

**THE APPLICATION OF STAND IMPROVEMENT MEASURES  
IN THE DOUGLAS FIR AND PONDEROSA PINE TYPES  
OF THE PACIFIC COAST**

**by**

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## PART I

### INTRODUCTION

We have come to learn, among other things, that one of the prime attributes of forest management lies in the recognition of the fact that the application of regulatory practice in any given region is governed by local conditions. Stand improvement measures are no exception to this principle. We cannot, then, set up any blanket rule whereby we can go into an area and establish silvicultural practices without first obtaining pertinent field data for the region. In short, what is needed is an actual check-up of the stand to be treated. The composition of the stand--be it pure or mixed, the age and condition, the degree of stocking, the productive capacity of the site, the topography and ownership limits, and the desires of management are among the factors up for analysis before cultural activities can be started. With this idea in mind we are ready for the objective.

## THE DESIRED OBJECTIVE

The principal objective of improvement measures shall be the betterment of growing conditions for the most valuable species on the best and most accessible sites. For the immediate future, it is desirable to indicate that these sites probably will be confined to cut-over areas and restocked burns in the National Forests. Several factors contribute to this limitation. Primarily, it is up to the forester to prove to himself as well as to the lumberman, that cultural work in the forest will pay. At the present time, unfortunately, there is but little data on the subject--either as to the cost, the proper method to use, or the resultant growth.<sup>1</sup> Also, there now exists a golden opportunity for the forester to make use of subsidized labor on his own land in seeking the necessary basic information. "Prove yourself in your own backyard" is a fitting axiom. As an additional control only areas dedicated to timber production will be selected for treatment. An exception to this clause would be areas given over to the production of Christmas trees.

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1. Lake States Experiment Station. "Instructions for Cultural Work", R-9, p.7, 1935.

### THE POLITICAL BACKGROUND

One item in particular is worthy of comment under this heading. Just as one limits others by imposing regulations so does he often limit himself. I refer to "political kickbacks" emanating from the timber sale contracts requiring loggers to pile and burn their slash. Where a stand improvement crew is working on land contiguous to the sale area, and, as is usually the case, not required to dispose of its debris, a situation is created which is not pleasing to the lumberman, since he is held responsible for all fires originating approximately within a mile of his operation boundaries.<sup>1</sup> Cases like this demand careful consideration if unsatisfactory public relations problems are to be avoided. Another item which one writer advocates is the leaving of a "lightly thinned screening strip" along roads and main arteries so that the layman passing by won't think that all the reproduction is being cut down.<sup>2</sup>

### THE SOCIAL BACKGROUND

A "fortunate" combination of circumstances--a forest-

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1. U.S.F.S. "Administrative Guide," Timber Sale Agreement, Sec. 17, Form 202, p.40

2. Woodhead, P. V. "The Thinning of Lodgepole Pine Stands in the Central Rocky Mountain Region." Journal of Forestry, 32; 592-597, 1934

minded president and a number of highly skilled and industrious men available--has provided us with a necessary impetus to cultural activity in the forest. Even though these two factors are tied up with political and economic "pressures," we can see the part which they play. The diversion to forestry of men who would rather work than live on outright charity together with a leadership which has apportioned considerable funds as a wherewithal has done much towards enlivening silvicultural activity. Indirect influences, such as education to many of our youth along forestry lines and through the cutting down of incendiarism are also worthy of mention.

#### THE ECONOMIC BACKGROUND

Several economic factors are up for discussion. In the first place, stand improvement measures are non-competitive by nature. Their practical application in no way competes with private enterprise with the possible exception of wood dealers in certain accessible areas, who may criticize the policy of extending free or cheap wood privileges. They should have little basis for this criticism since they handle coal and composition shingles as sidelines. In the second place, the work can be so divided

that it can be done during downswings of the business cycle with the result that the constant charges of labor are lessened--the big item in this kind of work.<sup>1</sup> In addition, more worthwhile benefits should accrue from this type of activity than from the expenditure of moneys into government roads which often begin nowhere and end the same way. Another economic factor particularly related to the Pacific coast is that no intermediate yield can be anticipated from improvement activities, with the possible exception of cordwood sales in accessible areas, and this in turn is not certain. "Capital value is unreliable and unsatisfactory until crystallized by sales" especially applies since it should be remembered that sales must be judged in the light of ultimate increased yield without intermediate returns. It is difficult to place an evaluation on cultural practices where the material cut is not utilized.

Again, we must realize that any material cut from the forest which does not benefit the final yield crop only adds to the cost of the operation, since no additional return is anticipated on that which is cut.

