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WHITE PAPER FROM DOUGLAS FIR

(~~This page is made wholly from Douglas fir pulp.~~)

Douglas fir, the most abundant and most used lumber species in the forests of the Pacific Northwest, is being pulped on a commercial scale by the sulfate and soda processes. The markets for unbleached pulps are limited, and there has been much speculation as to the possibilities of developing pulping processes whereby the enormous quantities of otherwise unutilized Douglas fir can economically be converted into a bleached pulp or paper, with extensive markets. Experiments have been carried on for a number of years with this end in view both by pulp companies within the region and by the United States Forest Products Laboratory, at Madison, Wis.

The Forest Products Laboratory has been able to produce an easily bleachable pulp by the sulfate process, principally by using a high liquor-wood ratio. It has produced satisfactory sulfite pulps, also, by substituting soda or ammonia for the customary lime base in the standard process. Another modification of the sulfite process, including impregnation of the chips with sodium sulfite followed by digestions with standard lime-base sulfite pulping liquor, has given satisfactory results. Also, bleachable pulps having exceptional strength have been produced from Douglas fir with neutral or alkaline sulfite liquor, the principal cooking agent of which is sodium sulfite.

It does not yet seem practical, however, to use Douglas fir for bleached pulp in competition with such easily bleached woods as spruce, hemlock, and the balsam firs.

The mimeograph sheet upon which this note is printed is an experimental paper produced by the Forest Products Laboratory at the request of the Pacific Northwest Forest Experiment Station. It is made from 100 percent Douglas fir soda-base sulfite pulp, filled with a small quantity of titanium oxide and sized with rosin. It shows that progress is being made in the production of white papers from Douglas fir.

J. Elton Lodewick

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POTENTIAL FOREST PRODUCTIVITY OF NATIONAL-FOREST AND OTHER LANDS IN THE DOUGLAS FIR REGION

With intensive forest practice, under current standards of utilization, commercial forest lands of the Douglas fir region could yield continuously 8.2 billion board feet of sawlogs per year. This yield would be practically equivalent to the average annual depletion of sawlog volume undergone by the forests of the region in the recent past. In other words, by intensive management of all the commercial forest land in the region forest industry could be sustained at approximately its present magnitude.

Many years would be required to bring all forest lands of the region to their potential productivity. Obviously the lands of best site quality, those of highest productive capacity, should receive earliest attention. On the basis of sawlog productivity, a single Site II acre is equal to 4 Site IV acres and a single Site I acre is equal to 22 Site V acres.

Figure 1 shows the total acreages of national-forest and other commercial coniferous forest land in the Douglas fir region and shows what proportions of these acreages are included in each of the five recognized site-quality classes. Figure 2 shows the potential annual timber production of this land and shows how this production is distributed among the five site-quality classes.

In site quality the commercial forest land of the region averages class III. Lands of average site quality compose 44 percent of the commercial forest area and have almost an equal proportion of the region's forest-growth capacity. Approximately one-quarter of the commercial forest land is rated as of site-quality classes IV and V. This poorer land has less than one-tenth of the region's potential forest productivity. Areas of better than average site quality (classes I and II) include less than one-third of the region's commercial coniferous forest land, but have nearly one-half of its growth capacity.

Almost one-third of the commercial forest land in the region is within national forests; but because of relatively low site quality, these national-forest lands have little more than one-fifth of the region's potential forest productivity.

If potential productivity is judged not on the basis of volume but on that of financial returns, the spread between high- and low-quality land is even greater, because areas of better-than-average site quality are in general more accessible.

