

Red Pine in the Northern Lake States

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ABSTRACT. Red pine is an important tree species for the Northern Lake States. About 4 percent of the total area of timberland is dominated by red pine but most other forest types also have red pine as a component. The red pine forest type in the region has dramatically increased in area since the 1930s. Stand-size class distribution of the red pine forest type has changed over time in the region to where currently; sawtimber-sized stands represent 41 percent of the total red pine forest type acreage. Over time the total area of red pine has remained at about 60 percent privately owned. Stocking levels, total number of trees, growing-stock volume, average annual net growth, and average annual removals have all increased over time in this region. Currently, the region's average annual net growth for red pine is five times as high as its removals.

KEY WORDS. Red pine, area, volume, growth, change

Red pine (*Pinus resinosa*) has historically been one of the most important woody plant species throughout the Northern Lake States. This importance was based on more than just a timber production perspective. Red pine makes important ecological contributions in watershed protection and soil stability, contributes to the region's well-known aesthetics and recreational opportunities, and is an important component of the region's forest lands for wildlife habitat. While it is difficult to determine the extent of red pine prior to European settlement, it is believed that, in conjunction with white pine (*Pinus strobus*), it was one of the dominant vegetative features of the landscape. With European settlement and the ensuing logging of the resource, red pine, white pine, hemlock (*Tsuga canadensis*), and white spruce (*Picea glauca*) were the most heavily harvested conifer species. As a result, by the early 1900s the forested landscape across the Northern Lake States was impacted to the point where it was often referred to as "stumplands." By 1996, only 2 percent of the total forest land resource in this region had average stand ages of more than 120 years and an additional 14 percent had average stand ages of between 80 and 120 years (Schmidt et al. 1996). Of the determined old and potential old forest land, only 2 percent was classified as being in the red pine forest type. Thus, only small remnants of the red pine forests existing prior to the turn of the 20th century still exist today.

¹ Schmidt, T. L. 2002. Highlights-Red pine in the northern Lake States. In *Proceedings of the Red Pine SAF Region V Technical Conference*, eds., Gilmore, D. W., and L. S. Yount, 3-16. Staff Paper no. 157. St. Paul, MN: University of Minnesota, College of Natural Resources, Department of Forest Resources.

Despite this adverse outlook for forest lands in the early 1900s, like a Phoenix rising from the ashes, forest lands across the Northern Lake States at the turn of 21st century have returned to dominate the landscape. The current forest land resource is different from what was first encountered by European settlers but nevertheless is of utmost value and importance. Documenting the resurgence of red pine in the context of the resurgence of the overall forest land resource of the Northern Lake States will improve our understanding of the resource and assist with development of management strategies.

Methods

Data presented are from the USDA Forest Service, Forest Inventory and Analysis' (FIA) Database (Miles et al. 2001), and are based on FIA statewide forest inventories for each state. The dates of the FIA inventories are Michigan 1935, 1955, 1966, 1980, and 1993; Wisconsin 1936, 1956, 1968, 1983, and 1996; and Minnesota 1936, 1953, 1962, 1977, and 1990. Data presented generally pertain only to timberland, however, more than 95 percent of the forest land in the Northern Lakes States region is classified as timberland (Powell et al. 1993). Timberland is forest land capable of producing more than 20 cubic feet per acre per year of industrial wood crops under natural conditions and not withdrawn from timber utilization. There are other classifications of land with trees, including reserved forest land, narrow planted and natural wooded strips, and pasture land with trees that do not meet the timberland definition. These nontimberlands make important contributions to the many forest-related resources and their use and do contain red pine. Until recently, FIA did not install field plots on these other forest lands and, as a result, data are very limited for forest land classifications other than timberlands.

Red pine forest type classification is based on forest lands where red pine trees comprise a plurality of the total stocking. Common associates in the red pine forest type are white pine, jack pine (*Pinus banksiana*), aspen (*Populus* spp.), birch (*Betula* spp.), and maple (*Acer* spp.). For red pine stand-size class determinations, sawtimber-sized stands are stands with half or more of the total live tree stocking in trees that are at least 9.0 inches d.b.h. Stand age is based on the average age of the dominant and codominant trees in the stand. Volume is the net volume of trees 5.0 inches d.b.h. and over, from 1 foot above the ground (stump) to a minimum 4-inch top diameter outside bark or to the point where the central stem breaks into limbs. Growing-stock volume is used in this study, which represents the volume in growing-stock trees (trees that meet specified standards of size, quality, and merchantability) more than 5.0 inches d.b.h.

FIA implements a systematic grid for its estimates. From the grid, plots are selected for determinations of land use through remote sensing. A subset of these plots is selected for field measurement where plot level and individual tree measurements are made. All data presented originated as field measures through the FIA program. Additional information regarding the red pine and overall forest land resource of the Northern Lake States can be obtained via the FIA Database at: (<http://www.ncrs.fs.fed.us/4801/FIADB/index.htm>).

Results

Area

Within the Northern Lake States, there are currently 122 million acres of land, 43 percent of which is classified as forest land. Of the 52 million acres of forest land, 49 million acres are timberland, 1.9 million acres are reserved forest land, and almost 1 million acres are classified as other forest land (land that does not meet minimum productivity standards). The red pine forest type represents 1.9 million acres of timberland and 104 thousand acres of reserved forest land. The area of forest land dominated by red pine represents about 4 percent of the total forest resource of the Northern Lake States region.

In addition to those timberlands that are dominated by red pine (and thus classified as being in the red pine forest type), some red pine can be found in almost all other forest types. Red pine plays a significant role in some forest types, while in others it is a minor component. In the 1993 inventory of Michigan, red pine represented more than 11 percent of the total volume in the jack pine forest type and 9 percent of the volume in the white pine forest type, but only 0.5 percent of the maple-beech-birch (*Acer-Fagus-Betula*) forest type. Ensuing discussions related to the area of red pine focus primarily on the red pine forest type but this species has a far greater impact than that portrayed simply by where it is the dominant species. Red pine makes significant contributions to economic, social, and biological diversity as well as the long-term sustainability of these other forest types. Thus, while the red pine forest type accounts for only 4 percent of the total area of forest land in the Northern Lake States, its overall impact is greater.

The red pine forest type in the Northern Lake States has dramatically increased in area since the 1930s (Fig. 1). In the 1930s, Minnesota had the most area of timberland classified as red pine. However, since the 1950s Michigan has led the region in terms of total area of red pine and currently represents almost half of all red pine dominated forests. Increases in area of red pine have occurred through both natural and artificial (primarily planting seedlings) regeneration. While the majority of the increases experienced from the 1930s through the 1960s were due to establishment efforts (both natural and artificial), the majority of the increases in the 1980s and 1990s were due to reclassification from other forest types to the red pine forest type.

