The Relationship between Public Approval and Ecosystem Services on Campus Greenspaces

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Abstract

This study examines the perceptions of green spaces on the Kansas State University campus and their associated ecosystem services. Surveys were sent out to students, faculty and staff, and Manhattan residents to assess their views on the aesthetics of the spaces. Ecological assessments including infiltration tests, arthropod sampling, and soil compaction tests were also performed to quantify the ecosystem services provided by these areas. The survey findings revealed that the Meadow was perceived as the most beneficial by individuals, and Campus Creek was the least beneficial. Additionally, the ecological assessments identified fast infiltration rates in the Bioswale due to the man-made aspects and a large and diverse set of arthropods at the Bioswale and Campus Creek. This research underscores the importance of considering diverse perspectives when designing urban green spaces, ensuring they provide social and environmental benefits.

Introduction

Relevance

The importance of this study is to determine what the stakeholders of Kansas State University are drawn to while comparing the ecological benefits supplied by various areas on campus. K-State's Master Plan was developed as a goal to transform physical spaces on campus to community inhabits to address needs of a growing university. It looks at various aspects such as space utilization, transportation, utilities, accessibility, and security and student experience. Part of the plan is to modernize facilities and enhance outdoor spaces with green spaces in mind. Areas the Master Plan focuses on are Anderson Lawn, the Quad, Campus Creek, Ahearn Field House, Quinlan Natural Area, and the K-State Gardens. Ideas like creating Wellness Loops, revitalizing Campus Creek, and enhancing green spaces is meant to add more social spaces for community members and add study spots overall improving student well-being.

Our research is important as it is information that connects our environment to the people who are using the spaces around campus and their desires. Kansas State University has a master plan "which is revised about every 10 years and is being redeveloped now, covers everything from facilities, space use, infrastructure and accessibility to security, transportation, student experience and more" Watson (2024). The current ten-year plan discusses the use of outdoor spaces, which directly correlates to our research in wanting to understand the alignment between what people perceive as a welcoming space and what nature can thrive in. It directly references the Quad, the Quinian Natural Area (an area along Campus Creek), and Seaton's outdoor theatre space (near Seaton bioswales) which are all areas we look at in this study. The ten-year plan wants to create more use for our outdoor spaces by creating areas for engagement both in and out of the classroom. We are analyzing what is currently in place, learning about what the people want, to then aid in decisions that can help the future K-State community. This directly correlates to the master plan's three phases of understanding what needs to be addressed, exploring a variety of methods for enhancement, and realizing the outcomes of the project. It is very easy to hear what the people want from our environment and through our research we can identify what our environment needs from us to continue thriving, ensuring sustainability, and strengthening the symbiotic relationship between humans and natural resources.

Objectives

Green spaces provide many benefits, including physical and psychological, but not all green spaces have the same characteristics nor are they perceived the same (Braçe et al., 2021). Here, we study the individuals' perceptions of green spaces and the spaces' ecosystem services offered to understand the relationship between the two. Specifically, we address the following objectives:

1. Investigate the perceptions of green spaces among various demographic groups on the Kansas State University campus and within the surrounding Manhattan area.
2. Examine the ecosystem services provided by the green spaces on campus.
3. Analyze the relationship between individuals' perceptions of green spaces and the ecosystem services these spaces offer.

Ecosystems Services

<u>Cultural</u>

Green spaces provide many benefits, including physical and psychological, but not all green spaces have the same characteristics nor are they perceived the same (Braçe et al., 2021). It is important to evaluate these differences in characteristics to help identify barriers related to the use of green spaces.

Characteristics influence perceptions not only in individuals but in communities as well. Maintaining gardens, planting, and monitoring usage and safety of green spaces make it more likely for a community to be involved with the local green space. The engaging residents then take ownership to make the area more inclusive and contribute to the community's health (Lahoti et al., 2023).

The current research on human health and well-being is based on landscape preference theory. This theory concerns the evaluation of aesthetic preferences for the environment based on the individuals' needs (Hao et al., 2024). Many of these studies have found a positive correlation between an individual's perception and plant species diversity, but different green space types show a significant difference in perceptions and preferences (Hao et al., 2024). There are many landscapes used in green spaces including trees, flower beds, shrubs, and lawns. The use of different vegetation elements can increase the use and appreciation of green spaces (Poje et al., 2024). But despite the clear benefits of urban vegetation, it is sometimes perceived negatively due to challenges like maintenance, safety, and allergens (Poje et al., 2024).

Demographics influence perceptions of green spaces significantly. Because of different cultural backgrounds, individuals will have varying preferences and emotional responses to green spaces (Wang et al., 2024). It is important to look at individuals' opinions of green spaces to provide the best approach to promote well-being and positive emotions.

The literature suggests individuals' and communities' perceptions of green spaces are heavily influenced by the space's characteristics and resident's demographics. After reviewing the research, the argument can be made that green spaces are an important part of a community as they positively impact mental and physical health. The best approach to providing proper accommodations is to continue researching this topic to understand the individual and community-wide wants in green spaces based on characteristics and demographics.

Biosystems

Hydrologic

In urban environments, runoff rates are high due to the high concentrations of impervious surfaces preventing infiltration into the soil and increasing flooding during storm events. Urban runoff is known to carry nutrients that negatively affect the water quality in surrounding watersheds. Vegetation acts as a natural filter for these nutrients and will slow down water runoff. Vegetative buffer strips encourage infiltration through preferential fluvial pathways before reaching these bodies of water. Green spaces provide a region of pervious surface in an urban environment that allows for infiltration, but in practice, these locations still face high runoff rates attributed to soil compaction. This compaction occurs in residential areas, park areas, road greenbelts, and campus areas because of construction, foot traffic, and other forms of weight that increase the soil bulk density and decrease the soil macropores Yang et al. (2011). Implementing vegetation in these compacted regions can increase soil macropores through root growth. Julia Bartens et al. (2008) researched the role of black oak trees with coarse roots and red maple trees with fine roots and found that coarse roots are more successful at increasing infiltration. Additionally, the soil type can influence infiltration rates where sandy soils are going to have higher infiltration rates than soil with clay layers as they retain water in the clay layers. Stähli et al. (1999) looked at winter conditions where they found the importance of preceding climatic conditions in winter infiltration and surface runoff as this is what sets the initial soil moisture, soil frost, and thawing periods. The wetter the preceding conditions, the less runoff occurs in the winter. Hydrological systems are naturally dynamic and with the influence of urbanization, we are constantly trying to understand ways to manage our water. Understanding the correlation between functionality of green spaces in a populated urban area and the qualities of a hydrological system can be essential in future management projects.

Arthropod Importance

Arthropods play an important role in ecosystem health by restoring and maintaining healthy soils (Kishore SM, et. al., 2024), increasing floral diversity (Goulnik J., et. al., 2020), rangeland health (Gilgert W., et. al. 2011), and cultural values like pollinating crops for human consumption. Soil is the basis for plant life and plays a big role in agriculture production. Arthropods from the top few soil layers consume the litter layer at the surface from plant material to other dead fauna/arthropods. Many arthropods are detritivores and consume dead organic material, while others are mycophages which consume fungi (Kishore SM, et. al., 2024). These food sources are nutrient rich for their young to thrive in and the waste they produce. Plants, fungi, and microorganisms use this waste to grow while also aerating the soil through the root channels and path they create (Auclerc, A., 2022). In turn, water retention increases as does carbon storage within soil. Many of these organisms have symbiotic bacteria they excrete or possess in their bodies that allow for the breaking down of materials they could not physically do on their own such as breaking down wood, leaves, and dung. Modern agricultural practices are having negative effects on these arthropod communities because of constant tilling, herbicide, pesticide, and fertilizers. The population decrease leads to poor nutrient soils. Additionally, the monoculture cropping draws in lower diversity of arthropods that look for specific flora to forage on, also decreasing the soil nutrients (Kishore SM, et. al., 2024).

