

Forest Statistics

for

Vermont

April, 1952



Northeastern Forest Experiment Station

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FOREWORD

This preliminary report is a product of the forest survey of the Northeast carried on by the Northeastern Forest Experiment Station as part of the nation-wide forest survey being made by the Forest Service, U. S. Department of Agriculture. A comprehensive report on the results of the forest survey in Vermont will be published later,

The forest survey in Vermont was undertaken with the help of the Vermont Forest Service. The State Forester provided many of the aerial photographs that were used, furnished office space and basic data, and gave other valuable assistance,

The statistical procedures for obtaining field-inventory data were developed by C. Allen Bickford. Field work in Vermont was supervised by Harry W. Camp, Jr. The men directly responsible for the field work were Alessio P. Caporaso, Howard J. Dean, William J. Goodheart, and Myron D. Ostrander. Computations were made under the supervision of Roland H. Ferguson.

If the figures in this report are compared with previous estimates of the forest situation in Vermont (such as those made by the Forest Service and the American Forestry Association for the "Reappraisal" of 1945), here are some points to keep in mind:

- Previous estimates were based largely upon general knowledge and the judgment of informed persons. The accuracy of such estimates cannot be controlled. Accuracy of the present survey is controlled by scientific survey design.
- Some specifications used in this report are different from specifications used in previous estimates.
- Changes in forest conditions in Vermont cannot be measured by comparing this report with previous estimates.
- Valid comparisons of changing forest conditions in Vermont will be possible when the same area is resurveyed in the future.

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Forest Statistics for Vermont

by

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The Forest Area

The State of Vermont contains 6 million acres of land. Sixty-three percent is forested,

Some 16,000 acres of forest land are permanently reserved from commercial timber cutting or are incapable of yielding merchantable timber crops. This is the forest land in public recreation areas and on the poorest tree-growing sites.

The commercial forest land amounts to 3.7 million acres. It is distributed rather evenly over the entire State. Of the 14 counties, 10 are more than half forested.

Forest - Land Ownership

Ninety-two percent of the commercial forest land is privately owned,

Private ownerships smaller than 5,000 acres number almost 40,000. About half of these are farm forests. The others belong to lumber companies, estates, public utilities, summer residents, retired people, and other nonfarm owners. All holdings smaller than 5,000 acres account for 79 percent of the total commercial forest acreage. The average size of these smaller holdings is 75 acres,

There are only 17 private ownerships larger than 5,900 acres. However, they contain 13 percent of all the commercial forest land,

Eight percent of the commercial forest area is publicly owned. Largest of the public holdings is the Green Mountain National Forest. It contains 210,000 acres owned by the United States, of which 191,000 acres are commercial forest land. Most of the other public forest holdings lie in State forests (71,000 acres) and State parks (5,000 acres),

The Forest Types

The hardwood forests of Vermont are justly famous. They cover more than two-thirds of the commercial forest land. The valuable northern hardwood type--sugar maple-beech-yellow birch--is the predominant type throughout most of the State. In fact, it occurs on half of the forest land,

The aspen-gray birch-pin cherry type and the important paper birch type are temporary occupants of some of the forest land. Generally they are the first types to become established after fire or heavy cutting,

Other hardwood types include hardwood-spruce-fir, ash-elm-maple, oak, and hardwood-white pine. Of these the most abundant is hardwood-spruce-fir, a type that usually forms the transition between the northern hardwood type and the spruce types,

Softwood forest types occupy less than one-third of Vermont's commercial forest acreage. The spruce types are more extensive than other softwood types. They occur at the high elevations and include spruce-fir and spruce-fir-hardwood. Included also in the spruce group is some of the cedar-tamarack-spruce type,

Other softwood types are hemlock, white pine, and white pine-hardwood. The white pine type occurs chiefly in the Champlain Valley.

Condition Of The Forest Stands

Saw-timber stands of 5,000 or more board feet per acre occupy 17 percent of Vermont's commercial forest land. Yet these stands bear more than half of all the sawlog volume in the State. They average 7,000 board feet per acre.

Saw-timber stands of 1,500 to 5,000 board feet per acre occupy 31 percent of the commercial forest area. They bear more than one-third of the total volume of sawlog material. Three-fourths of Vermont's saw-timber area has more than half its sawlog volume in trees smaller than 15 inches in diameter,

Pole-timber stands occupy 38 percent of the commercial forest land. The remaining 14 percent is in sapling and seedling stands or nonstocked areas.

Timber Volume

There are more than $8\frac{1}{2}$ billion board feet of sawlog material (International $\frac{1}{4}$ -inch rule) in the commercial forests of Vermont. Nearly half this volume occurs in the three major northern hardwood species: sugar maple, beech, and yellow birch. More than one-third is in softwood species, chiefly spruce and hemlock. The remaining volume is distributed among the lesser hardwoods,

The primary growing stock (trees 5 inches and larger in diameter) amounts to $3\frac{1}{2}$ billion cubic feet. This volume is the equivalent of about 44 million standard cords, including bark. Nearly half the volume is in trees of pole-timber size.

Timber Quality

The U. S. Forest Products Laboratory log-grading specifications were used for grading hardwood sawlog material. Of the hardwood sawlog volume in Vermont 21 percent is in Grade 1 factory logs, 31 percent in Grade 2 factory logs, and 36 percent in Grade 3. The remaining 12 percent is in the structural log class,

Limbianness was the criterion for softwood tree quality. All saw-timber trees were classed as smooth, limby, or rough. Twenty-seven percent of the softwood sawlog material is in the smooth class, 23 percent is in the limby class, and 50 percent is in the rough class.

