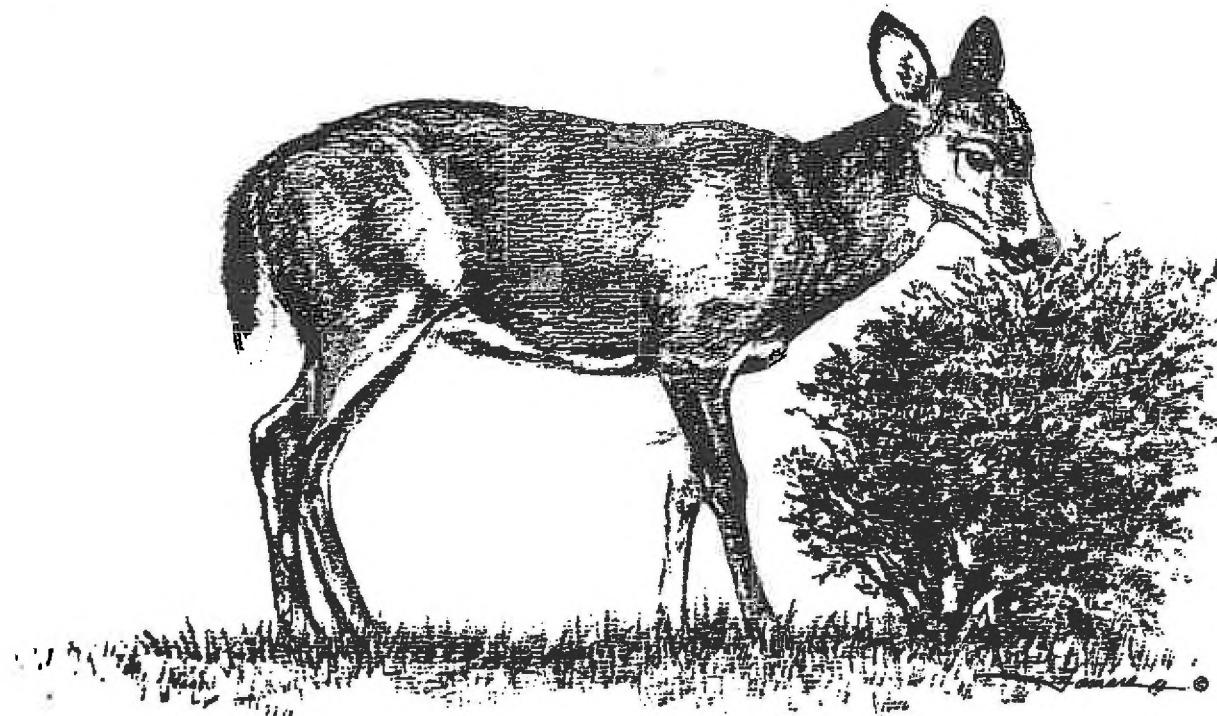


# **DEER DAMAGE TO THE ORNAMENTAL HORTICULTURE INDUSTRY IN SUBURBAN NEW YORK: EXTENT, NATURE AND ECONOMIC IMPACT**

by

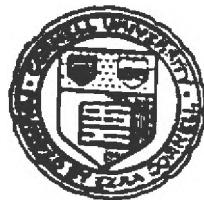
Roger W. Sayre and Daniel J. Decker

**HDRU LIBRARY**  
**DO NOT REMOVE**



**HDRU Series 90-1**

**March 1990**



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





## HUMAN DIMENSIONS RESEARCH UNIT PUBLICATIONS SERIES

This publication is part of a series of reports resulting from investigations dealing with public issues in the management of wildlife, fish, and other natural resources. The Human Dimensions Research Unit (HDRU) in the Department of Natural Resources at Cornell University is a nationally-recognized leader in the study of the economic and social values of wildlife, fish, and other natural resources and the application of such information in management planning and policy. A list of HDRU publications may be obtained by writing to the Human Dimensions Research Unit, Department of Natural Resources, Farnow Hall, Cornell University, Ithaca, NY 14853.





## ACKNOWLEDGEMENTS

Completion of this study would not have been possible without the assistance and cooperation of many individuals. We gratefully acknowledge the input and contributions made by the following members of the Project Review and Advisory Committee: G. Good and R. Kozlowski, Cornell University Department of Floriculture and Ornamental Horticulture; J. Farfaglia and L. Hulcoop, Cornell Cooperative Extension; N. Dickinson, G. Cole, and T. Moore, New York State Department of Environmental Conservation; R. Mungari, New York State Department of Agriculture and Markets; M. Richmond and M. Fargione, New York Cooperative Fish and Wildlife Research Unit; B. Chabot, Office of Research, Cornell University College of Agriculture and Life Science. Human Dimensions Research Unit staff members T. Brown, N. Connelly, J. Enck, M. Peech, G. Pomerantz, R. Shanks, R. Shiffler and W. Siemer provided valuable advice, assistance and support throughout this study. W. Brown conducted the nonrespondent phone survey. Cover illustration was drawn by T. Sayre. Funding for this research was provided by USDA/APHIS contract number 53-6395-8-122 and by Hatch Project NYC 147303, USDA.

## STUDY HIGHLIGHTS

### Introduction and Background

During the 1980s the recognized spectrum of stakeholders in the management of white-tailed deer (*Odocoileus virginianus*) expanded, especially in suburban areas where deer populations have grown substantially. The expansion of human and deer populations in areas surrounding large cities has led to an increased interaction between deer and people. Deer damage to the ornamental horticulture industry appears to have increased in recent years. Many horticultural specialists and wildlife managers have become concerned about deer damage to ornamentals, although the industry-wide impacts have not been documented extensively. This study focused on the impacts of deer damage to the ornamental horticulture industry in 2 suburban regions of New York State.

The production and sale of ornamental plants for landscape use is an important segment of agricultural industry in New York. The revenues generated by expenditures of consumers for ornamental plants and services of landscape contractors runs into the hundreds of millions of dollars each year. The purpose of this research was to assess the extent, nature and economic impact of deer damage to the ornamental horticulture industry, according to the perceptions and experiences of 3 key groups: nursery producers, landscape contractors and residential property owners.

### Methods

The study focused on 2 geographic regions of New York, the area consisting of Erie and Niagara Counties, hereafter called "western," and the area consisting of Dutchess, Orange, Putnam, Rockland, and Westchester Counties, hereafter called "southeastern." We developed self-administered,

mail-back questionnaires for each of the 3 groups surveyed. During spring 1989, we mailed 294 questionnaires to nursery producers, 614 questionnaires to landscape contractors, and 850 questionnaires to residential property owners. We sent up to 3 follow-up mailings to nonrespondents. During fall 1989, we conducted a telephone survey of nonrespondents to assess nonresponse bias.

### Results

Sixty-one percent of the nursery producers, 41% of the landscape contractors, and 63% of the residential property owners responded to the survey. Telephone interviews with 50 nonrespondents from each survey group revealed no nonresponse bias.

#### Nursery producers

- A majority of nursery producers indicated they had nursery stock damaged by deer during 1988 (61% western, 67% southeastern); of the producers who had damage, nearly one-half of the western and over one-third of the southeastern producers described it as moderate or severe.
- Approximately two-thirds of the producers from each region reported that damage was most severe during the winter.
- Yews (*Taxus spp.*), Arborvitae (*Thuja spp.*), Rhododendrons (*Rhododendron spp.*), and Hemlock (*Tsuga spp.*) were listed most frequently as the plants damaged by deer.
- Estimated replacement costs for damaged plants averaged nearly \$4,000 for western producers and over \$20,000 for southeastern producers.
- About two-thirds of the producers from each region indicated they attempted to prevent deer damage. Chemical repellents were used most frequently.
- According to estimates of the producers, damage prevention cost an average of over \$715 for western and nearly \$1,300 for southeastern producers who employed prevention measures.
- A greater percentage of southeastern producers than western producers (71% vs. 41%) indicated that they wanted more information about damage prevention; and about two-thirds of the producers from each region desired either technical assistance or special deer control permits.

- The majority of producers (55% western, 60% southeastern) wanted a decrease in current deer population levels in their area; few ( $\leq 10\%$ ) wanted deer populations to increase.
- The "deer acceptance capacity" of nursery producers appears to have been exceeded, exemplified by the fact that fewer than two-fifths of the western and about one-fourth of the southeastern producers were classified as accepting of deer at current population levels.
- Most producers (83% western, 90% southeastern) supported regulated hunting as a method to manage local deer populations.
- More southeastern producers (65%) than those in the western region (50%) believed that prevention of damage to ornamental plantings should be a primary concern of deer managers. Two-fifths of the western producers believed that prevention of deer-car collisions should be a primary management concern compared to fewer than one-sixth of the southeastern producers.
- Producers were more likely to believe the priority of deer management should be to sustain a healthy breeding population of deer for ecological reasons rather than for recreational hunting or aesthetic reasons.

#### Landscape contractors

- Seventy-four percent of the landscapers in the southeastern region had clients with deer damage to their ornamental plants, whereas 44% of the landscapers in western New York reported that they had clients with deer damage.
- According to estimates of landscapers, about one-half of southeastern clients had ornamental plants damaged by deer; whereas about 1 out of 4 western clients had plants damaged by deer.
- Approximately 70% of the landscapers from each region believed that winter was the most severe season of damage.
- Yews, Arborvitae, Euonymus (*Euonymus spp.*), and Rhododendrons were listed most frequently as plants damaged by deer.
- Most of the southeastern landscapers (80%) indicated they had been requested by clients to help with deer damage prevention, whereas about half of the western landscapers (52%) had similar requests.
- Chemical repellents and fencing were the most common prevention methods used by consumers.
- About three-quarters of the landscapers from either region indicated they needed more information on the availability and effectiveness of damage prevention methods.

- More than 75% of the southeastern landscapers believed that deer damage was affecting consumer buying behavior, compared to only 39% of the western landscapers. Of those landscapers who indicated changes in consumer buying behavior, most believed that the consumers were buying different, less palatable ornamental species. Only a fraction believed that some consumers had quit buying ornamental plants because of deer damage.
- Southeastern landscapers were more than twice as likely than western landscapers to want a decrease in deer populations (68% and 33%, respectively).
- Southeastern landscapers appeared to have lower "deer acceptance capacities" than landscapers in the western region. According to our acceptance typology only 31% of the southeastern landscapers were accepting of the existing (1988) deer population status compared to a 67% acceptance rate in western New York.
- More than one-half of the western landscapers believed that prevention of deer-car collisions should be the most important consideration of wildlife managers, compared to about one-third of the southeastern landscapers. However, less than one-tenth of the western landscapers believed protection of ornamental plants should be the most important management consideration, whereas nearly two-fifths of the southeastern landscapers believed that protection of ornamentals should be the most important management consideration.
- Similar to the nursery producers, more landscapers were inclined to believe that deer should be managed for ecological reasons than for recreational hunting or aesthetic reasons.

#### Residential property owners

- Most residential property owners (also called "homeowners" in this text) did not have deer damage to their ornamental plants. However, homeowners in southeastern New York (32%) were nearly twice as likely to have had deer damage than homeowners in the western part of the state (17%).
- Of those homeowners who had damage, about three-fourths from each region described it as light or moderate.
- Most homeowners who had their plants damaged by deer indicated damage was most severe during winter (60%) or spring (30%).
- Yews, Azaleas (*Rhododendron* type), and Arborvitae were listed most frequently as the plant types damaged by deer.
- Damage appeared to be more severe in the southeastern region. The average replacement costs for ornamental trees and shrubs in the southeastern region during 1988 were nearly \$500 per household with deer damage, compared to about \$160 per household in the western region.

- One-quarter of the western homeowners used prevention measures to diminish deer damage, compared to one-half of the homeowners in the southeastern region.
- Fencing was the method used most often by homeowners from both regions to prevent damage.
- The majority of homeowners (58% western 54% southeastern) wanted to maintain the local deer population at the current (1988) level, whereas one-fourth of the western and one-third of the southeastern homeowners wanted deer populations in their area to decrease.
- The "deer acceptance capacity" of homeowners was higher than either nursery producers or landscapers. According to our typologies, 76% of the western and 67% of the southeastern homeowners were accepting of the existing local deer population levels.
- Two-thirds of all homeowners believed that prevention of deer-car collisions should be the most important consideration of deer managers. Only 1 out of 8 or 10 homeowners believed that recreational hunting or aesthetics should be the most important management consideration.
- Approximately three-fourths of all homeowners (71% western, 76% southeastern) supported regulated hunting as a method to manage local deer populations.
- As with the producers and landscapers, the majority of homeowners believed that deer should be managed for ecological reasons, rather than hunting or aesthetic reasons.
- Deer damage in the western region appeared to be somewhat related to deer density and residential density. Damage costs were greater in towns with high residential density. However, we were not able to determine consistent statistical relationships.
- The relationship between deer damage, deer density and residential density in the southeastern region did not follow consistent patterns, although damage costs per household appeared to be greater in the towns with high deer densities.

## SUMMARY AND IMPLICATIONS

Deer damage has a direct impact on the ornamental horticulture industry, especially to the producers and consumers. This impact is not evenly distributed with some sites and geographical regions having greater levels of damage than others. These differences are related to factors such as physiographic characteristics, land-use patterns, deer population density, hunting pressure, and deer behavior. Subsequent research in both the biological and human dimensions could benefit by inquiring how these factors relate to deer damage.

Deer damage to ornamental plants is a primary concern of many producers, whereas homeowners and landscapers are more likely to classify damage as a nuisance. The latter 2 groups were more concerned about human health and safety risks associated with deer--i.e., Lyme disease and deer-car collisions. Nonetheless, producers and consumers will require more information on the costs and benefits of various damage prevention measures, and they will need to know how to apply that information to their specific situation. That only a few homeowners obtained damage prevention information from Cooperative Extension indicates a need for Cooperative Extension to seek creative ways to reach homeowners with information about damage prevention as well as information about deer management.

The people surveyed in this study were willing to express their opinions about the role of deer management. Most respondents wanted deer populations to be maintained at current levels or to be decreased, implying that these people support the management of deer populations. Furthermore, the majority of respondents supported hunting as a method to manage deer populations. In many areas hunting is the most effective and economically feasible means to

keep deer within biological carrying capacity as well as to reduce conflicts with people (Ellingwood and Caturano 1988).

However, in some suburban areas hunting with firearms may not be feasible. In these situations an archery season may be the best alternative. As of this printing, NYSDEC is considering the possibility of seeking legislation to allow an archery season in 50 square miles in the towns of Amherst, Clarence and West Seneca (Terry Moore NYSDEC pers. comm.). Capture and removal of deer and sterilization were listed as possible management techniques by some respondents. These methods may be possible alternatives for limited application in unique situations, but they are not yet economically feasible, nor have they been proven to be satisfactorily effective in the field. (See Ellingwood and Caturano [1988] for a review of alternatives regarding management of deer populations.)

A majority of respondents indicated deer should be managed for ecological reasons whereas deer management to provide recreational hunting opportunities and for aesthetic reasons were listed less frequently. These data may be indicative of a heightened ecological awareness across a broad group of constituencies. Even though managers have long placed primary importance on managing deer within ecological balance of the range and habitat, many in the public perceived that providing hunting opportunities was the primary role of deer management. Finally, the finding that only a minority of people surveyed indicated deer should be managed for aesthetic reasons may imply that deer are so ubiquitous that people are less concerned about their perpetuation or perhaps they are becoming more concerned about the costs associated with deer.

