Watershed and Lake Bio-Geochemistry: Movement of Phosphorus and Sediments from Forested Areas into Water Bodies

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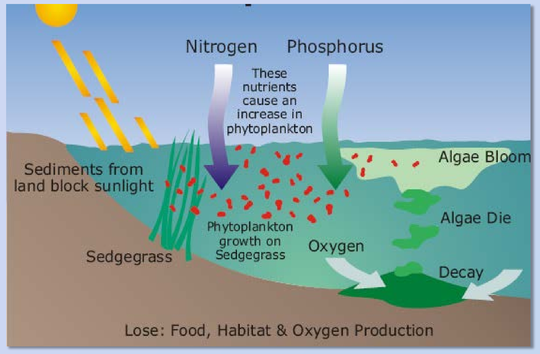
Abstract

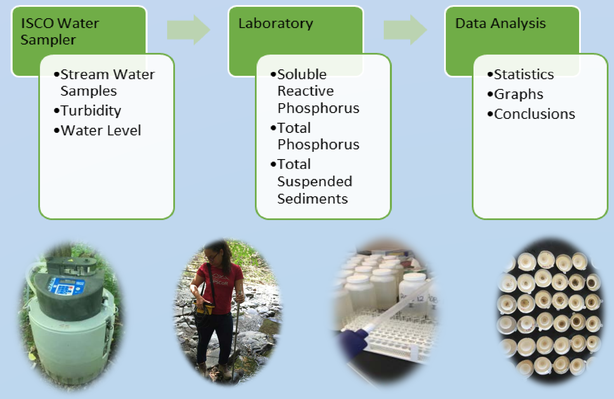
Eutrophication is known as an excess of nutrients (mainly nitrogen and phosphorus) in water bodies, specially rivers and lakes, due to runoff from lands which causes an incontrollable growth of algae that can cause animal death because of food, oxygen and habitat shortage. Lake Champlain, in the state of Vermont, has been experiencing an algae bloom problem through the past years. Many factors are believed responsible for the bloom, like for example agricultural practices, soil erosion and climate change. It was determined that phosphorus (P) is one of the main nutrients responsible for the algae blooms, especially in summer where the temperature tends to increase; also is the one factor that can actually be mitigated. This research was focused in Missisquoi Bay, which constitutes only 0.8% of the total volume of the lake. In the Missisquoi Bay two sites were studied, Ross Brook and Kings Hill Brook. Each one of these sites with different surroundings that contribute to the phosphorus (P) concentrations in the soils and water streams. Ross Brook has a maple sugaring farm and a livestock area where they had access to the stream and Kings Hill has a maple sugaring farm nearby and it is believed to be a logging site. Each site was water sampled by an ISCO during each big storm. Data was downloaded where levels, samples, temperature and turbidity values were obtained. After recollecting data, all the samples were taken to the chemistry laboratory analyze and quantify total phosphorus (TP), soluble reactive phosphorus (SRP) and total suspended solids (TSS). Further research would try to demonstrate that high phosphorus concentrations in the lake result mainly from agricultural activities rather than forested areas; given that agricultural activities are common in the state.

Eutrophication



Locations Studied

Methodology



Results

Figure 1a: Kings Hill Brook water level (m) versus monitored days by ISCO Water Sampler. The higher peaks observed are storms monitored by the equipment.

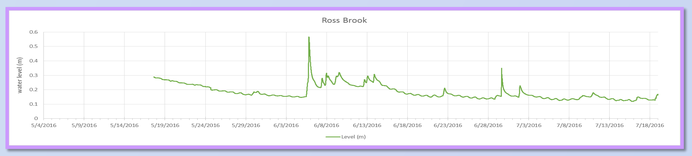


Figure 1b: Ross Brook water level (m) versus monitored days by ISCO Water Sampler. The higher peaks observed are storms monitored by the equipment.

