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UNITED STATES DEPARTMENT OF AGRICULTURE
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DIVISION OF FOREST ECONOMICS

THE SAW-TIMBER RESOURCE OF THE UNITED STATES, 1630-1930

The Origianal Forests of 1630
Original Saw Timber Stand
Cut and Destruction
Net Growth
Saw Timber Depletion

R.V. Reynolds, Forest Economist

A.H. Pierson, Associate Forester

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Contents

Tables

Graphs

The Saw Timber Resource of the United States, 1630-1930

Foreword

This project deals with the original timber stand of the United States as of 1630, and the major changes which have occurred during the succeeding 300 years such as the cut, destruction, and net growth. Saw timber alone is considered.

Such data are among the most important working tools of forest economists. None of them remain fixed. They change along irregular curves, the interrelations and trends of which give a thumb-nail sketch of the forests of today and tomorrow. On any such curve the single point for present time has high intrinsic value, but that value is greatly enhanced by a past record, without which there can be no trend. The longer the record the better the chance of sound interpretations. The present estimates provide long-time approximations of stand, cut, destruction, and net growth, previously uncharted either in time periods or by geographical locations. The relationships observable in these exhibits give a coordinated background of understanding which may prove helpful to some men of the present and interesting to some men of the future.

The fundamental estimate is that for the volume of the original saw-timber stand. Naturally the first settlers did not provide anything resembling such an estimate. They had neither the need nor the ability to do so. The journals of early explorers give intimations of the extent of the forests along their lines of march, but nothing tangible in regard to timber volumes or areas. Increasingly through the years came bits of information - no more than clues and indications, which, though crude and disconnected, serve as a basis for opinions as to the nature and extent of the early forests. Later came the Census records of population, beginning in 1790, and those of farms and of timber manufacturers, beginning about 1839. There are also the surveys of the General Land Office and other public agencies.

All of these are indispensable checks on the soundness of modern estimates. But it was not until after 1930 that sufficient organized records of our present forests existed to act as a basis from which the conditions in the past might be projected backward.

Only a small sample remains of the original saw-timber trees, and this sample is not applicable to regions other than those where it not stands along the Pacific Coast. On the other hand the present timber in the East and South is unquestionably poorer than that which formed the forests of those regions in 1630.

Practically all of our present eastern saw timber grew since the first white colonists landed. Because the farmers took the best soils it grew principally on the poorer sites, subject to constant attack, not only from the normal inroads of lightning fires, disease, insects, and windfall, but from the repeated slashings of the timber cutters and millions of man-caused fires.

The forest floors burned away and water for growth diminished. Timber grown under such adverse conditions is the principal timber with which we moderns are familiar. For such deterioration allowances are required. Small wonder that there has been a tendency to underrate the stand and growth that characterized the original forest and the future possibilities which they suggest.

As the basis for an estimate of the original timber stand we have, in order of reliability:

1. Expert estimates of past and present forest areas and present average saw timber stands, 1930 and 1938.
2. Records of the populations, the farm areas, and the cut of lumber and other forest commodities.
3. Estimated cut for fuel and other purposes, and of the destruction in clearing farms and in lumbering.
4. Estimates of destruction by disease, insects, windfall, and also by fires, based on recent rates of mortality.
5. Descriptions and some scanty record of the past timber stands and their characteristics in limited areas.

These data, when organized, determine the outlines of a rough sketch of the forest that was. Here and there are voids that can be filled only by using as data the probabilities suggested by general observation. To minimize the errors involved in such estimates the effort has been made to hold imagination within conservative bounds and avoid excessive conversion factors. The reader should recognize that these limitations on accuracy apply to the statistical tables, the graphs and the text in the following pages, which are presented as positive statements.

The Original Forests of 1630

Forest Areas

The forests of the United States in 1630 occupied a gross area of 937 million acres, practically half of the total land area. About 828 million acres of the gross area were what would be called saw timber forest today, meaning that in general the lands were either covered with saw timber or capable of producing it. There were, of course, interior voids, due to sterile soils, unfavorable climatic conditions, the surfaces of unmeandered lakes, streams, and swamps, and the temporary damage done by fires, disease, insects, and windfall. Such voids occurred in all regions. In the Rocky Mountains, particularly, the first two causes listed nullified a considerable percentage of the gross regional area now classified as saw-timber land.

By 1930 the "commercial" area has shrunk to 495 million acres, of which less than 200 million acres bears saw timber. Thus the clearing of farms, and the establishment of cities, towns, villages, roads, railroads and other improvements took 333 million acres permanently out of the original saw-timber area. The farms alone accounted for about 300 million acres which included the cream of the forest soils. Actually, between 1730 and 1930 the area bearing saw timber decreased by about 640 million acres, a loss of 77 percent.

Characteristics of the Original Forests

All age classes were represented in the original forests. The distribution of these classes, however, was quite different from that in most forest regions in 1930. The principal characteristic of the original forest was a preponderance of old and large trees relative to young saw timber, poles and saplings.

Along the Pacific Coast there were more big trees than now. In the East we have authentic references to white pines over 200 feet high and up to seven feet diameter. Also there were forest-grown hardwoods, four to seven feet diameter and soaring upward far beyond 100 feet in height. Such trees, although much above average for the East serve to show that the average dimensions were commonly greater than now. In some types of timber there were more saw-timber trees than now to the acre. In others relatively less, very large trees occupied all the growing space.

According to tradition there were limited areas in dense hardwoods where the great trunks stood so close together that a yoke of oxen could not be driven between them. Such crowded areas, however, could not have been very extensive.

Disease, insects, windfall, and lightning fires took steady toll from trees of all ages. Thousands of young trees died for every veteran that won through. The old trees stood until they were so weakened by the inroads of natural enemies that moderate windstorms sent them crashing down. Their giant trunks encumbering the ground were a familiar sight to early travelers.

The mature veterans grew hardly at all. The younger trees put on accretion mainly as light became available. Reproduction from seed or sprouts filled the voids where veterans fell or where fires destroyed considerable areas of timber. (Net growth probably exceeded destruction by a slight margin and this close balance would have been maintained had it not been for extensive human interference.

Relatively large areas of the old forests were clear of undergrowth. That was true, or nearly so, of the southern pine forests and the western pine forests, whose intolerance caused a rather open stand, admitting light and wind which tended to dry the soils.

In the northern white pine, along the North Pacific Coast and in much of the great hardwood forests of the Central region and down the Appalachians more tolerant trees held supremacy. Their crowns often formed canopies so dense that sunlight was all but excluded and undergrowth

discouraged. In such forests the floors were deep with litter. Moisture was plentiful, the forest streams were full and clear, and the trunks of the old trees were covered with mosses and lichens.

In 1907 an old settler in Arkansas said "When I came here 60 years ago you could see to shoot a deer 100 yards away." He was speaking of a part of the Ouachita National Forest which has become an almost impenetrable tangle of hardwood sprouts. His cattle could hardly force their way along the narrow trails. For a lifetime he and his neighbors had tried to clear the big hardwood timber from their lands, burning the stumps and sprouts year after year. Finally the forest had taken over the areas intended for clearings. Such was the vigor of growth when set free to operate by the admission of sunlight. A long struggle against growth was the experience of hundreds of thousands of settlers in timberland. It was an even more difficult task than breaking the tough sod of the prairies.

Damage to Timber by Indians

The Indian population of the United States reached its peak about 1650. At that time the number was about 750,000 persons, of whom about 600,000 lived in more or less timbered regions, and the remainder on the nontimbered plains. The greatest concentration of Indian population was in California. Approximately half of the timber-dwelling Indians lived in the densely forested States east of the prairies.

In the East agriculture within forested areas was practiced chiefly by the Atlantic and Gulf Coast Indians, who cleared timber by girding and burning. They frequently made use of less fertile soils as on account of their primitive tools and the fact that most of the labor was carried on by women, the removal of heavy hardwoods from the best soils was too great a task. Lacking fertilizers except fish and seaweeds they occasionally extended their clearings or even changed the sites of their villages, as the poorer soils became exhausted. In the far West there was practically no Indian agriculture that required timber clearing. The California Indians lived mainly on acorns. Those of Arizona and New Mexico cultivated alluvial flats below saw- timber levels. the Indians of the Columbia region were chiefly fish eaters. Along the Missouri River the rather extensive farming operations were conducted chiefly on prairie lands.

Mr. Mooney estimated that a third of a million acres was probably required for the sustenance of the Indians of the Atlantic and Gulf Coasts. Although not all of this area required clearing, let it be assumed that on account of the necessary extensions of the planted areas a total of 500,000 acres was actually cleared of saw timber for agricultural use.

Indians cut practically no saw timber for utilization, partly for lack of tools but principally because the logs obtainable from agricultural clearings or from blow-downs provided all that was necessary for canoe logs, palisades, house- frames, and fuels. Lodge poles, lance shafts, bows, arrows, paddles and domestic articles do not represent a measurable drain on saw timber. The largest timber used was for canoes, such as the birches stripped of bark in the northern forests, and the poplars hollowed out in the South by the laborious use of fire and stone axes.

Circling game with fire was practiced under circumstances which did not threaten conflagration, such as burning of swamp growth inward to the center. No doubt such fires escaped by accident at times, resulting in destruction of saw timber for which there is no basis of estimate.

Some light burning was done presumably to improve forage, particularly along the coastal plain of the southeast. These fires may also have escaped at times.

Before white men came Indians undoubtedly set fires as military measures, either to make signal smokes or to drive off enemies. The resultant losses of timber may have been heavy as some of these fires were intended to be destructive.

Horse Eagle, a centenarian Osage chief, spoke on this subject as the representative of 500 tribes, consisting of 210,000 Indians, before a YMCA camp at Sacramento, California, June 20, 1926. He said that..."his people had been taught care with fire for centuries, and that to his knowledge fire was never used by Indians to destroy except during warfare with other tribes."

