

Forest characteristics of the Flambeau River State Forest



WisCFI data 2007 - 2012

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Summary of the Flambeau River State Forest

There are approximately 83,469 ($\pm 1.1\%$ sampling error or SE) acres of [timberland](#) on the Flambeau River State Forest. The major [forest types](#) are northern hardwoods and aspen. These two types account for 52% of timberland in the forest. Over half of all acreage is in pole-sized stands, 9% in seedling and sapling stands (mostly aspen and black spruce) and about 40% in sawtimber-sized stands (mostly northern hardwoods). The majority of stands are between 21 and 80 years of age. Average site index on the forest is 59.6 which is about average for all state forests. About half of all timberland is classified as having a mesic habitat type and the other half is classified as mesic to wet mesic or wet mesic to wet.

There are 52 million trees ($\pm 3.8\%$ SE), 110.9 million cubic feet of growing stock volume ($\pm 3.5\%$ SE) and 319.6 million board feet of sawtimber ($\pm 5.6\%$ SE) on the Flambeau River State Forest. The most numerous [growing stock](#) species are sugar maple, red maple and quaking aspen with sugar maple accounting for 41% of all seedlings. The majority of growing stock and sawtimber volume is in sugar maple and red maple. However, these two species account for only 21% of grades 1 and 2 sawtimber. Eastern hemlock, white spruce and American basswood account for the majority of grade 1 logs. The Flambeau River State Forest has about 3.8 MBF/acre of sawtimber volume compared to 4.2 MBF/acre for all state forests.

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. On the Flambeau River State Forest, several of these measures are slightly higher than average, including the ratio of mortality to gross growth, the number and volume of standing dead trees and crown dieback and transparency.

The ratio of net annual growth to volume on the Flambeau River State Forest is 1.4%, equal to the average growth rate for all state forests. Species with higher than average growth to volume ratios include sugar maple, American basswood, northern red oak and eastern hemlock. Species with growth to volume ratios that are lower than the average for all state forests include eastern white pine, white ash, black ash, tamarack and white spruce.

Tamarack and white spruce have higher than average mortality to gross growth ratios on the Flambeau River State Forest. Quaking aspen and eastern hemlock have high mortality rates on all the forests including the Flambeau River. The overall mortality to growth ratio is slightly higher on the Flambeau River State Forest compared to all state forests.

Both the percentage of standing dead trees and volume in dead trees over 5 inches dbh is higher on the Flambeau River State Forest than on all state forests combined. Quaking aspen, eastern white pine, and sugar maple have a higher number and volume of standing dead trees on the Flambeau River State Forest than on all state forests.

The major species with higher than average values for dieback on the Flambeau River State Forest are black ash, white ash, tamarack, yellow birch and sugar maple. The ashes also have relatively high crown transparency as well. Both average crown dieback and transparency are slightly higher on the Flambeau River State Forest.

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 randomly 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 randomly located. 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

Almost one third of the timberland acreage on the Flambeau River State Forest is in northern hardwoods, 56% of which is in sawtimber-sized stands. About half of all sawtimber is in northern hardwoods stands. Over half of all acreage is in pole-sized stands.

Acres of timberland by WisDNR forest type and size class

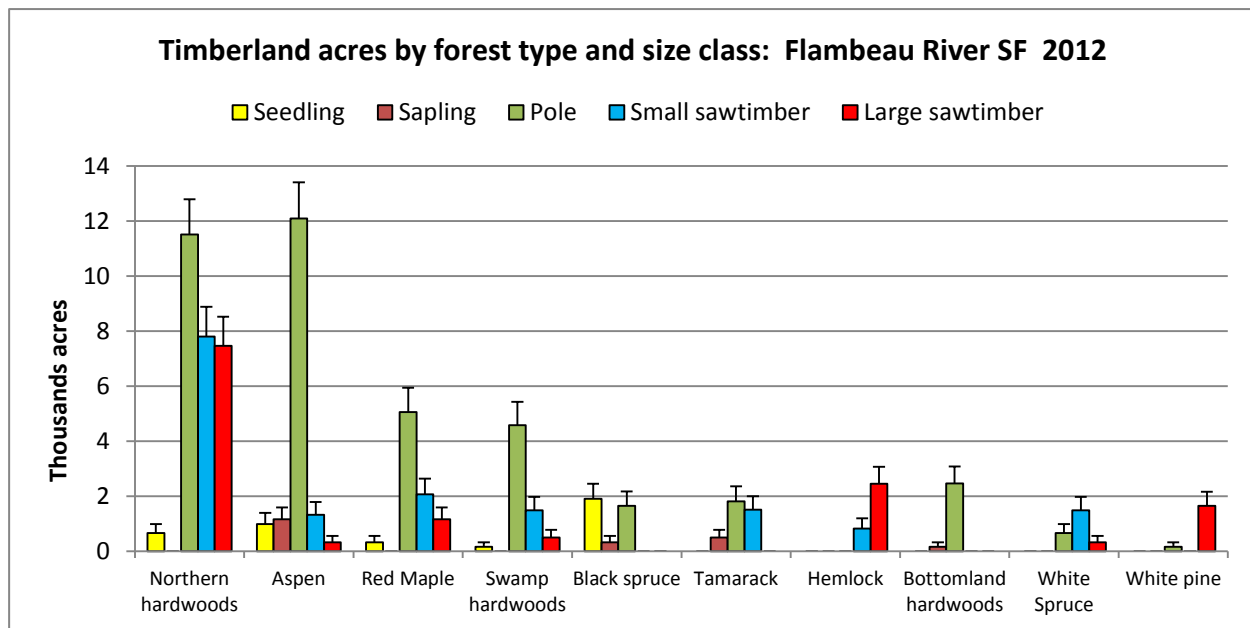
Forest type	Seedling	Sapling	Pole*	Small sawtimber*	Large sawtimber*	Total WisCFI**	Total WISFIRS
Northern hardwoods	662	-	11,517	7,801	7,467	27,447	31,403
Aspen	993	1,159	12,099	1,325	331	15,907	16,622
Red Maple	331	-	5,063	2,070	1,159	8,622	5,480
Swamp hardwoods	166	-	4,581	1,490	497	6,734	5,077
Black spruce	1,904	331	1,656	-	-	3,891	3,683
Tamarack	-	497	1,821	1,510	-	3,827	3,442
Hemlock	-	-	-	828	2,450	3,278	2,109
Bottomland hardwoods	-	166	2,467	-	-	2,633	110
White Spruce	-	-	662	1,490	331	2,484	1,784
White pine	-	-	166	-	1,647	1,813	1,216
Balsam Fir	331	-	1,325	-	-	1,656	316
Red pine	-	-	166	922	166	1,253	761
White birch	-	-	497	331	-	828	553
Misc Deciduous	370	78	331	-	-	780	17
Oak	-	-	331	-	331	662	79
White cedar	-	-	-	497	-	497	1,666
Misc Conifer	-	-	166	-	-	166	6
All forest types	4,758	2,231	42,845	18,263	14,379	83,469	74,324

*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 basswood, elm and quaking aspen and Misc Coniferous is mostly larch.

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



Acres by forest type and stand age

About 74% of acreage is between 21 and 80 years of age. Only 7 % is over 100 years old and 7% is 20 years or less. Northern hardwoods and swamp hardwoods make up 56% of timberland acres in old stands (>100 yrs) and the aspen type has the highest acreage in young stands (<21 yrs).

