Status and Spread of *Didymosphenia geminata* in Michigan

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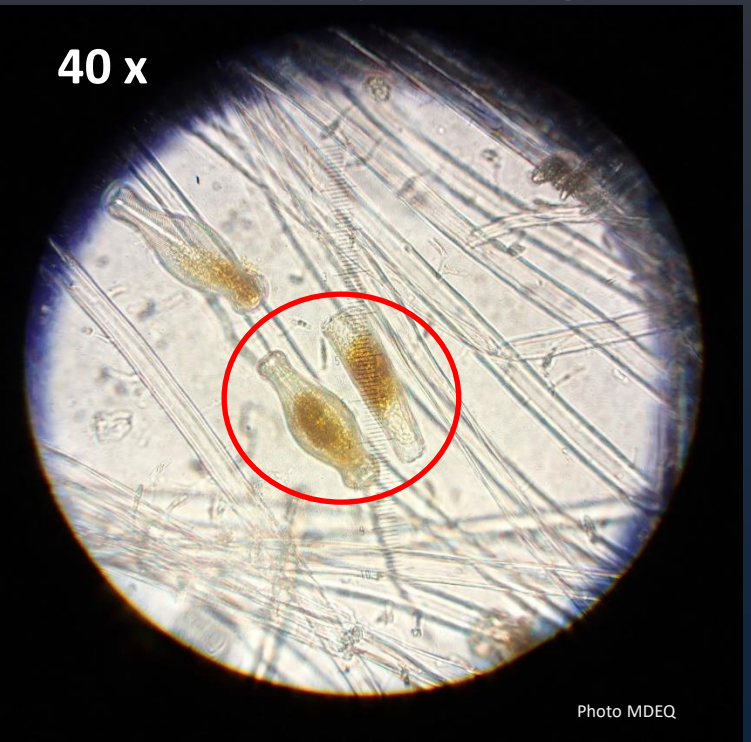
Didymosphenia geminata

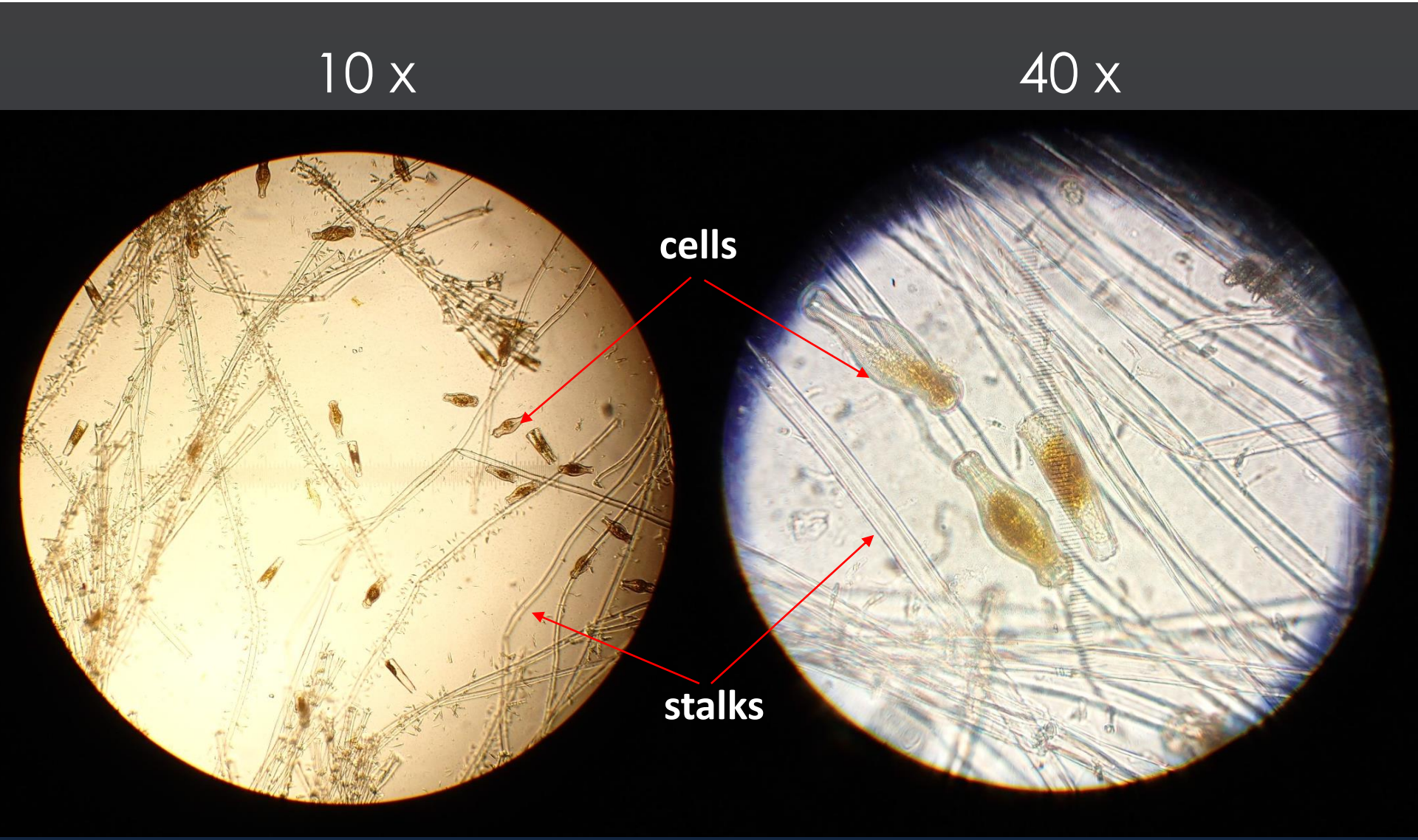
- Rock Snot or Didymo
- Diatom – Silica cell walls
- Grows in cold water & low nutrients
- Usually a single-cell, but can “bloom” – produce stalks



