

# Spruce

White spruce, *Picea glauca*  
Black spruce, *Picea mariana*



The volume of spruce has increased significantly since 1983. The number of trees in all size classes has increased suggesting that the spruce resource should remain stable in the future. Predictive models also show an increase in spruce volume through the middle of this century.

Mortality rates, however, are higher than average. Whereas spruce makes up 2.0% of volume in Wisconsin, it accounts for 4.3% of total mortality.

Spruce is not an important timber species, accounting for only 1% of roundwood product and 1.7% of woody biomass. It is a low density wood and may not be good for biofuel production.

- [How has the spruce resource changed?](#)  
Volume and diameter class distribution:
- [Where is spruce found in Wisconsin?](#)  
Growing stock volume by region with map
- [What kind of sites does spruce grow on?](#)  
Habitat type and site index distribution
- [How fast is spruce growing?](#)  
Average annual net growth: trends and ratio of growth to volume
- [How healthy is spruce in Wisconsin?](#)  
Average annual mortality: trends and ratio of mortality to volume
- [How much spruce do we harvest?](#)  
Roundwood production by product and ratio of growth to removals
- [How much spruce biomass do we have?](#)  
Tons of aboveground biomass by region of the state
- [Can we predict the future of spruce?](#)  
Modelling future volumes

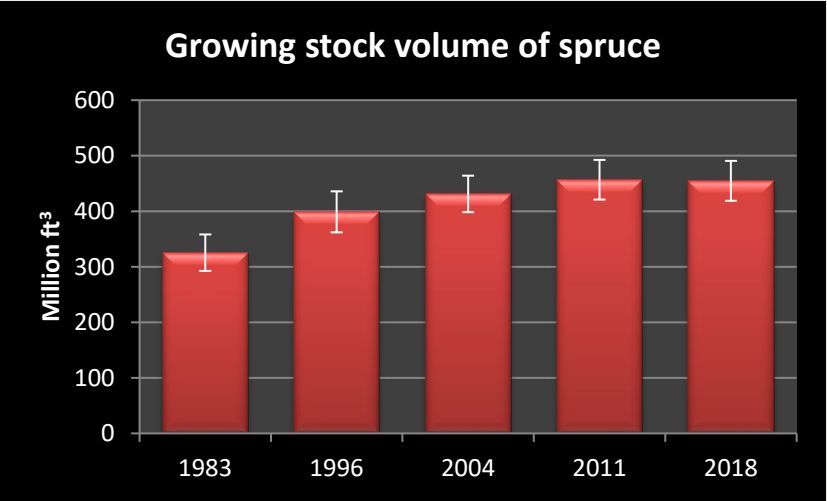


*“How has the spruce resource changed?”*  
**Growing stock volume and diameter class distribution by year**

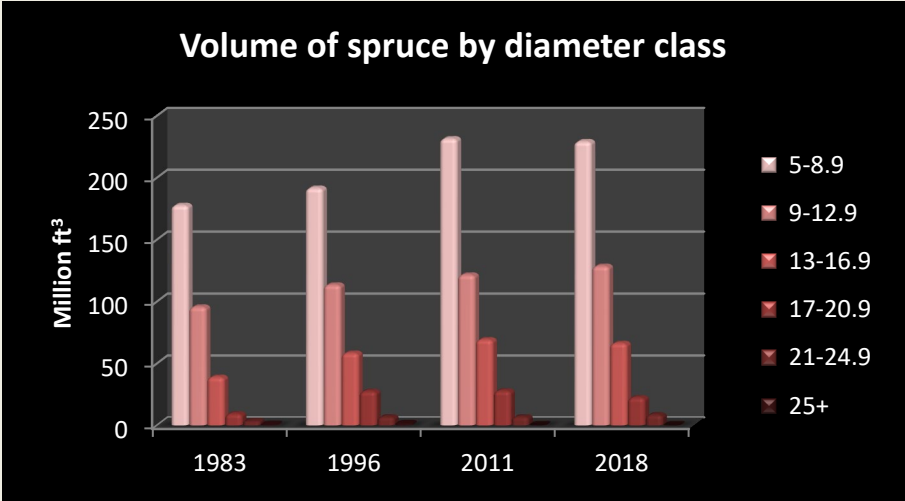
The [growing stock volume](#) of spruce in Wisconsin is 455 million cubic feet or about 2.0% of total statewide volume (chart on right). This represents an increase of 40% since 1983 and 14% since 1996.

