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Estimating Total Forest Biomass in New York, 1993

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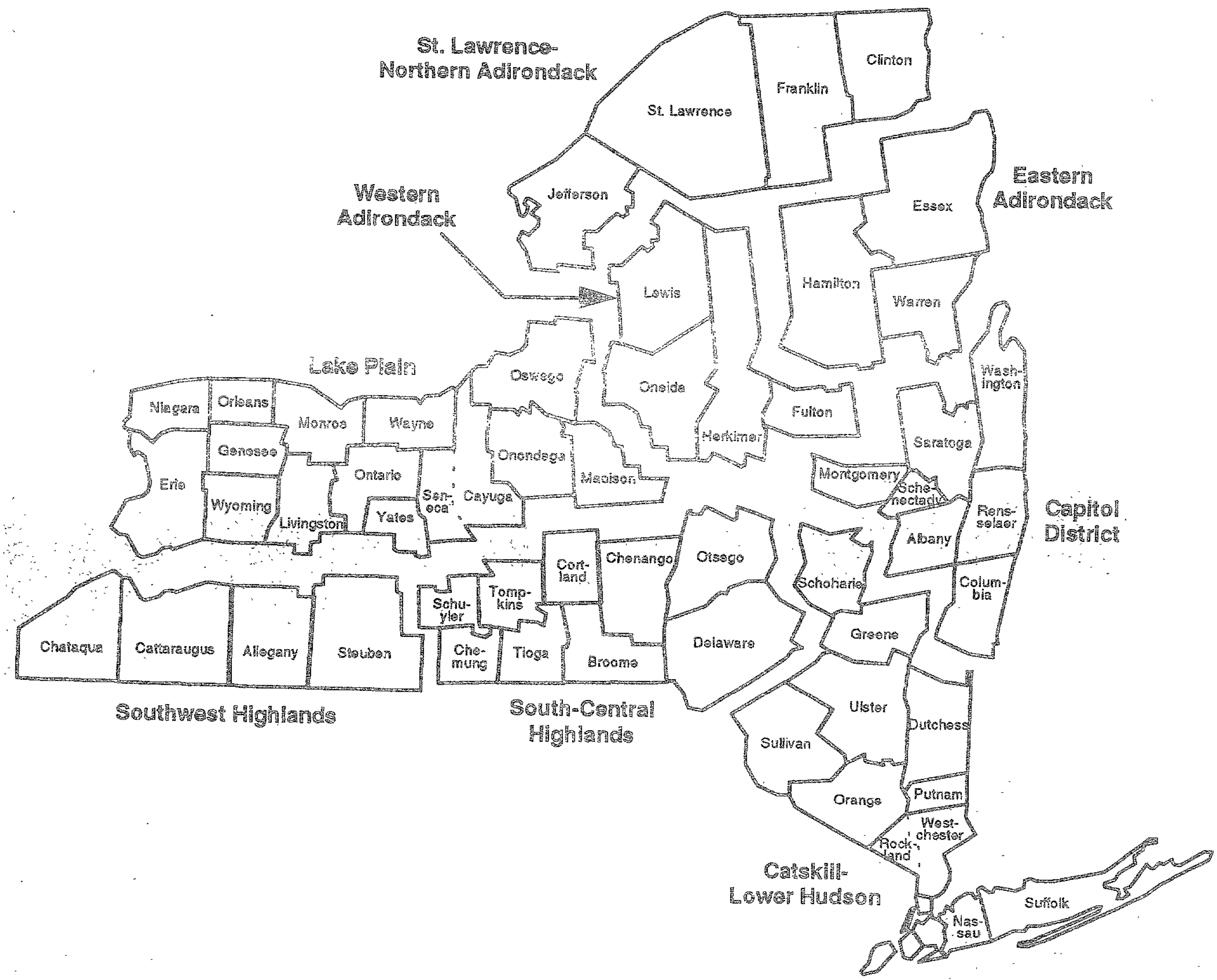

Abstract

The 1993 inventory of New York's forest lands included estimates of total forest biomass based upon an evaluation of available biomass-estimation techniques found in the literature. When applied to the forest resource inventory of New York, these regression equations yielded an estimate of more than 1 billion dry tons of total forest biomass, or 71 dry tons per acre, growing on New York's timberlands. Most of the biomass was in growing stock, but about 46 percent was in the branches, foliage, and stumps of growing-stock trees; cull trees; salvable dead trees; seedlings and saplings; and shrubs.

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Background

Since 1928, the USDA Forest Service has measured the Nation's forest resources, supplying information about their nature and condition. In the past, forest inventories focused on volume estimation: cubic feet for growing stock and board feet for sawtimber (these and other terms are defined in Appendix F). Volume statistics are useful to resource planners and managers for quantifying the timber supply and for tracking changes in the timber resource over time. But conventional methods for measuring timber volume do not adequately define conditions of the entire forest and, therefore, have limited applicability to the kinds of assessments required of today's resource planners, managers, and researchers.

We now recognize that our forests are a source not only of wood for traditional timber products but also of wood fiber for new industrial products and nonindustrial products such as fuelwood. In addition, the Nation's forest resource plays an important part with respect to wildlife habitat, plant diversity, nutrient recycling, and biochemical interchanges so essential to our survival.

Over the years, the complete-tree concept (Young 1965) has become more accepted even though methods for measuring the content of the whole tree have not always kept pace. Many methods for measuring biomass have been explored during the past couple of decades, but there is little consistency among them. The relationships that have been developed between common tree measurements and the weight of individual tree components, determined largely by regression equations, include many data-gathering and analytical techniques. This results in concern over their applicability, which is compounded by the fact that many of the regression equations now being used were designed for a few common species.

It was necessary to evaluate the accumulated procedures for estimating biomass as a means to more adequately assess New York's forest resources. Keays (1971a, b, c, d, e) published the earliest synthesis of literature available on biomass estimation. Other reviews of the North American literature were made by Young (1976) and Hitchcock and McDonnell (1979). Pelz (1987) reviewed European literature, and there have been regional reviews for the southern (Baldwin 1987) and northeastern (Tritton and Hornbeck 1982) United States. The regression equations they describe were evaluated and incorporated into the resource inventory process for New York.

Procedures for Estimating Green Weight

Many factors contribute to the variation of weight in trees; certainly moisture content is a critical one. In the past, green weight was commonly used by the Forest Service to measure biomass supplies, at least in the Northeast, because green weight most closely approximates the condition of standing trees. Because it reflects the economic cost of removing wood from the forest, this measure is preferred by the timber-using industry. However, merchantable-stem biomass may be the only green-weight statistic of value. Comparisons to dry weight can be made if needed, and yields of industrial forest products harvested and resulting residual weights can be developed from them.

There are many regression equations that predict the green weight of trees and their components. We were interested in how well these equations predict the green weight of trees in areas other than that for which they had been developed. Tritton and Hornbeck (1982) indicated that although most biomass equations for northeastern tree species were developed locally and their use was relatively limited, some may be useful for predicting weights of trees over extensive geographic regions.

Hocker and Early (1983) argued against using equations to predict weights of trees over large regions. However, a study by Jacobs and Monteith (1981) has shown that the weights of identical northeastern tree species are similar in different regions of the Northeast. And results from a more indepth study (Barrett and Jastrembski 1990) based on an analysis of indicator variables showed that differences in tree green weight between locations may not be important enough to preclude using regional models on a wide geographic scale. The results assured us of the validity of using regional biomass equations.

Regional Regression Equations

We used the regional regression equations developed by Barrett and Jastremski (1990) from sources in New Hampshire, New York, Ohio, West Virginia, and Michigan.

The form of the regional regression equation is:

$$Y = b_0 + b_1(D^2H)$$

where the dependent variable Y is total tree-stem biomass (in green pounds), and the independent variables D and H are, respectively, diameter at breast height (in inches) and total tree height (in feet). Regression coefficients for 14 species were developed (Table 1). Species were segregated into evergreen and deciduous species. Species that did not have a specific biomass regression equation were matched with those that did (called key species) based on green-weight densities (Appendix A). A detailed list of northeastern tree species can be found in Appendix E.

Table 1. Total stem-weight regression coefficients for selected species

$$Y = b_0 + b_1(D^2H)$$

Y = green weight (in pounds)
D = diameter at breast height (in inches)
H = total tree height (in feet)

Species	Coefficients	
	b_0	b_1
Hemlock	45.05	0.1856
Spruce	235.95	0.1378
Pine	116.92	0.1547
Fir	113.77	0.1603
Oak	51.28	0.1797
Maple	56.09	0.1663
Hickory	-58.58	0.2046
Basswood	19.95	0.1344
Aspen	53.47	0.1549
Cherry	-19.37	0.1753
Birch	-47.78	0.2076
Yellow-poplar	-39.77	0.1439
Ash	16.81	0.1496
Beech	34.69	0.2245

The Forest Inventory and Analysis research unit of the Forest Service equates the merchantable stem to growing stock, that is, the tree bole between a 1.0-foot stump height and a specified top. The growing-stock top is at a minimum 4.0-inch diameter outside the bark on the central stem, or the point at which the central stem breaks into branches if this occurs before the minimum diameter is reached.

Since the regional model predicts total-stem biomass, adjustments were made to quantify merchantable-stem biomass (growing-stock biomass). First, conversions were applied that relate total-stem biomass (the parameter predicted by the regional model) to aboveground tree biomass on a green-weight basis from regression equations developed by Monteith (1979). Then, conversions from the same study were applied that relate aboveground tree biomass to merchantable-stem biomass (the parameter of interest). The relationship of total-stem and merchantable-stem to aboveground tree biomass was averaged by evergreen and deciduous species, and by standard Forest Service stand-size classes (Table 2).

In the regional model, total tree height is used as an independent variable to predict biomass. This is a limitation because trees often are measured only to a certain merchantable height, as is done by Forest Inventory and Analysis. The regional equations described are unusable unless total tree height can be measured or predicted.

Total Tree Height

Measuring the total height of sample trees has been considered frequently in statewide inventory designs. However, we have found the cost of measuring total tree height to be prohibitive. Yet the value of total tree height cannot be overstated, especially considering its use as a parameter in many biomass regression equations. Most equations that predict total tree biomass incorporate total tree height. And in some instances, it can prove to be a significant predictor of biomass. Because of great differences in height over the range of some species, the measure of total tree height often is seen as essential.

Cunia and others (1984) developed a procedure for predicting total tree height from diameter and merchantable-height measurements. Developed to simulate populations of trees in order to test sample designs, this procedure can be applied to actual tree dimensions.

Table 2. Total-stem biomass and merchantable-stem biomass as a percentage of aboveground tree biomass, green-weight basis

Stand-size class	Total stem		Merchantable stem	
	Evergreen	Deciduous	Evergreen	Deciduous
Poletimber	0.7617	0.8010	0.6503	0.7269
Small sawtimber	0.8032	0.7990	0.7695	0.7737
Large sawtimber < 21.0" d.b.h.	0.8194	0.7979	0.8053	0.7852
Large sawtimber ≥ 21.0" d.b.h.	0.8235	0.7975	0.8136	0.7884

The form of the model is:

$$Y = b_0 + b_1(D) + b_2(H)$$

where the dependent variable Y is total tree height (in feet); the independent variables D and H are, respectively, diameter at breast height (in inches) and merchantable height (in feet). Consequently, we could estimate total tree height from measurements we already had.

Regression coefficients for 17 species were used (Table 3). Species that did not have specific regression coefficients were grouped with those that did based on average height and bole and crown characteristics that most closely approximated a species for which there was an equation (Appendix D).

Procedures for Estimating Dry Weight

Dry weight is more consistent over time, avoiding seasonal variations that occur when trees are measured in terms of green weight. The dry-weight measure also provides a more common base, yielding an easier solution to environmental questions such as those related to the carbon content of forests. Scientists prefer dry weight when accessing different biomass components because it allows analysis between trees and other vegetation.

Table 3. Total tree-height regression coefficients for selected species

$$Y = b_0 + b_1 (D) + b_2 (H)$$

Y = total tree height (in feet)
D = diameter at breast height (in inches)
H = merchantable height (in feet)

Species	Coefficients		
	b_0	b_1	b_2
Red maple	21.425	0.0000	1.03546
Sugar maple	33.477	0.0000	0.85822
Yellow birch	46.935	0.0000	0.48425
Beech	24.479	0.0000	0.93307
White ash	30.779	0.0000	0.87421
Black cherry	31.520	0.0000	0.78366
Basswood	39.430	0.0000	0.66960
Yellow-poplar	39.572	0.0000	0.63497
White oak	33.639	1.5880	0.29821
Scarlet oak	40.751	0.0000	0.53881
Chestnut oak	41.585	0.0000	0.48834
Northern red oak	40.805	0.0000	0.62504
Black oak	29.915	0.0000	0.79821
Trembling aspen	9.760	0.0000	1.11161
Balsam fir	19.818	0.0000	0.76839
Red pine	17.977	0.0000	0.85621
White spruce	11.924	0.0000	0.93523

Merchantable-stem biomass is best reported in both green weight and dry weight. However, most other components–branches, foliage, stumps and roots, cull trees, seedlings and saplings, shrubs, etc.–are best reported in dry weight because biomass studies today tend to be directed more to vegetation analysis and biodiversity studies. These generally require biomass to be reported in dry weight.

For extensive forest surveys, the most important parts of total forest biomass (Fig. 1) to report are:

•The biomass in the merchantable stem of growing-stock trees (also called growing-stock biomass), which can be further apportioned into poletimber, sawtimber, and the upper stem portion above sawtimber.

•Additional sources of biomass in growing-stock trees–branches, foliage, and the stump-root system–and cull trees, which together constitute timber.

•The biomass in nontimber trees, for example, salvable dead trees, seedlings, and saplings.

•Other kinds of nontree-related forest biomass, for example, shrubs.

Biomass of Growing Stock

Growing-stock trees are live, predominantly sound trees from which it is possible to harvest commercial timber products. When measuring the volume of growing-stock trees, it is customary to deduct the volume of rotten cull when reporting board-foot volume, and to also deduct the volume of sound cull (grade deductions that are still solid wood) when reporting cubic-foot volume. Rotten cull affects tree weight, but sound cull does not, so only the percentage of rotten cull in a tree is deducted when reporting tree quantities in terms of weight.

Three sets of regression equations were chosen from the literature that covered the greatest range of species encountered in the Northeast: Young and others (1980) developed models for species in Maine, Wiant and others (1977) developed models for species in West Virginia, and Monteith (1979) developed models for species in New York. These models predict aboveground tree biomass. Growing-stock biomass was estimated by subtracting the proportion in branches and foliage that was determined from regression equations developed by Young and others (1980).

Equations developed in Maine were the source for all evergreen species found: balsam fir, eastern white pine, red pine, spruce, hemlock, northern white-cedar, and larch; and for some deciduous species: red maple, yellow birch, and quaking aspen. Equations developed in West Virginia were the source primarily for Appalachian deciduous species: hickory, yellow-poplar, black cherry, white oak, scarlet oak, chestnut oak, northern red oak, and black oak. Equations developed in New York were the source for sugar maple, American beech, and white ash.

The form of the models developed in Maine (1), West Virginia (2), and New York (3) is:

$$\mathrm{Ln}Y = b_0 + b_1\mathrm{Ln}(D) \quad (1)$$

$$\mathrm{LOG}_{10}Y = \mathrm{LOG}_{10}b_0 + b_1\mathrm{LOG}_{10}(D) \quad (2)$$

where Ln is the natural logarithm, the dependent variable Y is dry weight (in pounds), and the independent variable D is diameter at breast height (in inches); and

$$Y = b_0 + b_1(D) + b_2(D^2) \quad (3)$$

where the dependent variable Y is dry weight (in kilograms), and the independent variables D and D^2 are, respectively, diameter at breast height and diameter at breast height squared (both in millimeters).

Regression coefficients for 21 species were developed (Table 4). Species were segregated into evergreen and deciduous species. Species that did not have a specific biomass regression equation were matched with those that did (called key species) based on dry-weight densities (Appendix B).

Biomass of Timber

The biomass of growing stock can be extended to include portions of the entire growing-stock tree–branches, foliage, stumps, and roots. Also included were cull trees, which along with the biomass of individual components of growing-stock trees comprise the biomass of timber.

