Intra-stream Variation in Water Temperature, Phosphorus, Nitrogen, and Stream Bank Soil Quality in Wells, VT

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BACKGROUND

Temperature is an important physical property of flowing waters because it significantly affects aspects of water quality, such as dissolved oxygen and suspended sediment concentration that influence the populations of freshwater organisms. (Webb *et al*., 2008).

Climate change associated with anthropogenically induced global warming has motivated us to examine instra-stream variation in water temperature, phosphorous and nitrogen and stream bank soil quality in a local stream.

OBJECTIVES

- Test and compare the stream bank soil from each site for nutrients.
- Determine and compare the phosphorous and nitrogen concentrations in water samples from each stream site.
- Monitor and compare temperatures of the water at each stream site from July 18 through December 3, 2014.

FIELD SITES

We sampled soil and water and monitored water temperature from two sites in Wells Brook located in Wells, VT. One site (Wells 436) was located approximately 43.410 N and -72.225 W and another site (Wells 494) that was located at 43.416 N and -73.204 W.

These sites differ in plant diversity, amount of sunlight, stream bank characteristics. Wells 436 has more diverse plant life and has a steeper stream bank than Wells 494. Wells is shaded by deciduous trees; while Wells 494 is completely open and receives direct sunlight.

METHODS

Riparian Soil Sampling:
We used a soil core sampler and collected soil on October 30, 2014 from the stream bank at Wells 436 at 1 meter and 5 meters from the edge of the stream and Wells 494 at 5 and 10 meters from the edge of the stream. The stream bank was too rocky to collect it at 1 meter at Wells 494 and the roots of the vegetation were to thick to collect a soil sample at 10 meters. Total Phosphorus was measured using the Modified Morgan extractant method. Total values for Calcium, Potassium, magnesium, Sodium, Aluminum, Manganese, Boron, Copper, Zinc and Sulfur were determined using microwave-assited nitric acid digestion. All values were measured in a lab at the University of Vermont.

Water Quality Sampling:
Water samples were collected on July 18, August 8, September,19, October 30, and December 3, 2014 from both stream sites and analyzed in a lab at Johnson State College. Samples were processed in a Seal Auto-Analyzer and were processed and Analyzed using ascorbic acid colorimetry to determine the total Phosphorous. Total Nitrogen was analyzed using a Copper/Cadmium Reduction followed by Sulfanilmide-NEDD colorimetry.
Total Suspended Solids were also measured in water samples through a filtration and desiccation method in the lab.

Water Temperature Sampling:
Water temperatures were measured using thermochron iButtons that were sealed in waterproof capsules and placed at the bottom of each stream at each site, anchored to a metal rod. Temperatures was recorded from July 18, through December 3, 2014.

RESULTS

Stream bank soil samples from Wells 436 had lower available and total Phosphorous, Magnesium, Sodium, Copper, Zinc, and Sulfur values than Wells 494. Soil collected 5 meters from the stream in Wells 494 had higher total Calcium, Potassium, Aluminum, and Manganese values than Wells 436.

Table 1. Nutrient analysis of stream bank soil samples from two sites in Wells Brook in Vermont

Site Code	Sample Depth (meters)	Available Phosphorous (Modified Morgan extract) (mg/kg)	Total Phosphorous (mg/Kg)	Total Calcium (mg/Kg)	Total Potassium (mg/Kg)	Total Magnesium (mg/Kg)	Total Sodium (mg/Kg)	Total Aluminum (mg/Kg)	Total Manganese (mg/Kg)	Total Boron (mg/Kg)	Total Copper (mg/Kg)	Total Zinc (mg/Kg)	Total Sulfur (mg/Kg)
LCC_Wlls Brk_436	1.00	4.77	569.94	2835.54	2192.82	5945.18	212.67	14933.84	24196.60	892.25	3.12	80.06	260.87
LCC_Wlls Brk_436	5.00	10.15	763.89	4425.93	3453.70	6287.04	314.81	17685.19	25462.96	1055.55	5.10	86.67	378.70
LCC_Wlls Brk_494	5.00	83.00	2440.09	24907.41	3037.04	6574.07	382.40	17037.04	24351.85	1361.11	10.46	198.15	817.87
LCC_Wlls Brk_494	10.00	64.00	1074.31	9140.77	3171.85	6983.55	416.82	17093.24	23948.81	903.12	26.14	112.43	404.30

REFERENCE:
Webb, B.W., Hannah, D.M., Moore, R.D., Brown, L.E. and F. Nobilis (2008). Recent advancesin stream and river temperature research. Hydrologic Processes 22, 902-918.

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RESULTS

From July 18 through September 11, 2014 the temperature of the water at Wells 494 was higher than Wells 436. The water temperature at 436 was higher than Wells 494 from September 12, to December 3, 2014.

Figure 1. Water temperatures from two sites in Wells Brook from July 18, through December 3, 2014.

Table 2. Stream water quality values (Average Phosphorous and Nitrogen, and total suspended solids) for two sites in Wells Brook in Vermont.

Site	Date	Average Phosphorous (µg/L)	Average Nitrogen (µg/L)	Total Suspended Solid
LCC_WllsBrk_494	7/18/14	0	388.854	1.18
LCC_WllsBrk_436	7/18/14	0	384.146	0
LCC_WllsBrk_494	8/8/14	0	304.24	1.49
LCC_WllsBrk_436	8/8/14	0	319.111	167.67
LCC_WllsBrk_494	9/19/14	3.596	277.566	0
LCC_WllsBrk_436	9/19/14	4.151	335.054	undefined
LCC_WllsBrk_494	10/30/14	8.291	488.902	2.49
LCC_WllsBrk_436	10/30/14	9.068	460.063	3.08
LCC_WllsBrk_494	12/3/14	9.285	496.592	3.49
LCC_WllsBrk_436	12/3/14	8.059	512.847	1.36

CONCLUSIONS

For at least 25 years there has been a great interest in thermal behavior of stream systems. The effects of human produced climate change has created a need to collect and analyze the temperatures and water quality of local streams and analyze soil nutrients of stream banks. This project reports baseline data for two sites in Wells Brook in Vermont

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