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APPLIED FOREST MANAGEMENT IN THE DOUGLAS-FIR REGION[1/]

By

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In the past decade or two sustained yield management has been emphasized as never before in the Douglas-fir region. It would be difficult to cite all the economic and technological factors that have encouraged landowners to grow timber as a crop. But one of the most potent sources of encouragement is the fund of technical information on timber growth, silviculture, and fire control that has been assembled since foresters came into the western woods. The Douglas-fir yield table, the regeneration manual, systematic fire-danger measurement--these are but a few of the improved tools available now to help answer the question: How can owners increase the yield from their lands?

Of course there are still many glaring blank spots in the mosaic of basic information needed to do the job of forest land management most effectively. Research must intensify its efforts to complete the required scientific basis. Meanwhile, forest administrators are faced with doing their everyday work as well as possible with what is known now. How to do this is the subject of a major research project in applied forest management at the Pacific Northwest Forest and Range Experiment Station. Practices that appear promising are being tried out on commercial-scale experimental logging operations, the researchers cooperating with both private and national forest administrators in making the layouts.

1/ Based on a talk presented at Canadian Society of Forest Engineers, March 4, 1949, and published in Forestry Chron. 25(3):173-180. Sept. 1949 and in British Columbia Lumberman 33(11):76,78,80,132. Nov. 1949.

For more than 30 years the Station has carried on small-plot studies of clear-cutting, partial cutting, fire hazard, regeneration, and growth. The results show that no one method is best for effecting an orderly transition of wild old forests to thrifty managed forests on the variety of stand, site, ground cover, and topographic conditions that occur. Hence, highly flexible combinations of staggered setting clear-cutting and tree selection partial cutting are being used in the applied tests.

Objective for Clearcuts in Old Growth

The objectives sought in making the clearcuts and techniques being used in seeking these objectives are outlined below:

(1) Harvest the mature crop with as efficient utilization as possible. For this purpose rather rigid utilization requirements must be a part of the timber sale contract. Where the timber stand is heavy, the individual trees large, and terrain permits tractor operation, it is likely that prelogging of windfalls plus stage falling and logging of the main stand will be required to minimize breakage and obtain the maximum harvest of merchantable volume. If there is a wide range in log size in the stand, the contract is likely to require that prelogging or relogging be integrated with the main operation. If the utilization standards specified are to be reasonable, roads and landings must be laid out on logical locations and yarding distances kept within limits consistent with efficient operation of yarding equipment well adapted to the size of the timber to be harvested.

(2) Provide abundant seed for regenerating the stand. Under the staggered setting system this objective is readily attained by limiting the unit size of clear-cut patch. From past research we know that adequate regeneration can be expected within 10 years under "average favorable" conditions if no part of the cutting is more than one-quarter mile from the edge of mature standing timber. In our applied forest management cuttings our objective generally is to provide sufficient seed for restocking under average conditions within 5 years. This means roughly that all of the cut-over area must be within one-eighth mile of an adequate seed source. This condition can usually be met rather readily when making the first cut in virgin watersheds. In severe brush-threat areas standards must be higher. On these the objective should be to obtain abundant regeneration in a single year. Prompt planting will be necessary to insure this on some areas.

Efforts are being made to speed the establishment of abundant regeneration following timber harvest. One method being tested is to poison seed-eating rodents just in advance of seed crops so that enough seed will survive to germinate and restock the area promptly. During years of abundant cone crops, enough seed usually escapes the rodents to regenerate the stand, but 10 years may intervene between abundant cone crops. Medium or light crops occur much more frequently, but rodents get much of the seed. If, in such seasons, rodents can be effectively poisoned, the seed they normally consume is available for germination, and years may be saved in getting the new stand started.

(3) Provide favorable seedbed for the new forest. This is not always a special problem, but frequently it is. Abundant seed does not insure regeneration if seedbed conditions are unfavorable. Parts of cutovers are commonly lost to brush even though seed trees are nearby. Our working hypothesis is that brushy areas in the virgin stand must be identified before cutting and special measures taken during logging and slash disposal to permit regeneration of valuable tree species and to prevent reversion to brush cover.

In the past the boundary of cutting areas has usually been located so as to just exclude brush patches along minor drainages. In our tests, cutting lines are being located so as to include such brush and some surrounding timber. Then tops may be felled into the thickets and timber skidded through them to break up the cover. The slash and as much of the brush as possible are burned as promptly after logging as can be arranged. Next step is to plant the brushy areas with conifer stock adapted to the site before the start of the following growing season. Studies are being made to determine specifically where planting is required and where natural seeding can be depended upon to do the job and to what extent artificial seeding can be substituted safely for planting. The effects of timing slash burning or of not burning slash, depending on the seed crop, are also being studied.

