



Impact of Artificial Circulation Devices & Aquatic Invasives in Otsego Lake, NY

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Ice-covered lakes: fun & beauty



Lake George - <https://www.visitlakegeorge.com>



Source: NYSDEC



Lake Champlain - Source: Sarah Harris /North Country Public Radio



@ciddibiri
<https://www.twenty20.com/photos/57474d72-ac95-4ccb-906b-0f49279b78f2>

https://upload.wikimedia.org/wikipedia/commons/c/c6/Frozen_Lake_Erie.jpg

with extra work...



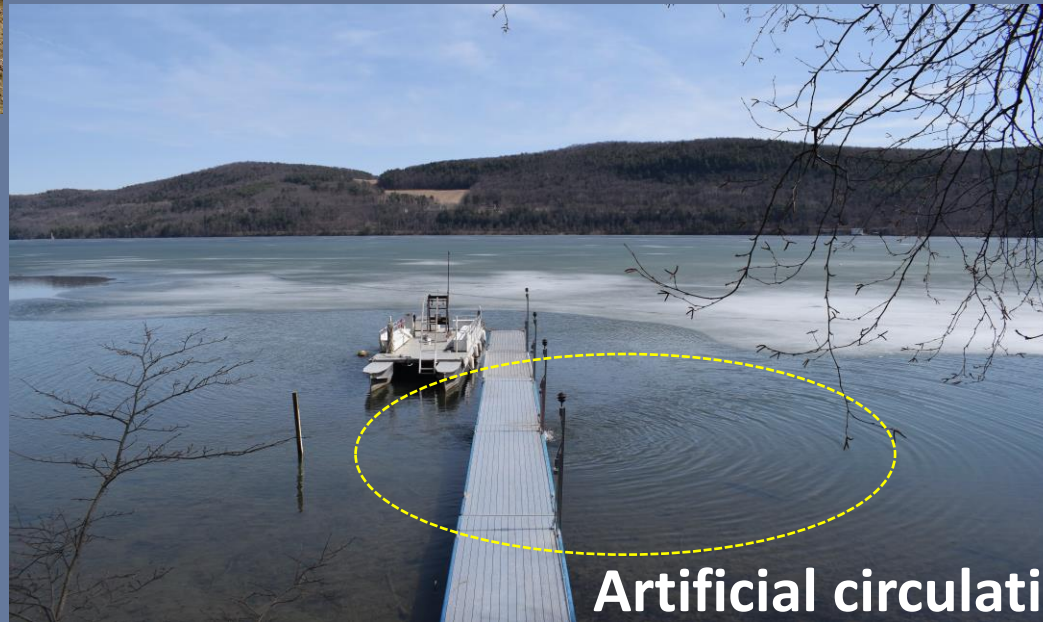
Remove in fall; re-deploy in spring

Video by William Blowers
<https://www.youtube.com/watch?v=29amsH8ENfk>

Annual winter drawdown selected for more tolerant macrophytes in MA lakes (Carmignani & Roy 2021)



Winter drawdown



Artificial circulation



Photo by F. Reyda

Dock de-icers



Agitators

(Photo source: Amazon.com)



Bubbler

(Photo source:
<https://www.lakesunapee.org/dock-deicers>)

- Work in moderately cold climate with reliable power supply
- Regulated or banned in some U.S. states & municipalities
 - Not regulated in New York State
- Stakeholder conflicts: ecological concerns & loss of public ice access → trespassing, etc.

Agitator de-icers on Otsego Lake, NY, USA



Runs 24/7 unless manually turned off
1 HP, moves ~1400 gallons / min

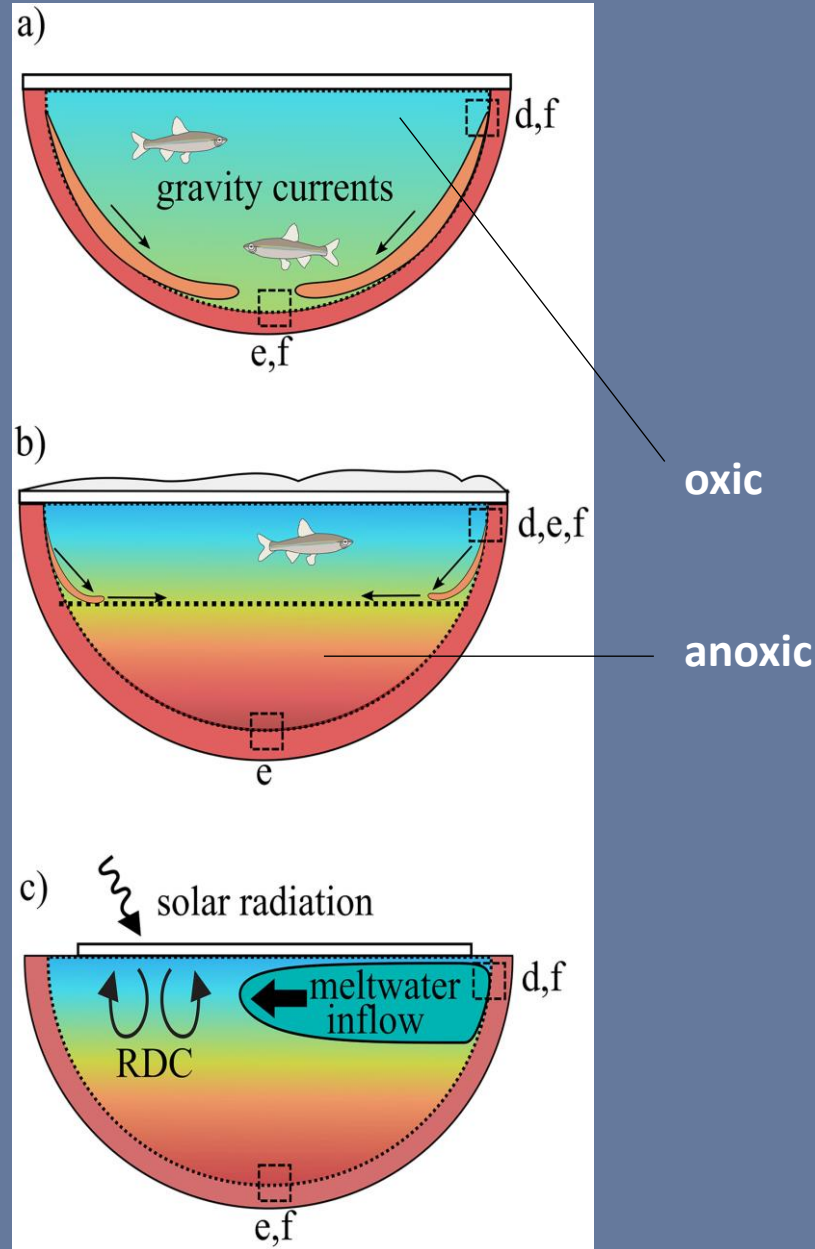
With thermostat: turns on when water temp drops below set point

