Microbial Phosphorus Levels in soils under different land use in the Missisquoi Watershed

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Introduction

The Missisquoi River is a major tributary of Lake Champlain, which is facing serious ecological degradation due to nonpoint source pollution. In the Missisquoi Bay, total phosphorus (P) concentrations have increased by 72% since 1979 and continue to rise (Smeltzer et al.,2012). The land in the Missisquoi drainage basin is dominated by forest cover, but also has substantial acres of cornfields. These land types act as nonpoint sources for phosphorus pollution in the Missisquoi Bay.

Organic P is an important type of nonpoint P pollution. Sources include manure, sediment runoff, and poor sewage treatment. More specifically, this study will observe the organic phosphorus in active microbial populations of forested sites and corn fields in the Missisquoi Bay watershed.

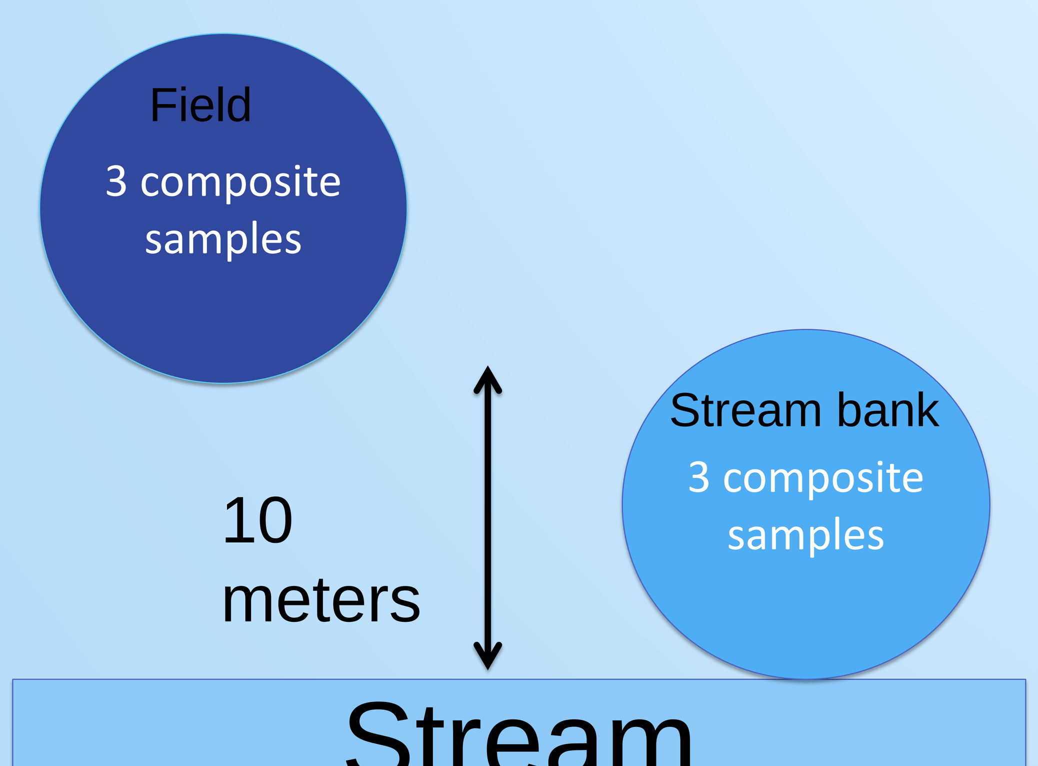
Objectives

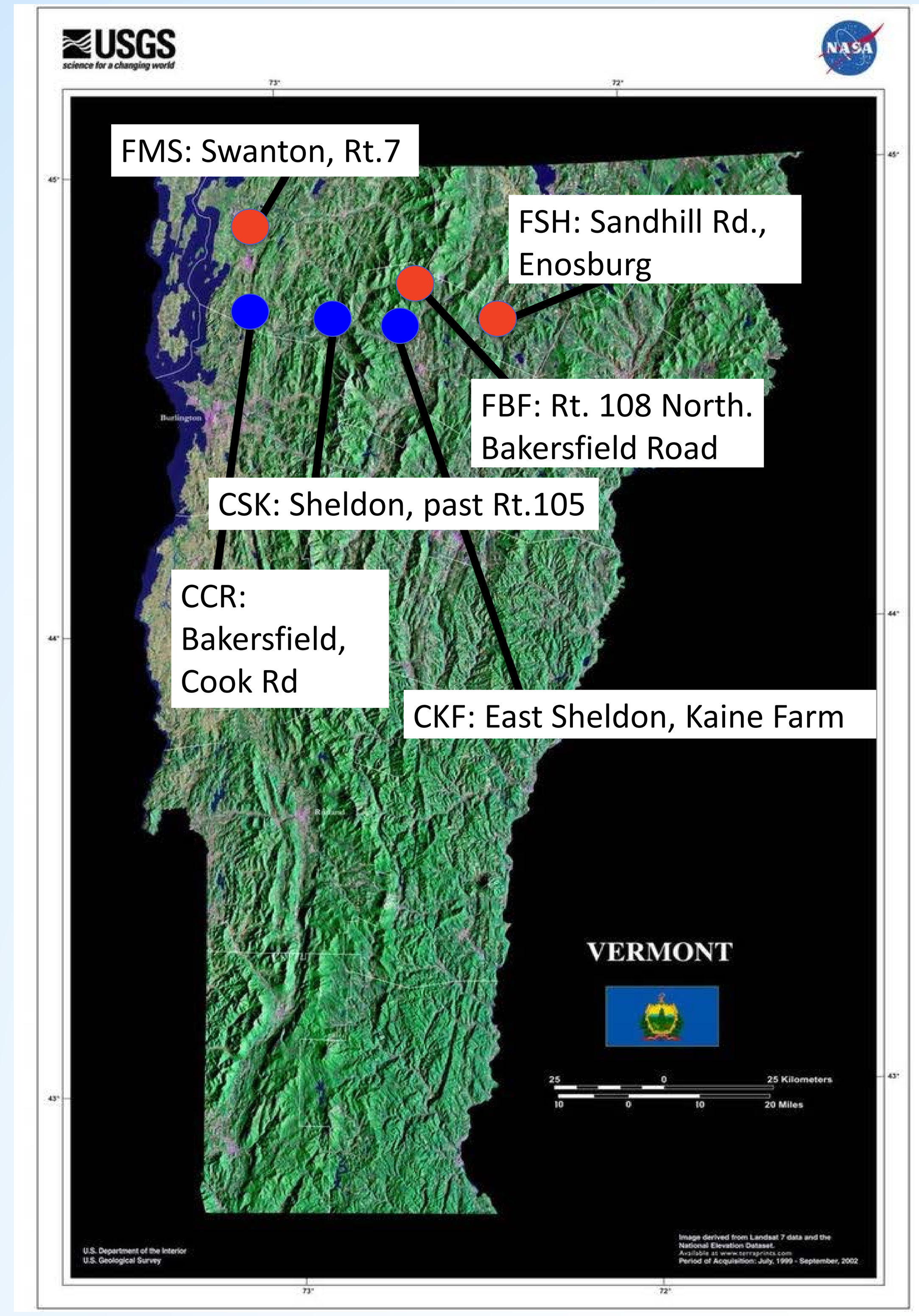
1. Understand microbial contribution to total and organic soil P
2. Characterize microbial P pools across two major land use types in the Missisquoi watershed, forest and corn

Methods

In the Field

- Six sites were chosen in the Missisquoi Watershed, 3 of which were forested and 3 of which were corn fields.





Map of sites sampled in this study, red indicates forested land cover and blue indicates cornfield cover

- Composite samples (n = 5 per composite) were taken in the field 10 m from the tributary, and along the streambank

In the Lab

- Sieved soils through 2 mm. Samples were refrigerated until processed.
- Moisture content was calculated by drying soils at 60ºC, and 10g of oven-dried equivalent soil was measured out for fumigation (two iterations per sample)

Fumigation/Extraction Treatment

- Fumigation/Extraction protocol as recommended by Wu et al. (2000) and by Voroney et al. (2008)

Left: Sampling method for sites. 5 subsamples combined for each sample, 6 total samples per site (3 field and 3 stream bank)