**Keywords:** Deer damage, deer management, socioeconomic, human dimensions, white-tailed deer.

## TABLE OF CONTENTS

	<u>Page</u>
<b>ACKNOWLEDGEMENTS . . . . .</b>	<b>i</b>
<b>STUDY HIGHLIGHTS . . . . .</b>	<b>ii</b>
<b>TABLE OF CONTENTS . . . . .</b>	<b>ix</b>
<b>LIST OF TABLES . . . . .</b>	<b>xi</b>
<b>LIST OF FIGURES . . . . .</b>	<b>xii</b>
<b>INTRODUCTION . . . . .</b>	<b>1</b>
<b>BACKGROUND . . . . .</b>	<b>2</b>
<b>STUDY OBJECTIVES . . . . .</b>	<b>3</b>
<b>STUDY AREA . . . . .</b>	<b>4</b>
<b>METHODS . . . . .</b>	<b>7</b>
Nursery Producers . . . . .	7
Landscape Contractors . . . . .	8
Residential Property Owners . . . . .	8
Data Analysis . . . . .	12
<b>RESULTS AND DISCUSSION . . . . .</b>	<b>12</b>
Survey Response . . . . .	12
Nursery Producers . . . . .	13
General characteristics of nursery producers . . . . .	13
Experiences with deer and deer damage . . . . .	14
Prevention of deer damage . . . . .	16
Impact of deer damage on consumers . . . . .	17
Attitudes about deer and deer management . . . . .	18
Concerns about deer . . . . .	22
Landscape Contractors . . . . .	23
General characteristics of landscape contractors . . . . .	23
Experiences with deer and deer damage . . . . .	23
Prevention of deer damage . . . . .	24
Impact of deer damage on consumers . . . . .	26
Attitudes about deer and deer management . . . . .	26
Concerns about deer . . . . .	27
Residential Property Owners . . . . .	28
General characteristics of residential property owners . . . . .	28
Experiences with deer and deer damage . . . . .	28
Prevention of deer damage . . . . .	31
Impact of deer damage on consumers . . . . .	32
Attitudes about deer and deer management . . . . .	34
Concerns about deer . . . . .	36
Deer density, residential density and deer damage . . . . .	36

	<u>PAGE</u>
SUMMARY AND IMPLICATIONS . . . . .	44
LITERATURE CITED . . . . .	46
APPENDICES	
Appendix A: Mail Questionnaire . . . . .	47
Appendix B: Deer Density and Residential Density, by Town . . . . .	63
Appendix C: Types of Plants Reported to be Damaged by Deer . . . . .	66
Appendix D: Types of Plants Used by Consumers to Avoid Deer Damage . . . . .	72

## LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	Response rates of nursery producers, landscape contractors and residential property owners, by study region . . . . .	13
2	Deer damage experiences of nursery producers . . . . .	15
3	Deer-damage prevention methods used by nursery producers . . . . .	16
4	Preferred population trend in local deer herds, according to key stakeholders in ornamental horticulture industry . . . . .	18
5	Deer-related concerns of nursery producers . . . . .	22
6	Deer-damage-experiences of landscape contractors . . . . .	24
7	Deer-damage-prevention methods used by consumers, according to landscape contractors . . . . .	25
8	Deer-related concerns of landscape contractors . . . . .	28
9	Deer-damage-experiences of homeowners . . . . .	29
10	Deer-damage-prevention methods used by homeowners . . . . .	31
11	Deer-related concerns of homeowners . . . . .	37

## LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1	Location of western (Erie and Niagara Counties) and southeastern (Dutchess, Orange, Putnam, Rockland and Westchester Counties) regions for 1989 deer damage to ornamentals survey in New York . . . . .	5
2	Location of towns selected for residential property owners' survey in western New York . . . . .	10
3	Location of towns selected for residential property owners' survey in southeastern New York . . . . .	11
4	Comparison of commercial nursery producers', landscape contractors' and residential property owners' deer acceptance levels in New York . . . . .	20
5	Deer acceptance levels of respondents who had deer damage on property or had clients with deer damage on property . . . . .	21
6	Percent of households with deer damage to ornamental plants in western region, by deer density and residential density . . . . .	39
7	Mean cost per household to replace plants damaged by deer in western region, by deer density and residential density . . . . .	40
8	Percent of households with deer damage to ornamental plants in southeastern region, by deer density and residential density . . . . .	42
9	Mean cost per household to replace plants damaged by deer in southeastern region, by deer density and residential density . . . . .	43

## BACKGROUND

The production, sale and use of nursery products for landscape designs is a significant agricultural industry in New York. Estimates derived from a recent survey placed the statewide gross sales of nursery plants grown in the state at \$67 million; the industry also employed over 6,000 people statewide (New York Nursery Producers Survey 1986). Landscape contractors are also significant participants in the ornamental horticulture industry. It is estimated the landscaping business in New York generates about \$400 to \$500 million in economic activity each year (George Good *pers. comm.*). Finally, an estimated 14 million consumers spend a total of \$1 billion each year on horticultural products in New York, with approximately \$175 million of that spent on plant materials (Robert Kozlowski *pers. comm.*).

As the ornamental horticulture industry has grown in New York, so has deer damage to plants in some areas of the state. Deer populations in New York and throughout the Northeast have increased substantially in recent decades. Simultaneously, human populations have expanded from the cities and nearby suburbs to outlying areas where many new communities and developments have been established. The concomitant increase of human and deer populations in the urban-rural fringe has increased the interaction between deer and people, including deer damage to ornamentals.

In the only previous documented systematic study of deer damage to commercial nursery production in New York, McAninch and Fargione (1987) reported that 44% of the growers in the state had deer damage to their nursery plants in 1985, and that losses averaged over \$3,000 for those growers who experienced deer damage. Moreover, according to unpublished (NYSDEC) annual deer damage reports, the number of complaints from nursery producers doubled

## INTRODUCTION

The primary objective of white-tailed deer (*Odocoileus virginianus*) management in New York is to maintain populations at biologically sound and socially acceptable levels. The New York State Department of Environmental Conservation (NYSDEC) strives to manage deer populations within carrying capacity of the land, but within "wildlife acceptance capacity" (Decker and Purdy 1988) of people. Hunters and farmers, especially orchardists, have long been considered to be key stakeholders in deer management in New York State. Several studies of these groups have assessed the socioeconomic values and impacts of deer (Brown et al 1980, Phillips et al. 1987, Brown and Decker 1979, Purdy et al. 1989). However, in recent years it has become increasingly apparent that other publics, including additional agricultural interests, residential property owners, motor vehicle operators and the general populace in some locales, have an identifiable and self-perceived stake in deer management.

This study focused on the impacts of deer damage to the ornamental horticulture industry in New York, an agricultural sector for which such impacts have not been studied extensively. Deer managers require an understanding of the impacts of deer damage to the primary groups comprising the ornamental horticulture industry--producers, landscapers, and consumers--to weigh the needs and preferences of those groups against other stakeholders. This study was conducted to assess the nature, extent and economic impact of deer damage to 3 key groups involved in the ornamental horticulture industry--commercial nursery producers, landscape contractors and residential property owners--and to determine the attitudes of these groups toward deer and deer management in New York.

from an average of about 65 per year from 1981 through 1986 to about 120 each year during 1987 and 1988. The estimated dollar value per damage incident is believed to have increased substantially throughout the 1980s as well. To our knowledge, the impact of deer damage to the landscaping industry in New York has not been documented previously. Deer damage to ornamentals on residential properties has been examined in New York, and recent studies have indicated that deer damage is significant in some suburban areas. For example, Decker and Gavin (1987) surveyed residents in Islip, New York, and reported that about one-fourth of the respondents had plants damaged by deer. In another study, 43% of the respondents in Westchester County, New York, (Connelly et al. 1987) indicated they had deer damage to their landscape and garden plants. Projected county-wide losses due to plant damage caused by deer ranged from \$6.4 to \$9.5 million in 1987. Thus, evidence existed to indicate the deer damage problem may be severe in some areas of the state, and may be increasing, but a systematic assessment of the impact of deer damage to the ornamental horticulture industry was needed.

#### **STUDY OBJECTIVES**

The primary objectives of this study were to: (1) determine the extent, nature, and economic impact of deer damage to the ornamental horticulture industry from the perspectives of nursery producers, landscape contractors and residential property owners, (2) assess the deer and deer-management-related attitudes, concerns and information needs of these groups and (3) determine the relationships between deer density, human population density and deer damage in residential areas.

## STUDY AREA

The study was focused on 7 counties outlying the 2 largest metropolitan areas in New York State (Figure 1). We selected these regions because our preliminary interviews of wildlife managers and horticultural specialists indicated the potential for deer damage to ornamental horticulture to be high in them. The areas had a combination of high human population densities and land-use patterns that either created additional deer habitat or encroached upon traditional deer habitat. Furthermore, deer living close to urban areas appear to be more accustomed to human activity and are more likely to be in conflict with people--especially in areas where hunting is prohibited.

The State of New York is inhabited by over 17 million people, with an average population density of 371 people per square mile (1980 census). In western New York we surveyed people in Erie and Niagara Counties, hereafter referred to as the "western" region. Nearly 1.25 million people live in this region, which has a human population density of 791 people per square mile. Buffalo, located in Erie County, is the second largest city in New York, and it is a center of manufacturing, commerce, transportation and services for the region. However, outside of Buffalo, much of the area is rural, with about one-third of the lands in the region devoted to agriculture (New York State Statistical Year Book 1989).

We also conducted surveys in Dutchess, Orange, Putnam, Rockland and Westchester Counties, hereafter called the "southeastern" region. Slightly over 1.7 million people inhabit these 5 southeastern counties, and the region has an overall human population density of 685 people per square mile. New York City, the largest city in the United States (according to the U.S. Bureau of Census 1980), is adjacent to the southern border of Westchester County.

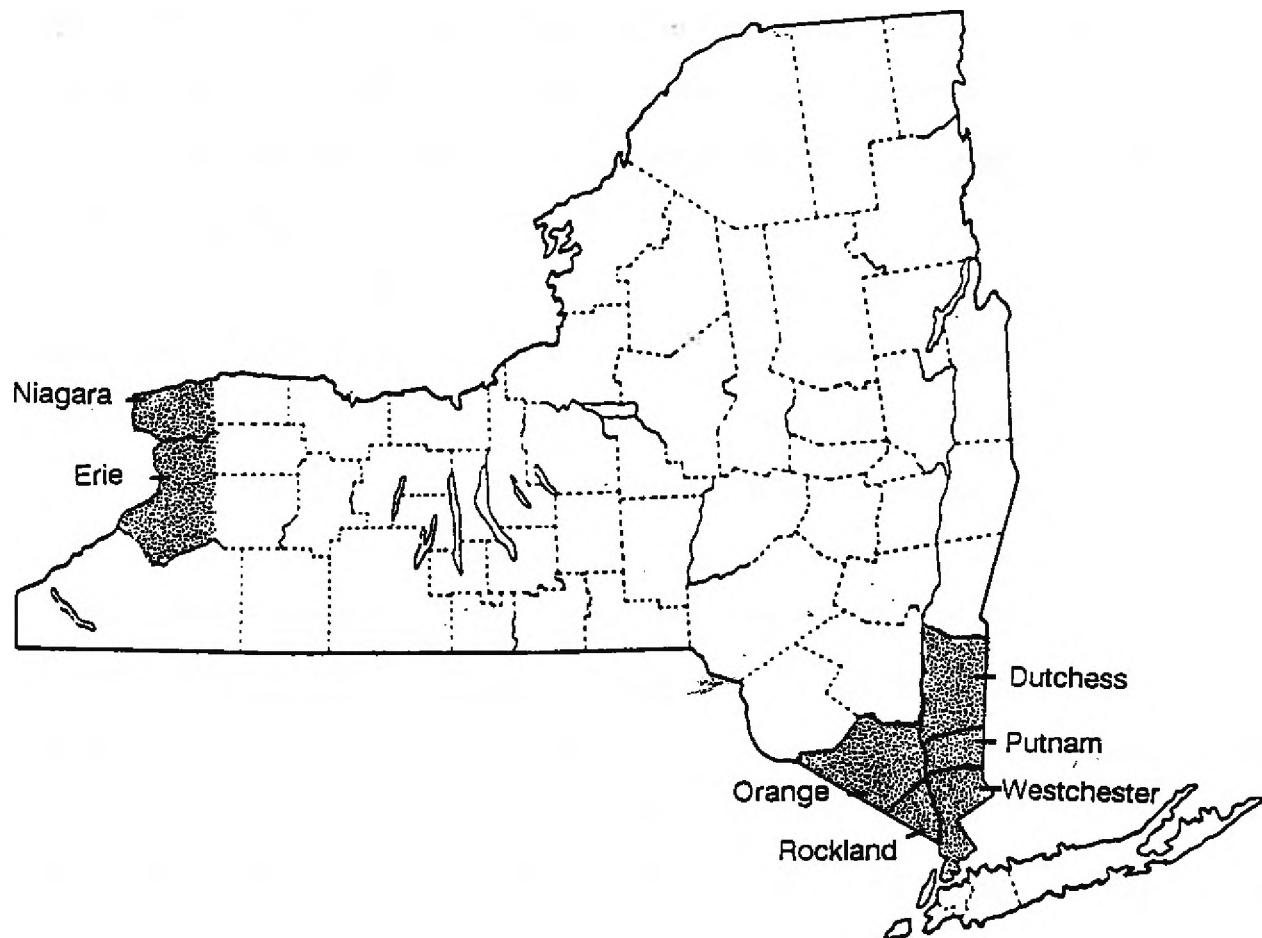


Figure 1. Location of "western" (Erie and Niagara Counties) and "southeastern" (Dutchess, Orange, Putnam, Rockland and Westchester Counties) regions for 1989 deer damage to ornamentals survey in New York.

Even though the human population densities are lower than in the western region, the southeastern region is more suburban with many small cities and developments scattered throughout. About one-fourth of the land in Dutchess and Orange Counties is devoted to agriculture, and less than one-tenth of the land in Putnam, Rockland, and Westchester Counties is agricultural (New York State Statistical Yearbook 1989). The southeastern region lacks agricultural land because the physiographic characteristics of the landscape are less favorable for agriculture, and a greater proportion of the land is forested.

The histories of deer populations in the 2 regions are relatively similar. Deer were extirpated from western New York by the 1860s, and they did not repopulate the area until the early 1900s when the populations expanded from the rugged Allegheny highlands of northwest Pennsylvania (Severinghaus and Brown 1956). By 1940, about the time deer began to come into conflict with agriculture in some areas, annual hunts were made legal. According to NYSDEC deer harvest records, deer populations in western New York have increased markedly during the last 40 years. Using buck take per square mile of deer habitat as an index, the harvest has increased from about 0.3 bucks taken per square mile (BT/SM) during the 1950s and 1960s, to about 0.5 BT/SM during the 1970s to 1.2 BT/SM during the first 9 seasons of the 1980s. Currently about 180 square miles of Erie County is closed to deer hunting. Most of the land is located in urban and suburban Buffalo. According to NYSDEC estimates (Terry Moore pers. comm.) approximately 700 to 800 deer occupy 30 square miles of deer habitat in the areas closed to deer hunting.

In southeastern New York, deer were also eliminated during late 19th century, and they did not return until early 20th century, when strict hunting regulations were imposed, giving deer the opportunity to expand from remnant

populations in the Berkshire mountains in Massachusetts and the southern Catskill mountains in Sullivan and Orange Counties of New York (Severinghaus and Brown 1956). By the 1940s, deer became so abundant in some areas that many succumbed to winter starvation. More recently, deer populations also have increased in the southeastern region. During the 1950s, annual harvest rates averaged about 1.5 BT/SM in Dutchess, Orange and Putnam Counties. (We did not include harvest data from Rockland or Westchester Counties because firearms restrictions in these areas make harvest density indices unreliable). However, during the 1960s, average BT/SM in the southeastern region dropped to 1.1. Harvests increased to 2.1 BT/SM during the 1970s and 2.6 BT/SM during the 1980s. Note that an unknown proportion of the harvest increase may be due to a drop in illegal harvest--coinciding with an increase in legal harvest--of deer during the past 2 decades (Nate Dickinson *pers. comm.*).

## METHODS

### Nursery Producers

We obtained names of individuals believed to be involved in commercial nursery production from the New York State Department of Agriculture and Markets (NY AG-MARK Service 1989) and lists provided by Cornell Cooperative Extension agents. All producers within the 2 regions listed as having nursery property were selected for the survey; 90 producers in the western region and 204 from the southeastern region. The self-administered questionnaire was identical to that used in the statewide survey of producers reported by Sayre and Decker (1989), and the questionnaire design was similar to those used by Brown et al. (1980) and Connelly et al. (1987). Respondents were asked to indicate the extent and nature of deer damage, as well as their attitudes

toward deer management (Appendix A). The mail survey was implemented in April of 1989, following the procedures described by Dillman (1978) and Brown et al. (1989). We sent up to 3 follow-up mailings to nonrespondents. Follow-up telephone interviews of nonrespondents were conducted in November 1989 to assess nonresponse bias.

#### Landscape Contractors

Names of landscape contractors, or "landscapers", were selected from the 1988 telephone directories (NYNEX 1988) and from lists provided by Cornell Cooperative Extension agents. We selected 147 landscape contracting businesses from the western region, and 467 businesses from the southeastern region. We designed a questionnaire similar to that used for the nursery producers, and the survey implementation procedures were identical. Respondents were asked where they had seen deer damage, the percent of clients with damage, and their own attitudes and concerns about deer and deer management in New York. The survey was implemented in May 1989, followed by nonrespondent telephone interviews to assess potential nonresponse bias during December 1989.

#### Residential Property Owners

Because the relationships between deer density, human population density in residential areas and deer damage to ornamental plants have not been documented, we designed the homeowner survey to allow us initial insights about whether such relationships existed. We obtained information on the number of residential property units per town from the County Assessors Office (New York Division of Equalization and Assessment) in each county we surveyed. NYSDEC provided us with buck harvest records, and we determined an average harvest rate, by town, of bucks (adult male deer) harvested from 1986 through

1988. In New York, buck harvest is used as the primary index of deer populations (New York State Dept. of Environmental Conservation 1987), and research and experience have demonstrated that it is a good measure of deer population trends, especially when populations are not changing drastically from year to year (Nate Dickinson *pers. comm.*). However, caution must be used when interpreting buck take data when deer populations are changing rapidly. We calculated deer and human densities by dividing the number of bucks harvested and number of residential units by the area of the town (excluding cities). We then categorized towns based on buck take per square mile (BT/SM) and residential units per square mile (RU/SM) (Towns surveyed shown in Figure 2, Figure 3; listed in Appendix B). Towns with  $<2.0$  BT/SM were classified as low deer density, those with BT/SM  $>2.0$  but  $<4.0$  were medium deer density, and  $\geq 4.0$  BT/SM were high deer density. Towns with  $<100$  RU/SM were classified as low residential density, and towns with  $\geq 100$  RU/SM were classified as high residential density.

