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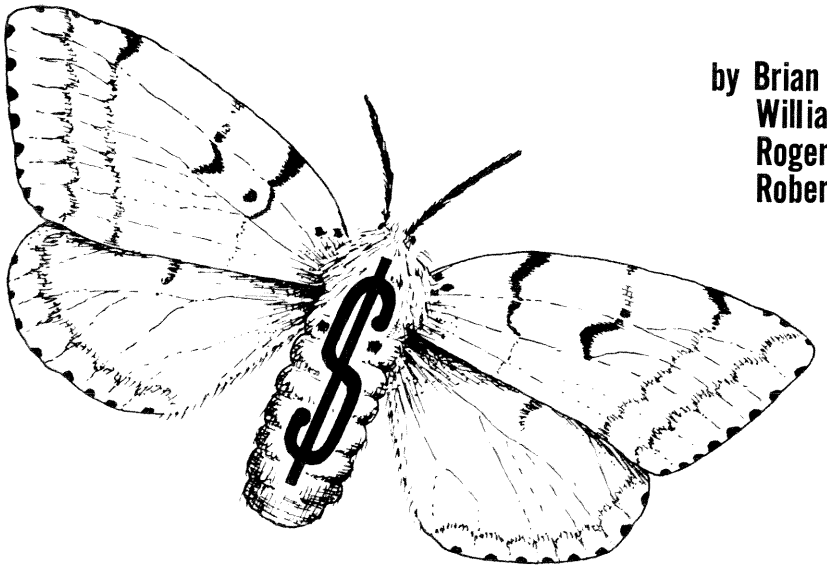
Economic Analysis of the Gypsy Moth Problem in the Northeast

II. Applied to Residential Property



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ABSTRACT

Guidelines are presented for determining dollar losses in residential property values from tree mortality caused by the gypsy moth. The method is based on an earlier study in Amherst, Massachusetts, of the contribution of trees to property values. For each target area, the method requires data on property value, lot size, and number of trees 6 inches dbh and larger for a sample of residential properties. Also required are predictions of tree mortality from a gypsy moth attack.

INTRODUCTION

THE GYPSY MOTH is an important insect pest affecting trees throughout the northeastern United States. It is particularly destructive in residential areas, where the value of trees for their production of amenities exceeds their value for conversion into wood products. Rational pest control decisions require knowledge of the economic impact of pest attacks, but a measure of the dollar value of trees in residential areas is difficult to obtain. This paper presents a method for evaluating the dollar loss in residential property values from tree mortality caused by the gypsy moth.

The method presented here is based on only one study, and its use is restricted by several assumptions detailed below. Thus, the value estimates this method produces are probably not accurate in many specific locations affected by the gypsy moth. At the same time, the estimates are expected to prove reasonably accurate in the many forested residential areas where this evaluation method is appropriate for use. Until now, no sound method has been available to quantify expected value losses there, and such estimates are urgently needed by federal, state, and local agencies to improve gypsy moth control decisions.

MEASURING THE CONTRIBUTION OF TREES TO PROPERTY VALUES

The value of trees in residential areas cannot be determined simply by examining market-established prices. Except in limited quantities and in the smallest sizes, these trees are not bought and sold separately from the property on which they grow. The value of trees for conversion into paper, lumber, or firewood is not appropriate for trees that are valuable primarily for their shade and other microclimatic benefits and for their aesthetic contributions. But, to a considerable extent, these benefits contribute to residential property values. This contribution can be measured by comparing the values of properties that have similar characteristics except for their tree cover.

