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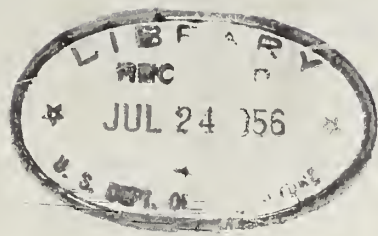
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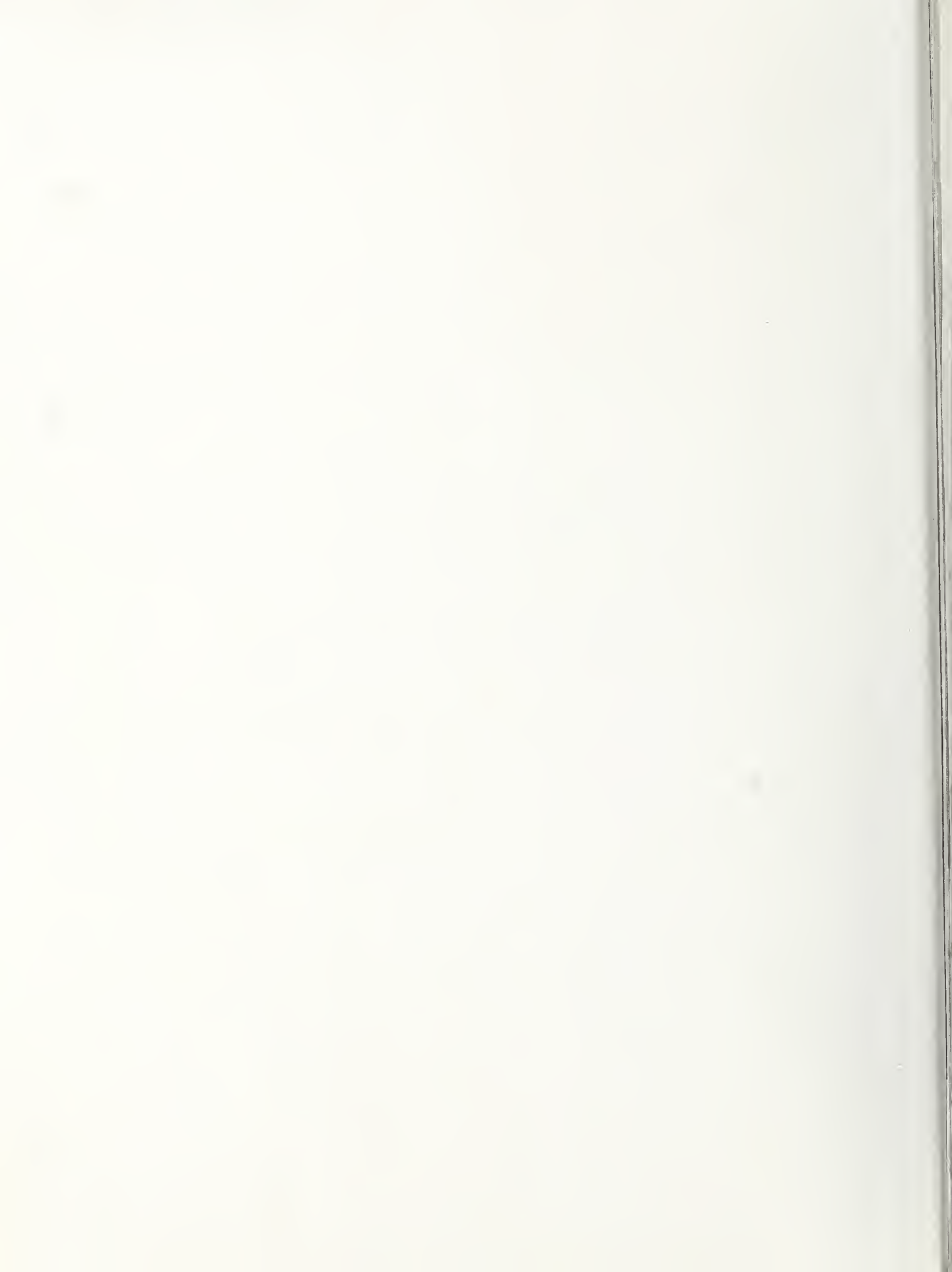
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Tractors
Tractor Logging

December 9, 1926.

T R A C T O R L O G G I N G D A M A G E S T U D Y

F R U I T G R O W E R S S U P P L Y C O M P A N Y S A L E A R E A

L A S S E N N A T I O N A L F O R E S T

D I S T R I C T 5 .

Respectfully Submitted:

John R Berry
Logging Engineer.

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I. INTRODUCTION:

Tractors of the track laying type were first used for logging in California during the season of 1922. These machines have proven to be such economical loggers that they have practically replaced both the steam donkey and the horse on the flatter country of northeastern California and are being used to some extent on the west slope of the Sierra, where the topography is steeper and more broken.

Fortunately the tractor, in addition to its economy, is less damaging to the reserve stand, under most conditions, than the various systems of steam donkey logging which are in use in District 5. Therefore the Forest Service favors the increased use of these machines on both private and government lands and is requiring tractor logging in National Forest timber sales wherever the topography will permit.

A study by Logging Engineer Price in 1925 indicated that the reserve stand above 8" d.b.h. was practically free from serious injury in tractor logging, but that considerable damage can be done to the smaller reproduction and poles. Although the observers were not present at the time the plot was logged, they thought that the damage to the young stuff was excessive and could be decreased by proper restrictions

Therefore, another study was conducted this season and an observer remained on the ground during the entire logging operation, to determine how the destruction occurred and if possible to formulate workable restrictions which might decrease it.

II. LOCATION AND DESCRIPTION OF PLOT:

A sample plot was laid out in September, 1926, on the government sale area of the Fruit Growers Supply Company, Lassen National Forest. It is located in Section 12, T. 32 N., R. 9 E., M.D.M., as shown on the attached map.

The slopes of the plot are gentle with no well defined drainages, the maximum grade being about 12%. The surface is smooth and free from rock with the exception of one small outcrop which did not interfere with logging. The soil was firm with some small loose rock offering very good traction. In general the area in which the plot was located was an excellent tractor logging chance.

The merchantable timber stand consisted of yellow pine, sugar pine, white fir and incense cedar, of all age classes and silvical description. Reproduction and poles of all ages were well distributed over the area. The young growth was largely white fir but all species were well represented. The attached map shows in detail the distribution of both the merchantable timber and the young growth.

The plot was laid out 10 chains square, with the boundaries $38^{\circ} 30'$ anticlockwise from the cardinal (magnetic) directions. Stakes were set every two chains along the boundaries and on cross strips so as to divide the plot into 25 squares each containing $4/10$ of an acre. Staff compass and chain were used for this work. With a plane table and a stadia rod, using the stakes as guides, the detailed map of the area was made.

All trees 4" d.b.h. and larger were located and recorded on the map. For trees up to 12" in diameter the record was kept separate for those under 8" d.b.h. and for those from 8" to 12" d.b.h. Actual diameters and heights (in merchantable logs) were recorded for all trees 12" and more in diameter. Reproduction was divided into three classes: Fully stocked areas where the reproduction was from 5' in height to 4" d.b.h. (assuming the stand to be fully stocked when individuals were not more than 6.6 feet apart); fully stocked areas where the reproduction was 0-5' in height; and areas which were not fully stocked in which the scattered individuals were shown. Snags were also located and the diameters recorded.

Two sub-plots each 10 chains long and .2 chains wide were established for a reproduction count. These sub-plots were located parallel to the eastern base line of the plot at distances of 2 and 8 chains. These locations were chosen so that the sub-plots would be well separated and approximately perpendicular to the natural direction of logging, thus giving a better cross-section of the average logging damage on the plot.



III. ORIGINAL STAND ON PLOT:

A. MERCHANTABLE TIMBER: Based on 100% count.

	*TO BE CUT		*TO BE LEFT		PERCENT TO BE LEFT		
	NUMBER	VOLUME	NUMBER	VOLUME	BY	BY	
		GROSS	NET		NUMBER	VOLUME	
	<u>BY SPECIES</u>						
Yellow pine	62	88,070	86,310	86	43,830	58%	34%
Sugar pine	12	23,480	23,010	26	9,880	68%	30%
White fir	95	53,490	37,440	137	18,520	59%	33%
Inconso codar	44	27,550	19,280	47	7,190	52%	27%
Totals	213	192,590	166,040	296	79,420	58%	32%

	<u>BY DIAMETER CLASS</u>						
12" - 17", d.b.h.	13	950	950	136	6,080	81%	86%
18" - 23", d.b.h.	42	6,820	6,480	80	13,570	66%	68%
24" - 29", d.b.h.	45	20,110	18,100	46	20,430	51%	53%
30" - 35", d.b.h.	54	46,390	39,630	25	24,040	32%	38%
36" and up,	59	118,320	100,880	9	15,300	13%	13%
Totals	213	192,590	166,040	296	79,420	58%	32%

Average cut per acre, 21.3 trees, 19,260 M gross, 16,600 M net,
 Average left per acre, 29.6 trees, 7,940 M gross, 7,940 M net,
 Total Stand: 50.9 trees, 27,200 M gross, 24,540 M net,

*Note: These figures are based upon the marking. Several unmarked trees were cut through carelessness or ignorance on the part of the crew or because of serious injury during falling. A table appearing later in the report gives the stand actually remaining on the area after logging.



B. POLES:

<u>DIAMETER BREAST HIGH</u>	<u>NUMBER ON PLOT</u>	<u>NUMBER PER ACRE</u>
4" - 7"	602	60.2
8" - 11"	<u>179</u>	<u>17.9</u>
Total:	781	78.1

C. REPRODUCTION - COUNT: Based on count of reproduction strips, which covered 4% of the plot.

<u>SIZE</u>	<u>NUMBER</u>
Less than 2' high, -----	3,350 per acre
2' - 5' high, -----	1,697 per acre
5' high to 4", d.b.h., -----	527 per acre
Total: -----	5,574 per acre

