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**WHITE-TAILED DEER IN WESTCHESTER COUNTY, NEW YORK:
PUBLIC PERCEPTIONS AND PREFERENCES**

by

Nancy A. Connelly, Daniel J. Decker, and Sam Wear

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**Human Dimensions Research Unit
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New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University, Ithaca, N. Y.**



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White-tailed Deer in Westchester County, New York:
Public Perceptions and Preferences

EXECUTIVE SUMMARY

Introduction and Methods

In recent years, residents of northern Westchester County, New York, have experienced increasing contact with white-tailed deer inhabiting the county. The perception that deer were causing considerable problems in terms of deer-car collisions, damage to residential plantings of all types, and anxiety over their possible role as agents in the transmission of Lyme disease to humans prompted the Westchester County Department of Planning to initiate this study in cooperation with the Human Dimensions Research Unit, Department of Natural Resources, Cornell University. The purpose of the study was to learn more about county residents': perceptions of the extent and nature of deer-human interactions, estimates of economic impacts of plant damage caused by deer, tolerance of deer, and support for deer management in the county.

A self-administered, mail-back questionnaire was developed and used to survey 1,002 households in the northern portion of the county. Over 70% responded. A sample of nonrespondents was contacted via telephone to assess nonresponse bias which was found to be negligible.

Findings

Respondents and Their Residences

In the year preceding the survey; 68% observed wildlife, 64% fed birds, 31% photographed wildlife, 14% hunted deer, and 9% fed deer.

19% were members of a conservation or environmental organization. Most popular were the National Wildlife Federation, Audubon, the Nature Conservancy, and Sierra Club. On their property, 91% had shrubs/woody ornamentals, 69% had flowers, 47% had a vegetable garden, and 44% had fruit trees.

Experience with Deer and Deer Damage

- 95% had seen a deer in Westchester County within the last 5 years.
- 49% perceived an increasing trend in deer numbers over the 5 years prior to the survey.
- 66% had seen a deer or evidence of deer feeding on their property in the last year.
- 43% reported some type of plant damage caused by deer.
- Of those with damage; 81% reported damage to shrubs/woody ornamentals, 53% to vegetable gardens, 52% to fruit trees, and 48% to flowers.
- 60% of respondents with damage to flowers, 57% with shrub damage, 56% with vegetable damage and 35% with fruit tree damage either had replaced or needed to replace plants that were damaged.
- Average costs of replacement for the categories of plants were \$94 for garden vegetables, \$102 for flowers, \$156 for fruit trees, and \$635 for shrubbery.
- Estimated total replacement costs for damaged plants in northern Westchester County ranged from \$6.4 million to \$9.5 million depending on assumptions about damage experienced by nonrespondents (i.e., none vs. same rate as respondents).

- 52% of those with damage used some method of control, with fencing and repellents reported most frequently.
- An estimated \$1.2 million to \$1.8 million was spent on deer damage control during the year preceding the survey.

Attitudes Toward Deer and Deer Damage

- 80% of urban residents described the level of damage as light or none compared with 57% of the suburban/rural residents.
- More suburban/rural than urban (26% vs. 16%) felt their damage was unreasonable.
- 2 to 3 times more respondents expressed concerns about deer-car collisions and Lyme disease than about plant damage.
- Even among those who reported deer damage, deer-car collisions and Lyme disease were listed more often than damage as a primary deer-related concern.
- 33% enjoyed deer unconditionally, 52% enjoyed deer but worried about problems, 8% did not enjoy deer and 7% had no particular feelings about deer.
- Almost equal numbers of respondents wanted the deer population to remain at its current level (42%) or wanted a decrease (40%).

Need and Support for Deer Management

- 72% of the respondents recognized the need for deer management in northern Westchester County.
- Of those who recognized a need for deer management, 44% would support the use of firearms during a regulated hunting season. Overall, about 30% of all respondents would support the use of some firearms hunting.

Other techniques suggested by respondents included: relocation of deer (13%), longer bow season (5%), and use of "professional" hunters (4%).

Conclusions and Implications

Deer cause some residents in northern Westchester County real problems. The estimated economic impact of the deer herd is staggering, but the personal safety (deer-car collisions) and health (Lyme disease) hazards county residents perceive to be associated with deer overshadow concerns about the costs of deer damage to residential plantings. Despite widespread concerns people expressed vis-a-vis the deer herd, they generally liked having deer in their area, but they wanted the population to stabilize at its recent level or decrease, not increase. County residents understood the need for deer management in their situation, but largely did not equate that with support for firearms hunting to control deer numbers. This presents a management dilemma, given the lack of cost-effective deer herd management techniques except recreational hunting with firearms.

TABLE OF CONTENTS

	<u>Page</u>
EXECUTIVE SUMMARY	i
TABLE OF CONTENTS	v
LIST OF TABLES	vi
LIST OF FIGURES	vii
INTRODUCTION	1
STUDY AREA :	5
METHODS	7
RESULTS AND DISCUSSION	9
Survey Response	9
Characteristics of Respondents and Their Residences	9
Perceptions of Deer and Deer Damage	13
Deer Damage and Control	14
Attitudes About Deer Damage	18
Deer Damage and Control in Westchester County Orchards	19
Residents' Concerns and Attitudes About Deer	24
Value of Westchester County Deer Herd	29
Wildlife Attitudes and Values Scale (WAVS)	33
Need and Support for Deer Management	41
Logistic Regression - A Way to Better Understand Residents'	
Attitudes About Deer and Support for Deer Management	43
Attitudes Toward Deer	46
Attitudes Toward Deer Management	48
Attitudes Toward Hunting	49
CONCLUSIONS AND IMPLICATIONS	51
LITERATURE CITED	53
APPENDICES	56
Appendix A: Mail Questionnaire	57
Appendix B: Mail Survey Cover Letters and Follow-Up Letters	69
Appendix C: Comparisons with 1980 Census Data	74
Appendix D: Organizational Membership	76
Appendix E: Wildlife Problem Tolerance Response Distribution	
Curves	78

LIST OF TABLES

<u>Table</u>	<u>Title</u>	<u>Page</u>
1	Respondents' mean scores for various beliefs about wildlife and wildlife uses	11
2	Various plantings on respondents' properties by audience type	12
3	Deer-related concerns of Westchester County residents .	25
4	Westchester County residents' attitudes about the presence of deer by primary concern	27
5	Westchester County residents' preferences for the future deer population trend by their attitude about deer . . .	27
6	Westchester County residents' preferences for the future deer population trend by primary concern	28
7	The total value of the deer herd to northern Westchester County residents under 4 different assumptions	31
8	The net value of the deer herd to northern Westchester County residents under 4 different assumptions	31
9	Wildlife Attitudes and Values Scale (WAVS) dimensions for Westchester County residents	35
10	Need for deer management in Westchester County by various respondent categories	42
11	Various respondent groups, who support deer management, by whether or not they would support some form of recreational hunting	44

LIST OF FIGURES

<u>Figure</u>	<u>Title</u>	<u>Page</u>
1	Location of Westchester County within New York State . .	2
2	Location of study area in northern Westchester County .	6
3	Percent of respondents with deer damage to plantings in each town	15
4	The level of deer damage reported by respondents who had seen deer or deer sign on their property	19
5	Respondents' feelings about deer damage by survey strata	21
6	Estimates of total dollars of damage, by tolerance of damage	22
7	WAVS item response curves	36
8	Wildlife extractive/economic use beliefs by support for recreational hunting in Westchester County	45

INTRODUCTION

As suburban areas of the eastern U.S. continue to expand, white-tailed deer (*Odocoileus virginianus*) habitat is changing. Deer numbers are increasing and expansion of populations into suburban and urban areas is occurring (Flyger et al. 1983). The coexistence of suburban deer and humans frequently results in conflicts due to deer damage to yard and garden plantings, deer-vehicle collisions and other problems. The existence of urban "greenbelts" (e.g., county parks, forestlands surrounding reservoirs) often aggravates the problem by providing refuge and travel corridors where deer may spend most of their time, but from which they can move easily to nearby private land to obtain additional food.

Considerable research has examined farmers' tolerance of white-tailed deer in rural areas (e.g., Brown et al. 1980, Decker et al. 1984, Flyger and Thorig 1962, Porath et al. 1984, Stoll and Mountz 1983, Tanner and Dimmick 1984), but few studies have examined suburban residents' tolerance of deer. One study in Islip, New York, examined deer-human interactions associated with the deer herd on Seatuck National Wildlife Refuge (Decker and Gavin 1987). This was a small deer herd which had recently (mid '70's) started to move off the refuge into residential areas. The study concluded that deer caused Islip residents problems such as damage to yard plantings and anxiety over Lyme disease, but at the same time, most people enjoyed having deer around (Decker and Gavin 1987).

The situation in Westchester County (Fig. 1) is different than in Islip. Deer have been present in Westchester County for most of this century. Originally extirpated between 1850 and 1900, deer began returning to Westchester County in 1905, where habitat conditions and a prohibition on deer hunting allowed the population to increase (Severinghaus and Brown 1956). By 1942 the population had grown sufficiently to permit hunting of bucks with bow

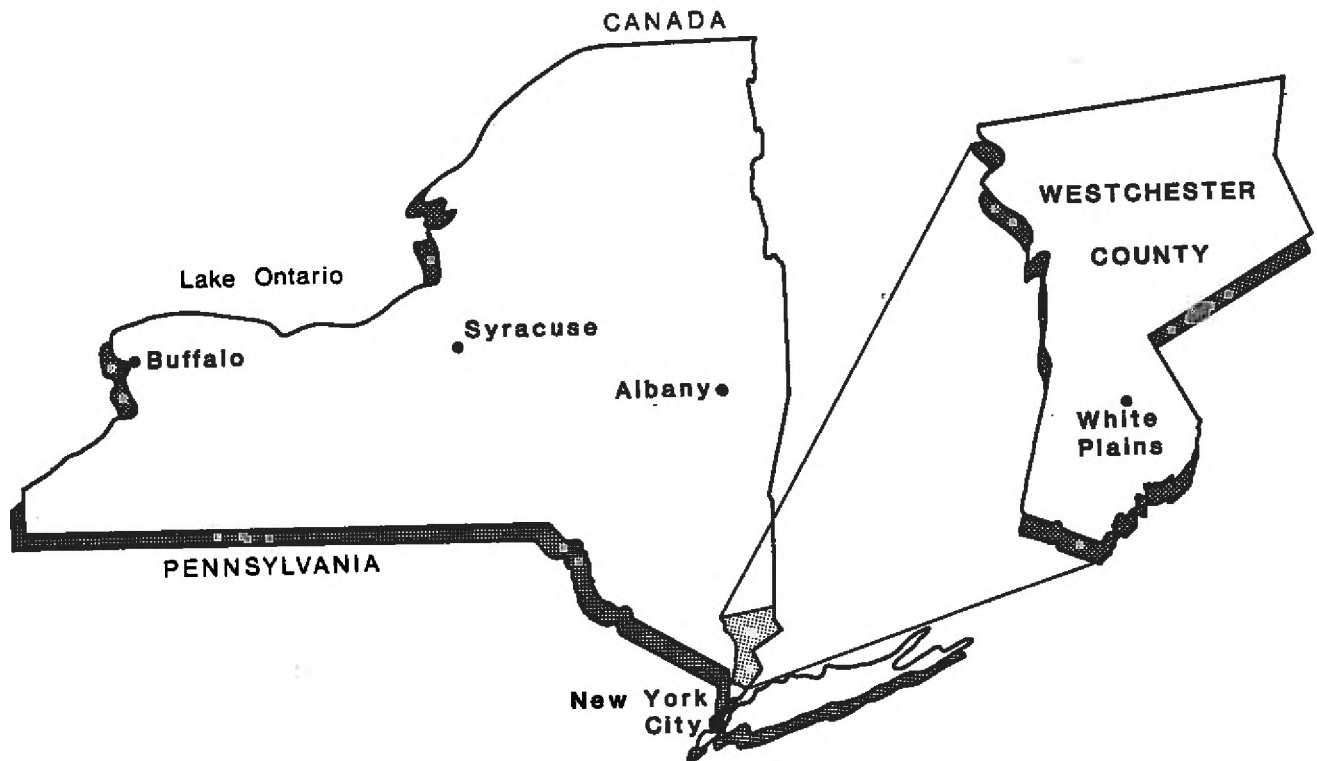


Figure 1. Location of Westchester County within New York State.

and arrow. (Since 1952 deer of either sex may be taken with bow and arrow.) The deer population has continued to grow since 1952, as the bow and arrow hunting season has proven to be an ineffective means of managing deer herd size. Although not employed, deer-of-either-sex hunts using shotguns may legally be held in January (N. Dickinson, 1987, pers. comm.).

In recent years, wildlife biologists have been unable to establish a reliable estimate of the current number of deer in Westchester County. This is because there is no annual harvest of deer by hunters using firearms, which in other areas of the State provides a reliable index of deer populations. Such an index is not possible with bow and arrow hunting because the harvest is too small.

In Westchester County there has been a reduction in the total area of deer habitat due to commercial and residential development. Since 1969, Westchester County has lost over 30% of its agricultural land to development, and in the 3 years prior to 1985 parcels totaling over 1,000 acres of open space were approved for development (Wear and Schreiner 1987). Deer are believed to use the "greenbelt" network associated with reservoirs (about 30% of open space in the county) and parks extensively. Thus, as deer habitat is destroyed, deer density on the remaining habitat may possibly be increasing (Glenn Cole, 1987, pers. comm.). Furthermore, in some areas the quality of habitat may improve on land adjacent to developed areas and deer may move from such land into developments where they may cause problems.

These factors have lead to increased deer-human conflicts in terms of vehicular collisions and damage to commercial and residential landscaping. Reported deer-car collisions (considered a low estimate of actual collisions [Knight 1986]) were increasing in the county from 106 in 1983 to 144 in 1985 (Danto 1986 [citing NYS Motor Vehicle Dep. records]). Also, Lyme disease has

become a serious public health problem in certain areas. Reported cases have increased county-wide from 175 in 1984, 381 in 1985, 293 in 1986, to 253 for Jan.-July 1987 (Westchester County Dep. of Health). Cases have occurred throughout Westchester County, but most are clustered in and adjacent to the Town of New Castle, in the northern portion of the county. Although deer have been implicated, their role in the transmission of Lyme disease is not well understood. Because the principal vector for the disease, *Ixodes dammini*, is commonly known as the deer tick, many people have assumed white-tailed deer to be the primary problem in transmission of the disease to pets and humans, when in fact many mammals have been found to carry this particular tick (Cochran 1987).

To address the growing number of human-deer conflicts, as well as to facilitate better land-use planning, the Westchester County Department of Planning, in cooperation with the Human Dimensions Research Unit, Department of Natural Resources, Cornell University initiated research to investigate county residents' attitudes and perceptions of deer and deer damage. The study was designed to learn more about the extent and nature of deer-human interactions and public tolerance of deer in various types of suburban situations. Additional information was sought on residents' support for deer management, information that could prove useful to the Department of Environmental Conservation (DEC). This included an assessment of public attitudes on the use of recreational hunting with firearms to manage deer in Westchester County.

The specific objectives of the study of residents of Westchester County were as follows:

- (1) to determine residents' perceptions of the nature and extent of deer impacts on their communities;

- (2) to estimate the economic impact of the deer population on the residents of the county;
- (3) to determine residents' perceptions of the social and economic values (positive or negative) of a suburban deer population; and
- (4) to determine the support for deer management in Westchester County.

