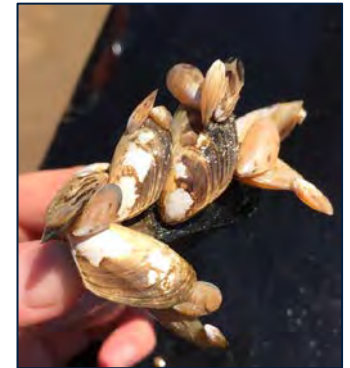


Long-term changes in the benthic community of Lake Michigan



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Thank you to my collaborators:



Great Lakes
RESTORATION



Cooperative Institute for
Great Lakes Research

CIGLR

Great Lakes Science for Society



BUFFALO STATE
The State University of New York

USGS
science for a changing world

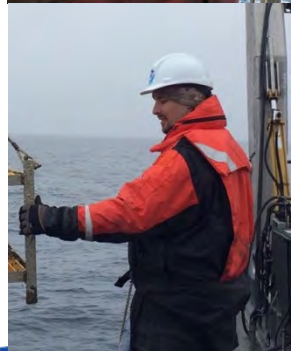
NOAA: Nalepa, Glyshaw, Pothoven, Elliot, Constant, Beadle, Yagiela, Braymer, Burlingame, Roetman, Workman

CIGLR: Wensman, Orzechowski, Carter, Dunnuck, Mabrey

Buffalo State College: Karatayev, Burlakova, Mehler

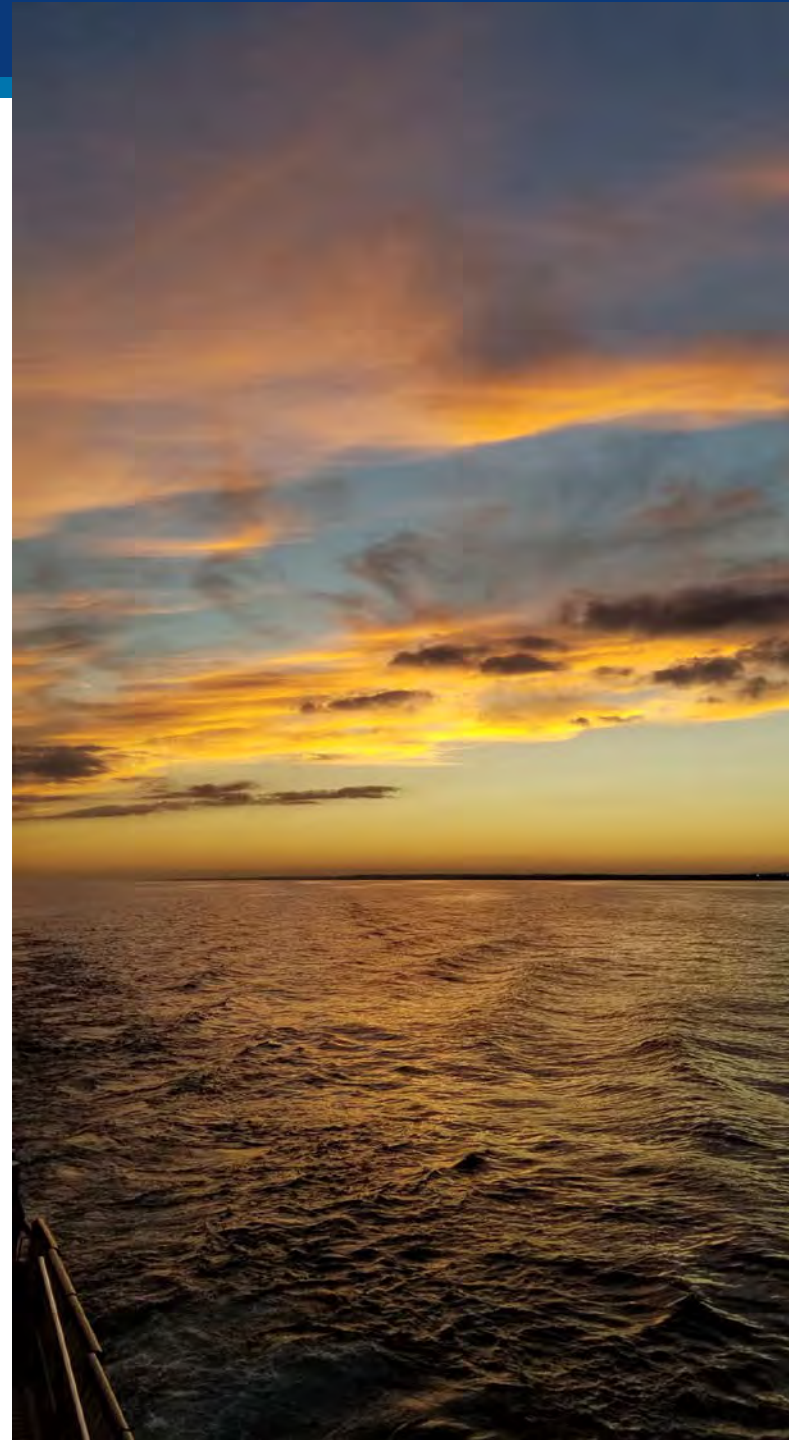
USGS: Esselman, Bunnell

EPA GLNPO: Hinchey-Malloy, Nettesheim, Scofield, R/V Lake Guardian Captain and Crew



