The Impact of Insect Diversity and Conservation Education on Willingness to Support Pollinators

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Abstract:

Conservation of pollinator species is essential to both human and environmental health. Purposeful implementation of pollinator habitats (commonly known as pollinator plots or bioswales) is especially important as rapid urbanization continues to increase. This is because pollination is critical to the reproduction of wild plants as well as crops grown industrially through agricultural practices (Ellis, Emilie E., et al. 2025). However, public perceptions of pollinator benefits and environmental health have a key role to play in increasing this implementation. Our team assessed how the use of educational data derived from the Kansas State University Campus on the benefits of bioswales and pollinator plots on insect diversity and abundance directly impacted the perceptions of students and faculty on campus through survey distribution. We used this survey to measure the student's and faculty's willingness to both adopt pollinator conservation practices at their own residences and support implementation in public spaces. We found through our preliminary research that bioswales/pollinator plots do increase both insect diversity and abundance. Through the results of our survey, we found that this information does have a positive impact on student and faculty willingness to adopt conservation practices at their own homes. The participants were also found to be more inclined to support the use of public spaces for pollinator habitat as well.

Introduction:

Engineered green infrastructure (GI), and specifically the use of bioswales, is emerging as an effective link between stormwater runoff and habitat enhancement. With the use of structurally and chemically diverse vegetation, the addition of bioswales could prove beneficial both for hydrological functions and habitat restoration in even the most trafficked areas within cities (Mohammed, et al 2025). The choice of vegetation is a crucial factor when considering the effectiveness of a bioswale (Wong, Darren C.J., et al 2023). An assortment of common ornamental perennials and upland grasses are often chosen for GI projects throughout the Midwest. This suggests a degree of variability when it comes to the ecological functions that these can be expected to play. The understanding of pollinators and plants having interactions remains poorly understood within the context of multi-used cities. Kansas is no exception, with the coexistence of prairies, bioswales, and commercial areas within its metropolitan areas. The early, intermediate, and late blooms of flowers are yet to be consistent within various cities concerning the phenological disaccord that limits the availability of resources for new generations of pollinators (Zinnen, Jack, et al. 2021). Moreover, the factors of light pollution, and habitat fragmentation within cities are further noted to be contributing towards a decline of over forty percent of the richness of the pollinators (Billeisen, Terri L., et al. 2021).

The primary objective we were looking to complete and support through this preliminary research was the correlation between the addition of native perennial vegetation and pollinator presence. Testing parameters for this was variation in vegetation (forbs, tallgrasses, and woody species) present and density of the vegetation. Secondary objectives are looking at the variation of the different sampling areas to observe if the data supports any claims regarding the composition of pollinator plots. The work that our study undertakes is important to the field because it will consider the densities of the beneficial insect groups found within maintained turfgrass, other vegetation, and bioswales at Kansas State University and the broader metro area. Together with the measurement of plant groups such as forbs, tallgrass, and the wood understory, the study will enable a thorough understanding of the local pollinators' use of the environment (Wong, Darren C.J., et al 2023). With the intention of combining knowledge and views related to the ecological, and management aspects of the issue, the significance of the research includes informing the development of a specific type of biodiverse feature meant to improve the contribution of these ecosystems toward the support of various types of pollinators within Kansas and other similar landscapes.

For the main purpose of this project, we aimed to understand the impact of the preliminary data (and general conservation education) on the perceptions of pollinator conservation. Previous research done by Knapp et al. (2020) show that social perceptions are the driver to making significant changes in the world of climate and biological/ecological conservation and protection. Bennet et al. (2021) explains that one of the most effective and efficient ways to reach people with education on pollinator conservation is through social media. Surveys are a streamlined method for gathering social data and perceptions on many topics. Using this information, we chose the survey method to conduct our main piece of research regarding the effect of conservation education on people's willingness to adopt conservation at their own residence or to support the use of public spaces for these purposes.

Part 1 (Pollinator Habitat Research)-

Study Area:

The study area of our project includes four locations on the Manhattan K-State campus found at 39.2086202, -96.5913852 latitude and longitude. When choosing locations on campus to sample, we immediately had several areas in mind; first was the Beach Art Museum chemical free landscape, a frequent area for students looking to enjoy vibrant colors and some quiet away from the foot traffic. Even through fall, the area still had late blooming flowers attracting many Monarch butterflies and even some bee and fly species. The main pollinators found in

Manhattan, Kansas in the vicinity are composed of insects like bees; including bumble bees, sweat bees, and leafcutter bees. These pollinators can be considered the most predominant and efficient pollinator species. Butterflies, like monarchs and swallowtail butterflies, are common and dependent on prairie flowers for nectar. Hoverflies and species of beetles are also considered secondary pollinators for plants. These components comprise the main pollinator community. A common theme across the bioswales on campus is similar vegetation composition, which ended up restricting researchers in means of not damaging the sampling areas. The region follows a humid continental climate with well-defined changes that occur throughout the year, from wet and stormy summers to very cold and dry winter months. A considerable amount of rainfall occurs during late spring and early summer, with mesoscale systems and thunderstorms. The average rainfall received on an annual basis ranges between 35 and 36 inches (USNWS 2023)

