PRELIMINARY EVALUATION OF PILOT-SCALE CONTAINER PLANTING IN THE FOOTHILLS OF ALBERTA - 1967 PLANTING

by

G. Dixon and H. J. Johnson

FOREST RESEARCH LABORATORY

EDMONTON, ALBERTA

INTERNAL REPORT A-19

FORESTRY BRANCH

MAY, 1969

CONTENTS

PRELIMINARY EVALUATION OF PILOT SCALE CONTAINER PLANTING IN THE FOOTHILLS OF ALBERTA - 1967 PLANTING

by

G. Dixon[1] and H. J. Johnson[2]

INTRODUCTION

This report presents the first-year survival results of container stock planted on the North Western Pulp and Power Limited lease in 1967. First-year results for 1965 and 1966 plantings were discussed in Regional Information Report A-X-11 (Johnson and Marsh 1967) and Internal Report A-11 (Johnson and Dixon 1968). Survival is assessed after one year and then again after three years. A third year assessment of 1965 plantings will follow in a later report.

The trials evaluate container planting in the High Foothills Section (Rowe 1959) of the Boreal Forest Region. Various sites are planted yearly to white spruce (Picea glauca (Moench) Voss var. Albertiana (S. Brown) Sarg.) and lodgepole pine (Pinus contorta)(Dougl.) var. latifolia Engelm.). The results of this study will assist in identifying problem conditions and in recognizing aspects of container planting requiring further research.

---

[1] Technician, Department of Fisheries and Forestry, Edmonton, Alberta.

[2] Forestry Officer, Department of Fisheries and Forestry, Edmonton, Alberta.

An earlier report (Johnson and Marsh 1967) included a description of container planting and culturing technique. Carman (1967) outlines, in detail, the greenhouse and planting techniques used by North Western Pulp and Power Ltd. in this aspect of their reforestation program.

DESCRIPTION OF THE AREA

The North Western Pulp and Power Limited lease is located near Hinton, Alberta. The elevations of planting areas range from 3100 to 5000 feet. Sites vary from wet, near muskeg conditions, to dry, on exposed upper south and southwest slopes. Surface soils are generally light-textured loams of glacial-colluvial or alluvial origin. A small portion of the lease along the Athabasca River Valley consists of tills which are capped by aeolian silts and sands.

Vegetative competition is moderate on well-drained, cutover areas. Grass and herbaceous cover, developed after logging, aids in the establishment of seedlings on exposed areas. Heavier grass competition is usually confined to the cool moist areas characterized by abundant surface moisture. Shrub competition usually indicates a cool site with telluric moisture.

The climate of the lease area is continental, with summer highs and winter lows of precipitation, and summer precipitation being generally well distributed. Table 1 shows the temperatures and precipitation for May to August from 1958 to 1968.

TABLE 1. MEAN TEMPERATURE AND MONTHLY PRECIPITATION

AT HINTON, ALBERTA

	Mean Temperature (F.)				Monthly Precipitation (Inches)				
Year	May	June	July	Aug.	May	June	July	Aug.	Total
1958	52	54	60	59	.52	4.09	2.24	1.73	8.58
1959	46	57	61	53	2.13	5.68	1.34	5.62	14.77
1960	44	52	63	56	4.54	6.95	1.13	4.85	17.47
1961	49	60	61	60	2.68	1.61	5.45	1.78	11.52
1962	45	54	57	56	2.22	2.62	3.48	1.83	10.15
1963	46	54	59	59	1.12	0.28	2.59	3.24	7.23
1964	46	55	58	54	2.18	2.91	2.16	2.87	10.12
1965	47	54	59	61	2.14	6.56	5.45	5.93	20.08
1966	48	51	57	55	4.00	1.51	4.26	6.82	16.59
1967	50	53	57	56	0.54	0.86	3.32	2.87	7.59
1968	45	52	59	53	1.64	1.11	3.09	2.22	8.06
MEAN	47	54	59	57	2.16	2.11	3.14	3.61	12.01

SAMPLING METHODS AND ANALYSES

Sixty plots were established, each of 100 seedlings. Each site condition sampled was replicated three times. Site characteristics of individual plots were described as follows:

Soil fabric - on the basis of North Western Pulp and Power Limited landform classification.

Depth to mineral soil - four classes: 0-1", 1-3", 3-6", and 6+".

Local climate - based on a composite evaluation of slope, aspect and topographic position. Contains nine classes, 0 being a hot dry climate and 8 a cold wet climate. The regional normal is 4.

Surface texture - texture of the upper six inches of mineral soil - sand, sandy loam, loamy sand, silt, silt loam etc.

Moisture regime - dry, normal, moist, and wet (after Hills, 1952).

Competing vegetation - grass, herb and shrub in three density classes.

Other site characteristics noted were: logging history and seedbed treatment, topographic position (i.e. slope direction, percentage, and position).

The rating of moisture regime, local climate and vegetative competition were subjective and must be presumed to apply only to the range of conditions in the lease area.

Survival and growth were recorded one year after establishment and will be observed again three years after establishment. Causes of mortality and damage, if obvious, were also noted.

FIRST-YEAR RESULTS

Survival

Average first-year survival of the 1967 lodgepole pine plantings was 45 per cent, the lowest of the three years' plantings to date. Survival of white spruce was 68 per cent. Average first-year survivals for the previous two plantings were as follows:

1965 planting	- white spruce,	81 per cent
	- lodgepole pine,	80 per cent
1966 planting	- white spruce	65 per cent
	- lodgepole pine,	71 per cent

Precipitation figures (Table 1) show great variation for the four-month period of measurement in each planting year. Late summer rains in 1966 were probably the reason that 1967 first-year survival was reasonable at 65 and 71 per cent, for spruce and pine. The eleven-year mean indicates that 1967 was very dry, with about half the normal precipitation. This, coupled with an abnormally low snow fall during the winter of 1967-68 and a second consecutive dry summer in 1968, was probably the reason for low pine survival in 1968.