STUDY AREA

The area of Westchester County chosen for this study was the portion of the county generally north of Interstate Highway 287 (Fig. 2). Observations of Department of Planning officials for Westchester County indicate that deer are seldom sighted south of the interstate highway. They hypothesize that the interstate may be a significant barrier for deer, largely preventing them from entering the more densely developed, southern portion of the county. Thus, southern residents were not contacted because of the low likelihood of exposure to deer in their neighborhoods. For sample selection purposes the southern boundary of the study area was moved slightly north to the political boundaries of the Towns of Mount Pleasant and North Castle, west of the Town of Harrison.

The northern portion of the county consists largely of suburban residential communities for the Greater New York Metropolitan Area. With less than 4% of the land area devoted to agriculture, it has only a small agricultural population (<1% according to the 1980 census). There are 8 small cities and villages (<20,000 people) in northern Westchester County whose public water supplies and sewage disposal systems permit high-density, small-lot zoning; some have well defined downtown areas. These urban areas have a population density of about 3,000 people/sq. mile (based on 1986 population estimates). Conversely, the remaining portion of northern Westchester County

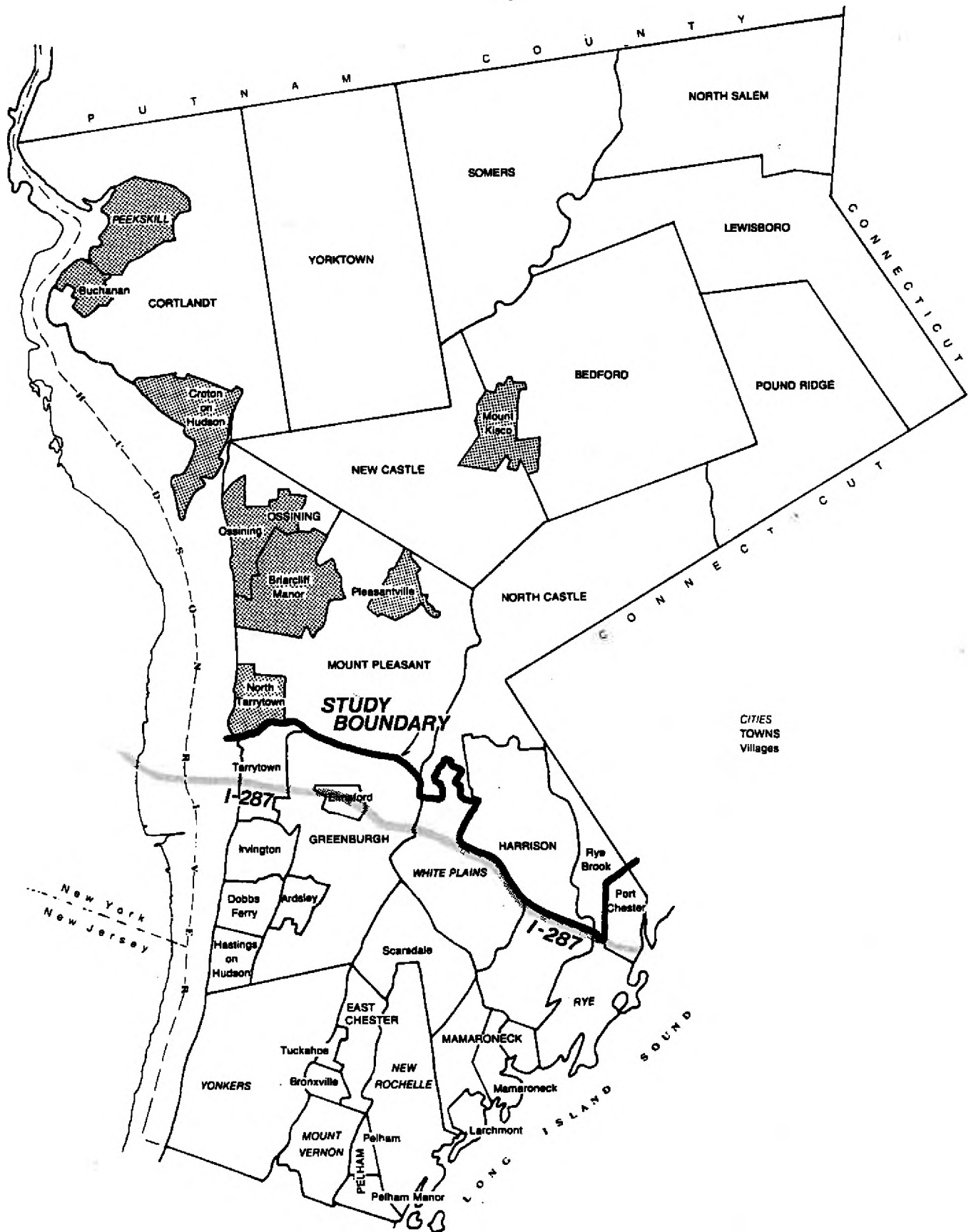


Figure 2. Location of study area in northern Westchester County (urban areas are shaded).

is less densely populated (610 people/sq. mi.) and has larger-lot zoning requiring on-site water and sewage disposal. We will refer to this area as suburban/rural. People owning land in this area were more likely to have contact with deer on their property than those living in the urban areas. Thus, two demographic categories of interest emerged: (1) urban--those selected city and village jurisdictions, and (2) suburban/rural--all remaining less populated areas (Fig. 2).

METHODS

A sample of 500 names and addresses for each strata (suburban/rural and urban areas) were collected. The samples were systematically selected by town in each stratum from the residential property tax rolls.

A self-administered, mail-back, booklet-format questionnaire (self-addressed and return postage prepaid) was developed for this study (Appendix A). It was primarily an adaptation of the questionnaire used in the study of suburban Islip residents' tolerance of deer (Decker and Gavin 1985). Questions adapted from the Islip study addressed the following specific information needs of this study:

- (1) characteristics of property owners and their property;
- (2) perceptions of deer and deer damage to yard plantings;
- (3) economic impact of deer damage to yard plantings;
- (4) actions taken in response to deer damage; and
- (5) underlying attitudes and beliefs about wildlife.

Additional questions were developed to measure the perceived need for deer management and support for hunting as a management technique.

The mail survey was implemented by the Westchester County Department of Planning in early spring 1987. A procedure using up to 3 follow-up mailings to nonrespondents was employed (cover letters are in Appendix B). In addition, a nonrespondent telephone interview was conducted with 38 nonrespondents to assess nonresponse bias.

Data were coded and keypunched at Cornell University. The data were weighted to reflect the proportion of residential properties in each stratum. Therefore numbers reported for northern Westchester County were weighted and numbers used when comparing the 2 strata were not. Analysis was conducted using the SPSSX and SAS computer program packages. Chi-square tests at the $P \leq 0.05$ level were used to examine differences between strata and other groupings. Factor analysis was used to aggregate items on a wildlife attitudes and values scale into meaningful categories. Logistic regression analysis was used to model experiential and perceptual influences on residents' attitudes about the presence of deer in their neighborhood and the need for deer management.

Personal interviews were conducted in March, 1987 with 2 of the 4 growers operating commercial orchards in northern Westchester County as part of another NYSCALS Hatch Project on deer damage control decisions. Selected results of those interviews are presented in this report to add another view of the deer damage problem in Westchester County. Questions asked during those interviews focused on the amount of deer damage, control methods used, and attitudes about deer damage. (A full discussion of methods and results of this larger statewide study will appear in a report by Siemer et al., which is currently in progress.)

RESULTS AND DISCUSSION

Survey Response

The survey of 1002 households had 34 undeliverable questionnaires and 684 useable responses, for an adjusted response rate of 70.7% of deliverable questionnaires. Of the respondents, 361 were in the suburban/rural stratum and 310 were in the urban stratum (13 were unclassifiable because of obliterated identification numbers). The initial sample sizes were equal for both strata, thus the suburban/rural audience responded at a slightly higher rate than the urban audience.

The telephone follow-up of 38 nonrespondents (24 from urban areas, 14 from suburban/rural areas) indicated these people differed little from the mail-survey respondents. A similar number had seen deer in Westchester County and on their property; had experienced deer damage; indicated similar concerns about deer; gave similar preferences for future deer population trends; and indicated similar preferences for deer management and hunting as a management technique. The only statistically significant difference found for the variables compared was suburban/rural respondents were more concerned about deer-car collisions than suburban/rural nonrespondents, 74% vs. 43%, respectively ($\chi^2 = 6.40$, $df = 1$, $P \leq 0.05$). However, caution should be used in interpreting this difference because the sample size for suburban/rural nonrespondents was only 14. Based on the similarity of respondents and nonrespondents, weighting for nonresponse bias was considered unnecessary.

Characteristics of Respondents and Their Residences

Respondents were typically middle aged (mean of 50 years old) and well educated (96% had graduated from high school; 51% had graduated from college;

and 9% had 8 or more years of college). Comparisons with 1980 Census data showed the survey audience to be slightly older and better educated (Appendix C). The ratio of males to females was 54:46. Most respondents reported some household involvement in wildlife-related recreational activities or hobbies during the year preceding the survey; 68% observed wildlife, 64% fed birds, and 31% photographed wildlife. Deer feeding was reported by 9% of the respondents, and 14% hunted deer in the 1986-87 season. Nineteen percent of respondents were members of a conservation or environmental organization. The most popular organizations were the National Wildlife Federation (38%), Audubon (18%), the Nature Conservancy (16%), and Sierra Club (10%). Many other local, state, and national organizations were each mentioned by just a few people (Appendix D).

Respondents' beliefs about wildlife and wildlife uses were measured. These reflected their basic attitudes and values on the subjects examined. Respondents placed little importance on three subjects--their personal involvement in trapping, hunting for recreation, and hunting for food (Table 1). Uses of wildlife which received higher personal importance ratings include: knowing that wildlife exists, the role of wildlife in the environment, and wildlife as a subject for learning more about nature. These basic attitudes and values help characterize county residents and will be used in a later section to help us better understand their concerns about deer and deer management.

Most property owners had lived at their current residence for ≥ 5 years (78%); few had lived there >30 years (12%) ($x = 15$ years). Parcel size for suburban/rural landowners averaged 5 times larger than urban landowners ($x = 2.6$ acres vs. 0.5 acres). Most respondents had a flower garden on their property and many had a vegetable garden (Table 2). Suburban/rural residents were more likely to have shrubs and fruit trees than urban residents.

Table 1. Respondents' agreement with the importance to them personally of various beliefs about wildlife and wildlife uses, using mean scores on the wildlife attitudes and values scale.^a

<u>Wildlife beliefs and values^b</u>	<u>Mean Score</u>	
Trapping	4.5	Disagreement
Hunt for recreation	4.3	
Hunt for food	4.0	
Tolerate disease risk	3.0	Neutral
Economic benefit to local economies	3.0	
Tolerate damage	2.7	Agreement
Renewable resource for human use	2.5	
Express opinion to officials	2.5	
Tolerate personal hazards	2.5	
Tolerate nuisance	2.4	
Vicarious experience	2.1	
Nonextractive recreation	2.1	
Behavior study	1.9	
Art	1.8	
Environmental quality indicator	1.7	
Learning subject	1.6	
Ecological role	1.6	
Existence value	1.5	

^aMean score on a scale from 1 to 5, where 1 - Strongly Agree and 5 - Strongly Disagree.

^bSee Appendix A for the exact wording of each question.

Table 2. Various plantings on respondents' properties by audience type.

<u>Plantings on property</u>	<u>Urban</u>	<u>Suburban/Rural</u> <u>Percent</u>	<u>Overall</u>
Vegetable garden	50.2	46.2	47.1
Flowers	70.8	68.5	69.0
Fruit trees*	35.2	46.8	44.1
Shrubs/woody ornamentals*	86.0	91.8	90.5

*Statistically significant difference between urban and suburban/rural audiences were found using the chi-square test at the $P \leq 0.05$ level.

Posting is often viewed by hunters as an indication that land is unavailable for hunting, but studies of landowners in New York have consistently shown that some landowners may allow people to hunt on posted land if permission is sought. The importance of access to lands for successful deer population management programs is apparent, therefore we investigated the land access question in Westchester County. Most property owners with 1 acre or more did not post their land (88%), but neither would most (86%) allow hunting on their land. Only 3% of property owners would allow strangers (who asked permission) to hunt on their land.

Perceptions of Deer and Deer Damage

Almost all respondents had seen a deer in Westchester County within the last 5 years (95%). Nearly one-half of the respondents (49%) perceived an increasing trend in deer numbers over the 5 years prior to the survey; 10% believed there were fewer deer, 24% thought there were about the same number of deer, and 17% had not formed an opinion about the status of the deer population for the period. Suburban/rural residents were more likely than urban residents to believe there were more deer now than 5 years ago (51% vs. 41%), while urban residents were more likely to believe there were fewer deer (15% vs. 8%) or had not formed an opinion about the status of the population (24% vs. 16%). As mentioned previously, a reliable estimate of the actual number of deer in Westchester County is not available. Wildlife managers do, however, believe that deer habitat in Westchester County is declining because of increased development of land for homes, and possibly the deer density on the remaining habitat is increasing (Glenn Cole, 1987, pers. comm.). Respondents' perceptions of an increasing deer population may reflect this situation.

Deer Damage and Control

Two-thirds of the suburban/rural respondents (66%) had seen a deer or evidence of deer feeding on their property in the last year, whereas 28% of urban respondents reported a similar experience. Of those who had seen deer on their property, 75% incurred damage to plantings regardless of whether their property was in the suburban/rural or urban area. Overall, 43% of respondents reported some type of plant damage.

Sample sizes in some towns were large enough (≥ 30) to permit analysis of the percent of residents with deer damage by town. Figure 3 depicts an area in the northeastern part of the county where well over half of the respondents from the suburban/rural towns reported deer damage. (Percentages reported for towns with small sample sizes [< 30] should be interpreted cautiously.) Figure 3 does not reveal residents' perceptions of the severity of damage or their tolerance of damage. Severity and tolerance of deer damage are examined in following sections.

Among Westchester County residents who experienced deer damage, reports of damage to shrubs/ornamental woody plants was most common (81%), followed by vegetable gardens (53%), fruit trees (52%), and flowers (48%). For respondents with damage to a particular category of plants, the mean percent of plants damaged was as follows: flowers - 52%, garden vegetables - 51%, shrubs/ornamental woody plants - 33%, and fruit trees - 26%.² Sixty percent of

²A methodological note: These data for fruit trees and shrubs were obtained in two ways on the questionnaire. First, the results reported above were responses to "the percent of the total number of trees (shrubs) that received any type of damage." Second, "the number of trees (shrubs) damaged" was compared with the total number of trees (shrubs) reported earlier in the questionnaire. The median difference between the percent damage reported and that calculated from the number of trees (shrubs) damaged was zero. However, the percent of outliers (those where the difference was greater than 10%) was 36% for fruit trees and 42% for shrubs. This implies that most people interpreted the questions in the same manner (as we had hoped), but a large minority of people had different interpretations of the two questions.

