

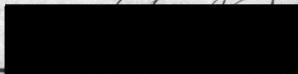
Breakage Reduction in Felling  
California Redwood

by  
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## INTRODUCTION

During the past few years there has been a great deal of thought in regard to conservation. The redwood lumber industry is confronted with a great deal of public opinion in regard to the conservation of redwood timber, a very limited and valuable species. In past years the operators of the region have not been worried by public opinion or conservation. During the eighty years of redwood logging, clear cutting was the practice and a great amount of wood waste has gone with it. Through the efforts of the California Redwood Association and their forester, Prof. Emanuel Fritz, a great deal has been done by the operators in regard to selective logging and conservation.

Felling of redwood is the most important logging practice contributing to the large amount of woods' waste. Another phase of the logging operation in which there has been a great deal of breakage is steam logging. However in recent years the advent of the tractor has reduced this percentage to an insignificant figure. Efficient management on steam shows, used for winter logging, has cut down breakage.

The breakage in felling coast redwood is greater than the felling of any other American species. Breakage often reaches and sometimes exceeds twenty percent of the sound merchantable volume. This is in Humboldt County where the stand is heavier per acre than in Mendocino County. Breakage in the latter region averages about ten percent.



Twenty percent breakage in such a valuable and limited timber as redwood is altogether too great and should no longer be accepted as inevitable. Higher cost and shrinking timber reserves are directing more attention to reduction of this loss. If present breakage is only cut in half it means not only reduced per thousand costs, but it saves acreage. Thus, cutting the breakage figure in half would be equal to saving ten acres of timber for every hundred acres logged plus the cost of its development. (1)

#### STUDY OF AMOUNT OF BREAKAGE

Professor Fritz recently made a study to determine exactly what the breakage percentage is. The study was made in Humboldt County covering 29.04 acres scaling 4,099,778 board feet, net, Spaulding scale. This is after reductions have been made for rot, hollow-butts, and rift cracks. The area was logged with both high lead and slack line. The results of the study showed that 19.42 percent of the net, sound merchantable tree scale was broken in falling. (1)

## FACTORS CAUSING HIGH BREAKAGE

### Characteristics of the Timber

Before attempting to advance any theory for reducing this loss it is necessary to find out why this timber is so difficult to fall without incurring heavy breakage. Redwood is the largest and heaviest of the commercial soft woods. An average tree stands 250 feet high and has a diameter of eight feet. One forty foot log may weigh around ten tons. Often there is a hundred and fifty feet of clear length before the first branch is reached. The wood is more or less of a brittle character.

### Topographic Features.

The redwood region is characterized by "short ground." This is the loggers term for the rough steep ground broken up by small draws and ridges on which redwood grows. Often there are sharp changes of gradient on the slopes within the length of a tree trunk. High points act as fulcrums over which the trunks bend and break. (1)

### Density of Stand

For the whole region the average stand per acre is about 100 thousand board feet. It is not uncommon for stands to run as high as two to three hundred thousand board feet per acre. The heaviest acre in the world is located in Bull Creek Flat and carries one million feet of timber. It is practically impossible to fall this tall timber in such heavy stands without crossing the boles.



Whenever a tree falls across another both trees are usually badly broken.

#### Attitudes of Operators Toward the Problem.

In the past, loggers regarded breakage as inevitable due to the difficulties in overcoming it. The acceptance of the high percentage by the loggers is due to the heavy yield per acre which is very high even after 20% of the original volume is broken. Timber was plentiful and stumpage prices were low. Loggers regarded the supply as inexhaustible and there was no thought of conservation. The large amount of wood's waste did not concern the loggers as long as there were plenty of logs on the cars.

Most of the lumber companies do not own their own timber. The timber is owned by large Eastern families and estates who have no knowledge of its value and are heavily taxed. They are very willing to liquidate their holdings at a low stumpage cost, usually about \$3. The loggers pay for the timber on a stumpage on car basis. Thus they pay no stumpage for any timber broken in the woods.

These factors have led to the lack of interest of the operators in breakage. In late years this attitude has changed and all loggers are striving to reduce this waste.

