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

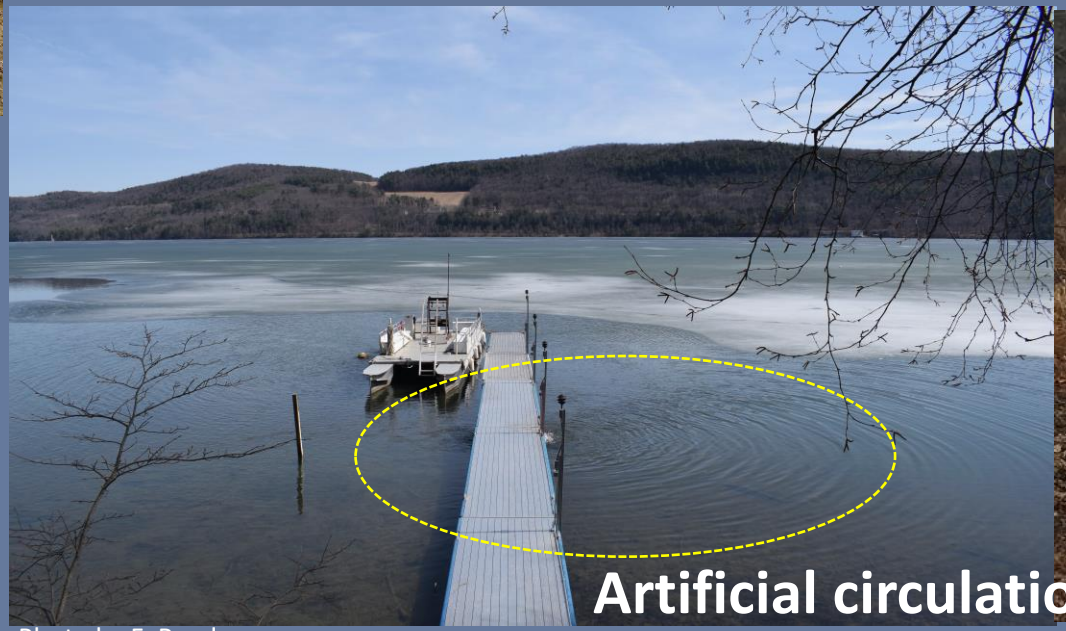
with extra work…

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

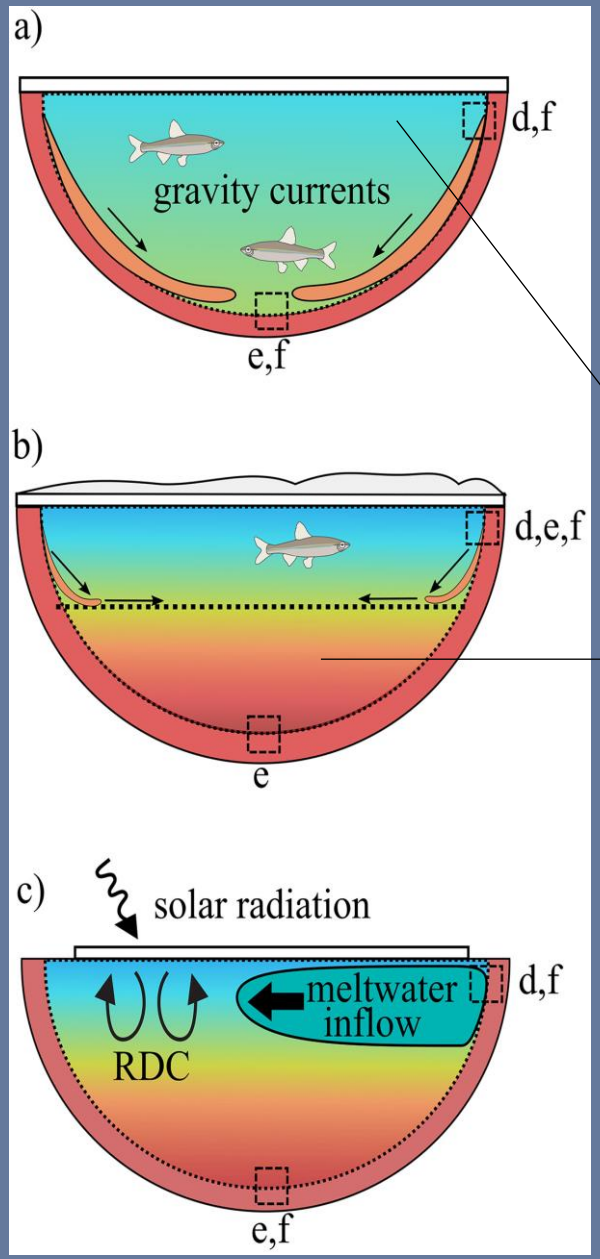
With thermostat: turns on when water temp drops below set point

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)