The distribution of plots in the various percentage survival classes is shown in Table 2.

TABLE 2. DISTRIBUTION OF PLOTS BY PERCENTAGE IN VARIOUS PERCENTAGE SURVIVAL CLASSES - 1967 PLANTINGS

Species	Percentage Distribution of Plots at Different Percentage Survival Classes				
	0-20	21-40	41-60	61-80	81-100
White Spruce	0	14.6	9.4	47.5	28.5
Lodgepole Pine	17.9	30.8	20.5	28.2	2.6

The relationships of various site factors to survival are discussed below.

1. Logging and scarification dates.

Areas planted to spruce and pine in 1967 were logged between 1957 and 1965. No significant survival trends were evident for spruce or pine in relation to date of logging.

There was no significance between dates of scarification and survival for spruce or pine. However, there was a much higher survival of spruce on the scarified areas than on the unscarified areas.

2. Aspect.

Comparing survival in the four cardinal directions was inconclusive owing to insufficient data. Regrouping to test northerly against southerly aspects produced no definite trend for spruce. Pine survival, however, was significantly better on a northerly aspect.

3. Depth to mineral soil.

Figure 2 shows average percentage survival as related to depth to mineral soil for spruce and pine. The relationship revealed is a

Figure 1.

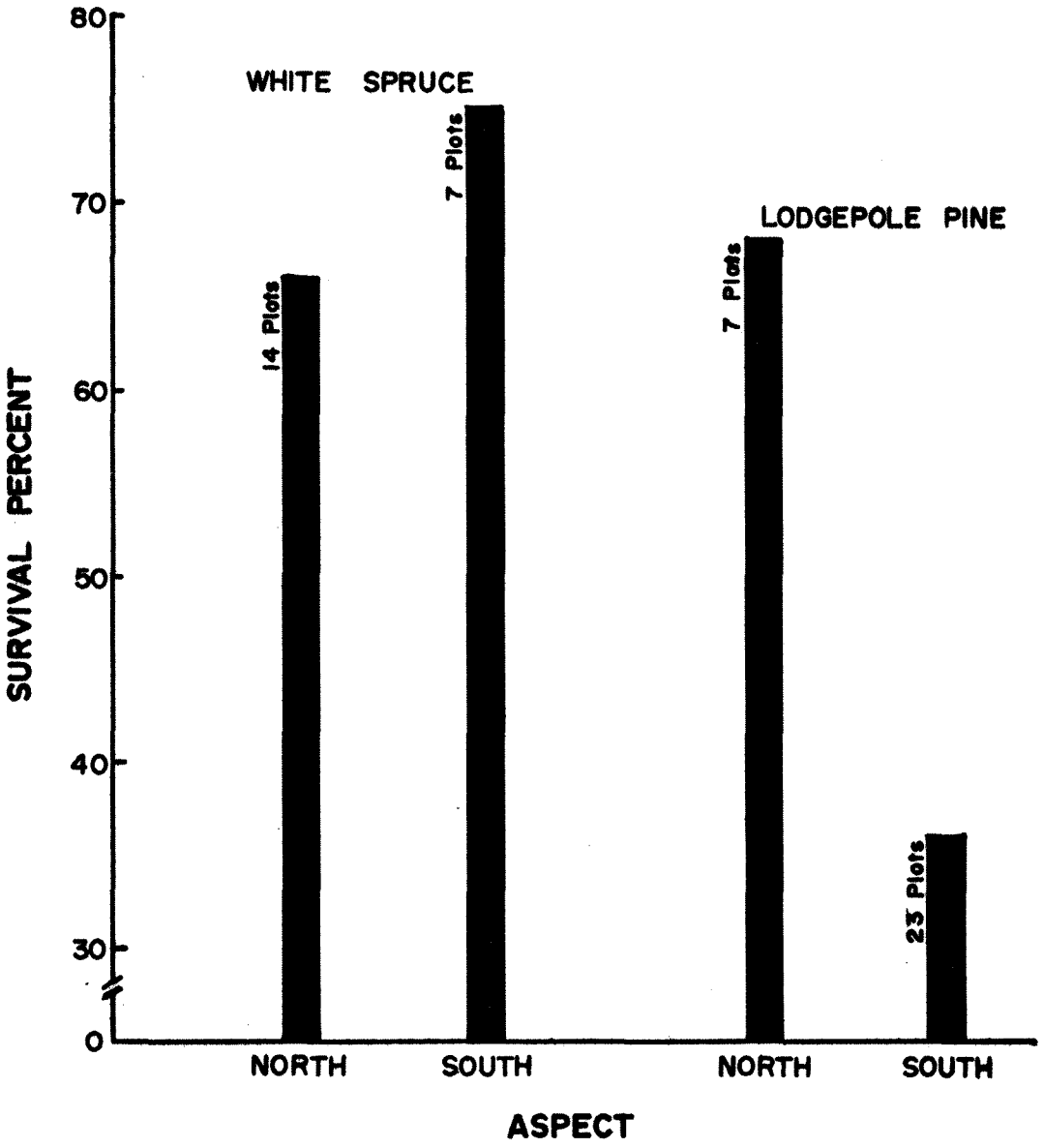

Figure 1. SURVIVAL PERCENT RELATED TO ASPECT

general reversal of results obtained from the first-year tally of 1966 plantings. Deep duff sites planted to spruce (figure 2) were logged only three years before planting and scarified one year previously. These circumstances possibly led to a fresher and wetter planting site than was the case for the 1966 plantings on wet sites. Moist sites planted to pine (figure 2) were either telluric, alluvial flats or steep protected pattern sites, which resulted in better survival.

