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

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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

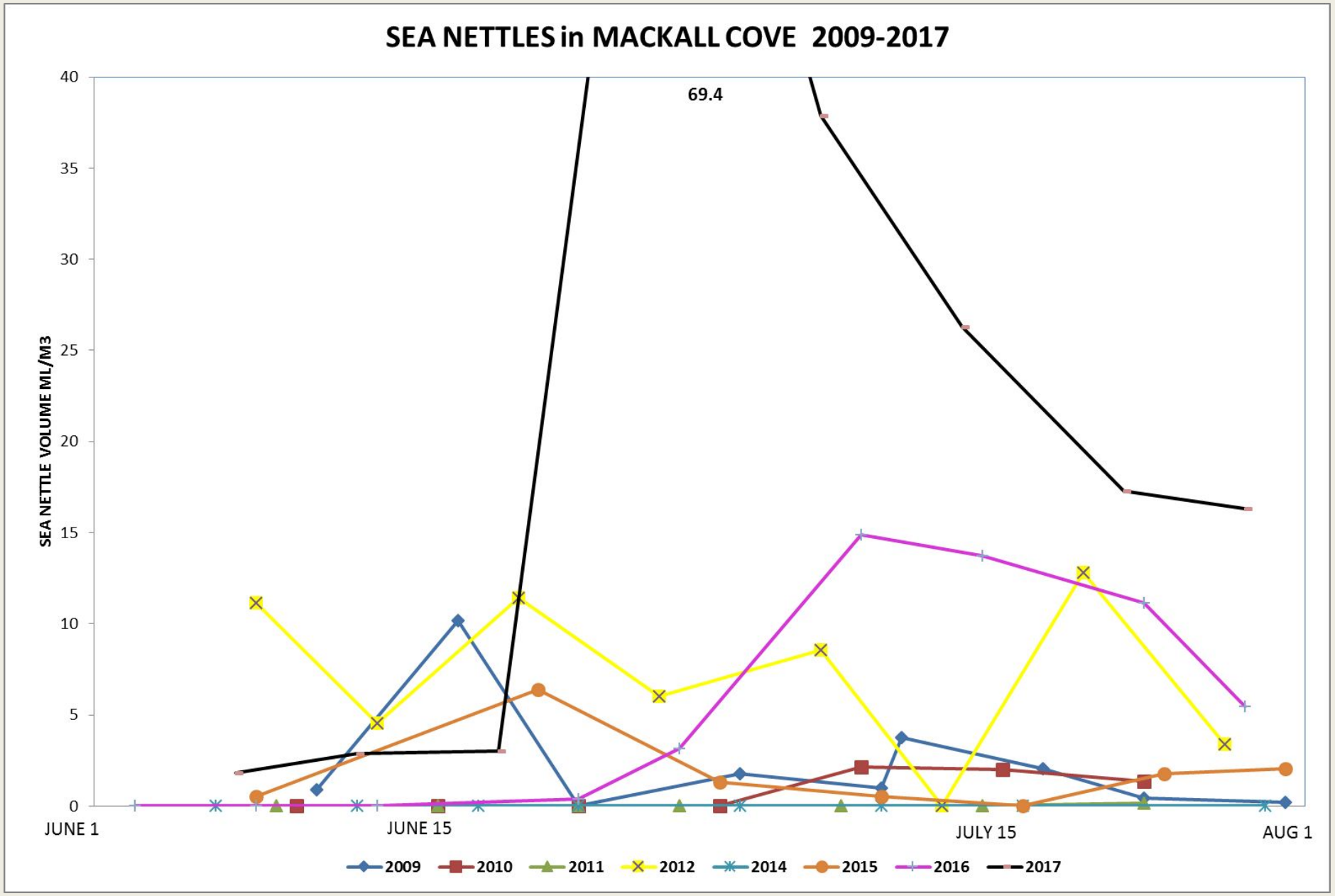
Why is it Important?

