

Red Pine

Pinus resinosa

The volume of red pine has increased significantly since 1996. This volume increase has occurred almost exclusively in sawtimber-sized trees. The number of saplings has decreased in the last 20 years, suggesting that red pine volume may diminish in the future. Models project increased volume for the next 30 years

Growth rates of red pine have increased and the ratio of growth to volume is much higher than the average for all species. The ratio of mortality to volume for red pine is much lower than average. Red pine makes up about 7.9% of all volume of trees in Wisconsin, 12.5% of growth but only 1.2% of total mortality.

Red pine is an important timber species, accounting for 13% of roundwood production in 2009. Red pine roundwood is mainly used for pulpwood and sawlogs, ranking first in sawlog production and third in pulpwood.

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Modelling future volumes





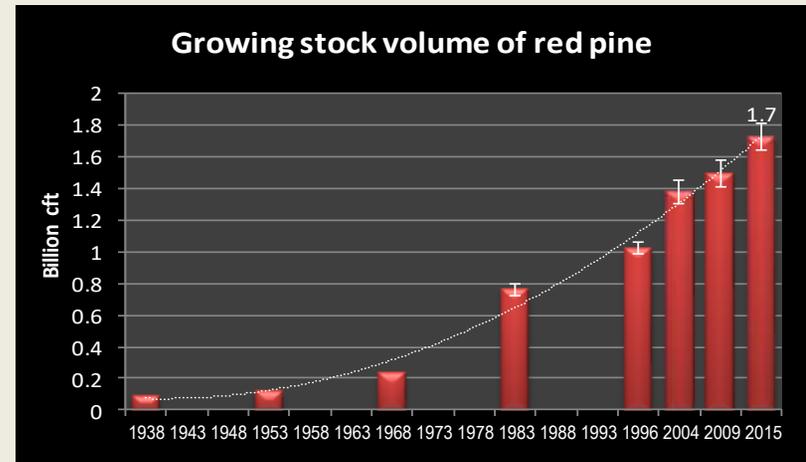
“How has the red pine resource changed?”

Growing stock volume and diameter class distribution

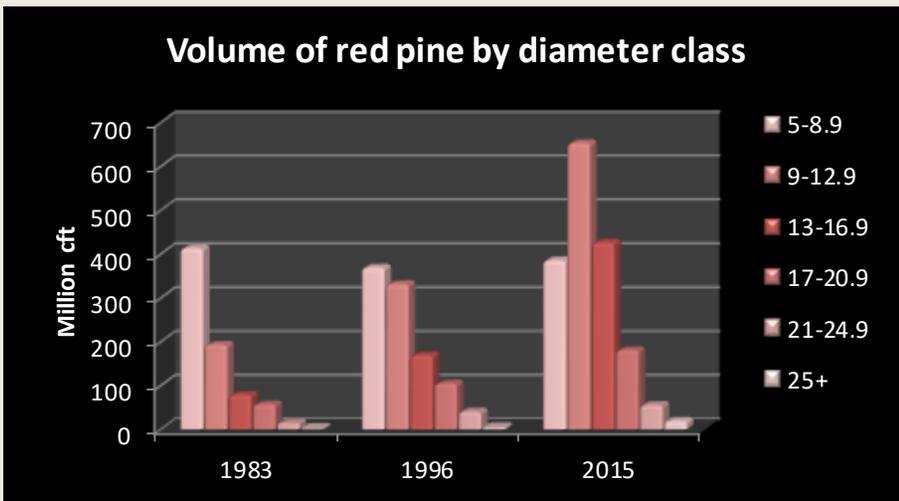
The [growing stock volume](#) of red pine has doubled since 1983 to 1.7 billion cubic feet or 7.9% of statewide volume (chart on right). The volume in red pine has risen significantly since 1938. Volume has more than doubled since 1983 and has increased 69% since 1996.

The increased volume has occurred mainly in [sawtimber](#) trees (charts below). Since 1996, the volume in sawtimber trees has doubled.

