



How does Mosquito Spraying in NYC Affect Non-Target Insects?

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Introduction

New York City participates in mosquito sprayings to reduce the risk of mosquito-borne diseases in major parks within the five boroughs. The Health Department mainly sprays pyrethroid-based adulticides at low concentrations to avoid health threats in humans and mammals. Unfortunately, non-target insects in NYC, like bees, butterflies, etc., can be exposed to these chemicals. Our focus is to understand how mosquito sprayings can effect non-target insects in sprayed parks. Wetlands and ponds in Prospect Park (Brooklyn), Van Cortlandt Park (Bronx), and Central Park (Manhattan) are treated annually, making them key places to study the impacts on non-target insects.

Using iNaturalist

Pros:

- **Citizen Database:** provides citizen-inputted data on insect observations across NYC neighborhoods, which is ideal for tracking changes before and after sprayings
 - reflects urban biodiversity patterns in real time
- **Accessibility:** avoids fieldwork costs and is easy to use
 - contains a simple interface that automatically tags observations with a GPS location and date
- **Fills Critical Data Gap:** provides data where traditional systematic surveys are absent due to cost, accessibility, and lack of resources.
- **Trends:** due to the large volume of observations, long-term trends and patterns can be analyzed across the urban settings

Cons:

- **Misidentification:** users can misidentify observations, which affects quality of data
- **Not Systematic:** several factors contribute to a lack of systematic data collection
 - observations likely to be submitted on weekends/during leisure time
 - weather impacts number of observations (bad weather means less)
 - participation varies across socio-economic and geographic areas, often clustered in wealthy and accessible areas
 - **User Density:** the effectiveness of data can depend on number of users which affects accuracy
 - previously we attempted to track the overall effectiveness of pesticide sprayings on mosquito populations, but there wasn't sufficient data to analyze a population decrease

Methods

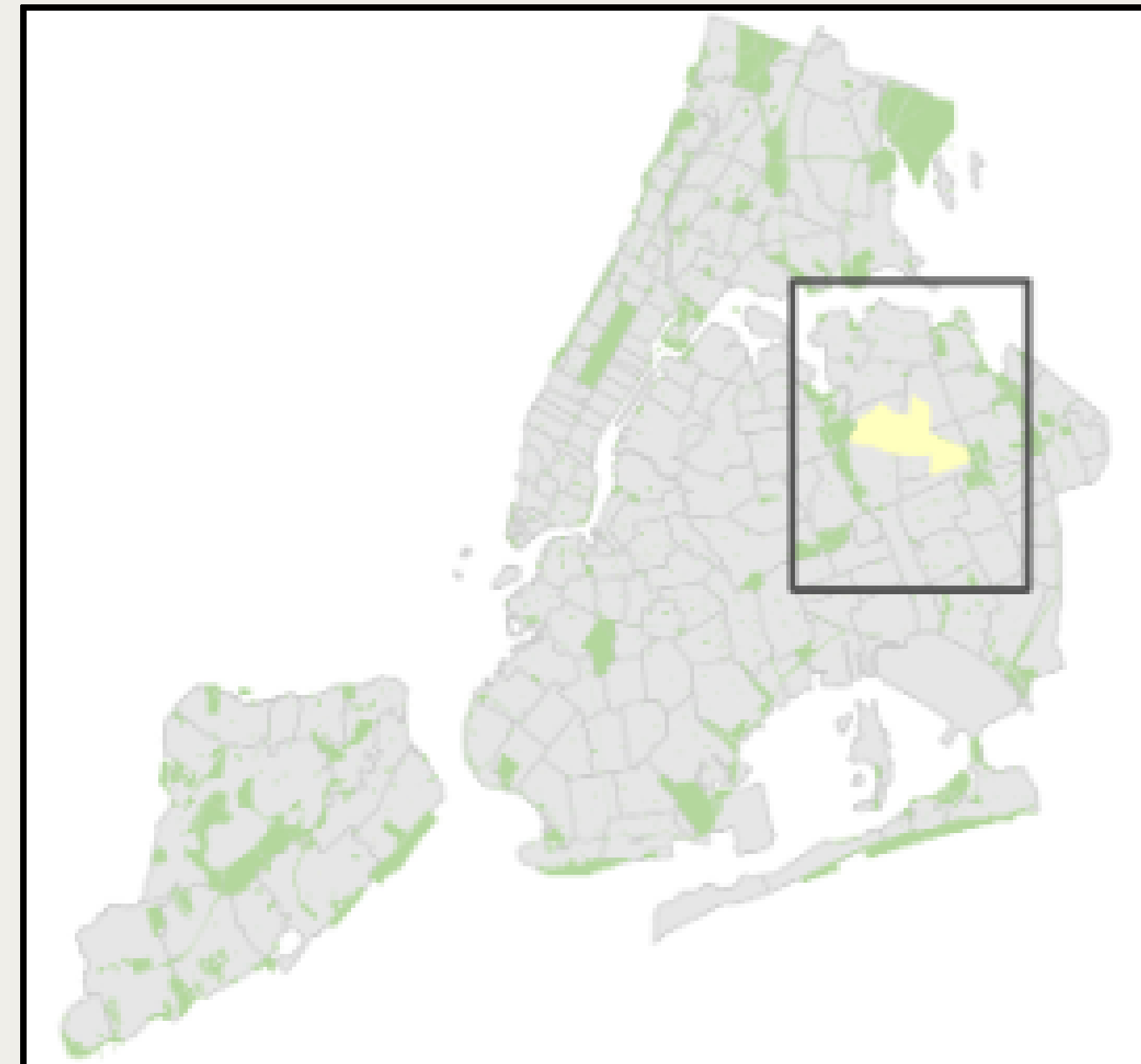
We searched for iNaturalist records of all insects from parks in neighborhoods the city publicized adulticide spray events; Prospect Park (Brooklyn), Van Cortlandt Park (Bronx), Central Park (Manhattan), and then Staten Island as our controlled variable. We tested whether there were more observations inputted in iNaturalist a week after spraying by comparing to the observations inputted a week before. First, we carried out a sign test (binomial probability) on the sign of before sprayings minus after sprayings to analyze if there was a drastic difference in biodiversity. Then another sign test was completed on the proportion of observations in each focal park over insect observations on Staten Island and minused the same proportion for the week after spraying at that focal park.



