EXTENT AND NATURE OF DEER DAMAGE TO COMMERCIAL NURSERIES IN NEW YORK[1/]

Roger W. Sayre and Daniel J. Decker[2/]

ABSTRACT

We surveyed nursery producers in New York to determine the extent, nature and economic impact of deer damage to their operations, and to assess their attitudes towards deer. Seventy-three percent of the producers experienced deer damage to their crops in 1988. Average costs for replacement were nearly $6,000 per grower for those reporting damage estimates (and over $8,000 if 1 extreme value was included). Statewide damage estimates ranged from $500,000 to $1.2 million (depending on assumptions). Forty-six percent used damage control, which cost an average of about $2,000 per grower. More than 80% of the producers were classified as "nonaccepting" of deer damage and deer populations. We also reviewed several deer damage studies to compare economic and attitudinal impacts of deer damage to various agricultural constituencies. Nursery producers, orchardists, and Christmas tree growers appear to incur the greatest per capita deer damage costs. Of agriculturists, nursery producers and orchardists appear to be the least accepting of deer and deer damage. Deer managers and policy makers may need to consider the nursery producers in the same "at risk" category as orchardists.

INTRODUCTION

The white-tailed deer (*Odocoileus virginianus*) is one of the most widely distributed and popular wildlife species in the northeastern United States. It also may be the most controversial. By the end of the 19th century, deer populations were severely depleted throughout most of the Northeast, and they were extirpated in many areas. Through the fortuitous combination of conservation actions and changes in land-use practices during the 20th century, deer populations have expanded to unprecedented levels. At these high levels, the positive values associated with deer sometimes have been offset by negative factors such as deer damage to agricultural crops, which in recent decades has become a major problem throughout the region.

Production of nursery plants--trees and shrubs produced and sold to be used as ornamental plants to homeowners, businesses, governmental agencies and private institutions--is an important agricultural industry in many states. For example, according to a recent survey, wholesale nursery sales by producers of nursery stock in 1985 totaled $68 million, ranking the industry among the top 10 agricultural commodities in the New York State (New York Nursery Producers Survey 1986). Information about the extent of deer damage to important agricultural commodity sectors is needed for management and mitigation purposes. Consequently, deer damage to commercial nursery plants has become a concern among many agriculturists and wildlife managers, particularly since deer damage at commercial nurseries appears to have increased in recent years. For example, from 1981 through 1986 the New York State Department of Environmental Conservation (NYSDEC) received an average of 65 damage complaints per year from nursery producers, but they

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[2/]Research Support Specialist and Assistant Professor, Human Dimensions Research Unit, Department of Natural Resources, Cornell University, Ithaca, NY.

had about 120 complaints in each year in 1987 and 1988. Moreover, per capita damage to nursery operations may be higher than any other crop industry, including orchards (Scott and Townsend 1985, McAninch and Fargione 1987). Deer managers need to know the economic impact of deer damage to commercial nurseries, and they require an understanding of the beliefs and preferences--i.e., the "deer acceptance capacity" (Decker and Purdy 1988)--of these constituents.

STUDY OBJECTIVES

The 3 primary objectives of this study were to: (1) describe the extent, nature and economic impact of deer damage to commercial nurseries in New York in 1988; (2) compare the economic impacts of deer damage at commercial nurseries in 1988 to similar studies of deer damage to other agricultural crops in New York and elsewhere, and to compare differences in deer acceptance over time and between agricultural sectors; and (3) determine the management implications of deer damage to plants at commercial nurseries in terms of damage control, research, and deer management policy.

METHODS

We used lists provided by the New York State Department of Agriculture and Markets (NY AG-MARK Service 1989) and lists provided by Cornell Cooperative Extension agents as sources of names of producers of nursery crops. Many of the producers listed in the NYS Department Agriculture and Markets publication were considered to be part-time or hobbyists. To obtain a census of all significant producers, we surveyed only those with >4 ha of land in nursery production. These larger operations generate the greatest proportion of economic activity associated with the production of nursery stock in New York State (George Good, Cornell University Department of Floriculture and Ornamental Horticulture *pers. comm.*). All producers (n=252) in New York listed as having >4 ha of nursery were surveyed. We developed a self-administered, mail-back questionnaire similar to those used by Brown et al. (1980), Decker and Gavin (1987), and Connelly et al. (1987). The survey was implemented in spring 1989. We sent up to 3 follow-up mailings to nonrespondents, as suggested by Dillman (1979). We conducted the analysis using the SPSSX computer program (SPSS Inc. 1983).

