Final Report for: Optimizing plant choices to maximize pollinator habitat, climate resilience, and social values across Denver parks and neighborhoods

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Executive Summary

Top Level Conclusions

- Park-level factors, like cultivated and native floral abundance and richness, predict pollinator diversity more than neighborhood factors - if you remove

weedy plants and plant pollinator friendly plants, bee and butterfly abundance is likely to increase regardless of landscape context.

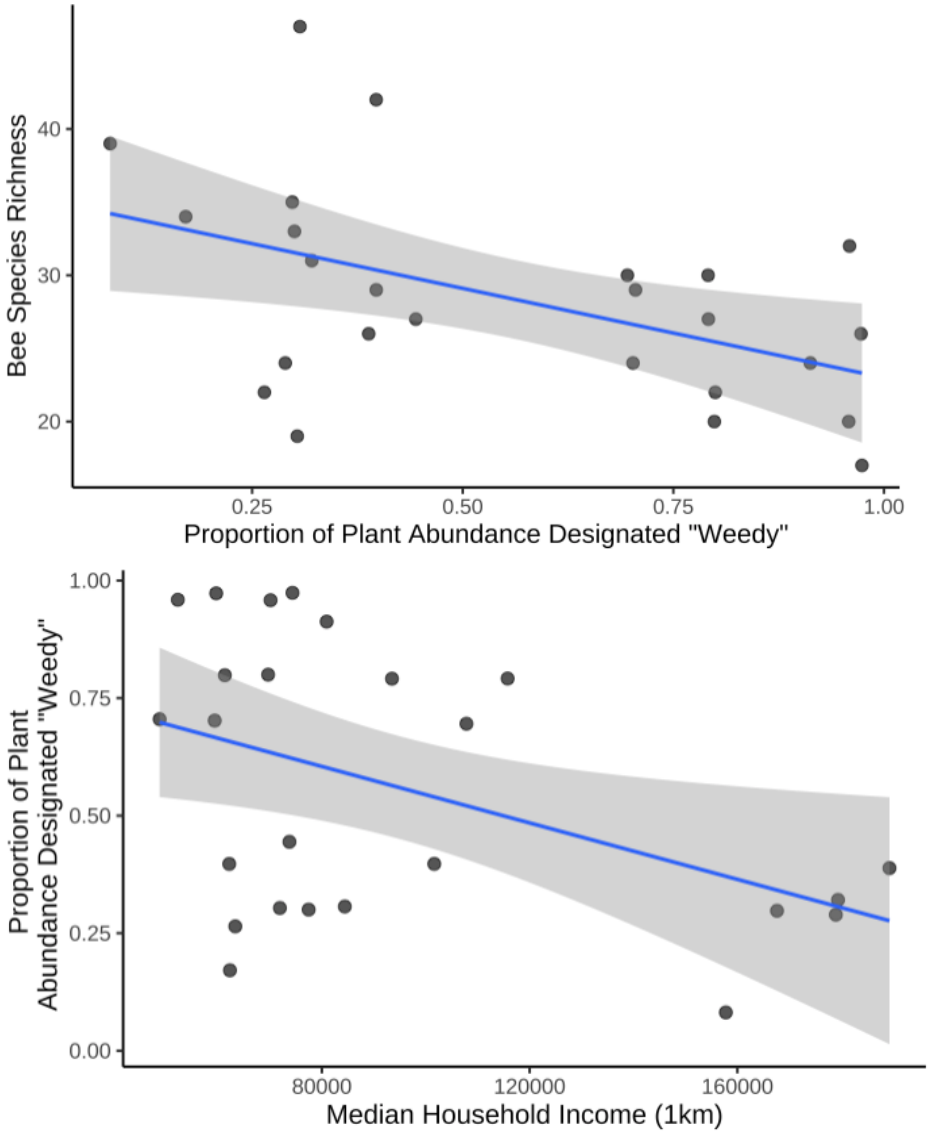
- Weedy plants have a complex role in the parks. Parks with a dominance of weedy plants tended to have lower bee species richness. Generally, weedy parks were those in lower income neighborhoods. However, although weed-dominance at the park level resulted in reduced bee diversity, weedy plants like white clover and thistles were still important food resources for pollinators when other plants were not present, and because of the commonality of weedy plants across most parks, they support a high number of local bee species. This suggests that at present, weedy plants fill an important role in supporting pollinators until native plants can be installed, but replacement with native plants should be the long-term goal.
- When installing native landscapes, “cues of care” like benches, pathways, and interpretive signs improve public acceptance of pollinator-friendly landscapes by ~5%. In our experiment, our cues of care were intentionally subtle. More apparent or visually obvious cues of care likely would yield higher rates of acceptance.
- Higher income residents, those with favorable views on bees, and more frequent park visitors are more likely to approve of pollinator-friendly landscapes. This suggests outreach and education efforts in lower income neighborhoods to encourage engagement with parks and understand bee biology are likely to improve acceptance of native Colorado landscapes.
- Key plants like purple prairie clover, various sunflowers, and milkweeds score high in almost all pollinator plant mix scenarios whether the emphasis is placed on drought or pollinator friendliness. However, complementary plants like rocky mountain bee plant, spreading fleabane, or goldenrod can help ensure objectives like more cultural relevance, diversity of pollinator species, and insurance against poor years for any particular plant species can be supported.

Global declines in pollinator populations and increasing urbanization call for the need to create pollinator-friendly habitat within urban environments and increase the connection that urban residents feel with natural spaces. Our program consisted of three broad objectives around this subject area. 1) To understand the existing pollinator biodiversity across Denver Parks and how it relates to local and landscape scale factors like floral species richness within parks and urbanization and economic factors surrounding parks; 2) to describe the values and perspectives of Denver residents towards pollinator-friendly landscaping and understand how

to improve the favorability of landscaping elements associated with native plant restoration; and 3) to provide guidance on pollinator-friendly plant mix design for Denver Parks and Recreation with respect to climatic factors like drought tolerance as well as their potential attractiveness to pollinators.

Objective 1 Executive Summary: Patterns of bee and butterfly diversity across Denver Parks

To address objective 1, we surveyed 25 parks representing a broad geographic and economic spectrum across Denver over 3 survey periods in summer 2023. We found 143 bee species and 33 butterfly species across the parks. 36 bee species are first-ever records within the county of Denver. Combined with previously known species for the county of Denver, this suggests our surveys detected approximately ~75% of the regional species pool (pending final identifications of some cryptic species). Bee and butterfly richness were not primarily determined by landscape scale factors like urban green space or surrounding population density. Instead, local factors like floral species richness and abundance predict bee and butterfly diversity. Importantly, although pollinator diversity was not *directly* predicted by factors like neighborhood wealth (e.g. median household income within 1km), parks in lower income neighborhoods were more likely to have a dominance of weedy plants and parks with weedy plants tended to have lower pollinator richness (i.e. species diversity). Because pollinator diversity is generally predicted by local factors (e.g. floral abundance and diversity), rather than landscape factors, this suggests that efforts to add pollinator habitat within parks are likely to be successful regardless of the surrounding landscape context (i.e. “if you build it they will come”). However, some caution is warranted with preliminary results and only a single year of study in a particularly wet season.



Objective 2 Executive Summary: Perceptions of practitioners and residents towards pollinator-friendly landscapes in Denver Parks

Within Objective 2, we conducted five focus groups with 24 practitioners from DPR and surveyed 832 Denver residents. Focus groups revealed insights about specific pollinator-friendly plants, design/maintenance decision-making, and social issues related to pollinator-friendly landscaping in Denver Parks. Online survey respondents were approximately representative of Denver residents by age, gender, and household income. Overall, survey respondents slightly preferred the turfgrass landscape render over the pollinator friendly landscape render in both seasons (summer: 55% turfgrass vs. 45% pollinator-friendly; winter: 57.8%

turfgrass vs. 42.2% pollinator-friendly). Experimental results showed that while the addition of “cues to care” (i.e., benches, signs, and wildlife houses) did not improve respondents perceptions of pollinator-friendly landscaping in Denver Parks using a statistical framework, preferences towards pollinator-friendly landscaping tended to increase (~5%) when participants were shown the hypothetical render with cues to care in either season. In a subgroup analysis, we found that frequent park goers rated the pollinator-friendly landscape higher than infrequent park visitors, lower income individuals had lower ratings of the pollinator-friendly landscape than high income earners, Denver residents who grew up “mostly outside” of Colorado where more likely to rate pollinator-friendly landscapes higher than those who grew up in the state, and positive feelings towards bees correlated with higher ratings of pollinator-friendly landscapes.

In a related survey on insect pollinator policies in Colorado, the research team found that Colorado residents are concerned about pollinators and willing to support many types of policies and programs to support native insect pollinators. Residents also believe they are highly knowledgeable about honeybees but the majority have incorrect perceptions about them. For example, the majority of respondents (55.8%) incorrectly believed that honeybees were native pollinators in Colorado and the vast majority (82.4%) believed that keeping honeybees (i.e., beekeeping) is a good strategy for supporting native insect pollinators.

Further highlights from the Social Science Survey Results:

- Cues of care had about a 4-5% increase in the change in preference for pollinator friendly landscapes, though turf dominant landscapes were always preferred. However, given our cues of care were subtle elements, more targetted or apparent elements may help increase acceptance.
- Residents that either “tolerate” or “like” bees had significantly more favorable attitudes towards pollinator-friendly landscaping. Suggesting educational efforts towards understanding bees can impact acceptance of native plantings.
- Frequent park goers and those who grew up “mostly outside of Colorado” were also significantly more accepting of pollinator-friendly landscapes than those who less frequently visit parks or who grew up in Colorado.
- Household income less than $50,000 had the lowest ratings of pollinator-friendly landscapes. Outreach efforts within these communities should be

prioritized, including efforts to understand what landscaping factors are preferred.

Objective 3 Executive Summary: Optimizing plant mixes to balance climate adaptation and pollinator attraction

Selecting seed and plant mixes for habitat restoration is an ongoing challenge in urban environments. Current plant mixes typically are chosen without a systematic process or flexibility to adapt to different scenarios or objectives. We have been implementing multi-objective decision analysis (MODA) within the context of plant species mix design using 120 plant species and 30 traits associated with pollinator attraction and drought resilience. Within this report, we provide preliminary results of this ongoing and challenging research problem using 30 plant species and 12 traits, with over 140,000 different plant combinations considered.

This work is still ongoing, and there remain several caveats to the current output. Although we place strong emphasis on understanding the model generates plant mixes rather than choosing individual plants, some key plants that are persistent "winners" across different modeling scenarios include *Daleae purpurea*, *Helianthus nuttallii*, *Ascelpias incarnata*, *Cleome serrulata*, and *Ipomoea leptophylla*.

Additional activities of the research team

Other notable outputs of our projects that extend beyond these objectives include a bumble bee identification workshop attended by 25 members of the public in Denver, an outreach day with high school students from the Urban Green Corps, a CSU Summer Extension Intern, podcast and blog appearances, multiple presentations at two academic conferences, the training of a masters student, partial support for a postdoctoral research in social science, and hourly positions for multiple CSU undergraduate students. Within the next year, we expect to submit at least two scientific manuscripts (one related to pollinator biodiversity, one on social values) and a large proposal to USDA to expand the plant selection optimization program.

Background

The global biodiversity crisis is well represented by concerns over declining insect biodiversity, including the loss of ecologically important and charismatic pollinators (Harvey et al. 2020, Wagner 2020). Evidence pointing to losses of pollinator species and declines in pollinator diversity in a variety of landscapes and regions has sparked restoration initiatives aimed at implementing “pollinator-friendly” policies by governments (Baldock 2020, Braman and Griffin 2022). The role of urbanization in pollinator conservation is complex. Land conversion is a primary stressor on pollinator populations, but green spaces within cities can also support biodiverse and robust assemblages of pollinators, especially bees (Baldock et al. 2019, Theodorou et al. 2020). Supporting pollinators within urban greenspaces, namely public parks, may be especially beneficial as urban planning must balance increasing growth with public demands for biodiversity and improved access to green space for public health and well-being (Aronson et al. 2017).

To this end, there is a need to 1) understand existing pollinator diversity within urban green spaces and how that relates to existing management practices and floral availability; 2) experimentally test the social perceptions of different pollinator-friendly landscaping approaches across different demographic groups; and 3) improve guidance in pollinator-friendly plant selection with respect to climate suitability and their potential to support high pollinator diversity.

This report details the final report of a project between Colorado State University (CSU) and Denver Parks and Recreation (DPR) to understand the local and landscape scale factors that affect pollinator biodiversity across the parks system in Denver. We consider plant species diversity, habitat structure, ecological landscape context (e.g. green space), and social landscape context (e.g. neighborhood income) to understand how bee and butterfly diversity changes. Building upon that, we use a social values framework to understand the attitudes of Denver residents towards different pollinator-friendly landscaping designs across seasons. We also report on a multi-objective decision analysis (MODA) framework that aids in the selection of pollinator-friendly plants for Denver parks. Lastly, we report on several outreach,

education, and training events that the project team conducted in parallel with our research efforts.

Objective 1: Patterns of pollinator biodiversity across Denver Parks

To understand the existing status of pollinator biodiversity across Denver parks our team conducted surveys of bees and butterflies at 25 parks in the summer of 2023. Each park was visited 3 times between June and August for 1 person-hours per visit. Butterfly surveys consisted of a standardized pollard walk with bee surveys consisting of collections of bees using aerial nets. Data on floral abundance was recorded alongside these pollinator surveys as well as the total abundance of honeybees observed foraging, as non-native honeybees have been shown to have a negative impact on native pollinator richness in other urban bee studies (MacInnis et al. 2023).

These surveys were used to answer three primary questions we will address in this report:

1. What is the existing species diversity of bees and butterflies across Denver parks?
2. Do local (e.g. floral abundance, honeybee abundance) or landscape (e.g. green space, median income) factors more strongly predict bee and butterfly diversity across Denver parks?
3. What are the key plants used by bees in Denver parks?

Objective 1 Results

1.1 What is the existing species diversity of bees and butterflies across Denver parks?

In total, we observed 143 species of bee and 33 species of butterflies across the 25 parks (Figures 1). Bee species richness was highest at City Park (47 species; Table 1), with butterfly richness being highest at Washington Park (Table 2).

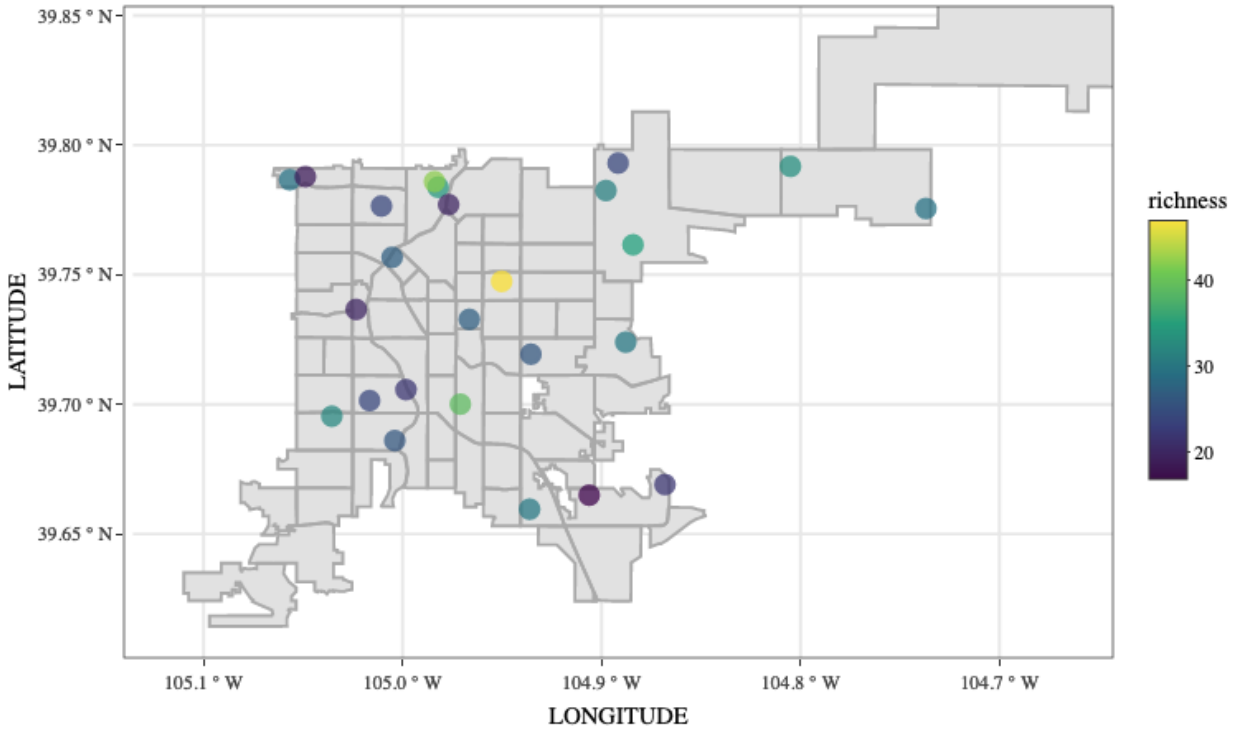


Figure 1. Map of the 25 surveyed parks across Denver. Color gradient represents total bee species richness (i.e. number of distinct species) observed at each park with brighter colors representing higher values.

Table 1: Bee species richness, abundance, diversity, and plant availability across the 25 surveyed parks. Sorted by bee species richness.

Park Name	Richness (% of total, rounded)	Number of Individuals	Shannon Diversity	Simpson Diversity	Plants used by bees
City Park	47 (33%)	185	3.2	0.93	34
Platte Farm Open Space	42 (29%)	172	3.06	0.91	11
Washington Park	39 (27%)	281	2.92	0.92	40
Central Park	35 (24%)	173	2.89	0.91	31
Argo Park	34 (24%)	224	2.97	0.93	25

Park Name	Richness (% of total, rounded)	Number of Individuals	Shannon Diversity	Simpson Diversity	Plants used by bees
Parkfield Lake	33 (23%)	155	2.74	0.89	12
Garfield Lake Park	32 (22%)	119	3	0.93	11
Northfield Pond	31 (22%)	98	3.03	0.93	26
Eisenhower Park	30 (21%)	122	2.84	0.91	20
Great Lawn Park	30 (21%)	173	2.6	0.87	23
First Creek at DEN Open Space	29 (20%)	103	2.75	0.9	10
Inspiration Point	29 (20%)	76	2.79	0.89	21
Cheesman Park	27 (19%)	104	2.44	0.8	19
Commons Park	27 (19%)	150	2.72	0.91	20
Cranmer Park	26 (18%)	84	2.82	0.91	13
Ruby Hill	26 (18%)	140	2.63	0.9	8
Chaffee Park	24 (17%)	106	2.72	0.9	10
Huston Lake	24 (17%)	78	2.59	0.89	15
Prairie Meadows	24 (17%)	62	2.88	0.93	10
Babi Yar Park	22 (15%)	99	2.4	0.86	20
Johnson Habitat Park	22 (15%)	141	2.31	0.85	16

Park Name	Richness (% of total, rounded)	Number of Individuals	Shannon Diversity	Simpson Diversity	Plants used by bees
Globeville Landing	20 (14%)	125	2.08	0.8	16
Rude Park	20 (14%)	73	2.56	0.89	15
Willis Case Golf Course	19 (13%)	95	2.49	0.9	21
James Bible Park	17 (12%)	61	2.18	0.82	7

Table 2: Butterfly species richness, abundance, diversity, and plant availability across the 25 surveyed parks. Sorted by bee species richness.

Park Name	Richness (% of total, rounded)	Number of Individuals	Shannon Diversity	Simpson Diversity	Plants used by butterflies
Washington Park	16 (48%)	79	2.27	0.86	31
Huston Lake	15 (45%)	37	2.46	0.9	7
Ruby Hill	15 (45%)	39	2.63	0.91	9
Inspiration Point	12 (36%)	48	2.24	0.87	13
Babi Yar Park	11 (33%)	25	2.05	0.82	11
Cheesman Park	11 (33%)	41	2.14	0.86	11
City Park	11 (33%)	40	2.02	0.82	13
Cranmer Park	11 (33%)	36	1.98	0.81	7

First Creek at DEN Open Space	11 (33%)	34	2.22	0.88	6
Globeville Landing	11 (33%)	51	1.89	0.79	10
Great Lawn Park	11 (33%)	30	2.09	0.84	10
Johnson Habitat Park	11 (33%)	22	2.04	0.81	5
Argo Park	10 (30%)	30	1.98	0.83	9
Garfield Lake Park	10 (30%)	33	1.84	0.8	6
James Bible Park	10 (30%)	34	2.12	0.85	4
Parkfield Lake	10 (30%)	22	2.2	0.88	6
Chaffee Park	9 (27%)	31	1.95	0.83	4
Platte Farm Open Space	9 (27%)	16	1.98	0.83	4
Central Park	8 (24%)	21	2.03	0.85	5
Northfield Pond	8 (24%)	29	1.86	0.82	11
Commons Park	7 (21%)	27	1.43	0.65	9
Eisenhower Park	7 (21%)	16	1.67	0.77	7
Rude Park	5 (15%)	20	1.36	0.71	7
Willis Case Golf Course	5 (15%)	14	1.49	0.76	3
Prairie Meadows	4 (12%)	6	1.24	0.67	1

It's notable that among the common species, not all species are native bee species. For example, *Megachile rotundata* (Alfalfa leafcutter bee) was the third most common species in our collections (N = 294). However, this species was introduced from Europe for alfalfa pollination but has since become naturalized within the region (Pitts-Singer and Cane 2011). This species, as well as the four other non-native species in the dataset, is a cavity nesting species. Cavity nesting species (those that use hollow stems or holes in structures) are common non-native species in urban environments in the United States (Fitch et al. 2019).

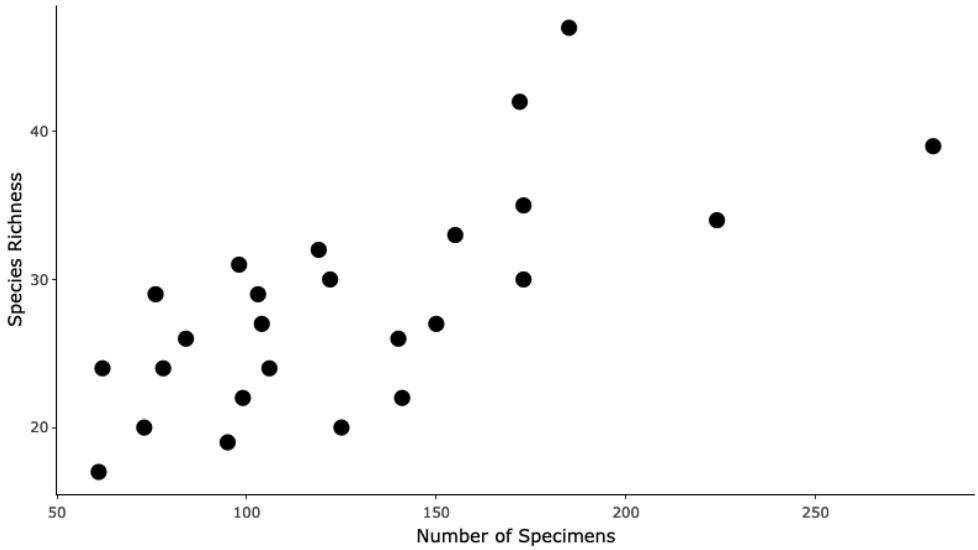


Figure 2. Scatterplot of bee species richness as a function of the number of specimens collected from the park.

1.2 Do local or landscape factors more strongly predict bee and butterfly diversity across Denver parks?

The final models for this section are still ongoing and are a part of the training for Nicki Bailey's master's thesis. For the purposes of this report, we provide basic graphical and descriptive statistics to describe the analyzed relationships.

Analyses for this project are still ongoing, but we examined several components of bee and butterfly diversity across Denver parks with respect to local (i.e. honeybee abundance, floral abundance, floral species origin) and landscape (i.e. population density, household income, impervious surface, etc) factors. To date, we have conducted univariate analyses (i.e. one predictor variable per response variable)

with plans to conduct formal modeling procedures in the immediate future. We will continue to provide DPR with outputs of ongoing analyses.

At present, in contrast to prior studies, there is no strong relationship between honeybee abundance and native bee diversity (Figure 3). Prior studies show a negative relationship between honeybee abundance and native bee abundance (Mallinger et al. 2017, MacInnis et al. 2023). However, in our system sites with high honeybee abundance are also sites with high floral abundance generally (Figure 4), suggesting that there may be enough resources for these two “groups” to coexist. Further research investigating if there are differential impacts across the bee community according to functional groups (e.g. body size, nesting guild, etc) are underway.

