



Maine's Forest Resources, 2006

Research Note NRS-51

This publication provides an overview of forest resource attributes for Maine based on an annual inventory conducted by the Forest Inventory and Analysis (FIA) program at the Northern Research Station of the U.S. Forest Service. These annual estimates, along with web-posted core tables, will be updated annually. For more information please refer to page 4 of this report.

Table 1.- Annual estimates, uncertainty, and change.

	Estimate (2006)	Sampling error (%)	Change (%) since 2003
Forest Land Estimates			
Area (1,000 acres)	17,695.4	0.4	-0.1
Number of live trees > 1-inch diameter (million trees)	22,687.5	1.5	4.9
Dry biomass of live trees > 1-inch diameter (1,000 tons)	660,893.1	1.0	1.0
Net volume of live trees > 5-inch diameter (1,000,000 ft ³)	25,565.6	1.2	-0.1
Annual net growth of live trees > 5-inch diameter (1,000 ft ³ /year)	548,271.4	3.1	-3.7
Annual mortality of live trees (1,000 ft ³ /year)	374,817.0	3.6	33.6
Annual removals of live trees (1,000 ft ³ /year)	607,390.6	7.2	13.3
Timberland Estimates			
Area (1,000 acres)	17,145.7	0.5	-0.3
Number of growing-stock trees (million trees)	2,692.1	1.5	-1.2
Dry biomass of live trees > 1-inch diameter (1,000 tons)	642,041.5	1.0	0.5
Net volume of live trees > 5-inch diameter (1,000,000 ft ³)	24,800.8	1.3	-0.7
Net volume of growing-stock trees (1,000,000 ft ³)	23,163.4	1.3	-0.8
Annual net growth of growing-stock trees (1,000 ft ³ /year)	518,760.0	2.7	1.2
Annual mortality of growing-stock trees (1,000 ft ³ /year)	288,659.0	3.9	17.4
Annual removals of growing-stock trees (1,000 ft ³ /year)	559,434.1	7.2	6.4

Note: When available, sampling errors/bars provided in Figures and Tables represent 68 percent confidence intervals

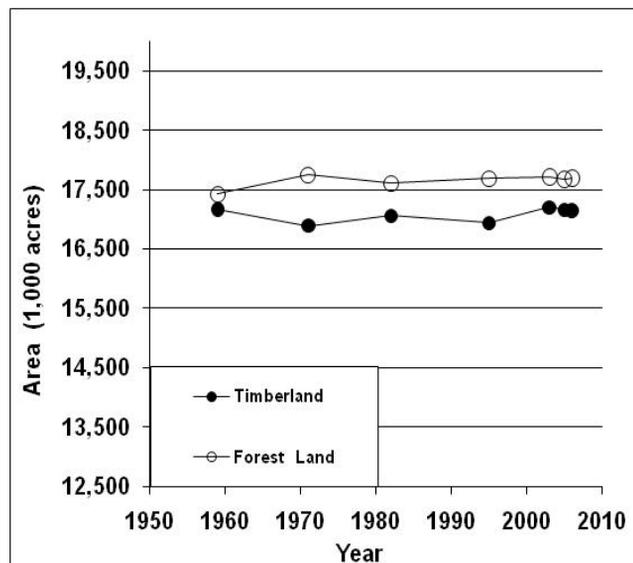


Figure 1. - Area of timberland and forest land by year.

