Testing the light nutrient hypothesis in stream periphyton: Do canopy cover and nutrient availability alter elemental stoichiometry?

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Introduction

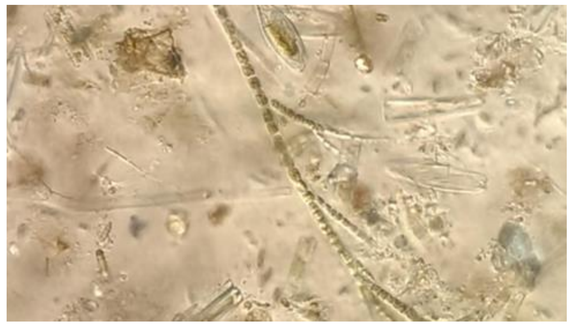


Figure 1. Photo of stream periphyton at 100x. Photo provided by Sarah Whorley.

- According to the light : nutrient hypothesis (LNH) as the ratio of light to available nutrients increases, the nutrient content of primary producers decreases. (Sterner et. al 1997)
- Low nutrional quality in primary producers may result in lower growth and reproduction rates for organisms higher in the food web (Hessen et. al 2002)
- C:N and C:P ratios are common indicators of nutrional quality of food resources (O'Brien & Wehr 2010)
- The LNH has shown to apply to experimental streams and manipulated streams (Fanta 2010)

Purpose of this study was to test the LNH with streams in natural settings

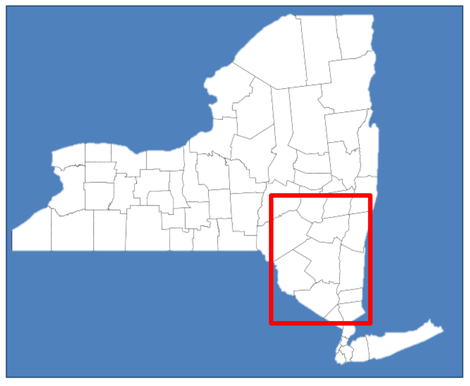


Figure 2. Samples were collected in Southeastern New York as indicated by the red box.

Methods

- Stream sampling period took place June-August 2015. 22 stream sites were sampled in Southeastern New York state. Streams had varying land use and canopy cover.
- Periphyton organic carbon calculated using AFDM in filtered sampled. Periphyton analyzed for total ntirogen using a CHN analyzer, phosphorous analyzed using method based off Solorzano & Sharp 1980.
- Data analyzed using Spearman correlations through SYSTAT v. 13

3a

3b

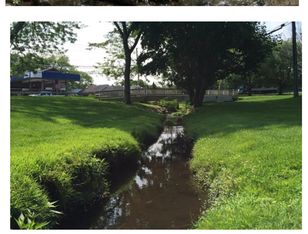


Figure 3. Examples of a shaded and unshaded stream sampled. (a) The Shekomeko Creek located in Dutchess County, NY. (b) Stream located in a small town in Westchester County, NY.

4

Figure 4. Open canopy was measured using a densiometer.

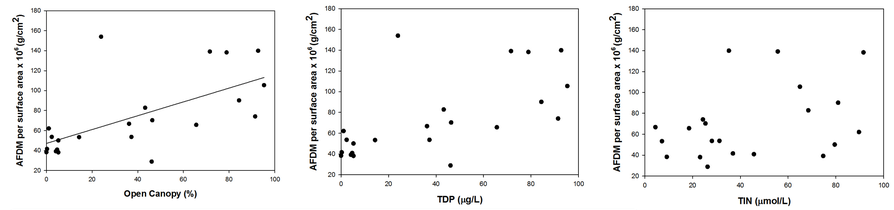
Results and Discussion

	Min	Max	Mean	SD
Chlα/AFDM (mg/g)	0.1	4.8	1.7	1.3
AFDM/Surface Area (g/cm² *10⁶)	28.9	154.0	73.9	38.1
C:N	7.1	12.3	9.1	1.2
C:P	10.5	1468.2	339.3	315.8

Table 1. Summary algal periphyton data of chlorophyll α, biomass, and nutrient stoichiometry. Stoichiometry calculated using molar values. Algal periphyton sampled from 22 streams in Southeastern New York.