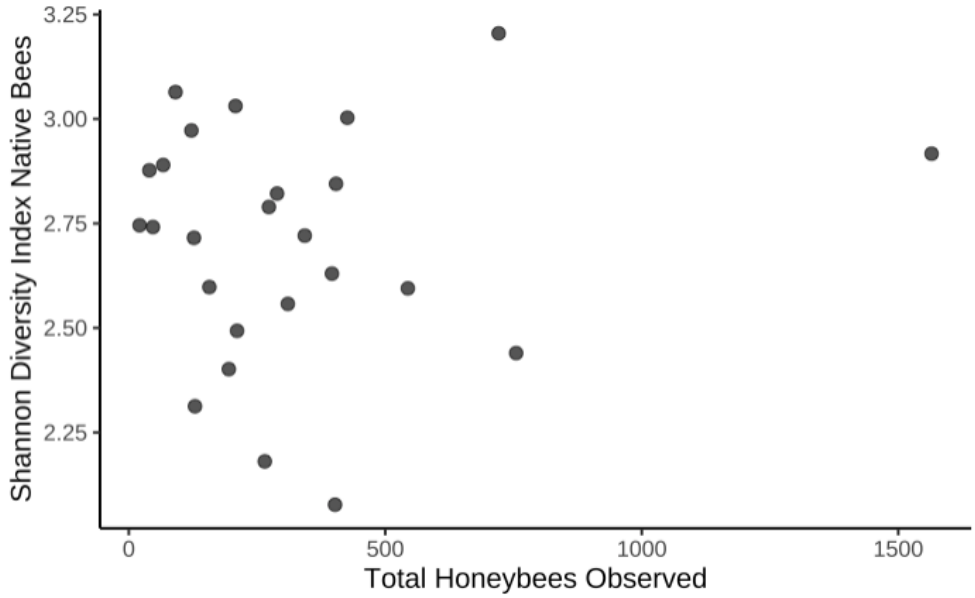


Figure 3. Native bee diversity as a function of total honeybee abundance observed at parks.

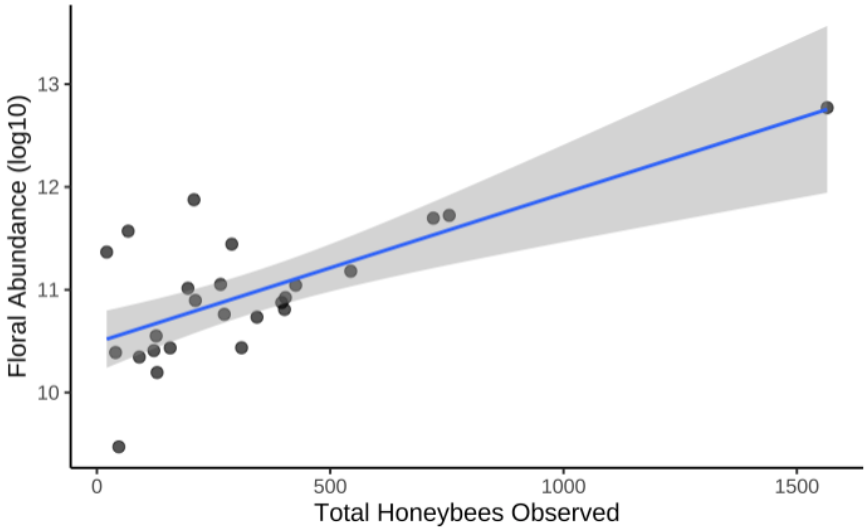


Figure 4. Floral abundance (log10) as a function of total honeybees observed. The intention here is to demonstrate that sites with high honeybee abundance simply seem to be those with lots of floral resources - paired with figure 3, this suggests resources are not limiting when honeybees are present.

Unsurprisingly, bee species richness was positively predicted by floral species richness (Figure 5) and total floral abundance (Figure 6). Interestingly, at sites with higher proportions of the floral community dominated by weedy plants (e.g. clovers or thistles), bee species richness declined (Figure 7). “Weedy sites” were also more likely to be lower income sites (Figure 8). Further work will be needed to tease out these collinear effects - but generally, we can suggest that although weedy plant species may be common resources for bees due to their commonality across sites (See section 1.3), they may not represent particularly diverse hosts for native bee species.

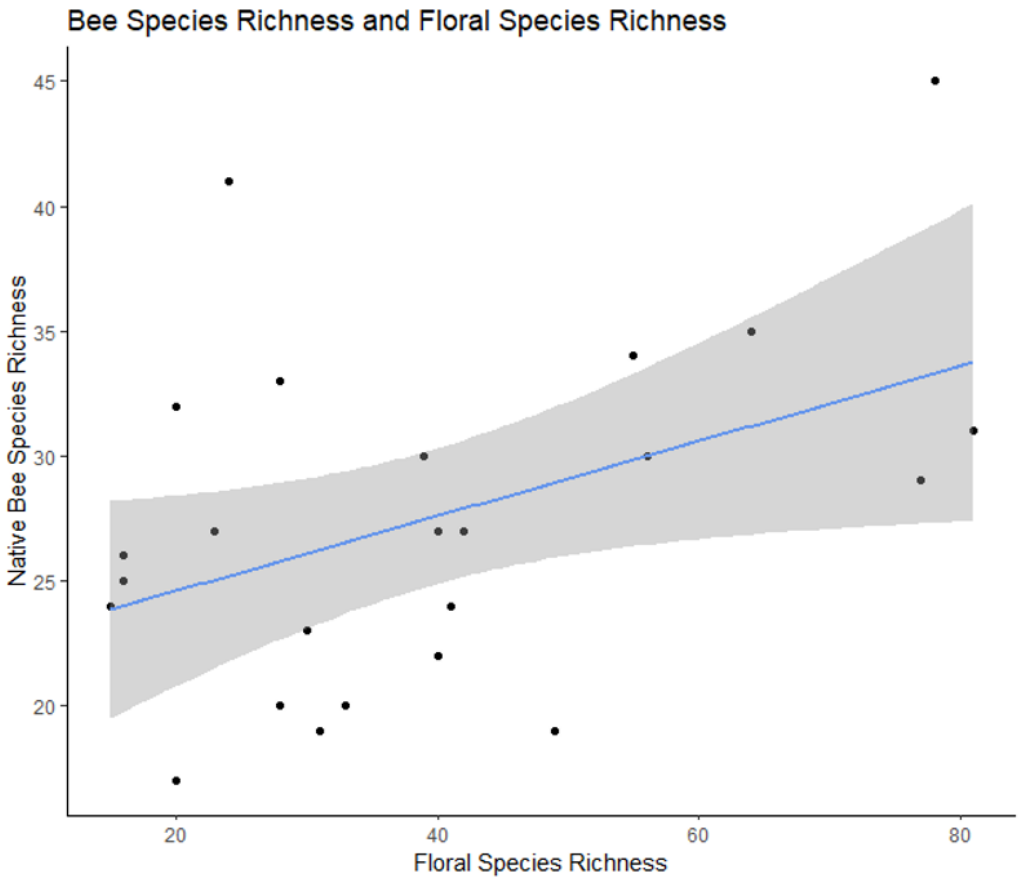


Figure 5. Native bee species richness as a function of floral species richness.

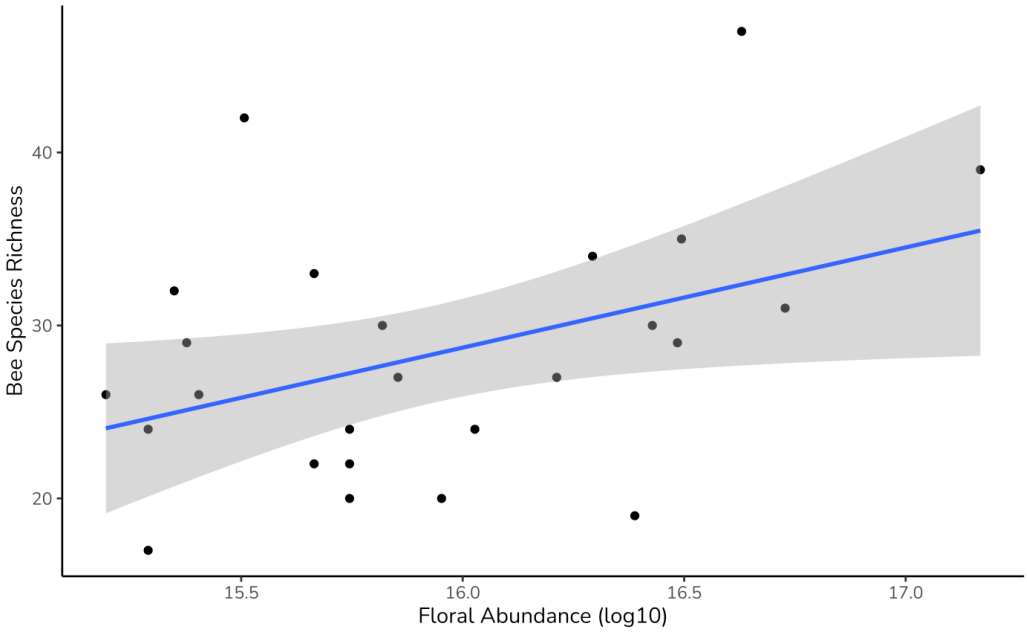


Figure 6. Native bee species richness as a function of the total floral abundance at parks (log10 transformed).

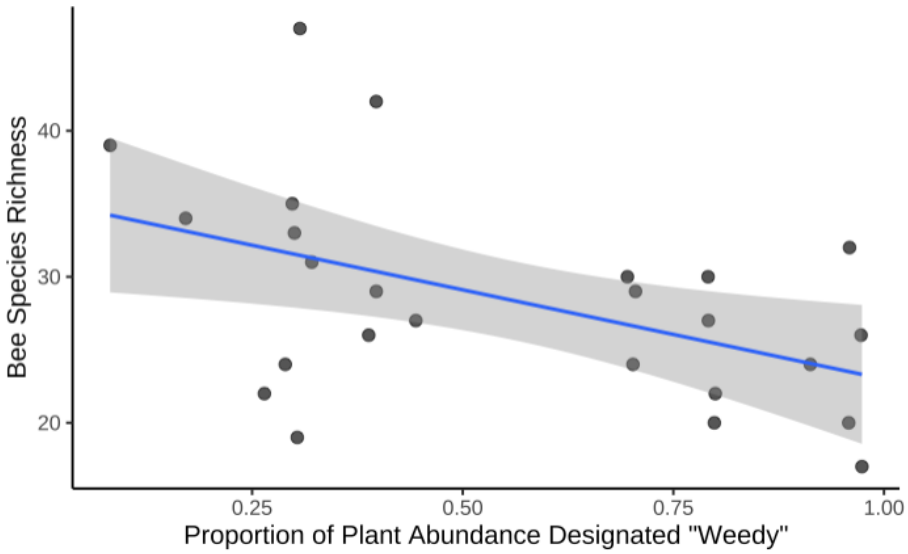


Figure 7. Bee species richness declines when the parks are dominated by weedy plants.

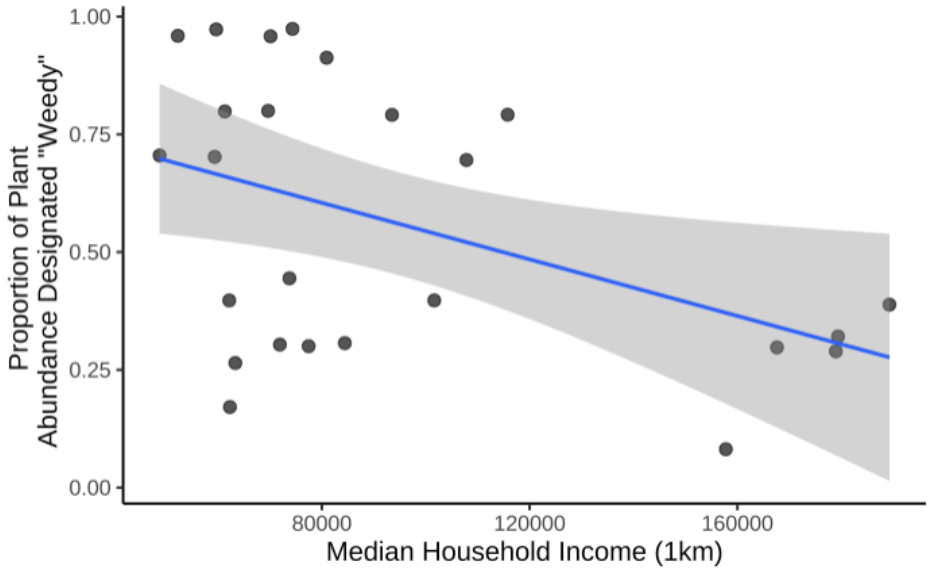


Figure 8. Parks in high income neighborhoods rarely contain high abundances of weedy plant species.

Continued analysis of bee and butterfly data is ongoing. Further preliminary plots are provided in Appendix 2.

1.3 What are the key plants used by bees in Denver parks?

Although plant availability is not consistent across parks (i.e. not all parks have all of the same plants in the same abundance), there appears to be some clear patterns in which plant species are most commonly associated with high bee abundance or richness.

A major objective of converting park landscapes to more closely emulate natural landscapes is the removal of non-native and invasive plant species. However, at present, in many parks across Denver these non-native plants represent the primary hosts of native bee abundance. If species like white clover (*Trifolium repens*), sweet clover (*Melilotus officinalis*), and bindweed (*Convolvulus arvensis*) are targeted for removal, these removals should be concurrent with replacement by high-value native floral species like spreading fleabane (*Erigeron divergens*), hairy goldenaster (*Heterotheca villosa*), prairie coneflower (*Ratibida columnifera*), or many other suitable native plant hosts (Tables 2). Native plant species do appear to support a high *richness* of native bee species (Table 3), and given that they are less commonly represented across all sites compared to weedy plants, on a per-plant basis are of higher value to native pollinator populations.

Table 2. Total bee specimens captured from the top 10 most represented floral species. Numeric values represent the number of specimens collected from that plant species. Full data table with all 338 plant species observed is provided in Appendix 1.

Floral Species	**Bee abundance**	**Family**	**Common Name**	**Floral Type**
Trifolium repens	203	Fabaceae	White Clover	weedy
Melilotus officinalis	174	Fabaceae	Yellow Sweetclover	weedy

Floral Species	Bee abundance	Family	Common Name	Floral Type
Erigeron divergens	151	Asteraceae	Spreading fleabane	native
Convolvulus arvensis	150	Convolvulaceae	Field Bindweed	weedy
Heterotheca villosa	144	Asteraceae	Hairy False Goldenaster	native
Ratibida columnifera	141	Asteraceae	Prairie coneflower	native
Helianthus annuus	110	Asteraceae	Common sunflower	native
Rudbeckia hirta	101	Asteraceae	Black-eyed Susan	native
Salvia yangii	81	Lamiaceae	Russian Sage	weedy
Echinacea purpurea	79	Asteraceae	Purple coneflower	cultivar

Table 3. Total bee species captured from the top 10 most represented floral species. Numeric values represent the number of bee species collected from that plant species. Full data table with all 338 plant species observed is provided in Appendix 1.

Floral Species	Species Richness	Family	Common Name	Floral Type
Heterotheca villosa	37	Asteraceae	Hairy False Goldenaster	native
Convolvulus arvensis	31	Convolvulaceae	Field Bindweed	weedy

Floral Species	Species Richness	Family	Common Name	Floral Type
Erigeron divergens	31	Asteraceae	Spreading fleabane	native
Cirsium arvense	28	Asteraceae	Canada thistle	weedy
Melilotus officinalis	28	Fabaceae	Yellow Sweetclover	weedy
Ratibida columnifera	26	Asteraceae	Prairie coneflower	native
Rudbeckia hirta	26	Asteraceae	Black-eyed Susan	native
Salvia yangii	25	Lamiaceae	Russian Sage	weedy
Erigeron speciosus	21	Asteraceae	Aspen fleabane	native
Trifolium repens	21	Fabaceae	White Clover	weedy

Conclusions and outputs to date

Although further analysis is ongoing, some preliminary conclusions seem reliable to date. It seems that park-level factors predict pollinator diversity more reliably than landscape (i.e. neighborhood) level factors thus far. So attributes like floral abundance, floral diversity, and the proportion of floral abundance due to native (and/or cultivated) plants all positively predict pollinator abundance. Landscape level factors like impervious surface cover or green space surrounding the park appear to be less predictive - suggesting a sort of “if you build it, they will come” approach to pollinator restoration in these landscapes. However, further analyses will be needed.

One striking observation is the relationship between pollinator diversity and non-native weedy plants. Weedy plants make up some of the largest hosts of total bee abundance. However, this is likely because they are present at all sites - and some

lower income sites can have nearly all of their floral resources coming from weedy plants. When looking across all sites, we see that sites with more weedy plants have lower bee biodiversity, and then weedy sites tend to be the lowest income sites. Overall, this suggests that the most effective strategy for pollinator restoration across Denver sites is also the most equitable one - **resources should be prioritized towards weedy plant removal and replacement with native or cultivated plants in the lowest income parks**. After those efforts, it may be possible that landscape level factors may limit pollinator species accumulation over time.

Products and output to date:

Presentations

- Bailey N, Mola JM (2024). *Parks Pollinators and People: Do bees and butterflies prefer higher income parks in Denver, Colorado?* Entomological Society of America North Central Branch Meeting. Fort Collins, CO
    - **Winner of "1st Place Master's Student Presentation"**
- Bailey N, Mola JM (2024). *Parks Pollinators and People: Do bees and butterflies prefer higher income parks in Denver, Colorado?* Front Range Student Ecology Symposium. Fort Collins, CO

Posters

- Bartholomew N, Comai N, Bailey N, Mola JM (2024). Does intraspecific bee body size vary across urban parks by land cover or affluence? Entomological Society of America North Central Branch Meeting. Fort Collins, CO
- Bartholomew N, Comai N, Bailey N, Mola JM (2024). Does intraspecific bee body size vary across urban parks by land cover or affluence? Front Range Student Ecology Symposium. Fort Collins, CO

Objective 2: Understanding social attitudes towards pollinator plantings in Denver Parks

As prepared by Dr. Veronica M. Champine; a summary poster of this work, as presented at the North Central Branch Entomological Society of America meeting in March 2024, is available in Appendix 4.

Social Science Findings Report: Parks for Plants, Pollinators, and People

Background

Research on green spaces in cities demonstrates distinct opportunities to improve both conservation outcomes and human wellbeing (Aerts et al., 2018; Gardiner et al., 2013; Ives et al., 2016; Sandifer et al., 2015). Community participation in the urban planning process not only reduces threats of green gentrification (i.e., the displacement of residents in low-income neighborhoods due to greening initiatives), but also contributes to projects that are more likely to reflect the needs and preferences of the people who benefit from them (Turo & Gardiner, 2019). Additionally, when people perceive landscapes as aesthetically pleasing, they are more likely to appreciate and take actions to protect them (Gobster et al., 2007). Wildlife-friendly gardening and landscaping appear to be gaining popularity in urban green spaces. A goal in the urban ecology field is to create an "ecological aesthetic," where humans value landscapes that are ecologically beneficial for non-human inhabitants (Gobster et al., 2007). A couple studies have demonstrated that this ecological aesthetic is emerging in some cities as many residents approve of infrequently mown meadows, a form of wildlife-friendly landscaping (Garbuzov et al., 2015; Southon et al., 2017). Native plants (i.e., plants that are ecologically adapted to a specific region), important for conserving native pollinators, are becoming more popular, especially in neighborhoods with strong native plant gardening norms (Peterson et al., 2012). An annual gardening survey by the National Gardening Association in 2022 found that 34% of U.S. adults purchase wildlife-friendly plants. Popularity for native gardening appears to be growing as 17% of American adults purchased native plants in 2020, while only 13% purchased native plants in 2018 (Fallon, 2022; Whitinger & Cohen, 2022).

The Research Project

This research project provides an opportunity for community engagement in the urban planning process to ensure that decisions about landscapes are sustainable and provide positive outcomes for both people and pollinators in Denver parks. In addition, this survey will uncover the existence or non-existence of an "ecological aesthetic" and if pollinator-friendly landscapes are supported by residents in Denver, Colorado. Pollinators are essential to the health of Denver's parks and people. Critical pollinators like some bee species have declined significantly over the last decade due to stressors like climate change and habitat loss. Increasing the number and variety of native pollinators is a key focus area for Denver Parks &

Recreation's (DPR) resiliency efforts. Social science findings in this report are part of a larger Colorado State University (CSU) research project, supported by the Salazar Center and DPR. The overall project aims to understand the complex factors impacting pollinators in Denver. This work can be used to create well-connected habitats across the region to support pollinator and human wellbeing now and in the future. The purpose of the social science work within this research project is to inform DPR's decision-making in designing and modifying landscapes in Denver Parks. As part of the city's resiliency plan, DPR's goal is to protect and restore healthy wildlife habitat and functional ecosystems to leverage the benefits of ecosystem services as infrastructure. The research team aimed to understand the level of support that Denver residents have for pollinator-friendly landscaping in parks. We sought to understand the perceptions of risks and benefits that residents hold in regard to pollinator-friendly landscaping, and if adding built features (like paths, benches, signs, and wildlife houses) improves people's perceptions towards these types of landscape designs.

Methods

Focus Groups - Denver Parks and Recreation (DPR) Employees

In March and April 2023, the research team conducted five focus groups with Denver Parks and Recreation staff members. The focus groups were split between two types of roles: leadership and practitioner. The two leadership focus groups asked members of the DPR leadership team overarching questions about DPR's goals for prioritizing pollinator-friendly landscaping in Denver Parks. Three practitioner focus groups asked on-the-ground DPR employees (e.g. horticulture team, operations supervisors/managers, and city-wide staff) questions about specific pollinator-friendly plants and social issues in Denver Parks. These focus groups aimed to inform two aspects of the larger project: A criteria matrix for choosing plants that balances needs of people (including DPR employees), pollinators, and climate The "social values" survey that measured residents' perceptions of pollinator-friendly plantings in Denver parks. More specifically, the focus groups informed the following elements of the survey: Photo-realistic renders Specific questions to ask/prioritize

Spring 2023 Focus Groups

1. March 28th - Horticulture Team 4 participants 40 minutes of recorded discussion

2. March 29th - City Wide Staff 9 participants 55 minutes of recorded discussion

3. April 3rd - Leadership 1 4 participants 36 minutes of recorded discussion

4. April 4th - Ops Supervisors/Managers 3 participants 37 minutes of recorded discussion

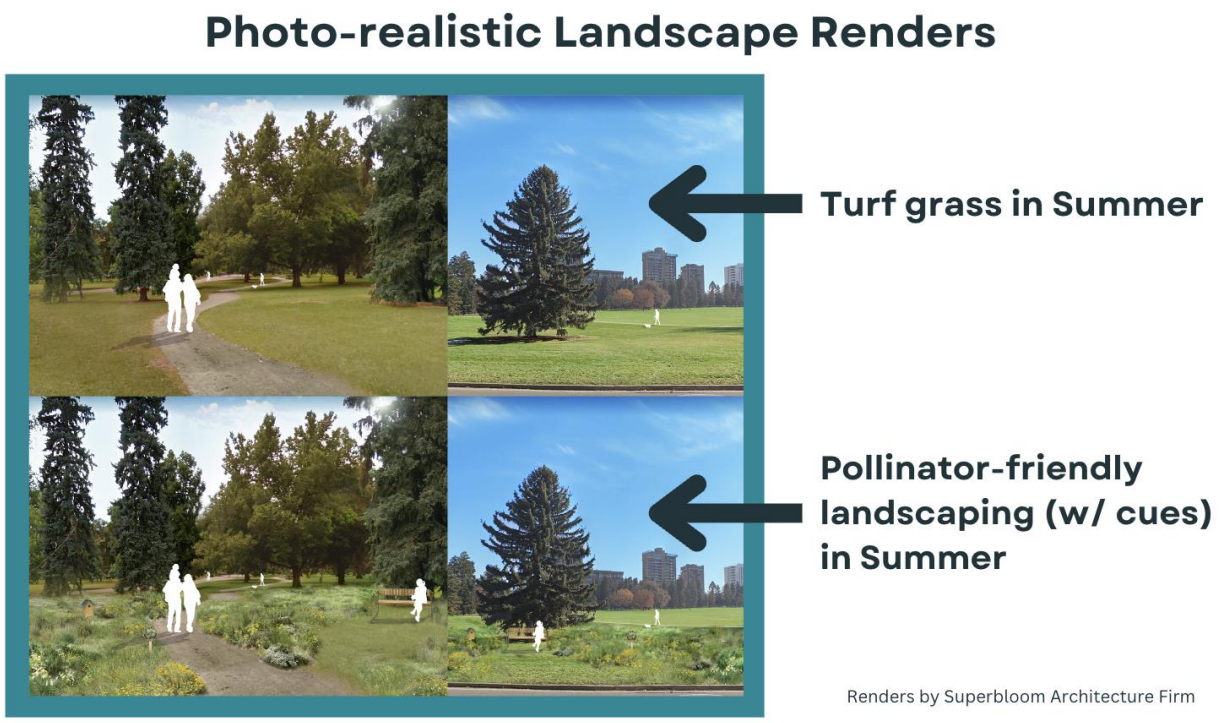
5. April 4th - Leadership 2 4 participants 42 minutes of recorded discussion

Social Values Survey- Denver Residents

In October 2023, the research team conducted an experimental social values survey to Denver residents through the online survey panel aggregator, Qualtrics. The survey asked residents questions about their typical park activities, demographics, and beliefs about hypothetical Denver Park landscapes (i.e., turf grass vs. pollinator-friendly landscaping). Half of participants were shown photo-realistic park renders of pollinator-friendly landscaping with “cues to care” or built features like benches, paths, signs, and wildlife houses that signal care for the land, and half of participants were shown renders without those features.

Research Questions

1. What are Denver residents' beliefs towards pollinator-friendly landscaping in Denver parks?
2. Do Denver residents prefer turf grass or pollinator-friendly landscaping?
    a. Does this preference depend on the season (summer vs. winter)?
    b. Are seasonal preferences offset by the inclusion of “cues to care” (i.e., elements that signal care for the land).
3. Exploratory: Do different subgroups of Denver residents vary in their perceptions towards pollinator-friendly landscaping



2.1 Results of Practitioner Focus Groups

Focus Groups: The following sections summarize the responses from practitioner focus groups

Specific Plants

Which Plants in Denver Parks are easiest to establish?

