SEED SOURCE-RESTOCKING RELATIONSHIP ON PRIVATE FOREST LAND IN WESTERN OREGON

By

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TABLE OF CONTENTS

INDEX OF TABLES

INTRODUCTION

Since the passing of the Oregon Forest Conservation Act in 1941 many thousands of acres of cutover land have been inspected by foresters of the Conservation Division of the State Forestry Department. Approximately six years have passed since the first areas were cut under the Act and such an interval provides sufficient time for reproduction to become established and checked.

Many questions have arisen regarding the effectiveness of the Act's requirements from the technical aspect, and some of these are: How well does the required seed source restock cutover areas in 5 years? How do one, two, three, four or more seed trees per acre compare in the effectiveness of their restocking qualities? And, how do seed trees, long corners or seed blocks, and adjacent timber compare as providers of seed?

This paper is no attempt to answer each of these questions, but it is a beginning, and from the limited data available for this study, an attempt will be made to show the comparative results of restocking between areas cut in compliance with the Act, and areas cut in violation. An attempt will also be made to compare the effectiveness of seed trees and long corners left as seed source.

FIELD DATA

The major part of the field data used was provided by N. S. Rogers, State Forester, through the cooperation of John B. Woods, Jr., Assistant State Forester in charge of the Act's administration. The sample areas used were logged in 1941 or 1942, and reproduction surveys

were made five years later, or 1946 and 1947.

Other sample areas were surveyed specifically for use in this study, and, except in one instance, were made in accordance with instructions governing the application of the Conservation Act.

METHODS USED

Seed Tree Surveys. - Conservation Act requirements designate the legally surveyed quarter section as the "seed source unit," and surveys are made with respect to quarter section boundaries.

Using a hand compass and pacing distances, seed trees were tallied by running strips 10 chains apart in a cardinal direction, the first strip being 5 chains distant from the nearest parallel quarter-section boundary. Four strips were run to each quarter-section.

Along the strips, one chain in from the boundary, the surveyor took a position from which he tallied all seed trees 18 inches in diameter and 100 feet high, in an area covering 2 acres. In doing this the surveyor estimated one chain ahead, one chain behind and 5 chains on each side. The next position was taken two chains further along the strip, and so on, making a 100 percent tally of all seed trees. Seed blocks, long corners, streams and topographic features are mapped as the surveyor progresses along the strip.

The seed trees are tallied on a printed form having individual rectangles for each 2 acres tallied. The position of each tree is plotted in the rectangle, using the figures 1, 2 or 3 depending on the class of the seed tree.

Stocking Surveys. - As a basis for the determination of the degree of stocking of reproduction on cutover lands, the stocked quadrat system, with modifications, is used. The quadrats were taken at 2 chain intervals along strips run 10 chains apart, or 4 strips to the

quarter-section. The center of each quadrat is the same point from which the two acre rectangle is surveyed for seed trees.

The quadrats are 1/250 acre in size, and each is divided, by eye, into four equal parts, or milacres. As a convenient method of determining the plot size, the surveyor carries a string, knotted at 7.45 feet, which is used to describe the periphery of the circular plot. In the surveys made by the state inspectors, a staff compass is used and one end of the string is tied to the staff.

With this method, 80-1/250 acre plots, and 320-1/1000 acre plots are taken on each quarter section.

The same tally card used for seed tree surveys is used in making stocking surveys. In the squares provided, the stocked milacre plots are checked in the order taken. Space is also provided for the number of established seedlings counted in each quadrat, the seedling species, slash conditions, ground cover, exposure, site, etc.

Since only established or advanced seedlings are tallied, three first year seedlings are considered the equivalent of one established seedling.

Survey Summaries. - At the completion of a seed tree or stocking survey, the information is transferred to a summary plat sheet (Appendix). Each plat sheet covers one quarter section. Seed trees are platted in their respective positions, counted and weighted by class and totaled at the top of the sheet.

In platting the results of the stocking survey, information is taken from the numbered field tally cards in the order the plots are taken in the field. In order to conveniently show stocked plots, an area of one square chain is used to indicate one 1/1000 acre plot, and each stocked plot is colored in green.

Stocked milacre and 1/250 acre plots are counted and indicated at the top of the sheet along with the percentages of total number of plots taken, that are stocked.

CONSERVATION ACT REQUIREMENTS

For the complete, detailed requirements of the Conservation Act, the reader is referred to the Oregon Forest Conservation Act Handbook (15). Insofar as this account is concerned, only sufficient information will be stated to provide a general picture of the requirements on areas used as samples, and to provide a distinction between those areas which were cut in compliance with the Act, and those cut in violation.

Seed Trees. - In accordance with the Act, seed trees are acceptable for compliance only if they meet the following requirements:

a. They must be coniferous species which are being harvested for commercial use in western Oregon.

b. They must be windfirm.

c. If slash is to be burned, they must be of fire resistant species.

d. They must be at least 18" in diameter breast high and must have relatively full crowns.

The State Forester has defined a "relatively full crown" as a wide dense crown which makes up at least one-fourth of the total tree length.

The standard seed tree with a "relatively full crown" has been defined as a tree at least 18 inches in diameter and at least 100 feet high with a wide, dense crown making up one-fourth of the total tree height.

Seed trees have been classified as follows:

Class I:	1/2 - 1/3 crown	One tree per acre required.
Class II:	1/4 - 1/6 crown	Two trees per acre required.
Class III:	1/7 - 1/8 crown	Four trees per acre required.

Long Corners, Seed Blocks. - A second method by which operators may comply with the Conservation Act is by leaving seed blocks, long corners, seed strips, etc. in sufficiently large areas. Several sample areas used in this study have long corners of varying sizes. (Samples II, III, IV and VIII.) The following quotation from the Oregon Forest Laws (amended in 1947), Section 6, Chapter 237, promulgates the requirements by which an operator may comply with the Act when he does not leave seed trees or use an alternate plan:

> "The Conservation Act shall be complied with ... if there shall have been reserved not less than 5 percent of each quarter section ... or fractional part thereof, well stocked with commercial trees species of seed bearing size. The foregoing may be accomplished by leaving, until the cutover areas for which the seed source was left are restocked in a manner satisfactory to the state board of forestry, (a) marginal long corners of timber between logged areas, or (b) strips of timber along creeks, across valleys, along ridges or natural fire breaks, or (c) staggered settings and the leaving of uncut settings ..."

Stocking Requirements. - When stocking surveys have been completed and platted on summary sheets, the percent of full stocking is determined. Adequate stocking has been defined as,

> "... a stand of at least 300 established live seedlings per acre, all of which are adequately spaced for normal growth and development and 100 of which are well distributed. In terms of quadrat stocking this would mean that thirty percent of all milacre quadrants would have to be stocked and that at least forty percent of all 1/250 acre plots would have to contain at least one established live seedling."

Although the relation of number of trees per acre to stocked quadrats is, in a correct sense, not constant, a sliding scale relationship has been worked out (7) for average Douglas fir logged-off land and

old burns carrying various sized seedlings and small saplings. The outstanding principle of such a relationship is that if a high percentage of the quadrats are classed as stocked, there will be several more than one seedling or sapling on many of the quadrats; and contrariwise, if only a small percentage of the quadrats are stocked, very few of them will have more than the one established seedling or sapling.

The following table is taken from a study of the forest survey of the Douglas fir region. (7) The total number of seedlings were counted on a large assortment of quadrats on land of various grades of stocking with reproduction from one to about 15 to 20 years old. The table shows for four groupings of stocked quadrats (Column 1), the probable minimum and maximum number of seedlings per acre (Column 4).

Table 1. Number of Seedlings per Stocked Quadrat and per Acre According to Stocking Percentage

Percentage of quadrats with one or more established seedlings.	Range in Average number of stocked quadrats per acre.	Range in Average number of seedlings per stocked quadrat.	Probable minimum and maximum number of seedlings per acre
0 to 9	0 to 24	1.0 - 1.2	0 - 29
10 to 39	25 to 99	1.2 - 3.2	30 - 319
40 to 69	100 to 174	3.2 - 8.6	320 - 1459
70 to 100	175 to 250	8.6 - 20.4	1460 plus

Figure 1
View of Sample V from
Southern end of strip

A check strip was run on Sample V, where 18 1/250 acre plots were taken and seedlings counted, with a resultant stocking of 83 percent. An average of the 18 plots shows 12.5 seedlings per stocked plot which is slightly below the comparable figure of 13.7 found by interpolation in Table 1.

An interpretation of percentage of quadrat stocking is generally accepted in the following terms:

Good	-	70 to 100%
Medium	-	40 to 69%
Poor	-	10 to 39%
Nonstocked	-	0 to 9%

The requirement of the Conservation Act, that 40 percent of the 1/250 acre plots and 30 percent of the 1/1000 acre plots be stocked, fulfills the definition of adequate stocking, that is that there be at least 300 established seedlings per acre, 100 of which are well spaced, in this way:

40 percent of 250 - 1/250 acre plots = at least 100 seedlings.
30 percent of 1000 - 1/1000 acre plots = at least 300 seedlings.

Generally, the 40 percent requirement would insure at least 320 seedlings per acre since from Table One, 40 percent stocking would average 3.2 seedlings per stocked quadrat.