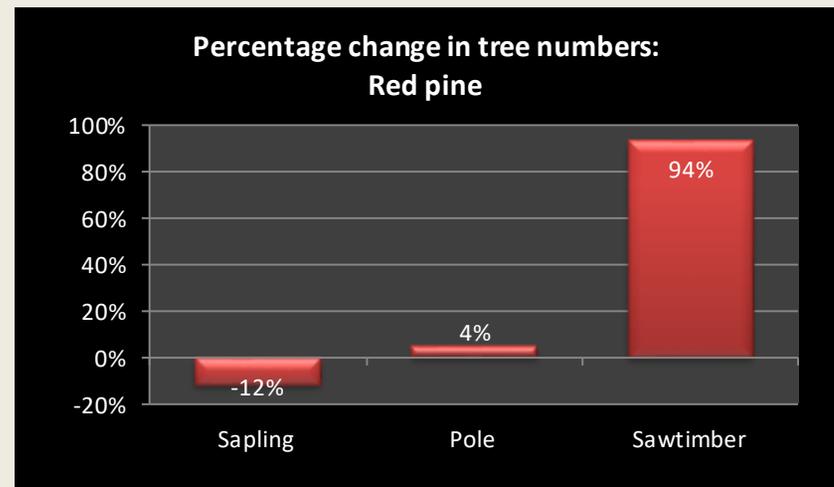
The red pine resource has aged since 1983. For instance, the volume in large trees (over 13 inches in diameter) has increased by more than four fold in this time (chart on left below).



Growing stock volume (million cubic feet) by inventory year.
Source: USDA Forest Inventory and Analysis data



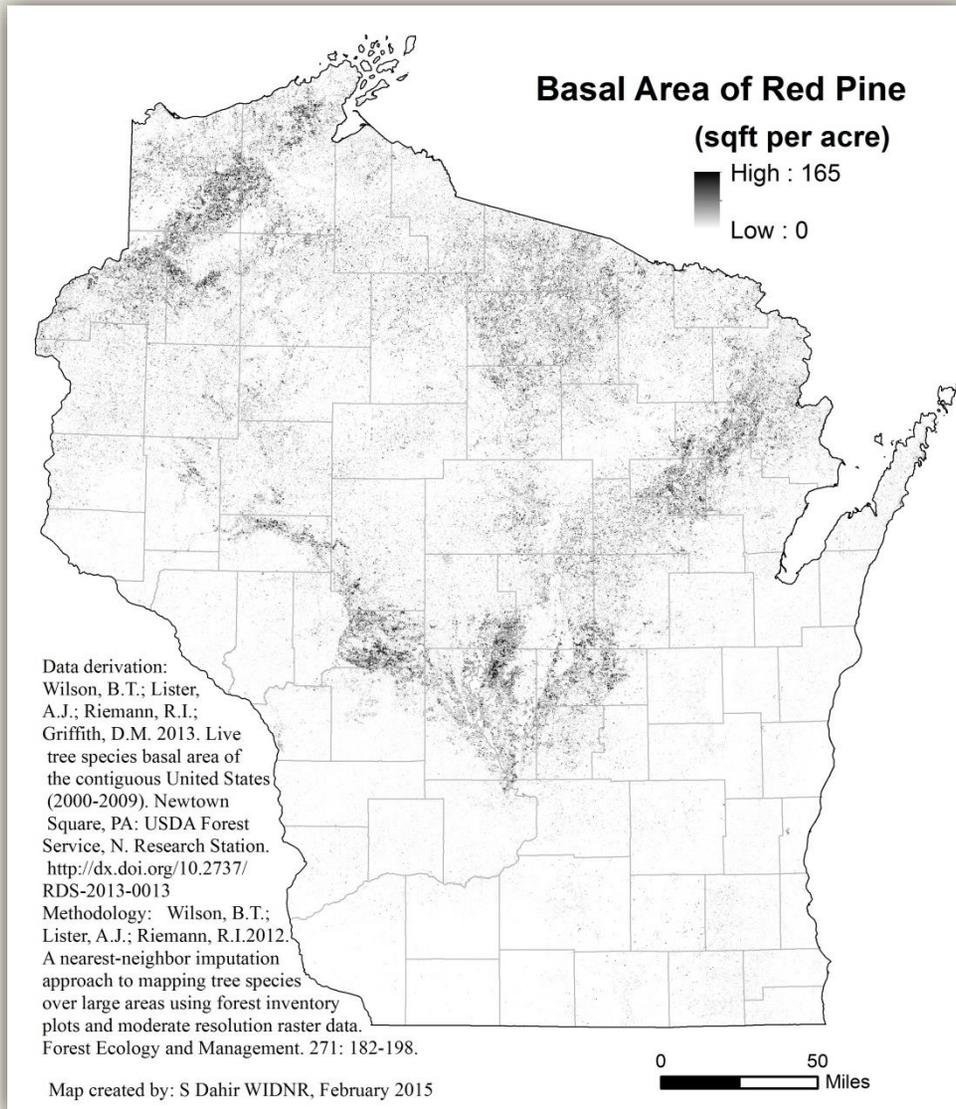
Growing stock volume (million cubic feet) by diameter class (inches).
Source: USDA Forest Inventory and Analysis data



