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Point source and non-point source pollution in a secondary stream: Nutrient concentration and fecal microbe counts in Tates Creek, Madison County, Kentucky

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Nutrient concentration and fecal microbe counts are elevated in Tates Creek, a stream that emanates from the town of Richmond, KY, passes by a conventional sewage treatment plant that discharges into the stream, and winds for 13 miles through pastureland and a series of small communities on septic systems before entering the Kentucky River. The sewage treatment plant shut-down operations during our study and we monitored dissolved nutrients (ammonium, nitrate, and phosphate), fecal microbes (total coliform and *Escherichia coli*), and stream biota before and after treatment operations ceased. Sampling occurred 4 times in both 2011 and 2012 between May and August at 25 stations within the trunk stream and its tributaries. We used established colorimetric methods to measure nutrient concentration and IDEXX methods to quantify microbe abundance.

Most nutrient pollution occurs from sewage treatment plant discharge. During operations, higher nutrient concentrations (~ 4.5, 12 to 13, and 7 mg/L for ammonium, nitrate, and phosphate respectively) occur immediately downstream of the plant and then wane to background levels downstream; nutrients in tributary streams are lower in concentration relative to Tates Creek. After the plant ceased operations, nutrient levels fell abruptly to background concentrations (~ 0.4, 4, and 1.5 mg/L for ammonium, nitrate, and phosphate respectively). Stream biota were also sampled before and after plant shutdown in July 2011 and sampling continued in 2012; we expect to see changes in the ecosystem reacting to lower nutrient levels and perhaps also to lower discharge.

Non-point source pollution is evident in fecal microbe counts, where abundance of *E. coli* is the most useful indicator as total coliform counts are uniformly high. High *E. coli* abundance occurs upstream of the plant with marked decreased immediately downstream, likely because of dilution of stream waters by aseptic discharge from the plant. Microbe levels increase anew when passing through active cattle pasture. We infer that leaky or broken sewage pipes in Richmond leak effluent into the stream. Downstream of the plant, fecal microbes from cattle enter Tates Creek; we cannot demonstrate that septic systems contribute to fecal microbe pollution.

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