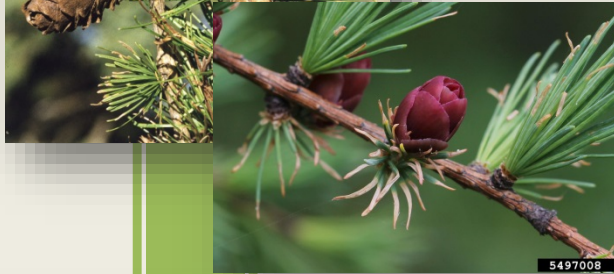


Tamarack

Larix laricina



The volume of tamarack has increased dramatically since 2004 with an increase in all size classes, but especially sawtimber. Growth rates have increased in the last 20 years, but mortality which is relatively low, has remained unchanged. Tamarack grows almost exclusively in wet, low quality sites in northern Wisconsin.

Tamarack is not an important timber species, accounting for only 0.1% of roundwood production. Currently, we harvest only 14% of total growth. The density of tamarack wood is the lowest of all tree species which makes it less desirable for biofuel production.

The main pest of tamarack is the eastern larch beetle which has recently begun to cause increased mortality in Wisconsin.

Predictive models show a steadily increasing volume of tamarack growing stock over the next 40 years.

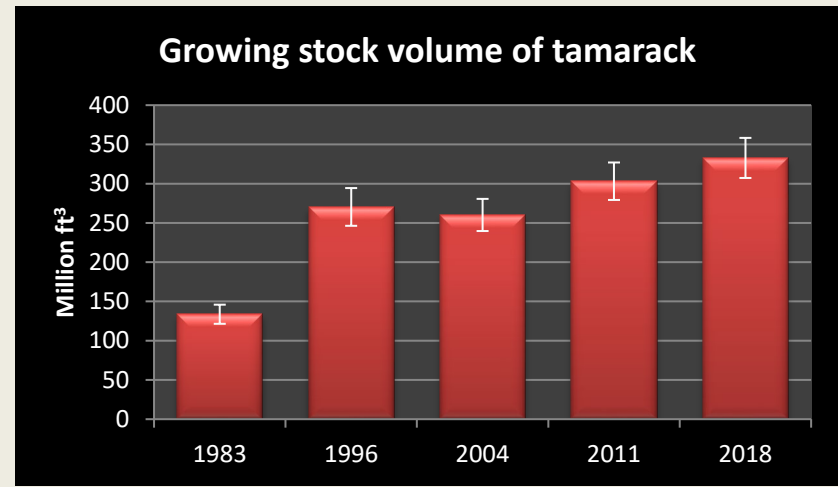
- [How has the tamarack resource changed?](#)
Volume and diameter class distribution:
- [Where is tamarack found in Wisconsin?](#)
Growing stock volume by region with map
- [What kind of sites does tamarack grow on?](#)
Habitat type and site index distribution
- [How fast is tamarack growing?](#)
Average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

"How has the tamarack resource changed?"
Growing stock volume and diameter class distribution

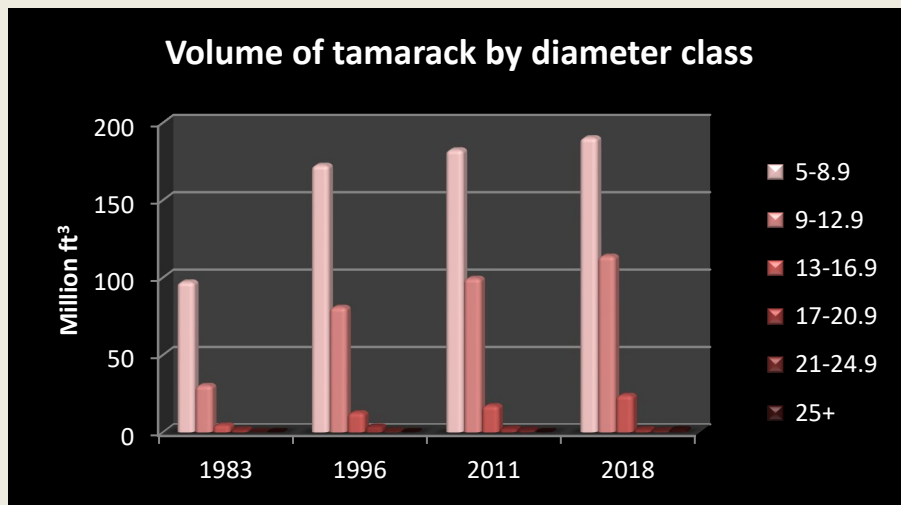
The [growing stock volume](#) of tamarack is about 333 million cubic feet or 1.5% of total statewide volume (chart on right). Volume has increased steadily and more than doubled since 1983.