A recently completed study[1] has measured the contribution of trees to residential property values in Amherst, Massachusetts. There, trees contribute an average of 7 percent and as much as 15 percent to the value of $25,000 to $50,000 homes on lots averaging 20,000 square feet. This contribution comes only from trees 6 inches dbh and larger. The relationship of value contributed by trees (V) to number of trees 6 inches dbh and larger (t) has the following form:

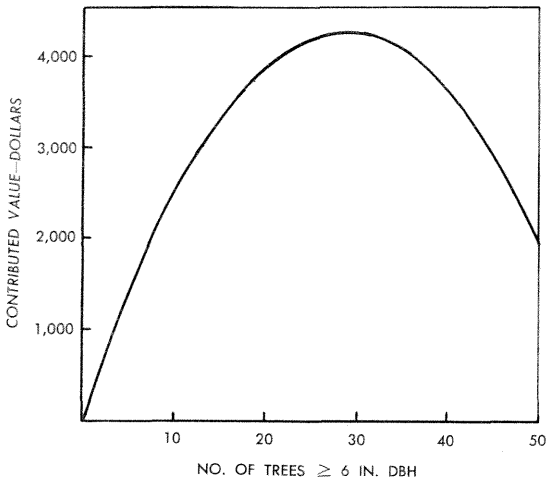
$$V = 300\,t - 5.22\,t^2 \text{ for } 0 < t < 50, \text{ and}$$
$$V = 1950 \text{ for } t \geq 50$$

Thus, value added by trees increases at a decreasing rate to a maximum value of $4,310 with 29 trees (fig. 1). Because the Amherst study included no properties with more than 50 six-inch and larger trees, the curve shown in figure 1 is truncated at that point, and the value contributed by 50 or more trees is assumed to be a constant $1,950. The values shown in figure 1 are listed in table 1 as an aid in calculating pre-attack and post-attack tree values.

To test the predictive ability of the Amherst property value equations and to develop a method for applying one or more of these equations to the estimation of losses caused by the gypsy moth, we selected a sample of properties near Stroudsburg, Pennsylvania, an area

[1]Payne, Brian R. (unpublished) The contribution of trees to residential property values in Amherst, Massachusetts. (Manuscript in process; Study Plan on file, USDA Forest Service, Northeastern Forest Experiment Station, 101 Flint Laboratory, University of Massachusetts, Amherst.)

Figure 1.—Contribution of trees to property value on lots averaging 20,000 square feet.



heavily infested with gypsy moths. Time and manpower limitations prevented a replication of the Amherst study; thus, we assumed that the coefficients for independent variables were applicable in Stroudsburg, and we tested the predictive ability of the entire equation. The range of property values was wider in Stroudsburg than in Amherst, as low as $7,000 and as high as $42,000. Although the Amherst equations overvalued properties at the low end of this range and undervalued properties at the high end, the average predicted value was nearly identical with the average observed value. Furthermore, the percentage of property value contributed by trees was within the range found in the Amherst study.

The field methods and calculation procedures developed as a result of the Stroudsburg test are presented below as a set of guidelines.

GUIDELINES FOR CALCULATING VALUE LOSSES

Loss of property value from tree mortality caused by the gypsy moth is predicted by (1) calculating the pre-attack value of trees, (2) predicting tree mortality from a specified level of gypsy moth attack, and (3) calculating the post-attack value of the remaining trees. Value loss is the difference between pre-attack and post-attack values.

This method assumes that the results of the Amherst study can be applied directly to the target area for which value loss estimates are to be made. Therefore, the method should be used only for residential property, that is, for lots with houses on them. Ideally, trees should be well distributed on each property rather than massed in only one area. Individual lot sizes should not be much smaller than ¼ acre or much larger than 1 acre, and the observed number of trees must be adjusted to a 20,000-square-foot lot-size basis. If possible, the value of properties should not be less than $25,000 or more than $50,000.

Collect Field Data

For each target area, select a sample of residential properties, and collect the following data for each property.

(1) Fair market value.
(2) Lot size in square feet.
(3) Number of trees 6 inches dbh or larger.
(4) Data required to predict tree mortality from gypsy moth attack.

The number of properties selected for the sample will depend on the precision of estimation desired and the inherent variability of the population being sampled. Calculate sample size following standard statistical practice; see, for example, Freese *(1967)* or consult a statistician.