DESCRIPTION OF SAMPLE AREAS

Of 21 sample quarter section areas, 9 are areas on which Douglas fir was left as a seed source, either in the form of individual seed trees, or in long corners, and on which Douglas fir was the dominant species of reproduction.

The remaining 12 samples are areas on which hemlock is the dominant remaining seed source and the reproduced species. These 12 sample areas have an inadequate amount of seed source. Five of the first 9 samples are areas with adequate seed source as judged by the Conservation Act, and the remaining 4 are areas which are in violation. The first 9 samples will be referred to for the major part of the discussion to follow. It may be well to point out that the seemingly excessive number of violations in this group of samples is no indication of a true average of violations of the Conservation Act, and that these areas are some of the first that were cut under the Act.

The following table summarizes the reproduction status of the areas in compliance and in violation by number of samples:

Table 2A. Summary of Areas Cut in Compliance with Conservation Act

	Type of Seed Source			Reproduction Status	
	Seed Trees	Long Corners	Combination	Satisfactory	Unsatisfactory
Number of Samples	2	1	2	2 1 2	2

Table 2B. Summary of Areas Cut in Violation of Conservation Act

Number of Samples	3	1	1	2

Table 2C. Summary of Hemlock Samples - All in Violation of Conservation Act

Number of Samples	12	2	10

A summary of the first 9 samples which includes the Conservation Act status, type of seed source, number of seed trees per acre, and the reproduction status is given in Table 3.

Table 3. Seed Source and its Effect on Reproduction
By Sample Area Numbers

Sample No.	Conservation Act Status	Type of Seed Source	Amount of Seed Source (Trees/Ac. or Area-Ac.)	Reproduction Status	Percent Stocked 1/1000 Ac.	1/250 Ac.
I	Compliance	ST*	2.0	Satisfactory	46	74
II	"	ST & LC	2.7 + 5.4 a.	Unsatisfactory	24	49
III	"	ST & LC	2.1 + 21.4 a.	Unsatisfactory	17	29
IV	"	LC	0.8 + 14.4 a.	Satisfactory	33	63
V	"	ST	2 +	Satisfactory	74	85
VI	Violation	ST	1.2	Unsatisfactory	23	55
VII	"	ST	0.3	Unsatisfactory	19	46
VIII	"	ST & LC	0.7 + 4.7 a.	Unsatisfactory	15	35
IX	"	ST	1.1	Satisfactory	35	64

* ST indicates Seed Trees; LC, Long Corners.

SAMPLE AREAS IN COMPLIANCE

Of the five samples with adequate seed source: Samples I and V have seed trees as the seed source, and both have become satisfactorily restocked. Samples II and III have both seed trees and long corners as their seed source. Neither has satisfactorily restocked as prescribed by the Conservation Act, although both have slightly more than 2 seed trees per acre in addition to the long corners. Sample IV has a 14.4 acre long corner as its major seed source and has become adequately restocked. An average of only 0.8 seed trees per acre were left on the cutover area.

SAMPLE AREAS IN VIOLATION

VI, VII, VIII and IX. - Seed trees remaining on these areas range in numbers per acre from 0.2 to 1.2. Sample VIII has a long corner of 4.7 acres in addition to the few seed trees remaining, but the total of both types of seed source is insufficient. Sample IX, although having 1.1 seed trees per acre, has satisfactorily restocked.

HEMLOCK SAMPLES

Eleven additional summary sheets of areas in northwestern Oregon were examined for this study, but were not included in the appendix. The predominating intrinsic seed source of these areas was hemlock, and the relationship between amount of seed source and hemlock reproduction was difficult to evaluate. On some, it was possible to determine the source of reproduction, but in the majority of samples reproduction has apparently come from a source not on the area. Two of these areas had 40-50 Douglas fir seed trees and were 31-40 percent stocked, respectively, with hemlock reproduction.

In view of the above irregularities, it was believed that any conclusions drawn with regard to intrinsic seed source and the degree of restocking would be of little value. The distance the small hemlock seeds travel when released is fortunate for the barren areas of northwestern Oregon where hemlock is one of the important commercial species, but the greater seed travel combined with the tolerance of hemlock lead to inconsistencies in reproduction, as compared to Douglas fir, that make the seed source-stocking relationship difficult to fix on areas of 160 acres. Table 4 gives such an indication.

Table 4. Relationship of Hemlock Seed Trees to Restocking on Eleven 160 Acre Areas in Northwestern Oregon.

Number of Trees per 160 Acres		:	Percent Stocked*	
Hemlock	Douglas fir	:	1/1000 a. plots	1/250 a. plots
21	15		35	60
14	0		47	73
35	0		11	21
56	0		19	34
13	0		6	16
4	0		8	26
2	0		13	25
0	50		22	80
0	40		13	31
0	30		18	40
0	10		10	24
6	19		12	31

*Reproduction all Hemlock.

PERCENTAGE OF RESTOCKING IN RELATION TO NUMBER OF SEED TREES PER ACRE

In comparing seed source on areas in compliance with those in violation of the Act, it was interesting to consider whether or not two seed trees per acre was the minimum that would satisfactorily restock an area 5 years after logging. Were two seed trees enough? How much better would three seed trees per acre be?

With the data available and by using 40 acre samples, it seemed that a fairly accurate answer to these questions could be found. The use of 40 acre samples was deemed advisable since on the smaller areas were to be found a more uniform distribution of seed trees as well as a smaller variation in numbers of trees per acre. Their use also made possible the elimination of long corners from the samples which would have made quarter sections useless.

Seed trees were counted and weighted on each of the 21 tracts selected, and the average number of seed trees per acre on each was computed. These were then grouped into 4 classes of trees per acre (1 tree per acre class included from 0 to 1.4; 2 from 1.5 to 2.4, etc.) and averaged. The percent of plots stocked with reproduction was also computed.

Table 5 is a summary of the seed-trees-per-acre classes, giving the average number of seed trees per acre for each sample used, the average for the class; the percent of stocking for each sample, and the average percent stocked for each class. The table also gives the location of each 40 acre tract within its sample quarter-section. From this information, the percent of stocking of both the 1/1000 acre

Table 5. Trees per Acre and Percent of Stocking on 40 Acre Sample Areas.

ST/Acre Class	Sample Number	Location in Quarter Section	ST/Acre	Percent Stocked Size of Plots, Acres 1/1000	1/250
	IV	SW	1.1	21	55
	VI	NW	1.0	34	70
	VI	NE	0.7	15	40
	VI	SE	1.3	19	50
	VII	NW	0.3	14	45
	VII	NE	0.2	20	50
	VII	SW	0.3	19	35
ONE	VII	SE	0.2	17	50
	VIII	NW	1.1	14	35
	VIII	NE	1.1	16	50
	VIII	SW	0.3	15	25
	IX	NW	1.3	52	85
	IX	SW	0.8	45	80
	IX	SE	0.5	6	15
		Average	0.7	22	49
	I	NW	1.7	35	55
TWO	I	SW	1.9	38	65
	VI	SW	1.8	26	60
	IX	NE	1.5	34	75
		Average	1.7	33	64
THREE	I	NE	2.6	51	80
	II	NW	3.1	40	75
		Average	2.7	45	77
FOUR	II	SW	4.4	31	55

