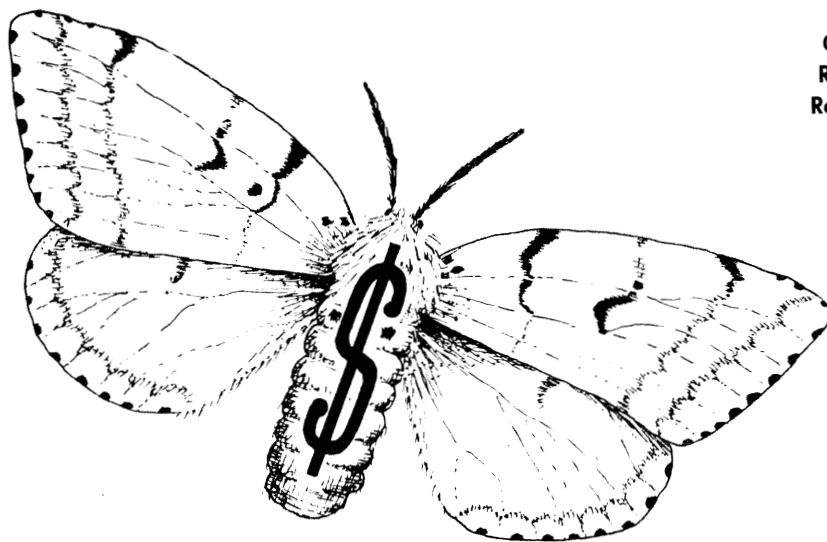


Economic Analysis of the Gypsy Moth Problem in the Northeast

III. Impacts on Homeowners and Managers of Recreation Areas



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PREFACE

This is the third in a series of papers on economic impacts of the gypsy moth in the Northeast. The first two papers (*McCay and White 1973*; *Payne et al. 1973*) dealt with the economic impacts of the gypsy moth on commercial forest production and on residential property values, respectively. Here, we deal with nonmarket impacts of a gypsy moth infestation on residential and on recreation properties. No method for obtaining information about such impacts has yet gained wide acceptance. This paper is intended to provide perspective for those who administer and implement gypsy moth control programs and to add to the state of the art for those who conduct related research on nonmarket impacts of forest pests.

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ABSTRACT

The economic impacts of a gypsy moth infestation on homeowners and on managers of recreation areas (commercial, public, and quasi-public) were determined from data collected via interviews with 540 homeowners and 170 managers of recreation areas in New York and Pennsylvania. The approach to measuring the impact of gypsy moth was to determine the interaction of a specific effect of an infestation (tree defoliation, tree mortality, nuisance) with a specific ownership objective (the reason a person has for owning or managing a property). Data were also collected on costs of controlling the gypsy moth, on financial losses resulting from infestation, and on person-days of recreational use of property lost by ownership class.

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Credit is also given to the state, federal and private agencies that supplied sampling lists used in this study. These agencies include the New York State Department of Environmental Conservation, the Pennsylvania Department of Environmental Resources, the USDA Animal and Plant Health Inspection Service, and local gypsy moth control offices. Finally, we thank the homeowners and managers of recreation areas who provided the detailed information used in this study.

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THE GYPSY MOTH has spread slowly throughout many sections of the north-eastern United States since it was accidentally introduced into Massachusetts in 1869. Various actions have been taken by state and federal governmental agencies to control its occurrence.

An intensive biological investigation of the gypsy moth is now in progress. Efforts to determine the impacts of a gypsy moth infestation on forest production and property values have succeeded (*McCay and White 1973; Payne et al. 1973*). These impacts are now understood and can be predicted within acceptable limits. But only limited research has been done on other impacts of gypsy moth: the impacts of nuisance, defoliation, and tree mortality on the recreational and esthetic values of forest land. The impacts of a gypsy moth infestation on these values are immediate, particularly in cases where tree cover contributes significantly to the recreational and esthetic components of property value. Thus, understanding the true magnitude of the gypsy moth problem requires accurate determinations of the impacts of a gypsy moth infestation, not only on timber production but on all other values associated with forested land.

