# Marion County Lake and Park User Survey Analysis

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Table of Contents

## Introduction

Marion County Lake and Park was an idea by many sportsmen that were a part of the Civilian Conservation Corps in 1933-34 and was finally finished and established in 1937. The Park includes roughly 300 acres of land and 153 acres of water with about 40 feet of depth. Marion County Lake and Park is located in the heart of the Flint Hills of Kansas. This is a great location for families, residents, visitors, and just the casual recreationalist. However, Marion County receives many different stressors from the surrounding community and visitors that our team decided to take a multidisciplinary approach to analyze some of the aspects of Marion County Lake that would benefit the park and its park managers of the area. The team wanted to focus on how Marion County Lake impacts all aspects of life around the area such as the ecological impact, anthropogenic impacts, nutrient pollution, social effects, etc. Some of our biggest ecological and anthropogenic concerns relate to water quality, shoreline vegetation, herbicides and pesticides, and local development. All these aspects also have a major effect on residents' and visitors' lives socially and economically. Based on the data collected from a previous team of NRES students, our team was able to analyze various visitors' and residents' opinions, expectations, and thoughts on the surrounding area. From the collected data, our team can also find a correlation between what activities might be affecting the environment around Marion County Lake.

## Background/Literature Review

Each group member prepared a literature review over a certain aspect of the total project concerning Marion County Lake and Park. Aspects considered were park survey & feedback, spatial analysis, interpretive signage, algal blooms and people's perceptions, and residential development. Key findings from the five literature reviews will be highlighted and categorized into one of these subheadings: *Ecological, Anthropogenic Impacts, Eutrophication and Nutrient Pollution, Social, Interpretive Signage, Landowners,* and *Economic*.

### *Ecological*

Ecosystem services are any human benefit gained or felt from the natural environment. The services are further classified into four categories: provisioning, regulating, supporting, and cultural. Provisional services are ones simply gained from the existence of nature, so for lake bodies this would include services such as drinking water, waterfowl, fisheries, recreation, and tourism. In the category of regulating and supporting services, there is nutrient and sediment processing and hydrologic regulation, which is flood control and water retention. Cultural services can often be less obvious as they are non-material benefits. This category of services strengthens the human knowledge base, and amplifies different experiences felt in nature. The population of fish is a good indicator of the health of a lake since they are the top predator in the system. Macroinvertebrates feed off aquatic vegetation as well as use it for their shelter (Schindler & Scheuerell, 2002). Macroinvertebrates can be used as an easy way to make a fair conclusion about the water quality (STREAM, 2020).

*Anthropogenic Impacts*

Water quality degrades over time as anthropogenic developments become commonplace and intensified. Human activities alter water quality by changing hydrologic pathways, adding pesticides, herbicides, and fertilizers, and leaching water from landfills, mine tailings, and irrigated farmlands into groundwater or surface water (Peters & Meybeck, 2009). When looking at anthropogenic impacts, the littoral zone and benthic zone within the lake ecosystem are considered. The littoral zone is near the shoreline and is characterized by ample vegetation. The littoral zone contains the most interaction with human development since that is where docks, retaining walls, and other structures are built. The benthic zone is the lake bottom and composed mainly of sediments and woody debris. The benthic zone collects everything that falls into the lake over time due to the force of gravity. Aquatic vegetation and coarse woody structures (CWS) both decreased in density as shoreline development became more intense. Macroinvertebrate biomass decreases with the increase of shoreline development due mainly to the destruction of CWS and aquatic vegetation (Brauns et al 2011). Additionally, the index of biotic integrity (IBI) of nearshore fish and fish throughout the lake were compared with shoreline development to produce the graphs in Figure 1 (Dustin & Vondracek 2017). Lakes that had residential development had negative growth rates for the two species (i.e., Largemouth Bass and Bluegill Sunfish). Bluegill sunfish, suffered more with 2.6 times lower growth rates and 2.3 times less productivity in heavily developed lakes (Schindler, Gieb, & Williams, 2000).

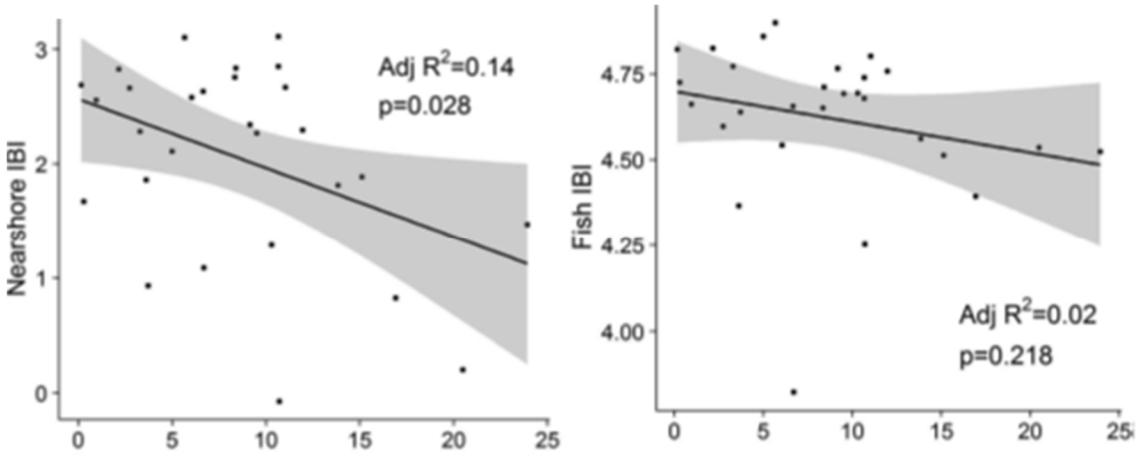


Figure 1: (Left) Nearshore Fish IBI vs. Shoreline Development. (Right) Fish Throughout the Lake vs. Shoreline Development (Dustin & Vondracek, 2017)