- 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

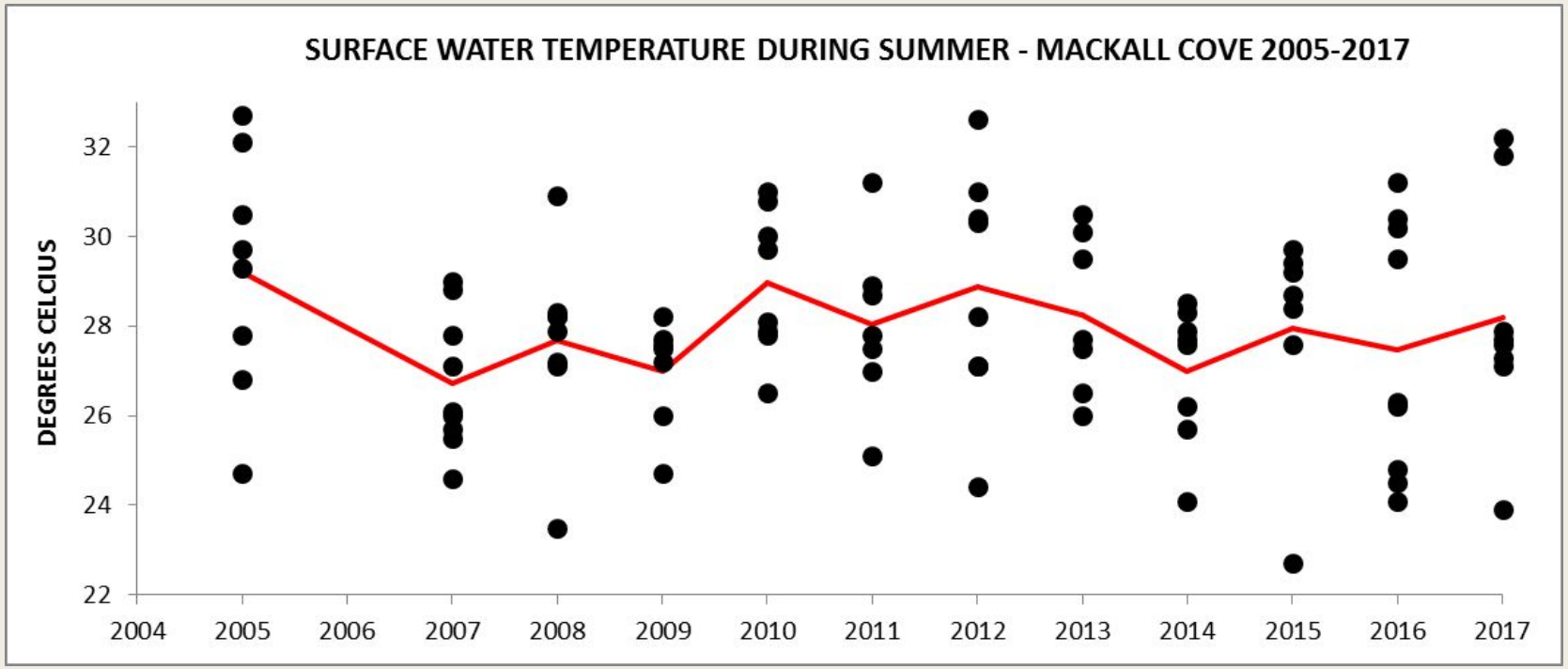
Field Methods

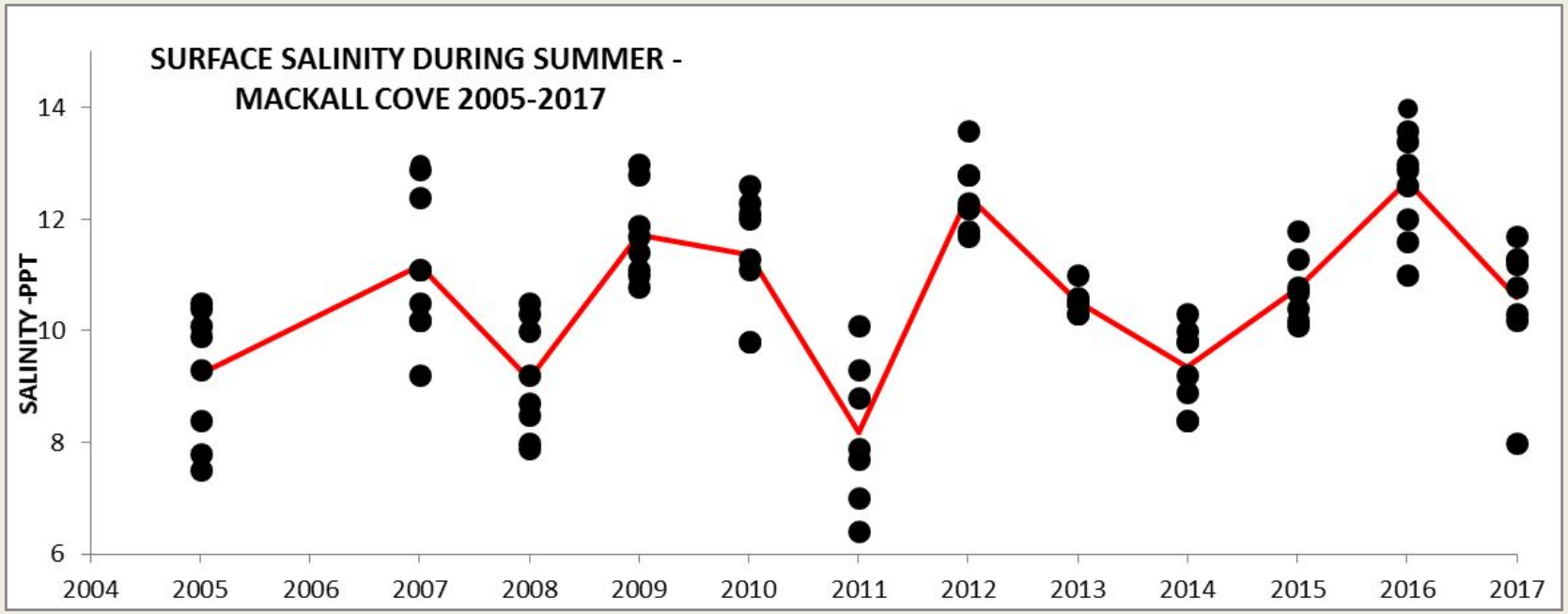
- Weekly sampling
- 0.5 meter tow net, 202 micron mesh
  - *Three oblique tows per site at three sites*
- Total volume (mL) of ctenophore and jellyfish samples recorded
  - *Organism volume normalized by calculating volume of water (m^3) filtered by the net using flow meter in net*
- Water quality (temp/DO/salinty/Secchi/chl a)

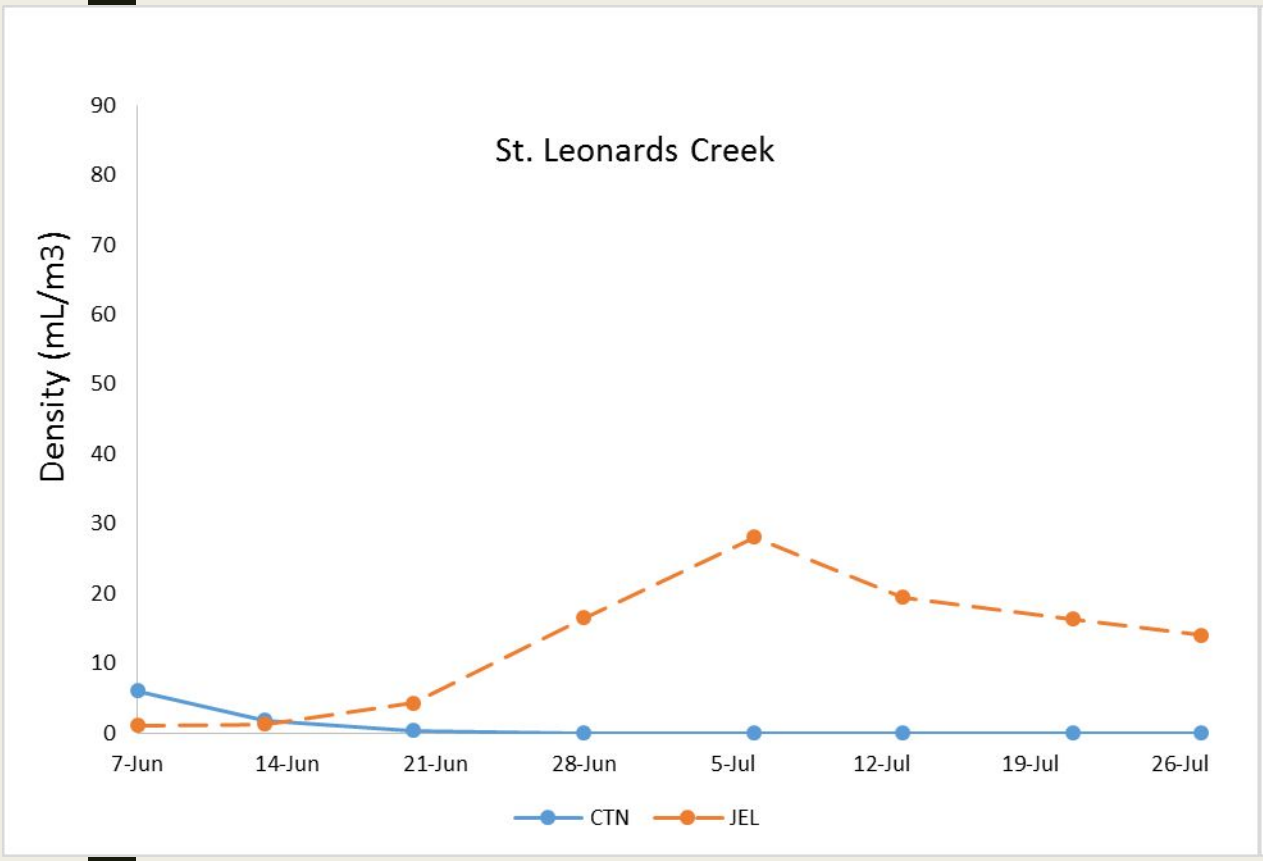

Station 2
Station 1
Station 3
Google earth
1993
Imagery Date: 10/19/2013 38°23'35.56" N 76°30'02.06" W elev 8 ft eye alt 21236 ft