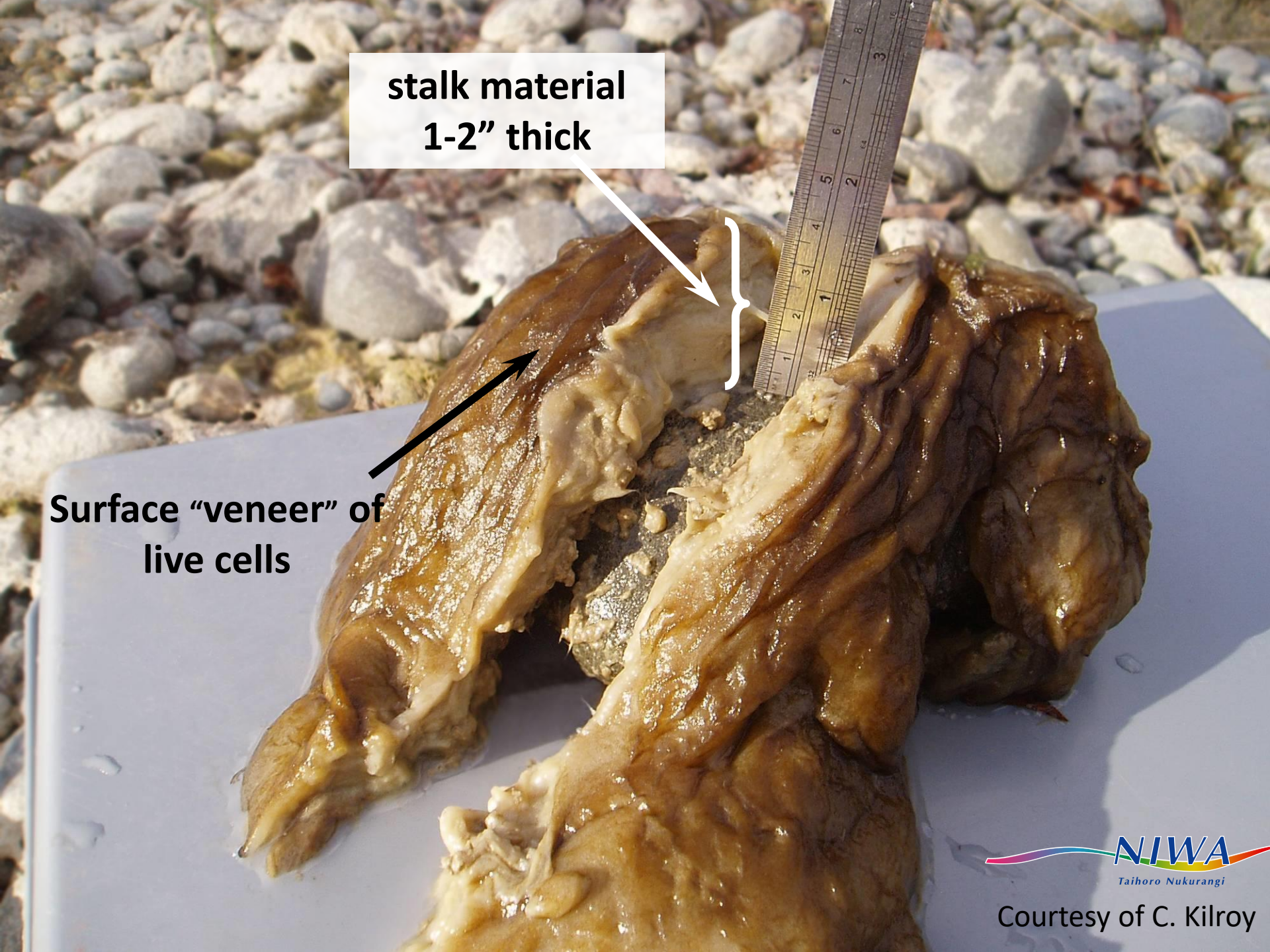
Didymo

- Stalks can create 2-3’ long mats
- Brown to white color
- Feels like wet wool

D. Geminata under the Scope



Photos by MDEQ

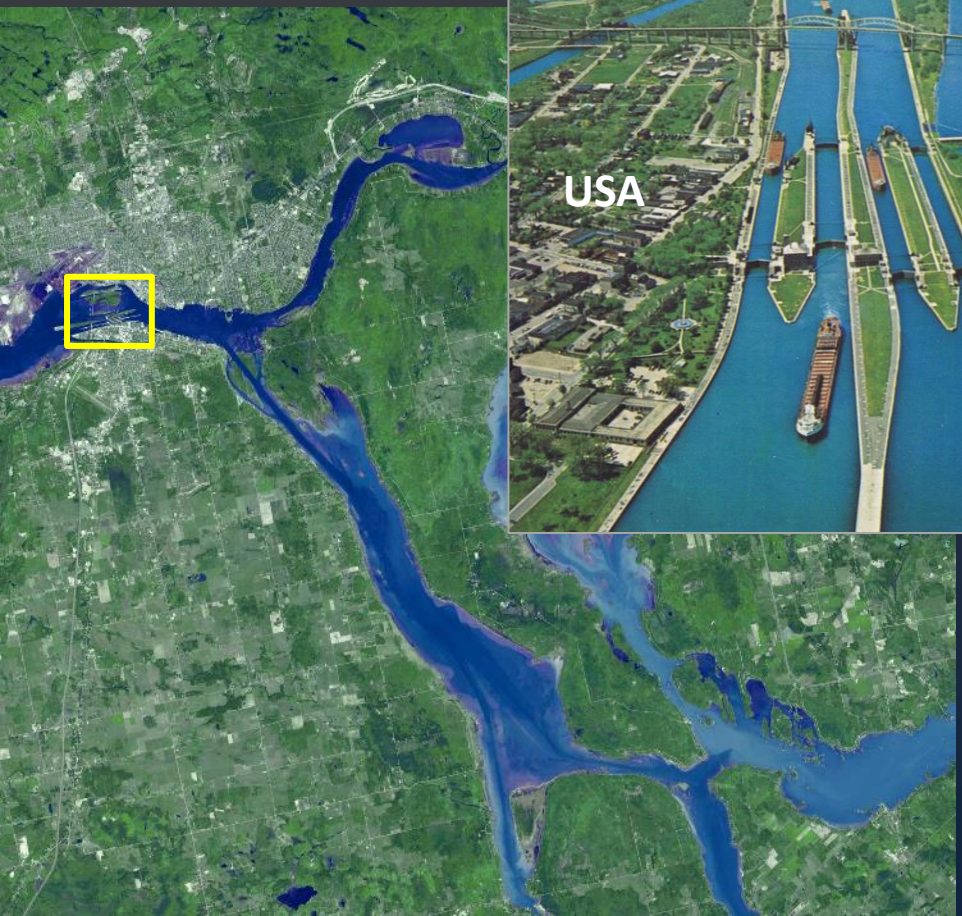

stalk material
1-2” thick
Surface “veneer” of
live cells
NIWA
Taihoro Nukurangi
Courtesy of C. Kilroy

Didymosphenia geminata in Michigan Waters

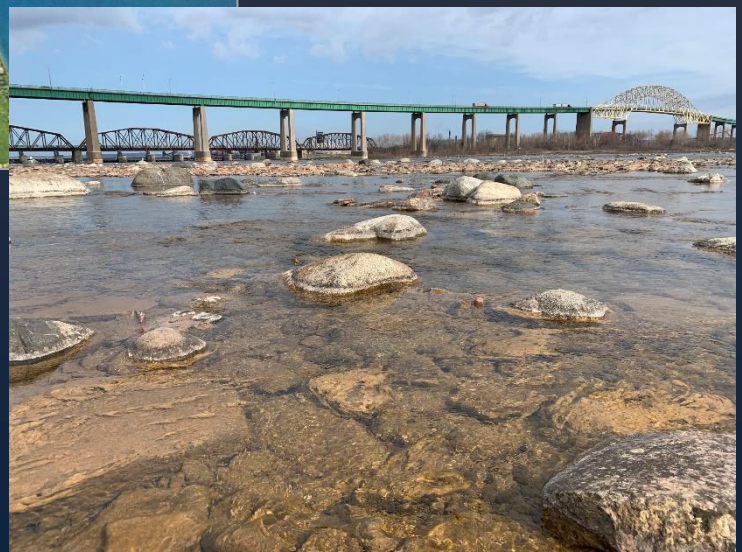
- First reported in St. Marys River in June 2015

Didymosphenia geminata in Michigan Waters

- Initial “bloom” site - Main Rapids



St. Marys River Rapids



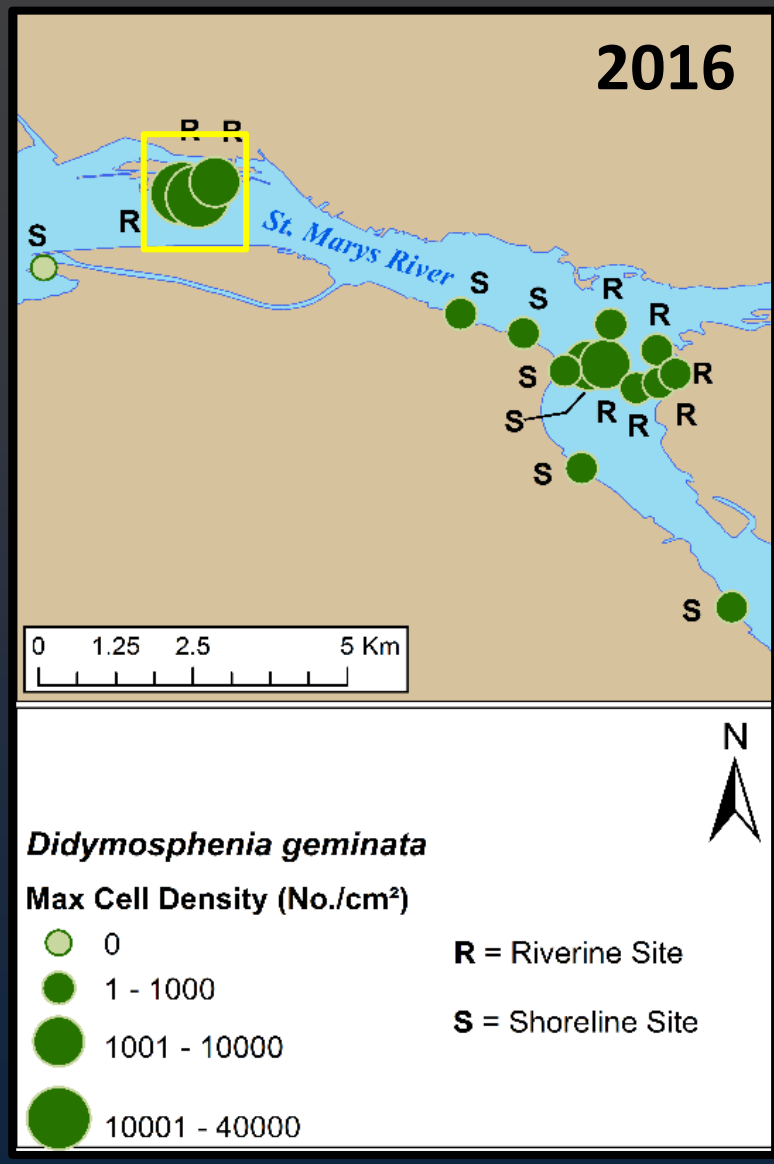
Didymo Mats

Photo Fisheries and Oceans Canada

Photo A. Earl

Rapid Spread to Critical Habitats

- Within 1 year, detected 30 km downstream
- High biomass at Little Rapids, recent restoration site



What Do We Know?