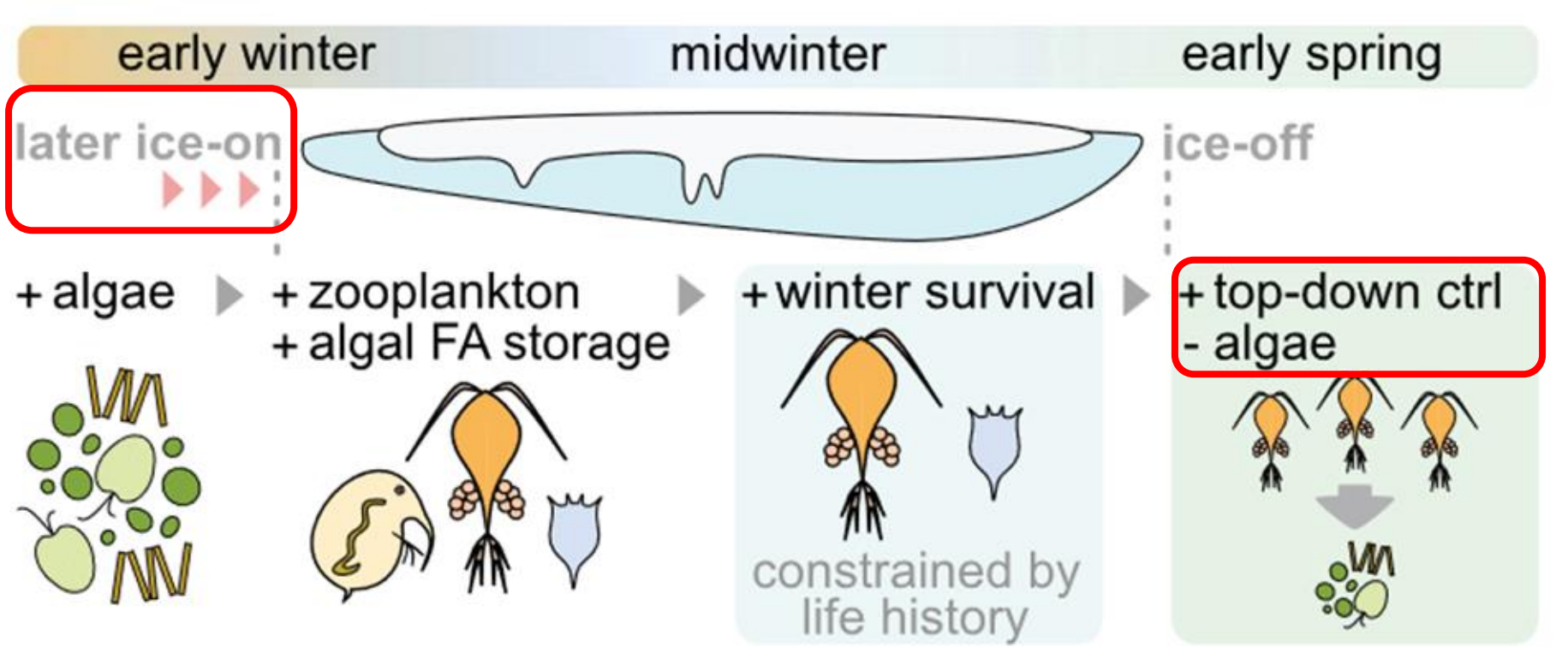


Fig. 5. Schematic summary of potential direct and indirect effects of later ice-cover onset on lake planktonic food webs, from early winter to spring.

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

What happens under the ice? (2)

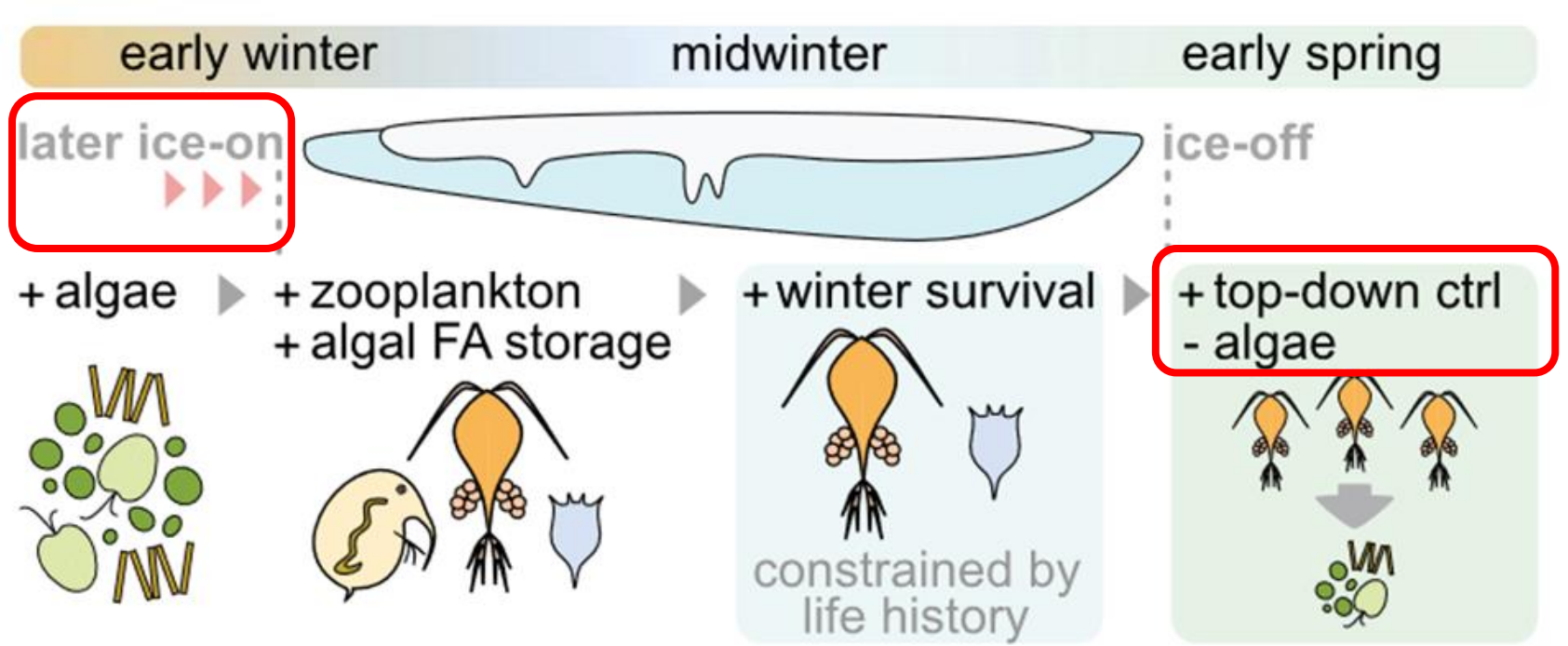


Fig. 5. Schematic summary of potential direct and indirect effects of later ice-cover onset on lake planktonic food webs, from early winter to spring.