After timber supplies became depleted and all the "gravy" stands were cut out the loggers had to go back further from common carrier roads and log lighter stands on steeper ground. This naturally brought about an increase in the



per thousand logging costs. Operators then began to look about for means of reducing costs. They became more efficiency minded. Part of their efficiency program was to attempt to reduce labor costs by speed up in production and a higher output per man hour. The effect of speed up and the contract system of wage payment on breakage will be discussed in detail latter in this thesis.

#### Methods of Falling Used by Old Time Fallers, and New Trends.

Also the adoption of the new modern methods of felling redwood have not served to reduce breakage. The machine age has influenced this job as well as other operations in the logging industry. All companies now employ fallers using the gasoline drag-saw which will be discussed later in this paper. The adoption of the gasoline saw has contributed to the "speed up" as far as production per man in felling is concerned. The old hand-fallers chopped an average of one or two large redwood each day but now drag saw sets drop as many as fourteen.

The old time fallers were craftsmen who took great pride in saving every tree. In order to put the maximum length of trunk on the ground without breakage "layouts" must be built. These old time craftsmen, working on day work basis, were willing to devote a great deal of time to the preparation of these layouts. The amount of time spent depended on the size and value of the tree. Often a set would spend as long as two days making a layout for

a valuable tree. When a set of choppers was assigned a strip by the bull-buck or chopping boss the head chopper first looked the strip over in the whole. He decided in his mind where each tree was to be placed. The first trees felled on the strip were the heavy leaners, trees which had to go in the direction of their lean. That is, the heavy leaners can not be wedged so as to fall in the direction desired by the choppers. The rest of the strip was felled in such a way as not to cross each other and those leaning trees which were dropped first.

Layouts were prepared for all trees. A layout is a landing place built up in such a way that the tree will have an even bearing throughout its length. The practice is never to fell timber down hill, but layouts should lay uphill with an even gradient for the entire length of the trunk. In the preparation of these layouts high points were leveled and roots cut with mattocks, holes filled with chunks and small sapling trees felled as bedding to cushion the fall of the giant sticks. (2) Then by placing "gun sticks" in the undercut the tree can be felled so as to hit its layout. Good fallers were very accurate when it came to dropping a tree into its layout. Many years experience were needed for a logger to work up to be a head faller. These men took great pride in their skill in saving trees.



An outsider is often impressed with the number of tools a set of choppers carry around with them in a redwood logging operation. A regular outfit for a set of hand fallers consist of; (1)

- 2  $4\frac{1}{2}$  lb. double bitted axes, 44 inch handles
- 2 8' saws, 12 - 17 guage 2 cutters, double rakers
- 2 10' saws, 12 - 17 guage, 2 cutters, double rakers
- 1 12' saw, 12 - 17 guage, 2 cutters, double rakers
- 1 dozen  $\frac{1}{2}$ " plates
- 1 dozen  $\frac{1}{4}$ " plates
- 1 dozen shims, 4 x 7 inch about 18 guage
- 2 sledges, 10 lbs.
- 1 pair gun sticks -8'
- 1 plumb bob
- 6 drivers (springboards) 2 x 6", tapered
- 6 drivers (springboards) irons
- 6 pieces  $1\frac{1}{4}$  x 6 inches, 9 feet long, staging.

As the years rolled by operators found the old time, highly skilled fallers were becoming scarce. Very few young men were taking up chopping as a trade. This is probably due to the hard manual labor and great danger involved.



## DRAGSAWS

In order to fully understand the influence of the dragsaw on redwood timber falling we should study its use.

### Development and Early Use of the Machine.

Dragsaws were first used locally to buck firewood. Then finally they came into use for cross cutting redwood logs. In recent years they have been adapted to falling.

