Of Time and the

Past changes in the landscape of Hopkins Forest may hold clues to its future.

A lot can happen in a century.

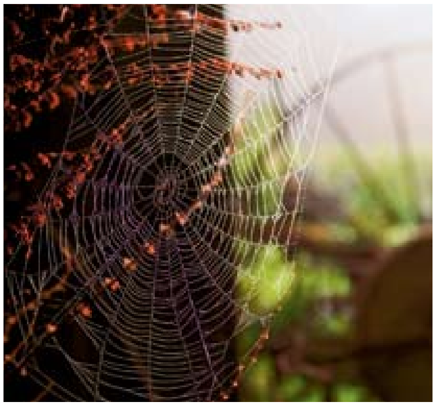
Though it's less obvious in a natural setting, evidence of change is there if you know where to look. In 1910, Col. Amos Lawrence Hopkins, Class of 1863, finished buying land for Buxton Farms, an estate covering more than 1,600 acres from Northwest Hill in Williamstown west to the New York state line and north to Vermont. Today those lands form the core of Hopkins Memorial Forest, where Williams researchers are studying patterns of long-term ecological change. The hills and plants of Hopkins Forest tell a story of farms reverting to woods—one that has played out across New England since the region's agriculture peaked before the Civil War.

"There's a misperception that we're a park, but the forest is much richer and more historical than that," says forest manager Drew Jones. In fact, Hopkins Forest has been a research site since 1935, when the College (which received it as a gift from Hopkins' widow) sold it to the U.S. Forest Service for $1, provided that the land would revert to Williams when the government's work was done. The forest service used the site to study how abandoned farmland reforested and to raise experimental crops of fast-growing, shade-tolerant tree species that might help to speed up the process. These "plantation plots" are easy to spot on a walk through the forest, where every so often the mixed vegetation gives way to uniform stands of soft poplar, Norway spruce or red pine in neat, precise rows.

In 1968 the forest service abandoned Hopkins Forest, leaving three decades of unpublished data. When biologist Hank Art arrived at Williams' Center for Environmental Studies (CES) in 1970 and was directed to design an environmental research and education site for the College, plans were in the works to sell off the forest for private development. But Art recognized it as a unique resource, especially the 220 permanent quarter-acre research plots that the government had set up to study how vegetation was changing. He convinced President Jack Sawyer '39 to keep the forest as a research station—a decision that probably cost the school a hefty chunk of revenue but gave Williams researchers a unique outdoor laboratory.

"Hopkins Forest is a wonderful resource, because it's so representative of a broader region but also very diverse," says Art, the Samuel Fessenden Clarke

Forest



BY JENNIFER WEEKS '83

PHOTOGRAPHY BY JASON HOUSTON

Professor of Biology. "Elevations range from 600 to 2,400 feet, there are many soil types, and we have north- and south-facing slopes. The land-use history wasn't marred by logging in the early 20th century, so you can see reforestation stages more clearly."

Forests regrow on abandoned Northeast farms in a clear pattern. Sun-loving weeds and herbs appear first, followed by dense shrubs like hardhack and blackberry. After about a decade, birches, aspens and other small, fast-growing trees move in, sprouting wherever the wind blows their lightweight seeds. In 30 to 40 years, slower-spreading trees like ash, red maple and oak take root. Lower areas of Hopkins Forest are dominated by these mid-successional species, along with some older stands that date back to the Civil War. Beeches, which grow well in low light, sprout in the shade and will become increasingly common in coming decades.

CES has installed trailside markers that point out clues to the forest's past. One way to spot tracts that formerly were pastures is to look for large isolated "wolf trees" whose branches spread widely on all sides because they grew up in open spaces. (Trees that sprout under a forest canopy typically grow straight up toward the light.) Former pasturelands also tend to have less undergrowth than other tracts, and many trees on these sections are species like hawthorn and juniper that are prickly or distasteful to livestock.

The forest also bears physical scars of its farming past. When the Berkshires start to warm in late winter, snow lingers on some sections in deep parallel furrows that were carved decades ago by plows. Many old stone walls have collapsed and sunk halfway into the ground. Some are flanked by parallel rows of hickory or cherry trees, planted unintentionally by squirrels hiding nuts in the stone chinks or by birds that perched on the walls to eat fruit and then excreted the seeds.

Below: David Dethier (center) and students shoveled out sediments in the south branch (Birch Brook) weir in Hopkins Forest in August.

Small upland mountain streams like Birch Brook are virtually unmonitored throughout the country, so research in the forest is a very valuable resource.

Research in Hopkins Forest also promises a future full of questions. New stresses are coming to bear on New England forests, and their scope is increasingly national and global rather than local. Invasive pests are ranging farther afield, and air pollutants blow in from hundreds of miles away. Greenhouse gases from coal-fired power plants in India and China are warming the atmosphere, which is changing local rainfall patterns.

The core of long-term analysis in Hopkins Forest is the array of permanent research plots, which now number 440. In the 1970s and 1990s, faculty and students went through the plots and counted every woody stem more than a half-inch in diameter; a fourth census since 1936 will take place in the next several years. These data, which build on forest service work, let researchers analyze forest growth rates, succession patterns, the composition of vegetation and lasting impacts of events like major storms. For scientists studying long-term trends, consistent records like this are the gold standard, even if it takes years of these detailed measurements before researchers know exactly what they have.

