City of Ann Arbor
Deer Management Program Evaluation

Conducted on Behalf of

The City of Ann Arbor

By

The Office for Survey Research
Institute for Public Policy and Social Research

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EXECUTIVE SUMMARY

A web-based survey of households in Ann Arbor with voters registered in one of the city's five wards was conducted in 2018 by the Michigan State University Office for Survey Research in order to assess the City of Ann Arbor's Deer Management Program. The survey mirrored a similar effort conducted in 2017, in order to allow the results to be reliably compared to identify trends over time.

In 2018, this program evaluation was conducted by sending mail invitations to 10,411 households randomly selected from a list of addresses provided to OSR by the City. The mailings directed recipients to access the survey via a web URL by telephone call-in, and included a unique passcode in order to help ensure that data was collected only from randomly sampled invitees. A total of 1,417 voters completed the survey, with at least 267 coming from each of the city's 5 wards. The overall completion rate for the study was 14.3 percent.

The substantive findings of the study can be summarized as follows:

- *Deer Population*
    - Respondents expressed *widely varied* sentiments toward the deer population in general. Approximately 29 percent of respondents city-wide said they felt "Mostly positive" toward the deer population, compared to 18 percent who answered "Mostly negative" and 31 percent who answered, "Both positive and negative." Responses in 2018 were nearly identical to the 2017 survey results, within the margin of error.
    - Between 24 and 43 percent of 3+ year residents in each ward estimated that the deer population in their neighborhood had increased over the previous 3 years, while 29 to 47 percent said it had stayed the same. No more than 23 percent in each ward, and fewer than 12 percent overall city-wide, estimated that it had decreased. Compared to 2017, respondents were *less likely* to say the deer population had increased (31 percent overall, compared to 40 percent in 2017).
    - Nearly half (44 to 45 percent) of all 3+ year residents city-wide indicated that deer / vehicle accidents, damage from over-browsing, and an increase in the deer population have been a "serious problem" over the last 3 years, while no more than one-fourth (25 percent or less) said any of these were "not at all a problem." Responses in 2018 were nearly identical to the 2017 survey results, within the margin of error.
    - About half (49 to 53 percent) of 3+ year residents city-wide said they considered a decline in native animal species, damage to landscape and garden plants, and transmission of diseases to humans or animals to be at least a "minor problem," with 19 to 26 percent calling each a "serious problem."
    - The most deer damage prevention measures home owners most commonly reported having used were deer-resistant plants (245 respondents) and odor or

taste repellants (239 respondents), while the measures rated as most effective by those who used them included fencing (25 percent "highly effective") and deer-resistant plants (17 percent "highly effective"). Responses in 2018 were nearly identical to the 2017 survey results, within the margin of error.

- *Deer Management Program*
    - Respondents reported a generally high level of awareness about the Deer Management Program. Between 43 and 61 percent of respondents in each ward said they considered themselves "Very Aware" while another 35 to 49 percent rated themselves as "Somewhat Aware." Responses in 2018 were nearly identical to the 2017 survey results, within the margin of error.
    - One (1) out of five (5) wards exceeded the target of 75 percent acceptance of the Deer Management Program overall, though the acceptance rate was statistically indistinguishable from 75 percent in four (4) out of five (5) wards. In Ward 3, the acceptance rate was significantly lower than 75 percent. The acceptance rate was slightly lower in 2018 than in 2017, but within the overall margin of error. The biggest decline was in Ward 4, where estimated acceptance dropped from 77 percent in 2017 to 72 percent in 2018.
    - Among those who disapproved of the plan overall, the lethal culling component was by far the least supported aspect. Just 19 percent of those who opposed the plan overall said they considered the lethal component acceptable.
    - Three (3) out of five (5) wards exceeded the target of 75 percent of surveyed respondents reporting that the level of damage to their landscape and garden plants was acceptable, though only two (2) of these wards were significantly higher than 75 percent. The acceptance rate was slightly higher in 2018 than in 2017, but within the overall margin of error.
    - All five (5) wards exceeded the target of 75 percent of surveyed respondents reporting that the level of park closures was acceptable, and three (4) of these wards were significantly higher than 75 percent. Responses in 2018 were nearly identical to the 2017 survey results, within the margin of error.

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SECTION I. INTRODUCTION

Purpose of Study

The purpose of this survey was to help the City of Ann Arbor evaluate its 2018 Deer Management Program (a multi-faceted strategy adopted and implemented by the city in order to help control the deer population in the area and prevent a variety of perceived problems caused by overpopulation) and help inform future policymaking decisions pertaining to deer living near Ann Arbor. The City of Ann Arbor contracted with MSU's Office for Survey Research (OSR) to conduct a scientific survey of a random sample of Ann Arbor residents using a sample frame defined by households with one or more voters registered in the city. The study was designed to produce results comparable to those from a similar survey conducted in 2017 using the same methods.

Methodology

To achieve the initial research goal of completing 260 surveys from household in each of the five wards (the final sample size needed to achieve a 6 percent margin of sampling error), a random sample of households with registered voters was drawn from each of the five wards and then randomly divided into three replicates such that adaptive measures could be taken based on what has been learned from previous replicates (e.g., contacting fewer households from a given ward if participation rates there were higher than expected in the first replicate).

Based on an initial assumption that the proportion of invalid addresses, eligibility rate, and completion rate within each ward would be the same as was observed in the 2017 survey, a total of 10,411 addresses were drawn, including:

- 2,744 from Ward 1,
- 1,574 from Ward 2,
- 2,190 from Ward 3,
- 2,268 from Ward 4, and
- 1,635 from Ward 5.

The data collection procedures included sending all randomly selected households a letter, which explained the purpose of the study and asked that an adult in the household complete the survey. The letter contained the URL to the survey and a passcode to access the survey. One week after sending the initial letter, a postcard reminder was sent to all households who had not completed the survey. The postcard also contained the URL and passcode unique to the household.

