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Timber Value Growth Rates in New England

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Abstract

Rates of growth in the value of standing timber can vary greatly from stand to stand and from tree to tree. In Maine, the compound annual rate of change in stand value between the two most recent forest inventories ranged from −12 to +43 percent. Faced with this kind of variation, forest managers can use help in determining financial rates of return for their woodland. From analyses of forest inventory data we have developed guides for estimating value growth potential for trees in New England.

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Introduction

Many things affect changes in timber value—tree species, size and quality; stand density and site productivity; markets and accessibility; insects and disease; even weather. So rates of growth in the value of standing timber can vary greatly from stand to stand and from tree to tree. For example, a recent study shows that compound annual rates of change in value for forest stands sampled in Maine between 1971 and 1982 ranged from −12 to +43 percent.[1] At today's stumpage prices, a well-stocked stand of good-quality cherry or oak, on a productive and accessible site, can grow to yield a landowner more than $2,500 per acre. That is a hundred times more than what some ridgetop chestnut oak stands can do. With this kind of variation, forest managers can use all the help they can get in determining financial rates of return for their woodlot. To help meet this need, we analyzed recent forest inventory measurements in New England to quantify changes in the tree value there. Our ultimate goal is to provide practical guides for estimating timber value growth rates in the region.

Approach

Data

The USDA Forest Service updates statewide timber resource information approximately every 10 years. Part of the updating process includes remeasuring a network of permanent forest-inventory plots. Plots (0.1 to 0.2 acres) that were measured in New England during the early 1970's were remeasured from 1982 through 1985 (Powell and Dickson 1984, Frieswyk and Malley 1985a,b; Dickson and McAfee 1988a,b,c). Data from more than 1,100 of these plots were used to analyze value growth. We included only those plots that remained relatively undisturbed, i.e., had less than 15 percent of their original basal area removed by people between inventories. These plots accounted for more than three-fourths of the total area sampled. The analysis incorporated more than 27,000 trees that were alive and 5.0 inches or larger in d.b.h. (diameter at breast height measured 4-1/2 feet above the ground) at the time of the initial inventories.

Analysis

Rates of change in tree value were based on measured changes in tree diameter, merchantable height, and quality. Compound annual rates of value change (r) were obtained using the expression:

$$r = (V_n/V_o)^{1/n} - 1$$

where n is the number of years between measurements, Vn is the value of a tree after n years, and Vo is its initial value.

Dollar values for hardwood sawtimber trees were based on tree-value conversion standards for 1984.[2] These standards represent consistent regional measures of a standing tree's net value (marginal value product or shadow price) in the production of 4/4 (1-inch) lumber, allowing for the cost of conversion. They account for a tree's species, diameter, merchantable height, and tree grade (based on butt-log grade measures). For example, a 16-inch-diameter red oak with a grade 2 butt log and merchantable height of 2 logs was valued at $29. For trees other than hardwood sawtimber, merchantable height, d.b.h., and cull estimates were converted to net volumes (Scott 1981) and assigned value based on recent local stumpage price information. For example, white pine sawtimber stumpage averages about $70 per thousand board feet and spruce and fir pulpwood averages about $10 per cord.

The same (constant) dollar-value standards were applied to both initial and current measurements to evaluate tree development, thereby eliminating valuation items that are irrelevant to biological change. This ignores unpredictable effects of inflation and changes in timber prices and markets, but does focus on the value of biological change in tree diameter, merchantable height, and tree grade. The few trees that were harvested between inventories were assigned the same value for both occasions.

The combined influence of tree and stand characteristics on rates of change in timber value was studied by Automatic Interaction Detection (AID) (Songuist et al. 1973). This statistical technique searched characteristics of the trees and timber stands for the best predictors of value change. Starting with the entire sample of trees in one group, the trees were partitioned through successive two-way splits into series of subgroups. The splits occur so that, at each step, the chosen predictor variable forms two new groups that cause the greatest reduction of variance in the dependent variable (value change). The result is a best set of predictors selected by the AID algorithm, and presented as a branching diagram that details the rate of value change configuration for individual trees as they responded to timber stand dynamics between the New England forest surveys.

[1] Gansner, David A.; Arner, Stanford L.; Zarnoch, Stanley J. Timber value growth rates in Maine. Submitted to Northern Journal of Applied Forestry.

[2] DeBald, Paul S. Tree value conversion standards revisited. Research Paper, Northeastern Forest Experiment Station. In preparation.

Results

Between the last two forest inventories of New England, the annual rate of change for all trees in our sample averaged 3.2 percent. Multivariable analysis of several tree and stand characteristics identified four that are significantly related to change in tree value: tree species, size, merchantability class, and stand density.

Species.—Compound rates of value change for individual timber species ranged from 5.8 to 0.5 percent, reflecting the great amount of variability in value growth for New England trees (Fig. 1). White ash, red oak, and white pine, which are known for their vigorous growth, had the highest rates. At the other end of the scale are beech, fir, and white oak which have suffered through outbreaks of Nectria complex, spruce budworm and gypsy moth, respectively.