For example, in Michigan between 1980 and 1993, the area classified as red pine timberland increased by 309 thousand acres. Of this increase, 76 percent was due to reclassification of existing timberland from other forest types to the red pine forest type and 24 percent was from lands that previously were not timberlands. Of the 76 percent that was reclassified from other forest types to red pine, 25 percent was from jack pine stands, 19 percent was from maple-beech-birch, 17 percent was from oak-hickory (*Quercus-Carya*), and the remaining 15 percent was from other forest types to red pine.

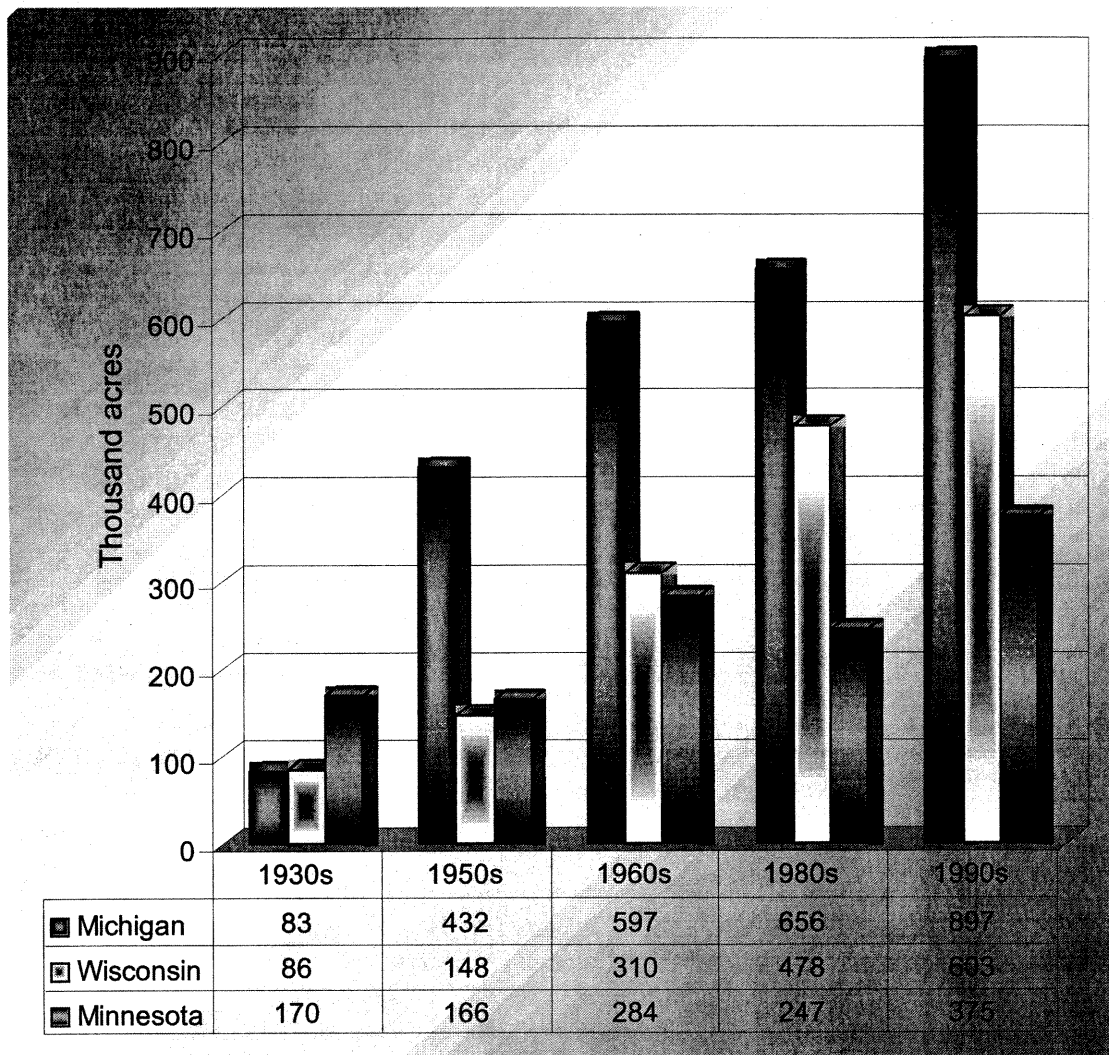


Figure 1. Area of red pine forest type in the Northern Lake States.

Stand-Size

The stand-size class distribution of the red pine forest type has changed in the Northern Lake States. In the 1930s, sapling-seedling sized stands represented about one-fourth of all red pine timberlands (Fig. 2). By the 1950s, sapling-seedlings accounted for more than 57 percent of all red pine timberlands. From the peak in the 1950s, the area of red pine in sapling-seedling sized stands has progressively declined (1960s-46 percent, 1980s-27 percent, and 1990s-23 percent). While the sapling-seedling sized stands have declined in total area, a corresponding increase has occurred in the area of sawtimber-sized red pine stands. Currently, across the Northern Lake States, sawtimber-sized stands represent 41 percent, poletimber-sized stands 36 percent, and sapling-seedling sized stands 23 percent of the total red pine forest type acreage. On a state basis, both Minnesota and Michigan follow similar trends but Wisconsin currently has a lower level of sawtimber-sized red pine stands.

This difference in red pine by stand-size class is similar for most other forest types in these three states. Across almost all forest types, Wisconsin has lower levels of sawtimber-sized stands than the other states.

