THE EFFECT OF LOGGING PRACTICES ON THE DEVELOPMENT OF NEW ASPEN STANDS, HUDSON BAY, SASKATCHEWAN

by

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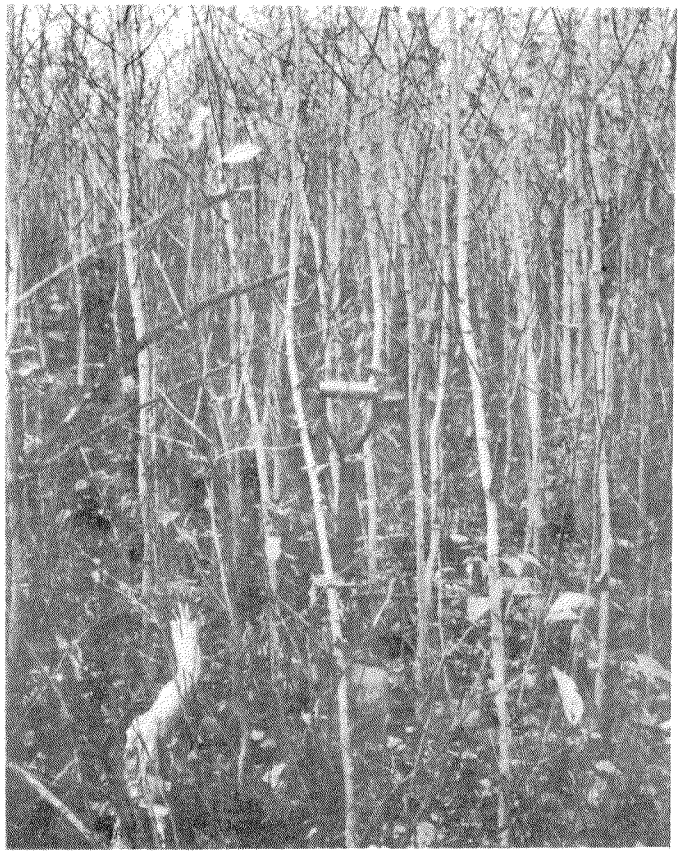
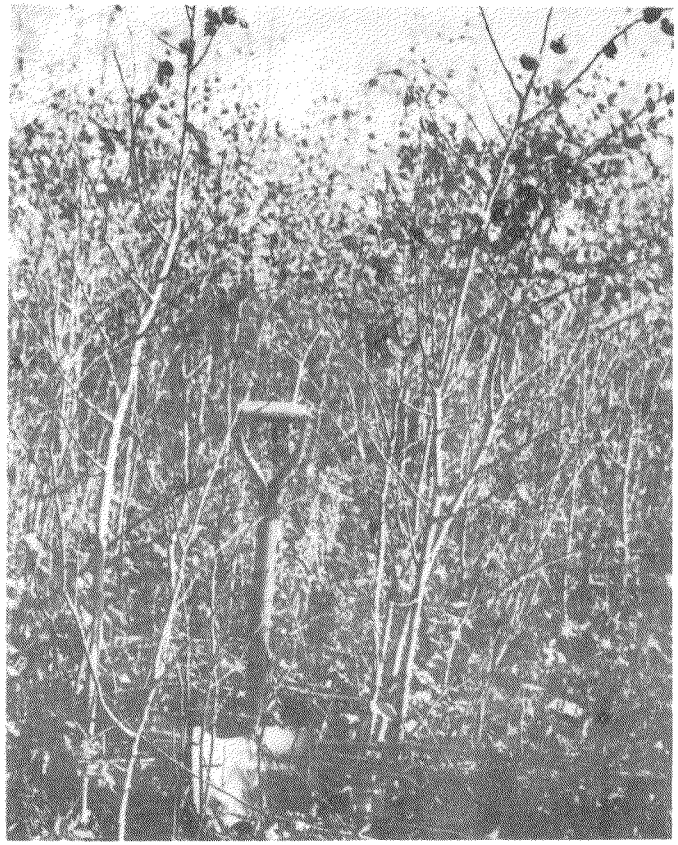


Vigorous 5-year-old aspen suckers growing under dense conditions; summer cut, no slash.



Stand density and tree vigor is variable where slash is present; five years after summer cut.

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ABSTRACT

Excellent aspen (*Populus tremuloides*, Michx.) sucker density and stocking was attained after summer and winter logging when all trees of the parent stand were cut. Summer logging resulted in much more prolific suckering than winter logging. Less slash generally meant more suckers. However, initial differences in number of suckers diminished with age and practically disappeared by six years of age. Although neither slash conditions nor season of logging is critical to adequate regeneration of these cut-overs, it pays to consider conditions of the area (soil, site, and lower vegetation) when allocating stands for summer or winter logging.

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INTRODUCTION

The amount of aspen harvested in Saskatchewan more than quadrupled in the 1960's. Approximately 88,000 cords of poplar which was mainly aspen, but including a small amount of balsam poplar (*P. balsamifera* L.), were harvested in Saskatchewan in 1970 (source: personal communications with Saskatchewan Department of Natural Resources staff). The increase results largely from the expanding production of aspen flake-board (ASPENITE) by MacMillan-Bloedel Ltd. at Hudson Bay, Saskatchewan. Although in the last year this plant has again substantially increased its production, no shortage of aspen wood is anticipated presently in the region. However, the company is concerned about future supplies of wood within its limits, or at least within economic hauling distance.