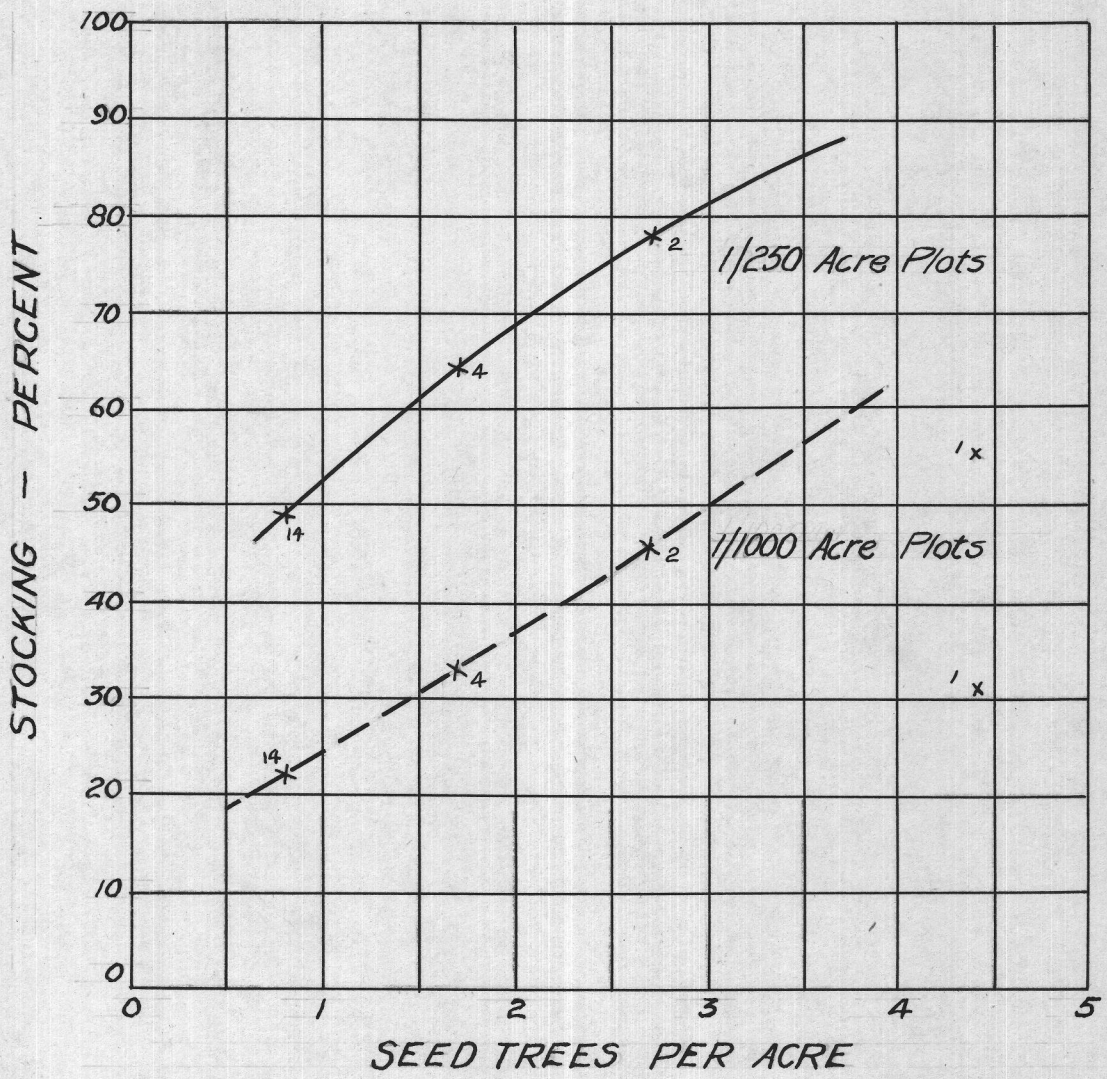


Figure 2
The relation between
Seed Trees per acre and
percent of stocking.

quadrats and the 1/250 acre plots were plotted against the numbers of seed trees per acre, and curves were drawn as in Figure 2.

Since only two samples were available for the three trees per acre class, and only one for the four, such points cannot be regarded as very accurate, although the three trees per acre point is probably close to its true value, while the point for 4 trees per acre is quite inaccurate.

The curves indicate that Conservation Act requirements of 2 seed trees per acre to provide stocking of 30 and 40 percent, have been well chosen. They show 2 trees will provide 37 percent stocking in 1/1000 acre plots, and amply meet the requirement in 1/250 acre plots with 69 percent.

The ratio of percent stocking of 1/250 acre plots to the percent of stocking of 1/1000 acre plots slowly but somewhat irregularly becomes smaller, which would be logical to expect. By rough approximation, 100 percent stocking would occur at about 7-8 seed trees per acre. In theory, both size plots should reach 100 percent stocking at the same time and the trend of the curves suggests this. The stocking of the smaller plots increases at a faster rate and would probably begin to level off later than the larger plots.

In selecting sample areas, the only consideration given was that seed trees were the only seed source. Other factors such as site, exposure, slope, slash conditions, type of cover, etc. were not considered because these samples probably cover nearly all of the ordinary conditions that will be found in the region from which they were taken. All areas complied with the state slash requirements, and slash and logging debris was either burned or, in cases of low hazard, placed on extension. Nearly the entire total area used in the study

has been slash burned with varying degrees of intensity.

It was mentioned at the outset that one objective of this study was to find the relationship between numbers of seed trees and the percent of stocking under conditions that are found in the application of the Conservation Act, and random samples such as these should give a truer picture than carefully layed out sample plots where all conditions are chosen. It is realized however that in applying the results to any conditions in the region from which these samples were taken a fairly large margin of error may be expected.

It was the practice on early National Forest timber sale areas to leave a minimum of 2 seed trees per acre, but the results were considered unsatisfactory (4; 2), and within the past few years the number has been increased to 8. This number of trees left after logging a good stand could represent a considerable sum to the private operator, especially during the present period of high operating costs and log prices.

SEEDLING ESTABLISHMENT

The shade requirements for the establishment of Douglas fir seedlings is not usually the same for optimum development of the seedlings. Forest Service studies (4) have shown that 8 trees per acre provide good restocking in about 10 years. A large amount of shade is cast by 6-10 trees per acre and is beneficial to seedling establishment, and a sufficient number of seed trees will probably die in the first 10 years so that they would not be likely to retard the growth of the new stand.

Figure 3
View of Seed Trees
and reproduction on the
east side of Sample I.

Sample III of Table 3 is very likely an unusual area and not representative of general conditions. Reproduction is generally very poor except in the southwest quarter of the quarter section which has the fewest seed trees of the area. The cutover portion of the northeast quarter is stocked with 5 seed trees per acre and in 5 years seedling establishment has been very poor. It does not seem likely that 5 trees per acre would provide too much shade, and if this were the case, restocking would probably be better where the trees are not as numerous, excluding the southwest quarter. If anything, this sample serves to illustrate one extreme of the wide variation in conditions of restocking to be found within one quarter section.

A conception of a slightly above average area (in slash disposal and seed tree survival) with 2 seed trees per acre may be found in Sample I. It is exposed to the south and west with slope varying up to about 25 percent. Brush is fairly light on the upper part of the slope where fern, Oregon grape, grass and salal predominate. The lower, or west side, is rather heavily overgrown in hardwood brush. The soil is rocky on upper slopes. Stocking was found slightly better than average as determined by the above curve, with the 1/1000 acre plots 46 percent stocked, and the 1/250 acre plots 74 percent stocked.

From controlled field tests over a three year period, Isaac (3) found that the minimum light intensity at which Douglas fir will become established is 20 percent of full overhead light at midday, even in the complete absence of overwood competition. He also found that light intensity resulting in the highest percentage of seedling establishment was 66 percent of full sunlight. Weaver and Clements (13) state that, "the seedlings of Douglas fir thrive best at about 50% full sunshine."

Isaac's observed that shade protects the seedlings not only from

heat and drought, but from frost as well; and that mortality was less in shade of slash and logs than from "live slash" of vegetation which competes with seedlings for moisture and plant food.

The effect of shade is also beneficial in decreasing the rate of evaporation of soil moisture, although brush and forest cover lose water through transpiration from the leaves, and the gain, if any, through decreasing evaporation is difficult to determine. Tests have shown (3) that evaporation was 46 percent less on an area of old growth than on an open area that had been severely slash burned.

Temperature of the surface soil was the factor causing more first year losses than any other in Isaac's study, and that author claims that a surface soil temperature of 125° or more for several days following germination is likely to kill seedlings. Such soil temperatures are not uncommon on open, gray soils with air temperatures of about 85°, even in the first half of the growing season.

Isaac lists soil-moisture content as the second most important environmental factor governing seedling establishment.

Tiedman (12) in reproduction studies made on the McDonald Forest states that soil moisture plays the leading role in survival of Douglas fir seedlings.

HEIGHT GROWTH

Shade from seed trees is considered to be a greater detriment to seedling growth than shade from brush cover. Once seedlings have overtopped the brush cover, which takes approximately 5 to 8 years for attainment of 2 to 4 feet in height above the ground, respectively, on Site III (4), their development is much better than it would be when established under a heavy cover of seed trees.

The mean growth of seedlings in the first four years on a fresh burn with light shade was 6.8 inches, and on an old burn with heavy brush cover, 2.8 inches. After overtopping the brush, provided seed trees were not very numerous, growth could be expected to be about a foot per year after an age of 6 years. Under seed trees however, growth continues to be retarded as long as the residual trees remain. Studies by Yocom and Hilsman (4) on National Forest land near Rujada, Oregon, produced the following table:

Table 6. Height Growth of Douglas fir Seedlings in Relation to Number of Reserved Trees in the Overwood

No. Plots	Average No. of Large Reserved Trees per Acre	Mean Annual Height Growth Inches
4	2.2	6.48
3	11.3	5.40
3	20.0	3.12

When there were 20 or more seed trees per acre the growth rate was about half of what it was with 2 trees per acre. It may also be possible in heavy residual stands that competition occurs from more tolerant species such as hemlock and cedar.

SEED TREE MORTALITY

The mortality rate of seed trees left after logging is usually very high. Slash fires often kill or injure them and many in damp or exposed places are windthrown. Still others succumb to bark beetle attack.

On several Forest Service test areas (4) the average loss of seed trees on the slash burned areas in 11 to 15 years was 91 percent, and on the unburned areas, 35 percent. Losses were extremely variable,

ranging from 8 to 98 percent. More than half the losses occurred during the first 5 years. A third of the loss on burned areas was attributed to wind, and over a half the loss on unburned areas was attributed to wind. Logging, slash burning and probable insect attack accounted for about one-quarter of the loss.

A study made by Berry (11) of the Oregon State Department of Forestry, shows, in a 60-80 percent cut, a mortality in the residual stand where slash was not burned, of 24 percent, and in the slash burned areas of 67 percent.

