Hidden Threats Take Toll in Amazon

Studies of deforestation in the Brazilian Amazon have overlooked more than half of the actual rainforest damage occurring each year, reports a team of U.S. and Brazilian researchers.

Past assessments of the Amazon have used satellite images to tally deforested areas, where farmers and ranchers have clear-cut and burned all trees. Such work has not addressed logging, which removes only selected trees, or surface fires that burn down individual trees but do not denude the forest.

The new analysis, published in the April 8 NATURE, indicates that logging and these fires degrade a larger area of forest than does strict deforestation—especially in dry years.

"This will really change quite fundamentally the way we think about deforestation," says study leader Daniel C. Nepstad of the Woods Hole (Mass.) Research Center and the Amazon Institute for Environmental Research in Belém, Brazil. "It shows that the effects of people on forests can be much greater than we thought."

Other researchers question the exact numbers in the study but agree with the conclusion. "Our surveys do not consider impoverishment of the forest by logging," says Diógenes S. Alves of Brazil's National Institute for Space Research in São José dos Campos. "This is a serious issue."

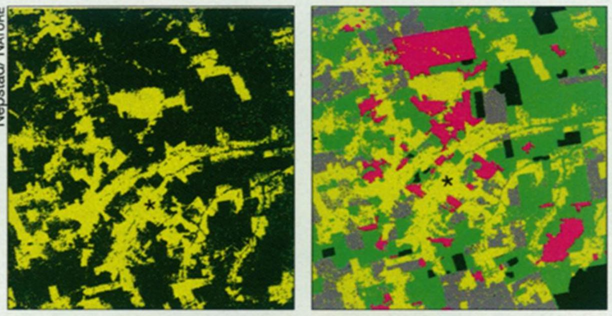
Satellite surveys have difficulty picking out effects of logging and fires because they remain obvious only for a year, then new growth obscures the damage, says Nepstad. To estimate the impact of logging, he and his colleagues interviewed 1,393 managers of sawmills and obtained records of wood harvests for 1996 and 1997.

The team tested the accuracy of the sawmill data by measuring wood harvesting at 22 square-kilometer patches of forest. "What the loggers were telling us was right on the money," says Nepstad.

To estimate the effects of recent fires, the researchers interviewed 202 landholders whose properties total 9,200 km^2. They checked this information against satellite data, which showed that the owners correctly gauged the number of fires but underestimated the area of burning by 43 percent.

Nepstad and his coworkers calculate that logging damaged 10,000 to 15,000 km^2 of undisturbed forest each year in 1996 and 1997. This represents 50 to 90 percent as much land as that totally deforested during 1996. The fire estimates are less precise but suggest that fires harmed an area roughly equal to the area of deforestation.

Logging and fire injuries can have far-reaching effects. By taking down trees, logging and fires open up the canopy, dry the forest floor, and increase the risk of fire. On a global scale, such forest degradation releases large amounts of carbon dioxide that are not currently included in global computations.



Nepstad/NATURE

Standard studies of satellite data (left) distinguish only between totally deforested (yellow) areas and primary forest (black). A new study (right) shows that much of what had been considered primary forest has been partially logged (green) or burned (red).

The combined effect of logging and fires is "a potentially large and significant phenomenon," says David Skole, a geographer at Michigan State University in East Lansing who uses satellite data to track deforestation. The new study, however, "doesn't provide us with direct measurements of the magnitude of this effect," he adds.

"It's very important to identify the size of the problem," says Eduardo Martins, president of the Brazilian Environment Institute in Brasília. Logging is often the first step toward total deforestation, he says. —*R. Monastersky*

Slow motion sets in when the light dims

When the lights go down, the world may appear to slow, new research suggests. Movement perceived by rods, the cells in the retina that register dim lights, looks slower than the same motion detected by the color-sensitive cones.

Most people see the world through four types of visual-receptor cells. Rods sense brightness alone, while the three types of cones register red, green, and blue wavelengths of light. "Anytime you can see color, you know you're stimulating the cones," says Marty Banks of the University of California, Berkeley.

The researchers, led by Karl R. Gegenfurtner of the Max Planck Institute for Biological Cybernetics in Tübingen, Germany, suspected that the rod- and cone-based visual systems interpret motion differently. For example, Gegenfurtner knew of a color-blind man lacking all three types of cone cells who complained of trouble catching a Frisbee.

In tests on five men with red-green color-blindness, the researchers pitted two types of visual-receptor cells against each other, they report in the April 8 NATURE.

In dimness, objects may seem to be moving less rapidly than they really are.

About 2 percent of white men can't distinguish green and red because they are missing the cone cells tuned to green light. The researchers manipulated the color and brightness of objects on a computer screen to activate either rods or red-sensitive cones but never the blue-sensitive cones, Gegenfurtner says.

The red-green color-blind subjects compared oscillating patterns, one stimulating the cones and the other, the rods. They judged the speed of the rod-activating pattern to be about 75 percent of the cone-activating pattern's speed.

The rod cells may see the world differently because of the way the retina is wired, says Banks. In very low light, only the rod cells are sensitive enough to see the dimmest objects. To better pick out faint light signals, which could be overshadowed by random nerve firings, the retina sacrifices resolution. It averages signals from many different rod cells and gathers rod signals for a relatively long time before passing a message further along in the visual system.

In comparison, Banks says, "cones have a direct line through the retina to the cortex." Each cone cell in the retina's center sends an unadulterated signal to the brain. This high-resolution system—like a computer screen—refreshes frequently and responds to movements quickly.

One potential danger of the rod system's slowed perception, Gegenfurtner says, arises during night driving. Although headlights illuminate the road brightly enough for the cones to kick in, objects outside the beams may appear to be moving more slowly than they are. —*L. Helmuth*