

FINAL REPORT

2019 DEER MANAGEMENT PROGRAM FOR ESSEX COUNTY, NEW JERSEY SOUTH MOUNTAIN RESERVATION HILLTOP RESERVATION

Prepared for

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and

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by

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Background

In 1896, a year after the formation of the Essex County Park System, John Durand described the mountain that includes South Mountain Reservation as “a wilderness, as it probably existed at the time of Henrick Hudson, a primitive forest abounding with deer and other wild animals, and traversed by streams alive with trout. Game was plentiful – partridges, quail, woodcock, rabbits, squirrels of every species, raccoons and foxes.”

Today, the County of Essex, like many governmental entities in New Jersey, finds that deer abound in much greater numbers than the other wild animals. In several of its large tracts of parkland and open space, the County sees the problems typically associated with an over-population of white-tailed deer:

- Vegetation in tracts of public open space is being over-browsed, resulting in a loss of vegetative biodiversity;
- Loss of vegetation due to over-browsing is forcing a decline in the number of animal species, particularly songbirds and small mammals, that depend on the herbaceous and shrub layers of the forest and fields for food and cover;
- Over-browsing of native tree seedlings is precluding growth of new trees, altering the age structure of forested areas and stopping the ability of the forest to regenerate as older trees are lost;
- Loss of vegetation is decreasing the ability of forested areas to retain rainwater, increasing the rate and volume of stormwater runoff to streams and rivers, exacerbating erosion and flooding problems;
- Loss of native vegetation is enabling an incursion of invasive exotic plants, which outcompete native species, and provide little or no benefit to native wildlife;
- Trees and shrubs in the surrounding residential areas are being heavily browsed, resulting in huge financial losses for area residents, landscapers and nurseries;
- Deer-related motor vehicle accidents result in personal injury, significant property damage, and mortality or injury of many deer, and could lead to loss of human life;
- The fear of Lyme Disease diminishes enjoyment of the out-of-doors for many people, both in public open space and in their own yards; and
- Destruction of garden plants and the ubiquitous presence of deer droppings hinder the ability of homeowners to enjoy use of their own yards for gardening and recreating.

Officials of the County of Essex, including its Department of Parks, Recreation and Cultural Affairs, have been concerned for over two decades with the dense population of white-tailed deer in the South Mountain Reservation, and the resultant effect on forest ecology and the surrounding community. Hearings organized by Freeholder Chairman (now County Executive) Joseph DiVincenzo in the mid 1990’s brought out residents complaining of the usual problems associated with high deer density in large tracts of public land surrounded by suburbia - residential landscaping damage, deer-related motor vehicle accidents, fear of Lyme Disease, and the inability of homeowners to enjoy use of their own yards.

Parks Department staff were particularly alarmed by the impact of overbrowsing of deer on the South Mountain Reservation, where the understory had been eaten away from most of the 2,047-acre park and the survival of plant and other animal communities was seriously threatened. In more recent years, expressions of concern for the forest ecology have been echoed by the South Mountain Conservancy and New Jersey Audubon.

In March, 2006, the County of Essex received a Landscape and Infrastructure Assessment and Restoration Management Plan for the South Mountain Reservation, prepared by Professional Planning and Engineering Corporation (PPE). Recommendations for management of deer presented in that plan were based on a Deer Management Report issued by The Louis Berger Group, Inc. in November, 2005.

Louis Berger and PPE noted that deer populations had been browsing on the understory of the forest at levels that were changing the vegetative species composition and disrupting the natural landscape. In addition, deer impacts were affecting the visitor's visual experience and the historic and scenic value of many areas in the largest park in the oldest County park system in the United States.

The impact of the high deer population on the forest ecology in South Mountain Reservation was most evident at the herbaceous and shrub layers of the understory. Tree seedlings, forbs, wildflowers, shrubs and even an accumulation of leaf litter had largely disappeared. The future effect on the forest was foretold as the tree canopy was thinning in some areas and not being replaced due to a lack of seedlings and saplings.

About 80% of the 2,047-acre park is forested. More than 75% of that area consists of an evenly aged stand of trees with low species diversity and minimal understory. The early successional habitat found in seedlings and saplings stands has been eliminated by deer overbrowsing, which precludes the possibility of forest regeneration.

In some areas, the lack of an understory has allowed the incursion of huge quantities of invasive exotic plants, which deer won't eat and which provide little or no food or shelter resources to other wildlife. Massive stands of Japanese knotweed are prevalent along many of the roads and at the edges of meadows and activity areas. Japanese stiltgrass covers acres of the forest floor.

A survey of vegetation species found throughout South Mountain Reservation as part of the PPE study identified 98 different tree, shrub and herbaceous species. Eleven of those species are invasive plants not native to North America.

The loss of vegetation due to overbrowsing by deer was leading to an increase in erosion and a decline in stream and lake water quality. Slope areas and hiking trails that were most badly eroded were in areas where the herbaceous layer of the forest had been stripped away. Instead of rainwater seeping into the porous ground of a healthy forest, thereby filtering pollutants and assimilating nutrients, the water was running quickly over the hardened slopes, washing soil with

it and causing a decrease in water quality in the park's streams.

As a first step in trying to deal with the burgeoning deer population, the County of Essex looked at the feasibility of instituting a deer management program in the South Mountain Reservation. The County hoped to draw upon the experience of its neighbor, the County of Union, which successfully addressed similar issues in its 2,065-acre Watchung Reservation.

