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A TECHNIQUE FOR COMPARING THE COSTS OF SKIDDING METHODS

PAUL L. SCHILLINGS

USDA Forest Service
Research Paper INT-60, 1969

INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION
Ogden, Utah

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PREFACE

During the summer of 1967, David B. Brown and Michael R. Carter, both graduate students in industrial engineering at Montana State University, were temporarily employed by the Station to investigate the economics of skidding systems commonly used in western Montana, Idaho, and northwestern Wyoming.

Brown had completed a thesis entitled "An economic comparison of skidding methods employed in the Northern Rocky Mountain area" in partial fulfillment of the requirements for a master's degree from the University. In it, he compared relative profits of four types of skidding methods--crawlers, wheeled vehicles, cranes, and high-lead towers. During their summer assignment, he and Carter gathered data on a fifth type, coordinated these data with those used in Brown's thesis, and constructed a mathematical model to provide comparative cost information on these five types of skidding methods. They chose to substitute "costs" for "profits" as the measure of comparison to avoid confounding their task because (1) some company policies preclude general dissemination of profit and loss information, and (2) fluctuating market conditions affect profits.

Lack of time cut short the data collection necessary to fully satisfy the objectives of the study. Most of the values in the tables are based on information obtained within a 75-mile radius of Bozeman, Montana. The values presented in the cost tables should be viewed as tentative--as estimates based only on information that was available at the time of the study. Furthermore, the author recognizes that these estimates can be upgraded in terms of accuracy when additional data are gathered in future studies. However, the tables are presented at this time purely for their possible interest to contractors, who shouldn't assume the values will accurately apply to their particular operations.

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INTRODUCTION

The nine tables presented on pages 15-23 permit a logging operator to compare relative operating costs among five different skidding methods. Tables 1-4 provide data for operations in which crawler tractors ranging from 25 to 130 drawbar horsepower (DBHP) are used; tables 5 and 6 for operations in which rubber-tired vehicles with a 55-80 or 81-117 brake horsepower (BHP) rating are used; table 7 for high-lead operations in which portable towers are used; table 8 for Idaho jammer operations, which consisted of a portable boom with a continuous haul-back line and chokers in every operation observed; and table 9 for what are called "shovel logging" operations.

The costs in these tables represent estimates based upon observations made at one shovel logging operation, eight portable tower operations, and from 10 to 20 different operations employing each of the three remaining skidding methods.

The shovel logging operation was found on the Gallatin National Forest, which is located in the vicinity of Bozeman, Montana. The rig consisted of a portable boom in which the A-frame is either of logs or fabricated steel and single drum pulley with a half-inch line and tongs. An operator worked along a skidding road or trail, casting the tongs either downhill 125 feet or uphill as far as 50 feet. Some tong setters carried tongs beyond the downhill cast another 25 feet, which allowed a maximum skidding distance of 150 feet. A good operator was capable of releasing the tongs from a log without leaving the cab. One log was handled at a time. We found that this method was uneconomical when skidding distances were beyond 150 feet.

Among the high-lead operations studied, towers ranged from 40 to 70 feet high and power plants ranged from 165 to 225 BHP. Remote-controlled carriage units were not used in any of these operations. High-lead operations were found to be the most economical in situations where skidding distances were over 500 feet and where there were steep slopes, large trees, and high acre densities.

For most operations observed, rubber-tired vehicles were found to be the most economical, assuming equal operator efficiencies. This is reflected by the increasing use of these vehicles throughout the country. In our contacts, however, we found some contractors who felt that downtime and operator unfamiliarity with rubber-tired vehicles do not permit them to realize maximum potential efficiency from such skidders. Furthermore, they preferred crawler tractors because they are needed in other phases of logging operations.

Not all of the operations studied were cutting logs large enough to fall within the 4, 6, or 8 logs/MBF categories. Therefore, costs had to be extrapolated using the mathematical model described in the Appendix. For example, in tables 1, 5, and 9, extrapolated values are used for all three of these categories; in tables 2 and 6, for only the 4 and 6 logs/MBF categories; and in table 3, for only the 4 logs/MBF category. Extrapolated costs are so indicated by being enclosed in rectangles on these tables.

Extrapolated costs can be compared directly with other extrapolated costs. However, when estimated costs are used, the lowest estimated cost is considered more economical than the lowest extrapolated cost unless the latter shows a cost savings of at least 20 percent. Those operators who have had experience using the skidding methods for which extrapolated costs are presented may wish to shave this percentage to 15 percent or less. Example 2 on page 3 deals with a situation involving both extrapolated and estimated costs.

HOW TO USE TABLES

Four variables must be known or estimated before entering the cost tables. These are:

1. Area density in MBF/acre, which is presented for a range of from 5 to 15 MBF/acre in steps of five on all of the tables.
2. Skidding distances in feet. In tables 1-7, these are presented in 100-foot steps ranging from 200 to 600 feet. In table 8, the distances range from 100 to 400 feet in 100-foot steps, while in table 9 they range from 25 to 125, in 25-foot steps.
3. Slope in percent, which ranges from 5 to 40 percent in steps of 5 percent on all tables.
4. Number of logs/MBF, or tree size, which ranges from 4 to 16 logs/MBF in steps of two logs on all tables.

Example 1.

Suppose the stand density in an operating area is about 10 MBF/acre, the average skidding distance is 400 feet, the average slope is around 30 percent, and the number of logs/MBF corresponding to the stand density is 14.

Enter table 1. The data under 10 MBF/acre would provide the desired values for the operating conditions given. Look to the left column under "DISTANCE" and stop at the 400 group in the middle of the sheet, then choose the 30-percent slope to the right of the 400 group. You are now on the correct row. Move across the row to the right and stop in the column labeled 14 logs/MBF. The cost estimate is \$7.65/MBF.

Next turn to table 2. Proceed as you did in table 1 and you'll get \$6.72/MBF. Continuing in this manner using the remaining seven tables, you would derive the following:

	<u>Cost</u> (\$/MBF)
Crawler tractor, 25-40 DBHP	7.65
Crawler tractor, 41-60 DBHP	6.72
Crawler tractor, 61-80 DBHP	4.32
Crawler tractor, 110-130 DBHP	7.87
Rubber-tired vehicle, 55-80 BHP	4.04
Rubber-tired vehicle, 81-117 BHP	5.63
High-lead, portable tower	9.02
Idaho jammer	8.71
Shovel (w/tongs)	Not practical

In this example, no extrapolated values were taken; hence, eight of the values may be compared directly. Shovel skidding was not considered because 400 feet is outside its skidding range. We immediately see that the smaller rubber-tired skidder is the most economical, as could be expected because of the low stand density and small logs involved.

Example 2.

Assume a thin stand has large timber on moderately steep slopes where average skidding distances run up to 600 feet. Assume further that high-lead equipment is not available. The variables for this situation: area density, 5 MBF/acre; skidding distance, 600 feet; slope, 40 percent; and tree size, 4 logs/MBF. Using the same procedure as you did in Example 1, you would derive the following:

<u>Skidding type</u>	<u>Cost</u> <u>(\$/MBF)</u>
Crawler tractor, 25-40 DBHP	5.89*
Crawler tractor, 41-60 DBHP	4.49*
Crawler tractor, 61-80 DBHP	2.90*
Crawler tractor, 110-130 DBHP	3.68
Rubber-tired vehicle, 55-80 BHP	2.88*
Rubber-tired vehicle, 81-117 BHP	4.09*
High-lead, portable tower	Not available
Idaho jammer	Not applicable
Shovel (w/tongs)	Not applicable

*Extrapolated values

As noted earlier, shovel logging is limited to a maximum skidding distance of 150 feet and couldn't be used in this situation. Furthermore, we didn't view the use of the Idaho jammer method as being applicable because among the operations studied none were for skidding distances of over 400 feet. This is not to say that the Idaho jammer can't be used for skidding longer distances.

Although the skidding cost for the 55-80 BHP rubber-tired vehicle is an extrapolation, it does represent a savings of at least 20 percent over the lowest estimated cost (\$3.68 for the 110-130 DBHP crawler tractor). The cost for the 61-80 DBHP crawler tractor also represents savings of at least 20 percent; thus, for all practical purposes it would be as economical to use the crawler tractor as it would be to use the smaller rubber-tired skidder. Your choice would rank as follows: (1) rubber-tired vehicle, 55-80 BHP, (2) crawler tractor, 61-80 DBHP, (3) crawler tractor, 110-130 DBHP, (4) rubber-tired vehicle, 81-117 BHP, etc. The level of 20 percent is set arbitrarily as a guide and may be changed at the discretion of the operator.

APPENDIX

Figure 1.--Flow diagram of the mathematical model is shown above; the dimensional equation for this model is shown below.

INPUT DESCRIPTIONS

EXTRACTION COSTS

Extraction costs are made up of the seven inputs shown in figure 1.

MBF/acre is a situation variable called density, which may be determined from a timber cruise or from contractors' records. It is designated either "XBFPFA" or "MBFPFA" in the computer program (see p. 14). Defect averaged 10 percent.

Logs/MBF also is a situation variable and is readily judged by experienced contractors. Its program designation is "XGPMBF" or "LGPMBF." Log lengths ranged from 16 to 40 feet.

Hours/cycle denotes production time and is generated by the following multiple-regression equation:

$$y = a_0 + a_1x_1 + a_2x_2 + a_3x_3,$$

where

$$\begin{aligned} y &= \text{cycle (turn) time in hours} \\ x_1 &= \text{skidding distance} \\ x_2 &= \text{slope} \\ x_3 &= \text{number of logs per cycle} \end{aligned}$$

Briefly, the equation gives cycle time in hours based on the three most significant variables we found--skidding distance, slope, and number of logs skidded during each cycle. The constants for this equation are as follows:

<u>Skidding type</u>	<u>Regression (a_0)</u>	<u>Distance (a_1)</u>	<u>Slope (a_2)</u>	<u>Logs (a_3)</u>
Crawler tractor, 25-40 DBHP	0.04293	0.0018800	0.0020339	0.02415
Crawler tractor, 41-60 DBHP	.08071	.0000953	.0020964	.02218
Crawler tractor, 61-80 DBHP	.10518	.0002705	— .0020109	.01257
Crawler tractor, 110-130 DBHP	.10736	.0004778	.0013270	.01502
Rubber-tired vehicle, 55-80 BHP	.01222	.0002291	— .0007572	.01912
Rubber-tired vehicle, 81-117 BHP	.08941	.0007040	.0012269	.01182
High-lead, portable tower	.04297	.0000024	.0009517	.00807
Idaho jammer	.00535	.0000475	.0001651	.00000
Shovel (w/tongs)	.01760	.0002081	— .0005169	.00000

The multiple-regression equation is shown in program statement 35, beginning with "RC" (regression constant) and ending with "XLGPC" (number of logs per cycle).

Delays are caused from equipment breakdowns, personnel "breaks," weather conditions, etc. These vary among individual skidding operations. Delay averages as percents of available operating times were established for the various skidding methods as follows: high-lead, portable tower, 20 percent; Idaho jammer, 15 percent; shovel (w/tongs), 20 percent; all

others, 25 percent. These were used in the mathematical model to ensure that the various methods were compared on an equal basis. Delay values are called "DELAY" in the program and entered as decimals.

Logs/cycle was derived by averaging the number of logs observed for each operating cycle. Values averaged from data gathered closely approached the even increment separations as shown below for each of the logs/MBF categories:

	<u>4</u>	<u>6</u>	<u>8</u>	<u>10</u>	<u>12</u>	<u>14</u>	<u>16</u>
Crawler tractor, 25-40 DBHP	1.2	1.8	2.4	3.0	3.6	4.2	4.8
Crawler tractor, 41-60 DBHP	2	3	4	5	6	7	8
Crawler tractor, 61-80 DBHP	3.6	5.4	7.2	9.0	10.8	12.6	14.4
Crawler tractor, 110-130 DBHP	8	12	16	16	16	16	16
Rubber-tired vehicle, 55-80 BHP	1.6	2.4	3.2	4.0	4.8	5.6	6.4
Rubber-tired vehicle, 81-117 BHP	2	3	4	5	6	7	8
High-lead portable tower	4	4	4	4	4	4	4
Idaho jammer	1	1	1	1	1	1	1
Shovel (w/tongs)	1	1	1	1	1	1	1

For example, in the case of the 25-40 DBHP crawler tractor, the separation is exactly 0.6 for each category of log sizes from 4 through 16 logs/MBF. Although it is unlikely that exact separations would be the real case, we assumed linearity because (1) the data closely approximated a straight line, hence it did represent the apparent situation; and (2) the total weight for each turn involving a tracked or wheeled skidder remained essentially the same for each class regardless of the number of logs skidded. Of course, shovels, jammers, and portable towers each skidded the same number of logs/cycle regardless of total weight. Logs/cycle appears in the program as "XXGPC" or "XLGPC."

Hours/acre means setup time for each acre of skidding area covered. It is the elapsed time from the moment a piece of equipment is in its new location until it begins a skidding cycle. This input was not considered applicable to tracklaying and wheeled skidder operations because the equipment is always in movement with its load. Setup times/acre are derived as functions of average skidding distances as follows:

FOR HIGH-LEAD, PORTABLE TOWER OPERATIONS.

(See figure 2 next page for typical area configuration.)

1. Average setup time = 0.84 hour (mean of eight setups, one setup being a single tower positioned with its corresponding tail block locations at A, B, C, D, and E).
2. Area for setup = 250,000 sq. ft. or 5.74 acres.
3. Combining steps 1 and 2 get 0.1463 hour/acre or 0.15.
4. Average skidding distance = 662 feet (distance to centroid of sector assuming uniform density throughout).

5. Multiplying results from 3 and 4 get 97, thus $y = 97/x$,

where

y = setup time/acre

x = average skidding distance

97 = constant written into program as "XETUP" or "SETUP."

At this point, one might question the accuracy of the hyperbolic function which was used to determine setup times for all ranges of skidding distances. It is true that the function was derived without benefit of data to match setup times with various skidding distances. Without this data, we relied upon the most common portable tower configuration as the source for the best values available.

Figure 2.--Typical configuration for a high-lead, portable tower.

FOR IDAHO JAMMER OPERATIONS.

(See figure 3 on facing page for typical area configuration.)

1. Average setup time = 0.416 hour (mean from 12 jammer operations).
2. Area for setup = 40,000 sq.ft. or 0.918 acre.
3. Combining steps 1 and 2 get 0.453 hour/acre.
4. Average skidding distance = 466 feet (slightly beyond center because of diagonal skidding).
5. Multiplying results from 3 and 4 get 211, thus $y = 211/x$ (see explanation in step 5 under "FOR HIGH-LEAD, PORTABLE TOWER OPERATIONS").

FOR SHOVEL SKIDDER OPERATIONS.

(See figure 4 on facing page for typical area configuration.)

1. Average setup time = 0.099 hour (mean from 16 shovel skidding operations).
2. Area for setup = 15,000 sq.ft. or 0.344 acre.
3. Combining steps 1 and 2 get 0.29 hour/acre.
4. Average skidding distance = 76 feet.
5. Multiplying results from 3 and 4 get 22, thus $y = 22/x$ (see explanation in step 5 under "FOR HIGH-LEAD, PORTABLE TOWER OPERATIONS").

Ideally, since the maximum skidding distance for shovel skidding is 150 feet, it would seem that each setup covered a semicircular area enclosing 35,350 sq.ft. instead of 15,000 sq.ft. However, in practice figure 4 as sketched shows the typical operating procedure.

FOR ROLLING STOCK SKIDDERS.

Setup times were not considered for rolling stock skidding operations, which includes such equipment as tracklaying and wheeled skidders. This equipment is used in other operations of the production cycle; namely, traveling unloaded, clearing trails, hooking chokers, freeing chokers, traveling loaded, unhooking chokers, and decking logs. However, "hook chokers" were not included in the production cycle for rolling stock.

\$/hour denotes the hourly owning and operating costs normally experienced from equipment service, which includes such items as depreciation (initial cost less salvage value), interest, insurance, taxes, fuel and lubricants, repairs, tires, workmen's compensation, and operator's wages. It is called "COST" in the program. The average hourly owning and operating costs for the skidding operations observed follow:

	<u>\$/hour</u>
Crawler tractor, 25-40 DBHP	6.86
Crawler tractor, 41-60 DBHP	8.21
Crawler tractor, 61-80 DBHP	9.97
Crawler tractor, 110-130 DBHP	12.00
Rubber-tired vehicle, 55-80 BHP	6.78
Rubber-tired vehicle, 81-117 BHP	9.85
High-lead, portable tower	18.87
Idaho jammer	16.00
Shovel (w/tongs)	8.36

Roadbuilding costs are made up of the three inputs shown in figure 1 and now described separately.

Figure 3.--Typical configuration for an Idaho jammer.

Figure 4.--Typical configuration for a shovel skidder.

ROADBUILDING COSTS

Feet/acre defines the road length in feet to be built for each acre to be skidded as a function of the average skidding distance. It is derived similarly to setup time/acre and introduced into the program as "RDLG." In figure 5 below,

$$x = \frac{1(\text{unit distance}) \times 43,560 (\text{sq. ft. / acre})}{2y (\text{feet})}$$

$$x = \frac{20,000}{y} \quad (\text{roughly, since the road length equation is the same for all skidding methods})$$

where

x = feet of road length/acre to be skidded

y = average skidding distance.

\$/hour represents the roadbuilding cost per hour. Like owning and operating costs, it is the average of all roadbuilding tractor costs observed--\$13.58/hour, which is shown in the program as \$13.58.

Figure 5.--Typical configuration when building skidding roads.

Feet/hour is the rate for building a skidding road. It appears as hours/feet in the program equation.