Diameter.—Value change rates increase through the 8- to 10-inch diameter classes before declining in the larger diameters. The higher average rates for 8- and 10-inch trees are due in large part to their growth into higher valued sawtimber-size material:

Diameter class (inches)	*Rate of value change* (percent)
<8	3.5
8-10	4.0
12-14	3.5
16-18	2.7
20+	1.0
All trees	3.2

The base or initial value of trees is important to the relative differences in their rate of change in value. Consider for example:

Initial value (V_o)	*End value* (V_n)	*Value change*	*No. of years*	*Rate of value change* (percent)
--------- (dollars) ---------				
1.00	2.00	1.00	10	7.2
5.00	6.00	1.00	10	1.8

In both examples, value increased by $1. But the smaller initial value in the first example ($1 versus $5) yields a much greater rate of value change over the 10 years.

Tree class.—Tree class reflects tree quality and quality correlates directly with rate of value change. Because of higher mortality rates and declines in quality, nongrowing-stock trees recorded negative rates of change.

Tree class	*Rate of value change* (percent)
Growing stock	3.3
Rough	-1.6
Rotten	-2.4
All trees	3.2

Growing-stock trees are those of commercial species that are merchantable for sawlogs now or in the future. *Rough* trees are unmerchantable for sawlogs because of roughness, poor form, or unacceptable species. *Rotten* trees are unmerchantable for sawlogs because of rot.

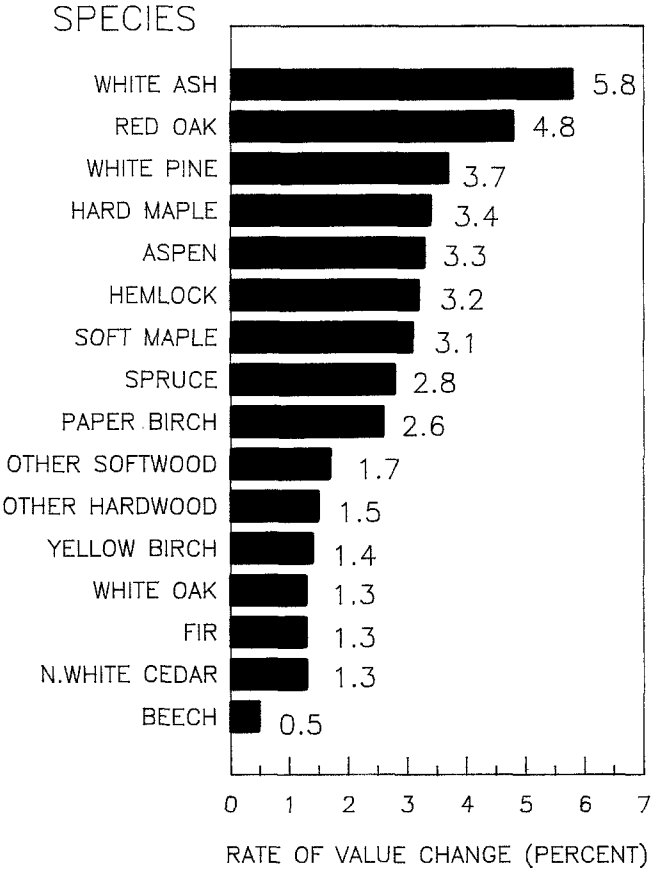

Figure 1.—Compound rates of value change for individual tree species in New England.

Stocking.—As undisturbed forests mature, they tend to form more densely stocked, slower growing timber stands that also contribute to a slowdown in rates of value change for individual trees. Value growth rates for trees in stands with fewer than 60 square feet of basal area are more than double those for trees in stands with more than 140 square feet:

Basal area/acre (square feet)	*Rate of value change* (percent)
<60	4.4
60- 99	3.6
100-139	2.9
140+	1.9
All trees	3.2

Predicting Rate of Change

Automatic interaction detection analysis of the rate of value change in individual trees generated nine mutually exclusive classification groups and the average rate of value change for each group (Fig. 2). Each tree is a member of one of the groups. Only four of the many tree and timber stand characteristics analyzed as predictor variables were retained in this value growth rate classification system: tree class, species, diameter, and stocking. White pine growing-stock trees less than 9 inches in diameter and growing in stands with fewer than 80 square feet of basal area per acre (Group 16) have the highest rate of value change, 19.2 percent, compared to 3.2 percent for the total sample. On the other hand, as testimony to high mortality rates and declines in quality, rotten trees have the lowest rate of value change, –2.4 percent (Group 7).

