Plant Diversity & Allergies

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Introduction

The impact of industrialization and its resulting decline in biodiversity may be a contributing factor to the rapidly increasing prevalence of allergies across the United States.

- This decline in biodiversity reduces the contact between people and various tree species, causing an increase in the number of individuals who experience moderate to severe allergies
- "Biodiversity Hypothesis": reduced contact of people with natural environmental features and biodiversity may impact the human commensal microbiota and its immunomodulatory capacity (Hanski et al. 2012)
- Maple, Pine, Oak, Birch and Ash produce pollen that is most likely to trigger an allergic response as the pollen produced is very fine and powdery, which allows the pollen to travel a distance of at least 200 miles. Furthermore, these trees can produce up to 5 million pollen grains and can stay in the air for long periods of time (Asam et al. 2015)

Our Study:

- We are examining the correlation between myriad allergies and geographic location in New York State (NYS)
- We hypothesize that there is a correlation between specific tree species and allergy severity due to the type of pollen produced and its distribution pattern
- The scientific community and general public should be aware of the tree species that may contribute to an increase in allergy severity in order to prevent severe seasonal allergies and asthma attacks. By understanding the distribution of tree species across NYS and analyzing which locations are associated with more severe allergies because of the presence of specific trees, there can be a better control and understanding of pollen related allergies

Methods

Survey

- An online survey was distributed to the Geneseo Student Body in order to determine if certain areas of New York State have higher reports of certain allergy types. The survey was intended to learn more about the urban biodiversity patterns in New York State by asking students to list lived-in locations by zip code and then note if they associate any of the listed locations with a change in their allergy severity.
- Participants were also asked to list the types of trees on their property in order to determine if there are specific tree species that produce higher proportions of certain allergy types.
- The online version of the survey was distributed to the Geneseo student body via Google Form. The survey was sent to Geneseo students in an email asking for voluntary participation. We were approved to distribute an online version of the survey via Google Form to the SUNY Geneseo student body by SUNY Geneseo's IRB (Proposal #201920039)
- We did not collect any identifying data from either survey

Data Analysis

We recorded the frequency of tree species reported as well as the frequency of responses that reported where allergy severity is considered to be the worst, using Geneseo as a reference point.

- A map was created to show the lived- in locations reported by student participants indicating the biodiversity patterns across New York State
- Participants were asked to list if their allergy severity is similar across all locations,worse in a location other than Geneseo or worse in Geneseo
- Since Maple, Pine, Oak, Birch and Ash were the most commonly reported trees across New York State and therefore across all lived-in locations reported by students, the frequency of 'other' tree species were used to determine if the change in allergy severity is correlated to the presence of these 'other' species
- Data visualizations were created in R (R Core Team 2019)

Results

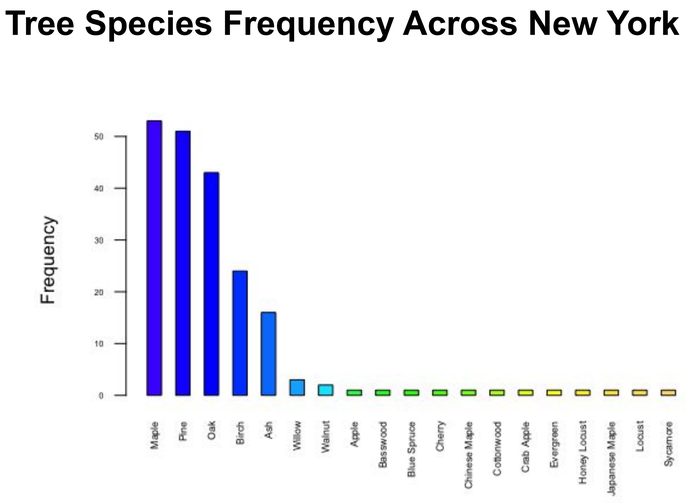

Figure 1: Every participant was asked to name the species they have on the property of their permanent residence. Maple, Pine, Oak, Birch and Ash were the most commonly reported trees across New York State.