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

Warmer winters

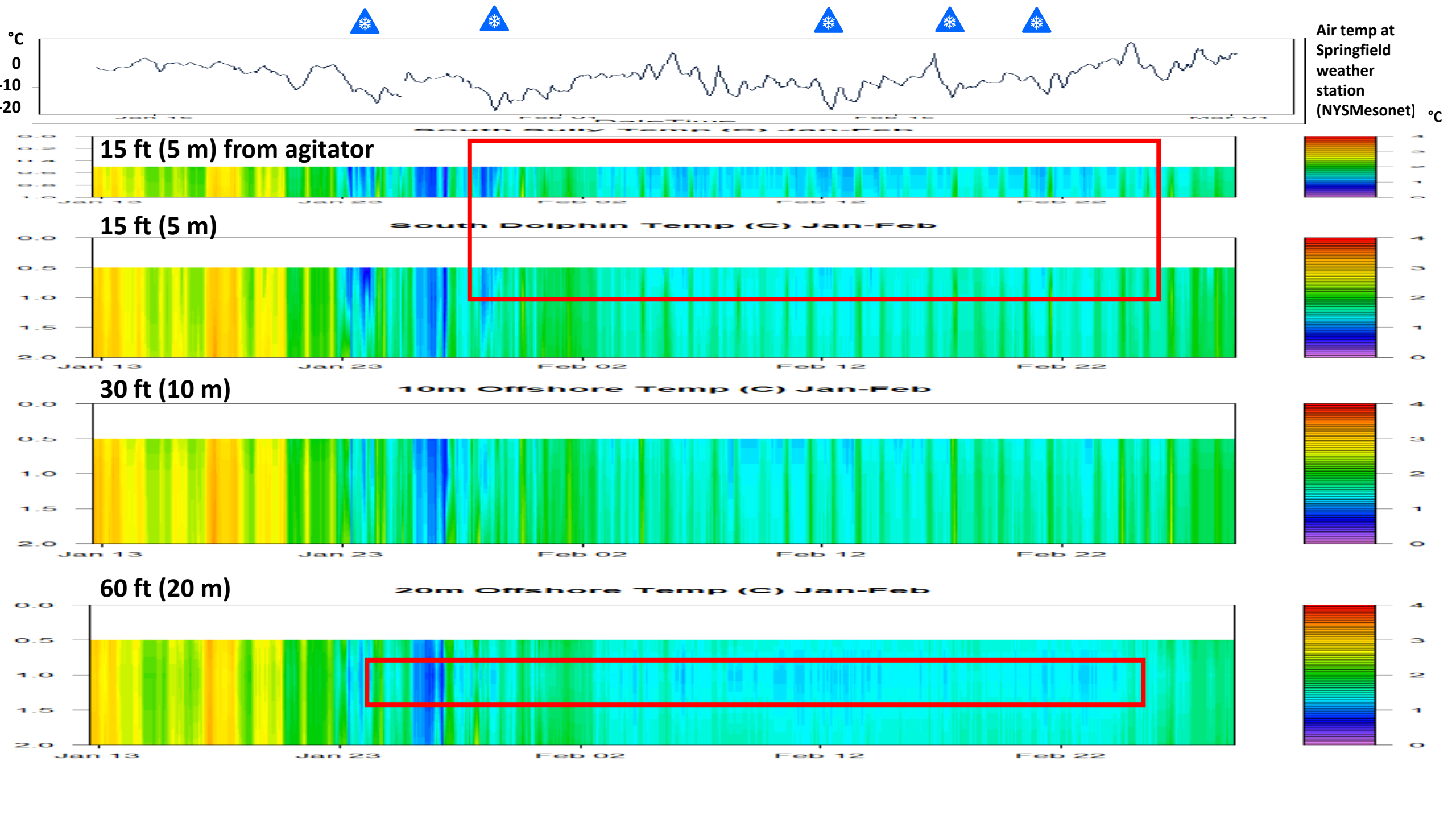
↓

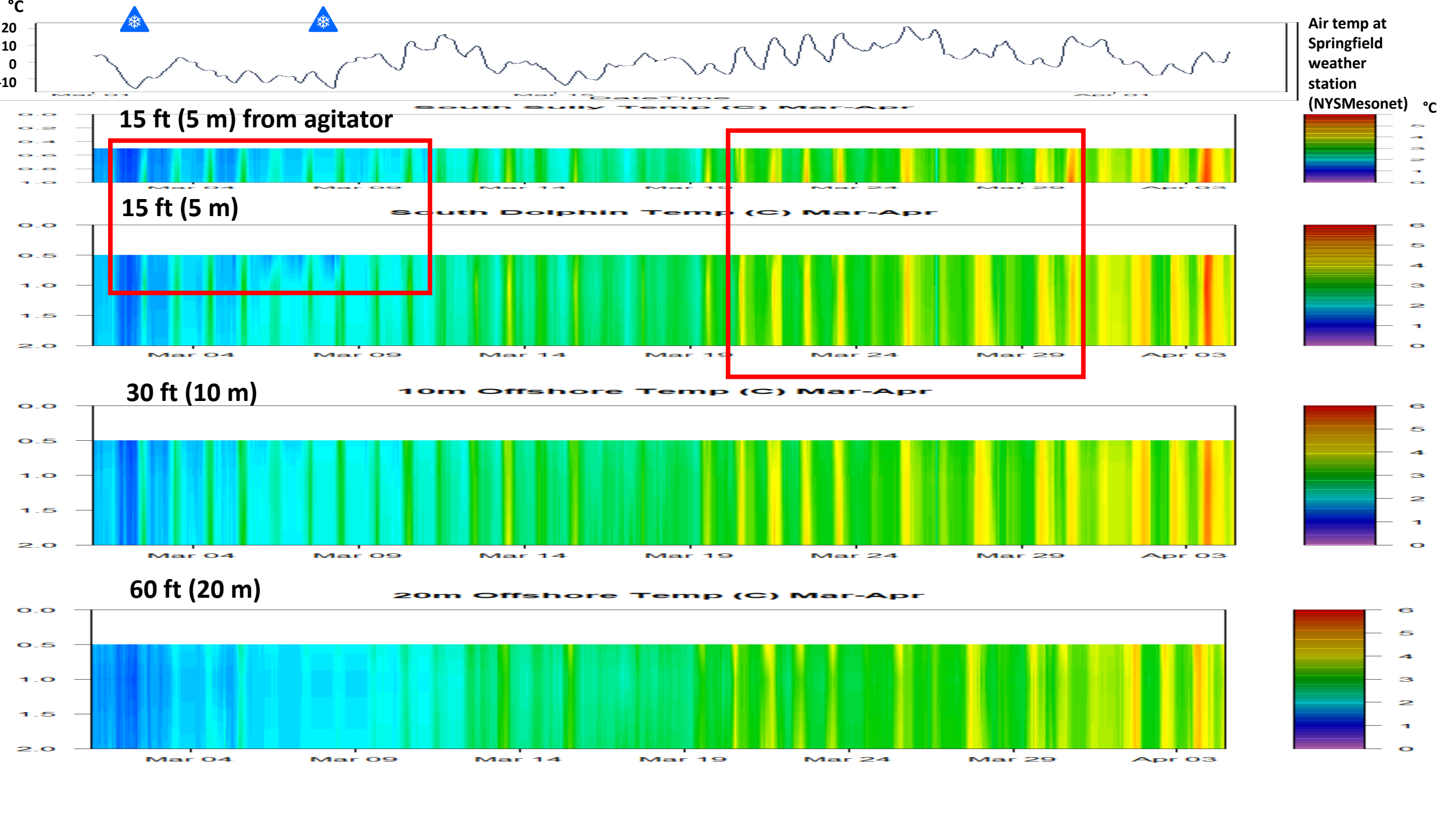
Earlier spring runoff

↓

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

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


°C
0
-10
-20
Air temp at Springfield weather station (NYSMesonet)
°C
15 ft (5 m) from agitator
15 ft (5 m)
South Dolphin Temp (C) Jan-Feb
30 ft (10 m)
10m Offshore Temp (C) Jan-Feb
60 ft (20 m)
20m Offshore Temp (C) Jan-Feb
0.0
0.5
1.0
1.5
2.0
Jan 13
Jan 23
Feb 02
Feb 12
Feb 22
4
3
2
1
0


°C
20
10
0
-10
Air temp at Springfield weather station (NYSMesonet)
°C
15 ft (5 m) from agitator
15 ft (5 m)
South Dolphin Temp (C) Mar-Apr
30 ft (10 m)
10m Offshore Temp (C) Mar-Apr
60 ft (20 m)
20m Offshore Temp (C) Mar-Apr
Mar 04
Mar 09
Mar 14
Mar 19
Mar 24
Mar 29
Apr 03