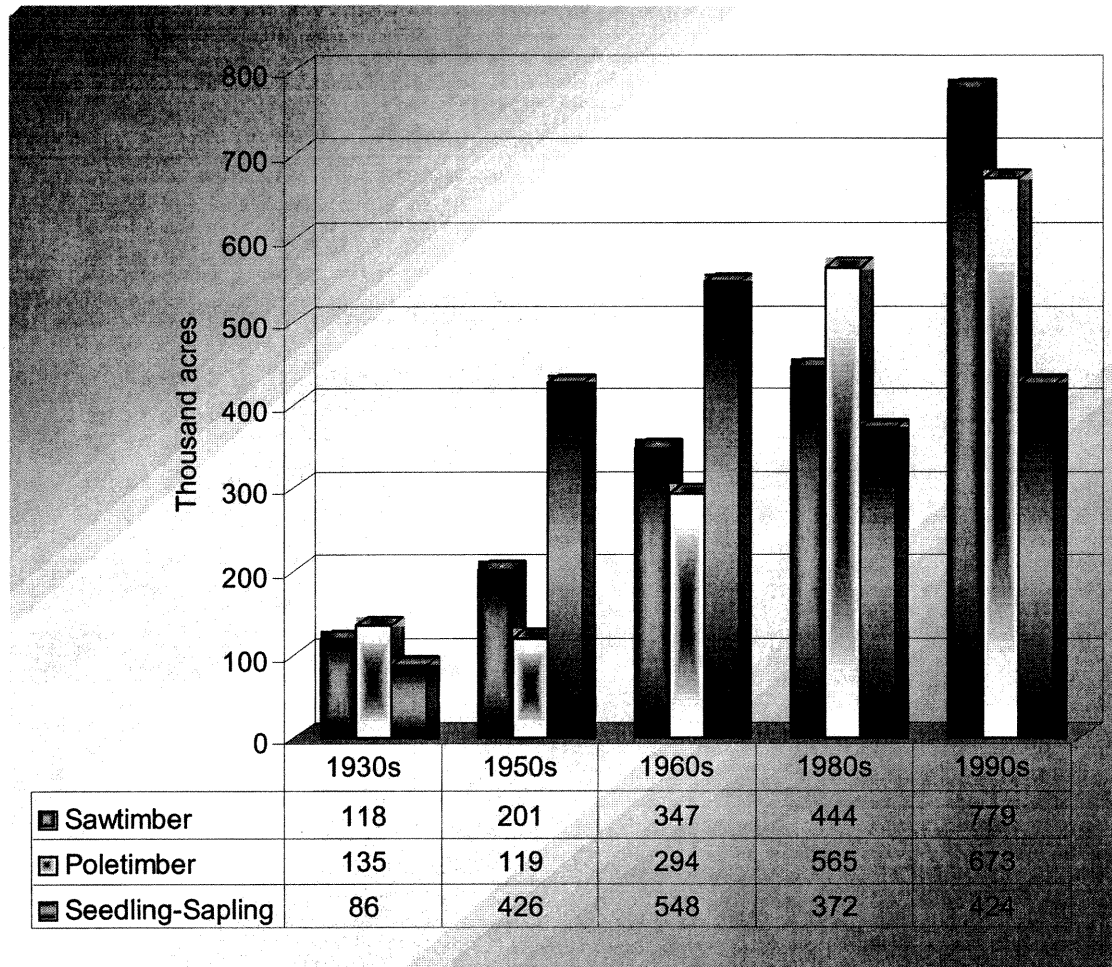


Figure 2. Area of red pine forest type in the Northern Lake States by stand-size class.

Ownership

Ownership of the overall timberland resource in the Northern Lake States has been relatively static over the past 40 years. While there have been changes, most have been minor involving a small percentage of the overall resource. For the total timberland resource across the region, slightly more than 60 percent is privately owned and slightly less than 40 percent is publicly owned. At the same time, the total area of red pine timberland has remained at about 60 percent publicly owned and 40 percent privately owned, reflecting that red pine is predominately a public resource. This has implications in that those producers that are dependent on red pine wood fiber rely more heavily on the public sector for their supply than most other forest product enterprises. There have been changes in ownership within the public sector. Federal ownership of red pine slightly decreased between the 1980s and

1990s, primarily due to successional processes that resulted in a reclassification to a different forest type, typically toward a deciduous type. At the same time, the area of red pine timberland owned by state and local government increased by two-thirds (Fig. 3). The increase in state and local government's area of red pine could be a reflection of their forest management being directed at maintaining red pine with its potentially strong economic returns.

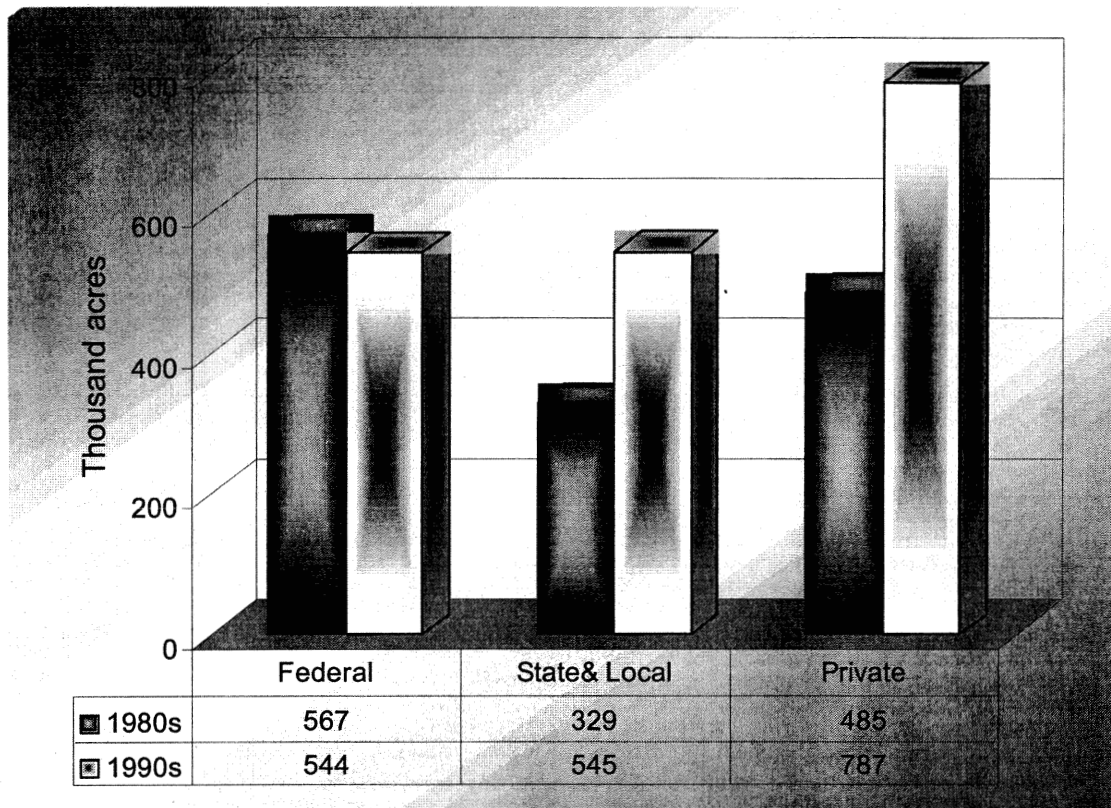


Figure 3. Area of red pine forest type in the Northern Lake States by ownership class.