- Found throughout the world
- Confirmed in 20+ states
- “Blooms” considered a nuisance

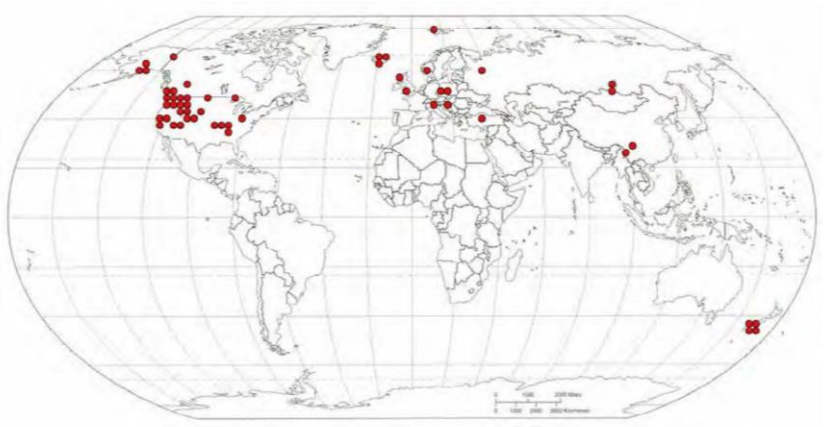
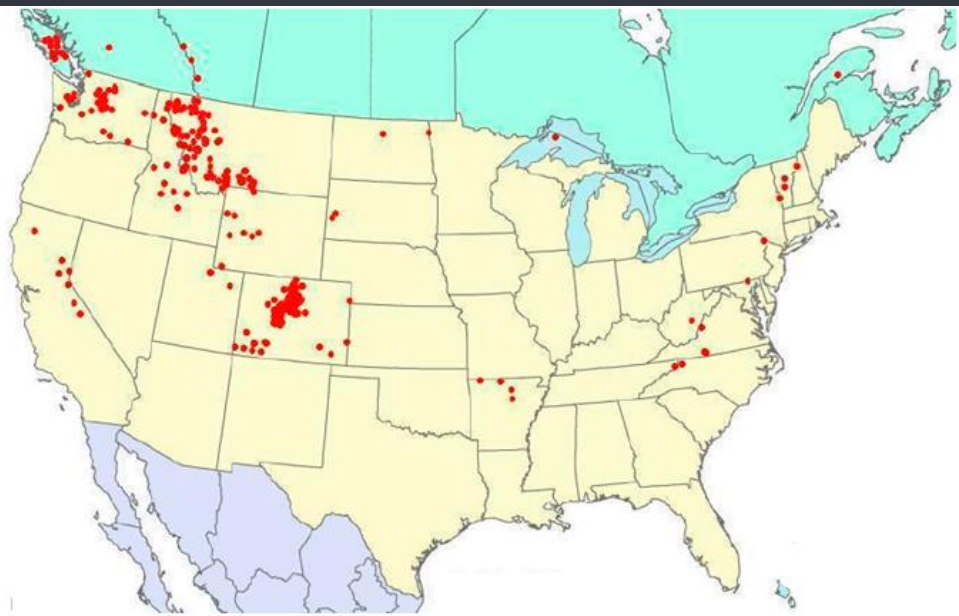
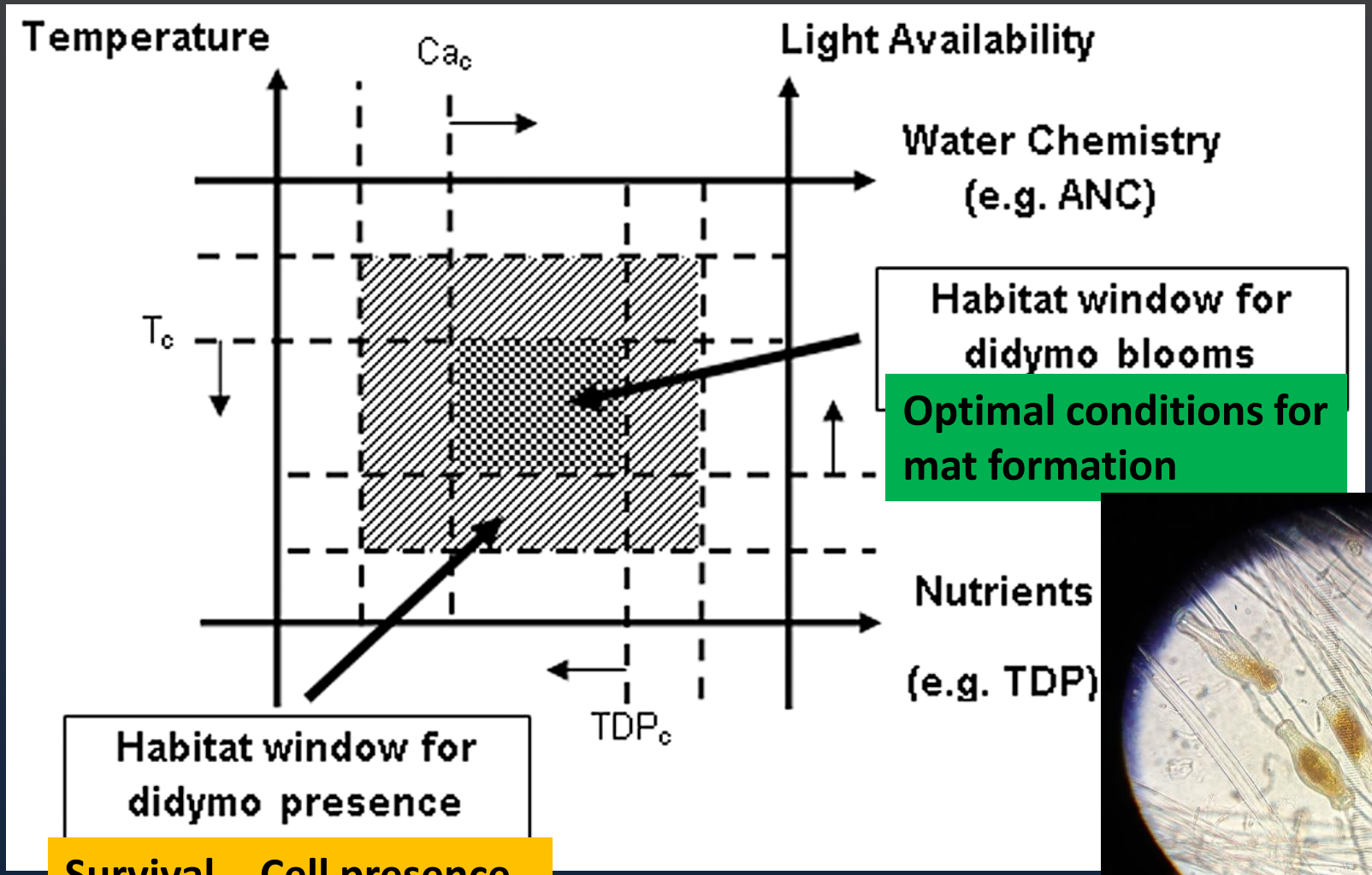
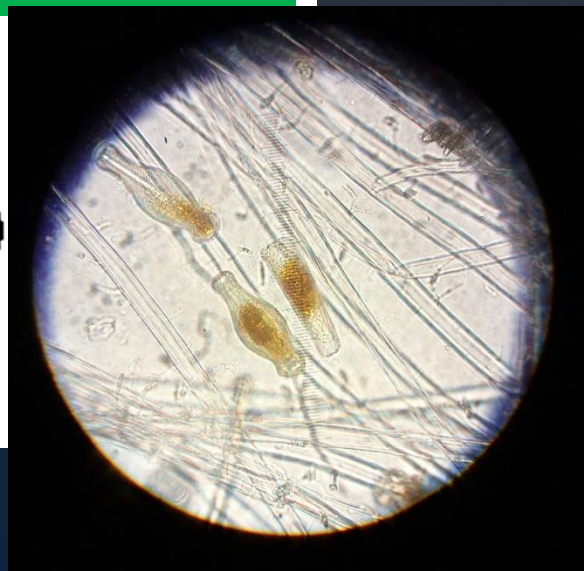


Figure 7. Confirmed presence and portion of published records of *D. geminata* from around the world. Dots do not represent number of reports, but show rough geographic area of populations. (Map by Sarah Spaulding, USGS.)



