Rock snot in a sick river: What causes didymo blooms in Esopus Creek?

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Introduction

•*Didymosphenia geminata* (didymo) is informally called "rock snot" because, during blooms (i.e., periods of rapid spread), the diatoms produce mats that resemble mucus→

•Over the past several years, didymo blooms have been identified in Esopus Creek above the Ashokan Reservoir in the Catskills.

•The causes of didymo blooms and its range expansion are not well understood.

•**We aimed to examine the abiotic factors that may control didymo blooms (e.g. water chemistry and hydrology).**

Methods

Figure 1. Esopus Creek sampling locations above the Ashokan Reservoir. The Portal (blue and white waves) brings water into Esopus from the Schoharie Reservoir.

- Throughout summer 2010, we sampled 7 locations along Esopus Creek weekly
- 3 locations upstream of the Shandaken Tunnel ("the Portal") (Fig. 1, blue)
- 4 locations downstream of the Portal (Fig. 1, green)

Weekly measurements at each site

Water Chemistry
- major anions and cations
- Conductivity; temperature; pH
- Dissolved organic carbon (DOC)
- Dissolved inorganic carbon (DIC)

Hydrology
- Discharge; Velocity

On stream bottom
- % didymo coverage
- Didymo rating scale (1-10)
- Dry mass
- Ash-free dry mass, AFDM (organic material)
- Chlorophyll *a*, *b*, and *c*

Acknowledgements
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Didymo cell attached to stalk.

Didymo abundance during summer

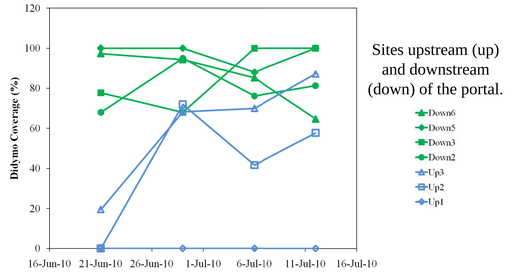


Figure 2. Didymo was consistently high at all sites below the portal (green lines). Didymo was found at two sites above the portal with DEC fishing access points, but didymo was not found at the upmost site.

Upstream and downstream of the portal

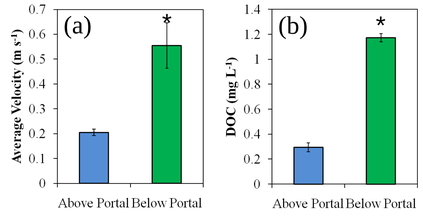


Figure 3. Below the portal, (**a**) average flow velocity was higher (t=3.8, df=3.12, p=0.015) and (**b**) dissolved organic carbon was higher (t=18.1, df=4.5, p<0.005). Discharge and total suspended solids were higher as well (data not shown).

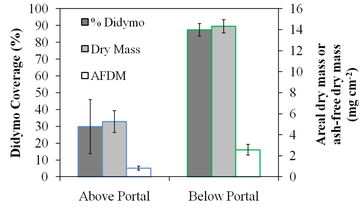
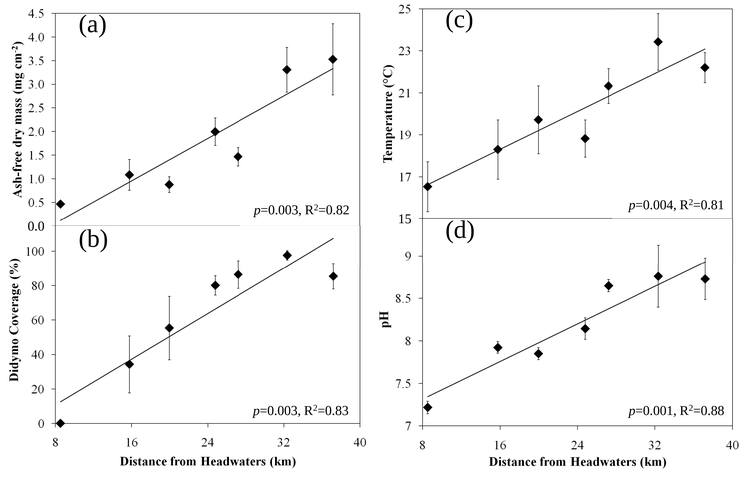


Figure 4. Below the portal, didymo coverage was higher (t=3.5, df=2.2, p=0.032), rock biofilm dry mass was higher (t=7.5, df=3.5, p=0.002) and ash-free dry mass was higher (t=3.3, df=3.8, p=0.016) compared to measurements above the portal.

Longitudinal effects

Linear trends in didymo, temperature, and pH



Presence/absence of didymo and water chemistry

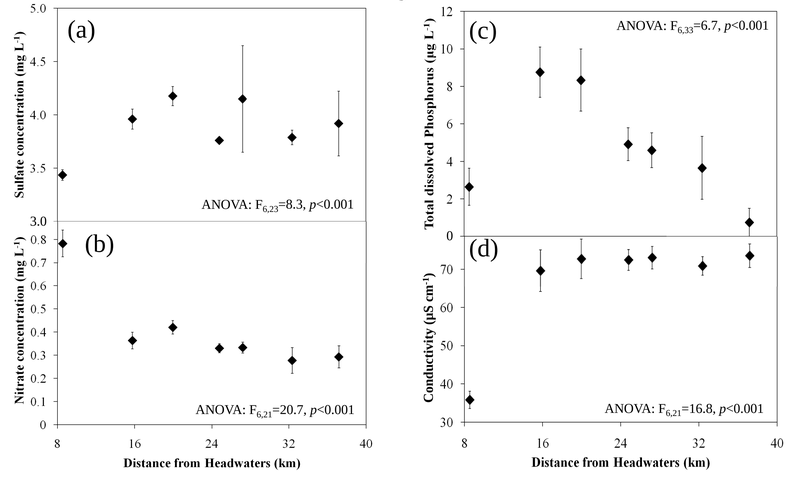
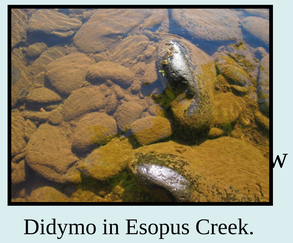


Figure 5. Moving downstream, (**a**) periphyton AFDM, (**b**) didymo coverage, (**c**) water temperature, and (**d**) pH increased linearly. Error bars represent 1 S.E.

Figure 6. Water chemistry was different at the upper site without didymo. (**a**) Sulfate and (**d**) conductivity were significantly lower at the upstream site. (**b**) Total dissolved phosphorus was lowest at the upper site and highest at the two sites above the portal with didymo. (**c**) Nitrate concentration was highest at the site without didymo. Error bars represent 1 S.E.

Conclusions: Didymo has spread from downstream to upstream since its initial discovery. This study is its first documentation upstream of the Portal.

- Didymo range expansion here appears to be controlled by human activity (i.e. angler boots and equipment)
- The *continued* spread of didymo, however, may be inhibited by nitrate, or limited by micronutrients (Low concentrations of sulfate, iron, and major cations result in lower water conductivity upstream)
- Reduced didymo density upstream could be associated with lower pH and temperature.
- Additional monitoring of the spatial and temporal distribution of environmental drivers of didymo range expansion will help identify potential management strategies to reduce its growth here and in other invaded rivers worldwide.



Didymo in Esopus Creek.