

White oak group

White oak, *Quercus alba*

Bur oak, *Quercus macrocarpa*

Swamp white oak, *Quercus bicolor*



The volume of white oak has increased significantly over the last 50 years due mainly to an increase in the number of large trees. Models predict an increase of 14% in the next 40 years but white oak volume is predicted to peak in 2039.

Rates of growth and mortality have increased but mortality is still lower than average for all species. Whereas white oaks make up about 4.7% of volume and 3.4% of growth in Wisconsin, this species group accounts for only 1.9% of mortality.

White oak is **an important timber species**, accounting for 3.2% of growing stock removals from 2012 to 2018. The density of white oak wood is very high which makes it a valuable species for biomass production.

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Modelling future volumes

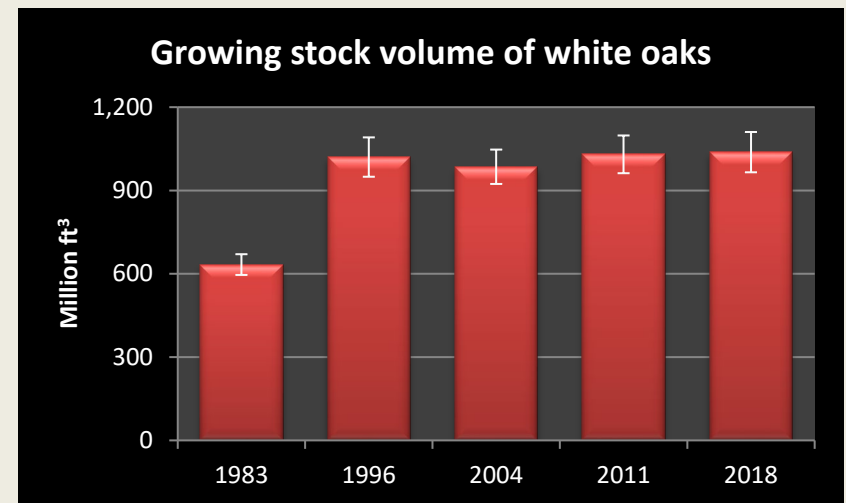
"How has the white oak resource changed?"

Growing stock volume and diameter class distribution by year

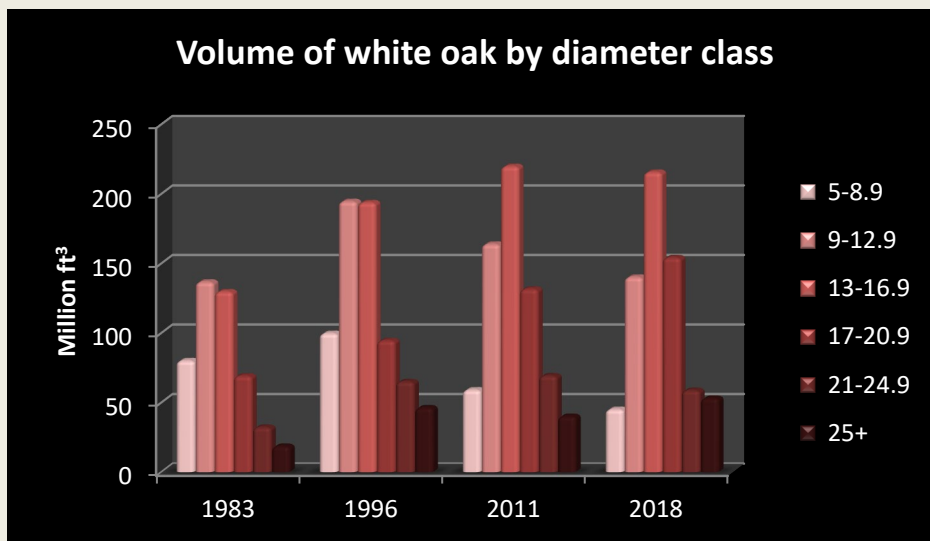
The [growing stock volume](#) of white oaks is approximately 1.0 billion cubic feet or about 4.7% of total statewide volume (chart on right). Volume rose steadily from in the decades prior to 1996 but has remained statistically unchanged since then.

Growing stock volume in large trees has nearly doubled since 1983. However, the volume in small trees (5 to 12.9 inches) has decreased 37% since 1996 while volume in large trees (13+ inches) has increased by 21% in the same period.

