Use of artificial substrate to monitor zebra mussel (*Dreissena polymorpha*) populations in lakes: potential for a citizen science method

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Thanks to our volunteers!

This work could not be completed without your support.

- Frank and Bonnie Bright (Silver Lake)
- John Maier (Hemlock and Canadice Lakes)
- Terry and Dorothy Gronwall (Honeoye Lake)
- Michele Bartlett (Owasco Lake)
- Seth Aldrich (Crooked Lake)
- Chris Kruth (Tully Lake)
- Tarki Heath (Song Lake)
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- Jim and Stephanie Crawford (Eaton Brook Reservoir)
- Patty Matson, Maggie Fitzpatrick, and Greg Fuller (Craine Lake)
- Caroline Tuttle, Jennifer O'Shea, and lake residents (Conesus Lake)

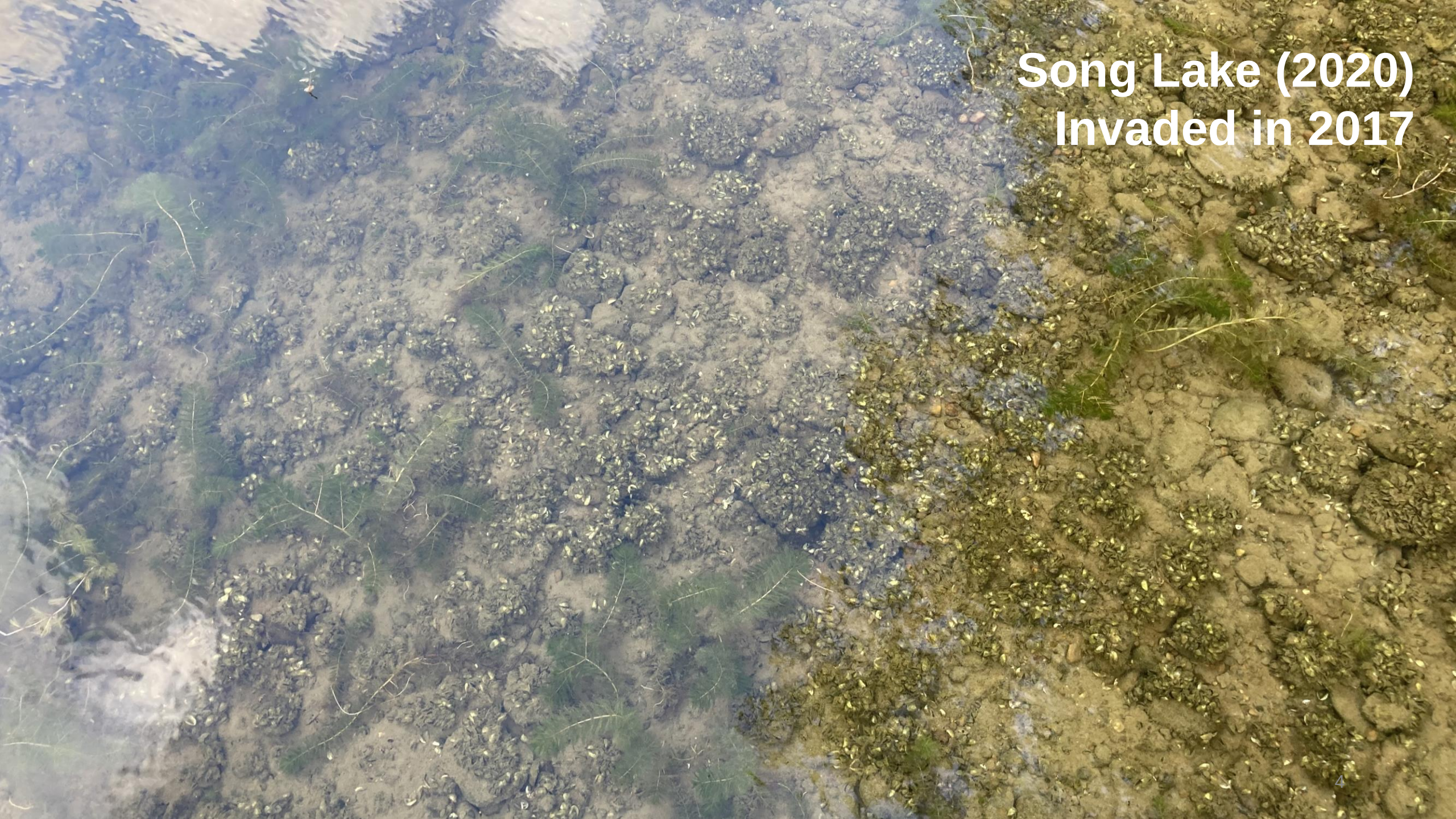
NYSFOLA New York State Federation of Lake Associations

NEW YORK STATE Department of Environmental Conservation

ESF State University of New York College of Environmental Science and Forestry

Our aim

Monitor zebra mussel population dynamics and distribution in invaded lakes through mussel density and shell length.