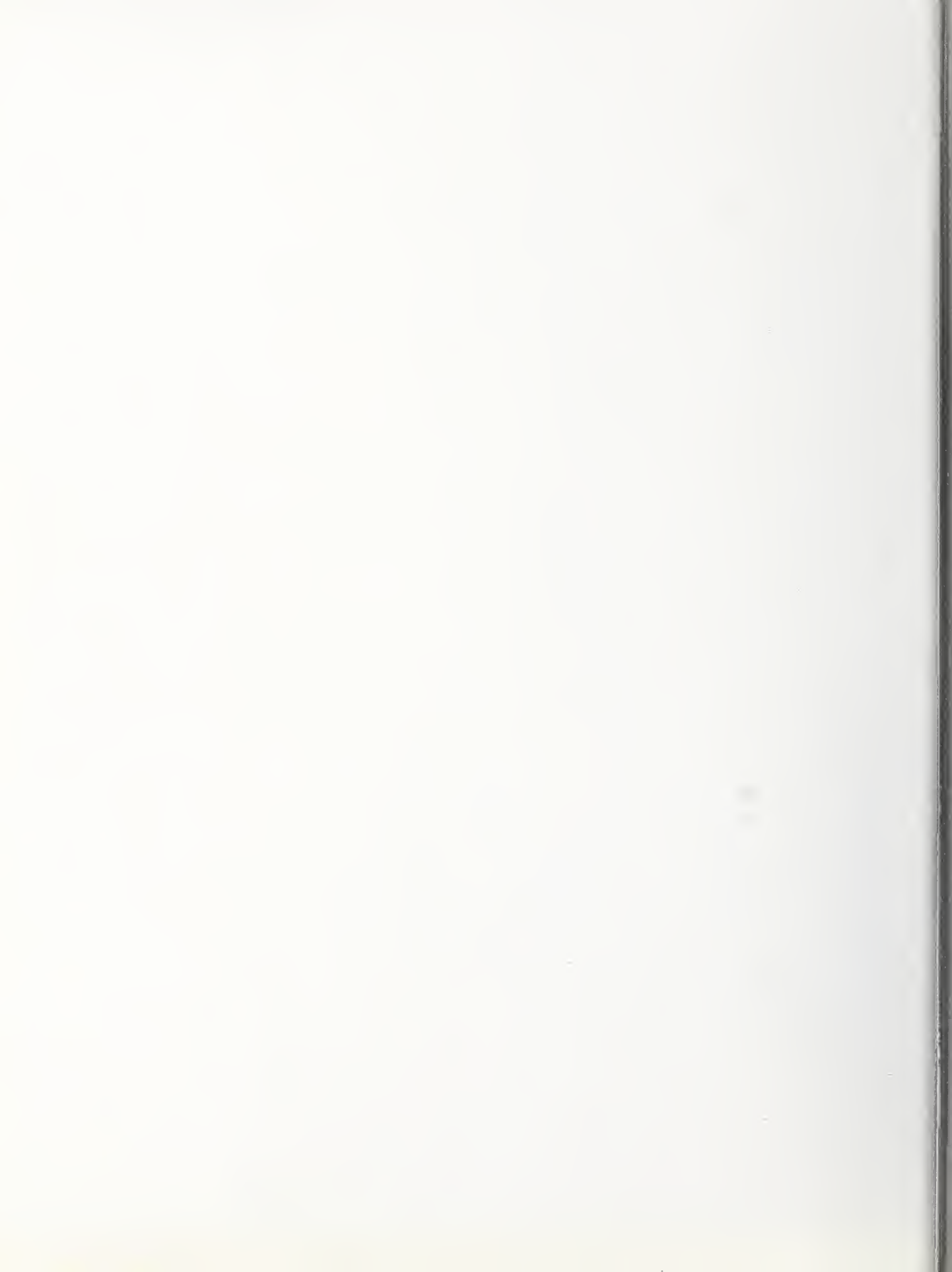
D. REPRODUCTION - AREA BASIS: Based on 100% survey.

Assuming an area to be fully stocked when there is at least one individual to a 6.6 foot square.

Percent of area fully stocked with reproduction 5' high - 4" d.b.h., ---	22.6
Percent of area fully stocked with reproduction 0' to 5' high, -----	<u>63.7</u>
Percent of area fully stocked, -----	86.3
Percent of area not fully stocked, -----	13.7
Scattered individuals in the unstocked areas, -----	188

IV. LOGGING METHODS:

The area was logged during September with six of the Caterpillar-60 tractors. Each tractor carried three chokers and skidded from 1 to 3 logs from the stump to the loading jammer at the railroad. No effort was made to locate the main roads before the timber was felled and as no swamping was done the choice of direction in which a log should go out was made by the cat driver or head choker setter.



Felling was done by day labor and in general the timber was pointed to or from the landing to which it was to go apparently regardless of the type of growth into which it fell.

V. METHOD OF CONDUCTING STUDY:

Before the timber was felled a survey with plane table and stadia was made by Logging Engineers Price and Berry, assisted by Assistant Chief of Management Dunston and Junior Forester Hughes, and a detailed map was prepared showing the location of each pole or tree above 4" d.b.h. and the location of the fully stocked stands of reproduction.

After felling was completed the area was examined to determine the damage which occurred and to plot the location of the felled trees.

The item of damage was divided into two classes dependent upon the seriousness of the injury: 1. "Injured or partially damaged" included those specimens which might be retarded in growth but which normally would not die; 2. "Destroyed or totally damaged" included those specimens which were so seriously injured that they will undoubtedly die or were felled and logged; Three trees which were left by the marker but which were cut through ignorance or carelessness by the fallers have been included in this class.

The plot was re-examined after skidding and the injury or destruction to poles and trees above 4" d.b.h. were recorded. The various areas upon which tractor injury occurred were sketched upon the map making it possible to determine the percentage of the area of each type of reproduction which had been partially or totally damaged, as well as the percentage of the plot which was covered by tractor main roads.

A third examination of the plot was made after the snags were felled. The only damage which occurred during this portion of the operation was the destruction of two 4" - 7" poles, and has been included with felling.

As the plot is within an experimental area upon which the brush is not going to be burned, the damage due to the logging operation was completed with the snag felling.

This segregation of data makes it possible to determine the injury or destruction from felling or skidding suffered by each class of material in the reserve stand.

VI. RESERVE STAND AFTER LOGGING:

The following tables are derived from an office examination of the data recorded.

A. MERCHANTABLE TIMBER: Based on 100% count.

	<u>CUT AND DESTROYED</u>			<u>EFFECTIVE RESERVE STAND</u>			
	<u>NUMBER</u>	<u>GROSS VOLUME</u>	<u>NET VOLUME</u>	<u>NUMBER</u>	<u>VOLUME</u>	<u>% BY NUMBER</u>	<u>% BY VOLUME</u>
	<u>BY SPECIES</u>						
Yellow pine	65	88,740	86,980	83	43,160	56	33
Sugar pine	12	23,480	23,010	26	9,880	68	30
White fir	108	54,790	38,740	124	17,220	53	31
Incense cedar	50	27,990	19,720	41	6,750	45	26
Total:	235	195,000	168,450	274	77,010	54	31

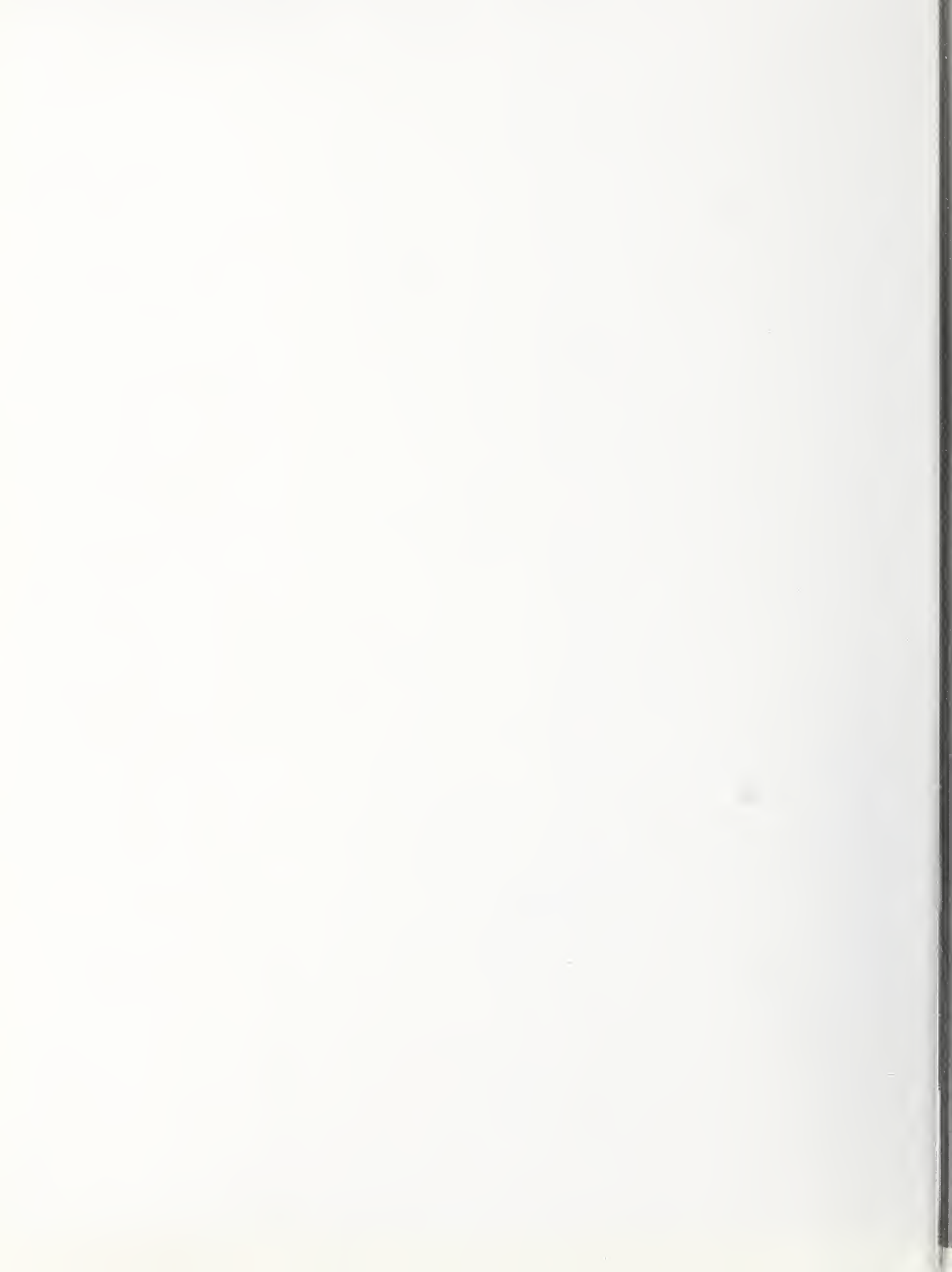
	<u>BY DIAMETER CLASS</u>						
	<u>NUMBER</u>	<u>GROSS VOLUME</u>	<u>NET VOLUME</u>	<u>NUMBER</u>	<u>VOLUME</u>	<u>% BY NUMBER</u>	<u>% BY VOLUME</u>
12" - 17" DBH	26	1,410	1,410	123	5,620	83	80
18" - 23" DBH	48	7,580	7,240	74	12,810	61	64
24" - 29" DBH	48	21,300	19,290	43	19,240	47	50
30" - 35" DBH	54	46,390	39,630	25	24,040	32	38
36" and up,	59	118,320	100,880	9	15,300	13	13
Total:	235	195,000	168,450	274	77,010	54	31

Average removed per acre, 23.5 trees, 19,500 M gross, 16,840 Net,
 Average reserve per acre, 27.4 7,700 7,700

Total Stand: 50.9 trees, 27,200 M Gross 24,540 M Net.

