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Assessment of Wildlife Depredation to Agricultural Crops in New Jersey

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Abstract
We documented wildlife depredation to vegetable, fruit, grain, and nursery crops in New Jersey during the 2000-growing season. Our objectives were to understand the economic impact wildlife has on agriculture and to identify the most common wildlife species causing depredation so county Extension agents can tailor strategies to minimize or eliminate wildlife conflicts. We documented $1,767,404.77 worth of economic damage to agricultural crops caused by at least 10 wildlife species. Our results may be used to support policies to reduce/eliminate conflicts between agriculture and wildlife and can aid county Extension agents in making cost-effective wildlife damage management recommendations to farmers.

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Introduction

Wildlife damage to agriculture has increased over the last 30 years (Conover & Decker, 1991; Jonker et al., 1998). A nationwide survey of agricultural producers in the United States reported that 80% of respondents had experienced wildlife damage to their crops, and 53% indicated that depredation exceeded their tolerance (Conover, 1998). Conservative estimates of agricultural losses nationwide from wildlife ranged as high as $2 billion (Conover, 1998).

A wide range of wildlife has been documented to depredate agricultural crops. A national survey of agricultural and wildlife professionals discovered at least 27 wildlife species that damaged agricultural crops (Conover & Decker, 1991). Other researchers have documented agricultural depredation by wildlife ranging from large mammals (Conover, 1994; Jonker et al., 1998; Van Tassell et al., 1999) to rodents (Messmer & Schroeder, 1996; Conover, 1998) and birds (Flegler et al., 1987; Wager-Page & Mason, 1996). White-tailed deer (*Odocoileus virginianus*), however, have been estimated to cause more damage to agricultural crops nationwide than any other vertebrate species (Conover, 1998; Conover & Decker, 1991).

While numerous wildlife species depredate agricultural crops in New Jersey, most of the attention has focused on the effect white-tailed deer have on agriculture. The New Jersey Agricultural Experiment Station conducted a survey of 4,403 New Jersey farmers who grossed more than $10,000 annually. Fifty-one percent of survey recipients responded and estimated that deer were responsible for 70% of their wildlife-caused crop losses (unpublished data, 1998). Furthermore, 39% responded that crop losses due to deer were intolerable (unpublished data, 1998). Overall, survey respondents estimated between $5 and $10 million in crop losses from deer during the 1997 growing season (unpublished data, 1998).

Farmers' perceptions regarding wildlife damage provide valuable information. However, documented validation of crop depredation to support or refute farmers' perceptions is required so

wildlife damage management policies and strategies can be enacted, if necessary, to reduce/eliminate conflicts between agriculture and wildlife. Furthermore, county Extension agents are often the first source farmers turn to for assistance with wildlife depredation to agricultural crops. In order to implement successful wildlife damage management strategies, it is necessary to identify the wildlife species responsible for the damage.

Therefore, we conducted a survey during the 2000 growing season to document wildlife damage to vegetable, fruit, grain, and nursery crops. Our objectives were to:

1. Better understand the economic impact wildlife has on agriculture for use in developing and implementing policies to alleviate wildlife damage and

2. Identify the more common wildlife species causing depredation so county Extension agents can tailor strategies to reduce wildlife conflicts.

Methods

We collected names, addresses, and phone numbers from New Jersey agricultural directories for growers of vegetable, fruit, grain, and nursery crops. We called farmers to inquire if they had experienced past crop damage from wildlife or were currently experiencing damage. If the farmer answered "YES," we asked to visit his farm and document the damage. We documented wildlife damage to agricultural crops during May - October of 2000. For comparative purposes, we divided the state into northern and southern regions, with the dividing line being roughly drawn east-west from Trenton, New Jersey.

Our selection of farmers to call and visit was not completely randomized. There are an estimated 9,600 farms in New Jersey (New Jersey Agricultural Statistics Service, 2001). However, due to the rapid pace of farmland conversion to urban development, there is no updated, comprehensive list of every farm in the state. Therefore, we chose to locate farmers via agricultural directories. As a result, an obvious bias exists because only farmers listed in the agricultural directories could be selected for our study.

