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AN ECONOMIC ASSESSMENT OF THE IMPACTS OF WHITE-TAILED DEER OVERABUNDANCE IN TOWN OF HAMILTON, NEW YORK

ABSTRACT

Across the United States white-tailed deer populations affect economics in a number of ways. The following paper will focus and expound on a handful of ways that deer populations have an effect on economics: 1. Disease 2. Agriculture & home gardens 3. Hunting 4. Deer-vehicle collisions (DVCs) 5. Intangible costs/benefits 6. Timber productivity (Cote 2004). This research project will assess the economic stakeholders as they relate to the white-tailed deer population in Hamilton, New York. The research considers biologic data, which assesses the state (whether the population of deer is overabundant, stable, or too low) of the white-tailed deer population. Our deer population data comes from a roadside survey covering a total of 9.27mi², from the Hamilton aggregate of 41.31mi² (22.38%); the roadside survey was conducted for a total of twenty-one observation hours (Baez A et al 2013). Overabundance (or overpopulation) is attributed to a certain wildlife species when it (a) affects human life or well-being, (b) affects the fitness of the overabundant species in question, (c) it reduces the density of species with an economic or aesthetic value, or (d) it causes dysfunctions in the ecosystem (Gortázar et al 2006). Our biology team’s data has proven that the deer population is over the sustainable threshold—this conclusion was drawn based on extensive literature research and interviews with experts (Baez A et al 2013). Additionally, our economic results focus on collected data directly from the citizens of the town of Hamilton; we conducted both a telephone and phone survey (Jensen et al 2013). Our goal is to establish the costs and benefits of white-tailed deer to Hamilton and the surrounding area. Stakeholders include both residents and non-residents because the economy of Hamilton is intricately connected to the broader New York State, as well as the even broader United States economy. We use research from literature, our colleagues, as well as interviews with experts to determine how the economic stakeholders are affected.

INTRODUCTION

Our research intends to answer the question: What are the economic effects of white-tailed deer overabundance on stakeholders in Hamilton, NY? Our biology colleagues have already identified that deer are overabundant in Hamilton, and thus
this paper’s main objective will be dealing with the stakeholders—focusing on the economic burdens/advantages they incur (Baez A et al 2013). We will identify the stakeholders a priori, and thus get into a discussion of their burdens/advantages. Deer cause economic problems at all levels of the community; people are aware that they must protect themselves, their families, and their homes/gardens from the effects of deer. Stakeholders we deem most affected by deer are homeowners, farmers, hunters, and drivers.

Disease

We focus on Lyme disease because it is historically the most commonly reported wildlife-vector disease, and because it is the most significant deer-related disease afflicting people in Madison County (Conover et al., 1995). The blacklegged tick (commonly known as the deer-tick) is a vector for Lyme disease, and is the main cause for the disease’s spreading. Lyme disease incidence in Madison County and Hamilton is low, in terms of number of confirmed cases, but it is a legitimate threat to residents. Lyme disease in New York State is almost impossible to accurately measure because statisticians and doctors believe that only a fraction of the people that contract the disease actually report it. According to the New York State Department of Health, there were seventeen cases of Lyme disease in Madison County from 2007 to 2009. Interestingly, the Madison County Department of Health revealed in 2012 that there were approximately forty-seven confirmed cases of Lyme disease that went unreported to the New York State Department of Health from 2007-2009. (Humane Society, Online 2013; Center for Disease Control, Online 2013).

