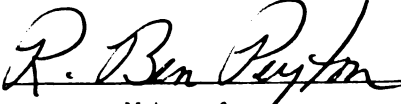




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Regarding Deer Drop Depredation to Fruit,
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**A SURVEY OF MICHIGAN AGRICULTURAL PRODUCERS'
ATTITUDES, PERCEPTIONS, AND BEHAVIORS
REGARDING
DEER CROP DEPREDAATION TO FRUIT, VEGETABLES, AND FIELD CROPS**

By

Peter Algren Fritzell, Jr.

A THESIS

**Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of**

MASTER OF SCIENCE

Department of Fisheries and Wildlife

1998

ABSTRACT

A SURVEY OF MICHIGAN AGRICULTURAL PRODUCERS' ATTITUDES, PERCEPTIONS, AND BEHAVIORS REGARDING DEER CROP DEPREDAATION TO FRUIT, VEGETABLES, AND FIELD CROPS

By

Peter A. Fritzell, Jr.

During the last 20 years several states have seen dramatic changes in the size of their white-tailed deer (Odocoileus virginianus) populations and also more frequent debates about how the deer resource should be managed. One central area of conflict between stakeholders involved in deer management is the issue of crop depredation and the management of deer, people, and habitat to minimize such depredation. Between April and June, 1995 agricultural producers from six regions of Michigan were surveyed about their attitudes and behaviors regarding deer crop depredation. Producers generally did not believe the state agency was considering farming interests fairly in their deer management decision making, and a majority of producers cited low deer harvests on adjacent lands as responsible for their inability to control losses to deer. The extent of crop losses to deer and producer responses to those losses were shown to vary regionally. Producers with intolerable losses more frequently indicated they provided deer hunting access to non-acquaintances, but some with intolerable losses were not encouraging the harvest of antlerless deer. Analysis suggested that producers with prolonged intolerable losses are more likely to engage in disruptive issue activity, but also that there are opportunities for biologists to moderate producer attitudes and behaviors through more frequent contact.

ACKNOWLEDGMENTS

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Editorial note -- Throughout this manuscript the terms farmer, producer, and grower are used interchangeably to mean a person who farms, grows, or raises an agricultural crop for commercial sale or as feed or fonder for livestock which are sold or which produce a product for subsequent sale.

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INTRODUCTION

Deer and Crop Damage in Michigan

White-tailed deer (*Odocoileus virginianus*) populations in Michigan quadrupled from approximately 500,000 animals in 1972 to over 2 million in 1989. During this period reports of severe crop damage increased dramatically as did hunter success which peaked with record harvests of over 400,000 deer in 1989, 90, and 91 (Langenau 1993). In part because of large numbers of complaints about crop losses from agricultural producers, the Michigan Department of Natural Resources (MDNR) increased available antlerless tags between 1987 and 1991 to reduce the deer herd. The herd was successfully reduced to approximately 1.7 million in 1992; however, reduced sightings of deer led deer hunters and newspaper writers to complain that there were not enough deer.

Since 1992, the MDNR has found it difficult to define and maintain an acceptable deer population goal for Michigan because of the significant political clout yielded by both deer hunting and agriculture interests. Both interests make significant economic and cultural contributions in Michigan. Agriculture is the second largest industry in the state and annually contributes \$37 billion into the state's economy (Skjaerlund and Norberg 1994), while over \$300 million accrues annually from deer hunting in the state (Dudderar et al. 1989). Between 1987 and 1994 several citizen action groups (UPWARD, Citizens for Responsible Wildlife Management, Concerned Sportspeople & Business People of NE Michigan) formed to espouse the views of hunters and farmers about the deer herd size and/or crop losses. This substantial amount of political lobbying about deer and deer damage has at times overwhelmed the activities of the MDNR and

other organizations involved in the issue, and the MDNR has frequently had to defend its management objectives and population estimates. In 1995, the issues associated with crop depredation by deer received the attention of the State House Committee on Agriculture and Forestry, raising the possibility that legislative action might be taken on the behalf of farming interests. Most recently the Michigan Farm Bureau has threatened legal action against the MDNR if deer numbers are not significantly reduced in the next two years.

Goal of Research

Michigan's large deer herd, large agricultural industry, and large deer hunting public provides a myriad of issues by which to examine the concept of "cultural carrying capacity" (Ellingwood and Spignesi 1986) as it applies to deer. Of greatest concern, however, is the pragmatic analysis of the conflicts surrounding Michigan's deer herd and understanding how these conflicts can best be resolved; or in other words applying cultural carrying capacity theory. The MDNR already attempts to adjust deer herd management in response to stakeholder concerns about crop damage, car accidents, harvest rates, etc., which could be taken as managing for cultural carrying capacity. Because conflicts have continued to erupt as different management strategies have been attempted, a better understanding of stakeholder (farmers and deer hunters) beliefs and values concerning deer and deer management has been needed to reduce the frequency of conflict.

The ultimate goals of this project were: to identify the level of crop damage problems reported by farmers, to evaluate factors that might influence their acceptance of

management alternatives, to predict stakeholder response to management and fluctuating deer numbers, and finally to identify targets for a communication plan to reduce the amount of issue activity and improve acceptance of MDNR deer management programs.

Given that farmers, deer hunters, and the MDNR are the key stakeholders in this issue, it appears that a better understanding of the perceptions, attitudes, and behaviors of each of these stakeholder groups about crop damage issues is needed to reduce the disruptive activities that follow crop damage. This study examined some of the social and psychological components which influence farmer attitudes and behaviors regarding deer damage, while a concurrent study examined the parallel components amongst deer hunters (Minnis 1996).

Objectives

This project's objectives were to:

1. Acquire information on Michigan farmers' tolerance of deer damage and deer population densities and to identify factors which influence this tolerance.

Specific research hypotheses:

Hyp. #1. Tolerance will be related to...

- a. past history of intolerable losses;
- b. extent of current year's losses;
- c. dependence on farm income;
- d. participation in deer hunting recreation;
- e. relationship with the wildlife agency.

2. Identify factors that appear to be impacting producers' abilities to control intolerable levels of loss.

Specific research hypotheses:

Hyp. #1. Producer's abilities to control losses will be related to...

- a. adjacent landowners' attitudes and behaviors about harvesting deer;
- b. producers' attitudes and behaviors about harvesting deer.

3. Determine what types of actions Michigan farmers have taken and are likely to take in response to deer depredation.

4. Identify Michigan farmers' attitudes about the MDNR and the current MDNR system of issuing block and shooting permits to control depredation in conjunction with regulated hunting.

Specific hypotheses:

Hyp. #1. Farmer attitudes about the MDNR and the current depredation control system will be related to...

- a. perceptions of the trustworthiness of the agency;
- b. perceptions of the expertise of the agency;
- c. perceptions of the competence of individual agency personnel.

Hyp. #2. Agency credibility will be positively correlated with tolerance of crop loss.

5. Identify indicators of escalating issue development among producers regarding deer crop damage.
6. Make recommendations about how information regarding these attitudes can be best incorporated into the Michigan Department of Natural Resources' deer management programs.

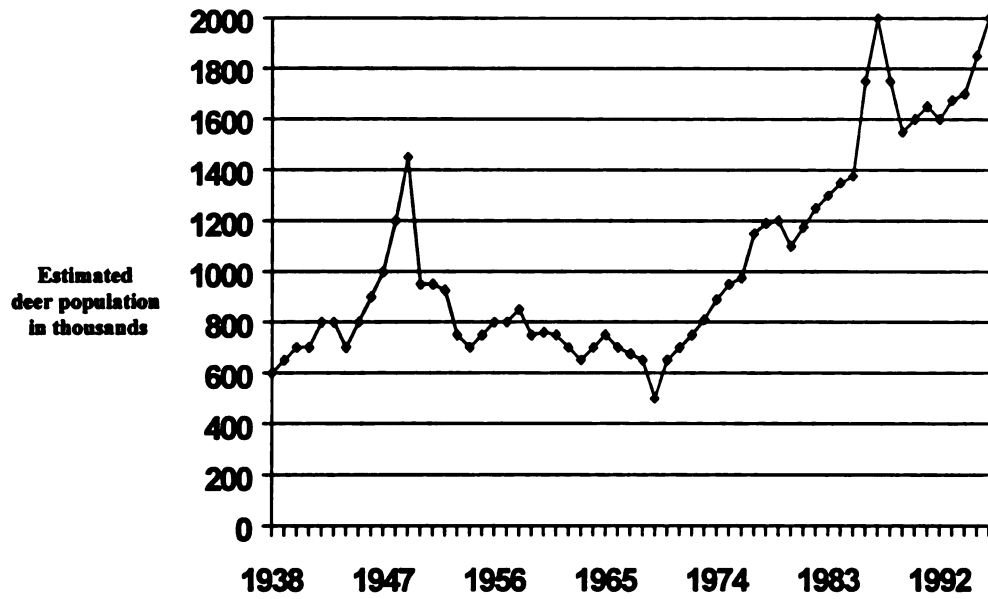
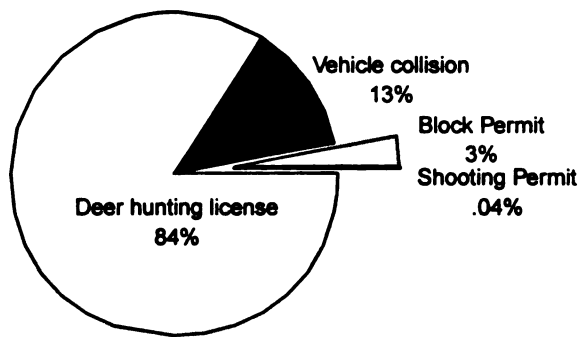
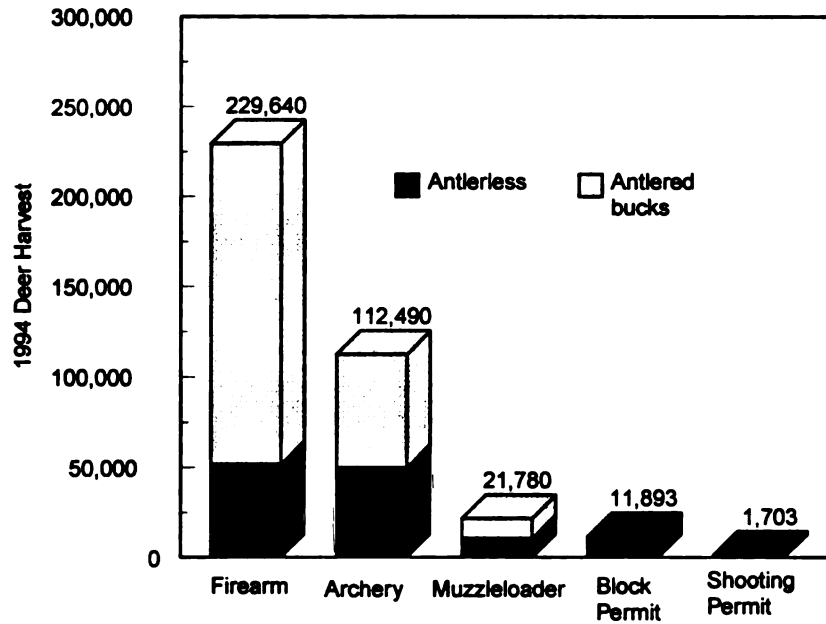


Figure 1: Number of White-tailed deer in Michigan (1938-1994)

Compiled from unpublished MDNR data.

Figure 2: Number of antlered bucks and antlerless deer taken in Michigan during 1994.



Note: Data for 1) deer taken by type of hunting license are preliminary,
 2) deer taken on Shooting Permits may include some antlered deer,
 3) deer killed in vehicle accidents assumes deer were killed in the collision.

Compiled from unpublished MDNR and Michigan State Police data.

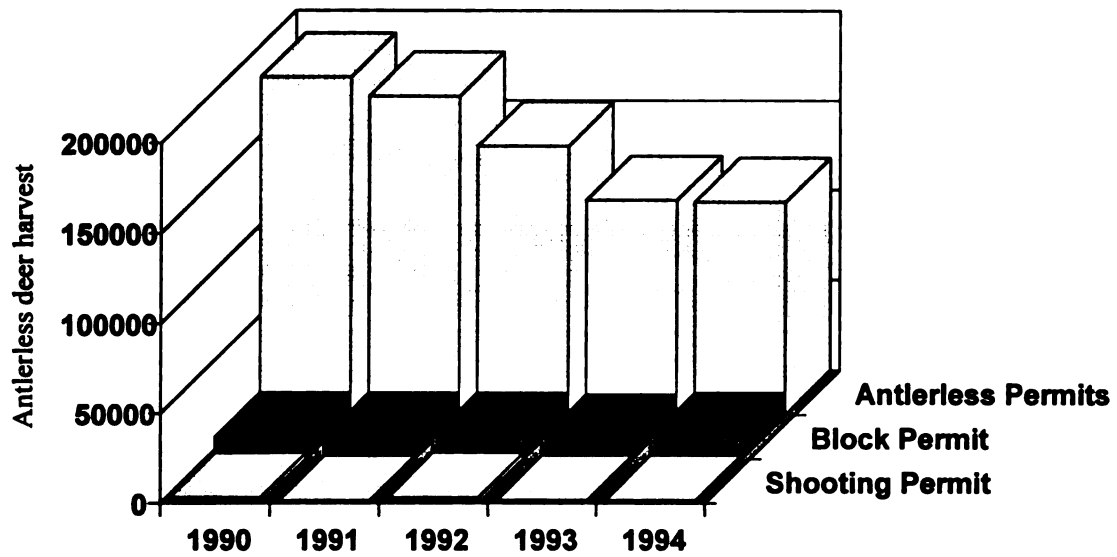


Figure 3: Number of antlerless deer taken in Michigan with antlerless deer licenses and crop damage control permits 1990-1994.

Compiled from unpublished MDNR data.

LITERATURE REVIEW

In preparing this manuscript and preparing for this study I was fortunate to have access to several excellent literature reviews regarding human tolerance of wildlife, human tolerance of crop damage, and reviews of management strategies for reducing crop losses (Dudderar et al. 1989, Langenau et al. 1993, Minnis 1996). Because of the comprehensive nature of these reviews, I have chosen not to duplicate these reviews here, but to use this chapter to propose that crop damage management be viewed as an issues management problem involving conflicting human values and beliefs.

Issues Management

The issues surrounding deer management in Michigan over the last 10 years well illustrate Aldo Leopold's comment that, "You cannot conserve wildlife by itself; to build the wildlife resource you must...rebuild the people who use it, and all the things they use it for..." (Leopold 1953). Leopold's statement appropriately points out the necessity of managing people in concert with wildlife populations, and illustrates two central points of Michigan's deer conflicts. First, "building" is no longer an appropriate paradigm for the deer resource; support for herd management, and therefore occasional herd reduction, is what currently needs support, and appears to be at the heart of current conflicts. Second, Leopold's comment is short-sighted in that it does not acknowledge that different stakeholders may need to be "rebuilt" with different parts or by different methods; farmers and deer hunters need to be approached differently as do different types of farmers (Decker and Brown 1982). As the MDNR has become acutely aware, conflicts between multiple stakeholders, and the diverse concerns of stakeholders can lead to

management problems unless these components of issues that cause conflict are addressed.

The initial step towards managing contentious issues is an identification of the components causing conflict. The components of deer management issues confronting the MDNR today and in the future are not necessarily the same as those faced in 1987 or 1992. Thus, it is important for managers to anticipate changes in issue components in addition to identifying current ones. In 1990, Peyton et al. listed 3 characteristics of issues that managers should keep in mind when attempting to identify and manage wildlife issues.

Issues and disputes are developmental. They evolve through social, psychological and political processes. The earlier a resource manager intervenes, the better.

Public beliefs, public values and priorities, and the adequacy of existing science, all play important roles in creating issues and must be dealt with differently by resource managers.

There are no institutional quick fixes which make issue management and personal involvement of managers unnecessary.

Stages of Issue Development

Perhaps the most important of these issue characteristics is that issues develop through stages. Knowing this, managers should be able to reduce the number of conflicts they encounter by anticipating issues and addressing them early in their development.

Peyton (1984) describes the stages of issue development as: 1) latent; 2) emerging; 3) active; and 4) disruptive (Figure 4). *Latent* issues are those that are concerns of individuals but which are not being communicated to others. *Emerging* issues are those that are being discussed by stakeholders amongst themselves, but not yet being brought to the attention of the agency or other authority figures. Currently, producer concerns about

geese (Branta canadensis), crane (Grus canadensis), and turkey (Meleagris gallopavo) damage to crops are at this level in certain parts of the state. *Active* issues are those issues which the stakeholders are actively communicating to the management agency. The stakeholders are voicing demands at this stage but the manager generally remains in control of the situation. When issues are taken to authorities other than the management agency they are considered *disruptive* issues. If an issue results in legislative action or court rulings they would be considered disruptive. The recent attention of the House Committee on Agriculture and Forestry to the deer crop damage concerns of farmers threatens to make farmers' deer crop losses a disruptive issue. Though this issue level is termed "disruptive," it is important to note that seeking legislative action can sometimes be a positive action and serve to improve management that has become too bureaucratic or unresponsive to stakeholder interests.

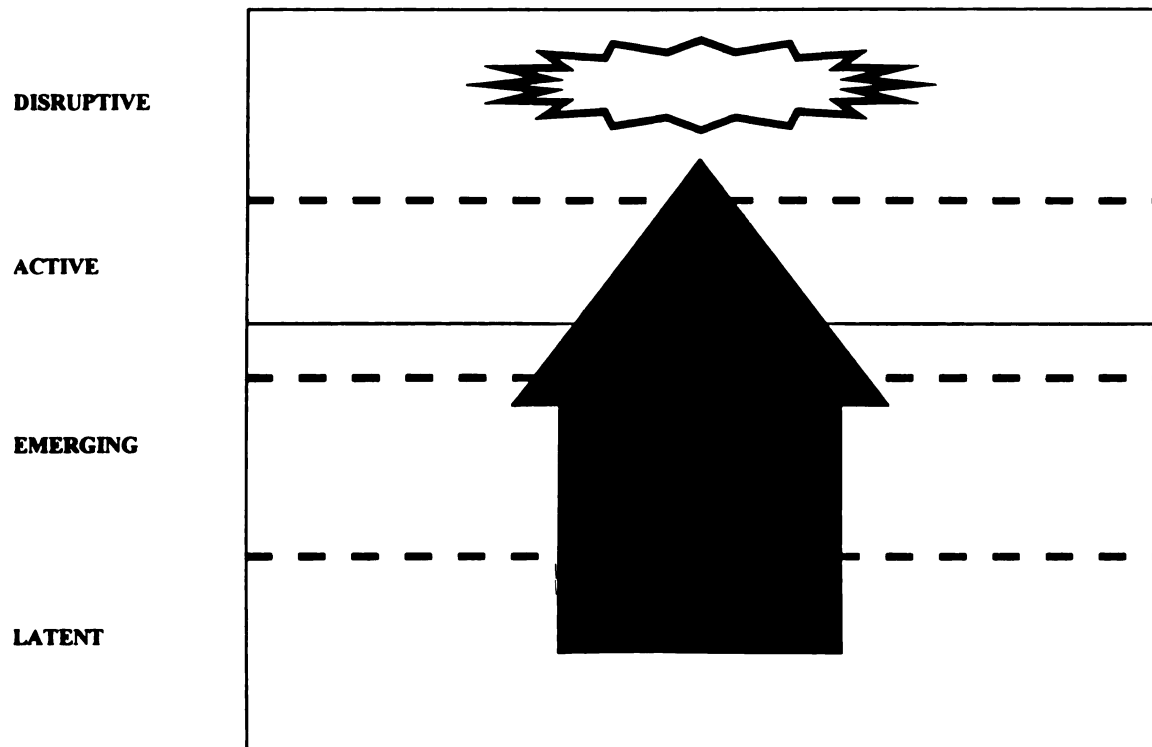


Figure 4: Representation of the stages of Issue Development (adapted from Peyton 1984)

Components of Issues

In a 1985 paper Kellert and Brown wrote, “Despite the willingness of the public to support the conservation and protection of many species, many Americans, while being aware of and interested in wildlife, appear to be motivated more by myth and bias than by knowledge and informed opinion about wildlife and its management.”

Public beliefs and biases appear to be important components of the issues surrounding deer management and crop damage and attention to stakeholder values and beliefs is likely an important key to managing issue development.

Peyton (1984) identifies 3 major components of resource management issues which may need addressing to resolve conflicts: 1) the adequacy of the existing science and technology, 2) public beliefs, and 3) public values. The impact of public beliefs in deer management issues is evident in Langenau’s (1993) response to questions about the scarcity of deer in the fall of 1992. Langenau stated, “Farmers were said to have killed off the deer last fall with block permits or with out-of-season shooting kill permits last summer.” He pointed out that neither was the case. This same complaint was made by hunters in Alpena County in 1994 where general antlerless harvest had actually been increased to lower deer densities in the areas’ Deer Management Units (DMU’s) (Carlson pers. comm.). Such perceptions and beliefs appear numerous in deer management issues and identifying and countering them has the potential for defusing issues before they become disruptive.

How many deer are there?

Though managers' scientific understanding of deer and the effects of deer damage is generally adequate, it is often the first area called into question by stakeholders as an issue develops. For example, in 1992 deer hunters questioned whether deer herd reduction had been necessary and whether the reduction had gone too far, and Langenau (1993) reported that MDNR deer population and harvest estimates were questioned. Similarly in 1994, sportsmen in Alpena County questioned the ability of the MDNR to estimate deer populations from pellet count indices. Often it appears that the public jumps to critiquing a single analytical tool although it may be only one of several indices used by the agency to estimate relative deer densities.

Loss Assessment Technology

Estimates of crop loss are also viewed suspiciously and the methodology for making such estimates is questioned. Studies and programs in other states have shown through a variety of methods that deer browsing can have a significant impact on the yields of agricultural crops, and result in large financial losses to producers (Craven 1983, Tanner and Dimmick 1983, Stoll and Mountz 1983). Still when seemingly large dollar values of crop loss are reported by farmers, the validity of their estimates is frequently questioned. Some deer hunters and others may have trouble comprehending how deer can cause such loss and they want proof there is an issue of crop loss.

The reliability of farmer reports of damage was one target of hunter scrutiny in the late 80's and early 90's. The same skepticism of farmer reports may also be expressed by agency personnel who may question producer assessments loss based solely on visual inspections of damage (not loss) and deer sightings in crops. Unfortunately, available

methods of assessing losses are labor intensive and beyond the means of most farmers and wildlife agencies. Thus, farmer estimates of intolerable losses are often all managers have to go on when making management decisions. This might not be a problem if individuals hadn't been known to claim losses that didn't exist (Dudderar, Odum, Carlson, Willman, Parr, pers. comm.), so that deer hunters and other stakeholders could trust that depredation control was necessary. One would like to believe that if a standardized systematic method were available for farmers to report their losses that there would be less conflict; however, even wildlife and agricultural professionals apparently have trouble agreeing to acceptable methods and designs.

In 1988 and 1989 the Michigan State University Extension Service estimated that some growers of certified seed beans in northeast Michigan were incurring losses in excess of \$225 per acre (Long et al. 1990). Despite having sought assistance from wildlife professionals (USDA-Wildlife Services, Michigan State University's Department of Fisheries and Wildlife) in performing this exclosure research, over 3 years, MDNR personnel were reportedly still critical of the exclosure protocol and the resultant data (Dudderar, Long and Parr pers. comm.). Interestingly, between 1993-1995 Braun (1996 unpublished) documented losses to alfalfa and beans in northeast Michigan of between 3% and 11%, but with apparently greater acceptance of the data by the agency. The political climates surrounding each exclosure study were markedly different in that the Extension work was done at a time of high deer numbers as opposed to the much reduced density surrounding the Braun study. Other differences that may have elicited the different agency responses might be the intended use of the data, and the person directing the work. In the Extension work there was apparently the potential of using the data in a

lawsuit by farmers, while the Braun study was directed by a former MDNR employee and the data was being used to evaluate the impact of adjacent habitat characteristics on losses caused by deer. Despite their obvious differences, these two cases illustrate that methodologies used to document crop losses need to be agreed to.

Though managers may debate the results of such exclosure work, this method and others have been broadly applied and are generally considered accurate and reliable means of quantifying losses (Litvaitis et al. 1994, Wisc. Co-op Wildl. Damage Control Program 1990). In fact, exclosure estimates are used to test the reliability of other methods of quantifying loss (Austin and Urness 1987). Thus, the science of quantifying losses appears to be adequate, though communicating the abilities of this science to the stakeholders needs improvement.

Non-lethal Control Alternatives?

The belief that deer damage can be eliminated with non-lethal control is another common belief expressed by stakeholders when deer herd reduction is an issue and much research has focused on evaluating the effectiveness of various control methods at reducing losses: chemical repellents (Sayre and Richmond 1991, Fargione and Richmond 1993, Lewison et al. 1993, Tanner and Dimmick 1983, Ellingwood et al. 1983), electric and non-electric fences (Jordan and Richmond 1991, McAninch et al. 1983, Owen et al. 1993), soap bars (Fargione and Richmond 1991), guard dogs (Beringer et al. 1994).

While these and other studies have shown that some methods are effective at reducing deer browsing in certain situations, they also point out that the costs of these methods may possibly prohibit use on larger scales, and that effectiveness declines as browsing

pressure increases (Fargione and Richmond 1993). Usually some form of herd reduction is required either through recreational hunting and/or special shooting permits.

Not only do biases and beliefs affect the attitudes of deer hunters but also those of farmers, who may not use a control when it would be effective. A study by Purdy et al. (1988) indicated that New York apple growers often made damage control decisions based on incomplete or subjective information about the effectiveness of different methods. Sizable numbers of producers with chronic deer damage in New Jersey have been shown to have limited knowledge of hunting seasons and bag limits that, if taken advantage of, might reduce their losses (Eriksen 1994). Apparently, science-based information is available on controlling deer depredation, and much of it may be appropriate to certain farming situations. Regrettably, this information does not appear to be getting to farmers whose situations warrant particular controls.

Who's Responsible for Deer Damage?

Not only do deer damage issues hinge on specific beliefs about the effectiveness of non-lethal control measures and what types of deer control are legitimate, they also hinge on philosophical beliefs about whether deer damage is a public responsibility given that deer are considered a public resource. In fact people's attitudes about who should be financially responsible for deer damage may be more important to the crop damage issues than any other single factor. Legally, states are allowed to "regulate" wildlife and wildlife agencies "manage" this public resource (Gray 1993). Whether the state is then "responsible" for losses caused by its charges (the deer) is a legitimate question for farmers with intolerable losses. Islieb's finding that only 31% of farmers would install

deer fencing even with a 75:25 (state:farmer) cost-share suggests that considerations other than just cost influence farmer willingness to engage in controls which have been scientifically proven (Islieb 1994). Perhaps farmers do not believe that they should have to pay to control the "state's" deer.

Conflicting Values

Public values are also an important component of deer management issues that need to be understood. Peyton (1985) identifies issues involving conflicting values as perhaps the most difficult conflicts to manage. Deer hunters, whose license fees support the majority of deer management, value the recreational opportunities provided by those dollars. Understandably, they may become upset if they perceive that the products of their dollars and their hunting opportunities are being given away to control crop losses. Consequently it can be hypothesized that issues may develop if hunters are not given opportunities to harvest animals that need to be removed to control crop losses. At the same time farmers who value living a farming lifestyle may see that value threatened by an over abundance of deer.

Tolerance of Crop Loss and Deer

Not all farmers respond to deer crop losses in the same way. It has been shown **that** not all farmers who have identical losses rate these losses similarly. Studies done in **New York** and **Ohio** indicate that when losses exceed \$500 producers consider the losses **to be** a problem and that losses of approximately \$1,500 are considered severe (Brown et al. 1978, Stoll and Mountz 1983). Still a single farmer may have particular values that **cause** him/her to tolerate a “severe” loss, while another farmer may find the same loss **intolerable**. This tendency is born out by the large variances surrounding the means **reported** in New York and Ohio studies. The median “tolerable” amount of loss in Brown et al. (1978) was the category \$1-99, with an inter-quartile range around that of \$0 to **\$100–499**. Similarly the median amount of loss considered “unreasonable” was \$500-999 **with an** inter-quartile range of \$100-499 to \$1,000-2,999. These studies did not, however, **document** what type of actions producers take as damage approaches these levels, nor did they **adequately** identify the factors that determine whether a producer will tolerate such **losses**. **For** instance, a producer may consider losses a problem but decide to tolerate **them, while** another producer may engage in damage control, and still another producer **may decide** to petition his state legislator to lobby for decreased deer numbers.

Prompted by the belief that managers need to better understand the views of their **constituents**, several studies have examined farmer and landowner attitudes toward deer **and the human** tolerance of deer populations and crop damage (Decker and Brown 1982, Tanner and Dimmick 1983, Stoll and Mountz 1986, Morgan et al. 1990, Minnis 1996). A **few studies** have even looked at Michigan farmers attitudes about deer and attempted to **identify trends** in the extent of deer caused losses to crops with surveys by Albright

(1993) and Nelson (1995) being the most recent. Some general findings of these studies were: that <10% of agricultural producers find deer damage to be intolerable, that the benefits derived from esthetic and consumptive uses of deer sometimes compensates for damages incurred, that those receiving a greater proportion of their income from the land are less tolerant of damage, and that landowner willingness to permit hunting increased as estimated losses increased. (For a more detailed review of the history of and research on Michigan's deer crop damage issues the reader is referred to the reports of Dudderar et al. (1989) and Minnis (1996).)

Attitudinal Response to Deer

Tolerance or intolerance is an attitudinal response to a stimuli such as crop depredation, and disruptive issue behaviors are one type of behavioral manifestation of such attitudinal responses to deer damage. This link of tolerance to behavior was not investigated by the aforementioned studies despite it being a critical piece of information for deer managers. To be able to prevent disruptive issue activity it is important that deer managers understand how stakeholder attitudes are developed, and how these attitudes express themselves in terms of action. In their 1995 paper “Cultural Carrying Capacity: modeling a notion” Minnis and Peyton proposed an Attitudinal Response Model (ARM) to explain human response to wildlife. Their model consists of 4 major dimensions: “actuality, perceptions of actuality, attitudinal response and behavioral response.”¹ The model poses that an individual’s behaviors regarding a wildlife population will be determined by a linear relationship between the actual nature of the wildlife-human interactions, the individual’s perception of those interactions, the individual’s evaluation of the costs and benefits of those interactions, and, eventually, the adoption of a behavioral intention (attitudinal response) in response to the wildlife-human interactions (Figure 5).

“Attitudinal response to a wildlife population level is proposed as being modified by actual and perceived wildlife-human interactions. Often, it is the perception of reality rather than the actual incidence of wildlife-human interactions that determines the attitudinal response” (Minnis and Peyton 1995). The crux of the ARM is the stakeholder’s evaluation of the perceived costs and benefits of the wildlife-human

interaction. Minnis and Peyton describe the process as stakeholders asking themselves, whether “the perceived cost-benefit assessment is satisfactory/desirable or unsatisfactory.” They explain, “A satisfactory/desirable response will result in the stakeholder taking no action to change the [wildlife-human] interaction and that following an unsatisfactory evaluation a person will either tolerate or not tolerate the perceived cost-benefit assessment.” Tolerance will result in no change being sought, while intolerance will result in some effort on the part of the stakeholder to change the wildlife-human interaction to create a satisfactory perceived cost-benefit assessment.

¹ The complexity of the model is too much to review in its entirety here and the reader is referred to Minnis and Peyton 1995 and Minnis 1996.

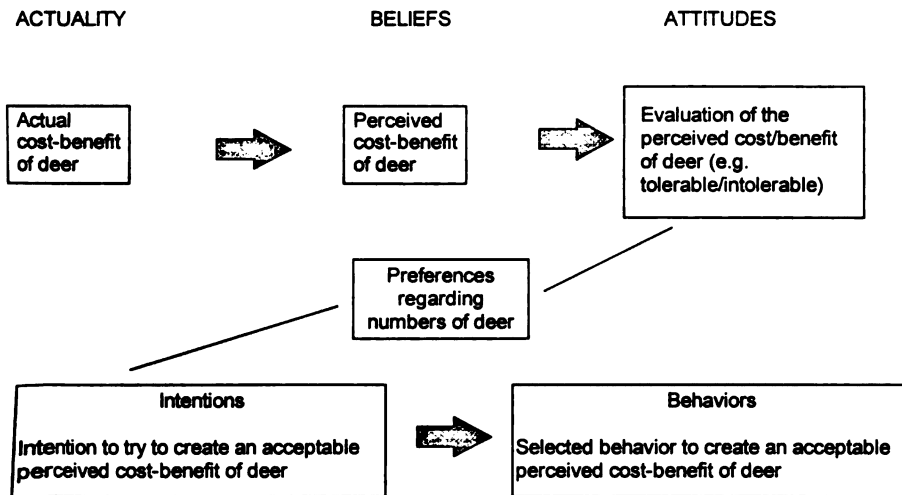


Figure 5: Major components of the Minnis and Peyton Attitudinal Response Model.

Hypothesized behaviors resulting from a stakeholder's intolerance might be that the person: abandons the situation (e.g. ceases to plant a crop), personally attempts to change the situation (e.g. alternative crops, fencing, repellents, shooting permits, non-permitted shooting), or to get others to change the cost-benefit in favor of the stakeholder (e.g. via agency harvest quotas, legislative mandates, compensation for losses, etc.)

Graphing human tolerance of deer numbers

Ellingwood and Spignesi (1986) defined the term Cultural Carrying Capacity (CCC) as “the maximum number of deer that can compatibly co-exist with a local human population.” Thus, there is logical link between tolerance and wildlife population size. This link between deer herd density and attitudinal response is a component of the Actuality segment of the ARM (Minnis and Peyton 1995). Minnis and Peyton (1995) propose that CCC may be best defined as “the wildlife population level in a defined area that produces the most manageable amount of issue activity at a particular time.” They propose that the relationship between issue activity and wildlife population size can be graphically represented by plotting issue activity and wildlife population size as axes on a Cartesian graph. Each stakeholder is proposed to have a pair of tolerance thresholds which bracket their preferred range of densities for a single wildlife species (Figure 6). At the lower end is the point of “Minimum Demand”, below which there are too few animals (deer) for the stakeholder's satisfaction. The upper threshold is the stakeholder's Wildlife Acceptance Capacity (WAC), a term borrowed from Decker and Purdy (1988). WAC is that population level beyond which there are too many animals (deer) for the stakeholder's liking. When jointly plotted each stakeholder should have a U or V-shaped

curve that represents their tolerance of deer densities. The distance between one's WAC and point of Minimum Demand is referred to as the stakeholder's "Latitude Of Acceptance" (LOA) for deer populations.

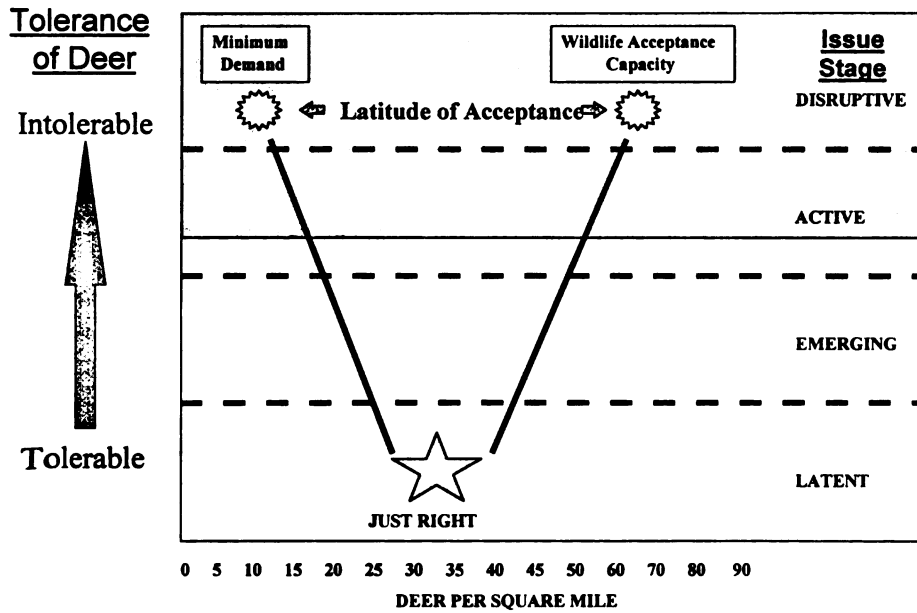


Figure 6: Hypothetical preferred deer density for one stakeholder group (adapted from Minnis and Peyton 1995)

Tolerance
of Deer

Intolerable



Tolerable

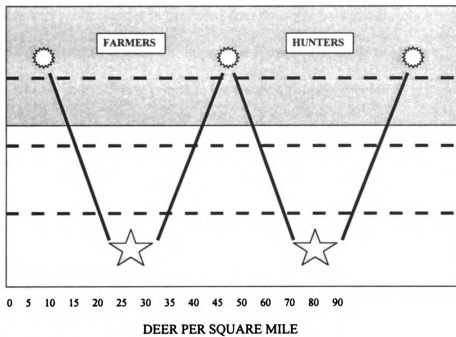


Figure 7: Hypothetical preferred deer densities of two stakeholder groups

When combined in stakeholder groups composite curves can then be used to illustrate differences and/or similarities in preferred deer densities between stakeholders such as farmers and deer hunters (Figure 7). In practice it may be possible to affect a change in a group's LOA, thus offering potential for resolving conflicts between groups over what is an acceptable number of deer (Figure 8). Minnis and Peyton (1995) propose that analyzing farmer and deer hunter attitudes and behaviors using the ARM may allow agencies to affect such changes among stakeholders.

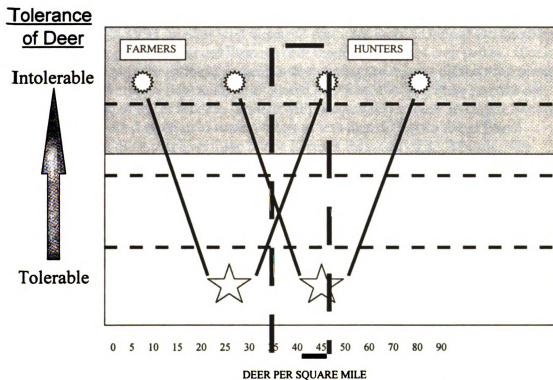


Figure 8: Hypothetical representation of Cultural Carrying Capacity

Synopsis of Michigan's Deer Depredation Control Permits

Three permit systems are currently used in Michigan to encourage the harvest of antlerless deer in specific areas to help reduce the local deer population and control crop losses.

Shooting Permits -- In 1979, the Natural Resources Commission in Michigan adopted Out-of-Season Shooting Permits to help control deer depredation of agricultural crops. These permits are issued to farmers whose losses to deer are deemed significant by MDNR biologists. The permits are issued to kill depredating antlerless deer at times outside of the regular firearms, muzzleloader and archery deer seasons. Permits allow antlered deer to be shot only when circumstances are deemed appropriate by MDNR biologists. The permits are valid only for times, fields, and the number of deer designated by the biologist. In most areas, deer shot under this permit system are to be collected by MDNR personnel or designated persons and distributed to charitable causes. Up to three designated shooters can be allowed to fill the permits, and there is no charge to the farmer for the permits.

Block Permits -- In 1990, another type of permit was introduced to reduce the number of Shooting Permits issued and to use licensed deer hunters to control crop losses. Block Permits are valid only for shooting antlerless deer during the regular fall hunting seasons. The biologist determines how many deer should be taken, and then these permits are issued in "blocks" of ten or more to farmers with documented losses. In certain situations the biologist has the discretion to issue a block of less than 10 but no fewer than 5 permits. Farmers must purchase these bonus licenses for a cost of \$3.00 each. The licenses are then distributed by the farmer to licensed hunters for use on their farm or adjacent lands with the permission of adjacent landowners. Hunters are allowed to keep the deer they shoot, and there is no limit to the number of Block Permit licenses that a hunter can fill. Licenses are also transferable between hunters so that unused tags can be returned to the farmer and then reissued to other hunters. All regular hunting season restrictions apply as to the type of equipment and legal shooting hours.

Regular Antlerless Lottery Licenses -- Michigan also uses a lottery system to allocate a limited number of antlerless deer hunting licenses in the majority of its deer management units. Antlerless licenses are issued both through a general and a private lands lottery. Selected hunters in the private lands category are issued one license to harvest an antlerless deer on the parcel they specified on their application.

Table 1: A comparison of Michigan's shooting and block permit programs.

Frequently asked questions:	Shooting Permits	Block Permits
First used statewide?	1979	1990
Purpose?	Control deer numbers to reduce crop loss at times outside of regular deer hunting seasons.	Reduce need for Shooting permits and allow licensed hunters during regular fall deer hunting seasons to help control numbers of deer that cause damage.
Who issues the permits?	Local MDNR personnel who assess agricultural loss.	Local MDNR personnel who assess agricultural loss.
Who can get the permits?	Producers with "significant" crop loss.	Producers with "a history of significant" crop loss.
Who shoots the deer?	Up to 3 shooters designated by the permittee.	Anyone who has a current deer hunting license.
Where can the permits be used?	Only on the permittee's lands/fields/blocks as designated on the permit.	On the permittee's land and on adjacent private land with permission.
What is the cost of the permits?	None	\$3 per permit; minimum block of 10 must be purchased, unless otherwise approved by MDNR.
How many deer can be shot?	Local MDNR biologists determine the maximum number of deer that can be removed.	Local MDNR biologists determine the maximum number of deer that can be removed.
Who gets the deer after it is shot?	Varies but the MDNR maintains the right to determine how deer are to be used and by whom.	The licensed hunter who shot the deer.
Can antlered bucks be shot? (i.e. deer with antlers extending more than 3" above the skull)	Only in select cases when the MDNR determines that a need exists. (e.g. when excessive buck rubbing damages fruit or Christmas trees)	No antlered deer can be shot with block permits.

Michigan Department of Natural Resources, 1995c. Guidelines and procedures for issuance of 1994 deer crop damage block permits. Interoffice communication from R.C. Elden to Regional Wildlife Supervisors. Wildl. Div. Lansing.