These words ring true. It would be hard to imagine forest dwellers willingly incurring the danger of timber fires or destroying the timber which was the habitat of much of their food.

For a crude indication of the direct damage done to saw timber by Indians let us assume that the total area burned or otherwise denuded through fires which escaped or fires set in war was 20 times as great as the maximum area cleared for agriculture. That would be 10,000,000 acres, or slightly more than 1 percent of the original saw-timber area. From this indication it appears that the drain on saw timber due to Indian occupation previous to 1630 was insignificant in relation to the resource.

Original Saw Timber Defined

Original saw timber, frequently mentioned in this article, is a term coined for the present purpose. It is not identical with "virgin timber" or "old-growth timber" as those terms have been used in many publications. It means the saw timber that was standing in 1630, the beginning of the 300-year period with which these estimates deal.

For the sake of definite understanding it is assumed that none of the trees in this category were less than 50 years old in 1630. some of them were many times older, has practically stopped growing, and were dying from age or damage, a process that continued with progressive effect throughout the three centuries ahead. In 1700 the youngest trees of the original forest were 120 years old. Original saw timber was 100 percent of the saw-timber formed only 11 percent of the stand. All the rest of the 1930 stand was part of the saw-timber (net) growth during 300 years.

The growing stock consisted of the original saw timber, as defined, and in addition some of the trees less than 50 years old in 1630, and the trees (which grew from seed or sprouts to saw timber size between 1630 and 1930). Much of the growth was cut or destroyed, and on some sites several successive generations of saw timber have occurred within the 300-year period.

Saw-Timber Stands

The relative density of original timber and the presence of numerous big trees made for a high average stand per acre. The larger average dimensions counted heavily. Double the diameter of a 20-inch tree and you may have five rotations of practical length.

The heaviest stands in the East were probably in the softwood forests of northern New England, New York, Pennsylvania and the Lake States. There is record of northern pine 40, 60, or even 100 thousand feet to the acre. A million feet on 40 acres was no uncommon thing. Although the average was much lower these samples tell us that present averages from "old-growth" cruising 3,000 to 10,000 feet per acre do not illustrate the situation a century ago. Dense and luxuriant hardwoods occupied the lands which are now the agricultural valleys of these States.

In the South good pine was plentiful and the best stands often showed as much as 25 thousand feet or even more per acre. Those forests have been burned over for more than a century, and the fuel cutters, the turpentine industry, the tie cutters, and the lumbermen have left what is practically no more than a vast cut-over area. All forms of damage continue, particularly the fires, intended to help grazing. Practically all timber has been more or less culled. It is beyond question that the averages of present "old-growth" pine (varying) from 3,000 to 8,000 feet per acre, are no fair criterion of the pine of 1630.

Even more unsatisfactory are the samples of "old-growth" hardwoods reported from the Central

Region for the Copeland Report. They indicate little more than 4,000 feet for the forest lands of the region as a whole with a range of 2,000 to 8,000 feet per acre. Foresters of the Central States Forest Experiment Station have recently assembled data gathered by them from cruises, published data, contacts with qualified residents and records of early cut for the charcoal industry. They also investigated, by States, the probable original forest areas. The average original stands (principally hardwoods) which they suggest as applicable are as follows:

State	M feet per acre	State	M feet per acre
Illinois	4.3	Ohio	15.0
Indiana	10.0	Tennessee	7.0
Kentucky	8.0	West Virginia	9.8
Missouri	5.0		
		Central Region	8.4

These averages are highly significant. They may readily be true for all those lands which were actually covered with saw timber, eliminating the voids within the gross forest area. The more conservative estimate given in Table 3 shows an average of 6.5 M feet per acre for the Central Region.

The Kellogg Estimate of Original Stand

Thirty-five years ago the Forest Service published Circular No. 97 under the title "The Timber Supply of the United States." The author was Royal S. Kellogg, a pioneer in forest economics. To him and his colleagues of 1907 we are indebted for the first official estimate of the original forest area and the original saw-timber stand of the United States.

The regions named in Table 1 are forest regions, which do not coincide with groups of States. It is therefore impossible to contrast them with later statistics of area and stand. There is little reason to doubt, however, that the first estimate of original stand was too conservative. That fact was officially recognized 13 years later, when in 1920, the following statement appeared in the Capper Report:

> *"The original stand of saw timber has been estimated at not less than 5,200 billion board feet. In the light of the cut that has already been obtained, and of present standards of utilization, it is probable that the actual stand was considerably larger."*

Table 1. Area and Stand of the original forests of the United States

Region	**Area**	**Stand**	**Average per acre**
	Million acres	*Billion feet*	*M feet*
Northern	150	1,000	6.7
Southern	220	1,000	5.0
Central	280	1,400	4.5
Rocky Mountain	110	400	3.6
Pacific	90	1,400	15.6
Total	850	5,200	6.1

1/ From the Timber Supply of the United States, by R. S. Kellogg, Assistant Forester. Forest Service Circular No. 97, G.P.O., 1907.

2/ Excludes 100 million acres of scrubby forest and brush land, chiefly in the West.

The Present Estimate of Original Stand

In 1931 estimates of stand and area by States and types became available, which served as the basis for a portion of the Copeland Report. These estimates covered all the States except Kansas and Nebraska and were much more detailed and more nearly reliable than any preceding data. From them it was possible to compile for each region:

1. The original saw-timber area
2. The estimated old-growth area, by types, 1930
3. The estimated old-growth stand, by type, 1930
4. Average old-growth stand per acre (3 + 2)
5. Estimated original stand (1 x 4)

Computation on this basis gives the preliminary estimate seen in Table 2.

Table 2 is the product of regional average stand per acre in "old growth" multiplied by the estimates of original saw-timber area. Each of these elements requires modification.

The samples of "old growth" stand for the West, particularly the Pacific Coast regions, are deemed to be fairly representative of mature timber in the original forest. They were therefore allowed to stand. But in the East there is little or no true original timber, and most of what we call "old growth" is located on the best sites of the original forest, namely our present farm lands, which constituted about a third of the original forest area. The average stand samples used for Eastern regions are therefore too low for averages of the original saw timber.

Table 2.--Preliminary estimate of original saw timber stand 1/

Region	Original stand estimates *Billion board feet*	Original area 2/ *Thousand acres*	Average 3/ *M feet per acre*
New England	279	36,908	7.2
Middle Atlantic	727	69,610	10.4
Lake	986	103,680	9.5
Central	647	158,720	4.1
Prairie	29	13,760	2.1
South Atlantic	470	72,960	6.4
East Gulf	446	97,280	4.6
Lower Mississippi	729	128,400	5.7
Eastern regions	4,313	683,318	6.3
North Pacific	1,541	56,700	27.2
South Pacific	464	19,951	23.2
North Rocky Mountain	310	33,490	9.3
South Rocky Mountain	227	35,101	6.5
Western regions	2,542	145,242	17.5
United States	**6,885**	**828,560**	**6.3**

1/ Prepared in 1937-38, based on regional areas and average "old growth" stand, derived from nation-wide reports and estimates of the Forest Service for 1930, commonly known as Extensive Revision. For regional boundaries see Figure 1.

2/ Source, in eastern regions from Table 5, Stat. Bull No. 21, in western regions from Extensive Revision reports, from which juniper and pinyon forests, chaparral and aspen areas and purely protective forests were excluded as far as possible.

3/ Lumber tally. In its Release No. 26, July 12, 1937, the Southern Forest Experiment

Station reported the acreage and stand of saw timber on "old growth partly cut" areas, and also on areas of "old growth, uncut", in parts of certain southern States. Such reports appear for Texas (2 units), Louisiana (2 units), Arkansas (2 units), and Oklahoma (1 unit). Averages taken from these records show that "uncut" areas carry 72 percent more timber per acre than "old growth, partly cut."

Those samples, however, cover only the western part of the South and very likely are not a true measure of increase for other Eastern regions, possibly not for the entire South. The stand averages for all parts of the East except the Central region were therefore raised, not 72 percent, but 40 percent, which seems conservative. The Central average however, was raised 72 percent on account of the Central date previously mentioned.

The averages per acre as thus modified are not applicable to the totals of acres estimated as original forest area. Those areas should be diminished to allow for the temporary blanks due to the usual destructive agencies, and also to offset small tracts of grassland, barrens, swamps, and the surfaces of unmeandered streams and lakes. The first two classes occur throughout the large parts of the Rocky Mountain regions, where it is impossible to estimate forest area without including a considerable percentage of land which never had saw timber, and never will. Such lands have appropriately been called "the hole in the doughnut."

All areas were therefore reduced by percentages ranging downward from 34 in South Rocky Mountain, 23 in Lake and North Rocky Mountain, and 20 in Prairie, to 15 in Middle Atlantic, South Atlantic and East Gulf, 10 in lower Mississippi, 9 in North Pacific, 7 in Central, 5 in New England, and 3 in South Pacific. The product of the averages of stand per acre by the areas, (both modified as stated), gives the revised estimate of original stand shown in Table 3.

Distribution of Original Stand

The total of the original saw timber was 7,625 billion board feet, an increase of 47 percent over the estimate of 1907. The East had more than four-fifths of the forest area, more than 70 percent of the total timber, more than half the softwoods, and practically all the hardwoods.

The three Pacific States combined had at least 1,850 billion board feet, which was one-fourth of the original timber, and more than a third of the softwoods. The original Douglas fir in these States probably amounted to 1,000 billion board feet.

The three Southern regions combined has four times as much forest area as the Pacific States. The southern softwood stand was about three-fourths as large as that on the West Coast. The southern pine stand was possible 1,300 billion board feet. In addition the South had a large supply of hardwoods. Its total exceeded that of the Pacific States.