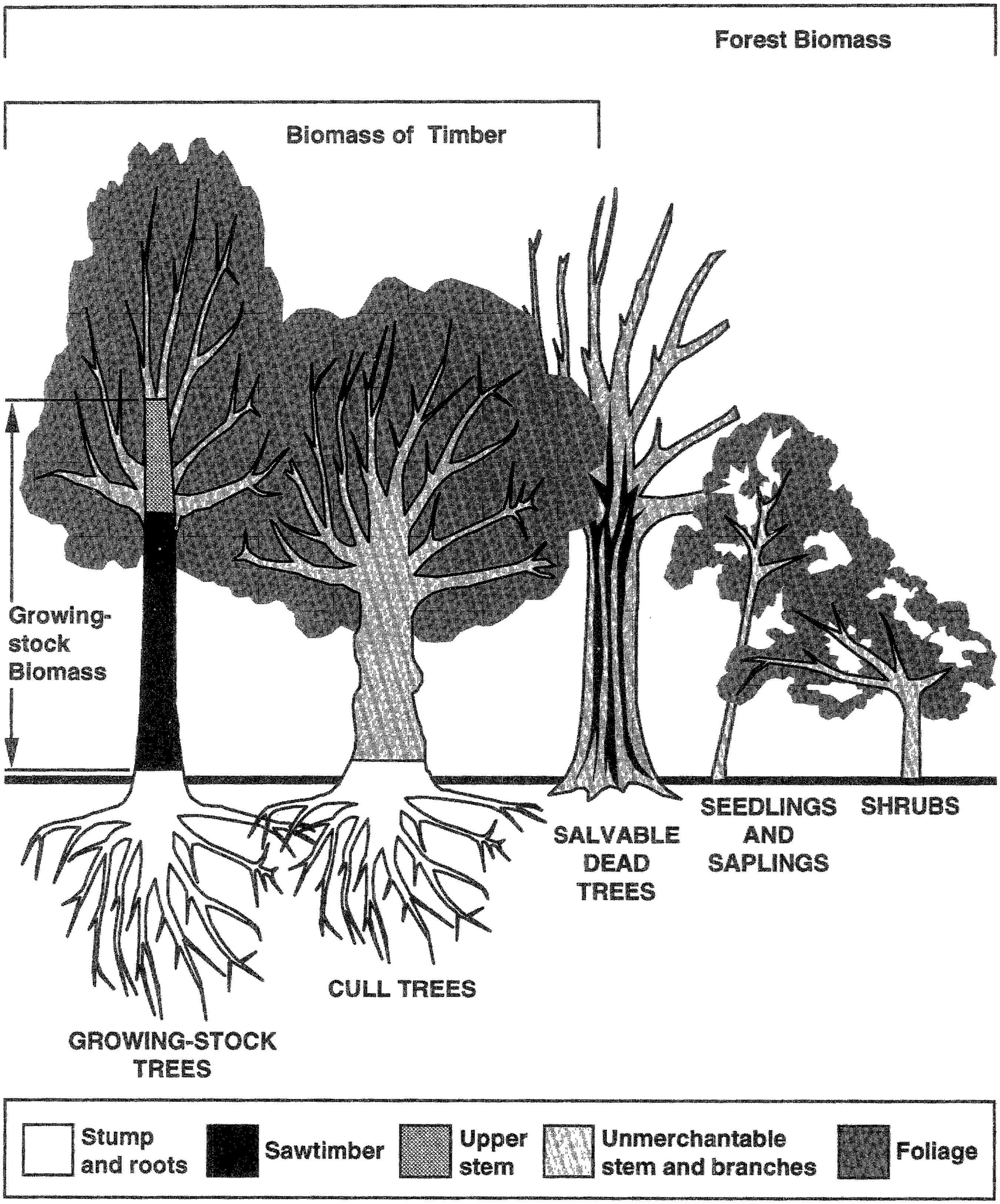

Figure 1. Relationship of total forest biomass components

Table 4. Aboveground tree-weight regression coefficients for selected species

$$LnY = b_0 + b_1 Ln(D) \quad (1)$$

$$LOG_{10}Y = LOG_{10}b_0 + b_1 LOG_{10}(D) \quad (2)$$

$$Y = b_0 + b_1(D) + b_2(D^2) \quad (3)$$

Y = dry weight (in pounds or kilograms)
D = d.b.h. (in inches or millimeters)
H = merchantable height (in meters)

Species	Coefficients			Equation number
	b_0	b_1	b_2	
Balsam fir	0.5958	2.4017	—	1
Eastern white pine	0.4080	2.4490	—	1
Red pine	0.7157	2.3865	—	1
Spruce	0.8079	2.3316	—	1
Hemlock	0.6803	2.3617	—	1
N. white-cedar	1.1182	1.9269	—	1
Larch	0.8162	2.2453	—	1
Red maple	0.9392	2.3804	—	1
Sugar maple	5.2480	0.3661	0.0076	3
Yellow birch	1.1297	2.3376	—	1
Hickory	1.9338	2.6209	—	2
American beech	5.3373	-0.3257	0.0072	3
White ash	3.2031	-0.2337	0.0061	3
Yellow-poplar	1.5779	2.5153	—	2
Black cherry	2.5883	2.4253	—	2
Aspen	0.4689	2.6087	—	1
White oak	1.2892	2.7010	—	2
Scarlet oak	2.6574	2.4395	—	2
Chestnut oak	2.1202	2.5344	—	2
Northern red oak	1.6891	2.6598	—	2
Black gum	2.1457	2.5050	—	2

Bark also could be included but little research has been conducted on the amount of bark biomass contained in standing trees, either on a green- or dry-weight basis. For those interested in estimates of bark biomass, one technique is to divide estimates of whole-tree wood biomass by estimates of whole-tree wood and bark biomass. Comparative regression equations useful for this purpose have been synthesized from the literature and presented in tabular format by the USDA Forest Service (1984). However, they were developed mostly for southeastern tree species.

Branch biomass–We derived biomass in branches from regression equations developed by Young and others (1980). By dividing the weight of branches by aboveground tree biomass, the proportion of branch biomass can be determined using averages by evergreen and deciduous species and by stand-size class (Table 5). Resulting branch percentages are applied to the estimates of aboveground biomass as outlined under the previous section.

Foliage biomass–This component of forest biomass has become more important recently. It has been used as a data input for determining hydrocarbon emissions and is a critical component of research on carbon sinks and sequestering. Foliage biomass can be estimated by the same technique outlined for branches. Average proportions are presented in Table 5.

Stump/root biomass–Information on stumps and roots is currently of little value, but may become more important. This component can be estimated by the same technique described for branches. However, root estimates may be poor due to incomplete recovery in the development of estimation procedures. Average proportions are presented in Table 5.

Cull trees–Cull trees have more than 67 percent of their volume deducted due to rot or poor form. As with other timber trees, only rotten cull is deducted to determine net weight. Cull trees pose no special problem other than that the regression equations may not fit trees of poor form. Some of these trees may be wolf trees whose biomass could be underestimated because regression equations usually are developed for dominant and codominant trees. Until regression equations are developed for rough, poorly formed trees, the biomass equations now available will have to suffice.

Forest Biomass

When other kinds of nontimber and nontree biomass in salvable dead trees, small trees, and shrubs are added to the biomass of timber, we approach forest biomass.

Salvable dead trees–These are dead trees with intact bark. Excluded from this particular classification of nontimber are snags, which have lost their bark and for the most part contain no sound wood. Salvable dead trees are assumed to contain sound wood, and are treated in the same way as cull trees.

Seedlings and saplings–Seedlings are trees less than 1.0 inch d.b.h., and saplings are trees at least 1.0 inch d.b.h. but less than 5.0 inches d.b.h. A single regression equation may be sufficient to estimate their aboveground biomass.

Table 5. Branch biomass and foliage biomass as a percentage of aboveground tree biomass, and stump-root biomass as a percentage of complete tree biomass, dry-weight basis

Stand-size class	Foliage		Branches		Stump/root	
	Evergreen	Deciduous	Evergreen	Deciduous	Evergreen	Deciduous
Poletimber	0.1126	0.0348	0.1402	0.1093	0.2033	0.2109
Small sawtimber	0.0960	0.0268	0.1410	0.0991	0.2030	0.2013
Large sawtimber < 21.0" d.b.h.	0.0860	0.0224	0.1427	0.0932	0.2032	0.1943
Large sawtimber ≥ 21.0" d.b.h.	0.0768	0.0175	0.1457	0.0860	0.2040	0.1844

In a study by Tritton and Hornbeck (1982), graphical analysis of biomass regression equations for a single species–red maple–showed little differences in the smaller diameter classes. The regressed lines diverged between a d.b.h. of 15 and 20 cm (6 and 8 inches). For trees between 1 and 5 inches d.b.h., the regression equations were virtually identical. Additional graphical analysis that we conducted showed that regression equations for many different species did not differ for small-diameter trees.

We felt that a single biomass regression equation chosen from the literature to predict the weight of small trees could be selected on the basis of the following criteria:

•D.b.h. must be the sole independent variable used to predict tree weight because tree height usually is not measured for saplings. And because saplings have no merchantable height, the regression equation to predict total tree height from diameter and merchantable height cannot be used.

•Aboveground tree weight must be predicted on a dry-weight basis.

•Tree weight must be predicted for as many of the most common northeastern species as possible.

A biomass regression equation developed by Wartluft (1977) met all of these criteria. In his study conducted in West Virginia, 17 randomly selected, naturally occurring Appalachian deciduous species (Table 6) were weighed, and a single biomass equation developed using d.b.h. as the sole predictor of aboveground tree biomass.

Equations to predict both green and dry weight were developed. The dry-weight equation is:

$$\mathrm{Ln}Y = 1.54934 + 2.39376\ \mathrm{Ln}\ (D)$$

where Ln is the natural logarithm, the dependent variable Y is total aboveground tree biomass (in dry pounds), and the independent variable D is d.b.h. (in inches).

Table 6. Species and number of observations used to develop a biomass regression equation for small Appalachian deciduous species

Common name	Scientific name	n
Soft maple	*Acer rubrum*	47
Hard maple	*A. saccharum*	9
Sweet birch	*Betula lenta*	1
Hickory	*Carya sp.*	13
Dogwood	*Cornus florida*	2
Beech	*Fagus grandifolia*	2
Yellow-poplar	*Liriodendron tulipifera*	4
Cucumber	*Magnolia acuminata*	2
Mountain magnolia	*M. fraseri*	3
Blackgum	*Nyssa sylvatica*	4
Sourwood	*Oxydendrum arboreum*	12
Aspen	*Populus sp.*	2
Black cherry	*Prunus serotina*	1
White oak	*Quercus alba*	28
Chestnut oak	*Q. prinus*	32
Red oak	*Q. sp.*	31
Sassafras	*Sassafras albidum*	7

Shrubs–Interest in shrub biomass has continued to increase because of interest in biodiversity and new research on global climate change, carbon sequestering, wildlife habitats, and forest fuel. As with the biomass of timber, shrub biomass can be determined by regression equations extracted from the literature. Most equations that predict shrub biomass include some measure of diameter, either at the base or at some point above that.

Unfortunately, diameter measurements are not taken for the shrubs encountered on our field plots, only stem counts. As a result, median stem diameters had to be substituted for diameters in the shrub biomass equations. These were obtained from the source of the equations themselves.

The shrub-biomass equations were obtained from Smith and Brand (1983). They synthesized equations from various sources along with ranges of diameters that could be used to determine average stem diameter. Occasionally, several equations were available for a particular species, so decisions had to be made concerning the best equation to use on the basis of the following criteria:

•The equations had to predict aboveground biomass, which includes foliage biomass. Those that did not include foliage biomass were excluded.

•Geographic source was considered–equations that were developed closest to the Northeast were selected over those developed elsewhere.

•Equations that had higher correlation coefficients (r^2) were selected.

These three criteria were sufficient to judge the equations suitable for each species and resulted in regression equations for 30 species (Table 7).

The form of the equation is:

$$Y = b_0(D)^{b_1}$$

where the dependent variable Y is aboveground biomass (in grams), and the independent variable D is the median stem diameter (in centimeters).

In the shrub-biomass equations, two diameter measurements were used. Most included basal stem diameter, but some included diameter 15 cm aboveground. This did not influence the results because median stem diameters (based on the range of published diameters) are used to determine average biomass per stem. The biomass per stem was then applied to stem counts collected during the resource inventory.

Species were segregated into evergreen and deciduous species. Species that did not have a specific biomass regression equation were matched with those that did (called key species) based on similar form (Appendix C). A detailed list of northeastern shrub species can be found in Appendix E.

Application to the Resource Inventory

The Forest Service conducts periodic forest inventories of all states in the Nation. Authority to conduct these inventories is provided by the McSweeny-McNary Forest Research Act of 1928 and subsequent acts, including the Renewable Resources Planning Act of 1974 and the Renewable Resources Research Act of 1978.

The Forest Inventory and Analysis unit has inventoried New York's timberlands four times. The most recent inventory was completed in 1993 (Alerich and Drake 1995). Previous inventories were conducted for 1952 (Armstrong and Bjorkbom 1956), 1967 (Ferguson and Mayer 1970), and 1980 (Considine and Frieswyk 1982). Previous biomass statistics were calculated for the 1980 inventory (Wharton 1984).

The inventory design employs multistage sampling of aerial photo points with a subsample of ground plots in New York except the Adirondack and Catskill Preserves. This procedure required the photointerpretation and classification of 82,775 new photo points and 6,452 previously sampled ground plot locations into land-use and cubic-foot volume classes. Field crews then remeasured 4,906 ground plots from the previous inventory and permanently located a subsample of 497 new ground plots.

Means and variances for each photo stratum were calculated from the ground sample. Bronx, Kings, Nassau, New York, Queens, and Richmond counties were excluded from the ground sample because all of the forest land within those counties was classified as urban, and therefore, non-forested.

Table 7. Shrub-biomass regression coefficients for selected species

$$Y = b_0(D)^{b_1}$$

Y = dry weight (in grams)
D = median stem diameter (in centimeters)

Species[a]	Aboveground biomass coefficients		Foliage biomass coefficients		Median stem diameter	Source[b]
	b_0	b_1	b_0	b_1	(cm)	
Alnus sp.	63.280	2.380	14.725	1.828	2.45	Minnesota (b)
Berberis repens	19.609	2.092	8.174	1.586	0.60	Idaho/Montana
Ceanothus velutinus	39.252	2.847	14.688	2.415	1.55	Idaho/Montana
Chamaedaphne calyculata	41.330	2.626	10.566	2.220	0.48	Canada
Comptonia peregrina	44.691	3.314	13.585	3.014	0.84	Canada
Cornus rugosa	74.114	2.457	17.131	2.093	1.95	Minnesota (b)
C. stolonifera	32.791	3.806	7.992	2.440	1.00	Minnesota (a)
Corylus cornuta	62.819	2.420	12.115	2.010	1.40	Minnesota (b)
Gaylussacia baccata	44.942	2.156	13.950	1.502	1.52	Canada
Hamamelis virginiana	38.111	2.900	9.480	2.162	2.24	Canada
Ilex verticillata	53.497	3.340	10.747	2.851	0.54	Canada
Juniperus communis	59.205	2.202	30.387	1.650	1.85	Idaho/Montana
Kalmia augustifolia	26.692	2.384	8.497	2.091	0.48	Canada
Ledum groenlandicum	37.597	2.832	12.331	2.413	0.53	Canada
Lonicera canadensis	51.996	2.770	15.610	2.399	0.40	Canada
L. hirsuta[c]	46.002	3.402	3.926	1.163	0.38	Minnesota (c)
Menziesia ferruginea	21.607	3.150	1.937	2.263	1.25	Idaho/Montana
Myrica pensylvanica	60.795	2.867	18.361	2.529	0.70	Canada
Nemopanthus mucronatus	31.532	2.819	4.246	2.231	1.50	Canada
Physocarpus malvaceus	41.679	2.576	9.728	2.036	2.10	Idaho/Montana
Rhamnus alnifolia[d]	30.791	2.764	2.009	3.835	1.12	Minnesota (c)
Rhododendron canadense	24.079	2.612	5.183	2.050	0.68	Canada
Ribes sp.	49.001	3.112	8.706	2.538	0.90	Idaho/Montana
Rosa sp.	37.637	2.779	7.561	2.112	0.70	Idaho/Montana
Rubus idaeus	43.992	2.860	18.394	2.932	0.60	Idaho/Montana
Shepherdia candensie	33.016	2.407	7.463	2.034	1.80	Idaho/Montana
Spirea sp.	36.648	2.579	5.493	1.720	0.68	Canada
Symphoricarpos alba	32.786	2.285	6.437	1.721	0.70	Idaho/Montana
Vaccinium sp.	95.143	3.706	13.224	3.034	0.35	Canada
Viburnum latinoides	43.570	2.774	7.143	2.205	1.70	Canada

[a]Species presented are common shrub species of the North-Central United States. Scientific names are given to relate these species to shrub species found in the Northeastern United States.

[b]Sources are: Canada, Maritime Provinces (Telfer 1969); Idaho/Montana, northern Idaho and western Montana (Brown 1976); Minnesota (a), northern Minnesota (Connally 1981); Minnesota (b), northern Minnesota (Roussopoulos and Loomis 1979); and Minnesota (c), northeastern Minnesota (Grigal and Ohmann 1977).

[c]Vine honeysuckle. Vines (and dwarf shrubs) are currently excluded from assessments of shrub biomass. However, it has been included in anticipation of future assessments.

[d]Woody aboveground biomass is used as the dependent variable in the equation to predict aboveground biomass because an equation for total aboveground biomass is unavailable.

One of the prerequisites for developing county-level statistics is that a county must have at least 60,000 acres of timberland. Counties that do not meet this criterion have too few plots to allow reliable estimates. Such counties are grouped with a neighboring county or counties to form a sampling base large enough to provide reliable estimates. These are called supercounties. Only two supercounties were necessary in New York: Cayuga and Seneca counties; Rockland and Westchester counties.

Reliability of the Estimates

The data in this report were based on a carefully designed sample of forest conditions throughout New York. But since field crews did not measure every tree or every acre in the state, the data are estimates. The reliability of the estimates can be judged by two important statistical measures: accuracy and precision. Accuracy refers to the success of estimating the true value; precision refers to the clustering of sample values about their own averages–the variation among repeated samples.