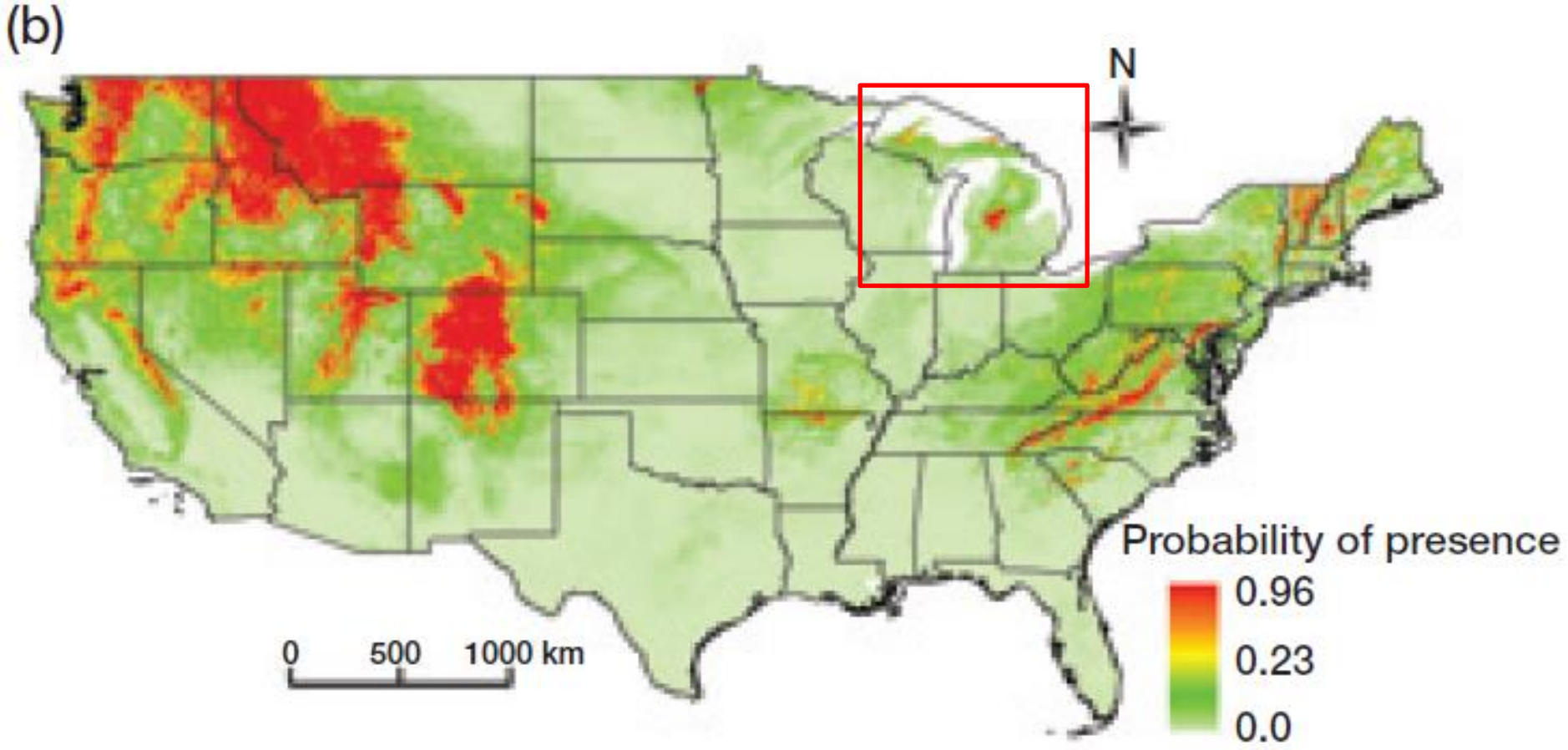
Factors Controlling Blooms





Cullis *et al.*, 2012

Predicted Habitat



Best fit model (Maxent) – red indicates high probability

Kumar et al. 2009

Potential Effects of Didymo

Photo Fisheries and Oceans Canada

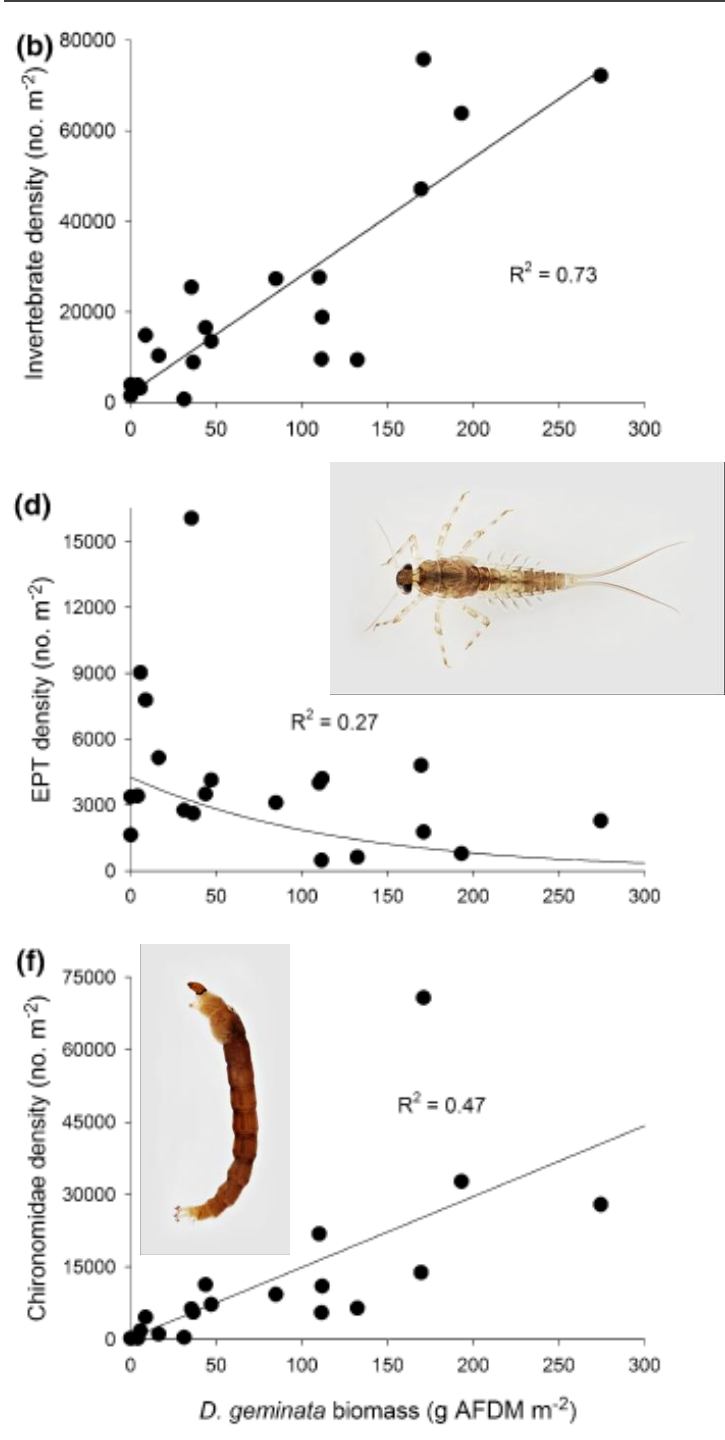
Photo: J. Giuliani

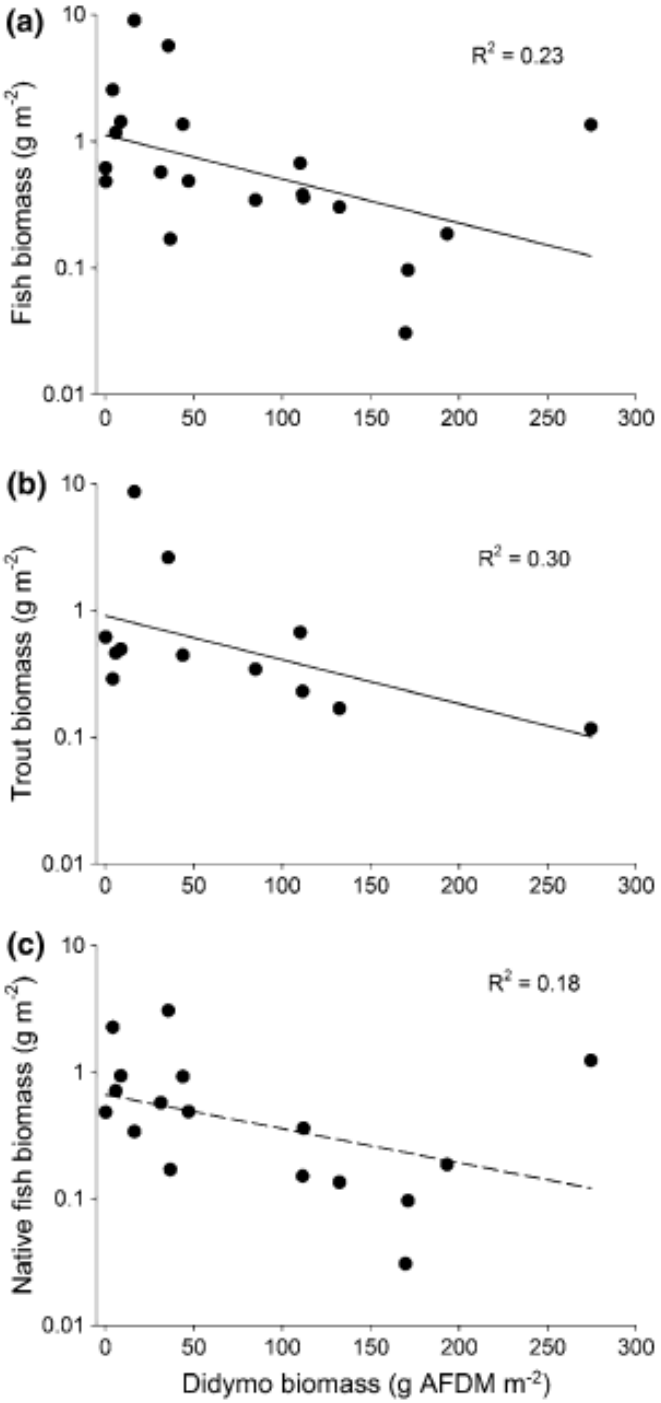
- Mat thickness 1-5”; slough
- Ecosystem engineer
- Potential effects on:
  - Aesthetics & recreation
  - benthic macroinvertebrates
  - drifting insects
  - Fish forage, spawning, and fry emergence

