

Hubbard Brook

Long Term Ecological Research

Ecosystem Science and Education at
New Hampshire's Hubbard Brook Experimental Forest

The Hubbard Brook Ecosystem Study (HBES) is among the longest-running and most comprehensive ecosystem studies in the world. The goal of the study is to better understand the ecological patterns and processes that characterize the Northern Forest in eastern North America, and its



response to both natural and human disturbances. Research is conducted at the bowl-shaped, 3,160-hectare (7,800-acre)

Hubbard Brook Experimental Forest, located within the White Mountain National Forest. The site was established in 1955 by the USDA Forest Service for hydrologic research and in 1987 joined the National Science Foundation's Long Term Ecological Research (LTER) network. Hubbard Brook is renowned for its long term record of measurements, landscape-scale experiments of whole watersheds, and the involvement of scientists from diverse disciplines and institutions.

In the mid-1950s, Forest Service scientists focused on the relationships among forest



Three examples of Hubbard Brook research: Long term bird studies; applying calcium to an experimental watershed; and limnological studies of Mirror Lake.

management practices, erosion, and stream flow at Hubbard Brook. The scope of research was expanded in 1963 when scientists pioneered the "small watershed approach" to study nutrient cycling in ecosystems. This groundbreaking method uses the forest as a living laboratory, monitoring changes in stream flows, soil and water chemistry, forest growth, and the associated biota.



The scope of research expanded again when Hubbard Brook joined the LTER network. Researchers use monitoring, experiments, models, and cross-site studies to assess the effects of disturbances. Major research themes encompass much of the ongoing research at the site, including effects from air pollution, forest perturbations, and climate change. Another important body of research focuses on the 15-hectare (37-acre) Mirror Lake.

Today dozens of studies at Hubbard Brook are conducted on a variety of scales, ranging from forest plots to small watersheds to the complex landscapes of the Hubbard Brook Valley and the Northern Forest region.

Brochure photos: Joseph Mehling; Jerry Franklin; Nick Rodenhouse; Hubbard Brook Archives.

HUBBARD BROOK



LONG TERM ECOLOGICAL RESEARCH



hbr.lternet.edu

USDA Forest Service
Hubbard Brook Project
Northeastern Research Station
271 Mast Road
Durham, NH 02824
603-868-7636

www.fs.fed.us/ne/durham/4352/hb.shtml

Hubbard Brook Research Foundation
Administrative Offices
16 Buck Road
Hanover, NH 03755
603-653-0390

www.hubbardbrook.org

This publication is a joint project of the Long Term Ecological Research (LTER) Network, the USDA Forest Service/Hubbard Brook Project, and the Hubbard Brook Research Foundation.



For more information about the LTER Network, see:

www.lternet.edu

Long Term Monitoring

Monitoring is at the core of the science conducted at Hubbard Brook. An uninterrupted data record has been collected of

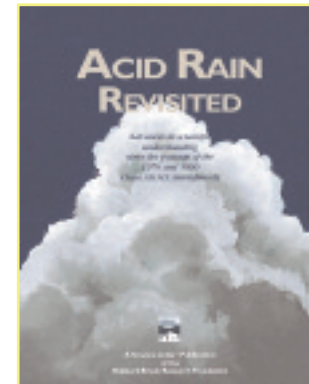


Meteorological station

meteorology, hydrology, biogeochemistry, forest growth, and population dynamics of key species. Available at www.hubbardbrook.org, these data have contributed much to our understanding of ecosystem structure and function, revealing striking trends in such diverse areas as air pollutants, forest growth, climate change, and songbird abundances.

The monitoring program includes, in part:

- A network of meteorological stations and stream-flow gauges, measuring rainfall, snowpack, and stream flow in nine watersheds.
- Chemical analyses of the nutrients and acidity of rain, snow, and stream water.
- Measurements of forest growth and species composition.
- Below-ground measurements of microbial activity, roots, and soil water.
- Water levels, groundwater flow, water chemistry, and biology in Mirror Lake.
- Abundances of forest bird, mammal, amphibian, snail, and insect populations.