Forbes¹ provided the following data on the performance of a typical roadbuilder using crawler tractors:

Performance (Linear feet/hour)	Slope	
	(Degrees)	(Percent)
400	10	17.6
190	20	36.4
110	30	57.7

Using this data, we developed the following quadratic formula for estimating linear feet/hour of road bladed as a function of slope:

$$F = 0.185 S^2 - 21.155 S + 715.045$$

where

F = linear feet per hour of road bladed

S = percent slope.

The regression equation of feet/hour as a function of slope is found at the end of line 2, statement 35, in the computer program.

¹Forbes, Reginald D. Forestry handbook, section 18, page 20, table 12. 1,143 pp., illus. New York: The Ronald Press Co. 1961.

COMPUTER PROGRAM

```

DIMENSION      (T(48),CPMBF(20))
13 CONTINUE
  J=0
  READ 1,(T(I),I=1,12)
  1  FORMAT (12A4)
  2  FORMAT (1H1,12A4)
  READ 5,K,RC,SC,DC,XLC,COST,DELAY
  5  FORMAT (110,4F8.6,2F5.2)
  IF(K-1) 3,4,4
  3  GO TO 50
  4  CONTINUE
  READ 10,L,M,N,XXGPC,XETUP,CLC
10  FORMAT (9F8.2)
20  DO 30 II= 5,60,5    MBFPA=II
  PRINT 2,(T(I),I=1,12)
  PUNCH 8,(T(I),I=1,12)
  8  FORMAT (12A4,20X,2H *)
  PRINT 40, MBFPA
40  FORMAT (/F10.0,29H THOUSAND BOARD FEET PER ACRE)
  PUNCH 6, MBFPA
  6  FORMAT (F10.0,29H THOUSAND BOARD FEET PER ACRE,29X,2H 1)
  PRINT 41
41  FORMAT(/5X,48H DIST      SLOPE      LOGS PER THOUSAND BOARD FEET)
  PUNCH 9
  9  FORMAT( 5X,48H DIST      SLOPE      LOGS PER THOUSAND BOARD FEET,
115X,2H 2)
  PRINT 42
42  FORMAT (25X,43H 4      6      8      10      12      14      16      //)
  PUNCH 7
  7  FORMAT (25X,45H 4      6      8      10      12      14      16      2)
  DO 30 IXX=L,M,N
  DIST=IXX
  RDLG=20000./DIST
  SETUP=XETUP/DIST
  PRINT 51
51  FORMAT(/)
  PUNCH 21
21  FORMAT(68X,2H 1)
  DO 30 IXXX = 5,40, 5
  SLOPE=IXXX
  XLGPC=XXGPC
  DO 35 IX=4,16,2
  LGPMBF=IX
  XLGPC=XLGPC+CLC
  IF (XLGPC-16.) 26,26,25
25  XLGPC=16.
26  CONTINUE
  J=J+1
  XGPMBF=LGPMBF
  XBFPA=MBFPA
35  CPMBF(J)= ((XGPMBF*XBFP*(RC+(SC*SLOPE)+(DC*DIST)+XLC*XLGPC))
1*(1.+DELAY)/
2XLGPC+SETUP)*COST+RDLG*(13.58/((.185*SLOPE**2)-(21.155*SLOPE)
3+715.045)))/XBFP
  PRINT 32, DIST,SLOPE,(CPMBF(JJ),JJ=1,J)
  PUNCH 32, DIST,SLOPE,(CPMBF(JJ),JJ=1,J)
32  FORMAT(F10.0,F7.0,6X,7F6.2)
  J=0
30  CONTINUE
  GO to 13
50  CALL EXIT
  END

```

Table 2.--Operating costs using 41-60 DBHP crawler tractors for three different st

Distance (feet)	Slope (percent)	5 THOUSAND BOARD FEET PER ACRE									
		Logs/M bd.ft.									
		4	6	8	10	12	14	16	4	6	
Dollars/M bd.ft.											
200	5	2.86	3.50	4.07	4.60	5.11	5.60	6.09	2.63	3.27	3.80
200	10	3.08	3.74	4.32	4.86	5.37	5.87	6.36	2.82	3.46	4.09
200	15	3.32	4.00	4.59	5.13	5.65	6.16	6.65	3.01	3.65	4.28
200	20	3.59	4.28	4.88	5.44	5.96	6.47	6.96	3.21	3.85	4.48
200	25	3.89	4.60	5.21	5.77	6.30	6.81	7.31	3.44	4.08	4.71
200	30	4.23	4.96	5.59	6.15	6.69	7.20	7.70	3.68	4.32	4.95
200	35	4.62	5.37	6.01	6.58	7.12	7.64	8.14	3.95	4.59	5.22
200	40	5.06	5.83	6.48	7.06	7.60	8.13	8.63	4.24	4.91	5.58
300	5	2.84	3.50	4.08	4.61	5.13	5.63	6.12	2.69	3.33	3.96
300	10	3.03	3.71	4.30	4.84	5.36	5.87	6.36	2.86	3.50	4.13
300	15	3.24	3.94	4.54	5.09	5.61	6.12	6.62	3.04	3.68	4.31
300	20	3.47	4.18	4.79	5.35	5.88	6.39	6.89	3.22	3.86	4.49
300	25	3.72	4.45	5.07	5.64	6.17	6.68	7.19	3.42	4.06	4.70
300	30	3.99	4.74	5.38	5.95	6.49	7.01	7.51	3.63	4.27	4.90
300	35	4.30	5.07	5.71	6.29	6.84	7.36	7.87	3.85	4.49	5.12
300	40	4.65	5.43	6.08	6.67	7.22	7.75	8.26	4.10	4.74	5.37
400	5	2.89	3.57	4.16	4.70	5.22	5.72	6.22	2.78	3.42	4.05
400	10	3.08	3.77	4.37	4.92	5.44	5.95	6.45	2.95	3.59	4.22
400	15	3.27	3.98	4.59	5.15	5.68	6.19	6.69	3.11	3.75	4.38
400	20	3.47	4.20	4.82	5.39	5.92	6.44	6.94	3.29	3.93	4.56
400	25	3.70	4.44	5.08	5.65	6.19	6.70	7.21	3.47	4.11	4.74
400	30	3.94	4.71	5.35	5.93	6.47	6.99	7.50	3.67	4.31	4.94
400	35	4.21	4.99	5.64	6.23	6.78	7.31	7.82	3.87	4.51	5.14
400	40	4.50	5.30	5.97	6.56	7.11	7.64	8.16	4.09	4.73	5.36
500	5	2.98	3.67	4.27	4.82	5.34	5.85	6.34	2.89	3.53	4.16
500	10	3.15	3.87	4.47	5.03	5.56	6.07	6.57	3.05	3.69	4.32
500	15	3.34	4.07	4.68	5.25	5.78	6.30	6.80	3.21	3.85	4.48
500	20	3.53	4.28	4.91	5.48	6.02	6.53	7.04	3.38	4.02	4.65
500	25	3.74	4.50	5.14	5.72	6.26	6.79	7.29	3.56	4.20	4.83
500	30	3.96	4.74	5.39	5.98	6.53	7.05	7.56	3.74	4.38	4.99
500	35	4.20	5.00	5.67	6.26	6.81	7.34	7.85	3.93	4.57	5.20
500	40	4.47	5.28	5.96	6.56	7.12	7.65	8.16	4.14	4.78	5.41
600	5	3.08	3.79	4.40	4.95	5.48	5.99	6.49	3.01	3.65	4.28
600	10	3.25	3.98	4.59	5.16	5.69	6.20	6.71	3.16	3.80	4.43
600	15	3.43	4.17	4.80	5.37	5.91	6.43	6.93	3.32	3.96	4.58
600	20	3.61	4.37	5.01	5.59	6.13	6.66	7.16	3.49	4.13	4.73
600	25	3.81	4.59	5.24	5.82	6.37	6.90	7.41	3.66	4.30	4.91
600	30	4.02	4.82	5.48	6.07	6.62	7.15	7.66	3.83	4.47	5.08
600	35	4.24	5.06	5.73	6.33	6.89	7.42	7.94	4.02	4.66	5.29
600	40	4.49	5.32	6.00	6.61	7.17	7.71	8.23	4.21	4.85	5.48

COMPUTER PROGRAM

```

DIMENSION      (T(48),CPMBF(20))
13 CONTINUE
  J=0
  READ 1,(T(I),I=1,12)
  1  FORMAT (12A4)
  2  FORMAT (1H1,12A4)
  READ 5,K,RC,SC,DC,XLC,COST,DELAY
  5  FORMAT (I10,4F8.6,2F5.2)
  IF(K-1) 3,4,4
  3  GO TO 50
  4  CONTINUE
  READ 10,L,M,N,XXGPC,XETUP,CLC
10  FORMAT (9F8.2)
20  DO 30 II= 5,60,5  MBFPA=II
  PRINT 2,(T(I),I=1,12)
  PUNCH 8,(T(I),I=1,12)
  8  FORMAT (12A4,20X,2H *)
  PRINT 40, MBFPA
40  FORMAT (/F10.0,29H THOUSAND BOARD FEET PER ACRE)
  PUNCH 6, MBFPA
  6  FORMAT (F10.0,29H THOUSAND BOARD FEET PER ACRE,29X,2H 1)
  PRINT 41
41  FORMAT(//5X,48H DIST      SLOPE      LOGS PER THOUSAND BOARD FEET)
  PUNCH 9
  9  FORMAT( 5X,48H DIST      SLOPE      LOGS PER THOUSAND BOARD FEET,
115X,2H 2)
  PRINT 42
42  FORMAT (25X,43H 4      6      8      10      12      14      16      //)
  PUNCH 7
  7  FORMAT (25X,45H 4      6      8      10      12      14      16      2)
  DO 30 IXX=L,M,N
  DIST=IXX
  RDLG=20000./DIST
  SETUP=XETUP/DIST
  PRINT 51
51  FORMAT(/)
  PUNCH 21
21  FORMAT(68X,2H 1)
  DO 30 IXXX= 5,40, 5
  SLOPE=IXXX
  XLGPC=XXGPC
  DO 35 IX=4,16,2
  LGPMBF=IX
  XLGPC=XLGPC+CLC
  IF (XLGPC-16.) 26,26,25
25  XLGPC=16.
26  CONTINUE
  J=J+1
  XGPMBF=LGPMBF
  XBFPA=MBFPA
35  CPMBF(J)= ((XGPMBF*XBFP*(RC+(SC*SLOPE)+(DC*DIST)+XLC*XLGPC))
1*(1.+DELAY)/
2XLGPC+SETUP)*COST+RDLG*(13.58/((.185*SLOPE**2)-(21.155*SLOPE)
3+715.045)))/XBFP
  PRINT 32, DIST,SLOPE,(CPMBF(JJ),JJ=1,J)
  PUNCH 32, DIST,SLOPE,(CPMBF(JJ),JJ=1,J)
32  FORMAT(F10.0,F7.0,6X,7F6.2)
  J=0
30  CONTINUE
  GO TO 13
50  CALL EXIT
  END

```

Distance (feet)	Slope (percent)	5 THOUSAND BOARD FEET PER ACRE							10 THOUSAND BOARD FEET PER ACRE							15 THOUSAND BOARD FEET PER ACRE						
		Logs/M bd.ft.							Logs/M bd.ft.							Logs/M bd.ft.						
		4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16
Dollars/M bd.ft.																						
200	5	2.99	3.62	4.17	4.67	5.14	5.61	6.06	2.77	3.40	3.95	4.45	4.92	5.38	5.83	2.70	3.33	3.87	4.37	4.85	5.31	5.76
200	10	3.27	3.92	4.48	4.99	5.47	5.94	6.39	3.01	3.66	4.22	4.73	5.21	5.68	6.13	2.92	3.57	4.13	4.64	5.12	5.59	6.04
200	15	3.56	4.24	4.81	5.33	5.82	6.29	6.75	3.25	3.93	4.50	5.02	5.51	5.98	6.44	3.15	3.82	4.40	4.92	5.41	5.88	6.34
200	20	3.88	4.58	5.17	5.70	6.19	6.67	7.13	3.50	4.21	4.79	5.32	5.82	6.30	6.76	3.38	4.08	4.67	5.20	5.70	6.17	6.64
200	25	4.23	4.95	5.56	6.10	6.60	7.08	7.55	3.78	4.50	5.11	5.65	6.15	6.63	7.10	3.63	4.35	4.96	5.50	6.00	6.48	6.95
200	30	4.62	5.37	5.99	6.54	7.05	7.53	8.00	4.07	4.82	5.44	5.99	6.50	6.98	7.45	3.89	4.64	5.26	5.80	6.31	6.80	7.27
200	35	5.06	5.84	6.47	7.03	7.55	8.04	8.51	4.39	5.16	5.80	6.35	6.87	7.36	7.84	4.16	4.94	5.57	6.13	6.65	7.14	7.61
200	40	5.56	6.36	7.00	7.57	8.09	8.59	9.07	4.73	5.53	6.18	6.75	7.27	7.77	8.25	4.46	5.26	5.90	6.47	7.00	7.49	7.97
Dollars/M bd.ft.																						
300	5	3.20	3.88	4.45	4.97	5.46	5.93	6.39	3.06	3.73	4.30	4.82	5.31	5.78	6.24	3.01	3.68	4.25	4.77	5.26	5.73	6.19
300	10	3.45	4.15	4.74	5.26	5.76	6.23	6.70	3.28	3.98	4.56	5.09	5.59	6.06	6.52	3.22	3.92	4.50	5.03	5.53	6.00	6.46
300	15	3.71	4.43	5.03	5.57	6.07	6.55	7.02	3.50	4.23	4.83	5.36	5.87	6.35	6.81	3.43	4.16	4.76	5.30	5.80	6.28	6.74
300	20	3.99	4.73	5.35	5.90	6.41	6.89	7.36	3.74	4.49	5.10	5.65	6.16	6.64	7.11	3.66	4.40	5.02	5.57	6.08	6.56	7.03
300	25	4.29	5.06	5.69	6.24	6.76	7.25	7.72	3.99	4.76	5.39	5.94	6.46	6.95	7.42	3.89	4.66	5.29	5.84	6.36	6.85	7.32
300	30	4.61	5.41	6.05	6.62	7.14	7.64	8.12	4.25	5.04	5.69	6.25	6.78	7.27	7.75	4.12	4.92	5.56	6.13	6.65	7.15	7.63
300	35	4.97	5.79	6.45	7.03	7.56	8.06	8.54	4.52	5.34	6.00	6.58	7.11	7.61	8.00	4.37	5.19	5.85	6.43	6.96	7.46	7.94
300	40	5.36	6.21	6.88	7.47	8.01	8.51	9.00	4.82	5.66	6.33	6.92	7.46	7.96	8.45	4.63	5.48	6.15	6.74	7.27	7.78	8.27
Dollars/M bd.ft.																						
400	5	3.49	4.21	4.81	5.34	5.84	6.32	6.79	3.38	4.10	4.70	5.23	5.73	6.21	6.68	3.34	4.06	4.66	5.20	5.70	6.18	6.64
400	10	3.72	4.47	5.08	5.62	6.13	6.62	7.09	3.59	4.34	4.95	5.49	6.00	6.49	6.96	3.55	4.29	4.90	5.45	5.96	6.44	6.91
400	15	3.96	4.73	5.36	5.92	6.43	6.92	7.39	3.81	4.58	5.21	5.76	6.28	6.77	7.24	3.76	4.53	5.15	5.71	6.22	6.71	7.19
400	20	4.22	5.01	5.65	6.22	6.74	7.24	7.71	4.04	4.83	5.47	6.03	6.56	7.05	7.53	3.97	4.77	5.41	5.97	6.49	6.99	7.47
400	25	4.49	5.31	5.97	6.54	7.07	7.57	8.05	4.27	5.09	5.74	6.32	6.85	7.35	7.83	4.19	5.01	5.67	6.24	6.77	7.27	7.75
400	30	4.79	5.63	6.30	6.88	7.42	7.92	8.41	4.51	5.35	6.02	6.61	7.14	7.65	8.14	4.42	5.26	5.93	6.52	7.05	7.56	8.04
400	35	5.11	5.97	6.66	7.25	7.79	8.30	8.79	4.77	5.63	6.32	6.91	7.46	7.97	8.46	4.66	5.52	6.21	6.80	7.34	7.85	8.34
400	40	5.45	6.34	7.04	7.64	8.19	8.71	9.20	5.04	5.93	6.63	7.23	7.78	8.30	8.79	4.90	5.79	6.49	7.09	7.64	8.16	8.65
Dollars/M bd.ft.																						
500	5	3.80	4.57	5.19	5.75	6.26	6.75	7.22	3.71	4.48	5.10	5.66	6.17	6.66	7.13	3.69	4.45	5.07	5.63	6.14	6.63	7.10
500	10	4.03	4.82	5.46	6.02	6.54	7.04	7.51	3.92	4.71	5.35	5.92	6.44	6.93	7.41	3.89	4.68	5.32	5.88	6.40	6.90	7.37
500	15	4.26	5.07	5.73	6.30	6.83	7.33	7.81	4.14	4.95	5.60	6.18	6.71	7.21	7.69	4.10	4.91	5.56	6.14	6.66	7.16	7.65
500	20	4.50	5.34	6.01	6.59	7.13	7.63	8.12	4.36	5.19	5.86	6.44	6.98	7.48	7.97	4.31	5.14	5.81	6.40	6.93	7.44	7.92
500	25	4.76	5.62	6.31	6.90	7.44	7.95	8.44	4.58	5.44	6.13	6.72	7.26	7.77	8.26	4.52	5.38	6.07	6.66	7.20	7.71	8.20
500	30	5.04	5.92	6.62	7.22	7.77	8.29	8.78	4.82	5.70	6.40	7.00	7.55	8.07	8.56	4.74	5.63	6.32	6.93	7.48	7.99	8.48
500	35	5.33	6.24	6.95	7.56	8.12	8.64	9.14	5.06	5.97	6.68	7.29	7.85	8.37	8.87	4.97	5.88	6.59	7.20	7.76	8.28	8.78
500	40	5.64	6.58	7.30	7.92	8.49	9.04	9.51	5.31	6.25	6.97	7.59	8.16	8.68	9.18	5.20	6.14	6.86	7.49	8.05	8.57	9.07
Dollars/M bd.ft.																						
600	5	4.13	4.94	5.59	6.16	6.69	7.19	7.67	4.06	4.87	5.52	6.09	6.62	7.12	7.60	4.03	4.84	5.49	6.07	6.59	7.09	7.57
600	10	4.35	5.19	5.85	6.43	6.97	7.47	7.96	4.27	5.10	5.76	6.35	6.88	7.38	7.87	4.24	5.07	5.74	6.32	6.85	7.36	7.84
600	15	4.58	5.44	6.12	6.71	7.25	7.76	8.25	4.48	5.33	6.01	6.61	7.15	7.66	8.14	4.44	5.30	5.98	6.57	7.11	7.62	8.11
600	20	4.81	5.70	6.39	6.99	7.54	8.05	8.55	4.69	5.57	6.27	6.87	7.42	7.93	8.42	4.65	5.53	6.23	6.83	7.37	7.89	8.38
600	25	5.06	5.97	6.68	7.29	7.84	8.36	8.86	4.91	5.82	6.53	7.14	7.69	8.21	8.71	4.86	5.77	6.48	7.09	7.64	8.16	8.66
600	30	5.32	6.25	6.97	7.60	8.16	8.68	9.18	5.14	6.07	6.79	7.41	7.97	8.50	9.00	5.08	6.01	6.73	7.35	7.91	8.44	8.94
600	35	5.60	6.55	7.29	7.92	8.49	9.02	9.52	5.37	6.33	7.07	7.70	8.26	8.79	9.30	5.30	6.25	6.99	7.62	8.19	8.72	9.22
600	40	5.89	6.87	7.62	8.26	8.84	9.37	9.88	5.62	6.59	7.35	7.99	8.56	9.10	9.61	5.52	6.50	7.26	7.90	8.47	9.01	9.52

