The Effect of Stream Disturbance on Total Phosphorus in Rural Agricultural Streams Compared to Mountain Streams

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INTRODUCTION:

A major concern of environmentalists in the world today is the pollution of streams, especially of ones that lead to large bodies of water. Phosphorus, a vital nutrient for living organisms, in excess, can become a detrimental pollutant producing drastic effects on our water systems. Eutrophication is a well-documented result of excessive amounts of phosphorus in a body of water. Increase in nutrient loading such as phosphorus leads to decreased water quality and an exponential increase in algal growth and decomposition resulting in depleted oxygen supply. Changes such as these in streambeds make it difficult to support aquatic life and maintain strong biologically diverse conditions.

Phosphorus can enter stream water from point sources such as waste-water discharge and non-point sources like agricultural runoff. Erosion is also a means by which phosphorus can enter stream water because P can attach to soil particles. Therefore, when the soil ends up in the stream as sediment it contains additional phosphorus, which eventually settles. The benthic sediment now has the potential to act as a "sink" for phosphorus, and holds the nutrient there until it is disrupted by activity or natural events. It is important to study different sources of pollutants such as phosphorus in order to better control the amount that is being delivered to the streams.

In this study, we hypothesized that a "stream disturbance" should lead to higher phosphorus levels due disruption of benthic sediments and release of phosphorus. Our group chose to compare a "mountain" stream, which we defined as a stream having an elevation of greater than 1000 feet to a rural agricultural stream (elevation below 1000 feet). Often times, phosphorus can come from "agricultural fertilizers, manure, and organic wastes in sewage and industrial effluent" (Perlman, 2012). Therefore, it is highly probable that streams that do not experience high amounts of agricultural run-off will have lower levels of phosphorus than streams at higher elevations, but will still exhibit a corresponding increase of phosphorus if sediment release is a contributor. We used an increase in the Total Suspended Solids (TSS) as an indicator for stream disturbance. Total suspended solids can increase with physical changes such as heavy rains and under certain biological conditions such as algal blooms. Therefore, by comparing TSS to Total Phosphorus (TP), we can see if there is a relationship between the two water quality measurements.

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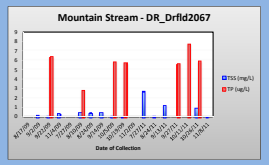
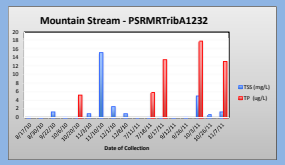
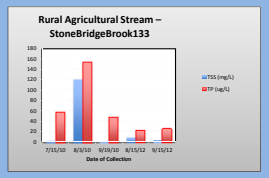
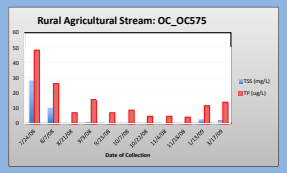
DATA:









ANALYSIS:

The data showed as TSS increased in the either of the rural agricultural streams, so did the TP level. However, there is no correlation between the increase in total suspended solids (TSS) and an increase in the total phosphorus (TP) in either of the mountain streams. Due to the fact that there is such limited data, we are unable to make a reliable conclusion about the data.

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Discussion:

The results obtained through our study relating to the effects of stream disturbances on phosphorus levels in two different types of streams helped us to come to a conclusion that disturbance of benthic stream sediment is not, in some cases, a major contributing source in elevating levels of phosphorus in streams. We compared four graphs, two rural streams and two mountain streams and found that in the mountain streams there was no corresponding increase in TP with disturbance (increase in TSS). Therefore, we are not able to accept our hypothesis, but are able to accept our null hypothesis.

The two rural agricultural streams at the lower elevation showed corresponding increased TP levels with disturbance (elevated TSS). A larger sample population is needed to validate the findings related to this stream type. When comparing the two stream types other factors need to be considered and investigated. The differences between the two different types of streams may be attributed to the following:

- Faster moving streams in higher elevations carry more phosphorus with attached sediment to slower moving (lower elevation) sections of a stream. Therefore, accumulation of sediment and phosphorus is greater in lower elevation streams.
- Rock particle size is smaller at lower elevations then higher elevations due to erosion as particles flow downstream. Smaller particle size increases the surface area for adsorption of phosphorus, increasing levels downstream.
- Lower elevation streams are fed from other branches upstream, which may be affected by other potential sources of phosphorus resulting in increased phosphorus downstream.
- The mountain stream has limited sources of phosphorus. When disturbances such as increased flow occurs, a dilutional effect on the phosphorus content results.

Due to inconclusive results, further studies are warranted.

Hypothesis:

If the TSS is increased, then the TP should be increased in both the rural agricultural stream and the mountain stream due to stream disturbance.

Null Hypothesis:

If the TP is increased, but the TSS is not increased in either the rural agricultural stream or the mountain stream, then other factors besides stream disturbance affects the TP of the stream.

METHODS:

- Data for the study was obtained from the *Vermont EPSCoR Streams Project*. The data chosen for analysis was based on the following criteria:
- TSS samples had corresponding TP samples collected on the same day
- Sample collection techniques for all samples collected were performed according to the protocols for TSS and TP as outlined in the *Vermont EPSCoR Streams Project* manual
- All sample data came from fourth order streams

- Each TSS and TP data point was obtained by calculating the average of 2 -3 samples taken on any given day and used to create the column graphs. Graphs were then analyzed for any spikes in TSS, which indicated a disturbance, and any corresponding change in the respective TP.

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