Interstitial Soil *Escherichia coli* in the Environment

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Introduction

Elevated levels of *E.coli* in rivers cause economic hardship and health issues (beach closings). *E.coli* in large quantities has lead state environmental decision-makers to presume that other fecal microbes that cause illness may be present in the water which can be a threat to public health (VT Department of Health, 2012b). The source of *E.coli* is often assumed to be overland runoff from impervious and agricultural areas. Jovanelly (2011) found that in Georgia, USA, *E.coli* levels were significantly elevated at locations where agriculture was adjacent to the river's bank. Based on the literature, the expectation is that land use with more animals correlates to greater levels of *E.coli* found in the soil.

Recent research suggests that stream bank erosion is actually a significant source of aquatic pollutants like phosphorus (Hudon & Carignan, 2008). Recent research has also shown that *E.coli* reside in stream bank and lake shore sediments. Ishii and Sadowsky (2008) found that *E.coli* can become "naturalized" to stream sediments and lake sand beaches at the right temperature to become an active member of natural microbial communities in the environment.

We wanted to see if *E.coli* comprised a significant component of stream bank sediments in the Lamoille River Basin, and whether their abundance was related to land use in close proximity to the stream. The focus for this research project was to determine if densities of interstitial *E.coli* are related to land use in the 19 stream sites from 10 tributaries of the Lamoille River Basin, Vermont.

Collecting environmental *E.coli.*

Materials and Methods

Field Assessment

Interstitial (soil) water samples were taken from 19 different stream sites during low flow conditions in June, 2014 and 2015. The samples were collected from three exposed areas of soil within one foot of the stream bank. Each hole was dug by scraping away the exposed layer of soil with a sterilized trowel to minimize contamination in the hole. After one scrape, the trowel was re-sterilized and used to dig down until interstitial water started to fill the hole. A sterile transfer pipette was used to pipette 25-30mL of the interstitial water into a sterile test tube. Samples were transported on ice back to the lab for processing. Samples were taken on two different days when streams had low flow rates.

Colilert-18/Quanti-Tray/2000 Method

This method is used to identify the presence and most probable number of total coliform and *E.coli* (IDEXX, 2013) in 1mL of sample. Samples were diluted with sterile buffer to bring the levels of *E.coli* within a range that could be analysed with the IDEXX system.

Land Use

The proportion of agricultural, impervious, and forested land uses was determined in a 100 m belt transect extending 100 m upstream from each sample site by employing ArcGIS software.

