Didymosphenia geminata (Rock Snot) in the New York City Watershed – Factors that Affect the Growth, Spatial Distribution, and Timing of the Didymo Bloom in the Esopus Creek (2010-2012)

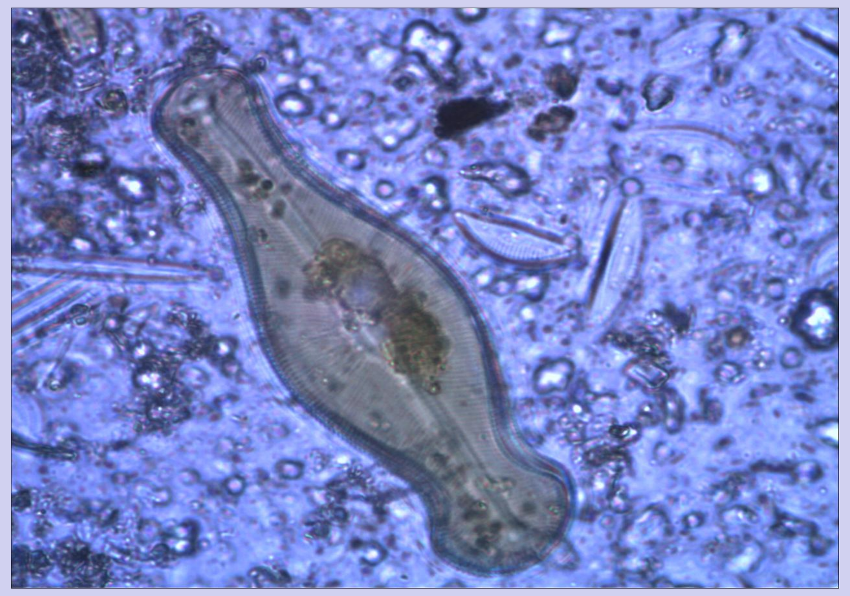
University of New Hampshire

Isabella Oleksy[1]; Amalia Handler[2]; David Richardson[2]; Cathy A. Gibson[3], Timothy J. Hoellein[4], David B. Arscott[5], Laura Achterberg[6], Emily Bialowas[7], Amalia M. Handler[8], Andrea Miller[9], Molly Redfield[10]

University of New Hampshire, Durham, NH[1]; State University of New York at New Paltz, New Paltz, NY[2], Skidmore College, Saratoga Springs, NY[3]; Loyola University, Chicago, IL[4]; Stroud Water Research Center, Avondale, PA[5], University of Nebraska, Lincoln, NE[6]; Cornell University, Ithaca, NY[7]; Franklin & Marshall College, Lancaster, PA[8]; Unity College, Unity, ME[9]; Mount Holyoke College, South Hadley, MA[10]

New Paltz STATE UNIVERSITY OF NEW YORK

Didymo mats in Esopus, 2012.



Didymo diatom magnified 100x.

What is didymo?

- Single-celled diatom
- When in bloom, grows in thick mats with large amounts of extra-cellular polysaccharide stalks
- Native to northern hemisphere in low nutrient, mountainous streams
- Recent nuisance blooms in northern hemisphere, and an invasive species in New Zealand

How does it spread?

- Fishing (esp. felt soled waders)
- Hiking
- Boating
- Tubing
- In the Catskills: Hurricane Irene stream remediation

Study Questions:

1. What is the extent of the bloom in Ashokan Reservoir watershed?
2. What causes differences in cell densities along Esopus Creek?
3. What locations may be vulnerable to didymo blooms in the future?

