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Final Report

The Effects of Urbanization on Pollinator Diversity and Abundance in Boulder Open Space

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Abstract

The purpose of this study was to evaluate the effects of urbanization on the composition and abundance of the pollinator community by comparing pollinators in grassland plots near urban areas with those in areas less disturbed by human development. Our hypothesis was that plots with little urbanization would attract a more diverse assemblage of pollinators and a greater abundance of pollinators than plots near urban areas.

Based on this first field season, the abundance of pollinators was not significantly different between the remote and urban plots. Preliminary observations suggest that species composition was similar between the two types of plots and that overall diversity was less than anticipated. We suspect that our "remote" plots were not isolated enough from the effects of human activity. We plan to continue this study next summer, adding an additional set of more isolated plots for comparison.

Objectives and Hypothesis

The purpose of this study was to evaluate the effects of urbanization on the composition and abundance of the pollinator community by comparing pollinators in grassland plots near urban areas with those in areas less disturbed by human development. Our hypothesis was that plots with little urbanization would attract a more diverse assemblage of pollinators and a greater abundance of pollinators than plots near urban areas.

Methods

The 16 study sites for the 2001 field season were initially chosen from among the plots identified in the Open Space grassland biodiversity study (Bock and Bock 1994). Paired sets of remote and urban plots with similar vegetation and soil types were used (2 remote and 2 urban plots per group). All biodiversity plots have been characterized for 24 variables including distance from the nearest urban area, percentage of bare soil, and percentage of pavement or buildings within the plot. In addition, the vegetation of each plot has been documented, and a relative importance scale for each plant species has been designated based on the percentage of coverage by that plant species.

Each of the 16 plots was sampled six to eight times over the course of the summer. The plots were marked with a permanent central stake. Circular transects with a radius of 25 m from the central stake were marked with pin flags that remained in place for the field season. Sampling involved walking the transects and collecting all flower-visiting bees and flies within an arm's length of either side of the transect. The time was noted at the start and finish of the transect walk and times were standardized within a limited time frame. One researcher carried a sweep net and collected insects from flowers, while a second researcher followed and recorded an accession number, field identification of insect type, and flower species on which the insect was collected. After walking the transect, both researchers spent ten minutes collecting additional insects within the 25 m radius circle. Initially all bees and flower-visiting flies were collected because field identifications to species for these groups are very difficult. Subsequently, when multiple specimens of common species were collected in the same plot on the same day, some individuals were released after recording the appropriate data.

Results

Eight hundred and forty insects were recorded on flowers and over 500 were collected for pinning and identification. At least half of the insects collected on flowers were flies.

Insect specimens were pinned (about 50 remain to be pinned) and sorted to family. Approximately 150 have been identified to genus at this point and further identification is in progress. Sarah Hinners, EPO Biology graduate student, registered for independent research credit to develop her skills in bee identification, and she has been working on this project all fall. Her identifications were checked by Virginia Scott of the CU museum's department of entomology. Once most of the insects have been identified to genus, they will be sorted to morphospecies within genera in order to evaluate diversity within urban and remote plots. Ultimately, specimens will be sent to taxonomic experts for species identifications. Voucher specimens will be deposited in the CU museum's entomology collection.

During the period of intensive collecting with equal effort in remote and urban plots, (6/11/01 - 8/17/01), a total of 783 bees and flies were recorded visiting flowers. Four hundred and thirty-six were recorded in remote plots, and 347 in urban plots. The mean number collected per plot per sampling period in remote plots was 9.15 (10.48 s.d., range 0 – 42) and 7.71 in urban plots (8.14 s.d., range 0 – 37). Variables were ln-transformed to meet normality requirements for analysis of variance. Analysis of variance indicated no significant difference in the numbers of insects collected between remote and urban plots within matched groups of plots ($p > 0.7$) although matched groups were significantly different from each other ($p < 0.005$).

Analysis of the difference in species richness between remote and urban plots will be conducted once all insects have been identified to genus and morphospecies. Identifications are time consuming. A follow-up report will be submitted when this analysis has been performed. Preliminary observations suggest that both remote and urban plots had high percentages of a few common genera including *Apis* (non-native honeybees), *Bombus* (bumblebees), *Dialictus* (Halictidae), *Lasioglossum* (Halictidae) and *Eristalsis* (Diptera: Syrphidae). After examining a representative sample of the bees collected, Virginia Scott estimated that we had about 16 of the 60 genera of bees in Colorado and suggested that bee diversity in Boulder Open Space is low. She added that many of the bees collected were generalists that could feed on a wide variety of flower species. Our expectations had been that we would find much higher levels of diversity in both the urban, and especially the remote plots than is apparent from our initial survey of the collection.

Conclusions

The abundance of pollinators in the remote plots was not significantly different than the number of pollinators in urban plots. At this point we can not make any definitive conclusions about the differences in species composition. Preliminary observations suggest that species composition was similar between the two types of plots and that diversity was less than anticipated. Additional identifications (in progress) will be needed to confirm this.

Based on our initial impression of the abundance of generalist species, we suggest that our "remote" plots were not remote enough from the perspective of pollinators. Similar studies comparing natural and disturbed areas have found that fewer insect species and higher proportions of insects with generalist feeding habits characterize disturbed areas. Kakutani et al. (1990) demonstrated that sites with the greatest human disturbance were poorest in insect species numbers, with only 37% of the total species richness of a natural, undisturbed site. Bañkowska (1980) documented dramatic differences in species composition of syrphid flies between natural and disturbed areas, with generalists dominating the disturbed areas.

Pollinator composition in our remote plots may still reflect the effects of mowing, pesticides, grazing in surrounding areas, and proximity to roads. Consequently, next summer we would like to expand our sampling to include an additional set of plots that are even more isolated from human activity. We will retain the 16 original plots that were used in the 2001 field season, and will add an additional eight plots in areas that are more remote than those sampled previously.

Anthropogenic disturbances including development, habitat fragmentation, the practice of monoculture for crop production, the use of pesticides and herbicides, and the introduction of non-native species have been cited as factors contributing to declines in pollinators (Kearns, Inouye and Waser 1998, Bond 1994, Osborne, Williams and Corbet 1991,). Declines are suspected to result from loss of suitable nesting habitat and food resources for pollinators. (Kearns, Inouye and Waser 1998). Pollinators with special food, nesting and habitat requirements may respond more dramatically to anthropogenic change than those with broader or more flexible requirements. Consequently, as natural habitat is disturbed, generalist pollinators may dominate. Ultimately, pollinator declines may have far-reaching effects through decreased fruit and seed production, resulting in changes in the plant community, and affecting the animal community that uses these plants for food or shelter.

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