Cull Trees

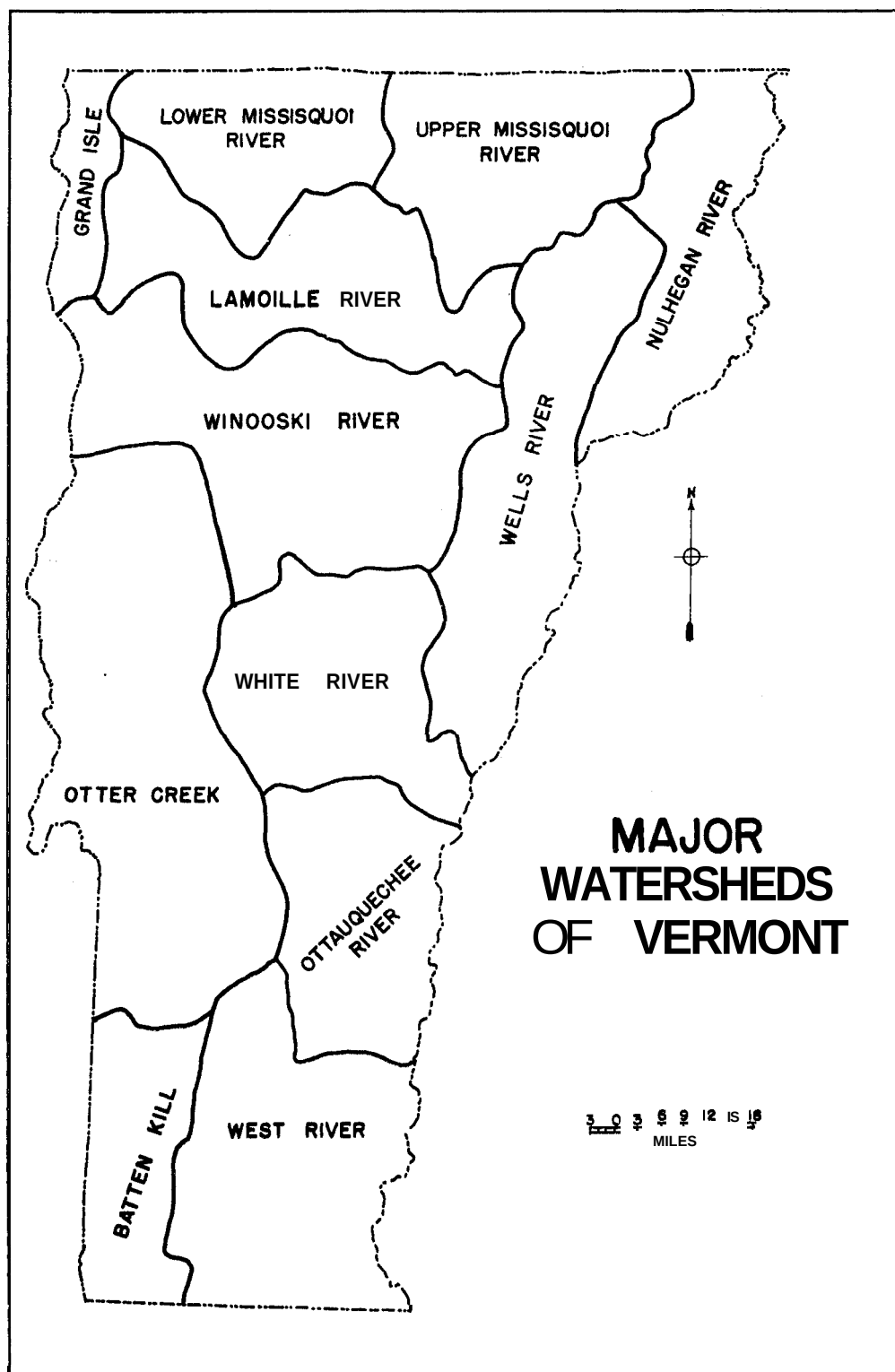
All the wood in the bole of a tree is not necessarily usable; many trees contain portions that are so decayed or deformed that these portions cannot be used. Any tree that has more than half its volume in such material is called "cull." The volume of cull trees is not included in the saw-timber volume,

In Vermont there are 784 million cubic feet of sound wood in cull trees. Most of this volume is hardwood of saw-timber size. These cull trees occupy space that could grow better timber,

Growth And Drain

The total current annual *net* growth of wood in Vermont's forests amounts to 120 million cubic feet (about $1\frac{1}{2}$ million cords). Co odity drain for 1948 was 85 million cubic feet (about 1 million cords),

This favorable ratio of growth to drain would seem to indicate that Vermont is growing more timber than it is cutting. On an over-all volume basis, this is true. However, breaking the total figure down brings to light a more sobering fact: the larger softwood trees are being heavily over-cut. For every 1,000 board feet of wood that is added to saw-timber sized softwood trees by growth, 1,780 board feet are cut,



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So the situation adds up to this: Vermont's forests are growing wood faster than it is being cut, But the growing is concentrated in the smaller hardwoods while the cutting is predominantly in the larger softwoods,

Watershed Statistics

Tables 18 to 22 contain estimates of forest area and timber volume in the various watersheds of Vermont., While these estimates are useful in locating the heavily forested areas, they are not so accurate as the statistics for the State as a whole,

Table 1.--Land area and forest area of Vermont, 1948

Class of land	Area	
	<u>Acres</u>	<u>Percent</u>
Forest land:		
Commercial	3,713,400	63
Reserved commercial ¹	9,700	(2/)
Noncommercial	6,600	(2/)
All forest land	3,729,700	63
Nonforest land	2,208,200	37
All land ³	5,937,900	100

¹ Included in the reserved forest land are 8,500 acres in the Green Mountain National Forest. There is no reserved noncommercial forest land in Vermont. These terms and others used in the tables are defined in the appendix.

² Less than 0.5 percent.

³ From Areas of the United States 1940, Bureau of the Census. The Census Bureau data for land area include bodies of inland water up to 40 acres. In the Forest Survey it has been possible to exclude all inland water bodies that exceed 1 acre. The difference in Vermont amounts to 31,600 acres.

Table 2.--Commercial forest area of Vermont
by forest type, 1948

Forest type		Comercial forest area	
		<u>Acres</u>	<u>Percent</u>
Spruce-fir		368,300	10
Spruce-fir-hardwood	<i>Spr-fir</i>	203,000	5
Cedar-tamarack-spruce		56,800	2
Hemlock		220,400	6
White pine	<i>wh. + red pine</i>	126,700	3
White pine-hardwood		69,400	2
Sugar maple-beech-yellow birch		1,863,000	50
(Aspen-gray birch-pin cherry		181,400	5
Paper birch		106,000	3
Hardwood-spruce-fir		315,000	8
Ash-elm-maple		72,900	2
Oak	<i>oak - hic</i>	71,100	2
Hardwood-white pine	<i>oak - pine</i>	59,400	2
All types		3,713,400	100

Table 3.--Commercial forest area of Vermont by stand-size class and major forest-type group, 1948

Forest type	Saw-timber stands		Pole-timber stands		Sapling and seedling stands	Other areas	Total commercial forest area
	More than 5,000 bd.ft. per acre	1,503-5,000 bd.ft. per acre	More than 600 cu.ft. per acre	200-600 cu.ft. per acre			
					<u>Acres</u>	<u>Acres</u>	<u>Acres</u>
Spruce types	91,400	170,600	152,300	82,500	93,600	37,700	628,100
Other softwood types	76,400	169,900	52,700	57,900	7,300	52,300	416,500
Sugar maple-beech-yellow birch	389,900	656,800	460,000	196,300	133,200	26,800	1,863,000
Aspen-gray birch-pin cherry-paper birch	8,800	18,600	76,700	123,200	45,900	14,200	287,400
Other hardwood types	67,700	148,700	102,700	110,500	45,200	43,600	518,400
All types	634,200	1,164,600	844,400	570,400	325,200	174,600	3,713,400
Percent	17	31	23	15	9	5	100