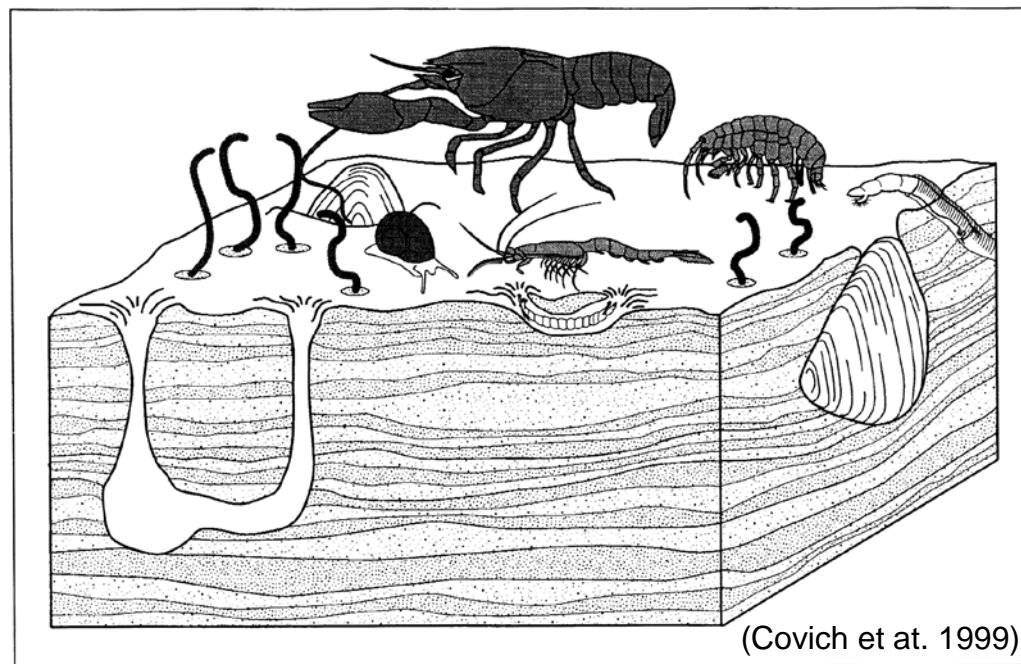
Overview

- Benthic invertebrates
- NOAA long-term benthic monitoring program
- Expansion of invasive mussels
- Benthic community response



Benthic Invertebrates

- Bottom-dwelling organisms
- Aquatic larval stages of insects
- Nutrient cycling
- Food source



(Covich et al. 1999)



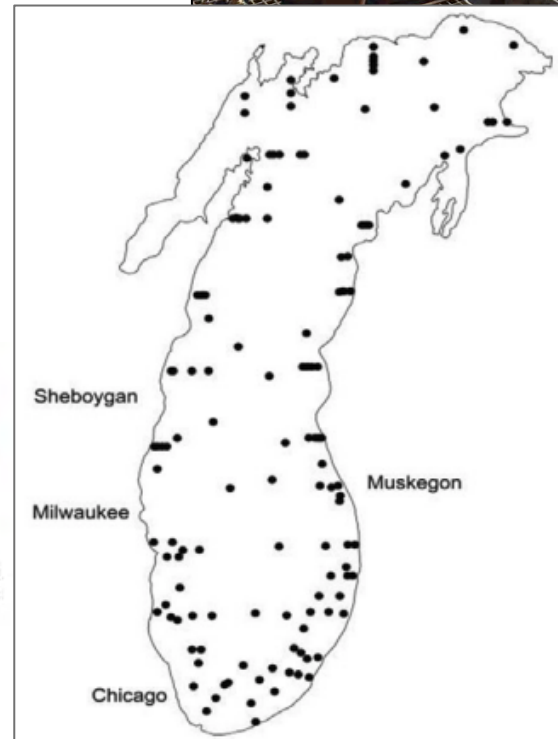
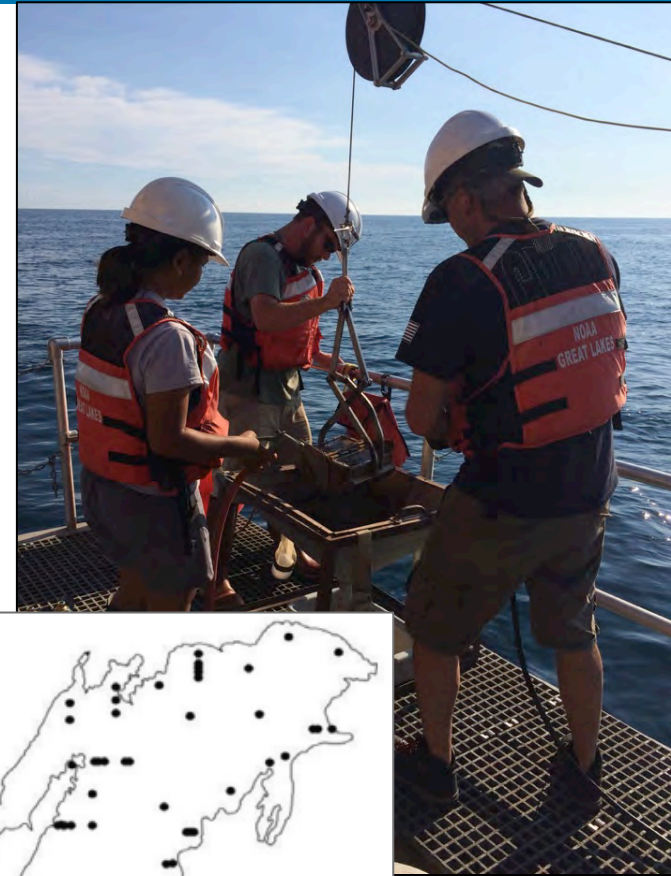
NOAA Long-term Benthic Monitoring Program

Mission:

To track invasive dreissenid mussel and other benthos populations in Lake Michigan (and beyond)