Acceptance of Damage Control Programs

Three recent studies in Pennsylvania, Michigan, and Wisconsin have looked at stakeholder use and acceptance of special culling programs and the factors related to attitudes about such programs to control deer-crop depredation. In Pennsylvania, landowner attitudes about an extended antlerless season to control crop losses were studied by Boyd and Palmer (1991). Farmer respondents to their survey indicated general approval of the extended season but indicated that it was not as effective as it could be because adjacent landowners were not supportive of killing deer to control crop losses. In Wisconsin, Horton and Craven (1996) examined farmer attitudes about Wisconsin's Shooting Permit system. They expressed doubt that the system was being used

effectively by farmers but went on to postulate that the system may be worth while because it gives producers a sense of control over the situation. Their analysis further suggested that farmers were unwilling to shoot pregnant or nursing does, that hunters could not be found to use shooting permits in the summer, and that shooting hour restrictions and shooter training prevented effective use of shooting permits. Nelson and Yuan (1991) studied farmer, hunter, and adjacent landowner attitudes about Michigan's Block Permit system two years after its inception as part of the program's 3-year evaluation. Some of their findings were that block permit recipients were more dependent upon farm income than non-recipients and that the system appeared to be achieving its purpose of locally increasing antlerless kill on affected farms. However, they also found that hunters who did not or could not participate in the control program were least supportive of the program, perhaps because they did not perceive the allocation of permits to be fair. This approach of the Michigan Department of Natural Resources' (MDNR) to deer depredation control continues to be one particular area of conflict between hunting and agricultural interests in Michigan. Several reports of urban deer reduction programs have been made in the last few years which suggest factors that impact on stakeholder acceptance of deer reduction programs. Common areas of conflict are beliefs about the need for herd reduction and the method of herd reduction, specifically whether lethal control is justified. Acceptance of herd reduction programs also appears related to the credibility of the management agency and the approach used by the agency to select the management technique (Stout and Knuth 1995, McAninch and Parker 1995, Curtis et al. 1995, Hall 1991).

Agency Credibility

Agency credibility appears important at many points throughout the issue management process. Eberhardt et al. (1990) define two components of agency credibility: 1) competence and 2) trustworthiness. Stakeholders' perceptions of an agency's competence to perform management functions and of an agency's willingness to act in the best interest of stakeholders can potentially make or break any management effort. Grise (1994) wrote that, "When agency credibility is high, decisions are more likely to be accepted as necessary and the best possible choice, even when they differ from the personal preferences of the stakeholder...With low agency credibility, stakeholders will... continue to question the agency's ability to manage effectively." In the case of deer crop damage management, the MDNR is precariously positioned because key values (financial security and recreation) held by farmers and deer hunters are fundamentally opposed. It would be easy for the agency to lose the trust of hunters while acting in the best interests of farmers, or conversely, to lose the trust of farmers while acting in the interest of deer hunters. Smolka and Decker (1985) found in New York that the conflicts over deer management appeared to revolve around beliefs about whether there is a problem or reason to change the status quo and/or about the appropriate method of addressing the problem. If the agency's credibility is high then stakeholders will more likely trust the agency's assessment of the existence of a problem and the most appropriate course of action. Crop damage abatement programs by their personal nature offer an interesting opportunity to examine the relationship between producer contact with agency personnel (biologists, game wardens, etc.), and producer perceptions of

agency competence. In particular it allows for an examination of the ability of local **biologists** to affect attitudes about crop damage and tolerance of deer.

Summary of Literature Review

This literature review sought to accomplish two things: first, to propose that deer depredation should be viewed by agencies as an issues management problem, and second, to frame or identify those components which appear to be contributing to conflicts concerning deer depredation management.

General Issues:

Issues can be large or small in magnitude, but all issues are significant because of their potential to escalate from emerging issues to active and disruptive issues.

Sources of issues:

- Gaps in scientific knowledge and understanding (Proven facts)
- Differing beliefs about what is known (Perceived facts)
- Differing beliefs about what should be done if facts are agreed on (Important values)

Crop Damage Issues:

Issues related to deer crop damage in Michigan appear to be both large and small in magnitude and appear to be present at different stages of development in different areas of the state and with different segments of the public.

Hypothesized components of issues contributing to conflicts concerning deer crop damage in Michigan:

- Existence of actual deer-caused crop losses
- Tolerance of losses in dollars, percent of crop (What is an acceptable loss?)
- Perceptions of current numbers of deer
- Tolerance of deer numbers (What is an acceptable number? CCC)
- Acceptance of crop damage control program (Identified need and appropriateness)
- Credibility of agency and personnel (Strengths, weaknesses, administrative ability)
- Lethal and non-lethal damage control tools (Use and preferences)
- Hunting as a control tool (Use and access)
- Role of hunters, farmers, and MDNR (Who's responsibility are the deer?)

The pragmatic orientation of this study sought to document the current state of the crop damage issue in different regions of Michigan and to determine the extent to which each of the above hypothesized components is contributing to the issue of crop damage in Michigan.

METHODS

Study Site Selection

This study was part of a larger comprehensive examination of deer depredation problems in Michigan funded by the Michigan Agricultural Experiment Station, MDNR, and Michigan State University Extension (MSUE). Ecological portions of the study took place in the northeastern (Presque Isle, Alpena, Montmorency Counties) and northwestern (Benzie and Leelanau Counties) portions of the lower peninsula, and therefore this study examined farmer attitudes about crop depredation in those areas. To better represent the breadth and variety of deer damage situations throughout the state, four additional areas were selected that were identified as having different types of damage problems and different levels of public involvement in the deer damage issue after consultation with Extension and DNR personnel and after examining the 1987 Deer Damage Committee report. In total 7 counties were selected for study (Calhoun, Montcalm, Oceana, Benzie/Leelanau, Presque Isle, and Menominee) (Figure 9). As much as possible, counties were paired so as to control for the ratio of cropland to forest, the types of crops grown, and the relative deer density (Table 2). For this reason Benzie and Leelanau counties were combined as one region that would be somewhat comparable to Oceana county. Calhoun County's index of deer related vehicle accidents (DRVA's) is greatly affected by the presence of 2 interstate highways (I-94 and I-69) which bisect the county and account for account for significantly more miles driven in the county relative to other counties. Despite the skewed DRVA index, MDNR biologists from Calhoun and Montcalm County did believe that deer densities were similar in these counties.

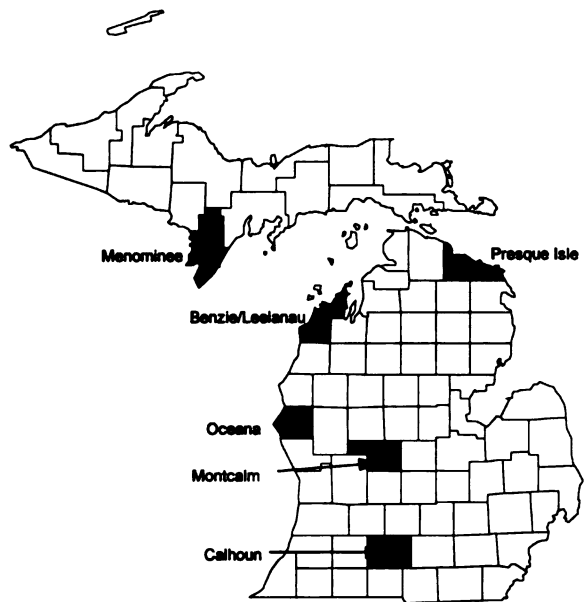


Figure 9: Counties included in a 1995 study of deer crop damage

Table 2: Profile of study counties by crop types, issue intensity, percentages of forest and agricultural lands, and relative deer densities.

County	Representative Crop types ^a	Crop Damage Issue Intensity ^b	Ratio of farmlands to forest ^c	Deer/Car Accidents per million miles driven ^d
Calhoun ¹	Corn, soybeans, grains	Low	56:24	0.97
Montcalm ¹	Corn, soybeans, table beans, potatoes	Moderate to High	53:29	2.42
Oceana ²	Fruit, vegetables	Moderate to High	38:54	1.61
Benzie/Leelanau ²	Fruit	Moderate to High	21:79	1.12
Presque Isle ³	Table beans, corn, alfalfa	High	19:74	2.45
Menominee ³	Corn, alfalfa	High	18:79	4.26

County pairings are denoted by common numbers following county names. ^a 1993 Michigan Agricultural Statistics, Mich. Dept. of Agriculture; ^b Pers. Commun. MDNR & MSU Extension; ^c 1993 Forest Inventory, North Central Forest Experiment Station; ^d 1991 Michigan State Police.

Interviews

Focus groups were initially planned for the spring of 1994 to become familiar with farmer beliefs, concerns, and values about deer crop damage and to identify language that would be appropriate for use in a questionnaire. Instead a personal interview format was adopted because it was more compatible with farmer schedules in May and June. County Extension agents provided the names and telephone numbers of clients whom they felt would provide a representative cross section of attitudes about deer damage in their counties. These clients were contacted by phone and asked if they would be willing to visit with the researcher at their farm for approximately 1 hour. Times were arranged that were convenient for the farmer, usually around the lunch, dinner and evening hours. Interviewees were asked for permission to tape record the session for note-taking purposes; however, because a number of producers appeared suspicious of

the proposed study and the use of such recordings, only written notes were taken after the first few interviews. Notes from these conversations were used as a guide in developing the content and wording of the subsequent mail questionnaire. Producers were asked to describe their experience with deer damage, their impressions of the current size of the deer herd, their use of deer damage control tools, their impressions of the benefits and costs of the presence of deer, their familiarity with Michigan Department of Natural Resources personnel, and to describe how they estimated losses.

Table 3: Number of interviews completed per county.

County	Number of interviews completed
Calhoun	4
Montcalm	6
Oceana	4
Benzie/Leelanau	8
Presque Isle	6
Menominee	6

Questionnaire testing and review

In early February, 1995 a pilot questionnaire was mailed to 102 MSU-E contacts in Isabella County to test the clarity and content of questions. Respondents were asked to complete the questionnaire and return it along with any additional written comments. The single mailing yielded 49 returned surveys from extension clients, 37 (76%) were full-time or part-time farmers that could be used in an analysis, 24% of the returns were from retired farmers and non-farmers. It was hypothesized that this percentage of non-eligibles would vary depending on the extension agent's maintenance of a farm list. The survey was also sent out to MSU-E and MDNR personnel for review. Adjustments to the questionnaire were made based on the pilot results and reviewer comments.

Sample Selection

Mailing lists of contacts were obtained from MSU-E directors and agricultural agents in the study counties. Agents were asked to clean lists as much as possible to eliminate those individuals who did not grow crops. Farms were often family operations and contact lists did not distinguish between different farming operations; therefore some of our respondents were likely describing the same farming operation. To somewhat control for this, mailings were sent only to the first name on the contact list when individuals had the same last name and address. Unfortunately, individuals with the same last name but different addresses could not be assumed to have the same or different farms. Mailings were sent to all contacts on the county lists except in Calhoun County, which had a prohibitively large number of contacts (907). Therefore 60% of the Calhoun County contacts were sampled. In total 2,134 individuals were selected to receive the questionnaire (Table 4).

Mail Survey Implementation

An initial mailing of the questionnaire, cover letter, and business reply envelope was made by 3rd. class mail on April 7, 1995 to producers in Calhoun and Montcalm Counties (Appendices I & II). Questionnaires to producers in more northern counties were initially mailed on April 14, 19, and 28. These initial mailings were followed approximately 10 days later by a postcard reminder/thank you which went out to all 2,134 individuals (Appendix IV). Approximately 2 weeks later a second mailing of the questionnaire and a modified cover letter, was sent to individuals who had not yet responded. All mailings were completed on June 20th., 1995.

Table 4: Initial per county sample size.

County	Initial sample size
Calhoun	545
Montcalm	329
Oceana	379
Benzie	100
Leelanau	263
Presque Isle	318
Menominee	200
Total	2134

Non-response Follow-up

During the period July 27, 1995 and through August 15, 1995, a non-response telephone follow-up was performed. This was due to concerns that the timing of the survey may have selected against active full- and part-time farmers who were in the field and had no time to respond. Non-respondents with published telephone numbers were sampled. This provided a sample of 280 individuals (29% of the non-respondents) who could be called. Selected questions on important descriptive variables such as tolerance of loss were drawn from the mail questionnaire and adapted for telephone use (Appendix III). The sample was called repeatedly until approximately 30 non-respondents had been contacted from each county. All calling was done between 1100 -- 1300 hours or after 1700 hours.

Data Entry and Analysis

All data were entered in and statistically analyzed using SPSS for WINDOWS version 6.0. The error rate of data entry was less than 0.05%, and was determined by sampling 10% of the coded surveys for errors. The error rate was determined by the following formula: (number of cells containing errors)/(total number of cells in the sample).

Primarily non-parametric statistics (Wilcoxon Matched Pairs, Mann-Whitney U, Kruskal-Wallis, Chi-square) were used to test differences because of the preponderance of nominal data and frequently polarized response frequencies which did not meet assumptions of normality and/or homogeneity of variance. In the few situations where the parametric assumptions were met the more powerful parametric technique was used to test for differences. All differences reported use a significance level of $\alpha=0.05$. Sample sizes are not equal for all questions because not all respondents answered all questions. Percentages given are the valid percentages for respondents who answered the question unless otherwise specified.

Special calculations and data transformations

Specific questions required special transformations and/or calculations for interpretation purposes and are presented below.

Procedures for Estimating percentage losses and dollar values of crop losses to deer:

Field/row crops

Crops were not identified by variety nor were individuals asked to report how they marketed their crops; therefore assumptions had to be made concerning the appropriateness of using the mean reported price per unit in estimating loss values. It was assumed that all losses reported in the same units (i.e. bushels, tons, hundred weights, etc.) were marketed in the same fashion or had the same equivalent value if kept on farm even though not all producers reported prices received. Applying the mean reported price per unit to individually reported losses did not seem appropriate because it was likely that some producers had more marketing opportunities than others which would have meant that the losses would have been either over or underestimated. This associated error further made it inappropriate to total each farmer's reported losses in a final dollar value for all crops combined. However, it seemed appropriate to apply the mean reported price per units to the median per farm units lost to obtain an estimate of the dollar value lost per farm for each crop type.

To estimate the dollar value of field and row crops lost to deer in 1994, the reported bushel, ton, or hundred weight loss to deer for each crop (Question #7) was multiplied by the mean price received for the crop in 1994 as reported by the producers in response to question number 21 on the questionnaire. It must be noted that because of producer abilities to market their products in different ways (i.e. futures, different elevators, cash market, etc.) dollar values reported may not accurately represent the value lost by producers. However, as an approximate measure for comparison of value lost by producers it is believed that the estimates are useful. Percentage losses of field/row crops

were calculated by dividing the production units of the crop lost to deer (Question #7) by the product of the acres planted in the crop (Question #7) and the average per acre yield of the crop.

Non-bearing fruit tree losses

To estimate the dollar value of non-bearing fruit tree losses, the reported number of non-bearing trees damaged by deer was multiplied by the estimated cost of replacing a single tree. The assumption was made that all trees reported as damaged by deer had to be replaced. Though some trees may not have been replaced, trees that were not replaced would have required extra care and pruning to restore them to usable condition. Thus, even though a damaged tree may not have been replaced it's extra care would still represent a financial cost to the farmer. The cost of caring for damaged trees could not be estimated without knowing the extent of damage to individual trees. Thus, the cost of replacing the tree was applied to the total number of trees the respondent indicated as damaged by deer. This method of estimating the dollar value of damage done to non-bearing trees was also supported by conversations with orchardists who indicated that trees that were once damaged by deer are often damaged again later, such that the tree will likely need to be replaced at a later date. The estimated cost of replacing a single tree was estimated using equipment and labor figures provided in 1989 MSU-E bulletins on the costs of producing apples (Kelsey and Schwallier 1989), cherries (Kelsey et al. 1989a), and peaches (Kelsey et al. 1989b), and tree cost figures from the 1995-96 price list of Hilltop Nurseries Hartford, MI. Hilltop Nurseries was used because they are a major provider of trees to the Michigan fruit industry, and because their prices

were reportedly representative of the general nursery market (Jim Nugent, Sutton's Bay Agricultural Experiment Station director, pers. comm.). Michigan State University Extension recommends that replants be at least 5/8" in diameter (Nugent and Bardenhagen, pers. comm.), therefore tree costs of this size were used assuming a bulk order of 100 trees. It is possible for producers to reduce the per tree price by purchasing still larger quantities; however, it is less likely that such orders will be made after the initial block establishment. The stated cost of replacing trees in the bulletins was divided by the number of trees to obtain a cost per tree figure for equipment and labor. Tree, equipment, and labor costs were adjusted to 1994 dollars using the 1982 base year producer price index for all commodities. Percentage losses to non-bearing fruit trees were estimated by dividing the reported number of trees damaged by deer (Question #10) by the product of the acres planted in the crop and the average number of trees planted per acre (Question #10). No allowance was made for future income lost due to delays in bringing trees into production. Production delays can have a significant impact on producers' profitability and would best be addressed by an agricultural economist. Losses calculated here represent only the replacement costs of trees.

Bearing age fruit tree losses

Bearing age fruit tree losses were calculated by multiplying the reported yield lost (Question #10) by the 1994 mean fruit price reported by producers in response to question number 21 on the questionnaire. Percentage production losses were estimated for bearing age fruit trees by dividing the estimated number of pounds lost to deer in 1994 by the product of average yield per acre and the number of acres in production (Question #10).

Christmas tree losses

Christmas trees that were reported damaged by deer were assumed to be unmarketable and therefore were priced at the mean price of a Christmas tree in 1994 as reported by producers in response to question number 21. A better estimate of loss would have been possible if the species and age of the damaged trees were known, however, this information was not collected on the questionnaire. Consequently the reported dollar value losses for Christmas trees should be viewed with caution.

Special permit favorability scales:

Because of space farmers were not asked explicitly to indicate their approval or disapproval of shooting and block permits; however, a measure of the favorability toward each of the two types of permits among farmers was obtained using summated scales created from attitudinal items about each permit type. The scale of favorability towards shooting permits was constructed from 5 items (50a, b, d, f, h) (Question #50). A reliability analysis using Cronbach's alpha ($\alpha = 0.71$) was performed which indicated that this combination of items was more appropriate for measuring the construct of favorability than other combinations of the items probing shooting permit attitudes. These five items were measured on a 5 point Likert scale where 1 = strongly agree, 3 = undecided, and 5 = strongly disagree. Items were recoded 2 to -2 to reflect the positive or negative favorability of the response items and then summed and the mean taken. A scale of favorability towards block permits was similarly constructed from 4 items (50i, j, l, n) (Question #50) and had a reliability coefficient of $\alpha = 0.70$. Even though the reliability coefficients indicate that the variables included in the scales measure a

construct better than the other variables considered, the validity of this measurement of favorability towards these two permit systems should be viewed cautiously as factors not measured may also determine whether producers are favorable approving of the permit systems.

Biologist, agent, and agency credibility scales:

Summated scales were also constructed to approximate the credibility that the MDNR and MSU-Extension have with farmers. Trust and competence were the two aspects of credibility that were measured. It is assumed that if an individual trusts an agency and believes an agency competent that the agency is then deemed credible by the individual. It is possible, however, that the measurement items are invalid and these scales should be viewed cautiously. Likert scales used were 1= strongly agree, 3= undecided, and 5= strongly disagree. These were recoded to reflect positive and negative favorability of the response items. Response scores were summed and averaged to obtain an index of credibility where -2 was the lowest possible credibility score, 0 was undecided, and +2 was the greatest possible credibility score. A three item scale consisting of items 61d,e, and f (Cronbach's alpha = 0.8305) was constructed to evaluate the credibility of local MDNR biologists among farmers. A two item scale consisting of items 61b and c (Cronbach's alpha = 0.7841) was constructed to obtain an indication of the credibility of the MDNR agency among farmers. A three item scale consisting of items 64a, b, and c (Cronbach's alpha=0.9257) probed producer perceptions of the credibility of local county extension agents.

Fairness of perceived MDNR stakeholder weightings:

Question 62 on the questionnaire assessed farmers' perceptions regarding the relative amount of consideration the MDNR was awarding to farmer and hunter interests when setting deer management objectives. It also asked farmers to indicate what weight they preferred to be assigned to farmer and hunter interests by the MDNR. To obtain an index of producer attitudes about the fairness of MDNR weightings, producer perceptions of the current MDNR weightings were compared to desired MDNR weightings to produce a ratio. It was assumed that producers who perceived the current MDNR weightings as fair would desire no change in weightings for the future, and that producers who perceived the current weighting of farmers as unfair would desire an increase in the farmer weighting for the future. It was also assumed that producers who desired a decrease in the farmer weighting considered the current weighting of farmer interests as "more than fair" to agricultural interests. Thus, a measure of the perceived fairness of MDNR weightings of stakeholders interests regarding deer population objectives was created by first dividing perceived and most desired farmer weights by hunter weights, and then subtracting the ratio of "desired" weights from the ratio of "perceived" weights.

As an equation:

$$\begin{aligned} &\text{Perceived fairness of current MDNR weighting of farmer interests} \\ &= \\ &(\text{PCF/PCH}) - (\text{DFF/DFH}) \end{aligned}$$

where:

Perceived current weighting of farmer interests = PCF

Perceived current weighting of deer hunter interests = PCH

Desired future weighting of farmer interests = DFF

Desired future weighting of deer hunter interests = DFH

If the result was ≥ 1 then the current weightings were assumed to be fair or in favor of the farmer. If the result was < 1 then the current weightings were assumed not to be fair or in favor of the farmer. Thus, a nominal measure was created to assess the fairness of the perceived MDNR weighting of stakeholder interests.

Tolerance of losses:

In this study we sought to account for some of the variance in dollar losses tolerated by farmers in others studies, but just as importantly to make the tolerance measures used by other studies (Brown et al. 1978, Stoll and Mountz 1983) more operational. We felt that the words “light”, “moderate”, “tolerable”, “unreasonable”, “moderate” and “severe” utilized by these earlier studies to describe loss severity and producer tolerance of loss were not practical, because they did not give us any information about intended producer responses. It was felt that these measures would be more useful to managers if they were descriptive of the type of action that a producer would take in response to the loss.

We therefore created a 3 tiered measure of tolerance suggested by Minnis and Peyton (1995) that was based on the producers desire to take “corrective action” to

change their loss situation. It was hypothesized that losses could either be a problem or not a problem. Problematic losses could be either tolerable or intolerable. Tolerable losses include both producers who sustain losses which are problematic but are endured because of offsetting benefits derived from having deer around, and also producers who maintain tolerable losses because they prevent the losses from being more severe.

Intolerable losses are those loss amounts at which a producer must go beyond their current efforts to maintain an acceptable level of crop loss or that threshold level of loss which they can no longer tolerate. It is important that the reader recognize that at some point intolerance expresses itself as action and that being able to predict this action is more useful to an agency than is knowing that the farmer considers his losses moderate.

To enable agencies to be more proactive in managing deer damage issues, we sought to identify those amounts of loss at which disruptive activity will occur and those at which agencies should begin managing to prevent the issue from reaching a disruptive point.

Thus, we defined tolerance as “Not a problem”, “A tolerable problem, no action to reduce losses to be taken”, and “An intolerable problem, action to reduce losses will be taken”.

RESULTS

Organization of this section: Because of the diverse nature of the questions posed to producers and the exploratory nature of this survey a non-traditional format is used in presenting the results of this study. So that results are fresh in reader's minds, major management implications and recommendations are presented immediately following many of the sections. Broader implications and recommendations that cut across result sections are reserved for the Discussion. It is hoped that this format will aid the reader by reducing the amount of time required to reference tables and figures in evaluating the implications and recommendations of this research. Throughout this section readers are referred to the question numbers of the questionnaire; unless otherwise noted these question #'s are found in Appendix 1.

Non-response

A total of 48% of the 2134 mailed questionnaires were not returned. Of the 52% who returned questionnaires only 595 met the criteria of being a full- or part-time farmer with greater than 1 acre in a study county. This was almost 25% less than the pilot survey conducted in Isabella County. (Full-time farmers were defined for this survey as individuals who spent > 50% of their working time engaged in farming activities, while part-time farmers were defined as those individuals who spent < 50% of their working time engaged in farming activities.) The usable response rate was therefore quite low (37%). It was not known prior to the survey which contacts from the initial sample were full- and part-time farmers. However, the non-response follow-up revealed no differences in the proportions of full- and part-time farmers vs. non-farmers and retirees

that had and had not returned the survey (Table 7). Therefore it can reasonably be assumed that approximately 52% of the targeted full-time and part-time farmers in the sample had responded.

Table 5: Initial sample size, returns, and response rates by county.

County	Returned surveys	Non-deliverables	Initial sample size	County response rate
Calhoun	281	38	545	0.55
Montcalm	170	16	329	0.54
Oceana	179	12	379	0.49
Benzie	47	1	100	0.47
Leelanau	163	3	263	0.63
Presque Isle	126	20	318	0.42
Menominee	93	3	200	0.47
Total	1059	93	2134	0.52

Table 6: Non-response telephone follow-up contacts.

County	Total called	Number contacted	% of non-respondents contacted
Calhoun	45	32	14.2
Montcalm	40	34	23.8
Oceana	36	29	15.4
Benzie	24	18	34.6
Leelanau	40	26	26.8
Presque Isle	58	35	20.3
Menominee	37	31	29.8
Totals:	280	205	20.9

Table 7: Comparison of job status between respondents and non-respondents.

	n	Full-time farmers %	Part-time farmers %	Retired/Non-farmers %	
Survey respondents	901	45.3	20.8	34.0	100%
Non-respondents	191	41.4	17.3	41.4	100%
$\chi^2=3.93$, df 2, p=0.139					

Because counties were selected to represent a range of attitudes and crop damage situations it was assumed that a non-response analysis should focus on the county level. In all counties there were no differences between respondents and non-respondents in the proportion of farmers requesting permits to kill deer, nor were there any differences

between respondents' and non-respondents' dependence on farm income (Tables 11 & 12). In all counties there were no differences in respondent and non-respondent attitudes about the number of deer in the respective counties; most felt there were too many (Table 9). Finally, there were no differences of opinion between respondents and non-respondents over the amount of consideration hunting and farming interests should receive from the MDNR when they set deer management objectives (Table 14).

Respondents were found to differ from non-respondents in terms of farm size, tolerance of 1994 crop losses, hunting participation, and perceptions of current MDNR weightings of stakeholder interests, but each of these differences appeared in no more than a single county. Farm sizes were larger among respondents than among non-respondents in the Benzie/Leelanau study area (Table 11), and non-respondents were more likely to indicate that the MDNR was either favoring farmers or weighting interests equally in the county (Table 13). Presque Isle county non-respondents also more frequently indicated that the agency was favoring farmers and/or weighting interests more equally than did respondents from that county (Table 13). The percent of producers who hunted differed between respondents and non-respondents in Montcalm county where 75% of the survey respondents deer hunted, while 47% of the non-respondents deer hunted (Table 10).

Respondents from this county also more frequently indicated intolerance of losses to the point of taking action than did non-respondents; however, there was no difference in attitudes about the numbers of deer in the county (Tables 8 & 9). It should be pointed out that respondents to the less personal mail questionnaire may have been more willing to express an extreme view than they would have if interviewed personally over the

telephone as were non-respondents; thus, I am cautious in assuming that the Montcalm County was biased in favor of the less tolerant of crop losses.

Table 8: Comparison of tolerance of 1994 crop losses between respondents and non-respondents by county.

		n	Not a problem %	Tolerable %	Intolerable %	
Calhoun	Survey respondents	128	32.0	39.8	28.1	100%
	Non-respondents	16	56.3	31.3	12.5	100%
	$\chi^2=3.99$, df 2 , p=0.136					
Montcalm	Survey respondents	101	30.7	35.6	33.7	100%
	Non-respondents	15	20.0	80.0	0.0	100%
	$\chi^2=11.77$, df 2 , p=0.003					
Oceana	Survey respondents	112	30.4	20.5	49.1	100%
	Non-respondents	15	33.3	20.0	46.7	100%
	$\chi^2=0.056$, df 2, p=0.972					
Benzie/Leelanau	Survey respondents	121	27.3	30.6	42.1	100%
	Non-respondents	23	34.8	43.5	21.7	100%
	$\chi^2=3.44$, df 2, p=0.179					
Presque Isle	Survey respondents	48	25.0	37.5	37.5	100%
	Non-respondents	13	38.5	53.8	7.7	100%
	$\chi^2=4.25$, df 2, p=0.119					
Menominee	Survey respondents	61	1.6	23.0	75.4	100%
	Non-respondents	17	5.9	17.6	76.5	100%
	$\chi^2=1.11$, df 2, p=0.575					

Table 9: Comparison of tolerance of 1994 deer numbers between respondents and non-respondents by county.

		n	Too few %	Satisfactory %	Too many %	
Calhoun	Survey respondents	124	8.9	32.3	58.9	100%
	Non-respondents	16	6.3	31.3	62.5	100%
	$\chi^2=0.15$, df 2, p=0.928					
Montcalm	Survey respondents	97	14.4	32.0	53.6	100%
	Non-respondents	15	6.7	26.7	66.7	100%
	$\chi^2=1.10$, df 2, p=0.576					
Oceana	Survey respondents	105	14.3	35.2	50.5	100%
	Non-respondents	16	12.5	31.3	56.3	100%
	$\chi^2=0.18$, df 2, p=0.911					
Benzie/Leelanau	Survey respondents	118	10.2	37.3	52.5	100%
	Non-respondents	23	0.0	47.8	52.2	100%
	$\chi^2=2.89$, df 2, p=0.236					
Presque Isle	Survey respondents	48	12.5	33.3	54.2	100%
	Non-respondents	13	7.7	53.8	38.5	100%
	$\chi^2=1.84$, df 2, p=0.397					
Menominee	Survey respondents	59	0.0	6.8	93.2	100%
	Non-respondents	17	0.0	17.6	82.4	100%
	$\chi^2=1.86$, df 2, p=0.374					

Table 10: Comparison of hunting participation between respondents and non-respondents by county.

		n	Non-Hunt %	Hunt %	
Calhoun	Survey respondents	130	40.8	59.2	100%
	Non-respondents	16	56.3	43.8	100%
	$\chi^2=0.84$, df 1, p=0.361				
Montcalm	Survey respondents	97	24.7	75.3	100%
	Non-respondents	15	53.3	46.7	100%
	$\chi^2=3.89$, df 1, p=0.048				
Oceana	Survey respondents	108	26.9	73.1	100%
	Non-respondents	16	50.0	50.0	100%
	$\chi^2=2.54$, df 1, p=0.110				
Benzie/Leelanau	Survey respondents	124	30.6	69.4	100%
	Non-respondents	23	52.2	47.8	100%
	$\chi^2=3.10$, df 1, p=0.078				
Presque Isle	Survey respondents	49	14.3	85.7	100%
	Non-respondents	13	30.8	69.2	100%
	$\chi^2=0.95$, df 1, p=0.329				
Menominee	Survey respondents	61	34.4	65.6	100%
	Non-respondents	17	35.3	64.7	100%
	$\chi^2=0.00$, df 1, p=1.000				

Table 11: Comparison of farm size and dependence on farm income between respondents and non-respondents by county. Farm size is the sum of owned and rented acres. Dependence on farm income represented as percentage of household gross income generated by farming.

		n	Mean farm size in acres (s.d.)	n	Mean % of gross income from farming (s.d.)
Calhoun	Survey respondents	82	586 (613)	11 5	71 (94)
	Non-respondents	16	493 (410)	15	59 (35)
	Mann-Whitney		Z=-0.408, P=0.682		Z=-0.158, P=0.874
Montcalm	Survey respondents	78	880 (732)	94	68 (36)
	Non-respondents	15	947 (789)	13	82 (24)
	Mann-Whitney		Z=-0.251, P=0.802		Z=-0.962, P=0.336
Oceana	Survey respondents	73	420 (430)	10 0	59 (33)
	Non-respondents	15	336 (423)	15	47 (35)
	Mann-Whitney		Z=-1.604, P=0.109		Z=-1.193, P=0.233
Benzie/Leelanau	Survey respondents	72	311 (340)	11 1	56 (36)
	Non-respondents	23	202 (228)	23	68 (33)
	Mann-Whitney		Z=-2.163, P=0.031		Z=-1.626, P=0.104
Presque Isle	Survey respondents	39	481 (421)	42	63 (37)
	Non-respondents	13	475 (438)	13	69 (36)
	Mann-Whitney		Z=-0.148, P=0.882		Z=-0.830, P=0.406
Menominee	Survey respondents	54	590 (387)	57	81 (28)
	Non-respondents	17	816 (615)	17	84 (23)
	Mann-Whitney		Z=-1.596, P=0.110		Z=-0.490, P=0.624

Table 12: Comparison of proportions of respondents and non-respondents by county who have requested special permits from the MDNR to shoot depredating deer.

		n	Percent who have requested permits	Percent who have never requested permits	
Calhoun	Survey respondents	129	79.8	20.2	100%
	Non-respondents	16	93.8	6.3	100%
	$\chi^2=1.01$, df 1, p=0.314				
Montcalm	Survey respondents	101	71.3	28.7	100%
	Non-respondents	15	80.0	20.0	100%
	$\chi^2=0.15$, df 1, p=0.693				
Oceana	Survey respondents	112	60.7	39.3	100%
	Non-respondents	16	62.5	37.5	100%
	$\chi^2=0.00$, df 1, p=1.000				
Benzie/Leelanau	Survey respondents	124	54.0	46.0	100%
	Non-respondents	23	47.8	52.2	100%
	$\chi^2=0.10$, df 1, p=0.748				
Presque Isle	Survey respondents	51	49.0	51.0	100%
	Non-respondents	13	53.8	46.2	100%
	$\chi^2=0.00$, df 1, p=1.000				
Menominee	Survey respondents	62	11.3	88.7	100%
	Non-respondents	17	11.8	88.2	100%
	$\chi^2=0.00$, df 1, p=1.000				

Table 13: Comparison of respondent and non-respondent perceptions of MDNR current weightings of stakeholders in deer management decisions by county.

		n	Hunters and Farmers weighted equally %	MDNR favors Farmers %	MDNR favors Hunters %	
Calhoun	Survey respondents	99	32.3	4.0	63.6	100%
	Non-respondents	12	33.3	0.0	66.7	100%
	$\chi^2=0.50$, df 2, p=0.777					
Montcalm	Survey respondents	86	30.2	5.8	64.0	100%
	Non-respondents	13	46.2	0.0	53.8	100%
	$\chi^2=1.82$, df 2, p=0.401					
Oceana	Survey respondents	91	31.9	9.9	58.2	100%
	Non-respondents	11	45.5	18.2	36.4	100%
	$\chi^2=2.01$, df 2, p=0.366					
Benzie/Leelanau	Survey respondents	106	30.2	8.5	61.3	100%
	Non-respondents	19	57.9	0.0	42.1	100%
	$\chi^2=6.23$, df 2, p=0.044					
Presque Isle	Survey respondents	35	22.9	2.9	74.3	100%
	Non-respondents	10	20.0	30.0	50.0	100%
	$\chi^2=7.14$, df 2, p=0.028					
Menominee	Survey respondents	54	24.1	9.3	66.7	100%
	Non-respondents	17	52.9	0.0	47.1	100%
	$\chi^2=5.85$, df 2, p=0.053					

Table 14: Comparison of respondent and non-respondent desired MDNR weightings of stakeholders in deer management decisions by county.

		n	Hunters and Farmers should be weighted equally	MDNR should favor Farmers	MDNR should favor Hunters	
Calhoun	Survey respondents	103	49.5	42.7	7.8	100%
	Non-respondents	11	63.6	36.4	0.0	100%
	$\chi^2=1.34$, df 2, p=0.512					
Montcalm	Survey respondents	87	47.1	36.8	16.1	100%
	Non-respondents	14	35.7	64.3	0.0	100%
	$\chi^2=4.85$, df 2, p=0.088					
Oceana	Survey respondents	91	37.4	41.8	20.9	100%
	Non-respondents	12	66.7	33.3	0.0	100%
	$\chi^2=4.92$, df 2, p=0.085					
Benzie/Leelanau	Survey respondents	110	41.8	43.6	14.5	100%
	Non-respondents	21	61.9	38.1	0.0	100%
	$\chi^2=4.76$, df 2, p=0.092					
Presque Isle	Survey respondents	35	42.9	45.7	11.4	100%
	Non-respondents	8	25.0	62.5	12.5	100%
	$\chi^2=0.91$, df 2, p=0.635					
Menominee	Survey respondents	55	43.6	54.5	1.8	100%
	Non-respondents	15	46.7	53.3	0.0	100%
	$\chi^2=0.30$, df 2, p=0.860					

Generalizability of results --

The sampling was such that results from this study should not be generalized to the greater population of Michigan farmers. I have no knowledge of how many farmers were not included on Extension mailing lists for any county, nor whether there are inherent bias' among those farmers who are on Extension mailing lists. Extension agents believed that their lists captured the majority (>80%) of farmers in their counties. Their appraisals suggest that the survey was inclusive enough to fairly represent the views and

concerns of growers of different crop types in our study counties; however, readers are cautioned not to attribute precise frequencies to the greater population of Michigan farmers.

Farmer Respondent Profile

The typical farmer respondent averaged 53 years old (Table 19), had a high-school diploma and some college or technical training (Table 15), had farmed in a study county for approximately 30 years (Table 17), earned 64% of their household gross income farming, and had a gross household income between \$25,000 and \$75,000 (Table 12). Sixty-nine percent of the respondents were full-time farmers, meaning they spent >50% of their working time engaged in farming activities. Oceana county had the lowest proportion of full-time farmers (60%), while Menominee county had the highest proportion with 87% (Table 16). Farmers from the Benzie/Leelanau area had been farming for the least number of years in the respective county (mean = 26.5 years), whereas Calhoun and Montcalm farmers had been farming for an average of 33 years (Table 17). Most producers (70%) deer hunt themselves (Table 22), and 50% of those that deer hunt indicated that deer hunting was more important than most other recreational activities in which they participate (Table 18).

Table 15: Education completed by respondents.

	n	% of respondents
No schooling	1	0.2
Less than 9th. grade	21	3.7
Some high school	33	5.8
High school diploma/GED	202	35.5
Some college or technical school	150	26.4
BA, BS, AB	116	20.4
MA, Ph.D., MD	46	8.1
	569	100%

Table 16: Number of full-time and part-time producer respondents per county.

County	n	Full-time	Part-time	
Calhoun	133	64%	36%	100%
Montcalm	104	73%	27%	100%
Oceana	115	60%	40%	100%
Benzie/Leelanau	128	69%	31%	100%
Presque Isle	52	67%	33%	100%
Menominee	63	87%	13%	100%
$\chi^2=16.53$, df 5, $p<0.006$				

Table 17: Respondents' mean years farming in same county.

	n	Mean years farming in county (s.d.)
Calhoun	129	33.2 (17.3)
Montcalm	103	33.3 (14.9)
Oceana	111	27.3 (15.5)
Benzie/Leelanau	123	26.6 (15.2)
Presque Isle	48	30.6 (16.8)
Menominee	59	27.7 (13.8)
Overall	573	29.8 (15.9)
$\chi^2=21.00$, df 5, $p<0.001$		

Table 18: Centrality of hunting as recreation to respondents.

	n	% of respondents
Most important recreational activity in which I participate	86	25.4
More important than most other recreational activities in which I participate	83	24.5
About as important as other recreational activities in which I participate	111	32.7
Less important than other recreational activities in which I participate	42	12.4
Not at all important to me	17	5.0
Overall	339	100%

Farm sizes were calculated by adding total reported acres owned and rented (including farmsteads and non-crop lands). Mean farm sizes differed by county, with fruit counties (Oceana and Benzie/Leelanau) having smaller farms (mean =322 acres and 250 acres respectively) than all other counties. Presque Isle county had the smallest mean farm size (420 acres) of the non-fruit counties, while Montcalm county had the largest mean size (702 acres) (Table 19).

Table 19: Age and farm size of respondents by county.

County	n	Mean Age in years x (s.d.)	n	Mean farm size in acres (Owned+Rented) x (s.d.)
Calhoun	127	53.7 (12.4)	133	477.3 (577.5)
Montcalm	102	53.0 (11.6)	104	703.0 (707.3)
Oceana	109	50.3 (11.2)	115	323.0 (376.4)
Benzie/Leelanau	122	54.2 (12.3)	128	250.7 (292.6)
Presque Isle	48	52.4 (13.9)	52	420.9 (383.2)
Menominee	56	50.4 (10.9)	63	557.7 (384.7)
Overall	564	52.6 (12.1)	595	441.7 (508.6)
		Kruskal-Wallis $\chi^2=8.99$, df 5, p=0.109		Kruskal-Wallis $\chi^2=80.90$, df 5, p<0.001

Farms were classified as being primarily oriented towards livestock, cash crops, or tree products if farmers indicated that $\geq 75\%$ of their farm sales were of one of these categories. Farms were designated as “mixed” if the primary orientation accounted for $<75\%$ farm sales and a second category was responsible for $> 25\%$ of their farm sales. Twenty farms could not be categorized by this scheme because these respondents did not indicate sales that totaled 100%. The question may have been interpreted as percent of “income” or the three sales categories may not have captured the orientation of the farm; for instance, if the farm was a horse boarding facility. As was expected by design, significant differences in farm type existed across counties (Table 22).

The majority (59%) of producers in this study had never requested either shooting or block permit assistance from the MDNR. Twenty-nine percent had requested shooting permits at some time in the past and 33% had requested block permits. Of those who had requested block permits 62% had requested them in 1994. Of those who had requested shooting permits 36% had requested them in 1994. Among those who requested shooting permits the mean number of years requested was 4.1 (s.d. =3.1, n=150). Among those who requested block permits the mean number of years requested was 3.4 (s.d. =1.9, n=178).

Approximately 60% of the respondents were members of the Michigan Farm Bureau, 21% were members of other farming organizations and 12% were members of conservation organizations. The United Farmers' Union, Michigan Horticultural Society, and Michigan Milk Producers' Association were the three most frequently identified farm organizations apart from Farm Bureau. Michigan United Conservation Clubs was the most frequently identified conservation organization to which producers belonged, followed by Pheasants Forever and the National Rifle Association. Other organizations identified ranged from The Nature Conservancy to local rod and gun clubs (Tables 20 & 21).

Table 20: Number of respondents indicating memberships in various farm organizations.

Farm Organization	Number of respondents
Farm Bureau	358
United Farmers Union	21
Grange	7
Michigan Pork Producers	5
Michigan Horticultural Society	15
Michigan Cattlemen	4
National Cattlemen	3
Michigan Herb Association	2
MASA	2
Soil and Water Conservation Districts	8
DHIA	4
Michigan Milk Producers Association	14
Michigan Crop Improvement	3
AAM	3
Michigan Christmas Tree Growers	3
South Albion Progressive Farmers	1
Mason-Oceana Pomsters	8
MACMA	7
Michigan Vegetable Council	1
Michigan Potato Growers	2
PCA	1
Michigan Livestock Exchange	2
OGM	1
Michigan Nut Growers	1
Future Farmers of America	1
National Farm Organization	2
Growing U.P. Association	1
Michigan Soybean Association	1
MABC	1
IDFTA	1
Maple Syrup Producers	1
Holstein Association	1

Table 21: Number of respondents indicating memberships in various conservation organizations.

