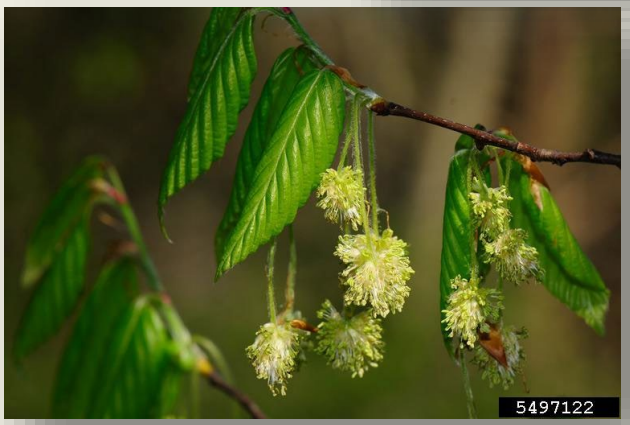
American beech

Fagus grandifolia



American beech is not a common species in Wisconsin and is confined almost exclusively to the eastern part of the state. It's a minor component of the northern hardwoods forest type in Wisconsin. The volume and growth of beech haven't changed much since 1983 but mortality has decreased significantly. In 2016, beech accounted for 0.2% of all volume, growth, and removals, and less than 0.1% of all mortality in Wisconsin.

Given the relatively lower rates of mortality and removals, the volume of American beech should increase in the future. Models show a 63% increase in the next 40 years.

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Division of Forestry
WI Dept of Natural Resources 2019

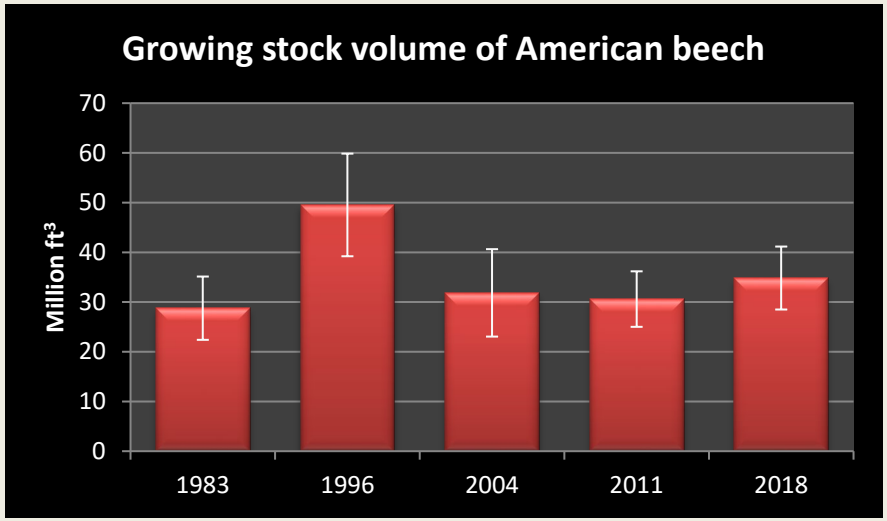
"How has the beech resource changed?"

Growing stock volume and diameter class distribution

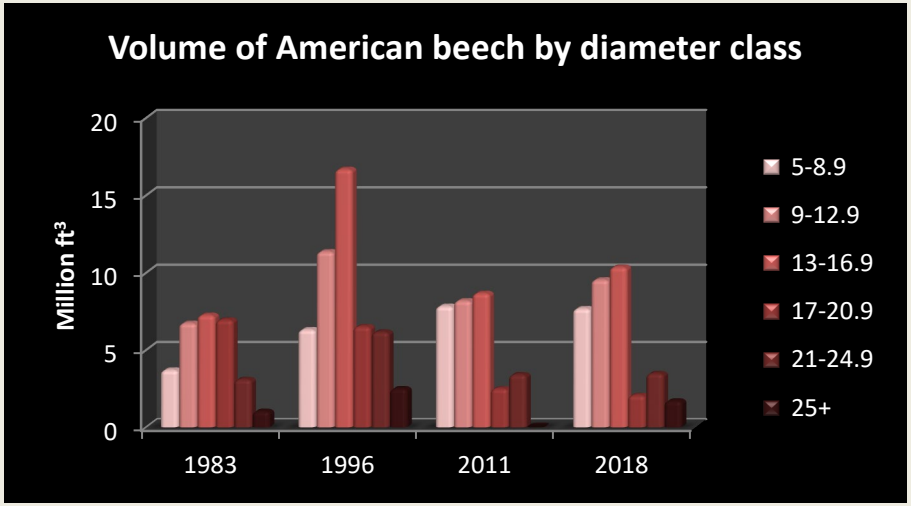
The growing stock volume of American beech in 2018 was about 35 million cubic feet or 0.2% of total statewide volume (chart on right). Volume has decreased since 1996 but, due to small volumes, sampling errors are very high.