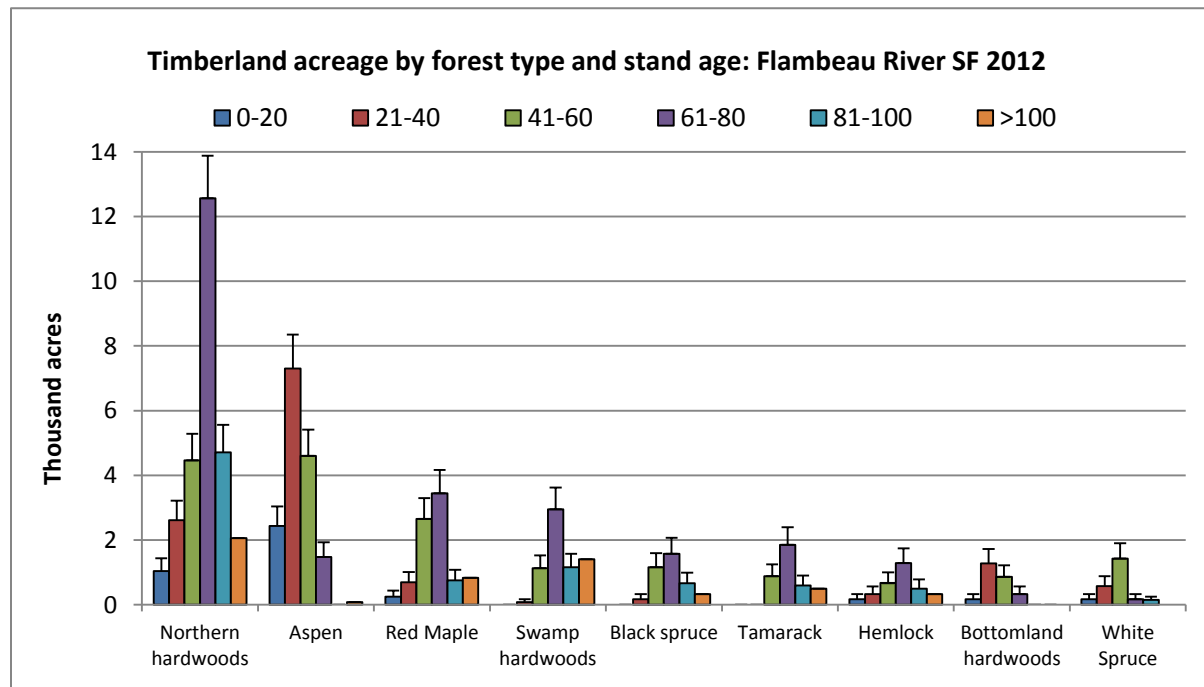
Acres of timberland by forest type and stand age

Forest type	0-20 yrs	21-40 yrs	41-60 yrs	61-80 yrs	81-100 yrs	>100 yrs	Total
Northern hardwoods	1,041	2,609	4,462	12,563	4,714	2,058	27,447
Aspen	2,438	7,306	4,604	1,476	-	83	15,907
Red Maple	248	695	2,649	3,444	758	828	8,622
Swamp hardwoods	-	83	1,131	2,953	1,159	1,407	6,734
Black spruce	-	166	1,159	1,573	662	331	3,891
Tamarack	-	-	879	1,852	599	497	3,827
Hemlock	166	328	669	1,287	497	331	3,278
Bottomland hardwoods	166	1,274	862	331	-	-	2,633
White Spruce	166	580	1,428	166	145	-	2,484
White pine	30	90	617	248	828	-	1,813
Balsam Fir	331	331	580	248	-	166	1,656
Red pine	-	412	841	-	-	-	1,253
White birch	-	-	248	331	-	248	828
Misc Deciduous	370	331	78	-	-	-	780
Oak	-	166	-	331	166	-	662
White cedar	-	-	166	-	166	166	497
Misc Conifer	-	166	-	-	-	-	166
Total WisCFI*	5,618	14,701	20,510	26,804	9,694	6,143	83,469
Total WISFIRS**	3,917	10,767	7,700	10,841	6,811	6,558	46,594

*Lowland brush and unsurveyed acreage have been omitted.

**27,730 acres were not recorded as to age.

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



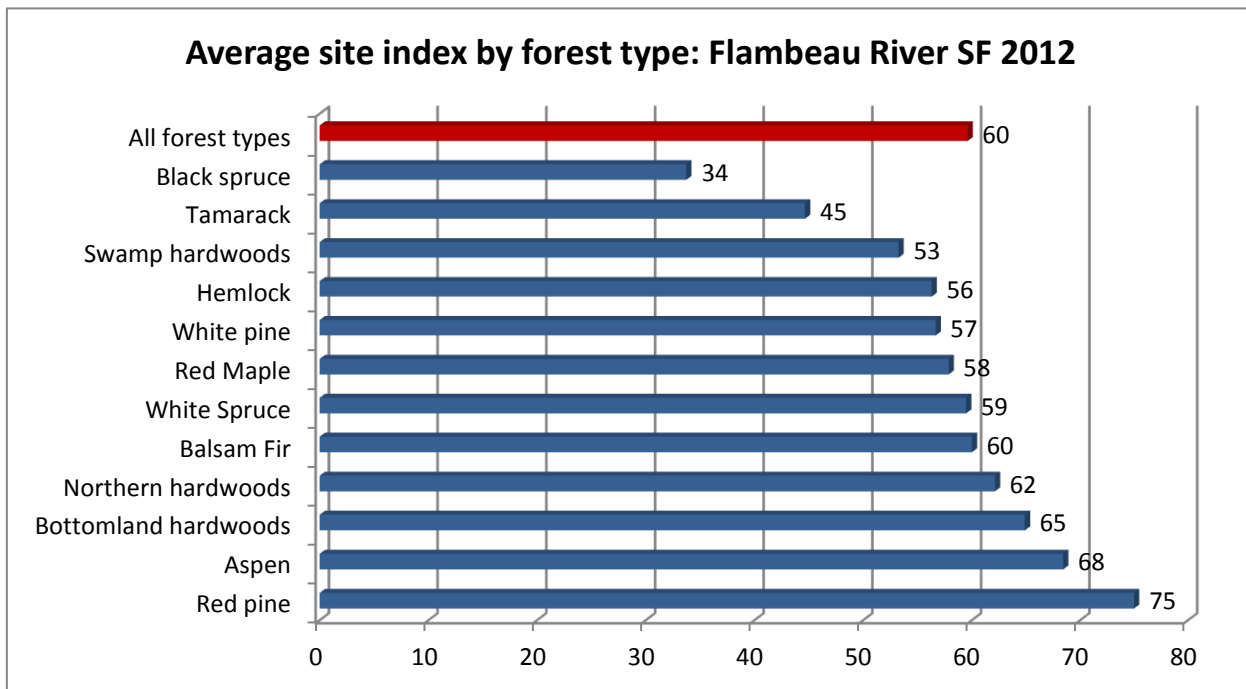
Acres by [site index](#) and forest type

The average site index on the Flambeau River State Forest is 59.6 compared to 56.8 for all state forests. The types with the highest average site index are red pine, aspen, and bottomland hardwoods. The forest types with the lowest site index are mostly wetland types such as black spruce, tamarack and swamp hardwoods.

Acres of timberland by forest type and site index.