The spruce resource is maturing. Volume in all size classes has increased but especially in larger trees (chart lower left). Since 1983, the volume in small trees (5 to 13 inches) has increased 31% but the volume in large trees (over 13 inches) has nearly tripled.

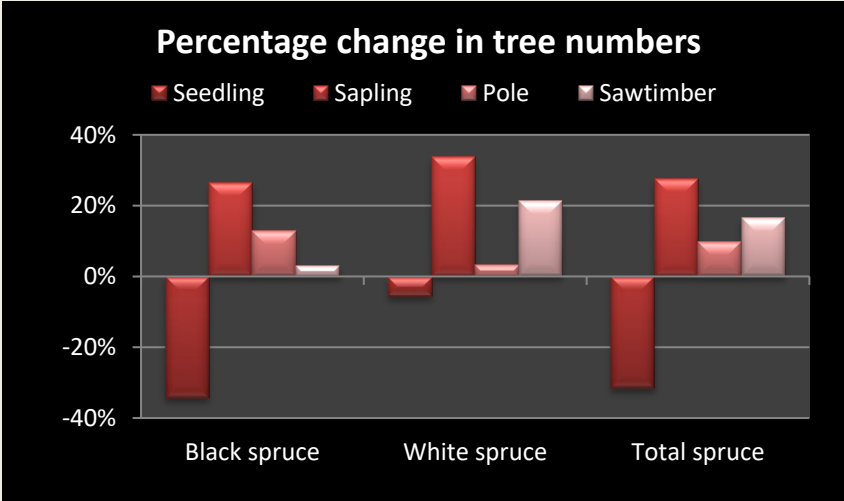
The number of saplings, poles, and sawtimber for both species has increased since 2004 (chart lower right), suggesting that spruce will remain a vital component of our forests in the future.