The tamarack resource has aged. For instance, the volume in small trees (5-12.9 inches in diameter) has increased 139% since 1983 whereas the volume in large trees (13+ inches) has more than quadrupled (chart below left).

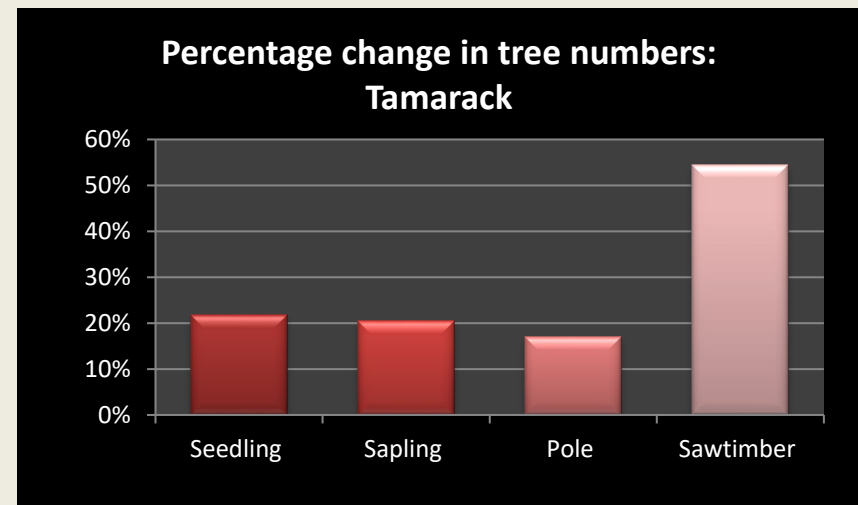
This aging is also reflected in the number of trees by size class (chart below right). The number of [sawtimber-sized](#) trees has increased 55% since 2004 while the number of saplings and poles has increased as well. This suggests that future populations should remain stable.



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



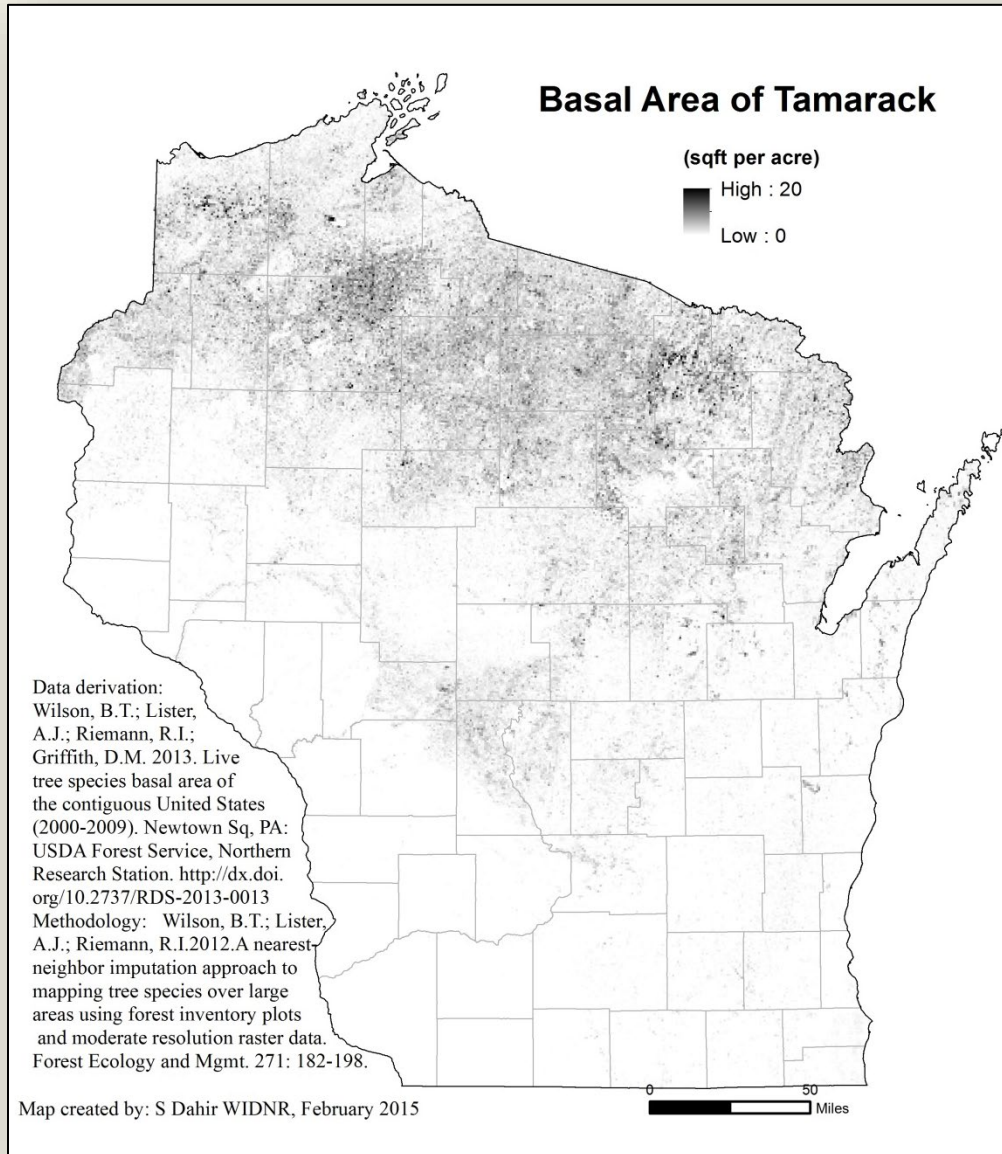
Growing stock volume (trees over 5 inches dbh) by diameter class (inches).
 Source: USDA Forest Inventory and Analysis data