Percentage change in the number of live trees by size class between 1996 and 2015.
Source: USDA Forest Inventory and Analysis data 1996 and 2015.

“Where is red pine found in Wisconsin?”

Growing stock volume by region with map



The majority of red pine, 78%, is planted with 94% occurring in central and northern Wisconsin (Table 1). In addition, this species occurs sporadically on more mesic soils throughout the state.

Table 1. Growing stock volume (million cft) by region of the state.

Species	Central	North east	North west	South east	South west	Total
Red pine	496	616	492	43	79	1,726
Percent of total	29%	36%	29%	2%	5%	100%

Source: USDA Forest Service, Forest Inventory and Analysis 2015 data

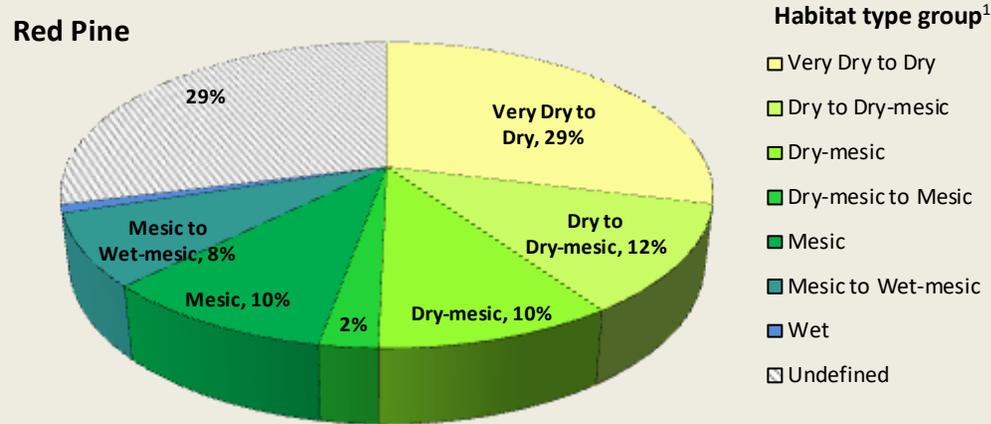
For a table of **Volume by County** go to:

<http://dnr.wi.gov/topic/ForestBusinesses/documents/tables/VolumeCountySpecies.pdf>

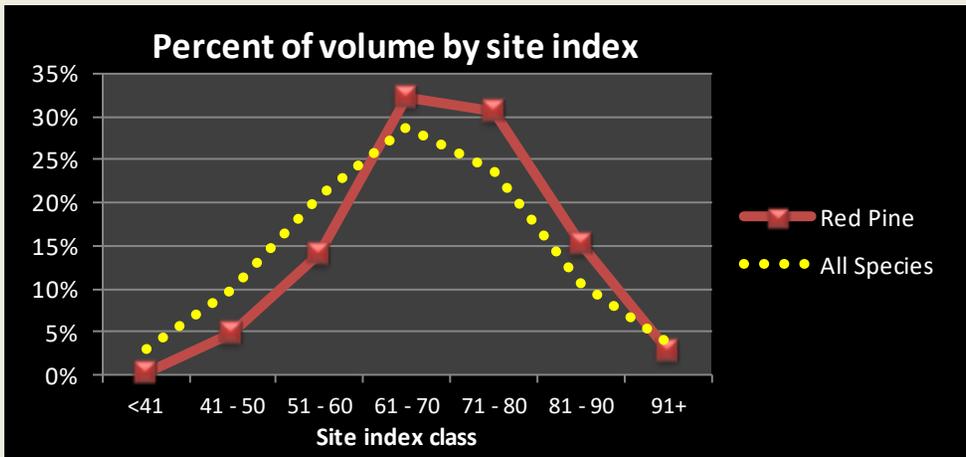


“What kind of sites does red pine grow on?”
Habitat type¹ and site index distribution

Over half of red pine volume occurs on very dry to dry mesic habitat types (chart below).