P. A. Briegleb

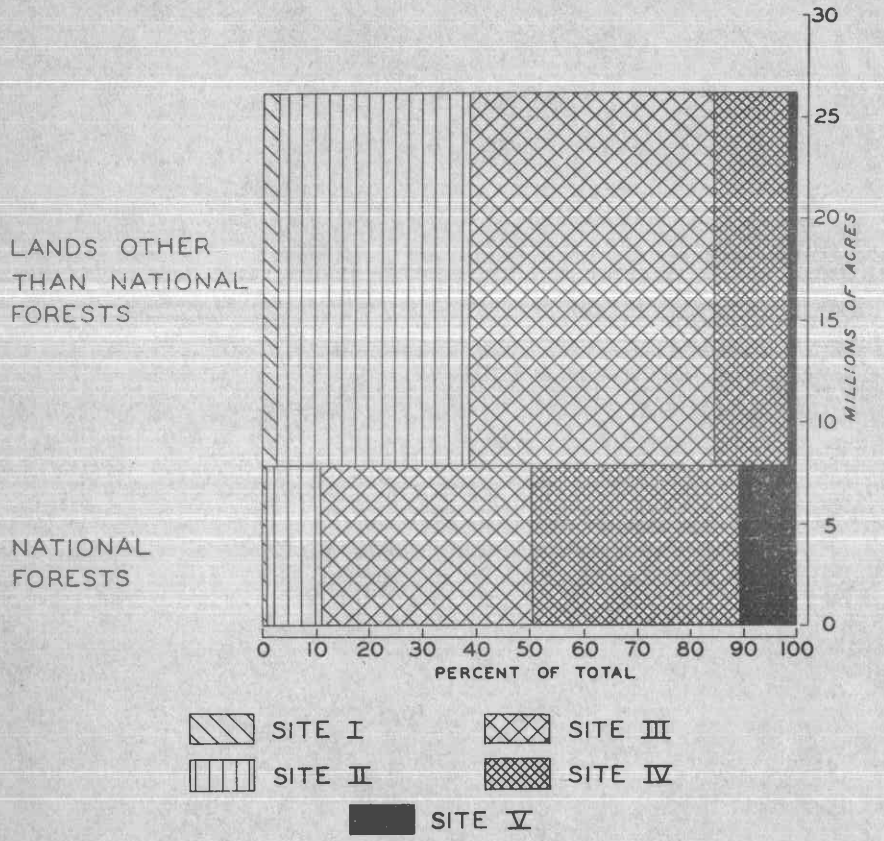

FIGURE 1 -- AREA OF COMMERCIAL CONIFEROUS FOREST LAND IN THE DOUGLAS FIR REGION, BY SITE QUALITY GLASS.

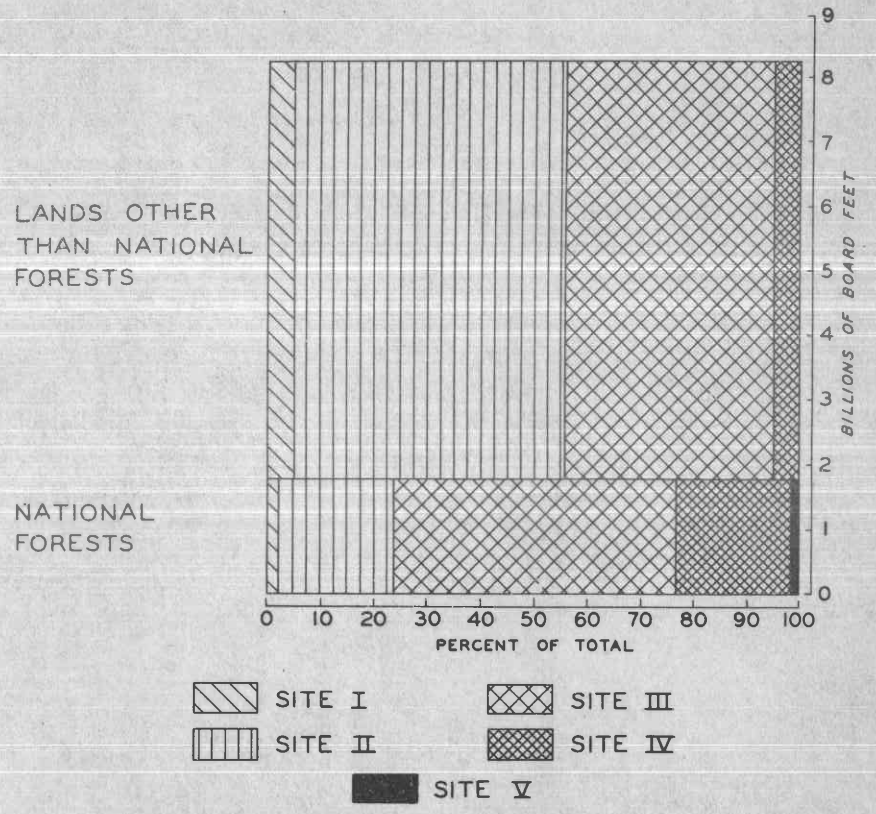

FIGURE 2 -- POTENTIAL ANNUAL CONIFEROUS GROWTH (BY SCRIBNER RULE, IN 32-FOOT LOGS TO 12-INCH TOP) OF TREES 15.1 INCHES OR MORE IN D.B.H. ON COMMERCIAL CONIFEROUS FOREST LAND IN THE DOUGLAS FIR REGION, BY SITE QUALITY CLASS.

