Timber Cropping
as a Private Enterprise
in the
Douglas Fir Region
by
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TIMBER CROPPING AS A PRIVATE ENTERPRISE
IN THE DOUGLAS FIR REGION

Introduction

Timber growing is becoming more urgently a necessity than it used to be in the not too distant past, and the development of this industry, along with public education as to its need, is the chief problem faced by prospective operators. The rapid depletion of virgin stands of timber makes it necessary to find some means of replacing them with stands which will be nearly equal in volume if not in quality. It is uneconomical to attempt to produce high quality lumber found in very old growth timber, by timber cropping; so the only solution lies in fast growth over a period of years determined by study to be the best rotation to get most volume for the least time and expense.

Large areas have been logged in the past without provision for replacement by artificial or natural reproduction. In addition, these areas have then been burned, sometimes more than once, which further holds up chances for a good stand of new growth to get started; besides furthering erosion by depletion of the soil of its humus and root system.

Subsidiary problems such as age and size variation, soundness of timber, market conditions, insurance, taxes, and labor problems are also very important and not to be sidetracked. They are treated individually in this paper.
Also there is a great diversity of ownership. Very small tracts on farms, up to large corporation holdings consist partly of timber ownership. The remainder is held by public interests such as Federal, State and County governments. These various interests are all intermingled and some of the former are sometimes loosely held. Privately owned Douglas Fir timber lands consist of 55 percent of the total in the Northwest, and was acquired mostly for the value of the timber alone, which means that the owner will probably liquidate and let the depleted land return to the government for the back taxes due. About 45 percent of all virgin timber is privately owned and the process of liquidation will probably account for most of it unless there is a certain amount of control and provision for replacement by new growth (1).

Private ownership at present constitutes a problem to quite a number of worthy individuals. Acquisition of timbered land is usually costly, but planting and care of new growth is also costly as it is a long time proposition and revenue is not obtainable for from 50 to 150 or more years, depending on the rotation desired.

True, there is a great supply of uncut timber left, but it is far from the market or otherwise difficult to get out which makes new timber crops for the future look more like a paying proposition. When leadership is assumed by large concerns in financing private forestry, and cooperatives are formed by separate individuals, the long term
risk is then not such a gigantic problem. But even provid-
ing this can be done the risk is still too great. Too
little insurance can be obtained for various reasons and
other costs such as taxes are not consistent with the prob-
lems faced by operators. The term "adventure" used by
Hoffman (1) aptly describes the situation as regards finan-
cially capable concerns and leaves private capital practi-
cally out of the race to maintain a going concern. Conse-
quently it seems that a more thorough analysis must be
made in planning a course for the future—a course that
will allow for more eligible men to engage in the industry
on limited capital.

An extra section on restocking has been incorporated
in this paper, because the process of getting a forest
started is as important as managing it afterwards. Sel-
ection of a suitable location for Douglas Fir, proper
planting methods, selection of companion species if any,
and care of a young forest plantation are as much of a
problem to the embryo forester as managing is to an experi-
enced person.

Some space is devoted to the Christmas tree industry
which has been a going concern for a considerable length
of time. Recently it has reached large proportions and
legislation has been enacted concerning it; as it was more
or less a cutthroat proposition and damage to young stands
was uncontrolled. Proper managing provides plentifully for
the holiday and yet assures future timber crops.
MANAGEMENT
General

Governmental Responsibility

Very little was accomplished before the close of the 19th century to further the interests of forestry. Forest fires were allowed to run rampant and millions of dollars of existing and potential timber supplies were reduced to ashes. This does not include damage to soil and esthetic values. But since 1898 national forests have been established and put under management to protect timber products as well as esthetic values. Total area in the United States by 1940 was approximately 177 million acres, and 39 states had set aside 13 1/2 million acres for forestry purposes. Numerous city parks, watersheds, etc. have been established, but only a beginning has been made in the conservation of private forests (2).

The responsibility of the government in attaining and maintaining constant production on the national forests as well as proper and just legislation for the perpetuation of private forests is unquestioned. If private industry cannot manage its forests so as to assure a sustained yield, the latter must be taken over by the government. This is being done to a certain extent now, but most of the land taken over is denuded and tax delinquent. Appropriations must be made to restore these lands to productivity and provide funds for further research to enable private owners to hold and maintain sustained yield forests.
Adequate protection by the government is also necessary. The public can well afford the funds for this work. Much loss is avoided as well as making forest lands better insurance risks. This one item alone has discouraged owners from long term forestry enterprises.

