

Forest characteristics of the Brule River State Forest



WisCFI data 2007 - 2012

SUMMARY OF THE BRULE RIVER STATE FOREST	2
FORWARD.....	3
STAND CHARACTERISTICS	5
ACRES BY FOREST TYPE AND STAND SIZE	5
ACRES BY FOREST TYPE AND STAND AGE	6
ACRES BY SITE INDEX AND FOREST TYPE	7
HABITAT TYPES	8
TREE NUMBERS AND VOLUME.....	9
NUMBER OF TREES BY SPECIES AND DIAMETER.....	9
NUMBER OF SEEDLINGS BY SPECIES AND FOREST TYPE GROUP	9
VOLUME OF GROWING STOCK (>4.9IN DBH) BY SPECIES AND DIAMETER.....	11
VOLUME OF SAWTIMBER BY SPECIES AND DIAMETER CLASS	12
VOLUME OF SAWTIMBER BY TREE GRADE AND SPECIES	13
FOREST HEALTH AND SUSTAINABILITY.....	14
RATIO OF ANNUAL NET GROWTH TO VOLUME.....	15
RATIO OF MORTALITY TO GROSS GROWTH	16
PERCENT STANDING DEAD TREES AND VOLUME BY SPECIES.....	17
CROWN DIEBACK AND TRANSPARENCY	18
TRENDS.....	19
GROWING STOCK VOLUME	19
DEFINITION OF TERMS.....	20
REFERENCES.....	23

Summary of the Brule River State Forest

There are approximately 35,704 acres ($\pm 2.1\%$ sampling error or SE) of [timberland](#) on the Brule River State Forest. The major [forest types](#) are aspen and red pine. These 2 types account for 51% of all timberland. The Brule River State Forest has the lowest percentage of acreage in small and large sawtimber, 25%, compared to 42% for all state forests.

About 60% of acreage is between 21 and 60 years of age. Average site index on the forest is 60 which is slightly above the average of 56.8 for all state forests. The southern part of the Brule River State Forest is composed of very dry habitat types with red pine dominating and the northern part is wetter, mesic to wet mesic and wet mesic to wet, much of which is in aspen.

There are 25.6 million trees ($\pm 6.3\%$ SE), 38.3 million cubic feet of growing stock volume ($\pm 5.9\%$ SE), and 94.9 million board feet of sawtimber ($\pm 10.2\%$ SE) on the Brule River State Forest. The Brule River State Forest has the lowest volume of sawtimber per timberland acre of all the state forests and the second lowest per acre volume of growing stock.

The most numerous [growing stock](#) species are quaking aspen, red pine and red maple. Red maple, black ash, quaking aspen and northern pin oak account for half of all seedlings. The majority of growing stock and sawtimber volume is in quaking aspen and red pine. However, these two species account for only 20% of grades 1 and 2 sawtimber. Eastern white pine, balsam fir and northern white cedar account for over half of sawtimber in Grades 1 and 2.

Several measures are reported which assess forest health and species sustainability. All are approximations, either based on only one year of data, such as growth and mortality, or peripheral measures of health, such as crown characteristics and the number and volume of standing dead trees. Caution should be used in drawing firm conclusions from this data.

There are indications that the health of trees on the Brule River State Forest is not as good on average as on other state forests. For instance, although overall growth rates are only slightly lower, mortality rates on the Brule are 47% higher, the annual percentage of trees dying is twice as high, the volume of standing dead trees is 40% higher and the average level of crown dieback is 67% higher than the average for all state forests combined.

Certain species score relatively poorly on several of these health measures. Jack pine and black ash have a below average growth to volume ratio, a high mortality to gross growth ratio, an above average volume in standing dead trees and higher than average levels of crown dieback. Big tooth aspen and northern pin oak both have poorer than average scores on three out of the four criteria. These are all very approximate measures but taken together indicate that populations of these species may not be sustainable.

Forward

There has always been a strong demand for timely, consistent, and reliable forest inventory and monitoring information for State Forests. Recently, the demand for timely and relevant information has been growing. Partners interested in State Forests want more recent information, covering a broader scope of forest attributes with more analysis and reporting capabilities. In response, the Wisconsin Department of Natural Resources implemented a State Forest Continuous Forest Inventory (WisCFI) program that will increase our capacity to collect, analyze and publish data on an annual basis for each State Forest individually and as a group (over 500,000 acres of forest and nonforest land).

The primary purpose of the Wisconsin CFI is to collect and report on the condition of the forest in a statistically sound manner on an annual basis for each State Forest. The information will be used to track the status and trends in forest extent, cover, growth, mortality, habitat, and overall health. The continuous forest inventory will provide unbiased, reliable information at the property level with the ability to incorporate regional trends. The inventory will assist in planning, management and monitoring.

Inventory goals:

- Provide information on the condition and health of the forest and track changes over time.
- Integrate effectively data, methods and tools in the planning and decision making processes.
- Develop and maintain data input models and methods for forestry analysis and planning.
- Develop up-to-date and easy-to-use information products and services for property managers and our public and partners.

Difference between WISFIRS (forest reconnaissance data) and WisCFI data

The WISFIRS (Wisconsin Forest Inventory and Reporting System or Recon) and the WisCFI (Wisconsin Continuous Forest Inventory) datasets are used to describe the same forests but their purpose, methodology and results are very different.

WISFIRS is a stand-based dataset and is used to **manage individual stands**. A stand is defined as having a fairly uniform composition of trees with a common management objective. The emphasis is on management. Since forests are never consistent throughout, data on cover type and tree composition must be generalized in order to describe the stand as a whole. Generalizing by stand is crucial for scheduling management activities but not for determining accurate forest-wide statistics such as volume by species, growth or mortality rates. In addition, since forest reconnaissance is performed at different intervals for different stands, tracking forest-wide trends such as changes in acreage by forest type, size class or other stand descriptors, is difficult.

WisCFI data is an analytical tool which can provide **statistically consistent and accurate** information as well as trends in this data. It is based on systematically randomized located plots (each plot represents c. 200 acres of forest) which are re-measured every five years. There are many stands defined by forest reconnaissance which will not have even one WisCFI plot and many stands which will have more than one. Many WisCFI plots will be assigned a cover type, size class or stand age which may be quite different from the forest reconnaissance typing of the stand in which they are located. As previously

stated, stands may be very inconsistent from one location to the next. The important thing is that the data is measured very consistently from plot to plot and from inventory to inventory and that each plot is located in a systematic and random manner. This allows a statistical determination of the amount of error attached to each measure. The more plots, the lower the sampling error. Knowing the amount of error means we can determine the accuracy of the measurement. For instance, for the NHAL an area of c. 2,500 acres yields a sampling error of about 25%. This means that there is a 2/3 probability that the actual value will be between 1,900 and 3,100.

WisCFI data cannot be used to describe small areas because of the large amount of error associated with small samples but it can be used to describe acreage by stand age, size class, forest type, soil type, habitat type, site index, and productivity for an entire state forest. It can be used to determine volume or number of trees by tree size class, crown class, stocking class, site index, etc. With the addition of P3 data, many other measures such as crown dieback or transparency, area of compacted or bare soil, quantity of coarse woody debris, or cover of invasive species can be estimated. These measures will initially have a large sampling error but as the plots are re-measured, the amount of error will diminish and trends will emerge from the data. Again, all of these measures have an associated sampling error and therefore their accuracy can be gauged. This allows us to say whether there is or is not, for instance, a significant change in the acreage of a forest type or the volume of a species.

As plots are re-measured for the first time in 2012, changes in these measures will emerge. For instance, as trees are re-inventoried, mortality or removals will be recorded. Growth rates will emerge as will changes in acreage by size class or forest type. As the definitions become clearer, the WisCFI data will become more and more useful as a tool to describe the effects of management forest-wide, including whether a State Forest is meeting the management goals set out in its Master Plan.

Sampling Error

The process of sampling (selecting a random subset of a population and calculating estimates from this subset) causes estimates to contain error they would not have if every member of the population (e.g., every tree in had been observed and included in the sample). The WisCFI inventory is based on a sample of 3,908 selected plots with an average sampling rate of about one plot for every 135 acres of state forest land.

Along with every estimate is an associated sampling error that is typically expressed as a percentage of the estimated value (the estimated value plus or minus the sampling error). This sampling error is the primary measure of the reliability of an estimate. We use a sampling error based on one standard error, that is, the chances are two in three that the results would have been within the limits indicated had a 100-percent inventory been conducted using these methods.

For instance, the Brule River State Forest has an estimated timberland acreage of 35,704 acres with a sampling error of 2.14%. This means that there is a 67% probability that the actual value is between 34,940 and 36,468 acres. The smaller the value being measured, the larger the sampling error. For instance the sampling error for seedling acreage is 22% and the error for seedling aspen acreage is 48%.

Sampling error must be considered when making assumptions about this data.

Stand Characteristics

Acres by [forest type](#) and [stand size](#)

Over one third of the timberland acreage on the Brule River State Forest is in aspen, 78% of which is in pole-sized stands. About half of all sawtimber acreage is in red pine stands.