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 organisms

  for food

  (Karatayev *et al*. 2014)
  - Phytoplankton

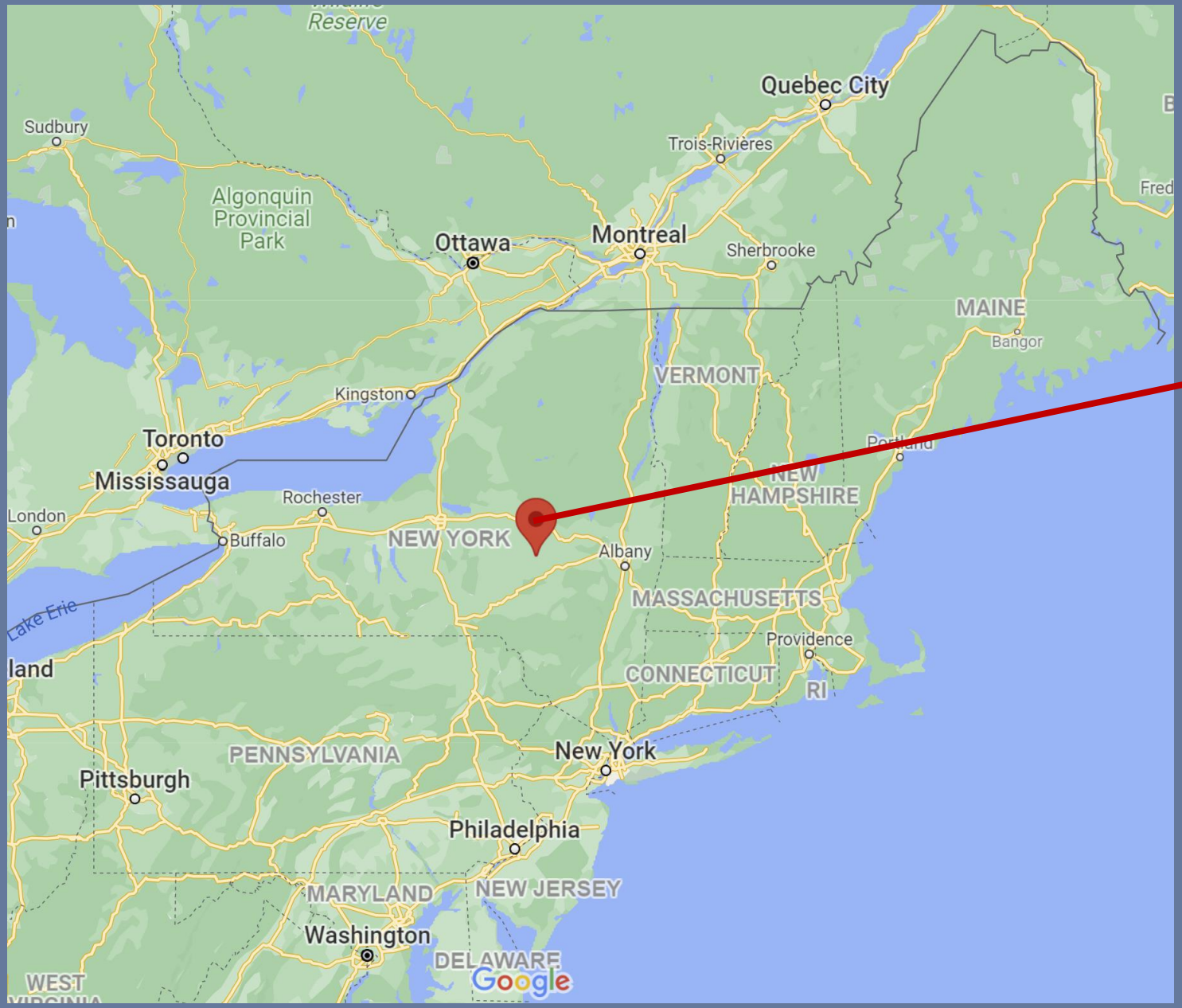
Two sampled zebra mussels.

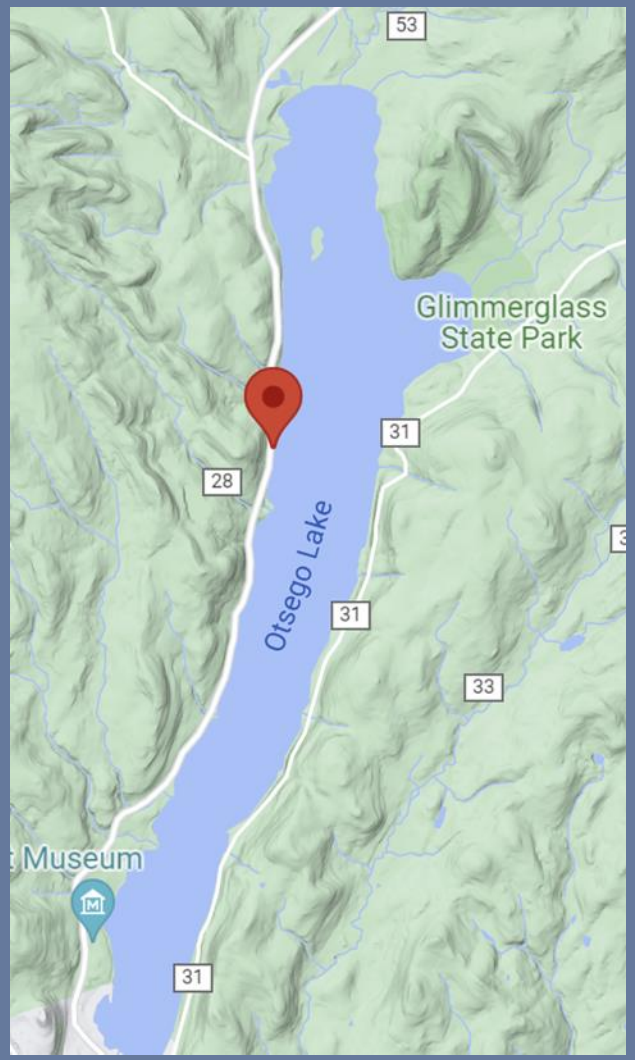
Two sampled quagga mussels – lighter shells.