Percent distribution of growing stock volume by habitat type group (USDA Forest Inventory & Analysis data 2015).



Percent distribution of growing stock volume by site index class (USDA Forest Inventory & Analysis data 2015).

The majority of red pine growing stock volume (81%) is found in stands with site indices over 60 (chart on left).

The average site index by volume for red pine is 70, higher than the average for all species which is 66. Of all the softwood species in Wisconsin, red pine has a greater occurrence on richer sites.

¹ For more information on habitat types see Schmidt, Thomas L. 1997. Wisconsin forest statistics, 1996. Resource Bulletin NC-183. St. Paul, MN: U.S. Dept. of Agriculture, Forest Service, North Central



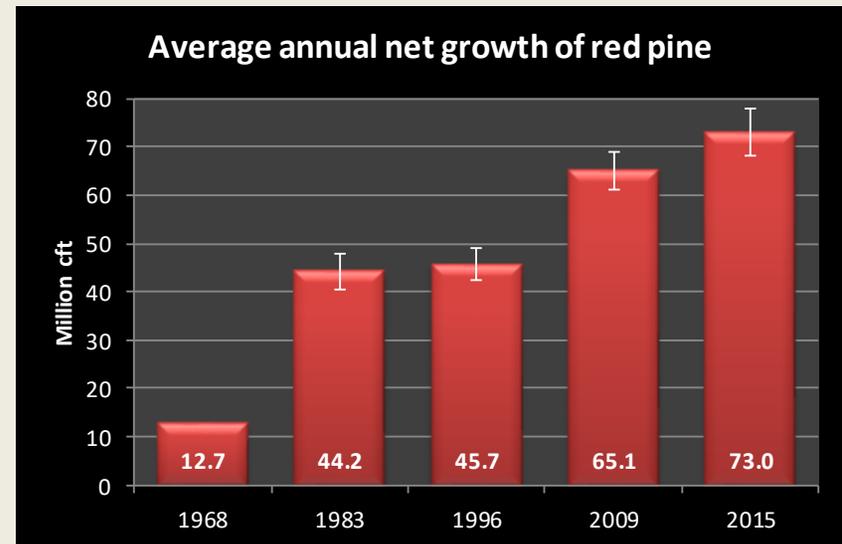
“How fast is red pine growing?”
Average annual net growth: trends and the ratio of growth to volume

Average annual net growth of red pine was about 73 million cubic feet from 2010 to 2015, or 12.6% of statewide volume growth (chart on right). Growth rates have increased by about 55% since 1996, mainly due to the increased growth of aging red pine forests.

Table 2. Average annual net growth (million cft/year) and ratio of growth to volume by region of the state .

Unit	Net growth of red pine (million cft/yr)	Percent of total	Ratio of growth to volume
Northeast	23.5	32%	3.8%
Northwest	21.0	29%	4.3%
Central	22.2	30%	4.5%
Southwest	5.0	7%	6.3%
Southeast	1.3	2%	3.0%
Statewide	73.0	100%	4.2%

Source: USDA Forest Inventory and Analysis data



Average annual net growth (million cubic feet).
 Source: USDA Forest Inventory & Analysis data

Although the highest volume of red pine occurs in central and northern Wisconsin, the highest growth to volume ratio occurs in the southwest part of the state (Table 2).

The ratio of growth to volume for red pine is 4.2%, much higher than the statewide average of 2.7% for all species.