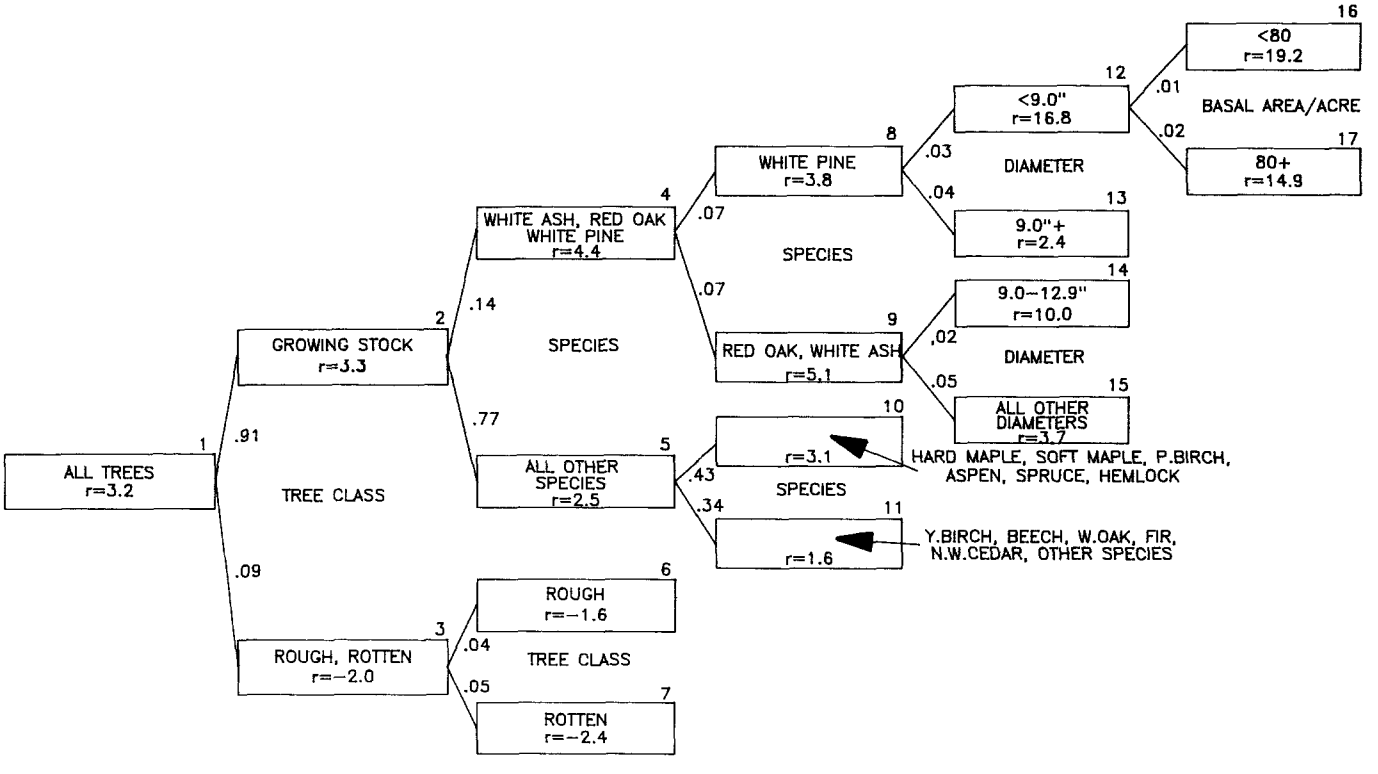

Figure 2.—Guide for estimating rate of value change for individual trees. Any tree can be assigned to a value-change group on the basis of the characteristics of that tree. The average rate of value change (r) is shown for each group. Fractions on each line connecting groups indicate the portion of the New England sample in that group.

Guides for Estimating Value Growth

Work tables showing rates of tree value growth (R) by diameter and stand stocking class (Tables 1A to 14B) provide guides for estimating rates of value change for New England's major timber species. Since most timber managers are not concerned with the development of culls, only growing-stock trees are considered.

Not surprisingly, white ash, red oak, and white pine led all other species of growing-stock in rates of value growth, while beech, white oak and fir had the lowest rates. In general, large poletimber-size trees on the verge of growing into higher valued sawtimber exhibit the highest rates of growth. And growth rates tend to decline with increases in tree size and stand stocking. Sample sizes (N) and standard errors (SE) for mean rates (R) give users a basis for gauging the reliability of table data. Beware of estimates based on a small number of sample trees and/or with large sampling errors.

Growing-stock trees that *survived* (Tables 1B-14B) between forest inventories recorded a compound average annual change in value of 4.4 percent, about 1 percent greater than the average for all growing-stock trees:

Species group	*Rate of value change* (percent)
White ash	6.1
Red oak	6.0
White oak	4.8
Aspen	4.7
Fir	4.6
Hard maple	4.6
White pine	4.2
Soft maple	4.0
Other hardwoods	3.9
Hemlock	3.7
Paper birch	3.6
Spruce	3.5
Yellow birch	3.0
Other softwood	2.7
Northern white-cedar	2.2
Beech	2.2
All surviving growing stock	4.4

Mortality rates for two of the region's important commercial species, fir and white oak, were especially high. However, fir and white oak growing-stock trees that survived scored relatively high average annual value gains of 4.6 and 4.8 percent, respectively.