What happens under the ice? (1)

Early winter
(thin ice cover)

During winter
(ice & snow)

Spring
(shoreline opening
in ice cover)



Jansen *et al.* 2021

Changing climate

Later ice-on
&
Earlier ice-off

Sharma *et al.* 2021

More stable
summer
stratification

Deep water
DO ↓

Jane *et al.* 2021

What happens under the ice? (2)

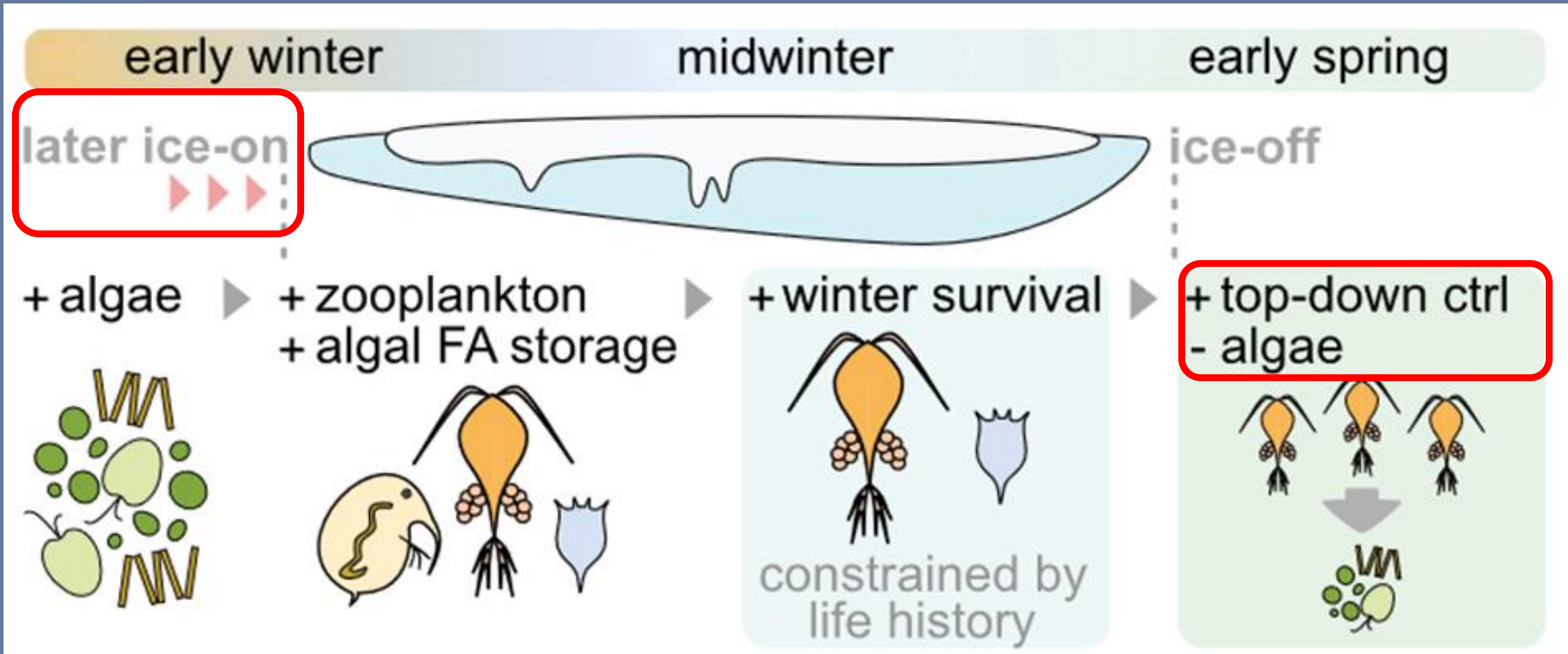


Fig. 5. Schematic summary of potential direct and indirect effects of later ice-cover onset on lake planktonic food webs, from early winter to spring.

Hébert *et al.* 2021
(enclosure experiment in a lake)



What happens under the ice? (2)

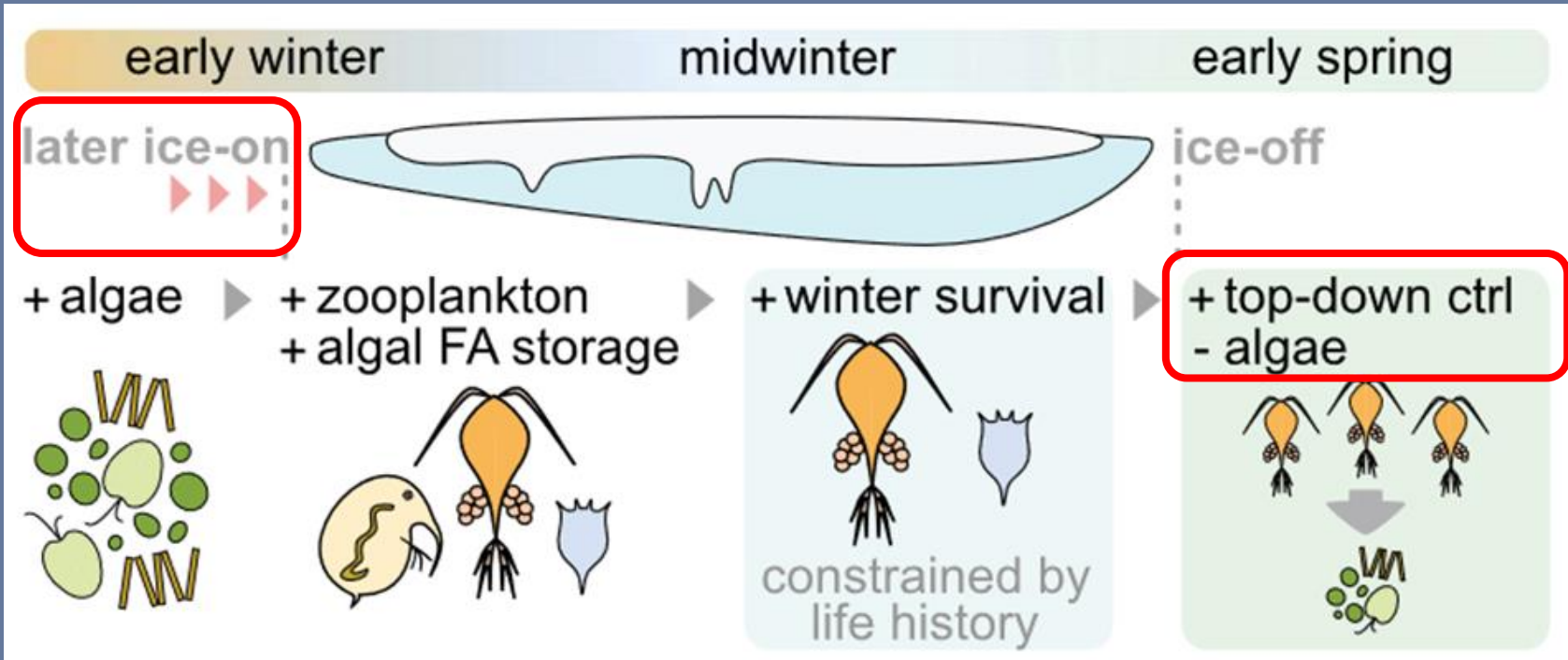


Fig. 5. Schematic summary of potential direct and indirect effects of later ice-cover onset on lake planktonic food webs, from early winter to spring.