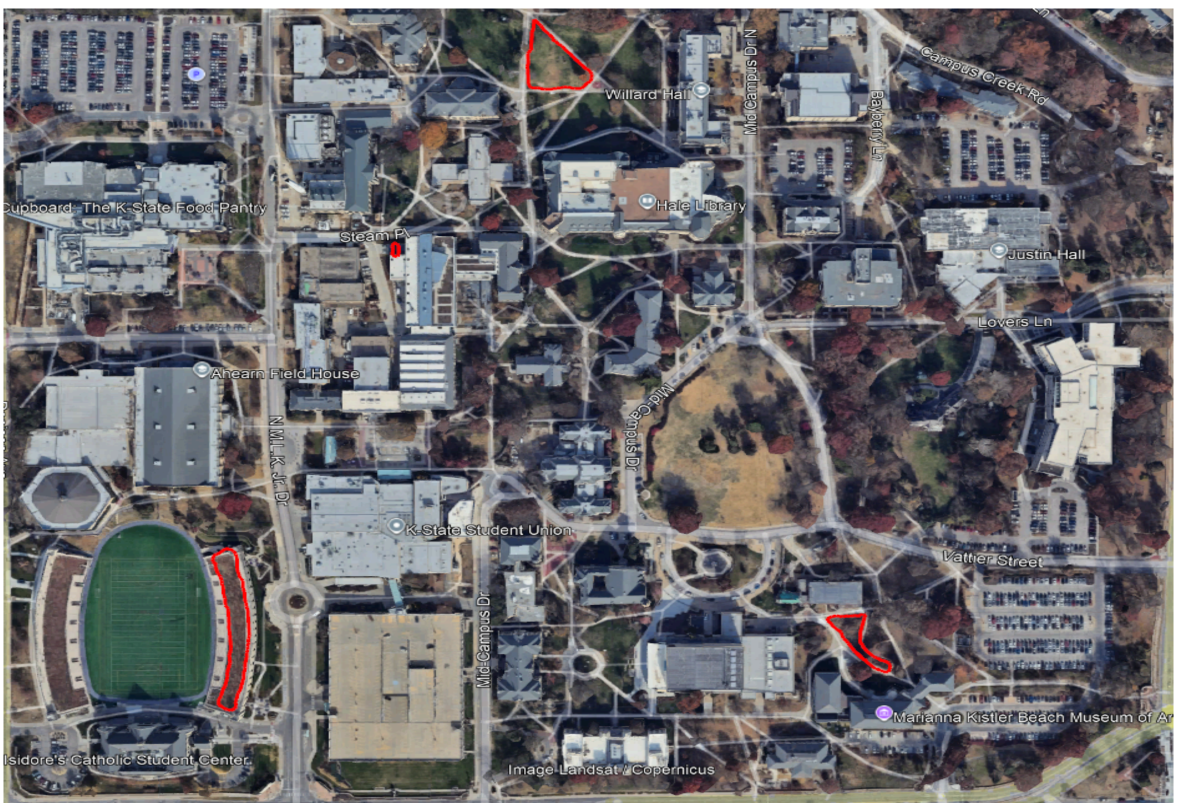

Figure 1. K-State campus map with sampled pollinator plots highlighted in red.

Methods

Sampling Area Selections

When selecting pollinator plots to sample, we used the following criteria: 1) foliage varieties differed at each site, 2) density of vegetation at each site varied, 3) area of each plot differed from one another. We selected a mowed grass lawn as our null to compare the effects of the pollinator plot implementation against a site with little to no value to pollinators. We chose three pollinator areas across campus to sample. These included the east stands garden in Memorial Stadium, a pollinator plot on the north side of the architecture building, and the butterfly garden at the Beach Museum of Art.

The number of samples taken at each pollinator plot was determined by finding the area of each plot and scaling the number of samples to the plot area using the equation; Repetitions =6+(area/250) (rounded to closest whole #). Using a 20-sided polyhedral die, we determined the number of paces along the perimeter of each pollinator plot until a new sampling point.

Study Area	Abbreviation	Area (m^2)
Plot 1	QUAD	1394.22
Plot 2	ARC	31.85
Plot 3	MEM	1664.21
Plot 4	ART	720.15

Figure 2 Table showing the area of each sampled plot

Vegetation sampling

Once at a sampling point, a Robel pole was placed one meter inside the perimeter and the Daubenmeir frame was placed around it. To take vegetation density measurements, the observer stood 4 meters from the Robel pole and knelt down. One observation was made every 10cm of vertical height. Only one direction of vegetation density was collected at each sample site to minimize disturbance of pollinator plots. Percentage makeup of grass, forbs, woody species, bare ground, and litter, were taken by visual observation looking down on the sample area. A count of different plant species was made by the observer by identifying visually distinct plants present in each sampling frame.

Pollinator sampling

Pollinators were sampled by a visual observation period of two minutes at each sample site. Both insects counted inside the frame, and those which flew over the frame in the allotted time were included in the total count. All insects found in the sample area within the two minutes were included in the total count. In addition, Apoidea and Lepidoptera were counted in a separate total to use as a metric of pollinators compared to total insect count.

Results (Pollinator Habitat Research):

The data provided total amounts of insects counted in each plot as well as estimations on orders they belonged to. Using nonlethal sampling techniques ensures that species population is not affected by the removal of individuals in each population (Thompson, Amibeth, et al. 2021). Classifying exact species was a less critical field of research to us, since our primary concern was the transfer of pollen from one plant to another.

	Total count of Insects	Total / number of samples
Plot	Sum	Mean
Quad	44	3.6
Architecture	55	9.166
Memorial	143	11.916
Art	113	14.25

Figure 3 Chart showing total count of insects compared to average count for each study plot

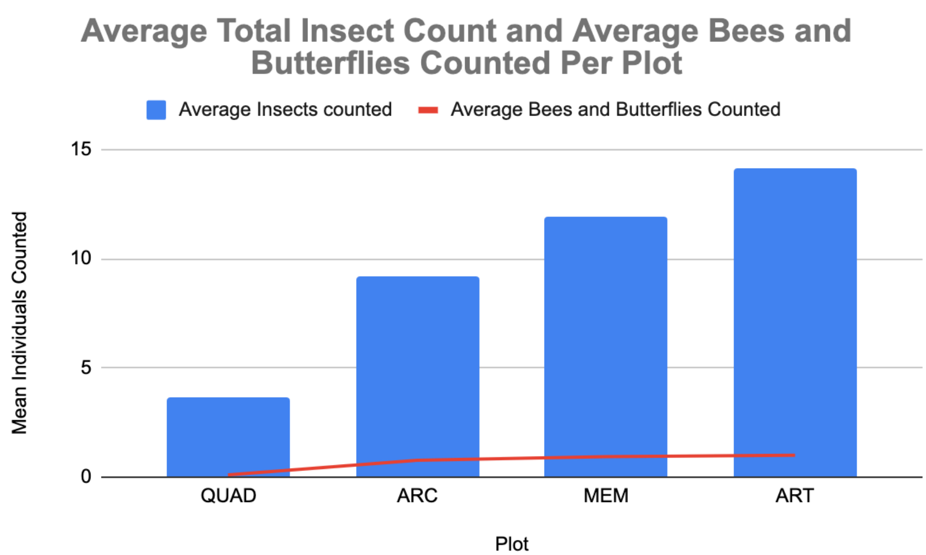

Figure 4 Graph showing average total insect count as well as average pollinator species counted for each sampling area

Once sampling requirements were collected, totals were averaged with the total amount of frames thrown. Arc stood for the Architecture building site, Mem was the Memorial Stadium, Art was the Beach Art Museum, and lastly the Quad was only partially sampled due to the segmentation and lack of vegetation variation.