In fact, most of the growing-stock trees that survived in New England between forest inventories did relatively well. The rates are especially impressive when you consider they are for trees in stands that had little human disturbance or improvement cutting between inventories.

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RATE OF VALUE CHANGE(R), SAMPLE SIZE(N), AND STANDARD ERROR(SE)
BY SPECIES GROUP, DIAMETER CLASS, AND BASAL AREA CLASS
ALL GROWING STOCK

TABLE 1A - HARD MAPLE

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	4.6	283	0.39	2.9	282	0.36	2.5	142	0.56	3.5	707	0.24
9-10.9	3.0	48	0.54	3.4	73	0.47	3.2	32	0.55	3.3	153	0.30
11-12.9	6.4	61	1.09	5.9	79	0.99	4.1	51	1.01	5.6	191	0.62
13-14.9	7.4	32	1.40	7.0	50	1.01	5.6	24	1.71	6.9	106	0.75
15+	6.0	36	1.37	1.3	69	1.75	2.2	57	1.87	2.6	162	1.07
ALL DIAMETERS	5.7	460	1.25	2.7	553	1.64	2.7	306	1.88	3.6	1319	0.98

TABLE 2A - SOFT MAPLE

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	4.5	836	0.24	3.4	787	0.24	3.6	373	0.33	3.9	1996	0.15
9-10.9	3.0	98	0.69	3.1	149	0.49	3.0	113	0.49	3.0	360	0.31
11-12.9	4.9	75	0.96	5.1	127	0.58	3.2	95	0.65	4.5	297	0.42
13-14.9	2.6	27	1.82	4.6	45	1.12	4.0	36	1.51	3.8	108	0.84
15+	4.0	27	1.91	1.8	44	1.68	2.0	56	2.00	2.3	127	1.12
ALL DIAMETERS	4.1	1063	0.67	3.3	1152	0.78	2.9	673	1.07	3.4	2888	0.50

TABLE 3A - YELLOW BIRCH

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	2.9	187	0.42	2.0	178	0.41	1.2	117	0.54	2.2	482	0.26
9-10.9	3.1	37	1.00	2.5	49	0.52	2.3	35	0.91	2.7	121	0.46
11-12.9	3.9	30	1.46	3.3	60	0.91	2.3	37	1.23	3.2	127	0.66
13-14.9	2.0	13	3.39	3.2	30	1.54	4.2	19	2.25	3.3	62	1.27
15+	-2.6	19	2.99	1.0	38	1.56	1.1	21	2.30	0.2	78	1.27
ALL DIAMETERS	1.1	286	1.77	1.9	355	1.17	1.8	229	1.76	1.6	870	0.88

RATE OF VALUE CHANGE(R), SAMPLE SIZE(N), AND STANDARD ERROR(SE)
BY SPECIES GROUP, DIAMETER CLASS, AND BASAL AREA CLASS
ALL GROWING STOCK

TABLE 4A - PAPER BIRCH

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	3.6	432	0.26	2.9	350	0.29	2.4	131	0.48	3.1	913	0.18
9-10.9	1.4	38	0.86	2.1	62	0.51	2.2	48	0.47	2.0	148	0.34
11-12.9	3.8	24	1.43	4.3	49	0.66	3.6	37	1.08	4.0	110	0.55
13-14.9	5.7	6	4.04	2.2	20	1.54	5.8	11	2.39	3.9	37	1.27
15+	6.6	2	3.17	-7.3	6	3.92	2.4	11	3.71	0.9	19	2.87
ALL DIAMETERS	3.5	502	0.59	2.1	487	0.79	2.8	238	1.96	2.7	1277	0.71

TABLE 5A - BEECH

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	4.1	248	0.40	3.1	242	0.42	0.7	54	0.92	3.3	544	0.28
9-10.9	1.5	31	0.87	2.0	37	0.60	-2.6	20	1.10	0.9	88	0.49
11-12.9	0.6	27	0.83	1.1	55	0.62	-1.5	26	1.09	0.4	108	0.46
13-14.9	-0.2	16	0.96	-1.0	27	1.11	0.9	15	1.04	-0.3	58	0.63
15+	-4.9	15	1.99	-1.5	18	1.27	-2.5	9	2.06	-2.7	42	0.95
ALL DIAMETERS	1.9	337	0.60	1.4	379	0.61	-0.9	124	0.91	1.2	840	0.39

TABLE 6A - WHITE ASH

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	9.6	69	2.77	4.2	84	1.02	10.0	34	3.87	7.5	187	1.53
9-10.9	13.6	15	3.48	14.7	22	2.90	15.8	7	6.03	14.4	44	2.05
11-12.9	7.7	9	3.36	9.5	20	1.65	10.8	9	2.44	9.2	38	1.42
13-14.9	4.1	9	2.24	7.5	7	2.59	7.1	4	1.83	6.1	20	1.36
15+	2.3	7	2.62	5.1	8	2.84	3.4	7	5.02	3.6	22	2.33
ALL DIAMETERS	5.0	109	3.01	7.5	141	2.65	4.8	61	4.97	5.8	311	2.28