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Warmer winters

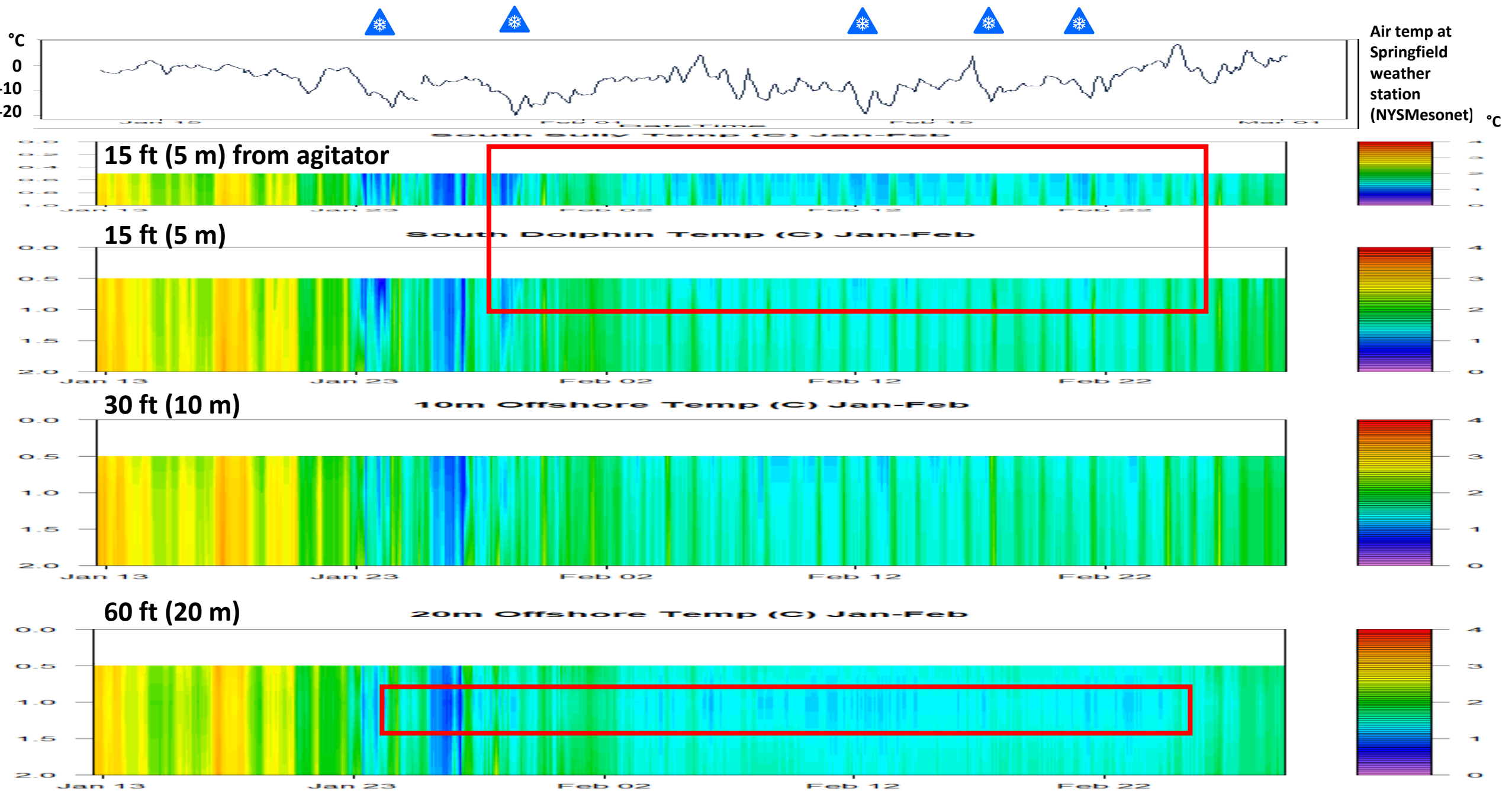


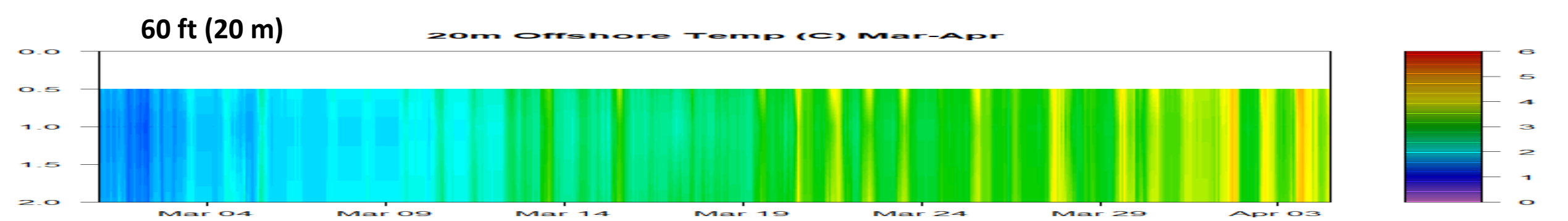
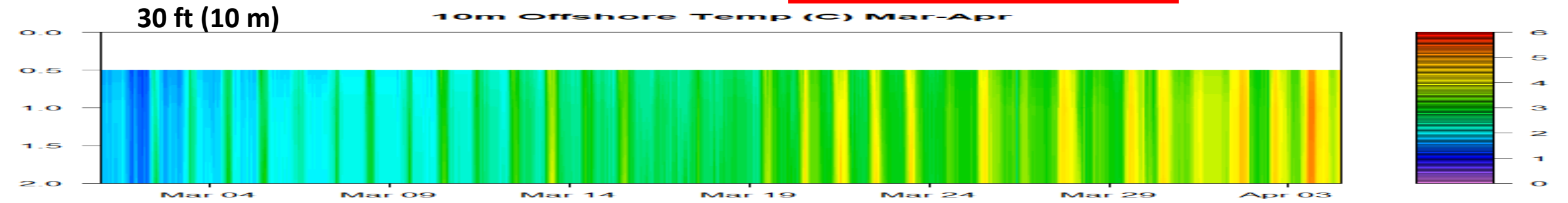
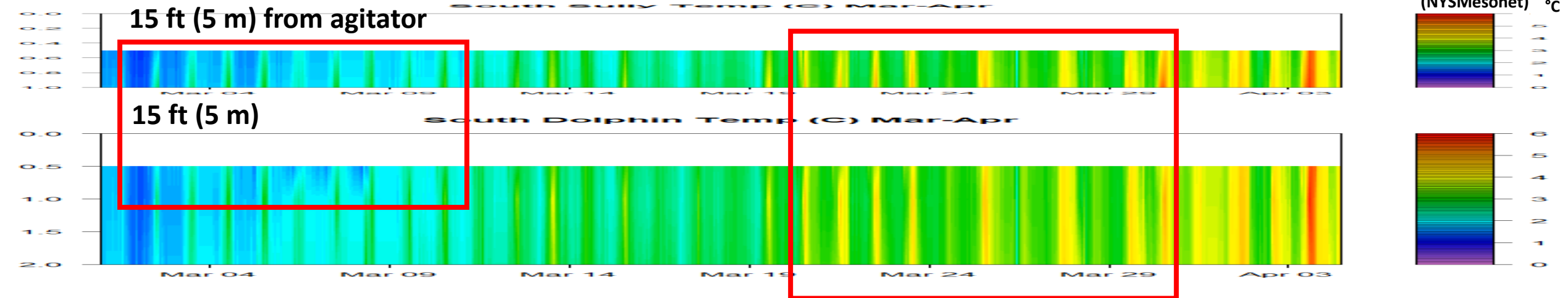
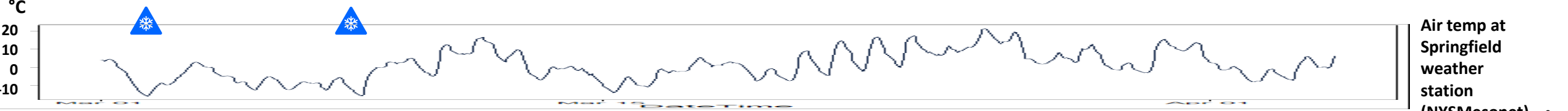
Earlier spring runoff



Lower summer chl. *a*
(~phytoplankton biomass)

Hrycik *et al.* 2021
(meta-analysis of 41 temperate lakes)





