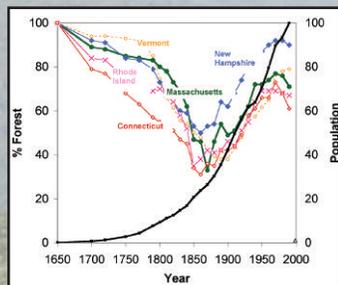


Harvard Forest LTER

Research and Education in Ecology, Conservation and Forest Biology

Research

Since 1907 scientists have been exploring forest ecology on the Harvard Forest LTER's (HFR) 3,500 acres in central Massachusetts, the surrounding area, and throughout the New England region. Research focuses on forest plant communities from the end of glaciation to



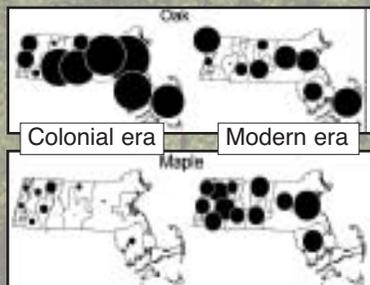
Forest cover and population trends in New England.

the present; disturbances ranging from hurricanes to forest harvesting, and from insect pest infestation to climate change; wildlife dynamics; ecosystem processes such as carbon and nutrient dynamics and water fluxes; and interactions between humans and forests.

The Harvard Forest LTER program was initiated in 1988. In 2007 Harvard Forest was nominated to be the northeastern center for the emerging National Ecological Observatory Network (NEON) project.



Sampling a core of sediment from a pond bottom. Changes in abundance of pollen of different species through time documents vegetation change since the last glaciation.



Frequency of species in witness tree records from colonial New England town surveys allows comparison with modern species abundance.

Outreach and Education



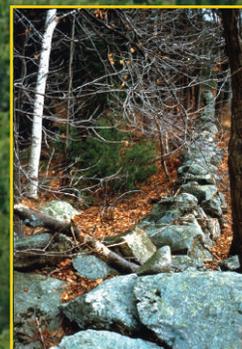
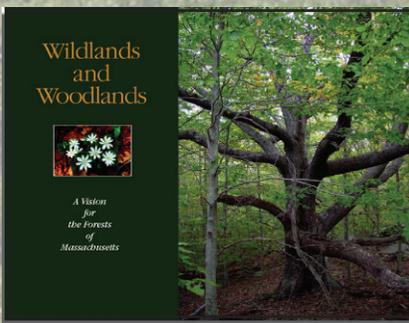
The Fisher Museum with its world-famous dioramas introduces the public, hundreds of schoolchildren and dozens of university classes annually to the region's dynamic forest history.

The **Research Experience for Undergraduates (REU)** program provides an opportunity for 25-30 summer interns to work directly with senior scientist mentors on current research.



Through the **HFR Schoolyard LTER program**, K-12 students and their teachers carry out research on tree phenology, invasive forest pests and freshwater ecology.

Harvard Forest publications contribute to public education and inform policy about forest ecology and conservation.



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For more information about the LTER Network, see: <http://www.lternet.edu>

Harvard Forest LTER



Historical Studies

The landscape of central Massachusetts has changed dramatically from the mid-1800s to the present as forests have regrown on abandoned agricultural land. This land-use history strongly influences nearly all ecological processes today, from species distributions and dynamics to carbon storage and nutrient fluxes. Understanding these complex interactions is a major focus of Harvard Forest's LTER research.



These identical views across the Swift River valley in southern Petersham illustrate the dramatic change in forest cover that followed the broad-scale abandonment of agricultural land across New England.



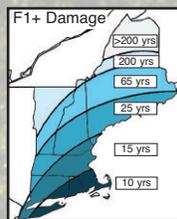
Natural Disturbance Dynamics



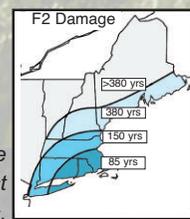
In this experiment, trees were pulled down to simulate hurricane damage. Despite massive structural change, the forest is resilient to hurricane disturbance in terms of biogeochemistry, productivity, and species composition. These results compare well with those from the Luquillo LTER site in Puerto Rico, which has a history of frequent hurricanes.

Long-term Impacts of Hurricanes

These contours represent average return intervals for different levels of damage from hurricanes.



Some trees windthrown.



