Events Leading to Establishment of the Hubbard Brook Experimental Forest

written by Jim Hornbeck, May 2001

The Hubbard Brook Experimental Forest (HBEF) was officially established by the U.S. Forest Service on May 17, 1955. What follows suggests a sequence of events transpiring over the preceding century that led to the 1955 establishment of HBEF. The more recent of these events were gleaned from Northeastern Research Station Annual Reports dating back to 1935 (I thank Bill Leak for suggesting them as a source), project files kept at the Forestry Sciences Laboratory in Durham, New Hampshire, and personal communications with Richard Sartz and Carol Pierce. These sources provide documentation of events directly related to the establishment of HBEF. The drawing in of earlier events (from the 1860's to 1930's) involves some speculation. These early events did not occur with the establishment of HBEF in mind, but likely strongly influenced the pathway of events that eventually led to HBEF.

It should be noted that this report addresses only the establishment of HBEF, and is not a history of ownership, forest development, and land use. Such information can be found in papers by Federer (1969) and Likens (1972) and in information assembled by Charles Cogbill of Plainfield, VT.

White Mountain forests under siege

The economic boom following the Civil War, the coming of age of steam railroads, and opportunities to purchase large parcels of public and private forest lands in the White Mountains set the stage for intense harvesting and destructive logging (Belcher 1980). The harvests, sometimes alluded to as "cut and run" and/or "clean-cutting", occurred across New Hampshire's White Mountains beginning in the late 1860's. Lumber production in New Hampshire trebled from the late 1860's to 1900 and reached an all-time peak in 1907 (Belcher 1980). Fire was prevalent in the logging slash, and erosion and sedimentation were extensive due to poor logging practices, including using riparian areas to transport logs via splash dams, horse skidding, and railroads.

There were suggestions that harvesting during this period also caused both increased flooding and drying up of streams. Increased flooding was certainly a possibility due to decreased soil water deficits immediately following intensive cutting, and to a potential for increased overland flow stemming from careless logging practices. However, as we now know, cutting of forest vegetation does not cause streams to "dry up" but rather causes an increase in water yield, particularly in summer.

Buying back the forests

By the early 1900's, conservationists (including the newly formed Society for Protection of New Hampshire Forests) had initiated serious efforts to establish protection for New Hampshire's forest and water resources. It was not an easy task and would eventually, as the saying goes, "take an act of Congress". Initial efforts were to persuade the U.S. government to buy logged over lands in the White Mountains and Appalachians based on considerations of scenic protection and "altruism" (Shea 1999, Judd 2000)

The suggested reasons for purchase proved controversial and largely unacceptable to Congress, and the approach was changed. Engineers from mills located on major rivers in New England, including the Merrimack, were brought to testify before Congress that floods and droughts resulting from forest harvests in the headwaters of New England rivers were jeopardizing mill production (Shea 1999). In conjunction with the testimony, Representative John Weeks of Massachusetts (but born in Lancaster, NH) introduced the Weeks Act in 1909 which called for land to be purchased "...for the purpose of preserving the navigability of navigable streams". The Weeks Act finally passed in 1911 and opened the door for beginning the purchases of all national forests east of the Mississippi. The Connecticut, Androscoggin, and Merrimack Rivers, all with headwaters in the White Mountains, qualified as navigable streams, thus allowing for purchase of the White Mountain National Forest. The portion of the White Mountain National Forest containing most of the present-day HBEF was purchased in August, 1920 (Federer 1969).

A need to know

Extensive harvesting was also occurring to the West and South in the early 1900's, usually with the same disregard for natural resources. Apart from general observations and intuition, there was little scientific information with which to confront the environmental concerns related to logging. Two national efforts to better understand forest-streamflow relationships took place around this time and are of interest in regard to establishment of HBEF.

First, C.G. Bates of the U.S. Forest Service and A.J. Henry of the U.S. Weather Bureau initiated the Wagon Wheel Gap study in Colorado. They borrowed the paired watershed design from Switzerland and used it in a 17-year study to determine impacts of forests and forest removal on water yield and quality (Bates and Henry 1928). Their careful attention to experimental details and a thorough job of analyzing and publishing the results led to a highly successful study. Perhaps more importantly, their research provided a clear demonstration of the utility and power of paired watershed studies. The pioneering work by Bates and Henry provided the framework for future paired watershed studies at locations such as Coweeta Hydrologic Laboratory, Fernow Experimental Forest, and eventually HBEF. Coincident with the Wagon Wheel Gap study, The U.S.