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 does tamarack grow in Wisconsin?"

Growing stock volume by region with map



Over 85% of tamarack growing stock volume is located in northern Wisconsin with 12% in the central part of the state.

The vast majority of volume, 85%, is located on the spruce / fir forest type with much less on the aspen / birch and elm / ash / cottonwood types.

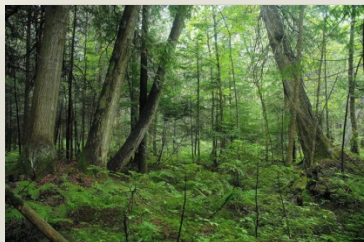
Growing stock volume (million cubic feet) by species and region of the state.

Species	Central	North east	North west	South east	South west	Total
Tamarack	38	144	140	9	1	333
Percent of total	12%	43%	42%	3%	0%	100%

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

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

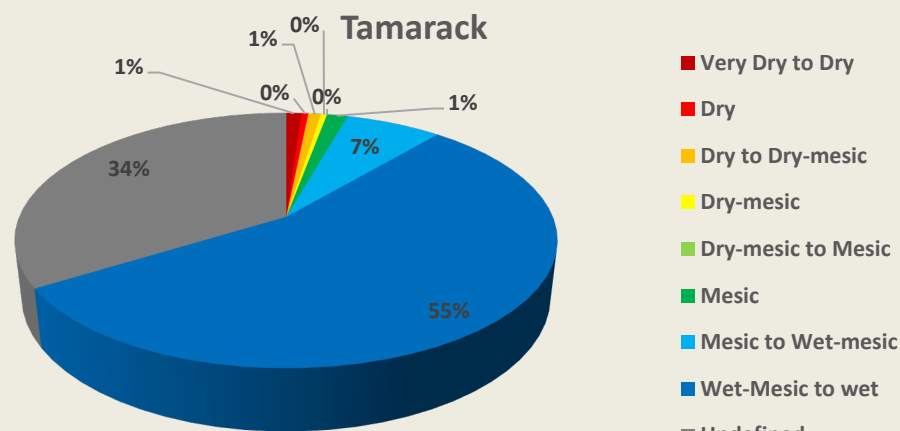
<http://dnr.wi.gov/topic/ForestBusinesses/documents/tables/VolumeCountySpecies.pdf>



