If you read newspapers or magazines looking for information about forests, what do you find? You find stories about the destruction of rain forests in South America, and about the logging battle raging in the Pacific Northwest over the spotted owl. Except for these two issues, forest problems don't make the news. But forest problems are pervasive, and are as important in their own way as toxics problems. To put it bluntly, trees are sick and dying everywhere in the U.S. At first blush this seems like an extreme statement. But a new book, THE DYING OF THE TREES by Charles Little, will convince you it is true. [1]

This book gives a detailed picture --from New England to Oregon and California, from Alaska to Florida, across the upper midwest, across the southern border states, and even into the desert southwest where the giant saguaro cactus is in major decline --of trees sick and dying. It seems clear that the dying trees are one more sign of danger, one more omen warning us that something is terribly wrong.

Why are the trees dying? The reasons are many and varied. In New England, New York, North Carolina, Tennessee, Georgia, Ohio, Indiana and Kentucky it's a combination of acid rain and clear cuts; in California it's killer smog; in Arizona and New Mexico and elsewhere it's excessive ultraviolet light filtering through the earth's damaged ozone shield; other places, it's pesticides, or it's toxic heavy metals released by burning coal and oil; in Alaska and Florida it's rising temperatures and rising sea levels from global warming; in Colorado, Oregon, and Washington state it's destructive forestry practices (clearcut logging, and fire suppression) that leave forests weakened, unable to withstand extremes of weather or attacks by insects or funguses. In most places, in truth, it's probably various combinations of all these factors. Scientists are playing catch-up now, conducting studies that may explain the complicated causes of widespread tree death. But, as with toxics problems, if we postpone action until the scientists have described the problems completely, we'll get the answers too late to do any good.

Answers come slowly. Hubert "Hub" Vogelmann, a botanist at the University of Vermont, wanted to study an undisturbed forest, so in 1965 he made a thorough survey of Camel's Hump, a 4083-foot peak in the Green Mountains. So far as he knew, he was describing a healthy ecosystem. He measured the types and sizes of the trees, and various other aspects of the ecosystem. He had no particular purpose in mind, other than to gather knowledge about nature.

Periodically, he re-surveyed Camel's Hump, and a pattern began to emerge. The trees were dying. His survey in 1979, compared to the baseline study of 1965, showed a 48% loss of red spruce; a 73% loss of mountain maple; a 49% loss of striped maple; and a 35% loss of sugar maple.

By examining tree rings, and by other studies, Hub Vogelmann was able to show that the health of Camel's Hump had begun to decline in the period 1950-1960. Similar studies in the Black Forest of Germany, and in southern Canada, revealed that the most likely cause was acid rain.

Acid rain occurs when coal and oil are burned, releasing sulfur in the smoke, which combines with rain (or fog or snow) to make acid precipitation. Acidity is measured in units called pH. Pure water has a pH of 7 --it is "neutral" --neither acidic nor alkaline. Pure rainfall has a pH of 5.6 --slightly acidic because, while in the air, rain absorbs carbon dioxide to form a weak solution of carbonic acid.

After World War II the U.S. saw a massive rise in use of fossil fuels, coal and oil. The resulting smoke was obvious, and obviously harmful; in Donora, Pennsylvania (south of Pittsburgh) in 1948, half the people in the town fell ill for 3 days because of coal smoke in the air. Twenty people died. In London, England, in 1952, coal smoke killed 4000 people during a pollution episode.[2]

The official response in the 1950s was to build smoke stacks hundreds of feet tall, to dilute the pollution. Today the Ohio River valley is still dotted by enormous coal-burning power plants with stacks as high as 700 or even 1000 feet. These tall stacks allow the sulfurous pollution to travel 1000 miles or more, where it forms acid rain across the Adirondack mountains of New York, and across northern New England and southern Canada.

In Vermont, the rain has a pH of 3.8 to 4.0. The pH scale is "logarithmic" so a change from normal (5.6) down to 4.6 means the rain has gotten ten times as acidic as normal; at 3.6 the rain is 100 times as acidic as normal.

It wasn't until 1972 that Eugene Likens (then at Cornell University) and F. Herbert Bornmann at Yale discovered acid rain. But meanwhile acid rain had been falling on northern New York and New England and on southern Canada for about 20 years.