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SIZE AND VOLUME OF PONDEROSA PINE IN KLAMATH, DESCHUTES, AND LAKE COUNTIES, OREGON

Size and volume averages for ponderosa pine stands in Klamath, Deschutes, and Lake Counties, in central and south-central Oregon, have been determined through an analysis of check cruises made by the Forest Survey.

The purpose of the check cruising was to bring private, county, Indian Service, and Forest Service cruises to a common standard set by the survey. In these three counties the ponderosa pine type occupies an area roughly 165 miles long from north to south and 15 to 110 miles wide from east to west, and the area of merchantable ponderosa pine stands is approximately 2,500,000 acres. A 10 percent cruise, by the 1/4-acre circular plot method, was made on 1,052 forties selected at random in units of 4, 8, or 16 forties throughout the counties. It consisted in a cruise of the stands on 16,832 sample plots, the area of which totaled 4,208 acres.

As is shown in table 1, stand characteristics do not differ greatly among the three counties. Number of trees of merchantable size (12 inches and more in d.b.h.) per acre averages 16.2 in Klamath County, 16.9 in Lake County, and 18.2 in Deschutes County. Diameter and log height of average tree, also, are about the same for each of the three counties. The average tree of Klamath County is the smallest in diameter and the shortest in log height, but has the greatest volume, which is probably due in part to less taper and in part to the distribution of the trees by diameter class and log height. Its smaller diameter is due to the fact that the percentage of total number of trees in the smallest diameter class (12 to 20 inches in d.b.h.) is greater in this county than in the other counties. Likewise, the slightly smaller average number of logs per tree in Klamath County is due to the fact, shown in table 2, that the percentage of total number of trees in the 1-, 2-, and 3-log classes is greater there.

If only the trees in the larger diameter classes (32 inches and more in d.b.h.) are considered, the average tree in Klamath County has a larger diameter, a greater log height, and considerably more volume than that in either of the other counties. Within this diameter range, the average tree in Klamath County has a d.b.h. of 36.6 inches, a height of 5.8 logs, and a volume of 2,610 board feet; that in Lake County has a d.b.h. of 36.2 inches, a height of 5.3 logs, and a volume of 2,330 board feet; and that in Deschutes County has a d.b.h. of 35.7 inches, a height of 5.0 logs, and a volume of only 2,160 board feet. Approximately three-fifths (58 percent) of the total volume on the plots in Klamath County was in trees 32 inches and more in d.b.h., whereas in Deschutes and Lake Counties less than half the total volume was in trees of that diameter range.

Table 1.--Stand data[1/] obtained through check cruise of ponderosa pine stands in Klamath, Deschutes, and Lake Counties, Oregon

Item	Klamath County	Deschutes County	Lake County	Total or weighted average
Quarter-acre plots taken---------- Number	9,536	4,224	3,072	16,832
Trees on plots---------- Number	38,639	19,254	12,945	70,838
Diameter of average tree---------- Inches	23.48	23.72	24.00	23.64
Average tree length, in 16-foot logs--Number	3.79	3.90	3.85	3.83
Volume of average log---------- Board feet	239	215	229	231
Volume of average tree---------- Board feet	907	839	880	884
Portion of total stand included in diameter class--				
12 to 20 inches				
Number of trees----Percent	44	39	39	42
Volume----------Percent	8	10	8	9
22 to 30 inches				
Number of trees----Percent	37	43	43	39
Volume----------Percent	34	44	43	39
32 to 40 inches				
Number of trees----Percent	16	16	15	16
Volume----------Percent	42	38	37	39
More than 40 inches				
Number of trees----Percent	3	2	3	3
Volume----------Percent	16	8	12	13

[1/] Data are for stand 12 inches and more in d.b.h., estimated in board feet, log scale, Scribner rule.

