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Department of Forestry

FOREST RESEARCH BRANCH

RESPONSE OF BALSAM FIR ADVANCE GROWTH TO PARTIAL LOGGING IN QUEBEC

(Projects Q-44 and Q-62)

by

R.J. Hatcher

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RESPONSE OF BALSAM FIR ADVANCE GROWTH TO PARTIAL LOGGING IN QUEBEC[1]

by R.J. Hatcher[2]

ABSTRACT

Two investigations were made in Quebec on the response of balsam fir advance growth to release by partial logging. Results indicate that younger and smaller seedlings respond faster and better to release than older and taller seedlings, and that a direct relationship exists between seedling vigour and height growth subsequent to release.

INTRODUCTION

In Eastern Canada most balsam fir[3] stands originate from advance growth present beneath the canopy of the old stand. A knowledge of the factors governing development of this advance growth following cutting is basic to the evolution of sound silvicultural practices for this species. Of the many factors involved, the influence of height, age and vigour of seedlings just prior to release by partial cutting were studied in 1959 at the Lake Edward Experimental Forest north of Grand'Mère, Quebec. Trends evident in this study were confirmed in 1961 by a similar but more limited investigation of smaller sized advance growth in the Laurentide Park north of Quebec City.

MATERIALS AND METHODS

At Lake Edward, 199 fir seedlings were studied in uneven-aged spruce-fir-yellow birch stands of the Oxalis-Cornus site type (Heimburger 1941)

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[1] Contribution No. from the Forest Research Branch, Dept. of Forestry.

[2] Research Officer Forestry, Forest Research Branch, Dept. of Forestry, Quebec.

[3] Nomenclature as in Native Trees of Canada, Bulletin 61. Canada, Dept. of Forestry. 6th Ed. 1961.

that were cut in 1955-1956 under a diameter limit control that removed approximately one-half of the growing stock. All fir reproduction from 1 to 12 feet tall was sampled on systematically spaced circular plots 15 feet in radius. For each seedling , total height and annual height growth for the three years immediately before and after logging were recorded in the field. Age was determined in the laboratory from discs cut at the root collar.

At Epaule River the analysis comprised 81 seedlings that were between 0.5 and 1.0 feet tall when 50 per cent of the growing stock was cut from a dense 50-year-old fir stand on the Hylocomium-Oxalis site type (Linteau 1955).

RESULTS

Seedling height at the time of release had a marked effect upon subsequent height growth (Figures 1 and 2). Small seedlings grew faster than large seedlings. This trend was not marked in the first year's growth after release but became evident during the second and third growing seasons. During the third growing season, seedlings that were initially in the 1- and 2-foot height class grew at least twice as fast as those of comparable vigour in the 5-foot class or larger.

The effect of age at the time of release on height growth (Figures 3 and 4) is similar to the effect of initial height. Young seedlings grew more rapidly after release than old seedlings. Notably the older seedlings at Lake Edward grew as fast or faster after release than the young seedlings at Epaule River. Site quality differences are probably the explanation.

Within a given height or age class, height growth following release was directly related to vigour of the seedling (expressed in terms of height growth in the three years prior to release) at the time of release. The pattern or trend of height growth (accelerating, decelerating or constant) in the three years preceding release also bears a relationship to subsequent

height growth. Trees accelerating in height growth before cutting grew faster than did those having a constant or decelerating growth (Figure 5).

The promptness of response to release appears to be a function of age (Table 1). The percentage of seedlings that responded either in diameter or height growth in the three years following release decreased with increasing seedling age.

DISCUSSION

The response in growth of fir seedlings to release by partial logging appears to be related to seedling age, height, and apparent vigour just prior to the release. For seedlings of a given age or height at the time of release, those classed as most vigorous grew best after release. For seedlings of equal vigour, the small and young seedlings outgrew the larger and older seedlings in height, not only cumulatively for a three-year period since release but also during the second and third year . Supplementing this superiority is the tendency of young seedlings to respond earlier.

At Lake Edward, trees in the 1 to 2 foot height class grew the fastest after release. In Newfoundland, Ellis (1959) reported most rapid response in 5- to 10-year-old fir 4 to 8 inches tall; in New Brunswick, Baskerville (1961) found the best and most rapid response on stems 4 feet tall at the time of release; and Westveld (1935) reported best response in 2- to 5-foot stems in northeastern United States. Among the reasons for these somewhat conflicting results are differences in seedling vigour caused by variation in crown canopy and differences in site quality.

