# Seventy Years of Forest Change in the Northern Great Lakes Region, USA

**Lisa A. Schulte[1], Thomas R. Crow[1], John Vissage[2], and Dave Cleland[3]**

[1] North Central Research Station, USDA Forest Service, Forestry Sciences Lab, 1831 Highway 169 E., Grand Rapids, MN 55744; 218-326-7122; laschulte@fs.fed.us
[2]North Central Research Station, USDA Forest Service, St. Paul, MN
[3]North Central Research Station, USDA Forest Service, Rhinelander, WI

## Introduction

The rates and magnitudes of forest change have important social and economic implications. We address facets of change associated with 20th century recovery of the U.S. Lake States (Michigan, Wisconsin, and Minnesota) forests from the Great Cutover, and discuss ecological and socioeconomic implications for future forest resources.

Between 1820 and 1920, logging and subsequent slash fires greatly altered the composition and structure of the U.S. Lakes States forests. Old growth forests dominated by a mixture of conifers and hardwoods were largely replaced by the early successional hardwood species of quaking aspen (*Populus tremuloides* Michx.), bigtooth aspen (*P. grandidentata* Michx.), and paper birch (*Betula papyrifera* Marsh.). Between 1940 and the present, abundant aspen fueled the growth of an extensive pulp and paper industry in the region. Wisconsin topped the nation in paper production for the 47th year in a row in 2002. Forests of the 21st Century are likely to look much different than those of the past; however, as natural succession, fire suppression, harvesting, herbivory, insects, pathogens, and climate change create different conditions at local and regional scales. Extensive social pressure exists to manage these forests for both early successional and old growth characteristics.

We use historical forest survey and timber utilization data to quantify changes in the composition and structure of the Lake States forests. Our specific study hypothesis is that the Lake States forests are in a period of rapid transition, as the early successional aspen-birch forests established during the Great Cutover mature and shift to later successional types. Evidence in support of this hypothesis comes from National Forests within the region, which have lost aspen acreage in recent years despite attempts to maintain it.

## Approach

Data on forest composition and structure are derived from the USDA Forest Service Forest Inventory and Analysis (FIA) survey. Digital versions of the full FIA datasets date back to the late 1970s and early 1980s in the region (survey cycles 4, 5, and 6); paper summaries are available through the mid-1930s (survey cycles 1, 2, and 3). Although the overall purpose of the survey, to inventory of forests conditions, has remained consistent, changes in sampling methodology over time limits the level of detail accessible in cross-cycle analysis.

We use data on pulpwood production to address socioeconomic facets of forest change. Summaries are available in the form of timber product output reports, compiled timber receipts furnished by pulp mills between 1946 and 1998.

## Results and Discussion

In Michigan and Wisconsin, the dominant trend in the FIA data is a gradual transition from young forests dominated by early successional aspen-birch to late successional maple-beech-birch (primarily sugar maple, *Acer saccharum* Marsh.; Figure 1a,b). The bulk of these shifts occurred between the 1950s and 1980s, and recent trends show slower rates of change. In contrast, the extent of aspen-birch has remained stable in Minnesota since the 1930s (Figure 1c). Although much of Minnesota has witnessed a slight

Buse, L.J. and A.H. Perera (comp.). 2003. Meeting emerging ecological, economic, and social challenges in the Great Lakes region: Popular summaries. Ont. Min. Nat. Resour, Ont. For. Res. Inst., Sault Ste. Marie, ON. For. Res. Inf. Pap. No. 155.

