HRI's Mission:

To direct, fund, promote and communicate horticultural research, which increases the quality and value of ornamental plants, improves the productivity and profitability of the nursery and landscape industry, and protects and enhances the environment.

The use of any trade name in this article does not imply an endorsement of the equipment, product or process named, nor any criticism of any similar products that are not mentioned.

Deer Damage to Landscape Plants in New York State: Perceptions of Nursery Producers, Landscape Firms, and Homeowners[1]

R.W. Sayre,[2] D.J. Decker,[3] and G.L. Good[3]
Department of Natural Resources
Cornell University
Ithaca, NY 14853

Abstract

Damage to landscape plants by white-tailed deer (*Odocoileus virginianus* Raf.) is widespread in many areas in the northeastern U.S. A mail survey to assess the extent and impact of deer damage to nursery producers, landscape firms and homeowners was conducted in suburban areas of southeastern and western New York in 1989. About two-thirds of producers and landscape firms, and slightly fewer than one-fourth of homeowners reported damage by deer during 1988. Yews, (*Taxus* spp.) and white cedar, (*Thuja occidentalis* L.), were listed most frequently by respondents as plants damaged by deer. The majority of respondents believed that damage was most severe during winter or spring. Some producers and homeowners reported severe economic losses from deer damage. Use of damage prevention was widespread among respondents who had experiences with deer and deer damage. Browse-resistant plants, such as spruce (*Picea* spp.), juniper (*Juniperus* spp.), andromeda (*Pieris* spp.), and boxwood (*Buxus* spp.) were used by some respondents. Many people also wanted additional information and research to improve damage prevention. Damage to landscape plants was a primary concern to a majority of producers, but was less of a concern to landscape firms and homeowners. Instead, these latter groups were most concerned about risks they associated with deer such as Lyme disease or deer-vehicle collisions.

Index words: browsing damage, nursery, landscape plants, surveys, white-tailed deer (*Odocoileus virginianus*)

Significance to the Nursery Industry

Deer damage at commercial nurseries and suburban landscapes is widespread in some areas of the northeastern U.S., it appears to be increasing, and it could have a significant impact on the landscape horticulture industry. A majority of respondents (62%; $n = 238$) indicated that they could use more information on damage prevention, and many (60%; $n = 234$) saw the need for additional research to improve methods to reduce damage. The extent and severity of plant damage by deer could be reduced with technical improvements in damage prevention.

Many producers and landscape firms (71%; $n = 144$) believed that consumers were using different types of plants to avoid deer damage, with spruce, juniper, andromeda and boxwood listed most often as the types of plants used. These plants are browse-resistant because they have chemical or physical defense mechanisms. Most information on browse-resistant landscape plants is qualitative or anecdotal, therefore quantifiable research to determine which landscape plants are avoided, or why they are avoided, is needed. Some producers and landscape firms (25%; $n = 50$) also believed that some consumers had ceased buying landscape plants because of repeated experiences with deer damage. Few homeowners (11%; $n = 50$) indicated that browsing damage had discouraged them from buying landscape plants, although the problem may require continued monitoring.

Many consumers have taken action to prevent or reduce damage. The impact of the damage could be reduced through proper planning of the design and location of nursery and landscape plantings. Dissemination of information about improved and reliable damage prevention could help people decide which of these measures would be most feasible.

Introduction

Damage to landscape trees and shrubs by white-tailed deer (*Odocoileus virginianus* Raf.) is widespread in some areas of the northeastern United States (3, 4, 16). The expansion of residential and commercial developments into rural areas and an increase of deer populations throughout the region appear to be important factors contributing to the problem (7).

People from both the commercial and consumer sectors of the landscape horticulture industry have experienced deer damage. Studies in Ohio (16) and Connecticut (4) have indicated that some nursery producers incur high economic losses from deer foraging on plant materials. Losses reported by nursery producers are among the highest of any agricultural sector, including orchardists (14). Other studies have reported that homeowners in suburban areas also suffer extensive deer damage to their trees and shrubs (3, 5). No comprehensive studies from an industry-wide perspective have been previously conducted.

