River Herring Life History Variation and Habitat Associations in Penobscot River Estuary, Maine USA

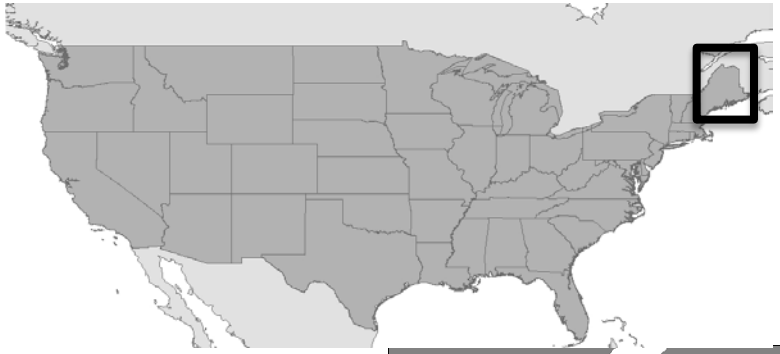
NOAA FISHERIES
NOAA Northeast Fisheries Science Center
NOAA Greater Atlantic Regional Field Office

Justin Stevens, Rachel Lasley-Rasher, Rory Saunders

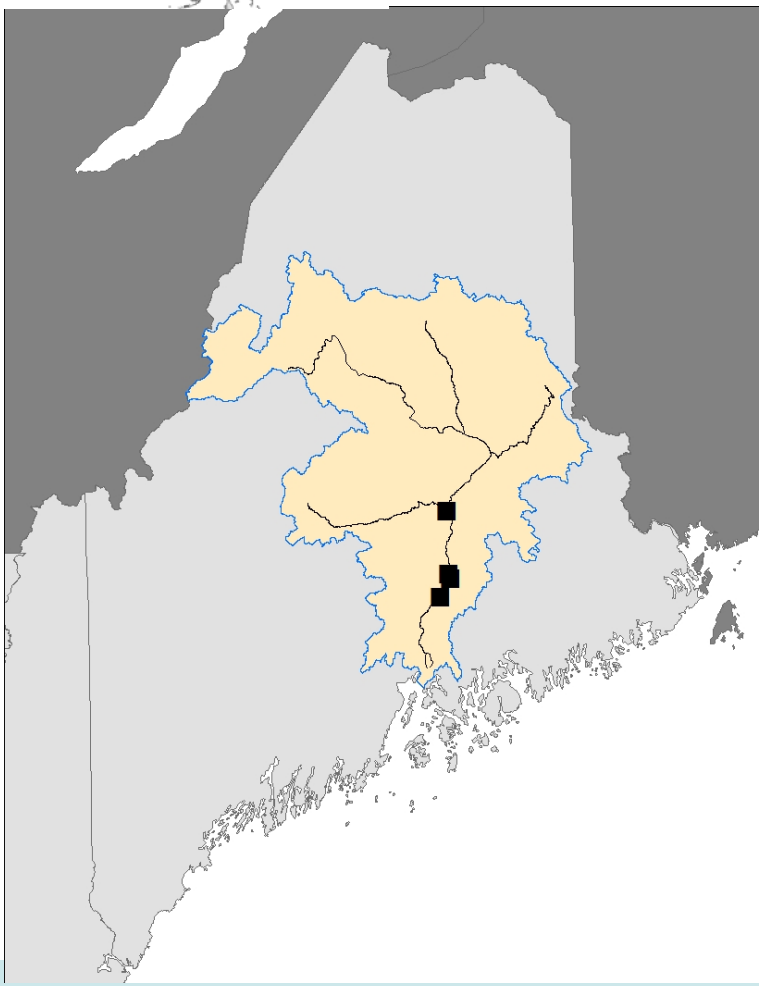
THE UNIVERSITY OF MAINE

September 1, 2016

Background



- Penobscot River

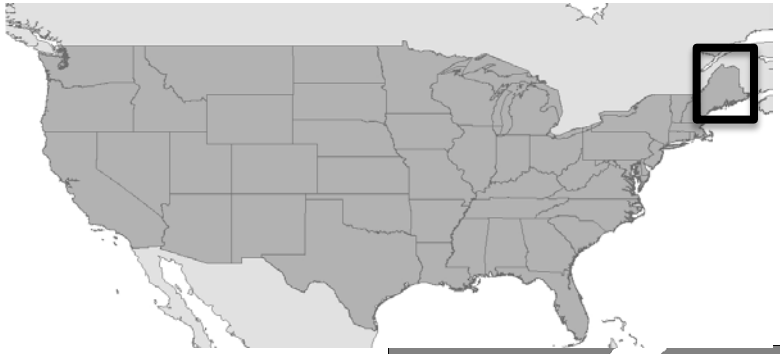


- Site of active restoration
  - Dam removal
  - Inter-basin stocking

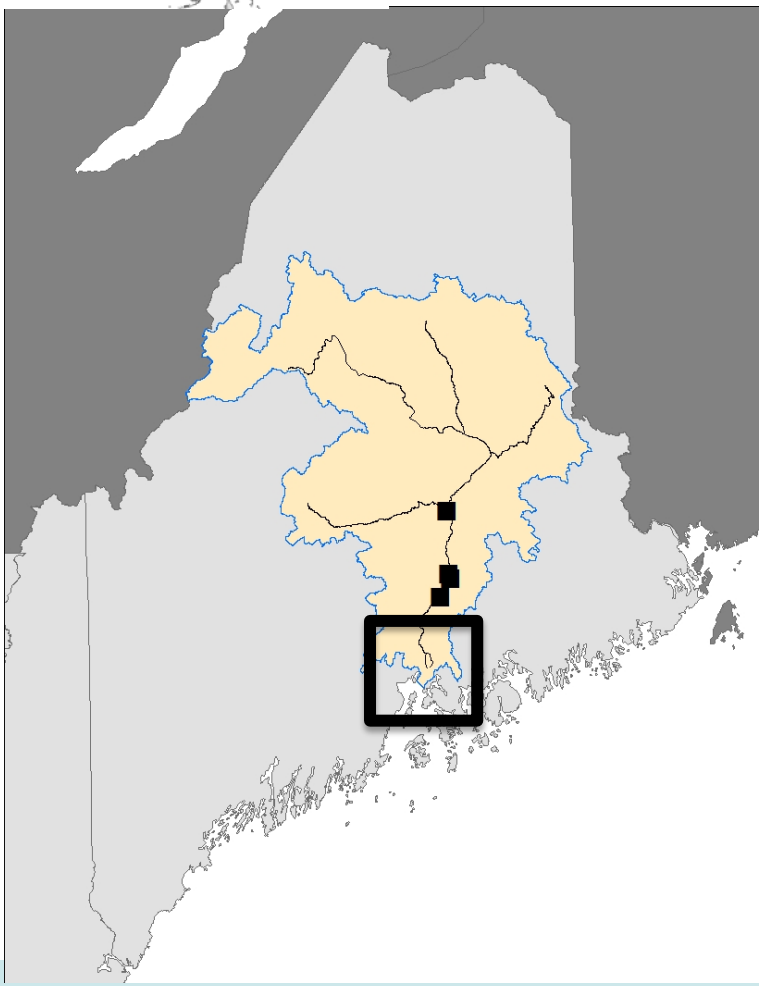
- NMFS survey 2012-present

- Umaine Collaboration 2013-present

Background



- Penobscot River

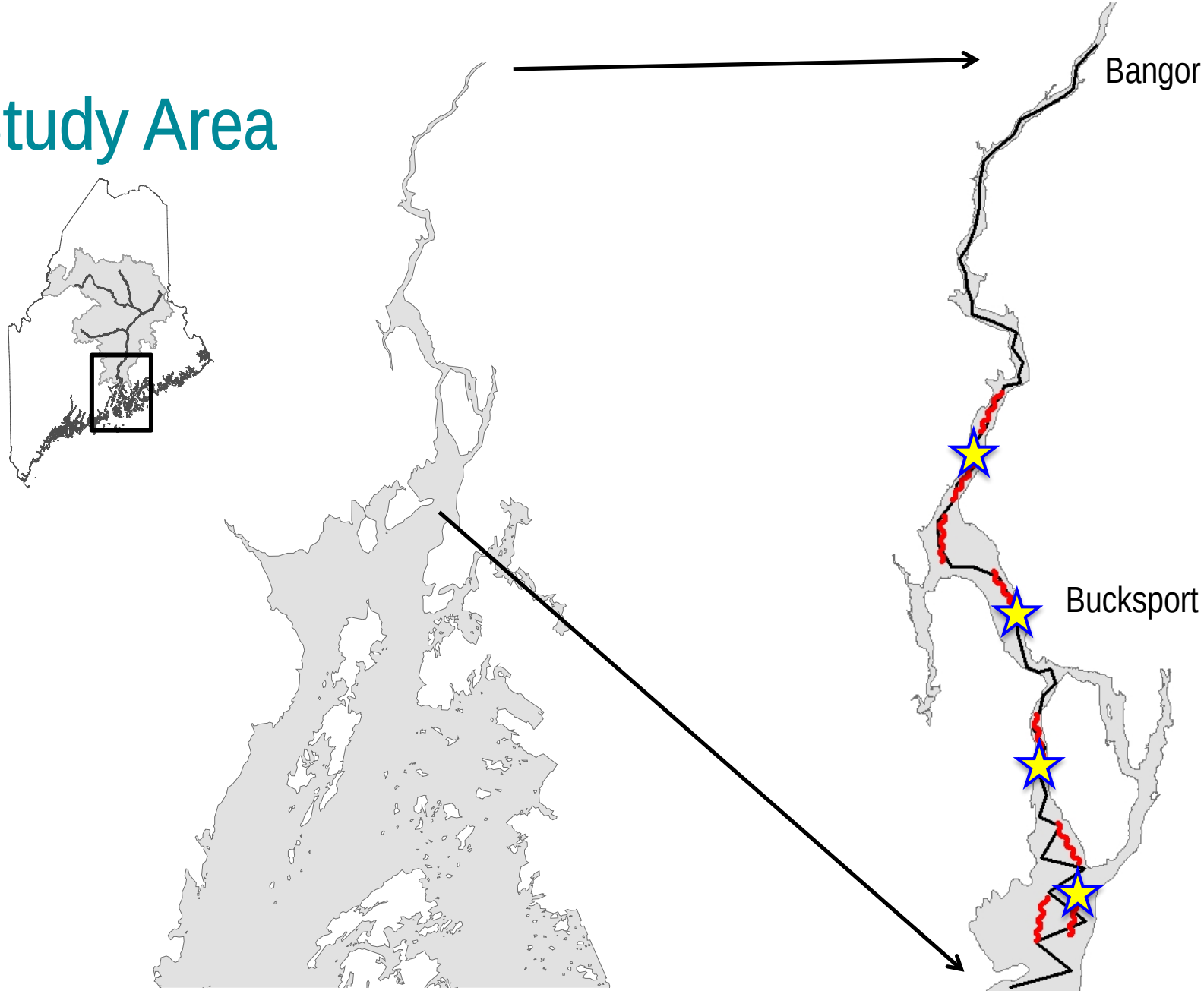


- Site of active restoration
  - Dam removal
  - Inter-basin stocking

- NMFS survey 2012-present

- Umaine Collaboration 2013-present

Study Area



Methods

- SIMRAD 38 & 120 kHz split-beam scientific echosounders
