



Forests of Vermont, 2013

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. Since 1999, FIA has employed an annual inventory measuring data on a nominal 20 percent of sample plots each year. For the 2013 inventory, estimates for current variables such as area, volume, and biomass are based on 1052 plot samples collected from 2009-2013. Change variables such as net growth, removals, and mortality are based on 964 samples collected in 2004-2008 and resampled in 2009-2013. 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). Since the 1983 inventory, the estimate of forest land has been relatively stable (Fig. 1). However, the volume and biomass of trees has risen (Table 1 and Morin et al. 2011). Average annual net growth, mortality, and removals have higher sampling errors, indicating higher uncertainty in trend estimates; however, the latest inventory shows a notable 23 percent decrease in average annual harvest removals of trees on forest land (Table 1).

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, 2013 and 2007. 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.

| | 2013 | | 2007 | | Change |
|---|----------|-----------------|----------|-----------------|----------------------|
| | Estimate | error (percent) | Estimate | error (percent) | since 2007 (percent) |
| Forest Land | | | | | |
| Area (thousand acres) | 4,514 | 1.0 | 4,589 | 1.0 | -1.6 |
| Number of live trees (million trees) | 3,400 | 2.6 | 3,511 | 2.6 | -3.2 |
| Aboveground biomass of live trees (thousand oven-dry tons) | 279,022 | 1.6 | 273,298 | 1.7 | 2.1 |
| Net volume of live trees (million ft ³) | 10,333 | 1.8 | 10,111 | 1.8 | 2.2 |
| Annual net growth of live trees (thousand ft ³ /yr) | 180,346 | 6.1 | 177,315 | 5.6 | 1.7 |
| Annual mortality of trees (thousand ft ³ /yr) | 112,045 | 6.1 | 116,856 | 6.2 | -4.1 |
| Annual harvest removals of live trees (thousand ft ³ /yr) | 88,487 | 14.4 | 114,440 | 12.6 | -22.7 |
| Timberland | | | | | |
| Area (thousand acres) | 4,285 | 1.2 | 4,370 | 1.2 | -2.0 |
| Number of live trees (million trees) | 3,224 | 2.8 | 3,336 | 2.8 | -3.3 |
| Aboveground biomass of live trees (thousand oven-dry tons) | 263,104 | 1.8 | 259,317 | 1.8 | 1.5 |
| Net volume of live trees (million ft ³) | 9,763 | 2.0 | 9,609 | 2.0 | 1.6 |
| Net volume of growing stock trees (million ft ³) | 8,584 | 2.1 | 8,638 | 2.1 | -0.6 |
| Annual net growth of growing stock trees (thousand ft ³ /yr) | 172,810 | 4.6 | 170,055 | 5.8 | 1.6 |
| Annual mortality of growing stock trees (thousand ft ³ /yr) | 70,247 | 6.3 | 83,180 | 6.8 | -15.5 |
| Annual harvest removals of growing stock trees (thousand ft ³ /yr) | 73,054 | 14.6 | 97,826 | 12.9 | -25.3 |



Forest Area

Vermont's current area of forest land has been stable since the early 1980s. Timberland accounts for 4.3 million acres or 95 percent of this forest land. Nearly 5 percent of forest land is reserved from timber production and less than 1 percent is other forest land identified as not being able to meet minimum productivity standards. Vermont's total area is 5.9 million acres (excludes census water, e.g., Lake Champlain).

Vermont's area of and proportion of forest land is nearly equal between the northern and southern units (Fig. 2). However the southern unit has more than double the proportion of forest land in public ownership (28 percent) when compared with the northern unit (13 percent).

Maple/beech/birch is the dominant forest-type group, covering 70 percent of the forest land (Fig. 3). In fact, the maple/beech/birch type group makes up over 50 percent of the forest land area in every county except Grand Isle.

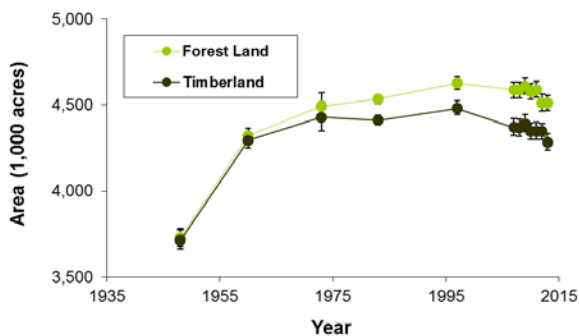


Figure 1.—Forest land and timberland by year, Vermont.

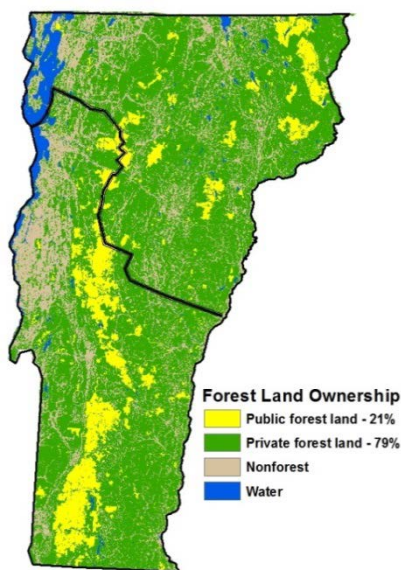


Figure 2.—FIA unit boundary and area of forest/nonforest with forest identified by major ownership group, Vermont, 2013.