Pollinators supply crucial services to ecosystems but have been facing declining populations in recent history and conservation efforts are crucial to ensure their habitats are protected and restored. Insect orders that are the most effective pollinators include *Hymenoptera* (bees and wasps), *Coleoptera* (beetles), and *Lepidoptera* (moths and butterflies). Flowering resources are what they rely on to forage nectar as adults and pollen provision for their young. This pollen can be found in forbs, legumes, shrubs, vines, and trees that use pollination to reproduce and feed these pollinators. Approximately 80% of all of Earth's flowers are pollinated by bees (Hoshiba & Sasaki, 2008) with 1 out of every 3 bites of food we eat are due to bees (Randall, 2022). Bees are the prevalent and efficient pollinators, yet their populations have been seeing declines worldwide (Goulson et al., 2015). Pollinators use holes dug by beetles, prairie dogs, rodents, and many other species to create nests and rest when not foraging. The range that bees cover can be anywhere from 200 meters for the smaller ones, to over 2 km for the larger bumblebees (Gilgert W., et. al. 2011). Pollinators such as some *Lepidoptera's* (moths and butterflies) have evolved to lay eggs on specific host flowers so that when their young hatch they have resources to feed on like leaves. Many of these plants rely on the pollinator just as much as the pollinator does on the plant, creating a conundrum for both if one is not present or dies out. Grazing has also shown to increase flowering resources for pollinators as well as increasing the density of falling terrestrial invertebrate biomass into stream, leading to more food resources for aquatic life (Gilgert W., et. al. 2011). Plants supply cover and foraging resources for pollinators, while pollinators in return facilitate the reproduction of plants. These plants can create cover and fruits that feed other animals, that then burrow and create habitat for these same pollinators to reside in.

Soil Health

Soil health includes a large variety of soil and ecosystem qualities that are important for human and ecosystem health. Organic matter and infiltration are very common as a measure of soil health as they affect many other aspects of the environment. For the Flint Hills native landscaping is very desirable from a soil health perspective(Freeman, 2023). Emulating native systems created improved soil and ecosystem conditions, with microbial biomass and soil carbon increasing(Freeman, 2023). Plant diversity provides many benefits for ecosystem services and soil health, as a variety of root types and microbial communities help to stabilize the soil and bring in more nutrients (Steinfort et al., 2020). Different root structures help to create soil structure, improve infiltration, and encourage microbial communities leading to healthier soils (Monteiro, 2017). Disturbance is one of the biggest setbacks to soil health indicators including soil habitat, carbon sequestration, and water storage and regulation (Ungaro et al., 2022). Disturbance causes microbes to grow and use organic matter as a food source consuming as much as it can while oxygen is high. Many other actions can affect soil health as well including irrigation, amendments, and land use. Irrigation and applications can have large impacts on microbial communities and change the bioavailability of many metals that are common in urban soils (Lyu & Chen, 2016). Soil is important for many ecosystem functions from habitats for insects to water quality, maintaining soil health is crucial for maintaining a healthy ecosystem and healthy humans.

Methods

Site Selection

Our test sites were chosen based on green spaces highlighted in the K-State Master Plan, with consideration given to the unique characteristics of each location. The Master Plan emphasized the Quad, Anderson Lawn, and Campus Creek, with the Meadow and a Seaton Hall bioswale rounding out our study sites. Each site has distinctive features that set it apart, offering a variety of foliage, water resources, and aesthetic value. The Quad and Anderson Lawn share similarities, both dominated by a well-maintained monoculture of turf grass with a diverse range of tree species scattered throughout. They also provide a historic backdrop, with landmarks such as Anderson Hall, Hale Library, and Justin Hall. Campus Creek runs through the campus, alleviating stormwater runoff and features a selection of tree species, wildflowers, and shrubs. The Meadow, located near the Marianna Kistler Beach Museum of Art, was chosen for its resemblance to grasses and forbs native to the Tallgrass Prairie ecoregion. Among the several bioswales on campus, we focused on the one southeast of Seaton Hall, notable for its wide array of grasses and forbs native to the Tallgrass Prairie. These plants play an essential role in stormwater retention, mitigating runoff from impermeable surfaces across campus while also providing a foraging opportunity to pollinators and arthropods.

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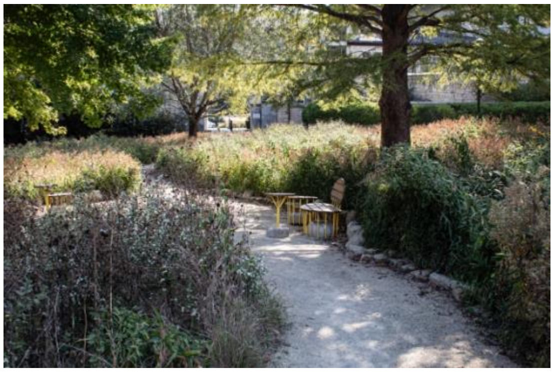
	

Fig. 1 – Green Space Survey Images – Survey respondents were asked to select their preferred green space from the options above. The images were taken by Madison Neal. The locations are listed as the following: 1) The Bioswales, 2) Campus Creek, 3) The Meadow, 4) The Quad/Lawn.

Soil Properties Assessment

The soil properties that were used in this research were focused on verifying that soils matched previous surveys so that we could compare properties from what is was previously surveyed to current conditions. Texture, Color, and Compaction were the main properties that we looked at in the soil. Color is done using a Munsell color book which helps us to determine whether the survey is still correct and whether the soil is relevant, while also allowing us to compare the surveyed color to current conditions for an approximation of organic matter. In agricultural settings, this is done on fence rows to show the difference between native or less intensely used soils versus anthropogenic soils. Texture is used to confirm the surveys and series of the soil, and texture gives some insight into the drainage and structure of the soil.

Infiltration Tests

Infiltration measurements were conducted using a single metal infiltrometer ring (diameter of 16 cm and height of 15.5 cm) to measure the water infiltration rate into the soil over time. The sample sites were selected by finding an area representative of the predetermined locations. The sample area was cleared of debris including vegetation, leaves, or stones to ensure the maximum surficial area for water flow. The single ring infiltrometer was hammered 5 cm into the ground to prioritize vertical infiltration into the soil profile. The ring was then filled with 80-100 mm of water and water levels were recorded at regular time intervals (approximately every two minutes) until the total drainage of the ring. This was conducted twice to ensure initial saturated conditions. The infiltration rate was then calculated by dividing the water depth by the time.

Fig. 2 – A) Shows the water depth measurement in the infiltration ring. B) Shows the cleared testing spot and the tools used to insert the infiltration ring.

Survey Development

This study was conducted using a quantitative survey and was administered to students, faculty, and staff across the Kansas State University (KSU) campus in Manhattan, Kansas. The survey was made using Google Forms. The survey first asked the participants five questions about demographics including race, age, and location. After asking about demographics, the survey then asked participants five more questions about the green spaces they find the most appealing and to rate each of the spaces.

The survey was distributed through many facets and was open for 15 days. It was distributed to campus clubs and organizations, email newsletters, and passed from person to person. KSU has a daily electronic newsletter that goes out to all students, faculty, and staff. The survey was included in the newsletter along with a QR code that led participants directly to the survey.

The survey was submitted to Kansas State University's Office of Research Integrity, Compliance, and Security (URCO) to gain clearance for the project. The project has been classified as Non-Research.

The targeted audience of this survey was KSU's students, faculty, and staff. The goal was to reach a diverse set of people in various roles on campus. The diversity of the participants was recorded by the demographic questions at the beginning of the survey.

After the survey responses were collected, the data was analyzed to find the trends and correlations. Results identified which campus green spaces were perceived as the most desirable overall and based on the demographics of the respondents.

Arthropod Sampling

1. Pitfall Traps

To sample ground-dwelling arthropods, we chose pitfall traps due to their ease of standardization, low maintenance, and straightforward installation and retrieval. Pitfall traps consist of two plastic cups stacked together, with the bottom cup featuring drainage holes to prevent excess water buildup. The top cup is filled with a soapy water solution that reduces surface tension, trapping any arthropod that falls in. The traps are flush with the soil surface and covered with a mesh wire to prevent small animals like mice and frogs from entering.

Additionally, a plastic cover, positioned about five inches above the trap, helps shield it from precipitation and prevents the cup from overflowing. At each site, we placed two pitfall traps—one in an open area and the other under shrub or canopy cover. Across our four sites, a total of eight pitfall traps were set out for one week (from October 1 to October 8, 2024). After the sampling period, the traps were retrieved, and the specimens were preserved in a 95% ethanol solution. The arthropods were then processed and sorted into the following groups: Roly Poly/Woodlice, Orthoptera (grasshoppers and crickets), Ground Beetles, Diptera (flies), Spiders, Ants, Hemiptera (true bugs), Beetles, and other Hymenoptera.

