



White Buffalo Inc.

Conserving Native Species and Ecosystems

**YEAR THREE
SUMMARY REPORT**

2018-19 Deer Research Program

Ann Arbor, Michigan

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Submitted by

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Executive Summary

Ann Arbor is a most challenging situation for deer managers; nearly built out and covered by single family homes surrounded by wooded corridors. It is excellent deer habitat with no hunting and no non-human predators. The directives set by the City included improving forest health/regeneration in natural areas, reduction in deer-vehicle collisions (DVCs), achieving 75% satisfaction level of residents, and gathering data to inform future management decisions. The primary objective in 2018/2019 was to assess the complementary effect of lethal management in larger wooded areas proximate to sterilization efforts in dense suburban neighborhoods.

Sterilization study areas were in the south (bounded by U of M Arboretum and Huron Hills Golf Course and Huron Parkway Nature Area), and north (bounded by Cedar Bend Nature Area and Leslie Park Golf Course). Six does were tagged and sterilized by ovariectomies from 28 – 30 November 2018. We demonstrated ~27% reduction in the SSA (63 to 46) and a slight population increase in the NSA (10-12) from Year 2 to Year 3. The increase in the NSA was the result of immigration. Overall, we have incurred a 49% reduction in the SSA (94 to 46) and a 20% decrease in the NSA (15-12) since the program was initiated. There were 29 deer/mile² in the SSA and only 10 deer/mile² in the NSA at the conclusion of Year 3. No sterilization efforts were conducted in the ESA given our relative access with sharpshooting.

Sharpshooting activities occurred from 2 – 20 January 2019, at 21 sites and 112 deer were culled. We used suppressed .223 caliber rifles, shot from elevated positions to ensure a steep angle of trajectory, and followed American Veterinary Medical Association *Guidelines for the Euthanasia of Animals* 2013. Results were: Barton/Foster 10; Bird Hills 9; Butternut (Ward 3) 1; Cedar Bend 9; Concordia 8; Foxfire 5; Huron NA 8; Leslie GC/W 5; Narrow Gauge 0; Newport 16; Oakwoods 0; South Pond 1; U.M. Arb 3; U.M. other 37.

A helicopter survey was conducted on 1 February 2019 using the same methods as in Year 2 except a Robinson 66 was used instead of a Robinson 44 helicopter. The snow count detected 298 deer (224 in City limits), compared to 276 (220 in City limits) in Year 2. The detection rate used for areas outside of the sterilization study areas were based on the literature and past experience (80%). Using the correction factor, there were ~233 deer in Wards 1 and 2; 62 of which were in the sterilization study areas. There were ~21 deer/mile² on average (233 deer in ~11.1 mile²) in Wards 1 and 2. In areas with good access outside of the sterilization study areas and excluding the western portion of the NW neighborhoods (39 deer observed in the neighborhood near the City/Township line), there were ~16 deer/mile² remaining (~113 deer in ~7 mile²). Given ~70 untreated adult females, outside of sterilization



areas, we expect an additional ~75 fawns to be recruited/added to the population next fall in Wards 1 and 2 raising the deer population in Wards 1 and 2 to about 250 (~310 when sterilization study areas are included) by Fall 2019. This will result in ~23 deer/mile².

Camera surveys were used to estimate the number of deer in the SSA. Using three different methods, an average estimated population prior to sharpshooting in the SSA was determined to be about 54 deer (~34 deer per mile²), and >97% of the does sterilized. The average doe:fawn ratio declined from 0.15 (2018) to 0.11 (2019).

On 13 December 2018 the Michigan House of Representatives gave final passage of a bill that would prohibit the issuance of any further deer sterilization permits, until 2022, by the Michigan Department of Natural Resources. This effectively removes any options for additional non-lethal deer management in Ann Arbor. The relative acceptance of lethal management by residents in various wards, coupled with desired deer densities for forest health in natural areas, will determine how many deer and where continued lethal deer management may occur.

INTRODUCTION

Ann Arbor is located in central Michigan and consists of approximately 27.8 miles² of total land area. The municipality represents one of the most challenging situations for deer managers. The community is nearing the point of being “built out” (121,477 people with 47,524 households as of the of 2017 census) with most of its land area covered by single family homes surrounded by wooded corridors. This development pattern provides excellent deer habitat and at the same time can be restrictive to the implementation of some deer management options. This deer habitat exists primarily in Wards 1 and 2 and covers approximately 40% of the land area within the municipal boundaries. There is no hunting permitted within the community, and there are no non-human predators present that are capable of limiting a deer population. Given the favorable conditions, the deer population in the community has increased to a level that is incompatible with city objectives. Only limited management actions had been used to control the deer population; including a sharpshooting effort in winter 2016 that resulted in 63 deer culled.

In the first year of the research (2017), we used a combination of methods to assess the impacts on the local deer population under Scientific Collectors Permit (#1600); culling 96 deer and sterilizing 54 female deer. During Year 2 we culled 115 deer and surgically sterilized 18 female deer. During Year 3 we culled 112 deer and surgically sterilized 6 female deer. Insights garnered during the first two years remained aligned with the pre-implementation assessment. In the more densely developed neighborhoods of Ann Arbor capture and surgical sterilization is



the best method to control deer abundance, whereas, in other areas with larger open spaces and fewer roads, sharpshooting is the most cost-effective method. There are areas in the City with an abundance of deer that do not have suitably discreet shooting locations because they contain only small, highly visible, wooded Parks to conduct shooting operations. With the elimination of sterilization as an option these areas will likely continue to be impacted by deer with no viable solution for managing the population.

The research objectives continue to be guided by directives set by the City Council; these include improving forest health/regeneration in natural areas, reduction in DVCs, and a 75% public satisfaction level of the resident in the five Wards. Meeting these objectives will require an adaptive process where annual data collection will direct future strategic use of field methods.

