CALIFORNIA FOREST AND RANGE EXPERIMENT STATION

FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE
IN COOPERATION WITH THE UNIVERSITY OF CALIFORNIA
BERKELEY

THE BLACKS MOUNTAIN EXPERIMENTAL FOREST

of the

CALIFORNIA FOREST AND RANGE EXPERIMENT STATION[1]

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U. S. Department of Agriculture, Forest Service
in cooperation with the University of California

Guide to the

BLACKS MOUNTAIN EXPERIMENTAL FOREST

A SUSTAINED YIELD EXPERIMENT IN PONDEROSA PINE

IN NORTHEASTERN CALIFORNIA

U. S. Department of Agriculture
Forest Service
California Forest and Range Experiment Station

E. I. Kotok, Director

1938

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IN NORTHEASTERN CALIFORNIA

Experimental forests, watersheds, and ranges are the field laboratories in the research structure of the Forest Service. The California Forest and Range Experiment Station maintains four experimental forests representing the more important timber types in the Pine Region.

The Blacks Mountain Experimental Forest represents the ponderosa pine type of California's northeastern plateau, commonly called "east slope" pine. The type occupies approximately 3,700,000 acres of which about 2,700,000 acres are virgin timber. Lumber is the principal source of income from land in this type. A severe climate restricts present agriculture to grazing of sheep and cattle. Watershed values are of minor consequence because of low gradients, pervious soils, light precipitation, and closed drainages. Recreational values are comparatively limited, being restricted to a few areas of high scenic interest and to deer hunting.

The lumber from virgin stands is of exceptional quality because of uniform slow growth and great age of the timber, the better grades competing successfully in markets throughout the country. Poor site quality, reflected in slow growth, and prevalent insect losses are features discouraging continuous forest management. Heavy liquidation cutting now being practiced probably will seriously deplete the virgin timber in 15 or 20 years.

PURPOSES OF THE SUSTAINED YIELD EXPERIMENT

A test of continuous forest management implies acceptance of the hypothesis that conservative use of natural virgin timber reserves over as long a period as possible is better social economy than rapid liquidation. Management of a specific tract imparts realism to the hypothesis through impelling choice of action in the forest.

The principal aim of the project is to test the practical value of certain theories of management, silviculture, and insect control derived from disconnected studies since 1910. Such theories should be subjected to proving-ground demonstrations before being recommended to industry or public land administrators.

Secondarily, the several research activities comprising a field work center are given orientation and perspective by the common aim, practical management of a forest.

