



Forest Research Branch

**RESULTS OF A 1936 RELEASE CUTTING TO
FAVOUR WHITE SPRUCE IN A 50-YEAR-OLD
WHITE SPRUCE-ASPEN STAND IN MANITOBA**

by
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Results of a 1936 Release Cutting to Favour White Spruce in a 50-Year-Old White Spruce-Aspen Stand in Manitoba¹

by

G. A. STENEKER²

INTRODUCTION

Immature mixedwood stands containing white spruce (*Picea glauca* Moench, Voss.) occupy large areas of the B.18a Forest Section (Rowe 1959). Unfortunately they are not favourable for development of the invariably overtopped spruce which often suffers severe suppression due to competition and mechanical injury from the hardwood overstory, mainly aspen (*Populus tremuloides* Michx.).

Kagis (1952) mentioned that as a result of competition and suppression from aspen, losses of white spruce volume are enormous. Kabzems (1952) claimed that height growth of white spruce in mixedwood stands is always lower than that in pure white spruce stands, attributing this in part to mechanical damage to spruce leaders from overtopping hardwoods. Cayford (1957) analyzed the effect of an aspen overstory on the growth of white spruce and found that in mixedwood stands up to 100 years of age, volume production of white spruce may be as much as 50 per cent lower than that of nearby free-growing white spruce of the same age. Kittredge and Gevorkiantz (1929) mentioned that white spruce is only freed from overhead suppression when the hardwood stand component starts to deteriorate, by which time the white spruce has often been severely damaged and suppressed.

Suppression of white spruce by aspen was early recognized as a serious problem in the Duck Mountain Forest Reserve, and in 1936 an experiment was established to assess the effects of two degrees of release on spruce volume production. This report presents results up to 1957.

DESCRIPTION OF EXPERIMENTAL AREA

The area is located on a south-west slope and is typical of the rolling uplands in Forest Section B. 18a. The parent material of the soil is a clay-loam glacial till. Sites vary from moderately fresh to moist and according to Hills' (1952) classification, range in moisture regime from 2 to 3.

The most widely represented species of herbaceous flora in 1936 were *Aralia nudicaulis* L., *Cornus canadensis* L., *Linnaea borealis* L., *Maianthemum canadense* Def. var. *interius* Fern., and *Pyrola ellyptica* Nutt. The shrub layer was composed primarily of *Viburnum trilobum* Marsh., *Corylus rostrata* Ait. and *Rosa* spp.

The stand originated from a fire that occurred in the late 1880's. Principal tree species in 1936 were white spruce and aspen; they made up almost 80 per cent of the stand before treatment. The remainder consisted of jack pine (*Pinus banksiana* Lamb.), black spruce (*Picea mariana* (Mill.) BSP), and a few balsam poplar (*Populus balsamifera* L.) and white birch (*Betula papyrifera* Marsh.).

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Figure 1 shows the size and frequency of the principal stand components in 1936 before treatment. Aspen and jack pine formed an upper canopy, and white spruce and black spruce an understory.

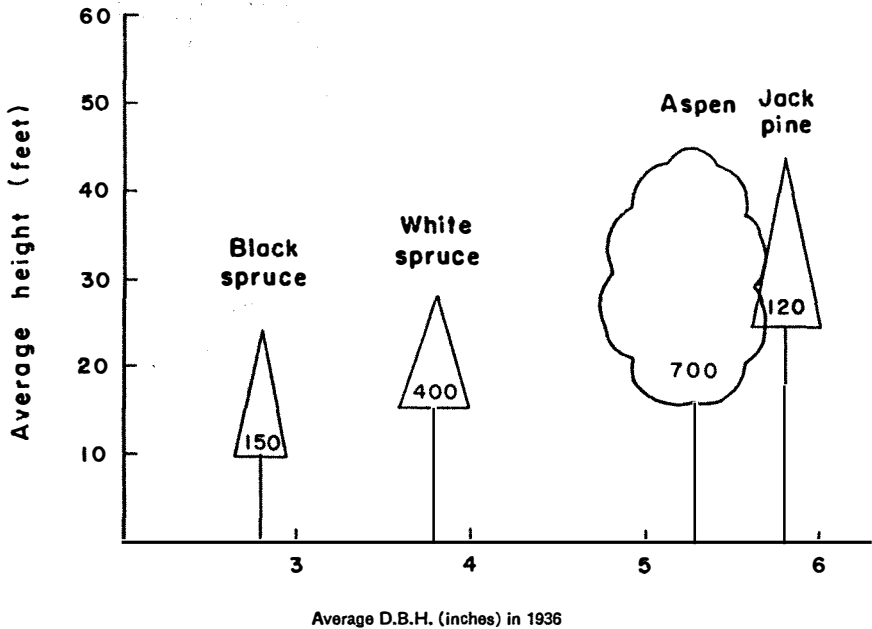


Figure 1. Average height and diameter, and number of trees per acre of the principle stand components in 1936 before treatment.