Quagga *Dreissena bugensis* & Zebra Mussel *Dreissena polymorpha*

- **A**quatic **I**nvasive **S**pecies
native to Eastern Europe
 - Disrupt recreational activities &
clog intake pipes
 - Outcompete native organisms
 - ⊞ benthic organismsfor food
- (Karatayev *et al.* 2014)
- Phytoplankton



Two sampled zebra mussels.



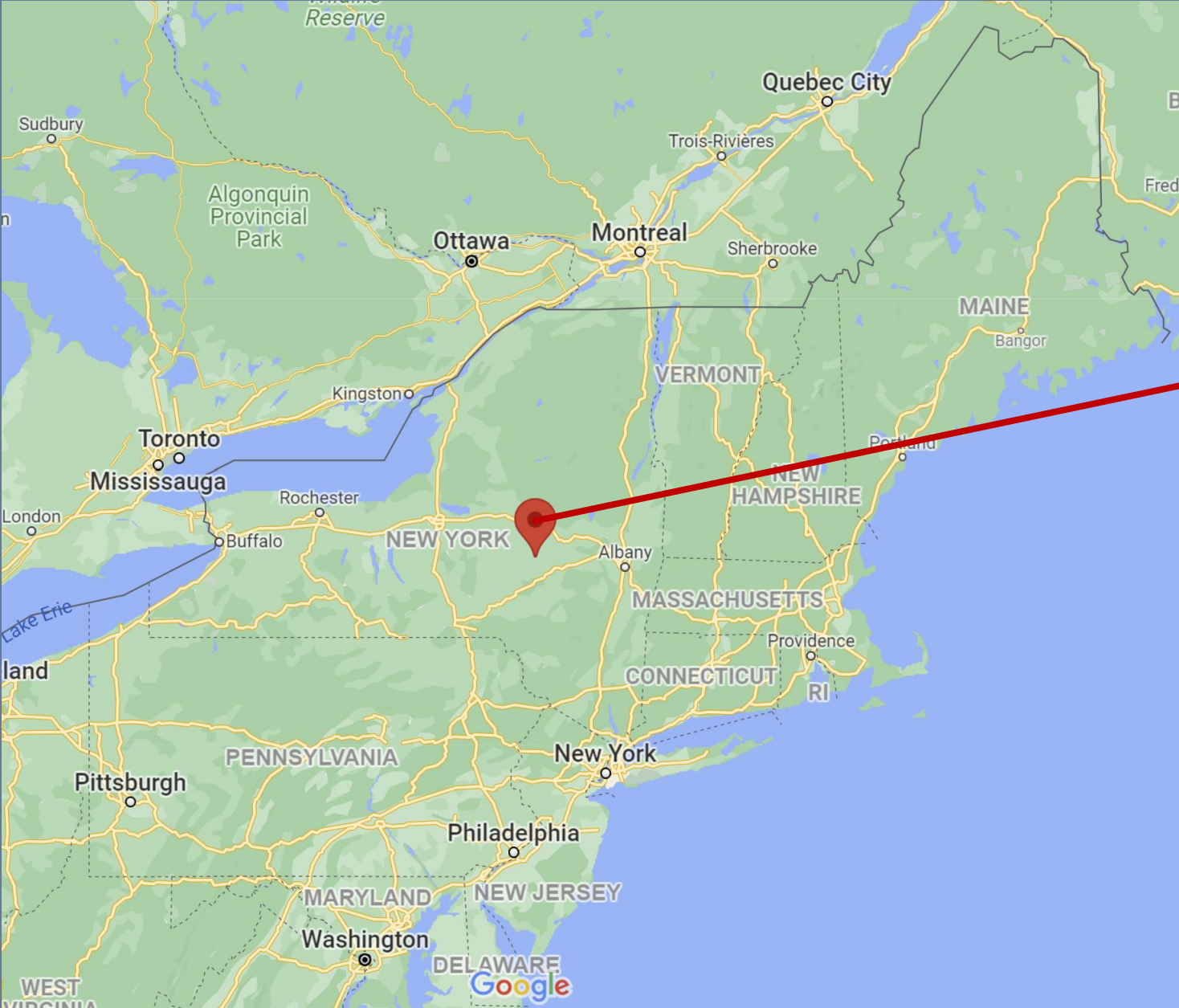
Two sampled quagga mussels – lighter shells.