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



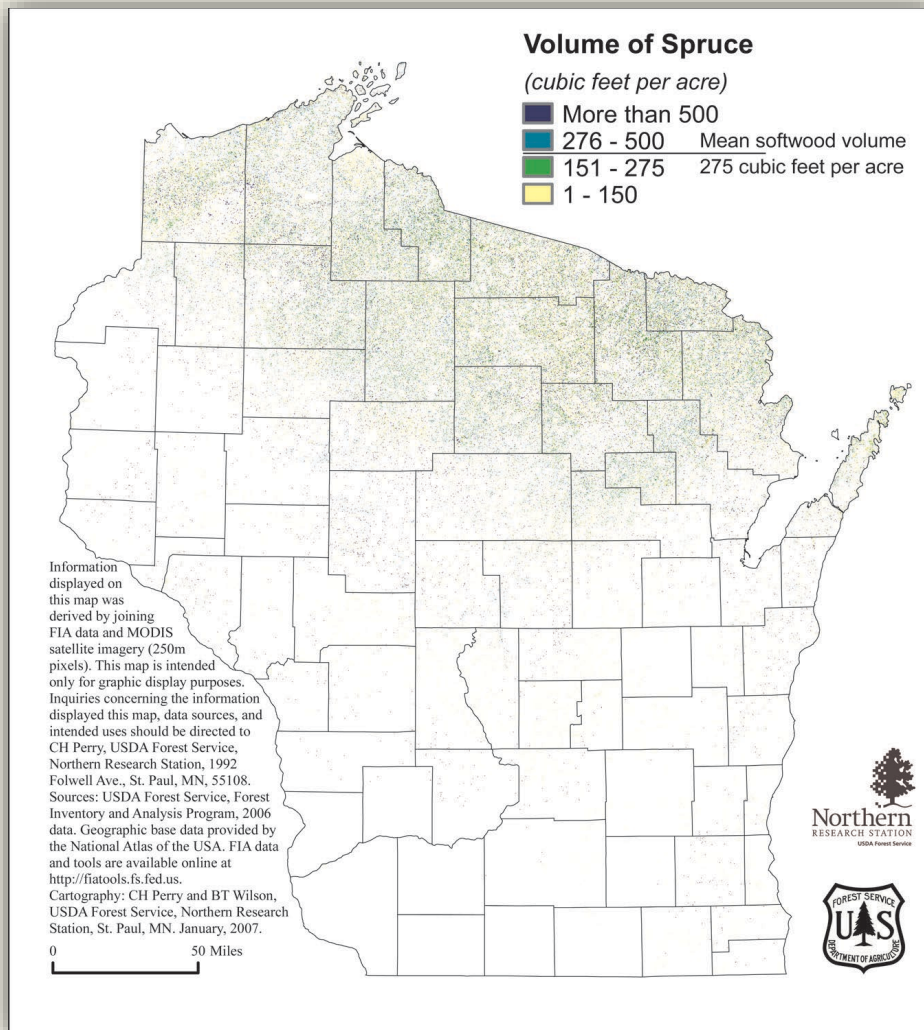
Growing stock volume (million cubic feet) by diameter class (inches).  
 Source: USDA Forest Inventory and Analysis data



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

## “Where does spruce grow in Wisconsin?”

### Growing stock volume by region with map



The vast majority of white and black spruce (89%) occurs in northern Wisconsin (Table 1). White spruce is found on a variety of soil and moisture conditions whereas black spruce occurs predominately in wet, low-nutrient soils.

Most spruce is found on the spruce-fir [forest type](#) but in central and northern Wisconsin, about one quarter is found on the aspen-birch type.

Table 1. Growing stock volume (million ft<sup>3</sup>) by species and region of the state.

Species	Central	North east	North west	South east	South west	Total	Percent of total
<b>Black Spruce</b>	5	122	72	0	-	199	<b>44%</b>
<b>White Spruce</b>	15	112	100	16	13	256	<b>56%</b>
<b>Total spruce</b>	20	234	172	16	13	455	<b>100%</b>
<b>Percent of total</b>	<b>4%</b>	<b>51%</b>	<b>38%</b>	<b>4%</b>	<b>3%</b>	<b>100%</b>	

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

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

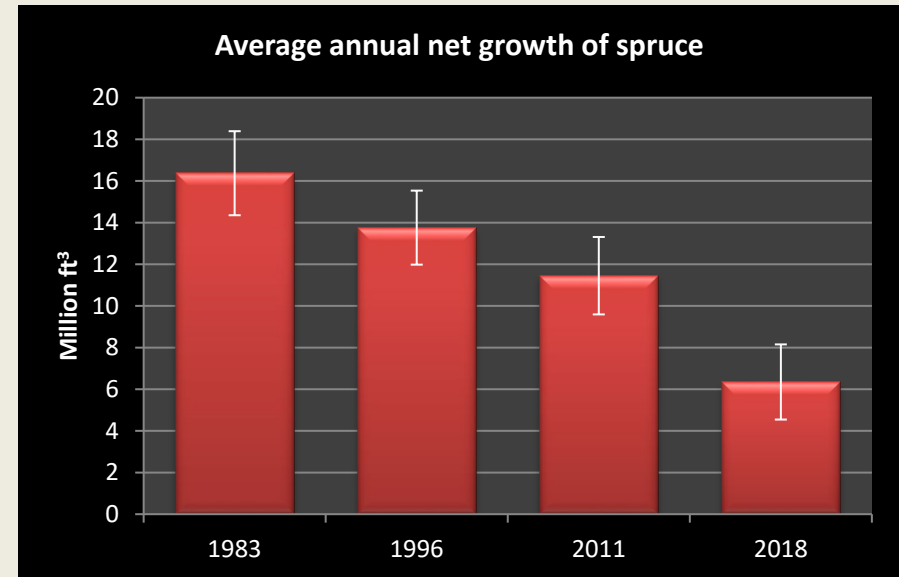
<http://dnr.wi.gov/topic/ForestBusinesses/documents/tables/VolumeCountySpecies.pdf>



