RESEARCH NOTE NO. 10

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PROGRESS REPORT ON THE COCHRAN AIRPLANE SEEDING EXPERIMENT

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INTRODUCTION

In February 1949 "Research Bulletin No. 2 - Preliminary Report On The Cochran Airplane Seeding Experiment" was issued by the Oregon State Board of Forestry. This report brings the results of that experiment up to date. The purpose of the experiment, the descriptions of the experimental plot and the experimental procedures are thoroughly covered in "Research Bulletin No. 2" but will be repeated briefly here for the benefit of those who do not have the earlier publication.

PURPOSE OF THE EXPERIMENT

1. To test the possibility of controlling rodent damage through the aerial distribution of poison bait.

2. To test the possibility of establishing satisfactory stands of reproduction through the aerial dissemination of seeds of various species.

3. To ascertain the effects of a variety of ground and cover conditions upon the germination and survival of aerially broadcast seeds.

4. To determine the costs of aerial rodent baiting and seeding.

PERSONNEL INVOLVED

John B. Woods, Jr., was in general charge of the planning and conduct of the experiment. John H. Hann and Brice L. Hammack did the major portion of the field work.

Mr. A. W. Moore and Lowell Adams, U. S. Fish and Wildlife Service, directed the rodent control phases of the project.

Mr. Leo Isaac, Northwest Forest and Range Experiment Station assisted in the initial planning of the experiment.

All the personnel of the research section have participated in the stocking surveys taken during the six years since the area was seeded.

DESCRIPTION OF THE EXPERIMENTAL PLOT

The experiment is located in sections 19, 20, 29 and 30 of T 3 N, R 6 W, W. M. It is approximately square, six hundred acres in size. The area was logged between 1920 and 1925 and has been burned at least five times since logging.

At the time of seeding the plot consisted of areas of recent hard, medium and light burn and areas which were unburned. The ground cover ranged from bare soil through light cover, medium cover to heavy cover. All exposures were well represented.

EXPERIMENTAL PROCEDURES

The original survey of the plot before seeding included topographic mapping and a line plot survey to obtain data on the degree of burn, soil condition, cover type and stocking. The results of the original stocking survey are given in Table I.

Rodent population checks on the area were made both before and after baiting. The catch dropped from 42 per cent in November 1945 before baiting to 3.5 per cent in February 1946 after baiting.

Bait used on the area was non-viable Douglas fir seed impregnated with thallous sulfate. The area was baited in January 1946 by use of aircraft and a buffer strip one-fourth mile wide around the North, East and South sides of plot was baited by hand.

The area was seeded by aircraft in February 1946 while the plot was covered with an average snowfall of 2.5 feet. One hundred acres of unburned area in the northeastern portions were seeded at a rate of one-half pound per acre with a mixture consisting of five parts, by weight, of Port Orford

cedar to two parts of Sitka spruce and one part of Western hemlock. The remaining 500 acres were seeded at a rate of one-half pound per acre with a mixture consisting of equal weights of Douglas fir and Port Orford cedar.

RESULTS OF THE EXPERIMENT

Project Costs:

In 1945-46 the entire cost of this experiment was $5.32 per acre. In these days of fluctuating prices of seed and labor it is better to state costs in man hours and seed and equipment such as follows:

Snag Falling	144 man hours
Survey	93 man hours
Hand Baiting	142 man hours
Bait	188 pounds
Douglas fir seed	125 pounds
Port Orford cedar seed	154 pounds
Sitka spruce seed	12 pounds
Western hemlock seed	6 pounds
Aircraft	(baiting contract for 600 acres) (seeding contract for 600 acres)

Rodent Control:

From the before and after rodent counts and from the satisfactory germination, both first and second year, it was determined that the rodent control measures were generally effective.