The area of privately owned red pine timberland increased by more than 60 percent between the 1980s and the 1990s, but with the overall increase in total area of red pine, the percentage in private ownership remained at the same level. In addition to potentially increasing in area due to management, the conversion of other forest types to red pine has occurred. In many stands, both jack and red pine occur on the same site. Without disturbance, and with the increasing age of the stands initially established around the turn of the century, jack pine are phasing out, leaving red pine as the dominant species. This ecological process results in a reclassification of many stands from jack to red pine.

Stocking

Across the Northern Lake States, the level of stocking (how fully occupied the site is by trees) has increased. Data related to stocking by specific forest type is only available for inventories completed since the 1980s. Between the 1980s and the 1990s, the percentage of

red pine timberland in the poorly to medium stocking classes decreased from 40 percent to 29 percent (Fig. 4). This decrease was due to an increase in the area of fully stocked timberland. The increase in stocking levels is due to the continuing positive growth-to-removals ratios experienced across the region, which are discussed in detail in the factors of change section.

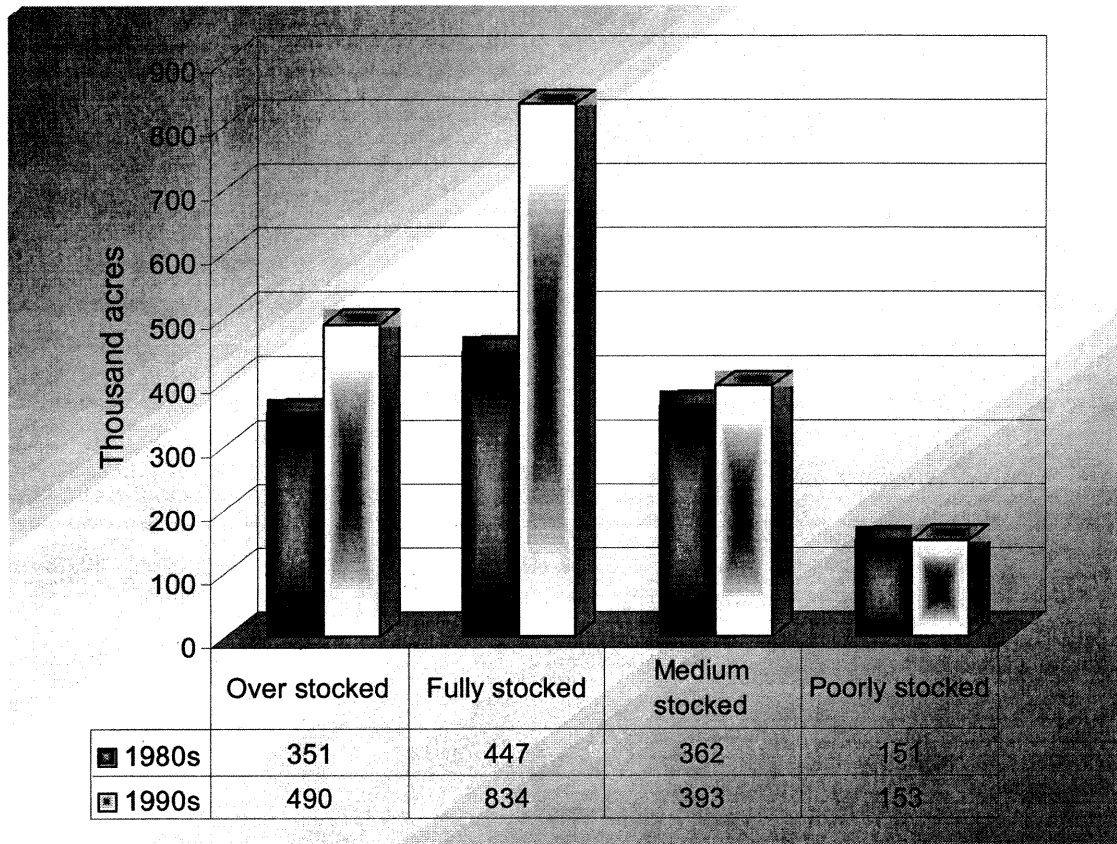


Figure 4. Area of red pine forest type in the Northern Lake States by stocking class.

Number of Trees

Discussions regarding the number of red pine trees relate to all red pine trees regardless of the forest type. As mentioned, red pine can be found in a number of forest types, thus management activities, successional processes, and land-use changes that impact all timberlands have the potential to impact the number of red pine trees. Until the 1990s, the number of red pine trees in the Northern Lake States followed the generally accepted standard distribution of the most trees in the smallest diameter size class and, as diameters increased, the number of trees decreased (Fig. 5). However, in the 1990s, the number of red pine trees in the 0to5 inch diameter class was lower than the number in the 5-to-9 inch diameter class. The 5-to-9 inch diameter class had the most red pine trees in the 1990s, followed by the 0-to-5 inch diameter class, followed by the standard decreasing number of trees as diameter increases. The primary reason for this was the large number of trees in

Michigan in the 5-to-9 inch diameter class but this unusual situation might also imply a concern regarding regeneration of red pine.