The beech resource has decreased dramatically since 1996 in almost all size classes. For instance, the volume in large trees (over 13 inches in diameter) has decreased by 54% while the volume in small trees has decreased by 9% in this time (chart on left below).

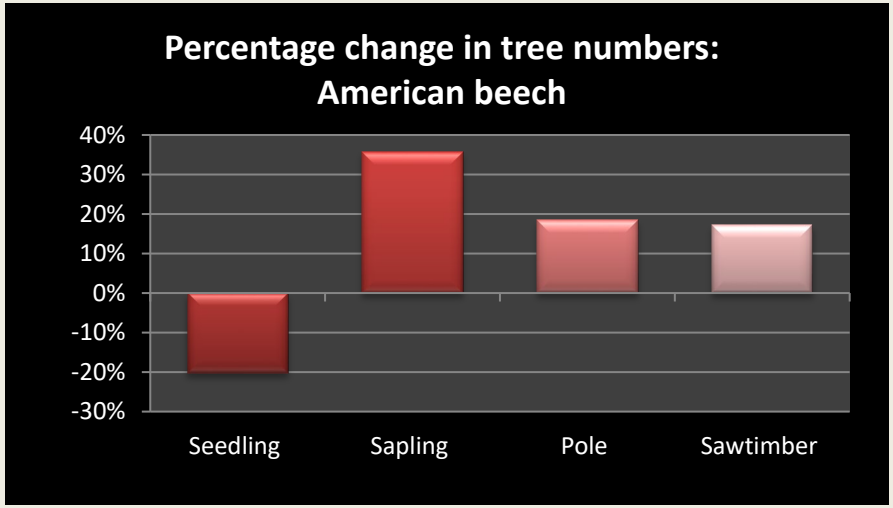
Since 2004 the number of saplings, poles, sawtimber sized trees has increased (chart on right below) suggesting a strong future for American beech.



Growing stock volume (million cubic feet) by inventory year. Bars represent the 67% confidence interval. Source: USDA Forest Inventory and Analysis data.



