The Problem of Brush Field Reclamation in the Northern California Pine Region

by

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CHAPTER I

Introduction

The purpose of this thesis is to examine the problem of brush field reclamation in the pine region of Northern California. The pine region of Northern California, as it is referred to here, consists of the forests of western yellow pine, sugar pine, white fir, incense cedar, Douglas fir and all the various combinations of these species. These forests are located on both the east and west slopes of the Coast and Sierra Nevada Ranges, on the extensive plateau of the northeastern part of the state and the northwestern cross ranges.

No attempt is made to compare the costs of the various methods employed in this work. The brush fields represent such a wide variety of conditions that comparison of costs would lead to erroneous conclusions.

The data for this thesis were obtained through interviews with Forest Service officials active in the work, personal experiences and observations in the field and examination of Forest Service publications and records.

In order to study this problem it is necessary to analyze the advantages and disadvantages of the various methods of brush field reclamation. The methods considered

in this report will be:

1. Natural reclamation, the natural succession from brush to timber.
2. Direct seeding.
3. Planting

Brush field reclamation is a problem of great importance in the pine region of Northern California. On the ten important national forests which comprise most of the California pine region 1,862,000 acres of the total 13,625,000 acres are occupied by brush. This 13.7% of the region is not productive to its full capacity. The number of different species of woody plants which form the brush cover in this region is well over one hundred. The mixture varies greatly according to the location of the area and the quality of the site that is occupied. The most widespread and abundant species are common manzanita, golden chinquapin, snowbrush, white thorn, bluebrush, western chokecherry, service berry, wild plum and sprouts of California black oak and huckleberry oak. The brush varies from three to eight feet in height and is usually so dense that walking through it is extremely difficult.

The brush cover affords some water-shed protection and acts as a check on erosion, but these functions could be performed as well or better by a stand of timber which would also have a commercial value.

In most cases brush fields are not attractive to wild life or grazing animals. Although the plants are nearly all palatable to browsing animals, the brush cover is usually too dense for such animals as deer, sheep and cattle to penetrate easily. Most of these brush areas, if converted to timber types would provide excellent forage for large numbers of domestic stock as well as food and cover for wild life.

A brush field has no aesthetic value. There is nothing about a vast brush area which would inspire a forest user to be more careful in the ways in which he uses the forest. Fifteen years ago this fact would have been of very little importance. The opening up of new recreational areas and the building of roads into the more isolated forest areas has brought the importance of aesthetic value to the foreground.

These brush areas are all higher than average in the Forest Service fire hazard ratings. The brush cover has very low value in itself, but fire in these areas is nearly impossible to control until it reaches some natural barrier or until it reaches green timber. Under favorable conditions, these brush fields burn with such intensity that serious site deterioration results. The ravages of successive fires, followed by erosion and leaching of soil nutrients so greatly reduces the fertility and amount of soil that in extreme cases no vegetation will grow.

The intensity of a fire in these brush fields is shown by review of Forest Service fire records. Table number 2 shows the relationship between amount of brush and the amount of heat killing during a fire. The fires indicated may be considered as an adequate sample of forest conditions throughout the region. The bear clover indicated in the table is Chamaebatia foliolosa, a low-spreading shrub which is quite common in most of the region. It burns very rapidly but has very little fuel substance and therefore retains heat for only a short time.

Table number 3 indicates the difficulty of controlling a brush field fire. The data compares the cost and size of brush and timber fires. In examining this table it should be remembered that the brush fields in most cases are better protected than the timber types, that is, suppression men are usually located within short travel distance from the high hazard area.

The high cost of fire control, together with the ever present danger of a fire getting a good start in the brush and spreading to the more valuable timber is reason enough in itself to justify steps to reclaim the areas for timber production.