The Watchung Reservation is similar to South Mountain Reservation in terms of size, ecology, and topography. Implementation of a deer management program there in 1995 achieved a reduction of deer density from 180/square mile to 35/square mile in just four years, and now is maintaining the population at about 30/square mile (though still trying to go lower). Impacts on the Watchung Reservation have been greatly reduced and signs of regeneration are found throughout the forest.

Essex County officials felt that lessons learned during and since the reduction phase of the Watchung Reservation program could be applied to efforts in South Mountain Reservation, and could be expected to achieve deer population reduction with greater efficiency of time and manpower. County Executive DiVincenzo recruited Daniel J. Bernier, a wildlife management consultant, in mid-2007 to design, permit, prepare and implement a deer management program for South Mountain Reservation. As Director of the Union County Division of Park Environmental Services, Bernier had administered the Watchung Reservation Deer Management Program since its inception in 1995.

Numerous meetings were held between the wildlife management consultant, Essex County officials and staff, municipal officials, and representatives of several law enforcement agencies. A set of Program Guidelines was developed that almost replicated the plan successfully used to remove deer by selected agents from the Watchung Reservation. All elements of the shooting program were crafted and carefully reviewed to ensure that deer would be removed in a manner that was safe for program participants, park users, and park neighbors, while at the same time being humane in its treatment of the deer.

Essex County set its initial goal at reducing the deer population to the 20 deer per square mile goal density that had typically been recommended for fostering a forest's ability to regenerate. That density equates to a targeted population size of about 64 deer in the park. Based on Forward Looking Infrared censuses of deer conducted between 1999 and 2005, it was estimated that achieving that density would require the removal of at least 250 deer.

After the New Jersey Division of Fish and Wildlife issued a Special Deer Management Permit, shooting activity began in January, 2008. When the program ended in late February, after 8 ½ days of operation, 213 deer had been harvested from the South Mountain Reservation. Similarly, in January and February of 2009, 83 deer were removed over the course of 9 days of hunting.

The Program Expands

In light of the considerable success achieved in reducing the deer density in South Mountain Reservation in just the first 2 years, County Executive DiVincenzo looked toward beginning to tackle the deer problem in other areas of the Essex County Park System. Two park properties where deer impacts were noticeable and complaints from the surrounding communities were high are Eagle Rock Reservation and the Hilltop Property.

Wildlife Management Consultant Bernier developed population density estimates that, in turn, guided the establishment of goals for removing 50 deer from South Mountain Reservation, 75 deer from Eagle Rock Reservation and 50 deer from the Hilltop Property in the 2010 season.

Because of a disparity in the number of deer killed on afternoon shifts versus morning shifts in 2009, it was recommended that hunting at South Mountain Reservation only be conducted in the afternoons in 2010. In 6 half-day shifts, another 44 deer were removed from the park. Remarkably, in 3 ½ full days of hunting, only 19 deer were removed from Eagle Rock Reservation. However, an incredible 97 deer were taken out of the Hilltop Property in that same time period.

Since 2010, goals have been set annually based on population density estimates. The length of the hunting program for South Mountain Reservation has varied from as short as 3 half-days to as long as 4.5 full days. Anywhere from 31 deer to 87 deer have been harvested in each of those years. At Hilltop Reservation, the harvest has varied from 7 deer to 102 deer in seasons that ranged from 2 ½ days to 7 days.

At Eagle Rock Reservation, between 19 and 23 deer were removed annually in seasons that lasted from 3 ½ days to 7 half-days. In 2013, no hunting was planned for Eagle Rock Reservation, as the deer population estimate at that time was lower than the amount that could be efficiently removed in terms of cost and manpower. Hunting has not returned to Eagle Rock Reservation since then, as the deer population has been too low to warrant the expense of a hunting program.

In 2018, 5 half-days of hunting yielded 87 deer from South Mountain Reservation. Fifty-two deer were taken out of the Hilltop Reservation in another 6 half-days.

The Approval Process

Authority for the conduct of a deer management program of the type conducted in Essex County's parks since 2008 lies with the New Jersey Division of Fish and Wildlife, upon approval by the New Jersey Fish and Game Council. The Fish and Game Council, in January of 1994, adopted a program entitled the Community-Based Plan for the Management of Suburban Deer Populations. That program set forth optional methodology for deer reduction in areas where traditional hunting is not possible due to concerns for safety or public acceptance.

Until 2009, under the Community Based Plan, a permit for a special deer management program could be granted to a municipality, but not to a county. In 2008 and 2009, County officials appeared before the governing bodies of the municipalities that are spanned by South Mountain Reservation, Eagle Rock Reservation and the Hilltop Property. The governing bodies of the Townships of Cedar Grove, Maplewood, Millburn, Verona and West Orange and the Borough of North Caldwell subsequently passed resolutions authorizing the County of Essex, through its Department of Parks, Recreation and Cultural Affairs, to submit the appropriate permit applications on their behalf for 2009 and 2010. In 2010, through the efforts of the Essex County delegation to the State Legislature, the enabling legislation was revised to allow counties to apply directly for a permit.

In subsequent years, an application for designation of the South Mountain, Eagle Rock and Hilltop Reservations as Special Deer Management Areas and for approval of a Community Based Deer Management Plan was prepared by Wildlife Management Consultant Bernier and submitted to the State. Each year, the Fish and Game Council authorized a Community Based Deer Management Permit and a permit was subsequently issued by the New Jersey Division of Fish and Wildlife.

