Deforestation: Major threat to ozone?

Nitrous oxide is best known as the anesthetic sometimes referred to as laughing gas. But the accumulation of this gas in earth's atmosphere is no laughing matter. Not only is it one of the most important "greenhouse gases," capable of contributing to global warming and climate change (SN:5/18/85,p.308), but it also is the primary chemical precursor in the stratosphere to nitric oxide, the molecule responsible for 70 percent of the destruction of earth's beneficial stratospheric ozone layer. In the past, when scientists worried about sources of this important pollutant, they focused on the increased use of nitrogen fertilizers and combustion of fossil fuels. But new research is pointing toward another potentially significant source of this gas – deforestation.

Working in the Hubbard Brook Experimental Forest in New Hampshire, Yale University forestry researchers William B. Bowden and F.H. Bormann have been studying nitrous oxide (N_2O) emissions produced by two generic classes of soil bacteria – nitrifiers and denitrifiers. Bacteria in the first group create N_2O as they convert one plant nutrient, ammonium, into another plant nutrient, nitrate. Those in the second group convert nitrates into molecular nitrogen.

Previously, research had shown that clear-cutting timber can encourage production of nitrate – and therefore of N_2O – by the nitrifiers. However, much of the concern over this focused on the nitrate, rather than on the N_2O, Bowden says, because measurements showed that nitrate runoff in streams accelerated dramatically after clear-cutting. And this loss of soil nitrogen – often the primary factor limiting soil productivity – indicated that these soils' ability to nurture new trees might diminish after several cycles of clear-cutting.

But N_2O loss, if it were high enough, would represent an additional cause of soil-nitrogen depletion and therefore threaten the productivity of these soils. And the Yale scientists reasoned that since the increased production of nitrate after clear-cutting would also give N_2O-producing denitrifiers a feast, there would be a great deal of N_2O to lose through runoff.

Results of their study investigating this idea, reported in the Aug. 22 SCIENCE and last week at the Fourth International Congress of Ecology in Syracuse, N.Y., shows that clear-cutting increased the N_2O concentrations dissolved in soil water "by two orders of magnitude [roughly by 100 times] over the concentrations expected." Even more important, Bowden says, their research showed that this N_2O in soil water tended to flow away from the clear-cut site to natural seeps, where it then was emitted into the air.

"The thing that's important about this work is the transport of N_2O by soil water," Bowden told SCIENCE NEWS. "Most people have assumed that N_2O just diffuses out of the soil and into the atmosphere." But since N_2O "is highly soluble in water," he says, one can't assume – as most field ecologists and atmospheric chemists have done thus far – that one can gauge the total N_2O production of a soil simply by measuring emissions above a clear-cut forest site or agricultural field. (Most measurements of soil-bacteria N_2O production have, in fact, focused on crop fields, Bowden notes.) By focusing on direct emissions from soil, Bowden says, researchers risk "missing a large part of the action – potentially up to 50 percent of the N_2O produced." He suspects that N_2O production and transport might be especially high in crop fields that not only are fertilized with high concentrations of nitrogen but also are irrigated.

What this means, Bowden says, is that organisms in soil – especially in soil that has been disturbed by deforestation or agriculture – appear to be a greater source of N_2O than most people have expected. And "this may be important on a global scale," he believes.

Work by Philip Robertson of Michigan State University's W.K. Kellogg Biological Station in Hickory Corners suggests that while deforestation may indeed increase global N_2O emissions, it may do so primarily in the case of relatively young forests less than 30 years old. His data on Costa Rican rain forests, also presented at the Syracuse meeting, indicate that older forests naturally produce so much N_2O that clear-cutting them has a negligible effect.

For this reason, Robertson suggests, the high concentrations of atmospheric N_2O above the Amazon – as reported by Harvard atmospheric chemists Steven Wofsy and Michael B. McElroy – are probably not attributable to deforestation there.

In addition, preliminary research by atmospheric chemists at NASA's Langley Research Center in Hampton, Va., suggests an additional N_2O-deforestation angle. Burning of forests produces significant amounts of N_2O, their research suggests. So the burning of forests in slash-and-burn agriculture, and as firewood, says Langley scientist Joel Levine, "may be an important source of N_2O in the global atmosphere." – *J. Raloff*

Hold that tiger

One of the newest species inadvertently imported into the United States is the Asian tiger mosquito, *Aedes albopictus*. First spotted by Harris County, Tex., mosquito-control officers a year ago, it appeared to be initially confined to Houston. But in the Aug. 8 MORBIDITY AND MORTALITY WEEKLY REPORT, published by the Centers for Disease Control (CDC), individuals with 34 different entomology, mosquito-control and health departments report on a survey they conducted in July that identified infestations in seven southern U.S. states and in Brazil.

"This is a very aggressive mosquito – a very aggressive biter," says CDC entomologist Chester G. Moore of Ft. Collins, Colo. Some mosquitoes subtly sneak a bite. *A. albopictus*, however, picks its target and blatantly divebombs for the blood, Moore says, explaining why he suspects more people will complain about this insect.

But CDC's main concern, he says, is the mosquito's potential for carrying viruses responsible for diseases including dengue, yellow fever, polyarthritis and California-type encephalitis. "We have mosquitoes here that will also transmit those diseases," Moore says. However, most mosquitoes don't tend to be carriers for so many different diseases. Moreover, he notes, research now under way at CDC suggests *A. albopictus* may be a more efficient carrier of many of these viruses than some of the other mosquitoes. Because it has yet to pick up any of these viruses in the blood of its U.S. victims, the insect hasn't been associated with any U.S. outbreaks of disease.

L. Munstermann/Notre Dame Univ.

Tiger mosquito taking a blood meal.

This mosquito prefers to breed in confined spaces – like holes in hardwood trees. In urban settings, however, it has shown a preference for rainwater that settles in stored tires. In fact, it is believed to have entered the United States in worn Asian tires being imported by tire retreaders.

Earlier this year, when it appeared the Asian tiger mosquito was still confined to the Houston area, CDC officials thought it might be possible to eradicate it. "It's still a possibility," Moore says, "though with each new report of its spread it seems somewhat less likely." To limit the mosquito's spread, CDC is recommending a halt in the interstate movement of tires. □