Hot, dry sites, particularly in the southern part of the region, need special treatment if they are to provide a favorable environment for the establishment of new seedlings after cutting. Observations indicate that partial shade is a far more important attribute of a favorable seedbed on such sites than on less severe exposures and areas farther north. Under such conditions, there is silvicultural incentive to reduce the size of unit clearcuts and to apply group clear-cuttings, progressive strip, or shelterwood cuttings where topographic and other conditions permit and stand structure indicates. Experience in the application of such silvicultural techniques in the Douglas-fir region is limited. But evidence on the ground from the few trials made indicates that such variations may be effective tools in solving regeneration problems in some of our most critical areas. Certainly these methods deserve thorough test where they appear to hold promise. Thus, we are including them in our applied forest management experiments.

(4) Obtain optimum species composition in the new forest. This requires study of the capacity of the different species to grow on the several soil-site combinations, and much more basic research must be completed before specific recommendations can be made in all cases. In the meanwhile, some promising leads deserve testing on a broad scale. For example, there is the hypothesis that mixed stands of Douglas-fir are less susceptible to damage from *Poria weirii* root rot than are pure stands, and that volume and quality yields may be better in mixed stands than in pure. For another instance, in the mixed-conifer zone of southwestern Oregon, there is strong evidence that both volume and value yields on some sites and soils can be much increased by increasing the percentage of sugar pine in the stand. Thus, systematic tests of the merits of species control are being included in our applied forest management cuttings.

This may require coordinating the time and method of slash disposal with the incidence of seed crops. Detailed planting and seeding plans may be required. Arrangements should be completed for obtaining needed seed or planting stock before cutting starts so that provisions for regeneration may be effected promptly after logging and slash treatment are completed.

(5) Avoid creation of excessive fire hazard. This requires limiting the size of clear-cut areas; it also requires that adequate width of green timber in which fuel hazard is normal be left to separate the several clear-cut areas. As a general guide, the undisturbed timber between clear-cuttings should be at least as wide as the cuttings themselves--preferably wider. Prompt, well-timed, and skillful slash burning may also be specified.2/ The upper size limit on unit clearcuts has been set at 60 acres, on the basis of judgment, until a sounder guide is available. Settings should be laid out with respect to topography so that slash can be burned safely: partial cuttings should not be located directly above clearcuts on steep slopes; cutting units should coincide with breaks in topography where parctical. It is particularly desirable to have a break in slope, preferably a main ridge, at the top of cutting units. Roads may be used to form a desirable upper margin for cutting units where it is impractical to locate the edge along a break in the topography. From the standpoint of fire control, minor ridges and roads make desirable side boundaries for cutting units. All trees and snags within clear-cutting areas should be felled. All trees cut should be felled into the cutting area. All dangerous snags should be removed for 200 feet around the boundaries of the cutting area. Width of clearing for roadways connecting clear-cut settings should be held to a practical minimum. In some instances alignment of the right-of-way may need to be varied deliberately to avoid creating extensive wind funnels through the timber which in periods of high fire danger would create sweeping drafts. The clear-cut units themselves should be laid out so as to avoid the build up of serious wind sweeps. Incidentally, all of the pros and cons of slash burning versus nonburning are the subject of a special detailed paired-plot study installed on a sampling of the test cuttings.

(6) Minimize windfall loss in the remaining stand. The perimeter of cutting edge created for a given area of clear-cutting is greater under the staggered setting system than under wide-area clear-cutting. Hence, when unit size of clearcuts is reduced, extra effort is required to locate cutting lines so that windfall loss per mile of cutting margin will be low. Much remains to be learned before this can be done with confidence. Thus, the technique of locating cutting lines also is being studied on each cutting. Results to date in the coastal forests show that most loss is caused by southwesterly winds, and most trees that are lost fall on the lee side of openings--into the remaining stand, not into the clear-cut opening. Within the limits permitted by topography, the

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2/ Aufderheide, Robert and Morris, William G. Broadcast slash burning after a rain. West Coast Lumberman 75(9):79-83. Sept. 1948.

extent of cutting edge exposed to the sweep of southwesterly gales should be kept to a minimum. Poorly drained sites, previously unexposed, should be avoided in locating cutting lines. Leaners and other obviously risky trees near the margins, of course, should be marked for cutting.

(7) Avoid excessive erosion and maintain watershed conditions favorable to uniform stream flow. This is an objective that will become increasingly important in the Douglas-fir region as demands increase for water power, irrigation, flood control, and recreation. One of our most urgent needs is systematic study of the watershed effects of different cutting methods. It is apparent that considerable erosion on Douglas-fir cutovers comes from truck roads and from logging. Until comprehensive study can supply detailed answers for minimizing watershed damage from these sources, the following precautions are proposed:

(a) Much stream siltation can be avoided by proper road location. Roads should be located far enough back from streams so that no dirt from the construction reaches the stream wash. Where this is not possible, as at stream crossings, earth should be end-hauled so that a minimum amount is dumped into the stream.