2. Pollinator Observations

Pollinators were collected using bee vacuums, a modified hand vacuum designed to gently suck up insects, which are then stored in small tubes covered with mesh and plastic to ensure proper airflow and sample retention. On October 3, 2024 collected insects pollinating flowers, while also noting any pollinators we couldn’t capture during a 10-minute observation period. Due to the conservation concerns surrounding bumblebees (*Bombus sp.*), we refrained from collecting them as the vacuuming method may prove lethal. These bumblebees were instead noted and left uncollected. All samples were stored in a freezer for later identification, with specimens pinned and labeled with information including the collector's name, site, date, and species. The pollinators were categorized into the following groups: *Apis mellifera* (honeybees), *Ceratina* (small carpenter bees), *Bombus* (bumblebees), *Halictus* (furrow bees), *Augochlorini* (green sweat bees), *Agapostemon* (striped sweat bees), Lepidoptera (moths and butterflies), wasps, *Diptera* (flies), goldenrod soldier beetles, *Hemiptera* (true bugs), cucumber beetles, spiders, and *Neuroptera* (lacewings).

3. Shannon-Weiner Species Diversity Index

$$H' = -\sum_{i=1}^{s} p_i \ln p_i$$

Fig. 3 – Equation for the Shannon-Weinver Species Diversity Index (Nolan, K.A. and Callahan, J.E., 2006)

The Shannon-Weiner Species Diversity Index (FIGURE 3) is an equation used to calculate the species diversity within a site. It is calculated by taking the total number of each species, the proportion of each species to the total number of individuals (pi), and sums the proportion times the natural log (ln) of the proportion for each species. It is then multiplied by –1 to make the negative value positive. A larger end value results in a higher species diversity within the site.

Results

Infiltration Results

The infiltration measurements were conducted under similar environmental conditions to ensure equal representation over the sites. The saturated infiltration rates were high with water movement between 10-20 minutes depending on the sites. Average infiltration rates are shown in Figure 4.

Average Infiltration Rates in Saturated Conditions			
Seaton Bioswale	Campus Creek	Quad/Lawn	The Meadow
24 mm/min	11 mm/min	21 mm/min	17 mm/min

Fig. 4

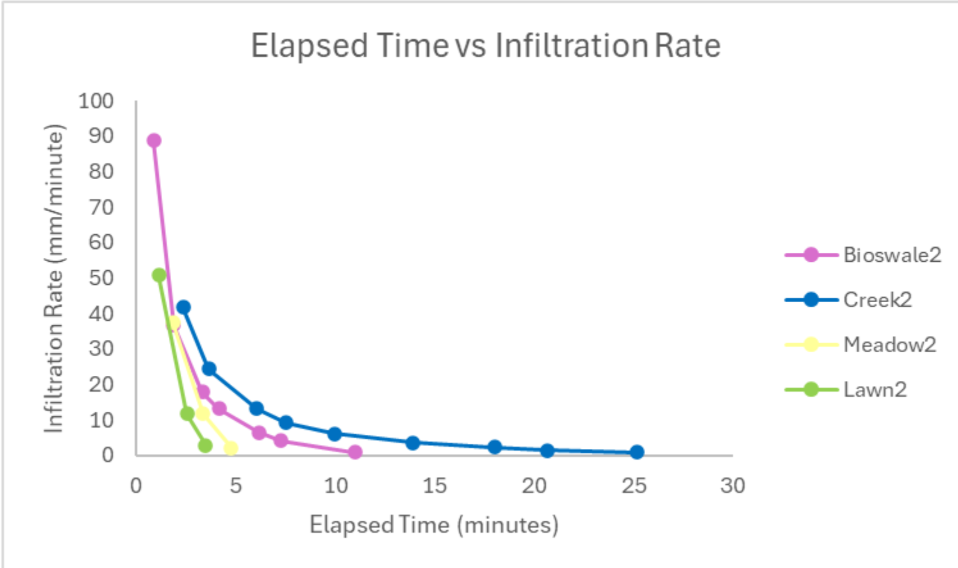


Fig. 5 – Infiltration Rate versus Time to visually compare the rates at each site.

Survey Results

The survey was distributed through messaging campus organizations and through the daily electronic newsletter sent out to all students, faculty, and staff. The survey was active from November 5th - November 19th, 2024, and received a total of 131 responses.

The Kruskal-Wallis test is a non-parametric statistical test that does not require data to be normally distributed. This test was used since not all of the survey data followed normal distributions. It is used for comparing data (in this case ratings of each landscape type) among two or more independent samples (in this case, the demographic categories established in the survey). Samples do not need equal numbers of data, which was another reason for using this test for the survey dataset (which had unequal numbers of responses across various demographic categories). When more than two categories were included in the KW test and a p-value of less than 0.1 was reported, the Steel Dwass non-parametric test for multiple comparisons was used to test for differences between each category.

P-values of less than 0.1 are noted as providing evidence for potential differences in landscape preferences by demographic category. All statistical tests were run using the JMP statistical software tool (SAS, version 18). (The p-value in the JMP reports is given in the table titled Kruskal-Wallis Test, ChiSquare Approximation.)

Overall Rating

The overall average ratings for each green space indicate that the Meadow is the most preferred area on KSU's campus, followed by the Bioswales, the Quad/Lawn, and Campus Creek. The Meadow received an average score of 3.16, while the Bioswales scored 2.95, the Quad/Lawn scored 2.30, and Campus Creek received a score of 2.08.

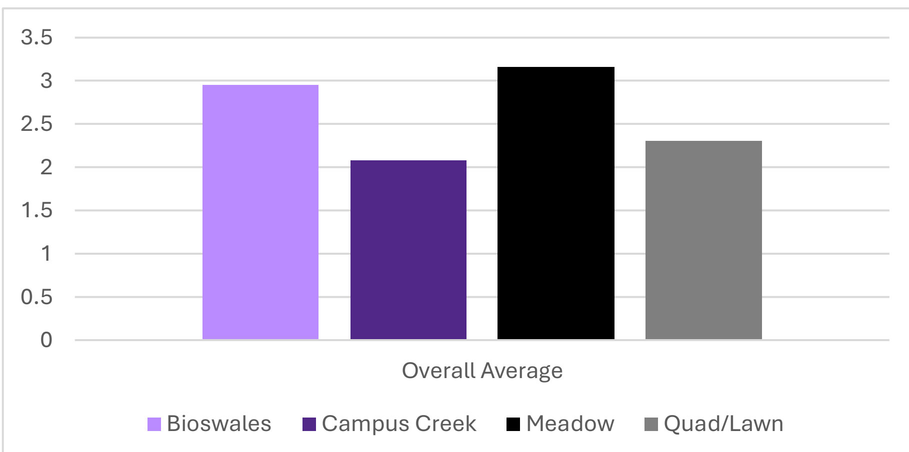


Fig. 6 – Overall Ratings of Each Green Space

Classification Rating

The average ratings for each of the green spaces based on classification indicate that K-State students prefer the Bioswales the most, with an average score of 3.13, while Campus Creek received the lowest score of 1.99. Among K-State faculty and staff, the Meadow is the most preferred, with an average score of 3.30, whereas Campus Creek again received the lowest score of 2.19. Manhattan residents prefer the Meadow the most with a score of 3.33, while the Bioswales and the Quad/Lawn tied for least preferred, each scoring 2.00.

According to the Kruskal-Wallis test, there is a statistical difference of 0.0109 between the groups for the bioswales. To further investigate, the Steel-Dwass method was applied, indicating that the observed significant differences are most likely between K-State students and both K-State faculty/staff, as well as between K-State students and Manhattan residents. No significant statistical differences were found for the meadow, the quad/lawn, or Campus Creek.

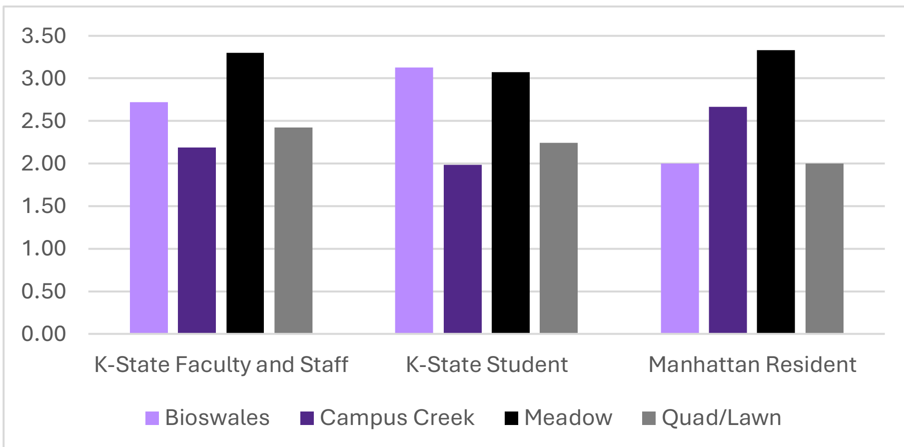


Fig. 7 – Classification Ratings of Each Green Space

Location Rating

The average ratings for each of the green spaces based on location indicate that rural residents prefer the Meadow the most, with an average score of 3.35, while Campus Creek received the lowest score of 2.08. Among suburban residents, the Bioswales is the most preferred, with an average score of 3.07, whereas Campus Creek again received the lowest score of 1.95. Urban residents prefer the Meadow the most with a score of 2.89, while the Quad/Lawn is the least preferred with a score of 2.21.

