Lloyd C. Irland, Ann E. Camp, John C. Brissette, Zachary R. Donohew, Editors
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Long-term Studies: The Roots of Silviculture in the Lake States

Dukes Experimental Forest, Michigan

Chapman Plantation, Minnesota

Christel C. Kern

USDA Forest Service North Central Research Station, Grand Rapids, MN

Introduction

The Lake States (Michigan, Wisconsin, and Minnesota) have been an important source of timber since the late 1800s. The white and red pine forests of the region were harvested to meet growing lumber needs in the mid-western United States. Once the pineries had been cut, hardwoods were then harvested for railroad ties, mining timbers, and other uses. The initial harvest was 'cut and leave;' lumber interests bought vast acreages, cut the timber, and then moved on to the South and West. This practice resulted in high slash loadings in much of the cut-over landscape which, coupled with regional drought and poor fire suppression policies, resulted in large wildfires and left the region with great concerns about the sustainability of forestry.

At the turn of the 20th century, the need for silvicultural research was immediate. Two major concerns for the region were lack of pine regeneration and poor hardwood quality in second-growth stands. Planting was quickly found to meet the pine regeneration needs, and research plantations were established early in the century. Natural regeneration of hardwoods was not nearly the problem as was the pines, but quality of second-growth hardwood stands was poor. Research on improving hardwood quality was underway by the 1920s. By the 1950s, silvicultural research trials were established on many additional topics across the region.

Our early logging history introduced some large scale problems. Early research efforts in the region were progressive and instrumental in shaping current management practices. Many universities and government organizations were a part of the early research trials. In this brief, selective history of silvicultural research in the Lake States, I mention only a few of the organizations with the longest, continuing studies.

USDA Forest Service

The USDA Forest Service has played an important role in influencing forestry practices in the Lakes States. A formal research branch was setup in St. Paul, Minnesota, in 1923, where the North Central Research Station had its beginnings. The Station started regeneration trials and nursery studies of pine across the region. Experimental Forests were established during the 1930s to address cutting methods, cutting cycles, and stocking level issues in pines and hardwoods. The Dukes (Upper Peninsula), Argonne and Cutfoot Experimental Forests are a few of the many experimental forests in the region that have been influential in Lake States silviculture.

Dukes (Upper Peninsula) Experimental Forest

The Dukes Experimental Forest, formerly known as the Upper Peninsula Experimental Forest, was established in 1938, although research was started as early as 1923 in the area. Early studies focused on old-growth northern hardwood selection cutting since, at the time, old-growth forests were still prevalent. One of the most influential studies was the Cutting Methods Trial in Old-Growth Northern Hardwoods. Eyre and Zillgitt (1953) published an in-depth evaluation of the trial showing how selection cutting sustains the production of quality hardwood products. This publication was used later by Arbogast (1957) to create the commonly known 'Arbogast Guide,' a guide well-respected and still used today. A later, replicated study initiated in 1951 was installed to better evaluate cutting methods in old growth, but also included cutting cycles and stocking levels. Crow et al. (1981) summed up 20 years of results from this replicated study and confirmed the early results from the trial.

Argonne Experimental Forest

As old-growth hardwoods disappeared and second-growth stands developed, it was soon recognized that second-growth management was different than that for old-growth. In 1947, the Argonne Experimental Forest was established to conduct research specific to second-growth northern hardwood management. A cutting methods study was established in 1951. This study has played a pivotal role in northern hardwood management. Both Strong et al. (1995) and Niese et al. (1995) summarized 40 years of data showing the economic gain associated with managing for quality in second-growth hardwoods. The work has also shown the inferior results gained from diameter-limit practices. This is an important result that can only be obtained by carefully monitoring several cutting cycles. This study is also routinely used for training and outreach. Hundreds of foresters representing virtually every management organization in the region have participated in northern hardwood management training at the Argonne Experimental Forest. Research results from the cutting methods study are applied to nearly all managed northern hardwood lands in the Lake States.

Cutfoot Experimental Forest

The Cutfoot Experimental Forest in Minnesota was established in 1932 but has research dating back to 1923. The Cutfoot Experimental Forest has been home to over a hundred studies on thinning, release and improvement cutting, growth studies, and reforestation in pine forests and has been influential in shaping

today's red pine (Pinus resinosa) management practices in the Lake States. Red Pine growth and yield equations used throughout the region were based on the Growing Stock Levels in Red Pine study (Buckman 1962).

University of Minnesota—*Chapman Plantation*

H. H. Chapman was the first superintendent at the University of Minnesota's North Central Research and Outreach Center (formerly known as the Northeastern Agricultural Experiment Farm). He set up the earliest research plantation in the state in 1900. This is now one of the oldest that we know of in the entire nation. Chapman's study examined 1) the value of planting red, white, jack and Scotch pines, 2) feasibility of planting the pines in mixtures, and 3) the most efficient spacing to use (O'Brien and Matson 2002). In 1905, a fire reduced the study to only the plots with 6'x 6' spacing treatment (Allison 1936). Since then the remaining plantation has been measured every 5 years and thinned four times (Dan Gilmore, personal communication). This plantation has a rare 100 + year history that is difficult to find anywhere in the U. S.

