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Spatial And Temporal Variability of Zooplankton Community Structure In The Chukchi Sea (2010-2012)

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Introduction and Approach

Changes underway in the US Arctic are unprecedented; the physical environment is experiencing increases in temperature, progressive declines in sea ice concentration, earlier spring ice retreat, and delayed fall ice formation. This physical restructuring is expected to propagate through the ecosystem, and include changes in primary, secondary and upper trophic level production. As part of the Chukchi Acoustic, Oceanographic, and Zooplankton (CHAOZ) project, a series of bio-oceanographic research surveys in the US Chukchi Sea were conducted in summer in 2010, 2011, and 2012 to characterize the physical environment and examine biological response. Surveys were conducted in August of each year (30 DAS) and collected data on water column properties (CTD), oceanographic currents (moorings, satellite-tracked drifters) sea ice presence and extent, and zooplankton prey base (Tucker trawls). Physical data were analyzed and evaluated relative to spatial and temporal patterns of zooplankton community structuring (multivariate clustering, PRIMER-E) to evaluate the influence of bottom-up forcing on secondary production.

Results

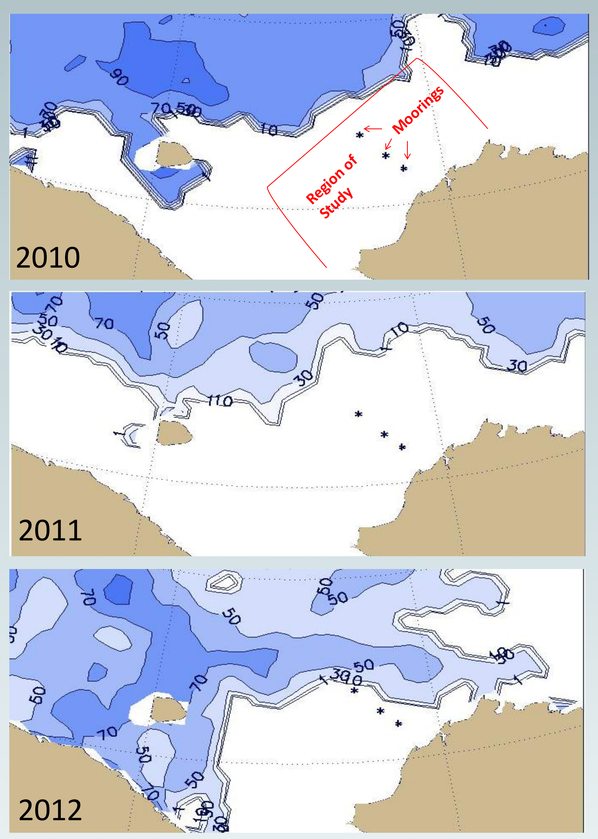

Figure 1. Sea Ice. Percent coverage on August 2, 2010 (top), 2011 (middle), 2012 (bottom). 2012 was a lower ice year in the Chukchi Sea overall, but there was more ice in the sampling region at the time of the surveys in that year compared to 2010 & 2011. Ocean temperatures (not shown) indicate colder conditions in 2012 and corroborate sea ice observations.

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BOEM
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The recommendations and general contents presented in this poster do not necessarily represent the views or official position of the Department of Commerce, the National Oceanic and Atmospheric Administration or the National Marine Fisheries Service.

Total Transport from SW to NE by Month 2010-2015

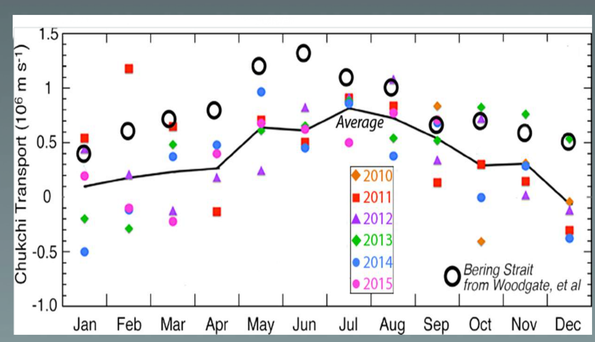


Figure 2. Colored symbols indicate mooring measurements located off Icy Cape (Figure 1). Black circles indicate Bering strait measurements. Volume transport was below average from March - May in 2012; average and above average March - May 2011. No data for 2010. Annual mean transport through Bering Strait was higher 2010 - 2011 than 2012 (Woodgate et al., 2015). Collectively, results indicate that despite above average flow to the NE just prior to and during the sampling period, overall flow was reduced in 2012, suggesting influence of southern-origin water and colder conditions in 2012.

