Phenology: Our History and Future

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INTRODUCTION

Phenology is the study of the relationship between climate and cyclical plant or animal events. This project focuses on collecting autumnal phenological data on thirteen native plant species on the Denison Pequotsepos Nature Center property in Stonington, CT. The goal of the project was to determine the phenological changes/events of the chosen plant species, analyze the data, and then try to increase the public's involvement with phenology.

WHY IS THIS PROJECT IMPORTANT?

Phenology has become more important than ever as climate change becomes a more prevalent issue every day. Phenology records help climate scientists to determine the long-term effects of climate change, and can be used to help predict how plants and animals will be affected in the future. The results of this project- of the autumnal phenological dates of plant species- is part of a patchwork of valuable phenological data that can be used by scientists to predict whether plants or animals will be able to adapt to a changing world.

MATERIALS AND METHODS

Data was recorded over the months of September, October, and November.

Weather, time, date was recorded at each data collection date. Depending on the species being recorded, the quantity or appearance of leaves, flowers, and/or fruit and nuts was also recorded.

A camera was used to take pictures of each specimen at each date of data collection, to help verify the qualitative data being recorded.

A

Location: Denison Pequotsepos Nature Center, Mystic CT

Date: _____

Time: _____

Weather: _____

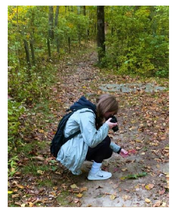
Deciduous Trees/ Shrubs	Leaves (withered, color, dropped)	Flowers	Fruit/Seeds (ripe, fallen off, change in color)	Other notes
Tulip Tree				
Crab Apple				
Red Maple				
Black Walnut				
Pignut Hickory				
Black Oak				
Black Birch				

Conifers	Needles (color, dropping)	Pollen (falling)	Fruit/Seed Cones (ripe, seeds dropping)	Other notes
Hemlock				

Herbs/Wild flowers	Leaves (withered, color)	Flowers	Fruit/seeds (ripe, fallen off)	Other notes
Goldenrod				
Sweet Joe-Pye Weed				
Pokeweed				
Cinnamon Fern				
Skunk Cabbage				

Fig. A (above) The blank data table used for observations. At every data collection, observations would be recorded.

B



C

Fig. B (top) Adelle takes pictures of the leaves of a plant specimen.
Fig. C (bottom) Adelle records the state of the fruit on the pokeweed specimen on a chart.

SUBJECT SPECIES

Tulip Tree *Liriodendron tulipifera*

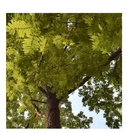
Crab Apple *Malus sylvestris*

Black Birch *Betula lenta*

Sweet Joe-Pye Weed *Eutrochium purpureum*

Goldenrod *Solidago*

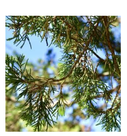
Red Maple *Acer rubrum*



Black Walnut *Juglans nigra*

Skunk Cabbage *Symplocarpus foetidus*

Black Oak *Quercus velutina*



Cedar *Cedrus*

Pokeweed *Phytolacca decandra*

Cinnamon Fern *Osmundastrum cinnamomeum*

Pignut Hickory *Carya glabra*

These thirteen plant species were chosen for their ability to change over the time period of the study.

RESULTS

	First Leaf Withered	All Leaves Withered	First Ripe Fruit	Late Flower	Early Fruiting	Middle Fruiting
Goldenrod	10/16/19	11/9/19	10/3/19	10/16/19	10/12/19	10/16/19
Sweet Joe-Pye	10/3/19	10/12/19	9/17/19	9/17/19	10/3/19	10/9/19
Pokeweed	10/29/19	11/9/19	9/10/19	9/3/19	9/17/19	10/3/19

	50% Leaf Color	50% Leaf Drop	First Ripe Fruit
Crab Apple	10/29/19	11/9/19	10/3/19
Black Walnut	10/16/19	10/19/19	10/3/19
Pignut Hickory	10/16/19	10/29/19	10/16/19

	50% Leaf Color	50% Leaf Drop
Tulip Tree	10/12/19	10/22/19
Red Maple	10/12/19	10/22/19
Black Oak	10/3/19	10/22/19
Black Birch	10/12/19	10/22/19