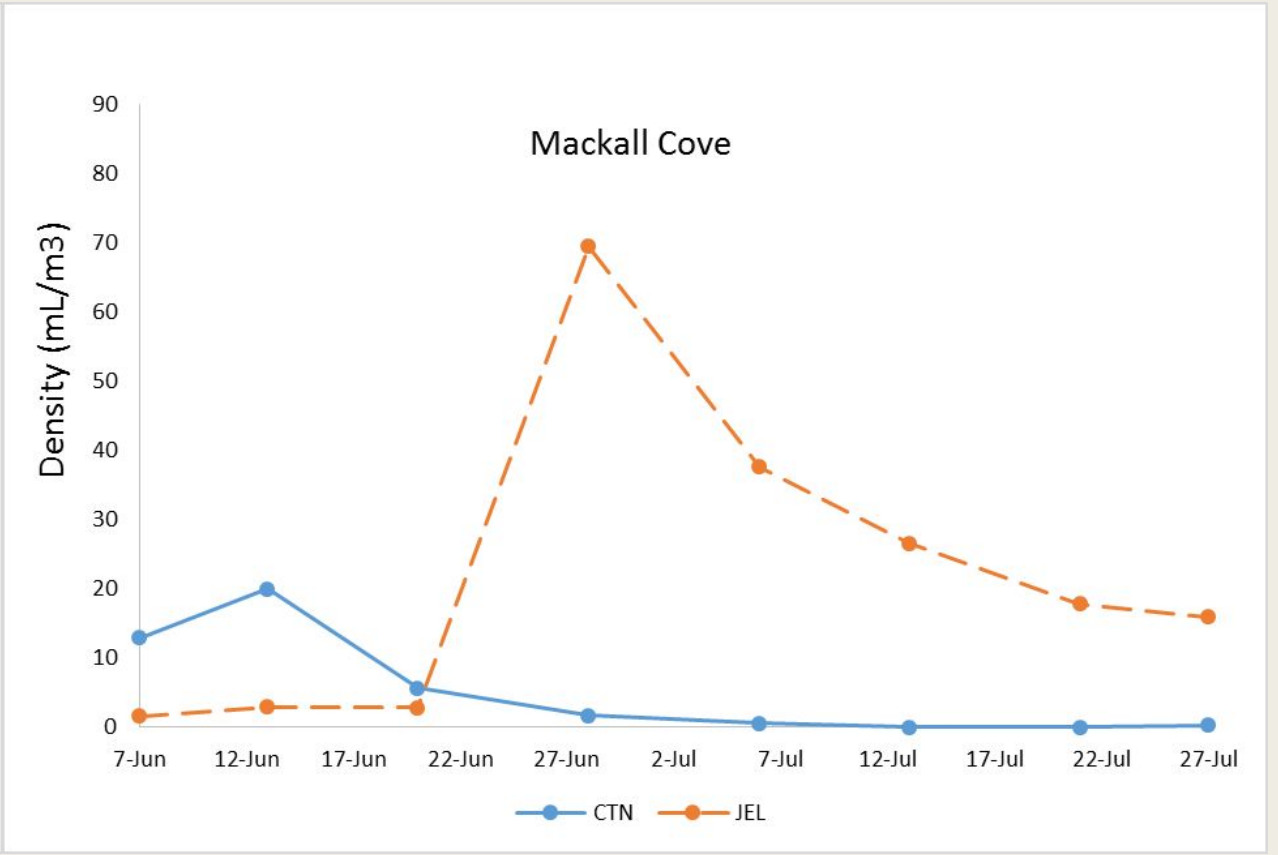


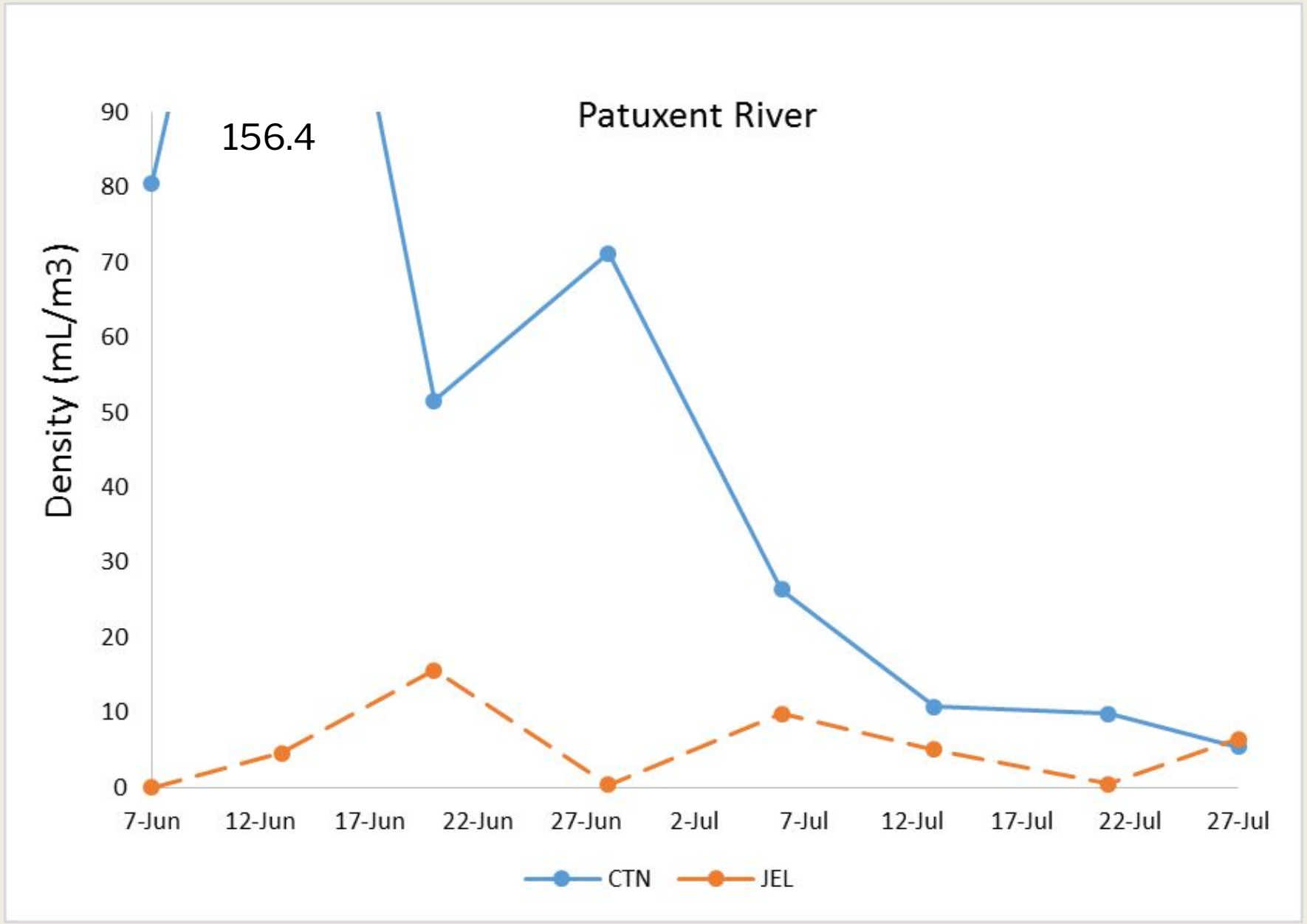
Should you go swimming in the cove this summer?