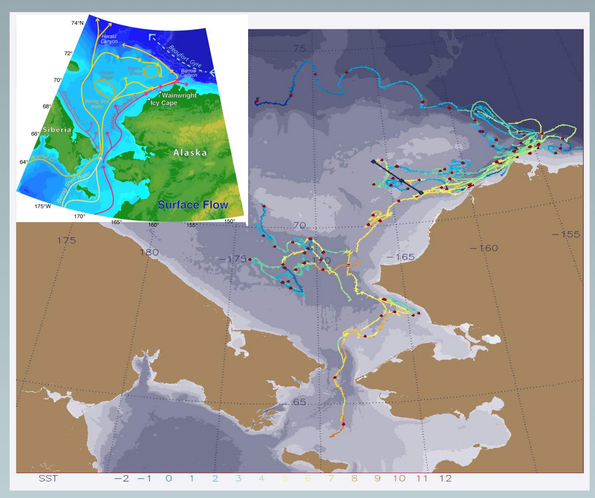


Figure 3. Satellite-tracked 30 m depth drifters (2012). The color of the line (see key below the plot) reflects SST (°C). Drifter trajectories (July–October) illustrate advection through Bering Strait, across the Chukchi Shelf, into Barrow Canyon and the Beaufort Gyre. Top left inset illustrates generalized current flow.

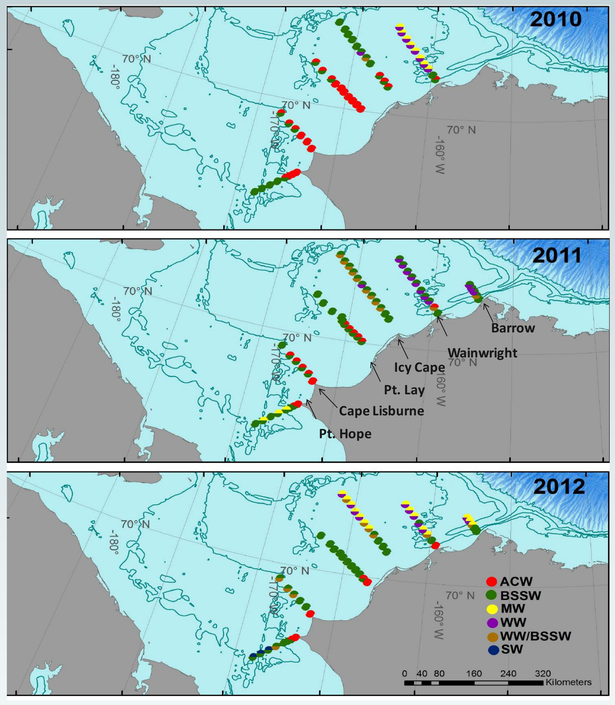


Figure 4. Water mass designations. Circle halves indicate surface (top half) and bottom (bottom half), respectively. Presence of Alaska Coastal Water (ACW) was significant in 2010 and was not constrained to the nearshore. Melt Water (MW) and Winter Water (WW) were more prominent in 2012. Remaining water mass abbreviations: BSSW, Bering Sea Shelf Water; SW, Siberian Coastal Water.

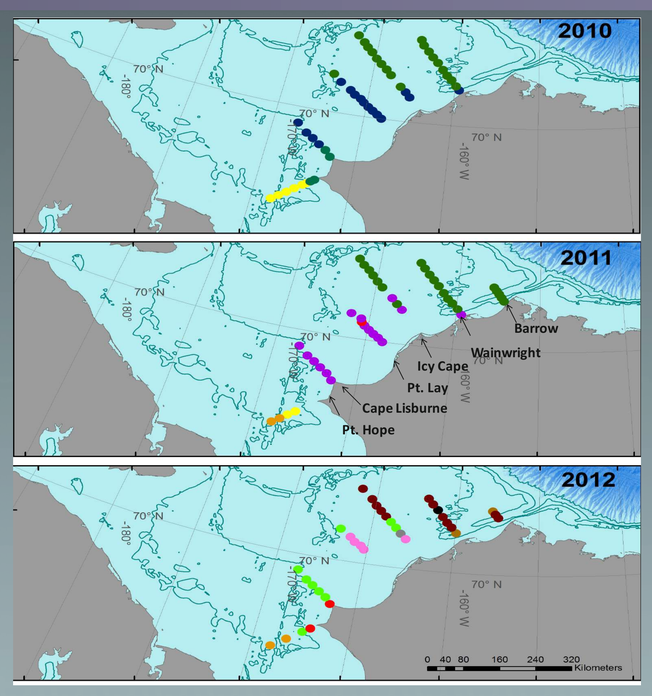


Figure 5. Zooplankton community cluster analysis. Zooplankton assemblages in the north (dk green) in 2010 and 2011 were characterized by larvaceans, cnidarians, cirripedia, *Pseudocalanus spp.* , and *Oithona spp.* In 2012, a dissimilar northern assemblage was noted (dk red) with lower numbers of most of the above species and more *Calanus glacialis,* an arctic copepod. Greater heterogeneity in the species assemblages in 2012 reflects the additional complexity in circulation. In 2010 the influence of ACW was noted by an assemblage (dk blue circles) characterized by greater numbers of cladocerans and thecosomata, and fewer larvaceans.

