Zooplankton Population Dynamics in Saint Leonard Creek and Adjacent Patuxent River Summer 2019

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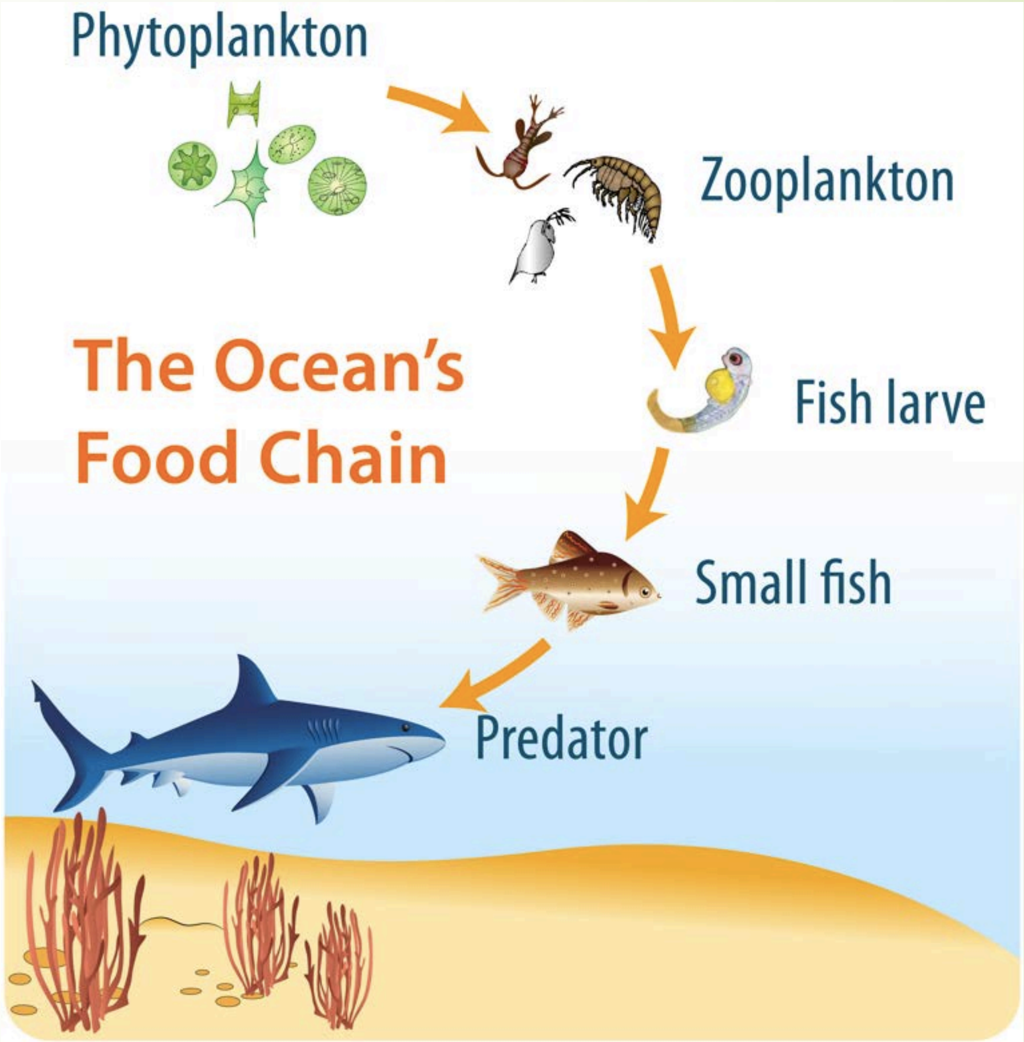
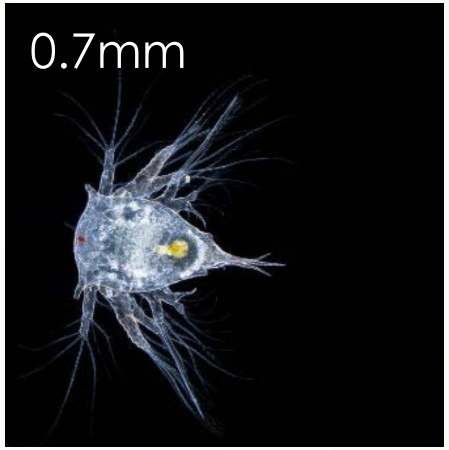
Zooplankton

- Zooplankton: small floating or weakly swimming organisms that drift with water currents but actively position themselves in the water column
- Diet of zooplankton: phytoplankton and other smaller zooplankton
- Can be found in sizes ranging from microscopic to jellyfish that grow upward of 8 feet
- Typical examples include: microscopic animals, copepods, jellyfish, and larval crustaceans.

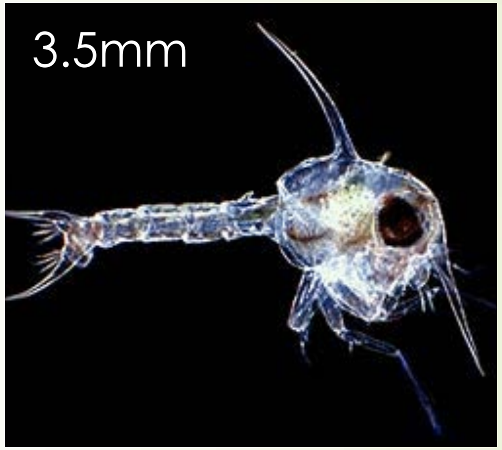


Mesozooplankton

- Mesozooplankton:
  - Larger zooplankton
  - Are > 200 μm in size
- Primarily eat phytoplankton
- What we typically see here in the river and in the bay:
  - Zoea
  - Fish larvae
  - Cladocerans
  - Copepods (ie. Acartia)
  - Shrimp
  - Juvenile jellyfish – Medusa
  - Barnacle larvae



Barnacle nauplii



Larval Crab (Zoea)

Harpacticoid

Copepod (ie. Acartia)

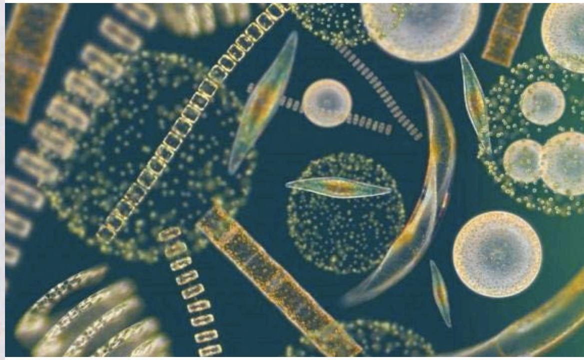
Ctenophores

- Comb jellies are transparent, jelly-like invertebrates with bright, iridescent color bands
- The common species of comb jellies we see around here is sea walnuts (*Mnemiopsis leidyi)*
- Unlike jellyfish who have nematocysts, comb jellies have colloblasts on their tentacles, which do not sting
- Typically feed exclusively on copepods and fish larvae
- Have been recorded consuming almost 500 copepods an hour!
- Most often preyed upon by sea nettles in the summer months