Acres of timberland by WisDNR forest type and size class

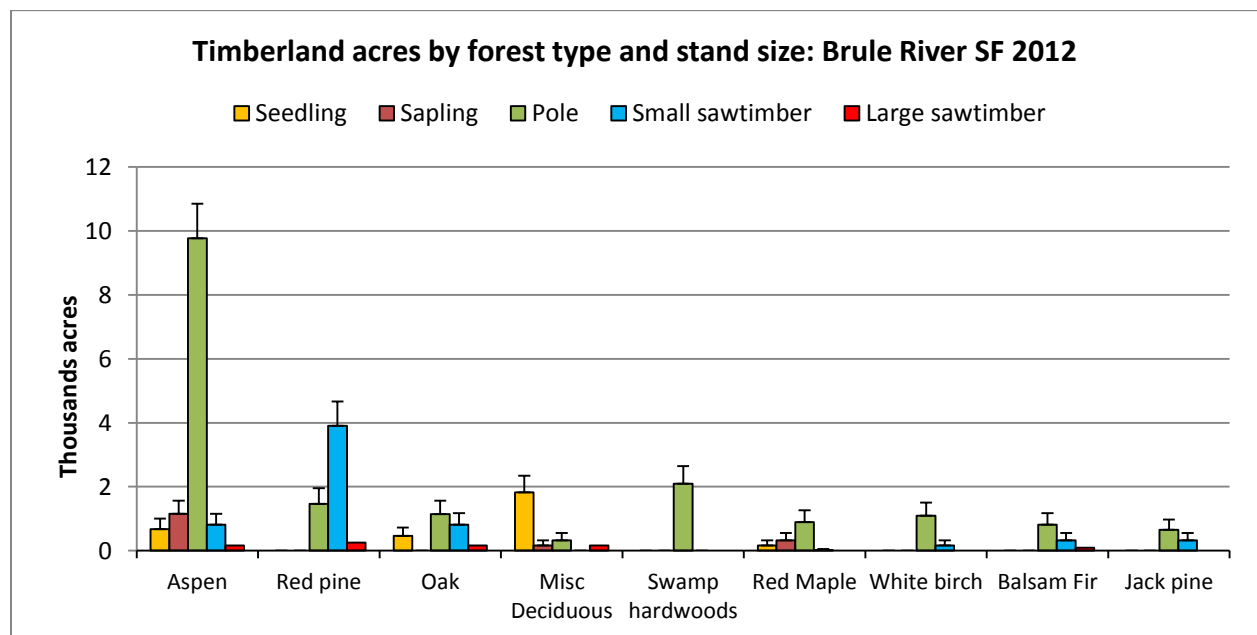
Forest type	Seedling	Sapling	Pole*	Small sawtimber*	Large sawtimber*	Total WisCFI**	Total WISFIRS
Aspen	674	1,152	9,771	816	163	12,577	21,136
Red pine	-	-	1,468	3,909	254	5,630	6,160
Oak	461	-	1,142	816	163	2,582	1,544
Misc Deciduous***	1,826	163	326	-	163	2,479	
Swamp hardwoods	-	-	2,091	-	-	2,091	1,683
Red Maple	163	326	897	27	-	1,413	127
White birch	-	-	1,097	163	-	1,260	761
Balsam Fir	-	-	816	326	91	1,233	943
Jack pine	-	-	653	326	-	979	3,479
Scrub oak	-	163	522	163	-	848	1,525
White cedar	-	-	163	489	163	816	1,095
Northern hardwoods	-	-	561	-	146	707	366
White Spruce	-	-	326	163	163	653	1,625
Black spruce	-	163	163	-	-	326	346
Misc Coniferous***	-	-	-	163	-	163	7
White pine	-	-	-	-	163	163	503
All forest types	3,124	1,968	20,084	7,361	1,470	35,704	41,562

*Pole: 5-9" softwood, 5-11" hardwoods Small sawtimber: 9-15" softwoods, 11-15" hardwoods Large sawtimber: 15+ "

**Lowland brush and unsurveyed acreage have been omitted. Some WISFIRS types have been combined under misc conifers.

*** Misc Deciduous is mostly aspen and jack pine and Misc Coniferous is mostly Norway spruce

Figures in red have over a 50% sampling error and should be used with caution



Acres by forest type and stand age

About 60% of acreage is between 21 and 60 years of age. Only 6 percent is over 100 years old and 19% is 20 years or less. The white cedar type has the most acreage in old stands (>100 yrs) and the aspen type has the highest acreage in young stands (<21 yrs).

Acres of timberland by forest type and stand age

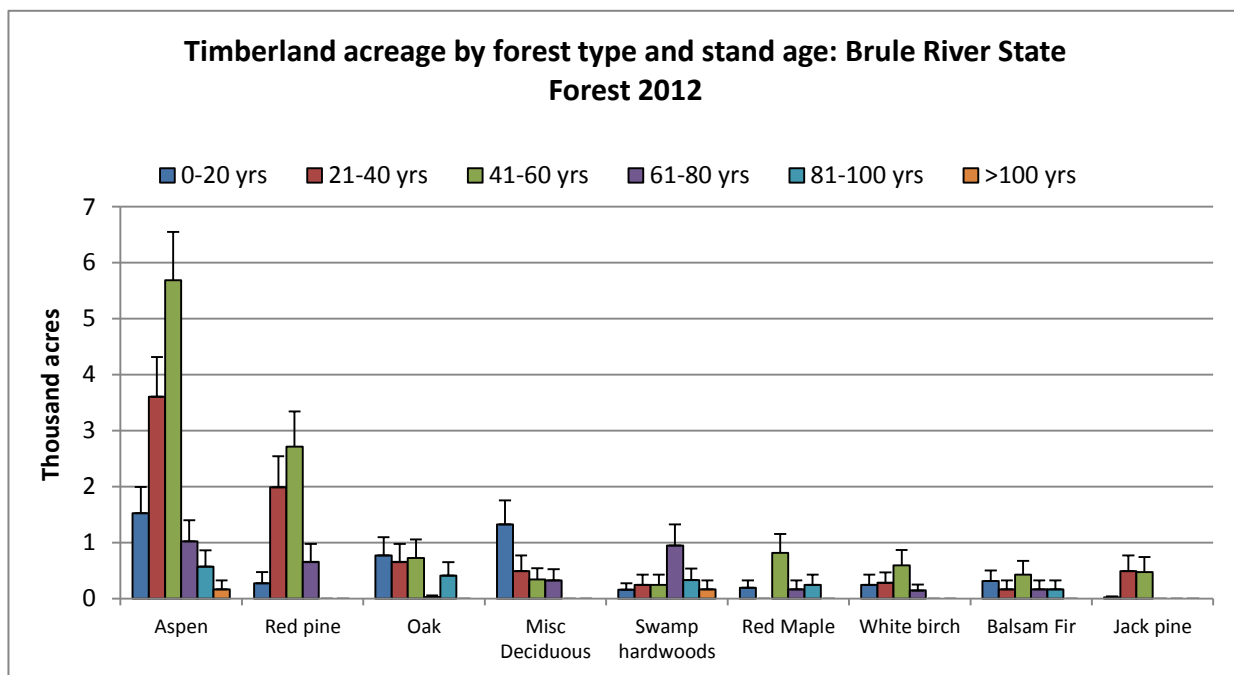
Forest type	0-20 yrs	21-40 yrs	41-60 yrs	61-80 yrs	81-100 yrs	>100 yrs	Total
Aspen	1,524	3,606	5,690	1,023	571	163	12,577
Red pine	275	1,989	2,715	653	-	-	5,630
Oak	770	653	724	27	408	-	2,582
Misc Deciduous***	1,324	489	338	326	-	-	2,479
Swamp hardwoods	158	245	245	949	331	163	2,091
Red Maple	191	-	815	163	245	-	1,413
White birch	245	281	590	144	-	-	1,260
Balsam Fir	315	163	429	163	163	-	1,233
Jack pine	18	489	471	-	-	-	979
Scrub oak	427	-	258	-	163	-	848
White cedar	-	-	326	163	-	326	816
Northern hardwoods	-	-	163	472	72	-	707
White Spruce	163	-	326	163	-	-	653
Black spruce	-	-	163	-	-	163	326
Misc Conifer***	-	-	-	163	-	-	163
White pine	-	-	-	-	-	163	163
Total WisCFI*	6,822	7,915	13,376	4,574	2,040	979	35,704
Total WISFIRS**	8,122	9,076	10,195	7,739	4,433	1,954	41,519

*Lowland brush and unsurveyed acreage have been omitted.

**43 acres were not recorded as to age.

***Misc Deciduous is mostly quaking aspen and jack pine and Misc conifer is mostly Norway spruce.

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Acres by [site index](#) and forest type

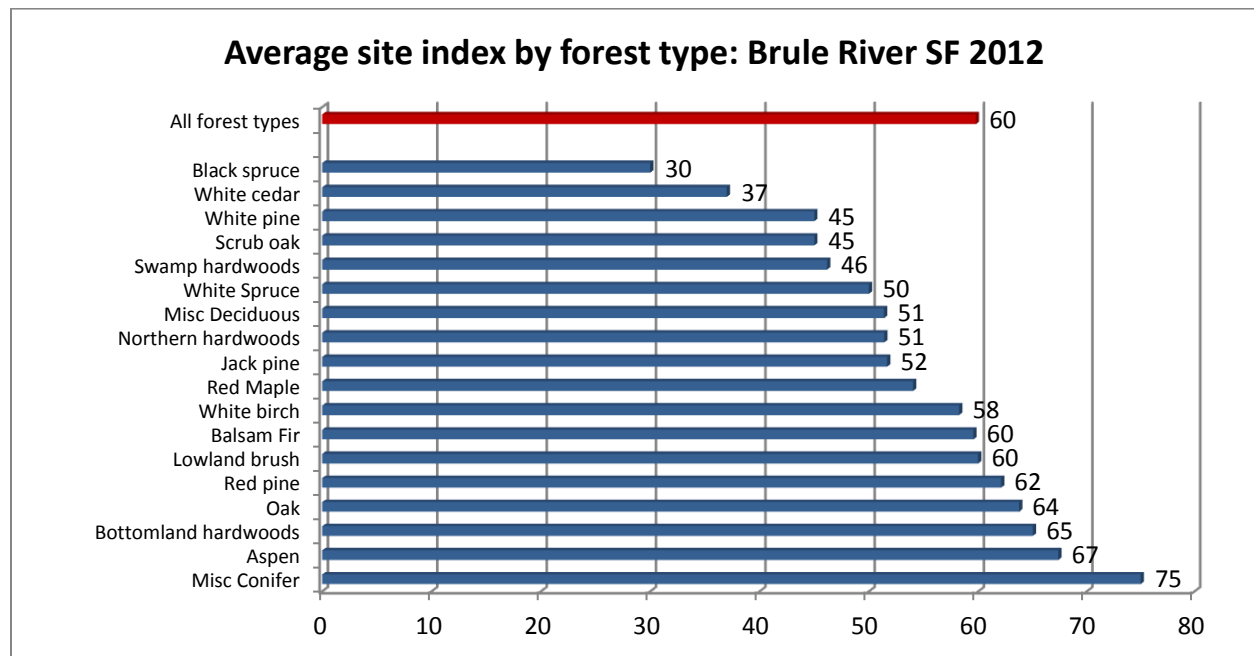
The average site index on the Brule River State Forest is 60. Excluding forest types with low acreage (and high errors) the types with the highest average site index are aspen, oak and red pine and the types with the lowest site index are scrub oak and wetland types.