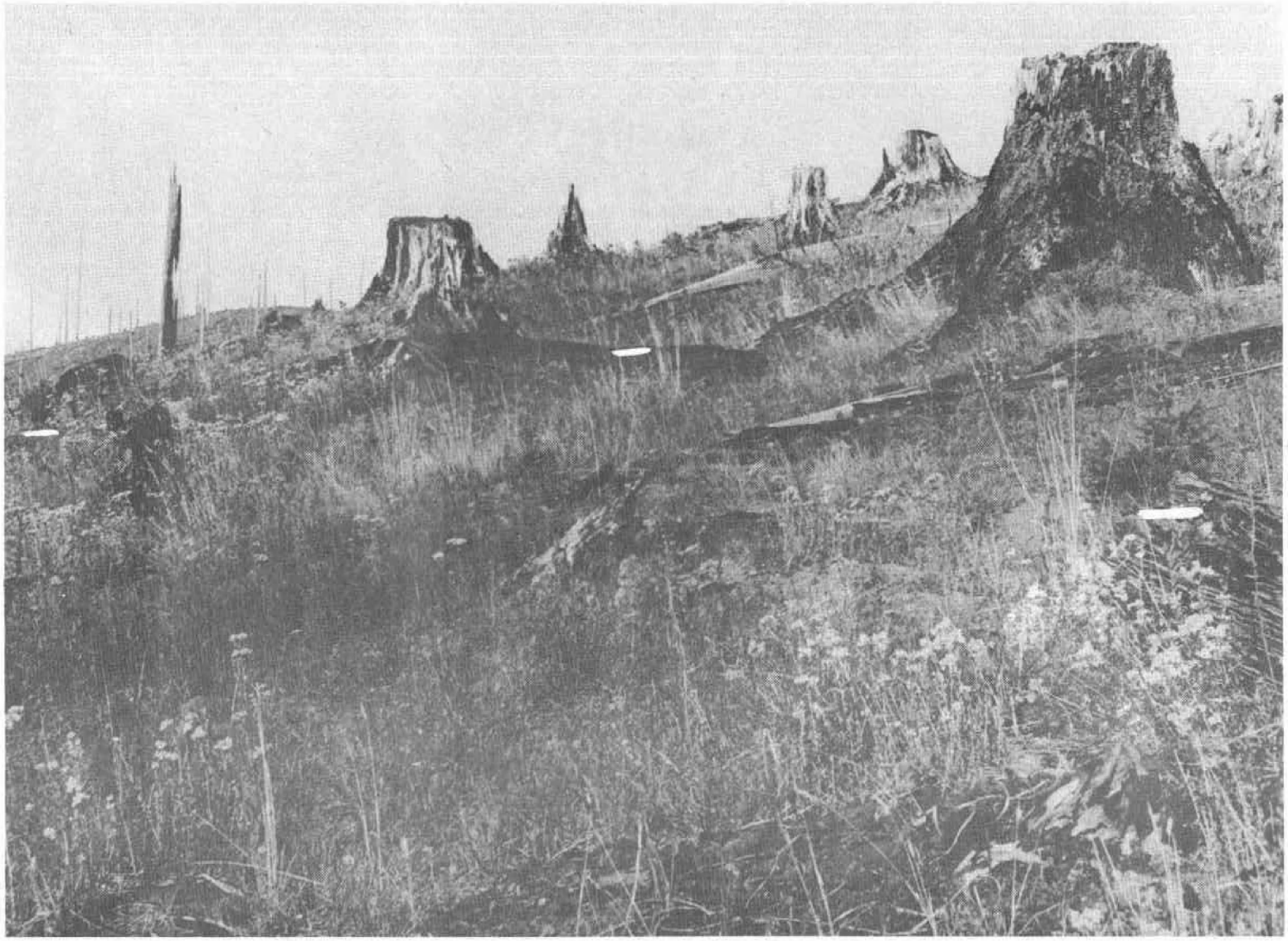
It should be noted here that rodent control techniques in current use by the Oregon State Board of Forestry have changed considerably and are believed to be much more effective. These procedures will be fully covered in a Bulletin on Aerial Seeding now in preparation.

SADDLE—NO PRINCIPAL EXPOSURE—HARD BURN

Looking toward the North

To Port Orford cedar seedlings occupying protected locations. These trees have been cropped by deer.

PLATE I



SOUTH WEST EXPOSURE—HARD BURN

Looking toward the North

Note that seedling survival here has been where shade was available during first few years after seeding. This picture (with more foreground (shows the same area as Plate #4 of Bulletin #2.

PLATE II

The results of the two foregoing items, project costs and rodent control, have not changed with the passing of the four years since the printing of the preliminary report on this project. The results of the stocking surveys taken since 1948, have, however, changed somewhat and this information might well be of interest to foresters.