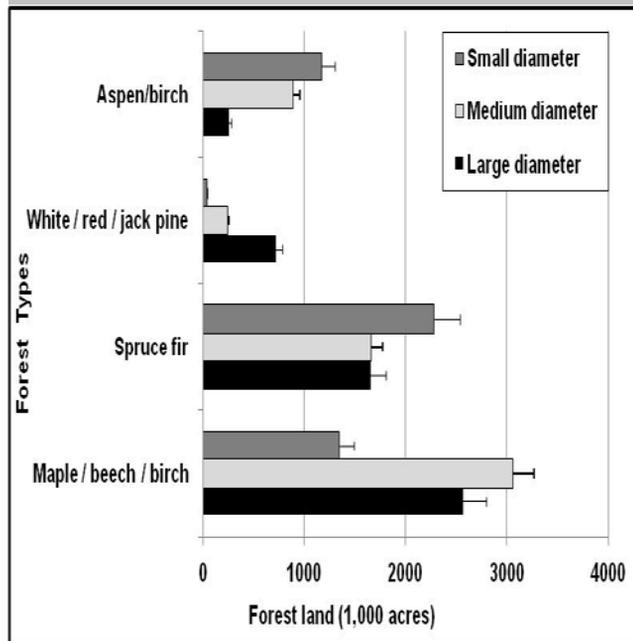


Figure 2. - Area of timberland for the top four forest-type groups by stand-size class.



Table 2. - Top ten species by statewide species group volume estimates, 2006

Rank	Species	Volume of live trees on forest land (1,000,000 ft ³)	Sampling error (%)	Change (%) since 2003	Volume of sawtimber trees on timberland (1,000,000 bdf)	Sampling error (%)	Change (%) since 2003
1	Red spruce	3,252.5	3.8	10.1	8,201.4	4.6	1.1
2	Red maple	3,116.9	2.8	-0.8	4,646.7	4.7	-0.4
3	Eastern white pine	2,646.2	5.4	-0.1	9,673.0	6.0	0.2
4	Sugar maple	2,188.5	5.3	0.5	6,008.7	6.6	1.1
5	Balsam fir	2,185.5	3	1.1	2,735.8	5.1	-0.8
6	Northern white-cedar	2,173.3	4.8	2.1	4,447.8	5.7	3.3
7	Eastern hemlock	1,841.7	5.3	0.5	5,046.5	5.9	1.1
8	Yellow birch	1,638.5	3.9	2.1	3,898.9	6.0	3.7
9	Paper birch	1,215.1	4.3	0.1	1,290.3	7.5	2.5
10	American beech	968.7	5.8	-3.3	1,299.8	9.0	-3.6
	Other softwoods	1,432.8	4.7	1.8	3,156.7	5.4	2.9
	Other hardwoods	2,905.9	4.1	-0.3	5,999.0	7.4	2.5
	All Species	25,565.6	1.3		56,404.6	1.9	

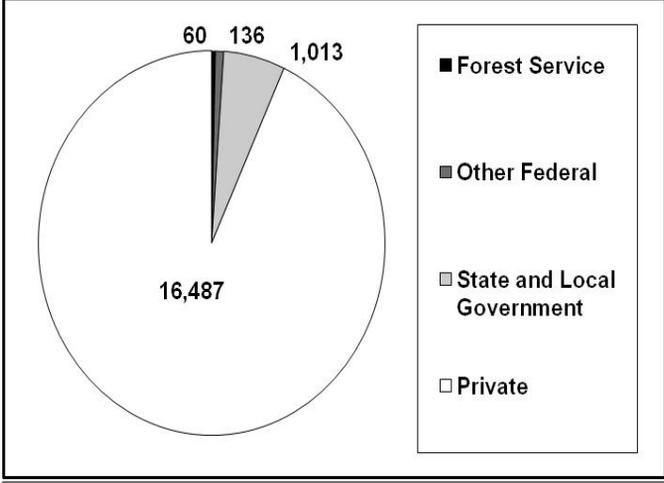


Figure 3. - Area of forest land area (1000 acres) by ownership group.

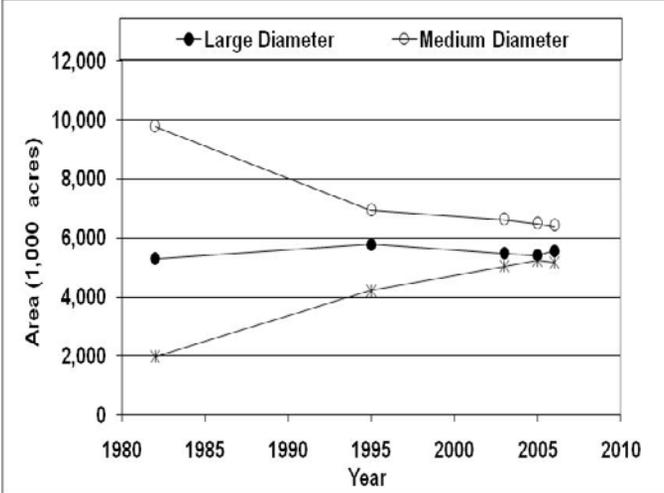


Figure 4. - Area of timberland by stand size and year.



