Temporal Variations of Macrobenthic Communities in the Northeastern Chukchi Sea

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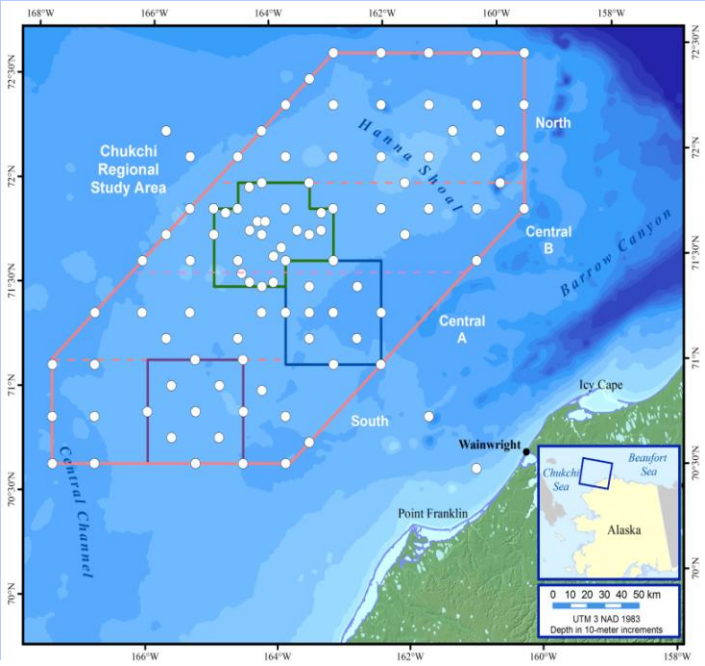
The Chukchi Sea Environmental Studies Program

- CSESP: A multidisciplinary investigation of the northeastern Chukchi Sea ecosystem, 2008-2013.
- Three focused areas sampled 2008-2013.
- A larger area sampled 2011-2013.
  - 2008-2012 data presented.



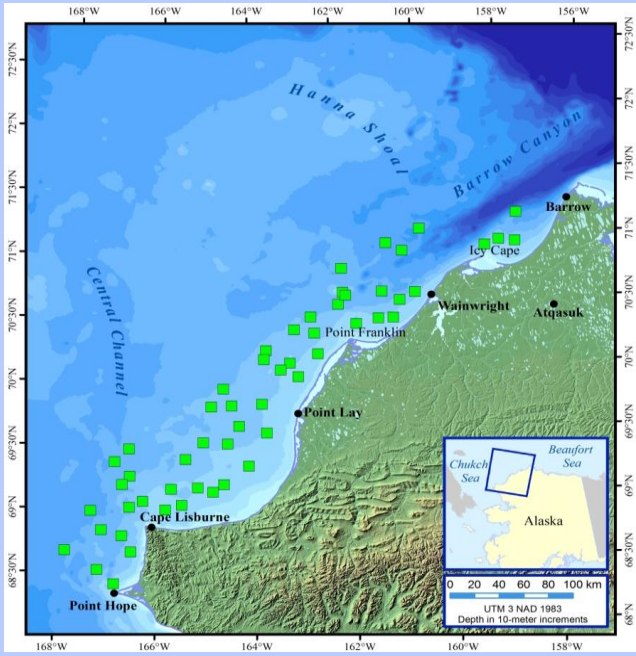
Shell

ConocoPhillips

Statoil

The Alaska Monitoring and Assessment Program

- AK MAP: A multidisciplinary investigation of the inshore northeastern Chukchi Sea ecosystem, 2010-2012.
- Documents the status of inshore marine communities.
  - 2010-2011 data presented.