To ensure a continuous supply of aspen wood, the foremost prerequisite is adequate restocking of logged-over areas without delay. Although aspen trees are prolific seeders, seedbed conditions are rarely suitable for germination and survival of aspen seedlings. Fortunately, aspen reproduces readily from root suckers after the parent stand is logged, or the above-ground parts of trees are killed by forest fire. The abundance of suckers depends on many factors, some of which are closely related to logging practices such as: (1) number of mature trees left standing; (2) the amount of logging slash (unmerchantable boles, tree tops, branches and foliage) and (3) the season and equipment of logging.

This study was undertaken at Hudson Bay, Saskatchewan in 1965 by the Canadian Forestry Service in co-operation with MacMillan-Bloedel

(Saskatchewan) Ltd., to evaluate the effect of different types of logging on the initial number of suckers per acre, and on the early development of young aspen sucker stands. Season and method of logging, and slash conditions were the main variables examined. Shoup (1967, 1968a and b, 1970) reported on the establishment and on the interim results of this study. This final report presents results on development of sucker stands up to age 5 and 6 years.

DESCRIPTION OF STUDY AREA

The study is located in the Mixedwood Section of the Boreal Forest Region, B18a (Rowe, 1959), approximately 23 miles south of Hudson Bay, Saskatchwan (Fig. 1). Topography is flat to gently rolling and soils are clay loam. The original aspen stands at the time of logging were 70 to 80 years old and they usually contained scattered individuals of balsam poplar and black spruce (*Picea mariana* (Mill.) BSP); shrub cover was relatively sparse. The sample stands were growing on moist sites.

METHODS

The "winter cut", logged in March 1966, is a rectangular area of 5 by 8 chains; the "summer cut", logged in June to mid-July and August 1967, is an area of 4 by 9 chains. Each area or block was subdivided into four strips; 2 by 4 chains on the summer cut, and 2 by 5 chains on the winter cut (Fig. 2). Chain saws and wheeled skidders were used for logging.

The following four treatment conditions were created.

Strip 1: Normal logging practices, i.e. tops lopped, and left where they fell, non-commercial trees left standing (this treatment in the winter cut was discarded as the area was found to support a substantial understorey of pole-size spruce; in the summer cut, this strip only, was logged in August).

Strip 2: As strip 1, except trees were skidded out with tops still attached.

Strip 3: As strip 1, except non-commercial trees were felled.

Strip 4: A combination of strips 2 and 3, i.e. non-commercial trees were felled and all trees were skidded out with their tops on.

In practice, only two treatment condition classes were created--tree tops left or tops removed from area--because none of the logging treatments left any trees on the area. However, the treatments did result in a range of slash conditions and provided data to determine the effect of slash on aspen suckering and subsequent development.

Sample quadrats were established in August 1966 in the winter cut and in September 1967 in the summer cut. Quadrats 3.3 by 6.6 ft (1/2 mil-acre) were located along straight transects that ran east-west, one chain apart, through each strip (Fig. 2). In the winter cut 480 quadrats were established and 543 in the summer cut. The number of quadrats were later reduced to 400 and 526 due to wet site conditions and disturbances due to logging trails.

Data recorded for each quadrat included: number of suckers and height (to the nearest 1/10 ft) of the largest tree for each species; in 1971 the d.b.h. of the tallest aspen and balsam poplar was also measured to the nearest 1/10 inch.

Slash conditions on each quadrat were recorded at establishment as follows: limbs only; logs only; limbs and logs; and, no slash. Quadrats were reexamined in the late summers of 1967, 1968, 1969, and 1971.

Quadrat data were summarized by slash condition and logging treatment for winter and summer cuts. Graphical procedures were used to evaluate relations between the density of the new sucker stands, up to age 6, and logging treatments, actual slash conditions and season of cut. A series of "t-tests" were also conducted on the data to find out if differences between treatments were real. Based on logging treatment (Table 1), comparisons were made at age 1 and 3 years between strips 3 and 4, and within strips between summer and winter cut. Similar tests were also conducted on the data when the separation was by actual slash conditions (Table 2). Again, comparisons were made at age 1 and 3, between "Limbs and Logs" and "No Slash", and within strips between summer and winter cut.

RESULTS

Sucker densities per acre are shown--to age 6 years, for winter cut and age 5 years for summer cut--by logging methods (i.e. treatment or

strip) in Fig. 3, and by actual slash conditions in Fig. 4.

Initial sucker density was about twice as high after summer cut than after winter cut; for the former, it averaged nearly 100,000 suckers per acre on strip 4. These differences were highly significant (.01 probability level) at ages 1 and 3 years for the two treatment and slash condition classes compared (Tables 1 and 2); with the exception of winter cut versus [redacted] summer cut at age 1 for "Limbs and Logs" class where the difference was not significant. There was also a greater variation in sucker density after summer cut both within and between logging treatments (Fig. 3 and Table 1). Strip 1 of the summer cut was an exception with abnormally low sucker density (7,000 trees/acre).