- Specific plants (or types of plants)
    - Salvia Echinacea
    - Native plants
    - Penstemons
    - Yarrow
    - Goldenrod
    - Lindernia
    - Coneflowers
    - Rudbeckias
    - Speedwells
    - Petunias
    - Maximilian sunflower
    - Blanketflower
    - Globemallow
    - Coreopsis
    - Native grasses (blue gramma, buffalo, western wheat)
    - Potentillas
    - Purple prairie clover
    - Mexican hat
    - Native agastaches
- Comments
    - Annuals are typically easy to establish
    - In an irrigated bed we can get anything going
    - Native beds with a couple years of watering
    - When irrigation gets turned off - the forbs get dinged up (prairie clover doesn't hold over super well)
    - Bad weather after turning off irrigation you can thrash the forbs
    - Depends on water - are you planting next to turf area?
    - Some natives are easy and some are hard
    - Denver is harsh with use and dogs so it makes it hard, things that can take abuse are valued in a dense urban environment
    - Depends on the space

Which plants in Denver Parks are easiest to maintain?

Specific plants (or types of plants)

- Natives
- Yarrow
- Penstemon
- Solidago

- Yarrow
- Penstemon
- Scarlett globemallow
- Blanketflower
- Milkweed
- Rabbit grass
- Shrubs (chokecherries and plums)

Comments

- South facing slopes can beat up penstemons
- In open spaces, anything thats not a noxious weed
- Deadheading is harder than cut backs
- If its a lot of grass it’s a lot of maintenance

Which plants in Denver Parks *attract the most pollinators* based on your experience?

Specific plants (or types of plants)

- Natives near fruit bearing trees
- Russian sage
- Agasatache
- Sweet alyssum
- Penstemon
- Poppies
- Salvia
- Calendula
- Yarrow
- Solidago
- Cleome
- Rabbit brush
- Linden tree
- Rocky mountain bee plant
- Yuccas
- Plums
- Chokecherries
- Wild cucumber
- Milkweed
- Clover
- Dandelions
- Rudbeckia
- Coneflowers
- Lavender

Table 1. Plants mentioned more than once in DPR Practitioner Focus Groups based on their characteristics

Plant	Count	Native	Easy to Establish	Easy to Maintain	Comments
Salvia	9	X	X	X	Salvia yangii: Hardy and difficult to knock back; good for late fall native bumblebees; Honeybee dense so it can freak people out Salvia greggii: good for hummingbirds
Penstemon	6	X	X	X	Not good on south-facing slopes
Yarrow	5	X	X	X	Can sometimes look reduced at first but will seed out and spread
Blanketflower/Gaillardia	4	X	X	X	It will take care of itself; gets positive feedback from the public
Goldenrod/Solidago	4	X	X	X	
Milkweed	3	X		X	
Purple Prairie Clover	3	X	X		Doesn’t hold over super well when irrigation gets turned off

Rudbeckia	3	X	X		Gets positive feedback from the public
Rocky mountain Bee plant	3	X			
Globemallow	2	X	X	X	
Echinacea	2		X		
Speedwell	2		X		
Agastache	2		X		
Yucca	2	X			Don’t plant on medians because they collect trash
California Poppy	2	X			Hard to establish
Rabbitbrush	2	X			Golf course users and employees don’t like it in the landscape
Wild Plum	2	X			
Chokecherry	2	X			
Dandelion	2				
Sweet Alyssum	2				

Thistle	2				Gets negative feedback from public

Practitioner focus group questions - Design/Maintenance choices for pollinator-friendly landscaping in Denver Parks

Is there a maximum number of plants you think should be used in a pollinator planting? Is there a minimum?

Maximum:

- 5-6 for a smaller garden
- No more than 10
- 10-20 species
- No max limit

Minimum

- 3

Comments

- Weigh public perception and maintenance
- More diverse the better
- Pack in as many species as you can
- Things that flower at different times
- Should have diversity, large numbers of that same grouping
- Try to use odd numbers
- Max is space allowed with large enough grouping for pollinators
- It depends

Do you have any comments on the following design/maintenance choices?

- **Perennials vs. annuals**
  - Perennials are more maintainable
  - Perennials take longer to establish and sometimes looks a little sparse at first
  - Add a pop of annuals to perennials to give a pop of color and variety
  - Mixing [perennials and annuals] is good as long as you take into account the water needs of the annual
  - Perennials are better for pollinators because we're not moving their habitat every year

        - 75% perennial to annual ratio is ideal
        - Perennials over annuals for open spaces
        - Perennials are easier to take care of
        - Stronger success rate with annuals - you can get them large quickly, it will look like a flower sooner and humans/dogs will respect the area sooner
        - A first year perennial is going to be much smaller - you get better longterm effort but immediate success will be with annuals
        - A mixture

- **Maintenance occurs at low intensity with regular visits, or fewer visits at higher intensity**
    - More frequent maintenance is probably best
    - Ideal maintenance: low intensity, regular visits
    - Low intensity regular visits
    - Low intensity more visits
    - Depends on the site
    - **Planting in rows, groups, or randomly?**
        - Grouping of plants best in terms of spacing (groups of 3/5/7)
        - Rows for annuals (or staggered planting) and groups for perennials
        - Grouping plants helps them support each other (shade, insulation, holding water)
        - Plant in groups
        - Grouping of forbs easier for treatments and management
        - Groups is great but random is what you want for more natural landscape
        - 3 6 9 ratios with groups
        - Small landscaping = good for grouping
        - Groups for perennial beds

Practitioner focus group questions - *Social Issues/Feedback*

What kinds of social issues are most common in formalized horticultural beds and larger continuous open spaces in Denver parks? Are there design choices that increase/decrease social issues?

- Tall grasses as hiding places
- Lawn spaces as dog park abuses (off leash dog opportunities)
- Any large shrubs that provide cover = shelter
- Shrubs = trash catchers (more maintenance)
- Large trees that go all the way to the ground = shelter
- Some people take annuals for their own gardens (some perennials too)
- Perennial bed = very high dog traffic area
- Anything planted around permanent structures (restroom, pavilion area, bench) can invite overnight guests

- Outlets attract guests
- Plants that are adjacent to roads can get trampled and dogs pee on them
- Planter boxes create tripping hazard
- People are less careful about trash with native areas
- People hide things in larger plants (shrubs, conifers)
- Conifers (spruce and fir) create a place for people to hide underneath (kind of like a tent)
- Around eating areas people are worried about bees if there are things planted nearby
- Ornamental beds lead to concerns of bees/pollinators for people picnicking
- Shrubs should be below eye height - so you can see people behind them
- Use barberry bush as boarders (i.e., use a “not as friendly” shrub to protect more fragile plants)
- Don’t plant yuccas on medians, they collect trash
- Be conscious of what you do on the “far side” of the building (i.e., the side with least visibility)
- It’s possible to add stepping stones to avoic trampled plants but many people don’t use them
- People tend to respect more highly tailored non native gardens

Have you gotten specific feedback from residents about any plants? If so, what was the nature of the feedback? Are there any plants that get more feedback?

- *More natives = more complaints*
- *People say native plants are messy, weedy, or unmanaged*
- *Russian sages are European honeybee dense so they can freak people out*
- *We get requests to limb the trees up but it makes it worse because the upper branches droop down (that’s why we try to keep the branches all the way to the ground)*
- *People don’t understand that native spaces are supposed to be a mosaic and patchy*

Practitioner focus group questions - Built Features (i.e., cues to care)

How feasible is it to maintain built features like signs, benches, paths, and/or wildlife houses/feeders in and around a pollinator-friendly planting?

- *Signs/benches/paths all great features*
- *Signs can lead to vandalism*
- *Removable signs will be taken*

- *Benches are reasonable*
- *Worry about theft overall*
- *Benches and paths have positives and negatives*
    - *They bring in people but also create trample situations*
- *Feeders may be stolen in certain districts*
    - *Maybe secure it or put it higher to reduce this threat*
- *Hard to create structures and things that are attached to other parts of the parks*
- *Smart paths and benches make it more functional*
    - *Private sector should partner in this*
- *Wildlife houses may be more challenging to maintain*
- *Signs, benches and paths are easier to maintain*
- *In southwest it's very feasible*
- *It's site specific and depends on park users*
- *When amenities are nicer (i.e., easier to understand/bilingual) they are less likely to be defaced*
- *They must be a quarter mile away from a skate park*
- *One negative connotation with wildlife feeders/houses is that people are scared of bees, so keep it away from playgrounds because people will associate it with the house/feeder*
- *If it's too nice someone will take it*
- *Careful labelling plants on signs, people will sometimes find out its rare and take it*
- *We've removed those signs for that reasoning*
- *Use signs with general information (not the specific plants)*
- *Doesn't matter the area, people watch and they take what they want*

Focus Groups: The following sections summarize the responses from leadership focus groups

What is the intended role of a pollinator-friendly municipal planting?

- *Maximize pollinator species richness + diversity*
- *Education should always be number one*
- *Reconnecting the ecological web of the urban environment*
- *Education is powerful, something to inspire people to do this at home*
- *Show and display trends in the industry*
- *Combat climate change*
- *Create habitat*
- *Support bee populations*
- *Move toward more resilient landscape*
- *To be a good steward/leader for the city*
- *Encourage pollination*
- *Increase biodiversity*
- *Set the example for the public*
- *To test things before we ask others to do it*

What does success look like?

- *An increase in pollinator species within parks system*
    - *Setting a baseline to see increase in diversity at a couple of given plots*
- *Measuring species we are attracting*
- *IncreasedPlant diversity across the board*
- *Any kind of reduction in water use*
    - *Measuring that upfront (does it take more, less, or equal?)*
- *A shift in public perception in what park spaces can look like*
- *More education to bring people change perceptions about ideal landscape aesthetics*
- *Reducing negative social feedback*
- *Increased connectivity*
- *Maintenance matches what we're doing*
- *No crazy chemicals*
- *Trying to plant plants that are useful and helpful*
    - *we have resources to test out different plants*
    - *increase innovation*
- *Recreate what a native landscape what a native landscape is for today and future so it's sustainable*
- *More education and research - plants that are useful, resilient, and maintainable*
- *Being thoughtful*
- *Increase communications and highlight what the department is doing to engage residents*
- *Increased education*
- *Getting the public supportive about changes*

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    - *Measuring that upfront (does it take more, less, or equal?)*
- *A shift in public perception in what park spaces can look like*
- *More education to bring people change perceptions about ideal landscape aesthetics*
- *Reducing negative social feedback*
- *Increased connectivity*
- ***Measures of success:***
    - *Plant and pollinators counts over a succession of years*
    - *Measure how many native plants we grew and put out from the green house (perennials, annuals, etc.)**
        - *How does this look by district?*
    - *We have figures on acres of flower beds in system, can we do the same for pollinator gardens?*
        - *Broken out by shrubs, etc.?*
    - *Public surveys to see what people think after big changes*
        - *70-75% acceptance would be great or higher?*
    - *At least 30% flower cover in pollinator gardens*

2.2 Results of Denver Residents Quantitative Survey

Provided below are some summaries of the data sourcing for the survey. To see a summary of the primary results, please see the poster in Appendix 4.

Removed 8 “sketchy” responses that were repeated
“It is very cool” It is very good” “it is very good and cool”

Full Sample
N = 832

Age

18-24 years	101	12.1%
25-34 years	218	26.2%
35-44 years	250	30.1%
45-54 years	70	8.4%
55-64 years	120	14.4%
65-74 years	58	7.0%
75 years and over	15	1.8%

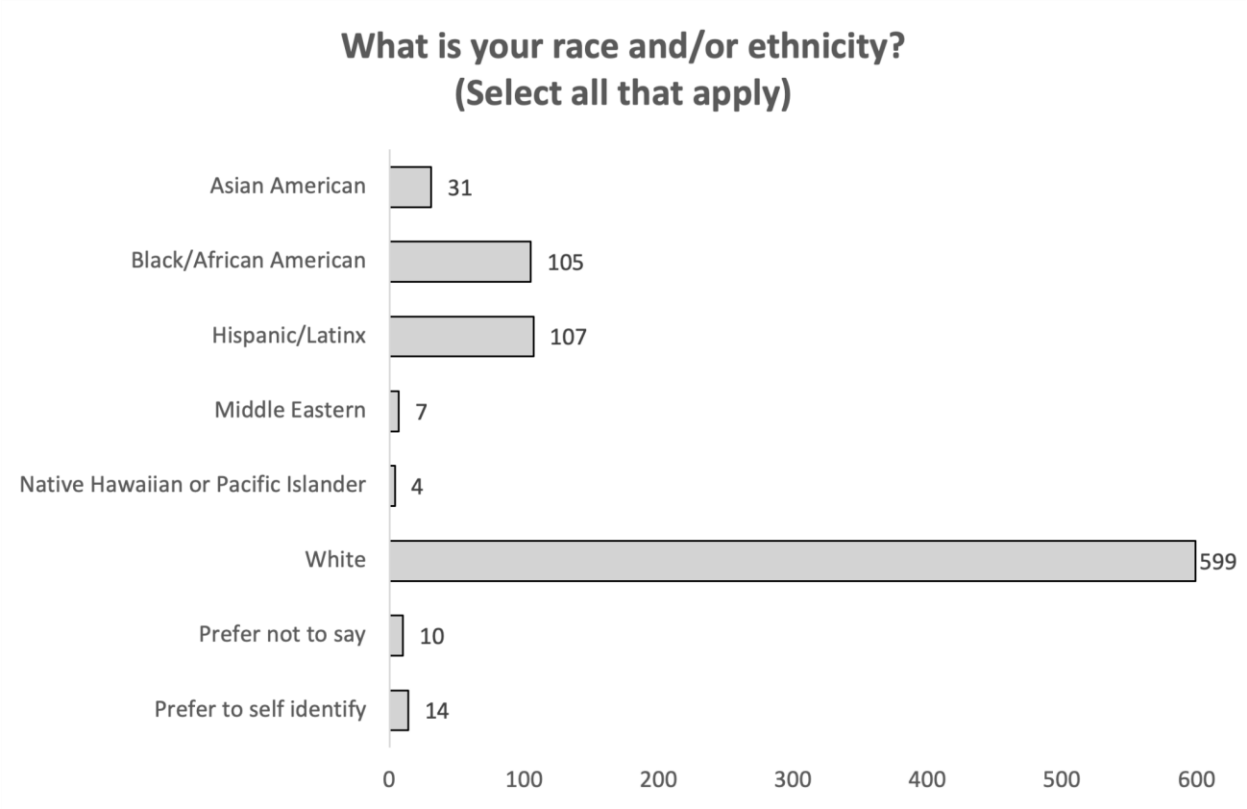
Gender

Gender nonbinary	7	0.8%
Man/Male	386	46.4%
Prefer to self-identify	2	0.2%
Woman/Female	437	52.5%

Household Income

Less than $50,000	294	35.3%
$50,000 - $100,000	295	35.5%
Greater than $100,000	243	29.2%

Race/Ethnicity

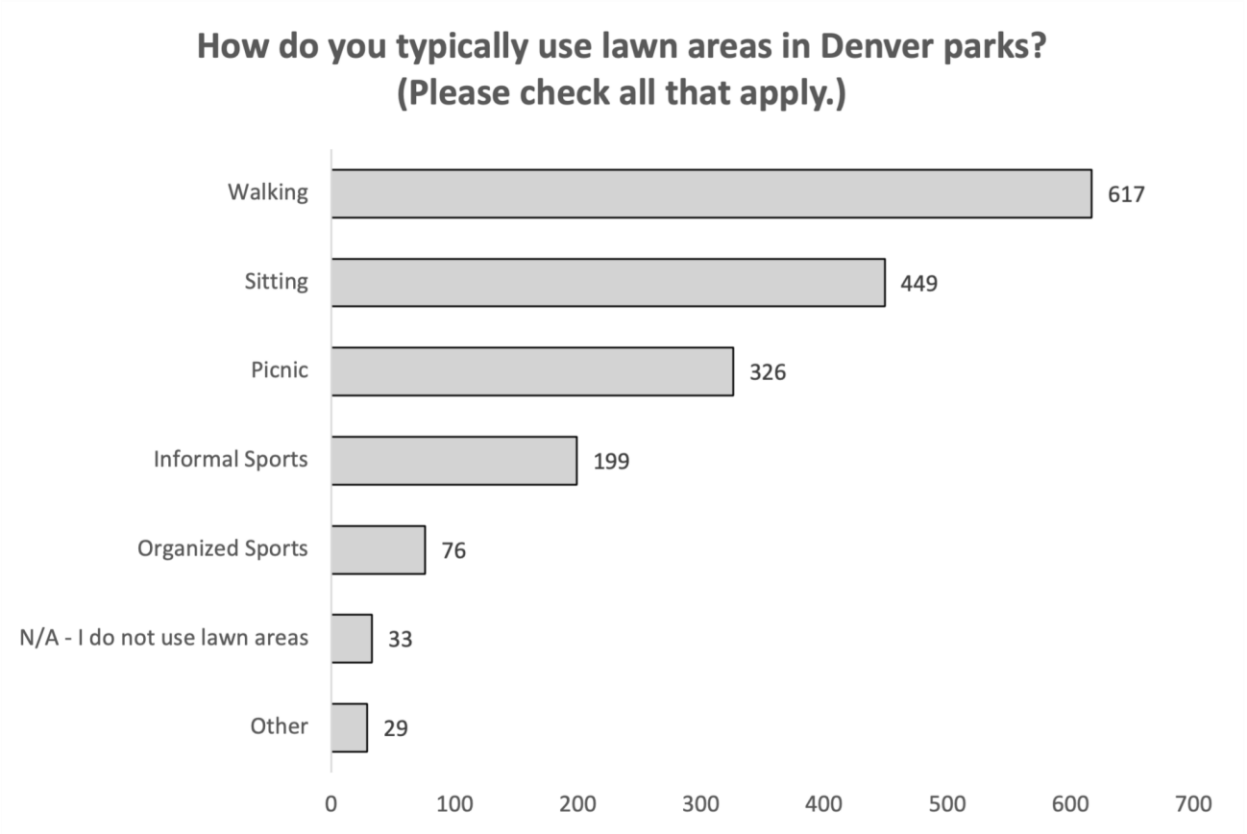


Grew Up

Mostly in Colorado	500	61.4%
Mostly outside of Colorado	314	38.6%

Visit Denver Parks

Daily	129	15.5%
Weekly	365	43.9%
Monthly	232	27.9%
Annually	82	9.9%
Never	24	2.9%



Please see Appendix 4 for a poster summary of the key results of this study.

Conclusions and outputs to date

- When installing native landscapes, “cues of care” like benches, pathways, and interpretive signs improve public acceptance of pollinator-friendly landscapes by ~5%
- Higher income residents are more likely to approve of pollinator-friendly landscapes.

Analyses for manuscript submission are still underway, but conclusions for the purposes of reporting are available. At present, turfgrass landscapes are somewhat preferred over pollinator friendly landscapes in both seasons (summer: 55% turfgrass vs. 45% pollinator-friendly; winter: 57.8% turfgrass vs. 42.2% pollinator-friendly). However, experimental results show a promising effect of “cues to care”

(i.e., benches, signage, and wildlife houses) resulting in about a ~5% increase in preference towards pollinator friendly landscapes. Although this result was not statistically significant using a frequentist approach, the consistency in the result across seasons and landscape renders combined with the subtly of the cues represented in the designs suggests a promising course of action for DPR and other municipalities.

Within subgroup analyses, we found that frequent park goers were more supportive of pollinator-friendly landscapes and that lower income individuals had lower ratings of the pollinator friendly landscapes. Importantly, respondents with more positive feelings towards bees were also more likely to score the pollinator-friendly landscapes more highlight. From a management perspective, this may suggest that investments into educational materials within parks focused on promoting the ecosystem services provided by bees, and calming fears around stinging insects, may help to improve acceptance of native, pollinator-friendly landscapes. Additionally, these efforts are needed more so in lower income neighborhoods, offering a potentially complementary conclusion to that of Objective 1. Providing a clear link between the importance of bees in our daily lives and the importance of native flowering landscapes to bees should be an area of implementation and ongoing research.

Products and output to date:

Poster

- Champine V, Mola JM (2024). Exploring residents' perceptions of pollinator friendly landscapes in Denver Parks. Entomological Society of America North Central Branch Meeting. Fort Collins, CO

Objective 3: Plant selection using multi-criteria decision analysis

Seed and plant mix selection is a major challenge for habitat restoration in a variety of landscapes. Within urban environments, the considerations may shift due to restrictions in municipal budgets, mixed land use requirements, or the availability of suitable and affordable seeds. Currently, several different plant lists exist for “pollinator friendly” plant mixes along the Colorado Front Range, but they may not be optimized for different scenarios.

We used multi-objective decision analysis (MODA) to help work towards better and more flexibly informed plant mixes for pollinator friendly landscaping within Denver Parks.

Multi-objective decision analysis does not seek to provide one single best answer to a problem. Instead, it acknowledges that there are trade offs among objectives. For example, if we were selecting which car to purchase, there is no one best car. Instead, if we wanted a budget-friendly car option, we may choose a car that has a low initial cost and good gas mileage, and deemphasize traits of the car like top speed or horsepower. If we wanted to find the “coolest car” we might use the same traits (cost, gas mileage, top speed, horsepower), but instead flip our emphasis, giving more “weight” to traits associated with speed and power.

Similarly, we can use this logic to select plant mixes for pollinators with respect to other objectives like heat or drought tolerance of the plants. Unlike the car example, here we are choosing from among hypothetical mixes of different plants and their assembled traits. Rather than selecting say the single plant with the longest bloom period, we may give more value to mixes that have species with a range of flowering periods (e.g. early, middle, and late summer). Because we are interested in attracting pollinators, we will always give weight to traits associated with supporting bees and butterflies like a diversity of floral colors or consistent flowering throughout the season, but we may have a scenario where we really want to be water conscious so we select plants that are a bit less attractive to pollinators, but have deep root systems or tissues that are resistant to drying out.

To achieve this end, we started with 120 plant species assembled from Denver Parks and Recreation's internal plant data base, plus two "pollinator friendly" plant lists from The Xerces Society for Invertebrate Conservation and Pollinator Partnership. For every plant, we scored it across a range of traits like height, month(s) of bloom, color, root depth, specific leaf area, etc. We had 30 traits in total. Because we are not interested in the individual traits of plants, but rather the traits of plant mixes, we then generated over 140,000 possible combinations of 5 plants at a time to yield 12 traits that we analyze here. These include flowering duration, variability in height, iNaturalist insect records, genus-level bee visitation (from Objective 1), and 8 additional traits associated with drought from the TRY plant database (leaf tissue mean, leaf tissue variability, root depth mean, root depth variability, specific leaf area mean, specific leaf area variability, specific root length mean, and specific root length variability).

We then fit a function to each of those traits to generate what is called a "single attribute value function" or SAVF (Figure 3.1). The SAVF helps us compare among our choices in a standardized manner. For example, we may fit a curve to the number of species observed visiting this plant species from Objective 1 as a trait associated with pollinator attractiveness. Plants that attract very few bee species (i.e. raw values close to 0) receive a low SAVF score whereas plants that attract many bee species receive a high SAVF score. We can fit linear, exponential, and/or decaying curves as we see fit to represent the values we associate with different traits in the dataset.

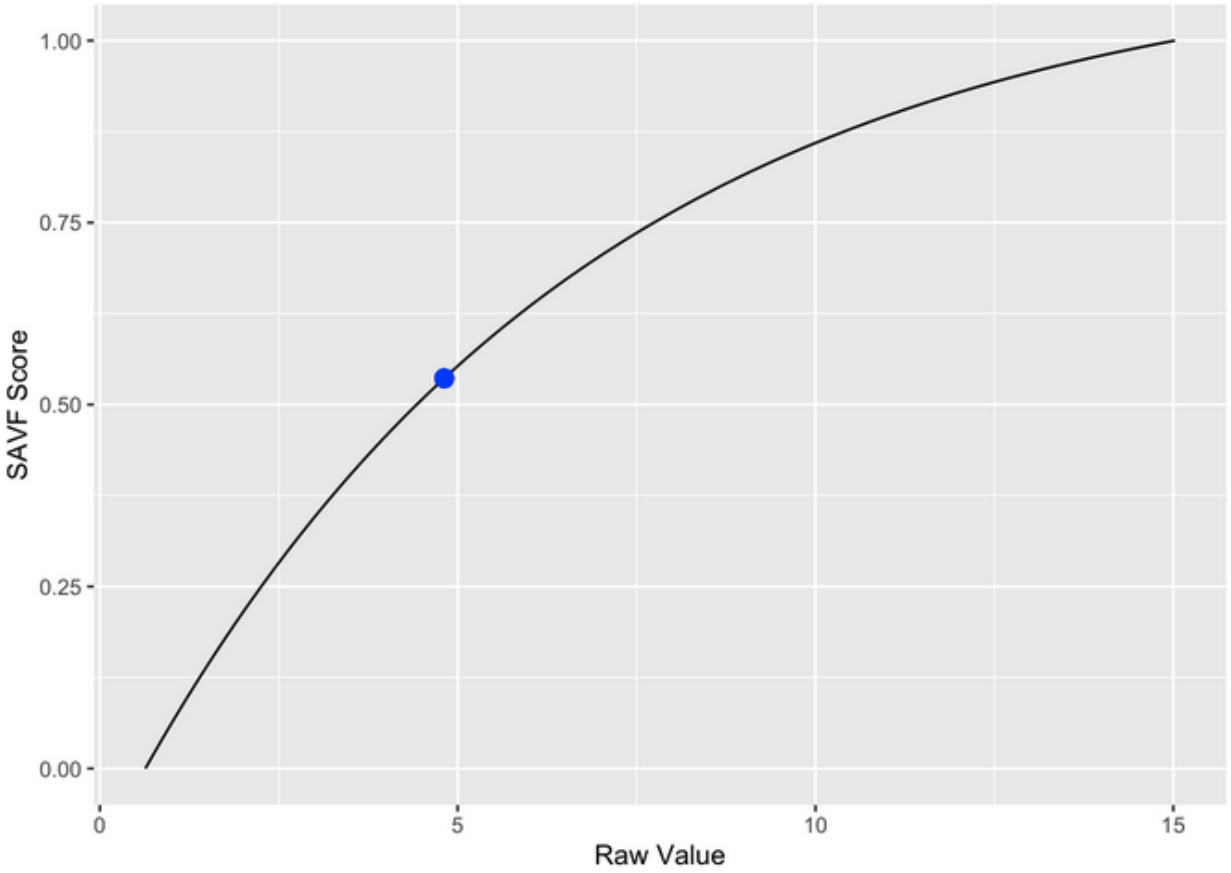


Figure 3.1. Single attribute value function for a hypothetical trait. Raw values with low scores (e.g. number of bee species visiting a plant) receive a low SAVF (y-axis), whereas those with high raw values receive a high SAVF score. We fit a decay function here because we place less value on going from, for example, 12 to 15 species, versus a lot of value is gained in going from 0 to 3 species (despite having the same absolute increase).