We are interested primarily in the accuracy of the inventory, but in most cases we can only measure precision. Accuracy is increased by keeping sources of procedural error to a minimum through careful training of personnel, frequent quality control, and application of reliable methods. The precision of an estimate is described by sampling error. It is expressed as a percentage of the estimate at one standard deviation, calculated as the square root of the variance, divided by the estimate, and multiplied by 100.

The sampling errors reported are for row and column totals only. Alegria and Scott (1991) have developed a procedure to approximate individual cell sampling errors from row and column totals. However, an indication of the magnitude of the cell sampling errors is provided. Estimates that have associated sampling errors greater than 25 percent but less than 50 percent are suspect and should be used with caution. Cell estimates that have associated sampling errors greater than or equal to 50 percent are not significantly different from zero, and are unreliable.

The sampling errors are used as follows: the estimate of total biomass of all trees and shrubs on New York timberlands is 1,100 million dry tons. The estimate has an associated sampling error of 0.9 percent, or 9.9 million dry tons. This means that we are 66 percent confident that the actual or true biomass of all trees and shrubs is between 1,090 and 1,110 million dry tons, and 95 percent confident that the actual or true value of all trees and shrubs is between 1,080 and 1,120 million dry tons.

State estimates have the smallest sampling errors and, therefore, are the most precise. County estimates are less reliable. For example, the sampling error for total biomass of timber on New York timberlands is 0.9 percent. The similar estimate for Erie County is 6.7 percent. In general, as the size of the estimate decreases in relation to the total, the sampling error increases.

To improve the reliability of the estimates, values can be combined to reduce the sampling error. This is possible only when combining row values because counties and geographic units are sampled independently. The calculated sampling errors will be approximations, but will be sufficient to make judgments of acceptability. The technique to approximate the sampling error of a combined row estimate uses the following formulas:

$$v(X_t) = (s_1 X_1)^2 + (s_2 X_2)^2$$

$$s(X_t) = \frac{\sqrt{v(X_t)}}{X_t}$$

where;

X_1 = first row-value estimate

X_2 = second row-value estimate

X_t = combined row-value estimate

S_1 = sampling error of first row-value estimate

S_2 = sampling error of second row-value estimate

$v(X_t)$ = variance of combined row-value estimate

$s(X_t)$ = sampling error of combined row-value estimate

New York Biomass Tables

The biomass tables are divided into four broad groups. The first three relate volume, green weight, and dry weight within the merchantable-stem portion of growing-stock trees. The estimates of volume are not considered biomass, but have been provided in order to relate biomass to volume in growing stock. The tables that follow these depict an increasingly broader range of biomass information.

Except for the first two tables, all tables report biomass on a dry-weight basis in English units. Conversions and metric equivalents have been provided for users requiring green-weight biomass statistics, for calculating energy values, or for converting the data to metric units (Appendix F).

In most of the tables, biomass is reported by evergreen and deciduous species. Classical distinctions of softwoods and hardwoods seem inappropriate for some components. The biomass of shrubs is one example. More descriptive terms were required to identify species groups even though nearly every classification is somewhat misleading. For example, some evergreen species loose their needles annually, and some deciduous trees have persistent leaves. Evergreen/deciduous was preferred to both the softwood/hardwood or the coniferous/broad-leaved classifications.

It should be noted that cell estimates may not sum to row and column totals. Because of the way in which sample data have been expanded to develop the statistics, rounding errors will occur. Sometimes, an estimate of zero occurs in the cells. This may not mean that a true null quantity exists but that no sample trees may have been encountered for that cell. This also happens when trees may have been sampled but the resulting biomass was fewer than 500 tons; consequently, the total is rounded to zero when reported in millions of tons.

The primary building blocks for reporting results are counties. Data are reported at the county level, the geographic unit level, and at the state level.

Index to Tables

Volume of growing stock on timberland, by county and component, cubic-foot basis, New York, 1993

County and geographic unit	Poletimber	Sawtimber		Total growing stock	Sampling error
		Sawlog	Upper stem		
	Thousand cubic feet				Percent
Erie	121,167	40,672	199,529	361,368	7.8
Genesee	50,706	9,462	45,073	105,241	16.7
Livingston	85,534	15,518	71,780	172,832	11.6
Madison	95,596	29,539	138,593	263,729	10.0
Monroe	42,021	11,867 †	52,335 †	106,223	19.4
Niagara	25,474 †	5,969 †	26,376 †	57,819	24.9
Onondaga	87,062	32,901	154,489	274,452	11.8
Ontario	57,649	21,013	90,984	169,647	11.7
Orleans	25,629 †	7,363 †	30,166 †	63,157 †	25.0
Oswego	267,233	85,794	429,684	782,712	6.0
Wayne	71,957	20,254	90,807	183,018	13.0
Wyoming	84,696	17,783	79,665	182,144	9.7
Yates	33,103	11,290	57,959	102,352	12.9
Cayuga and Seneca	96,740	38,537	185,620	320,896	11.0
Lake Plain	1,144,567	347,963	1,653,060	3,145,589	3.0
Allegany	270,859	53,552	238,196	562,607	5.6
Cattaraugus	263,985	78,233	363,350	705,568	6.3
Chautauqua	135,931	42,075	200,626	378,632	9.8
Steuben	266,647	57,773	258,287	582,708	6.6
Southwest Highlands	937,423	231,633	1,060,459	2,229,515	3.4
Broome	151,969	41,600	192,892	386,460	8.1
Chemung	90,688	17,767	81,855	190,311	10.1
Chenango	184,928	64,799	352,842	602,569	7.2
Cortland	82,700	25,455	108,797	216,953	10.6
Delaware	315,303	107,022	482,755	905,079	4.5
Otsego	190,392	62,320	320,141	572,853	6.3
Schuyler	73,167	14,751	69,823	157,741	12.0
Tioga	102,503	24,992	122,663	250,158	9.5
Tompkins	84,595	26,728	121,455	232,777	10.6
South-central Highlands	1,276,244	385,436	1,853,221	3,514,901	2.6
Clinton	303,145	39,737	186,561	529,443	6.9
Franklin	355,128	84,261	397,435	836,824	4.1
Jefferson	114,221	28,665	152,363	295,250	13.4
St. Lawrence	566,751	142,767	677,867	1,387,385	4.3
St. Lawrence/N. Adirondack	1,339,246	295,429	1,414,227	3,048,902	2.9

(continued)

County and geographic unit	Poletimber	Sawtimber		Total growing stock	Sampling error
		Sawlog	Upper stem		
	---------- *Thousand cubic feet*			----------	*Percent*
Fulton	93,753	27,685	146,354	267,793	10.6
Herkimer	170,078	49,164	242,847	462,089	7.4
Lewis	264,035	83,733	415,077	762,846	5.8
Oneida	193,285	72,968	394,332	660,585	7.0
Western Adirondack	721,151	233,551	1,198,611	2,153,312	3.6
Essex	333,066	101,507	567,900	1,002,473	5.9
Hamilton	179,202	50,998	264,926	495,127	7.2
Warren	246,339	59,192	331,342	636,872	6.5
Eastern Adirondack	758,608	211,697	1,164,167	2,134,472	3.8
Albany	95,959	26,156	158,671	280,786	11.9
Columbia	104,857	43,371	226,049	374,277	10.3
Montgomery	33,973	8,543	43,690	86,205	12.8
Rensselaer	165,557	38,252	186,392	390,201	8.6
Saratoga	213,814	60,358	334,118	608,290	7.1
Schenectady	25,006	6,303 †	31,608 †	62,917 †	27.3
Washington	156,072	41,024	221,194	418,290	8.9
Capitol District	795,239	224,005	1,201,722	2,220,966	3.9
Dutchess	120,541	51,741	235,010	407,293	8.9
Greene	186,229	42,015	230,425	458,669	6.0
Orange	100,895	35,624	180,518	317,038	10.1
Putnam	44,011	17,876	77,377	139,264	16.3
Schoharie	141,964	43,070	222,620	407,654	7.7
Suffolk	25,309 †	4,739 †	22,645 †	52,694 †	26.5
Sullivan	239,866	67,752	362,141	669,759	6.1
Ulster	222,765	77,534	399,858	700,157	5.2
Rockland and Westchester	39,839	21,246	102,890	163,975	14.5
Catskill/Lower Hudson	1,121,420	361,597	1,833,486	3,316,503	2.8
All counties and units	8,093,897	2,291,311	11,378,953	21,764,160	1.1
Sampling error (percent)	1.3	1.4	1.6	1.1	

NOTE: Cell estimates with sampling errors greater than 25 percent but less than 50 percent–denoted by (†)–are suspect and should be used with caution. Cell estimates with sampling errors greater than or equal to 50 percent–denoted by (‡)–are not significantly different from zero and are unreliable.

Biomass of growing stock on timberland, by county and component, green-weight basis, New York, 1993

County and geographic unit	Poletimber	Sawtimber		Total growing stock	Sampling error
		Sawlog	Upper stem		
	Thousand green tons				Percent
Erie	4,504	7,652	1,568	13,724	7.8
Genesee	1,756	1,780	377	3,912	16.2
Livingston	2,968	2,597	561	6,126	11.6
Madison	3,117	4,979	1,070	9,166	9.7
Monroe	1,501	1,967 †	439 †	3,906	19.5
Niagara	1,076 †	1,251 †	272 †	2,599	23.7
Onondaga	2,992	5,840	1,240	10,072	11.9
Ontario	2,083	3,496	805	6,385	11.3
Orleans	967	1,221 †	296 †	2,485	22.1
Oswego	9,143	15,618	3,121	27,882	5.9
Wayne	2,486	3,380	748	6,613	12.9
Wyoming	3,271	3,268	722	7,261	10.1
Yates	1,166	2,253	441	3,860	13.6
Cayuga and Seneca	3,553	7,204	1,497	12,253	11.3
Lake Plain	40,582	62,504	13,157	116,244	3.0
Allegany	9,217	8,951	2,003	20,172	5.4
Cattaraugus	9,375	13,794	2,973	26,142	6.2
Chautauqua	4,928	8,060	1,695	14,682	10.2
Steuben	9,461	9,925	2,205	21,591	6.4
Southwest Highlands	32,981	40,730	8,876	82,588	3.4
Broome	5,553	7,335	1,584	14,473	8.0
Chemung	3,170	2,990	652	6,811	9.9
Chenango	6,401	12,738	2,375	21,514	7.0
Cortland	2,882	3,990	926	7,798	10.0
Delaware	11,856	18,174	4,007	34,037	4.3
Otsego	6,630	11,666	2,308	20,605	6.1
Schuyler	2,571	2,622	554	5,747	12.0
Tioga	3,624	4,503	927	9,053	9.3
Tompkins	2,890	4,509	991	8,391	10.7
South-central Highlands	45,577	68,527	14,325	128,429	2.5
Clinton	10,204	6,723	1,471	18,398	6.8
Franklin	12,315	14,715	3,181	30,212	4.7
Jefferson	4,266	5,412	1,038	10,716	12.4
St. Lawrence	20,642	25,455	5,429	51,525	4.0
St. Lawrence/N. Adirondack	47,427	52,305	11,119	110,851	2.0

(continued)

County and geographic unit	Poletimber	Sawtimber		Total growing stock	Sampling error
		Sawlog	Upper stem		
	---------------------- *Thousand green tons*	----------------------			*Percent*
Fulton	3,358	5,329	1,022	9,710	10.0
Herkimer	6,152	8,830	1,818	16,800	6.9
Lewis	9,362	15,622	3,191	28,175	5.4
Oneida	7,149	14,306	2,691	24,146	6.8
Western Adirondack	26,021	44,087	8,722	78,830	3.4
Essex	11,317	19,824	3,654	34,794	5.7
Hamilton	6,424	9,435	1,877	17,736	7.0
Warren	8,216	11,700	2,142	22,058	6.5
Eastern Adirondack	25,957	40,959	7,673	74,589	3.7
Albany	3,186	5,842	969	9,996	12.1
Columbia	3,772	8,763	1,715	14,249	9.6
Montgomery	1,221	1,601	322	3,144	12.4
Rensselaer	6,046	7,128	1,483	14,657	8.5
Saratoga	7,297	12,150	2,223	21,669	7.2
Schenectady	951	1,192 †	242 †	2,385 †	26.4
Washington	5,400	8,286	1,586	15,272	8.3
Capitol District	27,873	44,961	8,539	81,373	3.8
Dutchess	4,645	9,731	2,128	16,504	9.0
Greene	6,694	8,600	1,602	16,896	5.8
Orange	4,361	7,470	1,498	13,330	9.4
Putnam	1,722	3,019	701	5,443	16.1
Schoharie	5,278	7,978	1,579	14,835	7.3
Suffolk	1,005 †	989 †	210 †	2,204 †	25.7
Sullivan	9,307	14,912	2,815	27,035	5.8
Ulster	8,495	15,338	3,014	26,846	5.0
Rockland and Westchester	1,675	4,516	925	7,115	14.9
Catskill/Lower Hudson	43,182	72,554	14,473	130,208	2.7
All counties and units	289,599	426,628	86,885	803,112	1.1
Sampling error (percent)	1.3	1.5	1.4	1.1	

NOTE: Cell estimates with sampling errors greater than 25 percent but less than 50 percent–denoted by (†)–are suspect and should be used with caution. Cell estimates with sampling errors greater than or equal to 50 percent–denoted by (‡)–are not significantly different from zero and are unreliable.

Biomass of growing stock on timberland, by county and component, dry-weight basis, New York, 1993

County and geographic unit	Poletimber	Sawtimber		Total growing stock	Sampling error
		Sawlog	Upper stem		
	Thousand dry tons				*Percent*
Erie	3,692	5,525	1,160	10,377	7.5
Genesee	1,534	1,285	277	3,097	14.3
Livingston	2,389	2,050	448	4,887	11.6
Madison	2,375	3,533	784	6,692	9.9
Monroe	1,144	1,612 †	351 †	3,107	19.8
Niagara	746	1,118 †	237 †	2,101	24.0
Onondaga	2,369	4,082	880	7,331	12.0
Ontario	1,665	2,947	671	5,283	11.5
Orleans	759	916	218	1,893	19.5
Oswego	6,818	9,959	2,063	18,840	5.7
Wayne	2,049	2,712	592	5,353	13.4
Wyoming	2,754	2,671	593	6,019	10.5
Yates	939	1,888	379	3,206	14.8
Cayuga and Seneca	2,774	5,195	1,087	9,057	11.6
Lake Plain	32,008	45,493	9,741	87,243	3.0
Allegany	7,417	7,296	1,631	16,344	5.2
Cattaraugus	7,527	9,918	2,175	19,619	5.6
Chautauqua	4,080	5,924	1,259	11,263	9.8
Steuben	7,519	7,732	1,726	16,977	6.2
Southwest Highlands	26,543	30,870	6,791	64,204	3.2
Broome	4,388	5,071	1,126	10,585	7.4
Chemung	2,418	2,170	484	5,072	9.1
Chenango	5,263	7,991	1,574	14,829	6.0
Cortland	2,297	2,977	697	5,972	10.0
Delaware	9,989	13,547	3,033	26,570	4.2
Otsego	5,289	8,405	1,736	15,430	5.7
Schuyler	1,971	1,853	408	4,233	11.5
Tioga	2,737	3,059	650	6,446	8.7
Tompkins	2,246	3,296	735	6,277	10.5
South-central Highlands	36,600	48,369	10,444	95,413	2.3
Clinton	7,801	4,640	1,070	13,511	6.4
Franklin	9,535	10,315	2,306	22,157	4.7
Jefferson	3,386	3,920	777	8,082	11.9
St. Lawrence	16,067	18,554	4,040	38,661	3.9
St. Lawrence/N. Adirondack	36,789	37,429	8,193	82,411	2.7

(continued)

County and geographic unit	Poletimber	Sawtimber		Total growing stock	Sampling error
		Sawlog	Upper stem		
	-------------------	*Thousand dry tons*	-------------------		*Percent*
Fulton	2,555	3,499	711	6,766	9.9
Herkimer	5,217	6,338	1,342	12,897	7.0
Lewis	7,446	11,626	2,448	21,519	5.3
Oneida	6,029	9,745	1,937	17,712	6.3
Western Adirondack	21,247	31,209	6,438	58,894	3.3
Essex	8,853	13,273	2,618	24,744	5.8
Hamilton	5,414	6,612	1,366	13,392	6.5
Warren	6,140	7,599	1,479	15,219	6.2
Eastern Adirondack	20,407	27,485	5,463	53,355	3.6
Albany	2,390	3,747	660	6,797	11.5
Columbia	2,657	6,008	1,218	9,884	9.1
Montgomery	1,049	1,231	260	2,540	12.3
Rensselaer	4,388	5,101	1,083	10,572	8.4
Saratoga	5,213	7,828	1,529	14,570	6.8
Schenectady	880	983 †	216 †	2,079 †	23.8
Washington	4,018	5,497	1,133	10,648	7.5
Capitol District	20,596	30,395	6,099	57,090	3.6
Dutchess	3,568	7,839	1,695	13,103	9.2
Greene	5,069	5,838	1,147	12,054	5.5
Orange	3,539	5,984	1,241	10,764	9.1
Putnam	1,303	2,585	585	4,473	16.2
Schoharie	4,440	5,700	1,192	11,333	6.9
Suffolk	720 †	798 †	170 †	1,687 †	26.0
Sullivan	6,889	10,041	2,019	18,949	5.5
Ulster	6,444	11,001	2,260	19,705	4.7
Rockland and Westchester	1,343	3,709	754	5,806	14.7
Catskill/Lower Hudson	33,316	53,496	11,064	97,875	2.7
All counties and units	227,507	304,745	64,233	596,485	1.1
Sampling error (percent)	1.2	1.5	1.4	1.1	

NOTE: Cell estimates with sampling errors greater than 25 percent but less than 50 percent–denoted by (†)–are suspect and should be used with caution. Cell estimates with sampling errors greater than or equal to 50 percent–denoted by (‡)–are not significantly different from zero and are unreliable.