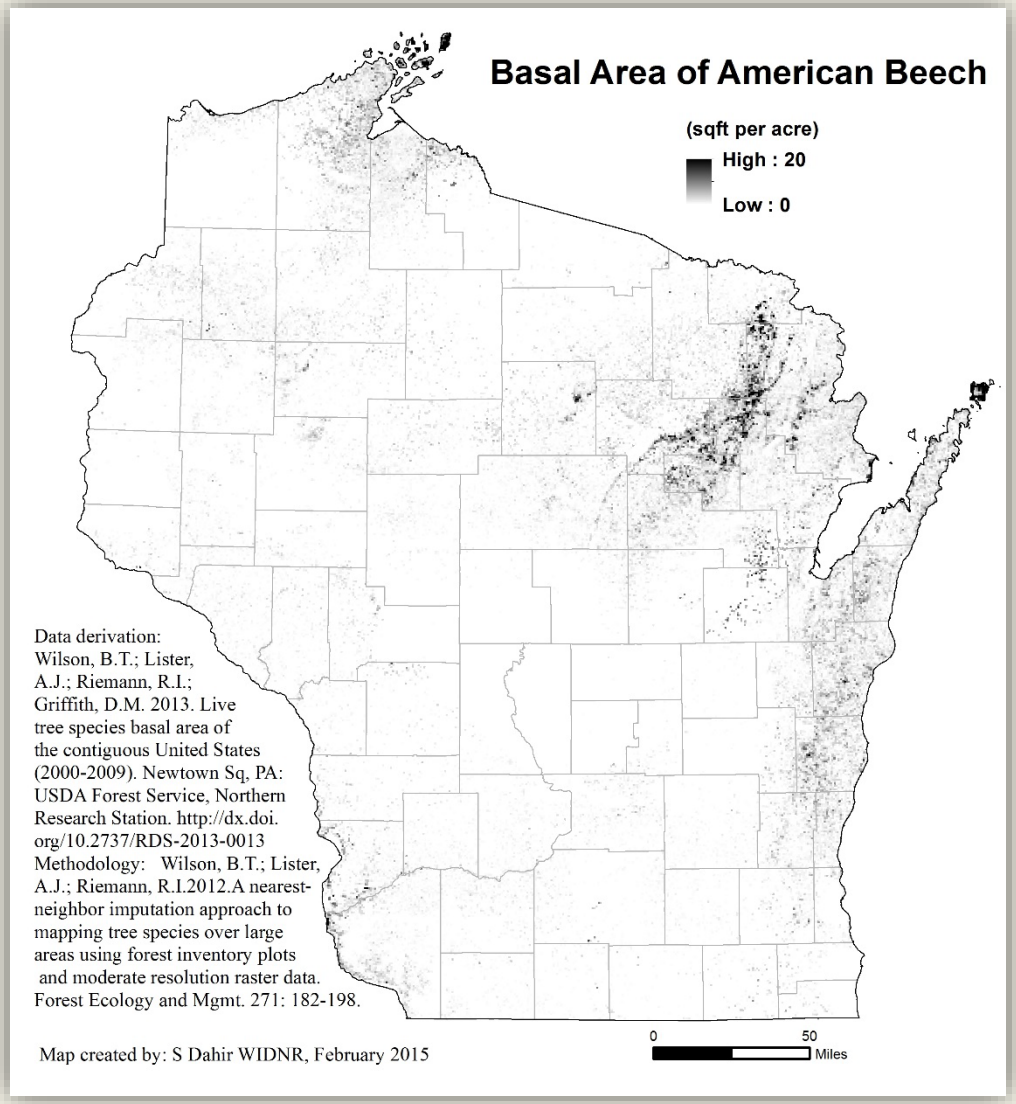
Growing stock volume (trees over 5 inches dbh) by diameter class (inches).
Source: USDA Forest Inventory and Analysis data



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 is beech found in Wisconsin?"

Growing stock volume by region with map



About 59% of all beech volume is located in northeast Wisconsin with the remainder in the southeast part of the state.

About 85% of beech volume is found on the sugar maple -beech-yellow birch and sugar maple-basswood forest types. The remainder is spread through various softwood and hardwood forest types.

Growing stock volume (million ft^3) by region of the state.

Species	Central	North east	North west	South east	South west	Total
Beech	-	21	-	14	-	**35**
% of total	**0%**	**59%**	**0%**	**41%**	**0%**	**100%**

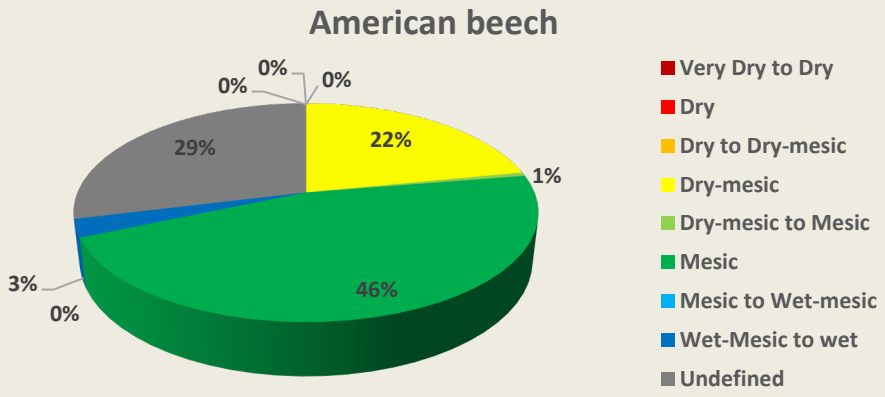
Source: USDA Forest Service, Forest Inventory and Analysis