Acres of timberland by forest type and site index.

Forest type*	<=30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	Total acres
Aspen	-	163	818	1,718	3,730	5,495	653	12,577
Red pine	-	-	408	1,961	2,121	1,141	-	5,630
Oak	-	-	-	1,142	787	489	163	2,582
Misc Deciduous	-	653	326	1,010	245	245	-	2,479
Swamp hardwoods	163	489	949	82	245	163	-	2,091
Red Maple	-	163	163	734	353	-	-	1,413
White birch	-	-	163	607	408	82	-	1,260
Balsam Fir	-	-	255	489	163	326	-	1,233
Jack pine	-	163	163	489	163	-	-	979
Scrub oak	-	-	848	-	-	-	-	848
White cedar	326	-	489	-	-	-	-	816
Northern hardwoods	-	-	326	309	72	-	-	707
White Spruce	-	163	326	-	-	163	-	653
Black spruce	163	163	-	-	-	-	-	326
Misc Conifer	-	-	-	-	-	163	-	163
White pine	-	-	163	-	-	-	-	163
Bottomland hardwoods	-	-	-	-	87	-	-	87
Total	653	1,958	5,562	9,261	8,862	8,593	816	35,704

*Lowland brush and unsurveyed acreage have been omitted.

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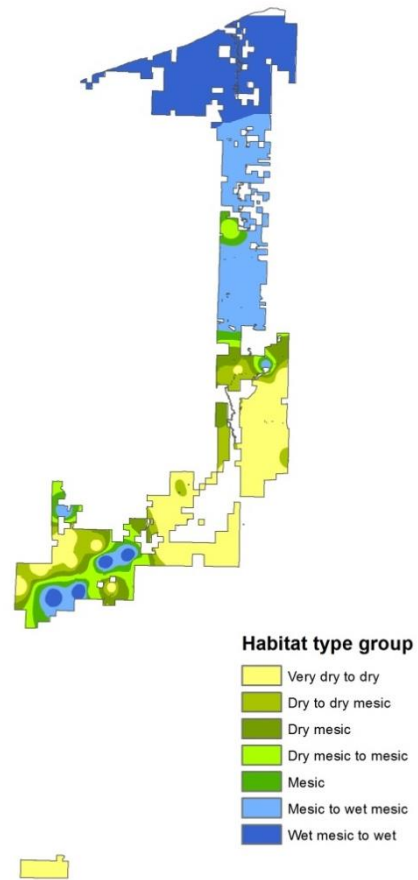
Habitat types

The habitat type system is a method of site classification that uses the floristic composition of a forest community (understory herbs and shrubs as well as trees) as an indicator of site capability along a moisture/nutrient gradient ranging from very dry to wet and nutrient poor to nutrient rich (Kotar et al. 1999).

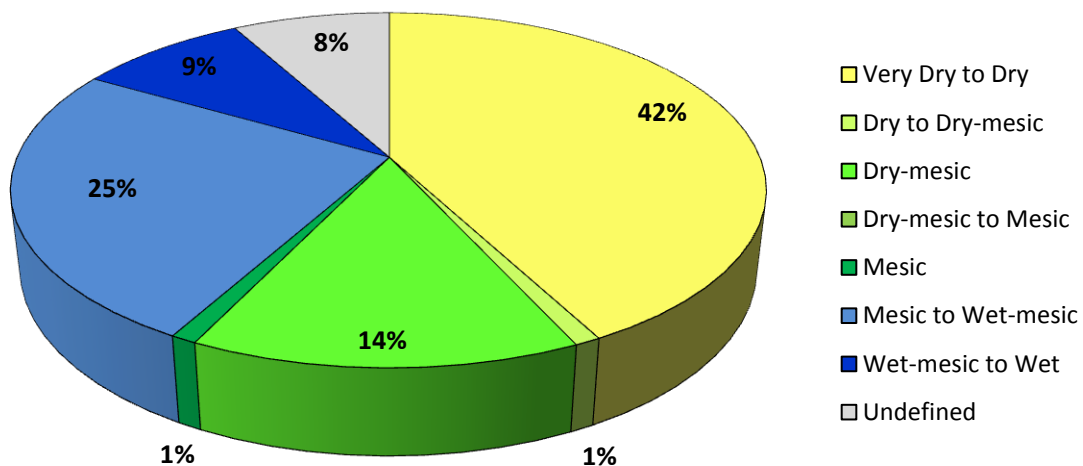
Only 24% of acreage on the Brule River State Forest was sampled for habitat type and sampling errors are very high. For this reason percentages rather than acres are reported.

About 42% of all timberland on the Brule River State Forest is classified as very dry to dry and the vast majority of this is in red pine. Over one third of timberland is on mesic to wet mesic or wet mesic to wet types with 82% of this acreage in aspen.

The map on the right is based on the approximate location of habitat types within the forest and may not reflect the percentages in the chart below.



Brule River State Forest



Tree Numbers and Volume

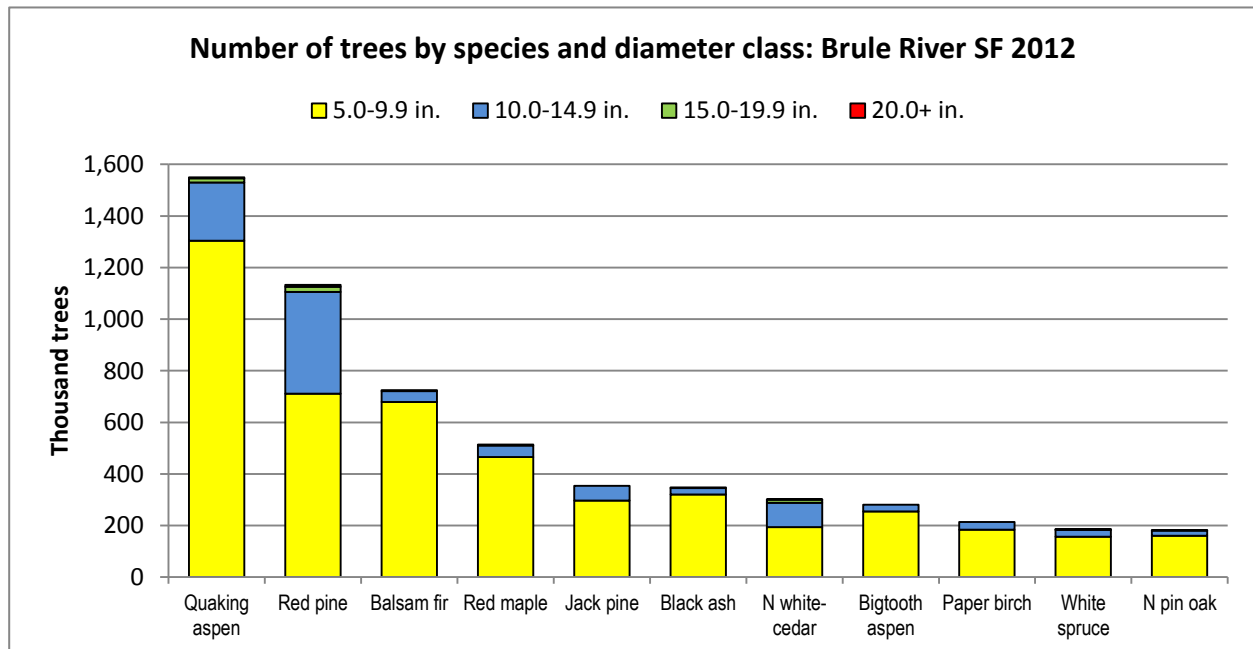
Number of trees by species and diameter

Quaking aspen, balsam fir and red maple are the most populous species due to large numbers of saplings. In trees over 5 inches dbh ([growing stock](#)), quaking aspen and red pine make up almost half of all trees. The vast majority (96%) of trees less than 10 inches dbh. Eastern white pine and red pine account for 72% of all trees over 20 inches dbh.

Number (thousands) of trees by species and diameter class.