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

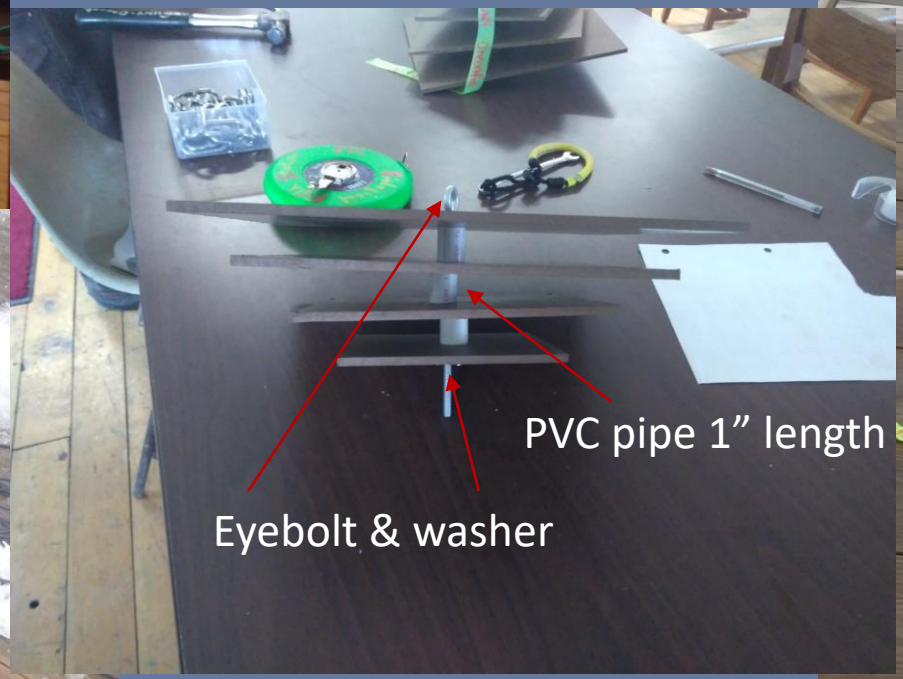




Google. (n.d.). [Google Maps of Otsego Lake, NY]. Retrieved October 28th, 2021

Methods

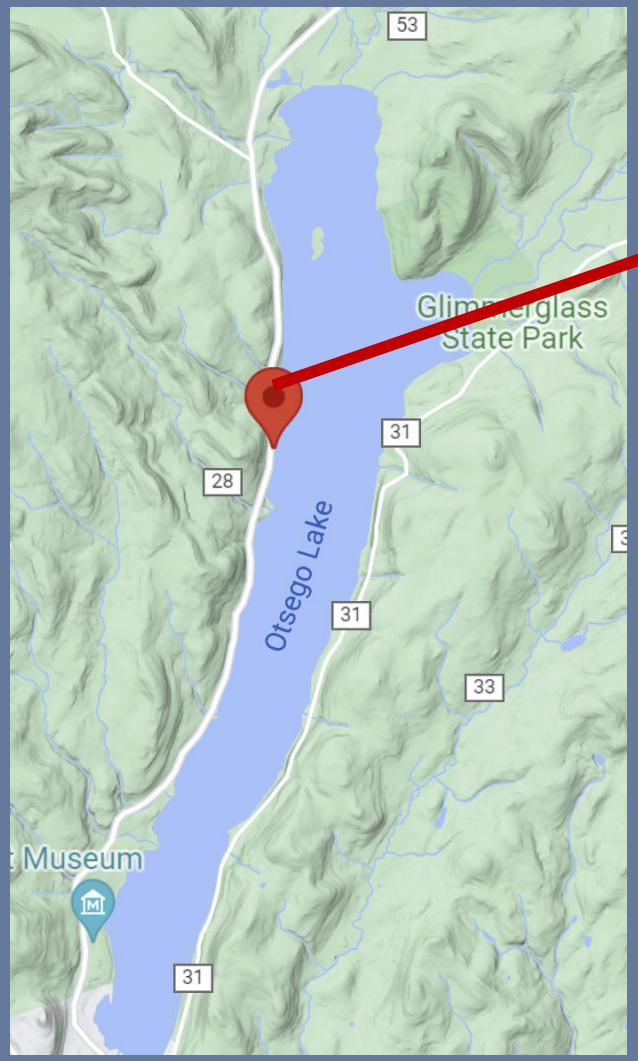
Assembled Masonite plates
12”x 12” (35.5 cm x 35.5 cm)

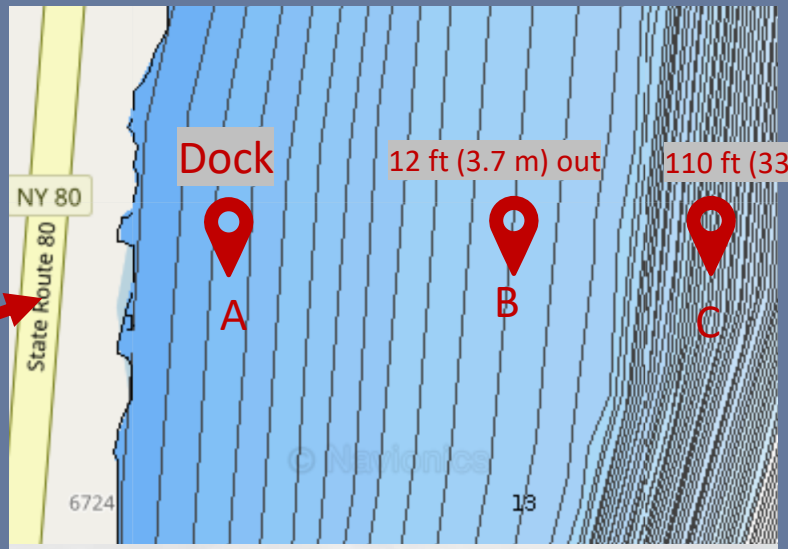


Attached ~20 ft
metal chain (~6m)