Forest type*	<=30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	>90	Total acres
Northern hardwoods		1,076	3,047	7,251	8,610	6,035	1,097	166	28,026
Aspen		83	2,152	1,141	4,011	6,242	1,928	349	15,237
Red maple		414	1,751	2,566	2,980	662	248		8,904
Swamp hardwoods		1,242	2,015	1,231	1,418	580	248		6,365
Black spruce	1,325	1,987	331	248					3,974
Tamarack	497	1,076	1,045	787	124	300			3,720
Hemlock		331	745	991	752	293	166		3,299
Bottomland hardwoods			166	1,026	448	828		166	2,798
White spruce			621	662	668	532			2,598
White pine		166	176	662	809				1,787
Balsam fir		83	662	248		497		166	1,636
Red pine					331	756		166	1,172
White birch			83	497	248				863
Misc deciduous		78	166		370	166			745
Oak					331	331			745
White cedar	166	166			166				497
Misc conifer					166				166
Total	1,987	6,977	13,097	17,642	21,432	17,469	3,688	1,011	83,469

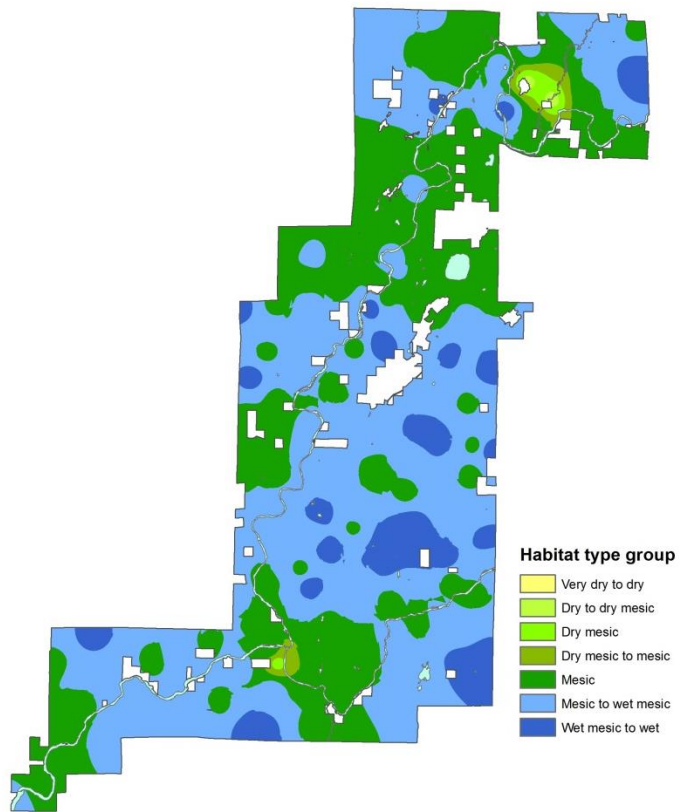
*Lowland brush and unsurveyed acreage have been omitted.



Habitat types

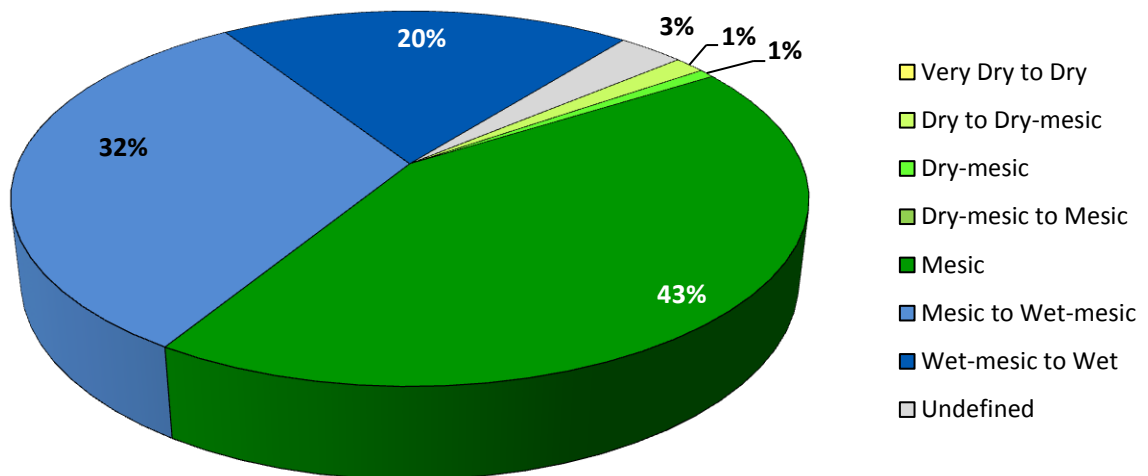
The habitat type system is a method of site classification that uses the floristic composition of a forest community (understory herbs and shrubs as well as trees) as an indicator of site capability along a moisture/nutrient gradient ranging from very dry to wet and nutrient poor to nutrient rich (Kotar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

Only 24% of acreage on the state forests was sampled for habitat type so percentages are reported instead of actual acres. About 43% of all timberland on the Flambeau River State Forest is classified as mesic and 52% is classified as mesic to wet mesic or wet mesic to wet. Most of the mesic timberland is in northern hardwoods and most of the wettest land is in black spruce, tamarack and bottomland hardwoods.



This map is based on interpolated plot data and is meant to be only a general depiction of the location of various habitat types within the state forest.

Flambeau River State Forest



Tree Numbers and Volume

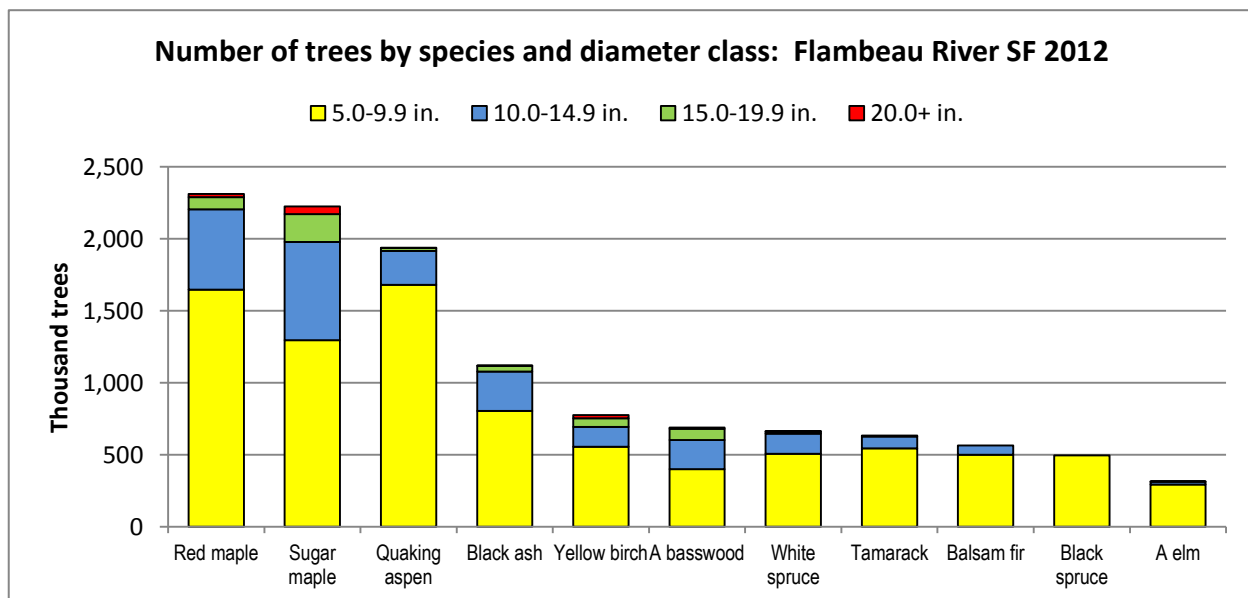
Number of trees by species and diameter

Of the almost 52 million trees on the Flambeau River State Forest, 3 species, sugar maple, red maple and quaking aspen, together account for half. The vast majority (74%) of trees are saplings. Sugar maple, eastern hemlock and eastern white pine account for 60% of all trees over 20 inches dbh. Only 1.7% of trees are over 15 inches and these are mostly sugar maple with lesser numbers of eastern hemlock, red maple, American basswood and yellow birch.

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
Red maple	4,788	1,646	558	86	22	7,100	17%	14%
Sugar maple	5,532	1,295	684	193	54	7,758	16%	15%
Quaking aspen	4,490	1,680	235	22	2	6,429	14%	12%
Black ash	2,133	805	273	40	2	3,253	8%	6%
Yellow birch	1,092	556	138	60	22	1,867	6%	4%
A basswood	670	401	201	78	10	1,359	5%	3%
White spruce	298	506	141	12	4	961	5%	2%
Tamarack	1,935	544	84	6		2,569	5%	5%
Balsam fir	3,523	500	64			4,087	4%	8%
Black spruce	2,754	496				3,250	4%	6%
A elm	1,588	293	20	2		1,903	2%	4%
E hemlock		40	124	94	30	287	2%	1%
White ash	298	106	80	30	6	519	2%	1%
Red pine	25	110	82	4		220	1%	0%
Paper birch	372	147	38	6		563	1%	1%
Black cherry	1,613	173	2	4		1,792	1%	3%
Green ash	397	92	40	8		536	1%	1%
E white pine	74	34	26	18	34	186	1%	0%
Total	38,403	9,809	2,890	699	195	51,996		

Minor species are not listed.