Geological Survey conducted studies in 1911-12 using several gauged watersheds in northern New Hampshire (Federer 1969). These studies, while short-lived, supported the premise of the Weeks Act and may have helped purchases of harvested forests to proceed.

Second, the U.S. Congress took a greater interest in the issues and controversies surrounding forest harvesting. In 1912, Congress invited Raphael Zon, a young forester of Russian descent, to testify on the general subject of relationships between forests and water. The published version of Zon's testimony, "Forests and Water in the Light of Scientific Investigation", prevailed for nearly two decades as the definitive reference on forest-streamflow relationships (Zon 1912). Among other things the testimony noted that forests alone can not prevent exceptional floods. Zon could not have known it at the time, but the relationships between forests and floods would become highly controversial and drive watershed research and management for the next several decades.

Forests and floods — the key to Pandora's box

By 1920, the logging boom was winding down in the Northeast and natural reforestation of harvested forests and abandoned agricultural land was well along. However, a pressing need was developing to obtain hard facts about forest effects on streamflow, including floods, low flows, water yield, and erosion/sedimentation. This need was fueled by Congressional efforts to develop a national plan for American forestry (Munns et al. 1933, Watts et al. 1933), and by continuing controversy over whether floods could be controlled by land treatment measures, including reforestation, as opposed to or in concert with expensive engineering structures.

The need for information led to the establishment of the Coweeta Hydrologic Laboratory in 1934, and passage of the Omnibus Flood Control Act of 1936. The Northeastern Forest Experiment Station (NEFES) was apparently eager to hop on the bandwagon. The NEFES Annual Report for 1936 stated: "An appropriation is needed to make surveys, to install weirs for the study of the behavior of headwater streams, and to conduct related studies of the effect of various types of vegetative cover on the regularity and quality of streamflow. Intensive investigations should be conducted on at least two typical watersheds, one in the glaciated region of central New England and the other in the heavy silt-loam soils on the headwaters of the Susquehanna or Delaware Rivers in New York." The Hubbard Brook watershed was waiting in the wings as a candidate for investigations in the glaciated region.

The Flood Control Act of 1936 directed the U.S. Department of Agriculture to determine the role of watershed management including reforestation. For forested lands in the northeast this task fell to NEFES and the Allegheny Forest Experiment Station (these two Experiment Stations would merge in 1942 to become NEFES) in cooperation with the Soil Conservation Service. Flood

control surveys (also called river basin surveys and watershed surveys in the NEFES annual reports) began immediately on major rivers, the urgency having been fueled by disastrous floods in March, 1936.

The flood surveys were plagued by questions about how they should be designed, what the objectives should be, and what should be measured. The NEFES Annual Report for 1939 stated: "The surveys have all been handicapped by lack of experimental data on relation of character of vegetative cover to run-off. This emphasizes the need for a comprehensive, long-term program of forest influences research in the region." In a similar vein the 1939 annual report of the Allegheny Forest Experiment Station stated: "Data on such important factors as infiltration, interception of rain and snow by tree crowns, evaporation from forest soils, transpiration from forest vegetation, and erosion, obtained in other regions with totally different climate, soils, topography, and vegetation, cannot be applied to this region, but must be gained through local research." These research needs expressed in 1939 are nearly identical to the studies that were first initiated when HBEF was established in 1955.

Despite the identity problems, the flood surveys continued until 1941 when they were halted by executive order because of World War II. Surprisingly (at least to me), flood surveys returned with even greater emphasis after the war and the role of NEFES was expanded. Recruiting and training of personnel began in July, 1946. Names of new employees assigned to flood surveys included Sidney Weitzman, George R. Trimble, Nedavia Bethlamy, and Robert Hobba, all of whom would play influential roles in the upcoming NEFES program on watershed management research.