Table 2.--Log height of trees on ponderosa pine areas check cruised

Number of 16-foot logs	Trees in-- Klamath County	Deschutes County	Lake County	Weighted average
	Percent	Percent	Percent	Percent
1	8	3	4	6
2	18	15	18	17
3	18	19	16	18
4	21	30	23	24
5	20	22	30	22
6	9	9	7	9
7	4	2	2	3
8 and more	2			1
	100	100	100	100

Table 3.--Site quality of ponderosa pine areas check cruised

Site quality class	Areas in-- Klamath County	Deschutes County	Lake County	Weighted average
	Percent	Percent	Percent	Percent
II	0.3	0.2	0.0	0.2
III	14.3	3.8	0.8	8.4
IV	75.5	90.3	73.4	77.6
V	9.8	5.7	25.4	13.6
VI	0.1	0.0	0.4	0.2
	100.0	100.0	100.0	100.0

The taller trees found in Klamath County were in the southwestern portion of the county; a total of 53 9-log trees and 7 10-log trees were tallied there. No trees more than 8 logs in height were found in Deschutes or Lake Counties.

The site quality of the ponderosa pine areas is shown, by county, in table 3.

F. L. Moravets

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10 YEARS' GROWTH OF DOUGLAS FIR SPACING-TEST PLANTATIONS

A series of Douglas fir plantations were established by the Experiment Station in 1925 to determine what spacing would result in the best growth of timber of desirable quality. Spacings of 4 x 4 feet, 5 x 5 feet, etc. up to 12 x 12 feet were used on 2½-acre plots of Douglas fir cut-over land in the Wind River Valley near Carson, Washington.

During the first few years there was heavy mortality in the plantations. This was attributed to the effect of an intensely hot slash fire on the soil. Soil tests indicated that on the "hot spots" practically all humus had been burned, most of the nitrogen driven off, and the moisture-holding capacity reduced.

Growth during the first 10 years of this experiment is shown in the following table. (Both the 1929 and 1934 examinations were made at the end of the growing season.)

Spacing (feet)	Average height in -- 1929 (5th year)	1934 (10th year)	Average crown width in 1934 (10th year)
	Feet	Feet	Feet
4 x 4	2.8	7.1	3.6
5 x 5	2.7	7.5	3.9
6 x 6	2.3	7.4	3.9
8 x 8	2.6	6.4	3.8
10 x 10	2.5	7.9	4.3
12 x 12	--	8.1	4.2
Average	2.6	7.4	3.9

Although the trees spaced 4 x 4 feet and 5 x 5 feet were the tallest in 1929, those spaced 10 x 10 feet and 12 x 12 feet were the tallest in 1934. This fact indicates that in the second 5-year period density exerted a retarding influence on average height growth. This influence may disappear when the dominant trees on each plot take possession of the crown space.

The importance of spacing from the protection standpoint is shown by the fact that the crowns of the 4 x 4 plantation had closed sufficiently to shade out most of the highly inflammable herbaceous vegetation by the end of the fifth year. The 6 x 6 plantation had arrived at a similar stage by the end of the tenth year, but the 8 x 8, 10 x 10, and 12 x 12 plantations will probably require an average of 5 years more to do so.

A check plot established in 1934 in a near-by natural stand of trees aged 5 to 12 years demonstrates the importance of even spacing. At the end of 1934 this plot had approximately the same number of trees per acre as the 6 x 6 plot, but because of uneven age and poor distribution the trees averaged only 5.5 feet in height and the canopy was less complete and had been no more effective in shading out inflammable vegetation than that on the 10 x 10 plot.

Leo A. Isaac

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TEMPERATURE AND HUMIDITY CONTROLS IN DOUGLAS FIR DRY KILNS

A recent survey of kiln drying in the Douglas fir region provides interesting data on the relative prevalence of manual and automatic control of temperature and humidity. As is shown in the accompanying table, automatic control of temperature is markedly more common than automatic control of humidity, both in the older-type (natural-draft) kilns and in the newer-type (forced-circulation) kilns. Since humidity control is no more costly to install than temperature control, it may be inferred that the industry considers the latter the more important. And, within limits, this view is warranted.

