

# A Comparison of Lady Beetle Abundance & Diversity In Urban vs. Rural



## Areas

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### INTRODUCTION

Lady beetles, also known as *Coccinellidae* or Ladybugs, are a family of beetles found throughout the world. They are often found in temperate climates, especially in gardens, forests and weeds. Lady Beetles are one of the most well known beneficial predatory insects as they help regulate the population of aphids to prevent them from eating away at crops and vegetation. Lady beetles are crucial for our environment as they maintain an ecological balance, are great indicators of our environment's health, and also serve as a natural way to control pests. Overall, they contribute to the well-being of our environment, which is why it is important to keep track of their population and where they are present.

Due to our world becoming increasingly industrialized, it is important that we look at how Lady Beetles are affected by urbanization and industrialization. For example, some research shows that, urban green spaces help restore biodiversity (Sanderson), whereas other studies show how urbanization causes habitat loss and decreases the abundance of species. Usually, Lady Beetles will adapt to available food sources, so they're more likely to reside in urban environments with both natural and cultivated plants (Wang). We chose to look at Lady Beetles in New York State, specifically because it is located in a temperate, humid climate, it is known for having many natural forests and gardens, and has extremely urbanized areas alongside extremely rural areas.

### HYPOTHESIS

We believe that there will be more abundance of species and more diversity of Lady Beetles in Urban areas of New York State compared to Rural areas of New York State. We believe this because, our research shows that Urban environments provide good habitats, like gardens, for all Lady Beetles to thrive. Furthermore, if there are more species of Lady Beetles in an area, we can assume that there will be more diversity between those species.

### METHODS

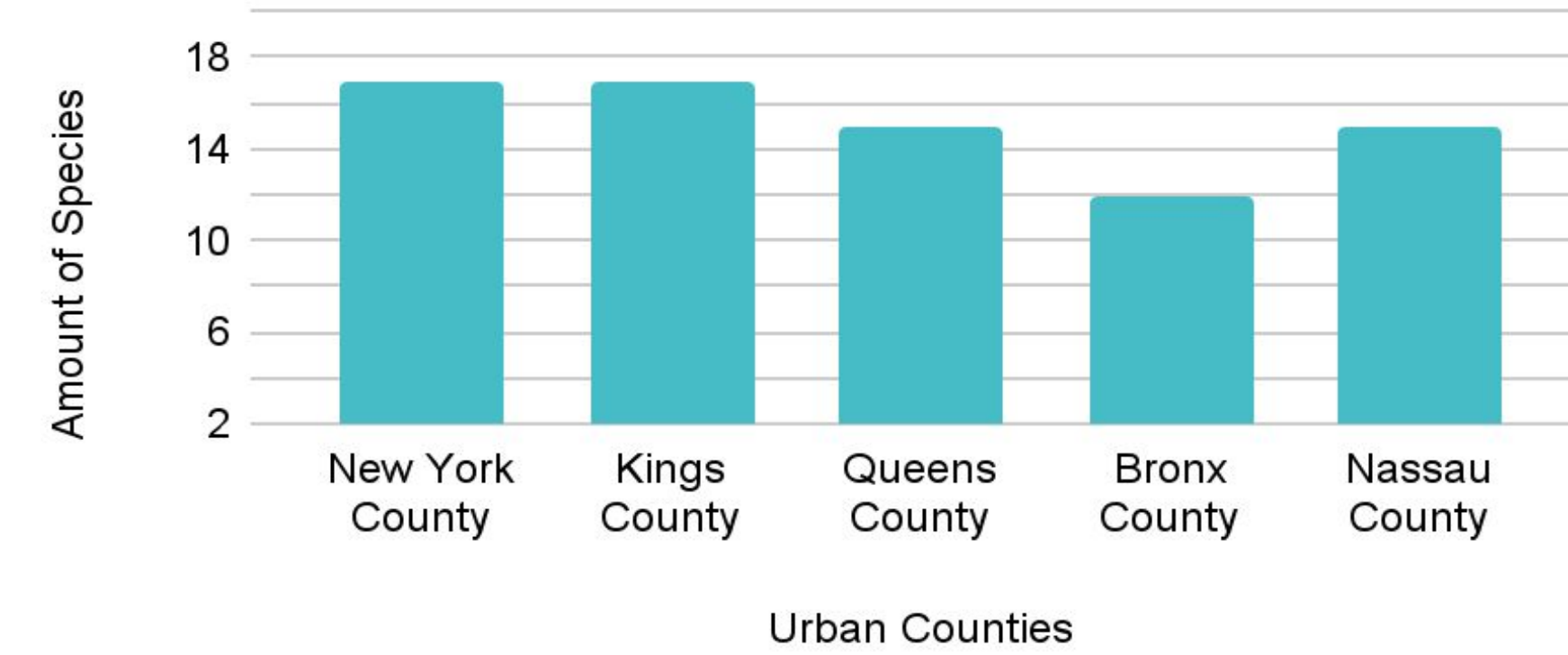
We began our study by deciding which 10 counties of New York State we would collect data from. We tried to keep all 10 counties in the southern region of New York to control the climate and we selected the counties based on data from worldpopulationreview.com. The 5 urban counties we chose had the highest population density in all of New York, ranging from 4,957/mi<sup>2</sup> to 75,077/mi<sup>2</sup>, and their populations varied from 1,412,646 to 2,805,485. The 5 rural counties we chose had a population density ranging from 30/mi<sup>2</sup> to 73/mi<sup>2</sup>, and a population ranging from 43,207 to 57,402. After selecting the areas, we then went on iNaturalist to record how many Lady Beetle species are found in each of the 10 counties, filtering the data by making sure it is Research Grade and was observed between 2013-2023. We organized the data into 2 bar graphs on Google Sheets, one for the amount of species in Urban areas, and the other for the amount of species in Rural areas and calculated the mean amount of species found in each county for each graph. Then we recorded every species found in total for the Urban and Rural areas, organizing them into 2 different pie charts. Lastly, we calculated Simpson's Index to assess the diversity between Urban and Rural areas.