*Eutrophication and Nutrient Pollution*

Algae is caused by an excess of nitrogen and phosphorus in a body of water. Blue-green algae, also called cyanobacteria, is very common in lakes across the world. Cyanobacteria produces a toxin called cyanotoxin that can cause serious harm or death to humans or animals that encounter it. Researchers concluded that based off blood tests, healthy people "will not have adverse acute effects from periodic exposures to MC in aerosols generated by water-based recreational activities in lakes with patches of toxin-producing blooms" (Backer et al., 2009). Anatoxin-a, a specific cyanotoxin, can penetrate through all three barriers of the skin showing that ingestion is not the only way cyanotoxins can harm humans. Algal blooms overtake bodies of water depleting the oxygen concentration which can cause mass fish deaths. Animals can become ill or die from drinking the water contaminated with cyanotoxins or eating prey that live in the contaminated water. Animals will also not lay their eggs in the water since their young will have a lower chance of survival in the presence of cyanotoxins (Trevino-Garrison et al., 2015).

*Social*

Lake Erie experienced a 10-13% decrease in fishing license purchases when harmful algal bloom conditions surpass the World Health Organization's moderate risk advisory (Wolf et al., 2017). In the year 2011, Lake Erie experienced a large harmful algal bloom which exceeded the moderate risk advisory. That year is shown in Figure 2 broken down by month as well as a comparison to the three years following that event. One study showed that 77.8% of respondents believed that access to clean water was important. 74.3% of respondents also believed that water quality is impacted by human activities. However, only 31% of respondents thought that water quality should be improved using public funding, but over double the number of respondents were willing to pay for reductions in risk posed by algal blooms. "Respondents in full-time employment, with higher incomes and from smaller households were more likely to enter the market for health risk reductions" according to Hunter et al. in this 2012 study. 44% of lake users submitted feedback using social media in a study in Finland (Heikinheimo et al., 2017). Humans tend to be most aware of the ecological services that directly benefit them.

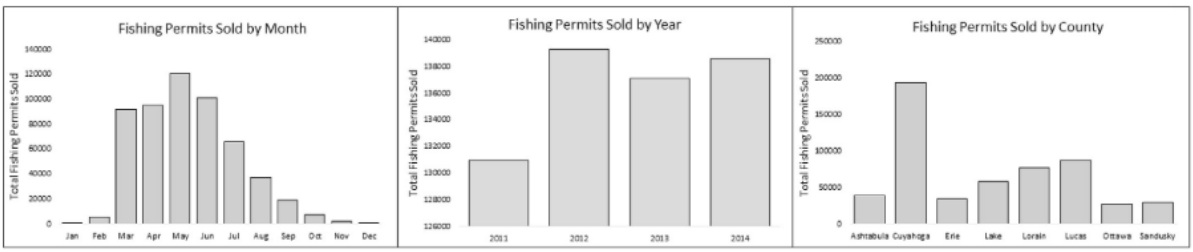


Figure 2: Decrease in Fishing Permits Sold in the Year 2011 Compared to 2012-14 (Wolf et al., 2017)

*Interpretive Signage*

Interpretive signage is a key component to communicating various ideas and knowledge. Benefits of interpretive signage include, "promotion, recreation, education, and management benefits" (Buckley, 2004). There are four guidelines to follow when designing a sign: (1) display near the requested behavior, (2) specifically state the desired behavior, (3) the behavior is convenient, and (4) the prompt is polite and non-demanding (Meis & Kashima, 2017). Messages delivered personally by uniformed personnel was most effective, however, that is not always feasible. Phrases that make the visitor feel personally responsible are effective (Kidd et al., 2015). It follows that if education and information can modify visitor attitudes, and/or address norms that may be underlying visitor behavior, then visitor behavior may also be modified.

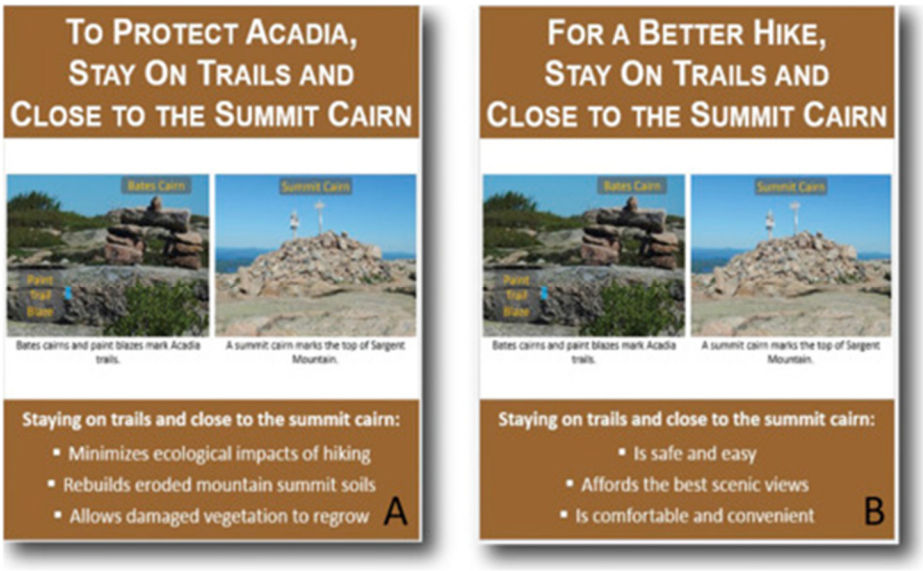


Figure 3: Image A is an ecological message while Image B is an amenity message (Kidd et al., 2015)