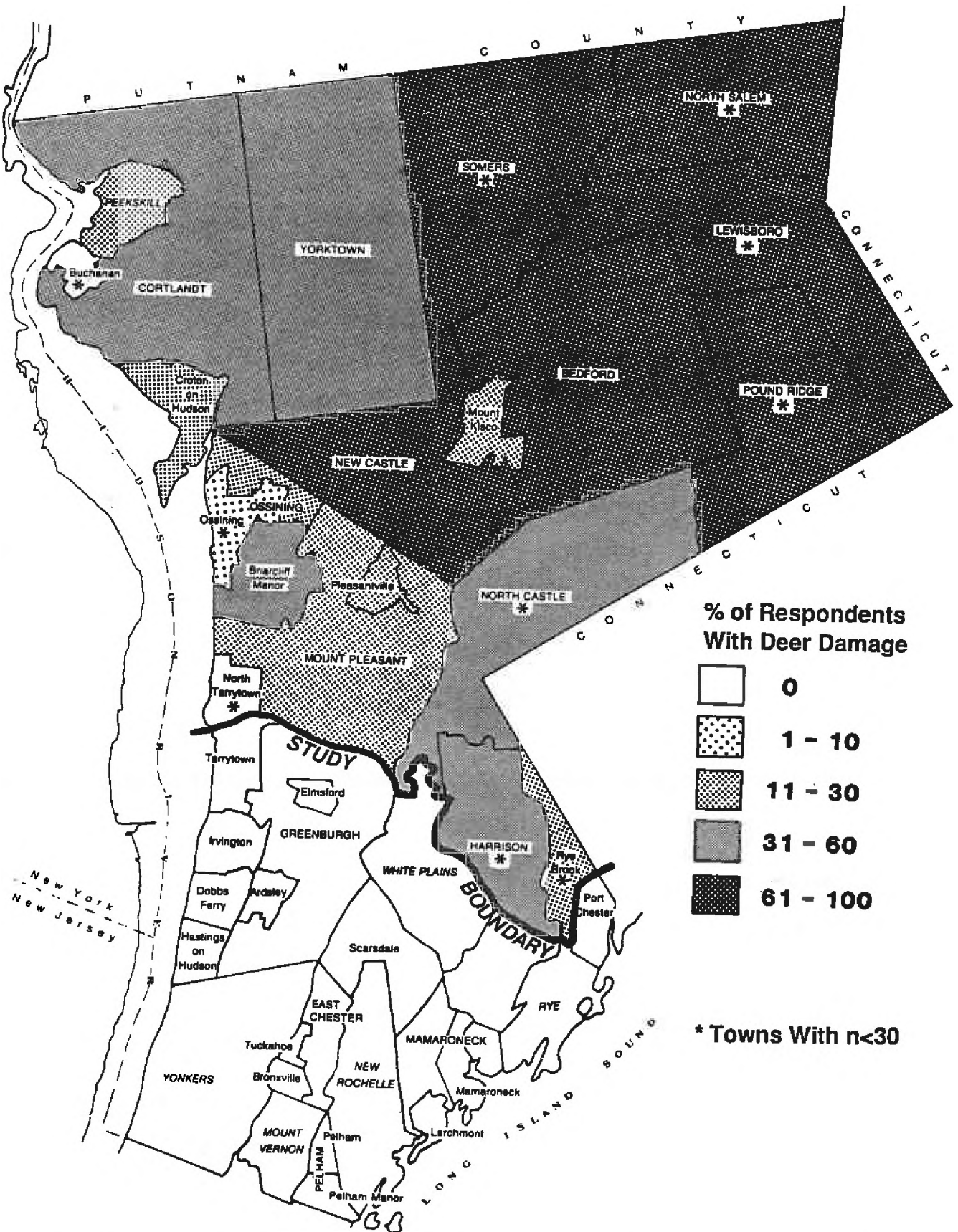


Figure 3. Percent of respondents with deer damage to plantings in each town.

respondents with damage to flowers, 57% with shrub damage, 56% with vegetable damage and 35% with fruit tree damage either had replaced or needed to replace plants that were damaged.

An assessment of the costs of deer damage to plant materials was made by estimating replacement costs for plants damaged to the point where replacement would be warranted. Estimates of replacement costs for fruit trees and shrubbery, in particular, may not reflect replacement of what was actually lost, but rather putting in young stock that may take some years to reach the same level of maturity as those damaged. Average costs of replacement for the categories of plants were \$94 for garden vegetables, \$102 for flowers, \$156 for fruit trees, and \$635 for shrubbery (i.e., per individual reporting damaged plants needing replacement). Replacement-cost estimates averaged \$34 per fruit tree and \$47 per shrub or woody ornamental plant. These estimates were similar to the replacement costs typical of Westchester County nurseries and landscaping services; fruit trees were slightly lower, shrubs slightly higher. The average costs of replacement were expanded to estimate the total cost of replacement for the northern portion of the county. In this estimate, 4 assumptions were made: (1) respondents' estimates of replacement cost were reasonably accurate, (2) damage not severe enough to require replacement was not reported, (3) those who said a plant type needed replacement but did not provide a cost estimate sustained an average replacement cost for that plant type, and (4) all members of the sample who had plants in need of replacement responded. An alternative to assumption 4 is that nonrespondents sustained deer damage to the same extent as respondents. This is based on the fact that we found no difference between respondents and nonrespondents (surveyed by telephone) in terms of the percent with deer damage. (Mean dollars of damage

could not be compared because of the small sample size of nonrespondents with damage.) Results will be presented for each of these 2 alternative assumptions.

Replacement costs for each plant type were calculated by multiplying the mean cost of replacement by the number of people who needed to replace that plant type, then expanding the total cost for the sample households to the northern Westchester County households. This was done for each plant type and then totalled for an estimate of total replacement costs due to deer damage of \$6.4 million (assuming nonrespondents had no deer damage) or \$9.5 million (assuming nonrespondents had deer damage) in 1986.³ The 90% confidence interval around these estimates was \$4.2 million to \$8.6 million for the former and \$6.3 million to \$12.7 million for the latter. Replacement costs for shrubbery contributed the most to this estimate (approximately 85%).

³Under the assumption that nonrespondents sustained the same amount of deer damage:

Garden Vegetables	$\$94 \times 44$ (sample size) = $\$4,136 \times 94.4$ (expansion factor) =
	\$390,438
Flowers	$\$102 \times 65$ (sample size) = $\$6,630 \times 94.4$ (expansion factor) =
	\$625,587
Fruit Trees	$\$156 \times 29$ (sample size) = $\$4,524 \times 94.4$ (expansion factor) =
	\$427,066
Shrubs	$\$635 \times 135$ (sample size) = $\$85,725 \times 94.4$ (expansion factor)
	<u>= \$8,092,440</u>
	\$9,535,531

Under the assumption that nonrespondents sustained no deer damage:	
Garden Vegetables	$\$94 \times 44$ (sample size) = $\$4,136 \times 63.3$ (expansion factor) =
	\$261,809
Flowers	$\$102 \times 44$ (sample size) = $\$6,630 \times 63.3$ (expansion factor) =
	\$419,679
Fruit Trees	$\$156 \times 29$ (sample size) = $\$4,524 \times 63.3$ (expansion factor) =
	\$286,369
Shrubs	$\$635 \times 135$ (sample size) = $\$85,725 \times 63.3$ (expansion factor)
	<u>= \$5,426,392</u>
	\$6,394,249

Another cost of deer damage was that of control. Fifty-two percent of those with plant damage used some method of deer damage control, with fencing and repellents reported most frequently. Individual expenditures of up to \$2,500 were reported for control over the last year, but most people reported much lower costs (median = \$45). By expanding to the county population of landowners under the 2 alternative assumptions discussed above, an estimated \$1.2 or \$1.8 million dollars was spent on deer damage control during the year preceding the survey. Thus, the estimated costs of deer damage incurred plus control measures totalled about \$7.6 or \$11.3 million (90% confidence intervals of \$5.2 to \$10.1 or \$7.7 million to \$15.0 million).

Very few respondents who had observed deer feeding or found evidence of such activity on their property reported damage to any official (4%). Of those few who did report their damage, most contacted local municipal authorities or DEC. More respondents sought information on deer damage controls (30%). Retailers of control supplies and landscape services were cited most often as sources of information (54% and 47%, respectively). Commercial pest control operators and friends were also frequently cited as sources of information (21% and 23%, respectively).

Attitudes About Deer Damage

Striking differences occurred between the suburban/rural and urban residents (who had seen deer or deer sign on their property) in their impressions of the severity of deer damage. Eighty percent of the urban residents described the level of damage as light or none compared with 57% of the suburban/rural residents (Fig. 4). Twenty-two percent of suburban/rural residents thought the damage was moderate, 16% substantial, and 5% severe. The

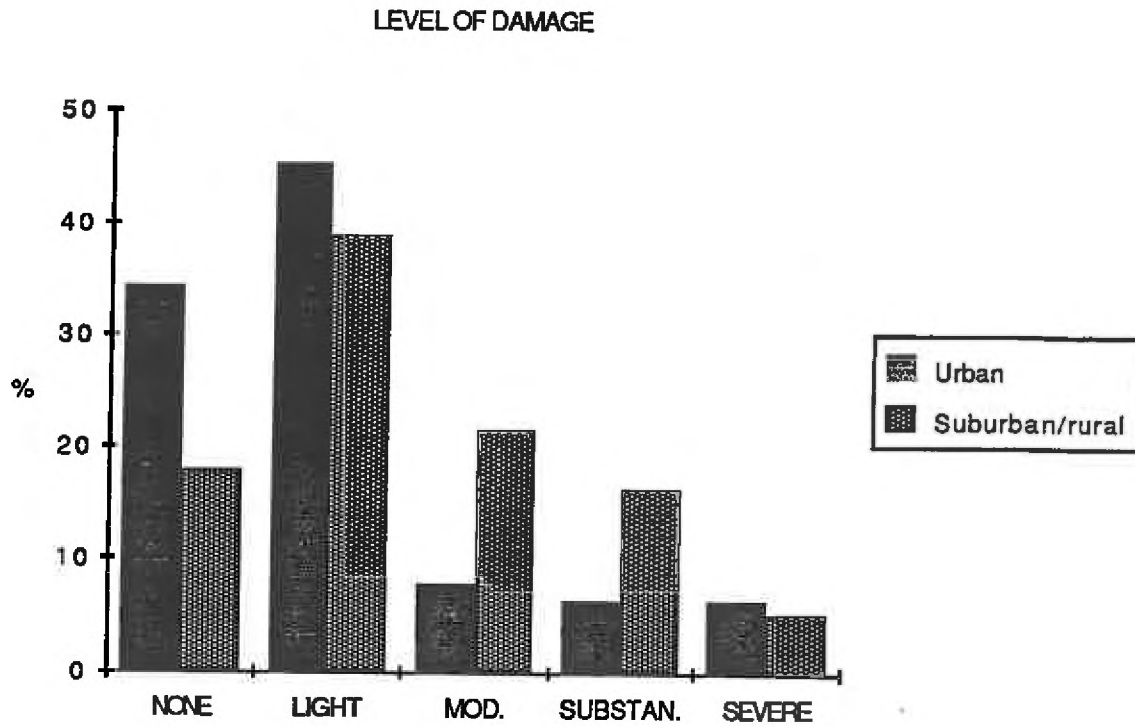


Figure 4. The level of deer damage reported by respondents who had seen deer or deer sign on their property.

greatest percentage of both urban and suburban/rural residents (33% and 43%, respectively) felt their damage was tolerable (Fig. 5). However, more suburban/rural than urban (26% vs. 16%) felt their damage was unreasonable.

In general, average dollar estimates for plant replacement between those reporting tolerable versus intolerable damage (means: \$343 vs. \$994; medians: \$100 vs. \$400) indicated that intolerance of deer damage was associated with considerably higher amounts of damage. Seventy-five percent of those with tolerable damage reported estimates below \$220 while 75% of those with intolerable damage reported estimates above \$220 (Fig. 6). Therefore, for the majority of respondents with damage, \$220 represents a threshold of damage tolerance.

Deer Damage and Control in Westchester County Orchards

Personal interviews with managers of 2 of the 4 commercial orchards in Westchester County yielded insight on deer damage severity and control efforts. Both orchard managers reported that the county's deer population, and the damage caused by that population, had increased in the last 5 years. Both thought the population would continue to increase in the next 5 years due to: low hunting pressure, abundant cover, protected refuge areas, anti-hunting sentiment, and recent mild winters.

Both orchardists felt that deer damage in their orchards had increased beyond a tolerable level. One grower estimated that deer browsing was cutting his fruit production by 30%, at an estimated cost of \$20,000 annually. Both growers claimed that in the last 12 months 80 to 100% of their trees had been browsed to some degree. By comparison, most (66%) of the orchardists

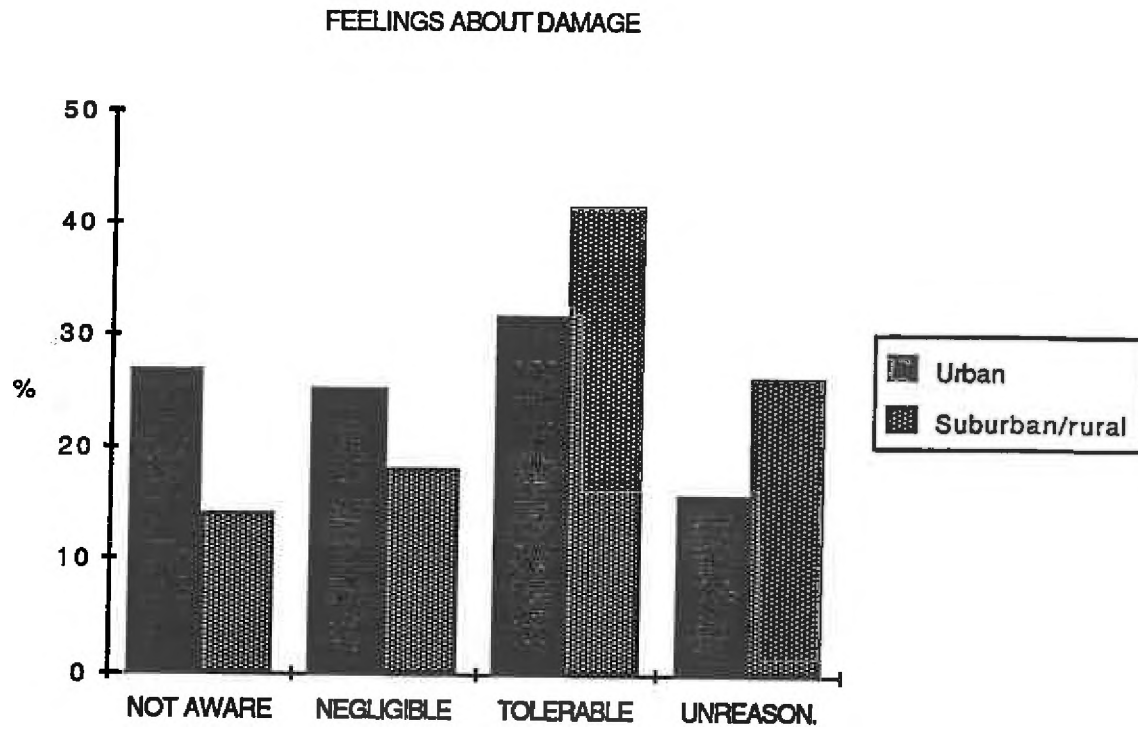


Figure 5. Respondents' feelings about deer damage by survey strata.

