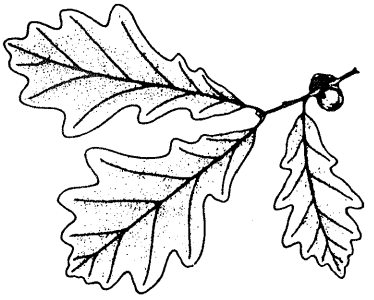
OAK SAWTIMBER LOSSES IN STANDS DEFOLIATED BY GYPSY MOTH[1,2]

David E. Donley[3] and David L. Feicht[4]



ABSTRACT.--Between 1978 and 1982, the "front" of defoliation by the gypsy moth, Lymantria dispar (L.), swept over central Pennsylvania. In the 5-year period, defoliation of individual stands was neither complete nor continuous but most of the study areas were defoliated at a level of over 50% for at least 2 years. In 1983, more than half the trees on some 6000 acres died. Oak volume and value estimates were obtained from salvage sale data and a series of prism point samples collected in 1983 and 1984. Dead oak volume ranged from 3.5 to 11.0 Mbf per acre. Values ranged from a low of $281 an acre to a high of $914. Dead oak trees averaged 246 board feet per tree. Timber buyers are biased against dead trees, which appears justified because trees dead more than 2 years are riddled with galleries of the oak timberworm, Arrhenodes minuta Drury.

INTRODUCTION

Losses from gypsy moth defoliation have been estimated in various forests throughout the infested area for over 100 years (Baker 1941; Campbell and Valentine 1972; Corliss 1955; Kegg 1971, 1973; Nichols 1961; Stephens 1971). The vastly different parameters used in these studies to report damage preclude comparison, but they agree that oak mortality is high in areas recently invaded by the gypsy moth. However, most of these estimates were made on the basis of tree mortality without considering salvage. Lumber recovery from dead oak trees has been found to decrease with time after the trees died (Garges et al. 1984). These losses were attributable to decay and drying checks in the sapwood. Losses in grade were attributable to decay, surface checks in sawn boards, and wood borer damage. A study was initiated to quantify losses in these salvage areas, and preliminary work was done toward identifying secondary wood borers responsible for further deterioration of dead timber.

METHODS

The data for this report were collected from the Tuscarora State Forest, nearby State Game Lands, the Colonel Denning State Park, and several private forest holdings adjacent to these public lands in central Pennsylvania. The Tuscarora State Forest contains more that 90,000 acres of mixed oak forests, including some of the most extensive and highest quality oak stands in the state (Pennsylvania Bureau of Forestry 1983).

Twenty-three salvage sale areas on the Tuscarora State Forest, for which complete economic assesment data were available, and 16 salvage sale areas on other public and private lands, for which economic assessment data were not available, were examined. The sizes and species of dead trees were determined from prism point samples. This report uses information from red, black, scarlet, white and chestnut oaks. In all, 4638 acres were sampled. All of the salvage areas were selected from aerial photos in which more than 50% of the trees were adjudged dead. All of them were Class 1 timber

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[1]Lepidoptera:Lymantriidae

[2]A paper presented at the Fifth Central Hardwood Forest Conference held at Urbana, Illinois on April 15-17, 1985.

[3]David E. Donley, Research Entomologist, Northeastern Forest Experiment Station, USDA Forest Service, Morgantown, WV 26505, retired.

[4]David L. Feicht, Biological Technician, Northeastern Forest Experiment Station, USDA Forest Service, Morgantown, WV 26505.

management areas.

Although no attempt was made to separate the losses caused by borers from those caused by other agents, an attempt was made to identify the primary wood borers responsible for the degrade over time. To accomplish this, standing dead trees and logs on landings or in mill yards were examined for insect damage and decay. Some standing trees were peeled to a height of 16 feet and each wood borer attack located and recorded. Larvae, pupae, and adults were chopped from galleries and collected from sections being cut for firewood. Tree sections were transported to the laboratory and held there until the insects emerged. Immature insects were reared in the laboratory on standard artificial diet.

There are some differences among host tree species in the wood volume damaged by borers, but no analysis for statistical significance was attempted because the samples in some species and size class combinations were too small.

A number of timber and log buyers were asked to scale individual standing dead trees or logs that ranged from 54 board feet to 780 board feet and assign dollar values to them. Trees in the sale areas had been dead from 1 to 4 years and included red, black, scarlet, white, and chestnut oaks.

RESULTS AND DISCUSSION

Volume and value estimates for the sales are summarized in Tables 1 and 2. In general, the value estimates were based on current stumpage values of $80 to $85/Mbf. Most buyers prefered white oak and were less interested in buying sale areas dominated by black and scarlet oak.

