USDA
United States Department of Agriculture

RESOURCE UPDATE FS-80

Forests of Vermont, 2015

Overview

This publication provides an overview of forest resources in Vermont based on inventories conducted by the U.S. Forest Service, Forest Inventory and Analysis (FIA) program of the Northern Research Station. For annual inventory years 2003-2013, the sample length was equal to 5 years. Beginning in 2014, the cycle length was changed to 7 years. For the 2015 inventory, estimates for current variables such as area, volume, and biomass are based on 1,101 plot samples collected from 2010-2015. Change variables, such as net growth, removals, and mortality, are based on 961 samples collected in 2004-2010 and resampled in 2010-2015. Estimates from earlier annual and periodic inventories are shown for comparison. See Bechtold and Patterson (2005) and O'Connell et al. (2013) for definitions and technical details.

Currently, Vermont is home to over 4.5 million acres of forest land (Table 1) which make its land approximately 73 percent forested. Since the 1997 inventory, the estimate of forest land has been relatively stable. However, the volume and biomass of trees has risen (Table 1; Morin et al. 2015). Average annual net growth, mortality, and removals have higher sampling errors than the other statistics, indicating higher uncertainty in trend estimates.

Note that net volume is defined as gross volume in cubic feet less deductions for rot, roughness, and poor form from a 1 foot stump to a minimum 4.0 inch top diameter. Biomass is defined as the aboveground weight of wood and bark in live trees 1.0 inch diameter and larger from the ground to the tip of the tree, excluding all foliage.

Table 1.—Vermont forest statistics, 2015 and 2010. Volumes are for trees 5-inch and larger in diameter. Number of trees and biomass are for trees 1-inch and larger in diameter. Sampling errors and error bars shown in tables and figures in this report represent 68 percent confidence intervals.

	2015 Estimate	Sampling error (percent)	2010 Estimate	Sampling error (percent)	Change since 2010 (percent)
Forest Land					
Area (thousand acres)	4,511	1.0	4,580	1.0	-1.5
Number of live trees (million trees)	3,416	2.7	3,514	2.7	-2.8
Aboveground biomass of live trees (thousand oven-dry tons)	282,016	1.6	280,019	1.6	0.7
Net volume of live trees (million ft^3)	10,426	1.8	10,370	1.8	0.5
Annual net growth of live trees (thousand ft^3/yr)	172,293	5.4	195,002	7.1	-11.6
Annual mortality of trees (thousand ft^3/yr)	117,088	6.0	103,670	7.3	12.9
Annual harvest removals of live trees (thousand ft^3/yr)	88,311	14.2	86,731	18.3	1.8
Timberland					
Area (thousand acres)	4,288	1.2	4,343	1.2	-1.3
Number of live trees (million trees)	3,241	2.9	3,352	2.9	-3.3
Aboveground biomass of live trees (thousand oven-dry tons)	266,610	1.8	264,483	1.8	0.8
Net volume of live trees (million ft^3)	9,876	2.0	9,807	1.9	0.7
Net volume of growing stock trees (million ft^3)	8,640	2.1	8,793	2.1	-1.7
Annual net growth of growing stock trees (thousand ft^3/yr)	159,598	3.9	191,515	5.3	-16.7
Annual mortality of growing stock trees (thousand ft^3/yr)	75,694	6.2	59,950	8.3	26.3
Annual harvest removals of growing stock trees (thousand ft^3/yr)	72,657	14.4	75,602	18.2	-3.9

Forest Area

Although Vermont's current area of forest land has been relatively stable since the late 1990s, there has been a gradual decline in forest area since 2010 that has resulted in a 1.5 percent decrease (Table 1, Fig. 1). Timberland accounts for 95 percent of forest land or 4.3 million acres. Slightly less than 5 percent of forest land is reserved from timber production or is unproductive. Vermont's total land area is 5.9 million acres (excluding census water, e.g., Lake Champlain).

Vermont's area and proportion of forest land is nearly equal between the Northern and Southern FIA Units (Fig. 2). However the Southern Unit has more than double the proportion of forest land in public ownership (27 percent) when compared with the Northern Unit (13 percent).

Maple/beech/birch is the dominant forest-type group, covering 71 percent of the forest land (Fig. 3). In fact, the maple/beech/birch group makes up over 50 percent of the forest land area in every county except Grand Isle.