METHODS

In 1936 two 1/4-acre plots were subjected to a light and a heavy release cutting respectively. Trees competing with or overtopping white spruce were removed. Although most of the trees cut were aspen and jack pine, a small number of white and black spruce in the lower diameter classes were also removed. Table 1 shows intensity of cutting by species. The light release cutting resulted in removal of 44 per cent and the heavy release cutting of 60 per cent of the total basal area. A third plot was retained as a control.

TABLE 1. PERCENTAGES OF BASAL AREA REMOVED BY TREATMENT

Species	Percentage of each species basal area removed		Percentage of total basal area removed	
	Light release	Heavy release	Light release	Heavy release
White spruce.....	9	20	1.7	3.4
Black spruce.....	25	33	.6	2.8
Jack pine.....	60	81	11.1	7.3
Aspen*.....	51	70	30.4	46.1
	Total		43.8	59.6

*The few balsam poplar and white birch have been included with the aspen.

After thinning, trees on each plot were tagged and mapped. At establishment and again at remeasurement in 1957, diameters of the trees were measured to the nearest one-tenth inch and sufficient height measurements were taken to construct height/diameter curves for each species within each plot.

RESULTS

Stand in 1957

Figures 2a, 2b, and 2c, show the diameter distributions of the species on the three plots before and after release in 1936, and in 1957.

The effect of release on volume production to 1957 is shown in Table 2. Results for white spruce are summarized as follows:

Total volume, all trees (cu. ft.)

Light release (1,439) }
Heavy release (1,502) }almost double that of control (844)

Total volume, trees $\geq 3.6''$ d.b.h. (cunits)

Light release (14.2) }
Heavy release (15.0) }almost double that of control (8.2)

Merchantable volume (bd. ft.)

Light release (2,601)almost double that of control (1,510)
Heavy release (4,230)almost triple that of control (1,510)

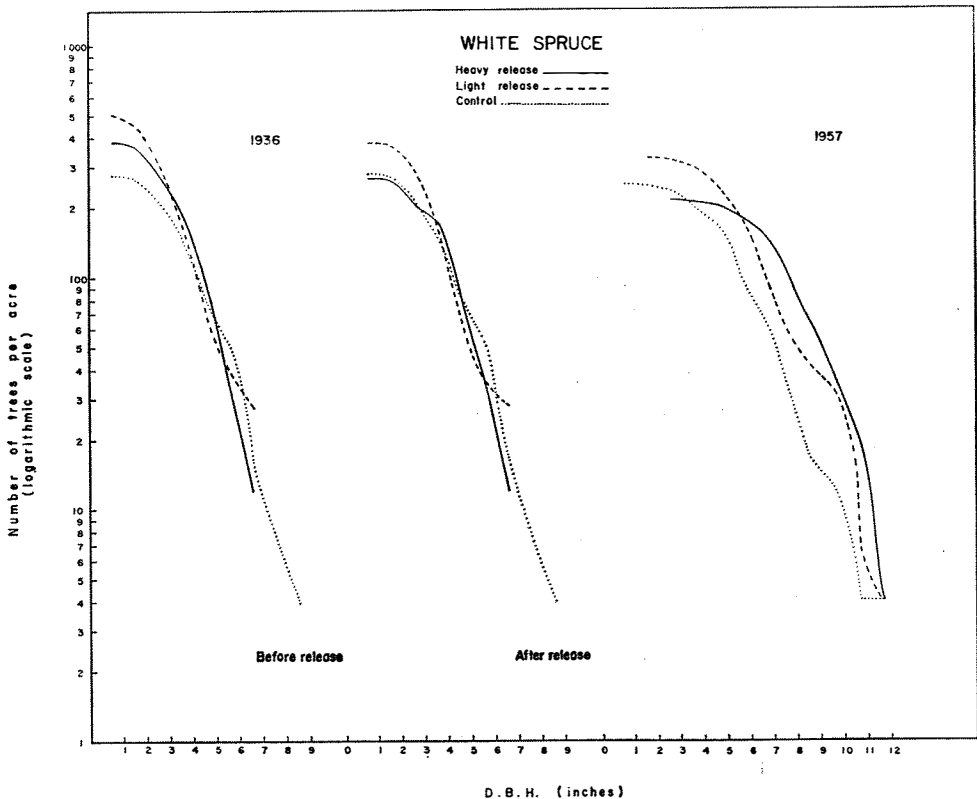


Figure 2a. Cumulative frequency curves for diameter distribution of white spruce by treatment in 1936 and 1957