*Landowners*

It has been found that most residents have a higher expectation and lower satisfaction with the same area when compared to a visitor (Allen et al., 1993). The resident's quality of life is increased due to the influences of tourism, mainly due to the economic impacts (Biagi et al., 2020). Younger residents have the highest quality of life due to the significant opportunities for social interaction with tourists. Residents will be stricter on the removal of land area or implementation that takes place in their backyard unless it benefits them directly.

*Economic*

People are more trusting of a mandatory visitation fee than a donation. In one study, beachgoers were surveyed, and researchers concluded that most did not care significantly about aesthetics and healthiness of the beach. They were willing to pay, however, to fix the pollution problem so that there could be a great biodiversity of fish and corals (Marcus et al., 2017). Ecosystem services coming from tourism is valued at an estimated $17 billion every year (ICUN-Med, 2020). Residents pay taxes to their local governments to help community parks and environment, whereas tourists' money goes towards the local economy directly impacting the people of the community (Boumaour et al., 2018). Tourists provide an economic boost which 30.4% of residents are dependent upon (Walpole et al., 2001). Tourists are more likely to donate to local charities when seeing that maintenance needs to be done (ICUN-Med, 2020).

Survey Background

In the fall of 2020, a previous NRES team administered the survey our results are based upon. The survey questions were both open and close-ended, and asked current residents and non-residents about environmental, recreational, and policy concerns. The survey was developed in Qualtrics, and after approval received from the Institutional Review Board (IRB), was administered online by the Marion County Park and Lake manager, Isaac Hett. The survey remained open for a period of two weeks, and then responses were collected in Qualtrics and coded. A total of 122 responses were collected to be analyzed, 40 of which identified as a permanent resident or trailer owner, 77 who were not. To further build upon this, our team conducted analysis in the Stata software program.

To code this data, the team chose to run analysis using a binary logistic regression model. Logistic regression is "a technique used when the dependent variable is categorical (or nominal), and binary logistic regression "determines the impact of multiple independent variables presented simultaneously to predict membership of one or other of the two dependent variable categories" (Shi, n.d.) This model employs the binomial probability theory of which there are two values to predict, represented as 0 and 1. Our team chose this regression model since most of the data obtained from this survey is categorical factors. With this data structure, our team was able to focus on questions relevant to our overarching outcomes of this research. One focus area was on the eutrophic nature of Marion County Park and Lake, and the increased presence of algal blooms over time. To learn more about this issue, Stata was used to test the respondent's opinion on algal blooms against the variables of whether they were a permanent resident or owned lakefront property. This analysis stemmed from question 20 which posed the selection of

"algal blooms have affected my decision to participate in lake activities", question four asking "Are you a resident or trailer owner at Marion County Lake" and question five "Is your residence or trailer a waterfront property?". Our hypothesis for the analysis was as follows:

$$(\text{Algal bloom opinion})_i = (\text{residency})_i + (\text{waterfront})_i$$

By contrasting these variables against one another, the team was able to gain further understanding of how residents and non-residents experience the lake in distinct ways. Another example the team ran was comparing opinion on educational signage to questions of whether the respondent had kids, residency type, their age and gender. The hypothesis for this analysis was:

$$(\text{Educ. Signage})_i = (\text{Kids})_i + (\text{residency})_i + (\text{Age})_i + (\text{Gender})_i$$

This data was pulled from question 23 asking "Which of the following outdoor education opportunities would you be interested in participating in at Marion County Lake? (Select all that apply), with options being educational signage, ranger talks, guided hikes/tours, ranger-led community events or other, question 15 asking "On average, when visiting the lake, are children part of your party", question two asking "What is your gender" and question three "What is your age".

Methods

The goal of this project is to find trends in the survey data. For example, this could be comparing survey questions based on whether the people answering were residents or non-residents. This could be asking about a question like should migratory geese be able to over winter at the park? Or have algal blooms impacted your decision in participating in lake activities? Then we would compare how residents answered the questions to how non-residents answered the question.

To be able to compare them, the team used the "reports" section of Qualtrics. In the reports section, it gives the user data in a visual form that tells the reader how each person who took the survey answered. Look at Figure 4 for an example. Then in the reports section, there is a secondary tab called "data source" that allows the user to break up data based on other questions. In Figure 4 the tab is on the right side of the screen. In the data tab, the user can use the "breakout by" tab to select a different survey question to include in the pie graph like shown in Figure 4. For an example I picked question 4 which is asking about residency status of the surveyor. Now I picked question 4, two pie graphs will show up. One will show how residence of Marion County Lake and Park answered and the other will show how non-residents of the park answered questions 20. An example of this is shown in Figure 5. It is also important to note that in a question like question 20 where there are many different questions imbedded into one question, Qualtrics allows the user to choose which questions they want to include in the visual. I picked only one choice which was algal blooms, but I could have also chosen migratory geese if I wanted to. Now that there are visuals between both residence and non-residents it is easy to see whether their choices are similar or not. In this case of algal blooms, it seems algal blooms have impacted a majority if people's choices to partake in recreational activities from both resident and non-resident categories. Now I can use this same method for all questions to test if residency

status, gender status, economic status etc. have an impact on peoples answers to the survey questions.