SURFACE WATER TEMPERATURE DURING SUMMER - MACKALL COVE 2005-2017
DEGREES CELCIUS
32
30
28
26
24
22
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017

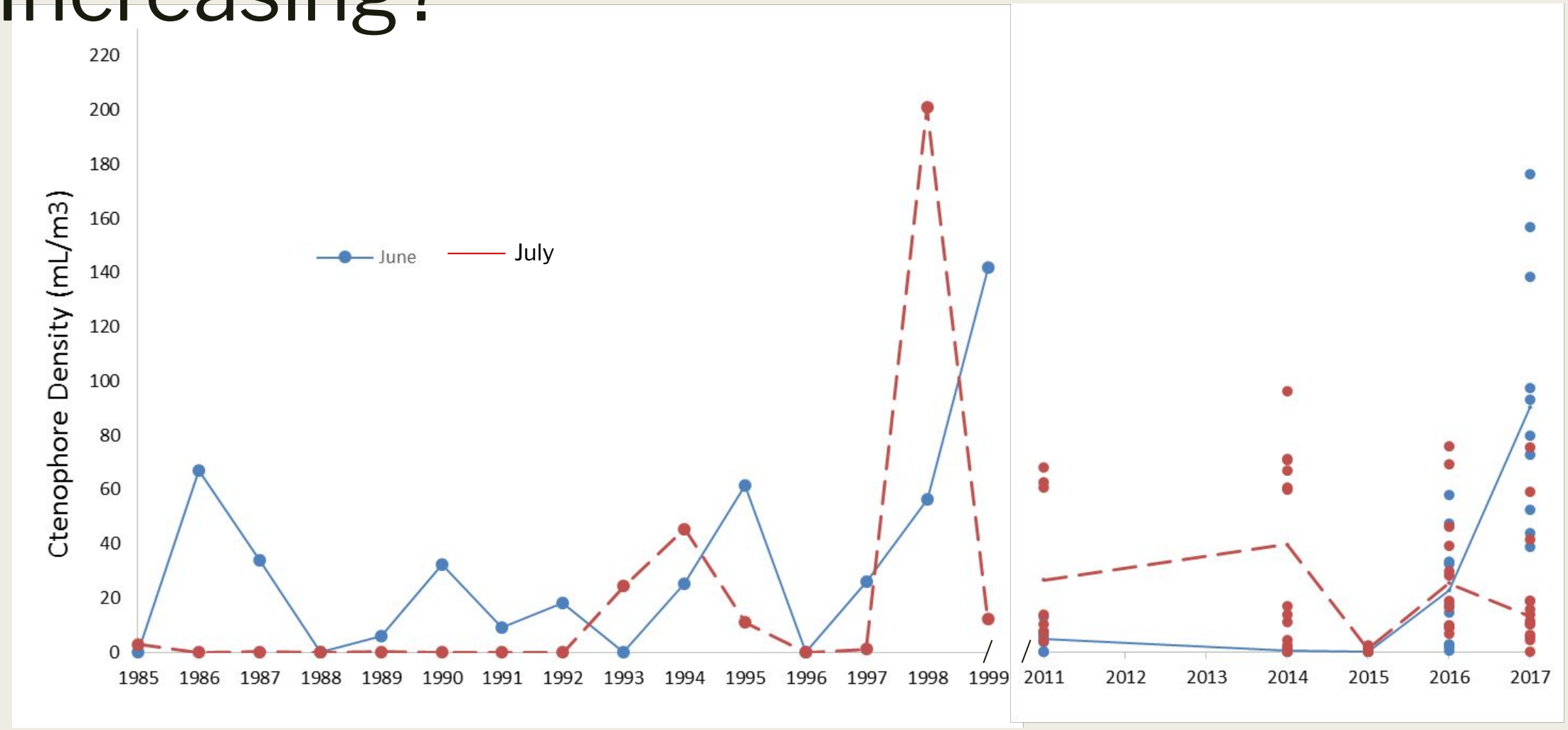

SURFACE SALINITY DURING SUMMER -
MACKALL COVE 2005-2017
SALINITY-PPT
14
12
10
8
6
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017


St. Leonards Creek
Density (mL/m3)
90
80
70
60
50
40
30
20
10
0
7-Jun
14-Jun
21-Jun
28-Jun
5-Jul
12-Jul
19-Jul
26-Jul
CTN
JEL


Mackall Cove
Density (mL/m3)
90
80
70
60
50
40
30
20
10
0
7-Jun
12-Jun
17-Jun
22-Jun
27-Jun
2-Jul
7-Jul
12-Jul
17-Jul
22-Jul
27-Jul
CTN
JEL


Patuxent River
156.4
Density (mL/m3)
90
80
70
60
50
40
30
20
10
0
7-Jun
12-Jun
17-Jun
22-Jun
27-Jun
2-Jul
7-Jul
12-Jul
17-Jul
22-Jul
27-Jul
CTN
JEL

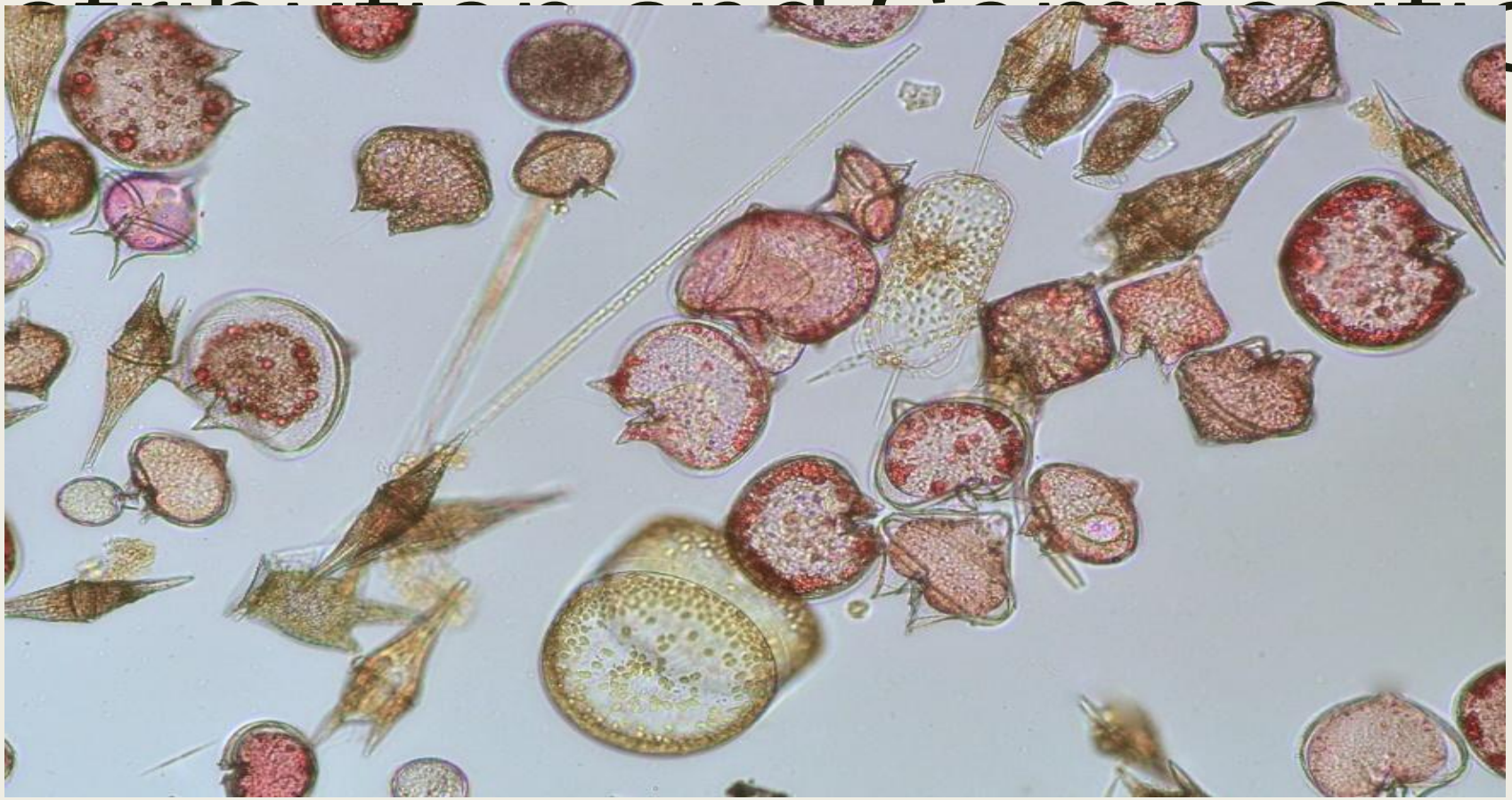
Are Ctenophore Numbers Increasing?