STUDY AREA

The areas of particular focus for sterilization activities, given the abundance of deer and high housing density, were: 1) the area bounded by the Huron River to the northeast, the University of Michigan Arboretum to the northwest, Washtenaw Avenue to the southwest, Huron Parkway to the east (hereafter South Study Area - SSA) and 2) the area bounded by Skydale Drive to the north, Route 23 and the Huron River to the west and south, and Black Pond Woods Nature Area, Murfin Avenue/Upland Drive to the east (hereafter North Study Area - NSA). The University of Michigan Arboretum and Huron Parkway Nature Areas served as proximate open space sharpshooting areas to the SSA. In the NSA, Cedar Bend Nature Area and Leslie Park Golf Course served as proximate open space sharpshooting areas.

In Year 2, we conducted preliminary capture and surgical sterilization efforts in a third study area (East Study Area – ESA) that was acknowledged in the original proposal as a future area that might be restricted by firearm discharge constraints. The ESA was defined by Plymouth Road to the north, Route 23 to the east, Green Road to the west, and Concordia University to the south (Figure 1). During Year 3 all sterilization efforts were focused in the NSA and the SSA. Sharpshooting was conducted in the remaining areas of Wards 1 and 2.



Figure 1. Delineation of surgical sterilization study areas.



METHODS

Capture

Deer sterilization activities were conducted from 28 - 30 November 2018. We followed the operations protocol used in Year 1 and outlined in the proposal, contract, and Michigan Department of Natural Resources (MIDNR) Scientific Collection Permit #1600. Female white-



tailed deer of all age classes were immobilized using projectors with 2 ml transmitter darts (Pneu-Dart Inc., Williamsport, PA, USA) to administer tiletamine/zolazepam (4.4 mg/kg) and xylazine hydrochloride (2.2 mg/kg). We approached deer in a vehicle on public roadways and private roadways/properties where permission was granted. We also darted deer over bait placed on private properties in the late afternoon. Once a dart was deployed and 15 minutes elapsed, the deer was located via radio-telemetry. Masks were placed over the eyes, and ophthalmic ointment was applied to prevent ocular desiccation. Deer were transported to a public property where a temporary veterinary surgical sterilization site was located.

All captured deer were fitted with ear tags for individual identification. The backplate of each tag was labeled “Call Before Consumption 860-790-0224.” We also collected data on weight, age, and general health of the deer.

Surgical Procedure

Upon arrival at the temporary surgical suite, all deer were premedicated with flunixin meglumine at a dosage of 2 mg/kg IM and a long-acting antibiotic (ceftiofur) at 4 mg/kg IM. Supplemental intravenous doses of ketamine HCl (2-4 mg/kg) were given as needed to maintain anesthesia. Females were sterilized with a routine prepubic ventral midline laparotomy exposing the uterine horns and ovaries. We performed bilateral ovariectomies using a Ligasure™ vessel sealing system. Intraoperative splash blocks and direct injection of lidocaine and bupivacaine were used to give up to 8 hours pain relief in addition to the flunixin. Following the ovariectomy, a routine three-layer closure of the abdomen was performed to complete the procedure using absorbable suture.

All deer were returned proximate to the capture location, in areas with the lowest likelihood of human disturbance during recovery. The reversal agent tolazoline HCL (200 mg IV and 100 mg IM) was administered, and each individual was monitored during recovery.

Sharpshooting

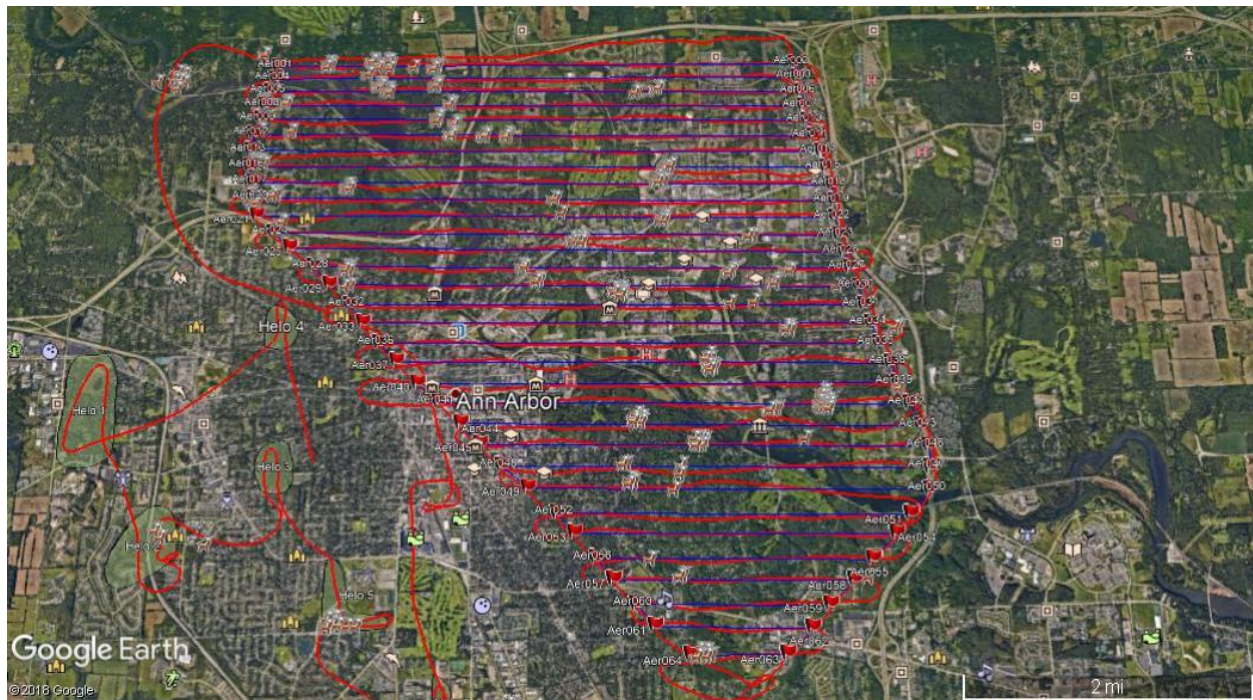
Pre-baiting was conducted from 15 December 2018 through 1 January 2019. Sharpshooting efforts were conducted from 2 - 20 January 2019. We followed the operations protocol outlined in the proposal; 1) we use suppressed .223 caliber rifles, 2) we shot from elevated positions to ensure a steep angle of trajectory, 3) all deer were shot following AVMA guidelines for euthanizing animals with firearms. Twenty-one sites were used throughout the area of operation.



