

Jack pine

(*Pinus banksiana*)

Since 1983, both the volume and rate of growth of jack pine have decreased significantly. Jack pine saplings, poles, and sawtimber trees have all decreased since 2004. Seedling numbers have decreased at a greater rate than any other species.

Jack pine has a much higher ratio of mortality to growth than other species in the state. For instance, jack pine accounts for about 1% of all volume and growth of trees in Wisconsin, but 2.9% of mortality and 2.3% of removals. Jack pine budworm is a major cause of mortality. Volume of jack pine is predicted to decrease by $\frac{2}{3}$ in the next 40 years.

Jack pine is an important timber species, accounting for 4.2% of roundwood product in 2013. We are harvesting more volume each year than is being replaced by new growth.

- [How has the jack pine resource changed?](#)
Growing stock volume and diameter class distribution
- [Where is jack pine found in Wisconsin?](#)
Growing stock volume by region with map
- [Where kind of sites does jack pine grow on?](#)
Habitat type and site index distribution
- [How fast is jack pine growing?](#)
Average annual net growth and the ratio of growth to volume
- [How healthy is jack pine in Wisconsin?](#)
Average annual mortality and the ratio of mortality to volume
- [How much jack pine do we harvest?](#)
Roundwood production and the ratio of growth to removals
- [How much jack pine biomass do we have?](#)
Aboveground biomass by region of the state
- [Does jack pine have any major disease or pest issues?](#)
Jack pine budworm: biology, symptoms and impact
- [Can we predict the future of jack pine?](#)
Modelling future volumes
- [Jack pine on the state forests](#)

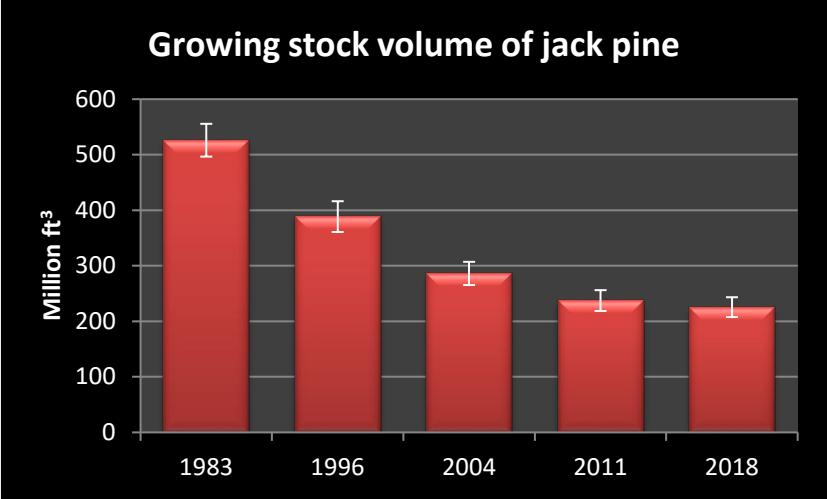


“How has the jack pine resource changed?”
Growing stock volume and diameter class distribution by year

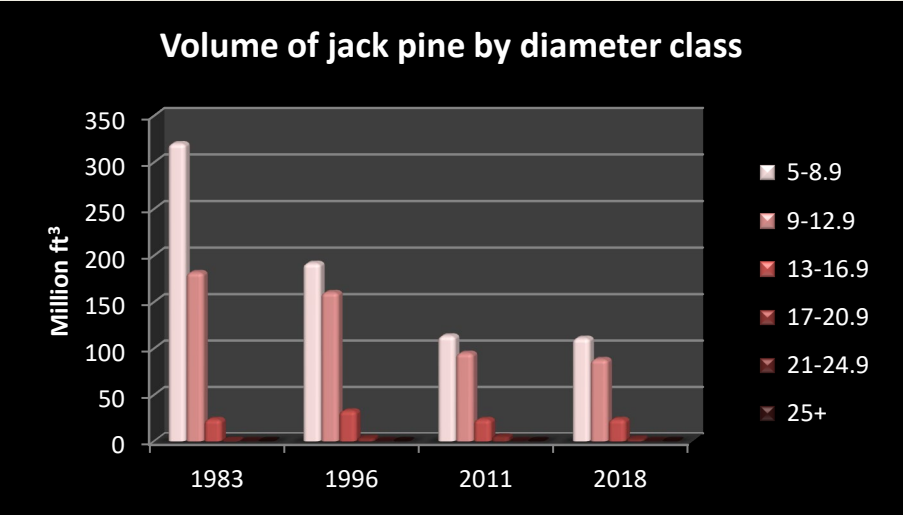
The [growing stock volume](#) of jack pine in 2018 was about 226 million cubic feet or 1% of total volume in the state (chart on right). Jack pine volume increased throughout the first half of the twentieth century, but jack pine budworm caused mortality to increase dramatically in the 1980s and 1990s.

