The effects of different *Ulmus* species on leaf miner predation

Michael Byrne, Siobhan O'Malley and Abby Salamon

ABSTRACT

The purpose of the experiment is to study the interactions between leaf miners and three different species of elm trees (*Ulmus americana*, *Ulmus parvifolia*, and *Ulmus minor*). Using the random sampling of fallen leaves from the different species, the number of leaf mines tunnels can be averaged. In addition, the survival rate would be determined by factoring the number of aborted leaf mines as well. From this information, it is the goal of the study to determine if there is a preference for the species of *Ulmus* that the leaf miners lay their eggs. In addition, the data would be used to determine if there is any correlation with the survival rate of the leaf miners with the species they were hosted in.

SPECIFIC AIMS

Overall Objective

Identify the average number of leaf miners in leaves of different species of elms across campus, to see if the leaf minors have a preference in host plant.

Specific Aim 1

Identify and collect leaves of six different trees of three different species across campus. Using the leaf shape we will identify American, Japanese, and Smooth Leaf elms across campus and collect leaves from each species. We will collect 25 leaves from each tree, or 50 from each species.

Specific Aim 2

Count the number of leaf miners on each leaf and determine the average number of leaf miners per leaf of each species. We will count by hand the number of miner paths present on each leaf and take the average.

BACKGROUND

The trees presented in the study are contained within the genus *Ulmus* or Elm trees. Based on the studies of Grudzinskaya and Wiegrefe et. al., the further classification of species based on morphological and morphological-molecular, respectively (Denk and Dillhoff 1664). Based on fossil records, remains of *Ulmus* plants can be dated to the Paleocene to Eocene in North America, Russia, Spitsbergen, China and Japan (Denk and Dillhoff 1664). From the phylogeny of *Ulmus* in Figure 1, *Ulmus* can be defined by two different subgenus groups *Oreoplteleo* and *Ulmus* with the *Ulmus american* and *Ulmus parvifolio* respectfully being

found in each subgenus. In addition, *Ulmus* american was one of the first branches from the *Ulmus* phylogeny.

The leafminer was introduced to North America in the twentieth century, from Europe (Nixon). The leafminer larvae burrow into the mesophyll layer of the leaf to eat the leaf for nutrients; once the leaf falls to the ground in the fall, the leafminer digs into the soil about one inch, and waits for spring in a cocoon (Nixon). The overall damage to the leaf is mostly aesthetic, intense leaf mining can cause death of the leaf, but is rare.

From the species of leaf miners, the *Fenusa ulmi* is an elm leafminer. This species of leafminer is a sawfly native to Eurasia. Of the species of elms, the Camperdown and American elms are the most susceptible to predation from leaf miners.

RESEARCH DESIGN

Tree designation

There will be three species of elm trees that will be collected from American Elm (*Ulmus americana*), Japanese Elm (*Ulmus parvifolia*), Smooth Leaf Elm (*Ulmus minor*). Leafs from two different trees from each species will be collected. The species of tree will be determined by the UMass Treefinder and by the morphology of the leaf.

Leaf collection

A random census of 25 leafs are to be collected from each tree so a total of 50 leaves collected per species. The leaves would have already fallen from the tree and be ~90% intact. The morphology of the leaf would be used to ensure we are collecting a leaf from the right species of tree leaf. After the leaves are collected, they will be placed in labeled paper bags to ensure they do not get moldy.

Data Analysis

When the leaves are brought back to the lab, they will be analyzed for the presence of leaf mines. The total number of leaf mines on each leaf will be counted as well as the number of aborted leaf mines, indicating the death of the leaf miner. The average number of leaf mines per leaf for each species would be determined. In addition, the percent of successful leaf mines would be calculated and compared between each species of tree.

IMPACT/SIGNIFICANCE

Leaf miners are best known for the tracts they create between the upper and lower leaf surface. Leaf miner flies lay eggs on the underside of the leaf, that hatch and burrow into the leaf (Cranshaw, 2014). Most of the time, there is a

commensalistic relationship between the plant's leaf and the leaf miner; the larvae hatch and burrow through the leaf gaining nutrients and protection, with little effect on the plant's leaf (Nixon).

In general, the leaf mining damage to the tree is minimal; however, multiple mines on one leaf causes browning and death of the leaf (Natural Resources Canada). According to the Natural Resources Center of Canada, there has been increased leaf mining activity on Camperdown and American Elms in recent years.

