

Spotting Change: Correlations between Spotted Lanternfly and Native and Invasive Arthropod Abundance

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Introduction

Citizen science is a growing genre of public data collection. iNaturalist is a citizen science platform intended for multi-taxon environmental observation data. Citizen science has increased in popularity in the past twenty years, furthering the basis for ecological data analysis.¹ This project is a continuation of our summer research where spotted lanternfly abundance was monitored for eight weeks using bag traps at the Bronx Zoo.²

Invasive species such as the spotted lanternfly come from other parts of the world, usually through anthropogenic means, and integrate themselves into a food web of that introduced range. Invasive species are problematic, because they often have no natural predators, and are thus free to prey on other species of organisms while reproducing rapidly.³ Very little is known however on how spotted lanternfly introductions affect other native and introduced species that are morphologically similar to the spotted lanternfly and follow a univoltine life cycle. Univoltine insects produce one generation of offspring per year in which a dormant phase follows after, which follows the spotted lanternfly life and reproduction cycle.

Previous studies have estimated the spotted lanternfly arrival in New York City on November 1, 2021⁴. The spotted lanternfly was well advertised as an invasive species that needs to be eradicated, leading to increased observations on iNaturalist.⁵ This study investigates the shifts in frequency in observations for multiple native and invasive univoltine insect species using citizen science data.

Methodology

Public access data was collected from iNaturalist. Six univoltine insect species were assessed for this study: three of them are native to NY (*Danaus plexippus*, *Xylocopa virginica*, *Oncopeltus fasciatus*), and three are invasive to NY (*Lycorma delicatula*, *Harmonia axyridis*, *Halyomorpha halys*). These five other species were selected because they were the most abundantly observed univoltine insect species (along with *L. delicatula*) in New York state that are morphologically similar to the spotted lanternfly.

The data was filtered to be only from New York state and was divided into ten years with a starting date of 11/01 in each specific year; the data was compared across consecutive years and the comparisons were made for the periods from [YEAR 1] to 2019 and from 2020 to 2025 and were analyzed utilizing the following methods: We used a Kolmogorov-Smirnov (KS) Test to identify significant differences between the rate of change for the population cycling for each of the species across the years that were observed in the iNaturalist data. The test is conducted by treating the Cumulative Relative Frequency (CRF) of the same species as distinct lists based on the year that the observations are taking place. For each date, the respective CRF of the two lists of the two years are subtracted from each other and then the maximum absolute difference between the years are the KS test-statistic. The KS test-statistic is compared to a critical value (if it is greater than the critical value, the results are statistically significant, if otherwise it is not statistically significant). We conducted the KS test using Google Colab with Chat GPT--assisted code generation.

Abstract

Open-source data was analyzed from the citizen science platform iNaturalist to examine whether there was a significant difference in the frequency of native and invasive insect observations following the emergence of spotted lanternflies. The spotted lanternflies are an invasive truebug species that have spreading across New York and it was hypothesized that the public advertisement related to the spotted lanternfly would cause insects within New York to be more frequently observed within iNaturalist. Significant differences between the frequency of insect observations across all of our analyzed species were found.

Data & Figures

Native Species

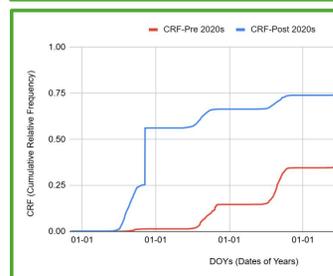
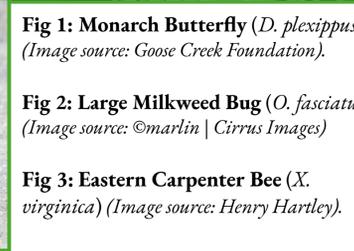


Fig 7: Danaus Plexippus (Monarch Butterfly)
-CRF trends for Pre-2020 (Red) vs Post-2020 (Blue), with an upward trend in the frequency of observations.