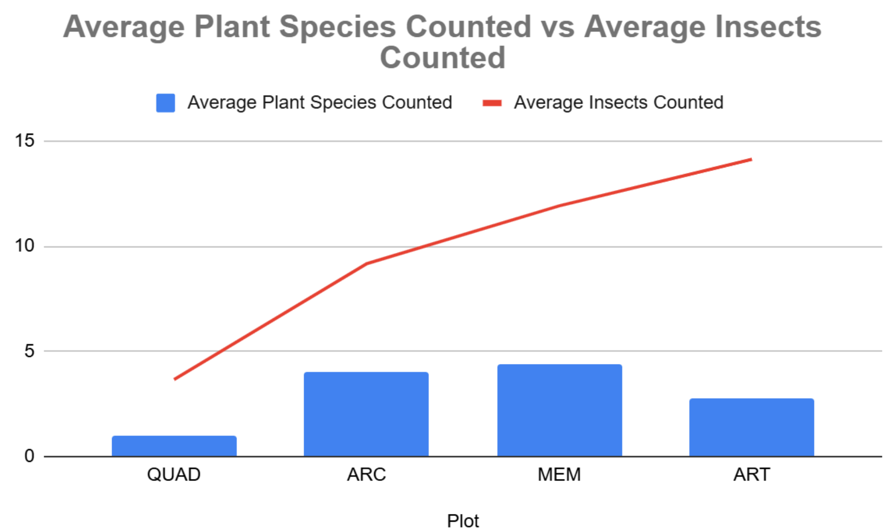

Figure 5 Graph showing average plant species counted compared to average insects counted

The highest average of insects counted per plot was the Art Museum at 14.25. The Art museum also showed the highest visual obstructive rating. As expected, the mowed lawn hosted very few insects, averaged 3.66 per plot, compared to the pollinator plots which hosted more than 300% more insects on average. Memorial Stadium had the highest mean Lepidoptera and Apoidea count at 0.9166 and also had the highest mean plant species counted at 7.583.

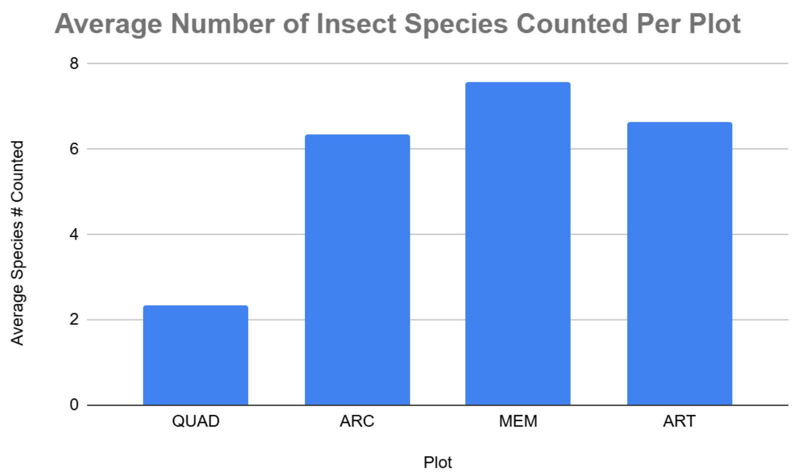

Figure 6 Graph showing average insect species counted for each study plot

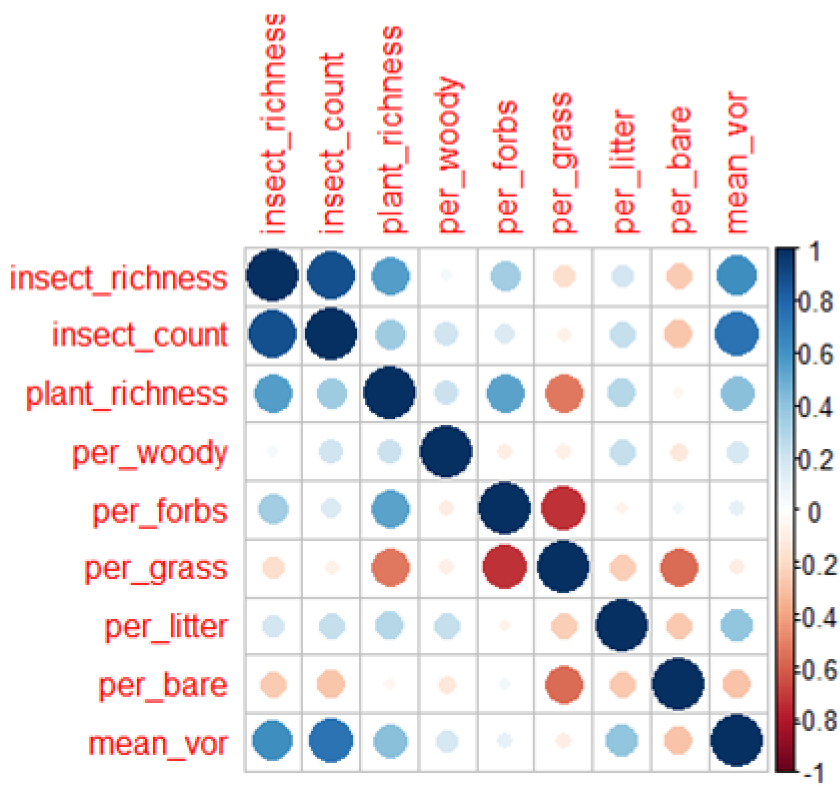

Figure 7 Chart showing correlation values between study variables across all study plots

When results from all study areas are combined and statistical correlation is performed, results of the study showed greatest positive correlation between mean vegetation obstruction rating and insect count at 0.887 while positive correlation was also found between mean vegetation obstruction rating and insect richness at 0.62 and plant richness and insect richness at 0.559.