Greatest number of suckers occurred with minimum slash cover; and the greatest difference in number of suckers between summer and winter cut occurred where no slash was present. Sucker abundance decreased as the amount of slash increased. This relation held regardless whether the amount of slash was estimated on the basis of logging treatment (Fig. 3 and Table 1), or when it was based on actual slash conditions on individual quadrats (Fig. 4 and Table 2). The relation applies to both winter and summer cuts and the differences between two logging treatments and two slash condition classes compared at age 1 were statistically significant. These differences were also insignificant at age 3 with one exception, viz., the difference between strip 3 and 4 of the winter cut was not significant. There were also greater relative, as well as absolute differences in sucker density between slash condition classes of the summer cut than of the winter cut (Fig. 4).

Fig. 3 and 4 also show average development trends in number of stems per acre up to age 6 years. High initial sucker density is associated with rapid decline in number of trees i.e. heavy mortality; mortality was more moderate where the density of sucker regeneration was relatively low. As a result, initial differences in sucker density have largely disappeared by age 6, although the ranking order of treatment conditions, in terms of number of suckers per acre, remained essentially the same.

Species composition varied from almost pure aspen to 14% admixture of balsam poplar. Aspen averaged approximately 94% for the whole study (Table 3). Variation in species composition did not appear to be related either to season of logging or to slash conditions, nor did it change with age.

Fig. 5 shows height growth trends of the largest aspen tree per quadrat by season of cut and slash conditions. Height growth seems to be greater after winter cut. The initial difference of about 1.5 ft (3.5 ft versus 2.0 ft) however is diminishing. Within season of cut, height growth does not appear to be influenced by actual slash conditions.

DISCUSSION AND CONCLUSION

For this study, Shoup (1968a and b) reported per cent stocking (based on 1/2 mil-acre quadrats) of 97% and 100%, two years after winter and summer cut. (These percentages are averages for the four types of logging treatments.) These stocking levels are considered more than

adequate for growing aspen stands for wood production.

Although other studies (Stoeckeler and Macon, 1956; Sandberg and Schneider, 1953) showed that greater number of suckers are produced if logging is done during the dormant season, i.e. from late fall to early spring, results from this study indicate much more prolific suckering after summer logging. These contradictory results in the present study may be related to two factors. (1) Logging in the summer destroys much of the ground vegetation and breaks up the humus layer. This in turn results in higher temperature in the upper soil horizon where lateral aspen roots are located that usually produce suckers. The warming of soil and roots promote suckering (Maini and Horton, 1966). Because of snow cover and frost, winter logging in this area creates relatively little soil disturbance and also has much less effect on the lower vegetation. Thus warming of the soil is not enhanced. (2) The summer logging in 1967 coincided with some exceptionally warm and dry weather, which may have further promoted suckering.

The amount of slash had pronounced effect on suckering. Slash shades the ground and hinders soil warming which is needed for vigorous suckering. The particularly large differences in initial number of suckers between slash condition classes after summer logging may have been, in part, the result of the presence of foliage on the branches of trees that were logged. Foliage may have accentuated differences in the degree of shading and soil warming for different slash condition classes. This seems to be supported by the fact that the highest variation in sucker density, between as well as within slash condition classes, occurred within the

first growing season following summer logging (i.e. during the period the effect of dead foliage would last). The generally greater variation in sucker density after summer logging than after winter logging suggest that a greater diversity of conditions--whether slash, lower vegetation or soil disturbance--are created by the former operation.

With increasing age, the initial differences in sucker densities that arose from logging treatment (slash conditions) and season of cut in these sucker stands are rapidly diminishing and are all but disappeared by six years of age. Sandberg and Schneider (1953) found aspen sucker density practically the same on winter and summer cuts after only two growing seasons. On the other hand, Garrett and Zahner (1964) found 400% difference in number of survivals four years after logging and attributed the difference mainly to clonal effect.

Species composition seems to be quite stable, at approximately 94% aspen and 6% balsam poplar. This is probably quite similar to the composition of the parent stand.

Height growth of the largest suckers per quadrat was considerably greater on the winter cut than on the summer cut-area in the first growing season. Most of this difference probably resulted from the actual length of time available for growth. Logging during the end of June or July considerably shortens the first growing season.

Because excellent stocking and density of aspen regeneration is achieved after logging and because initial differences in density tend to disappear by five - six years of age; it is concluded that under similar conditions, logging may well be done in winter or summer and that logging

slash may be left on cut over areas without creating problems in regenerating aspen stands. Winter logging may be favored, however, because it results in more uniform suckering which is less likely to be overdense. Generally, the best practice is to consider specific conditions of the present stand when making cutting plans. For example, in stands with heavy shrub cover (usually consisting of hazel Corylus cornuta Marsh.) summer logging may be advantageous because it destroys the shrub layer and thus improves growing conditions for the aspen suckers. On wetter sites with clay soils--similar to conditions covered in this study--where hazel is not a problem, winter logging may be more desirable both from silvicultural and from an operational view as it would prevent excessive compaction and disturbance of the soil on logging trails. Such disturbance can result in unstocked patches in the future stand.