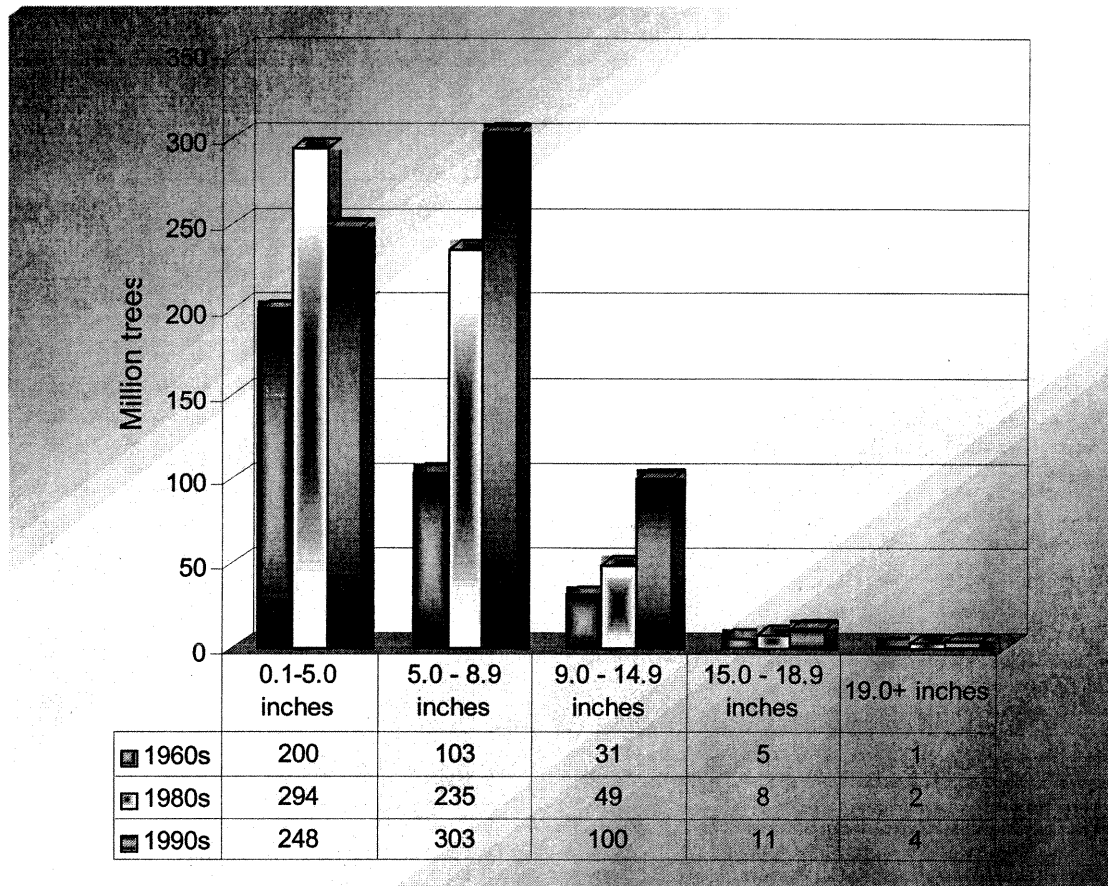


Figure 5. Number of red pine trees in the Northern Lake States by diameter class.

The number of larger diameter red pine trees in the region has been steadily increasing over time. As the timberlands across the region have been maturing, red pine has followed suit. This also matches with the analysis of stand-size class; the area of sawtimber sized red pine stands has been steadily increasing across the Northern Lake States. It is expected that in the absence of disturbance and/or management specifically directed at regeneration, the number of smaller sized red pine trees might decrease across the region with a corresponding increase in larger diameter red pine trees. As these larger trees reach full maturity and increase their susceptibility to environmental stresses, mortality is expected to increase. If this occurs, these larger red pine trees will be replaced and the stand might convert to other forest types.

Growing-Stock Volume

Across the Northern Lake States, total growing-stock volume for all species has steadily increased. Between the 1930s and the 1990s, total growing-stock volume increased by 133 percent. Each inventory period resulted in greater volumes for almost all forest types and

species groups. This continual increase occurred in all three states on a regular basis. This same phenomena has occurred with red pine but to a much greater extent. Between the 1930s and the 1990s, total growing-stock volume of red pine increased by more than 700 percent (Fig. 6). Volume of red pine in the Northern Lake States region is currently greatest in the east and decreases as you progress west. Michigan has almost three times as much red pine volume as Minnesota.

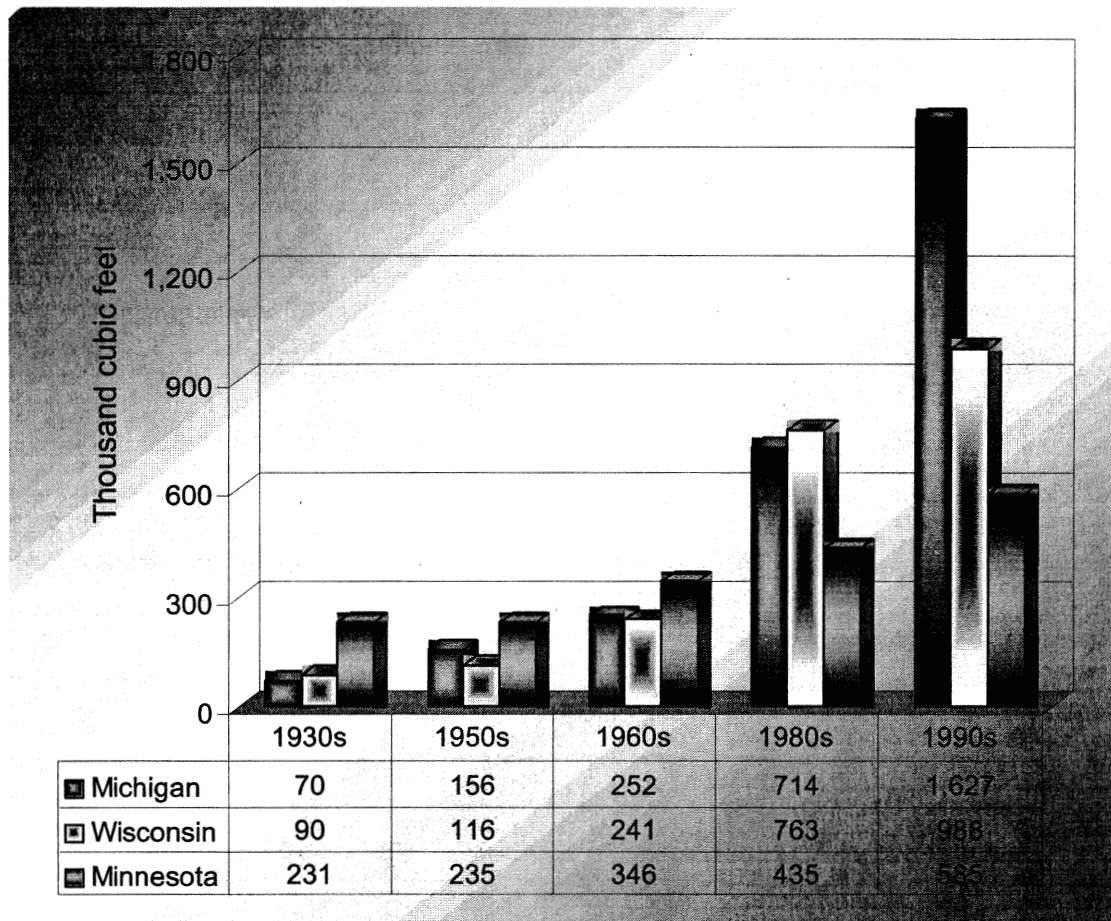


Figure 6. Growing-stock volume of red pine in the Northern Lake States.

While red pine occurs across almost all forest types and thus there is red pine volume that is not accounted for by the red pine forest type, there are other species that occur within the red pine forest type. For example in Michigan in 1993, 80 percent of the total red pine volume was in the red pine forest type and about 80 percent of the total volume in the red pine forest type was red pine. Thus, calculations based on average volume per acre seem reasonable (total red pine growing-stock volume by total area in the red pine forest type). Across all inventory periods, red pine volume per acre equaled or exceeded the average for all species. From the 1930s through the 1980s, red pine volume per acre was the lowest in Michigan and

greatest in Minnesota. However, by the 1990s Michigan had the greatest level of red pine volume per acre and Minnesota had the lowest among the three Northern Lake States.

