MECHANICAL BRUSH CONTROL ON STEEP SLOPES IN SOUTHWEST OREGON

by

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MECHANICAL BRUSH CONTROL ON STEEP SLOPES IN SOUTHWEST OREGON

I. INTRODUCTION

A. GENERAL BACKGROUND

Undesirable brush species presently occupy a substantial portion of land available for commercial timber production in the Pacific Northwest. In the Oregon coast range alone, 15% or 568,400 acres of forest land are occupied by noncommercial vegetation. If converted to full conifer production this land has the potential of producing 31.5 billion board feet of timber over a 60-year rotation (4).

Such lands exist today due to a variety of reasons including natural succession, natural catastrophic events, i.e., fire, and man's activities. Indians used fire on lands in southwest Oregon to enhance big game habitat. This practice was used by early settlers to convert lands for livestock management. More recently clearcuts left to natural regeneration have resulted in brushfields and hardwood stands. More specific and detailed information concerning the geography, history, and description of brushfields in southwest Oregon is available (15).

The problem of combating competing vegetation for site preparation or release has confronted foresters since the advent of modern forestry. Many tools have been developed to aid the forester in this problem. They can be grouped into three broad categories; fire, chemical methods, and mechanical methods.

Specifically, in the the Pacific Northwest, common techniques used for converting brush and hardwoods to conifers include harvest, tractor scarity, multiple spray, slash and burn, spray and burn, and combinations of two or more of these techniques (13). Success varies with all methods. Recently high-lead scarification has received limited application in site conversion and site preparation (13).

Typically, when access to sites by ground-based vehicles is precluded due to steepness in slope chemicals and fire, alone or in combination, are utilized for site conversion of brushfields. Increasingly social-political pressures are restricting the use of these management tools. The pressure has been so great that in some government agencies in northern California and southwest Oregon, the use of aerial application of herbicides is precluded by management direction. The use of fire is being impacted by recent federal legislation, resulting in logistic problems and a limited burning season.

On some sites, even if permissable and feasible, fire and chemical methods are not appropriate. Fuel loadings or moisture conditions may preclude the use of fire. On small units, even when burning is appropriate and feasible, the per acre burning costs are high. In dense brushfields spraying may effectively kill the brush, but it does not provide physical access. Herbicides alone are effective only when vegetation is very susceptible and the brush stand is sparse enough to allow planting at a reasonable cost. Even then, seedlings may need protection from small animals that move about freely under dead standing brush (16, 17).

Figure 1. Brushfield on the Galice Ranger District; Siskiyou National Forest.

Figure 2. Brushfield on the Butte Falls Ranger District, Rogue River National Forest.

The above conditions suggest a need for the development of an alternative management tool for conversion and site preparation on steep slopes. Cable systems have been used for decades for timber harvest. Utilizing this technology for site preparation and conversion is a natural step.

In this paper the extent of the steep slope brush conversion problem will be estimated. Potential solutions and development should be commensurable with the extent of the problem. The state-of-the-art of steep slope site preparation and conversion will be described. Feasible alternatives to these limited options will be developed.

B. LOCATION DESCRIPTION

This study is concerned primarily with the five southwest counties of Oregon; Coos, Curry, Jackson, Josephine, and Douglas Counties. Steep slope brush control problems are obviously not limited to these five counties. The reason for limiting the study to this area is twofold: 1) As a contiguous geographic area, brushfields occupy a relatively high percentage of commercial forest land compared to other regions in western Oregon (23). Reforestation is a dominant issue in southwest Oregon on both public and private lands. Oregon State University has been increasingly active in providing support in this region. 2) For logistic reasons in data collection the scope of the study had to be limited to some specific locality. Methods developed for conditions experienced in southwest Oregon will undoubtedly have applications in other regions.

C. VEGETATION DESCRIPTION

The term brushfield has been used loosely up to now, and for the purpose of this study required definition. The term brushfields will indicate sites with scattered large stem material, but predominantly occupied with vegetation ranging from 1/4 inch to 4 inch diameter measured one foot above ground with a canopy height up to 20 feet, including one or more of the following species:

Madrone (*Arbutus menziesii* Pursh)
Salal (*Gaultheria shallon* Pursh)
Manzanita (*Arctostaphylos* Adams)
Tanoak (*Lithocarpus densiflorus* (Hook & Arn.) Rehd.)
Oak, canyon live (*Quercus chrysolepis* Liebm.)
Oak, Sadler (*Quercus saleriana* Brown)
Huckleberry (*Vaccinium* L.)
Ceanothus (*Ceanothus* L.)
Alder (*Alnus* B. Ehrh.)
Chinkapin (*Castanopsis* (D. Don) Spach)
Rhododendron (*Rhododendron* L.)
Hazel (*Corylos* L.)

This list represents the most commonly encountered species. From personal conversations with practicing foresters throughout the region, the most predominant species are Manzanita, Ceanothus, and Chinkapin. A detailed and complete listing and description of brush species in southwest Oregon is available (15).

It is important to distinguish between brushfields and hardwood stands. Madrone, Tanoak, and Alder can exist in a shrub state or tree state. Conversion of hardwood stands is a totally different problem, requiring different treatment methods. The typical practice now is to slash and burn or slash and yard. Their inclusion here refers to their occurence in a shrub state; where treatment would be compatible with that required for brush species.

II. OBJECTIVES

1. Determine the number of acres of productive forest land, presently occupied by undesirable brush species, on slopes greater than 35%, on public and private lands in Coos, Curry, Jackson, Josephine, and Douglas Counties; the five southwest counties of Oregon.

2. Determine silvicultural criteria for a successfully treated site.

3. Recommend specific system(s) configuration for future research, design, and application. Determine operational constraints and estimated cost of operation for the proposed system(s).

4. Estimate the effects of operation. Consider enviornmental impact, slash disposal, and post-planting maintenance.

The intent of this study is to develop feasible alternatives to the brush conversion problem. Due to the complexities of the machine-soil interaction, various soil types and composition, and various vegetative types with different rooting characteristics an exact engineering analysis and design is not feasible. Further detailed study of cost effectiveness and feasibility will be required for the proposed systems.

III. AREA OF POTENTIAL APPLICATION

In any applied problem the solution technique should be compatible with the severity of the problem. For the brush conversion problem, the cost incurred in development and operation of any potential solution technique should be compatible with the need for such a technique. It is appropriate in this study to estimate the total acreage of potential application for a mechanical steep slope brush conversion technique.

Various options are available for determining such an estimate. Past work on estimates over such a large land base include high altitude photo interpretation and sampling using trisects. In this study estimates were made utilizing existing inventories on public and private lands. The reason is twofold: 1) We are concerned here with the relative magnitude of the problem, a detailed estimate of relatively high accuracy is not warranted; and 2) resource and manpower constraints in data collection necessitated the use of available data.

It would have been desirable to delineate lands into groups with similar attributes based on parameters such as slope, soil type, vegetation type, elevation and aspect. Conceivably these different groups would have different treatment criteria and response requiring different treatment methods. Unfortunately, the inventory systems on public and private lands were not of sufficient detail to facilitate extraction of data in this manner.

Collection of data consisted of personally contacting Forest Service district offices and Bureau of Land Management (BLM) resource areas for estimates on public lands. Estimates for private lands were obtained from contacting the large private industries in the study area, and county offices for estimates of holdings of small private woodland owners. The Oregon State Department of Forestry was contacted for an estimate of State lands in the study area.

Resources for retrieving the required information varied greatly. No inventories had their lands classified so as to facilitate direct extraction. The type of data desired in this study was often accounted for in various categories in the inventory systems. No inventory system was delineated on the basis of slope. A considerable amount of professional judgement supplemented by familiarity of their respective working areas was required for obtaining the data.

This study is concerned only with land over 35%. There are a variety of commercially available treatment methods utilizing ground based systems for treatment of land on slopes less than 35%. The acreage estimates obtained represents commercial forest land on slopes, greater than 35%, presently occupied by brush with no stocking of coniferous trees or stocking so low as to warrant conversion; as opposed to release. The determination of what is "commercial forest land" and "low stocking level" was left to the discretion of the practicing foresters contacted. The results are summarized in Table 1.

Medford BLM	36,300
Roseburg BLM	250
Siskiyou National Forest	24,600
Umpqua National Forest	920
Rogue River National Forest	5,600
Counties (small landowners)	120,000
Large Private	5,000
State	0
TOTAL	192,670 Acres

Table 1. Area of Potential Application.

The relative accuracy of the estimates varied from one source to the other. The total estimate is probably accurate to within ± 30%

This should not be taken to imply that there is a current pressing need for 192,670 acres of land to be treated by any proposed mechanical method. The area of potential application could be raised or lowered considerably by various factors. Cost efficient treatment methods could be utilized in release operations and after logging slash treatment; acreage which this estimate does not include. Some sources of acreage data reluctantly cooperated, maintaining that current treatment methods satisfied their needs at a much lower cost than any conceivable mechanical method. Another important consideration is that site conversion requires considerable capital expenditures with a long-time period before financial returns. This is a real deterrent for small woodland owners and an increasing deterrent for public agencies in light of current economical and political conditions.

Past studies have estimated the extent of the type conversion problem in southwest Oregon. In one study it was estimated that 1.0 million acres of commercial forest land is occupied by brushfields or weed trees (18). Another study estimated that 497,000 acres are non-stocked (7). Another study estimated conversion needs (excluding Alder conversion) at 303,000 acres (23). None of these studies delineated lands on the basis of slope.

IV. CRITERIA FOR A TREATED SITE

Any treatment method should modify the environment such that it is favorable to seedling establishment. Treatment should provide physical access, reduce competition and pest habitat, and create a favorable microsite for seedling survival and growth (15, 30, 38).

It is required to determine specifically what a successfully treated site should look like so that alternative treatment methods can be evaluated as to their effectiveness. The silvicultural criteria is essentially an end product evaluation. The method by which the end product is obtained must also be considered so that the preferred treatment method(s) are reasonable, cost effective, and compatible with associated land management activities. An evaluation against silvicultural, logistic, operational, and economic criteria will determine the preferred treatment method(s).

Figure 3. Brushfield on the Galice Ranger District; Siskiyou National Forest.

Practicing foresters and ecologists representing public agencies and private companies throughout southwest Oregon were consulted to gather the information required for determining silvicultural criteria. Sites representing most of the currently available treatment methods were examined. Methods were evaluated as to their effectiveness. These evaluations aided in generating criteria.

As would be expected, there is no "hard and fast" criteria. Each site represents a different complex interaction between vegetation and environment. Opinions varied and were at times conflicting. Still, agreement on basic requirements can be gleaned from the consultants.

The information requirements deemed necessary for generating silvicultural criteria are listed below; each are followed by a discussion. The discussion represents a majority opinion on that particular requirement or the opinions most substantiated by current knowledge as expressed in literature.

a. Method of removal; disposition of weed root systems.