Helicopter Survey

Prior to initiating the survey, transects were delineated (East-West) and entered into a GPS moving map software (ExpertGPS)(Figure 2). Transects were spaced at 200 yd intervals, which resulted in a total of 63 flight lines. On 1 February 2019, a Robinson 66 helicopter was used to fly transects at an elevation of 200-300 feet above ground level and an airspeed of 25 - 30 mph. Each observer counted all deer out to 100 yds from their respective side of the aircraft. There was a pilot and a navigator to ensure all transects were flown accurately. The navigator used a GPS system with a moving map to verify the accuracy of all transects. The number of deer detected were tallied as deer were detected along flight lines. In open forest areas, good conditions, the above methodologies produce a ~80% detection rate (Beringer et al. 1997). Under less ideal conditions, often present in suburban landscapes, the detection rate can be significantly <50% (DeNicola, unpublished data).

Figure 2. Helicopter survey transects, and observations of deer, 1 February 2019.



Camera Survey

After capture efforts were completed, a camera survey was conducted from 1 - 13 December 2018 to provide a population estimate in the SSA because the helicopter snow counts detected relatively few deer there in prior years. We used Moultrie White Flash



cameras (Moultrie Feeders, Alabaster, AL, USA) set on motion activated single shot with a 5-minute delay to optimize capture rates. Camera coverage of $\sim 1/150$ acres was used with one camera placed in each of 7 blocks. Each camera was elevated 0.6 m and oriented north. Cameras were retrieved once 150-200 photos were obtained from each baited location or after 10 days had passed. Each picture was closely studied, and all legible ear tag numbers were documented. We also recorded the total number of deer, the number of unmarked does, the number of bucks, the number of unmarked fawns, and the number of unidentifiable marked deer for each photo. From these photographic data, the total number of times each identifiable, marked deer was observed was entered into the program NOREMARK (White 1996), along with the total number of unmarked deer, and the total number of marked deer known to be alive in the population during the survey. We also used the same calculation method as Jacobson et al. (1997) to estimate population density and herd demographics. Finally, we used the camera data to determine the ratio of tagged to untagged females for the Lincoln-Petersen Estimator (LPE)(Curtis et al. 2009, Eberhardt 1969). Finally, we estimated the population based on our field observations and camera data. In summary, we used four different methods to estimate the total deer population: Jacobson's buck:doe ratios (BDR) method, LPE, program NOREMARK, and population reconstruction based on intensive field operations.

RESULTS

Capture and Sterilization

We captured six female deer with remote-injection tranquilizer darts (Appendix A). All of the deer captured were females (four adults, and two fawns). All of the females captured were sterilized via ovariectomy. Females received white ear tags. We expended 72 person-hours for capture and veterinary activities (12 person-hours per female deer captured), this does not include volunteer support hours. Two of 19 radio-collared females have died from causes unrelated to capture and handling since the last capture phase in January 2018; a 10.5% annual mortality rate. There were no mortalities associated with capture or the surgical procedure one-month post-handling.

Sharpshooting

Nineteen days of fieldwork were required to achieve the harvest of 112 deer. The entire data set generated from harvested deer is represented in "Deer harvest data 2 - 20 January 2019 in Ann Arbor, MI." (Appendix B). The overall harvest demographics are summarized in



Table 1. Harvest by day is summarized in Table 2. Harvest breakdown based on location is summarized in Table 3. We expended 516.75 person-hours for the sharpshooting activities (112 deer harvested) resulting in 4.61 person-hours per deer harvested.

There were 21 original bait sites selected, and 19 were utilized for sharpshooting as part of the 2019 Ann Arbor deer research program. One site was removed from the property list due to lack of consistent deer activity (Oakwoods) and one site was closed due to consistent harassment by protestors. One site was sat one evening with no harvest occurring. Harvest results from specific sites ranged from a high of 17 deer to a low of zero.

Table 1. Sex of deer harvested in Ann Arbor, Michigan from 2 - 20 January 2019.

| Age | # Male (%) | # Female (%) | # Combined |
|----------------|------------|--------------|------------|
| Yearling/Adult | 30 (27%) | 44 (39%) | 74 (66%) |
| Fawns | 25 (22%) | 13 (12%) | 38 (34%) |
| Total | 55 (49%) | 57 (51%) | 112 (100%) |

Table 2. The number of deer harvested by day 2 - 20 January 2019.

| Date | # Harvested |
|---------|-------------|
| 1/2/19 | 7 |
| 1/3/19 | 9 |
| 1/4/19 | 6 |
| 1/5/19 | 4 |
| 1/6/19 | 8 |
| 1/7/19 | 2 |
| 1/8/19 | 10 |
| 1/9/19 | 4 |
| 1/10/19 | 5 |
| 1/11/19 | 3 |
| 1/12/18 | 9 |
| 1/13/18 | 4 |
| 1/14/19 | 9 |



| | |
|---------|----|
| 1/15/19 | 11 |
| 1/16/19 | 3 |
| 1/17/19 | 4 |
| 1/18/19 | 5 |
| 1/19/19 | 8 |
| 1/20/19 | 1 |

Table 3. Deer harvest by location from 2 - 20 January 2019.

| Location | # Harvested |
|----------------|-------------|
| Barton/Foster | 10 |
| Bird Hills | 9 |
| Butternut | 1 |
| Concordia | 8 |
| Foxfire | 5 |
| Huron NA | 8 |
| Leslie | 5 |
| Narrow Gauge | 0 |
| Newport Rd | 16 |
| Oakwoods | 0 |
| Cedar Bend | 9 |
| South Pond | 1 |
| U.M. Arboretum | 3 |
| U.M. Other | 37 |

Helicopter Survey

The snow count detected 298 individual deer, of which 224 were located within the City limits at the time the survey was conducted (all five Wards). This count represents roughly the same number of deer within the municipal limits as last year's helicopter survey (220 in 2018). Total counts (including those observed just outside the City limit) varied by only 8%, 276 as



compared to 298, in 2018 and 2019 respectively. There was a significant increase in deer located outside of the City north of the Huron River and west of Highway 23/14 (56 in 2018 vs 74 in 2019). Flight conditions for the 2018 survey were very good so we used the same detection rates as in 2018 (i.e., 80% - based on Beringer et al. 1997), excluding the highly developed areas in the SSA and NSA.