RATE OF VALUE CHANGE(R), SAMPLE SIZE(N), AND STANDARD ERROR(SE)
BY SPECIES GROUP, DIAMETER CLASS, AND BASAL AREA CLASS
ALL GROWING STOCK

TABLE 7A - RED OAK

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	4.6	563	0.32	5.1	186	0.91	2.6	62	0.62	4.6	811	0.33
9-10.9	13.7	110	1.04	11.9	68	1.34	10.2	35	1.76	12.7	213	0.76
11-12.9	8.4	124	0.77	8.9	81	1.03	6.4	46	1.15	8.5	251	0.55
13-14.9	6.5	56	0.77	5.5	41	1.06	5.1	33	1.00	5.9	130	0.53
15+	2.2	46	1.34	2.0	69	1.59	4.1	35	0.86	2.6	150	0.95
ALL DIAMETERS	6.0	899	0.98	3.9	445	1.78	5.0	211	1.23	4.8	1555	0.91

TABLE 8A - WHITE OAK

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	1.0	230	0.38	0.2	101	0.59	0.1	20	1.11	0.7	351	0.31
9-10.9	2.6	21	0.85	0.2	36	0.96	-0.5	8	2.01	1.0	65	0.63
11-12.9	3.5	27	1.47	5.0	33	1.35	3.8	6	3.05	4.2	66	0.98
13-14.9	7.1	12	1.80	3.2	28	1.64	2.7	3	4.83	4.2	43	1.25
15+	2.1	9	2.69	1.7	17	2.28	-19.6	6	5.51	-0.4	32	1.79
ALL DIAMETERS	3.0	299	1.98	2.2	215	1.77	-8.8	43	4.58	1.4	557	1.39

TABLE 9A - ASPEN

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	4.3	443	0.33	3.1	186	0.50	3.9	41	1.10	4.0	670	0.27
9-10.9	3.8	55	0.63	4.7	40	0.64	5.2	25	0.97	4.4	120	0.41
11-12.9	-0.1	29	0.89	1.5	21	0.97	2.1	15	1.14	0.9	65	0.57
13-14.9	1.2	10	1.75	2.5	12	1.04	2.6	8	1.87	2.1	30	0.85
15+	4.1	2	1.77	2.2	10	1.65	2.1	8	1.47	2.4	20	1.00
ALL DIAMETERS	3.7	539	0.40	3.2	269	0.62	3.5	97	1.04	3.5	905	0.34

RATE OF VALUE CHANGE(R), SAMPLE SIZE(N), AND STANDARD ERROR(SE)
BY SPECIES GROUP, DIAMETER CLASS, AND BASAL AREA CLASS
ALL GROWING STOCK

TABLE 10A - WHITE PINE

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-6.9	17.0	247	1.04	7.0	135	1.85	9.8	166	1.16	12.9	548	0.74
7-8.9	20.5	135	0.63	17.4	89	1.03	18.4	108	0.75	19.1	332	0.45
9-10.9	3.8	113	0.31	2.8	116	0.33	3.5	131	0.30	3.4	360	0.18
11-12.9	3.8	94	0.30	3.1	74	0.32	2.9	107	0.37	3.3	275	0.20
13-14.9	2.4	46	0.53	3.3	54	0.30	2.8	61	0.44	2.8	161	0.24
15+	1.5	64	0.59	1.2	68	0.68	1.8	127	0.58	1.6	259	0.37
ALL DIAMETERS	5.1	699	0.63	3.2	536	0.63	3.1	700	0.55	3.8	1935	0.35

TABLE 11A - SPRUCE

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-6.9	3.5	543	0.25	2.8	604	0.22	1.7	451	0.26	2.7	1598	0.14
7-8.9	6.6	215	0.37	6.1	298	0.33	5.5	303	0.32	6.0	816	0.19
9-10.9	1.9	133	0.30	2.3	301	0.17	2.1	256	0.20	2.1	690	0.12
11-12.9	1.7	57	0.39	2.7	112	0.25	1.8	152	0.24	2.1	321	0.16
13-14.9	1.3	14	0.53	1.7	61	0.30	1.1	84	0.37	1.3	159	0.23
15+	-0.2	15	1.61	-0.1	28	0.90	1.4	53	0.62	0.7	96	0.49
ALL DIAMETERS	3.3	977	0.42	3.0	1404	0.32	2.4	1299	0.34	2.8	3680	0.21

TABLE 12A - FIR

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-6.9	3.5	658	0.30	2.1	784	0.24	0.8	721	0.23	2.2	2163	0.15
7-8.9	5.4	254	0.47	3.9	309	0.41	3.2	420	0.37	4.0	983	0.24
9-10.9	-0.7	120	0.65	-0.2	181	0.44	-1.0	285	0.41	-0.7	586	0.27
11-12.9	-1.6	40	1.14	0.8	41	0.80	-2.0	72	0.88	-1.1	153	0.55
13-14.9	-0.4	11	1.17	-5.9	7	4.87	-6.1	20	2.31	-3.9	38	1.36
15+	0.9	4	1.15				-2.4	8	2.50	-0.6	13	1.36
ALL DIAMETERS	2.6	1087	0.40	1.9	1323	0.34	0.4	1526	0.34	1.5	3936	0.21