This issue refers to the amount of ground disturbance desired and the desired effect on the weeds root system; i.e., is clipping, shearing, or crushing stems off near ground level acceptable, or should efforts be expended to pull, rake, or otherwise grub out the weeds root system.

The method and effectivness of the initial site preparation will effect seedling growth and survival (11, 20, 21). Competition for soil moisture from residual and invading weed species can reduce survival and growth of growing conifers (28, 32, 33, 39). One study which compared total and partial brush control showed that partial brush control did not benefit Douglas-fir saplings, but did improve conditions for the remaining brush (5). Another study showed negligible benefit to chainsaw release of Douglas-fir saplings; a method which leaves weed root systems intact (31).

Methods which completely eradicate sites of competing vegetation allow the seedlings to utilize the sites resources to their fullest extent. Shading and moisture competition will reduce seedling growth and survival. Douglas-fir needs at least 50 to 60 percent full sunlight for optimum growth (8, 34).

Methods which remove or disturb residual weed root systems are more desirable than those which do not. With residual weed root systems intact seedlings are forced to share available water and are quickly dominated by the weed species. Often the seedlings are subjected to at least partial shade as quick as one growing season after planting. The combined effect of moisture stress and shade can result, at best, in reduced growth and, at worst, in plantation failure.

On the harsh, droughty, and exposed sites, typical of the brushfields in southwest Oregon, nearly complete control or removal of competing vegetation is considered necessary for successful regeneration.

b. Expected environmental impacts by treatment method

Environmental impacts by mechanical methods depends primarily on the soil types and conditions. Generally, ground disturbing activities should be avoided on colluvial or granitic soils due to the potential of erosion or mass soil movement. Silviculturally ground disturbance is desired to create planting spots and eradicate competition. This contradiction may preclude mechanical methods on sensitive soils.

c. Expected post-planting maintenance by treatment method

Many of the shrub and brush species resprout from crowns and roots after disturbance. Physical disturbance of the soil surface can lead to rapid colonization by forbs and woody species (29). Use of chemical sprays to control competing vegetation is considered, in most cases, necessary for successful regeneration. The method and effectiveness of the initial site preparation influences the type and timing of needed control.

d. Constraints on treatment methods concerning slash disposal, such as physical access, fuel loading, or pest habitat

The degree to which slash must be removed from the site depends on the amount of slash generated and its disposal form. In many instances, partial removal, as a minimum, is required for physical access and for reducing fuel loading. The ideal system would leave a mulched litter layer which would protect the soil system, provide nutrient recycling, reduce weed growth, and moderate temperature extremes (10, 22). On sites adjacent to light seeded weed species an exposed soil surface invites rapid infestation (29). Concentrated downed slash or windrows may create pest habitat.

e. Variation of treatment methods by vegetative types

In general, most of the brush species under consideration have similar rooting and sprouting characteristics. The degree of treatment required and associated with post-planting maintenance will vary. But, for eradication purposes, criteria can be considered essentially the same.

The aforementioned requirements for a successfully treated site are reduced into silvicultural criteria. Operational, logistic, and economic criteria are also included.

Alternative treatment methods will be favored which:

1) Provide planting access.
2) Provide root removal or disturbance capabilities.
3) Provide slash reduction capabilities.
4) Are not restricted by steepness of slope.
5) Are compatible with timber harvest road spacing.
6) Have no vegetation limitations within the context of brushfields (as defined earlier).
7) Have minimal soil impacts.
8) Have high development feasibility.
9) Have low development cost.
10) Have low operating cost.

Additional operational considerations include the necessity and availability of tailhold access or anchors.

V. ALTERNATIVE TREATMENT METHODS

There are a multitude of conceivable treatment methods. Sources for alternatives came from existing applications, modifications of existing applications, adaptation of existing ground-based methods, and conceptualized system configurations.

First and foremost, an extensive review was made to identify any past efforts in steep slope brush or slash treatment. These represent considerable time and effort in system configuration and component design which should be taken advantage of.

When considering ground-based systems, there is equipment available to disc, furrow, trench, strip, rip, punch, slit, drag, chop, till, churn, or crush the ground and vegetation on it (12, 19, 26). This equipment can be used to remove debris, reduce competition, prepare seedbeds, or create favorable microsites (38). Some of these methods can be adopted to steep slope brush conversion using cable system technology.

Pulling brush up by the roots with a conventional yarder, either with chokers or grapples, was not considered as a feasible alternative. Preliminary investigations concerning the forces required to pull brush up by the roots were conducted by Hank Froehlich, Professor at Oregon State University, during the summer of 1981. His results are summarized in Table 1.

SPECIES	REQUIRED TENSION
Oak	18,000
Alder	8,000
Madrone	7,500
Chinquapin	6,500
Bitterbush	6,300
Snowberry	5,000
Oceanspray	5,000
Manzanita	4,600

Table 2. Line Tensions Required to Pull Plants with 25 sq. in. Basal Area.

Other investigators were unsuccessful in pulling California hazel, vine maple, and oceanspray with an Igland-Jones Trailer Alp yarder (5/8 in. skyline, 3/8 in. mainline, 70 hp engine) (35).

Based on these investigations, safe and efficient operation would require a yarder with 3/4 in. mainline and associated tensioning capabilities; approximately 150 hp. Various yarders are commercially available which meet these requirements. However, the high operating costs of these moderately sized yarders combined with the anticipated low production of this method precludes it as an alternative for use in southwest Oregon.

The following alternatives represent those which are considered the most realistic and cost effective and are considered for further analysis and evaluation.

It should be noted that, due to the broad nature of this study, each alternative actually represents a set of alternatives of a common treatment method. For any one method there are alternative component design and combination possibilities.

A. "FALLONS' TOOL"

Developer - Originally developed by Lynn Mitchner, Contractor, Coos Bay, Oregon, approximately 12 years ago; redesigned and modified by Ken Fallon, Contractor.

Manufacturer - Michner Reforestation Co.

System Configuration - A scarification tool is rigged high-lead with a conventional two-drum yarder. Treatment direction may be uphill, downhill, or traverse. A tractor crawler serves as a mobile tailhold.

System Components

Scarification Tool - Two steel cylinders welded together, filled with concrete, concave on both ends. Approximate weight is 5,000 lbs.

Yarder - Any conventional two-drum yarder. Past applications utilized Madill 071, Washington 208E, and smaller mobile yarders.

Tractor Crawler - Crawler type, D7E or equivalent, equipped with a high speed winch with at least 100 feet of 7/8 inch line. Tractor is modified by attaching a tower capable of supporting a tailblock.

Figure 4a.

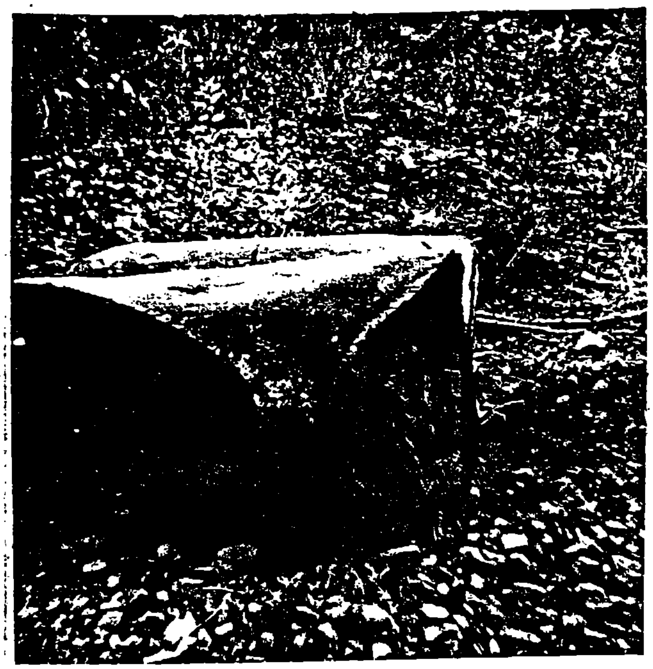


Figure 4b.

Figure 4a and 4b FALLONS' TOOL.

Working Material Type and Size - Post applications include salmonberry, chokecherry, vine maple, ceanothus, and Alder up to 4 in. DBH (36), suitable for small diameter logging residue or brush.

Production & Costs - Approximately 5 acres per day dependent on amount of scarification, type of yarder, ground conditions, and type of vegetation; at an average of 450 $/ac.

Effects of Treatment - Reduces standing brush and exposes mineral soil. Slash is masticated and rearranged, partially incorporated into the soil surface. Surface furrows result from passes made by the tool.

Comments - The design of the tool allows the cutting edge to "float" just below the soil surface. Too steep a cutting angle ploughs into the soil too deeply. Too flat an angle causes the tool to float above ground with little effectiveness. Ken Fallon has tried various models, experimenting with the cutting edge and angle and is satisfied with his latest, current design.

Access to the end of the unit is required for the tractor to act as a mobile trailhold. Maximum reach is dependent on the yarder's available line length.

Potential Modifications - The degree of scarification obtained by the tool is largely determined by the number of passes made. Prior applications in brush conversion resulted in partial scarification achieving planting spots. Presumably, the additional