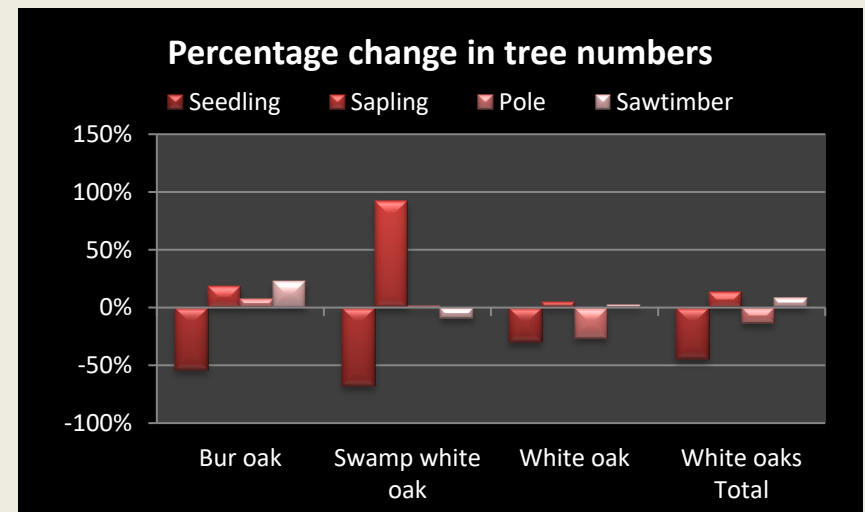
The number of poles has decreased by 14% for all white oaks and 26% for white oak since 2004 (chart below right). The number of [saplings](#) and [sawtimber](#) has increased slightly.



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



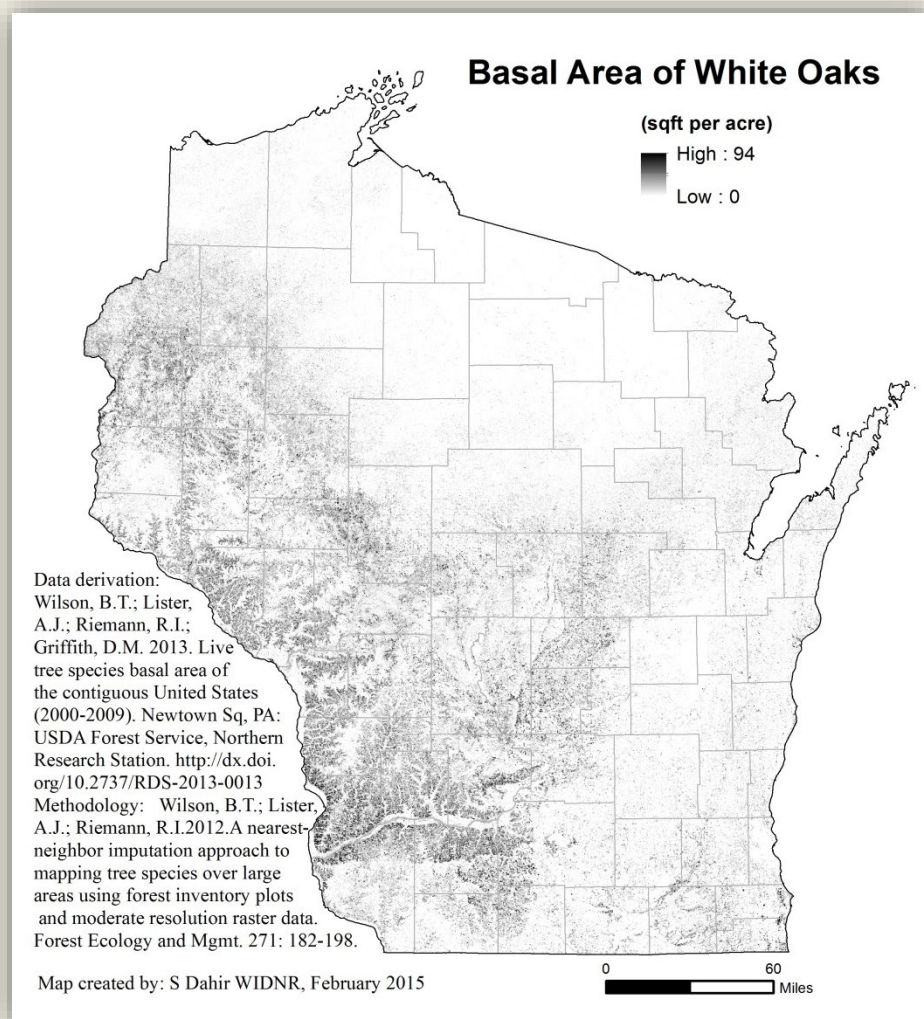
Growing stock volume (million cubic feet) by diameter class (inches).
Source: USDA Forest Inventory and Analysis data



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 do white oaks grow in Wisconsin?"