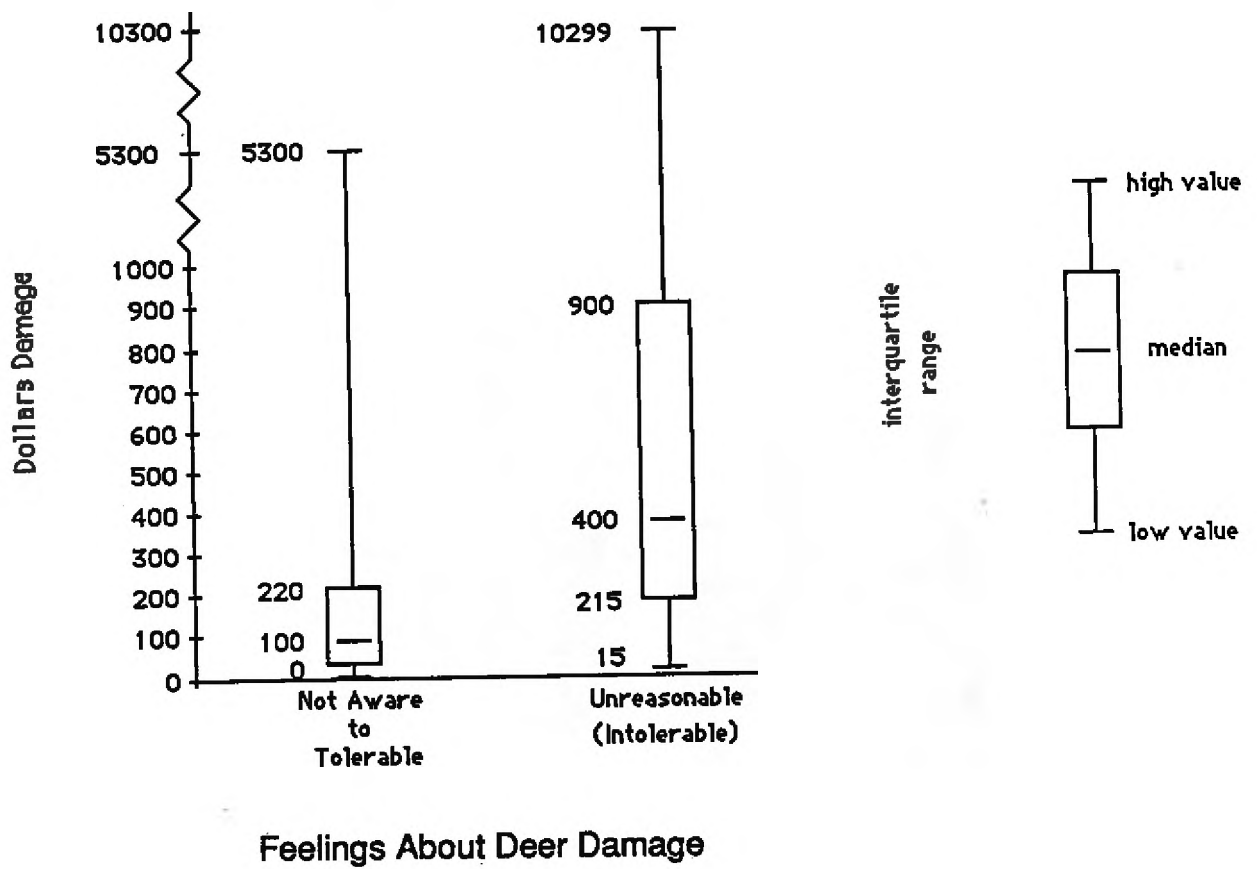


Figure 6. Estimates of total dollars of damage, by tolerance of damage.

interviewed in western and central New York (Purdy et al. in press) reported damage to $\leq 10\%$ of their trees.

The growers also reported that in Westchester County blocks of young (1-5 year old) trees were especially vulnerable to browsing and heavy damage. One grower reported losing 600 new trees in the last 3 years. The other grower had lost an entire block of 500 trees some years before the interview, and had simply stopped planting new apple trees.

Reported damage controls included: chemical repellents, human hair, soap, bow and arrow hunting, and nuisance deer removal permits. Soap, hunting, and nuisance deer removal permits were the only controls used currently.

Neither grower had used deer-proof fencing as a damage control method. Neither felt that fencing would be highly effective because the deer population was too high. Further, they did not feel fencing would be cost effective, since it would have to enclose not just new trees, but the entire orchard.

Both orchardists preferred reducing deer damage through a reduction of the deer population in the county. Yet neither grower felt that this goal could be achieved through bow and arrow hunting. Both growers felt that nuisance deer removal permits were the most effective control available. One grower reported taking approximately 100 deer by special permit. Reportedly, in the last year a neighboring orchardist had also removed 8-10 deer per month using the special permit. They felt that removing these animals, and hanging soap on young trees, had reduced their damage to a moderate level, and allowed continued planting of new tree blocks.

The other orchardist reported taking 6 deer by special permit, and 25 by hunters during the regular hunting season. However, despite using these control measures and soap, he still reportedly received heavy damage.

Residents' Concerns and Attitudes About Deer

The previous study in Islip, NY, reported that concerns such as health and safety risks associated with deer were more important to residents than deer damage (Decker and Gavin 1985). Similar results were found in Westchester County. Overall, 2 to 3 times more respondents expressed concerns about deer-car collisions and Lyme disease⁴ than about plant damage (Table 3). Differences occurred between urban and suburban/rural residents, but by grouping residents by their experience with deer instead of by residential stratum, greater insight is gained into residents' attitudes toward deer and potential reasons for concerns. Among those who reported deer damage, deer-car collisions and Lyme disease were listed more often than damage as a primary deer-related concern. Those who had never seen a deer on their property or who had seen deer but reported no plant damage were more concerned about deer-car collisions than Lyme disease, while those who experienced deer damage were 1 1/2 times more likely to have Lyme disease as their primary concern than deer-car collisions. Thus, from the perspective of a "primary" concern, even for the most affected landowner group (those with deer damage), damage to plantings was a minor consideration compared with the personal health and safety of respondents and their families.

The pervading attitude toward deer among respondents was favorable; 85% enjoyed having deer in their neighborhood. However, over 60% of those who enjoyed deer also worried about problems deer might cause. Only 8% did not enjoy having deer in their area and regarded them as a nuisance. Respondents' general attitude about deer typically was inversely related to their primary

⁴As reference to the questionnaire (Appendix A) will reveal, Lyme disease appeared in only one question and was one of several response options, so no particular emphasis was placed on Lyme disease in the questionnaire itself.

Table 3. Deer-related concerns of Westchester County residents.

<u>Concerns</u>	<u>Westchester County residents</u>		<u>Urban residents</u>		<u>Suburban/rural residents</u>		<u>Never saw deer on property</u>		<u>Saw deer or sign on property</u>		<u>Reported deer damage</u>	
	<u>A concern^a</u>	<u>Primary concern</u>	<u>Primary concern</u>	<u>Primary concern</u>	<u>Primary concern</u>	<u>Primary concern</u>	<u>Primary concern</u>	<u>Primary concern</u>	<u>Primary concern</u>	<u>Primary concern</u>	<u>Primary concern</u>	<u>Primary concern</u>
Deer-car collisions	71	38	30	41	42	53	29					
Lyme disease transmission	63	39	42	38	35	35	44					
Damage to garden and yard plantings	27	6	2	7	0	2	14					
No concerns	15	17	26	14	23	10	14					
		100%	100%	100%	100%	100%	100%					

^aData under this category does not sum to 100% because respondents could give multiple concerns.

concern about deer (Table 4). Generally, those who had no concerns about deer enjoyed them and did not worry about potential problems (73%). Those with concerns about Lyme disease and damage to plantings tended to worry about problems or think deer were a nuisance (81% and 86%, respectively).

Respondents' preferences for future deer population trends in their area can be used as a general indication of their beliefs and attitudes about deer. Using this indicator, almost equal numbers of respondents wanted the population to remain at its current level (42%) or wanted a decrease (40%). The relationship between preferences for future levels and attitudes about deer is presented in Table 5. Those who unconditionally enjoyed deer wanted the population to increase or remain at its current level, while those who enjoyed deer but worried about problems wanted the population to decrease or remain at its current level. Those who thought deer were a nuisance generally wanted a moderate decrease in the population.

Similarly, respondents' primary deer-related concern was related to their future population preferences (Table 6). Those whose primary concern was damage to plantings wanted a decrease in the population (82%). Fewer giving Lyme disease transmission as a primary concern wanted a decrease (45%), and even fewer giving deer-car collisions as a primary concern wanted a decrease (34%). Among those having no concerns, nearly 50% wanted the population to stay the same while 39% wanted an increase.

In summary, people who enjoyed deer and did not worry about problems generally wanted deer numbers to remain at their current levels or increase. People who enjoyed deer but worried about the disease or damage potential, or who considered deer a nuisance, generally wanted fewer deer.

Table 4. Westchester County residents' attitudes about the presence of deer by primary concern.

Primary deer-related concern	Attitude about deer				n
	Enjoy deer, do not worry	Enjoy deer, but worry	Do not enjoy, nuisance	No particular feelings	
	Percent				
Deer-car collisions	43.5	44.2	6.0	6.3	208
Lyme disease transmission	13.6	72.4	8.1	5.9	213
Damage to plantings	12.5	61.2	24.9	1.4	34
No concerns	72.9	9.0	1.1	17.0	92

Table 5. Westchester County residents' preferences for the future deer population trend by their attitude about deer.

Attitude about deer	Preferred deer population trend					n
	Moderate increase	Slight increase	No change	Slight decrease	Moderate decrease	
	Percent					
Enjoy deer, do not worry	27.9	14.7	46.2	8.3	2.9	213
Enjoy deer, but worry	3.1	3.9	42.3	25.1	25.6	332
Do not enjoy, nuisance	0.0	2.9	0.0	10.7	86.4	50
No particular feelings	1.2	3.5	64.3	15.4	15.5	41

Table 6. Westchester County residents' preferences for the future deer population trend by primary concern.

Primary deer-related concern	Preferred deer population trend					n
	<u>Moderate increase</u>	<u>Slight increase</u>	<u>No change</u> Percent	<u>Slight decrease</u>	<u>Moderate decrease</u>	
Deer-car collisions	12.3	7.1	46.4	18.8	15.4	202
Lyme disease transmission	7.5	6.1	41.1	18.0	27.4	207
Damage to plantings	0.0	4.2	13.9	31.9	50.0	34
No concerns	23.1	15.7	49.5	7.9	3.9	86

Value of Westchester County Deer Herd

To estimate the value of the local deer herd to Westchester residents, with regard to deer damage to plantings only, we can derive dollar estimates to correspond to the attitudinal data (a similar method was used in the Islip study [Decker and Gavin 1985]). This can be useful for decision-making; the relative effects of one decision over another can be assessed by impacts on value (i.e., dollars) added or diminished.

The first step in this procedure is assigning a reasonable value of the deer resource to an individual household. For our purposes, we regarded each respondent as representing a household, because the sample was selected based on property-tax records. The positive value of deer to be assigned for each household that reported "I enjoy having deer in my area and I do not worry about problems deer may cause" was determined from our only dollar estimates of deer--plant damage sustained from deer that was considered "tolerable in exchange for having deer around". This measure then was a surrogate for the sum of all the positive values associated with deer. (This does not include societal benefits such as deers' ecological value, scientific value, educational value.) Because the ranges of dollars of damage overlapped for those who considered their damage tolerable and those who considered their damage intolerable, we looked for that level of damage where a threshold occurred. Above the threshold were the majority of people with intolerable damage and below the threshold were the majority of people with tolerable damage. This was at \$220, below which were 75% of those with tolerable damage and above which were 75% of those with intolerable damage (refer back to Fig. 5). We assumed that this value represents the amount of damage people were willing to tolerate in return for having deer in their neighborhood. This then

is a reasonable average value of deer to assign to a typical individual (who is responding for a household) and was used as a base in the remainder of these calculations.

To determine the total positive value of the deer herd to northern Westchester County residents, we multiplied \$220 by the number of households where respondents unconditionally enjoyed deer in their area. To be conservative, we did not include those who enjoyed deer but worried about problems such as Lyme disease or deer/car collisions. Because we did not receive responses from every household in the sample, 2 scenarios were possible. One was that those who did not respond were disinterested in deer (i.e., assigning them a value of 0) and the other (based on no differences between the respondents to the mail survey and respondents to the telephone follow-up) was that those who did not respond were equally as interested in deer. We also calculated the total value of deer once for respondents who had seen deer on their property (n=120) and a second time by also including those who had not seen deer on their property (n=218). The value of deer to households expanded to a northern Westchester County total is shown in Table 7 for all possible assumption combinations.

The costs of the deer herd can be thought of as the total damage incurred by those who considered their damage intolerable minus the tolerable portion of that damage (\$220/household) plus the cost of damage control. This amount expanded to the total northern county population was \$4.0 million (assuming nonrespondents had no deer damage) or \$5.9 million (assuming nonrespondents had a similar amount of damage as respondents).

This amount was then subtracted from the positive value to arrive at a net value under the 4 assumptions presented earlier. It can be seen from Table 8

Table 7. The total value of the deer herd to northern Westchester County residents under 4 different assumptions.

	Nonrespondents Disinterested in Deer (expansion factor = 63.3)	Nonrespondents Interested in Deer (expansion factor = 94.4)
Seen deer on property (n=120)	\$1.7 million	\$2.5 million
Seen + had not seen deer on property (n=218)	\$3.0 million	\$4.5 million

Table 8. The net value of the deer herd to northern Westchester County residents under 4 different assumptions.

	Nonrespondents Disinterested in Deer and No Deer Damage	Nonrespondents Interested in Deer and Had Deer Damage
Seen deer on property	-\$2.3 (\$1.7-\$4.0)	-\$3.4 (\$2.5-\$5.9)
Seen + Had not seen deer on property	-\$1.0 (\$3.0-\$4.0)	-\$1.4 (\$4.5-\$5.9)

that by using any of the assumption combinations at this point in time, the damage caused by deer outweighs the benefits of those deer.

What are some applications of these values and their implications for management decision-making? For example, if the disease hazard could be overcome, and people made to realize (e.g., via an educational-communications program) that by driving carefully, deer-car collisions could be reduced to being a negligible concern, the proportion of those who unconditionally enjoy deer would increase (n=218 to n=562), and thus the value of the deer herd would increase from -\$1.4 million to \$5.7 million (using the assumptions in Table 8 for -1.4 million, $\$220 \times 344$ [increased sample size] $\times 94.4$ [expansion factor] - \$7.1 million + (-1.4) million = \$5.7 million).

Another use of these estimates would be in establishing the level of resources to allocate to a deer damage control program. The cost of the deer herd in terms of intolerable damage (minus the tolerable portion) was \$2.8 million or \$4.1 million. Therefore, an expenditure for deer damage control that results in a reduction of up to \$2.8 million or \$4.1 million (depending on your assumptions) of damage annually would be warranted, as long as the associated costs did not exceed this amount.

Another way of looking at the value of the deer herd is by looking at cost per deer. DEC does not have the data to estimate population size in Westchester County, but a number often quoted in Westchester is 4,000 to 6,000 deer (Merrill 1987). If we divide the intolerable portion of damage (\$2.8 or \$4.1 million) by the number of deer (4,000 to 6,000), we arrive at a cost range of \$467 to \$700/deer (for \$2.8 million) or \$683 to \$1,025 (for \$4.1 million). Recent estimates for various removal techniques used in urban areas suggest a much lower cost to remove deer; e.g., shooting over bait \$73.95/deer and live

removal by dart gun and transfer \$179.05/deer (Ishmael and Rongstad 1984). The most cost-effective method of managing deer would be through regulated recreational hunting. This approach has virtually no cost above that incurred by the individual hunter for licenses, equipment, transportation, etc. Thus a deer herd properly managed through recreational hunting, the approach used for deer population control throughout most of New York south of the Adirondack Region, would have a tremendous net economic benefit in Westchester County.