RESULTS AND DISCUSSION

Response to Survey

The survey of 252 nursery producers had 13 undeliverable questionnaires and 150 responses, for an adjusted response rate of 62.8%. Twenty-seven respondents indicated they did not produce nursery crops in 1988; some were no longer in business and others were involved in activities such as landscape contracting, lawn maintenance, sod producing, or operating garden centers. The remaining 83% of respondents (n=123) indicated they produced nursery stock in 1988. We limited our analysis to this population of producers.

Nature and Extent of Deer Damage to Nursery Plants

Eighty-eight percent of the respondents had seen deer or evidence of deer damage on their property during the 3 years prior to the survey. Nearly three-quarters (73%) of the respondents indicated they experienced deer damage on their property in 1988. Of those, about half (48%) reported that winter was the most severe season of damage, whereas one-fourth (25%) reported damage was most severe during fall.

Respondents with damage estimated that an average of 12% of their trees and 6% of their shrubs were damaged by deer in 1988. Browsing was the

most common type of damage, although some growers indicated that antler rubbing during the autumn rut caused substantial damage to their trees. Respondents listed 87 plant types that were damaged by deer. Yews (*Taxus* spp.) and fir (*Abies* spp.) reported most frequently as the plants damaged but this does not necessarily mean that these are the plants preferred by deer. The frequency of reports may reflect the abundance of plant types grown at commercial nurseries. Furthermore, as noted by Conover and Kania (1988), many plants have been shown to have interspecific variability in palatability for deer.

Estimates of plant replacement costs were provided by 64% of the respondents who experienced deer damage. The 32 respondents who had deer damage but did not provide dollar estimates for plant replacement perceived their damage to be less severe than those who did provide dollar estimates (X^2=11.6, $p<0.05$). The mean estimate replacement costs for all plant types was $8208 (Table 1). However, mean costs for plant replacement was $5,720 if 1 extreme value of $150,000 was excluded. Nonetheless, 22% of the growers who provided damage costs estimated plant replacement would be ≥$10,000. Total replacement costs of plants for all respondents reporting a dollar estimate was $476,050. The estimated dollar values of deer damage were not verified in the field. Although the dollar estimates of deer damage may not be precise cost estimates, they are useful indicators of the perceived amount of damage.

We projected total replacement costs by extrapolating the sum cost of replacement for those respondents reporting such costs to the all growers surveyed. Estimated total replacement costs were $738,706 (assuming nonrespondents had no deer damage) or $1,182,102 (assuming nonrespondents had deer damage). Excluding the outlier, these figures would range from $509,093 to $813,286.

These estimates were comparable to the damage losses of nursery producers as reported by McAninch and Fargione (1987) who projected statewide losses to be $1,254,675 (in 1988 dollars). Their estimates also included nursery operations <4 ha. Furthermore McAninch and Fargione (1987) reported that growers with >6 ha averaged $5866 in deer related damage (n=49), a figure comparable to ours.

Table 1. Nursery producers' estimates of replacement costs of plants damaged by deer and damage control costs.

	No. cases	Cost per grower $\bar{x}$	SD	range	median
Cost to Replace All Plants	58	$8,208	$20,953	$50-150,000	$1,750
Trees	52	7,594	21,801	25-150,000	1,650
Shrubs	22	3,415	884	25-15,000	1,000
Costs for Damage Control	37	1,964	3,010	50-12,600	750

We also asked about the use of damage control measures. Forty-six percent (n=56) of the respondents said they used some form of damage control to protect their crops. Of those, 50% said they used chemical repellents, 30% used soap, 30% used fencing, and 23% obtained special damage control permits from the New York State Department of Environmental Conservation. Damage control costs for those who provided estimates averaged $1,964/nursery producer. A majority of respondents (83%) said they would support regulated hunting in their area as a method to control deer populations. However, most (63%) indicated they needed more information on the types and effectiveness other of damage control alternatives. When asked specifically about what type of assistance they needed, 74% wanted more technical information about damage control, 54% wanted deer kill permits for nuisance deer, 39% wanted on-site advice, and fewer than one-third wanted cash payments (32%) or materials for damage control (27%).