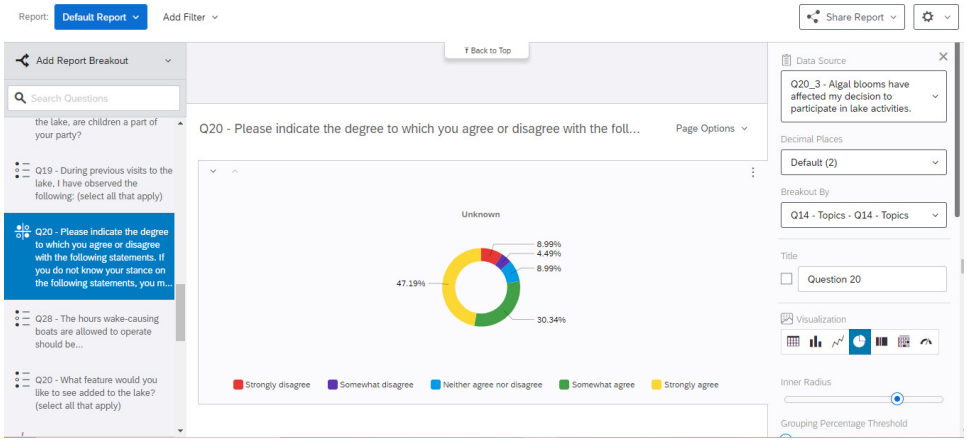


**Figure 4: Respondents answers for question 20.**

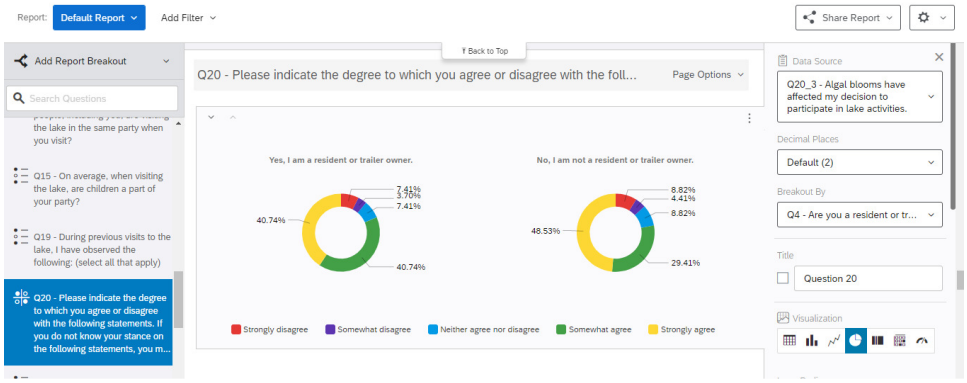


**Figure 5: Respondents answers for question 20 compared with question 4, residents and nonresident question.**

## Results

Since every team member studied a different aspect of Marion County Lake and Park, there are many different results found for each research topic. Jocelyn's research topic is understanding if harmful algal blooms influenced recreational activities like swimming and boating. Alec's research topic is analyzing the relationship between the distance a resident of Marion County or a visitor to Marion County has on their views of the lake and experiences while there. To do this, the team will analyze what things might affect residents' and visitors' viewpoints based on their age, distance traveled, gender, expectations and many other things related to tourism. Claire's research topic is about the impact of surveys and what aspects make a survey useful and helpful for the scientist gathering the data from the survey. Emma's research topic is interpretive signage and the role it plays in promoting conservation and protection of parks, and the benefits it creates in developing stewards for the environment, both within local populations and outside visitors. Finally, Marc's research topic has three main discussions examining lake ecosystems, docks on the shoreline, and human development and the impact these have on lake ecosystems.

Using all these research topics, the team will be looking at how the people who took the survey answered the survey questions and relate them back to the different research topics and how different categories of people answered them. For Jocelyn's research topic, the team compared how residents vs. non-residents answered the algal bloom question (question 20). How males vs. females answered question 20 and how having waterfront property impacted their answers. Comparing resident vs non-resident answers, it is shown that both residents and non-residents think that algal blooms have impacted their decision to participate in lake activities. This pie graph can be seen in Figure 6. Looking at male vs. female, it is shown that the majority of both

male and female also said algal blooms impacted their decision to participate in lake activities. This pie graph can be seen in Figure 7. Finally, it was clear from the pie graph in Figure 8, that people with waterfront property strongly agreed with the fact that algal blooms impacted their participation with water activities. People without waterfront property also said it impacted their participation but not as much as people with waterfront property.