Taxon	Year 2010	2011	2012
Euphausiids			
Calyptopis stage	1.18	0.03	0.04
Furcilia stage	9.75	6.61	8.38
Juvenile and adult stages	0.19	0.22	0.95
Amphipods			
Hyperiid amphipods	0.12	2.68	0.52
Gammarid amphipods	0.11	0.01	1.76
Copepods			
Pseudocalanus spp.	1052.69	1025.19	737.56
Calanus glacialis	82.08	63.25	290.48
Calanus hyperboreus	0.00	2.71	0.00
Other non-crustacean taxa			
Larvaceans	781.22	1096.01	8.10
Pteropods (with and without shells)	126.95	11.64	5.05
Chaetognaths	46.71	47.00	27.57

Table 1. Mean abundances (No. m^{-3}) of major taxa. The cold year (2012) had higher mean abundances of larger copepods (*Calanus glacialis*) and gammarid amphipods. 2010 & 2011 had higher mean abundances of small copepods and larvaceans. The warmest year (2010) had the highest abundance of calyptopis stage euphausiids. Are these larval stage euphausiids a result of reproduction in the Chukchi, or are they advected from the northern Bering Sea?

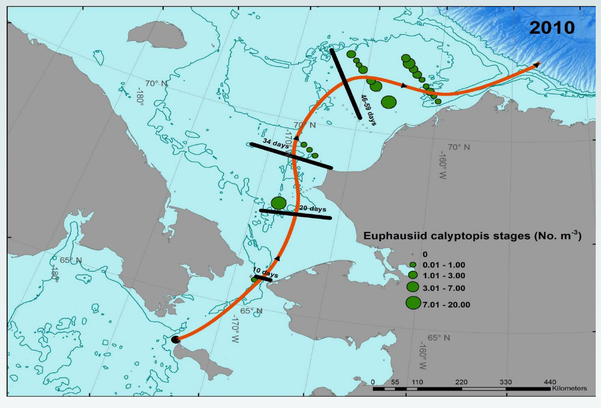
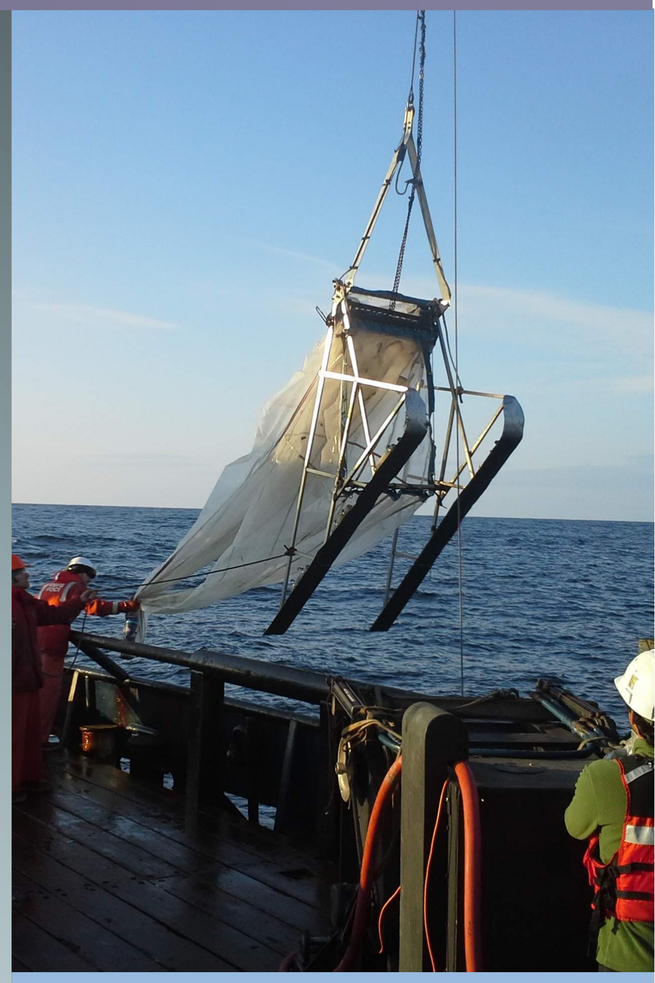


Figure 6. Transport Duration. Cumulative time (d) of zooplankton transport from St. Lawrence Island to the northeast Chukchi using known current speeds from moored ADCP measurements. Green circles indicate estimated number of euphausiid calyptopis. Results suggest euphausiid reproduction in the Chukchi during warmer years, given the number of days for particle transport from the northern Bering Sea, and the development rates of *Thysanoessa spp* (Teglhus et al., 2015).



Conclusions

1. Physical conditions were different among the three years (warm '10 & '11, cold '12) and are attributed to differential transport of water from the main sources, and the presence of sea ice and melt water.
2. Strong interannual and spatial variability of zooplankton community structure was influenced by water mass properties.
3. Warm years had a higher abundance of smaller zooplankton and presumed local reproduction of euphausiids.
4. In the cold year, with decreased Bering Strait transport, the zooplankton community structure over the shelf was more heterogeneous with increased abundance of large species.

References

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