LITERATURE CITED

Garrett, P.W., and R. Zahner. 1964. Clonal variation and suckering of aspen obscures effect of various clear cutting treatments. J. Forest. 62:749-750.

Maini, J. S., and K. W. Horton. 1966. Vegetative propagation of Populus spp. I. Influence of temperature on formation and initial growth of aspen suckers. Can. J. Bot. 44:1183-1189.

Rowe, J. S. 1959. Forest Regions of Canada. Can. Dept. N. Aff. Nat. Res., Forest. Br., Bull. 123. 71 p.

Sandberg, D., and A.E. Schneider. 1953. The regeneration of aspen by suckering. Univ. Minn. Forestry Note No. 24, 2 p.

Shoup, J. M. 1967. Effect of slash on aspen regeneration (winter cut) Hudson Bay, Saskatchewan. Can. Dep. Forest. Rural Develop., Forest Res. Lab., Winnipeg, Manitoba, Internal Rep. MS-50, 10 p.

Shoup, J. M. 1968a. Effect of slash on aspen regeneration (winter and summer cuts) Hudson Bay, Saskatchewan. Can. Dept. Forest. Rural Develop., Forest Res. Lab., Winnipeg, Man., Internal Rep. MS-73, 13 p.

Shoup, J. M. 1968b. Effect of slash on aspen regeneration (winter and summer cuts) Hudson Bay, Saskatchewan. Can. Dep. Fish. Forest., Forest Res. Lab., Winnipeg, Man., Internal Rep. MS-79, 9 p.

Shoup, J. M. 1970. Effects of slash on aspen regeneration (winter and summer cuts) Hudson Bay, Saskatchewan. Can. Dep. Fish. Forest.,

Res. Lab., Winnipeg, Man., Internal Rep. MS-114, 12 p.

Stoeckeler, J. H., and J. W. Macon. 1956. Regeneration of aspen cutover areas in northern Wisconsin. J. Forest. 54:13-16.

TABLE 1. NUMBER OF SUCKERS[1] PER ACRE BY LOGGING TREATMENT AND SEASON AT AGES ONE TO SIX YEARS.

		Age (years)								
		1		2		3		4	5	6
	Season of Cut[2]	W	S	W	S	W	S	W	S	W
Strip Number	Year of Meas.	1966	1967	1967	1968	1968	1969	1969	1971	1971
1		N.M.[3]	6,610 (131)[4]	N.M.	18,343 (64)	N.M.	18,514 (57)	N.M.	11,848 (61)	N.M.
2		28,245 (53)	53,493 (64)	22,187 (49)	43,360 (57)	18,518 (48)	34,853 (53)	19,324 (44)	15,373 (56)	10,806 (49)
3	[5]	18,673 (76)	33,748 (76)	16,574 (64)	34,437 (45)	15,208 (60)	31,974 (50)	14,614 (58)	16,827 (49)	8,455 (69)
4		26,362 (71)	92,900 (51)	21,338 (52)	67,583 (41)	18,250 (47)	53,250 (38)	17,713 (45)	20,450 (40)	10,763 (48)

[1] Young advanced growth included.

[2] Winter cut - cut during winter of 1966; Summer cut - cut during summer of 1967.

[3] Not Measured.

[4] Coefficient of variation in brackets.

[5] Level of significance for the "t-test"; ** significant at .01 level
NS None Significant

TABLE 2. NUMBER OF SUCKERS[1] PER ACRE BY ACTUAL SLASH CONDITIONS FOR SUMMER AND WINTER CUT AT AGES ONE TO SIX YEARS

Slash at Establishment	Season of Cut[2] / Year of Meas.	Age (years) 1		2		3		4	5	6
		W 1966	S 1967	W 1967	S 1968	W 1968	S 1969	W 1969	S 1971	W 1971
Limbs only		21,877 (63)[3]	23,118 (126)	18,596 (57)	27,186 (59)	16,543 (53)	24,542 (54)	16,439 (49)	13,061 (55)	9,579 (56)
Logs only		25,514 (73)	43,360 (94)	21,009 (51)	37,593 (69)	18,523 (51)	31,082 (62)	17,892 (49)	15,024 (56)	10,631 (48)
Limbs and logs	[4]	21,970 (70)	33,744 (103)	17,588 (60)	32,410 (78)	15,029 (47)	28,462 (70)	15,294 (46)	14,358 (52)	9,765 (46)
No slash		30,000 (58)	57,906 (80)	23,588 (50)	48,460 (57)	19,308 (48)	40,960 (51)	19,589 (46)	18,102 (49)	10,673 (60)

[1] Young advanced growth included.

[2] Winter cut - cut during winter of 1966; Summer cut - cut during summer of 1967.

[3] Coefficient of variation in brackets.