Conservation Organization	Number of respondents
Michigan United Conservation Clubs	38
Nature Conservancy	4
National Rifle Association	6
North American Hunting Club	2
Pheasants Forever	10
Ducks Unlimited	6
National Wildlife Federation	4
Suttons Bay Conservation Club	3
Michigan Wildlife Habitat Foundation	1
Tamarack Sportsmen's Club	1
Betsie River Res.	1
World Wildlife Fund	1
Safari Club International	1
The Wildlife Society	1
Wilder Creek Conservation Club	1
Michigan Hunting Dog Federation	1
Kellogg Sportsmen's Club	1
Rocky Mountain Elk Foundation	2
Hart Area Sportsmen's Club	1
National Audubon Society	1
Ruffed Grouse Society	1
National Parks Association	1
Rails to Trails Association	1
National Trappers Association	2
Michigan Trappers Association	2
White-tails Unlimited	1
Drummond Island Sportsmen's Club	1
National Arbor Day	1
American Farmland Trust	1
Sierra Club	1

Table 22: Farmer Respondent County Demographics -- Hunting participation, Farm type, Gross income, Education. Percent of respondents from each county who fall into each category. (%)

		Calhoun	Montcalm	Oceana	Benzie/ Leelanau	Presque Isle	Menominee
	n =	130	97	108	124	49	61
Hunting participation ($\chi^2=15.24$, df 5, $p=0.009$)							
Non-hunter		40.8	24.7	26.9	30.6	14.3	34.4
Hunter		59.2	75.3	73.1	69.4	85.7	65.6
		100%	100%	100%	100%	100%	100%
Farm type ($\chi^2=278.33$, df 25, $p<0.001$)	n =	120	99	107	117	50	59
Livestock		17.5	20.2	8.4	8.5	42.0	62.7
Cash crops		39.2	40.4	24.3	6.0	28.0	3.4
Fruit/trees		3.3	6.1	23.4	56.4	0.0	0.0
Livestock mixed		8.3	4.0	3.7	1.7	4.0	3.4
Cash crop mixed		19.2	15.2	19.6	17.9	14.0	8.5
Fruit/tree mixed		12.5	14.1	20.6	9.4	12.0	22.0
		100%	100%	100%	100%	100%	100%
Education completed ($\chi^2=65.13$, df 30, $p<0.001$)	n =	127	101	110	123	49	59
None		0.0	0.0	0.0	0.0	0.0	1.7
<9th. grade		1.6	4.0	3.6	4.9	8.2	1.7
Some high school		6.3	5.0	6.4	2.4	16.3	3.4
High diploma/GED		42.5	41.6	25.5	23.6	40.8	49.2
Some college or tech. school		25.2	22.8	32.7	26.8	26.5	22.0
BA, BS, AB,		17.3	19.8	23.6	27.6	4.1	20.3
MA, Ph.D., MD		7.1	6.9	8.2	14.6	4.1	1.7
		100%	100%	100%	100%	100%	100%
Gross income ($\chi^2=51.29$, df 35, $p=0.037$)	n =	110	87	94	108	43	56
<\$ 10,000		10.9	1.1	4.3	3.7	4.7	3.6
\$ 10,000-14,999		5.5	4.6	4.3	3.7	2.3	7.1
\$ 15,000-24,999		8.2	9.2	10.6	10.2	23.3	17.9
\$ 25,000-34,999		15.5	11.5	14.9	19.4	11.6	16.1
\$ 35,000-49,999		17.3	19.5	19.1	17.6	32.6	12.5
\$ 50,000-74,999		20.9	19.5	24.5	16.7	2.3	8.9
\$ 75,000-99,999		10.0	8.0	5.3	9.3	4.7	14.3
> \$ 100,000		11.8	26.4	17.0	19.4	18.6	19.6
		100%	100%	100%	100%	100%	100%

Levels of Crop Loss Tolerance

Producer tolerance of crop loss (Question #13) served as both a dependent and independent variable in this study, and levels of crop loss tolerance serve as the basis for much segmentation throughout this thesis. This first section treats crop loss tolerance as a dependent variable to illustrate how certain demographic factors are related to crop loss tolerance. Later sections then use crop loss tolerance as an independent variable by which to examine other variables. There are numerous correlations between farm type and county by design, in addition to correlations between county, crop damage issue history, and deer density. Where sample size allowed, I attempted to control for such correlations; however, this was not always possible. It is important that the reader be aware of these frequent correlations because it is possible that a combination of these factors is responsible for differences in attitudes among producer segments.

Cumulative Tolerance of Loss

Producers were asked to evaluate their cumulative 1994 losses caused by deer by indicating their relative tolerance of the losses; were the losses a problem and would they take action to reduce comparable losses in the future? Those producers who earned a greater percentage of their household gross income from farming were more likely than producers with less dependence on farming to indicate that their 1994 losses were a problem (Table 23). Similarly, full-time farmers more frequently indicated that their losses were intolerable (Table 25). Menominee County producers almost unanimously agree that 1994 losses were intolerable, while other producers from other counties were more evenly distributed across tolerance categories (Table 25).

Implications/Recommendations

Fruit growers, fruit growing counties, and Menominee County appear to include more intolerant producers than other groups. The agency may find that annual monitoring of this balance between “Not a problem” and “Intolerable” losses is useful for prioritizing agency funds and personnel in the future. For instance, among the producers studied here, the data (Tables 23, 24 & 25) suggest that the agency pay particular attention to addressing the concerns of fruit growers, full-time farmers, and farmers in Menominee County because of the skewed distribution of frequencies. The tendency for full-time farmers to be less tolerant should also be communicated to hunting factions so that they understand that crop damage is a major concern of those whose livelihood depends on farming.

Table 23: Farmer respondents’ tolerance of 1994 crop losses, and associated mean percent of gross income generated by farming.

	n	% of producers	n	Mean % of gross income from farming
Not a problem	152	26.6	130	47.9 (37.5)
Tolerable	179	31.3	158	64.3 (35.9)
Intolerable	240	42.0	215	73.2 (31.0)
	571	100%	503	(Kruskal-Wallis $\chi^2=33.93$, df 2, $p<0.001$)

Table 24: Farmer respondent tolerance of 1994 crop losses by mean farm size in acres (owned and rented).

	n	Mean farm size in acres (owned and rented)
Not a problem	152	346.3 (532.3)
Tolerable	179	424.5 (469.2)
Intolerable	240	513.7 (501.6)
Total	571	441.1 (503.9)
F= 5.35, df 2, p=0.005		

Table 25: Farmer attitudes about 1994's deer crop losses, by county, farm type, and job status.

		n	1994 Not a problem %	1994 Losses were a tolerable problem %	1994 Losses were intolerable and I am going to take action to reduce the losses. %	
County ($\chi^2=51.99$, df 10, p<0.001)	Calhoun	128	32.0	39.8	28.1	100%
	Montcalm	101	30.7	35.6	33.7	100%
	Oceana	112	30.4	20.5	49.1	100%
	Benzie/Leelanau	121	27.3	30.6	42.1	100%
	Presque Isle	48	25.0	37.5	37.5	100%
	Menominee	61	1.6	23.0	75.4	100%
Farm type ($\chi^2=18.85$, df 10, p<0.042)	Livestock	111	32.4	26.1	41.4	100%
	Cash crops	133	28.6	35.3	36.1	100%
	Fruit/trees	98	21.4	23.5	55.1	100%
	Livestock mixed	24	12.5	54.2	33.3	100%
	Cash crop mixed	87	21.8	34.5	43.7	100%
	Fruit/trees mixed	79	22.8	34.2	43.0	100%
Job status ($\chi^2=48.11$, df 2, p<0.001)	Full-time	392	19.1	30.4	50.5	100%
	Part-time	179	43.0	33.5	23.5	100%

Reported Crop Losses Due to Deer in 1994

In this section dollar values of 1994 crop losses are estimated from data provided by producers (Questions #7 and #10). These estimates were made to analyze producer tolerance levels comparable with other studies of tolerance (Brown et al. 1978, Stoll and Mountz 1983). Dollar values estimated were not designed to be used to establish economic parameters for qualifying for crop damage assistance programs. Calculations used to estimate percentage and dollar losses to crops are explained in the Methods chapter.

1994 Row and Field Crop Losses

Four-hundred and forty-two farmers indicated that they grew row or field crops for sale or feed in 1994. The most commonly grown crops were corn, alfalfa/hay, small grains, and soybeans (Table 26). Producers reported the number of acres they planted in each crop during 1994, their average yield per acre, the total losses they believed they had incurred due to deer during that year, and their tolerance of the losses to each crop type.

Though producers estimated their actual 1994 losses, percent losses were calculated by dividing reported losses (bushels, tons, etc.) by the product of average yield (bushels, tons, etc.) and total acreage planted for each crop. Calculated percent losses ranged from 0% to 100%. Median and second and third quartile values are reported because outliers made means unrepresentative and inappropriate for estimating threshold levels of tolerable and intolerable losses.

Among the different field crops grown by producers responding to our survey, table beans and corn were the most damaged crops in terms of value lost. In terms of percentage loss, table beans and alfalfa/hay were reportedly the most damaged by deer in

1994 (Table 26). The median estimated dollar value lost per farm ranged from \$547 for soybeans to \$3,135 for table beans.

Table 26: Row/field crop types grown, median per farm loss, median percent loss per farm, estimated dollar value loss to deer per farm in 1994.

Crop	n	Loss per farm				Estimated 1994 dollar value loss ^a
		1994 median loss	1994 median % loss (25th. percentile) (75th. percentile)			
Corn (bu)	131	469 bu	(1.0)	4.2	(10.1)	\$1,022.42 @ 2.18/bu
Soybeans (bu)	40	100 bu	(1.0)	4.0	(13.2)	\$ 547.00 @ 5.47/bu
Table beans (Cwts)	26	118 cwt	(3.4)	9.0	(16.0)	\$3,135.26 @ 26.57/cwt
Alfalfa/Hay (ton)	76	10 ton	(1.0)	8.5	(16.1)	\$ 834.60 @ 83.42/ton
Small grains (bu)	75	60 bu	(1.0)	4.2	(11.5)	\$ 176.40 @ 2.94/bu
Asparagus (ton)	15	<1 ton	<1			--
Potatoes (Cwts)	5	1 cwt	<1			--

^a Mean reported price per unit received by producers (Question #21) multiplied by the median loss amount.

1994 Fruit and Tree losses

Discussions with fruit growers and extension horticulture specialists indicated that growers are most sensitive to damages to, or losses of, young non-bearing fruit trees.

Losses and/or damage to mature bearing trees is less distinctive and more difficult to quantify on an annual basis. Consequently growers were asked to report their losses and tolerance for both bearing and non-bearing age fruit trees.

The number of non-bearing age trees damaged per farm varied substantially. Assuming that all damaged trees had to be replaced, the estimated replacement cost of the median number of trees lost per farm ranged from \$766 for peaches to \$1,728 for apples (Table 27). Minimal data were collected on Christmas tree losses as this survey was not

designed around this crop; Christmas tree data are reported for reference but the sample population represented only a fraction of Christmas tree growers.

Counties ranked by relative crop loss amounts

Percentage losses differed significantly by county for 4 of 5 selected crop types with Menominee county consistently having greater percentage losses than all other counties (Table 28). Estimated 1994 deer densities were highest in Menominee County (Table 28). This county also had the greatest proportion of forest to farmland (Table 2). A few producers in this county reported having stopped growing corn for grain because of the losses incurred to deer, and this was confirmed by the county agent.

Table 27: 1994 per farm losses to non-bearing fruit and Christmas trees.

Crop	n	1994 median trees damaged by deer (25th pct.) (75th pct.)	Median % of trees damaged by deer (25th pct.) (75th pct.)	Estimated 1994 replacement cost of 1 tree*	Estimated 1994 replacement cost per farm*
Apple	47	(45) 150 (325)	(4.0) 13.3 (33.1)	\$11.52	\$1,728.00
Cherry	79	(30) 100 (200)	(2.0) 6.8 (14.5)	\$11.95	\$1,195.00
Peach	14	(20) 73 (98)	(1.0) 1.6 (6.8)	\$10.50	\$ 766.50
Christmas tree	29	(0) 50 (500)	(0.0) 0.3 (4.1)	\$ 8.78	\$ 439.00

* 1994 costs per 5/8" saplings + 12 min. labor and equipment @ \$5.58. * Estimated replacement cost per tree x median trees per farm damaged by deer.

Table 28: Median percent losses and ranks of median losses by county for selected crop types.

Crop	Calhoun	Montcalm	Oceana	Benzie/Leelanau	Presque Isle	Menominee	Kruskal-Wallis test for differences in % losses
Corn	6 (1.8%)	4 (3.4%)	5 (3.3%)	3 (4.5%)	2 (8.4%)	1 (16.8%)	$\chi^2=35.78$, df 5, $p<0.001$
Soybeans	3 (4.3%)	4 (3.2%)	1 (100%)*	---	---	2 (16.7%)*	$\chi^2=4.10$, df 3, $p<0.251$
Table beans	---	3 (4.8%)	---	---	2 (15.9%)	1 (42.9%)*	$\chi^2=10.47$, df 2, $p<0.006$
Alfalfa/Hay	5 (0.4%)	3.5 (1.3%)	6 (0.3%)	3.5 (1.3%)	2 (9.1%)	1 (21.8%)	$\chi^2=30.58$, df 5, $p<0.001$
Small grains	4 (2.5%)	5 (1%)	6 (0%)	2 (9.9%)	3 (6.7%)	1 (12.9%)	$\chi^2=28.62$, df 5, $p<0.001$
Mean Rank	4.5	3.9	4.5	2.8	2.25	1.2	
MDNR Density estimates (deer/mi ²)	30-40+	30-45	± 35	10-25	35-45	30-60 (80-100 in DMU 215)	

* Only 1 producer reported losses

Tolerance of Reported 1994 Crop Loss Estimates

Farmer respondents were asked how much loss was incurred in 1994 for various crops and were then asked whether these amounts of loss were tolerable or intolerable. In evaluating threshold levels of producer tolerance of losses it was necessary to pool all counties to obtain adequate sample sizes. The reported values are median values of perceived 1994 losses that were considered tolerable and intolerable by producers. Since reported losses of both tolerable and intolerable categories varied substantially, the median values and inter-quartile range should be taken conservatively as an index of how much loss producers consider tolerable and intolerable. These values do not represent absolute threshold points.

Tolerance by Row/Field Crops

Though percent and estimated values associated with tolerable losses varied across crop types, losses of approximately 4% or of about \$500 appear to represent a problem for 50% of producers but a problem they may be willing to tolerate. Losses of approximately 11% or of about \$2,000 apparently represent an intolerable level of loss to 50% of producers (Table 29). The large inter-quartile ranges around these median values illustrates the importance of better understanding how producer characteristics affect tolerance of different amounts of loss. Unfortunately, restricted sample sizes did not allow further investigation in this study. These amounts are for individual crops. Cumulative losses to all crops grown would assumably be a better predictor of producer tolerance of lost value; however, the cumulative cost data as calculated in this study did not allow for an accurate representation of threshold levels of net value lost. It can assumed that if the value lost in a specific crop was intolerable, then the net value lost in

all crops would likely be intolerable. Unfortunately, this study was unable to determine how many producers considered their net losses intolerable, but without incurring intolerable losses to any individual crop. Using a different method of calculating lost value could provide a more reliable estimate of the net value of losses producers will tolerate.

Table 29: Per farm losses for corn, soybeans, alfalfa, table beans, small grains reported by tolerant and intolerant producers.

Crop	n	Tolerable		Intolerable		Mann-Whitney U
		Estimated '94 value of loss ^a	Median % of total crop loss (25th pct.)	Estimated '94 value of loss ^a	Median % of total crop loss (25th pct.)	% losses test for differences
Corn (grain bu)	131	\$572.25	(1.0) 2.7 (5.0)	\$2,071.00	(4.0) 9.3 (19.0)	$z = -5.52, p < 0.001$
Soybeans (bu)	40	\$273.50	(1.0) 2.0 (3.0)	\$1,367.50	(5.1) 12.5 (23.2)	$z = -3.94, p < 0.001$
Table beans (Cwts)	24	\$557.97	(0.5) 7.7 (10.0)	\$4,516.90	(4.5) 13.7 (21.5)	$z = -1.74, p = 0.081$
Alfalfa/Hay (tons)	63	\$834.20	(1.0) 4.0 (12.1)	\$4,004.16	(7.5) 12.5 (31.0)	$z = -2.90, p < 0.004$
Small grains (bu)	56	\$220.50	(1.0) 3.3 (7.5)	\$ 735.00	(7.0) 13.2 (25.9)	$z = -4.18, p < 0.001$

^a Mean reported price per unit received by producers multiplied by the median loss amount. Reliability of producer responses is questionable concerning reports of losses to alfalfa based on the rather extreme mean value calculated.

Table 30: Per farm 1994 replacement costs and numbers of trees lost to deer reported by tolerant and intolerant producers.

Crop	n	Tolerable		Intolerable		Mann-Whitney U
		Median # of trees damaged	Median % of trees damaged (25th pct.)	Estimated '94 replacement cost ^a	Median # of trees damaged	% trees damaged test for differences
Apple	44	24	(25th pct.) (4.0) 10.8 (33.1)	\$ 276.48	200	$z = -0.02, p = 0.987$
Cherry	68	40	(1.0) 5.0 (7.1)	\$ 478.00	150	$z = -1.32, p = 0.187$
Peach	12	48	(1.0) 1.1 (2.0)	\$ 504.00	98	$z = -1.10, p = 0.272$
Christmas tree	13	200	(2.0) 3.3 (3.4)	\$1,756.00	1300	$z = -0.29, p = 0.774$

^a Estimated replacement cost per tree including tree, equipment, and labor multiplied by median number of trees damaged per farm.

Tolerance by Fruit/Tree crops

Percent of non-bearing age trees reported damaged did not differ statistically between tolerant and intolerant producers; however, median percentages and estimated costs of the 2 groups appeared similar to tolerable and intolerable levels of loss computed for field crops (Table 30).

Inadequate sample sizes and concerns about question validity precluded an analysis of tolerable and intolerable 1994 losses to bearing age fruit trees, though the following table is included to illustrate median losses as reported.

Table 31: 1994 per farm estimated yield losses to bearing age fruit trees.

Crop	n	Median loss (lbs)	Median % yield loss			Estimated '94 value lost per farm ^a
			(25th pct.)		(75th pct.)	
Apple	29	40,000	(0.0)	0.1	(1.0)	\$4,000
Cherry	60	112,500	(0.0)	< 0.1	(0.0)	\$24,750

^a Mean producer reported price per pound (mean = \$ 0.10/lb apple, mean = \$ 0.22/lb cherry) multiplied by median pounds lost. These estimates likely reflect the potential production lost in 1994 due to the effects of deer browsing over the lifetime of the orchard; however, it was intended that producers report the resultant production lost in 1994 due specifically to deer damage inflicted prior to harvest in 1994. The responses are therefore somewhat suspect. 40,000 lbs lost of apples is approximately equivalent to 2 acres of total loss or approximately 414 trees. Similarly 112,500 lbs. of cherries lost is approximately equivalent to 17 acres of total loss or approximately 2076 trees.

Implications/Recommendations

Loss amounts vary substantially by farm, as does the tolerance of the amount of loss. Thus, there is a need to maintain flexibility in dealing with farmers' crop loss concerns and not to mandate an absolute set of loss criteria which a producer needs to meet before qualifying for assistance programs. The agency might also communicate this need to their hunting constituents.

The large variance in tolerance of losses represented by the inter-quartile ranges indicates that not all producers will be affected in the same way by a similar amount or

percentage of crop loss. Therefore it appears important that field staff administering crop loss assistance programs make efforts to acquaint themselves with farmers and their individual situations both financially and otherwise to determine how best to administer assistance.

Generally it appears that managers can assume that losses approaching 5% of total crop are going to be intolerable to most producers. Therefore regular monitoring of producer reports of loss may allow agencies to proactively manage components of the anticipated issue escalation. Such a percentage figure is limited, however, and the manager must also be cognizant of the total dollar value being lost which may not be illustrated by a small percentage loss. For example a larger farm of 4000 acres may have a 40 acre loss (1%) while a farm of 400 acres suffering the same acreage loss would suffer a 10% loss. The dollar losses may be significant to both farmers.

Most Severe Loss Years and Past Loss Attitudes

It was also hypothesized that past years' losses could impact on producers' attitudes about their current losses to deer. Producers indicated in what year they experienced their worst losses to deer (Question # 16), and, if not 1994, they reported relatively how much more severe the damage was in that year (Question #17). Thirty-five percent of the respondents were undecided about which year since 1986 they had sustained their most severe losses to deer. The 1994 calendar year was rated most severe for deer damage by 35% of the respondents, however, there were different patterns in the responses by county.

Worst year losses by county

In all counties except Presque Isle, 1994 was most frequently indicated as the year during which losses were most severe. This finding suggests that deer damage control programs and herd reduction implemented prior to 1994 has not been generally effective at reducing crop losses despite liberal regulations on antlerless harvest. Assumptions that the late 80's were the period of most severe losses to deer were not supported by producer reports for all counties nor by all producers within a county. Distributions of worst years were independent between counties, confirming that perceptions of deer damage, and likely actual losses, varies across the landscape and across time (Table 32).

Past losses by tolerance

Of the producers who reported that a year other than 1994 had been their most severe year of losses, 8% felt those losses had not been a problem, 26% classified that year's losses as a tolerable problem, and 66% indicated that the losses had been intolerable during that year. A significant positive correlation between past loss attitudes and cumulative 1994 loss attitudes existed (Spearman =0.4813, $p < 0.001$), suggesting that farmers with past losses of a certain perceived magnitude will likely have future losses of that same perceived magnitude (Table 33).

Implications/Recommendations

These data clearly illustrate that the extent of crop damage varies spatially and temporally, therefore it is unlikely that crop damage will disappear but will always be evident somewhere in the state. Analysis of these perceptions of most severe loss years in conjunction with an examination of antlerless and block permit availability suggests that managers should be aware of producers' perceptions of the trend in damage levels, as

MDNR management program objectives as reflected in harvest regulations may at times run counter to farmers' perceptions of crop loss severity. For instance, these data suggest that the frequency and severity of crop losses were increasing in Benzie and Leelanau counties between 1991 and 1994; however, there was a 66% decrease in the number of available antlerless tags over this same period, and block permits were not made available to growers in the fall of 1994. Also Oceana county's reporting frequency of crop loss severity was relatively high during the same period, yet available antlerless tags were down 95% in 1993 and 1994 from the four previous years (Langenau pers. comm.). Comments from producers in Benzie and Leelanau Counties indicated that they perceived the agency's restriction of block permits in 1994 as a disregard of their concerns about crop damage, even though the agency increased the number of available antlerless lottery tags in 1994.

Table 32: Number and percent of producers indicating year as most severe loss year.

County	1986	1987	1988	1989	1990	1991	1992	1993	1994	Total
Calhoun	6 7.8%	1 1.3%	9 11.7%	6 7.8%	3 3.9%	3 3.9%	8 10.4%	9 11.7%	32 41.6%	77 100%
Montcalm	1 1.5%	2 3%	9 13.6%	5 7.6%	11 16.7%	3 4.5%	11 16.7%	8 12.1%	16 24.2%	66 100%
Oceana	1 1.4%	1 1.4%	4 5.7%	6 8.6%	2 2.9%	10 14.3%	4 5.7%	7 10.0%	35 50.0%	70 100%
Benzie/Leelanau	4 6.0%	2 3.0%	2 3.0%	3 4.5%	4 6.0%	7 10.4%	9 13.4%	12 17.9%	24 35.8%	67 100%
Presque Isle	1 2.9%	3 8.8%	5 14.7%	5 14.7%	2 5.9%	5 14.7%	7 20.6%	3 8.8%	3 8.8%	34 100%
Menominee	0 0%	0 0%	1 2.2%	2 4.4%	4 8.9%	3 6.7%	10 22.2%	8 17.8%	17 37.8%	45 100%
Total	13 3.6%	9 2.5%	30 8.4%	27 7.5%	26 7.2%	31 8.6%	49 13.6%	47 13.1%	127 35.4%	359

Kruskal-Wallis $\chi^2=24.57$, df 5, $p<0.001$

Table 33: Relationship of 1994 tolerance of crop loss and tolerance of worst years' losses. Number of respondents indicating each tolerance level.

Tolerance of 1994 cumulative crop losses	Tolerance of crop loss amount in worst year			
	Not a problem	Tolerable	Intolerable	Total
Not a problem	15	13	13	41
Tolerable	2	31	50	83
Intolerable	0	11	83	94
Total	17	55	146	218

$\chi^2=80.88$, df 4, $p<0.001$; Spearman correlation coefficient = 0.4813, $p<0.001$

Quality losses

Items also probed whether the quality value of the remaining harvested crop was greater or less than the value of the crop actually consumed by the deer (Question #12). One third of the producers were not sure what affect deer browsing had had on the quality value of their harvested crops. Another third indicated that the lost value in crop quality was negligible. Though most producers believed that quality value lost was negligible, significantly more producers who had intolerable losses in 1994 indicated that the quality lost was greater than or equal to the yield lost (Table 34).

Quality losses by county

Only in Menominee and Presque Isle Counties was the dollar value of quality lost more likely than expected to be reported as greater than the volume value of the crops lost to deer (Table 34). According to Extension personnel when a bean or alfalfa plant is browsed the surviving dry beans and alfalfa are impacted. Beans are reportedly downgraded because of wrinkling and bloating when plants are browsed by deer (Long pers. comm.). Since these two crops are more frequently grown in these counties this may explain the greater than expected reporting on important quality losses in these counties. However, there were no significant differences in attitudes about the significance of quality lost by the type of farm (Table 34).

Implications/Recommendations

Though the frequency of significant quality losses does not appear to be high, manager's should be aware that quality damage is a real concern for certain crops and may result in significant losses to the producers. Potatoes are a crop where damage to the harvested product may downgrade the lot and consequently reduce the value to producers. This is an example of the possible need for collaboration with MSU-E personnel who have expertise in agricultural marketing. They could be consulted if field staff have questions about the impact that deer might have on the marketing of harvested crops.

Table 34: Farmer respondents perceptions of how significantly deer damage reduces the quality of harvested crops, by county, tolerance of loss and farm type.

		n	> value of yield lost to deer %	= value of yield lost to deer %	< value of yield lost to deer %	Lost quality value is negligible %	I'm not sure %
County ($\chi^2=102.85$, df 20, $p<0.001$)	Calhoun	125	3.2	12.0	20.0	36.0	28.8
	Montcalm	93	4.3	16.1	18.3	36.6	24.7
	Oceana	105	8.6	9.5	11.4	34.3	36.2
	Benzie/Leelanau	114	5.3	6.1	7.9	46.5	34.2
	Presque Isle	48	16.7	16.7	8.3	20.8	37.5
	Menominee	55	21.8	43.6	14.5	5.5	14.5
Tolerance of loss ($\chi^2=113.02$, df 8, $p<0.001$)	Not a problem	140	2.1	2.1	2.9	60.7	32.1
	Tolerable	173	5.2	13.9	16.2	32.9	31.8
	Intolerable	220	14.1	23.2	19.5	16.4	26.8
Farm type ($\chi^2=28.5$, df 20, $p<0.098$)	Livestock	107	13.1	22.4	9.3	29.0	26.2
	Cash crops	128	7.8	14.8	16.4	32.0	28.9
	Fruit/trees	89	5.6	4.5	13.5	48.3	28.1
	Livestock mixed	23	4.3	21.7	17.4	26.1	30.4
	Cash crop mixed	81	9.9	16.0	17.3	32.1	24.7
	Fruit/trees mixed	74	4.1	16.2	14.9	31.1	33.8

Crop losses to other wildlife

Producers were asked to evaluate the relative amount of crop loss they incurred due to deer compared to the amount lost to other wildlife species (Question #14). One half of the producers indicated that deer are the species causing the most significant damage to crops on their farm. Six percent of the producers were not sure how much they were losing to deer compared to other wildlife and about 10% did not believe that they were losing any crops to other wildlife species. Those producers who indicated that their 1994 losses to deer were “Not a problem” were more likely than expected to indicate that losses to other wildlife were more significant than losses to deer (Table 35).

Losses to other wildlife by county

More producers than expected reported that deer losses were less significant than losses to other wildlife in Calhoun and Benzie/Leelanau Counties, while most producers from Menominee County indicated that deer losses exceeded losses to other wildlife (Table 35). Producers in Calhoun, Benzie, and Leelanau Counties commented that raccoons (*Procyon lotor*), birds (Gulls, turkeys, blackbirds) and voles (*Microtus* spp.) caused frequent damage to their corn and fruit crops.

Implications/Recommendations

During the study producers commented that they had concerns about the increasing numbers of other species, such as turkeys and sandhill cranes, and the potential that these species have for damaging crops. The MDNR may wish to begin monitoring damage complaints caused by species other than deer so that future conflicts can be anticipated and proactively addressed before they become a widespread concern.

Table 35: Farmer respondents perceptions of the significance of crop losses caused by other wildlife compared with deer.

		n	Deer losses > losses to other wildlife %	Deer losses are about the same as losses to other wildlife %	Deer losses < losses to other wildlife %	I am not incurring losses to other wildlife %	I'm not sure %	Total %
County ($\chi^2=59.84$, df 20, $p<0.001$)	Calhoun	128	38.3	28.1	20.3	6.3	7.0	100%
	Montcalm	103	54.4	19.4	5.8	10.7	9.7	100%
	Oceana	112	55.4	15.2	11.6	15.2	2.7	100%
	Benzie/Leelanau	125	52.8	20.0	16.0	6.4	4.8	100%
	Presque Isle	50	54.0	16.0	4.0	14.0	12.0	100%
	Menominee	61	77.0	14.8	1.6	6.6	0.0	100%
Tolerance of loss ($\chi^2=264.98$, df 8, $p<0.001$)	Not a problem	151	10.6	19.2	32.5	21.2	16.6	100%
	Tolerable	179	48.0	33.0	8.4	6.1	4.5	100%
	Intolerable	238	82.4	10.9	1.7	5.0	0.0	100%
	Livestock	115	47.8	20.9	15.7	10.4	5.2	100%
Farm type ($\chi^2=18.37$, df 20, $p<0.563$)	Cash crops	132	50.8	20.5	11.4	9.8	7.6	100%
	Fruit/trees	99	61.6	14.1	15.2	8.1	1.0	100%
	Livestock mixed	24	54.2	29.2	8.3	0.0	8.3	100%
	Cash crop mixed	89	55.1	21.3	12.4	6.7	4.5	100%
	Fruit/trees mixed	80	56.3	18.8	7.5	12.5	5.0	100%

Loss estimation methods

It was anticipated that producer perceptions of the amount of loss they were incurring to deer and subsequently their tolerance of loss would be impacted by their method of estimating the severity of their loss (Question #15). Producers generally reported using a combination of methods for estimating their losses. Twelve percent of the producers indicated that they had “no idea what [their] losses were” in 1994. The majority of producers estimated losses by visually inspecting crops for damage, while 42% of the producers reported that the number of deer seen in fields was an index of the amount of loss they received. Relatively few producers reported they had crop inspectors, MSU-E, or MDNR professionals make estimates in 1994.

Loss estimation methods by tolerance

Producers whose losses were “Not a problem” were more likely to have “no idea what their losses were” than those producers, whose losses were intolerable (Table 36). Among producers with intolerable problems “visible damage to crops” and “deer seen in fields” were the 2 most frequently cited methods of estimating the amount of loss. Only 25% of producers with intolerable problems indicated that they estimated their crop losses by comparing harvest receipts. It is possible that damage for these producers may be so severe that they do not need to examine harvest receipts to get an idea of the severity of the problem. It may also be that comparisons of harvest receipts are not reliable indicators of how much a producer may have lost to deer. Apparently loss estimation among producers is largely a matter of inference based on field observation and experience.

Implications/Recommendations

Most MDNR field staff are likely aware of the uncertainty associated with estimating crop losses, but deer hunters do not understand this uncertainty and may expect that an absolute amount of crop loss should be a requirement to obtain assistance. As mentioned earlier the agency may need to communicate this uncertainty and the need for flexibility to hunters to lessen the frequency of complaints about the crop damage assistance programs.

The inherent variability of yields in fields makes it difficult to determine the amount of crop lost to deer in any given year in a particular field. Utah researchers (Austin and Urness 1987) found that a method for determining ungulate damage to alfalfa was reliable but could only document damages in excess of 20% of the crop. This difficulty in differentiating deer damage from other damages may explain why farmers who don't consider their losses a problem are less capable of estimating how much they might be losing. Designing better methods of quantifying damage may allow farmers to better distinguish deer damage from other wildlife damage. This may reveal that deer are not as large a problem as may be perceived, or such improved technology may cause more farmers to become intolerant if deer are discovered to be responsible for more loss than previously believed.

Combine-mounted yield monitors that record harvest per acre are now available for use with corn and other grains and may be an efficient way of determining relative losses in portions of fields most used by deer. Unfortunately these monitors are expensive and not all combines are outfitted to accept them. Thus, their use would probably be restricted to larger operations. Though these monitors have potential to

improve loss quantification, they do so at harvest and therefore do not allow managers to increase antlerless harvest in the immediate year if losses are deemed intolerable. All “at harvest” determinations of losses have this same weakness and cause management to play catch up with the deer herd the following year. Thus, it appears that methods that forecast losses early in the growing season, though less accurate, are preferable in that they allow for immediate rather than delayed management action. Despite this shortcoming of “at harvest” loss assessments, an annual monitoring of losses would allow some analysis of the effectiveness of control efforts over time if adjustments could be made for variations in crop rotation, climate, and habitat changes.

Table 36: Methods used by producers to estimate crop losses (% of producers indicating use of each method).

	n	No idea what losses were	# of deer seen in fields	Visible damage	Other farmer's reports	Harvest records	MDNR estimate	MSU-E estimate	Crop inspector estimate
Not a problem	152	26.3%	21.7%	57.2%	1.3%	2.0%	0.7%	0%	0%
Tolerable	179	13.4%	43.0%	85.5%	6.7%	7.3%	2.8%	1.1%	1.7%
Intolerable	240	2.9%	55.4%	94.2%	15.0%	25.0%	11.3%	1.3%	11.3%
		$\chi^2=47.02$, df 2, p<0.001	$\chi^2=43.27$, df 2, p<0.001	$\chi^2=87.16$, df 2, p<0.001	$\chi^2=23.19$, df 2, p<0.001	$\chi^2=51.03$, df 2, p<0.001	$\chi^2=23.44$, df 2, p<0.001	$\chi^2=1.85$, df 2, p=0.396	$\chi^2=30.37$, df 2, p<0.001

Behavioral Responses of Producers to Crop Losses

Wildlife agencies need to be able to predict what courses of action producers will take in response to intolerable amounts of crop loss. This study attempted to provide information about producer behaviors based on an Attitudinal Response Model (Minnis and Peyton 1995, Minnis 1996) used to predict producer behaviors in response to crop damage.

Lethal Control, Non-lethal Control, and Disruptive Behavior:

Producers were given the opportunity to indicate which of several controls and/or actions they had taken in direct response to deer damage. Three variables were created to attempt to capture the nature of these different types of action, lethal control, non-lethal control, and disruptive behavior. Actions considered to be lethal controls included the promotion of hunting, use of block permits, and use of shooting permits. Actions considered as non-lethal controls included the use of fencing, repellents, harassment devices, and buffer crops. Actions considered as disruptive behavior included seeking action from elected officials or the media, organizing meetings to address deer crop damage, and consulting an attorney regarding legal options. A producer was classified as having engaged in an action type if he/she reported having engaged in one of the activities considered under each heading.

Past, Current, And Future Behaviors Associated With Crop Losses

Of the behavioral options given on the questionnaire (Question #19), this sample of producers most frequently (44%) indicated that they encouraged or promoted hunting on their properties to reduce deer damage. The use of block permits (29%), shooting

permits (24%), and repellents (23%) were the next 3 most frequently indicated past behaviors done in response to deer damage (Table 37).

Table 37: Farmer respondents anticipated and actual damage controls and types of behavior done in direct response to deer damage. Percentage of total respondents checking the item.

(n = 595)	DID PRIOR TO 1994	DID IN 1994 OR STILL IN EFFECT IN 1994	I WILL LIKELY DO IF FUTURE LOSSES ARE INTOLERABLE
1) INSTALL FENCING TO KEEP DEER OUT OF AN AREA	4.9%	3.2%	11.8%
2) USE REPELLENTS TO DISCOURAGE DEER FROM EATING A CROP	23.0%	20.3%	22.0%
3) USE HARASSMENT DEVICES TO FRIGHTEN DEER AWAY	11.9%	8.7%	14.8%
4) USE SHOOTING PERMITS	24.2%	10.4%	28.7%
5) USE BLOCK PERMITS	28.9%	15.8%	34.8%
6) ENCOURAGE OR PROMOTE HUNTING ON YOUR PROPERTY (OTHER THAN THE USE OF BLOCK PERMITS)	43.9%	38.5%	35.6%
7) SEEK INFORMATION OR ADVICE FROM THE DNR, MSU-EXTENSION OR OTHER SOURCE ON HOW TO GO ABOUT REDUCING CROP LOSSES	16.5%	10.8%	20.8%
8) CHANGE OR SWITCH CROPS TO THOSE LESS PREFERRED BY DEER	8.7%	6.4%	10.4%
9) PLANT BUFFER CROPS BETWEEN DEER HABITAT AND MORE VALUABLE CROPS	6.2%	4.0%	8.6%
10) START PURCHASING FEED INSTEAD OF <u>OR</u> IN ADDITION TO GROWING YOUR OWN	7.2%	4.9%	6.1%
11) ABANDON A FIELD BECAUSE OF HIGH DEER LOSSES	9.4%	6.1%	9.7%
COMMUNICATE WITH <u>OR</u> SEEK ACTION FROM:			
12) AN ELECTED OFFICIAL	5.2%	3.4%	9.1%
13) A REPRESENTATIVE OF THE DNR	18.3%	12.3%	24.2%
14) A REPRESENTATIVE OF THE MEDIA	2.2%	0.5%	5.7%
15) A REPRESENTATIVE OF MSU-Ext	7.9%	5.5%	13.8%
16) HELP <u>ORGANIZE</u> MEETINGS TO DISCUSS AND ADDRESS DEER CROP DAMAGE	3.7%	2.0%	6.4%
17) <u>ATTEND</u> MEETINGS TO DISCUSS AND ADDRESS DEER CROP DAMAGE	17.3%	10.1%	21.8%
18) PERSONALLY <u>OR</u> JOINTLY CONSULT AN ATTORNEY REGARDING LEGAL OPTIONS TO REDUCE LOSSES TO DEER	2.4%	0.5%	8.7%

Actions 16, 17, 18, and 12 were defined as disruptive courses of action.

Behaviors by tolerance

Of the total respondents (n=595), 240 individuals (42%) indicated that 1994 losses were intolerable and that they would increase efforts in the future to reduce losses below 1994 levels, and of these, 55 (23%) producers did not undertake control or engage in a disruptive behavior in 1994.

For this analysis producers were segmented by their reported exposure to intolerable losses. Producers may have never considered losses a problem, always found losses tolerable, or experienced intolerable losses. Those who'd experienced intolerable losses may have done so only in 1994, done so prior to and during 1994, or may have found 1994 losses tolerable though in an earlier year they were intolerable.

Producers who had not experienced intolerable losses anticipated future use of lethal techniques (including the encouragement of hunting) twice as often as non-lethal techniques (Figure 10). This segmentation also revealed that among intolerant producers, those with a longer history of intolerant losses were twice as likely as those with more recent intolerable experiences to intend to engage in future disruptive behavior (Figure 10). Those who had intolerable losses in the past but whose current losses were tolerable were twice as likely to indicate that they will use lethal methods rather than non-lethal methods in the future, even though 50% of these producers tried non-lethal methods in the past. This appears to indicate a greater favoritism for lethal control methods among producers, and that those with a history of losses do not appear to accept loss as a cost of doing business. Those most likely to engage in disruptive behavior appear to be those with repeated exposure to intolerable losses.

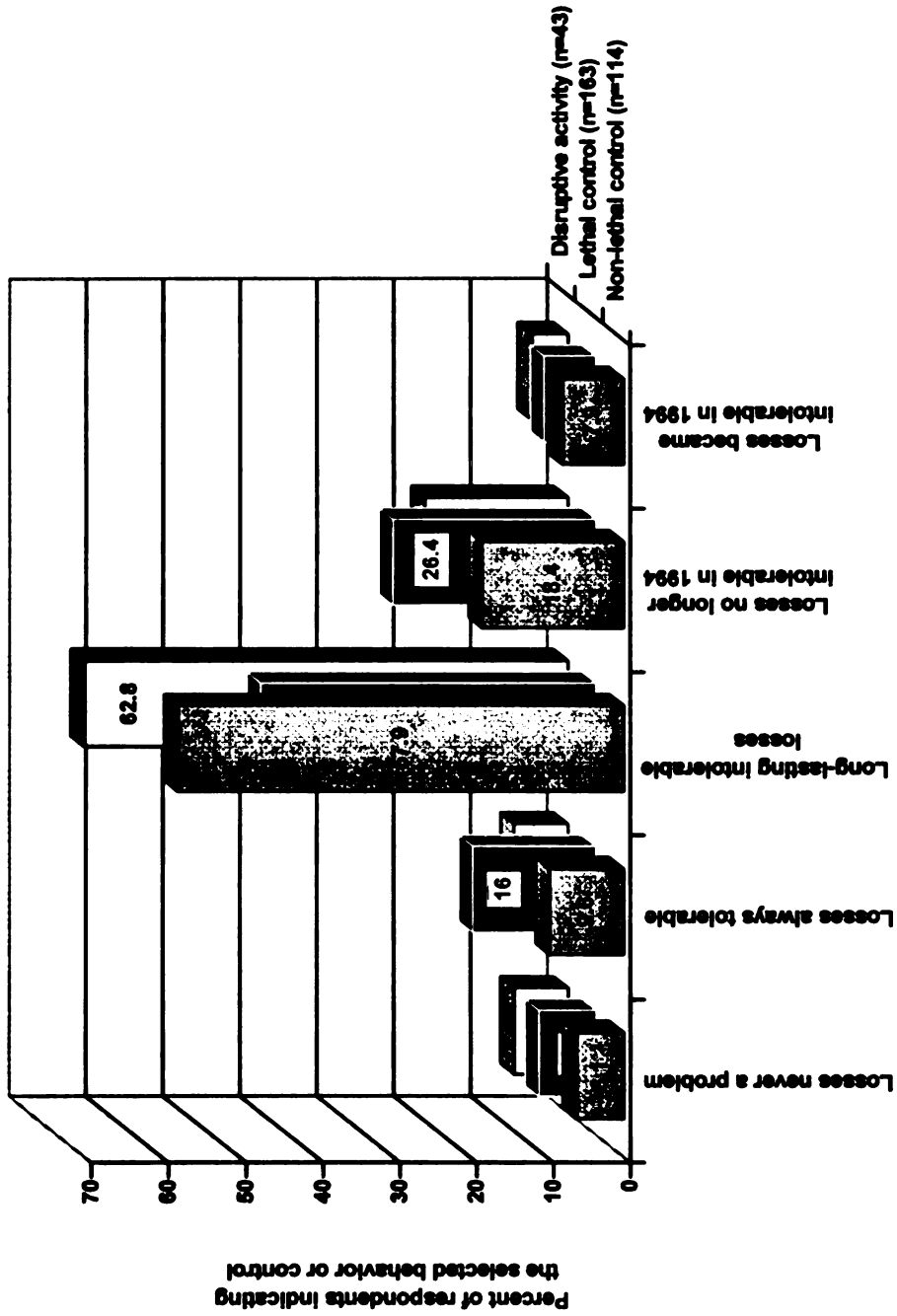


Figure 10: Intention of producers to engage in various behaviors if losses become/remain intolerable; analyzed by respondent's history of losses.