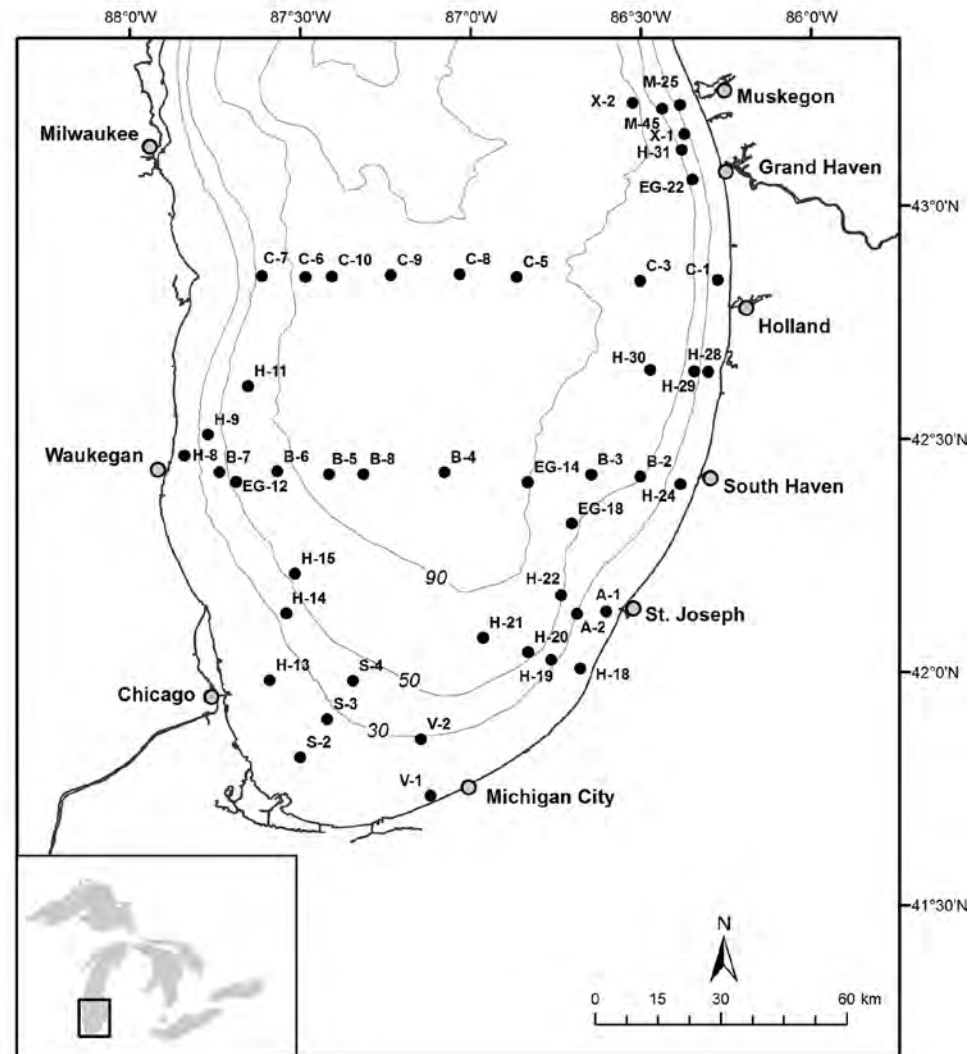
Approach:

- Annual surveys in S. Lake Michigan
- Whole-lake surveys in Lake Michigan on a 5-year cycle, starting in 1994/5



NOAA Annual S. Lake Michigan Benthic Survey

- Established in 1980 using some historic sites from the 1930's and 1960's
- Conducted annually since the 1990's
- **Original goal:** impacts of nutrient reductions
- **Revised goal:** impacts of invasive dreissenid mussels



Quagga Mussels (*Dreissena rostriformis bugensis*)



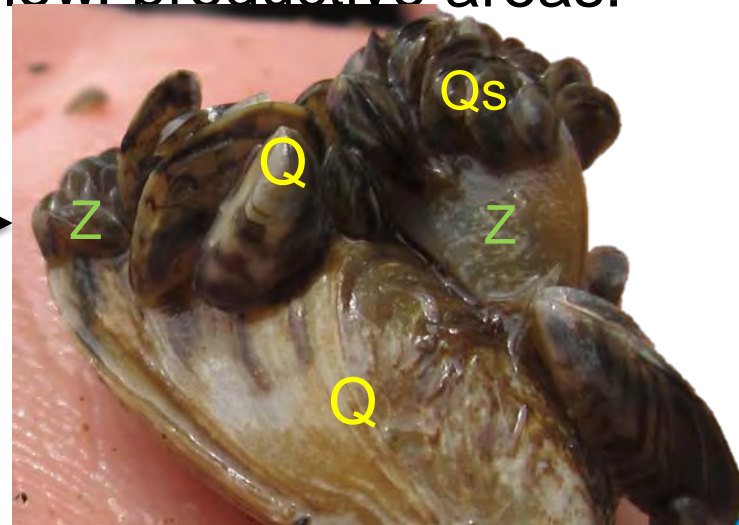
Zebra Mussels (*Dreissena polymorpha*)



Zebra vs. Quagga



- **Quaggas dominate in the Great Lakes**
- Zebra mussels rarely found in offshore sites (>15m)
- **Zebra mussels are more common in the nearshore, inland lakes, and on infrastructure**
- Coexistence occurs in shallow, productive areas:
 - Saginaw Bay
 - Green Bay
 - Western Lake Erie



