



City of Ann Arbor Deer Management Program Evaluation

Conducted on Behalf of

The City of Ann Arbor

By

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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 2017 by the Michigan State University Office for Survey Research in order to assess the City of Ann Arbor's Deer Management Program.

This program evaluation was conducted by sending mail invitations to 8,575 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 or a smartphone QR code, and included a unique passcode in order to help ensure that data was collected only from randomly sampled invitees. A total of 1,102 voters completed the survey, with at least 200 coming from each of the city's 5 wards.

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 19 percent who answered "Mostly negative" and 33 percent who answered, "Both positive and negative."
 - Between 33 and 61 percent of 3+ year residents in each ward estimated that the deer population in their neighborhood had increased over the previous 3 years, while 28 to 34 percent said it had stayed the same. Fewer than 23 percent in each ward, and fewer than 9 percent overall city-wide, estimated that it had decreased.
 - Nearly half (41 to 46 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 fewer than one-fourth (24 percent or less) said any of these were "not at all a problem."
 - About half (48 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 18 to 26 percent calling each a "serious problem."
 - The most deer damage prevention measures home owners most commonly reported having used were odor or taste repellants (197 respondents) and deer-repellant plants (177 respondents), while the measures rated as most effective by those who used them were fencing (32 percent).
- *Deer Management Program*
 - Respondents reported a generally high level of awareness about the Deer Management Program. Between 42 and 61 percent of respondents in each ward said they considered themselves "Very Aware" while another 39 to 49 percent rated themselves as "Somewhat Aware."

- Two (2) 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.
- Among those who disapproved of the plan overall, the lethal culling component was by far the least supported aspect. Just 16 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.
- All five (5) wards exceeded the target of 75 percent of surveyed respondents reporting that the level of park closures was acceptable, and four (4) of these wards were significantly higher than 75 percent.

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Purpose of Study

The purpose of this survey was to help the City of Ann Arbor evaluate its 2017 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.

Methodology

To achieve the initial research goal of completing 385-400 surveys from household in each of the five wards, a random sample of 1,450 registered voters was drawn from each of the five wards and then randomly divided into three replicates. The sample size of 1,450 was based on the following assumptions: 95 percent of the addresses selected would be valid Ann Arbor addresses, 95 percent of the addresses would have an adult registered voter residing in the household, and a 30 percent completion rate among randomly selected households.

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, a QR code, 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, QR code and passcode unique to the household.

This process began on March 16, 2017 and concluded for the initial sample on May 4, 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 falling short of the original projection. After a preliminary of the data which had been collected, OSR concluded that it would be possible to achieve a margin of error close to the original goal of +/- 5 percent in each ward even with a smaller sample size than previously expected, and that even a massive increase in the final sample size (which would be prohibitively costly) would be unlikely to change the conclusions of the analysis¹.

¹ The rationale for this conclusion was based on the observed distribution of responses to the major questions of interest (i.e., the "measures of success" outlined in Section IV of this report) being closer to a 75 percent – 25 percent split than a 50 percent – 50 percent split. When observed responses are split approximately *evenly* between the available answer choices (e.g., 50 – 50), the margin of error on each proportion is *larger* – that is, the precision of the estimate is *worse* -- than when the observed responses are more one-sided, as they were in this case. In addition, the observed results came so close to the targets set in advance by the City that it would have been very costly to achieve a sample size large enough that a test of statistical significance could distinguish the observed result from the targeted goals, except in instances where they could already do so even with much smaller sample sizes.

Upon the recommendation of the OSR, and with approval from the City, the research goal was therefore revised to 200 completed surveys from each ward, which necessitated drawing a supplemental sample due to the response rate being lower than expected.

This supplemental sample of residents was drawn in Wards 1, 2, and 4 with the goal of reaching at least 200 completed responses from each of the wards. Data collection for this supplemental sample began on May 18, 2017 and concluded on June 6, 2017.