The primary objective of this study was to assess the extent, nature, and economic impact of deer damage to 3

[1]Received for publication August 5, 1991; in revised form December 17, 1991. This research was supported by USDA/APHIS contract mber 53-6395-8-122 and by Hatch Project NYC 147303, USDA. We thank P. Curtis and M. Fargione for their comments on the manuscript; M. Peech for secretarial support; N. Bowers for typing; N. Connelly and R. Shiffler for assistance with the survey. We are grateful to L. Hulcoop, M. Riofrio, and P. Trader for providing lists of nursery producers and landscape firms. We are especially thankful to the respondents who took the time and interest to complete the questionnaires.

[2]Formerly, Research Support Specialist, Department of Natural Resources, Cornell University, Ithaca, NY 14853. *Current address*: Department of Biology, Box 8238, University Station, University of North Dakota, Grand Forks, ND 58202.

[3]Associate Professor, Department of Natural Resources, Cornell University, Ithaca, NY 14853.

[4]Professor and Head, Department of Floriculture and Ornamental Horticulture, Cornell University, Ithaca, NY 14853.

primary segments in the landscape horticulture industry: nursery producers, landscape firms and homeowners. Concerns about risks associated with deer also were examined.

Materials and Methods

A mail survey was conducted during 1989 in 2 counties (Erie and Niagara) in western New York (WNY), near the city of Buffalo; and in 5 counties (Dutchess, Orange, Putnam, Rockland, and Westchester) in southeastern New York (SENY), north of New York City (Fig. 1). Buffalo is the second largest and New York City is the largest metropolitan area in New York State. All nursery producers (referred to as "producers" herein) listed by the New York State Department of Agriculture and Markets (10) and by Cornell Cooperative Extension field staff were censused, resulting in a list of 90 producers in WNY and 204 from SENY. Landscape firms also were censused, and their names were drawn from the 1988 telephone directories and from lists provided by Cornell Cooperative Extension field staff, resulting in 147 landscape firms from WNY and 467 from SENY. Names of 450 homeowners from WNY and 400 from SENY were selected randomly from the property tax records for suburban townships in the respective counties, according to densities of deer and human residential units (15).

A self-administered, mail-back questionnaire was sent to each person surveyed. All respondents were asked to indicate the extent and nature of deer damage to their nursery stock (producers), clients' property (landscape firms) or landscape trees and shrubs (homeowners), as well as their concerns about deer, and information needs regarding deer damage. Producers and homeowners also were asked to provide estimates of economic losses due to deer damage. Nonrespondents were sent up to 3 follow-up mailings (2, 6). Telephone interviews of nonrespondents were conducted during autumn 1989 to assess nonresponse bias.

Survey responses were coded and the data were analyzed with the SPSSX computer program (19), and Minitab (13). The Chi-square (x^2) goodness of fit statistic (18) was used to compare differences between study areas ($p < 0.05$), and the nonparametric Mann-Whitney rank sum test (8) was used to test for differences between estimates of economic damage ($p < 0.05$).

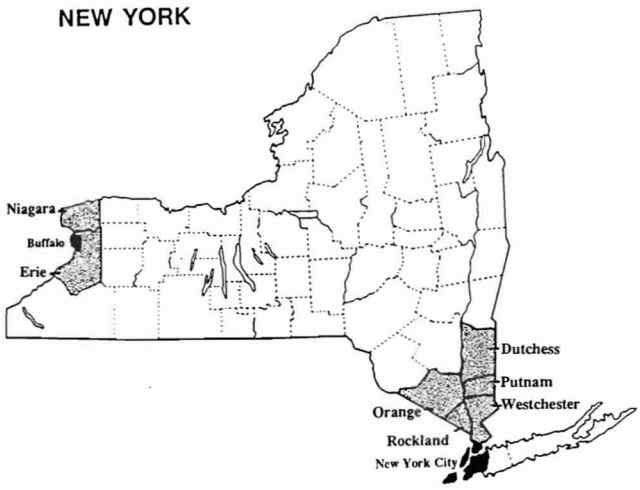


Fig. 1. Location of counties in southeastern New York (SENY) (Dutchess, Orange, Putnam, Rockland and Westchester) and western New York (WNY) (Erie and Niagara) study areas for 1989 deer damage to landscape horticulture survey.

Results and Discussion

After adjusting for undeliverable questionnaires, a total of 61% ($n = 152$) of producers, 41% of landscape firms ($n = 218$), and 63% ($n = 515$) of homeowners responded to the survey. Some producers ($n = 51$) and landscape firms ($n = 29$) indicated they were not in business in 1988, and their responses were not included in the analyses. Follow-up telephone interviews with 50 nonrespondents from each group indicated that the survey results were not biased by nonresponse.