Fair market value estimates are needed for two reasons: (1) to determine whether properties fall within the $25,000 to $50,000 range as in the Amherst study, and (2) to calculate the percentage contribution of trees to property value, as a check on the reasonability of the absolute values calculated.

The fair market value of each property is the value that it would bring if sold. Recent selling prices will not be available for most properties. However, local real estate appraisers can be asked to estimate the current value of each sample property. Depending on his knowledge of the local market, an appraiser should be able to estimate value fairly accurately by visiting each property for a few minutes but without entering the houses.

Interviewing homeowners is an alternative means of determining property values, but this method is more expensive and will produce less consistent results than realtor appraisals. Assessed values are relatively easy to obtain,

but they are generally poor estimates of current fair market values.

Lot size in square feet can be obtained by pacing property lines, by examining subdivision plans, or by identifying and measuring properties on large-scale aerial photographs.

Number of 6-inch or larger trees can be obtained by simple count with an "eyeball estimate" of minimum diameter. On many lots, this count can be made while pacing boundary lines. With more than 50 six-inch or larger trees per 20,000 square feet (approximately ½ acre), estimate their number to the nearest 5 or 10 trees.

Additional field data may be required to predict mortality from gypsy moth attack. Such predictions are outside the scope of this report, but a later paper in this series will provide a method of mortality estimation based on tables developed by Campbell and Valentine *(1972)*. Use of their tables requires observation of stand condition, tree species and dominance class, and a knowledge of an area's past history of attack.

Calculate Pre-Attack Value of Trees

To calculate the pre-attack value of trees for each property, adjust the observed number of 6-inch and larger trees to a 20,000-square-foot lot-size basis, using the following formula:

$$AT = OT\left[\frac{20{,}000}{LS}\right]$$

where: AT = adjusted number of trees
OT = observed number of trees
LS = observed lot size in square feet

Use table 1 to find the dollar value of the adjusted number of trees.

As a check on the reasonability of the values taken from table 1, calculate the percentage that trees contribute to the value of each property. If a substantial number of these exceed 15 percent, or if the average for all sample properties exceeds 15 percent, the values in table 1 are probably too high and should be adjusted downward. This problem is likely to occur with low valued properties, those below $25,000.

Observed and calculated values for lot size, number of trees, and tree values can be entered in a table similar to that shown in table 2.

Calculate Post-Attack Value of Trees

To calculate the post-attack value of trees, estimate the percentage or number of trees on each sample property that would be killed by a specified gypsy moth attack. Such an estimate may be based on field studies that accurately predict expected mortality, or it may be a best guess based on judgment and experience. Or, several levels of mortality may be postulated and the value of losses calculated for each level.

Enter estimated mortality of trees 6 inches and larger in column 6 of table 2. Subtract this number from the observed pre-attack number

Table 1.—Contribution to residential property value from trees 6 inches dbh and larger

No. of trees	Dollar value	No. of trees	Dollar value	No. of trees	Dollar value
0	$ 0	17	$3,590	34	$4,160
1	290	18	3,710	35	4,100
2	580	19	3,810	36	4,030
3	850	20	3,910	37	3,950
4	1,120	21	4,000	38	3,860
5	1,370	22	4,070	39	3,760
6	1,610	23	4,140	40	3,650
7	1,840	24	4,190	41	3,520
8	2,070	25	4,240	42	3,390
9	2,280	26	4,270	43	3,250
10	2,480	27	4,290	44	3,090
11	2,670	28	4,310	45	2,930
12	2,850	29	4,310	46	2,750
13	3,020	30	4,300	47	2,570
14	3,180	31	4,280	48	2,370
15	3,320	32	4,250	49	2,160
16	3,460	33	4,210	50	1,950

Table 2.—Worksheet for calculating value losses

Property number	Lot size, sq. ft.	Pre-attack			Mortality in No. of trees	Post-attack			Loss in dollars
		No. of trees ≥ 6″		Value in dollars		No. of trees ≥ 6″		Value in dollars	
		Observed	Adjusted			Observed	Adjusted		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
				Σ (5)				Σ (9)	Σ (10)

of trees per property shown in column 3. The result, entered in column 7, is observed post-attack number of trees per property. Adjust this number for lot size as before, and enter the result in column 8 of table 2.