Song Lake (2020)
Invaded in 2017

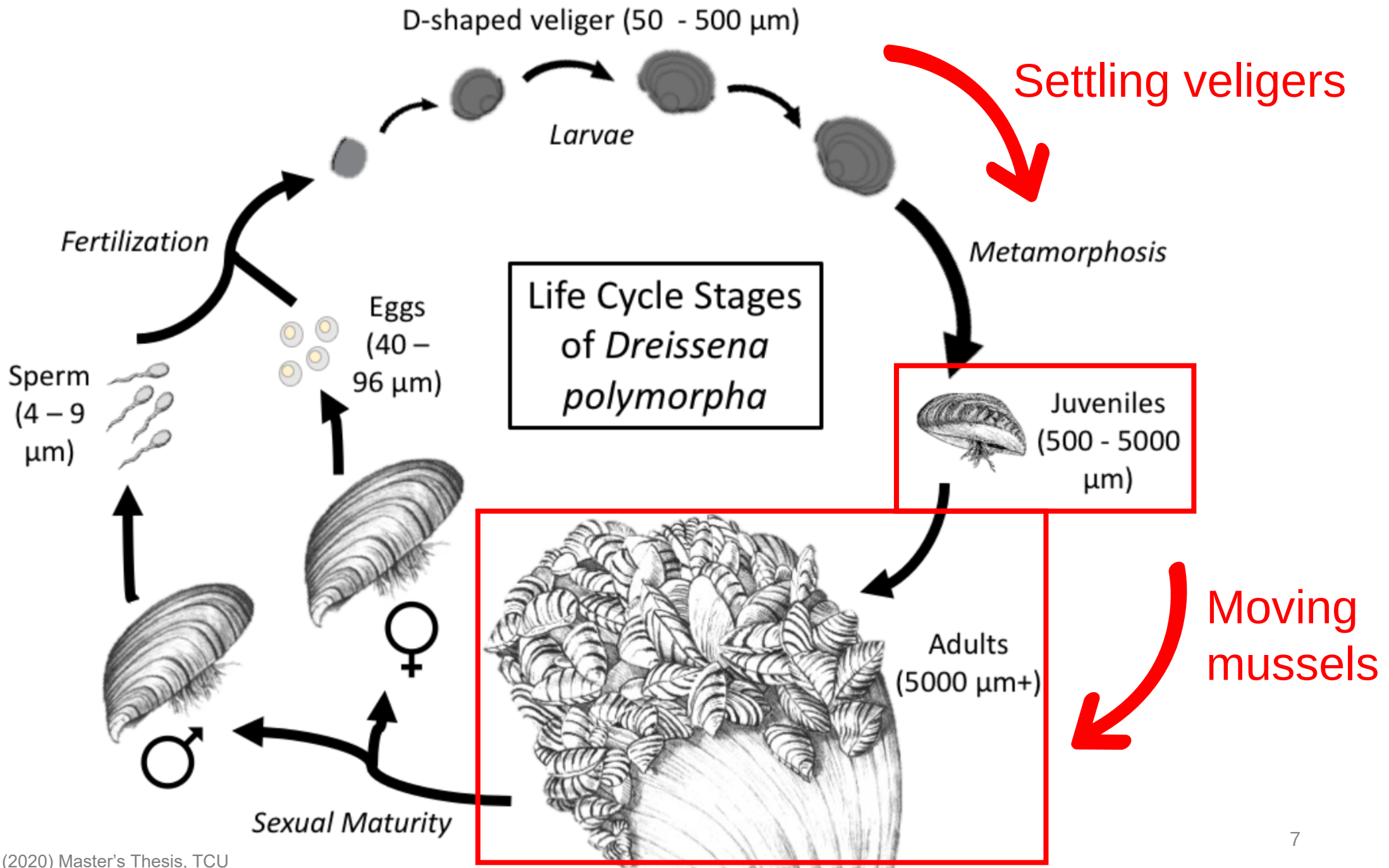
Zebra mussel

Invasive species

Photos by Amy Benson USGS

First reported in GLR in 1988

Native to Ponto-Caspian region



Adapted from Martinez (2020) Master's Thesis, TCU

Invasive zebra mussels are ecosystem engineers

Photo by Terry Gronwall

RESEARCH ARTICLE | BIOLOGICAL SCIENCES | FREE ACCESS

Benthic invaders control the phosphorus cycle in the world's largest freshwater ecosystem

Jiying Li, Vadym Ianaiev, Audrey Huff, +2, and Sergei Katsev | Authors Info & Affiliations

