

## **Report for 2003KY19B: Does straight pipes removal improve water quality in eastern Kentucky?**

- Conference Proceedings:
  - Coyne, Mark, George Hofius, Ann Freytag, and Siva Gandhapudi, 2004, Survey of water quality in several Kentucky PRIDE counties impacted by straightpipes, in Proceedings of the Kentucky Water Resources Annual Symposium, Kentucky Water Resources Research Institute, Lexington, Kentucky, 43-44.
  - Ritchey, Sloan, and Mark Coyne, 2004, Antibiotic resistance patterns of fecal streptococcus and fecal coliforms as water quality indicators, in Proceedings of the Kentucky Water Resources Annual Symposium, Kentucky Water Resources Research Institute, Lexington, Kentucky, 45-56.

Report Follows

## **Problem and Research Objectives**

Straight pipes and other inadequate on-site waste water disposal systems contaminate surface and groundwater resources with various potentially pathogenic microorganisms, reactive organic carbon, and readily available nutrients. These contaminants contribute to making over 1/3 of Kentucky's surface waters unfit for swimming and primary contact. Attempts have been made to reduce watershed contamination in eastern Kentucky by providing financial assistance to individuals, groups, and communities to install effective on-site waste water treatment systems or hook into existing community sewerage systems. These actions should improve water quality in the affected streams, but there is little proof that they do, and little follow-up on the performance of new on-site systems. The objectives of this project were: 1) identify streams affected by straight pipes and other failing on-site systems and characterize the number and composition of fecal bacteria and other water quality parameters; 2) follow changes in water quality parameters after existing systems are removed and replaced by new on-site waste-treatment facilities; and 3) evaluate the performance of new onsite systems.

Due to time constraints and the inability to identify new onsite systems, we did not carry out objective 3 – evaluation of new systems. We were also unable to get cooperation from the KY PRIDE project to facilitate identifying locations that were about to be converted from straight pipes to onsite systems as specified in objective 2. Therefore, we opted to work with our alternative plan for this objective, which was to conduct a pair-wise comparison of streams that were mapped as having numerous straight pipes versus those that were not.

## **Methodology**

There were no essential changes in methodology in the proposed study. Four sites with high and four sites with low straight pipe impact were identified in four counties (Green, Lee, Wolf, and Breathitt). A control watershed in Robinson Forest in which there is no influence of human septage was also identified with cooperation from the Department of Forestry. The control site was sampled with the same frequency as the research sites. The paired stream sites (impacted or unimpacted by straight pipes) were sampled on a weekly basis from October to December 2003. Water and sediment samples were collected and processed within 8 hours for fecal coliforms and fecal streptococci by membrane filtration, biological oxygen demand (BOD), electrical conductivity (EC), pH, inorganic N, TN, and TP. The 'pristine' site in Breathitt Co. (Robinson Forest) was used as a standard against which other sites were compared. Antibiotic resistance profiles were created for a subset of enterococci, fecal coliforms, and indigenous gram-negative bacteria for later use in assessing whether changes in septage load affected stream microbial ecology. Ecological profiles of species and antibiotic resistance patterns in impacted waters were assessed by discriminant analysis. Other statistical analyses will be performed as appropriate.

## **Principle Findings and Significance**

Weekly sampling at each site gave consistent results, and was sensitive to environmental influences that may have affected the measured water quality parameters. No stream met primary contact water standards for fecal bacteria (except for the pristine site) regardless of

whether it was identified as impacted or unimpacted by straight pipes. Most samples in most streams met recreational water standards during the sample period. The data did not allow us to distinguish between the two types of streams without prior knowledge of straight pipe density.

The lack of distinction could have been because of the season of sampling, or misclassification of streams in terms of pollution level. It may also simply reflect that dilution in these sites and native water properties were a more significant effect on microbial population than incident pollution.

In terms of antibiotic resistance patterns, fecal coliforms and fecal streptococci were comparable as water quality indicators. Preliminary data indicated that the antibiotic resistance analysis method did not separate location information based on the antibiotic resistance pattern (impacted vs. non-impacted). However, there was apparent separation based on the host source. Misclassification was greatest with human impacted streams and least in environments where the known pollution source was poultry. The larger the library of isolates from a particular host origin, the lower the misclassification.