A total of 1,102 households responded to the survey, which represents about 2 percent of the 50,235 households with registered voters provided to OSR by the City of Ann Arbor and 13 percent of the 8,575 households who were randomly sampled to participate. The final number of completed surveys was distributed amongst the city's five wards as follows:

- 202 from Ward 1
- 239 from Ward 2
- 219 from Ward 3
- 210 from Ward 4
- 232 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 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		1,102	50,235 ^b
Sex	% Male	44.4%	49.8%
	% Female	55.1%	50.2%
	% Another identity	0.6%	-
Race	% White alone	89.1%	72.3%
	% Black alone	1.6%	7.4%
	% Asian alone	4.4%	15.5%
	% Another race alone	2.6%	1.0%
	% Two or more races	2.3%	3.8%
Origin	% Hispanic or Latino origin	1.2%	4.1%
Education	% Less than high school graduate	0.0%	3.2%
	% High school graduate / GED	7.9%	42.5%
	% Bachelor's degree	28.2%	26.8%
	% Master's degree or higher	63.9%	27.5%
Household Income	% Less than \$20,000	4.2%	20.1%
	% \$20,000 to \$34,999	5.8%	13.8%
	% \$35,000 to \$49,999	8.9%	11.7%
	% \$50,000 to \$74,999	17.8%	15.7%
	% \$75,000 to \$99,999	14.7%	10.8%
	% \$100,000 or more	48.7%	28.0%
Home Ownership	% Owner occupied	77.1%	44.8%
	% Renter occupied	21.3%	55.2%
	% Other	1.7%	-
School Enrollment	% Student	6.3%	40.8%
Housing Unit	% Single-family home (detached)	66.2%	43.0%
Age	% 18 to 29	12.3%	46.6%
	% 30 to 39	14.5%	14.5%
	% 40 to 49	11.8%	10.1%
	% 50 to 59	20.4%	11.1%
	% 60 to 69	24.8%	9.3%
	% 70 or older	16.2%	8.4%

^a Unless otherwise noted, population figures were pulled from: United States Census Bureau / American FactFinder. 2011 – 2015 American Community Survey 5-Year Estimates. U.S. Census Bureau's American Community Survey Office, 2015. Web. May 2017 <<http://factfinder.census.gov>>.

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

The table indicates that the final sample includes:

- A *slightly greater* proportion of females (55 percent) as in the city adult population (50 percent);
- A *greater* proportion of individuals who identify their race as white alone (89 percent) than in the city adult population (72 percent);
- Individuals with *more* formal education (64 percent with a Master's or higher and 8 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 (49 percent with \$100,000 or more), on average, compared to the city adult population (28 percent with \$100,000 or more);
- A *greater* proportion of home owners (77 percent) than in the city adult population (45 percent);
- A *lower* proportion of students (6 percent) than in the city adult population (41 percent);
- A *greater* proportion of individuals living in single-family detached homes (66 percent) than in the city adult population (43 percent); and
- Individuals who are *younger* (12 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^{2,3}.
- 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 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.

² 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>

³ 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/>

- 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.

Table 2. Feelings toward Deer Population, by Ward

Ward	n	% “Mostly Positive”	% “Mostly Negative”	% “Both Positive and Negative”	% “No Particular Feelings”
1	202	35.2%	16.8%	27.6%	19.3%
2	239	22.6%	33.9%	33.9%	9.0%
3	218	35.3%	12.8%	31.3%	19.0%
4	209	28.2%	11.0%	30.9%	32.7%
5	232	22.8%	18.1%	34.1%	25.0%
Overall	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 36 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 35 percent apiece answering, “Mostly positive.”
- The ward expressing the *least favorable* attitudes toward the deer population, on average, was Ward 2, with less than 23 percent answering “Mostly positive” and 34 percent answering “Mostly negative.”
- City-wide, the *most common* answer was “Both positive and negative,” with nearly a third (32 percent) of all respondents selecting this option. The *second most common* answer was “Mostly positive,” with 29 percent.

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 specific 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	143	32.9%	22.4%	31.5%	13.3%
2	192	60.9%	6.8%	25.5%	6.8%
3	169	40.2%	5.3%	35.5%	18.9%
4	148	29.7%	5.4%	46.6%	18.2%
5	178	30.9%	6.2%	43.8%	19.1%
Overall	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 three out of five wards (i.e., Wards 1, 2, and 3), the most common response was, “It has increased” and the second most common response was, “It has stayed the same.”
- Over half (61 percent) of respondents in Ward 2 reported that the deer population has increased over the past three years, while another 26 percent said it had stayed the same.
- In Wards 4 and 5, a plurality (47 and 44 percent, respectively) of respondents said the deer population has stayed the same, and another three-tenths (30 and 31 percent, respectively) said it has stayed the same.
- Respondents in Ward 1 were by far the most likely to report that the deer population has decreased over the last three years, with over 22 percent of respondents giving that response. Fewer than 7 percent of respondents in any other ward reported this. However, note that even in Ward 1 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 stayed the same,” with 36 percent.