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?

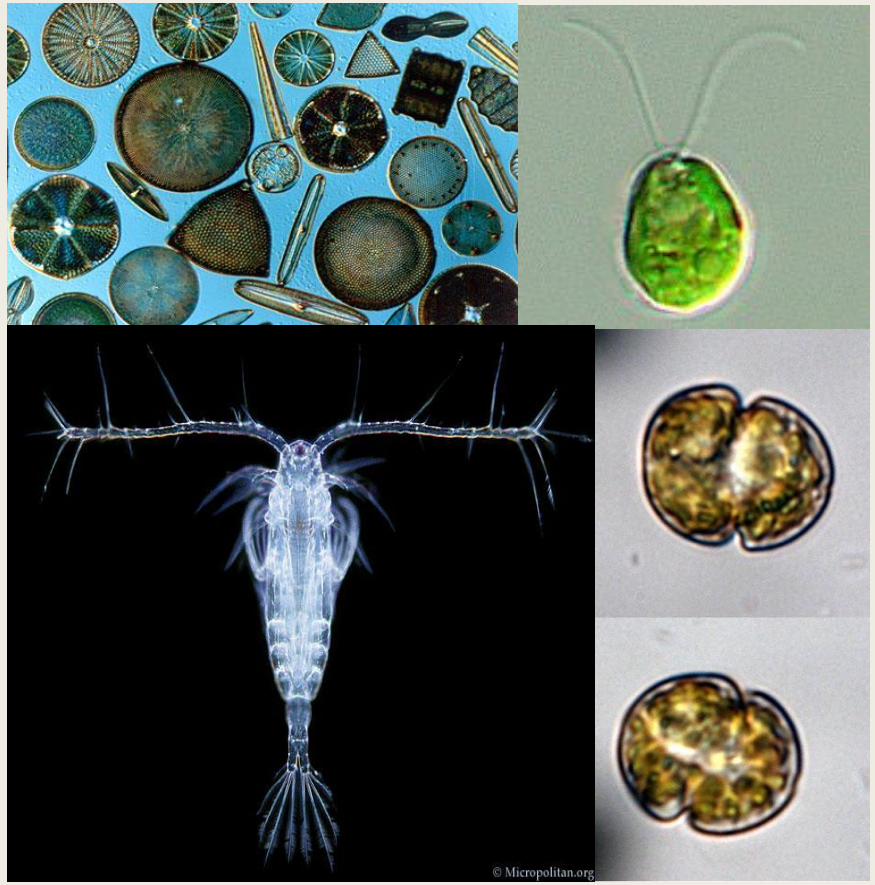
- Predation/Prey (food)
- Salinity/temperature/dissolved oxygen gradients
- Light (Time of Day)

- 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

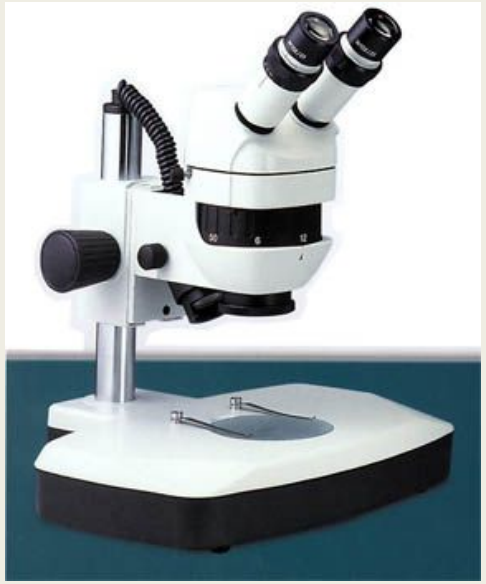
- One sample station (mid creek)
  - 0.5m, 3m, and 6m
  - Water quality profile

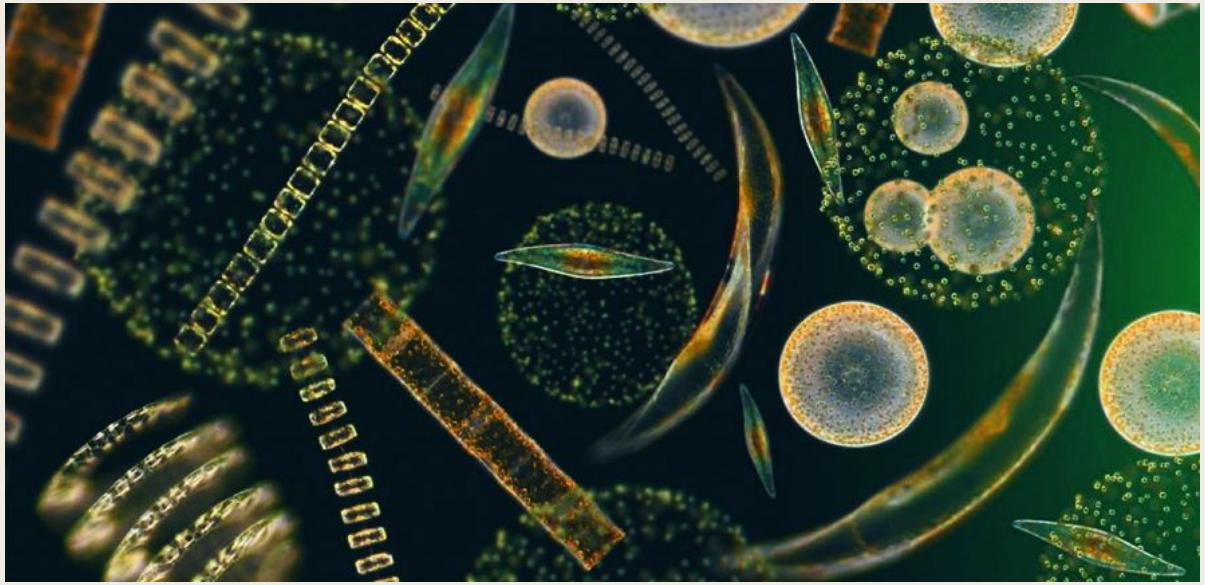
- Samples were pumped from depth
  - Phytoplankton samples taken with sampling cup, Lugol's as preservative
  - Zooplankton samples taken by pumping water though bongo net, total filtered volume calculated