Michigan Technical University—*Ford Forestry Center*

Established in 1956, the Ford Forestry Center has been the home to two notable demonstrations in northern hardwood management. The first, Long-term Selection Cutting Trials, was created to show landowners and industry a variety of cutting methods they could use on their high-graded, second-growth northern hardwood stands. The demonstration was been maintained since 1957 with regular cutting. By 1990, the 16" DL was showing the best, most even economic returns (Erickson et al. 1990).

The second demonstration, Basal Area Cutting Trial, focuses on uneven-age management with residual basal area levels and cutting cycle treatments. The trial was established to show absentee landowners potential management options while meeting their other objectives (e.g., hunting). The demonstration was established in 1958 and is on-going. The study is unique in that the cuttings were started when the stands were at low stocking levels in comparison to recommendations by Arbogast (1957). It has shown that private landowners could receive economic returns and meet other objectives by using higher residual basal areas and shorter cutting cycles with single-tree selection techniques (Orr et al. 1994).

Addressing New Concerns

The combined efforts of research institutions across the region have led to better management of Lake States forests. The long-term studies and experimental forests mentioned here are the longest running in the region. Benefits of this work have included:

— Basis for numerous economic analysis of management treatments (e.g. Lundgren)
— Basis for simulation models (e.g., NORTHWDS, Resinosa)
— Basic data for supporting long-term growth and yield predictions
— Development of thinning regimes in pine plantations.
— Development of uneven-age management in northern hardwoods
— Opportunity for addressing new concerns

Today, funding to continue these studies is difficult to find. However, some researchers have been able to continue the original studies by finding funding to address a new dimension. Several examples of this are on the Growing Stock Levels in Red Pine study in the Cutfoot Experimental Forest. One new twist evaluates extended rotation prescriptions. Research has established that, with regular thinning, culmination of mean annual increment for red pine can extend well beyond the traditional rotation age of 50 to 70 years. In fact, mean annual volume increment curves show no strong indication of culmination at 140 years of age (Kern and Palik 2004). Additionally, this study, along with the Northern Hardwood Cutting Methods Study on the Argonne Experimental Forest, are being evaluated for cumulative silvicultural impacts on soil productivity and carbon distribution. The cutting methods study was also examined for herbaceous vegetation diversity and composition changes. The understory diversity and composition did not differ after 40 years of both even-age and uneven-age management treatments (Kern et al. 2004).

These new research topics reflect objectives that were not foreseen when the study was originally established, yet could not have been properly addressed without the foresight of the early scientists establishing and maintaining these studies. Long-term studies have great potential to influence forest management practices in the region; the key to this success is an organizational commitment to maintain the studies and creativity in finding new ways to fund the research.

References

Allison, J.H. 1936. Original North Central Experiment Station correspondence, dated July 21, 1936. University of Minnesota.

Arbogast, C.A., 1957. Marking guides for northern hardwoods under the selection system. USDA For. Serv. Station Paper 56.

Buckman, R.E. 1962. Three Growing-Stock Density Experiments in Minnesota Red Pine. USDA. For. Serv. Station Paper 99.

Crow, T.R., Jacobs, R.D., Oberg, R.R., Tubbs, C.H., 1981. Stocking and Structure for maximum growth in sugar maple selection stands. USDA For. Serv. Research Paper NC -199.

Erickson, M.D., Reed, D.D., Mroz, G.D., 1990. Stand Development and Economic Analysis of Alternative Cutting Methods in Northern Hardwoods: 32-Year Results. NJAF 7: 153-157.

Eyre, F.H., Zillgitt, W.M., 1953. Partial Cuttings in Northern Hardwoods of the Lake States: Twenty-Year Experimental Results. USDA For. Serv. Technical Bulletin No.1076.

Kern, C.C, and Palik B.J., 2004a. Growth and yield of extended rotation red pine stands in Minnesota. In: Managing Forest Resources in the 21st Century: An Integrated Approach. North American Forest Biology Workshop, July 12-15, 2004, Michigan Technological University, Houghton, Michigan, USA.

Kern, C.C, Palik B.J., Strong T.F., 2004b. Comparing understory plant communities after 40 years of management in northern hardwood ecosystems. In: Managing Forest Resources in the 21st Century: An Integrated Approach. North American Forest Biology Workshop, July 12-15, 2004, Michigan Technological University, Houghton, Michigan, USA.

Niese, J.N., Strong, T.F., Erdmann, G.G., 1995. Forty years of alternative management practices in second-growth, pole-size northern hardwoods. II. Economic evaluation. Can.J.For.Res. 25: 1180-1188.

O'Brien, T.C. and Matson, K., 2002. The Chapman Plantation at the University of Minnesota, North Central Research and Outreach Center, Grand Rapids, Minnesota. In: Gilmore, D.G. and Yount, L.S. (Eds.), Proceedings of the Red Pine SAF Region V Technical Conference, March 26-27, 2002. Cloquet, MN: Cloquet Forestry Center, University of Minnesota: 131-135.

Orr, B.D., Reed, D.D., Mroz, G.D., 1994. Three Basal Area Level Harvest Trials in Uneven-Aged Northern Hardwoods. NJAF 11:(4), 117-123.

Strong, T.F., Erdmann, G.G., Niese, J.N., 1995. Forty years of alternative management practices in second-growth, pole-size northern hardwoods. I. Tree quality development. Can.J.For.Res. 25: 1173-1179.