After we have fit a SAVF for all 12 of our traits, we can then calculate the SAVF for each trait within each plant mix. This gives us 140,000 hypothetical plant mixes with their associated scores for each trait. Then, we can model different scenarios representing our desired plant lists (Table 3.1). The final result is a multi-attribute value function (MAVF), or more simply - a score from 0 to 1 with higher values representing more desired choices.

Table 3.1. The 12 traits used in our analysis and their weights given to them under different scenarios. In the pollinator scenario, a total of 75% of the weight is given to the first 4 traits. In the drought scenario, 66% of the total weight is given to the

traits associated with drought tolerance. In the balanced scenario, 50% of the total weight is given to each of the two broad categories. Traits thought to be associated most strongly with pollinator biodiversity are shown in green.

Trait	Pollinator	Drought	Balanced
Flowering duration	.1875	.063	.125
SD height	.1875	.063	.125
Mean iNat	.1875	.063	.125
Genus visits	.1875	.063	.125
Leaf tissue mean	.028	.083	.055
Leaf tissue SD	.028	.083	.055
Root depth mean	.028	.083	.055
Root depth SD	.028	.083	.055
SLA mean	.028	.083	.055
SLA SD	.028	.083	.055

SRL mean	.028	.083	.055
SRL SD	.028	.083	.055

Model Results

Strong caution is recommended in interpreting current model output. See discussion after tables.

Table 3.2. Top 10 plant mixes under pollinator scenario

Species in the mix	**Score**
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Blitum nuttallianum,Cleome serrulata	0.72
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Cleome serrulata,Helianthus maximiliani	0.72
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Mentzelia nuda,Cleome serrulata	0.72
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Ratibida columnifera,Cleome serrulata	0.72
Asclepias incarnata,Helianthus nuttallii,Solidago rigida,Dalea purpurea,Helianthus maximiliani	0.72
Asclepias incarnata,Helianthus nuttallii,Solidago rigida,Dalea purpurea,Cleome serrulata	0.71
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Cleome serrulata,Ipomoea leptophylla	0.71
Asclepias incarnata,Helianthus nuttallii,Gaillardia aristata,Dalea purpurea,Cleome serrulata	0.71
Asclepias incarnata,Helianthus nuttallii,Amorpha canescens,Dalea purpurea,Cleome serrulata	0.71
Helianthus nuttallii,Dalea purpurea,Cleome serrulata,Asclepias speciosa,Helianthus maximiliani	0.71

Table 3.3. Top 10 plant mixes under drought scenario

Species in the mix	Score
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Cleome serrulata,Ipomoea leptophylla	0.74
Asclepias incarnata,Verbena hastata,Helianthus nuttallii,Dalea purpurea,Ipomoea leptophylla	0.73
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Mentzelia nuda,Ipomoea leptophylla	0.73
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Ipomoea leptophylla,Eriogonum annuum	0.73
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Ipomoea leptophylla,Erythranthe guttata	0.73
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Ipomoea leptophylla,Maianthemum stellatum	0.72
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Blitum nuttallianum,Ipomoea leptophylla	0.72
Asclepias incarnata,Helianthus nuttallii,Amorpha canescens,Dalea purpurea,Cleome serrulata	0.72
Asclepias incarnata,Helianthus nuttallii,Gaillardia aristata,Dalea purpurea,Ipomoea leptophylla	0.72
Verbena hastata,Helianthus nuttallii,Dalea purpurea,Ipomoea leptophylla,Asclepias speciosa	0.72

Table 3.4. Top 10 plant mixes under balanced scenario

Species in the mix	Score
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Cleome serrulata,Ipomoea leptophylla	0.73
Asclepias incarnata,Helianthus nuttallii,Amorpha canescens,Dalea purpurea,Cleome serrulata	0.72
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Mentzelia nuda,Cleome serrulata	0.72
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Blitum nuttallianum,Cleome serrulata	0.72

Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Solidago canadensis,Cleome serrulata	0.71
Asclepias incarnata,Verbena hastata,Helianthus nuttallii,Dalea purpurea,Cleome serrulata	0.71
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Cleome serrulata,Eriogonum annuum	0.71
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Mentzelia nuda,Ipomoea leptophylla	0.71
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Cleome serrulata,Erythranthe guttata	0.71
Asclepias incarnata,Helianthus nuttallii,Dalea purpurea,Blitum nuttallianum,Ipomoea leptophylla	0.71

Table 3.5. Ranking of individual plants across how many times they appear under the top 100 mixes under each scenario.

Species	**Balance Appearances**	**Balance Rank**	**Pollinator Appearances**	**Pollinator Rank**	**Drought Appearances**	**Drought Rank**	**Mean Rank**
Dalea purpurea	100	1	100	1	10	1	1
Helianthus nuttallii	97	2	99	2	10	2	2
Asclepias incarnata	87	3	51	4	9	3	3.33
Cleome serrulata	37	4	66	3	2	5	4
Ipomoea leptophylla	23	5	7	14	9	4	7.67
Mentzelia nuda	15	6	9	11	1	14	10.33
Amorpha canescens	14	7	5	15	1	7	9.67
Helianthus maximiliani	14	8	31	5	100	100	37.67
Solidago rigida	14	9	29	6	100	100	38.33
Blitum nuttallianum	12	10	17	8	1	9	9
Solidago canadensis	12	11	3	20	100	100	43.67
Asclepias speciosa	11	12	17	7	1	8	9

Verbena hastata	11	13	9	12	2	6	10.33
Maianthemum stellatum	10	14	8	13	1	13	13.33
Eriogonum annuum	9	15	4	18	1	10	14.33
Gaillardia aristata	7	16	4	19	1	12	15.67
Ratibida columnifera	6	17	13	9	100	100	42
Erythranthe guttata	5	18	2	21	1	11	16.67
Chrysopsis villosa	3	19	9	10	100	100	43
Iris missouriensis	2	20	1	24	100	100	48
Oenothera elata	2	21	1	26	100	100	49
Oenothera suffrutescens	2	22	2	22	100	100	48
Tradescantia occidentalis	2	23	1	28	100	100	50.33
Achillea millefolium	1	24	4	17	100	100	47
Artemisia frigida	1	25	1	23	100	100	49.33
Liatris punctata	1	26	1	25	100	100	50.33
Sphaeralcea coccinea	1	27	1	27	100	100	51.33
Symphyotrichum falcatum	1	28	100	100	100	100	76
Monarda fistulosa	100	100	5	16	100	100	72

Again, it is important to recognize that there is no single best choice. To use our car example again, a Toyota Corolla and a Toyota Prius might both be good “budget” car options and the Corolla may score slightly higher than the Prius - but if we have money to cover the up front cost of the Prius easily, we may prefer the lower fuel cost over a long period of time. Simply, the results provide us with a ranked list of options, but we’re under no obligation to choose the highest ranking option. In our plant example, we may decide that although a certain combination of 5 plants “wins”, the second or even fourth ranking choices are preferable due to seed availability or some other unmeasured variable.

This work is still ongoing, and there remain several caveats to the current output. Although we place strong emphasis on understanding the model generates plant mixes rather than choosing individual plants, some key plants that are persistent "winners" across different modeling scenarios include *Daleae purpurea, Helianthus nuttallii, Ascelpias incarnata, Cleome serrulata,* and *Ipomoea leptophylla*.

Objective 4: Outreach and education activities

In addition to the primary objectives 1-3, the research team has undertaken several outreach, education, and extension activities as well as the training of students at various career stages.

In June 2023, PI Mola led a bumble bee identification workshop in Denver at the CSU Spur campus with ~25 attendees.

Photos from the Bumble Bee Identification Workshop held at the CSU Spur Campus May 13th, 2023. Left Photo taken by Emily Barbo.

In July 2023, Nicki Bailey led a field day with the Urban Green Corps where PI Mola, PI Champine, extension intern Bartholomew, and technician Comai attended to teach participants about native bees and flowers. (Of fun note, during this day

we detected a *Bombus morrisoni*, which had not been previously observed in Denver!)


Photos from the outreach day with Denver Parks and Recreation's Urban GreenCorps. Left, participant holds a male bumble bee (they can't sting!). Right, attendees gather bees for non-lethal identification and observation.

Other activities conducted by the team include:

- Recruitment and training of CSU Summer Extension intern Nancy Bartholomew, Nancy has continued to work with the Mola Lab on an independent research project
- Participation in the Denver "It's In Our Nature" podcast
- A blog post for the Salazar Center
- Funding and training of Master's student Nicki Bailey
- Funding of partial support for Research Associate Dr. Veronica Champine
- 3x CSU student hourly positions
- Production of enduring outreach materials (e.g. right photo from the Bumble Bee ID workshop)

The team expects in the next year to participate in the following grant related activities:

- Submission of 3 scientific manuscripts (two from objective 1, and 1 from objective 2)
- Expanded proposal to USDA for pollinator plantings project (i.e. continuation of objective 3)
- Ongoing collaborations with DPR

Conclusion and Synthesis

Our program had three primary objectives including 1) understanding the scale at which pollinator biodiversity is explained in Denver Parks, 2) describing the values and attitudes of Denver residents towards pollinator friendly landscapes, and 3) improving guidance in plant selection for pollinator friendly plant mixes. Although future work and ongoing collaboration is required to improve confidence in results, we have several clear conclusions and recommendations for implementation and future work.

The primary drivers of pollinator biodiversity appear to be local (i.e. park-level factors) associated with the floral community and possibly nesting resources within parks themselves, rather than landscape-scale (i.e. neighborhood) factors like the degree of urbanization or neighborhood affluence. However, these factors can interplay indirectly - as is evidenced by the suggestion that parks dominated by weedy plants have lower bee biodiversity and weedy dominated parks are more common in lower income neighborhoods. Future research may be necessary to disentangle effects of habitat connectivity or determine if landscape-scale factors may become limiting if local factors are first improved. **A primary management conclusion from this stage of the research is that weedy plant removal should occur alongside the installation of native plants, and those efforts should be prioritized in parks in the lowest income neighborhoods**, as that is where high weed dominance and low pollinator diversity is most common. Another priority area for future research should focus on investigating if plant diversity or planting area would be more effective in increasing total pollinator abundance at Denver parks.

Results from our survey of Denver residents on their attitudes towards pollinator friendly landscapes suggest a few primary conclusions. First, Denver residents have a slight preference towards turf-grass parks, but it's possible this preference can be overcome via targeted use of "cues of care" as well as educational programs aimed at understanding and appreciating bees and other pollinators. Complementary with the conclusions of objective 1, these efforts would be best placed in lower income neighborhoods where attitudes towards pollinator friendly

landscapes were least favorable. However, rather than a top-down approach, care should be taken to work with representatives from these communities to ensure these landscapes are actually wanted. Future research likely should focus on understanding the source of these unfavorable attitudes and determining agreeable approaches towards implementation or alternative pathways.

Although the results of objective 3 need to be approached with caution until future research can improve the availability of data and potentially a field realistic test of the results, we can provide a few conclusions at this time. First, the process of plant selection using MODA suggests a strong potential for this tool as a means to facilitate conversation and determine which plants may be complementary in their growth and attraction to pollinators. Second, plants like purple prairie clover (*Dalea purpurea*), Nuttall's Sunflower (*Helianthus nuttallii*), swamp milkweed (*Asclepias incarnata*), and rocky mountain bee plant (*Cleome serrulata*) performed well under all modeled scenarios (Table 3.5). Inclusion of these plants into most mixes seems prudent, especially when paired with plants that may complement their attributes in height, color, seasonality or drought tolerance. Future research should focus on expanding the availability of trait data for all plant species, considering mixes of varying species richness and cost, and conducting trials of mixes in common garden experiments.

Appendix 1. Extended data tables

Appendix Table 1. Total bee specimens captured from each host plant, sorted by species richness observed on the plant. Many plants never were observed to have an interaction with bees (though they may have simply been uncommon among parks).

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
1	*Heterotheca villosa*	Asteraceae	Hairy False Goldenaster	native	37	144
2	*Convolvulus arvensis*	Convolvulaceae	Field Bindweed	weedy	31	150
3	*Erigeron divergens*	Asteraceae	Spreading fleabane	native	31	151
4	*Cirsium arvense*	Asteraceae	Canada thistle	weedy	28	69
5	*Melilotus officinalis*	Fabaceae	Yellow Sweetclover	weedy	28	174
6	*Ratibida columnifera*	Asteraceae	Prairie coneflower	native	26	141
7	*Rudbeckia hirta*	Asteraceae	Black-eyed Susan	native	26	101
8	*Salvia yangii*	Lamiaceae	Russian Sage	weedy	25	81
9	*Erigeron speciosus*	Asteraceae	Aspen fleabane	native	21	48

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
10	*Trifolium repens*	Fabaceae	White Clover	weedy	21	203
11	*Taraxacum officinale*	Asteraceae	Common Dandelion	weedy	20	52
12	*Helianthus petiolaris*	Asteraceae	Prairie Sunflower	native	18	59
13	*Salvia nemorosa*	Lamiaceae	Woodland Sage	weedy	16	36
14	*Cleome serrulata*	Cleomaceae	Rocky Mountain Beeplant	native	15	46
15	*Echinacea purpurea*	Asteraceae	Purple coneflower	cultivar	15	79
16	*Helianthus annuus*	Asteraceae	Common sunflower	native	15	110
17	*Melilotus albus*	Fabaceae	White Sweetclover	weedy	14	62
18	*Antirrhinum majus*	Plantaginaceae	Snapdragon	cultivar	13	49
19	*Heliotropium arborescens*	Boraginaceae	Cherry pie plant	cultivar	13	19
20	*Medicago sativa*	Fabaceae	Alfalfa	weedy	13	58
21	*Penstemon strictus*	Plantaginaceae	Rocky Mountain Penstemon	native	13	35

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
22	*Sonchus arvensis*	Asteraceae	Perennial sowthistle	weedy	13	39
23	*Monarda fistulosa*	Lamiaceae	Wild bergamot	native	12	73
24	*Gaillardia pulchella*	Asteraceae	Indian Blanket	native	11	48
25	*Achillea millefolium*	Asteraceae	Yarrow	native	10	58
26	*Cosmos bipinnatus*	Asteraceae	Garden Cosmos	native	10	34
27	*Medicago lupulina*	Fabaceae	Black Medic	weedy	10	12
28	*Sedum spurium*	Crassulaceae	Two-row stonecrop	cultivar	10	25
29	*Tradescantia occidentalis*	Commelinaceae	Western Spiderwort	native	10	26
30	*Trifolium pratense*	Fabaceae	Red Clover	weedy	10	42
31	*Eryngium alpinum*	Apiaceae	Alpine sea holly	cultivar	9	15
32	*Helenium amarum*	Asteraceae	Bitter sneezeweed	weedy	9	25
33	*Berlandiera lyrata*	Asteraceae	Chocolate flower	native	8	17

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
34	*Carduus nutans*	Asteraceae	Nodding thistle	weedy	8	9
35	*Grindelia squarrosa*	Asteraceae	Curlycup gumweed	native	8	19
36	*Heliopsis helianthoides*	Asteraceae	False sunflower	native	8	13
37	*Salvia splendens*	Lamiaceae	Scarlet sage	cultivar	8	10
38	*Coreopsis verticillata*	Asteraceae	Threadleaf coreopsis	cultivar	7	16
39	*Eutrochium maculatum*	Asteraceae	Spotted Joe-Pye weed	native	7	15
40	*Galinsoga quadriradiata*	Asteraceae	Shaggy soldier	weedy	7	9
41	*Gomphrena globosa*	Amaranthaceae	Globe Amaranth	cultivar	7	9
42	*Nepeta cataria*	Lamiaceae	Catnip	weedy	7	14
43	*Penstemon digitalis*	Plantaginaceae	Foxglove beardtongue	cultivar	7	12
44	*Stachys byzantina*	Lamiaceae	Lamb's ear	cultivar	7	24
45	*Agastache cana*	Lamiaceae	Mosquito plant	cultivar	6	11

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
46	*Asclepias speciosa*	Apocynaceae	Showy Milkweed	native	6	8
47	*Callirhoe involucrata*	Malvaceae	Purple poppy mallow	native	6	10
48	*Caryopteris mongholica*	Lamiaceae	Bluebeard	cultivar	6	12
49	*Coreopsis lanceolata*	Asteraceae	Lanceleaf coreopsis	native	6	12
50	*Gaillardia aristata*	Asteraceae	Common blanketflower	native	6	14
51	*Phedimus spurius*	Crassulaceae	Caucasian stonecrop	cultivar	6	31
52	*Salvia farinacea*	Lamiaceae	Mealy sage	weedy	6	62
53	*Amsonia tabernaemontana*	Apocynaceae	Eastern bluestar	cultivar	5	8
54	*Argemone polyanthemos*	Papaveraceae	Prickly poppy	native	5	17
55	*Asclepias tuberosa*	Apocynaceae	Butterfly weed	native	5	13
56	*Centaurea cyanus*	Asteraceae	Cornflower	cultivar	5	15
57	*Dalea purpurea*	Fabaceae	Purple Praire Clover	native	5	17

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
58	*Echinacea paradoxa*	Asteraceae	Yellow coneflower	cultivar	5	12
59	*Lobularia maritima*	Brassicaceae	Sweet alyssum	native	5	12
60	*Nepeta faassenii*	Lamiaceae	Fassesn's catnip	weedy	5	14
61	*Onopordum acanthium*	Asteraceae	Scotch thistle	weedy	5	19
62	*Veronica spicata*	Plantaginaceae	Spiked speedwell	cultivar	5	7
63	*Agastache aurantiaca*	Lamiaceae	Orange Hummingbird Mint	cultivar	4	7
64	*Aster amellus*	Asteraceae	European michaelmas daisy	cultivar	4	9
65	*Astragalus cicer*	Fabaceae	Chickpea milkvetch	weedy	4	17
66	*Centaurea macrocephala*	Asteraceae	Giant Knapweed	cultivar	4	16
67	*Geranium sanguineum*	Geraniaceae	Bloody geranium	cultivar	4	5
68	*Lactuca serriola*	Asteraceae	Prickly lettuce	weedy	4	11
69	*Liatris spicata*	Asteraceae	Dense Blazing star	cultivar	4	7

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
70	*Limonium carolinianum*	Plumbaginaceae	Lavender thrift	cultivar	4	4
71	*Lythrum salicaria*	Lythraceae	Purple loosestrife	weedy	4	4
72	*Malva neglecta*	Malvaceae	Common Mallow	cultivar	4	4
73	*Salix exigua*	Salicaceae	Narrowleaf willow	weedy	4	18
74	*Sedum lineare*	Crassulaceae	Needle stonecrop	cultivar	4	14
75	*Solidago juncea*	Asteraceae	Early goldenrod	weedy	4	4
76	*Tithonia diversifolia*	Asteraceae	Mexican sunflower	cultivar	4	9
77	*Verbesina enceloides*				4	6
78	*Zinnia elegans*	Asteraceae	Common zinnia	cultivar	4	5
79	*Achillea tomentosa*	Asteraceae	Woolly Yarrow	weedy	3	11
80	*Amblyolepis setigera*	Asteraceae	Huisache daisy	cultivar	3	5
81	*Buddleja davidii*	Scrophulariaceae	Butterfly-bush	cultivar	3	5

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
82	*Chamaebatiaria millefolium*	Rosaceae	Desert sweet	native	3	4
83	*Cleome hassleriana*	Commelinaceae	Spiderflower	cultivar	3	6
84	*Erodium cicutarium*	Geraniaceae	Redstem stork's bill	weedy	3	8
85	*Lupinus sericeus*	Fabaceae	Silky Lupine	native	3	3
86	*Machaeranthera tanacetifolia*	Asteraceae	Tansyleaf Tansyaster	native	3	4
87	*Opuntia macrorhiza*	Cactaceae	Twist spine pricklypear	native	3	14
88	*Penstemon centranthifolius*	Plantaginaceae	Scarlet bugler	cultivar	3	3
89	*Penstemon heterophyllus*	Plantaginaceae	Bunchleaf penstemon	cultivar	3	3
90	*Phedimus aizoon*	Crassulaceae	Sedum aizoon	cultivar	3	5
91	*Physostegia virginiana*	Lamiaceae	Obedient plant	cultivar	3	9
92	*Sphaeralcea coccinea*	Malvaceae	Scarlet globemallow	native	3	5

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
93	*Tragopogon dubius*	Asteraceae	Yellow Salsify	cultivar	3	5
94	*Verbascum thapsus*	Scrophulariaceae	Common mullein	weedy	3	4
95	*Veronica longifolia*	Plantaginaceae	Garden speedwell	cultivar	3	3
96	*Zinnia angustifolia*	Asteraceae	Creeping zinnia	cultivar	3	11
97	*Achillea filipendulina*	Asteraceae	Fern-leaf yarrow	cultivar	2	3
98	*Allium cernuum*	Amaryllidaceae	Nodding onion	native	2	4
99	*Allium giganteum*	Amaryllidaceae	Giant onion	cultivar	2	2
100	*Baptisia sphaerocarpa*	Fabaceae	Yellow wild indigo	cultivar	2	2
101	*Celosea argentea*				2	2
102	*Centhranthus ruber*	Caprifoliaceae	Red valerian	cultivar	2	2
103	*Coreopsis tinctoria*	Asteraceae	Plains coreopsis	native	2	2
104	*Crataegus pinnatifida*	Rosaceae	Mountain Hawthorn	cultivar	2	2
105	*Descurainia pinnata*	Brassicaceae	Tansymustard	native	2	2

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
106	*Dianthus barbatus*	Caryophyllaceae	Sweet William	cultivar	2	3
107	*Echinops ritro*	Asteraceae	Southern globethistle	cultivar	2	6
108	*Erigeron annuus*	Asteraceae	Daisy Fleabane	weedy	2	2
109	*Erigeron canadensis*	Asteraceae	Horseweed	weedy	2	9
110	*Gazania rigens*	Asteraceae	Treasure Flower	cultivar	2	2
111	*Geranium himalayense*	Geraniaceae	Himalayan crane's-bill	cultivar	2	2
112	*Gypsophila paniculata*	Caryophyllaceae	Baby's breath	cultivar	2	3
113	*Hemerocallis fulva*	Asphodelaceae	Ditch lily	cultivar	2	2
114	*Lavendula angustifolia*				2	2
115	*Liatris punctata*	Asteraceae	Dotted Gayfeather	native	2	3
116	*Linaria dalmatica*	Plantaginaceae	Dalmation Toadflax	cultivar	2	2
117	*Lupinus arboreus*	Fabaceae	Yellow Bush Lupine	weedy	2	2
118	*Petunia atkinsiana*	Solanaceae	Garden petunia	cultivar	2	3

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
119	*Platycodon grandiflorus*	Campanulaceae	Balloon flower	cultivar	2	7
120	*Rosa arkansana*	Rosaceae	Prairie Rose	native	2	6
121	*Salvia azuria*				2	8
122	*Solidago canadensis*	Asteraceae	Canada goldenrod	native	2	2
123	*Stanleya pinnata*	Brassicaceae	Desert princesplume	native	2	2
124	*Tagetes erecta*	Asteraceae	Aztec marigold	cultivar	2	5
125	*Vernonia fasciculata*	Asteraceae	Western ironweed	native	2	2
126	*Ageratum houstonianum*	Asteraceae	Flossflower	cultivar	1	2
127	*Aquilegia coerulea*	Ranunculaceae	Colorado blue columbine	native	1	1
128	*Asclepias incarnata*	Apocynaceae	Swamp milkweed	native	1	1
129	*Baptisia australis*	Fabaceae	Blue wild indigo	native	1	1
130	*Cornus sericea*	Cornaceae	Red-osier Dogwood	native	1	1