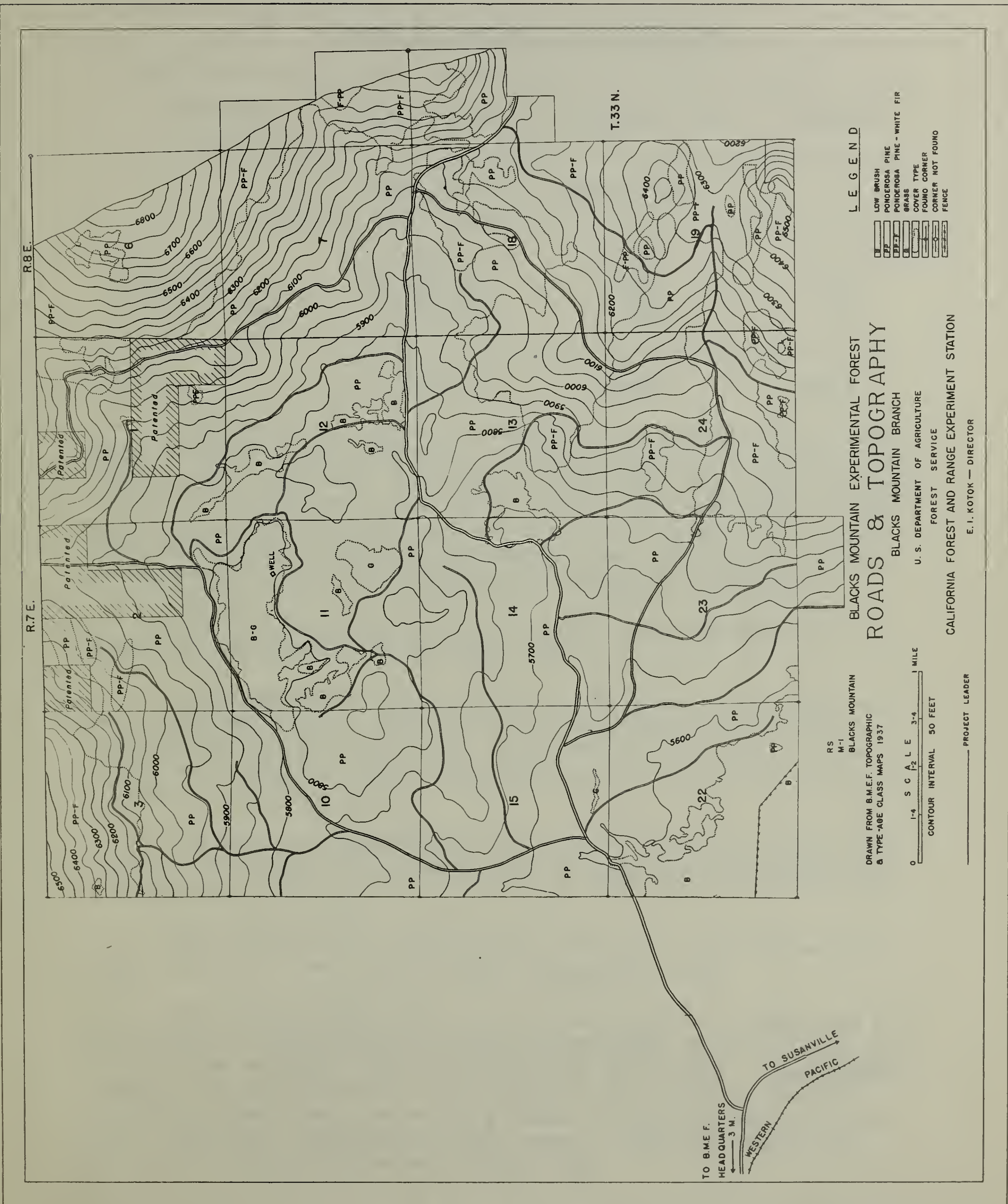
THE EXPERIMENTAL FOREST

The Blacks Mountain experimental forest is located about 40 miles northwest of Susanville and about 35 miles north of Westwood, in the Lassen National Forest. Susanville is the present milling center for the Eastern Lassen Working Circle, of which this area is a part. The location of the area with respect to highways and to the Western Pacific Railroad is shown by the map on the back cover. Reference to the more detailed map of roads and topography (Figure 1) shows the east boundary as about 7 miles, and the west boundary about 1 1/2 miles from the Western Pacific Railroad and the Susanville-Pittville highway toward which the topography inclines. Elevation ranges from 5600 to 6800 feet. All of the ground is favorable for tractor and truck logging. The gross area of the forest is 9826 acres of which 9094 acres are timbered.

The wood producing capacity of the soil and climate is below average for pine sites in California. The rating in a 5-site classification is between 3 and 4. The average total height of dominant trees at 300 years is 114 feet. The soil is derived from lava, mostly vesicular andesite. Rock outcrops are numerous and any soil disturbance, as in road building or skidding, turns up many loose rocks and boulders. The soil itself is quite productive when moisture is available, and it is probably the scarcity or lack of precipitation during the growing season that accounts for the low quality of site. Precipitation for the 1937-1938 season was 23 inches. Normally annual precipitation probably does not exceed 20 inches for this locality. Temperatures range from about -20° F. to about 95° F.

The timber is largely ponderosa and Jeffrey pine, but with some admixture of white fir and incense cedar on the upper slopes. These latter species are more prominent in the young growth than in the main stand. About 57 percent of the timbered area is fully stocked with advance growth reproduction up to 60 years old. (Full stocking is rated as 1000 trees per acre). Brush is comparatively light on all except 409 acres.

The stand is typically open with groupwise distribution. These small groups tend to be even-aged. About 95 percent of the volume is in trees more than 120 years old. The tree of average volume is 32 inches in diameter and 310 years old. Stocking is estimated at only 38 percent of the normal capacity. This may be explained largely by the poor representation of the thrifty intermediate age classes - trees 75 to 150 years old.



BLACKS MOUNTAIN EXPERIMENTAL FOREST
ROADS & TOPOGRAPHY
BLACKS MOUNTAIN BRANCH
U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
CALIFORNIA FOREST AND RANGE EXPERIMENT STATION
E. I. KOTOK — DIRECTOR
LEGEND
LOW BRUSH
PONDEROSA PINE
PONDEROSA PINE - WHITE FIR
GRASS
COVER TYPE
FOUND CORNER
CORNER NOT FOUND
FENCE
RS
M-1
BLACKS MOUNTAIN
DRAWN FROM B.M.E.F. TOPOGRAPHIC & TYPE-AGE CLASS MAPS 1937
SCALE
1 MILE
CONTOUR INTERVAL 50 FEET
PROJECT LEADER
R.7 E.
R.8 E.
T.33 N.
Patented
WELL
TO B.M.E.F. HEADQUARTERS 3 M.
TO SUSANVILLE
WESTERN PACIFIC

Figure 1.

The following table shows the distribution of volume (Scribner) by species:

Volume by species as of 1933-1934

Species	Total volume	Volume per acre	Percent
	Board feet	Board feet	
Pine	151,840,790	16,726	90.5
White fir	10,932,340	1,204	6.5
Incense cedar	5,032,807	554	3.0
Total	167,805,937	18,484	100.0

Quality of the timber is probably about average for the type. Decay in pine, on the 240 acres cut over in 1937, resulted in a cull deduction of 9 percent. Bark beetle losses have been high, averaging 203 board feet to the acre annually between 1933 and 1937. Present growth is about 127 board feet, so there is a net loss of 76 board feet to the acre annually in the virgin stand. Mistletoe infection is not general, but is of importance in specific localities.

The area was approved and set aside as an experimental forest by the Forester on March 28, 1934.

A 100 percent inventory of trees 3.6 inches d.b.h. and over was completed in 1934. Along with the inventory detailed topographic and type maps were made, which afforded the basis for deciding on location of roads and subdivision of the area into compartments or working units.

All construction work has been done by CCC labor under supervision of the Lassen Forest according to specifications drawn up by the Experiment Station.

Road construction was started in 1934 and completed early in 1937, except for surfacing the main utilization road.

The forest headquarters are located along the county road for convenience of visitors and because of proximity to the railroad and the CCC camp at Halls Flat (1 1/2 miles to the north). Improvements completed to date include an office-laboratory, superintendent's residence, bunk house, two small garages, a warehouse-garage, mess hall, dormitory, pumphouse and tank tower, a 600-foot well, and a 5000 gallon underground water storage tank.

The entire experimental forest is divided into compartments averaging about 100 acres each. These compartments are bounded by roads and monumented lines. In most cases the lines were located in such a manner that logs could be skidded from any part of the compartment to the road without crossing a compartment boundary.

OBJECTIVES OF MANAGEMENT

The objectives of management cannot be fixed with certainty in advance. Future markets and growth after regulation must be estimated. Certain hypotheses have been set up as goals to work towards.

The product is to be ponderosa and Jeffrey pine saw timber.

The size of the operation under regulated yield may be forecast approximately. It is desirable that the operation be large enough for efficiency, remembering that efficiency cannot be judged entirely by present-day lumbering standards. The poor site, experience with growth, and the area likely to be tributary to a single plant, dictate a small operation. The output aimed for will be 50,000 board feet a day for 100 days, or 5,000,000 feet a year.