Of the 984 kiln units in operation in the Douglas fir region in 1936, the data indicate, 454, or 46 percent, were of the natural-draft type. Many of these were old installations, very few natural-draft kilns having been constructed since the advent of forced circulation. A much smaller proportion of the forced-circulation kilns than of the others (12 percent as compared with 73 percent) had manual humidity control, and the same relation held for manual temperature control (5 percent compared with 51 percent); thus it appears that the trend toward automatic control has been accelerated by that toward forced circulation.

The yard driers, the latest development for cheaper seasoning, were all of the forced-circulation type, and 7 out of the total of 10 such driers had automatic control of temperature and humidity.

Natural-draft and forced-circulation kiln units in operation in the Douglas fir region in 1936, by type of temperature and humidity control

Type of use	Number of kilns, by type										Total
	Natural draft					Forced circulation					
	Hand control		Automatic control			Hand control		Automatic control			
	Temperature	Humidity	Temperature	Humidity	Total	Temperature	Humidity	Temperature	Humidity	Total	
Lumber											
Softwood	161	243	190	108	351	15	34	459	440	474	825
Hardwood	14	16	7	5	21	--	--	3	3	3	24
Yard drier	--	--	--	--	--	3	3	7	7	10	10
Shingles	48	65	17	--	65	--	18	21	3	21	86
Staves	7	7	2	2	9	--	--	--	--	--	9
Handles and turnery	2	2	6	6	8	5	8	6	3	11	19
Plywood	--	--	--	--	--	2	2	9	9	11	11
Total	232	333	222	121	454	25	65	505	465	530	984

J. Elton Lodewick

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RATING FUEL CONDITIONS ON CUT-OVER LANDS

A satisfactory method of measuring or estimating fire hazard on a given area so as to compare it with the hazard on other areas is basic to any analysis of the effects of various types of cutting and various slash-disposal practices on forest fire conditions, and therefore is basic to the development of sound slash-disposal policies and practices. A method[1/] has been devised by the Pacific Northwest Forest Experiment Station by which a series of small plots taken at intervals on an area is used to measure differences in fuel conditions. Experience with this method indicates that it may be useful in studying fuel conditions on all types of partially cut and clear-cut forest areas.

Each of the plots is a milacre square (6.6' by 6.6'). Usually, from 1 to 10 plots are taken per acre. The observer stands at the center of each plot and records the kind, quantity, and distribution of all green and dead fuels in each of six zones on and above the plot: (1) Crown zone and (2) secondary crown zone, both 30 feet or more above the ground; (3) 30- to 5-foot, or high-brush, zone: (4) 5- to 1-foot, or low-brush, zone; (5) 1- to 0-foot, or ground-cover, zone; and (6) surface and duff zone. The density of cover in zones 1 to 4 is studied principally because of the influence of the shade of this cover on the moisture content of the fuels underneath; the kind, quantity, and distribution of fuels in zones 5 and 6 receive special attention because these are the zones in which an ordinary fire spreads.

Observations are made and recorded, also, regarding aspect, soil, and topography. Attention is given to such items as snags, windfalls, and rotten wood. A record is made of the history of the plot, i.e., the date when it was last burned over or was cut over, etc.

After making a physical inventory as just described, the observer makes an estimate of the probable rate of spread of a fire on each plot under an assumed standard set of burning conditions. Four classes of rate of spread are recognized, designated low, moderate, high, and extreme. These have the approximate numerical relation one to another of 1, 2, 4, 8; i.e., low rate of spread is unity, moderate is twice as fast as low, high is four times as fast as low, and extreme is eight or more times as fast as low. Probable resistance to control, the quantity of work that would probably be required to control a fire, is estimated for each plot in four classes also designated low, moderate, high, and extreme and having the same numerical values assigned to the rate-of-spread classes--i.e., low resistance to control is unity, moderate requires twice as much control work as low, etc.

Observers are used who have had experience in fire control and understand fire behavior. They are trained to make consistent and therefore comparable ratings of all items, particularly rate of spread and resistance to control.

1/ This method is described in greater detail in the following: Matthews, D. N. Small-plot method of rating forest fuels. Jour. Forestry 35: 929-931.

When a series of plots has been taken to sample fuel conditions on an area it is possible to make comparisons item by item with the ratings of series of plots taken on other areas, and thus to determine the significant differences between the areas.