Methods

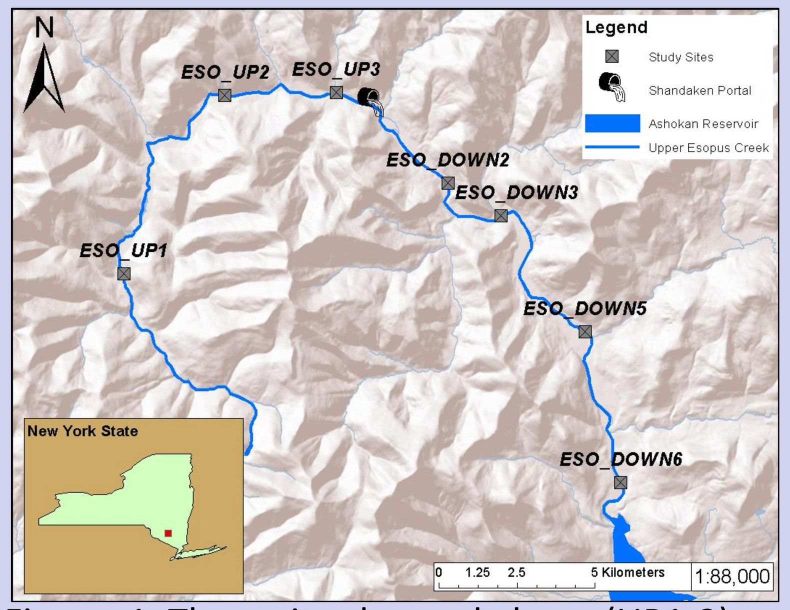


Figure. 1. Three sites located above (UP1-3) and four sites below (DOWN2-3,5-6) "the portal," an inflow of water from a tunnel connected to the Schoharie Reservoir

- Weekly sampling at 7 sites on the upper Esopus creek
- Water chemistry analysis (conductivity, pH, temp)
- Hydrology (discharge, velocity)
- Rock scrapings and % coverage
- H_2O_2 cell counting method
- Total Dissolved Phosphorus (Murphey and Riley 1962)

Left: Rock scraping at field site.

Right: Estimating discharge in Esopus Creek.

Spatial, Longitudinal, and Temporal Patterns

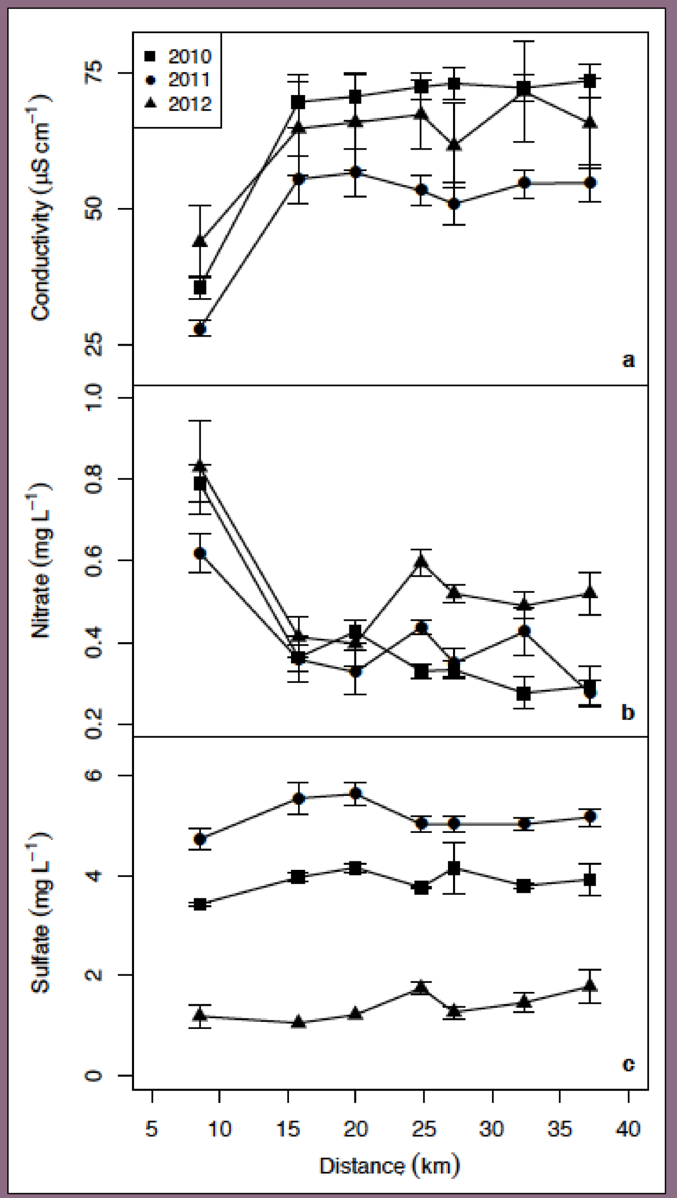


Figure 1. Conductivity is significantly lower at UP1 than at all other sites along stream (a). Nitrate concentrations were highest at UP1 and fairly stable at downstream locations (b). This is interesting because UP1 was the only site across all 3 years to be free of didymo. Sulfate concentrations were similar in 2010 and 2011, but significantly lower in 2012 (c).