Table #2*

RELATIONSHIP BETWEEN AMOUNT OF BRUSH AND FIRE DAMAGE

Name of Fire & Type of Cover	Area	Area Heavily Damaged		Quantity Killed /@	Value of Loss /@
	acres	acres	percent	bd.ft.	Dollars
Bear River-Bear clover	500	7	1.4	38	.08
Slate Mountain-Bear clover	350	-----	----	50	.10
Ham Station-Bear clover &brush	9,485	310	3.3	550	.54
Weed-Little brush	2,000	30	1.5	220	.66
Butler Meadows-Some brush	1,120	18	1.6	230	.66
Pilot Creek-Some brush	380	10	2.6	250	.25
White Horse-Some brush	20,500	2,300	11.2	1,580	3.90
Quincy Junction-Med. brush	200	30	15.0	2,100	4.50
Moffitt Creek-Med. brush	10,000	1,210	12,1	1,425	2.90
Boardman Ridge-Med. brush	400	40	10.0	1,390	2.63
Howard-Heavy brush	700	700	100.0	10,900	16.40
Hoey-Heavy brush	410	410	100.0	2,820	8.50
Soda Creek-Heavy brush	1,200	480	40.0	2,340	5.50
Ferris Creek-Heavy brush	4,635	2,220	47.9	3,360	6.90
Lassen-Walker-Heavy brush	220	220	100.0	3,350	5.50

Damage based on minimum stumpage prices of the Forest Service for the region. The prices for the five species concerned are: Sugar pine, $2.75; Western yellow pine, $1.75; Douglas fir, $0.75; white fir and incense cedar, $0.50.

*"The role of fire in the California pine forests", S.B.Show & E.I.Kotok.

*Table #3

RELATIVE SIZE OF TIMBER AND BRUSH FIRES IN CALIFORNIA

(1916-1918) Inc.

	Timber	Brush
Total area (estimate).....	10,000,000	5,000,000
Number of fires.....	1,757	1,878
Total area burned annually.....acres	66,690	204,702
%	0.7%	4.1%
Average size of fire.....acres	114	327
Proportion of fires over 10 acres %	18.3	42.4
Average cost per fire.....	$25.75	$98.40

*Show & Kotok, "The Role of Fire in California Pine Forests".

CHAPTER II

Natural Reclamation

Natural reclamation or the natural succession to the climax or timber type is a slow but effective method of reclaiming brush fields. All of the brush areas north of Lake county through the Coast and Sierra Nevada ranges show evidences that the areas were occupied by timber before repeated fires upset the natural balance. Evidence supporting this statement may be summarized as follows:

1. Living trees and snags, bearing scars from repeated fires may be found in nearly all brush fields regardless of how extensive they may be.
2. In the largest brush fields scattered islands of virgin forest are present. These patches of timber are found in naturally protected spots or places where the fires did not burn with sufficient intensity to destroy them.
3. Timber stands are found immediately adjacent to the brush areas and on areas of similar site quality.
4. The brush species which are part of the understory of virgin forests are the same as those occupying the brush fields. The only reason the cover type

is so distincly changed is that the brush species will sprout after a fire which will kill the coniferous species.

5. Reproduction will eventually come in under coniferous seed trees where these seed trees escaped the ravages of the fires.

Since all the evidence points to timber as the natural climax type, it is reasonable to assume that the areas will eventually return to timber cover. "Estimates made after years of study of brush fields indicate that about two-thirds of their area is reproducing sufficiently to establish eventually a commercial forest."[1]

The areas which are being naturally reclaimed are the smaller brush fields which have thrifty stands of timber along their edges. The extent that natural conifer reproduction takes place varies directly with the number of seed trees scattered throughout the area. Successful regeneration can be expected only a few hundred feet from the source of seed.

In extensive brush areas natural reclamation is nearly impossible. For example, the Burney Springs and Big Springs brush fields on the Lassen National Forest as well as the brush areas on the slopes of Mount Shasta each cover at least five thousand acres. It would be a matter of several

[1]Show & Kotok, "Role of Fire in California Pine Forests."

tree generations before these areas could possibly become restocked naturally. During such an extended period of time the area would have a chance to reburn several times.

Examples of the futility of natural restocking in large brush fields were found at Burney Springs. After careful search, several saplings were found deep in the brush patch. All of these young trees were stunted, gnarled and overtopped by the brush. A count of the branch whorls indicated that the trees were from twenty-five to thirty years old. At the rate these trees were progressing, it is extremely doubtful that this area would ever become restocked naturally because of the unfavorable combination of fire hazard and risk in that area. Fortunately these extremely large areas are the exception rather than the rule.