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 problem⁴ to the one *least commonly* perceived as a problem.

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

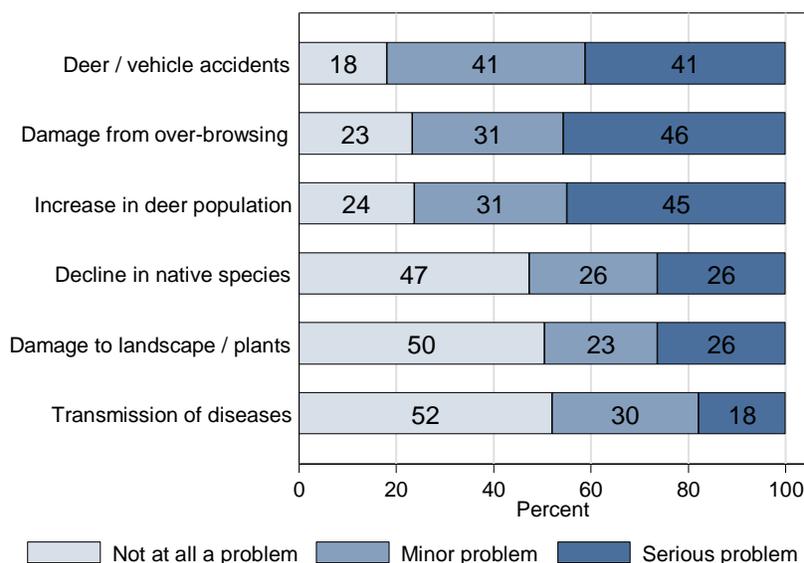


Figure 1 shows that respondents' perceptions differed widely from one issue to the next, suggesting that some issues were frequently seen as more serious problems than others. In particular:

- Most respondents (82 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 77 and 76 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.

⁴ Measured as $(1 - p)$, where p is the proportion of respondents who answered, “Not at all a problem.”

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

Issues	Wards					Total
	1	2	3	4	5	
Deer / vehicle accidents	2.25	2.35	2.16	2.11	2.21	2.22
Damage from over-browsing	2.16	2.38	2.12	1.98	2.28	2.19
Increase in deer population	2.09	2.37	2.07	2.05	2.24	2.17
Decline in animal species	1.85	1.83	1.74	1.65	1.88	1.79
Damage to landscape and plants	1.81	2.22	1.50	1.37	1.56	1.70
Transmission of diseases	1.63	1.73	1.62	1.50	1.73	1.65
<i>Average</i>	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 2.19 out of 3), while respondents from Ward 4 perceived them as the least severe problems (mean score of 1.77 out of 3).
- The mean score across all issues and all wards was 1.97, which means, approximately, the average respondent perceived the average deer-related issue on the list as a minor problem.

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 odor or taste repellants, as 197 respondents (24 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 2.05 (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 62 respondents had used them, and of those who did use it, over two-thirds (71 percent) said it was “Not effective” in preventing deer damage.

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

Measures	<i>n</i>	Not effective	Somewhat effective	Highly effective	Declined to assess	Mean ^a score
Fencing	133	27.1%	37.6%	32.3%	3.0%	2.05
Deer-resistant plants	177	29.4%	53.1%	13.0%	4.5%	1.83
Other (Chase by human / dog)	9	55.6%	22.2%	22.2%	0.0%	1.67
Repellants	197	44.7%	40.1%	8.1%	7.1%	1.61
Frightening devices	62	71.0%	21.0%	6.5%	1.6%	1.34
Other (Assorted)	11	0.0%	54.6%	9.1%	36.4%	2.14
No measures taken	536	-	-	-	-	-

^a Means are calculated using a three-point scale where 1 = “Not effective” and 3 = “Highly effective.”