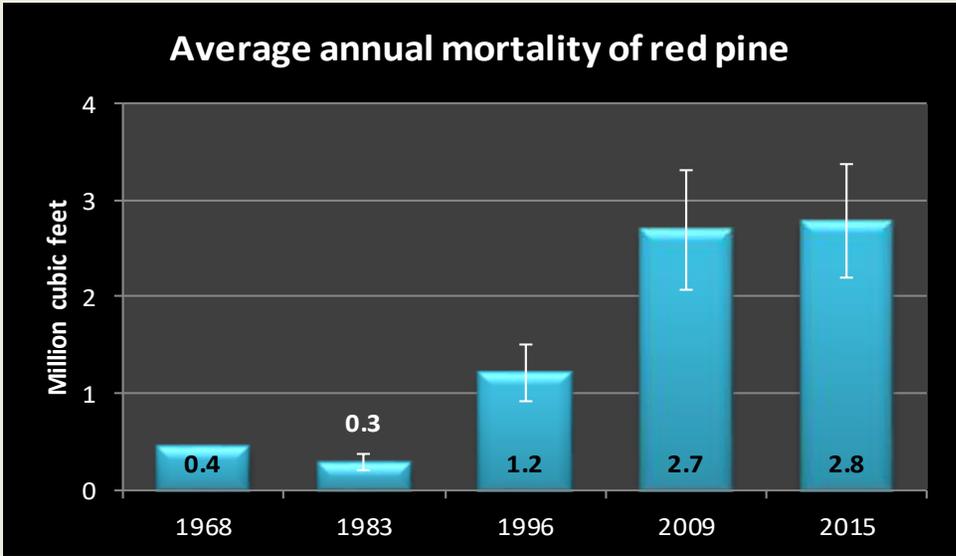
For a table of **Average annual growth, mortality and removals by region** go to:
<http://dnr.wi.gov/topic/ForestBusinesses/documents/tables/GrowthMortalityRemovals.pdf>



“How healthy is red pine in Wisconsin?”
Average annual mortality: trends and the ratio of mortality to volume

Average annual mortality of red pine, about 2.8 million cubic feet per year from 2010 to 2015, has more than doubled since 1996 (chart on right). Red pine accounts for 7.9% of volume, 12.6% of growth but only 1.2% of statewide mortality.

The ratio of mortality to volume is 0.2% for red pine, much lower than the statewide average of 1.1%, and one of the lowest of all commercial species (Table 3).



Average annual mortality (million cubic feet) by inventory year.
 Source: USDA Forest Inventory & Analysis data:

Table 3. Mortality, volume and the ratio of mortality to volume.

Species	Average annual mortality (cft)	Growing stock volume (cft)	Mortality / volume
Red pine	2,784,083	1,726,195,167	0.2%

Source: USDA Forest Inventory and Analysis data

For a table of **Average annual growth, mortality and removals by region** go to:
<http://dnr.wi.gov/topic/ForestBusinesses/documents/tables/GrowthMortalityRemovals.pdf>