Intended Behaviors by Past Behaviors

It was hypothesized that past behaviors done in response to damage would best predict future behaviors that producers would engage in. The nature of the data and item non-response precluded rigorous testing of this hypothesis, however, some comparisons could be made. Only 39% of those who had engaged in “disruptive” activity indicated they were likely to again engage in disruptive activity if damage becomes intolerable in the future. Of the current and past non-lethal users 62% were likely to engage in non-lethal control in the future, while 67% of current and past lethal users were likely to engage in lethal control in the future. The 38% and 33% of these producers who did not indicate that they would repeat lethal and/or non-lethal controls may not have found these options effective at reducing losses, or they may not have responded to the question. It is also possible that producers skipped the question because their intended action was not provided (i.e. a consequence of red-tape encountered in trying to follow proper channels may result in an intention to gut-shoot deer, an option not provided.)

Implications/Recommendations

We can assume that past controls will likely be repeated if they have been effective or perceived as being effective. Just as important is the finding that producers with a long history of intolerable losses will more frequently consider disruptive behavior in the future. This suggests that managers ensure that available controls can be applied effectively and immediately support/attend to producers with intolerable levels of loss. Otherwise there is potential for disruptive activity or illegal behavior.

Producer behavior preferences

Preferences of producers for individual behaviors were evaluated by ranking the frequencies of each intended behavior. Preferences of producers were then compared based on their exposure to severe losses (Table 38). The promotion of hunting (1st.) and the use of block (2nd.) and shooting (3rd.) permits were ranked highest for both those who had never experienced intolerable losses and those who had. An important difference in the rankings is that producers without exposure to intolerable losses indicated a desire to seek information and attend meetings about crop damage as frequently as they desired to use shooting permits. On the other hand, producers who had experienced intolerable losses followed lethal controls with seeking action from the MDNR, using repellents, and attending meetings. Both groups infrequently considered consulting attorneys, contacting the media, or contacting elected officials. These behaviors were further down the list than abandoning a field (Table 38).

Table 38: Frequencies and ranks of anticipated damage controls and types of behavior likely to be undertaken by farmer respondents if losses caused by deer increase in severity, as indicated by producers who have and have not experienced intolerable losses.

"I will likely do if future losses are intolerable:"	Never had an intolerable loss problem		Have experienced an intolerable level of loss	
	%	rank	%	rank
INSTALL FENCING TO KEEP DEER OUT OF AN AREA	5.5	9 tie	15.2	10 tie
USE REPELLENTS TO DISCOURAGE DEER FROM EATING A CROP	8.8	6 tie	28.3	5
USE HARASSMENT DEVICES TO FRIGHTEN DEER AWAY	7.7	7	20.9	8
USE SHOOTING PERMITS	14.3	3 tie	37.7	3
USE BLOCK PERMITS	20.9	2	44.5	2
ENCOURAGE OR PROMOTE HUNTING ON YOUR PROPERTY (OTHER THAN THE USE OF BLOCK PERMITS)	29.7	1	46.6	1
SEEK INFORMATION OR ADVICE FROM THE DNR, MSU-EXTENSION OR OTHER SOURCE ON HOW TO GO ABOUT REDUCING CROP LOSSES	14.3	3 tie	25.7	7
CHANGE OR SWITCH CROPS TO THOSE LESS PREFERRED BY DEER	8.8	6 tie	15.2	10 tie
PLANT BUFFER CROPS BETWEEN DEER HABITAT AND MORE VALUABLE CROPS	9.9	5 tie	8.9	14
START PURCHASING FEED INSTEAD OF <u>OR</u> IN ADDITION TO GROWING YOUR OWN	3.3	11 tie	9.4	13 tie
ABANDON A FIELD BECAUSE OF HIGH DEER LOSSES	6.6	8	16.2	9
COMMUNICATE WITH <u>OR</u> SEEK ACTION FROM:				
AN ELECTED OFFICIAL	4.4	10	11.5	12
A REPRESENTATIVE OF THE DNR	11.0	4	31.9	4
A REPRESENTATIVE OF THE MEDIA	3.3	11 tie	8.4	15
A REPRESENTATIVE OF MSU-EXT.	9.9	5 tie	15.2	10 tie
HELP <u>ORGANIZE</u> MEETINGS TO DISCUSS AND ADDRESS DEER CROP DAMAGE	5.5	9 tie	9.4	13 tie
<u>ATTEND</u> MEETINGS TO DISCUSS AND ADDRESS DEER CROP DAMAGE	14.3	3 tie	27.7	6
PERSONALLY <u>OR</u> JOINTLY CONSULT AN ATTORNEY REGARDING LEGAL OPTIONS TO REDUCE LOSSES TO DEER	3.3	11 tie	13.1	11
	n= 91		n= 191	

Behaviors by job type

Several behavioral differences between full-time and part-time farmers were also identified. Full-time farmers were more likely to have sought and to seek information and advice about reducing losses ($\chi^2 = 14.15$, df 1, $p < 0.001$) and to have attended or to attend meetings to discuss and address deer crop damage concerns than part-time farmers ($\chi^2 = 7.55$, df 1, $p < 0.007$). Full-time farmers were consistently more likely to have engaged in or to anticipate engaging in lethal control, non-lethal control, and disruptive activity than were part-time farmers (Figure 11), regardless of whether the producer personally hunted deer.

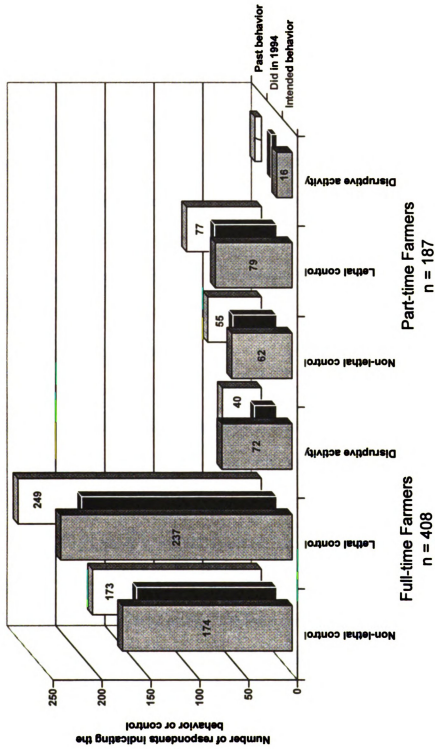


Figure 11: Number of full-time and part-time farmers who have engaged in or will likely engage in selected deer damage control measures and disruptive activity.

Behaviors by hunting participation

Two important behavioral differences between hunting and non-hunting farmers were identified. First, hunting farmers are slightly more likely to use lethal methods (including the promotion of hunting) in the future (56.7%) than are non-hunting farmers (47.7%) ($\chi^2 = 3.56$, df 1, $p = .05$). Second, hunting farmers are more likely to have used non-lethal controls (41.8%) in the past than were non-hunting farmers (32.6%) ($\chi^2 = 3.94$, df 1, $p = .05$). These findings suggest that hunting farmers may be more apt to recognize the use of hunting as a damage control tool than are non-hunting farmers. Also hunting farmers may place greater value on fall hunting opportunities for themselves and others, and therefore utilize non-lethal controls to avoid shooting deer at other times of the year.

Behaviors by farm type

The type of farm operation also appeared to influence the types of behaviors chosen by producers. Fruit and tree growers were more likely than other farm types to have used lethal controls prior to 1994 ($\chi^2 = 11.88$, df 5, $p = 0.036$), to have had lethal control in place in 1994 ($\chi^2 = 23.09$, df 5, $p < 0.001$), to have used non-lethal controls prior to 1994 ($\chi^2 = 83.69$, df 5, $p < 0.001$), to have had non-lethal controls in place in 1994 ($\chi^2 = 84.25$, df 5, $p < 0.001$), and were more likely to use non-lethal control in the future ($\chi^2 = 45.52$, df 5, $p < 0.001$) (Figure 12). Fruit/tree growers were more likely than other farm types to have sought “information and advice on reducing losses” prior to 1994 ($\chi^2 = 22.64$, df 5, $p < 0.001$) and during 1994 ($\chi^2 = 21.33$, df 5, $p < 0.001$), and were also more likely to indicate a likelihood of seeking such information and advice in the future. Providing non-lethal technical assistance to fruit growers might be something that an

agency could consider in order to reduce tensions between stakeholders about the most acceptable number of deer.

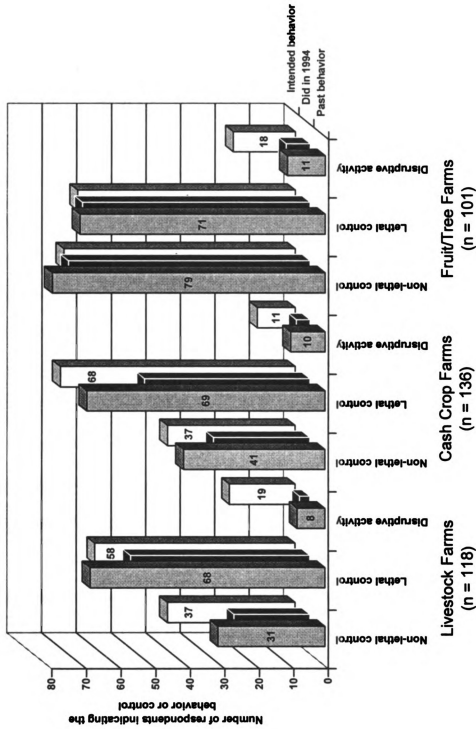


Figure 12: Number of primarily livestock, cash crop, and fruit/tree producers who have engaged in or will likely engage in selected deer damage control measures and disruptive activity.

Producer Perceptions and Use of Hunting as a Crop Damage Control Method

It was postulated that hunting participation would likely influence attitudes about deer numbers and tolerance of crop losses (Stoll and Mountz 1983). It was also known that farmers suffering crop losses tend to allow increased access to hunters, even non-acquaintances, as the severity of loss increases (Stoll and Mountz 1983, Scott and Townsend 1985, Morgan et al. 1990, Nelson and Schomaker 1995); however, comments made during preliminary interviews with farmers indicated that perhaps hunting was not being maximized, or could not be maximized, as a damage control tool by farmers suffering losses. As a result of these comments producers were questioned about the amount of access given to deer hunters, preferred hunter densities, and antlerless harvest on their farm.

Access to hunters

In general farmers allow deer hunting access to their immediate family and friends & neighbors. On average about a third of the producers also allowed non-acquaintances to deer hunt on their farms.

Access by county

Producers in Presque Isle County least frequently allowed non-acquaintances to hunt and most frequently allowed immediate family to hunt (Table 39). Producers in Benzie and Leelanau Counties appeared most willing to allow hunting by non-acquaintances. A large proportion of Menominee County producers also allowed non-acquaintances to deer hunt. Menominee County producers more frequently indicated that they lease hunting privileges on their farms.

Access by tolerance

Producers whose losses were not a problem were more likely than producers with problematic losses not to allow any hunting on their land (Table 40). Those producers with intolerable losses were most likely to allow friends and neighbors as well as non-acquaintances to deer hunt on their farm. Producers with intolerable losses were also more likely to allow non-acquaintances to deer hunt for a fee; most of these were Menominee county producers, where 25 to 38% of the producers indicated some degree of leasing. Of the producers in other counties, 0 to 4% indicated leasing either to non-acquaintances, friends, or neighbors.

Implications/Recommendations

Leasing has often been suggested as a means by which a farmer can realize a benefit from large deer populations, and some may turn to leasing in an attempt to recover some of their losses. Unfortunately, it does not appear that this source of income makes producers more tolerant of losses. In addition the producer must be willing to become more involved in dealing with and monitoring hunters. As Burger and Teer (1981) indicated, "wildlife was a nuisance to some ranchers (farmers) because it forces them to deal with people who wish to hunt." In preliminary interviews to this study a few producers' reflected this same sentiment, commenting that they did not have the time or desire to become hunt outfitters. Thus leasing hunting privileges is apparently of limited worth for defusing disruptive activity for some farmers.

Table 39: Percent of producers giving deer hunting access in 1994 in study counties.

County	n	No one	Immediate family	Friends and Neighbors	Non-acquaintances	Anyone w/o permission	Friends & Neighbors for a fee	Non-acquaintances for a fee
Calhoun	133	3.0%	66.9%	77.4%	21.8%	1.5%	3.8%	3.8%
Montcalm	104	1.0%	72.1%	76.9%	29.8%	0%	3.8%	2.9%
Oceana	115	0.9%	67.0%	75.7%	34.8%	7.8%	1.7%	2.6%
Benzie/Leelanau	128	6.3%	64.1%	72.7%	46.1%	23.4%	0.8%	0%
Presque Isle	52	1.9%	86.5%	67.3%	9.6%	0%	7.7%	5.8%
Menominee	63	1.6%	79.4%	87.3%	39.7%	3.2%	25.4%	38.1%
		$\chi^2=9.30$, df 5, p=0.098	$\chi^2=12.93$, df 5, p=0.024	$\chi^2=7.58$, df 5, p=0.181	$\chi^2=32.47$, df 5, p<0.001	$\chi^2=70.42$, df 5, p<0.001	$\chi^2=59.63$, df 5, p<0.001	$\chi^2=121.13$, df 5, p<0.001

Table 40: Percent of producers allowing deer hunting access by tolerance of 1994 crop losses.

	n	No one	Immediate family	Friends & Neighbors	Non-acquaintances	Anyone w/o permission	Friends & neighbors for a fee	Non-acquaintances for a fee
Not a Problem	152	6.6%	69.1%	65.1%	19.7%	3.9%	2.6%	1.3%
Tolerable	179	1.7%	75.4%	76.0%	29.1%	3.9%	5.6%	7.3%
Intolerable	240	1.3%	70.0%	84.2%	43.3%	11.7%	7.5%	9.6%
		$\chi^2=10.92$, df 2, p=0.004	$\chi^2=2.05$, df 2, p=0.359	$\chi^2=18.82$, df 2, p<0.001	$\chi^2=25.07$, df 2, p<0.001	$\chi^2=12.50$, df 2, p=0.002	$\chi^2=4.17$, df 2, p=0.124	$\chi^2=10.39$, df 2, p=0.006

Deer habitat acres per farm

By summing the acreages of wetland, forest, pasture, and fallow ground cover types reported by producers (Question #34), a habitat variable was created to give an estimate of the amount of total deer habitat per farm. (Agricultural crops such as corn provide substantial cover and food for deer; however, the purpose of the variable was to index how much non-agricultural habitat was available per farm.) The mean habitat per farm was equal to 113 acres (s.d. =140, n=595), and the mean habitat as percent of farm size was 32% (s.d. =27, n=592).

Habitat acres by county

Montcalm and Calhoun County farms contained the smallest proportions of deer habitat, while farms in Benzie/Leelanau, Menominee, and Presque Isle counties contained the greatest proportions of deer habitat per farm (Table 41). There were no differences in the percent of habitat on the farm between hunting and non-hunting producers.

Habitat acres by tolerance and farm type

Producers with intolerable problems had a significantly lower proportion of deer habitat on their farms than producers whose losses were not a problem (Table 41). Fruit and tree producers had a greater proportion of deer habitat on their farms than producers of cash crops and livestock (Table 41). These relationships between the proportion of deer habitat on the farm and the variables “tolerance” and “farm type” were consistent when entered as factors in an analysis of variance while controlling for “county of residence” and “hunting participation”. Both “tolerance” and “farm type” had significant

main effects with F-values of ($F = 9.696$, $df\ 2$, $p < 0.001$) and ($F = 3.652$, $df\ 2$, $p = 0.027$) respectively (Table 42).

Table 41: Acreage of deer habitat per farm and % proportion of deer habitat per farm: by county, tolerance of loss, farm type, and hunting participation.

		n	Mean acres of deer habitat per farm (s.d.)	n	Mean % of farm in deer habitat (s.d.)
County	Calhoun	133	97.2 (114.7)	132	28.7 (27.3)
	Montcalm	104	123.7 (135.6)	103	25.0 (24.3)
	Oceana	115	75.9 (94.7)	115	30.0 (29.3)
	Benzie/Leelanau	128	89.6 (116.1)	128	37.4 (25.1)
	Presque Isle	52	147.0 (181.0)	52	40.9 (30.9)
	Menominee	63	220.5 (206.0)	62	39.0 (25.3)
			Kruskal-Wallis $\chi^2=37.99$, $df\ 5$, $p<0.001$		Kruskal-Wallis $\chi^2=30.57$, $df\ 5$, $p<0.001$
Tolerance of loss	Not a problem	151	103.07 (117.00)	151	40 (32.2)
	Tolerable	178	107.79 (141.04)	178	31 (25.7)
	Intolerable	239	129.49 (156.98)	239	28 (23.8)
			Kruskal-Wallis $\chi^2=2.31$, $df\ 2$, $p=0.3143$		Kruskal-Wallis $\chi^2=11.07$, $df\ 2$, $p=0.0039$
Farm type	Livestock	118	152.8 (170.6)	117	35.24 (28.89)
	Cash crops	136	98.7 (125.8)	135	26.29 (24.09)
	Fruit/trees	101	84.0 (113.6)	101	35.87 (28.05)
	Livestock mixed	24	135.1 (178.1)	24	26.27 (23.56)
	Cash crops mixed	92	101.3 (103.7)	92	29.11 (23.69)
	Fruit/trees mixed	81	148.2 (170.8)	81	34.83 (29.55)
			Kruskal-Wallis $\chi^2=20.99$, $df\ 5$, $p<0.001$		Kruskal-Wallis $\chi^2=11.13$, $df\ 5$, $p=0.049$
Hunting participation	Non-hunter	172	120.62 (160.83)	171	31.2 (27.3)
	Hunter	397	115.58 (132.72)	395	34.2 (27.3)
			Mann-Whitney $z = -0.55$, $p= 0.583$		Mann-Whitney $z = -1.40$, $p= 0.162$

Table 42: Mean proportion of deer habitat (woods, wetlands, fallow) per farm reported by producers of different farm types and with varying tolerance of loss.

Tolerance of Loss	Type of Farm Operation			
	Primarily livestock operation	Primarily cash crop operation	Primarily Fruit and Tree products operation	F = 9.696, df 2, p < 0.001
	Not a problem	0.46 (n = 35)	0.30 (n = 35)	0.48 (n = 21)
	Tolerable problem	0.36 (n = 28)	0.24 (n = 45)	0.41 (n = 21)
	Intolerable problem	0.32 (n = 44)	0.24 (n = 46)	0.30 (n = 52)
F = 3.652, df 2, p = 0.027				

Number of hunters on opening day of deer firearm season (11-15-94)

Producers were asked to estimate the number of hunters that hunted deer on the lands they farmed on November 15, 1994 (opening day of the general firearms season) (Question #30). After removing extreme reported hunter numbers of 100 or more, the mean number of hunters per farm was 8.10 (s.d. = 6.86). Mean hunters per farm-acre was calculated by dividing the number of hunters on 11-15-94 by the farm size. The mean hunters per habitat acre was similarly calculated by dividing the number of hunters by the sum of the total acres of wetland, forest, fallow ground, and pasture on the farm (Question #34). The mean number of hunters per farm acre was 0.032 (s.d. = 0.043) and the mean hunters per habitat acre was 0.146 (s.d. = 0.299).

Hunter density by county

Mean hunter densities per farm acre were highest in the fruit growing counties of Benzie, Leelanau, and Oceana. Presque Isle County had the lowest hunter density per farm acre. Mean hunter densities per habitat acre were highest in Oceana and Calhoun Counties, and lowest in Presque Isle and Menominee counties (Table 43).

Table 43: Respondent reported per farm 11-15-94 hunter densities.

County	mean farm acres / hunter	mean habitat acres / hunter
Calhoun	32.1 (29.4)	5.2 (2.5)
Montcalm	42.6 (48.0)	8.3 (5.6)
Oceana	24.4 (18.7)	4.1 (2.2)
Benzie/Leelanau	22.1 (13.9)	9.5 (6.3)
Presque Isle	52.4 (61.3)	15.6 (8.3)
Menominee	39.7 (65.3)	11.9 (8.8)
Total	31.6 (23.5)	6.8 (3.3)
	KW $\chi^2=28.01$, df 5, $p<0.001$	KW $\chi^2=36.61$, df 5, $p<0.001$

Table 44: Per farm #'s of hunters and hunter densities segmented by tolerance of 1994 losses.

	n	Mean # of hunters on 11/15/94 (s.d.)	n	Mean farm acres per hunter (s.d.)	n	Mean habitat acres per hunter (s.d.)
Not a problem	104	5 (13.5)	103	33.22 (23.47)	94	11.75 (7.35)
Tolerable	140	8 (7.8)	139	26.60 (17.01)	128	5.49 (2.44)
Intolerable	187	10 (7.1)	186	35.21 (39.22)	166	6.48 (3.78)
Total	431	8 (6.9)	428	31.45 (23.26)	388	6.82 (3.32)
Kruskal-Wallis test of significance	$\chi^2=40.91$, df 2, $p<0.001$		$\chi^2=3.90$, df 2, $p=0.1423$		$\chi^2=19.69$, df 2, $p<0.001$	

Table 45: Number of hunters and hunter densities segmented by type of farm operation.

Farm type	n	Mean # of hunters per farm on 11/15/94 (s.d.)	n	Mean density of hunters per farm acre on 11/15/96 (s.d.)	n	Mean density of hunters per habitat acre on 11/15/96 (s.d.)
Livestock	97	8.7 (6.7)	96	.0236 (.0256)	88	.1009 (.1438)
Cash crops	103	7.3 (6.7)	102	.0289 (.0320)	89	.1366 (.1875)
Tree/Fruit	64	7.7 (5.9)	64	.0445 (.0337)	57	.2490 (.5799)
Mixed livestock	17	11.2 (13.7)	17	.0243 (.0212)	17	.0994 (.0677)
Mixed cash crops	68	7.4 (4.9)	68	.0243 (.0180)	61	.1187 (.2538)
Mixed tree/fruit	65	8.6 (7.0)	65	.0316 (.0630)	60	.1327 (.1813)
Total	414	8.1 (6.8)	412	.0296 (.0363)	372	.1401 (.2866)
Kruskal-Wallis test of significance	$\chi^2= 5.03$, df 5, $p=0.4127$		$\chi^2=33.62$, df 5, $p<0.001$		$\chi^2=7.65$, df 5, $p=0.1766$	

Hunter density by tolerance

Those producers who considered their losses a problem had more hunters on their properties on 11-15-94, and significantly higher hunter densities per habitat acre than those who did not consider losses a problem (Table 44). Hunter densities per habitat acre were highest for producers who considered their losses to be a tolerable problem (5.5 habitat acres/hunter) and were slightly lower for those whose losses were considered intolerable (6.5 habitat acres/hunter).

Implications/Recommendations

As shown in other studies, producers with more severe losses tend to allow more hunting access than do producers with less severe losses. Interestingly, hunter densities were highest among farmers who considered their losses to be a tolerable problem. Though we must be careful about inferring causality it may be possible that their tolerable level of losses is a function of that higher hunter density and the number of deer shot by those hunters. This relationship is certainly worthy of additional investigation as it suggests that farmers may be able to manage their losses by managing hunters and hunting pressure, and agencies might suggest means of improving such management by farmers.

Perceptions of safe hunter densities

Producers also reported the number of hunters they thought the lands they farmed could safely support on opening day of the 1994 firearms deer season (Question #31). A variable was created by subtracting perceived safe hunter numbers from 1994 reported

hunter numbers to get a measure of the proportion of producers who felt that opening day hunter numbers on their farmlands were at, below, or above what they considered safe levels. Extreme reports of 100 hunters or more for either the 1994 numbers or the safe level were not included for this analysis.

Forty-one percent of the producers considered the number of hunters on their farmlands on 11-15-94 to be below the number they considered safe for their farmlands. Nine percent of the producers felt that the number of hunters on their farmlands exceeded the number they considered safe for their farm, while the remaining 50% of the producers felt they were at the maximum safe level for their farm (Table 46).

Safe hunter densities by tolerance

Mean differences varied significantly depending on the producer's tolerance of their 1994 losses. Significantly more producers who rated the number of hunters on 11-15-94 below maximum safe levels considered their losses not to be a problem or to be an intolerable problem.

Table 46: Mean percent of farmers at, above, and below perceived safe opening day hunter densities on November 15, 1994.

	Percent of farmers indicating their farm was at, above, and below perceived safe opening day (11-15-94) hunter densities n=340			
	Above maximum %	At maximum %	Below maximum %	
Not a problem (n=81)	4.9	48.1	46.9	100%
Tolerable problem (n=112)	11.6	58.9	29.5	100%
Intolerable problem (n=147)	8.8	44.2	46.9	100%
Total	8.8	50.0	41.2	100%
Chi-square $\chi^2 = 10.75$, df 2, p=0.008				

A seemingly important segment of producers is the group of farmers that had intolerable losses, yet had hunter densities that were below what they felt they could safely support. Upon further investigation, this group was found to be composed mostly of full-time farmers (84%), and were well distributed across all counties. Oceana County producers made up 27% of the group while Montcalm County farmers accounted for the lowest proportion of the segment (10%). Forty-five percent of the segment reported allowing non-acquaintances to hunt with permission. This was slightly more than the percentage of producers having intolerable losses as a whole. Similarly, the segment reported allowing access to friends, neighbors, and family more than the larger group of producers with intolerable losses. Twenty-six percent of the segment reported having had no contact with MDNR biologists.

Implications/Recommendations

Apparently producers with intolerable amounts of losses would be willing to allow one or two more hunters on their farms to help harvest additional deer. Though this seems encouraging, one should consider that maximizing hunter numbers may not increase deer kill, nor even be desirable to producers or hunters. The reader should also bare in mind that the numbers provided by producers were opening day hunter numbers, and these may not reflect the continued hunting pressure on farms during the remainder of the season. Also higher hunter densities will not necessarily increase the harvest of antlerless deer. Some producers commented that they could no longer find hunters willing to harvest antlerless deer. Some producers also expressed an interest in

designating deer hunters as shooters for out-of-season shooting permits but could not or did not know of anyone willing to take on this role. Thus, it appears that this is opportunity for deer hunters to take on a more active role in crop damage management, perhaps through local coordination between deer hunting organizations, farmers, MSU-E, and the MDNR.

Number of deer harvested on respondent's farms in 1994

Respondents reported mean harvest rates of 9.6 bucks per square mile and 14.7 antlerless deer per square mile for their farms in 1994. Harvest rates differed significantly by county, with the effect of frequent block permit use clearly evident in the Menominee County antlerless harvest (Table 47).

Table 47: Average number of bucks and antlerless deer respondents reported were taken on farms in 1994; segmented by county.

County	Mean bucks taken per farm acre (all seasons)	Mean antlerless taken per farm acre (all seasons)	Bucks per mi ²	Antlerless per mi ²
Calhoun	0.013 (0.014)	0.021 (0.029)	8.32	13.44
Montcalm	0.012 (0.013)	0.012 (0.013)	7.68	7.68
Oceana	0.016 (0.015)	0.017 (0.025)	10.24	10.88
Benzie/Leelanau	0.023 (0.064)	0.022 (0.069)	14.72	14.08
Presque Isle	0.006 (0.005)	0.008 (0.009)	3.84	5.12
Menominee	0.018 (0.014)	0.053 (0.037)	11.52	33.92
Total	0.015 (0.023)	0.023 (0.040)	9.6	14.72
	KW $\chi^2=31.32$, df 5, p<0.001	KW $\chi^2=71.88$, df 5, p<0.001		

Harvest ratios of bucks and antlerless deer reported by respondents.

Though the total number of deer taken by hunters is important in controlling crop losses, so is taking the proper proportion of antlerless deer and antlered bucks. It was encouraging to find that producers who were least tolerant of their crop losses reported shooting a greater proportion of antlerless deer than did producers whose crop losses were tolerable or not a problem (Table 48). This relationship held regardless of the county in which the producer farmed. Among producers with intolerable losses, Menominee County producers reported shooting the greatest number of antlerless deer per buck taken. It was also encouraging to find that producers from all counties appeared to have a

“antlerless-oriented” harvest; a behavior consistent with trying to control their crop losses (Table 49).

Table 48: Number of antlerless deer reportedly shot on respondents' farms in 1994 per antlered bucks taken; segmented by tolerance of crop losses.

County	n	Mean number of antlerless deer shot per antlered buck taken.
Not a problem	48	1.06 (s.d. = 1.01)
Tolerable problem	76	1.37 (s.d. = 1.15)
Intolerable problem	101	3.48 (s.d. = 8.10)
Total	225	2.25 (s.d. = 5.58)
Chi-square = 25.60, df 2, p<0.001		

Table 49: Number of antlerless deer per antlered bucks taken in 1994, reported by respondents with intolerable crop losses and segmented by county.

County	n	Mean number of antlerless deer shot per antlered buck taken.
Calhoun	20	2.11 (s.d. = 1.96)
Montcalm	21	1.63 (s.d. = 1.46)
Oceana	12	1.56 (s.d. = 1.01)
Benzie/Leelanau	12	1.26 (s.d. = 0.80)
Presque Isle	5	2.03 (s.d. = 1.94)
Menominee	31	7.46 (s.d. = 13.78)
Total	101	3.48 (s.d. = 8.10)
F = 2.32, df 5, p = 0.049		

Encouragement of antlerless harvest

Interviews suggested that producers felt that deer hunters were generally unwilling to shoot antlerless deer and that this behavior would restrict the utility of manipulating hunting seasons to control crop losses. We sought to document this behavior in our survey of deer hunters, but we also wished to know to what extent farmers were encouraging the harvest of antlerless deer as some producers indicated that not all producers were using recreational hunting as a damage control tool. Horton and Craven (1995) also indicated that farmers in Wisconsin did not recognize hunting as a specific damage abatement technique.

Nearly 50% of the producers responding to our survey indicated that they did not encourage the harvest of antlerless deer in 1994 (Question #32); however, it is likely that not all producers felt a need to encourage such a harvest. The most common encouragement's offered by producers were either verbal requests to shoot antlerless deer before shooting bucks or distributions of block permits (Table 50). Only 11 respondents indicated that they provided their property tax numbers to hunters so that they might apply for antlerless tags through the private lands lottery; however, because this technique was not mentioned independently as an option on the questionnaire it is likely under represented. It may also be that these permits are not salient in producers' minds as being damage control measures.

Attitude about antlerless harvest by county

Producers from Menominee County, a county in which MDNR personnel estimated the deer density at between 60 and 100 deer/mi², were most likely to encourage

the harvest of antlerless deer (Table 50). Block permits were not available in Benzie and Leelanau Counties in 1994 and could not be offered to encourage antlerless harvest. Why Oceana County producers did not more frequently request hunters to shoot antlerless deer is not known, but it may have something to do with the firearm antlerless season having been closed the 2 years prior to 1994.

Table 50: Percent of respondents reporting having encouraged the harvest of antlerless in study counties in 1994.

County	n	Did not encourage %	Distributed Block Tags %	Requested hunters to shoot antlerless deer first %	Other %
Calhoun	133	42.1	12.8	28.6	9.8
Montcalm	104	43.3	14.4	26.0	17.3
Oceana	115	48.7	13.0	7.8	1.7
Benzie/Leelanau	128	36.7	2.3	13.3	14.1
Presque Isle	52	32.7	19.2	15.4	13.5
Menominee	63	6.3	73.0	63.5	15.9
		$\chi^2=35.32$, df 5, p=0.001	$\chi^2=157.02$, df 5, p<0.001	$\chi^2=83.69$, df 5, p<0.001	$\chi^2=16.90$, df 5, p<0.005

Attitude about antlerless harvest by tolerance

Producers with intolerable losses were more likely to encourage hunters to harvest antlerless deer than both producers with tolerable losses and those without a loss problem (Table 51). Oddly, 17% of producers with intolerable losses did not encourage the harvest of antlerless deer and 43% of those with tolerable problems did not encourage antlerless harvest (Table 51).

Table 51: Percent of producers encouraging antlerless harvest by tolerance of 1994 crop losses.

	n	Did not encourage %	Distribution of block tags %	Requested antlerless deer be shot first %	Other %
Not a problem	152	64.5	1.3	6.6	5.9
Tolerable	179	42.5	12.8	19.6	12.3
Intolerable	240	16.7	32.9	38.3	15.4
		$\chi^2=93.53$, df 2, p<0.001	$\chi^2=67.42$, df 2, p<0.001	$\chi^2=54.27$, df 2, p<0.001	$\chi^2=8.03$, df 2, p=0.018

Implications/Recommendations

The relatively large number of producers who considered losses a problem but did not encourage antlerless harvest should concern MDNR managers, especially those producers whose losses were intolerable. Farmers should be made aware that by encouraging antlerless harvest when loss problems are emerging that they can prevent losses from becoming intolerable for themselves and other farmers in the area.

Adjacent antlerless harvest a problem

Most producers (61%) supported the idea of manipulating hunting season design to reduce deer numbers so that special kill permits to control crop losses are not necessary

(Question #24) (Table 52). Even though several producers indicated that they felt that modifying hunting seasons could help to reduce the need for special kill permits, recreational hunting on its own cannot control all incidents of crop loss. For example, fifty-two percent of the producers indicated that they felt that low deer harvests on adjacent lands were a factor in their inability to control crop losses (Question #24).

Table 52: Percentage of respondents in agreement with the statement, "Hunting seasons should be designed to reduce deer numbers so that special kill permits to control crop losses are not necessary."

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
Hunting seasons should be designed to reduce deer numbers so that special kill permits to control crop losses are not necessary. n=522	31.6%	30.1%	16.4%	12.3%	9.6%

Adjacent antlerless harvest a problem by tolerance

Producers with intolerable losses were most likely to agree that they could not control their losses because not enough deer were harvested during the hunting season on lands adjacent to their farm (77%) (Table 53). Attitudes about harvests on adjacent lands did not differ significantly by county or between hunting and non-hunting farmers (Table 53).

Table 53: Farmer respondents' agreement with the statement, "I cannot control my crop losses because not enough deer are harvested during the hunting season on lands adjacent to my farm," by county, tolerance of loss, hunt participation, shooting and block permit recipients.

		n	Strongly Agree %	Agree %	Undecided %	Disagree %	Strongly Disagree %
County ($\chi^2=40.55$, df 20, $p=0.004$)	Calhoun	155	34.2	25.2	12.9	13.5	14.2
	Montcalm	97	18.6	28.9	16.5	14.4	21.6
	Oceana	106	28.3	20.8	17.9	15.1	17.9
	Benzie/Leelanau	126	26.2	19.0	19.0	19.8	15.9
	Presque Isle	47	29.8	25.5	21.3	6.4	17.0
	Menominee	61	50.8	21.3	8.2	19.7	0.0
Tolerance of loss ($\chi^2=215.98$, df 8, $p<0.001$)	Not a problem	131	6.9	4.6	18.3	23.7	46.6
	Tolerable	162	19.1	31.5	21.0	20.4	8.0
	Intolerable	219	47.5	30.1	12.3	7.8	2.3
	Hunt	411	28.2	20.9	16.5	16.5	17.8
Hunt ($\chi^2=12.94$, df 4, $p=0.012$)	Non-hunt	176	35.8	29.0	13.1	11.9	10.2
	Non-recipient	361	21.3	20.5	17.5	18.8	21.9
	Recipient	146	43.8	31.5	15.1	8.2	1.4
	Block permit recipient	334	21.6	19.5	17.4	19.5	22.2
	Recipient	150	39.3	32.0	15.3	9.3	4.0

Table 54: Farmer respondents' agreement with the statement, "I cannot control my crop losses because not enough deer are harvested during the hunting season on lands adjacent to my farm," by mean farm size and mean percent of gross income generated by farming.

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
n =	147	125	87	82	81
Mean farm size in acres (s.d.) (Kruskal-Wallis $\chi^2=17.29$, df 4, $p=0.002$)	483 (494)	547 (543)	405 (486)	381 (472)	412 (641)
n =	138	113	80	73	69
Mean % of gross income from farming (s.d.) (Kruskal-Wallis $\chi^2=23.34$, df 4, $p=0.001$)	70.3 (31.8)	72.6 (32.8)	63.5 (38.1)	53.3 (37.6)	50.9 (36.5)

Adjacent antlerless harvest a problem by permit recipients

Greater than 70% of both block and shooting permit recipients indicated that they were unable to control their losses for this reason, whereas non-recipients of both types of permits were split on whether this was a reason they could not control their crop losses (Table 53). Similarly, producers with larger farms were more likely to agree that they cannot control losses because of low adjacent harvests than were producers with less acreage, as were producers with a larger proportion of the household gross income generated by farming (Table 54).

Producer Perceptions and Use of Shooting and Block Permits

Other than the promotion of hunting on the farm, Out-of-Season Shooting permits and Crop Depredation Control Bonus Deer Hunting Licenses (Block permits) were the most widely used form of depredation control used by farmers in this survey (29% indicated using block permits, 24% indicated using shooting permits, whereas 44% had promoted hunting on their farm by means other than the distribution of block permits) (Table 37). Because of the important role of these permits in Michigan for deer and crop damage management producers were asked to evaluate certain aspects of these permit systems.

Permit favorability

Producers were not asked directly to indicate whether they approved or disapproved of block and/or shooting permits; however, an index of producer favorability towards the 2 types of permits was obtained through the use of a summated

scale (see Methods). A score of positive 2 was the greatest possible score while a score of negative 2 was the lowest possible score. A score of zero was taken to mean generally undecided or neutral.

The mean favorability of shooting permits was 0.029 or generally undecided. Favorability ratings for the two permit types also differed by county with Menominee county being significantly more favorable towards both shooting and block permits than all other counties (Table 55). Full-time farmers (mean = 0.152) differed from part-time farmers (mean = -0.245), and permit recipients were more favorable than non-recipients. Also hunting participation influenced favorability ratings of shooting permits (Table 56).

The mean favorability of block permits was -0.014 slightly negative but again generally undecided. Block permit favorability also differed between full-time (mean = 0.057) and part-time (mean = -0.175) farmers, and between recipients (mean = 0.323) and non-recipients of permits (mean = -0.194). There were no differences between hunters and non-hunters (Table 57).

Table 55: County mean favorabilities of shooting and block permits.

County	Mean favorability score of shooting permit program (s.d.) n= 513	Mean favorability score of block permit program (s.d.) n= 502
Calhoun	0.0602 (.7459)	-0.0068 (.7814)
Montcalm	-0.1070 (.7777)	0.0327 (.8017)
Oceana	-0.1683 (.6973)	-0.0662 (.8287)
Benzie/Leelanau	0.0804 (.7722)	-0.1944 (.7082)
Presque Isle	-0.2217 (.7557)	-0.1163 (.7566)
Menominee	0.6436 (.7559)	0.4273 (.7228)
Total	0.0288 (.7840)	-0.0144 (.7870)
	KW $\chi^2=53.34$, df 5, $p<0.001$	KW $\chi^2=26.14$, df 5, $p<0.001$

+2 = most favorable, 0 = undecided, -2 = least favorable

Table 56: Farmer respondents' mean favorability toward shooting permits, by hunt participation, job status, and shooting permit recipient.

		n	Mean favorability of shooting permits (s.d.)
Hunt participation Mann-Whitney $z = -4.68$, $p < 0.001$	Non-hunter	151	0.2768 (0.5977)
	Hunter	349	-0.0819 (0.8359)
Job status Mann-Whitney $z = -5.07$, $p < 0.001$	Full-time	354	0.1520 (0.744)
	Part-time	159	-0.2453 (0.804)
Shooting permit recipient Mann-Whitney $z = -8.31$, $p < 0.001$	Non-recipient	356	-0.1618 (0.762)
	Recipient	146	0.4589 (0.665)

Range: +2 = most favorable, 0 = undecided, -2 = least favorable

Table 57: Farmer respondents' mean favorability toward block permits, by hunt participation, job status, and block permit recipient.

		n	Mean favorability of block permits (s.d.)
Hunt participation Mann-Whitney $z = -1.36$, $p = 0.173$	Non-hunter	139	-0.0432 (0.5533)
	Hunter	351	-0.0114 (0.8649)
Job status Mann-Whitney $z = -3.08$, $p = 0.002$	Full-time	348	0.0568 (0.741)
	Part-time	154	-0.1753 (0.864)
Block permit recipient Mann-Whitney $z = -6.90$, $p < 0.001$	Non-recipient	322	-0.1941 (0.752)
	Recipient	147	0.3231 (0.743)

Range: +2 = most favorable, 0 = undecided, -2 = least favorable

Satisfaction with number of permits received in 1994

Most producers who requested either shooting or block permits in 1994 indicated that they received as many permits as they felt they needed (Questions #41 and #48); however, nearly half of shooting permit recipients and a third of block permit recipients indicated that they had not received the permits they needed. This was particularly prevalent in counties where the MDNR was attempting to restrict the antlerless kill to meet DMU goals (Table 58).

The agency may wish to monitor the proportion of dissatisfied recipients and non-recipients as it may be indicative of potential conflicts and an indicator of resentment against the agency. In any case this question should be further investigated with permit holders to determine what affects their satisfaction regarding the number of permits they receive.

Fourteen questions were asked to specifically tap attitudes and perceptions about block and shooting permits which were of interest to researchers and had been suggested by producers. These items composed question number 50 on the survey. Attitudes regarding the shooting and block permits themselves were also related to whether the producer had ever used the respective permits (Tables 59 & 60).

Shooting permits

Recipients generally agreed that shooting permits were distributed fairly and that they were used successfully to control losses within their counties, while non-recipients were undecided or tended to disagree. Recipients disagreed that too many male deer were being shot with shooting permits and that too many deer killed were not being utilized, while non-recipients were undecided or agreed. Both recipients and non-recipients indicated that permits should not be given more readily to growers of high value crops, indicating perhaps that if permits are warranted then it does not matter whether the crop is apples or alfalfa. Both groups were split about whether shooting permits were important because they made producers feel in control of the situation. Recipients and non-recipients for the most part did not feel that neighbor's objections to shooting permit use affected their decision to use the permits, though non-recipients tended to be more undecided. Assuming that non-recipients took the question as "would neighbor's objections influence your decision to use shooting permits", it would appear that most would not worry about upsetting a neighbor if they had a crop loss problem. Of the recipients, 25% indicated that neighbors' objections did influence their use of shooting permits.