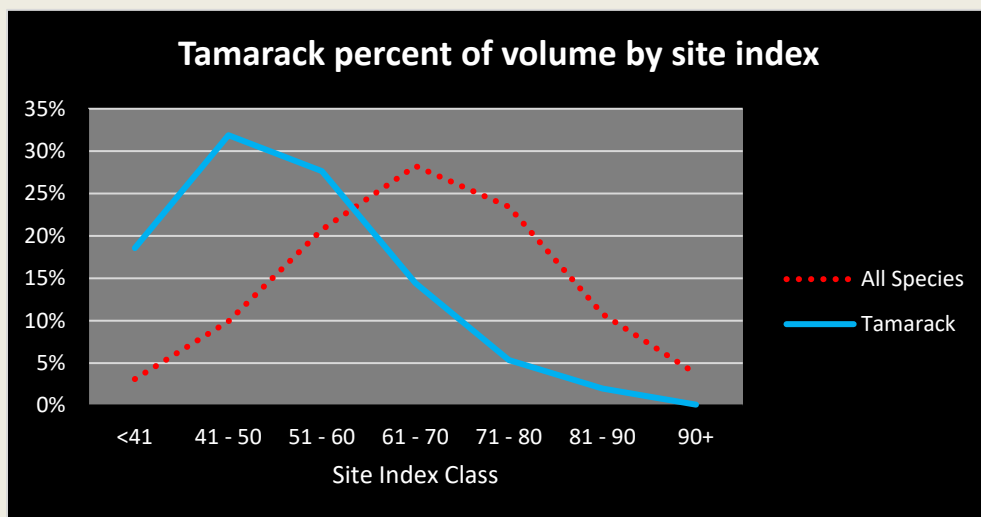
“What kind of sites does tamarack grow on?”

Habitat type¹ and site index distribution

The vast majority of tamarack growing stock volume is found on wet habitat types (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 tamarack growing stock volume is found on wet sites in the northern part of the state. These forests have some of the lowest site index values of all timberland (chart on left). Nearly 80% of volume is located in stands with a site index below 60.

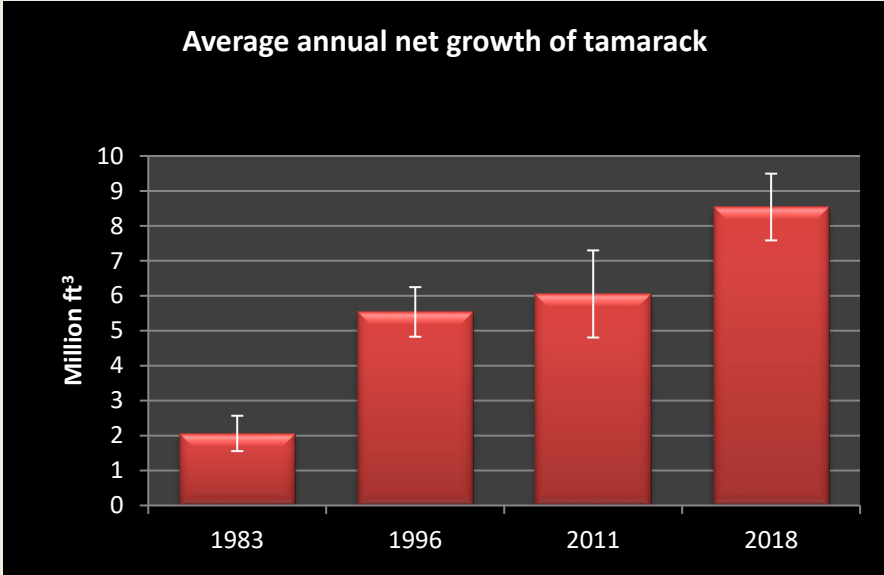
The average site index by volume for tamarack is 51, much lower than the average for all species, 66. Tamarack grows on some of the poorest soils in the state.

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 tamarack growing?”
Average annual net growth and ratio of growth to volume

Average annual net growth of tamarack was about 8.5 million cubic feet per year from 2012 to 2018 and accounts for 1.5% of total statewide growth (chart on right). The growth rate has increased more than quadrupled since 1983 and has increased by over 50% since 1996.



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

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

Region	Net growth	Percent of Total	Ratio of growth to volume
Northeast	4.2	49%	2.9%
Northwest	3.3	39%	2.4%
Central	0.8	9%	2.0%
Southwest	0.0	0%	3.4%
Southeast	0.2	3%	2.5%
Statewide	8.5	100%	2.6%

Source: USDA Forest Inventory and Analysis

- The highest volume growth for tamarack is in the northern part of the state.
- The average ratio of net growth to volume for tamarack is 2.6%, equal to the statewide average of 2.6% for all species.

