Patterns of Biomass and Primary Production of Benthic Biofilms in Wilderness Streams of Central Idaho

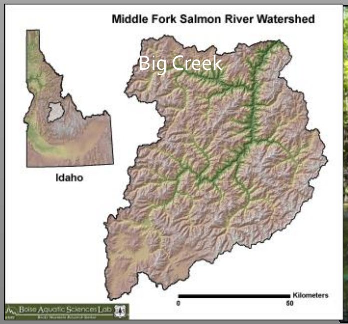
Tess A. Gardner and Colden V. Baxter, Stream Ecology Center, Department of Biological Sciences, Idaho State University

Rationale

- Primary producers (e.g. algae) provide basal energy resources that support higher trophic levels in aquatic food webs.
- In stream ecosystems it is common to measure biomass of primary producers rather than rates of primary production. However, we need to be able to interpret relationships between standing crop biomass and primary productivity.
- Without understanding rates of primary productivity, it may be hard to interpret dynamics at higher trophic levels or patterns in long term monitoring of biomass.

Study Design

- During the summer of 2011, we studied six 2nd to 5th order tributaries (drainage area 7.9 to 243.4 km^2) of the Big Creek watershed in the Frank Church 'River of no Return' Wilderness, central Idaho.
- Sites encompassed gradients in past wildfire and flow disturbance, aspect, stream size, and riparian vegetation, but were linked by similar climate and geology.
- Study sites are also the location of 25 years of annual monitoring of benthic periphyton biomass, but estimates of primary production are lacking.



Study site Cougar Creek

Methods

Gross Primary Productivity

- Gross primary productivity (GPP) was estimated three times from July 7 to August 13 for each study site using metabolism microcosms (N=30 per site per sample period).
- Each microcosm chamber was filled with filtered stream water and a rock representative of stream particle size.
- Chambers were inverted and submerged within the streams for a two hour incubation period in light levels representative of the overall site.
- Dissolved oxygen measurements were conducted under light and dark conditions

Light period incubation

- To establish a dark setting for respiration measurements, the sealed chambers were placed in black plastic bags.
- Primary production and respiration were calculated via oxygen balance methods, adjusted for water volume and rock surface area, and GPP estimates were obtained for each chamber following the methods of Hoellein et al. (2009).

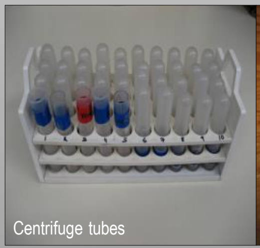
Study site Pioneer Creek

Periphyton Analysis

- The periphyton was scrubbed from rocks after microcosm incubations and a known volume was subsampled and filtered.
- Filters were frozen to await laboratory processing.
- Chlorophyll-*a* (chl-*a*) and Ash Free Dry Mass (AFDM) estimates were determined using standard methods (Steinman et. al 2006).

Periphyton filter

Pipette used in analysis



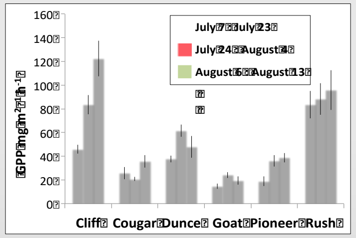
Centrifuge tubes

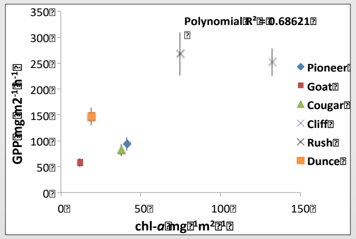
Methanol (CH_4O)

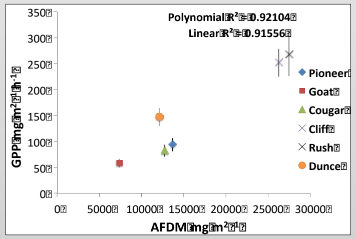
Results

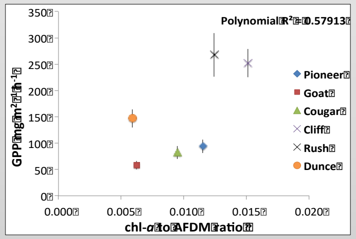
- Biomass of chl-*a*, total AFDM and GPP generally increased over time for all but the smallest streams, whose GPP peaked earlier.
- GPP and biomass were correlated across streams; this relationship became stronger and more linear later in the summer.

Results









Discussion

- We observed linear biomass-productivity relations, but because the slopes varied among streams simple applications of P:B ratios may be problematic.
- Measures of GPP may help explain patterns in occurrence of insects and fish observed in other studies (Malison and Baxter 2010).
- Investigation is underway of factors such as light, temperature, and nutrients, and their potential relationships with GPP.

Acknowledgments

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References

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