Table 4.--Commercial forest area of Vermont by ownership, 1948¹

Ownership class	Commercial forest area	
	Acres	Percent
Private:		
Farm forests:		
On 16,000 farms larger than 100 acres ²	1,428,903	39
On 3,000 farms smaller than 100 acres	122,600	3
Total	1,551,500	42
Industrial and other forests:		
5 holdings larger than 25,000 acres	312,700	8
12 holdings 5,000 to 25,000 acres	167,200	5
20,000 holdings smaller than 5 acres	1,384,500	37
Total	1,864,400	50
All private (39,000 holdings)	3,415,900	92
Public:		
National forests ³	190,800	5
Other Federal	8,100	(4/)
State ⁵	79,100	2
County and municipal	19,500	1
All public	297,500	8
Total commercial forest land	3,713,400	100

¹ Table 31 shows ownership of timber volume.

The number of forest ownerships on farms of 100 acres and more was estimated on the assumption that all such farms contain same forest land (Census of Agriculture, 1945).

³ In addition the Green Mountain National Forest contains 8,400 acres of reserved-commercial forest land, 1,700 acres of noncommercial forest land, and 8,400 acres of nonforest land.

⁴ Less than 0.5 percent.

⁵ State holdings of commercial forest land (not reserved) consist chiefly of State forests (70,800 acres) and State parks (5,400 acres).

Table 5.--Timber volume on commercial forest land
of Vermont, by species, 1948

Species	Primary growing stock ¹		Saw timber ²
	<u>Million cu.ft.</u>	<u>Equivalent in thousand cords</u>	<u>Million bd.ft.</u>
Spruce	440	5,500	1,422
Hemlock	327	4,100	1,031
White pine	156	2,000	598
Fir	189	2,400	362
Cedar and other softwoods	78	900	104
All softwood	1,190	14,900	3,517
Sugar maple	678	8,400	1,655
Yellow birch	438	5,500	1,279
Beech	329	4,100	925
Paper birch	230	2,900	306
Red maple	232	2,900	287
Red oak	72	900	201
Ash	82	1,000	107
Aspen	85	1,100	73
Other hardwoods	159	2,000	259
All hardwood	2,305	28,800	5,092
All species	3,495	43,700	8,609

¹ Excluding 784 million cubic feet of sound wood in cull trees--the secondary growing stock--of which 40 percent is in the larger hardwood trees,

² All saw-timber estimates in this report are based upon the International 4-inch Log Rule. Saw-timber volume represents a portion of primary growing stock; saw-timber volumes and primary-growing-stock volumes are not additive,

Table 6.--Timber volume on commercial forest land
of Vermont, by tree diameter, 1948¹

Cumulative diameter class	Primary growing stock	Saw timber
	<u>Million</u> <u>cu. ft.</u>	<u>Million</u> <u>bd. ft.</u>
Softwood:		
28 and larger	25	137
26 " "	39	216
24 " "	53	291
22 " "	68	374
20 " "	107	576
18 " "	163	865
16 " "	244	1,270
14 " "	358	1,823
12 " "	540	2,648
10 " "	757	3,517
8 " " } 433	994	--
6 " "	1,190	--
Hardwood:		
28 and larger	35	204
26 " "	58	334
24 " "	97	561
22 " "	165	936
20 " "	243	1,358
18 " "	360	1,979
16 " "	542	2,885
14 " "	760	3,916
12 " " } 1,258	1,047 287	5,092
10 " "	1,519	--
8 " "	1,955	--
6 " "	2,305	--
Softwood and hardwood	3,495	8,609

¹ Trees were tallied by 2-inch diameter class. For example, trees of 5.0 inches to and including 6.9 inches are in the 6-inch class.

Table 7.--Timber volume on commercial forest land in Vermont,
by stand-size class and species group, 1948

Stand-size class and species group	Primary growing stock	Saw timber
	<u>Million cu. ft.</u>	<u>Million bd. ft.</u>
Saw-timber stands:		
More than 5,000 bd. ft. per acre		
Softwood	447	1,800
Hardwood	731	2,661
Total (634,200 acres)	1,178	4,461
1,500-5,000 bd. ft. per acre		
Softwood	460	1,276
Hardwood	884	1,852
Total (1,164,600 acres)	1,344	3,128
Pole--timber stands:		
More than 600 cu.ft. per acre		
Softwood	195	266
Hardwood	522	391
Total (844,400 acres)	717	657
200-600 cu.ft. per acre		
Softwood	60	116
Hardwood	125	124
Total (570,400 acres)	185	240
Other stands:		
Softwood	28	59
Hardwood	43	64
Total (499,800 acres)	71	123
All stands:		
Softwood	1,190	3,517
Hardwood	2,305	5,092
Total (3,713,400 acres)	3,495	8,609

Table 8.--Average timber volume per acre of commercial forest land of Vermont, by stand-size class, 1948

Stand-size class (and acreage of each class)	Primary growing stock	Saw timber
	<u>Cubic feet</u>	<u>Board feet</u>
Saw-timber stands:		
More than 5,000 bd.ft. per acre (634,200 acres)	1,900	7,000
1,500-5,000 bd.ft. per acre (1,164,600 acres)	1,200	2,700
Pole-timber stands:		
More than 600 cu.ft. per acre (844,400 acres)	800	800
200-600 cu.ft. per acre (570,400 acres)	300	400
Other stands: (499,800 acres)	100	200
Average, all stands ¹ (3,713,400 acres)	900	2,300

¹ Hardwood constitutes 59 percent of the total board-foot volume, and 66 percent of the total cubic-foot volume, in the average stand.

