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# ***Escherichia coli* Concentrations in Recreational Streams and Backcountry Drinking-Water Supplies in Shenandoah National Park, Virginia, 2005–2006**

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Although fecal contamination of streams is a problem of national scope, few investigations have been directed at relatively pristine streams in forested basins in national parks. With approximately 1.8 million visitors annually, Shenandoah National Park in Virginia is subject to extensive recreational use. The effects of these visitors and their recreational activities on fecal indicator bacteria levels in the streams are poorly understood and of concern for Shenandoah National Park managers.

During 2005 and 2006, streams and springs in Shenandoah National Park were sampled for *Escherichia coli* (*E. coli*) concentrations. The first study objective was to evaluate the effects of recreational activities on *E. coli* concentrations in selected streams. Of the 20 streams that were selected, 14 were in basins with extensive recreational activity, and 6 were in control basins where minimal recreational activities occurred. Water-quality sampling was conducted during low-flow conditions during the relatively warm months, as this is when outdoor recreation and bacterial survivorship are greatest. Although most sampling was conducted during low-flow conditions, approximately three stormflow samples were collected from each stream. The second study objective was to evaluate *E. coli* levels in backcountry drinking-water supplies throughout Shenandoah National Park. Nineteen drinking-water supplies (springs and streams) were sampled two to six times each by Shenandoah National Park staff and analyzed by the U.S. Geological Survey for this purpose.

The water-quality sampling results indicated relatively low *E. coli* concentrations during low-flow conditions, and no statistically significant increase in *E. coli* concentrations was observed in the recreational streams relative to the control streams. These results indicate that during low-flow conditions, recreational activities had no significant effect on *E. coli* concentrations. During stormflow conditions, *E. coli* concentrations increased by nearly a factor of 10 in both basin types, and the Virginia instantaneous water-quality standard for *E. coli* (235 colonies per 100 milliliters) frequently was exceeded.

The sampling results from drinking-water supplies throughout Shenandoah National Park indicated relatively low *E. coli* concentrations in all springs that were sampled. Several of the streams that were sampled had slightly higher *E. coli* concentrations relative to the springs, but no *E. coli* concentrations exceeded the instantaneous water-quality standard. Although *E. coli* concentrations in all the drinking-water supplies were relatively low, Shenandoah National Park management continues to stress that all hikers must treat drinking water from all streams and springs prior to consumption.

After determining that recreational activities in Shenandoah National Park did not have a statistically significant effect on low-flow *E. coli* concentrations, an additional concern was addressed regarding the quality of the water releases from the wastewater-treatment plants in the park. Sampling of three wastewater-treatment plant outfalls was conducted in 2006 to evaluate their effects on water quality.

Samples were analyzed for *E. coli* and a collection of wastewater organic compounds that may be endocrine disruptors. Relatively elevated *E. coli* concentrations were observed in 2 of the 3 samples, and between 9 and 13 wastewater organic compounds were detected in the samples, including 3 known and 5 suspected endocrine-disrupting compounds.

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terms of ranges and maximum concentrations.