January 25, 2021 | 118 (6) e2008223118 | https://doi.org/10.1073/pnas.2008223118

HABITAT COMPLEXITY | Published: 02 August 2011

Invasive mussels induce community changes by increasing habitat complexity

Lyubov E. Burlakova, Alexander Y. Karatayev & Vadim A. Karatayev

Hydrobiologia **685**, 121–134 (2012) | Cite this article

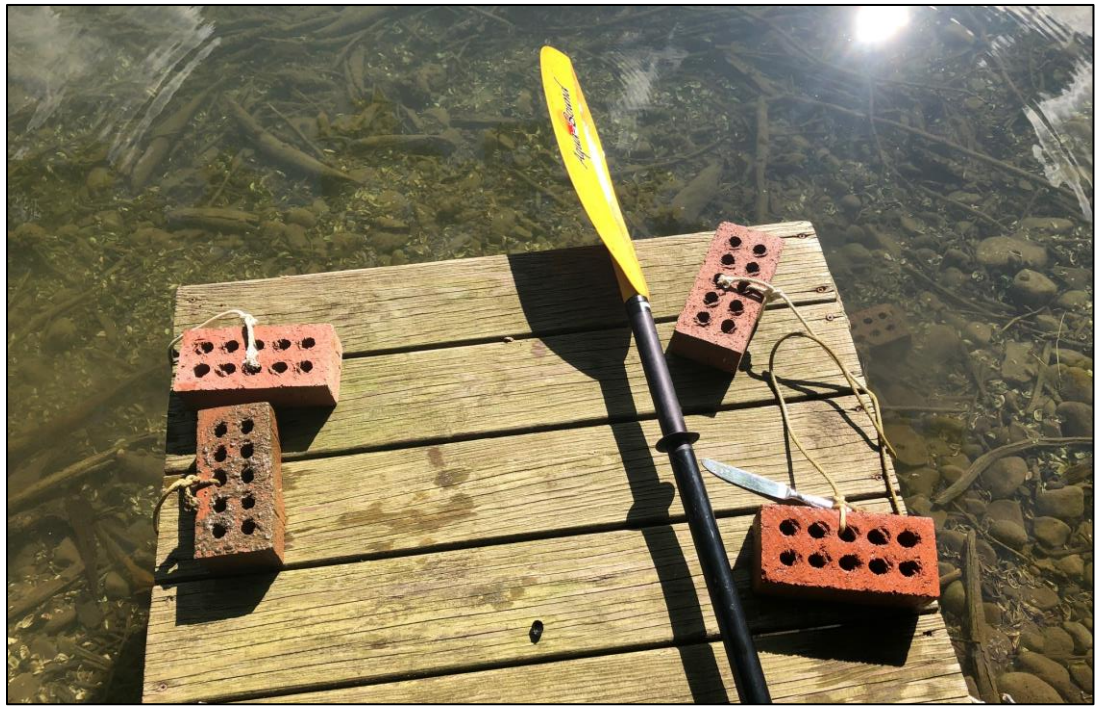
982 Accesses | **40** Citations | Metrics

The nearshore phosphorus shunt: a consequence of ecosystem engineering by dreissenids in the Laurentian Great Lakes

Authors: R E Hecky, R EH Smith, D R Barton, S J Guildford, W D Taylor, M N Charlton, and T Howell | AUTHORS INFO & AFFILIATIONS

Publication: Canadian Journal of Fisheries and Aquatic Sciences • July 2004 • https://doi.org/10.1139/f04-065

A mussel monitoring method for CSLAP



Photos from Victoria Clifton

Victoria (Field) Clifton, M.S.

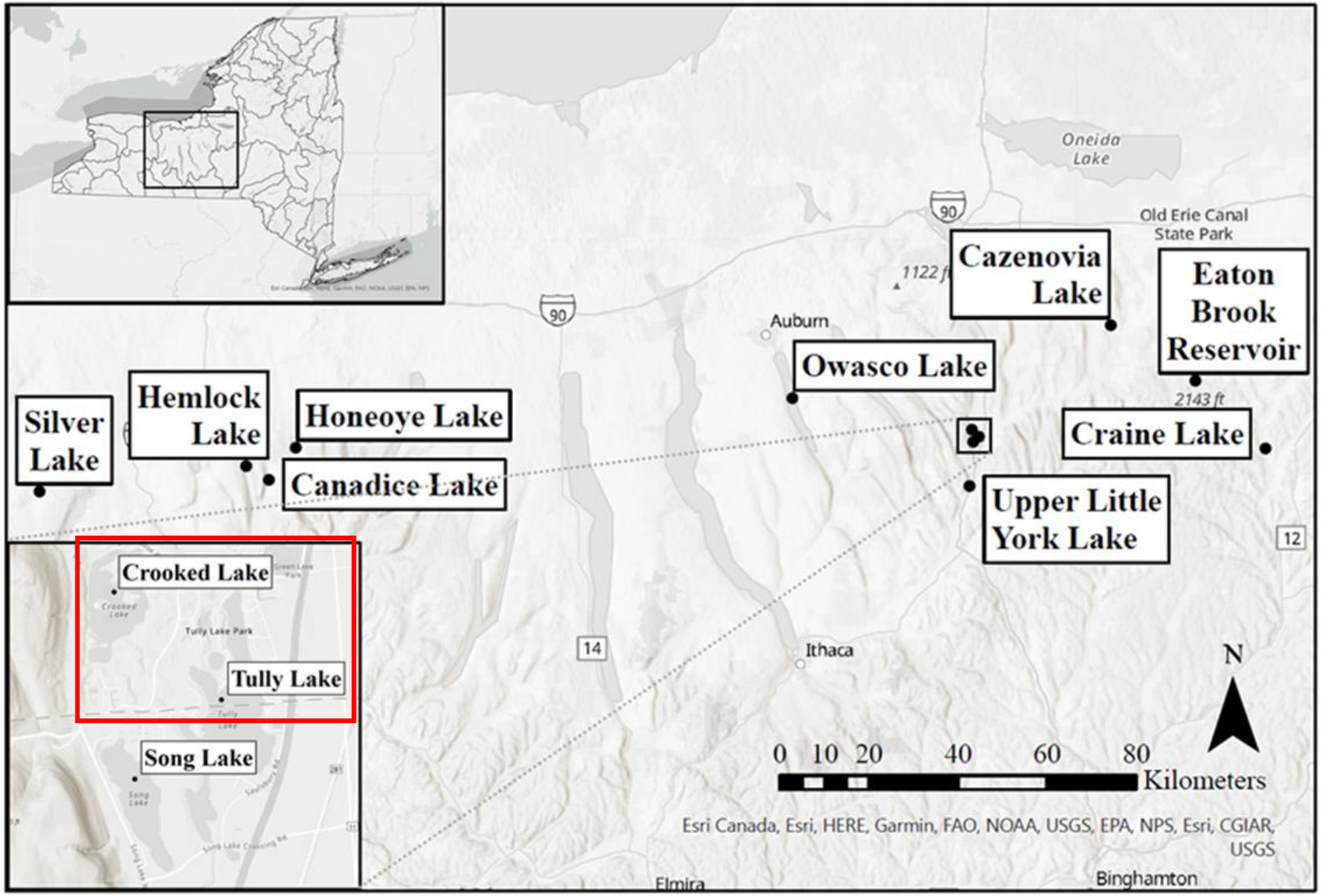
Can we develop an artificial substrate method that is feasible for citizen scientists and efficient in detecting new dreissenid populations or monitoring existing ones?