Jellyfish

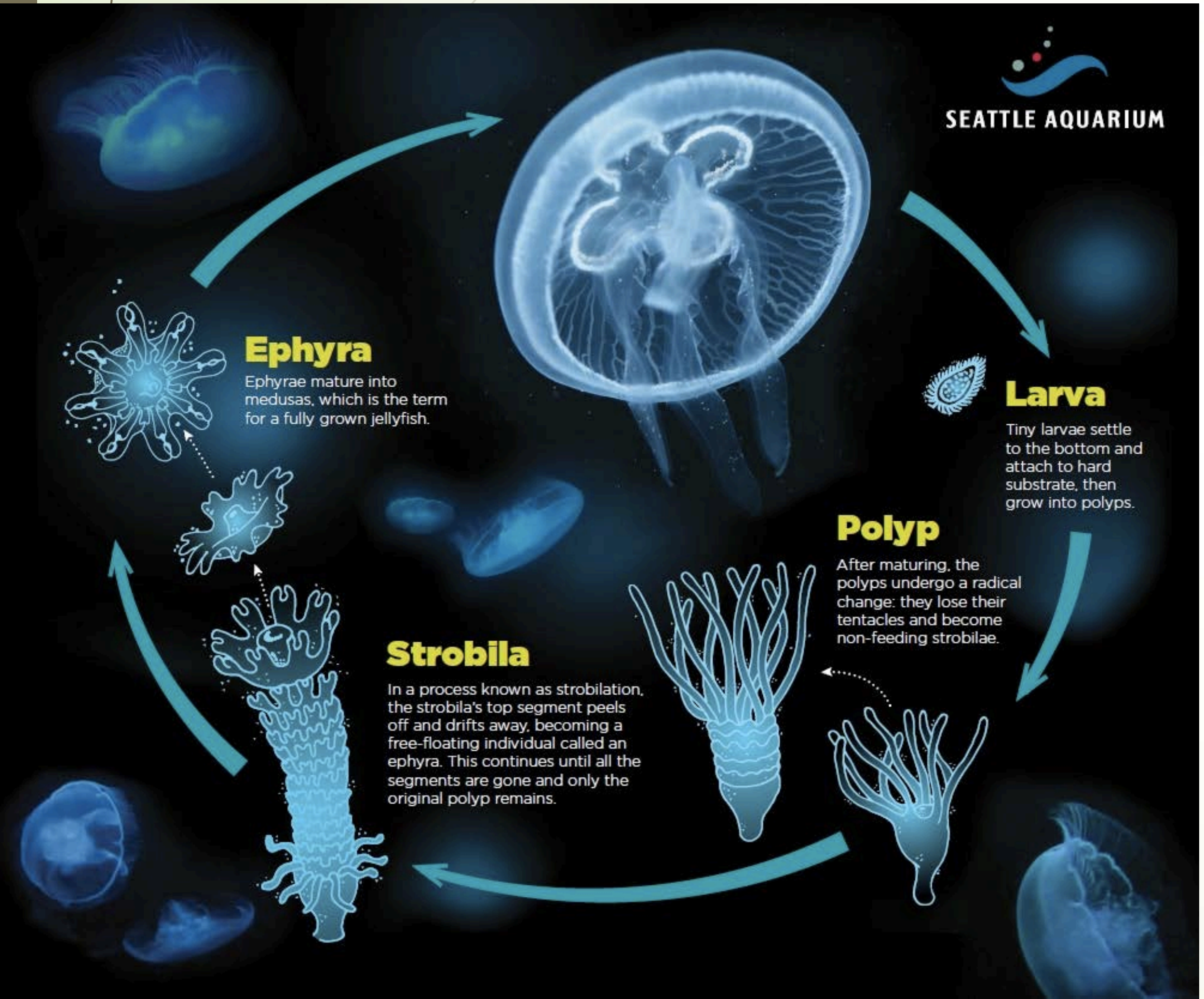
- Jellyfish are a prime predator and consumer of ctenophores
- Jellyfish, such as sea nettles, are typically abundant in the middle parts of the Chesapeake Bay during the summer, when ocean currents push saltwater up from the Atlantic to the Eastern Shore
- The jellyfish populations of the Chesapeake Bay were at record lows last summer and so far appear to still be relatively absent from the waters this season as well

Who eats who?