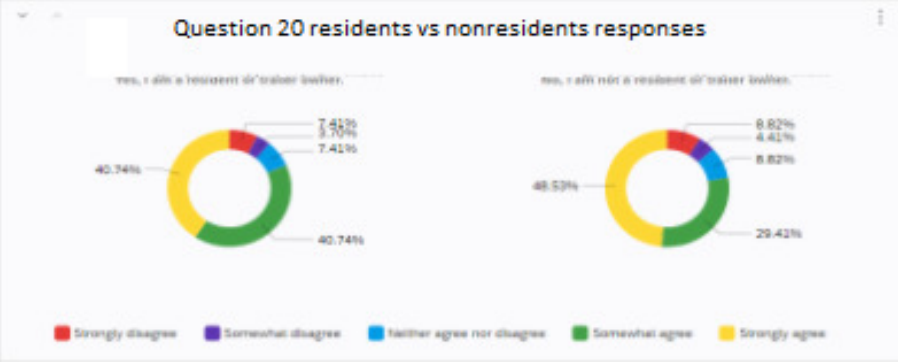


**Figure 6: Residents vs. non-residents view of algal blooms affecting activity.**

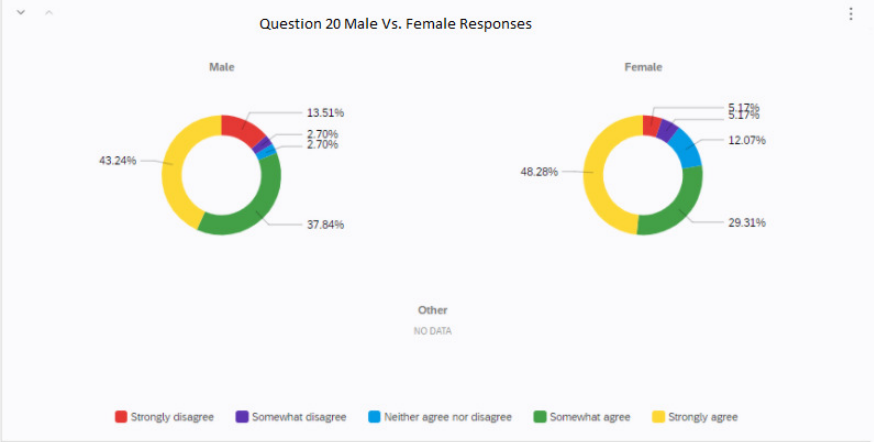


**Figure 7: Male vs. female view of algal blooms affecting activity.**

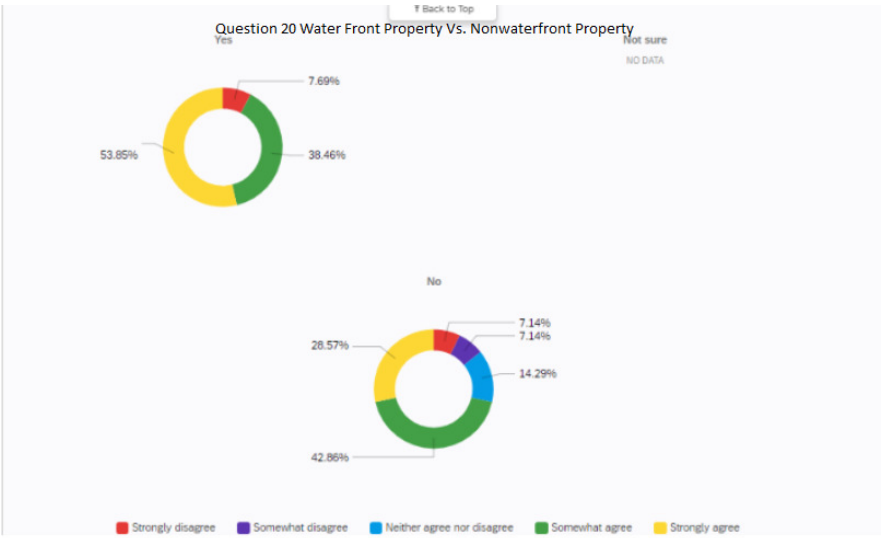


**Figure 8: Lakefront property owners vs. non-lakefront property owners view of algal blooms affecting activity.**

For Alec's research topic, questions 11 and 13 will be used to compare the differences between residence vs. non-resident use and male vs. female. Question 11 talks about what lake activities respondents participated in and question 13 talks about which of the following are most important to them at Marion County Lake and Park. Starting with question 11, looking at residents vs non-residents, from the bar graph created, the top answers for residents are walking, boating, and fishing. The top answers for non-residents are fishing, camping, and walking. These answers are very similar, but it makes sense why camping is a more frequent activity for non-residents than for residents. This bar graph can be seen in Figure 9. Looking at gender with question 11, male's top activities were fishing, boating, and camping while female's top activities were walking, fishing, and boating. Again, similar answers, but order of the top choices are different and there is one different top activity between the two. Now looking at question 13, residents' top choices that were most important were family atmosphere, care of facilities, and a tie between safety and variety of activities. The top choices that were most important to non-

residents were convenience of location, care of facilities, and family atmosphere. The top choice for non-residents makes since and the other answers are the same just in different orders of importance. Figure 10 shows this data. For gender in question 13, males' choices that were most important to them were convenience of location, care of facilities, and family atmosphere. For females, convenience of location, family atmosphere, and care of facilities were of most importance to them. These answers are the same except the 2nd and 3rd answers are switched for males and females. This data can be seen in Figure 11.

