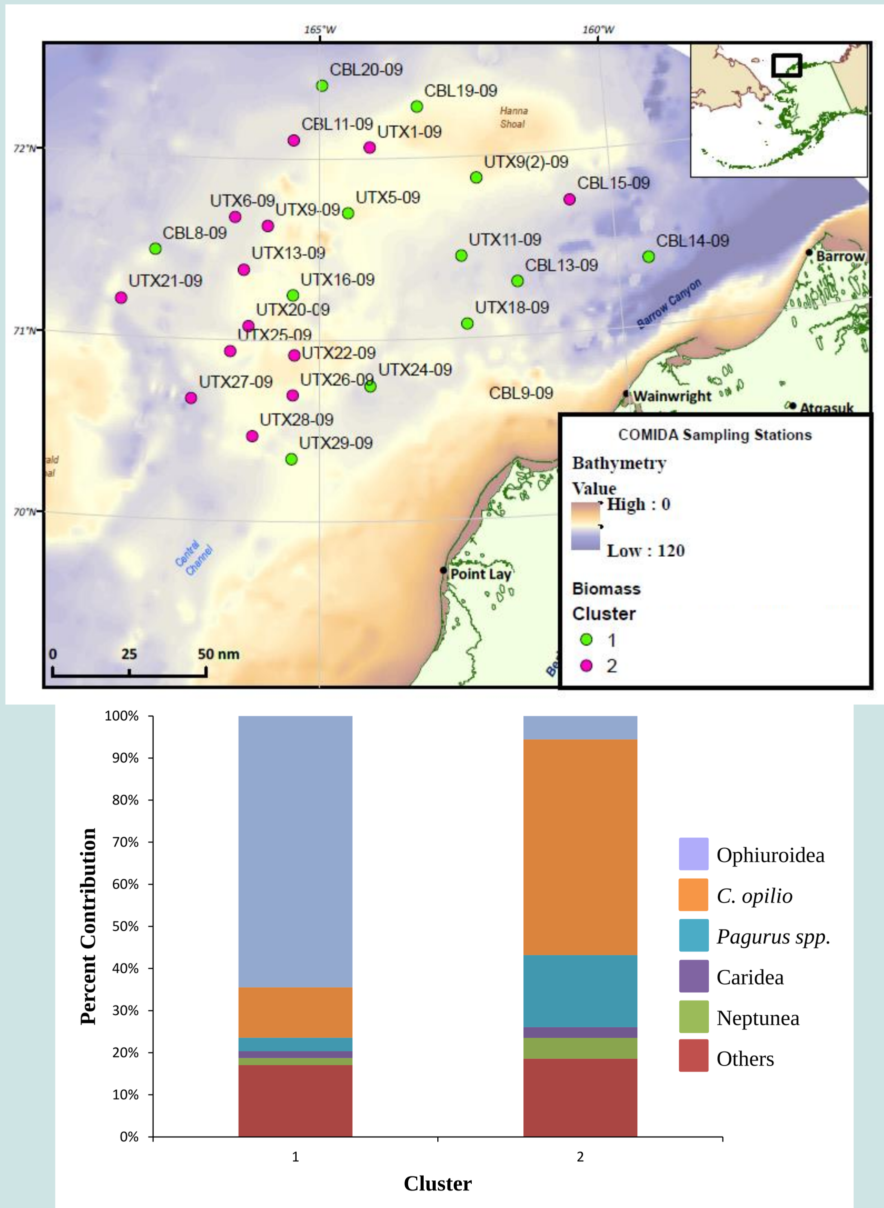

Fig 2: Top: Epibenthic community clusters based on 80% similarity for 2009. Bottom: Percent composition of the major taxonomic groups in clusters 1 (green) and 2 (pink).

2010: Communities grouped into 3 clusters at 80% similarity with *C. opilio*, Ophiuroidea, and *Pagurus spp.* contributing most to similarity (Fig 2).