Dreissenid Mussel Impacts

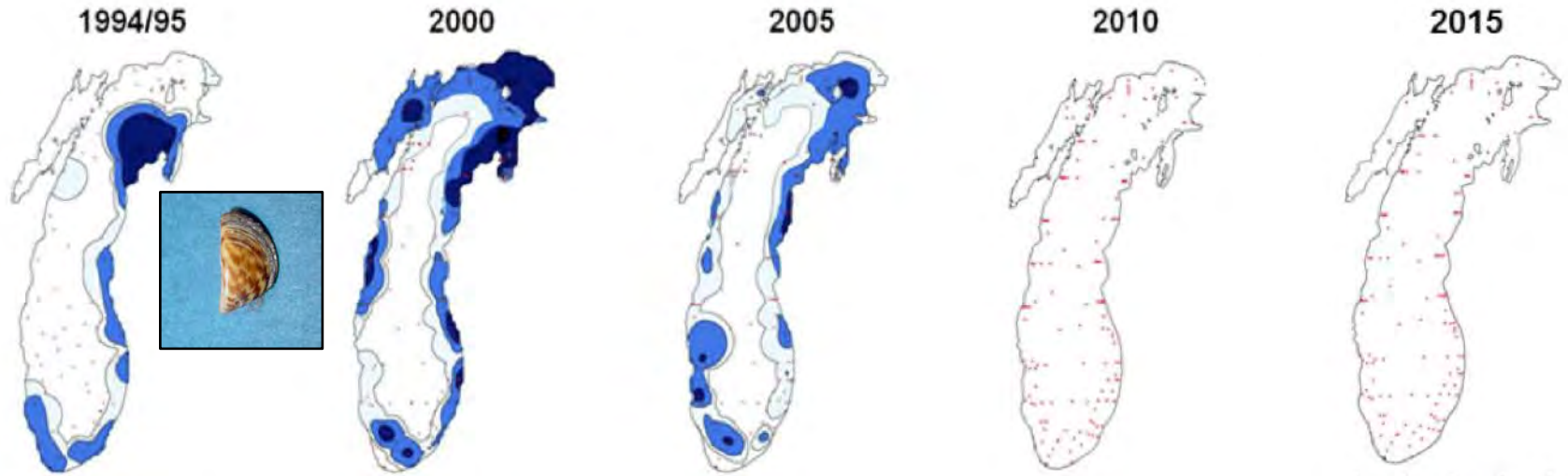
- Foul infrastructure
- Displace native mussels
- Reduce spring diatom bloom
- Increase water clarity and nuisance algae
- Shift energy from the water column to lake bed



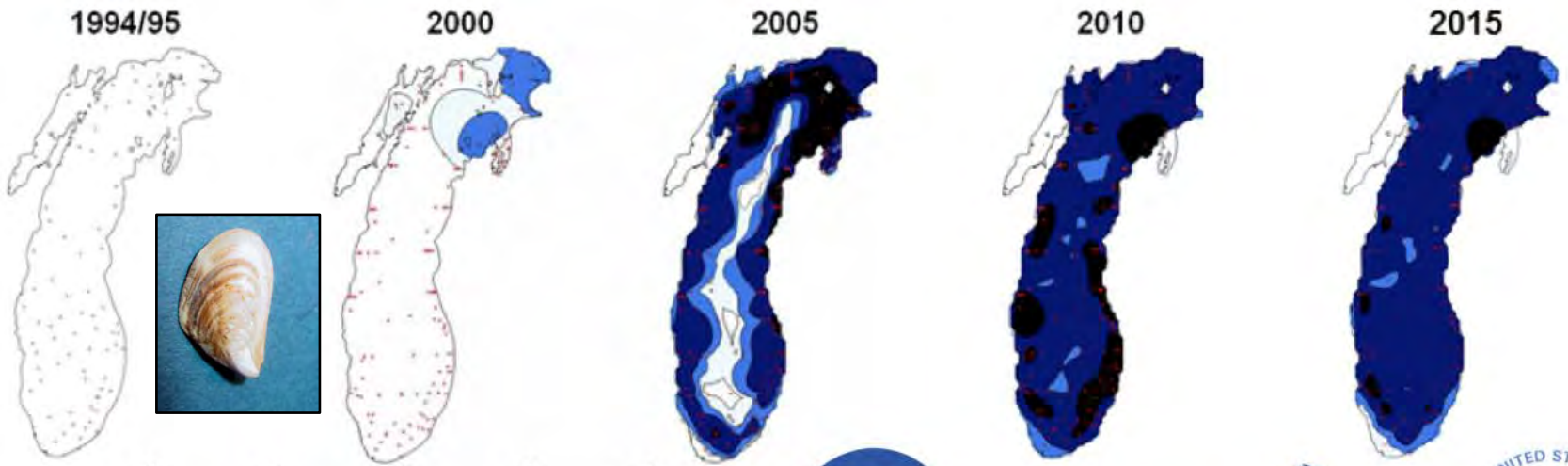
Lake Michigan Mussel Density

(Nalepa et al. 2014, 2020)

Zebra Mussels



Quagga Mussels



Density (No. m⁻²)