Perceptions and Attitudes About Deer Damage

Most respondents (57%) who saw deer or deer damage on their property believed that the damage had increased during the previous 3 years; few (6%) believed that damage was decreasing. Of respondents seeing deer or deer damage, two-thirds (66%) perceived their damage as light or moderate, whereas one-third (34%) indicated the damage was substantial or severe.

We used a typology of deer tolerance similar to that developed by Purdy and Decker (1985) and Purdy et al. (1985) to determine landowner tolerance towards beaver (*Castor canadensis*). Nursery producers were classified as tolerant or intolerant according to their answers to 2 questions: (1) "How do you feel about having deer in your area?"; and (2) "Would you like deer populations in your area to increase, decrease or remain at their present level?" Only 17% of nursery producers were classified as tolerant, whereas 83% were intolerant. Moreover, we found that 92% of the respondents who had previous experience with deer (those seeing deer or evidence of deer on their property) were intolerant. Furthermore, 50% of the respondents who had not experienced any deer damage, nor seen any deer on their property, wanted the deer population to decrease. These data imply that producers are nonaccepting of the present deer population or of deer damage to their plants.

Relation Between Deer Density and Severity of Damage

We attempted to determine the relationships between deer densities and severity of damage, and between deer densities and attitudes towards deer. Deer densities were calculated by dividing average buck take (BT) per township for the 3 seasons preceding the survey by the area of that town. BT/km^2 is used as the primary deer population index in New York. Important limitations of the BT index are that it is dependent upon hunter success and effort, and upon the availability of land for hunting. Producers in towns having deer densities <0.78 BT/km^2 reported damage estimates that were substantially lower ($p=0.049$, 43 df) than growers in towns with deer densities ≥ 0.78 BT/km^2 (Figure 1). However, we were unable to ascertain a linear relationship between deer density and damage severity. Nor were we able to determine linear and threshold patterns for attitudes toward deer. This is consistent with the finding that growers without damage to plants also do not accept deer.

Comparative Analysis of the Extent and Impact of Deer Damage to Various Crop Types: 1976-1989