Experiences with deer and deer damage. Overall, damage appeared to be more common in SENY. A greater proportion of producers reported damage, with 66.7% ($n = 38$) from SENY and 61.3% ($n = 27$) in WNY indicating that deer had damaged their plants during 1988. The damage to landscape firms was less direct because they did not incur damage on their personal property. In SENY 73.9% ($n = 99$) of landscape firms reported that customers had plants damaged by deer, compared to 45.3% ($n = 24$) in WNY ($\chi^2 = 12.1$, 1 df, $p < 0.05$). More homeowners in SENY (32%, $n = 70$) than in WNY (17%, $n = 50$) reported that they had seen evidence of deer damage on their property ($\chi^2 = 11.6$, 1 df, $p < 0.05$). Furthermore, a majority of producers (70% SENY, $n = 33$; 56% WNY, $n = 19$) believed deer damage had increased during the 3 previous years. More landscape firms in SENY, 78% ($n = 88$), compared to 44% ($n = 15$) in the WNY, also believed deer damage had increased ($\chi^2 = 14.7$, 1 df, $p < 0.05$).

Browsing (foraging by deer on shrubs and trees) was the most common type of damage. Damage could occur at any time of the year, although 83% ($n = 54$) of the producers, 91% ($n = 112$) of the landscape firms and 69% ($n = 83$) of the homeowners reported that damage was most severe during the winter or spring. Evergreens, specifically yews, (*Taxus* spp.), arborvitae *Thuja occidentalis* L.), Rhododendrons and azaleas *Rhododendron* spp.), fir (*Abies* spp.), and eastern hemlock *Tsuga canadensis* L.), were listed most frequently as the types of plants browsed by deer (Table 1). This plant species list does not necessarily represent foraging preferences, because the relative availability of these plant materials at nurseries or landscapes was not known; therefore, this list should be interpreted with caution. However, similar species of ornamental plants are frequently damaged by deer at nurseries and tree farms (4, 16). Several closely related species also rank high among the types of forage frequently eaten by deer in hardwood-mixed conifer forests of the northeastern U.S. (1, 9, 17). During winter, these evergreens are selected by deer because the plants retain their nutritive value longer than hardwoods, herbaceous plants, or grasses (12). Deer select these types of plants when food supplies are scarce, and would be expected to concentrate their feeding on these plants at nurseries and homesites. Quantitative research could help determine which landscape plants are preferred by deer and why they are preferred.

Impact of deer damage during 1988. The producers and homeowners were asked to provide estimates of the dollar value of plant damage caused by deer during 1988. They were asked to include the cost of the plants and labor for

Table 1. Types of landscape plants listed by nursery producers (n = 65), landscape firms (n = 123), and homeowners (n = 120) that are browsed by deer.[z]

Genera and species	Common name	N Responses
Taxus	Yews	
T. spp.	various species	148
T. × *media* hicksii Rehd.	Hick's yew	1
T. × *media* densiformis	Dense yew	1
Rhododendron		
Rhododendron spp.	Rhododendron	67
R. spp.	Azalea	58
Thuja occidentalis L.	American White cedar	60
Tsuga canadensis (L.) Carriere	Canada hemlock	50
Pinus	Pine	
P. spp.	various species	14
P. strobus L.	Eastern white pine	16
P. mugo Turr	Mountain pine	1
P. nigra Arnold	Austrian pine	1
P. sylvestris L.	Scotch pine	2
P. resinosa Ait.	Red pine	1
Abies	Fir	
A. spp.	various species	5
A. balsamea (L.) Mill	Balsam fir	10
A. concolor (Gord.) Lindl. Ex Hildebr.	White fir	2
A. fraseri (Pursh) Poir.	Fraser fir	7
Euonymus	Euonymus	
E. spp.	various species	13
E. atropurpurea Jacq.	Eastern wahoo	3
E. fortunei (tuncz.) Hand-Mazz	Wintercreeper	7
Acer	Maple	
A. spp.	various species	15
A. palmatum Thunb.	Japanese maple	2
A. rubrum L.	Red maple	1
Malus spp.	Apple and crabapple	
	Apple	9
	Crabapple	9
Ilex	Holly	
I. spp.	various species	10
I. × *meserveae*	Blue prince holly	1

[z]This is not a list of plants preferred by deer because the actual abundance of plant species was not known.

replanting in their estimates. Some producers (38%, n = 25) and many homeowners (60%, n = 72) who had damage did not provide estimates of losses. Although the damage estimates were not independently verified in the field, these economic estimates correspond with the perceived amount of damage (Table 2), and they represent a good index of relative severity of deer damage.