Obviously, the assumptions made and the procedure used to arrive at the value estimates should be reviewed critically. Nevertheless, we offer this for consideration primarily to raise awareness of a broad concept of costs and benefits associated with the Westchester County deer herd.

Wildlife Attitudes and Values Scale (WAVS)

The senior authors and their colleagues in the Human Dimensions Research Unit, Department of Natural Resources, Cornell University, have developed a Wildlife Attitudes and Values Scale (WAVS) as a standard measurement instrument for classifying people based on their attitudes and beliefs about wildlife (Purdy et al. 1984). This measurement device has consistently identified three dimensions to people's attitudes and beliefs about wildlife, which we believe is a fairly valid indicator of their values relative to wildlife. Because values cannot be "measured" directly, these indicators serve as surrogates.

Using a set of 18 items that are independently evaluated by a respondent using a 5-point Likert Scale (Appendix A, Question 18), an individual's attitudes toward wildlife beliefs can be measured. Previous research has demonstrated that there are three categories of beliefs (Decker 1985):

- (1) wildlife economic/extractive-use beliefs,

- (2) wildlife noneconomic/nonextractive-use beliefs, and
- (3) wildlife problem-tolerance beliefs.

Each of these categories represents response sets for the scale items.

Although the degree of positive or negative attitudes expressed by individuals may vary considerably, factor-analytic techniques have shown that these three categories of beliefs are common and consistent dimensions of how people think about wildlife.

We submitted the data from Westchester County respondents to factor analysis and found that four factors rather than three were identified (Table 9). However, two were identical to our previous (i.e., theoretical) categorizations: wildlife problem-tolerance beliefs, and wildlife economic/extractive-use beliefs. The remaining two factors were a division of wildlife noneconomic/nonextractive-use beliefs, which we have designated as A and B. The wildlife problem-tolerance beliefs and wildlife economic/extractive-use beliefs were the same as in the Islip study; the grouping of noneconomic/non-extractive A and B was slightly different. We found no significant differences between municipal and suburban/rural residents for any of the WAVS items.

Examination of items in the problem-tolerance beliefs portion of the WAVS revealed that respondents generally agreed that they must tolerate various problems caused by deer, except disease risk (Fig. 7). Respondents were less willing to tolerate disease risk than any other problem-tolerance item. This was especially true for those who had recently experienced deer damage; they exhibited a higher intensity of intolerance towards disease risk (Appendix E). This discrepancy indicated that disease may have been a greater concern for these people than damage. Perhaps their damage experience acts as a reinforcement to them of the close proximity of the perceived disease "threat".

Table 9. Wildlife Attitudes and Values Scale (WAVS) dimensions for Westchester County residents.

Wildlife Problem-Tolerance Beliefs

personal hazards
 damage
 nuisance
 disease risk

Wildlife Extractive/Economic-Use Beliefs

hunt for recreation
 hunt for food
 trapping
 renewable resource for human use
 economic benefit to local economies^a

Wildlife Nonextractive/Noneconomic-Use Beliefs

- A) ecological role
 - learning subject
 - existence value
 - art
 - environmental quality indicator
 - behavior study
 - nonextractive recreation
 - B) express opinion to officials
 - vicarious experience
-

^aThis item has consistently loaded highest on this category in the present and past surveys and so was included in the analysis. However, for this primarily suburban/urban audience, there was some indication on the questionnaires that respondents did not understand the potential connection between use of the wildlife resource and local economic benefit vis-a-vis local sale of equipment, supplies or services.

Wildlife Nonextractive/Noneconomic - Use Beliefs - A

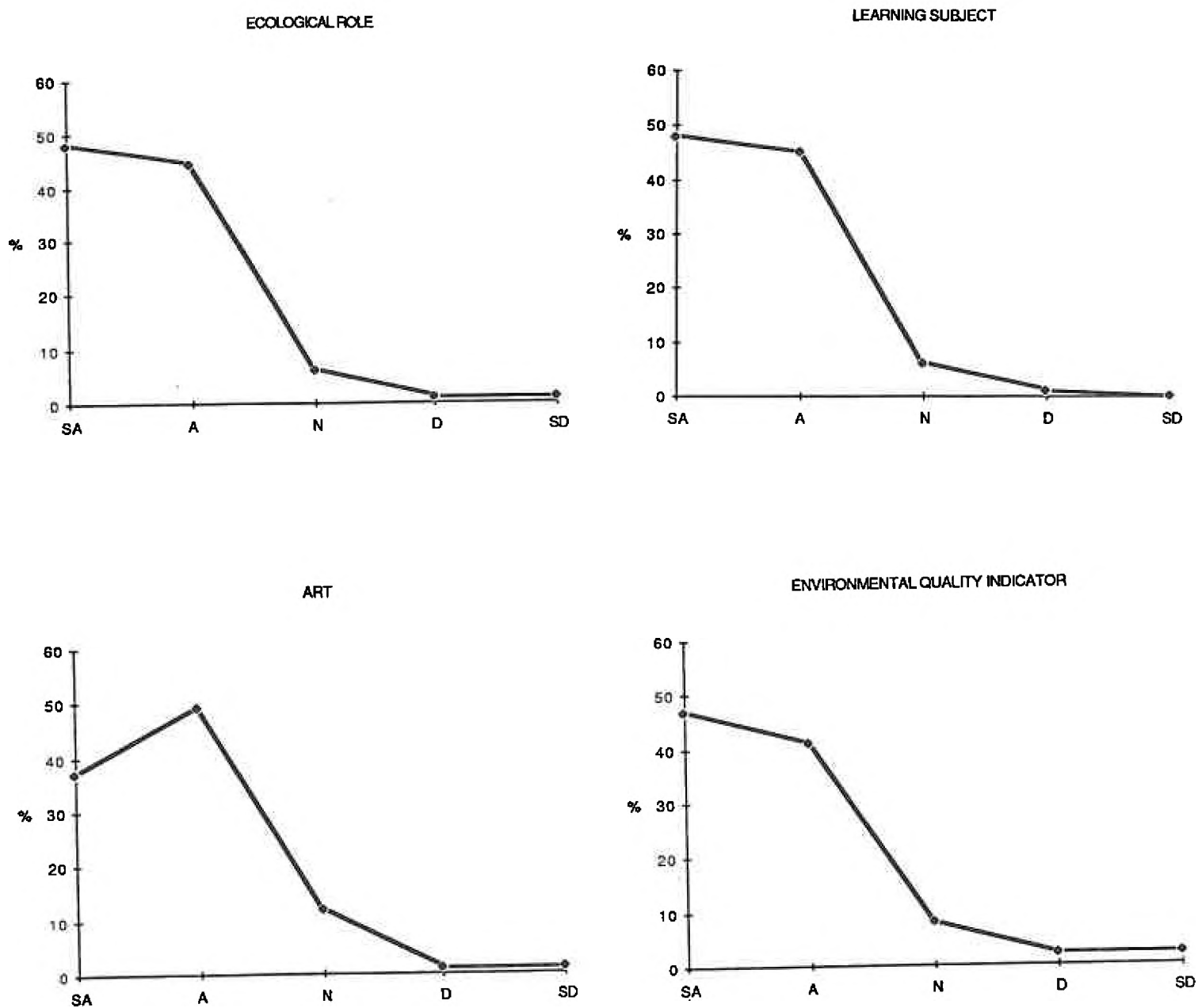
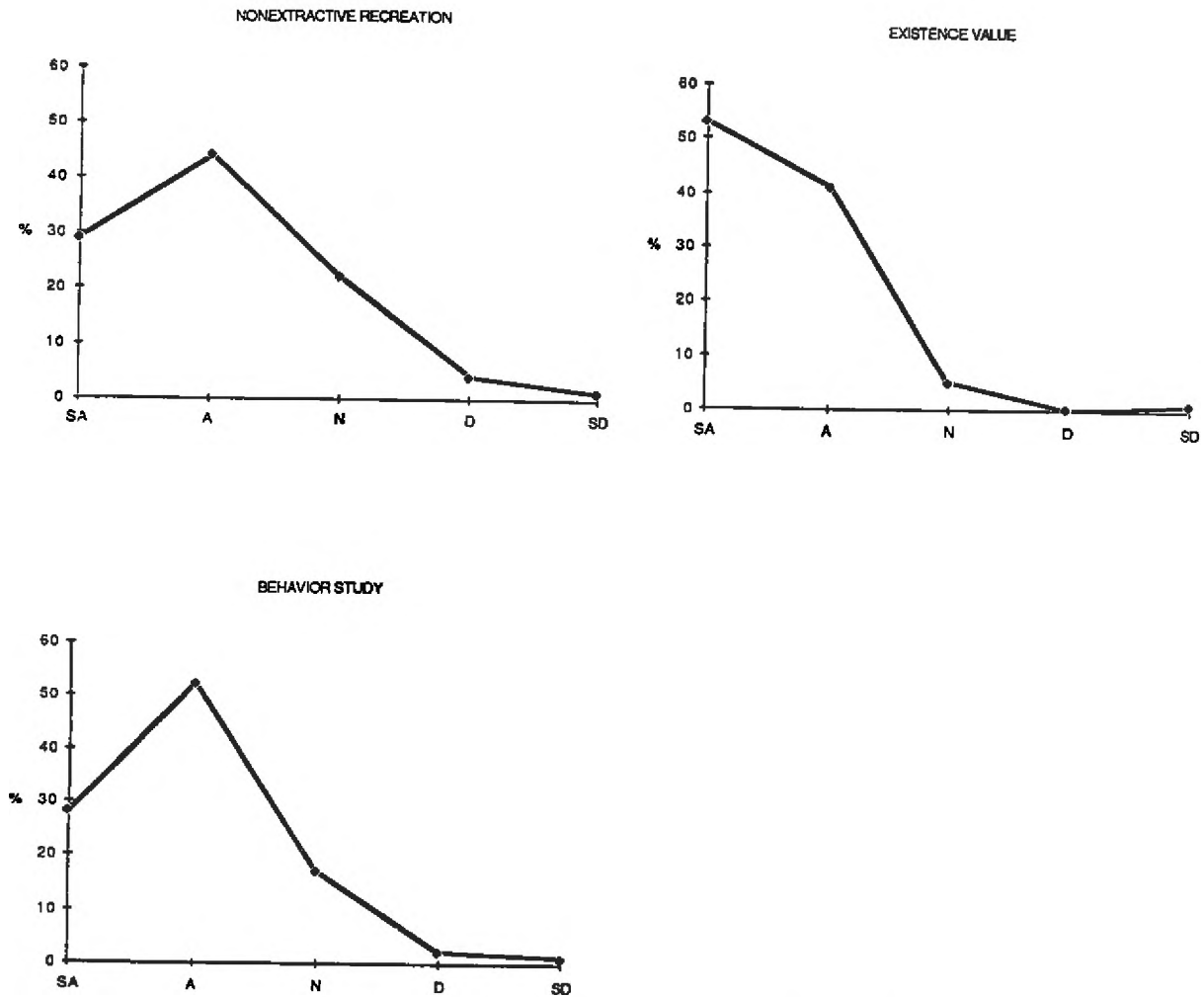


Figure 7. WAVS item response curves (SA = strongly agree, A = agree, N = neither agree nor disagree, D = disagree, SD = strongly disagree).

Figure 7 (continued)

Wildlife Nonextractive/Noneconomic - Use Beliefs - A (cont.)



Wildlife Nonextractive/Noneconomic - Use Beliefs - B

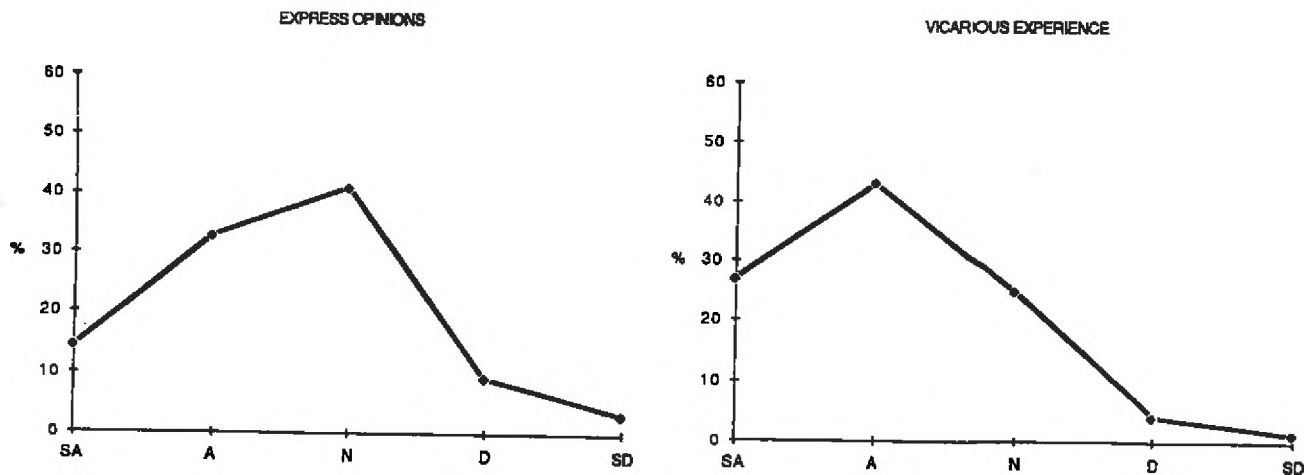


Figure 7 (continued)