Natural restocking is the salvation of the small brush areas, and those which are owned by the state, counties, private individuals and companies. In Northern California there is no agency other than the Forest Service which can afford to use other means of reclamation. If fire can be eliminated from these areas they will eventually become adequately restocked. The improvements in protection methods of the State Department of Forestry and development of a fire consciousness on the part of private land owners lends an encouraging aspect to this method of brush field reclamation.

CHAPTER III

Direct Seeding

That the brush fields were not restocking naturally, and the importance of restocking them, was early recognized by the executive heads of the Forest Service in the region. The first attempts to restock these areas were made in 1908, and in typical American fashion, the development of research was several years behind the executive action.

At first there was no true conception of the difficulties of the situation. It was thought that the areas were not receiving enough seed from natural sources, hence the first attempts to artificially restock the brush fields were by direct seeding. During the period from 1908 to 1913, seed of every important conifer native to the California pine region was sown in scores of brush fields.

The first seed was sown broadcast over the ground. The results of this method were embarrassingly negative, regardless of whether the seed was fall or spring sown. At that time no one realized the significance of the enormous rodent population of these areas. Various methods of sowing the seed were employed. Besides being broadcast on the ground, the seed was sown on the snow.

Seed spots were prepared by grubbing out brush and covering the seed with dirt. In some places where the brush density would permit, a corn planter was tried. The results of these attempts were no better than those which had gone before. The rodents ate the seed as soon as it was placed on the ground. Fall sown seed that did not escape the rodents in most cases was killed by the summer drought of the next year.

Attempts were made to reduce the rodent population, which consisted largely of golden-mantled ground squirrels, pine squirrels, brush rabbits and several varieties of mice. Several methods of poisoning as well as trapping were tried but no appreciable decrease in number of rodents was noted. Poisoning the seed coat with a strychnine formula was tried but the desired results were not obtained. This was largely due to the squirrel's habit of hulling off the seed coat before eating the seed.

Screening the seed spots protects the seed from the rodents, but it is too expensive for any use other than experimental. The seedlings produced in this manner apparently are not as hardy as 1-1 nursery stock transplanted to the field.

Except in a few very favorable spots, all attempts to restock brush fields in the California pine region by direct seeding have been magnificent failures. In those few locations where conditions were favorable the only species to grow successfully was jeffrey pine

(Pinus jeffreyi). Although these spots are extremely irregular and widely scattered, there are possibilities of using them as nuclei for natural restocking.

Although there has been no experimenting done as yet it seems there are good possibilities of establishing seedlings in screened plots scattered over the brush field. These spots would serve as focal points for natural reproduction by supplying seed after the trees reached seed producing age. This method would probably not be as expensive as planting and would speed up the natural reclamation by approximately one tree generation.

CHAPTER IV

Planting

Numerous methods of planting have been tried in the California brush fields. Some of the methods attempted are:

1. Planting without ground preparation.
2. Spot planting.
3. Planting following fire.
4. Planting in cleared strips.
5. Combination of burning and stripping methods.

Each of these methods will be discussed separately.

Planting without ground preparation

There is not much that can be said in favor of planting without ground preparation. On the surface this appears to be the cheapest possible method of brush field reclamation, but if one looks more deeply into this process he finds that in the end it is one of the most expensive.

The general method as it is employed in this region is to plant a tree in such openings as can be found in the brush cover. These openings are usually found along blown down snags or in spots where the soil is too poor in quality to support the brush plants. If the soil will not support brush species, there is very little chance of a tree

becoming established in the same spot. Trees planted by the side of a fallen snag have a better chance of getting a start, but are soon over-topped as the brush tends to close the hole in the canopy. Rodent damage in transplanted trees is in most cases quite severe and will be discussed at greater length later.

This is a slow method of planting because it is extremely difficult for the planter to walk through the brush area. Even though the ground is not prepared before planting, it probably takes as long to plant the same number of trees by this method as by the stripping method. The expense of this method is often increased by the planters. A day spent fighting his way through a dense patch of manzanita which averages five feet in height will severely tax the patience of the most sincere conservationist. It is only natural that the low paid laborer, who for obvious reasons must be employed for this kind of work, often has an overwhelming desire to toss bunches of trees into the brush.