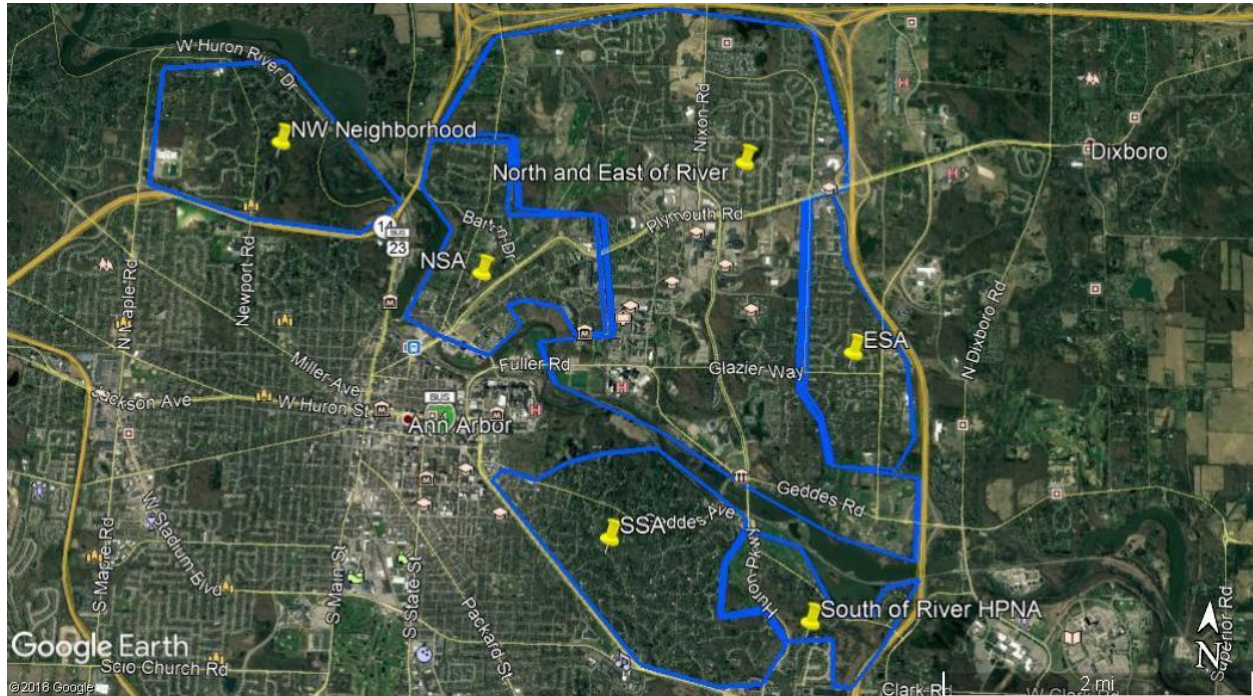
There were 171 deer observed in Wards 1 and 2 (172 in 2018), 24 deer observed in Ward 3 (11 in 2017, 19 in 2018), 21 deer in Ward 4 (8 in 2017, 23 in 2018), and 8 deer in Ward 5 (6 in 2017, 6 in 2018). Helicopter observations were not conducted systematically in Wards 3-5, and therefore those counts are bare minimums and we do not have a correction factor for adjustment. Based on the adjusted correction factor, and population reconstruction estimates in the surgical sterilization study areas, we estimated there were ~233 deer in Wards 1 and 2; 62 of which were in the sterilization study areas on 1 February 2019 (Table 4). Therefore, there were ~21 deer/mile² on average (233 deer in ~11.1 mile²) in Wards 1 and 2. In areas with good access, excluding the western portion of the NW neighborhoods (39 deer observed in the neighborhood along the City/Township line), outside of the sterilization study areas there are ~16 deer/mile² remaining (~113 deer in ~7 mile²).

Table 4. Deer abundance determined during the helicopter survey, within delineated zones in Wards 1 and 2, with an incorporated Correction Factor (CF). See Figure 3.

| | | |
|---|------------------------|---|
| Northwest Neighborhood - Skyline (west of river) | 46 X 80% CF = 58 | 1.2 mile ² = 48 deer/mile ² |
| South of River - Huron Parkway NA | 1 X 80% CF = 1 | 0.5 mile ² = 0.5 deer/mile ² |
| North and East of River | 90 X 80% CF = 112 | 5.8 mile ² = 19.4 deer/mile ² |
| Eastern Study Area | 3 X 80% CF = 4 | 0.8 mile ² = 6 deer/mile ² |
| Northern Study Area | ~12 (6 deer observed) | 1.2 mile ² = 10 deer/mile ² |
| Southern Study Area | ~46 (25 deer observed) | 1.6 mile ² = 29 deer/mile ² |



Figure 3. Helicopter survey area covering Wards 1 and 2 in Ann Arbor, Michigan with delineated areas based on detection rates.



Camera Survey

We obtained a total of 1,109 pictures from the seven baited camera sites, which included observations of 1,506 deer. There were 813 photos of tagged females as compared to 434 photos of males (Table 5). We observed 84% (31 of 37) of the tagged adult females in photos that were alive and presumed present in the study area during the survey.