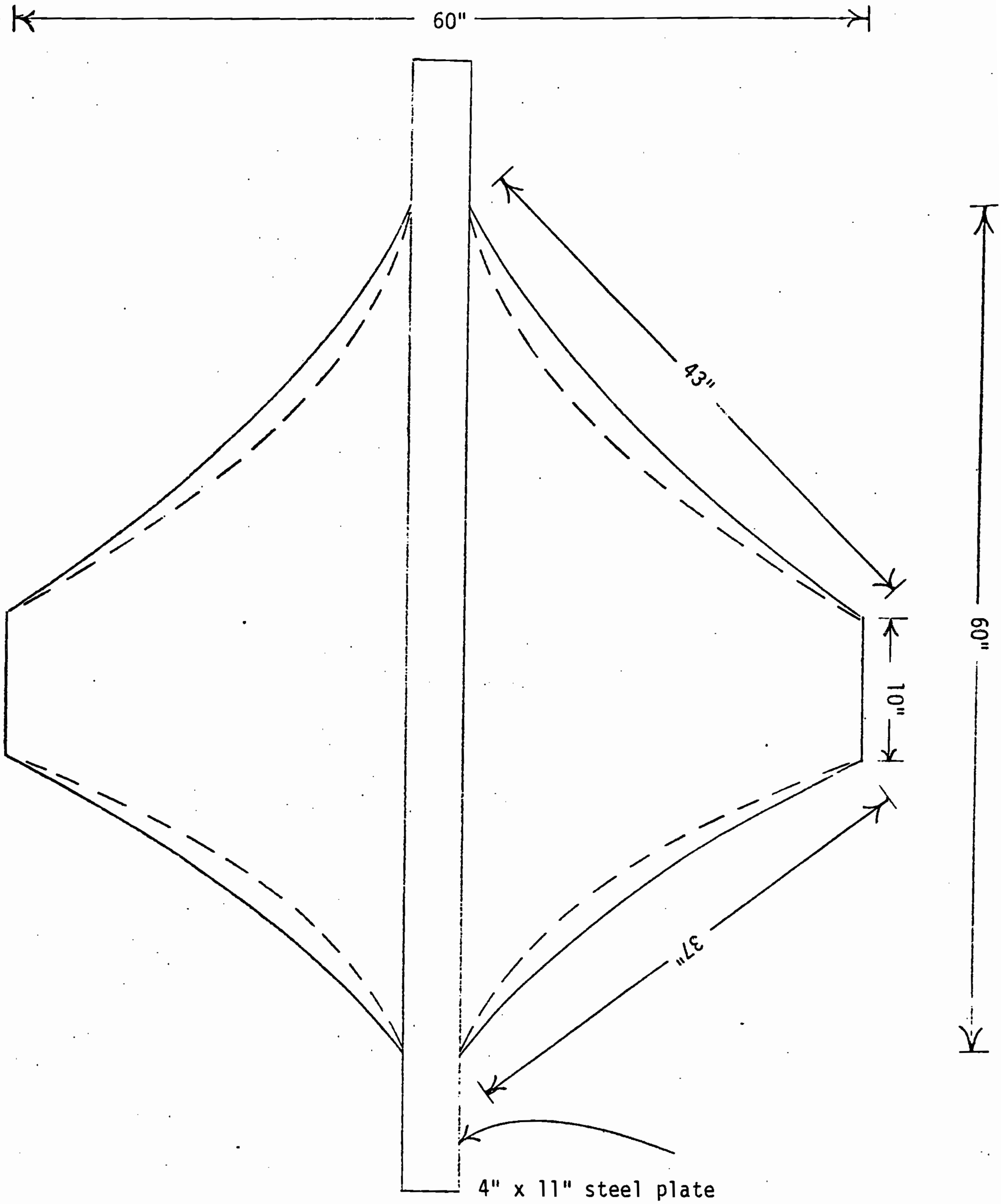


Figure 5. Current Design of Fallons' Tool.

Figure 6a.

Figure 6b.

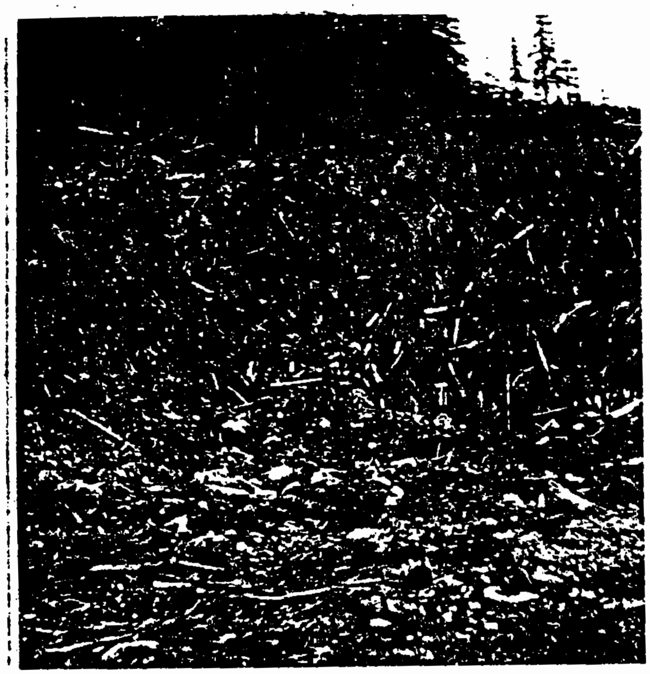


Figure 6a and 6b. Before (a) and after (b) treatment on scattered brush and logging slash using Fallons' Tool.

cost to achieve complete scarification was prohibited and/or not deemed silviculturally necessary.

In it's current form, the tool provides only moderate access and root removal, and poor slash reduction. Improvements should increase treated area coverage per pass, increase root grubbing effectiveness, and provide windrowing capabilities.

A modified design would incorporate the two concrete filled cylinders on the original tool. The drums would be separated with a steel truss containing two-sided grubbing teeth and a vertical trash rake. The teeth and rake would be effective in both forward and backward operation. The modified tool would be rigged running skyline fashion so that it could be lifted for windrowing slash and avoiding obstacles.

B. "PEPIOT'S RAKE"

Developer - Pat Pepiot, Contractor.

Manufacturer - Pepiot Forest Contractors.

System Configuration - A brush rake is rigged running skyline fashion with a conventional two-drum yarder. The tailblock is hung on a static line at the end of the unit or rigged to a tractor crawler.

System Components

Rake - A converted tractor brush rake modified for cable system operation. Approximate weight 2,500 lbs.

Yarder - Previous applications utilized a Linkbelt HC 98 loader, converted for use in yarding slash and small logs.

Tractor Crawler - Crawler type, D7E or equivalent, modified by attaching a tower capable of supporting a trailblock. Alternatively, the tailblock may be strung on a static line, usually the tractor's winch line, and clamped into position by cable clamps. Conventional stump tailholds are also an alternative.

Working Material Type and Size - Past applications include logging slash, canyon live oak, vine maple, and dogwood. Suitable for treating small diameter logging residue and brush.

Figure 7a.

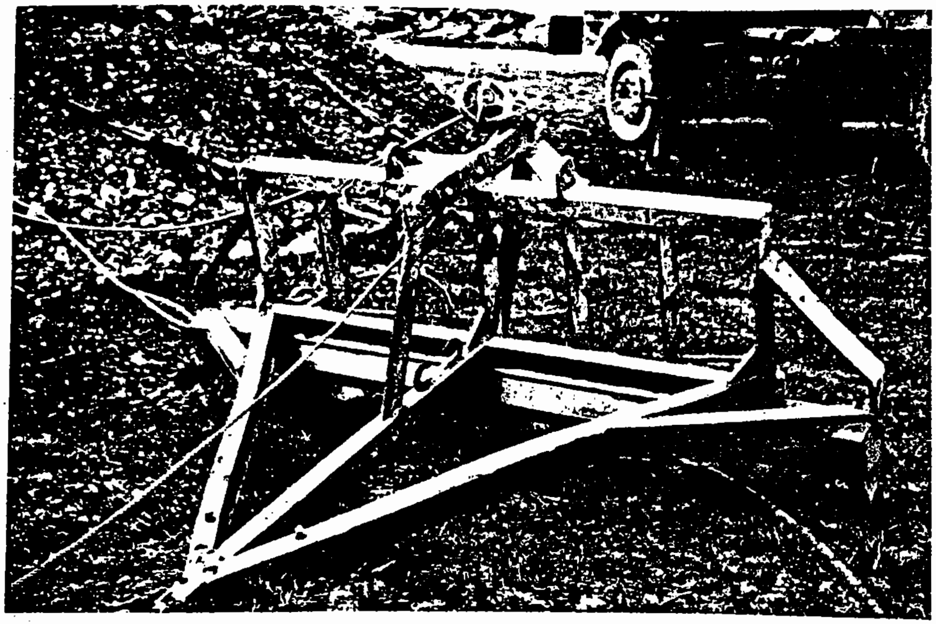


Figure 7b.

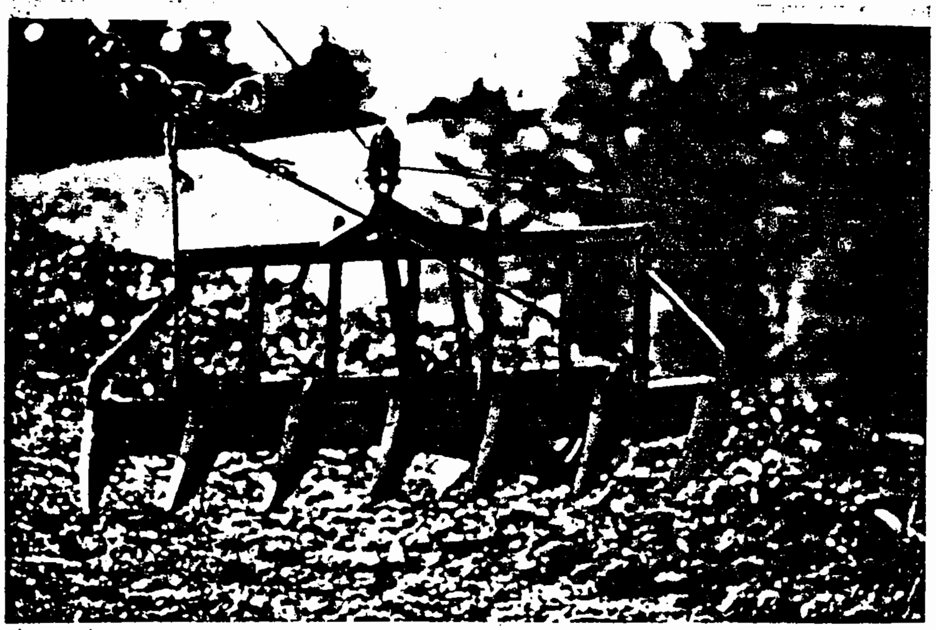


Figure 7a and 7b. Pepiot's Rake.

Production and Costs - 0.8 acres per day at 1,050 $/ac. Dependent on amount and type of vegetation, soil conditions, topography, and operator efficiency. These figures are results from a test application which experienced low potential production and repeated breakdowns.

Effects of Treatment - Disturbs root systems and scarifies soil exposing mineral soil. Rake is capable of moving slash to disposal sites.

Comments - The system configuration used in the test application for brush removal on the Starr Ranger District did not have sufficient power to move large obstacles. Large roots, stumps, and residual trees significantly decreased production. Large stems, 20 feet and greater in height, would bend down under the pressure of the rake and snap back. Downhill operation under moist soil conditions was preferred. This system was designed with the objective of clearing logging slash. The developer indicated that further applications in brush conversion should involve a much heavier rake with stronger teeth and a yarder with greater line tensioning capabilities.

Potential Modifications - Redesign of the rake specifically for brush removal. Match power requirements with an appropriate sized conventional yarder.