There are no significant statistical differences for each green space based on location. However, it should be noted that the meadow had a p-value of 0.0706 indicating evidence for potential differences in landscape preferences in suburban and rural locations.

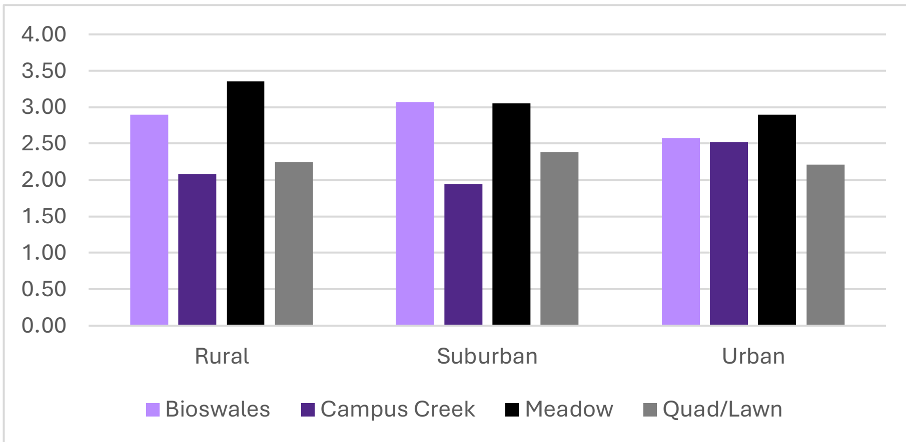


Fig. 8 – Location Ratings of Each Green Space

Gender Rating

The average ratings for each of the green spaces based on gender indicate that females prefer the Meadow the most, with an average score of 3.12, while Campus Creek received the lowest score of 1.98. Among males, the Meadow is the most preferred, with an average score of 3.16, whereas Campus Creek again received the lowest score of 2.18. Nonbinary/third gender prefer the Meadow the most with a score of 3.80, while the Quad/Lawn is the least preferred with a score of 1.80.

There are no significant statistical differences for each green space based on location.

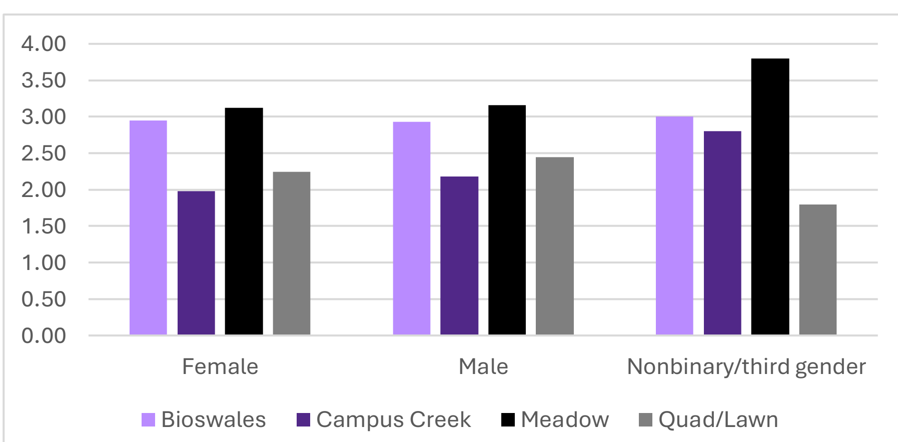


Fig. 9 – Gender Ratings of Each Green Space

Race Rating

The average ratings for each of the green spaces based on race indicate that racial/ethnic minority individuals prefer the Bioswales the most, with an average score of 3.08, while Campus Creek received the lowest score of 2.12. Among white/Caucasian individuals, the Meadow is the most preferred, with an average score of 3.21, whereas Campus Creek again received the lowest score of 2.07. The data was split and evaluated between racial/ethnic minority individuals and white/Caucasian individuals due to the overwhelming responses by white/Caucasian individuals.

There are no significant statistical differences for each green space based on location.

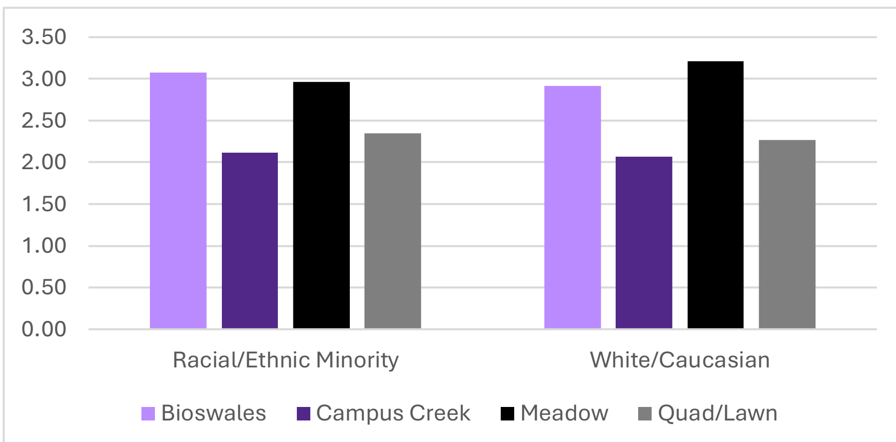


Fig. 10 – Gender Ratings of Each Green Space

Arthropod Sample Results

1. Pitfall Traps

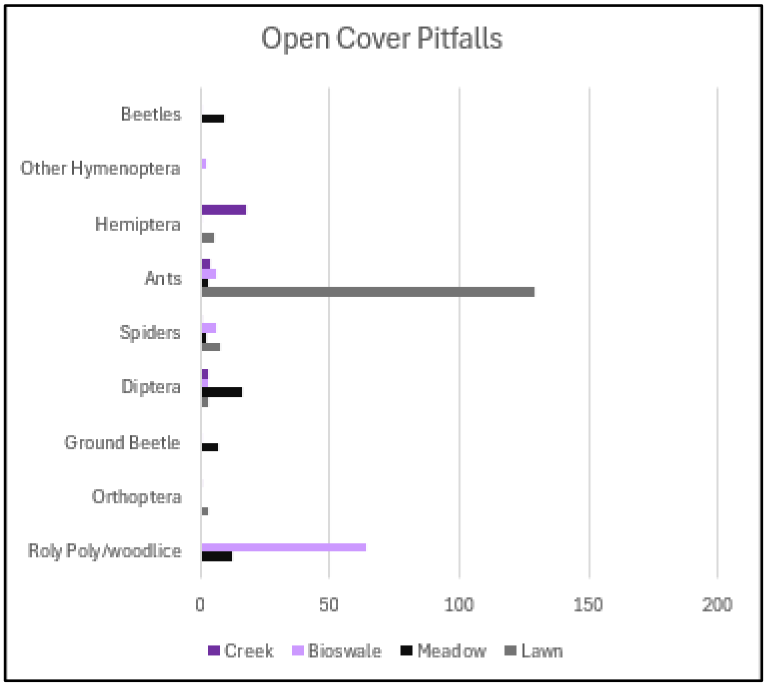


Fig. 11 – Open Cover Pitfall Trap results

Within the Open Cover Pitfall Trap results: Campus Creek had 0 *Roly-Polies*, 1 *Orthoptera*, 0 *Ground Beetles*, 3 *Diptera*, 1 *Spiders*, 4 *Ants*, 18 *Hemiptera*, 0 *Other Hymenoptera*, 0 *Beetles*, 0 *Neuroptera*, 0 *Mites*, 0 *Thrips*, and 0 *Centipede*; Seaton Bioswale had 64 *Roly-Polies*, 0 *Orthoptera*, 1 *Ground Beetles*, 3 *Diptera*, 6 *Spiders*, 6 *Ants*, 1 *Hemiptera*, 2 *Other Hymenoptera*, 1 *Beetles*, 0 *Neuroptera*, 0 *Mites*, 0 *Thrips*, and 0 *Centipedes*; Meadow had 12 *Roly-Polies*, 0 *Orthoptera*, 7 *Ground Beetles*, 16 *Diptera*, 2 *Spiders*, 3 *Ants*, 0 *Hemiptera*, 0 *Other Hymenoptera*, 9 *Beetles*, 0 *Neuroptera*, 0 *Mites*, 0 *Thrips*, and 0 *Centipede*; Anderson Lawn had 0 *Roly-Polies*, 3 *Orthoptera*, 0 *Ground Beetles*, 3 *Diptera*, 8 *Spiders*, 129 *Ants*, 5 *Hemiptera*, 0 *Other Hymenoptera*, 0 *Beetles*, 0 *Neuroptera*, 0 *Mites*, 0 *Thrips*, and 1 *Centipede*.