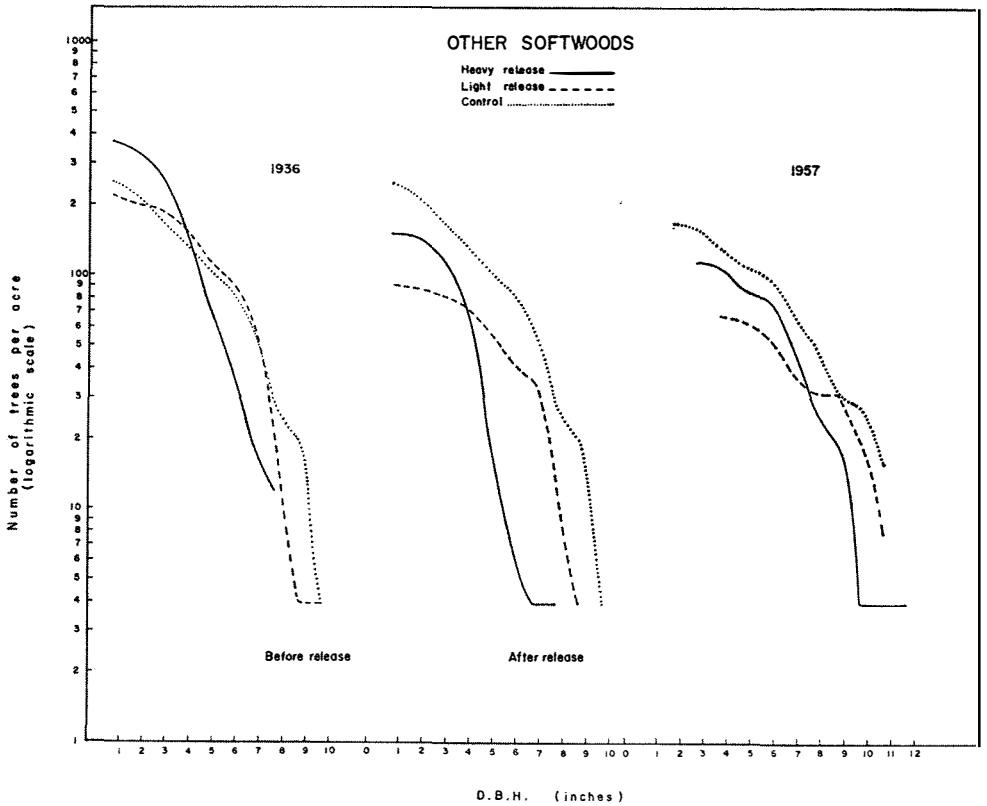


Figure 2b. Cumulative frequency curves for diameter distribution of other softwoods by treatment in 1936 and 1957

Total volume for white spruce, other softwoods, and hardwoods in 1936 and 1957 are presented graphically in Figure 3 for easy reference. Data for 1957, all species combined, show that no cutting gave the largest total volume expressed in cubic feet and cunits and that heavy release cutting gave the smallest. Heavy release cutting resulted in only a slightly greater board foot volume than no cutting.

Net and Gross Volume Increment and Mortality

Table 3 shows periodic net and gross volume increment by species for all plots. Net total and board foot volume increments of white spruce were more than doubled and more than tripled respectively, as a result of the heavy release cutting.

It is well established that within certain wide limits gross total volume increment is not influenced by stocking (Möller et al. 1954). Growth data for all species combined on each plot support this contention.

Greatest mortality expressed in total volume (all species combined) occurred with no treatment, whereas heavy release cutting showed least mortality. Mortality of white spruce was light and did not appear to be much influenced by treatment.