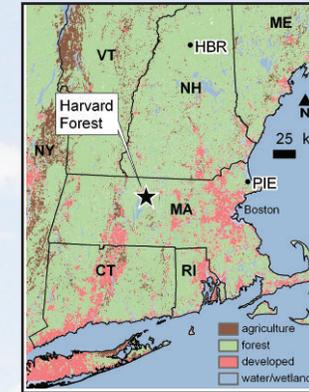
Extensive forest blowdowns.

Harvard Forest

Long Term Ecological Research

A century of investigating temperate forest dynamics in New England

Harvard Forest LTER (HFR) is an integrated program that studies forest response to natural and human disturbance and environmental change over broad spatial and temporal scales. Involving more than 25 senior researchers, 150 undergraduate and graduate students and a dozen institutions, HFR embraces the biological, physical, and social sciences to address fundamental and applied questions in dynamic ecosystems.



LTER sites in New England: Harvard Forest (HFR) in central Mass; Plum Island Ecosystem (PIE) in coastal Mass; and Hubbard Brook Experimental Forest (HBR) in New Hampshire.

The Need for Long Term Research

Carbon Dynamics

The Harvard Forest Environmental Measurement Station (EMS) tower provides the longest-running record of carbon exchange for any forest in the world. EMS measurements suggest that New England forests play a globally important role in mitigating climate change by storing carbon. However, more than a decade of measurements was needed to show that rates of carbon storage are actually increasing over time.



Scales of Study at Harvard Forest LTER

Illustrated by research on the introduced pest, the hemlock woolly adelgid

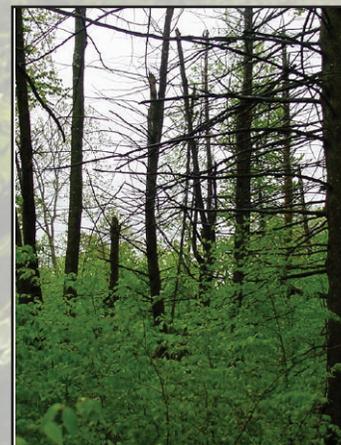
Organism



We are studying the rates of decline and mortality of infested hemlocks and the variety and growth of species that replace hemlock, such as black birch (shown below).



We are studying how adelgids (above) affect hemlocks physiologically and the interaction between adelgids and another introduced pest, the elongate hemlock scale insect.



Stand

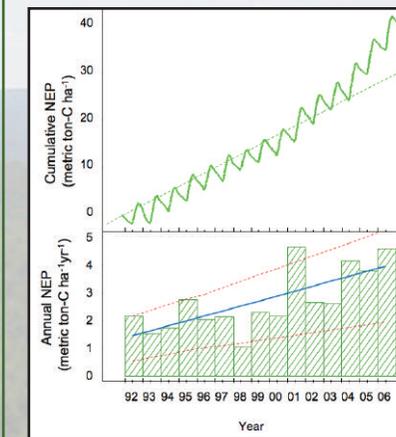
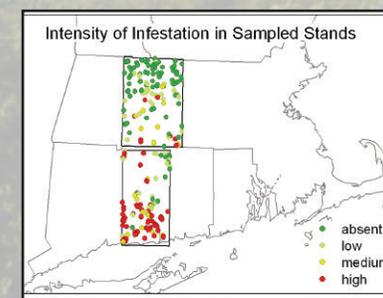
Watershed



The loss of hemlock typically results in major changes in forest type and ecosystem function. In gauged watersheds (like Nelson Brook, above), we are studying changes in water flow rates, stream chemistry, and species composition of invertebrates in streams flowing through hemlock stands.

Region

Since the early 1980s, hemlock woolly adelgid has expanded slowly northward through New England. Our regional-scale studies track the spread of the adelgid and the corresponding decline of hemlock across southern New England.



Annual carbon storage (Net Ecosystem Production—NEP) of 0.8 to 4.6 metric tons/ha per year has resulted in a cumulative uptake from 1992-2006 of about 40 metric tons/ha (top). Uptake is increasing by about 0.2 metric tons/ha each year (bottom).

Soil Warming

Harvard Forest scientists are also studying the effects of climate change on carbon storage and soil nutrient dynamics at two soil warming sites where buried heating cables maintain soil temperatures 5°C above ambient temperatures. An initial pulse of carbon released from the heated soil proved transient, while increased nitrogen mineralization has remained higher on the heated plots.