Agriculture & Home Gardens

According to a study by Brown et al. (2004), there are 300-400 crop farmers in Madison County, 39% of which produce alfalfa, 55.4% of which produce other types of hay, 37.5% of which produce grain crops; and 8.2% of which produce vegetables. Madison County is in Wildlife Management Unit (WMU) 7M, as designated by New York State Department of Environmental Conservation (NYS DEC). WMU 7M is a part of Central New York and covers an area of 1242 mi², which includes Town of Hamilton (NYS DEC 2013). Cornell researchers survey of 1,906 New York State farmers revealed that an average crop-producing farm in Central New York is about 274 acres, 157 of which are crop acres (Brown et al., 2004). Farmers throughout central New York indicated that they experienced mean monetary damages of $2,461, or $16 per crop acre as a result of white-tailed deer herbivory (or deer browse) (Brown et al., 2004). Madison County agricultural deer losses can be estimated to be about 2.5%-4% of a corn acre’s gross profit (Tzilkowski et al., 2004; Brown et al., 2004; AgCensus, 2007). Adjusting the loss per acre figure to $7 for grain, beans, hay, and alfalfa crops (Brown et al., 2004), the 95,760 acres (AgCensus, 2007) of those crops in Madison County lose $670,320 (6%) of their $11 million revenue to deer damage. Brown et al. (2004) estimated cost to a vegetable acre to be $29. Nursery producers incur a mean $149 revenue
loss per acre, the highest of all production categories (Brown et al., 2004). Cambronne (2013) conducted a survey in New Jersey that revealed that 25% of responding farmers had abandoned a parcel of tillable ground because of excessive white-tailed deer damage, and 36% stopped growing a preferred crop for the same reason (Cambronne, 2013). New York farmers could be at risk for the same abandonment, considering deer browse is currently at an unsustainable level.

A conservative estimate of agricultural losses in Madison County due to deer is 10%, the toll to individual farmers nearing $2,000 (Brown et al 2004). The average farmer’s net yearly income hovers between $20,000 and $30,000 (AgCensus), so if mitigation costs are low, farmers can save a significant profit. Because farmers do not have direct control of the deer population surrounding their property, their most direct mitigation methods will be physical barriers: fences and pesticides. An owner of Common Thread, a Hamilton-based organic farm, stated, “If we hadn’t had a fence, we would have lost a majority of our crops because there are just so many deer around” (Wendy Burkhart-Spiegel, Pers. Comm., 2013). Common Thread bought their “psychological fence” secondhand (at a reduced price) from another farm. The fence is mildly electrically charged and two posts deep, which confuses a deer’s eyesight. The farmers apply peanut butter to attract deer so the subsequent shock will deter them from returning. Due to its psychological dependence, however, the farmers do not expect the fence to fool deer longer than a few seasons. Furthermore, despite an urgent need for physical barriers, the Common Thread farmers waited until harvest season to erect the fence because their time was needed elsewhere on the farm. This behavior reflects the sensitive nature of the need to educate stakeholders of their status and the revenue they stand to protect.

Hunting

Hunting is big business in the United States; the industry generates $67 billion in economic output, and more than one million jobs in the United States. According to the 2006 US Fish and Wildlife survey, there were 10.1 million deer hunters in the United States; their total hunting related trip and equipment expenditures reached $8.9 billion. The total trip and equipment expenditures of deer and non-deer hunters were $17.4 billion in 2006; Deer hunter were responsible for $8.9 billion, or 51% of the total hunting expenditures. The average person spends $885 for trip and equipment expenditures per hunt. Furthermore, 80% of all hunters in the United States hunt deer; this number is congruent in New York. New York has 491,000 total resident hunters—452,000 that are deer hunters, which means that 92% of NYS hunters hunt deer. 47% of all hunters captured a deer in their home state in 2006. The more a person hunts, the more likely he or she will be successful; the successful hunters in 2006 spent an average of 18 days hunting, while the unsuccessful hunters spent an average of 9 days in the field (US Fish & Wildlife Service 2011).

The hunting industry is fueled by a variety of factors like hunt expenditures, (mentioned above—guns, ammo, clothing, dogs, etc.) licenses, and hunter education,
among several others. According to a spreadsheet provided by Jeremy Hurst at the DEC, 2,013,230 licenses were sold in New York for the 2012-2013 hunting season, totaling $49,689,054 in revenue. Madison County sold 18,691 licenses, which equaled a total revenue of $495,620.72. Hurst explains that the numbers are conservative because they do not include licenses purchased online or over the phone; the numbers only reflect licenses bought in-person.

