Short Communication

A SURVEY OF SUMMER POLLINATOR ASSEMBLIES IN TWO CONTIGUOUS RICHMOND, VIRGINIA (U.S.A.), URBAN GREEN SPACES

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Abstract—The interactions between plants and their pollinators provide essential ecosystem services in support of the reproduction and propagation of flowering plants, as well as the nutritive support for pollinators and their offspring. Given the critical nature of these activities, coupled with exponential urban development and the concurrent, dramatic decline in pollinators worldwide, it has become increasingly important to evaluate the complex and specialized interactions between pollinators and their host plants. This includes assessing plant-pollinator interactions within urban green infrastructure. Here, we surveyed floral visitor interactions on nineteen summer-blooming plant species in two contiguous Richmond, Virginia, gardens. We observed 110 distinct flower visitor taxa, with the majority seen on four or fewer plant species. The most common flower visitors were bees, including *Bombus impatiens*, which was found on every plant surveyed. Although the flower visitor assemblages varied categorically among plant species, in total the two gardens hosted a broad range of generalist and specialist visitors. The results of this survey provide a regional and seasonal perspective on urban green space ecosystem dynamics.

Keywords—Urban garden, native plants, pollinators, green infrastructure

INTRODUCTION

Global populations have become increasingly urbanized due to residency shifts and overall population gains. Current estimates project 9.7 billion people by 2050 (United Nations 2022), with 70% expected to reside in an urban setting (United Nations 2023). To keep pace, our urban footprint is continually expanding, as is the development of arable land for agriculture (Molotoks et al. 2018). With such projections come heightened concerns about the degradation of natural areas and subsequent loss of biodiversity (Simkin et al. 2022). In response, urban planners and residents have increasingly sought to incorporate natural elements, such as green infrastructure (GI), into the urban environment. GI spaces have demonstrated environmental and ecological benefits, and also provide notable economic and social improvements (Ramyar et al. 2021; Herath & Bai 2024).

Although urban GI can refer to a diversity of landscapes, their presence offers potential habitat and resources for many types of wildlife in the otherwise challenging urban ecological environment (Hall et al. 2017; Gallo et al. 2017; Rega-Brodsky et al. 2022). Pollinators, in particular, use these spaces for nesting (Sexton et al. 2021) and resources (Wray & Elle 2015; Daniels et al. 2020; Fuccillo Battle et al. 2021). In this work, our goal was to survey potential pollinators and other flower-interacting organisms on summer flowering plants in two contiguous Richmond, Virginia (U.S.A.) urban GI spaces (Fig. 1). The Low Line Garden and Great Shiplock Park are situated near a preponderance of impervious surfaces, including Virginia State Route 5 to the north. There are also nearby buildings, parking lots, surface- and elevated-level railroad tracks, and the recreational Virginia Capital Trail. The gardens are adjacent to the Kanawha Canal and the James River to their south. Both spaces contain predominantly state-native plants aimed at

supporting urban wildlife and providing a riparian buffer along the James River. Collectively, these spaces include over seventy unique plant species, the majority of which are flowering trees, shrubs, and herbaceous perennials.

Materials and Methods

Floral visitor interactions were monitored on nineteen different summer-blooming herbaceous plant species (Appendix I) in the Low Line Garden and Great Shiplock Park of Richmond, Virginia (U.S.A.) (Fig. 1). This survey was limited to a 10-week period from June – August 2023. Each plant species was monitored throughout its bloom period, which varied among species, leading to 5-16 monitoring events per species. All monitored plant species were intentionally cultivated except *Smallanthus uvedalia* (Bear's foot), a large cluster of which was found in a border area along the Kanawha Canal.

During each monitoring event, all blooming inflorescences for the plant species were observed for 15 minutes, with each 'flower visitor' recorded. Flower visitor identification was completed by real-time assessment or by *post hoc* analyses of photographs and/or hand-trapped specimens. Each flower visitor was identified with the highest resolution possible (either genus or species, hereafter: 'taxa'). Upon identification, they were categorized as follows: bee, wasp, butterfly/moth, fly, beetle, true bug; two organisms outside of these broad classification bins were collectively grouped as 'other' (Appendix I).