Per the recommendation of the wildlife management consultant, Eagle Rock Reservation was not included in the 2013 or subsequent applications. Spotlight counts have shown a density that, though still above the recommended level, was not high enough to warrant the resources needed for a safe and effective hunting program.

For 2019, a Special Deer Management Area application and Community Based Deer Management Plan for South Mountain Reservation and the Hilltop Property were submitted to NJDFW on September 7, 2018. A permit was approved and issued on January 8, 2019.

The Planning Process

In preparation for the 2018 deer management program, meetings were again held between the wildlife management consultant, Essex County officials and staff, municipal officials, and representatives of law enforcement agencies. The Program Guidelines for 2019 were revised (see Appendix A) to continue to ensure that deer would be removed in a manner that was safe for program participants, park users, and park neighbors, while at the same time being humane in its treatment of the deer.

As in 2018, key elements of the plan included:

- * The two park properties would be closed to the public during this program, although the major roadways that cross the parks would remain open.
- * Fifteen agents would be carefully selected from among licensed hunters who would be screened through an orientation and proficiency testing program. Up to 13 of the 15 agents would be chosen from among hunters who participated in the Essex County Deer

Management Programs between 2008 and 2018.

- * Shooting would occur only at pre-designated baiting stations, carefully chosen to effectuate site-specific reduction while ensuring absolute safety.
- * Shooting activities would be scheduled during daylight hours only.
- * Agents would be trained to maximize their chances of stopping a deer with one shot, in order to reduce suffering for the deer and to avoid the need to pursue a wounded deer into an area where shooting might be less safe than at the bait site.
- * Every effort would be made to minimize contact between agents and the general public and to preclude the possibility of offending the sensitivities of park users and neighbors.
- * Data would be collected not only to assess the health and demographics of the deer removed, but also to monitor the degree of effort required to effectuate that removal.
- * Although agents would be rewarded for their voluntary service with a share of the venison derived from the butchered deer, the majority of the meat would be distributed to homeless shelters and soup kitchens.

Public Notification

The County of Essex again utilized a variety of media outlets to notify the general public of the objectives and operational details of the Deer Management Program. Paid advertisements were placed in several local newspapers. News stories appeared in many local news outlets, in print and on-line, as the result of a County-issued press release. A postcard (see Appendix B) detailing the schedule for closing both park properties during the Deer Management Program was mailed to 40,000 homes in the affected municipalities.

Signs explaining the program were fabricated and posted at dozens of sites throughout both parks, including all parking areas. And electronic, trailer-mounted variable message boards operated at several major roadway locations throughout Essex County for a month before the program began and for the duration of the program.

Selection and Qualification of Agents

An application form (see Appendix C) for those interested in becoming agents of the County under this program was again distributed through park facilities. It was also mailed to hunters who had previously expressed interest in or participated in the Essex County Deer Management Program. A copy of the Program Guidelines was attached as part of the application. Applicants were required to possess a valid New Jersey firearm hunting license, have at least five years of successful experience in hunting white-tailed deer with a shotgun, and be available and willing to contribute voluntary service to the program for a minimum of 7 half-day shifts.

Twenty-one applications were received, including 17 from agents from prior years' programs, 1 person who lives or works in Essex County, and 3 non-County residents. All of the applicants were male. Thirteen of the agents from prior years, after being judged by program staff on the

basis of availability, reliability, safety consciousness, self discipline, adherence to program objectives, teamwork, hunting skill, marksmanship, and productivity, were selected to participate again. The new applicant who lives or works in Essex County and 1 non-County resident were also selected to participate. One veteran applicant was rejected for cause. Three of the applicants who were agents in prior years and two of the other out-of-county applicants were designated as alternates.

The selected agents and alternates were required to take a qualifying marksmanship test, which was administered by the Essex County Sheriff's Department at the Essex County College Police Academy shooting range on November 10, 2018. The test consisted of shooting 3-round 3-inch groups twice.

Fifteen of the selected agents and alternates took the marksmanship test and completed it successfully. One of the selected agents who participated in several previous years had a problem completing the test and was excluded. Two of the selected agents who had served as an agent in previous years and two of new applicants (one in-county and one out-of-county) could not attend the marksmanship test, and were therefore dropped from further consideration.

The 15 agents who passed the marksmanship test all participated in the subsequent 2-hour orientation program conducted by wildlife management consultant Daniel Bernier. The orientation stressed safety and ethics and included an introduction of program participants and staff, an explanation of the objectives of the program, the rules and regulations of the program, procedures to be followed, and scheduling of agents.

Fifteen applicants were certified as agents as a result of the selection and testing process. The participating agents included a factory manager, a fencing contractor, a landscaping contractor, a retired deputy police chief, a labor union officer, 2 firefighters, an educator, an automotive mechanic, a building contractor, a home inspector, a business manager, the owner of a truck repair company, and two men who are retired or unemployed.

Program Preparation

Baiting stations were established at 15 locations throughout the South Mountain Reservation and 8 locations in Hilltop Reservation. Locations were chosen in an attempt to achieve site-specific reduction where it was most warranted, while ensuring the safety of the general public. Stations were carefully selected to provide the marksman with the likelihood of attracting deer and minimal chance of disturbance by a park user or park neighbor.