- 40 km transect timed with tide stage
- Weekly (spring) to monthly (summer and fall), 2012-16
- Surface salinity @ 1 min.

- 12m (W) x 6m (H) surface trawl
- Eight - 20 minute tows
- Flood tide, timed with tide stage
- Weekly (spring) to monthly (summer and fall), 2012-16
- 4 zooplankton/ vertical profile stations

Zooplankton tows and vertical profiles

Plankton tows:

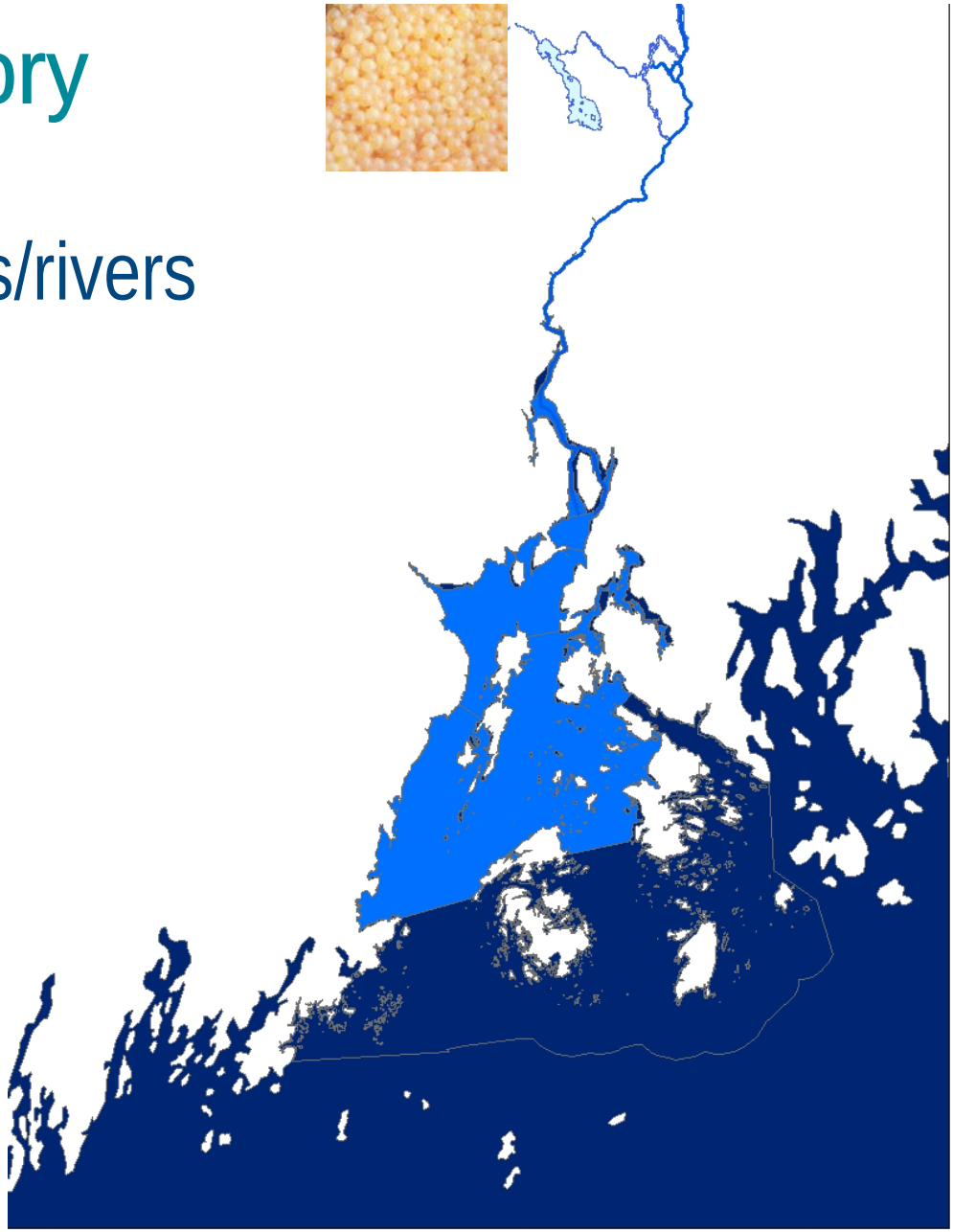
- 250 and 1000 micron mesh
- Towed vertically

YSI EXO Sonde:

- Temperature
- Salinity
- Turbidity
- Fluorescence (calibrated with extracted chlorophyll)
- Dissolved oxygen

Generalized Life History

- Spring – Spawn in lakes/rivers
- Summer
- Fall



Generalized Life History

- Spring
- Summer –freshwater nursery
- Fall

Generalized Life History

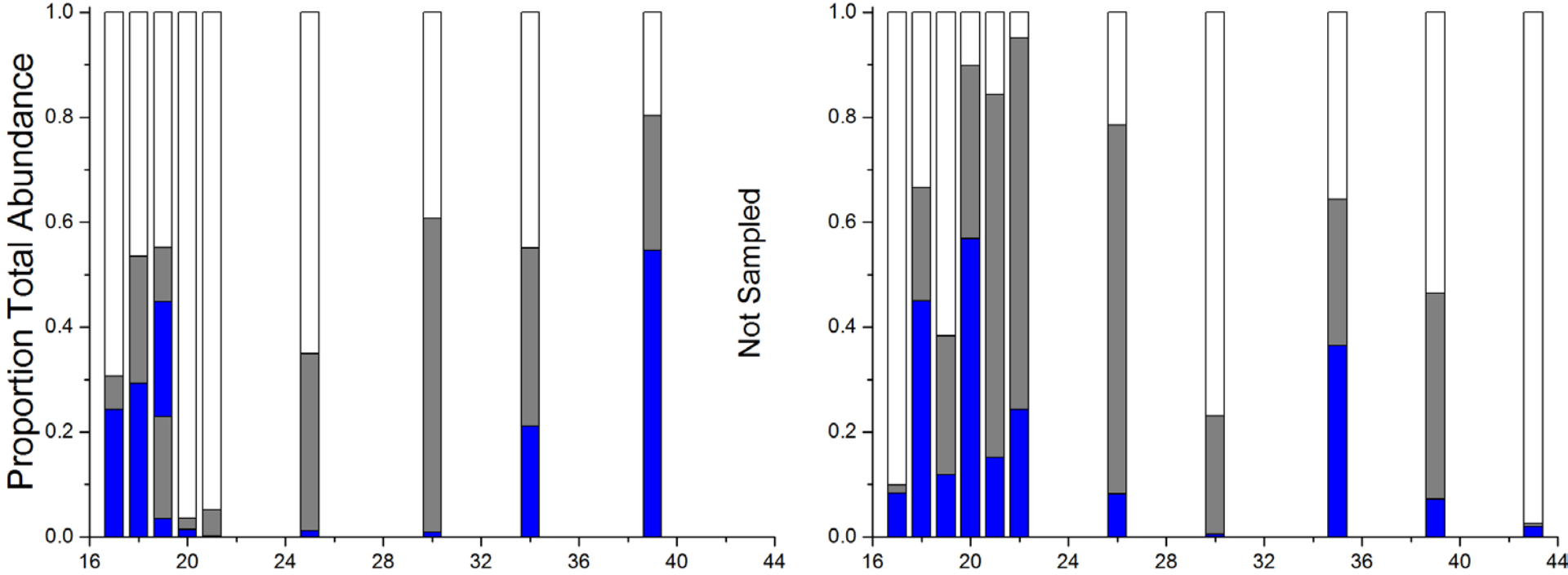
- Spring
- Summer
- Fall – migration to marine rearing for 3+ years