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
131	*Delphinium carolinianum*	Ranunculaceae	Carolina larkspur	native	1	1
132	*Digitalis purpurea*	Plantaginaceae	Common foxglove	cultivar	1	2
133	*Ericameria nauseosa*	Asteraceae	Rubber rabbitbrush	native	1	5
134	*Eryngium yuccifolium*	Apiaceae	Rattlesnake master	cultivar	1	1
135	*Eutrochium purpureum*	Asteraceae	Purple Joe-Pye weed	native	1	1
136	*Geum rivale*	Rosaceae	Water avens	native	1	1
137	*Gladularia tenera*				1	1
138	*Glycyrrhiza lepidota*	Fabaceae	American Licorice	native	1	1
139	*Grindelia subalpine*				1	1
140	*Hylotelephium telephium*	Crassulaceae	Orpine	cultivar	1	2
141	*Ipomoea alba*	Convolvulaceae	Moonflower	cultivar	1	1
142	*Ipomoea sagittata*	Convolvulaceae	Saltmarsh morning-glory	cultivar	1	1
143	*Leucanthemum vulgare*	Asteraceae	Oxeye daisy	cultivar	1	4

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
144	*Linum lewisii*	Linaceae	Lewis flax	native	1	1
145	*Origanum vulgare*	Lamiaceae	Oregano	weedy	1	3
146	*Papaver rhoeas*	Papaveraceae	Common poppy	cultivar	1	1
147	*Penstemon palmeri*	Plantaginaceae	Penstemon palmeri	native	1	1
148	*Plumbago auriculata*	Plumbaginaceae	Cape leadwort	cultivar	1	1
149	*Rosa chinensis*	Rosaceae	China rose	cultivar	1	1
150	*Rosa hybrida*	Rosaceae	Hybrid tea rose	cultivar	1	1
151	*Salvia greggii*	Lamiaceae	Autumn sage	cultivar	1	1
152	*Salvia pratensis*	Lamiaceae	Meadow sage	weedy	1	2
153	*Sisymbrium altissimum*	Brassicaceae	Tall tumblemustard	weedy	1	1
154	*Solanum angustifolium*	Solanaceae	Buffalo bur	weedy	1	1
155	*Solidago rigida*	Asteraceae	Stiff goldenrod	native	1	2

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
156	*Stachys palustris*	Lamiaceae	Marsh woundwort	weedy	1	2
157	*Symphoricarpos occidentalis*	Caprifoliaceae	Western snowberry	native	1	1
158	*Symphyotrichum lanceolatum*	Asteraceae	White-panicle aster	native	1	1
159	*Verbena bracteata*	Verbenaceae	Bigbract verbena	native	1	1
160	*Visnaga daucoides*	Apiaceae	False queen anne's lace	cultivar	1	1
161	*Warnockia scutellariodes*				1	1
162	*Achillea ptarmica*	Asteraceae	Sneezewort	weedy	0	0
163	*Argemone albiflora*	Papaveraceae	White prickly poppy	cultivar	0	0
164	*Ajuga*	Lamiaceae	Bugleweed	cultivar	0	0
165	*Alcea rosea*	Malvaceae	Hollyhock	cultivar	0	0
166	*Allium ampeloprasum*	Amaryllidaceae	Wild leek	cultivar	0	0
167	*Allium textile*	Amaryllidaceae	Wild Onion	native	0	0

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
168	*Allium tuberosum*	Amaryllidaceae	Garlic chives	cultivar	0	0
169	*Alstroemeria aurea*	Alstroemeriaceae	Peruvian lily	cultivar	0	0
170	*Ambrosia psilostachya*	Asteraceae	Cuman ragweed	native	0	0
171	*Anaphalis margaritacea*	Asteraceae	Pearly everlasting	native	0	0
172	*Apocynum cannabinum*	Apocynaceae	American hemp	native	0	0
173	*Aquilegia canadensis*	Ranunculaceae	Red Columbine	cultivar	0	0
174	*Aquilegia chrysantha*	Ranunculaceae	Golden columbine	native	0	0
175	*Asclepias subverticillata*	Apocynaceae	Whorled milkweed	native	0	0
176	*Boerhavia coccinea*	Nyctaginaceae	Scarlet spiderling	native	0	0
177	*Bromus*	Poaceae	Smooth Brome	cultivar	0	0
178	*Campanula rotundifolia*	Campanulaceae	Bluebell Bellflower	native	0	0
179	*Canna indica*	Cannaceae	Canna Lily	cultivar	0	0

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
180	*Castilleja indivisa*	Orobanchaceae	Entireleaf Indian paintbrush	cultivar	0	0
181	*Catalpa*	Bignoniaceae	Catalpa	cultivar	0	0
182	*Catananche caerulea*	Asteraceae	Blue cupidone	cultivar	0	0
183	*Catharanthus roseus*	Apocynaceae	Madagascar periwinkle	cultivar	0	0
184	*Celosia*	Amaranthaceae	Cock's comb	cultivar	0	0
185	*Celosia argentea*	Amaranthaceae	Plumed Cockscomb	cultivar	0	0
186	*Celosia cristata*	Amaranthaceae	Crested Cockscomb	cultivar	0	0
187	*Cenchrus americanus*	Poaceae	Pearl millet	cultivar	0	0
188	*Cephalanthus occidentalis*	Rubiaceae	Common buttonbush	native	0	0
189	*Cirsium texanum*	Asteraceae	Texas Thistle	cultivar	0	0
190	*Cleomella arborea*	Cleomaceae	Bladderpod	cultivar	0	0
191	*Coleus scutellarioides*	Lamiaceae	Coleus	cultivar	0	0

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
192	*Conium maculatum*	Apiaceae	Poison hemlock	weedy	0	0
193	*Coriandrum sativum*	Apiaceae	Cilantro	cultivar	0	0
194	*Crataegus crus-galli*	Rosaceae	Cockspur Hawthorn Tree	native	0	0
195	*Cyathula prostrata*	Amaranthaceae	Pastureweed	cultivar	0	0
196	*Dahlia pinnata*	Asteraceae	Dahlia pinnata	cultivar	0	0
197	*Datura metel*	Solanaceae	Devil's trumpet	cultivar	0	0
198	*Datura stramonium*	Solanaceae	Jimsonweed	cultivar	0	0
199	*Daucus carota*	Apiaceae	Queen Anne's Lace	weedy	0	0
200	*Delphinium elatum*	Ranunculaceae	Candle larkspur	cultivar	0	0
201	*Delphinium grandiflorum*	Ranunculaceae	Siberian larkspur	cultivar	0	0
202	*Descurainia sophia*	Brassicaceae	Flixweed	weedy	0	0
203	*Echinops sphaerocephalus*	Asteraceae	Great globethistle	cultivar	0	0

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
204	*Echium vulgare*	Boraginaceae	Viper's Bugloss	weedy	0	0
205	*Emilia fosbergii*	Asteraceae	Florida tasselflower	cultivar	0	0
206	*Engelmannia peristenia*	Asteraceae	Engelmann daisy	native	0	0
207	*Epilobium hirsutum*	Onagraceae	Hairy willowherb	weedy	0	0
208	*Erigeron strigosus*	Asteraceae	Daisy Fleabane	weedy	0	0
209	*Eriogonum heracleoides*	Polygonaceae	Parsnipflower buckwheat	native	0	0
210	*Eschscholzia californica*	Papaveraceae	California Poppy	cultivar	0	0
211	*Euphorbia esula*	Euphorbiaceae	Leafy spurge	weedy	0	0
212	*Euphorbia leucocephala*	Euphorbiaceae	Pascuita	cultivar	0	0
213	*Euthamia graminifolia*	Asteraceae	Grass-leaved goldenrod	native	0	0
214	*Euthamia occidentalis*	Asteraceae	Western goldentop	native	0	0
215	*Fallugia paradoxa*	Rosaceae	Apache Plume	native	0	0

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
216	*Gaillardia aestivalis*	Asteraceae	Lanceleaf blanketflower	native	0	0
217	*Galinsoga parviflora*	Galinsoga parviflora	Gallant soldier	cultivar	0	0
218	*Geranium maculatum*	Geraniaceae	Wild geranium	cultivar	0	0
219	*Geum aleppicum*	Rosaceae	Yellow avens	native	0	0
220	*Geum macrophyllum*	Rosaceae	Large-leaved avens	native	0	0
221	*Glandularia tenera*	Verbenaceae	Latin American Mock Vervain	cultivar	0	0
222	*Glandularia bipinnatifida*	Verbenaceae	Prairie verbena	native	0	0
223	*Glottiphyllum linguiforme*	Aizoaceae	Tongue plant	cultivar	0	0
224	*Helianthus angustifolius*	Asteraceae	Swamp sunflower	cultivar	0	0
225	*Helianthus pauciflorus*	Asteraceae	Stiff Sunflower	native	0	0
226	*Heliotropium*	Boraginaceae	Heliotrope	cultivar	0	0
227	*Hemerocallis*	Asphodelaceae	Yellow Daylily	cultivar	0	0

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
	lilioasphodelus					
228	*Hesperaloe parviflora*	Asparagaceae	Red yucca	cultivar	0	0
229	*Hesperis matronalis*	Brassicaceae	Dame's Rocket	cultivar	0	0
230	*Heterotheca subaxillaris*	Asteraceae	Camphorweed	native	0	0
231	*Hibiscus moscheutos*	Malvaceae	Swamp rose mallow	cultivar	0	0
232	*Hosta sieboldiana*	Asparagaceae	Siebold's Plantain Lily	cultivar	0	0
233	*Iberis sempervirens*	Brassicaceae	Evergreen candytuft	cultivar	0	0
234	*Incarvillea delavayi*	Bignoniaceae	Chinese trumpet-flower	cultivar	0	0
235	*Ipomoea purpurea*	Convolvulaceae	Common morning-glory	cultivar	0	0
236	*Ipomopsis aggregata*	Polemoniaceae	Scarlet gilia	native	0	0
237	*Ipomopsis rubra*	Polemoniaceae	Texas plume	cultivar	0	0
238	*Ipomopsis tenuituba*	Polemoniaceae	Slendertube Skyrocket	native	0	0

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
239	*Iris germanica*	Iridaceae	Purple bearded iris	cultivar	0	0
240	*Iris pseudacorus*	Iridaceae	Yellow Iris	cultivar	0	0
241	*Jacobaea maritima*	Asteraceae	Dusty miller	cultivar	0	0
242	*Kniphofia uvaria*	Asphodelaceae	Red hot poker	cultivar	0	0
243	*Lamium amplexicaule*	Lamiaceae	Henbit deadnettle	cultivar	0	0
244	*Lamium maculatum*	Lamiaceae	Spotted dead-nettle	weedy	0	0
245	*Lampranthus spectabilis*	Aizoaceae	Trailing ice-plant	cultivar	0	0
246	*Lantana camara*	Verbenaceae	Lantana camara	cultivar	0	0
247	*Lantana montevidensis*	Verbenaceae	Trailing latana	cultivar	0	0
248	*Lavandula angustifolia*	Lamiaceae	English lavender	weedy	0	0
249	*Legousia speculum-veneris*	Campanulaceae	Venus' looking glass	cultivar	0	0

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
250	*Leonurus cardiaca*	Lamiaceae	Common motherwort	weedy	0	0
251	*Lepidium draba*	Brassicaceae	Hoary Cress	weedy	0	0
252	*Liatris aspera*	Asteraceae	Rough blazing star	cultivar	0	0
253	*Ligustrum vulgare*	Oleaceae	Common privet	cultivar	0	0
254	*Lobelia siphilitica*	Campanulaceae	Great blue lobelia	native	0	0
255	*Lotus corniculatus*	Fabaceae	Bird's foot trefoil	weedy	0	0
256	*Lupinus polyphyllus*	Fabaceae	Large-leaved Lupine	weedy	0	0
257	*Malephora crocea*	Aizoaceae	Coppery mesemb	cultivar	0	0
258	*Marrubium vulgare*	Lamiaceae	White horehound	cultivar	0	0
259	*Melampodium divaricatum*	Asteraceae	Melampodium	cultivar	0	0
260	*Mentzelia multiflora*	Loasaceae	Adonis blazingstar	native	0	0
261	*Mirabilis laevis*	Nyctaginaceae	Desert Wishbone-Bush	cultivar	0	0

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
262	*Mirabilis multiflora*	Nyctaginaceae	Colorado four o'clock	native	0	0
263	*Mirabilis nyctaginea*	Nyctaginaceae	Wild four o'clock	native	0	0
264	*Monarda citriodora*	Lamiaceae	Lemon beebalm	cultivar	0	0
265	*Monarda didyma*	Fabaceae	Scarlet beebalm	cultivar	0	0
266	*Monarda punctata*	Lamiaceae	Spotted beebalm	cultivar	0	0
267	*Nepeta*	Lamiaceae	Unknown mint	weedy	0	0
268	*Nicotiana tabacum*	Solanaceae	Tobacco	cultivar	0	0
269	*Ocimum basilicum*	Lamiaceae	Basil	cultivar	0	0
270	*Oenothera albicaulis*	Onagraceae	Whitest evening primrose	native	0	0
271	*Oenothera macrocarpa*	Onagraceae	Missouri Evening Primrose	cultivar	0	0
272	*Oenothera serrulata*	Onagraceae	Yellow sundrops	native	0	0
273	*Oenothera speciosa*	Onagraceae	Pink evening primrose	cultivar	0	0
274	*Opuntia*	Cactaceae	Prickly Pear	native	0	0

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
275	*Oxalis dillenii*	Oxalidaceae	Slender yellow woodsorrel	native	0	0
276	*Papaver somniferum*	Papaveraceae	Opium poppy	cultivar	0	0
277	*Pelargonium hortorum*	Geraniaceae	Garden geranium	cultivar	0	0
278	*Pelargonium zonale*	Geraniaceae	Zonal geranium	cultivar	0	0
279	*Penstemon canescens*	Plantaginaceae	Eastern gray beardtongue	cultivar	0	0
280	*Penstemon cyananthus*	Plantaginaceae	Wasatch Penstemon	cultivar	0	0
281	*Penstemon eatonii*	Plantaginaceae	Firecracker penstemon	native	0	0
282	*Penstemon grandiflorus*	Plantaginaceae	Large Penstemon	native	0	0
283	*Penstemon rostriflorus*	Plantaginaceae	Bridge penstemon	native	0	0
284	*Penstemon spectabilis*	Plantaginaceae	Showy penstemon	cultivar	0	0
285	*Persicaria maculosa*	Polygonaceae	Lady's thumb	cultivar	0	0
286	*Phacelia tanacetifolia*	Hydrophyllaceae	Fiddleneck	native	0	0
287	*Phlox paniculata*	Polemoniaceae	Garden phlox	cultivar	0	0

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
288	*Physocarpus opulifolius*	Rosaceae	Common ninebark	native	0	0
289	*Plantago lanceolata*	Plantaginaceae	Ribwort plantain	cultivar	0	0
290	*Potentilla norvegica*	Rosaceae	Rough Cinquefoil	native	0	0
291	*Ratibida pinnata*	Asteraceae	Pinnate prairie coneflower	cultivar	0	0
292	*Rhododendron indicum*	Ericaceae	Satsuki azaelea	cultivar	0	0
293	*Ricinus communis*	Euphorbiaceae	Castor bean	cultivar	0	0
294	*Rosa gallica*	Rosaceae	French Rose	cultivar	0	0
295	*Rosa multiflora*	Rosaceae	Multiflora rose	cultivar	0	0
296	*Rosa woodsii*	Rosaceae	Woods' rose	native	0	0
297	*Rudbeckia fulgida*	Asteraceae	Orange coneflower	cultivar	0	0
298	*Rudbeckia maxima*	Asteraceae	Great Coneflower	cultivar	0	0
299	*Rudbeckia triloba*	Asteraceae	Brown-eyed susan	native	0	0
300	*Rumex crispus*	Polygonaceae	Curly dock	weedy	0	0

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
301	*Salvia azurea*	Lamiaceae	Asure blue sage	cultivar	0	0
302	*Salvia guaranitica*	Lamiaceae	Blue anise sage	cultivar	0	0
303	*Salvia microphylla*	Lamiaceae	Baby sage	cultivar	0	0
304	*Salvia spathacea*	Lamiaceae	California Hummingbird Sage	cultivar	0	0
305	*Salvia verticillata*	Lamiaceae	Lilac Sage	cultivar	0	0
306	*Scabiosa atropurpurea*	Caprifoliaceae	Sweet scabious	cultivar	0	0
307	*Scabiosa columbaria*	Caprifoliaceae	Dwarf pincushion flower	cultivar	0	0
308	*Scadoxus multiflorus*	Amaryllidaceae	Ball lily	cultivar	0	0
309	*Scrophularia californica*	Scrophulariaceae	California figwort	cultivar	0	0
310	*Silene chalcedonica*	Caryophyllaceae	Maltese Cross	cultivar	0	0
311	*Sonchus asper*	Asteraceae	Spiny sowthistle	weedy	0	0

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
312	*Sonchus oleraceus*	Asteraceae	Sowthistle	weedy	0	0
313	*Sphagneticola calendulacea*	Asteraceae	Chinese wedelia	cultivar	0	0
314	*Stachys bullata*	Lamiaceae	California hedgenettle	cultivar	0	0
315	*Stokesia laevis*	Asteraceae	Stokes' aster	cultivar	0	0
316	*Symphyotrichum chilense*	Asteraceae	Pacific Aster	cultivar	0	0
317	*Symphyotrichum laeve*	Asteraceae	Smooth blue aster	native	0	0
318	*Symphyotrichum patens*	Asteraceae	Late purple aster	cultivar	0	0
319	*Syringa reticulata*	Oleaceae	Japanese lilac tree	cultivar	0	0
320	*Tanacetum vulgare*	Asteraceae	Common tansy	cultivar	0	0
321	*Thelesperma megapotamicum*	Asteraceae	Hopi tea greenthread	native	0	0
322	*Thermopsis montana*	Fabaceae	False Lupine	native	0	0

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
323	*Thymus vulgaris*	Lamiaceae	Thyme	cultivar	0	0
324	*Tilia cordata*	Malvaceae	Littleleaf linden	cultivar	0	0
325	*Tribulus terrestris*	Zygophyllaceae	Puncture vine	weedy	0	0
326	*Tripleurospermum inodorum*	Asteraceae	Scentless mayweed	weedy	0	0
327	*Verbascum blattaria*	Scrophulariaceae	Moth mullein	weedy	0	0
328	*Verbena bonariensis*	Verbenaceae	Purpletop vervain	cultivar	0	0
329	*Verbena hastata*	Verbenaceae	Blue vervain	native	0	0
330	*Verbena stricta*	Verbenaceae	Hoary verbena	native	0	0
331	*Verbesina encelioides*	Asteraceae	Golden crownbeard	native	0	0
332	*Veronica chamaedrys*	Plantaginaceae	Germander speedwell	cultivar	0	0
333	*Veronicastrum virginicum*	Plantaginaceae	Culver's root	cultivar	0	0
334	*Vicia cracca*	Fabaceae	Bird vetch	cultivar	0	0

Rank	Floral Species	Family	Common Name	Floral Type	Species Richness	Specimens
335	*Warnockia scutellarioides*	Lamiaceae	Prairie brazosmint	cultivar	0	0
336	*Yucca*	Asparagaceae	Yucca	native	0	0
337	*Zinnia grandiflora*	Asteraceae	Rocky Mountain zinnia	native	0	0
338	*Zinnia haageana*	Asteraceae	Mexican zinnia	cultivar	0	0

Appendix Table 2: Complete list of bee species observed by park

Park	Bee species observed
Argo Park	*Agapostemon obliquus*, *Agapostemon virescens*, *Anthidium manicatum*, *Anthidium oblongatum*, *Augochlorella aurata*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Calliopsis andreniformes*, *Ceratina calcarata*, *Ceratina nanula*, *Ceratina neomexicana*, *Coelioxys octodentata OR novomexicana*, *Coelioxys rufitarsus*, *Dieunomia nevadensis bakeri*, *Halictus confusus*, *Halictus ligatus*, *Halictus rubicundus*, *Halictus tripartitus*, *Hoplitis producta*, *Hylaeus leptocephalus*, *Hylaeus mesillae*, *Lasioglossum (Dialictus) occidentale*, *Lasioglossum (Dialictus) semicaeruleum*, *Megachile lippiae*, *Megachile mendica*, *Megachile perihirta*, *Megachile rotundata*, *Melissodes 6*, *Melissodes 7*, *Melissodes agilis*, *Melissodes bimaculata*, *Nomada 5*, *Svastra obliqua*

Babi Yar Park	*Agapostemon virescens*, *Augochloropsis sumptuosa*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Calliopsis andreniformes*, *Dianthidium pudicum*, *Halictus rubicundus*, *Halictus tripartitus*, *Lasioglossum (Dialictus) semicaeruleum*, *Lasioglossum (Dialictus-tegulare) 1*, *Lasioglossum sisymbrii*, *Lithurgopsis apicalis*, *Megachile brevis*, *Megachile montivaga*, *Megachile perihirta*, *Megachile texana*, *Melissodes 6*, *Melissodes agilis*, *Melitoma grisella*, *Perdita albipennis*, *Stelis*
Central Park	*Agapostemon virescens*, *Anthidium manicatum*, *Anthidium oblongatum*, *Augochlorella aurata*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Bombus pennsylvanicus*, *Calliopsis chlorops*, *Ceratina calcarata*, *Ceratina nanula*, *Ceratina neomexicana*, *Coelioxys 1*, *Dianthidium pudicum*, *Halictus confusus*, *Halictus ligatus*, *Halictus rubicundus*, *Halictus tripartitus*, *Hoplitis producta*, *Hylaeus affinis*, *Hylaeus leptocephalus*, *Hylaeus mesillae*, *Lasioglossum (Dialictus) anomalum*, *Lasioglossum (Dialictus) semicaeruleum*, *Lasioglossum (Dialictus) trigeminum*, *Lasioglossum (Evylaeus) 2*, *Megachile frigida*, *Megachile montivaga*, *Megachile parallela*, *Megachile perihirta*, *Megachile rotundata*, *Melissodes 9*, *Melissodes agilis*, *Svastra obliqua*, *Triepeolus 4*
Chaffee Park	*Agapostemon obliquus*, *Agapostemon sericea*, *Agapostemon virescens*, *Anthidium manicatum*, *Anthidium oblongatum*, *Bombus fervidus*, *Bombus griseocollis*, *Calliopsis andreniformes*, *Ceratina nanula*, *Ceratina neomexicana*, *Halictus confusus*, *Halictus ligatus*, *Halictus rubicundus*, *Halictus tripartitus*, *Hoplitis producta*, *Lasioglossum (Dialictus) occidentale*, *Lasioglossum (Dialictus) semicaeruleum*, *Lasioglossum (Dialictus-tegulare) 1*, *Megachile latimanus*, *Megachile perihirta*, *Megachile rotundata*, *Melissodes agilis*, *Melissodes bimaculata*, *Svastra obliqua*

Cheesman Park	*Agapostemon obliquus*, *Agapostemon sericea*, *Agapostemon virescens*, *Andrena commoda*, *Anthidium manicatum*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Bombus pennsylvanicus*, *Coelioxys rufitarsus*, *Halictus ligatus*, *Hylaeus verticalis*, *Lasioglossum (Dialictus) occidentale*, *Lasioglossum (Dialictus) tenax*, *Lasioglossum (Dialictus) versatum-closest fit*, *Megachile frigida*, *Megachile lippiae*, *Megachile mendica*, *Megachile perihirta*, *Megachile rotundata*, *Megachile subexilis*, *Megachile texana*, *Melissodes agilis*, *Nomada 4*, *Osmia 1*, *Peponapis pruinosa*, *Protandrena albitarsis*
City Park	*Agapostemon obliquus*, *Agapostemon virescens*, *Andrena hippotes*, *Andrena wilkella*, *Anthidium oblongatum*, *Anthophora terminalis*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Bombus pennsylvanicus*, *Ceratina nanula*, *Coelioxys rufitarsus*, *Dianthidium pudicum*, *Halictus confusus*, *Halictus ligatus*, *Halictus rubicundus*, *Halictus tripartitus*, *Heriades carinatus*, *Hoplitis producta*, *Hylaeus affinis*, *Hylaeus leptocephalus*, *Hylaeus mesillae*, *Hylaeus verticalis*, *Lasioglossum (Dialictus) anomalum*, *Lasioglossum (Dialictus) imitatum*, *Lasioglossum (Dialictus) occidentale*, *Lasioglossum (Dialictus) semicaeruleum*, *Lasioglossum (Dialictus) tenax*, *Lasioglossum (Dialictus) versatum-closest fit*, *Lasioglossum (Dialictus-tegulare) 1*, *Megachile centuncularis*, *Megachile frigida*, *Megachile mellitarsus*, *Megachile mendica*, *Megachile paralella*, *Megachile perihirta*, *Megachile rotundata*, *Melissodes 1*, *Melissodes 6*, *Melissodes 7*, *Melissodes 8*, *Melissodes agilis*, *Melissodes bimaculata*, *Nomada 3*, *Protandrena albitarsis*, *Stelis 1*, *Triepeolus helianthi*
Commons Park	*Agapostemon virescens*, *Anthidium manicatum*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Calliopsis andreniformes*, *Ceratina neomexicana*, *Coelioxys 1*, *Coelioxys rufitarsus*, *Halictus confusus*, *Halictus ligatus*, *Halictus rubicundus*, *Halictus tripartitus*, *Hoplitis producta*, *Hylaeus affinis*, *Hylaeus leptocephalus*, *Hylaeus mesillae*,