Deer-Vehicle Collisions

It is important to note some strategies recommended for the prevention of deer-vehicle collisions considering their frequency in the Town of Hamilton. White-tailed deer cause $1.1 billion in vehicle damages and 150 deaths each year in the United States (National Highway Traffic Safety Administration, 2013). A number of methods have been proposed to reduce the frequency of deer-vehicle collisions, yet most are ineffective and/or would require significant funding (Hedlund et al., 2004). Romin and Dalton (1992) assessed the success of roadside whistles to scare deer from traffic, and reported minimal success. Romin and Bissonette (1996) reviewed state strategies to prevent and mitigate deer-vehicle collisions, which included a wide range of techniques discussed in the literature, including fencing, signs, whistles, underpasses, overpasses, and modified speed limits, but found that most state agencies did nothing to monitor the effectiveness of the strategies they employed. Sullivan and Messmer (2003) conducted a study on the perception of deer-vehicle collisions and deer-management programs by United States State Wildlife Agencies (SWAs) and Departments of Transportation (DOTs) (Sullivan and Messmer, 2003). Their survey revealed that state departments collect inconsistent DVC data, so our DVC research focused heavily on our survey responses. These two articles’ conclusions lead us to strongly recommend that, in order to fulfill our DVC-prevention objective, we suggest that whichever policy Hamilton implements must be strictly monitored for effectiveness.

A research team investigated the extent to which a reduction in a community’s deer population would have on DVCs. The team examined three areas that they deemed had overabundant deer populations: Iowa City, Iowa; Princeton, New Jersey; and Solon, Ohio. The management efforts were conducted over a 3-7 year period, and local herds were reduced by 76%, 72%, and 54%, which resulted in DVC reductions of 78%, 75%, and 49%, respectively: “There was a direct correlation between annual deer populations and DVCs in all study sites” (DeNicola 2008).

Hedlund et al. (2004) and Knapp et al. (2004) review methods for reducing deer-vehicle collisions. A number of methods were proposed, like roadside reflectors, “deer crossing” signs, deer whistles, fencing around highways, roadside clearing, speed-limit reduction, and even the implementation of infrared detection systems in consumer vehicles. Second to herd reduction, roadside fencing was proven to be the most effective method of reducing deer-vehicle collisions, especially because equipping consumer vehicles with infrared detection systems is extremely costly (Hedlund et al., 2004). Seamans et al. (2002) provide a novel
approach to white-tailed deer management in which predator fur (like coyote fur) is
distributed on land that is overpopulated or needs to be managed, and found this
approach to be successful. We question this method’s reduction in DVCs because,
while fur will repel deer from one location, it will push them to other locations,
including roads. Therefore, predator fur may increase the frequency of DVCs but
neither our research nor the literature has proven this theory empirically.

Intangible Costs/Benefits

Various studies were researched in which stakeholders are not able to
monetize their experiences with deer. These costs and benefits include, but are not
limited to: the burden of disease; the anxiety of driving with the risk of a deer-
vehicle collision; and the enjoyment of wildlife observation. With regard to
experiential value, our survey specifically referenced respondent’s enjoyment in
seeing deer around the Hamilton community. This information serves to assess the
non-monetary stakeholders in Hamilton, New York that must be considered in
policy recommendations, regardless of economic factors.

Timber Productivity

The DEC (2013) cited deer as one of the worst threats to forest regrowth in
state forests, affecting ecological forest health and timber revenue generation for
the state. Deer overabundance threatens the livelihood of this industry. Forests are
growing, but not maximizing profitably. The DEC is obligated to remove live trees,
but if undesirable undergrowth persists, then timber sales will decrease, and the
state will have to devise a new method of ecosystem maintenance, perhaps using
more tax dollars to operate.

Meanwhile, the DEC is harvesting timber below capacity. However,
production levels are expected to remain relatively constant. Therefore, as timber
needs are being met, and there is a profitable level of desirable old growth species, it
is unlikely that deer damage to new forest growth is economically significant at this
time. But, if New York State continues to dedicate more time and resources to
logging, then the present effect of deer browse on forest undergrowth and new
growth could stunt timber sales. In order to stay in control of said problem, two
Chenango County DEC foresters manage a pilot deer control program in Beaver
Meadow State Forest. The foresters, in addition to their regular duties, administer
Deer Management Agricultural/Forestry Permits (DMAPs) to hunters to cull what
the foresters have deemed the overabundant deer population. The foresters
expressed a need for a larger DMAP program to effectively manage deer
overabundance. (DEC 2013).