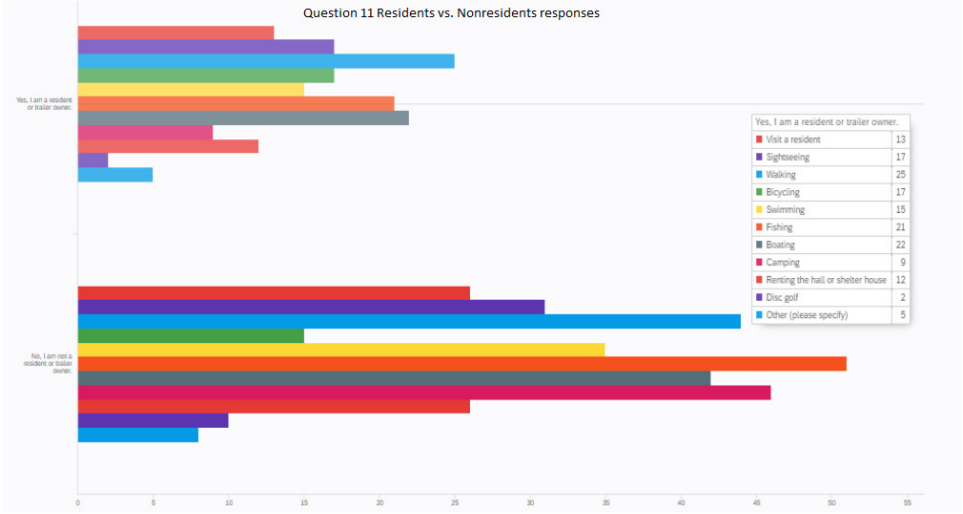


**Figure 9: Resident vs. non-residents responses for what lake activities they participate in**

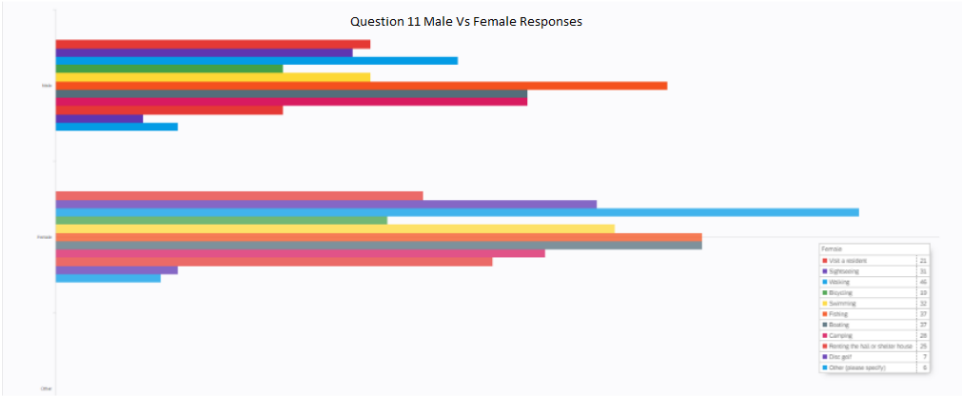


**Figure 10: Male vs. female responses for what lake activities they participate in**

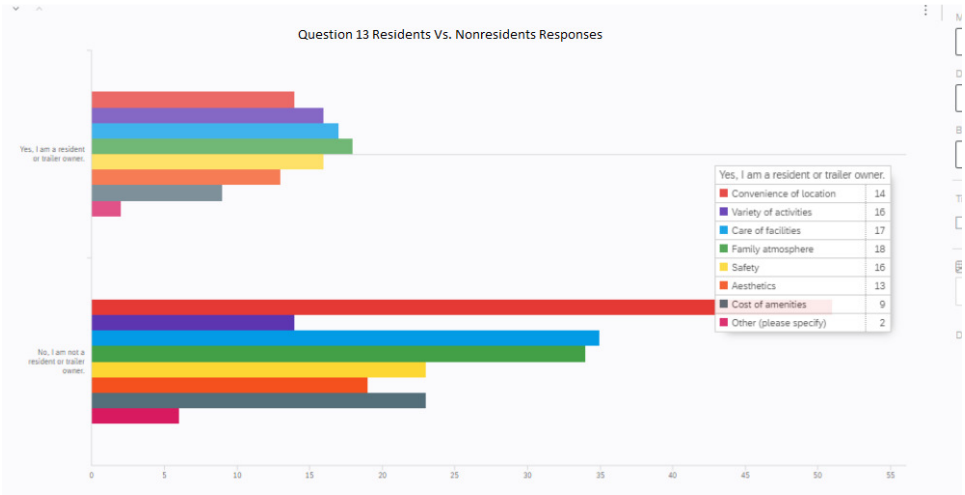


**Figure 11: Residents vs. non-residents responses to which lake amenity is most important to them**

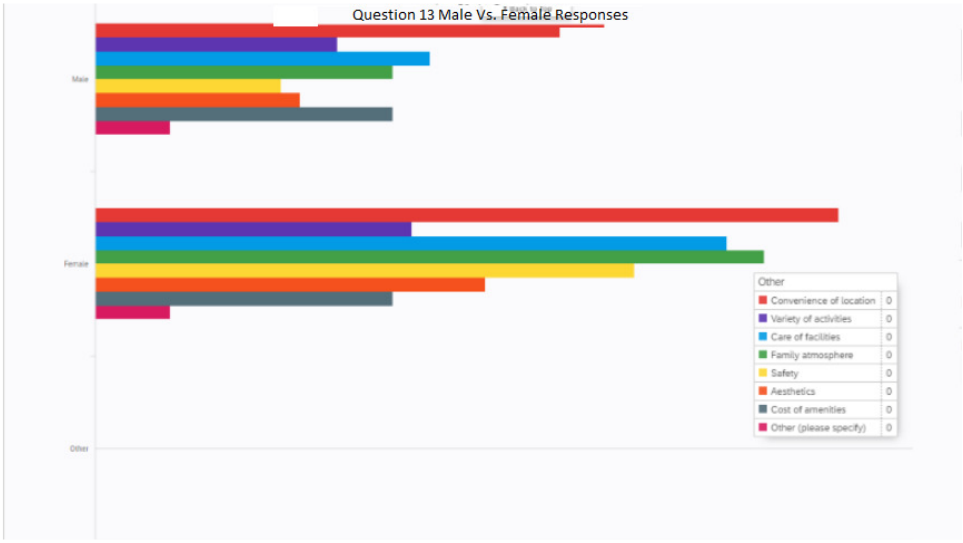


**Figure 12: Male vs. female responses to which lake amenity is most important to them**

For Claire's part of the project, the team studied multiple peer reviewed essays and concluded that feedback is the most important part about surveys. Various forms of feedback, which include