Due to the combination of adverse factors already named, there is small chance of survival of the planted trees. There is no possibility of later follow up action to release the transplants from the over-topping brush or otherwise bettering the growing conditions because the planters wander about following the course of least

resistance and no record is kept.

This method was tried by the Forest Service during the early days of planting in the pine region but was soon abandoned as unsound. It does not seem wise to spend money to grow a young tree, then add to this the cost of planting and then plant the tree in a place where it has such a slight chance of surviving. However, in 1938 this method was employed by two Northern California lumber companies who were suddenly struck by an unexplainable desire to reforest some brush areas which were being naturally restocked quite satisfactorily.

It must be said in defense of this method that in a few special cases it is practical. On an area which is too far removed from a natural seed source, where brush is not dense and plantable openings numerous this attack may prove successful. On the whole, however, planting without ground preparation cannot be done successfully in the brush fields of Northern California.

Spot Planting

The procedure of spot planting is much the same as that followed in seeding in prepared spots. The brush is cleared away in selected spots and several trees planted in the cleared area. This is a rather laborious process but has worked successfully in some areas. The brush is chopped out and the burl or "nigger head" is grubbed up.

This work must be done by hand because the spots are too scattered to make the use of tractors economical. Although the work is slow and the labor cost high, an elaborate system of service roads need not be built as is required in the stripping method.

There are good possibilities of survival when using this method if care is taken in selecting and preparing the spots. The spots should be located on the best sites. Unfortunately, these are the places where the brush growth is most luxuriant and the preparation most difficult. The plots must be made large enough to prevent over-topping of the planted stock by the surrounding brush. If the burls are not dug out the sprout growth will very soon overtop the planted trees and the trees will be killed or severely stunted by the resulting competition.

A desirable feature of this method is the possibility of follow-up action. The plots may be marked and charted in such manner that they may be located again a few years after planting and the trees released from the brush competition or dead trees replaced.

This method of planting has not been practiced extensively in the California pine region but will probably be seen more as state forestry develops. In the few attempts that have been made the results compared very

well with those of any other system. The trees planted in this manner are not expected to produce a timber crop because they are too scattered for logging if they ever reach logging size. The purpose of these trees is to furnish seed for natural reproduction which will come in as the brush is shaded out. Rodent damage to the planted stock is quite severe, but this is not the fault of the method. The damage would be as bad under any other type of planting. The only solution to this problem is an unceasing fight against the rodents and continual replacement of damaged trees.

This method of planting has much to recommend it. It is a slow method but in the end the desired result may be attained. The fire hazard is not appreciably decreased for many years and there is ever present the danger of losing all the work that has been done and having to start over in a worse situation. Increased protection must be given the area. This method, however, is a desirable one for the state forest lands on which it is impossible to use tractors because of the extremely high expenses involved.

Planting Following Fire

Planting following a fire is the quickest and cheapest method of planting trees on a brush area. There is only one drawback to this method--the trees usually

cannot withstand the brush competition. The procedure as it has been practiced in California is to plant the entire burned area, taking advantage of any favorable situations that are present. The usual spacing is eight feet by eight feet or more in some cases. Planting is usually done in the spring as soon as the snow melts sufficiently.

Studies carried on by Hoffman[1] clearly show the prolific sprouting ability of manzanita brush. In one instance he found that manzanita established 91 seedlings per square yard after a fire, and that this number of individuals increased 918 times. Unfortunately, the brush growth starts at the same time or earlier than that of the planted trees. The sprouts have the entire root system of the former plant to draw upon and grow quite rapidly. The brush sprouts soon overtop the trees and the process of shading out begins.

In most cases the trees do not have much chance of survival, especially when the predominating brush species is manzanita. In cases where the lesser brush species or even snow brush occupy the area the planted trees have a fairly good chance of growing up through the openings. Manzanita, however, grows too fast and covers the ground too densely for the trees to survive. The planted areas

[1]"Reforestation on National Forests", Tillotson, C. R.

must receive very intense protection. The fire hazard will remaind the same for at least 25 years, but there will be much more at stake in the event of a reburn. In most cases planting following fire will be unsuccessful. Only in naturally thin brush patches can the desired results be expected. This method of planting has been employed in several instances in the California pine region but with little success in most cases. In the few cases where the trees survived, manzanita species were not abundant.