	Lasioglossum (Dialictus) anomalum, *Lasioglossum (Dialictus) rudioense*, *Megachile frigida*, *Megachile inimica*, *Megachile perihirta*, *Megachile rotundata*, *Megachile texana*, *Melissodes 6*, *Melissodes agilis*, *Melissodes bimaculata*
Cranmer Park	*Agapostemon angelicus*, *Agapostemon obliquus*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Bombus occidentalis*, *Bombus pennsylvanicus*, *Calliopsis andreniformes*, *Epeolus 1*, *Halictus confusus*, *Halictus ligatus*, *Hoplitis producta*, *Hylaeus leptocephalus*, *Hylaeus mesillae*, *Lasioglossum (Dialictus) semicaeruleum*, *Lasioglossum (Evylaeus) 1*, *Lasioglossum sisymbrii*, *Megachile frigida*, *Megachile mendica*, *Megachile perihirta*, *Megachile rotundata*, *Melissodes 2*, *Melissodes 5*, *Melissodes 7*, *Melissodes 8*, *Melissodes agilis*
Eisenhower Park	*Agapostemon obliquus*, *Agapostemon virescens*, *Anthidium oblongatum*, *Bombus appositus*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Bombus rufocinctus*, *Calliopsis andreniformes*, *Ceratina calcarata*, *Halictus confusus*, *Halictus ligatus*, *Halictus rubicundus*, *Halictus tripartitus*, *Hoplitis producta*, *Hoplitis spoliata*, *Hylaeus mesillae*, *Hylaeus verticalis*, *Lasioglossum (Dialictus) anomalum*, *Lasioglossum (Dialictus) occidentale*, *Lasioglossum (Dialictus) semicaeruleum*, *Lasioglossum (Dialictus) tenax*, *Lasioglossum (Dialictus) versatum-closest fit*, *Megachile frigida*, *Megachile mendica*, *Megachile perihirta*, *Megachile rotundata*, *Melissodes agilis*, *Melissodes bimaculata*, *Osmia 4*
First Creek at DEN Open Space	*Agapostemon angelicus*, *Agapostemon angelicus/texanus*, *Agapostemon obliquus*, *Bombus fervidus*, *Ceratina neomexicana*, *Dianthidium pudicum*, *Halictus ligatus*, *Halictus parallelus*, *Halictus tripartitus*, *Hylaeus mesillae*, *Lasioglossum (Dialictus) pruinosum*, *Lasioglossum (Dialictus) semicaeruleum*, *Lasioglossum (Dialictus) versatum-closest fit*, *Lasioglossum (Evylaeus) 1*,

	Lasioglossum pectoraloides, *Megachile fortis*, *Megachile lippiae*, *Melissodes 10*, *Melissodes 3*, *Melissodes agilis*, *Osmia 3*, *Perdita albipennis*, *Perdita ignota*, *Perdita subgenus "Perdita" 2*, *Protandrena 1*, *Protandrena albitarsis*, *Triepeolus concavus*, *Triepeolus remigatus*
Garfield Lake Park	*Agapostemon virescens*, *Anthidium manicatum*, *Anthidium oblongatum*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Bombus occidentalis*, *Bombus pennsylvanicus*, *Calliopsis andreniformes*, *Ceratina nanula*, *Ceratina neomexicana*, *Coelioxys octodentata OR novomexicana*, *Coelioxys rufitarsus*, *Halictus confusus*, *Halictus ligatus*, *Halictus rubicundus*, *Halictus tripartitus*, *Hoplitis producta*, *Hylaeus leptocephalus*, *Hylaeus mesillae*, *Lasioglossum (Dialictus) occidentale*, *Lasioglossum (Dialictus) tenax*, *Lasioglossum (Dialictus) versatum-closest fit*, *Megachile latimanus*, *Megachile lippiae*, *Megachile mendica*, *Megachile onobrychidis*, *Megachile perihirta*, *Megachile rotundata*, *Megachile texana*, *Melissodes bimaculata*, *Nomada 6*
Globeville Landing	*Anthidium oblongatum*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus pennsylvanicus*, *Coelioxys rufitarsus*, *Colletes 1*, *Colletes 2*, *Eucera speciosa*, *Halictus confusus*, *Halictus ligatus*, *Halictus rubicundus*, *Halictus tripartitus*, *Hoplitis producta*, *Lasioglossum (Dialictus) semicaeruleum*, *Lasioglossum (Dialictus-tegulare) 1*, *Megachile frigida*, *Megachile perihirta*, *Megachile rotundata*, *Melissodes agilis*, *Svastra obliqua*
Great Lawn Park	*Agapostemon angelicus/texanus*, *Agapostemon virescens*, *Anthidium oblongatum*, *Augochlorella aurata*, *Augochloropsis metallica*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Bombus pennsylvanicus*, *Ceratina nanula*, *Dianthidium pudicum*, *Halictus confusus*, *Halictus ligatus*, *Halictus rubicundus*, *Hylaeus leptocephalus*, *Hylaeus mesillae*, *Lasioglossum (Dialictus) albipenne*, *Lasioglossum (Dialictus) occidentale*,

	Lasioglossum (Dialictus) semicaeruleum, *Lasioglossum (Dialictus) tenax*, *Lasioglossum (Dialictus) trigeminum*, *Lasioglossum (Dialictus) versatum-closest fit*, *Megachile brevis*, *Megachile mendica*, *Megachile onobrychidis*, *Megachile perihirta*, *Megachile rotundata*, *Melissodes agilis*, *Melissodes bimaculata*, *Triepeolus 1*
Huston Lake	*Agapostemon virescens*, *Andrena commoda*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Bombus pennsylvanicus*, *Calliopsis andreniformes*, *Coelioxys octodentata OR novomexicana*, *Coelioxys sayi*, *Halictus confusus*, *Halictus ligatus*, *Halictus rubicundus*, *Holcopasites calliopsidis*, *Hylaeus leptocephalus*, *Hylaeus mesillae*, *Lasioglossum (Dialictus) occidentale*, *Lithurgopsis apicalis*, *Megachile frigida*, *Megachile latimanus*, *Megachile lippiae*, *Megachile mendica*, *Megachile rotundata*, *Megachile texana*, *Melissodes bimaculata*
Inspiration Point	*Agapostemon virescens*, *Andrena wilkella*, *Augochlorella aurata*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Bombus insularis*, *Bombus pennsylvanicus*, *Ceratina calcarata*, *Ceratina nanula*, *Dieunomia nevadensis bakeri*, *Halictus ligatus*, *Halictus rubicundus*, *Halictus tripartitus*, *Hoplitis producta*, *Hoplitis truncata*, *Lasioglossum (Dialictus) occidentale*, *Lasioglossum (Dialictus) semicaeruleum*, *Lithurgopsis apicalis*, *Megachile rotundata*, *Melissodes 4*, *Melissodes 6*, *Melissodes 8*, *Melissodes agilis*, *Melissodes bimaculata*, *Nomada 1*, *Nomada 2*, *Protandrena albitarsis*
James Bible Park	*Agapostemon virescens*, *Andrena erythrogaster*, *Andrena hippotes*, *Andrena nigrae*, *Bombus fervidus*, *Bombus huntii*, *Halictus confusus*, *Halictus ligatus*, *Halictus rubicundus*, *Hoplitis producta*, *Lasioglossum (Dialictus) 1*, *Lasioglossum (Dialictus) occidentale*, *Megachile mendica*, *Megachile rotundata*, *Nomada 3*, *Osmia 2*, *Stelis lateralis*
Johnson Habitat Park	*Agapostemon angelicus/texanus*, *Anthophora urbana*, *Bombus fervidus*, *Ceratina nanula*, *Ceratina neomexicana*,

	Coelioxys rufitarsus, *Dianthidium pudicum*, *Halictus confusus*, *Halictus ligatus*, *Halictus tripartitus*, *Hylaeus leptocephalus*, *Hylaeus mesillae*, *Lasioglossum (Dialictus-tegulare) 1*, *Lithurgopsis apicalis*, *Megachile apicalis*, *Megachile brevis*, *Megachile perihirta*, *Megachile rotundata*, *Melissodes 8*, *Melissodes agilis*, *Sphecodes 1*
Northfield Pond	*Agapostemon angelicus/texanus*, *Agapostemon obliquus*, *Agapostemon sericea*, *Agapostemon virescens*, *Augochlorella aurata*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Bombus pennsylvanicus*, *Ceratina nanula*, *Ceratina neomexicana*, *Coelioxys rufitarsus*, *Halictus confusus*, *Halictus ligatus*, *Halictus rubicundus*, *Hoplitis producta*, *Hylaeus mesillae*, *Lasioglossum (Dialictus) occidentale*, *Lasioglossum (Dialictus) pruinosum*, *Lasioglossum (Dialictus) trigeminum*, *Lasioglossum (Dialictus-tegulare) 1*, *Megachile centuncularis*, *Megachile latimanus*, *Megachile lippiae*, *Megachile mendica*, *Megachile perihirta*, *Megachile rotundata*, *Melissodes agilis*, *Melissodes bimaculata*, *Protandrena albitarsis*, *Svastra obliqua*
Parkfield Lake	*Agapostemon obliquus*, *Agapostemon virescens*, *Anthidium oblongatum*, *Ashmeadiella bucconis*, *Ashmeadiella prosopidis*, *Augochlorella aurata*, *Bombus fervidus*, *Calliopsis chlorops*, *Ceratina calcarata*, *Ceratina nanula*, *Ceratina neomexicana*, *Coelioxys rufitarsus*, *Dieunomia nevadensis bakeri*, *Halictus ligatus*, *Halictus parallelus*, *Halictus tripartitus*, *Heriades carinatus*, *Hoplitis producta*, *Lasioglossum (Dialictus) occidentale*, *Lasioglossum (Dialictus) pruinosum*, *Lasioglossum pectoraloides*, *Megachile brevis*, *Megachile mendica*, *Megachile onobrychidis*, *Megachile perihirta*, *Megachile rotundata*, *Melissodes 7*, *Melissodes 8*, *Melissodes agilis*, *Nomada 3*, *Perdita ignota*, *Perdita subgenus "Perdita" 1*, *Triepeolus 6*
Platte Farm Open Space	*Agapostemon obliquus*, *Agapostemon virescens*, *Anthidium manicatum*, *Augochlorella aurata*, *Bombus fervidus*,

	Bombus griseocollis, *Bombus huntii*, *Calliopsis andreniformes*, *Ceratina nanula*, *Ceratina neomexicana*, *Coelioxys 1*, *Coelioxys rufitarsus*, *Dieunomia nevadensis bakeri*, *Epeolus bifascitus*, *Halictus confusus*, *Halictus ligatus*, *Halictus rubicundus*, *Holcopasites calliopsidis*, *Hoplitis producta*, *Hoplitis psilofrons*, *Hylaeus mesillae*, *Lasioglossum (Dialictus) pruinosum*, *Lasioglossum (Dialictus) semicaeruleum*, *Lasioglossum pectoraloides*, *Megachile apicalis*, *Megachile lippiae*, *Megachile mendica*, *Megachile parallela*, *Megachile perihirta*, *Megachile rotundata*, *Megachile subexilis*, *Melissodes 6*, *Melissodes 7*, *Melissodes agilis*, *Melissodes bimaculata*, *Nomada 3*, *Nomada 7*, *Perdita ignota*, *Protandrena albitarsis*, *Svastra obliqua*, *Triepeolus 5*, *Triepeolus concavus*
Prairie Meadows	*Agapostemon angelicus*, *Agapostemon virescens*, *Anthidium oblongatum*, *Augochlorella aurata*, *Bombus fervidus*, *Ceratina nanula*, *Colletes 1*, *Halictus confusus*, *Halictus ligatus*, *Halictus tripartitus*, *Hylaeus leptocephalus*, *Hylaeus mesillae*, *Lasioglossum (Dialictus) occidentale*, *Lasioglossum (Dialictus) pruinosum*, *Lasioglossum (Dialictus) semicaeruleum*, *Lasioglossum (Dialictus-tegulare) 1*, *Megachile perihirta*, *Megachile rotundata*, *Melissodes 7*, *Melissodes agilis*, *Nomada 3*, *Perdita albipennis*, *Protandrena albitarsis*, *Svastra obliqua*
Ruby Hill	*Agapostemon obliquus*, *Andrena wilkella*, *Anthidium oblongatum*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Bombus nevadensis*, *Bombus pennsylvanicus*, *Calliopsis andreniformes*, *Ceratina nanula*, *Halictus confusus*, *Halictus ligatus*, *Halictus rubicundus*, *Halictus tripartitus*, *Hoplitis fulgida*, *Hoplitis producta*, *Hylaeus leptocephalus*, *Hylaeus mesillae*, *Lasioglossum (Dialictus) anomalum*, *Lasioglossum (Dialictus) occidentale*, *Lasioglossum (Dialictus) pruinosum*, *Lasioglossum (Dialictus) semicaeruleum*, *Lasioglossum (Dialictus) tenax*, *Megachile frigida*, *Megachile mendica*, *Megachile rotundata*

Rude Park	*Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Bombus pennsylvanicus*, *Calliopsis andreniformes*, *Ceratina calcarata*, *Ceratina nanula*, *Halictus ligatus*, *Halictus rubicundus*, *Halictus tripartitus*, *Holcopasites calliopsidis*, *Hoplitis producta*, *Hylaeus affinis*, *Hylaeus leptocephalus*, *Hylaeus mesillae*, *Megachile centuncularis*, *Megachile latimanus*, *Megachile perihirta*, *Megachile rotundata*, *Melissodes agilis*
Washington Park	*Agapostemon angelicus*, *Agapostemon obliquus*, *Agapostemon sericea*, *Agapostemon virescens*, *Andrena hippotes*, *Anthidium oblongatum*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Bombus pennsylvanicus*, *Bombus sylvicola*, *Ceratina nanula*, *Coelioxys rufitarsus*, *Diadasia diminuta*, *Halictus confusus*, *Halictus ligatus*, *Halictus rubicundus*, *Heriades carinatus*, *Hoplitis producta*, *Hylaeus leptocephalus*, *Hylaeus mesillae*, *Lasioglossum (Dialictus) semicaeruleum*, *Megachile frigida*, *Megachile inimica*, *Megachile latimanus*, *Megachile lippiae*, *Megachile mellitarsus*, *Megachile mendica*, *Megachile perihirta*, *Megachile rotundata*, *Melissodes 6*, *Melissodes 7*, *Melissodes 8*, *Melissodes agilis*, *Osmia coloradensis*, *Protandrena albitarsis*, *Protandrena albitarsus*, *Stelis 1*, *Triepeolus 6*
Willis Case Golf Course	*Agapostemon obliquus*, *Agapostemon virescens*, *Anthidium manicatum*, *Augochlorella aurata*, *Bombus fervidus*, *Bombus griseocollis*, *Bombus huntii*, *Halictus ligatus*, *Halictus rubicundus*, *Heriades carinatus*, *Lasioglossum (Dialictus) occidentale*, *Megachile latimanus*, *Megachile perihirta*, *Megachile rotundata*, *Melissodes 7*, *Melissodes 8*, *Melissodes agilis*, *Protandrena albitarsis*

Appendix Table 3: Complete list of bee species and their associated parks

Bee species	Parks observed
Agapostemon angelicus	Cranmer Park, First Creek at DEN Open Space, Prairie Meadows, Washington Park
Agapostemon angelicus/texanus	First Creek at DEN Open Space, Great Lawn Park, Johnson Habitat Park, Northfield Pond
Agapostemon obliquus	Argo Park, Chaffee Park, Cheesman Park, City Park, Cranmer Park, Eisenhower Park, First Creek at DEN Open Space, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Ruby Hill, Washington Park, Willis Case Golf Course
Agapostemon sericea	Chaffee Park, Cheesman Park, Northfield Pond, Washington Park
Agapostemon virescens	Argo Park, Babi Yar Park, Central Park, Chaffee Park, Cheesman Park, City Park, Commons Park, Eisenhower Park, Garfield Lake Park, Great Lawn Park, Huston Lake, Inspiration Point, James Bible Park, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Prairie Meadows, Washington Park, Willis Case Golf Course
Andrena commoda	Cheesman Park, Huston Lake
Andrena erythrogaster	James Bible Park
Andrena hippotes	City Park, James Bible Park, Washington Park
Andrena nigrae	James Bible Park
Andrena wilkella	City Park, Inspiration Point, Ruby Hill
Anthidium manicatum	Argo Park, Central Park, Chaffee Park, Cheesman Park, Commons Park, Garfield Lake Park, Platte Farm Open Space, Willis Case Golf Course

Anthidium oblongatum	Argo Park, Central Park, Chaffee Park, City Park, Eisenhower Park, Garfield Lake Park, Globeville Landing, Great Lawn Park, Parkfield Lake, Prairie Meadows, Ruby Hill, Washington Park
Anthophora terminalis	City Park
Anthophora urbana	Johnson Habitat Park
Ashmeadiella bucconis	Parkfield Lake
Ashmeadiella prosopidis	Parkfield Lake
Augochlorella aurata	Argo Park, Central Park, Great Lawn Park, Inspiration Point, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Prairie Meadows, Willis Case Golf Course
Augochloropsis metallica	Great Lawn Park
Augochloropsis sumptuosa	Babi Yar Park
Bombus appositus	Eisenhower Park
Bombus fervidus	Argo Park, Babi Yar Park, Central Park, Chaffee Park, Cheesman Park, City Park, Commons Park, Cranmer Park, Eisenhower Park, First Creek at DEN Open Space, Garfield Lake Park, Globeville Landing, Great Lawn Park, Huston Lake, Inspiration Point, James Bible Park, Johnson Habitat Park, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Prairie Meadows, Ruby Hill, Rude Park, Washington Park, Willis Case Golf Course
Bombus griseocollis	Argo Park, Babi Yar Park, Central Park, Chaffee Park, Cheesman Park, City Park, Commons Park, Cranmer Park, Eisenhower Park, Garfield Lake Park,

	Globeville Landing, Great Lawn Park, Huston Lake, Inspiration Point, Northfield Pond, Platte Farm Open Space, Ruby Hill, Rude Park, Washington Park, Willis Case Golf Course
Bombus huntii	Argo Park, Babi Yar Park, Central Park, Cheesman Park, City Park, Commons Park, Cranmer Park, Eisenhower Park, Garfield Lake Park, Great Lawn Park, Huston Lake, Inspiration Point, James Bible Park, Northfield Pond, Platte Farm Open Space, Ruby Hill, Rude Park, Washington Park, Willis Case Golf Course
Bombus insularis	Inspiration Point
Bombus nevadensis	Ruby Hill
Bombus occidentalis	Cranmer Park, Garfield Lake Park
Bombus pennsylvanicus	Central Park, Cheesman Park, City Park, Cranmer Park, Garfield Lake Park, Globeville Landing, Great Lawn Park, Huston Lake, Inspiration Point, Northfield Pond, Ruby Hill, Rude Park, Washington Park
Bombus rufocinctus	Eisenhower Park
Bombus sylvicola	Washington Park
Calliopsis andreniformes	Argo Park, Babi Yar Park, Chaffee Park, Commons Park, Cranmer Park, Eisenhower Park, Garfield Lake Park, Huston Lake, Platte Farm Open Space, Ruby Hill, Rude Park
Calliopsis chlorops	Central Park, Parkfield Lake
Ceratina calcarata	Argo Park, Central Park, Eisenhower Park, Inspiration Point, Parkfield Lake, Rude Park

Ceratina nanula	Argo Park, Central Park, Chaffee Park, City Park, Garfield Lake Park, Great Lawn Park, Inspiration Point, Johnson Habitat Park, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Prairie Meadows, Ruby Hill, Rude Park, Washington Park
Ceratina neomexicana	Argo Park, Central Park, Chaffee Park, Commons Park, First Creek at DEN Open Space, Garfield Lake Park, Johnson Habitat Park, Northfield Pond, Parkfield Lake, Platte Farm Open Space
Coelioxys 1	Central Park, Commons Park, Platte Farm Open Space
Coelioxys octodentata OR novomexicana	Argo Park, Garfield Lake Park, Huston Lake
Coelioxys rufitarsus	Argo Park, Cheesman Park, City Park, Commons Park, Garfield Lake Park, Globeville Landing, Johnson Habitat Park, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Washington Park
Coelioxys sayi	Huston Lake
Colletes 1	Globeville Landing, Prairie Meadows
Colletes 2	Globeville Landing
Diadasia diminuta	Washington Park
Dianthidium pudicum	Babi Yar Park, Central Park, City Park, First Creek at DEN Open Space, Great Lawn Park, Johnson Habitat Park
Dieunomia nevadensis bakeri	Argo Park, Inspiration Point, Parkfield Lake, Platte Farm Open Space
Epeolus 1	Cranmer Park

Epeolus bifascitus	Platte Farm Open Space
Eucera speciosa	Globeville Landing
Halictus confusus	Argo Park, Central Park, Chaffee Park, City Park, Commons Park, Cranmer Park, Eisenhower Park, Garfield Lake Park, Globeville Landing, Great Lawn Park, Huston Lake, James Bible Park, Johnson Habitat Park, Northfield Pond, Platte Farm Open Space, Prairie Meadows, Ruby Hill, Washington Park
Halictus ligatus	Argo Park, Central Park, Chaffee Park, Cheesman Park, City Park, Commons Park, Cranmer Park, Eisenhower Park, First Creek at DEN Open Space, Garfield Lake Park, Globeville Landing, Great Lawn Park, Huston Lake, Inspiration Point, James Bible Park, Johnson Habitat Park, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Prairie Meadows, Ruby Hill, Rude Park, Washington Park, Willis Case Golf Course
Halictus parallelus	First Creek at DEN Open Space, Parkfield Lake
Halictus rubicundus	Argo Park, Babi Yar Park, Central Park, Chaffee Park, City Park, Commons Park, Eisenhower Park, Garfield Lake Park, Globeville Landing, Great Lawn Park, Huston Lake, Inspiration Point, James Bible Park, Northfield Pond, Platte Farm Open Space, Ruby Hill, Rude Park, Washington Park, Willis Case Golf Course
Halictus tripartitus	Argo Park, Babi Yar Park, Central Park, Chaffee Park, City Park, Commons Park, Eisenhower Park, First Creek at DEN Open Space, Garfield Lake Park, Globeville Landing, Inspiration Point, Johnson Habitat Park, Parkfield Lake, Prairie Meadows, Ruby Hill, Rude Park

Heriades carinatus	City Park, Parkfield Lake, Washington Park, Willis Case Golf Course
Holcopasites calliopsidis	Huston Lake, Platte Farm Open Space, Rude Park
Hoplitis fulgida	Ruby Hill
Hoplitis producta	Argo Park, Central Park, Chaffee Park, City Park, Commons Park, Cranmer Park, Eisenhower Park, Garfield Lake Park, Globeville Landing, Inspiration Point, James Bible Park, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Ruby Hill, Rude Park, Washington Park
Hoplitis psilofrons	Platte Farm Open Space
Hoplitis spoliata	Eisenhower Park
Hoplitis truncata	Inspiration Point
Hylaeus affinis	Central Park, City Park, Commons Park, Rude Park
Hylaeus leptocephalus	Argo Park, Central Park, City Park, Commons Park, Cranmer Park, Garfield Lake Park, Great Lawn Park, Huston Lake, Johnson Habitat Park, Prairie Meadows, Ruby Hill, Rude Park, Washington Park
Hylaeus mesillae	Argo Park, Central Park, City Park, Commons Park, Cranmer Park, Eisenhower Park, First Creek at DEN Open Space, Garfield Lake Park, Great Lawn Park, Huston Lake, Johnson Habitat Park, Northfield Pond, Platte Farm Open Space, Prairie Meadows, Ruby Hill, Rude Park, Washington Park
Hylaeus verticalis	Cheesman Park, City Park, Eisenhower Park
Lasioglossum (Dialictus) 1	James Bible Park

Lasioglossum (Dialictus) albipenne	Great Lawn Park
Lasioglossum (Dialictus) anomalum	Central Park, City Park, Commons Park, Eisenhower Park, Ruby Hill
Lasioglossum (Dialictus) imitatum	City Park
Lasioglossum (Dialictus) occidentale	Argo Park, Chaffee Park, Cheesman Park, City Park, Eisenhower Park, Garfield Lake Park, Great Lawn Park, Huston Lake, Inspiration Point, James Bible Park, Northfield Pond, Parkfield Lake, Prairie Meadows, Ruby Hill, Willis Case Golf Course
Lasioglossum (Dialictus) pruinosum	First Creek at DEN Open Space, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Prairie Meadows, Ruby Hill
Lasioglossum (Dialictus) rudioense	Commons Park
Lasioglossum (Dialictus) semicaeruleum	Argo Park, Babi Yar Park, Central Park, Chaffee Park, City Park, Cranmer Park, Eisenhower Park, First Creek at DEN Open Space, Globeville Landing, Great Lawn Park, Inspiration Point, Platte Farm Open Space, Prairie Meadows, Ruby Hill, Washington Park
Lasioglossum (Dialictus) tenax	Cheesman Park, City Park, Eisenhower Park, Garfield Lake Park, Great Lawn Park, Ruby Hill
Lasioglossum (Dialictus) trigeminum	Central Park, Great Lawn Park, Northfield Pond
Lasioglossum (Dialictus) versatum-closest fit	Cheesman Park, City Park, Eisenhower Park, First Creek at DEN Open Space, Garfield Lake Park, Great Lawn Park
Lasioglossum (Dialictus-tegulare) 1	Babi Yar Park, Chaffee Park, City Park, Globeville Landing, Johnson Habitat Park, Northfield Pond, Prairie Meadows