social media, writing, and verbal comments, allow visitors a quick and efficient way to relay their ideas back to the park. Good feedback leads to effective data for the parks to utilize in order to improve visitors' experiences and the impacts that come with it. The data that the surveys gather are a way to understand the various visitors that come to explore the parks, which is the main goal of any survey. So, good feedback equals a good survey.

For Emma's research topic, questions 15 and 23. Question 15 talks about if children are with you when you visit and question 23 asks what kind of educational opportunities would you want to partake in at the park. The team will be basing question 23 on whether they are residents or non-residents, whether they are male or female, and whether they have children in their party (question 15). When looking at residents vs. non-residents, residents' and non-residents' choices were the exact same. The top 3 choices were ranger led community events, ranger talks, and educational signs. So it seems both residents and non-residents would be interested in educational signage but it wasn't their first choice. This visual can be found in Figure 13. When looking at males and females, males top 3 choices were ranger talks, ranger led community talks, and guided hikes. For females it was educational signage, ranger led community talks, and ranger talks. Based on this data, males do not seem as interested in educational signs as females. This visual can be found in Figure 14. Finally, looking at whether children are in the party, when children are a part of the party, the top 3 choices are guided hikes, ranger led community talks, and educational signage. When children are not a part of the party, ranger talks, community led ranger talks, and educational signage are the top 3 choices. So whether there are children involved or not, educational signage seems to be of interest, but is not their first choice. This visual can be found in Figure 15.