Results of Stocking Survey:

The 100 acres seeded to the mixture of Port Orford cedar, Spruce, and hemlock has either been a failure or the resultant seedlings cannot yet be found due to the very heavy cover on the unburned portion of the plot. Stocking surveys in this area taken for the first few years after seeding showed nothing. The last survey, taken in 1952, revealed a very few scattered hemlock and cedar - no spruce has ever been recorded.

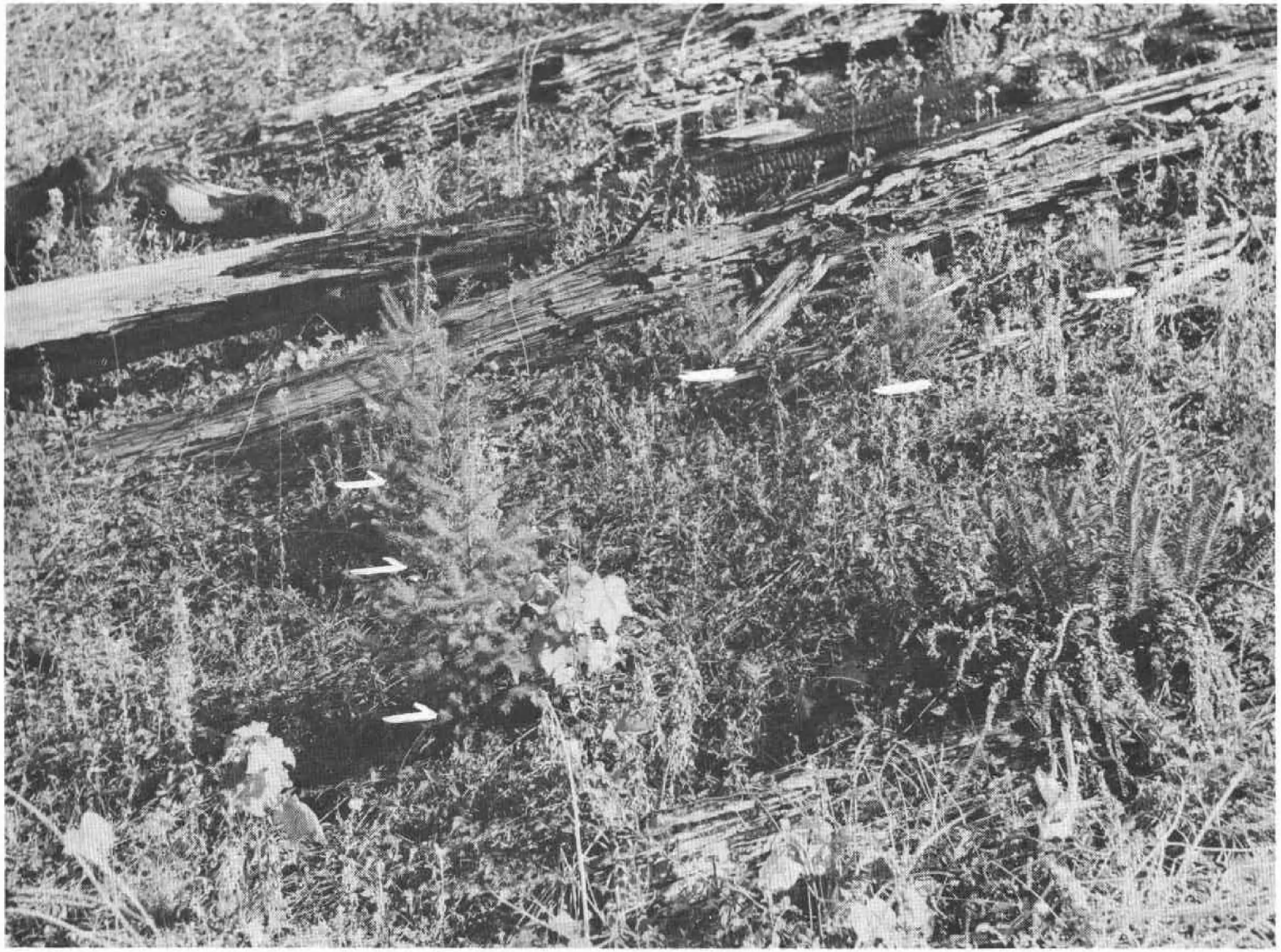
The remaining 500 acres has produced the most results and accordingly the most information of value.