Species	1.0-4.9 in.	5.0-9.9 in.	10.0-14.9 in.	15.0-19.9 in.	20.0+ in.	Total	% of trees > 5 in dbh	% of all trees
Quaking aspen	4,980	1,304	226	16	4	6,529	25%	26%
Red pine	220	711	395	20	8	1,353	18%	5%
Balsam fir	4,052	679	41	4		4,777	12%	19%
Red maple	2,734	465	45	4		3,248	8%	13%
Jack pine	317	297	57			671	6%	3%
Black ash	1,001	320	26	2		1,348	6%	5%
N white-cedar	49	194	94	12	2	351	5%	1%
Bigtooth aspen	830	255	26			1,111	5%	4%
Paper birch	1,050	185	29			1,264	3%	5%
White spruce	122	157	26	2	2	309	3%	1%
N pin oak	1,172	161	20		2	1,354	3%	5%
N red oak	24	27	27	4		83	1%	0%
E white pine	49	31	10	4	8	102	1%	0%
A basswood		35	14	2		51	1%	0%
Black spruce	342	39	10			391	1%	2%
Sugar maple	195	39	6	4		244	1%	1%
Balsam poplar	73	33	10	2		118	1%	0%
Bur oak	415	37	4	2		458	1%	2%
Total	19,357	5,046	1,086	77	26	25,592		

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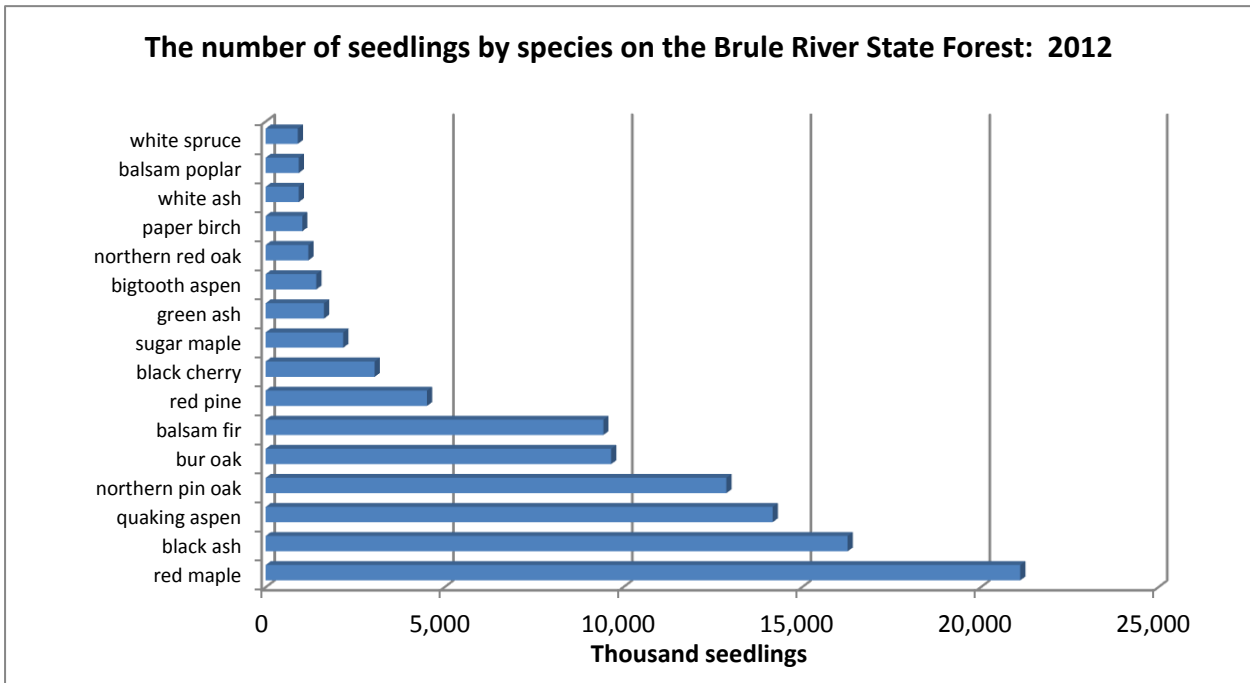
Number of seedlings by species and forest type group

Red maple, black ash, quaking aspen and northern pin oak account for half of all seedlings with one third of all seedlings on the aspen / birch forest type.

Number (thousands) of live seedlings on timberland by forest type group and species

Species	Aspen / birch	Elm / ash / cottonwood	Spruce / fir	Maple / beech / birch	White / red / jack pine	Oak / hickory	Total	Percent of total
red maple	8,153	98	195	3,954	2,368	5,834	21,115	16%
black ash	6,371	3,466	3,125	1,831	195	1,294	16,282	12%
quaking aspen	7,347	269	854	1,318	1,367	2,758	14,182	11%
N pin oak	2,197	-	-	1,367	3,320	4,467	12,889	10%
bur oak	1,465	-	73	586	3,808	1,684	9,666	7%
balsam fir	3,466	439	1,538	1,343	708	1,782	9,447	7%
red pine	-	-	-	24	4,296	24	4,516	3%
black cherry	561	415	-	415	1,098	415	3,051	2%
sugar maple	415	-	-	1,733	-	24	2,173	2%
green ash	952	195	49	-	98	342	1,635	1%
bigtooth aspen	806	-	-	122	49	293	1,416	1%
N red oak	269	24	-	317	24	561	1,196	1%
paper birch	439	24	24	49	24	342	1,025	1%
white ash	610	-	-	293	24	-	928	1%
balsam poplar	49	220	49	610	-	-	928	1%
white spruce	586	-	98	24	-	171	903	1%
Total	44,695	6,395	6,884	18,820	23,629	24,581	134,086	100%
% total	33%	5%	5%	14%	18%	18%	100%	

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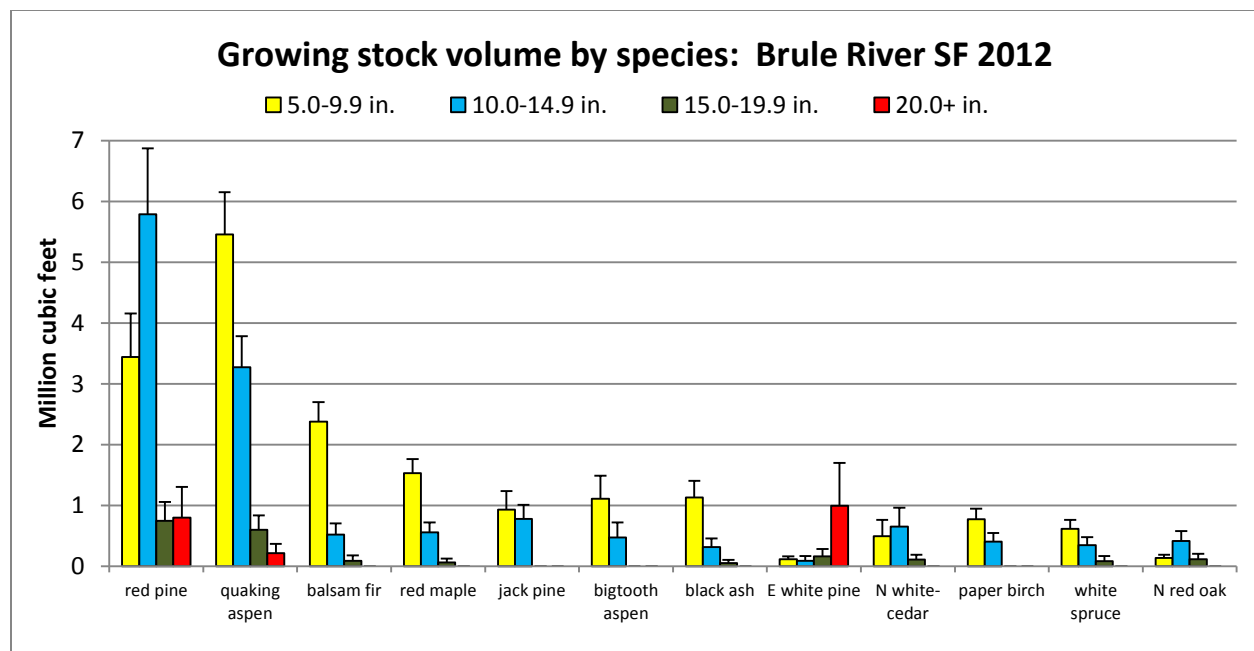
Volume of growing stock (>4.9in dbh) by species and diameter

Red pine and quaking aspen account for over half of all growing stock volume on the Brule River State Forest. The volume in trees less than 10 inches, 51%, is much higher than other state forests where, on average, one third of growing stock volume is in such small trees. Only 13% of trees are over 15 inches which is the lowest volume in large trees of all the state forests.

Volume of growing stock (thousand cubic feet) by species and diameter class.