Using the Jacobson's BDR method and an adjustment for camera bias, we estimated 49 deer in the SSA; 26.6% adult males ($n = 13$) and 73.4% antlerless deer (32 adult females, and four fawns = 36) (Table 6). When analyzing the photos using Jacobson's method, we examined the average number of photos of each tagged adult female as compared to the average number of photos of each individual adult male. We noticed there were 1.1 times more photos of antlered males than tagged females (e.g., greater likelihood to observe males on bait). We adjusted the number of females and fawns derived using this method with a correction factor of 1.1 to account for this camera bias. Based on observations in the field, even with the correction factor, there is a bias in the number of male photos.



When analyzing the pictures using the LPE (37 tagged adult females, one untagged adult female, and five fawns = 44 antlerless deer), and adding the number of individual antlered males identified ($n = 13$), the total estimate was 56 deer.

Table 5. Camera survey data collected from 1 - 13 December 2018 in Ann Arbor, Michigan used for Jacobson, LPE, NOREMARK, and population reconstruction estimators.

| Site | # Photos | Total Deer Observations | Tagged Adult Female | Untagged Adult Female | Adult Male | Fawns |
|-------|----------|-------------------------|---------------------|-----------------------|------------|-------|
| 1 | 119 | 150 | 74 | 14 | 32 | 15 |
| 2 | 135 | 189 | 147 | 4 | 25 | 0 |
| 3 | 93 | 140 | 86 | 4 | 33 | 3 |
| 4 | 53 | 106 | 78 | 0 | 5 | 2 |
| 5 | 199 | 212 | 53 | 0 | 159 | 0 |
| 6 | 154 | 294 | 117 | 0 | 15 | 79 |
| 7 | 356 | 460 | 258 | 0 | 165 | 16 |
| Total | 1109 | 1506 | 813 | 22 | 434 | 115 |

We ran program NOREMARK including all the tagged adult females potentially in the area, whether or not the deer were observed in the field or on camera ($n = 37$). If a tagged animal was missing from the camera survey this session, but was not missing in January 2018, we included it as in the area ($n = 6$). The antlerless deer population (tagged and untagged) was estimated to be 43 (95% CI: 40-47) and adding the number of individual antlered males identified ($n = 13$), and the total deer abundance was 56 in the SSA.

Using the population reconstruction method we projected a minimum of 54 deer in the SSA; 37 tagged adult female deer presumed alive at the time of the survey (#47 was sighted near Bluffs Nature Area near the time of the survey and is considered not available in the area), one untagged adult female, three fawns (one female fawn, two male fawns), and 13 individually identified adult males. We estimate there to be 12 deer in the north zone; nine tagged adult females, two tagged female fawns, and one male fawn. Using LPE, NOREMARK, and the population reconstruction methods to estimate the herd density, we found an average estimated density of ~ 34 deer/mile² (SSA area = ~ 1.6 mile²) (Table 6) prior to sharpshooting efforts. Eight adult males from the camera survey were culled at proximate sharpshooting locations, so there were ~ 46 deer present upon completion of Year 3 field efforts. We also



determined that ~97% of the adult females in the SSA (37 tagged adult females and one untagged adult female) were sterilized upon completion of the camera survey.

Table 6. Deer population estimates prior to sharpshooting efforts using Jacobson, LPE, NOREMARK and population reconstruction estimators for the SSA in Ann Arbor, Michigan.

| Estimation Method | Estimated Parameters |
|---|----------------------|
| December 2018 survey | 1,506 observations |
| Antlered male:tagged adult female ratio in photos | 1:2.13 |
| Antlered male:untagged adult female ratio in photos | 1:0.06 |
| Tagged adult female:fawn ratio in photos | 1:0.12 |
| Number of antlered males | 13 |
| Tagged adult female:untagged female ratio in photos | 1:0.03 |
| Population estimates (prior to sharpshooting efforts) | |
| Antlered Male:Adult/Yearling female ratio method (Jacobson et al. 1997) | 49 |
| Lincoln-Petersen Estimator | 56 |
| Bowden's ratio estimator (NOREMARK) | 56* |
| Population reconstruction (minimum number) | 54 |

* Adult females and fawns 43 (95% CI: 40-47), plus 13 adult males, total 56

DISCUSSION

Objectives and Overview

Our primary objective was to assess the complementary effect of lethal management in larger wooded areas proximate to sterilization efforts in dense suburban neighborhoods. We have demonstrated a ~50% reduction in the SSA (94 in 2017, 63 in 2018, 46 in 2019) and a 13% reduction in the NSA (15, 10, 12). In addition, there should be immediate impacts in nearly all areas that we had access with sharpshooting methods. We also have collected additional data to help the City Council move forward with future management decisions, including a third helicopter snow count and camera survey, effort/cost projections, and further demonstration of feasibility for the respective research actions.



Sterilization

We are aware of one adult female that we were not able to capture in the SSA. Based on field observations, we believe that the 37 adult does sterilized represents >97% of the adult females in this zone. There were two adult females that we did not capture in the NSA, however both deer were subsequently harvested at lethal sites proximate to the NSA. In each instance they were “fringe” deer spending most of their time outside the study area, only occasionally entering the NSA. After sharpshooting efforts, we estimate there to be 46 deer in the SSA and 12 in the NSA using population reconstruction. The limited number of unsterilized females in both study areas should greatly reduce the recruitment rate and contribute to continued population declines.

Sharpshooting

For Year 3 we eliminated three sites utilized in 2018 based on field observations and the results of the helicopter survey conducted January 2018 that reflected very few deer present. We added two new shooting locations to help alleviate high deer densities in the NW neighborhoods and the University of Michigan North Campus area. While the addition of the two new sites helped increase the total number of deer harvested, both areas will likely remain at above average deer densities given the relative number of deer harvested versus present. In the NW neighborhoods finding suitable parcels to sharpshoot continues to be a challenge. Most of the properties that would be conducive for removal efforts are under Township jurisdiction even though they are within the Ann Arbor Municipal boundary. This western section of Ward 1 contains substantial numbers of unannexed Township properties, and the Township did not participate in the deer management program. Pre-scheduled work days with the University of Michigan decreased our ability to be flexible in site considerations and resulted in fewer deer being harvested than anticipated in North Campus.