The private lands and other public lands used in this study are very similar to the Tuscarora State Forest. A comparison of the average volume and value data from these areas showed no significant differences (Table 3). Between 1978 and 1982 the gypsy moth defoliation "front" swept over the general area. Peak defoliation occurred in 1981, followed by a general decline in defoliation thru 1983, when almost no defoliation could be detected from aerial surveys. Although defoliation of individual stands was neither complete nor continuous, most of the area was more than 50% defoliated for at least 2 consecutive years. In 1983, tree mortality was over 50% on some 6,000 acres of the Tuscarora State Forest (Pennsylvania Bureau of Forestry 1983). Aerial mapping and U-2 flight photos were used to detect dead timber.

Timber buyers and mill operators in the area estimated that annual oak harvest and utilization had ranged from 2 to 5 million board feet over the previous 5 years, from an area of about 1 million acres. In just 1 to 2 years after defoliation, about 27 million board feet of insect-killed timber were available.

If no salvage sales had taken place, the values in Tables 1 and 2 would be losses, as was the case

TABLE 1.--Dead oak volumes and values in salvage sale areas on the Tuscarora State Forest.

Sale area	Acres	Mean Vol./Tree (bd. ft.)	Vol./Acre (M bd. ft.)	Mean Value/Acre ($)	Total Vol./ Sale Area (M bd. ft.)	Total Value/ Sale Area[a] ($)
1	248	260	4.9	411	1215.2	101,928
2	156	277	6.9	611	1076.4	95,316
3	230	238	6.7	883	1541.0	203,090
4	244	258	4.3	347	1049.2	84,668
5	171	266	6.5	553	1111.5	94,563
6	82	248	3.5	307	287.0	25,174
7	133	277	7.1	605	944.3	80,465
8	50	226	5.8	509	290.0	25,450
9	41	165	4.1	335	168.1	13,735
10	221	182	3.9	341	861.9	75,361
11	58	219	5.0	438	290.0	25,404
12	26	331	7.3	673	189.8	17,498
13	175	290	9.3	808	1627.5	141,400
14	115	263	6.6	513	759.0	58,995
15	90	208	4.7	382	423.0	34,380
16	48	267	5.9	522	283.2	25,056
17	27	257	11.0	914	297.0	24,678
18	40	241	8.4	736	336.0	29,440
19	40	210	8.4	636	336.0	25,440
20	109	255	6.3	510	686.7	55,590
21	21	293	4.9	401	102.9	8,421
22	71	296	3.8	343	209.8	24,353
23	425	242	7.7	593	3272.5	252,025

[a]Without salvage these values would be losses.

TABLE 2.--Dead oak volumes and values in salvage sale areas from non-state forest lands

Sale area	Acres	Mean Vol./Tree (bd. ft.)	Vol./Acre (M bd. ft.)	Mean Value/Acre ($)	Total Vol./ Sale Area (M bd. ft.)	Total Value/ Sale Area[a] ($)
1	22	300	4.6	391	101.2	8,600
2	228	173	6.7	603	1527.6	137,484
3	68	219	3.3	281	224.4	19,108
4	318	251	3.9	352	1240.2	111,936
5	129	230	7.2	612	928.8	78,948
6	145	266	5.7	485	826.5	70,325
7	37	291	3.4	292	125.8	10,804
8	93	263	6.0	486	558.0	45,198
9	186	154	4.4	374	818.4	69,564
10	25	285	8.2	697	205.0	17,425
11	71	272	9.3	818	660.3	58,078
12	46	228	5.8	487	226.8	22,402
13	44	246	4.5	383	198.8	16,852
14	240	215	6.1	525	1464.0	126,000
15	30	282	4.8	408	144.0	12,240
16	135	197	5.0	425	675.0	57,375

[a]Without salvage these values would be losses.

where no timber was salvaged and mortality reached 30% to 50%. These were permanent losses. Prompt salvage sales decreased the losses on defoliated stands.

The bias shown by buyers against dead wood is summarized in Figure 1. It is undoubtedly the result of past experience but is difficult to partition by cause. Undoubtedly some of it can be attributed to secondary wood borers. Although many species of wood borers were reared from trees that had been dead for 1, 2, 3, or 4 years, the most common were: from trees dead up to 1 year: ambrosia beetles; the twolined chestnut borer, Agrilus bilineatus Web.; and the cerambycid, Urographis fasciatus DeGreer; from trees dead from 1 to 2 years: these plus the cerambycid Sarosesthes fulminans Fab. From trees dead 2 to 3 years (and some dead 4 years), the most common new borer attack was by the oak timberworm, Arrhenodes minuta Drury.

Examination of trees dead for more than 4 years indicates that a sequence of borers attack dead trees until the trees are almost completely decayed. This has been reported elsewhere (Craighead 1928, Linsley 1959).