For the survey, we randomly selected names of 450 residential property owners from the tax rolls of 16 towns in Erie and Niagara Counties, and 400 names of residential property owners from the tax rolls of 32 towns in Dutchess, Orange and Putnam Counties. We sampled a greater number of homeowners in the western region to test the hypothesis that deer damage is more frequent in the towns of Amherst and West Seneca where hunting is prohibited. However, we did not sample any residential property owners in Rockland and Westchester Counties because there are county-wide firearms restrictions in these areas and buck harvests would not be a valid index to populations, thereby making it impossible for us to classify deer densities.

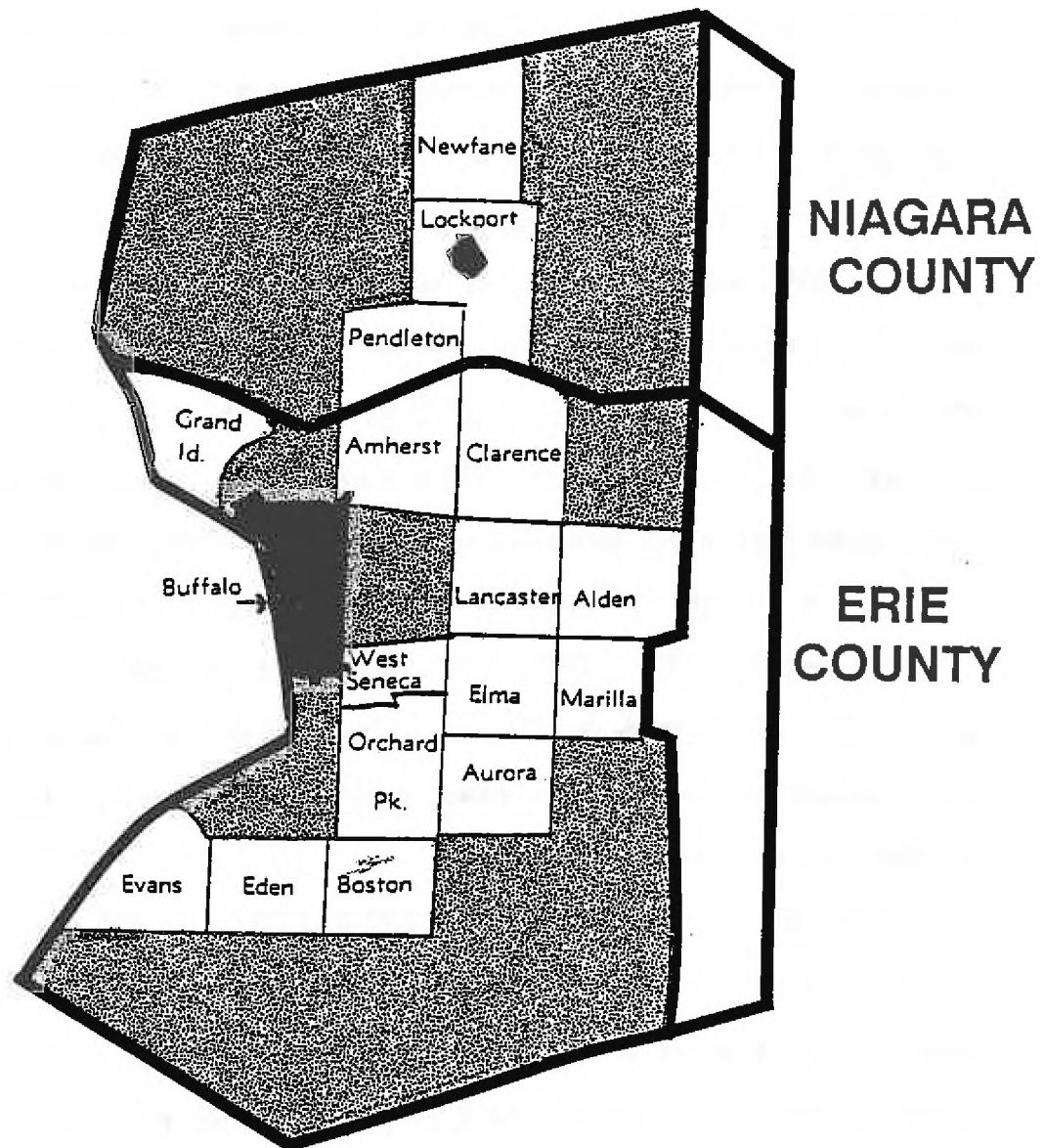


Figure 2. Location of towns selected for residential property owners in western New York (shaded portions represent areas not surveyed).

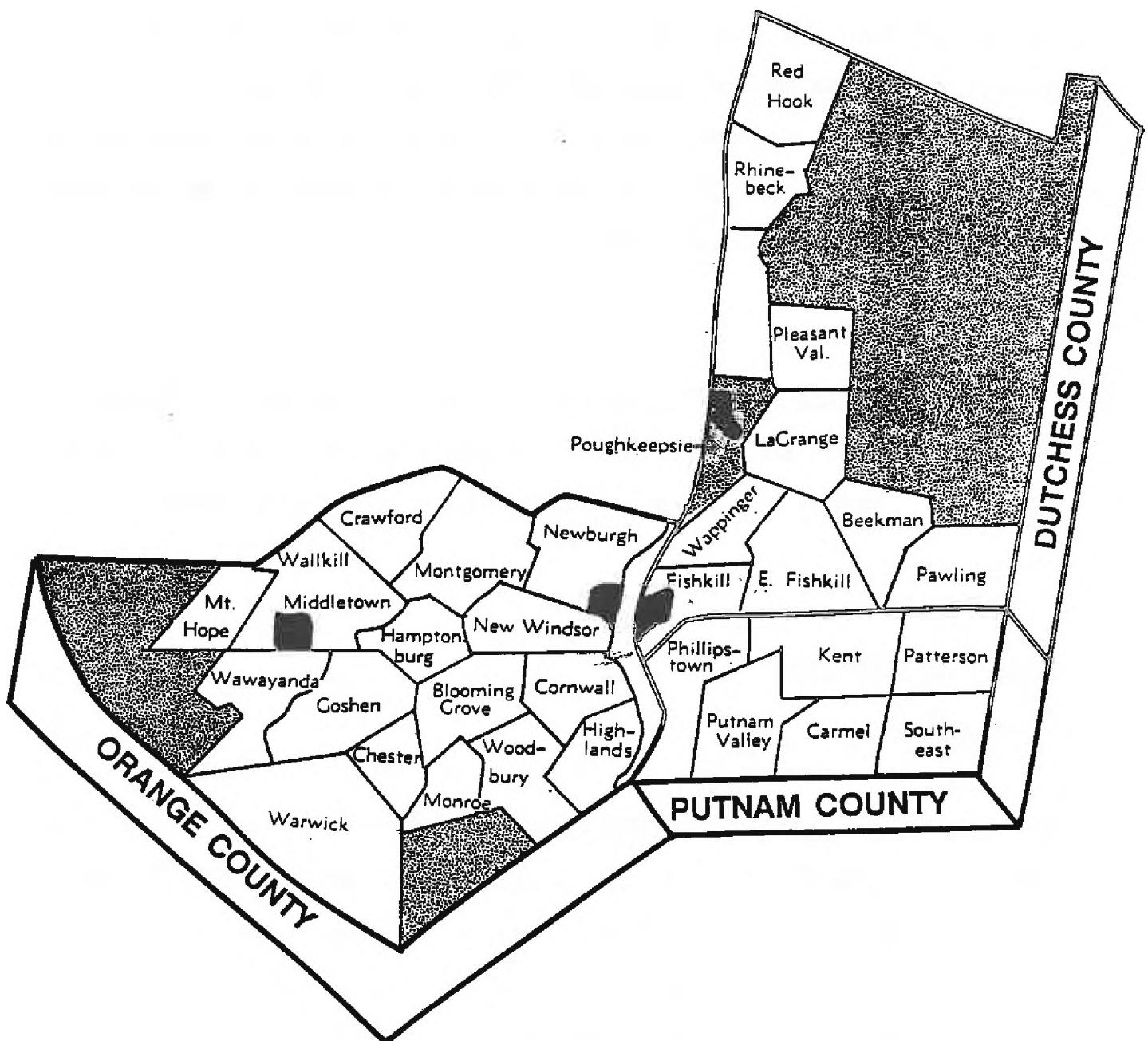


Figure 3. Location of towns selected for residential property owners in southeastern New York (shaded portions represent areas not surveyed).

The residential property owners' questionnaires were similar to those used for the producers and landscapers. Respondents were asked to characterize their property, relate their experiences with deer or deer damage, and provide information on their attitudes towards deer and deer management. Survey implementation and follow-up procedures were identical to the previous 2 surveys. Telephone interviews of nonrespondents were conducted in December 1989 to assess nonresponse bias.

### Data Analysis

The questionnaires were coded and analyzed using the SPSSX computer program (SPSS Inc. 1983). Statistical tests were conducted using chi square ( $\chi^2$ ) test, Student's t-test, and Duncan's multiple range test, where applicable.

## **RESULTS AND DISCUSSION**

### Survey Response

Sixty one percent of the nursery producers, 41% of the landscape contractors and 63% of the residential property owners responded to the survey (Table 1). Response rates from the landscapers were unexpectedly low, and we attributed this to 3 factors. First, landscape contracting appears to have a high turnover rate and a large proportion of businesses were no longer operating. Second, the survey was not as salient to this group as it was to the nursery producers or residential property owners. Third, we implemented the survey in May, when most landscapers were very busy, making it less likely they would take the time to participate in the study.

Table 1. Response rates of nursery producers, landscape contractors and residential property owners, by study region.

	<u>Western</u>	<u>Southeastern</u>
<b>Nursery producers</b>		
%	66	50
n	57	95
<b>Landscape contractors</b>		
%	48	39
n	61	157
<b>Residential Property Owners</b>		
%	69	57
n	291	224

Regardless of these problems and the low response rates from the landscapers, follow-up interviews with nonrespondents from each group indicated that the results were not biased by nonresponse.

#### Nursery Producers

**General Characteristics of Nursery Producers.** Fifty-one of the 152 respondents indicated they did not produce or sell nursery stock in 1988. Forty of those 51 were involved in other types of business such as landscape contracting, sod production, lawn care, garden center or unspecified other business. The remaining 11 were retired or no longer in business at all. These 51 respondents were eliminated from the subsequent analysis.

Many of the respondents who produced nursery stock were also involved in other types of related business. About 30% had landscaping businesses, 23% operated a garden center and 10% did lawn care. The mean size of nurseries in the western region was 91 acres ( $SE=42.9$ ; median=10), compared to 37 acres in the southeastern region ( $SE=12.3$ ; median=6). About one-half of the producers

from each region earned less than \$25,000 from gross sales of nursery products, approximately one-sixth earned between \$25,000 and \$100,000, and about one-third reported earnings of more than \$100,000 from sales of nursery stock. About two-fifths of the producers from each region reported that less than 25% of their earnings came from sales of nursery stock, whereas about one-third reported that these sales contributed to more than 75% of their net income.

**Experiences with deer and deer damage.** The relative frequencies of deer damage to nurseries in the 2 regions were similar, with nearly two-thirds of producers from each reporting damage to their plants during the previous 3 years (Table 2). About three-fourths of producers in each region indicated that winter was the most severe season of damage. Yews (*Taxus spp.*), arborvitae (*Thuja spp.*), fir (*Abies spp.*), and hemlock (*Tsuga spp.*) were listed most frequently as the species damaged by deer (Appendix C). These species lists should be interpreted with caution, because frequency of reports does not necessarily imply preferences by deer, and may simply reflect the relative frequency of these plants at nurseries. More research on species' preferences by deer is needed before definitive statements of such preferences can be made (Conover and Kania 1988).

Estimated replacement costs of damaged plants reported by the producers differed greatly between the 2 regions, averaging nearly \$4,000 in the western Counties but over \$20,000 in the southeastern counties (Table 2). This difference is primarily due to the fact that 2 producers in the southeastern region reported over \$100,000 in losses, whereas the highest reported loss by any producer in the western region was \$20,000.

Table 2. Deer damage experiences of nursery producers.

	<u>Western</u>	<u>Southeastern</u>
Had deer damage at nursery		
%	61	67
n	27	38
Estimated costs to replace plants		
mean	\$3,813	\$21,628
SE	\$1,324	\$11,217
median	\$1,800	\$ 3,000
range	\$8.00-20,000	\$180.00-257,000
n	16	24

\*differences between means not significant ( $t=-1.6$ ;  $P=0.13$ )

In contrast to the dollar value of damage estimates reported, a greater percentage of producers in the western region (45%) than in the southeastern region (35%) believed that damage was substantial or severe. Mean losses for the western producers who considered the damage was substantial or severe was \$6,200 (SE=\$2,043) whereas mean losses for southeastern producers who described damage as substantial or severe were \$43,800 (SE=\$24,346). The means were not significant ( $t=-1.54$ ;  $P=0.15$ ) due to small sample size and large standard error. Nonetheless, these data may indicate that producers in the southeastern region may be more accustomed to having their stock damaged by deer, thus their perceptions of the damage appear to be less severe than the producers in western New York.

The losses from deer damage reported in this survey, in addition to the coinciding statewide survey by Sayre and Decker (1989), are consistent with losses documented by other workers in New York (McAninch and Fargione 1987),

and elsewhere (Scott and Townsend 1985, Conover and Kania 1988). Moreover, our data adds to the documentation that nursery producers incur some of the highest deer damage losses of any agricultural sector, including orchardists (Purdy et al. 1989).

**Prevention of deer damage.** Approximately two-thirds of the producers from each region used damage prevention measures, with soaps and chemical repellents being the methods employed most frequently (Table 3). Cooperative

Table 3. Deer damage prevention methods used by nursery producers.

<u>Type of prevention</u>	<u>Percent Using Damage Prevention</u>	
	<u>Western</u> n=23	<u>Southeastern</u> n=32
Chemical repellents	52	84*
Soap	39	31
Fencing	22	25
Scare devices	22	22
Human hair	13	25

\* $\chi^2$  differences between regions significant at  $P \leq 0.05$

Extension was listed as the primary source of information for damage prevention. Other nursery producers and personal experience were also listed frequently as important information sources. However, few producers from either region listed sources such as pest control specialists, media or governmental agencies as being important information sources.

Seventy-one percent of producers from the southeastern region wanted information on damage control compared to only 41% from the western region ( $\chi^2=5.48$ ;  $P=0.019$ ). Moreover, 89% of southeastern producers expressed support for development of more effective damage control measures whereas only 56% of western producers supported such research ( $\chi^2=11.9$ ;  $P=0.003$ ). Perhaps these data indicate that deer pressure is more severe in southeastern New York, thus rendering many current damage control measures ineffective. When asked which type of assistance they needed, about two-thirds of the producers from each region wanted technical information and/or permits to shoot damage-causing deer. Other types of assistance such as on-site advice, damage control provisions or cash payments were preferred less often.

**Impact of deer damage on consumers.** The nursery industry in the 2 regions appears to be growing, with more than four-fifths of the producers reporting that sales were increasing in recent years. However, the majority of producers perceived that deer damage to ornamental plants affects consumer willingness to buy ornamentals (69% western, 88% southeastern) ( $\chi^2=4.1$ ;  $P=0.048$ ). When asked to indicate the types of changes they perceive, producers in southeastern New York were more inclined than the producers in western New York to believe that consumers were buying different species of plants that were considered less palatable to deer ( $\chi^2=15.8$ ;  $P<0.001$ ). Spruce (*Picea spp.*) was listed most frequently as the substitution plant for yews and arborvitae used by consumers to diminish deer damage (Appendix D). Approximately one-third of the producers from each region believed that repeated deer damage was causing some consumers to quit buying ornamental plants. About one-fifth of the western, and two-fifths of the southeastern

producers believed that consumers were replacing damaged plants with identical species.

**Attitudes about deer and deer management.** The majority of producers in both regions regarded the existing (1988) deer population levels as unacceptably high. More than half of the producers indicated they wanted local deer populations to decrease, whereas only one-tenth or fewer wanted deer populations to increase (Table 4).

Table 4. Preferred population trend in local deer herd according to stakeholders in ornamental horticulture industry.

Preferred trend in local deer populations (1988 levels)	Western			Southeastern		
	Producers	Landscapers	Homeowners	Producers	Landscapers	Homeowners
Increase	10	23	18	8	5	14
Maintain	35	44	58	23	28	54
Decrease	55	33	24	69	67	32

Using a tolerance typology similar to that developed by Purdy et al. (1985), we classified producers' acceptance levels for deer. The typology was based on producers' answers regarding desired deer population trend, in addition to the question "How do you feel about having deer in your area?" Those who considered deer to be a nuisance or wanted a decrease in deer numbers were classified as non-accepting, whereas those who enjoyed deer and wanted to maintain or increase local deer populations were classified as accepting of deer (i.e., at 1988 population levels). Only one-third of the western producers were accepting of deer and about one-quarter of the

producers from the southeastern region were accepting (Figure 4). Deer acceptance levels of producers were lower when deer had damaged their plants (Figure 5). Damage experiences apparently had an impact on acceptance capacity of western producers, but not the southeastern producers for whom the background acceptance capacity seems lower. This was exemplified by the fact that most of the producers from western counties (83%) without damage were accepting of deer, but few of the southeastern producers (17%) without damage were accepting ( $\chi^2=6.9$ ;  $P=0.008$ ). Finally, because the majority of respondents from both regions were non-accepting regardless of the amount of damage incurred, we were not able to determine any thresholds based on perceived severity of damage.