Table 9.—Softwood saw-timber volume on commercial forest
land of Vermont, by species and quality, 1948

(In million board feet)

Species	Tree-quality class			Total
	Smooth	Limby	Rough	
Spruce	344	350	728	1,422
Hemlock	333	210	488	1,031
White pine	154	141	303	598
Other softwood	115	95	256	466
All softwood	946	796	1,775	3,517
Percent	27	23	50	100

Table 10.--Hardwood saw-timber volume on commercial forest-
land of Vermont, by species and quality, 1948

(In million board feet)

Species	Factory logs			Structural logs	Total
	Grade 1	Grade 2	Grade 3		
Sugar maple	406	570	543	136	1,655
Yellow birch	380	426	371	102	1,279
Beech	129	220	389	187	925
Paper birch	32	106	143	25	306
Red maple	23	63	133	68	287
Red oak	24	48	85	44	201
Ash	22	38	38	9	107
Other hardwood	54	89	131	58	332
All hardwood	1,070	1,560	1,833	629	5,092
Percent	21	31	36	12	100

Table 11.--Softwood saw-timber volume on commercial forest land of Vermont, by stand-size class and tree quality. 1948

(In million board feet)

Stand-size class	Tree-quality class			Total
	Smooth	Limby	Rough	
Saw-timber stands:				
More than 5,000 bd.ft. per acre	750	472	578	1,800
1,500-5,000 bd.ft. per acre	148	282	846	1,276
All other stands:	48	42	351	441
All stands	946	796	1,775	3,517

Table 12.--Hardwood saw-timber volume on commercial forest
land of Vermont, by stand-size class and log
quality, 1948

(In million board feet)

Stand-size class	Factory logs			Structural logs	Total
	Grade 1	Grade 2	Grade 3		
Saw-timber stands:					
More than 5,000 bd.ft. per acre	764	828	794	275	2,661
1,500-5,000 bd. ft. per acre	261	607	730	254	1,852
All other stands	45	125	309	100	579
All stands	1,070	1,560	1,833	629	5,092

Table 13.--Annual net growth on commercial forest land
of Vermont, by tree-size class and species
group, 1948

Tree-size class and species group	Primary growing stock	timber
	<u>Thousand cu.ft.</u>	<u>Thousand bd.ft.</u>
Saw-timber trees;		
Softwood	24,700	116,100
Hardwood	46,800	194,100
All saw-timber trees	71,500	310,200
Pole-timber trees:		
Softwood	8,400	--
Hardwood	40,400	--
All pole-timber trees	48,800	--
Saw-timber and pole timber trees:		
Softwood	33,100	116,100
Hardwood	87,200	194,100
Total ¹	120,300	310,200

¹ The growth of primary growing stock is equivalent to about 413,000 rough standard cords of softwood and about 1,090,000 rough standard cords of hardwood.

Table 14.--Commodity drain on commercial forest land
of Vermont, by tree-size class and species
group, 1948

Tree-size class and species group	Primary growing stock	Saw timber
	<u>Thousand</u> <u>cu. f t.</u>	<u>Thousand</u> <u>bd. ft.</u>
Saw-timber trees:		
Softwood	41,200	206,200
Hardwood	25,700	125,100
All saw-timber trees	66,900	331,300
Pole-timber trees:		
Softwood	6,300	--
Hardwood	12,000	--
All pole-timber trees	18,300	--
Saw-timber and pole-timber trees:		
Softwood	47,500	206,200
Hardwood	37,700	125,100
Total ¹	85,200	331,300

¹ The drain from primary growing stock is equivalent to about 594,000 rough standard cords of softwood and about 471,000 rough standard cords of hardwood,

Table 15.--Relationship of drain to growth in Vermont,
by tree-size class and species group, 1948

Tree-size class and species group	Drain as , percentage of growth	
	Cubic-foot basis	Board-foot basis
	<u>Percent</u>	<u>Percent</u>
Saw-timber trees:		
Softwood	167	178
Hardwood	55	64
All saw-timber trees	94	107
Pole-timber trees:		
Softwood	75	--
Hardwood	30	--
All pole-timber trees	38	--
Saw-timber and pole-timber trees:		
Softwood	144	178
Hardwood	43	64
Total	71	107

Table 16,--Distribution of growth and drain on primary
growing stock in Vermont, by tree-size
class and species group, 1948

Tree-size class and species group	Growth		Drain	
	<u>Thousand cu.ft.</u>	<u>Per- cent</u>	<u>Thousand cu.ft.</u>	<u>Per- cent</u>
Saw-timber trees:				
Softwood	24,700	20	41,200	48
Hardwood	46,800	39	25,700	30
All saw-timber trees	71,500		66,900	78
Pole-timber trees:				
Softwood	8,400	7	6,300	7
Hardwood	40,400	34	12,000	15
All pole-timber trees	48,800	41	18,300	22
Saw-timber and pole-timber trees:				
Softwood	33,100	27	47,500	55
Hardwood	87,200	73	37,700	45
Total	120,300	100	85,200	100

Table 17,--Commodity drain on primary growing stock in
Vermont, by primary wood products, 1948

Primary wood product	Percentage of total drain
	<u>Percent</u>
Sawlogs	50
Veneer logs	5
Pulpwood	18
Fuelwood	11
Poles and posts	2
Other products	2
Total products (75 million cu.ft.)	88
Logging waste (10 million cu.ft.)	12
Total (85 million cu.ft.)	100

Table 18.--Land and commercial forest area of Vermont
by watershed, 1948

Watershed	Land area	Commercial forest area	
	<u>Acres</u>	<u>Acres</u>	<u>Percent</u>
Batten Kill	276,500	209,700	76
Grand Isle	49,300	9,400	19
Lamoille River	532,600	298,900	56
Lower Missisquoi River	358,000	159,100	44
Upper Missisquoi River	461,700	259,700	56
Nulhegan River	392,200	328,100	84
Ottawaquechee River	413,700	282,200	68
Otter Creek	1,004,800	508,300	51
Wells River	579,600	377,400	65
West River	634,000	504,100	80
White River	466,300	304,900	65
Winooski River	769,200	471,600	61
Total	5,937,900	3,713,400	63

Table 19.--Commercial forest area of Vermont by watershed
and forest-type group, 1948

Watershed	Softwood types	Hardwood types
	<u>Acres</u>	<u>Acres</u>
Batten Kill	18,600	191,100
Lamoille River	108,500	190,400
Lower Missisquoi River and Grand Isle	28,700	139,800
Upper Missisquoi River	127,400	132,300
Nulhegan River	105,500	222,600
Ottawquechee River	97,800	184,400
Otter Creek	101,200	407,100
Wells River	174,500	202,900
West River	106,900	397,200
White River	52,100	252,800
Winooski River	123,400	348,200
Total	1,044,600	2,668,800

Table 20,--Comercial forest area of Vermont by watershed
and atand-size class, 1948

Watershed	Saw- timber stands	Pole- timber stands	Other stands
	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>
Batten Kill	119,700	62,900	27,100
Lamoille River	141,000	122,800	35,100
Lower Missisquoi River and Grand Isle	92,000	40,300	36,200
Upper Missisquoi River	105,500	107,400	46,800
Nulhegan River,	128,100	151,200	48,800
Ottawaquechee River	140,600	110,300	31,300
Otter Creek	265,700	152,500	90,100
Wells River	130,600	193,300	53,500
West River	277,600	191,900	34,600
White River	150,900	122,700	31,300
Winooski River	247,100	159,500	65,000
Total	1,798,800	1,414,800	499,800

