Study: Forested riparian zones important to nitrogen control, stream health

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Human activities from agriculture to fossil fuel consumption have resulted in high levels of nitrates in many streams and rivers; now a new study suggests that nurturing riparian zone forests may be a key in maintaining healthy waterways.

Streams flowing through urban areas and agricultural lands may have some of the same ability to process nitrates as healthy forest streams – if they have adequate forest buffer zones along their banks, the researchers say.

Results of the research were just published the professional journal, *Ecosystems*.

“There are many important ways in which streamside trees help maintain healthy river systems,” said lead author Daniel Sobota, who conducted the research as part of his doctoral studies at Oregon State University. “The shade they offer may reduce the amount of sunlight reaching the stream, preventing excessive algae growth.

“Additionally, the leaves and woody debris generated by streamside forests hold the nitrogen and prevent it from being released downstream all at once,” added Sobota, whose Ph.D. was in fisheries and wildlife at OSU. “This ability of a stream to ‘take up’ the nitrogen can help reduce the impacts of nitrogen enrichment in human-altered river basins.”

In the study, which was funded by the National Science Foundation, Sobota and his colleagues looked at nine streams in Oregon's Willamette Valley that flowed through forest, agricultural or urban landscapes. Among their goals was to discover how much nitrogen was absorbed by the streams near the source, and how much went downriver.

In tests in Willamette Valley streams, the researchers discovered that 21 to 72 percent of nitrates entering the waterway could be stored in leaves, wood and aquatic mosses within one kilometer downstream.

The inability of a stream or river to hold nitrogen can cause "eutrophication," or excess algae growth that can die and lead to low-oxygen waters. Eutrophication has caused significant problems in the Gulf of Mexico where the Mississippi River drains, as well as in the Chesapeake Bay.

"Forested riparian buffers can help delay nitrogen from going downstream so there isn't a large influx at one time that could trigger harmful algal blooms," Sobota said. "From a management perspective, that is a desirable trait."

Rivers also can process nitrogen naturally through a process called "denitrification." When oxygen levels in the water are low, bacteria will consume nitrogen instead and release it into the atmosphere – mostly as a harmless gas, Sobota pointed out. However, previous studies by researchers at OSU and the U.S. Forest Service found that the Oregon streams in their study have lower-than-average rates of denitrification.

The reason is a combination of high-gradient streams, oxygenated water and porous streambeds, which are not conducive to denitrification, said Sherri Johnson, a research ecologist with the U.S. Forest Service and a courtesy professor of fisheries and wildlife at OSU.

"A lot of streams in Oregon have subsurface water flowing beneath the streambed through the gravel," said Johnson, also an author on the Ecosystems article. "This 'hyporheic' flow intermixes with the river water and limits the anaerobic processes."

Linda Ashkenas, a senior faculty research assistant in the Department of Fisheries and Wildlife at OSU and an author on the study, said maintaining complex river channels is also important to stream health.

"Human impacts on rivers have eliminated many of the braids and channels that existed naturally, causing water to flow downstream faster, carrying nitrates with it," Ashkenas said. "River systems that are more complex slow the water down and give organisms time to filter out the nitrogen."

Sobota is working with the U.S. Environmental Protection Agency office on the OSU campus as a National Research Council post-doctoral researcher. The Ecosystems study is part of a large, multi-institution project called Lotic Intersite Nitrogen Experiment II, or LINX II.

Provided by Oregon State University