For a table of **Volume by County** go to:
http://dnr.wi.gov/topic/ForestBusinesses/documents/tables/VolumeCountySpecies.pdf

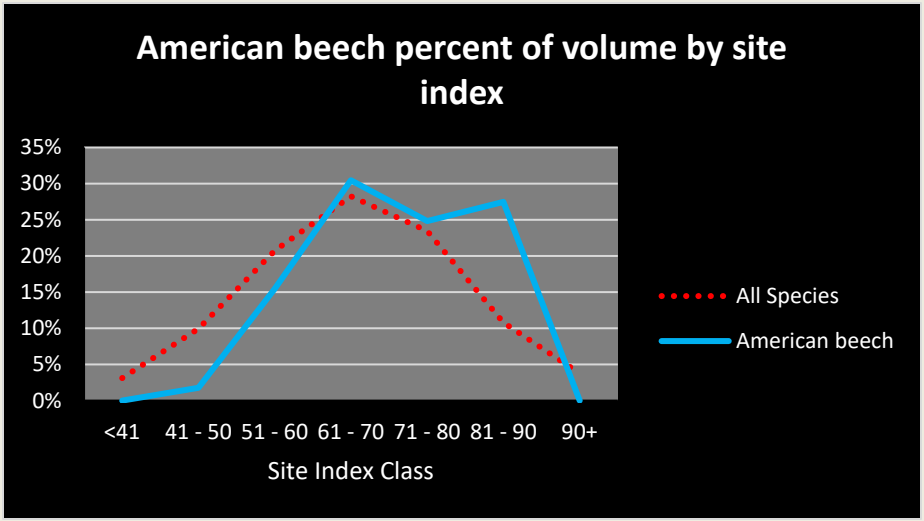
"What kind of sites does beech grow on?"

Habitat type and site index distribution

Beech volume is concentrated on mesic habitat types, though some volume also occurs on dry-mesic sites.



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



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

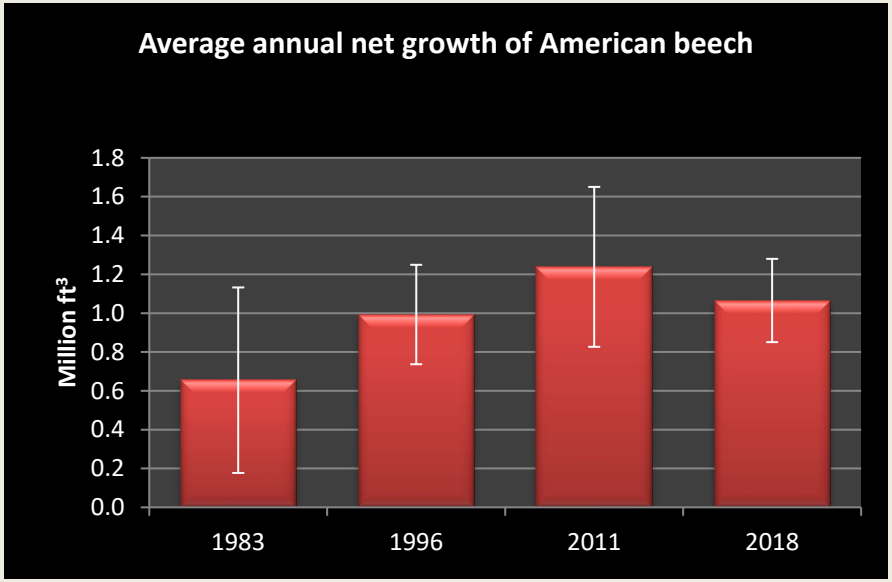
The majority of beech volume occurs on richer sites. Almost 85% is in stands with site indices over 60. As stated, beech occurs mainly on the maple / beech / birch forest type which is more prevalent on higher site indices.

The average site index by volume for beech is 71 compared to 66 for all species.