What Hub Vogelmann has been able to show by studying Camel's Hump for 30 years is that acid rain doesn't just affect the trees; it affects the soil and thus the entire ecosystem. Soil contains a large amount of aluminum, but it occurs in the form of aluminum silicates; in that form, aluminum is not available to the roots of plants. But acid rain dissolves the silicates, releasing the aluminum and making it available to plants. When plants get aluminum into their roots and their vascular system, the roots clog, which prevents the plant from taking up adequate nutrients and water. The trees are weakened, and may then fall prey to extreme cold, or to insects or pathogens.

Acid rain not only releases aluminum into the soil. It also releases other minerals --calcium, magnesium, phosphorus --which are fertilizer for the tree. Acid rain releases these fertilizers to be washed out of the soil, leaving the soil depleted of nutrients.

But that is not the end of the problem. The roots of many trees create a symbiotic (mutually beneficial) relationship with an orange-colored sponge-like fungus called mycorrhiza. The tree roots provide sustenance to the mycorrhiza, and the mycorrhiza help the tree roots gather water and nutrients from the soil. But acid rain kills mycorrhiza, thus further reducing the ability of trees to absorb water and nutrients from the soil.

But that is not all. Acid rain kills off portions of the detritus food chain. The detritus food chain is all the microscopic creatures that "compost" leaves, twigs, pine needles, dead branches and so forth, turning them back into soil. Because the detritus food chain is damaged by acid rain, forest "litter" builds up on the floor of the forest. The litter prevents new saplings from taking root --they cannot reach through the litter to make contact with the soil below. Furthermore, the litter promotes the growth of ferns, which give off substances that inhibit the growth of red spruce saplings, among others.

This is not a complete description of problems caused by acid rain, but it gives a sense of the complexity of ecosystems, and how they can become unbalanced by thoughtless human intrusions.

Given the high rates of tree death, and the widespread nature of the problem --it is occurring to one degree or another in every state in the union --one would think that the community of botanists, forest ecosystem specialists, and U.S. Forest Service employees would be up in arms, advocating change. But one would be disappointed.

Throughout the book, author Charles Little describes studies and statements by the U.S. Forest Service downplaying the importance of tree disease and death. For example, in 1991 the Procter Maple Research Center at University of Vermont pinpointed acid rain and other air pollution as an important cause of decline of sugar maples in Vermont: "We think we are looking at the early stages of an epidemic problem," the Center's report said. The following year the U.S. Forest Service issued a report saying that 90% of the sugar
maples surveyed were healthy and the overall numbers and volume of sugar maples was increasing. People in the maple sugar business were stunned--their own experience was telling them something that the U.S. Forest Service was officially denying. It turned out the Forest Service had used a tricky way of counting dead trees; only the standing dead were counted--those lying on the ground were not. Here's David Marvin, who owns a commercial "sugarbush"--a maple sugar farm in Vermont: "I don't want to condemn our forest scientists as a group," says Marvin, "but I am very concerned that a great deal of forest research is funded by the federal government, by chemical companies, and forest industry companies--and it's very difficult for people who depend on that funding to stick their necks out or to help influence policy that might go counter to what the funders are interested in. Many scientists I talk to will not publicly say anything about the connection between air pollution and forest decline, but privately, to a person, they tell me, yes, we've got a problem."

Forest-protection activists in the Pacific Northwest have long considered the Forest Service a rogue agency, captured by the forest products industry. Under the Reagan and Bush administrations, the situation grew so extreme that when Jack Ward Thomas took over the leadership of the Forest Service in 1992, he immediately issued six "messages" to personnel throughout the agency. The first three messages were: (1) Obey the law; (2) Tell the truth; (3) Implement ecosystem management. That such orders had to be issued speaks volumes about the past performance of this federal agency.

In 1993 there was evidence of new candor in the Forest Service. A report issued that year said timber mortality [death], on a volume basis, had increased 24% between 1986 and 1991, "in all regions, on all ownerships, and for both hardwoods and softwoods." Hardwoods were particularly affected, and particularly in the south, where the mortality increase was 37%.

A new candor--and a continuing candor--among scientists and foresters will be essential. But also we need a new recognition that there are many causes of tree death, just as there are many causes of toxic poisoning. To fix these problems, whether tree deaths or toxics, will require us first and foremost to study and emulate nature, to learn to live within natural limits, and to respect the right of non-human species to inhabit the planet. For starters, we should cut waste, not trees.[3] If we don't take these lessons to heart, and soon, the trees will survive but probably we will not.

--Peter Montague


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