Volume in both small (5-13 inches dbh) and large (>=13 inches dbh) growing stock trees has decreased significantly since 1983, although the decrease has noticeably slowed since 2011 (chart lower left).

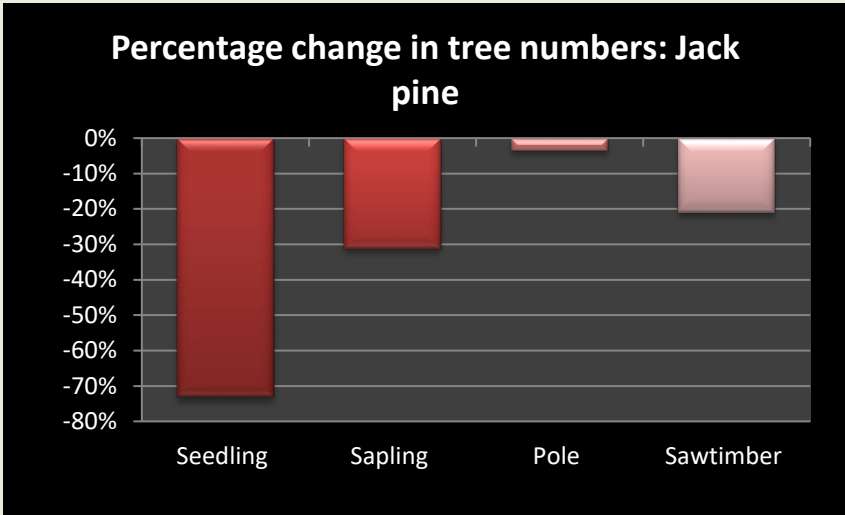
The number of jack pine trees continues to decrease for [sapling](#), [pole](#) and [sawtimber](#)-sized trees suggesting that jack pine populations will decrease in the future (chart lower right). Over three-quarters of all jack pine is naturally occurring (i.e. not planted).



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



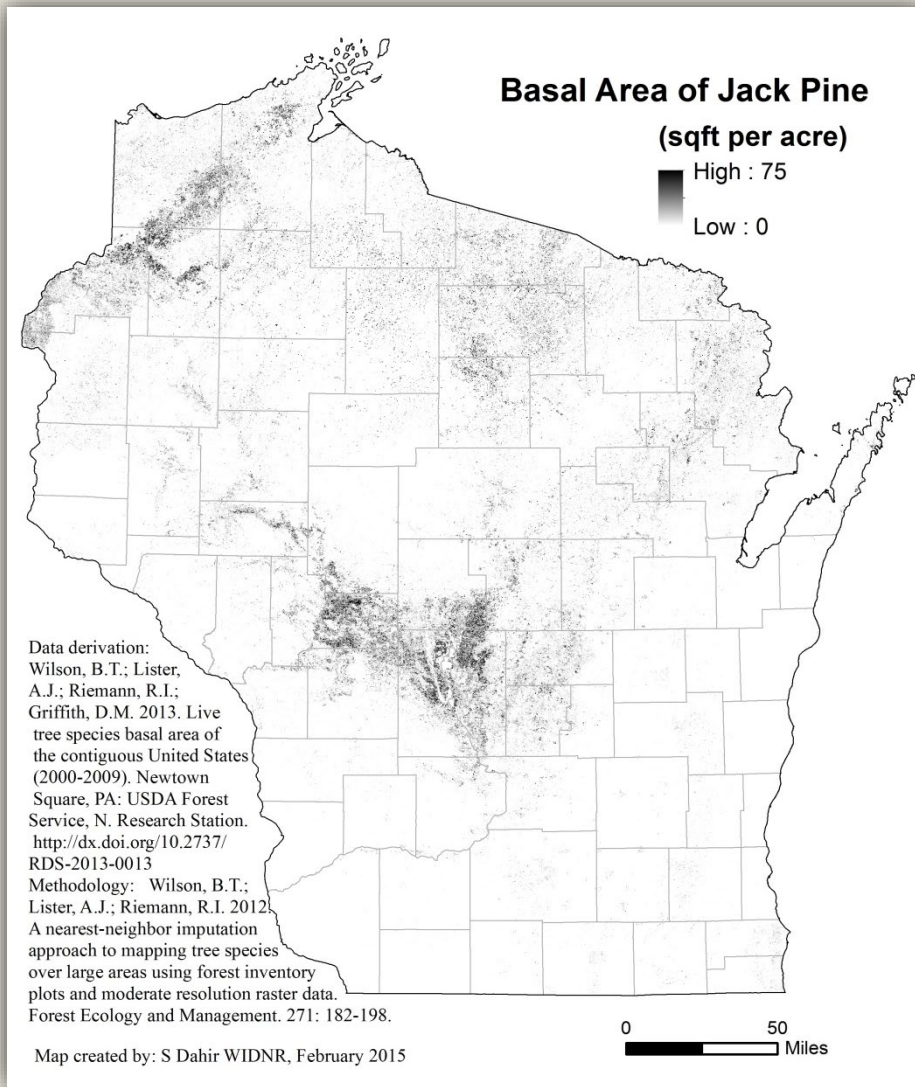
Growing stock volume (trees over 5 inches dbh) in million cubic feet
 Source: USDA Forest Inventory and Analysis data