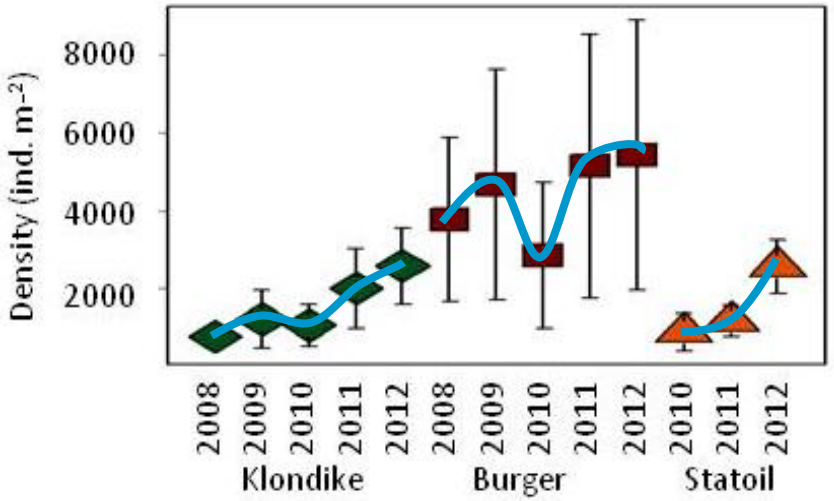


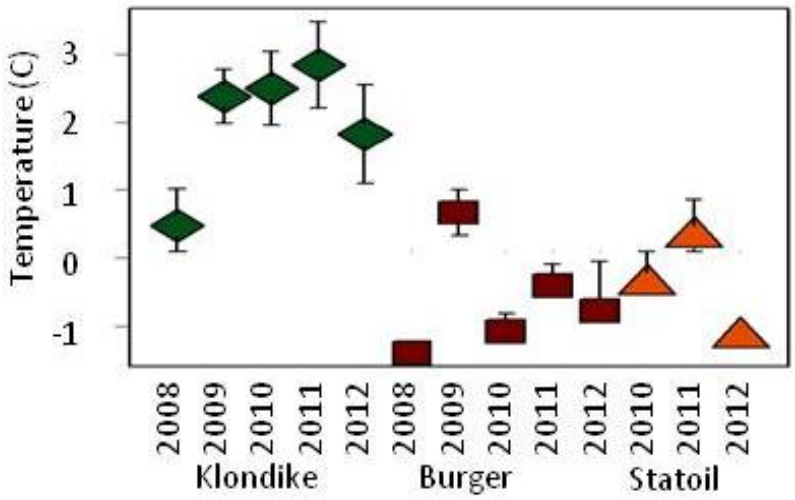
Oceanographic variations

- Temporal variations have been large.
  - Sea ice declines.
  - Temperature variations.
- Oceanographic variations may influence:
  - Strength of pelagic-benthic coupling.
  - Strength and variability of water circulation patterns.
- Has the benthos been affected?

Temporal Variations in CSESP

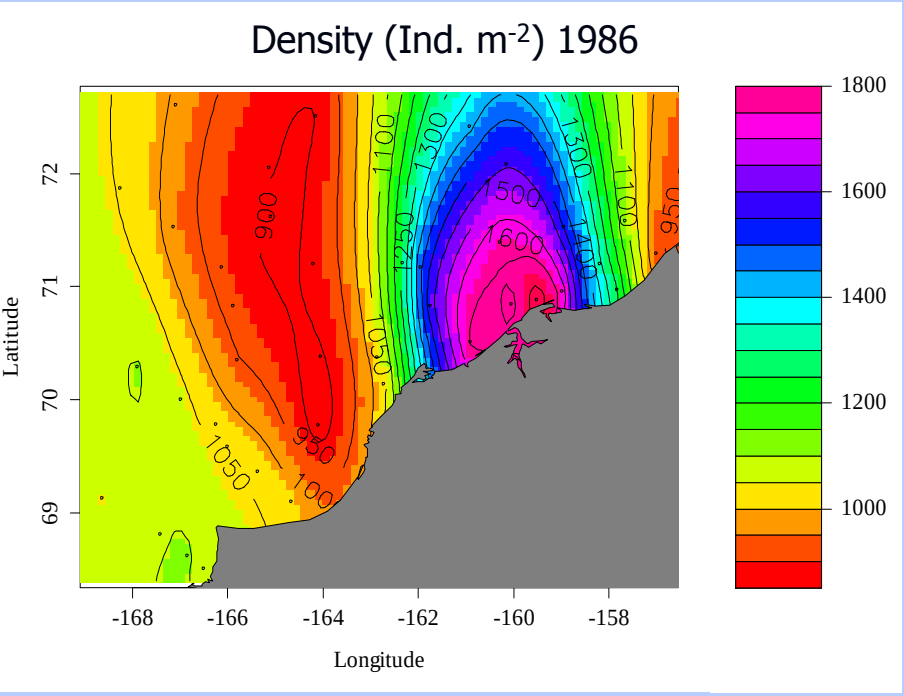
- Repeatedly-sampled, offshore stations do show significant temporal variations.
- Source and cause for variations not yet known.