Automatic bait dispensers were hung, one at each bait station, up to five weeks before the shooting program was scheduled to begin at that station. With a barrel that holds up to 200 pounds of whole corn and an electronic timer set to dispense a small quantity of corn at a specific time each day, the automatic feeders have shown themselves to be very effective at attracting deer to bait stations with great regularity. Supplemental feeding with additional corn and other

food products was conducted by the selected agents as their circumstances allowed. A four-bay maintenance garage in South Mountain Reservation was again converted to a facility for processing the deer carcasses and readying them for transport to a butcher. The garage was outfitted with the supplies and equipment needed for hunting deer and processing deer carcasses. An adjoining room was set up as the Essex County Sheriff's Department command center and as a location for agents to warm up and eat.

Program Administration and Operational Details

Daily coordination and oversight of the program was conducted by wildlife management consultant Daniel Bernier and Tara Casella, Director of the Essex County Environmental Center. They were assisted in this effort by an agent from previous years who can no longer hunt for medical reasons. Maintenance staff of the Department of Parks, Recreation and Cultural Affairs provided operational support.

This program was scheduled to operate for 12 days, afternoons only, on Tuesdays and Thursdays, from January 15 through March 7. In previous years, hunting was conducted on several consecutive Tuesdays and Thursdays at South Mountain Reservation, followed by several Tuesdays and Thursdays at Hilltop Reservation. In 2019, for the first time, hunting was alternated between locations, with hunting at South Mountain on Tuesdays and hunting at Hilltop Reservation on Thursdays. One rain date was built into the schedule for the South Mountain Reservation hunt and two rain dates were reserved for Hilltop Reservation.

Agents were scheduled based on their availability. At South Mountain Reservation, each agent was assigned to a particular bait station. In the Hilltop Property, the assignment of agents was varied based on their availability and the productivity of each site. At the beginning of each shift, the agents would report to the headquarters area and confirm their baiting station assignment and other instructions. Agents would then be transported by County vehicle or would drive their own personal vehicle to their assigned area. Communications between agents and staff was maintained via cellular phones.

Agents were not restricted as to the number of deer each agent could harvest. All deer were to be taken, regardless of the presence or absence of antlers. However, the reduction of a deer population is accelerated in proportion to the number of females that can be removed. Therefore, when presented with a choice of several deer, agents were encouraged to make their choice of target in the following order - any weak, crippled or maimed deer; does; fawns, antlerless males, and antlered males. If antlered males were culled, the antlers were cut off and sent to the Essex County Environmental Center for use in educational programs.

Agents utilized shotguns of various gauges, with telescopic sights. Wildlife management experts consider shotguns loaded with slugs to be the safest, most effective firearm for deer control since they have restricted shooting range, excellent knockdown power, and minimal ricocheting potential. Therefore, only slugs were allowed or used for ammunition.

Agents were located in positions where they would have a clear line of sight on deer at or near the scattered bait. The use of a portable tree stand gives the agent an advantage over deer by placing him where he is less likely to be seen or smelled. It also greatly increases the margin of safety by ensuring that any slug that might miss or pass through a deer can only go into the ground. Each agent was required to provide his own portable tree stand and to climb a tree to a height of at least 20 feet; some agents regularly climbed higher.

Agents were required to only take shots of less than 40 yards, to increase the likelihood of culling a deer with one shot. In the infrequent cases where a deer was not stopped with one shot, the agent would track the injured deer into the woods until it lay down and died or could be dispatched with a second shot. Agents going into the woods to pursue a wounded deer were instructed to put on hunter orange to preclude any accidents, and where possible to climb a tree to shoot from above.

When an agent was successful in harvesting a deer, he would mark the deer's location with a yellow reflective tag fabricated specifically for this program. These pocket-size tags, manufactured from traffic sign sheeting and issued to each agent, were especially helpful in finding deer carcasses again at the end of a shift, particularly in thickly wooded areas and in the dark. The tags were marked in advance with the agent's identification number and equipped with an elastic loop. When a deer carcass was removed from the woods, the agent's tag would be affixed to the carcass to facilitate the collection of data later during the processing operation. At the processing site, the deer would be matched by agent number to the site from which it was culled, as well as to scientific data.

At the end of each shift, the agents and program staff (including Park Maintenance personnel) were deployed to work in teams rounding up and removing deer carcasses from the forest. Plastic sleds and all-terrain vehicles were used to facilitate the effort of moving heavy deer and preserving the fur. All-terrain vehicles were loaned and operated by the agents who own them.

Considerable effort was made to prevent leaving traces of blood and to mask the carcass from any park users that might happen by. These efforts were taken both to respect the sensitivities of the general public and to try to maintain the confidentiality of the baiting station locations. Agents were instructed to remove all litter and spent shell casings and to otherwise minimize any lasting evidence of their presence. The harvested deer were generally picked up with a County vehicle and all deer carcasses and agents returned to the headquarters area.

The Processing Operation

Upon return to the headquarters area, all of the agents participating in a shift, whether they had taken a deer or not, would work together to dress those deer brought in on that shift. Scientific data was collected to determine demographics and general health of the deer population. Data was recorded on a standard data sheet supplied by NJ Division of Fish and Wildlife. The data

sheet (see Appendix D) was modified to allow the recording of additional information needed for evaluation of program results, including identification of the park and the baiting station from which the deer was taken, the agent who shot it, and any anomalies exhibited by the deer. As in the past, data collection included weighing the deer and determining its sex. David Alexander, an Essex County Environmental Center staff member, was trained by a NJ Division of Fish and Wildlife biologist during the previous years' programs on how to examine the deer's teeth to determine its age and to study the reproductive tract of female deer to determine whether the deer was pregnant, and, if so, how many viable fetuses she was carrying. Mr. Alexander carried out those functions again in 2019.