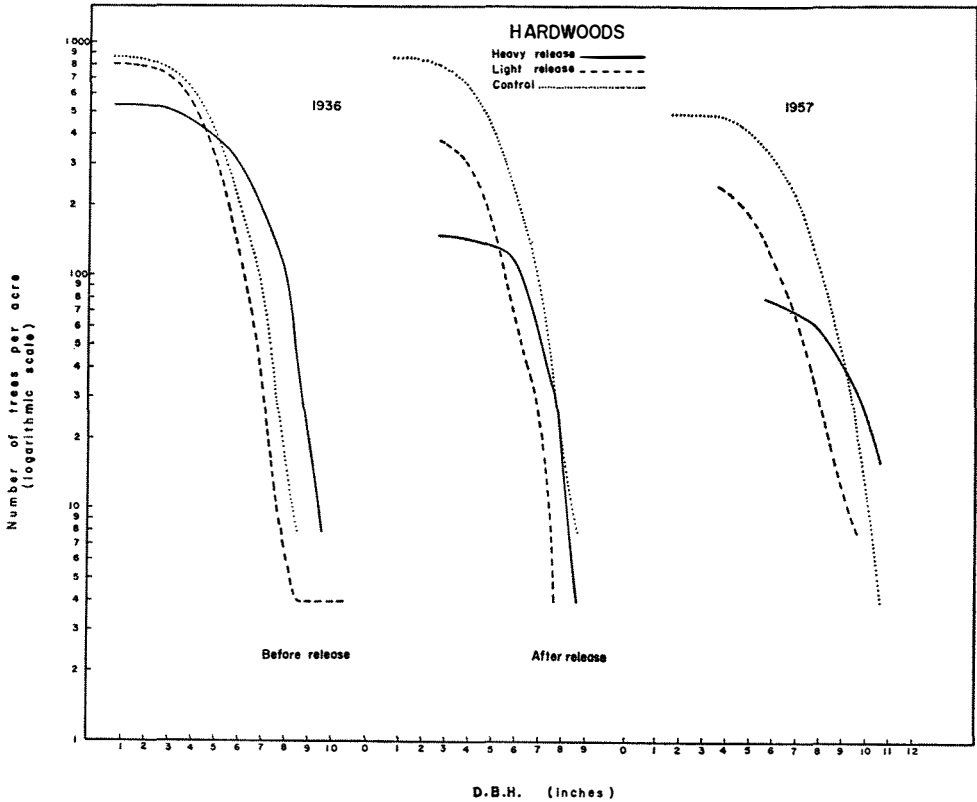


Figure 2c. Cumulative frequency curves for diameter distribution of hardwoods by treatment in 1936 and 1957

Diameter and Height Increment

Diameter increment increased for all species as a result of the release cutting (Figure 4), with the heavy release producing the greatest increase. Of all species, white spruce grew the fastest. Height increment of white spruce was doubled as a result of release. That of other softwoods was increased only slightly.

DISCUSSION

Much literature presenting the results of release cuttings in young mixed-wood stands is available. Westveld (1937) found that red spruce, released from overtopping hardwoods by girdling, produced several times as much pulpwood over a 30-year period as spruce that was not released. Clarke (1940) reported a net annual volume increase of from 2.9 per cent to 4.7 per cent over a period of 10 years in spruce and balsam fir that had been released by the removal of 75 per cent of the overtopping hardwoods. According to Robertson (1930) annual volume increment of spruce and balsam fir increased from 4.2 per cent to 5.6 per cent and 5.2 per cent over a period of 6 years after girdling 40 per cent and 100 per cent of the overtopping hardwoods, respectively. Daly (1950), Thomson (1949), Plice and Hedden (1931), and Mulloy (1941) also reported the favourable response of spruce to release. Results in this paper support those of other workers.

TABLE 2. STAND STATISTICS PER ACRE IN 1936 AND 1957

Treatment	Species	Number of trees			Basal area (sq. ft.)			Total volume						Merch. volume (6 bd. ft.)†		
								All trees (cu. ft.)*			Trees ≥ 3.6" d.b.h. (cunits)**					
		1936 Before release	After release	1957	1936 Before release	After release	1957	1936 Before release	After release	1957	1936 Before release	After release	1957	1936 Before release	After release	1957
Control.....	White spruce.....	276	—	248	27	—	44	398	—	844	3.4	—	8.2	212	—	1,510
	Other softwoods.....	248	—	168	35	—	43	643	—	909	6.1	—	8.8	844	—	2,438
	Hardwoods.....	856	—	496	121	—	126	2,748	—	3,044	26.6	—	30.4	863	—	4,092
	Total.....	1,380	—	912	183	—	213	3,789	—	4,797	36.1	—	47.4	1,919	—	8,040
Light release.....	White spruce.....	504	376	320	34	31	70	504	480	1,439	3.7	3.7	14.2	0	0	2,601
	Other softwoods.....	220	92	68	36	16	25	680	325	545	6.6	3.2	5.4	528	312	1,664
	Hardwoods.....	796	380	244	101	49	53	2,244	1,105	1,259	21.0	10.4	12.6	408	75	1,345
	Total.....	1,520	848	632	171	96	148	3,428	1,910	3,243	31.3	17.3	32.2	936	387	5,610
Heavy release.....	White spruce.....	384	264	212	30	24	70	430	355	1,502	3.6	3.2	15.0	0	0	4,230
	Other softwoods.....	372	152	116	31	13	29	488	193	550	4.1	1.6	5.5	264	102	1,119
	Hardwoods.....	532	148	80	117	35	37	3,203	912	929	31.6	9.1	9.3	3,752	822	2,831
	Total.....	1,288	564	408	178	72	136	4,121	1,460	2,981	39.3	13.9	29.8	4,016	924	8,180

*1944, Interpolated volume tables (total volume) for use in compilation of sample plot data. Canada Department of Mines and Resources, Lands, Parks and Forests Branch, Dom. For. Serv., Misc. Ser. No. 3.