	5.0-9.9 in.	10.0-14.9 in.	15.0-19.9 in.	20.0+ in.	Total Volume	% of all volume
red pine	3,439	5,789	747	799	10,774	28.2%
quaking aspen	5,458	3,275	600	218	9,550	25.0%
balsam fir	2,380	520	91		2,991	7.8%
red maple	1,534	557	63		2,153	5.6%
jack pine	932	781			1,713	4.5%
bigtooth aspen	1,111	473			1,584	4.1%
black ash	1,130	315	53		1,499	3.9%
E white pine	118	93	165	995	1,372	3.6%
N white-cedar	498	652	113		1,262	3.3%
paper birch	775	404			1,179	3.1%
white spruce	618	348	85		1,050	2.7%
N red oak	141	420	120		680	1.8%
N pin oak	319	105		127	551	1.4%
A basswood	175	220	90		485	1.3%
black spruce	184	128			312	0.8%
balsam poplar	107	129			236	0.6%
sugar maple	93	45	70		208	0.5%
Norway spruce	47	157			204	0.5%
bur oak	119	42			160	0.4%
green ash	98	28			126	0.3%
Total	19,349	14,567	2,197	2,139	38,252	100%
% of total	51%	38%	6%	6%	100%	

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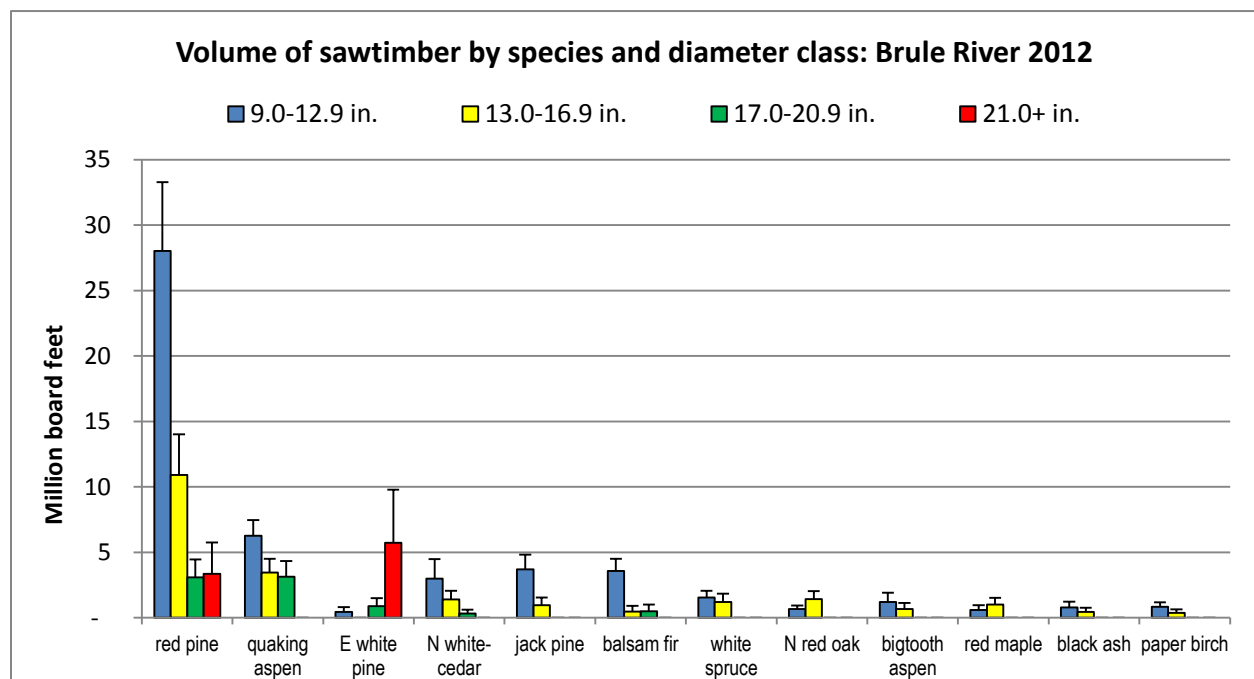


Volume of sawtimber by species and diameter class

Almost half of all sawtimber volume on the Brule River State Forest is in red pine with lesser amounts of aspen and eastern white pine. In addition, over half is in the smallest sawtimber size class, less than 13 inches. The Brule River State Forest has the lowest volume of sawtimber per timberland acre of all the state forests, 2.7 MBF/acre compared to 4.2 MBF/acre.

Volume of sawtimber (thousand board feet) by species and diameter class

	9.0-12.9 in.	13.0-16.9 in.	17.0-20.9 in.	21.0+ in.	Total	Percent total
red pine	28,030	10,907	3,072	3,358	45,368	48%
quaking aspen	6,260	3,452	3,139		12,851	14%
E white pine	449		870	5,723	7,042	7%
N white-cedar	2,979	1,400	310		4,690	5%
jack pine	3,689	952			4,642	5%
balsam fir	3,565	455	497		4,516	5%
white spruce	1,544	1,212			2,755	3%
N red oak	657	1,427			2,084	2%
bigtooth aspen	1,187	654			1,841	2%
red maple	583	1,006			1,590	2%
black ash	793	450			1,243	1%
paper birch	833	375			1,208	1%
A basswood	232	472	446		1,150	1%
N pin oak	359			635	995	1%
black spruce	980				980	1%
Norway spruce	459	409			868	1%
Total	52,802	24,094	8,335	9,717	94,948	100%
Percent total	56%	25%	9%	10%	100%	

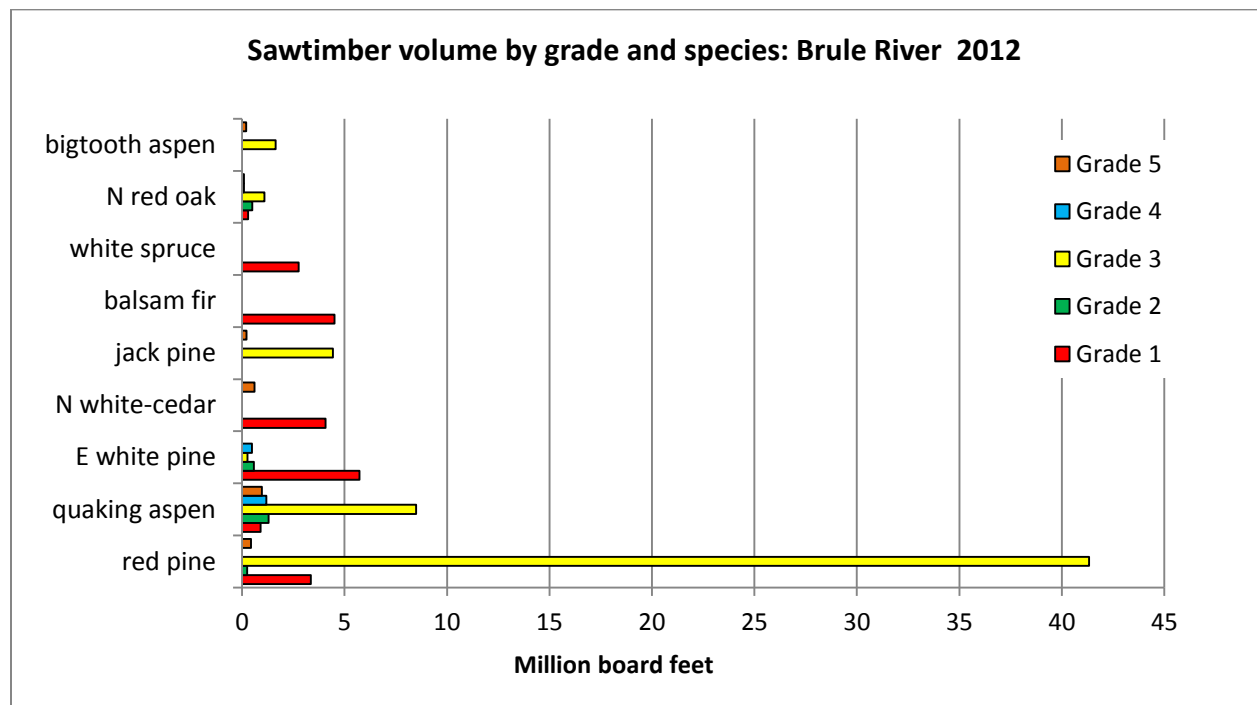


Volume of sawtimber by [tree grade](#) and species

Although about half of all sawtimber is in red pine, the majority of this is Grade 3 logs. Only one quarter of all sawtimber is grade 1 and this is mostly eastern white pine, northern white cedar and balsam fir.

Volume of sawtimber (thousand boardfeet) on timberland by species and tree grade

Species	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Total	% Grade 1
red pine	3,358	242	41,336	-	431	45,368	7%
quaking aspen	899	1,302	8,488	1,190	972	12,851	7%
E white pine	5,723	575	265	479	-	7,042	81%
N white-cedar	4,075	-	-	-	615	4,690	87%
jack pine	-	-	4,431	-	211	4,642	0%
balsam fir	4,516	-	-	-	-	4,516	100%
white spruce	2,755	-	-	-	-	2,755	100%
N red oak	299	501	1,091	99	94	2,084	14%
bigtooth aspen	-	-	1,636	-	205	1,841	0%
red maple	-	-	1,139	99	351	1,590	0%
black ash	-	193	1,050	-	-	1,243	0%
paper birch	-	-	1,208	-	-	1,208	0%
A basswood	446	472	232	-	-	1,150	39%
N pin oak	-	-	892	103	-	995	0%
black spruce	980	-	-	-	-	980	100%
Total	23,919	3,285	62,468	2,061	3,215	94,948	
Percent total	25%	3%	66%	2%	3%	100%	



Forest Health and Sustainability

There are several measures that serve as indicators of forest health and sustainability. These include the ratio of average annual net growth to volume, the ratio of mortality to gross growth, the number and volume of standing dead trees and the percentage of crown dieback and transparency. These measures assess very different aspects of forest health and have varying degrees of precision and statistical reliability. Since growth and mortality are based on only one year of data, sampling errors are high. For this reason and in order to normalize between site variability, ratios are presented as well as absolute values.

The ratio of growth to volume and the ratio of mortality to gross growth are measures of sustainability of species. So long as the growth rate is positive and maintained over time and so long as mortality does not surpass growth for long periods, a species should continue to play a sustainable role in the forest.

Mortality may be caused by insects, disease, adverse weather, succession, competition, fire, old age or human and animal activity and is often the result of a combination of these factors. The ratio of mortality to gross growth (growth plus mortality) indicates whether a species is declining or maintaining its current position in a particular forest. By normalizing mortality by growth rate, the ratio allows comparisons across diverse landscapes.