This process began on February 14, 2018 and concluded on May 2, 2017.

In the midst of the data collection process, it became apparent to the OSR research team that the actual response rate to the survey was higher than anticipated in Ward 1 and lower than anticipated in Wards 2, 4, and 5. Therefore, prior to contacting the third replicate a random subset of the (uncontacted) Ward 1 addresses in that replicate were replaced by additional

addresses from Wards 2, 4, and 5 drawn at random from those that had not already been sampled. After this adjustment, the final sampling frame still consisted of 10,411 addresses, distributed as follows:

- 2,320 from Ward 1,
- 1,674 from Ward 2,
- 2,190 from Ward 3,
- 2,368 from Ward 4, and
- 1,859 from Ward 5

A total of 1,417 households responded to the survey, which represents about 3 percent of the 50,848 households with registered voters provided to OSR by the City of Ann Arbor and 14 percent of the 10,411 households who were randomly sampled to participate. The final number of completed surveys was distributed amongst the city's five wards as follows:

- 344 from Ward 1
- 269 from Ward 2
- 267 from Ward 3
- 269 from Ward 4
- 268 from Ward 5

Further details, including the ineligibility and completion rates for the survey, are provided in Appendix A.

The statistical tests used for the analysis of the data included:

- A *95 Percent Confidence Interval* is a range of values which is likely to contain the true value of an unknown population parameter (such as the proportion of all individuals who feel a certain way) which is being estimated based on observed data. A "95 percent" confidence interval is calculated using a procedure that will contain the true population parameter 95 percent of the time. If a particular value falls outside the 95 percent confidence interval, then it would be unlikely for the true parameter to equal that value, given the fact that the random sample produced the observed results.

- A *One-Sample Test of Proportions* is a statistical test that compares an observed proportion (such as the proportion of respondents who gave a particular answer to a given question) to a particular hypothesized value. If the difference between the observed proportion and the hypothesized proportion is statistically significant, then the difference is large enough that it is unlikely to be attributed to random chance. The proportion is likely *not* equal to its hypothesized value.

SECTION II. PROFILE OF RESPONDENTS

In order to assess how closely the final sample of respondents represented the total population of Ann Arbor, the reported prevalence of particular demographic characteristics among survey respondents can be compared against known the known prevalence of the same demographic characteristics in the target population.

The sample demographics are easily measured using the proportion of respondents choosing various options on a series of survey questions. For the population demographics, the U.S. Census (American Community Survey – 5 Year Estimates) provides a common and widely trusted source of information. Table 1, below, breaks down the demographics of respondents to the Deer Management Program Evaluation Survey and compares them to the demographics reported in U.S. Census data.

An important caveat to Table 1 is that although the population demographics are based on U.S. census data about all adult Ann Arbor residents, the sampling frame (the list of households from which the random sample was drawn) included only the addresses of voters registered in one of the city's five wards.

Therefore, groups which are disproportionately less likely to be registered to vote – such as young people and racial/ethnic minorities – make up a smaller percentage in the sample than they do in the Census. In addition, many students who live in Ann Arbor are registered to vote at their home addresses outside the city, and would thus not be included in the sample.

Table 1. Breakdown of Respondents by Demographic Categories

Demographic Category		Final Sample	Population[a]
Households with Registered Voters		1,417	50,848[b]
Sex	% Male	47.8%	49.0%
	% Female	51.7%	51.0%
	% Another identity	0.6%	-
Race	% White alone	90.0%	73.0%
	% Black alone	1.3%	7.7%
	% Asian alone	3.7%	14.4%
	% Another race alone	2.4%	1.0%
	% Two or more races	2.5%	3.6%
Origin	% Hispanic or Latino origin	1.7%	4.1%
Education	% Less than high school graduate	0.0%	2.9%
	% High school graduate / GED	9.1%	42.5%
	% Bachelor's degree	30.1%	26.7%
	% Master's degree or higher	60.7%	27.9%
Household Income	% Less than $35,000	10.4%	33.1%
	% $35,000 to $49,999	8.8%	11.3%
	% $50,000 to $74,999	16.4%	15.4%
	% $75,000 to $99,999	17.0%	11.1%
	% $100,000 or more	47.4%	29.1%
Home Ownership	% Owner occupied	75.4%	45.0%
	% Renter occupied	23.0%	55.0%
	% Other	1.6%	-
School Enrollment	% Student	7.9%	42.5%
Housing Unit	% Single-family home (detached)	65.7%	42.3%
Age	% 18 to 29	12.6%	47.0%
	% 30 to 39	13.1%	14.1%
	% 40 to 49	10.9%	10.0%
	% 50 to 59	19.1%	10.8%
	% 60 to 69	26.4%	9.4%
	% 70 or older	17.9%	8.7%

[a] Unless otherwise noted, population figures were pulled from: United States Census Bureau / American FactFinder. 2011 – 2016 American Community Survey 5-Year Estimates. U.S. Census Bureau's American Community Survey Office, 2016. Web. May 2018 <http://factfinder.census.gov>.

[b] Source: Electronic list of addresses provided by City of Ann Arbor.

The table indicates that the final sample includes:

- Approximately *the same* proportion of females (52 percent) as in the city adult population (51 percent);
- A *greater* proportion of individuals who identify their race as white alone (90 percent) than in the city adult population (73 percent);
- Individuals with *more* formal education (61 percent with a Master's or higher and 9 percent with only a high school diploma or less), on average, compared to the city adult population (28 percent with Master's or higher and 46 percent with high school or less);
- Individuals with *higher* total annual household income (47 percent with $100,000 or more), on average, compared to the city adult population (29 percent with $100,000 or more);
- A *greater* proportion of home owners (75 percent) than in the city adult population (45 percent);
- A *lower* proportion of students (8 percent) than in the city adult population (43 percent);
- A *greater* proportion of individuals living in single-family detached homes (66 percent) than in the city adult population (42 percent); and
- Individuals who are *older* (13 percent 18 to 29 years old), on average, compared to the city adult population (47 percent 18 to 29 years old).