The 536 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

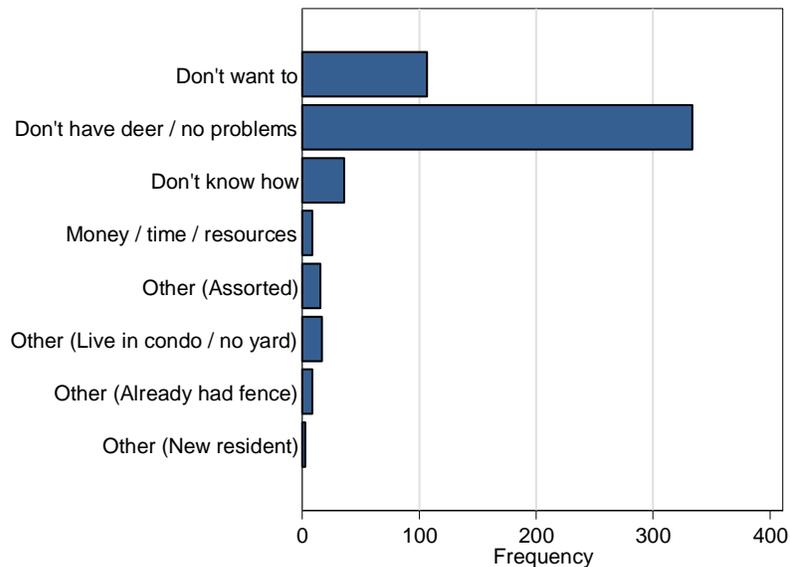


Figure 2 indicates that:

- 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).

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

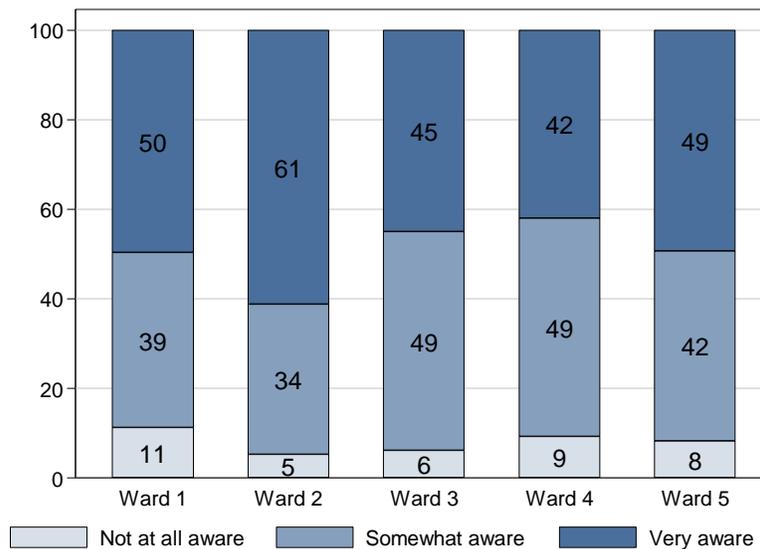


Figure 2 indicates that respondents generally see themselves as well informed about the deer management program. In particular:

- 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 (42 percent or more) of respondents in each ward said they are “Very aware” of the Deer Management Program, and at least one-third (34 percent or more) in each ward said they are “Somewhat aware.”
- Overall, combining all five wards, about half (50 percent) of all respondents chose “Very aware,” 42 percent chose “Somewhat aware,” and just 8 percent chose “Not at all 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 goals⁵:

- 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 6, 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 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 target population to find the plan acceptable but to draw a sample in which more than 75 percent approve, simply by chance (or vice versa)⁶.

⁵ <http://www.a2gov.org/departments/community-services/Pages/Deer-Management-Project.aspx>

⁶ The purpose of a survey is to estimate the characteristics (such as level of support) of a target population by collecting data from a smaller subset of that population, called a sample. Drawing that sample at random is an unbiased technique that has been shown scientifically to provide estimates very close to the “true” level of support in the population the vast majority of the time. However, because the sample is random and does not contain all members of the population, the statistics calculated on the sample are generally a little above or a little below the “true” value that would be observed if data could be collected from everyone in the population. The confidence interval accounts for this uncertainty by estimating a range of values within which the “true” percentage is very likely to fall.