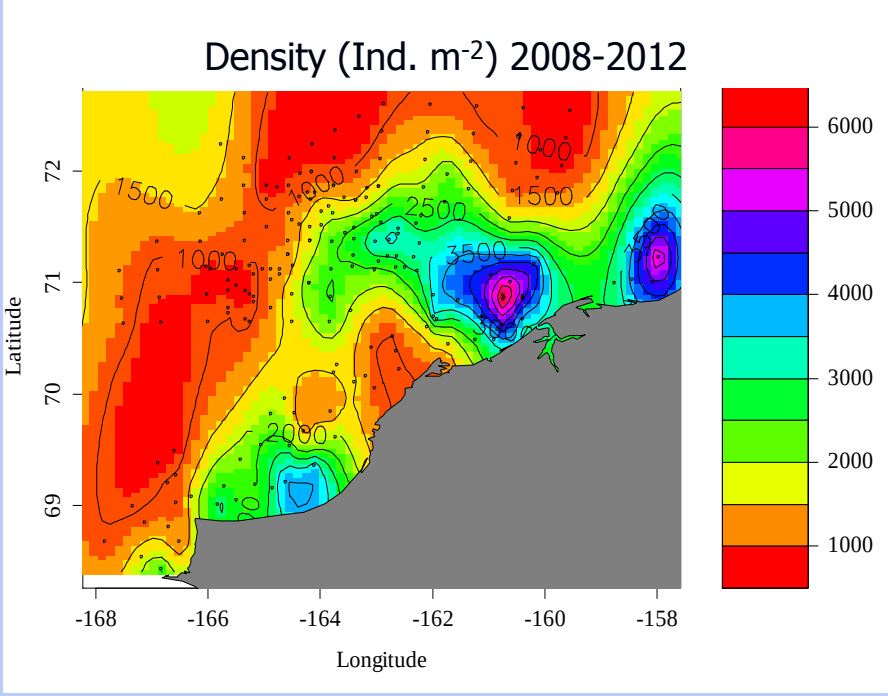




Spatial Variability 2008-2012

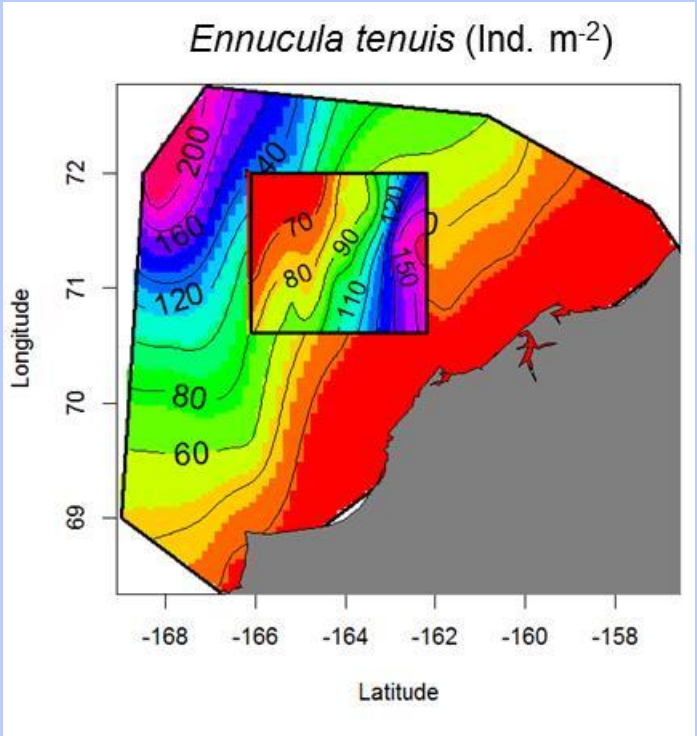
- Broad-scale trends in 1986 reflect inshore to offshore environmental gradients with hotspot.