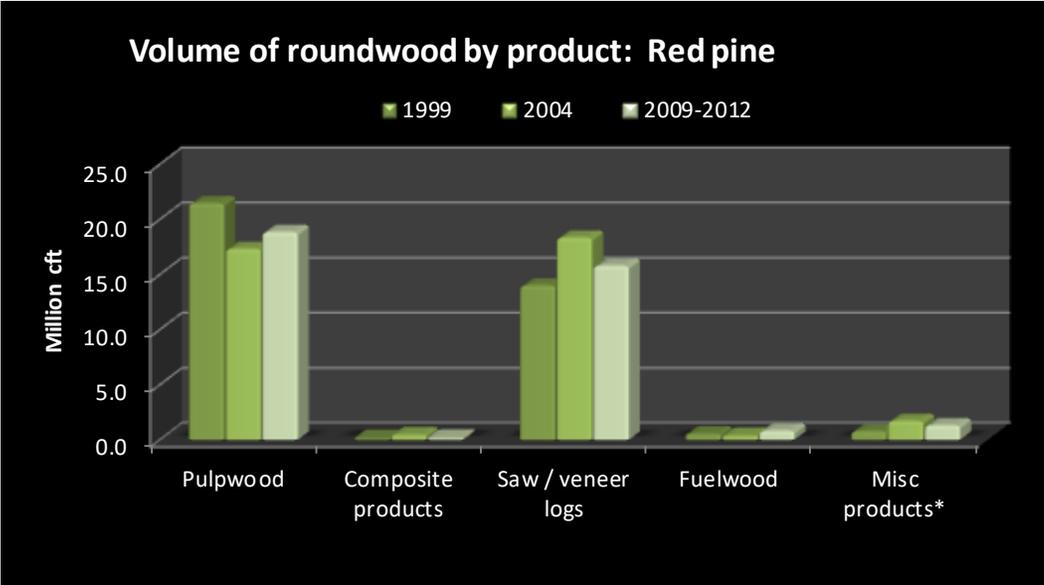


“How much red pine do we harvest?”

Roundwood production and the ratio of growth to removals

In 2009-2012, red pine accounted for 36.9 million cubic feet or about 9.7% of Wisconsin’s total [roundwood](#). Pulpwood accounted for 51% and sawlogs for another 43% (chart on right).

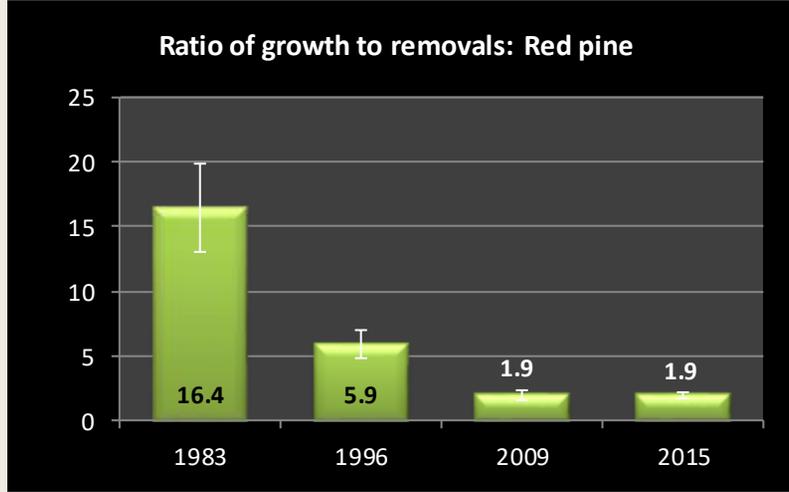
Red pine pulpwood made up 13% of total pulpwood in the state and sawlogs accounted for over 20% of all sawlog production.



Volume of roundwood. Most recent figures for pulpwood and composite products are from 2012 while other product volumes are from 2009. * Miscellaneous products include poles, posts and pilings.
 Source: Ronald Piva, USDA Forest Service, Northern Research Station, St. Paul MN

Removals of red pine totaled 37.5 million cubic feet per year from 2010 to 2015. This is equal to 12.3% of total removals in the state.

The ratio of average annual net growth to removals 1.9 for red pine, about equal to the average of 1.7 for all species (chart on left). This ratio has decreased dramatically since 1983 due to a six-fold increase in removals.



Source: USDA Forest Inventory & Analysis data

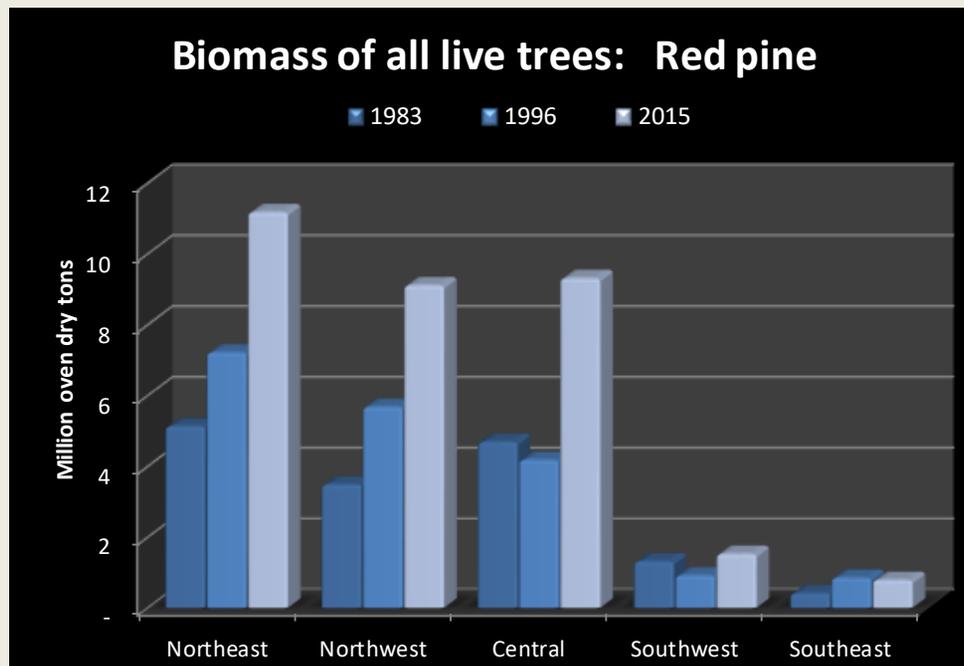
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“How much red pine biomass do we have?”