Table 6. Assessment of Deer Management Program Overall, by Ward

Ward	% “Acceptable”	95% Confidence Interval	n
1	72.4%	(66.1% - 78.6%)	199
2	72.5%	(66.8% - 78.2%)	236
3	65.6%	(59.2% - 72.0%)	215
4	77.1%	(71.3% - 82.8%)	205
5	79.0%	(73.8% - 84.3%)	229
Overall	73.3%	(70.7% - 76.0%)	1084

Table 6 shows that:

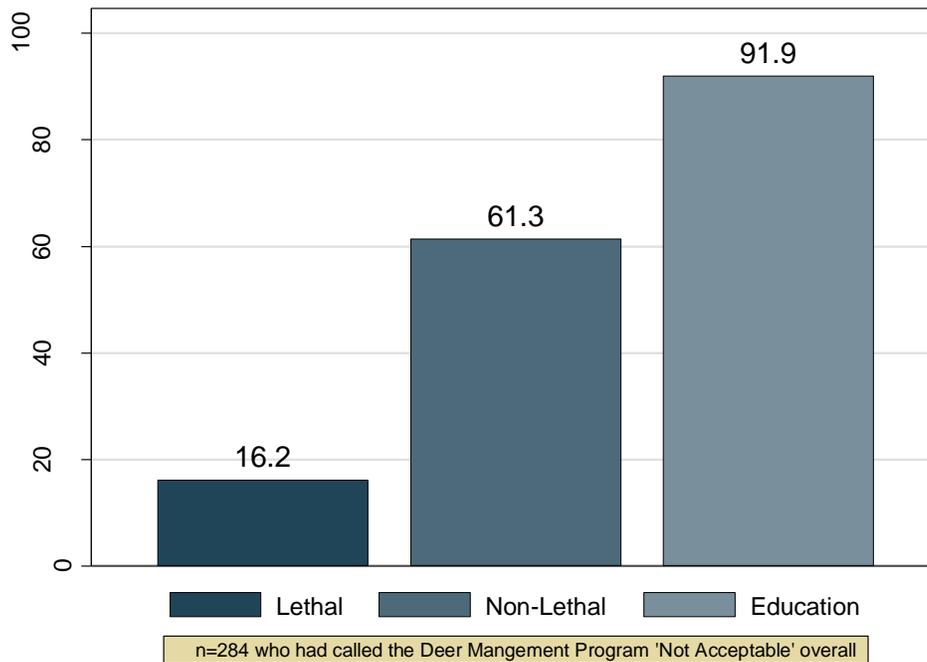
- In Wards 4 and 5, slightly *more* than 75 percent (specifically 77 and 79 percent, respectively) of surveyed residents responded that the City’s strategy of managing the deer population was acceptable. Taking the margin of error into account, these estimates are statistically indistinguishable from the target of 75% acceptance.
- In Wards 1 and 2, slightly *fewer* than 75 percent (specifically 72 and 73 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 66 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 5 wards in the city, about 73 percent of surveyed respondents said the plan was acceptable. This observed result is not statistically different from 75 percent acceptance.

In total, 289 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 16 percent of the plan’s opponents found the lethal culling aspect acceptable, compared to 61 percent who approved of the non-lethal sterilization and 92 percent who approved of the educational component.

Over two-thirds (69 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 7 (below), where the results from this question are shown for each ward.

Table 7. Assessment of Amount of Deer Damage Among those with Lawns, by Ward

Ward	% “Acceptable”	95% Confidence Interval	n	N/A (No Lawn)
1	64.5%	(56.6% - 72.5%)	141	59
2	44.0%	(36.9% - 51.0%)	191	44
3	84.3%	(78.6% - 90.0%)	159	58
4	85.7%	(79.6% - 91.9%)	126	80
5	78.5%	(72.0% - 84.9%)	158	71
<i>Overall</i>	<i>69.8%</i>	<i>(66.6% - 73.0%)</i>	<i>775</i>	<i>312</i>

Table 8 indicates wide 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 4 (85 percent) being almost two times larger than the corresponding percentage in Ward 2 (44 percent). In particular:

- In Wards 1 and 2, the rate of acceptance was significantly *lower* than 75 percent (estimated at 65 percent and 44 percent, respectively).
- In Wards 3 and 4, the rate of acceptance was significantly *higher* than 75 percent (estimated at 84 percent and 86 percent, respectively).
- In Ward 5, the rate of acceptance was slightly *higher* than, but statistically *indistinguishable* from, 75 percent (estimated at 79 percent).