Table 21.--Commercial forest area of Vermont by watershed
and ownership, 1948

Watershed	Private ownership	Public ownership
	<u>Acres</u>	<u>Acres</u>
Batten Kill	190,100	19,600
Lamoille River	285,600	13,300
Lower Missisquoi River and Grand Isle	168,300	200
Upper Missisquoi River	259,200	500
Nulhegan River	327,400	700
Ottawaquechee River	263,600	18,600
Otter Creek	432,400	75,900
Wells River	359,700	17,700
West River	447,200	56,900
White River	258,500	46,400
Winooski River	428,500	43,100
Total	3,420,500	292,900

Table 22.—Timber volume on commercial forest land
of Vermont, by watershed, 1948

Watershed	Primary growing stock		Saw ¹ timber
	<u>Million</u> <u>cu. ft.</u>	<u>Equivalent in</u> <u>thousand</u> <u>cords</u>	<u>Million</u> <u>bd. ft.</u>
Batten Kill	228	2,800	524
Lamoille River	197	2,500	490
Lower Missisquoi River and Grand Isle	115	1,400	344
Upper Missisquoi River	226	2,800	495
Nulhegan River	237	3,000	569
Ottawaquechee River	321	4,000	916
Otter Creek	508	6,400	1,321
Wells River	305	3,800	574
West River	513	6,400	1,188
White River	260	3,300	668
Winooski	585	7,300	1,520
Total	3,495	43,700	8,609

¹ As in table 5, primary growing stock and saw-timber volumes are not additive.

APPENDIX

DEFINITIONS OF TERM'S

Forest Area

Total forest-land area.--Includes (a) lands that are at least 10 percent stocked by trees of any size and capable of producing timber or other wood products, or of exerting an influence on the climate or on the water regime; (b) land from which the trees described in (a) have been removed to less than 10 percent stocking and which have not been developed for other use; and (c) afforested areas. Forest tracts of less than 1 acre and isolated strips of timber less than 120 feet wide are excluded,

Commercial forest-land area.--Forest land that is (a) producing, or physically capable of producing, usable crops of wood (usually saw timber), (b) economically available now or prospectively, and (c) not withdrawn from timber utilization,

Reserved-commercial forest-land area.--Forest land that has been withdrawn from timber utilization through statute, ordinance, or administrative order, but that otherwise qualifies as commercial forest land,

Noncommercial forest-land area.--Forest land incapable of yielding usable wood products (usually saw timber) because of adverse site conditions, or so physically inaccessible as to be permanently unavailable economically, and not withdrawn for specified purposes.

Forest type.--Classified according to the species or species group that accounts for the major portion of saw-timber volume in saw-timber stands or the major number of stems in other stands.

Saw-timber stands. - Stands with saw-timber trees having a minimum net volume per acre of 1,500 board feet, International $\frac{1}{4}$ -inch rule.

Pole-timber stands.--Stands failing to meet the saw-timber stand specification, but at least 10 percent stocked with pole-timber and larger (5.0 inches d.b.h. and larger) trees; with a minimum sound volume per acre of 200 cubic feet; and with at least half of this minimum volume in pole-timber trees.

Seedling and sapling stands.--Forest stands not qualifying as either saw-timber or pole-timber stands but having at least 10 percent stocking of trees and with at least half the minimum stocking in seedlings and saplings.

Other areas.--Areas not qualifying as saw-timber, pole-timber, or seedling and sapling stands) nonstocked areas,

Timber Volume

Saw-timber trees.--Live trees 9.0 inches d.b.h. and larger in softwood and 11.0 inches d.b.h. and larger in hardwood; $\frac{1}{2}$ -log trees contain at least an 8-foot section free of cull; 1-log and larger trees are more than 50 percent merchantable,

Pole-timber trees.--Live trees at least 5.0 inches d.b.h. that do not meet the specifications for saw-timber trees now, and that are straight and clear enough to make a saw-timber tree eventually,

Seedling and sapling trees.--Live trees less than 5.0 inches d.b.h.

Cull trees.--Live trees of saw-timber or pole-timber size that are unmerchantable for sawlogs now or prospectively because of defect or rot.

Primary growing stock.--Sound volume, in cubic feet, of saw-timber trees and pole-timber trees from stump to a minimum 4.0-inch top (of central stem) inside bark,

This volume is also given in rough, standard cords (bark included). Cord volume is derived from cubic-foot volume by applying a factor of 80 cubic feet per cord.

Secondary growing stock.--Sound volume in cubic feet of all cull trees from stump to a minimum 4.0-inch top (of central stem) inside bark.

Saw-timber volume.--Net volume in board feet, International-inch log rule, of saw-timber trees of all species to a merchantable top diameter, inside bark, of 6.0 inches in softwoods and 8.0 inches in hardwoods. Deductions are made for both sound and rotten cull. Hardwood saw-timber volume includes only factory (lumber) logs and structural (tie and timber) logs.

Timber- Quality

Softwood tree grades.--The grades for softwood saw-timber trees are based on the proportion of the merchantable stem that is relatively clear (80-100 percent clear) of limbs or indications of defect.

A smooth tree has at least half of its stem relatively clear.

A limby tree has one-third to one-half of its stem relatively clear.

A rough tree has less than one-third of its stem relatively clear,

Hardwood factory-lumber log grades.--Grade 1 factory logs are hardwood logs that yield about two-thirds of their volume as No. 1 common and better standard factory lumber, Grade 2 logs yield about half and Grade 3 logs yield about one-third in No. 1 common and better. The grading specifications used were developed by the U. S. Forest Products Laboratory¹ ; they are as follows:

¹U.S. FOREST PRODUCTS LABORATORY. HARDWOOD LOG GRADES FOR STANDARD LUMBER. PROPOSALS AND RESULTS. U.S. FOREST PROD. LAB. RPT. D1737. 15 PP., ILLUS. MADISON, WIS 1949.

Grading factors		Log grade						
		F1		F2				F3
Position in tree		Butts only	Butts and uppers		Butts and uppers			Butts and uppers
Scaling diameter (inches)		1/13-15	16-19	20+	2/11+	12+		8+
Length without trim (feet)		10+		10+		8-9	13-11	12+
Clear cuttings ³ on each of 3 best faces ⁴	Min. length (feet)	7	5	3	3	3	3	2
	Max. number	2	2	2	2	2	2	-
	Yield in face length	5/6	5/6	5/6	2/3	3/4	2/3	1/2
Max. sweep allowance (Percent of gross volume)	Less than 1/4 of end in sound defects	15%			30%			50%
	More than 1/4 of end in sound defects	10%			20%			35%
Cull and sweep allowance (maximum)		5/40%			6/50%			50%

¹ Ash and basswood butts can be 12 inches if otherwise meeting requirements for small No. 1's.