The NEFES Annual Report for 1946 stated: "The next watershed to be surveyed will be the Merrimack River in New Hampshire and Massachusetts, and field work in this watershed is expected to start early in the spring of 1947." This plan was interesting in that the NEFES Annual Report for 1939 stated that a flood survey for the Merrimack was nearing completion. The dual surveys suggest the interest and importance placed on the Merrimack watershed. As mentioned earlier, testimony about the importance of the Merrimack headwaters had been one of the keys to passage of the Weeks Act. During both the 1939 and 1947 Merrimack surveys, the Hubbard Brook watershed was biding time; forest regrowth continued unabated, save for blow-down and salvage logging related to the 1938 hurricane (Federer 1969).

The flood control surveys continued, but with decreasing intensity, into the early 1950's. The final report for the Merrimack watershed survey begun in 1947 was finally completed in 1951. In 1953 the 83rd Congress passed a new watershed protection and flood prevention act that placed the responsibility for initiating watershed protection projects with local sponsors. The act, together with a Forest Service reorganization that transferred all flood control surveys to State and Private Forestry, effectively ended NEFES participation in flood control surveys.

Pandora's box is opened - watershed management research is inside

The experience gained by NEFES while participating in flood control surveys provided a keen appreciation for research needs relating to forest-streamflow relationships. Even as flood control surveys continued in the late 1940's and early 1950's, NEFES began new initiatives relating to water resources. The NEFES Annual Report for 1948 gave its traditional (since 1937) report on flood control surveys, but for the first time it also included research on "Forest Influences" (changed in the 1949 report to "Watershed Management"). The 1948 report began by stating: "For managing our water resources intelligently, a great amount of basic information is needed on the various factors that influence the behavior of water after it is deposited on the land as rain or snow." The report went on to describe how such information was being obtained from a recently established gauged and instrumented watershed in the Delaware basin, and for the first time, mentioned plans for paired watershed experiments on the Fernow Experimental Forest on the Monongahela National Forest in central West Virginia. Sidney Weitzman and George Trimble, who had been conducting flood control surveys, were named to lead the initial watershed management research at the Fernow.

By 1950, five gauged watersheds were established on the Fernow, and a number of studies were underway relating to logging methods and soil erosion. The NEFES plan of work for 1951, given at the end of the Annual Report for 1950, called for "preparing an analysis of watershed problems for the White Mountain area of New Hampshire".

In 1951 NEFES established a Division of Forest Influences Research (changed two years later to Division of Watershed Management Research). The NEFES Annual Report for 1951 makes no mention of further plans for watershed research in the White Mountains, but lists an impressive array of studies being conducted elsewhere relating to soil frost, humus accumulation, canopy interception, and erosion from skid roads. Raymond Lavigne, who would become the first technician at HBEF, began working at the Hopkins Experimental Forest in Massachusetts. The Hubbard Brook watershed continued to regrow its forest and to wait — with arms wide open!

During 1952-53, NEFES reorganized its subregional research areas. The Hubbard Brook watershed became part of an 800,000 ha area in central New England administered by the White Pine-Hardwood Research Center in Laconia. Victor Jensen was named as the Center Leader. A primary problem of study listed for the research center was "Is good timber management also good watershed management? The importance of water is such that the cutting methods, logging practices, truck road standards, and even product objectives desirable for timber production must be evaluated and if necessary modified in the interest of watershed management."

Finally!

In early August, 1954, NEFES named Howard Lull, who had been working at the Southern Forest Experiment Station, as Chief of the Division of Watershed Management (based on NEFES annual reports, the position had remained vacant since its establishment in 1951). Lull stayed with NEFES through the late 1960's, earning an international reputation in forest hydrology for both himself and NEFES (Sopper and Lull 1967). Coinciding with but unrelated to Lull's arrival, Congress appropriated $350,000 to establish watershed management studies in the White Mountains of New England. The funding and Lull's initiative resulted in a quantum leap for watershed research in the White Mountains.

By late August, 1954, Lull (who had only begun work in early August), Herb Storey of the Forest Service Washington Office, and C. L. Graham, Supervisor of the WMNF were touring the WMNF selecting potential sites for watershed management studies. They narrowed the field to six possibilities. Unfortunately the names of the candidate sites (except for HBEF) and the selection criteria seem to be lost. Lull, Victor Jensen, head of the White Pine-Hardwood Research Center, and George R. Trimble, who had been detailed from the Fernow, chose the Hubbard Brook watershed as best suited for research needs. Research at Hubbard Brook was to be administered by and headquartered with the White Pine-Hardwood Research Center located in Laconia, New Hampshire.