METHODS

To determine the economic effects of deer overabundance on stakeholders,
as well as the costs and benefits associated with deer overabundance in Hamilton, NY, we used multiple approaches. We examined literature at multiple spatial scales from the Town of Hamilton and County of Madison, to regional, and finally country scale data; we conducted interviews with stakeholders, and we conducted a survey of Town of Hamilton residents. Through the literature we identified the main stakeholders: homeowners, hunters, farmers, and drivers. Data we collect includes, but is not limited to, 1) Insurance figures of crop losses due to wildlife (State Farm data); 2) Private and public expenditures on deer management, specific to garden and crop loss mitigation; 3) instances of Lyme disease in the county; 4) the economic burden of deer browsing in forest ecosystems; 5) auto insurance figures; 6) the quantification of qualitative attitudes towards deer; 6) our own survey method (including questions specifically designed to gauge deer effects on economics) conducted by members of ENST 390, Fall 2013.

With our research colleagues, we synthesized and conducted phone and Internet surveys for roughly 230 Hamilton residents in order to understand public perception of deer. Survey respondents were questioned about monetary losses due to deer damage. Loss possibilities included: 1) experience with Lyme disease; 2) agricultural losses or garden and crop losses; 3) hunting benefits 4) deer-vehicle-collision (DVC) incidences 5) non-monetary or intangible costs/benefits. Our survey’s results are used in each subsection to show a parallel between the monetary data associated with deer in the Town of Hamilton and the data collected by scholars in other focus areas around the country.

Study Area

The study area is the Town of Hamilton, NY, which is a predominantly rural region. The Town of Hamilton is a part of Madison County, and is contained within WMU 7M, which includes a great deal of public land.

Agricultural & Home Gardens

To determine if white-tailed deer have an economic impact on both farmers and homeowners via herbivory of produce, we researched farm revenue and garden damage in the town of Hamilton. Additionally, peer-reviewed literature regarding the impact of white-tailed deer herbivory on household gardens and larger scale farms was reviewed. We compared US Agricultural Census data for Madison County to estimated crop losses in Pennsylvania (Tzilkowski et al 2004), Maryland (Stewart et al 2007), and New York (Brown et al 2004) and compared them with Madison County’s losses.

Deer-Vehicle Collisions

We collected data from insurance agencies, and interviews with government officials to assess the economic impact of deer-vehicle collisions on Hamilton residents, as well as to understand the frequency and severity of deer-vehicle
collisions in Hamilton, Madison County, New York State, and the United States. Additionally, we included a number of survey questions in our survey to specifically address the issue of deer-vehicle collisions and their associated economic impacts on Hamilton residents.

**Hunting**

We use data from our community phone survey to assess the concentration of hunters in Hamilton, and to better understand the economic costs/benefits they receive from the hunting industry. Additionally, we compare hunting numbers to the broader New York State and United States levels in order to best conceptualize Hamilton’s hunting industry.

**Intangible Costs/Benefits**

Our research team identifies the intangible costs/benefits of white-tailed deer populations through our survey. There is limited literary research on the topic, and thus we found it would be best to ask specific questions in the survey that would yield data about public perception of intangible costs/benefits of deer.

**Timber Productivity**

The Department of Environmental Conservation’s Chenango and Madison County extension was interested in our research. Phone interviews were conducted with DEC employees: Jeremy Hurst, Robert Off, Andrew Blum, Chris Sprague, and Paul Romancuko to conceptualize the effect deer have on the timber industry. The DEC website also provided technical information, including measurements of timber yields by region and county.

**RESULTS**

**Disease**

In order to assess the negative impacts that white-tailed deer have on the Hamilton community via disease, we asked survey respondents whether they, or anyone in their immediate family have ever had Lyme disease. According to Zhang et al. (2006), the aggregate average cost per person per case of Lyme disease is $281 (number was monetized based on the following categories: direct medical costs,

**Figure 1:** Percent of total respondents who have personally, or have had family members, contract Lyme disease in Hamilton, NY. 13.43% of respondents have had a member of their household contract Lyme disease. 86.57% of respondents have not had a member of their household contract Lyme disease.
indirect medical costs, nonmedical costs, and productivity losses) (Zhang et al., 2006).