After regulation, the trees to be cut will range from 12 to 30 inches in diameter, with an average of about 20 inches. The average tree in the stand will be 14 inches in the year after a periodic cut. On this site such trees probably can be grown in a rotation of 140 years. Some lumber of higher grades may be obtained by pruning butt logs of the more promising dominant pines.

Cutting cycles, after regulation, will average 20 years. During the conversion period cutting cycles must be irregular, usually shorter than 20 years.

A forecast of growth indicates that not more than 150 board feet to the acre annually can be expected after regulation. It will be necessary to cut profitably as little as 3000 feet to the acre. Gross income from growth will be about 2 1/2 percent a year.

The test requires operating at a profit within these narrow margins.

It is proposed to manage about 8000 acres of the experimental forest as though this area were a fraction of a larger working circle capable of supporting an operation of five million feet annual capacity. Conversion cuttings in the merchantable stand will extend over a period of 10 or 12 years. Stand improvement, insect control, and fire protection will continue until the twentieth year. The aim is to manipulate the present large valuable reserve over a 20 year period in such a way as to establish the elements of a regulated stand and pay for improvements, cultural treatments, insect control, fire protection, and administration.

A research program cannot be projected safely beyond 20 years. Obviously, a stand of this kind cannot be brought under regulation in 20 years. It is necessary to have some standard against which progress toward regulation can be checked by periodic measurements. Such a standard has been set up from previous research, the framework of the ideal regulated stand being shown in the form of charts.

STANDARD FOR REGULATION

In setting up the ideal stand, the first item estimated was the volume of the working reserve at the beginning of a cutting cycle. Normal yield for selection stands of this character is indeterminate. It was necessary, therefore, to estimate the volume of the working reserve from a recent yield table prepared by Dr. Walter Meyer. The assumption was made that yield in a fully stocked selection stand will be the same as yield in a fully stocked even-aged stand. Most foresters hold the opinion that selection stands yield somewhat less than even-aged stands. The yield table for site index 114 feet was discounted to 80 percent, a customary allowance for deficiencies in stocking. For the regulated selection stand with seven 20-year cutting cycles, the working reserve was estimated by adding one-seventh of the discounted tabular values for the six age-classes 0 - 20, ---, 100 - 120, the sum being 5244 board feet to the acre.

The periodic cut was estimated at 2887 board feet by taking one-seventh of the corrected yield table value for age-class 120 - 140. The working reserve must grow at the annual rate of 144 board feet to produce this cut in 20 years. It was necessary to approximate the diameter and tree-class distribution of the reserve which would maintain this optimum growth.

Analysis of Blacks Mountain and other selection stand records has shown that when volume in board feet for the total stand, or for a Region 5 tree-class, is plotted over diameter, a normal distribution results. A normal distribution is described by the mean and the standard deviation. In the desired distribution the mean of the stand is fixed by capacity of the site and management objectives at 14 inches. It was necessary to assume that the standard deviation will be the same as for natural selection stands. From published tables for normal distributions, the proportion of the 5244 board feet expected in each diameter class was computed.

The proportion of the reserve in each tree-class was determined from studies of selection stand structure, yield, and effects of cutting. These experiments indicate that, by treatment control, it should be possible to maintain 80 percent of the reserve in Class 1 (dominant) trees. Site and management objectives fix the mean of these Class 1 trees at 20 inches. Taking the standard deviation for this group in natural stands, the volume was allocated to the various diameter classes. In a similar way the remaining 20 percent of the reserve in Classes 2 and 6 (codominant, and intermediate and suppressed) was distributed.

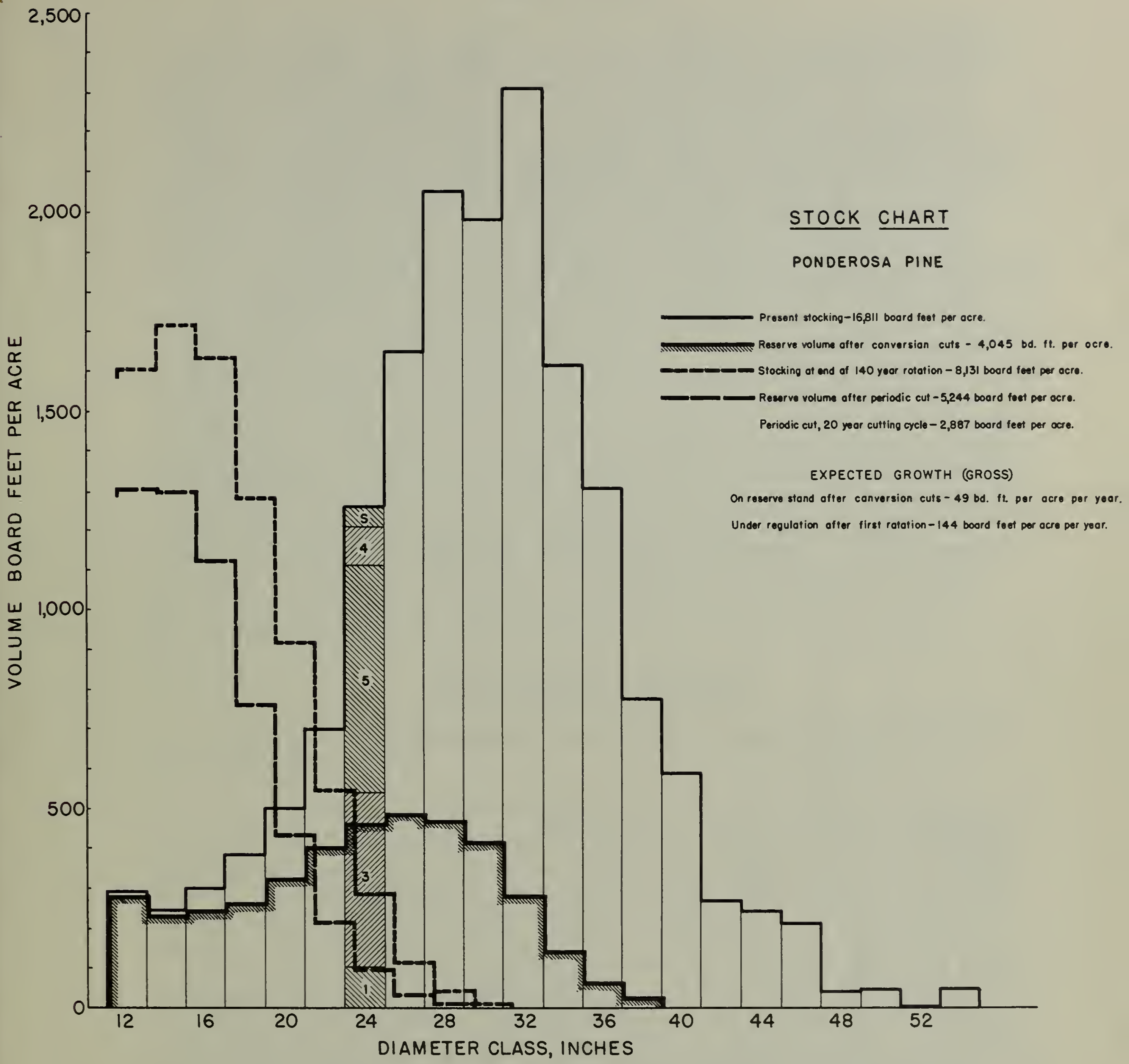
Since selection stand management requires individual tree control, it was necessary to know the number of trees there should be in each diameter and tree-class. Previous studies have shown that when number of trees in the stand, or in a Region 5 tree-class, is plotted over diameter, another characteristic distribution -- the J-shaped curve -- results. Relying on this fact, the number of trees were apportioned to the diameter classes in much the same way as for volume. (Figure 2).