In 1946, before the area was seeded a complete stocking survey was made of the area and this has been repeated in 1952. The table below represents all species all ages and the figures for 1952 includes those trees which resulted from seeding.

TABLE I

ENTIRE PLOT - ALL SPECIES - ALL AGES

DATE	STOCKING PERCENT	
	1/250 Acre	1/1000 Acre
1946 (prior to seeding)	11.8	4.1
1952 (after seeding)	46.8	16.8



WEST EXPOSURE—HARD BURN

Looking toward the East

Four of these six seedlings were well shaded by the log until noon of each day during their first few years.

PLATE III

SOUTH EXPOSURE—HARD BURN

Looking toward the North

Two that survived without benefit of shade. As a result of a great deal of delayed germination on this plot considerable difference in size of seedlings is quite noticeable and is well demonstrated here.

PLATE IV

Germination and Survival by Species:

In 1949 when "Bulletin No. 2" was written only 4.8 percent of the stocking was Port Orford cedar. In 1952 the picture has not changed to any appreciable extent as only 7.5 percent of the stocking is Port Orford cedar. What was written at that time regarding this poor showing of Port Orford cedar is still applicable.

"The poor field germination results with Port Orford cedar seed are probably due to the flake shape and light weight of the seeds which make it difficult for them to penetrate the ground cover to mineral soil. The poor survival reflects the natural inability of this fog-belt species to survive on unfavorable exposures."

Effects of Exposure and Degree of Burn Upon Germination and Survival:

Tables II and III and Figure 1 give separate pictures of the effects of exposure and degree of burn upon stocking. These results could be very misleading, however, as a favorable exposure might be composed of a high percent of unfavorable burn condition or a favorable burn condition might have a very high or very low percent of favorable exposure.

To offset this difficulty and to clear up the picture so that more proper analysis could be made the two have been considered together. In order to have a sufficiently large sample of each of the various exposure-burn combinations the results of 8 separate stocking surveys conducted on the plot were pooled. Even so there were twelve of the thirty-two combinations which were insufficiently sampled to make any comparisons. This then meant that on the plot these twelve combinations of exposure and degree of burn did not exist in sufficient area to be adequately sampled in a normal stocking survey.

TABLE II

STOCKING BY EXPOSURE

		Percent of Stocking By 1/1000 Acre							
		N	NE	E	SE	S	SW	W	NW
Bulletin #2	1948	25.4	32.3	13.1	11.0	14.3	11.1	20.0	16.1
	1950	25.9	17.4	16.6	19.1	9.5	12.5	11.4	9.4
	1951	11.8	17.7	10.1	8.8	11.3	5.0	11.7	5.0
	1952	12.7	17.3	8.2	9.2	12.9	11.0	10.8	11.5

TABLE III

STOCKING BY DEGREE OF BURN

	Percent of Stocking By 1/1000 Acre			
	Hard Burn	Medium Burn	Light Burn	Unburned
November 1948	21.6	39.7	16.1	16.1
December 1950	14.4	16.7	18.7	11.7
November 1951	12.5	18.0	7.7	12.9
August 1952	18.0	11.8	10.4	7.8

