How does Moth diversity differ across ecosystems?

Violet M. Guzman, Yaejin Kim, Kimberly Martinez, Leonna Prithwipaul, Kimesha Reid-Grant & Acer VanWallendael

Introduction

Urbanization has resulted in the decrease of various insect populations, posing a problem as many of our food crops are pollinated by insects like butterflies and moths. A decrease in the amount of Lepidoptera—the order that contains moths, butterflies and skippers—can be dangerous because they are important to many ecosystems as a source of food. This is an especially noticeable issue in New York City.

There are over 150,000 species in the order of Lepidoptera (van Nieukerken et al. 2011). Our research emphasized the study of moths, due to lack of previous research in urban areas. Not only did we want to examine the relative abundance, but we also wanted to see the differences in species diversity in two opposing environments.

Focusing on the differences between rural and urban areas in New York, a study on the population of insects between these environments using light traps was carried out to determine the abundance of species. The Calder Center, located in Armonk, Westchester, contain 113 acres of land which houses deciduous forests, and many other ecosystems. Some tree pruning is done, but it is not manicured for aesthetic like our other sampling site. Brooklyn Bridge Park, by the East River, is an 85 acre park formerly used as industrial piers. Established in 2010, this multifaceted ecosystem is just beginning to develop; in contrast, Calder's ecosystem was well established before the field station was created. Meanwhile at BBP, the areas are heavily manicured and weeded, only allowing the desired plants to thrive in this location in lieu of letting any colonist species take over and dominate the landscape.

In considering the diversity of the species in Brooklyn Bridge Park and Calder Center, we predicted that there would be a greater abundance and diversity of moths in Calder compared to Brooklyn Bridge Park.

Materials and methods

In order to collect data in both areas:

- Light traps were placed, as seen in Figure 1.
- It was placed in each location the night before, in order to collect the insects. They were trapped and drowned in a soapy water solution.
- The bucket was emptied and organisms filtered out. It was left to dry for an hour.
- Next the insects were laid out on sorting trays and separated by families
- The moths were laid out on their stomachs and pinned, as seen in Figure 2. Small rectangular pieces of paper were pinned on top of the wings to flatten them out and keep them stable, then removed later.
- Insects that were not Lepidoptera were placed into plastic bags and stored for later identification. These insects were pinned in the same manner as the moths.
- After a couple of hours, the insects could be identified. This was achieved by using insect identification books, and if they couldn't be identified they were sorted into morphospecies based on their appearances.

Figure 1. As seen in the picture to the left, a fluorescent light is connected to a car battery. The light was surrounded by aluminum sheeting to make it look more attractive. It was then placed on top of a bucket filled with a light soap water solution.

Results

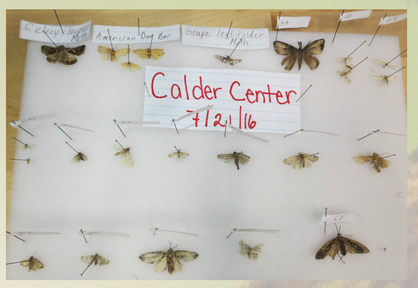

Figure 2. These pictures are of all the insects collected, pinned and identified/sorted over the course of four collection days, two per site. Not only were there a diverse range of moth species found in these traps, there were also a large variety of insects from other orders.

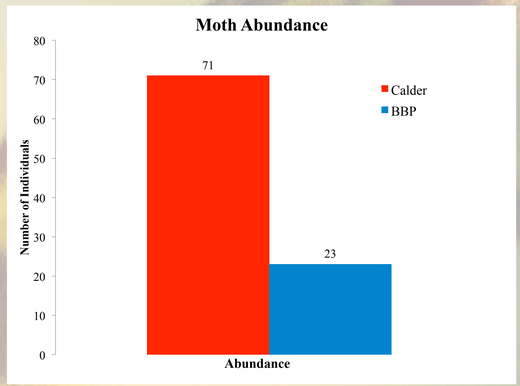

Figure 3. This figure gives us the actual number, or abundance, of individual moths that were caught in our trap over our sampling period at both sites.

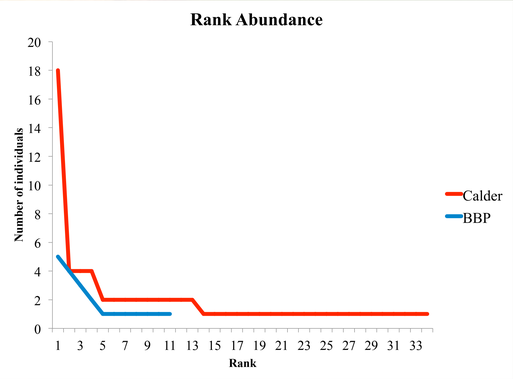

Figure 4. In this graph, we ranked each of the species of moths from greatest to least number of individuals in that species; Rank 1 has the most individuals, but rank 33 has the least.