The forced liquidation of our oak forest in response to defoliation by the gypsy moth on prime oak timber production sites does not alter the annual oak harvest from the Pennsylvania hardwood forest by very much, but for the owners of some Pennsylvania forest stands the timber loss was extreme. The average value lost to gypsy moth in killed timber in Pennsylvania from 1971 to 1983 was $26 per acre (Pennsylvania Bureau of Forestry 1983). The average value loss on these study plots was $507 per acre, with an average tree volume of 246 board feet per tree, indicative of the size of trees that are dying as well as the productivity of these sites. Wood borers, among the many agents that cause trees to deteriorate after gypsy moths have killed them, create cummulative damage and make prompt salvage of oak stands behind the gypsy

TABLE 3.--Comparison of dead oak volumes and values in salvage sale areas from state forest and non-state forest lands.

Ownership	Number of Sale Areas	Mean Volume/Tree (bd. ft.)	Volume/Acre (M bd. ft.)	Mean Volume/Acre ($)
State Forest	23	251	6.2	538
Non-State Forest	16	242	5.6	476
t-value[a]		0.431 ns	0.369 ns	0.728 ns

[a]t-test for unpaired means
ns = not significant at alpha = 0.05 level

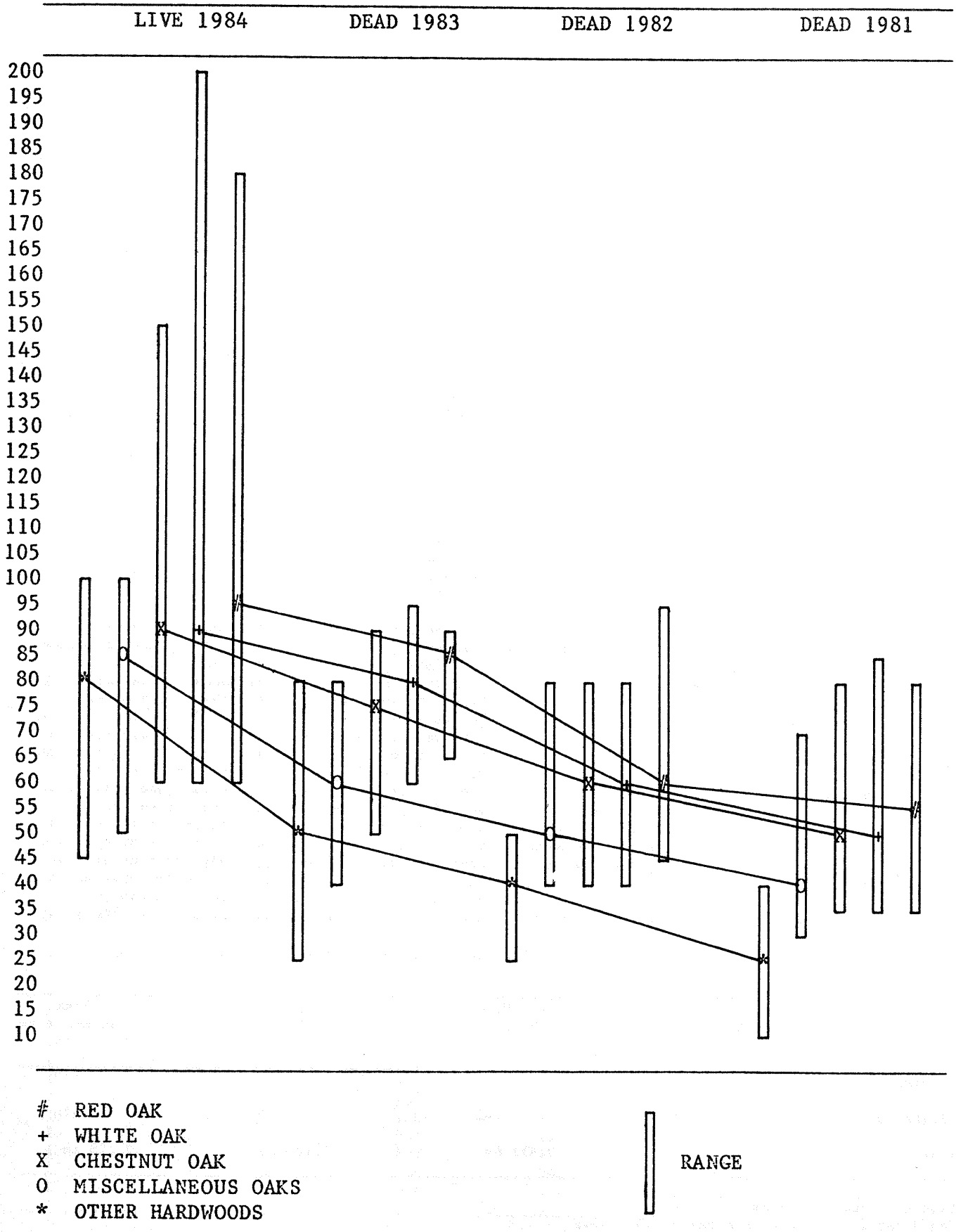

FIGURE 1.--Stumpage value estimates for hardwoods in dollars per thousand

moth defoliation front important.

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