Wildlife Extractive/Economic - Use Beliefs

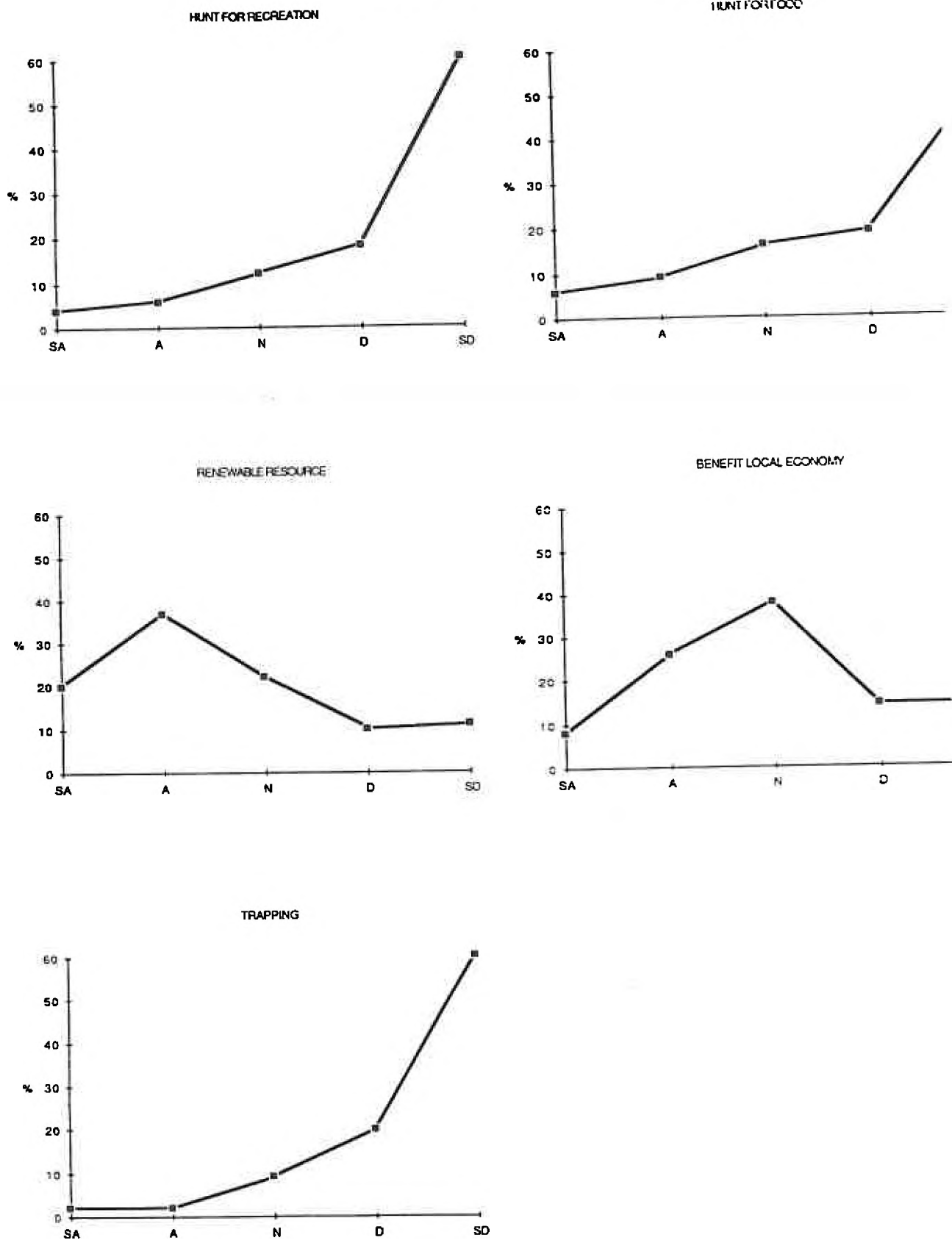
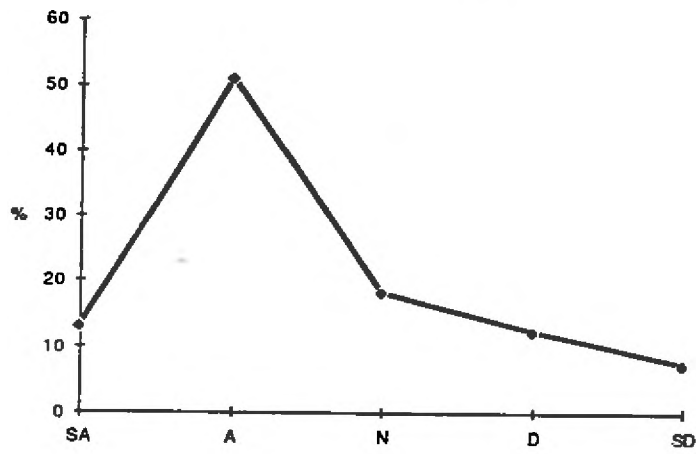


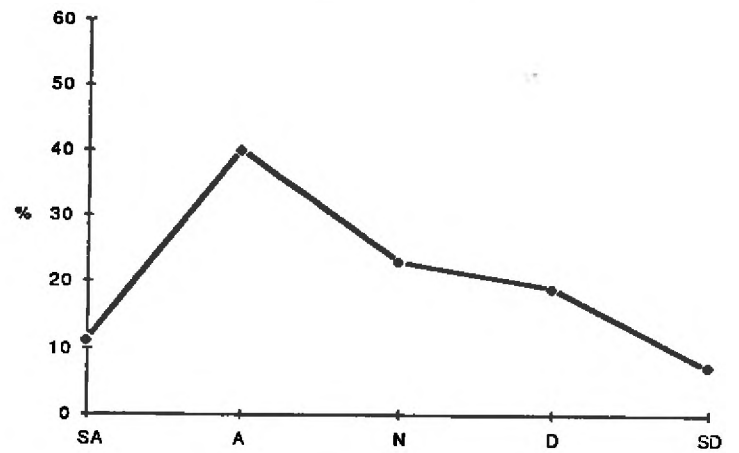
Figure 7 (continued)

Wildlife Problem - Tolerance Beliefs

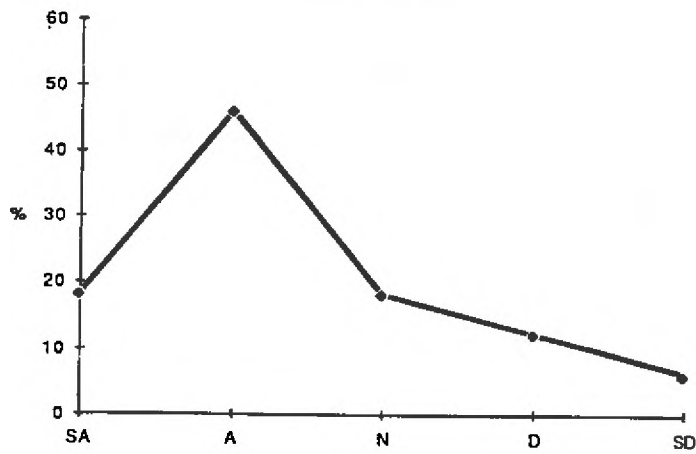
TOLERATE PERSONAL HAZARDS



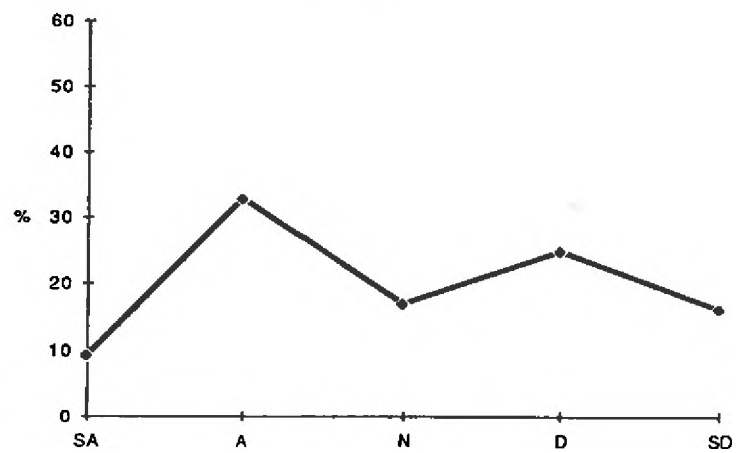
TOLERATE DAMAGE



TOLERATE NUISANCE



TOLERATE DISEASE RISK



This finding was corroborated earlier in Table 3 where respondents with deer damage gave Lyme disease transmission more often as their primary concern than damage to plantings. Also those who had Lyme disease as their primary concern were much less tolerant of the disease risk than those with other concerns (Appendix E).

Overall, respondents exhibited high consensus/moderate-to-very-high intensity attitude scores relative to noneconomic/nonextractive-use beliefs (Fig. 7). This is generally an asset to extension and educational communications programming because it indicates homogeneity of an audience, and diminishes the need for audience segmentations vis-a-vis message content. It is apparent that wildlife is valued by respondents, but primarily for nonextractive values and uses. Fortunately, the concept of wildlife as a renewable resource (part of the extractive/economic-use beliefs) is not contrary to most people's notion of an acceptable basis for wildlife management. This situation encourages the consideration of deer population control to address problems brought on by high densities of deer, but responses indicating the generally low level of personal importance respondents placed on extractive uses such as recreational and meat hunting indicate a low probability of widespread personal involvement in recreational hunting to control deer. This situation is not atypical of other areas of the state where hunting is used to manage deer populations; like Westchester County about 15% of households in other upstate counties of central and western New York have members who hunt. Thus, responses regarding the personal importance of hunting should not be construed as reflecting attitudes about hunting per se. Respondents' beliefs about deer as a renewable resource and their beliefs about hunting and trapping are consistent with their answers to questions about the

need for deer management and hunting as a management technique, discussed in the next section.

Need and Support for Deer Management

The need for deer management in Westchester County was recognized by almost three quarters (72%) of the residents. Those with greater interaction with deer were more likely to see the need for deer management (Table 10). Those with concerns about deer-related problems, especially Lyme disease and damage to plantings, were much more likely to see the need for deer management than those with no concerns.

Apparently, in Westchester County recognition of the need for deer management is not synonymous with support for recreational hunting as a management technique. Of those who recognized a need for deer management, only 44% would support the use of some firearm (i.e., muzzleloader [15%], shotgun [27%], rifle [18%]) during a regulated hunting season. Therefore, slightly less than 30% of all respondents would support the use of some firearms.

Respondents were also given the option of writing in a management technique they would support; 13% mentioned relocation of deer, 5% a longer bow season, and 4% use of "professional" hunters. Other options mentioned by just a few respondents included birth control, euthanasia, feeding the deer, fencing on reserves (enclosures), and increased land access for hunting. Another respondent added, "The only suggestion I can make is to have a period of permit hunting in Westchester County parks of large size and New York City watershed property during which time the general public is prohibited." Determining the suitability of any method of deer population management is a responsibility of

Table 10. Need for deer management in Westchester County by various respondent categories.

	Need for deer management in Westchester County	
	No	Yes
	Percent	
All respondents (n=628)	28.3	71.7
Never saw deer on property*	34.1	65.9
Saw deer or sign on property	37.3	62.7
Reported deer damage	20.1	79.9
Urban residents*	38.3	61.7
Suburban/rural residents	25.4	74.6
Hunted last year*	13.4	86.6
Did not hunt last year	30.8	69.2
<u>Primary Concern*</u>		
Deer-car collisions	28.8	71.2
Lyme disease transmission	20.8	79.2
Damage to plantings	8.4	91.6
No concern	50.1	49.9

*Statistically significant difference found using the chi-square test at the $P \leq 0.05$ level.

professional wildlife managers, but these data provide an indication of the public acceptability of such methods.

Although differences in support for deer management were found between people with greater exposure to deer, this did not carry over to support for recreational hunting. There were no statistically significant differences in support for hunting between urban and suburban/rural respondents or those with varying levels of exposure to deer (Table 11). Even those whose primary concern was either Lyme disease or damage to plantings were no more likely to support hunting than those without concerns.

Examination of the extractive/economic-use beliefs of these respondents provides some insight into potential support or opposition to hunting. A high intensity, high consensus on the unimportance of hunting for food or recreation for respondents personally was shown by those who were opposed to recreational hunting in Westchester County (Fig. 8). Those who would find hunting acceptable were more likely to regard deer as a renewable resource, but even of those opposed to hunting over 50% regarded wildlife as a renewable resource.

Logistic Regression - A Way to Better Understand Residents' Attitudes About Deer and Support for Deer Management

To help managers gain a better understanding of the relative importance of various factors to people's (1) attitudes about deer and (2) support for deer management, logistic regression was used to analyze the influence of key variables on those dependent variables. This procedure is useful in providing an estimate of the relative potential effects of changes in factors influencing these opinions. Of greatest interest are those factors that can be manipulated by management or educational-communications programming.

Table 11. Various respondent groups, who support deer management, by whether or not they would support some form of recreational hunting.

	<u>Support some form of recreational hunting</u>	
	<u>No</u>	<u>Yes</u>
	<u>Percent</u>	
All respondents (n=423)	56.2	43.8
Never saw deer on property	52.8	47.2
Saw deer or sign on property	56.7	43.3
Reported deer damage	59.0	41.0
Urban residents	51.5	48.5
Suburban/rural residents	57.4	42.6
<u>Primary Concern</u>		
Deer-car collisions	57.7	42.3
Lyme disease transmission	53.3	46.7
Damage to plantings	56.7	43.3
No concerns	60.0	40.0

Wildlife Extractive/Economic - Use Beliefs

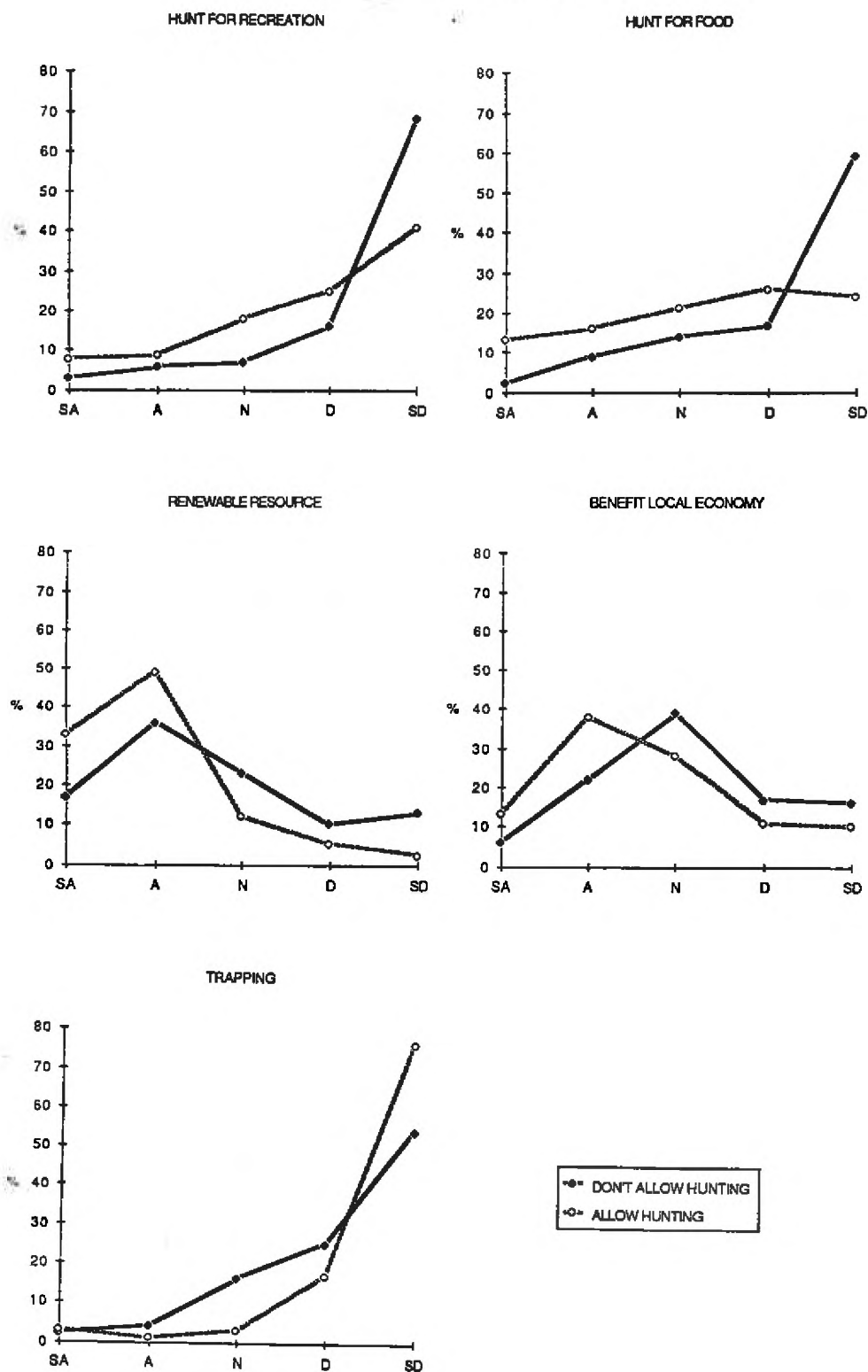


Figure 8. Wildlife extractive/economic use beliefs by support for recreational hunting in Westchester County (SA = strongly agree, A = agree, N = neither agree nor disagree, D = disagree, SD = strongly disagree).