4. Moisture regime.

Grouping survival for spruce and pine by the three moisture regime classes yielded results that were anticipated under the existing drought conditions (figure 3). Moist and wet sites had 78 and 69 per cent survival for spruce and pine respectively; survivals on drier sites were correspondingly lower. This trend was confirmed by t-test.

5. Competing vegetation.

All nine vegetative competition classes were sampled. However, an even distribution of plots in these classes was not possible. As in previous plantings, the largest vegetative classes sampled were light grass and medium grass, representing 60 per cent of the plots for spruce and pine. A statistical test indicated that light grass competition allowed higher survival of spruce than medium grass. No significant trends were noticed for pine in these two classes. Medium herb was the second largest vegetative competition class sampled in pine, containing 25 per cent of the sample plots. Pine survival was significantly higher in this class than in either light or medium grass.

6. Moisture index.

Moisture index is a rating based on Hills' (1952) moisture

Figure 2.

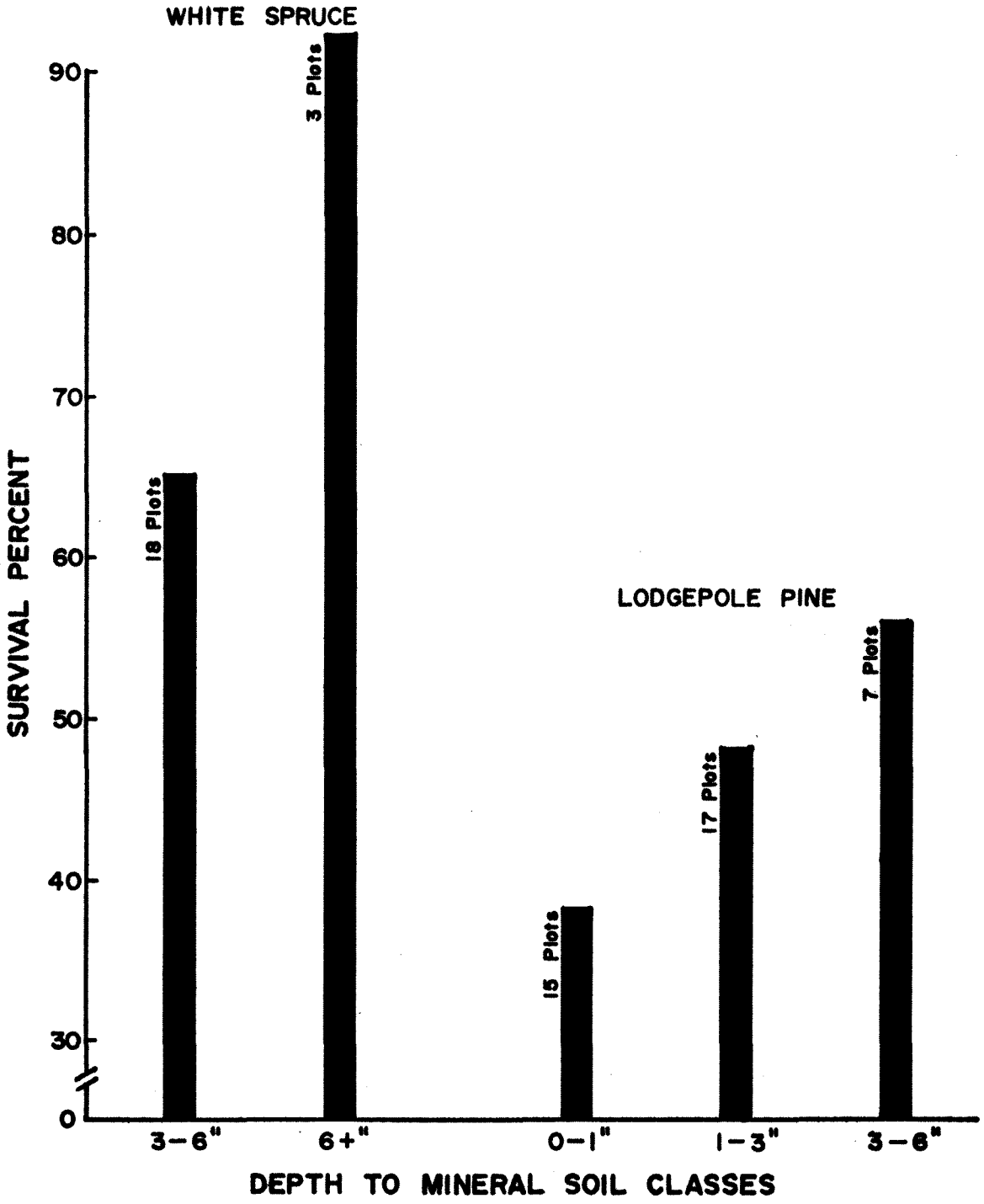

Figure 2. SURVIVAL PERCENT RELATED TO DEPTH TO MINERAL SOIL CLASSES

Figure 3.