Although the demographics of the sample do differ in a number of ways from the demographics of the total city population, there are a number of reasons to believe the results of the survey can still be considered a valid measure of public opinion toward the Ann Arbor Deer Management Program:

- It was conducted using a random sample drawn from a list of households with voters registered in Ann Arbor and therefore can be generalized to the population of "registered Ann Arbor voters" rather than the population of "all Ann Arbor residents." Detailed population demographics for registered voters only were not available, but the groups that appear underrepresented in Table 1 are groups that are, in general, less likely to be registered voters[1,2].
- Statistical analyses of the survey results (see Appendix B) show that, compared to the more represented demographic groups, the groups that appear underrepresented in Table 1 rated themselves as *less aware* of the deer management program on average and were more likely to report having no particular feelings about the deer population in

[1] United States Census Bureau. (2017). *Voting and Registration in the Election of November 2016*. Retrieved from https://www.census.gov/data/tables/time-series/demo/voting-and-registration/p20-580.html

[2] Pew Research Center. (2006). *Who Votes, Who Doesn't, and Why*. Retrieved from http://www.people-press.org/2006/10/18/who-votes-who-doesnt-and-why/

Ann Arbor. Therefore, the survey measures the views of those who know and care most about the deer issues more than those who are less informed or indifferent.

- Differences in the degree to which particular groups are represented in a survey sample are only problematic to the extent that membership in those groups is correlated with the variables of interest in an analysis. In this case, statistical analyses of the survey results (see Appendix B) show that approval of the Deer Management Program is statistically unrelated to nearly all of the demographic variables. If anything, these analyses suggest that the survey results may *underestimate* the level of support for the Deer Management Program because respondents belonging to the underrepresented groups were, on average, *more likely* to approve of it than were members of better represented demographic groups.

SECTION III. DEER POPULATION

Respondents were asked a series of questions about their personal experiences with, and attitudes toward, the deer population within the City of Ann Arbor.

In order to assess their general attitudes toward the deer population, they were asked: *"Generally, which of the following best describes your feelings toward the deer population in the City of Ann Arbor – 'Mostly positive,' 'Mostly negative,' 'Both positive and negative,' or 'I have no particular feelings about the deer population in Ann Arbor?'"*

The distribution of responses to this question is broken down by ward in Table 2, below. Percentages indicate the percent of respondents within each ward who gave each answer – thus all rows sum to 100 percent, within rounding error. Within each row, the most common answer is displayed in bold text.

The table also includes a row with the 2017 city-wide results, for comparison over time.

Table 2. Feelings toward Deer Population, by Ward

Ward	n	% "Mostly Positive"	% "Mostly Negative"	% "Both Positive and Negative"	% "No Particular Feelings"
1	342	**31.9%**	17.5%	26.6%	24.0%
2	268	24.6%	29.9%	**34.7%**	10.8%
3	267	**34.1%**	13.1%	32.6%	20.2%
4	267	27.0%	11.6%	**32.6%**	28.8%
5	267	24.3%	18.0%	28.1%	**29.6%**
Overall (2018)	*1411*	*28.6%*	*18.0%*	***30.7%***	*22.8%*
Comparison (2017)	*1100*	*28.6%*	*18.9%*	***32.6%***	*20.0%*

Bold text *indicates the most common answer given by respondents from each ward*

The results in Table 2 indicate a very diverse mix of attitudes, with fewer than 35 percent of respondents from any individual ward giving each answer. In particular:

- The wards expressing the *most favorable* attitudes toward the deer population, on average, were Wards 1 and 3, with over 31 percent apiece answering, "Mostly positive."
- The ward expressing the *least favorable* attitudes toward the deer population, on average, was Ward 2, with less than 25 percent answering "Mostly positive" and 30 percent answering "Mostly negative."
- City-wide, the *most common* answer was "Both positive and negative," with nearly a third (31 percent) of all respondents selecting this option. The *second most common* answer was "Mostly positive," with 29 percent.
- Responses were generally similar to those given in the 2017 survey, with the city-wide percentages coming within three percentage points for each answer choice.

In order to assess perceived changes in the size of the deer population, respondents were asked, *"Overall, has the number of deer in your neighborhood increased within the past three years, decreased within the past three years, or stayed about the same?"*

The distribution of responses to this question is broken down by ward in Table 3, below. Percentages indicate the percent of respondents within each ward who gave each answer – thus all rows sum to 100 percent, within rounding error. Because the question made specifc reference to a three-year time period, the Table shows the distribution of responses by those who said they had lived at their current residence for three or more years. However, the results would be nearly identical if newer residents were included as well.

Table 3. Perceived Change in Deer Population Among 3+ Year Residents, by Ward

Ward	n	Increased	Decreased	Stayed the same	Unsure
1	239	24.7%	23.0%	**38.1%**	14.2%
2	221	**43.4%**	17.2%	28.5%	10.9%
3	217	35.5%	6.9%	**42.4%**	15.2%
4	198	26.3%	3.5%	**45.5%**	24.8%
5	217	24.4%	6.9%	**46.5%**	22.1%
Overall (2018)	*1092*	*30.9%*	*11.9%*	***40.0%***	*17.2%*
Comparison (2017)	*830*	***39.9%***	*8.8%*	*36.3%*	*15.1%*

***Bold text** indicates the most common answer given by respondents from each ward*

The results in Table 3 suggest that far more respondents believe the deer population in their neighborhood has either increased or stayed the same over the past three years than believe it has decreased. In particular:

- In four out of five wards (i.e., Wards 1, 3, 4, and 5), the most common response was, "It has stayed the same" and the second most common response was, "It has increased."
- Nearly half (43 percent) of respondents in Ward 2 reported that the deer population has increased over the past three years, while another 29 percent said it had stayed the same.
- Respondents in Wards 1 and 2 were by far the most likely to report that the deer population has decreased over the last three years, with around 20 percent of respondents giving that response. Fewer than 7 percent of respondents in any other ward reported this. However, note that even in Wards 1 and 2 this was still the second least common answer given.
- City-wide, the *most common* answer was "It has stayed the same," with 40 percent of all respondents selecting this option. The *second most common* answer was "It has increased," with 31 percent.
- Compared to 2017, respondents were nine percentage points *less likely* to say the deer population had increased (31 percent, down from 40 percent a year ago), and *more likely* to say it had decreased or stayed the same. The biggest change was in Ward 2, where 61 percent of respondents in 2017 had answered "It has increased" compared to only 43 percent in 2018.

Respondents were also asked to assess the impact of the deer population on humans, plants, and other animal species by rating the extent to which each of the following potential issues related to deer has been a problem over the past three years:

- Increase in deer population
- Deer / vehicle accidents
- Damage to your landscape and garden plants
- Transmission of disease to humans or animals
- Damage to park and natural ecosystems by over-browsing of native foliage
- Decline in native animal species (songbirds, butterflies, etc.)

The results from this battery of questions are summarized in Figure 1, which combines the responses of all five wards. In the figure, the issues are listed in order from the one *most commonly* perceived as a problem[3] to the one *least commonly* perceived as a problem.

[3] Measured as (1 - *p*), where *p* is the proportion of respondents who answered, "Not at all a problem."

Figure 1. Perceived Severity of Problems Related to Deer, Among 3+ Year Residents

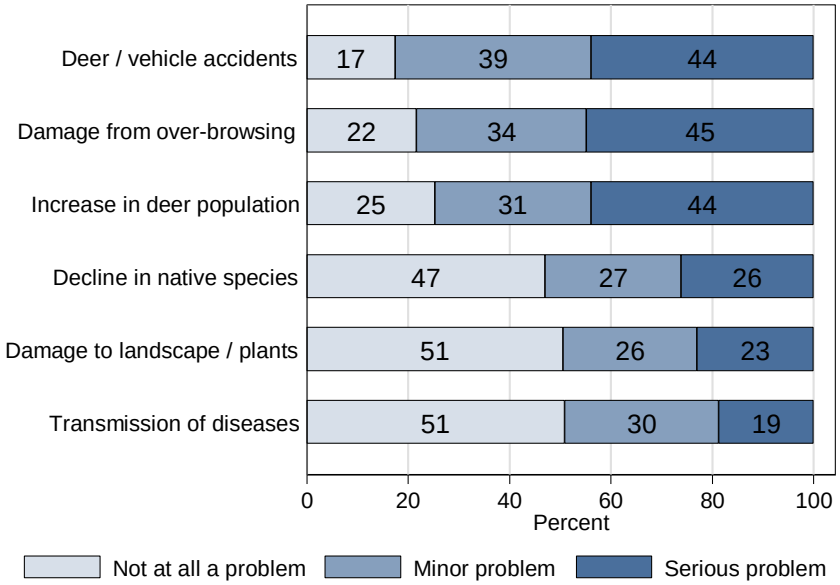


Figure 1 shows that respondents' perceptions differed widely from one issue to the next, suggesting that some issues were frequently seen as more serious problems than others. In particular:

- Most respondents (83 percent) rated "Deer / vehicle accidents" as a minor or serious problem, which was the *most* of any issue.
- "Damage from over-browsing" and "Increase in deer population" were perceived as minor or serious problems by 79 and 75 percent of respondents, respectively. These were also the two issues *most frequently* rated as serious, with 46 and 45 percent of respondents, respectively, choosing this answer respectively.
- "Decline in native species," "Damage to landscape / plants," and "Transmission of diseases" were the issues *least commonly* seen as problems, with 47 percent or more of respondents rating each one as "Not at all a problem." Even so, that leaves roughly half (48 to 53 percent) of respondents who did see them as at least minor problems.

The responses are also broken down by ward in Table 4, below. The table shows a mean score for each issue in each ward, which is calculated using a three-point scale where 1 = "Not at all a problem" and 3 = "Serious problem." In short, higher scores correspond to greater perceived severity.

Table 4. Mean Perceived Severity of Problems Related to Deer, by Ward

Issues	Wards 1	2	3	4	5	Total (2018)	Comparison (2017)
Deer / vehicle accidents	2.20	2.38	**2.18**	**2.17**	**2.23**	***2.23***	***2.22***
Damage from over-browsing	**2.22**	**2.38**	2.11	2.09	2.18	*2.20*	*2.19*
Increase in deer population	2.03	2.32	2.07	2.08	2.13	*2.12*	*2.17*
Decline in animal species	1.85	1.83	1.74	1.65	1.88	*1.79*	*1.79*
Damage to landscape and plants	1.72	2.06	1.67	1.48	1.47	*1.68*	*1.70*
Transmission of diseases	1.66	1.82	1.58	1.59	1.59	*1.64*	*1.65*
Average (2018)	*1.95*	*2.13*	*1.89*	*1.84*	*1.91*	*1.94*	*1.97*
Comparison (2017)	*1.98*	*2.19*	*1.88*	*1.77*	*1.97*	*1.97*	

*Note: means are calculated using a three-point scale where 1 = "Not at all a problem" and 3 = "Serious problem." **Bold text** indicates the problem perceived, on average, as most severe within each ward.*

Table 4 indicates that:

- In each of the five wards, the issue perceived as the *most severe* problem was either "Deer / vehicle accidents" or "Damage from over-browsing" and the issue perceived as the *least severe* problem was either "Damage to landscape and plants" or "Transmission of diseases."
- Overall, respondents from Ward 2 perceived deer-related issues as the most severe problems (mean score of 2.13 out of 3.00), while respondents from Ward 4 perceived them as the least severe problems (mean score of 1.84 out of 3.00).
- The mean score across all issues and all wards was 1.94, which means, approximately, the average respondent perceived the average deer-related issue on the list as a minor problem.
- Perceptions of deer-related problems were highly stable from 2017 to 2018, with the mean scores changing by less than 0.1 points in all five wards and on all six problems.