Lasioglossum (Evylaeus) 1	Cranmer Park, First Creek at DEN Open Space
Lasioglossum (Evylaeus) 2	Central Park
Lasioglossum pectoraloides	First Creek at DEN Open Space, Parkfield Lake, Platte Farm Open Space
Lasioglossum sisymbrii	Babi Yar Park, Cranmer Park
Lithurgopsis apicalis	Babi Yar Park, Huston Lake, Inspiration Point, Johnson Habitat Park
Megachile apicalis	Johnson Habitat Park, Platte Farm Open Space
Megachile brevis	Babi Yar Park, Great Lawn Park, Johnson Habitat Park, Parkfield Lake
Megachile centuncularis	City Park, Northfield Pond, Rude Park
Megachile fortis	First Creek at DEN Open Space
Megachile frigida	Central Park, Cheesman Park, City Park, Commons Park, Cranmer Park, Eisenhower Park, Globeville Landing, Huston Lake, Ruby Hill, Washington Park
Megachile inimica	Commons Park, Washington Park
Megachile latimanus	Chaffee Park, Garfield Lake Park, Huston Lake, Northfield Pond, Rude Park, Washington Park, Willis Case Golf Course
Megachile lippiae	Argo Park, Cheesman Park, First Creek at DEN Open Space, Garfield Lake Park, Huston Lake, Northfield Pond, Platte Farm Open Space, Washington Park
Megachile mellitarsus	City Park, Washington Park
Megachile mendica	Argo Park, Cheesman Park, City Park, Cranmer Park, Eisenhower Park, Garfield Lake Park, Great Lawn

	Park, Huston Lake, James Bible Park, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Ruby Hill, Washington Park
Megachile montivaga	Babi Yar Park, Central Park
Megachile onobrychidis	Garfield Lake Park, Great Lawn Park, Parkfield Lake
Megachile paralella	City Park
Megachile parallela	Central Park, Platte Farm Open Space
Megachile perihirta	Argo Park, Babi Yar Park, Central Park, Chaffee Park, Cheesman Park, City Park, Commons Park, Cranmer Park, Eisenhower Park, Garfield Lake Park, Globeville Landing, Great Lawn Park, Johnson Habitat Park, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Prairie Meadows, Rude Park, Washington Park, Willis Case Golf Course
Megachile rotundata	Argo Park, Central Park, Chaffee Park, Cheesman Park, City Park, Commons Park, Cranmer Park, Eisenhower Park, Garfield Lake Park, Globeville Landing, Great Lawn Park, Huston Lake, Inspiration Point, James Bible Park, Johnson Habitat Park, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Prairie Meadows, Ruby Hill, Rude Park, Washington Park, Willis Case Golf Course
Megachile subexilis	Cheesman Park, Platte Farm Open Space
Megachile texana	Babi Yar Park, Cheesman Park, Commons Park, Garfield Lake Park, Huston Lake
Melissodes 1	City Park
Melissodes 10	First Creek at DEN Open Space

Melissodes 2	Cranmer Park
Melissodes 3	First Creek at DEN Open Space
Melissodes 4	Inspiration Point
Melissodes 5	Cranmer Park
Melissodes 6	Argo Park, Babi Yar Park, City Park, Commons Park, Inspiration Point, Platte Farm Open Space, Washington Park
Melissodes 7	Argo Park, City Park, Cranmer Park, Parkfield Lake, Platte Farm Open Space, Prairie Meadows, Washington Park, Willis Case Golf Course
Melissodes 8	City Park, Cranmer Park, Inspiration Point, Johnson Habitat Park, Parkfield Lake, Washington Park, Willis Case Golf Course
Melissodes 9	Central Park
Melissodes agilis	Argo Park, Babi Yar Park, Central Park, Chaffee Park, Cheesman Park, City Park, Commons Park, Cranmer Park, Eisenhower Park, First Creek at DEN Open Space, Globeville Landing, Great Lawn Park, Inspiration Point, Johnson Habitat Park, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Prairie Meadows, Rude Park, Washington Park, Willis Case Golf Course
Melissodes bimaculata	Argo Park, Chaffee Park, City Park, Commons Park, Eisenhower Park, Garfield Lake Park, Great Lawn Park, Huston Lake, Inspiration Point, Northfield Pond, Platte Farm Open Space
Melitoma grisella	Babi Yar Park

Nomada 1	Inspiration Point
Nomada 2	Inspiration Point
Nomada 3	City Park, James Bible Park, Parkfield Lake, Platte Farm Open Space, Prairie Meadows
Nomada 4	Cheesman Park
Nomada 5	Argo Park
Nomada 6	Garfield Lake Park
Nomada 7	Platte Farm Open Space
Osmia 1	Cheesman Park
Osmia 2	James Bible Park
Osmia 3	First Creek at DEN Open Space
Osmia 4	Eisenhower Park
Osmia coloradensis	Washington Park
Peponapis pruinosa	Cheesman Park
Perdita albipennis	Babi Yar Park, First Creek at DEN Open Space, Prairie Meadows
Perdita ignota	First Creek at DEN Open Space, Parkfield Lake, Platte Farm Open Space
Perdita subgenus "Perdita" 1	Parkfield Lake

Perdita subgenus "Perdita" 2	First Creek at DEN Open Space
Protandrena 1	First Creek at DEN Open Space
Protandrena albitarsis	Cheesman Park, City Park, First Creek at DEN Open Space, Inspiration Point, Northfield Pond, Platte Farm Open Space, Prairie Meadows, Washington Park, Willis Case Golf Course
Protandrena albitarsus	Washington Park
Sphecodes 1	Johnson Habitat Park
Stelis	Babi Yar Park
Stelis 1	City Park, Washington Park
Stelis lateralis	James Bible Park
Svastra obliqua	Argo Park, Central Park, Chaffee Park, Globeville Landing, Northfield Pond, Platte Farm Open Space, Prairie Meadows
Triepeolus 1	Great Lawn Park
Triepeolus 4	Central Park
Triepeolus 5	Platte Farm Open Space
Triepeolus 6	Parkfield Lake, Washington Park
Triepeolus concavus	First Creek at DEN Open Space, Platte Farm Open Space
Triepeolus helianthi	City Park

Triepeolus remigatus	First Creek at DEN Open Space

Appendix Table 4: Complete list of butterfly species observed by park

Park	**Butterfly species observed**
Argo Park	*Vanessa cardui*, *Pieris rapae*, *Vanessa atalanta*, *Libytheana carinenta*, *Strymon melinus*, *Burnsius communis*, *Colias eurytheme*, *Lon taxiles*, *Polites themistocles*
Babi Yar Park	*Pieris rapae*, *Vanessa cardui*, *Burnsius communis*, *Euptoieta claudia*, *Tharsalea dione*, *Colias eurytheme*, *Lon taxiles*, *Strymon melinus*, *Echinargus isola*, *Phyciodes pulchella*
Central Park	*Pieris rapae*, *Burnsius communis*, *Vanessa cardui*, *Lon taxiles*, *Colias eurytheme*, *Danaus plexippus*, *Euptoieta claudia*
Chaffee Park	*Burnsius communis*, *Pieris rapae*, *Polites peckius*, *Strymon melinus*, *Danaus plexippus*, *Vanessa cardui*, *Colias eurytheme*, *Echinargus isola*
Cheesman Park	*Colias philodice*, *Pieris rapae*, *Pontia protodice*, *Vanessa atalanta*, *Burnsius communis*, *Colias eurytheme*, *Vanessa cardui*, *Papilio multicaudata*, *Lycaena heteronea*, *Danaus plexippus*, *Echinargus isola*
City Park	*Colias eurytheme*, *Vanessa cardui*, *Pieris rapae*, *Burnsius communis*, *Lon taxiles*, *Limenitis weiddmeyerii*, *Vanessa atalanta*, *Colias philodice*, *Euptoieta claudia*, *Papilio rutulus*

Commons Park	*Pieris rapae*, *Vanessa atalanta*, *Colias eurytheme*, *Vanessa cardui*, *Danaus plexippus*, *Burnsius communis*, *Euptoieta claudia*
Cranmer Park	*Vanessa cardui*, *Papilio rutulus*, *Papilio polyxenes*, *Colias eurytheme*, *Colias philodice*, *Burnsius communis*, *Brephidium exilis*, *Pieris rapae*, *Echinargus isola*, *Pontia protodice*, *Euptoieta claudia*
Eisenhower Park	*Vanessa cardui*, *Burnsius communis*, *Colias eurytheme*, *Pieris rapae*, *Lon taxiles*, *Polites themistocles*
First Creek at DEN Open Space	*Colias philodice*, *Pieris rapae*, *Colias eurytheme*, *Pontia protodice*, *Burnsius communis*, *Strymon melinus*, *Papilio rutulus*, *Vanessa cardui*, *Phyciodes pulchella*, *Nathalis iole*
Garfield Lake Park	*Pieris rapae*, *Vanessa cardui*, *Colias eurytheme*, *Papilio multicaudata*, *Pontia protodice*, *Burnsius communis*, *Ochlodes yuma*, *Danaus plexippus*, *Polites themistocles*, *Lon taxiles*
Globeville Landing	*Pieris rapae*, *Burnsius communis*, *Colias eurytheme*, *Colias philodice*, *Pontia protodice*, *Danaus plexippus*, *Papilio polyxenes*, *Vanessa cardui*, *Euptoieta claudia*, *Lycaeides melissa*
Great Lawn Park	*Danaus plexippus*, *Pieris rapae*, *Colias philodice*, *Vanessa atalanta*, *Burnsius communis*, *Pontia protodice*, *Colias eurytheme*, *Vanessa cardui*, *Euptoieta claudia*, *Echinargus isola*
Huston Lake	*Vanessa atalanta*, *Colias eurytheme*, *Vanessa cardui*, *Pieris rapae*, *Lon taxiles*, *Colias philodice*, *Euptoieta claudia*, *Echinargus isola*, *Danaus plexippus*, *Burnsius communis*, *Strymon melinus*, *Polites peckius*, *Nathalis iole*, *Polygonia interrogationis*
Inspiration Point	*Papilio polyxenes*, *Vanessa cardui*, *Colias eurytheme*, *Vanessa atalanta*, *Lon taxiles*, *Pieris rapae*, *Euptoieta*

	claudia, *Echinargus isola*, *Papilio rutulus*, *Burnsius communis*, *Hesperia uncas*
James Bible Park	*Pieris rapae*, *Vanessa atalanta*, *Vanessa cardui*, *Colias eurytheme*, *Burnsius communis*, *Vanessa annabella*, *Lon taxiles*, *Echinargus isola*, *Pontia protodice*
Johnson Habitat Park	*Pieris rapae*, *Vanessa cardui*, *Colias eurytheme*, *Pontia protodice*, *Junonia coenia*, *Burnsius communis*, *Lon taxiles*, *Strymon melinus*, *Echinargus isola*, *Junonia grisea*
Northfield Pond	*Pieris rapae*, *Colias eurytheme*, *Burnsius communis*, *Epargyreus clarus*, *Echinargus isola*, *Vanessa cardui*, *Strymon melinus*
Parkfield Lake	*Pontia protodice*, *Colias eurytheme*, *Burnsius communis*, *Vanessa cardui*, *Danaus plexippus*, *Pieris rapae*, *Echinargus isola*, *Polites peckius*, *Phyciodes pulchella*
Platte Farm Open Space	*Vanessa atalanta*, *Pieris rapae*, *Burnsius communis*, *Vanessa cardui*, *Vanessa annabella*, *Echinargus isola*, *Strymon melinus*, *Colias eurytheme*
Prairie Meadows	*Danaus plexippus*, *Pieris rapae*, *Echinargus isola*
Ruby Hill	*Colias eurytheme*, *Pieris rapae*, *Vanessa cardui*, *Papilio polyxenes*, *Polites peckius*, *Papilio rutulus*, *Burnsius communis*, *Lycaena dione*, *Danaus plexippus*, *Echinargus isola*, *Lon taxiles*, *Pontia protodice*, *Epargyreus clarus*, *Strymon melinus*
Rude Park	*Vanessa cardui*, *Pieris rapae*, *Colias eurytheme*, *Echinargus isola*, *Strymon melinus*
Washington Park	*Danaus plexippus*, *Pieris rapae*, *Papilio rutulus*, *Vanessa cardui*, *Vanessa atalanta*, *Burnsius communis*, *Colias eurytheme*, *Lon taxiles*, *Speyeria mormonia*, *Echinargus isola*, *Euptoieta claudia*, *Brephidium exilis*,

	Pontia protodice, Vanessa annabella, Polites themistocles
Willis Case Golf Course	*Pieris rapae, Burnsius communis, Pontia protodice, Vanessa cardui*

Appendix Table 5: Complete list of butterfly species and their associated parks

Butterfly species	**Parks observed**
Brephidium exilis	Cranmer Park, Washington Park
Burnsius communis	Argo Park, Babi Yar Park, Central Park, Chaffee Park, Cheesman Park, City Park, Commons Park, Cranmer Park, Eisenhower Park, First Creek at DEN Open Space, Garfield Lake Park, Globeville Landing, Great Lawn Park, Huston Lake, Inspiration Point, James Bible Park, Johnson Habitat Park, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Ruby Hill, Washington Park, Willis Case Golf Course
Colias eurytheme	Argo Park, Babi Yar Park, Central Park, Chaffee Park, Cheesman Park, City Park, Commons Park, Cranmer Park, Eisenhower Park, First Creek at DEN Open Space, Garfield Lake Park, Globeville Landing, Great Lawn Park, Huston Lake, Inspiration Point, James Bible Park, Johnson Habitat Park, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Ruby Hill, Rude Park, Washington Park
Colias philodice	Cheesman Park, City Park, Cranmer Park, First Creek at DEN Open Space, Globeville Landing, Great Lawn Park, Huston Lake

Danaus plexippus	Central Park, Chaffee Park, Cheesman Park, Commons Park, Garfield Lake Park, Globeville Landing, Great Lawn Park, Huston Lake, Parkfield Lake, Prairie Meadows, Ruby Hill, Washington Park
Echinargus isola	Babi Yar Park, Chaffee Park, Cheesman Park, Cranmer Park, Great Lawn Park, Huston Lake, Inspiration Point, James Bible Park, Johnson Habitat Park, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Prairie Meadows, Ruby Hill, Rude Park, Washington Park
Epargyreus clarus	Northfield Pond, Ruby Hill
Euptoieta claudia	Babi Yar Park, Central Park, City Park, Commons Park, Cranmer Park, Globeville Landing, Great Lawn Park, Huston Lake, Inspiration Point, Washington Park
Hesperia uncas	Inspiration Point
Junonia coenia	Johnson Habitat Park
Junonia grisea	Johnson Habitat Park
Libytheana carinenta	Argo Park
Limenitis weiddmeyerii	City Park
Lon taxiles	Argo Park, Babi Yar Park, Central Park, City Park, Eisenhower Park, Garfield Lake Park, Huston Lake, Inspiration Point, James Bible Park, Johnson Habitat Park, Ruby Hill, Washington Park
Lycaeides melissa	Globeville Landing

Lycaena dione	Ruby Hill
Lycaena heteronea	Cheesman Park
Nathalis iole	First Creek at DEN Open Space, Huston Lake
Ochlodes yuma	Garfield Lake Park
Papilio multicaudata	Cheesman Park, Garfield Lake Park
Papilio polyxenes	Cranmer Park, Globeville Landing, Inspiration Point, Ruby Hill
Papilio rutulus	City Park, Cranmer Park, First Creek at DEN Open Space, Inspiration Point, Ruby Hill, Washington Park
Phyciodes pulchella	Babi Yar Park, First Creek at DEN Open Space, Parkfield Lake
Pieris rapae	Argo Park, Babi Yar Park, Central Park, Chaffee Park, Cheesman Park, City Park, Commons Park, Cranmer Park, Eisenhower Park, First Creek at DEN Open Space, Garfield Lake Park, Globeville Landing, Great Lawn Park, Huston Lake, Inspiration Point, James Bible Park, Johnson Habitat Park, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Prairie Meadows, Ruby Hill, Rude Park, Washington Park, Willis Case Golf Course
Polites peckius	Chaffee Park, Huston Lake, Parkfield Lake, Ruby Hill
Polites themistocles	Argo Park, Eisenhower Park, Garfield Lake Park, Washington Park
Polygonia interrogationis	Huston Lake

Pontia protodice	Cheesman Park, Cranmer Park, First Creek at DEN Open Space, Garfield Lake Park, Globeville Landing, Great Lawn Park, James Bible Park, Johnson Habitat Park, Parkfield Lake, Ruby Hill, Washington Park, Willis Case Golf Course
Speyeria mormonia	Washington Park
Strymon melinus	Argo Park, Babi Yar Park, Chaffee Park, First Creek at DEN Open Space, Huston Lake, Johnson Habitat Park, Northfield Pond, Platte Farm Open Space, Ruby Hill, Rude Park
Tharsalea dione	Babi Yar Park
Vanessa annabella	James Bible Park, Platte Farm Open Space, Washington Park
Vanessa atalanta	Argo Park, Cheesman Park, City Park, Commons Park, Great Lawn Park, Huston Lake, Inspiration Point, James Bible Park, Platte Farm Open Space, Washington Park
Vanessa cardui	Argo Park, Babi Yar Park, Central Park, Chaffee Park, Cheesman Park, City Park, Commons Park, Cranmer Park, Eisenhower Park, First Creek at DEN Open Space, Garfield Lake Park, Globeville Landing, Great Lawn Park, Huston Lake, Inspiration Point, James Bible Park, Johnson Habitat Park, Northfield Pond, Parkfield Lake, Platte Farm Open Space, Ruby Hill, Rude Park, Washington Park, Willis Case Golf Course

Appendix Table 6: Park visitation dates. Note that Platte Farm was visited a total of four times because on the third visit, after completing part of the survey, rain forced us to have to revisit the next day.

Park Name	Date
Argo Park	6/20/23
Argo Park	7/13/23
Argo Park	8/9/23
Babi Yar Park	6/23/23
Babi Yar Park	7/18/23
Babi Yar Park	8/14/23
Central Park	6/22/23
Central Park	7/14/23
Central Park	8/11/23
Chaffee Park	6/29/23
Chaffee Park	7/25/23
Chaffee Park	8/17/23
Cheesman Park	6/20/23
Cheesman Park	7/12/23

Cheesman Park	8/9/23
City Park	6/15/23
City Park	7/11/23
City Park	8/10/23
Commons Park	6/19/23
Commons Park	7/12/23
Commons Park	8/8/23
Cranmer Park	6/21/23
Cranmer Park	7/13/23
Cranmer Park	8/8/23
Eisenhower Park	6/20/23
Eisenhower Park	7/12/23
Eisenhower Park	8/9/23
First Creek at DEN Open Space	6/27/23
First Creek at DEN Open Space	7/19/23
First Creek at DEN Open Space	8/15/23
Garfield Lake Park	6/21/23

Garfield Lake Park	7/13/23
Garfield Lake Park	8/10/23
Globeville Landing	6/27/23
Globeville Landing	7/21/23
Globeville Landing	8/17/23
Great Lawn Park	6/23/23
Great Lawn Park	7/14/23
Great Lawn Park	8/11/23
Huston Lake	6/14/23
Huston Lake	7/10/23
Huston Lake	8/7/23
Inspiration Point	6/14/23
Inspiration Point	7/10/23
Inspiration Point	8/7/23
James Bible Park	6/23/23
James Bible Park	7/17/23
James Bible Park	8/14/23
Johnson Habitat Park	6/21/23

Johnson Habitat Park	7/17/23
Johnson Habitat Park	8/11/23
Northfield Pond	6/26/23
Northfield Pond	7/18/23
Northfield Pond	8/15/23
Parkfield Lake	6/27/23
Parkfield Lake	7/19/23
Parkfield Lake	8/15/23
Platte Farm Open Space	6/22/23
Platte Farm Open Space	7/17/23
Platte Farm Open Space	8/10/23
Platte Farm Open Space	8/11/23
Prairie Meadows	6/26/23
Prairie Meadows	7/19/23
Prairie Meadows	8/14/23
Ruby Hill	6/14/23
Ruby Hill	7/11/23
Ruby Hill	8/7/23

Rude Park	6/19/23
Rude Park	7/11/23
Rude Park	8/8/23
Washington Park	6/26/23
Washington Park	7/18/23
Washington Park	8/14/23
Willis Case Golf Course	6/29/23
Willis Case Golf Course	7/25/23
Willis Case Golf Course	8/17/23

Appendix 2. Additional Objective 1 figures

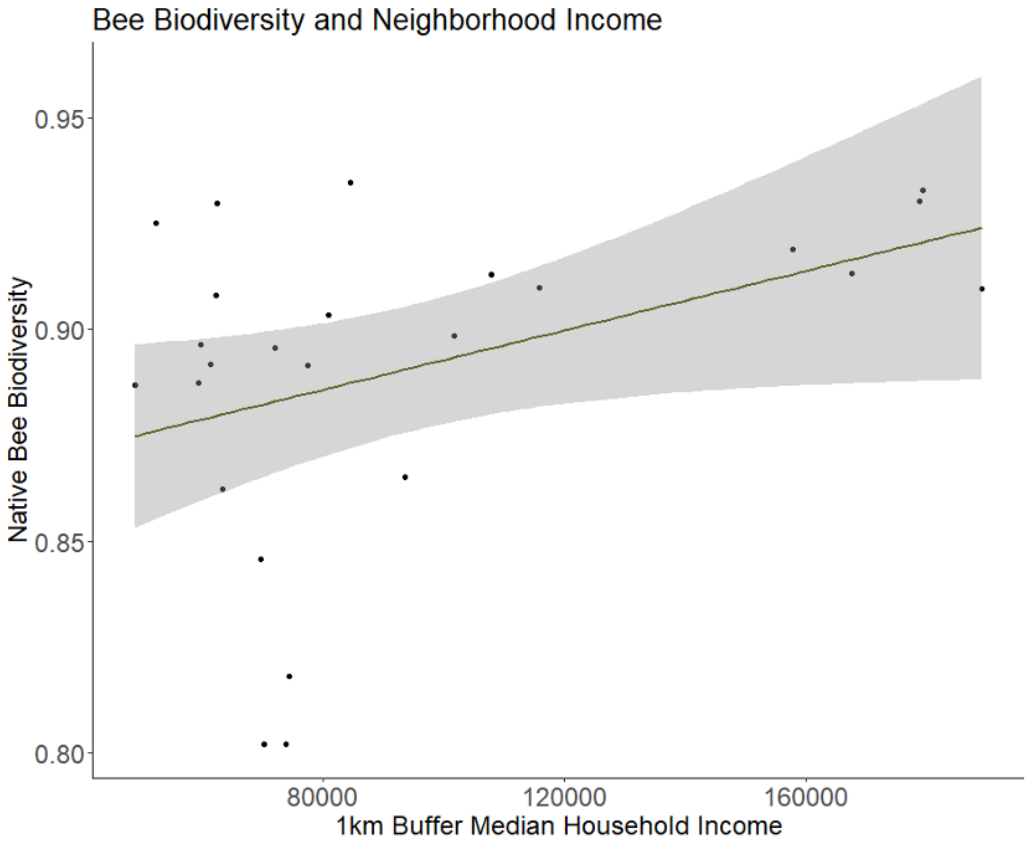


Figure 7. Bee diversity as a function of median household income within 1 km of the focal parks.

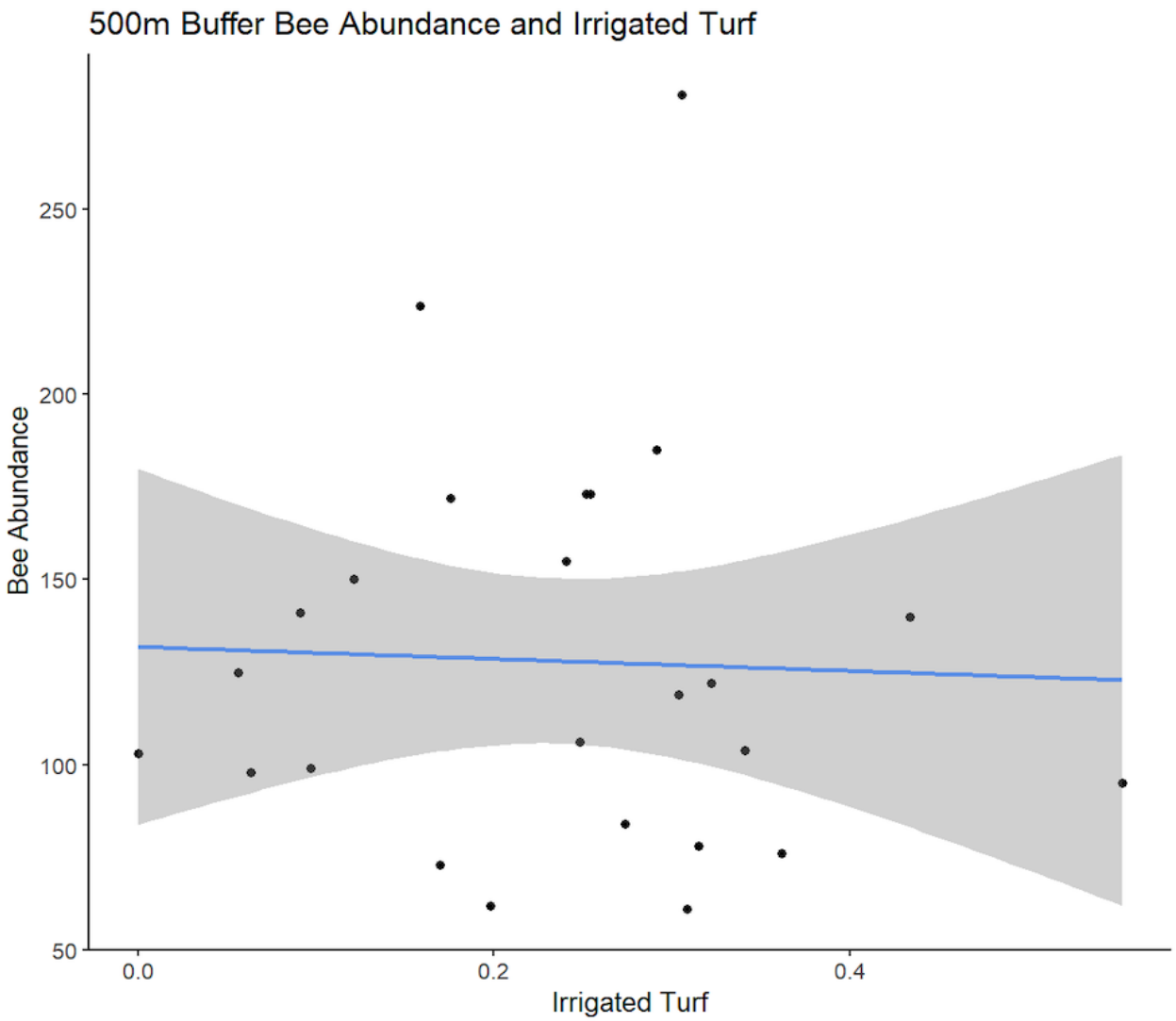


Figure 8. No relationship between the proportion of irrigated turf in 500 meters and bee abundance.