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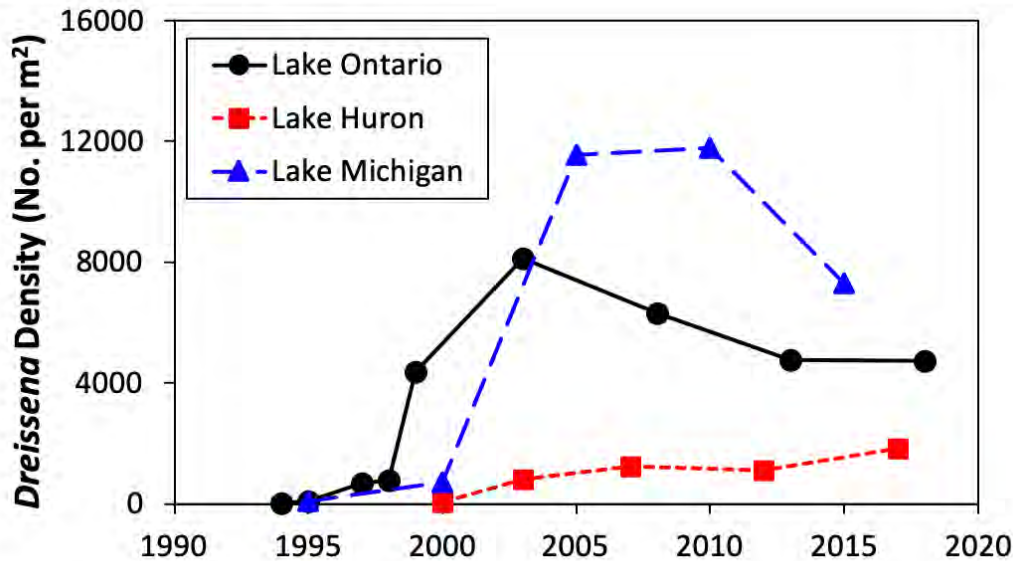


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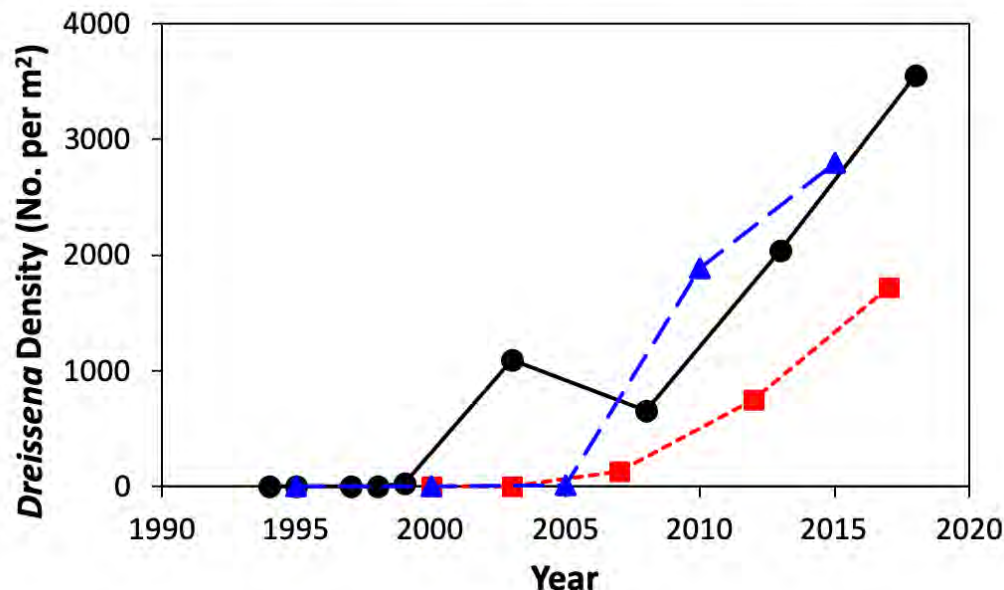


NOAA NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION
UNITED STATES DEPARTMENT OF COMMERCE

Great Lakes Comparison- Lake-wide Density



31-90m



>90m

Data from:

Watkins et al. 2007;

Birkett et al. 2015;

Karatayev et al.

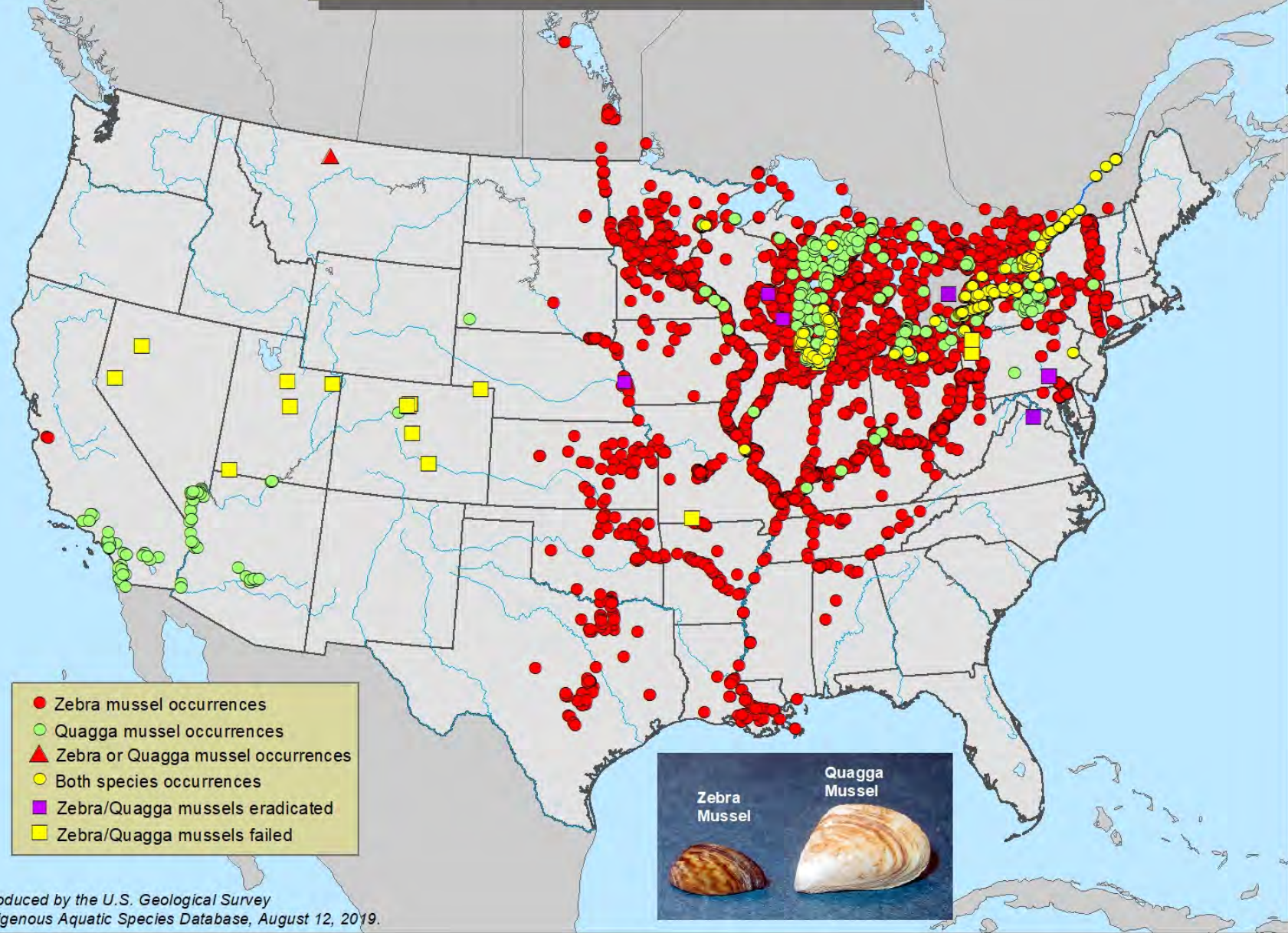
2020, 2021;