Data

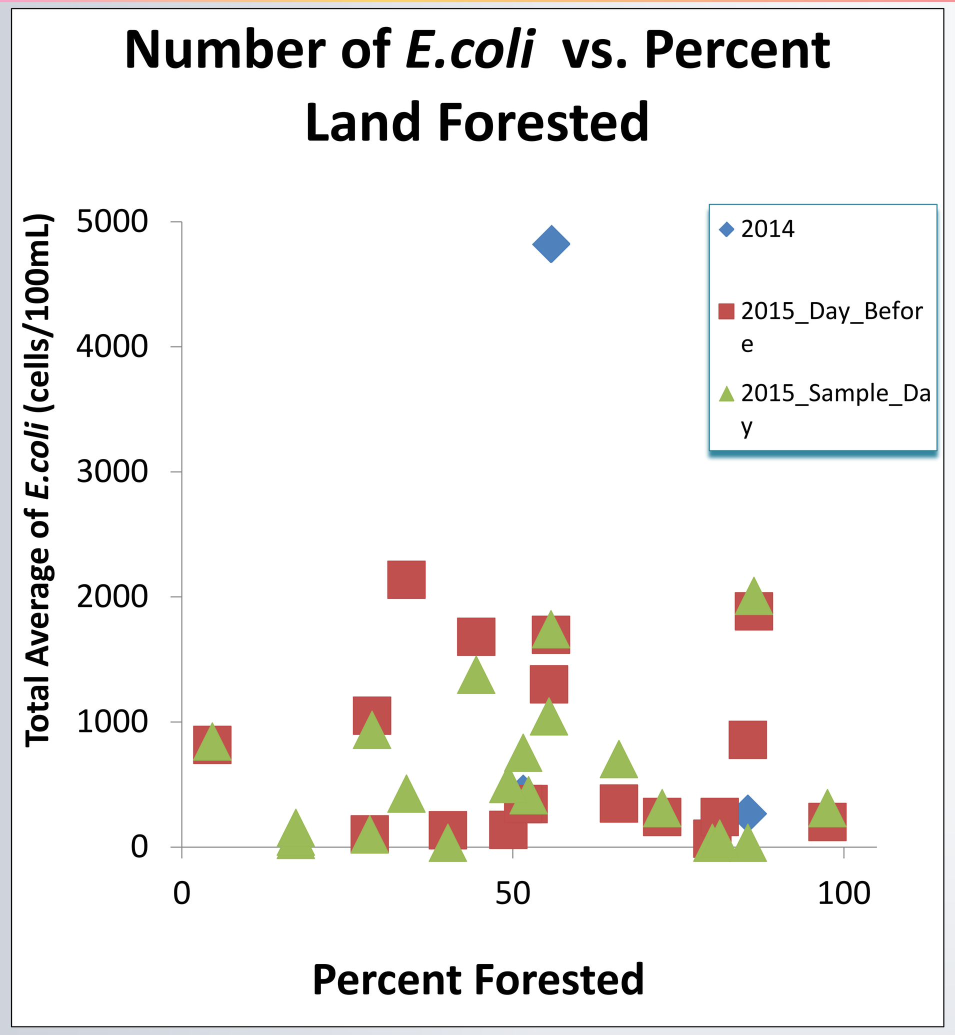

Figure 1.

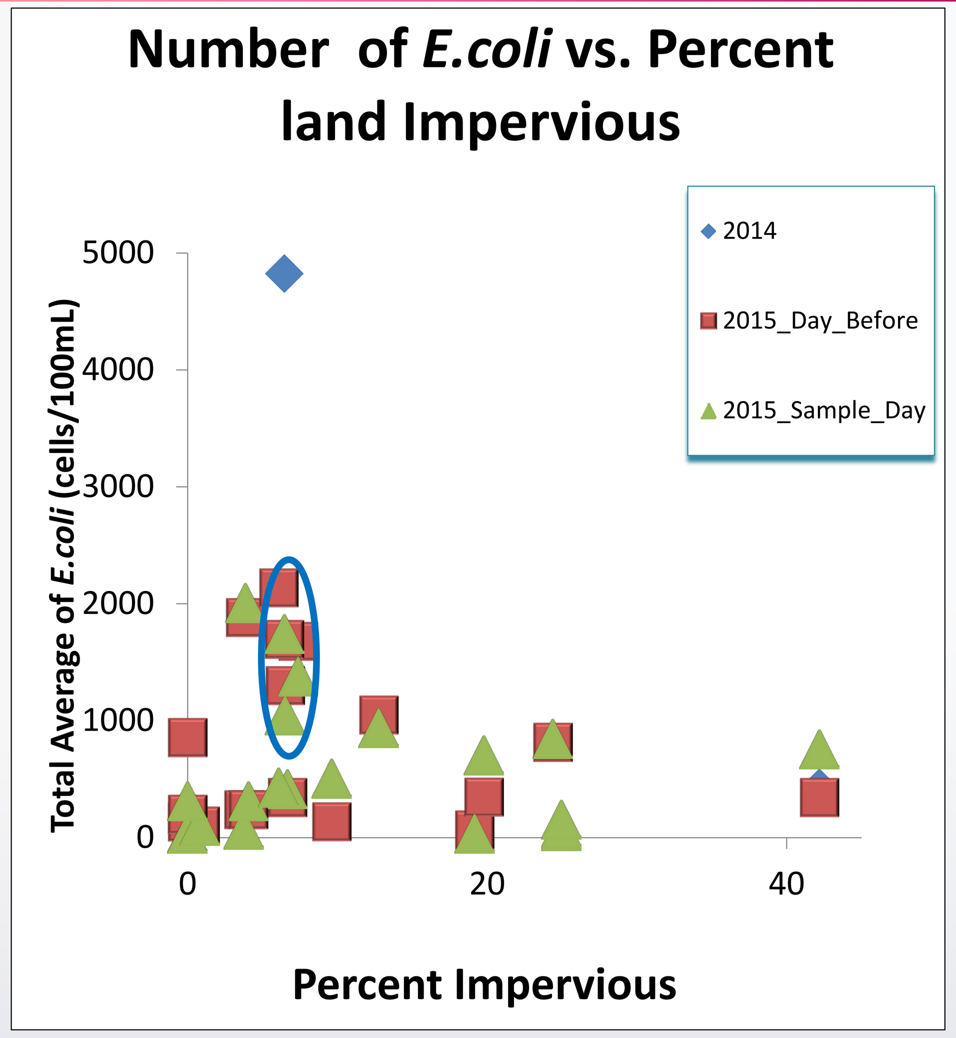

Figure 2.

