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# TECHNICAL NOTES

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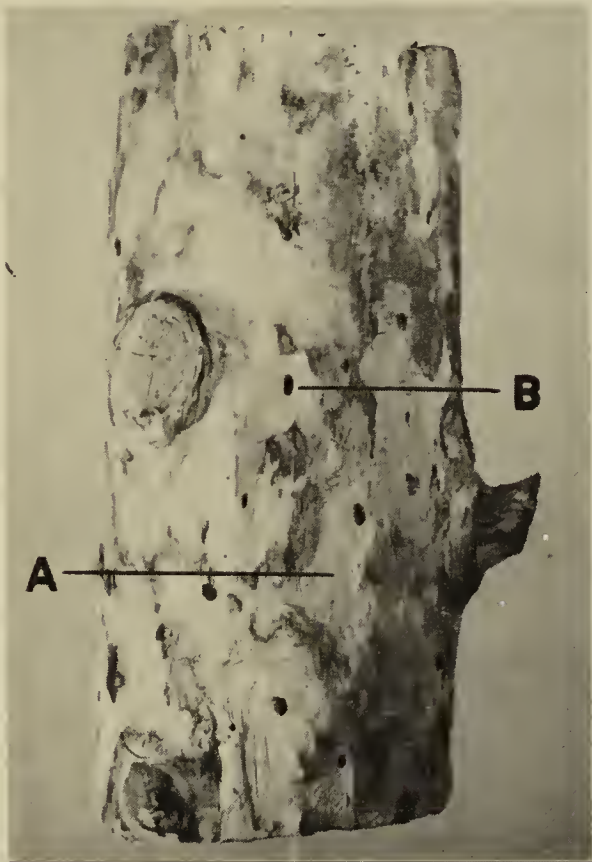
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LAKE STATES FOREST EXPERIMENT STATION  
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No. 599

## Calculating Volume Loss in Balsam Fir Pulpwood from Wood-Boring Insects

Studies conducted in northern Minnesota revealed that over 95 percent of the long-horned beetles (Cerambycidae) attacking balsam fir pulpwood were species of Monochamus. The larvae of these beetles, when young, feed upon the inner bark, cambium, and outer sapwood of weakened or dead trees and pulpwood, and form shallow excavations called surface galleries (fig. 1-A). As the larvae grow older, however, each bores a deep tunnel from its surface gallery into the heartwood. The oval-shaped entrance holes (fig. 1-B) to the tunnels are conspicuous and easily recognized when the bark is removed.



Seventy pulpwood sticks were examined after the insects had emerged, to determine the volume loss from Monochamus feeding. The volume loss in each stick was calculated by a method devised by the author<sup>1/</sup>. The number of insects that had been present was determined by counting the number of entrance holes. A graphic analysis showed a good correlation between the number of entrance holes per stick and the percent volume loss per stick. The calculated regression line of this graph was used to derive table 1.

It must be stressed that volume loss varies directly with the amount of insect feeding (i.e., the more the insect feeds the more damage it causes). To get maximal volume loss, only those sticks should be examined in which insect feeding has terminated. Since studies have shown that Monochamus spp. need about 23 months to develop in the northern United States and southern Canada<sup>2/</sup>, examinations should be made on sticks that have been cut at least two seasons prior to the time of sampling (i.e., sticks examined in the fall of 1961 must have been cut no later than midsummer of 1960; sticks examined in the spring of 1961 must have been cut no later than mid-

Figure 1.--Section from balsam fir bolt showing: A, surface galleries; B, entrance hole to tunnel.

summer of 1959). When this criterion has been established, volume loss may be calculated as follows:

1/ Wilson, L. F. Insect damage to field-piled pulpwood in northern Minnesota. Unpublished manuscript in files of Lake States Forest Experiment Station. 1961.

2/ Belyea, R. M. Death and deterioration of balsam fir weakened by spruce budworm defoliation in Ontario. Part I: Notes on the seasonal history and habits of insects breeding in severely weakened and dead trees. *Canad. Ent.* 84: 325-35. 1952.

(Over)

Table 1.--Percent volume loss from Monochamus borings for various sized pulpsticks determined by the number of entrance holes per stick<sup>1/</sup>.

Number of: entrance holes per 100" stick	Average diameter of balsam fir stick (inches)													
	3	4	5	6	7	8	9	10	11	12	13	14	15	
5	.4	.3	.3	.2	.2	.2	.2	.2	.2	.2	.1	.1	.1	
10	.7	.5	.5	.4	.3	.3	.3	.3	.3	.2	.2	.2	.2	
15	1.0	.8	.6	.5	.5	.4	.4	.3	.3	.3	.3	.3	.3	
20	1.3	1.0	.8	.7	.6	.5	.5	.5	.4	.4	.4	.3	.3	
25	1.6	1.2	1.0	.8	.7	.6	.6	.5	.5	.5	.4	.4	.4	
30	1.9	1.4	1.2	1.0	.9	.8	.7	.7	.6	.5	.5	.5	.4	
40	2.5	1.9	1.5	1.3	1.1	1.0	.9	.8	.7	.7	.6	.6	.6	
50	3.1	2.3	1.9	1.6	1.4	1.2	1.1	1.0	.9	.8	.8	.7	.7	
60	3.7	2.8	2.3	1.9	1.6	1.4	1.3	1.2	1.1	1.0	.9	.9	.8	
70	4.2	3.3	2.6	2.2	1.9	1.7	1.5	1.4	1.2	1.1	1.1	1.0	.9	
80	4.9	3.7	3.0	2.5	2.1	1.9	1.7	1.5	1.4	1.3	1.2	1.1	1.0	
90	5.5	4.1	3.0	2.8	2.4	2.1	1.9	1.7	1.6	1.4	1.3	1.2	1.2	
100	6.1	4.6	3.7	3.1	2.7	2.3	2.1	1.9	1.7	1.6	1.5	1.4	1.3	
110	6.7	5.0	4.1	3.4	2.9	2.6	2.3	2.1	1.9	1.7	1.6	1.5	1.4	
120	7.3	5.5	4.4	3.7	3.2	2.8	2.5	2.3	2.1	1.9	1.8	1.6	1.5	
130	7.9	5.9	4.8	4.0	3.4	3.1	2.7	2.4	2.2	2.0	1.9	1.8	1.6	
140	8.5	6.4	5.1	4.2	3.7	3.3	2.9	2.6	2.4	2.2	2.0	1.9	1.8	
150	9.1	6.7	5.5	4.6	4.0	3.5	3.1	2.8	2.5	2.3	2.2	2.0	1.9	

<sup>1/</sup> Values over 5 percent were calculated on the basis of the pattern established for the lower values, but no observations on losses were made in this area.

1. The bark should be removed from the samples.
2. The number of entrance holes and the average diameter (inches) of each 100-inch stick should be recorded.
3. The values from step 2 are used in table 1. The resultant number in the table gives an approximate percent volume loss for 100-inch pulpsticks.

Samples can be examined in the field or in the pulpyard, and those in the yard may be sent through the debarker prior to counting entrance holes. The number taken for samples may vary, but several sticks should be examined to get an average volume loss. Two or three sticks per cord will suffice if a small pile is sampled, while one stick per 1 or 2 cords is enough for large yard piles. As a general rule, a 100-stick sample will give an estimate within one-half of one percent. It should be noted that sticks on the outside of the piles are more vulnerable to attack by wood borers than those on the interior. Therefore both exterior and interior sticks should be sampled in proportion to their numbers.