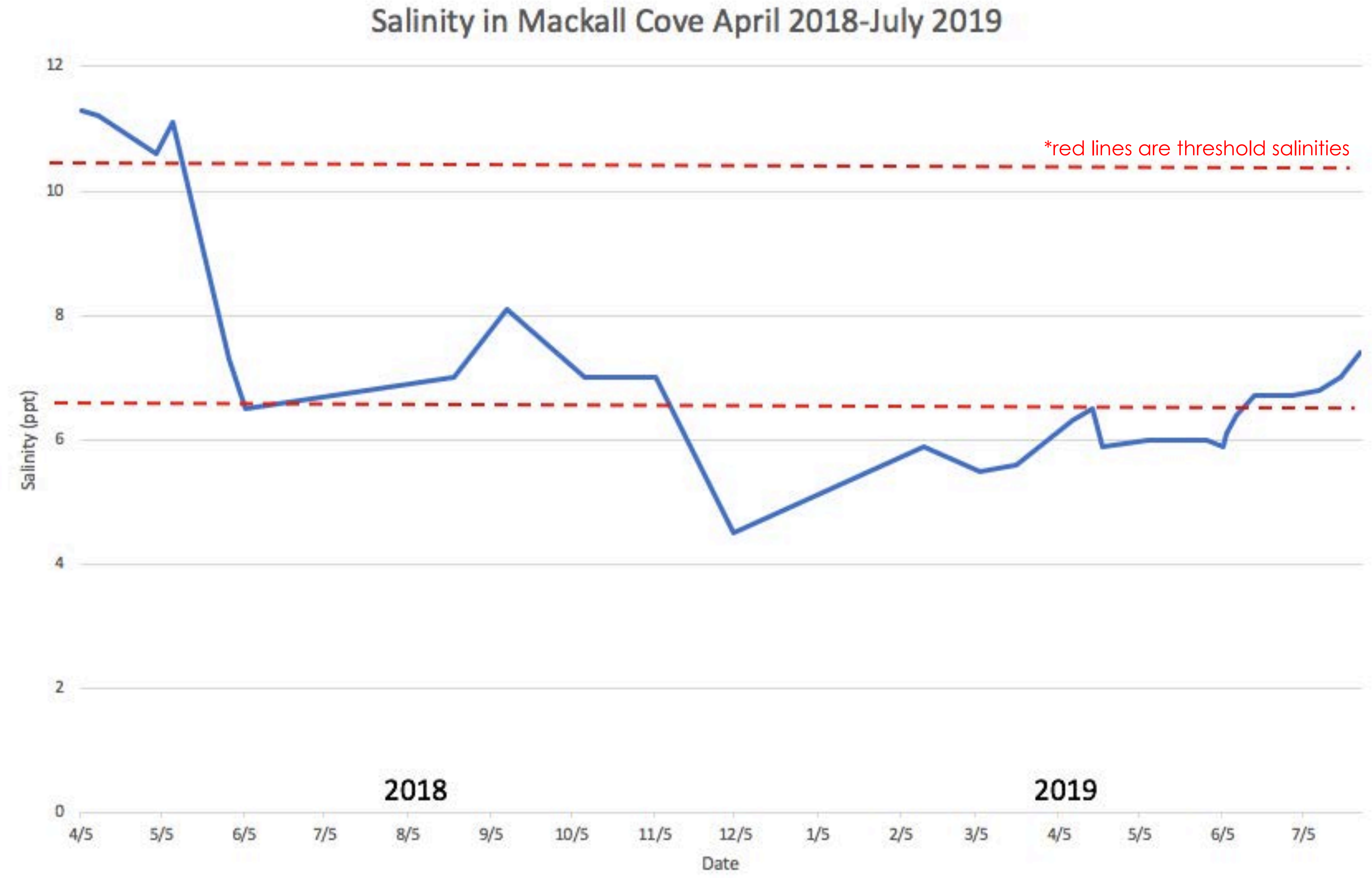


Jellyfish ← Ctenophores ← Mesozooplankton ← Microzooplankton ← Phytoplankton

Sea Nettle Prediction Model – Cargo et al. 1990

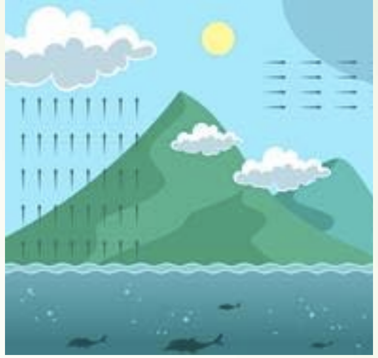


- Late spring salinities have a very significant effects on strobilation which is the way in which jellyfish reproduce asexually.
- The polyp needs salinities of 11ppt or higher during April, May, and June, especially after May 10 and before June 15 in order to induce strobilation and produce lots of ephyrae which are the free swimming jellyfish stage before medusa.
- <u>At salinities below 10ppt their numbers diminish, and they are **never** found in the wild where spring salinities fall below 7ppt.</u>


Salinity in Mackall Cove April 2018-July 2019
*red lines are threshold salinities
Salinity (ppt)
12
10
8
6
4
2
0
2018
2019
4/5
5/5
6/5
7/5
8/5
9/5
10/5
11/5
12/5
1/5
2/5
3/5
4/5
5/5
6/5
7/5
Date

Hypothesis

- Salinity was below threshold
  → no jellyfish
- Since no jellyfish to prey on ctenophores
  → ctenophore population explodes
- Ctenophores feed heavily on copepod population
  → fewer copepods



Low salinity

Little to no jellyfish

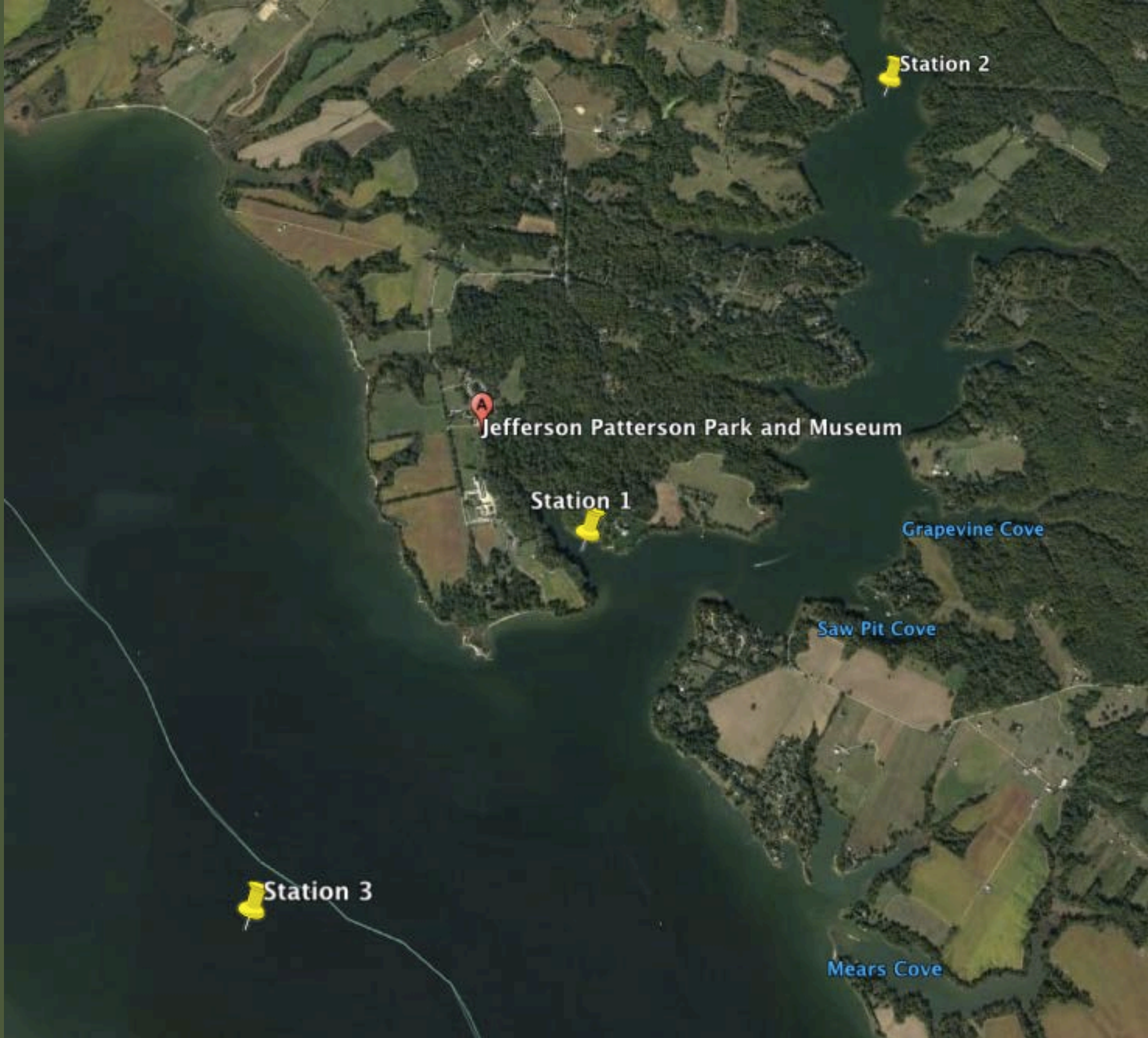
More ctenophores

Fewer copepods

Goals

- Characterize zooplankton population with respect to biotic and abiotic factors
- Use results to explore these organisms' interactions
- Look at unique features of population in this low salinity year compared to other years
- Compare 2019 data to historical data from Mackall Cove and look for trends

Field Sites



Station 2
Jefferson Patterson Park and Museum
Station 1
Grapevine Cove
Saw Pit Cove
Station 3
Mears Cove

Field Methods

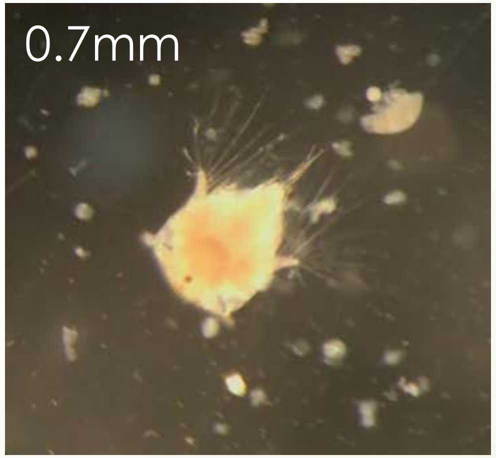
- Use YSI to record temperature, salinity, and dissolved oxygen at each station
- Use secchi disk to record water quality/turbidity at each station
- Collect samples by towing plankton net (202µm mesh) beginning just above the bottom and raising the net in progressive steps with the number of steps depending on station depth
- Use attached flow meter to record before and after tow revolutions to be used in calculating total volume of flow through the net
- Fix acquired samples from each site in 10% formalin
- Take samples weekly

Lab Methods

- Jellyfish

- Fish larvae

- Take three 2ml subsamples with Hensen Stempel pipette and put on counting wheel
- Count and identify organisms in each subsample and record in data sheet
- Calculate volume of water filtered by the towed net, the total number of organisms in the full sample collected by the net, the number of organisms per liter, and the biomass.