The leading regions as here defined were North Pacific, Lake, Central and Lower Mississippi in that order. The Lake States exceeded all regions except North Pacific in softwood timber and Central far exceeded all others in hardwood stand.

Hardwoods constituted one-fourth of the total timber and 40 percent of the eastern timber. Possibly 1,000 billion feet was oak. Considerably more than half the hardwoods lay north of the Ohio and the Potomac.

Disappearance of Original Saw Timber

The original saw-timber stand, by definition, was confined to a specific group of trees which excluded all young growth of 50 years or less in 1630, and also all young growth arising from seed and sprouting thereafter. It was a group of high average maturity, with the old trees forming a relatively large percentage of the whole, both by number and by volume. For that reason saw-timber accretion within the group was relatively restricted. Moreover, on account of the age of many of its members the group was especially venerable to attack by disease and insects.

Under such handicaps the original saw timber as defined was doomed to early and rapid depletion.

Then came the white man, the most destructive of all agencies. By 1700 nearly half a million white settlers were located in the forests along the Atlantic Coast. They were hungry for land and for commodities which could be sold abroad. Armed with steel tools, they cut swiftly into the eastern saw timber. The trees of moderate size were for house-lops, puncheons, fuel, lumber 1/, and cooperage stock. The choicest of the big pines went for masts and spars 2/. The big hardwoods on the rich soils of the bottom lands were principally girdled and burned. Thousands of runaway fires destroyed timber for which the settlers had no possible use.

Some of the big softwoods could be floated down streams and some of the early sash mills could accommodate them, but on account of relatively feeble power, both in the woods and in the mills, logs less than 30 inches diameter were far more economical for lumbermen. The butt log of a 40-inch pine weighs more than 2 tons. Really big logs usually stayed in the woods unless the logging was very favorable.

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1/ Although small power-driven sawmills were set up in New England and New York as early as 1630, the cost of such machinery compelled hand sawing of a considerable part of the lumber used previous to 1830.

2/ The largest sticks required for this purpose were main- masts for the great three-deckers of the Royal Navy known as "ships of the line." The dimensions were 40 inches diameter at the butt and 120 feet long. The British frigates, and large American ships as well, required main masts 36 inches diameter and 108 feet long. The bowsprits and foremasts were of somewhat less dimensions. New Hampshire, Main and New Brunswick supplied large numbers of such timbers, but they were hard to find, as many pines of suitable dimensions were found decayed in the butt.

The destruction of the large old timber was greatly accelerated by the introduction of steam power and railroads after 1830 and by the enormous program of land clearing near its peak about 1850. Farm clearing at that period caused the destruction of far more saw timber than was being cut for lumber, and for all other commodity used excepting fuel wood. (See Table 4.)

By 1800 about 15 percent of the original saw timber was gone; by 1850, 50 percent was gone; by 1900 over 90 percent had disappeared; in 1930 the only remainder, amounting to less than three percent of the original volume was found among the long lived sequoias (redwoods), some of the Douglas fir and associated species, and in the East limited quantities of cypress, with possibly a few scattered oaks and hemlocks. Figure 2 1/ gives a geographical conception of the disappearance of original saw timber. In 1850 much original forest area had been cleared , and the remaining saw-timber bodies had lost a great deal of their original timber. Practically all of the white pine and the southern pine standing at that date had brown subsequent to 1630, as neither of these trees is likely to attain average age much beyond 250 years.

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1/ In his Trees of North America, George Rex Green names 23 commercial saw-timber trees reported to have attained an age of 350 years or more. Three more are here included from other sources.

The western softwoods are Alaska cedar, Port Orford cedar, western red cedar, Douglas fir, noble fir, red fir, western hemlock, larch, Jeffrey pine, ponderosa, sugar pine, western white pine, redwood, big-tree, Englemann spruce, and Sitka spruce.

Eastern softwoods are bald cypress, Carolina hemlock, and eastern hemlock. The hardwoods are beech, sweet birch, sycamore, sugar maple, overcup oak, post oak and white oak, all eastern. The names underlined are those of trees reported to attain extreme age of 600 years, or even more as in the case of sequoias.

The attainment of great age is due in part to favorable site and partly to fortunate escape from

damage, or from utilization as in the case of the oaks. The extreme ages noted in the fortunate few are possibly double those of the average. Doubtless there are many individual trees of saw timber species in the East in addition to a limited part of the cypress stand, which were 350 years old or more in 1930. But it is deemed that such trees are too scattered or too decadent through age and damage to be regarded as commercial saw timber.

It is to the West that we must look for the modern remnant of the original saw-timber stand. While there are no records of stand by age classes, it appears that in California, Oregon, and Washington about 200 billion board feet, or about twenty percent of the Pacific Coast saw-timber stand can be considered as older than 350 years in 1930. The list thus designated includes Douglas fir, 66 billion board feet, redwood, 50 billion, ponderosa, 48 billion, sugar pine, 14 billion, western red cedar, 12 billion, other western softwoods, 8 billion. The list also includes 2 billion board feet of (Eastern) bald cypres.

By 1930 ninety-seven percent of the original timber had disappeared. The plotting of the remainder along the Pacific Coast is merely indicative of its location. In the East practically no commercial saw timber of the original stand was left except a part of the cypress.

SAW TIMBER DRAIN

The following statements apply to cut and destruction of the total saw timber available throughout three centuries. That includes both the original stand of 1630, and the subsequent net accretion and regeneration. A discussion of the depletion of the original saw timber appears in a later section of this article.

AGGREGATE

The aggregate drain, amounting to 14,675 billion board feet (See Table 4) has far exceeded the original stand of 7,625 billion feet, as shown in Table 3.

In the first few decades drain consisted almost solely of the damage done by natural agencies, estimated at 178 billion board feet for each 10 year period. Beginning about 1670 farm clearing began to have appreciable effect, reinforced by the cut for fuel wood and the cut for miscellaneous purposes, such as house logs, posts, export timbers, cooperage stock, masts, spars, and ship timbers. Sawed lumber did not materially swell the total until 140 years after the earliest settlement. It was not until after 1870 that aggregate drain reached its peak, with quantities exceeding 1,000 billion board feet per decade. More than half of the aggregate drain took place within the 19th century.

Drain may be considered from two aspects. First let us contrast utilization and destruction.

	Utilization			**Destruction**	
	Billion ft. b.m.	*Per-cent*		*Billion ft. b.m.*	*Per cent*
Fuel cut	2,701	45	Disease, insects,		
Lumber cut	2,150	36	windfall, etc.	4,651	53
All other cut	1 109	19	Farm clearing	2,100	24
Total	5,960	100	Fire	1,698	20
			woods waste	266	3
			Total	8,715	100

CUT

According to our data about 60 percent of all the saw-timber drain of the past was destroyed, either by nature or by man. Forty percent was cut for utilization.

We saw that fuel accounted for nearly half of the commodity cut, and that damage by disease and insects wrought more than half of the total destruction. The quantity utilized reaches its peak shortly after 1900, but the greatest destruction occurred half a century earlier. Throughout three centuries our people have never consumes less than 500 board feet per capita per year, but the greatest rate of use, calculated at 1,425 board feet per capita, was just before the Civil war. The high rate at that time was due mainly to the heavy consumption of wood fuel cut from saw timber.

From anther viewpoint we may contrast the drain due to natural damage with the drain caused by the activities of the white man.

DESTRUCTION

Natural drain by disease, insects, windfall, and lightning fires amounts to 5,457 billion board feet. Destruction resulting from human operations includes farm clearing, man-caused fires and woods waste in logging, totaling 3,258 billion board feet. The total destruction drain is 8,715 billion feet. Thus, on the face of it man has been responsible for only 37 percent of the destruction-drain. Actually his responsibility was considerably greater because his operations, directly or indirectly, brought about a considerable part of the destruction by insects, disease, and windfall.

Let us assume conservatively that this unknown part was 10 percent, or 465 billions. In that case man was responsible for 3,723 billions or 43 percent of the total destruction.

Charging also the 5,960 billion foot of commodity cut, it appears that man has been responsible for cut and destruction amounting to 9,683 billion board feet, a volume of saw timber equal to 125 percent, or more, of the original stand.

Figure 3 illustrates graphically the relations, both in time and volume, of all the elements of cut and destruction.

Endemic Losses

Available data for natural destruction do not represent the total destruction which has occurred from disease, insects, windfall, and fires. They indicate only those portions which are visible or tangible, and hence capable of measurement or estimate. They exclude a large, unknown percentage which up to the present time has not been successfully measured or estimated, and which is sometime called endemic or normal destruction.

Endemic destruction includes the losses from millions of fires so small that they escape notice and never appear in reports. The loss from any individual fire may be negligible, but the aggregate loss over centuries may be very large. Our fire loss estimates cover only the saw timber killed by reported conflagrations, and not salvaged.

Timber suffers continual endemic losses from disease, insects, and windfall, which are widespread, but not of cataclysmic or epidemic size. A single tree is blown down, or a small group or trees killed by fungous disease or blights, or insect depredations. Such losses, too small to find place in reports, may be very large in the aggregate. Our estimates deal only with the timber killed by reported losses and not salvages.

The unknown destruction wrought by endemic operations of disease, insects, windfall and fires is constantly offset, and to some extent masked, by saw-timber growth. A crude compensation is made by allowing the endemic losses to offset a part of the growth. As the result the growth estimates do not represent total growth as they include only that part which is not offset by endemic losses. The term used for the tangible remainder is net growth.

NET GROWTH

Net growth, as has been said, is total growth minus endemic or “normal” destruction. It includes also the volume of those trees which yearly become saw timber because their increase in dimensions warrants their transfer into that category from sapling or cordwood classifications.