Continuous Improvement Process for Volume, Biomass, and Carbon Estimation

Implementation of the annual inventory requires ongoing evaluation of existing methods and implementation of improved system components as they become available. Recently, significant changes were made to the methods for estimating tree-level volume and biomass (dry weight) for Northeastern states, and the calculation of change components (net growth, removals, and mortality) was modified for national consistency. These changes have focused on improving the ability to report consistent estimates across time and space--a primary objective for FIA.

Tree-level Volume Estimation

As the remeasurement phase of the annual inventory began, it became apparent that the 5-year measurement cycle was limiting the ability to track changes in volume over time because “noise” in the system outweighed the actual “signal” of the ecosystem. Sources of noise include: measurement variability, field protocol changes, field crew cohort changes, definition changes, processing algorithm changes, and model error. This noise impacts estimates of volume, biomass, carbon, and associated change component estimates.

Volume estimation is critically important because individual tree volume estimates form the basis for biomass and carbon estimates. In the past, estimates of individual tree gross volumes (cubic foot and board foot) were estimated using equations based on field-measured diameters and lengths (bole and sawlog). Net volume of the tree was computed by subtracting field-measured cull (Scott 1981, Scott 1979). Over time, it was found that noise in the measurements of tree lengths and cull outweighed the true signal. To ameliorate this, a taper model was used to estimate length (Westfall 2009). In addition, a model was developed for determining the percent of total tree volume represented by cull. The modeled length and cull estimates are used in conjunction with Scott’s volume equations; thus providing a consistent estimation procedure across the Northeast. In general, the new volume estimates will be higher because previous estimates were based on length measurements that included reductions based on merchantability, e.g., prior to 2007, the measurement of the top of the bole may have been below the 4-inch top due to form deficiencies that prevents use for pulpwood. In 2007, the merchantability limits were removed from the field protocols. In conjunction with the removal of merchantability limits, changes in cull measurements were implemented, such that net tree volume would continue to represent only the merchantable portion of the tree. The modeled lengths and culls are aligned with these new measurement protocols.

Component Ratio Method (CRM) for Biomass/Carbon Estimation

Biomass and carbon have become increasingly important to FIA clients as demand for bio-energy has increased and carbon sequestration has emerged as a vital component of climate change analyses. As such, a method for harmonizing volume, biomass, and carbon estimates was needed. Prior to implementation of the CRM method, volume and biomass were estimated using separate sets of equations. The CRM method is comprised of the following steps (Heath and others 2009):

- Conversion of sound-wood volume in the merchantable bole to biomass using species-level specific gravities (dry mass per unit of green volume)
- Calculation of bark biomass using a set of percent bark and bark specific gravities
- Calculation of biomass in tops and limbs as a proportion of merchantable bole biomass based on component proportions using equations from Jenkins and others (2003)
- Calculation of stump biomass using equations from Raile (1982)
- Summation of biomass components to obtain total aboveground biomass

Estimates of carbon are derived through simple conversion of the biomass variables.



Continuous Improvement Process for Volume, Biomass, and Carbon Estimation

Change Component Estimation

Change components are perhaps the most important volumetric variables reported by FIA because they are indicative of sustainability (net growth-to-removals ratio) and forest health (mortality). To summarize, gross growth is equal to ingrowth (volume of trees reaching the 5.0-inch minimum diameter threshold for merchantable volume) plus accretion (growth of surviving trees that were above the threshold at previous measurement). Net growth is equal to gross growth minus mortality (volume of trees meeting the threshold at previous measurement that died). Removals are equal to the volume of trees meeting the threshold at the previous measurement that were harvested or on forest land that changed to nonforest land. Net change in inventory is equal to net growth minus removals.