Percentage change in the number of live trees by size class between 2004 and 2018.
 Source: USDA Forest Inventory and Analysis data 2004 and 2018.

“Where does jack pine grow in Wisconsin?”

Growing stock volume by region with map



About $\frac{3}{4}$ of jack pine volume is found in the sandy soils of northwest and central Wisconsin with lesser amounts in the northeast (Table 1).

The vast majority of jack pine volume occurs on pine [forest types](#) with lesser amounts on oak/pine and oak/hickory types.

Table 1. Growing stock volume (million ft³) by species and region of the state.

Species	Central	North east	North west	South east	South west	Total
Jack pine	92	55	77	1	0	226
Percent of total	41%	25%	34%	0%	0%	100%

Source: USDA Forest Service, Forest Inventory and Analysis 2018 data

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

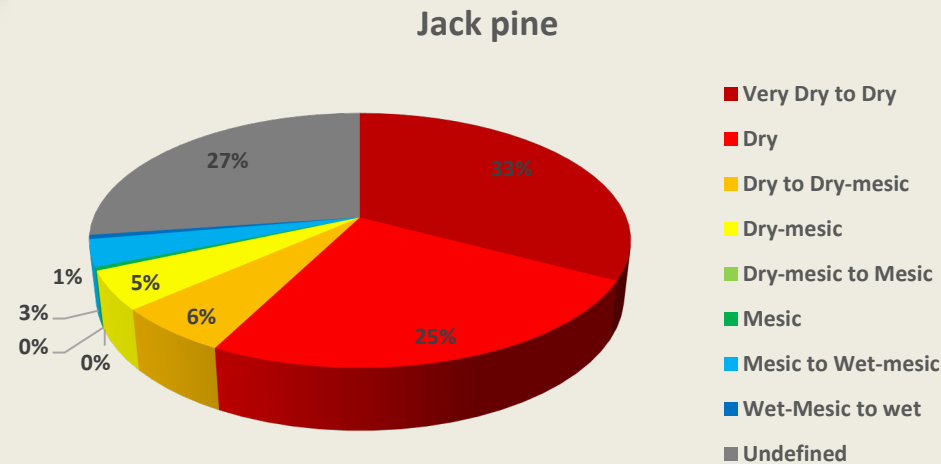
<http://dnr.wi.gov/topic/ForestBusinesses/documents/tables/VolumeCountySpecies.pdf>