[4] Level of significance for the "t-test": ** significant at .01 level
* significant at .05 level
NS None Significant

TABLE 3. SPECIES COMPOSITION PERCENTAGES BY LOGGING TREATMENT AND SEASON AT AGES ONE TO SIX YEARS

	Age(years)																	
	1				2				3				4		5		6	
Season of cut[1]	W		S		W		S		W		S		W		S		W	
Year of measure	1966		1967		1967		1968		1968		1969		1969		1971		1971	
Strip number (treatment) Species[2]	tA	bP	tA	bP	tA	bP	tA	bP	tA	bP	tA	bP	tA	bP	tA	bP	tA	bP
1	N.M.[3]		89	11	N.M.		96	4	N.M.		96	4	N.M.		96	4	N.M.	
2	98	2	88	12	99	1	88	12	99	1	90	10	99	1	90	10	99	1
3	91	9	94	6	94	6	96	4	94	6	96	4	94	6	96	4	93	7
4	86	14	96	4	92	8	94	6	90	10	95	5	91	9	95	5	90	10
All strips	92	8	93	7	95	5	94	6	94	6	94	6	95	5	94	6	94	6

1 Winter cut - cut during winter of 1966; Summer cut - cut during summer of 1967.

2 tA - trembling aspen; bP - balsam poplar.

3 Not measured.

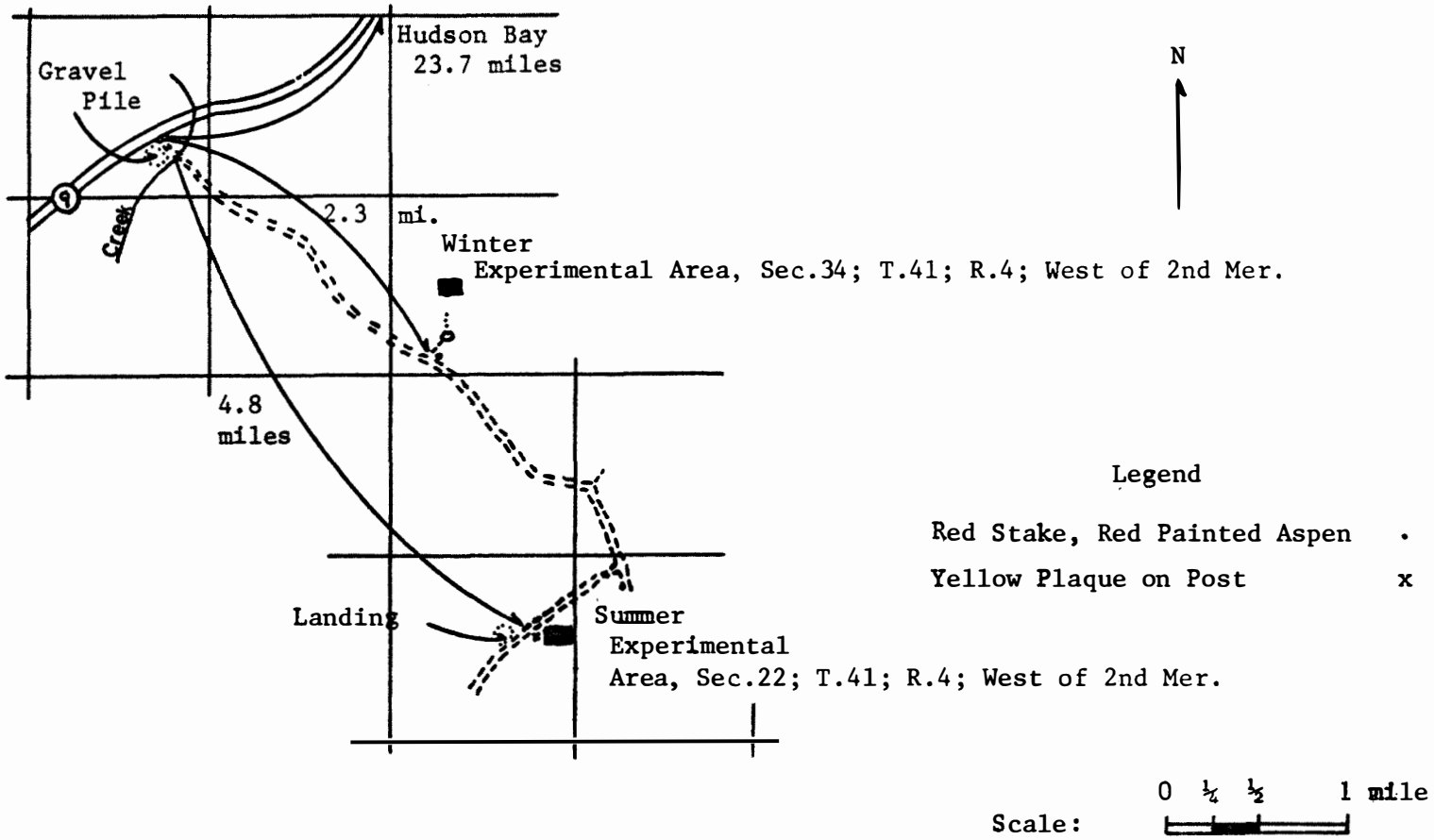

Fig.1 Location of experimental areas, winter and summer cuts. Hudson Bay, Saskatchewan.

