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LONG RANGE EFFECT ON ASPEN OF DEFOLIATION BY THE FOREST TENT CATERPILLAR 1/

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In 1961, after an earlier comprehensive investigation (1) of the effects on aspen (Populus tremuloides Michx.) of defoliation by the forest tent caterpillar (Malacosoma disstria Hbn.) a second study was undertaken. The objectives were: to define the conditions, if any, under which aspen mortality could be attributed to defoliation; to ascertain whether increased disease or insect attack followed defoliation; to evaluate the effects of defoliation upon subsequent growth.

The original study started in 1953 with 8210 trees on 97 plots. Logging, fire, etc. reduced these to 80 plots which carried 4458 live aspens in 1955 and 3116 in 1961. Diameter measurements, vigor class ratings, and insect and disease observations were made for all trees in both studies. Growth measurements using increment cores taken at breast height were also made for five dominant trees on each plot. All dead trees on the 80 plots were tallied in 1961 by the most probable mortality-causing factors. Dead trees lacking any indication of cause of death were tallied under "unknown" which included death ascribed to suppression. Table 1 provides the percentage of trees living in 1955 that had died by 1961, classified according to probable cause of death, defoliation history, site and age.

TABLE 1. Causes of Tree Mortality in Relation to Defoliation History, Site and Age.

Category	Number of live trees in 1955	Percent of live trees (1955) killed between 1955 and 1961 classed by most probable cause of death							Total Percent Killed (1955-1961)
		Decay	Hypoxylon	Nectria	Insect	Wind	Mechanical	Unknown	
All trees	4458	0.4	5.4	0.6	1.1	0.3	1.7	20.6	30.1
History a/									
L	465	0	4.9	0	0.2	0.2	2.4	19.1	26.8
H-L	377	1.3	4.5	0	0	0.5	1.1	15.6	23.0
L-H-L	353	0.3	6.8	0.3	0.6	0.3	1.4	22.4	32.1
H-H-L	405	0	7.2	0	0.5	0	1.5	15.1	24.3
H-H-H	309	0.3	7.4	2.3	2.9	0	1.6	34.6	49.1
Site b/ c/									
Good	1267	0.3	5.1	0	2.2	0.3	1.9	18.9	28.7
Medium	2710	0.4	5.9	0.9	0.7	0.3	1.4	20.2	29.8
Poor	437	0	4.1	0.7	0.4	0.2	1.6	26.7	33.7
Age c/									
≤43 yrs.	2644	0.3	5.9	0.5	0.8	0.2	2.1	22.8	32.6
>43 yrs.	1770	0.4	4.9	0.7	1.6	0.3	0.8	17.1	25.8

a/ L = one year light defoliation   H = one year heavy defoliation (Not all histories are included.)

b/ Good = site index 73-87   Medium = site index 58-72   Poor = site index 43-57

c/ One plot on which age and site data were not available is omitted.

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The unknown class shows rather high mortality following three years of heavy defoliation. This unknown mortality increased with defoliation intensity in all but the suppressed crown class. Data for the suppressed crown class and for all others combined are shown in Table 2. A chi-square test infers that although mortality in the suppressed vigor class is unrelated to defoliation history, mortality in other vigor classes is significantly related beyond the 0.005 level.

TABLE 2. Unknown Tree Mortality by Vigor Class as Related to Defoliation History

Defoliation History	Vigor Class: Suppressed Total Number	Suppressed Percent Dead	Intermediate, Codominant and Dominant Total Number	Intermediate, Codominant and Dominant Percent Dead
L	150	55.3	315	1.9
H-L	112	40.1	265	5.3
L-H-L	80	60.0	273	11.3
H-H-L	93	44.1	312	6.4
H-H-H	62	54.8	247	29.5
TOTAL	497	50.5	1412	10.2

Annual basal area growth was computed from the 1961 increment core measurements for the three years preceding defoliation and for the 1st, 2nd, and 3rd year after cessation. Variation due to previous basal area growth, to precipitation, to age, and to site quality as measured by site index were removed through analysis of covariance. Means so adjusted and classified by years following defoliation cessation and by defoliation histories are shown in Figure 1 and tests of significance were made among these adjusted means.

In the first year after cessation the H-H-H history showed a significantly smaller basal area growth than the L, H-L, and L-H-L defoliation histories. No significant differences were found among the mean basal area growths for the second year after cessation of defoliation. Basal area growth in the third year after cessation was found to be significantly greater for the H-H-H history than for the L history with no significant differences among the other histories.

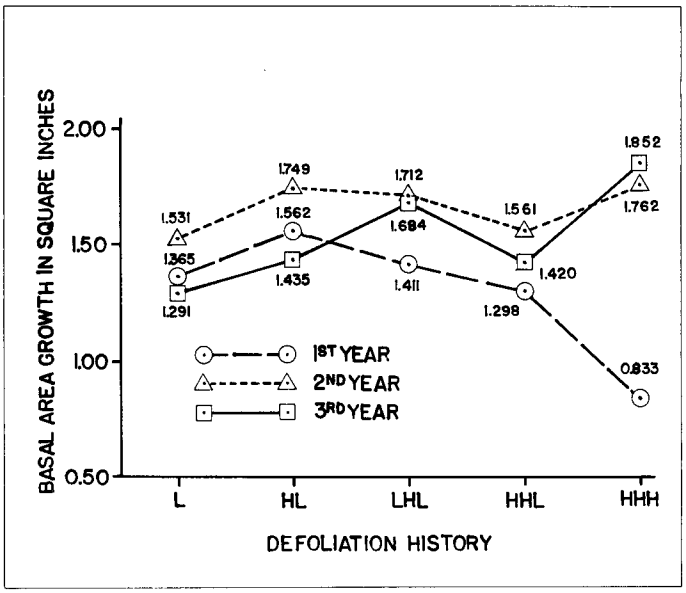

FIGURE 1. Basal Area Growth on Dominant Trees Related to Defoliation.

The recovery of growth after cessation of defoliation appears to take one growing season in the most severe cases of defoliation studied. During the second growing season after cessation of defoliation there was no apparent effect of defoliation upon basal area growth. These findings substantiate the results of the previous study published in 1958. The increased growth of dominants during the third year after defoliation in those stands having a history of three consecutive years of heavy attack may be the result of higher mortality in these stands.

(1) Duncan, D. P. and A. C. Hodson. 1958. Influence of the forest tent caterpillar upon the aspen forests of Minnesota. Forest Science, 4:71-93.

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