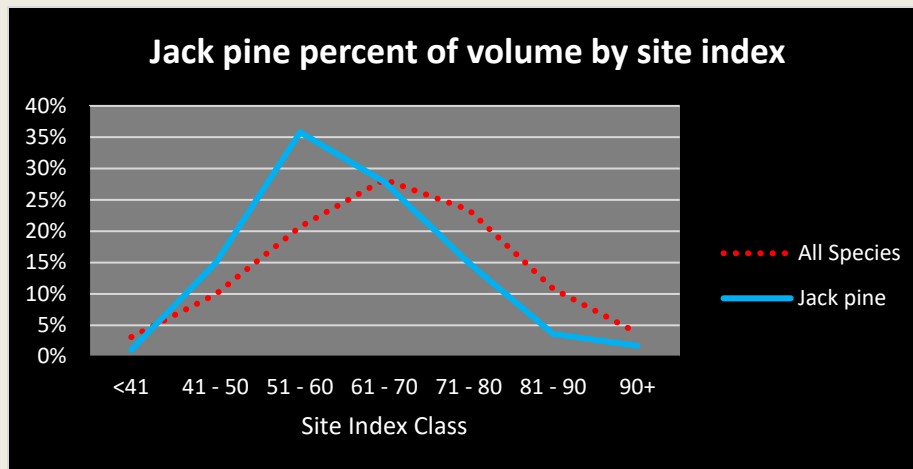
“What kind of sites does jack pine grow on?”

Habitat type and site index distribution

The vast majority of jack pine growing stock volume is found on dry habitat types: very dry to dry and dry to dry-mesic (chart below).



Percent distribution of growing stock volume by habitat type group¹ (USDA Forest Inventory & Analysis data).



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

The majority of jack pine growing stock volume is found in stands with low site indices (chart on left). Over half of volume is located on sites with site index less than 60.

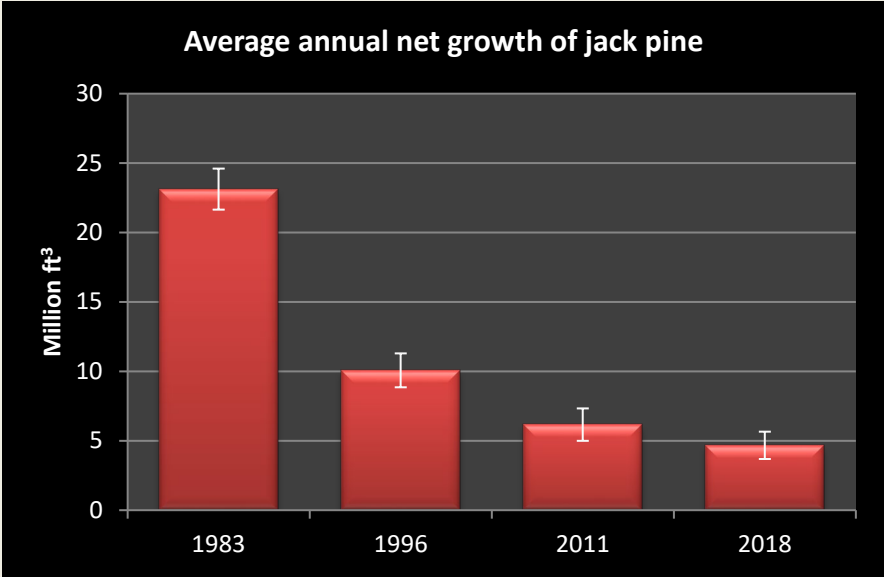
The average site index by volume for jack pine is 61, much lower than the average for all species, 66.

¹For 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 jack pine growing?”
Average annual net growth and the ratio of growth to volume

Average annual net growth of jack pine has decreased by 80% since 1983 to 4.7 million cubic feet per year currently (chart on right). This represents 0.8% of total volume growth in Wisconsin.



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

Table 2. Average annual net growth (million ft³/year) of growing stock and the ratio of growth to volume by region of the state.

Region	Net growth	Percent of Total	Ratio of growth to volume
Northeast	1.4	30%	2.5%
Northwest	1.7	37%	2.2%
Central	2.0	43%	2.2%
Southwest	-0.4	-8%	-
Southeast	0.0	-1%	-
Statewide	4.7	100%	2.1%

Source: USDA Forest Inventory and Analysis

There is almost no jack pine volume in southern Wisconsin. The highest ratio of growth to volume is in the northeast (Table 2).