Objectives

- Evaluate quagga mussel survival
 - Deployed February 28th, 2021
 - Retrieved May 19th, 2021
- Compare survival & growth of quagga mussels to zebra mussels



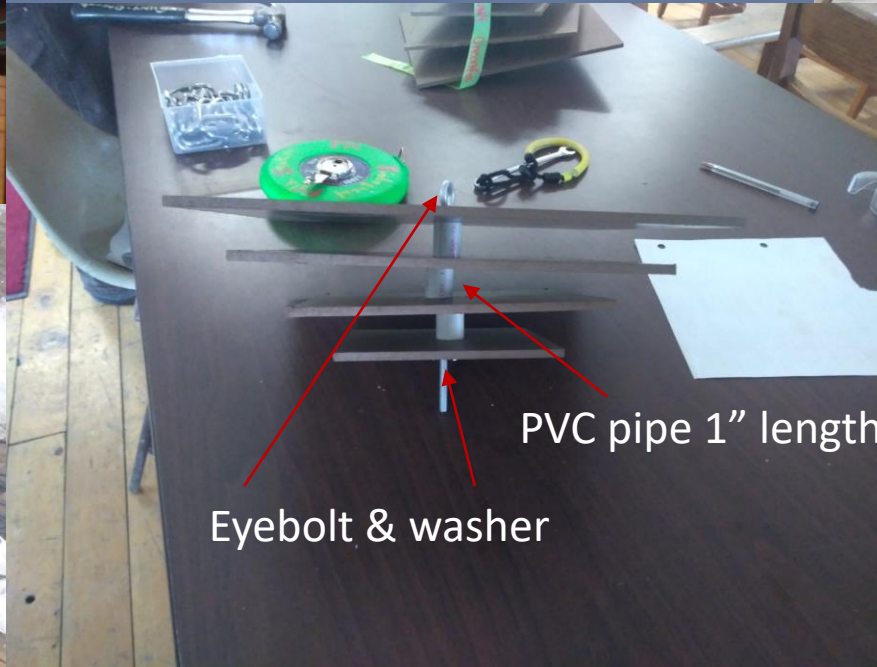
Sampler Sites Location: Otsego Lake, New York, United States



Google. (n.d.). [Google Maps of Otsego Lake, NY]. Retrieved October 28th, 2021

Methods

Assembled Masonite plates
12" x 12" (35.5 cm x 35.5 cm)



PVC pipe 1" length

Eyebolt & washer

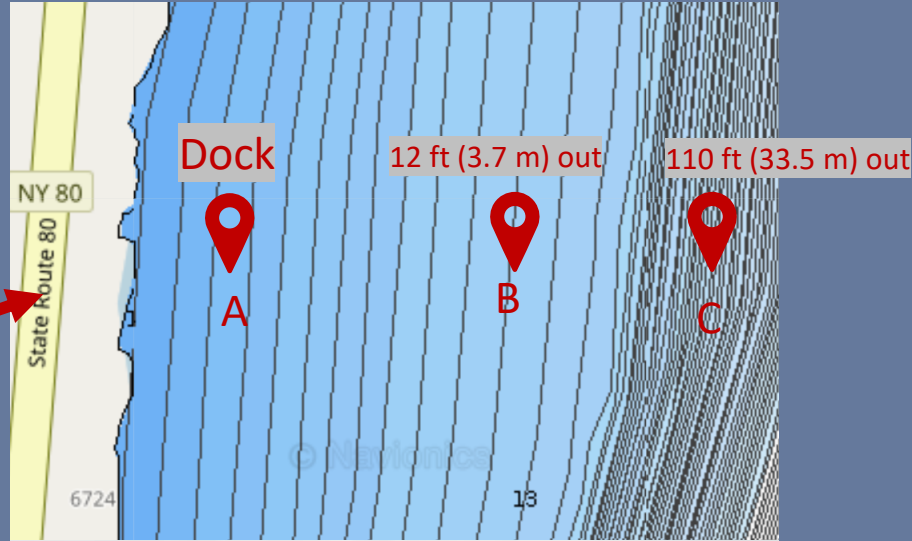
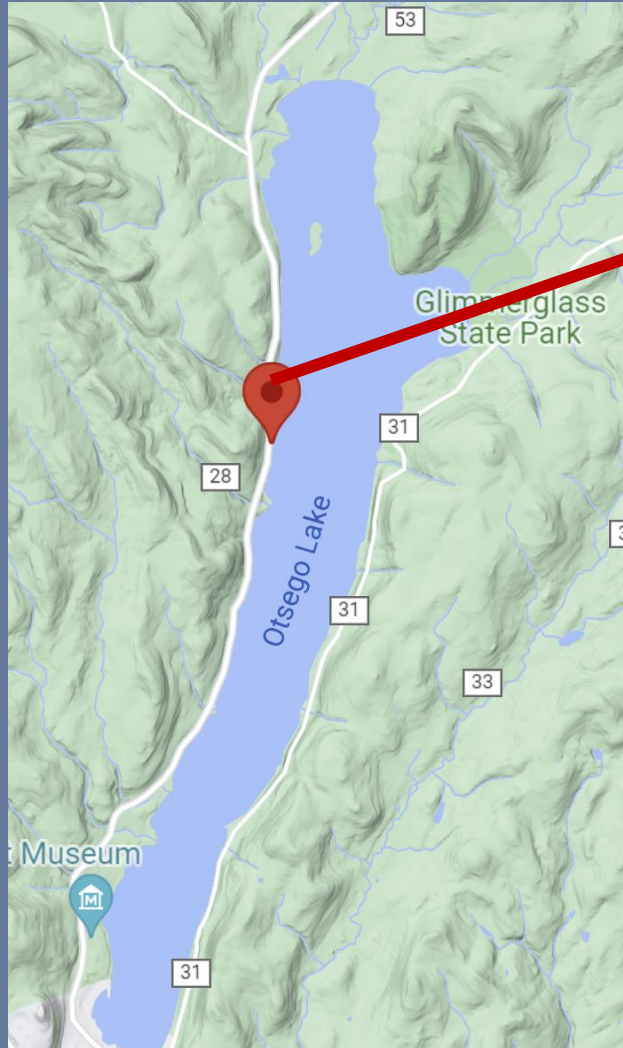


Attached ~20 ft
metal chain (~6m)