Seed trees left standing from a closely grown, even-aged stand normally have small crowns, and for the first year or two bear few cones, if any at all. This and the likelihood of windfall should be considered in a plan requiring seed trees as the source of seed. It is often the case, as was borne out in this study, that quite a number of trees are left after logging that are not tallied as seed trees because they are below size requirements. Others are not tallied due to their apparent lack of vigor, but these cannot be counted on to contribute any seed, whereas the undersized trees quite often do. This is shown in Sample X in which the number 4 seed trees (smaller size than is required of the better classes), all hemlock, were deliberately counted due to their unusually large number in relation to the three better classes of seed trees. The number four seed trees were not plotted on the summary sheet for this study, but it was estimated that there were about 1 per acre. Their presence may account for the 60 percent stocking on this area. No tally of number 4 Douglas fir seed trees was available when this data was assembled.

SLASH BURNING

Slash burning is generally considered to be harmful to the establishment of reproduction. Its affects on the soil are variable and complex, and usually detrimental, but the gain in hazard reduction far outweighs the harmful effects.

Comparison of reproduction on 77 burned and 41 unburned areas (4) indicates that 7 years after logging the burned areas were 25 percent stocked and the unburned 50 percent stocked.

The time of seed fall is important when associated with slash burning. Whether the seed fall occurs before or after the burn, and whether or not the burned surfaces are suitable to seedling establishment may mean the difference between success or failure of a seed crop.

LONG CORNERS vs. SEED TREES AS A SEED SOURCE

In formulating the discussion of this problem, consideration will be given Samples II, III, IV and VIII. All have as part of their seed source a long corner or uncut timber in some form. These samples are too few, however, to provide a basis for positive conclusions, but they are indicative of certain conditions.

Sample II is nearly ideal for such a discussion, for on it are examples of both types of seed source. On the west half are 322 seed trees, or 4 per acre, which have restocked 35.6 percent of the 1/1000 acre plots (required: 30 percent), and 65 percent of the 1/250 acre plots (required: 40 percent).

On the east half, a long corner of 5.4 acres was left in the center of the 80 acres. Since 8 acres of solid timber are required by the Act to restock 160 acres, this 5.4 acres should take care of 108 acres of bare land. Actually, 5 years after logging, only 4.4 percent of the 1/1000 acre plots had restocked, and 11.2 percent of the 1/250 acre plots. Although this is a good sized long corner it has fallen short in providing seed as compared to the seed tree side. The site can be expected to be the same over the entire quarter section as can the exposure, which presumably is southeastern, judging by the stream in the southeast corner. Slash conditions may vary, and before burning, slash would have been somewhat heavier on the long corner side. It is possible that a more intense slash fire on this side could have impaired the seed bed conditions. In addition to the long corner on the east half, are 97 seed trees, and it is interesting to note that

where there is a stocked plot there is also, nearby, a group of seed trees.

Sample III is not a representative sample. It was briefly discussed under seedling establishment.

Sample IV is another area with a long corner as seed source, but results are impossible to evaluate in this case since the strip adjacent to the long corner was not completely run. Restocking in the southwest corner is normal for the number of seed trees growing there, thus discrediting the long corner as a provider of any seed.

The long corner in Sample VIII may be responsible for the stocked plots on the two strips between which it is located. Without crediting the seed trees in that vicinity for any reproduction, restocking is still poor, at least on the area surveyed; the adjacent quarter section on the east may have received some of the seed.

CONCLUSIONS

From the few samples used here it appears that, within the first 5 years, 2 seed trees provide medium stocking while the resultant reproduction from 5 percent of the original timbered area left in long corners is negligible. One reason for such a difference may be due to a faster response of seed trees in developing full crowns than would occur with trees on the perimeter of a long corner or seed block, since the latter are still receiving crown competition on one side.

It is evident that the seed disbursing quality of a long corner or seed block is dependent upon its perimeter rather than area, and it would seem that a gain in perimeter would be more economically accomplished by cutting irregular borders on seed blocks rather than increasing the area where area is a limiting factor. Doubling the area of a circle or rectangle increases the perimeter only about 1.4 times,

Form 49A—4-46—2M

OREGON STATE BOARD OF FORESTRY

STOCKING AND SEED TREE SURVEY SUMMARY

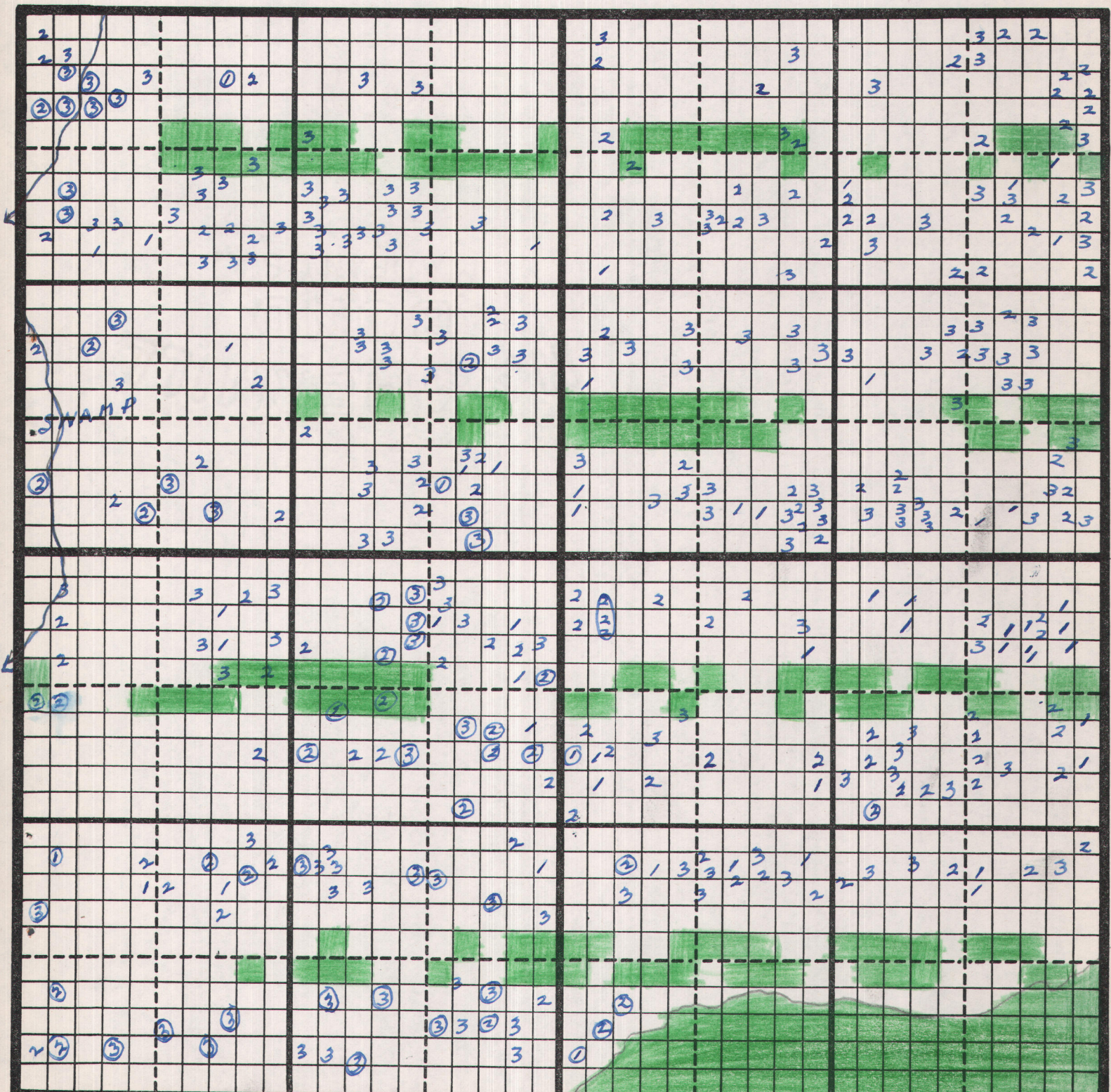
Sample No. I

Area Covered: Township 10S Range 2E Section RANDOM 160 40

Method 2+10 Done by BERRY & BRIGHAM Date 3/31/47

Operator Landowner

SEED TREES						STOCKING			
Class	Weight	No. Trees DF	No. Trees Other	Wt. Value DF	Wt. Value Other	By 1/1000 Acre Plots		By 1/250 Acre Plots	
I	2	50	3	100	6	Total No. Plots	320	Total No. Plots	80
II	1	113	27	113	27	Total Plots Stocked	148	Total Plots Stocked	59
III	0.5	137	31(1)	68	15	Per cent Plots Stocked	46	Per cent Plots Stocked	74
Total		300	61	281	48				