Results



Figure 1 & 2: NYC Mosquito Spraying maps of areas of Brooklyn, Queens, and Manhattan



In 10 out of 11 comparisons, More insects were recorded in the week before mosquito sprays than in the week after.

Figure 3:

The majority of the data falls in the positive range (between 0 and 200). This indicates that in most tested areas, the mosquito population decreased significantly after spraying.

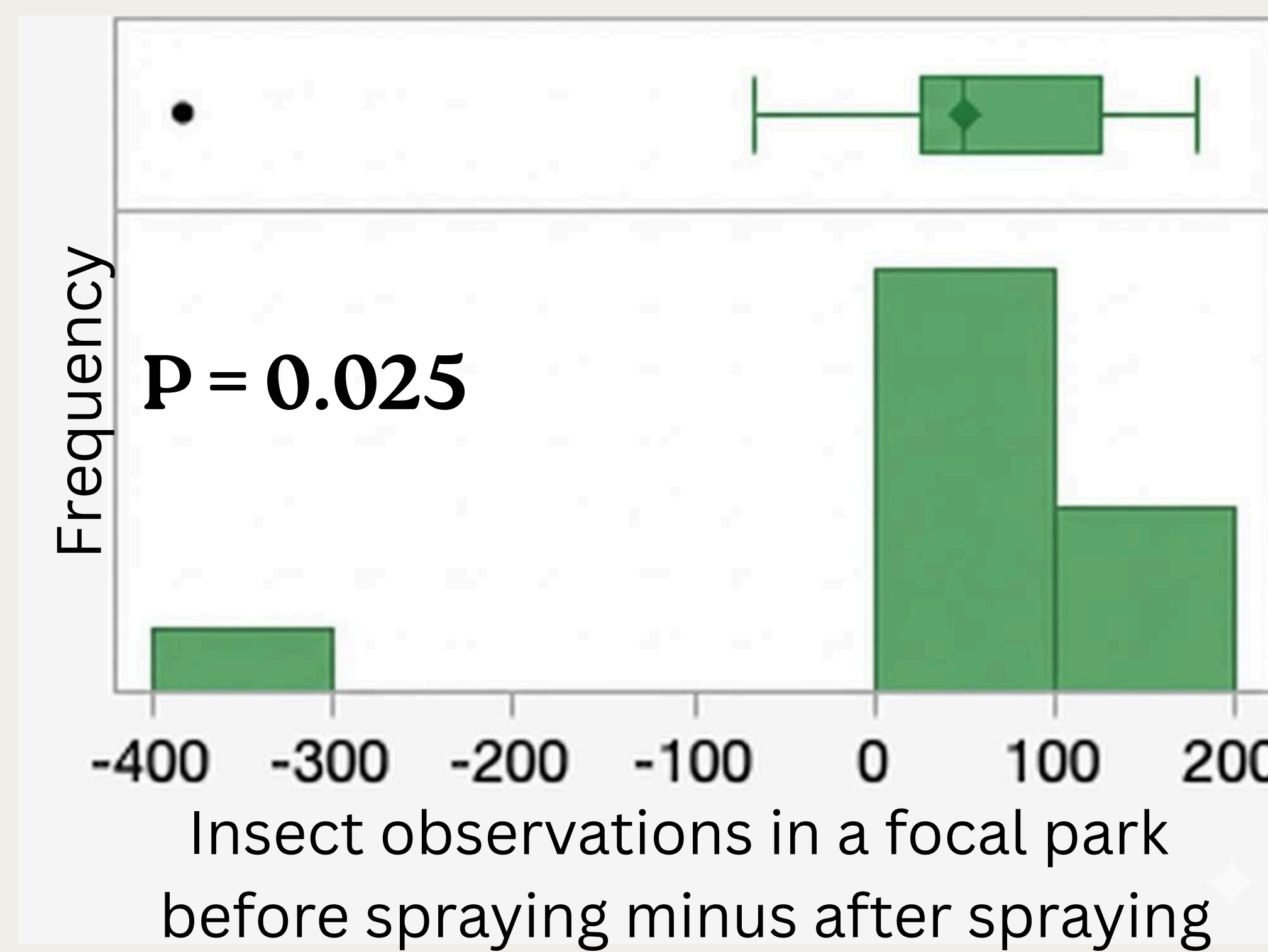


Figure 4:

Table depicting the values of before and after spraying in NYC, using Staten Island as a control, showing a decrease of population in the city after spraying.