*“How fast is spruce growing?”*

**Average annual net growth: trends and the ratio of growth to volume**

Average annual net growth of spruce is about 6.3 million cubic feet (chart on right). Spruce accounts for 2.0% of volume but only 1.1% of volume growth statewide. Growth rates have decreased 61% since 1983.



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

Table 2. Average annual net growth (million ft<sup>3</sup>/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	4.5	71%	<b>1.9%</b>
Northwest	0.3	5%	<b>0.2%</b>
Central	0.5	8%	<b>2.5%</b>
Southwest	0.4	7%	<b>5.4%</b>
Southeast	0.6	9%	<b>3.3%</b>
Statewide	<b>6.3</b>	<b>100%</b>	<b>1.4%</b>

Source: USDA Forest Inventory and Analysis

The highest volume growth for spruce occurs in northern Wisconsin where most spruce is found, but the highest growth to volume ratio occurs in the southern part of the state (Table 2).

The average statewide ratio for spruce is 1.4%, lower than the statewide 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>

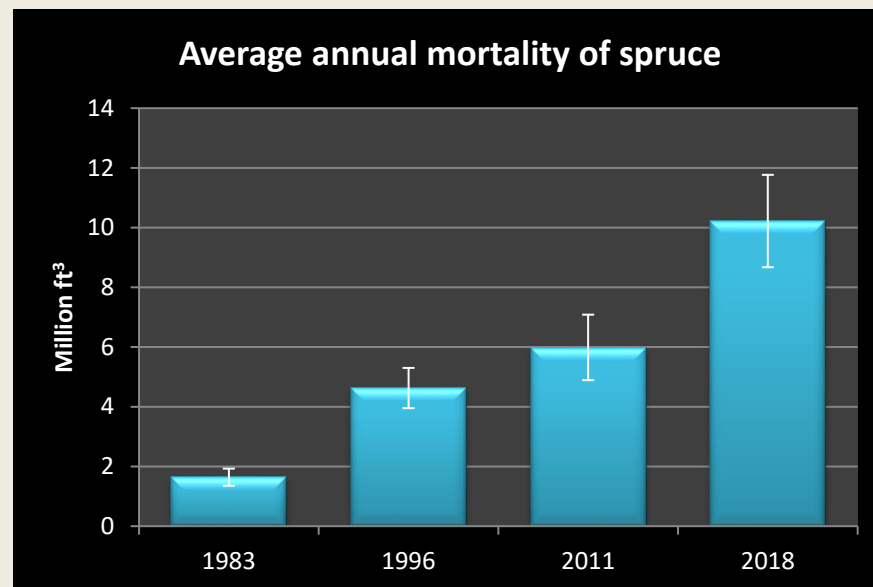


*“How healthy is spruce in Wisconsin?”*

**Average annual mortality: trends and the ratio of mortality to volume**

Average annual mortality of spruce was about 10.2 million cubic feet per year from 2012 to 2018, or about 4.3% of total statewide mortality (chart on right). Spruce mortality has increased sixfold since 1983 and more than doubled since 1996.

The ratio of mortality to volume is 2.2% for spruce, higher than the statewide average of 1.1% (Table 3). Spruce accounts for 2.0% of volume but 4.3% of 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.