### RESEARCH QUESTION

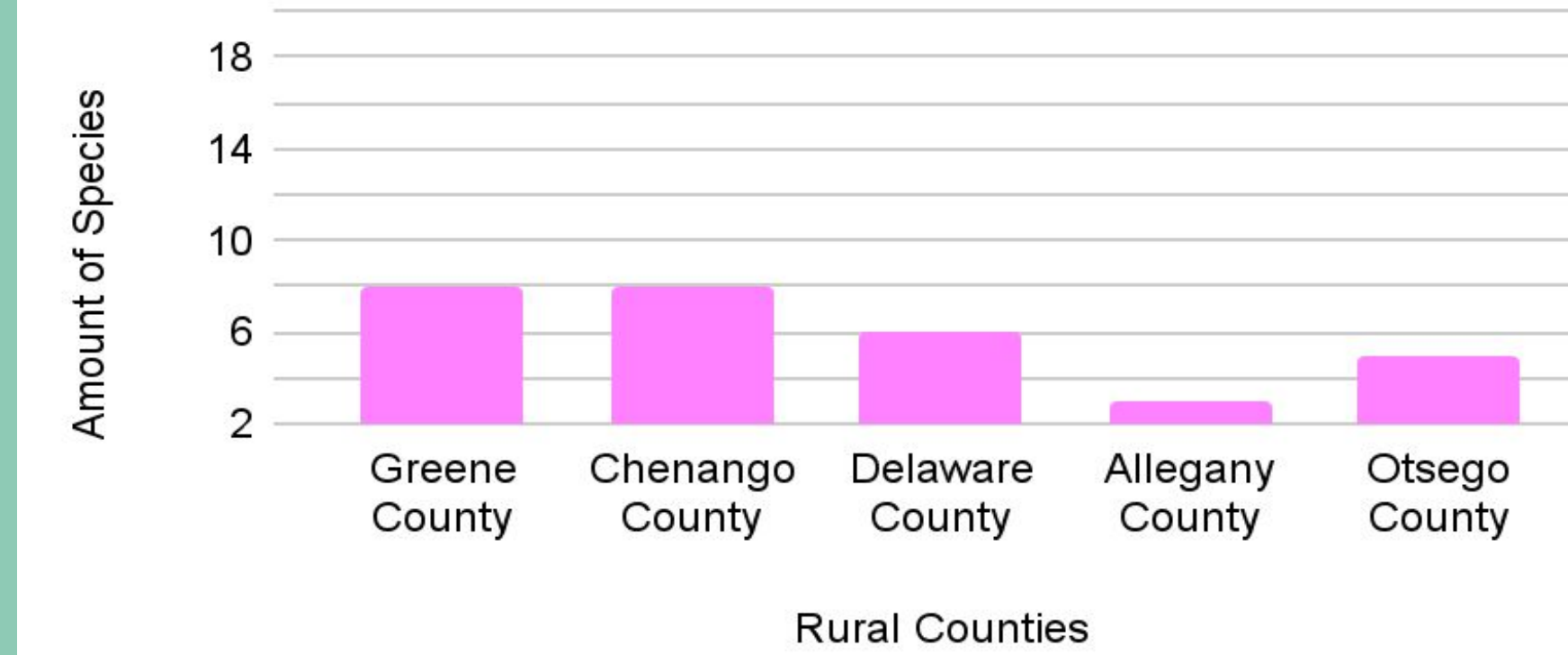
Is there a difference in abundance and diversity of Lady Beetles in Urban areas of New York State compared to Rural areas of New York State?