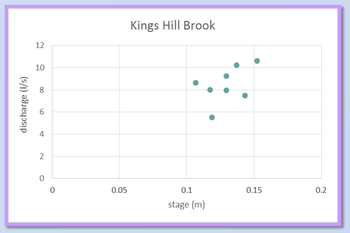


Figure 2a

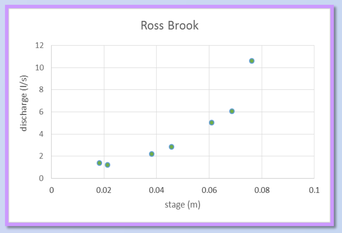


Figure 2b

Figure 2: Average Discharge (L/s) versus Stage Measurements (m). In order to determine flow measurements in each stream a relationship between discharge and stage needs to be established; higher the level better the measures.

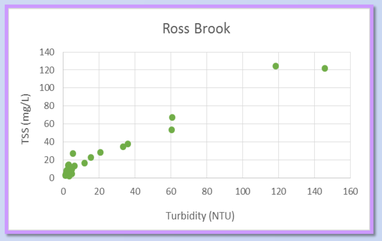


Figure 3: Total Suspended Solids (mg/L) versus Turbidity (NTU). A proportional relation between turbidity and total suspended solids was determined; when turbidity increased the total suspended solids recollected increased as well.

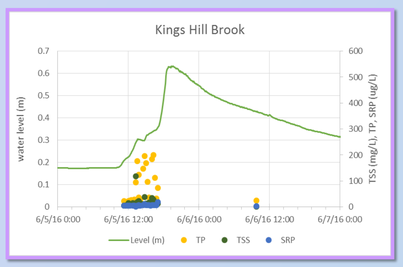


Figure 4a

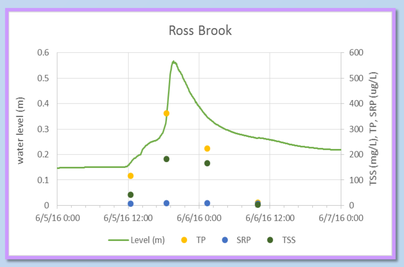


Figure 4b

Figure 4: Concentrations of Total Phosphorus (TP), Total Suspended Solids (TSS) and Soluble Reactive Phosphorus (SRP) in contrast with water level (m) and different dates (days). When in comparison it can be observed that the concentrations of TP, TSS and SRP are higher in Kings Hill Brook than Ross Brook when a storm occurs.

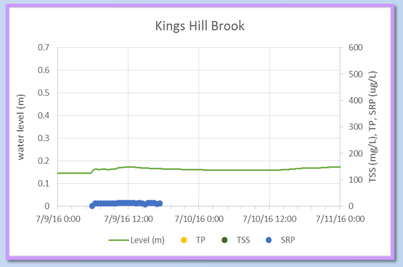


Figure 5a

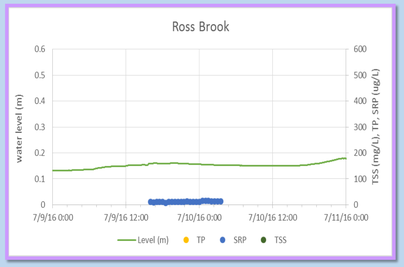


Figure 5b

Figure 5: Concentrations of Total Phosphorus (TP), Total Suspended Solids (TSS) and Soluble Reactive Phosphorus (SRP) in contrast with water level (m) and different dates (days). When compared to the figures above, we can demonstrate a relation between water levels and the variables measured. When the water level is lower as well TP, TSS and SRP values.

Conclusions

- Main goal is to demonstrate that phosphorus concentrations in forested areas after a storm are low in comparison with the concentrations in agricultural sites.
- Future work involves using hydrology in order to model and predict nutrients discharge to the water bodies; using variables as area and velocity measured in the two sites studied.
- Additionally, other bays in the Lake Champlain Basin would be studied following the same process followed in the Missisquoi Bay.
- Once all data is collected, a detailed comparison is going to be made in order to compare it with the agricultural data.

References

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