Species	Average annual mortality (ft³)	Growing stock volume (ft³)	Mortality /volume
Black Spruce	4,612,602	198,539,509	2.3%
White Spruce	5,607,731	256,237,026	2.2%
<b>Total Spruce</b>	<b>10,220,333</b>	<b>454,776,535</b>	<b>2.2%</b>

Source: USDA Forest Inventory and Analysis

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



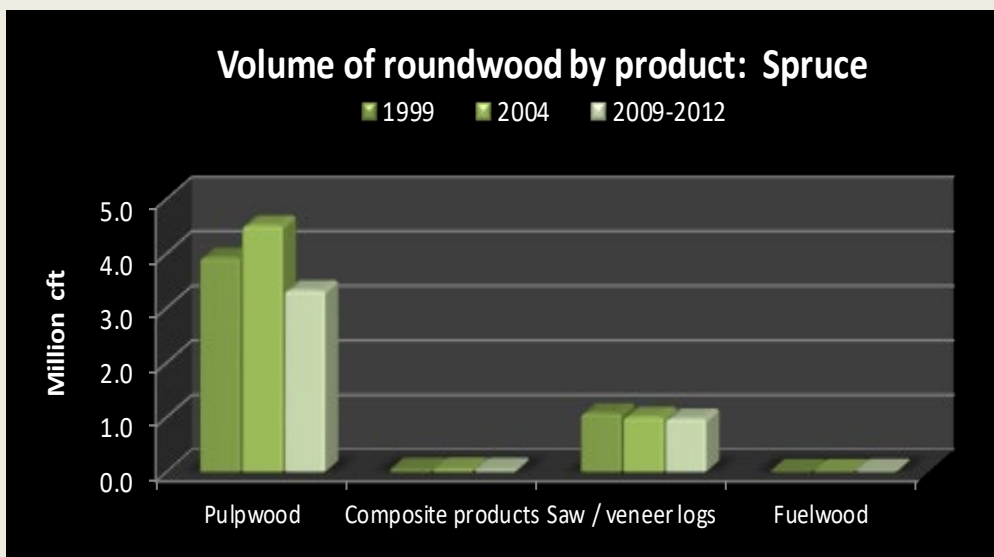


*“How much spruce do we harvest?”*

**Roundwood production and the ratio of growth to removals**

In 2012, spruce accounted for 3.7 million cubic feet or about 1% of Wisconsin’s total roundwood production. This was a decrease of 33% since 2004 (chart on the right).

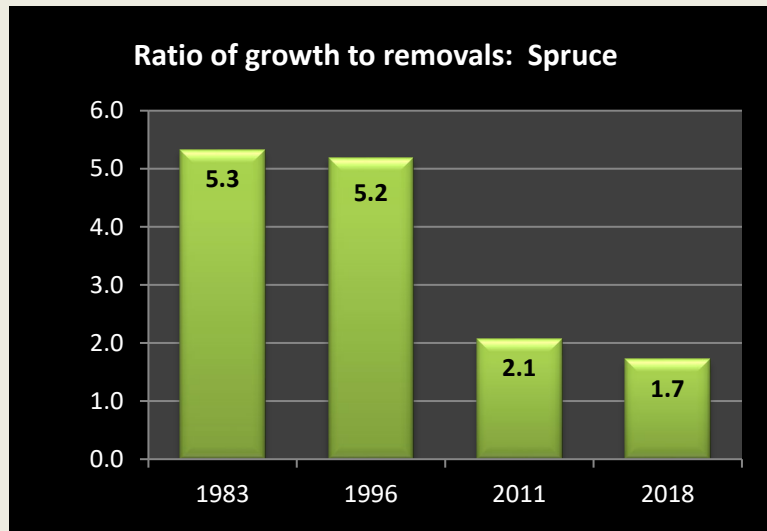
From 2004 to 2009, pulpwood production decreased by 40%. Spruce supplies around 4 million cubic feet or 1.2% of total pulpwood production.