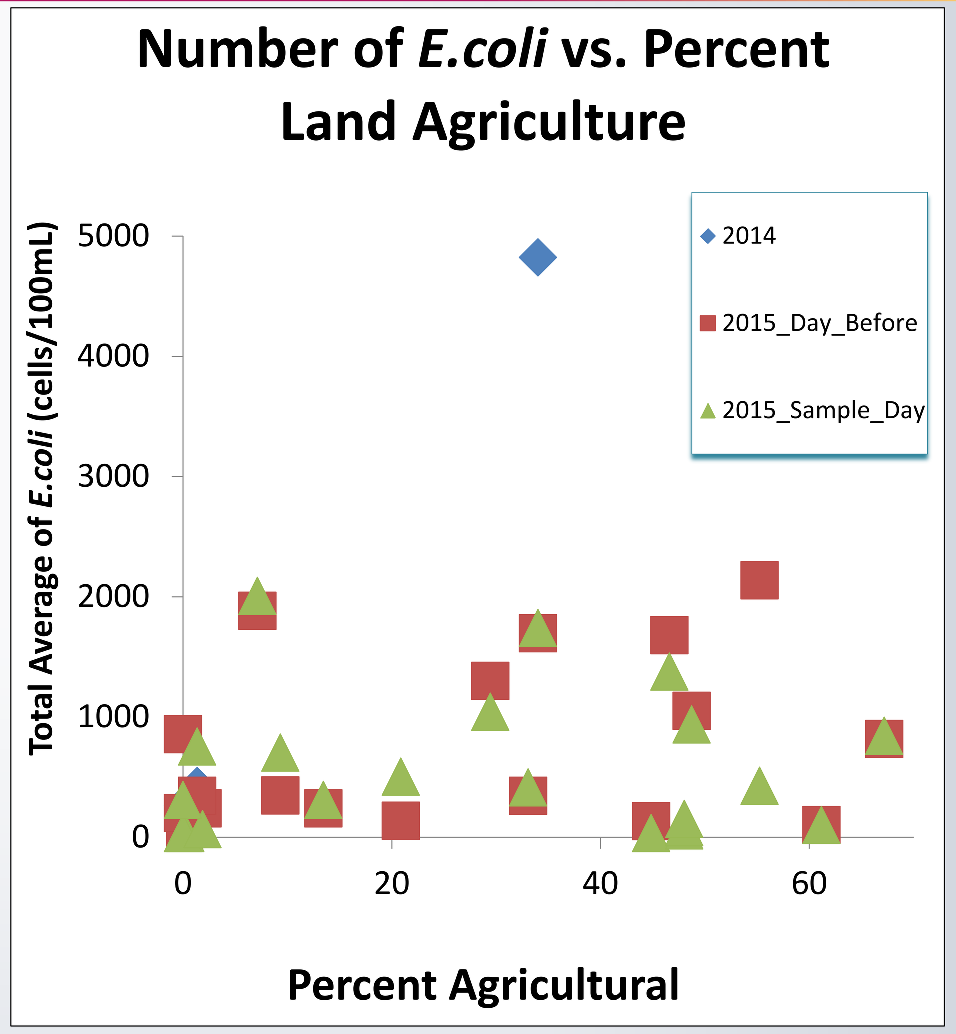

Figure 3.

Results

- This study found that elevated levels of *E.coli* appeared to be correlated to stream bank sediments at areas with 5-10% impervious land (Fig.2). High *E.coli* levels were observed throughout the spectrum of land use both at high and low percent's.
- *E.coli* abundance appears to be higher when impervious land is less than 10% of the stream-side land use (Fig. 2).
- No correlation was observed between abundance of *E.coli* and percent land agriculture or forested (Figures 3 & 1).
- *E.coli* abundance was similar at low percent agricultural areas and areas with 50% agriculture (Fig. 3).
- Large and small amounts of forested land use had similar *E.coli* concentrations (Fig. 1).
- *E.coli* abundance did not appear to be related to amounts of agricultural or forested land use at the 19 sites, but they did share similar amounts of *E.coli* levels at various percentages (Figures 3 & 1).

Discussion

The slightly higher densities of *E.coli* near impervious sites has also been observed by Desai and Rifai (2010) who found that urbanized stream sites exhibited overall higher *E.coli* concentrations than grasslands near upstream sites in Texas, USA. Additionally, they found that variability exhibited by downstream sites is due to cumulative effects of various stream flow and sources of bacteria (2010).

According to Ishii and Sadowsky (2008), the ability of *E.coli* to survive and grow in the environment is likely due to its versatility in energy acquisition, ability to degrade aromatic compounds, and grow over a broad range of temperatures. The *E.coli* identified in this study does not appear to be related to local land uses (within 100 m of the stream extending 1 km upstream) such as, farms and human habitation. This suggests that "naturalized" environmental *E.coli* in the soil can come from a variety of impervious, agricultural, and forested land uses. The data supports the hypothesis that there is environmental *E.coli* at these sites.

References

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