Biomass of evergreen timber on timberland, by county, class of timber, and component, dry-weight basis, New York, 1993

County and geographic unit	Growing stock	Growing-stock trees			Cull trees	Total timber	Sampling error
		Branches	Foliage	Stump and roots			
	Thousand dry tons						*Percent*
Erie	1,194	222	152	400	57 †	2,025	24.6
Genesee	353 ‡	66 ‡	47 ‡	119 ‡	0	585	66.2
Livingston	408 †	76 †	55 †	138 †	84 †	761 †	39.6
Madison	1,152 †	215 †	152 †	389 †	11	1,919	28.4
Monroe	128 ‡	24 ‡	19 ‡	43 ‡	50 ‡	264	93.0
Niagara	19 ‡	3 ‡	3 ‡	6 ‡	0 ‡	31	100.0
Onondaga	792	149	103	269	55	1,368	42.0
Ontario	125	23	17	42	0	207	48.7
Orleans	43 ‡	8 ‡	6 ‡	14 ‡	0	70	100.0
Oswego	3,354	626	423	1,128	234	5,765	15.0
Wayne	215	40	29	73	8	365	31.2
Wyoming	233	43	30	78	0	384	42.3
Yates	392	73	50	132	101 ‡	748	43.6
Cayuga and Seneca	576 ‡	107 ‡	69 ‡	192 ‡	12 ‡	956	60.8
Lake Plain	8,983	1,676	1,155	3,023	612	15,450	10.1
Allegany	1,099 †	205 †	138 †	369 †	68 †	1,879	25.7
Cattaraugus	2,369	442	312	799	150	4,073	18.3
Chautauqua	1,087 †	202 †	140 †	365 †	99 †	1,893	25.5
Steuben	1,117 †	209 †	141 †	376 †	144 †	1,987	25.9
Southwest Highlands	5,672	1,058	731	1,909	461	9,832	11.5
Broome	1,185	221	151	398	108	2,063	19.9
Chemung	770 †	144 †	98 †	259 †	79 †	1,350	27.3
Chenango	3,733	694	471	1,250	547 †	6,694	12.9
Cortland	234 †	44 †	30 †	79 †	44	430	42.2
Delaware	2,249	421	273	755	506 ‡	4,204 †	15.1
Otsego	2,797	521	351	938	393	5,000 †	15.9
Schuyler	488	91	60	163	28 ‡	830	21.2
Tioga	1,348 †	253 †	173	456 †	86 ‡	2,317	25.2
Tompkins	771 †	143 †	101	259 †	42 ‡	1,317	25.1
South-central Highlands	13,575	2,532	1,708	4,557	1,832	24,205	6.7
Clinton	2,365	447	316	806	153 †	4,087	18.0
Franklin	3,060	582	402	1,050	82 †	5,175	15.3
Jefferson	1,417 †	265 †	183 †	479 †	157 †	2,500	27.5
St. Lawrence	4,903	921	631	1,659	529	8,642	12.0
St. Lawrence/N. Adirondack	11,745	2,215	1,531	3,993	920	20,405	8.1

(continued)

County and geographic unit	Growing stock	Growing-stock trees			Cull trees	Total timber	Sampling error
		Branches	Foliage	Stump and roots			
	Thousand dry tons						*Percent*
Fulton	1,761 †	327	217	588	137 †	3,031	20.4
Herkimer	1,923 ‡	358	248	646	148 †	3,323	15.6
Lewis	3,160	589	401	1,061	414 †	5,625	19.0
Oneida	3,417	634	422	1,141	287	5,902	17.7
Western Adirondack	10,261	1,909	1,289	3,436	986	17,881	9.5
Essex	6,433	1,204	805	2,165	439 ‡	11,045	11.0
Hamilton	2,603	488	337	880	86 †	4,394	15.6
Warren	4,435	835	564	1,503	472 †	7,808	12.7
Eastern Adirondack	13,470	2,527	1,705	4,548	997 ‡	23,247	7.4
Albany	2,562	477	319	858	270 †	4,486	15.8
Columbia	1,812	343	226	616	43 ‡	3,041	22.4
Montgomery	579 †	109 †	75 †	196 †	102	1,061 †	27.3
Rensselaer	1,383	260	176	468	145	2,431	19.7
Saratoga	3,746	699	455	1,255	146	6,300	16.0
Schenectady	265	50	33	90	214	652 †	28.0
Washington	2,500	470	315	846	235	4,366	18.8
Capitol District	12,845	2,408	1,598	4,329	1,155	22,336	7.7
Dutchess	506	95	67	171	74	913 †	31.1
Greene	2,660	497	335	894	158 ‡	4,543	17.7
Orange	1,136	214	133	383	0	1,867 †	32.5
Putnam	41 ‡	8 ‡	5 ‡	14 ‡	19 ‡	85 ‡	50.7
Schoharie	2,345	438	301	790	447 ‡	4,321	15.3
Suffolk	344 ‡	65 ‡	46 ‡	117 ‡	30	601 ‡	51.8
Sullivan	3,906	730	464	1,307	332 ‡	6,739	11.2
Ulster	2,998	559	363	1,003	466	5,389	10.8
Rockland and Westchester	118	23	14	40	17	212 †	47.1
Catskill/Lower Hudson	14,054	2,628	1,727	4,719	1,542	24,670	6.5
All counties and units	90,606	16,953	11,445	30,516	8,505	158,025	2.9
Sampling error (percent)	2.9	2.9	2.9	2.9	6.5	2.9	

NOTE: Cell estimates with sampling errors greater than 25 percent but less than 50 percent–denoted by (†)–are suspect and should be used with caution. Cell estimates with sampling errors greater than or equal to 50 percent–denoted by (‡)–are not significantly different from zero and are unreliable.

Biomass of deciduous timber on timberland, by county, class of timber, and component, dry-weight basis, New York, 1993

County and geographic unit	Growing stock	Growing-stock trees			Cull trees	Total timber	Sampling error
		Branches	Foliage	Stump and roots			
	Thousand dry tons						*Percent*
Erie	9,183	1,058	291	2,668	1,270	14,471	8.4
Genesee	2,743	327	94	817	583 †	4,563	14.6
Livingston	4,479	532	152	1,334	875 †	7,371	13.0
Madison	5,540	656	182	1,654	1,312	9,344	11.8
Monroe	2,980	340	92	859	246 †	4,516	20.9
Niagara	2,082	236	63	597	1,110 †	4,089	20.3
Onondaga	6,540	757	205	1,915	1,143 †	10,559	12.7
Ontario	5,158	594	163	1,502	820	8,236	11.2
Orleans	1,851	217	61	546	459 ‡	3,134	18.6
Oswego	15,486	1,827	511	4,599	2,195	24,618	6.6
Wayne	5,138	596	164	1,502	1,046 †	8,446	13.5
Wyoming	5,785	680	192	1,707	902	9,266	10.6
Yates	2,815	316	84	803	506 †	4,524	17.6
Cayuga and Seneca	8,481	966	259	2,449	853	13,008	12.6
Lake Plain	78,259	9,102	2,512	22,953	13,320	126,146	3.2
Allegany	15,245	1,809	515	4,536	2,644	24,749	5.1
Cattaraugus	17,250	2,040	568	5,138	3,340	28,336	5.9
Chautauqua	10,176	1,186	327	2,991	2,045	16,726	10.7
Steuben	15,861	1,889	538	4,739	1,939	24,965	6.6
Southwest Highlands	58,532	6,925	1,948	17,405	9,967	94,776	3.4
Broome	9,400	1,114	316	2,797	953	14,580	7.5
Chemung	4,302	520	151	1,300	382 †	6,655	9.4
Chenango	11,096	1,303	365	3,278	1,477	17,518	7.5
Cortland	5,738	682	192	1,716	619 †	8,946	10.1
Delaware	24,320	2,886	811	7,259	4,356	39,632	4.2
Otsego	12,633	1,486	412	3,745	2,228	20,503	6.8
Schuyler	3,745	452	130	1,132	339 †	5,798	11.8
Tioga	5,098	607	173	1,522	720	8,120	9.9
Tompkins	5,506	648	180	1,632	557 †	8,523	11.4
South-central Highlands	81,838	9,698	2,731	24,380	11,630	130,277	2.5
Clinton	11,146	1,396	416	3,468	2,452	18,878	7.1
Franklin	19,097	2,409	686	6,044	3,569	31,805	5.8
Jefferson	6,665	793	223	1,992	1,547	11,220	13.4
St. Lawrence	33,757	4,064	1,151	10,203	5,061	54,236	4.3
St. Lawrence/N. Adirondack	70,666	8,661	2,475	21,708	12,629	116,139	3.1

(continued)

County and geographic unit	Growing stock	Growing-stock trees: Branches	Foliage	Stump and roots	Cull trees	Total timber	Sampling error
	------------	Thousand dry tons				------------	Percent
Fulton	5,005	597	172	1,496	496	7,766	12.3
Herkimer	10,974	1,295	365	3,254	2,002	17,889	8.1
Lewis	18,360	2,164	598	5,457	3,871	30,449	6.1
Oneida	14,295	1,676	465	4,225	2,882	23,543	7.6
Western Adirondack	48,633	5,732	1,600	14,432	9,251	79,649	3.9
Essex	18,311	2,196	617	5,521	1,975	28,619	7.2
Hamilton	10,789	1,274	358	3,202	874	16,496	8.1
Warren	10,784	1,298	371	3,251	1,280	16,984	8.1
Eastern Adirondack	39,885	4,767	1,346	11,974	4,128	62,100	4.5
Albany	4,235	500	141	1,256	724 †	6,856	15.2
Columbia	8,072	941	255	2,383	1,152	12,803	10.2
Montgomery	1,962	232	66	581	454 †	3,294	16.4
Rensselaer	9,189	1,096	309	2,753	1,291 †	14,639	8.0
Saratoga	10,824	1,295	369	3,250	839	16,577	8.5
Schenectady	1,814	214	60	536	174 ‡	2,798	21.3
Washington	8,148	981	280	2,460	1,773	13,642	8.5
Capitol District	44,244	5,258	1,480	13,220	6,406	70,609	4.0
Dutchess	12,597	1,424	379	3,617	1,336	19,353	9.0
Greene	9,394	1,115	318	2,794	1,447	15,068	7.7
Orange	9,628	1,113	307	2,809	687	14,544	9.6
Putnam	4,432	509	137	1,290	230 †	6,600	15.7
Schoharie	8,988	1,067	303	2,678	1,518	14,554	8.3
Suffolk	1,344 †	158 †	45 †	397 †	624 ‡	2,568 †	31.1
Sullivan	15,043	1,793	509	4,500	3,352	25,198	6.0
Ulster	16,707	1,938	536	4,889	2,945	27,015	5.2
Rockland and Westchester	5,689	632	163	1,611	471 †	8,565	14.5
Catskill/Lower Hudson	83,822	9,750	2,697	24,587	12,610	133,466	2.9
All counties and units	505,879	59,894	16,788	150,658	79,941	813,160	1.2
Sampling error (percent)	1.2	1.2	1.2	1.2	2.7	1.2	

NOTE: Cell estimates with sampling errors greater than 25 percent but less than 50 percent–denoted by (†)–are suspect and should be used with caution. Cell estimates with sampling errors greater than or equal to 50 percent–denoted by (‡)–are not significantly different from zero and are unreliable.

Biomass of all timber on timberland, by county, class of timber, and component, dry-weight basis, New York, 1993

County and geographic unit	Growing stock	Growing-stock trees			Cull trees	Total timber	Sampling error
		Branches	Foliage	Stump and roots			
	Thousand dry tons						Percent
Erie	10,377	1,279	443	3,069	1,327	16,496	7.0
Genesee	3,097	392	141	936	583 †	5,148	13.2
Livingston	4,887	608	207	1,471	958 †	8,132	11.0
Madison	6,692	871	334	2,043	1,323	11,263	9.3
Monroe	3,107	364	111	903	296 †	4,781	18.2
Niagara	2,101	239	66	604	1,110 †	4,120	20.1
Onondaga	7,331	906	309	2,184	1,198 †	11,927	10.7
Ontario	5,283	617	179	1,544	820	8,443	11.0
Orleans	1,893	225	67	561	459 ‡	3,205	18.4
Oswego	18,840	2,453	934	5,727	2,429	30,383	5.3
Wayne	5,353	636	193	1,575	1,054	8,811	12.8
Wyoming	6,019	723	222	1,785	902	9,650	9.9
Yates	3,206	390	133	935	607	5,272	13.5
Cayuga and Seneca	9,057	1,073	328	2,641	865 †	13,964	11.0
Lake Plain	87,243	10,778	3,667	25,976	13,931	141,595	2.8
Allegany	16,344	2,014	653	4,904	2,712	26,628	4.8
Cattaraugus	19,619	2,482	880	5,937	3,490	32,408	5.2
Chautauqua	11,263	1,388	467	3,356	2,144	18,619	9.4
Steuben	16,977	2,099	679	5,119	2,083	26,953	5.9
Southwest Highlands	64,204	7,983	2,679	19,313	10,428	104,607	3.0
Broome	10,585	1,335	467	3,195	1,061	16,643	6.8
Chemung	5,072	664	249	1,559	461	8,005	9.0
Chenango	14,829	1,997	836	4,527	2,024	24,213	5.4
Cortland	5,972	726	222	1,795	663	9,377	9.3
Delaware	26,570	3,307	1,084	8,014	4,861	43,836	3.8
Otsego	15,430	2,007	763	4,683	2,620	25,503	5.7
Schuyler	4,233	543	190	1,295	367	6,628	10.9
Tioga	6,446	860	347	1,978	806	10,437	8.3
Tompkins	6,277	791	281	1,891	598	9,839	10.0
South-central Highlands	95,413	12,230	4,439	28,937	13,462	154,481	2.2
Clinton	13,511	1,842	732	4,275	2,605	22,965	6.0
Franklin	22,157	2,991	1,088	7,093	3,651	36,980	4.6
Jefferson	8,082	1,058	405	2,470	1,704	13,720	11.1
St. Lawrence	38,661	4,985	1,781	11,862	5,590	62,879	3.7
St. Lawrence/N. Adirondack	82,411	10,876	4,007	25,701	13,549	136,544	2.6

(continued)

County and geographic unit	Growing stock	Growing-stock trees			Cull trees	Total timber	Sampling error
		Branches	Foliage	Stump and roots			
	Thousand dry tons						*Percent*
Fulton	6,766	925	389	2,085	633	10,798	9.6
Herkimer	12,897	1,653	613	3,899	2,150	21,212	6.6
Lewis	21,519	2,753	1,000	6,518	4,285	36,075	5.0
Oneida	17,712	2,311	888	5,366	3,169	29,445	5.8
Western Adirondack	58,894	7,641	2,889	17,869	10,237	97,530	3.1
Essex	24,744	3,399	1,421	7,686	2,414	39,664	5.3
Hamilton	13,392	1,762	695	4,082	959	20,890	6.4
Warren	15,219	2,132	935	4,754	1,751	24,792	5.9
Eastern Adirondack	53,355	7,293	3,051	16,522	5,125	85,347	8.7
Albany	6,797	977	459	2,114	994	11,341	11.1
Columbia	9,884	1,284	481	3,000	1,195	15,844	8.7
Montgomery	2,540	341	141	777	555 †	4,355	11.5
Rensselaer	10,572	1,356	485	3,221	1,436 †	17,070	7.4
Saratoga	14,570	1,995	825	4,505	985	22,878	6.7
Schenectady	2,079	264	93	626	388 †	3,449	21.2
Washington	10,648	1,451	594	3,306	2,009	18,007	7.2
Capitol District	57,090	7,667	3,078	17,549	7,561	92,944	3.4
Dutchess	13,103	1,519	445	3,788	1,410	20,266	8.7
Greene	12,054	1,612	653	3,688	1,604	19,611	5.2
Orange	10,764	1,328	440	3,192	687	16,411	9.0
Putnam	4,473	517	143	1,304	249 †	6,685	15.9
Schoharie	11,333	1,505	604	3,468	1,965	18,875	6.4
Suffolk	1,688 †	223 †	91 †	514 †	654 †	3,169 †	27.1
Sullivan	18,949	2,523	973	5,807	3,684	31,937	5.2
Ulster	19,705	2,497	899	5,892	3,411	32,404	4.5
Rockland and Westchester	5,806	654	177	1,651	488 †	8,777	14.6
Catskill/Lower Hudson	97,875	12,378	4,425	29,306	14,152	158,136	2.5
All counties and units	596,485	76,847	28,233	181,174	88,446	971,185	1.0
Sampling error (percent)	1.1	1.0	1.2	1.0	2.5	1.0	

NOTE: Cell estimates with sampling errors greater than 25 percent but less than 50 percent–denoted by (†)–are suspect and should be used with caution. Cell estimates with sampling errors greater than or equal to 50 percent–denoted by (‡)–are not significantly different from zero and are unreliable.