RATE OF VALUE CHANGE(R), SAMPLE SIZE(N), AND STANDARD ERROR(SE)
BY SPECIES GROUP, DIAMETER CLASS, AND BASAL AREA CLASS
ALL GROWING STOCK

TABLE 13A - N.W.CEDAR

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-6.9	1.9	117	0.39	2.4	181	0.29	1.7	226	0.26	2.0	524	0.17
7-8.9	2.5	64	0.64	3.5	121	0.35	2.6	199	0.29	2.9	384	0.21
9-10.9	0.2	44	0.59	1.4	137	0.27	1.1	205	0.25	1.1	386	0.18
11-12.9	1.7	13	0.56	0.5	62	0.50	1.8	106	0.26	1.4	181	0.23
13-14.9	-1.3	8	1.54	1.9	11	0.60	1.3	54	0.46	1.1	73	0.39
15+	0.2	4	2.94	1.1	16	0.75	1.2	49	0.64	1.1	69	0.51
ALL DIAMETERS	1.4	250	0.60	1.9	528	0.39	1.6	839	0.35	1.7	1617	0.25

TABLE 14A - HEMLOCK

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-6.9	6.3	114	0.63	3.6	198	0.41	2.9	228	0.34	4.0	540	0.27
7-8.9	10.9	77	0.53	8.0	143	0.52	7.8	182	0.44	8.7	402	0.30
9-10.9	3.0	123	0.23	2.7	166	0.20	2.5	196	0.18	2.7	485	0.12
11-12.9	3.0	48	0.35	2.3	88	0.21	2.5	80	0.23	2.6	216	0.15
13-14.9	2.2	20	0.76	2.1	41	0.39	1.9	43	0.34	2.1	104	0.26
15+	1.7	23	0.86	0.7	47	0.85	1.5	47	0.54	1.2	117	0.43
ALL DIAMETERS	4.1	405	0.55	2.9	683	0.48	3.2	776	0.45	3.3	1864	0.28

RATE OF VALUE CHANGE(R), SAMPLE SIZE(N), AND STANDARD ERROR(SE)
BY SPECIES GROUP, DIAMETER CLASS, AND BASAL AREA CLASS
GROWING STOCK THAT SURVIVED

TABLE 1B - HARD MAPLE

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	4.9	271	0.39	3.4	260	0.35	3.2	128	0.54	4.0	659	0.24
9-10.9	3.6	45	0.45	3.8	69	0.43	3.2	32	0.55	3.6	146	0.28
11-12.9	6.6	59	1.08	6.0	78	0.99	5.2	44	0.96	6.0	181	0.61
13-14.9	7.5	31	1.40	7.4	48	0.99	6.3	21	1.68	7.2	100	0.74
15+	6.0	36	1.37	2.5	67	1.71	4.8	52	1.48	4.0	155	0.99
ALL DIAMETERS	5.9	442	1.26	3.6	522	1.61	4.6	277	1.61	4.6	1241	0.92

TABLE 2B - SOFT MAPLE

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	4.9	792	0.24	3.8	742	0.23	3.9	342	0.33	4.3	1876	0.15
9-10.9	3.6	91	0.67	3.7	137	0.46	3.6	106	0.46	3.6	334	0.30
11-12.9	5.3	70	0.95	5.5	122	0.55	3.7	92	0.59	4.9	284	0.40
13-14.9	3.1	26	1.81	4.9	43	1.11	4.9	33	1.43	4.4	102	0.81
15+	4.7	26	1.85	1.9	42	1.70	4.1	52	1.39	3.3	120	0.97
ALL DIAMETERS	4.6	1005	0.68	3.6	1086	0.80	3.9	625	0.80	4.0	2716	0.45

TABLE 3B - YELLOW BIRCH

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	3.7	169	0.40	2.6	164	0.38	2.2	104	0.49	3.0	437	0.24
9-10.9	3.9	33	0.94	2.7	48	0.50	2.9	32	0.89	3.1	113	0.44
11-12.9	5.3	25	1.34	3.9	55	0.89	3.3	32	1.21	4.1	112	0.64
13-14.9	5.0	10	3.12	3.6	28	1.53	4.9	16	2.21	4.4	54	1.23
15+	0.5	17	2.41	4.1	32	1.26	1.6	20	2.32	2.4	69	1.16
ALL DIAMETERS	3.0	254	1.40	3.5	327	1.05	2.4	204	1.84	3.0	785	0.83

RATE OF VALUE CHANGE(R), SAMPLE SIZE(N), AND STANDARD ERROR(SE)
BY SPECIES GROUP, DIAMETER CLASS, AND BASAL AREA CLASS
GROWING STOCK THAT SURVIVED