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 2017, 11 out of 159 parks in the City of Ann Arbor were designated to be temporarily closed for a period of two weeks 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 2017 was acceptable or not acceptable?*”

The distribution of responses to this question, along with 95 percent confidence intervals, is shown in Table 8, below.

Table 8. Assessment of Park Closure Levels, by Ward

Ward	% “Acceptable”	95% Confidence Interval	n
1	81.9%	(76.5% - 87.3%)	199
2	81.2%	(76.2% - 86.2%)	234
3	80.2%	(74.9% - 85.5%)	217
4	84.2%	(79.2% - 89.3%)	203
5	83.2%	(78.3% - 88.1%)	226
<i>Overall</i>	<i>82.1%</i>	<i>(79.8% - 84.4%)</i>	<i>1079</i>

The Table indicates generally wide approval of the level of park closures, with over 80 percent of respondents in each ward calling it “Acceptable.” In four out of the five wards (i.e., all but Ward 3), this estimate is significantly *greater* than 75 percent acceptance, while Ward 3 is a borderline case 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 82 percent, and this is significantly greater than 75 percent at the $p < .05$ confidence level.

APPENDIX A. SAMPLING STATISTICS

Table 7, 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 ineligible, was 14.4%.

Table 7. Ineligibility and Completion Rates, by Ward

WARD	Initial Sample						Supplemental Sample					Overall	
	N	Sampled	Ineligible	% Ineligible	Completed	C-RATE	N	Completed	Ineligible	% Ineligible	C-RATE	Completed	C-RATE
1	10,114	1,450	223	15.4%	148	12.1%	600	55	12	2.0%	9.4%	202	11.2%
2	9,155	1,450	371	25.6%	239	22.2%						239	22.2%
3	9,667	1,450	94	6.5%	188	13.9%	375	31	11	2.9%	8.5%	219	12.7%
4	10,662	1,450	171	11.8%	169	13.2%	350	42	4	1.1%	12.1%	210	13.0%
5	11,193	1,450	52	3.6%	231	16.5%						232	16.5%
TOTAL	50,791	7,250	911	12.6%	975	15.4%	1,325	128	27	2.0%	9.9%	1,102	14.4%

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, in order to assess data quality it is also important to consider whether these groups are 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 8, 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 8. 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	.00	.01	.03
Education	.02	.06	-.10
Income	.05	.05	-.15
Renter	.06	.02	NA
Student	.09	.06	.01
Age	-.07	.03	-.20

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 8 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 three instances, which are all related to acceptance of the level of damage to one’s landscape or garden plants. Although these correlations are still quite weak overall (absolute value of .20 or below), they indicate that on average, respondents with less formal education, lower household incomes, or who are younger in age were more likely to call the level of damage “acceptable.” Since these groups were less represented than those with more education, higher incomes, and those who are older, if anything the results of the report may *underestimate* the level of success on this particular metric.

Table 9 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 9. Bivariate Correlations Between Demographics and Attentiveness

Variable	DV: Awareness	DV: "No Particular Feelings"
	Corr.	Corr.
Non-white	-.14	.09
Education	.07	-.07
Income	.20	-.12
Renter	-.33	.19
Student	-.28	.18
Age	.40	-.23

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 9 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.

APPENDIX C. SURVEY INSTRUMENT

Ann Arbor Deer Management

Q1 In November 2016, Ann Arbor City Council approved the city's 2017 Deer Management Program, which has four primary components:

- Data collection - collecting a variety of information that helps inform future deer management efforts and surveying residents on their views on certain aspects of the plan.
- Sterilization (non-lethal) Plan - pneumatically darting deer in two areas, temporarily removing and surgically sterilizing deer and returning deer to area where they were found.
- Lethal Plan - sharpshooting and lethally removing up to 100 deer on public lands and a small number of large city-selected large private parcels with appropriate consent
- Educational Program and Public Rights-of-Way Improvements - providing educational materials to the community in late spring 2017 on how to live with deer, evaluating the city's fencing ordinance, and recommending improvements that can be made in the city's rights-of-way, such as signage.