Ecosystem Impacts

- Altered macroinvertebrate composition and abundance
  - Reduced sensitive taxa (EPT)
  - Increased chironomids

James et al. 2010; South Dakota
Ladrera et al. 2018; Spain
Gillis and Chalfour 2010; Quebec
Clancy et al. 2021, Alaska





Ecosystem Impacts

- Impacts on fish less clear
  - Reductions in fish biomass in New Zealand streams
  - No effect on fish in western NA
- Potential deterioration of fish spawning habitat

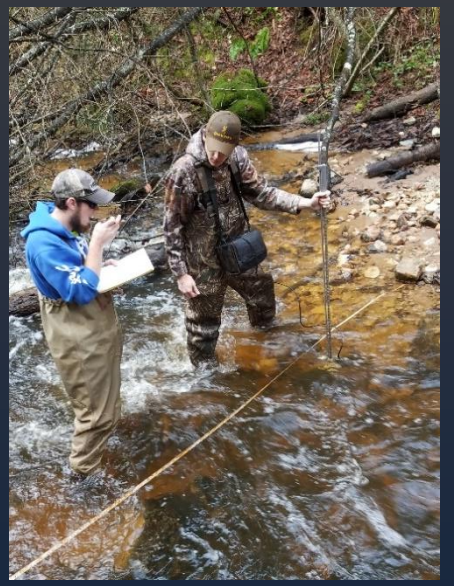
Jellyman and Harding 2016
Clancy et al. 2021

Ongoing Research

- Can we predict where Didymo could invade next?
  - 50 streams in the Upper Peninsula

Algal sampling
(scrapes and eDNA)

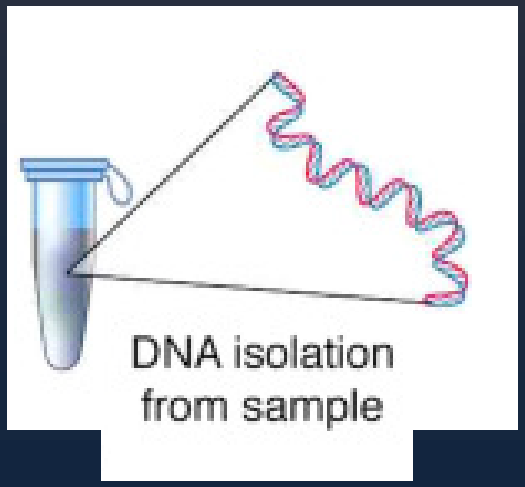
Water Chemistry

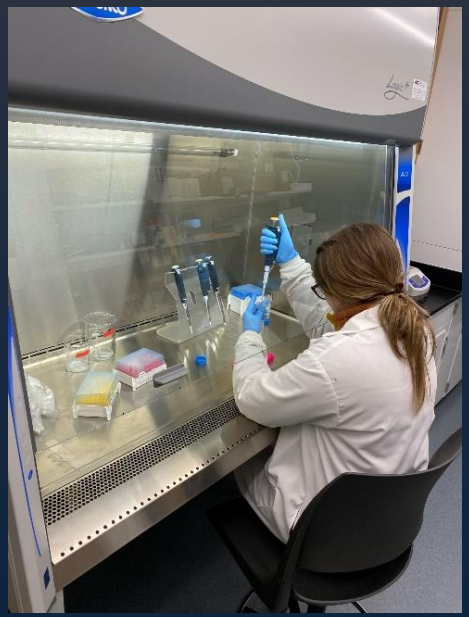


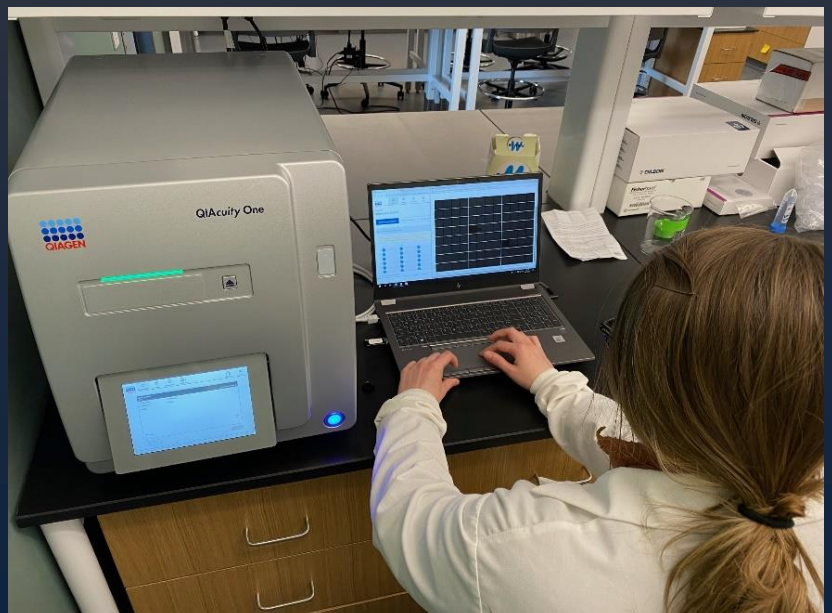
Habitat

A Novel Rapid Detection Tool

- Environmental DNA
- Digital PCR for analysis of DNA sequences specific for the *D. geminata* 18S rRNA gene sequence (modified from Cary et al. 2014)

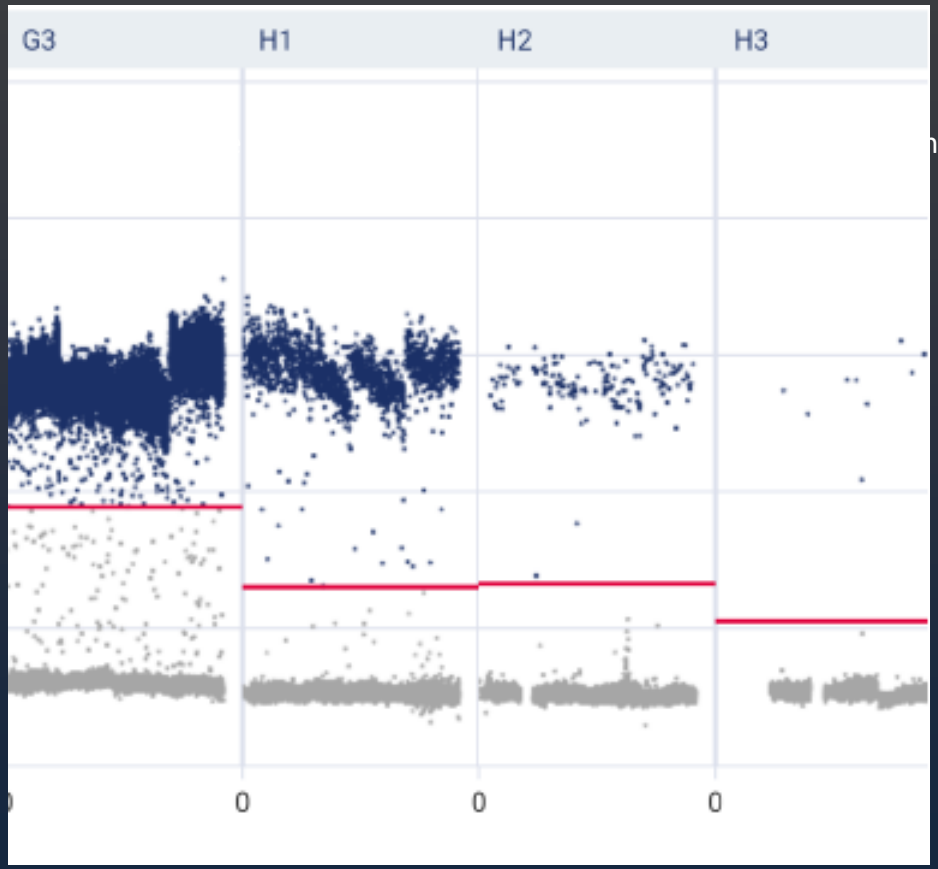






Success!