Discussion (Pollinator Habitat Research):

The research we conducted looked at the species richness and diversity of insects as a whole in these habitats, not strictly looking at bees or butterflies as the only pollinators, but instead incorporated ants, flies, wasps, and spiders present in these ecosystems as they also play a role in the transferring of pollen from plant to plant. Our group focused on the collection of data regarding the correlation of pollinator and insect presence in relation to plant species biodiversity. Choosing locations with high flowering plant density, increased tallgrass populations, as well as turf grass locations.

Positive correlation between vegetation obstruction rating and insect count reveal that when planting pollinator gardens, dense vegetation planting practices and tall growing species may be the most beneficial when planting for insect abundance. In addition, large areas of bare ground should be avoided when planning pollinator spaces. The number of plant species available in the pollinator plot also had an effect in total insect richness likely due to functional differences between insect species. This means planting a variety of plant species within a pollinator garden is likely to expand the kinds of insects that can be hosted by the area.

The data supported the hypothesis that areas with more diverse plant species and a variety of seasonal blooms allowed for more species variation and density to occur. Other journals have data supporting this association both in the area of research related to conservation and ecosystem management and through similar associations between plant density and species richness. While continuing to push the increase in research over topics such as bioswales and pollinator presence. There were other avenues that could have been researched with our group such as nocturnal pollinator presence or soil chemistry differentiation in each of the sites along with vegetation diversity, diving into the social perspective on adopting more green infrastructure can help bolster urban rural hybrid systems in a diminishing rural environment. Allowing future research on the topic to branch into more semi-urban areas or more populated urban areas.

Part 2 (Pollinator Perceptions Survey)-

Methods (Pollinator Perceptions Survey):

The study population for the social survey conducted was the Kansas State University Campus population (See study area description in the Pollinator Habitat Research section). We sent the survey out to K-State undergraduate students, graduate students, faculty, and staff across all departments and all responses are anonymous. We used the Qualtrics platform to create the survey, which provided electronic access for survey distribution. We chose this method because electronic surveys have become one of, if not the most efficient options for survey distribution in the current age of technology (Bennett et al., 2021).

To distribute the survey, we created flyers and placed them throughout the K-State Campus for students, faculty, and staff to complete the survey. We also distributed the survey to clubs/organizations, classes, and faculty members to aid in distribution. We chose these specific distribution methods because they were the most direct options available to us while still providing access to students and faculty across as many departments as possible. This was important for our research because we wanted to compare the difference in people's answers based on their backgrounds and areas of study in order to compare the impact of these factors on the participant's social perceptions. Other research has found that certain factors such as social norms, personal identity, and emotional connection to nature all significantly predict the level of people's engagement in the conservation of species (Knapp et al., 2020).

The content of the survey consisted of two main sections (See Appendix A: Survey Questions). The first section was a "Before Education" section that contained demographic/background questions as well as a set of questions pertaining to the user's pre-existing perceptions of environmental and human benefits of pollinator plots, as well as questions pertaining to their pre-existing level of willingness to adopt pollinator conservation practices at their personal residence. Based on the research of Knapp et al. (2020), we chose to ask the participants background questions about the environment they grew up in and the university department that they are from in order to help us see how those factors contributed to the pattern of their answers, as briefly mentioned earlier. We then began to ask questions about the participant's living scenarios and current willingness to adopt pollinator conservation practices in their own residences, as well as questions about their willingness to support public pollinator conservation implementation before having watched the provided educational video. It was important to include questions about public pollinator conservation implementation because it was found in other research that aesthetics, safety, and perceived environmental responsibility contribute greatly to how much the public accepts the presence of pollinator habitats in urban settings (Huber, 2020).

The survey then provided the user a video presentation link to watch that included both basic education about pollinator plot benefits and the resulting data from our preliminary research done prior to developing the survey. We chose to use an educational video in our survey to provide background to the participants about the importance and benefits of pollinators and providing habitats for them in urban settings. The second section was an “After Education” section that contained repeat questions from the “Before Education” section (besides the original background questions), to measure the participant’s change in response after having watched the educational video. A similar method was used by Haake et al. (2025) in their social survey on the public perceptions about prescribed burning. We chose this method of using the before/after education because it provided a direct way for us to measure the actual impact of the pollinator conservation education, and whether or not this was an effective way to change social perceptions.

Results (Pollinator Perceptions Survey):

In total, 58 participants completed both before and after education survey questions. From these survey responses, there was a change in perception in survey participants after viewing the educational video about our collected data on pollinator plots.

Q1 - What is your role at K-state? (124 responses)		
Response	**Percentage**	**Count**
Undergraduate Student	77%	96
Graduate Student	15%	18
Faculty	4%	5
Staff	2%	3
Other	2%	2

Figure 8 Participants' roles at K-State

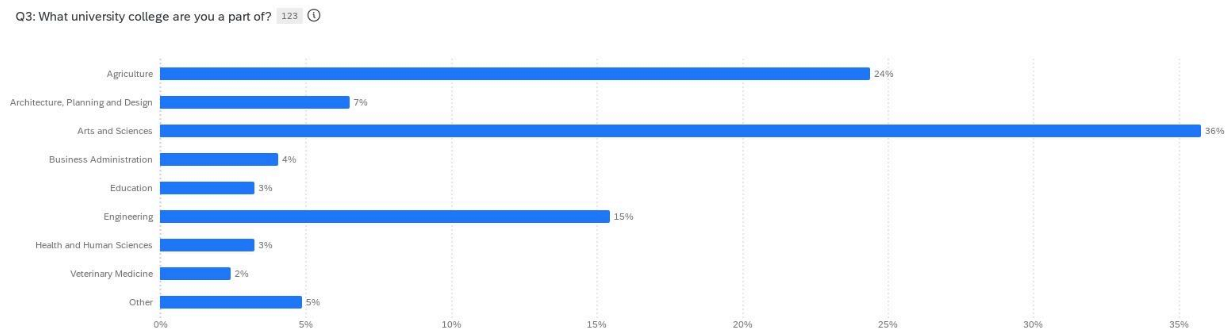

Figure 9 Which college participants are part of

Our survey was open to all students, faculty, and staff at Kansas State. A large majority of participants were undergraduate students with 77% according to Figure 1. There were smaller numbers of graduate students (15%), faculty (4%), and staff (2%) who participated in comparison to undergraduate students (77%). From figure 2, many of our participants came from the colleges of Agriculture (24%), Arts and Sciences (36%), and Engineering (15%) as participants could be reached from connections for survey distribution.