The number and volume of standing dead trees is much less precise as there is little indication of when trees died and some species will remain vertical for a longer period. But numbers are larger and the sampling error will be lower. Standing dead trees serve as an indicator of forest health and diversity in several ways, functioning as indicators of past mortality events, as habitat for many species and as carbon storage.

The condition of tree crowns within a stand reflects the overall health of a forest. Crown indicators can also vary by species and are often temporary. Dieback is the percentage of dead branch tips in the crown. Crown transparency is a measure of the proportion of the crown through which the sky is visible. A forest suffering from a disease epidemic or insect infestation will have obvious dieback and high transparency.

Because these measures are all approximations with a certain degree of error, taken together they can give a general accounting of forest health and sustainability.

Ratio of annual net growth to volume

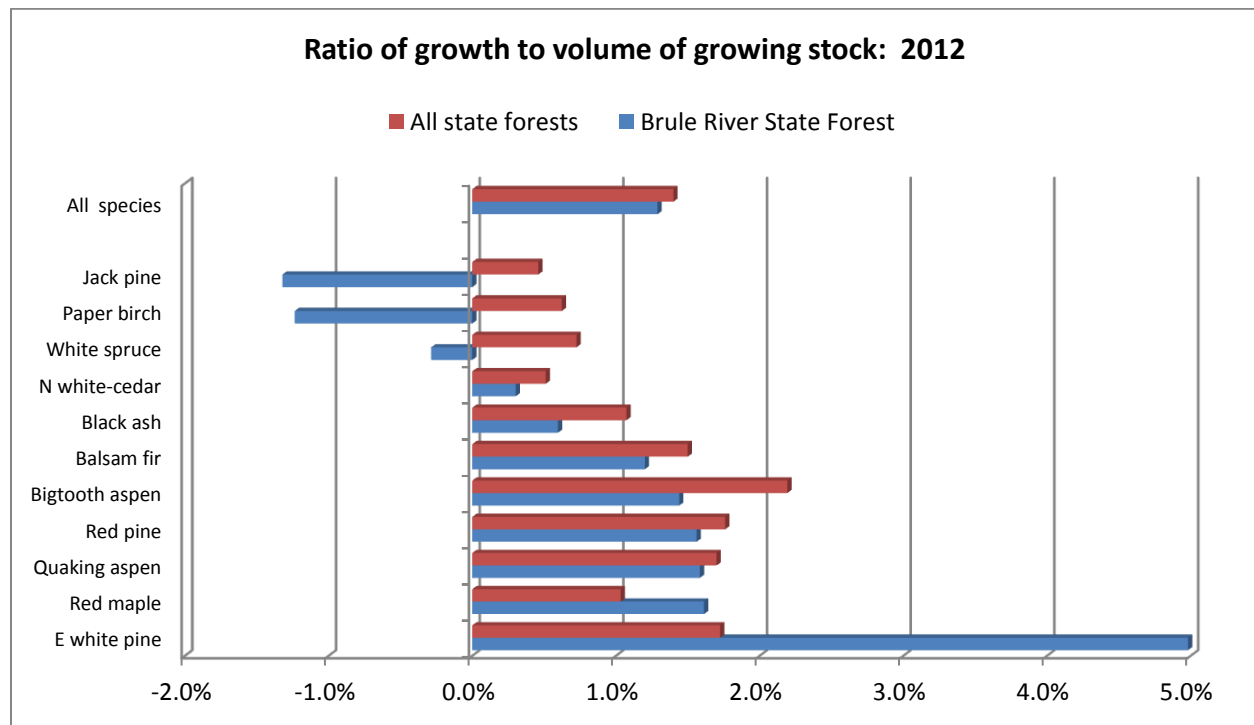
Quaking aspen and red pine make up 65% of all volume growth. Species with higher than average growth to volume ratios include eastern white pine, red maple and northern red oak.

Species with growth to volume ratios that are lower than the average for all state forests include jack pine, paper birch, bigtooth aspen, white spruce, black ash and northern pin oak. The average growth rate on the Brule River State Forest is slightly lower than for all state forests combined.

Average annual net growth (cubic feet per year) and growth/ volume ratio for the Brule River State Forest and all state forests combined.

Species*	Average annual net growth	Growth / volume ratio	
		Brule River State Forest	All state forests
Red pine	168,257	1.6%	1.8%
Quaking aspen	151,305	1.6%	1.7%
Balsam fir	35,921	1.2%	1.5%
Red maple	34,747	1.6%	1.0%
Jack pine	-22,650	-1.3%	0.5%
Bigtooth aspen	22,815	1.4%	2.2%
Black ash	8,943	0.6%	1.1%
E white pine	68,368	5.0%	1.7%
N white-cedar	3,808	0.3%	0.5%
Paper birch	-14,570	-1.2%	0.6%
White spruce	-3,012	-0.3%	0.7%
N red oak	17,142	2.5%	1.4%
N pin oak	3,817	0.7%	1.7%
All species	492,987	1.3%	1.4%

* Figures in red have a sampling error of at least 50% and should be used with caution.



Ratio of mortality to gross growth

The species with the highest mortality to gross growth ratio for the Brule River State Forest are paper birch, jack pine, white spruce and bigtooth aspen. All have ratios over 50% which means that over half of all growth is lost to mortality. The mortality ratio for these species is much higher than average for all state forests.

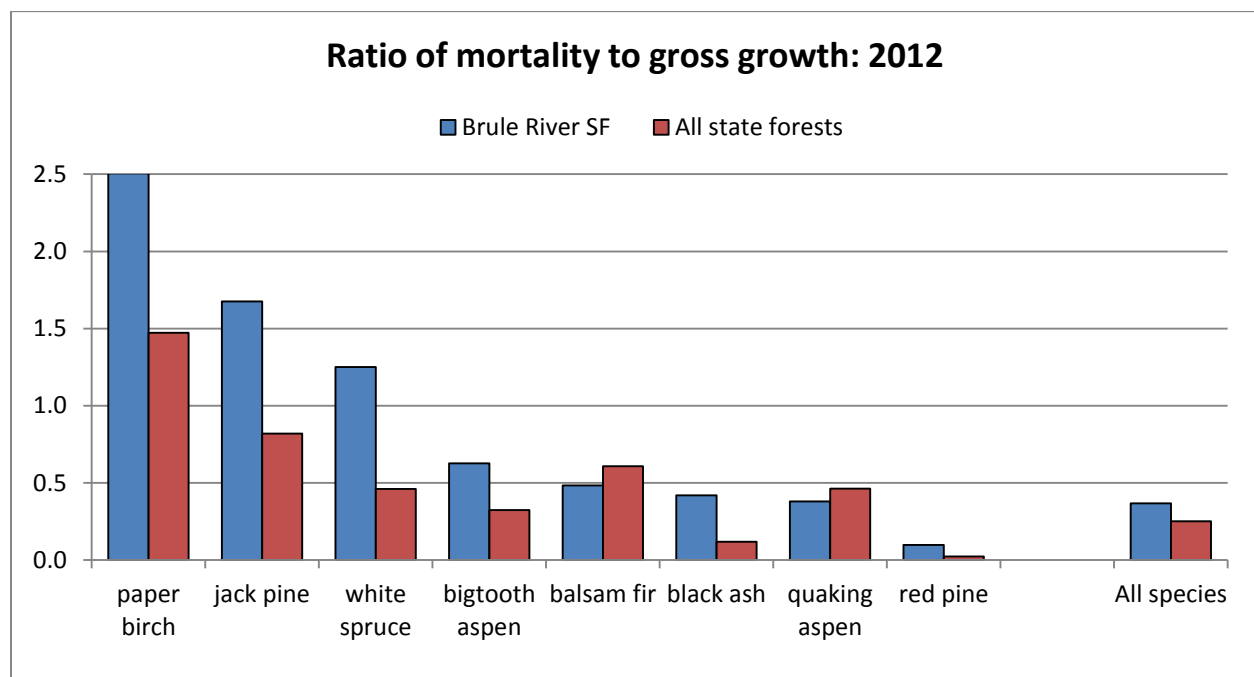
The mortality to gross growth ratio for all species as well as the annual percentage of trees dying is substantially higher on the Brule River State Forest compared to all properties combined.

Mortality to gross growth ratio of growing stock on the Northern Highland American Legion and for all state forests combined.

Species**	Brule River State Forest				All state forests			
	Mortality of growing stock (cft/yr)	Gross growth (cft/yr)	Mortality / gross growth	Percent trees dying per year*	Mortality of growing stock (cft/yr)	Gross growth (cft/yr)	Mortality / gross growth	Percent trees dying per year*
paper birch	24,255	9,685	2.50	0.67%	303,493	206,027	1.47	0.93%
jack pine	56,199	33,549	1.68	1.94%	194,865	237,779	0.82	0.44%
white spruce	15,056	12,044	1.25	0.99%	58,164	126,634	0.46	0.59%
bigtooth aspen	38,157	60,971	0.63	2.88%	171,043	529,353	0.32	0.54%
balsam fir	33,461	69,381	0.48	0.17%	334,663	550,824	0.61	0.16%
black ash	6,427	15,369	0.42	0.23%	20,809	177,520	0.12	0.10%
quaking aspen	92,149	243,454	0.38	0.35%	761,316	1,647,117	0.46	0.43%
red pine	18,060	186,317	0.10	0.52%	39,784	1,760,178	0.02	0.10%
All species	285,913	778,899	0.37	0.40%	2,767,937	11,082,704	0.25	0.20%

* Number of trees (at least 1 inch dbh) that died in one year divided by number of all trees, live and dead.