Attitudes Toward Deer

The best logistic regression model of the probability of having an unconditionally positive attitude about the presence of deer (i.e., "I enjoy having deer in my area and I do not worry about problems deer may cause.") included 4 independent variables, all significant ($P \leq 0.01$). The model was:

$$\log \frac{P_i}{(1-P_i)} = 2.91 - 1.61\text{LYME} - 1.01\text{PROB} + 1.70\text{NOCON} - 0.65\text{AMTDAM} + u$$

where:

P_i = probability that a resident will unconditionally want deer in his/her area,

LYME = variable indicating whether respondent had Lyme disease as a concern,

PROB = respondent's problem tolerance scale score mean from WAVS,

NOCON = variable indicating whether respondent had no concerns about deer,

AMTDAM = variable indicating how respondents describe the amount of deer damage to their property,

u = an error term.

The R statistic for the model, which is similar in interpretation to the multiple correlation coefficient in linear regression after being corrected for the number of parameters estimated, was 0.577. The model correctly predicted 80.4% of all cases -- 62.1% of those with the positive opinion, and 90.4% of those not of this opinion. The best predictive statistic (Harrell 1983), the fraction of concordant pairs of predicted probabilities and responses, was 0.724. That is, of all possible pairs of respondents that included one who enjoyed deer and did not worry and one who did worry, the model predicted correctly for 72.4% of the pairs a higher probability of enjoying deer and not worrying for the respondent who actually gave this response.

Examination of the model indicates that concern about Lyme disease, the amount of deer damage, and problem tolerance beliefs have a negative effect on unconditional enjoyment of deer. Only those with no concerns about deer have a positive effect on unconditional enjoyment of deer.

There are several avenues of educational-communications one might pursue to increase the number of respondents who enjoy deer unconditionally; one would be increasing the number of respondents with no concerns, another would be reducing the amount of damage or a third would be reducing the number of people concerned about transmission of Lyme disease by deer. In this model reducing the number of people concerned about Lyme disease would be the most effective in increasing the number who enjoy deer unconditionally. If an educational-communications program to alleviate concerns about Lyme disease was implemented, and was moderately successful to the point where 30% (rather than 63%) of residents gave Lyme disease as a concern, the probability of residents who would enjoy deer unconditionally would rise from 31% to 43%.

The independent variables included in this model were very similar in content to the variables in a similar model used in the Islip suburban deer study (Decker and Gavin 1985). Respondents' enjoyment of deer were affected by their concerns about Lyme disease, deer damage and problem tolerance beliefs. A variable representing people with no concerns was not available in the Islip study but a surrogate which was believed to represent people with no concerns did enter the model.

Attitudes Toward Deer Management

The best logistic regression model of the probability of seeing the need for deer management in Westchester County included 4 variables, all significant ($P \leq 0.01$). The model was:

$$\log \frac{P_i}{(1-P_i)} = 2.26 + 0.44\text{FTREND} - 0.68\text{EXTRACT} - 0.56\text{NONEXTRACTB} + 0.74\text{OPIN} + u$$

where:

P_i = probability that a resident will see the need for deer management in Westchester County,

FTREND = variable indicating respondent's desire for future trend in deer population,

EXTRACT = resident's extractive/economic scale score mean from WAVS,

NONEXTRACTB = resident's nonextractive/noneconomic - B scale score mean from WAVS,

OPIN = resident's opinion of unconditionally wanting deer in his/her area,

u = an error term.

The R statistic for the model was 0.374. The model correctly predicted 74.8% of all cases -- 91.8% of those wanting deer management, but only 29.7% of those not seeing a need for deer management. The fraction of concordant pairs of predicted probabilities and responses was 0.526.

This model predicts that as respondents' concerns about deer increased (FTREND and OPIN) their preference for deer management also increased. Also if they believed in the extractive/economic use of wildlife they were more likely to see a need for deer management. This coincides with our earlier finding that most people recognize deer as a renewable resource and thus favor deer management. The only disturbing aspect of this model is its inability to predict correctly those who do not see a need for deer management. Some

explanation may be possible after examining the next model which predicts support for hunting as a management technique.

Attitudes Toward Hunting

The best logistic regression model of the probability of favoring hunting (with guns) as a management technique in Westchester County included 1 significant ($P \leq 0.001$) variable. The model was:

$$\log \frac{P_i}{1-P_i} = 3.21 - 0.98\text{EXTRACT} + u$$

where:

P_i = probability that a resident will favor hunting as a management technique,

EXTRACT = resident's extractive/economic scale score mean from WAVS,

u = an error term.

The R statistic for the model was 0.328. The model correctly predicted 67.8% of all cases -- 79.5% of those supporting hunting, 52.8% of those opposed to hunting. The fraction of concordant pairs of predicted probabilities and responses was 0.467.

This is a weak model with only 1 variable predicting support for hunting in Westchester County, extractive/economic use beliefs. As a person exhibits more positive extractive/economic use beliefs the probability that they will support hunting increases. No other variables such as deer damage to plants or concerns about Lyme disease affect a respondent's support for deer hunting. Thus hunting and deer management (to a certain extent) are affected by beliefs about wildlife which might be very difficult to alter through traditional educational-communications programs.

As with any model of this sort, those reported above should be viewed with appropriate caution in light of their many limitations. Nevertheless, they do provide potential explanations for support for management and help put realistic expectations on the extent of change that might be expected from an educational-communications program.

CONCLUSIONS AND IMPLICATIONS

The various dimensions of managing the deer herd in northern Westchester County are challenging and complex. The analysis presented in this report provides insight into the impact of deer on the county, and on the experiences, perceptions, concerns, and preferences of residents relative to deer and deer management. Furthermore, identification of residents' beliefs and attitudes about wildlife generally provides managers and planners with valuable information for communication planning.

It is apparent that deer in Westchester County cause some residents real problems. The estimated cost of damage to plantings is quite high, \$6.4 million to \$9.5 million (depending on your assumptions about nonrespondents). This does not include all costs (e.g., vehicular accidents) associated with deer. Our findings show that health and safety risks are more of a concern to county residents than damage to plantings. Although deer have many positive values our rough economic cost/benefit analysis shows that currently the costs (risk of disease or accident, cost of damage) outweigh the benefits. Commercial orchardists also believe that the benefits associated with maintaining the deer population at its current level were exceeded by the costs of orchard damage. Furthermore, the more exposure to deer residents have, through sightings on their property or deer damage, the more likely they are to be concerned about Lyme disease.

Thus, along with increased exposure to deer and increased concern about deer, comes the acceptance of the idea of deer management. Over 70% of respondents felt there was a need for deer management in the county, and 40% of respondents wanted a decrease in the deer population. However, support for the

traditional technique of recreational hunting was not so evident. Whether or not a resident supported recreational hunting was based more on their underlying values and beliefs about extractive uses of the resource than their experience with deer or deer damage. This situation may create a real dilemma for wildlife managers.

There are also implications here for education and communication. Programs could address concerns such as deer/vehicle collisions (e.g., safe driving techniques along County parkways, time of year/day when deer are most mobile) or Lyme disease (e.g., the real role of deer in Lyme disease transmission, symptoms of the disease, tick identification). Some of the benefits possible with such programs in terms of increased enjoyment of deer were outlined earlier in the report.

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APPENDICES

APPENDIX A:
MAIL QUESTIONNAIRE

DEER AND YOUR COMMUNITY

A Survey of Residents of Westchester County



**DEER AND YOUR COMMUNITY:
A SURVEY OF RESIDENTS OF
WESTCHESTER COUNTY**

conducted by the

Department of Planning

Westchester County

and

Department of Natural Resources

New York State College of Agriculture and Life Sciences

Cornell University

This survey has been developed to help planners and state wildlife biologists studying the white-tailed deer herd in Westchester County. We are interested in learning more about local residents' interests in, contact with, and concerns about the deer herd. Information supplied by you will help broaden our perspectives about the deer resource and how it might be managed. Understanding the interaction of deer and people is an important aspect of the overall planning effort.

Your opinions about deer are of interest to us even if you have not seen a deer in your area. Please fill out this questionnaire and return it to us as soon as possible. Return postage has been provided.

Your cooperation in this study will be greatly appreciated.

THANK YOU FOR YOUR ASSISTANCE.

1. How long have you resided at your current address? (If it has been less than one year, please give fraction of year.)

____ years

2. Please describe your property by indicating on the following checklist those items you had on your property during the last 12 months: (Check all that apply.)

____ vegetable garden

____ flower garden

____ fruit tree(s) (please indicate how many: ____ fruit trees)

____ shrubs and other woody ornamentals (how many?: ____ shrubs/
ornamentals)

3. Have you seen a deer in Westchester County within the last 5 years?

____ no (Skip to Question 5)

____ yes

4. Over the past 5 years, what trend have you seen in deer numbers in Westchester County? (Check one.)

____ more deer now than 5 years ago

____ fewer deer now than 5 years ago

____ about the same number of deer now as 5 years ago

____ don't know

5. Have you seen deer or evidence of deer on your property in the last 12 months? (Check all that apply.)

____ saw a deer on my property

____ saw a deer feeding on my property

____ saw evidence of where deer had been feeding on my property

____ never saw deer or evidence of deer feeding on my property

****If you have never seen deer feeding or evidence of deer feeding on your property, skip to question 13.****

6. Please indicate below the types of plants deer appeared to be feeding on in the last 12 months by checking (✓) the box to the left of the item. Then indicate the percent of the total number of plants that received any type of damage.

<u>(✓) Types of Plants</u>	<u>Extent of Damage</u>
_____ garden vegetables	% damaged= _____%
_____ flowers	% damaged= _____%
_____ fruit trees	% damaged= _____%, number of trees damaged= _____
_____ shrubs or other woody ornamental plantings	% damaged= _____%, number of shrubs damaged= _____

7. If any plantings had to be replaced or currently need to be replaced because of deer damage to them in the past 12 months, please give your estimate of the total cost for replacement.

<u>(✓) Types of Plants</u>	<u>Estimated Cost of Replacement</u> (whether or not you have actually incurred the cost)
<u> </u> garden vegetables	\$ <u> </u>
<u> </u> flowers	\$ <u> </u>
<u> </u> fruit trees (how many? <u> </u>)	\$ <u> </u>
<u> </u> shrubs or other woody ornamental plants (how many? <u> </u>)	\$ <u> </u>

- 8. Have you ever reported deer damage to plantings on your property?**

_____ no
_____ yes

If "yes", to whom have you reported deer damage?

_____ municipal authorities

_____ Westchester County (please specify branch of government: _____)

____ New York State Department of Environmental Conservation

 Cooperative Extension

____ other (please specify: _____)

9. Have you taken any steps to protect your plantings from deer damage?

___ no

___ yes

If "yes", what measures have you taken?

___ repellents

___ scare devices

___ fencing

___ other (please specify: _____)

In the last 12 months, how much have you spent on deer damage control (do not include replacement of damaged plants)?

\$_____ in the last 12 months.

10. From whom have you sought damage control information? (Check all that apply.)

___ no one

___ New York State Department of Environmental Conservation

___ Cooperative Extension

___ Westchester County

___ commercial pest control operators

___ retailers of materials and supplies for control

___ landscape service

___ other (please specify: _____)

11. Overall, how would you describe the amount of deer damage to your property within the last 12 months? (Check one.)

___ none

___ light damage

___ moderate damage

___ substantial damage

___ severe damage

12. How do you feel about the amount of damage your property received from deer in the past 12 months? (Check one.)

☐ not aware of any damage
☐ the amount of damage was negligible
☐ the amount of damage was tolerable in exchange for having deer around
☐ the amount of damage was unreasonable

13. Please check (✓) any of the items below that are a concern you or your family have about deer in your area? (Check all that apply.)

☐ deer/car collision
☐ Lyme disease transmission
☐ damage to vegetable garden
☐ damage to yard plantings
☐ no concern

****Please circle the one item above that you are most concerned about.****

14. Generally, how do you feel about having deer in your area? (Check one.)

☐ I enjoy having deer in my area AND I do not worry about problems deer may cause.
☐ I enjoy having deer in my area BUT I worry about problems deer may cause.
☐ I do not enjoy having deer in my area and regard them as a nuisance.
☐ I have no particular feelings about deer.

15. Please indicate below whether you would like deer populations in your area to increase, decrease, or remain at their present level. (Check one.)

☐ moderately increase deer populations
☐ slightly increase deer populations
☐ maintain deer populations similar to present levels
☐ slightly decrease deer populations
☐ moderately decrease deer populations

16. Do you feel there is a need for deer management (either to increase, decrease, or maintain stable population numbers) in Westchester County?

___ No (Skip to Question 18)

___ Yes

17. Research and experience have shown that the current hunting of deer by long-bow only in Westchester County is an ineffective method for managing deer herd size. If a situation arises where deer herd size needs to be limited, which of the management techniques used elsewhere in New York State would you support for limiting deer herd size in Westchester County? (Check all that apply.)

___ use of muzzleloading firearm during a regulated hunting season

___ use of shotgun during a regulated hunting season

___ use of rifle during a regulated hunting season

___ other (please specify: _____)

___ none of these is acceptable

18. People differ in the ways they interact with wildlife. Some of these ways are listed below. Please indicate how you feel about the following by your agreement or disagreement with each statement. (Indicate your responses for each statement by checking (✓) the appropriate category.)

IT IS IMPORTANT FOR ME PERSONALLY:

That I talk about wildlife with family and friends.....

Strongly Agree
Agree
Neither Agree Nor Disagree
Disagree
Strongly Disagree

() () () () ()

That I observe or photograph wildlife...

() () () () ()

That I tolerate most wildlife nuisance problems.....

() () () () ()

That I trap furbearing animals for the sale of furs or pelts.....

() () () () ()

That I consider the presence of wildlife as a sign of the quality of the natural environment.....

() () () () ()

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
That I hunt game animals for recreation..	()	()	()	()	()
That I see wildlife in books, movies, paintings, or photographs.....	()	()	()	()	()
That I tolerate most levels of property damage by wildlife.....	()	()	()	()	()
That I express opinions about wildlife and their management to public officials or to officers of private conservation organizations.....	()	()	()	()	()
That I know that wildlife exist in nature	()	()	()	()	()
That I tolerate the ordinary risk of wildlife transmitting disease to humans or domestic animals.....	()	()	()	()	()
That I hunt game animals for food.....	()	()	()	()	()
That local economies benefit from the sale of equipment, supplies, or services related to wildlife recreation.....	()	()	()	()	()
That I appreciate the role that wildlife play in the natural environment.....	()	()	()	()	()
That wildlife are included in educational materials as the subject for learning more about nature.....	()	()	()	()	()
That game animals are managed for an annual harvest for human use without harming the future of the wildlife population.....	()	()	()	()	()
That I tolerate the ordinary personal safety hazards associated with some wildlife.....	()	()	()	()	()
That I understand more about the behavior of wildlife.....	()	()	()	()	()

The following personal information will be kept strictly confidential and is never associated with your name.