Next, respondents were asked if they had used any of the following measures to prevent deer damage in the last three years:

- Fencing
- Odor or taste repellants
- Frightening devices (e.g., lights or noises)
- Deer-resistant plants
- Other
- No measures taken to prevent damage

If they reported having used a particular measure, they were asked to assess how effective the measure has been in preventing deer damage in the last three years. The responses to both of

these sets of questions are summarized below in Table 5, where number of respondents who reported having used each measure is listed in the column labeled "*n*", and where the percent of users who evaluated the measure as not effective, somewhat effective, or highly effective, or who said they had used the measure but declined to evaluate its effectiveness are listed in the next four columns. The "mean score" column lists the average effectiveness rating of each measure among those who reported having used it, on a three-point scale where 1 = "Not effective" and 3 = "Highly effective."

In the table, the measures are listed in order from the one evaluated as *most effective* on average by those who had used it to the one evaluated *as least effective*, on average.

Table 5 shows that:

- The most *prevalent* damage prevention measure is deer-resistant plants, as 225 respondents (23 percent of home owners) reported having used it.
- Of the damage prevention measures listed on the questionnaire, the one rated as *most effective* according to its users was fencing, with an average score of 2.00 (corresponding roughly to an answer of "Somewhat effective").
- Among the damage prevention measures listed, the one that was both *least prevalent* and rated *least effective* was frightening devices. Just 82 respondents had used them, and of those who did use it, almost two-thirds (63 percent) said it was "Not effective" in preventing deer damage.

Table 5. Use and Efficacy of Damage Prevention Measures, Among Home Owners

Measures	*n*	Not effective	Somewhat effective	Highly effective	Declined to assess	Mean[a] (2018)	Comparison (2017)
Fencing	174	25.2%	46.3%	25.2%	3.4%	*2.00*	*2.05*
Deer-resistant plants	245	24.4%	50.2%	16.9%	8.4%	*1.92*	*1.83*
Repellants	239	38.0%	45.7%	7.7%	8.6%	*1.67*	*1.61*
Frightening devices	82	63.2%	22.4%	6.6%	7.9%	*1.39*	*1.34*
Other (Chase by human / dog)	22	22.7%	40.9%	27.3%	9.1%	*2.05*	*1.67*
Other (Assorted)	30	20.0%	26.7%	33.3%	20.0%	*2.17*	*2.14*
No measures taken	986	-	-	-	-	-	-

[a] *Means are calculated using a three-point scale where 1 = "Not effective" and 3 = "Highly effective."*

The 986 respondents who said they had not taken any measures to prevent deer damage were asked a follow-up question about why they had not done so. The results of this question are summarized below, in Figure 2.

Figure 2. Reasons for not Taking Damage Prevention Measures, Among Home Owners

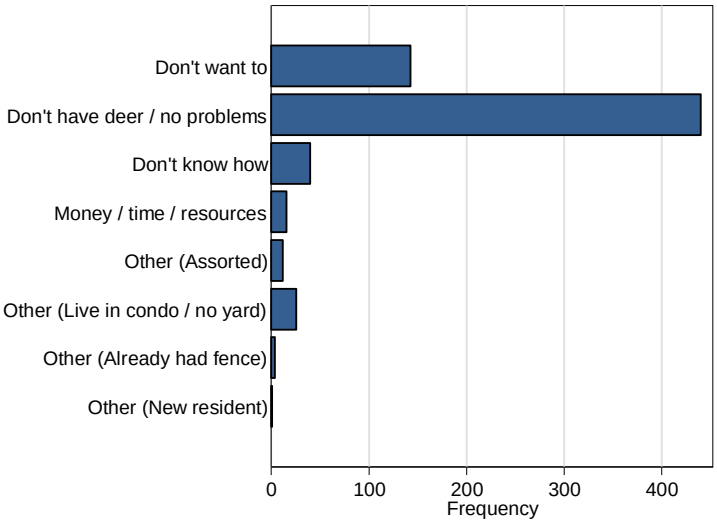


Figure 2 indicates that:

- Of the home owners who said they had taken no damage prevention measures, by far the most common reason given for it was, "I don't have deer" (including those who selected 'Other' and then indicated in the open-ended elaboration that they have deer but have not encountered any problems).
- The second most common reason given for having taken no damage prevention was, "I don't want to" (including those who selected 'Other' and then indicated in the open-ended elaboration that they appreciate the deer's presence or believe the deer should be free to enjoy their property).

Table 6 breaks these responses down by ward, and indicates that respondents in Wards 4 and 5 were especially likely to report having taken no prevention measures, and to indicate that the reason they took no such measures was because they have no deer or deer-related problems.

Table 6. Reasons for no Prevention Measures, by Ward

	Wards					
% of Homeowners	**1**	**2**	**3**	**4**	**5**	**Total (2018)**
No prevention measures – no deer / no problems	27%	17%	37%	65%	66%	42%
No prevention measures – don't want to	14%	13%	19%	12%	9%	14%
No prevention measures – all other reasons	12%	15%	9%	5%	6%	9%
Total reporting no prevention measures	*53%*	*45%*	*65%*	*82%*	*81%*	*64%*

Percentages represent the proportion of all occupant-owned households in each Ward that provided each answer. Renters are excluded from these calculations.