In the 1990s, red pine growing-stock volume averaged more than 1,700 cubic feet per acre across the region compared to 680 cubic feet per acre in the 1950s, an increase of 150 percent (Fig. 7). Average growing-stock volume for all species averaged 1,228 cubic feet per acre in the 1990s, exhibiting the heavier stocking associated with this species.

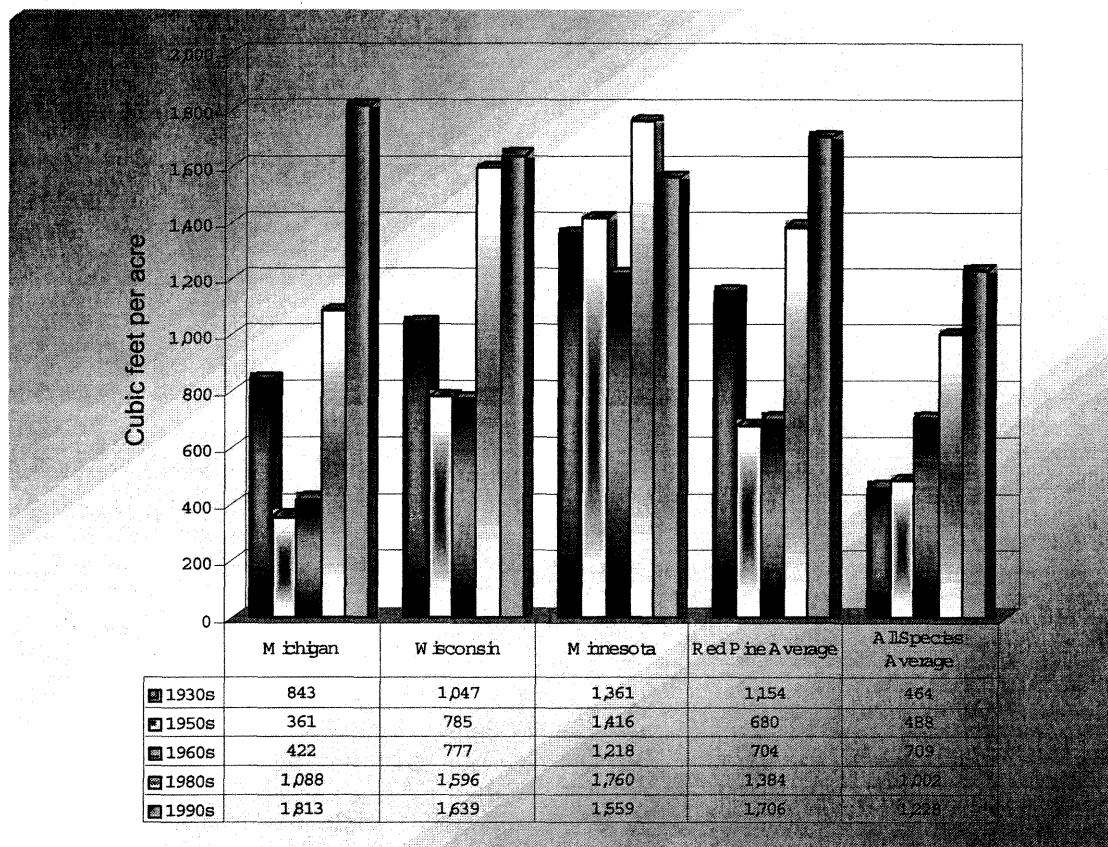


Figure 7. Growing-stock volume per acre of red pine in the Northern Lake States.

Factors of Change

There are three major factors of change with common measurements—average annual growth, mortality, and removals. While there are other factors of change, common measurements have not historically been made, thus the focus on these three factors of change. Most growth measures are reported as average annual net growth, which reflects gross growth minus mortality. In the case of red pine, mortality averages 0.06 percent of total growing-stock volume and 1.3 percent of total gross growth, thus discussions related to growth focus on average annual net growth for growing stock. Removals are totals and include removals due to land-use change, harvesting for all wood fiber products, and logging slash left in the woods. Growth-to-removal ratios compare average annual net growth to average annual removals.

Growth

Average annual net growth for red pine has consistently increased across the region and in each state since the 1960s (Fig. 8). For the region as a whole, between the 1960s and the 1990s, total red pine average annual net growth increased by more than 160 percent. The majority of the growth has occurred in Michigan. Michigan accounted for 45 percent of the total red pine growth in the region in the 1960s, 43 percent in the 1980s, and 52 percent in the 1990s.