Agriculture & Home Gardens

Our research determined that the impact of white-tailed deer on farm revenue was negative (Figures 2). Next, we monetized the incurred losses (Figure 3).

While many Hamilton residents do not experience agricultural damages as a result of white-tailed deer, a number of Hamilton residents own gardens and have landscaped lawns that are subjected to damage from deer with monetary losses (Figure 4).
Hunting

Aside from the negative economic impacts that white-tailed deer have on the Hamilton community, our survey and research sought to assess the positive economic impacts that white-tailed deer have on the Hamilton community. As of 2011, there are 823,000 hunters in New York State, who spent a total of 18,433,000 days per year hunting, and spent an average of $1,899 per hunter in hunting related activities a year, generating New York State a total revenue of $1,564,205,000 (USF&W Survey, 2011). In assessing these positive impacts, we asked respondents whether or not they or part of their family/ household hunts. 28.36% of total respondents indicated that they or a member of their household hunt. Compared to the 2.9% of the New York State population that hunts, and the 4.94% of the United States population that hunts, it is clear that Hamilton, New York, has a greater number of stakeholders in the hunting industry than is typical in the state, or country (DEC 2012-2016 Management Plan, 2011).

To understand the economic benefit hunters in Hamilton get from the white-tailed deer population, we asked whether or not respondents save or make money from the hunting industry. 17.72% of total respondents indicated that they do save or make money from the hunting industry, while the majority of Hamilton residents (80.38% respondents) do not benefit economically from the hunting industry. Of the 17.72% respondents who save or make money from the hunting or agricultural industry, 82.76% indicated that they do not have to buy as much meat when grocery shopping, 6.9% indicated that they lease their land for the use of hunters, and 10.34% benefitted economically in some other way. Of Hamilton respondents that did in fact benefit from the hunting industry, 47.83% experienced a benefit of $100-500, 24.74% experienced a benefit of over $1,000, 13.04% experienced a benefit of $500-700, and 17.39% experienced a benefit of under $100.

While hunters may be the most concentrated group that benefits monetarily from white-tailed deer populations, they are also the smallest group, and other residents do enjoy seeing deer around (Figure 5).

Figure 5: Percentage of total respondents that enjoy seeing deer around in Hamilton, NY. 10.73% strongly disagree with the above statement; 6.83% disagree; 17.56% are neutral; 43.90% agree; 20.98% strongly agree.
In order to assess the feasibility of increasing hunting land in Hamilton, and management options for controlling the negative economic impacts of white-tailed deer populations, we asked respondents whether or not they would consider letting people hunt on their land. 66.38% of respondents indicated they would not allow people to hunt on their land, while 31.90% of respondents would consider letting people hunt on their land—the remaining small percentage said they were “unsure.” To assess whether economic incentives would lead to landowners allowing hunters on their land, we asked whether landowners’ opinions would change (those that responded they would not allow hunters on their land) if they were compensated monetarily for the use of their land. In response to this question, 96.25% of respondents indicated that no, their opinion would not change if they were offered monetary compensation for the use of their land to hunt.

**Deer-Vehicle Collisions**

Deer-vehicle collisions are a major factor in determining the economic impact of white-tailed deer populations. According to State Farm Insurance, deer-related crashes in New York from July 1st 2012 to June 30th 2013 totaled 71,368, and the likelihood of colliding with a deer was one in 157.08, exceeding the national average of one in 174.03. Table one and figure 6 show each state’s likelihood of a collision: (Hamilton specific DVC data, from our community survey will be evaluated later in this section).

<table>
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<tr>
<th>STATE</th>
<th>Projected # of Deer-Vehicle Collisions (7-1-2012 to 6-30-2013)</th>
<th>Licensed Drivers in 2011</th>
<th>Likelihood Collision with Deer</th>
<th>State Ranking 2012-2013</th>
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<td><strong>21,874,649</strong></td>
<td><strong>1/74.03</strong></td>
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Table 1: Likelihood of involvement in a deer-vehicle collision by state (2012-2013). (State Farm Mutual Automobile Insurance Company, 2013.)
The Highway Loss Data Institute through the Department of Motor Vehicles monetizes average damages incurred in a deer-vehicle collision (Table 2).

