Hubbard Brook Experimental Forest (HBR)

Hubbard Brook Experimental Forest (HBEF) was established in 1955 as a center for hydrologic research in New England. The site is located within the White Mountain National Forest in central New Hampshire. Early studies focused on the impacts of forest management on water yield and quality. The Hubbard Brook Ecosystem Study (HBES) originated in the early1963s as joint research program between the USDA Forest Service and Dartmouth College to use the small watershed approach to study element flux and cycling. In 1988, the HBEF was designated as a Long Term Ecological Research site by the National Science Foundation. Today, over 40 scientists from approximately 20 institutions participate in the HBES. The Northeastern Forest Experiment Station of the USDA Forest Service manages the site for long-term ecosystem research. Research at the HBEF is representative of the Northern Forest, which covers more than 26 million acres stretching from the northern woods of Maine down into the Adirondack and Tug Hill regions of New York. Most of the Northern Forest is undeveloped forest that includes a mixture of mountain ranges, rivers, lakes, and wetlands that provide habitat for many wildlife species, including moose, pine marten, Canada lynx, song birds, peregrine falcons and bald eagles. Critical environmental issues for the Northern Forest are land development, air pollution, climate change, introduced species, water supply and quality and carbon management.

The primary goals of the HBES are: 1) to advance scientific understanding of forest and aquatic ecosystems, their ability to provide ecosystem services to humans, their response to natural and human-induced disturbances, and provide a scientific baseline for management and policy decisions; 2) to offer educational and research opportunities to students; and 3) to promote greater public awareness of ecosystem science, with a focus on the Northern Forest.

Site Description and Characteristics The HBEF is a 3,138-ha, bowl-shaped Valley, ranging from 222 to 1,015 m altitude. A network of precipitation and stream-gauging stations, weather instrumentation, as well as soil, vegetation and animal monitoring sites are established at the HBEF. There are ten gauged experimental watersheds, including several used for long-term experiments. Annual precipitation averages about 1,400 mm, with one-third to one-quarter as snow. A snowpack usually persists from mid-December until mid-April, with a peak depth in March. January temperature averages –9 ^{o}C and July is 18^{o}C. The growing season for trees is considered to be from 15 May to 15 September. The estimated annual evapotranspiration is about 500 mm. Soils at Hubbard Brook are predominantly well-drained Spodosols, Typic Haplorthods, derived from glacial till, with sandy loam textures. These soils are acidic (pH about 4.5 or less) and relatively infertile

(base saturation of mineral soil ~ 10%). A 20- to 200-mm thick forest floor layer is present. The HBEF is entirely forested, mainly with deciduous northern hardwoods: sugar maple (Acer saccharum), beech (Fagus grandifolia), and yellow birch (Betula allegheniensis). Red spruce (Picea rubens), balsam fir (Abies balsamea), and mountain paper birch (Betula papyrifera var. cordifolia) are abundant at higher elevations and on rock outcrops. Pin cherry (Prunus pensylvanica), a shade intolerant species, dominates all sites for the first decade following a major forest disturbance. Logging operations ending around 1915-1917 removed large portions of the conifers and better quality, accessible hardwoods. The present second-growth forest is even-aged and composed of about 80 to 90% hardwoods and 10 to 20% conifers.

Research Focus The small watershed ecosystem approach to nutrient cycling was pioneered at Hubbard Brook. This method uses the forest as a living laboratory in which scientists conduct experiments on an entire watershed and monitor resulting long-term changes in streamflow, nutrient cycling, forest growth and habitat. Whole ecosystem manipulations conducted at Hubbard Brook include experiments that simulate typical forest management practices, such as forest clear-cutting, strip cutting, herbicide application and base cation additions, and provide a scientific basis for improved forest management.

A strength of the HBES is the long-term monitoring program. Our long-term data show that short-term observations are often misleading and that decades may be required to detect real changes in complex ecosystems. The long-term record at the HBEF provides: 1) insight into ecosystem function, 2) empirical data for testing models and generating hypothesis, 3) a record of extreme or unusual events, and 4) information that is relevant to regional, national and global issues.