B. POLES: Based on 100% count.

<u>DIAMETER BREAST HIGH</u>	<u>NUMBER ON PLOT</u>	<u>NUMBER PER ACRE</u>
4" - 7"	475	47.5
8" - 11"	161	16.1
Total:	636	63.6



C. REPRODUCTION - COUNT: Based on recount of reproduction strips which covered 4% of the plot.

<u>SIZE</u>	<u>NUMBER</u>
Less than 2' high, -----	2,020 per acre
2' - 5' high, -----	1,090 per acre
5' high to 4" D.B.H., -----	370 per acre
Total: -----	3,480 per acre

D. REPRODUCTION - AREA BASIS: Based on 100% survey.

Percent of area fully stocked with reproduction 5' high - 4" D.B.H., -----	19.4
Percent of area fully stocked with reproduction 0' to 5' high, -----	43.9
Percent of area fully stocked after logging, -----	63.3
Scattered individuals in the unstocked areas, -----	113



VII. LOGGING DAMAGE:

The following tables express by percentages the amount and seriousness of the damage to all classes of material in the reserve stand, due to both felling and tractor skidding.

As the percentages are based upon the original reserve stand, the total under each class of damage is a summation of the felling and skidding.

Percentages of Original Reserve Stand						Based on 100% count				
D.B.H.	UNINJURED			INJURED			DESTROYED			ESTIMATED
	Fell-	Skid-	Total	Fell-	Skid-	Total	Fell-	Skid-	Total	EFFECTIVE
	ing	ding		ing	ding		ing	ding		SURVIVAL

A. MERCHANTABLE TIMBER:

36" and up,	100	89	89	-	11	11	-	-	-	100
30" - 35"	96	96	92	4	4	8	-	-	-	100
24" - 29"	92	91	83	2	9	11	6	-	6	94
18" - 23"	92	87	79	1	13	14	7	-	7	93
12" - 17"	86	97	83	5	2	7	9	1	10	90
Avg. over 12",										
By Number,	91	93	84	3	7	10	6	-	6	94
By Volume,	95	94	89	2	6	8	3	-	3	97

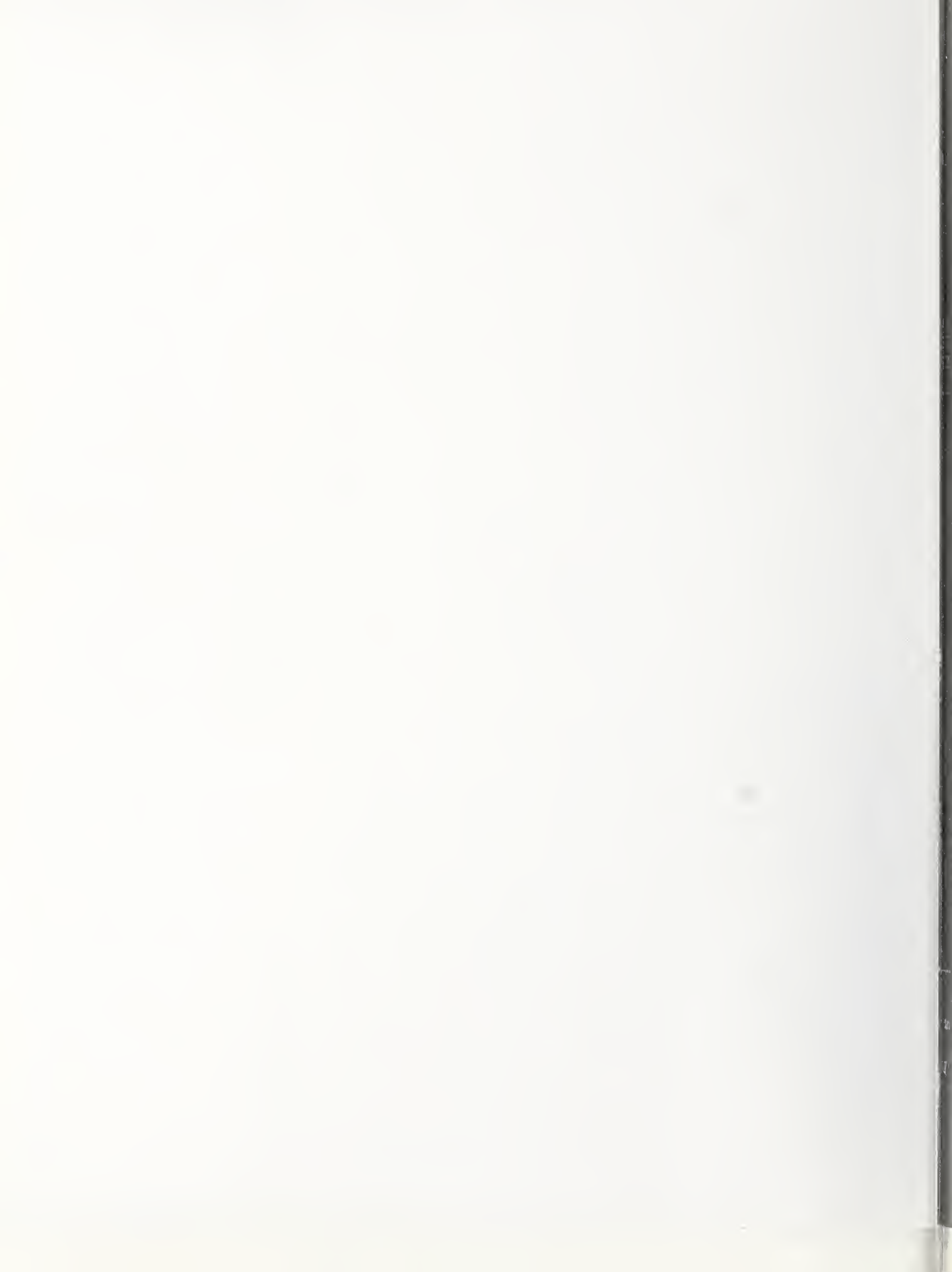
B. POLES:

8" - 11"	88	93	81	2	7	9	10	-	10	90
4" - 7"	84	93	77	2	2	4	14	5	19	79

C. REPRODUCTION STRIPS - COUNT:

5' - 4" DBH,	88	79	67	8	2	10	4	19	23	70
2' - 5'	-	60	60	-	10	10	-	30	30	64
0' - 2'	-	59	59	-	2	2	-	39	39	60
Average:			60			5			35	62

In the preceding tables the estimated effective survival is based upon an examination of each damaged individual. Any specimen damaged to the extent that the observer thought there was any chance of its dying, was placed in the "destroyed" classification. Those individuals which were so slightly damaged that there



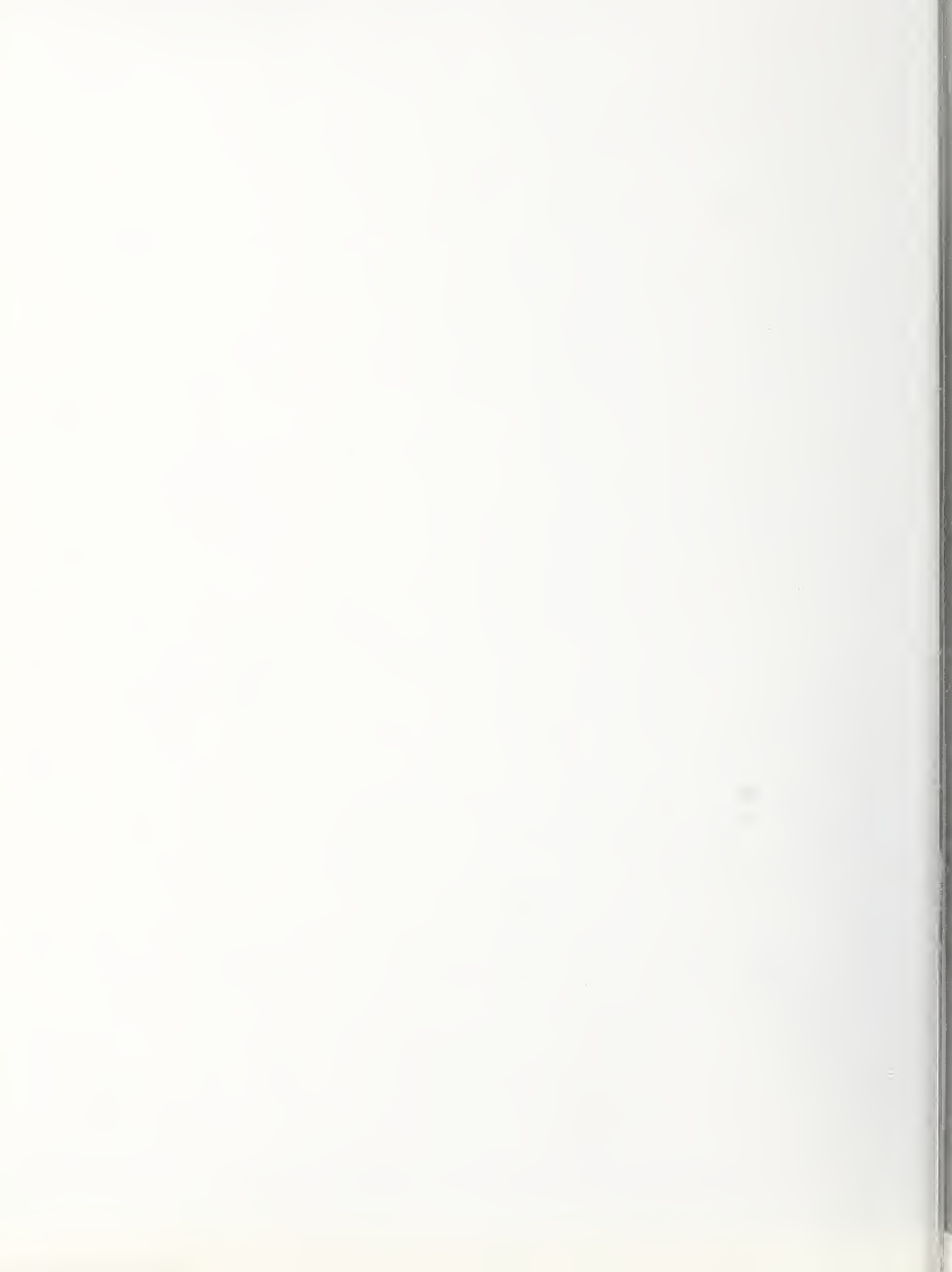
as no doubt of their satisfactory survival were classified as "injured".

Realizing the impossibility of positively forecasting the life or death of the smaller damaged individuals, without a re-examination after a period of a year or two, I have decreased the percentages of "Estimated Effective Survival" of the reproduction by approximately 50% of those injured. Due to the methods of recording and calculating the data, the figures of "Estimated Effective Survival" should be somewhat conservative.

It will be noted that falling damaged 9% of the trees and poles 12" and over d.b.h., and that skidding damaged an additional 7% of this stand. However, the skidding damage was practically confined to small scars at the base of the trees where the bark had been knocked off by the tractor treads or by a siwashing log. Only one tree, a small 12" d.b.h. white fir which was uprooted in a main road, was damaged enough by skidding to have its future growth affected. On the other hand, 6% of the reserve stand 12" d.b.h. and over was uprooted or broken by falling trees. This amount includes three unmarked trees which were felled through carelessness or ignorance. The 10% destruction suffered by the larger poles is also due to falling, none of the tractor damage being serious enough to cause retarded growth or death.