David Dethier, the Edward Brust Professor of Geology and Mineralogy, has monitored the chemistry of rainfall and the rate and volume of stream flow through Hopkins Forest for more than 20 years. "This is information we need to have available—it's the furniture of the forest," he says. Long-term geophysical measurements may signal impacts of global climate change. For example, many models suggest that warming temperatures will make the water cycle run faster in areas that are typically moist, so observers would expect to see more yearly precipitation and high runoff volumes. The way to tell is to measure how much water evaporates or transpires from plants, compared with how much flows out of Hopkins Forest into the Hoosic River.

"We've seen higher precipitation in the past 20 to 30 years than in the 1920s and '30s," says Dethier, who also serves as forest director. "When I arrived here, annual precipitation was around 42 inches, but now it's averaging 55 or 60 inches. We're collecting the data, and we look at pieces of it. Students pull out specific items for research, like the relationship between temperature, precipitation levels and the emergence of salamanders in the spring."

Will Ouimet '01, who wrote his senior thesis on sediment catchment rates in Birch Brook, is glad to have had this record available. "It was amazing to work with such a rich data set," says the Ph.D. student in earth, atmospheric and planetary sciences at MIT. "Small upland mountain streams like Birch Brook are virtually unmonitored throughout the country, so it's a very valuable resource."

It takes time for signals to emerge from the noise, but some changes are clear. Acid rain was a major environmental concern in the 1970s and 1980s. Sulfur dioxide and nitrogen oxide compounds emitted from coal-fired power plants came down as acids in rain and snow, seriously damaging many Northeast forests and lakes. But local rainfall is less acidic now. Dethier has tracked a modest rise in the pH value (i.e., a fall in acidity) of precipitation in Hopkins Forest. The sulfuric component, which was capped by air pollution laws in the 1990s, is falling. Nitrates, which are less tightly regulated, are holding constant or rising.

Changes in temperature, rainfall and other physical factors ripple through the living forest, but their effects are not always predictable. "The permanent plot inventories turn up things that we wouldn't have expected," says Art. For example, the last research plot inventory found that sugar maples were declining at high elevations along the Taconics, contrary to expectations that these trees would thrive as a late successional species. In her senior thesis, Flynn Boonstra '04 found that soils and rocks at higher levels in the forest were more acidic than those lower down the hillsides, and that acid rain was mobilizing aluminum in rocks and soils and poisoning sugar maples. But acid rain isn't necessarily the smoking gun, says Art: Some trees were stressed by drought and pests in the 1960s and '70s, so they probably were weakened already. In long-term ecosystem research, it can be hard to untangle contributing factors and track changes back to a single cause.

Subtle factors may affect how well a forest plot responds to stresses. Since 1998 biologist Joan Edwards has been studying the spread of garlic mustard, an invasive weed that sprouts small white flowers and peppery-tasting leaves on tall upright stalks. Research in other North American forests suggests that garlic mustard, which is found across 30 states and Canada, suppresses the growth of native trees by killing fungi that help the trees take up nutrients from soil.

Edwards, the Washington Gladden 1859 Professor of Biology, tracks garlic mustard plants on three forest sites in different stages of regrowth. The weed has spread throughout the early-succession plot, but older tracts appear to be more resistant. "I'm heartened that these very mature forests seem to be pretty robust," she says. "The literature suggests that once garlic mustard hits an area, it moves through like a wave. That's true for flood plains or open fields, but not so much for older forest stands."

Not every project has such global scope. In early spring Williams invites the public to help make maple syrup at the Sugarbush, a grove of large sugar maples near the forest entrance that was prized by Amos Hopkins. And for a field botany project, several of Edwards' students collected birch sap and steeped young birch twigs, then added sweetener and yeast to the brew to make birch beer. "It was unbelievable—cold and fizzy, and it tasted like wintergreen. It was pretty strong, too," she recalls.

Student, faculty and staff research in Hopkins Forest has generated more than 160 journal articles, senior theses, independent study papers and other publications in fields that include history, art and archaeology as well as the sciences. The "Williams Naturalists," a group of students from the classes of 1996 and 1997, published *Farms to Forests: A Naturalist's Guide to the Ecology and Human History of Hopkins Memorial Forest*, a valuable pocket resource for a walk through the woods.

Art, Dethier and their colleagues plan to publish more analyses of long-term Hopkins Forest monitoring. "I'm really looking forward to seeing that come out. It will only get more valuable as time goes on," says Ouimet. In the meantime, Ephs who have the Purple Valley on their minds can get current weather readings for Hopkins Forest or search the data archive back over more than 20 years at oit.williams.edu/weather/index.cfm.

This kind of record is scarcer than many people realize. According to a June 2006 report from the Heinz Center for Science, Economics and the Environment, major "data gaps" make it impossible to size up the health of U.S. ecosystems in a comprehensive way. But Williams researchers are tracking many key indicators, such as impacts of invasive species and the conditions of plant communities and streams. No one is complacent about how global environmental stresses will shape Hopkins Forest in coming decades, but the past century shows that it is a resilient ecosystem. And as Jones says, "Change is an interesting thing to study." ■

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