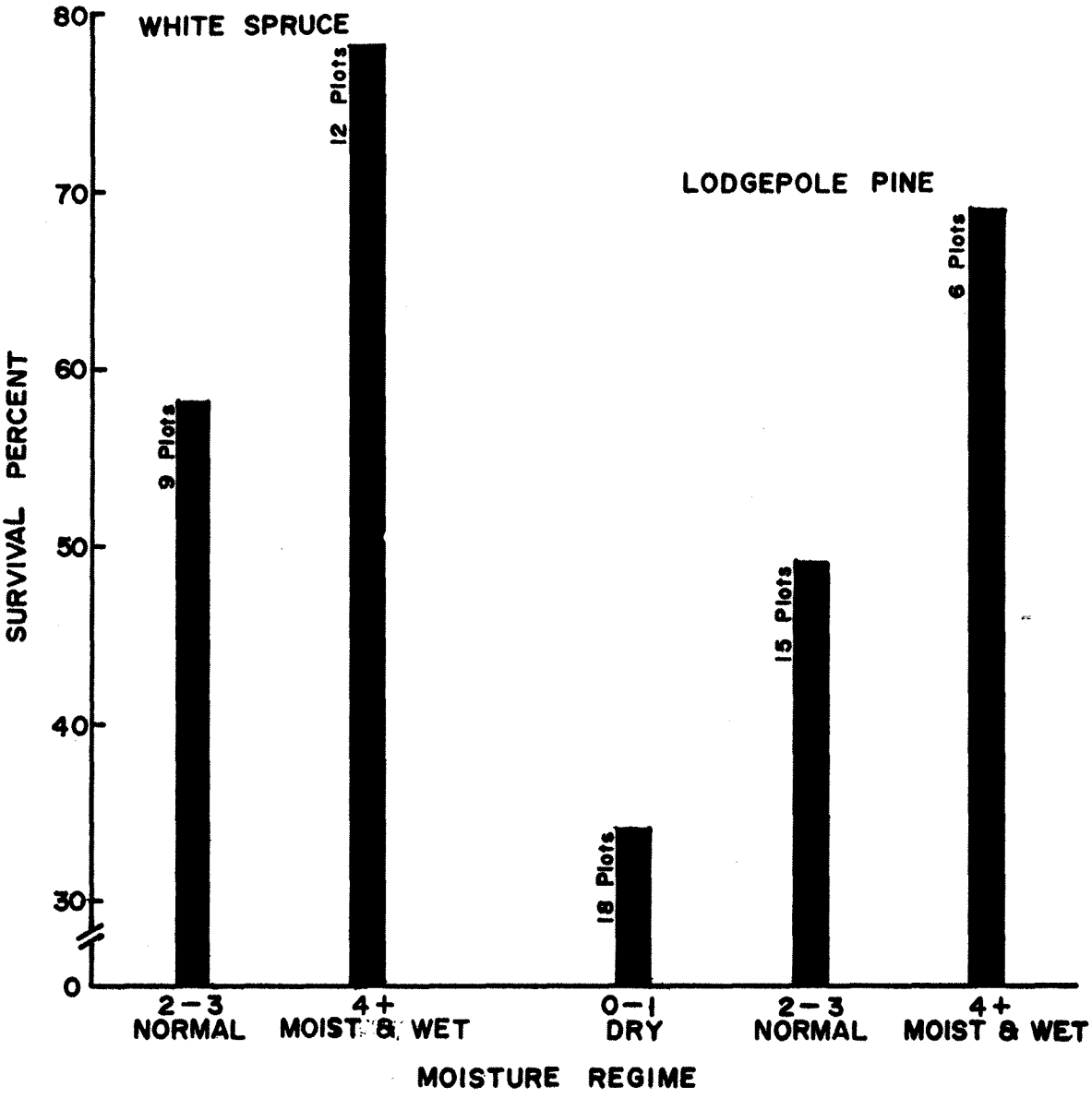

Figure 3. SURVIVAL PERCENT RELATED TO MOISTURE REGIME

regime and ecoclimate. An index number from 1 to 4 was assigned to the nine climatic classes, 1 being a cold wet climate and 4 a hot dry climate. Index numbers were assigned to the three moisture regime classes as follows: 1, moist and wet; 2, normal; and 3, dry. The two index numbers for a particular planting area were multiplied to give the moisture index rating. These ratings were plotted and are shown in Fig. 5. As planting sites vary from cool and moist to hot and dry, container planting survival decreases.

In all instances of similar climatic and soil moisture conditions sampled, spruce seedling survival was from 5 to 10 per cent higher than pine. This relationship was only true for the 1967 plantings.

7. Container size.

Data were collected to test the relationship between container diameter and first-year survival. Northwestern Pulp and Power Ltd. uses two tube-diameter sizes, half-inch and three-quarter-inch; both are 3 ½ inches in length. The average of all plots showed that percentage of survival for spruce was identical for both tube sizes: 69 per cent. Pine in three-quarter-inch tubes had double the survival of those in half-inch tubes, 54 and 26 per cent respectively.

Data were regrouped by moisture regime and depth to mineral soil to relate survival to container size. "t" tests on survival in similar depth to mineral and moisture regime classes for half-inch and three-quarter-inch containers produced no significant trends for spruce. The result of regrouping pine data is illustrated in Figure 6. Only one statistically significant difference resulted: the superiority of survival of pine in the three-quarter-inch tubes over the survival in the half-inch tubes on the dry moisture regime with a depth to mineral soil

Figure 4.