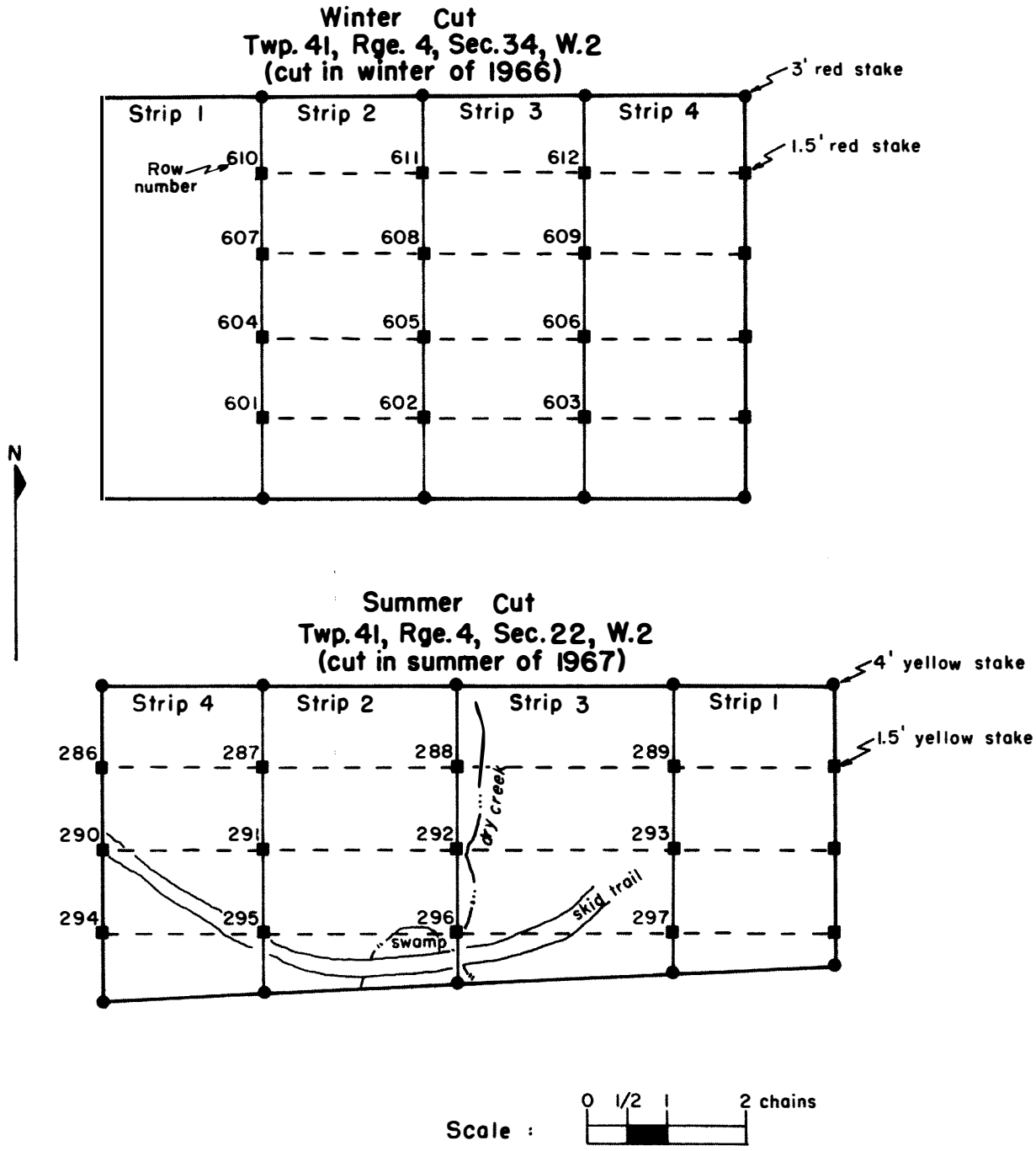

Fig.2 Layout of logging treatments by strips within winter and summer cut areas.