Falling and skidding both took part in the destruction of the smaller poles and larger reproduction from 5' in height to 7" d.b.h. The reproduction below 5' in height is too limber to be seriously injured by the falling trees but is easily broken down or uprooted by the tractors and suffers serious destruction during skidding.

There seems to be no type of material in the reserve stand that was entirely free from damage, the slighter injuries apparently occurring without relationship to the size of the growth. However, destruction did vary with the size of the growth. It will be noted that the "Estimated Effective Survival" decreases for the smaller material.



71.3
 18.1
 87.4
 10.6
 78.8

D. REPRODUCTION: Fully stocked area basis.

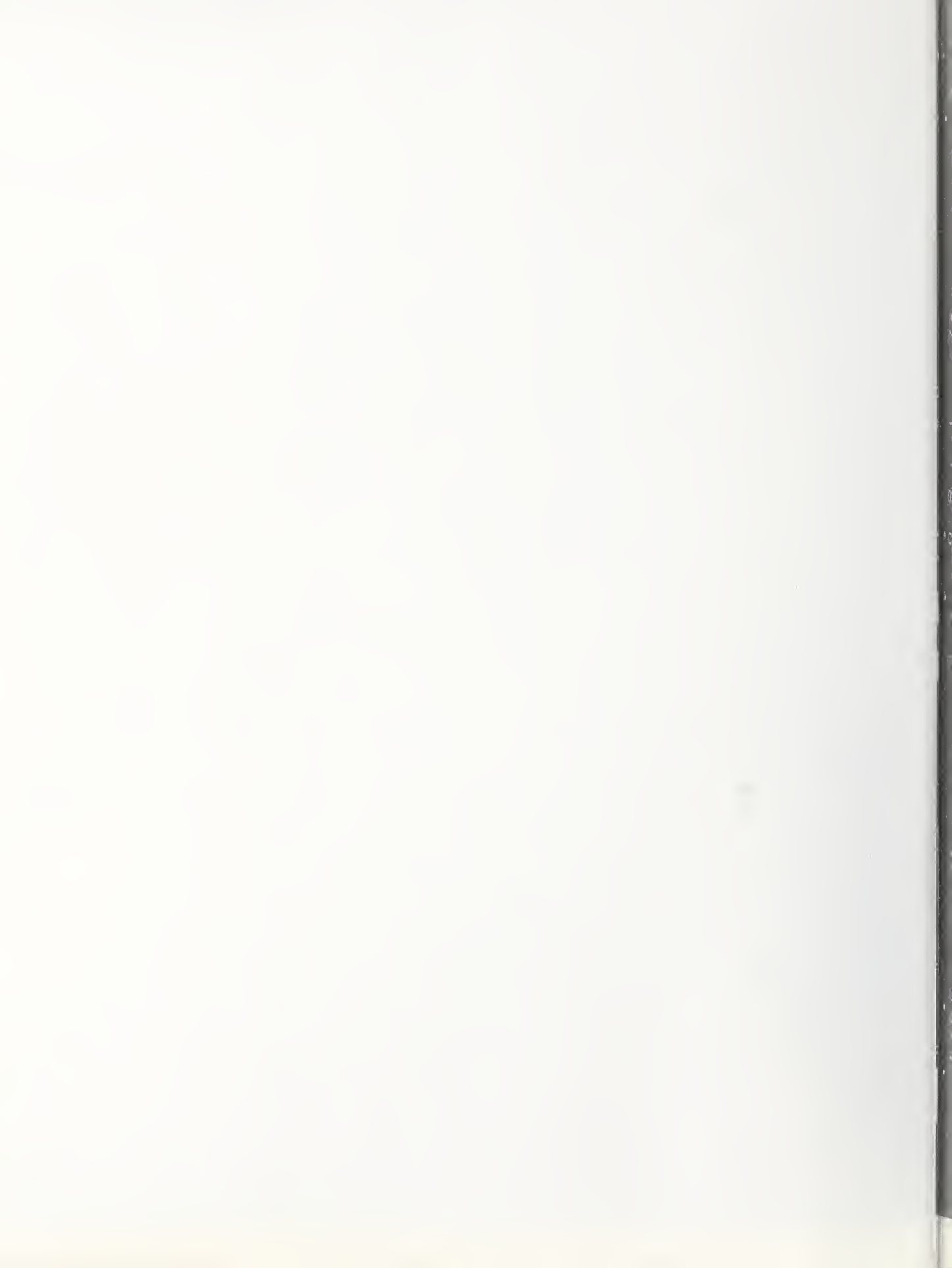
I T E M	PERCENT OF ORIGINAL AREA IN REPRODUCTION CLASS						
	RATIO OF AREA IN REPRODUCTION CLASS TO TOTAL AREA IN PLOT	UNINJURED	INJURED	DESTROYED (Outside of roads)	ROADS	ESTIMATED EFFECTIVE SURVIVAL	
Fully Stocked,							
5' high - 4" DBH	22.6%	71.3	18.1	3.1	7.5	85.8	
0' - 5' high,	63.7%	35.8	41.3	4.2	18.7	68.8	
Average Stocking,		45.0	35.5	3.8	15.7	73.2	
Unstocked areas, *	13.7%	40.9	34.3	3.1	19.0	69.3	
Percent of area stocked before falling,							86.0
Percent of area effectively stocked after logging,							63.0
Scattered Individuals,		60.0		40.0			60.0

* NOTE: The figures given in the table after "Unstocked Areas" represent the percentage of these areas which were covered by the tractor to an extent necessary to produce the class of injury shown in the headings had these areas been fully stocked.

The percentages given in this table are calculated from planimetered areas of relative damage as shown on the attached map. The damage was mapped, during the study, into four classes: 1. Uninjured (those areas which were free of tractor damage), 2. Injured (those areas which had been covered to some extent by the tractors without destroying all of the young growth; although the tractors destroyed some of the reproduction, it is estimated that 80% of these areas are still fully stocked), 3. Destroyed (those areas outside of main tractor roads upon which the reproduction has been completely destroyed). 4. Roads (the reproduction on the areas used for main tractor roads being completely destroyed). These last two classifications are independent of each other.

Although timber falling into the reproduction, destroyed some of the individuals, as shown in Table C, it did not reduce the stocking on a 6.6' x 6.6' square basis. The damage in Table D then is entirely due to the tractor operation.

It will be noted in the column "uninjured" that the percent of the area on which no tractor damage occurred was twice as great for the areas which were stocked by reproduction over 5' in height as it was for the areas of smaller repro-



duction or non-stocking. These figures clearly show that the tractor drivers made no attempt to stay out of the patches of reproduction over 5' in height, but ran over the smaller stuff as carelessly as they did the unstocked areas. These points are well shown in another table appearing later in the report.

III. SUMMARY AND COMPARISON WITH OTHER STUDIES:

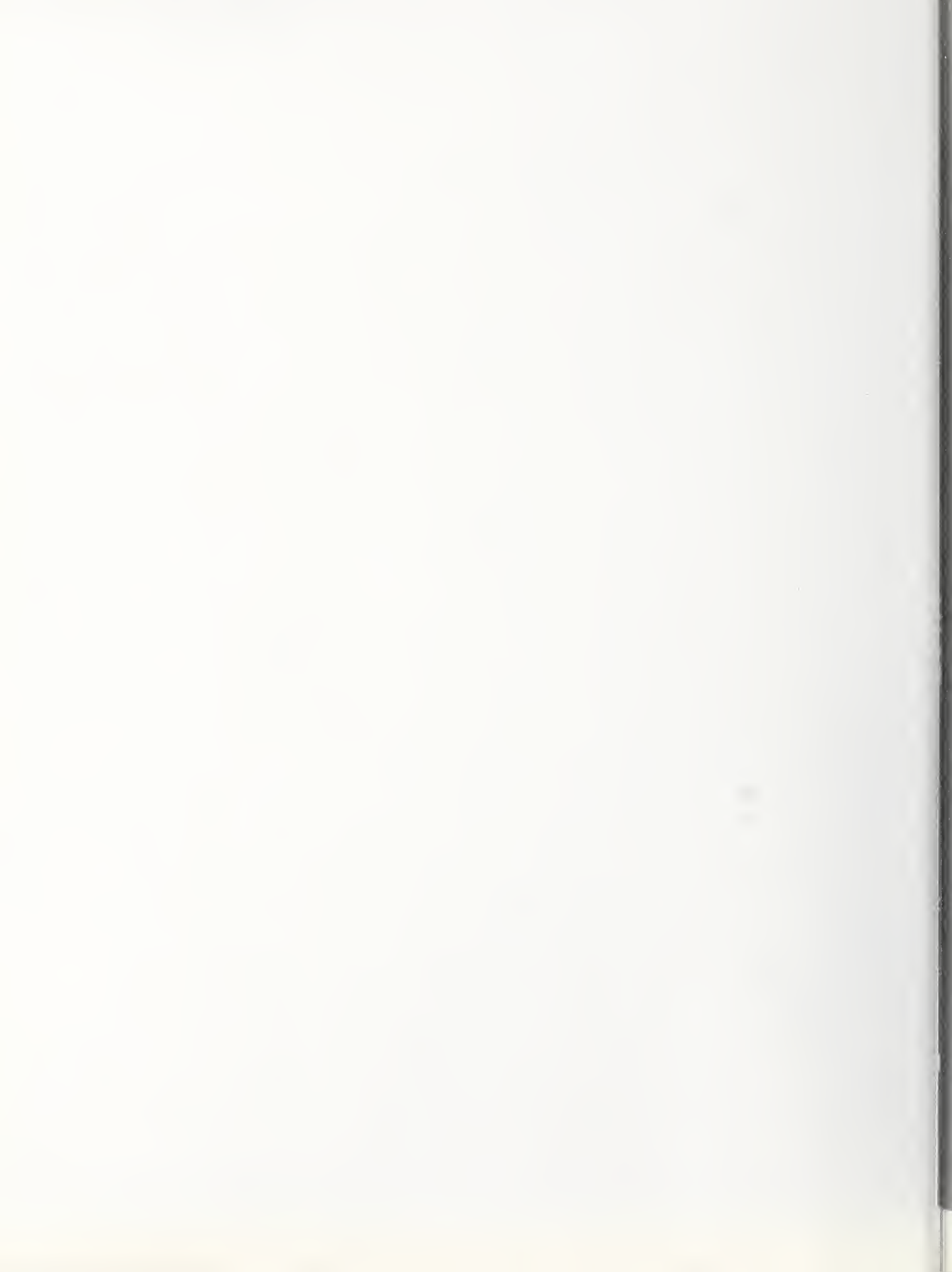
The following table presents the summary of results obtained in this study and gives a comparison with the results obtained by Price for the tractor and wheel study on the Plumas National Forest and with those indicated by the Office of Research for the modified lead donkey logging study on the Stanislaus National Forest. Figures are on a per acre basis.