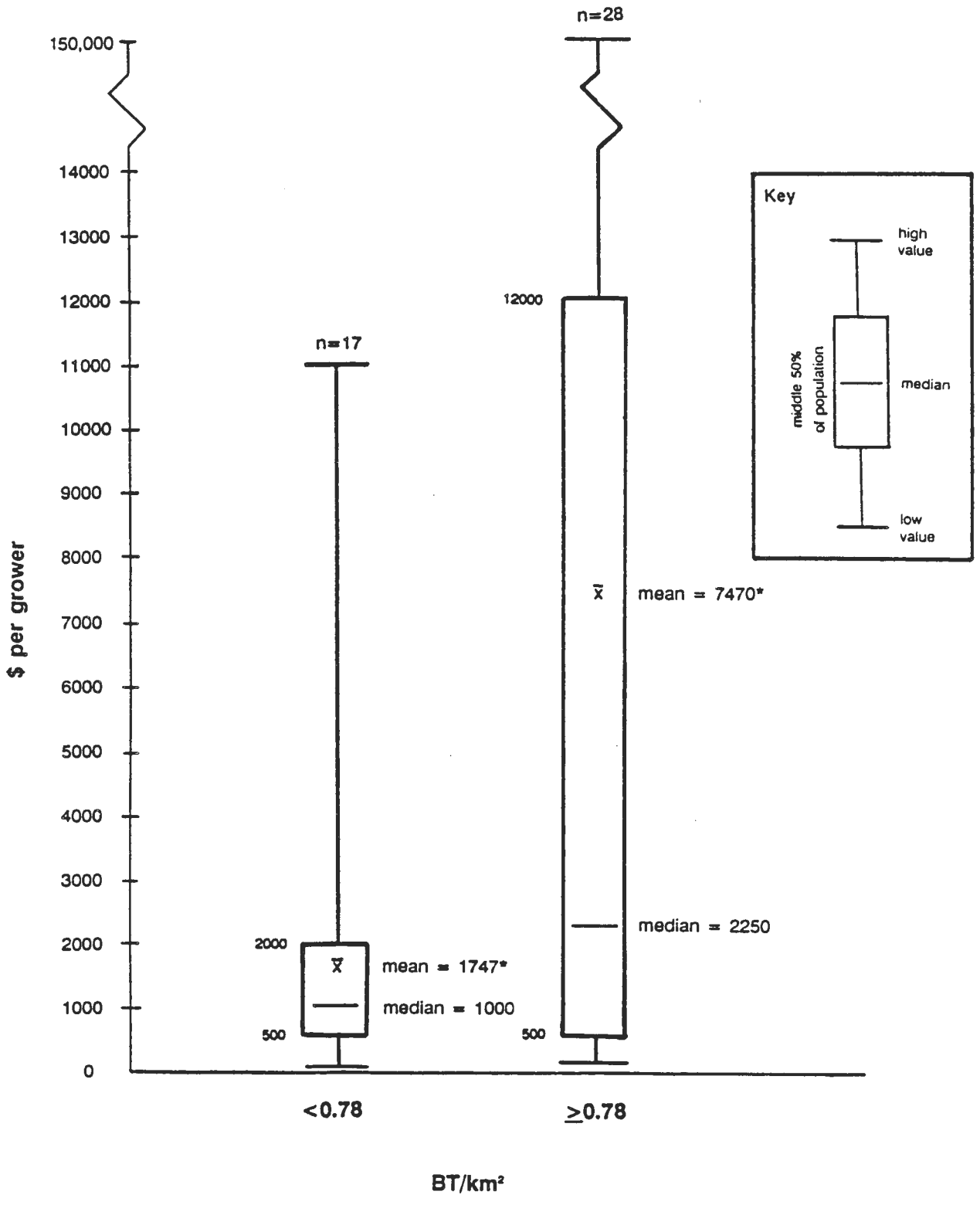

Fig. 1. Nursery producers' estimates of plant replacement costs, by buck take per square kilometer (BT/km²).

*means are different
($p = .049$, $df = 43$, $T = -2.05$)

We reviewed other deer damage studies to determine patterns in the frequency and economic impact of deer damage to different types of agricultural crops, and to ascertain how changes in deer damage have influenced attitudes towards deer (Table 2). Brown et al. (1980) surveyed farmers in central and western New York. Decker et al. (1982) resurveyed the central and western New York farmers to assess changes in deer damage and farmer attitudes towards deer. Decker et al. (1981) conducted a similar survey of farmers in southeastern New York. McAninch and Fargione (1987) surveyed nursery producers and Christmas tree growers in New York. Purdy et al. (1989) assessed attitudes of fruit growers toward deer in New York's Hudson Valley. Elsewhere, Jones (1984) surveyed Christmas tree growers in West Virginia, and Scott and Townsend (1985) studied the impact of deer damage to commercial nurseries, Christmas tree farms, and orchards in Ohio. We were primarily interested in describing the apparent patterns in deer damage and producer acceptance. Data from these studies vary over time, geographic region, crop type, and survey methodology. The comparisons depicted below were used only to elucidate these patterns in deer damage and acceptance of crop producers.