Spray date	Park	Before - After (Focal Park)	Week after (Focal park)	Week before (SI)	Week after (SI)	Sign (before-after)
8/20/2024	Prospect Park	50	134	106	282	1
9/24/2024	Prospect Park	126	28	259	115	1
9/27/2023	Prospect Park	149	90	102	145	1
9/7/2023	Prospect Park	-382	535	367	109	-1
9/26/2023	Van Cortlandt	180	19	157	144	1
9/25/2025	Van Cortlandt	51	36	153	174	1
8/24/2021	Van Cortlandt	25	17	245	222	1
9/15/2022	Van Cortlandt	25	29	124	267	1
9/22/2023	Van Cortlandt	49	60	147	99	1
9/9/2024	Central Park	12	61	181	261	1
9/14/2023	Central Park	66	208	145	157	1

Pesticide List

The insecticides used during NYC sprayings are Duet, Anvil, and Merus. These are all synthetic pyrethroids, a substitute for a natural insecticide found in chrysanthemum that works by disrupting the nervous system of insects. Their broad-spectrum action is detrimental to beneficial insects and other species if exposed.

Discussion

We conducted this study initially to question the effects of mosquito sprayings on mosquito populations through the use of iNaturalist. This was difficult due to a lack of significant data recorded, so the focus was shifted to the effects of adulticides used during mosquito sprayings on non-target insects. Our data was dependent on observations submitted on iNat: the total insect observations one week before and after the initial spray dates were used in comparison to identify a potential pattern. Spray dates within a five-year range were analyzed, and the population prior to spraying was taken as a baseline and the population after served as observable change. In the gathered data, we found that the use of adulticides almost always causes a decrease to the surrounding insect population. According to recent study in 2020, insecticide sprayings in a Malaysian community were extremely harmful to pollinators and species with low levels of tolerance. Similarly, a study in California found that a spraying of pesticides to control mosquito populations did show potential harm to non-target species. This was done through sampling after a spraying event, something that we did not have access to. These findings were located in urban areas, which is relevant to our own data as we relied on iNaturalist for observations in accessible areas. While our data would have been more distinct if we had participated in sampling and fieldwork, it's clear that citizen science like iNaturalist is important when studying biodiversity patterns where funding and studies are not accomplished.

Statistical Analysis:

The null hypothesis stated that insect observations would not differ before and after spraying. A Wilcoxon Signed-Rank test was used instead of a t-test due to the non-normal distribution and the presence of a major outlier. Results showed a significant decline in insect records after spraying (median = 31.91, $p = 0.0255^*$). The Focal vs. Staten Island control comparison was also significant (median = 0.148, $p = 0.0269^*$), confirming that the reduction was not caused by weather, upload variation, or chance. Although we had a major outlier, the rest of our data supported our hypothesis that mosquito spraying is harmful to non-target insects. But because both p-values were below 0.05, we rejected the null hypothesis, indicating that spraying led to a real decrease in insect activity.

References:

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<https://docs.google.com/document/d/1w5OJWPVFG15IbVHablhyZXvj8vZ9kPGzTzQ9rSdYS34/edit?usp=sharing>
Work cited page

Listing sources that i use during my research:

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https://www.researchgate.net/publication/377288488_Strengths_and_Challenges_of_Using_iNaturalist_in_Plant_Research_with_Focus_on_Data_Quality

<https://rdcu.be/eTbtK> - Mosquito control with green nanopesticides: towards the One Health approach? A review of non-target effects - refers to risks of using insecticides on mosquitos due to its adverse effects on non-target insects

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<https://www.kiwicare.co.nz/advice/pests/pyrethrum-pyrethrins-pyrethroids-whats-the-difference/>
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work he wanted in harvard format^^

<https://ldrv.ms/p/c/f74d7ec63b11116c/IQCgkEjyu9EBRLBINO73njIgAQQnqYlcM4AFefnYwBA7lyE?e=77Wojz>

[sources for discussion:](#)

california study he was talking abt (non target pesticide and urban areas) : https://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1306&context=bio_fac

malaysia study similar to the california one:

<https://pubmed.ncbi.nlm.nih.gov/33062440/>

[Find a study that will be better references for future:](#)

[---. "Effects of Aerial Adulticiding for Mosquito Management on](#)

[Nontarget Insects: A Bayesian and Community Ecology Approach."](#)
[Ecosphere, vol. 13, no. 1, Jan. 2022, https://doi.org/10.1002/ecs2.3896.](#)