and densities commonly found in Montana, Idaho, and northwestern Wyoming

10 THOUSAND BOARD FEET PER ACRE						15 THOUSAND BOARD FEET PER ACRE						
Logs/M bd.ft.						Logs/M bd.ft.						
3	8	10	12	14	16	4	6	8	10	12	14	16
<i>Dollars/M bd.ft.</i>						<i>Dollars/M bd.ft.</i>						
28	3.85	4.38	4.89	5.38	5.87	2.56	3.20	3.77	4.30	4.81	5.31	5.79
48	4.06	4.60	5.11	5.61	6.10	2.73	3.39	3.97	4.51	5.02	5.52	6.01
69	4.28	4.82	5.34	5.85	6.34	2.91	3.59	4.18	4.72	5.24	5.74	6.24
91	4.51	5.06	5.59	6.10	6.59	3.09	3.79	4.39	4.94	5.47	5.97	6.47
15	4.76	5.32	5.85	6.36	6.86	3.29	4.00	4.61	5.17	5.70	6.21	6.71
41	5.04	5.60	6.14	6.65	7.15	3.50	4.23	4.85	5.42	5.95	6.47	6.97
70	5.33	5.91	6.45	6.96	7.47	3.72	4.47	5.11	5.68	6.22	6.74	7.24
91	5.65	6.23	6.78	7.30	7.81	3.97	4.74	5.38	5.96	6.50	7.03	7.53
35	3.93	4.47	4.98	5.48	5.97	2.64	3.30	3.88	4.42	4.93	5.43	5.92
54	4.13	4.67	5.19	5.69	6.19	2.80	3.48	4.07	4.61	5.13	5.64	6.13
73	4.33	4.88	5.41	5.91	6.41	2.97	3.66	4.26	4.81	5.34	5.85	6.34
93	4.54	5.10	5.63	6.14	6.64	3.14	3.85	4.46	5.02	5.55	6.06	6.56
15	4.77	5.34	5.87	6.38	6.89	3.32	4.05	4.67	5.24	5.77	6.28	6.79
38	5.01	5.58	6.12	6.64	7.14	3.50	4.25	4.89	5.46	6.00	6.52	7.02
62	5.26	5.84	6.39	6.91	7.42	3.70	4.47	5.11	5.69	6.24	6.76	7.27
38	5.54	6.12	6.67	7.20	7.71	3.91	4.70	5.35	5.94	6.49	7.01	7.53
46	4.05	4.59	5.11	5.61	6.10	2.75	3.42	4.01	4.55	5.07	5.58	6.07
64	4.24	4.79	5.31	5.82	6.32	2.90	3.60	4.20	4.75	5.27	5.78	6.27
83	4.44	4.99	5.52	6.03	6.53	3.06	3.78	4.38	4.94	5.47	5.98	6.48
02	4.64	5.20	5.74	6.25	6.75	3.23	3.96	4.58	5.14	5.68	6.19	6.69
22	4.85	5.42	5.96	6.48	6.98	3.40	4.14	4.78	5.35	5.89	6.40	6.91
43	5.07	5.65	6.20	6.72	7.22	3.57	4.34	4.98	5.56	6.10	6.63	7.13
65	5.31	5.89	6.44	6.97	7.48	3.76	4.54	5.19	5.78	6.33	6.86	7.37
89	5.55	6.15	6.70	7.23	7.74	3.95	4.75	5.42	6.01	6.56	7.09	7.61
58	4.18	4.73	5.25	5.76	6.26	2.86	3.55	4.15	4.70	5.23	5.73	6.23
76	4.37	4.93	5.45	5.96	6.46	3.02	3.73	4.33	4.89	5.42	5.93	6.43
94	4.56	5.13	5.66	6.17	6.67	3.17	3.90	4.52	5.08	5.62	6.13	6.63
13	4.76	5.33	5.87	6.39	6.89	3.33	4.08	4.71	5.28	5.82	6.34	6.84
32	4.96	5.54	6.08	6.61	7.11	3.50	4.26	4.90	5.48	6.02	6.55	7.05
52	5.17	5.76	6.31	6.83	7.34	3.67	4.45	5.10	5.69	6.23	6.76	7.27
73	5.40	5.99	6.54	7.07	7.58	3.84	4.64	5.31	5.90	6.45	6.98	7.49
95	5.63	6.23	6.79	7.32	7.84	4.03	4.84	5.52	6.12	6.68	7.21	7.73
72	4.32	4.88	5.41	5.92	6.41	2.98	3.69	4.30	4.86	5.38	5.89	6.39
89	4.51	5.07	5.60	6.12	6.62	3.13	3.86	4.48	5.04	5.58	6.09	6.59
07	4.70	5.27	5.81	6.32	6.83	3.29	4.03	4.66	5.23	5.77	6.29	6.79
25	4.89	5.47	6.01	6.53	7.04	3.45	4.21	4.85	5.43	5.97	6.49	7.00
44	5.09	5.67	6.22	6.75	7.26	3.61	4.39	5.04	5.62	6.17	6.70	7.21
63	5.29	5.89	6.44	6.97	7.48	3.77	4.57	5.23	5.82	6.38	6.91	7.42
83	5.51	6.11	6.66	7.20	7.71	3.94	4.76	5.43	6.03	6.59	7.12	7.64
05	5.73	6.34	6.90	7.44	7.95	4.12	4.95	5.64	6.24	6.81	7.34	7.86

Table 4.--Operating costs using 110-130 DBHP crawler tractors for three differen

Distance (feet)	Slope (percent)	5 THOUSAND BOARD FEET PER ACRE								
		Logs/M bd.ft.								
		4	6	8	10	12	14	16	4	6
Dollars/M bd.ft.										
200	5	2.39	2.97	3.81	4.66	5.50	6.34	7.19	2.17	2.7
200	10	2.50	3.08	3.94	4.80	5.65	6.51	7.36	2.24	2.8
200	15	2.63	3.22	4.09	4.96	5.82	6.69	7.56	2.32	2.9
200	20	2.79	3.38	4.26	5.14	6.02	6.90	7.78	2.41	3.0
200	25	2.98	3.58	4.47	5.36	6.26	7.15	8.04	2.53	3.1
200	30	3.21	3.81	4.72	5.62	6.53	7.44	8.34	2.66	3.2
200	35	3.49	4.10	5.02	5.94	6.85	7.77	8.69	2.82	3.4
200	40	3.82	4.43	5.37	6.30	7.23	8.16	9.09	3.00	3.6
300	5	2.48	3.09	4.02	4.96	5.89	6.82	7.76	2.33	2.9
300	10	2.56	3.18	4.12	5.07	6.02	6.96	7.91	2.39	3.0
300	15	2.66	3.28	4.24	5.20	6.16	7.11	8.07	2.46	3.1
300	20	2.78	3.40	4.37	5.34	6.31	7.28	8.25	2.53	3.2
300	25	2.92	3.54	4.53	5.51	6.49	7.48	8.46	2.62	3.3
300	30	3.08	3.71	4.71	5.71	6.70	7.70	8.69	2.72	3.4
300	35	3.28	3.92	4.93	5.93	6.94	7.95	8.96	2.83	3.6
300	40	3.51	4.15	5.17	6.19	7.22	8.24	9.26	2.96	3.8
400	5	2.64	3.28	4.31	5.33	6.35	7.38	8.40	2.53	3.1
400	10	2.72	3.36	4.40	5.43	6.47	7.50	8.54	2.59	3.2
400	15	2.80	3.45	4.49	5.54	6.59	7.64	8.69	2.64	3.3
400	20	2.89	3.55	4.61	5.67	6.73	7.79	8.85	2.71	3.4
400	25	3.00	3.66	4.74	5.81	6.88	7.95	9.03	2.78	3.5
400	30	3.14	3.80	4.89	5.97	7.06	8.14	9.23	2.86	3.6
400	35	3.30	3.96	5.06	6.16	7.25	8.35	9.45	2.96	3.8
400	40	3.48	4.15	5.26	6.37	7.48	8.59	9.70	3.07	4.0
500	5	2.84	3.51	4.62	5.73	6.85	7.96	9.07	2.75	3.4
500	10	2.90	3.58	4.70	5.83	6.95	8.08	9.20	2.80	3.5
500	15	2.97	3.65	4.79	5.93	7.07	8.20	9.34	2.85	3.6
500	20	3.06	3.74	4.89	6.04	7.19	8.34	9.49	2.91	3.7
500	25	3.15	3.84	5.00	6.17	7.33	8.49	9.65	2.97	3.8
500	30	3.27	3.96	5.13	6.31	7.48	8.66	9.83	3.05	3.9
500	35	3.40	4.10	5.28	6.47	7.66	8.84	10.03	3.13	4.0
500	40	3.55	4.25	5.45	6.65	7.85	9.05	10.25	3.22	4.2
600	5	3.05	3.75	4.95	6.15	7.36	8.56	9.76	2.97	3.6
600	10	3.11	3.81	5.03	6.24	7.46	8.67	9.88	3.02	3.7
600	15	3.17	3.88	5.11	6.34	7.56	8.79	10.02	3.07	3.7
600	20	3.25	3.96	5.20	6.44	7.68	8.92	10.16	3.12	3.8
600	25	3.33	4.05	5.30	6.55	7.81	9.06	10.31	3.18	3.9
600	30	3.43	4.15	5.42	6.68	7.95	9.21	10.48	3.25	3.9
600	35	3.55	4.28	5.55	6.83	8.11	9.38	10.66	3.32	4.0
600	40	3.68	4.41	5.70	6.99	8.28	9.57	10.86	3.41	4.1

Table 2.--Operating costs using 41-60 DBHP crawler tractors for three different stand densities commonly found in Montana, Idaho, and northwestern Wyoming

Distance (feet)	Slope (percent)	5 THOUSAND BOARD FEET PER ACRE							10 THOUSAND BOARD FEET PER ACRE							15 THOUSAND BOARD FEET PER ACRE						
		Logs/M bd.ft.							Logs/M bd.ft.							Logs/M bd.ft.						
		4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16
Dollars/M bd.ft.																						
200	5	2.86	3.50	4.07	4.60	5.11	5.60	6.09	2.63	3.28	3.85	4.38	4.89	5.38	5.87	2.56	3.20	3.77	4.30	4.81	5.31	5.79
200	10	3.08	3.74	4.32	4.86	5.37	5.87	6.36	2.82	3.48	4.06	4.60	5.11	5.61	6.10	2.73	3.39	3.97	4.51	5.02	5.52	6.01
200	15	3.32	4.00	4.59	5.13	5.65	6.16	6.65	3.01	3.69	4.28	4.82	5.34	5.85	6.34	2.91	3.59	4.18	4.72	5.24	5.74	6.24
200	20	3.59	4.28	4.88	5.44	5.96	6.47	6.96	3.21	3.91	4.51	5.06	5.59	6.10	6.59	3.09	3.79	4.39	4.94	5.47	5.97	6.47
200	25	3.89	4.60	5.21	5.77	6.30	6.81	7.31	3.44	4.15	4.76	5.32	5.85	6.36	6.86	3.29	4.00	4.61	5.17	5.70	6.21	6.71
200	30	4.23	4.96	5.59	6.15	6.69	7.20	7.70	3.68	4.41	5.04	5.60	6.14	6.65	7.15	3.50	4.23	4.85	5.42	5.95	6.47	6.97
200	35	4.62	5.37	6.01	6.58	7.12	7.64	8.14	3.95	4.70	5.33	5.91	6.45	6.96	7.47	3.72	4.47	5.11	5.68	6.22	6.74	7.24
200	40	5.06	5.83	6.48	7.06	7.60	8.13	8.63	4.24	5.01	5.65	6.23	6.78	7.30	7.81	3.97	4.74	5.38	5.96	6.50	7.03	7.53
300	5	2.84	3.50	4.08	4.61	5.13	5.63	6.12	2.69	3.35	3.93	4.47	4.98	5.48	5.97	2.64	3.30	3.88	4.42	4.93	5.43	5.92
300	10	3.03	3.71	4.30	4.84	5.36	5.87	6.36	2.86	3.54	4.13	4.67	5.19	5.69	6.19	2.80	3.48	4.07	4.61	5.13	5.64	6.13
300	15	3.24	3.94	4.54	5.09	5.61	6.12	6.62	3.04	3.73	4.33	4.88	5.41	5.91	6.41	2.97	3.66	4.26	4.81	5.34	5.85	6.34
300	20	3.47	4.18	4.79	5.35	5.88	6.39	6.89	3.22	3.93	4.54	5.10	5.63	6.14	6.64	3.14	3.85	4.46	5.02	5.55	6.06	6.56
300	25	3.72	4.45	5.07	5.64	6.17	6.68	7.19	3.42	4.15	4.77	5.34	5.87	6.38	6.89	3.32	4.05	4.67	5.24	5.77	6.28	6.79
300	30	3.99	4.74	5.38	5.95	6.49	7.01	7.51	3.63	4.38	5.01	5.58	6.12	6.64	7.14	3.50	4.25	4.89	5.46	6.00	6.52	7.02
300	35	4.30	5.07	5.71	6.29	6.84	7.36	7.87	3.85	4.62	5.26	5.84	6.39	6.91	7.42	3.70	4.47	5.11	5.69	6.24	6.76	7.27
300	40	4.65	5.43	6.08	6.67	7.22	7.75	8.26	4.10	4.88	5.54	6.12	6.67	7.20	7.71	3.91	4.70	5.35	5.94	6.49	7.01	7.53
400	5	2.89	3.57	4.16	4.70	5.22	5.72	6.22	2.78	3.46	4.05	4.59	5.11	5.61	6.10	2.75	3.42	4.01	4.55	5.07	5.58	6.07
400	10	3.08	3.77	4.37	4.92	5.44	5.95	6.45	2.95	3.64	4.24	4.79	5.31	5.82	6.32	2.90	3.60	4.20	4.75	5.27	5.78	6.27
400	15	3.27	3.98	4.59	5.15	5.68	6.19	6.69	3.11	3.83	4.44	4.99	5.52	6.03	6.53	3.06	3.78	4.38	4.94	5.47	5.98	6.48
400	20	3.47	4.20	4.82	5.39	5.92	6.44	6.94	3.29	4.02	4.64	5.20	5.74	6.25	6.75	3.23	3.96	4.58	5.14	5.68	6.19	6.69
400	25	3.70	4.44	5.08	5.65	6.19	6.70	7.21	3.47	4.22	4.85	5.42	5.96	6.48	6.98	3.40	4.14	4.78	5.35	5.89	6.40	6.91
400	30	3.94	4.71	5.35	5.93	6.47	6.99	7.50	3.67	4.43	5.07	5.65	6.20	6.72	7.22	3.57	4.34	4.98	5.56	6.10	6.63	7.13
400	35	4.21	4.99	5.64	6.23	6.78	7.31	7.82	3.87	4.65	5.31	5.89	6.44	6.97	7.48	3.76	4.54	5.19	5.78	6.33	6.86	7.37
400	40	4.50	5.30	5.97	6.56	7.11	7.64	8.16	4.09	4.89	5.55	6.15	6.70	7.23	7.74	3.95	4.75	5.42	6.01	6.56	7.09	7.61
500	5	2.98	3.67	4.27	4.82	5.34	5.85	6.34	2.89	3.58	4.18	4.73	5.25	5.76	6.26	2.86	3.55	4.15	4.70	5.23	5.73	6.23
500	10	3.15	3.87	4.47	5.03	5.56	6.07	6.57	3.05	3.76	4.37	4.93	5.45	5.96	6.46	3.02	3.73	4.33	4.89	5.42	5.93	6.43
500	15	3.34	4.07	4.68	5.25	5.78	6.30	6.80	3.21	3.94	4.56	5.13	5.66	6.17	6.67	3.17	3.90	4.52	5.08	5.62	6.13	6.63
500	20	3.53	4.28	4.91	5.48	6.02	6.53	7.04	3.38	4.13	4.76	5.33	5.87	6.39	6.89	3.33	4.08	4.71	5.28	5.82	6.34	6.84
500	25	3.74	4.50	5.14	5.72	6.26	6.79	7.29	3.56	4.32	4.96	5.54	6.08	6.61	7.11	3.50	4.26	4.90	5.48	6.02	6.55	7.05
500	30	3.96	4.74	5.39	5.98	6.53	7.05	7.56	3.74	4.52	5.17	5.76	6.31	6.83	7.34	3.67	4.45	5.10	5.69	6.23	6.76	7.27
500	35	4.20	5.00	5.67	6.26	6.81	7.34	7.85	3.93	4.73	5.40	5.99	6.54	7.07	7.58	3.84	4.64	5.31	5.90	6.45	6.98	7.49
500	40	4.47	5.28	5.96	6.56	7.12	7.65	8.16	4.14	4.95	5.63	6.23	6.79	7.32	7.84	4.03	4.84	5.52	6.12	6.68	7.21	7.73
600	5	3.08	3.79	4.40	4.95	5.48	5.99	6.49	3.01	3.72	4.32	4.88	5.41	5.92	6.41	2.98	3.69	4.30	4.86	5.38	5.89	6.39
600	10	3.25	3.98	4.59	5.16	5.69	6.20	6.71	3.16	3.89	4.51	5.07	5.60	6.12	6.62	3.13	3.86	4.48	5.04	5.58	6.09	6.59
600	15	3.43	4.17	4.80	5.37	5.91	6.43	6.93	3.32	4.07	4.70	5.27	5.81	6.32	6.83	3.29	4.03	4.66	5.23	5.77	6.29	6.79
600	20	3.61	4.37	5.01	5.59	6.13	6.66	7.16	3.49	4.25	4.89	5.47	6.01	6.53	7.04	3.45	4.21	4.85	5.43	5.97	6.49	7.00
600	25	3.81	4.59	5.24	5.82	6.37	6.90	7.41	3.66	4.44	5.09	5.67	6.22	6.75	7.26	3.61	4.39	5.04	5.62	6.17	6.70	7.21
600	30	4.02	4.82	5.48	6.07	6.62	7.15	7.66	3.83	4.63	5.29	5.89	6.44	6.97	7.48	3.77	4.57	5.23	5.82	6.38	6.91	7.42
600	35	4.24	5.06	5.73	6.33	6.89	7.42	7.94	4.02	4.83	5.51	6.11	6.66	7.20	7.71	3.94	4.76	5.43	6.03	6.59	7.12	7.64
600	40	4.49	5.32	6.00	6.61	7.17	7.71	8.23	4.21	5.05	5.73	6.34	6.90	7.44	7.95	4.12	4.95	5.64	6.24	6.81	7.34	7.86