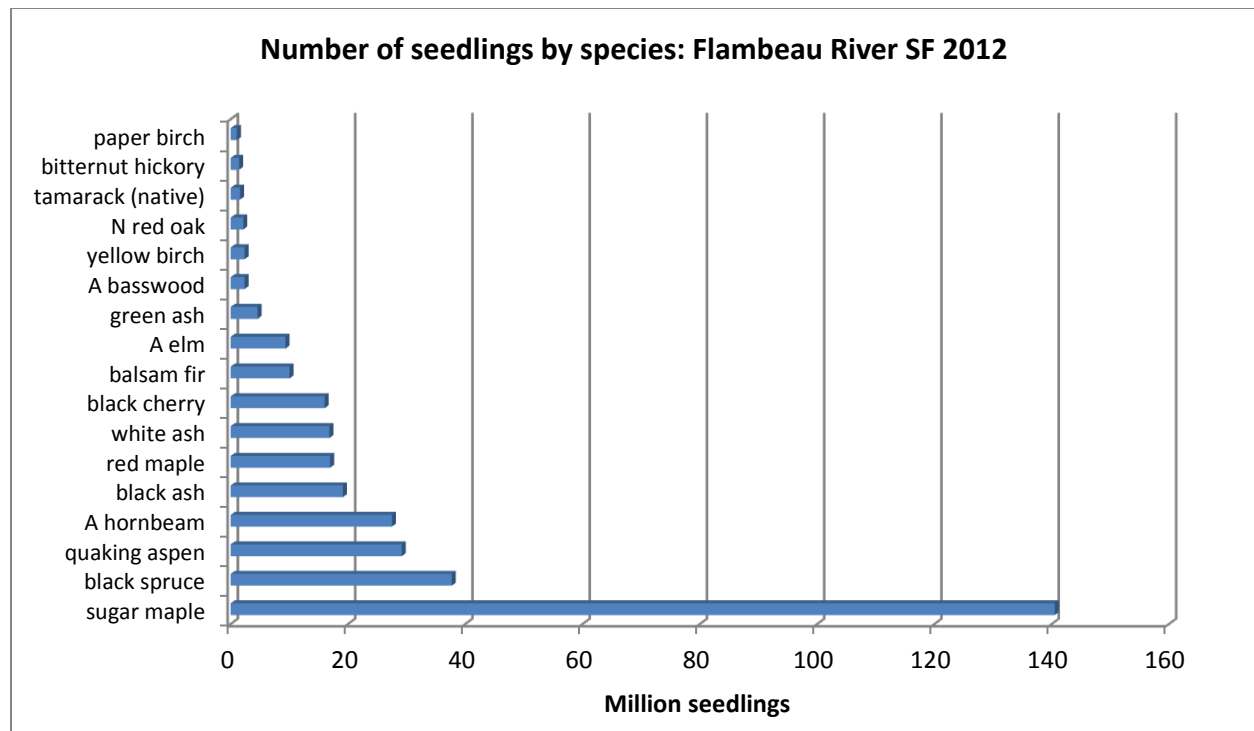


Number of seedlings by species and forest type group

Sugar maple accounts for the great majority of seedlings, 41%, and this is mostly on the northern hardwood or maple / beech / birch 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	% of total
sugar maple	12,652	9,030	1,439	109,205	6,996	1,116	140,513	41%
black spruce	25	0	33,813	0	0	0	37,683	11%
quaking aspen	12,057	2,084	4,019	5,210	3,002	25	29,174	9%
A hornbeam	6,004	5,557	223	14,165	1,488	0	27,463	8%
black ash	6,202	1,885	174	9,154	1,712	0	19,127	6%
red maple	5,036	1,116	4,639	5,185	843	0	16,944	5%
white ash	2,258	645	25	12,727	323	843	16,820	5%
black cherry	4,168	1,414	595	8,757	769	298	16,001	5%
balsam fir	2,183	1,290	1,761	3,324	1,017	347	10,022	3%
A elm	968	645	149	7,269	298	0	9,328	3%
green ash	1,414	149	25	2,679	323	0	4,589	1%
A basswood	546	174	99	1,389	99	50	2,357	1%
yellow birch	74	248	496	1,240	273	0	2,357	1%
N red oak	124	223	50	1,563	149	25	2,133	1%
tamarack	0	0	1,488	74	25	0	1,588	0%
bitternut hickory	99	50	0	1,141	74	50	1,414	0%
Total	62,864	28,480	51,601	202,260	21,906	3,299	341,458	
% total	18%	8%	15%	59%	6%	1%		



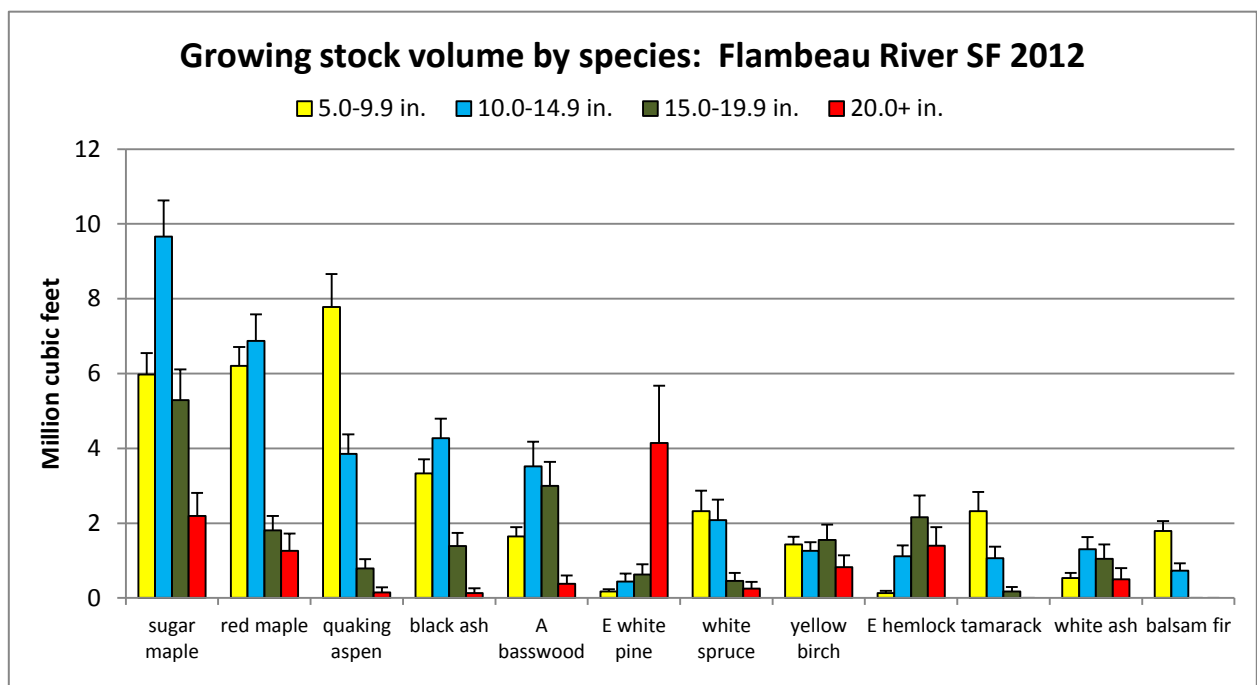
Volume of growing stock (>4.9in dbh) by species and diameter

Sugar maple, red maple and quaking aspen account for almost half of all growing stock volume on the Flambeau River State Forest. About $\frac{1}{3}$ of all trees are less than 10 inches dbh and 11% are over 20 inches. About 34% of volume in trees over 20 inches is in eastern white pine and 18% is sugar maple.