- Barnacle nauplii

- Shrimp


9mm
Larval fish


Barnacle
cyprid
1mm

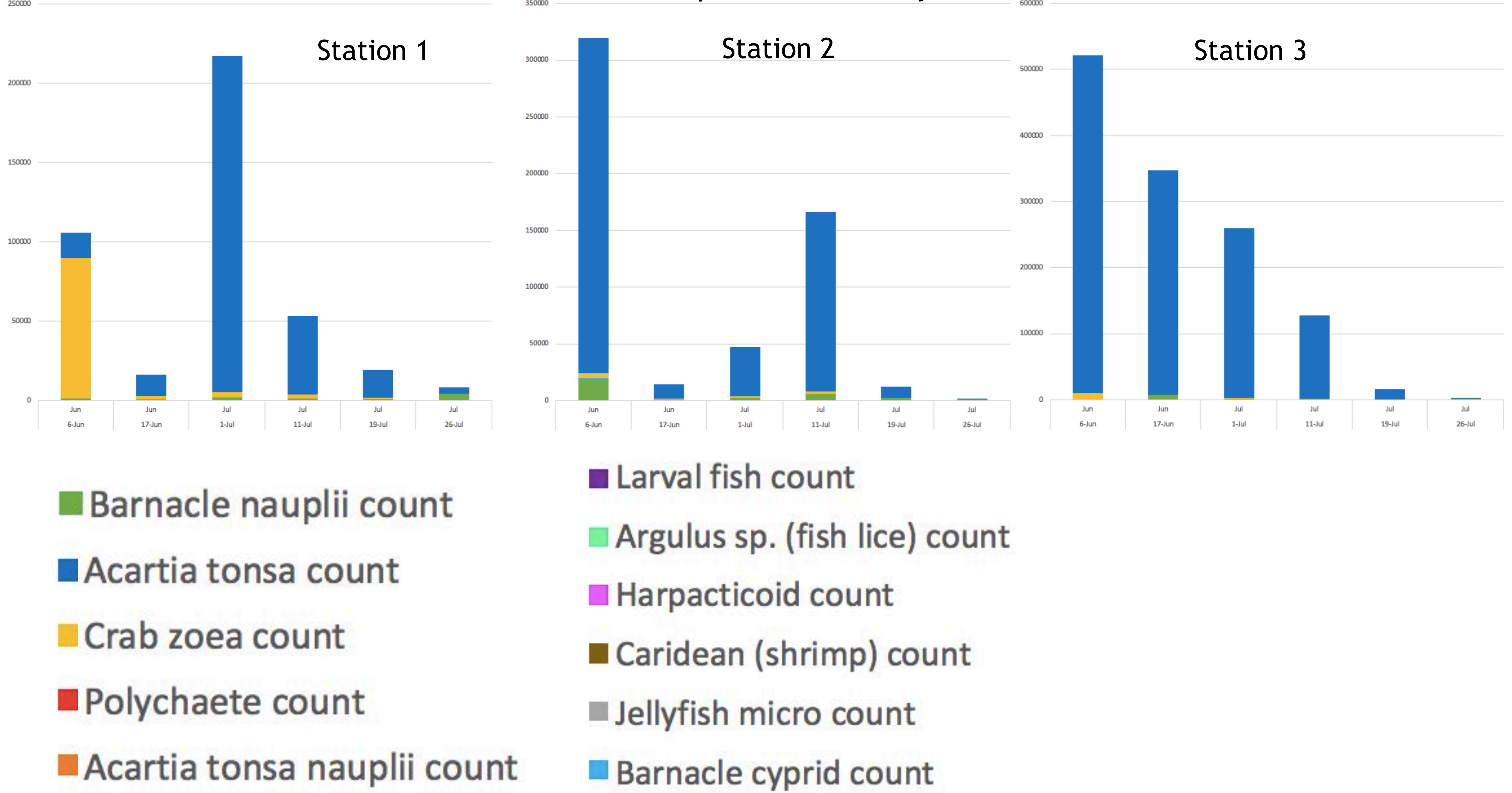

1mm
Copepod
(Acartia)