The present estimates were calculates on the basis that within any given period net growth equals the drain minus the decrease in the stand. The growth estimates for the several decades are therefore coordinates with the location of the curve of total saw timber stand shown in figure 5.

At the beginning, net growth probably exceeded natural losses by a slight margin. These opposing forces offset each other until the balance of the forest was disturbed by the white

settlers. After that, for 250 years the forest struggled vainly to heal its wounds. Destruction was the stimulus for vigorous accretion and liberal regeneration, but excessive losses diminished the stand, and quality of the growing stock. The greatest quantity of net growth occurred in the decade 1860-69, but the most rapid rate of growth relative to the growing stock was in 1920-29. (See Table 5.)

The aggregate of net growth in 300 years was 8,875 billion board feet, of which nearly 50 percent occurred in the three southern regions, 1 and 90 percent on forests east of the plains. (Fig. 6.) About 40 percent of the eastern growth was hardwoods.

1 Their leadership in growth, in combination with a wealth of valuable timber species, point to the South as the foremost region in future considerations of national saw -timber supply.

CONTRAST WITH AGGREGATE DRAIN

The aggregate net growth was considerably greater than the original timber stand, and throughout our entire history it has exceeded natural drain. But it is only about 60 percent of the aggregate drain on the forest resource, which includes the cut. Figure 4 contrasts, both in quantity and time, the relations of net growth and drain.

The ratio of drain to net growth was at first 1 to 1. The ratio increased slowly until it reaches a peak of 4.6 to 1 in the decade 1900-09. Since that period there has been a steady decline, the last two decades showing ratios of 3.8 and 2.3, respectively.[1]

Although the curve of drain at 1930 was declining very rapidly while that of the net growth was ascending, it is problematical whether, or at least how soon, balance of growth and drain in saw timber will again be attained. The decreased cut during the decade of depression following 1930 helped appreciably to narrow the gap between them, but that cut was abnormally low and probably will increase. The condition of the growing stock does not guarantee continued large increases of net growth. Considering these facts we must conclude that the white man had not yet so ordered his forestry that a sustained yield of saw timber within clear view of the present generation.

[1] In the depression period subsequent to 1930, the Joint Congressional Committee Report showed a ratio of 1.5 to 1.

DEPLETION OF THE SAW TIMBER STAND

The original saw-timber stand of 7,625 billion board feet had been depleted, decade after decade, by long continued minus balances between net growth and aggregate drain (Table 5.) Following 1800 the depletion became increasingly rapid, culminating in 1900-09 (the peak of the lumber out) with a deficit of 830 billion board feet for the decade. The total excess of drain over growth in 300 years, amounts to 5,800 billion board feet, leaving as existing saw timber stand of 1,825 billion feet in 1930. Figure 5 illustrates graphically the rate by time periods at which the total stand (including net growth) was swept away. The graph also shows the decline of the original saw timber to its present remainder of 200 billion board feet.

SAW TIMBER DEBITS AND CREDITS

The estimates of cut and destruction, previously discussed, plus the present stand amount to 16,500 billion feet, which represents the total saw timber existing in America between 1630 and 1930. Subtracting from this total the estimated original stand of 7,625 billion feat we again check a total net growth of 8,875 billion feet in 300 years. These figures and others allied to them are

assembled in Table 6 in the form of a balance sheet.

Table 6 is a distribution of the cut and destruction items to original timber and net growth by softwood percentages of aggregate saw timber items there is either record or a helpful degree of indication. The totals of original saw timber columns (including the hardwood percentage) are fixed by Table 3, and they in turn fix the corresponding totals for net growth. The entries for present saw timber stand are also fixed, being either record or the estimate of experts. The allocation of cut and destruction items to original timber are so determined that they agree with the fixed quantities and show the relationships which are apparently defensible. Due to the weight of the fuel wood item hardwoods forms a large percentage of the saw timber utilizes, whether taken from the original stand or the subsequent growth. Destruction, however, shows a large percentage of men. Another 26 percent was destroyed in farm clearing man caused fires and destructive logging making 83 percent destroyed while only 14 percent (chiefly the younger, smaller trees) was utilizes. As an outstanding example of use of younger timber about 90 percent of the aggregate lumber cut came, not from the big trees of the original timber stand, but from their descendants. Trees over three feet diameter, and there were many such, were too large to be readily transported without mechanical power.

It was not until the introduction of the band saw in 1880 and powerful logging machinery in 1890 that the utilization of really big timber became normal procedure. By that time less that 10 percent of the original stand remained to be used, and that mostly on the Pacific Coast. So far as the timber needs of the United States were concerned the greatest service performed by the original timber in the East and South was to govern the run-off, protect the soils, and generate a crop of smaller trees.

On the contrary, 55 percent of the saw timber growth subsequent to 1630 was utilized, and only 26 percent destroyed. The remaining 16 percent of hardwood appears in the original stand.

Forty percent of the not growth was hardwoods, although only 29 percent of hardwoods appears in the original stand.

REGIONAL STAND GROWTH AND DRAIN

Figure 6 presents regional allocations of stand, cut, destruction and net growth based on Table 4 and Table 5. In each region the stand of 1630 plus the net growth of 300 years equals the stand of 1930 plus the cut and destruction. This extensive regional breakdown affords a partial test of the reasonableness of the various estimates.

Net growth has exceeded the original stand in every eastern region except Lake and Prairie. In the Lake region the completeness of destruction by fire and other agencies in the white pine forests cut down the growing stock. Throughout the west, also, the growth of three centuries has been less than the original stand. Here some of the causes are climatic conditions, site, and the much shorter period of cut and man caused destruction.

In no region has growth equal led total drain. However, in nine of the 12 regions, hot including Central, Prairie and South Pacific, growth has notably exceeded the cut. In Central the early and extensive denudation of timber lands now in farms cut down the growing stock.

CONCLUSION

The original saw timber stand, combined with the net growth of three centuries amounts to 16,500 billion board feet. Of this total the growth was more than half, even though the forest area decreased by forty percent. Half of the net growth occurred on one third of the area, namely the three southern regions. Great as it was growth could have been greater.

More than five-tenths of the vast saw timber resource was destroyed. Sixty percent of the destruction was due to natural causes and therefore inevitable. Of the forty percent caused by man a very large part was necessary, but part was pure waste. Destruction should have been less.

Less than four-tenths of the saw timber was utilized. Half of the quantity was cut for fuel.

Slightly more than one-tenth of the saw timber that was available remains for future use.

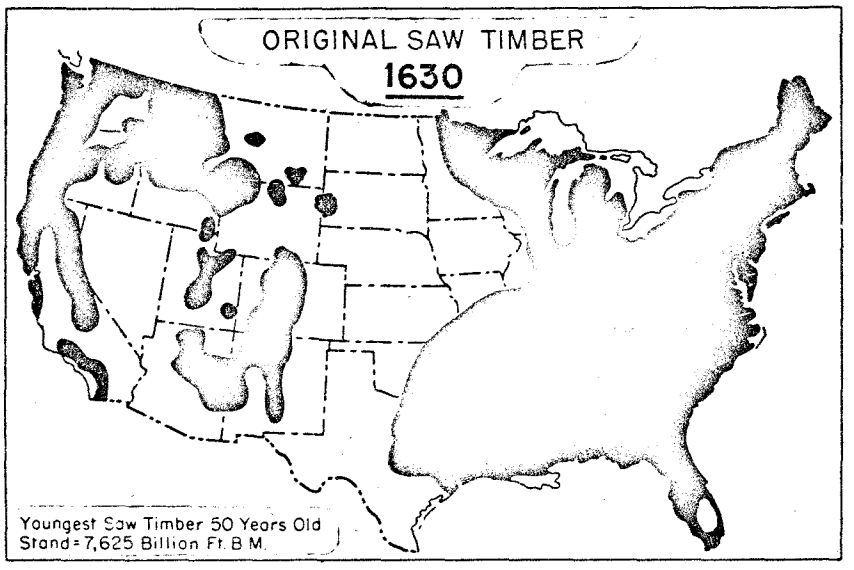
That in brief, is the history of our saw timber resource, up to 1930.

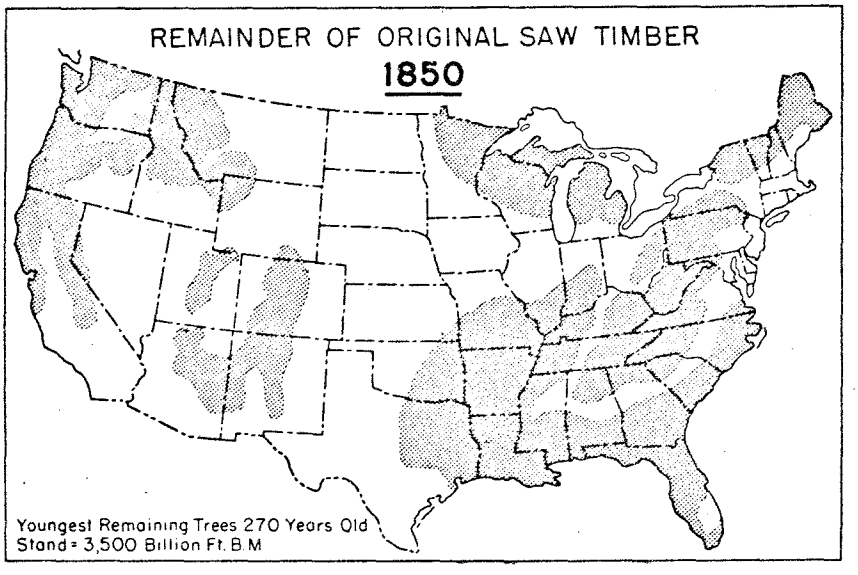
As to the future: we have far less reserve than the figures seem to indicate. well toward half of the present stand cannot be used because it is economically unavailable. Another considerable fraction of the timber ought not to be cut because it is immature and needed for growing stock. Although growth is increasing the present stand continues to decline as it has done without intermission for 200 years. The rate of decline, it is true, is decreasing, but even at the decreasing rate it may be near the end of this century before saw timber growth and drain can became equalized.