The faster height growth of smaller seedlings following logging may reasonably be expected to continue for one or even several more years. The effect will be a reduction in the original height differences of the reproduction and a tendency towards the development of a uniform sapling storey. Repeated partial logging at Lake Edward conceivably could have the

effect of producing a multi-storied stand structure quite unlike the uneven-aged structure of the past.

Seedling response to logging was rapid, with 88 per cent of the stems showing increased diameter growth, and 80 per cent showing increased height growth, within three years of release. This quick reaction suggests a possible solution to the problem of fir suppression and mortality caused by shrub competition following logging in mixedwood stands (Vincent 1956). Treatment to release advance growth two or three years before logging would better its chances to compete successfully with shrub growth, particularly mountain maple, after logging. Furthermore, there is some evidence (Baskerville 1961, Mulloy 1941) that the beneficial effects of release persist for several years after severe competition is re-established.

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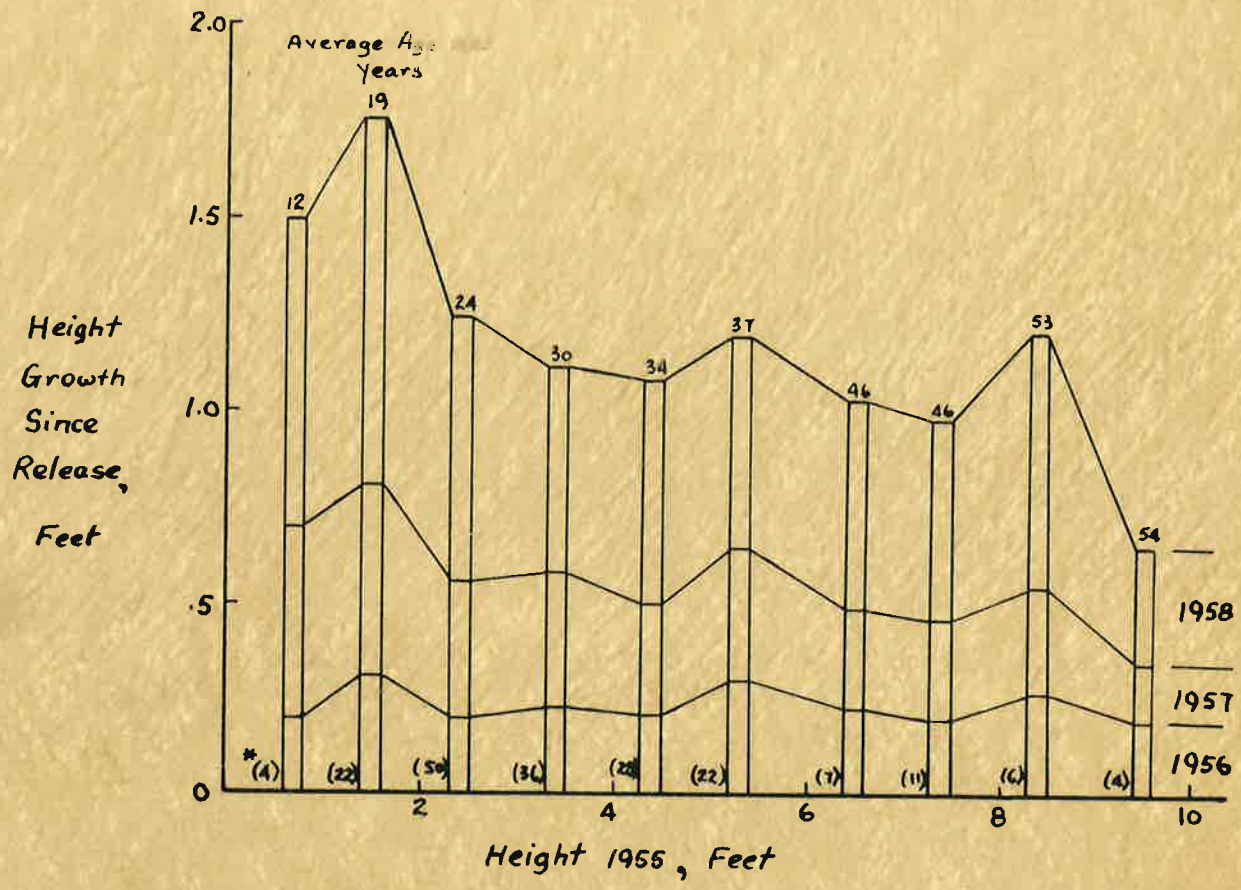