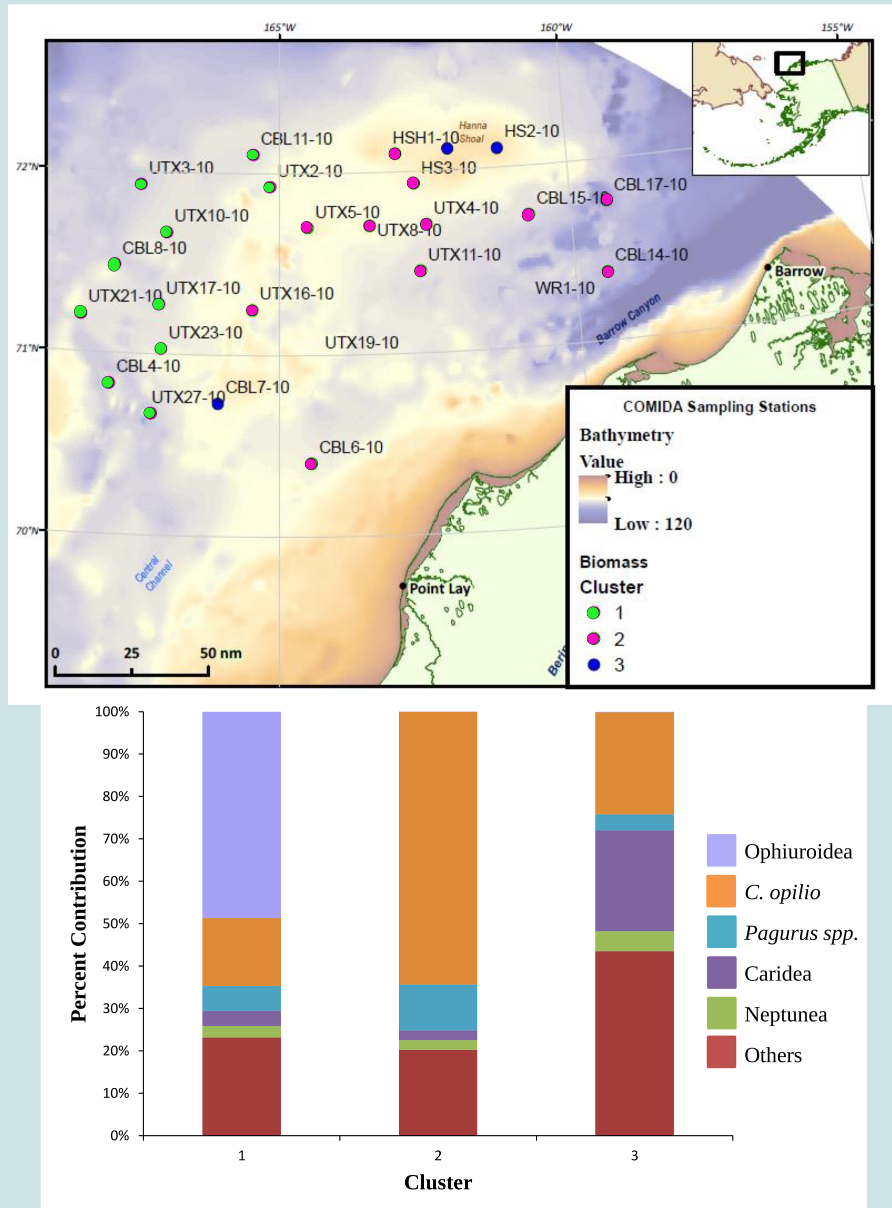

Fig 3: Top: Epibenthic community clusters based on 80% similarity for 2010. Bottom: Percent composition of the major taxonomic groups in clusters 1 (green), 2 (pink), and 3 (blue).

2012: Communities grouped into 2 clusters at 80% similarity with Ophiuroidea and Caridea contributing most to similarity (Fig 3).