We documented wildlife depredation, by species, using three methods. If more than one species depredated the surveyed area, we appropriated responsibility for damage by percentage for each species. We used Hyngstrom et al. (1994) to verify species identification of wildlife damage.

The first method we used involved exclosures that measured 10-feet by 10-feet and were constructed of 5-foot tall plastic mesh fencing with 1-inch mesh openings. Exclosures were randomly placed in grain fields prior to sprouting. We hand harvested the grain within each exclosure prior to harvest by the farmer and recorded the green weight. We hand harvested a randomly selected and equal-sized area 30 feet outside each exclosure and recorded the green weight. Prior to harvesting the area outside the exclosure, we documented any wildlife damage. Yield differences were calculated for each pair of harvested areas. An average yield difference was calculated for all exclosure pairs in a given field, and then extrapolated across the entire field. We erected 59 exclosures in 172 acres planted to grain.

The second method we employed was based on Wisconsin's Wildlife Damage Abatement and Claims Program (WDACP, 2000). We employed this method in fruit, vegetable, grain, and nursery crops. The WDACP provides detailed instructions regarding how large an area to sample for a given crop and how to determine the extent of wildlife depredation for a particular field based on sampled areas. We extrapolated results from sampled areas across the entire field.

The third method we used involved total crop depredation in part or all of a field. This method was employed most often in grain or vegetable crops. If no yield was evident in part or all of a field due to wildlife depredation, we measured the perimeter of the affected area and calculated total yield loss within the area.

For every crop surveyed, we converted yield loss into dollar loss based on the retail, wholesale, or commodity price the farmer was currently receiving.

Results

We visited 111 farms in 18 of New Jersey's 21 counties. We surveyed a total of 1,410 acres and documented $1,767,404.77 worth of economic damage to agricultural crops caused by at least 10 wildlife species. Based on the 1,410 acres surveyed, the average economic loss per acre equaled $1,253.48 (Table 1).

Table 1.
Number of Agricultural Acres Surveyed for Wildlife Damage, the Economic Loss from Wildlife, and the Average Dollar Loss per Acre in Northern and Southern New Jersey, 2000

Region	Acres Surveyed	Economic Loss($)	Economic Loss/Acre($)

North New Jersey	849	1,039,701.13	1,224.62
South New Jersey	561	727,703.64	1,297.15
TOTAL	1,410	1,767,404.77	1,253.48

Vegetable Crops

From 1997-1999, an average of 50,317 acres were in vegetable production statewide, with cash receipts totaling $135,098,000.00, or an average $2,685.00 per acre (New Jersey Agricultural Statistics Service, 2001). We surveyed 583 acres in vegetable production (337 acres in northern New Jersey, 246 acres in southern New Jersey) (Table 2). Economic loss to vegetable growers from wildlife totaled $1,424,287.00, or $2,443.00 per acre. Compared to the 1997-1999 statewide per acre average, vegetable growers that we surveyed lost 91% of their crop's value due to wildlife depredation.

Table 2.
Amount of Wildlife-Caused Yield Loss by Vegetable Type in Northern and Southern New Jersey, 2000

	Yield Loss		
Vegetable Type	**Northern New Jersey**	**Southern New Jersey**	**TOTAL**
Beans (Lima)	8 bushels	-----	8 bushels
Beans (Snap)	815 bushels	2,199 bushels	3,014 bushels
Broccoli	20 crates[1]	621 crates[1]	641 crates[1]
Cabbage	2,082 crates[2]	3,943 crates[2]	6,025 crates[2]
Corn (Sweet)	13,584 crates[3]	5,442 crates[3]	19,026 crates[3]
Cucumbers	291 bushels	727 bushels	1,018 bushels
Eggplant	39 bushels	-----	39 bushels
Lettuce	252 crates[4]	1,402 crates[4]	1,654 crates[4]
Peas	17 bushels	-----	17 bushels
Peppers (Green)	-----	7,125 bushels	7,125 bushels
Potatoes (Sweet)	562 bushels	70 bushels	632 bushels
Pumpkins	36,704 pumpkins	420 pumpkins	37,124 pumpkins
Spinach	-----	400 bushels	400 bushels
Squash	408 crates[5]	30 crates[5]	438 crates[5]
Tomatoes	6,585 cartons[6]	2,520 cartons[6]	9,105 cartons[6]