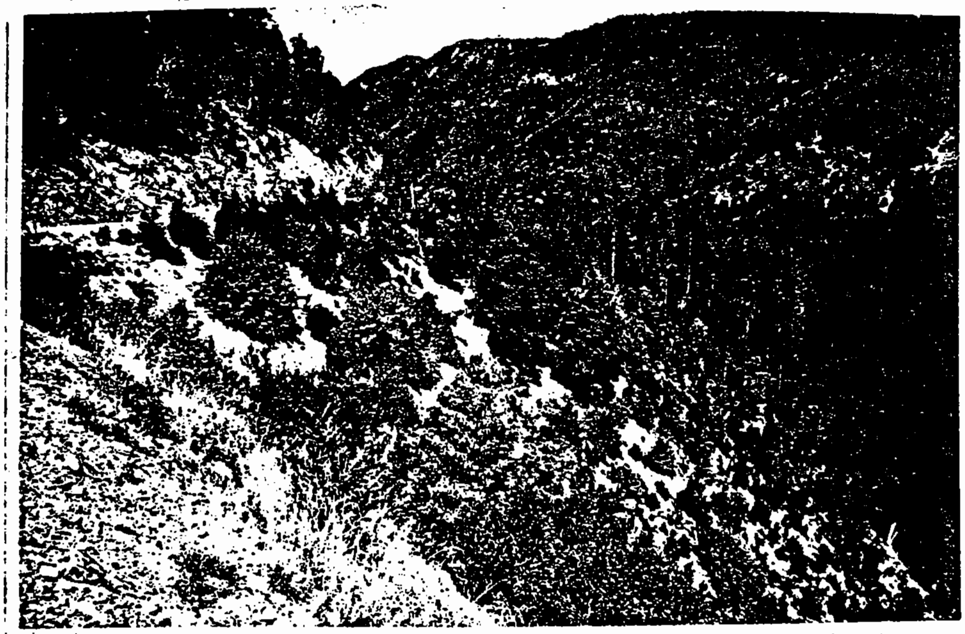


Figure 8. Site treated with rake for partial brush removal. Picture taken two years after treatment. Starr Ranger District; Rogue River National Forest.

Figure 9. After logging clean-up with rake on the Applegate Dam project.

C. Shar Twenty

Distributor - Shar Corporation, Redding, California.

System Configuration - A tracked articulated prime mover with a horizontal cutting wheel.

System Components

Prime Mover -

Length Without Chopper	16'
Width	88"
Weight With Chopper	14,000 lbs.
Track Width	26"
Ground Clearance	20"
Engine-Diesel	128 hp
Steering-Articulated	Hydraulic Powered
Ground Pressure	3 psi
Maximum Slope	60%

Reduction-Head Mechanism

Boom Length	60"
Chopper Diameter	70"
Chopper Teeth	High Alloy, Replaceable
Chopper Drive	Hydrostatic
Boom Swing	90°

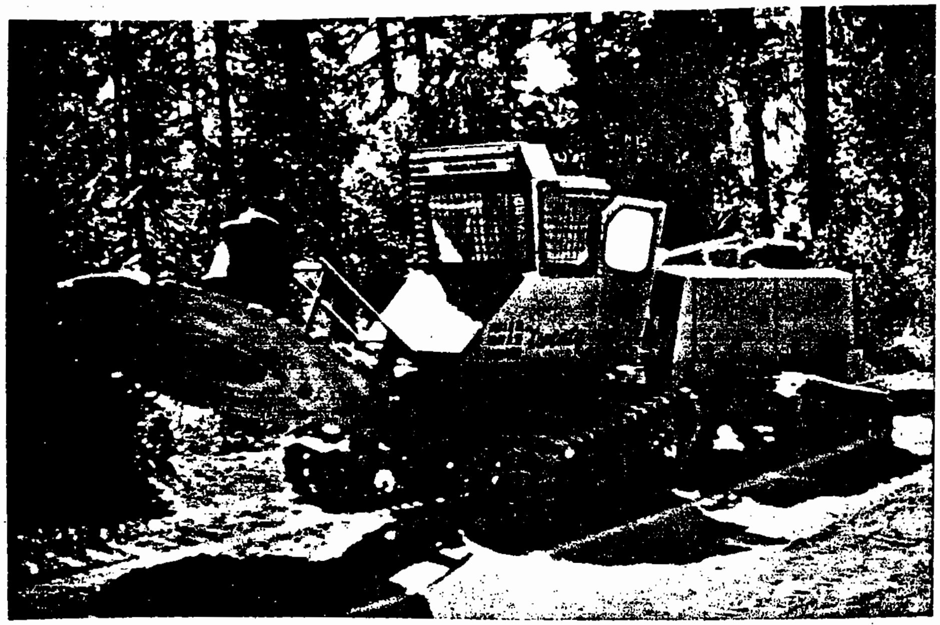


Figure 10. The Shar Twenty.

Working Material Type and Size - Large and small diameter logging slash, hardwood and brush species. Maximum material with continuous cut is 14". No limit on maximum material size.

Production and Costs - Five acres per day at $225 per acre on slopes from 30% to 60%.

Effects of Treatment - Cutting head rips vegetation near ground level and mulches into small partical sizes, ranging in dimension, but generally not exceeding, 1-1/2 feet in length and 3 inches in diameter.

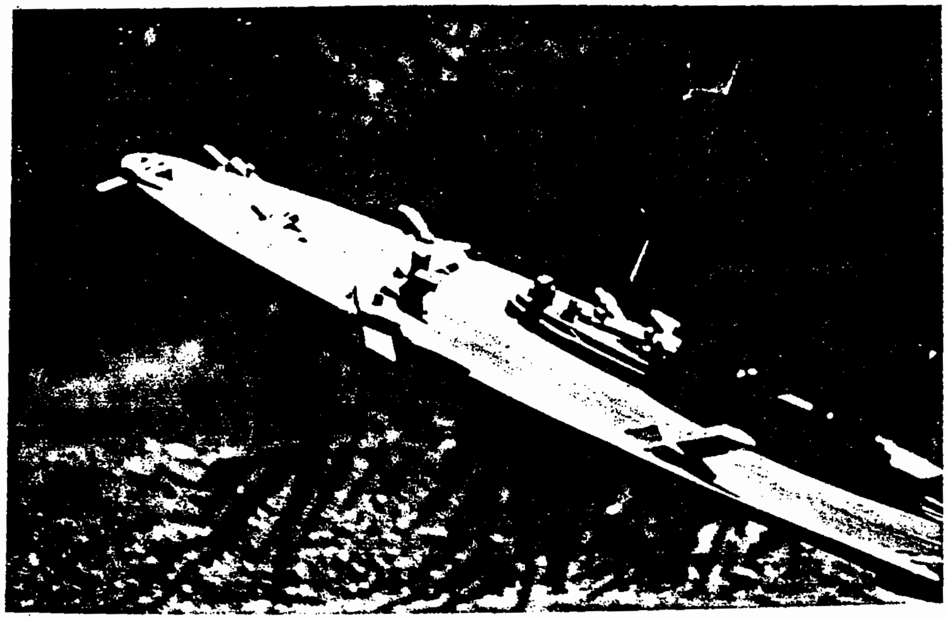


Figure 11. Shar Twenty Cutting Wheel.

Figure 12. Before (left) and after (right) treatment with the Shar Twenty.

Comments - Earlier models of this vehicle type (Trackmack TM-72 and Timbermaster TM-72, Washington Iron Works) have been used for brush conversion and timber stand improvement in various locations throughout the Pacific Northwest and California (27). Earlier models were limited to slopes less than 35%.

This model offers various mechanical and ergonomic improvements and greater versatility in operating conditions. Specified slope limit is 60%, but experienced operators can traverse up to 80% on the fall line and 40% sidehill.

D. TWIN- AND SINGLE-ROPE GRAVITY ROLLERS

Developer - Mr. M. Johnson, New Zealand

System Configuration - An adaptation of towed rolling choppers. Components consist of a tracked prime mover and a rolling chopper (14). Rollers are attached to a tractor's winch rope and drawn downslope by gravity. The tractor is relocated and the roller is winched up, and the procedure is repeated. Brush is crushed on the upward and downward pass.

System Components

Prime Mover - Adoption of this principle has been applied to tractors of various sizes to suit individual needs and choices. The latest twin-rope design features a Terex 240 kw (322 hp) engine. The two ropes are spooled independently by separate winches mounted on the back of the tractor. Maximum reach is 600 ft.

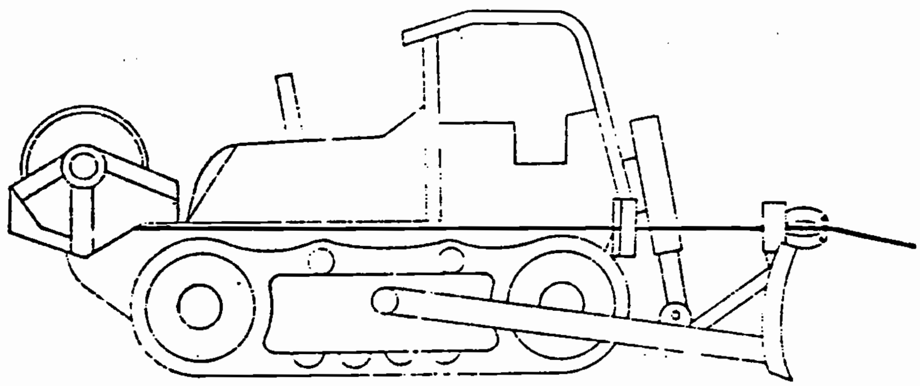


Figure 13. Twin-rope Tractor Unit (14).

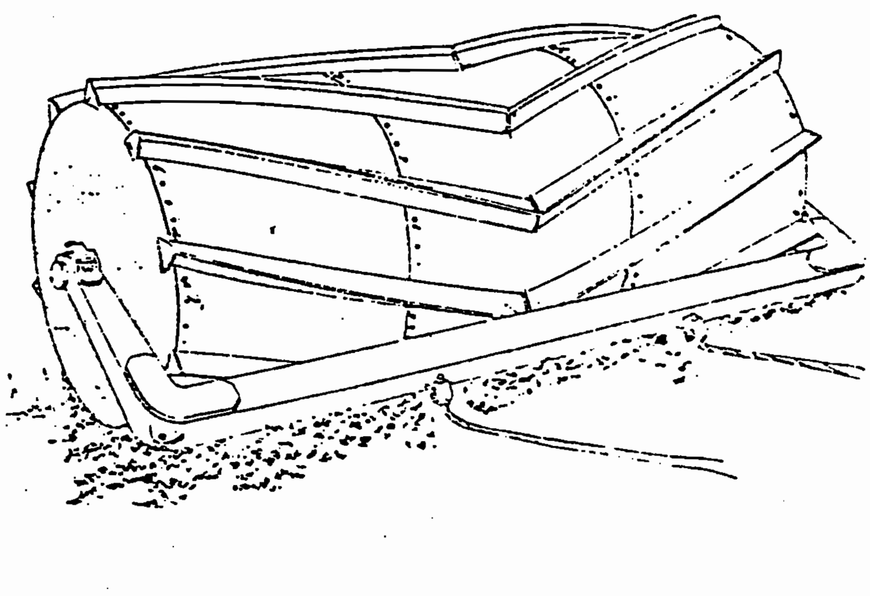


Figure 14. Basic Roller Design with the Rollers Placed in a Chevron Pattern (14).