Fish lice (Argulus)
5mm

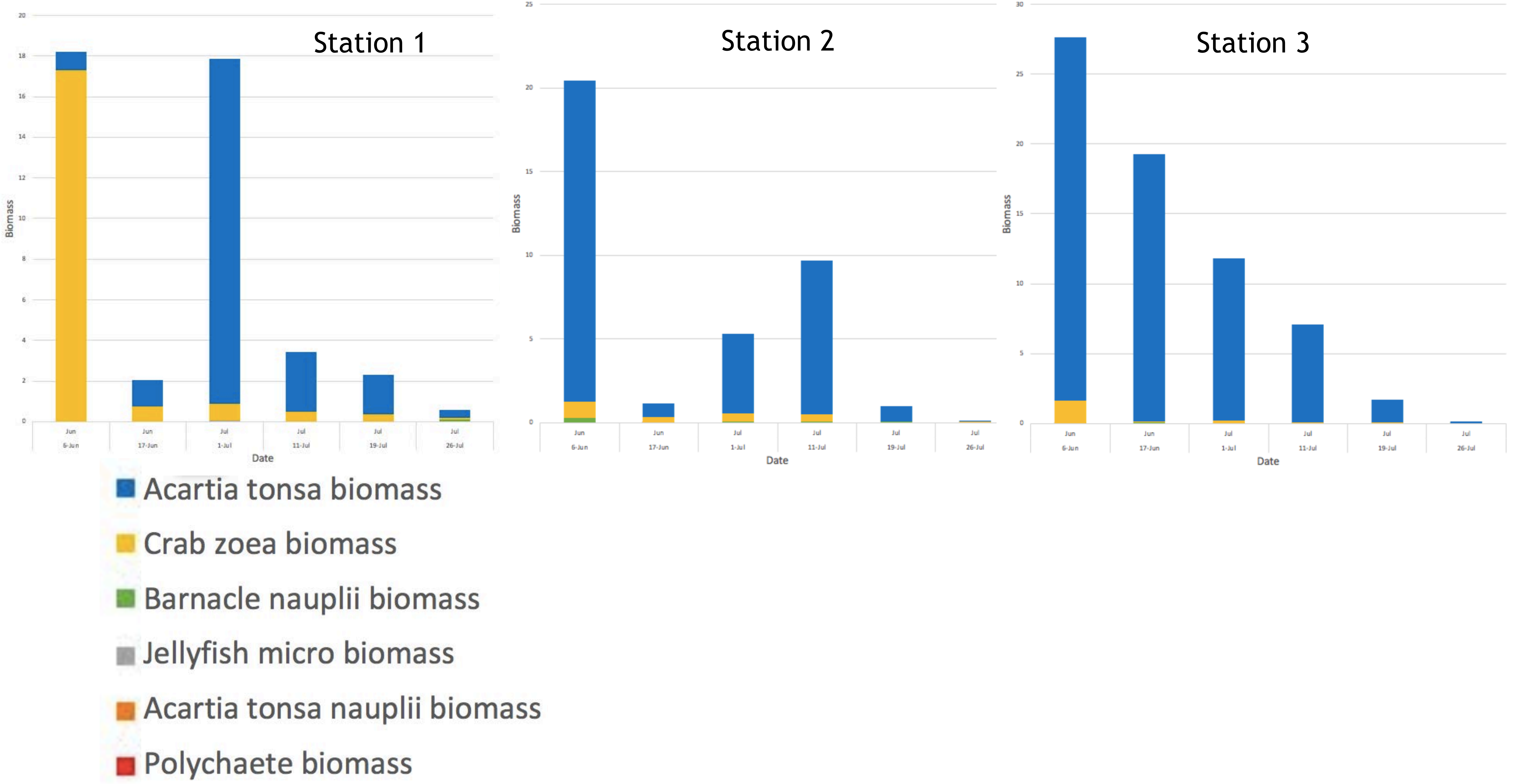

3.5mm
Crab zoea

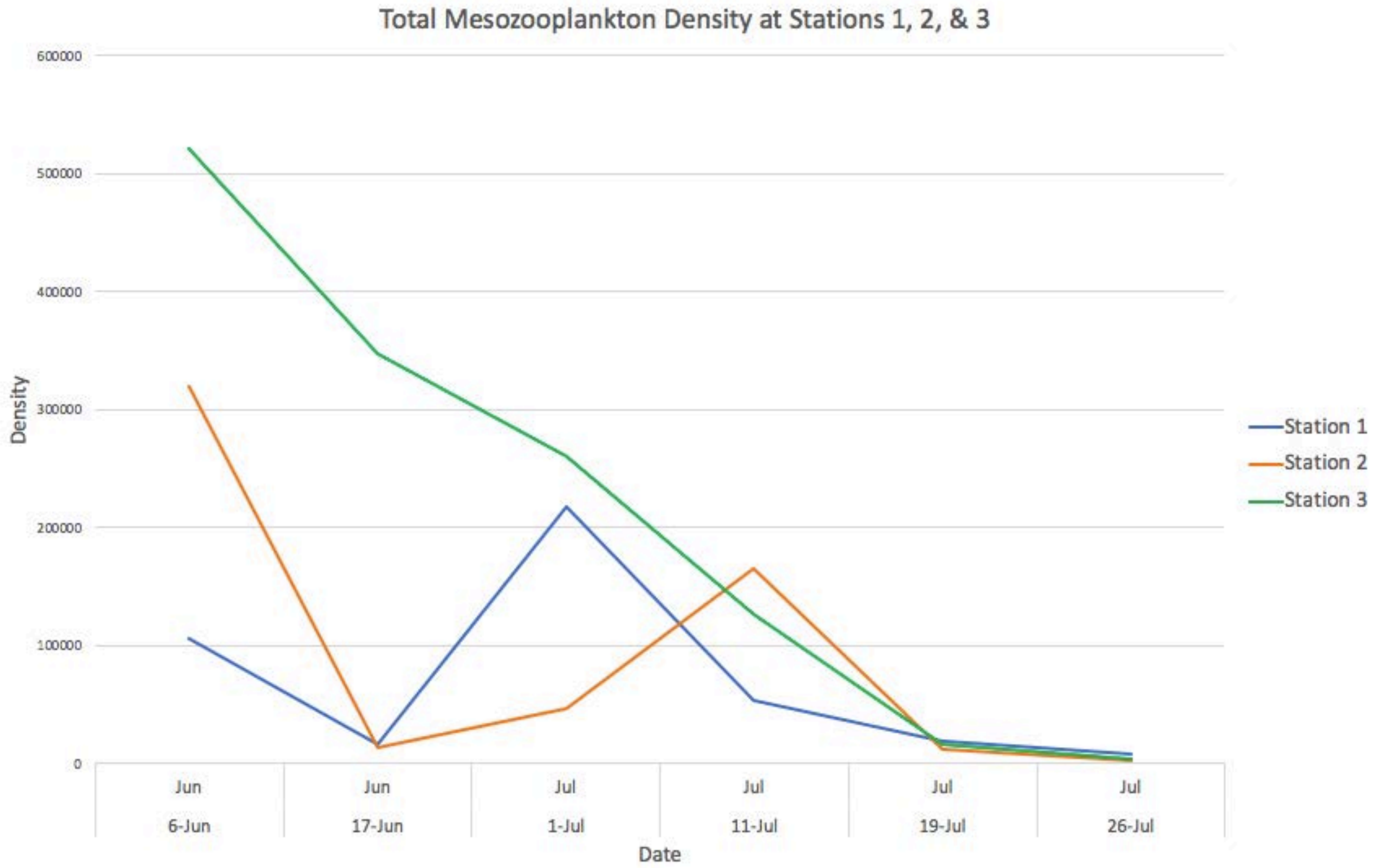

Jellyfish
4mm

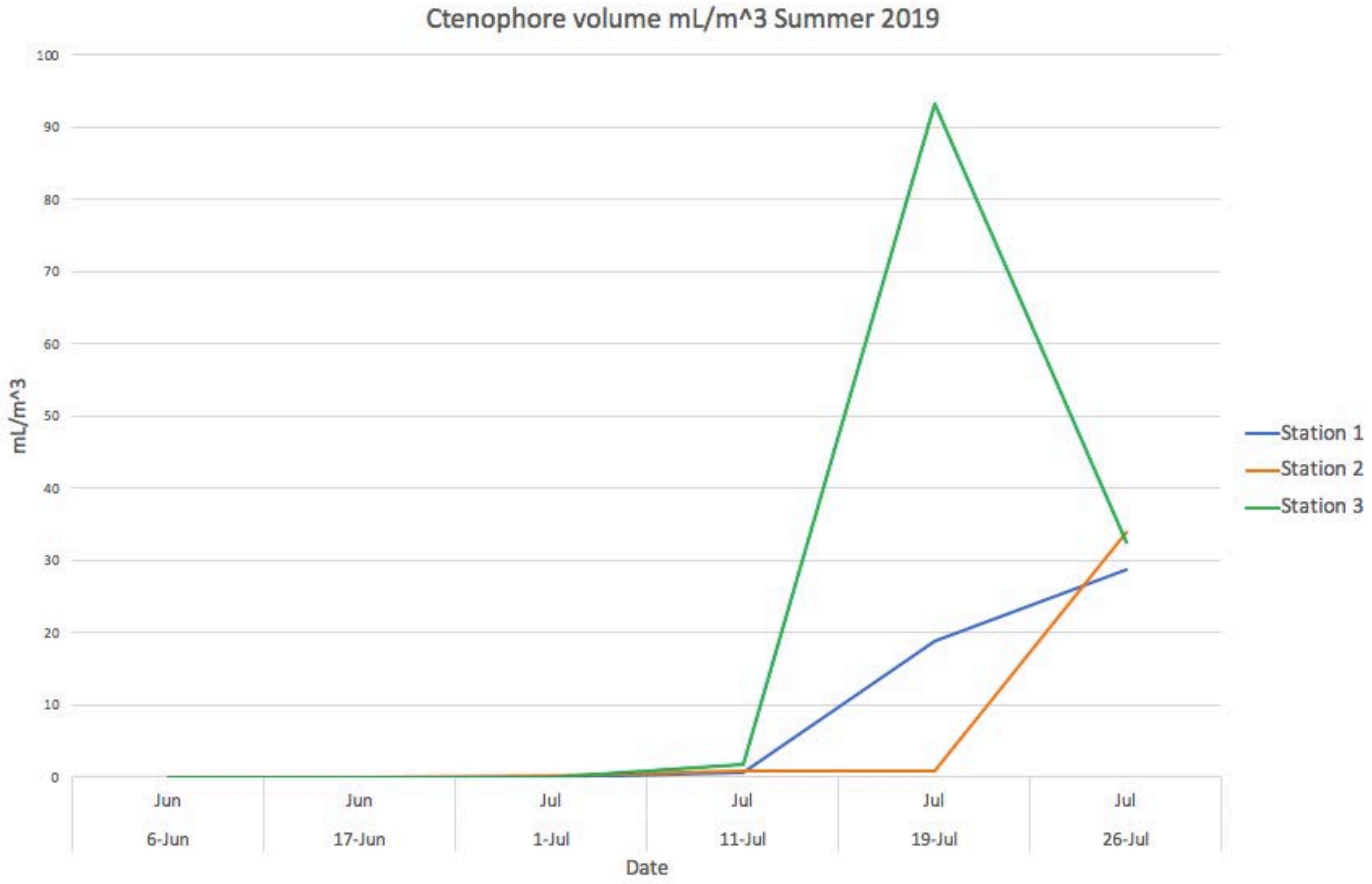
Mesozooplankton Density Count



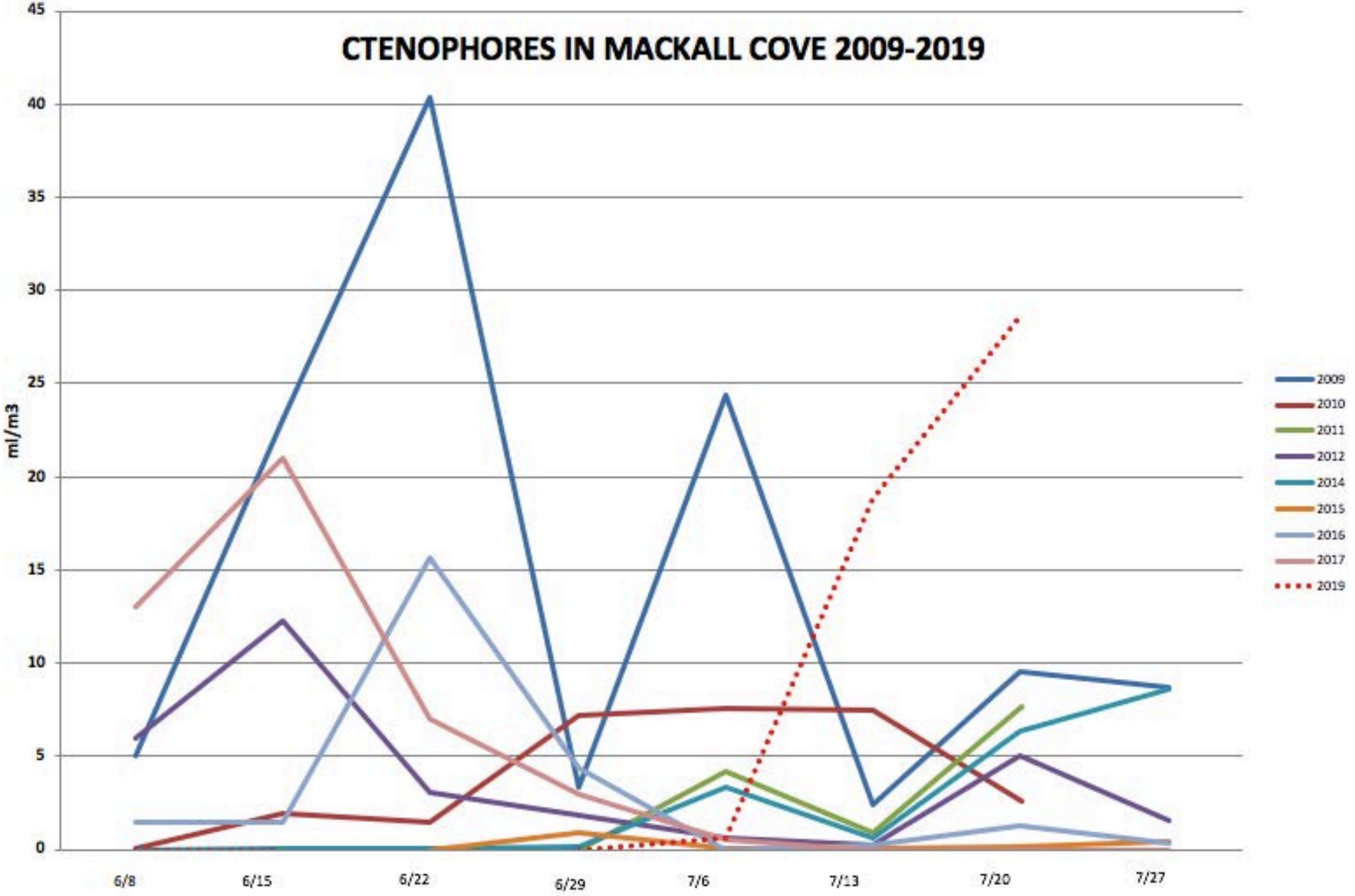