"How fast is beech growing?"

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

Average annual net growth, about 1.1 million cubic feet per year from 2012 to 2018, accounts for 0.2% of total statewide growth (chart on right). The growth rate has remained steady over the past few decades.



Average annual net growth (million cubic feet). Bars represent the 67% confidence interval.
Source: USDA Forest Inventory & Analysis data

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

Region	Net growth	Percent of total	Ratio of growth to volume
Northeast	0.7	68%	**3.5%**
Northwest	0.0	0.0%	.
Central	0.0	0.0%	.
Southwest	0.0	0.0%	.
Southeast	0.3	32%	**2.4%**
Statewide	**1.1**	100.0%	**3.1%**

Source: USDA Forest Inventory and Analysis

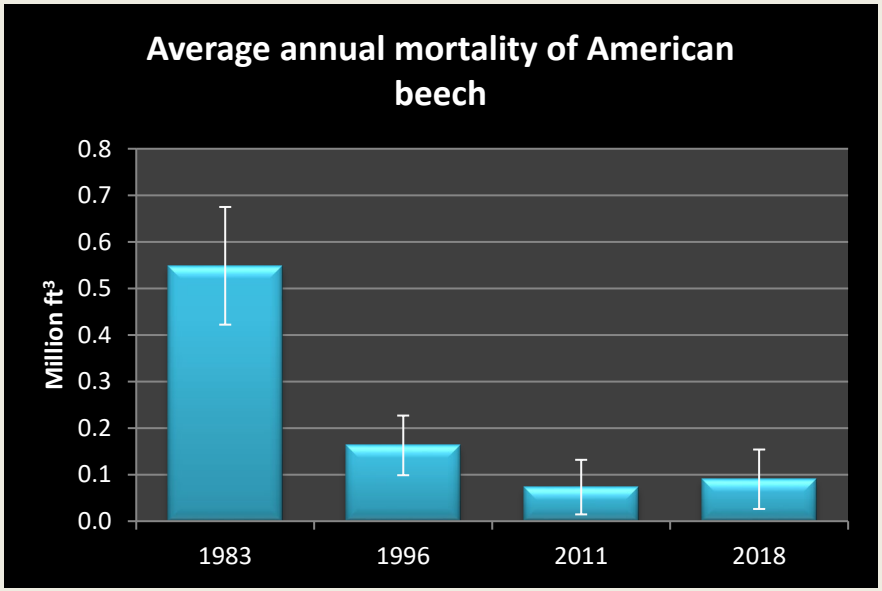
The highest volume growth for beech is in the northeast part of the state as is the highest rate of growth to volume.

The average ratio of net growth to volume for beech is 3.1%, higher 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 beech in Wisconsin?"

Average annual mortality: trends and ratio of mortality to growth



Average annual mortality (million cubic feet) by inventory year. Bars represent the 67% confidence interval. Source: USDA Forest Inventory & Analysis data

Average annual mortality of beech from 2012 to 2018 was about 90,000 cubic feet, or 0.3% of statewide mortality (chart on right). This rate has decreased slightly since 1983. Sampling error is very high making statements about trends uncertain.

The ratio of mortality to volume is about 0.3% for beech. This is much lower than the average for all species in Wisconsin which is 1.1%. American beech accounts for 0.2% of volume and growth but less than 0.1% of mortality.

Mortality, volume and the ratio of mortality to volume.

Species	Average annual mortality (ft^3)	Volume of growing stock (ft^3)	Ratio of mortality to volume
American Beech	**90,115**	**34,828,983**	**0.3%**

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

"Does beech have any major disease or pest issues?"

Beech bark disease: biology, symptoms and impact

Beech bark disease may affect the future survival of American beech in Wisconsin. The disease occurs when a tree is infected with a scale insect (*Cryptococcus fagisuga*) and then becomes colonized by one of several species of a fungus (*Nectria spp*) and can only occur when both are present. The fungus may cause cankers which can kill large trees.

When "scales" (an insect) begin to live on the bark there are scattered woolly spots on the trunk. After the scales reproduce, the entire trunk may be covered in white wool. The immature scales are blown by the wind and also moved by birds and people. Typically, the scale appears several years before disease symptoms.