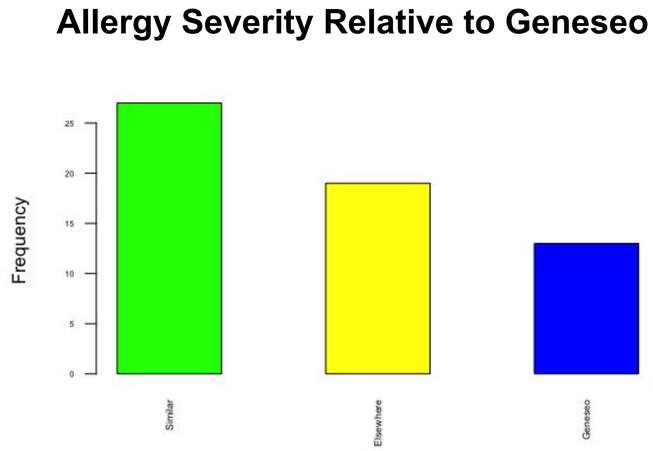

Figure 2: Every participant was asked to identify a location they associated with an increase in their allergy severity. Since Geneseo is a location shared by all participants, responses were separated into three subsets categorized by allergy severity relative to Geneseo. There was no bias in reporting a location with increased allergy severity (Chi-squared goodness of fit; p=0.08).

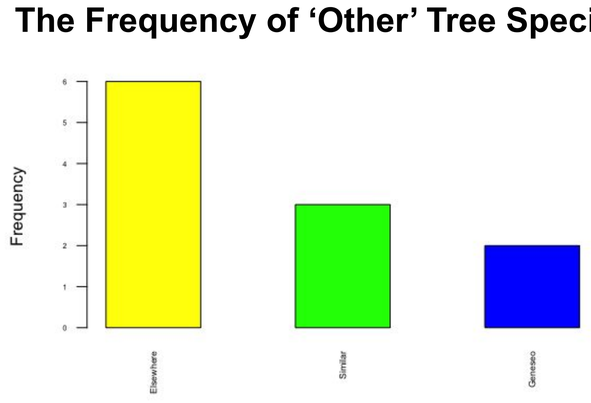

Figure 3: The frequency of the location of tree species that exist outside the top five most reported tree species in New York State. The highest frequency of 'other' tree species was reported within the category of 'Elsewhere'. The 'other' species reported include Basswood, Cottonwood, Sycamore, Walnut, Locust, Willow, Evergreen and Chinese Maple. There is no significant difference between the subsets that could explain a reported increase in allergy severity (Chi-squared goodness of fit; p=0.31).

Discussion

- Maple, Pine, Oak, Birch and Ash are the most commonly reported trees across New York State based on the trees reported by student participants
- Since the online survey was distributed to the Geneseo Student Body, Geneseo is the common lived-in location reported by all students. Students were asked to report a location they associated with an increase in their allergy severity. However, according to the chi-squared test, there is no significant difference between the three subsets, therefore indicating that there is no subset associated with an increase in allergy severity
- The most popular species of trees reported by the students are Maple, Pine, Oak, Birch and Ash which are also the most commonly planted trees in Geneseo. This possibly explains why students reported experiencing a similar allergic response across all locations because the tree species are similar
- However, some students reported experiencing an allergic response that is more severe in a location other than Geneseo. In order to determine why this may occur, the difference in tree species were analyzed in order to determine if these 'other' species could be the reason for an increase in allergy severity in other locations. However, the results of the chi-squared test indicates that there is no significant difference in the frequencies across the three groups
- Therefore, it can only be concluded that the reported similarities in allergic responses across all locations is due to the similarity of specific tree species across all locations

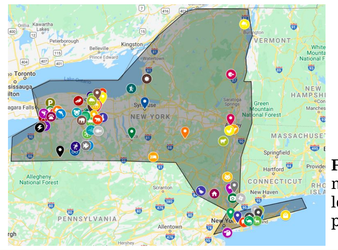

Figure 4: Each color on the map indicates a lived-in location of a student participant.

Conclusions

After conducting our study, we found that the most commonly planted trees across New York State is Maple, Pine, Oak, Birch and Ash. This trend is also exemplified by the town of Geneseo and therefore explains why many participants reported experiencing a similar allergic response to allergens across all locations. This trend with Maple, Pine, Oak, Birch and Ash may also account for the rapid increase in allergy prevalence as these tree species are known to produce moderate to severe allergies due to its pollen distribution patterns and its growing presence across New York State. However, some students did report experiencing an increase in allergy severity in locations other than Geneseo. This could be attributed to the presence of tree species that are not Maple, Pine, Oak, Birch and Ash. However, while Basswood and Cottonwood are known to be severe allergies due to their pollen distribution patterns, the chi-squared test results showed no significant difference among the three subsets. It is important to note that the survey method of self-reported data can create subjective data resulting in validity issues related to differences in lived-in locations and biodiversity knowledge

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References

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