Results

Results: Species Composition - Abundance

2012 – 49,000 fish

2013 – 40,000 fish

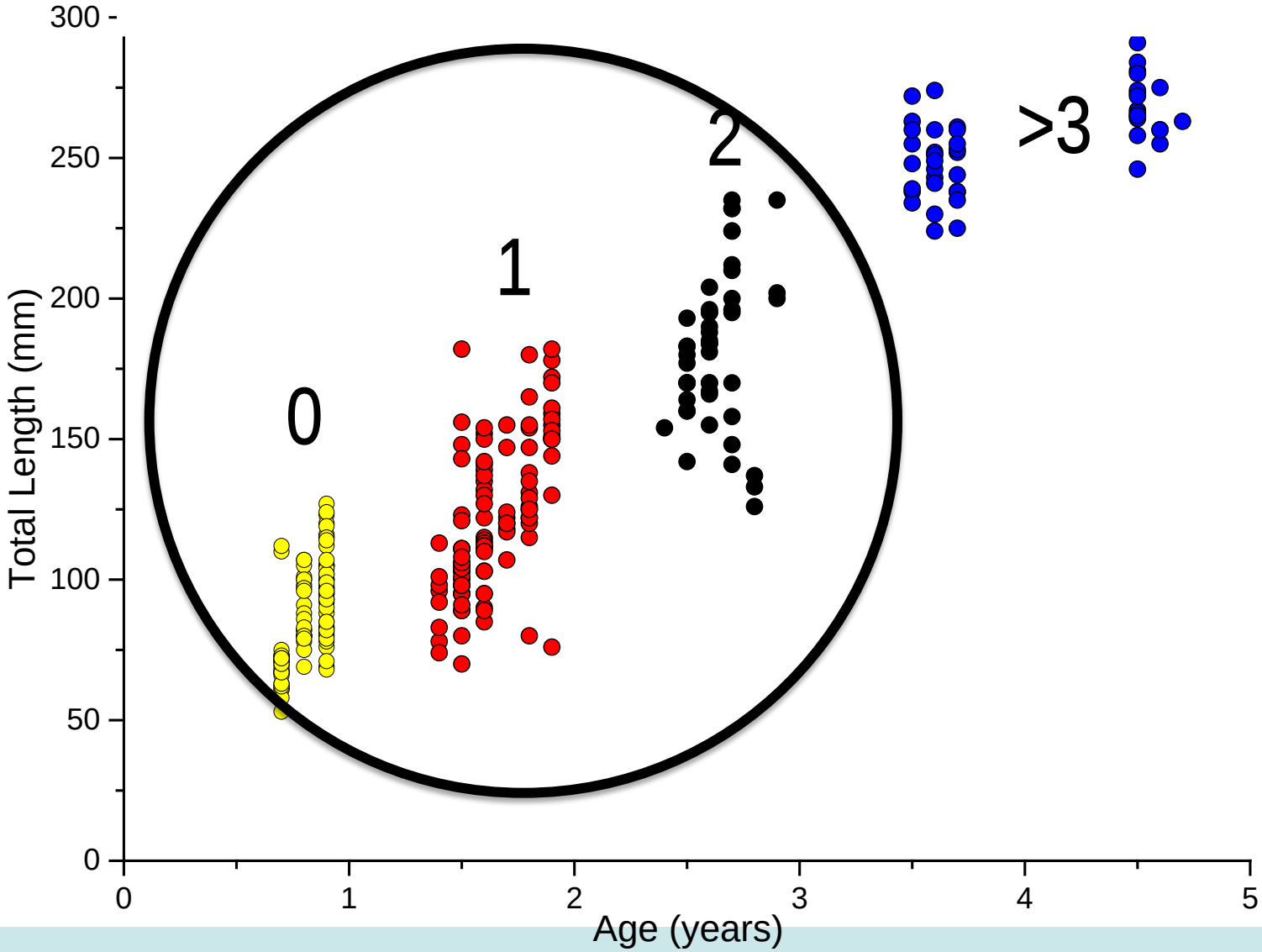


all other species

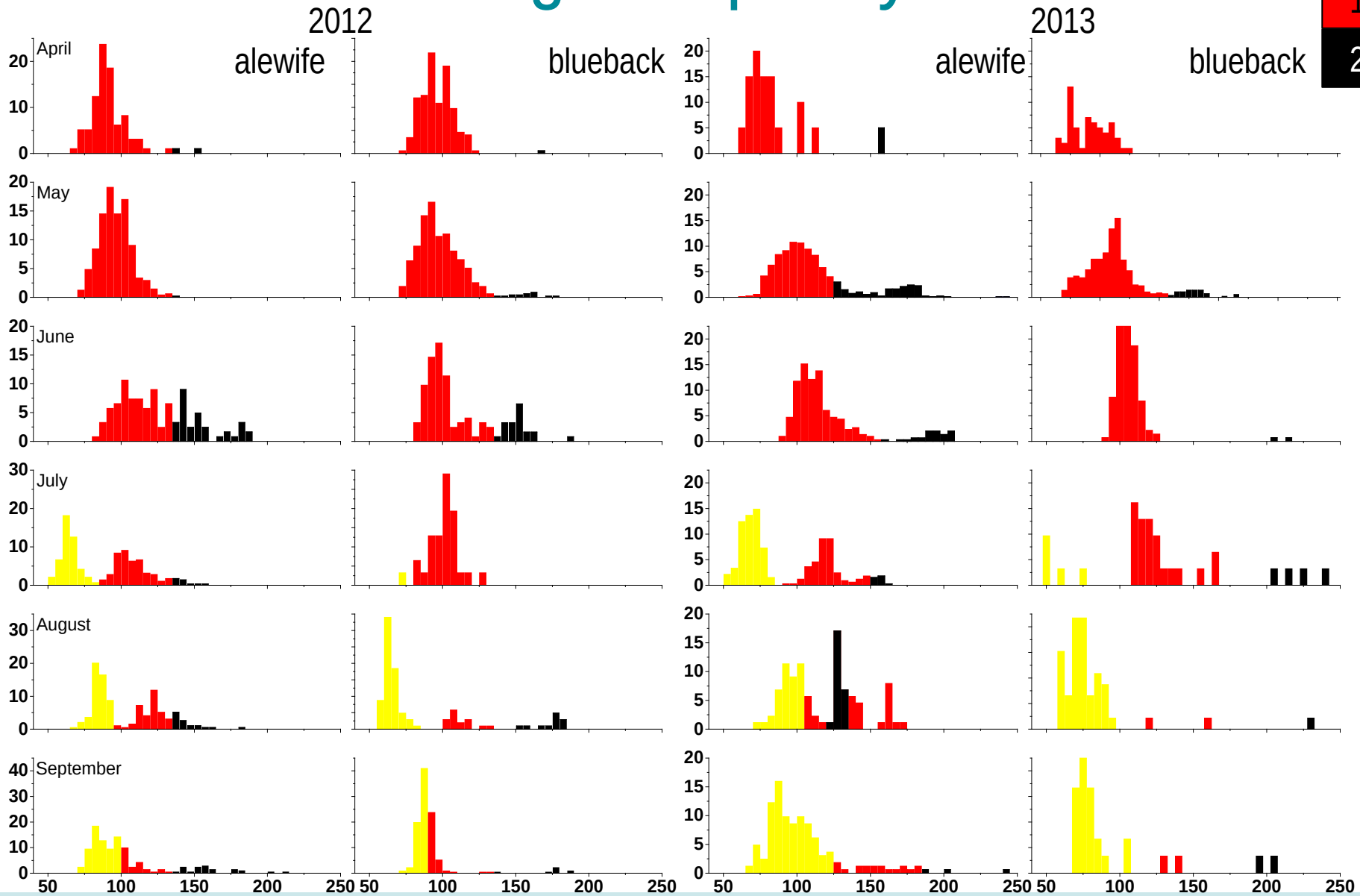
alewife

blueback

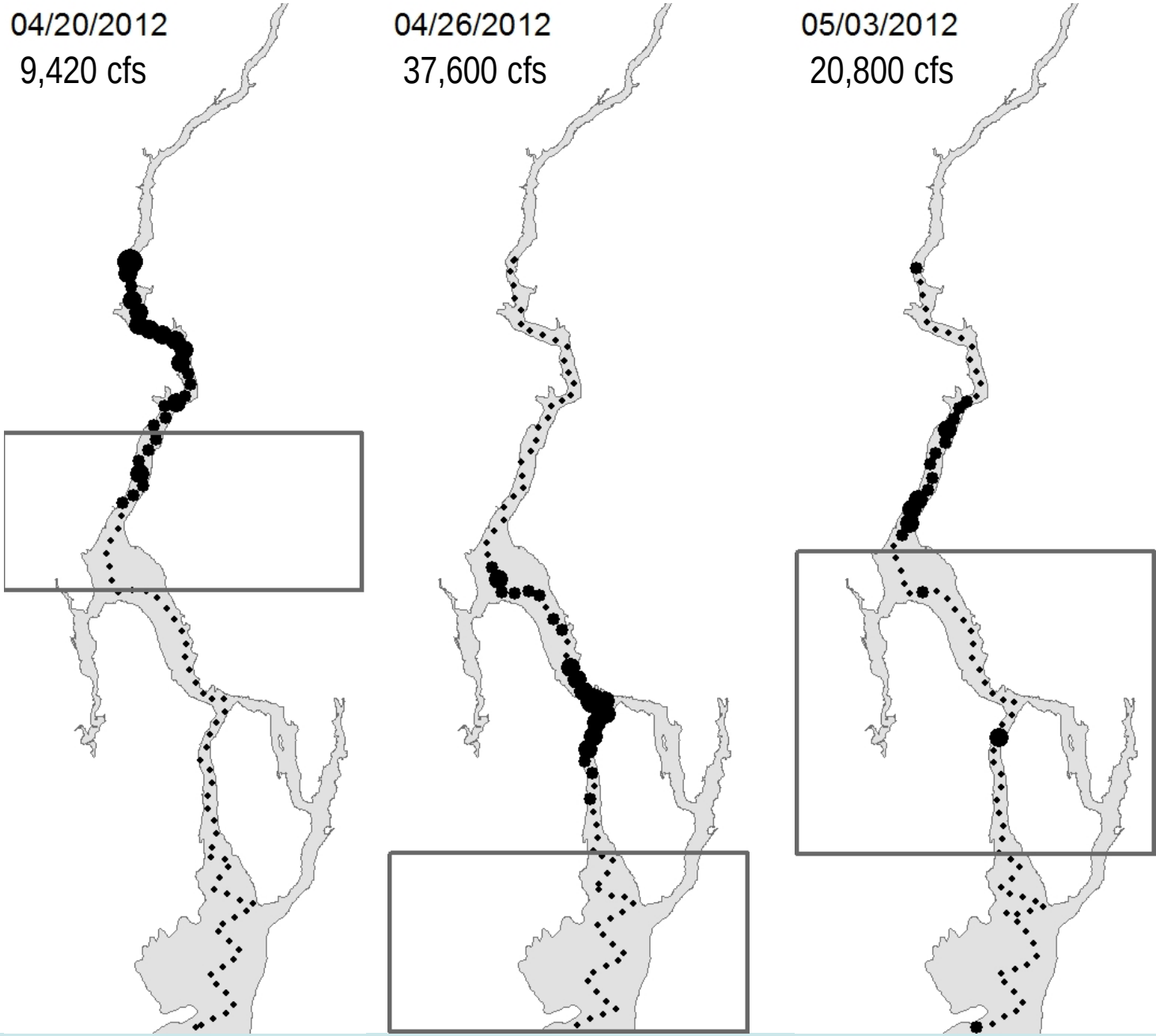