Substrate deployment

- 4 bricks
- Deployed May – September
- Retrieved one per month

Study sites

- 12 CSLAP lakes
  - All have citizen scientists
- 2019 and 2020
  - 7 of the 12 lakes repeated
- 2 lakes have no reports of zebra mussels
  - Crooked Lake
  - Tully Lake



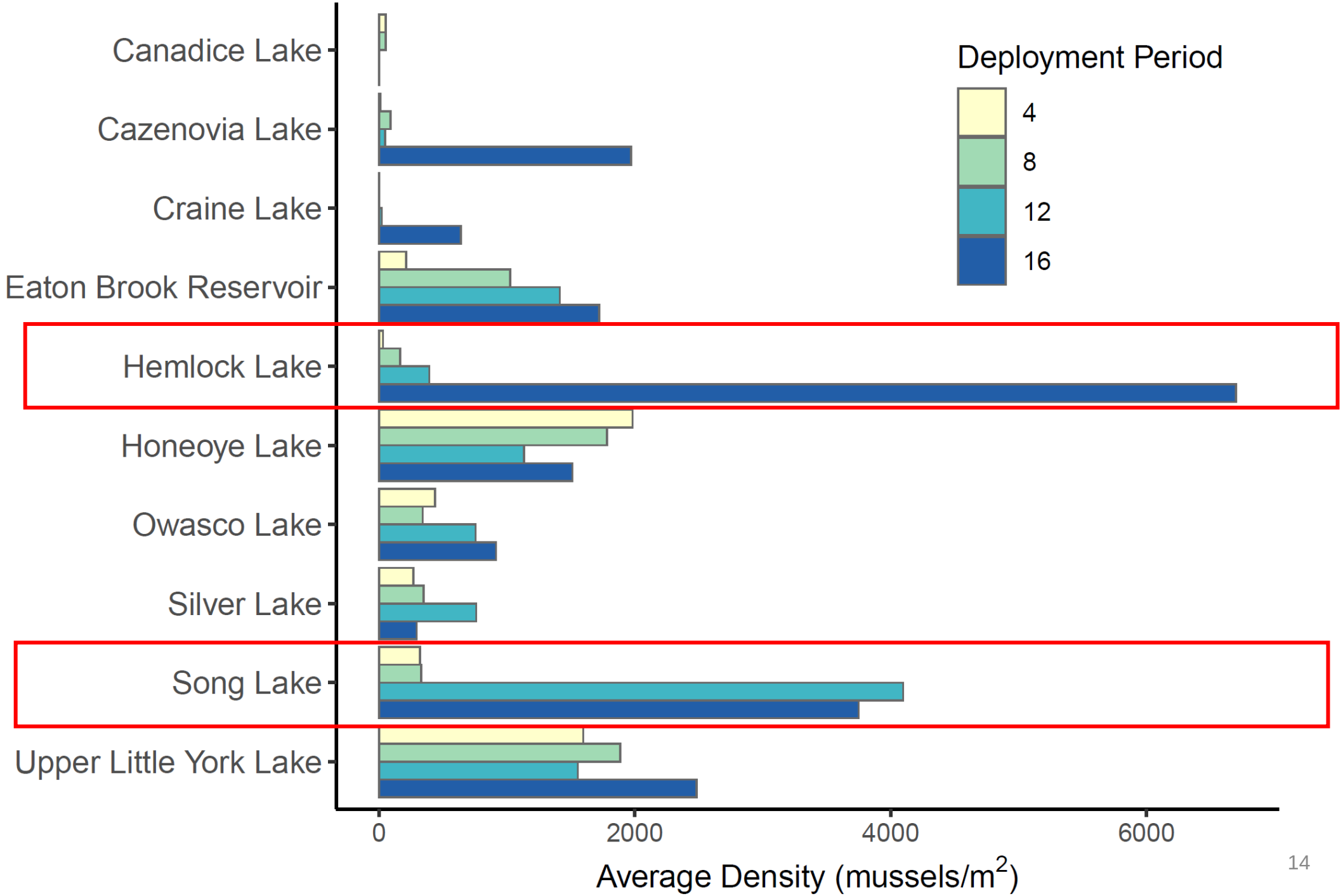
Mussel retrieval

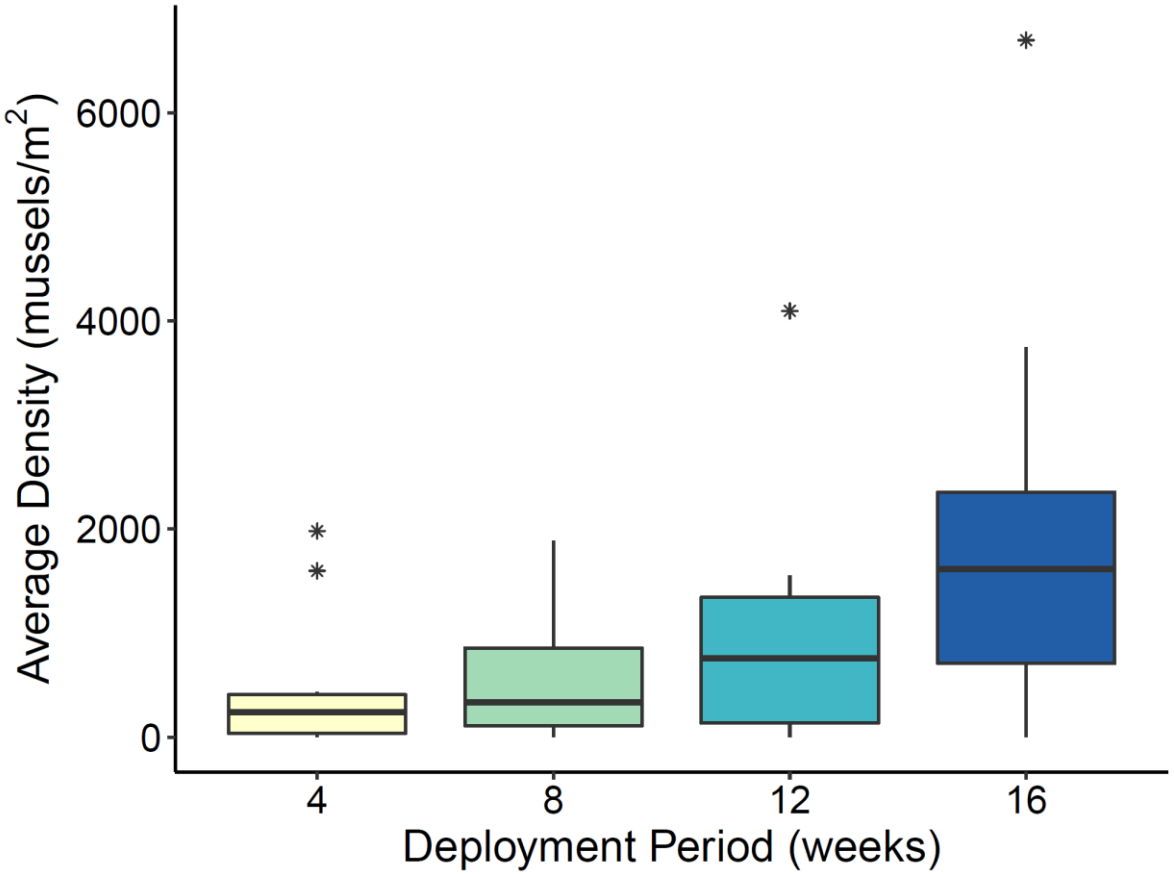
1. Pull brick
2. Remove mussels
3. ID species
   - Only zebra
4. Measure and count
5. Calculate density