² 10-inch logs of all species can be No. 2 if otherwise meeting requirements for small No. 1's.

³ A face is 1/4 of the surface of the log as divided lengthwise.

⁴ A clear cutting is a portion of a face free of defects, extending the width of the face.

⁵ Otherwise No. 1 logs with 51-60 percent cull can be No. 2.

⁶ Otherwise No. 2 logs with 51-60 percent cull can be No. 3.

Hardwood structural logs.--Logs suitable for hardwood ties and heavy timbers (but not suitable for standard factory lumber) that meet the following minimum specifications:

Grading factors		Specification
Position in tree		Butt and upper
D.i.b. small end (inches)		8+
Length without trim (feet)		8+
Clear cuttings		No requirements
Sweep allowance, maximum		1/4 d.i.b. of small end of log
Sound surface defects	Single knots	Sound knots permitted if diameter of knot collar is not more than 1/3 of log diameter at point of occurrence.
	Whorled knots	Any number occurring within 6" vertical distance permitted if aggregate knot-collar diameters do not exceed 1/3 of log diameter at point of occurrence.
Unsound defects	Surface	Any number permitted if they can be slabbed off.
	Interior	No interior unsound defect permitted.

Growth And Drain

Annual net growth.--The average annual change in volume of primary growing stock (in cubic feet, inside bark) or saw timber (in board feet, International $\frac{1}{4}$ -inch rule) on commercial forest land, resulting from natural causes exclusive of catastrophic losses.

Commodity drain.--The volume of primary growing stock (in cubic feet, inside bark) or saw-timber (in board feet,

International $\frac{1}{4}$ -inch rule) removed through cutting drain and logging waste during the inventory year.

FOREST SURVEY METHODS

Estimates of forest area, timber volume, and tree growth in Vermont are based on data obtained from sample plots that were first located on aerial photographs. These plots were distributed uniformly over the entire State. Trained photo interpreters examined the photos and classified each plot according to stand size. Field crews then inspected enough plots on the ground to attain a specified level of statistical accuracy. Species, volume, growth, and quality data were collected on these ground plots.

The survey was designed for maximum accuracy in the estimate of total cubic volume of primary growing stock.

Growth was computed from measurements of tree rings or, increment cores taken from sample trees. These data were used in estimating the diameter distribution of each species 10 years hence. Future volume was predicted from this new distribution of diameters. Growth was then determined by subtracting present volume from estimated future volume and reducing the difference to an annual basis. Allowances were made for mortality, ingrowth, and drain.

Drain estimates were derived from production data supplied by the State Forester, supplemented by special studies of fuelwood and fence post production and of logging waste,

ACCURACY OF THE ESTIMATES

The estimates in this report may contain two kinds of error. First, photo interpreters may make mistakes in judgment and fieldmen may make mistakes in measuring or recording. There is no practical way of finding out just how often such errors occur. But they are kept to a minimum by closely checking all phases of the work.

The second kind of error is associated with sampling procedures. The size of this error, can be measured. In Vermont the chances are 2 to 1 that the sampling error will not exceed 1.4 percent of the total forest area, 3.2 percent of the total board-foot volume, 2.2 percent of the total cubic-foot volume, or 2.9 percent of the total cubic-foot growth,

These percentages show that the area estimates are more accurate than the volume estimates, and that the cubic-foot estimates are more accurate than the board-foot estimates.

In each of the tables, the total figures are more accurate than the subtotals. For example, the sawlog volume in saw-timber stands has an error of 4.7 percent as compared with an error of 3.2 percent for the total sawlog volume. The subtotals are more accurate than any of the individual figures. Figures that are small in relation to totals are subject to larger sampling errors.

SPECIES TALLIED

The various tree species tallied in Vermont are listed below². Approved common names are shown in parentheses if these differ from the brief name used in the tables.

Softwoods

Spruce (Red spruce)	- <u>Picea rubens</u>
(White spruce)	- <u>Picea glauca</u>
(Black spruce)	- <u>Picea mariana</u>
Hemlock (Eastern hemlock)	- <u>Tsuga canadensis</u>
White pine (Eastern white pine)	- <u>Pinus strobus</u>
(Red pine)	- <u>Pinus resinosa</u>
Fir (Balsam fir)	- <u>Abies balsamea</u>
Cedar (Northern white-cedar)	- <u>Thuja occidentalis</u>
Other softwoods	
(Pitch pine)	- <u>Pinus rigida</u>

²U.S. FOREST SERVICE. CHECK LIST OF THE NATIVE AND NATURALIZED TREES OF THE UNITED STATES INCLUDING ALASKA. U.S. FOREST SERVICE. 325 PP. 1949.

(Scotch pine)
(Tamarack)

- Pinus sylvestris
- Larix laricina

Hardwoods

Sugar maple
Yellow birch
Beech (American beech)
Red maple
Paper birch
Red oak (Northern red oak)
Ash
Basswood (American basswood)
Black cherry
Aspen (Biftooth aspen)
 (Quaking aspen)
 (Balsam poplar)
Other hardwoods
 (American elm)
 (White oak)
 (Gray birch)
 (River birch)
 (Butternut)
 (Black willow)
 (Downy serviceberry)
 (Eastern hophornbeam)
 (Pin cherry)
 (Striped maple)
 (Mountain maple)
 (American mountain-ash)

- Acer saccharophorum
- Betula lutea
- Fagus grandifolia
- Acer rubrum
- Betula papyrifera
- Quercus borealis
- Fraxinus species
- Tilia americana
- Prunus serotina
- Populus grandidentata
- Populus tremuloides
- Populus tacamahacca
- Ulmus americana
- Quercus alba
- Betula populifolia
- Betula nigra
- Juglans cinerea
- Salix nigra
- Amelanchier arborea
- Ostrya virginiana
- Prunus pensylvanica
- Acer pensylvanicum
- Acer spicatum
- Sorbus americana

Table 23.--Land area and commercial forest area
of Vermont, by counties

County	Land area	Commercial forest area	
	<u>Acres</u>	<u>Acres</u>	<u>Percent</u>
Addison	502,400	242,900	48
Bennington	430,100	336,600	78
Caledonia	393,000	245,700	63
Chittenden	340,500	154,100	45
Essex	424,900	361,800	85
Franklin	421,800	172,000	41
Grand Isle	49,300	9,400	19
Lamoille	304,000	208,900	69
Orange	441,600	261,100	59
Orleans	457,600	243,000	53
Rutland	594,500	366,100	62
Washington	453,100	311,800	69
Windham	507,500	393,300	77
Windsor	617,600	406,700	66
Total	5,937,900	3,713,400	63

Table 24.--Timber volume on commercial forest land
of Vermont, by forest type, 1948

Forest type	Primary growing stock		Saw timber ¹
	<u>Million</u> <u>cu. ft.</u>	<u>Equivalent in</u> <u>thousand</u> <u>cords</u>	<u>Million</u> <u>bd. ft.</u>
Hemlock	240	3,000	661
White pine	119	1,500	391
White pine-hardwood	67	800	193
Spruce-fir	375	4,700	988
Spruce-fir-hardwood	169	2,100	325
Cedar-tamarack-spruce	66	800	110
Aspen-gray birch-pin cherry	87	1,100	77
Paper birch	114	1,500	138
Sugar maple-beech-yellow birch	1,849	23,100	4,742
Hardwood-spruce-fir	285	3,600	727
Ash-elm-maple	25	300	43
Oak	65	800	137
Hardwood-white pine	34	400	77
All types	3,495	43,700	8,609

¹ As in tables 5 and 22.