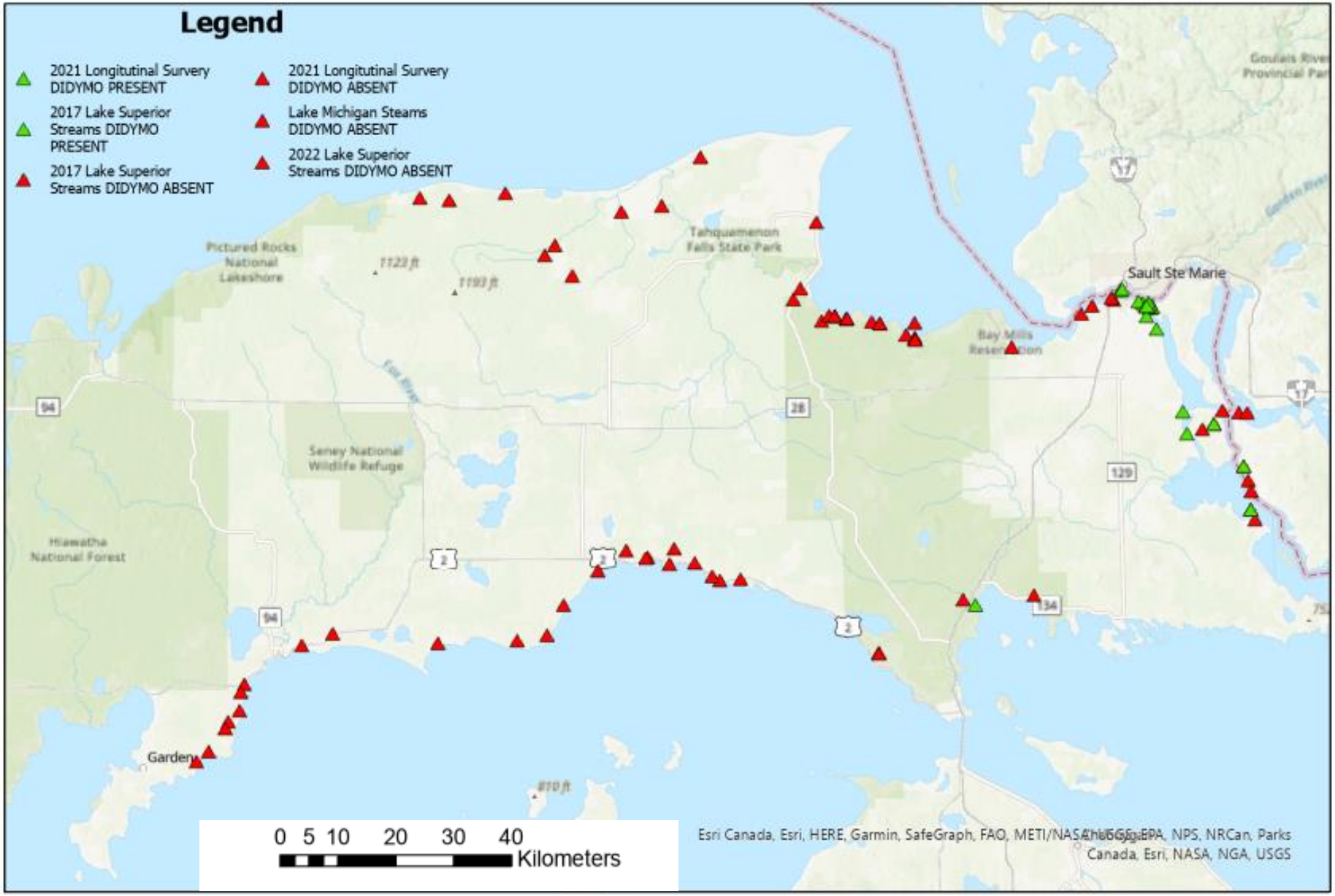
- Absolute quantification of target DNA in copies/ul, including confidence intervals



	Concentration copies/µL	CI (95%)	Partitions valid	positive	negative
G3	1130.1	1.3%	25356	15334	10022
H1	87.69	4.6%	24880	1729	23151
H2	8.719	15.5%	22562	161	22401
H3	0.678	68.7%	16159	9	16150

D. geminata positive eDNA sample collected from Main Rapids, St. Marys River, MI (5/10/22)

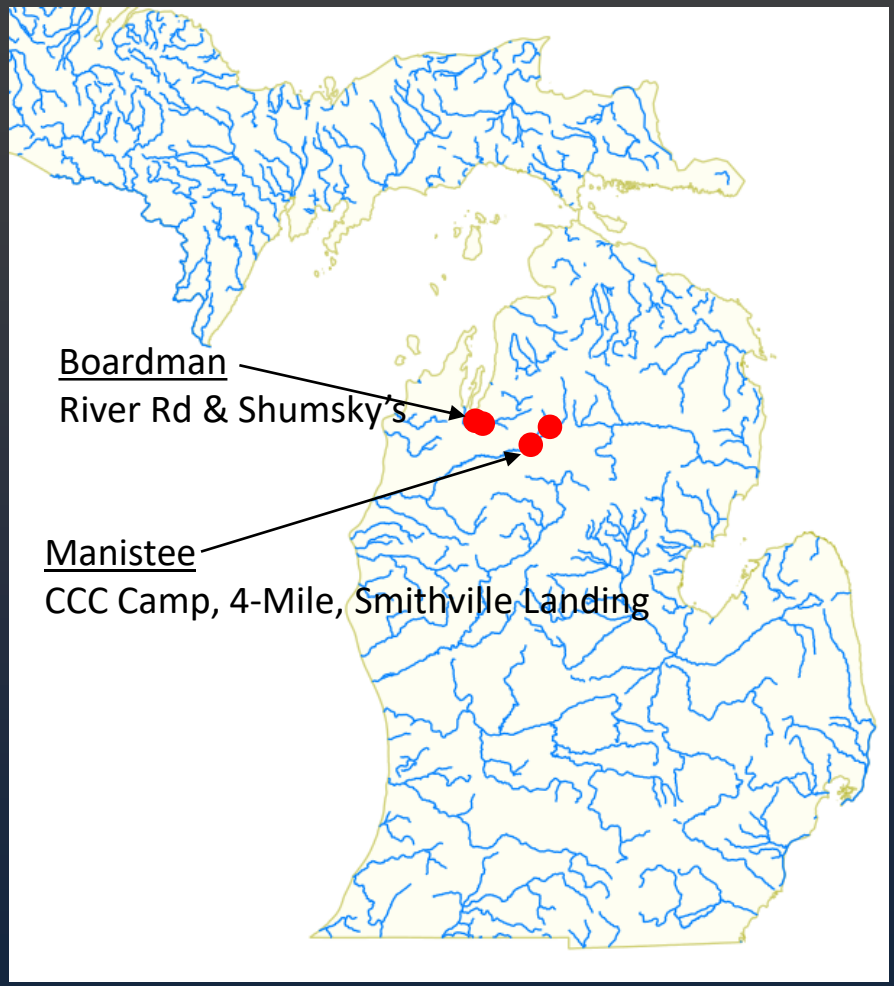
Geographic Extent of Didymo in UP



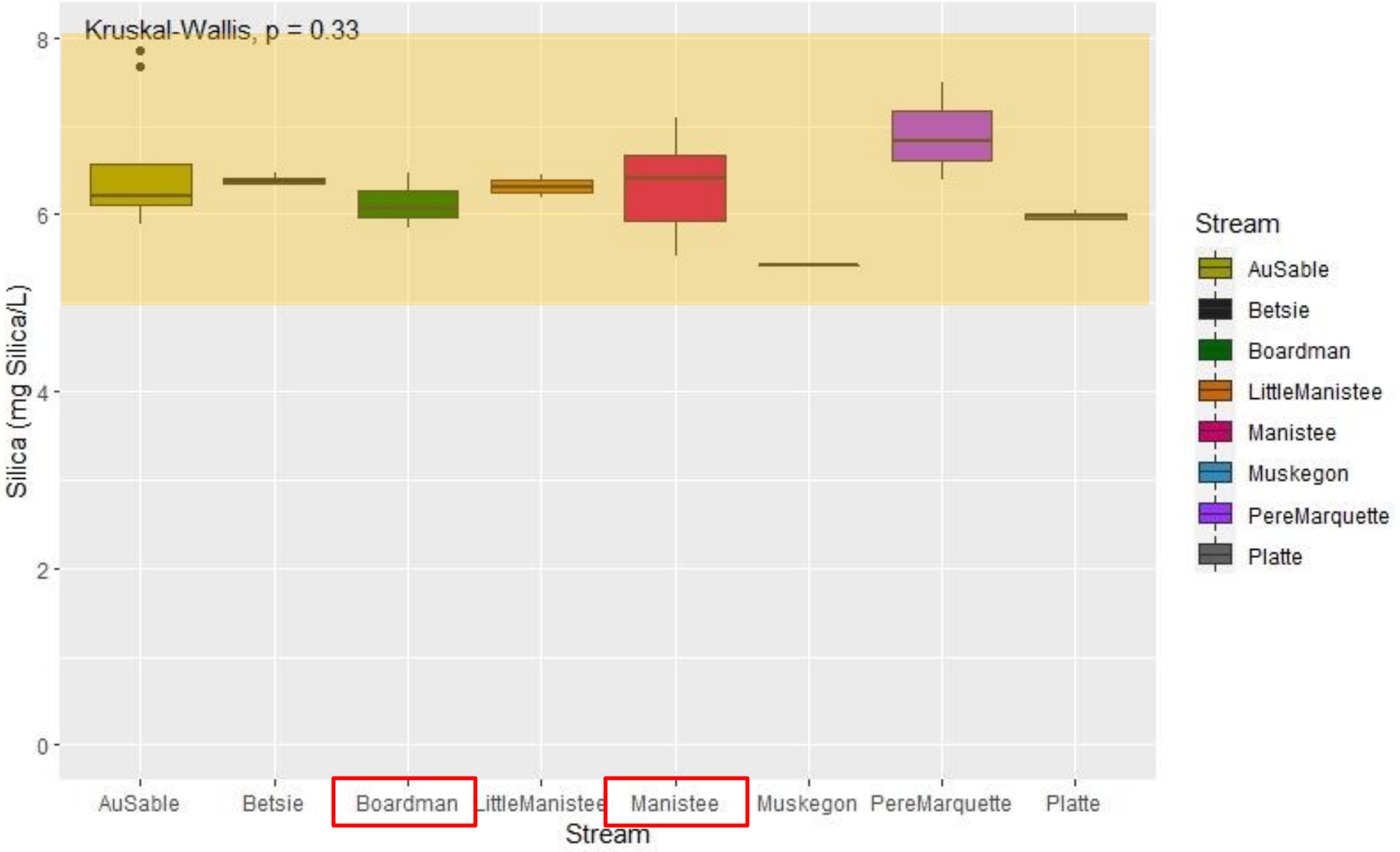
Didymosphenia geminata in northern lower Michigan waters