**100 cu. ft. total volume = 1 cunit (trees ≥ 3.6" d.b.h.)

†1948, Form class volume tables. Interpolated log rule (1) (trees ≥ 7.6" d.b.h.), form class 65. Canada, Department of Mines and Resources, Mines, Forests and Scientific Services Branch, Dom. For. Serv.

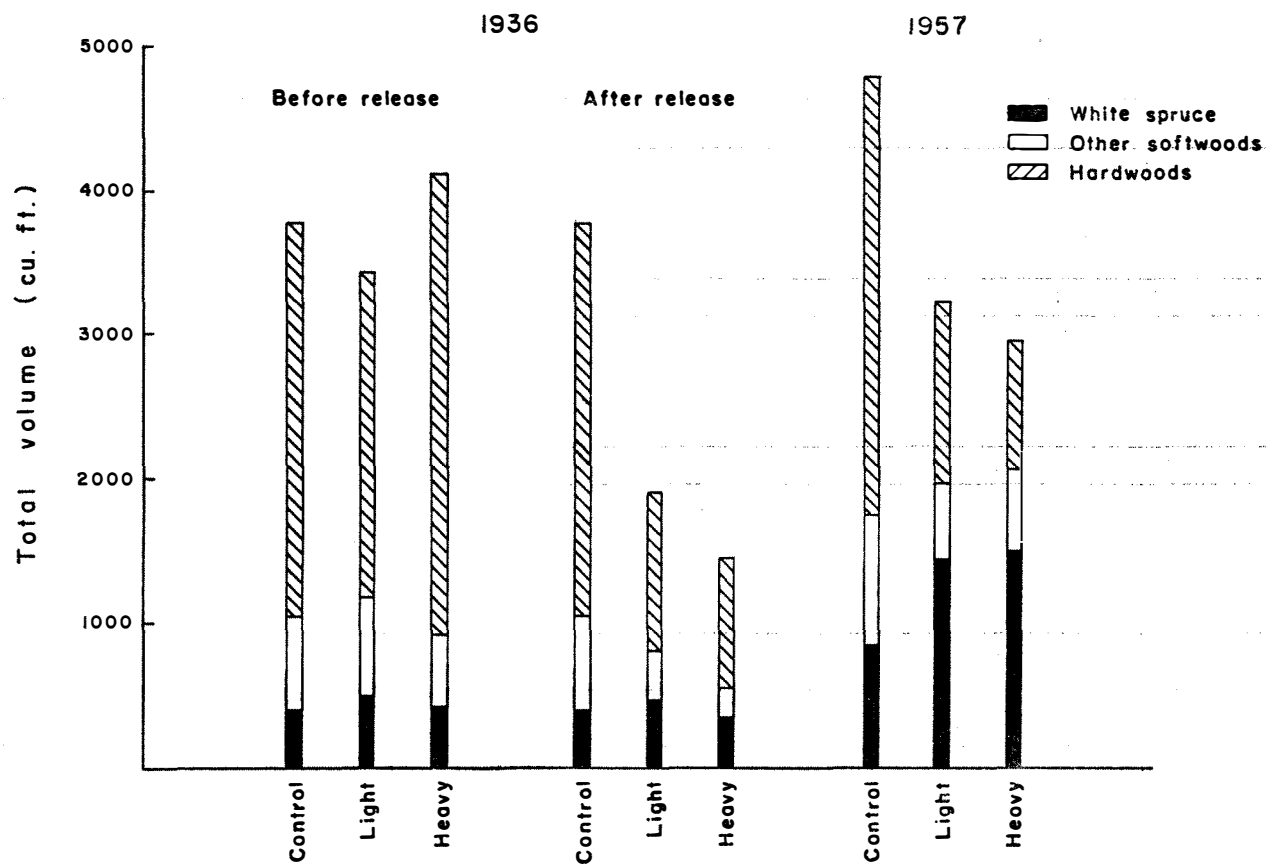


Figure 3. Total volume (cu. ft.) in 1936 and 1957 by treatment for white spruce, other softwoods, and hardwoods