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
sugar maple	5,975	9,660	5,292	2,195	23,123	21%
red maple	6,207	6,870	1,806	1,265	16,147	15%
quaking aspen	7,781	3,850	786	145	12,562	11%
black ash	3,332	4,270	1,392	130	9,123	8%
A basswood	1,645	3,523	2,994	382	8,543	8%
E white pine	172	435	629	4,141	5,377	5%
white spruce	2,320	2,082	457	254	5,113	5%
yellow birch	1,431	1,262	1,554	826	5,072	5%
E hemlock	131	1,114	2,158	1,399	4,802	4%
tamarack	2,323	1,060	171		3,554	3%
white ash	531	1,299	1,046	496	3,372	3%
balsam fir	1,793	726			2,519	2%
N red oak	175	365	815	641	1,996	2%
red pine	615	1,159	108		1,882	2%
black spruce	1,419				1,419	1%
paper birch	577	564	187		1,328	1%
A elm	864	231	49		1,144	1%
green ash	299	560	167		1,026	1%
black cherry	524	58	150		733	1%
bigtooth aspen	383	209	70		662	1%
Total	39,017	39,949	19,953	12,029	110,947	100%
% of total	35%	36%	18%	11%	100%	

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



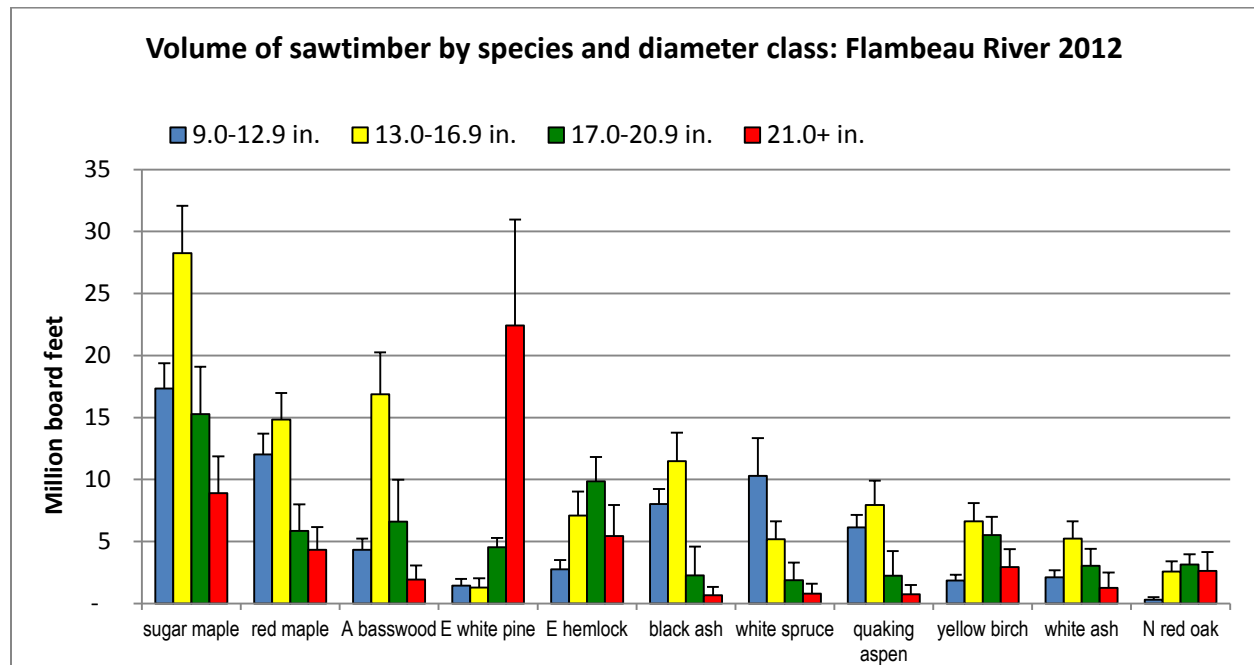
Volume of sawtimber by species and diameter class

Four species account for over half of all sawtimber volume on the Flambeau River State Forest: sugar maple, red maple, American basswood and eastern white pine. Eastern white pine makes up 42% of sawtimber over 21 inches dbh. The Flambeau has about 3.8 MBF/acre of sawtimber volume compared to 4.2 MBF/acre for all state forests combined.

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	% of total
sugar maple	17,336	28,266	15,281	8,903	69,785	22%
red maple	12,021	14,832	5,854	4,329	37,037	12%
A basswood	4,330	16,886	6,603	1,944	29,763	9%
E white pine	1,450	1,297	4,533	22,432	29,712	9%
E hemlock	2,770	7,086	9,859	5,448	25,162	8%
black ash	8,025	11,470	2,281	668	22,444	7%
white spruce	10,298	5,189	1,870	798	18,154	6%
quaking aspen	6,129	7,936	2,240	745	17,051	5%
yellow birch	1,862	6,620	5,521	2,932	16,935	5%
white ash	2,124	5,247	3,037	1,253	11,661	4%
N red oak	295	2,570	3,148	2,620	8,634	3%
tamarack	6,662	1,443	528		8,633	3%
red pine	5,145	2,232			7,377	2%
balsam fir	4,010	702			4,712	1%
paper birch	1,230	1,257	357		2,845	1%
green ash	925	1,560			2,485	1%
Total	86,521	119,062	61,111	52,880	319,575	100%
Percent total	27%	37%	19%	17%	100%	

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



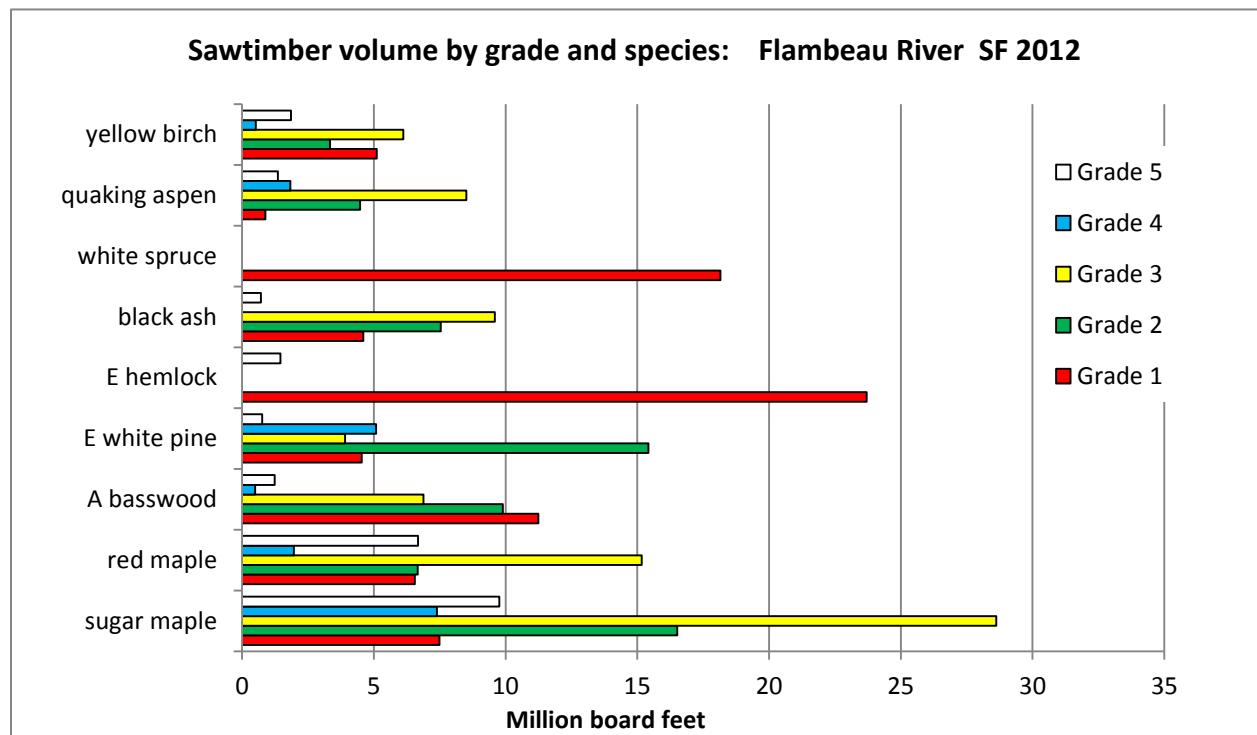
Volume of sawtimber by tree grade and species

Although about 22% of sawtimber is sugar maple, the majority of this is Grade 3 logs. About 1/3 of all sawtimber is grade 1 and this is mostly eastern hemlock, white spruce and American basswood.