Form 49A—4-46—2M

OREGON STATE BOARD OF FORESTRY

STOCKING AND SEED TREE SURVEY SUMMARY

Sample No. II

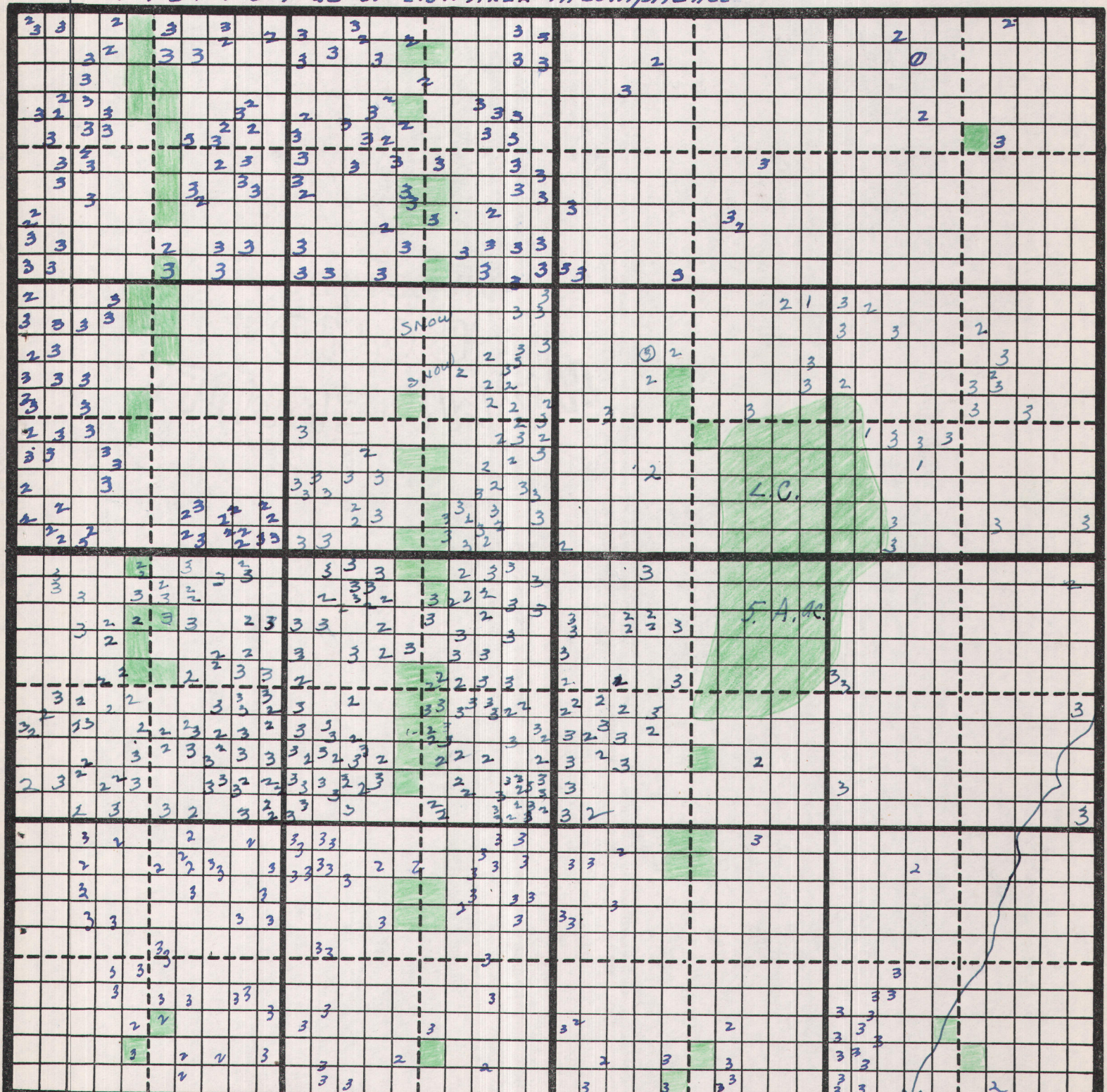
Area Covered: Township 5S Range AE Section 22 160 NW 40

Method 2X 10 Done by BEVOR-HANN-HANNOCK Date 2/MAY/46

Operator CROWN-ZELLERBACH Landowner SAME

SEED TREES						STOCKING			
Class	Weight	No. Trees DF	No. Trees Other	Wt. Value DF	Wt. Value Other	By 1/1000 Acre Plots		By 1/250 Acre Plots	
I	2	4	1	8	2	Total No. Plots	295	Total No. Plots	43.75
II	1	218		218		Total Plots Stocked	72	Total Plots Stocked	36
III	0.5	380	2	190	1	Per cent Plots Stocked	24.4	Per cent Plots Stocked	45.81
	Total	602	3	416	3				

419 ST + 5.4 AC OF L.C.. AREA IN COMPLIANCE



Form 49A—4-46—2M

OREGON STATE BOARD OF FORESTRY

STOCKING AND SEED TREE SURVEY SUMMARY

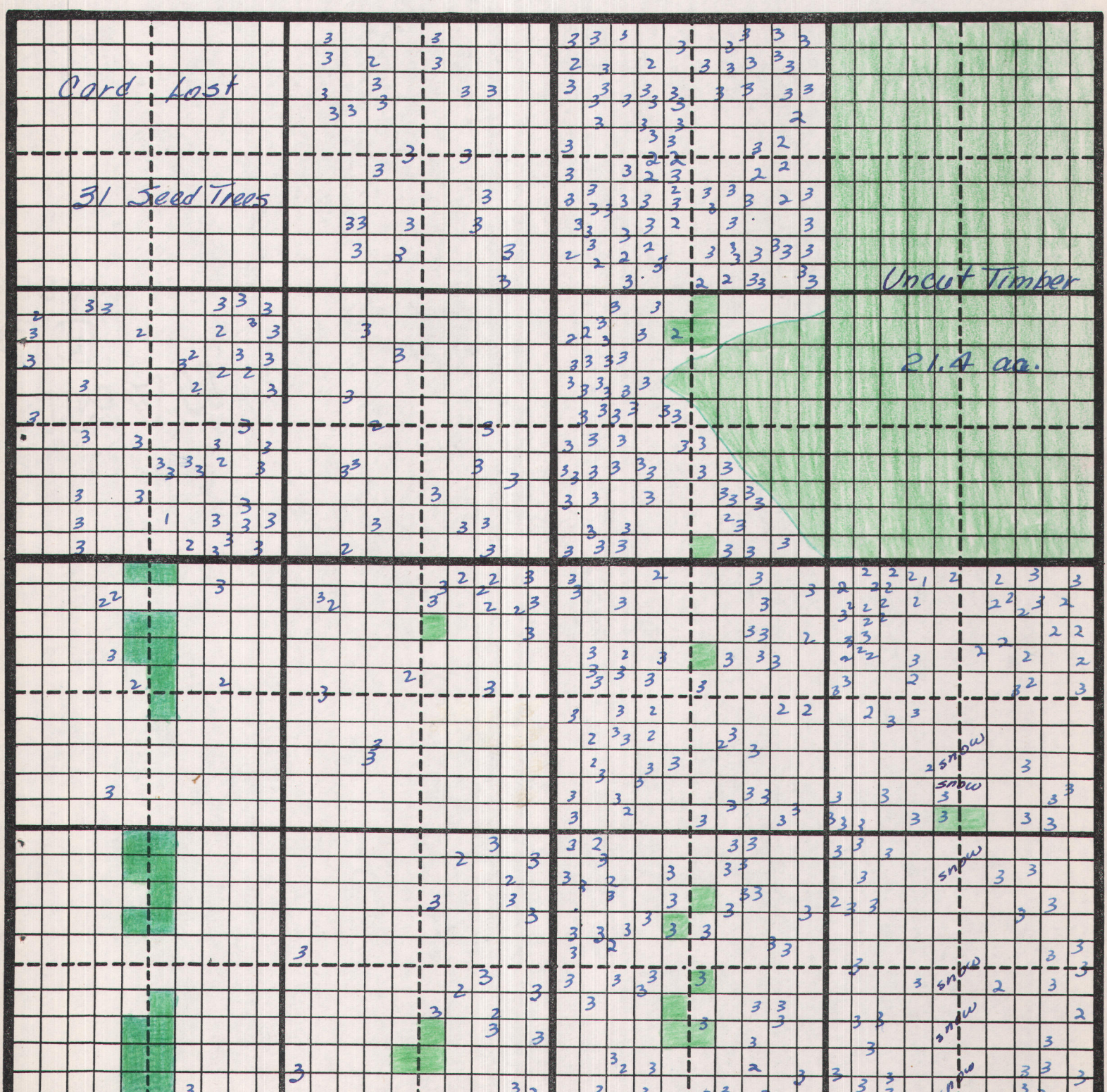
Sample III

Area Covered: Township 5S Range 4E Section 22 160 NE 40

Method 2x10 Done by BEVER & MAYNOCK Date 5/1/46

Operator Crown-Zellerbach Corp. Landowner Same

SEED TREES						STOCKING			
Class	Weight	No. Trees DF	No. Trees Other	Wt. Value DF	Wt. Value Other	By 1/1000 Acre Plots		By 1/250 Acre Plots	
I	2	3		6		Total No. Plots	234	Total No. Plots	58.5
II	1	138		138		Total Plots Stocked	39	Total Plots Stocked	17
III	0.5	293		146.5		Per cent Plots Stocked	16.67	Per cent Plots Stocked	29.06
	Total	434		290.5					