Rolling Chopper - Typical New Zealand designs are converted steam boilers or spiral welded drums of various weights. Chevron or herringbone blade pattern is used to reduce side-slip on the contour. The roller is mounted to a C-frame to which the ropes are attached to.

Working Material Type and Size - Previous applications range from light scrub and fern to dense broadleaf scrub. Working diameters range from less than 3 inches to greater than 12 inches. Working canopy height range from less than 15 feet to greater than 24 feet.

Production and Costs - The latest design has production rates of about 2.5 acres per machine hour with costs not exceeding 200 $/ac.

Effects of Treatment - Vegetation is crushed into short lengths and packed down in a dense layer. Stems are crushed off near ground level. Typically in New Zealand, burning follows roller chopping after a 4- to 6-week coning period.

Comments - Production is sensitive to operator skill. Tractor and roller must be strategically maneuvered to insure complete coverage and utilization on the upward and downward pass. Operation is dependent on tractor stability and is severly impacted during wet ground conditions on some soil types. Treatment is most effective on hard ground and small diameter material. If the slash is too supple to break and the ground is too soft to be an effective anvil, little treatment can be expected (19).

Potential Modifications - Application of twin-rope gravity rolling chopper to appropriate sized conventional yarder. Modification would increase the versatility of the method.

E. RESIDUE CHIPPER

Developer - San Dimas Equipment Development Center, U.S.D.A. Forest Service.

System Configuration - A field chipper is mounted on a sled and is pulled downslope either by a winch mounted on the sled or by a steep-slope backhoe. Slash is cut and fed into the chipper. The chipped slash is broadcast over the unit, or, alternatively, fed into a cable mounted conveyor and yarded up to a landing for utilization as hog fuel. The method is in a development stage with two years of field tests having been completed.

System Components

Field Chipper - A sled mounted Olathe chipper was used in the field tests. Further designs call for a self-mobile two winch chipper for independent in-the-woods broadcast chipping.

Working Material Type and Size - The Olathe chipper processes material less than 6 inches in diameter and less than 10 feet in length.

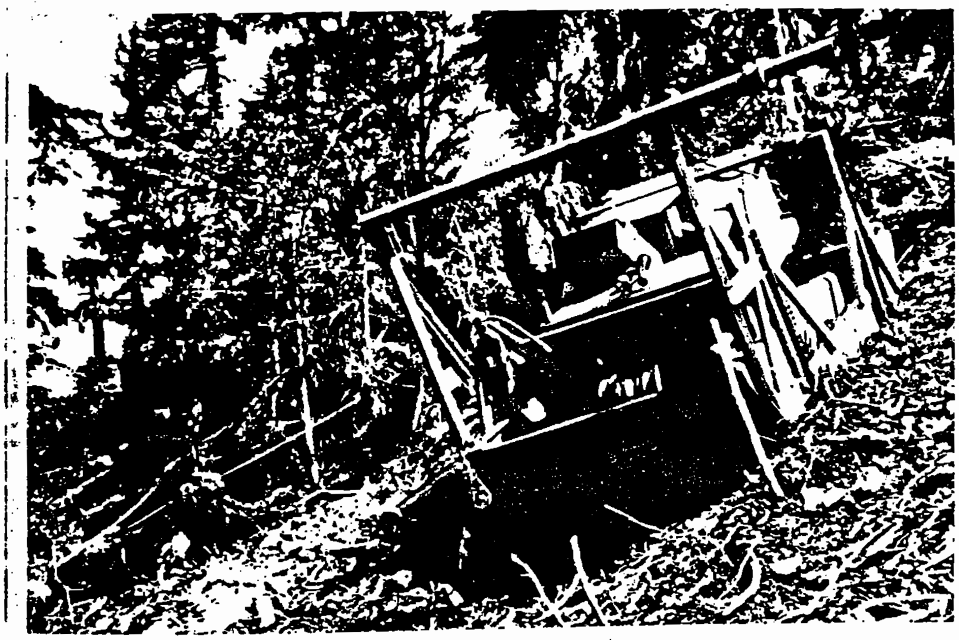


Figure 15. Sled mounted Olathe Chipper.

Figure 16. Chip Conveyor.

Figure 17a.

Figure 17b.

Figure 17a and 17b. Before (a) and after (b) treatment with the Olathe Chipper.

Production and Costs - At one field test, production was measured at a maximum of 2.57 tons per hour with a 10-man crew. When the climbing backhoe was used to load the chipper, production more than doubled. Cost data for the chipper is not yet available.

Effects of Treatment - Slash is fed into the chipper which throws out the chipped material in roughly a fan-shapped pattern up to 100 ft. below the chipper, resulting in a chip layer on the forest floor.

Comments - This system was initially conceptualized as a method to treat after logging slash, reduce fire hazard and utilize material usually left in the woods. Due to problems encountered during the field tests with the conveyor, that portion of the project has been dropped. Emphasis is now on perfecting a self-mobile broadcast chipper.

The current prototype is inoperable on slopes greater than 60% due to the existing fuel system. Future designs call for a fuel injected diesel engine which will be operable on slopes up to 100%.

F. CUT AND YARD

Developer - Tim Scherer and Ed Aulerich, O.S.U. (35).

System Configuration - A small yarder is used to bunch brush stems together. After bunching the stems are cut and yarded to the skyline road corridor.

Bunching the brush stems together is accomplished by encircling the brush with the mainline and hooking the mainline to itself. The mainline is tightened, cinching the brush stems together. The stems are cut with a chainsaw and yarded to the skyline corridor. A three man crew was used.

System Components - The Igland-Jones Trailer Alp yarder and small Christy carriage was used. The yarder carries 3300 ft. of 5/8 inch skyline; 1800 ft. of 3/8 inch mainline, 1800 ft. of 3/8 inch haulback, and was powered and transported by a John Deere 2640 farm tractor (70 hp).

Working Material Type and Size - This method is suitable for brush and shrub-size hardwoods greater than 1/2 inch in diameter.

Production and Costs - This was a release-conversion treatment which consisted of felling and yarding merchantible bigleaf maple, Douglas-fir, and windrowing brush, tops, and limbs. The combined net cost for this treatment was $1,127 per acre (1978).

Effects of Treatment - Brush is cut near ground level and windrowed at the skyline road corridor.

Comments - The necessity of considerable manual slackpulling of the mainline precludes use of this method with much larger line sizes.

Potential Modifications - Brush could be simply cut and conventionally yarded without using this hooking method. Although conventionally yarding brush would be extremely versitile, anticipated low production and associated high costs precludes this method for widespread use.

G. TETHERED SKIDDER

Developer - U.S.D.A. Forest Service, San Dimas Equipment Development Center (25).

System Configuration - Method is conceptual; no prototype has been developed. A four-wheel-drive articulated low-pressured-tired skidder is fitted with a slash treatment tool and a self-contained tether cable system. The vehicle anchors the cable to a tree, earth anchor, or rock anchor, and lowers itself downslope, treating slash as it proceeds.

System Components

Vehicle - A diesel powered four-wheel-drive articulated low-pressured-tired skidder. This type of vehicle is selected due to it's ability to negotiate rough terrain and to it's relatively low soil disturbance.

Winch - Basically the winch will pay out or pull in the vehicle up to a reach of 600 ft.

Slash Treatment Tool - No specifications are given in the SDEDC proposal, but a multitude of options are available (26). Probably would be fitted with a horizontal shaft reduction

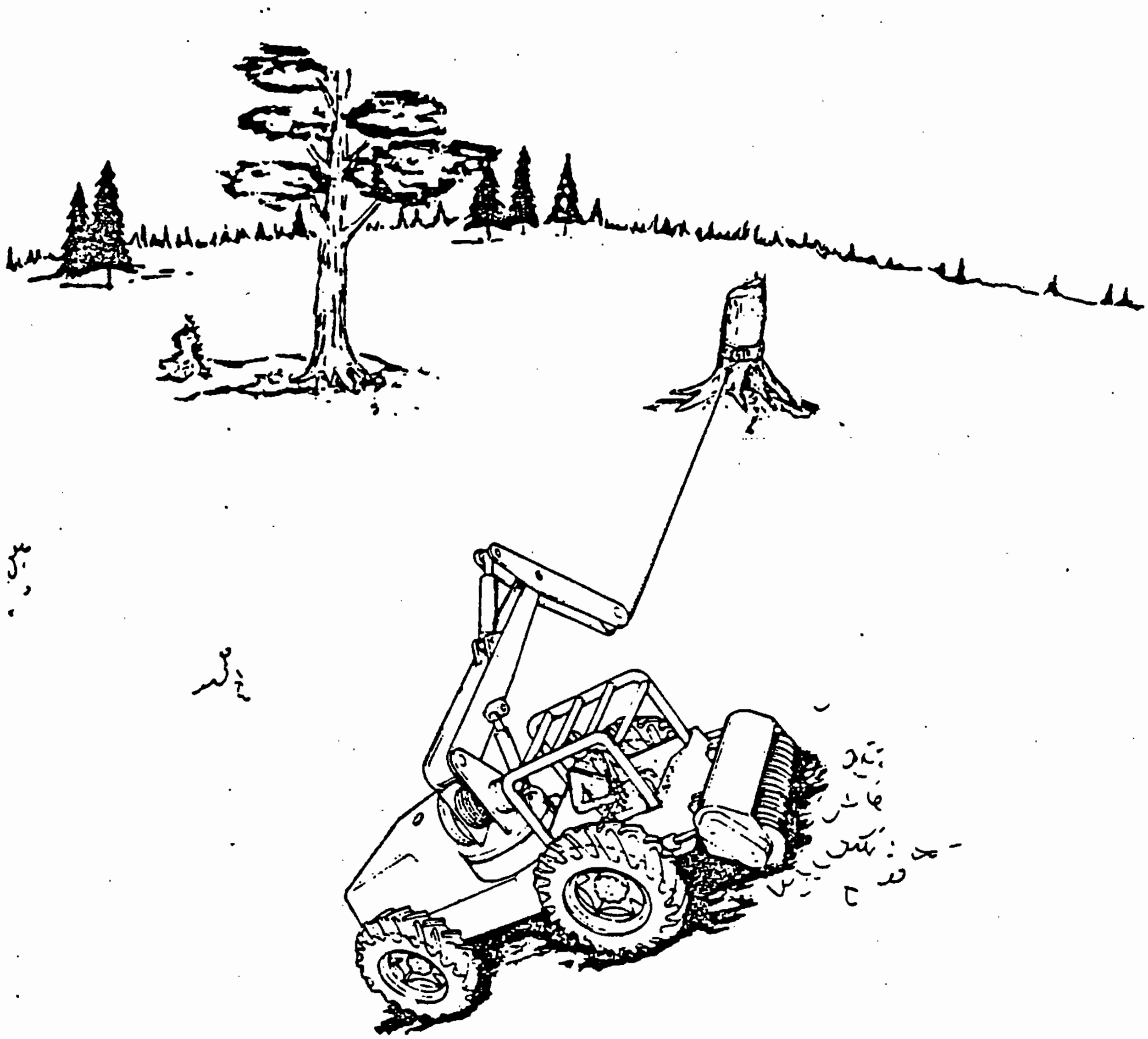


Figure 18. Artist Sketch of Self-Contained Tethered Cable System Treating Logging Slash on Steep Slope (24).

head with free swinging cutters.