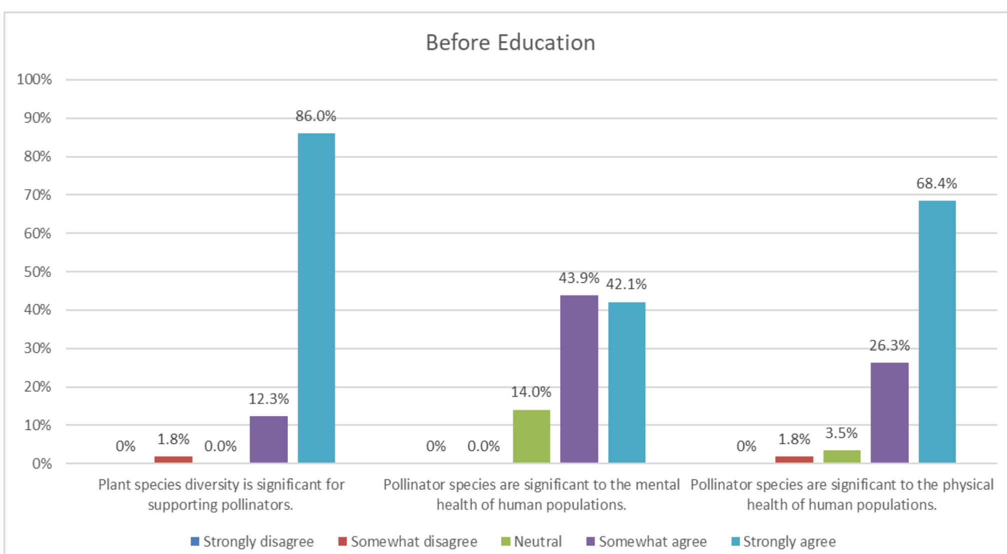

Figure 10 Participants level of agreement on statements of pollinator species benefits before viewing educational video.

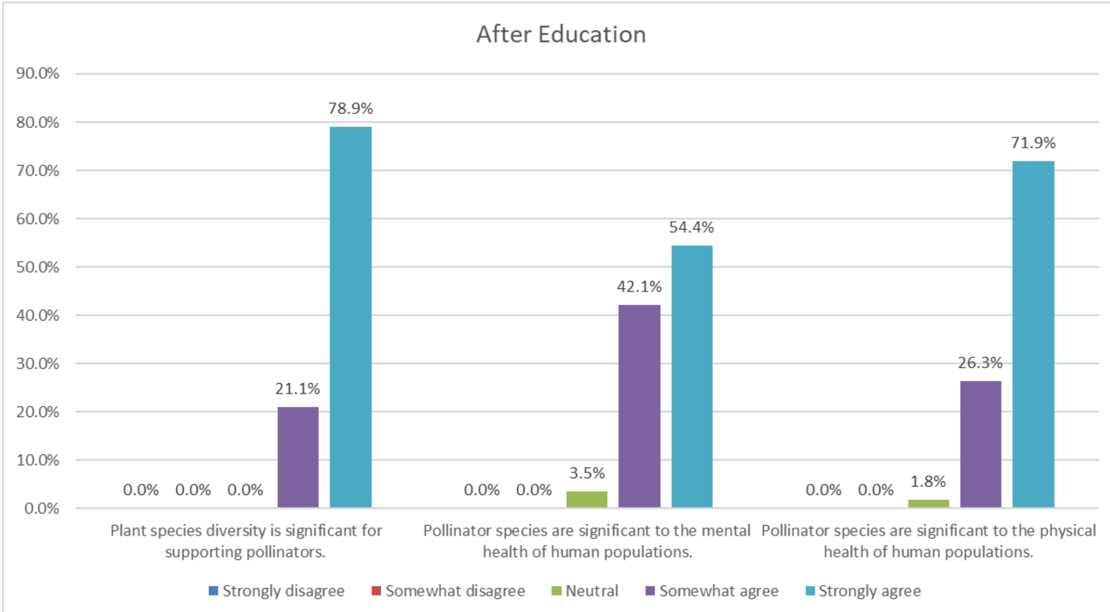

Figure 11 Participants level of agreement on statements of pollinator species benefits after viewing educational video.

Figures 3 and 4 show participants' responses to their level of agreement on statements of pollinator species benefits both before (Figure 3) and after (Figure 4) viewing our educational video. These statements include plant species diversity being significant for supporting pollinators, pollinator species being significant to mental health of humans, and pollinator species being significant to the physical health of humans. Overall, responses became more agreeable to these statements in the after education questions compared to before. Before education, there were 159 total answers of strongly agree and somewhat agree for the statements and 168 after. Participants that chose somewhat disagree and neutral for statements (12 answers in total) moved more towards somewhat agree and strongly agree as there were only 3 participants choosing these options after education. The choice of strongly agree rose in both the mental and physical health categories 12.3% and 3.5% respectively.