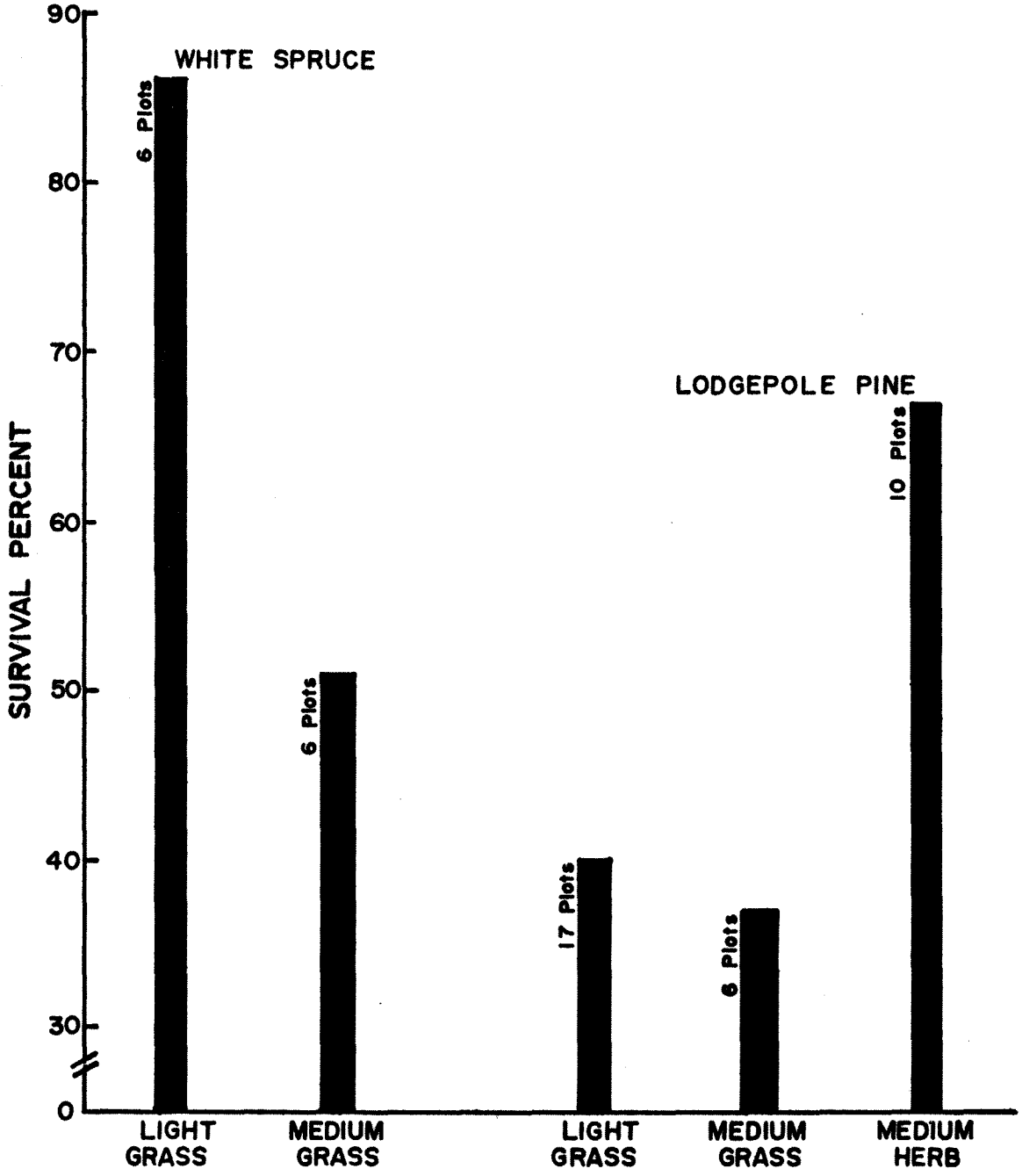

Figure 4. SURVIVAL PERCENT RELATED TO COMPETING VEGETATION

Figure 5.