The concluding economic factor is "on the other side of the fence," so to speak. At the present time there is a

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1. Starker, T. J., Filed unpublished manuscript, 1936

lumber grade ruling which states that structural timbers manufactured from Douglas fir (*Pseudotsuga taxifolia*) should contain "at least 4 growth rings per inch"<sup>1</sup>. Since stand improvement work, to show a positive value, when no intermediate yield can be expected, demands short rotations, and since our work lies in the betterment of growing conditions for second growth stands, it would seem that this clause would tend to make us non-operative. This "smart" move by the large owners of virgin stumpage is directed at the small sawmills using second-growth timber, and will act as a deterrent only in so long as old growth timber is a competing factor. The afterthought is that first growth timber will not be in active competition for more than another 60 years, at which time our treated stands will be taking over the market.<sup>2</sup>

#### THE CORRELATION OF POLITICAL, SOCIAL, AND ECONOMIC CONSIDERATIONS

As a summation to the preview, I again wish to mention to the reader that an unusual opportunity presents itself at the present time--the opportunity to adapt our stand

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1. West Coast Lumbermen's Association, "Standard Grading and Dressing Rules", Number 10, Pages 33-42, July, 1934  
2. Mason, Earl, G. Finance Readings, 1936

improvement activities to the various conditions encountered in the region, coming out with pertinent data which will enliven the privateer to the possibilities of employing more intensive silvicultural practices in the treatment of his second growth stands. It is accepted that a certain amount of experimentation is necessary. It might be well to do it now while the field personnel and economic easements are available.

## THE SILVICULTURAL BACKGROUND

As has been mentioned, our basis of silvical treatment is essentially a local consideration. Field conditions may be homogeneous over extensive areas or they may vary within an area as small as one acre. It is necessary, then, to describe each particular situation--each stand--before commencing the field work. There are, however, certain general rules and definitions which should and can be set down. This will be done before a discussion of the two types separately--Douglas fir and ponderosa pine (*Pinus ponderosa*) --is undertaken under the heading "stand selection".

### CLASSIFICATION OF TREATMENT

Unless otherwise mentioned the definitions are taken  
<sup>1</sup>  
 from one author.

- (a) Cleaning is defined as a cutting made in a stand not past the sapling stage,\* for the purpose of removing trees of undesirable species or form, that are injuring, or are likely to injure promising individuals of the same age. "Release" cut-

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\* A sapling is a tree over 3 feet high and under four inches d.b.h.

1. Hawley, R. C. "The Practice of Silviculture," Third edition, Pp 126-127, 1935

ting" and "weeding" are acceptable synonyms. A picture of a cleaning operation is shown on page 10. An example of a situation where a cleaning would be helpful is where the area has been logged and the original forest is being followed by a young growth made up of a mixture of valuable species (as ponderosa pine and Douglas fir in their respective types) and undesirable species such as balsam firs (*Abies* spp.) and oaks (*Quercus* spp.).

- (b) Liberation cutting --a cutting made in an immature stand, not past the sapling stage, for the purpose of freeing the young growth from older individuals ("wolf trees") which are overtopping. These older individuals may be either of good species but of the wolf tree type, or else of species less desirable than the overtopped young growth. A wolf tree can best be defined as a tree which takes up<sup>1</sup> more space than its silvicultural value warrants. Pictures of liberation cuttings are shown on page 12. An example of a situation where liberation cuttings are needed is in cut-over forests where young

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1. Starker, T. J. Filed unpublished manuscript, 1936.

Plate 1



Before treatment



After treatment

Cleaning cutting made in mixed ponderosa pine stand (California).

growth has come in under a scattering of old trees that were left behind at the time of logging. Usually these old trees were and still are culls.

- (c) Thinning--A cutting made in an immature stand for the purpose of increasing the rate of growth of the trees that remain and the total production of the stand; and removing mostly trees not in a dominant position (in contrast to cleanings, liberation cuttings and improvement cuttings which characteristically take out only trees overtopping better individuals). A distinction made by some, and one which is entirely plausible, is that the thinning operation removes trees of the same species as those for the final crop (as distinguished from cleanings which remove the undesirable species).<sup>1</sup>

Another writer states that thinnings are cuttings made in crowded stands of young trees for the purpose of increasing the rate of growth of