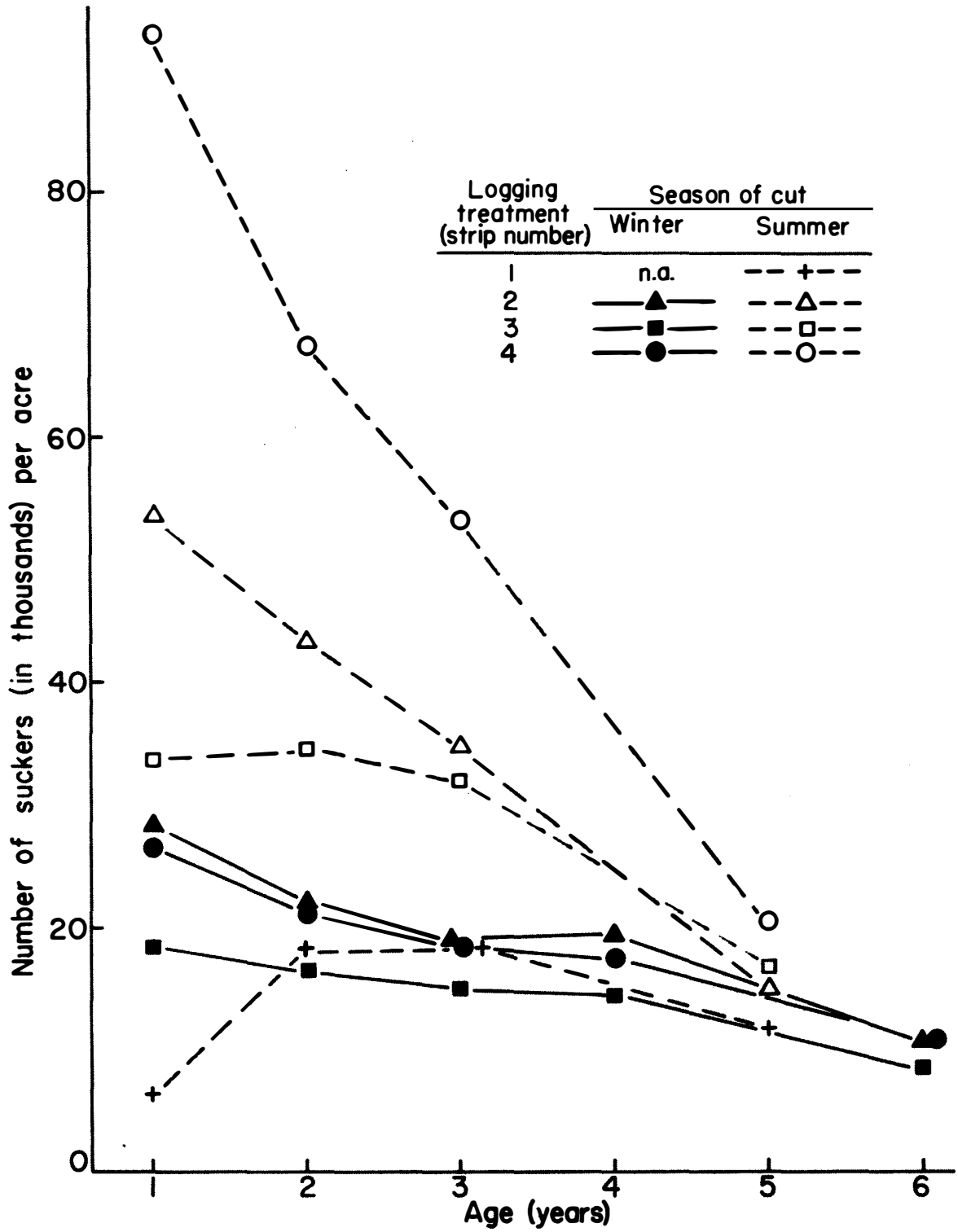

Fig.3 Number of suckers per acre (mainly aspen, but includes some balsam poplar) by logging treatment and season at ages one to six years.