HBRF Science Links Report

Public Policy, Education, and Outreach

Hubbard Brook scientists and their colleagues conduct education and outreach programs that raise awareness about the value of ecosystem science and long term monitoring, and help the public learn how ecological

knowledge is obtained and used for decision-making. The main programs include:

Committed to Long Term Ecological Research

Hubbard Brook Ecosystem Study

Major Achievements

The continuous research record at Hubbard Brook has proven invaluable in providing information on trends in ecosystem structure and function. That in turn has helped to solve major environmental problems and to identify significant new research questions. The scientific accomplishments at Hubbard Brook include:

- **Acid rain was first identified in North America** at Hubbard Brook in the mid-1960s and later shown to result from long-range transport from power plants. Hubbard Brook research influenced national and international acid rain policies, including the 1990 Clean Air Act Amendments. Scientists continue to study the effects of acid rain on forest growth and on soil and stream chemistry.
- **Long term biogeochemical measurements have documented a marked reduction of calcium levels** in soils and vegetation over the past 40 years, primarily due to leaching losses associated with acid deposition.

● **Research Training** – Including experience for undergraduates, graduate students, and postdoctoral fellows.

● **Science Links** – Brings together teams of scientists to produce synthesis papers and translations for the general public, opinion leaders, and land managers on vexing environmental issues.

● **Group Tours** – Guided field trips of the research forest for

college classes, visiting scientists, resource management and scientific organizations, and other interested individuals and groups.



Students participating in research

● **Highway construction and subsequent road salting** caused increases in chloride concentrations in Mirror Lake and Hubbard Brook, demonstrating land disturbance effects on adjoining lake and stream ecosystems.

● **Conspicuous losses of critical elements such as calcium, potassium, and nitrogen occurred after forest disturbances** such as clear-cutting or ice storms. These findings have been instrumental in developing protocols for sustainable forestry practices.

● **Long term declines in lead emissions associated with elimination of leaded fuels** nationwide have corresponded to the marked decreases of lead in precipitation and in the chemical makeup of the forest floor at local scales.

● **Studies of bird populations** have demonstrated that food limitation, effects of climate, and changes in forest structure account for most changes in the abundances of neotropical migrant birds, indicating that breeding season events are critical for maintaining these populations.

● **Annual Cooperators' Meeting** – A two-day meeting held every July during which Hubbard Brook scientists share their latest research with their colleagues and students.

● **Teacher Professional Development** – Workshops, institutes, and curriculum development that allow teachers to bring important lessons in ecosystem research and methodology back to local schools and communities.

● **Other Educational Resources** – Including virtual tours of the research forest and Mirror Lake, an annual lecture series by scientists, and general-interest articles sharing the results of Hubbard Brook science.

Facilities

Besides serving as a research site, Hubbard Brook is also a field station and education campus that offers housing, laboratories, high-speed internet access, and conference and meeting spaces to visiting scientists, teachers, and students. The facilities are managed by the USDA Forest Service and the Hubbard Brook Research Foundation, a



Pleasant View Farm

private, 501(c)3 nonprofit organization. Priority for use of facilities is given to scientists conducting research at Hubbard Brook and to others participating in outreach and education programs. Opportunities exist also for nonprofit organizations and government agencies to use the facilities for retreats and



R.S. Pierce Laboratory

other functions. Hubbard Brook facilities include:

● **Robert S. Pierce Ecosystem Laboratory** – A USDA Forest Service facility that includes office space, laboratories, an archive of ecological samples, conference and workshop facilities, and temporary living quarters.

● **Pleasant View Farm** – includes the Towers Laboratory and a farmhouse remodeled for dormitory-style housing.

● **Mirror Lake Campus** – Newly purchased by the Hubbard Brook Research Foundation,

this facility includes lakefront cottages and a multi-purpose meeting room.



Mirror Lake Campus