Mesozooplankton Biomass



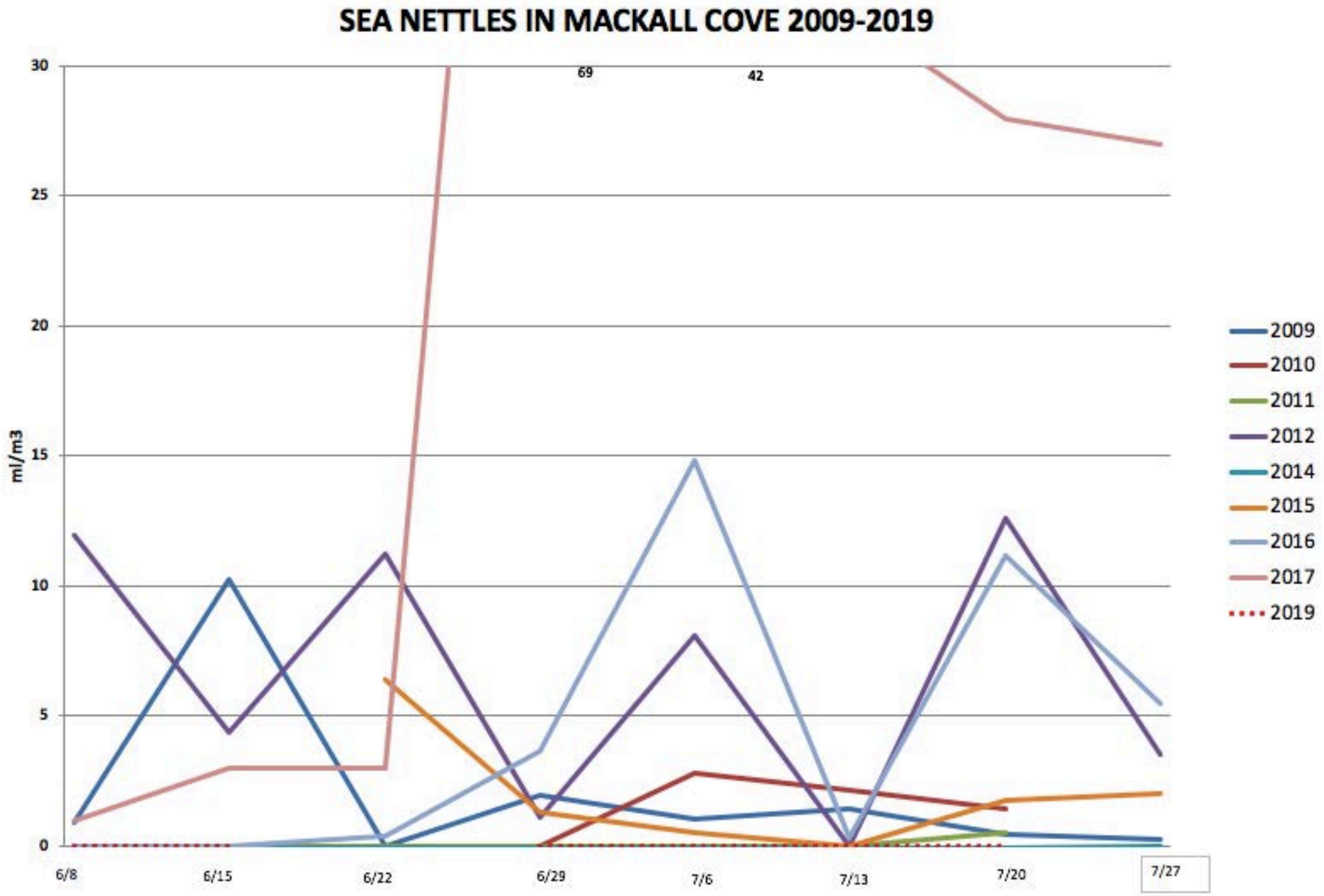

Total Mesozooplankton Density at Stations 1, 2, & 3
600000
500000
400000
300000
200000
100000
0
Density
Jun
6-Jun
Jun
17-Jun
Jul
1-Jul
Jul
11-Jul
Jul
19-Jul
Jul
26-Jul
Date
Station 1
Station 2
Station 3