To accept this situation means to acquiesce in the progressive deterioration of our slender forest capital. That entails the use of constantly less desirable forest products and the decline of the industries dependent on them. It foreshadows rivers whose shrunken flow can no longer provide water for power and navigation, or which flood disastrously, carrying to the sea the precious top soil of the farms. It means ugliness and poverty where nature planned beauty and self-perpetuating wealth.

The only alternative is the far more general application of forest management to the privately owned forest area, and which account for more than four-fifths of the destruction and the cut.

FIG. 1 —FOREST REGIONS AND PRINCIPAL TYPES OF FOREST, 1930





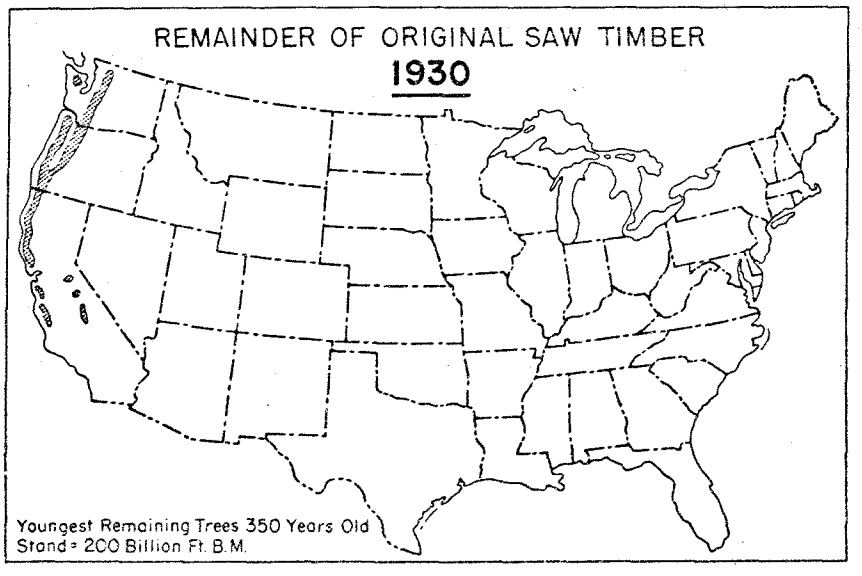


Fig. 2— Disappearance of Original Saw Timber

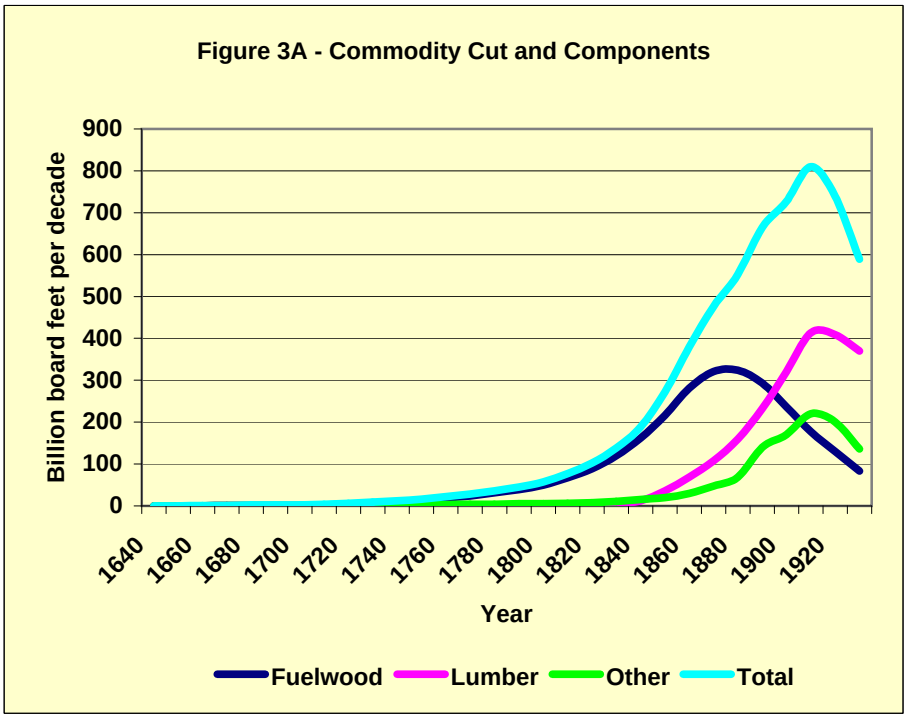


Figure 3A - Commodity Cut and Components
Billion board feet per decade
900
800
700
600
500
400
300
200
100
0
1640
1660
1680
1700
1720
1740
1760
1780
1800
1820
1840
1860
1880
1900
1920
Year
Fuelwood
Lumber
Other
Total

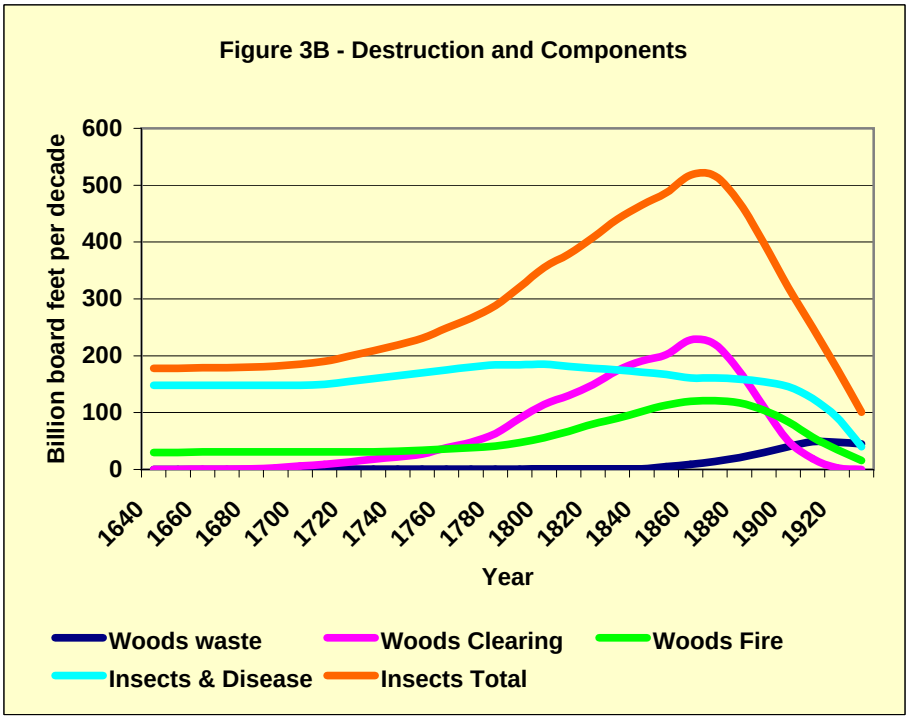


Figure 3B - Destruction and Components
Billion board feet per decade
600
500
400
300
200
100
0
1640
1660
1680
1700
1720
1740
1760
1780
1800
1820
1840
1860
1880
1900
1920
Year
Woods waste
Woods Clearing
Woods Fire
Insects & Disease
Insects Total

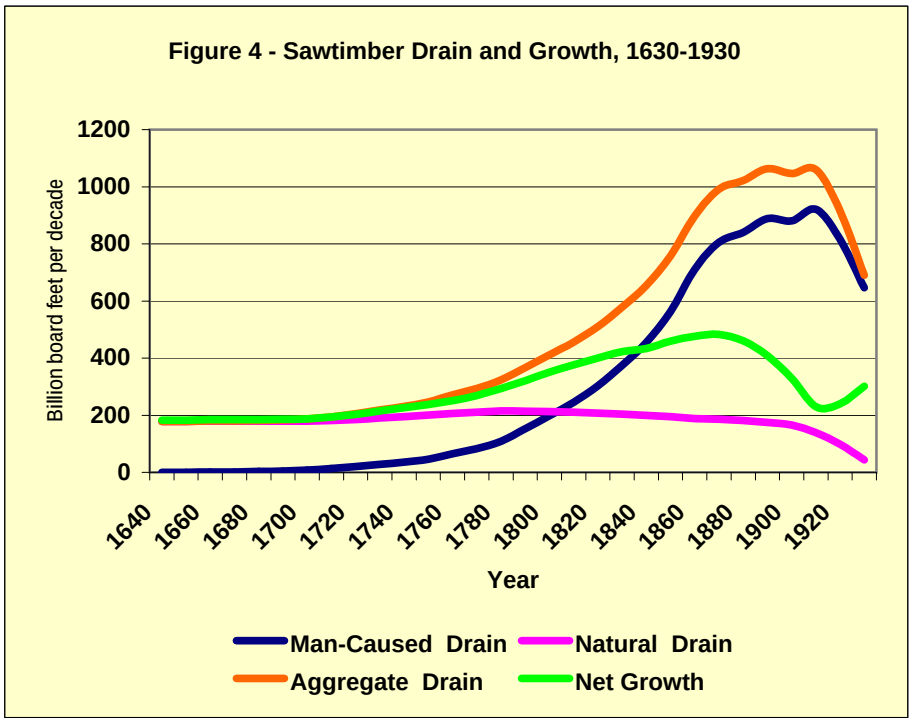


Figure 4 - Sawtimber Drain and Growth, 1630-1930
Billion board feet per decade
1200
1000
800
600
400
200
0
1640
1660
1680
1700
1720
1740
1760
1780
1800
1820
1840
1860
1880
1900
1920
Year
Man-Caused Drain
Natural Drain
Aggregate Drain
Net Growth