The present study sought to identify and quantify the impacts of a gypsy moth infestation on forested land values other than timber.

STUDY METHODS

Homeowners and managers of recreation areas in Pennsylvania and New York were interviewed between September and November 1973. This period was selected to afford respondents ample opportunity to observe the spring and summer effects of gypsy moths on their properties.

The person interviewed was, whenever possible, one who was directly involved in deciding whether to take gypsy moth control action. For private properties, this person was the individual property owner. For recreation areas, the person responsible for managing the property was interviewed. If three successive attempts to obtain an interview failed, a specific property was dropped from our sample.

The study questionnaire elicited information about the effects and impacts of a gypsy moth infestation (including dates of earliest infestation and control measures), related costs, evaluation of control programs, and satisfaction with past control efforts.¹ All information solicited during the interview related to the respondent's recollection of his first experience with the effects of a gypsy moth infestation. Thus, gypsy moth effects and impacts could be evaluated independent of subsequent control efforts.

Ownership Classes

Four types of properties were included in the survey: private homes, located in areas usually containing 1 to 50 homes per 50 acres, and differing from urban properties primarily in their size and forested character; commercial campgrounds located in forest settings and ranging in area from a few acres to several hundred acres; public recreation areas, forested properties publicly owned and operated for public recreational use; and quasi-public recreation areas, forested properties operated for institutional groups like the Boy Scouts of America and church organizations.

Some homeowners had paid commercial operators to control the gypsy moth. The remaining homeowners, as well as all managers of recreation areas, had participated in cooperative public control programs. Five ownership classes were thus established: 1) homeowners - public control; 2) homeowners - commercial control; 3) commercial campgrounds; 4) public recreation areas; and 5) quasi-public recreation areas.

Sampling

The survey was conducted in a 35-county area in which gypsy moth defoliation had been severe during the year prior to the study: the area included portions of southeastern New York State, all of Long Island, and portions of northeastern Pennsylvania.

¹A copy of the study questionnaire may be obtained from the USDA Forest Service, Forest Insect and Disease Laboratory, Hamden, Conn.

Sampling lists included all properties in the survey area that had been included in the 1973 cooperative public gypsy moth control program. In addition, a list of homeowners who had paid for their own gypsy moth control was developed from the records of commercial spray operators in the survey region.

The sample, drawn from a total of 8,165 properties, consisted of 590 homeowners and 201 managers of recreation areas. Interviews were completed at 710 out of the 791 sampled properties. Because of differences in relative availability of control records and unequal sizes of ownership classes, it was not possible to obtain a uniform distribution of respondents from the three geographic regions or from the five ownership classes (table 1).

DATA ANALYSIS

The interview of each respondent provided data on: ownership objectives and their relative importance; the effects of gypsy moth infestation and their relative importance; financial losses resulting from infestation; costs of gypsy moth control measures; and losses in the recreational use of properties.

Profiles of Ownership Objectives

The specific impacts that a gypsy moth infestation have on a particular property will depend, in part, on the property owner's objectives, i.e., his reasons for owning or managing a property. A profile of objectives, consisting of

six objectives, was determined for each respondent. The need for a place of residence was assumed to be common to all ownership classes and was not listed as an objective. Possible ownership objectives included:

1. Enjoyment of natural beauty
2. Backyard recreation
3. Maximizing recreation use
4. Maximizing recreation revenue
5. Property value (maintenance or enhancement thereof)
6. Other (as specified by respondents)

Each respondent was asked to indicate the significance of each objective by assigning it a percentage rating for its relative importance. On each questionnaire, the ratings for all objectives totaled 100 percent. Individual profile ratings were used to determine an average profile of ownership objectives for each ownership class.