SUMMARY AND COMPARISON (PER ACRE)

ITEM	TRACTOR SKIDDING	TRACTOR WHEELING	DONKEY MODIFIED LEAD
Original Stand, Gross B.M.	27,200	29,600	76,700
" " No. Trees.	50.9	25.7	41.6
Cut, Gross B.M.	19,500	26,290	65,400
" Number of Trees.	23.5	17.7	21.3
Percent Gross Stand Left, Vol.	28%	11%	14.7%
" " " " Trees	54%	31%	49%
Percent of total area of plot covered by main roads,	16%	17%	25%
Percent of area of reproduction: 5'-4" covered by main roads:	7%	15%	

ITEM	BEFORE LOGGING: (Un-marked)	PERCENT-AGE OF SURVIVAL	BEFORE LOGGING: (Un-marked)	PERCENT-AGE OF SURVIVAL	BEFORE LOGGING: (Un-marked)	PERCENT-AGE OF SURVIVAL
General Stocking (Reproduction)	86%	73%	48%	58%		
Grouped Reproduc. 0'-5' (Area)	64%	69%	73%	-		
Grouped Reproduc. 5'-4" (Area)	23%	86%	37%	59%		
Reproduction, 0'-5' (Count)	5047	61%	1022	39%	41%	2845
Reproduction, 5'-4" (Count)	527	70%	932	43%		25%
- 7" D.B.H., by count,	60.2	79%	62.6	73%		55.7
- 11" D.B.H. by count,	17.9	90%	13.6	90%		57%
2-17" D.B.H., by count,	13.6	90%	3.8	97%		11.1
18-23" D.B.H., by count,	8.0	93%	1.3	100%		3.4
24-29" D.B.H., by count,	4.6	94%	1.7	100%		2.8
30-35" D.B.H., by count,	2.5	100%	.6	100%		1.8
36" D.B.H., and over, by count,	.9	100%	.6	100%		1.2

This comparison is not conclusive as to the relative damage by the three methods of logging, since the stand and topographical conditions are different in



each case. However, a comparison of the area covered by main roads and their relation to groups of larger reproduction for the two methods of tractor logging, is interesting.

Referring to items #7 and #8 in the table it is seen that although the total area covered by main roads is about the same for the two plots, the percentage of the area of larger reproduction destroyed by these main roads is only half as great for the skidding as for the wheeling. It also appears that for the wheeling study the percentage of the area of larger reproduction destroyed on the main roads is nearly as great as the percentage of the area of the plot that was covered by the roads. This would seem to indicate that the swamping crew had made no effort to locate the wheel roads outside of the groups of larger reproduction.

When comparing the damage to trees over 12" d.b.h., it should be remembered that several trees were cut by the fallers which were not marked for cutting. In the wheeling study such trees were considered as having been marked, while in the skidding study such trees were considered as unmarked trees which had been destroyed.

IX. REGULATIONS PLACED IN EFFECT DURING THE STUDY:

The objects of the study were, mainly, two: (1) To determine the amount of damage being done under present methods of tractor logging, and (2) To formulate regulations which could be enforced by the regular timber sale personnel. Therefore, the officer making the study suggested some desirable practices but did not enter into the actual enforcement of logging regulations.

The fact that the loggers know that a damage study was being made and the additional fact that a Forest officer was on the plot at all times may have had some beneficial influence on the amount of skidding damage.

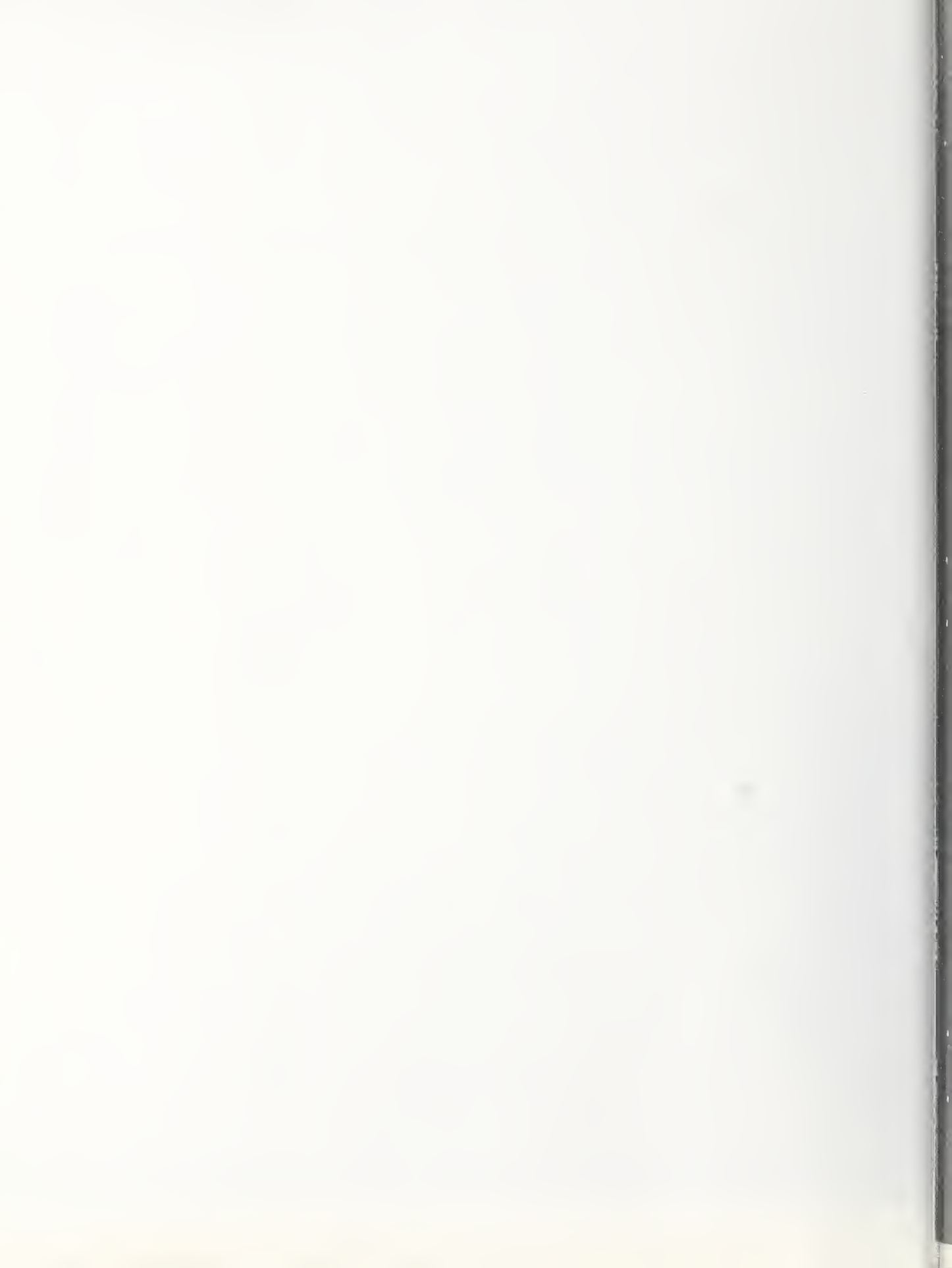
A. FALLING:

No regulations other than those in general use on government timber sales were placed on falling. However, the officer in charge spent somewhat more time on supervision within the plot than on the surrounding area.

B. SKIDDING:

The company had already placed two restrictions on the skidding operation at the suggestions of the Forest officer in charge:

1. In the case of a small tree where two logs are desired for a load, it was required that the first log should be rolled out just enough so that it could be skidded along the second log and both taken straight out instead of choking the two logs on either side of the saw cut and swinging them both out sideways with the resultant smashing down of considerable young growth.



2. When two tractors met, the one without a load was required to pull into an open place and stop until the loaded one had passed.

Some suggestions were made to the operator concerning the turning of tractors in the reproduction when hooking onto a log and the unnecessary breaking of new routes when an established road would serve.

It was noted, during the logging of the plot, that neither the Company's restrictions nor those suggested by the Forest officer were closely followed.

X. DAMAGING PRACTICES AND POSSIBILITIES OF REGULATION:

A. GENERAL:

The laying out of the operation is very important from both the production and damage standpoint. The railroads should be located so that there will be a minimum amount of uphill logging, as this not only decreases production but increases damage by the use of more roads and the cross hauling necessary when a tractor gets stuck.

Landings should be so located that tractor roads will take advantage of slopes and natural openings.

It is recommended that the purchaser prepare all railroad surveys a sufficient period in advance of construction to permit the officer in charge to check over the probable damage resulting from the layout.

The mobility of the tractor, one of the factors which makes it an efficient logging machine, also makes it extremely hard to regulate, especially on large operations. The Forest officer in charge cannot hope to personally supervise every step of the operation, therefore, full cooperation by the logging officials is essential to minimum damage. Orders concerning logging damage should come from those officials and the loggers must realize that they are to make a sincere effort to observe these instructions.

The camp boss is occupied with various duties which will not permit him to give the detailed supervision necessary for best results. A falling boss and a tractor boss are essential to work with the Forest officer in charge in planning the details of the operation, which affect the damage to the reserve stand, and to assume direct responsibility for the work done by their crews. Such bosses who know their work and are really interested in protecting the forest will be more effective than any set of logging restrictions.

The practice followed by some lumbermen of paying their loggers a bonus per M.B.M. above an established daily output, I believe, is detrimental from the damage point of view as it makes every man on the job hesitant about doing anything.

even at the request of his employer, which he thinks might slow up production. Such a condition makes supervision extremely difficult and sometimes leads to hard feelings between the loggers and the Forest officer. In any case where satisfactory results cannot be obtained under the bonus system it should be discontinued.

It has been previously noted that falling is responsible for practically all the destruction to the poles and trees above 4" d.b.h. and that skidding destruction is confined to the reproduction and smaller poles. It would seem that any logging regulations placed in effect should be planned to protect the poles and reserved trees from falling injury, and to decrease the tractor injury to the reproduction.