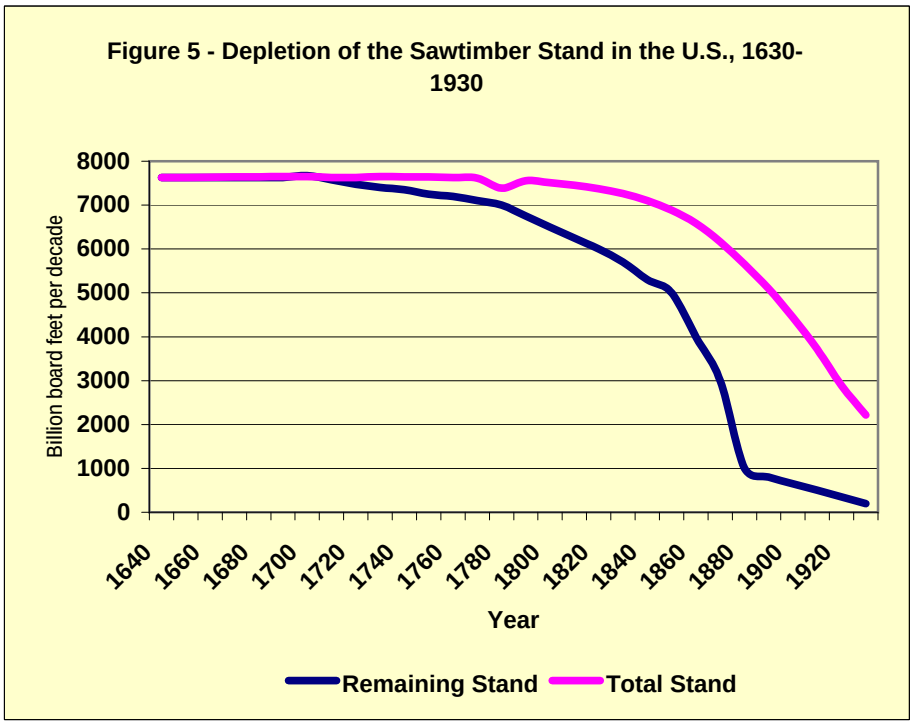


Figure 5 - Depletion of the Sawtimber Stand in the U.S., 1630-1930
Billion board feet per decade
8000
7000
6000
5000
4000
3000
2000
1000
0
1640
1660
1680
1700
1720
1740
1760
1780
1800
1820
1840
1860
1880
1900
1920
Year
Remaining Stand
Total Stand

Figure 6 - Regional balance of Sawtimber, growth, cut and destruction, 1630-1930

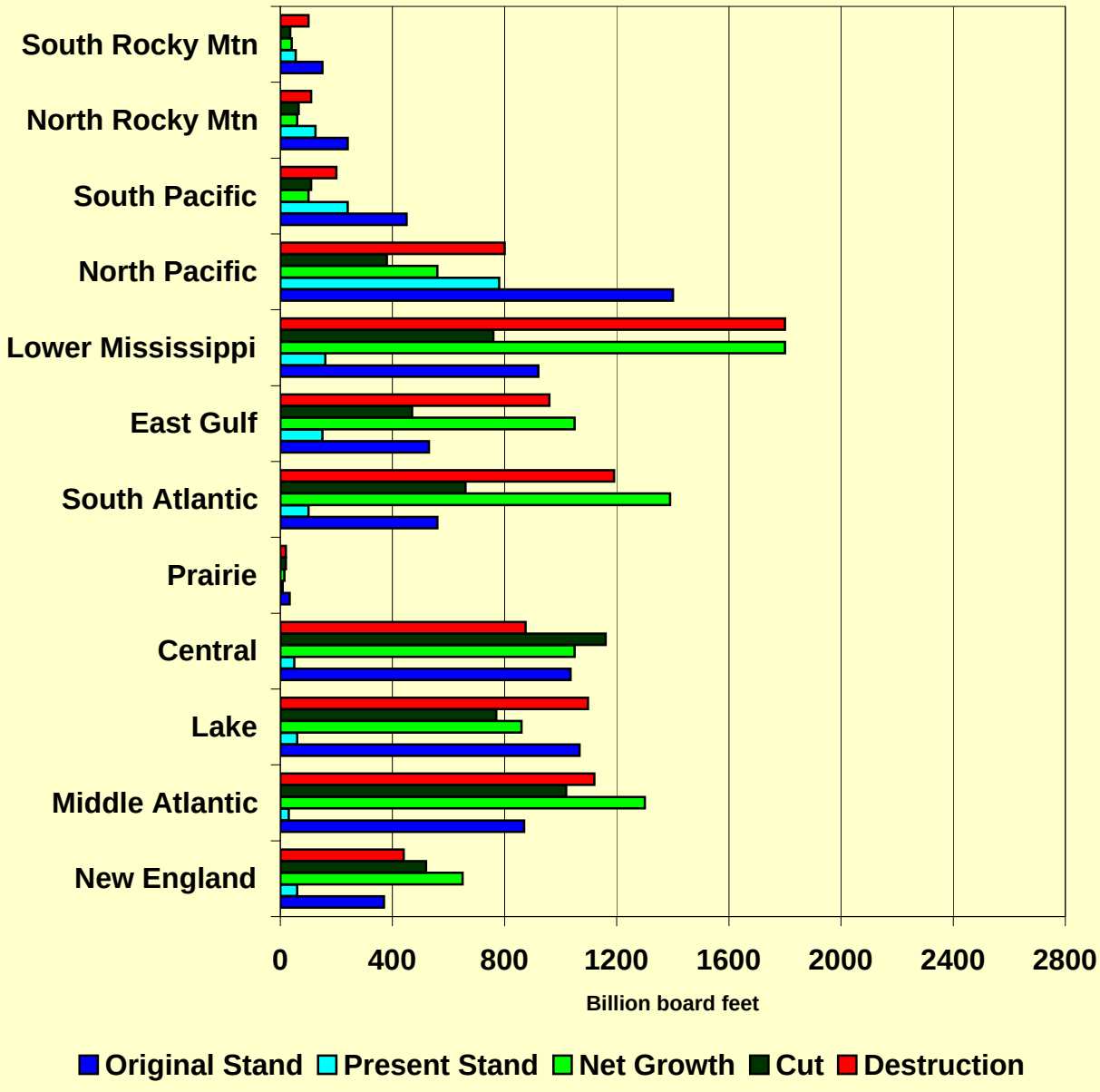


Figure 3A. - Commodity Cut and its components, 1630-1930
(billion board feet)

Year	Product			
	Fuelwood	Lumber	Other	Total
1640	0.1	0.1	0.1	0.0
1650	0.2	0.2	0.2	0.0
1660	0.3	0.3	0.3	1.0
1670	1.0	0.4	0.5	1.0
1680	1.0	0.5	1.0	2.0
1690	1.0	0.5	1.0	2.0
1700	1.0	0.5	1.0	2.0
1710	2.0	0.5	2.0	4.0
1720	4.0	0.5	2.0	6.0
1730	7.0	0.5	2.0	9.0
1740	9.0	0.5	3.0	12.0
1750	13.0	0.5	3.0	16.0
1760	19.0	0.5	3.0	22.0
1770	24.0	0.5	4.0	28.0
1780	31.0	1.0	4.0	36.0
1790	39.0	1.0	5.0	45.0
1800	50.0	2.0	5.0	57.0
1810	67.0	4.0	6.0	77.0
1820	89.0	5.0	8.0	102.0
1830	120.0	7.0	11.0	138.0
1840	162.0	12.0	15.0	189.0
1850	216.0	36.0	20.0	272.0
1860	281.0	69.0	30.0	380.0
1870	321.0	108.0	47.0	476.0
1880	324.0	160.0	69.0	553.0
1890	293.0	232.0	140.0	665.0
1900	236.0	321.0	170.0	727.0
1910	177.0	413.0	220.0	810.0
1920	130.0	409.0	200.0	739.0
1930	83.0	370.0	136.0	589.0

Figure 3B. - Destruction and its components, 1630-1930
(billion board feet)

Year					
	Woods waste	Clearing	Fire	Insects & Disease	Total
1640	0.2	0.1	30.0	148.0	178.0
1650	0.2	0.2	30.0	148.0	178.0
1660	0.2	0.3	31.0	148.0	179.0
1670	0.2	0.4	31.0	148.0	179.0
1680	0.2	1.0	31.0	148.0	180.0
1690	0.2	3.0	31.0	148.0	182.0
1700	0.2	6.0	31.0	148.0	185.0
1710	0.4	9.0	31.0	150.0	190.0
1720	0.4	13.0	31.0	155.0	199.0
1730	0.4	18.0	31.0	160.0	209.0
1740	0.4	22.0	32.0	165.0	219.0
1750	0.4	27.0	34.0	170.0	231.0
1760	0.4	38.0	36.0	175.0	249.0
1770	0.4	48.0	38.0	180.0	266.0
1780	0.4	63.0	41.0	184.0	288.0
1790	0.4	90.0	47.0	184.0	321.0
1800	1.0	114.0	56.0	185.0	355.0
1810	1.0	130.0	67.0	181.0	379.0
1820	1.0	149.0	80.0	178.0	408.0
1830	1.0	174.0	90.0	175.0	440.0
1840	1.0	191.0	102.0	171.0	465.0
1850	5.0	202.0	113.0	167.0	487.0
1860	9.0	228.0	120.0	161.0	518.0
1870	14.0	220.0	121.0	161.0	516.0
1880	21.0	172.0	117.0	159.0	469.0
1890	30.0	110.0	104.0	154.0	398.0
1900	40.0	50.0	84.0	146.0	320.0
1910	49.0	19.0	57.0	125.0	250.0
1920	48.0	3.0	35.0	91.0	177.0
1930	45.0	--	16.0	40.0	101.0