Growing stock volume by region with map



About two thirds of the white oak group is white oak with bur oak making up most of the remainder (Table 1).

White oaks occur throughout Wisconsin but are much more common in the western and central parts of the state. The northeast has only 2% of all white oak volume. The majority of white oak occurs on the oak hickory [forest type](#).

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	Percent of total
Bur oak	66	10	89	76	97	338	33%
Swamp white oak	11	3	0	11	5	31	3%
White oak	225	11	78	107	246	667	64%
Total white oaks	302	24	167	194	348	1,035	100%
Percent of total	29%	2%	16%	19%	34%	100%	

Source: USDA Forest Service, Forest Inventory and Analysis

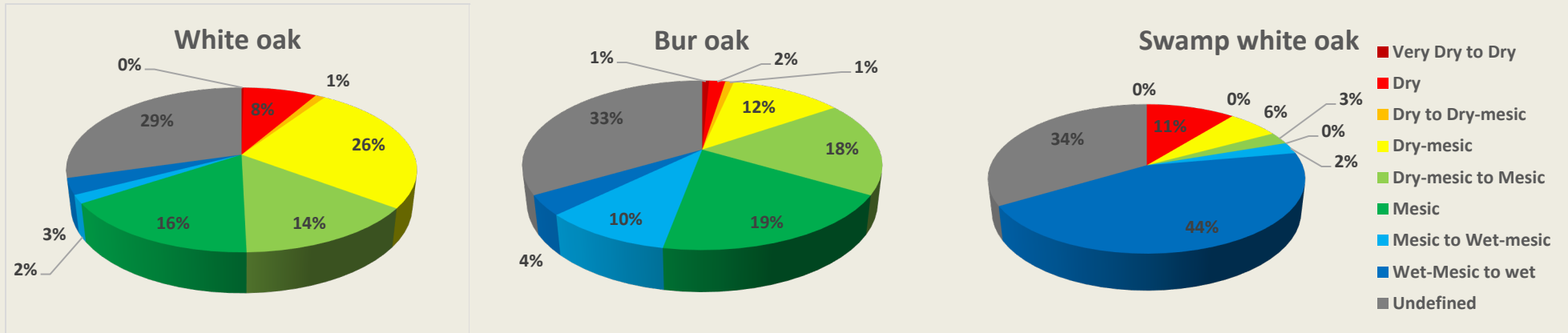
For a table of **Volume by County** go to:

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

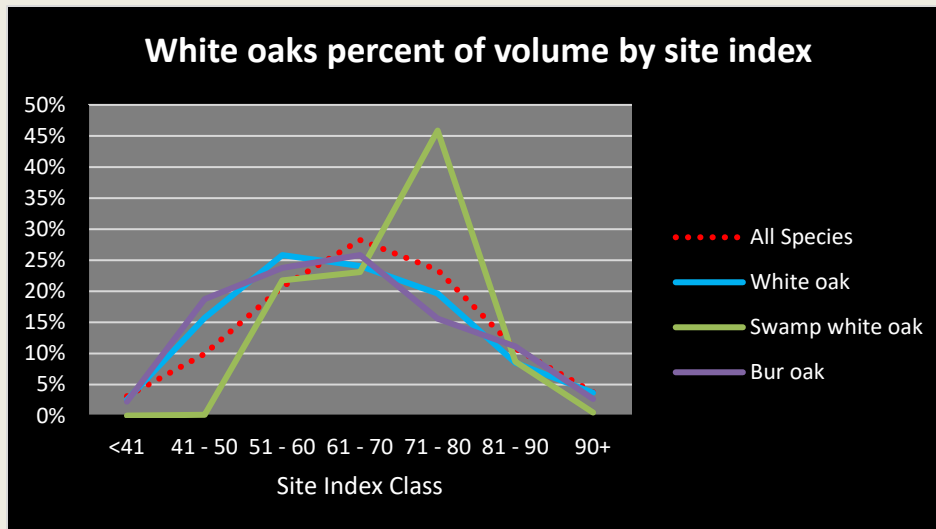
"What kind of sites does white oak grow on?"