Hugh Bower, logging engineer for Pacific Lumber Company, describes the first saws used on their operation; "The first power drag saw to be used in bucking by the Pacific Lumber Co., was brought in by two brothers in 1923. These two men were successful with their first trial, with this result the number of saws was soon increased to ten. These ten saws, with a few hand buckers in the rougher areas, were sufficient to keep the operation going. The drag saws averaged 30,000 to 35,000 feet per day, Humboldt scale, at a cost of approximately 56 cents per thousand." (2)

The first saw weighed about two hundred and ten pounds including water and gasoline. It was a very discouraging task for two men to carry this heavy machine from tree to tree through deep slash and over large windfalls. These first saws were invented by local mechanics, two of these early saws were the "Fortuna" Saw and the Vaughn Blue Streak saw. Since these saws were first introduced

mechanical improvement has been very rapid. "The water cooled Vaughn Blue Streaks were equipped with a single cylinder, two cycle motor developing three horsepower. The eccentric gives an 18" stroke. It has a chain drive with friction clutch," said Hugh Bower in describing the early saws. (2)

### Modern Saws and Their Operation

Since then many improvements have been made in these saws. They have been reduced in weight from two hundred and ten pounds to a little over one hundred pounds. They are smoother and faster in operation and break downs are infrequent since the number of working parts have been reduced. The modern Fortuna saw is a compact, light weight saw with a motor resembling an out-board boat motor. This new motor is air cooled thus eliminating the need for the choppers to carry water to cool the saw. The water cooling system added greatly to the weight of the old saw.

The saw blade is very similar to the blade of an ordinary bucking saw being only slightly different in shape and having more set in the teeth. The blades are ten or twelve guage, double raker with two cutters. Eight saws are used: one 5-foot, two 6-foot, one 7-foot, two 8-foot, one 10-foot and one 12-foot. In addition to the drag saw blades the fallers have two seven foot hand saws for finishing up cuts and smaller timber. The drag saws are



used on cuts down to two feet if the tree has an easy lay. On rough round more hand work is used, the drag saw being used on the larger trees only. (2)

It takes only a few minutes to make the slight mechanical changes necessary to adapt a saw from bucking to falling. It is essential to shift the gas tank when the saw is used, the gasoline is gravity fed to the carburator. The saw is placed against the side of a tree and held there with "dogs" attached to the A frame pounded into the tree.

On the new machines the main bearing on the crank shaft was lubricated by means of an oil cup set over the center of the motor. When the saw was set up on its side for falling this cup was in the wrong position for oil to flow into the bearing. To overcome this, an oil hole was drilled in the end of the crank shaft and a grease cup attached directly thereto.

A tail dog was added to the heel of the machine. This dog is attached to the machine by means of an eye-bolt and has an adjustable telescopic arm. (3)

Now practically all operators are encouraging the use of the drag saw to a great extent for both falling and bucking. Several of the larger companies operate with one hundred percent drag saw falling. Due to the increased out-put in thousands of board feet per set, per day, less men are required to fell timber than were formerly needed.



### Costs of Operation and Ownership.

The companies encourage drag saw felling by introducing plans whereby fallers can pay the companies on easy installments for their saws. The sawyers own all their own saws and tools. The modern drag saw costs approximately \$150. The company filer services all saw blades. Under this plan the company provides saws if the sawyers do not own saws of their own and are paid for out of wages.

Costs of operation for a Vaughn Blue Streak Saw on an operating day basis are as follows; (2)

1½ gallons gasoline @ 16¢	24¢
Oil	3½¢
Grease	3½¢
Repairs	25½¢
Depreciation	<u>37½¢</u>
Total	94¢

or \$1 or 10¢ per M.

Costs of saw and equipment are as follows; (2)

Cost of saw	\$142.50
1 5-foot blade	11.25
2 6-foot blades	27.00
1 7-foot blade	15.75
2 8-foot blades	36.00
1 10-foot blade	22.50
1 12-foot blade	<u>27.00</u>
Total	\$282.00

### Type of Labor Required

The "chain saws," such as the Timber Hog, popular in the Douglas Fir Region have not proved successful in redwoods as the cutting edge of these saws corresponding to the blade of the drag saw is not long enough for the large redwood timber since occasionally a 14 foot blade is needed. Also too long a time is required for the sawyers to hold this type of saw in the cut. Drag saw falling requires that operators be fairly good mechanics in order to keep the saw running efficiently and constantly. The old-time fallers are not mechanics. Thus, a new type of faller has evolved. Often mechanically-minded young men with no experience in actual falling have taken up redwood chopping. These men, unexperienced in woods practices, do not know how to save timber. This factor has greatly increased the breakage percentage.