Table 3.--Operating costs using 61-80 DBHP crawler tractors for three different stand densities commonly found in Montana, Idaho, and northwestern Wyoming

Distance (feet)	Slope (percent)	5 THOUSAND BOARD FEET PER ACRE							10 THOUSAND BOARD FEET PER ACRE							15 THOUSAND BOARD FEET PER ACRE						
		Logs/M bd.ft.							Logs/M bd.ft.							Logs/M bd.ft.						
		4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16
Dollars/M bd.ft.																						
200	5	2.44	2.93	3.34	3.73	4.09	4.44	4.80	2.22	2.71	3.12	3.51	3.87	4.22	4.58	2.15	2.63	3.05	3.43	3.79	4.14	4.51
200	10	2.43	2.90	3.31	3.69	4.05	4.40	4.76	2.17	2.64	3.05	3.43	3.79	4.14	4.50	2.08	2.55	2.96	3.34	3.70	4.05	4.41
200	15	2.43	2.90	3.30	3.67	4.03	4.37	4.73	2.12	2.59	2.99	3.36	3.72	4.06	4.42	2.02	2.48	2.89	3.26	3.61	3.96	4.32
200	20	2.46	2.91	3.31	3.68	4.03	4.37	4.73	2.09	2.54	2.94	3.31	3.66	4.00	4.36	1.97	2.42	2.82	3.18	3.54	3.88	4.23
200	25	2.53	2.97	3.36	3.72	4.07	4.41	4.76	2.08	2.52	2.91	3.27	3.62	3.96	4.31	1.93	2.37	2.76	3.12	3.47	3.81	4.16
200	30	2.64	3.06	3.45	3.80	4.15	4.49	4.84	2.09	2.51	2.90	3.25	3.60	3.94	4.29	1.90	2.33	2.71	3.07	3.42	3.75	4.10
200	35	2.79	3.21	3.58	3.94	4.28	4.62	4.96	2.12	2.53	2.91	3.26	3.61	3.94	4.29	1.89	2.31	2.68	3.04	3.38	3.72	4.06
200	40	3.00	3.40	3.77	4.12	4.46	4.79	5.13	2.17	2.58	2.95	3.30	3.64	3.97	4.31	1.90	2.30	2.67	3.02	3.36	3.69	4.03
Dollars/M bd.ft.																						
300	5	2.55	3.06	3.50	3.89	4.26	4.62	5.00	2.40	2.91	3.35	3.74	4.12	4.47	4.85	2.35	2.87	3.30	3.70	4.07	4.42	4.80
300	10	2.50	3.01	3.44	3.83	4.20	4.55	4.92	2.33	2.84	3.26	3.65	4.02	4.38	4.75	2.27	2.78	3.21	3.60	3.97	4.32	4.69
300	15	2.48	2.97	3.39	3.78	4.14	4.49	4.86	2.27	2.76	3.19	3.57	3.94	4.29	4.66	2.20	2.70	3.12	3.50	3.87	4.22	4.59
300	20	2.47	2.95	3.36	3.74	4.11	4.46	4.82	2.22	2.70	3.12	3.50	3.86	4.21	4.57	2.14	2.62	3.03	3.41	3.78	4.13	4.49
300	25	2.48	2.95	3.36	3.73	4.09	4.44	4.80	2.18	2.65	3.06	3.43	3.79	4.14	4.50	2.08	2.55	2.96	3.33	3.69	4.04	4.40
300	30	2.52	2.98	3.38	3.75	4.11	4.45	4.81	2.15	2.61	3.01	3.38	3.74	4.08	4.44	2.03	2.49	2.89	3.26	3.62	3.96	4.32
300	35	2.59	3.04	3.43	3.80	4.15	4.49	4.85	2.14	2.59	2.98	3.35	3.70	4.04	4.40	1.99	2.44	2.83	3.20	3.55	3.89	4.25
300	40	2.70	3.13	3.52	3.88	4.23	4.57	4.92	2.15	2.59	2.97	3.33	3.68	4.02	4.37	1.97	2.40	2.79	3.15	3.50	3.84	4.19
Dollars/M bd.ft.																						
400	5	2.72	3.27	3.72	4.13	4.51	4.88	5.26	2.61	3.16	3.61	4.02	4.40	4.76	5.15	2.57	3.12	3.58	3.98	4.36	4.73	5.11
400	10	2.67	3.20	3.65	4.05	4.43	4.79	5.17	2.54	3.07	3.52	3.92	4.30	4.66	5.04	2.49	3.03	3.48	3.88	4.26	4.62	5.00
400	15	2.62	3.15	3.59	3.99	4.36	4.72	5.10	2.47	2.99	3.43	3.83	4.21	4.57	4.94	2.42	2.94	3.38	3.78	4.15	4.51	4.89
400	20	2.59	3.11	3.54	3.93	4.30	4.66	5.03	2.41	2.92	3.35	3.75	4.12	4.47	4.85	2.35	2.86	3.29	3.69	4.06	4.41	4.79
400	25	2.58	3.08	3.51	3.90	4.26	4.62	4.99	2.35	2.86	3.28	3.67	4.04	4.39	4.76	2.28	2.78	3.21	3.60	3.96	4.32	4.69
400	30	2.59	3.08	3.50	3.88	4.24	4.60	4.96	2.31	2.80	3.22	3.60	3.97	4.32	4.69	2.22	2.71	3.13	3.51	3.88	4.23	4.59
400	35	2.62	3.10	3.51	3.89	4.25	4.60	4.96	2.28	2.76	3.17	3.55	3.91	4.26	4.62	2.17	2.65	3.06	3.44	3.80	4.15	4.51
400	40	2.67	3.14	3.55	3.92	4.28	4.63	4.98	2.26	2.73	3.14	3.51	3.87	4.21	4.57	2.13	2.59	3.00	3.37	3.73	4.08	4.44
Dollars/M bd.ft.																						
500	5	2.93	3.51	3.98	4.40	4.79	5.16	5.55	2.84	3.42	3.89	4.31	4.70	5.07	5.46	2.81	3.39	3.86	4.28	4.67	5.04	5.43
500	10	2.87	3.43	3.90	4.31	4.70	5.07	5.46	2.76	3.33	3.80	4.21	4.60	4.96	5.35	2.73	3.30	3.76	4.18	4.56	4.93	5.32
500	15	2.81	3.37	3.83	4.24	4.62	4.99	5.37	2.69	3.24	3.70	4.11	4.50	4.86	5.25	2.65	3.20	3.66	4.07	4.46	4.82	5.21
500	20	2.77	3.31	3.77	4.17	4.55	4.91	5.30	2.62	3.17	3.62	4.02	4.40	4.77	5.15	2.57	3.12	3.57	3.97	4.35	4.72	5.10
500	25	2.74	3.27	3.72	4.12	4.49	4.86	5.23	2.56	3.09	3.54	3.94	4.31	4.68	5.05	2.50	3.03	3.48	3.88	4.25	4.62	4.99
500	30	2.73	3.25	3.69	4.08	4.46	4.81	5.19	2.51	3.03	3.47	3.86	4.24	4.59	4.97	2.43	2.95	3.39	3.79	4.16	4.52	4.90
500	35	2.73	3.24	3.67	4.07	4.44	4.79	5.16	2.46	2.97	3.40	3.80	4.17	4.52	4.89	2.37	2.88	3.31	3.71	4.08	4.43	4.80
500	40	2.76	3.26	3.68	4.07	4.44	4.79	5.16	2.43	2.93	3.35	3.74	4.11	4.46	4.83	2.32	2.82	3.24	3.63	4.00	4.35	4.72
Dollars/M bd.ft.																						
600	5	3.15	3.76	4.25	4.68	5.08	5.46	5.86	3.07	3.69	4.18	4.61	5.01	5.38	5.79	3.05	3.66	4.15	4.58	4.98	5.36	5.76
600	10	3.08	3.68	4.17	4.59	4.99	5.36	5.76	2.99	3.59	4.08	4.51	4.90	5.28	5.67	2.97	3.56	4.05	4.48	4.87	5.25	5.65
600	15	3.02	3.61	4.09	4.51	4.90	5.27	5.67	2.92	3.51	3.98	4.41	4.80	5.17	5.57	2.88	3.47	3.95	4.37	4.76	5.14	5.53
600	20	2.97	3.55	4.02	4.43	4.82	5.19	5.58	2.85	3.42	3.89	4.31	4.70	5.07	5.46	2.80	3.38	3.85	4.27	4.66	5.03	5.42
600	25	2.93	3.49	3.96	4.37	4.76	5.12	5.51	2.78	3.34	3.81	4.22	4.61	4.97	5.36	2.73	3.29	3.76	4.17	4.56	4.92	5.31
600	30	2.90	3.46	3.91	4.32	4.70	5.07	5.45	2.72	3.27	3.73	4.14	4.52	4.89	5.27	2.66	3.21	3.67	4.08	4.46	4.82	5.21
600	35	2.89	3.43	3.88	4.29	4.67	5.03	5.41	2.67	3.21	3.66	4.06	4.44	4.80	5.19	2.59	3.13	3.58	3.99	4.37	4.73	5.11
600	40	2.90	3.43	3.87	4.27	4.65	5.01	5.39	2.63	3.16	3.60	4.00	4.37	4.73	5.11	2.53	3.06	3.51	3.91	4.28	4.64	5.02

t stand densities commonly found in Montana, Idaho, and northwestern Wyoming

10 THOUSAND BOARD FEET PER ACRE						15 THOUSAND BOARD FEET PER ACRE						
Logs/M bd.ft.						Logs/M bd.ft.						
	8	10	12	14	16	4	6	8	10	12	14	16
<i>Dollars/M bd.ft.</i>						<i>Dollars/M bd.ft.</i>						
5	3.59	4.43	5.28	6.12	6.96	2.09	2.67	3.52	4.36	5.20	6.05	6.89
2	3.68	4.54	5.39	6.25	7.10	2.15	2.74	3.59	4.45	5.30	6.16	7.02
1	3.78	4.65	5.51	6.38	7.25	2.22	2.81	3.67	4.54	5.41	6.28	7.15
1	3.89	4.77	5.65	6.53	7.41	2.29	2.89	3.77	4.65	5.53	6.41	7.29
3	4.02	4.91	5.81	6.70	7.59	2.38	2.98	3.87	4.76	5.66	6.55	7.44
6	4.17	5.07	5.98	6.89	7.79	2.48	3.08	3.98	4.89	5.80	6.70	7.61
2	4.34	5.26	6.18	7.10	8.02	2.59	3.20	4.12	5.04	5.95	6.87	7.79
1	4.54	5.47	6.40	7.33	8.26	2.73	3.34	4.27	5.20	6.13	7.06	7.99
4	3.88	4.81	5.74	6.67	7.61	2.28	2.89	3.83	4.76	5.69	6.63	7.56
1	3.95	4.90	5.84	6.79	7.73	2.33	2.95	3.89	4.84	5.78	6.73	7.68
8	4.03	4.99	5.95	6.91	7.87	2.39	3.01	3.96	4.92	5.88	6.84	7.80
5	4.12	5.10	6.07	7.04	8.01	2.45	3.07	4.04	5.01	5.98	6.95	7.92
4	4.23	5.21	6.19	7.18	8.16	2.52	3.14	4.13	5.11	6.09	7.08	8.06
5	4.34	5.34	6.33	7.33	8.33	2.59	3.23	4.22	5.22	6.21	7.21	8.20
7	4.48	5.48	6.49	7.50	8.51	2.68	3.32	4.33	5.33	6.34	7.35	8.36
1	4.63	5.65	6.67	7.69	8.71	2.78	3.42	4.44	5.46	6.48	7.50	8.52
7	4.20	5.22	6.24	7.27	8.29	2.50	3.14	4.16	5.18	6.21	7.23	8.25
3	4.27	5.30	6.34	7.37	8.41	2.54	3.19	4.22	5.26	6.29	7.33	8.36
9	4.34	5.39	6.44	7.48	8.53	2.59	3.24	4.29	5.34	6.38	7.43	8.48
6	4.42	5.48	6.54	7.60	8.66	2.65	3.30	4.36	5.42	6.48	7.54	8.60
4	4.51	5.58	6.66	7.73	8.80	2.70	3.36	4.44	5.51	6.58	7.65	8.73
3	4.61	5.70	6.78	7.87	8.95	2.77	3.43	4.52	5.60	6.69	7.77	8.86
2	4.72	5.82	6.92	8.01	9.11	2.85	3.51	4.61	5.71	6.80	7.90	9.00
4	4.85	5.96	7.07	8.18	9.29	2.93	3.60	4.71	5.82	6.93	8.04	9.15
2✓	4.53	5.65	6.76	7.87	8.98	2.72	3.39	4.50	5.62	6.73	7.84	8.95
7	4.60	5.72	6.85	7.97	9.10	2.76	3.44	4.56	5.69	6.81	7.94	9.06
3	4.67	5.81	6.94	8.08	9.22	2.81	3.49	4.63	5.76	6.90	8.04	9.18
9	4.74	5.89	7.04	8.19	9.34	2.86	3.54	4.69	5.84	6.99	8.14	9.29
6	4.82	5.99	7.15	8.31	9.47	2.91	3.60	4.76	5.93	7.09	8.25	9.41
4	4.91	6.09	7.26	8.44	9.61	2.97	3.67	4.84	6.02	7.19	8.36	9.54
3	5.01	6.20	7.39	8.57	9.76	3.04	3.74	4.92	6.11	7.30	8.48	9.67
2	5.12	6.32	7.52	8.72	9.92	3.11	3.81	5.01	6.21	7.41	8.61	9.81
8	4.88	6.08	7.28	8.48	9.69	2.95	3.65	4.85	6.05	7.26	8.46	9.66
3	4.94	6.15	7.37	8.58	9.80	2.99	3.70	4.91	6.13	7.34	8.55	9.77
8	5.01	6.23	7.46	8.69	9.91	3.04	3.74	4.97	6.20	7.43	8.65	9.88
4	5.08	6.32	7.56	8.79	10.03	3.08	3.80	5.04	6.27	7.51	8.75	9.99
0	5.15	6.40	7.66	8.91	10.16	3.13	3.85	5.10	6.35	7.61	8.86	10.11
7	5.24	6.50	7.76	9.03	10.29	3.19	3.91	5.17	6.44	7.70	8.97	10.23
5	5.33	6.60	7.88	9.16	10.43	3.25	3.98	5.25	6.53	7.81	9.08	10.36
4	5.43	6.72	8.00	9.29	10.58	3.32	4.05	5.33	6.62	7.91	9.20	10.49

Table 6.--Operating costs using 81-117 BHP rubber-tired vehicles for three different