<table>
<thead>
<tr>
<th>Type of Deer-Vehicle Collision</th>
<th>Average Cost to Driver</th>
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</thead>
<tbody>
<tr>
<td>Without Personal Injury</td>
<td>$2,800</td>
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<tr>
<td>With Personal Injury</td>
<td>$10,000</td>
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</table>

Table 2: Average cost of deer-vehicle collisions with and without personal injury. (Highway Loss Data Institute, 2013).

Deer collisions with aircraft also inflict economic costs. From 1990-2011, 879 incidents involving white-tailed deer and aircraft occurred. While aircraft-deer collisions only represent 0.9% of all aircraft-wildlife collisions, they incur 5.4% of the total cost of aircraft-wildlife collisions, totaling $75 million in damages. The 879 incidents reported to the Federal Aviation Administration resulted in one death and 26 injuries (Federal Aviation Administration; Biondi et al., 2011). Deer-aircraft collision data collected from 1983-1997 show that 21 deer-aircraft collisions
occurred in New York; the fifth highest occurrence during this time period (Wright et al., 1998). Deer rank seventh among animal species with the most frequent occurrence of aircraft collisions (Dolbeer et al., 2000).

To put the frequency of deer-vehicle collisions into perspective, there were 8,633 police reported alcohol-related car crashes in New York State in 2012. In comparison to the 71,368 deer-vehicle collisions in 2012, it is clear that deer-vehicle collisions are a serious threat to drivers. Furthermore, Hedlund et al. (2004) found that only half of all deer-vehicle collisions are reported to police, and less than half are reported to insurance companies (Hedlund et al., 2004). (State Farm Mutual Automobile Insurance Company, New York State Department of Motor Vehicles).

Data collected via a phone survey of approximately ten percent of the Hamilton community provide insight into the frequency and severity of deer-vehicle collisions in the area. Out of 202 participants asked whether or not they had been in a deer-vehicle collision, 64.85% of respondents (131) had been. When these 131 respondents were asked when they were involved in their latest deer-vehicle collision, 22.02% of respondents said, in the past year, and 39.45% of respondents said in the past two-five years. 38.53% of respondents have been involved in a deer-vehicle collision over six years ago. Of the respondents that had ever been in a deer-vehicle collision, 38.93% had incurred vehicle damages of $1,000-$5,000, while 16.79% incurred greater than $5,000 of vehicle damage, and 42.75% of respondents incurred less than $1,000 of damage. These data on the monetary cost associated with vehicle damage are congruent with data collected from the Highway Loss Data Institute (2013) on the average cost of deer-vehicle collisions without personal injury (Table 2). When those respondents who have ever been in a deer-vehicle collision were asked for an estimate of the total cost associated with personal health and injury associated with the deer-vehicle collision they were involved in, an overwhelming majority incurred no cost due to a lack of personal injury in the collision (95.68%), while 1.44% of respondents incurred less than $500 in damages, 0.72% of respondents incurred between $501 and $1,000 in damages, 0.72% of respondents incurred more than 0.72% of damages, and 1.44% were unsure or did not remember. These data suggest a low frequency of deer-vehicle collisions that lead to personal injury and medical expenses, but high cost associated with incidents in which personal health and safety is damaged.

Data collected from our community survey and other methods of collection were also used to assess the positive economic impacts of white-tailed deer on the Hamilton community. First, however, respondents were asked about the monetary costs associated with damages due to white-tailed deer that we had not previously mentioned in the survey. Of the total respondents, 93% had experienced no additional damages, while 7% of respondents experienced additional damage ranging from under $100 to over $1,000. These results indicate that the survey asked a thorough set of pertinent questions, addressing the depth and breadth of the negative economic impacts that white-tailed deer cause in the Town of Hamilton.
Timber Productivity