Table 59: Producer attitudes regarding specifics of the MDNR shooting permit system by total respondents and whether respondents were ever shooting permit recipients.

Question 50 -- SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree					
	SA	A	U	D	SD
a) In this county, shooting permits are distributed fairly to growers who need them regardless of the value of the crops grown. n=538 All respondents	5.6%	22.5 %	41.8 %	14.1 %	16.0%
n= 376 Non-Recipients of Shooting permits	2.9	12.8	51.9	14.1	18.4
n=150 Shooting permit recipients	11.3	46.7	18.0	15.3	8.7
Mann-Whitney z=-7.03, p<0.001					
b) Shooting permits are successfully used to reduce crop losses in this county. n=532	10.2 %	30.3 %	33.6 %	15.0 %	10.9%
n= 371 Non-Recipients of Shooting permits	4.6	27.2	37.2	16.4	14.6
n=150 Shooting permit recipients	22.7	38.0	24.7	12.0	2.7
Mann-Whitney z=-6.83, p<0.001					
c) In this county, shooting permits should be given more readily to growers of high value crops than to growers of lesser value crops. n=534	6.4%	18.0 %	20.6 %	34.1 %	21.0%
n= 372 Non-Recipients of Shooting permits	5.9	17.7	20.2	33.3	22.8
n=151 Shooting permit recipients	7.3	18.5	23.2	35.1	15.9
No differences					
d) Regardless of whether shooting permits actually reduce crop losses, they are still important to farmers because they at least make farmers feel in control of the situation. n=534	10.5 %	33.5 %	20.8 %	22.5 %	12.7%
n= 377 Non-Recipients of Shooting permits	8.5	35.3	22.8	19.4	14.1
n=146 Shooting permit recipients	14.4	30.8	15.8	28.8	10.3
No differences					
e) My neighbors' objections to the use of shooting permits influences my decision to use them. n=523	4.0%	14.0 %	22.2 %	41.7 %	18.2%
n= 364 Non-Recipients of Shooting permits	4.1	11.0	26.9	40.7	17.3
n=148 Shooting permit recipients	4.1	20.9	10.8	44.6	19.6
No differences					
f) Too many male deer are killed on shooting permits. n=536	11.0 %	17.0 %	33.4 %	25.9 %	12.7%
n= 373 Non-Recipients of Shooting permits	14.5	20.9	37.3	19.8	7.5
n=152 Shooting permit recipients	3.3	8.6	24.3	38.8	25.0
Mann-Whitney z=-8.04, p<0.001					
g) The venison and/or recreation I get by using shooting permits is important to me. n=509	5.7%	10.0 %	23.4 %	31.4 %	29.5%
n= 351 Non-Recipients of Shooting permits	4.8	9.1	28.5	32.2	25.4
n=147 Shooting permit recipients	7.5	12.2	12.9	29.3	38.1
Mann-Whitney z=-1.96, p=0.05					
h) Too many of the deer killed on shooting permits are not utilized. n=533	18.4 %	21.2 %	28.7 %	18.8 %	12.9%
n= 371 Non-Recipients of Shooting permits	22.4	23.2	32.1	14.6	7.8
n=151 Shooting permit recipients	9.9	16.6	19.9	29.1	24.5
Mann-Whitney z=-6.34, p<0.001					

Block permits

Block permit recipients tended to agree that the permits were distributed fairly and were used successfully to control losses within the counties. Non-recipients were undecided or expressed some feelings that the permits were not distributed fairly or were not effective. Non-recipients also tended to be undecided or to disagree with the items concerning crop value, farmer control, neighboring influence, and meat and recreational benefit. Recipients felt that crop type should not be a basis for permit distribution, and were not influenced by neighboring objections to permit use. Recipients were split on whether block permits were important solely because they gave the farmer perceived control of the situation, and were also split on whether meat and recreation acquired through block permit use were personally important (Table 60).

Table 60: Producer attitudes regarding specifics of the MDNR block permit assistance program by total respondents and whether respondents were ever block permit recipients.

Question 50 – SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree					
	SA	A	U	D	SD
i) In this county, block permits are distributed fairly to growers who need them regardless of the value of the crops grown. n=524 All respondents	7.8 %	26.7 %	40.6 %	11.3 %	13.5 %
n= 339 Non-block permit recipients	2.4	17.7	51.3	10.9	17.7
n=152 Block permit recipients	17.1	44.7	18.4	13.2	6.6
Mann-Whitney z=-7.53, p<0.001					
j) Block permits are successfully used to reduce crop losses in this county. n=527 All respondents	14.2 %	33.6 %	31.1 %	10.8 %	10.2 %
n= 337 Non-block permit recipients	4.5	28.2	40.7	13.9	12.8
n=155 Block permit recipients	32.9	43.2	12.3	5.2	6.5
Mann-Whitney z=-9.10, p<0.001					
k) In this county, block permits should be given more readily to growers of high value crops than to growers of lesser value crops. n=530 All respondents	4.9 %	14.7 %	23.0 %	35.5 %	21.9 %
n= 340 Non-block permit recipients	2.9	14.4	25.9	34.4	22.4
No differences n=154 Block permit recipients	7.1	14.9	15.6	41.6	20.8
l) Regardless of whether block permits actually reduce crop losses, they are still important to farmers because they at least make farmers feel in control of the situation. n=526 All respondents	9.3 %	33.1 %	23.2 %	20.5 %	13.9 %
n= 342 Non-block permit recipients	6.7	33.6	26.3	17.0	16.4
n=149 Block permit recipients	12.8	36.9	16.1	25.5	8.7
Mann-Whitney z=-7.54, p<0.001					
m) My neighbors' objections to the use of block permits influences my decision to use them. n=517 All respondents	2.9 %	8.1 %	21.9 %	44.1 %	23.0 %
n= 333 Non-block permit recipients	3.0	9.9	27.0	39.6	20.4
n=150 Block permit recipients	3.3	5.3	8.0	55.3	28.0
Mann-Whitney z=-4.03, p<0.001					
n) The venison and/or recreation I get by using block permits is important to me. n=514 All respondents	7.0 %	14.8 %	24.9 %	31.3 %	22.0 %
n= 327 Non-block permit recipients	5.2	9.5	31.5	33.0	20.8
n=152 Block permit recipients	10.5	26.3	12.5	27.6	23.0
Mann-Whitney z=-1.95, p=0.05					

Open-ended producer comments about special permits

Producers were also given the opportunity to make comments regarding the shooting and block permit systems (Questions #52 and #53). Two-hundred and thirty-six of the respondents made additional comments concerning the shooting permit system, and 237 made comments concerning the block permit system.

Shooting permits

The most frequently made comments about the shooting permit system were that the rules were too restrictive (23%) and that the practice of issuing shooting permits should be stopped (12%). Producers from Menominee County and fruit counties more frequently made comments that the shooting permit rules were too restrictive. Their comments ranged from simplifying the application procedure to extending the shooting hours and making the permits available earlier in the growing season. Producers from Presque Isle County more frequently expressed concerns about better monitoring the use of the permits and reducing waste and gut shooting which are perceived associated with the shooting permits (Table 61).

Block permits

The most frequently made comments about the block permit system were that they should be distributed more equitably amongst farmers (16%), that the practice of issuing block permits should be stopped (12%), that the rules were too restrictive (11%), and that no fee should be charged to the farmer (10%). When examined by county Benzie/Leelanau producers more frequently cited making block permits available as a

concern in their comments (Table 61). (Block permits were not issued the year preceding the survey in these counties.)

Table 61: Open-ended comments made by farmer respondents regarding the shooting and block permit programs. Reported as frequencies and as percent of respondents making comments.

	Shooting permits (n=236)		Block permits (n=237)	
	Frequency	Percent	Frequency	Percent
Stop or eliminate them	29	12.3	28	11.8
Rules too restrictive	54	22.9	27	11.4
Reduce the number given	11	4.7	9	3.8
No fee / right to protect property	7	3.0	24	10.1
Require public hunting access	10	4.2	14	5.9
Verify need and damage	9	3.8	12	5.1
Allow landowner/shooter to keep deer	12	5.1	1	0.4
Require non-lethal control attempts	3	1.3	0	0
Make tags available to all (fairness)	17	7.2	37	15.6
Increase regular antlerless tags	16	6.8	20	8.4
Restrict the number per farm	2	0.8	5	2.1
Monitor use (sale, areas, shooting)	13	5.5	18	7.6
Reduce waste and gut shooting	17	7.2	3	1.3
Unaware of permits and obtaining	14	5.9	11	4.6
Other comments supportive	13	5.5	23	9.7
Other comments non-supportive	9	3.8	5	2.1

Implications/Recommendations

The MDNR may be able to gain greater acceptance of the permit programs if producer concerns about the permits are addressed. Re-examining the regulations and purpose of permit programs may suggest ways to increase the effectiveness of permits and coordination with the Law Enforcement Division may lessen producer complaints about harassment in implementing damage control.

Acceptable criteria for evaluating need for special permits

Producers were asked what should be considered by the MDNR when issuing permits to a producer for killing deer to control crop losses (Question #51). More than 50% of the producers indicated that the financial dependence of the farmer on the crop, the willingness of the farmer to allow hunting on the farm, and the extent that non-lethal control had been attempted should be considered when issuing permits to kill deer (Table 61).

Table 62: Producer approval of selected criteria for determining eligibility for receiving shooting and block permits.

	n	Financial dependence	Non-lethal control attempted	Hunting access allowed	Ability & willingness to plant elsewhere	Other
Non-recipients of permits	353	55%	47%	58.9%	17.8%	2.5%
Recipients of permits	206	65%	47.1%	51.5%	9.2%	3.9%
	559	$\chi^2=4.88$, df 1, p=0.027	$\chi^2=0.003$, df 1, p=0.959	$\chi^2=2.95$, df 1, p=0.086	$\chi^2=7.72$, df 1, p=0.005	$\chi^2=0.784$, df 1, p=0.375

Implications/Recommendations

Interpretation of results concerning financial dependence as a criteria for determining eligibility for receiving shooting and block permits needs to be done cautiously as there is a possible validity problem. Producers may have responded affirmatively to the item not because they felt a certain level or amount of dependence on the crop should be required (this was the intent of the question), but rather because they felt the agency should generally realize that farmers are dependent on the crops they raise.

There are many indications that a blanket policy of meeting absolute qualification standards for damage control assistance is inappropriate. Damage control must be handled on a case by case basis; however, it appears farmers would support the evaluation of standard aspects of each situation. Though half of the producers felt that whether hunting access is allowed should be considered when issuing permits, this does not mean that half the producers would support mandatory open access to qualify for permits. There has been resistance to this sort of requirement in Wisconsin (Horton and Craven 1995). Managers might address the issue of hunting with affected farmers and encourage appropriate use of hunting as a control.

Producers' Perceptions and Attitudes about Deer Density

Perceived deer population trends

Trends by county

Most producers perceived deer numbers to be increasing in their counties over the past five years (Question #59) (Table 63). Different patterns in perceived trends were found across counties ($\chi^2 = 35.89$, df 10, $p < 0.001$). Presque Isle, Oceana, and Benzie/Leelanau producers estimates of population trends were in line with MDNR estimates; however, Calhoun, Menominee, and Montcalm county farmers differed from MDNR estimates (Figure 13).

Trends by tolerance

Producers who considered their 1994 losses to be intolerable were more likely that those with tolerable losses to perceive the deer herd as increasing regardless of county ($\chi^2 = 118.62$, df 4, $p < 0.001$). Likewise, producers with tolerable 1994 losses but previously intolerable losses were more likely to perceive that the deer herd in their county was decreasing than producers whose 1994 losses remained intolerable. This supports Decker et al. (1981) findings that producer beliefs about deer population trends are associated with the producer's experience with crop loss (Table 63).

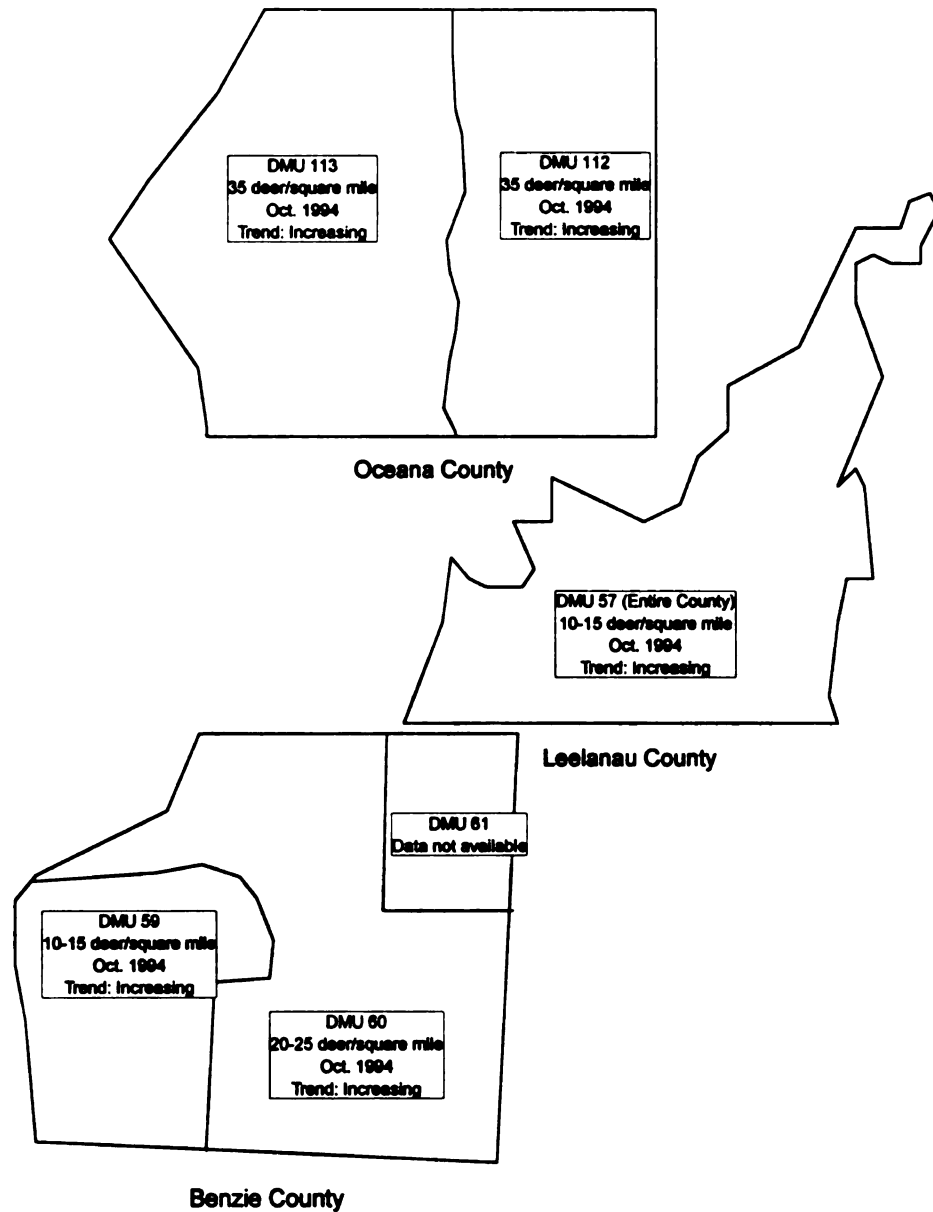


Figure 13: Deer Management Units (DMU) within each study county showing MDNR deer density indices (Oct. 1994) and MDNR judgment of trend in deer numbers over past 5 years within DMU's. Density indices are not estimates of the absolute number of deer in the DMU's. Maps are not to scale.

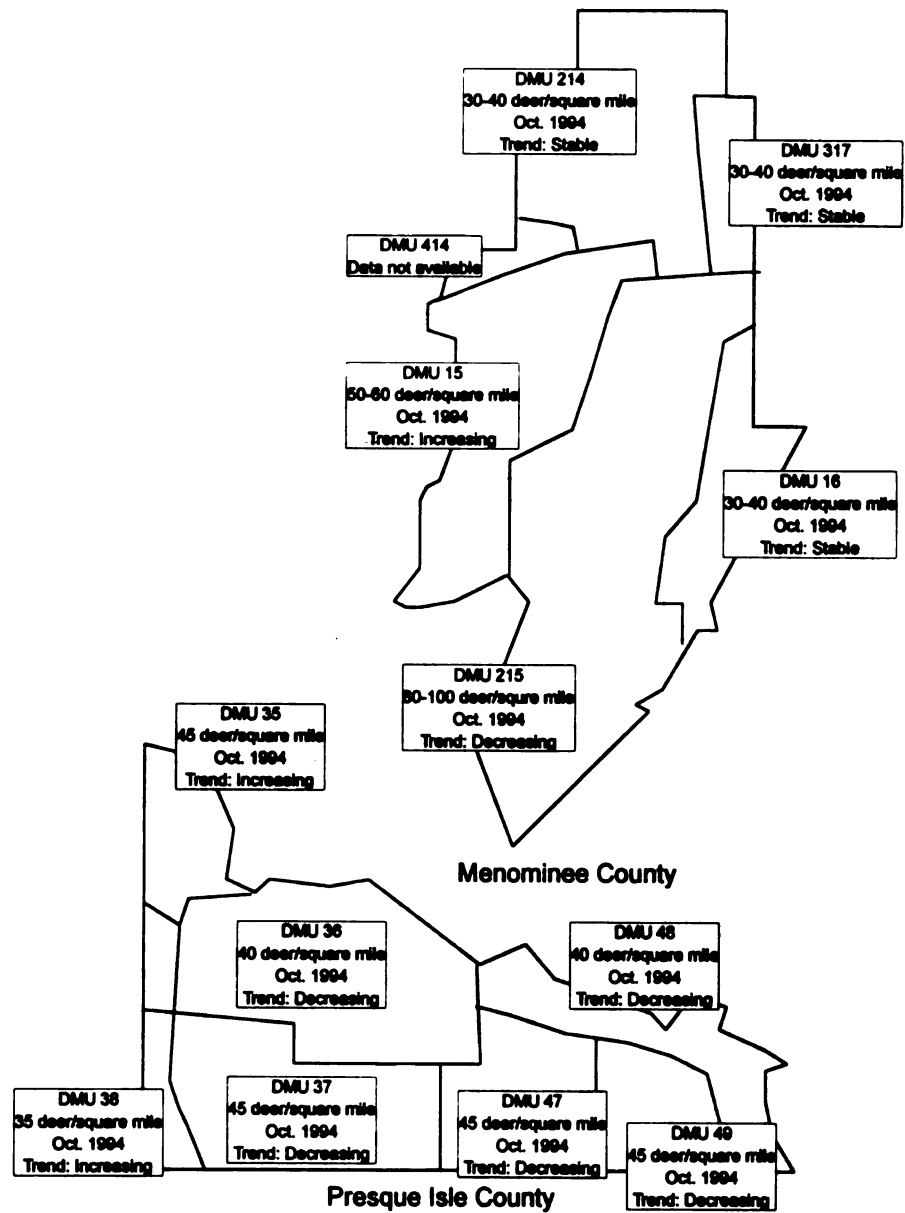


Figure 13: Continued

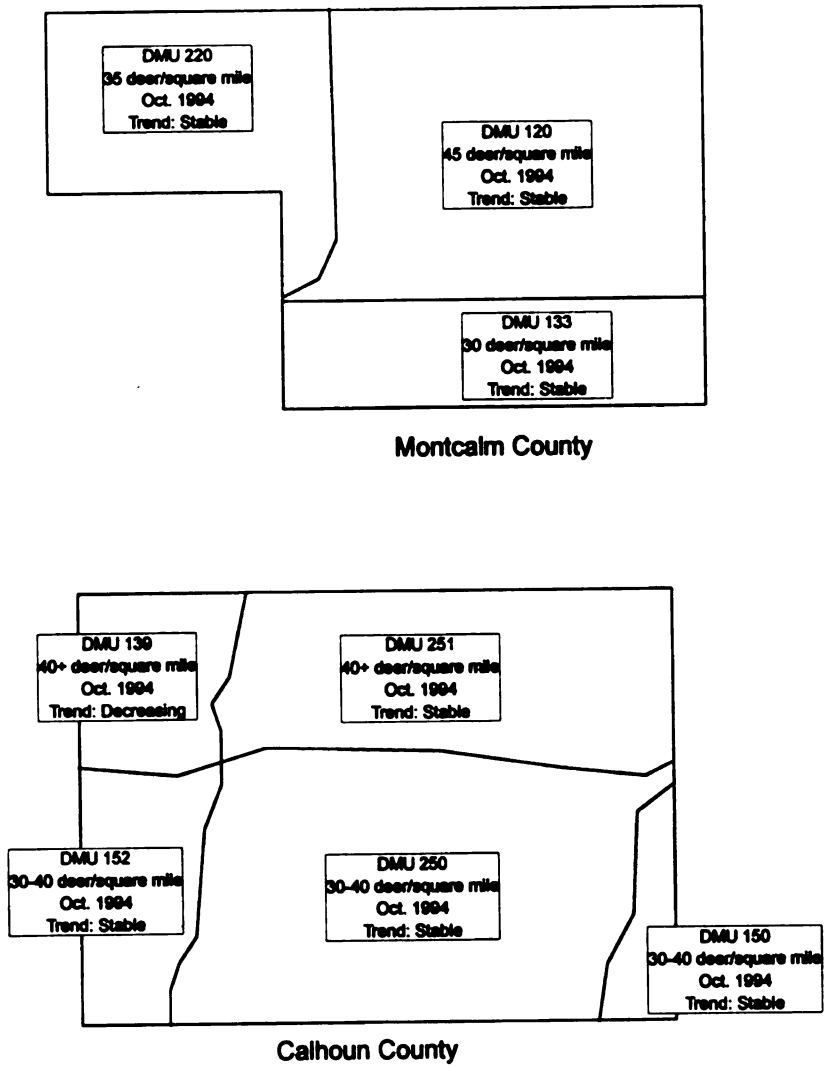


Figure 13: Continued

Table 63: Farmer respondents perceptions of deer population trends over the last 5 years, by county, tolerance of loss, hunting participation, and job status.

		n	Increasing %	About the same each year %	Decreasing %	I don't know %
County ($\chi^2=39.01$, df 15, $p<0.001$)	Calhoun	129	51.9	30.2	16.3	1.6
	Montcalm	98	32.7	28.6	36.7	2.0
	Oceana	108	50.0	30.6	18.5	0.9
	Benzie/Leelanau	120	47.5	33.3	16.7	2.5
	Presque Isle	49	22.4	42.9	34.7	0.0
	Menominee	58	51.7	37.9	10.3	0.0
Tolerance of loss ($\chi^2=119.46$, df 6, $p<0.001$)	Not a problem	147	17.0	34.7	46.3	2.0
	Tolerable	173	41.6	35.8	20.8	1.7
	Intolerable	227	65.6	27.8	5.7	0.9
Hunting participation ($\chi^2=11.59$, df 3, $p=0.008$)	Non-hunter	164	53.0	31.1	13.4	2.4
	Hunter	384	41.7	32.8	24.5	1.0
Job status ($\chi^2=29.32$, df 3, $p<0.001$)	Full-time	386	51.8	30.1	17.4	0.8
	Part-time	176	29.0	38.1	30.1	2.8

Note: χ^2 values presented in the text differ from those presented in this table, because respondents who checked the "I don't know" option were excluded from the comparisons done in the text.

Trends by job status and hunting participation

Approximately half (52%) of the full-time farmer respondents perceived deer populations as increasing in their counties, whereas part-time farmers reported all 3 trends equally ($\chi^2= 25.87$, df 2, $p<0.001$) (Table 63). Hunting producers were more likely than non-hunting producers to perceive the herd size as decreasing in their counties ($\chi^2= 10.09$, df 2, $p<0.007$) (Table 63).

Implications/Recommendations

It appears that producer perceptions of deer population trends are related to their underlying financial conditions and/or recreational values. If producers perceive that their financial security is at risk from deer depredation they appear to express beliefs

about the deer herd in concert with that perception of risk. Similarly those producers who value the recreation provided by deer hunting appear to express beliefs consistent with a perception that their recreational enjoyment is at risk. This knowledge may allow MDNR managers to target these perceptions of risk with information that places the amount of risk in context or its proper light.

Estimated deer densities

To support and augment work by Minnis (1996) on a cultural carrying capacity framework this questionnaire asked producers to estimate the October 1994 deer density (deer/mi²) in the portion of the county in which they did the majority of their farming and to indicate what deer densities they would consider most acceptable and intolerable. It was hypothesized that producers might have both a *Minimum Demand* for deer (a number below which they would not find tolerable because benefits they derive from deer would cease to exist), and a *maximum (Wildlife) Acceptance Capacity* for deer (a number above which additional deer would cause intolerable crop losses or otherwise incur intolerable costs to the farmer). Minnis and Peyton (1995) labeled the range of deer densities between these intolerable numbers as the “latitude of acceptance.” This section applies the work of Minnis (1996) by defining the latitude of acceptance for various farmer segments from each study county and regions within counties. Latitudes of acceptance are plotted relative to producer perceptions about the number of deer in their portion of the county in October 1994. Minimum Demand, Desired levels, and Wildlife Acceptance Capacity are therefore presented as a proportion of the producer’s estimate of the number

of deer present in his area in October 1994. MDNR density estimates are provided for reference although it should be noted that farmers may actually have experienced a much higher or much lower absolute density because of distributional differences within counties.

Table 64: Farmer respondents' beliefs about the most desirable number of deer per square mile , by tolerance of loss, hunt participation, farm type, and job status.

		n	Most desirable number of deer mean deer/mile ² (s.d.)
Tolerance of loss (Kruskal-Wallis $\chi^2=19.65$, df 2, $p<0.001$)	Not a problem	67	25 (30)
	Tolerable	80	14 (17)
	Intolerable	153	14 (15)
Hunt participation (Mann-Whitney $z=-3.54$, $p<0.001$)	Non-hunter	87	13 (18)
	Hunter	212	18 (21)
Farm type (Kruskal-Wallis $\chi^2=23.32$, df 5, $p<0.001$)	Livestock	70	23 (25)
	Cash crops	73	18 (22)
	Fruit/trees	47	9 (12)
	Livestock mixed	11	9 (6)
	Cash crops mixed	44	18 (31)
	Fruit/trees mixed	39	16 (14)
Job status (Mann-Whitney $z=-1.31$, $p=0.190$)	Full-time	212	15 (19)
	Part-time	94	20 (28)

Table 65: Farmer respondents' beliefs about the minimum number of deer per square mile they would tolerate in their county, by tolerance of loss, hunt participation, farm type, and job status.

		n	Lowest acceptable number of deer mean deer/mile ² (s.d.)
Tolerance of loss (Kruskal-Wallis $\chi^2=30.05$, df 2, $p<0.001$)	Not a problem	65	17 (22)
	Tolerable	72	10 (13)
	Intolerable	123	7 (10)
Hunt participation (Mann-Whitney $z=-3.53$, $p<0.001$)	Non-hunter	74	8 (12)
	Hunter	187	12 (16)
Farm type (Kruskal-Wallis $\chi^2=16.72$, df 5, $p=0.005$)	Livestock	64	13 (15)
	Cash crops	57	11 (11)
	Fruit/trees	39	6 (6)
	Livestock mixed	12	5 (4)
	Cash crops mixed	37	11 (24)
	Fruit/trees mixed	38	11 (11)
Job status (Mann-Whitney $z=-1.46$, $p=0.144$)	Full-time	181	10 (12)
	Part-time	83	13 (21)

Table 66: Farmer respondents' beliefs about the greatest number of deer per square mile (Wildlife Acceptance Capacity) they would tolerate in their county, by tolerance of loss, hunt participation, farm type, and job status.

		n	Greatest acceptable number of deer mean deer/mile ² (s.d.)
Tolerance of loss (Kruskal-Wallis $\chi^2=12.39$, df 2, $p=0.002$)	Not a problem	64	34 (38)
	Tolerable	73	26 (30)
	Intolerable	137	20 (23)
Hunt participation (Mann-Whitney $z=-3.02$, $p=0.003$)	Non-hunter	72	21 (31)
	Hunter	202	26 (29)
Farm type (Kruskal-Wallis $\chi^2=16.05$, df 5, $p=0.007$)	Livestock	71	30 (32)
	Cash crops	62	28 (30)
	Fruit/trees	43	15 (16)
	Livestock mixed	11	18 (12)
	Cash crops mixed	37	27 (43)
	Fruit/trees mixed	38	23 (19)
Job status (Mann-Whitney $z=-0.55$, $p=0.580$)	Full-time	194	24 (27)
	Part-time	84	26 (34)

Table 67: Farmer respondents' perceptions of the number of deer per square mile in their county in October, 1994, by tolerance of loss, hunt participation, farm type, and job status.

		n	Estimated mean number of deer in county during October, 1994. mean deer/mile ² (s.d.)
Tolerance of loss (Kruskal-Wallis $\chi^2=46.95$, df 2, $p<0.001$)	Not a problem	77	21 (23)
	Tolerable	98	37 (47)
	Intolerable	147	56 (56)
Hunt participation (Mann-Whitney $z=-2.10$, $p=0.036$)	Non-hunter	83	50 (52)
	Hunter	239	39 (48)
Farm type (Kruskal-Wallis $\chi^2=13.41$, df 5, $p=0.020$)	Livestock	73	63 (75)
	Cash crops	78	40 (51)
	Fruit/trees	45	29 (34)
	Livestock mixed	15	32 (28)
	Cash crops mixed	54	36 (36)
	Fruit/trees mixed	43	43 (39)
Job status (Mann-Whitney $z=-3.42$, $p<0.001$)	Full-time	225	48 (57)
	Part-time	105	32 (40)

Though these tables illustrate possible relationships between producer desired numbers of deer and selected variables, analysis of variance controlling for the effects of county revealed main effects only for tolerance of loss ($F = 6.28$, $df\ 2$, $p = 0.002$). Those producers who did not perceive their 1994 losses as a problem desired higher deer densities than did producers who considered their losses a problem regardless of the deer density in the county in which they farmed and regardless of whether the producer hunted deer. This appears to support the hypothesis that producers attitudes about deer numbers are most influenced by their perceptions of the amount of loss incurred to deer.

Table 68: Producer perceptions of deer densities that are desirable, minimal, and intolerable (WAC) expressed as a proportion of perceived October 1994 deer densities; segmented by crop types within DMU's with similar deer densities (e.g. Perceived densities considered desirable, minimal, and intolerable.)

County	Farm type	n		Mean	25th. pct.	75th. pct.
Presque Isle MDNR estimate: 40-45 deer/square mile	Livestock	9	Min. Demand	.34	.14	.60
		11	Desired	.57	.38	.88
		9	W.A.C.	.80	.49	1.23
	Cash Crops	6	Min. Demand	.24	.14	.40
		8	Desired	.50	.37	.62
		7	W.A.C.	.82	.57	1.07
	Trees or fruit	4	Min. Demand	.64	.44	.92
		2	Desired	.83	.67	1.00
		3	W.A.C.	1.44	1.00	2.00
Oceana MDNR estimate: 35 deer/square mile	Livestock	5	Min. Demand	1.29	.46	2.42
		7	Desired	1.51	.36	1.50
		7	W.A.C.	2.32	.56	2.00
	Cash Crops	19	Min. Demand	.65	.04	1.14
		24	Desired	1.03	.16	1.66
		19	W.A.C.	1.49	.20	2.00
	Trees or fruit	14	Min. Demand	.62	.20	.78
		19	Desired	.82	.29	1.20
		15	W.A.C.	1.36	.40	2.00
Benzie/Leelanau (57 & 59) MDNR estimate: 10-15 deer/square mile	Livestock	5	Min. Demand	.79	.37	1.32
		4	Desired	.69	.44	.95
		5	W.A.C.	1.76	.62	3.18
	Cash Crops	9	Min. Demand	.33	.17	.42
		9	Desired	.49	.25	.78
		9	W.A.C.	1.54	.43	2.43
	Trees or fruit	22	Min. Demand	.37	.03	.66
		24	Desired	.55	.12	.99
		25	W.A.C.	.80	.14	1.47
Menominee (215) MDNR estimate: 80-100 deer/square mile	Livestock	15	Min. Demand	.18	.03	.27
		16	Desired	.33	.11	.50
		16	W.A.C.	.51	.15	.66
	Cash Crops	3	Min. Demand	.25	.00	.60
		3	Desired	.32	.01	.60
		3	W.A.C.	.48	.02	1.00
	Trees or fruit	3	Min. Demand	.19	.11	.25
		3	Desired	.34	.27	.39
		3	W.A.C.	.44	.33	.56
Calhoun (South)(139,250,150) MDNR estimate: 30-40 deer/square mile	Livestock	7	Min. Demand	.51	.22	.67
		9	Desired	.91	.49	1.12
		9	W.A.C.	1.31	.70	1.75
	Cash Crops	18	Min. Demand	.22	.05	.40
		24	Desired	.40	.14	.64
		18	W.A.C.	.70	.16	1.22
	Trees or fruit	4	Min. Demand	.60	.43	.75
		6	Desired	.60	.25	.91
		6	W.A.C.	1.19	.25	1.87
Calhoun (North)(139&251) MDNR estimate: 40+ deer/square mile	Livestock	3	Min. Demand	1.80	.44	4.29
		5	Desired	1.66	.69	2.94
		4	W.A.C.	2.91	1.44	5.00
	Cash Crops	5	Min. Demand	.49	.12	.89
		6	Desired	.58	.13	.98
		5	W.A.C.	1.34	.33	2.57
	Trees or fruit	2	Min. Demand	.26	.12	.40
		2	Desired	.78	.35	1.20
		2	W.A.C.	1.24	.47	2.00

Table 68: Continued

County	Farm type	n		Mean	25th. pct.	75th. pct.
Montcalm (220&133) MDNR estimate: 30-35 deer/square mile	Livestock	6	Min. Demand	.26	.01	.43
		5	Desired	.52	.20	.87
		5	W.A.C.	.63	.27	1.04
	Cash Crops	6	Min. Demand	.65	.16	1.20
		10	Desired	.77	.33	1.22
		6	W.A.C.	1.43	.61	2.10
	Trees or fruit	4	Min. Demand	.28	.03	.61
		4	Desired	.43	.18	.83
		3	W.A.C.	.47	.33	.64
Montcalm (120) MDNR estimate: 45 deer/square mile	Livestock	7	Min. Demand	.52	.11	.70
		6	Desired	.48	.30	.72
		6	W.A.C.	.68	.39	.88
	Cash Crops	12	Min. Demand	.47	.29	.63
		13	Desired	.64	.33	.88
		13	W.A.C.	1.02	.48	1.58
	Trees or fruit	4	Min. Demand	.09	.04	.13
		4	Desired	.10	.03	.22
		4	W.A.C.	.22	.20	.26

Table 69: Producer perceptions of deer densities that are desirable, minimal, and intolerable (WAC) expressed as a proportion of the perceived October 1994 deer densities. Shown by county and segmented by DMU's with similar deer densities.

County	Farm type	n		Mean	25th. pct.	75th. pct.
Presque Isle MDNR estimate: 40-45 deer/square mile	Overall	19	Min. Demand	.37	.18	.44
		21	Desired	.57	.38	.67
		19	W.A.C.	.91	.60	1.28
Oceana MDNR estimate: 35 deer/square mile	Overall	39	Min. Demand	.73	.13	1.11
		51	Desired	1.03	.29	1.50
		42	W.A.C.	1.60	.39	2.00
	East: 112	7	Min. Demand	.78	.03	.67
		12	Desired	1.03	.27	1.25
		8	W.A.C.	1.73	.04	1.92
	West: 113	25	Min. Demand	.60	.10	.92
		32	Desired	.85	.29	1.38
		27	W.A.C.	1.32	.40	2.00
Benzie/Leelanau (57 & 59) MDNR estimate: 10-15 deer/square mile	Overall	38	Min. Demand	.43	.07	.64
		40	Desired	.65	.18	.99
		41	W.A.C.	1.15	.28	1.55
Menominee (215) MDNR estimate: 80-100 deer/square mile	Overall	22	Min. Demand	.19	.04	.27
		23	Desired	.33	.11	.50
		23	W.A.C.	.49	.23	.64
Calhoun MDNR estimate: 30-40 deer/square mile MDNR estimate: 40+ deer/square mile	Overall	50	Min. Demand	.46	.08	.60
		67	Desired	.62	.18	.86
		57	W.A.C.	1.10	.30	1.43
	South: 152,250,150	31	Min. Demand	.32	.07	.57
		43	Desired	.51	.16	.80
		36	W.A.C.	.89	.24	1.41
	North: 139, 251	13	Min. Demand	.75	.13	.91
		17	Desired	.87	.19	1.17
		14	W.A.C.	1.62	.40	2.17
Montcalm (220&133) MDNR estimate: 30-35 deer/square mile MDNR estimate: 45 deer/square mile	Overall	47	Min. Demand	.54	.13	.80
		49	Desired	.73	.30	1.00
		43	W.A.C.	1.07	.44	1.60
	East : 120	24	Min. Demand	.47	.14	.65
		24	Desired	.61	.27	.79
		24	W.A.C.	.89	.31	1.43
	South/West: 220, 133	18	Min. Demand	.54	.13	.98
		21	Desired	.80	.33	1.15
		16	W.A.C.	1.14	.47	1.73

Cultural Carrying Capacity Response Curves

To graphically illustrate producer deer density preferences Cultural Carrying Capacity response curves (Minnis 1996) were plotted for selected producer segments. The exploratory nature of this analysis and portion of the results needs to be emphasized and readers should evaluate this methodology for its potential and seek to refine the methodology.

The left-hand points of the curves represent the Minimum Demand of producers, while the right-hand points represent the Wildlife Acceptance Capacity of producers for deer. The most desirable deer density as indicated by each segment of producers is represented by the apex of each curve. Though each of these points is representative of a deer density they are presented as a ratio of 1994 producer perceived densities rather than as deer/mi² figures. The vertical dashed line at point 1 on each curve represents the 1994 perceived deer density. MDNR density indices are provided with each graph as these indices are the best estimates of population size for each county; however, these may be inadequate because of differences in deer distribution which may cause some farmers to be reacting to more or less deer than the MDNR figure.

The preponderance of county means desiring a 40% reduction in the October 1994 deer herd suggests that between 18-24 deer/mi² might be an appropriate October population density target for farmers, although we must recognize that there is substantial variance around these means.

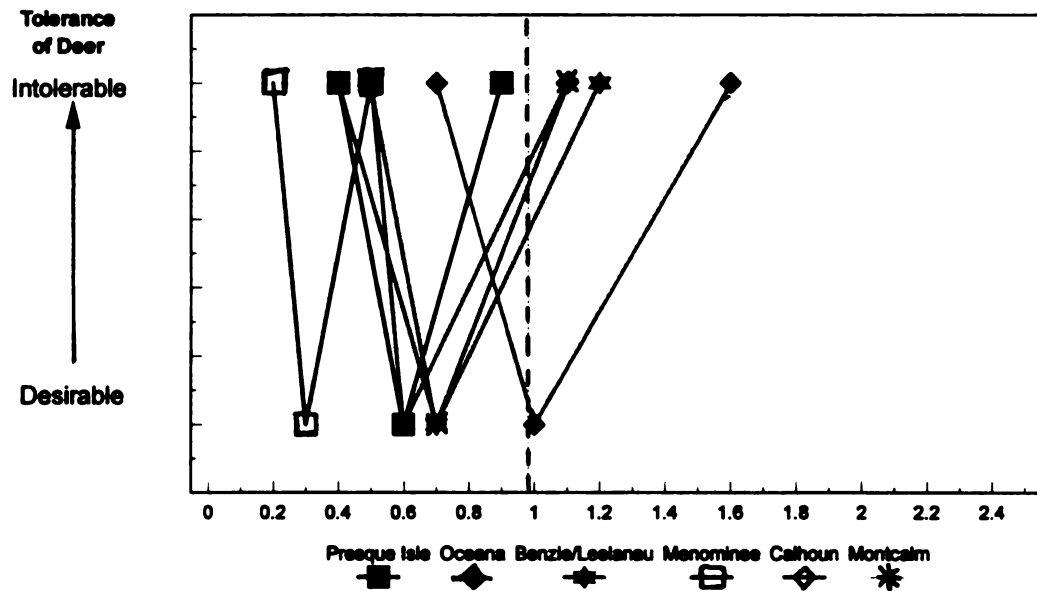


Figure 14: Cultural Carrying Capacity response curves for farmers in each study county. Horizontal axis is the average percent of the MDNR October 1994 deer density, which producers found desirable and intolerable. The current condition in October of 1994 is represented by the value 1. (i.e. Only Oceana County farmers found the October 1994 density desirable, while Menominee County farmers desired a deer density approximately 70% less than the October 1994 density.) The vertical axis is attitude toward the deer density measured as Intolerable and desirable. The 3 points on the curves represent producers' minimum deer density demand, most desirable density, and deer acceptance capacity.