** Figures in red have a sampling error of at least 50% and should be used with caution.



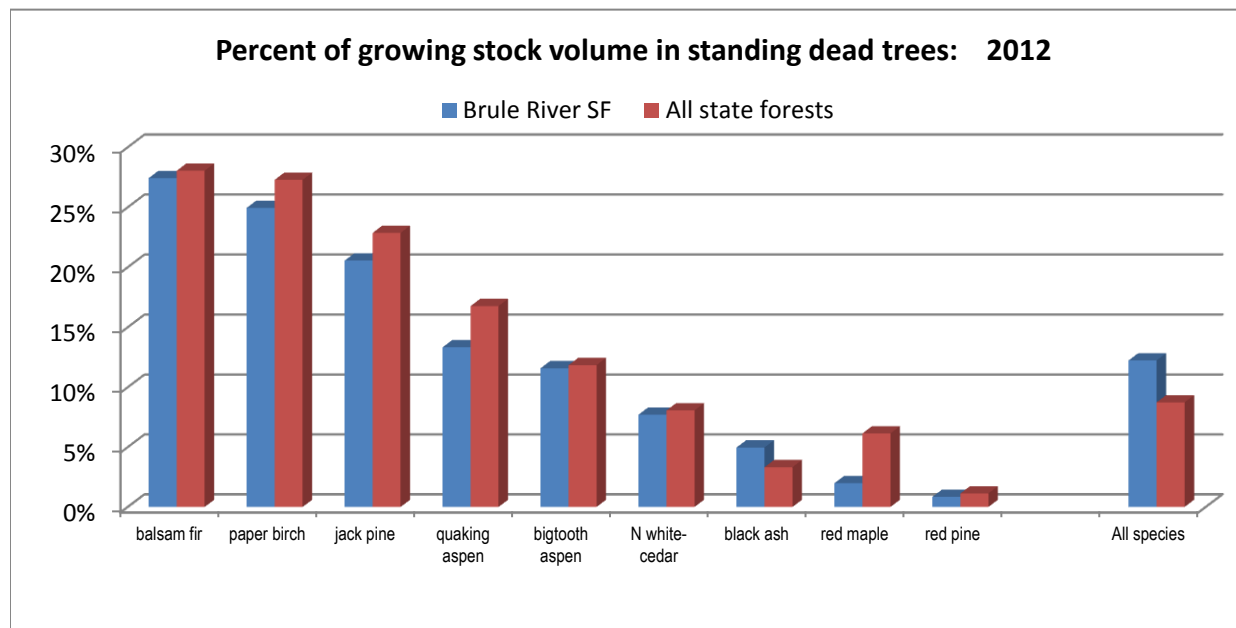
Percent standing dead trees and volume by species

The percentage of standing dead trees and volume in dead trees over 5 inches dbh is higher on the Brule River State Forest than on all state forests combined. Northern pin oak, northern red oak and white spruce have a much higher volume of standing dead trees on the Brule River State Forest than on all state forests combined. Quaking aspen and red maple have a lower percentage of standing dead trees and volume compared to all properties combined.

Percent of all trees and all volume in trees >5 inches dbh that are standing dead.

Species*	Percent of trees that are standing dead		Percent of volume in standing dead trees	
	Brule River SF	All state forests	Brule River SF	All state forests
balsam fir	4.3%	2.3%	27.4%	28.0%
paper birch	5.0%	9.9%	25.0%	27.3%
jack pine	11.2%	5.9%	20.6%	22.9%
quaking aspen	3.8%	4.8%	13.3%	16.8%
bigtooth aspen	5.0%	2.6%	11.6%	11.8%
N white-cedar	6.0%	5.6%	7.7%	8.1%
black ash	1.0%	1.2%	5.0%	3.3%
red maple	0.4%	1.2%	2.0%	6.1%
red pine	0.7%	1.4%	0.8%	1.1%
N pin oak	6.8%	3.3%	37.5%	14.8%
N red oak	12.0%	2.1%	32.7%	4.8%
white spruce	3.8%	5.9%	18.2%	12.0%
A basswood	5.6%	1.1%	0.8%	2.4%
All species	3.6%	2.8%	12.2%	8.7%

* Red indicates species which make up less than 3% of total volume and have high sampling error.



Crown dieback and transparency

The major species with the highest values for dieback on the Brule River State Forest are black ash, jack pine and quaking aspen. These values are all much higher than for all forests combined for these species.

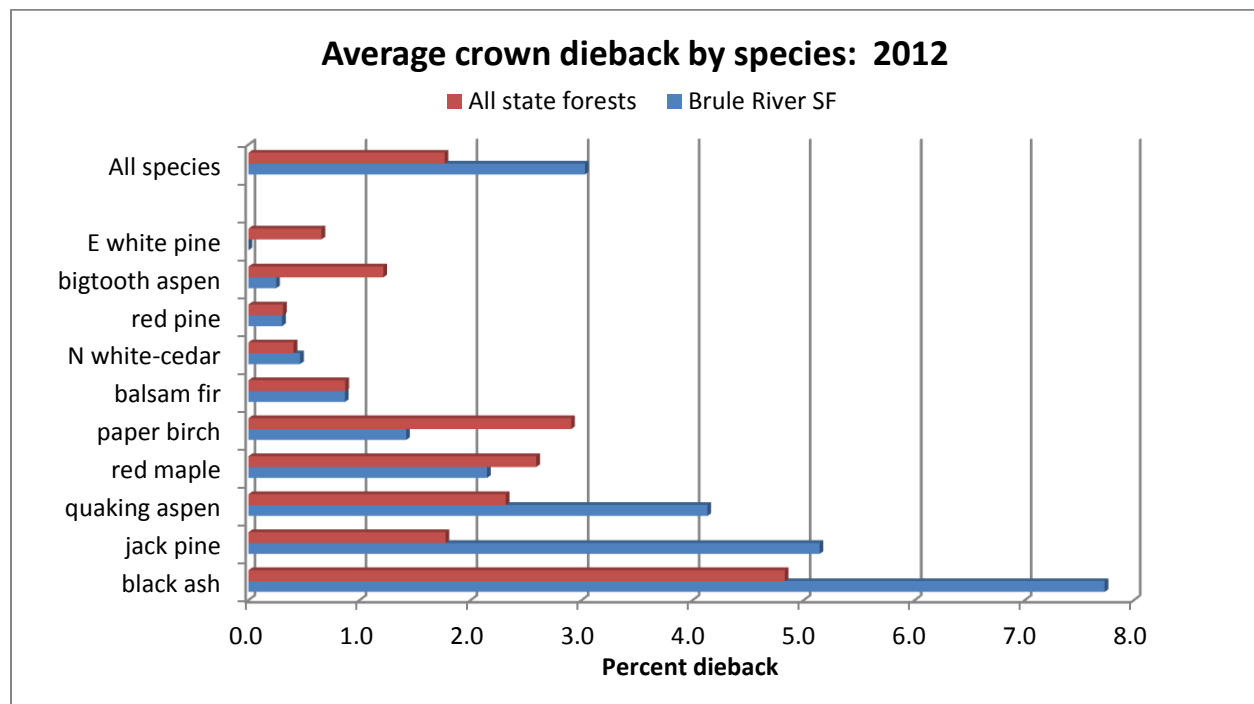
The major species with the highest values for crown transparency are black ash, quaking aspen, and red maple.

In general, dieback is 67% higher on the Brule River State Forest and transparency is only slightly higher than for all state forests combined.

Average crown dieback and transparency for the Brule River State Forest compared to all state forests combined.

Species*	Average crown dieback		Average crown transparency	
	Brule River State Forest	All state forests	Brule River State Forest	All state forests
black ash	7.7	4.8	28.0	22.0
jack pine	5.1	1.8	12.5	17.9
quaking aspen	4.1	2.3	23.9	20.1
red maple	2.1	2.6	21.1	17.8
paper birch	1.4	2.9	19.3	18.8
balsam fir	0.9	0.9	12.9	13.6
N white-cedar	0.5	0.4	9.4	18.1
red pine	0.3	0.3	11.7	13.6
bigtooth aspen	0.2	1.2	18.7	19.3
E white pine	0.0	0.7	12.2	17.0
N pin oak	18.9	8.2	32.8	21.4
N red oak	6.2	1.9	22.2	16.2
bur oak	4.4	3.3	25.5	20.3
white spruce	0.2	0.4	10.6	11.6
All Species	3.0	1.8	18.1	17.1

* Figures in red indicate species which make up less than 3% of total volume and have high sampling error.