In keeping with the Division of Fish and Wildlife's practice of strict accountability for each deer harvested in New Jersey each year, agents affixed a NJDFW metal seal to each dressed carcass. At the conclusion of each shift, program staff completed a Shift Activity Report form (Appendix E) that captured a variety of data. Information recorded included the parks that were hunted, the date and time period, weather conditions, man-hours expended, numbers of deer observed and culled, number of shots taken, and whether the shots were hits or misses.

Program Security

Security for the operation of the shooting program and the safety of program participants, park users, and park neighbors was again provided by the Essex County Sheriff's Department. Law enforcement officers closed the access drives to all park areas in the park being hunted that day, including Mayapple Hill, Turtle Back Rock, the Dog Park, and the Girl Scout Camp in South Mountain Reservation, and the parking area in Hilltop Reservation. Major roadways through and around South Mountain Reservation, including South Orange Avenue, Brookside Drive, and Cherry Lane, remained open.

All formal and informal parking areas were blocked off with barricades or yellow tape, and Essex County Parks workers were stationed in their own cars at many locations to enforce that restriction. Sheriff's officers in marked vehicles patrolled the main roadways to ensure that no one stopped or parked within the parks prior to or while hunting was underway. Turtle Back Zoo, the Richard J. Codey Arena and McLoone's Boathouse in South Mountain Reservation did remain open for business throughout the days of program operation.

Coordination of all law enforcement personnel was coordinated by Captain Peter Corbo of Sheriff Armando Fontoura's staff from a command post in the South Mountain Reservation maintenance facility during the days of hunting in South Mountain. A command post was set up in the community center building in Cedar Grove Park while hunting was ongoing in the Hilltop Reservation. Law enforcement officers stayed at their posts until all agents and deer carcasses were removed to the headquarters area. At least one officer stood by at the headquarters area as deer were being processed.

Oversight of the program operation and adherence to the terms of the Special Deer Management

Permit was provided by NJ Division of Fish and Wildlife Senior Biologist Jodi Powers.

Weather

In 2019, weather had only a minor impact on the schedule of the Essex County Deer Management Program. The calendar included one rain date for the South Mountain Reservation hunt and two for the program in the Hilltop Reservation. Hunting at Hilltop Reservation was conducted on schedule. One date at South Mountain Reservation had to be postponed due to rain and snow, but hunting was nevertheless conducted for the full number of days that had been planned. There was a small coating of snow on the ground during four afternoons of hunting throughout the 8-week season, and up to 6 inches of snow was present on the last day of hunting, at South Mountain Reservation, on March 5.

Results

Based on spotlight counts conducted on May 3, 2018, the Program Guidelines for the 2019 Essex County Deer Management Program set goals for the removal of 132 deer from South Mountain Reservation in 6 half-day sessions, and 107 deer from the Hilltop Reservation in another 6 afternoon sessions. In actuality, the 6 half-days of hunting yielded 101 deer from South Mountain. Ninety-nine deer were taken out of the Hilltop Reservation in the other 6 half-days.

A complete breakdown of the results by day, park and sex, as well as a daily shot count, can be found in Appendix F. A summary of deer removed since 2008 from South Mountain, Eagle Rock and Hilltop Reservations is found at Appendix G.

Disposition of Venison

Although state and federal law exempts the butchering of deer from inspection, the County contracted a butcher who is inspected and approved regularly by the USDA and his local Board of Health. Dressed deer were transported daily to the butcher's facility. The venison was cut by the butcher into steaks or roasts or ground into chopped meat. The butcher also handled disposal of the entrails.

The Program Guidelines for the Essex County Deer Management Program stipulated that the County of Essex would show its appreciation to any agent who voluntarily served on at least 7 half-day shifts by presenting him with 40 pounds of dressed venison, which approximates the average yield from one deer. Agents were given credit for any shift for which they were scheduled that was cancelled due to inclement weather. Fourteen agents qualified for, and accepted, the venison.

The bulk of the venison was presented to the Community FoodBank of New Jersey, located in

Hillside, for distribution to charitable organizations that operate within Essex County and elsewhere. A donation of 5,216 pounds of venison was made to the FoodBank. The venison will provide a protein portion in about 21,000 meals distributed through homeless shelters and soup kitchens to people who might otherwise have little meat in their diets. The Multi-Year Summary found at Appendix G shows that 47,075 pounds of venison have been donated to the Community FoodBank since 2008.

Agent Participation

Fifteen hunters were selected, tested and trained for participation as agents of the County in the 2019 Essex County Deer Management Program. Very shortly after the certified list of agents was submitted to the New Jersey Division of Fish and Wildlife, one agent had to withdraw from the program due to a death in his family. Therefore, a schedule was developed for participation of 14 agents.

Agents were placed in the field on a total of 12 shifts. The original schedule had a full roster of 14 agents assigned to every shift at South Mountain Reservation, and 8 agents on every shift at the Hilltop Reservation. However, it is typical for the actual attendance to have gaps due to illness, employment changes and poor weather. In 2019, 2 agents were removed from the schedule midway through the season due to violations of program protocols.

Overall, agents participated in 125 of 132, or 95%, of the available shifts. This extremely high rate of hunter participation resulted from diligent use of a rotational system for inviting agents to fill in vacancies as they developed. Agent participation is summarized in Table 1.

