

SOAR Project Proposal
Summer 2019

Project title: **Salamander diversity and ecology at the Deputy Field Center**

Faculty mentor: Dr. Daniel Proud, Visiting Assistant Professor, Department of Biological Sciences

Student: Carly Danoski, Class of 2020, Environmental science

Project start and end dates: June 3 to August 9, 2019 (10 weeks)

Project description:

The Deputy Field Center, located in Upper Mount Bethel Township (Northampton County, Pennsylvania) was recently donated to Moravian College. This 65-acre property is a prime site for setting up long term ecological research projects and studying biodiversity of this region of PA. The land contains forested woods as well as several streams and vernal pools. This site has been mapped using GIS tools and those maps are currently undergoing improvements as part of another project by Brandon Werner. Biodiversity is an important indicator of the health and stability of an ecosystem. Each species in that ecosystem plays an important role that may not be able to be replaced by another species. The species interactions within an ecosystem are important to understand because many species rely on each other to survive, which in turn creates a healthier ecosystem. Salamanders are an important species that control insect populations, such as mosquitoes. This has important implications for environmental and human health. Environmental health hinges on the prosperity of many organisms in the food web, including amphibians.

Throughout this project, the following three objectives will guide the research:

1. We will conduct a survey of diversity at the Deputy Field Center to quantify the species richness and density of salamanders in 30 random plots that measure 5x5 meters.
2. Salamanders (N=50) and potential arthropod prey will be collected during field work and housed in terraria in the lab. Experiments will be conducted to analyze the prey preference of the salamanders.
3. The salamanders will be tested for the fungus *Batrachochytrium dendrobatidis* (Bd) to determine whether this disease is present in populations at the Deputy Field Center.

Methods:

Throughout this research project, we will sample 30 plots at the Deputy Field Center. Plots will consist of a 5x5 m area in which we will search under logs and large rocks, where

salamanders are typically found. In each plot, we will quantify the abundance and diversity of salamander species, as well as several potential prey items (worms, collembola, spiders). Salamanders will be photographed in the field with a ruler, and image analysis software (ImageJ) will later be used to take measurements of body and limb lengths. Environmental data (soil moisture, air temperature, leaf litter depth, etc.) will be recorded in each plot.

A total of 50 salamanders will be collected during field work, brought to the laboratory, and used for behavioral assays to investigate their interactions with potential prey that they encounter in their natural habitats. After behavioral assays are conducted, salamanders will be returned to the same plots where they were collected; the salamanders will not be harmed or killed during the research.

We will also test salamanders for infection by the chytrid fungus *Batrachochytrium dendrobatidis*, abbreviated as Bd. It is a fungal infection on the skin of amphibians that has caused severe declines in amphibian populations worldwide. Testing for this fungus would be an indicator of the health of the amphibians at the Deputy Field Center and may impact species diversity. To sample for Bd, the underside of the salamander (neck, legs, and toe webbing) will be swabbed 30 times using a cotton-tipped applicator. We will employ nested polymerase chain reaction using primers designed to detect the presence of Bd following methods described by Kadekar and Une (2018).

Timetable of goals/milestones:

Weeks 1-6: Collecting data: field and lab work. Our first step is to randomly select sampling plots at the site. During the first six weeks of the project, Carly will travel to the Deputy Field Center in order to collect field data, and will run the behavioral assays (prey choice experiments) in the lab. Within each plot, we will quantify salamander abundance and diversity, and collect environmental data.

Weeks 7-10: Data analysis & writing. Once all data has been collected from the field, the next four weeks will be spent analyzing the data using the program EstimateS and packages available in R. We will test whether there are any correlations between salamander diversity or density and environmental factors like soil moisture and proximity to water features on the property. During this time, we will also run the nested PCR to test for Bd. The final week will be focused on writing up the results in a report that can be used by other researchers at the Deputy Field Center.

Roles/responsibilities of student/mentor:

Student: Carly will conduct the research project in collaboration with Dr. Proud to achieve the goals outlined in this proposal. She will conduct field work, collect data, conduct prey choice experiments, and contribute to writing a final report on the salamanders of the Deputy Field Center.

Mentor: Dr. Proud will serve as a mentor for the ten-week research project as well as any subsequent work in the fall. Throughout the project, he will assist with field collection methods, identification of species, molecular techniques for testing for Bd, and setting up behavioral assays in the lab. He will provide critical feedback on written work and presentation skills, and will be responsible for acquiring materials for the project and providing instruction for using lab equipment.