[1]New Jersey Agricultural Statistics Service (2001), 1 crate = 21 pounds (13 bunches)

[2]New Jersey Agricultural Statistics Service (2001), 1 crate = 50 pounds
[3]New Jersey Agricultural Statistics Service (2001), 1 crate = 42 pounds (50 ears)
[4]New Jersey Agricultural Statistics Service (2001), 1 crate = 50 pounds (24 heads)
[5]New Jersey Agricultural Statistics Service (2001), 1 crate = 25 pounds
[6]New Jersey Agricultural Statistics Service (2001), 1 carton = 25 pounds

Fruit Crops

From 1997-1999, an average of 23,283 acres were in fruit production statewide, with cash receipts totaling $88,811,000.00, or an average $3,814.00 per acre (New Jersey Agricultural Statistics Service, 2001). We surveyed 406 acres in fruit production (129 acres in northern New Jersey, 277 acres in southern New Jersey) (Table 3). Economic loss to fruit growers from wildlife totaled $154,636.89, or $379.94 per acre. Compared to the 1997-1999 statewide per acre average, fruit growers that we surveyed lost 10% of their crop's value due to wildlife depredation.

Table 3.
Amount of Wildlife-Caused Yield Loss by Fruit Type in Northern and Southern New Jersey, 2000

	Yield Loss		
Fruit Type	**Northern New Jersey**	**Southern New Jersey**	**TOTAL**
Apples	4,094 bushels	61 bushels	4,155 bushels
Cantaloupe	930 melons	1,727 melons	2,657 melons
Peaches	1,963 bushels	3,844 bushels	5,807 bushels
Strawberries	16 crates[1]	____	16 crates[1]
Watermelons	4,850 melons	539 melons	5,389 melons

[1]New Jersey Agricultural Statistics (2000), 1 crate = 24 pounds (16 quarts)

Grain Crops

From 1997-1999, an average of 220,332 acres were in corn (grain and silage) and soybean production statewide, with cash receipts totaling $35,797,000.00, or an average $162.00 per acre (New Jersey Agricultural Statistics Service, 2001). We surveyed 402 acres in corn (grain and silage) and soybean production (366 acres in northern New Jersey, 36 acres in southern New Jersey) (Table 4). Economic loss to corn and soybean farmers from wildlife totaled $46,979.38, or $116.86 per acre. Compared to the 1997-1999 statewide per acre average, corn and soybean growers that we surveyed lost 72% of their crop's value due to wildlife depredation.

Table 4.
Amount of Wildlife-Caused Yield Loss to Corn and Soybeans in Northern and Southern New Jersey, 2000

	Yield Loss		
Grain Type	**Northern New Jersey**	**Southern New Jersey**	**TOTAL**
Corn (grain/silage)	15,461 bushels	75 bushels	15,536 bushels
Soybeans	645 bushels	230 bushels	875 bushels

Nursery Crops

From 1997-1999, an average of 14,508 acres were in nursery production statewide, with cash

receipts totaling $272,579,000.00, or an average $18,788.00 per acre (New Jersey Agricultural Statistics Service, 2001). We surveyed 19 acres in nursery production (17 acres in northern New Jersey, 2 acres in southern New Jersey) and documented damage to a variety of flowers, shrubs, and trees. Economic loss to nursery growers from wildlife totaled $141,501.50, or $7,447.45 per acre. Compared to the 1997-1999 statewide per acre average, nursery growers that we surveyed lost 40% of their crop's value due to wildlife depredation.