The purpose of this survey is to evaluate residents' attitudes towards deer in the City of Ann Arbor as well as their awareness of and opinions toward the city's 2017 Deer Management Program.

Q2 Michigan State University requires us to provide you with the following information. Completing this confidential survey is, of course, up to you. You may decline to participate, decline to answer certain questions, or discontinue filling out the survey at any time. The Office for Survey Research at Michigan State University, who is conducting this survey on behalf of the City of Ann Arbor, will protect your privacy to the maximum extent allowable by local, state, and federal law. All reporting of the results will be in the aggregate and no individuals participating will be identified.

The survey should take about 10 minutes to complete. It may take more or less time depending on your responses and the level of detail you wish to provide. If you have any questions about this research, please contact the Project Manager at the Office for Survey Research, Dan Thaler, by email at thalerd1@msu.edu. By selecting yes below and then proceeding with the survey, you indicate your voluntary consent to participate in this survey and have your responses included in the data.

- Yes, I consent to participate (1)
- No, I do not consent (2)

Q3 Generally, which of the following best describes your feelings toward the deer population in the City of Ann Arbor?

- Mostly positive (1)
- Mostly negative (2)
- Both positive and negative (3)
- I have no particular feelings about the deer population in Ann Arbor (4)

Q4 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? (If you have lived in your neighborhood for less than three years, answer for the time period during which you have lived in your current neighborhood.)

- It has increased (1)
- It has decreased (2)
- It has stayed the same (3)
- Unsure (4)

Q5 In general, how would you rate your current level of awareness about the City of Ann Arbor's 2017 Deer Management Program?

- Very aware (3)
- Somewhat aware (2)
- Not at all aware (1)

Q6 In 2015, the Ann Arbor City Council approved the establishment of a four-year deer management program. In 2017, the program included lethal and nonlethal deer management methods, which were conducted by a contractor via a Michigan Department of Natural Resources special research permit. Nonlethal deer sterilization activities took place in select neighborhoods in Wards 1 and 2 where lethal removal of deer could not occur, but darting and surgical sterilization of deer could take place. Fifty-four deer were sterilized. Separately, sharpshooters lethally removed 96 deer in designated City of Ann Arbor parks and natural areas, two University of Michigan properties and in Nichols Arboretum after the sterilization program was completed.

More information about the city's deer management program is available at www.a2gov.org/deermanagement.

Q7 To what extent, if at all, do you believe each of following issues related to deer has been a problem over the past three years? (If you have lived in your neighborhood for less than three years, answer for the time period during which you have lived in your current neighborhood.)

	Not at all a Problem (1)	Minor Problem (2)	Serious Problem (3)	Unsure (4)
Increase in deer population (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Deer / vehicle accidents (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Damage to your landscape and garden plants (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Transmission of diseases to humans or animals (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Damage to park and natural area ecosystems by over-browsing of native foliage plants (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Decline in native animal species (songbirds, butterflies, etc.) (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q8 Have you used any of the following measures to prevent deer damage in the last three years? (Check all that apply.)

- Fencing (1)
- Odor or taste repellents (2)
- Frightening devices (e.g., lights or noises) (3)
- Deer-resistant plants (4)
- Other (please specify) (5) _____
- I have not taken measures to prevent damage (6)

Display This Question:

If "Have you used any of the following measures to prevent deer damage in the last three years? (Check all that apply.) I have not taken measures to prevent damage" Is Selected

Q9 You indicated that you have not taken measures to prevent deer damage. Which (if any) of the following best describes why you did not take such measures?

- I don't want to (1)
- I don't have the money and/or resources to (4)
- I don't know how, or am unsure about what measures I could be taking (3)
- I don't have deer (2)
- Other (please specify) (5) _____

Display This Question:

If “Have you used any of the following measures to prevent deer damage in the last three years? (Check all that apply.) Fencing” Is Selected

Or “Have you used any of the following measures to prevent deer damage in the last three years? (Check all that apply.) Odor or taste repellents” Is Selected

Or “Have you used any of the following measures to prevent deer damage in the last three years? (Check all that apply.) Frightening devices (e.g., lights or noises)” Is Selected

Or “Have you used any of the following measures to prevent deer damage in the last three years? (Check all that apply.) Deer-resistant plants” Is Selected

Or “Have you used any of the following measures to prevent deer damage in the last three years? (Check all that apply.) Other (please specify)” Is Selected

Q10 How effective has your use of the following measures been in preventing deer damage in the last three years?

