Introduction
The “Big Dip” was a diagnostic sampling of 917 headwaters streams in Southeastern Kentucky conducted in the summer of 2006 by 30 volunteers and 6 paid staff from the Eastern Kentucky Environmental Research Institute in collaboration with the Office of Surface Mining’s AmeriCorpsVISTA Appalachian Coal Country Watershed Team. The interdisciplinary project integrated geography and chemistry to establish baseline data on first-order headwater streams to better understand the relationship between the health of these small tributaries and water quality further downstream.

One major purpose of the study was to collect initial exploratory data of the many small headwater streams that have been overlooked in other comprehensive water quality studies performed by such agencies as the US Geological Survey, the Kentucky Division of Water, and Kentucky Fish and Wildlife. For example, the USGS lists 292 stream segments in Letcher County, while our field examinations identified approximately 500 first-order tributary streams.

Methodology
We attempted to sample as many reasonably accessible first-order headwater streams throughout the Upper Kentucky River Watershed as we could identify and locate. Target sample sites were identified using GIS overlay analysis to compare USGS National Hydrology Dataset 24k, digital orthophotography from the 2004 National Agricultural Imagery Project and roads (from Kentucky Office of GIS). “Target site” field sheets were then constructed by hand-plotting on Kentucky Gazetteer photocopies, with all sites at confluences of hollow streams and main tributaries. The sites chosen were also located along or near public roadways.

The water quality tests performed were those that could be tested at relatively low cost and using simple field collection methods easily performed by volunteers and community members with little scientific background (e.g., multiparameter probes and test strips.) Field sample testing was performed by two-person teams using a variety of instruments. EcoCheck 5-in-1 test strips were used to measure pH, alkalinity, hardness, nitrite, and nitrate. Iron was measured using LaMotte test tabs, and a YSI 556 multiprobe was used to read parameters including temperature, conductivity, pH and dissolved oxygen.

GPS reading were taken at each site. The resulting dataset was processed using GIS software to create a series of maps highlighting differences in general ambient water quality throughout the region.
OSM/Vista Intern, Jeff Combs, samples a stream in Perry County with high iron levels.

Observations
While the tests used were relatively simple and inexpensive, the project proved to be a successful approach to establishing generalized baseline data and identifying areas most at risk from acid mine drainage seeps and impairments related to surface mining.

Results
Among the nine parameters examined, three stood out as potentially good indicators of stream health--conductivity, iron, and pH. While about 29% of the samples had chemistry readings within “normal” or “healthy” ranges (GOOD), the remaining 71% had at least one parameter among iron, conductivity, or pH that would characterize it as “extremely poor” (BAD).

- **CONDUCTIVITY**: Conductivity between 100 and 500 µhos is considered good. Of the 900 total conductivity readings, 281 (31%) were between 500 and 1000 µhos, which suggests degraded habitat; and 195 (22%) were greater than 1000 µhos, which is associated with major habitat impairment.

- **IRON**: Iron above 1 ppm is considered toxic to aquatic life. Of the 894 total iron readings, 336 (38%) were between 1 and 5 ppm; and 72 (8%) were greater than 5 ppm.

- **pH**: A pH of 7 is neutral and the normal range of pH in stream habitats ranges from about 6.0-8.0. A pH below 5.5 or above 8.2 is considered dangerous to aquatic habitat. Of the 914 total pH readings, 31 (3%) had a pH below 5.5, while 319 (35%) had a pH of greater than 8.2.

Future Studies
The tests used in the “Big Dip” were deliberately chosen because of their cost and ease of use, and thus analysis is somewhat limited because of accuracy limitations and the general nature of the analyses performed. The results do, however, suggest further areas of study.

Conductivity and Metals
Conductivity was one parameter that was consistently extremely high throughout the region. Conductivity greater than 500 is considered a threat to aquatic habitat, but on its own, conductivity reveals little about contaminants that may be present—although it suggests the presence of salts and metals that can, in some cases, be extremely toxic to both wildlife and humans. A subsequent study examined the metals content of 26 “Big Dip” sample sites (see Weaver, Reagan 2007. “The Big Dip”: Geographic Distribution of High Metals Observed in Eastern Kentucky Headwater Streams RS07.003).

Geographic Distribution of Water Quality
One pattern observed in the official GIS maps was a strong concentration of low pH and high iron in the Letcher County region, and a concentration of high pH in the Perry/ Knott County area. Initial inspection suggests the Letcher County cluster may be associated with acid mine drainage from older deep mining practices, while the Perry/Knott county cluster may be associated with more recent surface mining—which would disturb the calciferous rock layers above the coal seams. Further analysis of land use/land coverage and the presence of deep and surface mine sites will be needed to determine whether, in fact, these initial observations can be corroborated with land use patterns.

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