Biomass of evergreen trees and shrubs on timberland, by county and class of material, dry-weight basis, New York, 1993

County and geographic unit	Timber	Nontimber			Shrubs	All trees and shrubs	Sampling error
		Salvable dead trees	Saplings	Seedlings			
	Thousand dry tons						Percent
Erie	2,025	30 ‡	153 †	3 ‡	0	2,211	23.4
Genesee	585 ‡	5 ‡	0	0	0	589 ‡	66.4
Livingston	761 †	50 ‡	191 †	0 ‡	0	1,002 †	35.1
Madison	1,919 †	39 ‡	301 †	10 ‡	0	2,270 †	26.7
Monroe	264 ‡	63 ‡	38 ‡	0	0	365 ‡	89.0
Niagara	31 ‡	0	9 ‡	0	0	40 ‡	80.7
Onondaga	1,368 †	0	150 ‡	1 ‡	0	1,519 †	42.1
Ontario	207 †	0	14 ‡	1 ‡	0	222 †	46.4
Orleans	70 ‡	0	0	0	0	70 ‡	100.0
Oswego	5,765	116 †	361 †	12 †	4 ‡	6,258	14.3
Wayne	365 †	16 ‡	113 †	0 ‡	1 ‡	495 †	31.5
Wyoming	384 †	12 ‡	24 ‡	0 ‡	0	421 †	43.2
Yates	748	9 ‡	61 ‡	0	0	818 †	41.9
Cayuga and Seneca	956 ‡	20 ‡	54 ‡	0	0	1,031 ‡	57.8
Lake Plain	15,450	360 †	1,470	27 †	5 ‡	17,311	9.6
Allegany	1,879 †	43 ‡	102 †	2 †	0	2,026	24.9
Cattaraugus	4,073	27 ‡	462 †	3 ‡	1 ‡	4,565	17.6
Chautauqua	1,893 †	22 ‡	69 †	3 ‡	0	1,987	24.8
Steuben	1,987 †	15 ‡	178 †	3 ‡	0 ‡	2,183 †	26.1
Southwest Highlands	9,832	108 †	812	10 †	1 ‡	10,761	11.2
Broome	2,063	36 ‡	397 †	1 ‡	0	2,497	20.6
Chemung	1,350 †	2 ‡	133 †	7 ‡	0	1,492 †	25.5
Chenango	6,694	183 ‡	359 †	5 †	0	7,242	12.8
Cortland	430	16 ‡	186 ‡	0	0	633 †	41.8
Delaware	4,204	2 ‡	133 †	2 †	1 ‡	4,342	14.8
Otsego	5,000	2 ‡	416 †	5 ‡	0	5,422	15.0
Schuyler	830	9 ‡	74 †	1 †	0	915	19.8
Tioga	2,317 †	6 ‡	335 †	4 †	0	2,662	24.6
Tompkins	1,317 †	0	102 ‡	1 ‡	0	1,419 †	25.3
South-central Highlands	24,205	257 †	2,135	25 †	1 ‡	26,623	6.5
Clinton	4,087	42 †	1,105 †	87	0 ‡	5,321	16.8
Franklin	5,175	48 †	1,016	94 †	0 ‡	6,334	14.2
Jefferson	2,500 †	10 ‡	356 †	48 ‡	3 ‡	2,917	24.9
St. Lawrence	8,642	237 †	1,847	112	6 ‡	10,843	11.2
St. Lawrence/N. Adirondack	20,405	337	4,324	341	9 ‡	25,415	7.5

(continued)

County and geographic unit	Timber	Nontimber			Shrubs	All trees and shrubs	Sampling error
		Salvable dead trees	Saplings	Seedlings			
	-------------------------	*Thousand dry tons*			-------------------------		*Percent*
Fulton	3,031 †	8 †	210	32 †	17	3,298	19.8
Herkimer	3,323 †	59 †	405	41	0 ‡	3,828	14.5
Lewis	5,625	41 ‡	1,066	72	9 ‡	6,813	16.8
Oneida	5,902	55 ‡	465 †	6 †	13 ‡	6,441	17.2
Western Adirondack	17,881	164 †	2,145	151	38 †	20,380	8.9
Essex	11,045	156 †	1,380 †	101	3 ‡	12,685	10.8
Hamilton	4,394	87 †	681	52 †	0	5,214	15.2
Warren	7,808	60 †	823	70	0	8,761	11.5
Eastern Adirondack	23,247	303	2,884	223	3 ‡	26,660	7.0
Albany	4,486	19 ‡	281 †	4 †	0	4,789	15.8
Columbia	3,041	45 ‡	156 ‡	2 †	0 ‡	3,244	22.1
Montgomery	1,061 †	15 †	109 ‡	0 ‡	0	1,185 †	28.0
Rensselaer	2,431	24 ‡	474 †	6 †	0	2,935	18.8
Saratoga	6,300	42 †	390 †	21 †	3 ‡	6,756	15.4
Schenectady	652 †	2 ‡	108 ‡	1 ‡	1 ‡	764	24.3
Washington	4,366	20 ‡	238 †	12 †	2 ‡	4,638	18.3
Capitol District	22,336	166	1,756	46	7 ‡	24,310	7.5
Dutchess	913 †	18 ‡	298 †	3 ‡	0 ‡	1,232 †	27.9
Greene	4,543	37 †	291	2 †	11 ‡	4,885	16.5
Orange	1,867 †	25 ‡	54 †	3 ‡	0 ‡	1,948 †	31.5
Putnam	85 ‡	7 ‡	48 ‡	0 ‡	0 ‡	141 ‡	58.9
Schoharie	4,321	18 ‡	297 †	3 †	0	4,639	14.3
Suffolk	601	0	19 ‡	3 †	1 ‡	624 ‡	51.4
Sullivan	6,739	23 ‡	465	12 †	5 †	7,244	10.9
Ulster	5,389	29 †	414	12 †	1 †	5,845	10.3
Rockland and Westchester	212 †	103 ‡	18 ‡	0	0 ‡	332 ‡	51.8
Catskill/Lower Hudson	24,670	261 †	1,903	37	19 ‡	26,890	6.1
All counties and units	158,025	1,957	17,428	860	81	178,351	2.7
Sampling error (percent)	2.9	10.8	5.2	8.1	24.0	2.7	

NOTE: Cell estimates with sampling errors greater than 25 percent but less than 50 percent–denoted by (†)–are suspect and should be used with caution. Cell estimates with sampling errors greater than or equal to 50 percent–denoted by (‡)–are not significantly different from zero and are unreliable.

Biomass of deciduous trees and shrubs on timberland, by county and class of material, dry-weight basis, New York, 1993

County and geographic unit	Timber	Nontimber			Shrubs	All trees and shrubs	Sampling error
		Salvable dead trees	Saplings	Seedlings			
	Thousand dry tons						Percent
Erie	14,471	90 †	1,796	141	354	16,853	7.9
Genesee	4,563	70 †	880	67 †	182 †	5,762	12.7
Livingston	7,371	100 †	893	154	221 †	8,739	12.1
Madison	9,344	62 †	825	157	90 †	10,478	10.9
Monroe	4,516	45 †	507	56 †	114 †	5,238	19.7
Niagara	4,089	57 ‡	474	38	200 †	4,857	17.8
Onondaga	10,559	100 †	713	208	174 †	11,755	11.6
Ontario	8,236	51 ‡	769	131	238 †	9,426	10.7
Orleans	3,134	22 ‡	263 †	24 †	79	3,522	17.9
Oswego	24,618	180 †	2,506	258	271	27,835	6.1
Wayne	8,446	87 †	563	90	142 †	9,328	12.6
Wyoming	9,266	40 †	896	120	99 †	10,420	10.2
Yates	4,524	51 †	380 †	138	297 †	5,390	15.7
Cayuga and Seneca	13,008	81 ‡	1,275	186	318	14,867	11.3
Lake Plain	126,146	1,035	12,741	1,768	2,779	144,469	3.0
Allegany	24,749	114 †	2,520	406	261 †	28,050	4.6
Cattaraugus	28,336	284 †	2,979	457	174	32,230	5.4
Chautauqua	16,726	78 †	1,696	193	444	19,137	9.6
Steuben	24,965	233	2,619	492	787 †	29,097	5.8
Southwest Highlands	94,776	709	9,814	1,549	1,666	108,514	3.0
Broome	14,580	132 †	1,406	301	344	16,764	6.8
Chemung	6,655	130 †	660	167	329 †	7,943	8.5
Chenango	17,518	40 †	1,553	232	104 †	19,446	6.9
Cortland	8,946	88 ‡	678	156	42 ‡	9,911	9.4
Delaware	39,632	145 †	3,548	217	111	43,653	3.9
Otsego	20,503	112 †	1,655	313	104 †	22,688	6.5
Schuyler	5,798	0	692	152	299 †	6,942	10.3
Tioga	8,120	13 ‡	1,006	155	46 †	9,340	9.3
Tompkins	8,523	72 ‡	451	208	104 †	9,358	10.6
South-central Highlands	130,277	732	11,650	1,902	1,484	146,044	2.4
Clinton	18,878	121 †	2,659	419	123 †	22,200	6.4
Franklin	31,805	314 †	3,146	804	255 †	36,325	5.3
Jefferson	11,220	70 †	1,633	409	738 †	14,070	11.2
St. Lawrence	54,236	848	5,669	1,015	573	62,342	4.0
St. Lawrence/N. Adirondack	116,139	1,354	13,107	2,648	1,688	134,936	2.8

(continued)

County and geographic unit	Timber	Nontimber			Shrubs	All trees and shrubs	Sampling error
		Salvable dead trees	Saplings	Seedlings			
	Thousand dry tons						*Percent*
Fulton	7,766	123	555	82	116 †	8,643	11.7
Herkimer	17,889	320 †	1,553	328	230	20,321	7.5
Lewis	30,449	463	2,636	684	642	34,874	5.5
Oneida	23,543	180 †	2,450	277	133	26,583	7.0
Western Adirondack	79,649	1,086	7,195	1,372	1,121	90,421	3.6
Essex	28,619	164 †	2,782	432	161	32,159	6.5
Hamilton	16,496	191 †	1,775	453	112	19,026	7.2
Warren	16,984	122 †	1,311	251	90	18,757	7.5
Eastern Adirondack	62,100	476	5,868	1,136	362	69,942	4.1
Albany	6,856	38 †	691	146	181 †	7,912	13.5
Columbia	12,803	107 †	895	185	246 †	14,236	9.5
Montgomery	3,294	43 ‡	458	49	135 †	3,980	13.9
Rensselaer	14,639	154 †	1,264	171	221 †	16,448	7.6
Saratoga	16,577	115 †	1,602	250	170	18,715	8.0
Schenectady	2,798	16 ‡	263	68	186 †	3,331	18.0
Washington	13,642	174 †	1,479	258	185	15,738	7.9
Capitol District	70,609	648	6,652	1,127	1,325	80,361	3.7
Dutchess	19,353	163 ‡	898	146	191	20,752	8.8
Greene	15,068	188 †	1,327	155	235	16,974 †	7.0
Orange	14,544	66 ‡	1,439	128	170	16,347	9.2
Putnam	6,600	30 ‡	419	33	50 †	7,131 †	15.3
Schoharie	14,554	41 ‡	1,331	140	210	16,276 †	7.6
Suffolk	2,568 †	33 ‡	521 †	82 †	16 †	3,219 †	28.2
Sullivan	25,198	269 †	2,087	166	85	27,805	5.6
Ulster	27,015	98 †	1,765	144 †	129 †	29,151	4.9
Rockland and Westchester	8,565	171 ‡	428	22	31	9,217	14.7
Catskill/Lower Hudson	133,466	1,059	10,216	1,016	1,115	146,872	2.8
All counties and units	813,160	7,099	77,244	12,517	11,541	921,560	1.1
Sampling error (percent)	1.2	5.9	1.8	2.0	4.4	1.1	

NOTE: Cell estimates with sampling errors greater than 25 percent but less than 50 percent–denoted by (†)–are suspect and should be used with caution. Cell estimates with sampling errors greater than or equal to 50 percent–denoted by (‡)–are not significantly different from zero and are unreliable.

Biomass of all trees and shrubs on timberland, by county and class of material, dry-weight basis, New York, 1993

County and geographic unit	Timber	Nontimber			Shrubs	All trees and shrubs	Sampling error
		Salvable dead trees	Saplings	Seedlings			
	Thousand dry tons						Percent
Erie	16,496	120	1,949	144	354	19,064	6.7
Genesee	5,148	74 †	880	67 †	182 †	6,352	11.7
Livingston	8,132	149 †	1,084	154	221 †	9,740	10.3
Madison	11,263	101	1,126	168 †	90 †	12,748	8.6
Monroe	4,781	108 ‡	545	56	113 †	5,603	17.0
Niagara	4,120	57 ‡	483	38	200 †	4,897	17.6
Onondaga	11,927	100	864	209	174 †	13,274	9.9
Ontario	8,443	51 ‡	783	131	238	9,647	10.6
Orleans	3,205	22 ‡	263 †	24 †	79 †	3,593	17.7
Oswego	30,383	297	2,867	270	276	34,093	4.9
Wayne	8,811	103 †	676	90	143 †	9,823	11.9
Wyoming	9,650	52 †	921	120	99 †	10,841	9.7
Yates	5,272	60 †	441	138	297 †	6,207	12.1
Cayuga and Seneca	13,964	101 ‡	1,329	186	318	15,898	10.3
Lake Plain	141,595	1,395	14,211	1,795	2,784	161,780	2.6
Allegany	26,628	157 †	2,622	408	261 †	30,076	4.3
Cattaraugus	32,408	311	3,441	460	174	36,795	4.7
Chautauqua	18,619	100 †	1,765	196	444	21,124	8.6
Steuben	26,953	248	2,797	495	787 †	31,279	5.2
Southwest Highlands	104,607	817	10,626	1,558	1,666	119,275	2.7
Broome	16,643	168 †	1,803	302	344	19,261	6.2
Chemung	8,005	132 †	793	175	329 †	9,434	8.1
Chenango	24,213	223 †	1,911	237	104 †	26,688	5.1
Cortland	9,377	104 †	865	156	42 ‡	10,543	8.7
Delaware	43,836	147 †	3,681	219	111	47,995	3.6
Otsego	25,503	114 †	2,071	318	104 †	28,111	5.4
Schuyler	6,628	9 ‡	766	153	299 †	7,857	9.7
Tioga	10,437	19 ‡	1,341	158	46 †	12,001	7.8
Tompkins	9,839	71 ‡	553	209	104 †	10,777	9.5
South-central Highlands	154,481	989	13,784	1,927	1,485	172,667	2.0
Clinton	22,965	163 †	3,764	506	123 †	27,521	5.5
Franklin	36,980	362	4,163	898	255 †	42,659	4.2
Jefferson	13,720	80 †	1,989	457	741 †	16,987	9.4
St. Lawrence	62,879	1,085	7,516	1,127	578	73,185	3.3
St. Lawrence/N. Adirondack	136,544	1,690	17,431	2,988	1,697	160,351	2.3

(continued)

County and geographic unit	Timber	Nontimber: Salvable dead trees	Nontimber: Saplings	Nontimber: Seedlings	Shrubs	All trees and shrubs	Sampling error
	Thousand dry tons						*Percent*
Fulton	10,798	131	765	114	133 †	11,941	9.3
Herkimer	21,212	379	1,958	368	230	24,148	6.1
Lewis	36,075	503	3,702	757	650	41,688	4.5
Oneida	29,445	236	2,915	283	145	33,025	5.4
Western Adirondack	97,530	1,250	9,340	1,523	1,159	110,802	2.9
Essex	39,664	320 †	4,162	533	164	44,843	4.7
Hamilton	20,890	278 †	2,456	504	112	24,240	5.7
Warren	24,792	182 †	2,134	321	89	27,518	5.3
Eastern Adirondack	85,347	780	8,752	1,359	365	96,602	3.0
Albany	11,341	57 †	972	150	181 †	12,701	10.3
Columbia	15,844	152 †	1,050	187	246 †	17,480	8.4
Montgomery	4,355	58 †	567	49	135 †	5,164	10.1
Rensselaer	17,070	178 †	1,738	177	221 †	19,383	7.1
Saratoga	22,878	156	1,992	271	173	25,471	6.4
Schenectady	3,449	18 ‡	371	69	187 †	4,095	17.9
Washington	18,007	194 †	1,717	270	188 †	20,376	6.7
Capitol District	92,944	814	8,408	1,173	1,331	104,671	3.2
Dutchess	20,266	181	1,196	149	191	21,984	8.5
Greene	19,611	225 †	1,618	158	246 †	21,859	4.7
Orange	16,411	91 ‡	1,493	130	170	18,295	8.6
Putnam	6,685	37 †	467	33 †	50 †	7,272	15.6
Schoharie	18,875	59 ‡	1,628	143	209 †	20,914	5.8
Suffolk	3,169 †	33 ‡	540 †	85 †	17 †	3,843	25.8
Sullivan	31,937	292 †	2,552	178	90	35,049	4.9
Ulster	32,404	127 †	2,179	155	130	34,995	4.2
Rockland and Westchester	8,777	274 ‡	446	22 †	31 †	9,549	14.7
Catskill/Lower Hudson	158,136	1,320	12,119	1,053	1,135	173,762	2.4
All counties and units	971,185	9,056	94,671	13,377	11,622	1,099,911	0.9
Sampling error (percent)	1.0	5.2	1.8	1.9	4.3	0.9	

NOTE: Cell estimates with sampling errors greater than 25 percent but less than 50 percent–denoted by (†)–are suspect and should be used with caution. Cell estimates with sampling errors greater than or equal to 50 percent–denoted by (‡)–are not significantly different from zero and are unreliable.