Figure 4. - Sawtimber Drain and Growth, 1630-1930
(billion board feet)

Year	Man-Caused Drain	Natural Drain	Aggregate Drain	Net Growth	Total Stand
1640	0.5	178	178.5	183	7,625
1650	0.5	178	178.5	183	7,630
1660	1	179	180	185	7,635
1670	1	179	180	185	7,640
1680	3	179	182	185	7,645
1690	5	179	184	186	7,648
1700	8	179	187	187	7,650
1710	13	181	194	194	7,630
1720	20	185	205	203	7,630
1730	28	190	218	215	7,648
1740	36	195	231	226	7,645
1750	46	201	247	237	7,640
1760	65	206	271	251	7,630
1770	83	211	294	269	7,610
1780	109	215	324	294	7,385
1790	152	214	366	321	7,555
1800	198	213	411	351	7,510
1810	245	211	456	376	7,450
1820	303	207	510	400	7,370
1830	374	204	578	422	7,260
1840	455	199	654	434	7,104
1850	564	195	759	459	6,884
1860	710	188	898	476	6,584
1870	806	186	992	483	6,162
1880	840	182	1,022	461	5,653
1890	888	175	1,063	409	5,098
1900	881	166	1,047	329	4,438
1910	921	139	1,060	230	3,720
1920	817	99	916	240	2,890
1930	646	44	690	301	2,214

Figure 5. - Depletion of sawtimber stand in the US, 1630-1930
(billion board feet)

	Remaining Stand	Total Stand
1640	7625	7,625
1650	7625	7,630
1660	7625	7,635
1670	7625	7,640
1680	7625	7,645
1690	7625	7,648
1700	7675	7,650
1710	7575	7,630
1720	7475	7,630
1730	7400	7,648
1740	7350	7,645
1750	7250	7,640
1760	7200	7,630
1770	7100	7,610
1780	7000	7,385
1790	6750	7,555
1800	6500	7,510
1810	6250	7,450
1820	6000	7,370
1830	5700	7,260
1840	5300	7,104
1850	5000	6,884
1860	4000	6,584
1870	3000	6,162
1880	1000	5,653
1890	800	5,098
1900	650	4,438
1910	500	3,720
1920	350	2,890
1930	200	2,214

Figure 6.- Regional balance of sawtimber stands, growth, cut, and destruction 1630-1930
(billion board feet)

Region	Original Stand	Present Stand	Net Growth	Cut	Destruction
New England	370	60	650	520	440
Middle Atlantic	870	30	1,300	1020	1120
Lake	1,067	60	860	770	1097
Central	1,035	50	1,050	1160	875
Prairie	33	8	15	20	20
South Atlantic	560	100	1,390	660	1190
East Gulf	530	150	1,050	470	960
Lower Mississippi	920	160	1,800	760	1800
North Pacific	1,400	780	560	380	800
South Pacific	450	240	100	110	200
North Rocky Mtn	240	125	60	65	110
South Rocky Mtn	150	55	40	35	100
United States	7,625	1,818	8,875	5,970	8,712

Table 3. --Revised estimate of the original saw-timber stand 1/

(Billion board feet)

Region	Original stand Total	Softwood	Hardwood		Percent hardwood 2/	Percent of total	Original saw-timber area	Average stand per acre
New England	370	252	118		31.9%	4.9%	38,908	9.5
Middle Atlantic	870	496	374		43.0%	11.4%	69,610	12.5
Lake	1,067	811	256		24.0%	14.0%	103,680	10.3
Central	1,035	145	890		86.0%	13.6%	158,720	6.5
Prairie	33	7	26		78.8%	0.4%	13,760	2.4
South Atlantic	560	398	162		28.9%	7.3%	72,960	7.7
EastGulf	530	429	101		19.1%	7.0%	97,280	5.4
Lower Mississippi	920	672	248		27.0%	12.1%	128,400	7.2
Eastern regions	5,385	3,210	2,175		40.4%	70.6%	683,318	7.9
North Pacific	1,400	1,397	3		0.2%	18.4%	56,700	24.7
South Pacific	450	450		/3	0.0%	5.9%	19,951	22.6
North Rocky Mountain	240	240		/3	0.0%	3.1%	33,490	7.2
South Rocky Mountain	150	150		/3	0.0%	2.0%	35,101	4.3
Western regions	2,240	2,237	3		0.1%	29.4%	145,242	15.4
United States	7,625	5,447	2,178		28.6%	100.0%	828,560	9.2

1/ For present purposes original sawtimber is defined as those trees were 50 years old or more, standing at the time of the occupation of this continent by white men approximately three centuries ago.

2/ The hardwood percentages applied are weighted estimates derived by allocating probable hardwood percentages to the regional items of present stand, cut, destruction, and net growth. Consideration was also given to indications in recent regional drain tables and the record of the aggregate lumber cut, bearing in mind that in some eastern regions the percentage of hardwoods in the stand has increased because of their greater resistance to fire, their tolerance of shade, and their ability to reproduce by sprouting.

3/ Less than half of one billion board feet.

Table 3. -- Revised estimate of the original saw-timber stand 1/

(Billion cubic feet)

Region	Original stand Total	Softwood	Hardwood		Percent hardwood 2/	Percent of total	Original saw-timber area	Average stand per acre
New England	126	79	47		37.5%	1.7%	38,908	3.2
Middle Atlantic	305	155	150		49.1%	4.0%	69,610	4.4
Lake	356	253	102		28.8%	4.7%	103,680	3.4
Central	401	45	356		88.7%	5.3%	158,720	2.5
Prairie	13	2	10		82.6%	0.2%	13,760	0.9
South Atlantic	189	124	65		34.3%	2.5%	72,960	2.6
EastGulf	174	134	40		23.2%	2.3%	97,280	1.8
Lower Mississippi	309	210	99		32.1%	4.1%	128,400	2.4
Eastern regions	1,873	1,003	870		46.4%	24.6%	683,318	2.7
North Pacific	250	249	1		0.4%	3.3%	56,700	4.4
South Pacific	80	80		/3	0.0%	1.1%	19,951	4.0
North Rocky Mountain	69	69		/3	0.0%	0.9%	33,490	2.0
South Rocky Mountain	43	43		/3	0.0%	0.6%	35,101	1.2
Western regions	442	441	1		0.2%	5.8%	145,242	3.0
United States	2,315	1,444	871		37.6%	30.4%	828,560	2.8

Table 4. -- Saw timber drain by decades, 1630-1930

(Billion board feet)

Decade	Commodity cut					Destruction							Aggregate drain
								Fires			Insects, diseases		
	Fuelwood 1/	Sawed lumber 2/	All other 3/	Total	Per capita cut mbf	Woods waste 4/	Farm 5/ clearing	Lightning	Man-caused	Total 6/	windfall, etc. 7/	Total	
1630 - 39	8/	8/	8/	8/	--	8/	8/	30	8/	30	148	178	178
1640 - 49	8/	8/	8/	8/	--	8/	8/	30	8/	30	148	178	178
1650 - 59	8/	8/	8/	1	765	8/	8/	31	8/	31	148	179	180
1660 - 69	1	8/	8/	1	770	8/	8/	31	8/	31	148	179	180
1670 - 79	1	8/	1	2	795	8/	1	31	8/	31	148	180	182
1680 - 89	1	8/	1	2	810	8/	3	31	8/	31	148	182	184
1690 - 99	1	8/	1	2	820	8/	6	31	8/	31	148	185	187
Subtotal	4	8/	3	8	••	8/	10	215	8/	215	1,036	1,261	1,269
1700 - 09	2	8/	2	4	835	8/	9	31	8/	31	150	190	194
1710 - 19	4	8/	2	6	860	8/	13	31	1	31	155	199	205
1720 - 29	7	8/	2	9	880	8/	18	31	1	31	160	209	218
1730 - 39	9	8/	3	12	900	8/	22	32	2	32	165	219	231
1740 - 49	13	8/	3	16	925	8/	27	34	3	34	170	231	247
1750 - 59	19	8/	3	22	1,005	8/	38	36	5	36	175	249	271
1760 - 69	24	8/	4	28	1,060	8/	48	38	7	38	180	266	294
1770 - 79	31	1	4	36	1,150	8/	63	41	10	41	184	288	324
1780 - 89	39	1	5	45	1,220	8/	90	47	17	47	184	321	366
1790 - 99	50	2	5	57	1,235	1	114	56	26	56	185	355	412
Subtotal	198	4	33	235	••	1	442	377	72	377	1,708	2,527	2,762
1800 - 09	67	4	6	77	1,255	1	130	30	37	67	181	379	456
1810 - 19	89	5	8	102	1,240	1	149	29	51	80	178	408	510
1820 - 29	120	7	11	138	1,255	1	174	29	61	90	175	440	578
1830 - 39	162	12	15	189	1,285	1	191	28	74	102	171	465	654
1840 - 49	216	36	20	272	1,380	5	202	28	85	113	167	487	759
1850 - 59	281	69	30	380	1,425	9	228	27	93	120	161	518	898
1860 - 69	321	108	47	476	1,390	14	220	25	96	121	161	516	992
1870 - 79	324	160	69	553	1,270	21	172	23	94	117	159	469	1,022
1880 - 89	293	232	140	665	1,200	30	110	21	83	104	154	398	1,063
1890 - 99	236	321	170	727	1,065	40	50	20	64	84	146	320	1,047
Subtotal	2,109	954	516	3,579	••	123	1,626	260	738	998	1,736	4,400	7,979
1900 - 09	177	413	220	810	980	49	19	14	43	57	125	250	1,060
1910 - 19	130	409	200	739	755	48	3	8	27	35	91	177	916
1920 - 29	83	370	136	589	520	45	--	4	12	16	40	101	690
Subtotal	390	1,192	556	2,138	••	142	22	26	82	108	256	528	2,666
Aggregate	2,701	2,150	1,108	5,960	••	266	2,100	878	892	1,698	4,736	8,716	14,676

1/ From Fuel Wood Used in the United States, 1630-1930, by R.V. Reynolds and A.H. Pierson, 1942. U.S. Dept. Agr. Cir. 641.