Quantifying Effects of Gypsy Moth

The four principal effects of a gypsy moth infestation on a property were defined as: the presence of insects, insect droppings, and egg masses, constituting an offense to the senses (Nuisance); the defoliation of trees or shrubs, resulting in loss of shade and in an unsightly appearance (Defoliation); the presence of dead trees (Mortality); and any additional effects specified by the respondent, e.g., allergic response to gypsy moth (Others). Each respondent was asked to indicate the significance of

Table 1.—Respondents by ownership class and geographic area

Ownership class	Number on sampling list	Sample size	Number of complete responses	Location of respondents		
				Southeastern New York	Long Island	Northeastern Pennsylvania
<i>Homeowners</i>						
Public control	7,888	523	481	55	214	212
Commercial control	76	67	59	0	14	45
All homeowners	7,964	590	540	55	228	257
<i>Managers of recreation areas</i>						
Commercial campgrounds	156	156	134	42	0	92
Public recreation areas	16	16	16	9	3	4
Quasi-public recreation areas	29	29	20	3	3	14
All managers	201	201	170	54	6	110
Total	8,165	791	710	109	234	367

each effect by assigning to it a percentage rating for its relative importance. On each questionnaire, the ratings for all effects totaled 100 percent. Individual effect ratings were used to determine an average effects profile for each ownership class.

Rating Impacts of Gypsy Moth Effects on Ownership Objectives

Each respondent was asked to estimate the relative impact that each effect of gypsy moth had had on his set of ownership objectives by assigning to each objective a percentage of total impact rating. On each questionnaire, the ratings for all impacts totaled 100 percent. Average impacts on objectives profiles were determined for each ownership class.

Importance Indices

A forecasting technique called PATTERN² can be used to isolate the interactions of elements involved in a particular decision (*Esch 1969*). The technique can be applied to almost any situation in which the importance of such interactions must be gauged.

By use of PATTERN, we developed a table of importance indices for each ownership class (tables 2-6). Each importance index is the product of an Effect Rating and the Importance Rating of an Impact on an Ownership Objective. For example, for homeowners-public control, (table 2) the importance index for the impact of nuisance on enjoyment of natural beauty (23.85 as expressed as a percentage) was determined by multiplying the average effect rating for nuisance (.53) by the average impact for the enjoyment of natural beauty ownership objective (.45). The importance index provides a measure of the relative importance of the impact of a particular effect of gypsy moth on a particular ownership objective. The four or five largest index values comprise an Importance Index Profile which identifies the most important aspects of the gypsy moth problem for each ownership class (tables 2-6).

Control Costs and Financial Losses

The amount of money that people are willing to spend is often equated with the importance they attach to a particular good or service. The

usual economic yardstick for measuring the financial magnitude of the gypsy moth problem is the homeowner's or property manager's demonstrated willingness to pay for control measures. Data on financial magnitudes of gypsy moth impacts were obtained from the respondent. Each respondent was asked to estimate the time spent in controlling gypsy moths and the total cost of equipment, materials and services. In estimating control costs, the respondent's own time was valued at \$2 per hour. Average control costs were determined for each ownership class. The average financial loss sustained by each ownership class was determined in an analogous manner.

Average annual costs of control measures and financial losses resulting from gypsy moth infestation were calculated for all ownership classes except managers of public recreation areas (tables 7-8).

Reductions in Recreational Use

The average number of person-days per year that were lost in the recreational use of properties was calculated for each ownership class (table 9).

First Occurrence and First Gypsy Moth Control Measures

Table 10 shows, for each ownership class, the distribution of respondents with respect to the first calendar year of gypsy moth infestation and the first calendar year in which control measures were taken.

RESULTS

Impacts on Objectives

The importance index profiles (tables 2-6) reveal that the nuisance and defoliation effects of gypsy moth infestation were the prime concerns of all ownership classes. For homeowners, the principal impacts of these two effects were on backyard recreation and on the enjoyment of natural beauty (tables 2-3). Managers of commercial campgrounds were concerned with the impacts of nuisance, defoliation, and tree mortality on the enjoyment of natural beauty. In addition, they were concerned with the impact of

²PATTERN = Planning Assistance Through Technical Evaluation of Relevance Numbers.