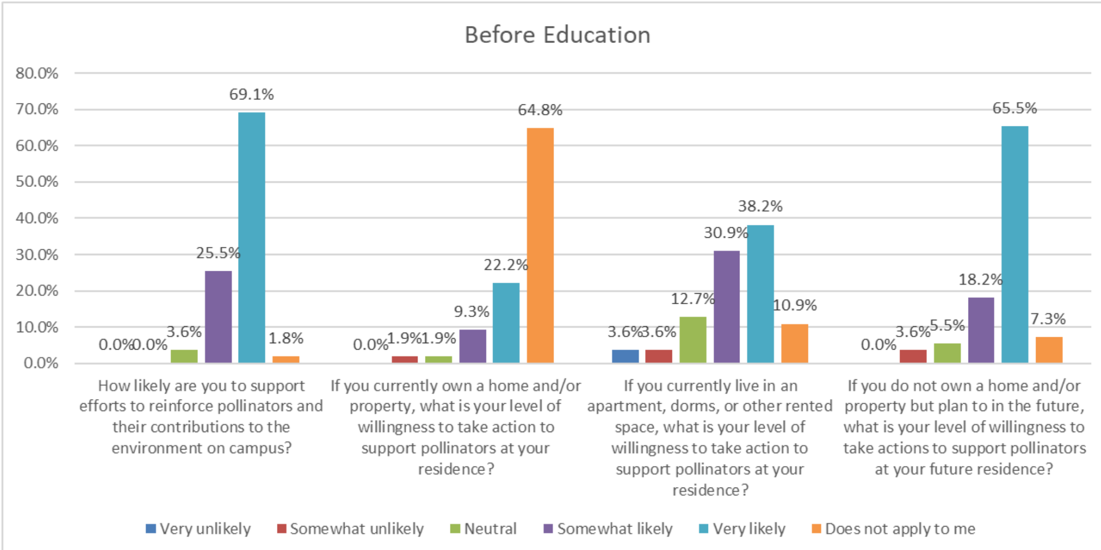

Figure 12 Participants level of willingness for implementing pollinator friendly practices before viewing educational video.

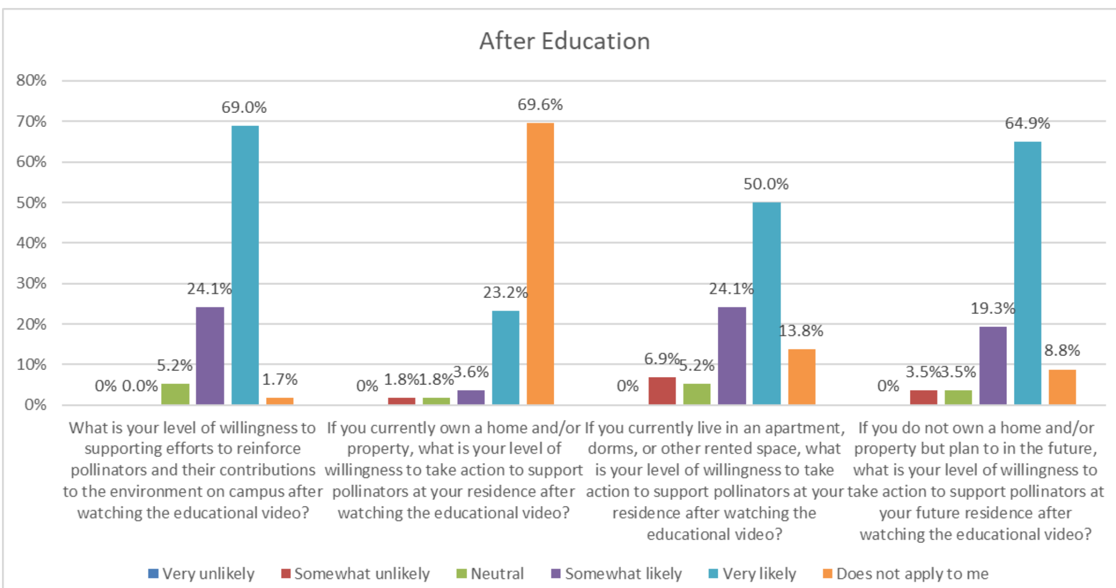

Figure 13 Participants level of willingness for implementing pollinator friendly practices after viewing educational videos.

Figures 5 and 6 looked at participants' willingness to implement pollinator friendly practices before and after viewing the educational video. The statements include supporting efforts to help pollinators on campus, taking action to support pollinators at their home or residence in varying forms, and supporting pollinators at a future home or property if not currently owning them. Because there were some questions that did not apply to all participants, an option "does not apply to me" was added. This option had a change in selection comparing the before and after questions suggesting participants incorrectly chose the option either before or after the video. The amount of participants choosing this option for currently owning a home before the video was 64.8% while after it rose to 69.6%.

Q20 - What barriers, if any, would prevent you from taking action to support pollinators at your own residence? (59 responses)		
Response	**Percentage**	**Count**
Cost	19%	11
Time	12%	7
All of the above	49%	29
None of the above	10%	6
I have no barriers	10%	6

Figure 14 Participants perceived barriers to supporting pollinators

There were perceived barriers for participants to take action to support pollinators as shown in Figure 7. Ninety percent of participants listed at least one barrier to taking action with 80% choosing time, cost, or both. Of the remaining barriers participants wrote in, lack of space/yard was most common. The 10% that chose the "I have no barriers" option.

Q8 - Do you already have or plan to have a pollinator plot at your residence? (13 responses)		
Response	**Percentage**	**Count**
Yes	62%	8
No	15%	2
I'm unsure	23%	3

Figure 15 Participants who already own home/property and if they currently have pollinator plots

Of the participants surveyed, only 13 currently own a home and/or property. A large majority stated they did not own a home or property so action in rented or confined residences could be limited for pollinator protection. Of the 13 individuals who did, 62% already have pollinator plots at their own residences while 23% were unsure if they had a plot. Only 15% said they did not have a pollinator plot at their home or property.

Discussion (Pollinator Perceptions Survey):

Our survey was successful in creating more positive perceptions of pollinators for students, faculty, and staff at K-State. There was an improvement in level of agreement for statements on pollinator benefits from before to after, there was also an improvement in level of willingness to take action to support pollinators from before to after. This shows the importance of education and conversations about issues such as pollinator conservation in changing the mindset surrounding willingness to adopt conservation practices. Social perceptions are the key to making significant changes in the world of climate and biological/ecological conservation and protection (Knapp et al., 2020).

