Researchers examine nitrous oxide emissions in streams and rivers

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A relatively unknown, hidden, artificial stream, called a "flume," located in the basement of the Idaho Water Center at Broadway and Front streets in downtown Boise is the site of a collaborative research initiative by scientists from Boise State University and the University of Idaho (UI). The project is funded by the National Science Foundation (NSF).

The scientists are trying to understand how populations of microorganisms regulate emissions of nitrous oxide from streams and rivers. Nitrous oxide is a potent greenhouse gas and contributor to climate change. The source of the gas is nitrate, a compound made up of nitrogen and oxygen, which is commonly used in fertilizers and finds its way into waterways from agricultural runoff.

The laboratory flume hosts its own little world—an isolated ecosystem modeled to mirror the natural conditions of the hyporheic zone, the space where surface and ground waters of rivers and streams meet. The flume was initially populated with microorganisms and nitrogen from sediment and vegetation obtained from an area near Lucky Peak State Park.

Microbes, bacteria in particular, often get a bad rap, but their biochemical activity is critical for sustaining life on Earth. Even the biosphere's atmospheric conditions are affected by microbial activity. One of these processes, denitrification, is what Boise State and UI scientists are really interested in measuring in the flume.

Normally, denitrification results in harmless nitrogen gas. In some cases, however, one of the intermediate compounds, nitrous oxide, is emitted instead of nitrogen gas before the denitrification process completes.

"Rates of nitrous oxide production in natural systems may be influenced by the distribution of microorganisms and whether they have the ability to reduce nitrous oxide to nitrogen gas," said

Kevin Feris, a microbial ecologist and associate professor in the Department of Biological Sciences at Boise State.

Nitrous oxide, informally known as laughing gas, may conjure up memories of the humorous dental scene with Inspector Clouseau in the "Pink Panther Strikes Back," but in reality it has serious impacts on the Earth's atmosphere.

"Nitrous oxide is approximately 300 times stronger as a greenhouse gas than carbon dioxide," said Feris. Nitrous oxide released from the hyporheic zone could be responsible for up to 10 percent of global human-caused nitrous oxide emissions, he added.

Feris hopes that a better understanding of the role of microbes in nitrous oxide production will inspire strategies to reduce greenhouse gas emissions from natural and man-made water systems.

"If you were to restore an affected waterway, or design an irrigation system for a large agricultural environment, having some idea of what the physical and chemical parameters are that influence the distribution of microorganisms that make nitrous oxide might make the emissions more manageable," said Feris, adding "You are not managing the emissions directly, but structuring the ecosystem so that it doesn't happen, or at least not as much."