Table 2.—Importance indices for homeowners (public control)

Item	Ownership objectives					Total	Average effect rating
	Enjoy natural beauty	Backyard recreation	Property value	Maximize recreation use	Other ^a		
	----- Percent -----					Percent	Percent
Average ranking of ownership objectives	41	29	15	2	13	100	—
Average gypsy moth impact on ownership objectives	45	42	6	2	5	100	—
<i>Gypsy moth effects</i>							
Nuisance	23.85 ^b	22.26	3.18	1.06	2.65	—	53
Defoliation	18.90	17.64	2.52	0.84	2.10	—	42
Mortality	1.80	1.68	.24	.08	.20	—	4
Other ^a	.45	.42	.06	.02	.05	—	1
						Total	100

^a As specified by respondents.

^b Indices in boldface comprise the importance index profile. They summarize the most important aspects of the gypsy moth problem for this ownership class.

Table 3.—Importance indices for homeowners (commercial control)

Item	Ownership objectives					Total	Average effect rating
	Enjoy natural beauty	Backyard recreation	Property value	Maximize recreation use	Other ^a		
	----- Percent -----					Percent	Percent
Average ranking of ownership objectives	39	23	17	0	21	100	—
Average gypsy moth impact on ownership objectives	49	28	13	2	8	100	—
<i>Gypsy moth effects</i>							
Nuisance	24.01 ^b	13.72	6.37	0.98	3.92	—	49
Defoliation	22.05	12.60	5.85	.90	3.60	—	45
Mortality	2.45	1.40	.65	.10	.40	—	5
Other ^a	.49	.28	.13	.02	.08	—	1
						Total	100

^a As specified by respondents.

^b Indices in boldface comprise the importance index profile. They summarize the most important aspects of the gypsy moth problem for this ownership class.

Table 4.—Importance indices for managers of commercial campgrounds

Item	Management objectives					Total	Average effect rating
	Maximize recreation revenue	Property value	Enjoy natural beauty	Maximize recreation use	Other ^a		
	----- Percent -----					Percent	Percent
Average ranking of management objectives	30	22	20	19	9	100	—
Average gypsy moth impact on management objectives	10	15	46	15	14	100	—
<i>Gypsy moth effects</i>							
Nuisance	4.30	6.45 ^b	19.78	6.45	6.02	—	43
Defoliation	3.20	4.80	14.72	4.80	4.48	—	32
Mortality	1.90	2.85	8.74	2.85	2.66	—	19
Other ^a	.60	.90	2.76	.90	.84	—	6
						Total	100

^a As specified by respondents.

^b Indices in boldface comprise the importance index profile. They summarize the most important aspects of the gypsy moth problem for this ownership class.

Table 5.—Importance indices for managers of public recreation areas

Item	Management objectives					Total	Average effect rating
	Maximize recreation use	Enjoy natural beauty	Maximize recreation revenue	Property value	Other ^a		
	----- Percent -----					Percent	Percent
Average ranking of management objectives	53	30	4	4	9	100	—
Average gypsy moth impact on management objectives	42	37	2	9	10	100	—
<i>Gypsy moth effects</i>							
Nuisance	21.84 ^b	19.24	1.04	4.68	5.20	—	52
Defoliation	17.22	15.17	.82	3.69	4.10	—	41
Mortality	2.94	2.59	.14	.63	.70	—	7
						Total	100

^a As specified by respondents.

^b Indices in boldface comprise the importance index profile. They summarize the most important aspects of the gypsy moth problem for this ownership class.

Table 6.—Importance indices for managers of quasi-public recreation areas

Item	Management objectives					Total	Average effect rating
	Maximize recreation use	Enjoy natural beauty	Property value	Maximize recreation revenue	Other ^a		
	----- Percent -----					Percent	Percent
Average ranking of management objectives	36	22	7	4	31	100	—
Average gypsy moth impact on management objectives	30	45	9	2	14	100	—
<i>Gypsy moth effects</i>							
Nuisance	12.00 ^b	18.00	3.60	0.80	5.60	—	40
Defoliation	14.70	22.05	4.41	.98	6.86	—	49
Mortality	3.00	4.50	.90	.20	1.40	—	10
Other ^a	.30	.45	.09	.02	.14	—	1
						Total	100

^a As specified by respondents.