Ctenophore volume mL/m^3 Summer 2019
100
90
80
70
60
50
40
30
20
10
0
mL/m^3
Jun
6-Jun
Jun
17-Jun
Jul
1-Jul
Jul
11-Jul
Jul
19-Jul
Jul
26-Jul
Date
Station 1
Station 2
Station 3

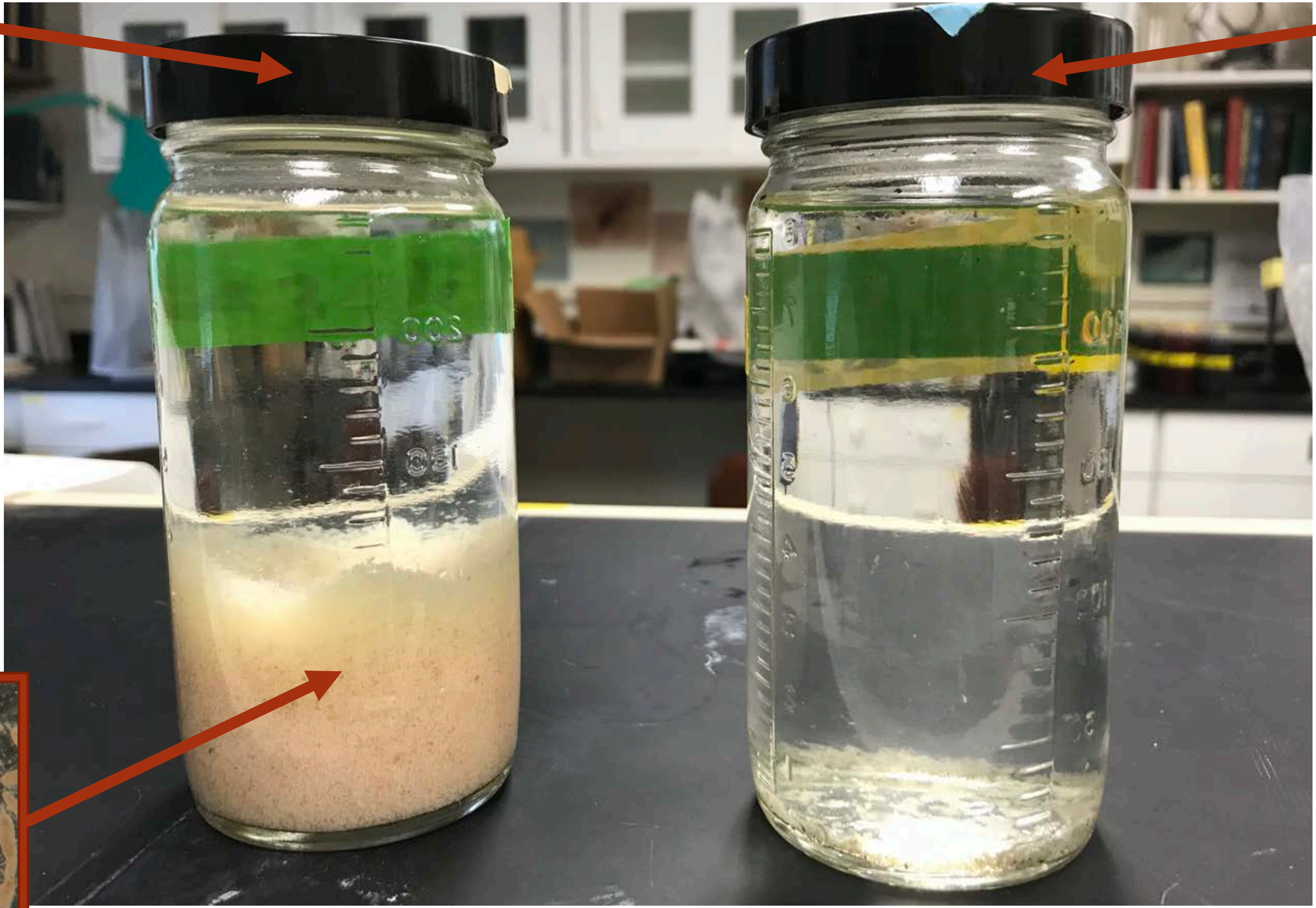


CTENOPHORES IN MACKALL COVE 2009-2019
ml/m3
45
40
35
30
25
20
15
10
5
0
6/8
6/15
6/22
6/29
7/6
7/13
7/20
7/27
2009
2010
2011
2012
2014
2015
2016
2017
2019


SEA NETTLES IN MACKALL COVE 2009-2019
ml/m3
30
25
20
15
10
5
0
69
42
6/8
6/15
6/22
6/29
7/6
7/13
7/20
7/27
2009
2010
2011
2012
2014
2015
2016
2017
2019