Habitat type¹ and site index distribution

The three white oak species have different habitat preferences (chart below). White oak volume is concentrated on dry habitat types, whereas most swamp white oak volume is found on wetter habitat types. Bur oak occurs on a broad range.



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 white oak and bur oak growing stock volume is found in stands with slightly poorer site indices (chart on left). Swamp white oak occurs on sites with a slightly higher average site index (sampling error is quite high).

The average site index by volume for white oak and bur oak is about 64, slightly lower than the average for all species, 66. The average index for swamp white oak is 68 slightly higher than the average for all species.

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 are white oaks growing?"

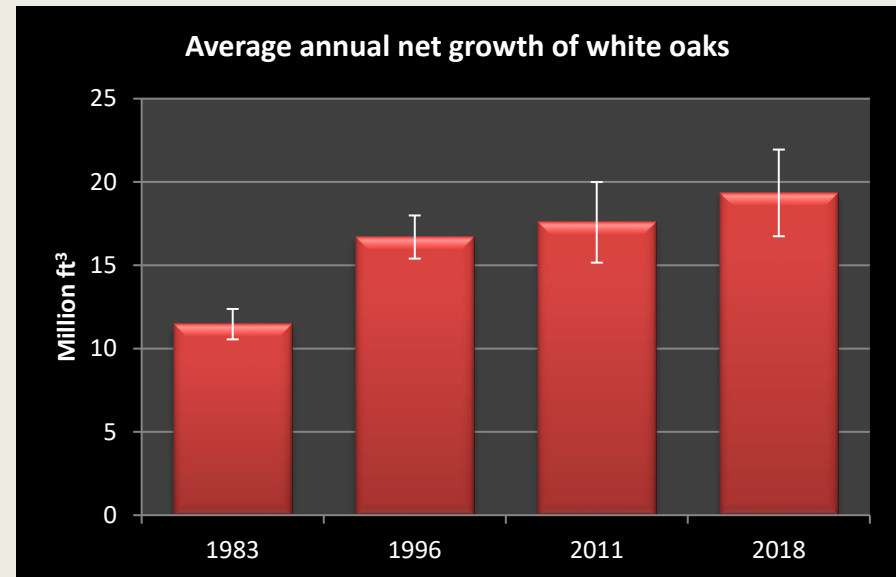
Average annual net growth by region and year

Average annual net growth of white oaks was about 19.4 million cubic feet per year between 2012 and 2018, representing 3.4% of statewide volume growth (chart on right). Growth rates have increased 69% since 1983 but have stalled over the past decade.

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	0.4	2%	1.7%
Northwest	3.6	19%	2.2%
Central	5.9	31%	2.0%
Southwest	6.0	31%	1.7%
Southeast	3.3	17%	1.7%
Statewide	19.3	100%	1.9%

Source: USDA Forest Inventory and Analysis



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

The greatest volume of white oak growth is in southern and central Wisconsin. The average ratio of growth to volume for white oaks is 1.9%, much lower than the statewide average of 2.6% for all species (Table 2). White oaks represent 4.7% of volume but only 3.4% of volume growth in the state.

For a table of **Average annual growth, mortality and removals by region** go to:

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

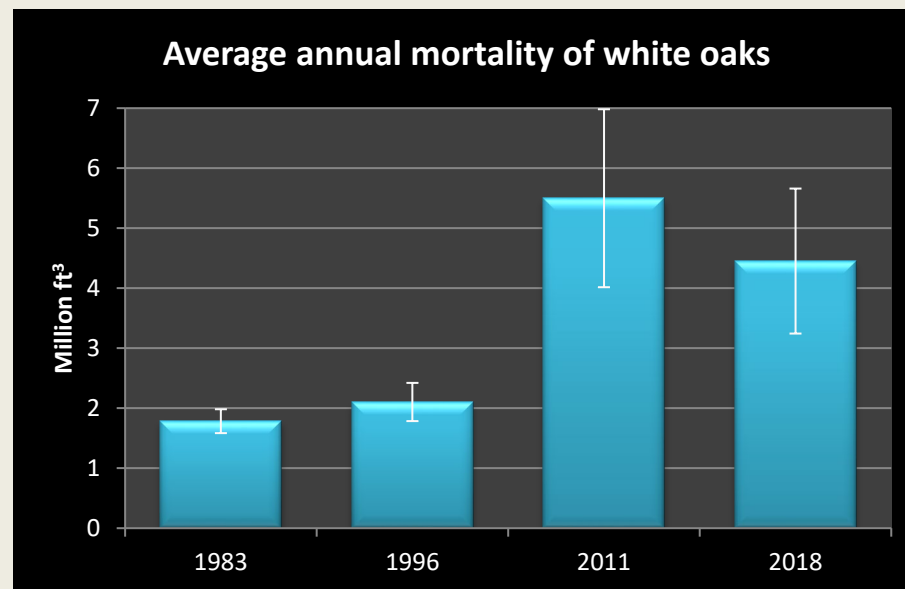


"How healthy are white oaks in Wisconsin?"

Average annual mortality by year and the ratio of mortality to volume

Average annual mortality of white oaks, about 4.5 million cubic feet per year from 2012 to 2018, has more than doubled since 1996 (chart on right). White oaks account for 4.7% of total volume in the state but only 1.9% of mortality.

The ratio of mortality to volume is 0.4% for white oaks, much lower than the statewide average of 1.1% for all 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 (ft³)	Growing stock volume (ft³)	Mortality / volume
Bur oak	1,407,065	337,541,779	0.4%
Swamp white oak	156,443	31,050,790	0.5%
White oak	2,888,491	666,570,747	0.4%
Total white oaks	4,451,999	1,038,039,181	0.4%

Source: USDA Forest Inventory & Analysis data: 2018

For a table of **Average annual growth, mortality and removals by region** go to:

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

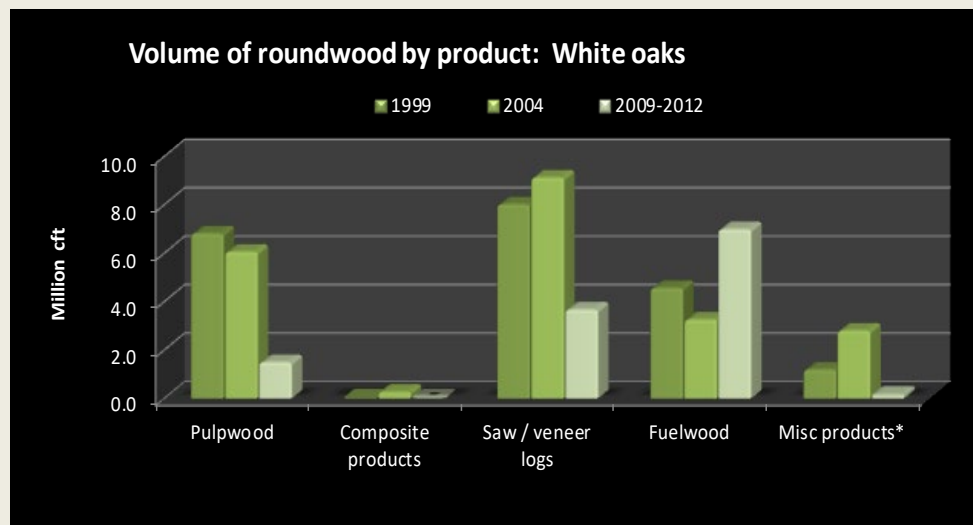


"How much white oak do we harvest?"

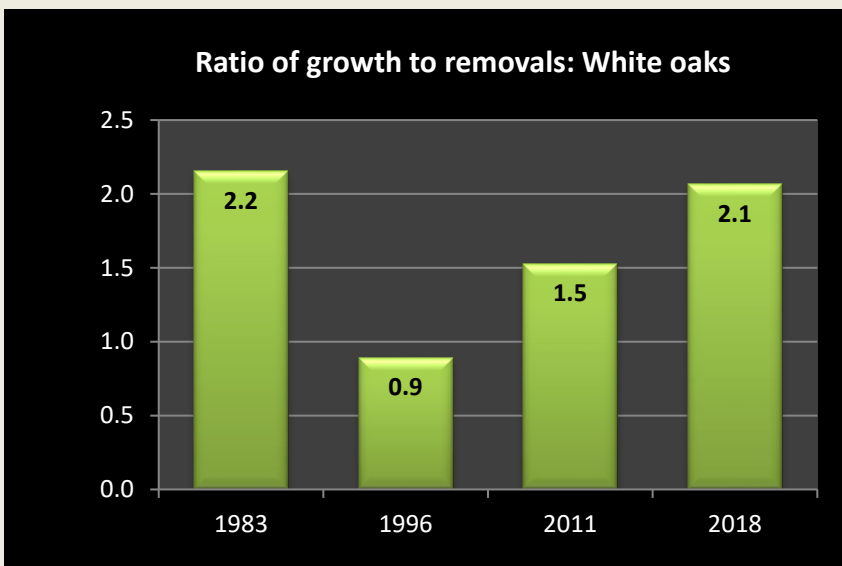
Roundwood production and removals by product and year