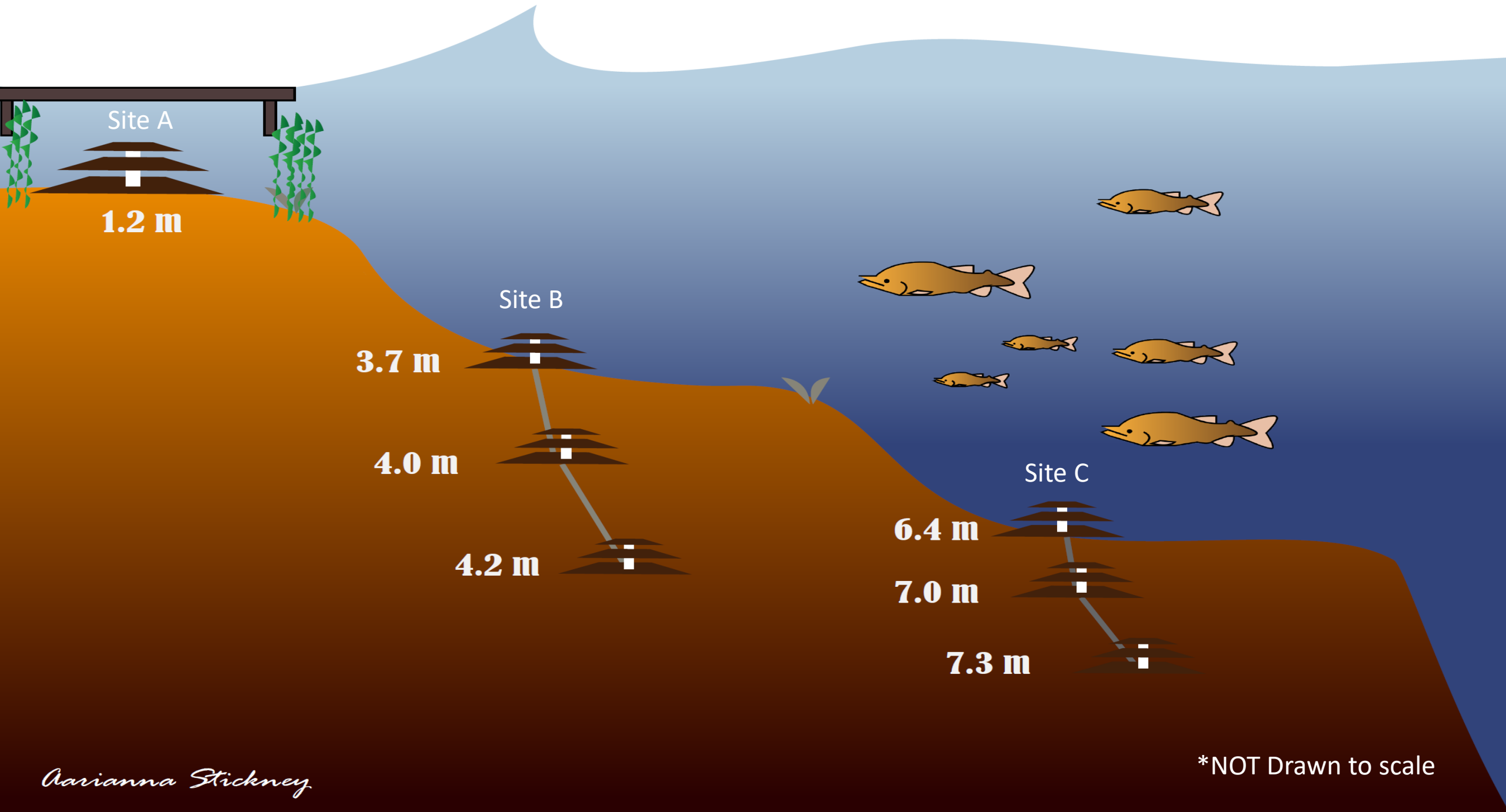
samplers 6.5 ft (~2 m) apart

Deployment



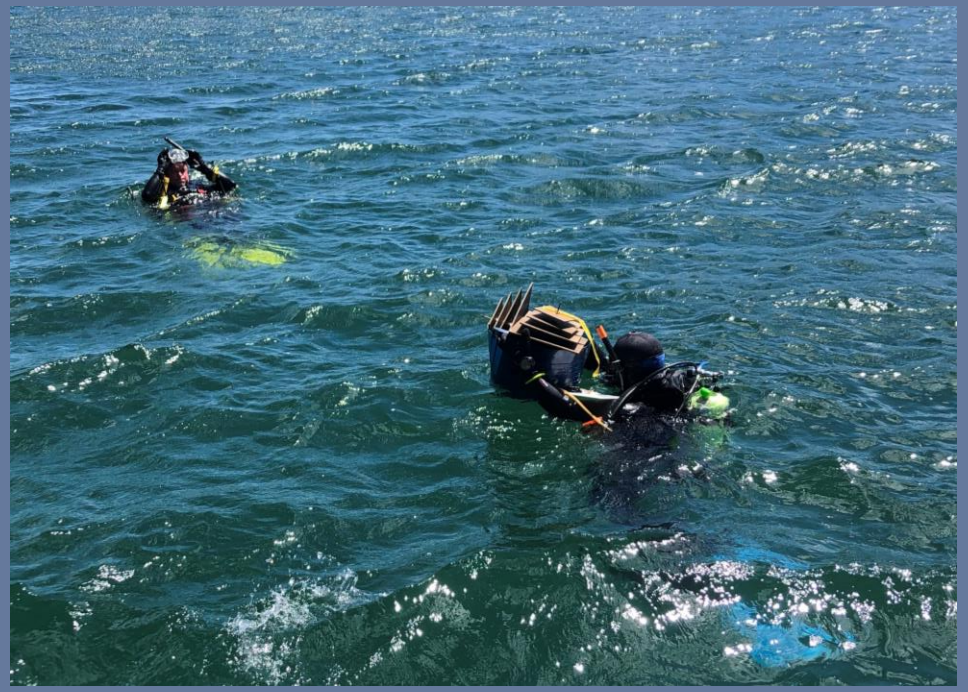


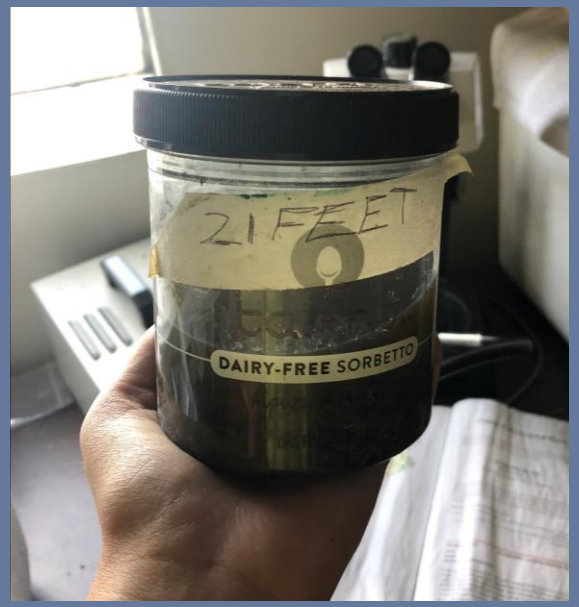
Dr. Yokota (left), Biology student Sierra Stickney (Right), and Ice dive volunteer, David Turner.
Picture by: Peter Regan


Site A
1.2 m
Site B
3.7 m
4.0 m
4.2 m
Site C
6.4 m
7.0 m
7.3 m
*NOT Drawn to scale
Aarianna Stickney