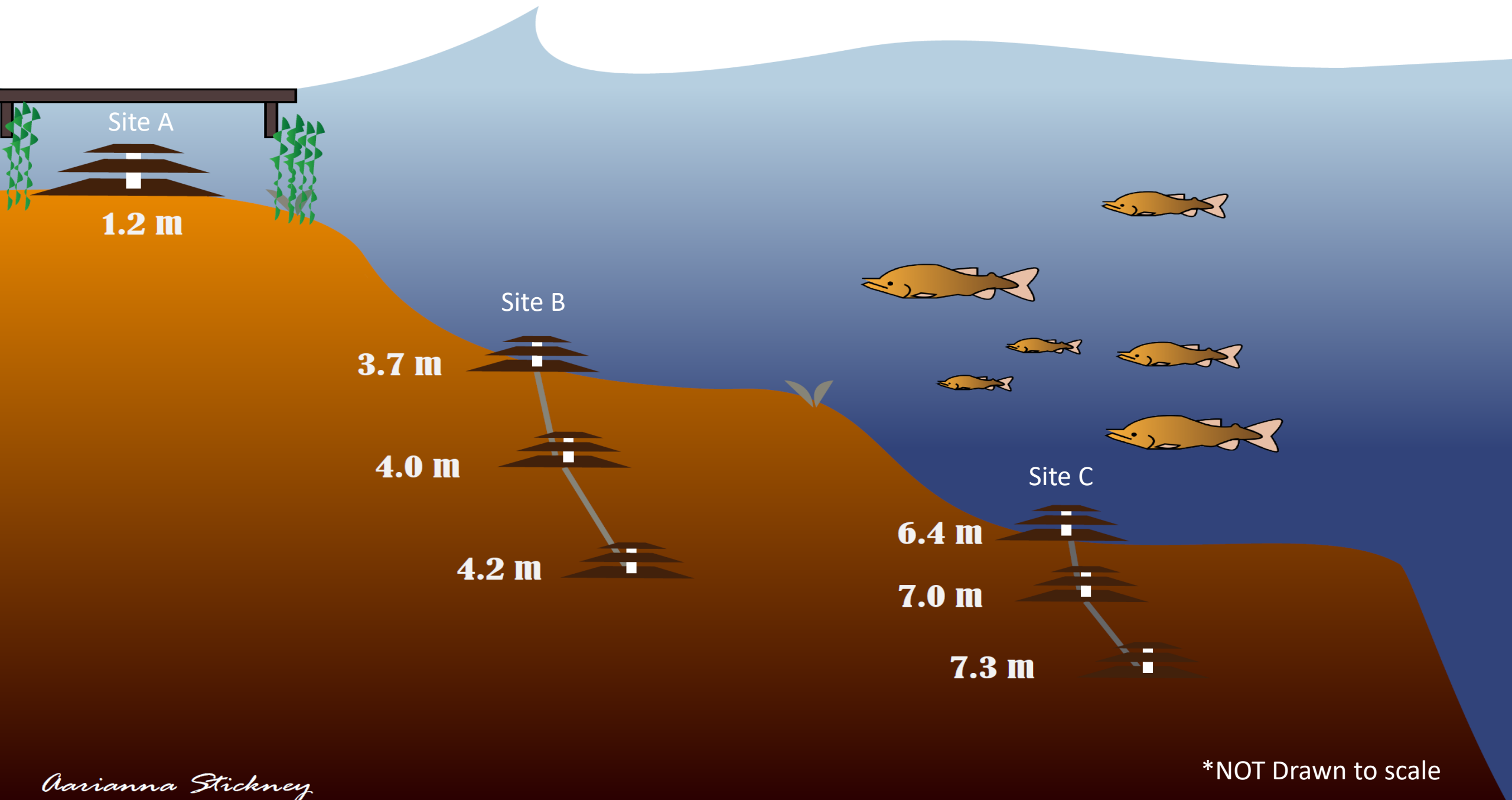


samplers 6.5 ft (~2 m) apart

Deployment



Dr. Yokota (left), Biology student Sierra Stickney (Right), and Ice dive volunteer, David Turner.
Picture by: Peter Regan



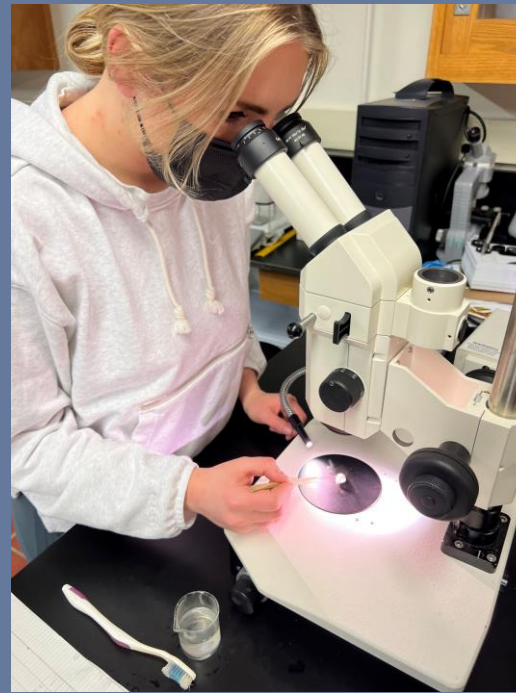
Retrieval

- Mussel samplers retrieved by Underwater Research Methods Class
- in water ~80 days
- February 28th - May 19th 2021



Assessing Mussels

- Each mussel measured using digital calipers
- Length, age, & species recorded - age estimated using annual growth rings
- Microscope used for smaller mussels
- RStudio® used for graphs



Rylie Smith aging and identifying a mussel.