Volume of roundwood products. \* Miscellaneous products include poles, posts, pilings and veneer. Recent numbers for pulpwood and composite products are from 2012. Other recent product data is from 2009. Source: Ronald Piva, USDA Forest Service, Northern Research Station, St. Paul MN

Removals of spruce were 3.7 million cubic feet from 2012 to 2018, 75% of which was white spruce.

The ratio of average annual net growth to removals for spruce is 1.7, slightly below the average for all species in the state (chart on left).



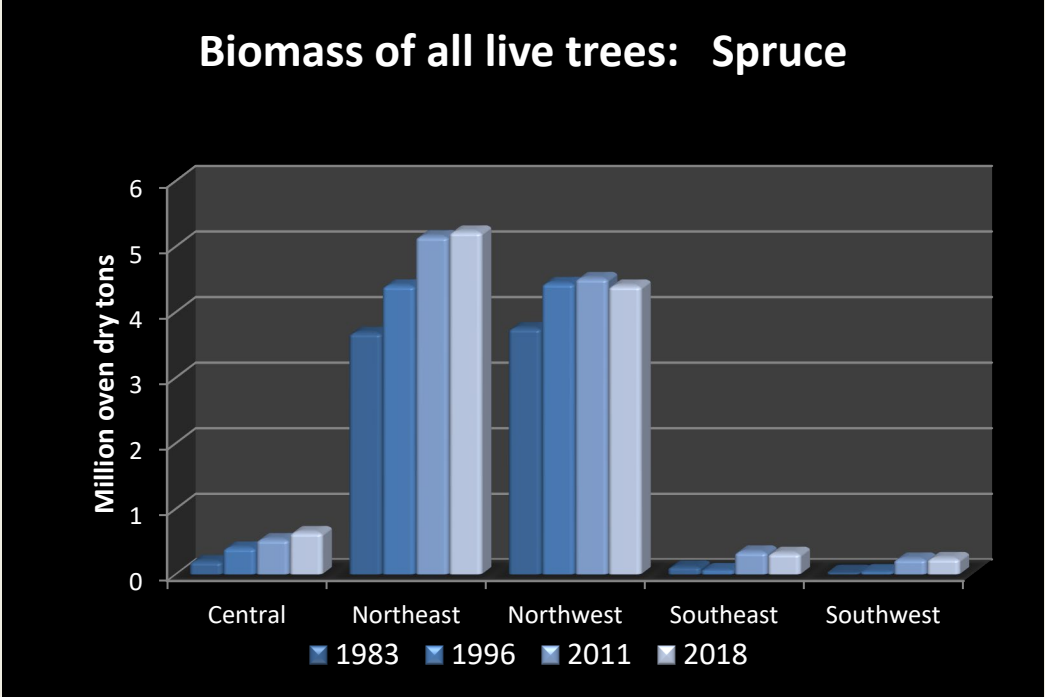
Source: USDA Forest Inventory & Analysis data

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 spruce biomass do we have?”*  
**Aboveground biomass by region of the state**

There are 10.9 million short tons of aboveground [biomass](#) in live spruce trees, an increase of 39% from 1983. This is equivalent to approximately 5.4 million tons of carbon and represents 1.7% of all aboveground biomass statewide. As with volume, most spruce is located in northern Wisconsin (chart 9).



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 spruce wood is slightly lower than average for softwoods with a ratio of biomass to volume of 26 oven-dry lbs. per cubic foot (ODP/ft<sup>3</sup>). The average for all softwoods is about 26 ODP/cubic feet and for all species is 33 ODP/cubic feet.

Approximately, 61% of all spruce biomass is located in the main stem, 24% in saplings, 4% in stumps, and 11% in the branches.