^b Indices in boldface comprise the importance index profile. They summarize the most important aspects of the gypsy moth problem for this ownership class.

Table 7.—Average control cost for owners who employed a gypsy moth control measure in addition to public control measures

Ownership class	Respondents within class	Cost of equipment, materials, services	Labor cost ^a	Total cost
	Percent	----- Dollars -----		
<i>Homeowners</i>				
Public control	52	16	46	62
Commercial control	54	120	26	146
<i>Managers of recreation areas</i>				
Commercial campgrounds	5	77	192	269
Quasi-public recreation areas	5	40	400	440

^a At \$2 per hour.

Table 8.—Average financial loss due to a gypsy moth infestation ^a

Ownership class	Respondents within class	Cost of equipment, materials, services	Labor cost ^b	Total loss
	<i>Percent</i>	<i>Dollars</i>		
<i>Homeowners</i>				
Public control	42	56	20	76
Commercial control	41	257	35	292
<i>Managers of recreation areas</i>				
Commercial campgrounds	22	116	36	152
Quasi-public recreation areas	35	521	86	607

^a Capital cost reduction in property value, increase in maintenance cost, and loss of revenue.

^b At \$2 per hour.

Table 9.—Person-days of recreation loss due to a gypsy moth infestation

Ownership class	Respondents	Respondents experiencing recreation impact	Recreation lost by respondents who experienced a recreation impact
	<i>Number</i>	<i>Percent</i>	<i>Person-days</i>
<i>Homeowners</i>			
Public control	481	51	108
Commercial control	59	44	133
<i>Managers of recreation areas</i>			
Commercial campgrounds	134	4	161
Public recreation areas	16	25	36,660
Quasi-public recreation areas	20	12	240

Table 10.—Distribution of respondents by ownership class, by first year they experienced an infestation, and by year of first control measure, in percent

Year	Homeowners (public control)		Homeowners (commercial control)		Commercial campground managers		Public recreation area managers		Quasi-public recreation area managers	
	First experience	First control	First experience	First control	First experience	First control	First experience	First control	First experience	First control
1969 or earlier	11.5	4.0	7.1	1.7	10.3	0.8	25.0	12.4	21.1	10.5
1970	12.8	5.2	5.7	.0	18.1	5.6	6.2	.0	5.3	5.3
1971	34.1	10.6	31.5	11.8	26.7	17.5	25.0	18.8	26.3	.0
1972	32.5	33.8	37.1	39.0	30.2	32.5	37.6	25.0	42.0	26.3
1973	9.1	46.4	18.6	47.5	14.7	43.6	6.2	43.8	5.3	57.9

nuisance on property value and on maximizing recreational use (table 4). The managers of both public and quasi-public recreation areas were most concerned with the impacts of nuisance and defoliation on enjoyment of natural beauty and on maximizing recreation use (tables 5-6).

Control Costs

Homeowners who participated in a cooperative public control program (250 respondents) spent an average of \$62, of which only \$16 went for expenses other than their own time. In contrast, homeowners who paid for commercial control measures (32 respondents) spent an average of \$146, of which \$120 went for expenses other than their own time. Managers of commercial campgrounds (7 respondents) who had participated in a cooperative public control program, spent an average of \$269, of which \$77 went for expenses other than their own time. The manager of a quasi-public recreation area, the sole respondent in this ownership class who paid for control in addition to participating in a cooperative public control program, spent \$440, only \$40 of which went for expenses other than his own time (table 7). No control cost data were available from managers of public recreation areas.

Financial Losses due to Infestation

The financial losses attributed to gypsy moth consisted of capital costs incurred in coping with the infestation plus increases in maintenance costs, reduction in property values and, where applicable reduction in revenues (table 8).

