Tree species composition influences nitrogen loss from forests

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Throughout the world, nitrogen compounds are released to the atmosphere from agricultural activities and combustion of fossil fuels. These pollutants are deposited to ecosystems as precipitation, gases, and particles, sometimes many hundreds of miles downwind of their release point. The Catskill Mountains of southeastern New York are a case in point—though they contain little in the way of industrial or agricultural pollution sources, they receive some of the highest nitrogen deposition rates in North America due to pollutants drifting in from midwestern power plants and east-coast cities.

Anyone who grows plants for food, fiber, or flowers, knows that nitrogen is crucial for healthy plant growth. But excess nitrogen that leaches from a forest can acidify the soils and streams and decrease water quality. Prior research has shown that in addition to plant uptake, microbial processes are very important in retaining nitrogen in forest soils, and that forested watersheds in the Catskills vary markedly in the amount of nitrogen they can absorb and prevent from leaching away. So why would atmospheric nitrogen deposition lead to increased losses of nitrogen from some forests and not from others? A study funded by the National Science Foundation and the U.S. Department of Agriculture provides some answers. The research, which is focused on the tree species control on nitrogen cycling dynamics in the Catskill Mountains, is published in the March-April 2009 issue of the Soil Science Society of America *Journal*.

Part of a long-term research project on nitrogen cycling in Catskill

forests, this study utilized a stable isotope technique to determine how the microbes consume and transform nitrogen in the soil under stands of five different tree species that are common in the Catskills. Half of the forest plots also had experimental nitrogen fertilizer treatments. The study showed that forests dominated by sugar maple are particularly susceptible to nitrogen leaching, while soils under red oak and hemlock forests are better at retaining nitrogen and preventing leaching losses. This difference was partially related to the ratio of carbon to nitrogen in the soils. The microbes under the different tree species vary considerably in their production of nitrate, the form of nitrogen that is most readily leached into streams. However, unlike previous studies from western forests, this study found very little consumption of nitrate by the soil microbes in any of the forest types. Because of the low nitrate consumption, the forest types that have high nitrate production (such as sugar maple) also have high nitrate losses via leaching.

Lead author Lynn Christenson of Vassar College in Poughkeepsie, NY noted, "The most significant difference we see in nitrogen cycling under sugar maple trees compared to other tree species are much higher rates of nitrification, with very little consumption of this nitrate occurring in sugar maple soils. Why the soils and trees are not consuming this nitrogen is still a mystery."

Project Leader Gary Lovett of the Cary Institute of Ecosystem Studies in Millbrook, NY stated, "It is important for watershed managers to know that differences in tree species composition can influence nitrogen retention. Some forest types are more likely to saturate with nitrogen than others."

More information: View the abstract at soil.scijournals.org/cgi/content/abstract/73/2/638

Source: Soil Science Society of America (news : web)