Although certain restrictions may work a hardship on some individuals, they will usually work out in the long run for the community as a whole. Therefore it is imperative that the government exercise control over enterprises that tend to reduce the value of timberlands over a long period. Cutting timber will naturally reduce the value of land, but provision must be made for replacement so that the land will continue to be productive. This is the job of government in forestry—to see that land which is more suitable for timber than for agricultural crops, continues to produce without working a hardship on either the individual or the community.

Outlook for the Future

In the past, virgin forests were freely available to all comers in order to encourage the migration of population and the development of industry. They were acquired in most instances along with the land, and the tendency has been in most cases to liquidate. At the present rates of drain the virgin timber supply will last from 40 to 50 years. During the war the depletion was enormous, and it is continuing during the present postwar recovery period. The government is permitting more and more timber to be
removed. Some of it is overripe and should be logged to save what value is left, but very little planting is being done to replace it. Now that the emergency is past provision should be made for the recovery of the forests.

The future for the plywood industry which forestry must supply is the least bright because of the drain on large timber with considerable clear material. Filler material at present is nearly all low grade wood.

Costs of logging and lumbering have increased considerably along with the market value. Maintaining quality will become more difficult as old growth timber disappears, and competition with other building materials will force a drastic reduction in these costs.

With proper control of the market and of cutting methods there is no reason why our forest lands should not be able to supply our own and some foreign needs indefinitely. And to do this there must be a vast amount of planting done, stricter control of logging methods and a definite supervision of the market.

Reforestation by Private Individuals, Corporations and Governments

Many individuals are beginning to realize the value of keeping their land productive and are reseeding idle land. Farmers are planting in their woodlots where they have removed timber and on land which has become unfit for agriculture. Wherever the land is productive corporations are doing the same thing. The span of a man's life is so
short as compared to that of a mature tree that he must have the benefit of outside finance or combine his resources with others in order to reap immediate dividends. In the latter instance cooperatives would supply the answer. There are quite a number of them in the United States now and a prospect for many more as the public becomes forestry minded. The need for them in the Douglas Fir region is becoming apparent to many owners, and the necessary steps in forming a cooperative are outlined in Drummond's thesis on cooperatives (3).

State and local governments are taking big strides in reforestation. Some of the burned areas in this region are getting some attention but is is only recently that the problem has been given serious consideration.

Reforestation by the National government has been the most outstanding. In the year 1939, 131,707 acres were planted in U. S. National forests (2). The Civilian Conservation Corps was most instrumental in planting and conservation in the Douglas Fir region. The government is cooperating with the states in the production and distribution of nursery stock to the people for forest planting. This assistance is provided for in the Clarke-McNary Act.
Characteristics of the Douglas Fir Region

Favorable

The forests of this region are usually very dense and the conditions for growth are excellent. Investing in timber land in territory west of the Cascades is a good risk for an operator as the climate is moist, which is an essential factor for growth in Douglas Fir (1).

There is a large volume of merchantable timber still standing, and although some of this is easily accessible the great majority is in rugged and distant sections of the region making the problem of transportation a difficult but not impossible one to solve.

The existing young stands and the possibility of securing new ones on denuded lands provide a basis for future and permanent industries. Over mature and decadent timber can be removed to provide space for young vigorous stands (1).

Location of lands with immature stands and of logged off lands with good topography near water, road and rail transportation provide conditions for low cost logging in the future (1).

Pulpwood producing localities in Northwestern Oregon and Washington coasts are favorably located and are vital to future development of the industry. Spruce, Hemlock and Noble Fir are the most used species (1).

In this region the growth is rapid and regeneration is prolific provided fire is kept out of newly logged land and
also well established stands.

Compared with other sections of the United States the Douglas Fir region is fairly free of insect pests and diseases such as Blister Rust (1).

Blowdowns and damage from earthquakes etc. are not serious and can hardly be called a problem.

Unfavorable

Most operators are discouraged from practicing forestry because of the long periods of waiting and consequent danger from fire and market slumps.

At present transportation is a bottleneck but should ease up as the market becomes supplied.

Competition from Scandinavian countries, Canada and Southern woods in the manufacture of paper pulp is a problem, but not of immediate concern.

Isolated cases of insect and disease infestation which are a localized problem rather than a general one.

Rough topography in much of the region causing a logging and transportation problem. This is further hampered by seasonal heavy rainfall (1).