	First Leaf Withered	All Leaves Withered
Cinnamon Fern	10/3/19	10/16/19

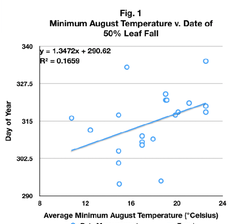
Skunk Cabbage	NCN*
Cedar	NCN*

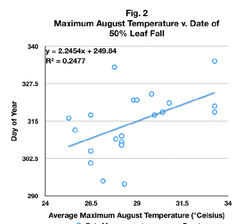
Phenophase Descriptions	
50% Leaf Color	Date when half or more of the branches have leaves that have started to change color.
50% Leaf Drop	Date when at least half of the leaves have fallen off the tree or shrub.
First Leaf Withered	Date when the first leaf has lost its green color or is dried and dead.
All Leaves Withered	Date when all flowers have wilted or fallen off.
First Ripe Fruit	Date when you notice the first fruits becoming fully ripe or seeds dropping naturally.
Late Flower	Date when most flowers have wilted or fallen off (over 95%).
Early Fruiting	Date when only a few ripe fruits are visible (less than 5%).
Middle Fruiting	Date when half or more of the fruits are completely ripe or seeds are dropping naturally.

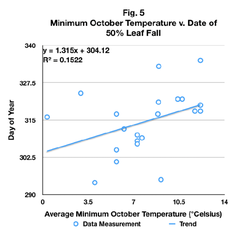
*** NCN = No Change Noted**

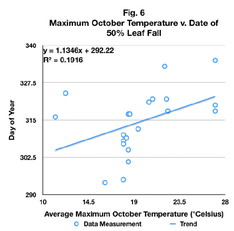
ANALYSIS OF RESULTS - *ACER RUBRUM*

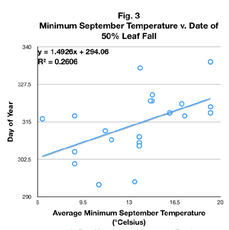
- **The result of the 50% Leaf Fall date for A*cer rubrum* (red maple) was compared with other results taken from BudBurst, an online database of phenological observations from around the United States.**
- **The average minimum and maximum temperatures of the months of August-November were taken from nearby weather stations of each data point location in the year the data was collected.**
- **The DOY (Day of Year) of each point was compared with the temperature data using linear regression. This is shown in the graphs below.**

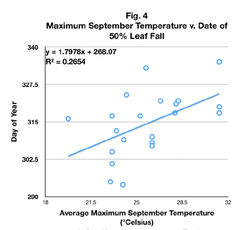


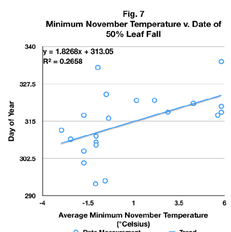


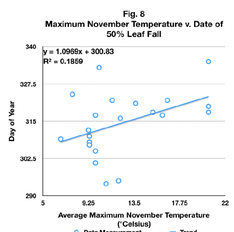












- **These graphs show the correlation between the DOY of 50% leaf fall of A*cer rubrum* and temperature. The data suggests that the date of 50% leaf fall is most closely correlated to November Minimum Temperatures.**

OUTREACH - PACKET

A packet was made with directions on how someone else could recreate this project or create their own phenology project. This packet was put on display at Denison Pequotsepos Nature Center for anyone to take and read. The idea is that it would encourage people to become interested in phenology, and the effects of climate change. It would also potentially help people find their own data so that they can contribute to an online database, thus increasing the amount of phenological data available.

D

Fig. D (above) A page from the packet showing a map of Denison Pequotsepos and the locations of specimen used in this project, which could be replicated.

OUTREACH - ONLINE DATABASE

The phenological dates found through this study were uploaded to Budburst, an online database of phenological observations from around the United States.

budburst
a project of Chicago Botanic Garden

CONCLUSION

The autumnal phenological dates collected in this study were added to a large database of phenological information. It can be used by scientists to help understand the implications of climate change on plants. The packet created for the public will also encourage people to become more interested in Environmental Science and phenology.

REFERENCES

Budburst. 2019. Budburst: An online database of plant observations, a citizen-science project of the Chicago Botanic Garden. Glencoe, Illinois. Available: http://www.budburst.org; Accessed: December 14th, 2019.

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