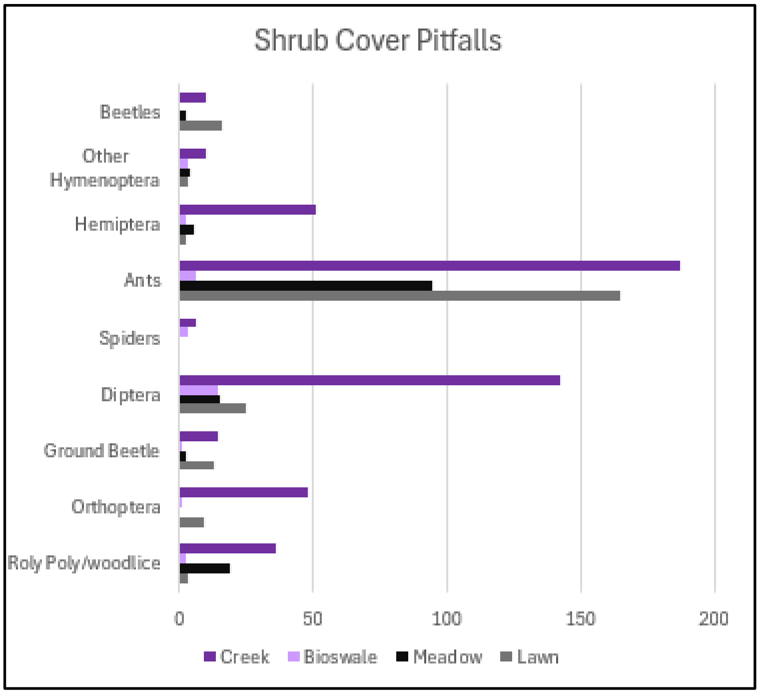


Fig. 12 – Shrub Cover Pitfall Trap results

Within the Shrub Cover Pitfall Trap results: Campus Creek had 36 *Roly-Polies*, 48 *Orthoptera*, 14 *Ground Beetles*, 142 *Diptera*, 6 *Spiders*, 187 *Ants*, 51 *Hemiptera*, 10 *Other Hymenoptera*, 10 *Beetles*, 1 *Neuroptera*, 0 *Mites*, 0 *Thrips*, and 0 *Centipede*; Seaton Bioswale had 2 *Roly-Polies*, 1 *Orthoptera*, 1 *Ground Beetles*, 14 *Diptera*, 3 *Spiders*, 6 *Ants*, 2 *Hemiptera*, 3 *Other Hymenoptera*, 0 *Beetles*, 0 *Neuroptera*, 0 *Mites*, 0 *Thrips*, and 0 *Centipedes*; Meadow had 19 *Roly-Polies*, 0 *Orthoptera*, 2 *Ground Beetles*, 15 *Diptera*, 0 *Spiders*, 94 *Ants*, 5 *Hemiptera*, 4 *Other Hymenoptera*, 2 *Beetles*, 0 *Neuroptera*, 0 *Mites*, 0 *Thrips*, and 0 *Centipede*; Anderson Lawn had 3 *Roly-Polies,* 9 *Orthoptera*, 13 *Ground Beetles*, 25 *Diptera*, 0 Spiders, 165 *Ants*, 2 *Hemiptera*, 3 *Other Hymenoptera*, 16 *Beetles*, 0 *Neuroptera*, 3 *Mites*, 2 *Thrips*, and 0 *Centipede*.

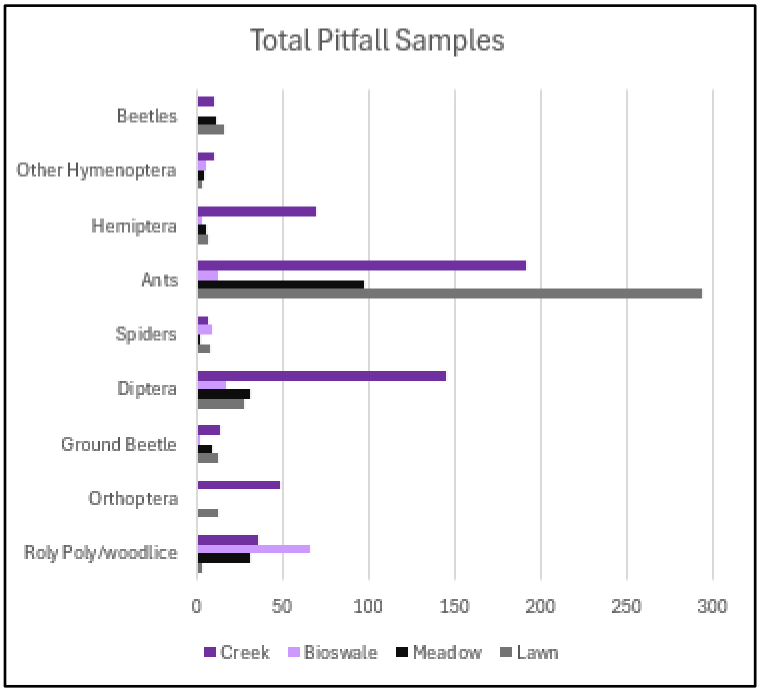


Fig. 13 – Shrub Cover Pitfall Trap results

The total Pitfall Trap results: Campus Creek had 36 *Roly-Polies*, 49 *Orthoptera*, 14 *Ground Beetles*, 145 *Diptera*, 7 *Spiders*, 191 *Ants*, 69 *Hemiptera*, 10 *Other Hymenoptera*, 10 Beetles, 1 *Neuroptera*, 0 *Mites*, 0 *Thrips*, and 0 *Centipede, TOTAL*= 532; Seaton Bioswale had 66 *Roly-Polies*, 1 *Orthoptera*, 2 *Ground Beetles*, 17 *Diptera*, 9 *Spiders*, 12 *Ants*, 3 *Hemiptera*, *Other Hymenoptera*, 1 *Beetles*, 0 *Neuroptera*, 0 *Mites*, 0 *Thrips*, and 0 *Centipedes, TOTAL*= 116; Meadow had 31 *Roly-Polies*, 0 *Orthoptera*, 9 *Ground Beetles*, 31 *Diptera*, 2 *Spiders*, 97 *Ants*, 5 *Hemiptera*, 4 *Other Hymenoptera*, 11 *Beetles*, 0 *Neuroptera*, 0 *Mites*, 0 *Thrips*, and 0 *Centipede, TOTAL*= 190; Anderson Lawn had 3 *Roly-Polies*, 12 *Orthoptera*, 13 *Ground Beetles*, 28 *Diptera*, 8 *Spiders*, 294 *Ants*, 7 *Hemiptera*, 3 *Other Hymenoptera*, 16 *Beetles*, 0 *Neuroptera*, 3 *Mites*, 2 *Thrips*, and 1 *Centipede, TOTAL*= 390.