(b) In critical watersheds specifications for alignment and widths may have to be adjusted in order to minimize the amount of earth that must be moved in building a road adequate to the needs. Frequently the amount of cutting and filling necessary can be greatly reduced by laying out a slightly rolling grade instead of a sustained grade, without significantly reducing the traffic-carrying capacity of the road. Preliminary soils studies indicate that specifications of maximum grade, back and fill slope, and size, frequency, and placement of culverts should be varied between the different soil types, grades, precipitation zones, and rock formations. Much work remains to be done to define optimum specifications for the great variety of terrain conditions, but it is clear that no single set will be equally efficient throughout. As a general principle, this will require that the road locator designate the detailed specifications to be observed after inspection of terrain conditions. For example, the road locator should designate culvert locations. The objective should be to run water from the roadway across natural settling basins or benches wherever possible before it reaches the stream. A diversion culvert should be placed a short distance above a stream so that water running hundreds of feet down a road ditch does not dump its sediment into the stream.

(c) Care and good timing in the road construction process can prevent much soil from moving into waterways. Construction during dry periods not only causes less erosion but, as every logger knows, is cheaper. Progress should be timed so that culverts are put in place before fill material is dumped into a stream course. Blasting along streams is another source of sediment. Where this cannot be avoided, the work should be done during periods of low water and a cleanup made before high water.

(d) During periods of heavy runoff a great deal of the sedimentation from road construction can be avoided by a man with a shovel diverting streams of water that run over the new roadway. This procedure should be continued after the road is in use until the surfaces are hard, safe new drainage patterns are well established, and the ditches run clear water.

(e) In logging as in road building, the first step in reducing erosion starts with the layout of the logging plan. For high lead settings landings should be located wherever practical to yard the logs uphill. The resulting pattern of skid roads tends to spread water rather than collect it. In some situations, however, downhill yarding by high lead may be preferable to uphill. This may avoid the necessity of moving much soil in heavy road construction to reach a proper landing site at the top of the setting. In any event, landings should not be constructed in stream beds, leaving heavy debris accumulations that will be swept out with the next freshet. Tractor logging should be confined to moderate topography and to dry periods. Tractor roads should be constructed, and "put to bed" at the end of the operation so that water will not rush down the ruts. This can be done by putting dips in the roadways at intervals at which water will be lead off to spread over undisturbed soil before it can attain enough volume and velocity to cause serious erosion. If tractors must cross streams, culverts should be provided. In neither tractor nor high lead operations should logs be dragged across streams.

On critical watersheds it will be found that logging cannot be tolerated unless it can be conducted with little or no soil disturbance. It is possible that some adaptation of the Swiss gravity cableway system may find a use in such situations.

(8) Provide a fair profit margin for the operator. This is an essential objective of applied forest management cuttings if better practices are to become a part of everyday procedures on operations of any extent. Thus, for these cuttings allowance is made in stumpage appraisals for all costs incurred as a result of the extra requirements written into applied forest management cutting contracts. The operator's detailed cost records become a part of study results so that realistic comparisons between estimated costs, actual costs, and benefits may be made. Most of the extra requirements written into the logging contract appear to be highly practical under current conditions; methods that give promise of having wide application only far in the future are also included in the tests.

Other Considerations

Besides these eight objectives of the test cuttings, many other considerations must be weighed in applying forestry principles to management of Douglas-fir lands. For example, when using the staggered setting system, what percent of total volume should be removed in the first series of cuts; what is the best size for unit clear-cuts; what should be the interval between the first, second, and succeeding cuts; what will be the effect on insect and disease losses; what will be the plan for regenerating the later cuttings after mature-timber seed sources are removed? These are some of the puzzling questions for which we hope to find helpful answers in the research installations being made.

Is There a Place for Partial Cutting?

Most partial cuttings by tree selection in Douglas-fir old growth were made on a high-grading basis during the past 10 or 12 years; generally the results have been very unfavorable. However, we believe there well may be a place for partial cuttings in Douglas-fir where these can be made on a stand-improvement basis. This means that the terrain must be adapted to tractor logging, good markets must be available for low-grade as well as high-grade wood, and the stand structure itself must be adapted to such a cut. This combination of circumstances is not found as commonly as the conditions that permit staggered setting clear-cuttings. There appear to be many opportunities, however, to increase total yield through making intermediate harvest cuts before the regeneration cut. Stands having an understory of thrifty, near-merchantable-sized trees may be adapted to this type of cutting. In addition, some of the seemingly uniform mature stands we have studied vary in growth rate within the stand in the ratio of 10 to 1; some of these, too, may be adapted to intermediate cuts.