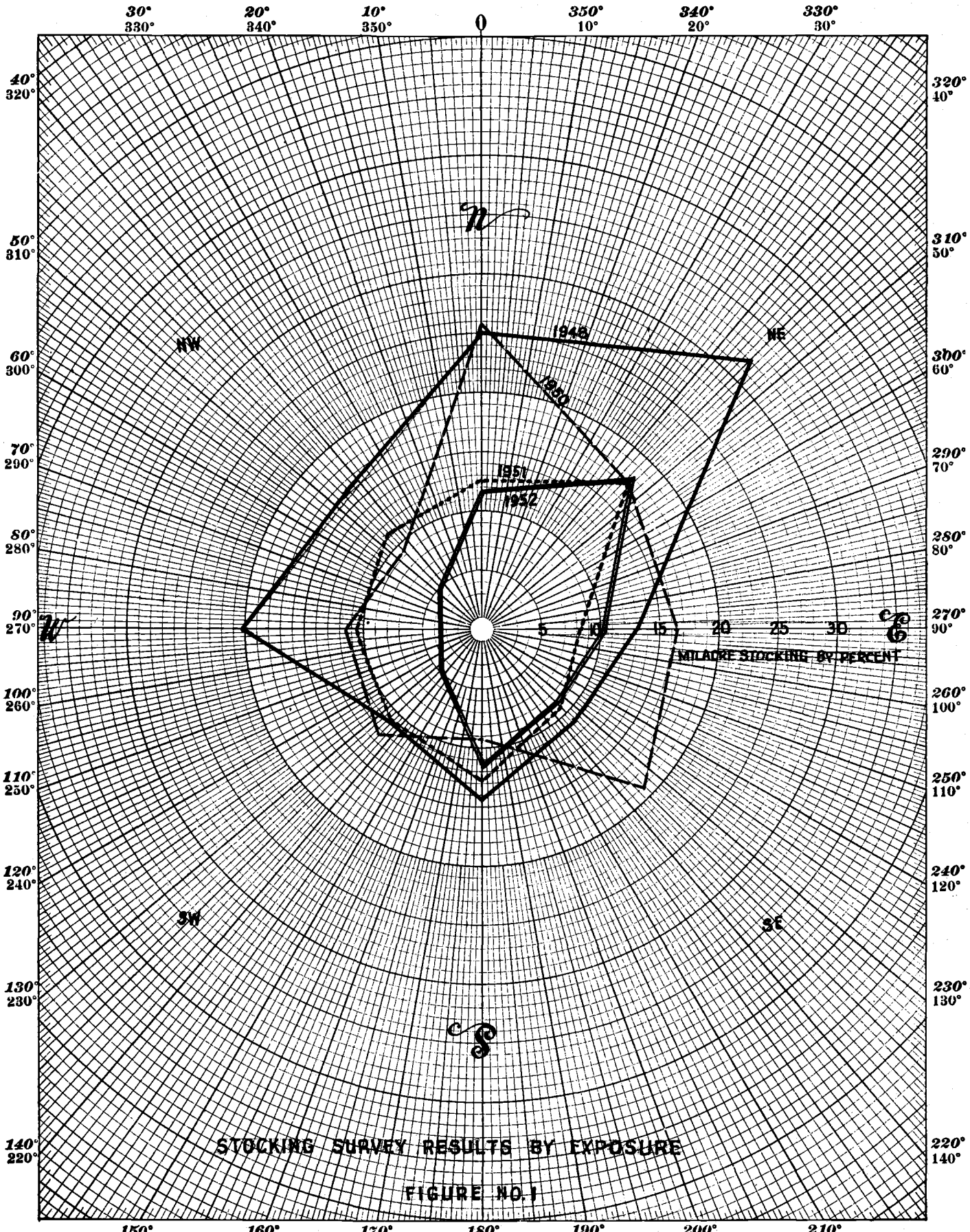
Table IV and Figure 2 show both in tabular and graphical form the results of this combination comparison. A study of Figure 2 indicates very strongly that exposure is much more important than degree of burn. Northern and northeastern exposures are the most favorable for seedling establishment regardless of the burn condition. The southwestern, southern, and southeastern exposures are the poorest. There does not seem to be any great superiority of any one type of burn condition. There are indications that on the more favorable exposures the hard and medium burns are somewhat better than the light burn or the unburned.

NORTH EXPOSURE—MEDIUM BURN

Looking toward the East

Even on the north exposure a preference for shaded locations is noticeable.