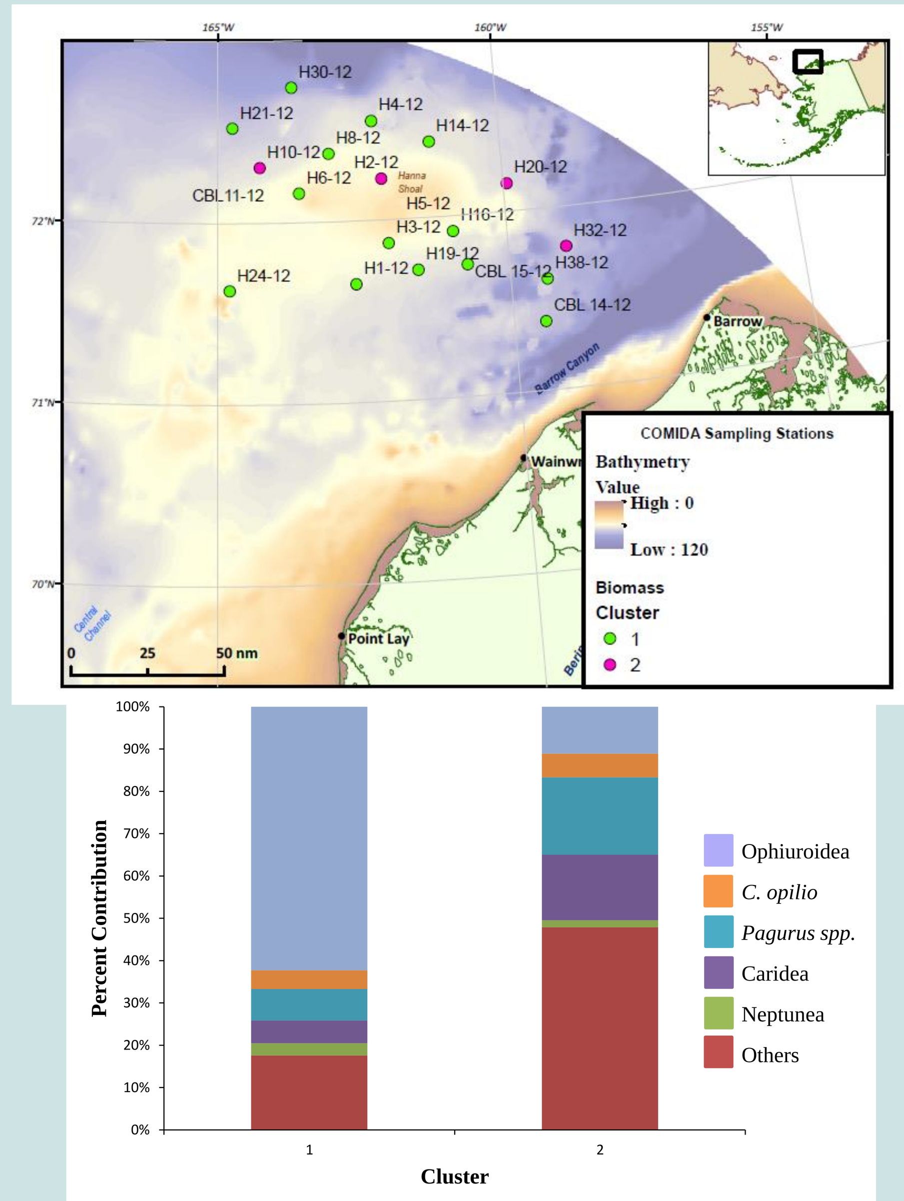

Fig 4: Top: Epibenthic community clusters based on 80% similarity for 2012. Bottom: Percent composition of the major taxonomic groups in clusters 1 (green) and 2 (pink).

2013: Communities grouped into 2 clusters at 80% similarity with Ophiuroidea and, Caridea, and *Pagurus spp*. contributing most to similarity (Fig 4).