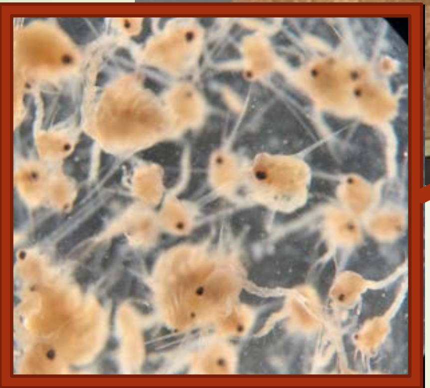
Single tow
from 6/6/19

Single tow
from 7/26/19

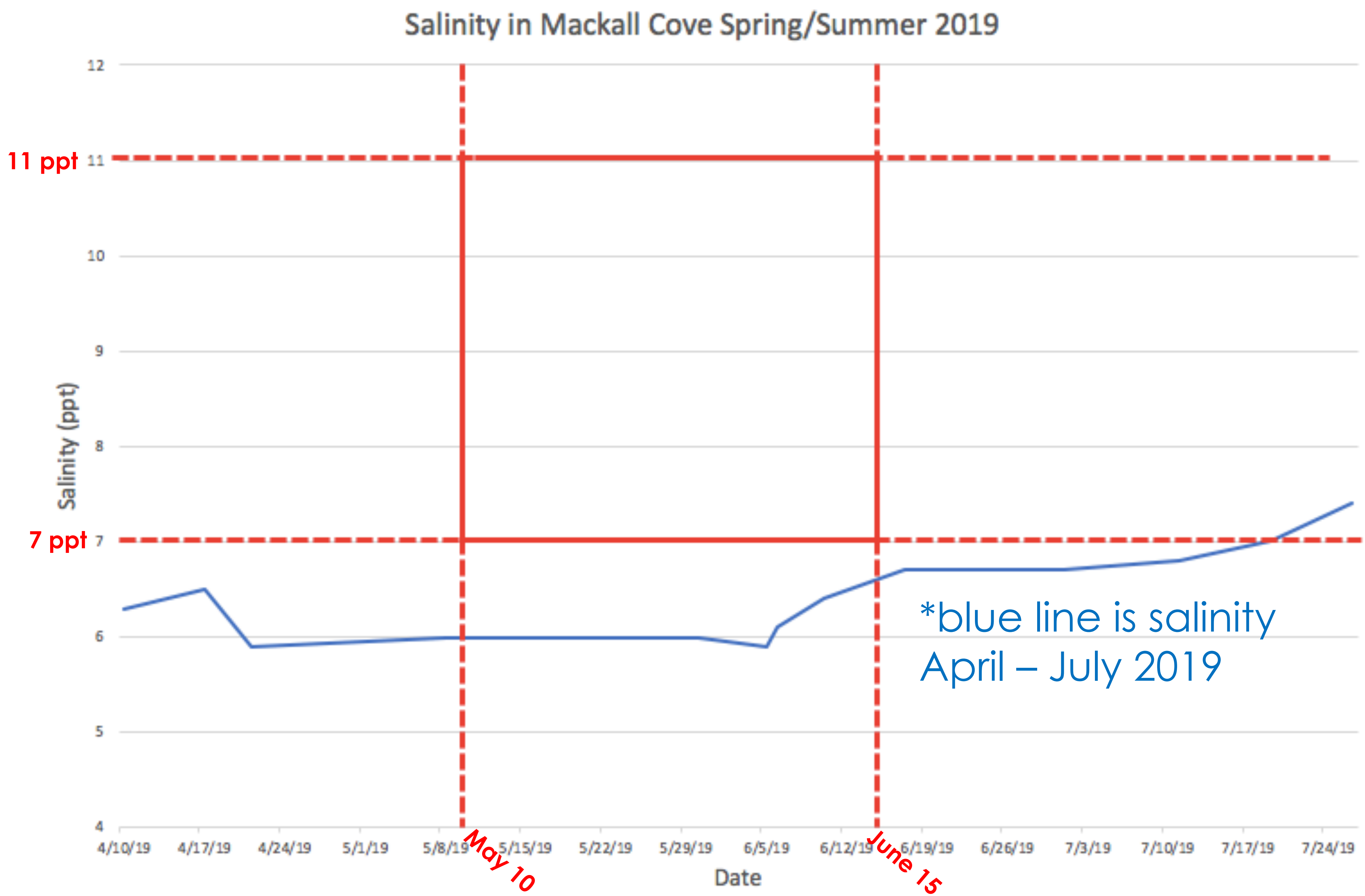


Single tow on 6/6/19

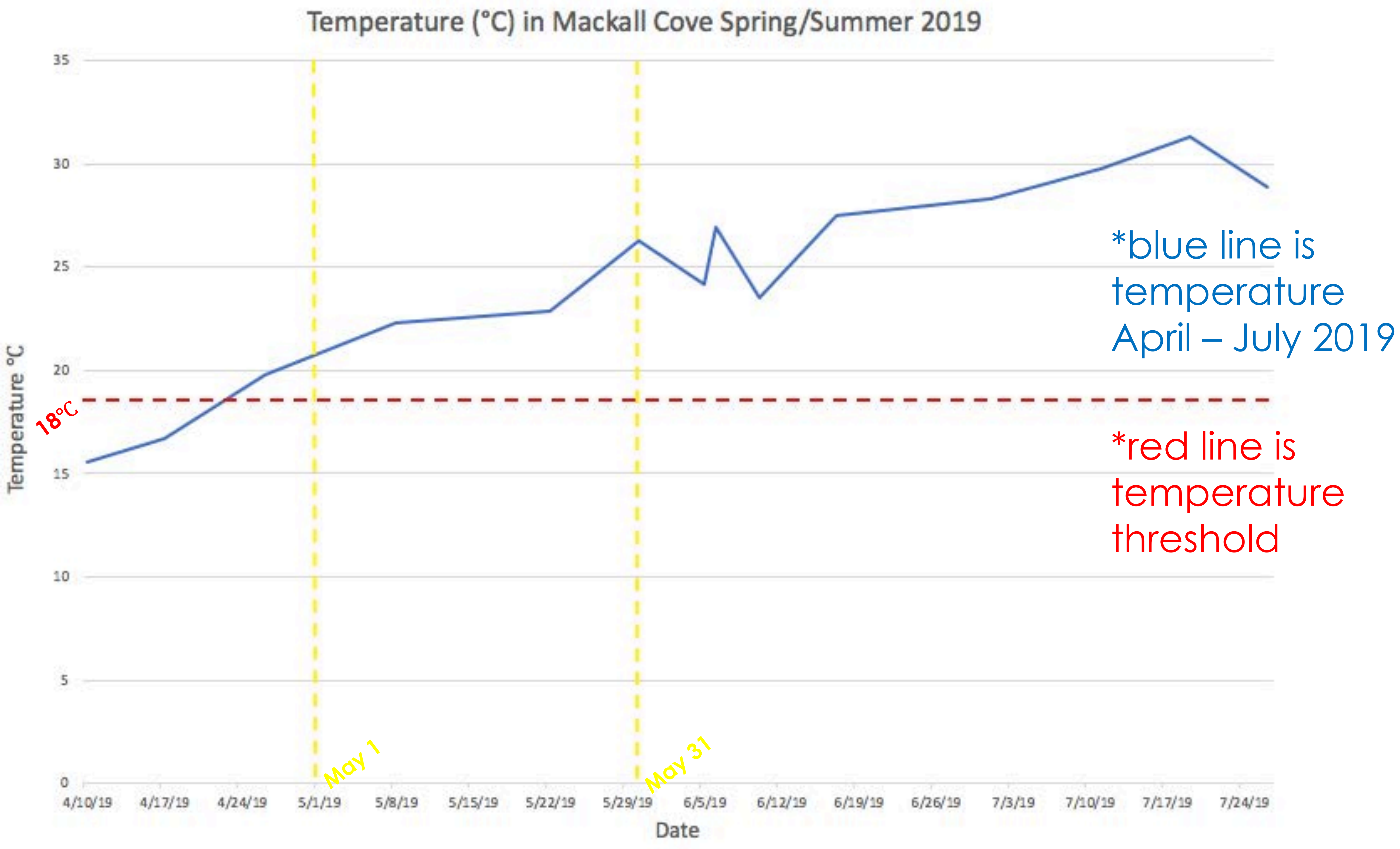
Single tow on 7/26/19



Both samples from station 1, but 7 weeks apart.



*red lines represent threshold salinites and window of time for those salinities to induce strobilation of polyps



Temperature (°C) in Mackall Cove Spring/Summer 2019
35
30
25
20
15
10
5
0
Temperature °C
18°C
May 1
May 31
4/10/19
4/17/19
4/24/19
5/1/19
5/8/19
5/15/19
5/22/19
5/29/19
6/5/19
6/12/19
6/19/19
6/26/19
7/3/19
7/10/19
7/17/19
7/24/19
Date
*blue line is temperature April – July 2019
*red line is temperature threshold

Conclusions

- Lower salinity waters were the driving factor which caused a change in populations, less sea nettles, more comb jellies, less copepods.
- This has implications for other species availability as food for other organisms reaching further up the food chain (ex. Bay anchovy)
- Acartia tonsa was the dominant species at all stations

Ackowledgements

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