Working Material Type and Size - Suitable for slash, brush and hardwoods up to 12 inches in diameter.

Production and Costs - Estimates would be speculative. Probably somewhat higher than a similar ground-based vehicle (Shar Twenty) due to time required for anchoring; less than 350 $/ac.

Effects of Treatment - Vegetation would be masticated into pieces of small length and diameter and distributed uniformly throughout the treated area. Soil impacts would be minimal.

Comments - For safety and stability reasons, this method would be inoperable on slopes greater than 75%.

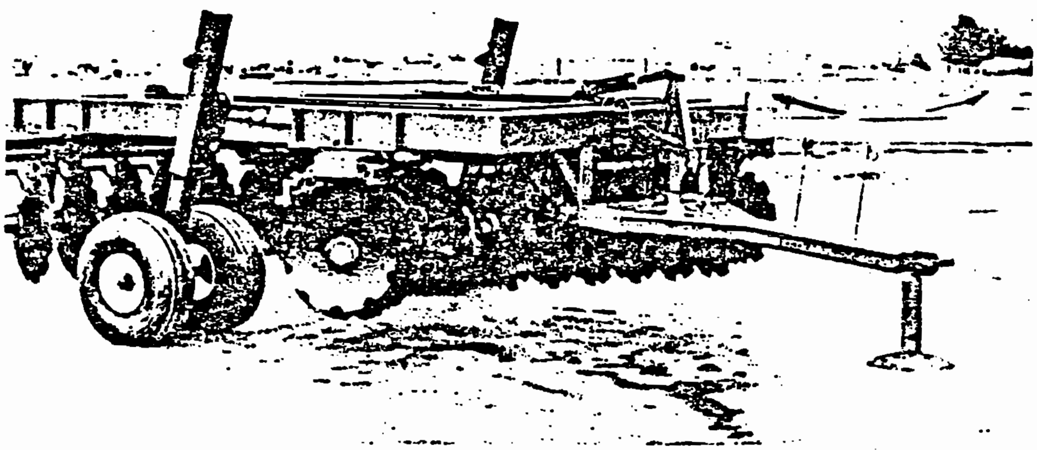
H. DISK HARROWS

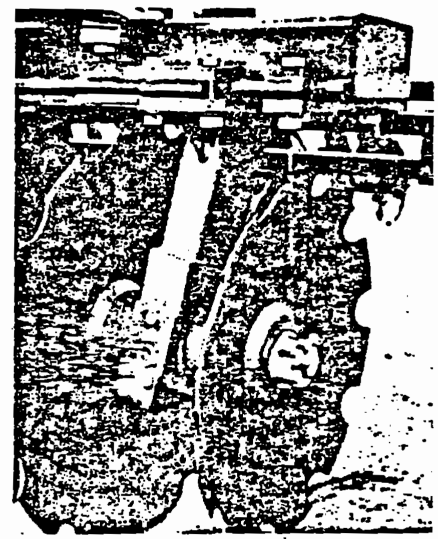
Developer - Conceptual.

Manufacturer - Large conventional disk furrows are available through Towner Mfg. Co., Santa Anna, CA; Greenline, Inc., Harper, KS.

System Configuration - Conventional or modified disk harrow is rigged high-lead with a two-drum yarder. A tractor crawler would serve as a mobile tailhold anchor.

SUPER DUTY 1800 SERIES
RIGID DOUBLE OFFSET DISC





SPECIFICATIONS

WIDTH	MODEL NO.	DISC SIZE	BLADE SIZE	NO. OF BLADES	NO. OF BRG. HGRS.	SPOOL SIZE FRONT	SPOOL SIZE REAR	APPROX. WEIGHT
14'	1814 244-66 •	14'	32" 3/8"	24	8	14"	14"	17.000
	1814 066-88 •	14'	40" 1/2"	20	8	16"	16"	18,500
16'	1816 244-66 •	16'	32" 3/8"	28	12	14"	14"	18.000
	1816 066-88 •	16'	40" 1/2"	24	12	16"	16"	19.500
18'	1818 244-66 •	18'	32" 3/8"	32	12	14"	14"	19.000
	1818 066-88 •	18'	40" 1/2"	28	12	16"	16"	20.500
20'	1820 244-66 •	20'	32" 3/8"	36	12	14"	14"	20.000
	1820 066-88 •	20'	40" 1/2"	32	12	16"	16"	21.500

Figure 19. Greenline "Big G" Disk Harrow.

System Components

Disk Harrow - For applications in brush the largest commercially available model or a specially designed model would be required. Current models are available in widths of 14 ft. to 20 ft., weights of 17,000 lbs. to 21,500 lbs., respectively, and incorporates 40 in. diameter, 1/2 in. thick notched steel blades.

Yarder - Considerable horsepower and corresponding rope sizes would be required to maneuver a large disk harrow and generate sufficient speed for effective treatment. Conventional operation on gentle terrain requires a Cat D8 (300 hp) or equivalent. Increased resistance from gravity and the dense vegetation commonly encountered in brushfields would significantly increase power requirements. Possible selections include the Madill 009 (525 hp) or the Skagit BU 199 (565 hp).

Tractor Crawler - Crawler type, Cat D8 or equivalent, equipped with a high speed winch with at least 100 feet of 1-1/4 inch line. Tractor is modified by attaching a tower capable of supporting a tailblock.

Working Material Type and Size - Suitable for small stem diameter brush with canopy heights no greater than approximately 4 ft.

Effects of Treatment - Passes of a disk harrow plow, mulch, and pulverize in one operation. Brush stems and shallow roots would be sheared into small piece lengths and incorporated into the soil

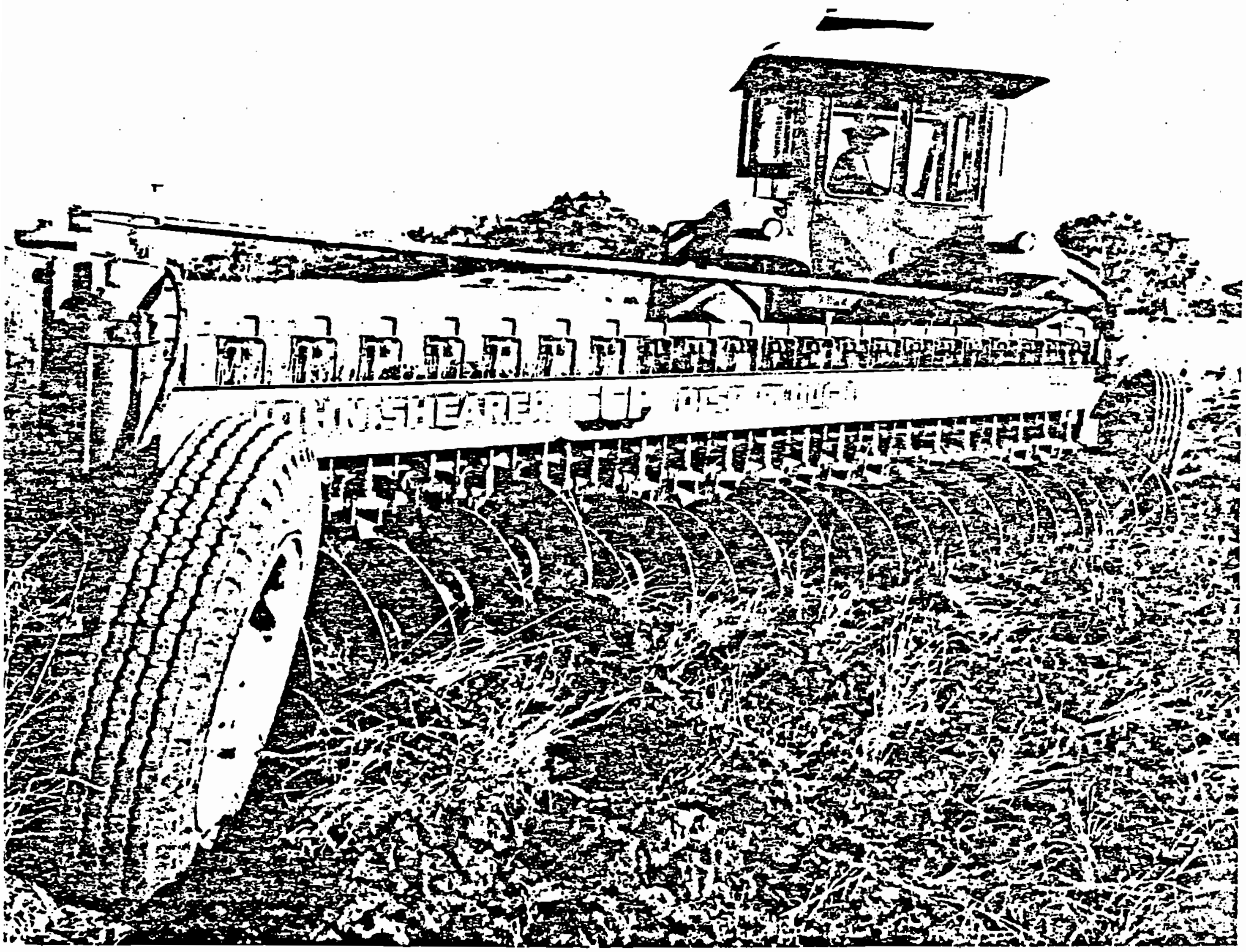


Figure 20. Australian "Jumping" Disk Plow.

mass. Exposed mineral soil would result on a majority of the treated area.

Costs and Production - Assuming an average speed of 1 ft./sec. up and down the slope, and no repeated passes, 40% utilization, a Greenline "Big G" 1800 series 14' disk harrow operating with a Skagit BU-199, production is estimated at 4 ac./day at a cost of 800 $/ac.

Comments - Disking for site preparation is common in various parts of this country and around the World (1, 2, 6, 12). Most applications are in plantation conditions on sites with gentle slopes previously cleared of large debris. Conventional disk harrows are not designed for forest applications. Problems would be encountered and frequent breakdowns are anticipated when dealing with rock outcrops, large rocks, broken ground and old stumps. A "jumping disk" plow developed for use in Australia may be an alternative. On this plow pairs of blades move independently circumventing obstacles such as big rocks. Penetration depth and associated treatment effectiveness is dependent on operating speed. High power requirements are necessary for efficient operation.