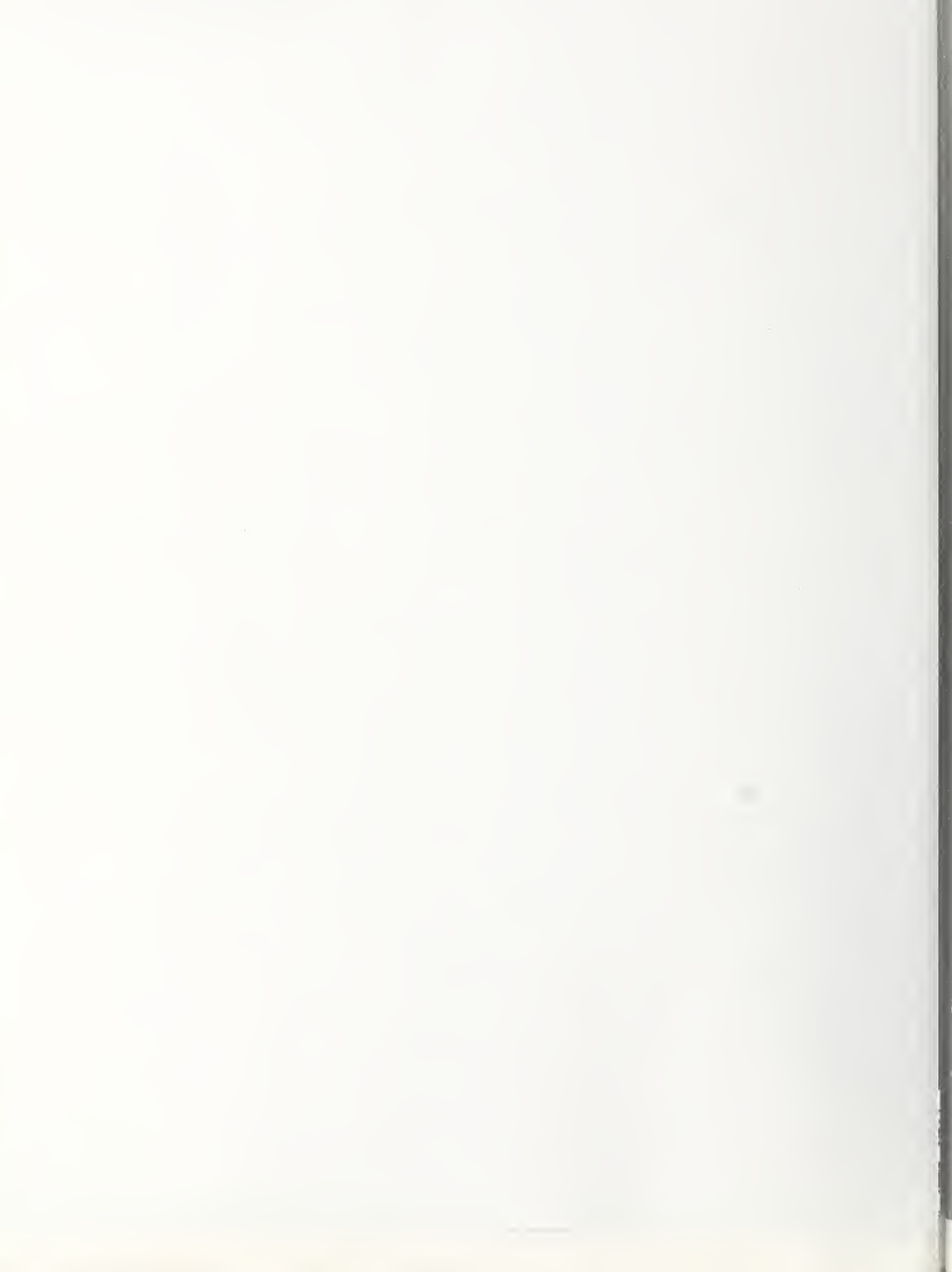
B. FALLING:

On this operation, the bull buck blazed "chopper strips" straight back from the railroad and the fallers laid the timber approximately to or from the landing to which it was to go. This system would probably be the best on flat ground if the reserve stand is disregarded. However, under the condition of changing slopes, although gentle, it results in excessive skidding damage through the turning of logs which lay along the hillside or which are taken out to a landing other than the one to which they were felled. The following table together with the destruction of the poles and trees previously shown, indicate that the reserve stand will suffer considerably in this method of falling.

TYPE OF REPRODUCTION	PERCENT OF AREA IN REPRODUCTION CLASS TO TOTAL AREA IN PLOT	PERCENT OF LENGTH OF FELLED TIMBER IN REPRODUCTION CLASS TO TOTAL LENGTH FELLED ON PLOT
Fully stocked reproduction 5'- 4"	22.6	22.8
Fully stocked reproduction 0' - 5'	63.7	63.6
Unstocked	13.7	13.6

One would expect to find the percentage of timber length felled in the larger reproduction to be somewhat smaller than the percentage of plot area covered by this type if a definite effort had been made to save this class of material. Apparently the timber was felled uniformly over the area without regard for the young growth.

The variations of timber stand, stocking of reproduction, ground cover, and slope, make it impossible to formulate a standard method of felling to fit all conditions. The Forest officer must in each case decide what type of second growth he wishes most to save, and, with the cooperation of the "bull buck" and "cat boss", must decide upon a method of falling which will give best results.



When planning a method of falling, the Officer in charge must consider the possibilities of additional breakage and balance this factor against the value of the young growth that will be saved.

Under most conditions, the saving of the seed trees is of first importance, with the poles a close second, and under conditions of heavy uniform stocking found on this area the larger reproduction is undoubtedly third in importance and should be protected at the expense of the smaller stuff.

The excessive falling damage which occurred to the poles and seed trees undoubtedly can be decreased by the employment of better workmen and by impressing them with the importance of these trees.

It seems to me that in a country of gentle or moderate slopes a system of falling can be used which will place every possible tree in the smaller reproduction or open places and will point them so that they can be skidded, without much turning, to openings between the larger reproduction. In other words, I believe it is possible, by teaching the fallers to recognize natural control points, to get the timber felled in the open and to the main roads without actually locating these roads before logging. If this can be done the protection of the larger reproduction from skidding damage will be much easier, because, as a rule, the cat drivers will not go into this class of stuff unless there is a log to bring out.

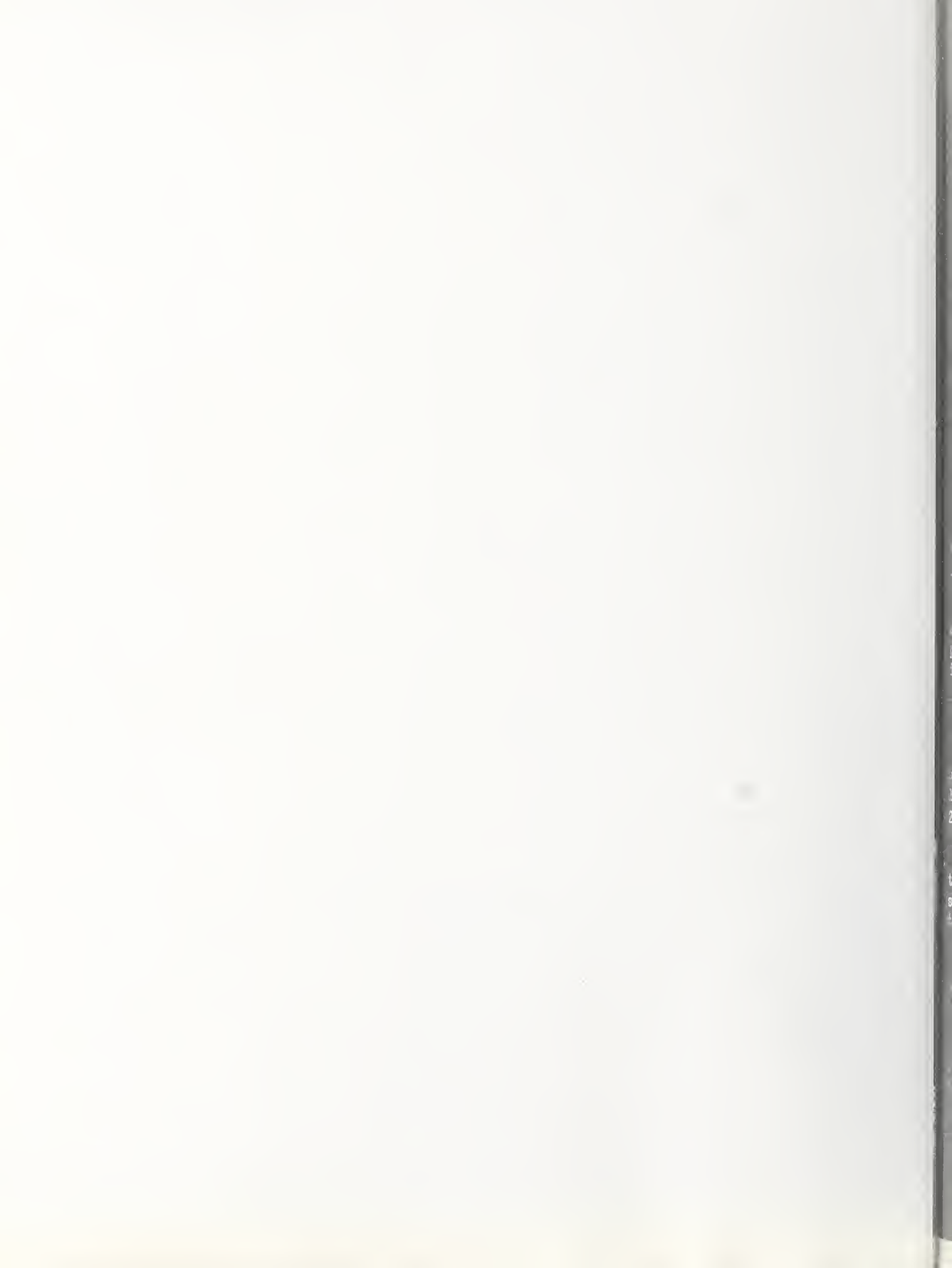
As the smaller reproduction offers no obstacle to the tractors this area is largely covered anyway and as this type of material is very pliable the destruction is seldom complete except in the main road, the probabilities are that the falling of more timber into this class of reproduction would not result in a material decrease of effective survival of stocking. This small reproduction is young and a much shorter growing period is lost than is the case where larger material is destroyed.

Of course, supervision of all parts of the operation is essential but as a portion of the skidding damage to the reproduction as well as practically all of the destruction to the poles and seed trees is directly chargeable to falling it is undoubtedly advisable for the officer in charge to give the major portion of his time to this activity. Supervision of falling should be current with the work, as it is extremely difficult, after the timber is down, to tell whether the damage was unavoidable or occurred through carelessness.

C. SKIDDING:

It was noted in Tables A, B, and C, under "Logging Damage", that although the tractors do some injury to the larger reservestand, the destruction is practically restricted to the poles and reproduction under 7" d.b.h.

The following table, which is a recalculation of the data used in Table D, indicates that the tractors used the areas covered with the larger reproduction less extensively than they did the areas of smaller reproduction or non-stocking.