Results and Discussion

Over the entire survey period, the broad visitor assemblage categories for each of the nineteen plant species varied considerably (Fig. 3). For example, over 70% of the visitors on *Scutellaria incana* and *Verbena hastata* (Blue vervain) were bees, whereas bees accounted for only 27% of those

Figure 1. The survey was conducted in the Low Line Garden (outlined in green; 37.52804, -77.42288) and Great Shiplock Park (outlined in pink; 37.52659, -77.42128) in Richmond, Virginia (U.S.A.). This map was created in Google Earth Pro (version 7.3.6.10155).

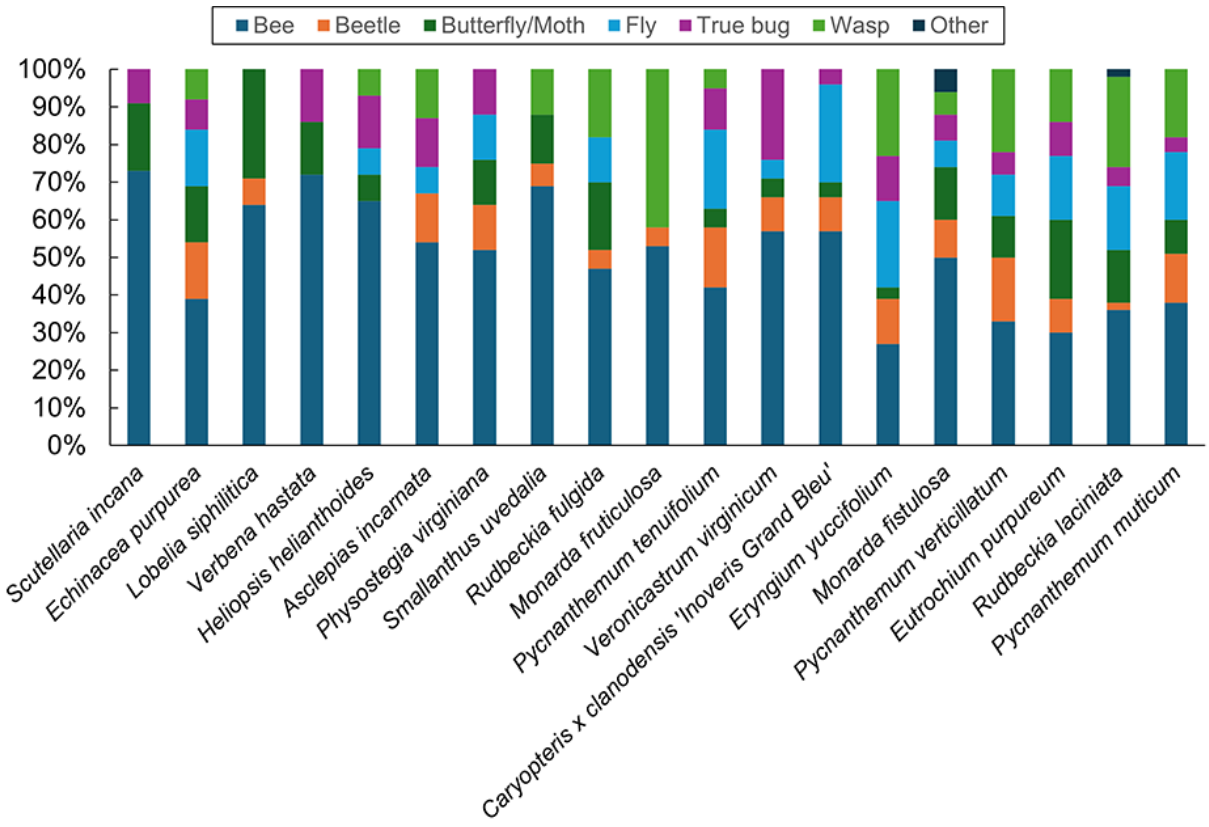

Figure 2. The broad flower-visitor categories that visited each of the nineteen plant species.

seen on *Eryngium yuccifolium* (Rattlesnake master). No flies were observed interacting with *S. incana*, *Lobelia siphilitica* (Blue cardinal flower), *V. hastata*, or *S. uvedalia*, but they accounted for 23% of the unique visitors on *Caryopteris x clanodensis* 'Inoveris Grand Bleu' (Bluebeard) and *E. yuccifolium*. Wasps accounted for 42% of the visitors on *Monarda fruticulosa* (Spotted bee balm) but were absent on six plant species (Fig. 2).