The statewide ratio for jack pine is 2.1%, lower than the average of 2.6% 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>

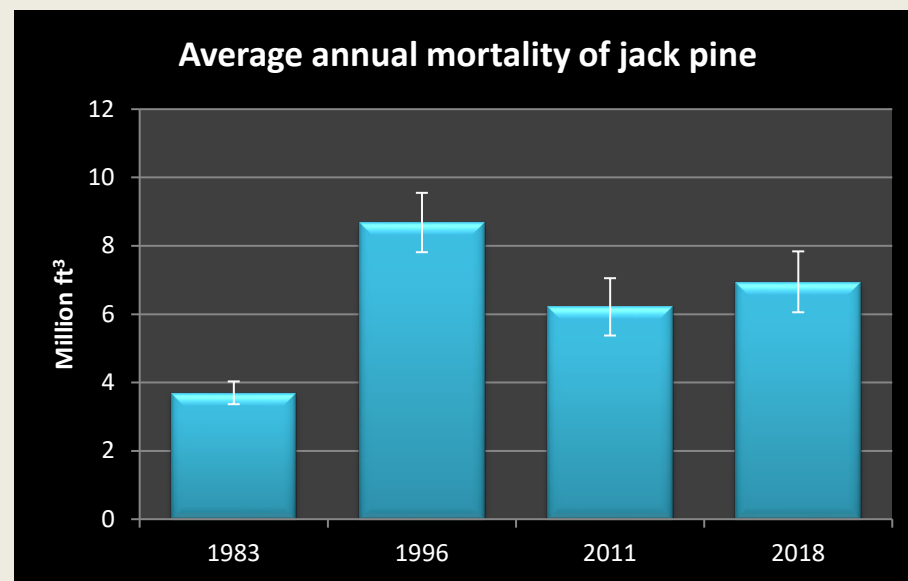


“How healthy is jack pine in Wisconsin?”

Average annual mortality and the ratio of mortality to volume

Average annual mortality of jack pine was 6.9 million cubic feet per year from 2012 to 2018 (chart on right). Mortality increased significantly between 1983 and 1996 probably due to jack pine budworm defoliation but has fallen 20% since 1996.

The ratio of mortality to volume is 2.9% for jack pine (Table 3), almost three times higher than the statewide average of 1.1%. Whereas jack pine accounts for 1% of total growing stock volume in the state, this species makes up 2.9% of total mortality.



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 of growing stock.

Species	Average annual mortality (ft ³)	Volume of growing stock (ft ³)	Mortality / volume
Jack Pine	6,947,308	225,551,355	3.1%

Source: USDA Forest Inventory & 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>

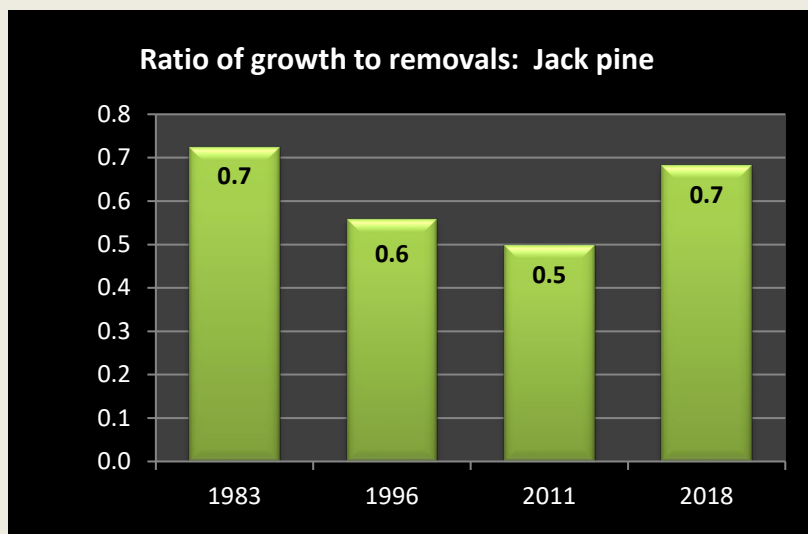


“How much jack pine do we harvest?”

Roundwood production and the ratio of growth to removals

In 2013, jack pine accounted for 13.5 million cubic feet or 4.2% of Wisconsin’s total [roundwood](#) production. About 67% was used for pulpwood and 31% for sawlogs and veneer (chart on right). Jack pine sawlogs account for 4.4% of statewide production. From 2004 to 2013, sawlog production had decreased 50%.

Volume of roundwood products. * Miscellaneous products include poles, posts, and pilings.
Source: Ronald Piva, USDA Forest Service, Northern Research Station, St. Paul MN



Source: USDA Forest Inventory & Analysis data.

We harvest 6.9 million cubic feet of jack pine each year. This is down from almost 32 million cubic feet in 1983.