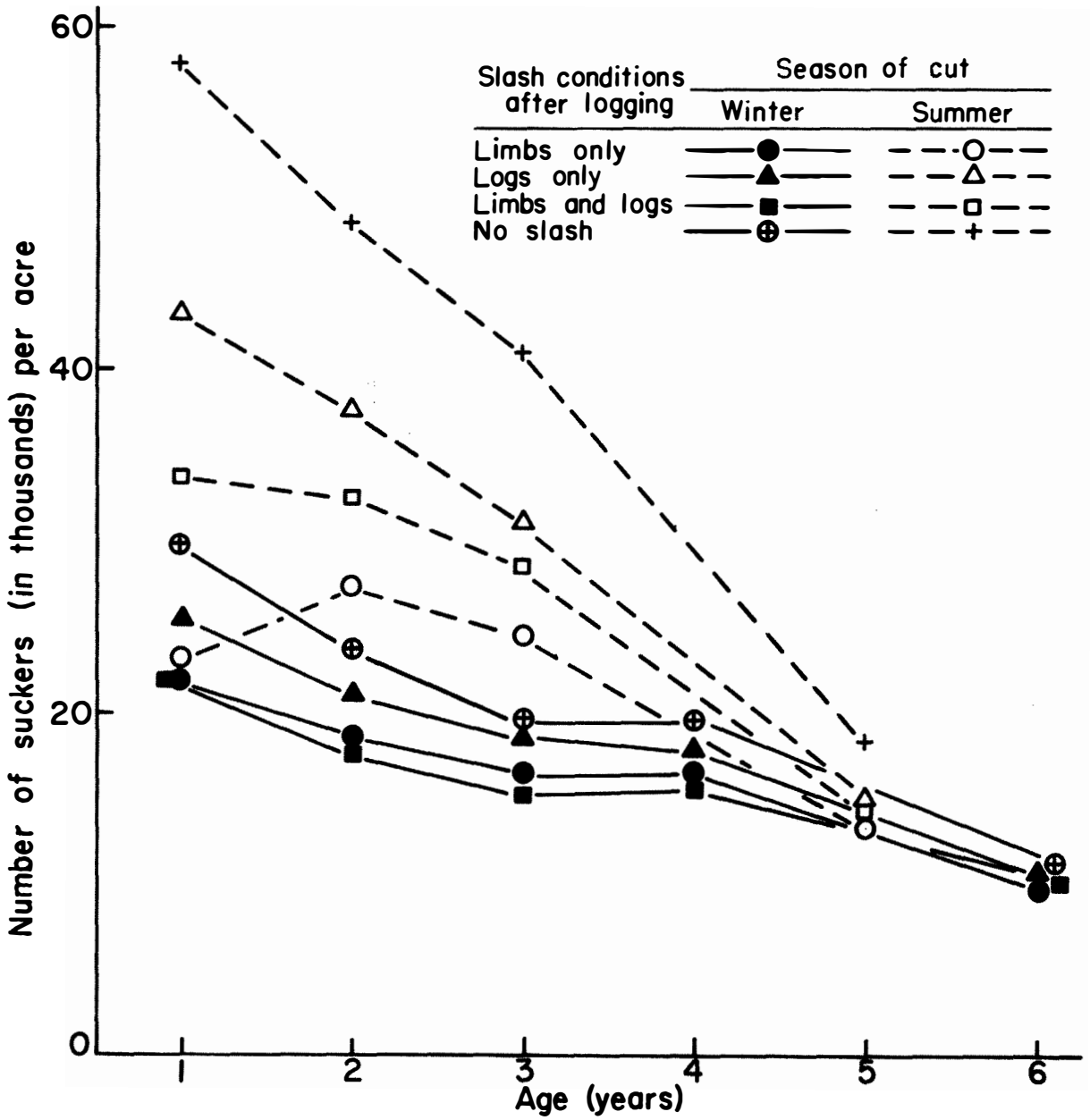

Fig.4 Number of suckers per acre (mainly aspen, but includes some balsam poplar) by actual slash conditions for summer- and winter-cut at ages one to six years.

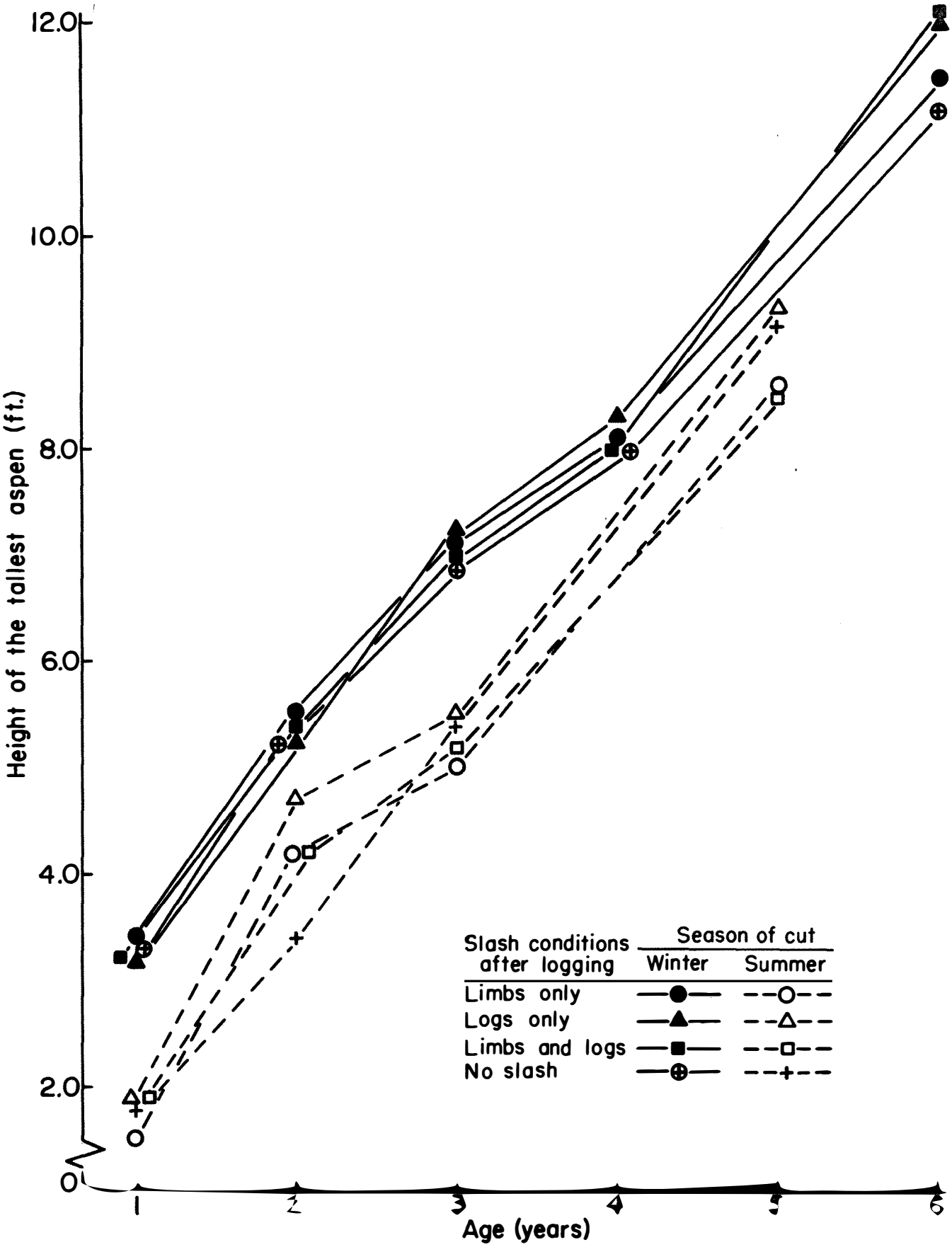

Fig.5 Height of the tallest aspen tree per quadrat averaged by slash conditions for summer- and winter-cut.

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