Nalepa et al. 2014,

2018, 2020

Zebra and Quagga Mussel Sightings Distribution

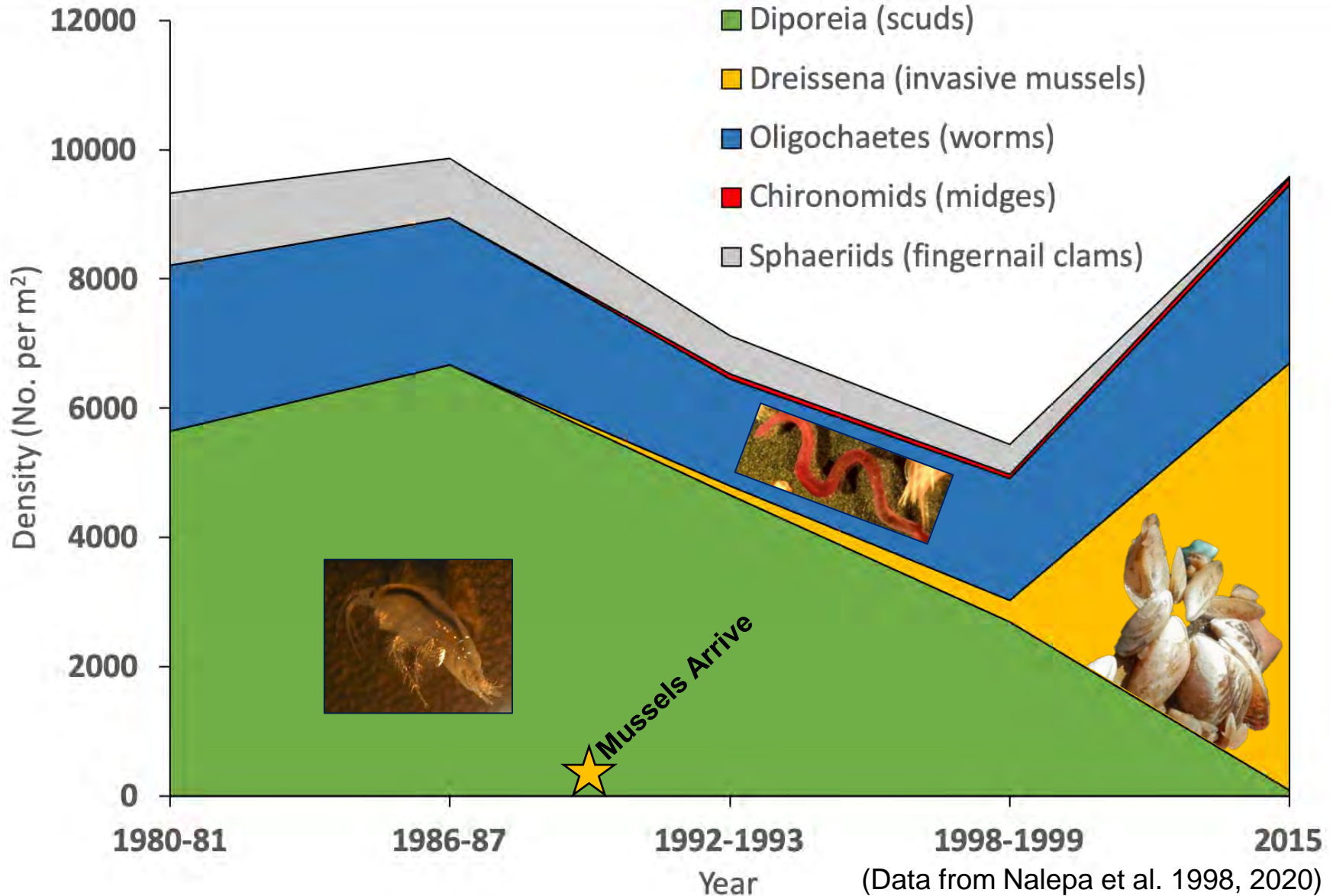
Dreissena polymorpha and *D. rostriformis bugensis*