St Leonard Creek
Cape Leonard
Jefferson
Patterson Park
and Museum

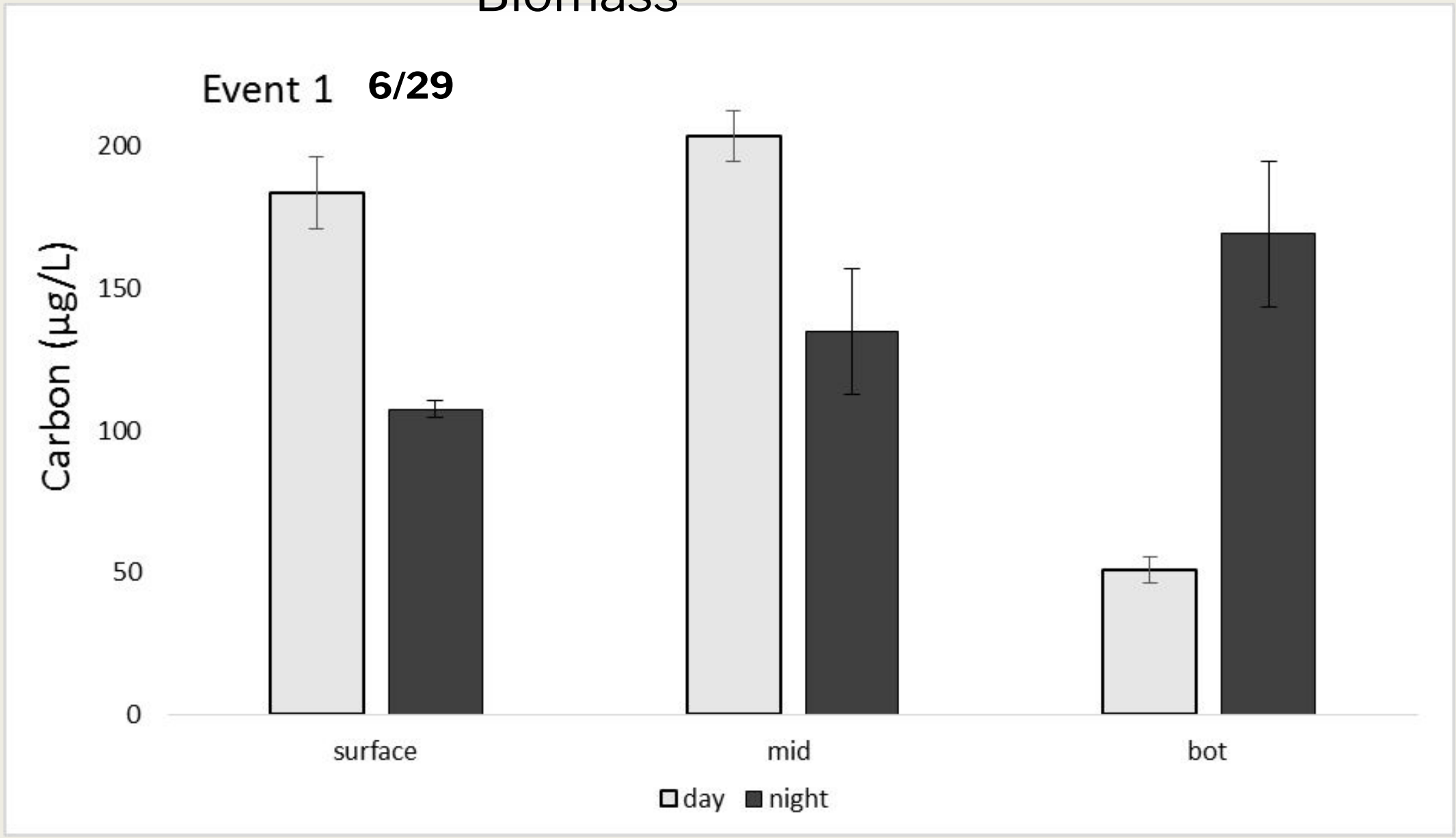
Lab Methodology

- Both phytoplankton and zooplankton were identified and enumerated
  - *Calculate density and carbon equivalents for each major phytoplankton group and copepod group*