Results: Age distribution - alewife



Results: Size & Age Frequency

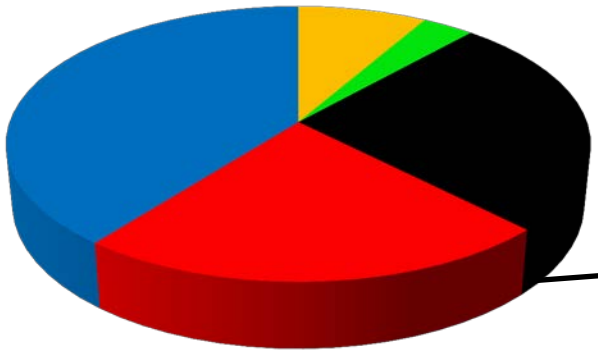


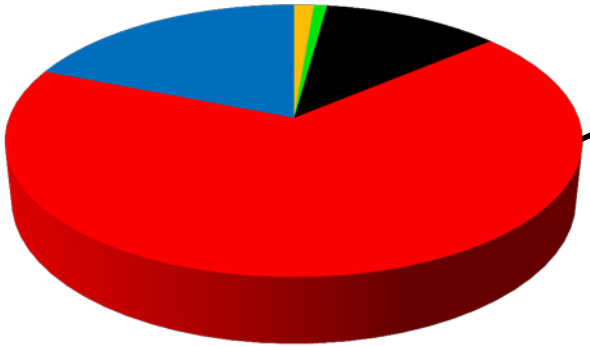
Results: Acoustic Biomass Flow Patterns

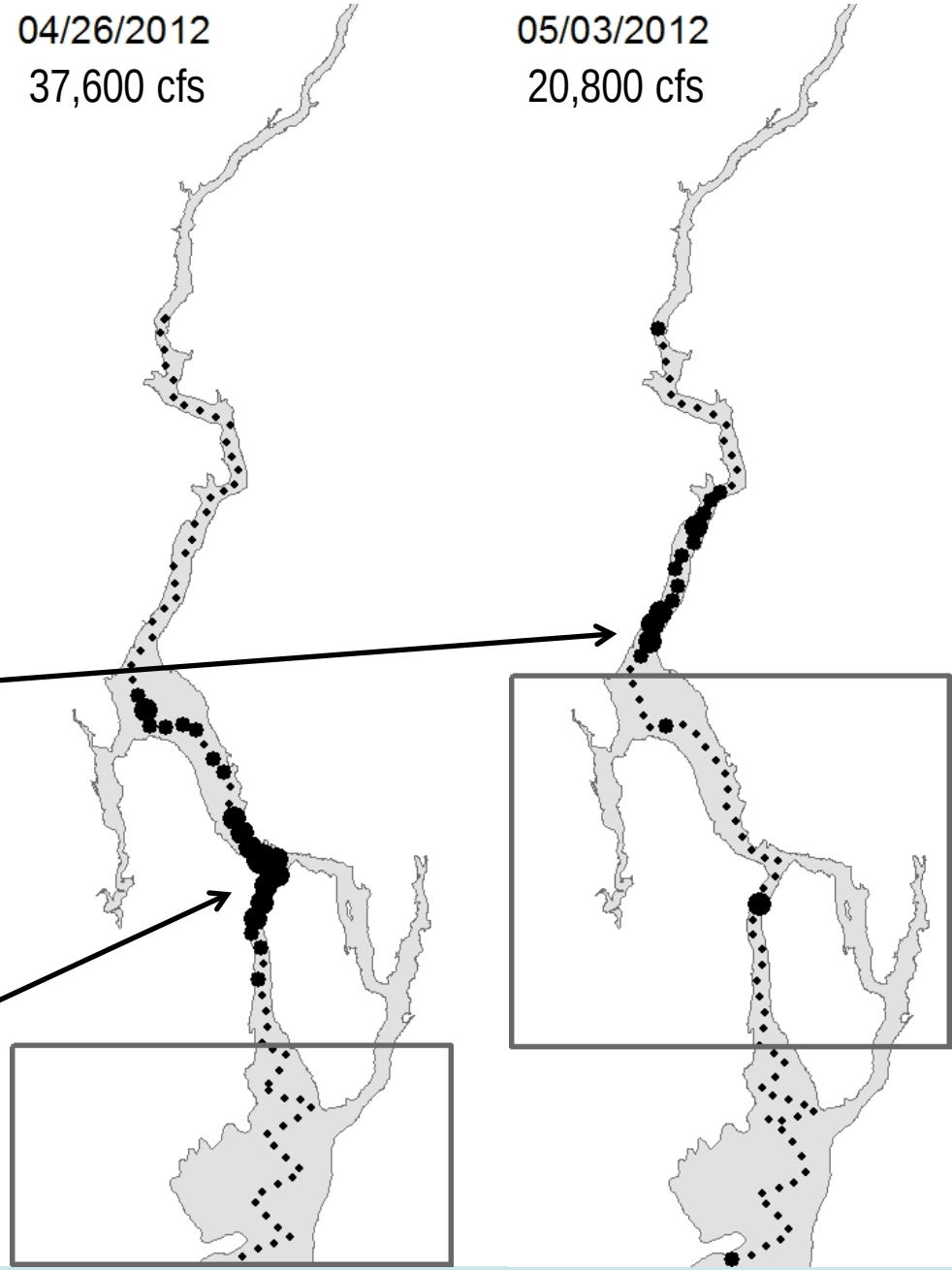


Results: Flow Patterns

- Smelt
- At. Herring