Consistent with other reports from New York (14) and elsewhere (4, 16) some producers incurred high levels of economic damage. For example, the 3 producers in SENY who reported severe damage averaged $150,000 in losses during 1988 (Table 2). Losses varied greatly, ranging from just a few dollars to estimates over $100,000. Producers in SENY reported total losses of $519,072 ($n$ = 24), compared to $61,008 ($n$ = 16) in WNY (Table 3). Differences in median losses between the two regions were not statistically significant (Mann-Whitney = 285.5, p = 0.18). In relation to total value of production (11), these losses represent at least 6% of the value of plants produced in SENY and 0.6% of the value in WNY. Note, however, that this is a conservative estimate, especially in WNY, because the values used from the New York Nursery Producers Survey (11) includes production of sod in addition to nursery plants.

Some homeowners also reported economic losses from deer damage in 1988. Homeowners in SENY reported median losses of $200 per household ($n$ = 26), which was greater than median losses of $90 ($n$ = 22) in WNY (Mann-Whitney = 419; $p < 0.05$) (Table 3). These losses are comparable to damage estimates reported by homeowners in suburban areas in New York State during the mid 1980s, and if projected to include all homeowners in the study areas, losses could run into the millions of dollars (3).

The extent and severity of deer damage varied due to many regional and site-specific differences. Specifically, environmental, biological and human-related characteristics of the areas influence the extent and severity of deer damage. Damage in SENY possibly is more severe because deer densities are higher than in WNY and because suburban developments are more interspersed with deer habitat (15).

Table 2. Degree of deer damage to landscape plants in southeastern (SENY) and western (WNY) New York during 1988, according to perceptions and estimates of producers and homeowners.

Group and area	Degree of damage			
	Light	Moderate	Substantial	Severe
Producers				
SENY				
% (n)	40.0 (18)	24.4 (11)	24.4 (11)	11.1 (5)
Median $ (n)	1000 (7)	1500[z] (7)	5500 (8)	150000[y] (3)
WNY				
% (n)	45.4 (15)	9.1 (3)	27.3 (9)	18.2 (6)
Median $ (n)	625 (4)	750 (3)	2450 (6)	11000 (3)
Homeowners				
SENY				
% (n)	50.7 (37)	27.3 (18)	15.6 (12)	6.5 (5)
Median $ (n)	100 (5)	200 (9)	275 (8)	578 (4)
WNY				
% (n)	58.0 (29)	20.0 (10)	14.0 (7)	8.0 (4)
Median $ (n)	38 (8)	60 (5)	200 (6)	288 (3)

[z]Producers in SENY who described damage as moderate had greater losses than in WNY (Mann Whitney Statistic = 6.0, $p < 0.05$).

[y]Producers in SENY who described damage as severe had greater losses than in WNY (Mann-Whitney Statistic = 6.0, $p < 0.05$).

Table 3. **Estimated cost to replace landscape plants damaged by deer during 1988, according to responses from nursery producers and homeowners in southeastern (SENY) and western (WNY) New York.**

Group	Variable	Study area SENY	WNY
Producers	n	24	16
	sum	$519,072	$61,008
	mean	$21,628	$3,813
	SE	$11,217	$1,324
	median	$3,000	$1,800
Homeowners	n	22	26
	mean	$474	$158
	SE	$145	$47
	median	$200[z]	$90

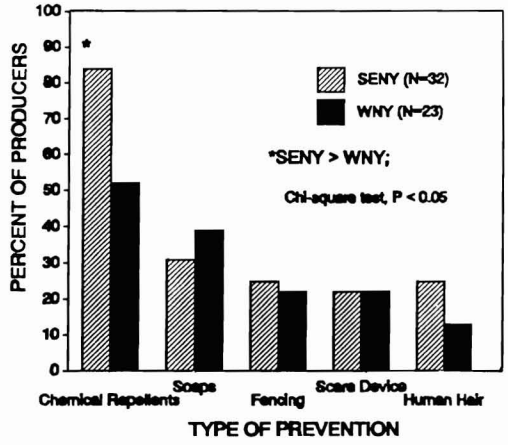
[z]Median losses reported by homeowners in SENY > WNY (Mann-Whitney Statistic = 419, $p < 0.5$).