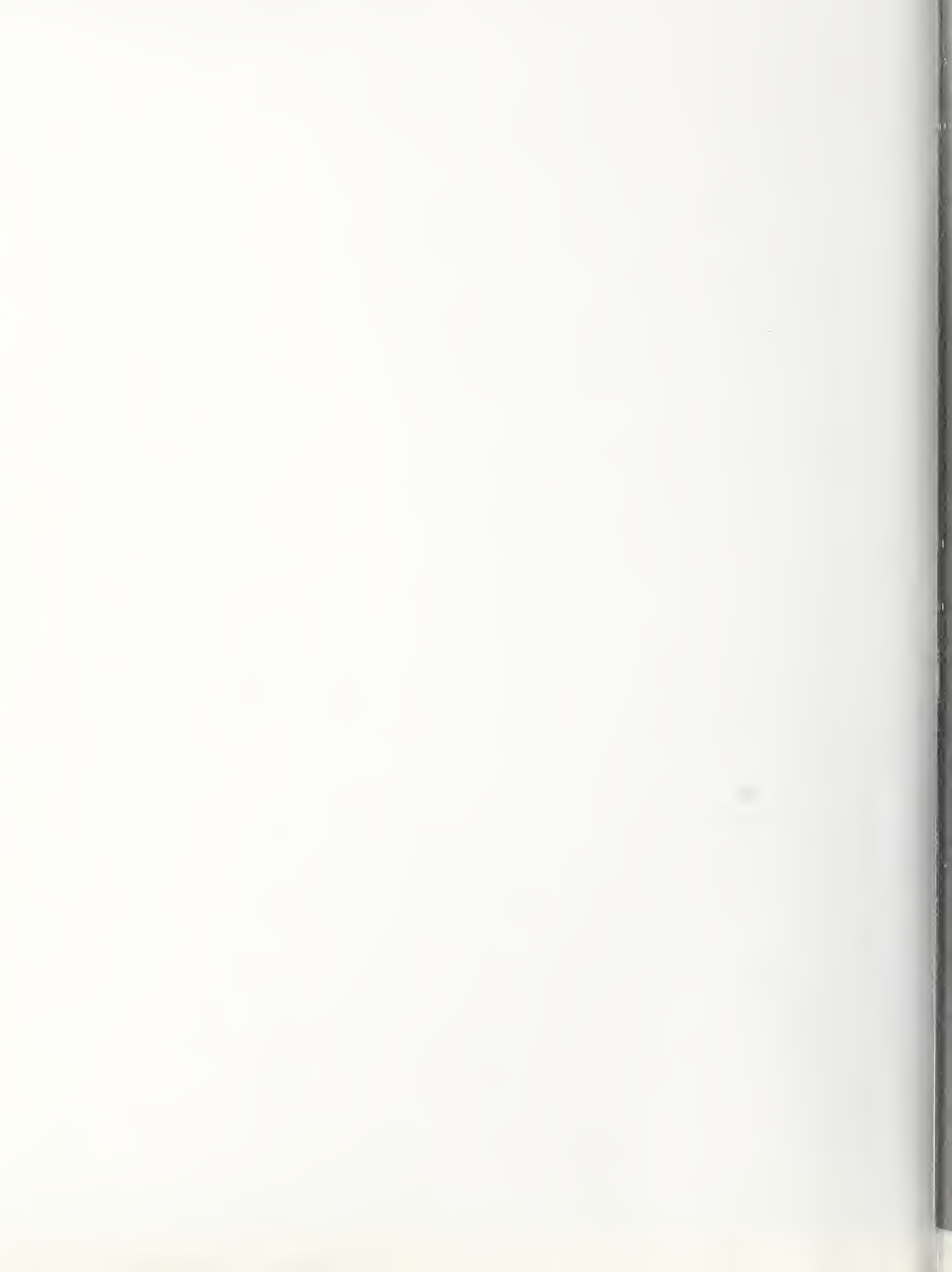
ITEM	FULLY STOCKED	FULLY STOCKED	UNSTOCKED AREAS
	REPRODUCTION	REPRODUCTION	
	5' - 4"	0' - 5'	
Percent of area in reproduction class to total area in plot,	22.6	63.7	13.7
Percent of length of felled timber in reproduction class to total length,	22.8	63.6	13.6
Percent of uninjured area in reproduction class to total uninjured area in plot,	36.2	51.2	12.6
Percent of area injured in reproduction class to total area injured in plot,	11.6	75.0	13.4
Percent of area destroyed in reproduction class to total area destroyed in plot,	16.7	64.2	19.1
Percent of area in roads in reproduction class to total area in roads in plot.	10.5	73.5	16.0

For example, the first column shows that, although the timber was felled uniformly in the various types of reproduction, 36.2% of the area uninjured after logging was fully stocked with the larger reproduction from 5' to 4", while only 22.6% of the original area was fully stocked with this type of growth.

The second column shows the reverse to be true for the smaller reproduction from 0' - 5' high, as 51.2% of the area uninjured after logging is fully stocked with this small growth, while 63.7% of the plot was originally stocked with this type.

The smaller proportionate injury to the larger reproduction is partially due to the request that it be protected and partially due to the retarded movements and dangers of breakdown to the tractors when operating in this type of growth.

These facts lead to the conclusion that a large portion of the tractor damage to the reproduction over 5' in height is due to the falling of trees in such a way that the tractors had to go through this growth to get the logs out.



In tractor logging each pair of machines have their own crew and work independently of other crews. It is impossible for the officer in charge or the cat boss to personally supervise every step of the operation. Each man in the crew must realize the importance of the young growth and must sincerely try to help preserve it before minimum damage can be obtained.

Several regulations follow, which usually would decrease damage but which in special cases might increase it. Therefore, certain responsible members of the crew must have some leeway to use their judgment:

1. Swamping other than for landings is not necessary for tractor skidding and should be prohibited in all cases.

2. A tractor should go into its load through an opening or along the route which will be taken in bringing the load out and turn around squarely at the load instead of making a wide swing to place the chokers for the setting crew. Chokers should be unhooked from the cat or extra ones used if necessary to prevent them fouling under the tractor when it turns around.

3. When two logs from the same tree are necessary for a load, the first log hooked should be pulled along the second one and both pulled straight out rather than hooking them both at the saw cut and siwashing them out sideways.

4. When logging small timber the collection of several logs from different trees is very destructive. This practice should be confined to open places where no damage will result, unless the logs are bunched one at a time near a road, or the load should be restricted to two logs from the same tree.

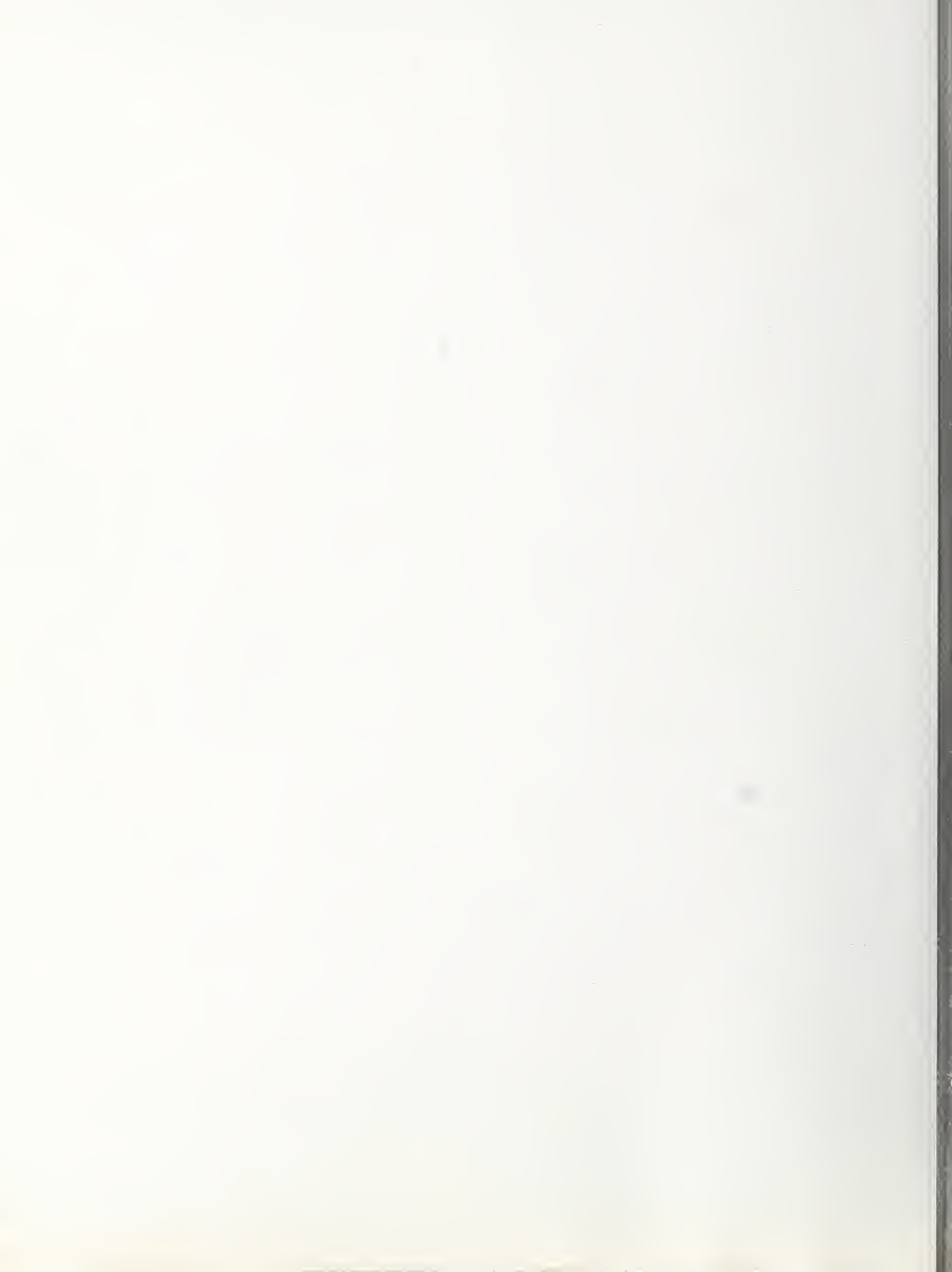
5. Tractors either empty or loaded should not ramble at random over the area but should follow previous tracks whenever possible.

6. Main roads should be kept to the minimum width necessary and when two tractors meet, one of them should pull into an opening and stop until the other has passed.