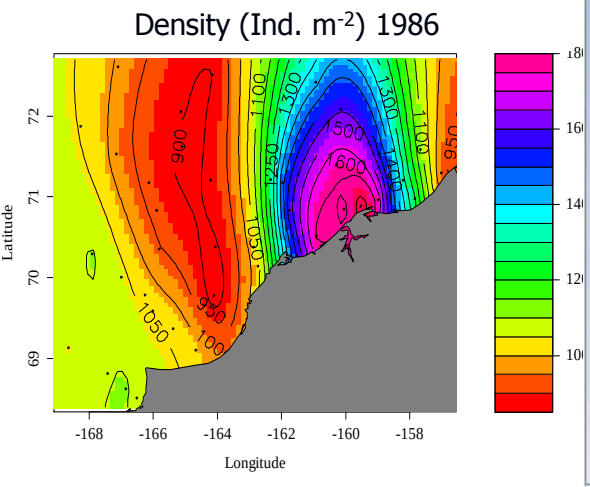
Spatial Variability 2008-2012

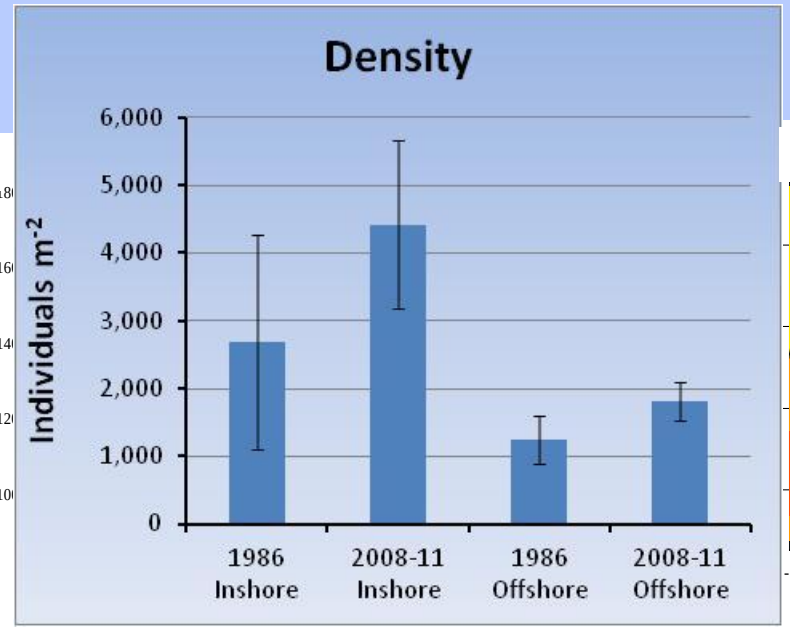
- Broad-scale trends in 1986 reflect inshore to offshore environmental gradients with hotspot.
- Within the CSESP study area, trends can be in the opposite direction.