SECTION IV. DEER MANAGEMENT PROGRAM

Awareness of Program

In addition to the questions about the deer population itself, respondents were asked a series of questions evaluating the City of Ann Arbor's Deer Management Program – a four-year plan which included lethal removal of deer, nonlethal sterilization of deer, and education for residents about private property options such as fencing and gardening modifications.

First, respondents were asked to rate their level of general awareness about the Deer Management Program on a three-point scale ranging from "Not at all aware" to "Very aware." The distribution of responses to this question are broken down by ward in Figure 2, below.

Figure 3. Awareness of Deer Management Program, by Ward

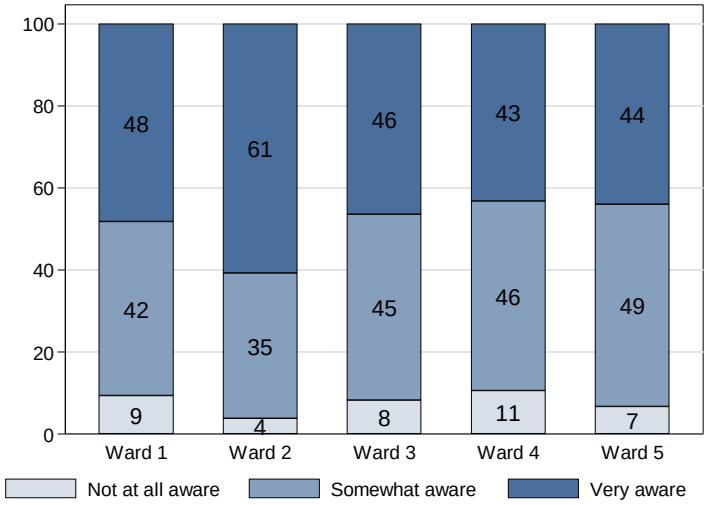


Figure 2 indicates that respondents generally see themselves as well informed about the deer management program. In particular:

- Fewer than 12 percent of respondents in any individual ward answered "Not at all aware," which indicates that about nine-out-of-ten rated themselves at least somewhat aware.
- At least two-fifths (43 percent or more) of respondents in each ward said they are "Very aware" of the Deer Management Program, and at least one-third (35 percent or more) in each ward said they are "Somewhat aware."
- Overall, combining all five wards, about half (49 percent) of all respondents chose "Very aware," 44 percent chose "Somewhat aware," and just 8 percent chose "Not at all aware."

In Table 7, the collective level of awareness within each ward is summarized as a mean score (calculated on a three-point scale where higher scores correspond to greater awareness), and compared to the results from the 2017 survey. The table indicates that respondents in Ward 2 reported a higher level of awareness than other wards, and that awareness in each ward exhibited remarkable stability over time, as the 2018 scores were all nearly identical to 2017.

Table 7. Awareness of Deer Management Program, Comparison to 2017

	Ward 1	Ward 2	Ward 3	Ward 4	Ward 5
Mean[a] (2018)	2.39	2.57	2.38	2.32	2.37
Comparison[a] (2017)	2.39	2.56	2.39	2.33	2.41

[a] *Means are calculated using a three-point scale where 1 = "Not at all aware" and 3 = "Very aware."*

Measures of Success

As approved by the Ann Arbor City Council, the program included a number of target metrics by which the success of the program could be evaluated, which included, among other goals[4]:

- Community acceptance of deer management program - when 75% of surveyed residents in a Ward respond that the City's strategy of managing the deer population is acceptable. Recognizing there will be variability of this measure over time, a trend toward 75% is desired.
- Community acceptance of herd impact - when 75% of surveyed residents in a Ward respond that damage to their landscape or garden plants is at an acceptable level on private lands. Recognizing there will be variability of this measure over time, a trend toward 75% is desired.
- Acceptable level of park closures

The survey was designed with an eye to assessing the extent to which these targets were met.

First, respondents were asked, "*Although you may have varying opinions about different specific components of the City of Ann Arbor's deer management program (which includes lethal removal, nonlethal sterilization, and education about private property options such as fencing and gardening modifications), would you say the plan is acceptable or not acceptable overall*?"

Table 8, below, shows the percentage of respondents who answered "Acceptable" from each ward, and overall. The Table also shows the 95 percent confidence interval – which incorporates the margin of error for the survey – for this percentage in each ward.

If the value 75 percent falls *outside* a given confidence interval, it can be said that the approval rating for the plan is significantly different from the target of 75 percent. If the value 75 percent

[4] http://www.a2gov.org/departments/community-services/Pages/Deer-Management-Project-.aspx

falls *within* the confidence interval, the estimated percent support within the population is statistically indistinguishable from the target of 75 percent acceptance. This is noteworthy because taking random sampling error into account, it is possible for fewer than 75 percent of the population to find the plan acceptable but to draw a sample in which more than 75 percent approve, simply by chance (or vice versa).

Table 8. Assessment of Deer Management Program Overall, by Ward

Ward	% "Acceptable"	95% Confidence Interval	*n*	*Comparison (2017)*
1	70.9%	(65.8% - 75.5%)	340	72.4%
2	72.7%	(67.0% - 77.8%)	264	72.5%
3	67.0%	(61.1% - 72.5%)	264	65.6%
4	72.1%	(66.4% - 77.2%)	265	77.1%
5	75.8%	(70.2% - 80.6%)	264	79.0%
Overall	*71.7%*	*(69.2% - 74.0%)*	*1,397*	*73.3%*

Table 8 shows that:

- In Ward 5, slightly *more* than 75 percent (specifically 76 percent) of surveyed residents responded that the City's strategy of managing the deer population was acceptable. Taking the margin of error into account, this estimate is statistically indistinguishable from the target of 75% acceptance.
- In Wards 1, 2, and 3, slightly *fewer* than 75 percent (specifically 71, 73 and 72 percent, respectively) of surveyed residents responded that the City's deer management strategy was acceptable, but these estimates are again statistically indistinguishable from the target of 75% acceptance.
- In Ward 3, *fewer* than 75 percent (specifically 67 percent) of surveyed residents responded that the deer management plan was acceptable. This was the only ward in which the estimated percent support is statistically different from 75 percent, which indicates that we would be highly unlikely to observe that result if 75 percent of residents in the population approved.
- Across all five wards in the city, about 72 percent of surveyed respondents said the plan was acceptable. This observed result falls significantly below the targeted level of acceptance, at the $p < .05$ confidence level.
- The estimated level of approval for the Deer Management Program slightly decreased, on average, from 2017 to 2018 overall and in three of the five wards. However, these differences were within the margin of error in each case, thus it cannot be concluded with certainty that approval for the program actually changed over time.