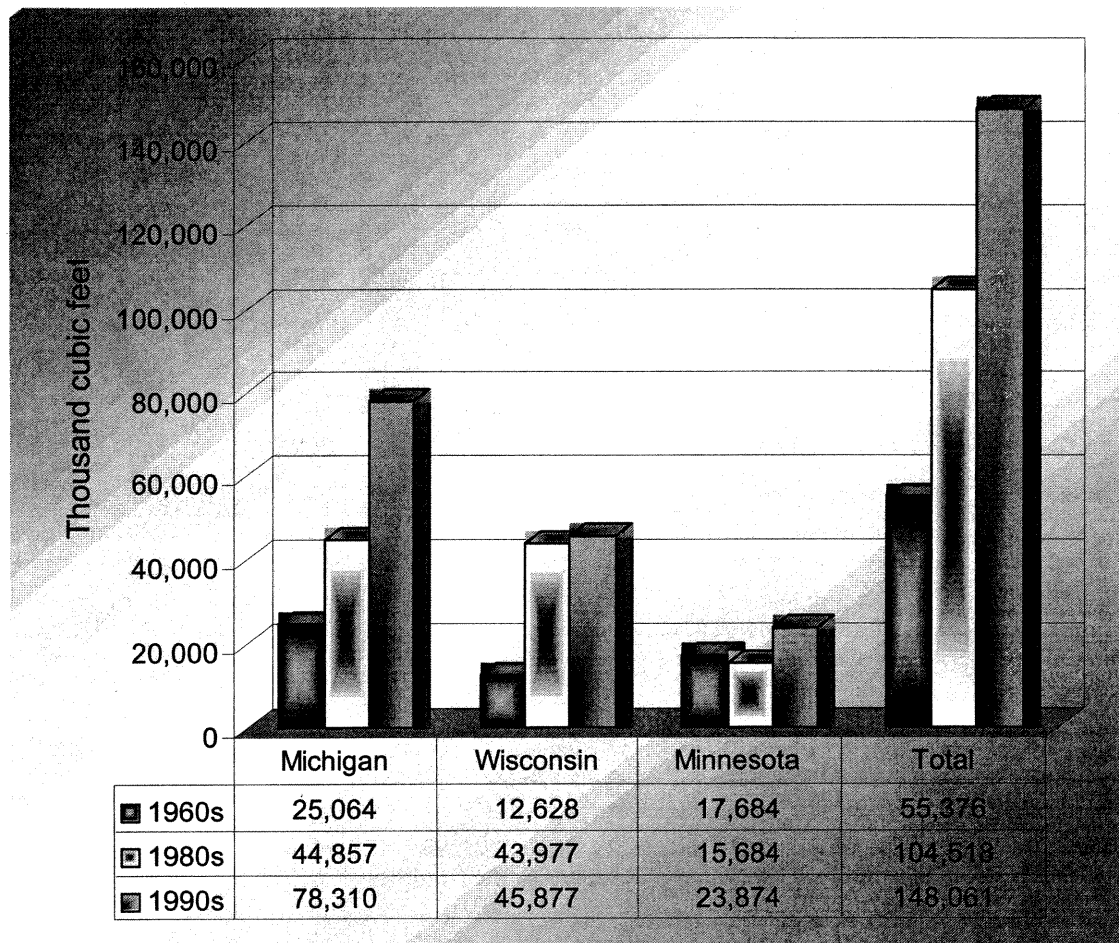


Figure 8. Average annual net growth of red pine in the Northern Lake States.

On a growth per acre basis, Minnesota has consistently averaged about 60 cubic feet of growth per acre per year (Fig. 9). Michigan has steadily increased to where it currently averages almost 90 cubic feet per acre per year. Across the three states, red pine averages almost 80 cubic feet per acre per year of net growth.

Mortality

Red pine historically has one of the lowest rates of mortality of all woody species in the Northern Lake States region. While mortality has been increasing, from 352 thousand cubic feet per year for the region in the 1980s to 1,971 thousand cubic feet per year in the 1990s, it

still only represents 0.06 percent of total volume. As a comparison, mortality of all species across the region averaged about 1.0 percent of total volume in the 1990s.

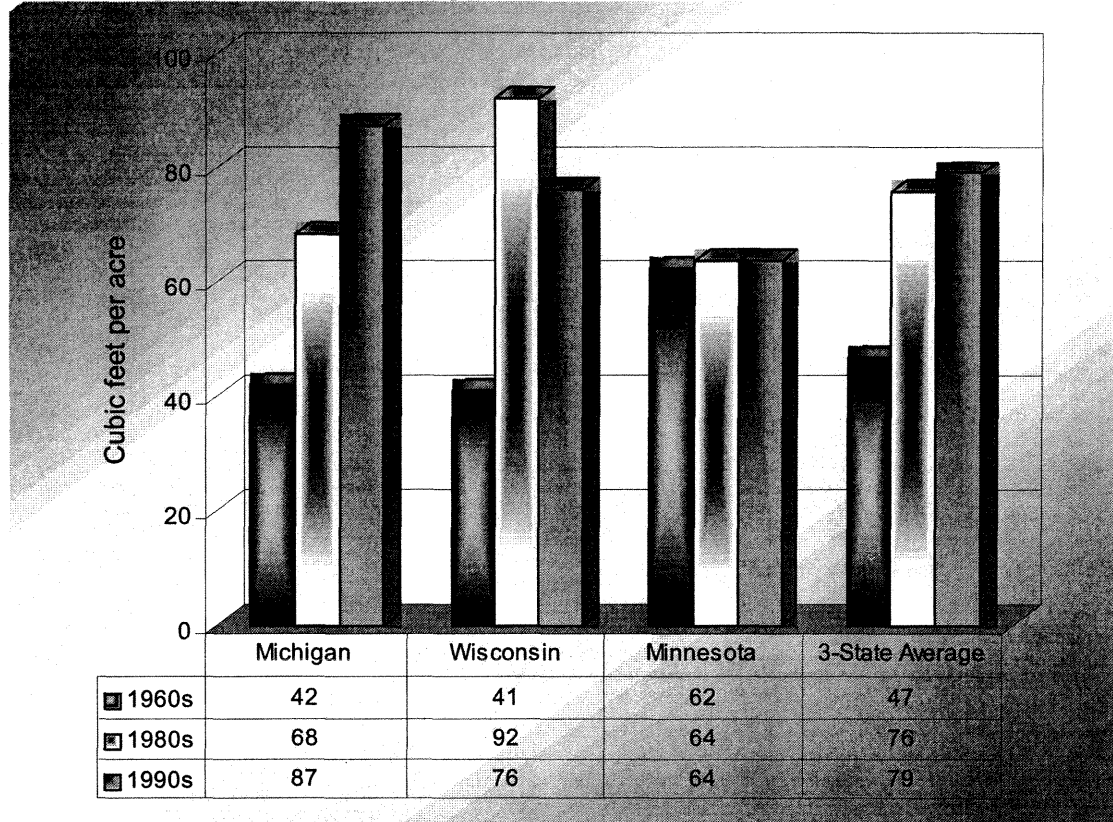


Figure 9. Average annual net growth per acre of red pine in the Northern Lake States.

Of the known causes of mortality, weather and fire were the leading causes followed to a lesser extent by insects and diseases. Currently, mortality of red pine is greatest in Wisconsin (about a million cubic feet per year) but it is at a low level and should not be of major concern. If the red pine resource continues to age and is not replaced by younger, more vigorous trees, it is expected that mortality rates will continue to increase and might become of concern in the future.

Removals

Average annual removals of red pine dramatically increased from the 1950s to the 1980s across the region (Fig. 10). From the 1980s to the 1990s, removals increased by 100 percent in Michigan, increased by 25 percent in Minnesota, and declined by 45 percent in Wisconsin. Recent differences between states partially reflect differences in their forest products industries and partially reflect resource availability. Currently, the Northern Lake States region averages slightly more than 30 million cubic feet of red pine removed annually. Interestingly, red pine removals currently represent 4 percent of all removals, matching the percentage for total area of timberland dominated by red pine.