- Salmon
- Alewive
- Blueback



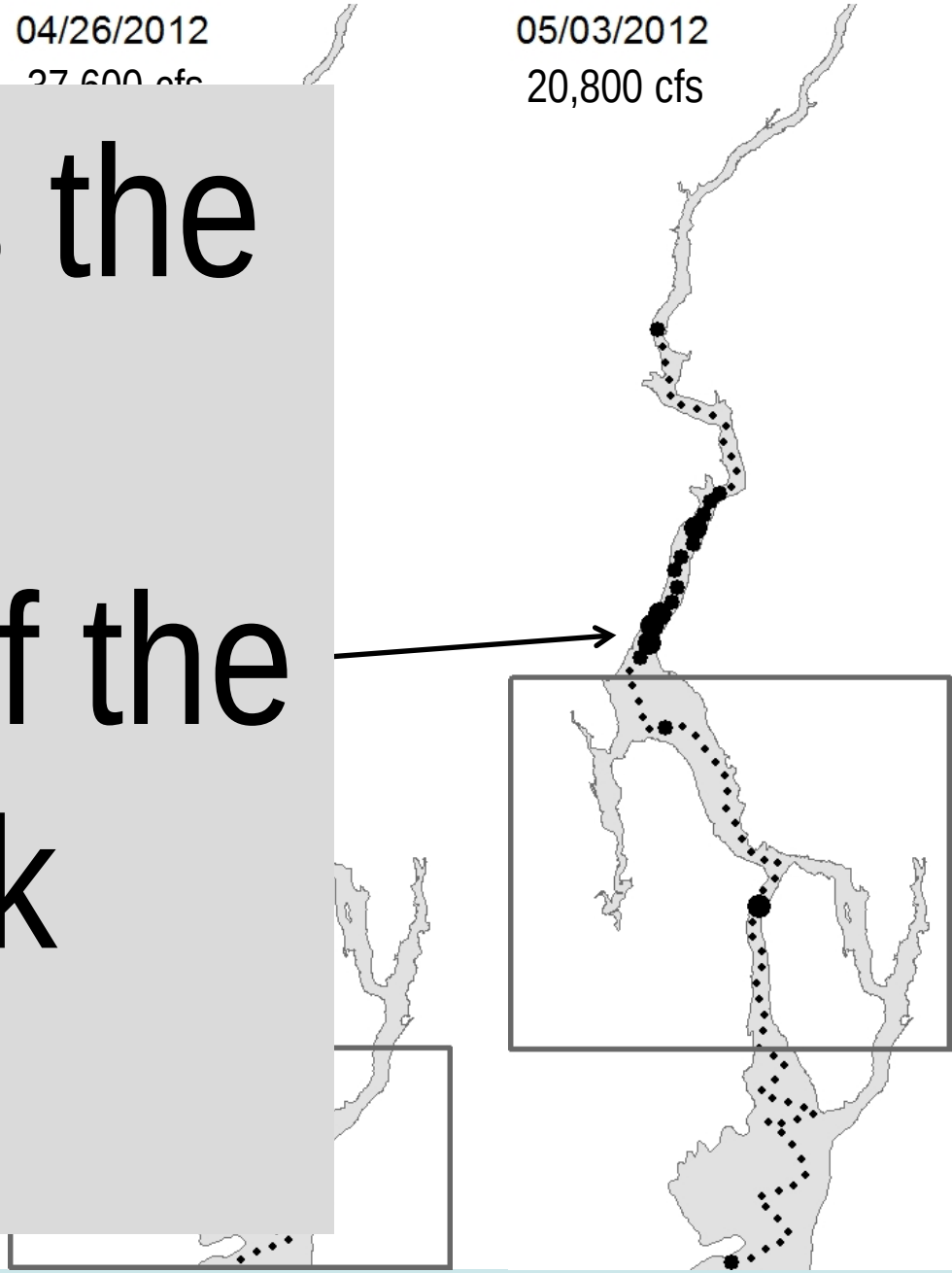




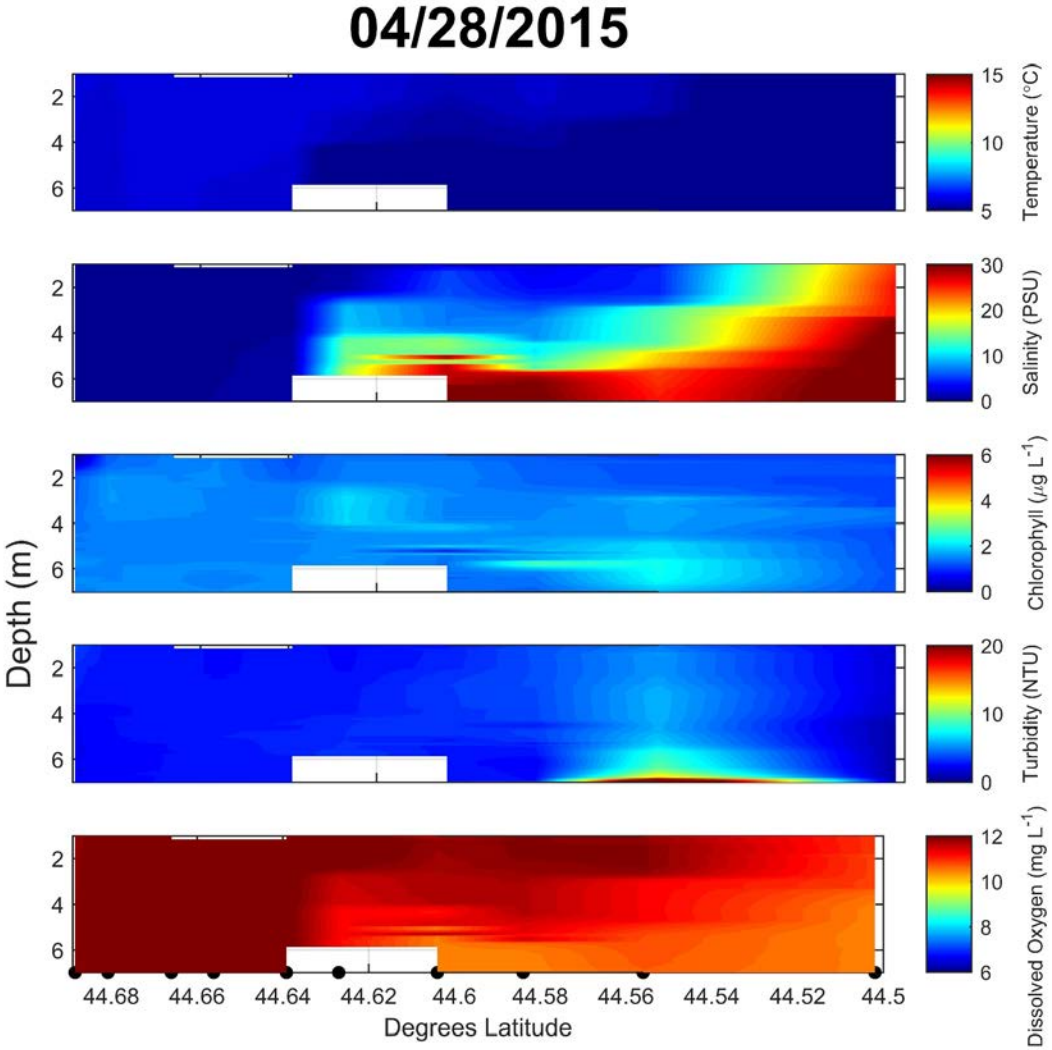
Res
Flov
Patt

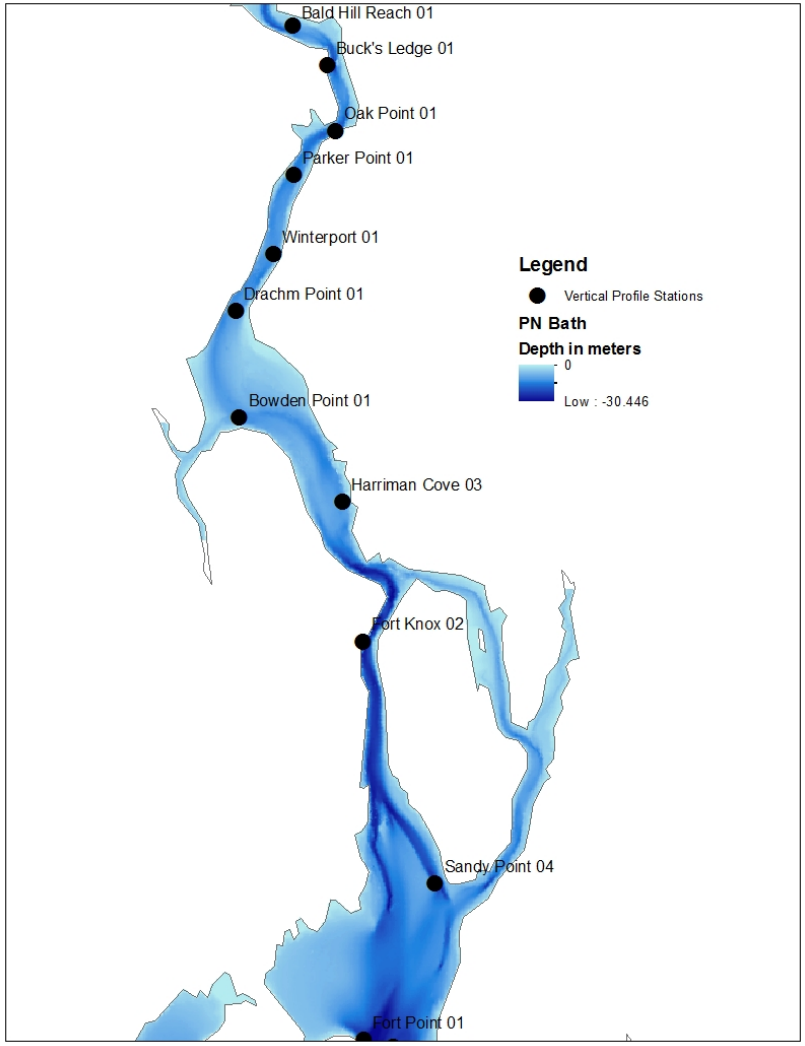
- Sme
- At. I
- Salr
- Alev
- Blue

What does the vertical structure of the habitat look like?