Figure 1. Relationship of height growth since logging to height prior to logging, Lake Edward

* Number of samples

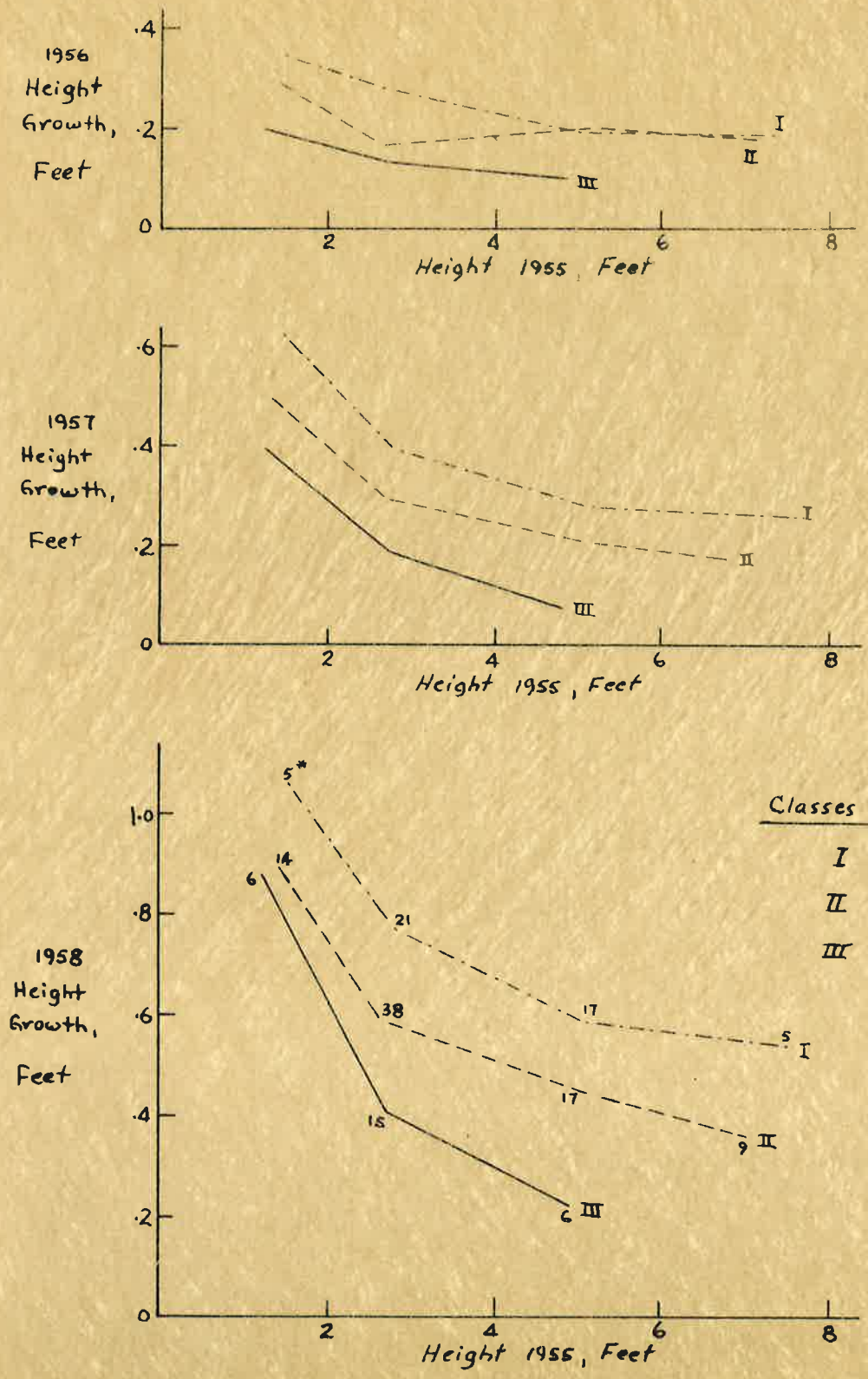

Figure 2. Relationship of height growth 1956, 1957, 1958 to height at time of release and height growth previous to release, Lake Edward