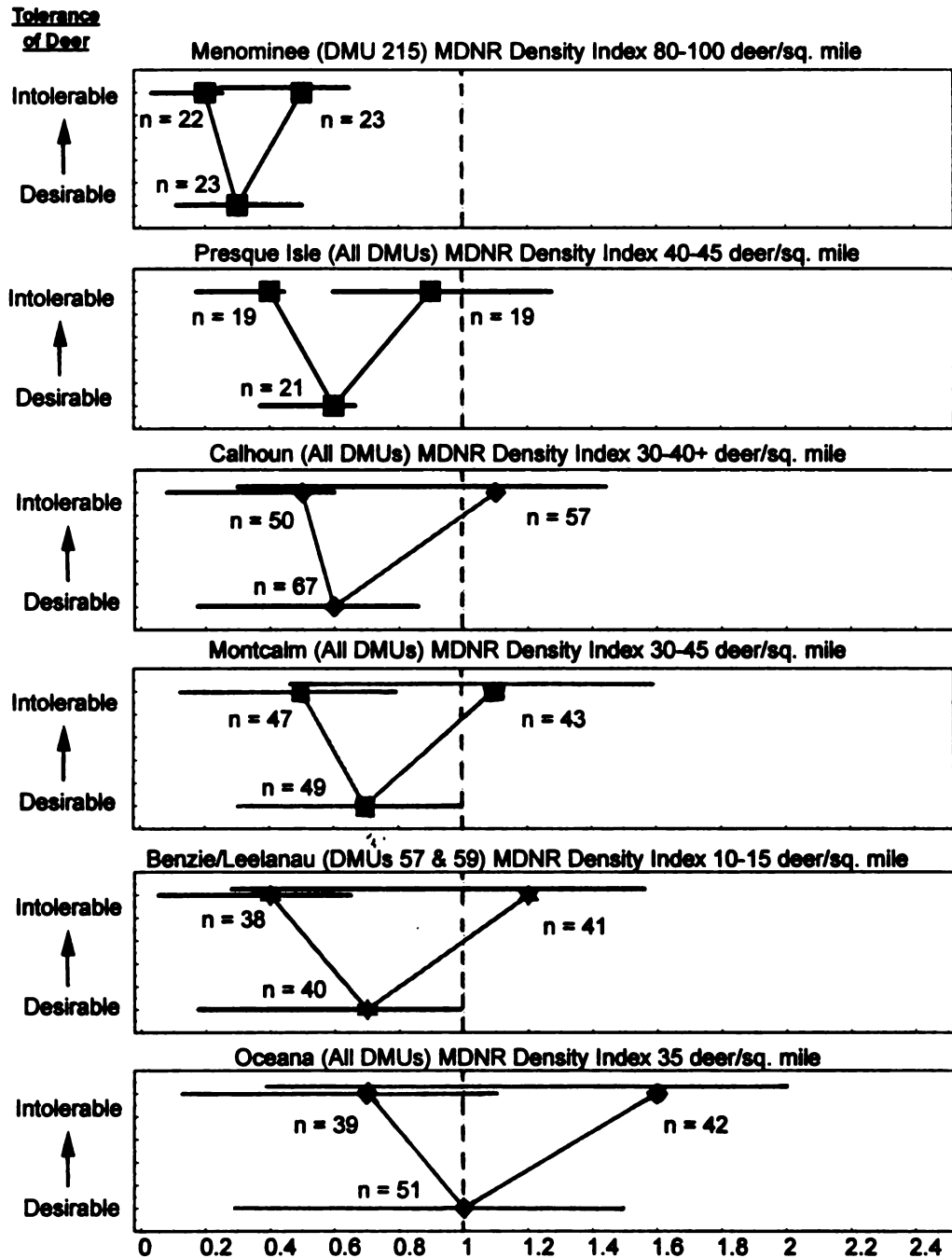


Figure 15: CCC distributions by county and similar October 1994 deer densities. The horizontal bars included on the graphs are the interquartile ranges of each point.

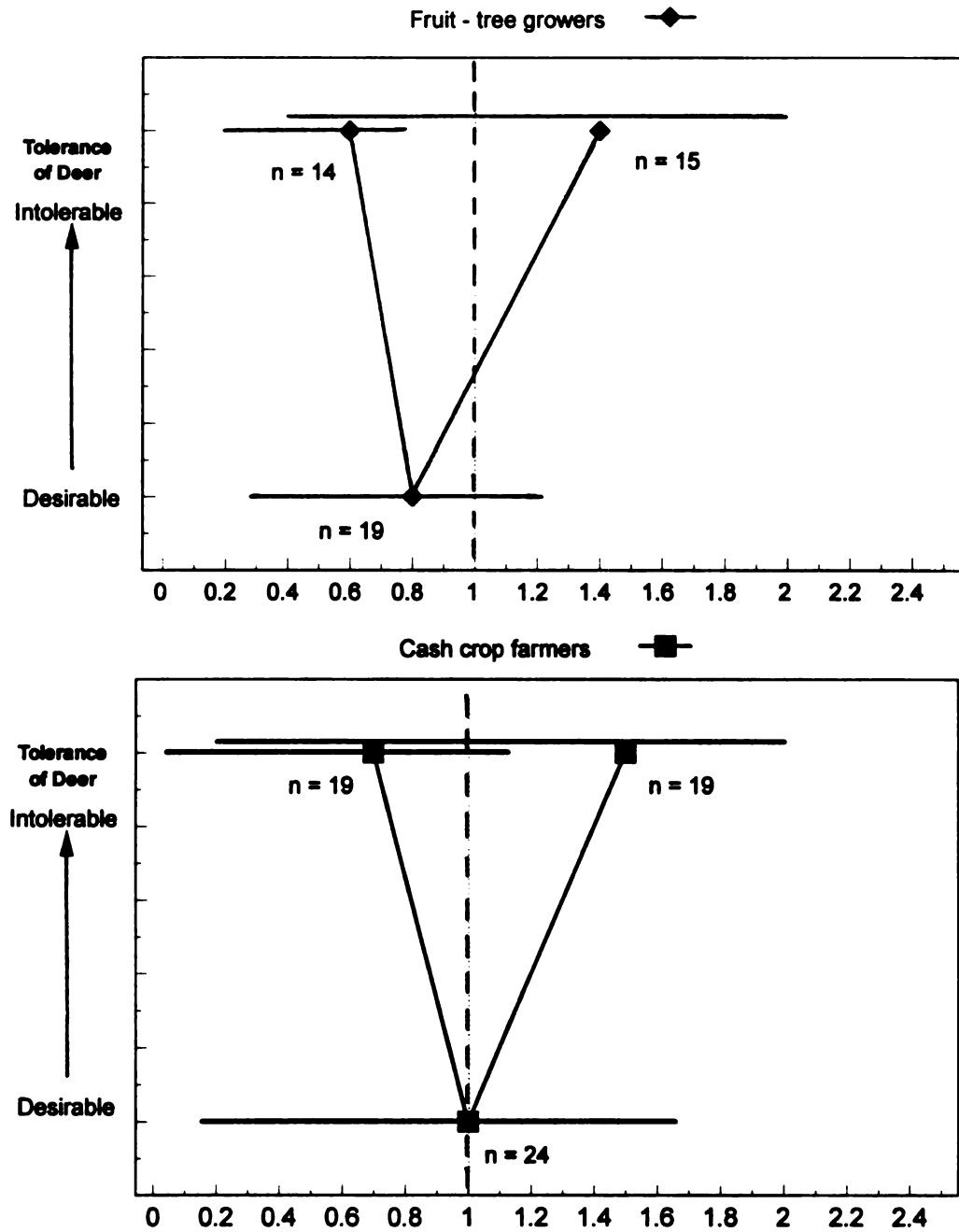


Figure 16: Oceana County CCC distributions segmented by farmtype. The horizontal bars included on the graphs are the interquartile ranges of each point.

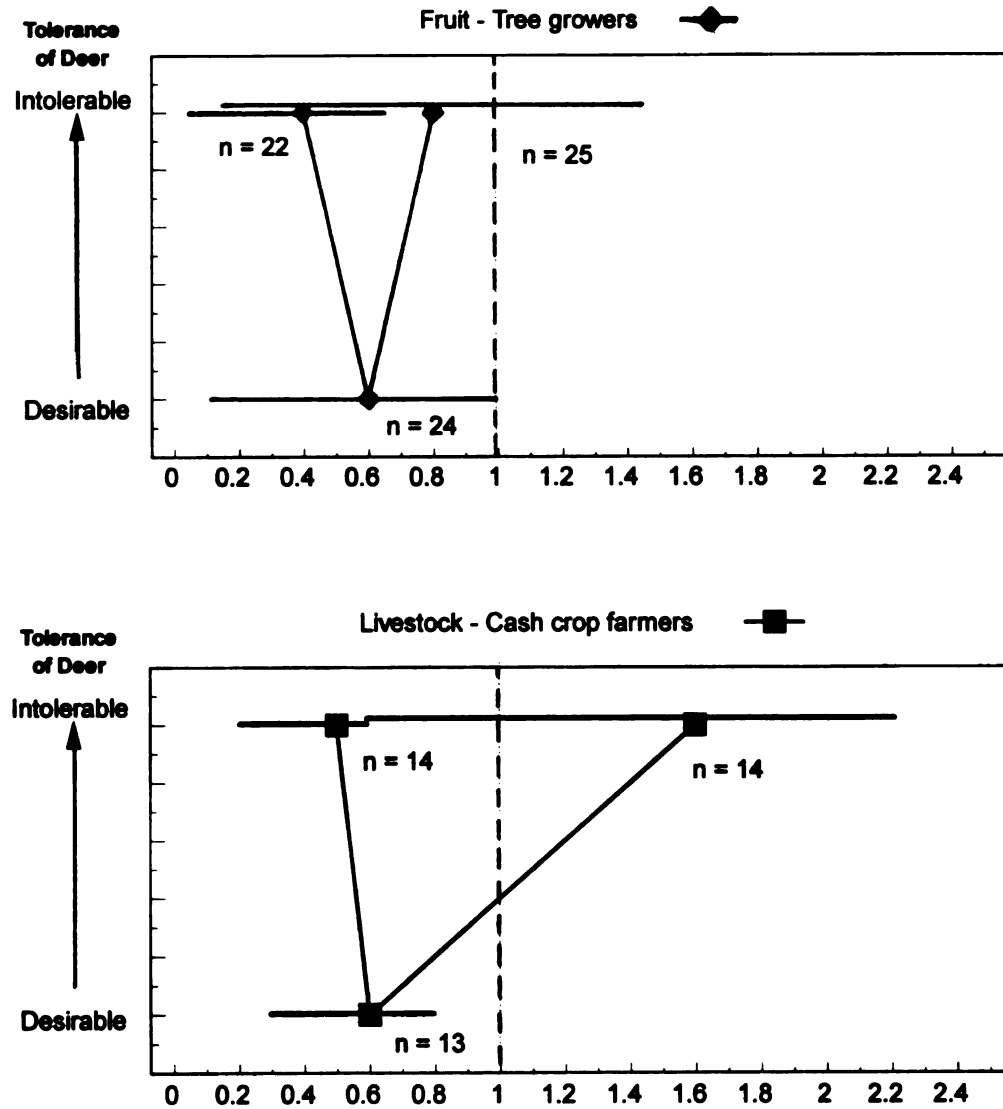


Figure 17: Benzie/Leelanau CCC distributions segmented by farmtype. The horizontal bars included on the graphs are the interquartile ranges of each point.

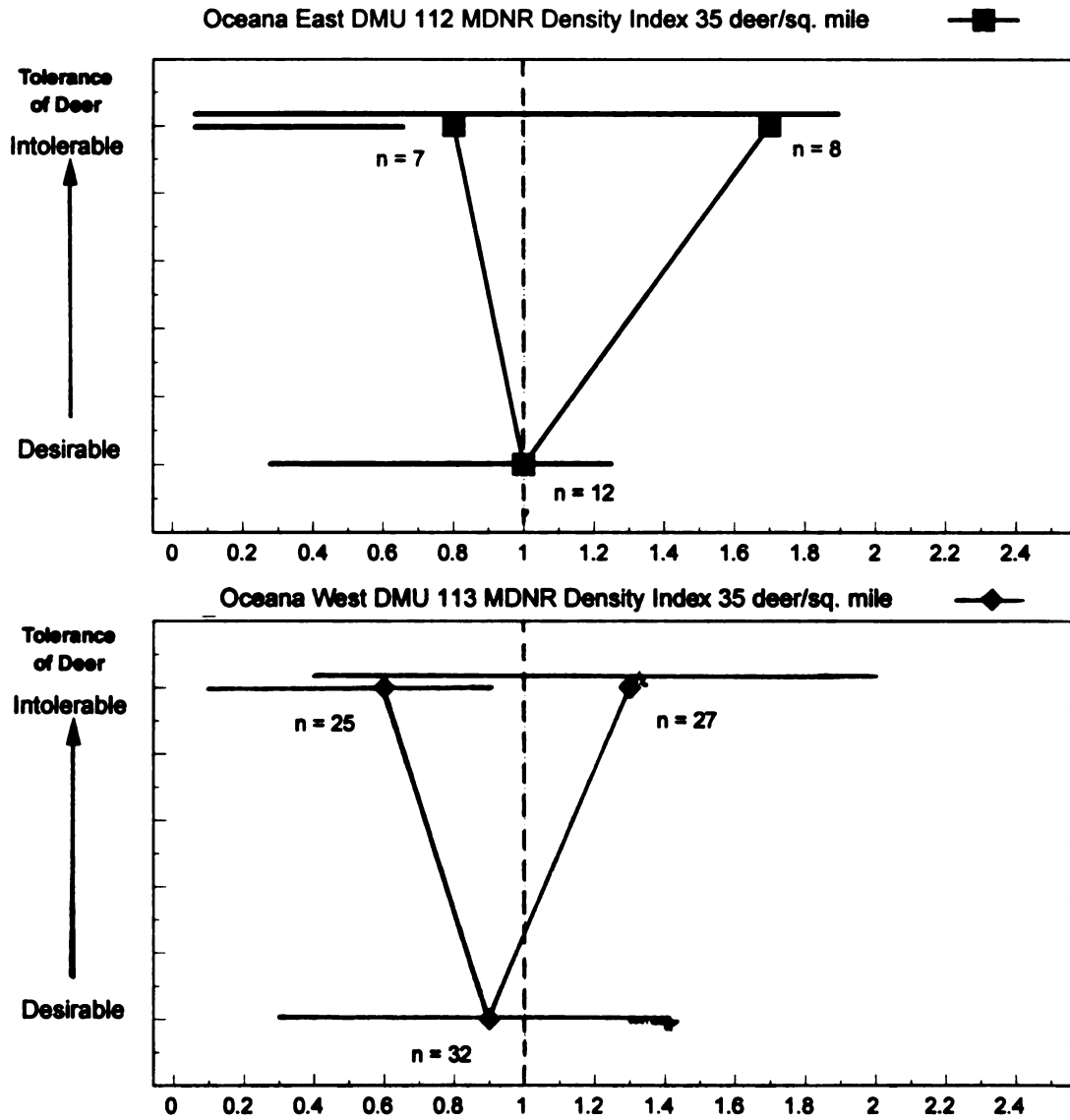


Figure 18: Oceana County CCC distributions segmented by DMUs with similar October 1994 deer densities. The horizontal bars included on the graphs are the interquartile ranges of each point.

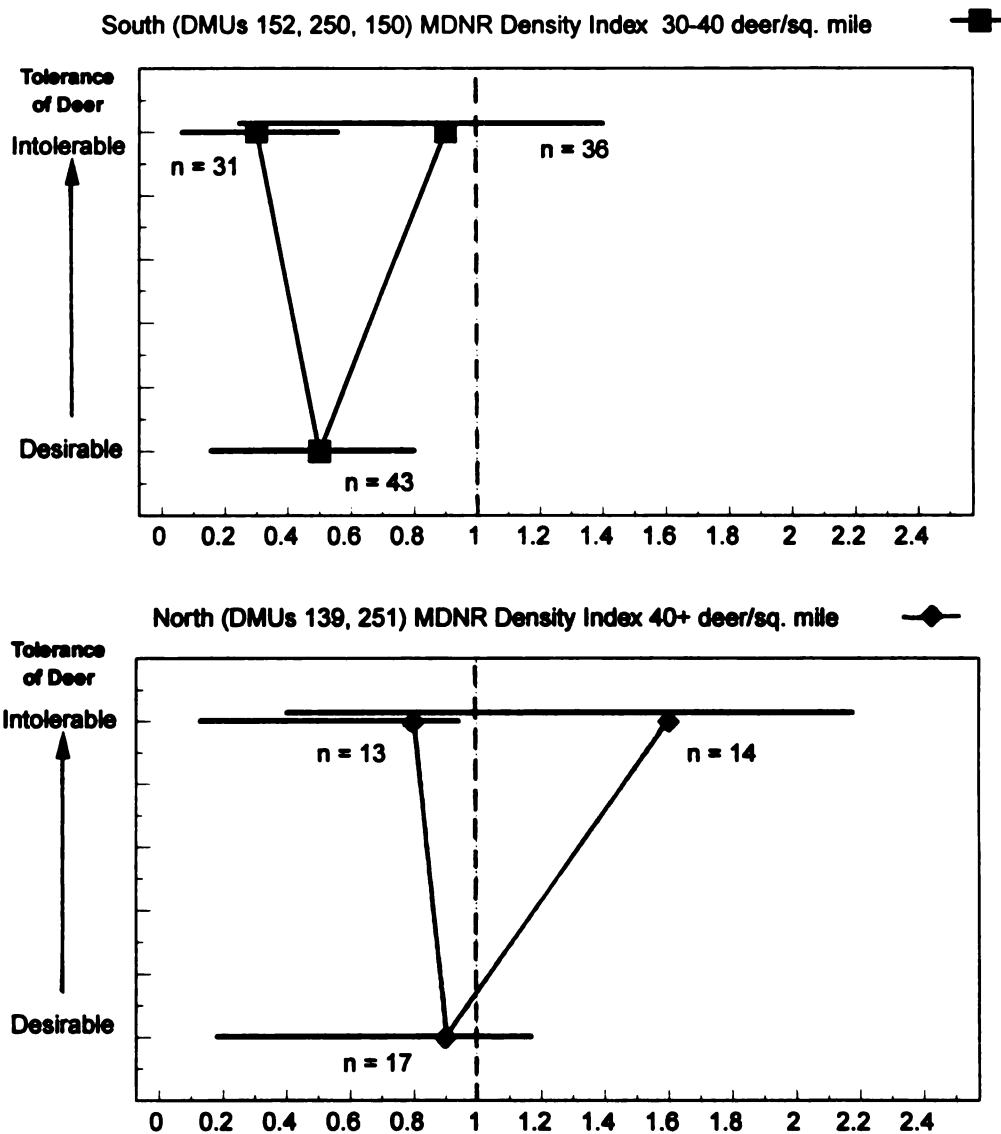


Figure 19: Calhoun County CCC distributions segmented by DMUs with similar October 1994 deer densities. The horizontal bars included on the graphs are the interquartile ranges of each point.

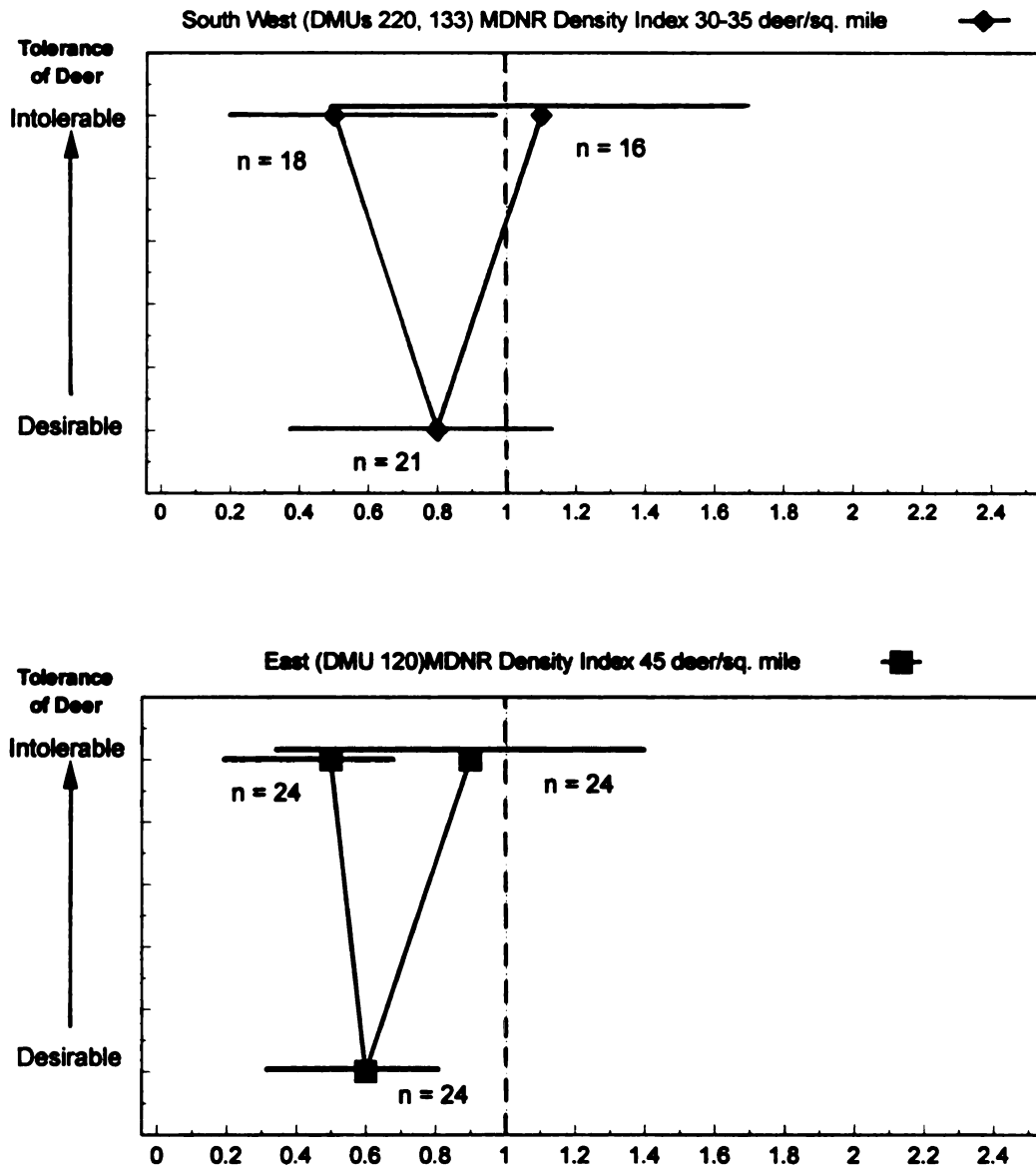


Figure 20: Montcalm County CCC distributions segmented by DMUs with similar October 1994 deer densities. The horizontal bars included on the graphs are the interquartile ranges of each point.

Tolerance of deer densities

The majority of producers believed there were too many deer in the counties in which they farmed (Question #56). This was generally opposite the feelings of hunter respondents to the deer hunter survey (Minnis 1996).

Tolerance of the deer density by county

Producers in Menominee county were most likely to believe that there were too many deer in the county. Conversely, producers in Oceana, Benzie, and Leelanau counties appeared more satisfied with the number of deer in their respective counties (Table 70).

Tolerance of the deer density by crop loss tolerance

Those producers whose losses were not a problem were more likely to be satisfied with the number of deer in the county or to think there were too few, than were the producers who indicated that losses were a problem (Table 70).

Tolerance of the deer density by hunting participation

Hunting farmers more frequently than non-hunting farmers believed there were too few deer in their county (Table 70); however, the majority of both groups believed that there were too many deer in the counties in which they farmed.

Tolerance of the deer density by job status

Full-time farmers more frequently than part-time farmers indicated there were too many deer in their county, while a greater proportion of part-time farmers indicated that the number of deer in their county was satisfactory or too low (Table 70).

Implications/recommendations

As was expected the majority of Menominee county farmers considered their 1994 losses intolerable and believed there were too many deer in the county. This finding was not surprising considering that MDNR indices indicated that the October 1994 deer density in DMU 215 was approximately 80-100 deer/mi². However, greater than 50% of the farmer respondents from each of the other study counties with considerably lower deer numbers also believed there were too many deer in their county in October of 1994. Generally a third of the farmers from these counties were satisfied with the number of deer in their county. In each county studied except Calhoun, greater than one third of the producers reported that their crop losses were intolerable, while from a quarter to a third of the producers in each county indicated that their 1994 crop losses were not a problem. These proportions suggest that increased levels of disruptive issue activity among farmers may be imminent in these counties in the future.

The difference between the proportion of producers indicating that crop losses were intolerable and that reporting there are too many deer in the county may suggest that producers have concerns for other values such as personal safety that may be at risk because of the current numbers of deer in the counties. These other values are likely additive to the risks of crop losses when determining an individual's tolerance of deer numbers. This suggests that deer managers should not limit themselves to monitoring producer tolerance of crop losses, but that they also continue to monitor stakeholders' risk perceptions concerning such things as the likelihood of deer-related vehicle accidents.

When determining which counties to include in this study consideration was given to the historic and suspected intensity of crop damage issues in the counties, and selection was made so as to provide a cross section of high and low intensity counties. Menominee County proved to be a hot-bed of activity during the study period, while other counties were noticeably lower in intensity. Calhoun County was suspected to have a lower amount of issue intensity than the other counties. This was supported by the lower proportion of Calhoun County farmers who indicated that losses and deer numbers were intolerable, but it is notable that >50% of farmers from this county still believed that there were too many deer in the county and that losses were a problem. Presque Isle County was expected to be an area of higher issue intensity relative to Calhoun and Montcalm Counties and this was supported by the tolerance of losses reported by producers. The fruit growing regions of Benzie, Leelanau, and Oceana counties were also expected to reflect a greater amount of issue activity relative to the non-fruit growing counties. In these fruit growing counties there was a greater amount of intolerance of losses than in the non-fruit growing counties. The relative levels of issue activity were apparently similar to the levels hypothesized in the study; however, the proportions of intolerant producers in each county were greater than expected based upon conversations with MDNR and Extension personnel at the beginning of the study. The data also confirm the regional variability of crop losses and producer responses to depredation. This inherent variability highlights the importance of maintaining a flexible system of addressing deer depredation concerns and for systematic monitoring of producer perceptions of depredation.

Table 70: Tolerance of October 1994 deer densities segmented by job status, hunt participation, county, and tolerance of crop losses.

		n	Too few , take action %	Too few %	Satisfied %	Too many %	Too many, take action %		
Job Status	Full-time	376	2.4	3.2	27.7	18.6	48.1	100 %	$\chi^2=51.74$ df 4 p<0.001
	Part-time	175	12.0	9.1	38.9	16.6	23.4	100 %	
Hunt Participation	Hunt	377	7.7	7.2	31.6	13.0	40.6	100 %	$\chi^2=37.45$ df 4 p<0.001
	Non-hunt	159	0.6	0.0	30.2	28.9	40.3	100 %	
County	Calhoun	124	5.6	3.2	32.3	28.2	30.6	100 %	$\chi^2=78.74$ df 20 p<0.001
	Montcalm	97	8.2	6.2	32.0	16.5	37.1	100 %	
	Oceana	105	9.5	4.8	35.2	10.5	40.0	100 %	
	Benzie/Leelanau	118	3.4	6.8	37.3	17.8	34.7	100 %	
	Presque Isle	48	2.1	10.4	33.3	22.9	31.3	100 %	
	Menominee	59	0.0	0.0	6.8	8.5	84.7	100 %	
Tolerance of loss	Not a Problem	147	17.0	15.6	55.1	8.8	3.4	100 %	$\chi^2=353.3$ 5, df 8, p<0.001
	Tolerable	166	2.4	1.8	39.8	35.5	20.5	100 %	
	Intolerable	225	0.4	0.4	9.8	9.8	79.6	100 %	

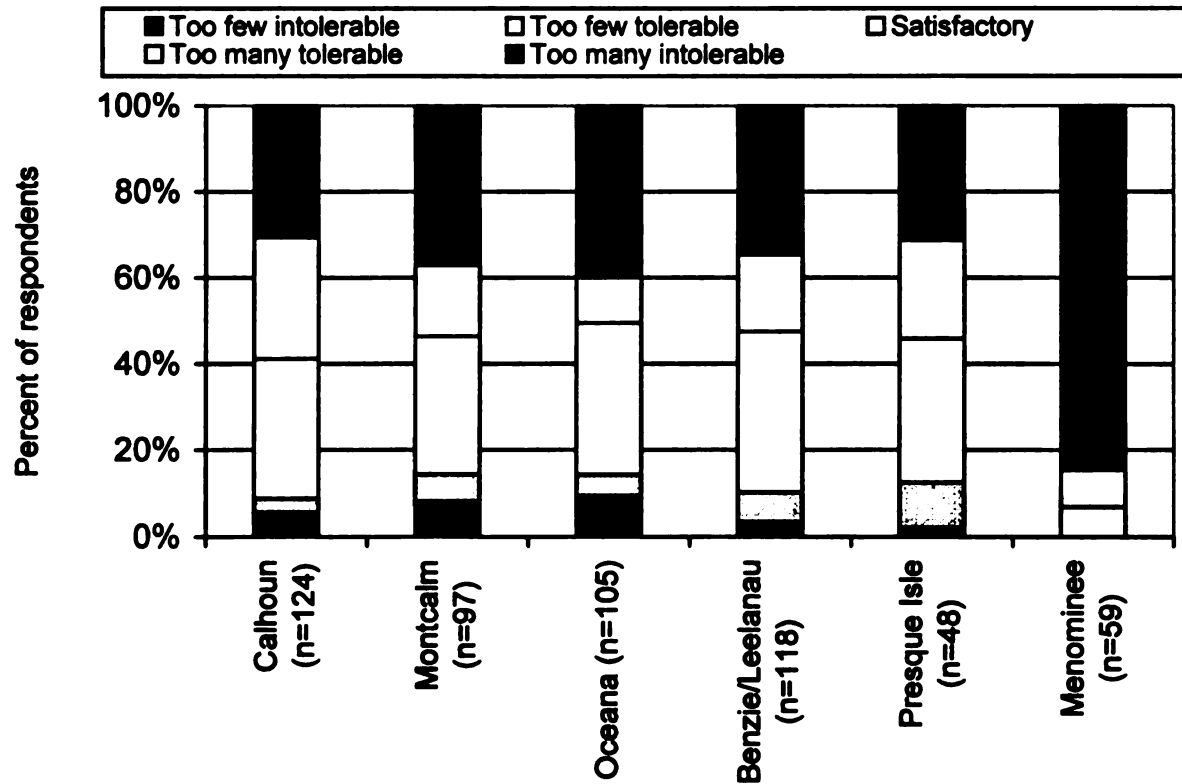


Figure 21: Tolerance of 1994 deer numbers in study counties.

Factors influencing tolerance of deer density

Also of interest to this study were the factors that contribute to producer tolerance of the deer herd size (Question #54). After recoding the variables in Table 68 to remove those that were “Unsure” of how much importance the items had on their decision making, a Friedman’s two-way ANOVA was used to test for a difference in the mean ranking of each item by the respondents. Producers weighted each of the provided values differently in forming their opinions about the acceptability of deer herd numbers (Table 71). Personal crop losses, others’ crop losses and deer-car collisions were ranked mostly highly by the respondents. Personal recreational benefits of deer were somewhat important to farmer respondents but less so than the costs of deer.

Table 71: The relative importance of factors associated with opinions about satisfactory deer densities.

Circle only one answer for each row.	Mean Importance of item*	Very Important	Somewhat Important	Slightly Important	Not Important	Unsure
Personal recreational benefits from deer (e.g., viewing, hunting, feeding, etc.) n=552	1.79	32.1%	32.4%	15.2%	18.1%	2.2%
Recreational benefits from deer provided to others in the county. n=548	1.68	23.9%	35.9%	20.6%	16.8%	2.7%
Personal economic benefits from the presence of deer (e.g., hunting leases, goods and services provided to hunters and tourists.) n=546	0.80	8.6%	16.8%	16.8%	53.8%	3.8%
Economic benefits to the county from the presence of deer. n=542	1.29	13.7%	31.4%	20.7%	29.7%	4.6%
Personal crop losses to deer. n=552	2.29	54.7%	22.6%	13.2%	7.2%	2.2%
Other farmers' crop losses to deer. n=551	2.33	49.7%	32.8%	10.0%	3.4%	4.0%
The number of deer-related vehicle accidents in the county. n=556	2.31	51.6%	30.8%	9.0%	5.8%	2.9%

* Mean importance after removing respondents that were unsure (Friedman's two-way ANOVA $\chi^2 = 620.92$, df 6, $p < 0.001$). Scale of importance: 3=very important, 2=somewhat important, 1=slightly important, 0=not important.

Relationship between tolerance of crop losses and personal and community values of deer

Segmenting producers by their tolerance of 1994 losses revealed the following patterns as intolerance increases:

- personal recreation becomes less of a factor in determining satisfaction with the deer herd size (Table 72).
- other's recreational benefits decrease in importance in determining satisfaction with the deer herd size (Table 73).
- personal economic benefits related to the presence of deer become less important in determining satisfaction with the deer herd size (Table 78).
- other's economic benefits become less important in determining satisfaction with the deer herd size (Table 74).
- personal crop losses become more important in determining satisfaction with the deer herd size (Table 76).
- other farmers crop losses become more important in determining satisfaction with the deer herd size (Table 77).
- the frequency of deer/vehicle accidents becomes marginally less important in determining satisfaction with the deer herd size (Table 75).

These tendencies were consistent regardless of whether the farmer was full- or part-time, or whether the farmer personally hunted deer. As was hypothesized, when income and

thereby livelihood are threatened other concerns and considerations become less important to the individual in determining their satisfaction with deer numbers.

Table 72: Farmer respondents' ratings of the importance of personal recreational benefits (e.g., viewing, hunting, feeding, etc.) in determining their tolerance of the deer population in the county, by tolerance of loss.

		n	Very important %	Somewhat important %	Slightly important %	Not important %	Unsure %
Tolerance of loss ($\chi^2=60.08$, df 8, $p<0.001$)	Not a problem	144	52.1	29.9	6.3	9.0	2.8
	Tolerable	170	32.4	35.9	15.3	16.5	0.0
	Intolerable	222	20.3	29.7	20.7	26.1	3.2

Table 73: Farmer respondents' ratings of the importance of others' recreational benefits (e.g., viewing, hunting, feeding, etc.) in determining their tolerance of the deer population in the county, by tolerance of loss.

		n	Very important %	Somewhat important %	Slightly important %	Not important %	Unsure %
Tolerance of loss ($\chi^2=30.56$, df 8, $p<0.001$)	Not a problem	143	37.8	31.5	12.6	13.3	4.9
	Tolerable	168	22.0	37.5	23.2	16.7	0.6
	Intolerable	221	16.7	38.5	22.6	19.5	2.7

Table 74: Farmer respondents' ratings of the importance of economic benefits to the county from the presence of deer in determining their tolerance of the deer population in the county, by tolerance of loss.

		n	Very important %	Somewhat important %	Slightly important %	Not important %	Unsure %
Tolerance of loss ($\chi^2=17.72$, df 8, $p=0.023$)	Not a problem	143	15.4	40.6	13.3	27.3	3.5
	Tolerable	165	17.6	26.1	21.8	30.3	4.2
	Intolerable	218	9.2	29.4	24.8	31.7	5.0

Table 75: Farmer respondents' ratings of the importance of the number of deer-related vehicle accidents in the county in determining their tolerance of the deer population in the county, by tolerance of loss.

		n	Very important %	Somewhat important %	Slightly important %	Not important %	Unsure %
Tolerance of loss ($\chi^2=70.63$, df 8, $p<0.001$)	Not a problem	145	31.0	31.7	14.5	15.9	6.9
	Tolerable	170	53.5	35.9	7.1	2.9	0.6
	Intolerable	225	62.2	26.7	7.1	1.8	2.2

Table 76: Farmer respondents' ratings of the importance of personal crop losses in the county in determining their tolerance of the deer population in the county, by tolerance of loss.

		n	Very important %	Somewhat important %	Slightly important %	Not important %	Unsure %
Tolerance of loss ($\chi^2=262.54$, df 8, $p<0.001$)	Not a problem	143	14.0	24.5	29.4	25.9	6.3
	Tolerable	170	47.6	34.7	15.9	1.8	0.0
	Intolerable	224	85.3	12.1	1.8	0.0	0.9

Table 77: Farmer respondents' ratings of the importance of other farmers' crop losses in the county in determining their tolerance of the deer population in the county, by tolerance of loss.

		n	Very important %	Somewhat important %	Slightly important %	Not important %	Unsure %
Tolerance of loss ($\chi^2=151.04$, df 8, $p<0.001$)	Not a problem	141	17.7	37.6	23.4	10.6	10.6
	Tolerable	170	44.7	40.6	10.6	1.8	2.4
	Intolerable	224	72.8	23.7	1.8	0.4	1.3

Table 78: Farmer respondents' ratings of the importance of personal economic benefits from the presence of deer (e.g., hunting leases, goods and services provided to hunters and tourists) in determining their tolerance of the deer population in the county, by tolerance of loss.

		n	Very important %	Somewhat important %	Slightly important %	Not important %	Unsure %	
Tolerance of loss ($\chi^2=10.48$, df 8, p=0.233)	Not a problem	143	10.5	23.1	14.0	48.3	4.2	100%
	Tolerable	168	10.1	16.1	16.7	54.2	3.0	100%
	Intolerable	219	5.9	13.7	18.7	58.0	3.7	100%

Discriminant Analysis of Factors that Predict Farmer Tolerance of October 1994 Deer Densities

A major objective of this study was to attempt to predict producer tolerance of deer populations. Discriminant analysis of producer tolerance of perceived October 1994 deer densities was examined and the most appropriate model for producer tolerance of October 1994 deer densities is presented here.

The dependent variable tolerance of deer was evaluated using the producer ratings of importance provided in response to Question #54. The model offering the most predictive ability for tolerance of county deer densities consisted of 3 variables: importance of personal recreational benefits derived from deer, importance of personal crop loss, and importance of the number of deer/vehicle related accidents in the county (Table 79). This model accounted for 45% of the variance in the dependent variable, and correctly classified 58% of the grouped cases. The model does need to be viewed conservatively because the Box's M test for equality of group covariance matrices was significant. It would not be appropriate to place much faith in the standardized weights provided by the model; however, it seems safe to assume that the model has selected the most discriminating variables from those provided.

Table 79: Summary Table of Discriminant analysis of factors affecting producer tolerance of county deer populations.

Step	Label	Wilks' Lambda	Sig.	Standardized canonical discriminant function coefficient
1	Importance of personal crop losses	.6651	.000	.7013
2	Importance of personal recreational benefits	.5610	.000	-.5912
3	Importance of number of deer/vehicle accidents in the county	.5193	.000	.2810

Wilks' Lambda = .5193, Canonical Corr. = .6703, $\chi^2 = 330.88$, df 12, $p < 0.001$

Box's M = 195.95, F = 7.95, df 24, $p < 0.001$

Percent of grouped cases correctly classified: 58.13%

Perceptions of and Attitudes about the Michigan Department of Natural Resources

Perceptions of the MDNR

Producer attitudes about the Michigan Department of Natural Resources were measured with eight items (Questions #60, #61, and #63). These items probed the frequency of farmer contact with DNR biologists, the credibility of the local biologist, the perceived expertise of the MDNR to manage deer populations, and the perceived importance of different stakeholders in the MDNR's management of the deer herd.

The credibility attributed to a management agency by its constituents involves two components. One is the perceived level of trust the constituents place in the agency to represent their interests. The second is the assessment of the agency's expertise or competence to manage. The competence of the agency and its biologists was evaluated using items that compose question #61 on the survey, while the perceived trustworthiness of the agency had to be inferred from responses to question #62 regarding the agency's consideration of farmers' interests.

Data from this study indicates both the expertise and the trustworthiness of the MDNR are questioned by a substantial number of farmers in the seven study counties. Farmers were either undecided or did not think that the MDNR had the expertise or enough information to manage the state's deer herd (Table 81). Though 34% of the farmer respondents believed that DNR biologists could adequately determine crop losses, another 66% of the farmers either disagreed or were undecided (Table 81).

An index of biologist credibility relating to crop damage was created using a summated scale (see Methods) where +2 = the greatest possible credibility, -2 = the least

possible credibility and where 0 = generally undecided. The mean credibility rating for local biologists statewide was 0.155 (S.D.=0.865) or generally undecided, which is not surprising considering that nearly 50% of the farmers indicated that they had never had contact with a local biologist.

Biologist credibility by contact time

We tested the hypothesis that mean biologist credibility ratings would differ based on the frequency of contact with the local biologist. As contact time with the biologist increased, mean credibility improved (Kruskal-Wallis $\chi^2 = 27.7$, df 2, $p < 0.001$). The tendency for credibility of the local biologist to improve with increased contact with biologists held even for those farmers reporting the most serious crop loss problems (Kruskal-Wallis $\chi^2 = 14.0$, df 2, $p < 0.001$) (Table 80).

Implications/Recommendations

An important inference of this finding is that poor attitudes about agency professionals -- at least those associated with crop damage control programs -- are not generally the result of personal interactions with agency personnel. In fact, it appears that wildlife professionals are generally effective in their personal dealings with crop damage complaints by farmers, but may be too constrained by budget and time to fully meet this public relations need. Though we could not show a significant positive correlation between increased contact time with local biologists and perceived agency competence it seems intuitive that a better perception of the agency would result from more frequent contact with its professionals, thus increased contact time with biologists may result in increased support among farmers for other agency programs.

Table 80: Mean credibility assigned to local biologist by agricultural producers with varying frequency of contact and levels of crop loss tolerance.

	No contact (s.d.)	≤1 time per year (s.d.)	A few times per year (s.d.)	Total (s.d.)
1994 losses were not a problem	0.1313 (0.7751) n = 99	0.3600 (0.6155) n = 25	0.3529 (0.9608) n = 17	0.1986 (0.6843) n = 141
1994 losses were a tolerable problem	-0.0355 (0.7904) n = 94	0.2885 (0.8808) n = 52	0.6481 (0.7274) n = 18	0.1333 (0.8465) n = 164
1994 losses were intolerable	-0.2103 (0.8967) n = 65	0.1569 (0.9401) n = 68	0.3804 (1.0289) n = 85	0.1339 (0.9873) n = 218
Total	-0.0155 (0.7751) n = 258	0.2391 (0.8693) n = 145	0.4167 (0.9781) n = 120	0.1511 (0.8693) n = 523

Note: +2 = greatest possible credibility, -2 = least possible credibility, and 0 = undecided.

Biologist credibility by county

These mean credibility ratings differed by county (-0.27 to 0.49) (Table 82).

Presque Isle county had the only negative credibility rating and was distinctly lower than Menominee County which had the highest credibility rating (Table 82). Both Presque Isle and Menominee Counties have had a considerable history of deer damage and it is likely that differences in the nature and handling of the issues in these 2 counties is responsible for the difference in their credibility ratings. Menominee County managers have had a very liberal policy regarding issuance of block, shooting, and regular antlerless permits which may contribute to its positive evaluation.

Table 81: Percentage of respondents in agreement with each statement about the MDNR's competence to manage deer populations and evaluate crop damage situations.

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
Crop losses are imposed on farmers by the DNR and hunters. n=539	16.5%	28.6%	22.4%	24.5%	8.0%
The DNR has the expertise to manage the state's deer herd. n=547	6.6%	34.2%	26.1%	18.6%	14.4%
The DNR has enough information on the deer population to adequately decide how many deer to harvest in Michigan each year. n=554	7.4%	31.4%	25.5%	22.7%	13.0%
DNR biologists treat farmers in this county professionally and with respect. n=547	9.7%	32.7%	43.7%	8.6%	5.3%
Our local DNR biologists can adequately determine the amount of loss a farmer is incurring to deer. n=545	4.8%	28.8%	38.5%	19.3%	8.6%
Our local DNR biologists understand the significance of crop losses to the economic well-being of the farmer. n=545	7.2%	32.1%	34.3%	18.0%	8.4%

Table 82: Credibility of local MDNR biologists and the agency with producers in study counties.