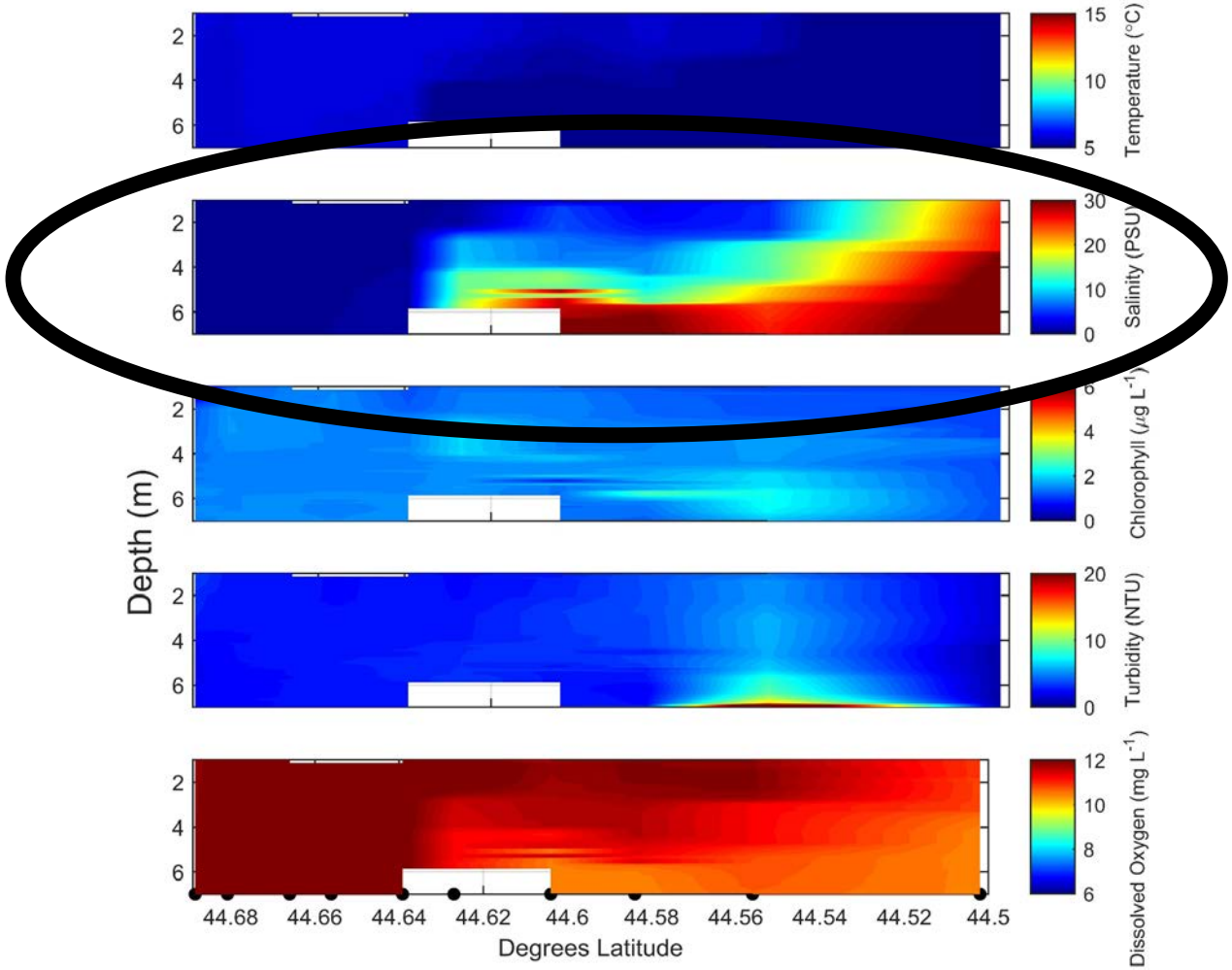


More detailed characterization of transition zone

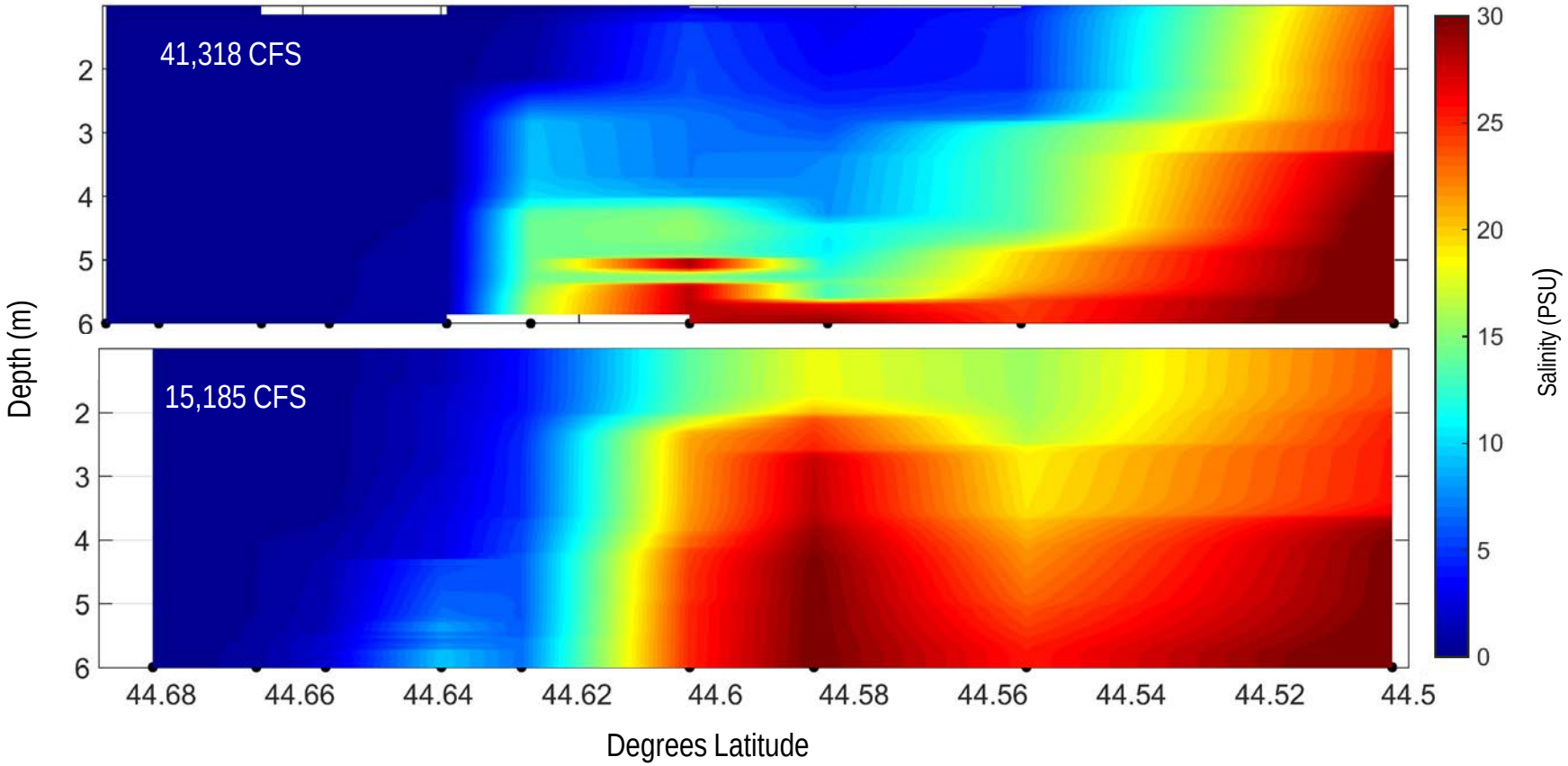




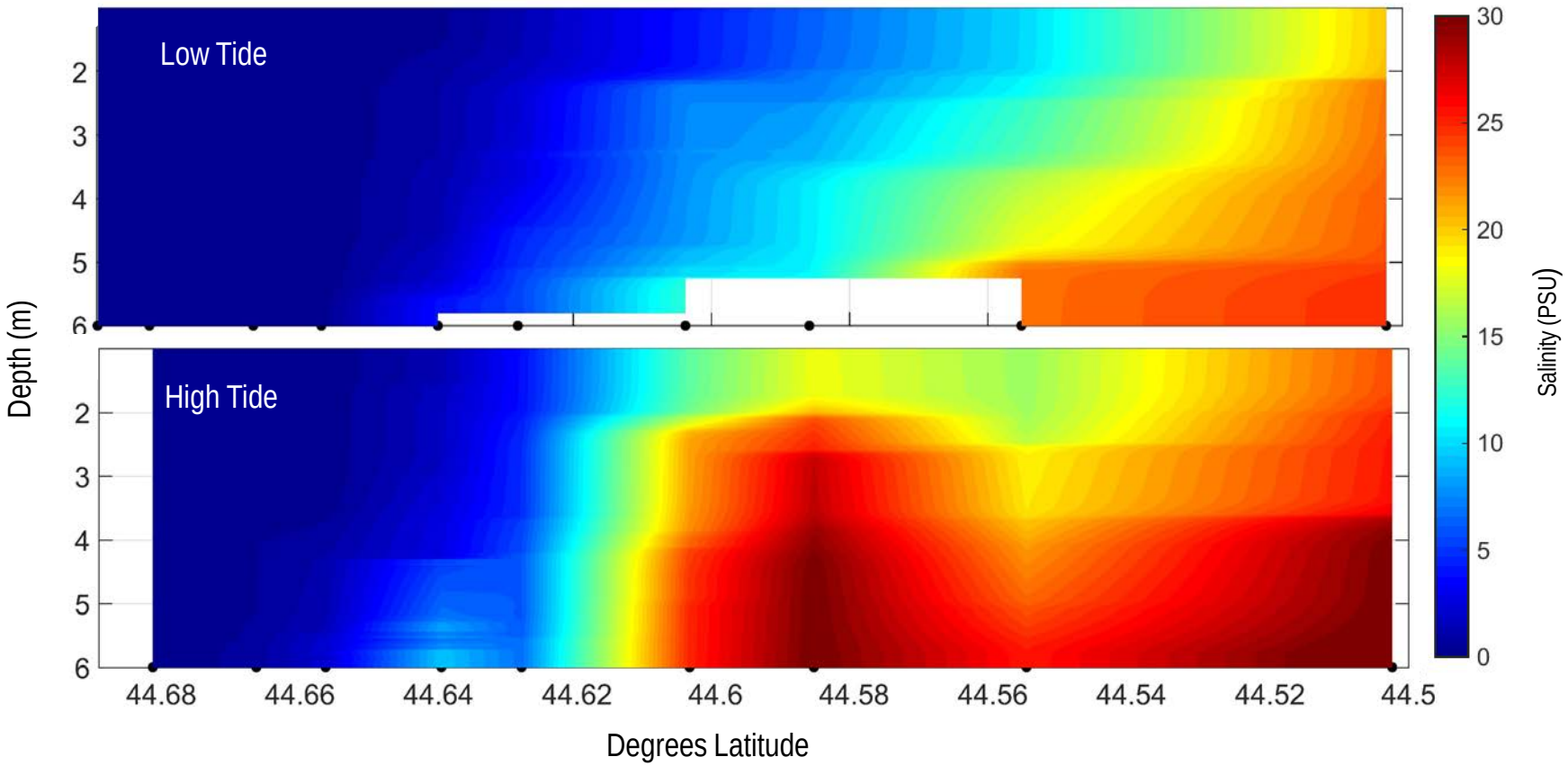
04/28/2015


Depth (m)
2
4
6
Temperature (°C)
15
10
5
Salinity (PSU)
30
20
10
0
Chlorophyll (μg L-1)
6
4
2
0
Turbidity (NTU)
20
10
0
Dissolved Oxygen (mg L-1)
12
10
8
6
44.68
44.66
44.64
44.62
44.6
44.58
44.56
44.54
44.52
44.5
Degrees Latitude