Upper left. Woolly spots caused by scales. Upper right: Scale nymph. Lower left. *Nectria coccinea* fruiting bodies. Lower right: Cankers of BBD

After the scale is well established on a tree, the fungi can enter the tree through feeding wounds. As the fungus grows, it kills the living tissue beneath the outer bark and a canker will develop, making the bark appear rough.

Distribution of beech scale in Wisconsin as of 2013. Source: WI Dept of Natural Resources http://dnr.wi.gov/topic/foresthealth/beechbarkdisease.html

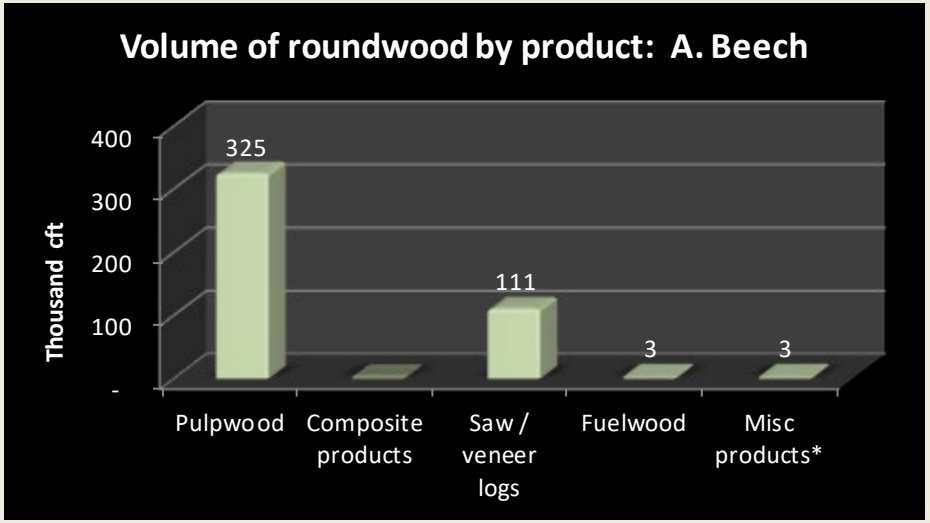
As the disease first invades a forest, the impact is noticeable because large beech trees usually die within a few years of scale buildup. This first wave of dead trees is called a "killing front." This loss of beech can dramatically change forest structure and can negatively impact many wildlife species.

Although, as of December 2013, the beech scale had been found in low populations throughout most of the range of beech in Wisconsin (map above), the disease and high populations of beech scale have only been found in Door County, Wisconsin.

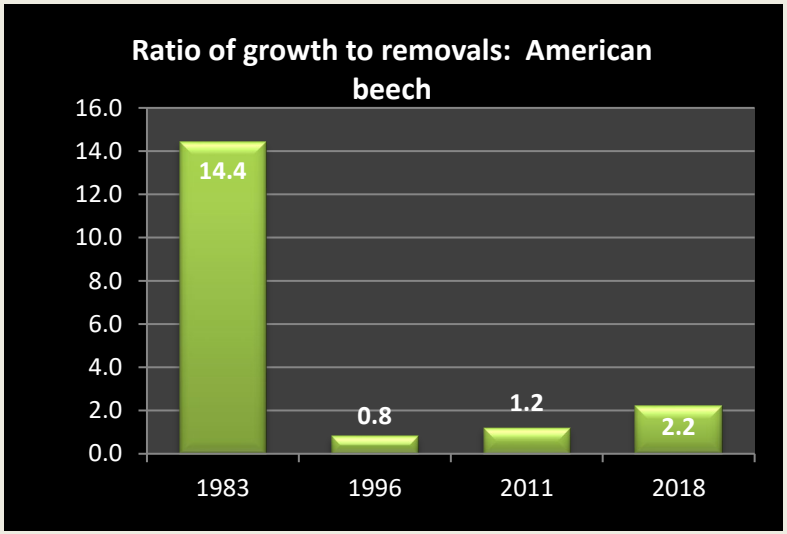
"How much American beech do we harvest?"