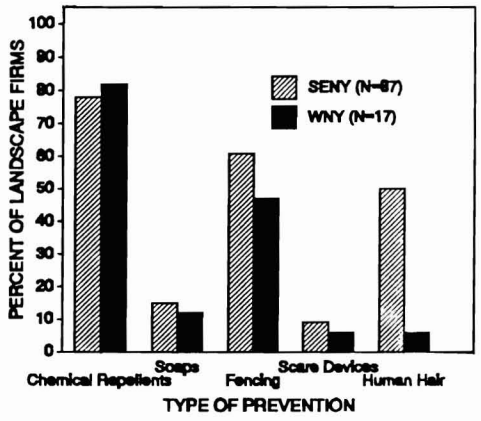
Prevention of damage. Use of damage-prevention measures also reflects the relative extent and severity of deer damage. About two-thirds of the producers (71% SENY, $n = 31$; 64% WNY, $n = 23$) indicated they had attempted to prevent damage. More landscape firms (80%, $n = 88$) in SENY than in WNY (51%, $n = 17$) used damage prevention ($\chi^2 = 9.1$, 1 df, $p < 0.05$). Likewise, a greater proportion of homeowners in SENY, 19% ($n = 42$) compared to WNY (7%, $n = 17$), reported they tried to prevent deer damage ($\chi^2 = 7.7$, 1 df, $p < 0.05$).

Chemical repellents (i.e., commercially produced deer repellents) and bars of soap tied to trees were the most popular methods used by producers, with other techniques such as fencing, scare devices, and human hair used less frequently (Fig. 2). About 4 out of 5 landscape firms indicated that their clients used chemical repellents, and about one-half used fencing. However, relatively few homeowners reported using repellents; instead they appeared to favor fencing or other physical barriers and home remedies such as human hair tied to trees and shrubs.

Some respondents also reported they used "browse-resistant" plants to avoid damage (38.6%, $n = 39$, of producers; 21.7%, $n = 41$ of landscape firms; and 2.9%, $n = 15$, of homeowners). Only a few provided information on specific plants used, but spruce (*Picea* spp.) ($n = 23$), juniper (*Juniperus* spp.) ($n = 19$), Andromeda (*Pieris* spp.) ($n = 21$) and boxwood (*Buxus* spp.) ($n = 9$) were listed most frequently. Deer probably avoid these types of plants because of low nutritive quality, high content of secondary compounds (e.g., terpenes) or structural material (e.g., lignin), which hinder digestion of plant material, or because spines and thorns make the plants difficult to browse (12). Quantitative information on browse-resistant landscape plants is lacking, and this subject requires additional research attention.

Information needs. Many respondents wanted more information and improved technology for damage prevention. Specifically, 71% ($n = 30$) of producers in SENY, and 41% ($n = 15$) in WNY ($\chi^2 = 5.5$, 1 df, $p < 0.05$); 75% ($n = 85$) of landscape firms in SENY, and 77% ($n = 24$) in WNY; and 54% ($n = 49$) of homeowners in SENY and 51% ($n = 35$) in WNY indicated they needed additional information on how to prevent deer damage to landscape plants. A majority of producers (89% SENY, $n = 40$; 56% WNY, $n = 20$ [$\chi^2 = 11.9$, 1 df, $p < 0.05$]) and landscape firms (87% SENY, $n = 99$; 68% WNY, $n = 24$ [$\chi^2 = 6.4$, 2 df, $p < 0.05$]) also wanted improved technology for damage control. About one-third of homeowners also requested improved methods to prevent deer damage (34% SENY, $n = 31$; 28% WNY, $n = 20$).