White 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 95 and 93 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 3 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, 2013.

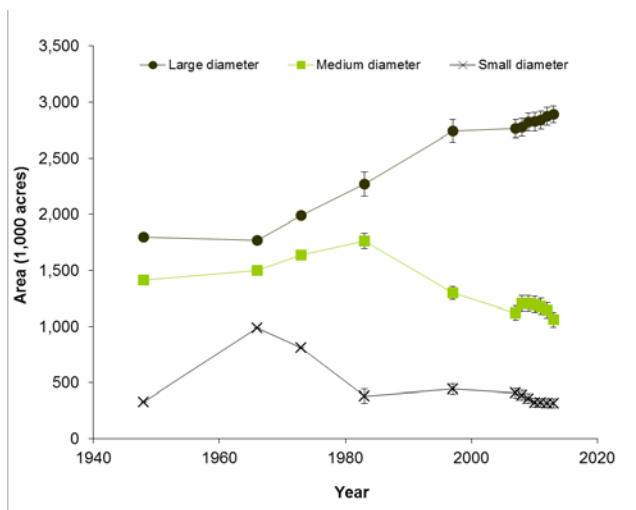


Figure 4.—Timberland by stand-size class and year, Vermont.

Volume, Biomass, and Trends

Increases in volume, biomass, and number of large-diameter trees have accompanied the increase in area of forest land and large-diameter stands in Vermont.

There are approximately 822 million live trees (at least 5-inch diameter) on forest land accounting for approximately 10.3 billion ft³ of volume and 258.4 million oven-dry tons of aboveground biomass. Volume increased 2.2 percent and biomass increased by 2.1 percent since the 2007 inventory (Table 1).

Contributing to this increase, notable gains in volume were observed for eastern hemlock (*Tsuga canadensis*), white ash (*Fraxinus americana*), yellow birch (*Betula alleghaniensis*), and red spruce (*Picea rubens*) at 9, 6, 4, and 3 percent, respectively. By contrast, paper birch (*Betula papyrifera*), American beech (*Fagus grandifolia*), northern red oak (*Quercus rubra*), and eastern white pine (*Pinus strobus*) decreased in volume.

The average annual mortality rate as a proportion of annual mortality volume to the live volume at the beginning of the inventory period for all species combined is 1.1 percent. Only paper birch, balsam fir, and American beech had annual mortality rates greater than 2.5 percent (Fig. 5).

The negative net growth estimate for paper birch indicates that mortality was greater than growth (Table 2). While the net growth rate for American beech was not negative, the species is clearly still suffering from the adverse effects of beech bark disease (*Cryptococcus fagisuga* and *Neonectria*) based on the high annual mortality and low annual net growth. Note that net growth is defined as mortality volume subtracted from gross growth and does not include removals.

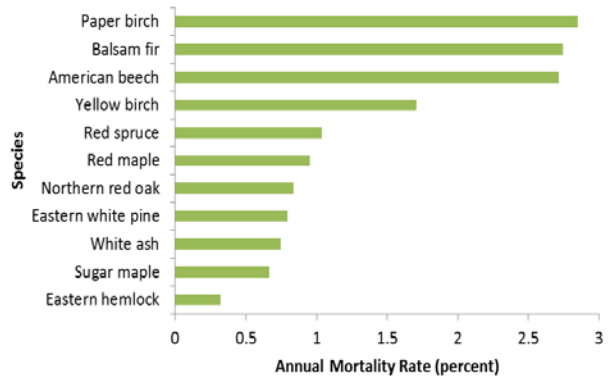
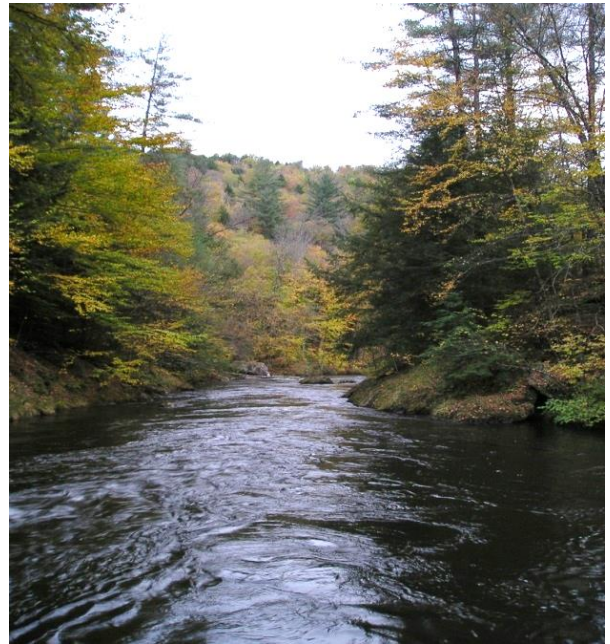


Figure 5.—Annual mortality rate by species, Vermont, 2013.