Table 1. - Summary of Agent-related Data

<i>Agent #</i>	<i>Shifts Worked</i>	<i>Hours Worked</i>	<i>Hit/ Kill</i>	<i>Hit/ Wound or Finish</i>	<i>Miss</i>	<i>Total Shots</i>	<i>Deer Culled</i>
3	8	53.5	10	0	2	12	10
6	9	59.00	7	8	1	16	10
7	5	32.50	7	3	0	10	8
9	10	68.50	12	0	0	12	12
11	10	69.00	5	2	0	7	6
27	11	74.25	62	4	2	68	63
29	8	54.25	9	4	1	14	11
30	10	65.15	18	0	0	18	18
32	11	66.50	15	5	2	22	18
40	9	60.00	7	6	1	14	9
45	10	63.00	15	0	2	17	15
50	9	62.25	6	8	3	17	10
61	9	49.00	6	0	0	6	6
71	6	30.50	2	4	6	12	4
Total	125	807.40	181	44	20	245	200

Cumulatively, the 14 agents dedicated 807.4 man-hours, or an average of 57.7 hours per person. This time includes that spent sitting at a baiting station, retrieving dead or wounded deer, and processing the carcasses. It does not include the many additional hours that agents contributed to set up and remove the automatic bait feeders and to provide supplemental baiting in the 5 weeks preceding any shooting. Individual agents donated anywhere from 30.5 to 74.25 hours each to the program, in a range of from 5 to 11 shifts worked. The average agent worked 9 shifts during the 12 days of operation.

About 4.95 hours of effort were expended for the removal of each deer from South Mountain Reservation in 2019. This is a decrease from the 5.5 hours per deer expended in 2017, and is

lower than the 6.5 hours per deer expended in 2016 and 7.9 hours per deer in 2015. At Hilltop Reservation, 3.14 man-hours were used by the agents for each deer taken in 2019, which is considerably less than the 5.87 hours expended in 2018 and 6.3 hours expended in 2017.

In 2012, 11.2 hours per deer was expended to remove deer from South Mountain and 7 hours per deer at Hilltop. In 2019, the number of man-hours spent to remove one deer was less than half of the 2012 figures for both parks. These figures bear out the premise that an increased level of experience among the agents results in greater teamwork and cooperation, greater familiarity with deer movements, and greater ease in processing the carcasses.

Agents adhered tightly to the guidelines set forth for the program and were visibly mindful of the deer reduction program objectives. No agents were injured in the execution of this program. However, two agents were suspended from the program midway through the season due to violation of program protocols.

Ballistics Data

Because of the tight controls and reporting requirements built into this program, every aspect of the program can be well documented, including data on the number of shots fired, as shown in Table 1. It can be reported with a high degree of certainty that only 245 shots were fired during the 12-day program.

Misses can generally be attributed to maladjusted gun sights, which are the inevitable result of jostling men and equipment around in trucks in such an intensive hunting program. Other misses can be caused by slugs striking and being deflected by twigs, which are not seen by the hunter in his focal plane as he lines up a deer in his telescopic sight. Of the 254 shots fired in the 2019 program, 20 (or 8%) were missed shots. That is an increase of 2% over the previous year, and will be addressed in future programs in the agent selection process and in the agent orientation.

Of the 200 deer harvested, 181 deer, or 90.5% of the total, were removed with one shot. Though this is an excellent ratio, it is 5% lower than the rate in 2018. This also will be addressed in future agent selection and training.

The number of deer harvested per agent ranged from 4 up to 63 with an average of 14 deer per agent. Table 1 shows that 3 of the 14 agents, or 21% of the total number of agents, removed 99, or 50%, of the 200 deer. Of course, there is generally a correlation between the number of deer harvested by an agent and the number of hours he dedicates to the program. However, the productivity of particular hunters is also often seen to be a direct result of the agent's hunting knowledge, skill, and patience.

Critical Losses

Agents were trained to carefully select a shot that would drop a deer in its tracks. However, even with the most well placed shots, critically wounded deer sometimes run long distances before dying. Agents were drilled on the importance of searching for and retrieving all such deer, both to eliminate needless suffering by the deer and to prevent members of the public from being traumatized by the sight of a wounded deer. Agents must report to the program administrator that a wounded deer has left a baiting station area, and, where necessary, additional agents or County staff are dispatched to assist in the search.

Each year, as a result of these precautions, the number of unrecovered losses (deer which were shot but not recovered) in this program is typically only 2% or 3% of the total number of deer shot. In 2019, there were only 2 unrecovered loss, which is a loss rate of 1%. This is an outstanding accomplishment!

Baiting Station Productivity

This year's program utilized 14 baiting stations in South Mountain Reservation and 8 in the Hilltop Property. The selection of sites was based not only on where deer were expected to be seen, but also on the potential impact of use of those sites on park users and neighborhoods.

Table 2 shows the number of times that each site was hunted, and the yield from each site. Baiting sites are identified by a letter/number designation. The actual locations of sites will not be revealed so as to protect them from tampering in the future by those who oppose hunting.