Homeowner-commercial control (24 respondents) sustained an average financial loss of \$292, in contrast to the average loss of \$76 sustained by homeowner-public control (202 respondents). Managers of commercial campgrounds (29 respondents) sustained an average loss of \$152. Managers of quasi-public recreation areas (7 respondents) sustained an average loss of \$607.

Recreation Losses due to Infestation

Of 59 respondents in the class, 44 percent of homeowners-commercial control lost annually an average of 133 person-days of recreational use of their property because of gypsy moth infestation. Of 481 homeowners-public control, 51 percent lost annually an average of 108 person-days of recreational use of their property. Four

percent of managers of commercial campgrounds suffered a recreation loss due to infestation. This loss amounted to an average of 161 person-days of recreational use of their facilities annually. Of 16 managers of public recreation areas, 25 percent lost annually an average of 36,660 person-days of use of their facilities. Of 20 managers of quasi-public recreation areas, 12 percent lost annually an average of 240 person-days of use of their facilities (table 9).

DISCUSSION

The purpose of this study was to identify and, whenever possible, quantify the impacts of gypsy moth on non-commercial forest owner objectives. The information is intended to assist public decision makers who are responsible for design, implementation, and coordination of gypsy moth control programs.

The information contained here is not available elsewhere. The information should provide a basis for beginning to incorporate financial and other non-market gypsy moth impact data into the decisionmaking processes—particularly for high value forest properties where commercial timber production is not a major objective of ownership. It is in such high value forest properties that control programs can prove immediately beneficial.

For all ownership groups it was demonstrated that specific ownership or management objectives were seriously affected by a gypsy moth outbreak.

Loss of recreational use of private home properties ranged from 180 person days per year for homeowners—public control to 54 days for homeowners—commercial control. Impacted commercial recreation areas averaged 161 person-days of recreation loss annually. These public recreation areas and quasi-public areas that were impacted lost an average of 36,300 person-days and 240 days of recreation use, respectively.

The financial information on gypsy moth impacts—control costs and financial impacts—provide some insight into the financial magnitude of the gypsy moth problem. However, more research will be needed to refine these figures. The data on financial implications should be used with caution. Under no circumstances should total financial impacts for an ownership class be derived by adding average control cost and average financial impact. This is because owners who sustained

a control cost are not necessarily the same as those who sustained a financial impact and vice versa.

In approaching the study problem, difficult problems were encountered with regard to study design. The PATTERN technique for identifying the interactions between effects of gypsy moth and impacts on owner objectives had not been previously applied to the problem. Although results do point out the relative magnitude of impacts on owner objectives, other techniques should be applied to the problem. Results of the PATTERN analysis can be used to design control programs that are directed to the most important aspects of the gypsy moth problem.

Sampling also presented a problem. We used more than one ownership class because we felt that impacts of gypsy moth would vary depending on objectives of ownership. Results showed that this was correct. But definition of ownership classes presented a difficult problem. Three criteria had to be met: 1) owners within a class must have experienced a gypsy moth infestation; 2) they should have fallen into a clearly defined ownership class; and 3) they should have been able to recall with some accuracy their experience with the gypsy moth. Because of the study design, responses were based on the first year of experience with the gypsy moth. This is because a continual program of control would have reduced the impacts we wanted to measure. The year for which people responded varied and consequently recall errors could be present. Further studies can be designed to reduce these sources of sampling error, but they will be more expensive than the present study. Preparation of sampling frames will be costly. It

is uncertain whether useful information can be gathered through the mail questionnaire survey technique.

In future research, alternative techniques could be used to evaluate gypsy moth impacts. We feel our technique works. Major problems in conducting any such research are preparation of sampling lists, interviewer training, and cost. Additional research should also be done in other geographic areas and under different conditions of infestation.

The above limitations should be taken into account when using the information contained in this study. However, we feel the information is sufficiently accurate to begin the process of incorporating non-market impacts of gypsy moth into the decisionmaking process and to serve as a basis for designing control programs directed toward the most important aspects of the gypsy moth problem.

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