Our experiments include intermediate harvest cutting tests in such stands. The cuttings are made with the primary objective of harvesting low-vigor trees before they are lost through mortality, leaving trees of fair vigor stored on the stump for a later cut and trees of good vigor to continue to grow and improve in quality. An effort is made to keep the cuts light enough to avoid stimulating brush development or encouraging the establishment of regeneration at a time when it is not wanted, to avoid overexposure to wind and sun, and to prevent accumulation of excessive slash. In general, this requires that not more than a maximum of about 30 percent of total volume be removed from stands of good density in the first logging. A lighter cut is usually silviculturally preferable. The minimum volume that can be cut is controlled by logging costs; on favorable areas it may amount to less than 15 percent of total stand volume in green timber plus the sound material in windfalls and snags harvested as salvage at the same time. In some areas it is even possible to salvage windfalls and snags without cutting into the living stand. Our installations cover this range in cut. The frequency with which such cuts can be made and the period over which they can be extended with good effect are being tested. Specific provision is made to retain in the stand the trees of best vigor and best quality. This will give the silviculturist the opportunity to regenerate the stand later on with seed from the best growing stock in the forest, using clear-cut patches or strips. The unit area for these regeneration cuttings may range from perhaps 5 acres up to 40 acres. A series of sizes is being tried. In some of the warmer, drier parts of the region and on the poorer sites we anticipate, as mentioned previously, that shelterwood and small-group selection cutting will have a place in regeneration. Obviously, as with clear-cuttings, appropriate provisions for watershed control and cost control must be made a part of the plan for partial cutting. Such light partial cuts may have a significant place in the management of scenic and recreational areas where timber production is a secondary consideration.

Significance of Second-Growth Management

An adequate discussion of second-growth management would be a major treatise in itself. Sufficient to say here is that second-growth and old-growth management are both essential parts of one job. Vastly different methods must be applied in each, but the over-all job of forest land management is immeasurably simplified if the work in old growth is integrated with that in second growth. Having second-growth age classes under management with old growth is of key importance in speeding up the transition of wild forests to thrifty managed forests. Also, by integrated management the premature cutting of rapidly growing young forests can be avoided. In the meantime, second-growth forests need more than mere protection if their potential yields are to be realized. They must have the benefit of stand-improvement thinnings and of pruning. Such practices are being given extensive trials on a series of commercial-scale cuttings from Puget Sound to the upper Willamette Valley on both private and public lands, but that is another story--also in applied forest management.

How the Job is Done

The job of actually attaining all of the foregoing objectives is tremendous. Our approach is as follows:

First step is an inventory and silvicultural analysis of stand conditions to determine the treatment or treatments that are needed to improve or to restore productivity area by area. This includes deciding which areas are most in need of cutting to restore productivity and drawing up a cutting-priority schedule by cutting units of logical size. Obvious provisions are made, of course, to cut the oldest age classes first and, within any age class, to cut first the stands in which retrogression appears to be most rapid and the need for regeneration most pressing.

Coordinated with this on-the-ground analysis are topographic mapping, a study of terrain conditions, and preliminary classification of the tract into portions that can be logged by tractor or by horse and those so steep that cable logging methods must be used. Incidentally, the speed with which this work can be done accurately has been stepped up greatly by using aerial photo techniques to supplement the ground work.

Next step is the making of a road plan and a logging plan which, insofar as is reasonably practical, will facilitate the cuttings which good silviculture dictates. Roads should be located efficiently to provide access to the delayed settings as well as to the timber to be cut first. After the ground work outlined above, a "paper" plan is drawn on the topographic-type map. Next, this preliminary plan is marked out on the ground; in the process, conflicting objectives of efficient logging versus good silviculture, fire protection, and watershed protection are coordinated, improvements are made in the final location of roads, landings, and cutting boundaries, and the timber to be removed by tree selection is marked.3/

We call the man who does these jobs a forester-logging engineer, but he is more than a logging engineer, more than a silviculturist. He must be open-minded as a judge and master of the gentle art of compromise. He must be strong to climb over his rugged forested domain and learn intimately its many variations. He must be ingenious to prescribe the best treatment for each individual stand condition.

The skill with which he does his job today can determine in large degree the level of productivity of our forest lands and the standard of living of our people today and in the centuries to come.

3/ Ruth, Robert H. and Silen, Roy R. Suggestions for Getting More Forestry in the Logging Plan. Pacific Northwest Forest and Range Experiment Station, Research Notes No. 72, December 1950.