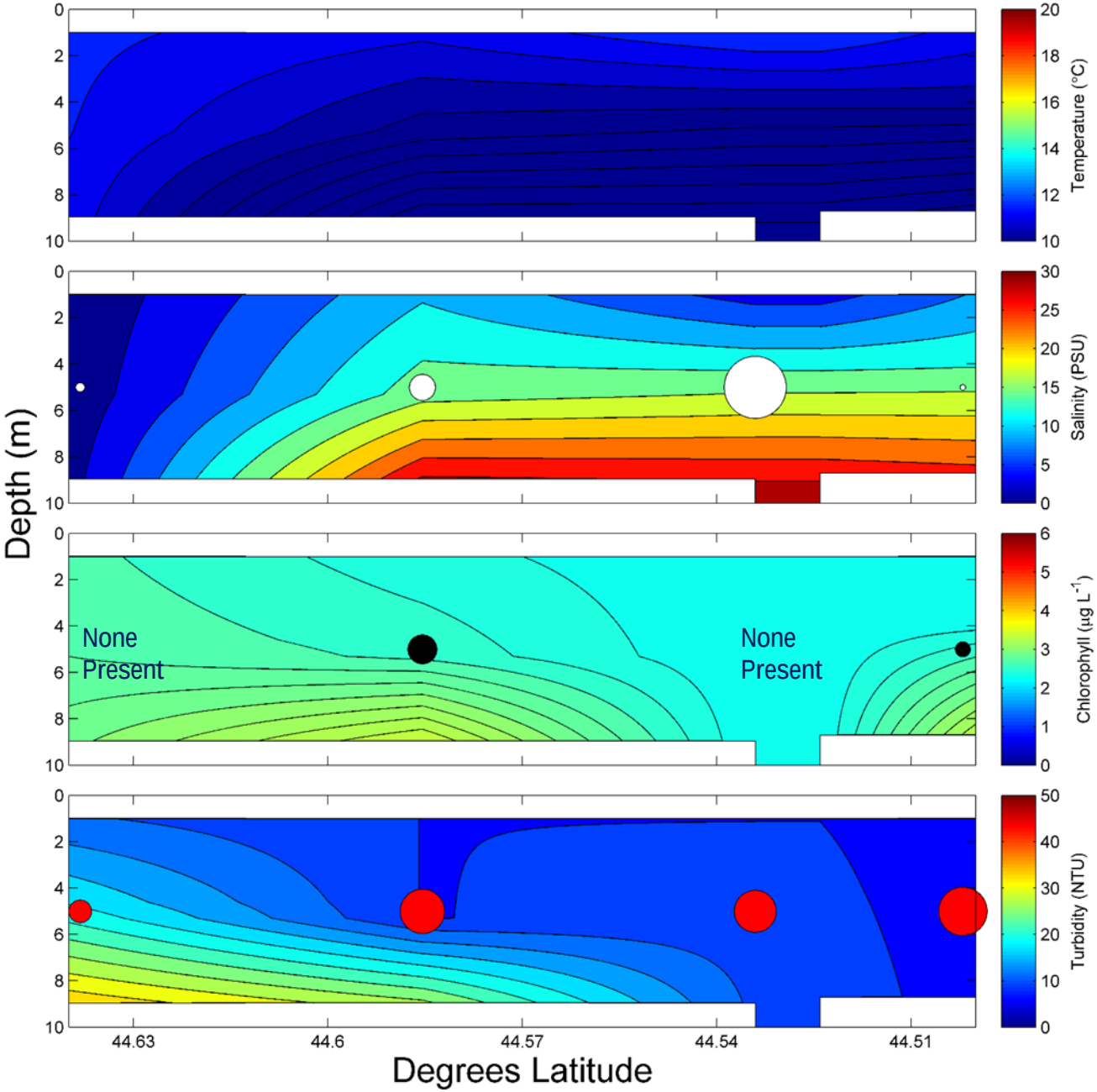
Effects of flow on the salt wedge



Effects of tide on the salt wedge



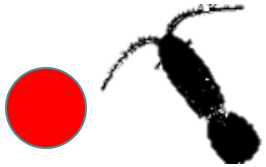
05/28/2013



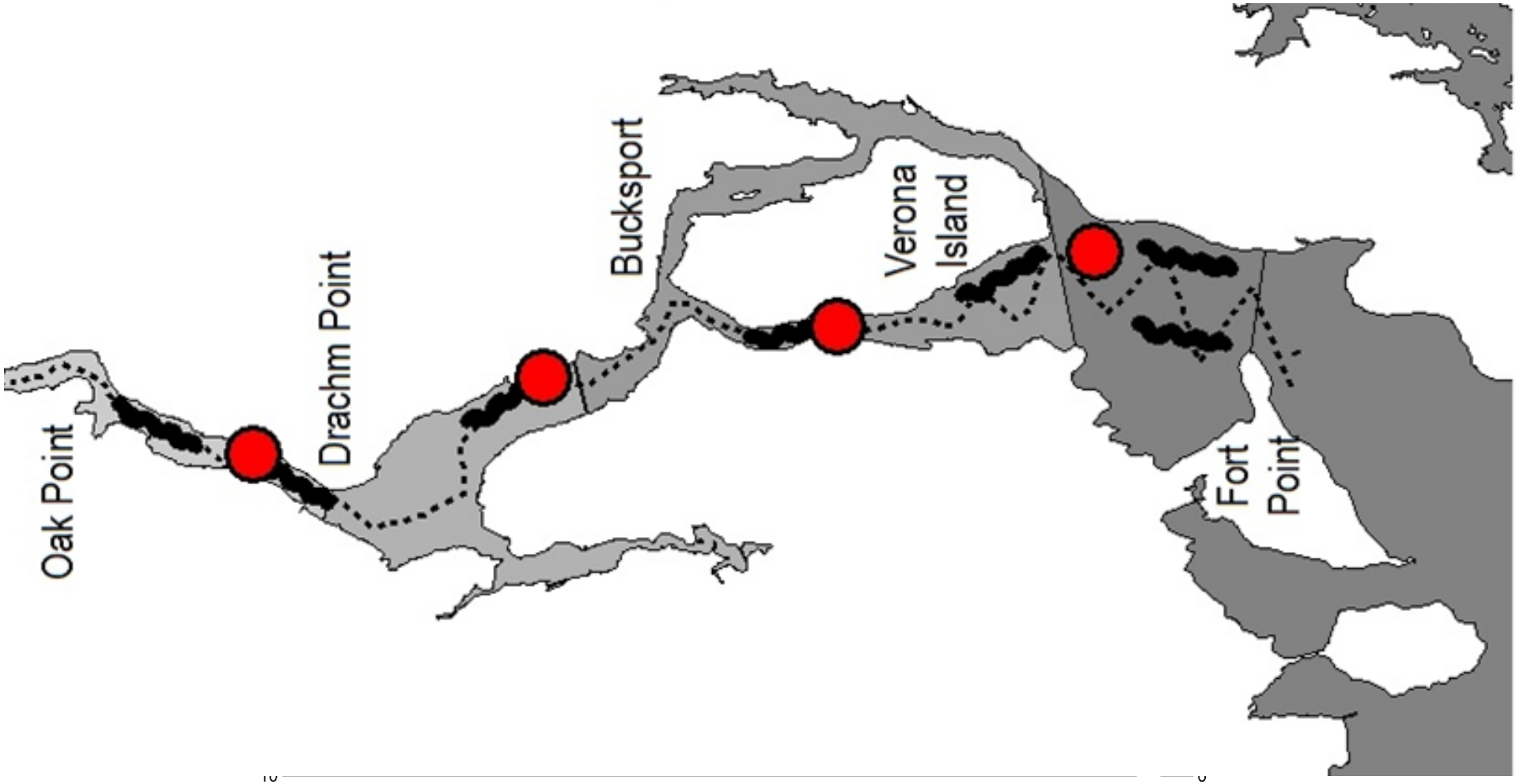
47,960 cfs

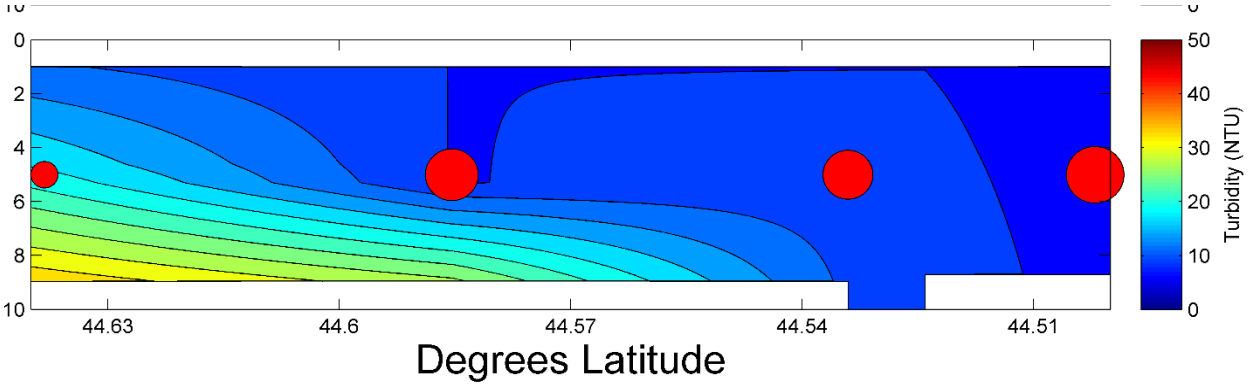
CPUE / 10

Density x 50



Density / 10


Oak Point
Drachm Point
Bucksport
Verona Island
Fort Point


0
2
4
6
8
10
44.63
44.6
44.57
44.54
44.51
Degrees Latitude
50
40
30
20
10
0
Turbidity (NTU)