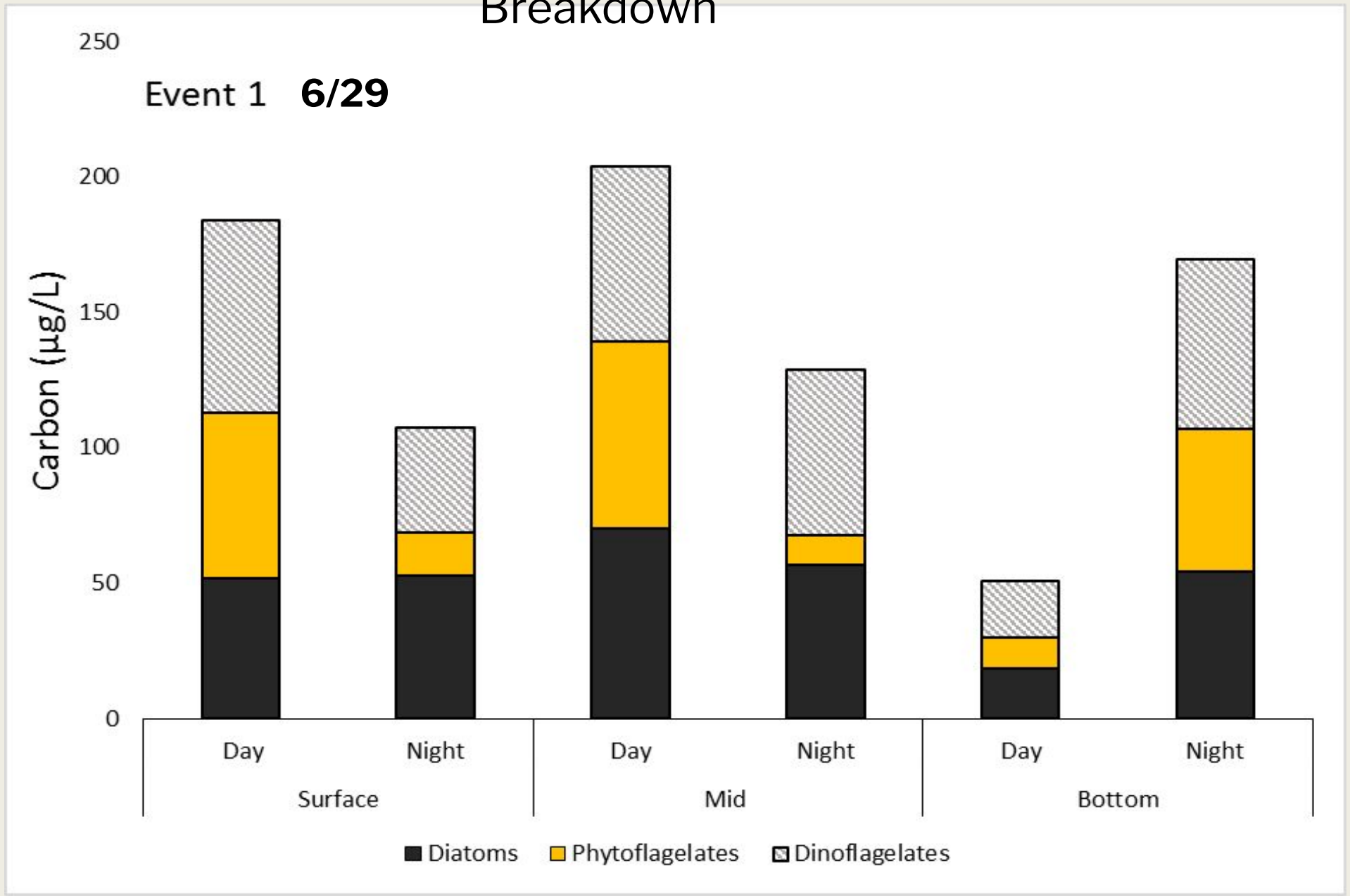




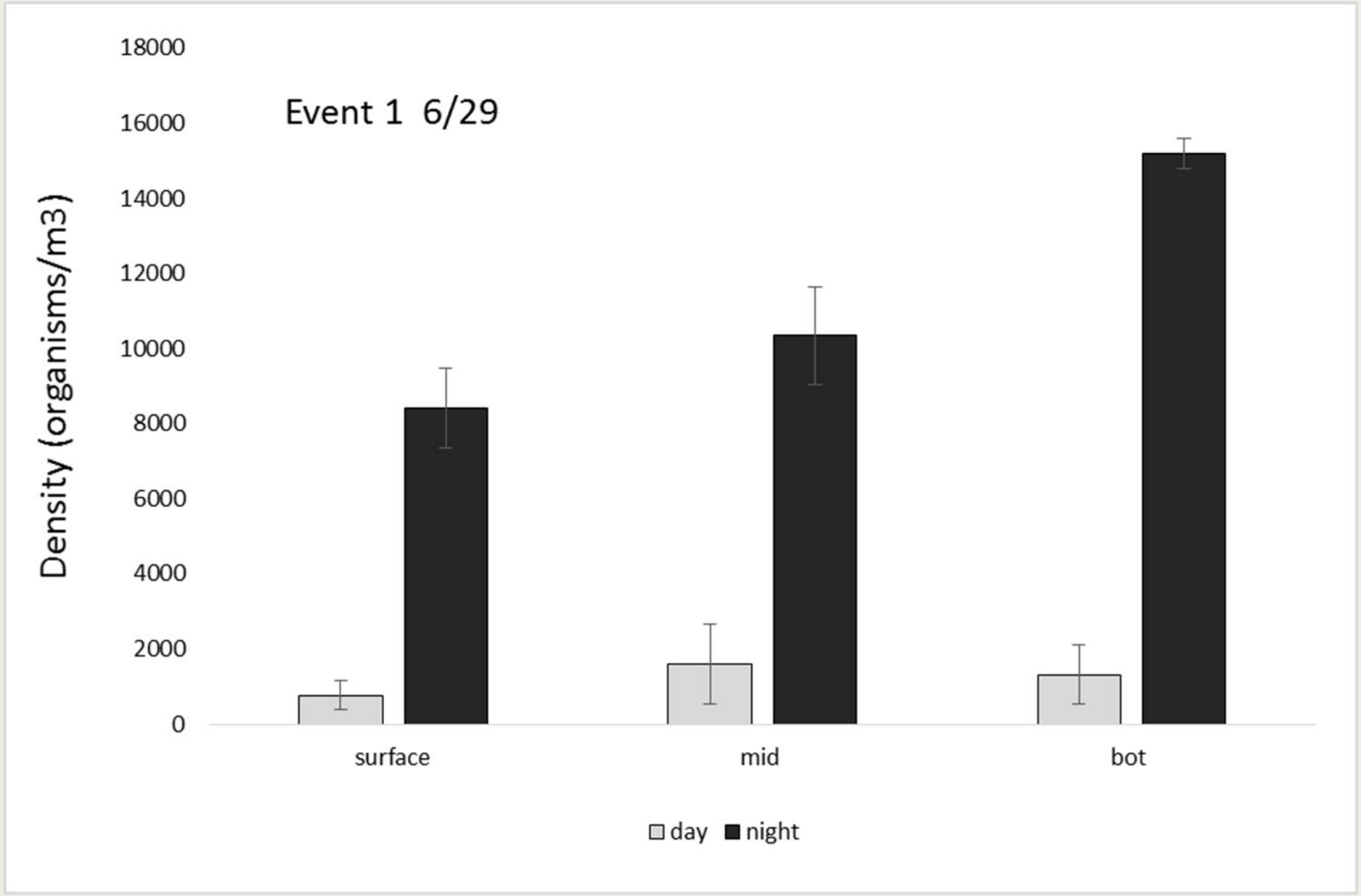
Phytoplankton Biomass

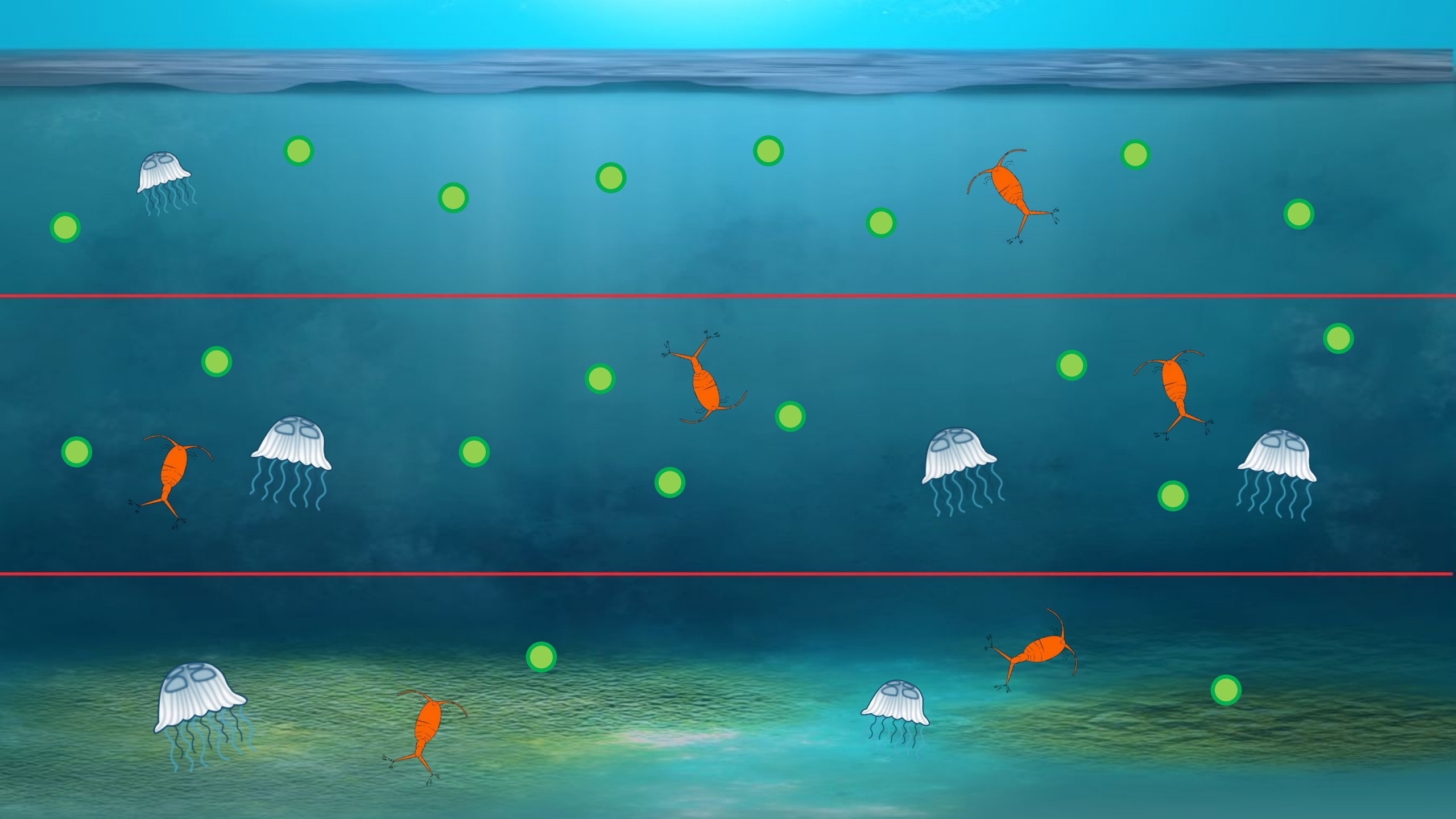