Table 2. - BAITING STATION PRODUCTIVITY

South Mountain Reservation

<i>Station</i>	<i>Municipality</i>	<i># of Times Used</i>	<i>Deer Taken</i>
C	Millburn	6	5
E	Millburn	6	6
F	Maplewood	4	0
G	Maplewood	6	9
HN	Millburn	6	2
HS	Millburn	6	11
HF	Millburn	2	0
M	West Orange	6	32
N	West Orange	6	8
SF	Maplewood	6	4
T	West Orange	6	9
TR	West Orange	6	6
V	Millburn	6	3
W	Millburn	6	6

Hilltop Reservation

<i>Station</i>	<i>Municipality</i>	<i># of Times Used</i>	<i>Deer Taken</i>
H-1	Verona	6	11
H-2	Cedar Grove	6	13
H-3	Cedar Grove	6	11
H-4	Cedar Grove	6	24
H-9	North Caldwell	5	4
H-10	Cedar Grove	6	22
H-11	Verona	6	12
H-13	Verona	6	2

Deer Data

Eighty-five of the 200 deer harvested, or 42.5% of the total, were females. This is a considerable decrease from the 49.6% ratio from 2018 and 44.9% from 2017, but not as low as the 41.6% and 38.6% ratios from 2016 and 2015. In this deer management program, there is a bias for the taking of female deer in order to have the greatest effect on reducing the reproductive potential of the deer population.

The low percentages of females versus males harvested three and four years ago suggested that a larger portion of the female segment of the population, as opposed to male, had previously been removed. In 2018, the ratio had become more even. In 2019, it has swung back to a male dominant population.

At South Mountain Reservation, 39 of the 101 deer harvested (38.6%) were female, which was a significant drop from the 49% rate in 2018 and 46% rate in 2017, but still higher than the 31% and 32% from the two years prior to that. At the Hilltop Property, 46 of the 99 deer taken (46%) were female, which is similar to the 50% ratio seen in 2018.

Fifty-seven of the 85 females, or 67%, were pregnant, which is an increase from the 62% rate in 2018, but still lower than the 80% rate in 2017 and the 75% rate in 2016. That number includes 52 of the 56 adult females and 5 of the 29 female fawns. The 57 pregnant females were carrying a total of 100 fetuses, for an average of 1.75 each. That average is consistent with the 1.7, 1.75 and 1.79 averages in 2018, 2017 and 2016, but less than the 1.94 average in 2015. Thirty-nine does (75%) were carrying twins (a 15% jump from last year) and two bore triplets.

There was a huge increase in the number of antlered deer harvested. Of the 115 total males, 49% (56 deer) were antlered, compared to 23% in 2018. Another 32 males had shed their antlers, and 22 were button bucks (fawns). At South Mountain Reservation, 24 of the 101 total deer killed (24%) were male or female fawns, which was a decrease from the 32% in 2018 and 27% in 2017, and even with the 24% in 2016 and 23% in 2015. And at the Hilltop Property, 37 of the 99 total deer harvested (37%) were in that age category, an increase from the 29% rate in 2018 but less than the 44% rate in 2017, 39% in 2016 and 46% in 2015.

Program Costs

Direct costs to the County of Essex for the operation of the Essex County Deer Management Program in 2019 were as follows:

Personnel overtime	
Park Maintenance	\$ 35,447.26
Sheriff's Department	21,821.76
Contracted services	
Wildlife Management Consultant	12,000.00
Butchering fees	15,000.00
Electronic message boards	10,200.00
Expendable materials	
Bait (whole corn)	1,800.00
Food	4,980.00
Miscellaneous items	981.66
Newspaper advertisements	2,057.88

TOTAL program costs	104,288.56

As shown, the total direct program costs amounted to \$104,288.56. With 200 deer having been removed, this expense equates to a cost of \$521.44 per deer, which is a 9% decrease from the cost of \$571.65 in 2018, when only 139 deer were harvested. And the cost is 30% lower than the \$736.10 per deer cost in 2015, when inclement weather resulted in a low harvest, and fixed costs were spread out over less deer.

The County of Essex again implemented all reasonable measures to ensure that this effort would be conducted in a manner that would be as safe and humane as possible, and that the general public would be well informed and inconvenienced as little as possible. Some of those measures could be scaled back in subsequent years, thereby resulting in a lower cost per deer.

Subsequent Census Data

Spotlight counts of deer were conducted in South Mountain Reservation, Eagle Rock Reservation and the Hilltop Property on April 23, 2019. The counts were conducted at night by staff of the Essex County Department of Parks, Recreation and Cultural Affairs and Daniel Bernier, the County's wildlife management consultant. Copies of the three spotlight count reports are attached as Appendix H.

Two 1,000-lumen LED lithium ion spotlights were used to watch for deer from both sides of the survey vehicle. Light reflecting off the retina of a deer's eyes can be seen for more than 100 yards. Whenever the eyeshine of a deer was observed, the vehicle would be stopped to conduct a more thorough search for any other deer that might be nearby. The locations of all individuals or groups of deer were recorded on a standard report form.

Deer in the Watchung Reservation in Union County were counted through the use of helicopter-mounted (FLIR) photography between 1997 and 2001. Spotlight counts were conducted in each of those years as well, within a few weeks of the FLIR counts. A comparison of the results of the FLIR counts and the spotlight counts showed that spotlight counts are a pretty consistent and reliable method for counting deer, but that the results need to be adjusted to correlate with the amount of land area that, because of topography, forest cover or road access, is viewable with spotlights.

Although spotlight count results can be erratic in any given year, perhaps due to a weather-related influence on deer behavior, the spotlight count results have been fairly consistent for the last 10 years, and will therefore be used as the basis for estimating the post-hunt deer population densities. Although an aerial FLIR count was conducted in 2012, none has been available since then.