- 2021 –Upper Manistee River
- 2022 – Boardman River
- Potential to spread

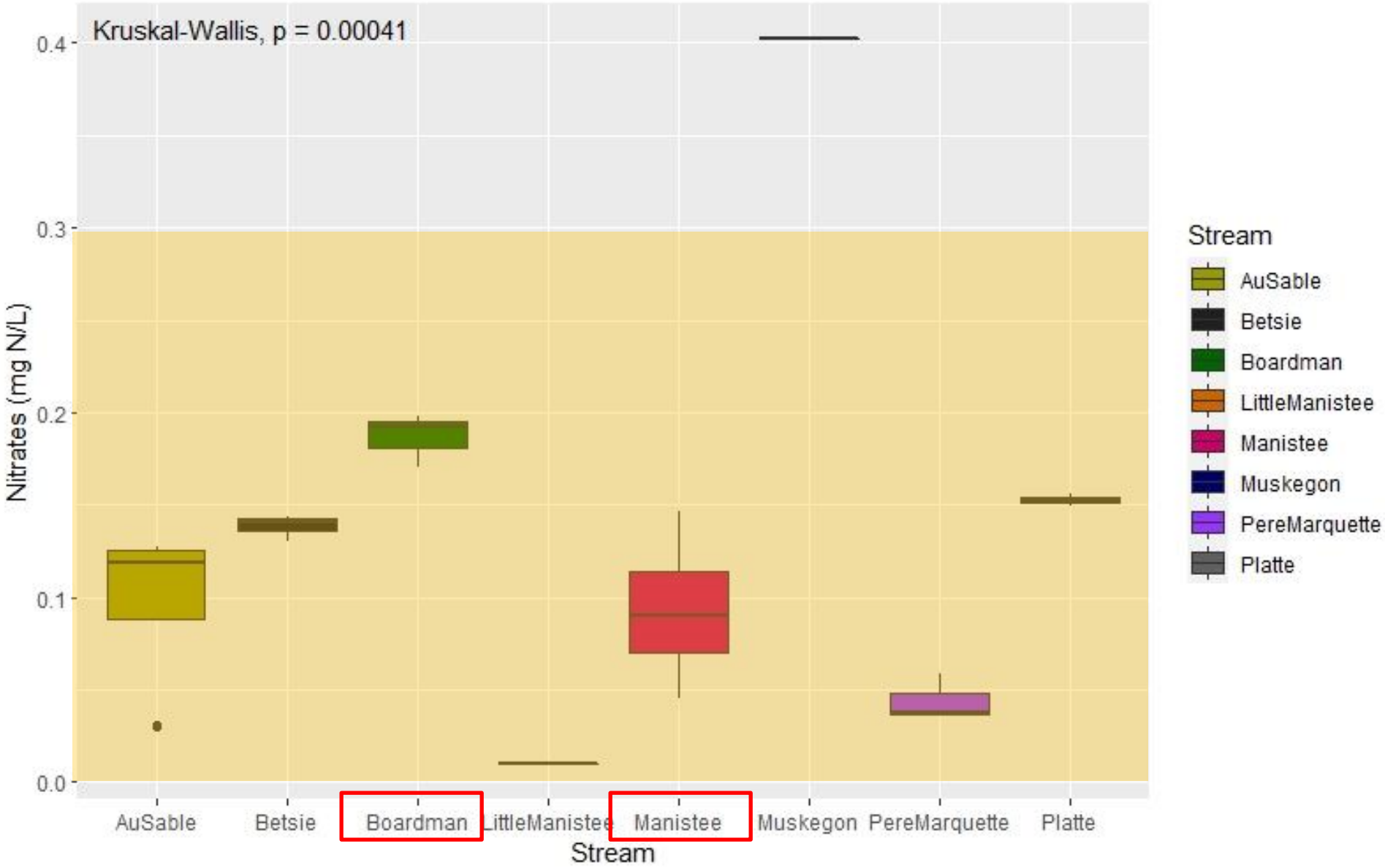
Photo: Sam Day



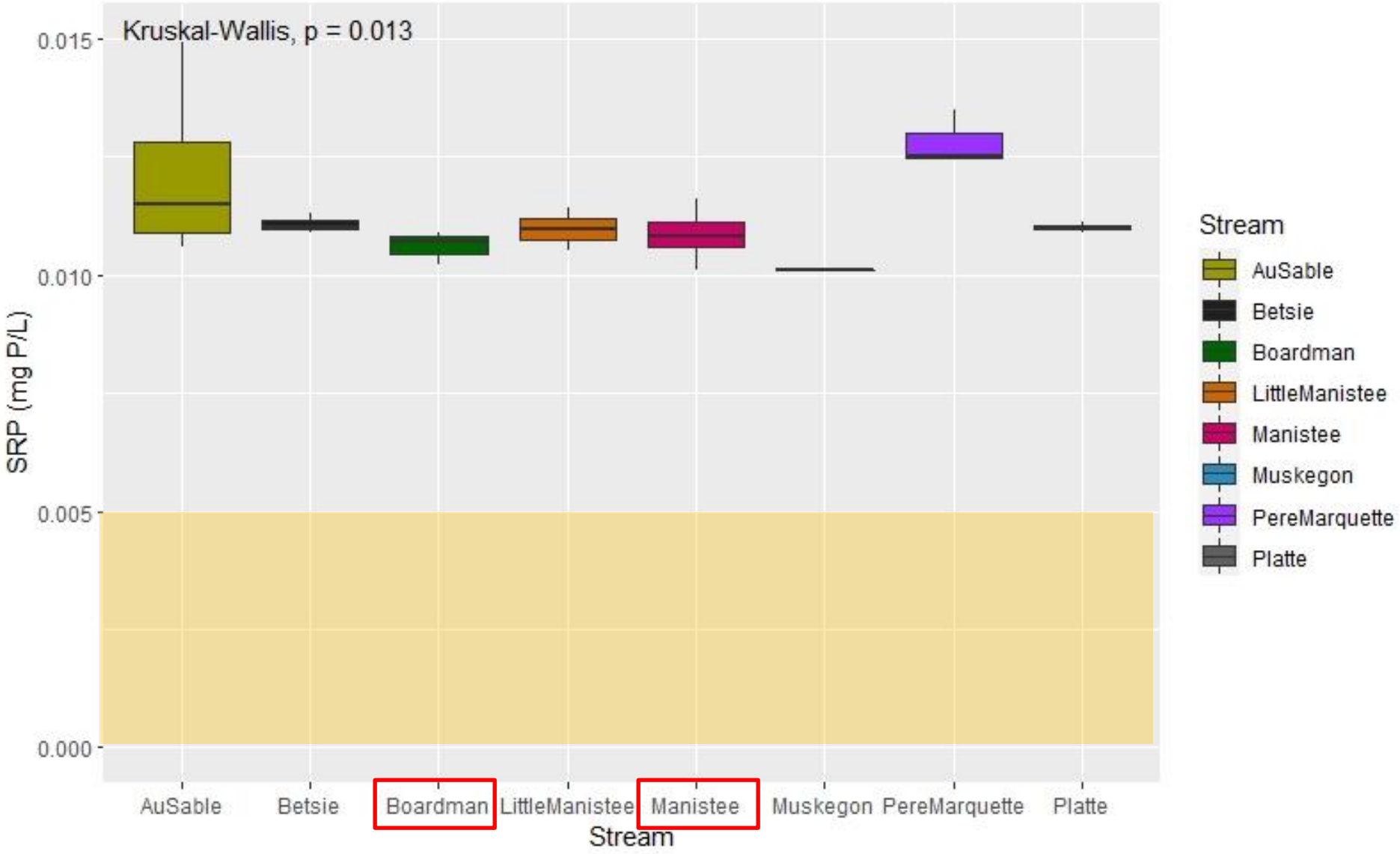
Silica in Lower Peninsula Streams



Nitrate in the Lower Peninsula



Phosphorus in the Lower Peninsula



Reducing the Spread

- Avoid areas with known Didymo infestations
- Avoid using felt-sole boots

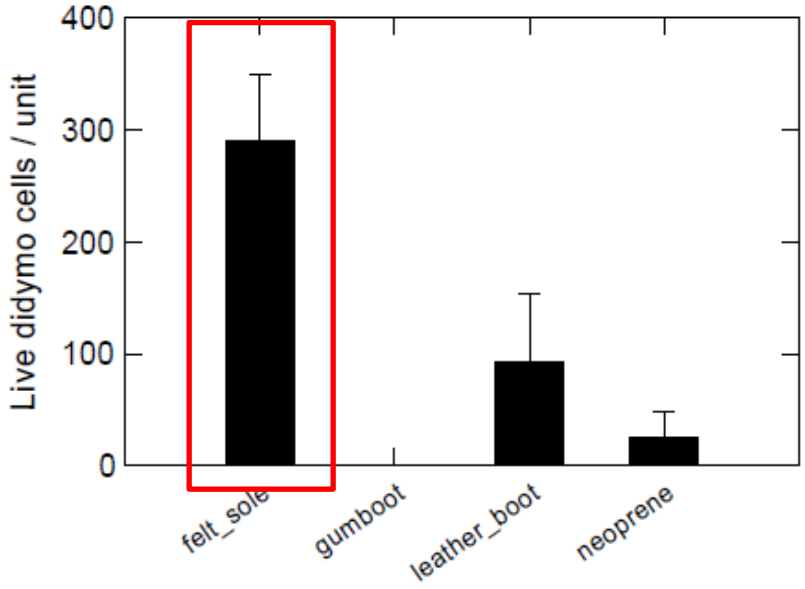


Figure 20. Comparison of live *D. geminata* cells retrieved from four types of material after 36 hours at 5 - 15 °C. $n = 4$, error bars are standard deviations.

Kilroy et al. 2006, NIWA Report CHC2006-116

Clean Your Gear

- Multiple options are effective at killing Didymo cells
  - Detergents
  - Bleach
- Drying is NOT effective
