Yearly Variability in *Echinacea angustifolia* Achene Production

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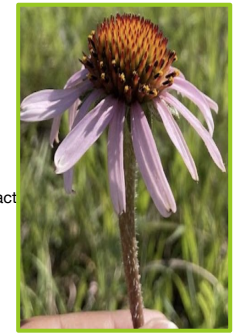
Introduction

The main goal of this project is to investigate how to conserve prairie plants in fragmented landscapes. *Echinacea angustifolia* (Asteraceae) is commonly known as the purple coneflower. It is regularly found in central and southwest prairies in the USA. Each flower contains 100-300 central disc florets which contain achene fruits and contains 10-30 ray florets (5). Achenes are small, indehiscent dry single-seeded that don't open until released from the flower. From the middle of Summer to early Fall, Plants grow in large colonies to easily attract pollinators like butterflies, hummingbirds, and bees (2). There is no fragmentation effect in the population sizes of different flowering seasons when comparing fragmented areas and that isolated plants actually had higher rates of pollinator visitations and decreased reproduction (2).



The study site (red dot) is located in Western Minnesota, near the towns of Kensington and Hoffman. Remnant populations are studied, with a total of 30 sites used for research. The majority of sites are on hillsides and areas where agricultural production is prohibited. The Echinacea Project was started in 1995, in which Dr.Wagenius and his team have investigated a variety of ecology and evolution questions in fragmented prairie habitats.

Hypotheses

H_0: There is no differences in head size and achene production between 2020 and 2021 *E. angustifolia* plants.

H_1: Number of achenes in *E. angustifolia* head's will increase from 2020 to 2021.

H_2: Number of achenes in *E. angustifolia* head's will decrease from 2020 to 2021.

Results

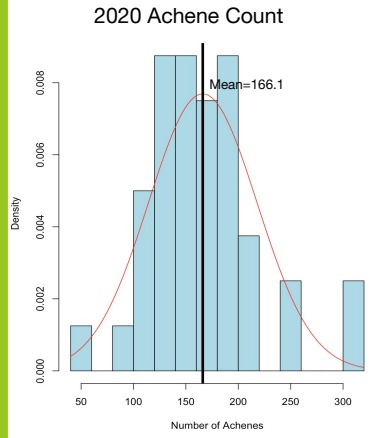


Figure 1: Distribution of the number of achene data from 2020. n= 40, K-S statistic (D)= 0.1416, p= 0.3646, skewness= 0.91, standard deviation= 51.86.

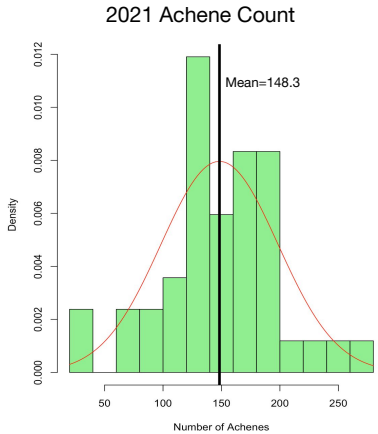
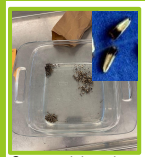


Figure 2: Distribution of the number of achene data from 2021. n= 42, K-S statistic (D)= 0.1037, p= 0.7183, skewness= -0.25, standard deviation= 50.12.

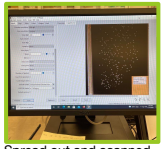
A two tailed t-test was performed to determine whether the difference between 2020 and 2021 is statistically significant. The p=0.1176 and the t-test value=1.581. The density curve (red lines) represents numerical distribution where the outcomes are continuous.

Methods

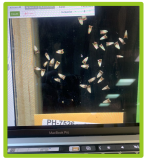


Separated the achenes from the chaff of the *E. angustifolia*. Placed in two separate bags.

Rechecked flower heads for missed achenes and confirmed registration number.



Spread out and scanned the achene with an Epson Perfection V300 PHOTO and VueScan 2021 software.



Counted the achenes using the ACE Echinacea Project website.

Discussion

Initially we projected that the 2020 achene count's mean would be higher than the 2021 achene count. After statistical analysis of the dataset's, it was concluded that there was no statistical significance between the two sets and that we failed to reject the null hypothesis. Both dataset skewnesses were acceptable values. The 2020 count was positive indicating that potential outliers are present to the right of the mean while the 2021 count was negative indicating potential outliers are present to the left of the mean. The differential in skewness was an unexpected finding that could prompt further investigation.

Although the 2020 dataset has a higher mean, there were limitations to this study that could have factored into this outcome. The sample size of the dataset could've been increased, as an increased sample size makes it less likely to fail to reject the null hypothesis. We didn't distinguish burned and unburned *E. angustifolia* heads when computing, Dr. Beck has recently been investigating how fire affects plant reproduction, thus these statistics don't account for the difference in burned and unburned flower heads (4). We only compared two years when there is over 25 years of previous achene count data, similar to how the sample size plays a role in the results (1, 3).

Previous research has shown that habitat fragmentation can change mating patterns, causing an increase in relatedness between individual plants. This can have a direct effect on population dynamics, resulting in the reduction of seed production or plant fitness (6).

Future Experiments

This experiment strictly focused on the comparison of achene averages between the years of 2020 and 2021. Future research includes testing to see how drought or precipitation levels affects achene production. In 2021, Western Minnesota experienced its most serious drought in the past 40 years. Further analysis could be done to test various independent variables and see how or if drought has any influence on *E. angustifolia* growth or reproduction. Other future experiments includes effect of fire, soil quality, pollen limitations, and exposure to sunlight and their effects on reproduction and growth.

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