Great size of some logs is still a problem in a few small mills, but as second growth timber is being utilized this becomes less and less of a problem.

Forest fires are a constant danger, and the hazard is especially high when winds blow from east of the Cascades. Logging itself is then dangerous because of friction by running lines which is unavoidable. Increasing use by the
public is a source of fires and only proper public education and administration of laws can help this problem.
Even Aged Stands (Mature and Immature)

In the case of mature stands the problem of cutting is comparatively simple and clear cutting is silviculturally and financially advisable. Of course the area cut must be planted or reseeded to keep the land producing. The financial outlay in acquisition is a problem to most operators getting started. The most feasible method of procedure is to acquire only a small amount and to purchase more areas as profits accrue, at the same time planting the cut over areas so that a new forest is ready for cutting when the operator finishes with the old. As he progresses, he can also acquire other immature stands which will be ready to log at a convenient time. The rotation at which to cut must be determined from a study of the stands or from previous studies by foresters.

The chief problem is to have enough separate stands of different ages so that the operation as a whole is continuous. A gap in production is an indication of a lack of a stand of the right age or too quick liquidation of timber not sufficiently ripe.

Roads must be built and maintained indefinitely, which means that they should be well located and of good construction.

Market value of timber and its products usually fluctuates and so presents a problem which is unavoidable. Provision should be made for a sufficiently high profit and risk allowance to carry the operator over slump periods.
Costs of logging and milling subtracted from the selling price equals the stumpage price plus a profit. If the stumpage is bought outright, the profit and risk allowance is then a percentage of the logging and milling costs.

Complete formulae for figuring the present and future value of forest land and timber are presented in Buttrick (4) and Matthews (5). These are compound interest formulae and show a truer picture of value than most small operators usually obtain by guess work.
Uneven Aged Stands

This class of timber presents more of a problem than even aged stands. Some of the timber is ripe or over ripe and should be cut immediately. If this is not done very carefully, damage to the reserve stand results. Very young growth is damaged more than the older.

The diameter classes to cut are determined by the smallest tree that will pay its way. Usually it is not necessary to cut too extensively as the added room will allow most of the timber to grow valuable increment in just a few years; besides providing material for a sustained yield.

Which trees to cut as well as the length of time between cuts should be determined for the particular area concerned. Length of haul and other factors controlling the cost of production, coupled with a knowledge of the rate of growth for the region, determine the DBH limits and the rotation to use.

Where reproduction is not complete, planting has to be done to supplement natural seeding.

A method of cutting is to be used which will allow least damage to the stand. Skylines and hi-leads are out of the picture. Tractor logging in most cases is preferable. Some owners might find it profitable to use animal power, as this method will be the least damaging.

Roads have to be maintained as on any sustained yield operation and their cost distributed over a long period.
Ideally it would be an infinite length of time.

Protection must be afforded during fire season and provision made for insurance either privately or through an insurance company. Usually the area is partly protected by Federal or State agencies, but in the absence of their assistance the burden is all borne by the individual or company.
Liquidation Versus Sustained Yield

A problem faced by every owner is whether he should cut out completely as rapidly as possible, then wait a generation for a new crop, or cut a small area periodically so as to maintain constant production.

There are pros and cons on both sides of this question. The large operator will be in favor of liquidation, then replanting, for two reasons: because the extra cost of working around standing trees in an uneven aged stand without injuring them is prohibitive, and because investment in timber and equipment must be repaid quickly.

There are three methods of cutting: improvement cutting (in uneven aged stands), group selection cutting, and area selection cutting. The latter method is preferable as it is most economical and practical on a large scale logging operation.

Mortality is 50 to 80 per cent in the first method and is impractical on large operations. The second method eliminates the waste of the first method but entails moving costs from one small group to another. In the area selection method the operator can work a season in one area, then move during the slack of the year to another.

Actually the latter two methods are a form of sustained yield if the areas cut are planted yearly to provide new crops.

The second method can be used by smaller companies where the equipment is small and cost of moving it is neg-
Selective cutting should be practiced by only the small concerns working on public forests or property of their own. The latter system has its limitations in the present economic set-up and degree of utilization. Unless a forest is uneven aged, selective cutting should not be practiced.

Farmers Cooperatives provide a solution for small operators and farmers faced with a depletion of their stocks. In this way they can pool their resources and be able to figure on a yearly income from their land. They will be able to keep their land stocked, log only merchantable timber, and be assured of a good market for it.