In total, we observed 110 distinct flower visitor taxa (Appendix I). The majority of these visitors were seen on four or fewer plant species. The common Eastern bumblebee, *Bombus impatiens*, was observed on all nineteen plant species; other common visitors included *Apis mellifera* (Western honey bee), *Bombus griseocolis* (Brown-belted bumblebee), *Lasioglossum* spp. (a genus of sweat bees), and *Halictus ligatus* (Ligated furrow bee) (Appendix I). Overall, bees were the most highly observed flower visitor, with ten taxa observed on ten or more plant species.

Most flower visitor taxa were observed on four or fewer plant species (Appendix I). For some, including those in the butterfly/moth and fly categories, this was expected based on the presumption their populations would be of lower abundance locally. For example, throughout the entire monitoring period we only observed a single *Danaus plexippus* (Monarch). Monarch populations have been in decline and are projected by some to continue their downward trend (Zylstra et al. 2022); however, urban GI, especially those with high floral diversity, are known to be supportive of monarch populations (Nestle et al. 2020). The incorporation of milkweeds is critical for their reproductive needs, including the *Asclepias incarnata* (Swamp milkweed) found at Great Shiplock Park. Although flower visitor abundance was not our focus, GI that support low-abundance pollinators can be critically important, especially for threatened or endangered taxa.

Of the observed bees, 11 taxa were detected on four or fewer plant species (Appendix I). Two bumblebees, *Bombus fervidus* (Golden northern bumblebee) and *Bombus fraternus* (Southern plains bumblebee), were among these less-common bee populations. *B. fraternus*, which was recently recommended for federal protection (Endangered and Threatened Wildlife and Plants 2024), was