TABLE 3. PERIODIC NET AND GROSS VOLUME INCREMENT AND MORTALITY PER ACRE, 1936-1957

Treatment	Species	Total volume						Merch. volume (bd. ft.)		
		All trees (cu. ft.)			Trees \geq 3.6" d.b.h. (cunits)					
		Net incr.	Mort.	Gross incr.	Net incr.	Mort.	Gross incr.	Net incr.	Mort.	Gross incr.
Control.....	White spruce.....	446	22	468	4.8	.2	5.0	1,298	0	1,298
	Other softwoods.....	266	114	380	2.7	1.0	3.7	1,594	0	1,594
	Hardwoods.....	296	769	1,065	3.8	6.5	10.3	3,229	76	3,305
	Total.....	1,008	905	1,913	11.3	7.7	19.0	6,121	76	6,197
Light release.....	White spruce.....	959	25	984	10.5	.1	10.6	2,601	0	2,601
	Other softwoods.....	220	58	278	2.2	.6	2.8	1,352	104	1,456
	Hardwoods.....	154	401	555	2.2	3.7	5.9	1,270	0	1,270
	Total.....	1,333	484	1,817	14.9	4.4	19.3	5,223	104	5,327
Heavy release.....	White spruce.....	1,147	43	1,190	11.8	.3	12.1	4,230	0	4,230
	Other softwoods.....	357	28	385	3.9	.2	4.1	1,017	0	1,017
	Hardwoods.....	17	323	340	.2	3.2	3.4	2,009	342	2,351
	Total.....	1,521	394	1,915	15.9	3.7	19.6	7,256	342	7,598