Retrieval

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





Assessing Mussels

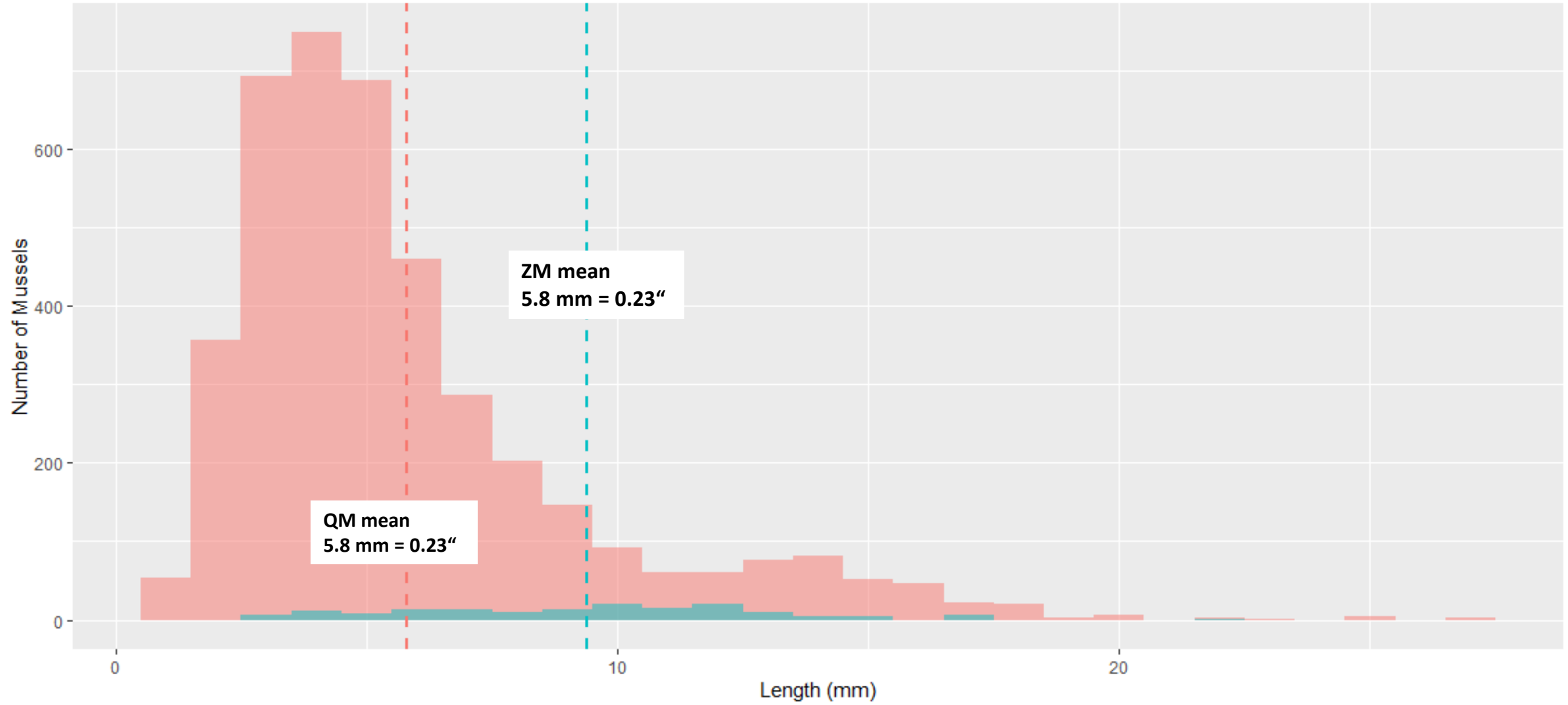
- Each mussel measured
  using digital calipers
- Length, age, & species recorded
  - age estimated
  using annual growth rings
- Microscope used
  for smaller mussels
- RStudio® used for graphs

Rylie Smith aging and identifying a mussel.