	Site Name	Roly Poly/woodlice	Orthoptera	Ground Beetle	Diptera	Spiders	Ants	Hemiptera	Other Hymenoptera	Beetles	Neuroptera	Mites	Thrips	Centipede	Shannon Diversity Index
pi	Anderson	0.007692308	0.030769231	0.033333333	0.07179487	0.02051282	0.753846	0.017948718	0.007692308	0.04102564		0.007692308	0.005128205	0.002564103	
ln(pi)	Anderson	-4.86753445	-3.481240089	-3.401197382	-2.6339422	-3.8867052	-0.28257	-4.02023659	-4.86753445	-3.19355802		-4.86753445	-5.27299956	-5.966146739	
pi x (ln(pi))	Anderson	-0.037442573	-0.10711508	-0.113373246	-0.1891035	-0.0797273	-0.21301	-0.072158093	-0.037442573	-0.13101776		-0.037442573	-0.02704102	-0.015297812	1.060
pi	Meadow	0.163157895		0.047368421	0.16315789	0.01052632	0.510526	0.026315789	0.021052632	0.05789474					
ln(pi)	Meadow	-1.813036868		-3.049799495	-1.8130369	-4.5538769	-0.67231	-3.63758616	-3.860729711	-2.8491288					
pi x (ln(pi))	Meadow	-0.295811278		-0.144464187	-0.2958113	-0.0479355	-0.34323	-0.095725952	-0.08127852	-0.16494956					1.469
pi	Bioswale	0.568965517	0.00862069	0.017241379	0.14655172	0.07758621	0.103448	0.025862069	0.043103448	0.00862069					
ln(pi)	Bioswale	-0.563935449	-4.753590191	-4.060443011	-1.9203768	-2.5563656	-2.26868	-3.654977902	-3.144152279	-4.75359019					
pi x (ln(pi))	Bioswale	-0.320859824	-0.040979226	-0.070007638	-0.2814345	-0.1983387	-0.23469	-0.094525291	-0.135523805	-0.04097923					1.417
pi	Creek	0.067669173	0.092105263	0.026315789	0.27255639	0.01315789	0.359023	0.129699248	0.018796992	0.01879699	0.001879699				
ln(pi)	Creek	-2.693124551	-2.384823191	-3.63758616	-1.2999097	-4.3307333	-1.02437	-2.042536985	-3.974058396	-3.9740584	-6.276643489				
pi x (ln(pi))	Creek	-0.182241511	-0.219654768	-0.095725952	-0.3542987	-0.0569833	-0.36777	-0.264915511	-0.074700346	-0.07470035	-0.011798202				1.703

Fig. 14 – Shannon-Weiner Species Diversity Index of Pitfall traps

After entering the Pitfall trap data into the Shannon-Weiner Species Diversity Index the results were: Anderson Lawn at 1.060; Meadow at 1.469; Seaton Bioswale at 1.417; and Campus Creek at 1.703.

2. Pollinator Observations

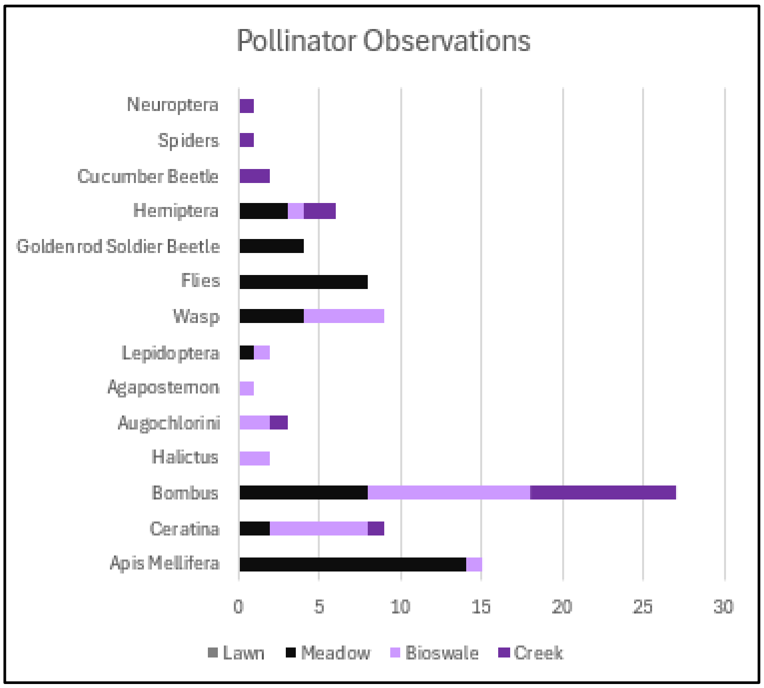


Fig. 15 – Pollinator Observation data

The total pollinator observations were as follows: Anderson Lawn had 0 *Apis mellifera*, 0 *Ceratina*, 0 *Bombus*, 0 *Halictus*, 0 *Augochlorini*, 0 *Agapostemon*, 0 *Lepidoptera*, 0 *wasps*, 0 *Diptera*, 0 *goldenrod soldier beetles*, 0 *Hemiptera*, 0 *cucumber beetles*, 0 *spiders*, and 0 *Neuroptera, TOTAL*= 0*;* Meadow had 14 *Apis mellifera*, 2 *Ceratina*, 8 *Bombus*, 0 *Halictus*, 0 *Augochlorini*, 0 *Agapostemon*, 1 *Lepidoptera*, 4 *wasps*, 8 *Diptera*, 4 *goldenrod soldier beetles*, 3 *Hemiptera*, 0 *cucumber beetles*, 0 *spiders*, and 0 *Neuroptera, TOTAL*= 44*;* Seaton Bioswale had 1 *Apis mellifera*, 6 *Ceratina*, 10 *Bombus*, 2 *Halictus*, 2 *Augochlorini*, 1 *Agapostemon*, 1 *Lepidoptera*, 5 *wasps*, 0 *Diptera*, 0 *goldenrod soldier beetles*, 1 *Hemiptera*, 0 *cucumber beetles*, 0 *spiders*, and 0 *Neuroptera, TOTAL*= 29*;* and Campus Creek had 0 *Apis mellifera*, 1 *Ceratina*, 9 *Bombus*, 0 *Halictus*, 1 *Augochlorini*, 0 *Agapostemon*, 0 *Lepidoptera*, 0 *wasps*, 0 *Diptera*, 0 *goldenrod soldier beetles*, 2 *Hemiptera*, 2 *cucumber beetles*, 1 *spiders*, and 1 *Neuroptera, TOTAL*= 17.

	Site Name	Apis Mellifera	Ceratina	Bombus	Halictus	Augochlorini	Agapostemon	Lepidoptera	Wasp	Flies	Goldenrod Soldier Beetle	Hemiptera	Cucumber Beetle	Spiders	Neuroptera	Shannon Diversity Index
pi	Anderson															
ln(pi)	Anderson															
pi x (ln(pi))	Anderson															No value
pi	Meadow	0.318181818	0.045454545	0.18181818				0.022727273	0.090909091	0.1818	0.090909091	0.068181818				
ln(pi)	Meadow	-1.145132304	-3.09104245	-1.70474809				-3.784189634	-2.39789527	-1.7047	-2.397895273	-2.685577345				
pi x (ln(pi))	Meadow	-0.364360279	-0.14050193	-0.3099542				-0.08600431	-0.21799048	-0.31	-0.217990479	-0.183107546				1.830
pi	Bioswale	0.034482759	0.206896552	0.34482759	0.068965517	0.068965517	0.034482759	0.034482759	0.172413793			0.034482759				
ln(pi)	Bioswale	-3.36729583	-1.57553636	-1.06471074	-2.674148649	-2.674148649	-3.36729583	-3.36729583	-1.75785792			-3.36729583				
pi x (ln(pi))	Bioswale	-0.116113649	-0.32597304	-0.36714163	-0.184424045	-0.184424045	-0.116113649	-0.116113649	-0.30307895			-0.116113649				1.713
pi	Creek		0.058823529	0.52941176		0.058823529						0.117647059	0.117647059	0.058823529	0.058823529	
ln(pi)	Creek		-2.83321334	-0.63598877		-2.833213344						-2.140066163	-2.140066163	-2.833213344	-2.833213344	
pi x (ln(pi))	Creek		-0.16665961	-0.33669994		-0.166659608						-0.25177249	-0.25177249	-0.166659608	-0.166659608	1.507

Fig. 16 – Shannon-Weiner Species Diversity Index of Pollinator Observations

After entering the Pollinator Observation data into the Shannon-Weiner Species Diversity Index the results were: Anderson Lawn at NO VALUE; Meadow at 1.830; Seaton Bioswale at 1.713; and Campus Creek at 1.507.

<u>Soil Health Results</u>

Color is used as an indirect measure of soil organic matter and showed no difference on any sites except for the Meadow. The Bioswale could not be compared to any site because of man-made changes during the process of making the bioswale. The Bioswale seemed to be a top layer of mostly sand used to increase infiltration and reduce runoff with the old soil compacted underneath. Compaction was looked at slightly to determine if a compacted layer would impact infiltrations; Campus Creek was the only site that showed signs of compaction.

Site Name	Series	Expected Color	Observed Color	Texture
Meadow	Reading	10YR 3/2	10YR 2/2	Silt Loam
Campus Creek	Ivan	10YR 2/2	10YR 2/2	Silt Loam
Anderson Lawn	Smolan	10YR 3/2	10YR 3/2	Silty Clay Loam
Bioswale*	N/A	N/A	10YR 2/2	Sandy Loam

Fig. 17 – Soil Color/Texture Results

Discussion

Infiltration

The results from the infiltration tests show how different vegetative green spaces can manage urban stormwater runoff. Each location has unique properties such as vegetation, percentage of ground cover, and soil type that contribute to water's ability to infiltrate. In regions with well-established vegetation, there is a presence of root systems that create macropores that allow preferential flow for water infiltration.