The following example shows a few of the comparisons made possible by taking a series of small plots on an area before logging and later taking plots, in the unburned slash, on a part of the same area that was cat-logged and on the remainder of the area, which was donkey-logged.

Example of changes in fuel conditions resulting from logging, as measured by small-plot method

Item	Before logging (332 plots)	After light cut--cat logging (542 plots)	After heavy cut--donkey logging (232 plots)
	Percent of plots		
Exposure to sunlight			
Closed (full shade)	84	37	12
Intermediate	14	54	61
Open (no shade)	2	9	27
Hazard rating			
Rate of spread			
Low	47	29	16
Moderate	40	50	34
High	12	14	30
Extreme	1	7	20
Resistance to control			
Low	46	32	17
Moderate	39	48	34
High	11	16	36
Extreme	4	4	13
Average rating[1/]	Index number		
Rate of spread	1.83	2.36	3.59
Resistance to control	2.00	2.17	3.30
Combined (rate of spread times resistance to control)	3.66	5.12	11.85

1/ Each plot was given a rate-of-spread and a resistance-to-control rating based on the following scale: 1=low, 2=moderate, 4=high, and 8=extreme. These ratings were then averaged for each of the three conditions and the two index numbers thus arrived at for each condition were multiplied together to determine the combined rating.

D. N. Matthews

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SUMMER MOISTURE CHANGES IN SOME DEAD AND LIVE FOREST FUELS

Forest fire fighters in western Oregon and western Washington have learned by experience that a fire occurring in September burns more intensely than one occurring in July under the same weather conditions. In an effort to find an explanation for this difference, the moisture content of logs and snags ranging from 4 to 33 inches in diameter and of the foliage of live vegetation was measured several times weekly during the summers of 1935 and 1936 at the Wind River Experimental Forest, near Carson, Wash.

In 1935 the moisture content of Douglas fir logs and snags was measured by cutting out samples and drying them. Under this method, each measurement is made at a different point in the log or snag. In 1936 use was made of an electric device that measures wood moisture content repeatedly at the same points, by means of fixed electrodes. The electrodes were placed at depths of 1/2 inch to 5 inches. During both seasons the moisture content of the foliage of live vegetation was measured by gathering and drying quart samples of three shrub species, namely, vine maple (Acer circinatum), salal (Gaultheria shallon), and ceanothus (Ceanothus velutinus), and of Douglas fir needles from saplings, bracken (Pteris aquilina), and fireweed (Epilobium angustifolium). The Douglas fir needles were collected from various parts of the tree, so as to represent the foliage grown in previous years as well as that grown in the current year.

At a depth of 1/2 inch below the surface, the moisture content of the various sizes of logs and snags did not show any appreciable downward trend from July to September. The values for different logs and snags ranged from less than 7 percent to 20 percent(of the oven-dry weight of the wood). On the few days when rain occurred the moisture content increased sharply by 5 to 8 percent in the logs and somewhat less in the snags. At depths of 2 inches and 4 inches certain logs became slightly drier in September than they were in July, but the snags and the other logs showed no significant change. The moisture content at these depths in different logs and snags ranged from 12 percent to more than 60 percent. The southwest side of a snag was usually found to be much drier than the northeast side.

From July to September the foliage of vine maple, salal, ceanothus, bracken, and fireweed growing in the open showed a gradual decrease of moisture content. The samples collected in July had a moisture content in the neighborhood of 200 percent; those collected in September were from 40 to 60 percent drier. Vine maple foliage growing under a stand of virgin timber had a moisture content about 100 percent greater than that growing in the open. Douglas fir needles showed no significant change in moisture content from July to September.

