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Phosphorus Loading in the Lake Champlain Basin

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Study Question

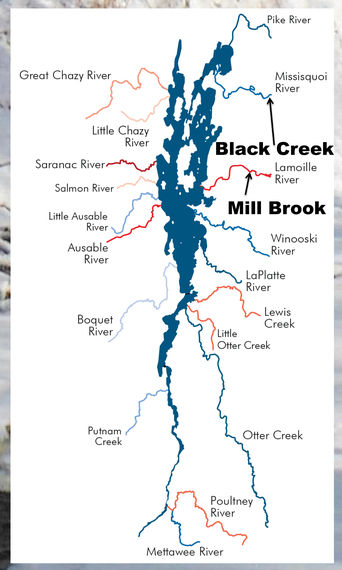
Does Phosphorus loading occur in the winter months?

Introduction

- Lake Champlain basin covers 21,326 Km^2. It is home to over ½ a million people (U.S. Census, 2000). 68% of these people live in Vermont on its east side. In the west is New York with 27% and to the north where Lake Champlain outflows through the Richelieu R. 6% of the population of the basin is Canadian. (LCBP, 2016)
- Lake Champlain is the centerpiece of the basin. Its health is important. Not only does it provide clean drinking water to 200,000+ people it is of major economic importance with a 3.8$ billion annual tourism and recreation industry (LCBP, 2016).
- Unfortunately the Lake is in trouble. P loading causes unsightly algae blooms, is depriving aquatic organisms of oxygen and pollutes the lake as a source of drinking water. P loading threatens human health, aquatic biodiversity and tourism revenue. (Bloom 2010 and Holmes et. al. 1999)
- P moves by attachment to particulate or is dissolved in runoff. (Randall, 2002) P comes primarily from its tributaries rivers. (Smeltzer, Quinn, 1996) Millions of dollars have been spent and continue to be spent in research, monitoring, and mitigation efforts of phosphorus. Despite this P concentrations have not decreased in any areas of the Lake. (State of the Lake Report, 2015)
- Monitoring P levels has historically, due to winter freezing, only occurred between the months of May to November.
- With warming temperatures Vermonters may be seeing more winter rains than snow. (Morse and Munroe, 2011) Climate change with associated increased frequency of storm events carrying runoff and flooding could account for up to 95% phosphorus loading. (Stager and Thill, 2010)
- Our research seeks to 'fill the gap" in the data. We examine, in addition to months May-November, P and TSS in tributaries to Lake Champlain during the months December through April.

Materials and Methods

- Water samples (total phosphate and total suspended solids) were collected from 2nd level streams to two major tributaries to Lake Champlain bi-monthly year around between July 2013 and August 2016.
- The ascorbic acid colorimetry protocol was used from the Standards Methods Manual (AQ2 method EPA-118-A Rev. 5) to analyze total phosphate (TP). These samples were analyzed at Johnson State College, VT.
- Total Suspended Solids (TSS) were analyzed using the Standard Methods for the Examination of Water & Wastewater (APHA 2005) and Wetzel & Likens 2000. These samples were analyzed at St. Michael's College, VT.
- Total phosphate from both streams was averaged together per month, as was Total Suspended Solids.




Black Creek E. Fairfield, VT

MONTH	P µg/L	TSS mg/L
January	30.19	14.72
February	17.72	9.23
March	82.82	16.51
April	29.1	19.4
May	8.17	6.96
June	18.96	10.51
July	26.83	7.67
August	20.12	17.38
September	24.54	6.22
October	14.05	4.57
November	25.42	11.85
December	10.57	4.49
AVERAGE	25.7	16.51

Table 1

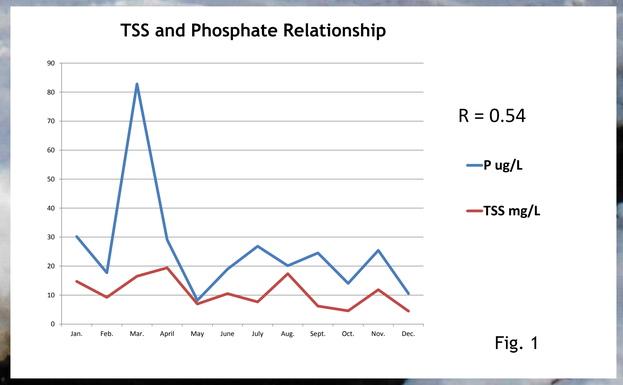


Fig. 1

Discussion

- TSS and P are averaged per month for two 2nd level streams contributing to two different tributaries to Lake Champlain show year round flux, particularly in the winter months.
- P showed a moderate correlation (R=.54) Table 1 to TSS in year around average monthly comparison.
- The overall yearly P average is 25.7 µg/L, and the yearly TSS average is 10.79 mg/L (Table 1). Higher levels of TSS and P were found in March (P, 82.82 µg/L, TSS, 16.51 mg/L). Above average levels were also found in Jan. for both TSS and P, as well as in Feb. for P.
- This data indicates phosphorus loading also occurs during the winter months.
- P and TSS data has previously been collected only during May-November (Smeltzer, Quinn 1996) and during large storm events (LCBP, 2016).
- Continued data collection during the winter months may show the actual P loading on Lake Champlain in mt/yr may be much higher than what is reported.

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Mill Brook in March at Fairfax, VT

RACC Research on Adaptation to Climate Change in the Lake Champlain Basin

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