Important habitat variables for zooplankton

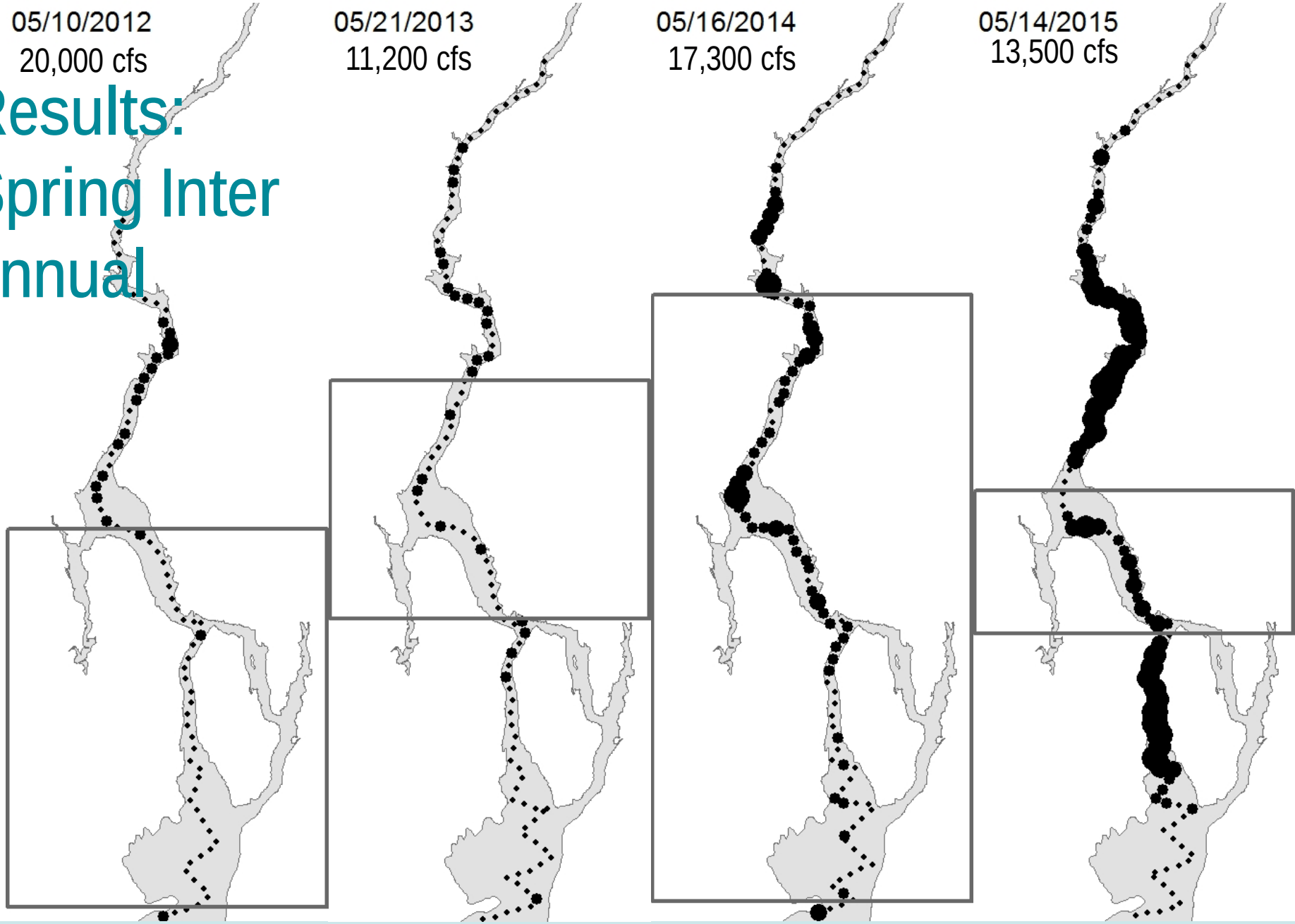
Meso zooplanktons (mostly copepods)

- Upper stations in spring/early summer
- Lower stations in late summer/fall
  - Temperature preference ~ 12° C

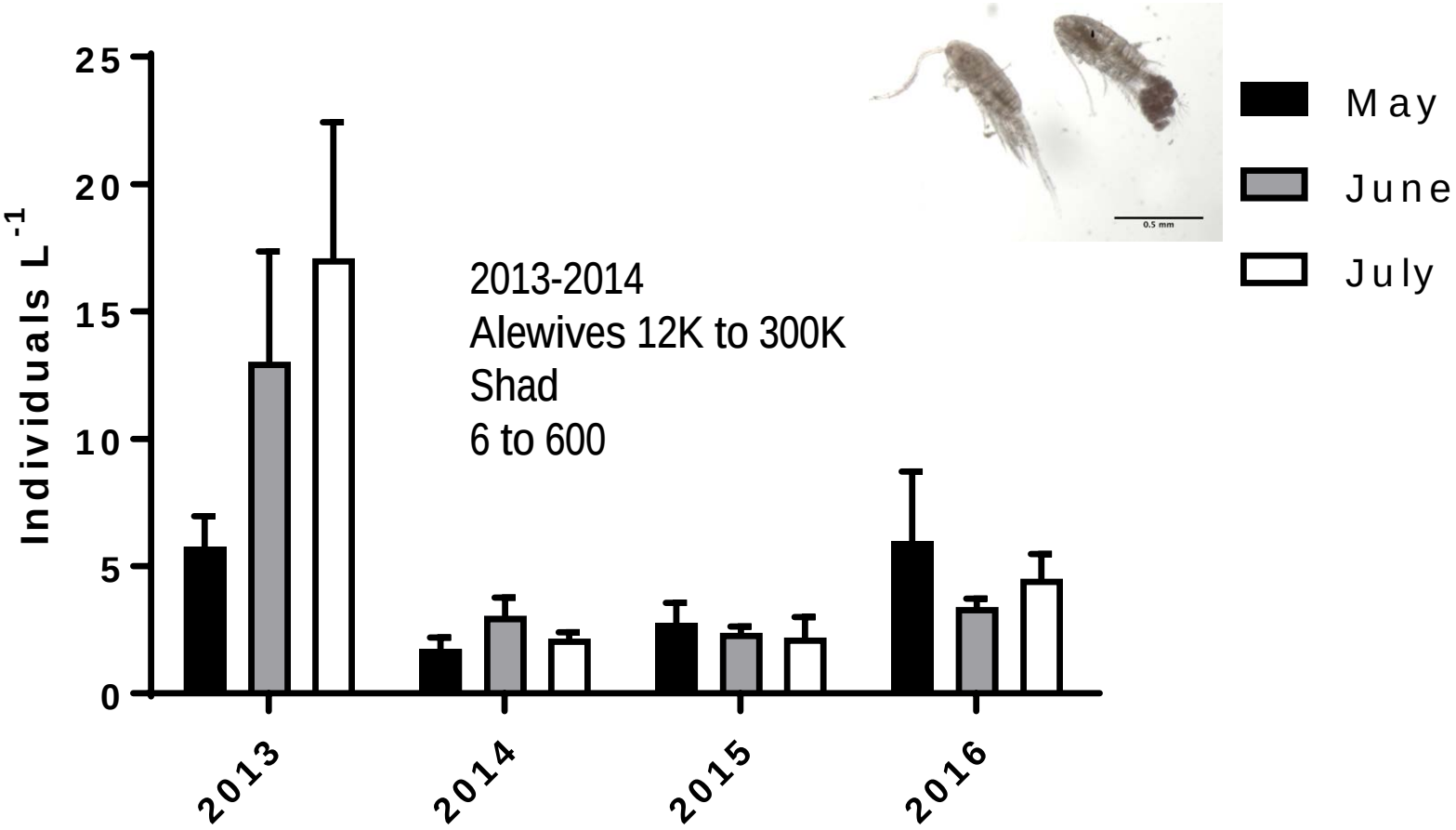
Large plankton (mostly mysid shrimp)

- Middle stations throughout the year
  - High turbidity and steep salinity gradient

Results: Spring Inter annual



Zooplankton Density



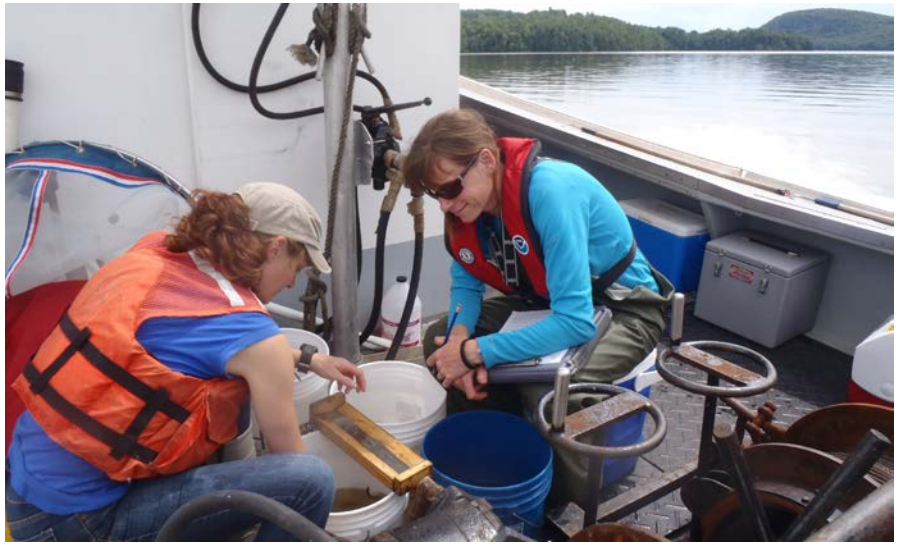
Summary:

- Juvenile river herring are persistent in pelagic estuary fish community
  - Age 0 – enter July – October as expected
  - Age 1 and 2 present April – October - unexpected
- Fish biomass appears coincident with estuary habitat gradients
- Fish biomass increasing over time (2012-2016)

Conclusions: Implications

- Species Resilience
  - Life history diversity as solution to environmental stochasticity (i.e. Pacific Salmon)
  - See *Fisheries* March ‘ 16
  - Further evidence of life history diversity in *Alosa*
  - More evidence of “Non-textbook migrations”
- River Herring
  - Important component of the estuary ecosystem

Thoughts & Questions?

- Acknowledgements
  - Capt. Josh Conover, F/V Odd Ball, Islesboro, Maine
  - Tim Sheehan, NEFSC Woods Hole
  - Christine Lipsky, NEFSC Maine
  - Maine Field Station staff
- Contacts
  - justin.stevens@noaa.gov
  - rachel.lasleyrasher@maine.edu

Data are preliminary and should not be cited without consent of authors