Byssal threads keep mussels attached

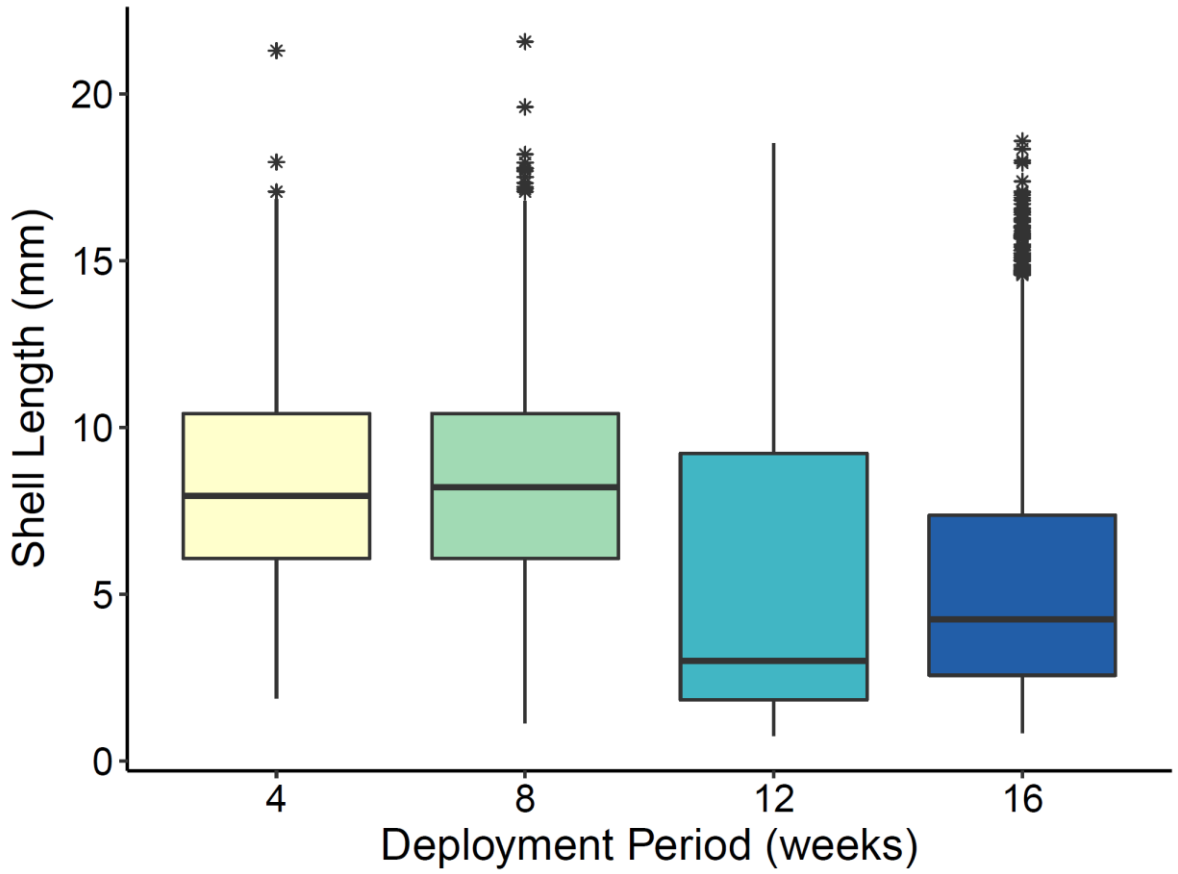
Photos from Victoria Clifton

How does the deployment period and time since invasion affect mussel density and shell length?

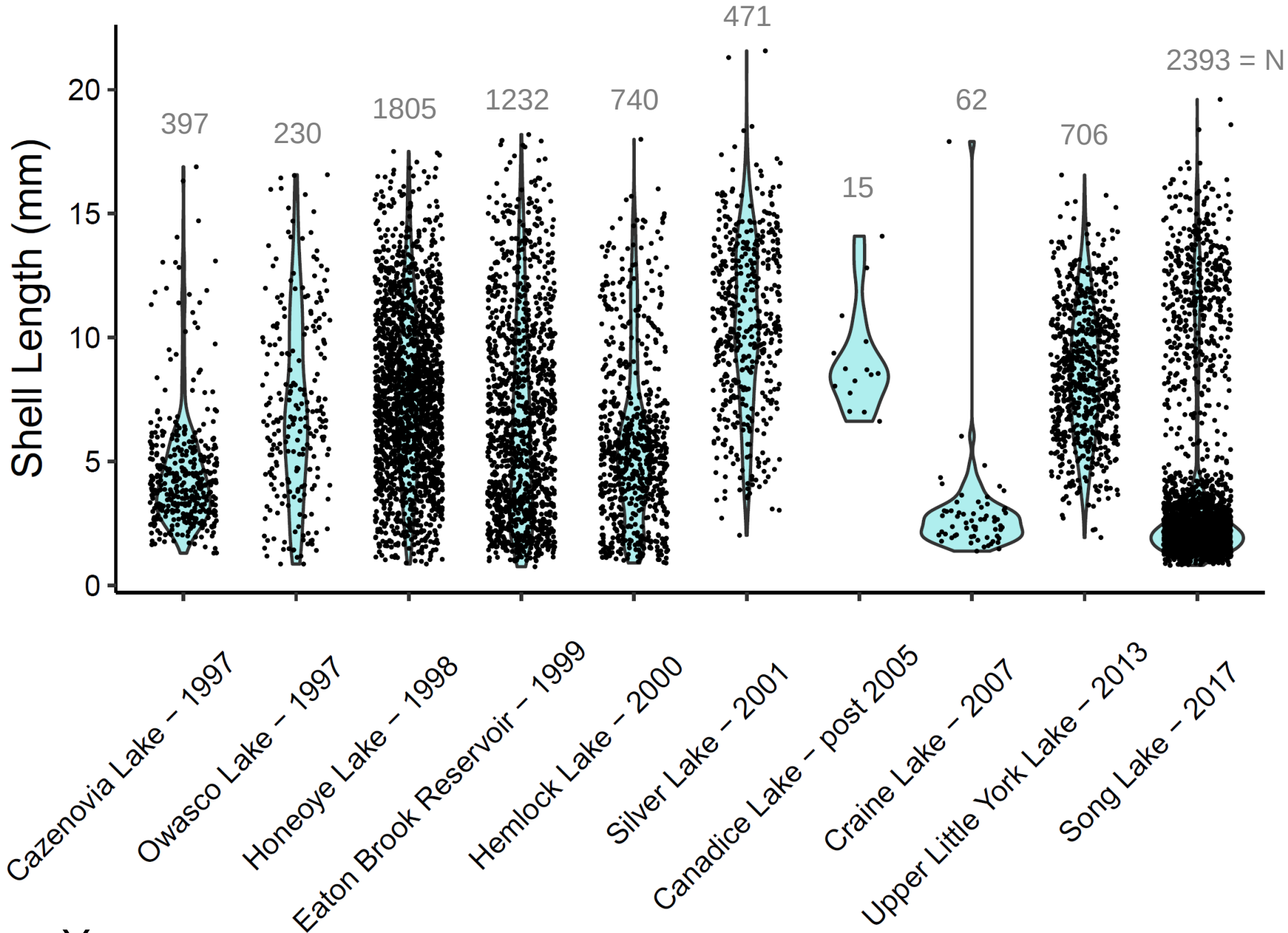

Canadice Lake
Cazenovia Lake
Craine Lake
Eaton Brook Reservoir
Hemlock Lake
Honeoye Lake
Owasco Lake
Silver Lake
Song Lake
Upper Little York Lake
Deployment Period
4
8
12
16
0
2000
4000
6000
Average Density (mussels/m^2)