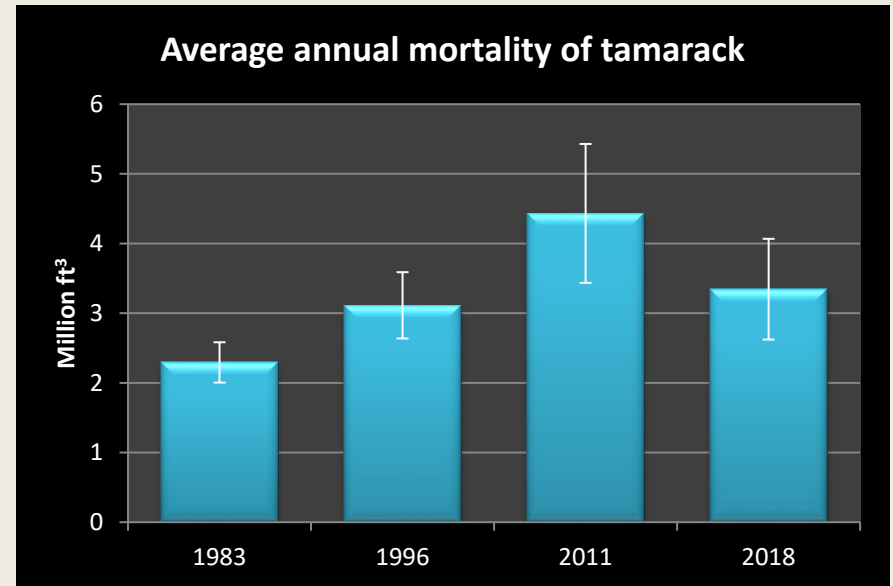
For a table of **Average annual growth, mortality and removals by region** go to:
<http://dnr.wi.gov/topic/ForestBusinesses/documents/tables/GrowthMortalityRemovals.pdf>



“How healthy is tamarack in Wisconsin?”
Average annual mortality and the ratio of mortality to volume

Average annual mortality of tamarack from 2012 to 2018 was about 3.3 million cubic feet, or 1.4% of statewide mortality (chart on right). High sampling error makes it difficult to know how mortality may have changed since 1983.

The ratio of mortality to volume is about 1.0% for tamarack. This is similar to the average for all species in Wisconsin, which is 1.1%.



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

Mortality, volume and the ratio of mortality to volume.

Species	Average annual mortality (ft ³)	Growing stock volume (ft ³)	Mortality / volume
Tamarack	3,344,389	332,803,302	1.0%

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

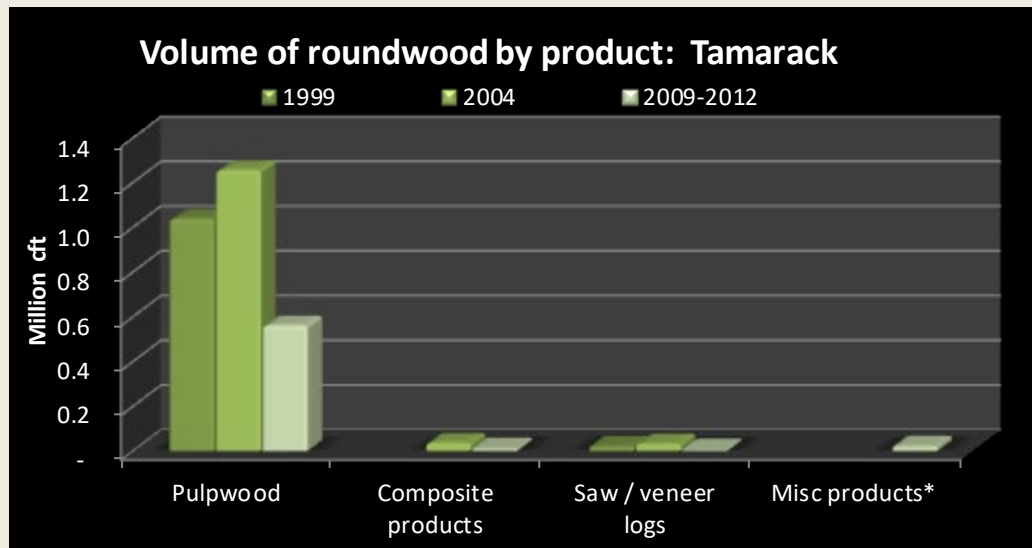


“How much tamarack do we harvest?”