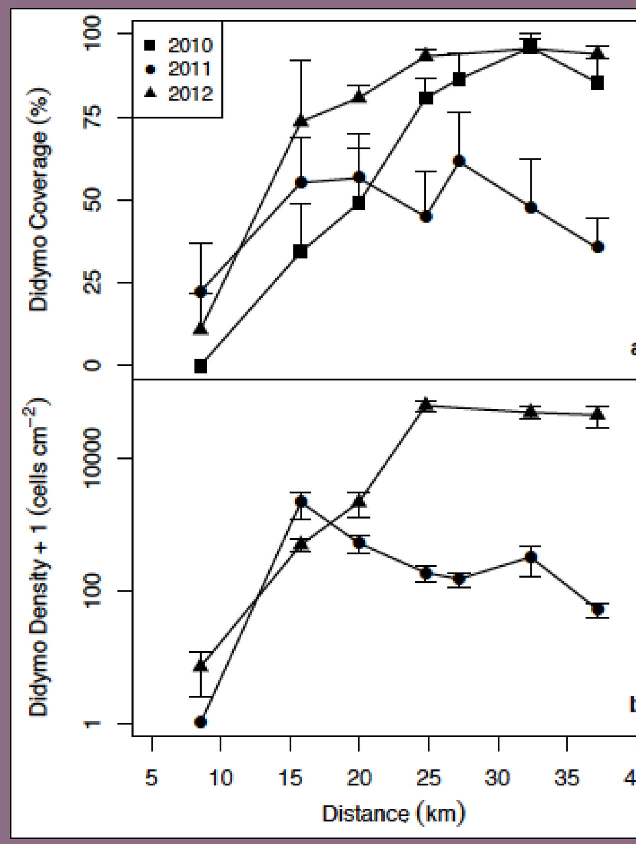


Figure 2. Didymo % coverage of the stream bottom for 2010-2012 compared to didymo cell densities for 2011 & 2012. Maximum cell densities in 2012 were at least 2 orders of magnitude higher in 2012 than in 2011. The blooms in 2010 were comparable in distribution and magnitude to 2012. In 2011 the peak of the bloom occurred at UP2 while in 2012 the bloom grew longitudinally.