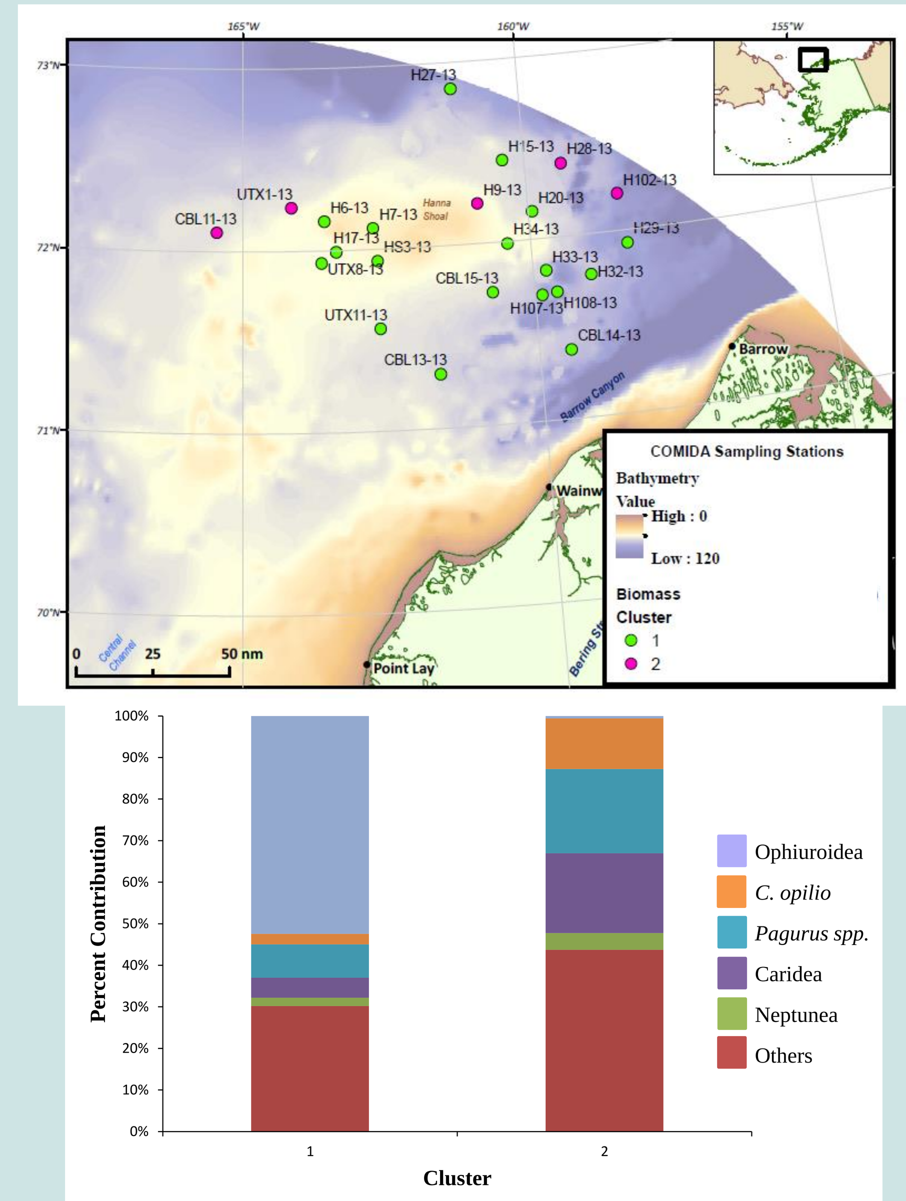

Fig 5: Top: Epibenthic community clusters based on 80% similarity for 2013. Bottom: Percent composition of the major taxonomic groups in clusters 1 (green) and 2 (pink).

- More community variability was found between 2009 and 2010 than between 2012 and 2013.
  - An additional cluster group in 2010 when compared to 2009 (Figs 2-3) increased overall community complexity.
  - There were more *Chionoecetes opilio* in 2009 and 2010 than 2012 and 2013 (Figs 4-5).
  - Caridea had a higher contribution to community similarity in 2012 and 2013 than in 2009 and 2010.
- Ophiuroidea, *C.opilio*, Caridea, *Pagurus spp.*, and *Neptunea spp.* dominated community biomass in all years (Fig 6).
- The structuring drivers for the community are associated with water mass characteristics and currents.
  - Bottom water temperature, salinity, and % CN varied with the epibenthic community (Table 1).
  - Sediment grain size was a consistent important driver throughout the study.

Table 1: Environmental drivers that best described the variation in epibenthic communities for 2009, 2010, 2012, and 2013.

Year	Environmental Drivers	Spearman Coefficient
2009	Sediment grain size and pH	0.631
2010	Sediment grain size, temperature, and % CN	0.541
2012	Sediment grain size, temperature, and % CN	0.523
2013	sediment grain size and temperature	0.625

The brittle star *Ophiura sarsii*

The snow crab *Chionoecetes opilio*

A shrimp in the infraorder Caridea

Fig. 6: Dominant taxa in the epibenthic communities.

The hermit crab *Pagurus sp.*

The gastropod *Neptunea sp.*

Conclusion

- The Chukchi Sea is a very dynamic environment with high interannual variability in both biological and environmental factors.
- A shift in dominant players could be occurring in the Chukchi Sea due to changes in importance of drivers.
- Change in the composition and relative biomass could have large implications for higher tropic levels and the overall ecosystem since the extensive Chukchi Sea benthic community can support a large abundance and diversity of marine mammals as well as contributing to overall benthic production and remineralization.

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