Distance (feet)	Slope (percent)	5 THOUSAND BOARD FEET PER ACRE								
		Logs/M bd.ft.								
		4	6	8	10	12	14	16	4	6
Dollars/M bd.ft.										
200	5	2.82	3.33	3.76	4.14	4.50	4.84	5.16	2.60	3.1
200	10	3.00	3.53	3.96	4.34	4.70	5.05	5.38	2.74	3.2
200	15	3.20	3.74	4.18	4.57	4.93	5.28	5.61	2.89	3.4
200	20	3.42	3.97	4.42	4.82	5.18	5.53	5.87	3.05	3.6
200	25	3.68	4.24	4.70	5.10	5.47	5.82	6.16	3.23	3.7
200	30	3.98	4.56	5.02	5.43	5.80	6.15	6.49	3.43	4.0
200	35	4.33	4.92	5.39	5.80	6.18	6.54	6.88	3.65	4.2
200	40	4.73	5.33	5.81	6.23	6.61	6.97	7.31	3.90	4.5
300	5	2.79	3.32	3.75	4.14	4.50	4.84	5.17	2.64	3.1
300	10	2.94	3.48	3.92	4.31	4.68	5.02	5.36	2.76	3.3
300	15	3.10	3.66	4.11	4.51	4.87	5.22	5.56	2.90	3.4
300	20	3.29	3.86	4.31	4.71	5.08	5.44	5.77	3.04	3.6
300	25	3.49	4.07	4.54	4.95	5.32	5.67	6.01	3.19	3.7
300	30	3.73	4.32	4.79	5.20	5.58	5.94	6.28	3.36	3.9
300	35	3.99	4.60	5.08	5.50	5.88	6.24	6.58	3.54	4.1
300	40	4.29	4.91	5.40	5.82	6.21	6.57	6.91	3.74	4.3
400	5	2.83	3.37	3.81	4.21	4.57	4.92	5.25	2.72	3.2
400	10	2.97	3.52	3.97	4.37	4.74	5.09	5.42	2.84	3.3
400	15	3.12	3.69	4.14	4.55	4.92	5.27	5.61	2.96	3.5
400	20	3.28	3.86	4.33	4.73	5.11	5.46	5.80	3.09	3.6
400	25	3.46	4.05	4.53	4.94	5.32	5.67	6.02	3.23	3.8
400	30	3.66	4.27	4.75	5.17	5.55	5.91	6.25	3.38	3.9
400	35	3.88	4.50	4.99	5.42	5.80	6.16	6.51	3.55	4.1
400	40	4.13	4.77	5.26	5.69	6.08	6.44	6.79	3.72	4.3
500	5	2.90	3.46	3.91	4.31	4.67	5.02	5.36	2.81	3.3
500	10	3.03	3.60	4.06	4.46	4.83	5.19	5.52	2.93	3.5
500	15	3.17	3.75	4.22	4.63	5.00	5.36	5.70	3.05	3.6
500	20	3.32	3.92	4.39	4.80	5.18	5.54	5.88	3.17	3.7
500	25	3.48	4.09	4.57	4.99	5.37	5.73	6.08	3.30	3.9
500	30	3.66	4.29	4.78	5.20	5.58	5.95	6.29	3.44	4.0
500	35	3.86	4.50	5.00	5.42	5.81	6.18	6.53	3.59	4.2
500	40	4.08	4.73	5.24	5.67	6.06	6.43	6.78	3.75	4.4
600	5	2.98	3.56	4.02	4.42	4.79	5.14	5.48	2.91	3.4
600	10	3.11	3.70	4.16	4.57	4.95	5.30	5.64	3.02	3.6
600	15	3.24	3.84	4.32	4.73	5.11	5.47	5.81	3.14	3.7
600	20	3.38	4.00	4.48	4.90	5.28	5.64	5.98	3.26	3.8
600	25	3.54	4.16	4.65	5.08	5.46	5.83	6.17	3.39	4.0
600	30	3.71	4.34	4.84	5.27	5.66	6.02	6.37	3.52	4.1
600	35	3.89	4.54	5.04	5.48	5.87	6.24	6.59	3.66	4.3
600	40	4.09	4.75	5.26	5.70	6.10	6.47	6.82	3.81	4.4

Table 4.--Operating costs using 110-130 DBHP crawler tractors for three different stand densities commonly found in Montana, Idaho, and northwestern Wyoming

Distance (feet)	Slope (percent)	5 THOUSAND BOARD FEET PER ACRE							10 THOUSAND BOARD FEET PER ACRE							15 THOUSAND BOARD FEET PER ACRE						
		Logs/M bd.ft.							Logs/M bd.ft.							Logs/M bd.ft.						
		4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16
Dollars/M bd.ft.																						
200	5	2.39	2.97	3.81	4.66	5.50	6.34	7.19	2.17	2.75	3.59	4.43	5.28	6.12	6.96	2.09	2.67	3.52	4.36	5.20	6.05	6.89
200	10	2.50	3.08	3.94	4.80	5.65	6.51	7.36	2.24	2.82	3.68	4.54	5.39	6.25	7.10	2.15	2.74	3.59	4.45	5.30	6.16	7.02
200	15	2.63	3.22	4.09	4.96	5.82	6.69	7.56	2.32	2.91	3.78	4.65	5.51	6.38	7.25	2.22	2.81	3.67	4.54	5.41	6.28	7.15
200	20	2.79	3.38	4.26	5.14	6.02	6.90	7.78	2.41	3.01	3.89	4.77	5.65	6.53	7.41	2.29	2.89	3.77	4.65	5.53	6.41	7.29
200	25	2.98	3.58	4.47	5.36	6.26	7.15	8.04	2.53	3.13	4.02	4.91	5.81	6.70	7.59	2.38	2.98	3.87	4.76	5.66	6.55	7.44
200	30	3.21	3.81	4.72	5.62	6.53	7.44	8.34	2.66	3.26	4.17	5.07	5.98	6.89	7.79	2.48	3.08	3.98	4.89	5.80	6.70	7.61
200	35	3.49	4.10	5.02	5.94	6.85	7.77	8.69	2.82	3.42	4.34	5.26	6.18	7.10	8.02	2.59	3.20	4.12	5.04	5.95	6.87	7.79
200	40	3.82	4.43	5.37	6.30	7.23	8.16	9.09	3.00	3.61	4.54	5.47	6.40	7.33	8.26	2.73	3.34	4.27	5.20	6.13	7.06	7.99
Dollars/M bd.ft.																						
300	5	2.48	3.09	4.02	4.96	5.89	6.82	7.76	2.33	2.94	3.88	4.81	5.74	6.67	7.61	2.28	2.89	3.83	4.76	5.69	6.63	7.56
300	10	2.56	3.18	4.12	5.07	6.02	6.96	7.91	2.39	3.01	3.95	4.90	5.84	6.79	7.73	2.33	2.95	3.89	4.84	5.78	6.73	7.68
300	15	2.66	3.28	4.24	5.20	6.16	7.11	8.07	2.46	3.08	4.03	4.99	5.95	6.91	7.87	2.39	3.01	3.96	4.92	5.88	6.84	7.80
300	20	2.78	3.40	4.37	5.34	6.31	7.28	8.25	2.53	3.15	4.12	5.10	6.07	7.04	8.01	2.45	3.07	4.04	5.01	5.98	6.95	7.92
300	25	2.92	3.54	4.53	5.51	6.49	7.48	8.46	2.62	3.24	4.23	5.21	6.19	7.18	8.16	2.52	3.14	4.13	5.11	6.09	7.08	8.06
300	30	3.08	3.71	4.71	5.71	6.70	7.70	8.69	2.72	3.35	4.34	5.34	6.33	7.33	8.33	2.59	3.23	4.22	5.22	6.21	7.21	8.20
300	35	3.28	3.92	4.93	5.93	6.94	7.95	8.96	2.83	3.47	4.48	5.48	6.49	7.50	8.51	2.68	3.32	4.33	5.33	6.34	7.35	8.36
300	40	3.51	4.15	5.17	6.19	7.22	8.24	9.26	2.96	3.61	4.63	5.65	6.67	7.69	8.71	2.78	3.42	4.44	5.46	6.48	7.50	8.52
Dollars/M bd.ft.																						
400	5	2.64	3.28	4.31	5.33	6.35	7.38	8.40	2.53	3.17	4.20	5.22	6.24	7.27	8.29	2.50	3.14	4.16	5.18	6.21	7.23	8.25
400	10	2.72	3.36	4.40	5.43	6.47	7.50	8.54	2.59	3.23	4.27	5.30	6.34	7.37	8.41	2.54	3.19	4.22	5.26	6.29	7.33	8.36
400	15	2.80	3.45	4.49	5.54	6.59	7.64	8.69	2.64	3.29	4.34	5.39	6.44	7.48	8.53	2.59	3.24	4.29	5.34	6.38	7.43	8.48
400	20	2.89	3.55	4.61	5.67	6.73	7.79	8.85	2.71	3.36	4.42	5.48	6.54	7.60	8.66	2.65	3.30	4.36	5.42	6.48	7.54	8.60
400	25	3.00	3.66	4.74	5.81	6.88	7.95	9.03	2.78	3.44	4.51	5.58	6.66	7.73	8.80	2.70	3.36	4.44	5.51	6.58	7.65	8.73
400	30	3.14	3.80	4.89	5.97	7.06	8.14	9.23	2.86	3.53	4.61	5.70	6.78	7.87	8.95	2.77	3.43	4.52	5.60	6.69	7.77	8.86
400	35	3.30	3.96	5.06	6.16	7.25	8.35	9.45	2.96	3.62	4.72	5.82	6.92	8.01	9.11	2.85	3.51	4.61	5.71	6.80	7.90	9.00
400	40	3.48	4.15	5.26	6.37	7.48	8.59	9.70	3.07	3.74	4.85	5.96	7.07	8.18	9.29	2.93	3.60	4.71	5.82	6.93	8.04	9.15
Dollars/M bd.ft.																						
500	5	2.84	3.51	4.62	5.73	6.85	7.96	9.07	2.75	3.42	4.53	5.65	6.76	7.87	8.98	2.72	3.39	4.50	5.62	6.73	7.84	8.95
500	10	2.90	3.58	4.70	5.83	6.95	8.08	9.20	2.80	3.47	4.60	5.72	6.85	7.97	9.10	2.76	3.44	4.56	5.69	6.81	7.94	9.06
500	15	2.97	3.65	4.79	5.93	7.07	8.20	9.34	2.85	3.53	4.67	5.81	6.94	8.08	9.22	2.81	3.49	4.63	5.76	6.90	8.04	9.18
500	20	3.06	3.74	4.89	6.04	7.19	8.34	9.49	2.91	3.59	4.74	5.89	7.04	8.19	9.34	2.86	3.54	4.69	5.84	6.99	8.14	9.29
500	25	3.15	3.84	5.00	6.17	7.33	8.49	9.65	2.97	3.66	4.82	5.99	7.15	8.31	9.47	2.91	3.60	4.76	5.93	7.09	8.25	9.41
500	30	3.27	3.96	5.13	6.31	7.48	8.66	9.83	3.05	3.74	4.91	6.09	7.26	8.44	9.61	2.97	3.67	4.84	6.02	7.19	8.36	9.54
500	35	3.40	4.10	5.28	6.47	7.66	8.84	10.03	3.13	3.83	5.01	6.20	7.39	8.57	9.76	3.04	3.74	4.92	6.11	7.30	8.48	9.67
500	40	3.55	4.25	5.45	6.65	7.85	9.05	10.25	3.22	3.92	5.12	6.32	7.52	8.72	9.92	3.11	3.81	5.01	6.21	7.41	8.61	9.81
Dollars/M bd.ft.																						
600	5	3.05	3.75	4.95	6.15	7.36	8.56	9.76	2.97	3.68	4.88	6.08	7.28	8.48	9.69	2.95	3.65	4.85	6.05	7.26	8.46	9.66
600	10	3.11	3.81	5.03	6.24	7.46	8.67	9.88	3.02	3.73	4.94	6.15	7.37	8.58	9.80	2.99	3.70	4.91	6.13	7.34	8.55	9.77
600	15	3.17	3.88	5.11	6.34	7.56	8.79	10.02	3.07	3.78	5.01	6.23	7.46	8.69	9.91	3.04	3.74	4.97	6.20	7.43	8.65	9.88
600	20	3.25	3.96	5.20	6.44	7.68	8.92	10.16	3.12	3.84	5.08	6.32	7.56	8.79	10.03	3.08	3.80	5.04	6.27	7.51	8.75	9.99
600	25	3.33	4.05	5.30	6.55	7.81	9.06	10.31	3.18	3.90	5.15	6.40	7.66	8.91	10.16	3.13	3.85	5.10	6.35	7.61	8.86	10.11
600	30	3.43	4.15	5.42	6.68	7.95	9.21	10.48	3.25	3.97	5.24	6.50	7.76	9.03	10.29	3.19	3.91	5.17	6.44	7.70	8.97	10.23
600	35	3.55	4.28	5.55	6.83	8.11	9.38	10.66	3.32	4.05	5.33	6.60	7.88	9.16	10.43	3.25	3.98	5.25	6.53	7.81	9.08	10.36
600	40	3.68	4.41	5.70	6.99	8.28	9.57	10.86	3.41	4.14	5.43	6.72	8.00	9.29	10.58	3.32	4.05	5.33	6.62	7.91	9.20	10.49

Table 5.--Operating costs using 55-80 BHP rubber-tired vehicles for three different stand densities commonly found in Montana, Idaho, and northwestern Wyoming

Distance (feet)	Slope (percent)	5 THOUSAND BOARD FEET PER ACRE							10 THOUSAND BOARD FEET PER ACRE							15 THOUSAND BOARD FEET PER ACRE						
		Logs/M bd.ft.							Logs/M bd.ft.							Logs/M bd.ft.						
		4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16
		Dollars/M bd.ft.							Dollars/M bd.ft.							Dollars/M bd.ft.						
200	5	1.85	2.27	2.65	3.02	3.37	3.71	4.05	1.63	2.05	2.43	2.79	3.15	3.49	3.83	1.56	1.98	2.36	2.72	3.07	3.42	3.76
200	10	1.88	2.29	2.67	3.03	3.38	3.72	4.06	1.62	2.03	2.41	2.77	3.12	3.46	3.80	1.53	1.94	2.32	2.68	3.03	3.37	3.71
200	15	1.92	2.33	2.70	3.06	3.41	3.75	4.08	1.61	2.02	2.39	2.75	3.10	3.44	3.78	1.51	1.91	2.29	2.65	2.99	3.33	3.67
200	20	1.99	2.39	2.76	3.11	3.46	3.80	4.14	1.62	2.02	2.39	2.74	3.09	3.43	3.77	1.50	1.90	2.27	2.62	2.97	3.31	3.64
200	25	2.10	2.49	2.85	3.21	3.55	3.89	4.22	1.65	2.04	2.40	2.76	3.10	3.44	3.77	1.50	1.89	2.25	2.61	2.95	3.29	3.62
200	30	2.24	2.63	2.99	3.34	3.68	4.02	4.35	1.69	2.08	2.44	2.79	3.13	3.47	3.80	1.51	1.90	2.26	2.61	2.95	3.28	3.62
200	35	2.44	2.82	3.18	3.52	3.86	4.20	4.53	1.76	2.14	2.50	2.85	3.19	3.52	3.86	1.54	1.92	2.28	2.62	2.96	3.30	3.63
200	40	2.68	3.06	3.41	3.75	4.09	4.43	4.76	1.86	2.23	2.59	2.93	3.27	3.60	3.93	1.58	1.96	2.31	2.65	2.99	3.33	3.66
300	5	2.03	2.49	2.89	3.27	3.64	3.99	4.34	1.88	2.34	2.75	3.12	3.49	3.84	4.19	1.83	2.29	2.70	3.08	3.44	3.79	4.14
300	10	2.03	2.48	2.88	3.26	3.62	3.97	4.32	1.85	2.31	2.71	3.08	3.45	3.80	4.14	1.79	2.25	2.65	3.03	3.39	3.74	4.08
300	15	2.04	2.48	2.88	3.26	3.61	3.97	4.31	1.83	2.28	2.68	3.05	3.41	3.76	4.10	1.76	2.21	2.61	2.98	3.34	3.69	4.04
300	20	2.07	2.51	2.90	3.27	3.63	3.98	4.32	1.82	2.26	2.65	3.02	3.38	3.73	4.07	1.74	2.18	2.57	2.94	3.30	3.65	3.99
300	25	2.12	2.55	2.94	3.31	3.67	4.01	4.36	1.82	2.25	2.64	3.01	3.37	3.71	4.06	1.72	2.15	2.54	2.91	3.27	3.61	3.96
300	30	2.20	2.63	3.01	3.38	3.73	4.08	4.42	1.83	2.26	2.64	3.01	3.36	3.71	4.05	1.71	2.14	2.52	2.89	3.24	3.59	3.93
300	35	2.31	2.73	3.11	3.48	3.83	4.17	4.51	1.86	2.28	2.66	3.03	3.38	3.72	4.06	1.71	2.13	2.51	2.88	3.23	3.57	3.91
300	40	2.46	2.87	3.25	3.61	3.96	4.30	4.64	1.91	2.32	2.70	3.06	3.41	3.75	4.09	1.72	2.14	2.52	2.88	3.23	3.57	3.91
400	5	2.28	2.78	3.21	3.60	3.98	4.34	4.69	2.17	2.67	3.10	3.49	3.87	4.23	4.58	2.13	2.63	3.06	3.46	3.83	4.19	4.55
400	10	2.26	2.76	3.18	3.57	3.95	4.31	4.66	2.13	2.63	3.05	3.44	3.82	4.18	4.53	2.09	2.58	3.01	3.40	3.77	4.13	4.49
400	15	2.26	2.75	3.17	3.56	3.93	4.29	4.64	2.10	2.59	3.01	3.40	3.77	4.13	4.48	2.05	2.54	2.96	3.35	3.72	4.08	4.43
400	20	2.27	2.75	3.17	3.55	3.92	4.28	4.63	2.08	2.56	2.98	3.37	3.74	4.09	4.44	2.02	2.50	2.92	3.30	3.67	4.03	4.38
400	25	2.29	2.77	3.18	3.56	3.93	4.29	4.64	2.07	2.54	2.96	3.34	3.71	4.06	4.41	1.99	2.47	2.88	3.26	3.63	3.99	4.34
400	30	2.34	2.81	3.22	3.60	3.96	4.32	4.67	2.06	2.53	2.94	3.32	3.69	4.04	4.39	1.97	2.44	2.85	3.23	3.60	3.95	4.30
400	35	2.41	2.87	3.28	3.66	4.02	4.37	4.72	2.07	2.53	2.94	3.32	3.68	4.03	4.38	1.96	2.42	2.83	3.21	3.57	3.92	4.27
400	40	2.51	2.96	3.36	3.74	4.10	4.45	4.80	2.09	2.55	2.95	3.33	3.69	4.04	4.38	1.96	2.41	2.81	3.19	3.55	3.90	4.25
500	5	2.56	3.10	3.55	3.96	4.35	4.72	5.08	2.47	3.01	3.46	3.87	4.26	4.63	4.99	2.44	2.98	3.43	3.84	4.23	4.60	4.96
500	10	2.53	3.07	3.52	3.93	4.31	4.68	5.04	2.43	2.96	3.41	3.82	4.21	4.58	4.94	2.40	2.93	3.38	3.79	4.17	4.54	4.90
500	15	2.52	3.05	3.49	3.90	4.28	4.65	5.01	2.40	2.92	3.37	3.78	4.16	4.53	4.88	2.36	2.88	3.33	3.73	4.12	4.48	4.84
500	20	2.52	3.04	3.48	3.88	4.26	4.63	4.99	2.37	2.89	3.33	3.73	4.11	4.48	4.84	2.32	2.84	3.28	3.68	4.06	4.43	4.79
500	25	2.53	3.04	3.48	3.88	4.26	4.62	4.98	2.35	2.86	3.30	3.70	4.08	4.44	4.80	2.29	2.80	3.24	3.64	4.02	4.38	4.74
500	30	2.55	3.06	3.49	3.89	4.27	4.63	4.99	2.33	2.84	3.27	3.67	4.05	4.41	4.77	2.26	2.77	3.20	3.60	3.98	4.34	4.69
500	35	2.60	3.10	3.53	3.92	4.30	4.66	5.02	2.33	2.83	3.26	3.65	4.03	4.39	4.75	2.24	2.74	3.17	3.56	3.94	4.30	4.66
500	40	2.66	3.16	3.59	3.98	4.35	4.71	5.06	2.33	2.83	3.26	3.65	4.02	4.38	4.73	2.23	2.72	3.15	3.54	3.91	4.27	4.62
600	5	2.85	3.43	3.91	4.34	4.74	5.11	5.48	2.78	3.36	3.84	4.26	4.66	5.04	5.41	2.75	3.33	3.81	4.24	4.64	5.02	5.38
600	10	2.82	3.40	3.87	4.30	4.69	5.07	5.44	2.74	3.31	3.79	4.21	4.61	4.98	5.35	2.71	3.28	3.76	4.18	4.58	4.95	5.32
600	15	2.80	3.37	3.84	4.26	4.66	5.03	5.40	2.70	3.27	3.74	4.16	4.55	4.93	5.29	2.66	3.23	3.70	4.13	4.52	4.90	5.26
600	20	2.79	3.35	3.82	4.24	4.63	5.00	5.37	2.67	3.23	3.69	4.11	4.51	4.88	5.24	2.63	3.19	3.65	4.07	4.46	4.84	5.20
600	25	2.79	3.34	3.81	4.22	4.61	4.99	5.35	2.64	3.19	3.66	4.07	4.46	4.84	5.20	2.59	3.14	3.61	4.02	4.41	4.79	5.15
600	30	2.80	3.35	3.81	4.22	4.61	4.98	5.34	2.62	3.17	3.63	4.04	4.43	4.80	5.16	2.56	3.11	3.56	3.98	4.37	4.74	5.10
600	35	2.83	3.37	3.83	4.24	4.63	5.00	5.36	2.61	3.15	3.60	4.01	4.40	4.77	5.13	2.53	3.07	3.53	3.94	4.33	4.70	5.06
600	40	2.88	3.41	3.86	4.27	4.66	5.03	5.38	2.60	3.14	3.59	4.00	4.38	4.75	5.11	2.51	3.05	3.50	3.91	4.29	4.66	5.02