One way our survey needed to be improved was through clarifying some questions. Specifically, when asking participants about the environment they grew up in (rural, urban, suburban, mixed), we had a question asking what led them to choose the option they did. This question confused many participants as it started on a new page when taking the survey. Many participants were not sure how to answer this question and thought it was linked to other background questions we had asked on the previous page including college and major choice or the setting they wanted to live in for the future. Another way our survey could have been improved was making it shorter. In total with the video, this survey took over 15 minutes to complete which led to many people not answering some questions towards the end. We had 127 completed surveys but only 58 participants completed the before and after education questions we were looking at to get a majority of data relating to the project of whether education would change perceptions. These same issues were also found in a previous social survey done on public perceptions of prescribed burning (Haake et al., 2025). A combination of shortening the video to 5-7 minutes, condensing down the number of questions asked to 15-20, and making specific questions required before moving on would have improved the number of participants meaningfully completing our survey. Haake et al. (2025) also came to a similar conclusion about the length of the educational video and number of survey questions asked.

This information has real world applications by showing that people's perceptions of environmental topics can be changed by information and education (Huber, 2020). From a simple video explaining the benefits of pollinators, people stated they were more willing to take actions like using native plants and supporting campus efforts to help pollinators. This is helpful in a campus setting as students can get more involved with organized conservation efforts through campuses. Involving both students and faculty help encourage conservation-minded individuals from different backgrounds to be more willing to support pollinators. This also provides benefits in the long run, as those who currently have homes and/or property can take actions now and those who don't will be more willing to take action in the future, creating lasting impacts that leave pollinators in a better place, and ultimately the planet in a better place.

Conclusion:

Pollinators provide many benefits to both humans and the environment. This project's goal was to see how they create these benefits and how people perceive them. As there are many pollinator plots on campus, we sought to find how these plots help the pollinators through population numbers. And, as pollinators help humans, we also sought to find out how people perceived pollinators on campus. With education showing evidence with benefits of pollinators and participants answering perception questions both before and after viewing this education, we were able to see a positive change in how pollinators were viewed and improved calls to action for those who can. Other methods to determine pollinator perceptions can be made to explore different age groups, as our project mainly had participants who are undergraduate students. Other ages could be researched to see differing levels of willingness to help pollinators. Overall, our project showed how pollinators benefited from plots on campus and how education can improve perceptions of them. A further look into other groups of people can determine how effective education can be in improving perceptions of environmental topics.

Appendix A: Survey Questions

Before Education

1. What is your role at K-state

Undergraduate student, graduate student, faculty, staff, or other (please specify).

2. Open-ended question: What university department are you a part of?

3. Which best describes the environment you grew up in?

Rural, suburban, urban, mixed (Moved between rural, suburban, and/or urban), or other (please specify).

4. Open-ended question: What led you to choose this option?

5. Do you currently own a home and/or property?

Yes, or no.

5a. (For if user marks no on Q5. If yes, skip to Q6) Do you plan to own a home and/or property in the future?

Yes, no, I'm unsure.

6. Do you already have, or plan to have a pollinator plot at your residence?

Yes, no, I'm unsure.

7. Are you familiar with the bioswales on campus and their intended purposes (include an example photo)?

Familiar with the purpose, seen but unsure, unfamiliar.

8. Have you participated in conservation or environmental activities before?

Yes, no, I'm unsure.

Matrix Questions 9-11, likert scale: "strongly disagree" "somewhat disagree" "neutral" "somewhat agree" and "strongly agree":

Please mark your level of agreement for each statement:

9. Plant species diversity is significant for supporting pollinators.

10. Pollinator species are significant to the mental health of human populations.

11. Pollinator species are significant to the physical health of human populations.

Matrix Questions 12-15, likert scale: "very unlikely" "somewhat unlikely" "neutral" "somewhat likely" and "very likely" with additional "does not apply to me" (non-scoreable) option for 13, 14, & 15:

Please mark your level of willingness for each prompt:

12. How likely are you to support efforts to reinforce pollinators and their contributions to the environment on campus?

13. If you currently own a home and/or property, what is your level of willingness to take action to support pollinators at your residence?

14. If you currently live in an apartment, dorms, or other rented space, what is your level of willingness to take action to support pollinators at your residence?

15. If you do not own a home and/or property but plan to in the future, what is your level of willingness to take actions to support pollinators at your future residence?

16. Open-ended question: What specific benefits do you currently believe pollinators provide to communities?

17. Open-ended question: What specific actions are you currently willing to take to support pollinators at your own residence in or around Manhattan?

Educational Video Link:

https://www.youtube.com/watch?v=okRajLenIu8

After Education

Matrix Questions 1-3, lickert scale: "strongly disagree" "somewhat disagree" "neutral" "somewhat agree" and "strongly agree":

Please mark your level of agreement for each statement:

1. Plant species diversity is significant for supporting pollinators.

2. Pollinator species are significant to the mental health of human populations.

3. Pollinator species are significant to the physical health of human populations.

Matrix Questions 4-7, lickert scale: “very unlikely” “somewhat unlikely” “neutral” “somewhat likely” and “very likely” with an additional “does not apply to me” (non-scoreable) option for 4, 5, & 6:

Please mark your level of willingness for each prompt:

4. How likely are you to support efforts to reinforce pollinators and their contributions to the environment on campus after watching the educational videos?

5. If you currently own a home and/or property, what is your level of willingness to take action to support pollinators at your residence after watching the educational videos?

6. If you currently live in an apartment, dorms, or other rented space, what is your level of willingness to take action to support pollinators at your residence after watching the educational videos?

7. If you do not own a home and/or property but plan to in the future, what is your level of willingness to take action to support pollinators at your future residence after watching the educational videos?

8. Would you prefer taking action to support pollinators in your own residence or support the use of campus spaces for pollinator habitat establishment?

own residence, public spaces, both equally, I'm not sure

9. What barriers, if any, would prevent you from taking action to support pollinators at your own residence?

Cost, time, space, all of the above, or none of the above (please specify).