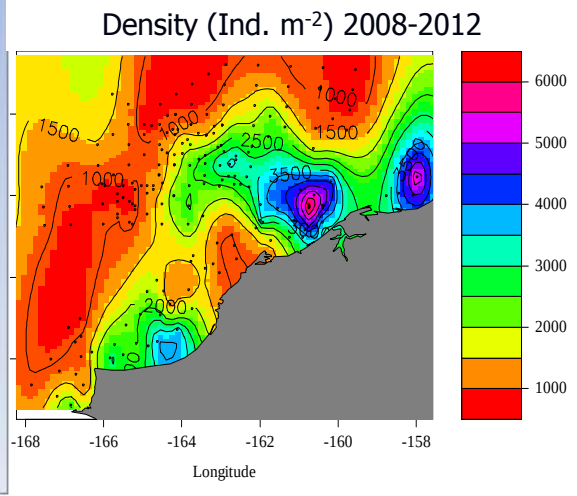


Comparison of Years

- No significant differences within the same areas between 1986 and 2008-2011.
- Better definition of nearshore distributions in 2008-2011 due to greater sampling effort.

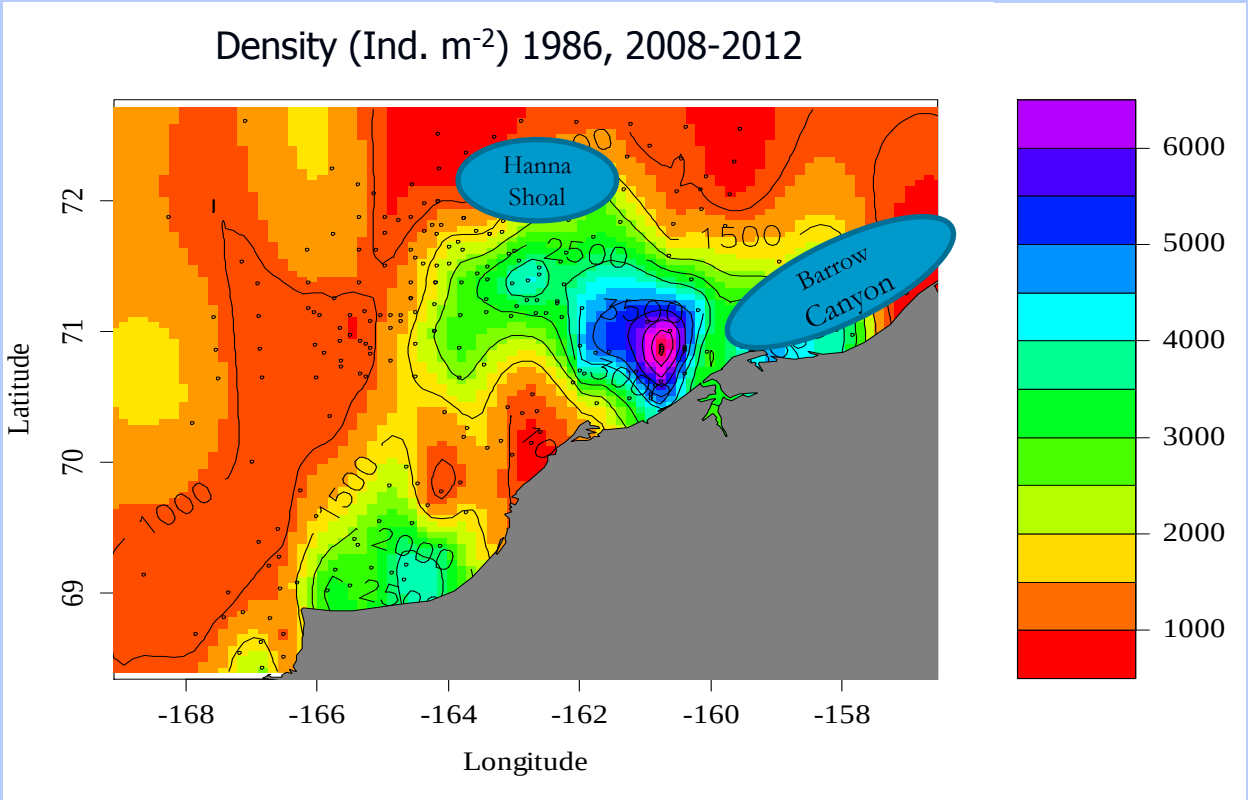






Combined Spatial Model

- Benthic production associated with water circulation in two different “hotpots” with connected drivers.
  - Direct vs. Indirect effects.
- Inshore to offshore/depth gradient apparent.