Vermont fall color. 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, 2013 (selected prominent species)

| Species | Trees ^a (million trees) | 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) |
|--------------------|---------------------------------------|---|---|---|--|---|
| Sugar maple | 155 | 2,394 | 76,461 | 36,093 | 15,835 | 14,877 |
| Red maple | 108 | 1,266 | 34,745 | 22,996 | 11,882 | 11,704 |
| Eastern hemlock | 83 | 1,154 | 21,989 | 23,326 | 3,377 | 3,663 |
| Eastern white pine | 36 | 919 | 15,963 | 25,249 | 7,421 | 19,991 |
| Yellow birch | 57 | 754 | 23,545 | 12,451 | 12,390 | 3,674 |
| American beech | 66 | 584 | 19,837 | 1,380 | 16,719 | 1,361 |
| White ash | 33 | 545 | 16,621 | 15,702 | 3,805 | 2,859 |
| Red spruce | 49 | 522 | 9,351 | 6,493 | 5,245 | 5,544 |
| Paper birch | 39 | 398 | 11,092 | -5,716 | 12,390 | 3,568 |
| Balsam fir | 62 | 386 | 7,348 | 8,789 | 10,680 | 7,950 |
| Northern red oak | 12 | 338 | 10,869 | 6,825 | 2,919 | 1,003 |

^aTrees at least 5-inch diameter. ^bTrees at least 1-inch diameter.

Reserve Status — Improved Implementation

FIA defines reserved forest land as forest land withdrawn by law(s) prohibiting the management of land for the production of wood products (not merely controlling or prohibiting wood-harvesting methods). All private forest land, regardless of conservation easements that may restrict harvesting, is not reserved. Timberland does not include reserved forest land. The new procedures allow for some publicly owned forest land to be classified as reserved even in the absence of a strict law against commercial harvesting. Examples are local parks, state parks, and national wildlife refuges.

In an effort to increase consistency among states and across inventory years, a refined set of procedures determining reserve status have been implemented with version 6.0 of the FIA field manual which took effect with the 2013 inventory year (began October 2012).

Furthermore, all previously collected annual inventory data (1999 to present) have been updated using the new standardized interpretation.

Starting now, timberland estimates generated for earlier annual inventories can differ from previously published estimates. The 2012 inventory was the last inventory in which all data were available under the previous and improved implementations (Table 3). Small changes in the timberland estimates are minor given the inherent variability in the associated estimates.

The improved implementation of the reserve status definition increases the spatial and temporal accuracy of timberland estimates allowing for higher quality trend analyses and potentially better forest management decisions.

Table 3.—Comparison of timberland estimates calculated using previous and improved reserve status implementations, Vermont 2012. Volumes are for trees 5-inch and larger in diameter.

| | 2012 Estimate improved | 2012 Estimate previous | Difference | Difference (percent) |
|---|------------------------------|------------------------------|------------|-------------------------|
| Timberland | | | | |
| Area (thousand acres) | 4,336 | 4,475 | -139 | -3.1 |
| Number of live trees ≥1 in diameter (million trees) | 3,293 | 3,390 | -97 | -2.9 |
| Aboveground biomass of live trees ≥1 in (thousand oven-dry tons) | 284,117 | 277,255 | 6,862 | 2.5 |
| Net volume of live trees ≥5 in diameter (million ft ³) | 9,869 | 10,266 | -397 | -3.9 |
| Net volume of growing stock trees ≥5 in diameter (million ft ³) | 8,733 | 9,101 | -368 | -4.0 |
| Annual net growth of growing stock trees (thousand ft ³ /yr) | 183,863 | 185,050 | -1,187 | -0.6 |
| Annual mortality of growing stock trees (thousand ft ³ /yr) | 68,095 | 73,392 | -5,297 | -7.2 |
| Annual harvest removals of growing stock trees (thousand ft ³ /yr) | 77,088 | 78,760 | -1,672 | -2.1 |
| Annual other removals of growing stock trees (thousand ft ³ /yr) | 21,447 | 17,236 | 4,211 | 24.4 |

Literature Cited

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.

O'Connell, B.M.; LaPoint, E.B.; Turner, J.A.; et al. 2013. **The Forest Inventory and Analysis database: database description and users manual version 5.16 for Phase 2**. Washington, DC: U.S. Department of Agriculture, Forest Service. (<http://www.fia.fs.fed.us/library/database-documentation/>)

Morin, R.S. 2013. **Vermont's forest resources, 2012**. Res. Note. NRS-177. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 4 p.

Morin, R.S.; C.J. Barnett; G.J. Brand; B.J. Butler; R. De Geus; M.H. Et al. 2011. **Vermont's Forests 2007**. Resour. Bull. NRS-51. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 56 p. [DVD included].

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