The Effect of Didymosphenia geminata (Didymo) on Macroinvertebrate Communities in Esopus Creek, NY

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Background

Didymosphenia geminata (Didymo) is an algae that has been producing nuisance blooms in streams around the world in recent years. Blooms have been recorded in New York State since 2007 and in the Esopus watershed since 2009. Didymo blooms are composed of mats of extracellular polysacchiride stalks with their diatom cells at the ends (Figure 1). Macroinvertebrate orders associated with high water quality, such as Ephemeroptera, Plecoptera, and Trichoptera,(EPT) require smooth, rocky substrates in riffle zones for growth and feeding. Didymo physically changes this rocky substrate to a fibrous, cottony substrate, removing the habitat that these organisms require.

Objective

The goal of this study is to explore the effects of didymo blooms on the ecological health of the streams which it has affected, particularly the effects on macroinvertebrate communities.

Figure 1. Microscopic view of didymo cells and extracellular stalks.

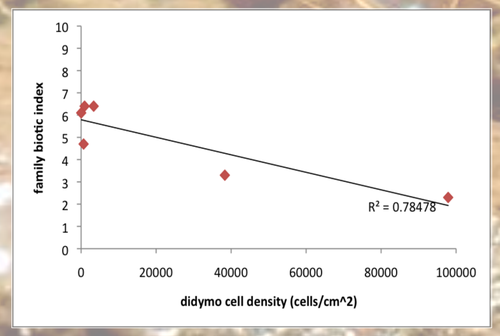

Figure 2. The hilsenhoff family biotic index from 4 sites on the Esopus (in 2011 and 2012) and 2 sites on the Neversink (in 2012), plotted against the density of didymo at those sites.

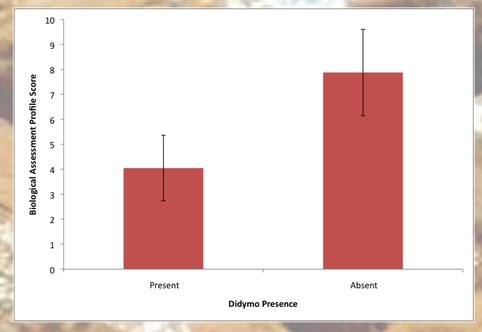

Figure 3. The Biological Assessment Profiles from sites on the Esopus and the Neversink in 2012, with and without didymo present.

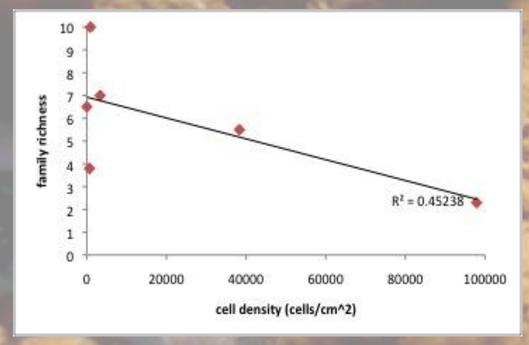

Figure 4. Family richness of macroinvertebrates at 4 sites on the Esopus (in 2011 and 2012) and 2 sites on the Neversink (in 2012) on a 0-10 scale

Methods

We tracked the intensity of the didymo bloom at 7 sites upstream of Ashokan Reservoir on Esopus creek throughout the summer months. This was accomplished through collectiing rock scrapings at these sites and measuring the chlorophyll A, the biofilm mass, and counting didymo cells. We sampled macroinvertebrates at 4 of these 7 sites using a kicknet method. We identified the specimens to families, and used that data to determine the community compositions and the water quality impact at those sites. The metric that we used, developed by the NYS DEC, combines family richness, EPT richness, the hilsenhoff biotic index, and percent model affinity on 0-10 scales to obtain an overall Biological Assessment Profile (BAP) for that site. Additional sampling was conducted in the Neversink river as a point of contrast to the didymo-affected sites on the Esopus.

Results

There was a strong negative correlation found between didymo cell density and the hilsenhoff biotic index (Figure 2). We found that sites with high levels of didymo had the lowest BAP scores, i.e. the most impacted water quality. The average BAP score was significantly lower in sites with didymo present than those with didymo absent (Figure 3). These sites with low BAP scores had the highest occurrences of oligochaetes and chironomids, and the lowest biodiversity of families (Figure 4).

Conclusion

Didymo has changed the substrate in the streams where it has bloomed. Its very presence appears to impact the ecological health of those sites that it has affected. Macroinvertebrates with high tolerance of low water quality and change to their environment are becoming dominant in places with high didymo densities. This indicates a change towards more homogenous communities of macroinvertebrates in didymo-affected streams. Without management solutions to didymo's spread, stream ecosystems throughout the region may become seriously impacted.

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