Species Composition

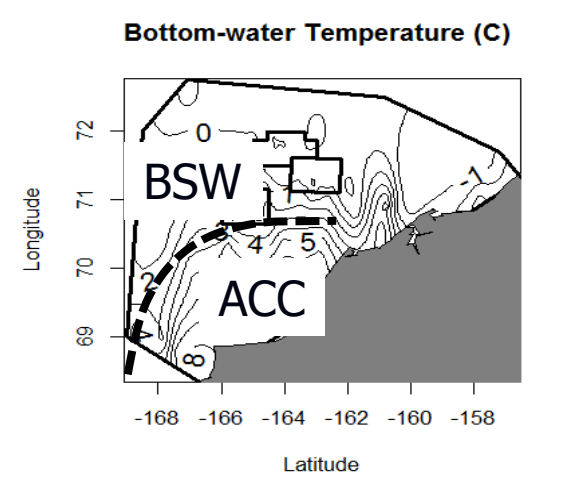
- Dominant species relatively unchanged:
  - Inshore dominated by crustaceans and
  - Offshore by polychaetes and bivalves.

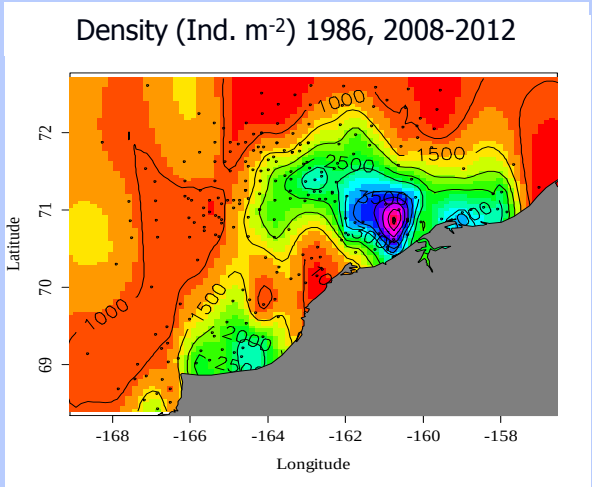
1986	Taxon	Density	CSESP	Taxon	Density	AKMAP	Taxon	Density
							Galathowenia	
Inshore	*Atylus bruggeni*	314	Inshore	*Byblis* sp.	3676	Inshore	*oculata*	579
	Protomedeia sp.	287		*Protomedeia* sp.	764		*Photis vinogradovi*	281
	Ampelisca							
	macrocephala	170		*Ischyrocerus* sp.	511		Capitellidae	158
	Photis sp.	133		Cirratulidae	321		*Protomedeia* sp.	155
	Byblis gaimardi	72		Amphipoda	312		Cirratulidae	151
Offshore	*Ennucula tenuis*	127	Offshore	*Maldane sarsi*	363			
	Maldane sarsi	112		*Ennucula tenuis*	168			
	Byblis sp.	63		Ostracoda	104			
	Leitoscoloplos							
	pugettensis	51		Cirratulidae	78			
	Cirratulidae	48		*Macoma* sp.	59			

Color Code: Crustaceans, Bivalves, and Polychaetes.

What has changed?

- Feder et al. (1994)*:
  - Greater density and biomass north of a bottom-water front suggesting water mass differences.
- The combined data:
  - Inshore to offshore gradient with exceptions.
  - Exceptions due to circulation, not water masses.