Additional data

The tables presented in this report are only a summary of the full range of available data. For analyses beyond the scope of this publication, a data base has been developed. Referred to as the Eastwide Data Base, it provides hierarchical data at three levels: county, plot, and tree. A detailed explanation of data elements and how to use the database has been reported by Hansen and others (1992). Accessing this data base can provide additional information on biomass by parameters such as ownership, forest type, stand size, stocking class, species, diameter, tree class, etc. The biomass variables are in green weight, but conversions can be applied (based on information in this publication, for example) to compute dry-weight biomass by many data elements. For information, please contact the Eastwide Data Base Manager of the Forest Inventory and Analysis unit at:

USDA Forest Service
Northeastern Forest Experiment Station
5 Radnor Corporate Center, Suite 200
Radnor, PA 19087-4585

Phone: (610) 975-4075
Fax: (610) 975-4100

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Appendix A

Species key for green-weight regression equations of northeastern tree species

Density[a] (lb/ft^3)	Tree species	Key species[b]
Evergreen Trees		
26	Atlantic white-cedar	white spruce
28	northern white-cedar	white spruce
34	black spruce	white spruce
	red spruce	white spruce
	blue spruce[c]	white spruce
	Norway spruce[c]	white spruce
	spruces[c]	white spruce
35	white spruce	**key species**
36	eastern white pine	red pine
37	eastern redcedar	red pine
	Douglas-fir[d]	red pine
42	red pine	**key species**
	Scotch pine[e]	red pine
	Austrian pine[f]	red pine
	misc. evergreen trees[g]	red pine
45	balsam fir	**key species**
47	tamarack	balsam fir
	larch[c]	balsam fir
49	pond pine	eastern hemlock
50	jack pine	eastern hemlock
	pitch pine	eastern hemlock
	baldcypress	eastern hemlock
	eastern hemlock	**key species**
51	shortleaf pine	eastern hemlock
	Table Mountain pine[h]	eastern hemlock
	Virginia pine[h]	eastern hemlock
54	loblolly pine	eastern hemlock
Deciduous Trees		
33	pin cherry	yellow-poplar
37	striped maple	yellow-poplar
	boxelder[i]	yellow-poplar
	mountain maple[j]	yellow-poplar
	ailanthus	yellow-poplar
38	yellow-poplar	**key species**
40	balsam poplar	basswood
	cherries and plums[k]	basswood
41	northern catalpa	basswood
	Paulownia[l]	basswood
	American basswood	**key species**
	white basswood[c]	basswood
	basswoods[c]	basswood
43	bigtooth aspen	quaking aspen
	quaking aspen	**key species**
44	sassafras	quaking aspen
45	silver maple	black cherry
	blackgum	black cherry
	swamp tupelo[m]	black cherry
	aspens/cottonwoods[k]	black cherry
46	gray birch	black cherry
	pumpkin ash	black cherry
	blue ash	black cherry
	butternut	black cherry
	black cherry	**key species**
47	pawpaw[n]	black cherry
	eastern redbud[n]	black cherry
	Kentucky coffeetree[o]	black cherry
48	sugarberry	white ash
	white ash	**key species**
	ashes[k]	white ash
49	yellow buckeye	white ash
	Ohio buckeye[c]	white ash
	buckeyes/horsechestnuts[k]	white ash
	green ash	white ash
	cucumbertree	white ash
	sweetbay[c]	white ash
	magnolia[c]	white ash
	eastern cottonwood	white ash
	swamp cottonwood[c]	white ash
50	red maple	**key species**
	paper birch	red maple
	river birch[p]	red maple
	hackberry	red maple
	sweetgum	red maple
	black willow	red maple
	willows[k]	red maple
51	maples[k]	red maple
52	sycamore	American beech
53	American hornbeam	American beech
	black ash	American beech
	sourwood	American beech
54	black maple	American beech
	American beech	**key species**
	winged elm[q]	American beech
	American elm	American beech
	rock elm	American beech
	birches[k]	American beech
	elms[k]	American beech
55	American chestnut	yellow birch
	apple	yellow birch

(continued)

Density[a] (lb/ft^3)	Tree species	Key species[b]
55	misc. deciduous trees[k]	yellow birch
56	sugar maple	yellow birch
	Norway maple	yellow birch
	slippery elm	yellow birch
	water tupelo	yellow birch
57	yellow birch	**key species**
	sweet birch	yellow birch
	American holly	yellow birch
58	black locust	yellow birch
	yellowwood[r]	yellow birch
	black walnut	yellow birch
60	nutmeg hickory	hickories
	eastern hophornbeam	oaks
	white mulberry[s]	oaks
	red mulberry[s]	oaks
	mulberries[s]	oaks
	chokecherry[t]	oaks
	American mountain-ash[u]	oaks
	European mountain-ash[u]	oaks
61	serviceberry	oaks
	pecan	hickories
	honeylocust	oaks
	chestnut oak	oaks
62	Osage-orange	oaks
	white oak	oaks
	scarlet oak	oaks
	southern red oak	oaks
	bur oak	oaks

Density[a] (lb/ft^3)	Tree species	Key species[b]
63	overcup oak[v]	oaks
	chinkapin oak[v]	oaks
	water oak	oaks
	pin oak	oaks
	northern red oak	oaks
	post oak	oaks
	black oak	oaks
	bitternut hickory	hickories
	shellbark hickory[w]	hickories
	hawthorn	hickories
	persimmon	hickories
	hickories[k,x]	**key species**
	oaks[k,x]	**key species**
64	pignut hickory	hickories
	shagbark hickory	hickories
	mockernut hickory	hickories
	flowering dogwood	hickories
	northern pin oak[v]	oaks
	bear oak[y]	oaks
	shingle oak[y]	oaks
	blackjack oak[y]	oaks
	Shumard oak[y]	oaks
65	laurel oak	oaks
	swamp chestnut oak	oaks
67	willow oak	oaks
68	water hickory	hickories
	cherrybark oak	oaks
69	swamp white oak	oaks

[a]Primary source of information was Markwardt (1930),which contains densities and specific gravities for 75 northeastern tree species. Judgments were made as to which density should be used when equations were unavailable for a particular species. These judgments were related to the morphology, taxonomy, and utilization based on information in Harlow and Harrar (1969), Johnson (1973), Peattie (1991), and Shaw (1914). If a judgment could not be made on the basis of these criteria, averages were assigned. Averages were developed for evergreen, light deciduous, and heavy deciduous species. Species greater than or equal to 0.50 were considered heavy deciduous, and those less than 0.50 were considered light deciduous species. Evergreen trees averaged 42 pounds per cubic foot, light deciduous trees averaged 47 pounds per cubic foot, and heavy deciduous trees averaged 60 pounds per cubic foot, green-weight basis.

[b]Key species are those for which there is a regression equation . The coefficients for key species were used to approximate other species with similar characteristics, primarily wood density.

[c]No green-weight density is available, but densities were available from within the same genus.

[d]Average of coast type, inland empire type, and Rocky Mountain type (Markwardt 1930).

[e]Shaw (1914) places Scotch pine in the subgenus Diploxylon, subsection Pinaster, and group Lariciones. Red pine also is placed in this taxonomic classification.

[f]Superficially, Austrian pine is similar to red pine (Harlow and Harrar 1969).

[g]No green-weight density is available. The average density for evergreen trees–42 pounds per cubic foot–has been used (refer to footnote a).

[h]Both Table Mountain pine and Virginia pine are small to medium-sized trees. In the Northeast, Table Mountain pine is found sparingly on dry, often rocky slopes (Harlow and Harrar 1969). Both species are similar to shortleaf pine in superficial characteristics and range.

(continued)

[i]Boxelder, in terms of dry weight, most closely approximates silver maple and striped maple. Boxelder averages 27 pounds per cubic foot; the latter two maples average 33 pounds per cubic foot (Peattie 1991). Lacking a justifiable green-weight density, boxelder is placed with striped maple, the least dense maple in terms of green weight.

[j]Mountain maple is similar to striped maple, both superficially and by density; both species average 33 pounds per cubic foot, dry-weight basis (Peattie 1991).

[k]Average pounds per cubic foot are used for those species where only the genus is known. Cherries and plums average 40; aspens and cottonwoods average 45; ashes average 48; willows average 50; maples average 51; birches and elms average 54; hickories average 63; and miscellaneous or unknown evergreen trees and deciduous trees average, respectively, 42 and 55 pounds per cubic foot, green-weight basis. In the case of buckeyes and horsechestnuts, only one density is available: 49 pounds per cubic foot for yellow buckeye (Markwardt 1930).

[l]Paulownia is similar to catalpa in many ways, even though they are in different botanical families, Bignoniaceae and Scrophulariaceae respectively (Johnson 1973).

[m]Harlow and Harrar (1969) consider swamp tupelo a variety of blackgum, *Nyssa sylvatica* var. *biflora*.

[n]No green-weight density is available. The average density for light deciduous trees–47 pounds per cubic foot–has been used (refer to footnote a).

[o]Kentucky coffeetree is botanically in the same subfamily as honeylocust and eastern redbud, Caesalpiniodeae (Harlow and Harrar 1969). In terms of wood density, it is more likely related to eastern redbud; the Forest Service identifies Kentucky coffeetree as a soft hardwood.

[p]The density of river birch, 40 pounds per cubic foot, most closely resembles paper birch, 39 pounds per cubic foot, dry-weight basis (Peattie 1991).

[q]Harlow and Harrar (1969) indicate that winged elm has been harvested as a substitute for rock elm.

[r]Yellowwood is of the subfamily Papilionoideae, of the Leguminosea family (Harlow and Harrar 1969). The only other northeastern species in this taxonomic classification is black locust.

[s]Mulberry is similar to Osage-orange; both are in the family Moraceae. While the wood of mulberry probably is not as heavy as that of Osage-orange, it is considered to have wood of medium weight (Peattie 1991). This, coupled with the fact that the Forest Service lists red mulberry as a hard deciduous tree, indicates that both red and white mulberry may be at or slightly over the limit for heavy deciduous trees. The average density for a heavy deciduous tree–60 pounds per cubic foot–has been used (refer to footnote a).

[t]Peattie (1991) indicates that the wood of chokecherry is heavy and hard. The average density for a heavy deciduous tree–60 pounds per cubic foot–has been used (refer to footnote a).

[u]The wood of the rowan-tree, as these two species have been called, generally is characterized as medium-light (Peattie 1991). However, its dry-weight density of 34 pounds per cubic foot indicates that it may be a heavy deciduous tree; medium-light deciduous trees such as eastern redbud and mulberry are classed as heavy deciduous trees. The average density for a heavy deciduous trees–60 pounds per cubic foot–has been used (refer to footnote a).

[v]This species falls in the subgenera Leucobalanus, the white oaks (Harlow and Harrar 1969), which average 63 pounds per cubic foot, green-weight basis (Markwardt 1930).

[w]Shellbark hickory falls into the subgenera Eucarya, the true hickories (Harlow and Harrar 1969), which average 63 pounds per cubic foot, green-weight basis (Markwardt 1930).

[x]Oak or hickory could be used to predict the weight of trees whose densities are 63 pound per cubic foot or greater. Hickory was selected to predict the weight of trees in its own genus and other heavy deciduous trees; oak was selected to predict the weight of all oaks greater than 63 pounds per cubic foot.

[y]This species falls in the subgenera Erythrobalanus, the red or black oaks (Harlow and Harrar 1969), which average 64 pounds per cubic foot, green-weight basis (Markwardt 1930).

Appendix B

Species key for dry-weight regression equations of northeastern tree species

Density[a] (lb/ft^3)	Tree species	Key species[b]
Evergreen Trees		
22	northern white-cedar	**key species**
23	Atlantic white-cedar	n. white cedar
25	eastern white pine	**key species**
26	balsam fir	**key species**
28	white spruce	red spruce
	black spruce	red spruce
	red spruce	**key species**
	blue spruce[c]	red spruce
	Norway spruce[c]	red spruce
	spruces[c]	red spruce
	eastern hemlock	**key species**
30	jack pine	eastern hemlock
	Table Mountain pine[d]	eastern hemlock
31	misc. evergreen trees[e]	eastern hemlock
33	baldcypress	red pine
32	eastern redcedar	red pine
	Virginia pine[d]	red pine
	Douglas-fir[f]	red pine
34	red pine	**key species**
	pitch pine	red pine
	Scotch pine[g]	red pine
	Austrian pine[h]	red pine
37	tamarack	larch
	larch[c]	**key species**
38	shortleaf pine	larch
	pond pine	larch
	loblolly pine	larch
Deciduous Trees		
23	balsam poplar	quaking aspen
24	ailanthus	quaking aspen
25	yellow buckeye	quaking aspen
	pawpaw[i]	quaking aspen
	swamp cottonwood[i]	quaking aspen
	buckeyes/horsechestnuts[j]	quaking aspen
26	black willow	quaking aspen
	American basswood	quaking aspen
	white basswood[k]	quaking aspen
	basswoods[k]	quaking aspen
	willows	quaking aspen
	aspens/cottonwoods	quaking aspen
27	boxelder[i]	quaking aspen
	butternut	quaking aspen
	bigtooth aspen	quaking aspen
	quaking aspen	**key species**
28	Ohio buckeye[i]	yellow-poplar
28	yellow-poplar	**key species**
	eastern cottonwood	yellow-poplar
	pin cherry	yellow-poplar
29	northern catalpa	yellow-poplar
29	Paulownia[l]	yellow-poplar
30	American chestnut	yellow-poplar
32	striped maple	black cherry
	sassafrass	black cherry
	cherries and plums[j]	black cherry
33	silver maple	black cherry
	mountain maple[i]	black cherry
34	black ash	black cherry
	sweetgum	black cherry
	cucumbertree	black cherry
	sweetbay[k]	black cherry
	magnolia[k]	black cherry
	American mountain-ash[i]	black cherry
	European mountain-ash[k]	black cherry
35	gray birch	black cherry
	water tupelo	black cherry
	blackgum	black cherry
	swamp tupelo[m]	black cherry
	sycamore	black cherry
	black cherry	**key species**
36	sugarberry	red maple
	pumpkin ash	red maple
	American elm	red maple
37	hackberry	red maple
	red mulberry[i]	red maple
	white mulberry[k]	red maple
	mulberries[k]	red maple
	slippery elm	red maple
38	red maple	**key species**
	sourwood	red maple
	ashes	red maple
39	paper birch	red maple
	eastern redbud[i]	red maple
	yellowwood[i]	American beech
	black walnut	red maple
	birches	red maple
	elms[j]	red maple
40	black maple	red maple
	river birch[j]	red maple
	green ash	red maple
	blue ash	red maple
	American holly	red maple

(continued)

Density[a] (lb/ft^3)	Tree species	Key species[b]
40	maples[j]	red maple
	Kentucky coffeetree[i]	white ash
	southern red oak	white ash
42	nutmeg hickory	white ash
	white ash	**key species**
	hardwoods[j]	white ash
43	yellow birch	**key species**
	water hickory	black oak
	black oak	**key species**
	sugar maple	**key species**
44	Norway maple	sugar maple
	honeylocust	sugar maple
	northern pin oak	northern red oak
	bear oak[n]	northern red oak
	laurel oak	norrthern red oak
	water oak	northern red oak
	pin oak	northern red oak
	northern red oak	**key species**
	Shumard oak[n]	northern red oak
	oaks	northern red oak
	rock elm	northern red oak
45	American beech	**key species**
	bur oak	American beech
46	sweet birch	chestnut oak
	bitternut hickory	chestnut oak
	blackjack oak[i]	chestnut oak
	chestnut oak	**key species**

Density[a] (lb/ft^3)	Tree species	Key species[b]
47	pecan	scarlet oak
	apple	scarlet oak
	scarlet oak	**key species**
	shingle oak[i]	scarlet oak
	swamp chestnut oak	scarlet oak
	post oak	scarlet oak
	hawthorn	white oak
	winged elm[i]	scarlet oak
48	American hornbeam	white oak
	black locust	white oak
	Osage-orange[o]	white oak
	chokecherry[o]	white oak
	white oak	**key species**
	cherrybark oak	white oak
49	willow oak	white oak
50	eastern hophornbeam	hickory
	shellbark hickory[i]	hickory
	swamp white oak	hickory
	hickories[j]	hickory
51	shagbark hickory	hickory
	mockernut hickory	hickory
	flowering dogwood	hickory
	overcup oak[i]	hickory
52	serviceberry	hickory
54	persimmon	hickory
	chinkapin oak[i]	hickory
63	pignut hickory	hickory

[a]Primary source of information was Markwardt (1930),which contains densities and specific gravities for 75 northeastern tree species. Additional dry-weight densities were from Peattie(1991). Judgments were made as to which density should be used when equations were unavailable for a particular species. These judgments were related to the morphology, taxonomy, and utilization based on information in Harlow and Harrar (1969), Johnson (1973), Peattie (1991), and Shaw (1914). If a judgment could not be made on the basis of these criteria, averages were assigned. Averages were developed for evergreen, light deciduous, and heavy deciduous species. Species greater than or equal to 0.50 were considered heavy deciduous, and those less than 0.50 were considered light deciduous species. Evergreen trees and light deciduous trees averaged 31 pounds per cubic foot, and heavy deciduous trees averaged 48 pounds per cubic foot, dry-weight basis.