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
sugar maple	7,495	16,514	28,620	7,389	9,766	69,785	11%
red maple	6,557	6,665	15,170	1,964	6,679	37,037	18%
A basswood	11,244	9,894	6,885	498	1,242	29,763	38%
E white pine	4,542	15,420	3,906	5,083	760	29,712	15%
E hemlock	23,708				1,454	25,162	94%
black ash	4,601	7,539	9,588		716	22,444	20%
white spruce	18,154					18,154	100%
quaking aspen	880	4,478	8,511	1,827	1,355	17,051	5%
yellow birch	5,109	3,335	6,119	518	1,855	16,935	30%
white ash	5,939	1,975	2,494		1,253	11,661	51%
N red oak	2,170	1,407	1,963		3,094	8,634	25%
tamarack	8,425				208	8,633	98%
red pine			7,068		309	7,377	
balsam fir	4,712					4,712	100%
paper birch		223	1,045	398	1,180	2,845	
green ash		872	925		688	2,485	
Total	106,399	69,074	93,773	18,784	31,546	319,575	100%
Percent total	33%	22%	29%	6%	10%	33%	

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



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

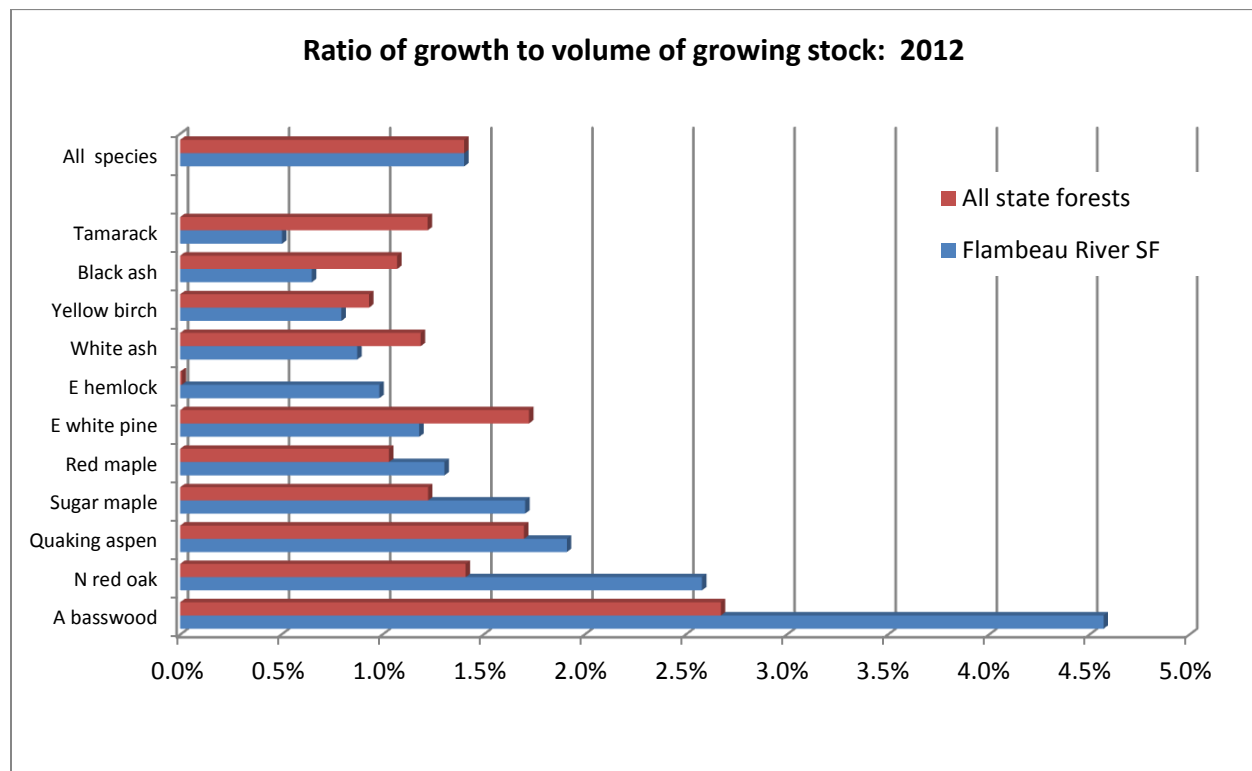
Sugar maple, American basswood, quaking aspen and red maple make up 71% of net annual growth. Species with higher than average growth to volume ratios include sugar maple, red maple, quaking aspen, American basswood and northern red oak.

Species with growth to volume ratios that are lower than the average for all state forests include eastern white pine, eastern hemlock, white ash, black ash, balsam fir and tamarack. The growth rate for all species on the Flambeau River State Forest is about the same as for all state forests.

Annual net growth (cubic feet per year), and growth rates for the Flambeau and all state forests combined.

Species	Average annual net growth	Growth / volume ratio	
		Flambeau River State Forest	All state forests
Sugar maple	394,466	1.7%	1.2%
Red maple	211,142	1.3%	1.0%
Quaking aspen	240,268	1.9%	1.7%
Black ash	59,384	0.7%	1.1%
A basswood	390,510	4.6%	2.7%
E white pine	63,603	1.2%	1.7%
White spruce	19,903	0.4%	0.7%
Yellow birch	40,442	0.8%	0.9%
E hemlock	-47,288	-1.0%	0.0%
Tamarack	-17,912	-0.5%	1.2%
White ash	29,526	0.9%	1.2%
Balsam fir	5,175	0.2%	1.5%
N red oak	51,517	2.6%	1.4%
All species	1,558,174	1.4%	1.4%

Figures in red have a sampling error over 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 Flambeau River State Forest are eastern hemlock, tamarack, balsam fir, white spruce, black spruce and quaking aspen. All have ratios over 25% which means that over one quarter of all growth is lost to mortality. All of these species except quaking aspen have higher than average ratios. The ratio for all species on the Flambeau River State Forest, 25.8%, is about the same as for all state forest properties combined, 25.0%.