Correlations of Ash-free dry mass and:

Open Canopy (%) | Total Dissolved Phosphorus (µg/L) | Total Inorganic Nitrogen (µmol/L)



LNH and Nitrogen

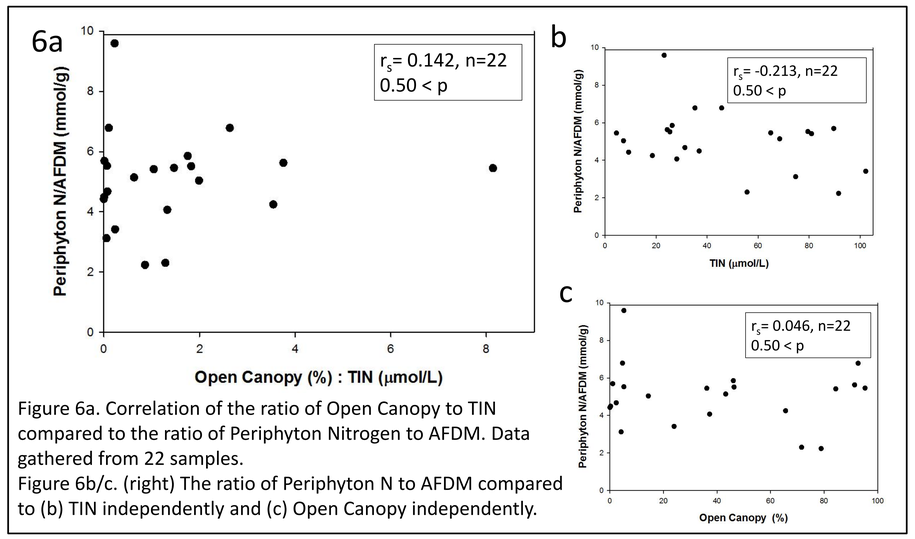


Figure 6a. Correlation of the ratio of Open Canopy to TIN compared to the ratio of Periphyton Nitrogen to AFDM. Data gathered from 22 samples.
Figure 6b/c. (right) The ratio of Periphyton N to AFDM compared to (b) TIN independently and (c) Open Canopy independently.

LNH and Phosphorous

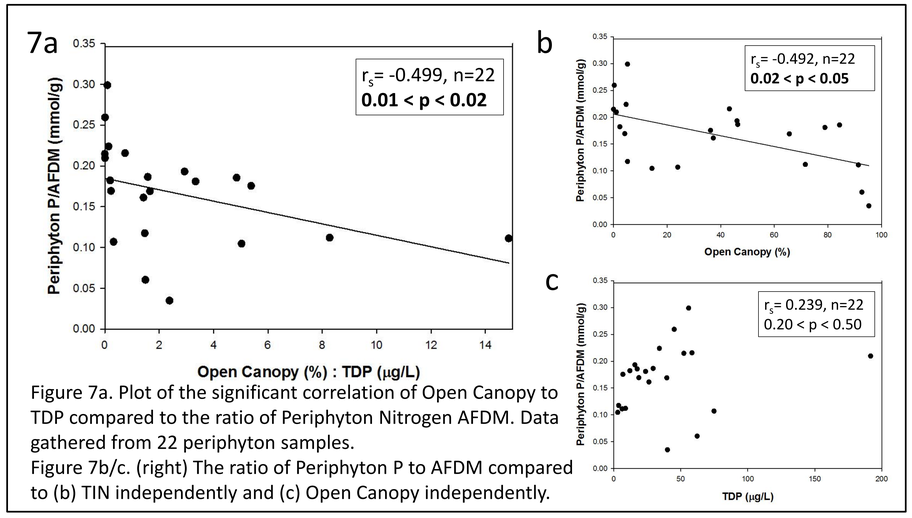


Figure 7a. Plot of the significant correlation of Open Canopy to TDP compared to the ratio of Periphyton Nitrogen AFDM. Data gathered from 22 periphyton samples.
Figure 7b/c. (right) The ratio of Periphyton P to AFDM compared to (b) TIN independently and (c) Open Canopy independently.

Evidence suggests LNH patterns can be applied to Periphyton P in natural settings, but not Periphyton N. Reduction in relative Periphyton P showed to be significantly correlated with available light independently; however correlation is stronger with Open Canopy:TDP.

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