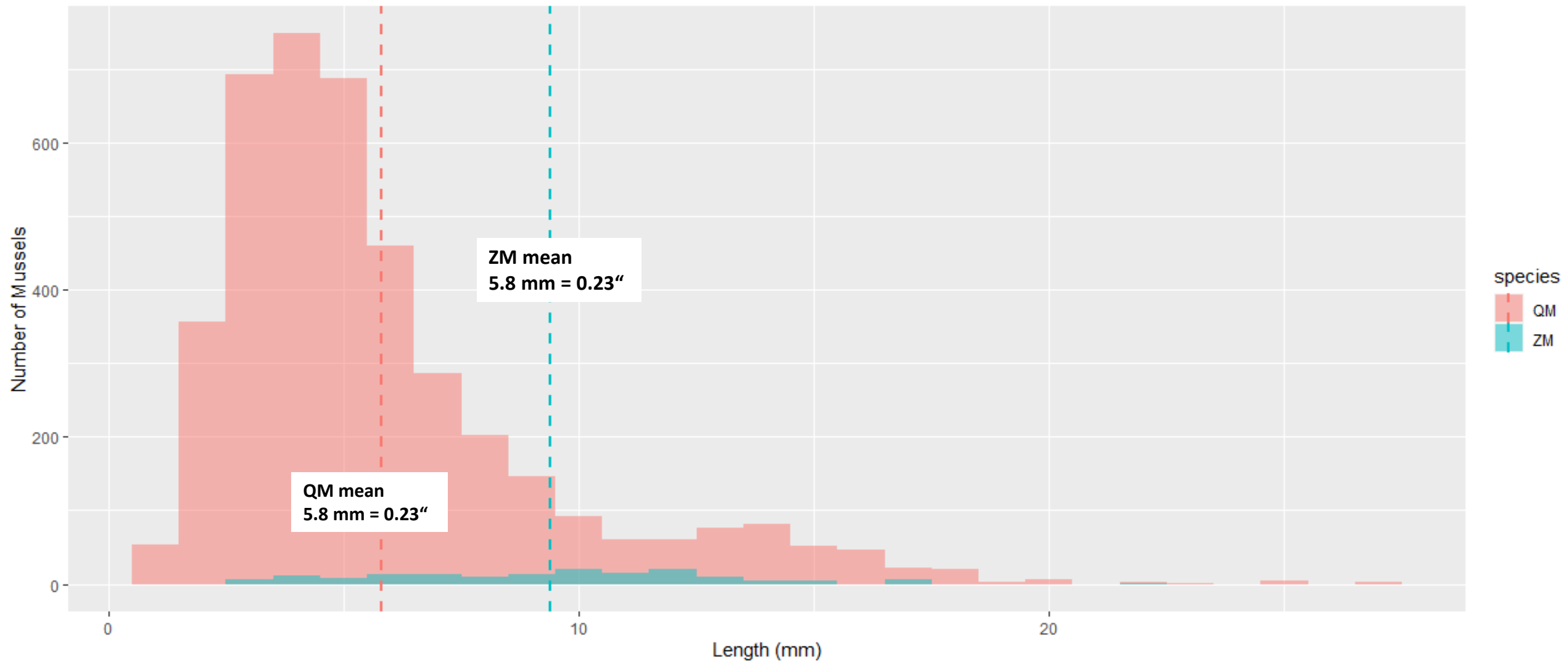
Quagga mussel under microscope



Digital caliper



Kari Minissale using Rstudio®

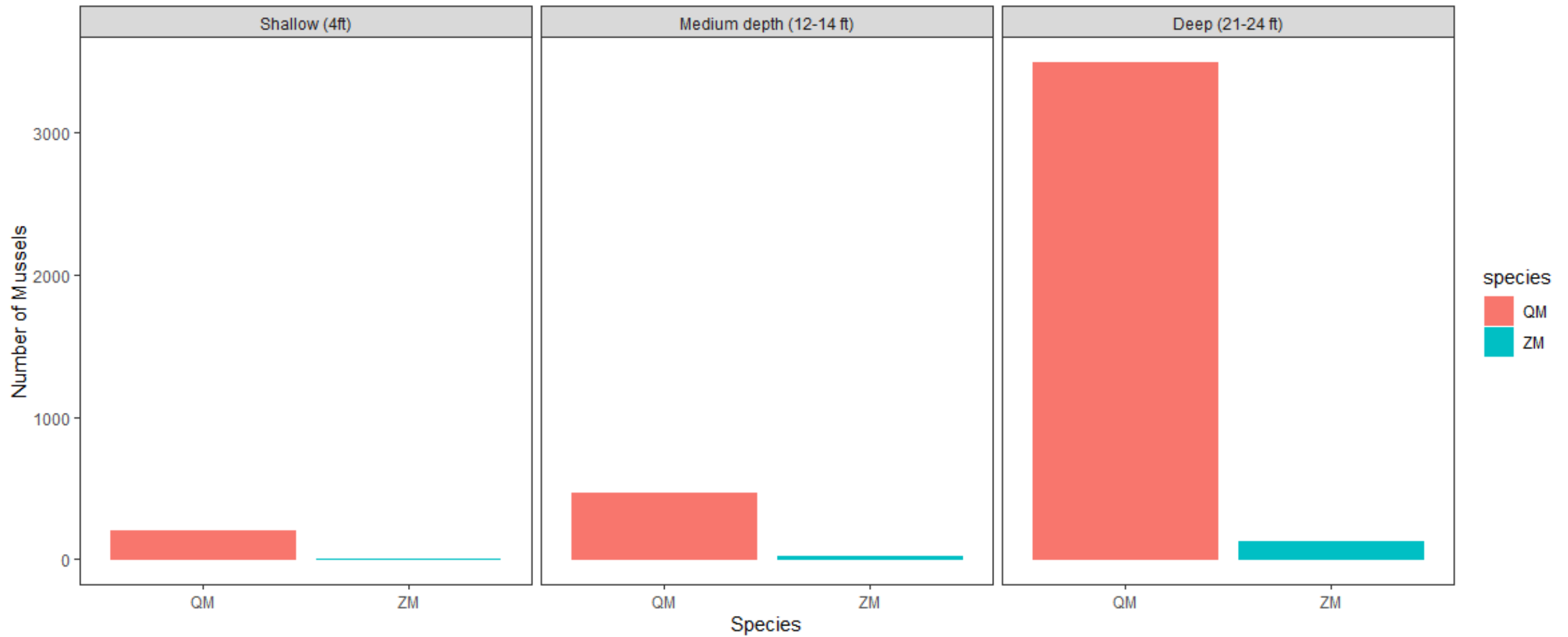


Quagga mussel (QM): 4161 individuals 96% of total

Zebra mussel (ZM): 160 individuals 4% of total

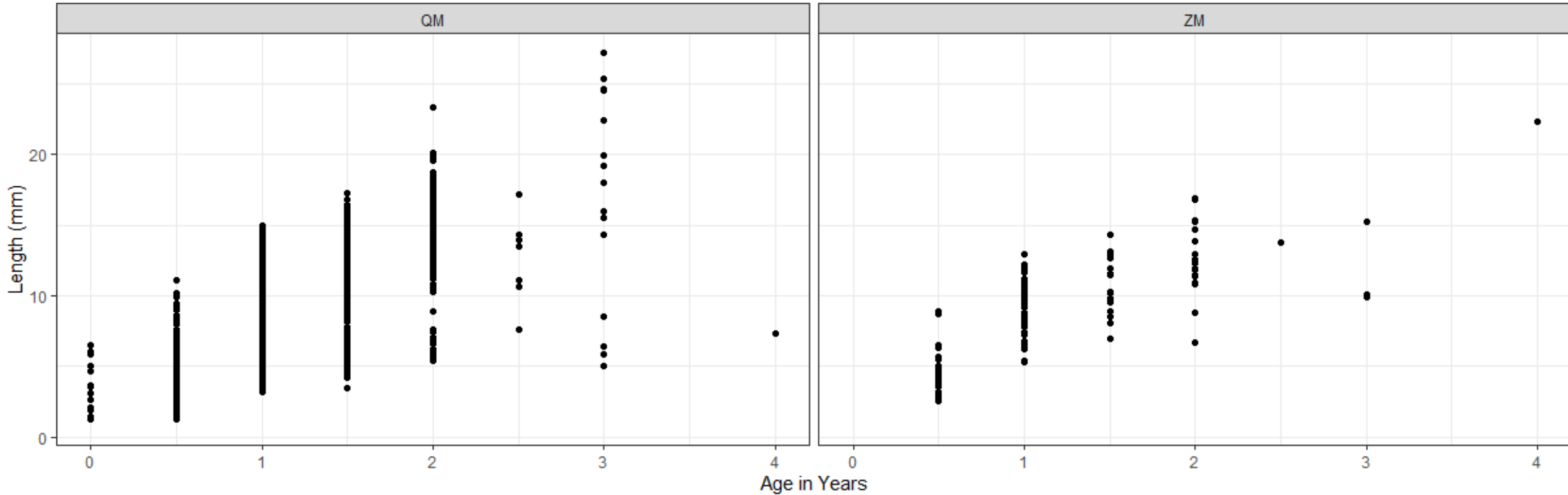
Median:	Mean:
QM: ~6.1	QM: ~ 5.8
ZM: ~9.6	ZM: ~ 9.4