[b]Key species are those for which there is a regression equation. The coefficients for key species were used to approximate other species with similar characteristics, primarily wood density.

[c]No dry-weight density is available, but densities were available from within the same genus.

[d]Dry-weight ratio from Peattie (1991).

[e]No dry-weight density is available. The average density for evergreen trees–31 pounds per cubic foot–has been used (refer to footnote a).

[f]Average of coast type, inland empire type, and Rocky Mountain type (Markwardt 1930).

[g]Shaw (1914) places Scotch pine in the subgenus Diploxylon, subsection Pinaster, and group Lariciones. Red pine also is in this taxonomic classification.

[h]Superficially, Austrian pine is similar to red pine (Harlow and Harrar 1969).

[i]Dry-weight ratio from Peattie (1991).

(continued)

[j]Averages are used for those species where only the genus is known. Cherries and plums average 32, elms average 39, maples average 40, deciduous trees average 42, and hickories average 50 pounds per cubic foot, dry-weight basis. In the case of buckeyes and horsechestnuts, only one density is available: 25 pounds per cubic foot for yellow buckeye (Markwardt 1930).

[k]No dry-weight density is available, but densities were available from within the same genus.

[l]Paulownia is similar to catalpa in many ways, even though they are in different botanical families, Bignoniaceae and Scrophulariaceae, respectively (Johnson 1973).

[m]Harlow and Harrar (1969) consider swamp tupelo a variety of blackgum, classifying it as *Nyssa sylvatica* var. *biflora.*

[n]This species falls into the subgenera Erythrobalanus, the red or black oaks (Harlow and Harrar 1969), which average 44 pounds per cubic foot, dry-weight basis (Markwardt 1930).

[o]No dry-weight density is available. The average density for heavy deciduous trees–48 pounds per cubic foot–has been used (refer to footnote a).

Appendix C

Species key for dry-weight regression equations of northeastern shrub species

Shrub species	Key species[a]	Shrub species	Key species[a]
common juniper	**key species**	bayberry	**key species**
Canada yew	common juniper[b]	mountain-holly	**key species**
alder	**key species**	ninebark	mallow ninebark[d]
Hercules club	European red raspberry[b]	buckthorn	alder-leaved buckthorn[d]
bog rosemary	Labrador tea[c]	rhododendron	rhodora[d]
chokeberry	alder-leaved buckthorn[c]	winged sumac	red-osier dogwood[b]
azalea	rhododendron[c]	smooth sumac	red-osier dogwood[b]
barberry	**key species**	staghorn sumac	red-osier dogwood[b]
New Jersey tea	**key species**	poison sumac	red-osier dogwood[b]
leatherleaf	**key species**	current, gooseberry	**key species**
fringetree	sheep laurel[c]	rose	key species
sweetfern	**key species**	brier, bramble, raspberry	European red raspberry[d]
alternate-leaved dogwood	red-osier dogwood	American elderberry	red-osier dogwood[b]
silky dogwood	red-osier dogwood	red-berried elderberry	red-osier dogwood[b]
round-leaved dogwood	**key species**	buffalo-berry, soapberry	**key species**
gray-stemmed dogwood	round-leaved dogwood	spirea	**key species**
red-osier dogwood	**key species**	snowberry	**key species**
American hazelnut	bleaked hazelnut	sweetleaf	mountain-holly[c]
bleaked hazelnut	**key species**	American bladdernut	red-osier dogwood[c]
leatherwood	red-osier dogwood[c]	blueberry	**key species**
autumn olive	mountain-holly[c]	viburnum	American wayfaring tree[d]
huckleberry	black huckleberry[d]	maple-leaved viburnum	American wayfaring tree[d]
witch-hazel	**key species**	hobblebush viburnum	American wayfaring tree[d]
large-leaf holly	winterberry holly	wild raisin	American wayfaring tree[d]
winterberry holly	**key species**	arrowwood	American wayfaring tree[d]
sheep laurel	**key species**	nannyberry	American wayfaring tree[d]
mountain laurel	sheep laurel	blackhaw	American wayfaring tree[d]
Labrador tea	**key species**	highbush cranberry	American wayfaring tree[d]
common spicebush	red-osier dogwood[c]	common prickly-ash	red-osier dogwood[b]
honeysuckle	American-fly honeysuckle[d]	unknown deciduous shrub	European red raspberry[e]
Allegheny menziesia	rust menziesia[d]	unknown evergreen shrub	sheep laurel[f]

[a]Key species are those for which there is a regression equation. The coefficients for key species were used to approximate other species with similar characteristics. Unless otherwise noted, key species were from within the same genus.

[b]Based on Symonds and Merwin (1963). Where an equation did not exist, common juniper, *Juniperus communis*, was used for evergreen, needled species; sheep laurel, *Kalmia augustifolia*, was used for evergreen, broad-leaved species; and red-osier dogwood, *Cornus stolonifera*, was used for high deciduous shrubs.

[c]Based on personal communication with Robert T. Brooks, USDA Forest Service, Northeastern Forest Experiment Station, Forest Inventory and Analysis, Amherst, MA, 30 May 1991.

[d]Key species that are not northeastern species, and so do not appear in Appendix E, northeastern trees and shrubs. They are: black huckleberry, *Gaylussacia baccata*; American-fly honeysuckle, *Lonicera canadensis*; rust menziesia, *Menziesia ferruginea*; mallow ninebark, *Physocarpus malvaceus*; alder-leaved buckthorn, *Rhamnus alnifolia*; rhodora, *Rhododendron canadense*; European red raspberry, *Rubus idaeus*; American wayfaring tree, *Viburnum latanoides*.

[e]Unknown deciduous shrubs were assumed to be low shrubs, probably brambles or briers.

[f]Unknown evergreen shrubs were assumed to be broad leaved, probably closest in form and habitat to laurel.

Appendix D

Species key for total tree height regression equations, northeastern tree species

Species	Height (feet)	Bole and crown characteristics[a]	Key species[b]
Evergreen Trees			
balsam fir	40-60	moderately tapering bole–dense narrow pyramidal crown	**key species**
Atlantic white-cedar	80-85	long, cylindrical, clear bole–small, narrow, conical crown	balsam fir
eastern redcedar	40-50	tapering bole–dense, narrow, pyrimidal crown	balsam fir
larch	140-180	long, clear bole–short, open, pyramidal crown	red pine
tamarack	40-80	long, clear, cylindrical bole–open, pyramidal crown	red pine
Norway spruce	tall	–[c]	white spruce
white spruce	60-70	–[c]	**key species**
black spruce	30-40	long, straight, tapering bole–irregular, cylindrical crown	white spruce
blue spruce	100-120	–[c]	white spruce
red spruce	60-70	long, cylindrical bole–pagoda-shaped crown	white spruce
spruces	–[c]	–[c]	white spruce
jack pine	70-80	irregular, rounded crown	red pine
shortleaf pine	80-100	well-formed, clear bole-small, narrow, pyramidal crown	red pine
Table Mountain pine	medium	–[c]	red pine
red pine	50-80	well-formed, long, cylindrical bole-symmetric, oval crown	**key species**
pitch pine	50-60	mostly tall, columnar bole-open, small crown	red pine
pond pine	medium	southern variety of pitch pine	red pine
eastern white pine	80-100	tall, clear, cylindrical bole-plume-like crown	red pine
Scotch pine	–[c]	–[c]	red pine
loblolly pine	90-110	long, cylindrical bole-open, yet dense crown	red pine
Virginia pine	40	small bole-unkempt crown	red pine
Austrian pine	50-80	similar to red pine	red pine
Douglas-fir	180-250	long, cylindrical bole-rounded or irregular, flat-topped crown	white spruce
baldcypress	100-120	tapering bole-irregular, flattened crown	white spruce
northern white-cedar	40-50	tapering bole-irregular, oblong crown	balsam fir
eastern hemlock	60-70	tapering bole-pyramidal crown; branches may touch ground	balsam fir
misc. evergreen trees	–[c]	–[c]	red pine
Deciduous Trees			
maples	–[c]	–[c]	red maple
boxelder	75	irregular bole-bushy, spreading crown	red maple
black maple	60-80	similar to sugar maple	sugar maple
striped maple	small	shrub-like	red maple
red maple	50-70	long bole–irregular crown	**key species**
silver maple	60-80	short bole, dividing low into branches	red maple
sugar maple	60-80	straight, full bole	**key species**
mountain maple	small	shrub-like	red maple
Norway maple	–[c]	–[c]	sugar maple
buckeyes /horsechestnuts	–[c]	–[c]	white ash
Ohio buckeye	60-90	–[c]	white ash
yellow buckeye	60-90	–[c]	white ash
ailanthus	–[c]	–[c]	red maple
serviceberry	small	shrub-like	red maple
pawpaw	–[c]	–[c]	red maple

(continued)

Species	Height (feet)	Bole and crown characteristics[a]	Key species[b]
birches	–[c]	–[c]	yellow birch
yellow birch	60-70	long, well-formed bole–round, irregular crown	**key species**
sweet birch	50-60	long, clear bole	yellow birch
river birch	70-80	dividing bole, several branches	yellow birch
paper birch	50-70	long, clear bole–open, irregular, pyramidal crown	yellow birch
gray birch	20-30	poorly shaped bole, limby–open, irregular, pyramidal crown	red maple
American hornbeam	small	poorly formed, twisted bole	red maple
hickories	–[c]	–[c]	basswood
water hickory	110-140	similar to pecan	yellow-poplar
bitternut hickory	50-60	–[c]	yellow-poplar
pignut hickory	50-60	–[c]	black cherry
pecan	110-140	–[c]	yellow-poplar
shellbark hickory	70-80	similar to shagbark hickory	basswood
nutmeg hickory	80-100	–[c]	basswood
shagbark hickory	70-80	straight, cylindrical bole–oblong crown	basswood
mockernut hickory	40-60	–[c]	black cherry
American chestnut	small	blight-affected	red maple
Northern catalpa	120	well-formed bole (may be crooked)	yellow-poplar
sugarberry	60-80	–[c]	sugar maple
hackberry	30-40	–[c]	yellow birch
eastern redbud	small	–[c]	red maple
yellowwood	–[c]	–[c]	red maple
flowering dogwood	40	short bole, branchy–low, dense crown	red maple
hawthorn	small	shrub-like	red maple
persimmon	30-50	short bole–round-topped crown	red maple
American beech	70-80	straight, clear, massive bole–spreading crown	**key species**
ashes	–[c]	–[c]	white ash
white ash	70-80	long, straight, cylindrical bole–crown open	**key species**
black ash	40-50	poorly formed bole–small, open crown	yellow birch
green ash	30-50	short, poorly formed bole–broad, irregular crown	yellow birch
pumpkin ash	–[c]	–[c]	yellow birch
blue ash	medium	–[c]	yellow birch
honeylocust	70-80	short bole–open, spreading crown	red maple
Kentucky coffeetree	medium	–[c]	red maple
American holly	40-50	straight, short bole	red maple
butternut	40-60	short bole, stout limbs–broad, open crown	beech
black walnut	70-90	tall, well-formed bole–small, open crown	basswood
sweetgum	80-120	long, straight bole–small, oblong or pyramidal crown	basswood
yellow-poplar	100-120	tall, clear, arrow-straight bole–small, open, oblong crown	**key species**
Osage-orange	small	shrub-like	red maple
magnolia	–[c]	–[c]	basswood
cucumbertree	80-90	straight, clear bole–pyramidal crown	basswood
sweetbay	60-70	similar to cucumbertree	basswood
apple	–[c]	–[c]	red maple
mulberries	–[c]	–[c]	red maple
white mulberry	small	shrub-like	red maple
red mulberry	small	shrub-like	red maple
water tupelo	80-90	long, clear bole–crown narrow and open	basswood
blackgum	50-60	–[c]	black cherry
swamp tupelo	50-60	similar to blackgum	black cherry
eastern hophornbeam	small	similar to hornbeam	red maple

(continued)

Species	Height (feet)	Bole and crown characteristics[a]	Key species[b]
sourwood	small	–[c]	red maple
Paulownia	–[c]	–[c]	red maple
sycamore	80-100	open, spreading crown	beech
aspens/cottonwoods	–[c]	–[c]	quaking aspen
balsam poplar	60-80	long, cylindrical bole–narrow, pyramidal crown	quaking aspen
eastern cottonwood	80-100	ong, cylindrical bole–somewhat small crown	quaking aspen
bigtooth aspen	60-70	similar to quaking aspen	quaking aspen
swamp cottonwood	medium	similar to other cottonwoods	quaking aspen
quaking aspen	50-60	long, clear bole–small, rounded crown	**key species**
cherries/plums	–[c]	–[c]	black cherry
pin cherry	small	shrub-like	red maple
black cherry	50-60	long, straight, clear, cylindrical bole–narrow, oblong crown	**key species**
chokecherry	small	shrub-like	red maple
oaks	–[c]	–[c]	northern red oak
white oak	80-100	short, stocky bole–wide-spreading crown	**key species**
swamp white oak	60-70	poorly pruned bole–irregular crown	scarlet oak
scarlet oak	70-80	–[c]	**key species**
northern pin oak	70-80	similar to pin oak	white oak
southern red oak	60-80	similar to northern red oak	northern red oak
cherrybark oak	100-130	clear bole	northern red oak
bear oak	–[c]	–[c]	chestnut oak
shingle oak	50-60	–[c]	chestnut oak
laurel oak	60-70	–[c]	scarlet oak
overcup oak	70-80	poorly-formed, short, twisted bole–large, open crown	white oak
bur oak	70-80	massive bole, stout branches–broad crown	white oak
blackjack oak	small	poorly formed bole	chestnut oak
swamp chestnut oak	60-80	well-formed, straight, massive bole–narrow crown	northern red oak
chinkapin oak	60-80	–[c]	northern red oak
water oak	60-70	tall, slender bole–symmetrical, rounded crown	northern red oak
pin oak	70-80	tough-studded-branchlet bole–broad, pyramid crown	white oak
willow oak	80-100	full rounded crown, slender lower branches	white oak
chestnut oak	50-60	–[c]	**key species**
northern red oak	60-80	tall, straight, columnar bole–small rounded bole	**key species**
Shumard oak	100-125	Long, clear, symmetrical bole–open, wide-spreading crown	scarlet oak
post oak	40-50	gnarled, twisted bole–often shrubby crown	chestnut oak
black oak	50-60	tapering, limby bole–irregular, rounded crown	black oak
black locust	40-60	poorly formed bole–spreading crown	red maple
willows	–[c]	–[c]	red maple
black willow	30-60	broad, irregular crown	red maple
sassafrass	60-80	–[c]	red maple
American mountain-ash	small	shrub-like	red maple
Europeon mountain-ash	small	shrub-like	red maple
basswoods	–[c]	–[c]	basswood
American basswood	70-80	long, cylindrical bole	**key species**
white basswood	60-80	similar to American basswood	basswood
elms	–[c]	–[c]	yellow-poplar
winged elm	small	–[c]	red maple
American elm	80-100	columnar trunk, branching at 50-60 feet–small, arching crown	yellow-poplar
slippery elm	60-70	great clear bole	yellow-poplar
rock elm	60-80	tall, straight, unbranched bole–narrow, oblong crown	yellow-poplar
unknown species			red maple

(continued)

[a]Bole and crown characteristics from Harlow and Harrar (1969).

[b]Key species are those for which there is a regression equation. The coefficients for key species are then used to approximate other species with similar characteristics (refer to the appropriate table of regression coefficients). Generally, evergreen species of similar heights were grouped together. These groupings occurred mostly within the same genus, e.g., red pine was used for pines. Deciduous species were more difficult to group because of their many different bole and crown characteristics. Among deciduous trees with well-formed boles and open, irregular crowns, white ash, sugar maple, and yellow birch were designated as key species. Yellow birch was used for small trees, sugar maple for medium trees, and white ash for tall trees exhibiting these growth characteristics. Among deciduous trees with straight, clear boles and small, oblong or narrow crowns, yellow-poplar, basswood, and black cherry were designated as key species. Black cherry was used for small trees, basswood for medium trees, and yellow-poplar for tall trees with these characteristics. As a group, oaks exhibit many different bole and crown characteristics, but white oak and chestnut oak tend to have shorter boles and wide, spreading crowns. So chestnut oak was used for smaller oaks and white oak was used for taller oaks with these characteristics. Similarly, black oak and northern red oak were used for smaller and larger oak trees, respectively, but for trees with straight boles and relatively smaller crowns. Finally, scarlet oak was used for oaks with relatively straight boles but more irregularly shaped crowns. Two species remained–beech and red maple. Beech was used for deciduous trees with large tree boles and large, spreading crowns. Red maple was used for small deciduous trees with irregular crowns–the majority of the trees found in the Northeast.