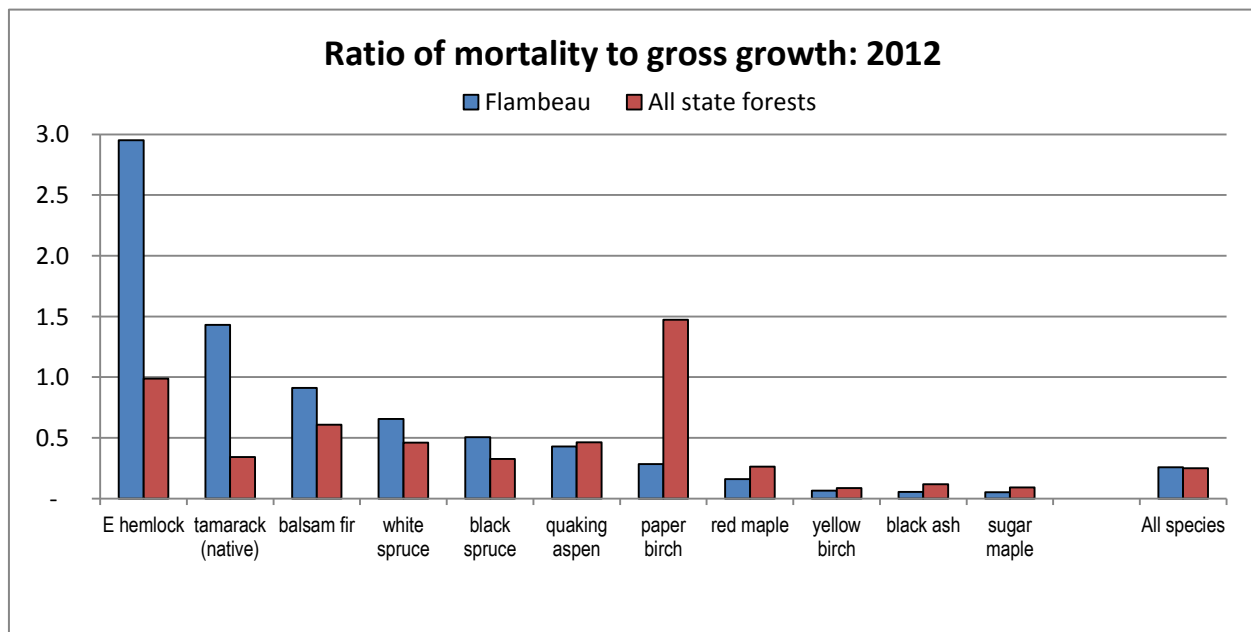
The percentage of trees dying in one year on the Flambeau River State Forest, 0.21% is about equal to the rate for all properties, 0.20%. Both measures are approximations based on one year of data.

Mortality to gross growth ratio for the Flambeau River State Forest and for all state forests combined.

Species**	Flambeau River State Forest				Statewide			
	Mortality (cft)	Gross growth (cft)	Mortality / gross growth	Percent of trees dying per year *	Mortality (cft)	Gross growth (cft)	Mortality / gross growth	Percent of trees dying per year*
E hemlock	71,525	24,237	2.95	1.83%	71,525	72,448	0.99	0.33%
tamarack	59,458	41,546	1.43	0.12%	59,458	173,297	0.34	0.04%
balsam fir	52,964	58,139	0.91	0.29%	334,663	550,824	0.61	0.16%
white spruce	37,928	57,831	0.66	0.84%	58,164	126,634	0.46	0.59%
black spruce	15,521	30,673	0.51	0.23%	35,224	108,333	0.33	0.07%
quaking aspen	179,579	419,846	0.43	0.39%	761,316	1,647,117	0.46	0.43%
paper birch	8,358	29,425	0.28	0.41%	303,493	206,027	1.47	0.93%
red maple	40,227	251,369	0.16	0.19%	162,805	621,649	0.26	0.10%
yellow birch	2,874	43,315	0.07	0.24%	6,848	80,572	0.08	0.19%
black ash	3,448	62,832	0.05	0.04%	20,809	177,520	0.12	0.10%
sugar maple	22,104	416,570	0.05	0.14%	57,604	629,920	0.09	0.08%
All species	540,856	2,099,030	25.8%	0.21%	2,767,937	11,082,704	25.0%	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 over 50% and should be used with caution



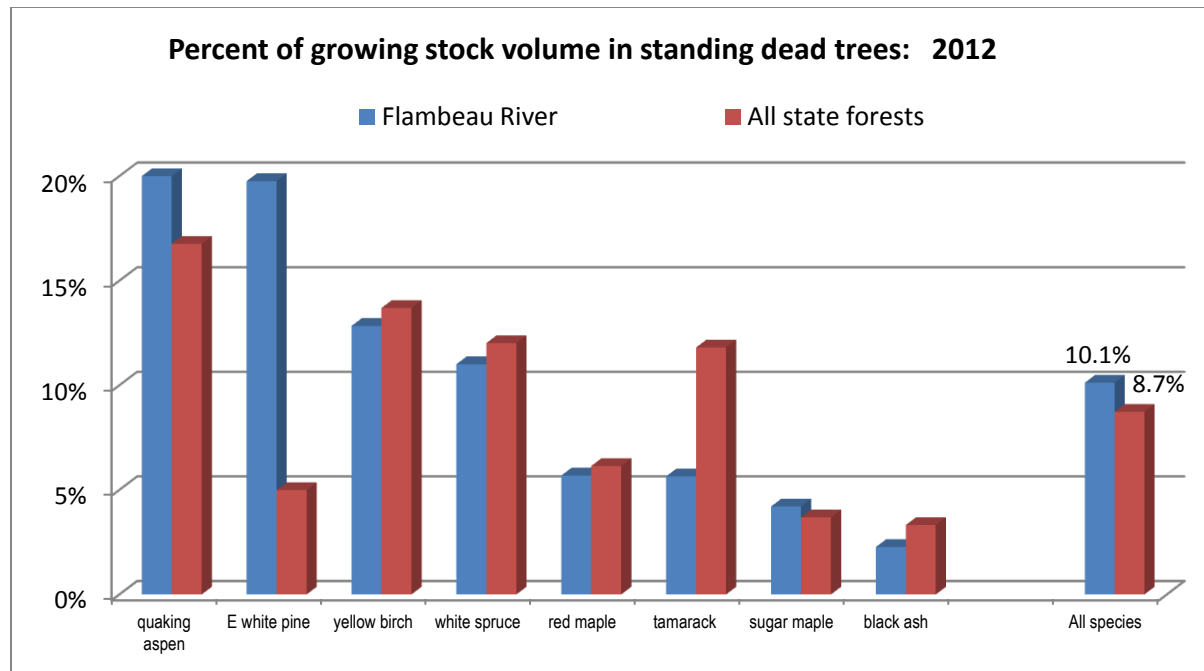
Number and volume of standing dead trees

Both the percentage of standing dead trees and volume in dead trees over 5 inches dbh is higher on the Flambeau River State Forest than on all state forests combined. Quaking aspen, eastern white pine, and sugar maple have a higher number and volume of standing dead trees on the Flambeau River State Forest than on all state forests. Tamarack has a lower percentage of standing dead trees and volume compared to all properties combined.

Percent of all trees and all volume in trees >5 inch dbh that are standing dead by species.

Species	Percent of trees that are standing dead		Percent of volume in standing dead trees	
	Flambeau River SF	All state forests	Flambeau River SF	All state forests
quaking aspen	9.5%	4.8%	20.0%	16.8%
E white pine	24.2%	1.8%	19.8%	5.0%
yellow birch	7.1%	6.3%	12.8%	13.7%
white spruce	9.1%	5.9%	11.0%	12.0%
red maple	2.1%	1.2%	5.7%	6.1%
tamarack	1.4%	2.1%	5.6%	11.8%
sugar maple	1.4%	1.1%	4.2%	3.7%
black ash	1.4%	1.2%	2.3%	3.3%
A basswood	1.4%	1.1%	2.2%	2.4%
white ash	0.0%	0.8%	0.0%	0.9%
balsam fir	3.7%	2.3%	29.8%	28.0%
red pine	5.2%	1.4%	2.6%	1.1%
All Species	3.8%	2.8%	10.1%	8.7%

Species in red make up less than 3% of volume and data has a large sampling error.



Crown dieback and transparency

The major species with higher than average values for dieback on the Flambeau River State Forest are black ash, white ash, tamarack, yellow birch and sugar maple. These values are all higher than the average for these species on all state forests.