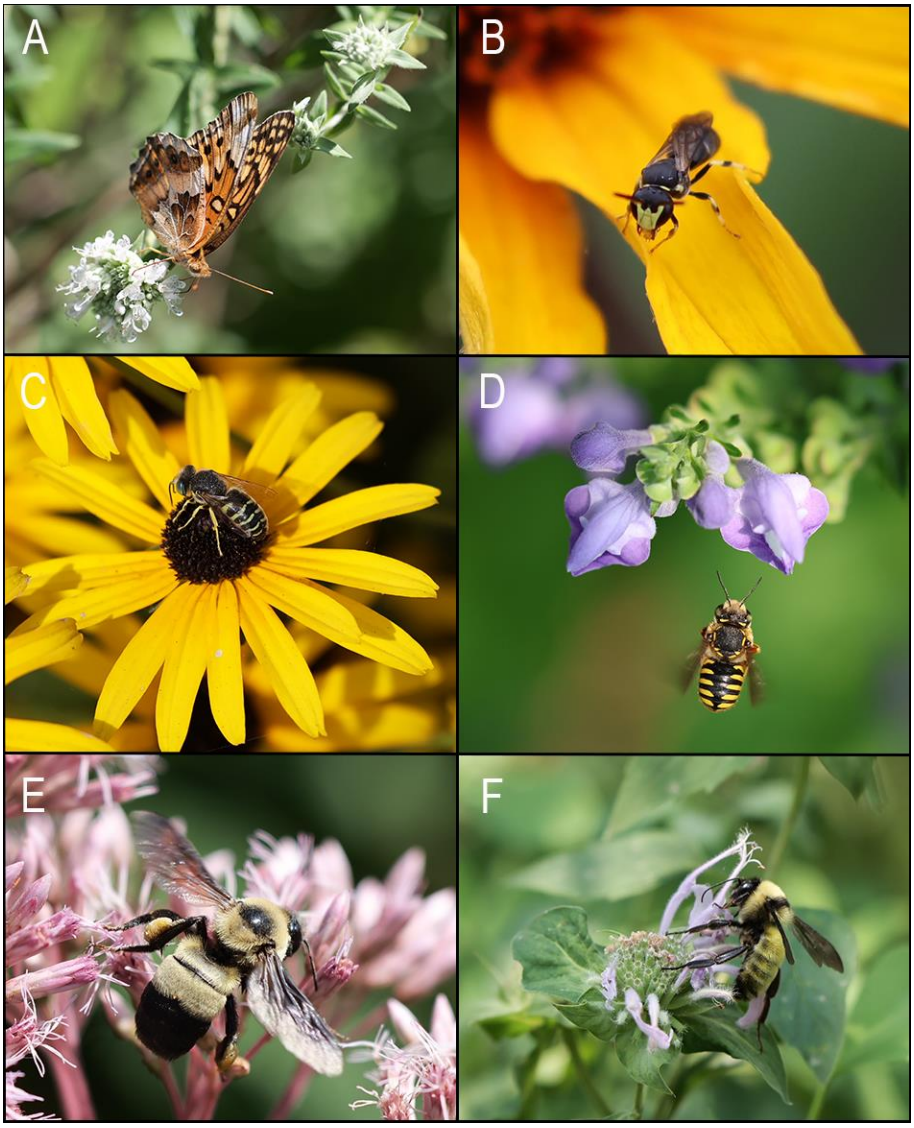

Figure 3. Pollinators of the Low Line garden and Great Shiplock Park. A) *Euptoieta claudia* (Variegated fritillary) on *P. verticillatum*. B) *Hylaeus modestus* (Modest masked bee) on *Heliopsis helianthoides*. C) *Bembix americana* (American sand wasp) on *Rudbeckia fulgida*. D) *Anthidium manicatum* (European woolcarder bee) approaching *Scutellaria incana*. E) *Bombus fraternus* (Southern plains bumblebee) on *Eutrochium purpureum*. F) *Bombus fervidus* (Golden northern bumblebee) on *Monarda fistulosa*.

seen foraging on *Eutrochium purpureum*. Many of the other bees we observed were also detected in another survey recently conducted in the region (Ostrom & Grayson 2021). Ostrom and Grayson (2021) collected their specimens by Malaise traps, suggesting that the use of varied collection methodologies may help maximize species detections.

Although we did not actively measure pollination success, many of the 110 taxa we observed (Appendix I) are presumed to be pollinators with varying levels of effectiveness. These include bees (25% of all taxa observed), butterflies/moths (16% of all taxa observed), some wasps (18% of all taxa observed), and certain flies (15% of all taxa observed). Their abundance and richness in urban environments are largely influenced by the availability of resources such as pollen and nectar, as well as local landscape features (Bennett & Lovell 2019; O'Connell et al. 2021), and their foraging activity often contributes to the reproductive success of the plants. However, it is also possible that the flower visitors we observed interact with these plants for other reasons, such as predator behaviors (e.g. *Polistes metricus*) (Dew & Michener 1978) or non-floral herbivory (e.g. *Sehirus cinctus*) (Sites & McPherson 1982). Overall, the presence of this diverse community in these two urban GI spaces indicates that these areas potentially provide a range of valuable ecosystem services, although direct comparison with regional GI or surrounding natural areas is needed.

In all, our observations provide an inventory of the summer flower-visiting organisms in a highly-urbanized GI space. These data may serve as a

valuable reference for the creation of similar spaces. Additionally, our findings can be used to assess future impacts of climate change and other aspects of urbanization on urban plant-pollinator interactions (Marshman et al. 2019).

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AUTHOR CONTRIBUTION

NJR designed and evaluated the data from the study. Both authors (NJR and LT) performed fieldwork and wrote the manuscript.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author(s).

DATA AVAILABILITY STATEMENT

The data used to write this article are available in the Appendix.

APPENDICES

Additional supporting information may be found in the online version of this article:

Appendix I. Flower visitor taxa observed from during a 10-week period from June – August 2023.

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