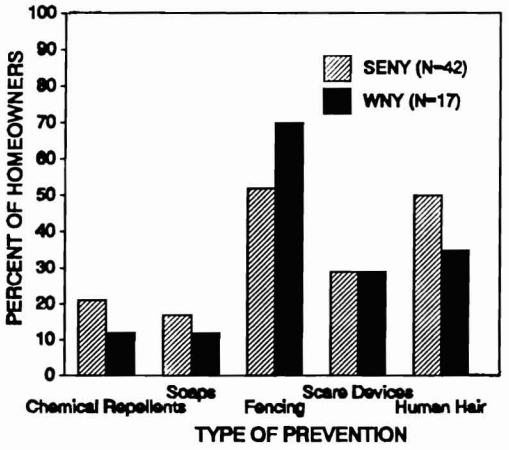


Fig. 2. Methods used by nursery producers, landscape firms, and homeowners to prevent deer damage to landscape trees and shrubs at nurseries in southeastern (SENY) and western (WNY) New York during 1988.

When asked to indicate their primary source of information regarding deer damage, about one-half of the producers listed Cooperative Extension (48% SENY, $n = 20$; 54% WNY, $n = 18$), and many listed other professionals in their field (38% SENY, $n = 16$; 22% WNY, $n = 8$). Landscape firms also obtained information from Cooperative Extension (64% SENY, $n = 70$; 36% WNY, $n = 11$ [$\chi^2 = 6.7$, 1 df, $p < 0.05$]), or other landscape firms (32% SENY, $n = 35$; 36% WNY, $n = 11$). One-half of the homeowners ($n = 41$) in SENY and two-thirds ($n = 43$) in WNY responded they did not seek outside advice about preventing deer damage. Of those who did seek help, friends (33% SENY, $n = 27$; 17% WNY, $n = 11$) or landscape services (15% SENY, $n = 12$; 11% WNY, $n = 7$) were their most frequent sources.

Producers were asked which types of assistance for damage control they believed would be of greatest benefit, and most (90% SENY, $n = 28$; 94% WNY, $n = 34$) indicated that technical information or advice would help. Many also believed that issuance of permits to kill deer could alleviate damage problems (72% SENY, $n = 24$; 65% WNY, $n = 20$). When asked to indicate which type of assistance they preferred, 64% ($n = 14$) of the producers from SENY reported that they preferred technical information and advice, whereas producers in WNY were split; about 40% ($n = 8$) favored information/advice and 40% ($n = 8$) preferred permits to kill deer. Few producers overall (12%, $n = 5$) preferred being recipients of damage control materials or cash payments.

Concerns about deer. Another important aspect of the survey was to gain insight about how deer damage has affected the use of landscape plants by consumers for landscape design, and to assess the deer-related concerns of people. Problems with deer damage not withstanding, the nursery and landscaping industry appears to be growing in southeastern and western New York, where a majority of producers and landscape firms (at least 80% from each area) believed that sales of landscape plants was stable or increasing. Much of the increase in sales is probably due to continued commercial and residential development in these areas.

A greater proportion of respondents from SENY believed that deer damage was affecting the use of landscape plants. More producers in SENY (88%, $n = 44$), compared to WNY (69%, $n = 29$) ($\chi^2 = 4.1$, 2 df, $p < 0.05$), and more landscape firms in SENY (76%, $n = 87$) than in WNY (39%, $n = 12$) ($\chi^2 = 13.6$, 2 df, $p < 0.05$), indicated that consumers were either purchasing different types of plants or had ceased buying landscape plants because of deer damage (Fig. 3). Likewise, a greater proportion of homeowners in SENY (42%, $n = 53$), than in WNY (19%, $n = 13$) ($\chi^2 = 9.7$, 2 df, $p < 0.05$) reported they had changed their buying habits.

One specific change was the types of plants purchased by consumers. More producers in SENY than in WNY believed that some consumers were purchasing plants that were believed to be browse-resistant ($\chi^2 = 17.4$, 1 df, $p < 0.05$). About four-fifths of the landscape firms from both study areas believed some consumers were changing plant types to avoid deer damage. More homeowners in SENY indicated they were buying browse-resistant plants ($\chi^2 = 5.4$, 1 df, $p < 0.05$); however, the proportion of homeowners who