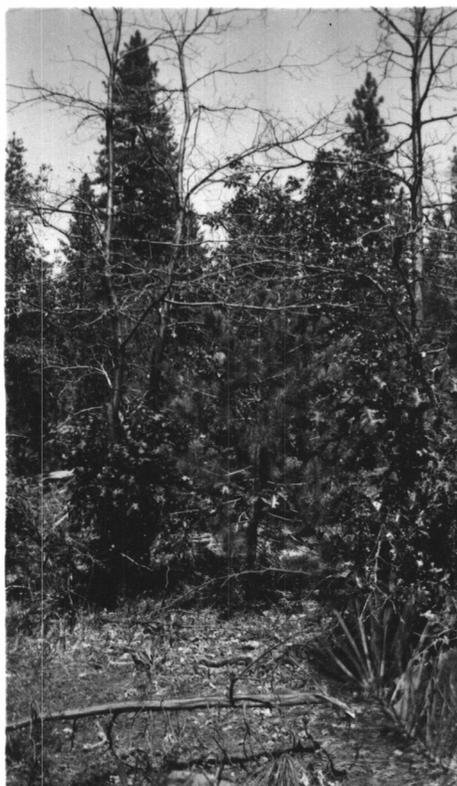
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1. Lake States Experiment Station. "Instructions for Cultural Work," R-9, p.2, 1935.

2. Lodewick, J. E. and O'Byrne, J. W. "Farm Forestry for Virginians." "Bulletin of the Virginia Polytechnic Institute, 24; p.40, July, 1931.



Liberation cutting in Douglas fir sapling stand to remove overstory oak (Oregon).



Liberation of sugar pine sapling by girdling over-topping oak (California).

the trees that remain and of salvaging material that would otherwise be wasted. As brought out, we do not have available markets on the Pacific Coast for absorbing this 'salvaged' material.

- (d) Improvement Cutting--A cutting made in a stand past the sapling stage for the purpose of improving the composition and character by removing trees of undesirable species, form and condition, occupying dominant positions in the main crown canopy. This type of cutting would occur only when other classes have been neglected.
- (e) Salvage Cutting--A cutting made for the purpose of removing trees killed or damaged by various forest agencies, of which fungi, insects, and fire are the most serious. Only in isolated cases, where the damaged area and the logging area are contiguous, will this operation be performed.
- (f) Pruning--A cutting which removes branches from standing trees for the purpose of increasing the quality of the final product. Two additional reasons advanced are for prevention of a

ground fire crowning and for aesthetic values.<sup>1</sup>  
Since silvicultural work in the forest is not  
concerned with making the treated area look like  
a park, the latter reason may be ignored.

#### AREA SELECTION

As previously stated the application shall be confined to the best and most accessible sites on cut-over areas under government ownership. In 1913, Greeley<sup>2</sup> very aptly stated this point when he mentioned that it is preferable to develop successful methods and learn their limitations on the most favorable sites before attacking those areas which are physically inferior. The reasoning is logical; if we cannot prove that cultural activity is worthwhile by 'honing-up' the better sites, there is no need to turn to the poorer areas. To select the desirable areas, it is necessary to draw up a project plan and map.

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1. Lake States Experiment Station, "Instructions for Cultural Work," R-9, p.2, 1935.

2. Greeley, W. B. "Reforestation on the National Forests". Proc. Society American Forester, 8; 216-277, 1913



An example of area selection in the ponderosa pine type (California).

STAND SELECTION IN GENERAL

A suggested order of priority for use in selecting  
\*  
stands for treatment would be:

- (a) Stands not yet past the sapling stage. By this I mean mixed conifer types as Douglas fir--western hemlock (*Tsuga heterophylla*) and ponderosa pine--Douglas fir--white fir (*Abies concolor*). As will be brought out, the author gives low priority to pure types where some assertion of dominance is distinguishable and no liberation cutting is necessary.
- (b) Stands of scattered, defective, unmerchantable, old growth trees that spread disease and impede or prevent the development of a young and vigorous stand. This condition is common on lands acquired via land exchange with privateers.
- (c) Pole stands. Individual trees here are so large that cutting is expensive and the fire hazard

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\* "Stand" is a general descriptive term referring to an area in which condition, age composition, and species composition are relatively uniform throughout. It may cover many acres or only a fraction of an acre.

assumes considerable proportions. Conversely, it might be worthwhile to suggest areas in which<sup>1</sup> no work should be done.

a. Stands in which, because of the heavy reserve stand, little or no release of the advance reproduction would occur. The term "reserve", as used here, should be thought of as meaning the equivalent of overwood.

b. Stands that are already understocked.

The writer does not agree with this statement entirely. Mulloy, in his article,<sup>2</sup> says essentially the same thing; "Thinning presupposes that the stand is overstocked." However, this should be accepted with a "grain of salt" since many ponderosa pine lands are characteristically understocked due to light-burn-

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1. United States Forest Service, "Instructions and Information concerning Stand Improvement Work in California Region", Impnira, March, 1934.