Given the choice of no population control, regulated hunting, or other techniques (e.g., live trap and relocate, special kill permits, etc.), most nursery producers supported regulated hunting to control deer populations (83% western, 90% southeastern). Most producers preferred an archery season and/or shotgun or muzzleloader seasons. However, 32% of southeastern producers supported a rifle season, compared to only 11% of the producers from the western region ( $\chi^2=4.3$ ;  $P=0.039$ ). (Note that for the last several decades there has been a tradition of shotgun-only hunting in the western study area).

We also asked the producers to indicate their perception of the role of deer management in New York. We provided 3 reasons for managing deer populations: (1) for ecological reasons--that is, to maintain a balance with nature, (2) for aesthetic purposes--that is, for symbolic or artistic values, or (3) to provide recreational hunting opportunities, and we asked them to check as many reasons as apply or to provide their own reasons. More than

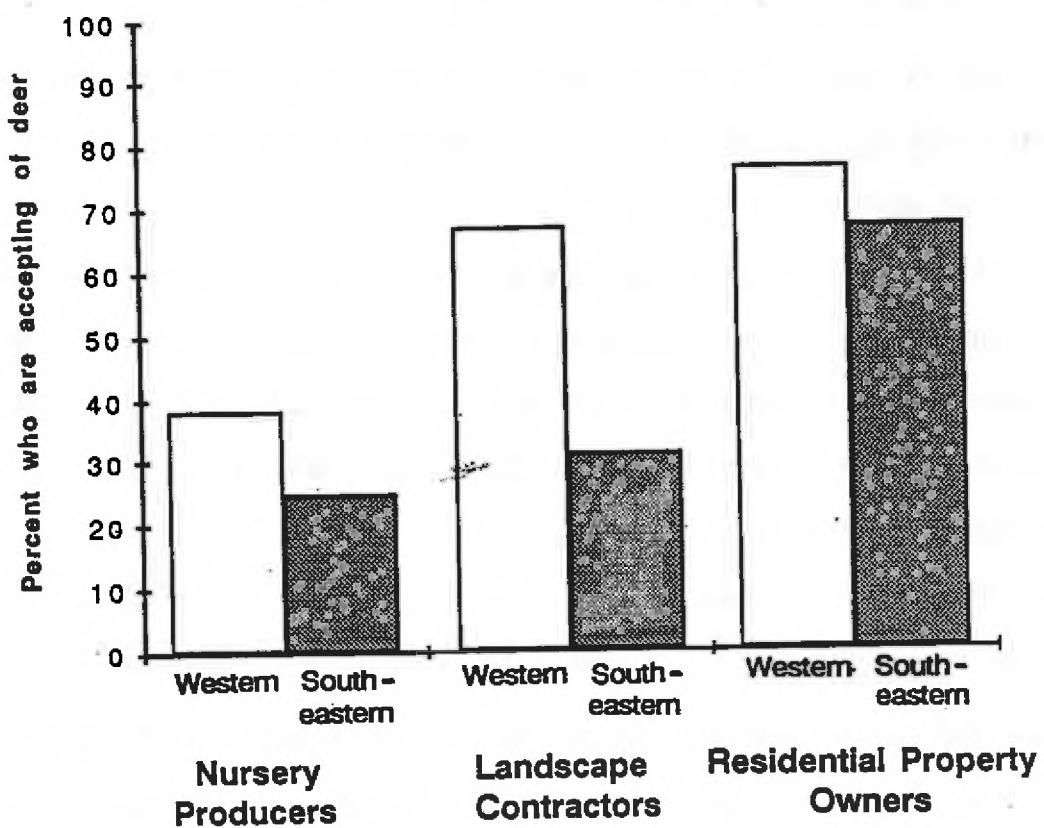


Figure 4. Comparison of commercial nursery producers', landscape contractors', and residential property owners' deer acceptance levels in New York.

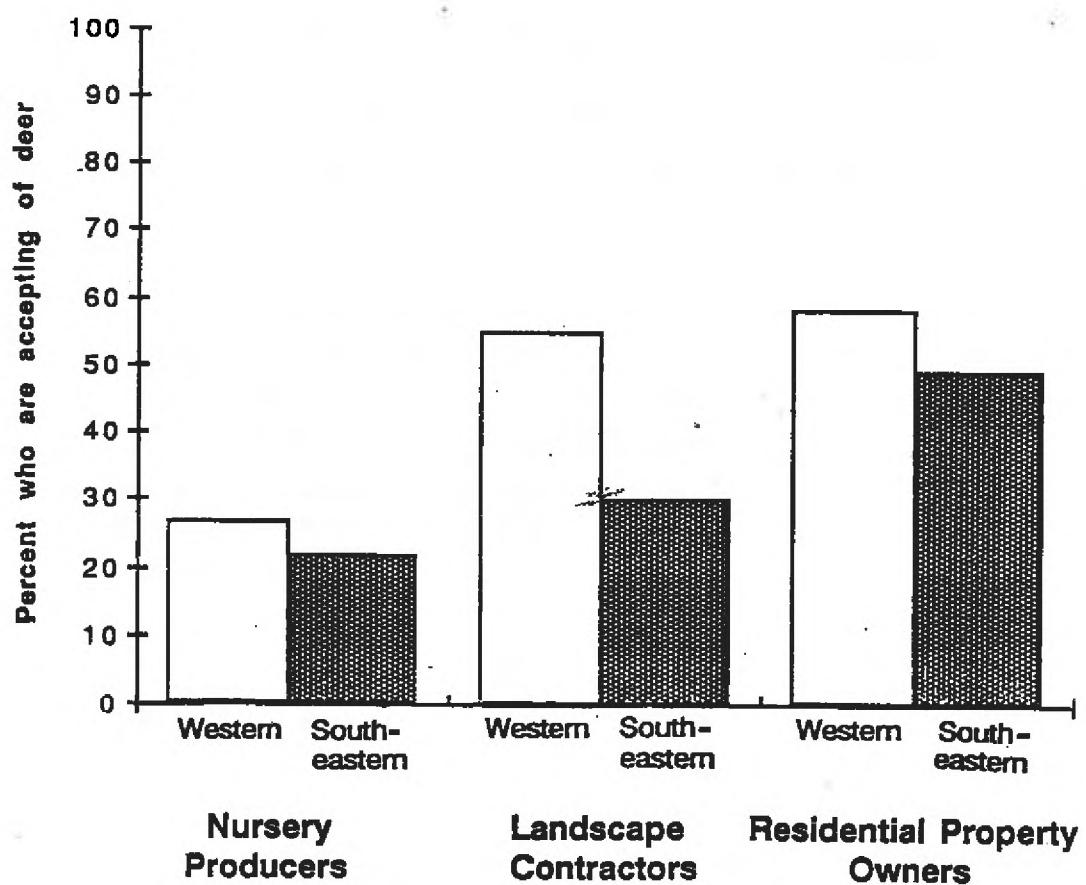


Figure 5. Deer acceptance levels of respondents who had deer damage on property or had clients with deer damage on property.

half of the producers (58% western, 63% southeastern) believed that deer should be managed for ecological reasons, whereas about one-fifth from each region thought deer should be managed to provide recreational hunting, and only 10% thought deer should be managed for aesthetic reasons.

**Concerns about deer.** About two-thirds of the producers from each region believed that when developing deer management plans deer managers should put more emphasis on information about damage to the ornamental horticulture industry. Damage to plants and human health and safety risks associated with deer (deer-car collisions, Lyme disease) were common concerns of nursery producers as well (Table 5). When asked to indicate their primary concern, a

Table 5. Deer-related concerns of nursery producers.

Concern	Percent having a concern		Percent rating as a primary concern	
	Western n=39	Southeastern n=55	Western n=26	Southeastern n=34
Ornamental plant damage	62	82*	50	65
Deer-car collisions	85	53*	39	15*
Damage to farm crops	51	58	11	0
Lyme disease	28	66*	0	20*
No concerns	10	7	0	0

\* $\chi^2$  differences between regions significant at  $P \leq 0.05$

majority felt that damage to ornamental plants was most important (50% western, 65% southeastern). Among the other producers, most from western New York indicated deer-car collisions were their primary concern whereas those in the southeastern region were split between deer-car collisions and Lyme

disease as their primary concern. In 1988 Lyme disease was classified as endemic to the southeastern region (New York State Department of Health 1989), but as of 1988 no cases had been reported to be contracted in the 2 western counties. Therefore, it is not surprising that the southeastern producers were more concerned about Lyme disease.

#### Landscape Contractors

**General Characteristics of Landscape Contractors.** Not all of the people contacted in the survey were active landscape contractors. Twenty-nine of the 218 respondents were not involved in the landscaping business during 1988. Nine replied they were involved in lawn maintenance, 5 were no longer in business, 3 were tree surgeons and 12 had other businesses such as excavating, sod production, or landscape design. We limited our analysis to the 189 respondents who were involved in landscape planting work during 1988; they are referred to as "landscapers." Nearly all of the landscapers worked with residential properties (94% western, 98% southeastern) and most worked with commercial properties (92% western, 65% southeastern), but few were hired to do landscaping on governmental or municipal properties (32% western, 13% southeastern).

**Experiences with deer and deer damage.** Deer damage appears to be more common in the southeastern region, where 74% of landscapers had at least some clients with deer damage to their plants, whereas 45% of the western landscapers reported that they had clients with deer damage ( $\chi^2=12.1$ ;  $P=0.001$ ). Southeastern landscapers also had more than twice the overall percentage of clients with deer damage to both trees and shrubs ( $P<0.001$ ) (Table 6).

Table 6. Deer damage experiences of landscape contractors.

	<u>Western</u>	<u>Southeastern</u>
Had clients with deer damage on their property		
%	45	74*
n	24	99
Percent of clients with damage		
Trees	15	38*
Shrubs	27	55*

\* $\chi^2$  differences between regions significant at  $P \leq 0.01$

That is, according to estimates of landscapers, 38% of all clients in the southeastern region had deer damage to trees compared to only 15% of the clients in the western region ( $\chi^2=13.6$ ;  $P < 0.001$ ), and 55% of southeastern clients had damaged shrubs compared to 27% of all western clients ( $\chi^2=16.2$ ;  $P < 0.001$ ). The belief that deer damage was increasing prevailed among 78% of the southeastern landscapers compared to only 44% of the western landscapers ( $\chi^2=14.7$ ;  $P < 0.001$ ). Yews, arborvitae, *Euonymus* spp. and *Rhododendron* spp. were listed most frequently as species damaged by deer (Appendix C). However, as with the producers' plant list, this may be an artifact of the relative abundance of plant species rather than actual preferences deer exhibit for various species.

**Prevention of deer damage.** Indicative of the greater incidence of deer damage in the region, four-fifths of the landscapers in the southeastern region with clients who had experienced deer damage reported that they had

been requested to help protect plants from deer damage. In comparison, one-half of the western landscapers with clients who had damage indicated they had been requested to assist with damage prevention. This was a significantly lower rate of damage prevention activity ( $\chi^2=9.1$ ;  $P=0.003$ ). Chemical repellents and fencing were the most common forms of damage control requested by clients (Table 7). Other methods such as soap, human hair or scare devices were used, with about one-fourth of the western and one-half of the southeastern clients employing at least 1 of these 3 methods.

Table 7. Deer damage prevention methods used by consumers, according to Landscape contractors.

<u>Type of prevention</u>	<u>Percent Using Damage Prevention</u>	
	<u>Western</u> n=17	<u>Southeastern</u> n=87
Chemical repellents	82	78
Fencing	47	12
Human hair	12	23
Soap	6	15
Scare devices	6	9

Landscapers from the western region listed themselves (40%), other landscapers (36%) and Cooperative Extension agents (36%), as principal sources of information regarding damage control (n=31). Almost two-thirds of the southeastern landscapers indicated Cooperative Extension (64%) was used as a common information source, and about one-third said that other landscapers (32%) or newspapers and magazines (35%) were also used (n=102). Three-fourths of the landscapers from both regions indicated they needed more information

regarding damage prevention, although more southeastern landscapers (87%) than western landscapers (68%) wanted better damage prevention methods developed ( $\chi^2=6.4$ ;  $P=0.04$ ).

**Impact of deer damage on consumers.** Although 98% of the landscape contractors reported that requests for landscaping were increasing or steady, many believed that deer damage was affecting consumer behavior. This was more common among southeastern landscapers (76%) than among western landscapers (39%) ( $\chi^2=13.6$ ;  $P<0.001$ ). Of those who had such beliefs, most (83% western, 88% southeastern) indicated that consumers were buying different plants to avoid deer damage. Spruce and Andromeda (*Pieris* spp.) were listed most frequently as substitute plants used to reduce deer damage (Appendix D). Deer damage has caused some consumers to quit buying ornamental plants according to 18% of the southeastern and 8% of the western landscapers. In summary, deer damage appears to be affecting some consumers, but most have not stopped buying landscape plants altogether.

**Attitudes about deer and deer management.** The attitudes of western vs. southeastern landscapers were consistent with their experiences and perceptions. One-third of the western landscapers wanted a decrease in local deer populations, compared to more than two-thirds from the southeastern region ( $P<0.001$ ) (Table 4). The acceptance typology data follows this pattern as well, where two-thirds of the western landscapers were accepting of deer at 1988 population levels (Figure 4), but less than one-third of the southeastern landscapers were accepting of deer at 1988 population levels ( $\chi^2=16.7$ ;  $P=<0.001$ ). Moreover, differences in deer acceptance were apparent even among those who had clients with deer damage ( $\chi^2=5.3$ ;  $P=0.021$ ) (Figure 5),

indicating a greater dissatisfaction with the problems associated with deer in southeastern New York.

Similar to nursery producers, many landscapers believed that deer should be managed for ecological reasons (81% western, 83% southeastern); fewer endorsed hunting (35% western, 34% southeastern) and aesthetic reasons (26% western, 28% southeastern). When asked to rate various considerations of deer managers, over half of the western landscapers believed preventing deer-car collisions was the most important consideration but fewer than one-tenth believed prevention of damage to ornamentals should be the most important consideration. The deer-related considerations of landscapers in the southeastern region were different than their western counterparts ( $\chi^2=16.6$ ;  $P=0.002$ ); slightly over one-third believed that deer managers should prevent deer-car collisions, and another one-third believed that preventing damage to ornamental plants should be the primary consideration.

**Concerns about deer.** Landscapers indicated they had concerns about deer in their area. For example, one-third of the western and two-thirds of the southeastern landscapers thought deer managers should be more concerned about deer damage to ornamental plants. Landscapers registered concern about perceived human health and safety risks associated with deer (i.e., Lyme disease and deer-car collisions) as well as damage to ornamental plants (Table 8). Health and safety risks appear to outweigh plant damage as primary concerns of the landscapers, who indicated that deer-car collisions or Lyme disease were their most important concerns. Landscapers from the southeastern part of the state were more concerned about transmission of Lyme disease than

Table 8. Deer-related concerns of landscape contractors.

Concern	Percent having a concern		Percent rating as a primary concern	
	Western n=50	Southeastern n=128	Western n=33	Southeastern n=85
Deer-car collisions	70	69	64	17*
Lyme disease	38	80*	15	60*
Ornamental plant damage	46	78*	18	20
Damage to farm crops	40	48	3	2
No concerns	16	7	0	1

\* $\chi^2$  differences between regions significant at  $P \leq 0.05$

in the western region. This is not surprising due to the prevalence of Lyme disease in southeastern New York, especially in Westchester County.

#### Residential Property Owners

**General characteristics of residential property owners.** Most residential property owners, referred to as "homeowners" in this text, were middle aged (median=53 years western and 46 years southeastern). The majority were male (3:1 male to female ratio western; 2:1 ratio southeastern). Most described their area of residence as rural or small town (78% western, 93% southeastern), with the remainder living in suburbs of cities. Virtually all respondents had gardens, fruit trees, or ornamental trees and shrubs on their property, with most of them (77% western, 83% southeastern) having ornamental trees and shrubs.

**Experiences with deer and deer damage.** At least four-fifths of the homeowners from both regions had seen deer within a mile of their residence

during the 3 previous years although most had not experienced deer damage to their gardens or ornamental plants. Deer damage appeared to be more common in the southeastern region, where 32% of the homeowners reported their plants were damaged by deer during the 3 previous years, compared to the western region, where 17% of the homeowners reported such damage ( $P=0.001$ ) (Table 9).

Table 9. Deer damage experiences of homeowners.

	<u>Western</u>	<u>Southeastern</u>
Had deer damage on property*		
%	17	32
n	49	71
Estimated cost to replace ornamental trees and shrubs		
mean**	\$158	\$474
SE	\$ 47	\$145
median	\$ 90	\$200
range	\$5-1,000	\$5-3,000
n	22	26

\* $\chi^2$  differences between regions significant at  $P=0.001$

\*\*Mean significantly different at  $P=0.048$ ;  $t=-2.06$

Of the homeowners who had damaged plants, nearly all agreed that winter and/or spring were the seasons when deer damage was most severe. Among homeowners who reported deer damage, damage to ornamental trees (46%) and shrubs (46%) was most frequent in the western region, whereas shrub (65%) and flower (49%) damage was most frequent in southeastern New York. Yews, *Rhododendrons* and Azaleas, and *Arborvitae* were listed most frequently as plants damaged by deer (Appendix C), though these reports may be a reflection of relative abundance of plants rather than preferences to deer for them.