PLATE V



STOCKING SURVEY RESULTS BY EXPOSURE

FIGURE NO. 1

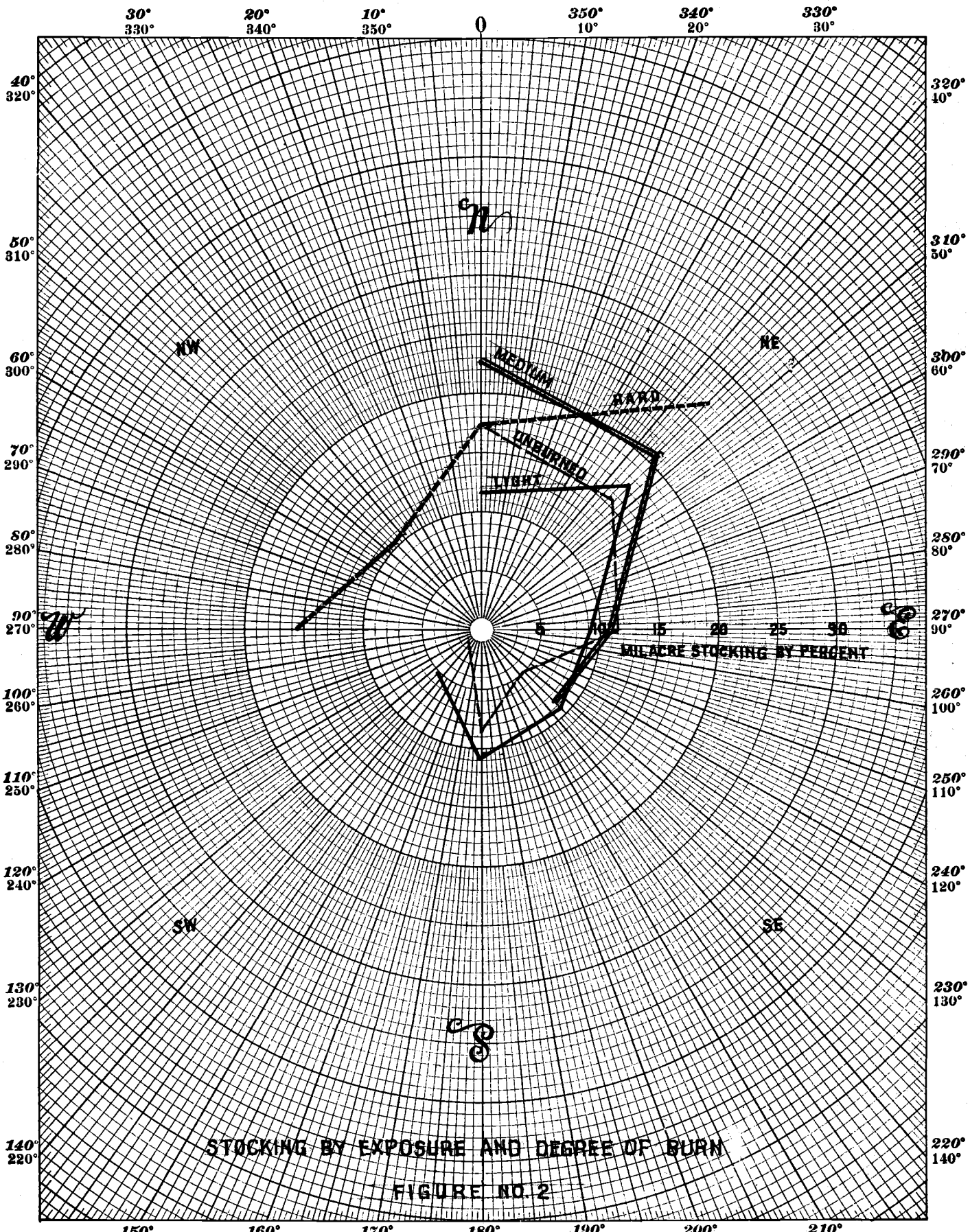
TABLE IV

STOCKING BY EXPOSURE AND DEGREE OF BURN

1946-1952 (8 Stocking Surveys)

EXPOSURE	BURN	1/1000 Acre		
		# PLOTS	# STOCKED	% STOCKING
N	H	369	64	17.3
	M	180	41	22.8
	L	372	44	11.8
	U	132	23	17.4
NE	H	126	34	27.0
	M	277	57	20.6
	L	285	51	17.9
	U	442	70	15.8
E	H	*		
	M	139	45	9.2
	L	490	86	11.8
	U	726	56	15.3
SE	H	*		
	M	94	8	8.5
	L	708	68	9.6
	U	358	18	5.0
S	H	*		
	M	*		
	L	565	61	10.8
	U	356	31	8.7
SW	H	*		
	M	*		
	L	175	9	5.1
	U	158	2	1.3
W	H	366	51	15.3
	M	*		
	L	*		
	U	*		
NW	H	387	41	10.6
	M	*		
	L	*		
	U	*		

*Insufficient samples on these exposure-burn combinations.



