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The Evolution of USDA Forest Service Experimental Forest Research on Northern Conifers in the Northeast

Laura S. Kenefic and Nicole S. Rogers

The degraded stand pictured in this 1955 USDA Forest Service photograph from Maine was dominated by balsam fir (*Abies balsamea*), red maple (*Acer rubrum*), paper birch (*Betula papyrifera*), and American beech (*Fagus grandifolia*). Stands such as these were typical of second-growth, lowland spruce–fir (*Picea–Abies*) forests in the Northeast following repeated high grading in the 1800s and early 1900s (Judd 1997). In light of concerns about the sustainability of the eastern spruce–fir cover type, the Forest Service began researching these forests in 1926 at the 1,863-acre Gale River Experimental Forest (EF) in the White Mountains of New Hampshire. Marinus Westveld, now known as the "Father" of spruce–fir silviculture (Berven et al. 2013), oversaw studies on partial cutting at the Gale River EF with a focus on increasing the softwood component of degraded mixedwood stands similar to the one shown here (e.g., Westveld 1930).

Unfortunately, the Great New England Hurricane of 1938 destroyed the experiments on the Gale River EF. This 1938 Forest Service photograph (FS #369669, courtesy of the Forest History Society) was taken in the immediate aftermath of the hurricane, which had one of the highest forward speeds ever documented for a tropical cyclone (Grossi 2008) and leveled close to 250 million cubic feet of timber across more than 500 thousand acres (Kenefic et al. 2014). With the forests of central New England in ". . .tangled heaps of splintered trunks and limbs like giant matchsticks waiting for sparks to turn a literal inferno loose. . ." (Anonymous 1938, p. 252), Forest Service research at the Gale River EF was abandoned and the site transferred to the White Mountain National Forest.

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Affiliations: *Laura S. Kenefic (lkenefic@fs.fed.us), USDA Forest Service, Northern Research Station, Orono, ME. Nicole S. Rogers (nrogers@uvm.edu), University of Vermont, Rubenstein School of Environment and Natural Resources.*

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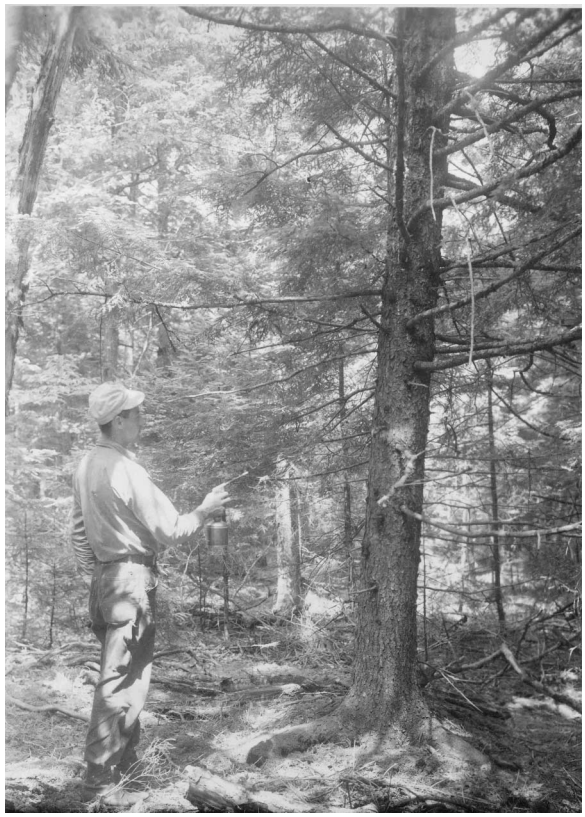
The Forest Service initiated early silvicultural studies in the Adirondacks of New York on the 622-acre Finch-Pruyn EF in 1934 and 2,200-acre Paul Smith EF in 1945. This circa 1950 agency photograph shows a forester inspecting old-growth red spruce (*Picea rubens*) for eastern spruce beetle (*Dendroctonus rufipennis*) damage on the Paul Smith EF. Typical of the selective cutting era in American forestry (1925–1960; Seymour et al. 2006), Forest Service research in the Adirondacks focused on uneven-age management with experiments in selection cutting and forest improvement through hardwood control (e.g., Curry and Rushmore 1955). The Finch-Pruyn and Paul Smith EFs, which had been consolidated as the Adirondack Research Center, closed in 1961. At that time, the Forest Service's experimental forest research in the Adirondacks was discontinued and the Paul Smith EF was transferred to Paul Smith's College (Berven et al. 2013).