Results



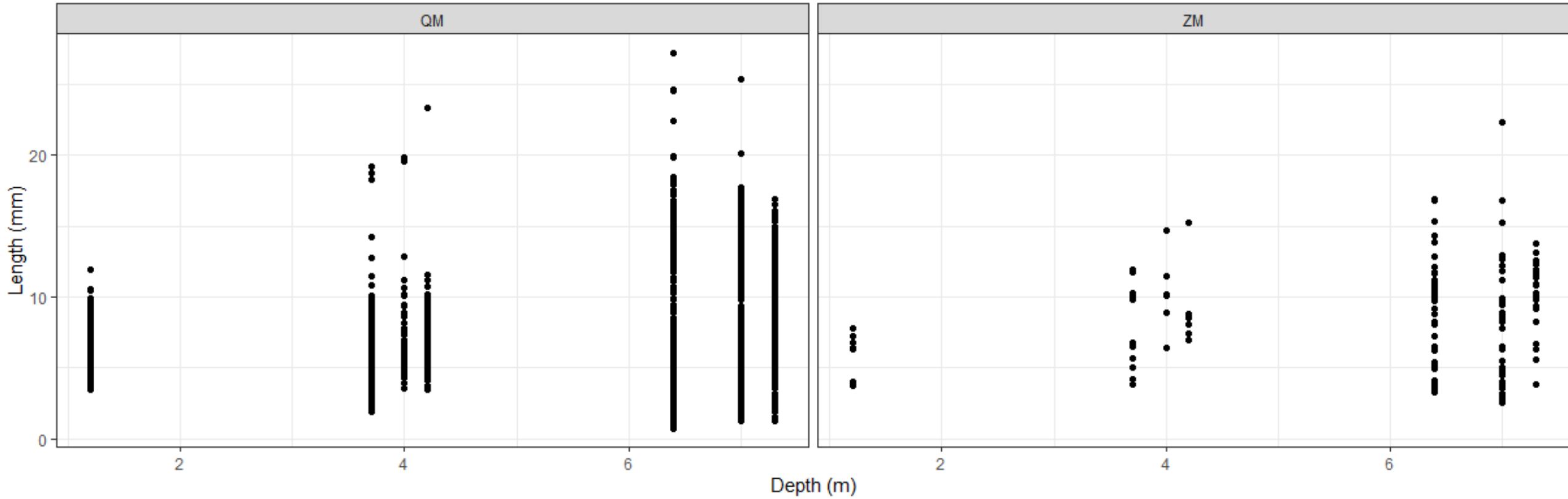
QM: Quagga mussel
ZM: Zebra mussel

Abundance based on age and length



QM: Quagga mussel ZM: Zebra mussel

Abundance based on length and depth



Discussion

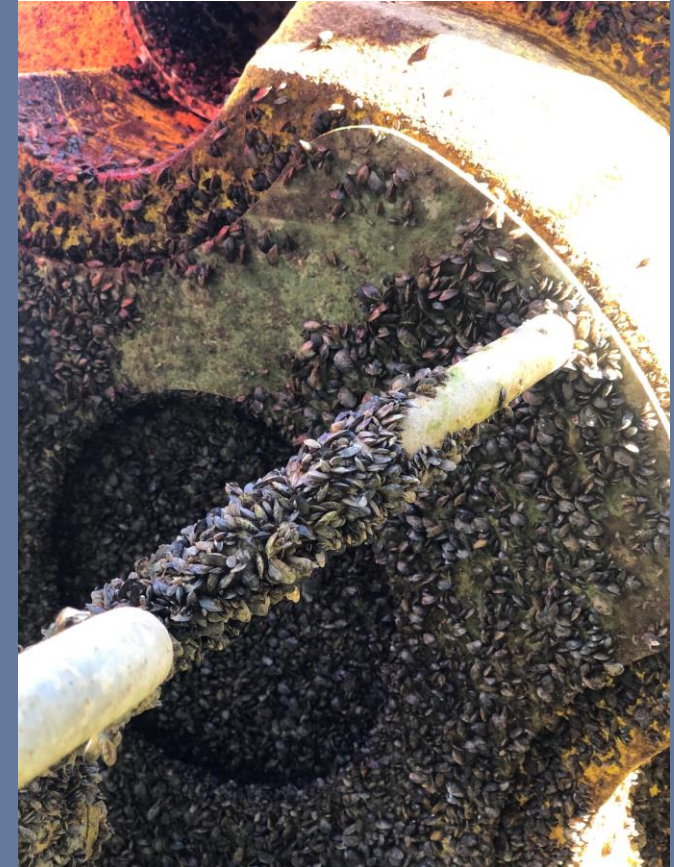
- Quagga outcompeting zebra in Otsego Lake, NY
 - Congruent with other studies (e.g., Matthews *et al.*, 2015)
 - Found at ~167 ft (51 m) where no zebra was ever found
 - Long-term competitive outcome?
- Emerging predator (e.g., round goby) may reduce quagga (Hetherington *et al.*, 2019)



https://www.invasivespeciescentre.ca/wp-content/uploads/2022/03/round-goby-mouth_Optimized.jpg



presentermedia.com



Quagga mussels on lake monitoring buoy

Quagga mussel established



**Altered P cycling
(Vanni 2021)**



Clearer water



**Potential increase in aq.
vegetation, esp. invasives**



**Decreased
property values**

**Clogged water
intake pipes**



**Village of Cooperstown water supply intake
pipe encrusted with quagga & zebra mussels**



Potential Impact

Excellent video on **YouTube** on this topic – search for “**mussel pains Great Lakes**”



Mussel Pains – Episode 1023

🕒 March 26, 2021 - by GLN Editor

Invasive mussels are hastening the deterioration of historic Great Lakes shipwrecks, like the submerged Prins Willem V off Milwaukee. Zebra...

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