Wildlife Species Responsible for Crop Depredation

We documented agricultural damage caused by at least 10 wildlife species (Table 5). In some instances, we documented bird damage but were unable to identify an individual species. The majority of documented agricultural damage was caused by deer (79%). Groundhogs (*Marmota monax*) caused the second-largest amount of economic loss (14%).

Table 5.
Wildlife Species Responsible for Economic Loss to Agriculture in Northern and Southern New Jersey, 2000

Wildlife Species	**Economic Loss ($) in Northern New Jersey**	**Economic Loss ($) in Southern New Jersey**	**TOTAL ($)**
White-tailed Deer	792,907.35	600,352.29	1,393,259.64
Groundhog	202,759.63	53,576.05	256,335.68
Canada Geese (*Branta canadensis*)	6,280.25	29,582.73	35,862.98
Raccoon (*Procyon lotor*)	0.00	34,436.82	34,436.82
Birds (unidentified)	18,975.00	2,822.50	21,797.50
Rabbit (*Sylvilagus floridanus*)	10,560.00	78.00	10,638.00
Meadow Vole (*Microtus pennsylvanicus*)	0.00	6,160.95	6,160.95
American Crow (*Corvus brachyrhynchos*)	4,400.00	732.81	5,132.81
Black Bear (*Ursus americanus*)	3,688.39	0.00	3,688.39
House mouse (*Mus musculus*)	92.00	0.00	92.00

Discussion

A number of issues limit the extrapolation of our results across New Jersey. One limitation is that we were not able to fully randomize the selection of farms to visit. Second, it is impossible to separate from total statewide agricultural statistics the acreage and cash receipts from livestock, dairy, and poultry—crops we did not survey—because New Jersey is a mixed agriculture state and farmers are rarely dedicated to raising only livestock, dairy, or poultry.

For example, from 1997-1999, an average 830,000 acres were in agricultural production in New Jersey, with cash receipts totaling $757,134,000.00, or an average $912.00 per acre statewide (New Jersey Agricultural Statistics Service, 2001). We found the average economic loss per acre from wildlife depredation equaled $1,253.48, which clearly exceeds total per acre cash receipts. However, an unknown percentage of the 830,000 acres and total cash receipts were for the production of livestock, dairy, and poultry. If we were able to subtract from total statewide agricultural statistics the acreage and cash receipts from livestock, dairy, and poultry, it would raise the statewide average per acre cash receipt. Finally, we have no idea what percentage of farmers throughout New Jersey employ wildlife damage management practices or the success of practices that are employed.

While a straight extrapolation of our results across New Jersey is not a fair estimate, we also suggest that the amount of wildlife damage that we documented to surveyed crops is conservative for a number of reasons. First, we visited 111 farms, which is only 1% of the estimated 9,600 farms in the state. Second, we surveyed 1,410 acres, or less than 1% of the estimated 830,000 acres in agricultural production. Third, we visited most farms only once during the growing season, so we only documented damage that had occurred prior to our visit to a particular farm. Any wildlife depredation that occurred throughout the remainder of the growing season and after our visit was not documented. Fourth, we may not have surveyed an entire farm for wildlife depredation. For example, if we visited a 500-acre farm, we may have only surveyed 100 acres due to time constraints.

Frequently, county Extension personnel are contacted as a first resource to assist farmers in New Jersey with reducing wildlife depredation to agricultural crops. Our results will aid county Extension agents in making cost-effective recommendations to farmers. Prior to recommending any wildlife damage management practice, it is necessary to correctly identify the species responsible for the damage. It is also useful to conduct a cost-benefit analysis to determine the annual economic impact from wildlife depredation. Determining annual economic loss can help a farmer decide how much money to invest in reducing/eliminating agricultural yield loss and at what point in time the investment will pay for itself.

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