The number of harvested deer decreased slightly from Year 2 (115) to Year 3 (112). The overall harvest efficiency was similar to Year 2 (21 person-days, Year 1; 43 person-days; Year 2; 38 person-days, Year 3). The primary cause of harvest inefficiency was direct interference with sharpshooting operations. On several occasions a small group of protestors prevented deer from utilizing sharpshooting locations. We also documented several occasions where bait sites were contaminated. For the second year interference reduced operational efficiency, increasing the overall cost of the program on a per deer basis. During the first eight days of sharpshooting activities, when the majority of interference occurred, we averaged 1.3 deer/shooting effort where interference occurred compared to 4.9 deer/shooting effort where we worked unimpeded. It is more difficult to calculate the lost harvest opportunities



associated with sites that were contaminated. In addition to the lost productivity there was a substantial increase in administrative cost due to documenting, reporting, and developing contingency strategies associated with interference.

As expected, sites that were very successful during Year 1 and 2 sharpshooting operations showed decreased productivity (e.g., Nichols Arboretum, Huron Parkway Nature Area (HPNA) and Bird Hills Nature Area (BHNA)). At Nichols Arboretum the number of deer engaged during Year 3 was one third of Year 2. Surveillance of the active bait sites within the Arboretum confirmed that all but 2 untagged individuals present on camera were removed during Year 3 sharpshooting operations. Both individuals were males and exhibited sporadic activity in the Arboretum.

Consistent harvest in the Bird Hills Nature Area (BHNA) from Year 2 (8 deer harvested) to Year 3 (9 deer harvested) further reinforces our assumption that deer residing in the area west of Newport Road to the municipal line are not overlapping the park. A lack of immigration from the NW neighborhood to BHNA left only three possible sites in the NW neighborhoods to address this significant population of deer. Two private properties along Newport Road and one public property provided access to a portion of these deer. We harvested 26 deer at these locations, a significant improvement over Year 2 (16 deer harvested), but likely not enough to reach goal densities. The Barton/Foster Nature Area contributed significantly to the harvest in this area during Year 3.

Harvest at HPNA was ~50% than the previous year. Six known deer remained in this area at the conclusion of the 2019 program; one adult doe, two fawns and three antlered males were evidenced on camera during the last night of operations.

Total harvest on University of Michigan property in 2019 was 12.5% higher than in 2018 with 40 and 35 deer removed, respectively. During 2019, fewer deer were harvested from the Arboretum and more deer were harvested in North Campus area. At the conclusion of the program at least eight deer were known to be in the area bounded by Plymouth Road to the north, Green Road to the east, Huron Parkway to the West and Glazier Way to the South.

The renewed utilization of the site at Cedar Bend Nature Area resulted in the removal of nine deer. Continued lethal management in this area will likely help prevent repopulation of the NSA with unsterilized deer.

The site at Narrow Gauge Way Park (NGWP) was abandon due to consistent interference at the shooting location. An adjustment was made to address these deer at other proximate sharpshooting locations. While the adjustment resulted in moderate success the residents around NGWP will continue to be impacted by deer. The helicopter survey revealed



13 deer remaining, one of the largest concentrations in the City, many of which would have been removed if interference had not compromised this shooting location.

Sites in the north central and northeast regions of the city showed minimal harvest numbers as a result of low deer densities. Camera data and ground snow tracking supported this outcome.

Only one sharpshooting location was utilized in Ward 3, where access was granted, but overall impact on the deer population in the Ward was low with only one deer harvested. Protestor interference impacted harvest results on the one shooting attempt at this location. No sharpshooting efforts were undertaken in Wards 4 or 5.

Combined Methods

At the conclusion of Year 3 there were few remaining in the Arboretum (SSA), HPNA (SSA), Leslie Golf Course (NSA) and Cedar Bend (NSA). This should greatly minimize any influx of untagged females into the NSA and SSA areas in the near future. The one exception is the bait contamination at Leslie Golf Course, an associated compromised harvest at that location, which will allow for increased risk of deer immigrating into the NSA as was observed this past year. Continued lethal management on the perimeter of each area will be critical to ensure repopulation does not occur given our inability to continue sterilization efforts.

One untagged adult female and two female fawns were detected at the Traver Road site, in the NSA northwest of Plymouth Road. The tagged females from Year 1 and 2 were also present. The untagged adult female and both fawns were successfully captured and sterilized at Beckley Park. At the time of capture they were with doe #39.

One adult female was successfully sterilized along Cedar Bend Drive during the non-lethal effort. This was the only known unsterilized female at the time of capture. During the lethal phase, two adult females and a female fawn were harvested from the Cedar Bend Nature Area. It is likely deer are overlapping the CBNA and the western portion of the University of Michigan campus where sharpshooting opportunities are limited. It is critical that CBNA remains a viable site for lethal operation. We have no other sites to address deer that may enter the southeastern edge of the NSA.

One adult female was captured and sterilized from the Tibbits Road site. She was associated with an unsterilized adult female and two male fawns. All three untagged associates were subsequently harvested from a sharpshooting site at Leslie Golf Course. The option to use combined methods reinforces the value of having both lethal and non-lethal approaches in some areas of the City.



At the completion of Year 3 no known unsterilized female deer remained in the NSA. Risk of ingress does exist from the northeast and southeast sides of the study area. Both areas have known populations of unsterilized deer to serve as a reservoir. It will be important in the future to focus lethal management activities in these areas to prevent repopulation.