Ratio of growth to removals

In 2013, Wisconsin produced about 442,000 cubic feet of American beech roundwood (Chart on right) or less than 1% of statewide production. Almost ¾ was in pulpwood and ¼ was in sawlogs and veneer.



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



Ratio of average annual growth to removals. Error bars represent the 67% confidence interval.
Source: USDA Forest Inventory & Analysis data.

Removals of American beech totaled 0.5 million cubic feet per year from 2012 to 2018. Beech accounts for 0.2% of growing stock volume and 0.2% of removals.

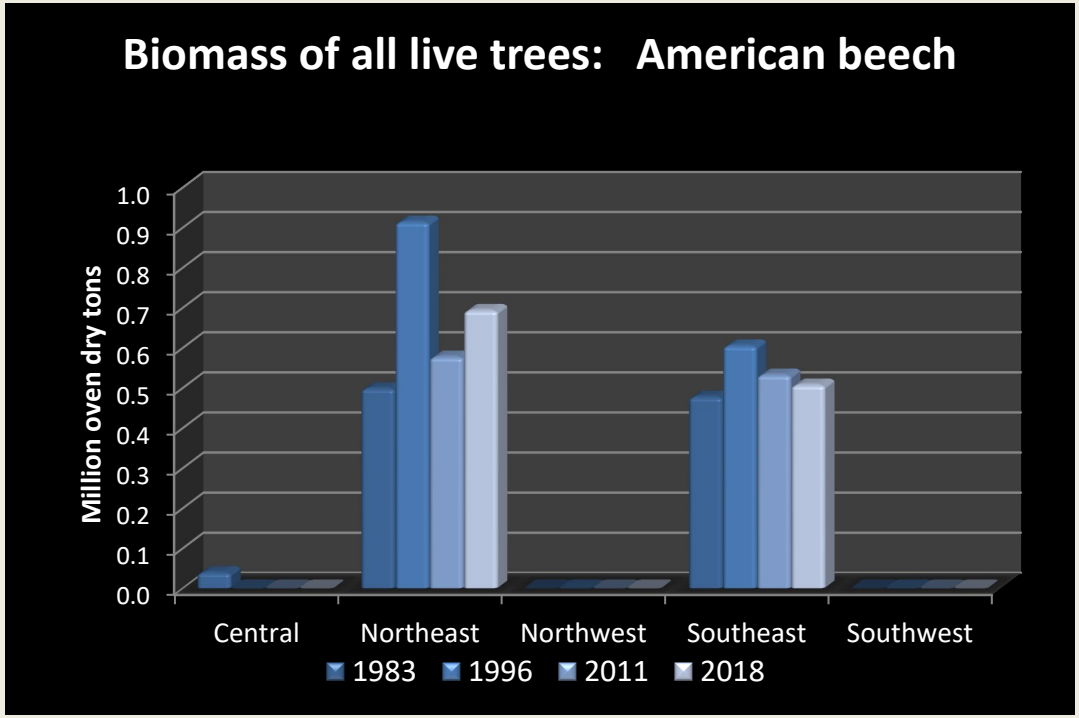
The ratio of average annual net growth to removals is 2.2 for beech, slightly higher than the statewide average ratio of 1.9 for all species (chart on left). Growth has remained mostly unchanged since 2011 but removals have fallen.

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 beech biomass do we have?"

Tons of aboveground biomass by region of the state

There were 1.2 million short tons of aboveground biomass in live beech trees in 2018, up from about 1.0 million tons in 1983, an increase of 18%. This is equivalent to approximately 0.6 million tons of carbon and represents 0.2% of all aboveground biomass statewide. As with volume, most beech is located in northeast and southeast 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

Beech has one of the lowest density of any of the commercial species in Wisconsin, with a specific gravity of 0.64 and an average oven-dry weight of 39.9 pounds per cubic foot. The average specific gravity for all hardwoods is about 0.56 with an average weight of 34 lbs/cft. Approximately 68% of all biomass is located in the bole, 10% in saplings, 4% in stumps, and 18% in tops and limbs.

