Search

Article Resources

Media

EPA Overview of Acid Rain

EPA Sources of Pollutants in NC

Acid rain in the Great Smoky Mountains

Health Effects of Air Pollutants

Peer-Reviewed Research

Acid rain's effects on aquatic biodiversity

Effects of acid rain on nutrient cycling

Effects of acid rain on foliage

Simulated effects of acid rain (Part 1)

Simulated effects of acid rain (Part 2)

Community Links

Bill McLarney and LTLT Biomonitoring

Acid Rain and Air Quality in the Appalachians

Posted on January 8, 2012

Science, Public Policy, and Community: Acid Rain and Air Quality in the Appalachians

By the Coweeta Listening Project

The Franklin Press B4
Friday, September 16, 2011

Air pollution in the mountains can generally be grouped into three categories: nitrogen and sulfur, ozone, and haze. These pollutants can contribute to a long list of problems including but not limited to damage to vegetation, acidification of streams, and damage to human health. The next two columns will explore the different airborne pollutants and their effects on the local ecosystem, beginning with sulfur and nitrogen deposition.

As many of you who have spent hot summer days hiking or exercising outdoors in Macon County know, the topography that makes the views here so breathtaking can also both literally and figuratively take your breath away on some days of the year. Air quality monitors show that the Smoky Mountains have some of the most polluted air in the nation, especially at the higher elevations. Why does a national park, like Great Smoky Mountains National Park, with nothing but trees, wildlife, and clear streams have some of the worst air in the eastern U.S.? Much of it has to do with topography and where the park lies within the southern Appalachians and the region. Emissions from coal fired power plants to the west and from surrounding urban and agricultural areas (including exhaust from cars and tractors, etc.) tend to get trapped in valleys by the high mountain ridges. This dirty air is out of reach from winds that would otherwise help to flush it out. This stagnant air, especially during the "dog days" of summer, is the primary reason the air quality is so poor relative to other areas in the East.

Sulfur compounds are released primarily from coal-fired power plants while nitrogen oxides are mostly from automobiles, utilities, and animal feed operations. According to the National Park Service, Great Smoky Mountains National Park has the highest level of sulfur and nitrogen deposition of any monitored national park. Sulfur and nitrogen are prime contributors to acid rain, which includes precipitation in the form of rain, snow, hail, dew, or fog- basically anything that takes these compounds out of the air and deposits them on the ground, on vegetation, or in streams. These compounds can also reach the ground without precipitation, through a process called "dry deposition." Acid deposition is generally greater at the highest elevations within the park. This is because the tops of the mountains receive 1) more precipitation, 2) are often bathed in fog, which is often lower in pH (more acidic) than rainwater, and 3) the rugged terrain creates "eddies" where sulfur and nitrogen oxides are deposited in greater amounts.

Acid rain damages the forest ecosystem in several ways. It can directly damage leaves on trees, decreasing their ability to photosynthesize. Acid rain can also cause the loss of critical nutrients from forest soils, such as calcium. Both nitrogen and sulfur compounds are plant nutrients and, in small amounts, promote the growth of vegetation. As levels continue to rise, however, plant health and vegetation diversity declines. When nitrogen and sulfur deposition exceeds the amount that vegetation can uptake and soils can absorb, the excess acidic compounds begin to leach out of the soil, taking with them positively charged nutrients that are important for plant growth. This upsets the charge balance of soil and decreases the nutrients that are available to plants, weakening trees and leaving them more susceptible to insects, diseases and other environmental stressors.

Coweeta researchers have been using computer models to predict how acid deposition will impact nutrient cycles in the forest given different levels of future sulfur and nitrogen emissions. Unfortunately, findings suggest that even with continued reductions in acid deposition it may take decades or even centuries for some areas recover from depletion of these nutrients.

Other ecosystems in the southern Appalachians are also sensitive to high levels of acidic deposition. When lakes and streams become too acidic, sensitive fish species can no longer survive. The native southern Appalachian brook trout is more tolerant of streams with lower pH than the non-native rainbow and brown trout. However, brown trout cannot compete with the other trout species for food or habitat and are thus restricted to high elevation streams where a barrier such as a waterfall prevents the upstream migrations of these non-native competitors. These high elevation streams receive greater inputs of acidic deposition relative to lower elevations, leaving the brook trout trapped between higher elevation streams that may become too acidic for their survival and lower elevation streams where they cannot compete with the larger rainbow and brown trout.

This column is produced by members of the Coweeta Listening Project. For questions, comments, or suggestions about topics community members would be interested in from a Coweeta LTER perspective, please send an e-mail to: CWTLISTN@UGA.EDU or other correspondence to:

Coweeta Listening Project, 210 Field St.,

Room 204, University of Georgia Athens,

Georgia 30602-1619 USA.

For more information about the Coweeta LTER please see: http://coweeta.uga.edu/

Log in or Register to post comments