UNH Scientist's Studies Show Pollution Is Sickening Trees in the Northeast

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DURHAM, N.H. -- President Clinton this year announced new initiatives to provide Americans with cleaner air. The proposed new standards are designed to reduce pollution released through automobile emissions. This is good news for Northeast forests, as mounting evidence shows that excessive amounts of nitrogen -- a component of air pollution whose chief source is auto emissions -- are slowing the growth of trees and contributing to the infiltration of heavy metals into streams. Airborne ozone, formed when volatile organic compounds and oxides of nitrogen interact in the presence of sunlight, is also detrimental.

This documentation comes from 11 years of National Science Foundation-sponsored research by John Aber, professor of natural resources in the University of New Hampshire's Institute for the Study of Earth, Oceans and Space, and other scientists conducting experiments in three Northeast forests -- Harvard Forest in Petersham, Mass., Mount Ascutney in Vermont and Bear Brooks Watershed, 60 miles inland from Acadia National Park in Maine. By adding nitrogen to the soil around the trees and comparing it to untreated areas, they were able to record the damage caused by excessive amounts.

In normal concentrations, nitrogen is a vital fertilizer. In excess, it can severely stress the biosphere, upsetting the natural balance and saturating the soil in excess of what the plants need. The effects are damaging in several ways.

"The deposited nitrogen upsets the nitrogen/magnesium balance in plants, resulting in a lot of leaves, but no chlorophyll," says Aber. "Excess nitrogen can also cause a loss of frost-hardiness, needle loss and reduced productivity, such as what we see in spruce die-back."

Nitrogen's effects also spread beyond the trees. What plants don't need often runs off, reacting with other minerals such as magnesium, potassium and aluminum and carrying them away from the site. The runoff depletes the soil nutrient value, and contaminates ground water and streams.

Aber says the Northeast is particularly vulnerable to deposited pollution because wind flows from west to east, bringing pollution from the industrial Midwest. And because precipitation is greater at higher elevations, nitrogen deposition is most harmful on mountain tops.

"We had predicted that forest decline would occur, that you could start killing off the trees by adding excess nitrogen," says Aber. "But I never expected to see the declines in the growth rate that we have seen. There can be no denying that excess nitrogen represents a unique form of stress that results in measurable changes in foliar chemistry."

Some good news for New England forests did surface from the research results, Aber explains. Because much of the land was once used for agricultural purposes, it is nitrogren poor. These lands, which are naturally reforesting, act like sponges by soaking up excess nitrogen, making them more resilient in the short-term.

In addition to nitrates, Aber's research shows that trees are also harmed by chronic exposure to excess ozone. Compared to adding nitrogen and causing a relatively slow change in the forest, ozone's effects are immediate.

"It directly affects the leaves, damaging cell membranes. The necessary repair reduces the amount of energy left for growth of the tree," says Aber, adding that a computer model shows that the ozone effect alone could reduce annual forest production by 3 to 16 percent. Unlike nitrogen deposition, ozone is produced within the northeastern region, primarily by automobiles. Because of the way ozone is formed and broken down, concentrations tend to be highest in two locations where vacationers go to escape air pollution, the top of Mt. Washington and Acadia National Park in Maine. "It is ironic," says Aber, "that travelers to these remote areas should experience such high levels of ozone."

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