Independent support for the belief that this reserve stand of 5244 board feet will yield the requisite 144 board feet annually was sought in a recently prepared growth predicting mechanism for selection stands. This yield predicting mechanism consists of three alinement charts -- one for growth of trees 12 inches and larger, one for those trees which become 12 inches and larger in a 20-year period, and one for losses. The first two charts indicate that, in a stand of this type, the trees 12 inches and larger may be expected to produce about 80 board feet to the acre yearly, and the pole stand may contribute an additional 63 board feet, giving a total gross growth of 143 board feet. The third chart indicates that normal losses should average about 12 board feet, so that net growth will be only 131 board feet to the acre annually.

These growth and loss predictions are founded on records from stands receiving but a single conversion cut. The more intensive silviculture contemplated should result in better growth rates than estimated. On the other hand, losses are now abnormal, and if the optimum net growth is to be maintained, there must be effective insect control as well as intensive silviculture.

SILVICULTURE

In the method of cutting proposed in this area the idea of single-cut lumbering and mere culling of stands will be abandoned, because this practice offers little hope of getting regeneration, satisfactory growth, good quality, proper composition, and control of brush and insects. It is recognized that intensive silviculture is needed and that costs must be kept within the low income from growth. Part of the income from the initial cuts will be reinvested in the remaining stand with the intent of recovering the investment from future crops. During the course of the study, how much should be spent and what treatments will be effective are to be determined, if possible.



BLACKS MOUNTAIN EXPERIMENTAL FOREST

COMPARTMENT B 25-1

Figure 2

Insect Control

One of the most pressing problems is that of insect control. At the current rate of loss, every year's delay in reaching an acre results, on the average, in a gross loss of 203 board feet and an estimated net loss of 76 board feet. A basis for selective risk marking is needed when relatively large reserves of old timber are to be carried as in the present experiment. A tentative basis for such selection has been developed by the Bureau of Entomology and Plant Quarantine during the past 7 years and is being adequately tested in this area. These studies have shown that incipient broods of the California flathead borer are present in a relatively large proportion of the green trees. It is believed the continuation of conditions adverse to the trees permits the larval broods to develop rapidly and kill the trees or induces attacks by bark beetles. These incipient flathead infestations are associated with deteriorative changes in the needles and crowns of trees which can be detected for an, as yet, undetermined period of time before the trees are killed. The Bureau has prepared a tentative risk marking guide for this project, based on appearances of the leaves and crowns of the trees. Four degrees of risk are recognized. Salvage logging is directed to those areas having the greatest numbers of high risk trees. Trees considered doomed will be cut in advance of death and staining. If the supply of highly susceptible trees can be maintained low enough, perhaps bark beetle populations cannot gain sufficient strength to attack more resistant trees in great numbers.

Silvicultural Principles

Previous studies suggest the following general silvicultural principles for trial:

1. Cutting will be flexible with respect to time. (Figure 3) Pine seed crops are infrequent, irregular, and so, are unpredictable for more than a year in advance. Only good crops are of much importance in restocking because rodents and many other agencies overtax light sporadic yields. There should be openings free of competition and with exposed soil, coincident with seed fall. If logging precedes the seed crop by more than two or three years, brush and weeds often usurp these favorable openings. An effort will be made to time cutting by observing seed crops a year in advance of seed fall. Just as good germination will be sporadic, so will release of reproduction come due at irregular, though less compelling intervals. Large reproduction approaching merchantable size-limits will be released first. Frequent returns to the same acre are necessary to maintain uniform growth (volume and quality) of light demanding trees in selection forests. Insect damage occurs sporadically. The hypothesis of salvage-control requires anticipation of killing and staining of timber and the build-up of broods. In deference to management, it must be recognized that the market is variable. Since the stands are not uniform in quality, there must be freedom to select what is wanted currently. Priority in timing cutting will follow the order of needs for insect control, for release, for seeding, and for quality of product.

Figure 3. Mature ponderosa pine stand without advance growth. A series of light cuts will be made when good seed crops are ripe in order to make conditions favorable for establishment of reproduction.