I. CABLE OPERATED REDUCTION HEAD

Developer - Conceptual.

System Configuration - A conventional reduction head mechanism (designed for use with a ground-based vehicle) is mounted, including power source, on a sled and rigged high-lead to a conventional yarder.

System Components

Reduction Head Mechanism - An adaptation of a conventional reduction head mechanism would need to be specially designed and developed for this purpose. A vertical shaft reduction head would probably be preferred due to its low horsepower requirement and dull cutting edge (26). Weight, including power source, would be around 8,000 to 10,000 lbs.

Yarder - A yarder with large horsepower and line sizes would be required to maneuver such a sled. Possibilities include the Madill 009 or the Skagit BU-199.

Working Material Type and Size - Suitable for brush, hardwoods and slash up to 12 in. in diameter.

Production and Costs - Considering time and associated costs to move in and rig, and decreased control and maneuverability from a landing setting, cost can be expected to be at least three times that of conventional operation; approximately 900 $/ac.

Effects of Treatment - Brush would be masticated into piece sizes of small diameter and length and uniformly distributed on the treated area. Operation would probably leave small portions of the area not treated due to rock outcrops, gullies, etc. Soil impacts would be minimal.

Comments - Such a method would require an expensive development effort with a 50% chance of successful development. Once developed the purchase price would be in excess of $200,000 (10).

Potential Modifications -

1. Equip the sled with a winch and operator so that it is independently self-mobile.
2. Operate the reduction head off a skyline carriage with the carriage containing the power source.

J. CABLE GRAPPLE RAKE

Developer - Conceptual.

System Configuration - A clamshell type grapple rake with interlocking cutting teeth is rigged running skyline fashion to a conventional yarder. The grapple is positioned over the brush and closed. The act of closing the grapple shears the brush and the brush is yarded to a windrow or landing. A tractor crawler would serve as a mobile tailhold anchor.

System Components

Grapple Rake - Rake would require a large opening to maximize the amount of brush removed per turn. Heavy power closing jaws would be required for effective shear of the stems. Various commercial models are available for potential adoption (9).

Yarder - A yarder with moderate payload capability, high line speeds, and reach compatible with conventional harvesting layout would be required. Possibilities include the Madill 071 and Skagit SY-717.

Tractor Crawler - Crawler type, Cat D6 or equivalent, equipped with a high speed winch with at least 100 feet of 5/8 inch line. Tractor is modified by attaching a tower capable of supporting a tailblock.

Working Material Type and Size - Dependent on grapple rake design. Should be suitable for diameters up to 5 inches and lengths up to 15 ft.

Production and Costs - Estimated at 6 ac./day at a cost not exceeding 600 $/ac.

Effects of Treatment - Brush would be cut at/or near ground level. Complete removal or windrowing would be possible. No adverse soil impacts.

Comments - Cost of system design and development would be relatively small with high chance of successful development.

Potential Modifications - Other shearing-grubbing mechanisms are conceivable. Possibilities include adaptation of conventional feller-bunchers.

VI. EVALUATION OF TREATMENT METHODS

Thus far the relative need for a treatment method has been assessed. Silvicultural and operational criteria for potential methods has been developed. Various parameters have been determined describing what effect these alternatives will have in brush conversion. These effects are now evaluated against the established criteria to aid in the selection process. This is best accomplished by arranging the alternative methods against the evaluation criteria in tabular form (Table 3).

Effects have been measured in a qualitative manner, relative to the other alternatives. This is appropriate for the evaluation process. Selection based on this process will identify the treatment method(s) for which more detailed estimates and design parameters can be developed for future development and application.

A. SELECTION CRITERIA

<u>Definition of Terms</u>

1. Good (G) - Performance is as well as any of the alternatives and is completely satisfactory for that purpose.
2. High (H) - Impact, effect, or cost is at an unacceptable level.
    a. Development infeasibility. Probability of successful development is less than 50%.
    b. Development cost. Cost of development exceeds $100,000.

c. Operating costs. Operating costs exceeds $800 per acre.

3. Moderate (M) - Performance is adequate for that purpose.

   a. Development infeasibility. Probability of successful development is less than 75%, but greater than 50%.

   b. Development costs. Cost of development exceeds $50,000, but is less than $100,000.

   c. Operating costs. Operating costs exceed $500 per acre, but are less than $800 per acre.

4. Low (L) - Impact, effect, or cost is of a satisfactory level.

   a. Development infeasibility. Probability of successful development is greater than 75%.

   b. Development costs. Cost of development is less than $50,000.

   c. Operating costs. Operating costs are less than $500 per acre.

5. Poor (P) - Performance is inadequate for that purpose.

6. Yes (Y)

   a. Requires tailhold anchors or access. Requires tailhold anchors or access for operation.

   b. Slope limitations. Is inoperative on slopes greater than 75%.

   c. Vegetative limitations. Is inoperative over a portion of the range of material as described in I.C., Vegetation Description.

7. No (N)

   a. Requires tailhold anchors or access. Does not require tailhold anchors or access for operation.

b. Slope limitations. Is operative on slopes greater than 75%.

c. Vegetative limitations. Is operative over the range of material as described in I.C., Vegetation Description.

Alternatives will be rejected if they have:

1. Poor root disturbance capabilities.
2. Poor slash reduction capabilities.
3. Slope limitations.
4. Vegetation limitations.
5. High soil impacts.
6. High development infeasibility.
7. High development cost.
8. High operating costs.

B. SELECTED ALTERNATIVES

Based on the above selection criteria, the following alternatives are selected for further consideration:

1. Modified Fallons' Tool.
2. Modified Pepiot's Rake.

These alternatives satisfy the selection criteria of acceptable levels. They will require moderate development cost with a high probability of successful development. System components for these alternatives are commercially available or require only moderate adaptation. Considering treatment options currently available (including non-mechanical methods), and the current demand for steep slope brushfield conversion, these alternatives are appropriate and reasonable.

	FALLONS' TOOL	MODIF. FALLONS' TOOL	PEPIOT'S RAKE	MODIF. PEPIOT'S RAKE	SHAR TWENTY	GRAVITY ROLLER	MODIF. GRAVITY ROLLER	RESIDUE CHIPPER	CUT & YARD	DISK HARROW	TETHERED SKIDDER	CABLE REDUCTION HEAD	GRAPPLE RAKE	TERMS USED FOR EVALUATION
Provides Planting Access	M	G	M	G	G	G	G	G	G	G	G	G	G	G/M/P
Provide Root Disturbance	M	M	M	G	P	M	M	P	P	G	P	P	P	G/M/P
Has Slash Reduction Capabilities	P	M	G	G	G	M	M	G	G	G	G	G	G	G/M/P
Compatible With Harvest Road Spacing	G	G	G	G	G	M	G	G	G	G	P	G	G	G/M/P
Requires Tailhold Anchors or Access	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y/N
Slope Limitations	N	N	N	N	Y	N	N	N	N	N	Y	Y	N	Y/N
Vegetation Limitations	N	N	Y	N	N	Y	Y	N	N	Y	N	N	N	Y/N
Soil Impacts	M	M	M	M	L	L	L	L	L	H	L	L	L	H/M/L
Development Infeasibility	-	L	-	L	-	L	L	L	-	M	L	H	L	H/M/L
Development Cost	-	L	-	L	-	L	L	M	-	M	H	H	L	H/M/L
OPERATING COST	M	M	H	M	L	L	M	M	H	H	L	H	M	H/M/L

TERMS: G = GOOD, M = MODERATE, P = POOR; H = HIGH, M = MODERATE, L = LOW; Y = YES, N = NO

Table 3. Evaluation of Treatment Methods.

VII. RECOMMENDATIONS AND CONCLUSIONS

The alternatives selected are adaptations of post-applications. Changes and modifications in system configuration and component design should increase productivity, reduce downtime, and reduce operating costs.

Basically, both tools are intended to grub roots and rake slash. Further development should determine the tool design that best accomplishes these tasks. It is recommended that further development utilize the brush rake concept in tool design. This design has a high chance of successful development and offers versatility in operation. The basic tool design can be modified in terms of depth of grubbing, weight, and rake capacity to meet a variety of conditions.

A. RECOMMENDED SYSTEM CONFIGURATION AND COMPONENTS

<u>Rake Requirements</u> -

1. Sufficient weight to insure adequate penetration for grubbing for all slope conditions; approximately 5,000 lbs.
2. Rake teeth of adequate strength to prevent excessive wear and fractures, suitable for operation in rocky soil conditions.
3. Rake capable of sufficient capacity so that turns to disposal site are minimized.

Rake Design - Modify a commercially available brush rake. Appropriate size would be a rake designed for operation with a Cat D8 or equivalent. Rake shown is manufactured by Mann's Equipment Mfg., Inc.; Arlington, WA. Teeth penetration is 21 in., 8 teeth total, teeth width is 2-1/2 in., 17-1/2 in. distance center to center. Other options are available (3).

For starters the rake should be modified similar to Pepiot's rake (V.B.). Further refining of hardware and rigging placement will require field testing.

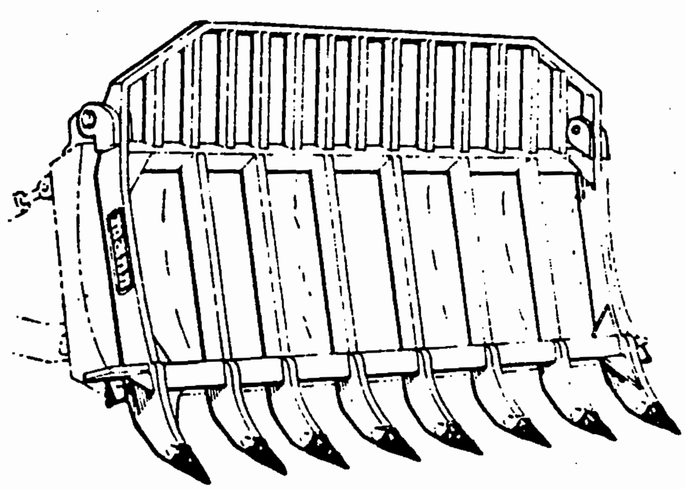


Figure 21. Typical swing rake designed for use with a Cat D8.

Yarder Requirements -

1) Self-powered mobile to expedite skyline road changes.
2) Sufficient power for efficient operation; approximately 200 hp.
3) Capability for running skyline rigging configuration.
4) Capability of external operating distances not less than 1,000 ft.
5) Initial and operating costs as inexpensive as possible for cost efficiency.