Perceptions of damage severity among those who had deer damage on their property were nearly identical between the two regions. More than three-quarters of the homeowners from each region perceived deer damage to be moderate or light, and about one-quarter perceived their damage to be substantial to severe.

In contrast to these perceptions are the differences in estimated plant costs which indicates the severity of deer damage per household is greater in the southeastern region where estimates of replacement costs for ornamental plants were 3 times those of homeowners in the western region ( $t=2.06$ ;  $P=0.048$ ) (Table 9). The actual amount of physical damage to plants western vs. southeastern may not be as different as these data indicate because the replacement costs (purchase price of plants, labor, etc.) may have been greater in southeastern New York. On the other hand, these data also may imply that homeowners in the southeastern region are more accustomed to deer damage, and to incurring damage costs, thus their perceptions of damage severity are similar to the western homeowners despite disparate actual costs. This may explain why perceived severity was similar between the 2 regions, but damage estimates differed. Perceived severity by region was similar even for those respondents who reported estimates of plant replacement costs. That is, 41% of the western and 46% of the southeastern homeowners who provided estimates indicated that damage was substantial or severe. However, southeastern homeowners who reported substantial or severe damage to their ornamental plants averaged \$920 in losses compared to \$435 for western homeowners with substantial or severe damage. These data indicate that damage may be more severe in the southeastern region.

Homeowners in both regions had expenditures other than replacement costs for ornamental trees and shrubs damaged by deer, such as damage to flowers, fruit trees and vegetable gardens and costs associated with damage control expenditures. Homeowners in the southeastern region averaged twice the total expenditures (mean=\$440, SE=109, n=45) of western region homeowners (mean=\$220, SE=62, n=26) ( $P>0.05$ ). Overall, these damage-related experiences and associated expenditures of the homeowners in this study were similar to those reported by suburban residents surveyed by Decker and Gavin (1987) and Connally et al. (1987).

**Prevention of deer damage.** Use of damage prevention measures was reported by 7% of western and 19% of southeastern homeowners (assuming that respondents who had never seen a deer on their property did not use damage prevention). Of those providing information on damage prevention, fencing and human hair were employed most frequently (Table 10). Cost estimates

Table 10. Deer damage prevention methods used by homeowners.

<u>Type of prevention</u>	<u>Percent Using Damage Prevention</u>	
	<u>Western</u> n=17	<u>Southeastern</u> n=42
Fencing	70	52
Human hair	35	50
Scare devices	29	29
Chemical repellents	12	21
Soap	12	17

of damage control were provided by 10 western homeowners (mean=\$103, median=\$35) and 27 southeastern homeowners (mean=\$158, median=\$100).

Homeowners were less inclined than either producers or landscapers to seek damage prevention information. Two-thirds of the western and one-half of the southeastern homeowners who had seen deer on their property reported that they did not seek damage control information. Friends and neighbors were important information sources for 17% of the western and 33% of the southeastern homeowners, and landscape contractors were listed as the next most common information source (11% western; 15% southeastern).

Homeowners appeared to want information about damage prevention rather than development of new prevention techniques. Slightly more than one-half the homeowners from both regions indicated that they needed more information on damage prevention, implying a relatively high rate of interest in the matter due to experiences with deer damage. However, only about one-third of the homeowners from either region believed that better damage prevention methods should be developed.

**Impact of deer damage on consumers.** Deer damage affects the buying habits of some homeowners, but the impact may not be as severe as indicated by the producers and landscapers. Most homeowners from the western region (81%) replied that experiences with deer have not affected their willingness to purchase ornamental trees and shrubs. Seventy-four percent of the western respondents who had plants damaged by deer did not think the damage would affect their choice to buy ornamentals in the future. Deer damage had a greater impact on the southeastern homeowners ( $\chi^2=8.6$ ;  $P=0.003$ ) where only 58% thought their experiences with deer had no effect on their desire to buy ornamentals. The difference between those who had damage and those who did not was greater among homeowners in the southeastern region. Fourteen percent

of those without damage reported their expectations about deer damage had affected their buying behavior, whereas 48% of those with deer damage reported that the damage had affected their choices of ornamentals ( $\chi^2=8.3$ ;  $P=0.003$ ). The finding that almost half of the southeastern homeowners with damaged plants changed their choice of purchases (compared to about one-fourth western) may reflect several factors: (1) greater frequency and severity of deer damage in southeastern New York, (2) lower replacement costs in the western region, and (3) occurrence of damage is less frequent in the western region.

We also asked homeowners to specify the changes, if any, in the types of plants they were willing to purchase. Seven percent of the western homeowners were buying different species, and 6% indicated that deer damage had caused them to quit buying ornamentals. In the southeastern region, the proportions of homeowners indicating these changes were greater; 15% indicated they were purchasing different species of plants to diminish deer damage; and 21% were no longer buying ornamental plants because of deer damage (Appendix D).

Most (79% western; 58% southeastern) reported that retailers did not provide any information regarding damage prevention. The homeowners who did receive information reported that the retailers advised fencing (16% western; 21% southeastern), repellents (15% western; 23% southeastern), or replacement with species less desirable to deer (5% western; 13% southeastern) (Percentages add up to more than 100 because respondents were allowed to indicate more than 1 type of prevention measure.) Although during the planning of this study concern had been expressed by some deer managers and ornamental industry specialists that retailers were capitalizing on deer

damage by simply replacing damaged plants with identical species, none of the respondents from either region reported that they had received such advice. Only a fraction of the homeowners indicated they followed the recommendations received ( $n=9$  western;  $n=22$  southeastern). Six of the western homeowners and 15 southeastern reported that the actions they took helped prevent deer damage.

**Attitudes about deer and deer management.** A majority of homeowners from each region indicated they wanted to maintain deer populations at 1988 levels (Table 4). Homeowners in both regions were generally accepting of deer (Figure 4), although southeastern homeowners were slightly less accepting ( $P=0.05$ ). Experiences with deer damage appeared to have a significant impact on the acceptance capacities of homeowners. For example, 78% of the western respondents without deer damage were accepting of deer compared to 58% of those with damage ( $\chi^2=5.6$ ;  $P=0.018$ ). Seventy-seven percent of the southeastern homeowners without damage were accepting, compared to only 49% of those with deer damage ( $\chi^2=10.7$ ;  $P=0.001$ ).

We attempted to determine an acceptance threshold in terms of dollars of damage incurred per household using a scheme similar to that described by Connelly et al. (1987) to determine threshold levels. The dollar value above which a majority (75%) were non-accepting and below which a majority (75%) indicated they were accepting of deer represented the threshold. In the western region this threshold was at \$100 per household, whereas it was higher in the southeastern region, at \$200 per household. This difference in threshold levels can be influenced by a number of factors. As stated previously, southeastern homeowners may be more accustomed to having their

plants damaged by deer, and purchase and planting costs may be higher in that part of the state. Moreover, income levels of homeowners in the southeast region are higher, where 73% of households earned more than \$40,000 per year, compared to western households where 42% earned more than \$40,000 per year. Conceivably, homeowners with higher incomes could have higher tolerance thresholds. (The higher cost of living expenses in southeastern New York may offset this hypothesized effect of higher income and damage acceptance.)

Similar to the producers and landscapers, the majority of homeowners from both regions indicated that deer should be managed for ecological reasons (72% western, 88% southeastern;  $P=0.04$ ), whereas aesthetic values (40% for each region) and surplus for hunting (38% western, 24% southeastern;  $P=0.04$ ) were listed less frequently (note that percentages add up to more than 100 because respondents could list more than 1 reason.) These data parallel the data reported by Connelly et al. 1987, where the majority of respondents agreed that the ecological value of deer is important. Ten years ago, Kellert (1980) reported that most people regarded wildlife with a utilitarian or dominionistic perspective, although he speculated that aesthetic and ecological values associated with wildlife were on the increase.

Most homeowners supported regulated hunting as a means to control deer populations (71% western, 76% southeastern). The occurrence or absence of deer damage did not appear to have an effect on homeowners' support of regulated hunting as a management tool. Specifically, in the western region, 73% of the homeowners without deer damage supported hunting compared to 64% of those with damage. Likewise, in the southeastern region, 73% of the homeowners without deer damage on their property supported hunting, whereas 80% of those who had damage supported hunting as a method to manage deer

populations. Capture and removal was supported as an alternative by 12% of the western and 9% of the southeastern homeowners.

When asked to rank the importance of various factors that deer managers must consider, two-thirds of the homeowners from each region believed that preventing deer-car collisions should be most important. Ten to 14% of the respondents from each region believed that deer should be managed to provide recreational hunting opportunities and about 10% believed they should be managed for aesthetic reasons. Fewer than 10% of the homeowners thought that protection of farm crops or ornamental plants should be a primary consideration of deer managers. To summarize, these data indicate that reducing human health and safety risks associated with deer far outweigh other considerations for homeowners, and that protection of crops and ornamental plants is a relatively minor concern of homeowners.

**Concerns about deer.** The deer-related concerns of homeowners were similar to those of the producers and landscapers in that perceived human health and safety risks associated with Lyme disease and deer-car collisions are their most important concerns (Table 11). However, homeowners were much less concerned than producers or landscapers about deer damage to farm crops and ornamental plants. These data are consistent with the concerns of suburban residents as reported by Connelly et al. (1987) and Decker and Gavin (1987).

**Deer density, residential density and deer damage.** The use of buck take per square mile (BT/SM) data as an index of deer densities is most reliable in areas where hunting pressure is high and consistent from year to year and where access to land for hunting is available (New York State Department of Environmental Conservation 1987; Dickinson 1986). Population effects of deer-

Table 11. Deer-related concerns of homeowners.

Concern	Percent having a concern		Percent rating as a primary concern	
	Western n=282	Southeastern n=222	Western n=138	Southeastern n=135
Deer-car collisions	72	74*	71	30*
Lyme disease	38	74*	16	62*
Ornamental plant damage	11	23*	4	2
No concerns	22	12*	1	0
Damage to farm crops	5	25	3	2

\* $\chi^2$  differences between regions significant at  $P \leq 0.05$

car collisions, illegal harvest, predation, or starvation can be accounted for when analyzing buck take data (N. Dickinson *pers. comm.*). However, the index is not reliable in heavily urbanized areas where a large portion of land is developed, nor is it reliable in areas where hunting with firearms is restricted. Furthermore, caution must be used in the interpretation of buck take index when deer population levels are changing markedly from year to year (N. Dickinson *pers. comm.*). The primary assumption for use of density of residential units (RU/SM) is that the homeowners sampled are distributed throughout the town so that they have had experiences with deer that are representative of all homeowners. In addition, residential density data do not account for land-use characteristics (*i.e.*, land under commercial development, transportation routes and areas covered by water such as small lakes and ponds, rivers, or wetlands).

In the western region, as expected, the proportion of homeowners with deer damage to their plants increased as both deer density and residential density

increased (Figure 6). Unexpectedly, the towns of Amherst and West Seneca--where hunting is prohibited and no harvest occurs--did not have a greater proportion of homeowners who had deer damage on their property, nor were the average damage expenditures any higher. These 2 towns have high human population densities, and the highest residential densities of the towns in this survey (Appendix B).

Upon further examination, we found that many of the homeowners surveyed in Amherst and West Seneca were located in heavily developed areas largely uninhabited by deer. Those who had damage lived in the suburban-rural fringe. This situation was identified when we plotted the location of respondents in Amherst and West Seneca, which revealed that 19 out of 20 of the homeowners who did not have deer damage resided in "developed" areas<sup>1</sup> whereas 6 of 10 homeowners in "non-developed" areas had their plants damaged by deer. This analysis has obvious statistical limitations due to the low numbers of observations, but it indicates that the undeveloped areas in these towns may have extensive deer damage occurring. It also demonstrates the need for future research to be sensitive to deer density or residential density smaller than at the town level. For example, deer habitat and human land-use characteristics in an area need to be taken into account to gain a better understanding of factors relating to deer damage.

Homeowners in the western region living in towns with low RU/SM reported little or no damage costs whereas homeowners in the towns with high RU/SM had greater damage costs ( $t=-3.29$ ;  $P=0.004$ ) (Figure 7). This may indicate that

---

<sup>1</sup>We used the New York State Atlas and Gazetteer [1987, Delorme Mapping Company, Freeport, Maine] to define "developed" and "non-developed" sections of Amherst and West Seneca.

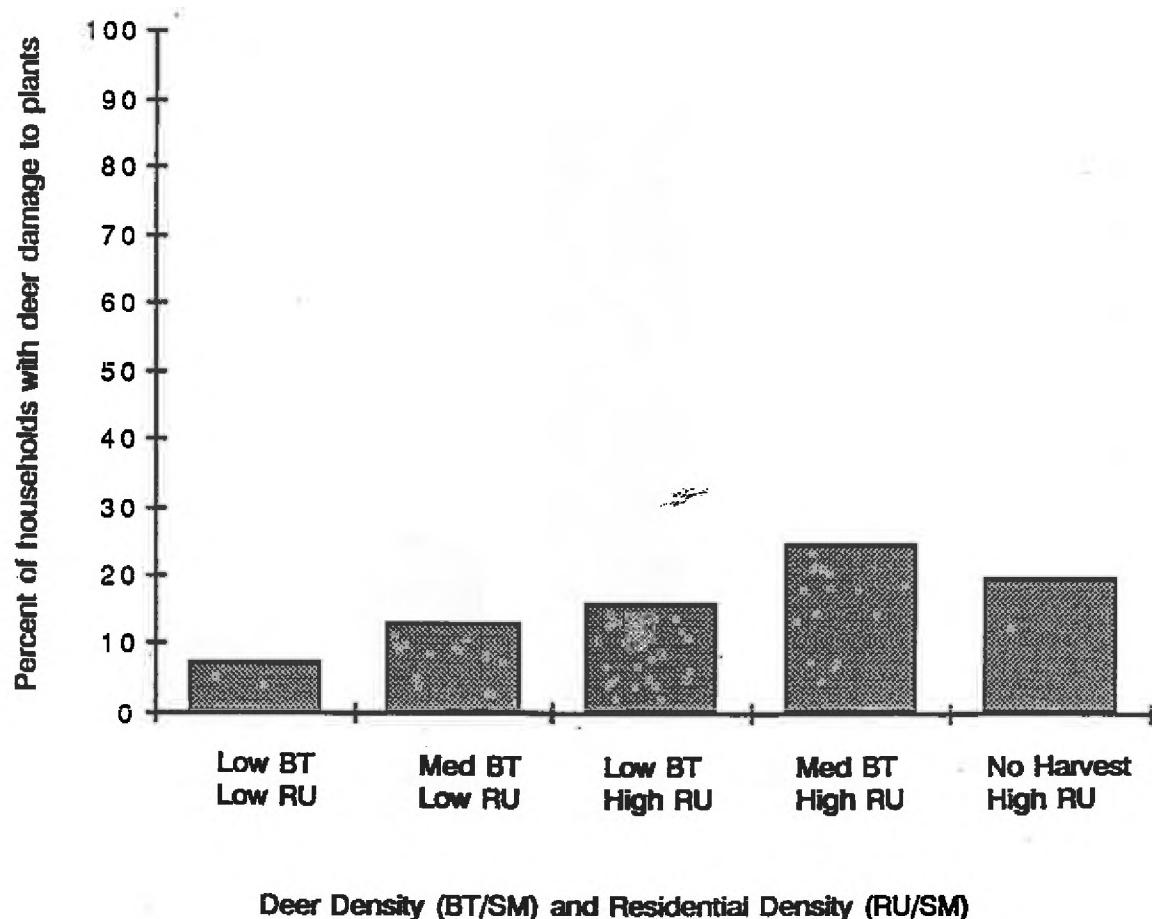


Figure 6. Percent of households with deer damage to ornamental plants in western region, by deer density and residential density.

