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PROGRESS REPORT

SPRUCE BUDWORM DAMAGE TO IMMATURE BALSAM FIR STANDS, QUEBEC

(Project Q-33)

by

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INTRODUCTION

Forest entomologists seem to agree that during an outbreak of the spruce budworm, in general a greater defoliation and fir mortality occur in mature and overmature stands than in immature and young stands. While the literature provides irrefutable evidence that mature and overmature fir forests are more susceptible to budworm outbreaks, the fact remains that a greater vulnerability of mature stands to damage remains to be verified by field study over an extensive area.

Thus the severe damage discovered in 1961 throughout a 3-square-mile young fir forest on the Vermillion River [2/] was of considerable interest, and resulted in the decision to remeasure a second area of immature fir that had been damaged by the budworm, and whose scheduled 1959 remeasurement had been deferred because of the insect attack.

The following pages report on the state of a 350-acre dominantly balsam fir forest in 1949 and 1963, and provides an idea of the damage caused by a spruce budworm outbreak which may have begun as early as 1946 and which had caused light to moderate defoliation by 1949.

THE STUDY AREA

The forest studied is in the Cyriac River Observation Area which was established in 1949 about 30 miles south of Chicoutimi, Quebec (48°05'N, 71°20'W), in Forest Section B.1a. The spruce budworm had caused noticeable

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2/ Hatcher, R.J. 1963. Spruce budworm damage to balsam fir in immature stands, Quebec. Canada, Dept. of Forestry Mimeo Report 63-Q-15 (revised).

defoliation by 1949 and, according to the establishment report[3/], may have been feeding since 1946.

Salvage logging began in the area in the mid-fifties because of high fir mortality from the spruce budworm. The logging included many stands of immature fir that were seemingly being destroyed along with the mature stands. Much of the Observation Area was logged.

About 350 acres of dominantly even-aged fir forest that followed a clear-cut in 1924 was not logged in the recent salvage cutting, and the 33 tenth-acre systematically spaced square line plots therein were re-measured in August 1963. This forest was classified in 1949 as the spruce-fir-white birch cover type. The measurement consisted of a tally of living stems only, by one-inch diameter classes, and a stocked quadrat tally of regeneration on 10 milacres per plot.

RESULTS

The budworm caused heavy but irregular mortality through these 25-year-old stands. Many small stands were completely killed but many others seemed to survive relatively well. For the area as a whole, average fir stocking dropped from 3,531 stems per acre in 1949 to 815 in 1963 (Table 1). Addition of 142 white and black spruce stems provides a total conifer stocking of 957 stems per acre in 1963. Such stocking would be no cause for concern if it were of uniform distribution. However, a classification of plots by three arbitrarily selected spruce-fir stocking classes suggests that about a third of the area could be considered understocked in 1963 (Table 2).

3/ Ray, R.G. 1955. A report on the establishment of Observation Area No. 3, Cyriac River. Canada, Dept. Northern Affairs and National Resources, Forestry Branch Binder No. 1178.

An example of the worst damage inflicted by the budworm is provided by a pair of one-fifth acre sample plots established in 1949 to study the effect of thinning (Table 3). Fir stocking on the thinned plot dropped from the equivalent of 3,110 stems per acre in 1949 to 15 stems in 1963. On the control plot, the drop was from 6,520 down to 60.

A calculation made to estimate the volume loss caused by the budworm attack is shown in the following tabulation. The assumed annual growth potential of 60 cubic feet per acre was chosen after noting the 48 cubic feet per acre growth rate over the first 25 years since stand origin, and after examination of growth rates for similar but uninfested stands about 50 miles south of the study area[4/]. Growth rates were over 80 cubic feet per acre annually at stand age 30.

Estimated annual growth potential	60	cu. ft./acre
Years in study period	14	
Total potential growth to 1963	840	cu. ft./acre
1949 spruce-fir growing stock (Table 4)	1,211	cu. ft./acre
Projected 1963 growing stock	2,051	" " "
Actual 1963 growing stock (Table 4)	824	" " "
Total loss, 1949-63	1,227	" " "

Loss in cords (85 cu. ft./cord) for 350-acre study area: 5,040 cords.