Engagement in discipline-appropriate scholarly research:

Carly will gain research experience related to experimental design, data collection, data analysis, searching the scientific literature, and scientific writing. This work will enable her to build upon previous experiences in scientific writing including taking an environmental writing intensive course, serving as a first-year writing seminar tutor and working as a writing center tutor.

Contributions to the discipline and opportunities to share:

This project will advance our knowledge of biodiversity at the Deputy Field Site. It will serve as the foundation for future student projects and long term ecological projects at this site, giving us a more holistic picture of the property. The findings from this project will generate additional research questions, and may be useful to Moravian College classes that visit the site (e.g., Ecology). As arthropods are generally declining across the globe (Sánchez-Bayo & Wyckhuys, 2019), species that rely on them could also be at risk. In addition, diseases like Bd threaten the health of salamander populations. Thus, understanding the relationship between salamanders and their prey will help us to better understand and predict the effects of anthropogenic changes to our environment. Testing for the Bd fungus will enable us to monitor its spread and whether it is affecting populations in eastern Pennsylvania. Carly will present her work at the Moravian College Scholarship and Creative Endeavors Day, and will have the opportunity to present at the Lehigh Valley Ecology & Evolution Symposium (LVEES) in 2020. The results of this research will provide insight on the salamanders at the Deputy Field Center, their interactions with other species (especially arthropod prey), and the environment as a whole.

References:

Kadekaru, Sho and Yumi Une. "Comparison of methods for detection of chytrid fungus (*Batrachochytrium dendrobatidis*) in bullfrog tadpole mouthparts." *The Journal of Veterinary Medical Science* 80.2 (2018): 260-262. Web. 6 Mar 2019.

Sánchez-Bayo, Francisco and Kris A.G. Wyckhuys. "Worldwide decline of the entomofauna: A review of its drivers." *Biological Conservation* 232 (2019): 8-27. *Science Direct*. Web. 6 Mar 2019.

Student Statement of Purpose

Title: Salamander diversity and ecology at the Deputy Field Center

Name: Carly Danoski

Major: Environmental Science

Date of graduation: May 2020

Faculty Mentor: Dr. Daniel Proud

When I first came to Moravian College as a freshman, I remember walking through the halls of the Hall of Science and seeing project posterboards lining the walls. Going up to the biology department on the second floor was eye-opening, because there were so many different projects in fields that captured my attention. I didn't realize until later in the semester that these projects were previous SOAR projects. Once I learned what SOAR was, I knew that it was something I would want to eventually do. Getting hands-on experience in the environmental science field is something that I think is crucial. Working directly in the field is something that I find extremely exciting, and I hope to extend this enthusiasm in a SOAR project.

At the end of this project, I hope to have a better understanding of the interactions of species at the Deputy Field Center, specifically between salamanders and arthropods. These interactions are important to accurately assess the health of the ecosystem. I also hope to gain extensive knowledge in not only the the direct research questions I'm asking, but in the research method as well. I think it will be beneficial to gain the skills needed to successfully conduct a full research project, especially as I go forward and hope to apply to graduate school.

Besides my own personal hopes for this project, I also hope that this research project will be useful to future Moravian College students. The Deputy Field Center is a great resource for students to use, especially in the field of environmental science. Hands-on learning is a great tool for college students and hopefully this project will result in a more comprehensive understanding of the property. I hope that new knowledge can be gained from this project, such as which species reside on the property, as well as their population interactions and dynamics.

Expense Proposal

Title: Salamander diversity and ecology at the Deputy Field Center

Faculty Mentor: Dr. Daniel Proud

Student: Carly Danoski

Budget:

Field collecting equipment and basic laboratory needs are available in the Proud lab. A number of the required reagents to test for Bd infections are already available in the lab. In order to complete the proposed research project, we are requesting funding for the expenses listed below.

Expenses:

Materials for Bd testing

In order to test for Bd we will need to purchase several items that total \$76.06. They are listed in the table below:

Product	Supplier	Cost per unit	Quantity	Total
Bd specific PCR primers	Eurofins	\$10	4	\$40
GoTaq G2 Green Master Mix, 100 reactions	VWR	\$36.06	1	\$36.06

Travel

In order to complete the field work, Carly will travel to the Deputy Field Center 3 times/week for the first six weeks. The distance between Moravian College to Deputy Field Center is 28 miles (56 miles roundtrip). The standard mileage rate for 2019 is \$0.58/mile. Thus, the total cost of travel for this project is \$584.64.

In total, we are requesting \$500 for laboratory reagents and travel-related expenses for this project. The remaining costs of travel will be covered by the stipend paid to Carly. Other costs associated with lab work will be covered by research funds in the Proud lab.