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Mammoth Cave National Park Backcountry Trail and Stream Monitoring, 2009-2012

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Abstract

This project conducted an assessment of backcountry trail conditions on the north side of the Green River in Mammoth Cave National Park during summers of 2009-2012. The project included assessing physical parameters of trails, (width, depth, etc.) and conducting an assessment of water quality of streams in proximity of backcountry trails. The project was conducted by Student Conservation Association resource assistants (12 weeks each) supervised by a natural resource specialist from the Mammoth Cave Division of Science and Resources Management. Trail assessment procedures were based on techniques developed by Jeffery L. Marion, Ph.D, USGS, Virginia Tech (et al.) and previously implemented at Big South Fork NRRA and Hoosier National Forest. These protocols were adjusted by Science and Resources Management staff at Mammoth Cave NP to meet the specific goals this project. (See Marion, J.L. et al. at http://www.pwrc.usgs.gov/prodabs/pubpdfs/6612_Marion.pdf http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5292110.pdf)

This project also conducted an assessment of basic water quality parameters of backcountry streams in proximity of trails to provide supplemental data for the park's larger scale water quality monitoring program. Monitoring of these streams will provide data to detect and track any changes occurring over time which might be related to backcountry trail use, such as increased siltation and/or changes in water chemistry. The project monitored five basic parameters of water quality, including temperature, specific conductance, pH, dissolved oxygen, and rate of flow/discharge. These parameters provide the most basic, yet informative characterization of a stream, and are typically the fundamental components of any monitoring and regulatory program.

In addition to physical and chemical parameters, the project conducted an assessment of biological integrity as an indicator of overall stream health. Bioassessments were conducted by inventorying populations of benthic macroinvertebrates (BMI) present in the waters. (BMIs are animals without backbones which are generally visible with the naked eye.)

The project utilized Streamside Biosurvey protocols redeveloped by the EPA to identify BMI, and sorted these BMI into specific groups that indicated the overall quality of the water. BMI were identified to a broad taxonomic order level (stonefly, mayfly, caddisfly, etc.) and sorted into three general EPA-established groups based on sensitivity or tolerance to pollution/environmental stress; Group 1, Sensitive Species, Group 2, Somewhat Sensitive, and Group 3, Tolerant Species. Higher occurrences of Groups 1 and 2 indicate higher water quality. See website at: http://www.epa.gov/volunteer/stream/vms42.html

Trail Assessment

The project assessed over 207,000 linear feet of trails annually (39.2 miles). All trails assessed are open to hiking and horseback riding. Trails which are also administrative roads and open to official vehicles (i.e. Collie Ridge Trail, White Oak Trail, Buffalo Trail) were not assessed.

The project recorded average length, width, and depth of each trail, and documented the extent of excessive muddiness, excessive erosion, and displaced soil. The project also recorded the number of "unauthorized" or secondary trails present, including shortcuts, cut-arounds, and parallel trails. A brief narrative summary was prepared for each trail and provided to park management. Copies of the Trail Monitoring Manual and the original field data and spreadsheets are on file in the Science and Resources Management office at Mammoth Cave NP.

Results (As of Sept. 2012)

Average tread width: 43.99 inches

Average maximum depth of tread: 2.86 inches

Total soil loss/displacement: 132,202 cubic feet

Total number of secondary trails: 1045

Changes Observed 2009-2012

- As of September, 2012, the total soil loss from all trails assessed, 132,202 cubic feet, would fill a hole more than 100 feet square and 32 feet deep. This would be equivalent to 979 single axle dump-truck loads of soil (5 cubic yards each).
- Of the 39 miles of trail surveyed, overall parameters (trail width, depth, average area) are increasing approximately 4.2% annually. (Total soil loss has increased 17.1% during the 4 year study period.) Several tails sustained notable increases in erosion. Most notably, between the 2011 and 2012 monitoring seasons, Good Springs Trail, west, increased in average width from 50 inches to 64 inches, (+28%) and in average depth from 2.4 to 3.9 inches , (+61%) and in average cross-sectional area from 71 to 195 square inches, (+174%.) During the same time period, Good Springs Trail, east increased from 38% highly eroded to 76.5% highly eroded (greater than 5 inches in average depth).
- The number of secondary, illegal trails has increased from 509 to 1045, an increase of more than 102%.

Backcountry Stream Water Quality/BMI Assessment Results

The BMI surveys indicate that the overall biological integrity/water quality of the backcountry streams in proximity of most trails assessed is excellent. Of the 3 primary streams surveyed, (Wet Prong, Raymer Hollow, and Second Creek), more than 70% of the organisms observed were EPA Group 1, Sensitive Species. Chemical parameters (dissolved oxygen, pH, electrical conductivity, and temperature) also indicate water quality is within normal and acceptable limits at sample points.

The one exception was a major impact area noted where the Mill Branch segment of Good Springs (east) Trail crosses Mill Branch and runoff from the trail enters the stream. The occurrence of EPA Group 1, Sensitive Species was dramatically lower downstream of the crossing, and the percentage of EPA Group 3, Tolerant Species, was significantly higher. This substantial shift is almost certainly due to the runoff/erosion from the Mill Branch trail segment, which is clearly visible throughout the length of the trail. This 2,311 foot trail leads from Good Springs Church down to Mill Branch Road, and receives heavy use from horses. More than 7687 cubic feet of soil has been displaced

on this trail, which amounts to an average loss of 3.32 cubic feet of soil per linear foot of trail. (For comparison, a 3 foot wide trail averaging 1-inch deep would lose .25 cubic feet of soil per linear foot; it would take 4 linear feet to displace 1 cubic foot of soil. The average soil loss for the entire 39 miles of surveyed trails in the rest of the backcountry is .64 feet per linear foot.)

Mill Branch, at the immediate bottom of this trail, receives much of this displaced soil, which can be seen on the stream bottom for at least 100 feet downstream of the intersection with the trail. This soil completely covers and replaces the natural rocky substrate of the streambed, thus destroying the habitat for benthic macroinvertebrates. (This trail is scheduled to be closed and rehabilitated as soon as the proposed Big Hollow Trail and Raymer Hollow Extension loop through Maple Springs area is completed, tentatively 2013.)

Overall, the research suggests that erosion and soil loss due to heavy trail use and/or improperly constructed trails can negatively impact biological communities in receiving streams.