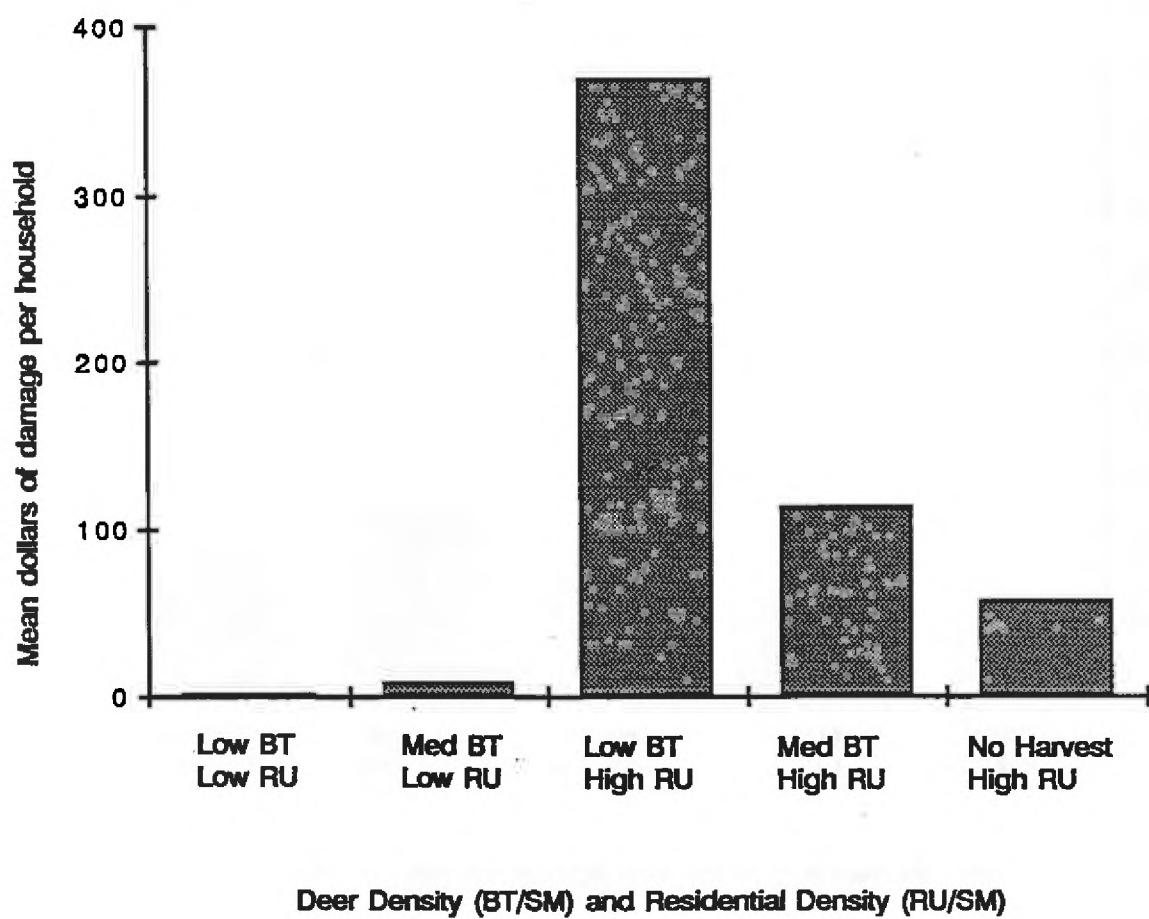


Figure 7. Mean cost per household to replace plants damaged by deer in western region, by deer density and residential density.

deer have less natural habitat available in the towns with high RU/SM and deer may be concentrated into refugia, from which they move to forage on ornamental plants in order to survive. The end result is that density of deer per unit of habitat is higher than indicated at the level of deer harvested by town.

Patterns in deer damage experiences and related expenditures were nearly opposite in the southeastern region compared with the western region. More homeowners in the Low RU towns had deer damage to their ornamental plants than did the homeowners in the High RU towns (Figure 8). However, no consistent relationships between BT/SM and frequency or severity of damage were found. Reported plant replacement expenditures were somewhat greater in the High BT/SM towns, and they were greater in the High RU/SM towns (Figure 9).

The only between-region comparisons of variables associated with deer damage where adequate response frequencies resulted were of the homeowners whose residences were in towns with medium BT/SM. The western region had no towns with a high deer density ( $BT/SM \geq 4.0$ ), likewise we did not have an adequate number of responses to analyze data from southeastern towns with low deer density ( $BT/SM < 2.0$ ). However, the patterns in the medium deer density towns were nearly opposite in terms of experiences with and expenditures relating to deer damage.

We were unable to identify consistent relationships between deer density, residential density and the frequency and severity of deer damage using the analytic constructs and sample sizes in this study. That does not imply that such relationships do not exist. Rather it does indicate the possible complexity of the situation. For example, land-use configurations affect the distribution and abundance of deer in ways that cannot be determined by density data alone.

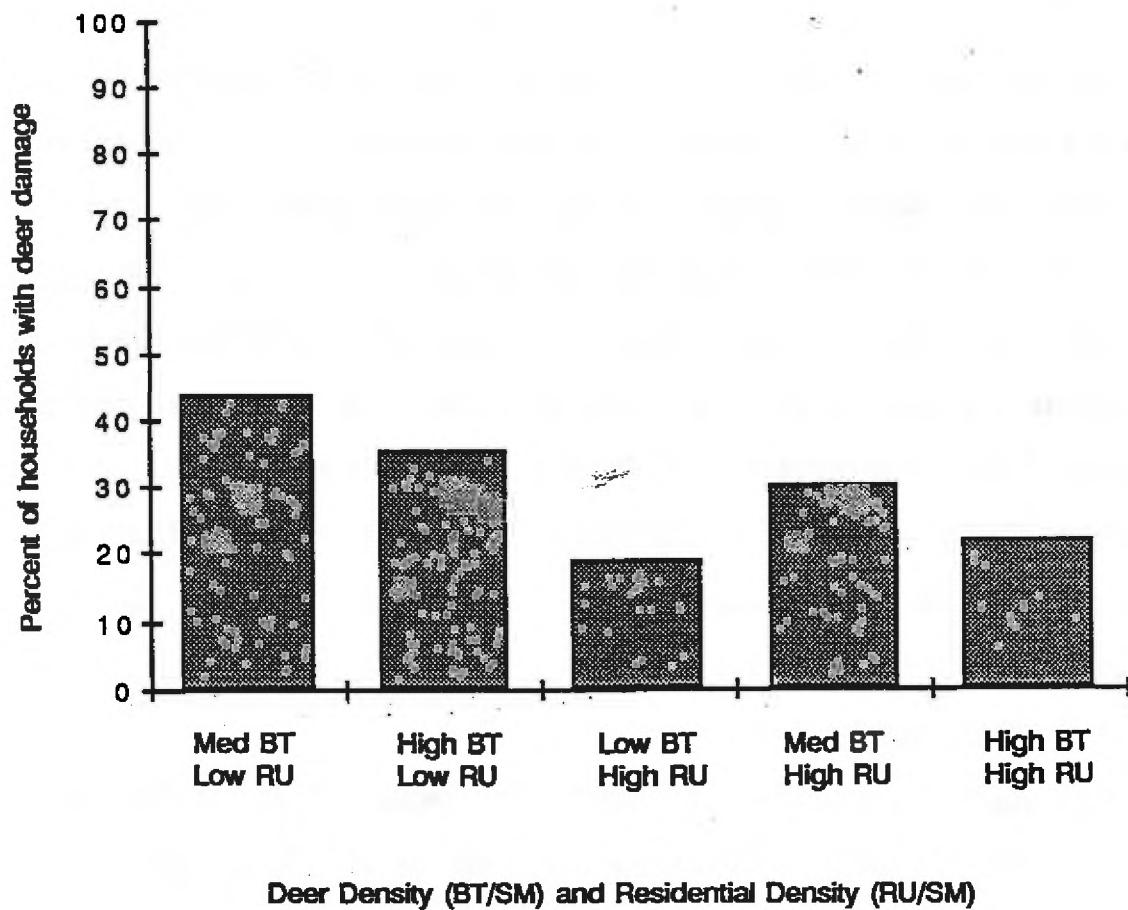


Figure 8. Percent of households with deer damage to ornamental plants in souteastern region, by deer density and residential density.

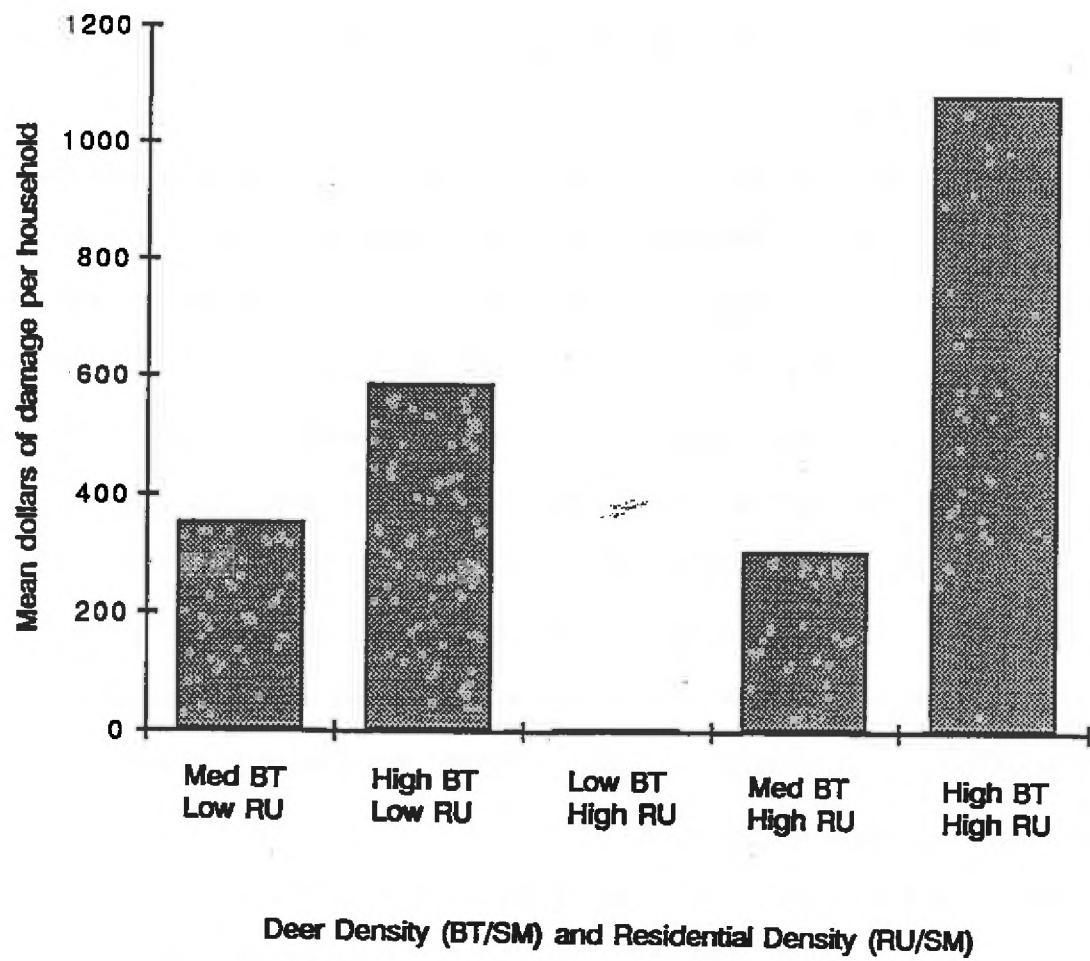


Figure 9. Mean cost per household to replace plants damaged by deer in southeastern region, by deer density and residential density.

## SUMMARY AND IMPLICATIONS

Deer damage has a direct impact on the ornamental horticulture industry, especially to the producers and consumers. This impact is not evenly distributed with some sites and geographical regions having greater levels of damage than others. These differences are related to factors such as physiographic characteristics, land-use patterns, deer population density, hunting pressure, and deer behavior. Subsequent research in both the biological and human dimensions could benefit by inquiring how these factors relate to deer damage.

Deer damage to ornamental plants is a primary concern of many producers, whereas homeowners and landscapers are more likely to classify damage as a nuisance. The latter 2 groups were more concerned about human health and safety risks associated with deer--i.e., Lyme disease and deer-car collisions. Nonetheless, producers and consumers will require more information on the costs and benefits of various damage prevention measures, and they will need to know how to apply that information to their specific situation. That only a few homeowners obtained damage prevention information from Cooperative Extension indicates a need for Cooperative Extension to seek creative ways to reach homeowners with information about damage prevention as well as information about deer management.

The people surveyed in this study were willing to express their opinions about the role of deer management. Most respondents wanted deer populations to be maintained at current levels or to be decreased, implying that these people support the management of deer populations. Furthermore, the majority of respondents supported hunting as a method to manage deer populations. In many areas hunting is the most effective and economically feasible means to

keep deer within biological carrying capacity as well as to reduce conflicts with people (Ellingwood and Caturano 1988).

However, in some suburban areas hunting with firearms may not be feasible. In these situations an archery season may be the best alternative. As of this printing, NYSDEC is considering the possibility of seeking legislation to allow an archery season in 50 square miles in the towns of Amherst, Clarence and West Seneca (Terry Moore NYSDEC *pers. comm.*). Capture and removal of deer and sterilization were listed as possible management techniques by some respondents. These methods may be possible alternatives for limited application in unique situations, but they are not yet economically feasible, nor have they been proven to be satisfactorily effective in the field. (See Ellingwood and Caturano for a review of alternatives regarding management of deer populations.)

A majority of respondents indicated deer should be managed for ecological reasons whereas deer management to provide recreational hunting opportunities and for aesthetic reasons were listed less frequently. These data may be indicative of a heightened ecological awareness across a broad group of constituencies. Even though managers have long placed primary importance on managing deer within ecological balance of the range and habitat, many in the public perceived that providing hunting opportunities was the primary role of deer management. Finally, the finding that only a minority of people surveyed indicated deer should be managed for aesthetic reasons may imply that deer are so ubiquitous that people are less concerned about their perpetuation or perhaps they are becoming concerned about the costs associated with deer.

## LITERATURE CITED

- Brown, T. L., and D. J. Decker. 1979. Incorporating farmers' attitudes into management of white-tailed deer in New York. *J. Wildl. Manage.* 43: 236-239.
- Brown, T. L., D. J. Decker, and D. L. Huston. 1980. Farmers' tolerance of white-tailed deer in central and western New York. *Search: Agriculture No. 7.* N.Y.S. Coll. Agric. and Life Sci., Cornell Univ., Ithaca, N.Y. 16pp.
- Brown, T. L., D. J. Decker, and N. A. Connelly. 1989. Response to mail surveys on resource-based recreation topics: a behavioral model and an empirical analysis. *Leisure Sci.* 11:99-110.
- Connelly, N. A., D. J. Decker, and S. Wear. 1987. White-tailed deer in Westchester County, New York: public perceptions and preferences. *Human Dimensions Res. Unit Publ. 87-5.* Dep. Nat. Resour., N.Y.S. Coll. Agric. and Life Sci., Cornell Univ., Ithaca, N.Y. 80pp.
- Conover, M. R. and G. S. Kania. 1988. Browsing preference of white-tailed deer for different ornamental species. *Wildl. Soc. Bull.* 16:175-179.
- Decker, D. J., and T. A. Gavin. 1987. Public attitudes toward a suburban deer herd. *Wildl. Soc. Bull.* 15:173-180.
- Decker, D. J. and K. G. Purdy. 1988. Toward a concept of wildlife acceptance capacity in wildlife management. *Wildl. Soc. Bull.* 16:53-57.
- Dickinson, N. R.. 1986. Testing selected harvest ratios for adult deer. *N.Y. Fish and Game J.* 33:11-15.
- Dillman, D. A. 1978. Mail and telephone surveys: the total design method. John Wiley & Sons, New York, N.Y. 325pp.
- Ellingwood, M. R. and S. L. Caturano. 1988. An evaluation of deer management options. The Northeast Deer Technical Committee. *Publ. No. DR-11.* 12pp.
- McAninch, J. B., and M. J. Fargione. 1987. Unpubl. report. Proj. No. 4943. Submitted to N.Y.S. Dep. Agric. and Markets. Albany, N.Y. 106pp.
- Kellert, S. R. 1980. Contemporary values of wildlife in American society. Pages 31-81 in W. W. Shaw, and E. H. Zube, eds. *Wildlife values.* Vol. 1. Center for Assessment of Noncommodity Natural Resources, Inst. Ser. Rep. School of Renewable Nat. Resour., Univ. Ariz., Tuscon, Ariz. 1:31-81.
- NY AG-MARK Service. 1989. List of certified nurseries and greenhouses for the registration period ending 28 February 1989. Circular 932. Dep. Agric. and Markets. Albany, N.Y. 54pp.
- NYNEX. 1988. The official directory of New York Telephone. NYNEX Information Resources Company.

New York Nursery Producers Survey. 1986. New York Agricultural Statistics Service. Albany, N.Y. 42pp.

New York State Department of Health. 1989. Epidemiology notes 4(3):1-3. Div. of Epidemiology, N.Y.S. Dep. Health. Corning Tower, Room 503 Empire State Plaza, Albany, N.Y.

New York State Department of Environmental Conservation. 1987. New York State 1987 deer management update. N.Y.S. Dep. Environ. Conserv., Big Game Unit. Delmar, N.Y. 4pp.

New York State Statistical Yearbook. 1989. Science Press, New York, N.Y.

Phillips, M., C. G. Forshey, G. B. White and M. E. Richmond. The economic impact of wildlife damage on Hudson Valley orchards. Pages 66-82 in N. R. Holler, ed. Proc. Third East. Wildl. Damage Control Conf. Gulf Shores, Ala.

Purdy, K. G., T. L. Brown, D. J. Decker, and J. W. Enck. 1989. Deer management in New York's Hudson Valley region: an assessment of the interests and opinions of three key constituencies. Human Dimensions Res. Unit Publ. 89-1. Dep. Nat. Resour. N.Y.S. Coll. Agric. and Life Sci., Cornell Univ., Ithaca, N.Y. 29pp.

Purdy, K. G., D. J. Decker, R. A. Malecki, and J. C. Proud. 1985. Landowner tolerance of beavers: implications for damage management and control. Pages 83-88 in P. T. Bromley, ed. Proc. Second Eastern Wildl. Damage Control Conf. Raleigh, N.C.

Sayre, R. W., and D. J. Decker. 1989. The extent and nature of deer damage to commercial nurseries in New York. Pages 162-172 in S. R. Craven, ed. Proc. Fourth East. Wildl. Damage Control Conf. Madison, Wis.