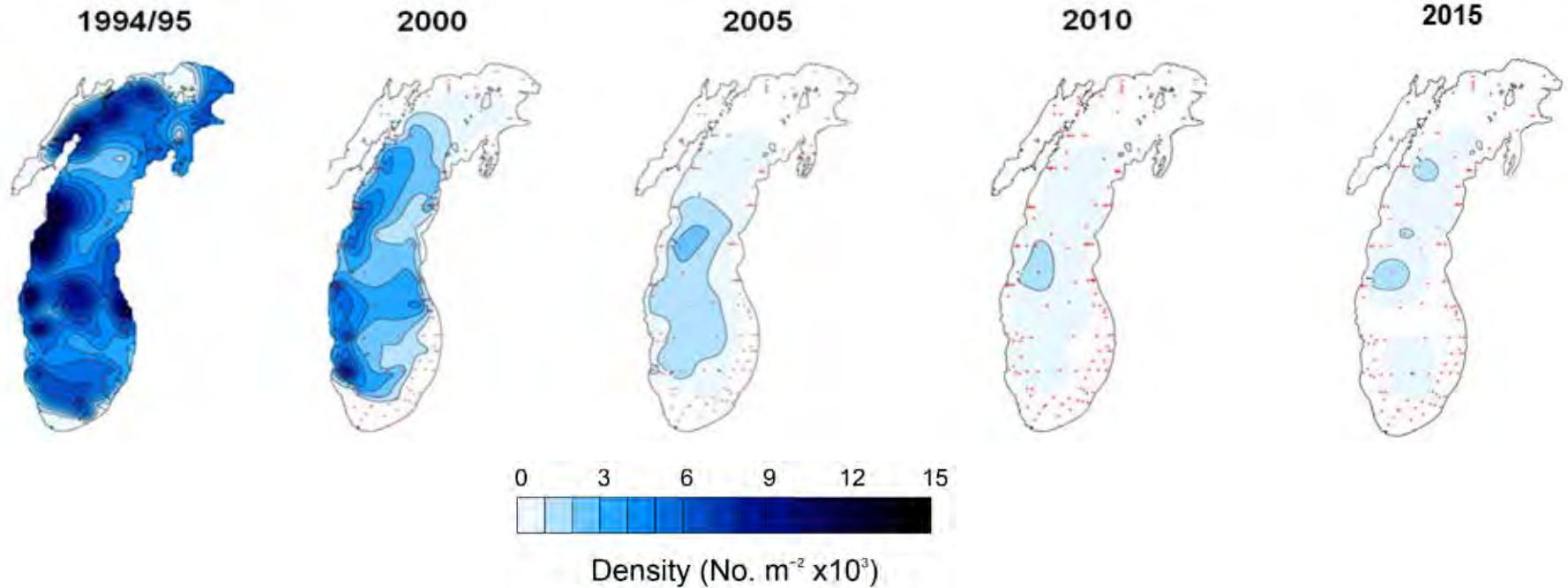
- Zebra mussel occurrences
- Quagga mussel occurrences
- ▲ Zebra or Quagga mussel occurrences
- Both species occurrences
- Zebra/Quagga mussels eradicated
- Zebra/Quagga mussels failed



Changes in the Benthic Community Over Time

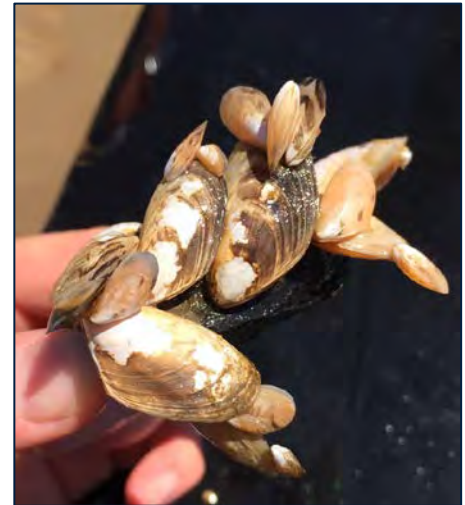


Diporeia continue to decline and are only found deep



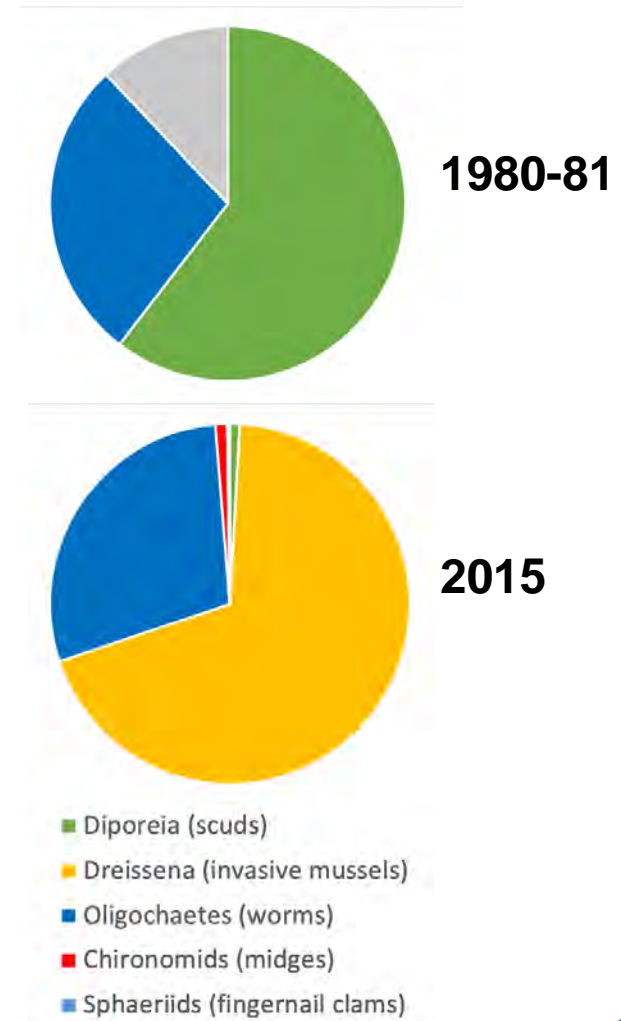
Diporeia/Dreissenid mussel connections

- Reasons for rapid declines of *Diporeia* are unclear
- Are mussels out-competing *Diporeia* for food?
- Is the decline in *Diporeia* related to disease or parasites?