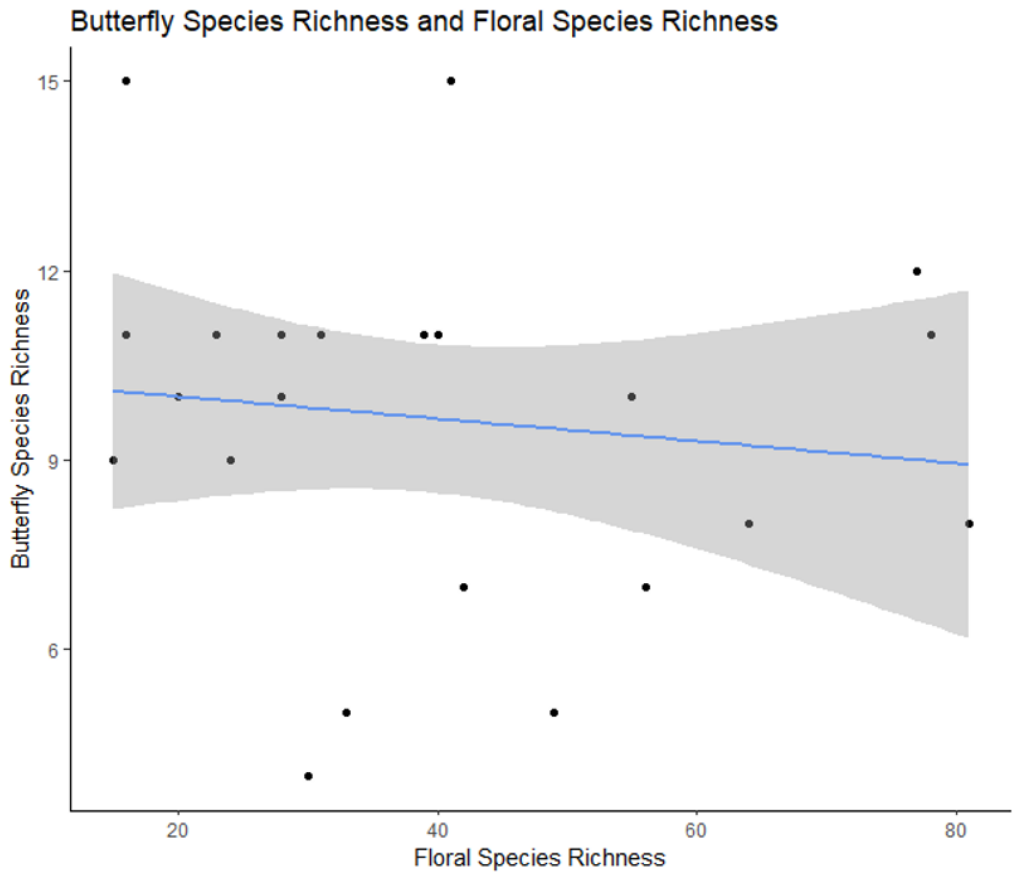


Figure 9. Butterfly species richness is not predicted by floral species richness, perhaps suggesting the importance of larval host plants (not measured).

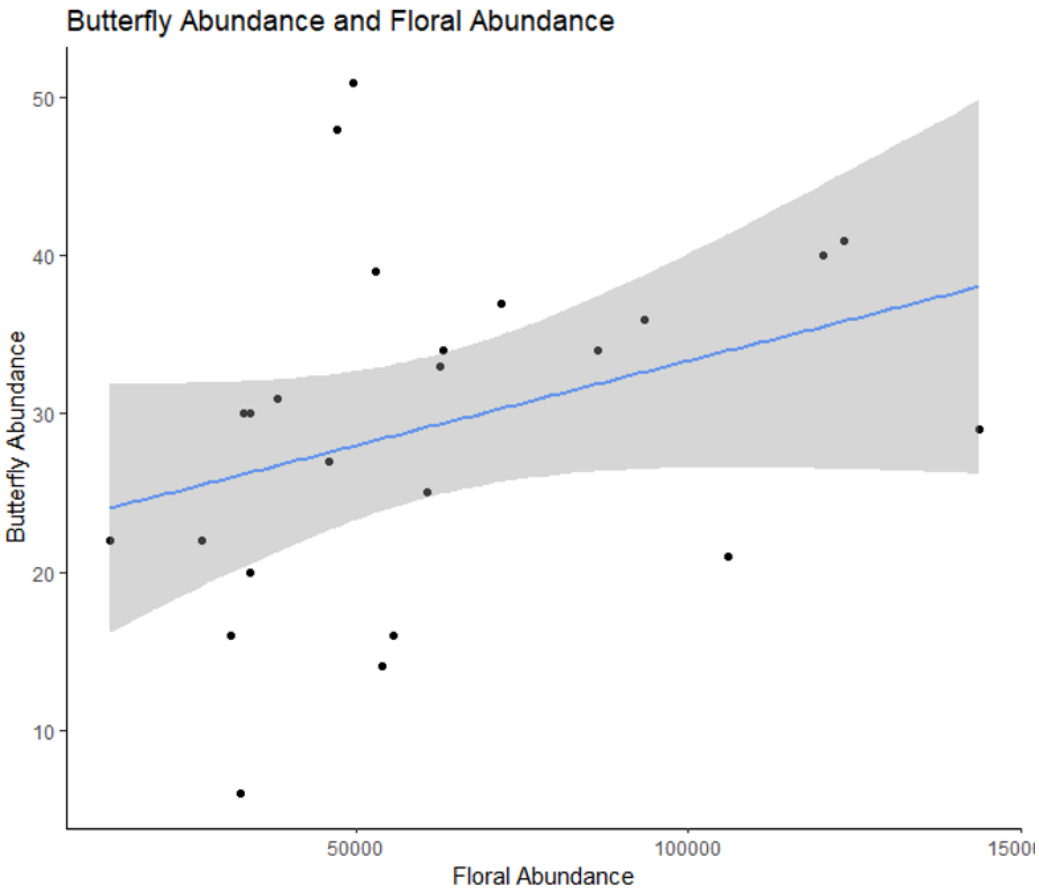


Figure 10. Butterfly abundance is positively predicted by site floral abundance.

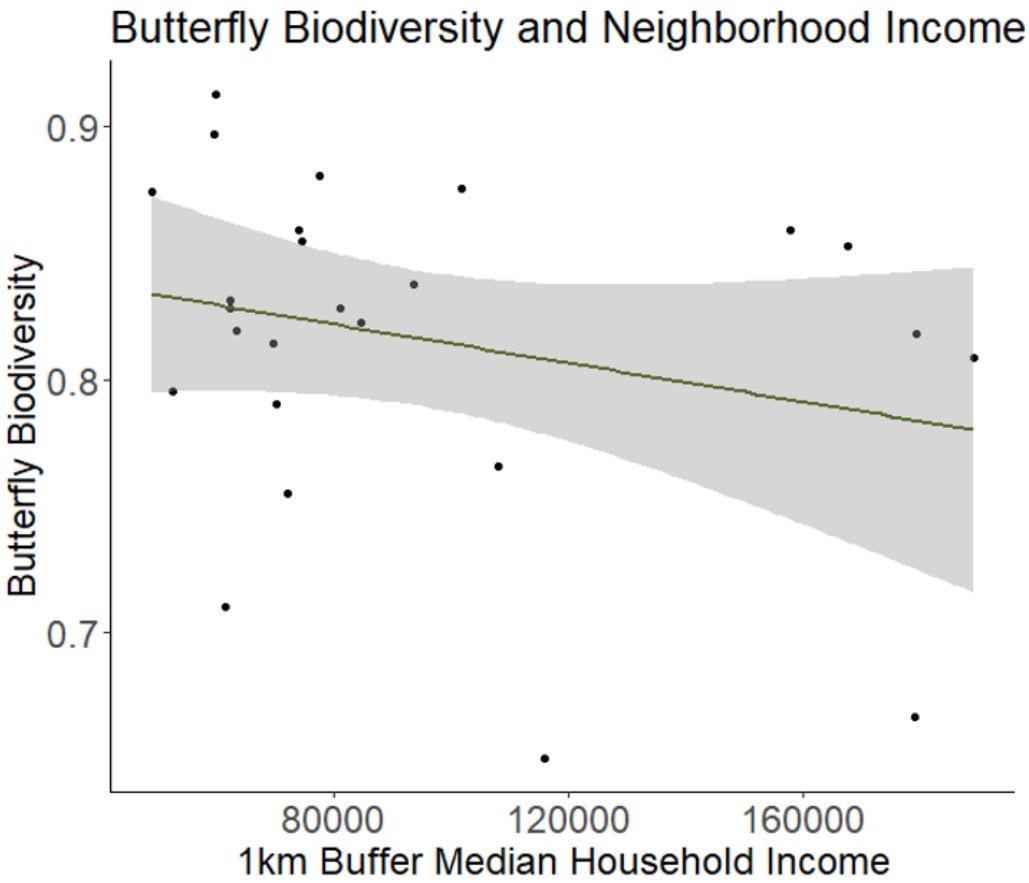


Figure 12. There is no consistent relationship between butterfly biodiversity and median household income within 1km of the focal parks.

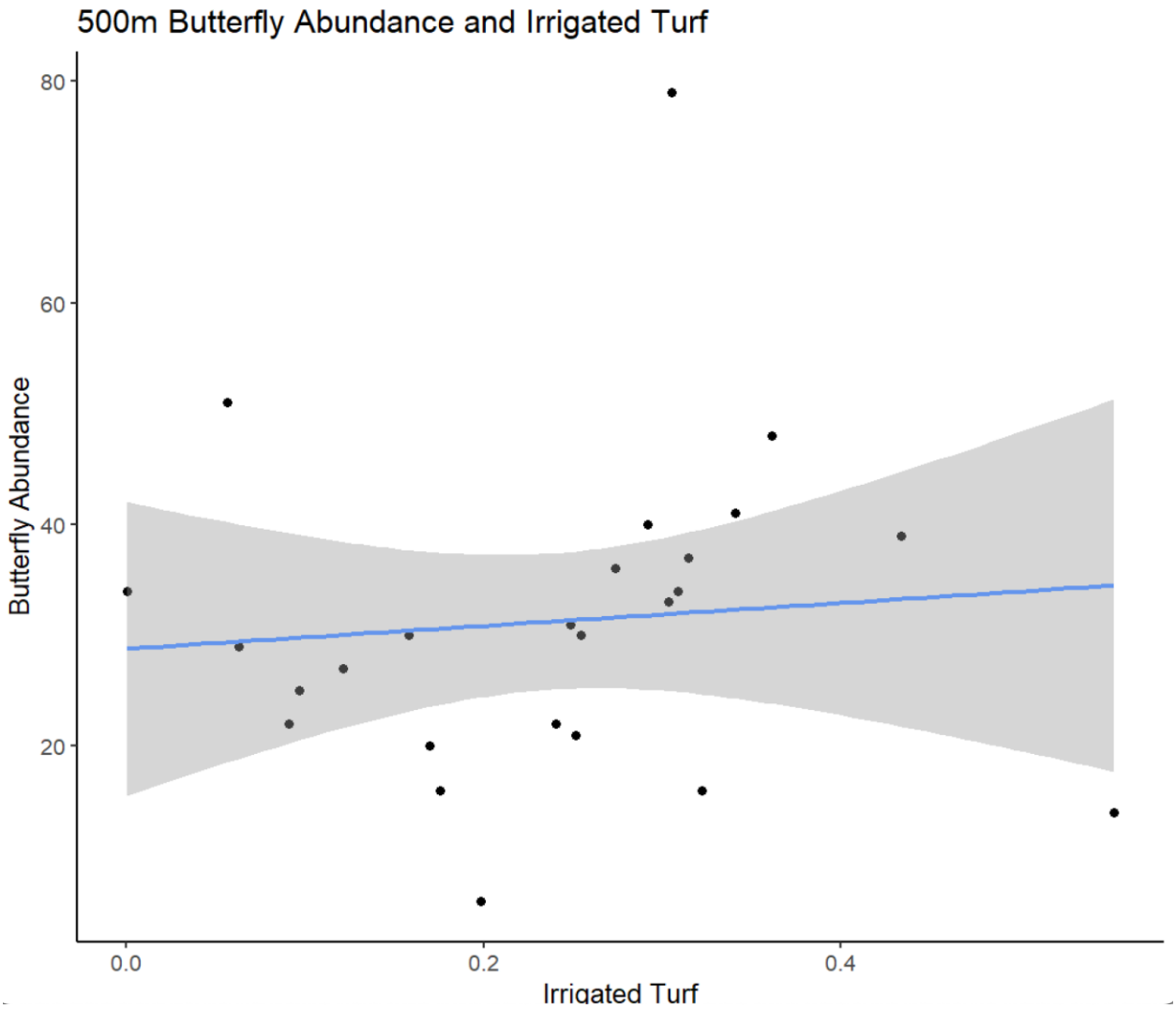


Figure 13. There is no consistent relationship between butterfly abundance and the proportion of irrigated turf within 500m of the sampled parks.

Appendix 3. Social Values Survey

[Consent Notice and Survey on the next 6 pages]

Hello,

We are conducting a research study on public attitudes and beliefs towards landscaping in Denver Parks. The Principal Investigator of the project is Dr. John Mola, an Assistant Professor in the Forest and Rangeland Stewardship Department at Colorado State University (CSU).

We invite you to take a survey. Participation will take approximately 5-10 minutes. Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participation at any time without penalty.

We will be collecting individually identifiable data, such as your age, gender, and area of residence, in addition to information about your beliefs and attitudes towards public landscapes. We will keep your individually identifiable data confidential; your personal information will be kept in a password-protected folder accessible only to the research team. When we report and share the results of the survey with others outside the research team, we will combine the data from all participants so that your individual responses will not be identifiable. After removing identifiers from any private information, this data may be used for future research studies without additional informed consent.

There are no known risks or direct benefits to you. However, we hope to gain more knowledge on park goers' perceptions of landscaping in Denver Parks. It is not possible to identify all potential risks in research procedures, but the researchers have taken reasonable safeguards to minimize any known and potential (but unknown) risks.

If you have any questions about the research, please contact the graduate student researcher on this project, Veronica Champine, at Veronica.Champine@colostate.edu or 415-233-1631. If you have any questions about your rights as a volunteer in this research, contact the CSU IRB at: csu_irb@colostate.edu; 970-491-1553. The title of the protocol is "Plants for Parks, Pollinators, and People (Part 2)."

Veronica Champine, M.S., and Dr. John Mola
Human Dimensions of Natural Resources Department
Forest and Rangeland Stewardship Department
Colorado State University

Denver Parks and Recreation (DPR) would like to hear from you to help inform future projects in Denver parks.

How often do you visit Denver parks?

- ☐ Daily
- ☐ Weekly
- ☐ Monthly
- ☐ Annually
- ☐ Never

How do you typically use grassy areas in Denver parks? (Please check all that apply.)

- ☐ Walking
- ☐ Sitting
- ☐ Picnic
- ☐ Informal sports
- ☐ Organized sports
- ☐ Other (please specify): _____

A surveyor will now show you two hypothetical renders of landscapes in Denver parks. Please answer the following questions to help us understand your thoughts and beliefs towards them:

Which park landscape do you prefer?

- ☐ Landscape 1
- ☐ Landscape 2

How much do you agree or disagree with the following statements?

I like the way **Landscape 1** looks.

☐	☐	☐	☐	☐	☐	☐
Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

I like the way **Landscape 2** looks.

☐	☐	☐	☐	☐	☐	☐
Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

A surveyor will now show you two more hypothetical renders of landscapes in Denver parks. Please answer the following questions to help us understand your thoughts and beliefs towards them:

Which park landscape do you prefer?

- ☐ Landscape 3
- ☐ Landscape 4

How much do you agree or disagree with the following statements?

I like the way **Landscape 3** looks.

☐	☐	☐	☐	☐	☐	☐
Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

I like the way **Landscape 4** looks.

☐	☐	☐	☐	☐	☐	☐
Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

Please answer the following questions to help us understand your beliefs towards these park landscapes. Below are a couple of definitions of terms.

Pollinator: an animal that transfers pollen to assist in the fertilization of plants
Pollinator-friendly landscaping: creating spaces specifically for host plants (i.e., plants that create habitat for native pollinators), which are often native plants and/or wildflowers

The surveyor will now show you the hypothetical renders of pollinator-friendly plantings in Denver parks. Please answer the following questions to help us understand your thoughts and beliefs towards them:

How much do you agree or disagree with the following statements?

I would avoid an area with pollinator-friendly landscaping.

□	□	□	□	□	□	□
Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

I support Denver Parks and Recreation creating pollinator-friendly landscaping in Denver parks.

□	□	□	□	□	□	□
Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

Pollinator-friendly landscapes appear good for butterflies, bees and other insects.

□	□	□	□	□	□	□
Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

How do you feel about bees?

- □ I like them
- □ I tolerate them
- □ I dislike them

On a scale from 1-10, how concerned are you about bee stings while at the park?

_____

On a scale from 1-10, how concerned are you about tall grasses while at the park?

_____

Do you have any other thoughts or concerns about these plantings? If so, what are they?

_____

_____

DPR would like your input in pollinator-friendly planting projects specifically. From the list of issues below, please choose the top three most important issues to consider in the planning process.

Aesthetic beauty

Climate change

Green gentrification

Human health

Pollinator conservation

Safety

Water conservation

1. _____
2. _____
3. _____

In this final section we would like to learn a bit more about you. As a reminder, your responses to these questions are confidential:

What is your age (in years)? _____

What is your gender?

- ☐ Woman
- ☐ Man
- ☐ Gender nonbinary
- ☐ Prefer to self-identify. What is your gender identity? _____

What is your highest level of education?

- ☐ Less than high school graduate
- ☐ High school graduate (or equivalent)
- ☐ Some college or associate's degree
- ☐ Bachelor's degree
- ☐ Graduate degree or higher

Do you currently live in the Denver Metro area?

- ☐ Yes
- ☐ No

Where did you grow up?

- ☐ Mostly in Colorado
- ☐ Mostly outside of Colorado

What is your race and ethnicity? (Select all that apply)

- ☐ American Indian or Alaska Native
- ☐ Asian American (e.g., Chinese, Filipino, Japanese, Korean, Vietnamese, or other Asian)
- ☐ Black/African American
- ☐ Middle Eastern
- ☐ Native Hawaiian or Pacific Islander (e.g., Guamanian or Chamorro, Samoan, or other Pacific Islander)
- ☐ White
- ☐ Hispanic, Latinx, or of Spanish origin
- ☐ Prefer to self-identify: _____

Thank you for taking the time to complete this survey! You may hand this questionnaire back to a surveyor.

Appendix 4. Poster of Social Values Study

Exploring residents' perceptions of pollinator-friendly landscaping in Denver parks

Veronica Champine, PhD and John Mola, PhD, Colorado State University

DENVER PARKS & RECREATION

SALAZAR CENTER FOR NORTH AMERICAN CONSERVATION
COLORADO STATE UNIVERSITY

INTRODUCTION

- Urban green spaces (e.g., parks, yards, roadsides, school grounds) can help address complex socio-ecological issues like biodiversity loss
- Green spaces should reflect the needs and preferences of the local community to be successful
- When people perceive landscapes as aesthetically pleasing, they are more likely to appreciate and take actions to protect them
- We worked with Denver Parks and Recreation (DPR) to understand the level of support that Denver residents have for pollinator-friendly landscaping in parks

METHODS

- Online survey of Denver residents in October 2023 ($n = 832$)
- Measured:
  - Typical park activities
  - Beliefs about pollinators and hypothetical landscapes
  - Demographics
- Experimental Design:
  - Half of participants ($n = 422$) saw pollinator-friendly landscaping with cues to care (i.e., built features like benches, paths, signs, and wildlife houses that signal care for the land)
  - The other half ($n = 410$) saw pollinator-friendly landscaping without cues

Research Questions:

RQ1: Do Denver residents prefer turf grass or pollinator-friendly landscaping?
- Does it depend on the season (summer vs. winter)?
- Do "cues to care" affect perceptions of landscaping?

RQ2: Do different subgroups of Denver residents vary in their perceptions towards pollinator-friendly landscaping?

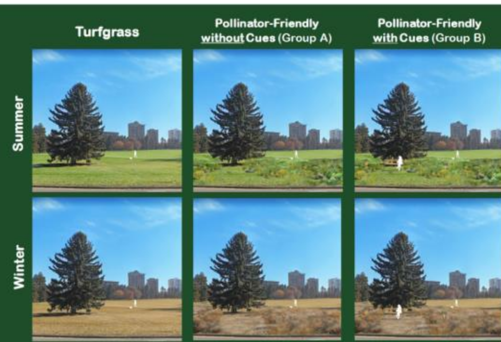


Table 1

Pollinator-Friendly Landscaping Preference	Without Cues ($n = 422$)	With Cues ($n = 410$)	% Change
Summer	190 (45.0%)	201 (49.0%)	+4.0%
Winter	178 (42.2%)	192 (46.8%)	+4.6%

Graphic: Example of a photo-realistic render of a Denver park in both seasons and with and without cues to care.
Table 1: Preference for pollinator-friendly landscaping in hypothetical Denver park renders in summer and winter.

Table 2

Bee Feeling	Average Summer Pollinator-Friendly Landscape Rating (1-7)	95% CI
I dislike them	4.18*	3.76 - 4.60
I tolerate them	5.00*	4.80 - 5.20
I like them	5.45*	5.30 - 5.60

Table 3

Household Income Level	Average Summer Pollinator-Friendly Landscaping Rating (1-7)	95% CI
Less than $50,000	4.81*	4.60 -5.03
$50,000 - $100,000	5.33	5.12 - 5.53
Greater than $100,000	5.40	5.22 - 5.59

Tables 2 and 3: Average rating of pollinator-friendly landscaping in summer by participants' feeling towards bees and their income level. Asterisks represent a subgroup that was significantly different than at least one other subgroup using a Tukey HSD post-hoc analysis.

RESULTS

RQ1: Landscape Ratings/Preferences

- **Aesthetic ratings of pollinator-friendly landscaping** were ***not different*** between the two groups in either season (Summer: $B = 0.36$, $SE = 0.32$, $p = .49$; Winter: $B = -0.16$, $SE = 0.29$, $p = .59$)
- **Participants preferred turfgrass** in both seasons (Summer: $t = 2.43$, $df = 1637.8$, $p = 0.02$; Winter: $t = 4.45$, $df = 1621.3$, $p < .001$)

RQ2: Subgroup Differences

- **Frequency of Park Visits:** Frequent park goers (daily/weekly) rated pollinator-friendly landscapes higher than infrequent parkgoers (never/annually/monthly) in both seasons (Summer: $t = 2.76$, $df = 675.68$, $p = .006$, Winter: $t = 2.76$, $df = 677.59$, $p = .006$)
- **Feelings towards bees:** Ratings of the pollinator-friendly landscape differed between people who "dislike bees," "tolerate bees," and "like bees" in both seasons (Summer: $F = 22.14$, $df = 2$, $p < .001$; Winter: $F = 25.14$, $df = 2$, $p < .001$)
- **Income Level:** Lower income individuals had a lower average rating of the pollinator-friendly landscape in both seasons. (Summer: $F = 9.832$, $df = 2$, $p < .001$; Winter: $F = 12.49$, $df = 2$, $p < .001$)
- **Growing up in Colorado:** Respondents who grew up "mostly outside of Colorado" had a significantly higher average rating of the pollinator-friendly landscape. (Summer: $t = -2.66$, $df = 710.6$, $p = .008$; Winter: $t = -2.2041$, $df = 702.14$, $p = .03$)

DISCUSSION

- Denver residents are split in their preference for landscape type
- More explicit "cues to care" in a different context may increase positive perceptions around pollinator-friendly landscaping in Denver Parks
- Targeted public engagement to increase resident park visit frequency and positive feelings towards bees may help grow support for more pollinator-friendly landscaping
- Public engagement campaigns focusing on lower income households and Colorado residents who grew up in the state may help increase support for more pollinator-friendly landscaping

References