* Number of samples

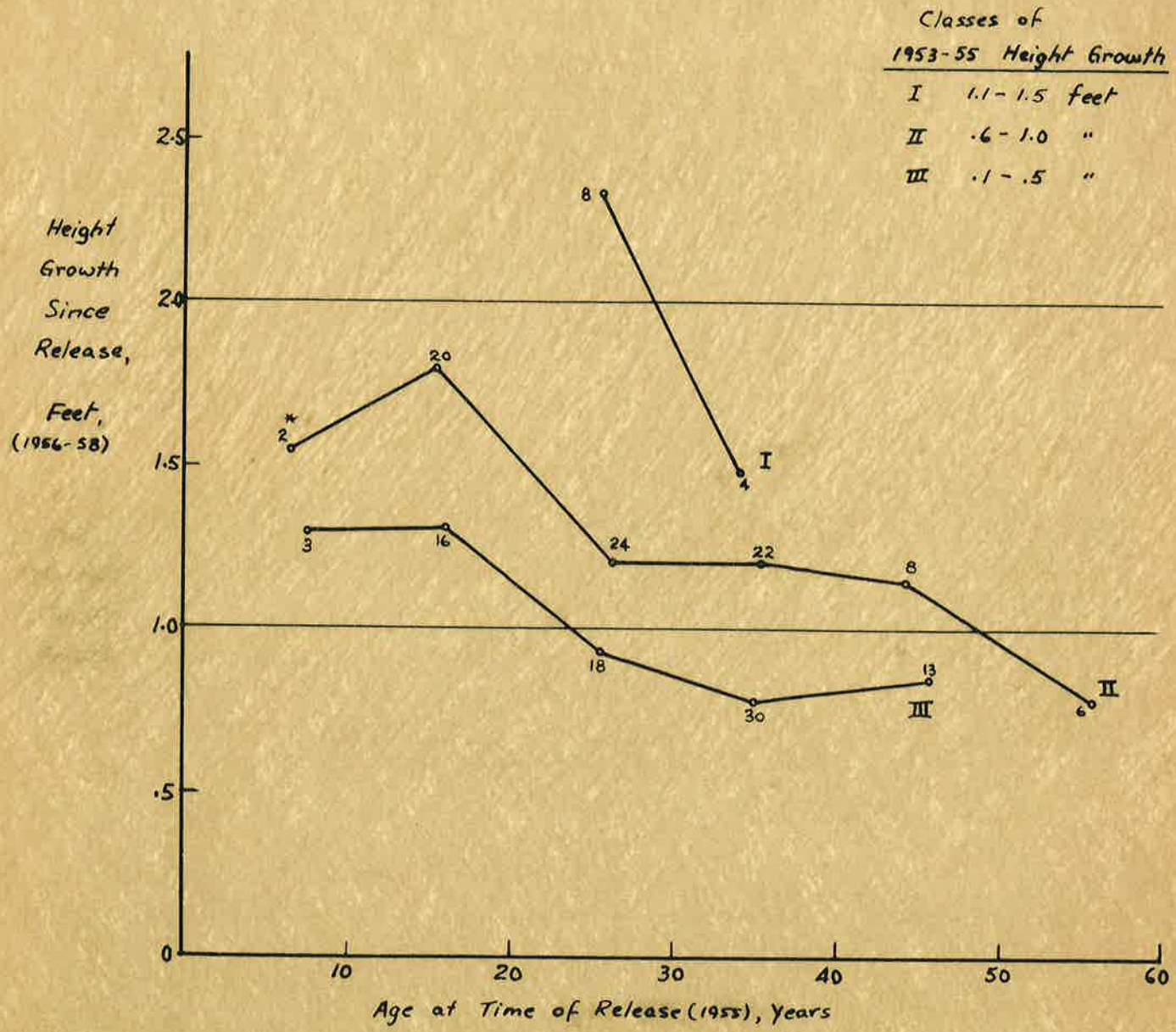

Figure 3. Relationship of height growth since release (1956-58) to age at time of release and height growth previous to release, Lake Edward