In the 2019 spotlight count, 32 deer were observed in the 3.2 square mile South Mountain Reservation, with about 35% of the total land area having been accessible to spotlighting. Therefore, the number of deer observed (32) was divided by .35 to include the non-viewable area, and the corrected figure was divided by 3.2 to determine density on a per square mile basis. That calculation yielded a Spring, 2019 deer population estimate of 29 deer per square mile, or a total of 92 deer in the 2,047-acre park.

Likewise, a total of 25 deer were counted by spotlight in the 265-acre Hilltop Property. The spotlights reached about 50% of the total land area. Using the formula described above yields a Spring, 2019 population estimate of 50 deer, or 114 per square mile.

And lastly, at Eagle Rock Reservation, 5 deer were observed in the 408-acre park during the spotlight count. Approximately 25% of the land area was accessible to viewing by spotlight. These numbers result in a population estimate of 20 deer, or 29 deer per square mile.

Recommendations

The results of the 2019 deer management program and the subsequent spotlight counts show that the population of deer in three Essex County parks is greatly reduced since deer management activities were first undertaken in 2008. However, that population, especially in the Hilltop Reservation, is still considerably higher than it should be.

Forest ecologists recommend a deer density no greater than 20 deer per square mile in a healthy forest ecosystem. In a forest that is damaged by overbrowsing by deer, as is certainly the case at South Mountain and Hilltop Reservations, the density might need to be reduced to as low as 5 deer per square mile in order for forest regeneration to succeed.

In order to gauge the likelihood of that success, we must project the deer population estimates ahead to the winter of 2019-20, after factoring in new births from Spring/early summer of 2019. We will assume conservatively, based on an average of the last 3 years, that 46% of the deer population is female. We will also assume, again based on 3-year averages, that 70% of the females are pregnant, and that the pregnant females will deliver an average of 1.73 offspring each. The number of deer will be reduced by 15% to account for loss to natural or accidental mortality.

Running out those numbers for South Mountain Reservation, we calculate an overwintering population for 2019-20 of 122 deer (38 per square mile), which is 2 times the recommended population of 64 deer (20/square mile x 3.2 square miles) for this park, if this park had a healthy ecosystem. At the 5 deer/square mile density recommended for an impaired ecosystem, there is an excess of 106 deer.

Essex County has invested considerable resources to establish 41 fenced enclosures throughout South Mountain Reservation, in which native plantings have been installed to jumpstart the forest's recovery from the impacts of deer. In theory, as the deer population is incrementally decreased in size by the deer management program, the native plantings will have an increasing chance of repopulating themselves as they spread their seed beyond the fenced enclosures.

Therefore, reduction of the deer population in South Mountain Reservation should be continued. Though the Deer Population Estimator (see Appendix I) calls for removing 106 deer over the course of 5 shifts, I recommend repeating a 6-day season to ensure that the density is finally pushed as low as possible. It is recommended that hunting occur at 14 baited sites. Based on past experience, hunting should be limited to afternoon shifts only.

The estimated 2019-20 overwintering population of deer for the Hilltop Property will be 66 deer (150/sq. mi.), or 64 deer more than the 2 deer recommended for this 0.44 square mile area. Therefore, the effort at the Hilltop Property should be continued in earnest. The extremely high density in and around the Hilltop Property needs to be cut drastically for the safety and welfare of park neighbors and the motoring public. However, it is not practical, fiscally responsible or socially acceptable to extend the hunting season across the 13 shifts recommended by the Deer

Population Estimator. Therefore, in 2020, hunting should again occur on 6 afternoons, at 8 baited sites, with a goal of removing 40 deer.

The 2019-20 overwintering population at Eagle Rock will be 26 deer, which is 23 more than the recommended population of 3 deer for this 0.68 square mile park. Removing that relatively small number of deer is still not warranted, in light of the manpower that would be required to accomplish it and the costs associated with securing that park during hunting. Therefore, it is not recommended that hunting be resumed at Eagle Rock Reservation in 2020.

However, it is likely that in 2021, the population densities will be such as to allow 3 to 6 of the hunting shifts to be allocated to Eagle Rock Reservation, rather than South Mountain Reservation.

Spotlight counts should be conducted as soon as possible after the 2020 deer removal concludes. They are important to determining the success of each harvest and in guiding continued deer removal efforts.

Acknowledgments

Essex County Executive Joseph DiVincenzo is to be commended for continuing the Essex County Deer Management Program in two of Essex County's most significant park properties. He recognizes the perilous future of the ecology of these irreplaceable park resources and is fighting to correct it in the most efficient and effective method possible, despite the objections of some County residents. The Essex County Board of Chosen Freeholders showed that they share the County Executive's concern by voting to allow this program to continue.

The success of the Essex County Deer Management Program is due to the hard work, commitment and cooperation of hundreds of people. Thanks are extended to the staff of the Essex County Department of Parks, Recreation and Cultural Affairs, and in particular its Director, Daniel Salvante, and Tara Casella, Environmental Center Director; the Essex County Sheriff's Department, and in particular Sheriff Armando Fontoura and Captain Peter Corbo; and the numerous other Essex County and municipal agencies and offices that contributed to this effort.

The County of Essex extends its thanks to Jodi Powers, Senior Biologist with the New Jersey Division of Fish and Wildlife, for her assistance in the conduct of this program.

The residents of Essex County again owe a great deal of thanks to the hunters who took time away from their families, jobs, and their own personal pursuits to serve voluntarily in a program that is saving the ecology of parks in the Essex County Park System for the enjoyment and benefit of future generations of County residents and visitors.