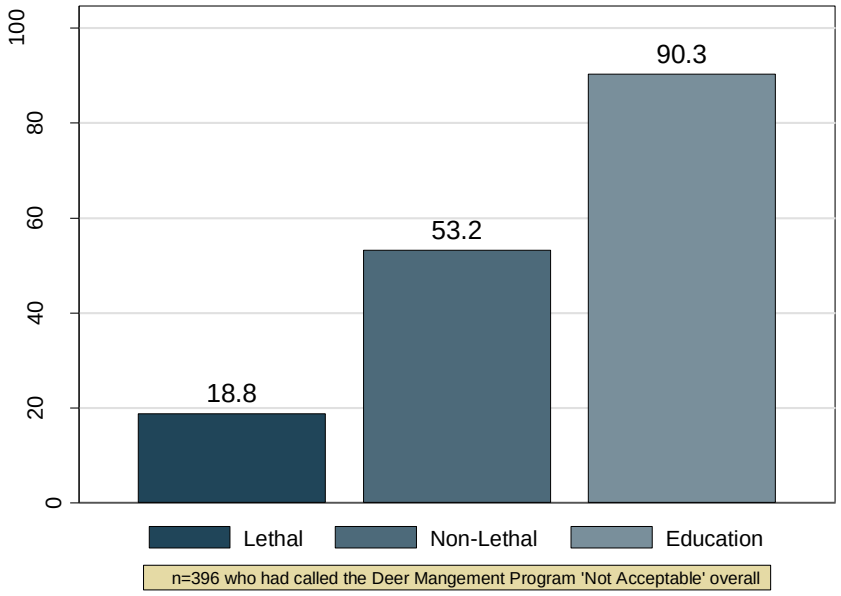
In total, 396 respondents called the City's strategy, "Not Acceptable" overall. To better understand the reasons for their disagreement with the plan, these respondents were asked the follow-up question, "*Which specific components of the City of Ann Arbor's deer management plan do you find acceptable or not acceptable?*" The questionnaire listed each of the following

components and prompted the respondent to choose either "Acceptable" or "Not Acceptable" for each component:

- Lethal methods (e.g., culling with firearms)
- Non-lethal methods (e.g., doe sterilizing)
- Education about private property options (e.g., fencing, deer resistant plants, odor repellants)

Figure 4, below, shows the level of acceptance of each particular aspect of the Deer Management Plan among those who disapproved of the plan overall and who answered the follow-up question posed to them.

Figure 4. Support for Individual Plan Components, Among Overall Disapprovers



The chart indicates that for most of those who disapproved of the plan, their attitudes toward the lethal culling component drove their overall opinion more often than the other two components. Specifically, just 19 percent of the plan's opponents found the lethal culling aspect acceptable, compared to 53 percent who approved of the non-lethal sterilization and 90 percent who approved of the educational component.

Three-fifths (61 percent) of those who said they opposed the lethal component of the plan indicated that both of the other components were acceptable to them.

To assess whether the City has achieved an acceptable level of damage to landscape and garden plants in the eyes of 75 percent acceptance of residents in each ward, the survey asked, "*Although you may have varying opinions about other specific aspects of the deer management program, would you say the amount of damage caused by deer to your landscape or garden plants on private lands over the past year was acceptable or not acceptable?*"

In addition to being able to answer "Acceptable" or "Not Acceptable," respondents were also given the option to answer, "I did not have any landscape or garden plants over this time period." Because the question did not apply to them, individuals who chose this option are excluded from the acceptance rate presented in Table 9 (below), where the results from this question are shown for each ward.

Table 9. Assessment of Amount of Deer Damage Among those with Lawns, by Ward

Ward	% "Acceptable"	95% Confidence Interval	*n*	*N/A (No Lawn)*	*Comparison (2017)*
1	72.0%	(65.9% - 77.3%)	239	102	64.5%
2	51.6%	(45.0% - 58.2%)	219	49	44.0%
3	77.4%	(71.0% - 82.7%)	199	67	84.3%
4	82.3%	(75.7% - 87.4%)	164	101	85.7%
5	83.4%	(77.1% - 88.3%)	175	90	78.5%
Overall	*72.2%*	*(69.3% - 74.9%)*	*775*	*312*	*69.8%*

Table 9 indicates some variation between wards in terms of the percentage of respondents who said the damage to their landscape was at an acceptable level, with the percentage answering "Acceptable" in Ward 5 (83 percent) being over 30 percentage points larger than the corresponding percentage in Ward 2 (52 percent). In particular:

- In Wards 4 and 5, the rate of acceptance was significantly *higher* than 75 percent (estimated at 82 percent and 83 percent, respectively).
- In Ward 3, the rate of acceptance was slightly *higher* than, but statistically *indistinguishable* from, 75 percent (estimated at 77 percent).
- In Ward 2, the rate of acceptance was significantly *lower* than 75 percent (estimated at 52 percent).
- In Ward 1, the rate of acceptance was slightly *lower* than, but statistically *indistinguishable* from, 75 percent (estimated at 72 percent).
- However, in Wards 1 and 2 the rate of acceptance was approximately eight percentage points higher in 2018 than it was in 2017, which could indicate a trend over time toward greater satisfaction with the level of deer damage. Meanwhile, in Ward 3 the rate of acceptance was seven percentage points lower in 2018 than it was in 2017, yet still exceeded the target of 75 percent acceptance overall.