In general, certain types of crops seem to incur more damage than others. Nursery products, fruit trees and Christmas trees appear to be damaged by deer more frequently than other crops, and producers who grow these types of crops have the perception that they incur greater per capita damage costs than farmers who grow other types of agricultural products such as grains, green vegetables, and hay. For example, Scott and Townsend (1985) reported that only 16% of the Ohio farmers who grew vegetables indicated their crops had been damaged by deer, whereas more than 32% of the nursery producers and 41% Christmas tree growers had deer damage to their trees (Table 2). Moreover, producers of nursery plants, fruit trees, and Christmas trees also appear to have the greatest per grower costs associated with deer damage. Producers surveyed in our study seemed to have higher damage per capita (adjusted to 1988 dollars) than other growers in any other studies (Figure 2).

More growers are experiencing deer damage to their crops than they were a decade ago. For example, 41% of the nursery producers surveyed in 1985 by McAninch and Fargione (1987) had deer damage, but in our study, only four years later, 73% of the producers reported deer damage. However, some of the change may be explained by operation size; the former authors reported that more large nurseries incurred damage than the small operations. In other studies, 35% of fruit growers incurred deer damage in the Hudson Valley, New York in 1981 (Decker et al. 1981), but by 1988, 90% of the fruit growers in the same townships as the original survey, reported deer damage (Purdy et al. 1989). However, relatively few systematic studies are available to further validate these perceptions.

With the exception of fruit growers, the attitudes of nursery producers indicate they are less tolerant of deer than other farmers. The Hudson Valley fruit growers surveyed by Purdy et al. (1989) were the least tolerant group; 18% indicated they felt deer were a nuisance (Figure 3), 60% worried about problems associated with deer and 59% wanted a decrease in deer populations (Figure 4). In comparison, only 9% of the 1989 New York nursery producers thought deer were a nuisance (Figure 3), but 64% said they worried about problems deer may cause, and over half of them (55%) wanted to decrease the deer populations (Figure 4).

Table 2. Summary of deer damage to various crop types as reported in selected deer damage studies.

Author	Location	Type of Crop Produced	Number of Respondents	Percent Experiencing Deer Damage
Brown et al. (1980)	Upstate New York	Fruit	436	14.9
		Green Vegetables	555	17.3
		Grains	3962	21.6
		Hay	4031	11.9
		Forest Plantations	924	3.7
Decker et al. (1982)	Upstate New York	Fruit	408	18.6
		Green Vegetables	286	9.8
		Grains	2821	23.8
		Hay	1215	7.9
		Forest Plantations	223	5.8
Decker et al. (1981)	Southeast New York	Tree Fruits	226	37.2
		Green Vegetables	154	33.6
		Grains	666	36.3
		Hay	816	17.8
		Forest Plantations	172	11.4
Jones (1984)	West Virginia	Christmas trees (1983)	149	53.7
		Christmas trees (1984)	129	62.8
Scott and Townsend (1985)	Ohio	Nursery plants	296	32.5
		Christmas trees	480	43.1
		Orchards	723	41.3
		Vegetables	461	16.1
McAninch and Fargione (1987)	New York	Nursery plants	432	44.0
		Christmas trees	379	57.0
Purdy et al. (1989)	Hudson Valley New York	Fruit	118	89.7

