Escherichia coli Levels Based on Land Use Percentages

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Introduction

Escherichia coli are a group of bacteria that are used to determine the presence of human pathogens in water. This study focuses primarily on the *E. coli* presence within the tributaries of the Lamoille River. Water samples were taken from 19 stream sites during different weather events. The results from weather events that showed a rising hydrograph appeared to have a higher Most Probable Number (MPN) of *E. coli.*
A study in Africa determined that looking at the land use along the river basin could explain up to 95% of the variability in *E. coli* levels (Anyona, 2013). The current theory that land that is dominantly agricultural results in an increase in the *E. coli* levels has been reaffirmed in a 2008 study in Illinois. This study showed that during "stormflow," (or a rising hydrograph), the levels are significantly higher on dominantly agricultural lands (Friedmann, 2008). A 1998 study in Guam assured that levels of *E. coli* were raised during storm-events but put the blame on *E. coli* that was in the soil (Fujioka, 1998). The runoff during storm events pushed more *E. coli* into the river. The purpose of my study was to confirm the hypothesis that agricultural lands have the biggest influx of *E. coli* during rain events that caused a rising hydrograph by examining the catchment 1 mile upstream from each site.

Methods

Samples were collected from 19 stream sites in the Lamoille River watershed over the course of three years. Each time samples were collected 3 samples were taken from each site. For this study any samples that were collected on a rising hydrograph day were used. The samples were then put into 1%, 10%, and 100% dilutions and poured into quanti-trays. Quanti-trays were used to determine the Most Probable Number (MPN) of total coliform and *E. coli* present in the 100mL sample. For my purposes only the *E. coli* numbers were used.
The mean was taken from each of the samples collected from each site per day and were compared to the % Agricultural, Forested, and Impervious land use. These percentages were obtained by using the NOAA NLCD land cover data and reduced it to the total catchment area going 1 mile upstream from the stream site. These numbers were then placed in a scatterplot to determine the correlation between % land use and MPN *E. coli*. In order to do this a linear transgression was used and R^2 values were determined.

Results

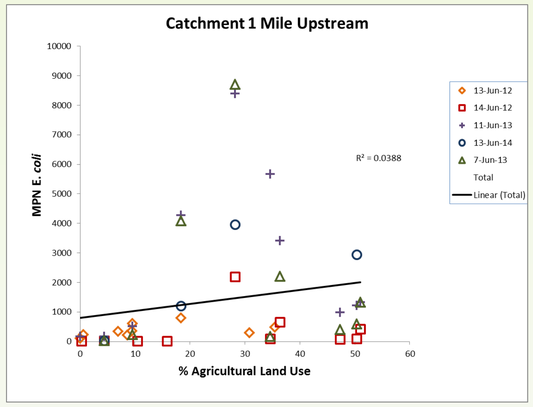

Figure 1.

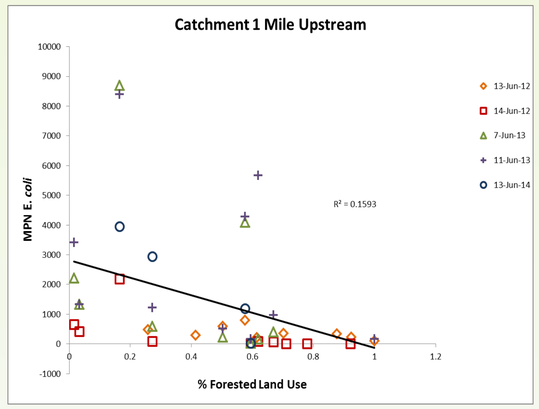

Figure 2.

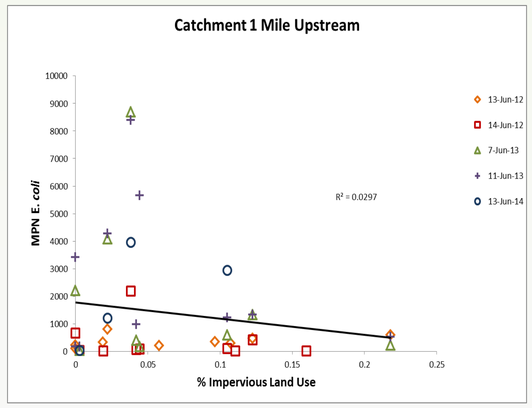

Figure 3.

Figures 1,2,3. Most Probable Number (MPN) of *E. coli* was obtained by taking the mean from samples collected on rising hydrograph days from each stream site.

Discussion

The use of the entire catchment to determine influx of *E. coli* would have resulted in a lack of evidence as it would hide the real effect on the river. Lands that are a great distance from the stream appeared to have no direct effect on the *E. coli* levels. Figure 1 shows agricultural land use and there is a peak at 27% agricultural land. The points that create this peak are both from the Deer Brook 0380 site. Based on this figure Deer Brook 0380 is the most polluted site on the Lamoille River, however further research is required. Figure 2 portrays the *E. coli* levels at lands with a higher percentage of forested land. This linear regression had the best R^2 value of the three figures. Forested lands have the least amount of human influence and therefore can be considered the natural change of *E. coli* levels during a rising hydrograph. Figure 3 shows impervious lands and land that was 13% impervious or less had the higher levels of *E. coli.* Land that was less impervious was likely to be more agricultural.

Conclusion

In conclusion, although it appears that agricultural land is where the majority of *E. coli* levels are coming from, more research is needed. Future research should include looking more closely at the various types of agricultural land to determine better agricultural land use. These types should include whether there are grazing animals, compost spreading, vegetable gardens, animals present, and fertilizers used on said land.

References

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