The National Inventory Management System (NIMS) is the compilation system for all FIA estimates. Implementation of NIMS has included some adjustments to regional change-component algorithms to achieve national consistency. A new method, termed the “midpoint method,” has introduced some fundamental differences in methods (Westfall and others 2009). Essentially, the new approach involves growing trees to the midpoint of the inventory cycle (2.5 years for a 5-year cycle). Although the overall net change component is equivalent under the previous and new theory evaluations, estimates for individual components will be different. For ingrowth, the midpoint method produces a smaller estimate because volumes are calculated at the 5.0-inch threshold instead of using the actual diameter measurement, which may be larger. The estimate for accretion is higher because growth on ingrowth, mortality, and removal trees is included. As such, the removals and mortality estimates will also be higher than before.



Citation for this Publication

McCaskill, G.L.; McWilliams, W.H.; Butler, B.J.; Barnett, C.J.; Hansen, M.H. 2010. Maine's forest resources, 2006. Res. Note. NRS-51. Newtown Square, PA. U.S. Department of Agriculture, Forest Service, Northern Research Station. 5 p.

FIA Program Information

Bechtold, W.A.; Patterson, P.L. 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.

Heath, L.S.; Hansen, M.H.; Smith, J.E.; Smith, W.B.; Miles, P.D. 2009. Investigation into calculating tree biomass and carbon in the FIADB using a biomass expansion factor approach. In: McWilliams, W.; Moisen, G.; Czaplowski, R., comps. 2008 Forest Inventory and Analysis (FIA) Symposium; 2008 October 21-23; Park City, UT. Proc. RMRS-P-56CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 1 CD.

Jenkins, J.; Chojnacky, D.C.; Heath, L.S.; Birdsey, R.A. 2003. National scale biomass estimators for United States tree species. *Forest Science*. 49(1): 12-35.

Raile, G.K. 1982. Estimating stump volume. Res. Paper NC-224. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 4 p.

Smith, J.E.; Heath, L.S.; Skog, K.E.; Birdsey, R.A. 2006. Methods for calculating forest ecosystem and harvested carbon with standard estimates for forest types of the United States. Gen. Tech. Rep. NE-343. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 216 p.

Scott, C.T. 1981. Northeastern forest survey revised cubic-foot volume equations. Research Note NE-304. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 2 p.

Scott, C.T. 1979. Northeastern forest survey board-foot volume equations. Research Note NE-271. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 2 p.

Smith, W.B. 2002. Forest inventory and analysis: a national inventory and monitoring program. *Environmental Pollution*. 116: 233-242.

USDA Forest Service. 2009. Forest inventory and analysis national core field guide, Vol. 1, field data collection procedures for Phase 2 plots, Ver. 5.0. Available at www.fia.fs.fed.us/library/field-guides-methods-proc (verified July 2009).

Westfall, J.A.; Frieswyk, T.; Griffith, D.M. 2009. Implementing the measurement interval midpoint method for change estimation. In: McRoberts, R.E.; Reams, G.A.; Van Deusen, P.C.; McWilliams, W.H., eds. Proceedings of the Eighth Annual Forest Inventory and analysis Symposium. 2006 October 16-19; Monterey, CA. Gen. Tech. Rep. WO-79. U.S. Department of Agriculture, Forest Service: 231-236.

Contact Information

FIA Maine Analyst: George McCaskill, (610) 557-4045, georgemccaskill@fs.fed.us
 Data Management: Carol L. Alerich, 610-557-4068, calerich@fs.fed.us
 Website: fiatools.fs.fed.us

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance program (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternate means for communication of program information (Braille, large print, audiotope, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, DC 20250-9410, or call (800)795-3272 (voice) or (202)720-6382 (TDD). USDA is an equal opportunity provider and employer.