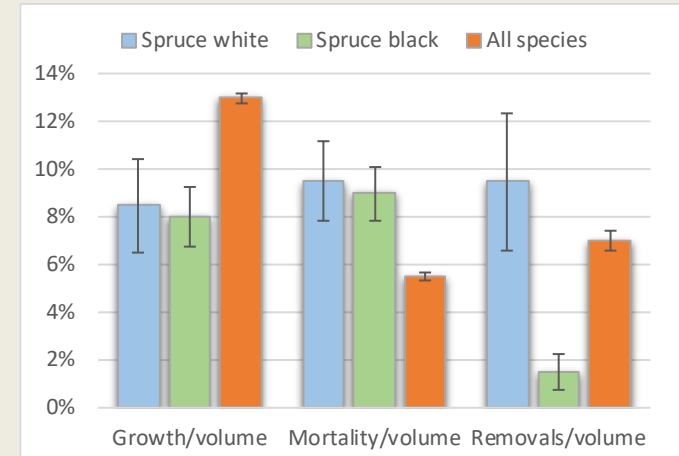
For a table of **Biomass by County** go to:  
<http://dnr.wi.gov/topic/ForestBusinesses/documents/tables/BiomassByCounty.pdf>

*"Can we predict the future of spruce?"*

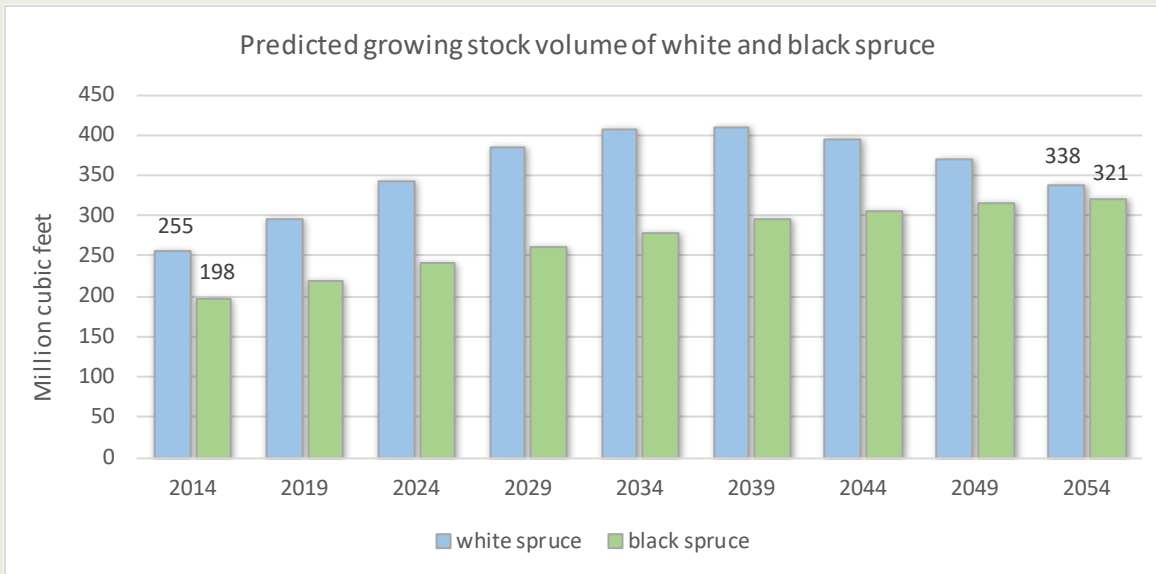
**Predicted volumes based on current rates of mortality and harvest**

The 5-year ratios of growth to volume of both white and black spruce is much lower than the average for all species and the ratio of mortality to volume is much higher for both species. But the ratio of removals to volume is over five times higher for white spruce compared to black spruce (chart on right).

The Forest Vegetation Simulator (FVS<sup>1</sup>) was used to predict future volumes of black and white spruce through 2054 using current mortality and removal rates.



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



The volume of both white and black spruce increase by 2054, 32% for white spruce and 62% for black spruce (chart on left).

However, the volume of white spruce peaks in 2039 and then decreases while the volume of black spruce continues to increase. This may be due to high removal rates for white spruce.