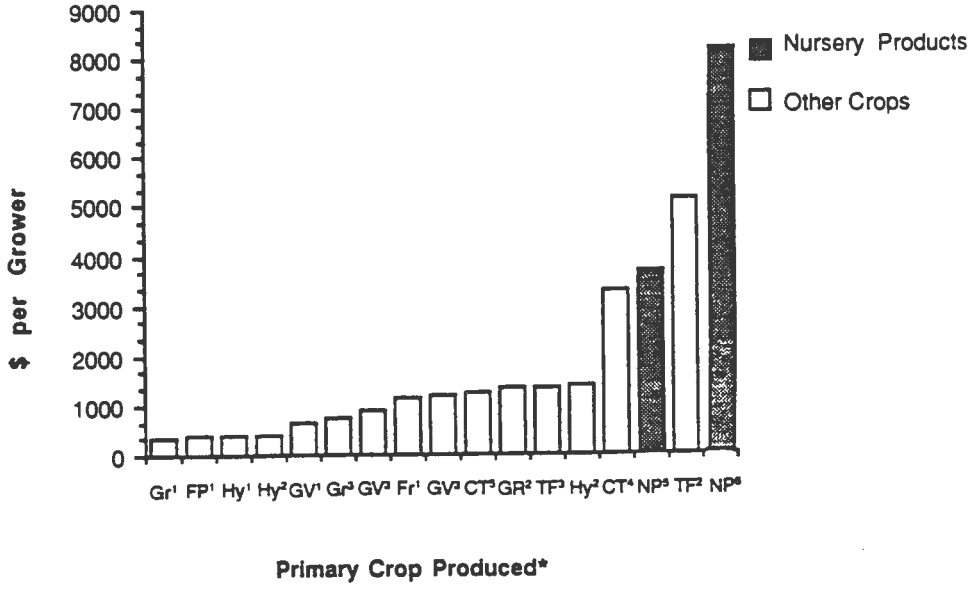

Fig. 2. Average dollars of damage per grower, by crop type. (Values are adjusted to 1988 dollars.)

¹Brown et al. (1980)
²Decker et al. (1981)
³Decker et al. (1982)
⁴Jones (1984)
⁵McAninch and Fargione (1987)
⁶Sayre and Decker (this study)

*Key

Gr=Grains
FP=Forest Products
Hy=Hay
GV=Green Vegetables
Fr=Fruit
TF=Tree Fruits
CT=Christmas Trees
NP=Nursery Products

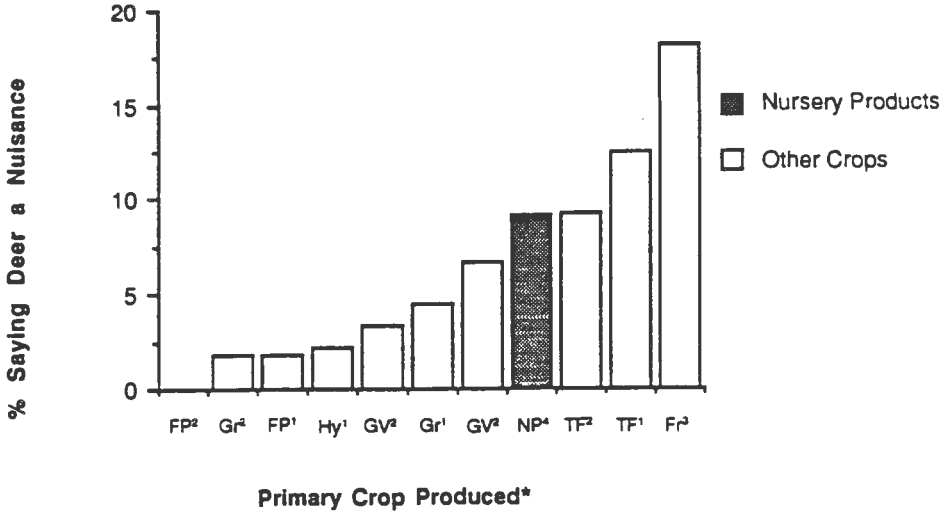

Fig. 3. Percent of respondents saying deer are a nuisance, by primary crop type produced.

¹Decker et al. (1981)
²Decker et al. (1982)
³Purdy et al. (1989)
⁴Sayre and Decker (this study)