County	n	Mean Credibility of biologist	n	Mean agency credibility (2 point scale)
Calhoun	123	0.0027 (sd = 0.8434)	124	0.0927 (sd = 1.0406)
Montcalm	92	0.2065 (sd = 0.8543)	94	0.0904 (sd = 0.9559)
Oceana	104	0.1186 (sd = 0.8614)	104	-0.1971 (sd = 1.1003)
Benzie/Leelanau	117	0.2991 (sd = 0.8251)	121	0.0661 (sd = 1.0164)
Presque Isle	43	-0.2713 (sd = 0.8141)	44	-0.4659 (sd = 0.9906)
Menominee	57	0.4912 (sd = 0.8866)	57	0.1140 (sd = 1.2248)
Total	536	0.1549 (sd = 0.8651)	544	-0.0119 (sd = 1.0596)
		KW $\chi^2=28.3$, df 5, $p<0.001$		KW $\chi^2=15.25$, df 5, $p=0.009$

Note: Possible credibility values are -2 = non-supportive, 0 = undecided, 2 = supportive.

Agency competence

The mean competence score of the state agency was low relative to the mean local biologist credibility score. Though not conclusive this may suggest that farmers are capable of discriminating between the MDNR's local agents and the state agency.

The amount of contact time that the producer had with a biologist did not have a statistically significant effect on the mean agency competence rating; however, it seems logical that local biologists could affect the acceptance of the agency as a whole by working with farmers. Of the farmers who had contact with biologists more frequently,

those with crop loss problems were more likely than those without problems to agree that the MDNR possessed enough information to manage the deer herd (Table 83). Of the farmers who had no contact with biologists, those with no loss problems were more undecided than those with problematic losses about whether the DNR has enough information to manage the deer herd (Table 84).

Table 83: Percent of respondents with more frequent contact with MDNR biologists in agreement with the statement: “the MDNR has enough information on the deer population to adequately decide how many deer to harvest in Michigan each year,” by tolerance of loss.

	Strongly Disagree %	Disagree %	Undecided %	Agree %	Strongly Agree %	
Not a problem (n = 17)	35.3	41.2	11.8	11.8	0	100%
Tolerable (n = 18)	5.6	16.7	16.7	61.1	0	100%
Intolerable (n = 88)	12.5	22.7	19.3	35.2	10.2	100%
Overall (n = 123)	14.6	24.4	17.9	35.8	7.3	
$\chi^2=18.78$, df 8, p=0.016						

Table 84: Percent of respondents with no contact with MDNR biologists in agreement with the statement: “the MDNR has enough information on the deer population to adequately decide how many deer to harvest in Michigan each year,” by tolerance of loss.

	Strongly Disagree %	Disagree %	Undecided %	Agree %	Strongly Agree %	
Not a problem (n = 102)	12.7	19.6	33.3	32.4	2.0	100%
Tolerable (n = 95)	10.5	25.3	27.4	33.7	3.2	100%
Intolerable (n = 69)	21.7	14.5	26.1	23.2	14.5	100%
Overall (n = 266)	14.3	20.3	29.3	30.5	5.6	100%
$\chi^2=21.76$, df 8, p=0.005						

Implications/Recommendations

This difference between county perceptions of the MDNR strongly suggests that district policies regarding crop damage and individual personalities affect the perceived credibility of the biologist and by implication the agency. This may also imply that the efforts of individuals are appreciated by farmers and that they are perhaps educated/informed by biologists.

Agency Weighting of Constituents' Interests

Interviews with farmers suggested that they did not generally feel appropriately represented by the MDNR in decisions involving deer management. To obtain a more accurate picture of the extent of this perception, producers were asked to indicate how much consideration farmers' interests were receiving from the MDNR relative to the interests of deer hunters and other stakeholders (Question #62). Respondents were also asked to indicate how much consideration they desired the MDNR to place on the interests of each stakeholder group. I have duplicated the question for the reader below. The first weightings in the left column are referenced as the "current perceived" weightings, while the second series in right column is referenced as the "desired" weightings.

62. Please distribute 100 points within each of the following two columns to indicate how much importance you think the DNR currently places and should place on each of the following interest groups when the agency sets deer population goals for Oceana county.

THE DNR
CURRENTLY PLACES IMPORTANCE ON:
(current perceived weightings)
 _____ HUNTERS
 _____ FARMERS
 _____ OTHER: _____
 = 100

THE DNR
SHOULD PLACE IMPORTANCE ON:
(desired weightings)
 _____ HUNTERS
 _____ FARMERS
 _____ OTHER: _____
 = 100

Perceived weighting of stakeholders by tolerance

No differences in how respondents perceived the consideration currently given to farmers and hunters existed between counties (Table 85). Producers with intolerable losses were more likely to indicate that farmers were currently given less consideration than producers whose losses were more tolerable. Conversely those with more severe losses were more likely to indicate that greater proportions of consideration be given to farming interests in the future, and they were also more likely to indicate that lesser proportions of consideration be given to hunters interests (Tables 85 & 86).

Perceived stakeholder weighting by hunting participation

Hunting farmers consistently differed from non-hunting farmers on their perceptions of the current weightings and desired weightings. For example, hunting farmers perceived the current weighting of hunting interests to be significantly lower than did non-hunting farmers (Table 85).

Table 85: Producer perceived weightings of stakeholders interests in MDNR deer management objectives, segmented by hunt participation and tolerance of loss. Values reported are proportions of 100 possible points that represent how MDNR is perceived to weight the interests of stakeholders when determining deer management objectives.

	n	Mean weighting of farmers (s.d.)	n	Mean weighting of deer hunters (s.d.)	n	Mean weighting of other stakeholder interests (s.d.)
Overall	477	31.4 (20.3)	504	63.1 (23.7)	136	32.1 (26.0)
County						
Calhoun	100	30.2 (19.4)	111	64.9 (24.0)	27	39.7 (31.5)
Montcalm	87	32.3 (19.2)	90	61.2 (21.8)	24	32.2 (18.8)
Oceana	92	32.4 (20.6)	95	60.4 (24.9)	26	33.4 (27.1)
Benzie/Leelanau	107	31.4 (20.6)	113	61.9 (23.1)	40	28.1 (24.7)
Presque Isle	36	27.1 (24.0)	37	69.7 (25.8)	6	41.6 (29.9)
Menominee	55	33.6 (19.8)	58	65.1 (23.5)	13	21.1 (22.8)
Kruskal-Wallis statistic		$\chi^2=4.75$, df 5, p=0.447		$\chi^2=7.45$, df 5, p=0.189		$\chi^2=6.37$, df 5, p=0.272
Tolerance of loss						
Not a problem	124	37.4 (20.2)	125	53.6 (22.4)	35	46.9 (17.4)
Tolerable	143	32.3 (20.1)	153	63.7 (22.8)	41	42.9 (16.9)
Intolerable	199	27.2 (18.9)	216	68.0 (23.5)	57	35.9 (16.3)
Kruskal-Wallis statistic		$\chi^2=22.0$, df 2, p<0.001		$\chi^2=31.0$, df 2, p<0.001		$\chi^2=9.7$, df 2, p=0.007
Hunt participation						
Hunt	334	32.7 (20.4)	353	60.6 (24.0)	100	35.6 (26.4)
Non-hunt	133	28.1 (18.9)	141	69.9 (21.1)	34	21.4 (20.1)
Mann-Whitney statistic		z = -2.07, p=0.038		z = -3.89, p<0.001		z = -2.92, p=0.004

Table 86: Producer desired weightings of stakeholders interests in MDNR deer management objectives, segmented by hunt participation and tolerance of loss. Values reported are proportions of 100 possible points that represent how farmer respondents desire MDNR to weight the interests of stakeholders when determining deer management objectives.

	n	Mean weighting of farmers (s.d.)	n	Mean weighting of deer hunters (s.d.)	n	Mean weighting of other stakeholder interests (s.d.)
Overall	512	58.2 (20.2)	484	41.0 (17.3)	112	15.8 (13.8)
County						
Calhoun	115	62.0 (20.8)	106	40.2 (17.0)	23	13.6 (13.1)
Montcalm	92	56.7 (18.6)	86	42.5 (13.8)	22	14.1 (10.5)
Oceana	97	55.3 (21.3)	91	43.7 (19.3)	19	14.0 (13.8)
Benzie/Leelanau	114	54.1 (18.4)	111	41.9 (15.7)	33	20.1 (16.1)
Presque Isle	37	62.1 (23.3)	35	38.9 (22.9)	4	11.2 (6.2)
Menominee	57	63.2 (18.1)	55	35.1 (17.3)	11	15.0 (15.0)
Kruskal-Wallis statistic		$\chi^2=16.06$, df 5, p=0.007		$\chi^2=7.78$, df 5, p=0.169		$\chi^2=4.99$, df 5, p=0.417
Tolerance of loss						
Not a problem	127	51.3 (18.8)	126	46.9 (17.4)	26	19.8 (18.7)
Tolerable	159	56.4 (19.8)	151	42.9 (16.9)	33	13.2 (10.1)
Intolerable	214	63.5 (19.6)	197	35.9 (16.3)	50	14.8 (12.6)
Kruskal-Wallis statistic		$\chi^2=34.8$, df 2, p<0.001		$\chi^2=36.7$, df 2, p<0.001		$\chi^2=1.2$, df 2, p=0.536
Hunt participation						
Hunt	349	55.7 (18.8)	337	43.4 (16.7)	74	14.8 (11.5)
Non-hunt	151	63.4 (21.8)	139	35.2 (17.7)	35	18.4 (17.9)
Mann-Whitney statistic		z = -3.87, p<0.001		z = -4.18, p<0.001		z = 0.56, p=0.575

Tending toward equality

A finding with some promise for reducing conflict is the reduction in the magnitude of the difference between the weightings of farmers and hunters. The mean difference between the current perceived weightings of farmers and hunters was 30.7 (s.d. = 37.4) percentage points, (i.e. current farmer weighting - current hunter weighting = | 30 | points). This compared to a mean difference between the desired weightings of 15.0 (s.d. = 33.5) percentage points (i.e. desired farmer weighting - desired hunter weighting = | 15 | points). This suggests that a more equal weighting of interests would be preferable to producers. MDNR personnel in all study counties indicated that they attempted to balance the interests of hunters and farmers 50:50, thus perhaps farmers can be made more aware of the consideration that the agency is giving them.

Perceived fairness of current stakeholder weighting

It was hypothesized that the preferred (desired) weightings provided by farmers in response to Question #62 could be used to assess whether farmers considered the current perceived weighting as fair. The calculation used to make this assessment is found in the Methods on page 48, and is based on the assumption that producers who perceive the current MDNR weightings of interests as fair will desire no change in weightings for the future. Conversely, producers who perceive the current amount of consideration given to farmers as unfair will desire an increase in the consideration given to farmers in the future. For the reader's convenience the equation used to assess fairness is provided again below.

$$\begin{aligned} &\text{Perceived fairness of current MDNR weighting of farmer interests} \\ &= \\ &(\text{PCF/PCH}) - (\text{DFF/DFH}) \end{aligned}$$

where: Perceived current weighting of farmer interests = PCF
 Perceived current weighting of deer hunter interests = PCH
 Desired future weighting of farmer interests = DFF
 Desired future weighting of deer hunter interests = DFH

If the calculated result was ≥ 1 then the current weightings were assumed to be fair or in favor of the farmer. If the result was < 1 then the current weightings were assumed not to be fair or in favor of the farmer.

Seventy-one percent of the farmer respondents perceived the current weighting of farmers as “not fair,” and 29% perceived the current weighting as “fair.” There were no county differences nor differences by farm type, but there were significant differences by hunting participation, full/part-time status, and tolerance attitude (Table 88). The majority of both hunting (67%) and non-hunting (83%) farmers found the current weighting unfair, however, the percentage of hunting farmers who viewed the current weighting as fair was 2 times higher than for non-hunting farmers. Similarly, the majority of full-time (77%) and part-time (56%) farmers found the current weighting unfair, except that the percentage of part-timers that considered the weighting fair was twice as large as the percentage of full-time farmers. Additionally, those who perceive the current weighting as unfair earned a greater proportion of their household income from farming (Table 87). Those producers whose 1994 losses were not a problem were split on the fairness of the weighting, while the majority of those whose losses were a tolerable (68%) or intolerable (87%) problem found the weighting unfair. This relationship held even while controlling for farmers that hunt. The majority of both

permit recipients (83%) and non-recipients (62%) found the current weighting unfair, though twice as many non-recipients found the weighting to be fair.

Table 87: Farmer respondents' perceptions of the fairness of perceived stakeholder weightings by the MDNR when setting deer population objectives by dependence on farm income.

	n	Mean Percent of household income earned by farm. (s.d.)
Not fairly weighted for farmer	298	68.94 (34.23)
Fair or more than fair for farmer	115	55.54 (36.27)
Total	413	65.21 (35.29)
Mann-Whitney Z=-2.98, p=0.003		

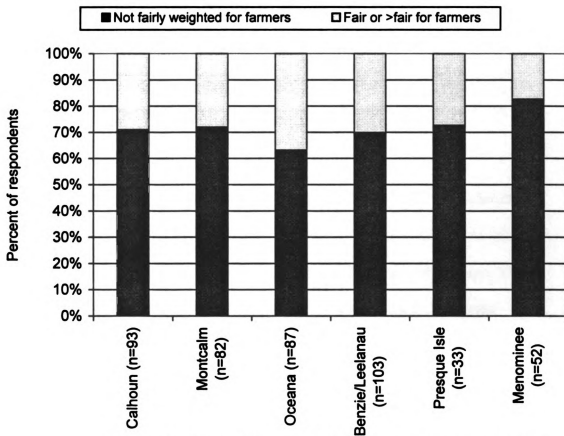


Figure 22: Perceived fairness of the amount of consideration given farming interests by the MDNR.

Table 88: Farmer respondents' perceptions of the fairness of perceived stakeholder weightings by the MDNR when setting deer population objectives by county, tolerance, hunting participation, job status, and permit recipients.

		n	Not fairly weighted for farmers %	Fair or more than fairly weighted for farmers %
County ($\chi^2=6.13$, df 5, $p<0.293$)	Calhoun	93	71.0	29.0
	Montcalm	82	72.0	28.0
	Oceana	87	63.2	36.8
	Benzie/Leelanau	103	69.9	30.1
	Presque Isle	33	72.7	27.3
	Menominee	52	82.7	17.3
Tolerance of loss ($\chi^2=56.30$, df 2, $p<0.001$)	Not a problem	113	46.9	53.1
	Tolerable	139	68.3	31.7
	Intolerable	188	87.2	12.8
Hunting participation ($\chi^2=11.87$, df 1, $p<0.001$)	Non-hunter	128	82.8	17.2
	Hunter	316	66.5	33.5
Job status ($\chi^2=19.90$, df 1, $p<0.001$)	Full-time	315	77.1	22.9
	Part-time	135	56.3	43.7
Shooting permit recipient ($\chi^2=16.34$, df 1, $p<0.001$)	Non-recipient	304	65.1	34.9
	Recipient	133	84.2	15.8
Block permit recipient ($\chi^2=12.32$, df 1, $p<0.001$)	Non-recipient	280	64.6	35.4
	Recipient	135	81.5	18.5

Implications/Recommendations

The finding that a large proportion of the respondents, even from the segments of hunting farmers and farmers without depredation problems, thought that the consideration perceived given to farmers by the MDNR was unfair might concern the agency. These segments might be anticipated to be less sensitive to the fairness issue. Perceived weightings are likely to be an on-going area of concern and conflict for both farmers and hunters, and the agency may wish to reevaluate its public participation process to ensure that groups feel that they have been given an opportunity for input into management decisions.

Other groups considered to be stakeholders in the deer damage issue

In an open-ended question nearly one-fifth of the respondents added groups other than farmers and hunters that should be considered when determining deer population goals (Table 89). Some respondents also indicated that they believed other groups are currently being considered by the agency. Non-consumptive wildlife users received relatively frequent consideration by respondents when the assorted classifications were combined (Table 89). Unfortunately, one of the more frequent additions was the MDNR as a self-serving interest.

Table 89: Producer perceptions about other stakeholders whose interests are being considered, and should be considered, by the MDNR when determining deer population goals.

	Currently considered by MDNR		Should be considered by MDNR	
	Frequency	Mean Weighting	Frequency	Mean weighting
DNR Employees, money	15	54.3 (sd = 23.8)	5	4.4 (sd = 5.1)
Environmentalists	5	44.0 (sd = 16.3)	2	5.0 (sd = 7.1)
Wildlife fans, nature lovers	8	39.1 (sd = 23.9)	4	15.0 (sd = 12.2)
Non-hunters	2	40.0 (sd = 0.0)	2	10.0 (sd = 0.0)
Recreational groups	3	18.3 (sd = 10.4)	4	18.2 (sd = 10.9)
General public	4	20.8 (sd = 12.5)	8	24.5 (sd = 14.5)
Loggers	1	25.0 (sd = --)	1	25 (sd = --)
Hunting related businesses	4	27.5 (sd = 15.0)	5	19.0 (sd = 13.4)
Hobby farmers	1	0 (sd = --)	0	---
Habitat conservation	3	60.0 (sd = 17.3)	4	35.0 (sd = 34.9)
Politics	2	50.0 (sd = 42.4)	0	---
Landowners	2	47.5 (sd = 38.9)	3	26.7 (sd = 20.8)
Automobile drivers	5	11.2 (sd = 16.5)	5	21.0 (sd = 12.4)
Auto insurance companies	15	42.6 (sd = 23.4)	9	11.5 (sd = 9.6)
Total	70	39.6 (sd = 24.5)	52	17.9 (sd = 15.8)

Perceptions of the Michigan State University Extension Service

Producer attitudes about the Michigan State University Extension Service (MSU-E) were measured with four items regarding; the frequency of contact with MSU-E county representatives, MSU-E agent treatment of farmers, the familiarity of MSU-E agents with farming, and the helpfulness of MSU-E agents for locating information about farming problems. The final three questions were designed to provide a relative measure of how credible county MSU-E personnel are perceived by farmers. The items are similar to three items which probe farmer attitudes about the abilities of local DNR biologists and provide the grounds for some comparisons of credibility between the two groups.

Contact frequency

Nearly 70% of the respondents indicated that they had contact with Extension more than a “few times per year”. Extension contact frequency was significantly higher in fruit counties, probably because of the bi-weekly meetings conducted by Extension IPM agents during the summer months with fruit growers (Table 90). There was a positive Spearman correlation (0.3037) between the amount of contact and tree growers, while there was a negative Spearman correlation (-0.1999) with non-tree growers. A cross-tabulation revealed that significantly more tree growers had frequent contact with Extension than non-tree growers ($\chi^2=57.83$, df 3, $p<0.001$).

Table 90: Farmer respondents' reported contact frequency with MSU-E agents, by county.

County	n	Never %	< once/year %	A few times/year %	> once/month %	
Calhoun	130	23.8	22.3	49.2	4.6	100%
Montcalm	100	11.0	18.0	60.0	11.0	100%
Oceana	109	10.1	14.7	56.9	18.3	100%
Benzie/Leelanau	125	0.8	12.8	57.6	28.8	100%
Presque Isle	49	10.2	16.3	63.3	10.2	100%
Menominee	60	11.7	13.3	61.7	13.3	100%
$\chi^2=64.36$, df 15, $p<0.001$						

Credibility of Extension Agents

Producers were generally positive about the knowledge, abilities, and professionalism of their county extension agents. Local extension agents had a mean credibility rating of 1.24 (s.d. = 0.71) (+2 = greatest possible credibility, -2 = least possible credibility, 0 = generally undecided). An important implication of this finding is that given the high credibility of MSU-E, it might be possible for the MDNR to work more closely with that agency and thereby improve its own credibility with farmers.

DISCUSSION

The study's over-riding purpose was to identify factors affecting farmer tolerance of deer numbers and crop loss that might be targeted so as to reduce conflict between stakeholders over how the deer herd is managed. In other words, a primary goal was to advance our understanding of how crop damage issues are perceived and dealt with by farmers, and to suggest improvements in policy, administration and communication to reduce deer depredation and associated problems.

Some important points need to be made about Michigan's deer crop damage situation: first, there is no single deer crop damage issue, rather there are many points of contention between stakeholders and within segments of stakeholder groups. As became clear during the study, not all farmers have the same attitudes regarding acceptable numbers of deer; likewise, actions taken to control damage varied within segments. Second, the state of issues associated with deer crop damage varies both temporally and spatially across the counties studied. An awareness of the inherent diversity of crop damage issues and situations is critical for effective management and suggests two important approaches towards managing crop damage issues; first, readiness, and second, flexibility. Having flexible agency protocols for addressing crop damage situations as they arise should do much to diffuse potentially disruptive situations; unfortunately, flexibility also leads to perceptions of inconsistency by other stakeholders such as deer hunters. This is the ultimate paradox facing wildlife agencies. To overcome this paradox agencies may need to have proactive, involved, and well-funded information and education (I&E) programs.

Without such professional support, reducing the amount of disruptive issue activity over deer depredation and other issues may be extremely difficult if not impossible. What follows, in terms of recommendations to agencies, assumes that there is or will be adequate backing for I & E programming targeted at farmers, deer hunters, and other stakeholders affected by deer management.

Values, Perceptions, and Behaviors

As was hypothesized, value differences are central to the issues surrounding deer depredation. It was found in this study that farmers are not that different from deer hunters in that they have multiple values associated with the deer resource including consumptive and non-consumptive recreational values, economic values, health and safety values, and financial security values both for themselves and others. However, as crop loss threatens financial security producers' values of deer take on different priorities. Even though 70% of the respondents personally hunted deer, and most of these rated deer hunting as an important personal recreational activity, when livelihood was threatened by crop losses, having large numbers of deer to hunt became less of a concern than being financially secure. Clearly the dominant value of producers is earning a living, and this value supercedes deer hunting when priorities are assigned. Conversely, when referring to deer, the dominant value for hunters appears to be having a quality personal recreational hunting experience. These are pronounced differences in value priorities when crop losses are a problem but less so when losses are insignificant or tolerable.

Even though tolerances of deer populations (Minnis 1996) and crop losses appear to increase if producers are themselves avid deer hunters, this study confirms that loss amounts and dependence on the farm income are pivotal factors in determining producer tolerance of deer (Nelson and Yuan 1991, Nelson and Schomaker 1995). Producers earning a greater percentage of their household income from the farm and those who were full-time farmers consistently were less tolerant of losses and were more likely to have applied for and used special kill permits.

When there is conflict over whether deer numbers should be reduced to protect farmers from crop losses and these value differences emerge, an agency might be able to target misperceptions and to remind stakeholder groups that they share common values such as financial security and recreation. In addition the agency may need to educate deer hunters who do not perceive that producers' financial security is at risk.

Alternatively, agencies may target the behaviors of both groups which impede the ability to reduce losses caused by deer. For instance, 17% of the respondents with intolerable losses did not encourage the harvest of antlerless deer by their hunters. Other studies have shown that farmers do not maximize the effectiveness of hunting as a damage control tool (Eriksen 1994, Nelson and Schomaker 1995), and that farmers resist using fencing even if cost shared with the agency (Islieb 1994).

Still farmers with intolerable losses appear to be doing a reasonable job of targeting antlerless deer, especially in Menominee County. Unfortunately, their efforts may not be sufficient to control their losses if adjacent landowners are not contributing to the harvest of antlerless deer or allow no hunting whatsoever. The finding that 52% of the respondents indicated that low deer harvests on adjacent lands were contributing

to their crop losses appears to indicate that hunter access to private lands and hunter behavior may need to be addressed by the agency. The recent failure of Michigan's firearms deer hunters to harvest more than 1/2 of the agency's 1996 antlerless harvest goal speaks to the size of the problem (Michigan Out-of-Doors, January 1997). A season such as Wisconsin's 1996 Earn-a-Buck season offers one method of forcing hunter behavior change. Alternatively, allowing greater opportunities for antlerless harvest by non-farm landowners is suggested by Nelson and Schomaker (1995) whose finding was that non-farm landowners were more likely than farmer owners to harvest antlerless deer.

The remainder of this chapter will further examine factors which appear to be focal points of contention among stakeholders: agency credibility, biologist competence, program administration and stakeholder involvement and education. In each case an attempt is made to describe how deer managers can proactively target these factors and thereby diffuse the potentially disruptive nature of these issues.

Agency Credibility

The influence of agency credibility on farmers has the potential to affect not only acceptance of depredation assistance programs but other natural resource management programs as well. It is desirable that stakeholders believe that management agencies are competent and trustworthy.

Anti-government attitudes present a challenge to professional wildlife management. These attitudes appear to center on the perception of government as an independent regulatory agency rather than as a democratic public service organization.

This is reflected by the 2.5% of respondents who believed that the MDNR was catering to itself when setting deer management goals. These perceptions of government as a self-perpetuating regulatory agency versus a service organization appear to be linked to perceptions of the fairness of the consideration given to all stakeholders by the government. Currently it appears that farmers do not trust the MDNR to fairly consider the interests of agriculture in their deer management decisions, as 71% of the respondents apparently believe that the current weighting of farmer and hunter interests by the MDNR was not fair. When an agency is perceived as unfairly catering too much to the interests of a single group (i.e. deer hunters, farmers, animal rightists, etc.) stakeholders lose trust in the agency and may more frequently pursue disruptive courses of action to get their interests considered (i.e. lawsuits, legislative action). Actions caused by such perceptions of unfairness may in extreme cases lead to a stripping of agency authority to manage natural resources as was the case in Colorado with furbearers in 1995 and 96 (Lipsher 1996). Such action is perhaps less likely in Michigan given the recent passage of a ballot initiative giving the MDNR and the state's Natural Resource Commission greater control over wildlife management in the state.

The finding that farmers in this study generally did not consider the current weighting of stakeholder interests by the MDNR as fair is a major problem facing deer management in Michigan at this time.

Disruptive issue activity among farmers appears to be largely a result of accumulated frustration and the inability of producers to control losses even after having sought assistance from the agency. In this study, producers with chronic intolerable levels of loss were twice as likely as producers with less deer damage experience to

anticipate taking disruptive courses of action if intolerable losses continue. It was hypothesized that producers might be becoming more tolerant of crop losses over time as they learned to control losses and no longer contacted the MDNR for assistance. The opposite is apparently the case, as producers appear to remain intolerant and may stop contacting the agency because they perceive it won't help their situation. Producers may learn to cope with damage, but they may also cope with deer damage by taking undesirable and perhaps even illegal actions to reduce damage after prolonged losses without substantive assistance from the agency. The perceived slowness of the MDNR to respond to their concerns by reducing the deer herd appears to have caused producers in Menominee, Presque Isle, and Saginaw counties to explore other avenues for making themselves heard (Erdman, Long, and Reeves pers. comm.). Testimony at legislative hearings and threatened court action appear to have come about because of perceived delays or lack of action on the part of the MDNR.

Such perceptions also suggest an emerging issue concerning the competence of the agency and whether it can adequately control the harvest so that deer population goals can be met. This was reflected by the respondents who were generally divided about whether the MDNR had the expertise and information to manage the state's deer herd. The current deer herd size and its tremendous reproductive potential are such that the number of producer complaints could quickly increase if significant reductions in the herd are not made fairly soon. This is doubly alarming if hunter values and behaviors continue to favor shooting bucks and if hunter access to private lands becomes more restricted. Without being able to control hunter behavior and hunter access to private

lands it does not appear that agencies have the ability to quickly “turn off the tap” when deer numbers become problematic.

This suggests three immediate courses of action for agencies. First, gain the trust of stakeholders and involve them in the management process, and second, attempt to remove obstacles that prevent immediate action from being taken to reduce crop damage in the year when it becomes intolerable to farmers. At least intolerable losses must not be allowed to go unaddressed. Finally agencies should attempt to maintain deer populations at what they believe to be appropriate density levels.

Biologist Competence

Contact frequency influenced perceptions about the professionalism, knowledge, and expertise of local biologists as they are related to managing crop damage. Thus, local biologists appear to have the potential for affecting producer attitudes about the agency as a whole by moderating beliefs about the competence and trustworthiness of the agency. The tendency of biologist credibility to increase as contact with producers becomes more frequent, provides a clear opportunity to improve producers’ perceptions of the agency.

Given that farmers control 28% of the state’s land area statewide, and a significantly greater percentage in southern Michigan, such farmer attention might be an agency priority because of the potential impact on a number of species, especially if management is to be accomplished on an ecosystem scale. Since 48% of the respondents and 19% of those reporting chronic intolerable losses never had any contact with their local MDNR biologist, it may be effective to seek opportunities to increase the exposure of the biologist to area farmers.

Sixty percent of respondents were not entirely sure that biologists could understand the significance of crop losses to their financial well-being. To be better able to evaluate and understand farmers' concerns about losses, managers might attempt to learn as much as possible about crop production and marketing. It may also be appropriate for biologists to receive some interpersonal training to improve farmer -- biologist interactions and to ensure that the agency is represented uniformly between counties.

Program Administration

Several issues uncovered by this study involved the administration of the agency's crop damage assistance programs. These issues provide concrete targets for reducing issue activity.

Agency administration of the crop damage program was questioned by some farmers who felt that applying for assistance was unduly difficult and that once shooting permits were obtained that their use was overly restricted or too confined to make them effective. Farmers frequently expressed dislike for the paperwork involved with the application procedure for block permits. Streamlining the application and reporting procedure for these permits while providing rationale for the imposed regulations may ease some tension among farmers. Producers also disliked having to pay for permits especially when hunters benefit by keeping the deer. Farmers also commented that they were constrained by the regulations surrounding shooting permits, and some complained of harassment by law enforcement personnel when they attempted to use their permits.

Publicly acknowledging farmer contributions to deer management may also alter perceptions of the agency's priorities. Allowing a farmer a free deer hunting license on

their own property, or permitting them to keep for their own consumption the first deer taken on a shooting permit might ease objections of having to pay for block permits. Ohio, Indiana, Wisconsin, and New Jersey have such regulations in place and could be contacted to see how these have been received.

Though producers largely favored the manipulation of hunting seasons to control deer damage, managers would still need to find effective seasons acceptable to both producers and hunters. Several producers indicated that longer and/or more frequent seasons (early goose, late goose, spring turkey, etc.) meant they were bothered more frequently by hunters looking for permission. Additional or longer deer seasons may not be acceptable to all farmers.

Proactive Opportunities

There are several opportunities for the MDNR to encourage behaviors during the latent and emerging phases of issue development that may forestall the issues ever reaching the active or disruptive stages.

Non-lethal depredation control

Encouraging producers to be proactive and to adopt non-lethal damage controls may decrease some conflicts over the shooting of deer to protect crops; however, general use of non-lethal control should not be expected. Islieb's (1994) finding that producers may not fence fields despite significant cost-sharing by the agency suggests that producers strongly object to having to pay anything to manage deer that feed on their crops. In situations such as new orchard blocks, some producers adopt fencing when shown the long term cost:benefit of doing so (Long, pers. comm.).

Effective shooting permit use

Though Horton and Craven's (1995) work indicates that shooting permits are of limited effectiveness as generally practiced by farmers in Wisconsin when restricted by traditional hunting season shooting hours; appropriate use of shooting permits may be effective at reducing current year losses and aid in controlling subsequent losses when combined with block permits and normal hunting. Farmer comments frequently indicated that shooting hours need to be relaxed for shooting permits and that shooting permits need to be issued earlier in the growing season. Earlier use of shooting permits would ensure that deer that are actually doing the damage are taken and prevent losses from occurring.

Farmers resist earlier use of shooting permits as there are some who do not wish to shoot pregnant or nursing females and fawns (Horton and Craven 1995). Hunter and general public resistance is likely as well; however, this resistance might be moderated by providing the knowledge that only deer causing losses are shot and "innocent" deer will not be targeted later on. Shooting permits might be made more effective if producers are allowed to occasionally shoot after dark, as studies have shown that less than 50% of the deer that may use a crop field in a night will be present at dusk (Montgomery 1963, Larson et al. 1978). Communications with USDA-APHIS-WS professionals also indicates that after initial attempts to shoot deer from baited blinds during daylight hours, shooters found deer visiting baits and becoming visibly active later at night (Parr pers. comm.). Provided that neighbors concerns about such shooting can be addressed, it might benefit producers to be able to shoot during night-time hours.

Potentially equally effective and less controversial would be an integrated program of occasional night shooting combined with regular night harassment.

Effectiveness of block permits

The findings of Nelson and Yuan (1990) as confirmed by this study indicate that farmer use of block permits increases the number of deer taken per farm acre on affected farms, and therefore can be assumed to reduce the subsequent year's crop losses somewhat when the permits are used liberally. However, Sitar (1996), suggests that because of factors associated with deer migration that block permits used during Michigan's general firearms season may not target the deer doing the damage, and that an earlier use of block permits would be more appropriate. Unfortunately, it is not likely that bow harvest can be increased substantially to improve the use of these permits. An early firearms antlerless season, as will be attempted in the fall of 1997 in Deer Management Unit 215 in Menominee County, may be an effective means of increasing antlerless harvest and use of block permits. However, a large scale implementation of such a season should be approached cautiously, as bowhunters may oppose an infringement on their season and firearm hunters have expressed desires to maintain the traditional November 15th. opener (Hauge 1997, Michigan Out-of-Doors April 1997).

Hunter Management

Encouraging farmer management of hunters to maximize on-farm harvest of antlerless deer could help to prevent losses from becoming intolerable on some farms. Forty-three percent of farmers with tolerable losses and 17% of farmers with intolerable

losses did not encourage the harvest of antlerless deer on their farm. Farmers may not understand the need to harvest antlerless deer or they may not feel comfortable imposing restrictions on those that hunt their lands. Eriksen (1994) found that farmers with chronic deer damage kept poor records of deer harvested on their properties, and those that did revealed that the harvest was too buck-oriented to effect a reduction in deer numbers on the farm.

Several farmers in Menominee county have found that by leasing hunting privileges they are able to recoup some of their losses to deer. However, if leasees are not encouraged to shoot antlerless deer, leasing may do little to resolve chronic intolerable losses. Farmers should also recognize that seasonal leases will result in dead periods or days during which there are no hunters on the property and thus no potential harvest of deer. Since there are reliable safe hunters who cannot afford to pay a fee, but who are willing to fill their antlerless tags and/or block permits on the farmer's property to help the farmer; farmers might consider leasing their land during the first week of the firearms season but not charging a fee the remainder of the season. Farmers may also recruit bowhunters and black powder hunters to hunt in the early and late portions of the season. This is not an exhaustive list of ways that farmers might better manage the hunting on their farms, but it should be clear that agencies have opportunities for working with farmers to promote such on-farm management.

There are also regulations that restrict the ability of farmers to efficiently use regular antlerless permits to control deer numbers surrounding their farms. Current Michigan law prohibits an individual with the opportunity to fill one of his party's antlerless tags from actually doing so. This restriction discourages individuals from

aiding other hunters in filling available antlerless tags and makes it more difficult for a producer to use regular antlerless tags exclusively as a damage control technique.

Considering that the agency is frequently unable to achieve its antlerless harvest goals, the MDNR might consider adopting a restricted party hunting regulation such as Wisconsin's, which would allow hunters of the same party within non-assisted auditory range of each other to fill each other's antlerless tags.

Inadequate harvests on adjacent lands

Fifty-two percent of the respondents indicated that they believed that low deer harvests on adjacent lands were a factor in their inability to control crop losses. From the data gathered and the comments producers returned on the survey, there are apparently two factors that may contribute low adjacent land harvests: 1) hunter preference for antlered bucks and 2) limited or restricted access.

Hunter preference

In response to a question on our deer hunter survey 8% of deer hunter respondents indicated that they were opposed to the harvest of antlerless deer and 17% indicated that though they supported the choice of others to harvest antlerless deer, they would not do so themselves. One tract of land in Presque Isle county was identified in the platbook as the "No Does Hunting Club. Overcoming this preference of hunters for shooting only antlered deer appears critical for controlling deer numbers and therein crop losses. The MDNR proposed Deer Management Assistance Program (Reeves, pers. comm.) also offers promise of reducing damage concerns on private lands. Under this

proposal large landowners or groups of adjacent landowners who agree to deer management objectives would be issued appropriate numbers of tags to regulate buck and doe harvest on their combined ownerships.

Areas closed to hunting

Some producers commented that areas near their farms provided refuges to deer during the hunting season. The Audubon Society's Baker Sanctuary and Marshall public school forest lands were mentioned as refuges in Calhoun county, as were residential and lakefront developments in Leelanau county and Lake Michigan lakefront developments in Oceana county. The potential impact and significance of these refuges should not be underestimated. Agencies may be able to aid farmers by communicating to these landowners and organizations the effect that their policies regarding hunting are having on producers' abilities to control crop losses.

Public Involvement and Education

Producers with intolerable levels of loss were more likely to have engaged in disruptive activity and appear more likely to engage in it in the future and thus, are important receivers of I&E efforts. However, the recurrent and diverse nature of crop damage issues makes it just as important to communicate with those producers for whom crop damage is yet tolerable. Likewise, the confirmation that crop damage and crop damage issue activity vary across time and across the state points to the need for agencies to allocate resources to maintain crop damage assistance programs, ongoing

communication, education and public involvement campaigns, and to establish adaptable crop damage assistance protocols.

Though 70% of the farmer respondents personally hunted deer, only 12% belonged to conservation organizations. Managers should not expect to effectively reach farmers through media channels used to communicate with hunters. Since 60% of our respondents belonged to the Michigan Farm Bureau and greater than 60% of the farmers had regular contacts with the Michigan State University Extension service, managers might consider using these and other agencies such as the Natural Resource Conservation Service as vehicles for communicating with farmers.

In a short survey we sent to potential issue managers, most MSU-E agents were not familiar with the MDNR biologists in their respective counties. They also expressed an interest in having a more involved relationship with the MDNR. Though it does not appear that MSU-E agents wish to take on large time consuming duties, it did appear that agents would be willing to aid the MDNR in managing crop damage issues as much as practicable while fulfilling their normal functions. Thus, potential exists for agencies to make use of Extension's interactions with farmers to improve their own credibility with farmers and to improve farmer understanding of wildlife management objectives.

For example, brochures describing the MDNR's services to farmers might be distributed to farmers via MSU-E during their farm visits. The type of information included might be such administrative things as annual application deadlines qualifying criteria for permits, and contact persons. Additionally, the information might include current estimates of herd density, area management objectives, and other information deemed appropriate by biologists.

Also, in cases where the MDNR biologist is uncomfortable judging whether the damage to crops is sufficient to warrant issuing permits, it may be appropriate to ask the county MSU-E agent to also evaluate the farmer's loss. This may especially be helpful in the case of specialty crops with which the MDNR biologist is less familiar. Similarly, if the biologist and farmer cannot agree on the extent of the producer's losses and/or the action that should be taken, they might ask the MSU-E agent to serve as an intermediary.

Identification of issue stages

One premise of this research was that issues, including deer crop damage issues, are developmental. Findings of the study support this premise and suggest cues and methods that the agency may use to monitor the emergence and development of crop damage issues. The fact that deer densities fluctuate and that amounts of crop loss are related to deer densities assures that issues will continue to arise in the future. The following table (Table 91) is the author's attempt to define the stages of crop damage issue development bearing in mind the inherent variability of producer situations.

Table 91: Characteristics of issue stages (Crop loss amounts, Deer densities, Intended behaviors, Management strategies for issue reduction.)

	Issue Stage			
	Latent	Emerging	Active	Disruptive
Tolerance indicator	Not a problem	Tolerable loss	Intolerable loss	Intolerable loss
Loss amount	Farmer does not recognize loss as occurring	Crop losses approaching \$500 or 4% of crop	Crop losses of approximately \$2,000 or 11% of crop	Crop losses of the intolerable level for more than 1 year
Tolerance indicator	Satisfactory numbers of deer	Too many deer may or may not take action to reduce #	Too many deer take action to reduce #	Too many deer take action to reduce #
Density range	<15 deer/square mile	20-30 deer/square mile	>35 deer/square mile	>35 deer/square mile (refuges likely?)
Intended behavior	None or no change	Producer promotion of hunting, seeking advice from DNR and MSU-E, requests for special permits	Producer promotion of hunting, requests for permits, use of repellents, seeking action from DNR	Producers demanding action from DNR, threatening legal action, calling state representatives
Management strategies	Communicate with farmers via media, acknowledge farmer's role in management, inform farmers about agency services	Communicate with farmers via media, encourage farmers to manage their hunters, increase private lands tags, issue shooting permits early in year	Personally contact farmers, encourage farmers to manage their hunters, relax shooting permit restrictions, issue block tags	Personally contact farmers, continue all previous strategies, seek creative/experimental alternatives, involve adjacent landowners
On-going:	Monitoring stakeholder tolerance, loss amounts, deer density, issue components. Communicate herd status and objectives to stakeholders. Incorporate stakeholder preferences into management objectives.			

The inherent flaw in this situation analysis is that it considers issue development at the level of the individual producer, while issues are normally considered at the societal level. Still, all issues start with individuals, and individuals have the ability to rally others to their causes. Unfortunately this study could not determine the number of producers required to place a crop damage issue at each of these stages; however, even a societal categorization may not have utility in that the state of the issue might be determined as much by the verbosity of a single producer as by the number of producers experiencing intolerable levels of loss. The evolution of the Michigan Farm Bureau's

threatened lawsuit appears to be the result of a few farmers with chronic losses drumming up enough support among other less vocal farmers, and not solely a result of a majority of farmers having intolerable levels of loss (Reeves pers. comm.). However, it appeared that enough counties had to be having damage problems before the Michigan Farm Bureau would pursue action at the state level.

Tying the development of issues to deer densities is similarly flawed in that all crop types are not equally impacted by the same numbers of deer. Still, when taken as a composite there appears to be promise in monitoring each of these indices together. The crux of predicting potential disruptive activity appears to be monitoring changes in the relative proportions of producers across each of the continuums (rows), specifically the variables tolerance of loss, tolerance of deer numbers, and perceived value of losses (Table 91). Thus, to be of use these indices need to be monitored on a regular basis as are indices of harvest and natural mortality.

Such periodic monitoring incorporated into agency operations will allow managers to be aware of when different issue stages are approaching. Regular monitoring will also help to make managers aware of when farmers may perceive that management is not considering their interests (i.e. Non-issuance of block permits in Benzie/Leelanau counties in 1994). Crop damage is a localized phenomena and as such requires some case by case management; however, monitoring the population of farmers in the area with the tolerance items used in this study will let a manager know when broader management is required. For example, examining charts such as Figures 21 and 22 may help detect when issues have grown beyond county borders and have approached a critical mass statewide. Monitoring will also allow proactive informational strategies

to be directed to specific segments of farmers even though issues have not yet been communicated to the agency, and this may in turn help to reduce the need for block and shooting permits among the farming population.

Research Needs

The response curves hypothesized by Minnis and Peyton (1995) and developed here (Figures 16-20) show promise as quantitative monitoring and analysis tools for defining Cultural Carrying Capacity. Currently the variances around means are relatively large and further research might examine methods of improving this instrument. Assuming that variances can be narrowed, charts such as these might have applications as monitoring and management tools.

Further investigation might examine the validity of producer's perceptions that adjacent landowners' attitudes regarding deer hunting are impacting crop depredation. Adjacent landowners' attitudes about deer hunting and deer hunter attitudes about the taking of antlerless deer apparently played an important role leading up to Wisconsin's decision to require hunters to Earn-a-Buck in 1996 (Hauge 1997). Early identification of factors such as these that impact levels of crop depredation may allow the MDNR to adopt regulations that better address factors influencing crop damage problems.