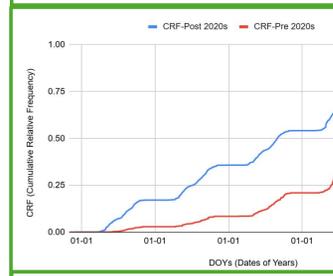


Fig 8: Xylocopa Virginica (Eastern Carpenter Bee)
-CRF trends for Pre-2020 (Red) vs Post-2020 (Blue), with an upward trend in the frequency of observations.

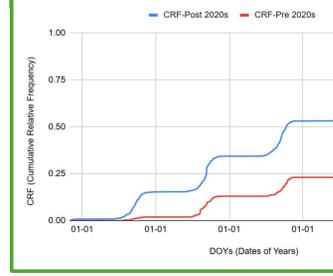


Fig 9: Oncopeltus Fasciatus (Large Milkweed Bug)
-CRF trends for Pre-2020 (Red) vs Post-2020 (Blue), with an upward trend in the frequency of observations.

Invasive Species



Fig 4: Spotted Lanternfly (*L. delicatula*)
(Image source: The Daily Pest).



Fig 5: Asian Lady Beetle (*H. axyridis*)
(Image source: Corey Poole, Natchitoches Parish Journal)



Fig 6: Brown Marmorated Stink Bug (*H. halys*)
(Image source: Morton Arboretum).

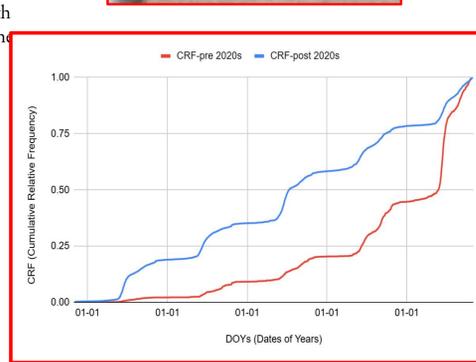


Fig 10: Harmonia Axyridis (Asian Lady Beetle)
-CRF trends for Pre-2020 (Red) vs Post-2020 (Blue), with an upward trend in the frequency of observations.

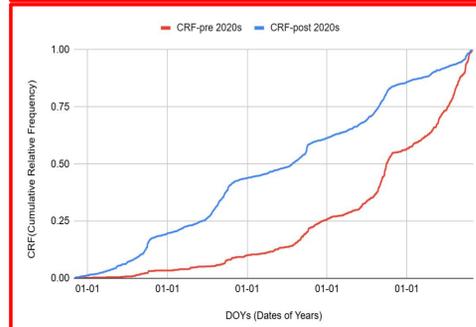


Fig 11: Halyomorpha Halys (Brown Marmorated Stink Bug)
-CRF trends for Pre-2020 (Red) vs Post-2020 (Blue), with an upward trend in the frequency of observations.

Research Questions & Hypotheses

Question: How have the frequency of the observations of native and invasive univoltine insects been affected by the emergence of spotted lanternflies in New York State?

Hypothesis: The introduction of spotted lanternflies to New York will increase the rate of citizen science observations of invasive univoltine species in comparison to native ones univoltine species in New York.

Results & Discussion

According to the KS Test, for each of the five species, there were statistically significant differences ($p < 0.05$) between the CRF (cumulative relative frequency) graphs of each year (i.e comparing the CRF graphs of a species between 2021 and 2022, 2021 and 2023, etc., there were statistically significant KS test-statistic). This indicates that with the progression of years, the frequency of observation data from citizen scientists among both native and invasive species have increased. This is consistent with existing literature indicating that environmental citizen science use has increased drastically as time has passed on. Moreover, this indicates that the distinction of invasive versus native species has no impact on the rate of observations (observation frequency) across years. This evidence does not support the hypothesis that invasive species would have a higher change of observation frequency, due to the increasing public awareness of the spotted lanternfly.

In conclusion, our hypothesis was not supported and instead the change in observation frequency was uniform across the invasive and native species. Future research should look into larger datasets and perhaps spot if other species exist that have existing citizen science data that are more morphologically related to the spotted lanternflies in order to indicate if there is a more significant increase in observation frequency among those morphologically similar species, compared to other native species.

Acknowledgements

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