stand densities commonly found in Montana, Idaho, and northwestern Wyoming

10 THOUSAND BOARD FEET PER ACRE						15 THOUSAND BOARD FEET PER ACRE						
Logs/M bd.ft.						Logs/M bd.ft.						
	8	10	12	14	16	4	6	8	10	12	14	16
<i>Dollars/M bd.ft.</i>						<i>Dollars/M bd.ft.</i>						
1	3.54	3.92	4.28	4.61	4.94	2.52	3.04	3.46	3.85	4.20	4.54	4.87
7	3.70	4.08	4.44	4.79	5.12	2.65	3.18	3.61	4.00	4.36	4.70	5.03
3	3.87	4.26	4.62	4.97	5.30	2.78	3.32	3.77	4.16	4.52	4.86	5.20
0	4.05	4.45	4.81	5.16	5.50	2.93	3.48	3.93	4.32	4.69	5.04	5.37
9	4.25	4.65	5.02	5.37	5.71	3.08	3.64	4.10	4.50	4.87	5.22	5.56
1	4.47	4.88	5.25	5.60	5.94	3.25	3.82	4.29	4.69	5.07	5.42	5.76
5	4.72	5.13	5.51	5.86	6.20	3.43	4.02	4.49	4.90	5.28	5.64	5.98
1	4.99	5.40	5.78	6.14	6.49	3.63	4.23	4.71	5.13	5.51	5.87	6.21
7	3.60	3.99	4.35	4.69	5.02	2.59	3.12	3.55	3.94	4.30	4.64	4.97
1	3.75	4.14	4.50	4.85	5.18	2.71	3.25	3.69	4.08	4.45	4.79	5.12
5	3.90	4.30	4.67	5.01	5.35	2.83	3.38	3.83	4.23	4.60	4.95	5.28
1	4.07	4.47	4.84	5.19	5.53	2.96	3.53	3.98	4.38	4.75	5.11	5.44
7	4.24	4.65	5.02	5.37	5.71	3.09	3.67	4.14	4.55	4.92	5.27	5.61
5	4.43	4.84	5.22	5.57	5.91	3.24	3.83	4.30	4.72	5.09	5.45	5.79
5	4.63	5.05	5.43	5.79	6.13	3.39	4.00	4.48	4.90	5.28	5.64	5.98
6	4.85	5.27	5.66	6.02	6.36	3.56	4.18	4.67	5.09	5.47	5.84	6.18
6	3.70	4.10	4.46	4.81	5.14	2.68	3.22	3.67	4.06	4.42	4.77	5.10
9	3.84	4.24	4.61	4.96	5.29	2.79	3.35	3.80	4.20	4.57	4.91	5.25
3	3.99	4.39	4.76	5.11	5.45	2.91	3.48	3.94	4.34	4.71	5.06	5.40
8	4.14	4.55	4.92	5.28	5.62	3.03	3.61	4.08	4.49	4.86	5.21	5.55
3	4.30	4.71	5.09	5.45	5.79	3.16	3.75	4.23	4.64	5.02	5.37	5.72
9	4.47	4.89	5.27	5.63	5.97	3.29	3.90	4.38	4.80	5.18	5.54	5.88
7	4.66	5.08	5.46	5.83	6.17	3.43	4.05	4.54	4.97	5.35	5.71	6.06
6	4.85	5.28	5.67	6.03	6.38	3.59	4.22	4.71	5.14	5.53	5.89	6.24
7	3.82	4.22	4.59	4.93	5.27	2.78	3.34	3.79	4.19	4.56	4.90	5.24
0	3.96	4.36	4.73	5.08	5.42	2.89	3.46	3.92	4.32	4.70	5.05	5.38
3	4.10	4.50	4.88	5.23	5.57	3.00	3.59	4.06	4.46	4.84	5.19	5.53
7	4.24	4.66	5.03	5.39	5.73	3.12	3.72	4.19	4.61	4.98	5.34	5.68
1	4.39	4.81	5.20	5.55	5.90	3.24	3.85	4.33	4.75	5.14	5.49	5.84
7	4.56	4.98	5.36	5.73	6.07	3.37	3.99	4.48	4.91	5.29	5.65	6.00
3	4.73	5.15	5.54	5.91	6.26	3.50	4.14	4.64	5.06	5.45	5.82	6.17
0	4.91	5.34	5.73	6.10	6.45	3.65	4.29	4.80	5.23	5.62	5.99	6.34
8	3.94	4.35	4.72	5.07	5.41	2.88	3.46	3.92	4.32	4.69	5.05	5.38
1	4.08	4.49	4.86	5.22	5.56	2.99	3.58	4.05	4.46	4.83	5.19	5.53
4	4.21	4.63	5.01	5.36	5.71	3.11	3.70	4.18	4.59	4.97	5.33	5.67
7	4.36	4.77	5.16	5.52	5.86	3.22	3.83	4.31	4.73	5.12	5.48	5.82
1	4.50	4.93	5.31	5.68	6.02	3.34	3.96	4.45	4.88	5.26	5.63	5.97
6	4.66	5.09	5.48	5.84	6.19	3.46	4.10	4.60	5.02	5.41	5.78	6.13
1	4.82	5.25	5.65	6.01	6.37	3.59	4.24	4.74	5.18	5.57	5.94	6.29
8	4.99	5.43	5.83	6.20	6.55	3.72	4.38	4.90	5.34	5.73	6.10	6.46

Table 8.--Operating costs using Idaho jammers for three different stand densi

Distance (feet)	Slope (percent)	5 THOUSAND BOARD FEET PER ACRE								
		Logs/M bd.ft.								
		4	6	8	10	12	14	16	4	6
Dollars/M bd. ft.										
100	5	8.44	8.84	9.25	9.65	10.06	10.46	10.86	4.62	5.03
100	10	8.66	9.09	9.52	9.96	10.39	10.83	11.26	4.76	5.19
100	15	8.91	9.38	9.84	10.31	10.77	11.24	11.70	4.92	5.38
100	20	9.22	9.72	10.21	10.71	11.20	11.70	12.19	5.10	5.60
100	25	9.60	10.12	10.65	11.17	11.70	12.22	12.75	5.32	5.85
100	30	10.06	10.61	11.17	11.73	12.28	12.84	13.39	5.58	6.14
100	35	10.62	11.20	11.79	12.38	12.96	13.55	14.13	5.89	6.48
100	40	11.28	11.89	12.51	13.12	13.74	14.36	14.97	6.25	6.87
200	5	4.97	5.55	6.14	6.72	7.30	7.88	8.46	3.07	3.65
200	10	5.11	5.72	6.33	6.95	7.56	8.17	8.78	3.16	3.78
200	15	5.27	5.91	6.55	7.20	7.84	8.48	9.12	3.27	3.92
200	20	5.46	6.13	6.80	7.47	8.14	8.81	9.49	3.40	4.07
200	25	5.67	6.38	7.08	7.78	8.48	9.18	9.89	3.54	4.24
200	30	5.94	6.67	7.40	8.13	8.86	9.60	10.33	3.70	4.43
200	35	6.25	7.01	7.77	8.53	9.30	10.06	10.82	3.88	4.65
200	40	6.60	7.40	8.19	8.98	9.78	10.57	11.36	4.09	4.89
300	5	4.05	4.81	5.57	6.33	7.08	7.84	8.60	2.78	3.54
300	10	4.17	4.96	5.74	6.53	7.32	8.11	8.89	2.87	3.66
300	15	4.29	5.11	5.93	6.75	7.57	8.38	9.20	2.96	3.78
300	20	4.44	5.29	6.13	6.98	7.83	8.68	9.53	3.06	3.91
300	25	4.60	5.48	6.36	7.24	8.12	9.00	9.87	3.18	4.06
300	30	4.80	5.71	6.61	7.52	8.43	9.34	10.25	3.30	4.21
300	35	5.02	5.96	6.90	7.84	8.78	9.72	10.66	3.45	4.39
300	40	5.28	6.25	7.22	8.19	9.16	10.13	11.10	3.61	4.58
400	5	3.77	4.71	5.64	6.57	7.51	8.44	9.37	2.82	3.75
400	10	3.87	4.84	5.80	6.76	7.73	8.69	9.66	2.90	3.86
400	15	3.98	4.98	5.97	6.96	7.96	8.95	9.95	2.98	3.98
400	20	4.10	5.13	6.15	7.18	8.20	9.23	10.25	3.07	4.10
400	25	4.24	5.30	6.35	7.41	8.46	9.52	10.57	3.17	4.23
400	30	4.40	5.49	6.58	7.66	8.75	9.83	10.92	3.29	4.37
400	35	4.59	5.71	6.82	7.94	9.05	10.17	11.29	3.41	4.52
400	40	4.80	5.95	7.09	8.24	9.38	10.53	11.68	3.54	4.69

Table 6.--Operating costs using 81-117 BHP rubber-tired vehicles for three different stand densities commonly found in Montana, Idaho, and northwestern Wyoming