[c]Information is not available.

Appendix E

Northeastern tree and shrub species

Common name	Genus and species
Evergreen Trees	
fir	*Abies sp.*
balsam fir	*A. balsamea*
cedar	*Chamaecyparis sp.*
Atlantic white-cedar	*C. thyoides*
eastern redcedar	*Juniperus virginiana*
larch	*Larix sp.*
tamarack	*L. laricina*
Norway spruce	*Picea abies*
white spruce	*P. glauca*
black spruce	*P. mariana*
blue spruce	*P. pungens*
red spruce	*P. rubens*
jack pine	*Pinus banksiana*
shortleaf pine	*P. echinata*
Table Mountain pine	*P. pungens*
red pine	*P. resinosa*
pitch pine	*P. rigida*
pond pine	*P. serotina*
eastern white pine	*P. strobus*
Scotch pine	*P. sylvestris*
loblolly pine	*P. taeda*
Virginia pine	*P. virginiana*
Austrian pine	*P. nigra*
Douglas-fir	*Pseudotsuga menziesii*
baldcypress	*Taxodium distichum*
northern white-cedar	*Thuja occidentalis*
eastern hemlock	*Tsuga canadensis*
Deciduous Trees	
maple	*Acer sp.*
boxelder	*A. negundo*
black maple	*A. nigrum*
striped maple	*A. pensylvanicum*
red maple	*A. rubrum*
silver maple	*A. saccharinum*
sugar maple	*A. saccharum*
mountain maple	*A. spicatum*
buckeye, horsechestnut	*Aesculus sp.*
Ohio buckeye	*A. glabra*
yellow buckeye	*A. octandra*
ailanthus	*Ailanthus altissima*
serviceberry	*Amelamchier sp.*
pawpaw	*Asimina triloba*
birches	*Betula sp.*
yellow birch	*B. alleghaniensis*
sweet birch	*B. lenta*
river birch	*B. nigra*
paper birch	*B. papyrifera*
gray birch	*B. populifolia*
American hornbeam	*Carpinus caroliniana*
hickory	*Carya sp.*
water hickory	*Carya aquatica*
bitternut hickory	*C. cordiformis*
pignut hickory	*C. glabra*
pecan	*C. illinoensis*
shellbark hickory	*C. laciniosa*
shagbark hickory	*C. ovata*
mockernut hickory	*C. tomentosa*
American chestnut	*Castanea dentata*
catalpa	*Catalpa sp.*
Northern catalpa	*C. speciosa*
sugarberry	*Celtis laevigata*
hackberry	*C. occidentalis*
eastern redbud	*Cercis canadensis*
yellowwood	*Cladrastis lutea*
flowering dogwood	*Cornus florida*
hawthorn	*Crataegus sp.*
persimmon	*Diospyros virginiana*
American beech	*Fagus grandifolia*
ash	*Fraxinus sp.*
white ash	*F. americana*
black ash	*F. nigra*
green ash	*F. pennsylvanica*
pumpkin ash	*F. profunda*
blue ash	*F. quadrangulata*
honeylocust	*Gleditsia triacanthos*
Kentucky coffeetree	*Gymnocladus dioicus*
American holly	*Ilex opaca*
butternut	*Juglans cinerea*
black walnut	*J. nigra*
sweetgum	*Liquidambar styraciflua*
yellow-poplar	*Liriodendron tulipifera*
Osage-orange	*Maclura pomifera*
magnolia	*Magnolia sp.*
cucumbertree	*M. acuminata*
sweetbay	*M. virginiana*
apple	*Malus sp.*
mulberry	*Morus sp.*
white mulberry	*M. alba*
red mulberry	*M. rubra*
tupelo	*Nyssa sp.*
water tupelo	*N. aquatica*
blackgum	*N. sylvatica*
swamp tupelo	*N. biflora*
eastern hophornbeam	*Ostrya virginiana*
sourwood	*Oxydendrum arboreum*
Paulownia	*Paulownia tomentosa*
American sycamore	*Platanus occidentalis*
poplar, cottonwood	*Populus sp.*
balsam poplar	*P. balsamifera*
eastern cottonwood	*P. deltoides*
bigtooth aspen	*P. grandidentata*

(continued)

Common name	Genus and species
swamp cottonwood	*Populus heterophylla*
quaking aspen	*P. tremuloides*
cherry, plum	*Prunus sp.*
pin cherry	*P. pensylvanica*
black cherry	*P. serotina*
chokecherry	*P. virginiana*
oak	*Quercus sp.*
white oak	*Q. alba*
swamp white oak	*Q. bicolor*
scarlet oak	*Q. coccinea*
northern pin oak	*Q. ellipsoidalis*
southern pin oak	*Q. falcata var. falcata*
cherrybark oak	*Q. falcata var. pagodaefolia*
bear oak	*Q. ilicifolia*
shingle oak	*Q. imbricaria*
laurel oak	*Q. laurifolia*
overcup oak	*Q. lyrata*
bur oak	*Q. macrocarpa*
blackjack oak	*Q. marilandica*
swamp chestnut oak	*Q. michauxii*
chinkapin oak	*Q. muehlenbergii*
water oak	*Q. nigra*
pin oak	*Q. palustris*
willow oak	*Q. phellos*
chestnut oak	*Q. prinus*
northern red oak	*Q. rubra*
Shumard oak	*Q. shumardii*
post oak	*Q. stellata*
black oak	*Q. velutina*
black locust	*Robinia psuedoacacia*
willow	*Salix sp.*
black willow	*S. nigra*
sassafrass	*Sassafras albidum*
American mountain-ash	*Sorbus americana*
Europeon mountain-ash	*S. aucuparia*
basswood	*Tilia sp.*
American basswood	*T. americana*
white basswood	*T. heterophylla*
elm	*Ulmus sp.*
winged elm	*U. alata*
American elm	*U. americana*
slippery elm	*U. rubra*
rock elm	*U. thomasii*
Evergreen Shrubs	
common juniper	*Juniperus communis*
Canada yew	*Taxus canadensis*
bog rosemary	*Andromeda glaucophylla*
sheep laurel	*Kalmia augustifolia*
mountain laurel	*K. latifolia*
Labrador tea	*Ledum groenlandicum*
rhododendron	*Rhododendron sp.*
sweetleaf	*Symplocos tinctoria*

Common name	Genus and species
Deciduous Shrubs	
alder	*Alnus sp.*
Hercules club	*Aralia spinosa*
chokeberry	*Aronia sp.*
azalea	*Azalea sp.*
barberry	*Berberis sp.*
New Jersey tea	*Ceanothus americanus*
leatherleaf	*Chamaedaphne calyculata*
fringetree	*Chionanthus virginicus*
sweetfern	*Comptonia peregrina*
alternate-leaved dogwood	*Cornus alternifolia*
silky dogwood	*C. amomum (obliqua)*
round-leaved dogwood	*C. rugosa (circinata)*
gray-stemmed dogwood	*C. racemosa (paniculata)*
red-osier dogwood	*C. stolonifera*
American hazelnut	*Corylus americana*
bleaked hazeknut	*C. cornuta*
leatherwood	*Dirca palustris*
autumn olive	*Elaeagnus augustifolia*
huckleberry	*Gaylussacia sp.*
witch-hazel	*Hamamelis virginiana*
large-leaf holly	*Ilex montana (monticola)*
winterberry holly	*I. verticillata*
common spicebush	*Lindera benzoin*
honeysuckle	*Lonicera sp.*
Allegheny menziesia	*Menziesia pilosa*
bayberry	*Myrica pensylvanica*
mountain-holly	*Nemopanthus mucronatus*
ninebark	*Physocarpus opulifolius*
buckthorn	*Rhamnus sp.*
winged sumac	*Rhus copallina*
smooth sumac	*R. glabra*
staghorn sumac	*R. typhina*
poison sumac	*R. vernix*
current, gooseberry	*Ribes sp.*
rose	*Rosa sp.*
brier, bramble, raspberry	*Rubus sp.*
American elderberry	*Sambucus canadensis*
red-berried elderberry	*S. racemosa*
buffalo-berry, soapberry	*Shepherdia canadensis*
spirea	*Spirea sp.*
snowberry	*Symphoricarpos albus*
American bladdernut	*Staphylea trifolia*
blueberry	*Vaccinium sp.*
viburnum	*Viburnum sp.*
maple-leaved viburnum	*V. acerifolium*
hobblebush viburnum	*V. alnifolium*
wild raisin	*V. cassinoides*
arrowwood	*V. dentatum*
nannyberry	*V. lentago*
blackhaw	*V. prunifolium*
highbush cranberry	*V. trilobum*
common prickly-ash	*Zanthoxylum americanum*

Appendix F

Definitions

The following definitions are based on the USDA Forest Service's "Forest Survey Handbook", except for those dealing with shrubs, which are based on definitions from the Society of Range Management (1974).

Aboveground biomass–The weight of wood and bark in trees and/or shrubs above ground level, including branches and foliage.

Board foot–A unit of lumber measurement 1 foot long, 1 foot wide, and 1 inch thick, or its equivalent.

Branches–All wood and bark outside of the minimum top diameter of the merchantable stem. Includes the unmerchantable stem, branches, and twigs; excludes foliage.

Cull tree–A rough cull tree or rotten cull tree.

Dead tree–A tree whose cambium is no longer living, ordinarily indicated by permanent loss of all foliage. The tree may be standing, fallen, windthrown, knocked down, or broken off.

Deciduous–Dicotyledonous trees and shrubs, having broad leaves that drop seasonally, though some are persistent. Deciduous trees are commonly called hardwoods even though some have soft wood.

Density–Weight per unit volume, usually expressed in lb/ft^3 or gm/cm^3. Basic wood density is based on oven-dry weight and green volume.

Diameter at breast height (d.b.h.)–The diameter taken outside the bark of standing trees measured at 4½ feet above the ground.

Diameter outside bark (d.o.b.)–The diameter taken outside the bark at some specified point on the main stem of a standing or down tree.

Dry weight–When applied to trees, dry weight is the oven-dry weight of wood and bark, expressed in pounds or tons.

Evergreen–Trees and shrubs having needles or scale-like leaves, usually cone-bearing. Evergreen trees are commonly called softwoods even though some have hard wood.

Foliage–The leaves and fruits on trees and shrubs.

Forest biomass–The weight of wood, bark, and foliage in all living woody plants. Includes the biomass of growing stock, above and below ground biomass of timber, and the aboveground biomass of salvable dead trees, seedlings, saplings, and shrubs. Does not include the biomass of grasses, forbs, or other similar herbaceous plants.

Forest land–Land areas 1 acre in size at least 10-percent stocked with trees of any size, or that formerly had such tree cover and are not currently developed for a nonforest use.

Geographic unit–A county or a group of counties within a state large enough to provide an adequate sample base and have common physiographic features.

Green weight–When applied to trees and shrubs, green weight is the weight of wood and bark while they are alive, freshly cut, or still containing most of the moisture present at the time of cutting. Expressed in pounds or tons.

Growing stock–The main stem of growing-stock trees between a 1-foot stump height and the growing-stock top. Also called the merchantable stem.

Growing-stock top–The point on the main stem of a growing-stock tree above which industrial products cannot be produced. The minimum growing-stock top is 4.0 inches d.o.b., or the point at which the main stem breaks into branches if this occurs before it reaches the top diameter.

Growing-stock tree–A live tree of commercial species 5.0 inches d.b.h. or larger, that contains at least one 12-foot sawlog or two 8-foot noncontiguous sawlogs, and meets regional specifications for freedom from defect. Excludes rough and rotten trees.

Growing stock biomass–The weight of wood and bark in growing stock. Includes sawlog biomass and upper stem biomass

Merchantable-stem biomass–The main stem of growing-stock trees between a 1-foot stump height and the growing-stock top. Also called growing stock biomass.

Moisture content–In wood, the amount of water present, generally expressed as a percentage of its oven-dry weight.

Nontimber–Trees that are not timber, such as salvable dead trees, seelings, and saplings. Does not include shrubs, which are not trees.

Other forest land–Forest land other than timberland; includes reserved, unproductive, and urban forest land.

Oven-dry–The process whereby green wood has had moisture removed in a kiln through the use of artificial heat, in the range of 102º to 105ºC. By industry standards, oven-dried (or kiln-dried) wood is usually at 12 percent moisture content.

Poletimber–Growing-stock trees at least 5.0 inches d.b.h., but smaller than sawtimber trees.

Reserved forest land–Forest land withdrawn from timber utilization by administrative designation, such as parks or exclusive use for Christmas trees.

Roots–The entire below ground portion of trees.

Rotten tree–A live tree of a commercial species, 5.0 inches d.b.h. or larger, that does not meet regional specifications for freedom from defect primarily because more than 50 percent of the tree is rotten.

Rough tree–A live tree of commercial species 5.0 inches d.b.h. or larger (or a live tree of a noncommercial species), that does not meet regional specifications for freedom from defect primarily because of poor form.

Salvable dead tree–A dead tree 5.0 inches d.b.h. or larger that has died recently. Many branches remain and the bark is still intact (it is generally very tight and difficult to remove from the tree).

Sapling–A live tree less than 5.0 inches d.b.h., but larger than 1.0 inch.

Sawlog–The main stem of a sawtimber tree between the stump height and the sawlog top.

Sawlog top–The point on the main stem of a sawtimber tree above which a sawlog cannot be produced. The minimum sawlog top is 7.0 inches d.o.b. for softwoods and 9.0 inches d.o.b. for hardwoods.

Sawtimber–Growing-stock trees at least 9.0 inches d.b.h. for softwoods or 11.0 inches for hardwoods, containing at least one 12-foot sawlog or two noncontiguous 8-foot sawlogs, and meeting regional specifications for freedom from defect. Small sawtimber is less than 15.0 inches d.b.h.; large sawtimber is greater than or equal to 15.0 inches d.b.h.

Seedling–A live tree less than 1.0 inch d.b.h., and that is free to grow.

Shrub–A live plant that has a persistent, woody stem and relatively low growth habit, and that generally produces several basal shoots. Differs from a tree because of its low stature and nonarborescent form.

Snag–A dead tree 5.0 inches d.b.h. or larger that has been dead for some time. Most of the bark may be missing, or the tree may be covered with bark that is very loose (it can be removed with little effort).

Sound cull–Defect that is free from decay. The defect may lower the timber's utility or commercial value, relegating it to a lower grade, but does not cause its rejection. It may be a blemish or imperfection such as stain that may be acceptable by regional standards, or cull such as crook or sweep which affects only the board-foot volume of a log.

Specific gravity–As applied to wood, the ratio of the oven-dried weight of a wood sample to the weight of a volume of water equal to the volume of the sample at a specified moisture content (green, air-dried, oven-dried).

Stump–The main stem of living trees 5.0 inches d.b.h. and larger, between the ground and a 1-foot height.

Timber–All living trees 5.0 inches d.b.h. and larger, including growing-stock trees and cull trees.

Timber biomass–The weight of wood, bark, and foliage in growing-stock trees and cull trees. Includes the biomass of all tree components above and below the ground such as the merchantable stem, unmerchantable stem, branches, twigs, stump, and roots.

Timberland–Forest land producing or capable of producing annual crops of industrial forest products (at least 20 cubic feet per acre per year). Does not include productive-reserved land. Currently inaccessible and inoperable areas are included except when the areas involved are small and unlikely to become suitable for production of industrial wood.

Tree–A woody plant that has a well-developed stem and is usually more than 12 feet high at maturity.

Unmerchantable stem–The main stem of growing-stock trees above the growing-stock top.

Unproductive forest land–Forest land that is incapable of producing 20 cubic feet per acre per year of industrial wood under natural conditions, because of adverse site conditions (also called woodland).

Upper stem–The main stem of sawtimber trees between the sawlog top and growing-stock top.

Urban forest land–Forest land that is surrounded by urban development (not parks) whether commercial, industrial, or residential.

Conversions and Metric Equivalents

1 cubic foot of softwoods = 0.027 green tons
1 cubic foot of hardwoods = 0.033 green tons
1 green ton of softwoods = 9.0 million b.t.u.
1 green ton of hardwoods = 8.6 million b.t.u.
1 green ton = 2.1 dry tons

1 inch = 2.54 centimeters
1 cubic foot = 0.02832 cubic meters
1 ton = 2,000 pounds
1 ton = 907.1848 kilograms
1 acre = 0.4047 hectares

Wharton, Eric H.; Alerich, Carol L.; Drake, David A. 1997. **Estimating total forest biomass in New York, 1993.** Resour. Bull. NE-139. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 48 p.

Presents methods for synthesizing information from existing biomass literature for estimating biomass over extensive forest areas, with specific applications to New York. Tables of appropriate regression equations and the tree and shrub species to which these equations can be applied are presented, as well as biomass estimates at the county, geographic unit, and state level.

Keywords: forest inventory; weight estimation; tree biomass; forest biomass; shrub biomass; regression equations

Headquarters of the Northeastern Forest Experiment Station is in Radnor, Pennsylvania. Field laboratories are maintained at:

Amherst, Massachusetts, in cooperation with the University of Massachusetts

Bradley, Maine, in cooperation with the University of Maine

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