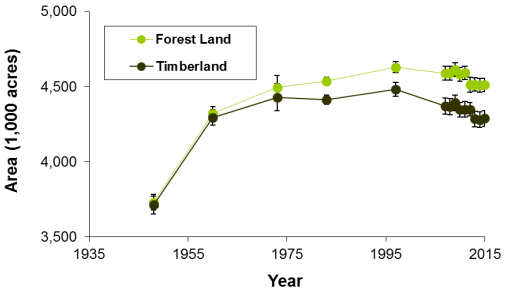

Figure 1.—Forest land and timberland by year, Vermont, 2015.

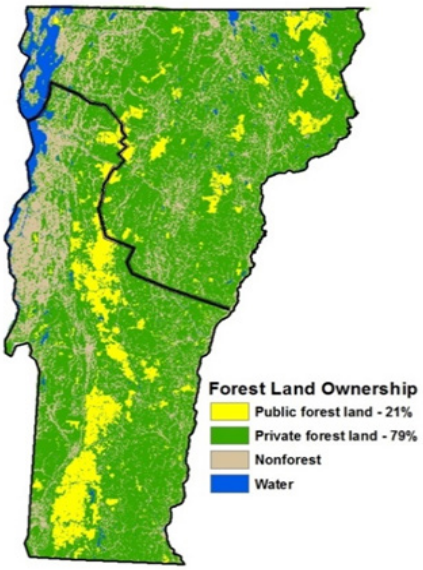

Figure 2.—FIA unit boundary and area of forest/nonforest with forest identified by major ownership group, Vermont, 2013. The boundary between the North and South FIA units is shown with a heavy black line.

White/red pine and spruce/fir are the most abundant softwood forest-type groups. Together they account for 16 percent of the forest land in the State. The white pine and oak/pine forest type-groups have the highest levels of private ownership at 93 and 92 percent, respectively.

Families and individuals, corporations, and other private entities own most of the forest land (61, 15, and 3 percent, respectively). The state of Vermont, U.S. Forest Service, and local public entities own the remainder (8, 10, and 2 percent, respectively).

Vermont's forests have been maturing as illustrated in the distribution of timberland by stand-size classes (Fig. 4). Since the 1960 inventory, the acreage of large-diameter stands has been increasing. Until the 1983 inventory, the acreage in small-diameter stands was declining and has since been stable. The acreage of medium-diameter stands has been declining since the 1983 inventory.

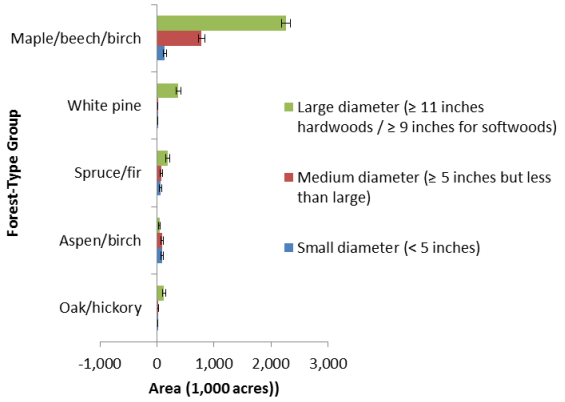

Figure 3.—Forest land by stand-size class (based on small, medium, and large trees) for top five forest-type groups by acres, Vermont, 2015.

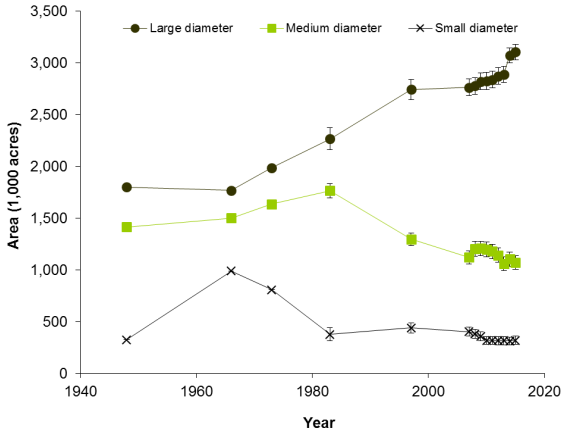

Figure 4.—Timberland by stand-size class and year, Vermont.