Table 25.--Timber volume on commercial forest land of Vermont,
by species and stand-size class, 1948

PRIMARY GROWING STOCK

Species	Saw- timber stands	Pole- timber stands	Other stands	Total	
	<u>Million cu.ft.</u>	<u>Million cu.ft.</u>	<u>Million cu.ft.</u>	<u>Million cu.ft.</u>	<u>Percent</u>
Spruce	347	79	14	440	13
Hemlock	279	45	3	327	9
Fir	125	61	3	189	5
Other softwoods	156	70	8	234	6
Sugar maple	492	174	12	678	19
Yellow birch	355	75	8	438	13
Beech	285	42	2	329	10
Red maple	146	79	7	232	7
Paper birch	125	100	5	230	7
Other hardwoods	212	177	9	398	11
All species	2,522	902	71	3,495	100
SAW-TIMBER VOLUME					
	<u>Million bd. ft.</u>	<u>Million bd. ft.</u>	<u>Million bd. ft.</u>	<u>Million bd. ft.</u>	<u>Percent</u>
Spruce	1,266	124	32	1,422	17
Hemlock	929	98	4	1,031	12
White pine	526	51	21	598	7
Other softwoods	355	109	2	466	5
Sugar maple	1,484	146	25	1,655	19
Yellow birch	1,151	103	25	1,279	15
Beech	861	58	6	925	11
Other hardwoods	1,017	208	8	1,233	14
All species	7,589	897	123	8,609	100

Table 26.--Timber volume on commercial forest land of Vermont, by forest-type group and stand-size class, 1948

PRIMARY GROWING STOCK

Forest-type group	Saw-timber stands		Pole-timber stands	Other stands
	More than 5,000 bd.ft. per acre	1,500-5,000 bd.ft. per acre		
	<u>Million cu.ft.</u>	<u>Million cu.ft.</u>	<u>Million cu.ft.</u>	<u>Million cu.ft.</u>
Spruce types	183	245	170	12
Other softwood types	183	177	60	6
Sugar maple-beech-yellow birch	671	722	418	38
Aspen-gray birch-pin cherry and paper birch	26	32	140	3
Other hardwood types	115	168	114	12
All types	1,178	1,344	902	71
SAW-TIMBER VOLUME				
	<u>Million bd.ft.</u>	<u>Million bd.ft.</u>	<u>Million bd.ft.</u>	<u>Million bd.ft.</u>
Spruce types	671	555	177	20
Other softwood types	726	435	68	16
Sugar maple-beech-yellow birch	2,604	1,680	383	75
Aspen-gray birch-pin cherry and paper birch	62	52	100	1
Other hardwood types	398	406	169	11
All types	4,461	3,128	897	123

Table 27.--Volume of primary *growing* stock in Vermont,
by stand-size class and kind of material

(In million cubic feet)

Stand-size class	Saw-timber trees		Pole-timber trees	Total primary growing stock
	Sawlog material	Tops		
Saw-timber stands:				
More than 5,000 bd.ft. per acre	840	55	283	1,178
1,500-5,000 bd.ft. per acre	616	62	666	1,344
Total	1,456	117	949	2,522
Pole-timber stands:				
More than 600 cu.ft. per acre	135	17	565	717
200-600 cu.ft. per acre	48	5	132	185
Total	183	22	697	902
Other stands	23	3	45	71
Total	1,662	142	1,691	3,495

Table 28.--Components of annual net growth by species group

(In thousand cubic feet)

Item	Softwood	Hardwood	All species
Growth on primary growing stock	30,300	59,700	90,000
Ingrowth—saplings that become pole timber	10,700	39,500	50,200
Total	41,000	99,200	140,200
Normal mortality	7,900	12,000	19,900
Annual net growth	33,100	87,200	120,300

Table 29.—Comparison of Forest Survey findings in Vermont
with Reappraisal estimates¹

Item	Forest Survey estimate (1948)	Survey sampling error	Reappraisal estimate (1945)	Relationship of Reappraisal estimate to Survey estimate
	<u>Thousand</u> <u>m</u>	<u>Per-</u> <u>cent</u>	<u>Thousand</u> <u>m</u>	<u>Per-</u> <u>cent</u>
Commercial forest area in--				
Saw-timber stands	1,798	3.2	1,604	- 10.8
All other stands	1,915	--	2,216	+ 15.7
Total	3,713	1.4	3,820	+ 2.9
	<u>Million</u> <u>bd.ft.</u>	<u>Per-</u> <u>cent</u>	<u>Million</u> <u>bd.ft.</u>	<u>Per-</u> <u>cent</u>
Sawlog volume in--				
Saw-timber stands	7,589	4.7	6,005	- 20.9
All other stands	1,020	--	1,330	+ 30.4
Total	8,609	3.2	7,335	- 14.8
Softwood species	3,517	--	3,334	- 5.2
Hardwood species	5,092	--	4,001	- 21.4
	<u>Million</u> <u>cu.ft.</u>	<u>Per-</u> <u>cent</u>	<u>Million</u> <u>cu.ft.</u>	<u>Per-</u> <u>cent</u>
Primary-growing-stock volume in--				
Sawlog trees	1,804	4.0	1,667	- 7.6
Pole trees	1,691	7.8	1,254	- 25.8
Total	3,495	2.2	2,921	- 16.4
Softwood species	1,190	--	1,291	+ 8.5
Hardwood species	2,305	--	1,630	- 29.3
	<u>Million</u> <u>bd.ft.</u>	<u>Per-</u> <u>cent</u>	<u>Million</u> <u>bd.ft.</u>	<u>Per-</u> <u>cent</u>
Annual net growth in--				
Softwood species	116	--	134	+ 15.5
Hardwood species	194	--	158	- 18.6
Total	310	--	292	- 5.8
	<u>Million</u> <u>cu.ft.</u>	<u>Per-</u> <u>cent</u>	<u>Million</u> <u>cu.ft.</u>	<u>Per-</u> <u>cent</u>
Softwood species	33	--	55	+ 66.7
Hardwood species	87	--	79	- 9.2
Total	120	2.9	138	+ 11.7

¹ For further explanation of comparability of these estimates see Foreword.