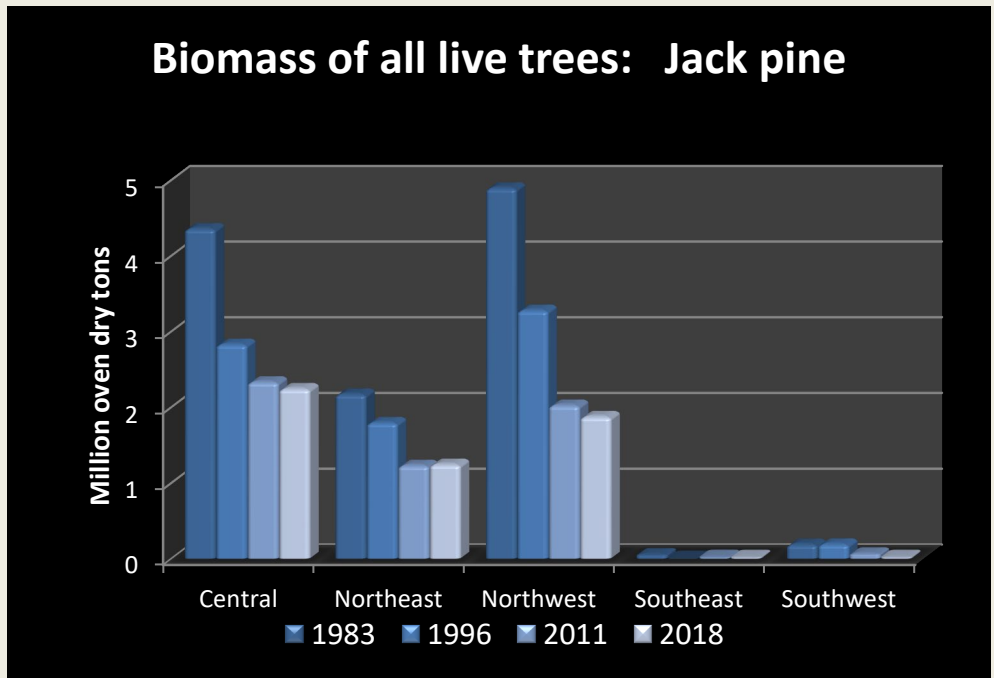
The ratio of average annual net growth to removals has remained remarkably steady since 1983, as both net growth and removals have declined significantly (chart 7).

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 jack pine biomass do we have?”
Aboveground biomass by region of the state

There were 5.4 million tons of aboveground [biomass](#) in live jack pine trees in 2018, a decrease of 54% from 1983. This is equivalent to approximately 2.7 million tons of carbon and represents 0.8% of all biomass statewide. As with volume, most jack pine is located in northwest and central 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 jack pine wood is fairly low with a ratio of biomass to volume of 29 oven-dry lbs. per cubic foot (ODP/ft³). The average for all softwoods is about 26 ODP/cubic feet and for all species is 33 ODP/cubic feet. Approximately 69% of all jack pine biomass is located in the main stem, 14% in saplings, 4% in stumps, and 13% in the branches.

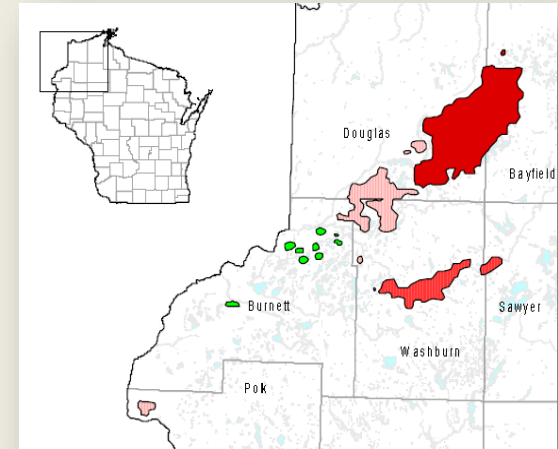
The declining volume of jack pine as well as the low density of its wood may make it a poorer choice for biomass production.

For a table of **Biomass by County** go to:
<http://dnr.wi.gov/topic/ForestBusinesses/documents/tables/BiomassByCounty.pdf>

“Does jack pine have any major disease or pest issues?”
Jack pine budworm: biology, symptoms and impact

The jack pine budworm is native to North America and feeds mainly on jack pine and red pine in Wisconsin. Budworm outbreaks occur fairly predictably every 10-12 years and can last several years. In Wisconsin major recent outbreaks have occurred in northwest and central Wisconsin from 1992-98 and from 2003-2008 (map on right).