TABLE 48 - PAPER BIRCH

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	4.0	402	0.25	3.6	322	0.28	3.1	117	0.45	3.7	841	0.17
9-10.9	2.4	34	0.76	3.0	53	0.40	2.5	46	0.44	2.7	133	0.29
11-12.9	4.8	21	1.32	4.3	49	0.66	4.8	32	0.99	4.6	102	0.52
13-14.9	6.8	5	4.11	3.1	19	1.41	6.1	10	2.29	4.6	34	1.20
15+	6.6	2	3.17	-4.9	5	3.93	5.5	9	3.77	3.5	16	2.84
ALL DIAMETERS	4.1	464	0.59	3.0	448	0.75	4.1	214	1.93	3.6	1126	0.69

TABLE 58 - BEECH

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	4.7	225	0.39	3.4	227	0.41	1.5	49	0.90	3.8	501	0.27
9-10.9	2.6	26	0.71	2.2	36	0.58	-1.6	16	1.08	1.6	78	0.44
11-12.9	1.5	25	0.61	1.7	51	0.56	0.3	20	0.93	1.4	96	0.39
13-14.9	0.4	14	0.84	1.2	21	0.74	0.9	15	1.04	0.9	50	0.49
15+	-0.2	9	1.45	-0.0	14	1.10	1.1	5	1.19	0.1	28	0.77
ALL DIAMETERS	3.1	299	0.54	2.2	349	0.61	0.5	105	0.93	2.2	753	0.38

TABLE 66 - WHITE ASH

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	10.2	64	2.80	5.7	69	1.00	10.5	32	3.89	8.6	165	1.57
9-10.9	14.1	14	3.44	16.5	19	2.90	15.8	7	6.03	15.5	40	2.03
11-12.9	7.7	9	3.36	9.5	20	1.85	10.8	9	2.44	9.2	38	1.42
13-14.9	6.9	7	1.50	7.5	7	2.59	7.1	4	1.83	7.1	18	1.24
15+	2.3	7	2.62	5.1	8	2.84	3.4	7	5.02	3.6	22	2.33
ALL DIAMETERS	5.6	101	3.14	7.8	123	2.71	4.8	59	4.97	6.1	283	2.34

RATE OF VALUE CHANGE(R), SAMPLE SIZE(N), AND STANDARD ERROR(SE)
BY SPECIES GROUP, DIAMETER CLASS, AND BASAL AREA CLASS
GROWING STOCK THAT SURVIVED

TABLE 7B - RED OAK

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	5.0	535	0.32	5.6	169	0.93	3.2	52	0.58	5.0	756	0.33
9-10.9	14.5	101	1.02	12.9	60	1.33	10.5	34	1.75	13.5	195	0.75
11-12.9	8.5	121	0.77	9.7	76	1.01	9.3	43	1.12	9.0	240	0.54
13-14.9	6.9	53	0.76	6.2	38	1.03	5.5	29	0.98	6.4	120	0.52
15+	4.5	40	0.90	4.1	64	1.01	4.1	35	0.86	4.2	139	0.62
ALL DIAMETERS	7.1	850	0.83	5.7	407	1.32	5.2	193	1.25	6.0	1450	0.70

TABLE 8B - WHITE OAK

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	2.1	186	0.36	2.0	64	0.50	1.4	15	0.82	2.0	265	0.28
9-10.9	3.1	20	0.78	2.5	26	0.71	1.9	6	1.33	2.7	52	0.48
11-12.9	4.8	24	1.42	6.6	26	1.28	6.2	4	2.77	5.7	54	0.96
13-14.9	7.1	12	1.80	6.1	23	1.29	7.5	2	2.14	6.5	37	1.00
15+	5.0	7	2.35	4.5	13	2.18				4.6	21	1.59
ALL DIAMETERS	4.6	249	1.90	4.9	152	1.82	4.1	28	2.90	4.8	429	1.31

TABLE 9B - ASPEN

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-8.9	6.0	349	0.30	4.8	131	0.47	5.0	35	0.99	5.6	515	0.25
9-10.9	4.5	51	0.55	5.6	35	0.48	5.9	23	0.86	5.2	109	0.35
11-12.9	2.0	21	0.52	2.6	18	0.79	3.2	13	0.95	2.5	52	0.41
13-14.9	2.5	8	1.65	3.0	11	0.85	4.8	6	1.12	3.3	25	0.69
15+	4.1	2	1.77	2.8	9	1.55	2.1	8	1.47	2.7	19	0.95
ALL DIAMETERS	5.1	431	0.40	4.4	204	0.65	4.4	85	1.05	4.7	720	0.35

RATE OF VALUE CHANGE(R), SAMPLE SIZE(N), AND STANDARD ERROR(SE)
BY SPECIES GROUP, DIAMETER CLASS, AND BASAL AREA CLASS
GROWING STOCK THAT SURVIVED