Figure 4. Pruning will be started in trees of pole size when dead limbs extend up the bole 6 feet or more. Under future management the 31 inch tree to the right will be the maximum size grown and the butt 32 feet will be free of dead limbs and surface knots.

2. Cutting will be flexible with respect to area. Seed crops usually do not occur simultaneously over large areas. Advance growth is irregularly distributed and new reproduction may be expected to occur in the same way. It follows that preparatory seed and release cuttings must be irregularly spaced over the area. Insects have a tendency to attack trees in groups, and the intensity of damage is seldom uniform over large areas. The brush hazard is not uniform. Similarly, the quality of timber varies from place to place. Area priority will be in the same order as for time.

3. Cutting will be flexible with respect to the volume removed. Where advance growth is absent, the first cut will be light. Where there is no reproduction and brush is present, only those trees rated highly susceptible to insect attacks will be cut. The light reserve stands left in single-cut lumbering produce too little seed to effect prompt restocking. A light initial cut should provide openings and insure a greater seed supply. Where reproduction is already established, moderate to heavy release cuttings will be made, regulated by the age, stature, and density of the advance growth. In the first salvage cut, the volume removed will vary with the occurrence of trees highly susceptible to insects.

4. Tree selection will be based on an insect risk rating, Region 5 tree classes, and new Region 5 log grades. Trees which can never be merchantable because of species, form, or disease, will be removed as a stand improvement measure where future crop trees are affected adversely.

Cutting System

The selection form of forest has been adopted for this trial, a fact already apparent from the text. Some may have doubts as to the wisdom of this attempt to maintain a light-demanding species like ponderosa pine in the selection form. In support of this decision, it should be explained that the grouped arrangement of age classes will be sought, -- a form most frequently assumed by natural forests. Also, the possible shade-enduring invaders, white fir and incense cedar, are at the disadvantage of being near the limits of their natural distribution and should not be very troublesome here. Brush promises more difficulty than the minor trees, and selection treatments seem best adapted to its control. A cogent factor in the decision was the belief that bark beetle infestations are less likely to reach epidemic proportions in selection stands.

Sanitation - Salvage Cut

The first cutting treatment, begun in September, 1937, is designed for salvage-insect control. The aim is to cover in 2 to 4 years the portions of the area with accumulations of high risk timber. This rapid coverage required a tentative decision as to the lightest cut which could be logged economically where the volume is widely dispersed. There was no similar lumbering experience to draw upon. The cut being tried is a minimum of 2500 board feet to the acre. Advance surveys indicate that this volume usually will include all the high risk trees. Where the volume of high risk trees falls below 2500 feet, enough good risk trees of highest quality are being marked to make up the deficit. When defect is encountered, additional trees are marked to keep the net volume up to this figure. In 1937 the cut averaged 2604 board feet to the acre, or about 14 percent of the stand.

This salvage-sanitation treatment probably will have no appreciable effects on growth rates in the remaining stand, or on restocking.

Conversion Cuts

Subsequent silvicultural cuttings will be based on the principles outlined above. Marking will be guided by detailed maps showing the status of reproduction and brush in each compartment, and by stand graphs showing for each compartment the current stand structure and the ideal stand to be approached.

These conversion treatments obviously will result in varied reserve stands, some light and some heavy. The decadent condition of the timber indicates that by the end of 12 years, reserve stands probably should be reduced to about 20 to 25 percent of the original volume. This will be accomplished in from one to three cuttings.

The cut, of course, also will be variable. The inventory data indicate that a fairly uniform output from the area as a whole can be maintained. The most uncertain elements are insect control and the occurrence of reproduction. When cutting for these two essentials does not provide a sufficient monthly or seasonal output, the deficit can be made up by cutting to release advance growth in which there is considerable option as to time and area.

Stand Improvement

Reference to earlier growth estimates shows that 63 board feet, or 44 percent, of the expected growth must come from small trees largely present as advance growth. Growth of these trees to merchantable size must be hastened if the gap between conversion and regulated cuts is to be shortened. (Figure 5) Thinning experiments show that progress cannot be left to Nature, and that the harvest cuts, alone, will not be sufficient. Over limited portions of the area, fir and cedar advance growth must be kept in check. Thinning will be designed to release the number of crop trees indicated as desirable by the stand graphs.

Figure 5. An excellent pole stand which has developed in an opening free from competition with the old stand. Crop trees will be selected and pruned to produce butt logs of high quality. Saplings in dense stands under an overstory of mature trees may be expected to develop into stands such as this following release.

Recalling that the average tree cut can be only 20 inches in diameter, it appears necessary to prune first logs of the most promising young dominant pines. (Figure 4)

To prevent further seeding in of fir and cedar, the few larger trees of these species will be cut. Most of these trees are unmerchantable because of decay. Some of the cedar will be yarded in tree-lengths to roadways and made into fence posts. The other trees, including pines with no present or future value, will be felled and lopped in place.

Stand improvement will be performed as a separate operation independent of logging. An attempt will be made to use unskilled labor not employable in logging, and to extend the work season for loggers over periods when such workers usually would be idle. No stand improvement has been done thus far. Probably such work will be limited to special experiments large enough to determine costs and silvicultural effects.

Fire Protection

A special plan for protecting the experimental forest from fire is in operation. General protection is provided by the local District Ranger's force. During periods of extreme fire danger, a lookout within the forest will be manned. The visibility map discloses that three regular lookouts see parts of the area, but are too distant for intensive protection. A telephone line is under construction to connect the lookout with headquarters. Radios maintain contact between lookouts and woods crews. Utilization roads permit convenient access to all parts of the forest. In addition to these roads, one to three permanent main skid trails in each 100-acre compartment serve as firebreaks. A tank-truck of 1100 gallons capacity, with pump attached, serves the dual purpose of road sprinkling and fire suppression. Smoking restrictions conform to rules in effect on Region 5 timber sales.

Slash from the present light sanitation cut is being left in place. Tops and unmerchantable trees are lopped. When heavier cuttings are begun, the system of partial piling and burning slash will be followed.