William G. Morris

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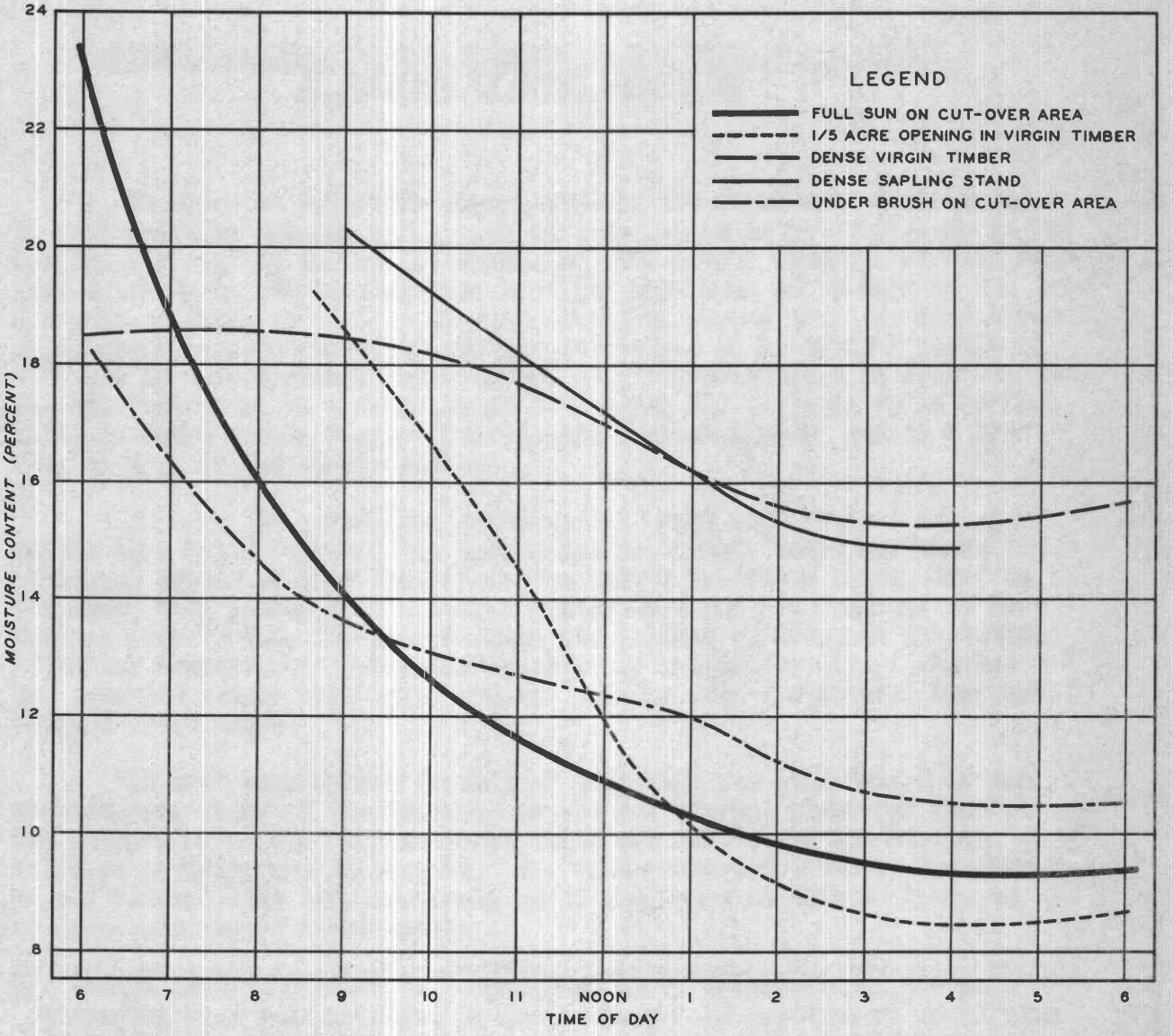
DIURNAL CHANGES IN FUEL MOISTURE IN THE DOUGLAS FIR FOREST AS AFFECTED BY COVER CONDITIONS

In order to determine experimentally the magnitude of differences in fuel moisture corresponding with differences in cover conditions in the Douglas fir region, during the summer of 1936 hourly readings of fuel moisture as shown by hazard indicator sticks[1/] were made on 10 days in the latter part of July, in five different situations on and near the Wind River Experimental Forest where the weather was judged to be uniform except as affected by forest cover: under brush on a cut-over area; in full sun on the cut-over area; in a dense stand of Douglas fir saplings 35 to 45 feet tall; in dense virgin Douglas fir-western hemlock timber; and in a 1/5-acre opening in the virgin timber.

In order to reduce the experimental error and obtain a series of sticks that would register the same moisture content under any given set of normal summer weather conditions the hazard indicator sticks used in the study were picked from a larger number that had been exposed to the weather side by side for several days and weighed at frequent intervals. After the measurements under different cover conditions were completed the selected sticks were again exposed side by side for several days and weighed frequently.