A relative resistance of white and black spruce to severe damage and mortality is apparent (Tables 1 and 3), a finding which conforms to events in the budworm outbreak studies elsewhere. As in other areas, at least 5 years defoliation was necessary to cause extensive fir mortality.

4/ Current growth of balsam fir stands of age-class 30 on the Epaule River, P.Q., Canada, Dept. of Forestry, Forest Research Branch Binder No. 1905.

Results from the stocked quadrat survey tend to confirm that 1963 conifer stocking is somewhat low (Table 5). By Candy's regeneration standard 5/, 57 per cent spruce-fir stocking would be classed as moderate.

DISCUSSION

An estimated volume loss of over 5,000 cords within a small area of 350 acres is certainly thought-provoking, particularly when such immature stands as those studied are often reported to be more resistant to damage than mature stands. Admittedly, scattered young stands, relatively isolated in a vast forest of mature fir, are reported to be badly damaged. But the Cyriac study area, and the previously studied Vermillion River area, could hardly be classed as such because both are characteristic of the cut-over forest for miles around them!

Unfortunately the scattered mature and uneven-aged fir stands that might have been studied for comparison with these young stands were logged before the scheduled plot remeasurement. Thus these results do not shed much light on the question of relative resistance to budworm damage of different age stands. However, the conclusion at Vermillion River that forests of immature fir may suffer severe loss through budworm defoliation is certainly supported by the Cyriac study.

5/ Candy, R.H. 1951. Reproduction on cut-over and burned-over land in Canada. Canada, Dept. of Resources and Development, For. Res. Div., Silv. Res. Note No. 92.

Table 1. Number of Trees per Acre by Diameter Class, Species and Year

Species	Year	Number of Trees per Acre Diameter class-Inches												Total
		1	2	3	4	5	6	7	8	9	10	11	12	
Balsam Fir	1949	1475	1232	587	137	64	21	9	3	1	1	-	1	3531
	1963	171	277	201	89	40	22	9	3	2	1	-	-	815
Spruce	1949	31	41	51	18	7	7	2	2	2	-	-	-	160
	1963	20	24	26	21	18	14	8	6	3	2	1	-	142
White Birch	1949	139	127	56	9	2	1	-	2	1	1	1	-	338
	1963	34	103	110	58	32	8	3	2	-	-	1	1	352

Table 2. Frequency of Line Plots and Approximate Per Cent of Forest by Conifer Stocking Standard

	Number of Spruce and Fir Per Acre, 1963		
	< 500 Under Stocked	500-1500 Well Stocked	> 1500 Over Stocked
Number of Plots	12	17	4
Per Cent of Total	36	52	12

Table 3. Summary of Stand Tables for Two Fifth-Acre Sample Plots in Thinning Experiment

Measurement	Thinned Plot			Control Plot		
	Fir	Spruce	White Birch	Fir	Spruce	White Birch
			Number of Stems Per Acre			
1949						
Before Thinning	7650	15	310	-	-	-
After Thinning	3110	5	170	6520	0	475
1954	2830	10	145	5960	5	525
1963	15	10	110	60	5	375
			Basal Area, Sq. Ft. Per Acre			
1949						
Before Thinning	171	<1	6	-	-	-
After Thinning	102	<1	4	161	0	8
1954	113	1	4	166	1	10
1963	1	1	11	3	2	24

Table 4. Summary of Basal Area and Volume, per Acre, by Species and Year

Species	Basal Area, Sq. Ft.		Volume, Cu. Ft., One Inch D.B.H. and Over		Volume, Cu. Ft., Four Inches D.B.H. and Over	
	1949	1963	1949	1963	1949	1963
Fir	93	40	1,085	556	466	386
Spruce	9	16	126	268	92	250
Fir plus Spruce	102	56	1,211	824	558	636
White Birch	10	22	171	376	71	248
Yellow Birch	< 1	< 1	3	5	3	5
Total	112	78	1,385	1,205	632	889

Table 5. Summary of Stocked Quadrat Regeneration Survey, 1963

Size Class	Per Cent Stocked Quadrats					
	Fir	Spruce	Fir or Spruce	White Birch	Yellow Birch	All Species
Less than 0.6 Inch d.b.h.	34	5	34	8	< 1	34
0.6-3.5 inches d.b.h.	20	5	23	15	< 1	35
Total	54	10	57	23	1	69