

Norris Center Natural History Project Award Proposal

Project Title: Investigating the effects of *Scoliopus bigelovii* leaf mottling on herbivory

Background and justification for project

Fetid Adder's Tongue (*Scoliopus bigelovii*) is a plant species in the Lilaceae family, native to California, that occurs on the UCSC campus. Though beautiful and unique, very little is known about this species. Fetid Adder's Tongue blooms throughout the winter into early spring. Its flowers consist of three petals of off-white color and deep purple veins, and have wide spreading sepals, an ill scent, and are fly pollinated (Baldwin & Goldman 2012). One of the plant's more notable features, however, is its leaves - Fetid Adder's Tongue has two leaves per plant which grow up to 20 cm long and 10 cm wide, have parallel venation typical to monocots, and most notably, are often spotted with deep purple mottling. Generally, leaf spotting is associated with herbivory defense mechanisms (La Roccaa 2014), but this has not been studied in this species. This research will allow us to fill a knowledge gap in the evolution and morphology of Fetid Adder's Tongue, and therefore a plant native to UCSC.

Demonstrated initiative and preparation

This senior thesis project is supervised by Stacy Philpott, Professor of Environmental Studies at UCSC, and assisted by Alex Jones, manager of the UCSC Campus Natural Reserve. Stacy Philpott and Alex Jones are experts in various fields of insect and plant sciences, and with their help and guidance, I have created a research plan and chosen the sites for my field work. I have been trained in and have experience conducting independent scientific research both at the Stromberg Lab at the University of Washington in Seattle, as well as the Parker Lab at UC Santa Cruz. I have taken several courses relevant to this project including Ecology, Evolution, Genetics, Systematic Botany, Plant Physiology, Molecular Ecology, and Plant Disease Ecology. All project preparations have been made, and I am ready to start my field work and data collection come Winter, when Fetid Adder's Tongue growth begins.

Plan for implementation: goals, questions, or hypotheses; and methodology

Hypothesis

Fetid Adder's Tongue (*Scoliopus bigelovii*) leaf spotting acts as an herbivore defense mechanism.

Experiment 1: Proposed Methods

My study site will consist of two areas of naturally occurring Fetid Adder's Tongue on the UCSC campus: Site A) north of Hahn Student Services and Site B) Cave Gulch north of Empire Cave. At each plot, I will mark fifty leaves at the beginning of their growth period with numbered popsicle sticks (1a-50a and 1b-50b). When the leaves begin to expand, I will take photos of all leaves, and will use ImageJ to determine the surface area covered by spotting of each leaf, and any existing herbivory. After marking the leaves and measuring the spotted surface area, I will visit the two sites once a week to check in on the leaves and to visually inspect plants for herbivores (e.g., chewing insects, slugs, snails) or signs of mammalian browsers. At the three week mark, I will again photograph each leaf, and will use ImageJ to determine the area removed by herbivores and browsers. I will then calculate the change in percent of leaf area removed between the end and start of the experiment for each leaf. I will use linear regression models to examine the relationships between the area of leaf with spotting and the change in leaf area removed.

Experiment 2: Proposed Methods

At the study site with more Fetid Adder's Tongue plants (to be determined after the growth season begins), I will mark thirty additional leaves once fully grown for conducting a manipulative experiment. Using unscented, oil based pens, I will draw supplemental dark purple spots on to fifteen of these leaves (1p-15p) and green spots that match the leaf color onto the remaining fifteen (1c-15c). I will photograph the leaves as described above, and will use ImageJ to determine the area of each leaf removed by herbivores and browsers at the start and end of the experiment (once Fetid Adder's Tongue seeds have dropped). I will use ImageJ to determine the percentage of herbivorized surface area of each leaf. At the end of the experiment, I will calculate the change in percent of leaf area removed between the end and start of the experiment for each leaf, and will use t-tests to compare herbivory between the treatment (purple spots) and control (green spots) plants.

Tangible Outcomes

Results from this study will be prepared as a scientific paper and submitted as a senior thesis. I will also be applying to present my work at the annual UCSC Undergraduate Research Symposium in Spring 2021. If accepted, my research poster can be provided to the Norris Center.

Timeline

Fall 2020: Do readings of related research, plan study with Stacy Philpott, get permission to work on desired field sites from Alex Jones, get permission to do field work during COVID 19 from UCSC, and collect experiment materials.

Winter 2021: Conduct research and collect data.

Spring 2021: Enroll in BIOE 195, do thesis write up, and produce a manuscript.

Budget & Justification

<i>Item</i>	<i>Justification</i>	<i>Amount</i>
Pack of 200 popsicle sticks	Popsicle sticks will be used to label each leaf used in the study.	\$10.00
Pack of sharpies	Sharpies to label the popsicle sticks with the given sample number	\$10.00
Oil-based unscented pens	Pens will be used to draw spots on leaves in experiment 2.	\$50.00
Gas	Transportation costs for driving to campus (5 miles each way) once a week for the entirety of Winter quarter 2021.	57.5 cents per mile x 10 miles/week x 11 total weeks/winter quarter = \$63.25 total
TOTAL		\$133.25

Works Cited

1. Baldwin, B. G., & Goldman, D. H. (2012). *The Jepson manual: vascular plants of California*. (pg 1394) Berkeley, CA: University of California Press.
2. La Roccaa, N., Pupillob, P., Puppica, G., & Rascioa, N. (2014). *Erythronium dens-canis* L. (Liliaceae): An unusual case of change of leaf mottling. *Plant Physiology and Biochemistry*, 74, 108-117. doi:10.3897/bdj.4.e7720.figure2f