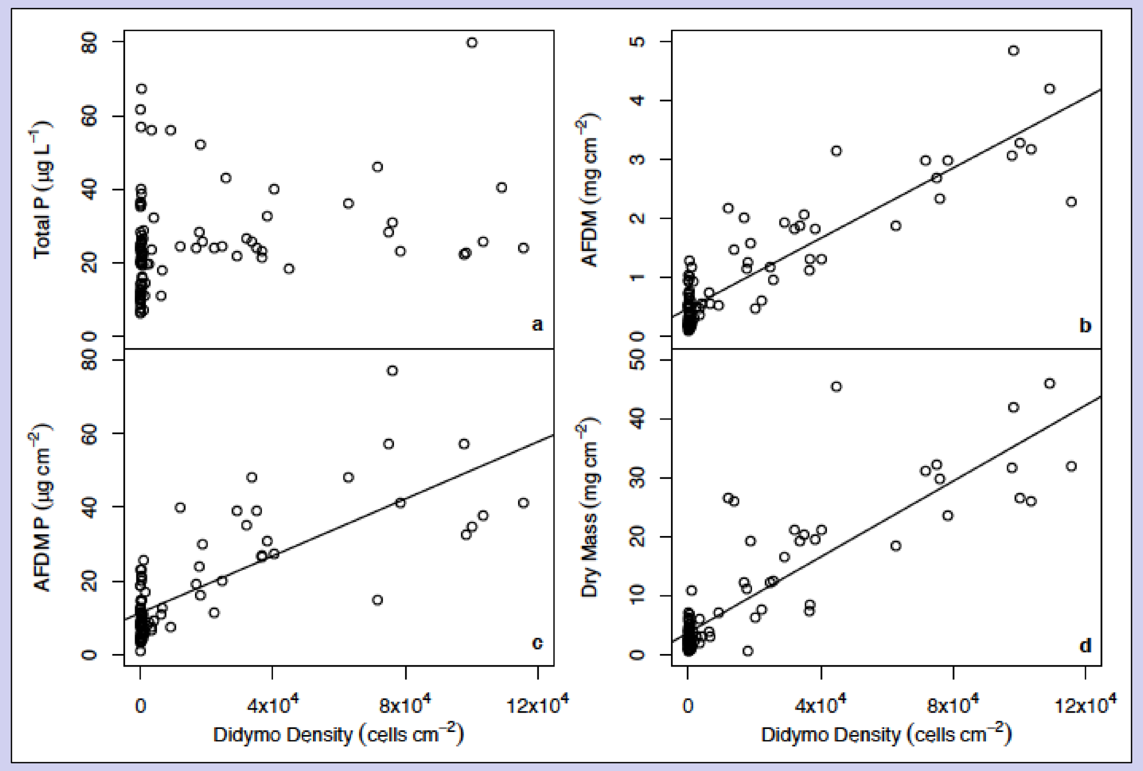


Figure 3. The relationships between total P (TDP + particulate P), AFDM ($F_{(1,93)} = 384.5$, $p < 0.001$), AFDM.P ($F_{(1,93)} = 71.7$, $p < 0.001$)and Dry Mass and cell density ($F_{(1,93)} = 342.5$, $p = 0.001$) for all 2011 and 2012 data. Although P in the water column is scarce, these figures suggests that didymo extracts and bioaccumulates P, most likely through a mechanism in the stalk material of the mats .

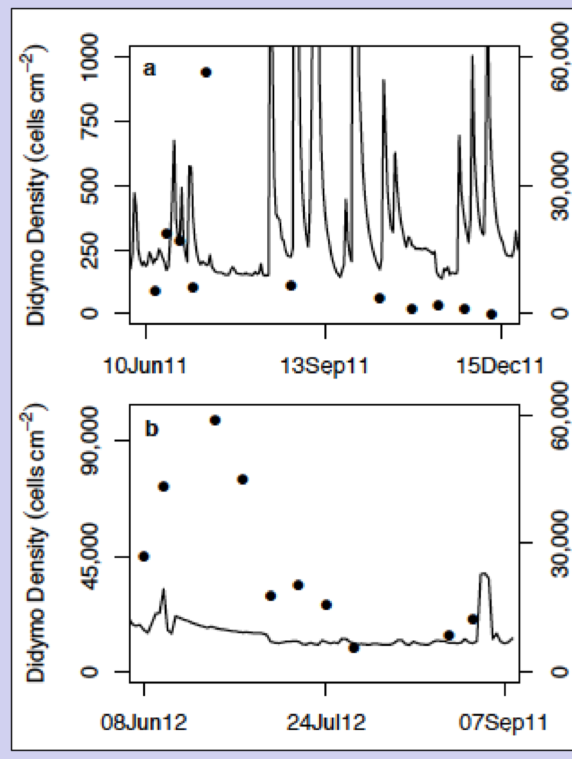


Figure 4. Flashy flow conditions in 2011 kept didymo in check, but even a week without rain caused a spike in cell densities. Steady flow conditions in 2012 allowed the blooms grow thicker. They experienced a natural die-back in late summer.

Conclusions

- Frequent flood events kept didymo blooms in check during Summer 2011
- Birch creek high conductivity could account for large bloom above the Shandaken tunnel. This sudden rise in conductivity is most likely caused by a wastewater treatment plant and ski mountain located upstream.
- Anthropogenic activity is still the main driver of the spread of didymo in the Catskills
- All Esopus tributaries except Birch Creek were didymo-free in 2011; in 2012 it was found in Warner Creek and Stony Clove Creek. Further education for the public and government agencies is necessary. Informational sign posts needed near popular recreation spots in tributaries to prevent further spread.
- Continued monitoring is necessary to gain a better understanding of the nuisance alga.

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