The rapid growth and urbanization that is occurring in many locations is increasing the already significant deterioration of surface water quality. Increased listing of surface water bodies on impaired waters (303(d) lists) for pollution impairment and the need to address these through the Total Maximum Daily Load (TMDL) process as required under the Clean Water Act of 1972 has resulted in increased research to find methods that effectively and universally identify sources of fecal pollution. Combined with a targeted water sampling approach to identify pollution sources and monitor remediation efforts, Boones, Buffalo and Cash Hollow Creeks on the State of Tennessee’s 303(d) list due to pathogen loading (1), and a TMDL for Sinking Creeks are listed on the State of Tennessee’s 303d list due to pathogen loading (1), and a TMDL for Sinking Creek in Tennessee has been approved. The data demonstrate that the creeks vary in their extent of fecal pollution (309 – 1175 CFU/100ml), and that land use patterns influence the microbial and chemical water quality parameters that are correlated with fecal indicator concentrations. This suggests that not only TMDL development require multi-year data using a targeted sampling approach instead of a 30-day geometric mean, but also that the development of TMDLs for entire watersheds may be limited in their ability to effectively identify sources of fecal pollution throughout the entire watershed. The objective of this research is to update results of previous reports and apply multivariate statistical techniques to identify common patterns that influence the fate and transport of fecal indicators from various watersources. We will discuss the conclusions and usefulness of these data to accomplish this objective.

INTRODUCTION

OBJECTIVES

1. Assess the overall chemical and microbial factors that influence the water quality in the Watauga River watershed using a targeted sampling and monitoring approach to identify common patterns that influence the monitored water quality parameters to various pollution sources.
2. Apply multivariate statistical methodology to the collected data to better understand how chemical and microbial variables are influencing fecal water quality.
3. Using this watershed as a model, determine the usefulness of this approach to identify common patterns associating these monitored water quality parameters to sources of fecal pollution.

RESULTS

• Significant differences in fecal coliform concentrations are observed for Boones, Buffalo, Cash Hollow and Sinking Creeks within the Watauga River watershed (Fig. 3a). Seasonal variation of fecal coliform concentrations was also observed with the highest concentrations observed in the summer and fall months (Fig. 2b).
• Fecal coliform concentrations vary within and between creeks. Typically, the highest concentrations are observed at agricultural land use sites (Fig 4a-c).
• Yearly fecal coliform concentrations also display spatial and seasonal trends. All creeks exceed regulatory limits for fecal coliform concentrations (Fig. 3a) in each year with the highest fecal coliform concentrations observed during the winter and fall months (Fig. 5b).
• Canonical discriminant analysis of fecal water quality data indicates sources of fecal pollution vary within the watershed. Soil erosion primarily impacts Boones and Buffalo Creeks. Sinking Creek is impacted by urban runoff and Sinking Creek is impacted by a combination of soil erosion and urban runoff.
• Canonical discriminant analysis demonstrates a grouping effect of class means by site and land use pattern. A plot of the discriminant canonical variables displays the degree of discrimination between sites (Fig. 6a). The canonical variables show strong separation between sites and land uses, demonstrating the strong influence of spatial specific conditions on water quality within and between creeks in the Watauga River watershed (Table 1).

CONCLUSIONS

The application of multivariate statistical methods to water quality data has helped to identify common patterns associating monitored water quality parameters to various pollution sources. Combined with a targeted water quality monitoring program, the data analysis approach is a useful method to identify sources of impairment to and identify BMPs that can prevent and remediate the effects of rapid urbanization.

BIBLIOGRAPHY


Table 1. Description of Canonical Structure by Land Use

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<thead>
<tr>
<th>Canonical Variable</th>
<th>Water Quality Variables Describing Canonical Structure</th>
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<tr>
<td>Alkalinity</td>
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<tr>
<td>Total Coliforms</td>
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<td>Fecal Coliforms in Sediment</td>
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