	Highly Effective (1)	Somewhat Effective (2)	Not Effective (3)	Unsure (4)
If “Have you used any of the following measures to prevent deer damage in the last three years?Check... Fencing” Is Selected Fencing (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If “Have you used any of the following measures to prevent deer damage in the last three years?Check... Odor or taste repellents” Is Selected Odor or taste repellents (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If “Have you used any of the following measures to prevent deer damage in the last three years?Check... Frightening devices (e.g., lights or noises)” Is Selected Frightening devices (e.g., lights or noises) (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If “Have you used any of the following measures to prevent deer damage in the last three years?Check... Deer-resistant plants” Is Selected Deer-resistant plants (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If “Have you used any of the following measures to prevent deer damage in the last three years?Check... Other (please specify)” Is Selected Other ({\$q://QID11/ChoiceTextEntryValue/5}) (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q11 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?

- Acceptable (1)
- Not acceptable (2)

Display This Question:
 If "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 ... Not acceptable" Is Selected

Q12 Which specific components of the City of Ann Arbor's deer management plan do you find acceptable or not acceptable?

	Acceptable (1)	Not acceptable (2)
Lethal methods (e.g., culling with firearms) (1)	<input type="radio"/>	<input type="radio"/>
Non-lethal methods (e.g., doe sterilizing) (2)	<input type="radio"/>	<input type="radio"/>
Education about private property options (e.g., fencing, deer-resistant plants, odor repellents) (3)	<input type="radio"/>	<input type="radio"/>

Q13 In 2017, 11 out of 159 parks in the City of Ann Arbor were designated to be temporarily closed for a period of two weeks 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 2017 was acceptable or not acceptable?

- Acceptable (1)
- Not acceptable (2)

Q14 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? (If you have lived in Ann Arbor for less than one year, answer for the time period during which you have lived in Ann Arbor.)

- Acceptable (1)
- Not acceptable (2)
- I did not have any landscape or garden plants over this time period (3)

Q15 Please use the space below to share any suggestions or comments you have about the City of Ann Arbor's deer management program.

Q16 The following demographic questions will be used only to ensure that the sample of survey respondents is representative of the population of the City of Ann Arbor, and not for any other purpose. You may skip any question you do not wish to answer. What is your age?

- 18-29 (1)
- 30-39 (2)
- 40-49 (3)
- 50-59 (4)
- 60-69 (5)
- 70+ (6)

Q17 How long have you lived:

	Less Than 1 Year (1)	1 to 2 Years (2)	3 Years or More (3)
In the City of Ann Arbor? (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
At your current address? (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q18 What type of residence do you live in?

- Apartment (1)
- Single-family home (2)
- Mobile home (3)
- Condo/townhouse/duplex (4)
- Other (please specify) (5) _____

Q19 Does your family rent or own your residence?

- Rent (1)
- Own (2)
- Other (please specify) (4) _____

Q20 What is the highest level of education you have obtained?

- Less than high school degree or GED (1)
- High school or GED (2)
- Associate's or other 2-year degree (3)
- Bachelor's degree (4)
- Master's degree or higher (5)

Q21 Is your annual household income from all sources ...

- Less than \$20,000 (1)
- \$20,000 to \$34,999 (2)
- \$35,000 to \$49,999 (3)
- \$50,000 to \$74,999 (4)
- \$75,000 to \$99,999 (5)
- \$100,000 or more (6)

Q22 What is your sex?

- Male (1)
- Female (2)
- Another identity not listed (please specify if you wish): (3) _____

Q23 Which one or more of the following would you say is your race / ethnicity? (Please check all that apply)

- White (1)
- Hispanic, Latino/Latina, or Spanish origin (8)
- Black or African American (2)
- Asian (3)
- American Indian or Alaska Native (4)
- Native Hawaiian or Pacific Islander (5)
- Other (please specify) (6) _____
- Unsure (7)

Q24 Are you currently ...

- Employed for wages (1)
- Self-employed (2)
- Out of work (3)
- A Homemaker (4)
- A Student (8)
- Retired (5)
- Unable to work (7)