19. In what year were you born?

19__

20. What is your sex?

___ male

___ female

21. Please circle the highest grade or year of schooling you have completed:

Elementary School: 1 2 3 4 5 6 7 8

High School: 9 10 11 12

College: 1 2 3 4 5 6 7 8 years or more

22. Which of the following wildlife-related activities have you or members of your household participated in during the last 12 months? (Check all that apply.)

___ wildlife observation

___ trapping

___ hunting

___ wildlife photography

___ bird feeding

___ wildlife painting/drawing/carving

___ deer feeding

23. Are you a member of any conservation or environmental organization (such as National Wildlife Federation, Sportsmen's Club, Sierra Club)?

___ no

___ yes

If "yes", which one(s)? _____

24. What is the size of your property?

_____ less than 1 acre (Skip to Question 27)

_____ 1 acre or more (please specify: _____ acres)

25. Was your property posted during deer hunting season in 1986?

_____ no

_____ yes

26. Which of the following groups would you usually allow to hunt deer on your property? (Check all that apply.)

_____ no one

_____ your family

_____ friends and neighbors

_____ strangers who ask permission

27. Please use the space below for any other comments or observations you may have about deer in your area.

THANK YOU FOR YOUR TIME AND EFFORT.

TO RETURN THIS QUESTIONNAIRE, simply seal it and deposit it in any mailbox.
Return postage has been provided.



Westchester County

000133



County of Westchester
Department of Planning
Room 432, Michaelian Office Building
148 Martine Ave.
White Plains, New York 10601

APPENDIX B:
MAIL SURVEY COVER LETTERS
AND FOLLOW-UP LETTERS



ANDREW P. O'ROURKE
County Executive

DEPARTMENT OF PLANNING

PETER Q. ESCHWEILER, AICP
Commissioner

JOSEPH R. POTENZA, AICP
Deputy Commissioner

March 1987

Dear Westchester County Resident:

We need your help in completing the enclosed survey by the Westchester County Department of Planning and Cornell University to learn more about the White-tailed Deer herd in Westchester County. We need information about our county residents' interest in, contact with, and concerns about the deer. Information supplied by you will help broaden our perspectives about these deer and how they might best be managed in Westchester County. Your opinions about deer are of interest to us even if you have not seen deer in your immediate neighborhood.

You may be assured of complete confidentiality. The questionnaire has an identification number on it for mailing purposes only. This is so we may check your name off the mailing list when your questionnaire is returned. Your name and address will never be associated with your reply and will never be made available to anyone. Data will be analyzed at Cornell University and reported in aggregate summary statistics.

Your cooperation in this study is greatly appreciated.

Sincerely,

Peter Q. Eschweiler
Commissioner of Planning
Westchester County



ANDREW P. O'ROURKE
County Executive

DEPARTMENT OF PLANNING

PETER Q. ESCHWEILER, AICP
Commissioner

JOSEPH R. POTENZA, AICP
Deputy Commissioner

March 1987


Dear Westchester County Resident:

Last week we mailed you a questionnaire asking for your opinion of and interest in the White-tailed Deer herd in Westchester County.

If you have already completed and returned the questionnaire, please accept our sincere thanks for your help. If you have not yet completed it, please do so today. The questionnaire was sent to a randomly selected but representative group of Westchester County residents. We need your response for the survey to accurately represent all Westchester County residents.

Thanks again for your cooperation.

Sincerely,



Peter Q. Eschweiler
Commissioner of Planning
Westchester County



ANDREW P. O'ROURKE
County Executive

DEPARTMENT OF PLANNING

PETER Q. ESCHWEILER, AICP
Commissioner

JOSEPH R. POTENZA, AICP
Deputy Commissioner

March 1987

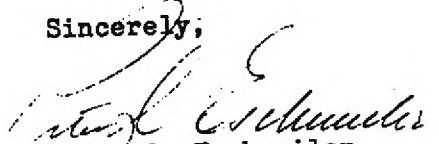
Dear Westchester County Resident:

About 3 weeks ago we sent you a questionnaire that sought your opinions about and interest in the deer herd in Westchester County. If you have already completed and returned it to us please accept our sincere thanks. If you have not yet done so, please take the time to complete it today.

We are interested in learning more about county residents' interests in, contact with, and concerns about the deer herd living in Westchester County. Information supplied by you will help broaden our perspectives about these deer and how they might best be managed in Westchester. Your opinions about deer are of interest to us even if you have not seen a deer in your immediate neighborhood.

Your cooperation in completing the questionnaire will be appreciated. You may be assured of complete confidentiality. Your name and address will never be associated with your response to the questions. In the event your questionnaire has been misplaced, a replacement is enclosed. Postage has been provided. Simply seal it and drop it into any mailbox.

Sincerely,


Peter Q. Eschweiler
Commissioner of Planning
Westchester County



ANDREW P. O'ROURKE
County Executive

DEPARTMENT OF PLANNING

PETER Q. ESCHWEILER, AICP
Commissioner

JOSEPH R. POTENZA, AICP
Deputy Commissioner

April 1987

Dear Westchester County Resident:

I am writing about our study of Westchester County residents' interests in, contact with, and concerns about your local deer herd. We have not yet received your completed questionnaire.

The large number of questionnaires returned to date is very encouraging. But, whether we will be able to describe accurately how Westchester County residents feel about the local deer herd depends on you and others who have not yet responded. This is because our past experiences suggest that those who have not yet sent in questionnaires may hold quite different views than those who returned their questionnaires early.

I am writing to you again because of the significance each and every questionnaire has to the usefulness of this study. To ensure that the results of this study faithfully represent public opinion, it is important for us to know how you feel about deer and their management in Westchester County. Your response is important no matter what your feelings or experiences are.

Your contribution to the success of this study will be greatly appreciated. Please return your survey form today!

Sincerely,

Peter Q. Eschweiler
Commissioner of Planning
Westchester County

APPENDIX C:
COMPARISONS WITH 1980 CENSUS DATA

Table C-1. Comparison of survey audience with 1980 Census Data for appropriate age subgroups and educational attainment.

<u>Age Groups</u>	<u>Urban</u>		<u>Suburban/rural</u>	
	<u>1980 Census</u>	<u>Survey Audience</u>	<u>1980 Census</u>	<u>Survey Audience</u>
	<u>Percent</u>			
22-29	20.3	3.0	15.0	3.4
30-59	54.4	65.3	64.3	75.2
60+	<u>25.3</u>	<u>31.7</u>	<u>20.7</u>	<u>21.4</u>
	100.0	100.0	100.0	100.0
<u>Highest Education Level for Persons Age 25+</u>				
1-3 years college	13.9	20.9	17.3	19.8
4 or more years college	25.1	44.4	35.0	53.2

APPENDIX D:
ORGANIZATIONAL MEMBERSHIP

Table D-1. Respondents' membership in various environmental organizations (minimum reported is 2 respondents).

<u>Organization</u>	<u>Respondents Who Belonged</u>
National Wildlife Federation	44
National Audubon	21
Nature Conservancy	18
Sierra Club	12
National Rifle Association	9
Greenpeace	8
Teatown Reservation	8
Adirondack Mountain Club	7
Trout Unlimited	4
Local Fish & Game Clubs	3
Hudson River Keepers	3
National Parks Association	3
Humane Society	3
Save The Whales	2
World Wildlife Fund	2
Museum of Natural History	2
Ducks Unlimited	2

APPENDIX E:

WILDLIFE PROBLEM TOLERANCE RESPONSE DISTRIBUTION CURVES

Wildlife Problem - Tolerance Beliefs

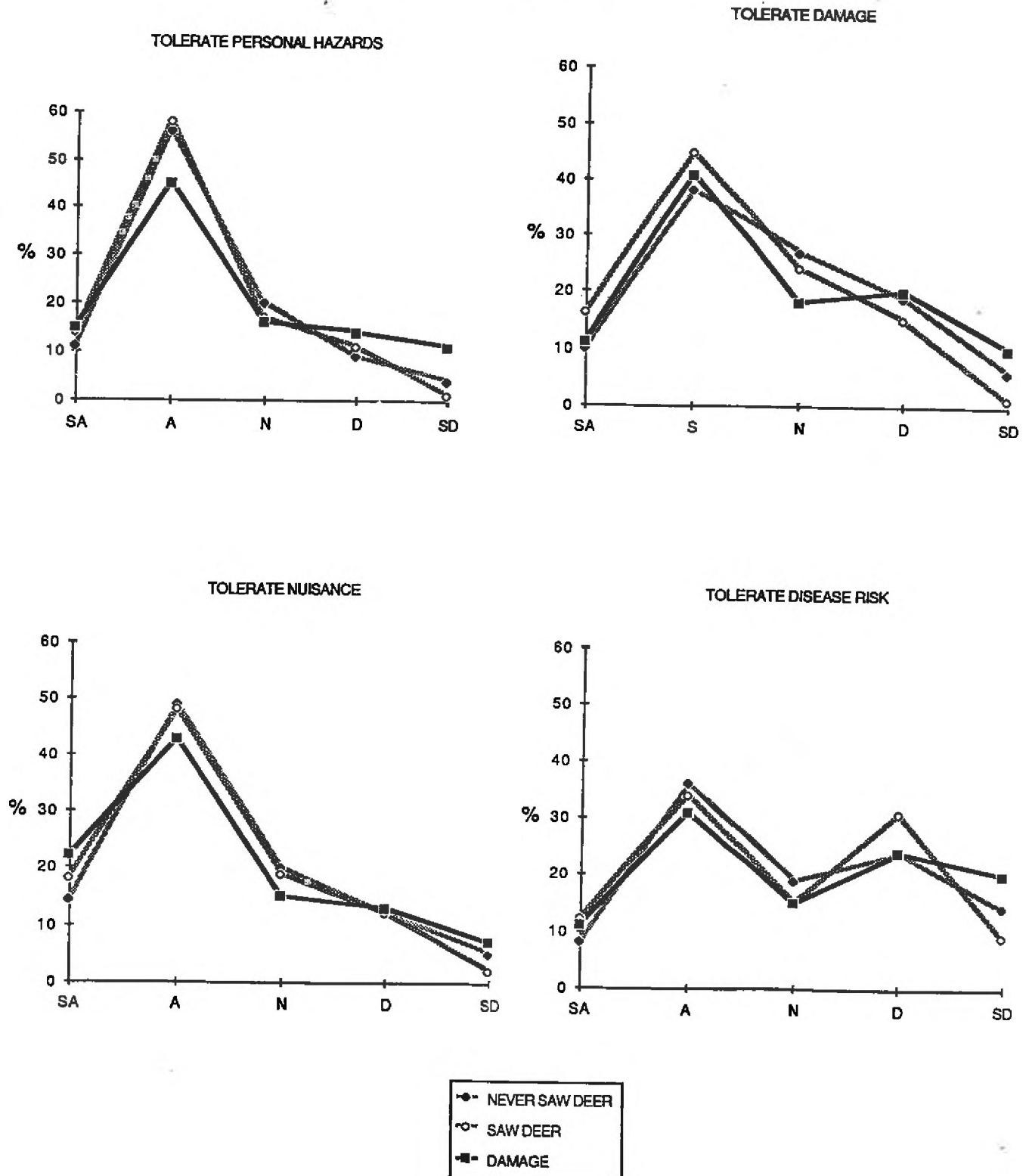


Figure E-1. Wildlife Problem Tolerance Beliefs by Experience with Deer (SA = Strongly Agree, A = Agree, N = Neither Agree nor Disagree, D = Disagree, SD = Strongly Disagree).

Wildlife Problem - Tolerance Beliefs

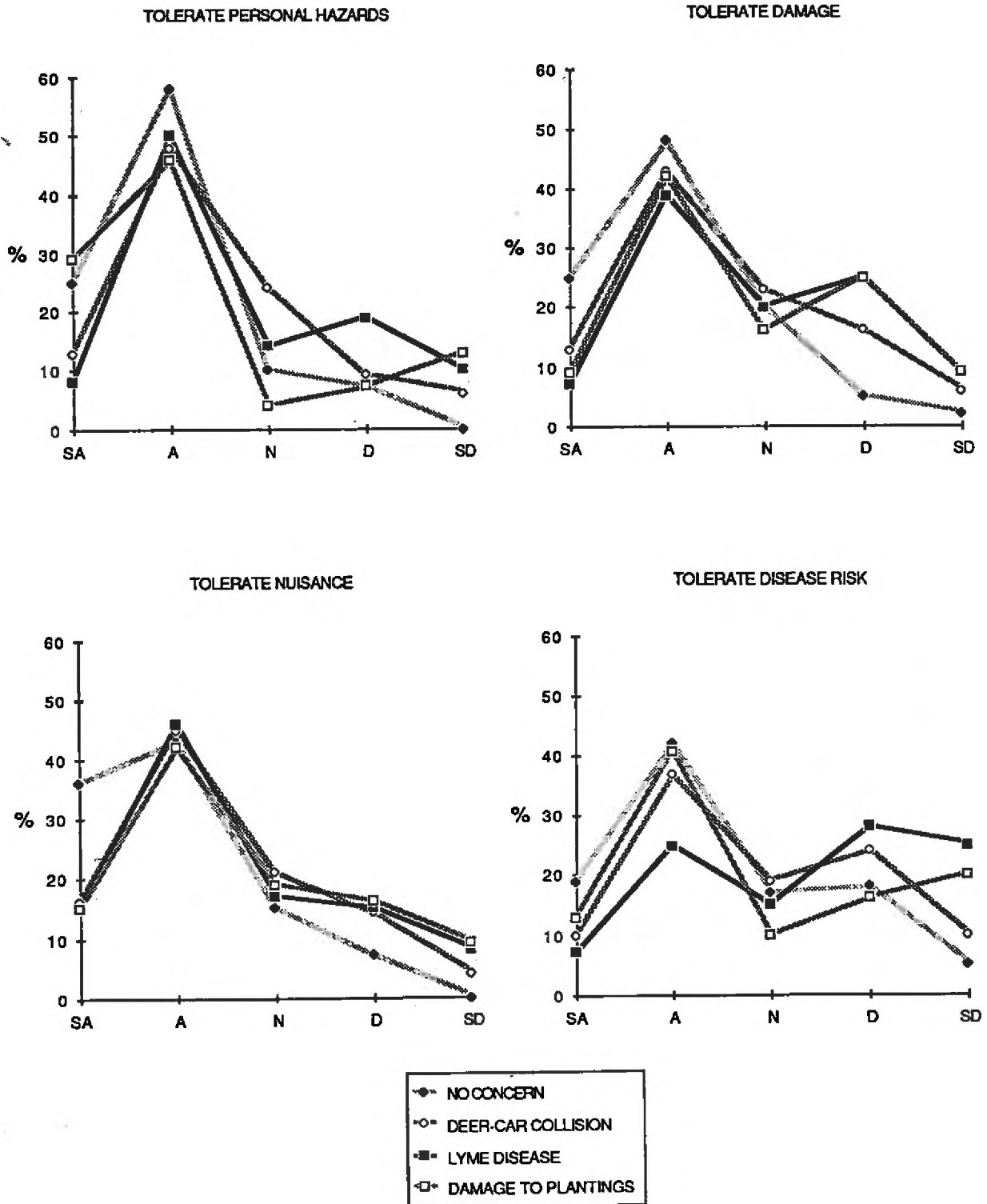


Figure E-2. Wildlife Problem Tolerance Beliefs by Primary Deer-related Concern (SA = Strongly Agree, A = Agree, N = Neither Agree nor Disagree, D = Disagree, SD = Strongly Disagree).