Snags are numerous. In some places insects have killed trees at the rate of 600 to the section in a single year. (Figure 6) Many of these dead trees have fallen from natural causes. To fell the many now standing would interfere seriously with a type of logging that requires repeated cuts. For the present, snag disposal is confined to roadways and main skid trails. Snags which are a menace to yarding crews are felled in advance of logging. After the final conversion cut is made, snags still standing will be cut.

Figure 6. Losses from insects averaged 203 board feet per acre annually between 1933 and 1937. These losses are continuing in the uncut stands. The accumulation of snags constitutes a serious fire hazard.

Figure 7. The "V" notch blaze shows the CCC felling crew the direction the tree is to be felled. Avoidance of damage to reproduction and direction of skidding are the main considerations here.

LOGGING

The tractor and truck system of logging is being used. All woods operations are performed by Federal employees with Government owned equipment. Research cannot be scheduled far enough in advance to permit equitable contracts with private loggers.

Road System

Flexibility in cutting with respect to time, area, and volume required advance construction of a road system. The location, mileage, and standards could not be determined entirely by the present virgin stand. The roads must be adapted to future, lighter and less valuable cuts, as well. It was assumed that roads meeting the requirement for logging would be sufficient for protection and administrative needs. The mileage that would be efficient would depend upon construction and maintenance costs, and the relative costs of tractor and truck hauls where loads would be more widely dispersed than in one-cut operations of today. Again estimates had to be made subject to confirmation by study.

Location was determined entirely by topography and capacity of the land to grow merchantable timber. Paper locations were made on a map which showed 10 foot differences in elevation, barriers to logging, and fail places. From office notes, a trial ground location was made and adjusted later to the final line, where construction difficulties were encountered. Compartment boundaries were made to conform to the roads in such a way that the timber in any compartment can be yarded downslope without disturbing any other compartment. To facilitate protection, particularly, most of the roads are inter-communicating to avoid culs-de-sac.

Mileage was determined by setting the standard of 2000 feet as the maximum tractor haul. There was definite intent to set mileage higher than would be necessary in standard logging in order to include the maximum study might show to be efficient. If portions of the system do not pay, they can be omitted from cost figures. The road system amounts to about 47 miles.

Roads are of three standards. The main road of highest standard extends from the railroad and county highway by the lowest route through the middle of the forest for about 7 miles. The road is cleared to a width of 22 feet. The tread is 13 to 15 feet wide. The road is now being surfaced with fine crushed rock over a coarser crushed rock base 8 inches thick. Turnouts are 125 feet long and 24 feet wide for a distance of 75 feet. Curves are limited to a radius of 60 feet. There are no adverse grades and the maximum favorable grade is only 5 percent for about one mile. Construction cost about $5000 a mile.

Three secondary roads have a total length of 12 miles. These are cleared to a width of 18 feet. The tread is 11 to 12 feet wide and is unsurfaced. Curves have a minimum radius of 60 feet. Grades are all with the load, the maximum being 10 percent for 750 feet. Construction cost approximately $2000 a mile.

Tertiary roads number 23 with a total length of 28 miles. These are cleared to a width of 16 feet, have 10 to 12 foot treads, and curves of 50 feet minimum radius. They are unsurfaced. Grades are limited to 10 percent with the load and 5 percent against the load. They were simply constructed by ripping, rock picking, and blading to make easy travel for trucks with pneumatic tires. Construction cost about $800 a mile.

All truck roads were constructed by Civilian Conservation Corps labor.

In addition to the truck roads, one to three permanent tractor trails are opened into each compartment by confining the larger tractor to the predetermined locations in logging.

For road maintenance a motorized patrol is used. To repair surfaced sections, a stock of crushed rock is being made by a crusher in the forest. Sprinkling unsurfaced roads has not been necessary thus far, so the sprinkler truck has been constantly available for fire suppression.

Crews

At the present time, all members of the logging crew are Civilian Conservation Corps men, except the foremen. A technical forester is in general charge of all operations in the experimental forest. An experienced logging superintendent has direct charge of woods operations. There are three experienced foremen -- a bull-buck, a truck landing boss, and a top-loader at the railroad. Maintenance and servicing of equipment is handled by contract with the Forest Service Redding Shops, a head mechanic being stationed on the operation.

Felling, Limbing, and Bucking

The trees are marked for insect risk by a resident entomologist of the Bureau. A technical forester marks the trees for cutting, log-grades each tree, and indicates the most desirable direction of felling. (Figure 7) Because the trees are necessarily scattered, he also prepares a rough map for the woods foremen, showing the location of each marked tree, the main skidding trails, and the landings.

Hand tools of the usual kinds are used in felling, limbing, and bucking. Limbing is done where the tree falls, except that those limbs on the under side are removed after the tree is yarded to the main trail. Bucking is accomplished at the main skid trails.

Yarding

Present equipment for yarding consists of one 64 horse-power semi-diesel tractor with single drum and arch, and one 96 horse-power diesel tractor with single drum and arch. Trees are yarded, full length, with the smaller tractor to the main skid trails where they are spotted for bucking, inclined toward the landing. The larger tractor is confined to hauling along main skid trails to landings. This system permits large loads and reduces damage in the reserve stand to a minimum.

Loading Trucks

Loading the trucks is a crucial operation in present light sanitation logging. Landings are necessarily small and moves are frequent. The loader must be mobile, yet powerful enough to handle large logs. No suitable standard equipment was available. The loading equipment being tested consists of a two-wheeled industrial crane with a live boom, attached to the rear of a 62 horse-power diesel tractor fitted with two drums. This crane is furnished under cooperative agreement by the Le Tourneau Company. The company made minor changes to adapt the crane for logging after first tests in 1937. (Figure 8) A report on this piece of equipment will be prepared at the end of this season.

The tractor used in loading is equipped with trail-builder, and serves to clear landings of numerous rocks unearthed in road construction, to make turn-arounds, extend spurs, and for standby yarding.