Quagga mussel under microscope

Digital caliper

Kari Minissale using Rstudio®

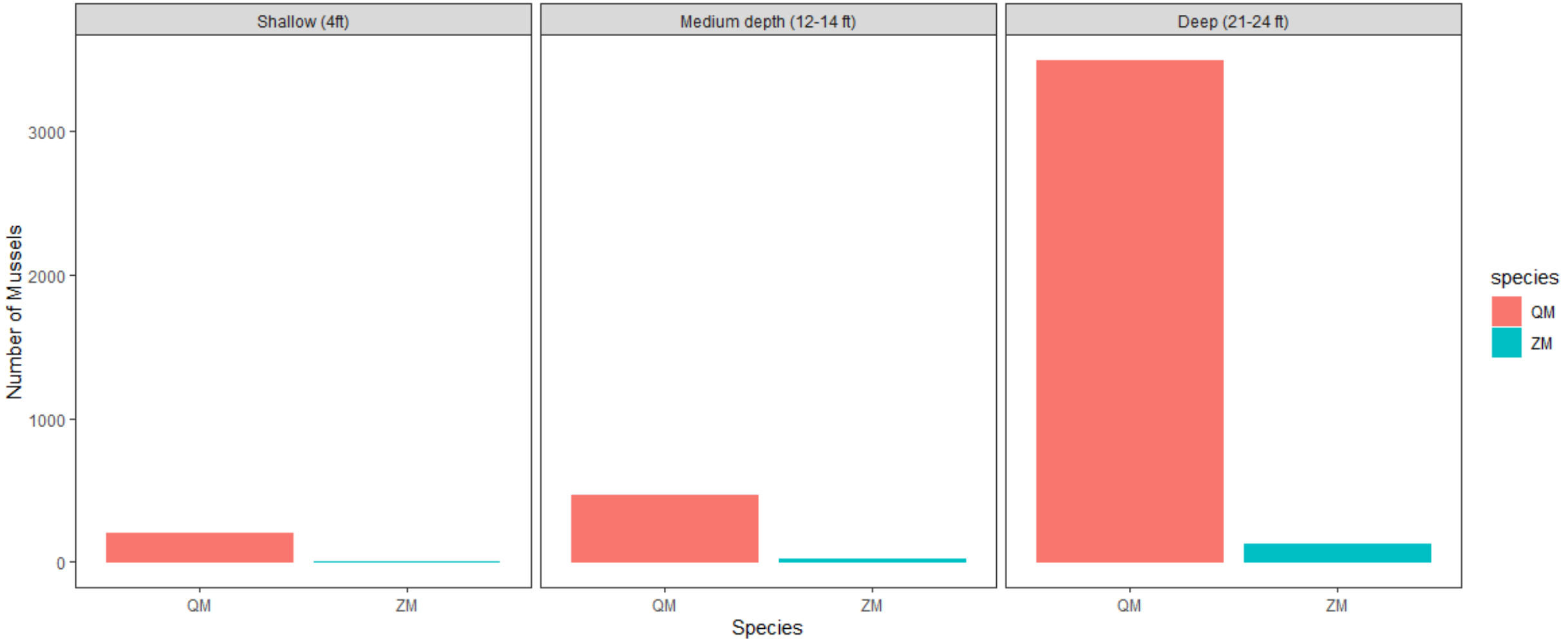


Quagga mussel (QM): 4161 individuals 96% of total

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

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

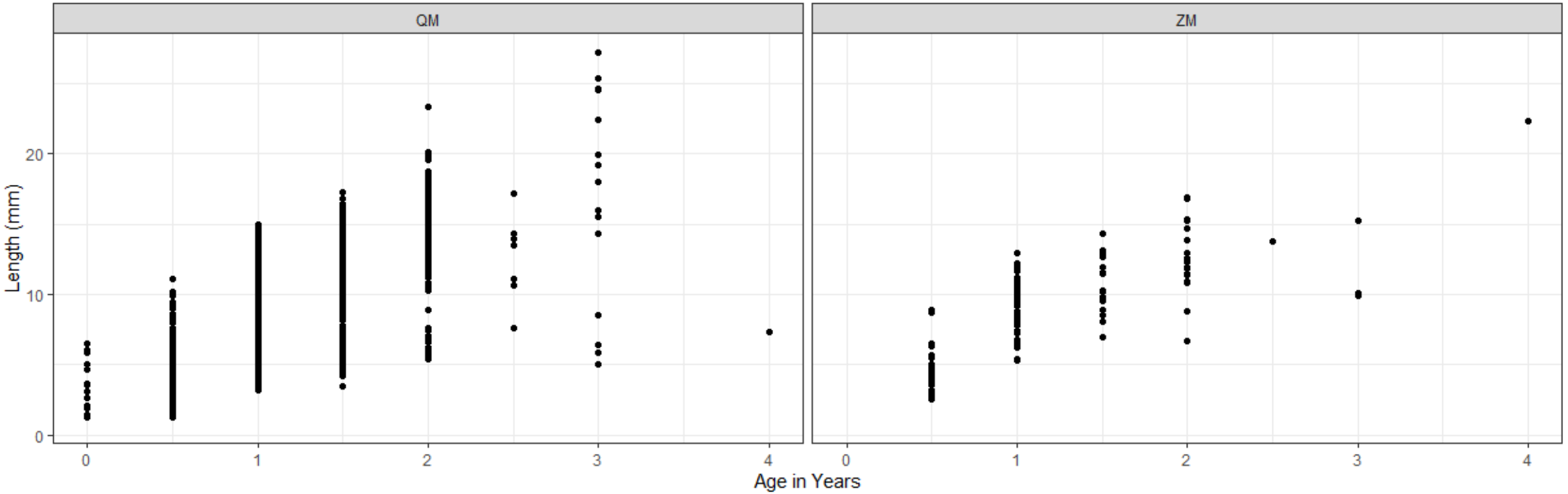
Results



QM: Quagga mussel

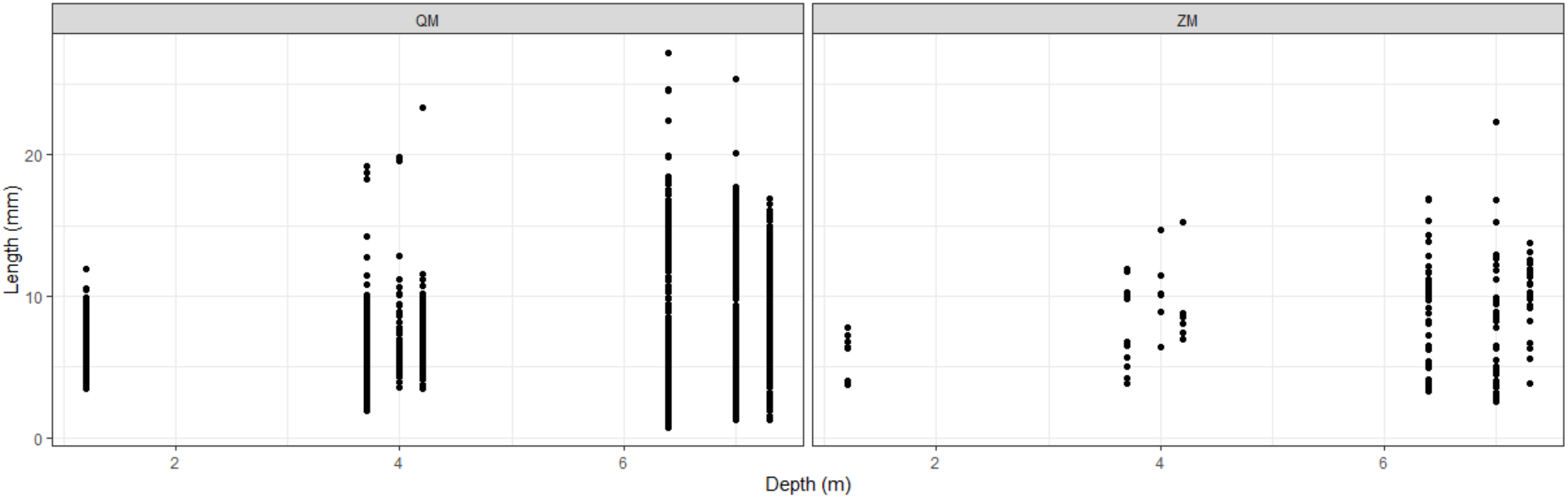
ZM: Zebra mussel

Abundance based on age and length



QM: Quagga mussel ZM: Zebra mussel

Abundance based on length and depth

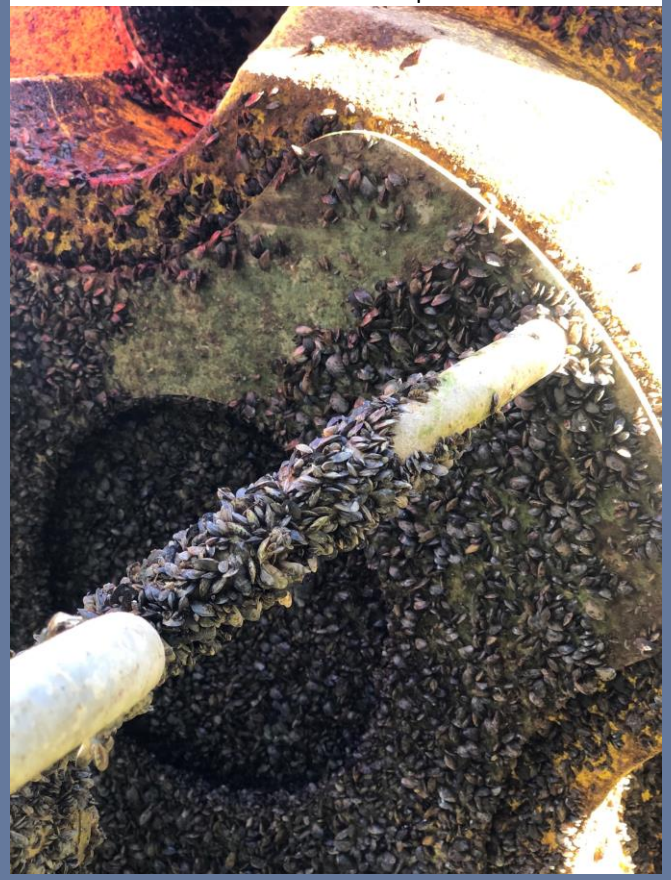


Discussion

- 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



Quagga mussels on lake monitoring buoy

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”**

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