Planting in Cleared Strips

This method of planting presents the best possibilities of reclaiming the brush fields. A great amount of work has been done in developing this method of planting. The principal problem is removing the brush. Other things being equal, the trees will grow as well in the cleared areas as on any other location.

[1]One of the most extensive investigations into this method was carried on at the Burney Springs brush field near Mount Lassen on the Lassen National Forest. In order to describe what has been done, it is necessary to describe the conditions present and the information that was desired in the experiment.

[1]Information about Burney Springs brush field was obtained through an interview with Mr. C. W. Corson, Regional Planting Inspector. R. V.

Burney Springs planting project is located near the base of Burney Mountain on the southeast and southwest slopes. The area, 5,100 acres, was practically all brush, chiefly of the following mixture: Manzanita 54%, snow brush 36%, wild cherry 10%. In places this mixture is intermingled with numerous other species. The average height is five feet with low growing plants occupying the space not covered by brush. The altitude of this area is from 4500 to 5000 feet which is considered excellent for tree growth in that particular region. The conditions for reforestation are ideal. There is sufficient moisture, usually in the form of deep winter snow. It has a deep fertile lava loam soil on moderate slopes which are easily accessible. The plantable area is in large unbroken units which makes for more efficient planting. The area, as far as is known, was first burned about seventy-nine years ago. It has been reburned several times since then; the last fire occurred about 1911. Previously a stand of ponderosa pine, sugar pine, Douglas fir and white fir grew on the area, but a few scattered much burned stumps are the only indicators of the original stand. A good stand of timber was probably present at one time because the site is quite favorable for growth of brush plants and therefore should produce a good tree crop.

This project was undertaken by the United States Forest Service in conjunction with the California Forest and Range Experiment Station. The principal object of the work was to determine if three methods of partial eradication of brush differed significantly in their effects on survival of planting stock. The methods of clearing were: 1. Burning 2. Stripping 3. Burning followed by stripping. The clearing was completed in the fall of 1936.

Other objectives were to compare Jeffery pine and ponderosa pine as planting materials, nursery grown 1-1 transplants with seedlings from direct seeding and stock sprayed with a rezyl-strychnine-choloroform rabbit poison with unsprayed stock. Planting was done in May, 1937, and stratified seed was sown in screened seed plots.

Planting foloowing fire has been previously discussed and the results found at Burney Springs did not differ from the results described. It is very dangerous practice to deliberately set a brush field on fire. Burning in this particular project was only partly successful. Part of the burning that was done was controlled and part of it burned out of control.

Stripping in this project was done with trailbuilders. The equipment used was Cletrac tractors with front end hydraulic lift bulldozers. It would be to no avail to

bring costs into this examination because they would not be representative figures.

Clearing heavy brush with a trailbuilder requires a good tractor operator in order to prevent excessive damage to the equipment. In tall brush it is difficult for the operator to see the ground and what he is driving into. The principal cause of breakdowns in the Burney Springs area was driving into boulders. Stripping by this method was rather slow because the root burls had to be removed as well as the surface brush. Burning before stripping practically doubled the amount of clearing that can be done in the same length of time.

At Burney Springs planting in the strips was done the following spring. The regular open hole method was used and ponderosa and Jeffery pine were planted. Because of the severe rabbit damage some of the trees were sprayed with a poison mixture to see if there would be any appreciable difference in damage. Apparently the poison deteriorated or leached off the trees because there was no noticeable decrease in rabbit damage to the trees. The survival of the two species did not differ greatly the first year, but at the end of the second year there was a slightly higher percentage of Jeffery pine trees alive.

Stripping following burning is by far the fastest

method of clearing the brush but is not always the cheapest. There is always the possibility of the fire getting out of control. In order to do any good the fire must burn very intensely and a hot fire in a brush field is a very dangerous proposition. When the stripping operation is done it is still necessary to uproot the root burls but the operator does not have to remove the surface brush. Breakdowns are fewer and the amount of strip per machine is greatly increased. Regardless of the things in favor of this method, the risk involved makes it impractical.

At Burney Springs, there was no noticeable difference in the survival of seedlings planted in the burned strips and cleared strips. It is probable, however, that if some species other than pine had been planted there would have been some difference in results. The blackened soil reaches extremely high temperatures during the hot summer days.