### Effect of Straight Contract System of Wage Payment on Breakage.

The tendency has been toward the gyppo method of wage payment, that is, payment for labor on the basis of the number of thousands of feet produced per man. Falling and bucking lend themselves very easily to the per thousand basis of wage payment. This wage payment has resulted in a speed up of production and very high between gyppo fallers. This idea of competition, the desire for high wages and the drag-saw has added to breakage.

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The fallers strive to keep the drag saw in the cut the maximum amount of time, as they are making money only when the saws are cutting for them. Thus they are not willing to plan the felling of their strip. They do not move over the strip felling the leaners and key trees first, as too much time is lost in moving the saw. Drag saw men start at the bottom of the strip and work straight through dropping each tree indiscriminate of direction or layouts. They prepare no layouts.

As a result trees are broken over the rough ground and across one another. This crossing of trunks not only breaks a tree felled across another but also crushes a tree underneath. Often trees are not broken in falling if dropped into a bad lay but will be sprung so that when sawed will fly into splinters. Thus the whole log is a loss.



## PLANS FOR REDUCING BREAKAGE

Logging superintendents have tried several plans for reducing breakage with varying success. Some of the plans are basically sound but failed due to poor administration. The most important of these systems will be discussed in the following pages in regard to their advantages and disadvantages. At first operators paid on a straight per thousand basis for falling but the breakage percentage rose so alarmingly that various penalty scales for breakage and modifications of the wage system were devised. Only one or two logging companies now pay on a per thousand basis without penalty scale for breakage.

Scaling up to Twelve Feet Below the First Break.

This is the most common penalty scale used in conjunction with the straight per thousand basis of wage payment. Loggers are paid for the volume of each tree felled, scaled up to twelve feet below the first break. Thus if a butt log is smashed on the stump the choppers will receive no scale even if there are two or three sound logs above the break. There is little penalty if the top logs are broken and this is as it should be as the greatest value and volume is in the butt and second log. Use of this penalty scale has served to cut down the breakage a great deal, as careless choppers, finding their wages drastically reduced soon work to save their timber. (4)

### Sliding Scale of Wage Payment

The most drastic plan used to reduce breakage is the one devised by Kelly McGuire, O.S.C. graduate and logging superintendent for Caspar Lumber Co. of Fort Bragg.

Mendocino County timber is smaller in size and the stands are not nearly so dense as in the rest of the redwood region. The average breakage percent for Mendocino timber is 10% as compared to 20% in Humboldt. McGuire's system was successful in reducing breakage by nearly 50% almost immediately, a figure that has been maintained constantly ever since.

This system might be called a sliding scale of contract wage payment. A careful study was made, the results of which were used to make up a system fair to employees and the company alike. The study was made on 2750 trees, scaling 8,500,000 feet. McGuire's system has been in operation for over ten years and is still being used with great success today.

Fallers are paid on a per thousand basis for all timber felled. However the base rate per thousand is adjusted according to the percentage of the scale broken during the pay period. For instance, if a set has saved all their timber during the past pay period they will receive the maximum rate per thousand for all timber felled during that period. The rate paid per thousand is graduated down according to the breakage percentage.



until careless or unskilled workmen will not be able to make wages. This automatically eliminates poor labor from the felling crew with no bad feelings among the other men. There is no discrimination, if breakage is excessive a set will not make enough money to remain on the job. Thus Caspar Lumber Company has more highly skilled fallers than almost any other company.

This plan is very detailed as compared to the ordinary systems as very careful scaling is required and there is a large amount of extra bookkeeping involved. Check scales and studies are made from time to time to adjust the base rates to various conditions such as density of stand, amount of rot, and topography.

However, in spite of the extra time and cost brought about by the complexity of the system, there is no doubt as to its value as McGuire has reduced logging costs considerably by holding breakage down to a consistent five percent.

#### Combined Felling and Bucking

One plan to reduce breakage has been to have the fallers buck each tree after they have felled it. One large company has used this plan off and on for several years with varying success. I think, basically the idea is sound and that with this company the fault lies with the management because of their lack of interest and enthusiasm in putting over the plan.