Trends

Growing stock volume

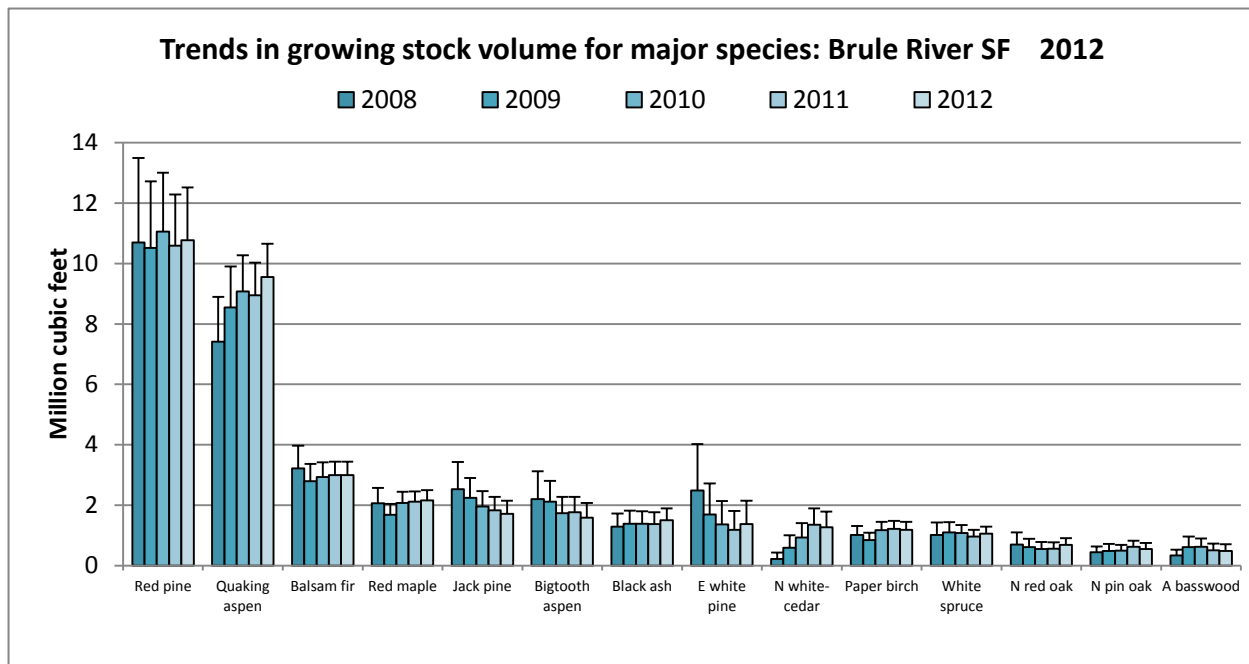
There appear to be trends in species volume which cannot be verified statistically since the data is highly auto-correlated. Future re-measurements may help to reduce this correlation.

The increase in northern white cedar volume from 2008 to 2012 may be significant but auto-correlation may make this difficult to determine.

Growing stock volume (thousand cubic feet) by major species and year

Species	2008*	2009	2010	2011	2012	Change 2008 to 2012
Red pine	10,693	10,515	11,056	10,593	10,774	1%
Quaking aspen	7,414	8,549	9,072	8,951	9,550	29%
Balsam fir	3,221	2,791	2,935	2,992	2,991	-7%
Red maple	2,064	1,682	2,071	2,115	2,153	4%
Jack pine	2,525	2,244	1,953	1,826	1,713	-32%
Bigtooth aspen	2,203	2,110	1,736	1,764	1,584	-28%
Black ash	1,288	1,388	1,382	1,372	1,499	16%
E white pine	2,490	1,693	1,361	1,185	1,372	-45%
N white-cedar	213	586	926	1,351	1,262	492%
Paper birch	1,013	846	1,168	1,211	1,179	16%
White spruce	1,007	1,100	1,076	959	1,050	4%
N red oak	691	606	546	561	680	-2%
N pin oak	442	485	494	618	551	25%
All species	36,997	36,592	37,841	37,622	38,252	3%

* Each year contains previous years' data, i.e. 2010 includes 2008, 2009 and 2010 data.



Definition of Terms

Average net annual growth of growing stock --The annual change in cubic foot volume of sound wood in live sawtimber and poletimber trees, and the total volume of trees entering these classes through ingrowth, less volume losses resulting from natural causes. Average net annual growing stock is the average for the years between inventories.

Forest type-WisCFI. - A tract of forest land characterized by the predominance of one or more key species which make up 50 percent or more of the basal area of saw-timber and pole-timber stands, or of the number of trees in seedling and sapling stands. Forest land less than 10 percent stocked with commercial tree species is classified as upland brush, grass or lowland brush.

Aspen--Aspen comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands.

Bottomland hardwoods --Any combination of silver maple, green ash, swamp white oak, American elm, river birch, and cottonwood comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands. Hardwood dominated forests occurring on floodplains and some terraces.

White birch --White Birch comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands.

White cedar --White cedar comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands. In mixed swamp conifer stands, white cedar is predominant.

Central hardwoods --Any combination of oaks, hickories, elms, black cherry, hackberry, red maple, white ash, green ash, basswood, and sugar maple, which does not satisfy the defining criteria for NH, MR, or O cover types. The CH type occurs only on uplands within and south of the Tension Zone (southern Wisconsin).

Balsam Fir --Balsam fir comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands. In mixed swamp conifer stands, balsam fir is predominant.

Hemlock --Hemlock comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands.

Miscellaneous Conifers --Conifer forests dominated by uncommon or exotic species; e.g. Eastern red cedar, Scotch pine, Norway spruce, European Larch.

Miscellaneous Deciduous --Hardwood forests dominated by uncommon or exotic species; e.g. box elder, honey locust, black locust, Norway maple.

Red Maple --Red Maple comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands. If soil is poorly drained, then swamp hardwood.

Northern hardwoods --Any combination of sugar maple, beech, basswood, white ash, and yellow birch comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands.

Oak --Oak comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in saplings and seedling stands.

Scrub oak --More than 50% of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands is comprised of oak with site indices ≤ 50 . Typical forest products include only fuelwood and fiber.

Red pine --Red pine comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands. In mixed pine stands, red pine is predominant.

White pine --White pine comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands. In mixed pine stands, eastern white pine is predominant.

Jack pine --Jack pine comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands. In mixed pine stands, jack pine is predominant.

Black spruce --Black spruce comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands. In mixed swamp conifer stands, black spruce is predominant.

Swamp hardwoods --Any combination of black ash, green ash, red maple, silver maple, swamp white oak, and American elm that comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands. This type occurs on wetlands characterized by periodic inundation (fluctuating water table near or above the soil surface) and nearly permanent subsurface water flow.

White Spruce --White spruce comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands.

Tamarack --Tamarack comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands. In mixed swamp conifer stands, tamarack is predominant.

Black Walnut --Black walnut comprises 50% or more of the basal area in saw-timber and pole-timber stands, or 50% or more of the stems in sapling and seedling stands.

Growing-stock tree.0—A live timberland tree of commercial species that meets specified standards of size, quality, and merchantability. (Note: Excludes rough, rotten, and dead trees.)

Growing-stock volume.0—Net volume in cubic feet of growing-stock trees 5.0 inches d.b.h. and over, from 1 foot above the ground to a minimum 4.0-inch top diameter outside bark of the central stem or to the point where the central stem breaks into limbs.

Habitat types and habitat type groups — An aggregation of units of land capable of producing similar plant communities at climax and having similar potential productivity. Habitat type groups are groupings of habitat types with similar soil moisture and nutrient regimes and potential productivity.

Sawtimber tree.0—A live tree of commercial species containing at least a 12-foot saw log or two noncontiguous saw logs 8 feet or longer, and meeting regional specifications for freedom from defect. Softwoods must be at least 9.0 inches d. b. h. Hardwoods must be at least 11.0 inches d.b.h.

Sawtimber volume.0-Net volume of the saw-log portion of live sawtimber in board feet, International 1/4-inch rule (unless specified otherwise), from stump to a minimum 7.0 inches top d. o. b, for softwoods and a minimum 9.0 inches top d. o. b, for hardwoods.

Site index.0-An expression of forest site quality based on the height of a free-growing dominant or codominant tree of a representative species in the forest type at age 50.

Stand-size class.0-A classification of stocked (see Stocking) forest land based on the size class of live trees on the area; that is, sawtimber, poletimber, or seedlings and saplings.

Nonstocked - Meeting the definition of accessible forest land, and one of the following applies: (a) less than 10 percent stocked by trees of any size, and not classified as cover trees (see code 6), or (b) for several woodland species where stocking standards are not available, less than 5 percent **crown cover** of trees of any size.

Large saw-timber stands (15+)" - Saw-timber stands typed as large saw-timber within the primary cover type based on the basal area size class distribution of saw timber trees 15.0 inches d.b.h. and larger.

Small saw-timber stands (Softwoods 9-14.9", Hardwoods 11-14.9") - Saw-timber stands typed as small saw-timber within the primary cover type based on the basal area size class distribution of saw-timber trees less than 15.0 inches d.b.h.

Pole-timber stands (Softwoods 5-8.9", Hardwoods 5-10.9") - Stands typed as pole-timber within the primary cover type having a minimum net basal area of 10 sq. ft./acre.

Sapling stands (1-4.9") - Forest stands typed as saplings within the primary cover type having a minimum of 200 seedlings per acre.

Seedling stands (<1") - Forest stands typed as seedlings within the primary cover type having a minimum of 200 seedlings per acre.

Stand-age class.0-A classification based on age of the main stand. Main stand refers to trees of the dominant forest type and stand-size class.

Timberland.0-Forest land that is producing, or is capable of producing, more than 20 cubic feet per acre per year of industrial wood crops under natural conditions, that is not withdrawn from timber utilization, and that is not associated with urban or rural development. Currently inaccessible and inoperable areas are included. (Timberland was formerly called commercial forest land.)

Tree grade.0-A classification of the lower 16 feet of the bole of standing trees based on external characteristics as indicators of the quality and quantity of lumber that could be produced from the tree. Tree grade was assigned to a sample of hardwood sawtimber trees during the 1996 inventory. See Wisconsin Dept of Natural Resources Division of Forestry. October 2011. Wisconsin State Forest Continuous Forest Inventory Volume I: Field Data Collection Procedures for Phase 2 Plots-Version 3.0, <http://dnr.wi.gov/topic/ForestPlanning/documents/WisCFIvolumelversion3.pdf>, pp 219-229.

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For more information on the WisCFI database including background, reports, tables and access to the data, please go to the WIDNR Wisconsin's Continuous Forest Inventory website at: <http://dnr.wi.gov/topic/ForestPlanning/forestInventory.html>