Volume, Biomass, and Trends

Sugar maple (*Acer saccharum*) continues to be the most numerous tree in Vermont (Table 2), and sugar maple volume has remained stable since 2010 (Fig. 5). Over the same period, balsam fir (*Abies balsamea*), white ash (*Fraxinus americana*), eastern hemlock (*Tsuga canadensis*), and yellow birch (*Betula allegheniensis*) volume increased by 5 percent each.

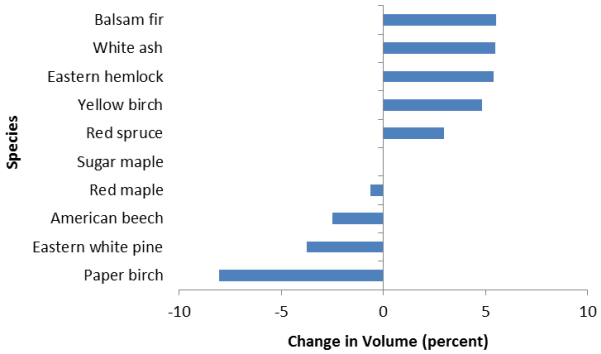

Figure 5.—Percent change in inventory net volume by species, Vermont, 2010 to 2015.

Trends in volume, number of trees, growth, removals, and mortality are all important for understanding the current status of Vermont's forests (Tables 1, 2), but the seedling- and sapling-size trees, which form the understory, represent the advanced regeneration which is available to grow into the overstory.

A comparison of numbers of trees (≥5 inches d.b.h.; Table 2), saplings (1 to 4.9 inches d.b.h.; Fig. 6), and seedlings (<1 inch d.b.h. and at least 1 foot tall; Fig. 7) by species highlights a number of differences that have important implications for future species composition. Many factors drive understory composition including management, disturbance, herbivory, climate, and presence of invasive plants.

American beech (*Fagus grandifolia*) is the most numerous sapling followed by balsam fir, sugar maple, striped maple (*Acer pensylvanicum*), red maple (*Acer rubrum*), and red spruce (*Picea rubens*). Northern red oak (*Quercus rubra*) and eastern white pine (*Pinus strobus*) occur at low densities in the sapling-size class.

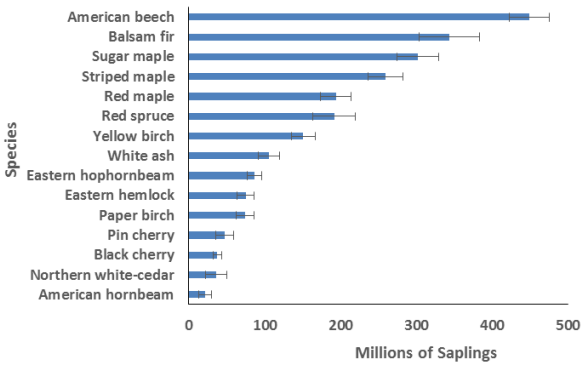

Figure 6.—Species ranked by number of saplings (1 to 4.9 inches d.b.h.), Vermont, 2015.

Cow moose and calf. Photo by Randall Morin, U.S. Forest Service.

Table 2.—Number, net volume, oven-dry biomass, net growth, mortality, and harvest removals of live trees on forest land, Vermont, 2015 (selected prominent species)

Species	Trees[a] (millions)	Net volume[a] (million ft^3)	Aboveground biomass[b] (thousand tons)	Net growth[a] (thousand ft^3/yr)	Mortality[a] (thousand ft^3/yr)	Harvest removals[a] (thousand ft^3/yr)	G:R Ratio[d]
Sugar maple	108	2,401	76,447	32,956	19,099	14,941	2.2
Red maple	82	1,278	35,091	21,970	12,365	13,585	1.6
Eastern hemlock	67	1,170	22,292	23,676	3,499	3,188	7.4
American beech	64	587	20,223	5,681	12,859	2,072	2.7
Balsam fir	59	401	7,725	8,403	11,385	6,291	1.3
Yellow birch	48	784	24,412	13,529	8,612	3,114	4.3
Red spruce	37	520	9,404	9,197	3,675	3,866	2.4
Paper birch	35	388	10,887	-5,966	12,763	3,077	-1.9
Eastern white pine	34	918	15,966	19,468	9,573	22,688	0.9
White ash	17	558	17,114	14,490	5,085	4,163	3.5
Northern white-cedar	15	108	1,788	2,719	1,077	770	3.5
Black cherry	15	163	4,478	3,813	1,331	1,878	2.0
Sweet birch	14	156	5,061	4,465	445	1,867	2.4
Northern red oak	11	350	11,261	7,686	2,366	409	18.8