Results

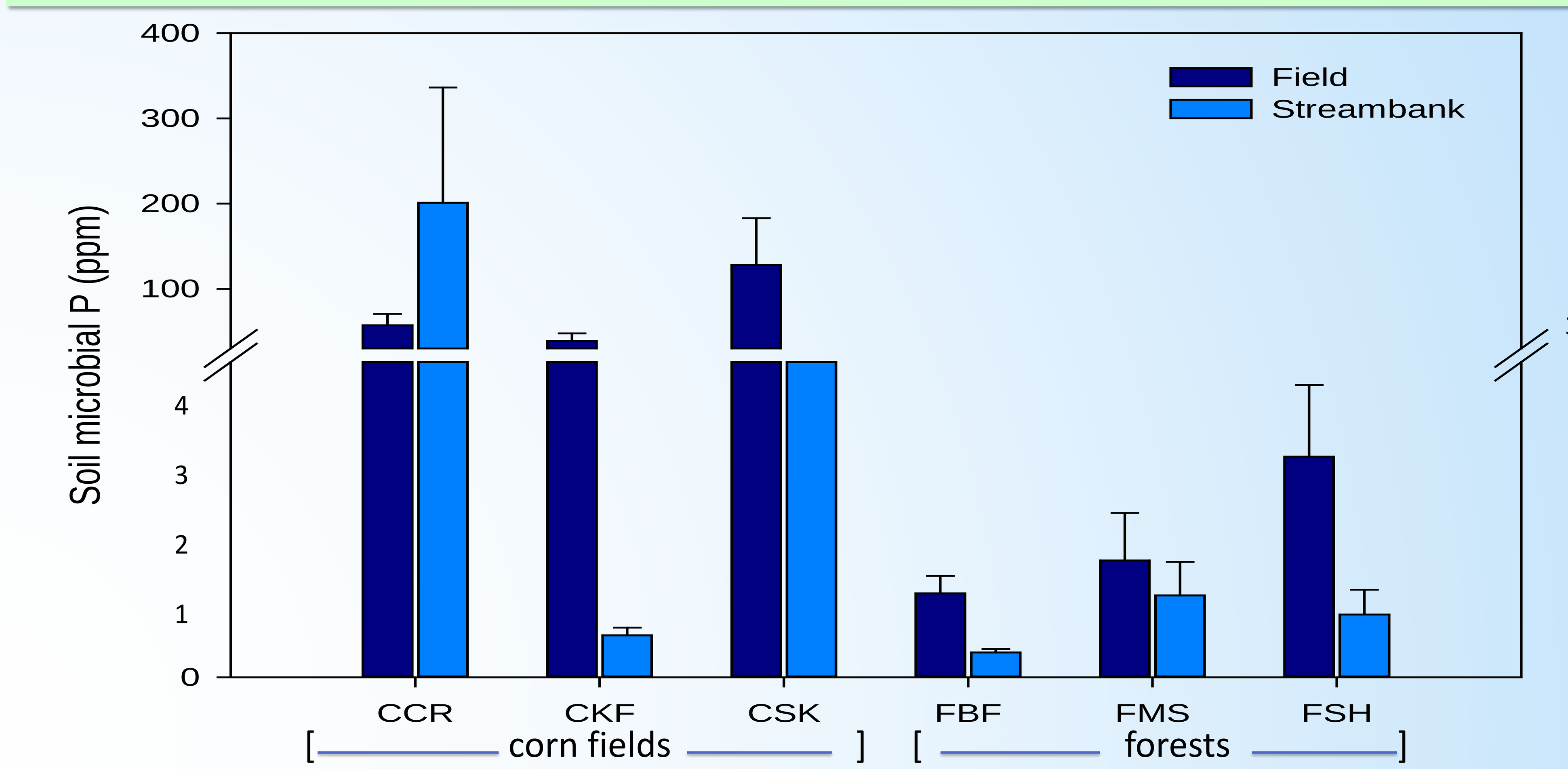


Figure 1. Average microbial P (ppm) of each site for both field (10 meters away from tributary) and stream bank samples

Conclusion

Areas under cornfield cover had higher microbial P concentrations compared with forest cover. However, the transformation patterns from inland to stream bank sites (Figure 1) show that microbial P is not high in stream bank soils regardless of concentrations in upland fields (with exception of CCR).

These data suggest there fertilizer inputs in cornfields may stimulate microbial P uptake. However, it is unclear how the differences in microbial P among these two land types influence retention of organic P in these soils. These data should not negate the importance of riparian zones in reducing runoff into water sources, which can capture both chemical contaminants and soil mass (Aguiar et al., 2015). Having a strong and diversified riparian zone will reduce any further microbial P runoff.

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References

Aguiar Jr., T. R., Rasera, K., Parron, L. M., Brito, A. G., & Ferreira, M. T. (2015). Nutrient removal effectiveness by riparian buffer zones in rural temperate watersheds: The impact of no-till crops practices. *Agricultural Water Management, 149*, 74-80..

Smeltzer, E., Shambaugh, A., Stangel, P., 2012. Environmental change in Lake Cham- plain revealed by long-term monitoring. J. Great Lakes Res. 38 (Supplement 1), 6–18.

J. Wu, et al. (2000). Quantifying microbial phosphorus biomass in acid soils. *Biol Fertil Soils, 32*: 500-507.

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