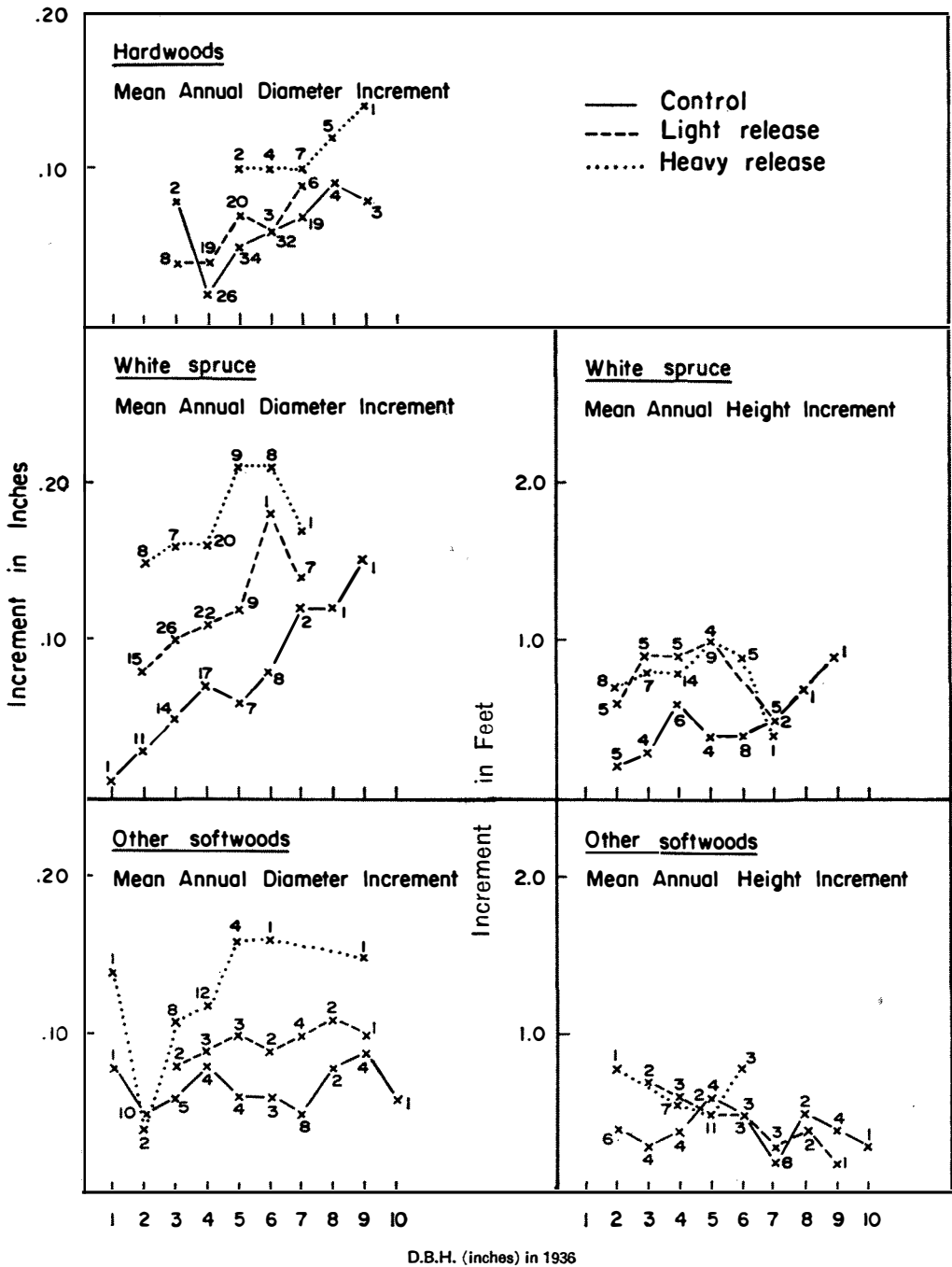


Figure 4. Mean annual diameter and height increment, 1936-1957

The primary objective of a release cutting in white spruce-aspen stands should be the freeing of all good quality white spruce from overhead suppression. Owing to the great variation in stand structure and composition of spruce-aspen stands in Forest Section B.18a, precise methods for releasing spruce cannot be prescribed; it might be necessary to remove many or only a few aspen, depending upon the distribution and density of the aspen and that of the spruce. Although white spruce will respond to release at advanced-ages, the most benefit will likely be early in its life; but at the latest, spruce should be released just before it comes into contact with the crowns of the upper canopy hardwoods if damage to leaders from whipping and abrasive action is to be avoided.

Economic factors will influence time and method of release, and the immediate feasibility of release cutting will depend on whether the aspen to be cut is marketable. If aspen is marketable, it can be cut for pulpwood when about 60 years old. In Alberta, Ontkean and Smithers (1949) suggested the removal of 50 per cent of aspen basal area in the form of pulpwood at an age of 60 years. If the aspen is not marketable, poisoning is recommended either by broadcast methods or by treatment of individual trees. Aerial spraying is recommended for killing aspen over larger areas, and it has given good results in the Lake States as an economic means of disposing of undesirable hardwoods (Arend 1959). The individual tree method is likely to be most economical over limited areas and in recent years poisoning of trees by means of tree injections has shown promise (Jokela and Lorenz 1955, Stephenson and Gibbs 1959).

SUMMARY

In 1936 an experimental cutting was carried out in a 50-year old white spruce-aspen stand to study the effects of release on the volume production of white spruce. Forty-four per cent of the total basal area was removed from one $\frac{1}{4}$ -acre plot and sixty per cent from another; a third $\frac{1}{4}$ -acre plot was retained as a control.

Results to 1957 showed that total volume of white spruce on the treated plots was almost double that on the control. Light and heavy release cutting resulted in board-foot volumes of white spruce that were, respectively, almost double and triple that on the control.

SOMMAIRE

En 1936, on a effectué une coupe expérimentale dans un peuplement d'épinette blanche et de peuplier faux-tremble âgé de 50 ans, en vue d'étudier les effets de cette coupe de nettoyage sur le volume marchand d'épinette blanche. La coupe a été de quarante-quatre pour cent de la surface terrière dans une place d'un quart d'acre, et de soixante pour cent dans une autre; on a conservé comme témoin une troisième place d'un quart d'acre.

Les résultats observés jusqu'en 1957 ont indiqué que le volume global d'épinette blanche dans les places soumises à une coupe de nettoyage était presque le double du volume qui se trouvait dans la place témoin. A la suite de coupes légères et de coupes claires de nettoyage, le volume d'épinette blanche en pieds mesure de planche a été, dans chaque cas, presque le double et le triple du volume qui se trouvait dans la place témoin.

APPENDIX I
STAND TABLES PER ACRE, 1936 AND 1957
(number of trees)