Aboveground biomass by region of the state

There were 31.9 million short tons of aboveground [biomass](#) in live red pine trees in 2015, a doubling since 1983. This is equivalent to approximately 16 million tons of carbon and represents 5% of all aboveground biomass statewide. As with volume, most red pine is located in central and northern Wisconsin (chart below).



Biomass (above ground dry weight of live trees >1 in dbh, short tons) by year and region of the state.
Source: USDA Forest Inventory & Analysis data

The density of red pine wood is about average for softwoods with a ratio of biomass to volume of 28 oven-dry lbs. per cubic foot (ODP/cft). The average for all softwoods is about 26 ODP/cubic feet and for all species is 33 ODP/cubic feet.

Approximately, 81% of all red pine biomass is located in the main stem and 14% in the branches.

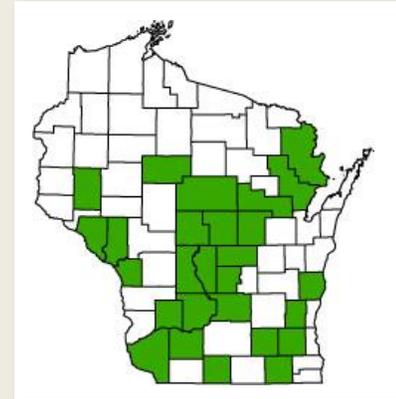
For a table of **Biomass by County** go to:

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“Does red pine have any major disease or pest issues?”
Annosum root rot: biology, symptoms and impact

Since 1993, annosum root rot has been confirmed in 27 Wisconsin counties (map on right).

Annosum root rot is most damaging in plantation-grown conifers (especially pines) where freshly cut stumps offer a place for infection to start. Basidiospores, produced by the fungus *Heterobasidium irregulare*, land and grow on the surface of a freshly cut stump. This infection process is why annosum can be so damaging in an area where trees are cut down. These basidiospores can be carried by the wind over hundreds of miles. The fungus starts living in the stump and moves into the root. Where roots connect, it moves from tree to tree. Infected trees and stumps may have fruit bodies (spore-producing part of the fungus) or conks (Figure below) at the base of the trunk.



Counties with confirmed annosum root rot infection as of December 2016.



Left: Annosum fruit bodies on stump. Upper right: Fruit bodies on white pine seedling. Lower right: Sporax fungicide applied to freshly cut stump.

Annosum root rot causes a decay of the roots and lower stem, attacks the cambium and kills infected trees. Infected trees show thin foliage, reduced height, diameter and shoot growth and eventual mortality. This process can take 3 to 5 years after harvesting.

Understory seedlings and saplings that are near infected older trees may also become infected. As pockets of trees die, gaps are created in the forest canopy where brush and early successional trees can grow.