The most significant results of the study are illustrated by the accompanying graph of the measurements on one typical clear day when on the cut-over area the maximum temperature was 93° F. and the minimum relative humidity was 38 percent. The values charted cannot, of course, be put forward with such assurance as if they were arithmetic averages of large numbers of measurements.

1/ A hazard indicator stick is composed of three ½-inch-square pieces of ponderosa pine sapwood about 20 inches long held together by dowel pins with ½-inch spaces between the pieces. This is exposed to the weather and is weighed periodically for the purpose of determining its moisture content. Moisture content is expressed in percent of oven-dry weight of the indicator sticks. When weather conditions cause a change in the moisture content of nearby forest litter and other dead fuels, the relative magnitude of the change is shown by the change in weight of the hazard stick.



AVERAGE DAILY CHANGE IN MOISTURE CONTENT OF HAZARD INDICATOR STICKS EXPOSED UNDER DIFFERENT COVER CONDITIONS

On the cut-over area the hazard indicator sticks absorbed considerable dew on clear nights and at 6 a.m. contained about 23 percent moisture, which was equal to or more than that recorded at the same time in any of the other situations. The moisture in these sticks was quickly reduced by the heat of the direct sunlight and by the decrease in relative humidity, so that between 9 and 10 a.m. they became drier than the sticks in any of the other situations. Drying continued, but at a slower rate, until after 4 p.m.

The stick under brush on the cut-over area was sheltered so effectively that it did not receive much dew, and consequently showed 5 percent less moisture content at 6 a.m. than the stick in full sunlight. Its rate of drying, however, was slower than that of the stick in full sunlight and resembled that of the stick in the sapling stand. From 9:30 a.m. on, consequently, its moisture content was greater than that of the stick in full sunlight on the cut-over area.

In the sapling and virgin timber stands, where the sticks contained more than 18 percent moisture early in the morning, the moisture content diminished much more gradually than in full sunlight and at no time approached the low points registered there.

In the opening in virgin timber the stick contained as much moisture at 9 a.m. as that 200 feet distant in the dense timber. It was first struck by the sun about that time. From then until 2 p.m. it lost moisture as rapidly as the sticks on the cut-over area did earlier in the day, and by 1 p.m. it was slightly drier than the latter. No explanation can be offered at present for the apparent paradox that on most days the stick in the small timber opening became drier than that on the cut-over area.

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TAX RELIEF THROUGH REORGANIZATION OF LOCAL GOVERNMENT

A forest-taxation study is being made in two representative western Washington counties, Skamania and Pacific, with a view to adapting to northwestern conditions the recommendations made by the Forest Taxation Inquiry as to methods of reducing the cost of local government on forest and wild-land areas. Results of this study show that reorganization of local government to bring it into harmony with local geographic and economic conditions would vitally affect the tax burden on forests.

If the property tax on forests were made reasonably predictable for long periods and freed from great fluctuations due to fluctuating tax base and revenue needs of the small units of local government, then investment in growing forests could be made more attractive. The results of these studies show how this may be accomplished.

It has been found that in drawing school-district boundaries, many years ago, local boundary boards have in effect allotted the timber and wild-land tax base among the districts in an arbitrary fashion, without any well-defined ideas of equity. This has encouraged local extravagance in some districts and, in some others, very high taxes to preserve the districts' existence. The later introduction of port, public-utility, and other special taxing districts, having arbitrary boundaries that embrace portions of the important timber values but that bear no relation to the areas benefited, has increased the tax hazards of timberland ownership.

A plan is suggested whereby the revenue to be derived from all wild lands, timberlands, and other property in the State lying outside the zone of local-government influence would be pooled. An unorganized territory and a State joint school district coextensive therewith would be established and would be administered by the State. Property in this unorganized territory would bear the usual tax for State purposes and a tax at a uniform rate for county and school purposes, but would be immune from all special district levies. County and school monies raised in this manner would be distributed to the counties and school districts of the State in some equitable manner provided by State law. This is a local adaption of a plan that has been in effect in the State of Maine for more than 100 years. The forest-taxation study involves computations to determine just how adoption of the suggested plan would affect government costs and tax burdens in the selected counties.

Work has been completed in Skamania County, is nearly completed in Pacific County, and will be undertaken shortly in a third county in Washington.

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