D.B.H.	Control						Light release									Heavy release												
	White spruce			Other softwoods			Hardwoods			White spruce			Other softwoods			Hardwoods			White spruce			Other softwoods			Hardwoods			
	1936 Before re- lease	After re- lease	1957	1936 Before re- lease	After re- lease	1957	1936 Before re- lease	After re- lease	1957	1936 Before re- lease	After re- lease	1957	1936 Before re- lease	After re- lease	1957	1936 Before re- lease	After re- lease	1957	1936 Before re- lease	After re- lease	1957	1936 Before re- lease	After re- lease	1957				
1	8	4		28	—		8	—		52	8	—	20	4	—	8	—	—	16	4	—	36	4	—	4	—	—	
2	56	12		44	8		52	4		140	80	8	8	4	—	40	—	—	92	56	—	60	24	—	4	—	—	
3	64	36		36	28		108	—		144	128	20	32	8	—	132	60	—	88	32	8	104	44	8	48	4	—	
4	68	32		32	20		204	52		100	96	52	32	16	4	224	112	44	96	92	4	92	56	20	60	8	—	
5	28	68		20	12		212	88		28	28	64	32	16	8	208	124	60	56	44	24	36	16	8	76	12	—	
6	36	32		28	28		144	96		12	8	76	32	8	16	116	48	56	32	32	28	24	4	28	112	52	8	
7	8	32		32	20		96	112		28	28	44	44	24	8	56	32	44	4	4	48	8	—	24	88	40	8	
8	4	16		8	20		24	80		—	—	16	16	8	—	8	4	24	—	—	40	12	4	8	104	28	16	
9	4	4		16	4		8	44		—	—	8	—	4	12	—	—	8	—	—	24	—	—	16	28	4	16	
10	—	8		4	12		—	16		—	—	24	4	—	12	—	—	8	—	—	16	—	—	—	8	—	16	
11	—	—		—	16		—	4		—	—	4	—	—	8	4	—	—	—	—	16	—	—	—	—	—	16	
12	—	4		—	—		—	—		—	—	4	—	—	—	—	—	—	—	—	4	—	—	4	—	—	—	
Total	276	248		248	168		856	496		504	376	320	220	92	68		796	380	244	384	264	212	372	152	116	532	148	80

APPENDIX II
STOCK TABLES PER ACRE, 1936 AND 1957
 Total volume (cu. ft.)

D.B.H.	Control						Light release									Heavy release								
	White spruce		Other softwoods		Hardwoods		White spruce			Other softwoods			Hardwoods			White spruce			Other softwoods			Hardwoods		
	1936	1957	1936	1957	1936	1957	1936 Before release	1936 After release	1957	1936 Before release	1936 After release	1957	1936 Before release	1936 After release	1957	1936 Before release	1936 After release	1957	1936 Before release	1936 After release	1957	1936 Before release	1936 After release	1957
1	0.4	0.4	0.4	—	1	—	4	0.4	—	1	0.4	—	1	—	—	0.4	0.4	—	1	0.4	—	0.4	—	—
2	18	3	12	3	34	1	33	22	2	2	1	—	20	—	—	18	15	—	13	6	—	1	—	—
3	38	22	21	23	52	—	94	84	14	20	4	—	122	65	—	52	19	5	64	29	4	40	5	—
4	80	33	40	25	382	113	124	126	72	48	19	7	424	217	79	116	111	5	116	79	23	108	14	—
5	60	146	42	24	675	266	64	67	136	80	44	20	661	370	189	118	89	50	79	31	18	242	35	—
6	111	111	107	94	662	435	40	29	293	119	25	60	534	215	258	106	103	107	89	16	100	762	270	38
7	34	161	173	129	650	727	145	152	254	252	132	45	349	204	240	20	18	261	42	—	117	620	275	52
8	25	132	56	166	198	681	—	—	126	116	58	—	66	34	248	—	—	299	84	32	56	979	269	140
9	32	37	145	46	94	475	—	—	86	44	42	129	—	—	132	—	—	240	—	—	160	333	44	182
10	—	115	47	148	—	214	—	—	315	—	—	158	—	—	113	—	—	202	—	—	—	118	—	224
11	—	—	—	251	—	58	—	—	63	—	—	126	67	—	—	—	—	255	—	—	—	—	—	293
12	—	84	—	—	—	74	—	—	78	—	—	—	—	—	—	—	—	78	—	—	72	—	—	—
Total	398.4	844.4	643.4	909	2,748	3,044	504	480.4	1,439	682	325.4	545	2,244	1,105	1,259	430.4	355.4	1,502	488	193.4	550	3,203.4	912	929

Merchantable volume (bd. ft.)

8	88	480	174	592	579	1,520	—	—	302	368	176	—	146	75	581	—	—	1,020	264	102	187	2,304	694	320
9	124	136	496	176	284	1,324	—	—	339	160	136	494	—	—	374	—	—	914	—	—	609	1,022	128	533
10	—	496	174	590	—	717	—	—	1,322	—	—	632	—	—	390	—	—	838	—	—	—	426	—	784
11	—	—	—	1,080	—	223	—	—	278	—	—	538	262	—	—	—	—	1,104	—	—	—	—	—	1,194
12	—	398	—	—	—	308	—	—	360	—	—	—	—	—	—	—	—	354	—	—	323	—	—	—
Total	212	1,510	844	2,438	863	4,092	—	—	2,601	528	312	1,664	408	75	1,345	—	—	4,230	264	102	1,119	3,752	822	2,831

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