Plankton Vertical Distribution and Population Dynamics in the Patuxent River and St. Leonard's Creek

Kieran Broder
With Richard Lacouture and Marcia Olson
Project Components

- Examination of historical and recent data on gelatinous zooplankton populations

- Analysis of phytoplankton and mesozooplankton community composition, vertical distribution, and its determining factors
Examination of *Ctenophora* and *Cnidaria* Populations in the Patuxent and St. Leonard’s Creek

*Chrysaora quinquecirrha*  
Atlantic Sea Nettle

*Mnemiopsis leidyi*  
Sea Walnut
Why is it Important?

- Gelatinous zooplankton are trophic ‘dead ends’
- Increasing gelatinous zooplankton numbers compete with forage fish for zooplankton food
- Increased predation on larval crabs and oysters
- Extreme numbers of gelatinous zooplankton could impact fisheries and other coastal economic activity
Field Methods

- Weekly sampling

- 0.5 meter tow net, 202 micron mesh
  - Three oblique tows per site at three sites

- Total volume (mL) of ctenophore and jellyfish samples recorded
  - Organism volume normalized by calculating volume of water (m$^3$) filtered by the net using flow meter in net

- Water quality (temp/DO/salinity/Secchi/chl a)
Should you go swimming in the cove this summer?
Are Ctenophore Numbers Increasing?

![Graph showing changes in Ctenophore Density (mL/m3) from 1985 to 2017. The graph compares June and July data.](image-url)
Conclusions

- Highest recorded jellyfish density in Mackall Cove
- Highest recorded June ctenophore density in the Patuxent River
  - *Early peak in ctenophore populations could strain developing forage fish, crab, and oyster larvae*
  - *Could lead to early peaking sea nettles*
  - *Both scenarios could impact economic activity in the area*
Mesozooplankton and Phytoplankton Vertical Distribution and Composition
What factors affect vertical plankton distribution?

- Predation/Prey (food)
- Salinity/temperature/dissolved oxygen gradients
- Light (Time of Day)

- Some zooplankton and phytoplankton species are known to move based on the time of day
  - ‘Diel vertical migration’
Mesozooplankton and Phytoplankton
Vertical Distribution and Composition

Phytoplankton
• Diatoms
• Dinoflagellates
• Phytoflagellates

Zooplankton
• Copepods (*Acartia tonsa*)
**Question:** Are phytoplankton and mesozooplankton unequally distributed through the water column?
- If so, what physical, trophic or day/night factors are associated with the differences in composition and densities?

**Hypothesis:** Yes, mesozooplankton and phytoplankton will be unequally distributed and that vertical distribution will be a response to predation and light levels (time of day).
Field Methodology:

- Two sets of day/night cruises
- One sample station (mid creek)
  - 0.5m, 3m, and 6m
  - Water quality profile
- Samples were pumped from depth
  - Phytoplankton samples taken with sampling cup, Lugol’s as preservative
  - Zooplankton samples taken by pumping water though bongo net, total filtered volume calculated
Lab Methodology

- Both phytoplankton and zooplankton were identified and enumerated

  - Calculate density and carbon equivalents for each major phytoplankton group and copepod group
Biomass Breakdown

Event 1 6/29

Carbon (μg/L)

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Diatoms | Phytoflagellates | Dinoflagellates
Acartia tonsa

Event 1 6/29

Density (organisms/m³)

- surface
- mid
- bot

Day • Night
Event 2

- High predation could have affected zooplankton counts

- Water temperatures were ~5°C hotter at the surface and mid depths during Event 2
  - Surface temperature reached 32.8°C (91.1°F) during event 2 (event 1 was 27.0°C)
  - Organisms were likely trying to avoid unfavorable temperatures
Conclusions

- Distribution seemed to be dictated mostly by the time of day and the location of food

- Predation avoidance might have been a factor but doesn’t seem significant

- Temperature can also play a huge role in affecting the normal distribution of plankton
Thank You!

- Richard and Marcia for their mentorship
- The entire PEARL staff and the other interns for a great summer!
Questions?