Form 49A—4-46—2M

OREGON STATE BOARD OF FORESTRY

STOCKING AND SEED TREE SURVEY SUMMARY

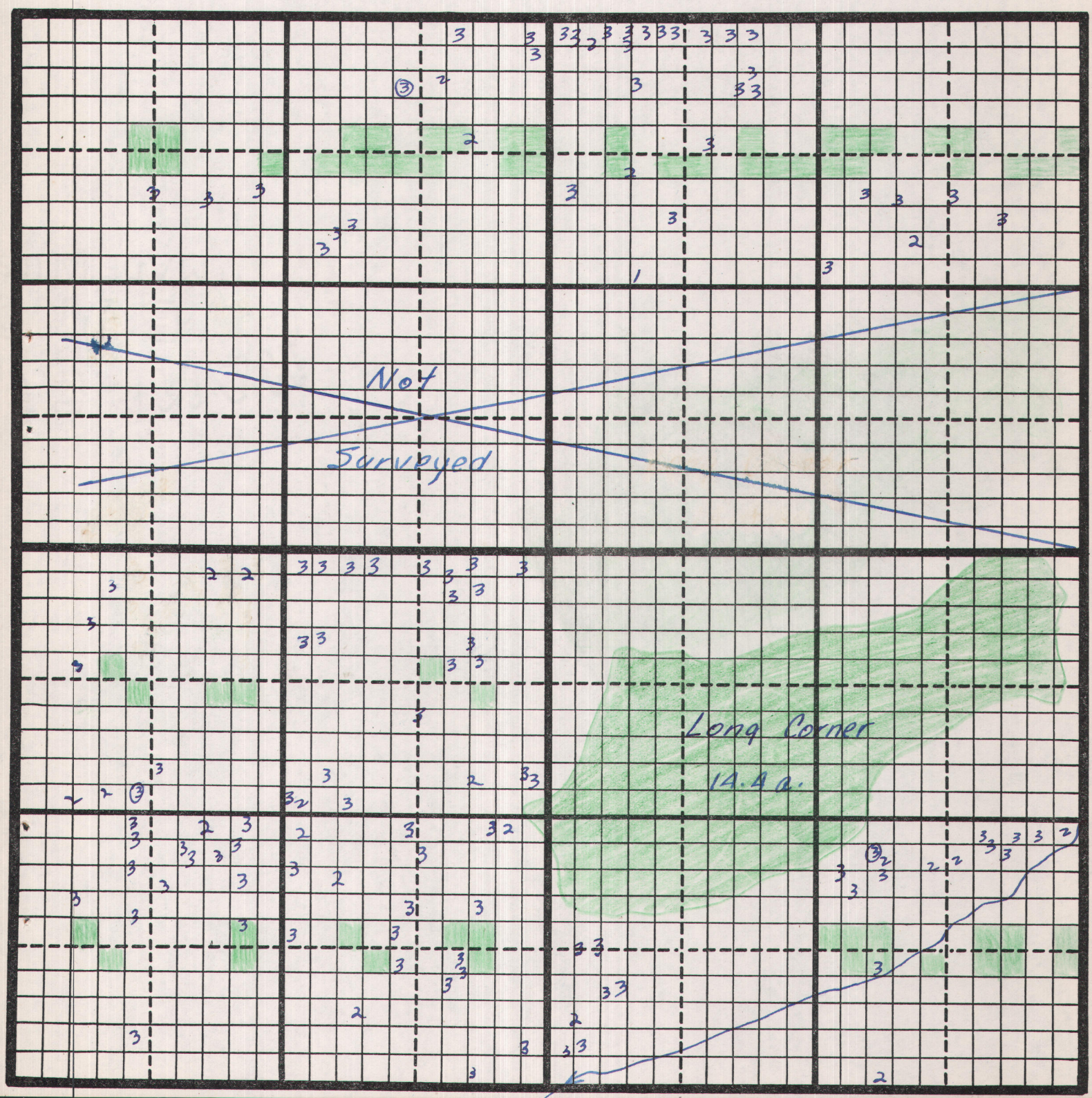
Sample IV

Area Covered: Township 5S Range 4E Section 27 160 NW 40

Method 1 x 10 Done by Bever & Mannock Date 5/31/46

Operator Crown Zellerbach Corp. Landowner Same.

SEED TREES						STOCKING			
Class	Weight	No. Trees DF	No. Trees Other	Wt. Value DF	Wt. Value Other	By 1/1000 Acre Plots		By 1/250 Acre Plots	
I	2					Total No. Plots	204	Total No. Plots	51
II	1	25		25		Total Plots Stocked	67	Total Plots Stocked	32
III	0.5	125	3	62.5	1.5	Per cent Plots Stocked	32.8	Per cent Plots Stocked	62.7
	Total	150	3	87.5	1.5				



Form 49A—4-46—2M

OREGON STATE BOARD OF FORESTRY

STOCKING AND SEED TREE SURVEY SUMMARY

Sample V

Area Covered: Township 11S Range 7W Section 12 160 NE 40

Method ..... Done by ..... Date 2/8/47

Operator ..... Landowner .....

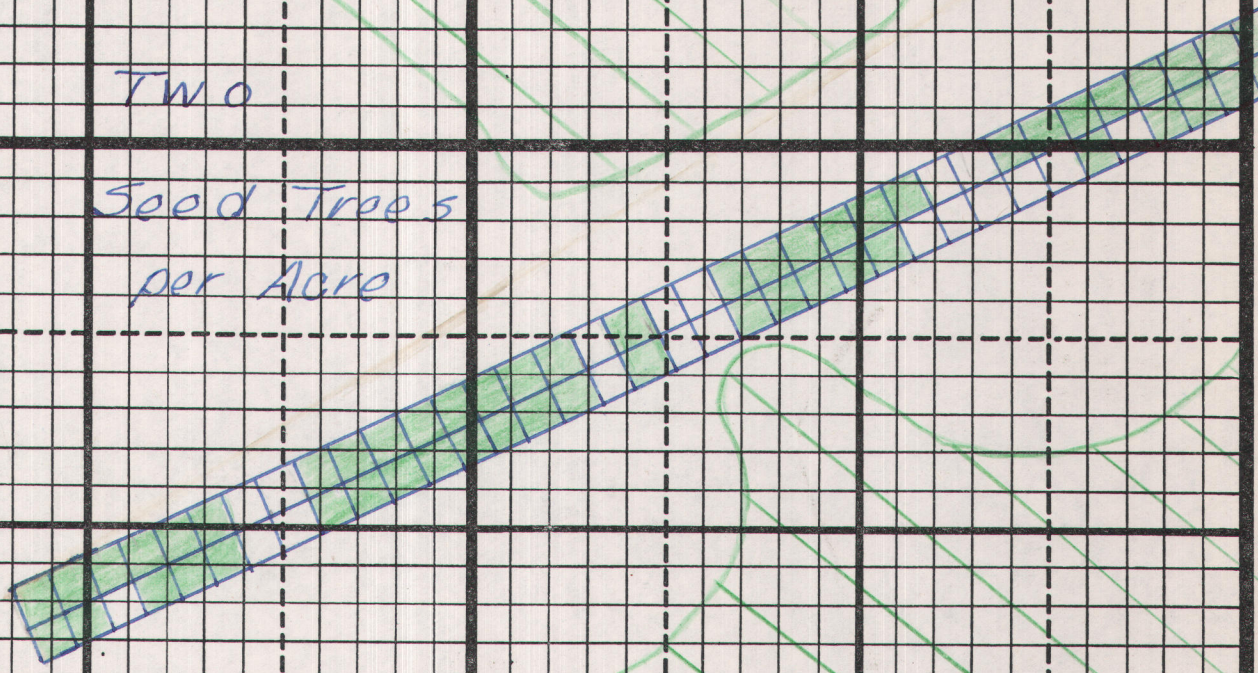
SEED TREES					
Class	Weight	No. Trees DF	No. Trees Other	Wt. Value DF	Wt. Value Other
I	2				
II	1				
III	0.5				
Total					

STOCKING			
By 1/1000 Acre Plots		By 1/250 Acre Plots	
Total No. Plots	72	Total No. Plots	18
Total Plots Stocked	53	Total Plots Stocked	15
Per cent Plots Stocked	74	Per cent Plots Stocked	83