Population Estimates - Helicopter Count and Camera Survey

There were very similar numbers of deer (224 versus 220) within the municipal limits as last year's helicopter survey. Total helicopter counts increased by ~8% (298 versus 276), reflecting an increase in deer abundance outside the City limits in the areas sampled. It should be noted that deer abundance is increasing in Wards 3 - 5 where minimal sharpshooting activities have occurred. We used the same detection rate (80%), and associated correction factor, this year as last year outside of the sterilization study areas. The detection rate in the sterilization study areas was improved when compared to last year (~55%; 34 deer counted and ~62 deer present; ~30% in Year 2), resulting in moderate detection rates in the dense neighborhoods.

The combined camera survey estimates projected the population in the SSA to be 34 deer/mile² deer on average prior to sharpshooting efforts. Eight adult males counted in the camera survey were known to be removed during sharpshooting efforts. This leaves an estimated population in the SSA of 29 deer/mile² (10.5% antlered males, 81.2% adult females, 8.3% fawns). This represents a 50% decrease since 2017 (59 deer/mile² to 29 deer/mile²). Ninety-seven percent of adult females were sterilized in the SSA; one adult female and one female fawn remained. Since the start of the program, there have been 15 mortalities between the NSA and SSA (9 DVCs, 5 unknown cause and 1 (#32) euthanized after last field season), and nine missing (#4, #5, #10, #11, #18, #40, #42, #44, and #65) from the camera survey for two years and not observed in the field.

In summary, there are ~21 deer/mile² on average in Wards 1 and 2 (233 deer in ~11.1 mile²), with obvious concentrations in the Skyline School neighborhood (i.e., "NW neighborhood" in Figure 3). The higher density in the SSA also increased the overall deer density. If interference by protesters had been managed effectively, we would likely have met our goal of 150 deer removed using sharpshooting methods. This would have been ~40 fewer deer in Wards 1 and 2 which would have resulted in ~190 deer, or ~17 deer/mile². There also would be far fewer fawns born that will have to be culled next winter.

Fawn Recruitment



The average doe:fawn ratio across the three methods in the SSA was ~0.11 (~38 adult females – includes 37 tagged adult females, one known untagged and ~three fawns) reflecting a marked reduction over the 2017 recruitment ratio of 1.1.

Given the estimated number of untreated adult females (~40% of ~171 [outside of sterilization areas] = ~70 fertile adult females; see Table 4, and DeNicola et al. 2008), and a recruitment rate of 1.1 (doe:fawn from 2017), we expect an additional ~75 fawns to be recruited/added to the population next fall in Wards 1 and 2. Significant growth also is expected in Wards 3-5 given the population increase since the inception of the project two years ago.

Future Management Considerations

The area adjacent to Skyline High School in the NW neighborhoods continues to be a challenge. High deer densities in the Township abutting the municipal line and lack of access to conducive shooting locations near the school is likely to result in below average impact from deer management activities. The one resident who volunteered their property last year saw a dramatic decrease in the number of deer they observed between the end of Year 2 and the beginning of Year 3. The localized impact is substantial, but on a broader scale we need to find additional access points in this area. We should be near maintenance level densities in the rest of the Wards 1 and 2, with pockets of deer in Wards 3, 4, and 5 that should be monitored, and/or acted upon, before they become a problem.

The Department of Parks and Recreation received complaints from residents in Wards 3 and 5 expressing concerns regarding numerous deer in and around their neighborhoods. The complaint in Ward 3 was centered around Scarlett Woods and Pittsview Drive/Charing Cross area where as many as 11 deer in one herd have been observed. The complaint from Ward 5 noted ten deer in the area south of M-14, west of Main Street, north of Miller Avenue, and east of Newport Road.

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- Ann Arbor Police Chief Robert Pfannes and staff



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APPENDIX A

Deer capture data 28 - 30 November 2018 from Ann Arbor, MI.

| Date | Ear Tag # | Ear Tag Color | VHF Frequency | Sex | Age | Area | Zone |
|------------|-----------|---------------|---------------|--------|-----|--------------|------|
| 11/28/2018 | 71 | White | | Female | 2.5 | Cedar Bend | N |
| 11/28/2018 | 72 | White | | Female | 1.5 | Tibbets | N |
| 11/29/2018 | 75 | White | | Female | 3.5 | Geddes | S |
| 11/30/2018 | 76 | White | 150.763 | Female | 2.5 | Beckley Park | N |
| 11/30/2018 | 77 | White | | Female | 0.5 | Beckley Park | N |
| 11/30/2018 | 78 | White | | Female | 0.5 | Beckley Park | N |



APPENDIX B

Deer harvest data 2 - 20 January 2019 from Ann Arbor, MI.

| Date | Tag Number | Age | Sex | Location |
|--------|------------|-----|-----|--------------|
| 1/2/19 | 588884 | Y | M | Huron Pkwy |
| 1/2/19 | 588885 | Y | M | Huron Pkwy |
| 1/2/19 | 588886 | Y | M | Huron Pkwy |
| 1/2/19 | 588887 | A | M | Huron Pkwy |
| 1/2/19 | 588898 | F | M | Huron Pkwy |
| 1/2/19 | 588899 | Y | F | Huron Pkwy |
| 1/2/19 | 588900 | F | M | Huron Pkwy |
| 1/3/19 | 588894 | A | F | Bird Hills N |
| 1/3/19 | 588896 | F | F | Bird Hills N |
| 1/3/19 | 588897 | A | F | Bird Hills N |
| 1/3/19 | 588864 | F | F | Barton |
| 1/3/19 | 588865 | F | M | Barton |
| 1/3/19 | 588868 | A | F | Barton |
| 1/3/19 | 588869 | F | F | Barton |
| 1/3/19 | 588870 | A | F | Barton |
| 1/3/19 | 588880 | A | F | Barton |
| 1/4/19 | 588867 | Y | M | Newport (N) |
| 1/4/19 | 588877 | A | F | Newport (N) |
| 1/4/19 | 588878 | F | M | Newport (N) |
| 1/4/19 | 588879 | A | M | Newport (N) |
| 1/4/19 | 588889 | Y | M | Newport (N) |
| 1/4/19 | 588866 | A | F | Butternut |
| 1/5/19 | 588935 | A | F | Glazier |