Trucking

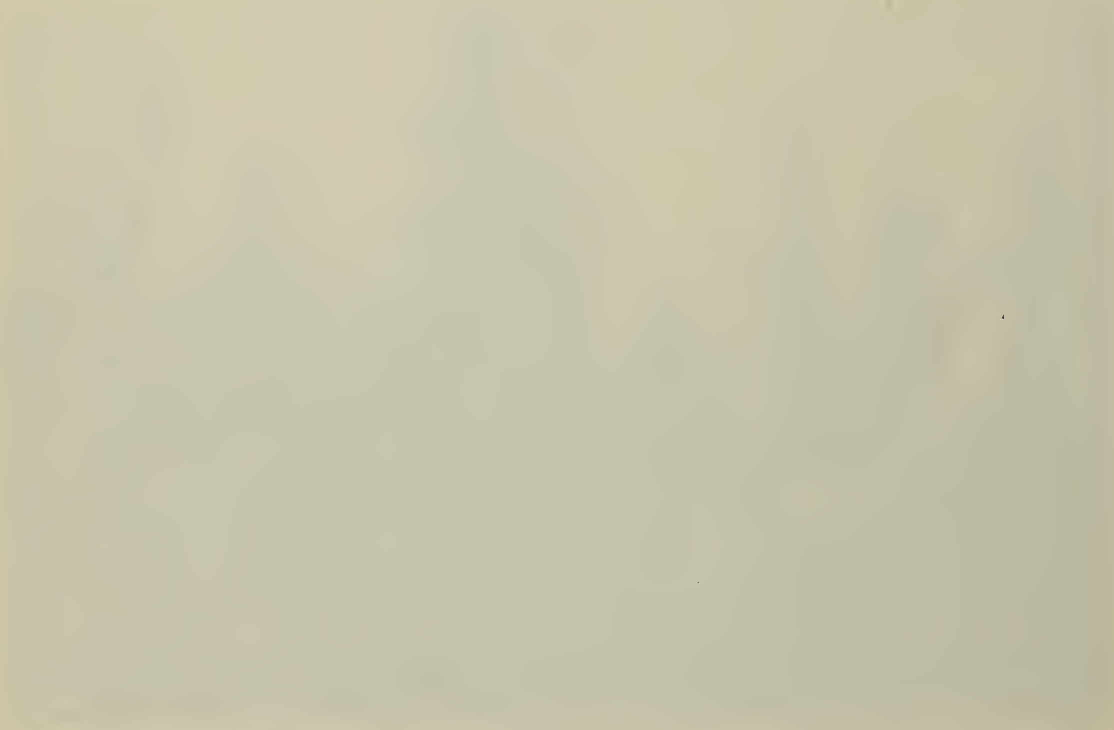
Hauling equipment consists of five trucks with trailers with load capacities of 3000 board feet, and two trucks with trailers capable of hauling average loads of 4000 feet. At the present time the logs are being hauled an extra 22 miles over the county road to the Fruit Growers Supply Company logging railroad, because arrangements have not been completed for hauling over the nearby Western Pacific. (Figure 9)

Loading Cars

Logs are unloaded from the trucks and loaded on cars with a 50 horse-power, two-drum, diesel winch. Two poles are used to permit decking in case cars are not always on the spur.

Figure 8. Loading a 32-foot log with the Le Tourneau industrial crane. Mobile loading equipment, making frequent moves to new landings feasible, is essential to the Blacks Mountain method of cutting .

Figure 9. Railroad landing at the Fruit Growers Supply Company's Feather Lake spur. The truck haul is 22 miles.



Utilization

The standards for utilization are about the same as for current Forest Service sales. The logs are cut to 32-foot lengths whenever possible. Because of expected prevalence of incipient insect attacks in this sanitation cut, stained logs are not sent to the mill by special agreement with the buyer. But little stain has appeared thus far. Scaling follows standard Forest Service procedure. The daily output is about 30,000 feet in six hours, at present. The timber averaged about three 16-foot logs to the thousand board feet in 1937.

Sale of logs by grades is planned, after a period of study to determine reliability of a new grading system, and feasibility of this method of marketing.

RECORDS

The Blacks Mountain project has two aspects of interest with respect to general research methodology. First, it exemplifies the principle that theories derived from small scale, often disconnected, laboratory-type of studies should be put to a proving-ground test before they are recommended to forest administrators. In the second place, it exemplifies the conviction that the several studies at a field research center should have a common aim, namely, management for the type of forest represented. This common aim gives realism and practical orientation to research, not possible when the experimental forest is used merely as a place for field plots.

The project has been discussed as a unit. Obviously, if observations are to take the form of independent measurements, the project must be handled as a series of separate studies, each with a definite plan and yielding results of independent value. This procedure minimizes the risk of complete failure and insures a continuing output of useful reports at not too lengthy intervals. The numerous studies can be characterized only briefly by examples.

Comparison of different methods of cutting will be continued, even though a special method has been adopted as most promising for the major test. This year, and in each of the next nine years, installation of permanent plots will be completed to afford comparisons of Forest Service, modified Forest Service, and Blacks Mountain methods of cutting, using a random block design.

Entomological studies by the Bureau, aside from the main object of salvage control, should yield information on such questions as to whether or not lack of control on one property jeopardizes adjoining treated timber. Several compartments will be left in the natural state in various parts of the forest.

Utilization studies should result in improved log grade standards, standards for grading standing trees, and costs of operating standard equipment. Probably some new equipment will be developed, or will be tested in the experimental forest, as has already been done with the loader mentioned.

Sampling methods, as may be inferred are receiving special attention. Costs, particularly, must be representative and sound if success is to be attained. A special study of administrative costs will be made to determine the portion justly due to timber management. Cost calculations will be made from the standpoint of both private and public owner.