In 2009-2012, white oak accounted for 12.3 million cubic feet or 3.2% of Wisconsin's total [roundwood](#), a decrease of 43% since 2004. About 60% is in fuelwood, 30% in veneer and sawlogs and 12% pulpwood (chart on right).

From 2004 to 2009-2012, pulpwood production decreased by 76% while sawlog production decreased by 60%. White oak supplies less than 1% of pulpwood but 4.8% of sawlogs.



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



Source: USDA Forest Inventory & Analysis data

Average annual removals were 9.4 million cubic feet per year from 2012-2018 or 3.2% of statewide removals. The vast majority of this, 82%, was white oak.

The ratio of average annual net growth to removals is 2.1 for white oaks, slightly higher than the statewide average ratio of 1.9 (chart on left). Removals are almost twice what they were in 1983 but only half of what they were in 1996.

For a table of **Average annual growth, mortality and removals by region** go to:

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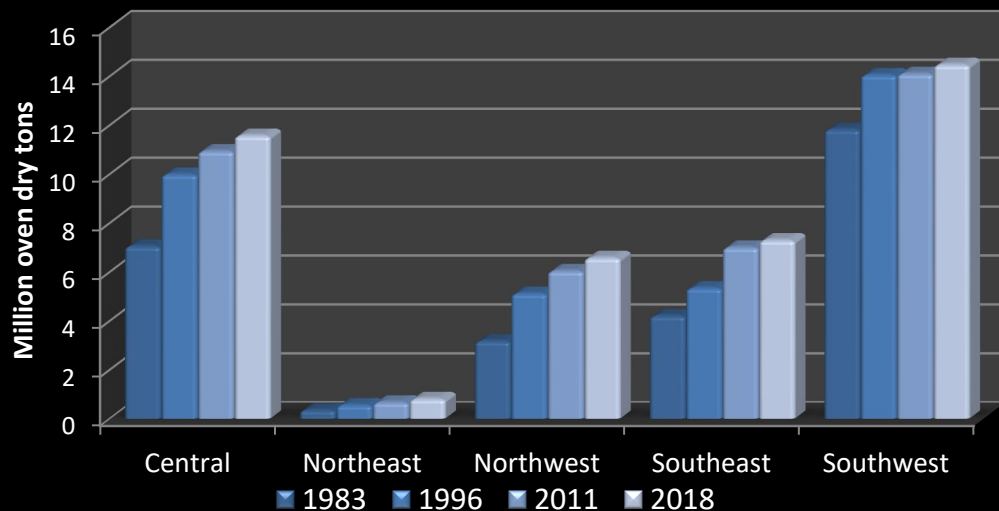


"How much white oak biomass do we have?"

Aboveground carbon by region of the state

There were 40.8 million tons of aboveground [biomass](#) in live trees of the white oak group in 2018, an increase of 53% from 1983. This is equivalent to approximately 20.4 million tons of carbon and represents 6.3% of all aboveground biomass statewide. As with volume, most white oak biomass is located in southwest and central Wisconsin (chart below).

Biomass of all live trees: White oaks



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 white oak wood is much higher than average with a ratio of biomass to volume of 43 oven-dry lbs. per cubic foot, second only to hickory. The average for all hardwoods is about 36 ODP/cubic feet and for all species is 33 ODP/cubic feet.

Approximately 76% of all white oak biomass is located in the main stem, 3% in saplings, 4% in stumps, and 17% in the branches.