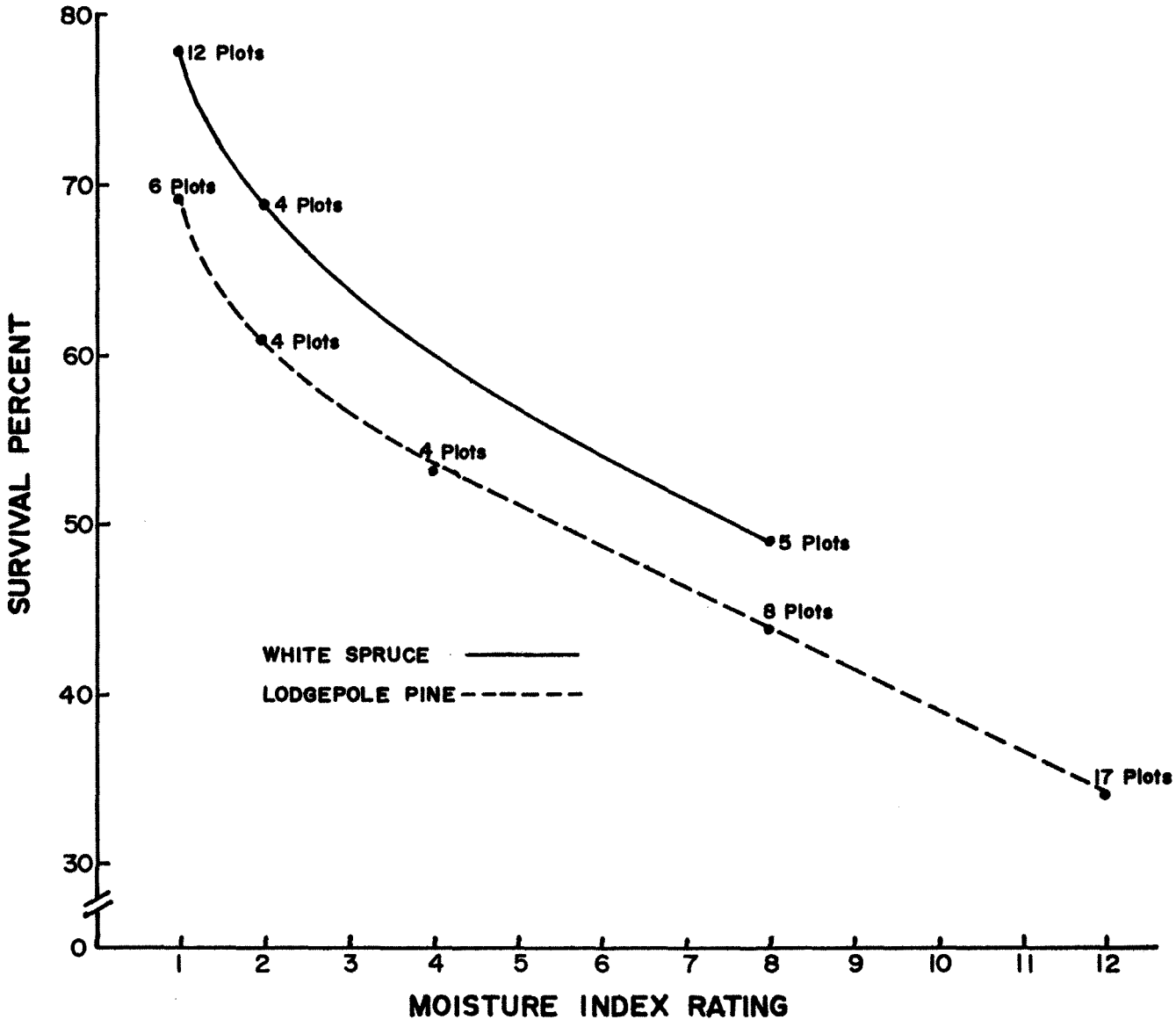

Figure 5. MOISTURE INDEX RATING RELATED TO SURVIVAL

of from 0-1 inch. Limited data precluded an intensive study of survival in relation to tube size and the above indications must be accepted with caution.

Discussion of Survival

The Appendix lists, by logging camp, plots that were established in 1967. Replicates are grouped and survival results are presented.

It will be noted that survival is very uniform within a replicate group. This suggests excellent planting supervision as well as careful site selection. Care was exercised to select only planting stock of uniformly good quality and these were carefully handled from greenhouse to planting site.

The most critical feature of 1967 plantings was the drastic reduction in pine survival after one year compared to previous plantings. Unlike the spruce plantings, 85 per cent of the pine plantings were on dry to normal moisture regimes. Highest mortality was found on these areas. One aspect that needs further study is the very high survival of pine in the three-quarter-inch tubes on all sites with shallow duff and a low to normal moisture regime.

Mortality and Injury

A schedule of mortality and injury is given in Table 3, by species and logging camp number. Unknown or undetermined causes once again represent the largest segment of total mortality, 77 per cent for spruce and 90 per cent for pine.

Seedling injury was confined to frost damage with 9 per cent for spruce and 2 per cent for pine.

Figure 6.