Personnel for the new "Hubbard Brook" project were brought on board immediately. Trimble was selected as Project Leader and began official duties on November 10, 1954. Richard Sartz transferred from the Forest Service, Washington Office Photo Interpretation Project and reported for work October 10, 1954. Robert Pierce who had been working with Lull at the Southern Forest Experiment Station, was recruited by Lull and arrived for work January 23, 1955. Carol Pierce remembers that within a week of his arrival, Bob was on snowshoes at Hubbard Brook assisting Trimble and Sartz in defining watershed boundaries and measuring snow courses. Sartz remembers first attempts at marking snow courses with tree blazes, only to have them nearly covered with subsequent snowfalls.

It's official

The paper work establishing HBEF was surprisingly minimal. A six-page "Establishment Report of the Hubbard Brook Experimental Forest, White Mountain National Forest, New Hampshire" was dated April 19, 1955, and provided objectives of the establishment, public sentiment, a description of the area, values involved, relation to management of adjacent national forest, and proposed plan for management. The last section of the report was a recommendation that the tract be set aside as a field laboratory designated the Hubbard Brook Experimental Forest. The report and recommendation were signed by Victor

Jensen, White Pine-Hardwood Research Center Leader, on April 28, 1955, Gerald Wheeler, Forest Supervisor, WMNF on May 12, 1955, Ralph W. Marquis, Director, NEFES, on May 16, 1955, Charles Tebbs, Regional Forester on May 16, 1955, and V. L. Harper, Acting Chief of the Forest Service on May 17, 1955.

Underway

Trimble (1955) published an analysis of New England's water problems and how they would be researched at HBEF. Flood flows, water quality, and water supply were listed as primary problems to be addressed using a combination of gauged watersheds and special studies. Trimble noted that an important part of the HBEF program would be conducting "show-me-trips" (talk about being clairvoyant!). A soil survey of the entire HBEF was conducted in the summer of 1955 by Bob Pierce together with Frank Vierra, Sid Pilgrim, and Lloyd Garland of the U.S. Soil Conservation Service (procedures are described in Garland et al. 1959). Geologists Edward Bradley and R.V. Cushman with the U.S. Geological Survey completed a geologic survey of HBEF in 1956. Aerial photos of the Hubbard Brook watershed were taken on November 10, 1954 and used to help locate experimental watersheds. A detailed topographic map of HBEF was made from another set of aerial photos taken in May, 1956. Dick Sartz helped with triangulation procedures used in making the map. Weir construction began in the summer of 1955 and watersheds 1, 2, and 3 were being gauged by 1958. The jeep road to the early weirs served as a study site for road erosion. Gauges were added to five additional watersheds in the 1960's.

The early field headquarters at HBEF was the Kendall cottage located on the Mirror Lake Road, across from Mirror Lake. The cottage served as office, storage, and temporary living quarters. In 1958 the Forest Service purchased an additional 55 ha of land adjoining HBEF on the southeast. This land is the site of the current HBEF headquarters buildings, including the barn, sample archive building, and the Robert S. Pierce Ecosystem Laboratory.

Early personnel at HBEF shifted fairly rapidly. Trimble left in 1957 to become a Center Leader in West Virginia and Sartz left in 1958 to become a Center Leader in the Lake States. Bob Pierce became Project Leader in 1958 and served in that capacity until 1991. Ray Leonard arrived in 1957 and began studies of canopy interception and stemflow. Tony Federer began his HBEF career as a "student trainee" in the summers of 1958 and 1959.

The rest of the story

Research at HBEF for the first 5 or 6 years after establishment focused solely on effects of forests on components of the hydrologic cycle, erosion, and water quality. In the late 1950's, Herb Bormann, A Professor at Dartmouth College, began bringing his ecology classes to view the research at Hubbard Brook. In the

early 1960's, Bormann's visits to HBEF evolved into a cooperative research effort involving himself, Bob Pierce, and Gene Likens and Noye Johnson, two faculty members also located at Dartmouth. Together they began using the gauged watersheds at HBEF as experimental ecosystems for studies of elemental budgets and cycles (Bormann 1996). These studies would expand and eventually involve hundreds of cooperators and become known as the Hubbard Brook Ecosystem Study. The HBES added a new dimension to paired watershed studies and brought international recognition to HBEF.

Acknowledgement

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