Related to agricultural losses, yet not specifically addressed in our Hamilton community survey, is the effect of white-tailed deer overabundance on timber productivity in New York State. According to the Bureau of State Land Management (2008), New York State yields and annual $6.9 billion in timber sales. The average timber sales contract in WMU 7M is $31,000, which equates to total revenues for this area of $1.2 million. Deer browsing negatively affects the growth of economically desirable species like red pine, black cherry, and white ash, and has the potential to significantly impact future timber revenues without increased management (New York State Department of Environmental Conservation, Personal Communication 2013). This is especially the case considering that the New York State Department of Environmental Conservation is now harvesting timber below potential rates. While average production is $5.5 million from 9,000 acres, production could increase to $11 million from 17,000 acres. New York State officials are advocating for such an increase in timber production in the future. The hope is to meet the potential rate of $11 million, but the risk is a larger overall impact of white-tailed deer browse on timber production—though the percentage of impact should remain the same. Department of Environmental Conservation officials suggest that these projected losses to the New York State timber industry could be mitigated by an increased allocation of DMAPs, which are free of charge, but indicate that time constraints in pre-DMAP allocation procedures are a bottleneck to DMAP allocation (Department of Environmental Conservation, Personal Communication, 2013).

DISCUSSION

We conclude that the negative effects deer have on Hamilton’s economics outweigh their positive effects. According to the literature we have reviewed, as well as our own survey, it is evident that high populations of deer have significant negative effects on this community. People, animals, plants, and forests are all notably affected. Consistent with other research, our survey of the Hamilton community showed that people perceive high populations of deer to be a threat to the community.

Disease

While the incidence of Lyme in Hamilton, may now seem low, the nationwide economic impact of Lyme disease is at least $203 million (Zhang et al., 2006). Research shows that deer culling will not significantly affect Lyme disease contraction, as deer are not the only tick host species (Humane Society, Online 2013; Center for Disease Control, Online 2013). Our survey results reveal that Hamilton residents do not understand the indirect correlation between Lyme and deer (Jensen et al 2013), even though many of them are still contracting the disease. In
addition to an average monetary cost of $281 per case, Lyme may induce chronic nervous system defects and joint pain, which can lead to death (Zhang et al., 2006). Experts suggest the best way to avoid contraction of Lyme disease in an area heavily populated with deer, is to use tick repellent sprays and to wear clothing that covers most of your skin when outdoors (Knapp et al. 2004).

**Agriculture & Home Gardens**

We asked survey respondents whether or not they have experienced agricultural losses as a result of white-tailed deer. 14% total respondents reported that they have, in fact, experienced agricultural losses as a result of white-tailed deer; of these respondents, 57% of respondents experienced damages over $100. Small-scale producers’ (gardeners’ and homeowners’) most cost-effective solutions are to erect fences and apply homemade (preferably organic) pesticides to their plants to repel deer. Recipes for organic pesticides can be made from household ingredients, and can also be made more readily available through town or county agencies (Knapp et al. 2004). Pesticide use for voluminous crops is costly and time-consuming.

John Pumilio, Colgate University’s Sustainability Coordinator, cited a fence-cost figure for a 7.5 acre willow tree plot to consist of initial installment fees ($4,000) and yearly maintenance fees ($1,000) (John Pumilio, Pers. Comm., 2013). If the average crop farm plants roughly 157 acres, an average farmer would incur $83,000 in initial fencing costs and yearly maintenance thereafter. This mitigation method’s cost exceeds deer damages, and thus we deem it economically inefficient. However, a physical barrier may be necessary for large-scale vegetable farmers who stand to lose an average three times as much revenue as grain and hay farmers.

We conclude that large-scale agricultural damage mitigation must be extremely low-cost to farmers, or it will not be cost-effective. Our results show that home gardens suffer significant economic damages that must be reconciled; few Hamilton residents own large-scale farms, but many Hamilton residents own gardens or have landscaping that is subjected to browse by white-tailed deer. Thus, we asked our survey respondents the following question: “what, if any, monetary costs have you incurred associated with garden damage as a result of white-tailed deer?” Over 50% of total respondents in Hamilton, New York reported that they have incurred damages to their gardens as a result of white-tailed deer. Almost a quarter of the respondents reported damages under $100. The fact that the majority of Hamilton residents reported garden damages is in line with research from Connelly and Decker (1987). They found that homeowner’s costs incurred by white-tailed deer outweigh the benefits they provide to residents of Westchester County (Connelly and Decker, 1987).

