Diatom assemblage responses to wildfire in wilderness streams of Central Idaho

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Rationale

Research has indicated increases in productivity at multiple trophic levels associated with streams severely burnt by wildfire. Moreover, this increased productivity can last more than a decade. Why are some streams more productive many years after fire? We chose to investigate how wildfire and associated regrowth of riparian canopy affects light availability, and how this affects chlorophyll-a (Chl-a) biomass, gross primary production (GPP), and diatom community composition.

We hypothesize that this increased productivity is fueled by elevated light availability after wildfire, and predict that streams retaining an open canopy will exhibit increased GPP and harbor a higher proportion of diatoms with nitrogen fixing endosymbionts. We further predict that streams not limited by light may be limited by other factors such as nutrient availability, and that organisms capable of nitrogen fixation such as the endosymbionts of diatoms may be secondarily contributing to the prolonged increase in productivity.

Methods

We employed a nested study design, combining long-term monitoring with a paired stream analysis of diatom community assemblage and chlorophyll - a biomass in two wilderness streams of Idaho. These streams are similar in most respects, but differed in the amount of light they received after being burnt with similar severity in a 2000 wildfire. The long-term monitoring guided our hypothesis and the paired stream analysis allowed us to explore how light affects GPP.

Photosynthetically active radiation (PAR) was measured with a handheld sensor at stream level along the study reach. Chl-a and diatom community composition were sampled bi-weekly throughout the summer of 2014 by scrubbing periphyton from rocks and subsampling the resulting slurry. GPP was estimated using open channel metabolism techniques using data collected via YSI Sondes.

Results

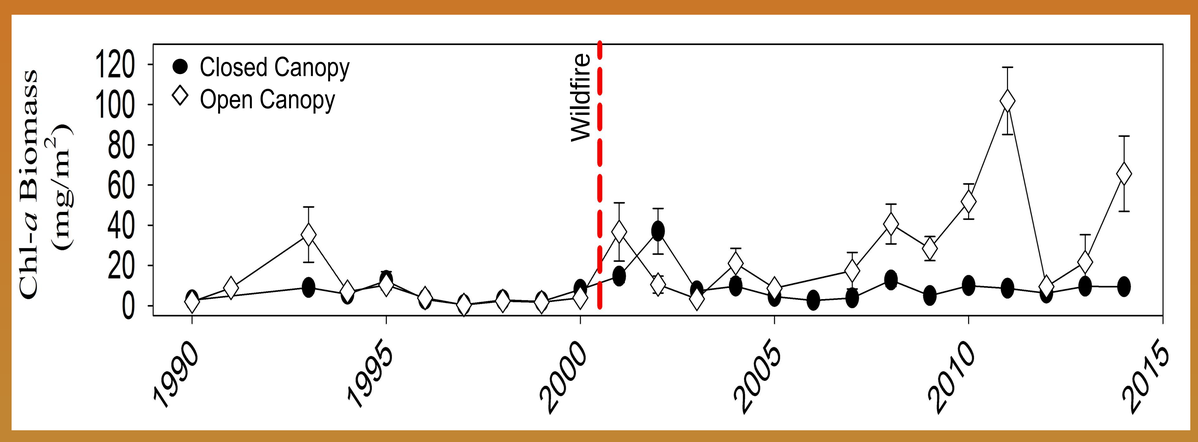


Figure 1. Mean ± SD for Chl-a biomass of the open and closed canopy

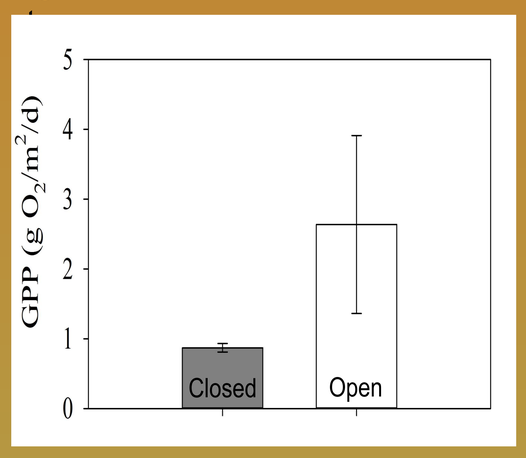
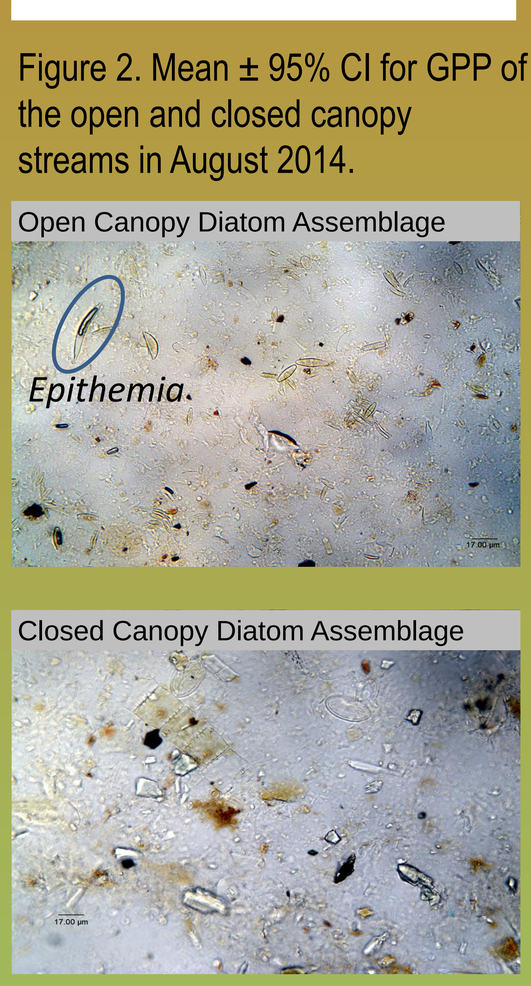