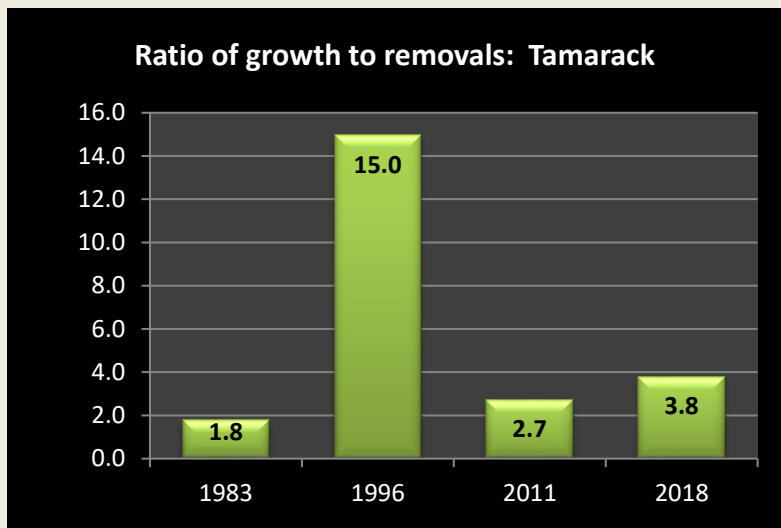
Roundwood production and the ratio of removals to growth

In 2009-2012, Wisconsin produced about 275,000 cubic feet of tamarack roundwood, or about 0.1% of the total harvest (chart on right). Tamarack roundwood production has decreased 86% since 2004.

Tamarack is used mostly for miscellaneous products such as poles, posts and pilings.



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

We remove about 2.3 million cubic feet of tamarack volume each year. Tamarack accounts for 1.5% of volume and growth but only 0.8% of removals statewide.

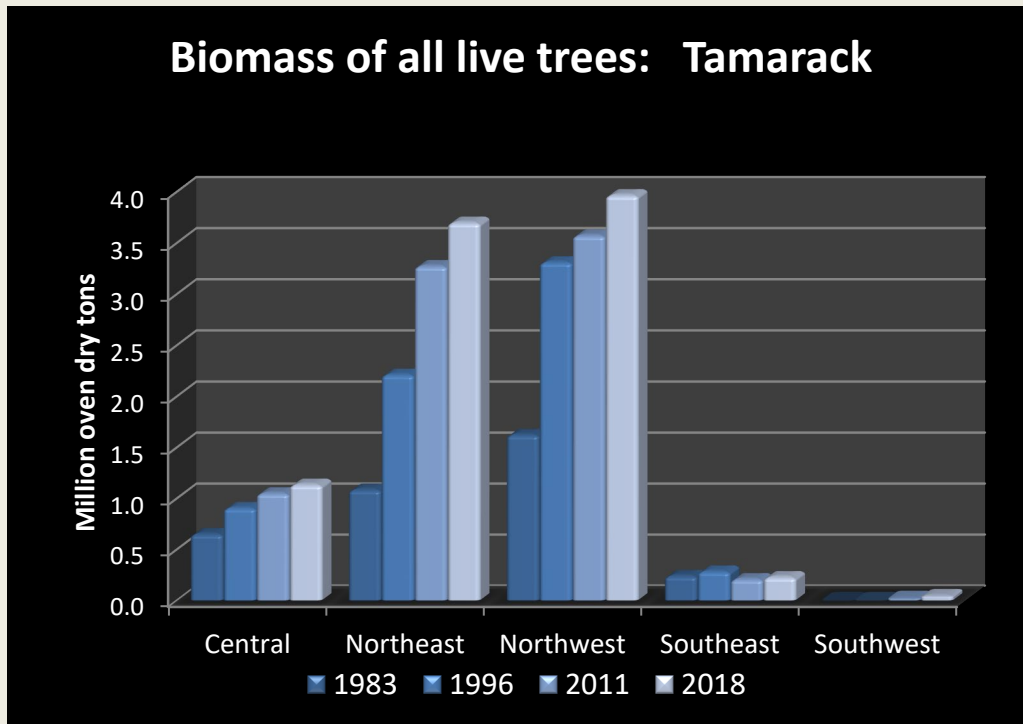
The ratio of average annual net growth to removals is 3.8 for tamarack, much higher than the statewide average of 1.9 (chart 7). Due to very high sampling error, it's difficult to identify verifiable trends.