NATIONAL STANDARD TABLES

The following tables will be found in all forest survey state or subregional reports to enable readers to combine or compare the data with ~~similar~~ data for other areas and to facilitate national compilations.

Table 30.--Land area by major classes of forest land,
Vermont, 1948

Class of land	Land area
	<u>Thousand acres</u>
Forest land:	
Commercial	3,713
Noncommercial	7
Reserved	--
Commercial	10
Noncommercial	--
Total forest land	3,730
Nonforest land	2,208
Total	5,938

Table 31.--Commercial forest-land area by ownership class
and stand-size class. Vermont. 1948

Ownership class	Total	Saw- timber stands	Pole- timber stands	Seedling & sapling stands	Nonstocked & other areas n.e.c. ¹
	<u>Thousand</u> a~	<u>Thousand</u> acre~	<u>Thousand</u> a s	<u>Thousand</u> acre~	<u>Thousand</u> a~
Federally owned or managed:					
National forest	191	118	53	18	2
Indian	--	--	--	--	--
Other	8	3	3	2	--
Total Federal	199	121	56	20	2
State	79	37	30	10	2
County and municipal	19	8	8	2	1
Private	3,116	1,632	1,321	293	170
Total, all ownerships	3,713	1,798	1,415	325	175

¹ Not elsewhere classified.

Table 32.--Volume of live saw timber and primary growing stock on commercial forest land by stand-size class, Vermont 1948

Stand-size class	Volume	
	Live saw timber	Primary growing stock
	<u>Million bd.ft.</u>	<u>Million cu.ft.</u>
Saw-timber stands	7,589	2,522
Pole-timber stands	897	902
Seedling and sapling stands	93	57
Nonstocked and other areas not elsewhere classified	30	14
Total, all stands	8,609	3,495

Table 33.--Volume of live saw timber and primary growing stock on commercial forest land by ownership class. Vermont, 1948

Ownership class	Volume	
	Live saw timber	Primary growing stock
	<u>Million</u> <u>bd. ft.</u>	<u>Million</u> <u>cu. ft.</u>
Federally owned or managed:		
National forest	541	210
Indian	--	--
Other	15	7
Total Federal	556	217
State	155	67
County and municipal	30	13
Private:		
Farm	2,927	1,276
Industrial and other	4,941	1,922
Total private	7,868	3,198
Total, all ownerships	8,609	3,495

Table 34.—Volume of live saw timber and primary growing stock on commercial forest land by species.
Vermont, 1948.

Species ¹	Volume	
	Live saw timber	Primary growing stock
	<u>Million</u> <u>bd.ft.</u>	<u>Million</u> <u>cu.ft.</u>
Softwoods:		
Spruce and balsam fir	1,784	629
Red and white pines	598	156
Hemlock	1,031	327
Other eastern softwoods	104	78
Total softwoods	3,517	1,190
Hardwoods:		
Red oak ²	201	72
Yellow birch	1,279	438
Sugar maple	1,655	678
Soft maple	287	232
Beech	925	329
Ash	107	82
Cottonwood and aspen	73	85
Basswood	59	21
Other eastern hardwoods ³	506	368
Total hardwoods	5,092	2,305
Total all species	8,609	3,495

¹ Species from the national standard list that do not appear here are either not present in Vermont or were found so infrequently that no reliable estimate of volume could be made.

² Includes only Quercus borealis.

³ Includes 306,000,000 board feet or 230,000,000 cubic feet of paper birch.

Table 35.--All-timber volume on commercial forest land
by kind of material, Vermont, 1948

Kind of material	Volume
	<u>Million</u> <u>cu.ft.</u>
Live all timber:	
Primary growing stock	3,495
Secondary growing stock	784
Total	4,279
Salvable dead all timber	--
Total, all timber ¹	4,279

¹ Limbwood of all kinds is excluded from total growing stock.

Table 36.--Net growth and normal mortality of live saw timber and primary growing stock on commercial forest land by species group. Vermont, 1948

Species group	Live saw-timber volume		Primary growing stock	
	Current annual net growth	Current annual normal mortality	Current annual net growth	Current annual normal mortality
	<u>Million</u> <u>bd. ft.</u>	<u>Million</u> <u>bd. ft.</u>	<u>Million</u> <u>cu. ft.</u>	<u>Million</u> <u>cu. ft.</u>
Softwoods	116	29	33	8
Hardwoods	194	38	87	12
Total	310	67	120	20

Table 37.--Commodity drain of live saw timber and primary growing stock on commercial forest land by species group.
Vermont, 1948

Species group	Live saw-timber volume			Primary growing stock		
	Cutting drain ¹	Logging waste	Commodity drain ²	Cutting drain ¹	Logging waste	Commodity drain ²
	<u>Million</u> <u>bd.ft.</u>	<u>Million</u> <u>bd.ft.</u>	<u>Million</u> <u>bd.ft.</u>	<u>Million</u> <u>cu.ft.</u>	<u>Million</u> <u>cu.ft.</u>	<u>Million</u> <u>cu.ft.</u>
Softwoods	203	3	206	45	2	47
Hardwoods	105	20	125	30	8	38
Total	308	23	331	75	10	85

¹ Volume of the primary products harvested within the State.

² Total of cutting drain plus logging waste.

Table 38.--Commodity production by timber products, in cubic volume
and in standard units. Vermont, 1948

Timber-product class	Quantity	
	Cubic volume	Standard units
	<u>M cubic ft.</u>	<u>Unit</u> <u>Number</u>
Sawlogs (for lumber, timber, and sawn ties)	42,674	M board feet ¹ 227,462
Veneer logs and bolts	4,322	M board feet ¹ 24,009
Cooperage logs and bolts ³	--	--
Pulpwood logs ³	--	--
Pulpwood bolts (1947)	15,489	Standard cords ² 197,172
Fuel wood	8,830	Standard cords ² 135,453
Chemical wood ³	--	--
Piling ³	--	--
poles ⁴	2,048	Poles --
Posts (round and split) ⁴	--	--
Hewn ties ³	--	--
Round mine timbers ³	--	--
Miscellaneous	1,785	M cubic feet 1,785
Total all products	75,148	--

5.330 } 5.351
5.555 }

18.555
65.188

¹ Board feet, International *-inch rule.

² Standard cords--rough wood (unpeeled). A pile of stacked wood 4 feet by 4 feet by 8 feet.

³ None separately reported.

⁴ Poles and posts combined.