### RESULTS

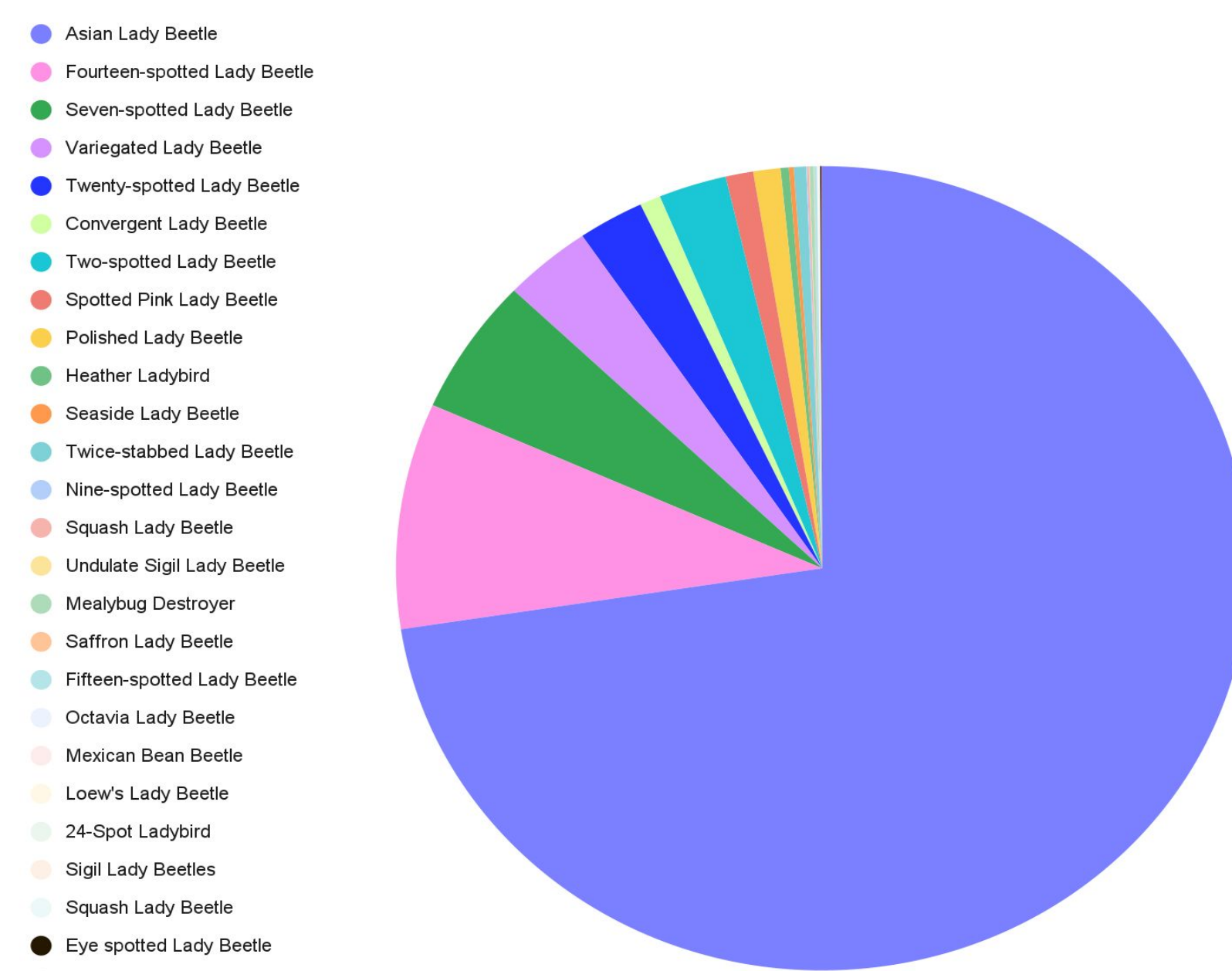
Amount of Species in Urban Counties



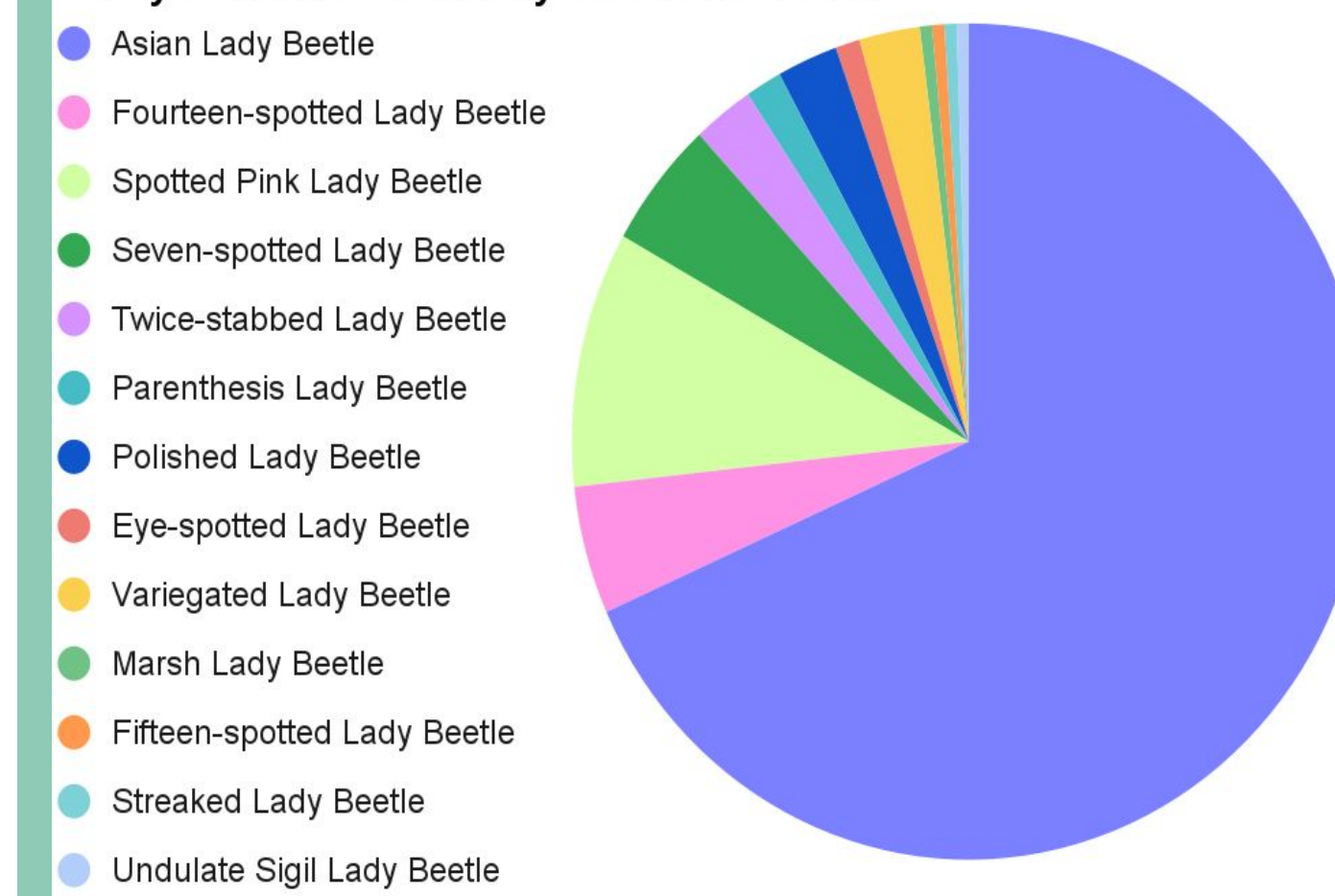
Amount of Species in Rural Counties



Lady Beetle Diversity in Urban Area



Lady Beetle Diversity in Rural Area



Area	Simpson's Index
Urban Area	0.4593136632
Rural Area	0.5163219292

### ANALYSIS

Our analysis of the data shows that there are many more species of Lady Beetles in Urban areas, compared to Rural areas of New York State. The mean number of species per county in the Urban areas is 15.2, while the mean number of species per county in the Rural areas is 6. The total number of species we found when we added up all the species in the Urban counties is 29, while the total number of species we found when we added up all the species in Rural counties is 13.

We then calculated the index of diversity using Simpson's Index ( $D = \sum(n/N)^2$ ). To find the Diversity Index, we took D and subtracted it from 1. The Urban area had a diversity index of 0.4593, while the Rural area had a diversity index of 0.5163. This