Liquidation without providing for new growth is not a good policy for the country as a whole. Future welfare depends a great deal on the forests and its products.
Economic Problems

Investment

In 1940 the average investment in sawmill and logging equipment and working capital was at least $35 per M board ft. of annual output (1). Increasing that figure by 100 per cent the present investment would be about $70 per M bd. ft. annual output. To secure 6 per cent return on this investment a margin of $4.20 per M bd. ft. of annual production is required. An annual expectation of margin to cover stumpage, interest earned or paid, taxes, and profit should then be about $10 per M bd. ft. of annual production. Deducting $4.20 on plant investment there is $5.80 left for raw material and profit. If this is not enough, the operating efficiency is low or the stumpage is too high, which is often the case.

Instability of Ownership and Financing

"There are over two thousand owners of forest land in the Douglas Fir region, holding areas that range from as little as forty acres to tracts many thousands of acres in extent. Many of these ownerships are small or weak, and most of them are eager to liquidate their timber and dispose of their holdings. As a result, the forest ownership situation is characterized by impermanence and instability, and seriously impedes progress toward permanent forest management" (1).

This paragraph best describes the situation in the Douglas Fir region. Enlargement of State and National
Forests has been suggested and is now being carried out to a certain extent as a means of stabilizing ownership. Much of the marginal land should be included in these areas.

Mergers of the better lands and timber has also been suggested as a basis for long term managing and a better control of the raw material supply. This will provide for closer control of market conditions also.

This does not mean that the smaller units should be discouraged or that they will not work, but that the larger concerns have a financial advantage and better chances for research. Consolidation of smaller ownerships in cooperatives as suggested earlier in this paper should be given very serious thought, and more of them formed.

Financing in the past has been somewhat unsound and evidence has shown that the high interest bonds and loans are impractical for the small owner. Capital should be available at low interest rates and under terms best adapted to forestry enterprises. Federal loans have been helpful in sawmills, road improvements etc., but little aid has been advanced for investment in young growth and cut-over land to further permanent forest industries. Considerably more of this type of investment should be provided for.

Fire and Fire Insurance

The problem of fire is generally conceded to be one of the worst. It is ever present and in spite of the great effort expended to perfect the protection system, it is constantly in need of adjustment to meet changing conditions.
Better road systems increase the liability of fire from public causes.

However, information from the regional Forester's Office at Portland show a decrease in man-caused fires for 1946 under 1945 for 19 National Forests of the North Pacific region including Oregon and Washington (6). 288 fires were man-caused in 1946 and 417 were man-caused in 1945. The subdivision is tabulated as follows:

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<tr>
<th>Subdivision</th>
<th>1945</th>
<th>1946</th>
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<tr>
<td>Smokers fires</td>
<td>208 in 1945</td>
<td>137 in 1946</td>
</tr>
<tr>
<td>Campers fires</td>
<td>80 in 1945</td>
<td>76 in 1946</td>
</tr>
<tr>
<td>Lumbering</td>
<td>24 in 1945</td>
<td>17 in 1946</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>105 in 1945</td>
<td>58 in 1946</td>
</tr>
<tr>
<td>Total acreage</td>
<td>27,806 in 1945</td>
<td>9,589 in 1946</td>
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The protection system is further to be commended on the reduction of the size of these fires for the same period. 1196 of a total of 1470 fires were held to class A, which are fires under 1/4 of an acre. Lightning fires increased considerably and are included in the 1470 total. The most striking example of reduction in fires is shown by that of the smokers and campers because of the increased recreational use. The present "Keep Oregon and Washington Green" policy has done much toward public education, and if the trend of the figures shown is carried further, foresters can figure on a better outlook from the public and
industry as a whole.

Insurance of timber is an obstacle to permanent forest industry because of the high hazard during the dry season. Insurance which can be obtained at present usually has a dry season clause in which 80 per cent of the annual premium is added for the dry season, and provision made for a small return premium to discourage dropping insurance after the fire season.

There are several types of companies offering insurance. Among them are Stock companies, Mutual companies, Reciprocal companies (development of mutual) and Lloyd's Associations. These are more completely described in a reference (7).

Forest insurance organizations similar to protective associations can be developed to provide insurance which will supplement protection benefits.