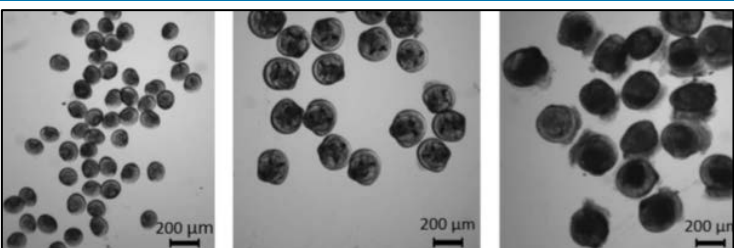
Conclusions

- **Dreissenid mussels** are ecosystem engineers that alter substrate, light and food supply
- **Diporeia** declines have altered the food web
- **Oligochaetes** have fared well





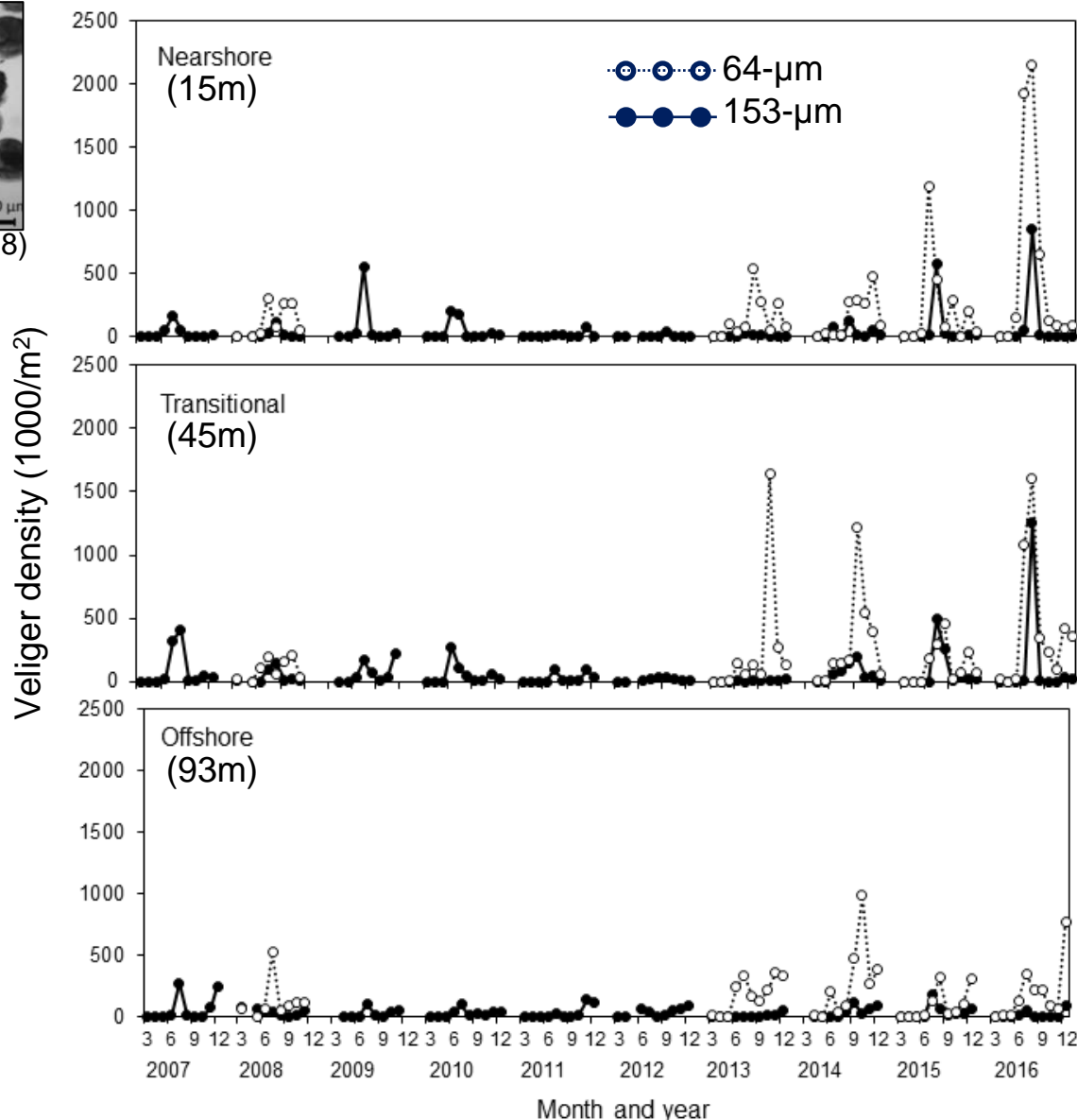
Questions?
ashley.elgin@noaa.gov



(Bowen et al. 2018)

Mussel Veligers

- Free-floating larval life stage of mussels
- Veligers can dominate the zooplankton community
- Less is known about their contribution to the food web



(Pothoven and Elgin 2019)