* Number of samples

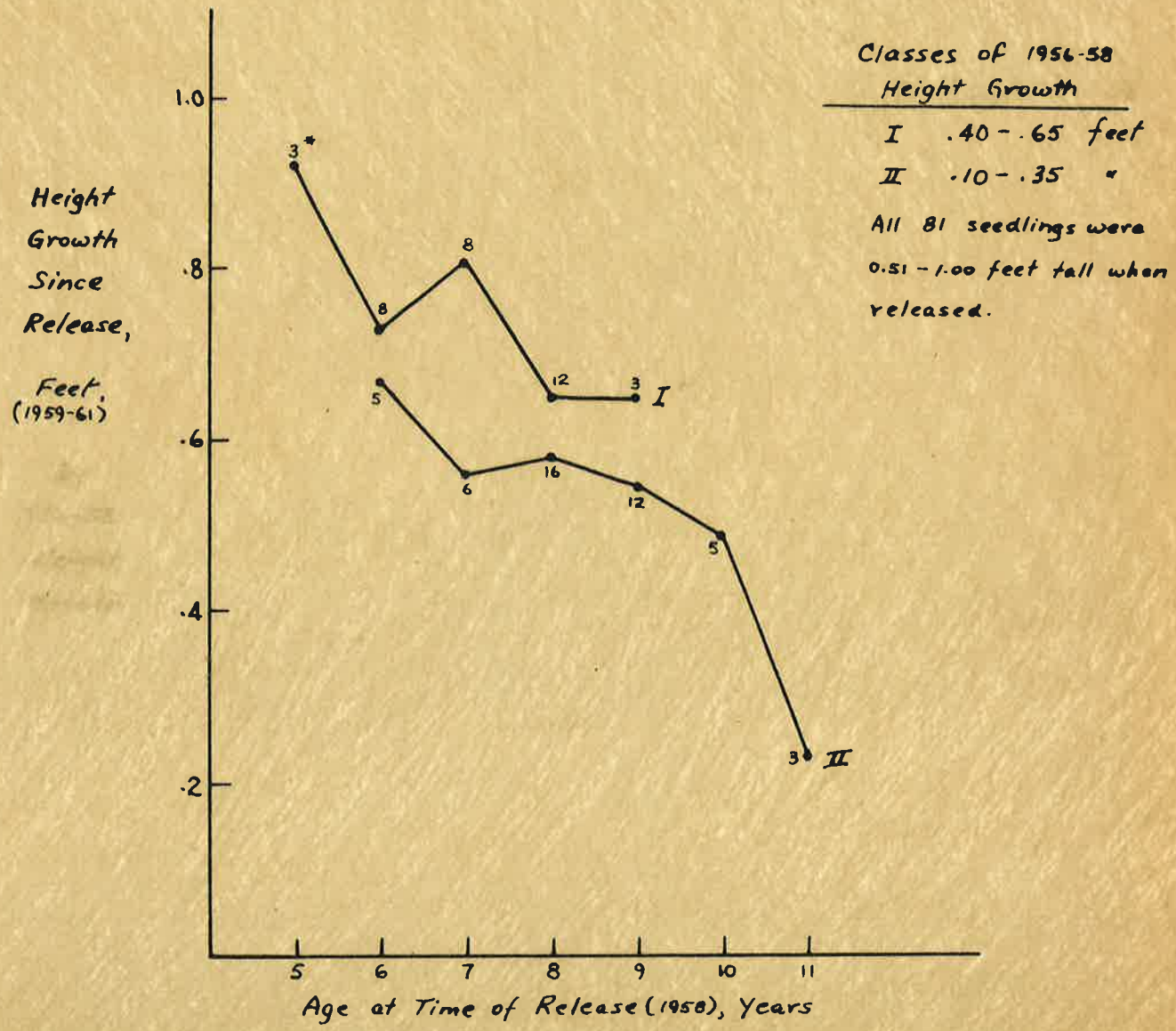

Figure 4. Relationship of height growth since release (1959-61) to age at time of release and height growth previous to release, Epaule River