10. Open-ended question: What actions are you now willing to take to support pollinators at your current residence or future residence after watching the educational videos?

Literature Cited:

Bennet, J., Rachunok, B., Flage, R., & Nateghi, R. "Mapping Climate Discourse to Climate Opinion: An Approach for Augmenting Surveys with Social Media to Enhance Understandings of Climate Opinion in the United States." *Plos One,* vol. 16, no. 1, 2021, https://doi.org/10.1371/journal.pone.0245319.

Billeisen, Terri L., et al. "Presence of pollinator‐friendly habitat on pollinator communities in managed turfgrass systems." *International Turfgrass Society Research Journal*, vol. 14, no. 1, 26 Apr. 2021, pp. 295–303, https://doi.org/10.1002/its2.56.

Chen, Tong, et al. "Unlocking the positive impact of bio-swales on hydrology, water quality, and Biodiversity: A bibliometric review." *Sustainability*, vol. 15, no. 10, 17 May 2023, p. 8141, https://doi.org/10.3390/su15108141.

Ellis, Emilie E., et al. "Drivers of nocturnal and diurnal pollinating insect declines in urban landscapes." *Proceedings of the Royal Society B: Biological Sciences*, vol. 292, no. 2052, Aug. 2025, https://doi.org/10.1098/rspb.2025.0102.

Erickson, E., et al. "Herbaceous perennial ornamental plants can support complex pollinator communities." *Scientific Reports*, vol. 11, no. 1, 16 Feb. 2022, https://doi.org/10.1038/s41598-021-95892-w.

Haake, I., Holmes, S., Hudelson, B., & Peak, C. "Public Perceptions of Prescribed Burning and the Impact of Education Over Time." *Kansas State University NRES Capstone,* 2025, https://www.k-state.edu/nres/capstone/NRESReportS25_TeamNeda.pdf

Huber, G. "Understanding Perceptions to Improve the Acceptance of Insect Pollinator Habitat in Public Spaces." *University of Georgia,* 2020, https://www.proquest.com/docview/2489769217?pq-origsite=gscholar&fromopenview=true&sourcetype=Dissertations%20&%20These

Knapp, J., Phillips, B., Clements, J., Shaw, R., & Osborne, J. "Socio-Psychological Factors, Beyond Knowledge, Predict People's Engagement in Pollinator Conservation." *People and Nature,* vol. 3, 2020, pp. 204-220, DOI: 10.1002/pan3.10168

Locklear, J. (2023, Spring). *Perceptions of Pollinators: Knowledge, Attitudes, and Behaviors Among University Faculty, Students, and Staff* . University of North Carolina at Pembroke. https://libres.uncg.edu/ir/uncp/f/Perceptions%20of%20Pollinators_LocklearJamesP.pdf

Levenson, H., Sharp, A., & Tarpy, D. (2022, June 15). *Evaluating the impact of increased pollinator habitat on bee visitation and yield metrics in soybean crops*. Agriculture, Ecosystems & Environment. https://www.sciencedirect.com/science/article/pii/S0167880922000500

Maduneme, E. (2024, May 22). *Some Slice of Climate Anxiety … Is Good: A Cross-Sectional Survey Exploring the Relationship Between College Students Media Exposure and Perceptions About Climate Change*. Journal of Health Communications. https://www.tandfonline.com/doi/full/10.1080/10810730.2024.2354370#d1e175

Mohamed, Mohamed S., et al. “Bioswales and permeable pavements as green infrastructure for flood mitigation in Chicago neighborhoods.” *Journal of Hazardous, Toxic, and Radioactive Waste*, vol. 29, no. 2, Apr. 2025, https://doi.org/10.1061/jhtrbp.hzeng-1380.

Mwebaze , P., Marris, G., Mike Brown, Macleod, A., Jones, G., & Budge, G. (2018, February). *Measuring public perception and preferences for ecosystem services: A case study of bee pollination in the UK - sciencedirect*. Land Use Policy. https://www.sciencedirect.com/science/article/abs/pii/S0264837717304192

Palmersheim, M. C., Schürch, R., O’Rourke, M. E., Slezak, J., & Couvillon, M. J. (2022, November 14). *If you grow it, they will come: Ornamental plants impact the abundance and diversity of pollinators and other flower-visiting insects in gardens*. MDPI. https://www.mdpi.com/2311-7524/8/11/1068

Pham, Michelle A., et al. “Reclaiming urban vacant land to manage stormwater and support insect habitat.” *Urban Ecosystems*, vol. 26, no. 6, 22 Aug. 2023, pp. 1813–1827, https://doi.org/10.1007/s11252-023-01418-9.

Şen, Emine, and Beyza Şat. “Bioswales as engineering functions of nature-based solutions to increase Urban Resilience: A Review.” *FORESTIST*, vol. 74, no. 2, 29 Aug. 2024, pp. 253–258, https://doi.org/10.5152/forestist.2024.23080.

Thompson, Amibeth, et al. “Pollinator sampling methods influence community patterns assessments by capturing species with different traits and at different abundances.” *Ecological Indicators*, vol. 132, Dec. 2021, p. 108284, https://doi.org/10.1016/j.ecolind.2021.108284.

USNWS. “PF Data Server-PFDS/HDSC/OWP.” *Noaa.gov*, 2023, hdsc.nws.noaa.gov/pfds/.

van Marwijk, R., Elands, B., & Kampen, J. (2011, August 24). *Public Perceptions of the Attractiveness of Restored Nature*. Restoration Ecology. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1526-100X.2011.00813.x

Wong, Darren C.J., et al. “Many different flowers make a bouquet: Lessons from specialized metabolite diversity in plant–pollinator interactions.” *Current Opinion in Plant Biology*, vol. 73, 16 Jan. 2023, p. 102332, https://doi.org/10.1016/j.pbi.2022.102332.

Zinnen, Jack, et al. “Pollinator seed mixes are phenologically dissimilar to prairie remnants.” *Restoration Ecology*, vol. 33, no. 3, 25 Dec. 2024, https://doi.org/10.1111/rec.14352.