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

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

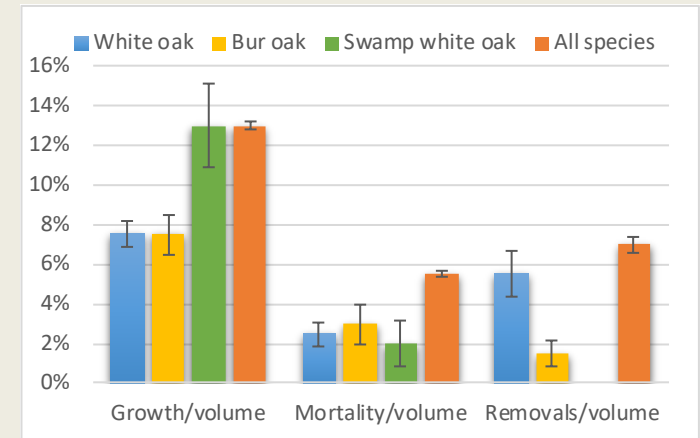


"Can we predict the future of white oaks?"

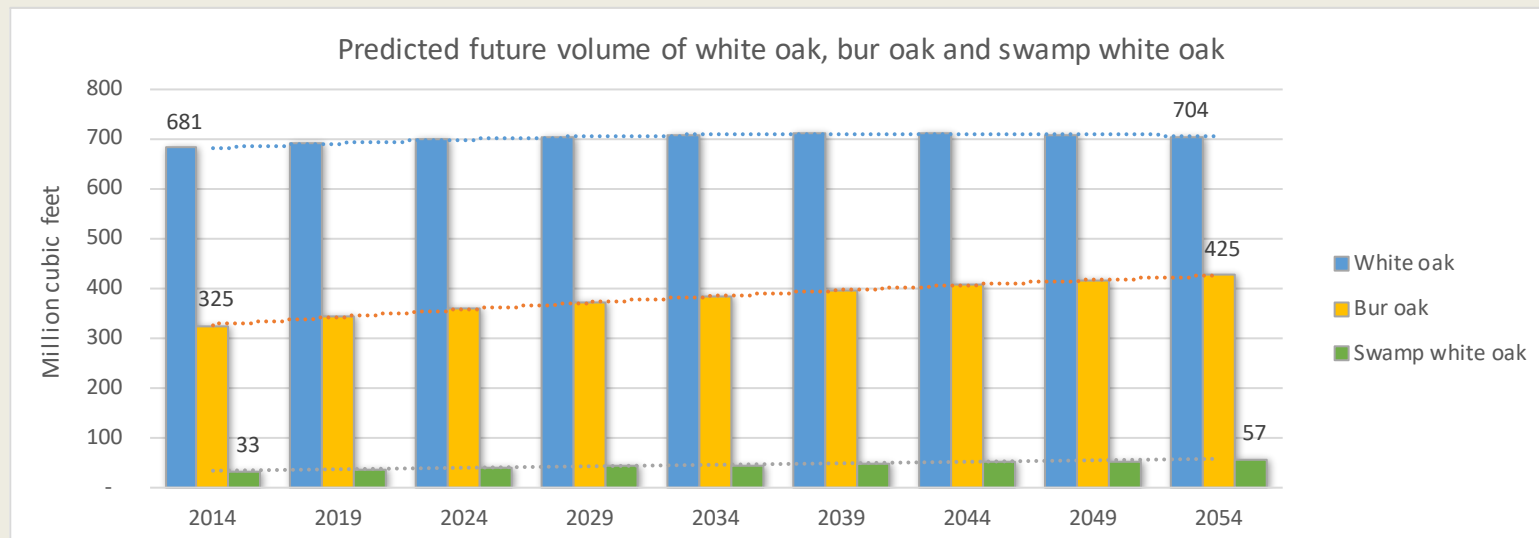
Predicted volumes based on current rates of mortality and harvest

Compared to other species, the ratios of growth, mortality and removals to volume is much lower for both bur oak and white oak (chart on right). The difference between the growth to volume ratio and the removals to volume ratio is quite small for white oak, suggesting that volume may not increase significantly in the future.

FVS (Forest Vegetation Simulator¹) was used to predict future volumes of white oaks through 2054 based on these rates of mortality and removals. As predicted, the volume of white oak increases only 3% and peaks in 2039. Bur oak increases 31% and swamp white oak increases 72%. Both have a much higher difference between the growth to volume ratio and the removals to volume ratio.



Ratios of growth, mortality and removals to volume of growing stock
Source: USDA Forest Inventory & Analysis



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