* Number of samples

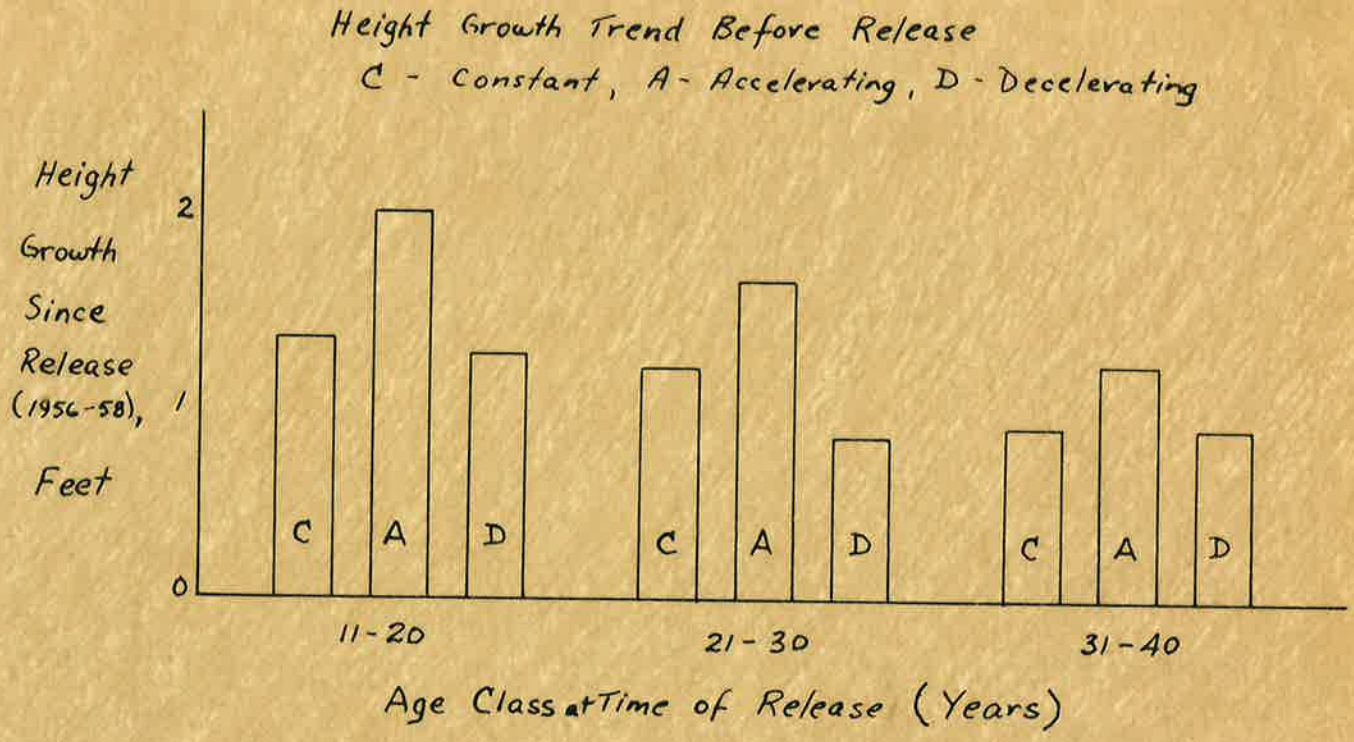

Figure 5. Relationship of height growth since release to pre-release growth trend, by age classes, Lake Edward

TABLE 1. RELATIONSHIP OF THE PROMPTNESS OF DIAMETER AND HEIGHT GROWTH RESPONSE TO RELEASE, TO SEEDLING AGE JUST PRIOR TO RELEASE, LAKE EDWARD.

Age Class Prior to Release (1955) Years	Number of Samples	Cumulative Frequency of Seedling Response, Per Cent					
		Diameter Growth			Height Growth		
		Year of Response Following Release					
		1st	2nd	3rd	1st	2nd	3rd
1-10	7	43	100	100	43	72	100
11-20	38	34	79	97	29	82	98
21-30	51	25	51	80	20	44	76
31-40	58	17	39	89	9	35	73
41-50	25	16	36	84	20	32	80
51 +	14	7	50	79	0	0	71
TOTAL	193 4/	23	53	88	18	44	80

4/ Two samples never suppressed, and four samples of doubtful age were omitted.