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.
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.

![Diagram](image)

Density (Ind. m$^{-2}$) 1986, 2008-2012

- Hanna Shoal
- Barrow Canyon

Legend:
- 6000
- 5000
- 4000
- 3000
- 2000
- 1000
Species Composition

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Taxon</th>
<th>Density</th>
<th>Location</th>
<th>Taxon</th>
<th>Density</th>
<th>Location</th>
<th>Taxon</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td><em>Atylus bruggeni</em></td>
<td>314</td>
<td>Inshore</td>
<td><em>Byblis sp.</em></td>
<td>3676</td>
<td>Inshore</td>
<td><em>Galathowenia oculata</em></td>
<td>579</td>
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<tr>
<td></td>
<td><em>Protomedeia sp.</em></td>
<td>287</td>
<td>Inshore</td>
<td><em>Protomedeia sp.</em></td>
<td>764</td>
<td>Inshore</td>
<td><em>Photis vinogradovi</em></td>
<td>281</td>
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<tr>
<td></td>
<td><em>Ampelisca macrocephala</em></td>
<td>170</td>
<td>Inshore</td>
<td><em>Ischyrocerus sp.</em></td>
<td>511</td>
<td>Offshore</td>
<td><em>Capitellidae</em></td>
<td>158</td>
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<tr>
<td></td>
<td><em>Photis sp.</em></td>
<td>133</td>
<td>Inshore</td>
<td><em>Cirratulidae</em></td>
<td>321</td>
<td>Offshore</td>
<td><em>Protomedeia sp.</em></td>
<td>155</td>
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<tr>
<td></td>
<td><em>Byblis gaimardi</em></td>
<td>72</td>
<td>Inshore</td>
<td><em>Amphipoda</em></td>
<td>312</td>
<td>Offshore</td>
<td><em>Cirratulidae</em></td>
<td>151</td>
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<tr>
<td></td>
<td><em>Ennucula tenuis</em></td>
<td>127</td>
<td>Offshore</td>
<td><em>Maldane sarsi</em></td>
<td>363</td>
<td>Offshore</td>
<td><em>Ennucula tenuis</em></td>
<td>168</td>
</tr>
<tr>
<td></td>
<td><em>Maldane sarsi</em></td>
<td>112</td>
<td>Offshore</td>
<td><em>Ennucula tenuis</em></td>
<td>168</td>
<td>Offshore</td>
<td><em>Ostracoda</em></td>
<td>104</td>
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<tr>
<td></td>
<td><em>Byblis sp.</em></td>
<td>63</td>
<td>Offshore</td>
<td><em>Ostracoda</em></td>
<td>104</td>
<td>Offshore</td>
<td><em>Macoma sp.</em></td>
<td>59</td>
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<tr>
<td></td>
<td><em>Leitoscoloplos pugettensis</em></td>
<td>51</td>
<td>Offshore</td>
<td><em>Cirratulidae</em></td>
<td>78</td>
<td>Offshore</td>
<td></td>
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<td><em>Cirratulidae</em></td>
<td>48</td>
<td>Offshore</td>
<td><em>Macoma sp.</em></td>
<td>59</td>
<td>Offshore</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.

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.

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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