2. Mulloy, G. A. Answer to "A More Scientific Method of Experimental Thinnings." Journal of Forestry, 27;

ing in the past, and yet the reproduction present is so "bunched" that cultural measures will prove beneficial.

- c. Portions of any given area where reproduction is reclaiming brushfields. In this case a heavier than normal stand will hasten the destruction of the brush.
- d. Stands composed entirely of inferior species, unless some special or local market for that species exists. 'Christmas' tree production would be an exception.
- e. Stands which are less than 4 feet in height. Too many things can happen to stands of this size, and it is impossible to tell which "trees" should be left as future crop trees.

#### Stand selection in the ponderosa pine type

The author has indicated that pure sapling stands of ponderosa pine should be given low priority in stand selection. Little can be gained from a qualitative standpoint in thinning such stands, whereas by contrast the results of cleanings in mixed sapling stands of ponderosa pine--white fir--Douglas fir--incense cedar are both quantitative and qualitative. The proportion of pine is

increased by reduction of the 'inferior' species where competing with the former. Munger<sup>1</sup> points out that although young stands of pure ponderosa pine often stagnate, such is not always the case and pine will grow well even in dense stands. The possibility of insect infestation (*Ips* spp. and *Dendroctonus* spp.) following the cutting in pure pine stands during the "flight" season must also be considered. Mainly, though, so much more can be accomplished by working mixed stands that is is probably better procedure to pass up the pure pine type where some assertion of dominance is distinguishable. The same procedure applies to pure stands of the so-called 'inferior' species. There is reason to believe, though, that the last place rating of white fir may be wrong. Doctor Schenck, founder of the Biltmore Forest School, made a trip to the Pacific coast several years ago, and told the people of northern California that "they were looking a gift horse in the mouth" by regarding white fir as worthless. The inference was that the species may enjoy a greater demand in the future because of its large volume for diameter size, its fast growth, workability, and wood pulp possibilities.

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1. Munger, T. T. "How Fast Can We Grow Timber?"  
The Timberman, 37:13-14, February, 1936.

Stand selection in Douglas Fir type:

Stand selection in the Douglas fir type presents somewhat of a different problem than is encountered in the ponderosa pine region. Unlike mature ponderosa pine stands, which have advance reproduction present in the understory, mature Douglas fir stands are almost entirely lacking both in reproduction and in an understory of small trees.<sup>1</sup> What reproduction is present consists of slow-growing lowland white fir (*Abies grandis*) white fir, western hemlock and western red cedar. Many of these mature stands are highly defective, in fact so highly defective that the loss from decay exceeds the growth.<sup>1</sup> In some instances the decaying Douglas fir is being replaced by understory-grown hemlock, balsam firs and cedar that are of inferior quality. In other instances hemlock that developed in the original stand is beginning to decay, it being a shorter lived tree than Douglas fir.<sup>1</sup> As pointed out the unfortunate feature of the situation is that the decaying trees continue to live and use up the growth power of the soil. Such a stand will probably have a lower volume per acre in the future than it does at the pres-

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1. Pacific Northwest Experiment Station, "Working Plan for Stand Improvement Study in Defective Douglas Fir Stands" page 1, September 12, 1935.

ent time. There can be no economy in protecting such stands from fire unless improvement measures are undertaken. Here again, though, it is difficult to forecast if the resulting increase in value will offset the present expenditure for improvement.

Dense sapling stands of Douglas fir (and associates) are highly desirable as areas for cultural improvement. These stands, occurring on cut-over areas or as the result of fires, probably deserve primary consideration (presupposing, of course, that they are favorably situated and on the better sites).

Stands which contain both sapling and pole stock, wherein the pole stands will be logged in the next decade or so should be passed up, since it is difficult to tell how the logging plan will be laid out, and hence the safety of any improvement work is at stake.

## TREE SELECTION

### (a) In tree selection the specific objects are:

1. To increase the proportions of valuable species in the stand.
2. To improve the form and value of the crop trees.
3. To increase the final yield.
4. To secure the most rapid growth compatible with a full stand and good quality.

### (b) Spacing

The exact spacing of trees is usually impracticable and is not sought as an end in itself. The governing principle is to give each crop tree room to develop properly and to provide that the available growing space shall be utilized as far as possible by trees of desired species, form, and condition. Virtually all foresters are agreed on this principle.

The California Forest Experiment Station has developed a table which will serve as a guide to securing correct spacing in a majority of cases.<sup>1</sup>

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1. U.S.F.S. "Instructions and Information Concerning Stand Improvement Work in California Region". Impnira, March, 1934.