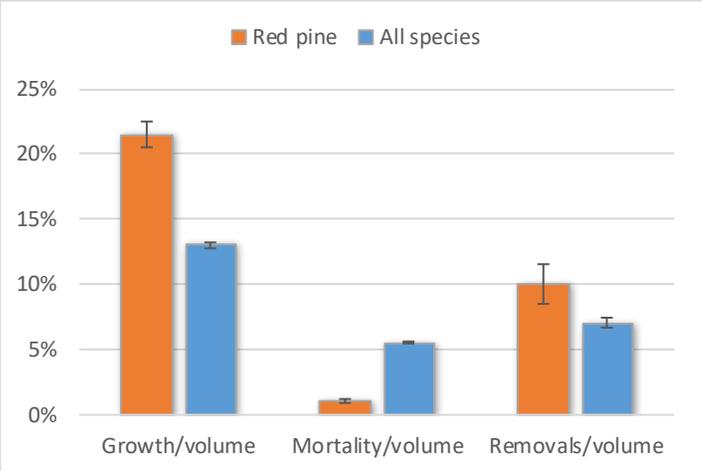
Annosum root rot can be prevented by treating freshly cut stumps with fungicide immediately after cutting. Fungicides such as powdered Sporax and liquid Cellu-Treat, will help prevent new infections, but will not stop the growth of the fungus if the stump is already infected.

“Can we predict the future of red pine?”

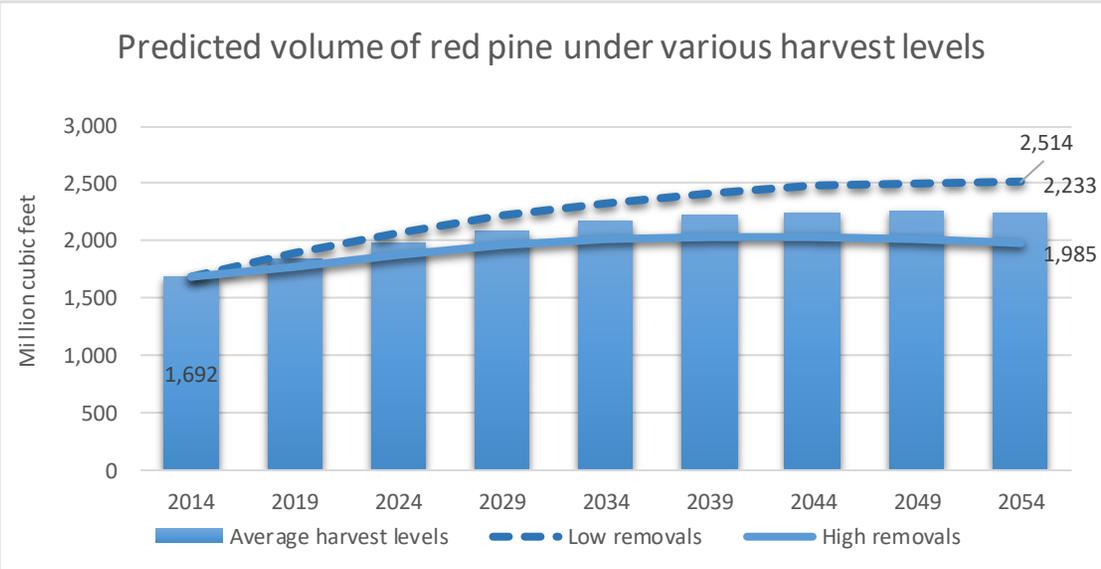
Predicted volumes based on current rates of mortality and harvest

The 5-year ratios of growth to volume and removals to volume are significantly higher for red pine compared to all species in the state and the ratio of mortality to volume is significantly lower (chart on right). These trends would likely indicate an increase in future volume.

The Forest Vegetation Simulator (FVS¹) was used to predict future volumes of red pine through 2054. Three scenarios are forecast. One with current rates of mortality and removals (i.e. average annual mortality and removals for 2009 to 2014). Another with current mortality rates and the lower 67% confidence interval for current removals and another with the upper 67% confidence interval for removals.



Five year ratios of mortality, removals and growth to volume.
Source: USDA Forest Inventory & Analysis data



As expected, volume increases in all three scenarios by 2054, 32% for average current removal levels, 49% for low removals and 17% for high removals.

Probably due to a higher than average rate of removals, volume levels out in 2049 using average harvest levels. Volume never peaks for low harvest levels and peaks in 2044 for high levels of harvest.

¹The Forest Vegetation Simulator is a forest growth and yield simulation model created by the USDA Forest Service, see <http://www.fs.fed.us/fmnc/fvs/>.