Inter-Annual Variation of Zooplankton Communities in the Pacific Arctic

ELIZAVETA ERSHOVA, UAF
RUSS HOPCROFT, UAF
KSENIA KOSOBOKOVA, SHIRSOV INST. OF OCEANOLOGY
Introduction

- **CHUKCHI SEA** – highly productive Arctic sea
- Northward flow from the Pacific Ocean in a mixture of currents
- Historically, data collection limited to either the Russian or U.S. side of the area – missing simultaneous estimates from both sides of the Bering Strait
RUSALCA: Russian-American Long-Term Census of the Arctic

- **Stations sampled:**
  - 34 stations in 2004 *(yellow)* (Hopcroft et al., 2010)
  - 62 stations in 2009 *(green)*
  - 25 stations in 2012 *(red)*

- **Nets used for collection:**
  - Paired 150um Bongo nets, vertical
  - Paired 505um Bongo nets, horizontal
Community structure

- Total 70 holoplanktonic species from 8 different taxonomic groups plus a wide variety of meroplankton
- ~3-5 species dominate in terms of biomass, different ~5 species dominate numbers
- Community differences mainly due to “minor” players!
Zooplankton biomass

2004

2009

2012

42 mg m$^{-3}$

70 mg m$^{-3}$

83 mg m$^{-3}$
Key players: Copepods

- 60-90% biomass at most stations

![Maps showing Copepod biomass in 2009 and 2012. Each dot represents a station with varying colors indicating biomass levels in milligrams per cubic meter (mg m⁻³).]
Key players: Copepods

- 60-90% biomass at most stations
- *Calanus glacialis/marshallae*, *Neocalanus* spp.

Exceptions – some shallow nearshore stations
Key players: Copepods

- Abundance – 85-99%
- *Pseudocalanus* spp., *Oithona similis*

2009

2012

Total copepod abund.

*Pseudocalanus* and *Oithona* abund.
Other taxa – Southern Chukchi

- 2004
  - Meroplankton
  - Appendicularians

- 2009
  - Chaetognaths
  - Euphausiids
  - Pteropods

- 2012
  - Euphausiids
  - Chaetognaths
  - Appendicularians

Legend:
- Copepoda
- Appendicularia
- Meroplankton
- Pteropods
- Chaetognaths
- Euphausiacea
- Cnidaria
- Amphipoda
Other taxa – Northern Chukchi

- Meroplankton
- Appendicularians
- Chaetognaths
- Cnidarians
- Ctenophores (not yet included in analysis)
- Pteropods
- Euphausiids
- Euphausiids
- Amphipods
- Chaetognaths
- Larvaceans
- Copepods
- Other taxa

Year:
- 2004
- 2009
- 2012
Community patterns - 2004

Temperature

Salinity

SST

Transform: Fourth root
Resemblance: S17 Bray Curtis similarity

Hopcroft et al., 2010
Community patterns - 2009

Temperature

Salinity

Samples

Siberian CC

Chukchi

Bering

Transform: Fourth root

Resemblance: S17 Bray Curtis similarity

Community patterns

Temperature

Salinity

Bering

Chukchi

Siberian CC

SST

Temperature

Salinity

SST
Community patterns – 2012

Bray-Curtis Dissim.
Distribution of *Pseudocalanus* spp.

- 2004
  - Arctic: *P. acuspes*, *P. minutus*
  - Pacific: *P. newmani*, *P. mimus*

- 2009
- 2012
Community structure

Bering oceanic forms (Anadyr Current)
- Neocalanus spp.
- Eucalanus bungii
- Metridia pacifica
- Microcalanus

Bering Shelf forms
- Metridia pacifica
- Pseudocalanus spp.
- Aglantha digitale
- Acartia longiremis

Low salinity, neritic (Alaska Coastal Current)
- Acartia hudsonica
- Centropages hamatus
- Eurytemora spp.
- Evadne, Podon

Meroplankton in Bering Strait
Community structure

Resident Chukchi fauna
Calanus glacialis (Arctic morph)
Metridia longa
Themisto abyssorum
Jashnovia brevis
Jellyfish:
Aeginopsis
Plotocnide
Halitholis
Obelia

Neritic forms
Pseudocalanus acuspes
P. minutus
Acartia longerimis
Centropages hamatus
Parasagitta elegans
Aeginopsis

East Siberian Coastal Current
<table>
<thead>
<tr>
<th></th>
<th>2004</th>
<th>2009</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>MONTHS SAMPLED</td>
<td>August</td>
<td>September</td>
<td>September</td>
</tr>
<tr>
<td>AVERAGE BIOMASS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Chukchi</td>
<td>55 mg DW m⁻³</td>
<td>110 mg DW m⁻³</td>
<td>98 mg DW m⁻³</td>
</tr>
<tr>
<td>North Chukchi</td>
<td>51 mg DW m⁻³</td>
<td>80 mg DW m⁻³</td>
<td>64 mg DW m⁻³</td>
</tr>
<tr>
<td>CROSS-SHELF GRADIENT</td>
<td>strong</td>
<td>weak</td>
<td>strong</td>
</tr>
<tr>
<td>IMPORTANT TAXONOMIC GROUPS</td>
<td>Copepods, meroplankton, appendicularians</td>
<td>Copepods, chaetognaths, cnidarians, ctenophores</td>
<td>Copepods, euphausiids, appendicularians</td>
</tr>
</tbody>
</table>
Summary

- Zooplankton communities of the Chukchi Sea show high variability in zooplankton biomass, abundance and composition, showing high flexibility to changing conditions.
- Zooplankton communities are different in different water mass types, with gradients visible both from south to north and from east to west, varying in strength from year to year.
- Very few species account for the bulk of the biomass and abundance; however, community differences are usually due to less abundant species.
- Different taxonomic groups are important between the years and across the area; in 2004 and 2012 appendicularians were particularly prominent, in 2009 the groups that contributed most to biomass were chaetognaths and jellyfish.
- This work provides a baseline to monitor change in the Arctic, long-term observations are needed.
Acknowledgements:

Cornelia Jaspers and Imme Rutzen for help in the field

Bob Pickart and WHOI for providing CTD plots

Rest of science team and crew of RV “Professor Khromov”

This work is sponsored by the Cooperative Institute for Alaska Research at UAF with funds from the National Oceanic and Atmospheric Administration under cooperative agreement NA08OAR4320870

Thank you for your attention!