Average Density (mussels/m^2)
6000
4000
2000
0
4
8
12
16
Deployment Period (weeks)

$p = 0.001$


Shell Length (mm)
20
15
10
5
0
4
8
12
16
Deployment Period (weeks)

$p < 0.001$



$p < 0.001$

Invasion Year

General Trends

As deployment period ↑

- Average mussel density ↑
- Shell length ↓

As the time since invasion ↑

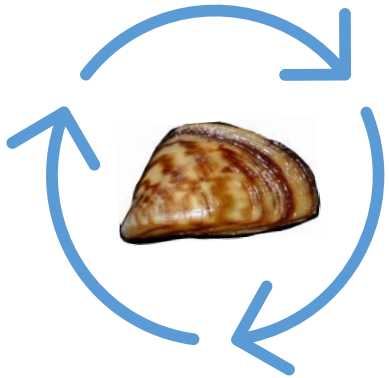
- Average mussel density **NS**
- Shell length ↓

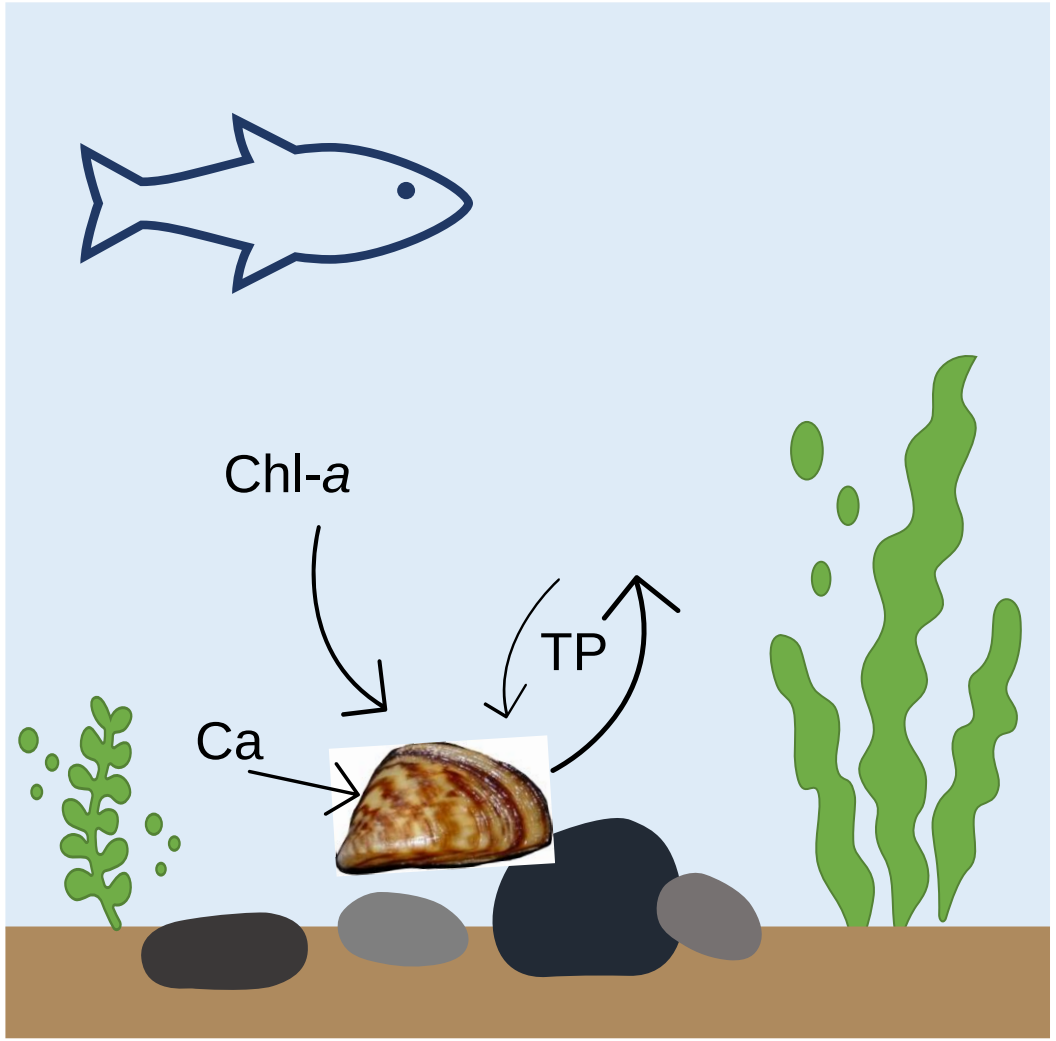
Deployment period results are likely highly influenced by timing of the zebra mussel's reproductive cycle and seasonal changes

What about the water?