Again refer to table 1 for the value of the adjusted number of trees. Enter this value in column 9 of table 2.

Calculate Value Loss

The values entered in table 2 are used to estimate the potential or expected property value loss for a target area or community. Calculate the total pre-attack value of trees for the target area by summing the values for the sample properties (column 5), and expand the sample values to population values. For example, if a simple random sample of 5 percent of residential properties in a community has been selected, the pre-attack property value of trees in the community will be 20 times the total value for the sample. Similarly, calculate the total post-attack property value of trees (sum of column 9), and subtract it from the pre-attack value. The result is an estimate of property value loss due to the gypsy moth.

An alternative calculation will yield the same answer. Calculate the loss for each sample property by subtracting post-attack value from pre-attack value, and enter the result in column 10 of table 2. Calculate the total loss for sample properties and expand this figure to a population value.

With either calculation method, the result is the loss in residential property value from tree mortality caused by the gypsy moth, for the entire community. If desired, this value can be converted to a per acre value by dividing the total loss by the total residential acreage within the community.

Interpretation of Calculated Losses

It is possible that this method of estimating losses will produce negative values, either for sample properties or for an entire community. That is, tree mortality may result in higher property values. As shown in figure 1, the contribution of trees to property values is a maximum with 29 six-inch or larger trees on a property of 20,000 square feet. Thus, if the gypsy moth reduces the adjusted number of trees to the 29 to 49 range, estimated property value will rise. If the gypsy moth kills trees but leaves at least 50 on a 20,000-square-foot lot, estimated property value will be unchanged.

Property value losses (or gains) estimated by this method are those expected to occur in the absence of control measures. These potential losses provide a partial basis for deciding what level of control is economically justified.

Also needed for control decisions is cost-effectiveness information for alternative methods of control. If control effectiveness can be measured in terms of a reduction in tree mortality, the method described here can be used to convert this measure of effectiveness into a dollar value.

CONCLUSIONS AND LIMITATIONS

The method presented here for estimating property value losses from gypsy moth attack is appropriate only for residential property. The values given in table 1 are not appropriate for parks or other forested tracts not used for homes. Furthermore, the method is appropriate for only that type of residential property characterized by a home located in the midst of large trees. Thus, lots cleared of trees for home building, with woodland remaining at the rear of the property, are not appropriate for economic evaluation by this method.

Our method does not account for values of trees that are not realized by owners of private properties. These might include offsite benefits, such as microclimatic effects on nearby land or aesthetic benefits to neighbors or passers-by. In particular, the values used here are not appropriate for single specimen trees: trees that are very large or very old, and that are situated so as to provide outstanding beauty or other amenities to their surroundings. These trees can be better evaluated by using the formula of the International Shade Tree Conference *(1970)*.

Calculation of property value losses due to the gypsy moth includes only those losses from tree mortality. No effects on value from reduced tree vigor or the unsightly appearance of defoliated trees are included. Neither is the nuisance value of gypsy moth caterpillars, but this nuisance may cause more concern to some homeowners than the loss of a few trees. Often,

dead trees must be removed, but this cost is not considered here. Thus this method underestimates the true cost of a gypsy moth attack in residential areas. But it does provide objective estimates of one important segment of this cost.

Future research will provide more refined estimates of the dollar value of losses to the gypsy moth in residential areas, but even our crude estimates of the value of residential trees are surprisingly high relative to timber values. Thus, we believe that more expensive and more selective control measures are justified for gypsy moth control in residential areas than in timber-producing areas.

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