In short, the City appears to have met the target level of acceptable damage to landscape and garden plants in some, but not all, wards.

To assess whether the City achieved an acceptable level of park closures (the Deer Management Program included a strategy of closing certain public parks within the city in order to allow sharpshooters to carry out the lethal culling while ensuring the safety of people who might otherwise visit the parks), the survey asked, "*In 2018, 16 out of 159 parks in the City of*

Ann Arbor were designated to be temporarily closed from January 8 through January 31 in order to carry out the deer management program. Although you may have varying opinions about other specific aspects of the deer management program, would you say the level of park closures in 2018 was acceptable or not acceptable?"

The distribution of responses to this question, along with 95 percent confidence intervals, is shown in Table 10, below.

Table 10. Assessment of Park Closure Levels, by Ward

Ward	% "Acceptable"	95% Confidence Interval	*n*	*Comparison (2017)*
1	79.4%	(74.8% - 83.4%)	340	81.9%
2	80.6%	(75.4% - 84.9%)	268	81.2%
3	79.5%	(74.1% - 83.9%)	263	80.2%
4	84.9%	(80.0% - 88.7%)	264	84.2%
5	83.1%	(78.1% - 87.1%)	266	83.2%
Overall	*81.4%*	*(79.3% - 83.3%)*	*1,401*	*82.1%*

The table indicates generally wide approval of the level of park closures, with over 79 percent of respondents in each ward calling it "Acceptable." In three out of the five wards (Wards 2, 4, and 5), this estimate is significantly *greater* than 75 percent acceptance, while Wards 1 and 3 are both borderline cases but statistically indistinguishable from having 75 percent acceptance at the $p < .05$ confidence level.

Combining all five wards, the city-wide acceptance rate of the park closure levels is estimated at 81 percent, and this is significantly greater than 75 percent at the $p < .05$ confidence level.

APPENDIX A. SAMPLING STATISTICS

Table A-1, below, summarizes the ineligibility and completion rates for both the initial and supplemental samples, for each ward and also for the city overall. The overall completion rate for the survey, after excluding ineligibles, was 14.3%.

Table A-1. Eligibility and Completion Rates from Sample, by Ward

WARD	Initial Sample					
	N	Sampled	Ineligible	% Ineligible	Completed	C-RATE
1	10,191	2,320	131	5.6%	344	15.7%
2	9,020	1,674	102	6.1%	269	17.1%
3	9,555	2,190	88	4.0%	267	12.7%
4	10,505	2,368	119	5.0%	269	12.0%
5	11,577	1,859	79	4.2%	268	15.1%
TOTAL	50,848	10,411	519	5.0%	1,417	14.3%

APPENDIX B. ANALYSIS OF RESPONDENT CHARACTERISTICS

As shown in Table 1, the major demographic groups which are "underrepresented" in the survey sample by more than 5 percentage points (compared to the U.S. Census data) include:

- Non-whites
- Less formal education
- Lower income households
- Renters / apartment dwellers
- Students
- Young people

Section I notes that these groups are less likely to be registered voters and participate in the political process. However, it is also important to consider whether these groups are strongly correlated with the major variables of interest. If a group is underrepresented, and membership in that group is highly related to the major variables of interest, then the estimates on those variables of interest could be biased.

Table A-2, below, shows the bivariate correlation coefficient between each of the demographic variables listed above and the three major "measures of success" that are evaluated in the body of this report.

Table A-2. Bivariate Correlations between Demographics and "Measures of Success"

	DV: Accept Plan	DV: Accept Park Closures	DV: Accept Damage Level
Variable	**Corr.**	**Corr.**	**Corr.**
Non-white	-.07	-.03	.04
Education	.02	.02	-.06
Income	.04	.04	-.08
Renter	.02	-.01	NA
Student	.09	.06	.08
Age	-.07	-.03	-.27

Education, Income, and Age are coded such that higher values correspond to more formal education, higher household income, and older ages. Therefore, the underrepresented groups are those corresponding to lower values on these variables.

Table A-2 shows that these demographic variables are, for the most part, very weakly correlated with the major variables of interest – in particular, the absolute value of the correlation coefficient only exceeds .09 in one instance, which was related to acceptance of the level of damage to one's landscape or garden plants. This correlation was still quite weak overall (absolute value of .27), but indicates that on average, respondents who are younger in age were more likely to call the level of damage "acceptable." Since these groups were less represented

than those who are older, if anything the results of the report may *underestimate* the level of success on this particular metric.

Table A-3 shows the bivariate correlation coefficient between each of the demographic variables and two variables related to respondents' attentiveness or interest in the deer management issue: (1) their self-assessed level of awareness of the Deer Management Program, and (2) whether or not they reported having "No Particular Feelings" toward the deer population.

Table A-3. Bivariate Correlations between Demographics and Attentiveness

	DV: Awareness	DV: "No Particular Feelings"
Variable	**Corr.**	**Corr.**
Non-white	-.14	.09
Education	.07	.01
Income	.21	-.12
Renter	-.34	.22
Student	-.30	.22
Age	.38	-.31

Education, Income, and Age are coded such that higher values correspond to more formal education, higher household income, and older ages. Therefore, the underrepresented groups are those corresponding to lower values on these variables.

Table A-3 shows that, on average, each of the underrepresented groups rated themselves as less aware of the Deer Management Program overall, and was more likely to report having "No Particular Feelings" toward the deer population, compared to groups that were more represented. Therefore, the survey results reflect the views of those who knew and cared most about the topic.