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Pennsylvania Forests Changing From Red Oak To Red Maple Dominated

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UNIVERSITY PARK, Pa. -- Whether they blame Smoky Bear, acid rain or white-tailed deer, experts in Penn State's College of Agricultural Sciences agree that the species composition of forests in Pennsylvania is changing and warn that economically important species such as red oaks are not regenerating at historic levels.

Scientists may debate the reasons for forest change, but it now appears that they might all be right.

"The decline of oak in our forests is a big story," says Marc Abrams, a professor of forest ecology and physiology who has been honored several times in recent years for outstanding research on systematic change in Eastern forests. "The change actually started in the early 1900s when forest fires first were suppressed."

Abrams tracks a fascinating trend over the last century when red maple -- a tree species that originated in swampy habitats -- started taking over eastern forests. "Originally, because of its sensitivity to fire, red maple was relegated to the swamps," explains Abrams. "In fact, it used to be called swamp maple. But now that we suppress forest fires, red maple has emerged from the swamps and taken over upland sites, and can be found on just about every landscape in the eastern deciduous forest. This change in our forests may have profound economic and ecological consequences.

"Forest regeneration is a huge concern," adds Abrams. "Trees that historically dominated this region -- the pines, oaks, hemlocks and hickories -- no longer regenerate very well. Red maple is replacing trees that have high economic value. Its soft wood, color and grain aren't as highly valued as that of black cherry and oak. Also, many wildlife species depend on the trees that are being replaced."

Forest hydrology professor Bill Sharpe -- who has chronicled the effects of acid rain in Pennsylvania for several decades -- also has watched red oaks decline and red maples become predominant. But his explanation for the trend is a bit different. He maintains that soils in many places have become too acidic to support adequate growth of red oak.

According to Sharpe, Pennsylvania's forest soils for many decades have been absorbing acidic precipitation originating in the Ohio Valley -- the greatest industrial complex in the world. "The acid comes from sulfur dioxide in the emissions from coal-fired generating plants in Ohio, Indiana, Illinois, West Virginia and western Pennsylvania. Our forests long have been the victim of the most acidic precipitation in North America and our data show that forests soils are much more acidic now than they were 40 to 50 years ago.

"The acid deposition leaches aluminum out of the soils, which is toxic to plants, and also lowers the availability of calcium and magnesium, both essential elements for plant growth," Sharpe says. "We have a forest regeneration problem and a forest health problem -- our forests are sick. We know there is very little regeneration of red oak and large, mature red oaks are dying. That cannot be blamed on deer or the lack of fire."

Sharpe has completed several research projects that suggest soil acidification may be responsible for the rising fortunes of red maple. In a simulated deer browsing study, red maple grew better after simulated browsing than red oak, and in plant bioassays red maple was much less sensitive to aluminum and low calcium than red oak. In deer studies done at Penn State in the 1970s, deer actually preferred to browse red maple over red oak, so Sharpe does not subscribe to the deer hypothesis. "We can do something now and that is to demand tighter emissions controls, including controls on tail pipe emissions," insists Sharpe. "We also should lime areas to be harvested where regeneration is problematic."

Abrams believes a shift in wildlife populations is likely to parallel this shift in tree species. Oaks and hickories supply many small mammals and birds with nuts and acorns. And the oak's rough bark -- unlike the maple's smooth bark -- houses bark-dwelling insects for insect-eating birds. Red maple's proliferation also poses a biodiversity concern, he points out.

"Very diverse forests -- with six to 12 different species in the overstory -- may be changing to red maple-dominated stands," he says. "And stands of single species are more susceptible to total devastation by insects and disease."

Abrams believes many forests can be managed with controlled burns on a case-by-case basis. "In many instances," he says, "a controlled understory fire is highly realistic and will go a long way in encouraging oak regeneration and retarding further development of red maple."

Selective browsing by an overpopulation of white-tailed deer also has been widely blamed for a lack of forest regeneration. Deer damage has caused an increase in species such as hay-scented ferns, which compete successfully with tree seedlings. Some experts, such as wildlife resources professor Gary San Julian, say it seems clear that where deer are most numerous, seedlings are devoured before they can grow out of reach of voracious herds of whitetails.

"In many areas of Pennsylvania in the last 40 years or so, deer numbers and densities significantly altered habitat," says San Julian, who has done research in wildlife damage management. "In some areas, very few deer -- because of past heavy browsing -- can greatly affect regeneration."

But, San Julian concedes, it is likely that several factors are contributing to the change in forest composition in Pennsylvania. "All three theories about why young oaks have become scarce in our forests have merit," he says. "It may be that decades of fire suppression, acid rain and deer damage have all combined to create an environment that is not favorable to red oaks and a few other desirable tree species."

The subjects of deer damage to forests and deer management have proven to be extremely controversial in Pennsylvania, to say the least, but San Julian is philosophical about the debate surrounding the state's efforts to decrease deer numbers for the benefit of the forests.

"What if the cause of poor regeneration of oaks and other economically important tree species in our forests is a combination of three factors, as we suspect?" he asks. "What if it is caused by fire suppression, acid rain and too many deer? What can we do?"

"We no longer can just let wild fires burn -- there are too many people and too many valuable properties to take that kind of risk. And there is little that we in Pennsylvania can do about acid rain in the short term. The kind of pollution abatement needed will take a national effort, and the results won't be felt for years. But we can bring deer numbers into harmony with the habitat. We can do that much right now for the health of our forests."

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