Yarder Selection - Since slackpulling capability is not required conventional two-drum yarders are appropriate. Options include:

1) Madill 071
2) Skagit SY-717
3) Thunderbird Mobile Yarder
4) Washington 78SL

Tractor Requirements -

1) Crawler type, weight not less than 30,000 lbs., with hydraulic blade, safety canopy and rear mounted high speed logging winch with not less than 100 ft. of 7/8 in. line.
2. Engine to develop not less than 150 drawbar horsepower.
3. Modify by attaching a tower capable of supporting a tail-block for operation with tower-yarder. Tower should support the tailblock at least 12 ft. above the ground.

Tractor Selection - Appropriate options include:

1) Caterpiller D7G

2) John Deere JD850

3) International TD-2SE

Operation

Requirements

1) Road access for yarder location.

2) Anchor availability or yarder guylines.

3) Tractor-crawler access at end of treated unit.

4) Two man crew required for operation.

Physical Limitations

1) Suitable for operation in brush, as defined in I.C. Not suitable for hardwood conversion.

2. External distances determined by available line lengths.

Description - Suitable for uphill, downhill, or across slope operation; concave or convex slopes. Treatment begins at the end of the unit and proceeds to the yarder. Once a pass has been made, the tractor-tailhold positions itself for the next pass and the process is repeated. For grubbing the haulback line is slackened and the mainline tensioned. For windrowing the tool is lifted above ground by tensioning the haulback and mainline and positioned to disposal area. This method is also used to avoid obstacles. Running skyline will be required to obtain adequate lift.

Production and Costs - Operating for full scarification and removal production is estimated at 3 ac./day at a cost of $450 per acre.

B. DISCUSSION

The selection of a particular treatment or conversion method should be put into context. It is but one activity integrated with all other silvicultural activities which, together, comprise the management plan for that particular stand. The selected treatment method affects, to some degree, all timber stand improvement activities through rotation (24).

The choice of a treatment method is determined by economics and influenced by political and sociological conditions. The total cost of treatment is the combined cost of the initial treatment and indirect costs determined by seedling survival and growth and associated maintenance activities, such as release operations. These indirect costs were addressed in the assumptions inherent in the evaluation and selection criteria. A detailed treatment of these indirect costs is beyond the scope of this paper.

Both selected alternatives require tractor access for tailholds; a severe limitation for some potential applications. The use of clumps of brush stems for anchors should be considered. Two or more clumps could be rigged in series with connecting lines. The tailblock could be hung from these line anchors and held in place by cable clamps. The test conducted on brush pulling suggest many brush species have sufficient resistance to pull to make them suitable for anchors.

Another alternative to circumvent the need for anchors is application of gravity rollers. This method is currently undergoing testing in New Zealand; only assimulation of current knowledge on specific equipment requirements is needed.

These requirements can be matched to commercially available equipment in Oregon and modifications made as required. The concept is patented in New Zealand. The modified gravity roller is an adaptation of this principle utilizing conventional yarders for more versatility and compatibility with harvesting road spacing.

There is a definite need for steep slope mechanical brush conversion methods in southwest Oregon. The recommended alternatives are considered an appropriate solution to this need.

VIII. SUGGESTIONS FOR FURTHER RESEARCH

Two independent groups within the same agency, U.S.D.A. Forest Service, are currently active in some aspect of equipment development for steep slope brush conversion or slash treatment; Sam Dimas Equipment Development Center (contact Fred Commick), and Missoula Equipment Development Center (contact Ben Lowmen). These investigators should be contacted before any further development proceeds to insure that efforts are not duplicated.

Further research and development should investigate:

1) The detailed tool design. It is recommended that a swing rake (VII.A.) be modified similar to Pepiot's rake. Field testing will be required to determine what hardware and rigging is most conducive for efficient operation.
2) Analysis of the operation of the modified rake on the effects on brush.
3) Economic analysis of the treatment.
4) Basic biological knowledge concerning seedling response to alternative treatment methods considering soil displacement and compaction, shading, and moisture competition.
5) Integration of biological knowledge of seedling response with performance efficiency of alternative treatment methods and associated silvicultural activities to determine the most cost effective treatment method.

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APPENDIX A

ACREAGE CALCULATIONS

Estimates were made to determine the amount of commercial forest land on slopes greater than 35%, presently occuppied by brush with no stocking of coniferous trees, or stocking so low as to warrant conversion; as opposed to release. Estimates were obtained through personal contacts, phone conversations, and correspondence. Methods for obtaining estimates varied depending on the available information from the inventory systems.

The agencies, counties, and companies contacted are listed below with a brief description on the method used to obtain the estimates, the persons contacted, and, where necessary, calculations showing how the estimates were developed from the given inventory data.

MEDFORD BLM

Method - Current inventory data of total brush occupied lands and percent of Resource Areas (R.A.) stratified by slope. Odds ratio and contingency tables used for data reduction.

Contacts - Butte Falls R.A.	-	Jim Weldon
Jacksonville R.A.	-	Jim Weldon
Klamath R.A.	-	Larry Larson
Grants Pass R.A.	-	Joy Donkam
Galice R.A.	-	Rick Prusz
Glendale R.A.	-	Garry Ryan

Calculations - Example: Butte Falls R.A. from inventory data, total C.F.L. is 137,492 acres, 31,220 acres of this total on slopes greater than 35%; total brush acres is 8,118 acres.

	Steep	Flat	Total
Brush	a	b	8,118
No-Brush			
TOTAL	43,997	93,494	137,492

Odds of brush if steep = $P_a/(1-P_a)$

Odds of brush if flat = $P_b/(1-P_b)$

P_a = a/43,997

P_b = b/93,494

Assume odds of having brush is three times higher if steep

Then, $3 = \dfrac{\dfrac{P_a}{1-P_a}}{\dfrac{P_b}{1-P_b}}$

and, a + b = 8,118

Solving yields a = 4,600, which represents the number of brush acres on slopes greater than 35%. Data from the other resource areas is reduced similarly.

Resource Area	Total CFL (acres)	Total Brush Acres (acres)	% Land >35% (%)	Brush on land >35% (acres)
Butte Falls	137,492	8,118	32	4,600
Jacksonville	179,979	27,622	74	24,400
Klamath				0
Grants Pass	152,244	5,000	79	4,600
Galice	134,464	1,750	89	1,700
Glendale	84,459	1,200	74	1,100
				36,400

ROSEBURG BLM

Contact - Jesse Higdon

Estimate - 250 acres

SISKIYOU NATIONAL FOREST

Method - From 'TRI' inventory system and/or other district resource data.

Ranger District	Contact	Acres
Illinois Valley	Ron Garner	1,100
Chetco	Douglas Bright	5,800
Galice	Dave Craig	8,100
Gold Beach	Dick Kerns	8,950
Powers	James Nielsen	650
		24,600

UMPQUA NATIONAL FOREST

Method - Updated district resource data.

Contact - Virgil Wilson

Estimate - 920 acres in Douglas County.

ROGUE RIVER NATIONAL FOREST

Method - District resource data.

Ranger District	Contact	Acres
Ashland	Mike deLuz	300
Butte Falls	Brian Klenke	300
Applegate	Floyd Smith	5,000
		5,600

COUNTIES

Method - Weighted average of estimated brushlands and estimated percent of lands over 35%.

County	Contact	Acres
Douglas	Robert Logan	59,200
Coos	Paul Oester	7,200
Jackson/Josephine	Allan Campbell	50,000
Curry	Walter Schroeder	3,600

LARGE PRIVATE

Method - Company resource data.

Company	Contact	Acres
Sun Studs		2,000
Longview Fibre	Stan Benson	500
Roseburg Lumber	Dave Russell	5,000*
Boise Cascade	Bob Thrust	1,500
Kogap	Dave Kaiser	0
Timber Products	Duane Crites	0
Medco	Mike Meredith	0
		9,000

* Roseburg Lumber noted that their conversion needs can be adequately treated using non-mechanical methods.

STATE

Contact - Blair Hoops

Estimate - None requiring mechanical treatments.

APPENDIX B

CRITERIA DEVELOPMENT

Practicing foresters and ecologists representing public agencies and private companies throughout southwest Oregon were consulted to gather the information required for determining silvicultural criteria. The approach to gather the necessary information was that of an interview with questions prepared beforehand, tailored to each consultants particular expertise. Almost all of the meetings were conducted in the field while inspecting brushfields requiring treatment and sites that have recently been treated.

The results of the qualitative information collected is summarized below, followed by a list of the consultants contacted. The final silvicultural evaluation criteria represents a majority opinion, or the opinions most substantiated by current knowledge as expressed in the literature.

a. Method of removal; disposition of weed root system (refers to the amount of ground disturbance desired and the desired effect on the weeds root system).

	% Agreement
1. A crushing treatment resulting in masticating brush stems into small piece sizes and moderate ground disturbance is acceptable.	25%
2. Shearing or ripping brush stems near ground level with little or no ground disturbance is acceptable.	30%
3. Efforts to remove or grub roots, by raking or plowing are necessary or preferred.	70%

	% Agreement
4. Efforts made to remove or grub roots are justified; increased initial site preparation costs (if any) will yield returns by increased seedling growth and survival.	70%
b. Expected environmental impacts by treatment method (refers to soil related impacts, such as compaction, surface erosion, or mass soil movement).	
1. A crushing treatment would result in unacceptable impacts.	10%
2. Treatment by shearing or ripping would result in unacceptable impacts.	0%
3. Treatment by plowing or raking would result in unacceptable impacts.	10%
4. Adverse impacts would preclude use of mechanical methods on slopes over 35% only on select sensitive sites.	100%
c. Expected post-planting maintenance by treatment method.	
1. Treatment by plowing or raking would require maintenance or release operations.	80%
2. Intensity of maintenance or release operations would be greater for treatment by crushing as compared to treatment by plowing or raking.	30%

	% Agreement
3. Intensity of maintenance or release operations would be greater for treatment by shearing or ripping as compared to treatment by crushing or plowing or raking.	80%
4. Maintenance or release operations are required regardless of treatment method. The method and effectiveness of the initial site preparation influences the type and timing of needed control.	90%
d. Constraints on treatment method concerning slash disposal.	
1. Partial or total slash removal is required for pest habitat control.	40%
2. Partial or total slash removal is required for fire hazard control.	60%
3. Partial or total slash removal is required for physical access.	80%
4. Slash reduction, such as chipping or mulching, is preferred to removal.	100%
e. Variation of treatment methods by vegetative types.	
1. Similar treatment method is acceptable for the range of material under consideration (I.C. Vegetation Description). Intensity of	100%

treatment required will vary.

LIST OF CONSULTANTS

Mel Greenup, Siskiyou National Forest

Dave Ropert, Rogue River National Forest

Mike deLez, Rogue River National Forest

Ivend Holen, Medford BLM

Bob Thrust, Boise Cascade

Ken Wearstler, Boise Cascade

Jesse Higdon, Roseburg BLM

Denny Lavender, OSU

Duane Kingsley, Rogue River National Forest