STOCKING BY EXPOSURE AND DEGREE OF BURN

FIGURE NO. 2

The following are the results of seven stocking surveys taken from 1946 to 1952. The first four were reported on in Bulletin #2. The surveys of 1950, 1951 and 1952 have been taken since that Bulletin was published.

TABLE V

STOCKING AS A RESULT OF SEEDING

(Douglas fir - Port Orford cedar Acreage Only)

	Stocking Percent	
	1/250 Acre	1/1000 Acre
August 1946	11.8	3.3
August 1947	34.3	13.7
December 1947	49.2	22.7
November 1948	46.1	19.4
December 1950	44.0	16.0
November 1951	32.0	12.2
August 1952	36.5	12.3

GENERAL CONCLUSIONS

As shown in Table V there was little change in stocking results between the surveys of November 1951 and August 1952. This would indicate that the stand is more or less stabilized and that the trees now established should suffer little further loss. Therefore, it seems justifiable to evaluate the results of the experiment at this time and to determine whether or not it has accomplished the purposes for which it was designed.

With reference to the first purpose of the experiment, testing the possibility of controlling rodent damage through the aerial distribution of poison bait, this experiment has definitely shown that baiting in this manner

is economically feasible and will yield satisfactory results. The results of this experiment have been substantiated through subsequent experimental and project scale baitings. In this subsequent work better baits than those employed in this experiment were available and in nearly every instance satisfactory rodent control was achieved through the aerial dissemination of these baits.

The results of this experiment in showing the possibility of establishing satisfactory stands of reproduction through the aerial dissemination of seeds of various species are not wholly conclusive, but they have led to further experiments and project work from which definite results have been obtained. In the Cochran experiment, as mentioned above, little if any, stocking was established through the aerial dissemination of western hemlock and Sitka spruce seeds. Aerially disseminated Port Orford cedar seeds germinated fairly well but seedlings were quickly lost through dessication. The results from the aerial dissemination of Douglas fir seeds were much more encouraging. On the most favorable sites adequate stands were established and are still thriving five years after seeding. On the less favorable sites, although seedlings have been established, the number established is not adequate. However, only a fourth of a pound of Douglas fir seed was applied on all exposures, and it is reasonable to assume that by increasing the quantity of seed the deleterious effects of unfavorable exposures or ground conditions could be offset. This supposition has been substantiated through later work. Where unfavorable exposures have been seeded at a rate of one-half pound per acre with Douglas fir seed adequate stands have usually resulted.

The effects of the variety of soil, cover and degree of burn conditions in the Cochran experimental area upon the germination and survival of aerially

broadcast seed are extremely difficult to interpret because the results represent the effects of combinations of factors. However, as demonstrated in Figure 1 and Figure 2, northerly exposures offer the best germinating and growing conditions while southerly exposures are definitely more severe. The effects of varying degrees of burn is extremely difficult to analyze, but it would appear that hard and medium burns offer better germinating and growing conditions than light and unburned areas. Undoubtedly the poorer results on light and unburned areas were due to heavy vegetative cover which made it difficult for seeds to reach mineral soil and which competed with the seedlings for moisture during dry periods.

The cost data obtained from this experiment demonstrated very clearly that direct aerial seeding is an economically feasible method of reforesting denuded areas. In work subsequent to this experiment the helicopter has replaced the airplane and larger quantities of seed are being used. These changes represent increases in the cost of the work but nevertheless total costs of recent state project seedings have been only approximately $6.00 per acre, or less than one-third of the cost of hand planting.

The speed with which aerial seeding can be accomplished, and the ease with which seeding can be done in areas which would be inaccessible to hand planting crews are further important advantages of this reforestation method.

In summary, the Cochran Direct Aerial Seeding Experiment has been extremely valuable in helping to solve reforestation problems. Some of the information gained from this experiment has been immediately applicable to project work. Other information has served as a basis for further experiments through which practical direct seeding techniques have been developed.