A comprehensive evaluation of farmers' efforts to control deer damage, would be beneficial and would allow managers to better aid producers in managing their own problems with currently available tools. In this survey, indications were that a fair number of producers with intolerable losses were not taking full advantage of the deer

damage control measures available to them, and Horton and Craven (1996) suggested similar weaknesses in producers' applications of deer damage controls.

Finally, agency credibility appears to have a significant impact on the attitudes of producers regarding deer damage and deer management. The finding that quality personal contact appears to moderate attitudes about the agency, suggests that widespread efforts to cut agency budgets and downsize staffs may be counterproductive. Because of the importance of credibility to all agency programs, it appears important that researchers test methods of enhancing the credibility of agencies with stakeholders, especially ways that credibility can be maintained without significantly increasing staffing.

Conclusion

The diversity of crop depredation issues cannot be reduced into a single management prescription. Acknowledgment of this variability by maintaining a structured yet flexible approach toward managing crop damage situations is perhaps the most important step in managing crop damage issues. No miracle cure for deer crop depredation is likely to result from this or any other study; however, it appears that crop loss conflicts can be reduced by focusing energies in 3 key areas: **agency credibility, issue monitoring, and application of controls.**

A trusted and competent management agency is a prerequisite to any effective management program and credibility is no less significant in managing depredation issues. To avoid disruptive issue development among producers, an agency cannot allow itself to be perceived as only being interested in perpetuating game or generating

revenue. To change this perception agencies will be judged by their actions and therefore may need to involve themselves more directly with their constituents on a regular basis. Monitoring indices of producer tolerance and components of issues will alert managers as to when they need to work with their constituents as well as what issues need addressing. Such monitoring should reduce the amount of reactive crisis management that agencies do, and may reduce the frequency of threats to an agency's credibility.

Two final objectives for reducing depredation conflicts are: maximizing efficient application of available controls and gaining greater acceptance of those controls by stakeholders. The first objective might be accomplished by removing barriers to use and effective application of available controls. For instance, requiring hunters to shoot a larger proportion of antlerless deer in an area; however, agencies typically give up control of >25% of the potential antlerless harvest by permitting hunters to choose what they shoot (Hauge 1997, Minnis 1996, Maedke and Anderson 1994). Management that changes hunter behavior has been shown to be unpopular even though it is necessary (Hauge 1997), therefore the second objective might be accomplished through the never ending process of educating and involving stakeholders. Part of the education of stakeholders should involve convincing them of the need to undertake control activities and to convince them that the chosen method of control is the most appropriate.

These are not easy tasks, in fact the undertaking is extremely arduous and complex given the paradoxical position of wildlife agencies and the diverse and often conflicting dominant values of their stakeholders. Still it is the author's belief that by improving credibility, increasing stakeholder understanding and acceptance of deer

management and damage control, and by monitoring issue development managers can reduce the frequency and magnitude of deer depredation, the amount of farmer mistrust of wildlife agencies, and the threat of disruptive issue activity.

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APPENDICES

APPENDIX I

APPENDIX I

1995 OPINION SURVEY OF MICHIGAN FARMERS ABOUT DEER AND DEER MANAGEMENT

INSTRUCTIONS FOR COMPLETING THIS SURVEY:

Please mark boxes clearly, as shown here: ☐ ☐

A farmer is anyone who attempted to produce a crop (apples, cherries, corn, beans, Christmas trees, etc.) or an animal product (beef, pork, poultry, milk, etc.) for profit during 1994.

An "antlerless" deer is a deer without antlers or with antlers less than 3 inches in length.

"DNR" means the Michigan Department of Natural Resources.

"Shooting Permits" are permits issued by the DNR for shooting deer outside of the regular deer hunting seasons.

"Block Permits" are special licenses sold to farmers in blocks of 5 or more by the DNR for shooting antlerless deer during the regular deer hunting seasons.

L. YOUR FARMING OPERATION

1. Please check one of the following that best describes you.

- ☐ FULL-TIME FARMER (FARMING IS MY PRIMARY OCCUPATION; I SPEND OVER 50% OF MY WORKING TIME FARMING.)
☐ PART-TIME FARMER (FARMING IS NOT MY PRIMARY OCCUPATION; I SPEND LESS THAN 50 % OF MY WORKING TIME FARMING.)
☐ RETIRED FARMER / NOT A FARMER ⇒ ⇒ (Thank you for your cooperation, please place the questionnaire in the enclosed envelope and return.)

2. In 1994 about how many total acres (including homesteads, feedlots, woodlots, fields, buildings, etc.) of your farming operation were:

A) OWNED? _____ ACRES

B) RENTED FROM SOMEONE ELSE? _____ ACRES

3. Please indicate the percentage of your annual farm sales represented by each crop or product.

Crop or Product	% of Farm Sales
LIVESTOCK, DAIRY OR POULTRY PRODUCTS	
CASH CROPS (e.g., vegetables, field crops)	
TREES OR TREE PRODUCTS (e.g., Christmas trees, orchards, etc.)	

4. How many acres did you farm in 1994 in Oceana county. Please add other counties and acreages you farmed in 1994.

County	Acres
OCEANA COUNTY	
OTHER COUNTIES (Please specify)	

For the remainder of this questionnaire please refer only to that portion of your farm that falls within the borders of OCEANA county.

5. We need an approximate location of your primary farming operation so we can analyze surrounding land use and deer distributions. On this map please circle that portion of Oceana county in which you do the majority of your farming.

– Map of County placed here –

6. Did you grow row/field crops for sale or feed (e.g., corn, soybeans, vegetables, alfalfa, etc.) in 1994 in Oceana county?

☐ YES ☐ NO ⇒ GO TO # 9

II. ROW / FIELD CROP LOSSES TO DEER IN OCEANA COUNTY

7. If you grew row / field crops in 1994, please provide your best estimate of the following information.

*If you don't know or aren't sure how much you lost to deer place a question mark "?" in the box.

Crop Type	1994 Acres	1994 Ave. yield per acre. Please include the type of unit (bu./ac, tons/ac, cwts/ac, etc.)	Lost to deer in 1994.* (Estimated Bushels, Tons, Cwts...)	The level of my 1994 losses to deer was... 1=Not a problem. 2=A problem but tolerable 3=A problem and I intend to increase my efforts to reduce the losses below 1994 levels. (Circle only one response per crop)		
CORN				1	2	3
SOYBEANS				1	2	3
DRY BEANS - Table				1	2	3
DRY BEANS - Certified				1	2	3
ALFALFA / HAY				1	2	3
SMALL GRAINS				1	2	3
VEGETABLES (Please List)				1	2	3
				1	2	3
OTHER-				1	2	3

8. Please complete the following sentence by providing the characteristics that describe your worst case field loss in 1994.

(For example: "In 1994, my worst losses to deer on a single field were on a 100 acre field of corn where deer reduced my yield from that field by 30 %.")

IN 1994, MY WORST LOSSES TO DEER ON A SINGLE FIELD WERE ON A (size) _____ ACRE FIELD OF (crop) _____ WHERE DEER REDUCED MY YIELD FROM THAT FIELD BY (amount) _____ %.

9. Did you grow fruit trees, nursery products or Christmas trees commercially in Oceana county in 1994?

☐ YES ☐ NO ⇒ GO TO # 12

III. FRUIT AND CHRISTMAS TREE LOSSES TO DEER IN OCEANA COUNTY

10. If you grew fruit, Christmas or other trees in 1994, please provide your best estimate of the following information.
 *If you don't know or aren't sure how much you lost to deer place a question mark "?" in the box.

Type of Trees	Acres	Trees per acre	Estimated # of Trees damaged by deer in 1994.*	1994 Farm Ave. yield in total lbs.	Estimated total lbs. lost due to deer browsing in 1994.*	The level of my 1994 losses to deer was... 1=Not a problem. 2=A problem but tolerable 3=A problem and I intend to increase my efforts to reduce the losses below 1994 levels. (Circle only one for each crop.)		
APPLE NON-BEARING						1	2	3
BEARING						1	2	3
CHERRY NON-BEARING						1	2	3
BEARING						1	2	3
OTHER -						1	2	3
						1	2	3
CHRISTMAS TREES						1	2	3
NURSERY PRODUCTS						1	2	3

If you intend to increase your deer damage control efforts in 1995, please ⇒ GO TO # 12

If not, please ⇒ GO TO # 11

11. If your 1994 losses to deer were tolerable, please give your best estimate of the level of loss that would be intolerable; that is, cause you to take (further) action to reduce losses.

Type of Trees	Intolerable # of damaged trees	Intolerable loss in lbs.
APPLE NON-BEARING		
BEARING		
CHERRY NON-BEARING		
BEARING		
OTHER -		
CHRISTMAS TREES		
NURSERY PRODUCTS		

12. In addition to total yield lost, how significantly does deer damage reduce the quality of your harvested crops?

The value lost in crop quality due to deer is... (Check ONLY one)

- ☐ GREATER THAN THE VALUE OF THE YIELD LOST TO DEER.
☐ EQUAL TO THE VALUE OF THE YIELD LOST TO DEER.
☐ LESS THAN THE VALUE OF THE YIELD LOST TO DEER.
☐ THE LOST VALUE IN CROP QUALITY IS NEGLIGIBLE.
☐ I'M NOT SURE.

13. Considering ALL crops (row, field, fruits, trees, etc.) how do you rate 1994's total losses to deer?

The level of my 1994 losses to deer was... (Check ONLY one)

- ☐ NOT A PROBLEM.
☐ A PROBLEM BUT I DO NOT INTEND TO INCREASE MY EFFORTS TO REDUCE THE LOSSES.
☐ A PROBLEM AND I INTEND TO INCREASE MY EFFORTS TO REDUCE THE LOSSES BELOW 1994 LEVELS.

14. Compared to deer, how would you describe the crop losses you incurred to all other wildlife such as beaver, raccoons, geese, blackbirds, mice, etc. in 1994? (Check ONLY one)

- ☐ LOSSES TO DEER ARE MORE SIGNIFICANT THAN LOSSES TO OTHER WILDLIFE
☐ LOSSES TO DEER ARE ABOUT THE SAME AS LOSSES TO OTHER WILDLIFE
☐ LOSSES TO DEER ARE LESS SIGNIFICANT THAN LOSSES TO OTHER WILDLIFE
☐ I AM NOT INCURRING ANY CROP LOSSES TO OTHER WILDLIFE
☐ I'M NOT SURE

15. On what have you based your estimates of 1994 crop losses to deer? (Check ALL that apply)

- ☐ I HAVE NO IDEA WHAT MY LOSSES WERE
☐ THE NUMBER OF DEER SEEN IN FIELDS
☐ THE VISIBLE DAMAGE TO CROPS
☐ REPORTED LOSSES BY OTHER FARMERS IN THE AREA
☐ COMPARISONS OF HARVEST RECEIPTS AND PERSONAL RECORDS
ESTIMATES MADE BY OTHER PERSONS

- ☐ DNR PERSONNEL
☐ MSU-EXTENSION AGENT
☐ CROP INSPECTOR

- ☐ OTHER: (PLEASE DESCRIBE) _____

16. Of the years listed below, which year was your loss to deer the highest in Oceana county? (Check ONLY one)

☐ 1986 ☐ 1987 ☐ 1988 ☐ 1989 ☐ 1990 ☐ 1991 ☐ 1992 ☐ 1993 ☐ 1994

⇒ GO TO # 18

☐ Undecided ⇒ GO TO # 19

17. Compared to your 1994 losses to deer in Oceana county, how much more was the loss for the year you indicated above? (Please specify)

- ☐ ABOUT THE SAME AS I LOST IN 1994
☐ ABOUT _____ % MORE THAN I LOST IN 1994
☐ NOT SURE

18. How would you rate the level of loss you indicated in the above question?

The level of my losses to deer during the year checked above in #16 was... (Check ONLY one)

- ☐ NOT A PROBLEM.
☐ A PROBLEM BUT I DID NOT INCREASE MY EFFORTS TO REDUCE THE LOSSES.
☐ A PROBLEM AND I INCREASED MY EFFORTS TO REDUCE THE LOSSES.

19. In the following table, indicate whether you have done and/or are likely to do any of the following in direct response to deer damage in Oceana county.

⇒ ⇒ ⇒ PLEASE RESPOND TO ALL 3 COLUMNS (Check ALL that apply)	DID PRIOR TO 1994	DID IN 1994 OR STILL IN EFFECT IN 1994	I WILL LIKELY DO IF FUTURE LOSSES ARE INTOLERABLE
INSTALL FENCING TO KEEP DEER OUT OF AN AREA	☐	☐	☐
USE REPELLENTS TO DISCOURAGE DEER FROM EATING A CROP	☐	☐	☐
USE HARASSMENT DEVICES TO FRIGHTEN DEER AWAY	☐	☐	☐
USE SHOOTING PERMITS	☐	☐	☐
USE BLOCK PERMITS	☐	☐	☐
ENCOURAGE OR PROMOTE HUNTING ON YOUR PROPERTY (OTHER THAN THE USE OF BLOCK PERMITS)	☐	☐	☐
SEEK INFORMATION OR ADVICE FROM THE DNR, MSU-EXTENSION OR OTHER SOURCE ON HOW TO GO ABOUT REDUCING CROP LOSSES	☐	☐	☐
CHANGE OR SWITCH CROPS TO THOSE LESS PREFERRED BY DEER	☐	☐	☐
PLANT BUFFER CROPS BETWEEN DEER HABITAT AND MORE VALUABLE CROPS	☐	☐	☐
START PURCHASING FEED INSTEAD OF <u>OR</u> IN ADDITION TO GROWING YOUR OWN	☐	☐	☐
ABANDON A FIELD BECAUSE OF HIGH DEER LOSSES	☐	☐	☐
COMMUNICATE WITH <u>OR</u> SEEK ACTION FROM:			
AN ELECTED OFFICIAL	☐	☐	☐
A REPRESENTATIVE OF THE DNR	☐	☐	☐
A REPRESENTATIVE OF THE MEDIA	☐	☐	☐
A REPRESENTATIVE OF MSU-EXTENSION	☐	☐	☐
HELP <u>ORGANIZE</u> MEETINGS TO DISCUSS AND ADDRESS DEER CROP DAMAGE	☐	☐	☐
<u>ATTEND</u> MEETINGS TO DISCUSS AND ADDRESS DEER CROP DAMAGE	☐	☐	☐
PERSONALLY <u>OR</u> JOINTLY CONSULT AN ATTORNEY REGARDING LEGAL OPTIONS TO REDUCE LOSSES TO DEER	☐	☐	☐

IV. COSTS OF DAMAGE CONTROL TREATMENTS / NON-TREATMENTS

20. Which crop generated the most revenue for your farm in 1994? _____

21. What was the price per unit (e.g. \$/bushel, \$/ton, \$/Cwt) for this crop in 1994? \$_____ per _____

22. For this crop, please indicate in the table below the damage control techniques you used by field in 1994 including fields receiving no protection, your estimate of the costs (if any) of the techniques used, and the effects on yields. If you have more than 3 fields in this crop, please provide information for the 3 fields receiving the most control.

Field or Block size		Techniques used in 1994 specifically to reduce crop losses caused by deer. (Check ALL that apply)	Costs of Damage Control Techniques Used on Fields (if any)				Yield Information Please provide both the yield and the units (e.g., bu/acre, tons/acre, Cwt/acre, \$, etc.)	
			Installation cost (if any)	Year installed	1994 Non-labor Maintenance or Operating cost	1994 Labor hours		
Field or Block 1	ACRES: _____	☐ NO CONTROLS ☐ HIGH TENSILE ELECTRIC FENCE (7 OR MORE WIRES)..... ☐ WOVEN WIRE (8+ FEET) ☐ REPELLENTS (SOAP, ETC.) ☐ HARASSMENT DEVICES..... ☐ SHOOTING PERMITS..... ☐ BLOCK PERMITS..... ☐ OTHER : (please describe)	_____	_____	_____	_____	1994 Ave. yield per acre: _____	Without damage controls, how much yield would you or did you lose?
_____		_____	_____	_____	_____	_____		
Field or Block 2	ACRES: _____	☐ NO CONTROLS ☐ HIGH TENSILE ELECTRIC FENCE (7 OR MORE WIRES) ☐ WOVEN WIRE (8+ FEET) ☐ REPELLENTS ☐ HARASSMENT DEVICES ☐ SHOOTING PERMITS..... ☐ BLOCK PERMITS ☐ OTHER : (please describe)	_____	_____	_____	_____	1994 Ave. yield per acre: _____	Without damage controls, how much yield would you or did you lose?
_____		_____	_____	_____	_____	_____		
Field or Block 3	ACRES: _____	☐ NO CONTROLS ☐ HIGH TENSILE ELECTRIC FENCE (7 OR MORE WIRES) ☐ WOVEN WIRE (8+ FEET) ☐ REPELLENTS..... ☐ HARASSMENT DEVICES..... ☐ SHOOTING PERMITS ☐ BLOCK PERMITS ☐ OTHER : (please describe)	_____	_____	_____	_____	1994 Ave. yield per acre: _____	Without damage controls, how much yield would you or did you lose?
_____		_____	_____	_____	_____	_____		

23. Are there other costs or losses associated with these fields that are not reflected in the preceding table? (Please specify)

V. DEER HUNTING INVOLVEMENT, ATTITUDES ABOUT HUNTING AND ACCESS

24. Please indicate to what extent you agree or disagree with the following statements by circling the appropriate response.

SA=Strongly Agree	A=Agree	U=Undecided	D=Disagree	SD=Strongly Disagree
(Circle ONLY one response for each statement)				
SA	A	U	D	SD
I cannot control my crop losses because not enough deer are harvested during the hunting season on lands adjacent to my farm.				
SA	A	U	D	SD
Hunting seasons should be designed to reduce deer numbers so that special kill permits to control crop losses are not necessary.				

25. Do you hunt deer yourself? ☐ YES ☐ NO ⇒ GO TO # 27

26. How important is deer hunting to you compared to other types of recreation in which you participate, such as other types of hunting, fishing, camping, jogging, bowling, competitive sports, etc.?

DEER HUNTING IS... (Check ONLY one)

- ☐ THE MOST IMPORTANT RECREATIONAL ACTIVITY IN WHICH I PARTICIPATE
- ☐ MORE IMPORTANT THAN MOST OTHER RECREATIONAL ACTIVITIES IN WHICH I PARTICIPATE
- ☐ ABOUT AS IMPORTANT AS THE OTHER RECREATIONAL ACTIVITIES IN WHICH I PARTICIPATE
- ☐ LESS IMPORTANT THAN MOST OTHER RECREATIONAL ACTIVITIES IN WHICH I PARTICIPATE
- ☐ NOT AT ALL IMPORTANT TO ME

27. Please check ALL who are allowed to hunt deer on your farm in Oceana county.

- ☐ NO ONE (INCLUDING MYSELF) ⇒ GO TO # 34
- ☐ ME AND/OR MY IMMEDIATE FAMILY
- ☐ FRIENDS AND NEIGHBORS
- ☐ NON-ACQUAINTANCES WHO REQUEST PERMISSION
- ☐ MY LAND IS OPEN TO ANYONE WHO WANTS TO HUNT, THEY NEED NOT ASK PERMISSION
- ☐ FRIENDS AND NEIGHBORS WHO PAY A FEE OR LEASE MY LAND*
- ☐ NON-ACQUAINTANCES WHO PAY A FEE OR LEASE MY LAND*

• If no hunters paid you for the privilege of deer hunting your farm in 1994 ⇒ GO TO # 30

28. If hunters paid you for the privilege of deer hunting on your farm in 1994, how much did you receive in total from deer hunters using your Oceana county farm in 1994? \$ _____ or Other payment: _____

29. On what basis were you paid by hunters? (e.g., annually, daily, etc.)

Please explain: _____

30. About how many hunters hunted deer on lands you farm in Oceana county on the opening day of the firearms deer season in 1994?

_____ HUNTERS ☐ I DON'T KNOW

31. About how many deer hunters do you think the lands you farm in Oceana county can safely support on opening day of the firearms deer season?

_____ HUNTERS ☐ I'M NOT SURE

32. Did you do any of the following to encourage those who hunted your lands to harvest antlerless deer in 1994?
(Check ALL that apply)

- ☐ I DID NOT ENCOURAGE THE HARVEST OF ANTLERLESS DEER IN 1994.
☐ I DISTRIBUTED BLOCK PERMITS
☐ I REQUESTED THAT ANTLERLESS DEER BE SHOT BEFORE BUCKS
☐ OTHER: (please describe) _____

33. Approximately how many deer were taken on your farmlands in Oceana county during ALL of the 1994 deer hunting seasons?

_____ ANTLERED BUCKS _____ ANTLERLESS DEER ☐ I DON'T KNOW

34. Please indicate how many acres of the lands you farmed in 1994 in Oceana county were in each of the following non-crop cover types.

Non-Crop cover types in Oceana county in 1994	Acres
PASTURES	
UNCULTIVATED, FALLOW FIELDS, OR C.R.P.	
WETLANDS (MARSHES, POTHOLEs, SLOUGHS, ETC.)	
ALL WOODED COVER (UPLAND FORESTS, CEDAR SWAMPS)	

VI. ATTITUDES AND USE OF SHOOTING AND BLOCK PERMITS IN OCEANA COUNTY

SHOOTING PERMITS are permits issued by the DNR for shooting deer outside of the regular deer

hunting seasons.

BLOCK PERMITS are special permits sold to farmers in blocks of 5 or more by the DNR for shooting

antlerless deer during the regular deer hunting seasons.

35. Have you ever requested Shooting and/or Block permits from the DNR for lands which you farm in Oceana county?
☐ YES ☐ NO ⇒ GO TO # 43

36. Have you ever requested Shooting permits from the DNR?

☐ YES ☐ NO ⇒ GO TO # 43

37. About how many years did you request shooting permits? _____ YEARS

38. About how many years did you receive shooting permits? _____ YEARS

39. Did you request Shooting permits in 1994?

☐ YES ☐ NO ⇒ GO TO # 43

40. How many Shooting permits did you receive in 1994? _____ PERMITS

41. Did you receive as many as you thought you needed? ☐ YES ☐ NO

42. How many of those Shooting permits were filled in 1994? _____ PERMITS WERE FILLED.

43. Have you ever requested Block permits from the DNR?

☐ YES ☐ NO ⇒ GO TO # 88

44. About how many years did you request Block permits? _____ YEARS

45. About how many years did you receive Block permits? _____ YEARS

46. Did you request Block permits in 1994?

☐ YES ☐ NO ⇒ GO TO # 88

47. How many Block permits did you receive in 1994? _____ BLOCK PERMITS

48. Did you receive as many as you thought you needed? ☐ YES ☐ NO

49. How many of those Block permits were filled in 1994? _____ BLOCK PERMITS WERE FILLED.

50. Please indicate in the following tables whether you agree or disagree with the following statements about Shooting permits and/or Block permits in Oceana county by circling the appropriate response.

SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree					
Shooting Permits:	(Circle ONLY one for each statement)				
In this county, shooting permits are distributed fairly to growers who need them regardless of the value of the crops grown.	SA	A	U	D	SD
Shooting permits are successfully used to reduce crop losses in this county.	SA	A	U	D	SD
In this county, shooting permits should be given more readily to growers of high value crops than to growers of lesser value crops.	SA	A	U	D	SD
Regardless of whether shooting permits actually reduce crop losses, they are still important to farmers because they at least make farmers feel in control of the situation.	SA	A	U	D	SD
My neighbors' objections to the use of shooting permits influences my decision to use them.	SA	A	U	D	SD
Too many male deer are killed on shooting permits.	SA	A	U	D	SD
The venison and/or recreation I get by using shooting permits is important to me.	SA	A	U	D	SD
Too many of the deer killed on shooting permits are not utilized.	SA	A	U	D	SD

SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree					
Block Permits:	(Circle ONLY one for each statement)				
In this county, block permits are distributed fairly to growers who need them regardless of the value of the crops grown.	SA	A	U	D	SD
Block permits are successfully used to reduce crop losses in this county.	SA	A	U	D	SD
In this county, block permits should be given more readily to growers of high value crops than to growers of lesser value crops.	SA	A	U	D	SD
Regardless of whether block permits actually reduce crop losses, they are still important to farmers because they at least make farmers feel in control of the situation.	SA	A	U	D	SD
My neighbors' objections to the use of block permits influences my decision to use them.	SA	A	U	D	SD
The venison and/or recreation I get by using block permits is important to me.	SA	A	U	D	SD

51. Please indicate whether any of the following should be considered by the DNR when issuing permits to a farmer for killing deer to control crop losses caused by deer. (Check ALL that apply)

- ☐ THE FINANCIAL DEPENDENCE OF THE FARMER ON THE CROP
- ☐ THE EXTENT TO WHICH THE FARMER HAS TRIED TO CONTROL LOSSES THROUGH NON-LETHAL MEANS
- ☐ THE FARMER'S WILLINGNESS TO ALLOW HUNTERS TO HUNT ON HIS/HER LAND
- ☐ THE WILLINGNESS AND ABILITY OF THE FARMER TO AVOID PLANTING HIGH VALUE CROPS NEAR DEER HABITAT
- ☐ OTHER: _____

52. Please describe any changes you would like to see made in the Shooting permit system in Oceana county.

53. Please describe any changes you would like to see made in the Block permit system in Oceana county.

VII. ATTITUDES ABOUT THE DEER POPULATION SIZE IN OCEANA COUNTY

54. When you form your opinion on whether the deer population size in OCEANA county is acceptable, how important is each of the following considerations to you?

Circle ONLY one answer for each row. ⇒ ⇒ ⇒	VERY IMPORTANT	SOMEWHAT IMPORTANT	SLIGHTLY IMPORTANT	NOT IMPORTANT	UNSURE
Personal recreational benefits from deer (e.g., viewing, hunting, feeding, etc.)	VERY	SOME	SLIGHT	NOT	U
Recreational benefits from deer provided to others in the county.	VERY	SOME	SLIGHT	NOT	U
Personal economic benefits from the presence of deer (e.g., hunting leases, goods and services provided to hunters and tourists.)	VERY	SOME	SLIGHT	NOT	U
Economic benefits to the county from the presence of deer.	VERY	SOME	SLIGHT	NOT	U
Personal crop losses to deer.	VERY	SOME	SLIGHT	NOT	U
Other farmers' crop losses to deer.	VERY	SOME	SLIGHT	NOT	U
The number of deer-related vehicle accidents in the county.	VERY	SOME	SLIGHT	NOT	U

55. For the portion of Oceana county where you do the majority of your farming, what is your best estimate of what the average number of deer per square mile was in October of 1994?

I BELIEVE THERE WERE BETWEEN _____ AND _____ DEER PER SQUARE MILE IN THIS AREA IN OCTOBER OF 1994.

☐ I HAVE NO IDEA WHATSOEVER

56. Considering both the positive and negative impacts of deer to yourself and the local community, how would you describe your reaction to the number of deer per square mile that you indicated in question 55 above? (Check ONLY one)

☐ TOO FEW, AND I INTEND TO TRY TO DO SOMETHING ABOUT IT.

☐ TOO FEW, BUT I DO NOT INTEND TO DO ANYTHING ABOUT IT.

☐ I AM SATISFIED WITH THE NUMBER OF DEER.

☐ TOO MANY, BUT I DO NOT INTEND TO DO ANYTHING ABOUT IT.

☐ TOO MANY, AND I INTEND TO TRY TO DO SOMETHING ABOUT IT.

57. In the portion of Oceana county where you do the majority of your farming, what number of deer per square mile would be most desirable to you (not too many or too few, but just right)?

THE MOST DESIRABLE NUMBER TO ME WOULD BE _____ DEER PER SQUARE MILE.

☐ I HAVE NO IDEA WHATSOEVER

58. Considering both the positive and negative impacts to yourself and the local community, please indicate the minimum and maximum number of deer per square mile that you would tolerate in that portion of Oceana county where you do the majority of your farming. (Answer BOTH A and B below)

PART A: ⇒ I WOULD NOT BE WILLING TO TOLERATE ANY FEWER THAN _____ DEER PER SQUARE MILE.

☐ I HAVE NO IDEA WHATSOEVER

PART B: ⇒ I WOULD NOT BE WILLING TO TOLERATE ANY MORE THAN _____ DEER PER SQUARE MILE.

☐ I HAVE NO IDEA WHATSOEVER

59. How would you describe the trend in deer numbers over the past five years in that portion of Oceana county where you do the majority of your farming? (Check ONLY one)

☐ INCREASING

☐ ABOUT THE SAME EACH YEAR

☐ DECREASING

☐ I DON'T KNOW

VIII. ATTITUDES ABOUT AGENCIES IN OCEANA COUNTY

60. In any given year, how often do you typically have contact with local DNR biologist(s)? (Check ONLY one)

- ☐ NEVER
☐ LESS THAN ONCE PER YEAR
☐ A FEW TIMES PER YEAR
☐ MORE THAN ONCE PER MONTH

61. Please indicate to what extent you agree or disagree with the following statements by circling the appropriate response.

SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree (Circle ONLY one response for each statement)	SA	A	U	D	SD
Crop losses are imposed on farmers by the DNR and hunters.	SA	A	U	D	SD
The DNR has the expertise to manage the state's deer herd.	SA	A	U	D	SD
The DNR has enough information on the deer population to adequately decide how many deer to harvest in Michigan each year.	SA	A	U	D	SD
DNR biologists treat farmers in this county professionally and with respect.	SA	A	U	D	SD
Our local DNR biologists can adequately determine the amount of loss a farmer is incurring to deer.	SA	A	U	D	SD
Our local DNR biologists understand the significance of crop losses to the economic well-being of the farmer.	SA	A	U	D	SD

62. Please distribute 100 points within each of the following two columns to indicate how much importance you think the DNR currently places and should place on each of the following interest groups when the agency sets deer population goals for Oceana county.

For example, if you think that the DNR currently places importance only on hunters' interests in setting deer population goals in OCEANA county, place 100 points next to hunters and 0 points next to farmers in the column on the left below. Or, if you think that hunter and farmer interests are equally important to the DNR, give each group 50 points. If another interest group is important to the DNR, write in the group and weight them accordingly. Follow this same procedure for the column on the right to show us where you feel the DNR should be placing importance.

THE DNR
CURRENTLY PLACES IMPORTANCE ON:

_____ HUNTERS
_____ FARMERS
_____ OTHER: _____
= 100

THE DNR
SHOULD PLACE IMPORTANCE ON:

_____ HUNTERS
_____ FARMERS
_____ OTHER: _____
= 100

63. In any given year, how frequently do you typically have contact with Oceana county MSU-Extension representatives? (Check ONLY one)

- ☐ NEVER
☐ LESS THAN ONCE PER YEAR
☐ A FEW TIMES PER YEAR
☐ MORE THAN ONCE PER MONTH

64. Please indicate to what extent you agree or disagree with the following statements by circling the appropriate response.

SA=Strongly Agree A=Agree U=Undecided D=Disagree SD=Strongly Disagree (Circle ONLY one response for each statement)					
The Oceana county extension agent(s) treat farmers professionally and with respect.	SA	A	U	D	SD
The Oceana county extension agent(s) are knowledgeable about farming.	SA	A	U	D	SD
The Oceana county extension agent(s) are helpful for locating information about farming problems.	SA	A	U	D	SD

IX. BACKGROUND INFORMATION

We need the following information to compare our sample of farmers with the statewide population of farmers.
As with the other information you have provided, this information will also remain confidential.

65. About what percent of your household gross income was generated by farming in 1994? _____ %
66. What was your total gross household income in 1994 (before deductions for taxes, bonds, dues or other items)?
(Check ONLY one)
- | | | | |
|--|--|--|---|
| ☐ LESS THAN \$9,999 | ☐ \$15,000 - \$24,999 | ☐ \$35,000 - \$49,999 | ☐ \$75,000 - \$99,999 |
| ☐ \$10,000 - \$14,999 | ☐ \$25,000 - \$34,999 | ☐ \$50,000 - \$74,999 | ☐ GREATER THAN \$100,000 |
67. What is your age? _____ YEARS
68. How long have you been farming in Oceana county? _____ YEARS
69. What was your highest level of schooling completed or degree received? (Check ONLY one)
- ☐ NO SCHOOL
 - ☐ LESS THAN 8TH. GRADE
 - ☐ SOME HIGH SCHOOL
 - ☐ HIGH SCHOOL DIPLOMA OR EQUIVALENT (GED)
 - ☐ SOME COLLEGE OR TECHNICAL SCHOOL
 - ☐ COLLEGE OR TECHNICAL SCHOOL DEGREE (BA, BS, AB, etc.)
 - ☐ GRADUATE OR PROFESSIONAL SCHOOL DEGREE (MA, MS, Ph.D., M.Ed., etc.)
70. Would you be willing to participate in a follow-up survey about the effectiveness and methods of the damage control you have used? (Check ONLY one)
- ☐ YES ☐ NO ☐ I HAVE NOT USED ANY CONTROLS
71. Please indicate if you currently belong to any of the following organizations. (Check ALL that apply)
- ☐ FARM BUREAU
 - ☐ OTHER FARMING ORGANIZATIONS: _____
 - ☐ LOCAL ORGANIZATIONS CONCERNED WITH CROP DAMAGE (e.g., Upward, Responsible Wildlife Management, etc.)
- PLEASE SPECIFY: _____
- ☐ CONSERVATION ORGANIZATIONS (e.g., MUCC, Pheasants Forever, National Wildlife Federation)
- PLEASE SPECIFY: _____

We welcome any additional comments you may have that will help us better understand how farmers view deer and deer-caused crop damage. Feel free to add your comments [here](#).

THANK YOU FOR YOUR PARTICIPATION!

Please place the questionnaire in the stamped envelope provided and mail to:

**Peter A. Fritzell
13 Natural Resources Building
Department of Fisheries & Wildlife
Michigan State University
East Lansing, MI 48824-1222**

APPENDIX II

APPENDIX II

MICHIGAN STATE UNIVERSITY
DEPARTMENT OF FISHERIES AND WILDLIFE
EAST LANSING, MI 48824-1222
13 NATURAL RESOURCES BUILDING
(517) 432-1491
FAX: (517) 432-1699

May 12, 1995

Dear Sir/Madame:

Recently I sent you a survey regarding your opinions about deer and deer management. If you have already completed and returned the questionnaire, thank you for your assistance and please disregard this letter. If you did not, please reconsider taking the time to complete the questionnaire. I have enclosed another copy in case you may have misplaced the first.

I realize how busy you are at this time of year, and this survey may seem an untimely burden; however, let me assure you that the time you spend completing this survey will not be wasted. Your response is very important and will aid Michigan State University Extension Agents, the Michigan Agricultural Experiment Station and the Michigan Department of Natural Resources in better understanding how deer and deer management affect Michigan agriculture.

- Even if you are not a farmer or have no opinion about deer, your response is important. If you do not farm, please complete the first page of the questionnaire, then fold and return the survey in the enclosed envelope.
- If the land you farm is not within the county specified in the questionnaire, please don't throw the survey away, I need to know about mistakes in our mailing lists; please fill out the first page and return the survey.
- The handwritten number on the back cover of the survey is not being associated with the answers that you give in the survey; the number is only there so that I do not send additional mailings to people who have responded to the survey. In no way will your name be associated with the information you provide on the questionnaire. Your responses will be kept completely confidential.
- If you are unsure about how to answer a question or if you would like more information about the study that Michigan State University is conducting please, don't hesitate to call me toll-free at (1-800-433-3741).

Please help by completing this questionnaire.

Sincerely,
Peter A. Fritzell, Jr.
Research Assistant

APPENDIX III

APPENDIX III

Telephone Non-Response Follow-up Questions

Phone Number:	Name of Person: (id number:)			
Date of Call	Contact Made	Message Left	Time of Call	Comments

Targeted county: Oceana Benzie Leelanau Calhoun Montcalm Presque Isle Menominee

Hello, could I speak with Mr./Mrs. _____ ?

This is Peter Fritzell calling from Michigan State University. Recently I sent a survey to farmers in XXXXXXXXXX county trying to get their opinions about deer management. Could you tell me if you/he/she received this survey from Michigan State University?
☐ **YES, THE SURVEY WAS RECEIVED.** ☐ **NO, THE SURVEY WAS NOT RECEIVED.**

Did you/he/she return the survey? ☐ YES ⇒ STOP ☐ NO ⇒ CONTINUE

About 50% of the individuals I sent surveys to responded. So that I can identify the weaknesses of this survey can you tell me why you/he/she did not return the survey.

- ☐ I AM NOT A FARMER ⇒ STOP
- ☐ I AM A RETIRED FARMER ⇒ STOP
- ☐ I DID NOT FARM IN XXXXXXXX COUNTY ⇒ STOP
- ☐ I WAS TOO BUSY FARMING WHEN I RECEIVED THE SURVEY
- ☐ SOMEONE ELSE FROM OUR FARM RETURNED A SURVEY
- ☐ I AM NOT INTERESTED IN DEER. ⇒ CONTINUE
- ☐ I DON'T HAVE ANY DEER PROBLEMS
- ☐ I DON'T TRUST MSU WITH SUCH INFORMATION
- ☐ I DON'T TRUST THE DNR WITH SUCH INFORMATION

Thank you.

Would you/he/she be willing to answer 12 questions about deer and deer management either now or at another time? ☐ YES ☐ NO

Is this a good time? ☐ YES ☐ NO

If this is not a good time can I call back at a more convenient time? ☐ YES ☐ NO

DAY _____ TIME _____ DON'T WISH TO TALK

Yes -- Okay. First...

No -- Okay, That's not a problem.
Thank you for speaking with me. I'm sorry
to have taken your time.



STOP

1. Which of the following best describes your participation in farming in 1994?

- ☐ FULL-TIME (FARMING IS YOUR PRIMARY OCCUPATION, IN WHICH YOU SPEND >50% OF YOUR WORKING TIME.)
☐ PART-TIME (FARMING IS NOT YOUR PRIMARY OCCUPATION, YOU SPEND <50% OF YOUR WORKING TIME FARMING.)
☐ RETIRED FARMER
☐ NOT A FARMER

2. How many acres did you farm in XXXXXXXXX county in 1994?

_____ ACRES ☐ I DID NOT FARM ANY LAND IN XXXXXXXX
COUNTY IN 1994.

3. In 1994 about how many total acres of your farming operation were...

OWNED	ACRES
RENTED	ACRES

_____ TOTAL ACRES

4. Approximately what percentage of your annual farm sales is represented by...

DAIRY, LIVESTOCK, POULTRY OR RELATED PRODUCTS	%
TREES, FRUIT OR RELATED TREE PRODUCTS	%
CASH CROPS (VEGETABLES AND FIELD CROPS)	%

5. Take a moment to consider the crop losses you may have incurred in 1994 due to the presence of deer. Considering ALL crops (row, field, fruits, trees, etc.) how do you rate 1994's total losses to deer?

Were your 1994 losses... (Check Only One)

☐ NOT A PROBLEM.

☐ A PROBLEM, BUT NOT SO MUCH THAT YOU INCREASED YOUR EFFORTS TO REDUCE THE LOSSES IN 1995.

☐ A PROBLEM THAT CAUSED YOU TO TAKE ACTION TO REDUCE OR PREVENT SIMILAR LOSSES FROM OCCURRING IN 1995.

6. Have you ever requested Shooting permits from the DNR? ☐ YES ☐ NO

7. Have you ever requested Block permits from the DNR? ☐ YES ☐ NO

8. Do you yourself hunt deer? ☐ YES ☐ NO

9. Take a moment to consider both the positive and negative impacts deer had on **yourself** and the **local community** in 1994; consider such things as recreational benefits, economic benefits, deer vehicle accidents, crop losses, etc. to yourself and others. Considering all these things which of the following statements most accurately describes your opinion of the size 1994's deer herd.

There were/was... (Check Only One)

☐ TOO FEW DEER IN XXXXXXXX COUNTY IN 1994, AND I HAVE TAKEN ACTION TO INCREASE THE HERD IN 1995.

☐ TOO FEW DEER IN XXXXXXXX COUNTY IN 1994, BUT NOT SO FEW TO DO ANYTHING ABOUT IT IN 1995.

☐ A SATISFACTORY NUMBER OF DEER IN 1994.

☐ TOO MANY DEER IN XXXXXXXX COUNTY IN 1994, BUT NOT SO MANY TO DO ANYTHING ABOUT IT IN 1995.

☐ TOO MANY DEER IN XXXXXXXX COUNTY IN 1994, AND I HAVE TAKEN ACTION TO REDUCE THE HERD IN 1995.

Okay, just 3 more questions.

10. Relative to the interests of hunters, how much importance do you believe the DNR currently places on the interests of farmers when setting deer population goals for XXXXXXXX county? (Check Only One)

Does the DNR currently place...

☐ AN EQUAL AMOUNT OF IMPORTANCE ON THE INTERESTS OF FARMERS AND HUNTERS.

☐ MORE IMPORTANCE ON THE INTERESTS OF FARMERS THAN ON THE INTERESTS OF HUNTERS.

☐ LESS IMPORTANCE ON THE INTERESTS OF FARMERS THAN ON THE INTERESTS OF HUNTERS.

Relative to the interests of hunters, how much importance **should** the DNR place on the interests of farmers?

The DNR **should** place...

- ☐ **AN EQUAL AMOUNT** OF IMPORTANCE ON THE INTERESTS OF FARMERS AND HUNTERS.
- ☐ **MORE IMPORTANCE ON THE INTERESTS OF FARMERS** THAN ON THE INTERESTS OF HUNTERS.
- ☐ **LESS IMPORTANCE ON THE INTERESTS OF FARMERS** THAN ON THE INTERESTS OF HUNTERS.

11. In what year were you born? _____ ☐ Refused to answer

I have one final question.

12. My early analysis of the responses I have received indicates that peoples attitudes about deer are related to their family's dependence on farm income. Could you tell me approximately what percentage of your gross household income was generated by farming in 1994?

_____ % ☐ Refused to answer

That's all.

Do you have any questions?

Thank you, I really appreciate the time you've given me. Don't let me keep you from your work anymore. If any questions do come to mind please don't hesitate to call. The number is 1-800-433-3741. ⇒ **Stop**

APPENDIX IV

APPENDIX IV

Postcard Reminder Text

Dear Michigan Farmer,

Recently I sent you a survey regarding your opinions about deer, crop damage and deer management. If you have already completed this survey, thank you for your assistance. If not, please complete and return it **as soon as possible**.

PLEASE HELP!! We need your assistance to ensure that Michigan agricultural interests and concerns are adequately understood by Michigan's wildlife managers.

Thanks for your help!

Sincerely,

Peter A. Fritzell, Jr.
Research Assistant
Michigan State University
(800) 433-3741

MICHIGAN STATE UNIV. LIBRARIES



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