Under this plan the fallers buck each tree with a drag-saw as soon as it is felled. Wage payment for felling is on a per thousand basis for all board footage scaled twelve feet below the first break. Then they are paid on a per thousand basis for bucking. If they break the tree in falling they take a penalty when it comes to bucking as the volume available for bucking is greatly reduced. Then, too, by scaling up to twelve feet below the first break there is a penalty effecting their earnings for felling the tree.

From the standpoint of efficiency there is a great advantage over having falling and bucking done by seperate <sup>sp.</sup> crews. This way the fallers merely move their saw from the stump to the tree, change over the gas tank and buck the trunk into log lengths. This avoids having another crew carry a saw over the same ground to buck after falling. One of the biggest items cutting down earnings of drag saw crews is transporting their saw from tree to tree. They only make money when the saw is cutting wood. This plan eliminated a lot of this transportation thus enabling the sawyer to make higher earnings and reducing costs.

The woodsmen will take pains to save the maximum length and to put the tree on the ground in a position for easiest bucking. When separate crews do falling and bucking fallers often drop trees in near impossible positions for the buckers. (3)

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This plan has several marked disadvantages which should be considered. Under this plan the sawyers must mark their own log lengths. The usual system is to have a log marker, skilled in log and lumber grades, to do this job. However in the redwoods the grade of lumber in a log is not as important and there are no log grades. Logs are usually marked to get a 16 or 20 foot butt log and as many 40 foot lengths as possible.

When tractors were introduced, the system of combination falling and bucking had an added advantage in that it was not necessary to carry such a large down timber inventory. By immediately bucking the logs after falling, the timber is ready for yarding. Under the old system of two separate operations, the buckers must work at a safe distance behind the fallers. (2)

This plan requires very highly skilled men as they must be both skilled fallers and buckers. In practice it is difficult to find woodsmen possessing this degree of skill and experience.

#### Using Tractors to Pull Leaners Into Beds and Prepare Layouts.

Off and on tractors have been used in conjunction with falling to reduce breakage. Operators have used the tractor winch, small blocks and wire rope to pull heavy leaners in a direction opposite to the lean so they will fall into a layout. This has been used only in isolated instances on very valuable trees.

Kelly McGuire has saved leaners on many occasions by use of the Beebe hand winch. Two thirds up the merchantable length of the tree a strap is attached and the line wound in with the winch or even a tractor. It is not always possible to place a sidehill leaner on the falling layout, but with trees that lean downhill it is a rather simple matter. It is found that falling cost on these special trees is about three times that of ordinary trees. (1)

Other operators have purchased small tractors equipped with bull-dozer blades for the purpose of building layouts. A great many layouts can be constructed in a short time in this manner. This tractor is very handy in leveling off hummocks and rolling out windfalls and chunks. The method has been to utilize on small cat exclusively for building these layouts.

However in a camp of any size the felling operations are scattered over such a wide area that too much time is lost in moving this equipment from strip to strip. From the standpoint of safety, fallers can not work close together. Many accidents have resulted because of one set of fallers working too close to another.

The main disadvantage to using tractors in conjunction with felling is the cost. Tractors are very expensive machines to operate depending on the size of the machine. Daily operating costs run from \$40 to \$70. Using a tractor exclusively for layout preparation runs the cost of falling to a prohibitive figure. (5)



### Double Falling System or Young's River System

Gordon Manary of Pacific Lumber Company utilized a system that has been named the Double Falling System or Young's River System. This consists of selecting the most skillful fallers to drop the big and more valuable timber. These trees are dropped first to the best available beds. After the big trees are felled and bucked they are yarded to the landing. Then the so called "pick-up" fallers drop the remaining timber. The adoption of this method reduced the breakage in the merchantable portion of the trees from fourteen to four percent. This, when applied to data collected by Branstrom on tree values, showed that the net savings under the double falling system amounted in this case to 45 cents per thousand feet for trees thirty inches in diameter and rose to a peak of 99 cents for trees fifty inches in diameter. (4)

### Miscellaneous Systems

Operators have devised various systems to encourage fallers to save timber. One operator posted, each pay period on the office bulletin board, the names of all fallers, their scale for the past pay period and the percent of breakage. This quickly showed up the inefficient, careless and unskilled fallers. Any man hates to be listed as a poor workman and this plan was effective in making the men breakage conscious and the total breakage soon dropped.