<u>Average d.b.h. of trees to be released</u>	<u>Average height of trees to be released in feet</u>	<u>Approximate spacing in feet</u>	<u>Number of trees per acre in fully stock- ed stands</u>
0	4 $\frac{1}{2}$	5 $\frac{1}{2}$	1440
1	8	6	1210
2	12	6 $\frac{1}{2}$	1031
3	16	7	889
4	20	7 $\frac{1}{2}$	774
5	24	8	680
6	28	8 $\frac{1}{2}$	603
7	33	9 $\frac{1}{2}$	482
8	38	10	436
9	43	10 $\frac{1}{2}$	395
10	48	11	360
11	51	11 $\frac{1}{2}$	329
12	54	12	302

The last column in the table will be of value in checking work completed to see how closely the optimum spacing has been attained. The only trees considered are those selected for release and deliberately left. Undesirable neutral trees, left only because they exert no ill effect on desirable neighbors, should not be considered in arriving at spacing and number of trees per acre.

A rule of thumb which was developed for the several operations was to allow a 6 foot spacing for trees averaging one inch d.b.h. and add one-half foot to spacing for

every one inch increase of d.b.h. For all practical purposes this approximation was close enough.

### TREE CLASSIFICATION

As the basis for a clear-cut classification as set up by the Society of American Foresters<sup>1</sup> the following definitions are presented:

Seedling--A tree not yet 3 feet high.

Small sapling--a tree from 3 to 10 feet high.

Large sapling --a tree 10 feet or over in height and less than 4 inches d.b.h.

Small pole--a tree from 4 to 8 inches d.b.h.

Large pole --a tree from 8 to 12 inches d.b.h.

Standard--a tree from 1 to 2 feet d.b.h.

### CROWN CLASSIFICATION

The crown classification which has been most widely used in American silvicultural practice is the one favored by the Society of American Foresters<sup>1</sup> and is as follows:

- (a) Dominant--trees with crowns extending above the general level of the forest canopy and receiving full light from above and partly from the side; larger than the average trees in the stand, and with crowns well developed but possibly somewhat crowded on the sides.

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1. Fernow, B. E. "Forest Terminology. Report of Committee". Journal of Forestry, 15:68-101, 1917.

- (b) Co-dominant--trees with crowns forming the general level of the forest canopy and receiving full light from above but comparatively little from the sides; usually with medium sized crowns considerably crowded on the sides.
- (c) Intermediate--trees with crowns below, but still extending into the general level of the forest canopy, receiving a little direct light from above but none from the sides; usually with small crowns considerably crowded on the sides.
- (d) Overtopped--trees with crowns entirely below the general forest canopy and receiving no light either from above or from the sides. These may be divided into:
- (1) Oppressed--usually with small poorly developed crowns still alive, and possibly able to recover.
  - (2) Suppressed--dying and dead trees.

### CUTTING REGULATIONS

Before analyzing the regulations to apply in cuttings, it is best to reiterate the cutting objective which is "to increase the proportions of valuable species and to secure the most rapid growth consistent with a full stand and good quality." These regulations, or standards, may differ some-

what from those of other authors, but their application was apparently successful on the operations from which the writer derived them.

a. Selection of "leave" trees

1. Individual trees shall be selected for leave on the basis of form and vigor. Straight stems, length and breadth of crown, dense foliage, rate of growth, and healthy appearance are indicators.
2. Ability to profit by release. This result cannot be obtained by selecting leave trees under the canopies of larger uncut trees.
3. Favor species in the following order: In the ponderosa pine type, sugar pine (*Pinus lambertiana*) ponderosa pine, incense cedar (*Libocedrus decurrens*), and Douglas fir. A qualifying recommendation here is that sugar pine be favored on North and East slopes, while ponderosa pine is given priority on South and West slopes. In certain areas, where local markets dictate, the favoring of Douglas fir over incense cedar is permissible. On southerly exposures young in-

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1. U.S.F.S. "Instructions and Information concerning Stand Improvement Work". California Region, March, 1934.

cense cedars are found to be commonly top-killed or in a dying condition, apparently as a result of attack by a species of *Phloeosinus*<sup>1</sup>. This widespread occurrence of insect attack would indicate that Douglas fir should be given preference, especially on southern and western exposures.

