Restoring native plant and pollinator communities on New York City green roofs

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Abstract

Urban development has dramatically decreased habitat for native plants and other wildlife. One of the native insect groups affected by this change are the bees and wasps (Order Hymenoptera), which provide valuable ecosystem services like pollination of crops and ornamental plants. These insects are experiencing rapid population declines in urbanizing areas. A major obstacle to restoring pollinator populations in cities is the scarcity of space available that can be managed as habitat. A potential solution to this is to create patches of native vegetation on green roofs. Green roofs consist of live plants, growing media, and a drainage layer on top of a waterproof membrane. Most green roofs are planted with a mixture of non-native succulent plants (mostly from the genus Sedum), which are favored for their high survivorship and low maintenance requirements. On roofs with somewhat deeper media, a greater diversity of plants, including native plants typical of local grasslands, can persist. Here, we report on the differences in abundance and diversity of Hymenoptera attracted to native green roofs, Sedum green roofs, non-vegetated roofs, and ground-level green spaces. Preliminary data indicate extensive insect use of green roofs, with higher abundances on roofs planted with native species. The next phase of this research will involve comparing how the landscape context provided by different neighborhoods affects the development of the green roof biological communities.

Introduction

Green roofs first gained popularity as a way to deal with negative effects of urbanization (Rosenzweig et al. 2006). For example, storm water overflows occur when rain events cause urban sewer systems to release untreated water into surrounding water bodies. Green roofs mitigate this problem by absorbing rainfall and releasing it through evapotranspiration. Green roofs also decrease the ambient temperature on roofs, reducing the urban heat island effect, the phenomenon that urban areas have higher temperatures than surrounding areas.

In recent years, ecologists have begun to consider green roofs as a way to preserve biodiversity (Brenneisen 2006, Oberndorfer et al. 2007) (Figure 1). A study in London found that the bee community on green roofs was similar to that of ground sites, indicating that green roofs offer suitable habitat for Hymenoptera (Colla et al. 2009).

Multiple green roofs with a variety of vegetation types have been planted in recent years in New York City, but there has been no organized study on the diversity of green roof invertebrate communities. Despite this fact, some studies have looked at Hymenoptera diversity at street level gardens and found high numbers of exotic species (Matteson 2008). However, the ornamental flowers and crops planted in these gardens creates a different plant community than the Sedums and native plants inhabiting green roofs.

In this study, we address the following research questions:

• What insect communities are found on non-vegetated roofs, and how do these communities vary across New York City?

• Are there differences in the insect communities found on green roofs planted with native plants versus those planted with non-native Sedum?

Methods

Insects were sampled on two vegetated and nine non-vegetated roofs throughout New York City in October 2009. The non-vegetated roofs sampled were on recreation centers owned by the New York City Department of Parks and Recreation that will receive green roofs in 2010 (Figure 2). Vegetated roof samples were taken at the Ethical Culture Fieldston School in Riverdale, Bronx.

This building had two separate roofs, a lower roof planted with New York native grasses and a higher roof planted with non-native Sedum. The lower roof received more sunlight than the higher roof.

Several insect collection methods, including malaise traps, aerial nets and pan traps were tested for relative effectiveness in capturing different insect taxa. The results presented here are data collected from pan traps, which are bowls painted with yellow, blue and white ultraviolet paint and filled with soapy water. Only one pan trap was set out on roofs for 3-5 nights, and insect samples from each bowl were collected, stored in ethanol, and sorted to family or order in the lab.

Results and Discussion

Samples from the three roof habitats at Fieldston yielded between 69 and 97 insects from 5-6 orders. Collembola and Hymenoptera were the most common orders on these roofs. The two roofs planted with Sedums each had 6 orders, while the non-vegetated roof had 3 orders (Table 1). Although the super roof, planted only with Sedums, had the highest number of families, the Sedum community on the lower roof yielded 11 families and the highest number of individuals (Table 1). The increase in insects in the Sedum section of the lower roof could be due to greater diversity in vegetation types or the presence of native species in the vicinity.

Samples from the non-vegetated recreation center roofs yielded between 4 and 56 insects from one to five different orders. Diptera and Hymenoptera were the most common orders, representing 79% of the collected insects. Two roofs had fewer than 10 insects, while the other seven all had greater than 25 insects (Figure 4). There was substantial variation in the number of families across the roofs: Four roofs had 5 or fewer families, while two roofs were inhabited by greater than 13 families. Interestingly, the roof with the highest number of individual insects yielded 8 families (Table 2).

The study will continue in the summer of 2010, with standardized collection techniques and an increased number of study sites. The non-vegetated Parks and Recreation roofs that were surveyed in the fall of 2009 will be planted with native plants and will continue to be included in the study. In order to compare them properly with Sedum planted roofs of the same age, we are looking for newly planted Sedum roofs. Several ground-level sites will also be added to the study and those roofs will be located as close to the green roof as possible. For example, Jackie Robinson recreation center is located in a park that is planted with several native plants.

Although the garden is one season older than the roof, it may located in a park that is planted with several native plants. When comparing the abundance and diversity of insects between the Sedum roof and the garden, we report on the differences in abundance and diversity of Hymenoptera attracted to native green roofs, Sedum green roofs, and non-vegetated roofs on recreation centers throughout New York City.

Table 2: The number of insect families and individual insects sampled from non-vegetated roofs on recreation centers throughout New York City. "UNK" represents numbers that could not be estimated when arthropods were not identified.

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References


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