Other operators have held monthly meetings, on company time, with the fallers and bull-buck. At these meetings better methods of falling and reducing breakage are discussed, along with wages, safety measures, etc. This makes the fallers conscious of the problem and enlists their support in cutting down this waste.

Periodical bonuses have been given to all those sets of fallers whose breakage for the past six months has been consistently low. This is very successful when used in conjunction with other systems of breakage reduction.



## CONCLUSIONS

To conclude and summarize this thesis I have described a plan which I would recommend for reduction of felling breakage. This plan is made up of some parts of the more workable plans described in the preceeding pages.

I am assuming that drag saws will be used for falling as this has become the accepted practice and has proved to be the most efficient and cheapest method of falling redwood.

### Organization of Personnel

The essential element in any breakage reduction plan, a point often overlooked by many operators, is the full cooperation of all men in the felling organization. Without their aid even the best plan will be a miserable failure. They must become interested in the problem and become breakage conscious. That is every tree must be placed where breakage will be a minimum. This can only be accomplished by efficient management, payment of good wages and the hiring of the most skilled personnel available.

The key man of the falling organization is the bull buck, or chopping boss as he is called in the redwoods. He should cooperate with the superintendent or chief logging engineer in the selection of qualified assistants; namely scalers, markers, filers and the choppers themselves.(6) The chopping boss should be highly skilled and widely

experienced in the handling of men and have an intensive knowledge of all phases of falling timber and logging. He will be required to be familiar with lumber grades and should make observations in the saw mill to check scales and overrun, defect, quality and breakage.

The chopping boss must be a leader; that is he must be able to secure the friendship, good will and cooperation of every man on the crew. Then they will work for him as a friend and not as a superior. This is the type of relationship desired between the bull buck and his crew. He should, of course, have complete control of all hiring and firing.

In order to secure this cooperation the chopping boss and his assistants must be fair, impartial and honest. A few companies have endeavored to reduce costs by requiring or encouraging the bull buck to be dishonest and instruct scalers to cut on the choppers scale. Of course this is foolhardy as a good set of fallers will soon discover the dishonesty. Many sets scale each tree as it is felled and compare their scales with the scale sheets. This should be encouraged.

Directly under the bull buck and acting as his assistants are the scalers. The number of scalers needed, of course, depends on the number of sets of fallers in the woods. In the redwoods one scaler can scale the output of four to six sets. The ideal scaler is preferably a man with a practical knowledge of falling and bucking with a



thorough knowledge of values and lumber grades. He should also have sufficient executive ability and diplomacy to enable him to get along harmoniously with the men. It is very essential that a scaler be accurate and honest in his work. Next to a good filer a conscientious scaler should be the greatest aid any bull buck can have in solving his labor problem and keeping satisfied high caliber men on the job. (6)

In the redwoods all filing is done by the company filer. Sometimes there are two or three filers if the crew is large enough. Falling saws are filed every day and the chopping boss should cooperate in every way between the filer and crew, to further increase the fitness of saws. "A dull saw is nonproductive and costly to both the man and his employer." (6) It is impossible to stress too greatly the value of a good filer as concerns falling and bucking costs. Even though all other conditions are satisfactory the filer has much to do with holding a crew, as well as attracting efficient men to a camp.

All men in the falling organization should be of the highest caliber and in order to attract men of this type they should be well paid.

#### Breakage Reduction Program

I would recommend the adoption of Kelly McGuire's sliding scale of wage payment as the means of keeping the breakage down to a minimum. This seems to be the most effective method of keeping good men in the organization

and at the same time has reduced breakage to a lower figure than any other method devised. Also it is practical and proven as it has been in use for many years, although it has never been adopted by any other company. This system, like any other, requires a great deal of management on the part of the bull buck to keep the wage basis fair to employees. That is, the bull buck must lay out the strips so that they will be as similar as possible as far as topography and stand of timber are concerned. Also the wage basis must be adjusted from time to time in accordance with living conditions, topography, the type and character of timber.

In concluding I believe the company should hold meetings with the fallers at regular intervals on company time to discuss felling and personnel problems. The management should do everything in their power to encourage the men to reduce breakage and make the sliding scale operate efficiently.

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