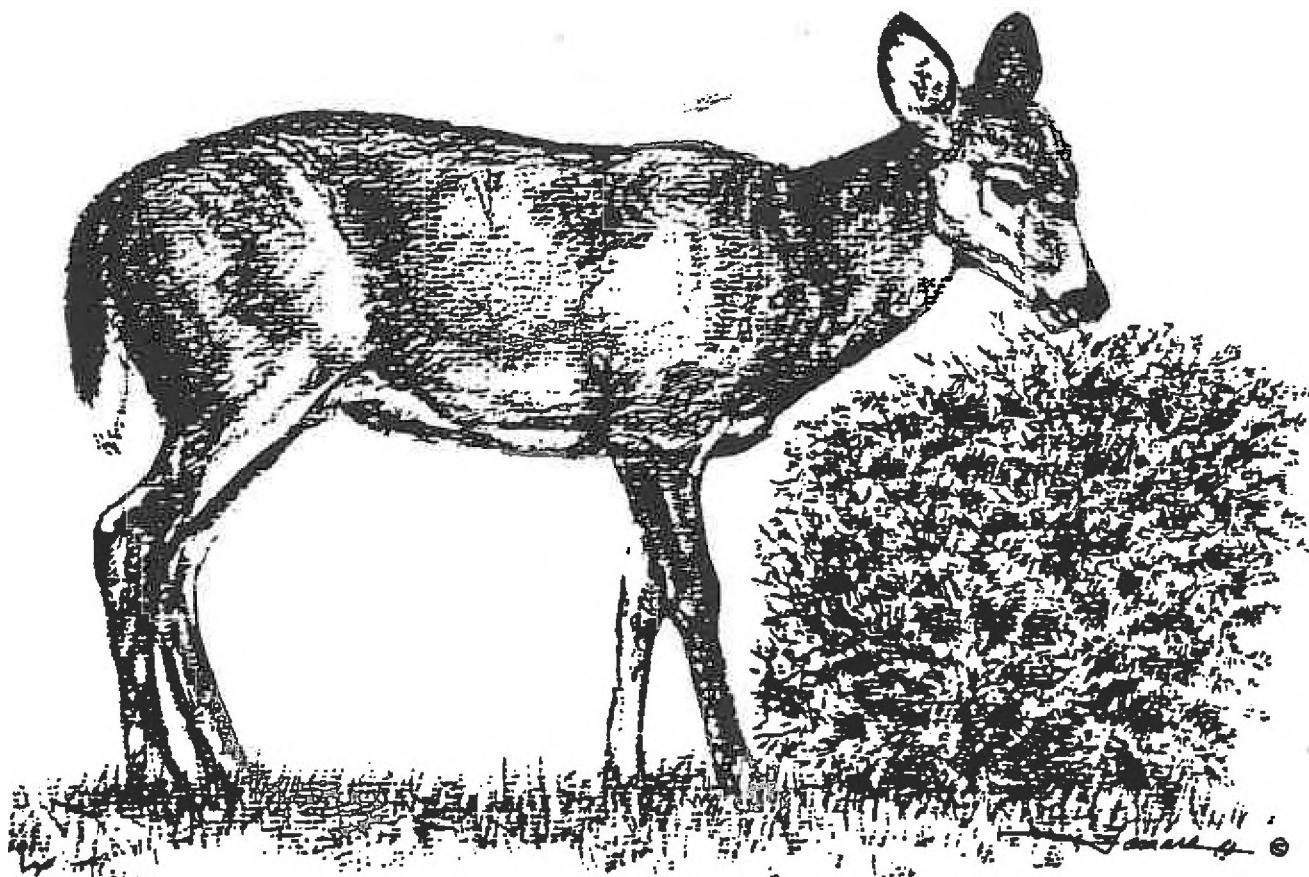
Scott, J. D., and T. W. Townsend. 1985. Characteristics of deer damage to commercial tree industries of Ohio. Wildl. Soc. Bull. 13:135-143.

Severinghaus, C. W., and C. P. Brown. History of white-tailed deer in New York. N.Y. Fish and Game J. 3:129-167.

SPSS Inc. 1983. SPSSX user's guide. McGraw-Hill Book Co., New York, N.Y. 806pp.

**APPENDIX A:**  
**MAIL QUESTIONNAIRE**

**DEER DAMAGE  
TO  
ORNAMENTAL PLANTS:  
A SURVEY OF NURSERY PRODUCERS  
IN NEW YORK**



DEER DAMAGE TO ORNAMENTAL PLANTS:  
A SURVEY OF NURSERY PRODUCERS IN NEW YORK  
conducted by the  
Department of Natural Resources  
and the  
Department of Floriculture and Ornamental Horticulture  
New York State College of Agriculture and Life Sciences  
Cornell University

This survey has been developed to help Cornell Cooperative Extension personnel and state wildlife biologists studying white-tailed deer damage to nurseries in New York. We are interested in learning more about commercial nursery producers' experiences with deer damage and interests in deer management. Information supplied by you will help us understand the extent and nature of the impact of deer populations on nurseries. Understanding the interaction between deer and people is important for the planning and implementing of deer management objectives that are both biologically sound and acceptable to the public.

Your opinions about deer are important to us even if you have not seen a deer in your area or not had deer damage on your property. Please fill out this questionnaire and return it to us as soon as possible. Return postage has been provided for your convenience.

Your cooperation in this study will be greatly appreciated.

THANK YOU FOR YOUR ASSISTANCE

1. Please indicate below the type of business you operated in 1988. (Check all that apply.)

grower or producer of nursery plants  
 landscape contractor  
 sod producer  
 wholesaler of nursery products and supplies  
 garden center  
 lawn maintenance

2. Did you produce and sell any nursery crops during 1988?

yes Go to question 3  
 no

If "no" please describe the types of agricultural products you produced in 1988: \_\_\_\_\_ You are now finished with this survey. However, we are still interested to know the type of business you operate, so please return this questionnaire by simply sealing it and depositing it in any mail box. Return postage has been provided. THANK YOU FOR YOUR TIME AND EFFORT!

3. What trend in deer numbers have you seen over the past 3 years in the area where your nursery is located?

deer numbers are increasing  
 deer numbers are stable  
 deer numbers are decreasing  
 don't know

4. Have you seen deer or evidence of deer (i.e., deer tracks, pellets, antler rubs, or browsing) on your nursery property in the last 3 years? (Check all that apply.)

saw deer in my nursery  
 saw deer feeding or causing damage in my nursery  
 saw evidence of where deer had fed on or damaged my nursery plants  
 never saw deer or evidence of deer damage in my nursery

\*\*If you have never seen deer or evidence of deer on your nursery, skip to question 20.\*\*

#### DEER DAMAGE EXPERIENCES

5. What trend have you observed in deer damage to plants in your nursery over the past 3 years?

deer damage is increasing  
 deer damage has stayed about the same  
 deer damage is decreasing  
 don't know

6. During which season does deer damage to plants in your nursery appear to be most severe? (Check one.)

winter (December-February)  
 spring (March-May)  
 summer (June-August)  
 fall (September-November)

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

light damage  
 moderate damage  
 substantial damage  
 severe damage

8. Please indicate below the types of plants deer damaged (i.e., from feeding or antler rubbing) in your nursery during the last 12 months by checking ( ) the line to the left of the item. Please also estimate the extent of damage on the line to the right.

<u>( ) Types of Plants</u>	<u>Extent of Damage</u>
<u>      </u> trees	% of total number of trees damaged= _____ % total number of trees damaged= _____
<u>      </u> shrubs	% of total number of shrubs damaged= _____ % total number of shrubs damaged= _____
<u>      </u> other plants	% of plants damaged= _____ % total number of plants damaged= _____

9. 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 (including purchase price of new plants, shipping, labor, etc.) for replacement.

<u>( ) Types of Plants</u>	<u>Estimated Cost of Replacement</u> (whether or not you have actually incurred the cost)
<u>      </u> trees	\$ _____ total cost
<u>      </u> shrubs	\$ _____ total cost
<u>      </u> others	\$ _____ total cost

10. Please define the following characteristics of the plants that typically incur damage from deer.

<u>species</u>	<u>age of plant</u>	<u>height of plant</u>
e.g., _____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

**DAMAGE CONTROL**

11. Have you taken any steps to protect your nursery from deer damage?

no

yes

If "yes," what kind of measures have you taken? (Check all that apply.)

soap

human hair

chemical repellents

scare devices

fencing (please describe type: \_\_\_\_\_.)

others (please specify: \_\_\_\_\_.)

In the last 12 months, approximately how much have you spent on deer damage control, including time and labor? (Do not include cost of replacing damaged plants.)

\$ \_\_\_\_\_ in the last 12 months.

12. From whom have you received deer damage control information? (Check all that apply.)

No one

New York State Department of Environmental Conservation

Cooperative Extension

County or Municipal Government

Commercial pest control operators/consultants

Animal damage control material distributors

Other nursery producers

Newspapers or magazines

Television or radio

Other (please specify: \_\_\_\_\_.)

13. Are you satisfied with the information and educational opportunities offered by Cooperative Extension in reference to deer damage and damage control?

       no

       yes

       no basis to make judgement

Please explain why you are or are not satisfied with these opportunities:

---

---

14. Do you need more information on the types and effectiveness of deer damage control methods that are currently available?

       no

       yes

15. The following items refer to the types of assistance for deer damage control that commercial nursery producers might find helpful. Those types that may involve some cost to the recipient are indicated.

Please think about your own situation with deer. First, check ( ) all the types of assistance that are of interest to you. Next, circle the one type of assistance you most need.

       Technical information about deer damage control.

       On-site advice/assistance from deer damage control technicians.

       Provision of damage control materials (e.g., deer fencing supplies); *some cost to recipient*.

       Cash payments or reimbursements for deer damage; *some cost to recipient*.

       Permits for on-site destruction of deer.

16. Do you believe more effective deer damage control methods need to be developed?

no

yes

don't know

17. Do you sell damage control materials such as fencing, chemical repellents, or scare devices?

no

yes

If "yes", approximately what percent of your total sales do you earn from the sale of damage control materials: \_\_\_\_ %?

18. Have you reported deer damage to the New York State Department of Environmental Conservation (NYSDEC) in the past 12 months?

no

If "no", have you ever reported deer damage to NYSDEC?

no

yes

yes

If "yes," what type of action did they take?

no action

surveyed damage and recommended damage control, BUT did not issue special nuisance permits

surveyed damage AND issued special nuisance permit (How many deer were taken? \_\_\_\_\_ deer)

other (please specify: \_\_\_\_\_)

)

19. Were you satisfied with the information given or action taken by NYSDEC regarding your deer damage problem?

no

yes

(Please explain: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_.)

#### CONSUMER BEHAVIOR

20. Over the past 3 years, what trend have you seen in sales of ornamental plants?

sales are increasing

sales are about the same

sales are decreasing

21. Do you believe that deer damage is affecting some consumers' willingness to purchase ornamental plants? (Check all that apply.)

No.

Yes, some consumers have been purchasing plants they believe deer are less likely to damage.

Yes, some consumers have purchased more ornamentals to replace damaged plants.

Yes, some consumers have quit buying ornamental plants because of deer damage.

I don't know.

22. If consumers have changed their buying habits, what kinds of plants have they been buying in order to reduce deer damage? (e.g., annuals, taller or more mature shrubs and trees, different species)

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**ATTITUDES ABOUT DEER**

23. 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.

24. Are any of the items below a concern of yours about deer in your area? (Check all that apply.)

- I have no concerns
- Lyme disease transmission
- deer/car collisions
- ornamental plant damage
- damage to other plantings
- other concerns (please specify: \_\_\_\_\_)

Please circle the most important concern to you from among those you checked above.

**DEER MANAGEMENT OPINIONS**

25. 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 level  
 slightly decrease deer populations  
 moderately decrease deer populations

Why do you want the trend you indicated above? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_.)

26. If a situation arose where deer were becoming over-populated in your area, which management techniques would you support for managing herd size? (Check all that apply.)

none, let the deer herd alone  
 regulated hunting  
 other (please specify: \_\_\_\_\_  
\_\_\_\_\_.)

If you checked "regulated hunting" above, what type of hunting season would you prefer? (Check all that apply.)

a regulated hunting season where hunters were allowed to use rifles  
 a regulated hunting season where hunters were allowed to use shotguns with rifle slugs or muzzleloading firearms  
 a regulated season where hunters were allowed to use a bow and arrow  
 a regulated season where hunters were allowed to use licensed handguns of appropriate caliber

27. How do you feel about the attention wildlife biologists are paying to your concerns about deer damage to ornamental plants?

wildlife managers should be more concerned

wildlife managers should be less concerned

wildlife managers have shown about the right level of concern

28. Wildlife managers must consider many factors when they make decisions concerning management of deer herds. Please rate the relative importance of the following factors.

	<u>Importance</u>			
	<u>None</u>	<u>Little</u>	<u>Moderate</u>	<u>Great</u>
a. protect against high rates of deer-vehicle collisions	0	1	2	3
b. manage herds for recreational hunting opportunities	0	1	2	3
c. protect against unacceptable damage to fruit orchards and vegetable crops	0	1	2	3
d. protect against damage to commercial and residential ornamental plantings	0	1	2	3
e. manage deer for optimum aesthetic values	0	1	2	3

Now circle the letter corresponding to the one factor that is most important, in your opinion.

29. Please check the one item below that best reflects your opinion of the most important role of deer management in New York. If none of the definitions apply, please submit your own.

Deer management should. . .

sustain healthy breeding populations of deer for ecological reasons.

sustain healthy breeding populations of deer for aesthetic reasons.

produce a sustained annual surplus of deer for recreational hunting.

other (please specify: \_\_\_\_\_)

## **BACKGROUND INFORMATION**

To better interpret your answers to previous questions, we need some information about your nursery. The following information you provide will be kept strictly confidential, and will not be associated with your name.

30. Consider the area surrounding your nursery (approximately 1 mile in any direction). Are there parks, forests, open space, or undeveloped lands that you believe are used by deer?

no

yes

If "yes", what kind of land is nearby? (Check all that apply.)

state, county, or municipal park

open space or undeveloped private land

### \_\_\_\_\_ agricultural land

other (please specify: \_\_\_\_\_.)

31. Approximately what size is your nursery?

acres

32. Please indicate below the amount of gross sales (in dollars) produced by your nursery business in 1988.

below \$10,000

\$100,000-249,999

\$10,000-24,999

\$250,000-499,999

\$25,000-49,999

\$500,000-999,999

\$50,000-99,999

\$1,000,000 or more

33. Approximately what percent of your household's net income was derived from the sale of nursery or horticultural products in 1988?

- less than 10 percent
- 10-25 percent
- 26-50 percent
- 51-75 percent
- 76-100 percent

34. Please indicate the town in which your nursery is located:

Town of: \_\_\_\_\_

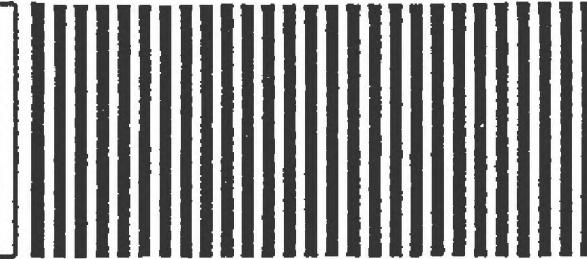
Please use this space for any additional comments you wish to make:

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.

833  
10

NO POSTAGE  
NECESSARY  
IF MAILED  
IN THE  
UNITED STATES



**BUSINESS REPLY MAIL**

FIRST CLASS PERMIT NO. 178 ITHACA, N.Y.

POSTAGE WILL BE PAID BY ADDRESSEE

CORNELL UNIVERSITY

Natural Resources, D. Decker

P.O. Box DH

Ithaca, New York 14851-9978

APPENDIX B:  
DEER DENSITY AND RESIDENTIAL DENSITY BY TOWN.

Table B-1. Deer density (BT/SM) and residential density (RU/SM) by town in Upstate New York; summary of damage experiences of homeowners by town.

<u>TOWN</u>	<u>COUNTY</u>	<u>BT/SM</u>	<u>RU/SM</u>	<u># of resp.</u>	<u>% with damage</u>	<u>mean \$ damage</u>	<u>(n)</u>
<b>LOW DEER DENSITY</b>							
Boston	ER <sup>1</sup>	1.9	62.1	7	----		
Clarence	ER	1.2	104.7	12	33.3	1012.50	(2)
Eden	ER	1.5	51.1	8	25.0		
Elma	ER	1.7	93.3	9	----		
Evans	ER	1.5	142.4	20	15.0	300.00	(1)
Grand Island	ER	1.2	173.6	12	8.3	293.00	(1)
Lancaster	ER	1.5	230.8	21	9.5	50.50	(2)
Marilla	ER	1.7	46.4	4	----		
Orchard Park	ER	1.2	181.3	17	17.7	200.00	(3)
Lockport	NI <sup>2</sup>	1.1	218.3	11	18.2		
Newfane	NI	1.1	50.3	8	----		
Pendleton	NI	1.0	41.0	5	20.0		
<b>MEDIUM DEER DENSITY</b>							
Alden	ER	2.0	67.2	46	13.0	8.50	(2)
Aurora	ER	2.4	108.2	78	24.4	113.10	(10)
<b>NO DEER HARVEST</b>							
Amherst	ER	---	457.2	25	24.0	56.25	(4)
West Seneca	ER	---	654.4	11	9.1		

<sup>1</sup>Erie County

<sup>2</sup>Niagara County

Table B-2. Deer density (BT/SM) and residential density (RU/SM) by town in New York; summary of deer damage experiences of homeowners by town.