  - Cells can survive >40 d

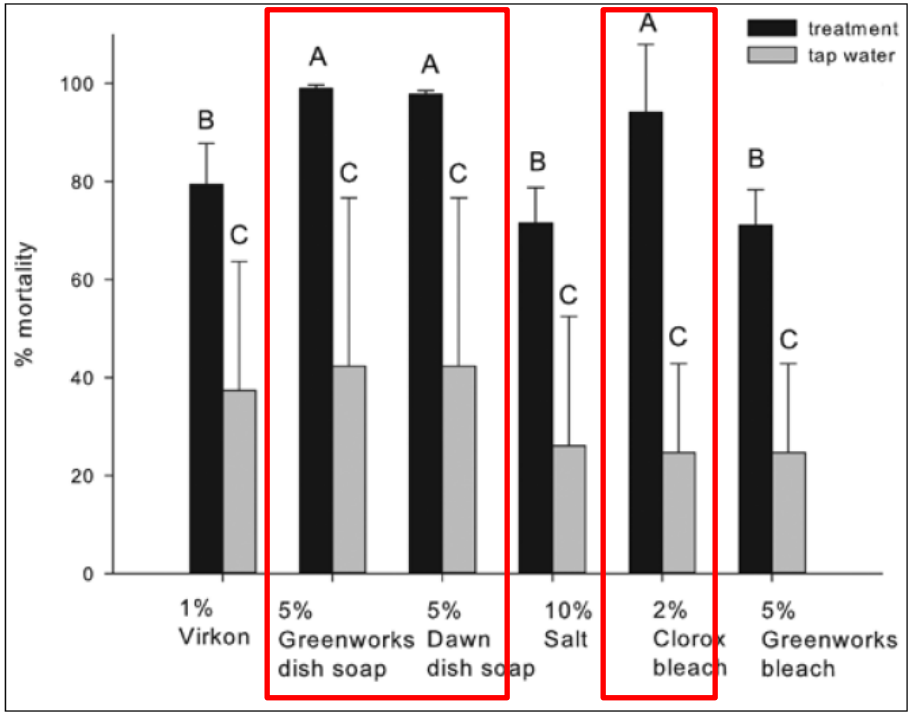
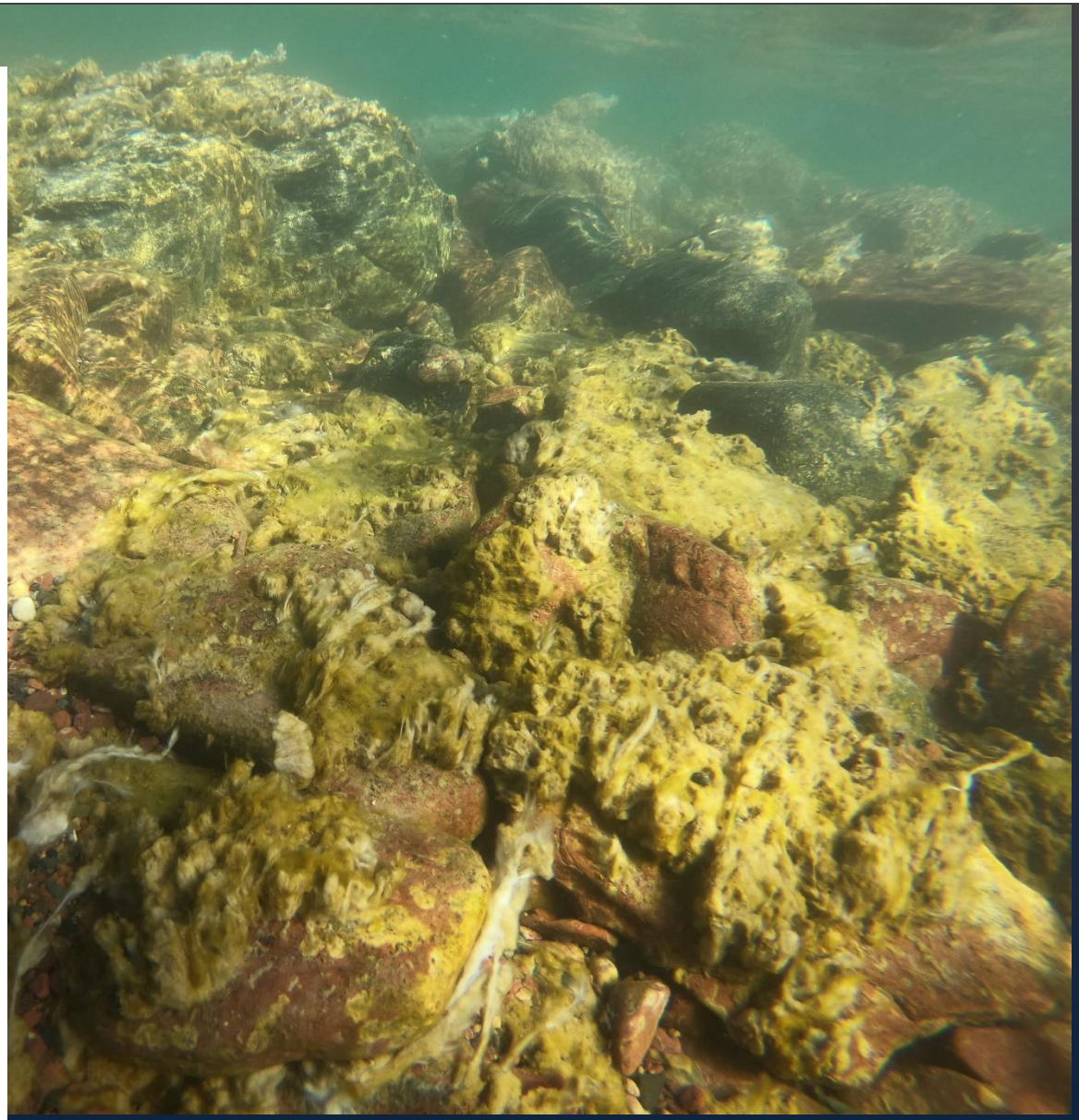


Figure 1. Effectiveness of decontamination treatments compared to a control of tap water. Treatments were significantly more effective than tap water. Letters show significant differences among the treatments. Data are means (n = 10) with standard error.

Kilroy et al. 2006, NIWA Report CHC2006-116

Root and O'Reilly 2015

Report Potential Sightings



Can We Manage Didymo?

- Maybe, but if so it will be challenging
- What environmental conditions trigger stalk production in Michigan waters and when?
  - Dissolved nutrients
  - Flow
  - Light

Thank you!

Questions? Contact me at amoerke@lssu.edu

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