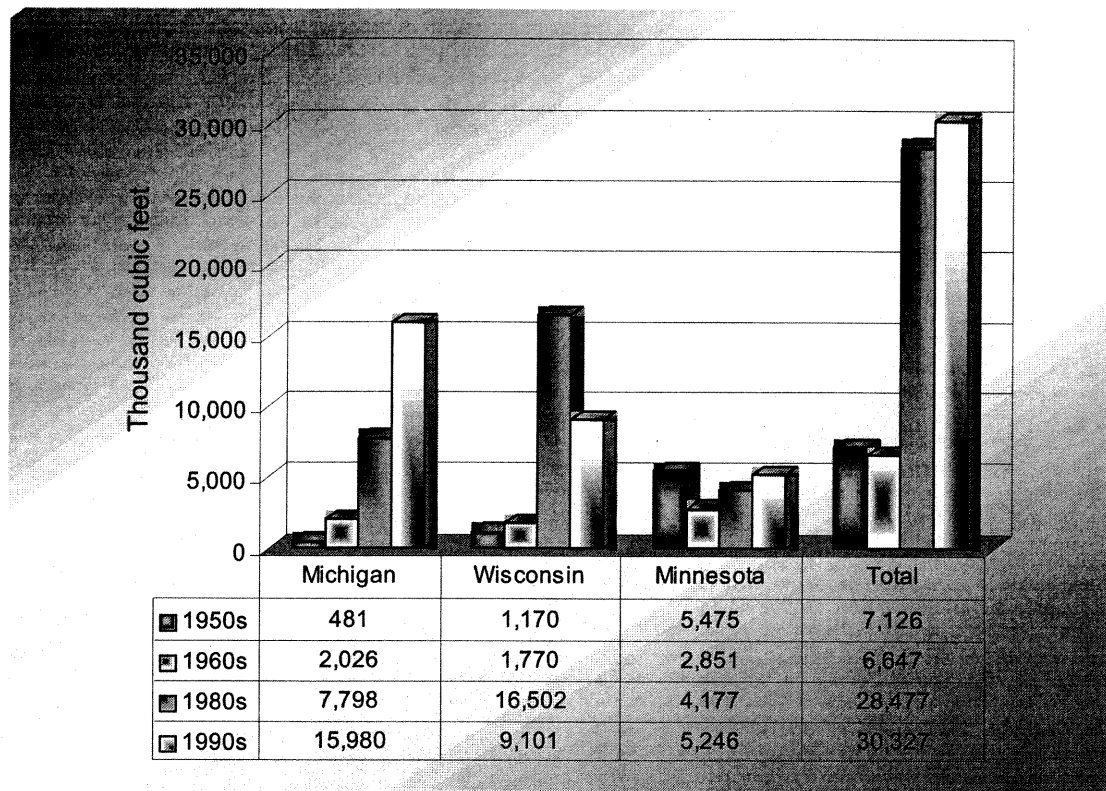


Figure 10. Average annual removals of red pine in the Northern Lake States.

Analyzing growth-to-removals ratios for red pine reveal that between the 1960s and the 1980s the ratio decreased, exhibiting that removals were increasing in relation to growth (Fig.11). However, between the 1980s and the 1990s the region's growth-to-removal ratio has been increasing. Currently, the Northern Lake States have a growth-to-removals ratio of almost 5-to-1, implying that five times as much growth is occurring as is being removed. The region averages a growth-to-removals ratio of about 2-to-1 when all species are considered.

Discussion

Red pine is a vital component of the timberland resources in the Northern Lake States region and with its current condition is expected to continue its critical role. One of the areas of concern relates to the decreasing levels of regeneration compared to other diameter classes. This situation is similar for all timberlands in the region as they continue to mature and move toward a more sawtimber-size dominated status. Current and future policy and management decisions regarding the overall forest resource and red pine in particular will have to address this situation and the resource will reflect their outcome. While the current future for red pine appears bright, it must be constantly monitored to ensure that our goals for this resource can continue to be met.

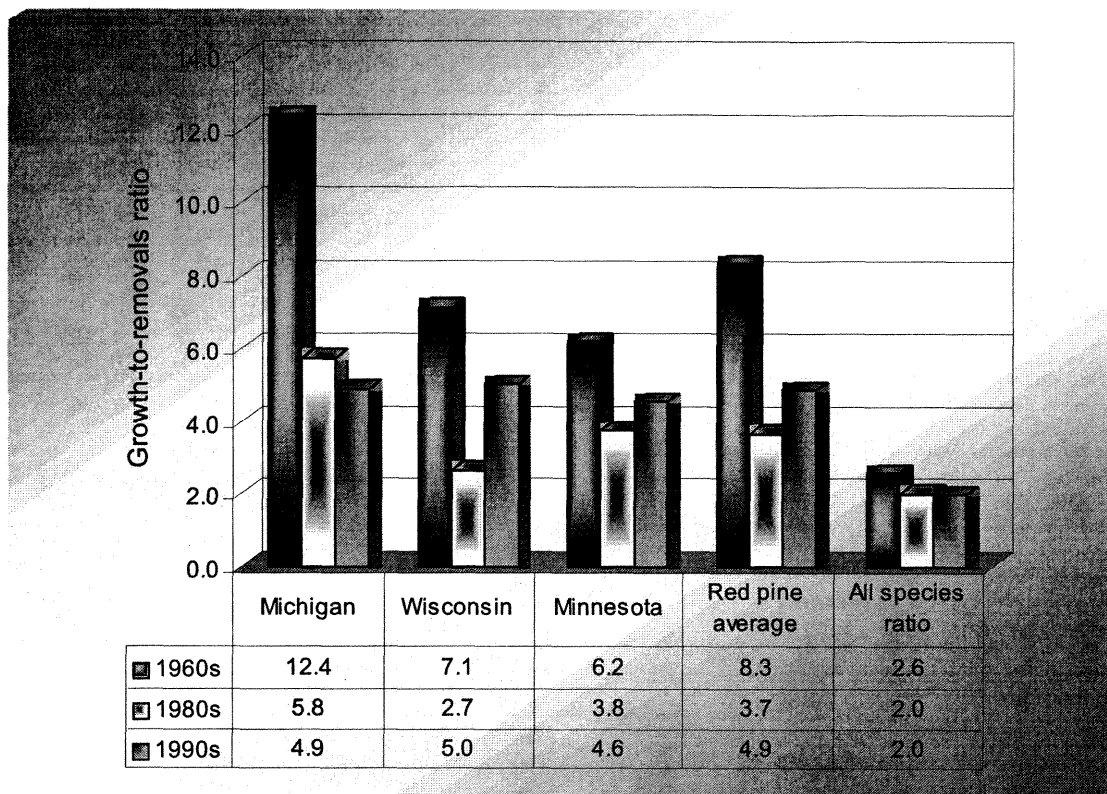


Figure 11. Average growth-to-removals ratios for red pine in the Northern Lake States.

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