Distance (feet)	Slope (percent)	5 THOUSAND BOARD FEET PER ACRE							10 THOUSAND BOARD FEET PER ACRE							15 THOUSAND BOARD FEET PER ACRE						
		Logs/M bd.ft.							Logs/M bd.ft.							Logs/M bd.ft.						
		4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16
		Dollars/M bd.ft.							Dollars/M bd.ft.							Dollars/M bd.ft.						
200	5	2.82	3.33	3.76	4.14	4.50	4.84	5.16	2.60	3.11	3.54	3.92	4.28	4.61	4.94	2.52	3.04	3.46	3.85	4.20	4.54	4.87
200	10	3.00	3.53	3.96	4.34	4.70	5.05	5.38	2.74	3.27	3.70	4.08	4.44	4.79	5.12	2.65	3.18	3.61	4.00	4.36	4.70	5.03
200	15	3.20	3.74	4.18	4.57	4.93	5.28	5.61	2.89	3.43	3.87	4.26	4.62	4.97	5.30	2.78	3.32	3.77	4.16	4.52	4.86	5.20
200	20	3.42	3.97	4.42	4.82	5.18	5.53	5.87	3.05	3.60	4.05	4.45	4.81	5.16	5.50	2.93	3.48	3.93	4.32	4.69	5.04	5.37
200	25	3.68	4.24	4.70	5.10	5.47	5.82	6.16	3.23	3.79	4.25	4.65	5.02	5.37	5.71	3.08	3.64	4.10	4.50	4.87	5.22	5.56
200	30	3.98	4.56	5.02	5.43	5.80	6.15	6.49	3.43	4.01	4.47	4.88	5.25	5.60	5.94	3.25	3.82	4.29	4.69	5.07	5.42	5.76
200	35	4.33	4.92	5.39	5.80	6.18	6.54	6.88	3.65	4.25	4.72	5.13	5.51	5.86	6.20	3.43	4.02	4.49	4.90	5.28	5.64	5.98
200	40	4.73	5.33	5.81	6.23	6.61	6.97	7.31	3.90	4.51	4.99	5.40	5.78	6.14	6.49	3.63	4.23	4.71	5.13	5.51	5.87	6.21
300	5	2.79	3.32	3.75	4.14	4.50	4.84	5.17	2.64	3.17	3.60	3.99	4.35	4.69	5.02	2.59	3.12	3.55	3.94	4.30	4.64	4.97
300	10	2.94	3.48	3.92	4.31	4.68	5.02	5.36	2.76	3.31	3.75	4.14	4.50	4.85	5.18	2.71	3.25	3.69	4.08	4.45	4.79	5.12
300	15	3.10	3.66	4.11	4.51	4.87	5.22	5.56	2.90	3.45	3.90	4.30	4.67	5.01	5.35	2.83	3.38	3.83	4.23	4.60	4.95	5.28
300	20	3.29	3.86	4.31	4.71	5.08	5.44	5.77	3.04	3.61	4.07	4.47	4.84	5.19	5.53	2.96	3.53	3.98	4.38	4.75	5.11	5.44
300	25	3.49	4.07	4.54	4.95	5.32	5.67	6.01	3.19	3.77	4.24	4.65	5.02	5.37	5.71	3.09	3.67	4.14	4.55	4.92	5.27	5.61
300	30	3.73	4.32	4.79	5.20	5.58	5.94	6.28	3.36	3.95	4.43	4.84	5.22	5.57	5.91	3.24	3.83	4.30	4.72	5.09	5.45	5.79
300	35	3.99	4.60	5.08	5.50	5.88	6.24	6.58	3.54	4.15	4.63	5.05	5.43	5.79	6.13	3.39	4.00	4.48	4.90	5.28	5.64	5.98
300	40	4.29	4.91	5.40	5.82	6.21	6.57	6.91	3.74	4.36	4.85	5.27	5.66	6.02	6.36	3.56	4.18	4.67	5.09	5.47	5.84	6.18
400	5	2.83	3.37	3.81	4.21	4.57	4.92	5.25	2.72	3.26	3.70	4.10	4.46	4.81	5.14	2.68	3.22	3.67	4.06	4.42	4.77	5.10
400	10	2.97	3.52	3.97	4.37	4.74	5.09	5.42	2.84	3.39	3.84	4.24	4.61	4.96	5.29	2.79	3.35	3.80	4.20	4.57	4.91	5.25
400	15	3.12	3.69	4.14	4.55	4.92	5.27	5.61	2.96	3.53	3.99	4.39	4.76	5.11	5.45	2.91	3.48	3.94	4.34	4.71	5.06	5.40
400	20	3.28	3.86	4.33	4.73	5.11	5.46	5.80	3.09	3.68	4.14	4.55	4.92	5.28	5.62	3.03	3.61	4.08	4.49	4.86	5.21	5.55
400	25	3.46	4.05	4.53	4.94	5.32	5.67	6.02	3.23	3.83	4.30	4.71	5.09	5.45	5.79	3.16	3.75	4.23	4.64	5.02	5.37	5.72
400	30	3.66	4.27	4.75	5.17	5.55	5.91	6.25	3.38	3.99	4.47	4.89	5.27	5.63	5.97	3.29	3.90	4.38	4.80	5.18	5.54	5.88
400	35	3.88	4.50	4.99	5.42	5.80	6.16	6.51	3.55	4.17	4.66	5.08	5.46	5.83	6.17	3.43	4.05	4.54	4.97	5.35	5.71	6.06
400	40	4.13	4.77	5.26	5.69	6.08	6.44	6.79	3.72	4.36	4.85	5.28	5.67	6.03	6.38	3.59	4.22	4.71	5.14	5.53	5.89	6.24
500	5	2.90	3.46	3.91	4.31	4.67	5.02	5.36	2.81	3.37	3.82	4.22	4.59	4.93	5.27	2.78	3.34	3.79	4.19	4.56	4.90	5.24
500	10	3.03	3.60	4.06	4.46	4.83	5.19	5.52	2.93	3.50	3.96	4.36	4.73	5.08	5.42	2.89	3.46	3.92	4.32	4.70	5.05	5.38
500	15	3.17	3.75	4.22	4.63	5.00	5.36	5.70	3.05	3.63	4.10	4.50	4.88	5.23	5.57	3.00	3.59	4.06	4.46	4.84	5.19	5.53
500	20	3.32	3.92	4.39	4.80	5.18	5.54	5.88	3.17	3.77	4.24	4.66	5.03	5.39	5.73	3.12	3.72	4.19	4.61	4.98	5.34	5.68
500	25	3.48	4.09	4.57	4.99	5.37	5.73	6.08	3.30	3.91	4.39	4.81	5.20	5.55	5.90	3.24	3.85	4.33	4.75	5.14	5.49	5.84
500	30	3.66	4.29	4.78	5.20	5.58	5.95	6.29	3.44	4.07	4.56	4.98	5.36	5.73	6.07	3.37	3.99	4.48	4.91	5.29	5.65	6.00
500	35	3.86	4.50	5.00	5.42	5.81	6.18	6.53	3.59	4.23	4.73	5.15	5.54	5.91	6.26	3.50	4.14	4.64	5.06	5.45	5.82	6.17
500	40	4.08	4.73	5.24	5.67	6.06	6.43	6.78	3.75	4.40	4.91	5.34	5.73	6.10	6.45	3.65	4.29	4.80	5.23	5.62	5.99	6.34
600	5	2.98	3.56	4.02	4.42	4.79	5.14	5.48	2.91	3.48	3.94	4.35	4.72	5.07	5.41	2.88	3.46	3.92	4.32	4.69	5.05	5.38
600	10	3.11	3.70	4.16	4.57	4.95	5.30	5.64	3.02	3.61	4.08	4.49	4.86	5.22	5.56	2.99	3.58	4.05	4.46	4.83	5.19	5.53
600	15	3.24	3.84	4.32	4.73	5.11	5.47	5.81	3.14	3.74	4.21	4.63	5.01	5.36	5.71	3.11	3.70	4.18	4.59	4.97	5.33	5.67
600	20	3.38	4.00	4.48	4.90	5.28	5.64	5.98	3.26	3.87	4.36	4.77	5.16	5.52	5.86	3.22	3.83	4.31	4.73	5.12	5.48	5.82
600	25	3.54	4.16	4.65	5.08	5.46	5.83	6.17	3.39	4.01	4.50	4.93	5.31	5.68	6.02	3.34	3.96	4.45	4.88	5.26	5.63	5.97
600	30	3.71	4.34	4.84	5.27	5.66	6.02	6.37	3.52	4.16	4.66	5.09	5.48	5.84	6.19	3.46	4.10	4.60	5.02	5.41	5.78	6.13
600	35	3.89	4.54	5.04	5.48	5.87	6.24	6.59	3.66	4.31	4.82	5.25	5.65	6.01	6.37	3.59	4.24	4.74	5.18	5.57	5.94	6.29
600	40	4.09	4.75	5.26	5.70	6.10	6.47	6.82	3.81	4.48	4.99	5.43	5.83	6.20	6.55	3.72	4.38	4.90	5.34	5.73	6.10	6.46

Table 7.--Operating costs using high-lead portable towers for three different stand densities commonly found in Montana, Idaho, and northwestern Wyoming

Distance (feet)	Slope (percent)	5 THOUSAND BOARD FEET PER ACRE							10 THOUSAND BOARD FEET PER ACRE							15 THOUSAND BOARD FEET PER ACRE						
		Logs/M bd.ft.							Logs/M bd.ft.							Logs/M bd.ft.						
		4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16
Dollars/M bd.ft.																						
200	5	4.09	5.00	5.91	6.82	7.73	8.64	9.55	2.95	3.86	4.77	5.68	6.59	7.50	8.41	2.57	3.48	4.39	5.30	6.22	7.13	8.01
200	10	4.27	5.24	6.20	7.17	8.13	9.10	10.06	3.10	4.06	5.03	5.99	6.96	7.92	8.88	2.71	3.67	4.61	5.60	6.56	7.53	8.49
200	15	4.48	5.50	6.52	7.53	8.55	9.57	10.59	3.26	4.27	5.29	6.31	7.33	8.35	9.36	2.85	3.87	4.88	5.90	6.92	7.94	8.96
200	20	4.71	5.78	6.86	7.93	9.00	10.07	11.14	3.43	4.50	5.57	6.64	7.71	8.79	9.86	3.00	4.07	5.14	6.21	7.29	8.36	9.43
200	25	4.98	6.10	7.23	8.36	9.48	10.61	11.73	3.61	4.74	5.86	6.99	8.12	9.24	10.37	3.16	4.28	5.41	6.53	7.66	8.79	9.91
200	30	5.29	6.47	7.64	8.82	10.00	11.18	12.36	3.82	5.00	6.18	7.36	8.51	9.72	10.90	3.33	4.51	5.69	6.87	8.05	9.23	10.41
200	35	5.64	6.88	8.11	9.34	10.58	11.81	13.05	4.05	5.29	6.52	7.75	8.99	10.22	11.46	3.52	4.76	5.99	7.22	8.46	9.69	10.93
200	40	6.05	7.34	8.62	9.91	11.20	12.49	13.77	4.31	5.60	6.88	8.17	9.46	10.75	12.04	3.73	5.02	6.30	7.59	8.88	10.17	11.46
Dollars/M bd.ft.																						
300	5	3.34	4.25	5.16	6.07	6.99	7.90	8.81	2.58	3.49	4.40	5.32	6.23	7.14	8.05	2.33	3.24	4.15	5.06	5.98	6.89	7.80
300	10	3.50	4.46	5.43	6.39	7.36	8.33	9.29	2.71	3.68	4.64	5.61	6.58	7.54	8.51	2.45	3.42	4.38	5.35	6.32	7.28	8.25
300	15	3.67	4.69	5.71	6.73	7.75	8.77	9.79	2.85	3.87	4.89	5.91	6.93	7.95	8.97	2.58	3.60	4.62	5.64	6.66	7.68	8.70
300	20	3.86	4.93	6.01	7.08	8.16	9.23	10.30	3.00	4.08	5.15	6.22	7.30	8.37	9.45	2.72	3.79	4.86	5.94	7.01	8.09	9.16
300	25	4.07	5.20	6.33	7.46	8.58	9.71	10.84	3.16	4.29	5.42	6.55	7.67	8.80	9.93	2.86	3.99	5.11	6.24	7.37	8.50	9.63
300	30	4.31	5.50	6.68	7.86	9.01	10.22	11.41	3.34	4.52	5.70	6.88	8.06	9.25	10.43	3.01	4.19	5.37	6.56	7.74	8.92	10.10
300	35	4.59	5.82	7.06	8.30	9.53	10.77	12.00	3.53	4.76	6.00	7.24	8.47	9.71	10.94	3.17	4.41	5.65	6.88	8.12	9.35	10.59
300	40	4.89	6.18	7.47	8.76	10.05	11.34	12.63	3.73	5.02	6.31	7.60	8.89	10.18	11.47	3.35	4.64	5.93	7.22	8.51	9.80	11.09
Dollars/M bd.ft.																						
400	5	2.96	3.88	4.79	5.71	6.62	7.54	8.45	2.39	3.31	4.22	5.14	6.05	6.97	7.88	2.20	3.12	4.03	4.95	5.86	6.78	7.69
400	10	3.11	4.08	5.05	6.01	6.98	7.95	8.92	2.52	3.49	4.46	5.43	6.40	7.36	8.33	2.32	3.29	4.26	5.23	6.20	7.17	8.14
400	15	3.26	4.29	5.31	6.33	7.36	8.38	9.40	2.65	3.68	4.70	5.72	6.71	7.77	8.79	2.45	3.47	4.49	5.52	6.54	7.56	8.58
400	20	3.43	4.51	5.59	6.66	7.74	8.82	9.89	2.79	3.87	4.94	6.02	7.10	8.17	9.25	2.58	3.65	4.73	5.81	6.88	7.96	9.04
400	25	3.62	4.75	5.88	7.01	8.14	9.27	10.40	2.94	4.07	5.20	6.33	7.46	8.59	9.72	2.71	3.84	4.97	6.10	7.23	8.36	9.49
400	30	3.83	5.01	6.20	7.38	8.57	9.75	10.94	3.10	4.28	5.47	6.65	7.83	9.02	10.20	2.85	4.04	5.22	6.41	7.59	8.77	9.96
400	35	4.06	5.30	6.54	7.78	9.01	10.25	11.49	3.27	4.50	5.74	6.98	8.22	9.46	10.70	3.00	4.24	5.48	6.72	7.95	9.19	10.43
400	40	4.32	5.61	6.90	8.19	9.49	10.78	12.07	3.45	4.74	6.03	7.33	8.62	9.91	11.20	3.16	4.45	5.74	7.04	8.33	9.62	10.91
Dollars/M bd.ft.																						
500	5	2.74	3.66	4.57	5.49	6.41	7.32	8.24	2.28	3.20	4.12	5.04	5.95	6.87	7.79	2.13	3.05	3.97	4.88	5.80	6.72	7.64
500	10	2.88	3.85	4.82	5.79	6.76	7.73	8.70	2.41	3.38	4.35	5.32	6.29	7.26	8.23	2.25	3.22	4.19	5.16	6.13	7.11	8.08
500	15	3.02	4.05	5.07	6.10	7.12	8.15	9.17	2.53	3.56	4.58	5.61	6.63	7.66	8.68	2.37	3.40	4.42	5.45	6.47	7.50	8.52
500	20	3.18	4.26	5.34	6.42	7.50	8.58	9.66	2.67	3.75	4.83	5.90	6.98	8.06	9.14	2.50	3.57	4.65	5.73	6.81	7.89	8.97
500	25	3.35	4.49	5.62	6.75	7.88	9.02	10.15	2.81	3.94	5.07	6.20	7.34	8.47	9.60	2.62	3.76	4.89	6.02	7.16	8.29	9.42
500	30	3.54	4.73	5.91	7.10	8.29	9.47	10.66	2.95	4.14	5.33	6.51	7.70	8.89	10.07	2.76	3.95	5.13	6.32	7.51	8.69	9.88
500	35	3.75	4.99	6.23	7.47	8.71	9.95	11.19	3.11	4.35	5.59	6.83	8.07	9.31	10.56	2.90	4.14	5.38	6.62	7.86	9.10	10.34
500	40	3.98	5.27	6.56	7.86	9.15	10.45	11.74	3.28	4.57	5.87	7.16	8.46	9.75	11.05	3.05	4.34	5.64	6.93	8.23	9.52	10.81
Dollars/M bd.ft.																						
600	5	2.59	3.51	4.43	5.35	6.27	7.19	8.11	2.21	3.13	4.05	4.97	5.89	6.81	7.73	2.09	3.01	3.93	4.84	5.76	6.68	7.60
600	10	2.73	3.70	4.67	5.65	6.62	7.59	8.57	2.33	3.31	4.28	5.25	6.23	7.20	8.17	2.20	3.18	4.15	5.12	6.10	7.07	8.04
600	15	2.87	3.89	4.92	5.95	6.97	8.00	9.03	2.46	3.48	4.51	5.54	6.57	7.59	8.62	2.32	3.35	4.38	5.40	6.43	7.46	8.49
600	20	3.01	4.10	5.18	6.26	7.34	8.42	9.50	2.59	3.67	4.75	5.83	6.91	7.99	9.07	2.44	3.52	4.61	5.69	6.77	7.85	8.93
600	25	3.18	4.31	5.45	6.58	7.72	8.85	9.99	2.72	3.86	4.99	6.13	7.26	8.40	9.53	2.57	3.70	4.84	5.97	7.11	8.24	9.38
600	30	3.35	4.54	5.73	6.92	8.11	9.29	10.48	2.86	4.05	5.24	6.43	7.62	8.81	9.99	2.70	3.89	5.08	6.27	7.45	8.64	9.83
600	35	3.54	4.78	6.03	7.27	8.51	9.75	11.00	3.01	4.25	5.50	6.74	7.98	9.22	10.47	2.83	4.08	5.32	6.56	7.81	9.05	10.29
600	40	3.75	5.04	6.34	7.64	8.93	10.23	11.53	3.17	4.46	5.76	7.06	8.35	9.65	10.95	2.97	4.27	5.57	6.86	8.16	9.46	10.76

ties commonly found in Montana, Idaho, and northwestern Wyoming

10 THOUSAND BOARD FEET PER ACRE						15 THOUSAND BOARD FEET PER ACRE						
Logs/M bd.ft.						Logs/M bd.ft.						
8	10	12	14	16		4	6	8	10	12	14	16
Dollars/M bd. ft.						Dollars/M bd. ft.						
5.43	5.83	6.24	6.64	7.04		3.35	3.75	4.16	4.56	4.96	5.37	5.77
5.63	6.06	6.50	6.93	7.37		3.46	3.90	4.33	4.76	5.20	5.63	6.07
5.85	6.31	6.78	7.24	7.71		3.59	4.05	4.52	4.98	5.45	5.91	6.37
6.09	6.59	7.08	7.58	8.07		3.73	4.23	4.72	5.22	5.71	6.21	6.70
6.37	6.90	7.42	7.95	8.47		3.90	4.42	4.95	5.47	6.00	6.52	7.05
6.69	7.25	7.81	8.36	8.92		4.09	4.65	5.20	5.76	6.31	6.87	7.42
7.06	7.65	8.24	8.82	9.41		4.32	4.90	5.49	6.08	6.66	7.25	7.83
7.48	8.10	8.72	9.33	9.95		4.58	5.19	5.81	6.43	7.04	7.66	8.28
4.23	4.81	5.39	5.97	6.55		2.43	3.01	3.59	4.17	4.75	5.33	5.91
4.39	5.00	5.61	6.22	6.83		2.52	3.13	3.74	4.35	4.96	5.57	6.18
4.56	5.20	5.84	6.48	7.12		2.61	3.25	3.89	4.53	5.17	5.82	6.46
4.74	5.41	6.08	6.76	7.43		2.71	3.38	4.05	4.73	5.40	6.07	6.74
4.94	5.64	6.34	7.05	7.75		2.82	3.53	4.23	4.93	5.63	6.33	7.04
5.16	5.89	6.63	7.36	8.09		2.95	3.68	4.42	5.15	5.88	6.61	7.35
5.41	6.17	6.93	7.70	8.46		3.10	3.86	4.62	5.38	6.15	6.91	7.67
5.68	6.47	7.27	8.06	8.85		3.26	4.05	4.84	5.63	6.43	7.22	8.01
4.30	5.05	5.81	6.57	7.33		2.36	3.12	3.87	4.63	5.39	6.14	6.90
4.44	5.23	6.02	6.81	7.59		2.44	3.22	4.01	4.80	5.59	6.37	7.16
4.60	5.42	6.23	7.05	7.87		2.52	3.34	4.15	4.97	5.79	6.61	7.43
4.76	5.61	6.46	7.31	8.15		2.61	3.45	4.30	5.15	6.00	6.85	7.70
4.93	5.81	6.69	7.57	8.45		2.70	3.58	4.46	5.34	6.22	7.10	7.97
5.12	6.03	6.94	7.85	8.76		2.81	3.72	4.63	5.53	6.44	7.35	8.26
5.33	6.27	7.21	8.15	9.08		2.92	3.86	4.80	5.74	6.68	7.62	8.56
5.55	6.52	7.49	8.46	9.43		3.05	4.02	4.99	5.96	6.93	7.90	8.87
4.68	5.62	6.55	7.49	8.42		2.50	3.43	4.37	5.30	6.23	7.17	8.10
4.83	5.79	6.75	7.72	8.68		2.57	3.54	4.50	5.47	6.43	7.39	8.36
4.97	5.97	6.96	7.96	8.95		2.65	3.64	4.64	5.63	6.63	7.62	8.62
5.12	6.15	7.17	8.20	9.22		2.73	3.76	4.78	5.81	6.83	7.86	8.88
5.28	6.34	7.40	8.45	9.51		2.82	3.87	4.93	5.98	7.04	8.09	9.15
5.46	6.54	7.63	8.71	9.80		2.91	4.00	5.08	6.17	7.25	8.34	9.43
5.64	6.76	7.87	8.99	10.10		3.01	4.13	5.25	6.36	7.48	8.59	9.71
5.84	6.98	8.13	9.28	10.42		3.12	4.27	5.42	6.56	7.71	8.86	10.00