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

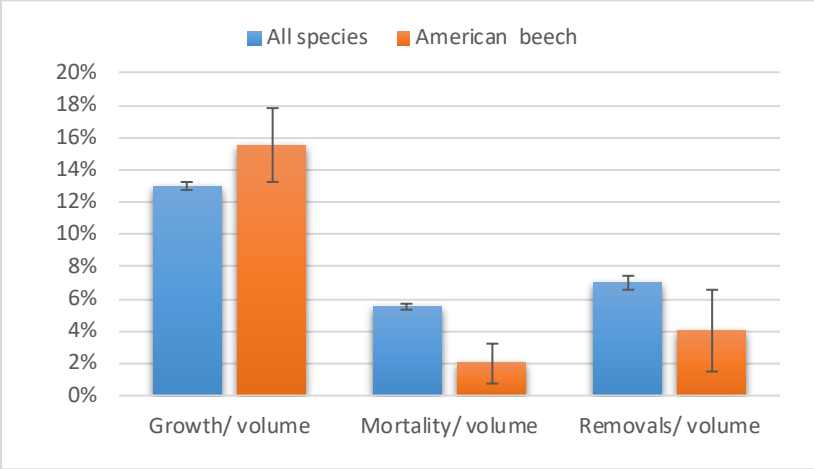
"Can we predict the future of beech?"

Predicted volumes based on current rates of mortality and harvest

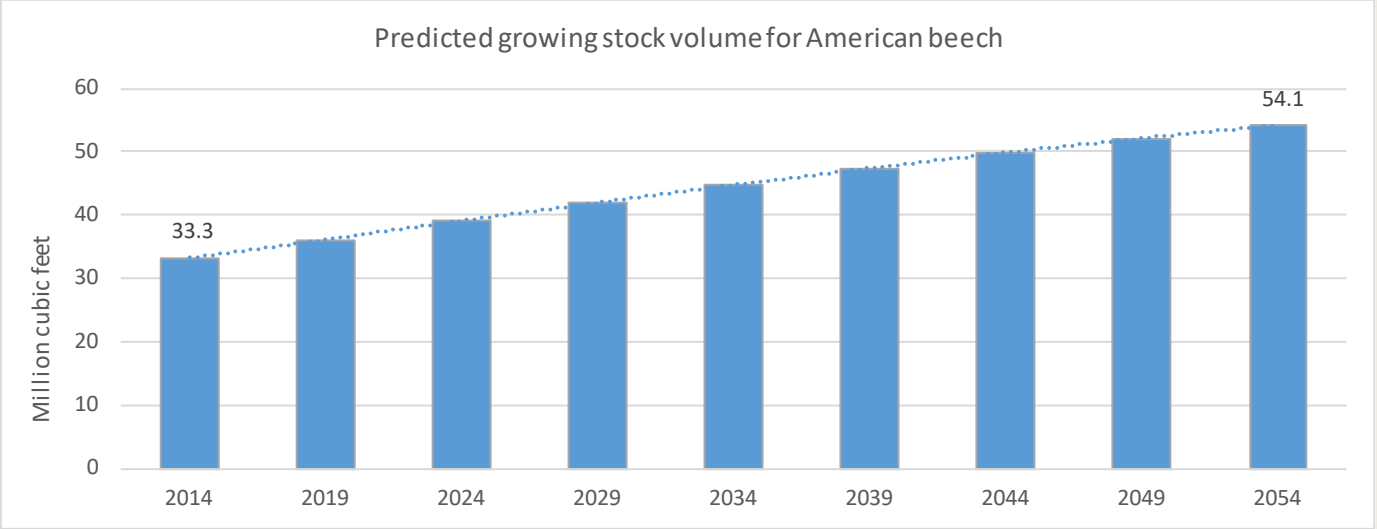
The 5-year ratio of growth to volume is significantly higher for beech while the ratios of mortality to volume and removals to volume are significantly lower for beech compared to all species in the state (chart on right). All of these trends indicate a likely increase in volume in the future.

The Forest Vegetation Simulator (FVS[1]) was used to predict future volumes of beech through 2054 using current mortality and removal rates.

Volume increases 63% by the year 2054 to 54.1 million cubic feet.



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



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