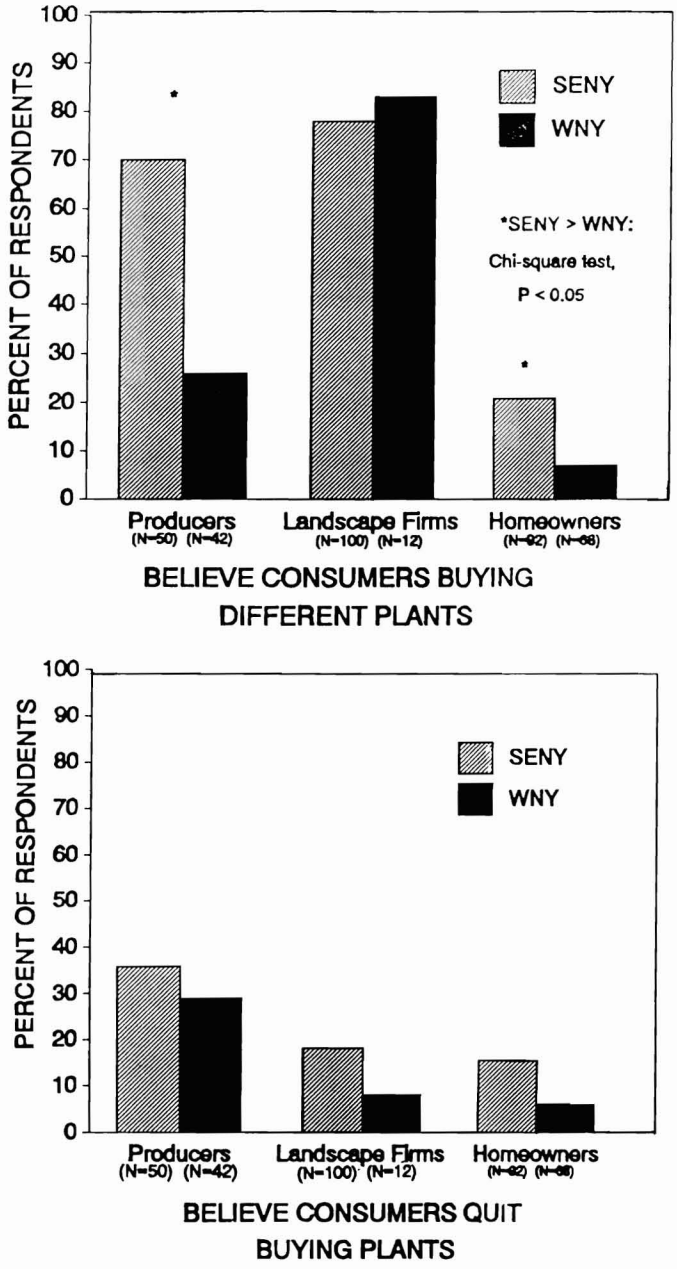


Fig. 3. Percentage of nursery producers, landscape firms, and homeowners in southeastern (SENY) and western (WNY) New York who believed (a) consumers were buying different plants, or (b) some consumers had ceased buying plants.

reported these changes was relatively small (SENY $n = 19$; WNY $n = 5$).

Another concern was to determine whether people ceased buying plants because of deer damage. About one-third of the producers believed that some consumers had ceased buying plants, although relatively few homeowners indicated they had quit purchasing landscape plants because of repeated experiences with deer damage (Fig. 3). Nontheless, some homeowners who had deer damage (21% SENY, $n = 14$; 10% WNY, $n = 4$), reported that they had ceased buying landscape plants because of deer damage. As of 1989, these numbers were small, but with deer increasingly adapting to suburban habitats, the proportion of consumers who forego buying plants could increase to levels that may cause a negative impact to the horticulture industry.

Many respondents, especially in SENY, were concerned about deer damage to landscape plants. Eighty-two percent (n = 45) of the producers in SENY indicated that deer damage to ornamental plants was a concern, compared to 62% (n = 24) in WNY (χ^2 = 4.8, 1 df, $p < 0.05$). The difference among landscape firms was even greater, with 78% (n = 100) in SENY and 46% (n = 23) in WNY reporting that damage to landscape plants was a concern (χ^2 = 17.4, 1 df, $p < 0.05$). Differences between the areas were also apparent among homeowners, where 23% (n = 51) in SENY and 11% (n = 31) in WNY listed deer damage to ornamentals as a concern (χ^2 = 13.1, 1 df, p = 0.05).