Figure 2. Mean ± 95% CI for GPP of the open and closed canopy streams in August 2014.



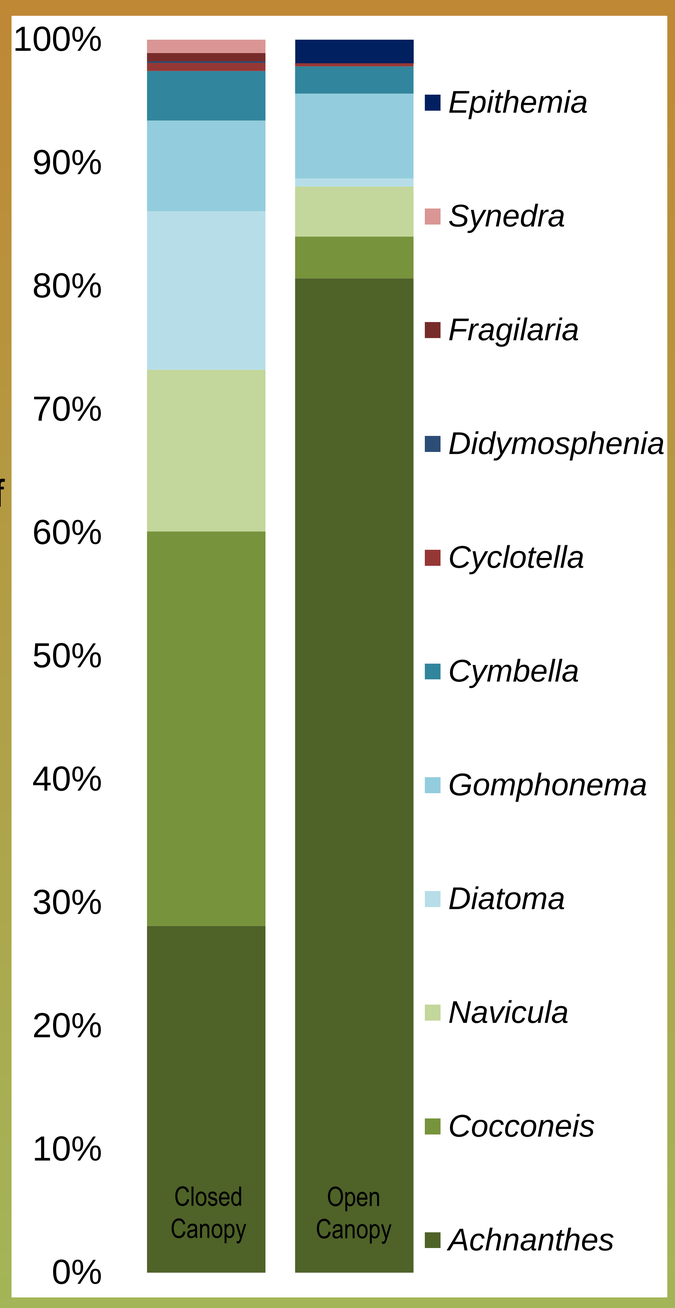


Figure 3. Diatom assemblage composition in streams with open (Cliff) and closed (Pioneer) canopies in summer 2014.

Discussion

Figure 4. Sonde Deployment on the open canopy stream (Cliff Creek)

The stream that retained an open canopy after severe wildfire exhibited 3 fold higher available light, 6 fold higher chlorophyll - a biomass, and 3 fold higher rates of gross primary production than the stream that quickly regained a closed canopy. Additionally, the open-canopy stream had higher abundance of diatoms, and harbored diatoms with nitrogen fixing endosymbionts (i.e., *Epithemia*), whereas the closed canopy stream had lower diatom density, but greater diversity.

We suspect that observed increases in chl-a biomass and productivity after wildfire is fueled by increased light availability due to the removal of riparian canopy. A smaller secondary driver may be nitrogen fixation by endosymbionts of diatoms. These diatoms are used as a quality food source for stream invertebrates, and provide valuable nitrogen to streams whose primary production is typically limited by nutrients.

We propose that these increases in GPP and basal food resources may have significant impacts for higher trophic levels, such as stream invertebrates and fish.

Acknowledgments

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