Taxes and Other Assessments

Taxes at present are usually based on present value and payable annually, property taxes being the outstanding type. This works a hardship on the owner who plans to harvest in the future, and various plans have been adopted to allay this condition. Oregon and Washington have yield tax laws which keep the annual assessment low until the timber is harvested. A study headed by Professor F. R. Fairchild (4) presents three forms of tax laws (not yet adopted) which should give a fair distribution of the tax load. They are the differential tax, the deferred timber tax and the ad-
justed property tax.

tax delinquency in many cases of liquidation is transferring the tax load to going concerns. Reasonable taxes for land, and young growth which will not be harvested for some time to come would encourage owners to plant and retain cut-over holdings. An example of tax delinquent lands is shown in Clallam County, Washington, where 23.2 per cent of total county and private lands is tax delinquent (8).

In addition to these taxes there are other assessments such as tax on operating plant, old age benefits, unemployment taxes, state excise tax, taxes on capital stock, industrial insurance and medical aid. In 1929 the total payroll assessment (less old age benefits, unemployment taxes and state excise tax) per M bd. ft. of annual production was $0.491 for a typical operation. In 1938 the charge was $1.159 per M bd. ft. of annual production (1). At the same rate of increase the charges for 1946 would be approximately $1.66 per M bd. ft. annual production.

Inheritance taxes sometimes work a hardship as the sudden expense discourages proper management.

Labor

Labor costs in the Western United States lumber industry constitute over 50 per cent of the value of the products as compared to 16 1/2 per cent for other major industries such as steel and automobiles. The average daily wage has risen from $0.61 per hour in 1924 to $0.75 per hour in 1929 (1). In 1940 they averaged about $1.05 per hour.
At present there are three main unions established in the Douglas Fir region—the American Federation of Labor and its affiliates, and the CIO and its affiliated union the IWA (International Woodworkers of America). They have received their second round of wage increases since V-J day and the IWA has three increases making the combined average wage $1.43 1/2 per hour in the Douglas Fir industry, which is higher than any other, nationally. Of the 100,000 workers in the region 20 per cent have had no increases at all. The weekly average take home pay of loggers and millers is $62.14 (10).

But in spite of these wage increases the production per week has dropped 6.4 bd. ft. in mills and 36.4 bd. ft. in logging camps since V-J day. This drop is due to lifting of high geared war production standards.

Travelling time is a factor to be considered in paying wages. It is counted as compensable if the distance is very great or other conditions make it impossible for the employee to live on or close to the job. On the other hand, if travelling takes too much time, it is unjust for the employer. The current portal pay legislation does the latter, and proper adjustment will have to be made.

Considerable study is needed to develop fair labor policies. The responsibility of industry is to pay a fair wage commensurate with returns possible. Labor itself should avoid unnecessary stoppage of work. The present closed shop policy which labor is attempting to force on
industry tends to demoralize constructive and sound operating practices. The attitude of the public generally should be one of fair legislation and policy toward both labor and industry.

Research

As the writer has mentioned before, the rapid depletion of mature old growth timber with a large percentage of clear lumber has made it necessary to use more second growth. In order to fully utilize this timber and use it in place of old growth, considerable research must be done. At present any grade of lumber will sell, but under ordinary circumstances only high grade lumber has a good market.

Several lines of research are suggested by Hoffman (1). Principally they are:

a. Selective cutting and its economic possibilities.

b. Improving efficiency in logging methods, equipment etc.

c. Research in analysis of timber stands of 160 acres or less.

d. Research in prevention and use of fire.

e. Study of protection systems as a means of coordinating and improving them.

f. Study of restocking methods—natural and artificial.

g. Study of forest fire insurance and its application.

Improvements in manufacturing are also necessary but do not come within the scope of this paper.
An addition to the first item above, suggested by the writer, is to apply study in selective cutting toward more efficient use of machinery in close quarters.

Conclusions

In the treatment of a subject of this sort only an outline of the problems confronted can be presented. With proper coordination of the public, its agencies and private industry, these problems will not be nearly as hard to solve as they appear.

Revival of public interest in land ownership and their responsibility in keeping destructive agencies out of the forests is the best solution of the fire problem. Combined with efficient protection systems this problem becomes extremely simplified and the only exception lies in lightning fires which are uncontrollable in number, but can be kept to a minimum area.

Improving the wood-working industries of the region is the solution to competition from concerns offering related products. Personal interests and prejudices should be cast aside to allow for constructive action where it is evident that such action will benefit the majority.

Reasonable land management by Federal and other governmental agencies will attract many owners and encourage sustained yield industries.

