New study documents cumulative impact of mountaintop mining

December 12 2011

Increased salinity and concentrations of trace elements in one West Virginia watershed have been tied directly to multiple surface coal mines upstream by a detailed new survey of stream chemistry. The Duke University team that conducted the study said it provides new evidence of the cumulative effects multiple mountaintop mining permits can have in a river network.

"Our analysis of water samples from 23 sites along West Virginia's Upper Mud River and its tributaries shows that salinity and trace element concentrations, including selenium, increased at a rate directly proportional to the cumulative amount of surface mining in the watershed," said Duke researcher Ty Lindberg. "We found a strong linear correlation."

Changes in water quality due to the increased salinity in the Upper Mud from mine runoff also were found to be "exceptionally persistent," Lindberg said. "Mines reclaimed almost two decades ago are continuing to release effluents with salinity similar to active mines in the region."

The Duke team's study appears this week in the peer-reviewed online Early Edition of the Proceedings of the National Academy of Sciences.

In mountaintop mining, companies use explosives and heavy machinery to clear away surface rocks and extract shallow deposits of high-quality coal below. The companies typically dispose of the waste rock in adjacent valleys, where it buries existing headwater streams.

To assess the cumulative impact of the more than 100 permitted discharge outlets draining approximately 28 square kilometers of active and reclaimed mountaintop coal mines in the Upper Mud watershed, the Duke researchers collected 152 sets of samples from 23 sites – including two sites upstream of any active or reclaimed surface mines – between May and December 2010. They sampled for electrical conductivity, a measure of salinity and for concentrations of major ions and trace elements derived from coal or its matrix rock.

All conductivity measurements taken downstream of mine discharge outlets exceeded levels known to be harmful to aquatic life, said Richard Di Giulio, professor of environmental toxicology. At the two sampling sites upstream of any mines, conductivity levels were within an acceptable range. Concentrations of selenium, a known fish toxin, followed a similar trend, Di Giulio said. The researchers also observed deformities typical of selenium exposure in fish collected from downstream waters.

"As eight separate mining-impacted tributaries flowed into the Upper Mud, conductivity and concentrations of selenium, sulfate, magnesium and other inorganic solutes increased proportionately," said Avner Vengosh, professor of geochemistry and water quality. "Nearly 90 percent of the variation in trace elements and salinity could be explained by the amount of upstream surface mining."

The Upper Mud flows through sparsely populated sections of Boone and Lincoln counties in southern West Virginia as a headwater stream until reaching its impoundment in the Mud River reservoir 25 kilometers downstream. For about 10 kilometers, the river passes through the Hobet 21 surface mining complex, which has been active since the 1970s and is among the largest in the Appalachian coalfields region.

The Duke team selected the Upper Mud watershed for their field survey because water-quality impacts from other potential sources are largely absent. Historically, surface rather than underground mining has been the dominant form of coal extraction in the Upper Mud's river basin, and there are very few people now living within the Hobet mine's permitted boundary. This helped to minimize other factors that might account for changes in water quality.

"This is a remarkably clean dataset and that's why it's so powerful," said Emily Bernhardt, associate professor of biogeochemistry. "We see these incredibly strong patterns, which previously have not been well established."

Past studies have shown that individual mines profoundly impact stream water quality, biological community structure and ecosystem function immediately downstream of valley fills, but empirical data on the cumulative impacts of multiple mining operations on larger downstream rivers has been lacking, she said.

"Individual permitting decisions are typically made without consideration of the extent of historic mining impacts already occurring within a watershed," Bernhardt said. "Our survey helps fill that gap."

Duke PhD students Raven Bier and Brittany Merola and postdoctoral researcher Ashley Helton co-authored the study.

Provided by Duke University

Citation: New study documents cumulative impact of mountaintop mining (2011, December 12) retrieved 9 April 2024 from
https://phys.org/news/2011-12-documents-cumulative-impact-mountaintop.html