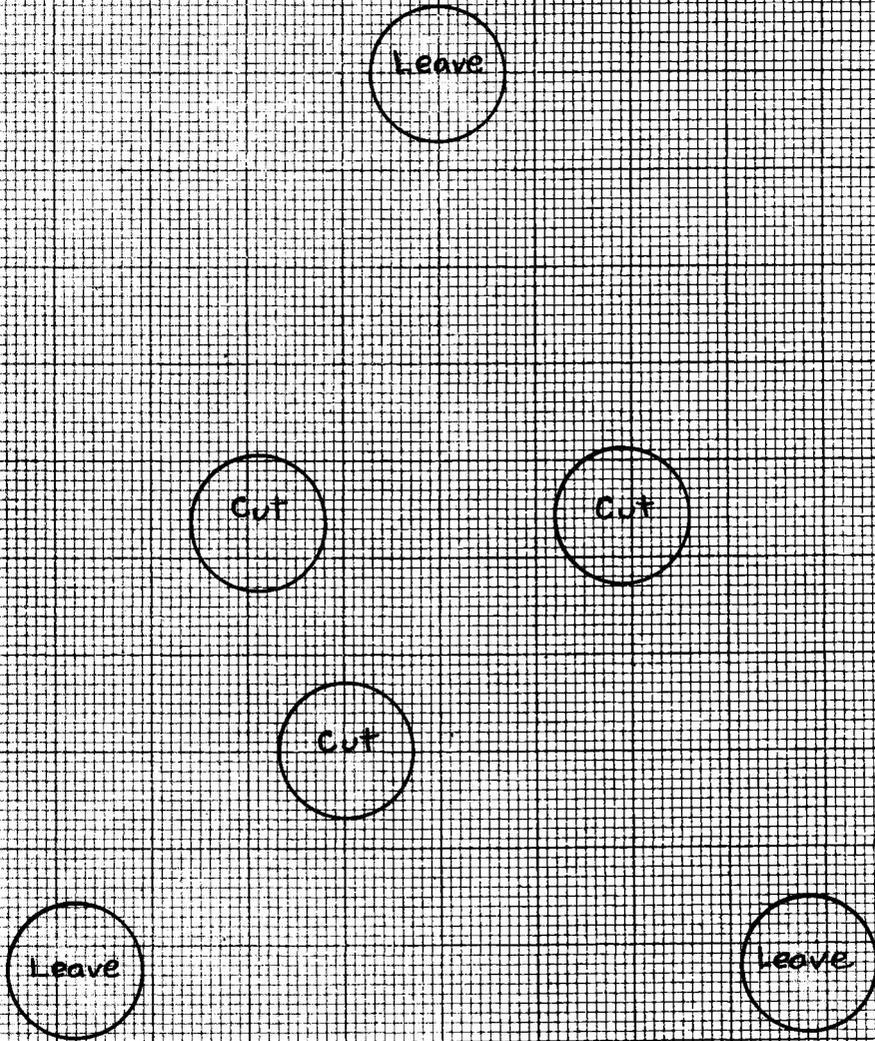
In the Douglas fir type, Douglas fir, ponderosa pine and western white pine (*Pinus monticola*) Sitka spruce (*Picea sitchensis*) would be favored over western hemlock and western red cedar (*Thuja plicata*), balsam firs, although this procedure is not inflexible, especially on certain sites.

4. In cutting out a group or thicket, do not reduce the "area coverage". In other words, do not cut individuals growing on the outer edge of groups when their removal would materially reduce the total crown space originally occupied by the group (Observe charts on pages 28 and 28A for illustration of this principle).
5. In working out a thicket select your leave trees and method of attack before cutting.
6. REMEMBER, which tree to save and which to cut is determined more by the size, shape, and position

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1. U.S.F.S. "Project Report on Massack Timber Stand Improvement Project", October, 1934.