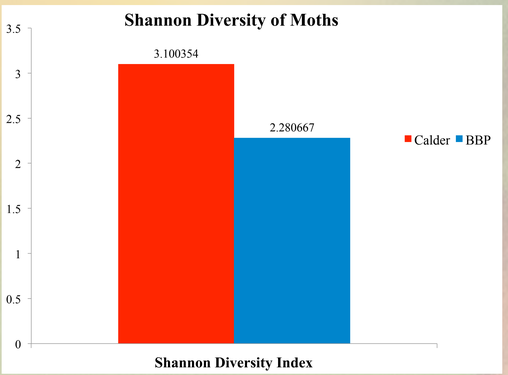

Figure 5. This graph gives us the Shannon Diversity Index value for each of our locations, with respect to moths. Values that are zero are considered no diversity, and values greater than zero indicates there is some type of diversity in the area.

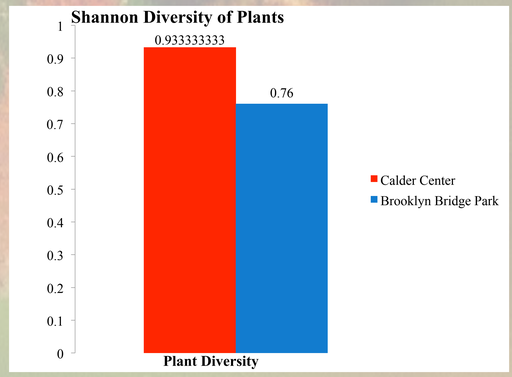

Figure 6. This graph gives us the Shannon Diversity Index values for both of our locations, but with respect to plants, unlike Figure 5.

Discussion

In Figure 2, pictures were taken of all the insects that were gathered, and chosen to be pinned onto the pinning boxes. Separated by the date and site, you can see the difference in abundance between the two sites. The insects were organized into species and labeled by their common name, and others that could not be identified to their species were put into a group called a morphospecies, which was based on similar outward characteristics.

In Figure 3, the graph displays the actual number of moths caught in our trap in the rural and urban areas. In Calder Center, there were 71 moths collected, while in BBP there were 23 moths. This data tells us just how much of a difference there is in the number of moths present at each site.

In figure 4, the graph shows the species being ranked by number of individuals in the species. Rank 1 has the largest amount of individuals which came from the Calder Center. From the graph, there is a greater of richness at Calder Center than at BBP. Furthermore the graph shows that while the Calder Center has a greater species richness, one species seems to dominate the landscape; there's 18 individuals of one species, whereas all of the other species only have a couple individuals at most. Yet at Brooklyn Bridge Park, we see less richness, but the number of individuals in each species is far more even.

Figure 5 tells us the Shannon diversity index values for each location regarding moths, which was calculated from our light trapping collections; this index's minimum value is 0, which indicates no diversity and its maximum never usually exceeds 4. Here we see a 0.8 difference in the diversity values for each site, which indicates that Calder has a slightly more diverse moth population in comparison to Brooklyn Bridge Park.

In Figure 6, the graph shows the plant diversity index using Shannon Diversity as well between the two locations Brooklyn Bridge Park and Calder Center. It demonstrates that there is a 0.17 difference, therefore showing that Calder only has a slightly more diverse plant population than Brooklyn Bridge Park; yet this slight difference in diversity plays an important part in the moth population's overall diversity, as shown in the previous figures.

But what can explain the divide in results between our two sites? The reasoning for this may be stemmed from factors such as increased light pollution, foot traffic, and disruptive noise. Not to mention destruction of host species for immature insects (such as moth and butterfly caterpillars as well as eggs for a myriad of species) and habitat loss/fragmentation.

Conclusion

From analyzing all of the data that we have collected, we can infer that there is a greater abundance and richness of moths and other insects in Calder Center compared to Brooklyn Bridge Park. These data support our hypothesis through the graphs created, and the analysis done. From the research conducted in these two areas, we can hypothesize further that rural areas in New York will have a greater biodiversity than surrounding urban areas.

Going forward, in possible future research, it would be great if others could examine the factors that lead to this difference in diversity across various areas in New York State. Could plant diversity play a factor, or proximity to ecosystems other than open fields and meadows? Should we start following the example of Brooklyn Bridge Park, or should we go for a more naturalistic approach for building parks in urban areas?

Literature cited

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