The Quad/Lawn had 100% ground coverage and consisted of Bermuda grass with silty clay soil. Quick infiltration in the Quad/Lawn location was expected and can be related to the work done in the Liang et al. (2017) study. Liang et al. (2017) describe the presence of thatch in lawns allowing for a higher maximum water content and increasing the time water seeps into the subsurface. We can interpret this quick infiltration as due to the presence of thatch and well-developed root systems.

The Meadow had 100% ground coverage with a silty loam soil and had a variety of vegetation present such as Little Bluestem, Aster Daisy, Side Oats Gramma, Black Eye Susans, Su Mac, Coreopsis, River Oats, Coneflowers, New England Aster trees, Bald Cypress trees. The vegetation at this site was selected from the Flint Hills grassland, and it has been eleven years since it established a bountiful root system below the surface. Van der Kamp et al. (2002) found large amounts of infiltration for a plot of land converted from cultivated plots to a natural prairie system. Five years after its establishment, the prairie developed an extensive macropore system that increased infiltration. The Meadow mirrors this study and is shown in the fast infiltration rates at this site.

The Seaton Bioswale had about 80% ground coverage with sandy soil and vegetation such as Chinese Elks, Milkweed, Aster, Golden Rod, and Coneflowers. This location had the quickest infiltration rates as it is designed to retain stormwater. The presence of sandy soil and vegetation with expansive roots increases the infiltration rate.

Campus Creek had 60% ground coverage and Bald Cypress trees, Willow trees, Creeping Charlie, and Bermuda grass vegetation. This region has been heavily altered due to human activity to increase the storage capacity of urban runoff on campus and reduce flooding during storm events. This anthropogenic aspect has resulted in compacted urban soils decreasing the infiltration rate. Data has shown that compacted soils decrease water infiltration and increase nutrient runoff. Dense vegetation acts as a buffer strip to encourage infiltration through the tortuous pathways before reaching an open body of water Steinke et al. (2007). Yang et al. (2011) emphasized the importance of infiltration as the soil is a purification system for nutrients like nitrate and in compacted areas with low vegetation runoff increases. As this location only had 60% ground coverage we can connect the slow infiltration rate to these variables.

This study was conducted in the early fall season which creates limitations in understanding the infiltration rate changes that occur during a frozen condition. Steinke et al. (2007) described infiltration rates in a frozen condition, which is something we can take into consideration for future research in this area.

Survey

The results from the survey show how different demographics prefer different campus green spaces. The results indicate that demographics play a significant role in the perception of green spaces. These findings align with previous studies that show that demographics influence perceptions of green spaces. Because of different cultural backgrounds, individuals will have varying preferences and emotional responses to green spaces (Wang et al., 2024). The differences in perception may be attributed to the varying needs and experiences of these groups.

The Meadow consistently received the highest ratings across all groups indicating that the space is generally perceived as the most desirable on KSU's campus. This is likely due to the natural environment that represents the surrounding areas like the Konza Prairie Natural Area. The Bioswales was rated second and was particularly favored by students and suburban residents. The Quad/Lawn and Campus Creek were rated the lowest, but Campus Creek consistently scored low across almost all demographic groups suggesting dissatisfaction with the space. This is possibly due to issues related to aesthetic appeal compared to other green spaces. Previous studies have suggested that perceptions of green spaces are often driven by factors such as plant species diversity, maintenance, safety, and allergens (Hao et al., 2024; Poje et al., 2024)

Among K-State students, the Bioswales were the most preferred. This suggests that students may be more attuned to the ecological aspects of green spaces since this area was designed for stormwater management. Both Manhattan residents and KSU faculty/staff preferred the Meadow. This could be due to the placement of the green space being on the outskirts of campus and closer to the Manhattan community. The low rating of the Bioswales and the Quad/Lawn by the Manhattan residents suggests that these spaces do not meet the needs of residents, possibly due to accessibility.

This study also explored preferences based on geographic location including rural, suburban, and urban residents. Rural residents rated the Meadow the highest suggesting a preference for more natural spaces typical of rural areas. Suburban residents preferred the Bioswales potentially reflecting the ecological and aesthetic aspects that suburban environments hold. Urban residents also favored the Meadow but rated the Quad/Lawn the least, which may suggest a preference for more natural spaces rather than a manicured and highly trafficked area.

For gender preferences, each category ranked the Meadow as the most preferred space which aligns with the green space having the highest overall average.

This study found that racial/ethnic minority individuals preferred the Bioswales, while white/Caucasian individuals preferred the Meadow. These differences may be due to varying cultural values or experiences with green spaces. However, it is important to note that the data for racial/ethnic minorities is limited and does not accurately represent the population. Further research with a more diverse sample is needed to better understand these preferences.

Arthropod Sampling

In all the Pitfall traps, the shrub cover had higher individual abundance than the open cover except for in the Bioswale trap. Campus Creek had the highest number of individuals at 532 followed by Anderson Lawn at 390, then the Meadow at 190, and lastly Seaton Bioswale at 116. Campus Creek also had the highest diversity at 1.703, followed by the Meadow at 1.469, the Seaton Bioswale at 1.417, and lastly Anderson Lawn at 1.060. The reason the diversity was so low at Anderson could be a result of the short and a monoculture grass it has when compared to the high diversity of Campus Creek, having a water source running through with various species of shrubs, trees, and wildflowers with a great range of open ground and covered ground. The Meadow and Seaton's Bioswale were very similar in terms of individual arthropod abundance and diversity. It makes sense given their similarities in grasses and forbs native to the Tallgrass Prairie ecoregion.

For this reason, the abundance and diversity in pollinator observations were so high as well. There is a greater number of wildflowers and nectar resources for pollinators to take advantage of at the Meadow and Seaton's Bioswale. They each had 44 individuals at 1.830 diversity and 29 individuals at 1.713, respectively. Campus Creek had 17 individuals at 1.507 diversity, whereas Anderson Lawn did not have any pollinators and therefore no diversity within its parameters. This area was dominated by the monoculture lawn and few shrubs and trees without any flowering resources for the pollinators to gather around.

The implications of these results show that the Eurocentric monoculture lawn that has dominated the U.S.'s aesthetic landscape for years is not the most practical in terms of ecosystem services. It offers the least amount of habitat for arthropods. Sure, it did have a large number of individuals at 390, but the diversity of them was low represented by 1.060. Having a water source and varying habitat in the form of grasses, trees, and forbs for arthropods is beneficial. As is planting an abundance of native wildflower and grass species represented in the Meadow and Seaton Bioswale. These resources alone drew an array of pollinators and ground-dwelling arthropods at these sites, proving that plant diversity will increase arthropod diversity.

Soil Health

When looking at the results of the color tests done on our sampling sites it is important to understand how long-term irrigation, fertilizers, and other management affect the soil. Campus Creek is not heavily managed and has been off and on construction for many years. Heavy equipment and any other effects of high foot traffic and large machines could be affecting plant growth, structure, and infiltration rates of the soil. The turf and bioswales are both more heavily managed with irrigation, fertilizers, and weed control. Fertilizers and irrigation can lessen organic matter loss and help plants create strong unstressed roots. Specifically, the Quad/Lawn has also very little disturbance to disrupt and make organic matter available leading to stable organic matter levels in the soil, while the meadow and bioswale are relatively recent developments where the soil is probably still adjusting to the disturbance. The Meadow and Bioswales create the best environment for improved soil conditions to improve with the diversity of root types and trees along with being somewhat protected from future disturbances. The lawn with irrigation and fertilization maintains its soil health through these means, and without would start to see a slowing of nutrients and plant growth. Campus Creek has a lack of groundcover that leaves it vulnerable to erosion along with high foot traffic and disturbances which leads it to be the worst out of our four sample sites.

Conclusion

This study observed the relationship between public approval and ecosystem services through scientific testing and surveying methods. It was conducted to identify areas of environmental need in the Kansas State University Master Plan. We used a Google Form survey to understand the perceptions of various demographic groups compared to the ecosystem services different green spaces provide. We researched the hydrological, arthropod, and soil quality components to analyze the ecosystem services. The results from the study show public favorability towards the Meadow and Bioswale green spaces which were both rated to have positive environmental benefits. These sites had the largest insect population and diversity and could handle high precipitation events. Continuing research on this topic can create a sustainable environment that coincides with psychological public benefits.

References

Apolline Auclerc, Léa Beaumelle, Sandra Barantal, Matthieu Chauvat, Jérôme Cortet, et al.. "Fostering the use of soil invertebrate traits to restore ecosystem functioning. Geoderma", 2022, 424, pp.116019.