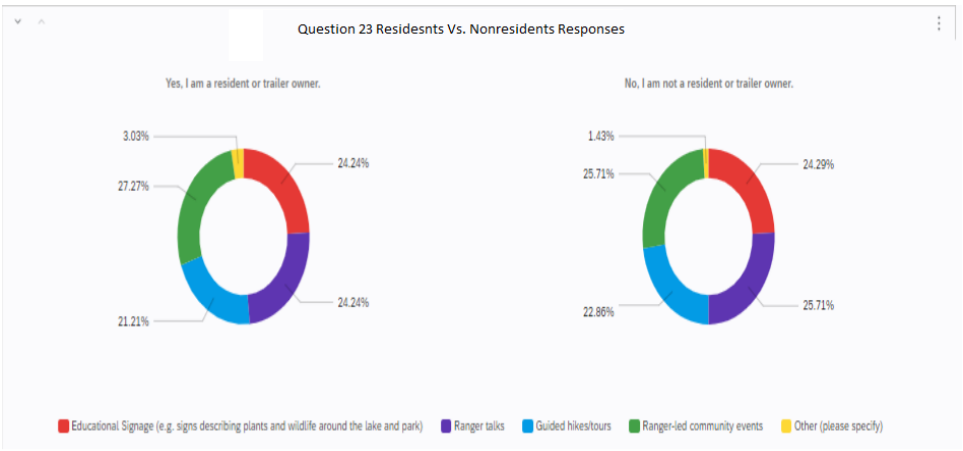


**Figure 13: Residents vs. non-residents educational opportunities desired**

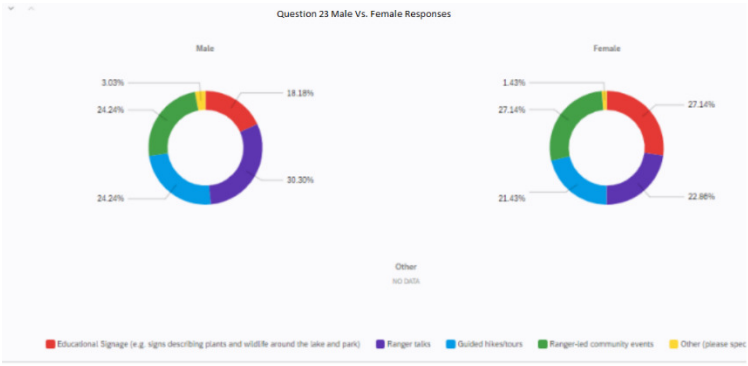


**Figure 14: Male vs. female educational opportunities wanted**

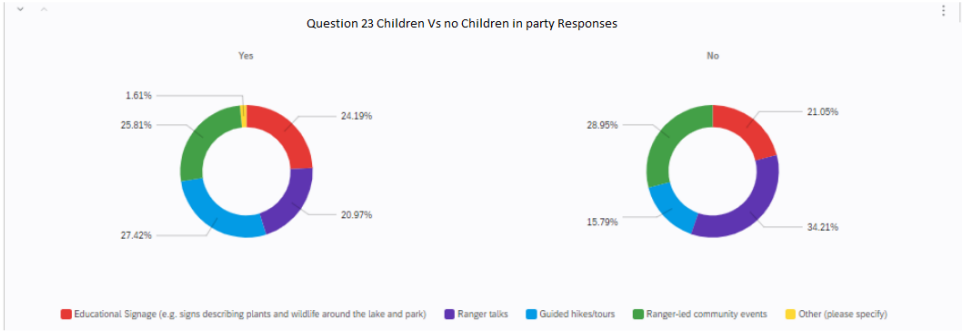


**Figure 15: Children in party vs. no children in party educational opportunities wanted**

Finally, Marc's research topic will be dealing with question 20 and will be basing their answers on whether they are residents vs. non-residents and whether their property goes up to the shore line. Question 20 is asking what features the reader would like to see added to the lake  First, question 20 will be compared to residents vs. non-residents. Residents top 3 choices are playgrounds, docks, and other. Non-residents top 3 choices are playgrounds, docks, and benches. Docks are both resident and non-residents top choices which means there is a desire for them and that it could potentially affect the lake ecosystem if implemented. This visual is in Figure 16. Secondly, question 20 will be compared with whether the residents property is lakefront or not. Residents with lakefront property top 3 choices are, playground, docks, and benches and other tied. Non-lakefront residents' top 3 choices are playground, docks and other. Based on this data, docks are also second in both lakefront and non-lakefront property and it could potentially have an impact on the lake ecosystem if implemented. This can be seen in Figure 17.

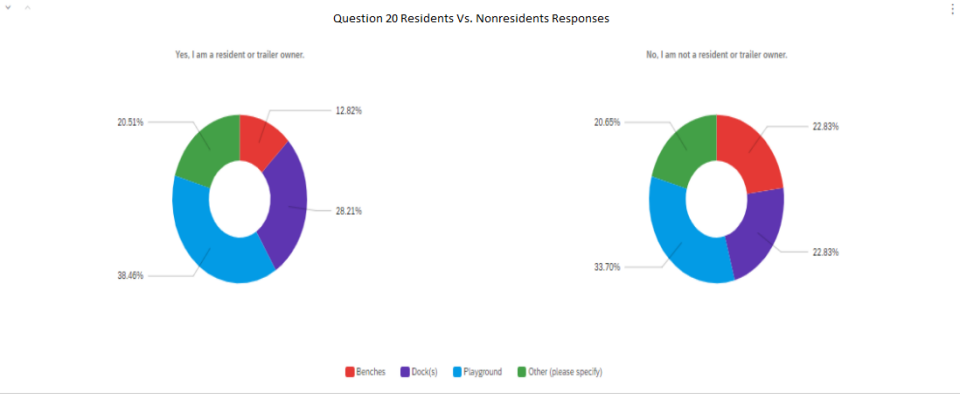


**Figure 16: Residents vs. non-residents additional features wanted**

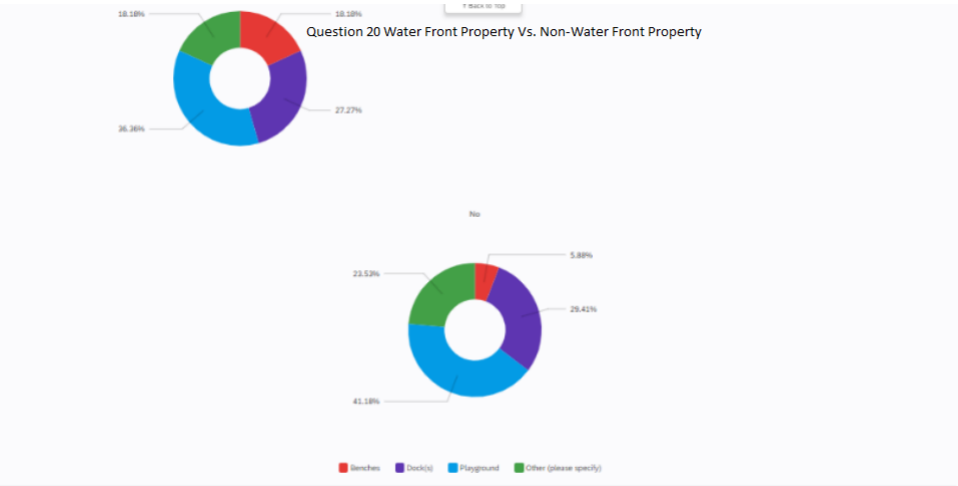


**Figure 17: Lakefront property owners vs. non-lakefront property owners additional features wanted.**

## Discussion

Marion County Lake and Park is a way to get away from daily stressors, so when visiting, the team wants park goers to have the best experience. Our team recognized the problems that occur daily within the park, so the team analyzed survey data and turned it into answers for our research topics. The team found the responses of both residents and non-residents do not like the presences of algal blooms, but residents that have lakefront property were more displeased. When encountering interpretive signage and the importance of education that it provides, the team found most visitors appreciate having it. Although implementing docks is a common want with residents and non-residents, it could impose environmental issues if implemented too widely. Overall, our team found that it is important to consider every background when trying to attempt to solve the problems that are ongoing within the park. Some issues could be more of a problem to residents than non-residents, so the surveys are a useful tool to find out visitors' views. If the team takes these answers into consideration, then Marion County Lake and Park will be more enjoyable to all.

## Conclusion

Our team uncovered some unanswered questions about Marion County Lake and Park. The team analyzed all aspects of life around the area such as the ecological impact, anthropogenic impacts, nutrient pollution, social effects. The methods the team used within the survey helped visualize the thoughts the community had about Marion County Lake and Park. Our research topics: park survey & feedback, spatial analysis, interpretive signage, algal blooms and people's perceptions, and residential development, were answered by analyzing the survey on Qualtrics within the report. Our team found differences between residents and non-residents. Every person has a different point of view so utilizing surveys helped us decipher what the community wanted to change.

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