[a]At least 5-inch diameter trees. [b]At least 1-inch diameter trees. [c]Net growth=gross growth-mortality. [d]Net growth to harvest removals

Regeneration and Future Species Composition

American beech, sugar maple, and balsam fir are the most numerous seedlings followed by striped maple, and white ash (Fig. 7). Despite the lack of eastern white pine saplings, the species has the fourteenth highest number of seedlings. Northern red oak occurs at very low densities and does not appear in the top 15 species in the seedling or sapling size-classes (Figs. 6, 7).

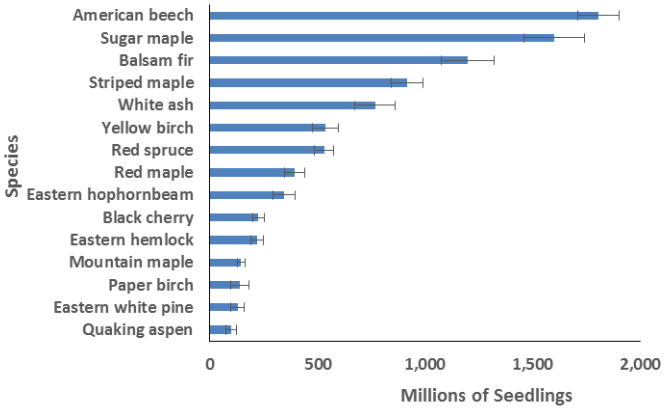

Figure 7.—Species ranked by number of seedlings (at least 1 foot tall and less than 1 inch d.b.h.), Vermont, 2015.

Although overstory tree species composition has been relatively stable over the last decade, the species composition of the understory suggests that changes are likely to occur. A lack of oaks and pines in the sapling diameter classes (Fig. 6) means that as large oaks and pines are harvested or die, they will likely be replaced by species such as American beech, balsam fir, sugar maple, red maple, and red spruce that dominate the sapling size-class. This is reinforced further by a dearth of oak and pine seedlings (Fig. 7). By contrast, balsam fir and red spruce regeneration appears to be adequate and increasing.

Future projections of suitable habitat based on future climate scenarios predict that much of Vermont may be more suitable for the oak/hickory forest type than the maple/beech/birch or spruce/fir forest types (Rustad et al. 2013). However, based on the current status of regeneration in the State, both the maple/beech/birch and spruce/fir forest types appear poised to increase or remain stable.

Fall color in Vermont. Photo by Randall Morin, U.S. Forest Service.

References

Bechtold, W.A.; Patterson, P.L., eds. 2005. **The enhanced Forest Inventory and Analysis program: national sampling design and estimation procedures.** Gen. Tech. Rep. SRS-80. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 85 p.

Morin, R.S.; C.J. Barnett; B.J. Butler; S.J. Crocker, [et al.]. 2015. **Forests of Vermont and New Hampshire 2012**. Resour. Bull. NRS-95. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 80 p. [DVD included].

O'Connell, B.M.; LaPoint, E.B.; Turner, J.A., [et al.]. 2014. The Forest Inventory and Analysis database: database description and user guide version 6.0.1 for Phase 2. Washington, DC: U.S. Department of Agriculture, Forest Service. 748 p. http://www.fia.fs.fed.us/library/database-documentation/.

Rustad, L.; Campbell, J.; Dukes, J.S., [et al.]. 2012. **Changing climate, changing forests: The impacts of climate change on forests of the northeastern United States and eastern Canada**. Gen. Tech. Rep. NRS-99. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 48 p.

How to Cite This Publication
Morin, R.S.; Widmann R.H. 2016.
Forests of Vermont, 2015.
Resource Update FS-80. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 4 p.
.

Contact Information
Randall S. Morin, Research Forester
USDA Forest Service, Northern Research Station
11 Campus Blvd., Ste. 200
Newtown Square, PA 19073
Ph: 610-557-4054 / Fax: 610-557-4250
rsmorin@fs.fed.us
Northern FIA: http://nrs.fs.fed.us/fia/
National FIA: http://fia.fs.fed.us

The published report is available online at http://treesearch.fs.fed.us