Bartens, Julia, et al. "Can Urban Tree Roots Improve Infiltration through Compacted Subsoils for Stormwater Management?" *Journal of Environment Quality*, vol. 37, no. 6, 2008, p. 2048, https://doi.org/10.2134/jeq2008.0117.

Braçe, O., Garrido-Cumbrera, M., & Correa-Fernández, J. (2021). Gender differences in the perceptions of green spaces characteristics. *Social Science Quarterly*, *102*(6). https://doi.org/10.1111/ssqu.13074

Freeman, K. M. (2023). *Urban development impacts on soil health and function: A landscape architecture perspective from the Flint Hills Ecoregion.* https://hdl.handle.net/2097/43280

Gilgert, W., & Vaughan, M. (2011). "The value of pollinators and pollinator habitat to rangelands: Connections among pollinators, insects, plant communities, fish, and Wildlife". *Rangelands*, *33*(3), 14–19.

Goulson, D., Nicholls, E., Botías, C., & Rotheray, E. L. (2015). Bee declines driven by combined stress from parasites, pesticides, and lack of flowers. Science, 347(6229). https://doi.org/10.1126/science.1255957

Hao, J., Gao, T., & Qiu, L. (2024). How do species richness and colour diversity of plants affect public perception, preference and sense of restoration in urban green spaces? *Urban Forestry & Urban Greening*, *100*, 128487–128487. https://doi.org/10.1016/j.ufug.2024.128487

Hoshiba, H., & Sasaki, M. (2008). Perspectives of multi-modal contribution of Honeybee Resources to our life. Entomological Research, 38(s1). https://doi.org/10.1111/j.1748-5967.2008.00170.x

Kansas State University Campus Master Plan." *K-State.edu*, masterplan.k-state.edu/. Accessed 6 Dec. 2024.

Kishore SM, Priyadharshini TB, & Sowmya , K. (2024). "Soil Arthropods: An Unsung Heroes of Soil Fertility". *Journal of Advances in Biology & Biotechnology*, *27*(6), 118–126.

Liang, Xi, et al. "Effects of Turfgrass Thatch on Water Infiltration, Surface Runoff, and Evaporation." *Journal of Water Resource and Protection*, vol. 09, no. 07, 2017, pp. 799–810, https://doi.org/10.4236/jwarp.2017.97053.

Lyu, S., & Chen, W. (2016). Soil quality assessment of urban green space under long-term reclaimed water irrigation. *Environmental Science and Pollution Research*, *23*(5), 4639–4649. https://doi.org/10.1007/s11356-015-5693-y

Monteiro, J. A. (2017). Ecosystem services from turfgrass landscapes. *Urban Forestry & Urban Greening*, *26*, 151–157. https://doi.org/10.1016/j.ufug.2017.04.001

Nolan, K.A. and J.E. Callahan. 2006. Beachcomber biology: The Shannon-Weiner Species Diversity Index. Pages 334-338, in Tested Studies for Laboratory Teaching, Volume 27.

Poje, M., Vukelić, A., Vesna Židovec, Tatjana Prebeg, & Mihael Kušen. (2024). Perception of the Vegetation Elements of Urban Green Spaces with a Focus on Flower Beds. *Plants*, *13*(17). https://doi.org/10.3390/plants13172485

Randall, B. (2022, June 6). The value of birds and bees. Farmers.gov. https://www.farmers.gov/blog/value-birds-andbees#:~:text=Honey%20bees%20alone%20pollinate%2080,types%20of%20fruits%20and%20vegetables.

Stähli, Manfred, et al. "Soil Moisture Redistribution and Infiltration in Frozen Sandy Soils." *Water Resources Research*, vol. 35, no. 1, Jan. 1999, pp. 95–103, https://doi.org/10.1029/1998wr900045. Accessed 17 Mar. 2023.

Steinfort, U., Contreras, A., Albornoz, F., Reyes-Paecke, S., & Guilleminot, P. (2020). Vegetation survival and condition in public green spaces after their establishment: Evidence from a semi-arid metropolis. *INTERNATIONAL JOURNAL OF AGRICULTURE AND NATURAL RESOURCES*, *47*(2), 90–104. https://doi.org/10.7764/ijanr.v47i2.2045

Steinke, K., et al. "Prairie and Turf Buffer Strips for Controlling Runoff from Paved Surfaces." *Journal of Environment Quality*, vol. 36, no. 2, 2007, p. 426, https://doi.org/10.2134/jeq2006.0232. Accessed 25 Oct. 2019.

Ungaro, F., Maienza, A., Ugolini, F., Lanini, G. M., Baronti, S., & Calzolari, C. (2022). Assessment of joint soil ecosystem services supply in urban green spaces: A case study in Northern Italy. *URBAN FORESTRY & URBAN GREENING*, *67*, 127455. https://doi.org/10.1016/j.ufug.2021.127455

Van der Kamp, G., et al. "Comparing the Hydrology of Grassed and Cultivated Catchments in the Semi-Arid Canadian Prairies." *Hydrological Processes*, vol. 17, no. 3, 23 Dec. 2002, pp. 559–575, https://doi.org/10.1002/hyp.1157. Accessed 25 Mar. 2020.

Wang, M., Yu, Y., Li, M., & Long, Z. (2024). Differences in Emotional Preferences toward Urban Green Spaces among Various Cultural Groups in Macau and Their Influencing Factors. *MDPI*, *13*(4). https://doi.org/10.3390/land13040414

Watson, Vikki. "Purposeful Planning Process Drives Emotional Connections to the Spot We Love Full Well." *Kansas State University*, 30 Aug. 2024, www.k-state.edu/media/newsreleases/2024-09/by-design-campus-master-plan/. Accessed 6 Dec. 2024.

Yang, Jin-Ling, and Gan-Lin Zhang. "Water Infiltration in Urban Soils and Its Effects on the Quantity and Quality of Runoff." *Journal of Soils and Sediments*, vol. 11, no. 5, 7 Apr. 2011, pp. 751–761, link.springer.com/article/10.1007/s11368-011-0356-1, https://doi.org/10.1007/s11368-011-0356-1.

Appendix

<u>Project Survey</u>

This survey was created by Google Forms.

NRES Project Survey

The survey responses will be used to collect quantitative data on perspectives of green spaces on K-State's campus to address the research questions. This information will then be analyzed to identify trends, patterns, & relationships, ultimately informing conclusions about the relationship between perspectives and functionality of green spaces on K-State's campus.

* Indicates required question

1. What is your classification? *

Mark only one oval.

- ◯ K-State Student
- ◯ K-State Faculty & Staff
- ◯ Manhattan Resident
- ◯ Other: ____________

2. Where did you live growing up? *

Mark only one oval.

- ◯ Rural
- ◯ Suburban
- ◯ Urban
- ◯ Other: ____________

3. What is your gender identity? *

Mark only one oval.

- ◯ Male
- ◯ Female
- ◯ Nonbinary/third gender
- ◯ Other: ____________

4. What is your ethnicity? *

Check all that apply.

- ☐ Asian
- ☐ Black/African American
- ☐ Hispanic/Latino
- ☐ Native American/American Indian/Alaskan Native
- ☐ Native Hawaiian/Pacific Islander
- ☐ White/Caucasian
- ☐ Other: ____________

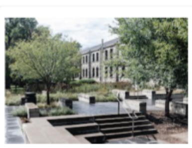
5. How old are you? *

Mark only one oval.

- ◯ Under 18 years
- ◯ 18-24 years
- ◯ 25-35 years
- ◯ 35-44 years
- ◯ 45-54 years
- ◯ 55-64 years
- ◯ 65+ years

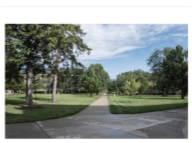
6. Which campus green space do you find most appealing? *

Mark only one oval.



◯ Bioswales

◯ The Meadow



◯ The Quad/Lawn

◯ Campus Creek

Please rate the following campus green spaces.
Note: 1 = least perferred, 4 = most preferred

7. How do you rate the Bioswales? *

Mark only one oval.

	1	2	3	4	
Lea:	◯	◯	◯	◯	Most Preferred

8. How do you rate the Meadow? *

Mark only one oval.

	1	2	3	4	
Lea:	◯	◯	◯	◯	Most Preferred

9. How do you rate the Quad/Lawn? *

Mark only one oval.

	1	2	3	4	
Lea:	◯	◯	◯	◯	Most Preferred

10. How do you rate Campus Creek? *

Mark only one oval.

	1	2	3	4	
Lea:	◯	◯	◯	◯	Most Preferred