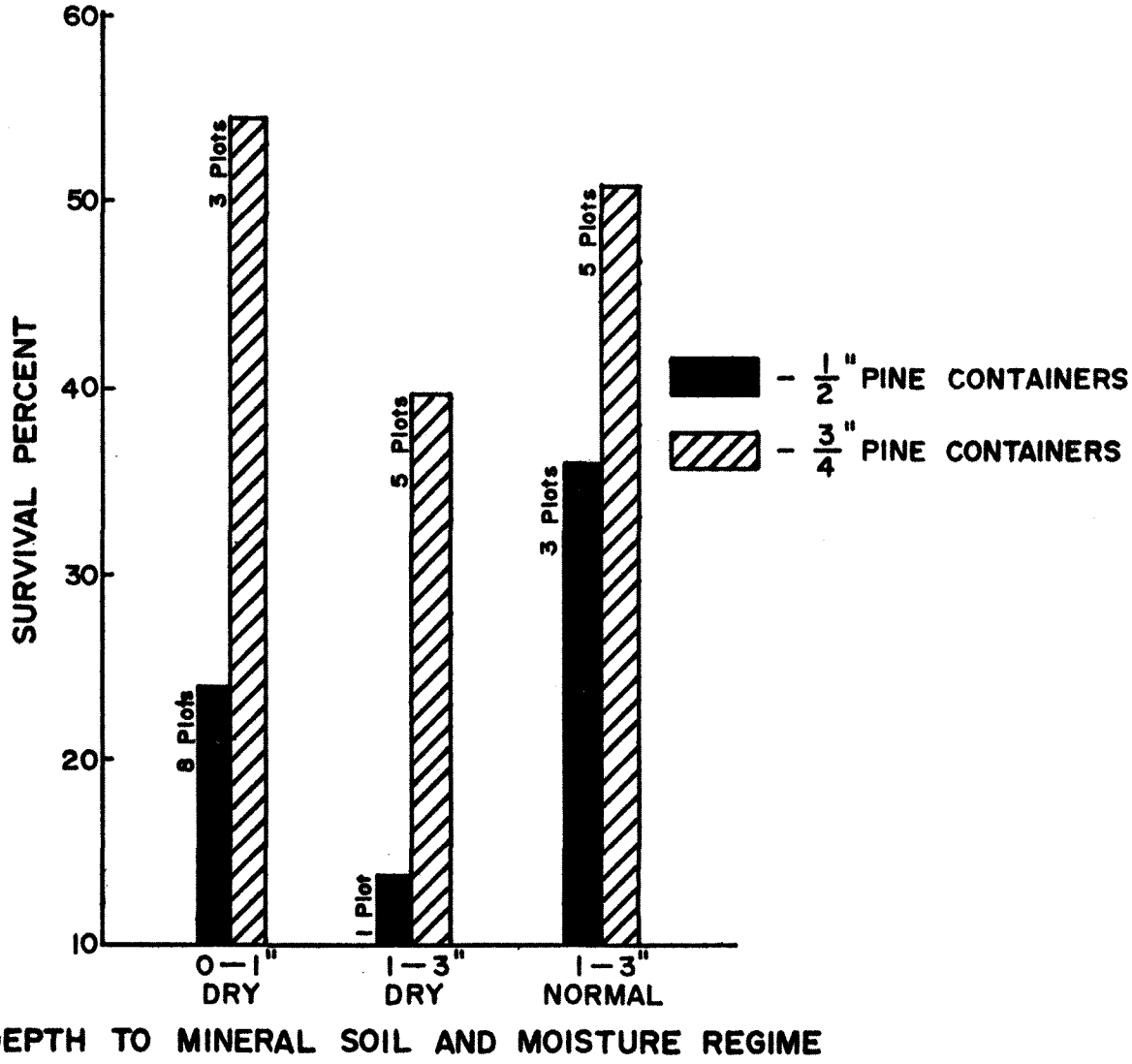

Figure 6. SURVIVAL IN PINE RELATED TO CONTAINER SIZE DEPTH TO MINERAL SOIL AND MOISTURE REGIME

All other causes of mortality were minor (1 per cent), except smothering in spruce which was 4 per cent. In most cases, smothering occurred in deeply planted containers on sites with a 3-6 inch depth to mineral soil. Moisture was classed as normal but would drop rapidly during a drought period, which would cause drying out of the container medium if the seedling roots did not reach mineral soil.

Effect of More Than One Seedling per Container

The number of seedlings per container in 1967 varied from 1 to 3, with 99 per cent of containers having 1 or 2 seedlings. Figure 7 presents the relationship between seedling survival and the number of seedlings per container. The difference between 1 and 2 seedlings per container was significant for spruce, but not for pine. Maximum number of seedlings per container decreased from 7 for the 1965 plantings to 3 for 1967 plantings. This was due to refined greenhouse-seeding techniques and superior seedlings which also might have caused the curve for pine in Figure 7 to have weakened.

CAMP	Trampling			Smothered			Frost Heaving			Poor Planting			Frost Damage			Unknown			Missing			All	
	D[a]	1[b]	D+1	D	1	D+1	D	1	D+1	D	1	D+1	D	1	D+1	D	1	D+1	D	1	D+1	D	1
WHITE SPRUCE																							
AGENT OF MORTALITY OR INJURY																							
6	1	-	1	6	-	6	1	-	1	2	-	2	-	6	6	32	-	32	1	-	1	43	6
13	-	-	-	2	-	2	1	-	1	1	-	1	-	11	11	19	-	19	-	-	-	23	11
MEAN	-	-	-	4	-	4	1	-	1	1	-	1	-	9	9	24	-	24	1	-	1	31	9
LODGEPOLE PINE																							
5	1	-	1	2	-	2	-	-	-	-	-	-	-	1	1	44	-	44	2	-	2	49	1
*9	1	-	1	-	-	-	-	-	-	1	-	1	-	10	10	67	-	67	1	-	1	70	10
7 & 29	-	-	-	2	-	2	4	-	4	6	-	6	-	3	3	35	-	35	-	-	-	47	3
25	-	-	-	-	-	-	1	-	1	1	-	1	-	3	3	50	-	50	-	-	-	52	3
33	2	-	2	-	-	-	2	-	2	-	-	-	-	1	1	52	-	52	1	-	1	57	1
MEAN	1	-	1	1	-	1	1	-	1	1	-	1	-	2	2	50	-	50	1	-	1	55	2

* North of Camp 29

a - Dead

b - Injured

TABLE 3. PERCENTAGE MORTALITY AND INJURY IN 1968 TO WHITE SPRUCE AND LODGEPOLE PINE SEEDLINGS PLANTED IN 1967.

Figure 7.