Some Old Growth & Young Second Growth

TWO

Seed Trees per Acre



Young Second Growth

Form 49A—4-46—2M

OREGON STATE BOARD OF FORESTRY

STOCKING AND SEED TREE SURVEY SUMMARY

Sample VI

Area Covered: Township 5S Range 4E Section 21 160 SE 40

Method 2x10 Done by Date 4/18/46

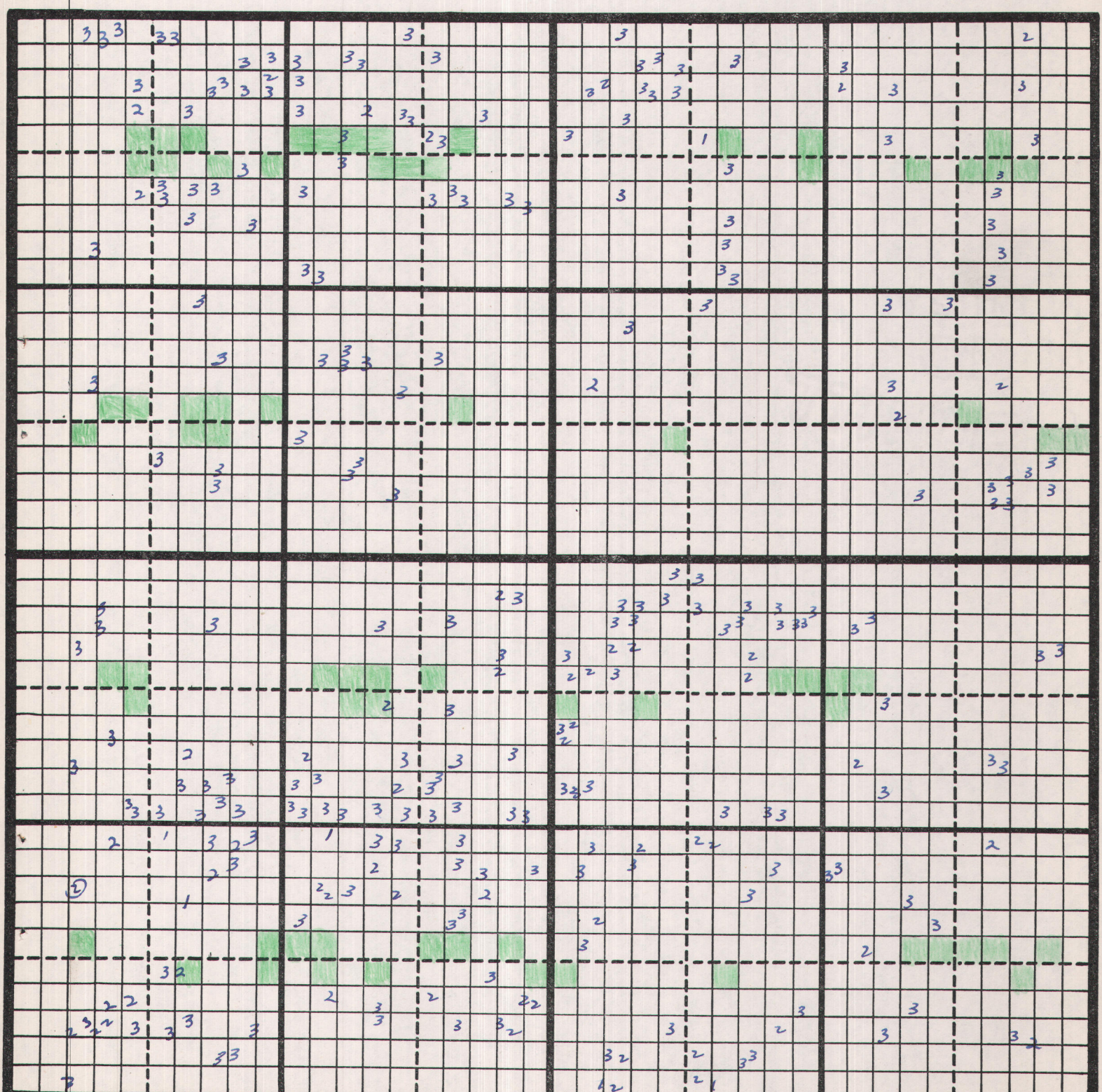
Operator Crown Zell. Corp. Landowner Same

SEED TREES

Class	Weight	No. Trees DF	No. Trees Other	Wt. Value DF	Wt. Value Other
I	2	8		16	
II	1	64	1	64	1
III	0.5	223		112	
	Total	295	1	192	1

STOCKING

By 1/1000 Acre Plots		By 1/250 Acre Plots	
Total No. Plots	320	Total No. Plots	80
Total Plots Stocked	75	Total Plots Stocked	44
Per cent Plots Stocked	23.4	Per cent Plots Stocked	55



Form 49A—4-46—2M

OREGON STATE BOARD OF FORESTRY

STOCKING AND SEED TREE SURVEY SUMMARY

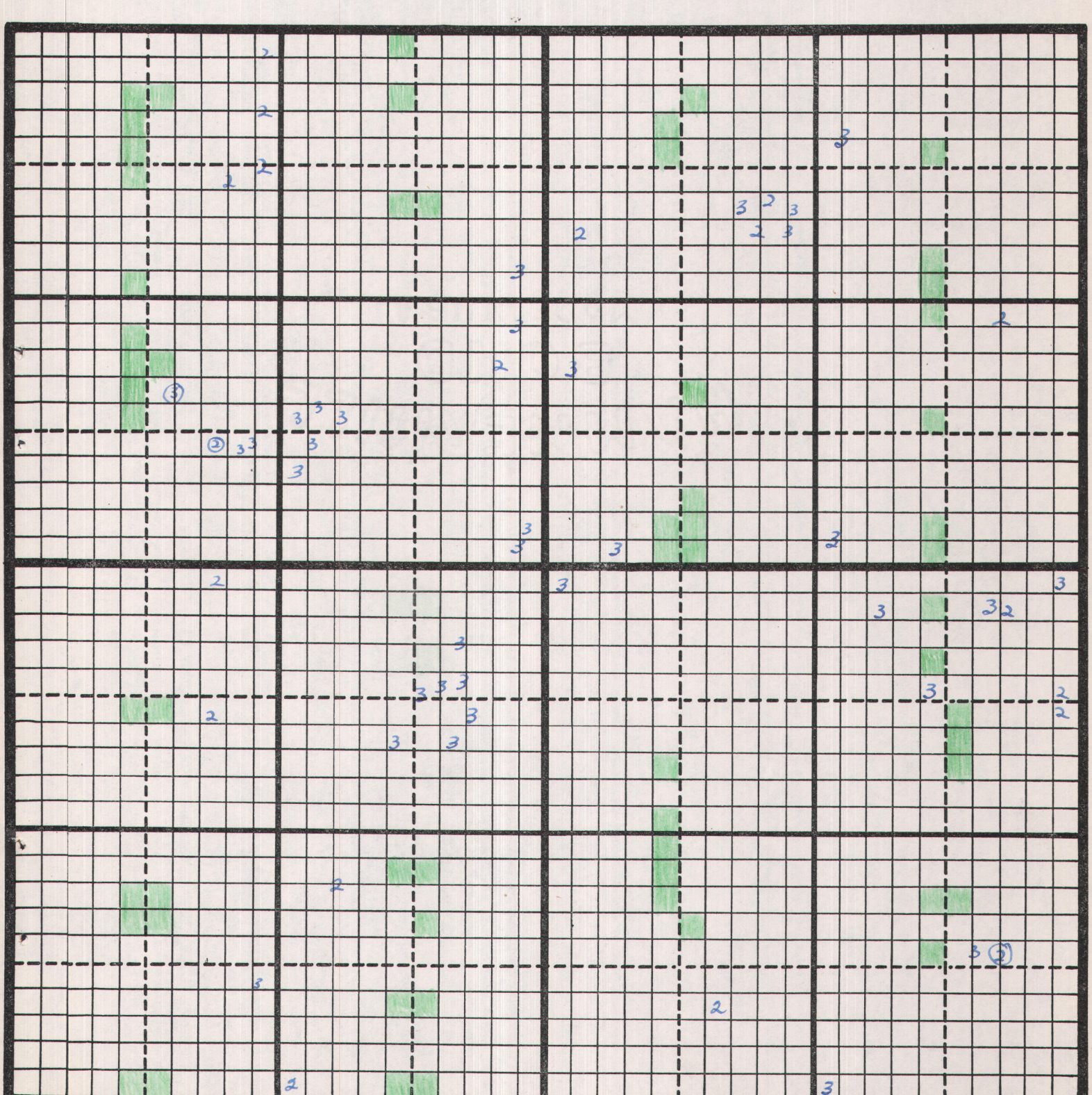
Sample VII

Area Covered: Township 5 S Range 4 E Section 28 160 SW 40

Method 3 x 10 Done by Date 5/13/46

Operator Crown Zell. Corp. Landowner Same

SEED TREES						STOCKING			
Class	Weight	No. Trees DF	No. Trees Other	Wt. Value DF	Wt. Value Other	By 1/1000 Acre Plots		By 1/250 Acre Plots	
I	2					Total No. Plots	320	Total No. Plots	80
II	1	22	1	22	1	Total Plots Stocked	61	Total Plots Stocked	37
III	0.5	33	1	16.5	.5	Per cent Plots Stocked	19.06	Per cent Plots Stocked	46.25
	Total	55	2	38.5	1.5				