TABLE 108 - WHITE PINE

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-6.9	17.8	228	1.02	9.0	102	1.95	11.0	137	1.20	14.3	467	0.75
7-8.9	21.4	123	0.58	18.0	85	1.02	19.4	98	0.71	20.0	306	0.42
9-10.9	4.2	108	0.26	3.4	108	0.25	4.3	119	0.20	4.0	335	0.14
11-12.9	4.0	92	0.27	3.4	72	0.28	3.8	96	0.25	3.8	260	0.15
13-14.9	2.6	44	0.48	3.3	53	0.29	3.6	55	0.28	3.2	152	0.20
15+	1.6	63	0.57	2.2	63	0.54	2.0	121	0.58	2.0	247	0.36
ALL DIAMETERS	5.4	658	0.63	3.9	483	0.58	3.7	626	0.56	4.2	1767	0.35

TABLE 118 - SPRUCE

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-6.9	4.4	471	0.23	3.7	534	0.20	2.9	383	0.22	3.7	1388	0.13
7-8.9	7.1	199	0.33	6.8	272	0.29	6.2	280	0.29	6.7	751	0.18
9-10.9	2.5	123	0.23	2.8	283	0.12	2.7	238	0.14	2.7	644	0.09
11-12.9	2.0	55	0.34	2.9	108	0.21	2.3	142	0.18	2.5	305	0.13
13-14.9	1.3	14	0.53	1.9	60	0.26	1.9	75	0.21	1.9	149	0.16
15+	2.4	12	0.67	1.4	25	0.61	2.2	49	0.48	2.0	86	0.34
ALL DIAMETERS	4.1	874	0.39	3.6	1282	0.32	3.1	1167	0.33	3.5	3323	0.20

TABLE 128 - FIR

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-6.9	5.7	486	0.27	4.3	587	0.20	3.5	504	0.16	4.6	1577	0.13
7-8.9	8.0	182	0.39	6.2	235	0.33	6.1	296	0.29	6.7	713	0.19
9-10.9	3.4	72	0.37	3.0	126	0.19	3.0	178	0.19	3.0	376	0.13
11-12.9	2.8	24	0.49	3.0	31	0.40	2.9	40	0.31	2.9	95	0.22
13-14.9	0.6	10	0.80	5.5	2	2.10	3.0	7	0.72	2.0	19	0.61
15+	0.9	4	1.15				1.1	5	1.04	1.2	10	0.71
ALL DIAMETERS	5.5	778	0.43	4.5	982	0.33	4.1	1030	0.34	4.6	2790	0.21

RATE OF VALUE CHANGE(R), SAMPLE SIZE(N), AND STANDARD ERROR(SE)
BY SPECIES GROUP, DIAMETER CLASS, AND BASAL AREA CLASS
GROWING STOCK THAT SURVIVED

TABLE 138 - N.W.CEDAR

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-6.9	2.4	110	0.34	2.8	174	0.27	2.2	210	0.23	2.5	494	0.16
7-8.9	3.3	57	0.58	3.9	115	0.32	2.9	190	0.27	3.3	362	0.20
9-10.9	1.2	39	0.42	1.9	129	0.22	2.0	185	0.17	1.9	353	0.13
11-12.9	1.7	13	0.56	1.9	52	0.29	2.0	103	0.22	2.0	168	0.17
13-14.9	-0.3	7	1.26	1.9	11	0.60	1.9	50	0.35	1.7	68	0.30
15+	2.8	3	1.55	1.4	15	0.61	1.9	47	0.36	1.9	65	0.30
ALL DIAMETERS	2.2	229	0.59	2.4	496	0.39	2.2	785	0.33	2.2	1510	0.24

TABLE 148 - HEMLOCK

	BASAL AREA CLASS - SQUARE FEET											
	<80			80-119			120+			ALL BASAL AREAS		
	R	N	SE	R	N	SE	R	N	SE	R	N	SE
DIAMETER CLASS INCHES												
5-6.9	6.5	111	0.63	3.9	186	0.41	3.2	218	0.34	4.3	515	0.27
7-8.9	11.0	76	0.52	8.4	136	0.50	8.0	178	0.44	8.9	390	0.29
9-10.9	3.2	120	0.21	2.9	162	0.18	2.6	193	0.17	2.8	475	0.11
11-12.9	3.3	46	0.27	2.3	88	0.21	2.5	80	0.23	2.6	214	0.14
13-14.9	3.2	18	0.31	2.6	39	0.26	2.2	41	0.26	2.6	98	0.17
15+	2.6	20	0.72	2.2	40	0.63	1.9	45	0.47	2.2	105	0.34
ALL DIAMETERS	4.6	391	0.54	3.4	651	0.47	3.3	755	0.45	3.7	1797	0.28

Gansner, David A.; Arner, Stanford L.; Birch, Thomas W. 1990. **Timber value growth rates in New England.** Res. Pap. NE-632. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 14 p.

Rates of growth in the value of standing timber can vary greatly from stand to stand and from tree to tree. In Maine, the compound annual rate of change in stand value between the two most recent forest inventories ranged from −12 to +43 percent. Faced with this kind of variation, forest managers can use help in determining financial rates of return for their woodland. From analyses of forest inventory data we have developed guides for estimating value growth potential for trees in New England.

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