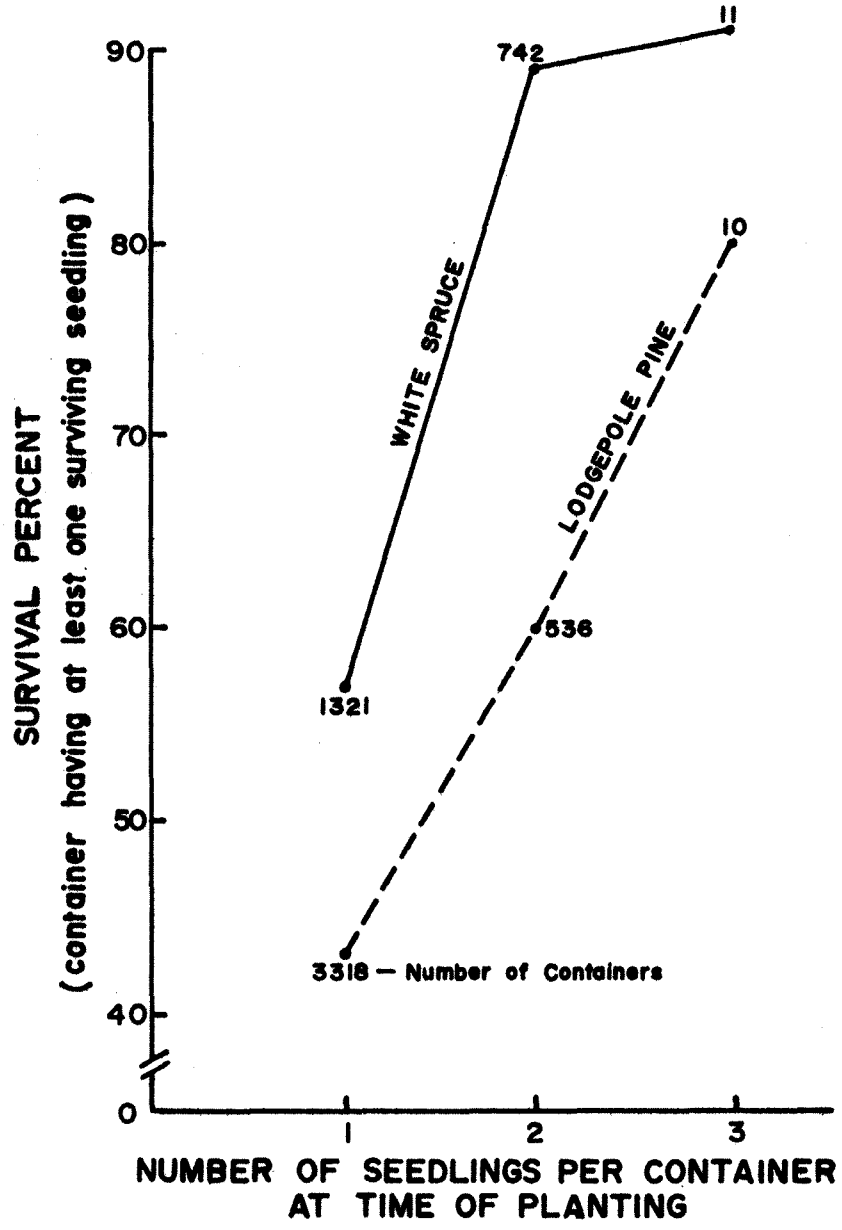

Figure 7. RELATIONSHIP OF INITIAL NUMBER OF SEEDLINGS PER CONTAINER TO SURVIVAL AFTER ONE YEAR

REFERENCES

Carman, R. D. 1967. An industrial application of the container planting technique. Woodlands Review, Can. Pulp Pap. Ass. April. Index 2414 (F-2).

Hills, G. A. 1952. The classification and evaluation of site for forestry. Ontario Dep. Lands Forests, Res. Rep. No. 24.

Johnson, H. J. and Marsh, F. 1967. Preliminary evaluation of pilot-scale container planting in the foothills of Alberta. Can. Dep. Forest. Rural Dev., Inform. Rep. A-X-11.

Johnson, H. J. and Dixon, G. 1968. Preliminary evaluation of pilot-scale container planting in the foothills of Alberta - 1966 Planting. Can. Dep. Forest. Rural Dev., Forest. Br., Intern. Rep. A-11.

Rowe, J. S. 1959. Forest regions of Canada. Can. Dep. N. Aff. Natur. Resourc., Forest. Br., Bull. 123.

APPENDIX

Camp	Plot	Species	No. of Plants	Aspect	% Survival	Container size	Remarks
5	(1	Lp	100	S22°W	17	½"	
1	(2	Lp	95	S22°W	14	½"	
	(3	Lp	100	S22°W	17	½"	
	(4	Lp	99	North	76	3/4"	
	(5	Lp	99	North	72	3/4"	
	(6	Lp	96	North	82	3/4"	
	(7	Lp	98	S20°E	60	3/4"	
	(8	Lp	99	S20°E	65	3/4"	
	(9	Lp	104	S20°E	59	3/4"	
6	(1	Sw	100	S50°E	40	3/4"	
	(2	Sw	99	S50°E	36	3/4"	
	(3	Sw	100	S40°E	27	3/4"	
	4	Sw	98	N10°E	69	3/4"	
	5	Sw	97	N20 E	64	3/4"	
	6	Sw	98	North	68	3/4"	
	7	Sw	100	S60°E	71	½"	
	8	Sw	100	N10°W	70	½"	Pattern
	9	Sw	96	N10°W	73	½"	Site
7 & 29	1	Lp	99	N20°E	62	3/4"	North of
	2	Lp	100	N20°W	57	3/4"	Camp 29
	3	Lp	100	S.E.	39	3/4"	Pattern Site

1 Planting sites are replicated with 3 plots.

APPENDIX

Camp	Plot	Species	No. of Plants	Aspect	% Survival	Container size	Remarks
13	1	Sw	99	S52°W	66	½"	
	2	Sw	97	S59°W	77	½"	
	3	Sw	99	West	81	½"	
	4	Sw	100	N80°E	89	3/4"	
	5	Sw	97	N40°E	88	3/4"	
	6	Sw	95	East	73	3/4"	
	7	Sw	101	S74°W	97	3/4"	
	8	Sw	100	West	96	3/4"	
	9	Sw	99	S64°W	82	3/4"	
	10	Sw	100	N10°E	67	½"	
	11	Sw	99	N32°E	56	½"	
	12	Sw	100	N50°E	59	½"	
25	1	Lp	100	S20°E	38	3/4"	
	2	Lp	101	S20°E	30	3/4"	
	3	Lp	100	S15°E	12	3/4"	
	4	Lp	100	N80°W	25	3/4"	
	5	Lp	100	S80°W	47	3/4"	
	6	Lp	99	N30°W	50	3/4"	
	7	Lp	100	West	77	3/4"	
	8	Lp	100	N10°W	76	3/4"	
	9	Lp	100	S.E.	73	3/4"	

APPENDIX

Camp	Plot	Species	No. of Plants	Aspect	% Survival	Container size	Remarks
33	1	Lp	98	Flat	47	3/4"	
	2	Lp	100	Flat	71	3/4"	
	3	Lp	100	Flat	68	3/4"	
	4	Lp	100	Flat	55	3/4"	
	5	Lp	100	Flat	61	3/4"	
	6	Lp	100	Flat	70	3/4"	
	7	Lp	99	West	33	½"	
	8	Lp	96	West	14	½"	
	9	Lp	97	West	37	½"	
	10	Lp	96	S60°W	25	½"	
	11	Lp	99	S60°W	50	½"	
	12	Lp	99	S60°W	37	½"	
	13	Lp	99	S60°W	33	½"	
	14	Lp	96	S60°W	15	½"	
	15	Lp	100	S60°W	19	½"	
9	1	Lp	90	Flat	34	3/4"	
	2	Lp	99	Flat	28	3/4"	
	3	Lp	98	Flat	28	3/4"	