Long range planning by industry in the timber growing localities with emphasis on the financial side of the question is essential. Timber cropping is a long term
proposition and as such requires capital which can be invested at low interest rates until a crop matures. Provision for reasonable long-term loans must be made by legislation or by qualified financing companies.

Timber growing to be successful must have adequate backing and be efficiently run. Provision for ups and downs in a business of this sort are paramount, as it is impracticable to plan on perfect stability in market conditions for the time required.
Foreword

The region in the Pacific Northwest devoted to the Douglas Fir industry has a favorable climate, and the soil generally is suited for growing. Very rocky or swampy land is not productive of Douglas Fir and a little observation on the part of the individual will show him which land is suited for his purpose.

Natural Versus Artificial Reproduction

Local conditions are the chief consideration, and much depends on whether the owner wants a pure or mixed stand. If selective cutting is practiced, regeneration is usually taken care of except where change of species is desired. In clear cutting methods the owner must decide whether it is cheaper to leave seed trees or cut them and plant. Sometimes their market value is much more than the cost of planting. Points to consider in the selection of the proper method are the cost, time required to complete the stand, and type of stand attained.

Natural and artificial regeneration are considered separately in the following pages.

Natural Reproduction

Natural reproduction in the virgin forest fills up spaces left by fallen trees, but this tends to make a forest uneven-aged. Natural reproduction after fire and logging is the least complete and planting is necessary to fill out the stand. Following a fire complete restocking
is often the only remaining thing to do.

Several methods of natural reproduction are used. Essentially they are the selection, shelterwood and clear cutting methods. The shelterwood method is usually practiced in even-aged stands and the mature crop is removed by a series of cuttings. In clear cutting trees are left in strips, groups, or as scattered seed trees until reproduction is complete, then removed.

Vegetative reproduction is impossible in the Douglas Fir region except where a mixed stand is desired. Balsam fir and a few other species of Abies will reproduce in layers.

Artificial Reproduction

Mixed stands in the Douglas Fir region are not considered of much value as each species must be treated separately. Logging mixed stands usually entails greater cost and sometimes an additional loss through sale of the foreign species.

On the other hand mixed stands will occupy the ground more completely and are less dangerous from the standpoint of fire hazard. They also improve the soil condition.

Pure stands are much easier managed than mixed ones and natural pruning is much better and uniform. Harvesting the crop is simplified and restocking afterwards is less expensive and more complete.

Planting of nursery stock is preferably done in the spring in the Douglas Fir region and plants are spaced ac-
In this connection it might be well to mention the Christmas tree industry of this region (9). Several companies have been formed and are cutting second growth trees from naturally or artificially reforested land of the National or State Forests, or from holdings of logging companies. Contracts are entered into and the regulations of the state adhered to. Farmers woodlots furnish many of them. In a few cases the company buys logged-over land and raises its own trees. When they have thinned the stand sufficiently and the remaining trees are too large to sell, the land is re-sold to a logging company to add to its holdings for future timber. A ready market is found for trees in the large cities and as far east as Chicago.

In order to stock efficiently and to get the most growth possible a survey should be made of the contemplated area to determine total area, type of soil or soils, part of area unsuitable for timber, and species of timber best suited for the area—whether a pure Douglas Fir stand or a mixed stand would be best. Cost of planting area and making possible thinnings should be calculated as nearly correct as possible.

Establishing by Seeding and Transplanting

Seeding an area directly has been employed consider-
ably and is done by hand or from the air. Broadcast seed-
ing on top of the ground has been found to result in an irregular germination rate although it is far less expen-
sive than dibbling (seeding in holes). Transplanting is the most expensive but is the most positive method of getting a good stand of young growth. Broadcast seeding followed in a year or two with transplanting to fill in the gaps is a good method.

**Summary**

Natural reproduction in the Douglas Fir region is prolific and ordinarily sufficiently reseeds an area so that no transplanting is necessary. Even on some burned-over areas, seed which has been wind borne for miles resulted in a thick covering of second growth. In the absence of natural reproduction, transplanting is a necessity. Areas such as the Tillamook burn have not restocked completely because of their great extent. The best method is not always the cheapest. An example is the mixed Hemlock and Douglas Fir stands on the west slope of the Cascades, and in the Coast Range from northern Oregon through Washington. Areas that are being allowed to reseed themselves are almost predominantly of Hemlock, which is greatly inferior to fir for lumber.

A complete treatment of planting methods and growing transplanting material in nurseries is presented in a reference by Toumey (2).