Table 8.--Operating costs using Idaho jammers for three different stand densities commonly found in Montana, Idaho, and northwestern Wyoming

Distance (feet)	Slope (percent)	5 THOUSAND BOARD FEET PER ACRE							10 THOUSAND BOARD FEET PER ACRE							15 THOUSAND BOARD FEET PER ACRE						
		Logs/M bd.ft.							Logs/M bd.ft.							Logs/M bd.ft.						
		4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16
<i>Dollars/M bd. ft.</i>																						
100	5	8.44	8.84	9.25	9.65	10.06	10.46	10.86	4.62	5.03	5.43	5.83	6.24	6.64	7.04	3.35	3.75	4.16	4.56	4.96	5.37	5.77
100	10	8.66	9.09	9.52	9.96	10.39	10.83	11.26	4.76	5.19	5.63	6.06	6.50	6.93	7.37	3.46	3.90	4.33	4.76	5.20	5.63	6.07
100	15	8.91	9.38	9.84	10.31	10.77	11.24	11.70	4.92	5.38	5.85	6.31	6.78	7.24	7.71	3.59	4.05	4.52	4.98	5.45	5.91	6.37
100	20	9.22	9.72	10.21	10.71	11.20	11.70	12.19	5.10	5.60	6.09	6.59	7.08	7.58	8.07	3.73	4.23	4.72	5.22	5.71	6.21	6.70
100	25	9.60	10.12	10.65	11.17	11.70	12.22	12.75	5.32	5.85	6.37	6.90	7.42	7.95	8.47	3.90	4.42	4.95	5.47	6.00	6.52	7.05
100	30	10.06	10.61	11.17	11.73	12.28	12.84	13.39	5.58	6.14	6.69	7.25	7.81	8.36	8.92	4.09	4.65	5.20	5.76	6.31	6.87	7.42
100	35	10.62	11.20	11.79	12.38	12.96	13.55	14.13	5.89	6.48	7.06	7.65	8.24	8.82	9.41	4.32	4.90	5.49	6.08	6.66	7.25	7.83
100	40	11.28	11.89	12.51	13.12	13.74	14.36	14.97	6.25	6.87	7.48	8.10	8.72	9.33	9.95	4.58	5.19	5.81	6.43	7.04	7.66	8.28
200	5	4.97	5.55	6.14	6.72	7.30	7.88	8.46	3.07	3.65	4.23	4.81	5.39	5.97	6.55	2.43	3.01	3.59	4.17	4.75	5.33	5.91
200	10	5.11	5.72	6.33	6.95	7.56	8.17	8.78	3.16	3.78	4.39	5.00	5.61	6.22	6.83	2.52	3.13	3.74	4.35	4.96	5.57	6.18
200	15	5.27	5.91	6.55	7.20	7.84	8.48	9.12	3.27	3.92	4.56	5.20	5.84	6.48	7.12	2.61	3.25	3.89	4.53	5.17	5.82	6.46
200	20	5.46	6.13	6.80	7.47	8.14	8.81	9.49	3.40	4.07	4.74	5.41	6.08	6.76	7.43	2.71	3.38	4.05	4.73	5.40	6.07	6.74
200	25	5.67	6.38	7.08	7.78	8.48	9.18	9.89	3.54	4.24	4.94	5.64	6.34	7.05	7.75	2.82	3.53	4.23	4.93	5.63	6.33	7.04
200	30	5.94	6.67	7.40	8.13	8.86	9.60	10.33	3.70	4.43	5.16	5.89	6.63	7.36	8.09	2.95	3.68	4.42	5.15	5.88	6.61	7.35
200	35	6.25	7.01	7.77	8.53	9.30	10.06	10.82	3.88	4.65	5.41	6.17	6.93	7.70	8.46	3.10	3.86	4.62	5.38	6.15	6.91	7.67
200	40	6.60	7.40	8.19	8.98	9.78	10.57	11.36	4.09	4.89	5.68	6.47	7.27	8.06	8.85	3.26	4.05	4.84	5.63	6.43	7.22	8.01
300	5	4.05	4.81	5.57	6.33	7.08	7.84	8.60	2.78	3.54	4.30	5.05	5.81	6.57	7.33	2.36	3.12	3.87	4.63	5.39	6.14	6.90
300	10	4.17	4.96	5.74	6.53	7.32	8.11	8.89	2.87	3.66	4.44	5.23	6.02	6.81	7.59	2.44	3.22	4.01	4.80	5.59	6.37	7.16
300	15	4.29	5.11	5.93	6.75	7.57	8.38	9.20	2.96	3.78	4.60	5.42	6.23	7.05	7.87	2.52	3.34	4.15	4.97	5.79	6.61	7.43
300	20	4.41	5.29	6.13	6.98	7.83	8.68	9.53	3.06	3.91	4.76	5.61	6.46	7.31	8.15	2.61	3.45	4.30	5.15	6.00	6.85	7.70
300	25	4.60	5.48	6.36	7.24	8.12	9.00	9.87	3.18	4.06	4.93	5.81	6.69	7.57	8.45	2.70	3.58	4.46	5.34	6.22	7.10	7.97
300	30	4.80	5.71	6.61	7.52	8.43	9.34	10.25	3.30	4.21	5.12	6.03	6.94	7.85	8.76	2.81	3.72	4.63	5.53	6.44	7.35	8.26
300	35	5.02	5.96	6.90	7.84	8.78	9.72	10.66	3.45	4.39	5.33	6.27	7.21	8.15	9.08	2.92	3.86	4.80	5.74	6.68	7.62	8.56
300	40	5.28	6.25	7.22	8.19	9.16	10.13	11.10	3.61	4.58	5.55	6.52	7.49	8.46	9.43	3.05	4.02	4.99	5.96	6.93	7.90	8.87
400	5	3.77	4.71	5.64	6.57	7.51	8.44	9.37	2.82	3.75	4.68	5.62	6.55	7.49	8.42	2.50	3.43	4.37	5.30	6.23	7.17	8.10
400	10	3.87	4.84	5.80	6.76	7.73	8.69	9.66	2.90	3.86	4.83	5.79	6.75	7.72	8.68	2.57	3.54	4.50	5.47	6.43	7.39	8.36
400	15	3.98	4.98	5.97	6.96	7.96	8.95	9.95	2.98	3.98	4.97	5.97	6.96	7.96	8.95	2.65	3.64	4.64	5.63	6.63	7.62	8.62
400	20	4.10	5.13	6.15	7.18	8.20	9.23	10.25	3.07	4.10	5.12	6.15	7.17	8.20	9.22	2.73	3.76	4.78	5.81	6.83	7.86	8.88
400	25	4.24	5.30	6.35	7.41	8.46	9.52	10.57	3.17	4.23	5.28	6.34	7.40	8.45	9.51	2.82	3.87	4.93	5.98	7.04	8.09	9.15
400	30	4.40	5.49	6.58	7.66	8.75	9.83	10.92	3.29	4.37	5.46	6.54	7.63	8.71	9.80	2.91	4.00	5.08	6.17	7.25	8.34	9.43
400	35	4.59	5.71	6.82	7.94	9.05	10.17	11.29	3.41	4.52	5.64	6.76	7.87	8.99	10.10	3.01	4.13	5.25	6.36	7.48	8.59	9.71
400	40	4.80	5.95	7.09	8.24	9.38	10.53	11.68	3.54	4.69	5.84	6.98	8.13	9.28	10.42	3.12	4.27	5.42	6.56	7.71	8.86	10.00

Table 9.--Operating costs using shovels (tongs) for three different stand densities commonly found in Montana, Idaho, and northwestern Wyoming

Distance (feet)	Slope (percent)	5 THOUSAND BOARD FEET PER ACRE							10 THOUSAND BOARD FEET PER ACRE							15 THOUSAND BOARD FEET PER ACRE						
		Logs/M bd.ft.							Logs/M bd.ft.							Logs/M bd.ft.						
		4	6	8	10	12	14	16	4	6	8	10	12	14	16	4	6	8	10	12	14	16
Dollars/M bd.ft.																						
25	5	5.82	6.22	6.63	7.03	7.44	7.84	8.25	3.31	3.72	4.12	4.53	4.93	5.34	5.75	2.48	2.88	3.29	3.69	4.10	4.50	4.91
25	10	6.34	6.69	7.04	7.40	7.75	8.10	8.46	3.52	3.87	4.23	4.58	4.93	5.29	5.64	2.58	2.93	3.29	3.64	4.00	4.35	4.70
25	15	7.02	7.32	7.62	7.92	8.22	8.52	8.83	3.81	4.11	4.41	4.71	5.01	5.32	5.62	2.74	3.04	3.34	3.64	3.95	4.25	4.55
25	20	7.90	8.15	8.40	8.65	8.90	9.15	9.40	4.20	4.45	4.70	4.95	5.20	5.45	5.70	2.96	3.21	3.46	3.71	3.96	4.21	4.46
25	25	9.06	9.26	9.46	9.66	9.85	10.05	10.25	4.73	4.92	5.12	5.32	5.52	5.72	5.92	3.28	3.48	3.68	3.88	4.07	4.27	4.47
25	30	10.56	10.71	10.85	11.00	11.14	11.29	11.44	5.42	5.57	5.72	5.86	6.01	6.15	6.30	3.71	3.86	4.00	4.15	4.30	4.44	4.59
25	35	12.45	12.55	12.64	12.74	12.83	12.92	13.02	6.32	6.41	6.51	6.60	6.70	6.79	6.88	4.27	4.37	4.46	4.56	4.65	4.75	4.84
25	40	14.73	14.77	14.82	14.86	14.90	14.94	14.99	7.41	7.45	7.49	7.53	7.58	7.62	7.66	4.96	5.01	5.05	5.09	5.13	5.18	5.22
Dollars/M bd.ft.																						
50	5	3.52	4.03	4.54	5.05	5.56	6.07	6.58	2.27	2.78	3.29	3.80	4.31	4.82	5.33	1.85	2.36	2.87	3.38	3.89	4.40	4.91
50	10	3.73	4.19	4.64	5.10	5.56	6.02	6.48	2.32	2.78	3.24	3.69	4.15	4.61	5.07	1.85	2.31	2.77	3.22	3.68	4.14	4.60
50	15	4.02	4.42	4.83	5.23	5.64	6.05	6.45	2.41	2.82	3.22	3.63	4.04	4.44	4.85	1.88	2.28	2.69	3.10	3.50	3.91	4.31
50	20	4.41	4.76	5.12	5.47	5.83	6.18	6.53	2.56	2.91	3.26	3.62	3.97	4.33	4.68	1.94	2.29	2.65	3.00	3.36	3.71	4.06
50	25	4.94	5.24	5.54	5.84	6.15	6.45	6.75	2.77	3.07	3.37	3.68	3.98	4.28	4.58	2.05	2.35	2.65	2.95	3.25	3.56	3.86
50	30	5.63	5.88	6.13	6.38	6.63	6.89	7.14	3.06	3.31	3.57	3.82	4.07	4.32	4.57	2.21	2.46	2.71	2.96	3.21	3.46	3.71
50	35	6.53	6.73	6.92	7.12	7.32	7.52	7.72	3.46	3.66	3.86	4.06	4.25	4.45	4.65	2.44	2.64	2.83	3.03	3.23	3.43	3.63
50	40	7.61	7.76	7.91	8.06	8.20	8.35	8.50	3.95	4.10	4.25	4.39	4.54	4.69	4.83	2.73	2.88	3.02	3.17	3.32	3.47	3.61
Dollars/M bd.ft.																						
75	5	2.89	3.51	4.12	4.74	5.35	5.97	6.58	2.06	2.67	3.29	3.90	4.52	5.13	5.74	1.78	2.39	3.01	3.62	4.24	4.85	5.47
75	10	3.00	3.56	4.12	4.68	5.25	5.81	6.37	2.06	2.62	3.18	3.75	4.31	4.87	5.43	1.75	2.31	2.87	3.43	4.00	4.56	5.12
75	15	3.16	3.67	4.18	4.69	5.20	5.71	6.22	2.09	2.60	3.11	3.62	4.13	4.64	5.15	1.73	2.24	2.75	3.26	3.77	4.28	4.79
75	20	3.38	3.84	4.30	4.76	5.22	5.68	6.13	2.15	2.61	3.06	3.52	3.98	4.44	4.90	1.74	2.19	2.65	3.11	3.57	4.03	4.49
75	25	3.70	4.11	4.51	4.92	5.33	5.73	6.14	2.25	2.66	3.07	3.47	3.88	4.29	4.69	1.77	2.18	2.59	2.99	3.40	3.81	4.21
75	30	4.13	4.48	4.84	5.19	5.55	5.90	6.26	2.42	2.77	3.13	3.48	3.84	4.19	4.55	1.85	2.20	2.56	2.91	3.27	3.62	3.98
75	35	4.69	4.99	5.30	5.60	5.90	6.21	6.51	2.65	2.95	3.25	3.56	3.86	4.16	4.46	1.96	2.27	2.57	2.87	3.18	3.48	3.78
75	40	5.38	5.63	5.88	6.14	6.39	6.64	6.89	2.94	3.19	3.44	3.69	3.94	4.20	4.45	2.13	2.38	2.63	2.88	3.13	3.38	3.63
Dollars/M bd.ft.																						
100	5	2.68	3.40	4.12	4.84	5.56	6.28	7.00	2.06	2.78	3.50	4.21	4.93	5.65	6.37	1.85	2.57	3.29	4.01	4.72	5.44	6.16
100	10	2.74	3.40	4.07	4.74	5.40	6.07	6.74	2.03	2.70	3.37	4.03	4.70	5.37	6.03	1.80	2.46	3.13	3.80	4.46	5.13	5.80
100	15	2.83	3.44	4.06	4.67	5.29	5.90	6.52	2.03	2.64	3.26	3.87	4.49	5.10	5.72	1.76	2.37	2.99	3.60	4.22	4.83	5.45
100	20	2.97	3.54	4.10	4.66	5.23	5.79	6.35	2.05	2.61	3.17	3.74	4.30	4.86	5.43	1.74	2.30	2.86	3.43	3.99	4.55	5.12
100	25	3.18	3.70	4.21	4.72	5.23	5.74	6.25	2.10	2.61	3.12	3.63	4.15	4.66	5.17	1.74	2.25	2.76	3.27	3.78	4.30	4.81
100	30	3.48	3.94	4.40	4.86	5.32	5.78	6.24	2.20	2.66	3.12	3.58	4.03	4.49	4.95	1.77	2.23	2.69	3.15	3.61	4.07	4.53
100	35	3.88	4.28	4.69	5.10	5.51	5.91	6.32	2.34	2.75	3.16	3.57	3.97	4.38	4.79	1.83	2.24	2.65	3.05	3.46	3.87	4.28
100	40	4.37	4.72	5.08	5.44	5.79	6.15	6.50	2.54	2.89	3.25	3.60	3.96	4.32	4.67	1.93	2.28	2.64	2.99	3.35	3.70	4.06
Dollars/M bd.ft.																						
125	5	2.64	3.47	4.29	5.11	5.93	6.76	7.58	2.14	2.96	3.79	4.61	5.43	6.26	7.08	1.97	2.80	3.62	4.44	5.27	6.09	6.91
125	10	2.66	3.43	4.21	4.98	5.75	6.52	7.29	2.10	2.87	3.64	4.41	5.18	5.96	6.73	1.91	2.68	3.45	4.23	5.00	5.77	6.54
125	15	2.72	3.44	4.16	4.87	5.59	6.31	7.03	2.08	2.79	3.51	4.23	4.95	5.67	6.39	1.86	2.58	3.30	4.02	4.74	5.46	6.18
125	20	2.81	3.48	4.15	4.81	5.48	6.15	6.82	2.07	2.74	3.41	4.07	4.74	5.41	6.07	1.82	2.49	3.16	3.83	4.49	5.16	5.83
125	25	2.96	3.58	4.19	4.81	5.42	6.04	6.65	2.09	2.71	3.32	3.94	4.55	5.17	5.79	1.80	2.42	3.03	3.65	4.27	4.88	5.50
125	30	3.18	3.74	4.30	4.87	5.43	5.99	6.56	2.15	2.71	3.28	3.84	4.40	4.97	5.53	1.81	2.37	2.93	3.50	4.06	4.62	5.19
125	35	3.47	3.98	4.50	5.01	5.52	6.03	6.54	2.25	2.76	3.27	3.78	4.29	4.80	5.32	1.84	2.35	2.86	3.37	3.88	4.40	4.91
125	40	3.85	4.31	4.76	5.22	5.68	6.14	6.60	2.38	2.84	3.30	3.76	4.22	4.68	5.14	1.89	2.35	2.81	3.27	3.73	4.19	4.65

Schillings, Paul L.

1969. A technique for comparing the costs of skidding methods. U.S. Dep. Agr., Forest Serv., Intermountain Forest and Range Exp. Sta., Ogden, Utah 84401. 23 pp., illus. (USDA Forest Serv. Res. Pap. INT-60)

A series of tables shows costs of skidding as determined by various types of equipment, distances for skidding, percent of slope, logs per MBF, and MBF per acre. By consulting these tables a contractor can compare methods of skidding according to their relative operating costs and thus estimate costs for his own operation. Such cost estimates must be regarded as tentative and subject to revision.

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Headquarters for the Intermountain Forest and
Range Experiment Station are in Ogden, Utah.
Field Research Work Units are maintained in:

Boise, Idaho

Bozeman, Montana (in cooperation with
Montana State University)

Logan, Utah (in cooperation with Utah
State University)

Missoula, Montana (in cooperation with
University of Montana)

Moscow, Idaho (in cooperation with the
University of Idaho)

Provo, Utah (in cooperation with
Brigham Young University)

FOREST SERVICE CREED

The Forest Service of the U. S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing nation.