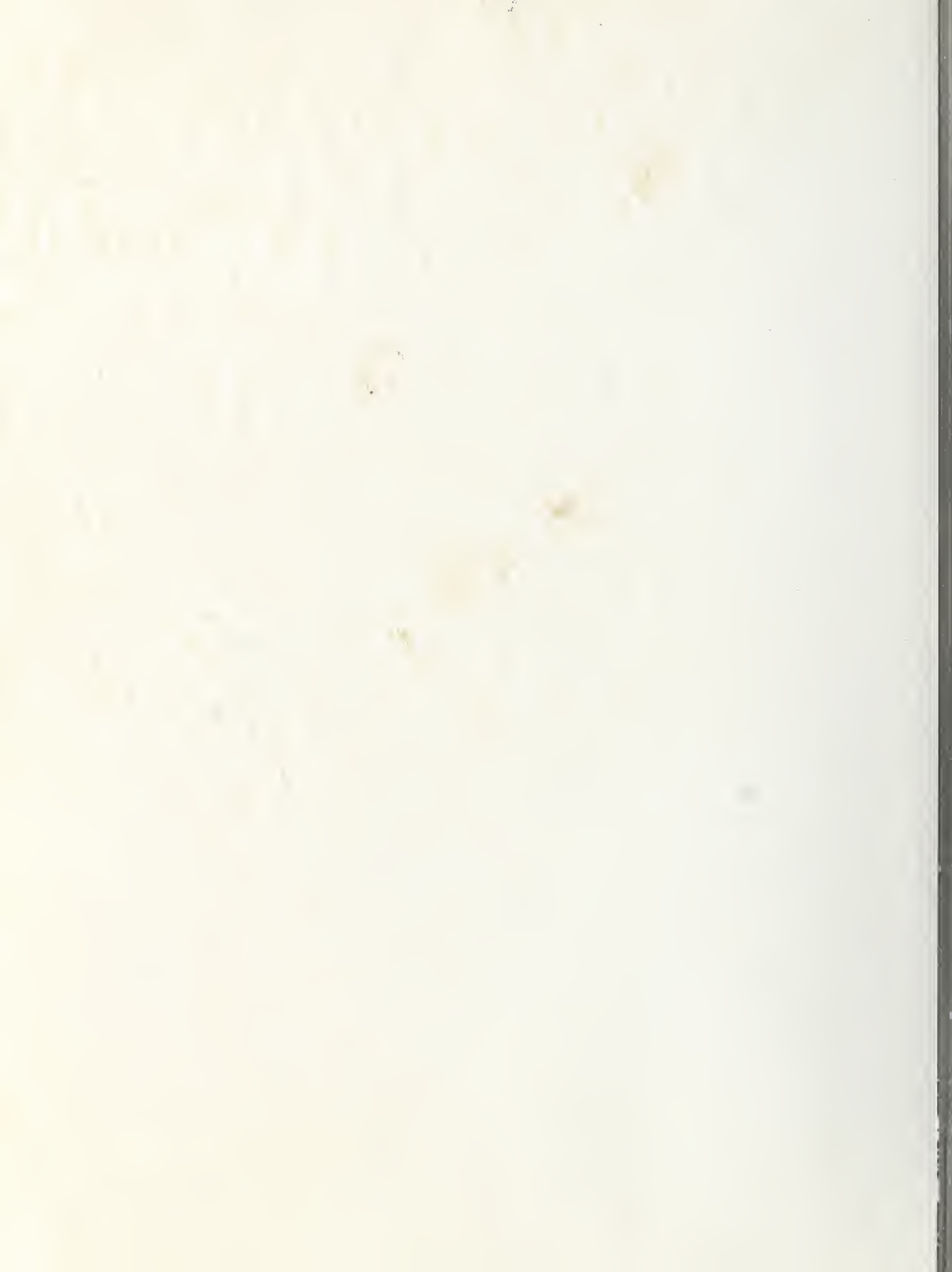
7. When skidding starts at a landing each choker setting crew should choose a main road and finish it to the end rather than to try to work two roads at the same time, as this leads to confusion and cutting across by the tractors.

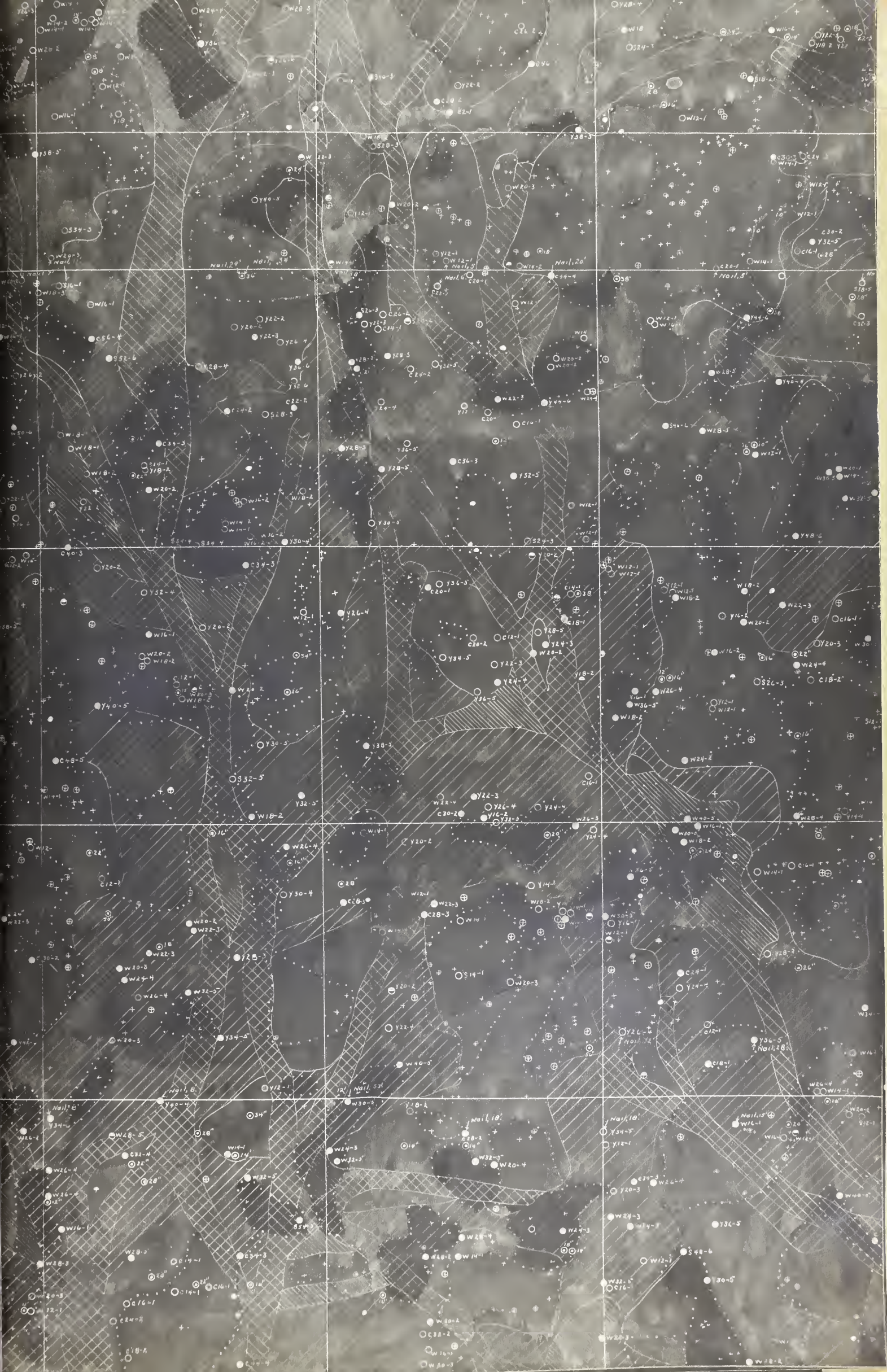
8. Logs should be skidded to the road to which they are pointed rather than swung around to another road.

9. The "bull buck" and the "cat boss" should assume responsibility for their portion of the operation. They should be on the area at all times to give detailed supervision and to issue instructions eliminating destructive practices. On an operation which is too small to require a man's full time, some competent man in the crew should assume those duties and responsibilities.

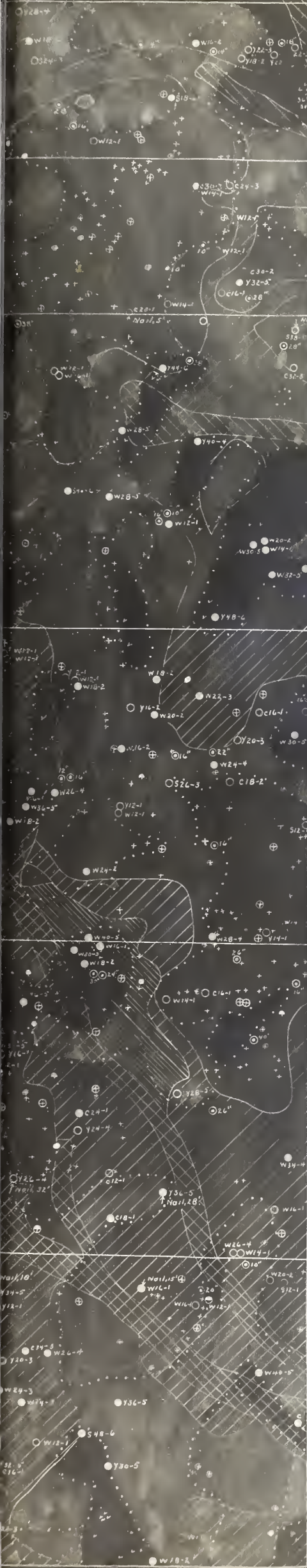




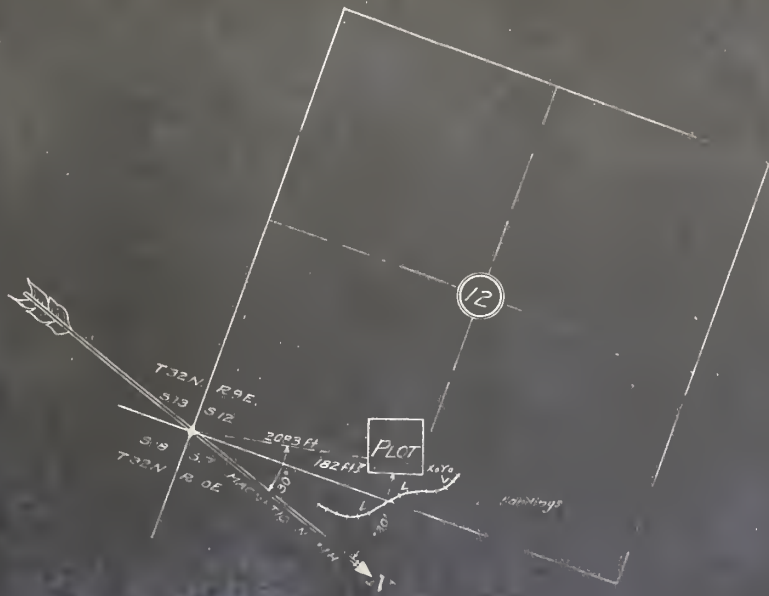




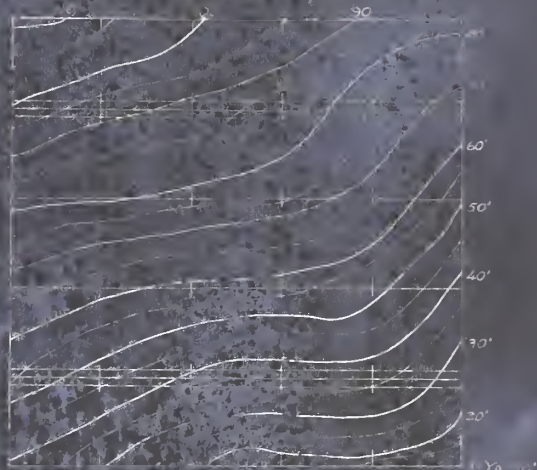




Location of Plot
Scale 4" = 1 mile.



Topography of Plot
Scale 1" = 660 ft.



TRACTOR LOGGING DAMAGE FRUIT GROWERS SUPPLY CO. SALE AREA LASSEN NATIONAL FOREST

Prepared by J. R. Herge, September 1926.

LEGEND

- Reproduction - Not Stocked
- Reproduction - Fully Stocked - 0-5 ft high
- Reproduction - Fully Stocked - over 5 ft high
- Reproduction - Individuals - 0-4" DB.H
- Trees over 12" DB.H Marked for Cutting
- Snags
- Tractor Partial Damage (Injured)
- Tractor Total Damage (Destroyed)
- Tractor Roads (Destroyed)

- + Poles 4"-8" D.B.H.
- ⊕ Poles 8"-12" D.B.H.
- Leave Trees over 12" D.B.H.

Falling Injured	Damage Destroyed	Tractor Injured	Damage Destroyed
+	+	+	+
⊕	⊕	⊕	⊕
○	○	○	○