Form 49A—4-46—2M

OREGON STATE BOARD OF FORESTRY

STOCKING AND SEED TREE SURVEY SUMMARY

Sample VIII

Area Covered: Township 5S Range 4E Section 28 160 NE 40

Method 2+10 Done by Beuer Date 5/3/46

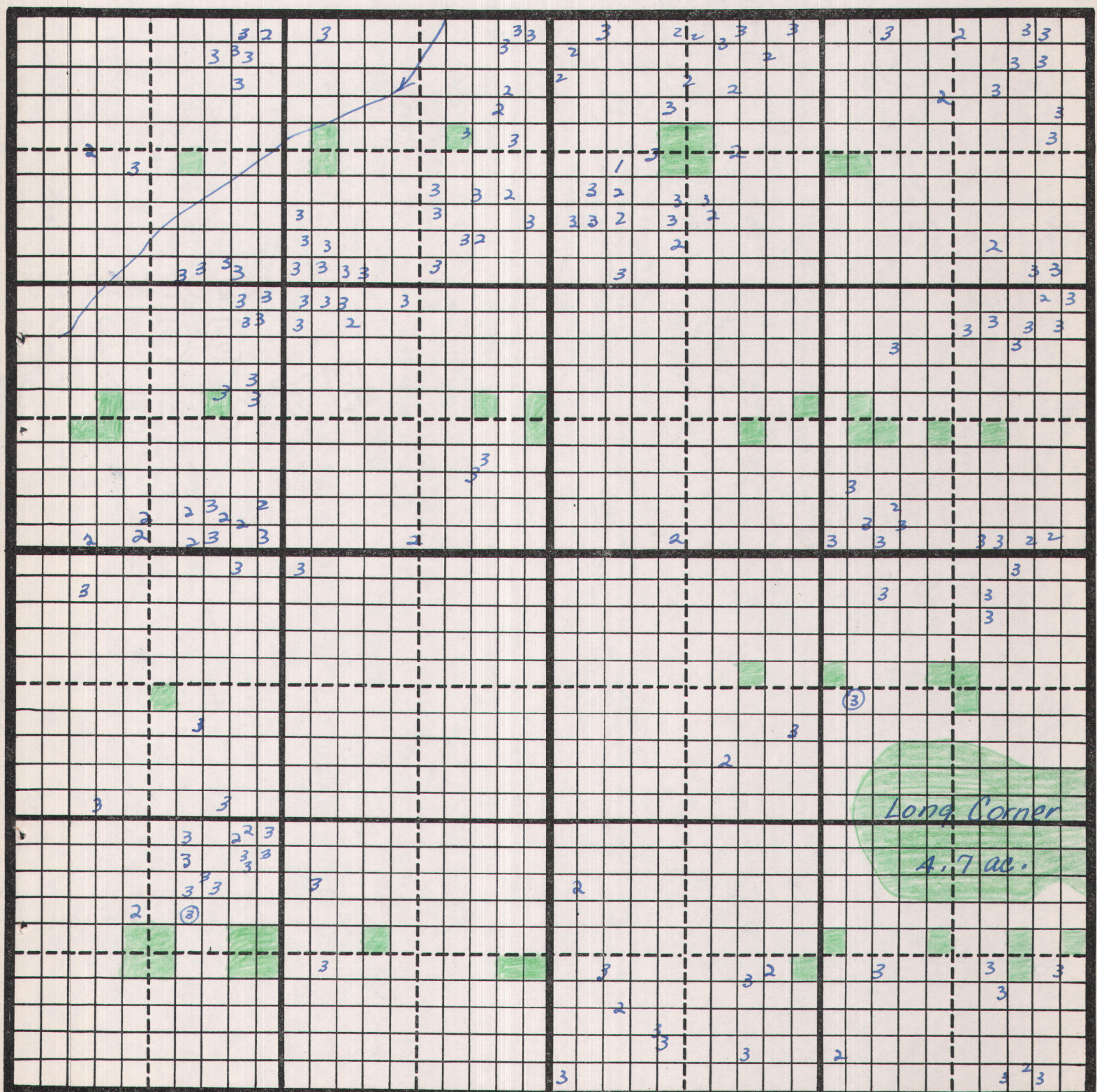
Operator Crown-Zell. Landowner Same

SEED TREES

Class	Weight	No. Trees DF	No. Trees Other	Wt. Value DF	Wt. Value Other
I	2	1		2	
II	1	46		46	
III	0.5	124	2	62	1
Total		171	2	110	1

STOCKING

By 1/1000 Acre Plots		By 1/250 Acre Plots	
Total No. Plots	320	Total No. Plots	80
Total Plots Stocked	47	Total Plots Stocked	28
Per cent Plots Stocked	14.7	Per cent Plots Stocked	35.0



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OREGON STATE BOARD OF FORESTRY

STOCKING AND SEED TREE SURVEY SUMMARY

Sample IX

Area Covered: Township 55 Range 4E Section 21 160 SW 40

Method 2 x 10 Done by Date 4/23/46

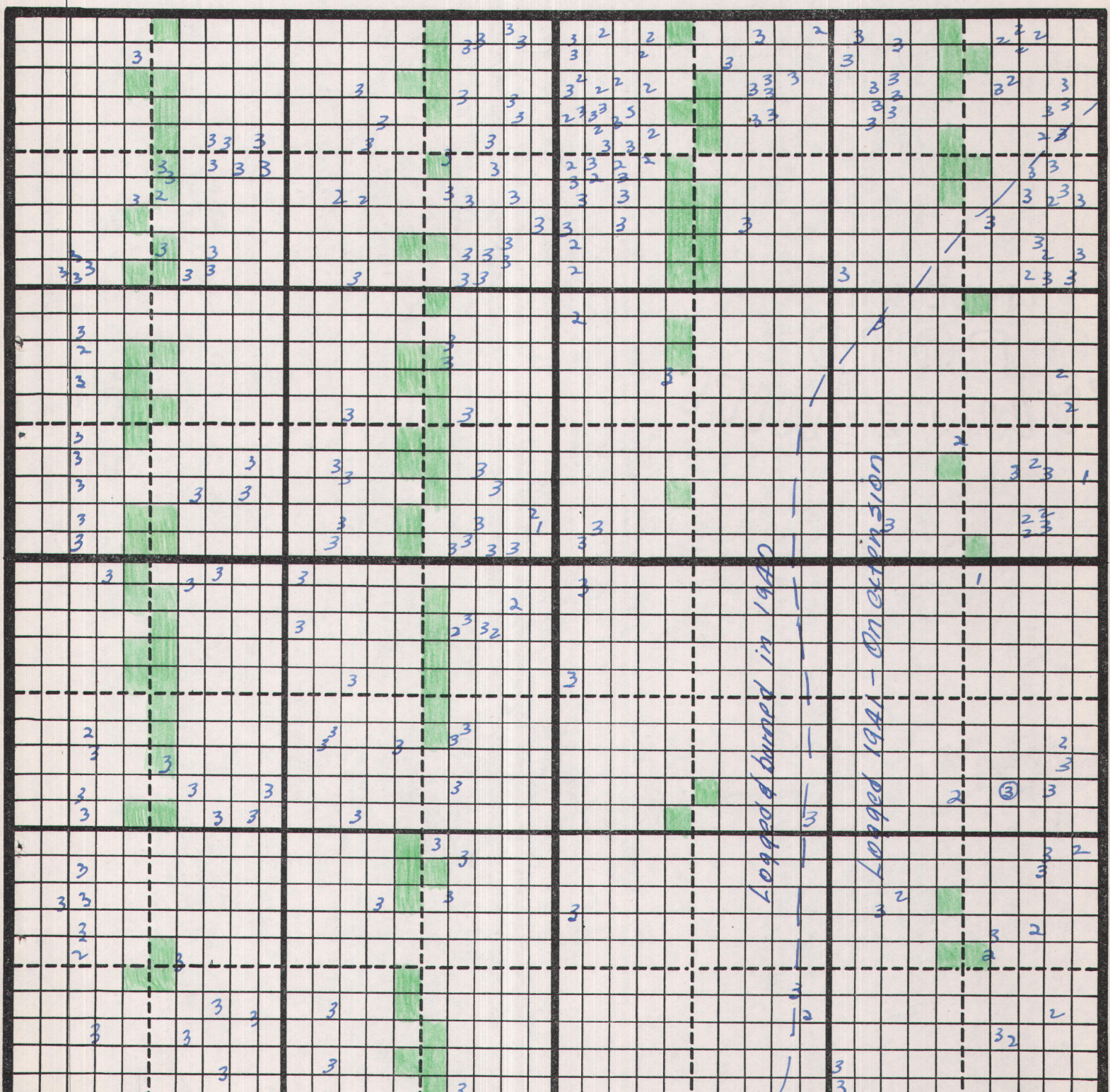
Operator Crown Zell. Corp. Landowner Same

SEED TREES

Class	Weight	No. Trees DF	No. Trees Other	Wt. Value DF	Wt. Value Other
I	2	3		6	
II	1	59		59	
III	0.5	215	1	107.5	.5
	Total	277	1	172.5	.5

STOCKING

By 1/1000 Acre Plots		By 1/250 Acre Plots	
Total No. Plots	320	Total No. Plots	80
Total Plots Stocked	111	Total Plots Stocked	51
Per cent Plots Stocked	34.7	Per cent Plots Stocked	63.7



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OREGON STATE BOARD OF FORESTRY

STOCKING AND SEED TREE SURVEY SUMMARY

Area Covered: Township 5N Range 10W Section NW5 160 NW 40 Sample X

Method 2+10 Done by Hammock Date

Operator Landowner

SEED TREES						STOCKING			
Class	Weight	No. Trees DF	No. Trees Other	Wt. Value DF	Wt. Value Other	By 1/1000 Acre Plots		By 1/250 Acre Plots	
I	2					Total No. Plots	320	Total No. Plots	80
II	1	12	4	12	4	Total Plots Stocked	111	Total Plots Stocked	48
III	0.5	3	34	3	17	Per cent Plots Stocked	34.7	Per cent Plots Stocked	60
	Total	18	38	15	21				

Many #4 S.T.

Reprod all Hemlock