When asked to rate their most important concerns about local deer herds (i.e., transmission of Lyme disease, risk of deer-vehicle collisions, ornamental plant damage or other crop damage) (3, 5), at least one half of the producers (56% SENY n = 22; 50% WNY n = 13) indicated that damage to landscape plants was their primary concern. This was expected because their livelihood depends on the sale of landscape plants. However, only 20% (n = 17) of landscape firms in SENY and 18% (n = 6) in WNY indicated that deer damage to landscape plants was their most important concern. Instead, landscape firms gave greater importance to the health and safety risks they associated with deer; 77% (n = 65) from SENY and 79% (n = 26) from WNY reported that they were primarily concerned about the role of deer in the spread of Lyme disease and/or the risk of deer-vehicle collisions. As long as consumers continue replanting damaged landscape plants, landscape firms may benefit from deer damage. Therefore, landscape firms appeared to be more worried about the risk of contracting disease or having a motor vehicle collision with a deer. Homeowner responses were similar to landscape firms. Only 2% (n = 3) from SENY and 4% (n = 6) from WNY indicated that damage to landscape plants was their primary concern. Instead, most homeowners (92% SENY, n = 124; 87% WNY, n = 120) listed Lyme disease or deer-vehicle collisions as their primary concerns. The homeowners who had damaged plants were also more concerned about Lyme disease and deer-vehicle collisions than about plant damage.

Literature Cited

1. Anderson, R.C., and O.L. Loucks. 1979. White-tailed deer (*Odocoileus virginianus*) influence on structure and composition of *Tsuga canadensis* forests. J. Appl. Ecol. 16:855–861.

2. 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 empricial analysis. Leisure Sci. 11:99–110.

3. Connelly, N.A., D.J. Decker, and S. Wear. 1987. White-tailed deer in Westchester County, New York: Public perceptions and preferences. Human Dimensions Research Unit Publication 87-5. Dept. Nat. Resour., N.Y.S. Coll. Agric. and Life Sci., Cornell Univ., Ithaca, N.Y. 80 pp.

4. Conover, M.R. and G.S. Kania. 1988. Browsing preference of white-tailed deer for different ornamental species. Wildl. Soc. Bull. 16:175–179.

5. Decker, D.J. and T.A. Gavin. 1987. Public attitudes toward a suburban deer herd. Wildl. Soc. Bull. 15:173–180.

6. Dillman, D.A. 1978. Mail and telephone surveys: the Total Design Method. John Wiley & Sons, New York, N.Y. 325 pp.

7. Halls, L.K. 1978. White-tailed deer. Pages 43–65, *in* J.L. Schmidt and D.L. Gilbert eds. Big Game of North America. Stackpole Books. Harrisburg, PA, 494 pp.

8. Hollander, M. and D.A. Wolfe. 1973. Nonparametric statistical methods. John Wiley & Sons. New York. 503 pp.

9. Klein, D.R. 1970. Food selection by North-American deer and their response to over-utilization of preferred plant species. Pages 25–46, *In* Animal Populations in Relation to their Food Resources, A. Watson ed. Blackwell Sci. Publ., Oxford. 407 pp.

10. NY AG-MARK Service. 1989. List of certified nurseries and greenhouses for the registration period ending 28 February 1989. Circular 932. Dept. Agric. and Markets. Albany, N.Y. 54 pp.

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

12. Robbins, C.T. 1983. Wildlife Feeding and Nutrition. Academic Press. New York and London. 343 pp.

13. Ryan, B.F., B.L. Joiner, T.A. Ryan. Minitab Sourcebook. Second Edition. PWS-Kent. Boston, MA. 384 pp.

14. Sayre, R.W. and D.J. Decker. 1989. Extent and nature of deer damage to commerial nurseries in New York. Proc. East. Wildl. Damage Control Conf. 4:162–172.

15. Sayre, R.W. and D.J. Decker. 1990. Deer damage to the ornamental horticulture industry in suburban New York: Extent, nature and economic impact. Human Dimensions Res. Unit. Publ. 90-1. Dept. Nat. Resour., N.Y.S. Coll. Agric. and Life Sci., Cornell Univ., Ithaca, N.Y. 75 pp.

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

17. Severinghaus, C.W. and C.P. Brown. 1956. History of white-tailed deer in New York. N.Y. Fish and Game J. 3:129–167.

18. Snedecor, G.W. and W.G. Cochran. 1989. Statistical Methods. Eighth Edition. Iowa State University Press. Ames, IA. 503 pp.

19. SPSS Inc. 1983. SPSSX User's Guide. McGraw Hill Book Co. New York, N.Y. 806 pp.