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 tamarack biomass do we have?”
Tons of aboveground biomass by region of the state

There are 9.1 million short tons of aboveground [biomass](#) in live tamarack trees, an increase of 152% since 1983. This is equivalent to approximately 4.5 million tons of carbon and represents 1.4% of all aboveground biomass statewide. As with volume, most tamarack 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

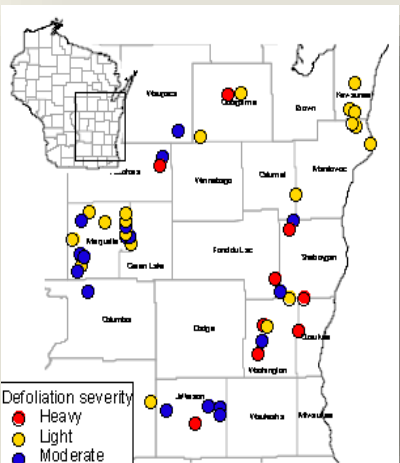
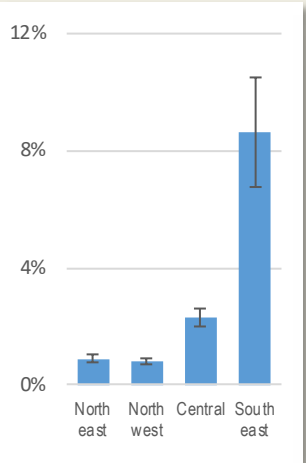
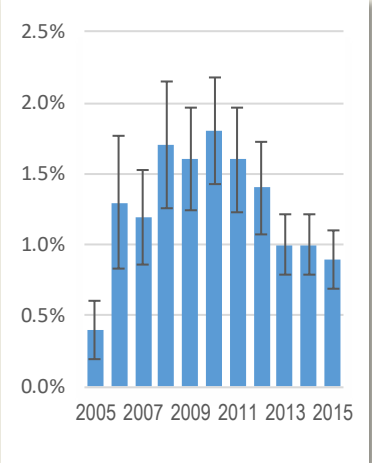
Tamarack has the lowest density of any of the commercial tree species in Wisconsin, with a ratio of biomass to volume of 22 oven-dry lbs. per cubic foot. The average for all softwoods is about 26 ODP/cubic feet and for all species is 33 ODP/cubic feet. Approximately 69% of biomass is located in the bole, 14% in saplings, 6% in stumps, and 13% in the top branches.

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

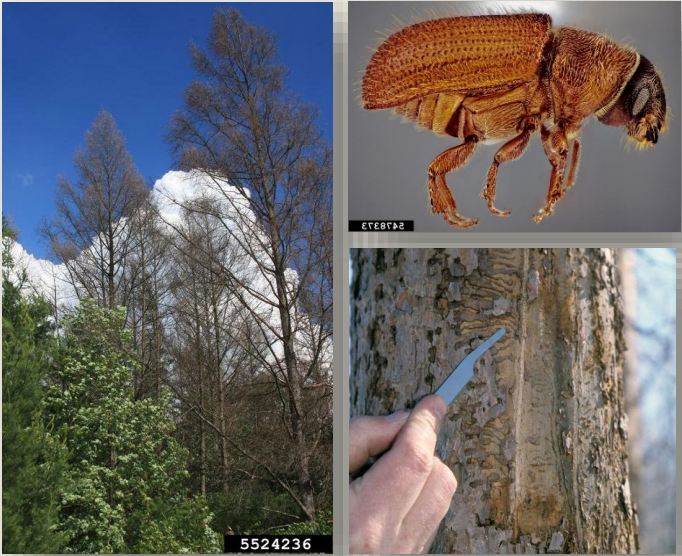
“Does tamarack have any disease or insect pests?”
Eastern larch beetle: biology and possible impact

Eastern larch beetle, *Dendroctonus simplex*, is a native pest of tamarack and attacks mainly stressed trees. The colonization of this beetle, if severe enough can kill trees. Widespread outbreaks may occur with severe drought, flooding, defoliation, fire, or advanced age.

High mortality of tamarack due to eastern larch beetle has been noted in Minnesota affecting over 100,000 acres over the last decade. Since 2000, mortality has also been showing up in parts of Wisconsin as well peaking in 2008-2011 and in the southeast (Figure on right).



Left: Tamarack mortality ratio by year. Center: Mortality ratio by region of state (2005-15). Error bars represent the 67% confidence interval. Right: Map of heavy defoliation in southeast Wisconsin (Mark Guthmiller).