would mean that the rural area is more diverse than the urban area, because a greater diversity index indicates that the probability of randomly selecting two of the same species in the Rural area is lower. This is also reflected in the pie charts, where we see that the Asian Lady Beetle dominated Urban areas (72.6%) more than Rural areas (68.3%)

### DISCUSSION

After collecting and analyzing our data, we found that the amount of species of Lady Beetles found in Urban areas of New York State exceeds the amount of species found in Rural areas of New York State. Although our hypothesis was initially proven to be correct, the actual diversity of the species' is higher in Rural areas compared to Urban areas. Overall, there is less of a chance that we would choose 2 Lady Beetles of the same species in Rural areas than Urban areas when they are randomly selected. It is also important to highlight the potential errors that could have occurred in the data collection process. One of our sources, iNaturalist, relies on regular people to enter personal observations of different plants and animals that they see, which, while it is fun and useful for learning about the biodiversity in our environment, can introduce inaccuracy. Due to the fact that iNaturalist is a relatively new app, it gains new users every year, which means that the observations are completely dependent on how many users the website has. The data on iNaturalist won't reflect how many Lady Beetles each county of New York actually has. Furthermore, the population of each county also affects how many observations are made, as the fewer people there are to observe, the less observations will be recorded, which hinders our results. To improve our study, we could try to find databases similar to iNaturalist that provide a broader and more accurate collection of data, and base our study off of that. Despite these challenges, our study provides a foundational understanding of the amount of Lady Beetles found across New York State and the diversity found in Urban and Rural environments.

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