# SPACING PLAN IN THICKET TO AVOID AREA REDUCTION



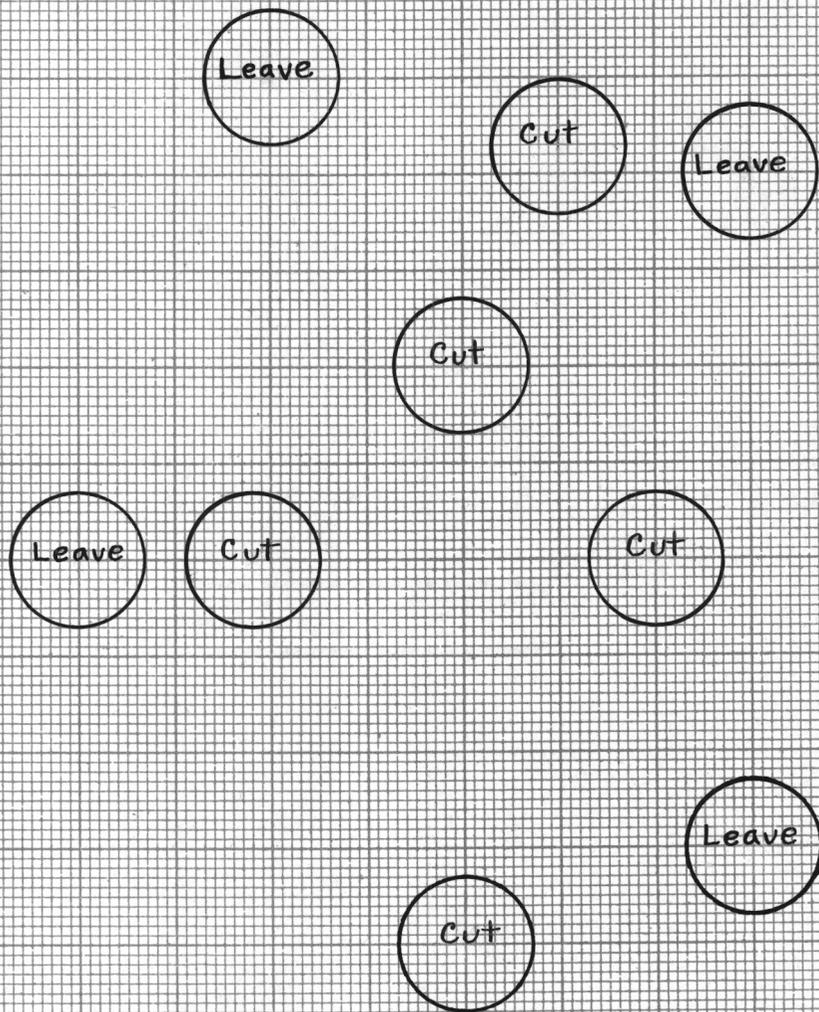
### Legend:

Even aged trees

Average d.b.h. 1"

Scale - 1" = 1.2ft.

# SPACING PLAN IN THICKET TO AVOID AREA REDUCTION



Legend:

Even aged trees

Average d.b.h. 1"

Scale - 1" = 1.8 ft.

of the top than by the size or location of the base of the tree. Look up as well as down. Watch for porcupine girdles, insect infestations in your leave trees.

b. Removal of Trees

1. Don't cut a tree which is "licked" already.

Cutting out a fully suppressed tree has little or no effect on the growth of the remaining trees. <sup>1</sup>

2. Don't think of your mother and strive for beauty.

Remember the objective--you're not making a park.

3. Don't work in front of another man. You do not know what trees he has selected for cut and leave.

4. Don't cut brush or dead trees unless necessary.

5. Don't cut a tree "because it isn't doing any good",

REMEMBER, you cut a tree to benefit another.

c. Slash Disposal

1. The object of lopping is to get the slash as close to the ground as possible with a minimum of labor.

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1. Hawley, R. C. "The Practice of Silviculture"  
Third edition, p. 171, 1935.

2. Don't attempt to "bunch" the slash. Fall your trees the same direction and let it "lay as it falls". It takes time to handle slash.

d. General observations

1. Two trees together in the open "grow more valuable than one."
2. There is no gain made in liberation cutting where 50% or even less of the reproduction to be freed is injured or destroyed in the process.
3. It is doubtful that it pays to cut in stands of sound trees greater than 12" DBH--isolated or wolf trees the exceptions. This principle applies to cleaning and thinning measures and indicates the maximum size range within which stands should be considered workable.
4. The idea of a full stand should be kept in mind. It is too easy to fell a tree and wish that you could replace it later. There can be no advantage in removing an inferior tree (except a diseased one) unless it is interfering with the development of a better one.

5. Remember, you do not develop the art of cutting practices by reading books. Go out in the forest; there, through application, the complete "picture" will be spread before you. Thinnings and other types of cutting are not rigid mechanical processes, but must flex to meet the variations of the stand. In addition, the exercise of common sense is necessary to bring about the adaptation of the cutting system to the ever-changing field conditions. Additional discussion of cutting regulations will be included in the discussion of field work.

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1. Barret, L. I., and Righter, F. I. "Working Plan for Experimental Thinnings in Shortleaf and Loblolly Pines." Journal of Forestry, 27: 682-803, 1929.

## PART II

## PROJECT ADMINISTRATION

## PRELIMINARY WORK

In order to plan the work intelligently for present and future projects, so that the men may be distributed to the best advantage, and reasonable standards for cost, progress, and accomplishment be developed, it is necessary to know

- (1) Which stands will be worked and which will not be worked, the approximate area occupied by each stand and its location.
- (2) How much of the area is occupied by stands needing similar treatment such as seedling, sapling, or pole stands.
- (3) A rough classification as to the relative density of stands such as light, medium, or heavy.