Left: Dead tamarack trees in Wisconsin. Upper right: Eastern larch beetle

Eastern larch beetles have been around for thousands of years but recently populations have exploded. Research suggests that increased growing season length related to climate change may allow females to produce two generations per year instead of one. If this is the case, mortality may increase across the range of the eastern larch beetle including Wisconsin.

The dark-colored insect is about the size of a grain of rice (Figure on left). Female beetles lay their eggs beneath the bark and when the larvae hatch, they feed on the inner bark cutting off the tree's ability to transport water and nutrients. Dry conditions and other stressors weaken trees and make them more vulnerable to attack.

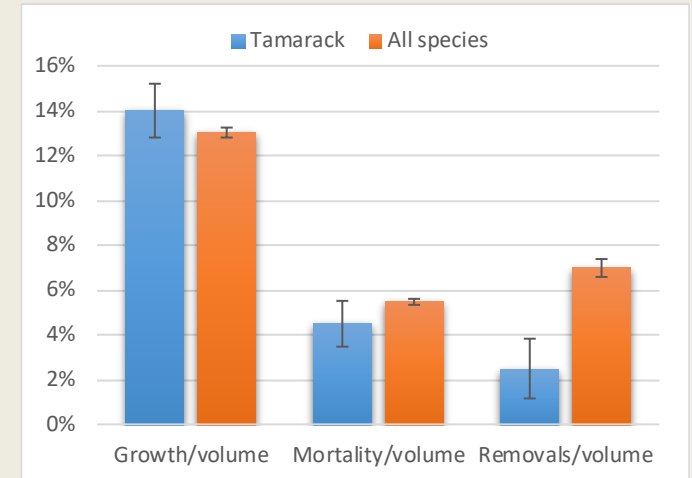
Tamarack survival will depend on seedlings, which typically aren't affected by the eastern larch beetle.

“Can we predict the future of tamarack?”

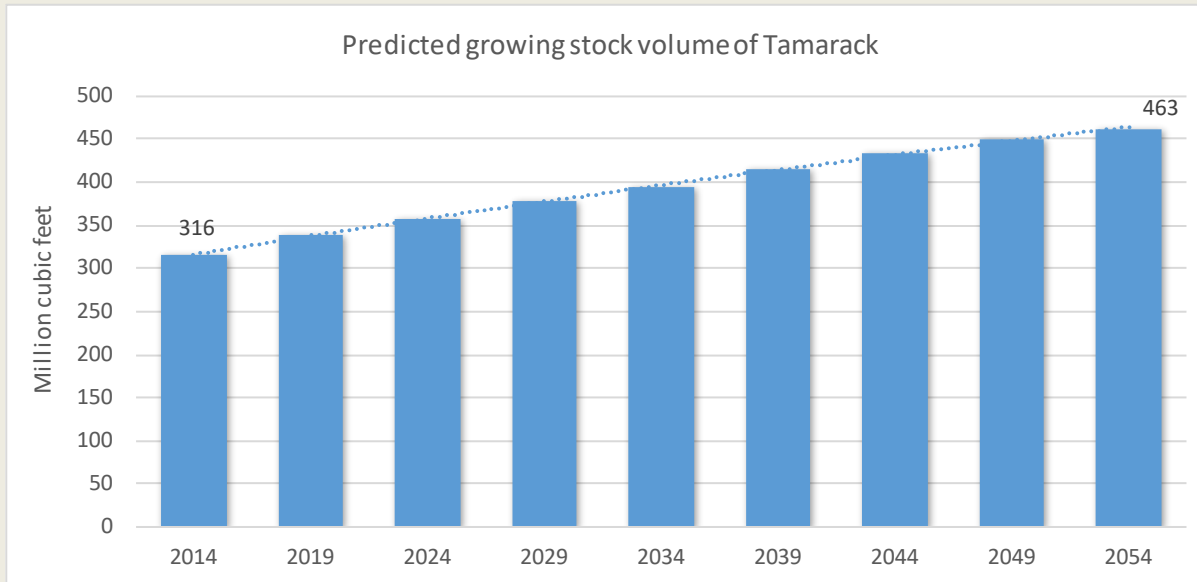
Predicted volumes based on current rates of mortality and harvest

The 5-year ratios of growth and mortality to volume are not significantly different from the average for all species but the ratio of removals to volume is much lower for tamarack (chart on right). The fact that mortality and removals are so low means that volume will probably increase in the near future.

The Forest Vegetation Simulator (FVS¹) was used to predict future volumes of tamarack 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 tamarack increases 46% by 2054, with no indication of a leveling out before then (chart on left).