Most of the damage is cosmetic, but this can be costly. Trees that are used in landscaping ideally are not covered in wilting brown leaves. There are various insecticides to prevent leaf miner damage, but these are costly and require maintenance (Nixon). Determining which type of elm tree is least susceptible to leaf miner damage could influence which tree is planted for aesthetic reasons.

REFERENCES

Cranshaw, W.S., et al. "Leafmining Insects - 5.548." *Colorado State University* , 2014, extension.colostate.edu/topic-areas/insects/leafmining-insects-5-548/.

Denk, Thomas, and Richard M. Dillhoff. "Ulmus Leaves and Fruits

from the Early–Middle Eocene of Northwestern North America: Systematics and Implications for Character Evolution within Ulmaceae." *Canadian Journal of Botany*, vol. 83, no. 12, Dec. 2005, p. 1663.

Faeth, Stanely, and Daniel Simberloff. "Population Regulation of Leaf Mining Insect, Cameraria Sp. Nov., at Increased Field Densities" *Ecology*, vol . 62, no. 3, pp. 620-624, 1981.

Faeth , Stanley, et al. *Oikos* . 1981.

Natural Resources Canada, Forest Service. "Elm Leafminer." *Government of Canada, Natural Resources Canada, Canadian Forest Service*, 24 July 2015, tidcf.nrcan.gc.ca/en/insects/factsheet/7767.

Nixon, Phil. "Elm Leafminers." *Elm Leafminers*, Phil Nixon Norton Arboretum, hyg.ipm.illinois.edu/pastpest/200806f.html.

"UMass Campus Tree Finder." *Waugh Arboretum Capus Tree Viewer*, Sustainable UMass, 2019.

Wiegrefe, S. J., et al. "Phylogeny of Elms (Ulmus, Ulmaceae): Molecular Evidence for a Sectional Classification." *Systematic Botany*, vol. 19, no. 4, 1994, pp. 590–612.

FIGURES

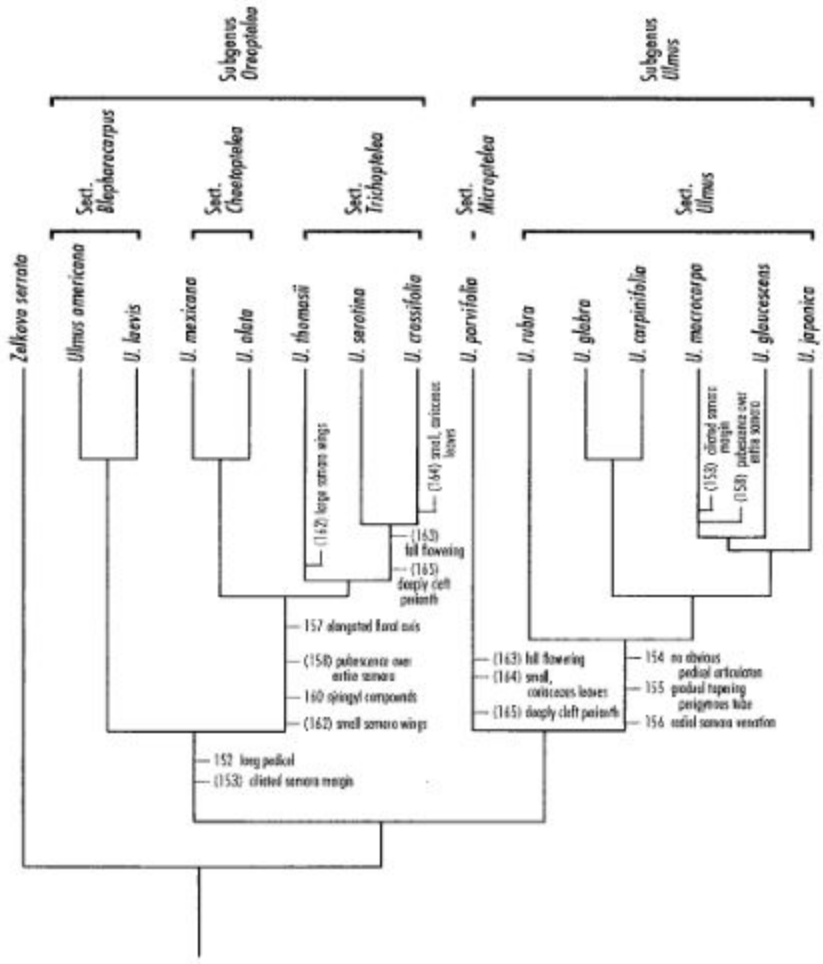

Figure 1: Phylogeny of *Ulmus*. Proposed phylogeny of *Ulmus* based on the work of Wiegrefe.