It is appreciated that operating costs, with present emergency type labor, are not representative of standards of the industry. An important aim of the CCC is to train men, and this purpose requires frequent replacements with inexperienced crews. Incidentally, it is safe to say that few other CCC activities have been received with greater interest by the enrollees. It should be explained that most of the operations involved in logging have been studied already, under standard conditions. The time units can be applied to any cost structure. Important procedures peculiar to this project will be studied by hiring skilled labor for periods long enough to provide reliable samples.

Growth, loss, and stand structure changes, for the area as a whole, will be determined by periodic sampling inventories. Anticipating that ordinary cruising would not be efficient, and that permanent sample plots would be too expensive, a study of sampling methods was undertaken when the project was started. A complete inventory of the forest was made by small units of 2 1/2 acres. With the total stand variance to check against, it is possible to determine what size, shape, or arrangement of sampling units is most efficient for the most important attributes.

To detect changes assignable to growth, which may be as small as 2 or 3 percent, it is necessary to exclude from periodic comparisons the errors of sampling, which may be as large as 10 to 30 percent. To exclude sampling error, it is necessary to relocate the same units or plots, each period. An intensive control survey makes this possible in the experimental forest.

It will be necessary to study tree attributes which change with time, such as tree-class, or risk rating. Such comparisons require that the tree-class groups contain the same trees at the beginning and end of the period. It will be necessary to identify individual trees by mapping, numbering, or both. Expensive as this procedure may be, it is deemed essential.

A by-product of this project is a report on sampling procedure by A. A. Hasel, now awaiting publication. The paper has an important bearing on cruising, larger forest surveys, and similar work.

In conclusion it may be said that those responsible for the Blacks Mountain project are burdened with no illusions of simplicity of the many problems involved. Experienced counsel is being sought from forest administrators, lumbermen, engineers, and other groups. (Figure 10) A considerable number of persons and agencies are cooperating wholeheartedly to make the undertaking succeed. Interested criticism is most welcome.

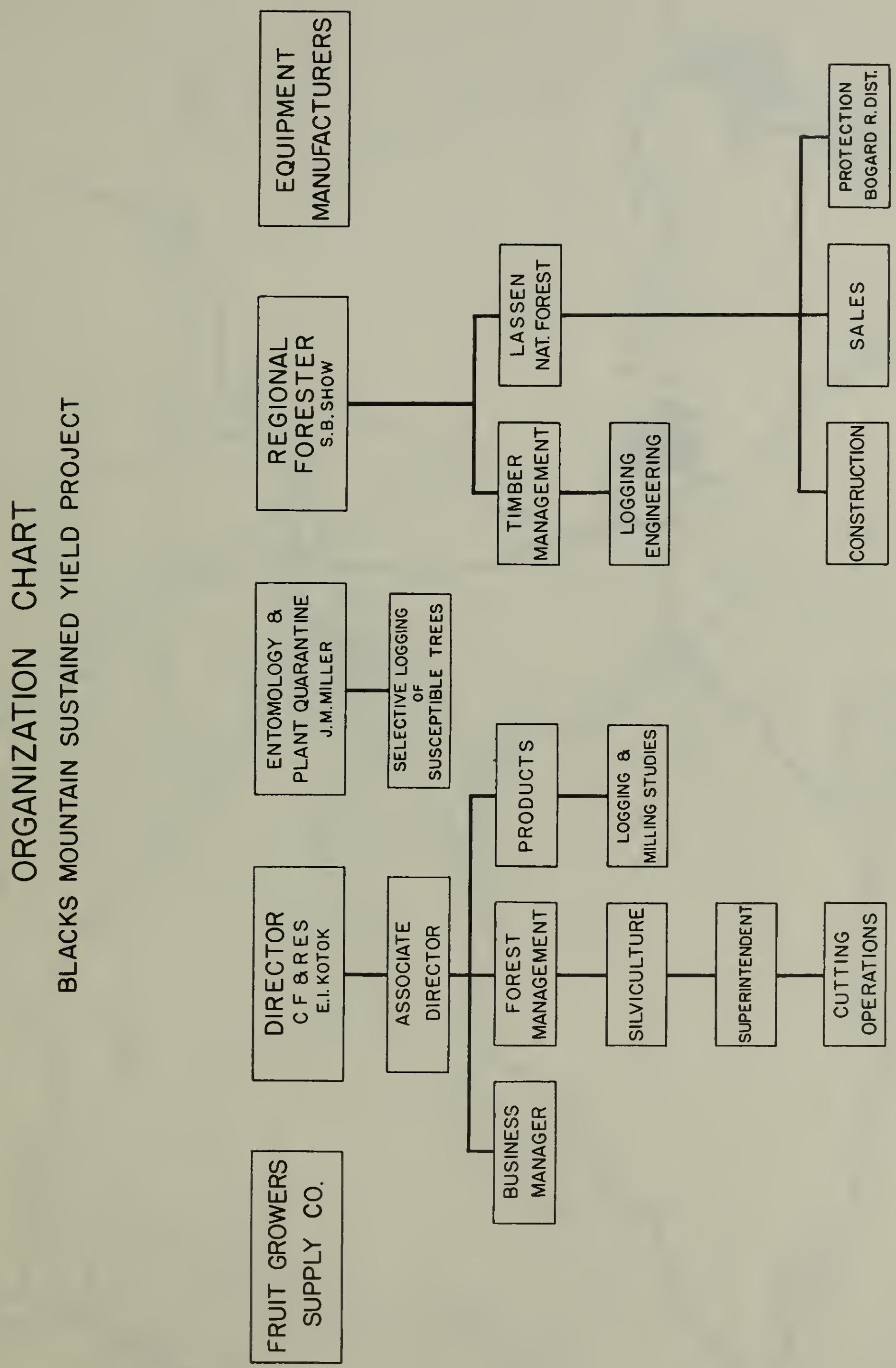

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Figure 10


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PIT
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Millville
Anderson
Cottonwood
SHASTA
TEHAMA
RED BLUFF
Paynes Creek
Mineral
0
20 Miles
Shingletown
Viala
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