<u>TOWN</u>	<u>COUNTY</u>	<u>BT/SM</u>	<u>RU/SM</u>	<u># of resp.</u>	<u>% with damage</u>	<u>mean \$ damage</u>	<u>(n)</u>
<b>LOW DEER DENSITY</b>							
Wappinger	DU <sup>1</sup>	1.6	214.5	7	28.6		
Newburgh	OR <sup>2</sup>	1.4	261.5	9	11.1	30.00	(1)
Wawayanda	OR	1.7	42.8	2	----		
<b>MEDIUM DEER DENSITY</b>							
Beekman	DU	3.3	74.3	7	57.1	27.50	(2)
E. Fishkill	DU	2.9	112.1	8	62.5	274.67	(3)
Fishkill	DU	3.5	123.2	5	20.0		
Hyde Park	DU	2.4	125.7	13	15.4		
La Grange	DU	3.6	104.9	5	40.0	220.00	(2)
Pleasant Valley	DU	2.9	65.7	4	25.0		
Red Hook	DU	2.8	63.3	5	----		
Blooming Grove	OR	2.8	115.8	7	----	20.00	(1)
Crawford	OR	3.0	44.9	3	33.3		
Goshen	OR	2.0	59.5	3	66.7	162.50	(2)
Hamptonburgh	OR	2.3	38.9	1	100.0		
Monroe	OR	2.9	205.0	5	50.0	183.33	(3)
Montgomery	OR	2.6	90.1	7	14.3		
Wallkill	OR	2.8	84.0	6	16.7		
Warwick	OR	2.7	77.3	11	45.5	22.50	(2)
Woodbury	OR	2.3	61.6	3	66.7	275.00	(1)
Carmel	PU <sup>3</sup>	2.3	219.3	9	11.1		
Kent	PU	2.3	113.8	7	28.6	425.00	(1)
Patterson	PU	3.7	84.3	7	28.6	275.00	(2)
Phillipstown	PU	3.2	58.1	10	80.0	758.00	(5)
Putnam Valley	PU	2.7	92.8	6	66.7	309.00	(3)
Southeast	PU	3.9	110.0	10	30.0	1100.00	(1)
<b>HIGH DEER DENSITY</b>							
Pawling	DU	5.4	46.1	9	44.4	175.00	(1)
Rhinebeck	DU	4.0	53.2	7	42.9		
Chester	OR	4.1	78.1	7	14.3		
Cornwall	OR	4.5	112.9	17	35.3	1081.67	(3)
Highlands	OR	4.9	44.2	6	50.0	512.50	(2)
Mount Hope	OR	4.1	48.0	5	20.0		
New Windsor	OR	5.0	135.6	15	6.7		

<sup>1</sup>Dutchess County

<sup>2</sup>Orange County

<sup>3</sup>Putnam County

**APPENDIX C:**  
**TYPES OF PLANTS REPORTED TO BE DAMAGED BY DEER**

Table C-1. Types of plants damaged by deer as reported by nursery  
producers in New York.<sup>1</sup>

<u>Scientific Name</u>	<u>Common Name</u>	<u>n</u>	<u>% of responses</u>
<i>Taxus</i> spp.	Yews	34	19.8
<i>Thuja occidentalis</i>	White cedar	17	9.9
<i>Rhododendron</i> spp.	Rhododendron	15	8.7
<i>Tsuga</i> spp.	Hemlock	9	5.2
<i>Abies balsamea</i>	Balsam fir	8	4.7
<i>Abies fraseri</i>	Fraser fir	7	4.1
<i>Acer</i> spp.	Maple	7	4.1
<i>Juniperus</i> spp.	Juniper	5	2.9
<i>Malus</i> spp.	Crabapple	5	2.9
	"Shade trees"	4	2.3
<i>Ilex</i> spp.	Holly	4	2.3
<i>Pseudotsuga menziesii</i>	Douglas fir	4	2.3
<i>Abies</i> spp.	Fir	3	1.7
<i>Tsuga canadensis</i>	Fruit trees	3	1.7
<i>Abies concolor</i>	Eastern hemlock	3	1.7
<i>Cornus</i> spp.	Colorado fir	2	1.2
<i>Euonymus fortunei</i>	Dogwood	2	1.2
<i>Leucothoe</i>	Spindle tree	2	1.2
<i>Picea glauca</i>	Fetterbush	2	1.2
<i>Pinus</i> spp.	White spruce	2	1.2
<i>Pinus strobus</i>	Pine	2	1.2
<i>Prunus cistina</i>	White pine	2	1.2
<i>Prunus</i> spp.	Purple-leaved sand cherry	2	1.2
<i>Viburnum</i> spp.		2	1.2
	Cranberry	2	1.2
<i>Betula</i> spp.		1	0.6
<i>Carya</i> spp.	Birch	1	0.6
<i>Castanea</i> spp.	Hickory	1	0.6
<i>Corylus</i> spp.	Chestnut	1	0.6
<i>Ilex x meserveae</i>	Filbert	1	0.6
<i>Juglans ailanthifolia</i> <i>cordiformis</i>	Blue prince	1	0.6
	Heart nut	1	0.6
<i>Juglans</i> spp.	Walnut	1	0.6
<i>Kalmia latifolia</i>	Mountain laurel	1	0.6
<i>Malus</i>	Apple	1	0.6
<i>Picea pungens</i>	Colorado blue spruce	1	0.6
<i>Picea</i> spp.	Spruce	1	0.6
<i>Pinus nigra</i>	Austrian pine	1	0.6
<i>Prunus</i>	Cherry	1	0.6
<i>Quercus rubra</i>	Red oak	1	0.6
<i>Rubus</i> spp.	Raspberry	1	0.6
<i>Salix</i> spp.	Willow	1	0.6
<i>Sambucus</i> spp.	Elderberries	1	0.6
<i>Taxus x m. hicksii</i>	Hick's Yew	1	0.6
<i>Taxus x media densiforma</i>	Angola-Japanese Yew-dense	1	0.6

Table C-1. (cont.)

<u>Scientific Name</u>	<u>Common Name</u>	<u>n</u>	<u>% of responses</u>
<i>Tilia</i> spp.	Linden	1	0.6
	Evergreen	1	0.6
<i>Tulipa</i>	Tulip	1	0.6
<i>Vaccinium</i> spp.	Blueberry	1	0.6
<i>Zelkova</i>	Zelkova	1	0.6

<sup>1</sup>Frequency of cases does not necessarily represent preferences by deer.

Table C-2. Types of plants damaged by deer as reported by landscape contractors in New York.<sup>1</sup>

<u>Scientific Name</u>	<u>Common Name</u>	<u>n</u>	<u>% of responses</u>
<i>Taxus</i> spp.	Yews	98	26.8
<i>Rhododendron</i> spp.	Rhododendron	52	14.2
<i>Rhododendron</i> spp.	Azalea	33	9.0
<i>Tsuga canadensis</i>	Eastern hemlock	33	9.0
<i>Thuja occidentalis</i>	White cedar	30	8.4
<i>Euonymus</i>	Euonymus	13	3.6
<i>Juniperus</i> spp.	Juniper	13	3.6
<i>Pinus strobus</i>	White pine	7	1.9
	Evergreen	6	1.7
<i>Kalmia latiflora</i>	Mountain laurel	5	1.4
<i>Malus</i> spp.	Apple	5	1.4
<i>Tulipa</i> spp.	Tulips	5	1.4
<i>Cornus</i> spp.	Dogwood	4	1.1
<i>Ilex</i> spp.	Holly	4	1.1
<i>Picea</i> spp.	Spruce	4	1.1
<i>Pinus</i> spp.	Pine spp.	4	1.1
<i>Euonymus atropurpurea</i>	Burning bush	3	0.8
<i>Kalmia</i> spp.	Laurel	3	0.8
<i>Albies balsamea</i>	Balsam fir	2	0.5
	Perennials	2	0.5
	"Shade trees"	2	0.6
	Fruit trees	2	0.5
	Crabapple	2	0.5
	<i>Pachysandra</i>	2	0.5
	Flowering shrubs	2	0.5
	Annuals	2	0.5
	Flowering crabs	2	0.5
	Purple leaf sand cherry	2	0.6
<i>Prunus cistina</i>	Hedge	1	0.3
	Bulbs	1	0.3
	Flowers	1	0.3
<i>Acer</i> spp.	Maple	1	0.3
<i>Acer japonica</i>	Japanese maple	1	0.3
<i>Acer rubra</i>	Red maple	1	0.3
<i>Abies</i> spp.	Fir	1	0.3
<i>Abies fraseri</i>	Fraser fir	1	0.3
<i>Ericaceae</i>	Heath	1	0.3
<i>Fagus</i> spp.	Beech	1	0.3
<i>Hedera helix</i>	English ivy	1	0.3
<i>Hibiscus syriacus</i>	Rose-of-sharon	1	0.3
<i>Impatiens</i> spp.	Impatiens	1	0.3
<i>Kalmia</i>	Laurel	1	0.3
<i>Leucothoe</i>	Fetterbush	1	0.3
<i>Picea glauca</i>	White spruce	1	0.3

Table C-2 (cont.)

<u>Scientific Name</u>	<u>Common Name</u>	<u>n</u>	<u>% of responses</u>
<i>Pinus mugo</i>	Mugo	1	0.3
<i>Pinus sylvestris</i>	Scotch pine	1	0.3
<i>Pseudotsuga menziesii</i>	Douglas fir	1	0.3
<i>Pyrus</i>	Pear tree	1	0.3
<i>Quercus</i> spp.	Oak	1	0.3
<i>Robinia</i> spp.	Black locust	1	0.3
<i>Syringa</i> spp.	Lilac	1	0.3
<i>Viburnum</i>	Cranberry	1	0.3

<sup>1</sup>Frequency of cases does not necessarily represent preferences by deer.

Table C-3. Types of plants damaged by deer reported by residential property owners in New York.<sup>1</sup>

<u>Scientific Name</u>	<u>Common Name</u>	<u>n</u>	<u>% of responses</u>
<i>Taxus</i> spp.	Yews	26	15.7
<i>Rhododendron</i> spp.	Azalea	25	15.0
<i>Thuja occidentalis</i>	White cedar	13	7.8
<i>Pinus</i> spp.	Pine spp.	8	4.8
	Evergreen	8	4.8
<i>Acer</i> spp.	Maple	7	4.2
<i>Pinus strobus</i>	White pine	7	4.2
<i>Euonymus fortunei</i>	Spindle tree	5	3.0
<i>Kalmia latifolia</i>	Mountain laurel	5	3.0
<i>Tsuga canadensis</i>	Eastern hemlock	5	3.0
<i>Malus</i> spp.	Apple spp.	4	2.4
<i>Picea pungens</i>	Blue spruce	4	2.4
<i>Pseudotsuga menziesii</i>	Douglas fir	4	2.4
<i>Forsythia</i> spp.	Forsythia	3	1.8
<i>Picea glauca</i>	White spruce	3	1.8
<i>Hibiscus syriacus</i>	Rose-of-Sharon	2	1.2
<i>Ilex</i> spp.	Holly	2	1.2
<i>Juniperus</i> spp.	Juniper spp.	2	1.2
<i>Magnolia</i> spp.	Magnolia	2	1.2
<i>Picea</i> spp.	Spruce spp.	2	1.2
<i>Pinus resinosa</i>	Red pine	2	1.2
<i>Syringa</i> spp.	Lilac	2	1.2
<i>Abies</i> spp.	Fir spp.	1	0.6
<i>Acer japonicum</i>	Japanese red maple	1	0.6
<i>Buxus</i> spp.	Boxwood	1	0.6
<i>Cornus</i> spp.	Dogwood spp.	1	0.6
<i>Lonicera</i> spp.	Honeysuckle	1	0.6
<i>Pieris</i> spp.	Andromeda	1	0.6
<i>Pinus sylvestrus</i>	Scotch pine	1	0.6
<i>Populus</i> spp.	Poplar	1	0.6
<i>Prunus persica</i>	Peach	1	0.6
<i>Prunus</i> spp.	Cherry	1	0.6
<i>Pyrus</i> spp.	Pear spp.	1	0.6
<i>Quercus</i> spp.	Oak	1	0.6
<i>Salix discolor</i>	Pussy willow	1	0.6
<i>Salix</i> spp.	Willow spp.	1	0.6
<i>Sambucus</i> spp.	Elderberries	1	0.6
<i>Sequoiadendron gigantea</i>	Redwood	1	0.6
<i>Vaccinium</i> spp.	Blueberry	1	0.6
<i>Viburnum</i>	Cranberry	1	0.6
<i>Yucca</i> spp.	Yucca	1	0.6

<sup>1</sup>Frequency of cases does not necessarily represent preferences by deer.

**APPENDIX D:**  
**TYPES OF PLANTS USED BY CONSUMERS TO AVOID DEER DAMAGE**

Table D-1. Types of changes in plant types used by consumers to diminish deer damage, according to perceptions of nursery producers.

<u>General changes used to avoid deer damage</u>	<u>n</u>	<u>% of responses</u>
"Different species"	39	19.7
Mature plants	4	2.0
Annuals	3	1.5
Thorned varieties	2	1.0
Deciduous shrubs	1	0.5
Evergreens	1	0.5

<u>Specific plant types used to avoid deer damage</u>	<u>n</u>	<u>% of responses</u>	
<i>Picea</i> spp.	Spruce	9	4.5
<i>Buxus</i> spp.	Boxwood	3	1.5
<i>Juniperus</i> spp.	Juniper	2	1.0
<i>Pieris</i> spp.	Andromeda	2	1.0
<i>Taxus</i> spp.	Yews	1	0.5

Table D-3. Types of changes in plant types used by residential property owners to diminish deer damage.

<u>General changes used to avoid deer damage</u>	<u>n</u>	<u>% of responses</u>
"Different species"	15	2.4
Mature plants	3	0.6
Taller plants	2	0.4
Annuals	1	0.2
Evergreen	1	0.2

<u>Specific types of plants used to avoid deer damage</u>	<u>n</u>	<u>% of responses</u>
<i>Juniperus</i> spp.	Juniper	0.4
<i>Rhodendron</i> type	Azaleas	0.4
<i>Hydrangea</i> spp.	Hydrangea	0.2
<i>Tagetes</i> spp.	Marigolds	0.2
<i>Tsuga canadensis</i>	Hemlock	0.2
<i>Yucca</i> spp.	Yucca	0.2
<i>Zinnia</i> spp.	Zinnia	0.2

Table D-2. Types of changes in plant types used by consumers to diminish deer damage, according to perceptions of landscape contractors.

<u>General changes used to avoid deer damage</u>	<u>n</u>	<u>% of responses</u>
"Different species"	41	21.6
Annuals	5	2.6
Deciduous shrubs	5	4.9
Perennials	4	2.2
Non-evergreens	2	1.1
More mature	1	0.5
Taller plants	1	0.5
Poisonous plants	1	0.5
Evergreens	1	0.5
Woody plants	1	0.5
Flowering shrubs	1	1.0

<u>Specific types of plants used to avoid deer damage</u>	<u>n</u>	<u>% of responses</u>	
<i>Juniperus</i> spp.	Juniper	15	14.6
<i>Pieris</i> spp.	Andromeda	14	13.6
<i>Picea</i> spp.	Spruce	11	10.7
<i>Ilex</i> spp.	Holly	10	9.7
<i>Buxus</i> spp.	Boxwood	6	5.8
<i>Berberis</i> spp.	Barberry	4	3.9
<i>Pinus</i> spp.	Pine	4	3.9
<i>Pieris japonica</i>	Japanese andromeda	3	2.9
<i>Picea glauca</i> 'cornuta'	Alberta spruce	3	2.9
<i>Rhododendron</i> spp.	Rhododendron	3	2.9
<i>Tsuga canadensis</i>	Eastern hemlock	2	1.9
<i>Betula</i> spp.	Birch	1	1.0
<i>Ilex</i>	English holly	1	1.0
<i>Ilex opaca</i>	American holly	1	1.0
<i>Kalmia latifolia</i>	Mountain laurel	1	1.0
<i>Kalmia</i> spp.	Laurel	1	1.0
<i>Leucothoe fontanesiana</i>			
<i>cataesbae</i>	Drooping Leucothoe	1	1.0
<i>Leucothoe</i> spp.	Fetterbush	1	1.0
<i>Narcissus</i> spp.	Daffodils	1	1.0
<i>Pieris floribunda</i>	Mountain andromeda	1	1.0
<i>Pieris japonica</i>	Japanese andromeda	1	1.0
<i>Pinus mugo</i>	Mugo pine	1	1.0
<i>Pyracantha</i> spp.	Firethorn	1	1.0
<i>Rhododendron</i> type	Azaleas	1	1.0
<i>Spiraea</i> spp.	Spirea	1	1.0
<i>Syringa</i>	Lilac	1	1.0
<i>Thuja</i> spp.	Cedar	1	1.0
<i>Viburnum</i> spp.	Cranberry	1	1.0