*Key

Gr=Grains
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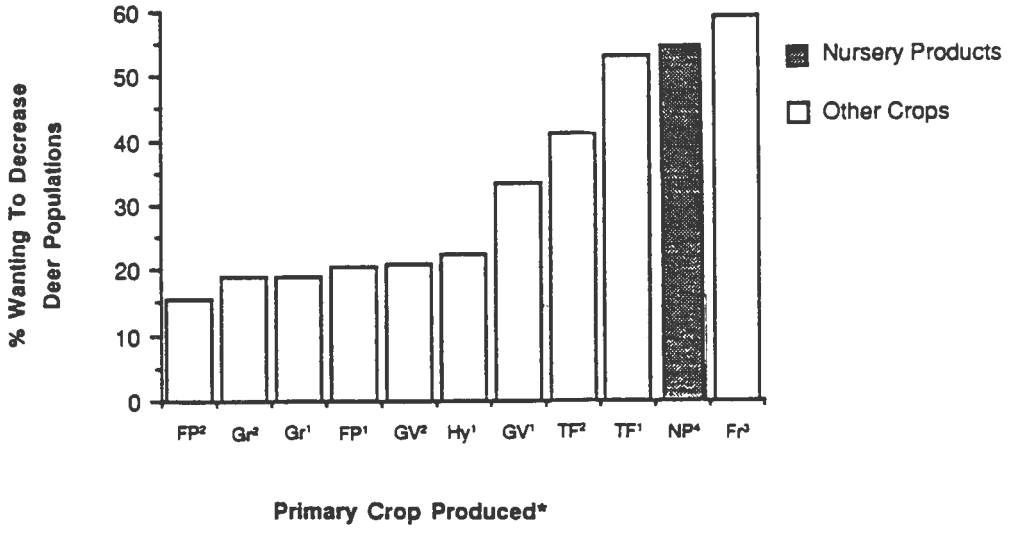

Fig. 4. Percent of respondents wanting to decrease deer populations, by primary crop produced.

*Key

[1]Decker et al. (1981)
[2]Decker et al. (1982)
[3]Purdy et al. (1989)
[4]Sayre and Decker (this study)

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FP=Forest Products
Hy=Hay
GV=Green Vegetables
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TF=Tree Fruits
NP=Nursery Products

MANAGEMENT IMPLICATIONS

The "deer acceptance capacity" (Decker and Purdy 1988) of nursery producers has likely been exceeded. This reflects the severity and apparent recent increase of deer damage these producers have experienced. An intriguing point, however, is that the producers maintain an extremely low deer acceptance capacity, regardless of the amount of damage incurred. Fruit growers have traditionally been regarded as the group with the most severe deer damage problems, and subsequently they have been considered least accepting of deer or deer damage (Decker and Brown 1982, Pomerantz et al. 1986). However, the deer acceptance capacity of nursery producers appears to be as low or lower than fruit growers. It is evident that wildlife managers and policy makers need to consider the perceptions and preferences of nursery producers, and to recognize the low tolerance of these producers for deer. To alleviate deer damage to nursery crops we need to focus attention on at least 3 areas: damage control, research, and policy.

First, producers of nursery crops need more information on the efficacy, costs and benefits of damage control. They also need to know how to apply that information to their specific situation. For example, those who consistently incur substantial losses to deer damage might consider using high quality fencing, while repellents may only be adequate in areas where damage is moderate or sporadic (McAninch et al. 1983). Special kill permits may be useful in an emergency situation, but it is only a temporary solution. Moreover, deer can cause substantial crop damage before a wildlife agent has the chance to survey the property. Producers need to be educated about this, in light of the fact that 54% wanted special permits.

Second, although much research has been conducted on different aspects of deer damage to agriculture, most studies to date have been short term and compartmentalized. A research team approach is needed. This concept is similar to the "management team" advocated by Krueger et al. (1986), where workers from several disciplines collaborate toward a common natural resources management goal. For example, intensive research by teams of biologists, horticulturists, and economists is needed to develop accurate methods to assess the economic impact of deer damage on crops, and to develop cost effective damage prevention measures. Concurrently, we need extensive socio-economic research to monitor trends in the extent and impact of deer damage, and to assess how deer affect the attitudes and preferences of farmers. To maintain perspective over time, we need long-term research to monitor trends for adaptive and responsive management adjustment. A specific example would be to monitor wildlife acceptance capacity of different agricultural constituencies over time, geographic regions or management systems. These kinds of research would facilitate decision-making by wildlife managers and policy makers.

Third, deer managers and policy makers need to be aware that, in terms of costs per grower, nursery producers incur an inordinate amount of deer damage, and they should be considered in the same "at risk" category as fruit growers. Moreover, many commercial nurseries are situated close to cities, suburbs and developed where areas, where hunting is often restricted due to safety reasons and social constraints. Growers in these areas need to protect their crops accordingly, and in extreme cases where damage prevention fails, other solutions might be necessary.

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