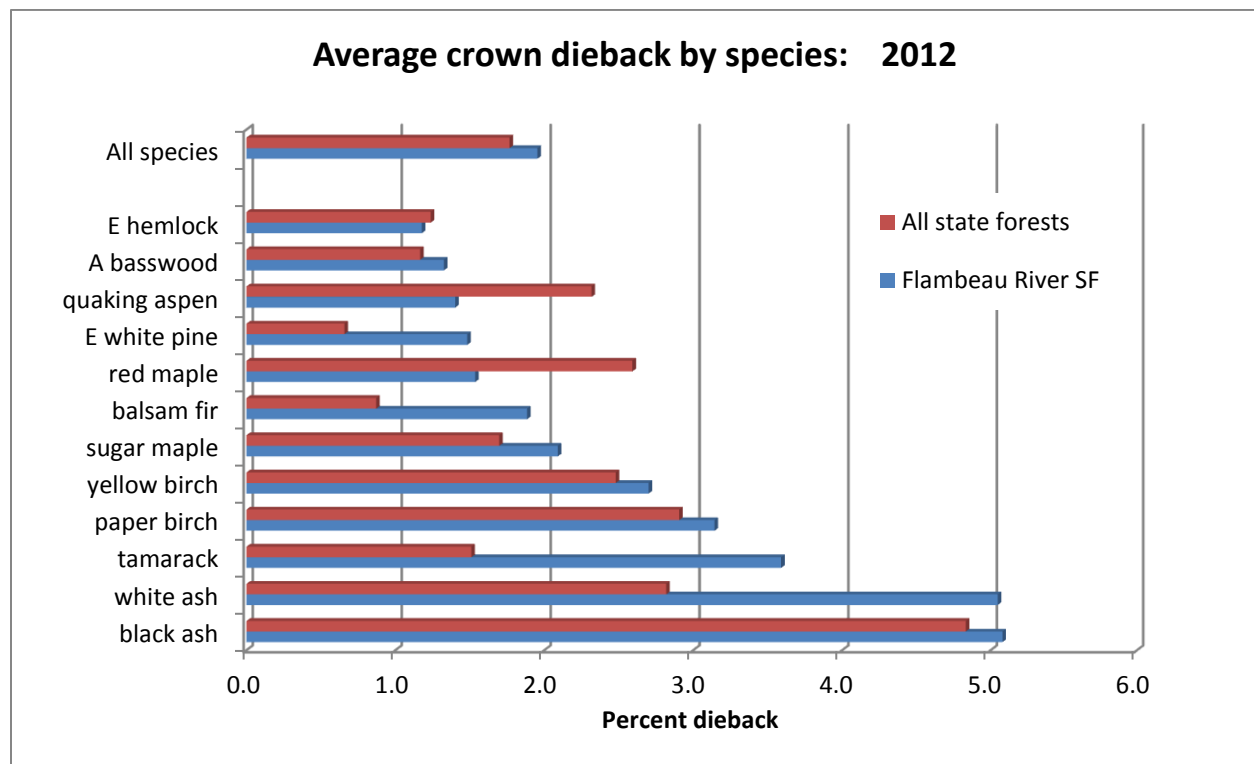
The species with higher than average values for crown transparency include white ash, black ash, quaking aspen and red maple.

In general, dieback and transparency are higher on the Flambeau River State Forest compared to all state forests combined.

Average percent of crown dieback and transparency by species.

Species	Average crown dieback		Average crown transparency	
	Flambeau River SF	All state forests	Flambeau River SF	All state forests
black ash	5.1	4.8	21.8	22.0
white ash	5.0	2.8	23.2	21.7
tamarack	3.6	1.5	16.7	16.9
yellow birch	2.7	2.5	17.2	17.7
sugar maple	2.1	1.7	17.9	15.8
red maple	1.5	2.6	18.9	17.8
E white pine	1.5	0.7	16.9	17.0
quaking aspen	1.4	2.3	20.2	20.1
A basswood	1.3	1.2	17.4	16.5
E hemlock	1.2	1.2	12.5	15.9
white spruce	0.6	0.4	11.0	11.6
paper birch	3.1	2.9	21.3	18.8
balsam fir	1.9	0.9	13.1	13.6
A elm	0.9	3.7	19.7	20.4
N red oak	0.6	1.9	18.0	16.2
red pine	0.6	0.3	18.9	13.6
black spruce	0.4	0.9	11.3	13.0
All Species	2.0	1.8	17.9	17.1

Species in red make up less than 3% of volume and data has a large sampling error.



Trends

Growing stock volume

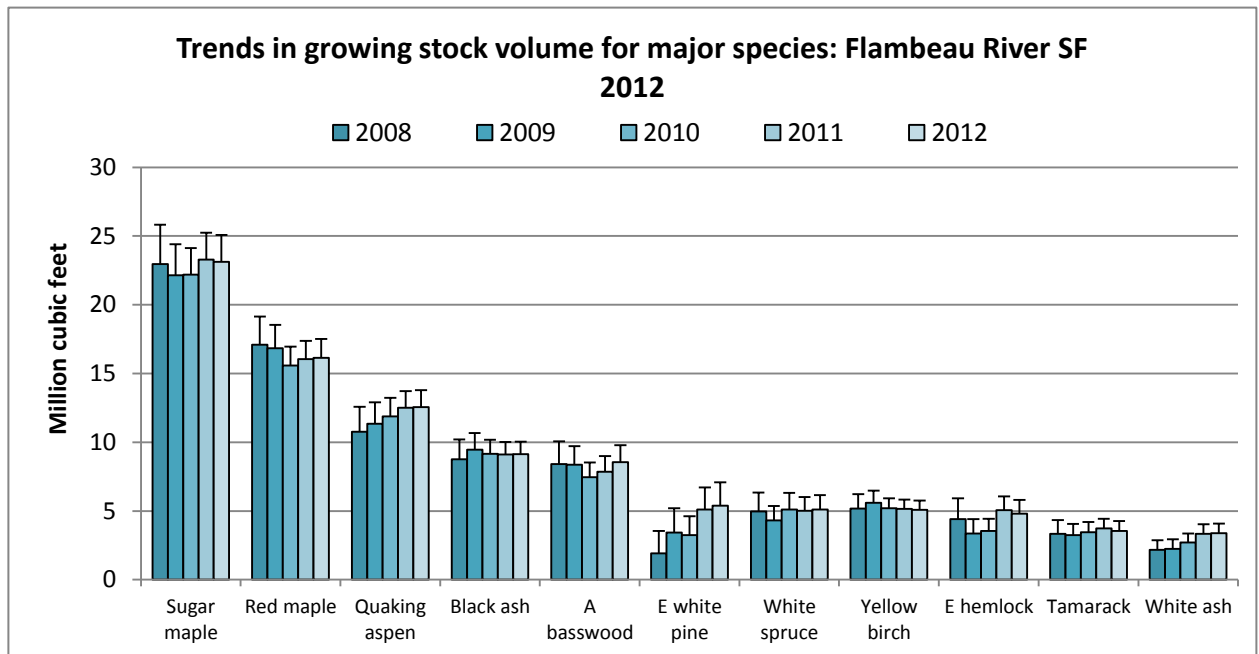
There appear to be trends in species volume which cannot be verified statistically since the data is highly auto-correlated. Future re-measurements may help to reduce this correlation.

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

Species**	2008*	2009	2010	2011	2012	Change 2008 to 2012
Sugar maple	22,952	22,153	22,186	23,278	23,123	1%
Red maple	17,084	16,843	15,576	16,042	16,147	-5%
Quaking aspen	10,772	11,342	11,883	12,510	12,562	17%
Black ash	8,771	9,451	9,147	9,105	9,123	4%
A basswood	8,404	8,362	7,446	7,847	8,543	2%
E white pine	1,921	3,421	3,235	5,105	5,377	180%
White spruce	4,956	4,308	5,112	5,001	5,113	3%
Yellow birch	5,181	5,594	5,205	5,150	5,072	-2%
E hemlock	4,397	3,363	3,536	5,052	4,802	9%
Tamarack	3,334	3,241	3,456	3,728	3,554	7%
White ash	2,177	2,243	2,702	3,328	3,372	55%
Balsam fir	2,458	2,410	2,474	2,648	2,519	2%
N red oak	1,450	1,554	1,237	1,848	1,996	38%
Red pine	-	-	1,223	1,882	1,882	-
Black spruce	1,451	1,168	1,486	1,412	1,419	-2%
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.

** Species in red account for less than 3% of volume and data will have a high sampling error.



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

Timberland.--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.--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>