To get the necessary information, we describe the situation as a whole. The logical procedure, then, is to make a field map which will show the desired information. A survey is made of the proposed area, which mechanically does not differ from an 100 per cent cruise.<sup>1</sup> It is not

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1. Mason, E. G. "Forest Mensuration" Second Edition, page 144, 1934.

necessary, in all cases that the area be completely mapped. Ocular estimates "spread" from a 20 to 40 per cent coverage will often suffice. The survey consists of making a map upon which will be indicated:

1. Land status.
2. Found corners.
3. Topography and drainage.
4. Improvements such as roads, trails, logging railroads, telephone lines, fire breaks, guard stations, etc.
5. Selected camp sites for project.
6. A division of the area into
  - (a) Stands to be worked (best ocular estimates possible)
  - (b) Areas not to be worked, such as brushfields, old growth stands (exception; defective Douglas fir stands), areas of poor site quality and areas on which reproduction is poor.

Map sheets for ease and simplicity in actual mapping as well as in planimeter work, should be on a scale of 8 inches to the mile. The map form 878, used by the United States Forest Service, is acceptable. Using the scale of 8 inches to the mile allows areas as small as 1 acre to be mapped. Naturally, it is not nearly as important to get

an accurate delineation of unworkable areas as it is to get the exact location of areas which are workable. A plan for mapping in the ponderosa pine type was developed<sup>1</sup> which the author will set up as being a suitable method for designating workable areas in the Douglas fir type:

F -seedling stands too open to benefit by cleanings.

F+ -seedling stands which would benefit by cleaning.

F20 --stands the dominants among which average between 3 and 20 feet in height, but which will not benefit by cutting.

F20+ -same as F20, except that stands would benefit by cutting.

F40 -same as F20, except that dominants average 20 to 40 feet in height.

F40+ -same as F40, except that stands would benefit by cutting.

F60 and F60+ would correspond to F40 and F40+ except that the dominants average between 40 feet and 60 feet and under 12" d.b.h.

R -stands where dominants are over 12" d.b.h.

B -brush areas, including restocking brush fields.

O -openings such as meadows, barrens, glades.

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1. U. S. F. S. "Instructions for Keeping Records of Costs and Accomplishment of Stand Improvement Work, California Region, pp. 1-2, April 27, 1934.

An additional refinement would be to indicate the species to be removed. For instance, if the stand of Douglas fir to be benefited was mixed with undesirable white fir averaging 20 feet in height and an overstory of oak 40 feet in height, the symbol could be designated as F20+WF20 Q40, where the letter Q stands for oak.

A mapping procedure such as the one described would give the information for the actual stand. In the office, this field data could be transferred to a progress map, which in turn could be used as an overlay for a base map.

A complete outline for a stand improvement project plan, including the given map preparation, can be set up as follows:

- (1) Purpose of project
- (2) Location and time of project.
- (3) Description of area and stand.
- (4) History
  - (a) Logging
  - (b) Fire
  - (c) Insect infestation
  - (d) Previous stand improvement work
- (5) Selection of stands for treatment.
  - (a) Stands on which work will be done. (Show on map)
  - (b) Stands which will not be worked.

- (c) Order in which work will be done.
- (6) Treatment of stands.
- (a) Application of general instructions to local projects.
  - (b) Special instructions for local conditions.
  - (c) Sanitation work on stands selected for treatment.
- (7) Slash disposal
- (a) Show on map type of disposal to be employed on various portions of area.
- (8) Snag disposal
- (a) A specific plan for local area correlated with forest plans for hazard and snag disposal.
- (9) Camp organization
- (a) Personnel and size of camp.
  - (b) Location of camps in relation to walking distance to work.
  - (c) Camp regulations to cover:
    - 1.-Meal time and working hours
    - 2.-Sanitation
    - 3.-Families in or near camp.
    - 4.-Fire prevention.
    - 5.-Plan and organization for fire suppression prepared in cooperation with local administrative officers. Such a plan

should consider the policy of:

- (A) Keeping men in camp over week-ends.
  - (B) If so, should they be required to pay board?
  - (C) Fiscal policy which should be followed in regard to the payment of men when on fire suppression work.
- (10) Crew organization
- (a) Number of strawbosses.
  - (b) Number of experienced laborers.
  - (c) Number of laborers.
- (11) Preparation of maps.
- (a) A base map, scale 4 inches to the mile, should be prepared in advance of the work and should show:
    1. -Land status.
    2. -Found corners.
    3. -Topography and drainage.
    4. -Improvements such as roads, trails, logging railroads, telephone lines, fire-breaks, guard stations, etc.
    5. -Selected camp sites for project.
    6. -A division of the area into
      - (A) Stands to be worked. Make best estimates possible.
      - (B) Areas not to be worked, such as brushfields, old growth stands,