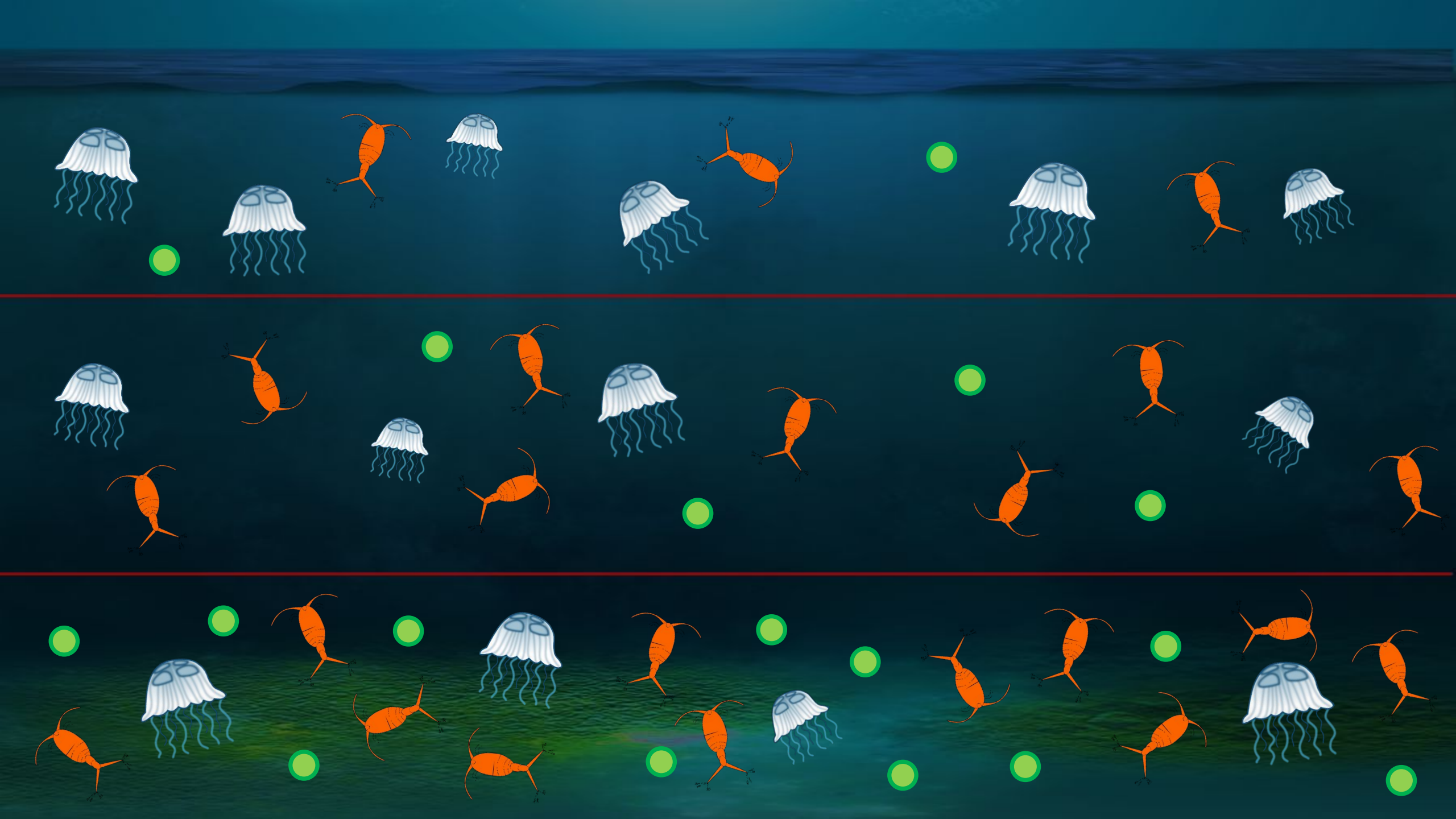
Biomass Breakdown



Acartia tonsa

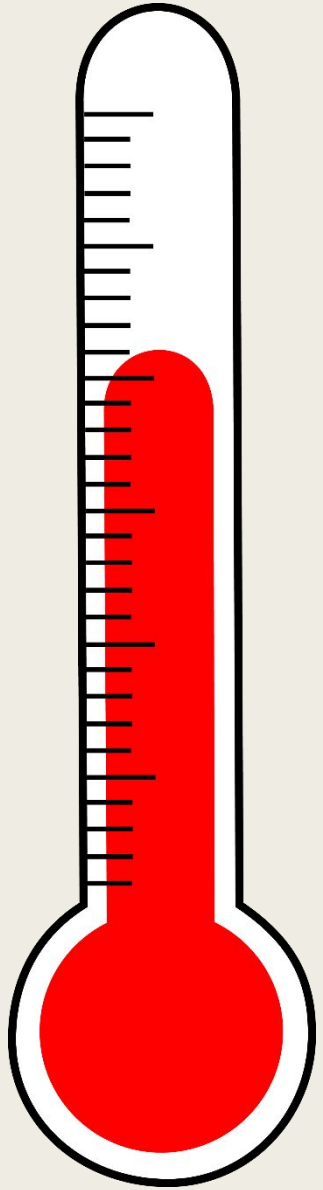






Event 2

- 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 ?