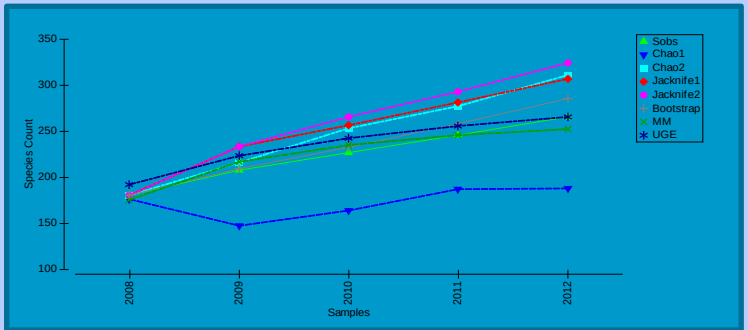




*Feder et al., 1994. The northeastern Chukchi Sea: benthos-environmental interactions. Marine Ecology Progress Series 111, 171-190.

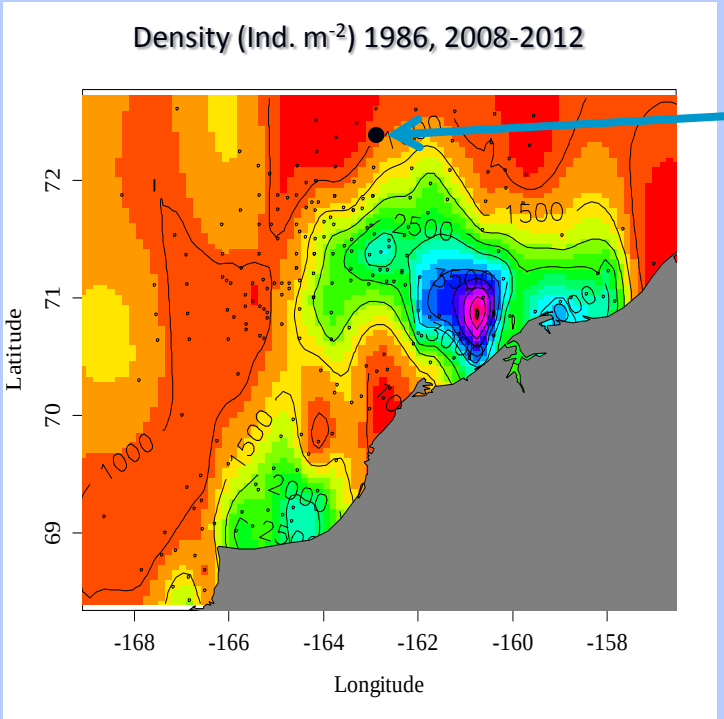
What has changed?

- Three species proposed to be recent invaders into the Chukchi Sea due to climate change.
  - Historical data note *Telemessus*, *Pododesmus*, and *Oregonia* as community members as early as the 1950's.
  - Species accumulation curves for over 5 years in the CSESP study suggest ~10 years for an adequate definition of species composition.



What has changed?

- One study noted ampeliscid amphipods (qualitative) north of Hanna Shoal in 1988*.
  - We found no such evidence when sampling that same vicinity in 2011 and 2012.



> 1,200 Ampeliscid amphipods m^{-2}.

*Nelson et al., 1994. Gray whale and Pacific walrus benthic feeding grounds and sea floor interaction in the Chukchi Sea. Final report by U.S. Geological Survey, Menlo Park, California, for Minerals Management Service, Anchorage, AK.

Conclusions

- The combined spatial model refines our understanding of the NE Chukchi Sea ecosystem:
  - The apparent relationship with a bottom-water front appears to be a sampling issue.

- Interactions of topography and water circulation leading to greater food deposition provide an explanation for the enhanced production in a number of areas throughout the Chukchi Sea.

Acknowledgments

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- AK MAP*: This project was funded by the Coastal Impact Assistance Program, U.S. Fish and Wildlife Service, U.S. Department of Interior, and Alaska Department of Environmental Conservation. Field surveys were conducted aboard the *R/V Norseman II.*

*The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions or policies of the U.S. Government and research sponsors