2/ Based on The Aggregate Cut of American Lumber, 1801-1935, by Reynolds and Pierson, in Journal of Forestry, December 1937.

3/ Based on data in modern drain tables, with modifications for probable earlier relations in lumber and fuel wood. The use of round and hewn materials for houses, ships, bridges, etc., was considered.

4/ Estimated on data from Allen S. ?od?son relative to woods waste in the Douglas fir region. Applied with reduced factors to lumber and other cut in all regions at all periods. Much of this could not be economically salvaged, but nevertheless should be charged against the stand.

5/ Estimated on the basis of 2,500,000 farms and 70 acres per farm, or 175,000,000 acres of timber destroyed in clearing. On farm soils allow 12 thousand feet per acre. This item is mainly original timber. In addition to destructive clearing for agriculture it is probable that the timber on as much as 125,000,000 acres of farm land was removed for use or by fire and disease. That would be equivalent to about 1,250 billion feet, which is accounted for under cut, and in destruction classes other than farm clearing. Much of it was not original timber, but growth.

6/ Computed by applying a changing factor to the estimated saw-timber stand in each decade. The J.C.C. Repport shows fire damage 0.00079 of stand in 1938. From 1630 to 1740 the factor (per decade) was reduced to 0.004, thence rising to a peak of 0.020 in 1870-79 and thence declining to 0.008 in 1920-29. It is assumed that at the first all fires were lightning fires, acting principally on the heavy softwood stands of mountainous regions. The percentage of man-caused fires applied was zero for the first four decades, increasing thence to 75 in 1920-29.

7/ Computed by applying a changing factor to the estimated saw-timber stand in each decade. The J.C.C. Repport shows damage by disease, insects windfall, etc., to be 0.0022 of the saw-timber stand in 1938. The factor (per decade) applied from 1630 to 1699 was 0.019 increasing thence to a peak of 0.038 in 1900-09, and thence decreasing to 0.020 in 1920-29.

8/ Less than half of one billion board feet.

NOTE: The esimates above are believed conservative. The percentages used in calculating damage by fire and disease represent timber killed and not salvaged. Acutally greater quantities were killed, of which the salvaged part is considered included in the commodity cut items.

Table 5. -- Aggregate drain, net growth, and saw timber stand, 1630-1930

(Billion board feet)

	Man-caused drain						
	Commodity cut	Destruction 1/	Total	Natural drain 2/	Aggregate drain	Net growth 3/	Saw timber stand 4/
1630 - 39	5/	5/	5/	178	178	183	7,625
1640 - 49	5/	5/	5/	178	178	183	7,630
1650 - 59	1	5/	1	179	180	185	7,635
1660 - 69	1	5/	1	179	180	185	7,640
1670 - 79	2	1	3	179	182	185	7,645
1680 - 89	2	3	5	179	184	186	7,648
1690 - 99	2	6	8	179	187	187	7,650
Subtotal	8	10	18	1251	1269	1294	••
1700 - 09	4	9	13	181	194	194	7,630
1710 - 19	6	14	20	185	205	203	7,630
1720 - 29	9	19	28	190	218	215	7,648
1730 - 39	12	24	36	195	231	226	7,645
1740 - 49	16	30	46	201	247	237	7,640
1750 - 59	22	43	65	206	271	251	7,630
1760 - 69	28	55	83	211	294	269	7,610
1770 - 79	36	73	109	215	324	294	7,385
1780 - 89	45	107	152	214	366	321	7,555
1790 - 99	57	141	198	213	411	351	7,510
Subtotal	235	515	750	2,011	2,761	2,561	••
1800 - 09	77	168	245	211	456	376	7,450
1810 - 19	102	201	303	207	510	400	7,370
1820 - 29	138	236	374	204	578	422	7,260
1830 - 39	189	266	455	199	654	434	7,104
1840 - 49	272	292	564	195	759	459	6,884
1850 - 59	380	330	710	188	898	476	6,584
1860 - 69	476	330	806	186	992	483	6,162
1870 - 79	553	287	840	182	1,022	461	5,653
1880 - 89	665	223	888	175	1,063	409	5,098
1890 - 99	727	154	881	166	1,047	329	4,438
Subtotal	3,579	2,487	6,066	1,913	7,979	4,249	••
1900 - 09	810	111	921	139	1,060	230	3,720
1910 - 19	739	78	817	99	916	240	2,890 5/
1920 - 29	589	57	646	44	690	301	2,214 5/
Subtotal	2,138	246	2,384	282	2,666	771	••
Aggregate	5,960	3,248	9,218	5,457	14,675	8,875	1,825 6/

1/ Includes woods waste, farm clearing, and man-caused fires.

2/ Includes lightning fires, plus destruction by insects, disease, windfall, etc., which is of an epidemic or cataclysmic nature, not compensated by growth.

3/ Aggregate drain in each decade less the decrease of the saw-timber stand within that decade, i.e., between decennial years. The assumption has been made that up to 1790 net growth slightly exceeded the aggregate destruction, resulting in a small increase of the stand.

4/ These quantities represent the stand at the beginning of each decade.

5/ The Bureau of Corporations estimate of about 1911, as recompiled by W.H. Greeley and H.S. Betts, showed a total saw-timber stand 2,826 billion feet; for 1920 the Capper Report showed 2,213 billion feet; the Joint Congressional Committee Report showed 1,794 billion feet as of the latter part of 1938.

6/ Stand as estimated for 1930.

Table 6. -- Allocation of cut, destruction, and present stand to original saw timber and the subsequent net grwoth, 1630-1930

(Billion board feet)

Saw timber items	Aggregate saw timber 1/				Original saw timber 1630 2/				Net grwoth, 1630-1930 3/			
	Total	Softwood	percent	Hardwood	Total	Softwood	percent	Hardwood	Total	Softwood	percent	Hardwood
Cut												
Fuel wood	2,701	770	71%	1,931	766	169	78%	597	1,935	601	69%	1,334
Lumber	2,150	1,651	23%	499	194	145	25%	49	1,956	1,506	23%	450
Other commodities	1,109	667	40%	442	89	32	64%	57	1,020	635	38%	385
Total	5,960	3,088	48%	2,872	1,049	346	67%	703	4,911	2,742	44%	2,169
Destroyed												
In woods waste	266	176	34%	90	56	45	20%	11	212	133	37%	79
By farm clearing	2,100	559	73%	1,541	1,358	421	69%	937	741	137	82%	604
By fires												
Lightning	972	875	10%	97	777	715	8%	62	195	160	18%	35
Man-caused	726	619	15%	107	549	507	8%	42	177	112	37%	65
Total by fires	1,698	1,494	12%	204	1,326	1,222	8%	104	372	272	27%	100
By insects, disease, windfall, etc.	4,651	3,969	15%	682	3,637	3,214	12%	423	1,014	755	26%	259
Total destroyed	8,715	6,198	29%	2,517	6,377	4,902	23%	1,475	2,339	1,297	45%	1,042
Stand, 1930	1,825	1,487	19%	338	/4 200	200	0%	0	1,625	1,287	21%	338
Aggregate Saw timber	16,500	10,773	35%	5,727	7,626	5,448	29%	2,178	8,875	5,326	40%	3,549

1/ The computation of the cut and destruction items are described in the notes of Table 4. Remaining stand, 1930, is an estimate base principally on the record figure of 1,864 billion feet, as shown by the Joint Congressional Committee Report for 193

2/ Saw timber of all age classes from 50 years up, living in 1630. The youngest remaining members of this group were 350 years old i 1930, and some trees in this remainder, such as sequoias and Douglas-fir, were very much older. The footage of these columns are thos of Table5.

3/ Net accretion of all trees living in 1630 plus those generated after 1630 which attained saw timber size by 193

4/ An estimate of the volume of the timber aged 350 years or more in 1930, by J.W. Girard and B.P. Kirkland. Reporting two billion feet c cypress this volume consists of western softwoods, such as Douglas-fir, redwood, ponerosa, sugar pine, etc

Table 6a. -- Percentage distributions of sawtimber items in Table 6 (not for publication)

Saw timber items	*Horizontal* To original timber	To net growth	*Verical (in total columns)* Aggregate	Original timber	Net growth
Cut					
Fuel wood	28%	72%	16%	10%	22%
Lumber	9%	91%	13%	3%	22%
Other commodities	8%	92%	7%	1%	11%
Total	18%	82%	36%	14%	55%
Destroyed					
In woods waste	21%	80%	2%	1%	2%
By farm clearing	65%	35%	13%	18%	8%
By fires					
Lightning	80%	20%	6%	10%	2%
Man-caused	76%	24%	4%	7%	2%
Total by fires	78%	22%	10%	17%	4%
By insects, disease, windfall, etc.	78%	22%	28%	48%	11%
Total destroyed	73%	27%	53%	84%	26%
Stand, 1930	11%	89%	11%	3%	18%
Aggregate Saw timber	46%	54%	100%	100%	100%