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The Cutting Practice Level Study at the Penobscot Experimental Forest in Maine

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This USDA Forest Service photograph from 1950 shows a second-growth, conifer-dominated stand characteristic of the Penobscot Experimental Forest (EF) in Maine. After decades of repeated harvests of eastern white pine (*Pinus strobus*), spruce (*Picea rubens*, *P. mariana*, and *P. glauca*), and balsam fir (*Abies balsamea*), much of the region's commercial timberland was in a degraded state (Westveld 1928, Hart 1963, Seymour 1995). Following a national Forest Service assessment (USDA Forest Service 1948) that characterized the potential of conventional cutting practices for sustained yield, a series of unreplicated Cutting Practice Level (CPL) studies were implemented at experimental forests throughout the Northeast. Researchers at the Penobscot EF hoped to highlight the inadequacy of common cutting practices and demonstrate the long-term benefits of alternative management approaches in the spruce-fir forest. In 1950, the following silvicultural treatments were installed on the Penobscot EF to represent four of the five cutting practice levels defined by the USDA Forest Service (1948): single-tree selection cutting on a 5-year cycle (high-order), single-tree selection cutting on a 15-year cycle (good), fixed diameter-limit cutting (fair), and commercial clearcutting (also called unregulated harvesting or logger's choice, poor).

In this 1958 Forest Service photograph, researchers confer with industry cooperators about an early single-tree selection cut at the Penobscot EF. From left to right: Dwight B. Demeritt (Dead River Company), Ralph W. Marquis (USDA Forest Service), Robert E. Buckman (USDA Forest Service), Verne L. Harper (USDA Forest Service), and Edwin L. Giddings (Penobscot Development Company). As the lead author of the national cutting practice assessment (USDA Forest Service 1948), Harper outlined a plan for CPL studies on experimental forests across the Forest Service's Northeastern Forest Experiment Station (now Northern Research Station) to address concerns about the status of managed forests. At that time, over 50% of managed commercial forests had been subjected to poor or destructive cutting, reducing their overall productive potential. Note the sign above Giddings—one of the main objectives of the research at the Penobscot EF was to provide forestry practitioners with a visible contrast between varying intensities of cutting practice levels.

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A forest technician stands in the commercial (logger's choice) clearcut portion of the CPL study at the Penobscot EF in this Forest Service photograph from 1950. In the Penobscot EF CPL study, the commercial clearcut was used to demonstrate the negative effects of volume-removal driven harvesting conducted without consideration of the residual stand. Treatment guidelines specified the removal of all trees greater than 5 in. in dbh unless the logger deemed a tree unmerchantable. Trees left behind were of low value, either too small to meet merchantability standards or poorly formed. Repeated application was expected to reduce both the quality and quantity of residual growing stock. After the initial harvest, the stand was comprised of a few low-vigor trees in the overstory and a dense understory of woody shrubs—a "poor" cutting practice, indeed!

In this 1954 Forest Service photograph, research forester Arthur Hart examines dense red spruce after early cutting in a selection stand at the Penobscot EF. Single-tree selection cutting on 5- and 15-year cycles offered long-term stand-level sustained yield. Classified as high-order and good cutting levels, respectively, these treatments were considered responsible silviculture because, based on species and structural goals, they maintained or increased stand quality over time through removal of unacceptable growing stock and excess trees. When considering composition, preference was given to spruce, followed by other softwoods and hardwoods. Additionally, light, repeated cutting across merchantable size classes created uneven-aged stand structures and allowed for management of sawlogs as well as pulpwood.

This 1969 Forest Service photograph shows logger Frank Roy skidding logs from a selection stand in the Penobscot EF CPL study. Loggers working with horses often built temporary hovels for the animals on the forest. Draft horses were a common method for skidding logs from the woods on the Penobscot EF through the 1960s, though "jitterbugs" (vehicles re-purposed for skidding) were also sometimes used. Rubber-tired or tracked skidders replaced horses for skidding in the 1970s. Researchers on the Penobscot EF recall little difference in residual stand damage resulting from operations using horses, jitterbugs, or small skidders (Frank and Kenefic 2014). Though harvests over the past 60 years on the Penobscot EF have become increasingly mechanized in response to trends in forestry operations, selection cutting is still conducted by hand crews with cable skidders.

As can be seen from this 2014 photograph, repeated fixed diameter-limit cutting in the CPL study at the Penobscot EF reduced average tree diameters relative to initial stand conditions, and shifted composition toward less desirable balsam fir and hardwood species. Fixed diameter-limit cutting, a common management approach at the time of study implementation, was thought to represent a "fair" cutting practice that could maintain desired species and adequate stocking levels. However, as this picture clearly shows, after 60 years and five separate entries the production potential of the stand has been greatly reduced. The stand consists of clumps and voids of merchantable trees and unacceptable growing stock, with increased proportions of balsam fir and hardwood species. Photo credit: Nicole Rogers, University of Vermont.

This photograph, taken in 2014, exemplifies the long-term potential of the single-tree selection system to maintain residual stand quality and production potential. To date, 12 cuts have occurred in the 5-year single-tree selection and 5 cuts in the 15-year selection in the Penobscot EF CPL study. In stark contrast with the fair and poor cutting practice levels applied in the CPL study, the selection stands are diverse both in composition and structure, with an array of size classes and retention of desired species (specifically spruce).

The CPL is the longest running study on the Penobscot EF, with over 60 years of continuous measurement data. Studies of this nature provide the unique opportunity to examine long-term forest dynamics and explore outcomes not usually visible on shorter term studies.

While the CPL study on the Penobscot does not include even-aged silvicultural systems, it provides an effective long-term demonstration of the outcomes of different partial cutting practices and serves as a complement to the larger and more comprehensive Compartment Management study initiated in 1952 (Brissette and Kenefic 2014, Kenefic and Brissette 2014). Regionally, although many CPL studies have been discontinued, five are still in active management—in addition to the Penobscot (from 1950 to present), CPL studies continue at the Fernow EF in West Virginia (1949 to present), at the Bartlett EF in New Hampshire (1951 to present), at the Vinton Furnace State EF in Ohio (1954 to present), and at the Kane EF in Pennsylvania (1959 to present). Photo Credit: Laura Kenefic, USDA Forest Service.

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