Jack pine budworm produces one generation per year. After overwintering under bark, early stage caterpillars start mining staminate flowers, cones, older needles and even the bark of twigs before the new foliage appears. Most damage is done in June and early July.



Jack pine budworm defoliation in northwest Wisconsin in 2005.



Left: Caterpillars spin silk around needles Right: Feeding is heaviest in tree crowns. Repeated defoliation can lead to mortality

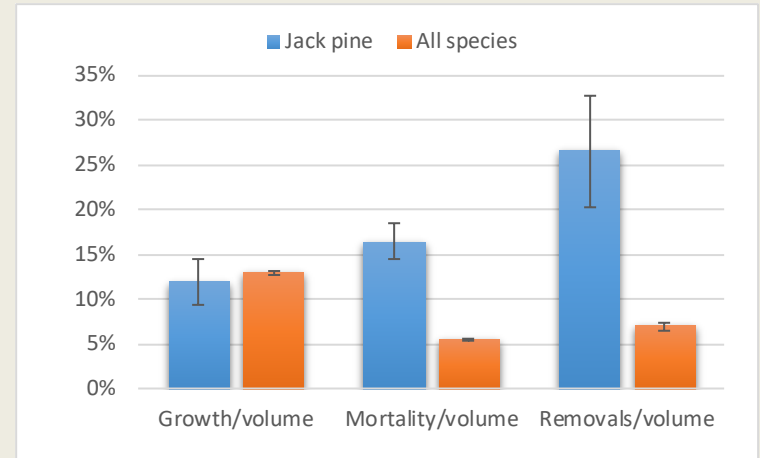
A heavy jack pine staminate flower crop will support a building larval population and has been associated with the rise of epidemic levels of budworm. As the larvae grow, they web needles and needle debris together to form a protective shelter (Figure on left).

Defoliation by jack pine budworm can cause significant impacts on individual tree and forest health. The top of the crown is most severely affected. While one year of defoliation can cause a reduction in growth and yield, several years of defoliation can cause significant tree and stand mortality.

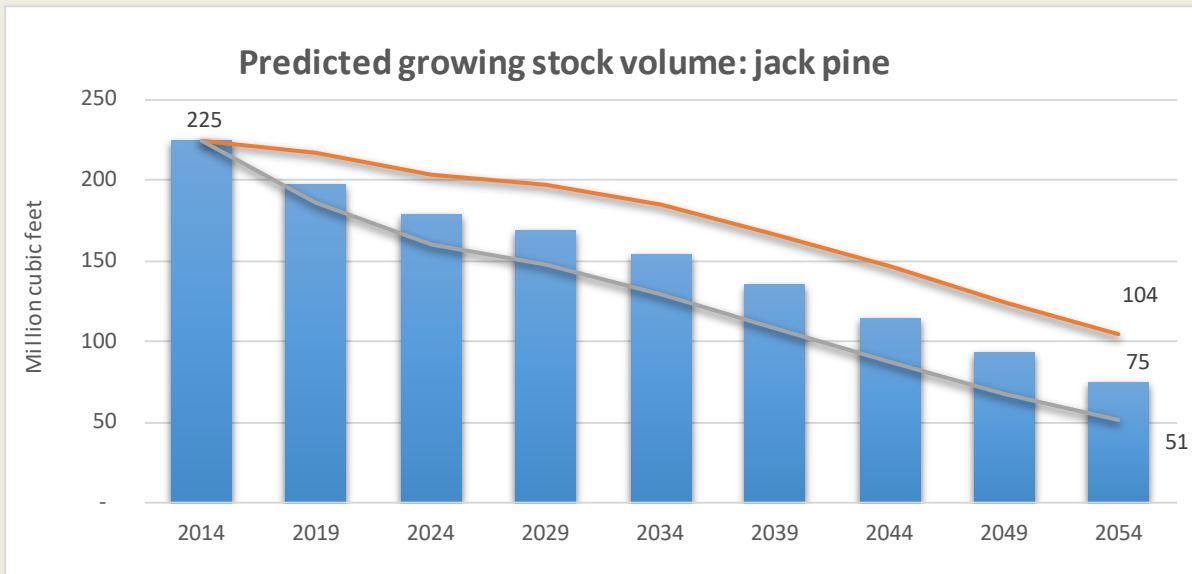
“Can we predict the future of jack pine?”
Predicted volumes based on current rates of mortality and harvest

The 5-year ratios of mortality to volume and removals to volume are much higher for jack pine compared to all species in the state (chart on right).