In later years different types of blades have been tried on the trailbuilders. The original type used was the ordinary dirt blade. It was found that a modified rock blade was more efficient. The modifed rock blade tears up the roots rather than merely cutting them off. With this type of blade it is not necessary to move as much dirt as with the ordinary dirt blade.

On the Plumas National Forest a very efficient brush

removing machine has been developed. This machine is a very large tractor-drawn plow. The plow is equipped with mold boards to which are attached sections of grader blades which serve to shear off the brush. A ripper tooth forms the point which uproots the brush. Behind the moldboards are two large brush wings which move the brush out of the strip. It is not necessary that much earth be moved in order to get effective clearing. The frame is made of 15 inch I beams and the moldboards and brush wings are made of 5/16 inch boiler plate; all of the joints are electric welded. The overall dimensions of the machine including the tongue, are 25 feet long, 8 feed wide and 15 feet high. The weight is carried on two bummer type wheels. The wheels in some instances are replaced by two skids which prevent side slipping of the plow but make it harder to pull. The point of the plow is raised or lowered by a cable line running to a winch on the back of the tractor. The brush wings are adjusted by a ratchet and screw device.

The Plumas plow is a very efficient implement in situations where the ground is not too steep or rocky. In steep ground it is necessary that the strips be made more or less along the contour or soil erosion will result. This puts the plow at a decided disadvantage because of its top-heaviness and the tendency to slip sideways.

However, there are plenty of brush fields in the California pine region where conditions are favorable for this machine. This plow greatly reduces the cost of brush removal which is really the major headache in the reclamation problem.

To summarize the brush removing methods:

1. Burning is too dangerous to be used.
2. Trailbuilders equipped with a modified rock blade are more efficient than those with the ordinary dirt blade.
3. The Plumas brush plow is the best machine for removing brush but it cannot be used on steep or rocky ground.
4. There is very little difference in the survival of the planting stock under any of the different stripping methods.

CHAPTER V

Summary

I. The natural process of succession through which the timber reclaims the brush fields without human aid is a slow but effective process. This natural succession will probably never be completed in the larger brush fields because of the high fire hazard. In the smaller areas it is best to let nature take its course, but the importance of protection from fire cannot be stressed too strongly.

II. Successful direct seeding is not possible. Seed eating rodents make this method impractical. Seeding in protected spots, however, has good possibilities of success. This method has not been tried other than experimentally but good results were obtained whenever it was tired.

III. Planting is the only method of brush field reclamation which should be employed in large areas.

A. Planting without ground preparation is valueless because of the very low survival of planted material.

B. Spot planting has much to recommend it. It is one of the most inexpensive methods of restocking the areas. Survival is as high in this method as in any other. It is possible to return to the

spots and release the trees from the brush suppression.

C. Planting following fire will be unsuccessful because the trees will nearly always be over-topped by the fast sprouting brush.

D. Planting in cleared strips is the best method of reclaiming the brush fields. The trees have a good cahnce of surviving if the brush is properly removed. Removing the brush is the major problem. Brush removal has been done by many methods the most important of which are:

1. Burning and stripping.--This method is too dangerous to be used.
2. Trailbuilders.--This is an expensive but effective method.
3. Plumas brush plow.--This is the least expensive method of brush removal. The machine, however, cannot be used on slopes over 25% or on very rocky ground.

There is very little difference in the survival of planted material regardless of the method by which the brush is removed.

IV. Ponderosa pine and Jeffery pine are the principal species planted in the brush fields. There is slight difference in the survival of the two species. The

difference in most cases has been in favor of Jeffery pine.

V. Rodent damage is very severe in brush field plantations. The present methods of rodent control are ineffective. Poison baits and trapping do not reduce the rodent population significantly. Spraying the trees with a poison mixture has no effect on the amount of rodent damage.

In conclusion it may be said that brush field reclamation is slow and expensive at best, but it is work that must be done. With the aid of new and better means of removing the brush cover there is hope of some day replacing the brush areas with timber cover. Better methods of fire protection will be a great help in this work. Brush fields are not a natural condition. Prevent fires and no brush fields will be developed.

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