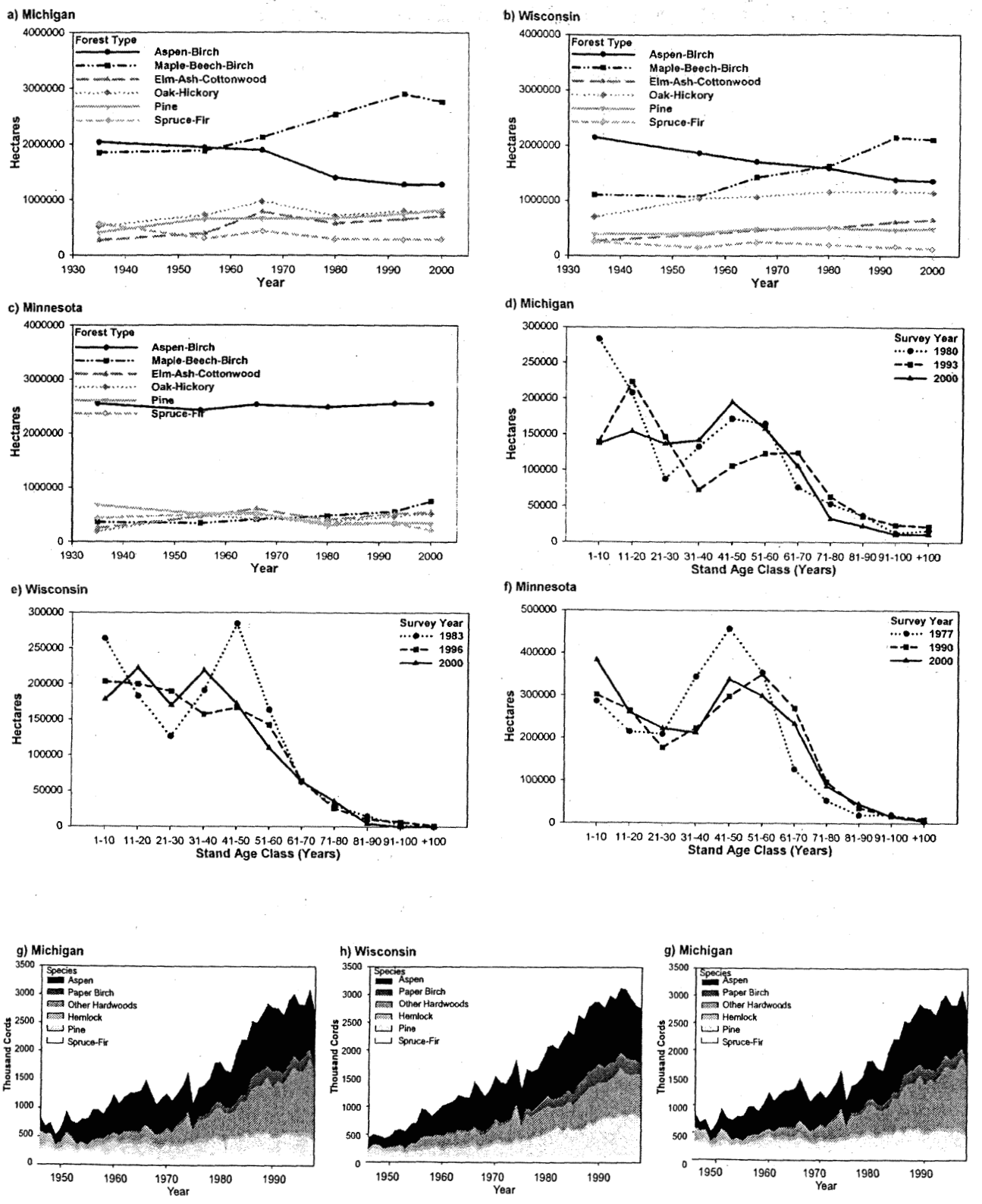


***Figure 1.*** *Trends in forest type extent (a-c), aspen-birch stand age (d-f), and pulpwood production (g-i) for the U.S. Lake States.*

increase in the amount of maple-beech-birch forest, conversions are split between aspen-birch, elm-ash-cottonwood, and oak-hickory types. Pine forests constitute a minor forest type in all three states; however, the region has seen a two- (Minnesota) to 12-fold (Michigan) increase in the extent of red pine (*Pinus resinosa* Ait.) between the 1930s and the present. White pine (*P. strobus* L.) has also increased in Michigan and Wisconsin, though less dramatically, and jack pine (*P. banksiana* Lamb.) acreage has been lost from all 3 states. All states have also seen a gradual decline in the extent of the spruce-fir forest type (Figure 1a-c). Although the direction and rate of change varies among ecosystems and ownerships, tree volume across the region has nearly doubled over the survey period. Barring aspen on federal lands, growth in the 1990s continued to exceed harvest for nearly all forest types and ownerships.

Age structure data from the last 3 FIA survey cycles reveal a region still dominated by young forests. Most stands are between 30 and60 years of age, and few forests greater than 100 years old exist (11.8%, 7.2%, and 5.3% of forestlands in Michigan, Wisconsin, and Minnesota, respectively). Aspen-birch forests are dominated by young stands (1 to 60 years), and intensive harvesting is eliminating the marked bimodal age distribution present during the fourth survey cycle. Few stands reach older age classes (>80 years; Figure 1d-f), especially in Wisconsin (Figure 1e), at which time conversion to other forest types occur. Age structure data corroborate compositional data in suggesting a continuation of current cover type trends for sometime to come.

Rates of forest utilization as measured by pulpwood production have tripled in the U.S. Lake States (Figure 1g-i). Data from Wisconsin show near linear increases between the mid-1940s and early 1990s, whereas pulpwood industries in Minnesota developed much later. Recent trends suggest stabilization of aspen use by industry. Rather, producers in Michigan and Wisconsin have recently shifted to using maple-beech-birch, concomitant with its increased availability on the landscape (Figure 1g,h).

## Conclusions

Michigan, Wisconsin, and Minnesota have unique patterns in forest succession and utilization between the 1930s and today – it is difficult to generalize across the region. As expected, the extent of late successional maple-beech-birch forest is increasing throughout the Lake States, but:

- In Michigan and Wisconsin, most shifts between aspen-birch and maple-beech birch occurred between the 1950s and 1990s; current changes in composition and structure are occurring at much slower rates.
- In Minnesota, the extent of aspen-birch far exceeds that of all other forest types and shows stability over time. The acreage of maple-beech-birch has increased only slightly here.

These trends suggest that the U.S. Lake States forests may be shifting from a period of recovery, in response to the Great Cutover, to a period of intensive management and utilization, with continued hardwood dominance of the landscape. Harvesting aspen-birch via traditional clearcutting methods and maple-beech-birch through group selection will likely maintain these forest types through time, with few opportunities for other species mixtures. Though beneficial from an operations standpoint, a more constant composition and structure in the region could present many ecological and socioeconomic challenges in the future, including:

- Although forest industry has adapted to the influx of maple-beech-birch, the ramifications on regional forest productivity of conversion of fast growing aspen to slow growing maple may not yet be realized. This factor may be offset by a focus on wood quality.
- Few opportunities exist to shift the forest to valuable softwood species via natural regeneration and selection-based silviculture. Restoration of conifers will likely be slow and expensive.
- Forests of uniform composition and structure lack ecological resilience and do not weather the trials of insects, disease, or climate change well. The socioeconomic impact of a lack of ecological resilience can be substantial.