The Forest Vegetation Simulator (FVS¹) was used to predict future volumes of jack 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



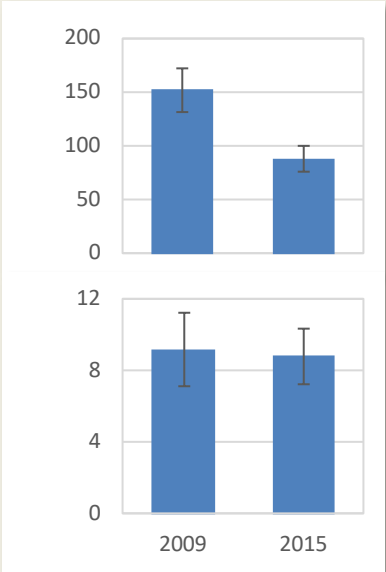
As would be expected with such high rate of removals and mortality, jack pine volume decreases significantly regardless of harvest rates. By 2054, volume is 67% lower for current removal levels, 54% lower for low removals and 77% lower for high removals.

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/>.

“Jack pine on the state forests”

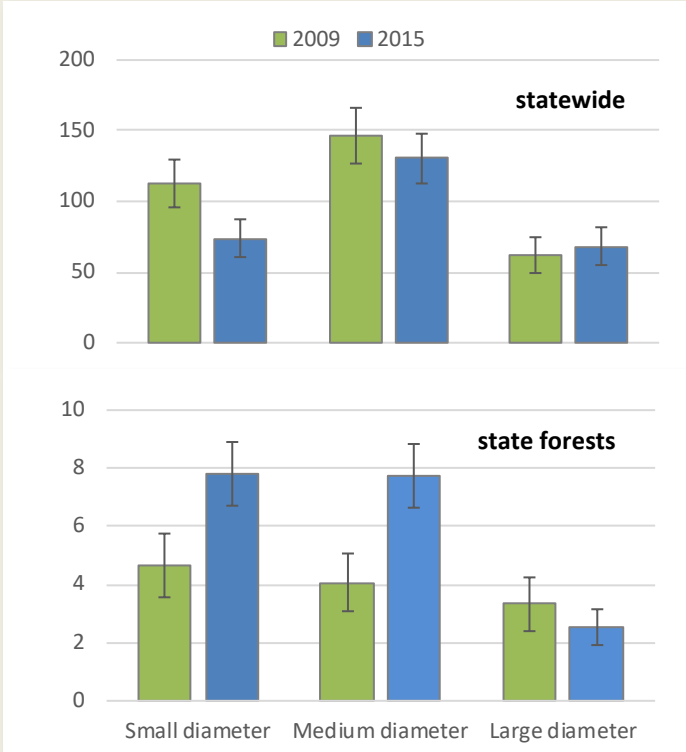
Statewide, mortality and harvesting will remove about 40% of jack pine volume over a 5-year period. This is unsustainable over the long run as seen with the predictive models. On the state forests, however, mortality and harvesting are far lower with a combined removal of only 12.4%.

In 2016, over 4% of jack pine volume was located on the state forests but only 1.5% of mortality and 1.3% of removals. The mortality ratio on state forests is 1.1%, compared to 3.1% statewide. The volume of mortality has decreased significantly since 2012. The ratio of growth to removals is 1.3 on the state forests compared to 0.4 statewide.



Number of jack pine seedlings in the state (top) and on the state forests (bottom) by inventory year. Source: FIA data

The number of acres of small diameter jack pine is decreasing statewide but increasing on the state forests as is the acreage in medium diameter stands as well (figure on the right).



Acreage trend by stand size statewide (top) and on the state forests (bottom) Error bars represent the 67% confidence interval. Source: FIA data

The number of jack pines seedlings, which has decreased 76% since 2004 statewide, has remained steady on the state forests. Statewide, the percentage of seedlings that are jack pine on the jack pine forest type has gone from 13% in 2009 to only 9% in 2016 but remained unchanged on the state forests. Hardwoods such as oak and red maple are increasingly dominating this type both statewide and on the state forests. If this trend continues, we will see further conversion from jack pine to other types such as oak / hickory, aspen and mixed hardwood/pine across all forest ownerships.