| | | | | |
|--------|--------|---|---|------------|
| 1/5/19 | 588888 | F | F | MCity |
| 1/5/19 | 588891 | F | M | MCity |
| 1/5/19 | 588936 | A | F | MCity |
| 1/6/19 | 588934 | F | F | Concordia |
| 1/6/19 | 588941 | A | F | Concordia |
| 1/6/19 | 588873 | A | M | Concordia |
| 1/6/19 | 588937 | Y | M | Cedar Bend |
| 1/6/19 | 588938 | Y | M | Cedar Bend |
| 1/6/19 | 588939 | Y | M | Cedar Bend |
| 1/6/19 | 588893 | Y | M | Cedar Bend |
| 1/6/19 | 588895 | A | M | Cedar Bend |
| 1/7/19 | 588851 | Y | M | Arb |
| 1/7/19 | 588858 | Y | M | Arb |
| 1/8/19 | 588859 | A | F | Glazier |
| 1/8/19 | 588861 | F | M | Glazier |
| 1/8/19 | 588862 | Y | F | Glazier |
| 1/8/19 | 588863 | A | F | Glazier |
| 1/8/19 | 588892 | F | M | Glazier |
| 1/8/19 | 588856 | F | M | UM Laundry |
| 1/8/19 | 588857 | A | F | UM Laundry |
| 1/8/19 | 588871 | A | M | UM Laundry |
| 1/8/19 | 588872 | A | M | UM Laundry |
| 1/8/19 | 588883 | F | M | UM Laundry |
| 1/9/19 | 588855 | F | M | UM USGS |
| 1/9/19 | 588929 | F | F | Foxfire |
| 1/9/19 | 588930 | A | F | Foxfire |
| 1/9/19 | 588860 | A | F | Foxfire |



| | | | | |
|---------|--------|---|---|--------------|
| 1/10/19 | 588924 | Y | M | Leslie Woods |
| 1/10/19 | 588927 | F | M | Leslie Woods |
| 1/10/19 | 588932 | A | M | Concordia |
| 1/10/19 | 588933 | F | M | Concordia |
| 1/10/19 | 588854 | A | F | Concordia |
| 1/11/19 | 588931 | A | F | Leslie GC |
| 1/11/19 | 588875 | F | M | Leslie GC |
| 1/11/19 | 588876 | F | M | Leslie GC |
| 1/12/19 | 588920 | F | F | Glazier |
| 1/12/19 | 588923 | A | F | Glazier |
| 1/12/19 | 598408 | A | F | Glazier |
| 1/12/19 | 588921 | A | F | Bird Hills S |
| 1/12/19 | 588922 | F | M | Bird Hills S |
| 1/12/19 | 588925 | F | M | Bird Hills S |
| 1/12/19 | 588926 | F | M | Bird Hills S |
| 1/12/19 | 588928 | F | M | Bird Hills S |
| 1/12/19 | 588940 | A | F | Bird Hills S |
| 1/13/19 | 588914 | A | F | Cedar Bend |
| 1/13/19 | 588915 | A | F | Cedar Bend |
| 1/13/19 | 588918 | F | F | Cedar Bend |
| 1/13/19 | 588919 | F | M | Cedar Bend |
| 1/14/19 | 588912 | Y | M | Arb |
| 1/14/19 | 588907 | F | F | UM Laundry |
| 1/14/19 | 588908 | A | F | UM Laundry |
| 1/14/19 | 588909 | A | F | UM Laundry |
| 1/14/19 | 588910 | A | F | UM Laundry |
| 1/14/19 | 588948 | A | F | UM Laundry |
| 1/14/19 | 588874 | F | M | UM Laundry |



| | | | | |
|---------|--------|---|---|-------------|
| 1/14/19 | 588881 | F | F | UM Laundry |
| 1/14/19 | 588882 | F | M | UM Laundry |
| 1/15/19 | 588600 | A | F | Barton |
| 1/15/19 | 588901 | F | F | Barton |
| 1/15/19 | 588904 | A | F | Barton |
| 1/15/19 | 588905 | A | F | Barton |
| 1/15/19 | 588852 | Y | M | Newport (S) |
| 1/15/19 | 588853 | Y | M | Newport (S) |
| 1/15/19 | 588890 | F | M | Newport (S) |
| 1/15/19 | 588911 | A | F | Newport (S) |
| 1/15/19 | 588913 | Y | M | Newport (S) |
| 1/15/19 | 588916 | Y | M | Newport (S) |
| 1/15/19 | 588917 | F | M | Newport (S) |
| 1/16/19 | 588902 | A | M | Concordia |
| 1/16/19 | 588593 | A | M | Concordia |
| 1/16/19 | 588599 | A | F | South Pond |
| 1/17/19 | 588903 | A | F | Huron Pkwy |
| 1/17/19 | 598409 | A | F | Glazier |
| 1/17/19 | 588595 | F | F | Glazier |
| 1/17/19 | 588598 | F | M | Glazier |
| 1/18/19 | 588596 | A | F | Newport (N) |
| 1/18/19 | 588597 | A | F | Newport (N) |
| 1/18/19 | 588942 | A | M | Newport (N) |
| 1/18/19 | 588947 | A | F | Foxfire |
| 1/18/19 | 588906 | A | F | Foxfire |
| 1/19/19 | 588590 | A | F | MCity |
| 1/19/19 | 588943 | F | F | MCity |
| 1/19/19 | 588946 | A | F | MCity |



| | | | | |
|---------|--------|---|---|-------------|
| 1/19/19 | 588592 | A | F | MCity |
| 1/19/19 | 588944 | A | M | UM Laundry |
| 1/19/19 | 588945 | F | M | UM Laundry |
| 1/19/19 | 588949 | A | M | UM Laundry |
| 1/19/19 | 588950 | A | M | UM Laundry |
| 1/20/19 | 588594 | A | F | Newport (S) |