**Hunting**

Hunters are a huge part of the Hamilton community; according to our survey, almost one third of the Town of Hamilton population hunts. Deer hunters make up
the majority of hunters in both New York State and the United States; our survey yielded similar results. Of the population that hunts in Hamilton, over a 60% majority hunts deer. Therefore, it is important to heed hunter’s concerns; since hunting is such a lucrative industry across the United States, it is imperative that it stays intact in the Hamilton area. Hunter’s frustrations with the deer issues are evident, and thus, to keep these stakeholders relatively happy, we must ensure that the population of white-tailed deer stays at a healthy, hunt-able level.

Hunting affects everyone in Hamilton, and thus we asked all survey respondents if they save or make money from the hunting industry; 18% responded that they do save or make money from the hunting industry, while 80% replied that they did not benefit monetarily from the hunting industry. Compared to the state and national levels, the percentage of hunters in Hamilton is large; almost a third of Hamilton residents hunt, compared to about 3% of all of New Yorkers and 5% of the entire country. Many believe that opening posted lands to hunting could help to stabilize the deer population, but our survey shows that people do not want others hunting on their land. 31% of respondents said they would consider allowing people to hunt on their posted land, but of this group, 96% of them would not allow people to hunt on their land if offered monetary compensation. The conclusion here seems to be that hunting is a viable option, that would efficiently reduce deer populations, but it would be necessary to get all stakeholders on board with a change in management strategy in order to execute culling effectively.

*Deer-Vehicle Collisions*

Deer-vehicle collisions need to be drastically reduced in the Hamilton area; not only do they affect a large pool of people, the average cost of repair is substantial. Deer-vehicle collisions are very common in New York State as a whole, and to reduce these numbers we must consider new policy that will regulate white-tailed deer populations. Ultimately, much of the literature regarding the reduction of DVCs advises to decrease the local deer population through the increased allocation of Deer Management Permits (DMPs), by the DEC.

We were able to assess the likelihood of getting into a deer-vehicle collision in New York State, and how that compares to the rest of the nation. In New York State the likelihood of getting into a deer-vehicle collision in the past year (June 2012-July 2013) was 1/157 (State Farm Mutual Automobile Insurance Company, 2013). Furthermore, there are huge economic burdens that come with a deer-vehicle collision; without personal injury the average cost of a DVC is $2,800, and if personal injury is incurred the average cost jumps to $10,000 (Highway Loss Data Institute, 2013). The results we yielded in our survey divulge a bit from the highway Loss Data Institute’s monetization of DVCs. In our survey, 38.93% of people involved in a DVC admit that it cost them $1,000-$5,000, while 16.79% said they had damages of $5,001 or greater, and 42.75% of respondents said their damages cost $999 or less. The majority of people had damages of $999 or less, which is substantially lower than the average $2,800 of damages reported by the Highway Loss Institute. When asked about additional damages on our community survey, the
majority of residents reported that they had no other damages besides the ones mentioned explicitly above.

**Intangible Costs/Benefits**

The Hamilton survey qualitatively measured these experiences by offering participants response choices, “I cannot quantify costs,” and “time and aggravation costs.” Intangible benefits of white-tailed deer include wildlife watching; approximately 65% of Hamilton residents like seeing deer around. As far as intangible costs, it can be extremely aggravating for homeowners to constantly worry about the possibility of negative tangible effects from deer; certainly the worry that people have on a day-to-day basis about deer constitutes a real problem. One example that was prevalent in the survey was the fact that deer harm people’s gardens, which not only create tangible monetary effects, but the destruction of people’s lawns is more than the money they put into them, it is a representation of their time spent landscaping and their livelihood.

**Timber Productivity**

Unsustainably high levels of deer threaten the timber industry’s revenue, not to mention the threat they pose to an ecosystem’s ecology. Though timber productivity is related to agricultural losses associated with white-tailed deer, we did not specifically address timber in our Hamilton survey; timber yields nearly reach $7 billion per year in New York State. Specifically region 7M, brings in about $1.2 million in timber revenues, but this number could suffer if deer populations are not controlled. There is potential to increase timber revenues in 7M, but without proper monitoring of the deer population, the area will never reach its potential.

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