A group of industrial landowners (listed on the sign in this 1950 Forest Service photograph) approached the Forest Service about establishing a new experimental forest in Maine's spruce–fir region. Ultimately, 3,800 acres of forestland were purchased in central Maine by nine pulp and paper and land-holding companies for lease to the Forest Service. From this 1950 acquisition, the Penobscot EF became the primary location for long-term Forest Service research on the ecology and management of northern conifers (when established, species composition was 30% eastern hemlock [*Tsuga canadensis*], 20% balsam fir, 16% spruce, 12% northern white-cedar [*Thuja occidentalis*], 9% red maple, and 4% each of eastern white pine [*Pinus strobus*], paper birch, and other species [Kenefic and Brissette 2014]). In 1995, the industrial landowners of the experimental forest donated the land to the University of Maine Foundation. Today, the Forest Service continues its northern conifer research on the Penobscot EF and the University has added a complementary large-scale, long-term ecological forestry experiment in which removal intensities are based on natural disturbance rates (the Acadian Forest Ecosystem Research Program; Saunders et al. 2014).

This 1954 Forest Service photograph shows a technician marking a 12-in. dbh red spruce with a forked top for removal in an early selection cut on the Penobscot EF. A large-scale, replicated compartment- (stand-) level study was initiated on the Penobscot EF to evaluate a range of silvicultural treatments and exploitative harvesting methods in northern conifers. Treatments included single-tree selection cutting on 5-, 10-, and 20-year cycles; uniform shelterwood with two- and three-stage overstory removal; modified (flexible) and fixed diameter-limit cutting; commercial clearcutting (unregulated harvesting); and no harvesting (reference) (Brissette and Kenefic 2014). The earliest cutting practice studies on the Penobscot EF in the 1950s have continued to the present day with repeated treatment and periodic inventory of numbered trees on permanent sample plots (Kenefic et al. 2015). Over time, silvicultural treatments with deliberate control of structure and regeneration (such as the one pictured) generally improved species composition and quality, while repeated exploitative harvests (diameter-limit and commercial clearcutting) degraded residual stand condition (Sendak et al. 2003, Kenefic et al. 2005).



This circa 1970 Forest Service photograph shows technician Orman Carol describing the layout of clearcut strips in a study of strip width and slash disposal effects on regeneration. Initiated in the winter of 1964–1965, this new research direction on the Penobscot EF reflected a transition in American forestry. Between 1960 and 1980, the national forestry paradigm shifted to a focus on high-yield wood production (Seymour et al. 2006). On the Penobscot EF, studies of planting, fertilization, thinning, and strip clearcutting (pictured) were initiated (Kenefic and Brissette 2014). A Forest Service experiment comparing stem-only and whole-tree harvesting on the Penobscot EF is now more than 50 years old and represents the oldest known study of biomass harvesting in temperate forests worldwide. First-decadal response from that study showed no differences in soil and foliar nutrition with incremental stem-only to whole-tree removal (Czapowskyj et al. 1977, Czapowskyj 1979); the study is now being used to assess long-term productivity implications of biomass harvesting (Muñoz et al. 2014).

An irregular shelterwood treatment was initiated on the Penobscot EF in 1995 by research forester Robert M. Frank Jr.; the resulting stand is shown in this 2001 Forest Service photograph. The treatment retained 20–30 large sawtimber spruce, pine, and hemlock trees per acre for volume accretion and snag recruitment. This notable departure from production-oriented silviculture emerged as the concepts of "New Forestry" (Franklin 1989) shifted the focus of forestry from maximizing production to ecosystem management on many federal lands in the 1990s. Increasing interest in balancing commodity production with biodiversity maintenance led to the development of silvicultural treatments, such as the irregular shelterwood pictured, that included structural retention, deadwood recruitment, and other ecological objectives.

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