- Phosphorus
- Calcium
- Chlorophyll-*a*
- Predation
- Substrate

… and more!





What we learned from Song Lake

- Invaded in 2017
- Did zebra mussel population change from 2019 to 2020?
  - 2019: Among lowest mussel density
  - 2020: Among highest
- Significantly higher density later in season (weeks 12 and 16)
- Evidence of shift in population dynamic?

Limitations

- High variation in mussel density both within and among lakes
  - → Need for in-lake and interannual replication across multiple sites
- Time-intensive to count and measure mussels
- Species identification can be difficult
- Mussels can be very small (< 3 mm) and hard to see

Potential for citizen science

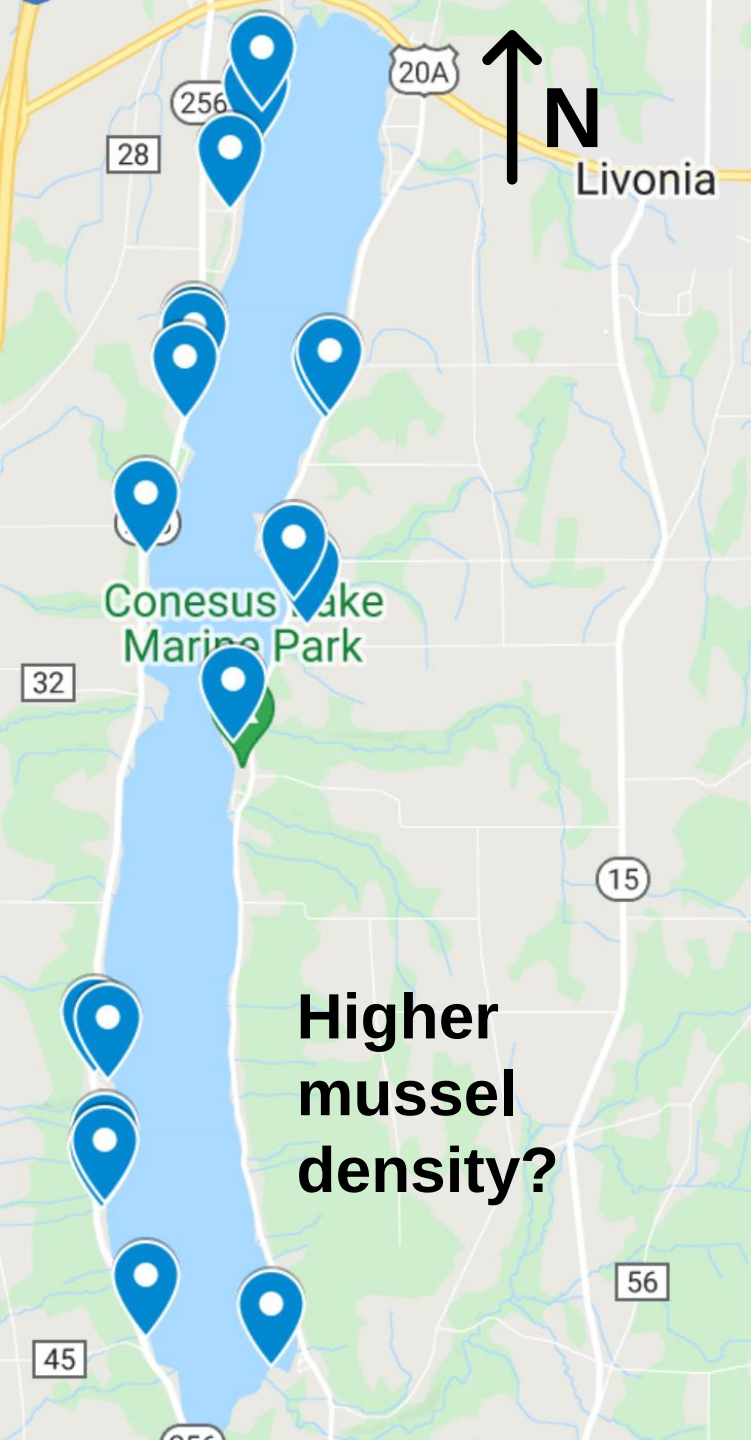
- Low-cost
- Simple materials
- Ease of use
- Valuable to track populations during initial years since invasion



The utility of this method depends on your goals

- If the goal is to detect a new population
  → deploy near probable invasion points

- If the goal is to monitor an existing population
  → difficult to do this without many sites around a lake



A case study for lake-wide monitoring: Conesus Lake

- 19 sites
- Preliminary results suggest higher mussel density near South end than near North end
- 8,000+ mussels from weeks 4 and 8 and counting…

Map by Shannon Croft

Concluding thoughts…

- Quantifying mussels is difficult to do anywhere
  - All methods are variable

- ~~Estimate populations?~~

↓

Distribution of populations
  - What's moving / what's settling?

You can help stop the spread!

- Keep an eye out
- Check your gear between lakes
- Allow boat stewards to check your boat
- Report suspected invasions

NY iMapInvasives Network

Photo of Hydrilla from NYSFOLA

Photo of Round Goby from InvasiveSpeciesCentre.Ca

Photo from NYS DEC

CLEAN DRAIN DRY™ INITIATIVE

Thank you!

Thanks to the students involved at SUNY ESF,
and thanks again to all our volunteers:

- Frank and Bonnie Bright (Silver Lake)
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