Effect of Temperature on Cirsium pitcher Germination

SURG | Natural Sciences and Engineering (NSE) | *Tags: Fieldwork, Lab-based*

This cover page is meant to focus your reading of the sample proposal, summarizing important aspects of proposal writing that the author did well or could have improved. ***Review the following sections before reading the sample****. The proposal is also annotated throughout to highlight key elements of the proposal's structure and content.*

Proposal Strengths	Areas for Improvement
The background and literature review of this proposal presents a clear gap in knowledge as well as a justification for why the gap in knowledge should be filled.	In order to show that the researcher understands the analysis and can interpret results, the proposal should include a specific description of what the results of the study would look like, and how the analysis methods were chosen
The methods describe each step of the project, while also including explanations that connect each step back to the research question/research aims.	Some jargon is not defined in simple terms.
The proposal goes a step further by describing possible limitations of the proposed methodology and ways these limitations will be addressed.	While an aim/objective statement is present, rephrasing to create or including an explicit research question could strengthen the proposal.

Other Key Features to Take Note Of
You don't need to include your title or your name in the 2 pages of your proposal since a cover page is automatically generated for you through the application system.

Effect of Temperature on *Cirsium pitcheri* Germination

Intro moves from broad topic to specific issue

Plant populations across the world have been greatly affected by shifts in insect pests and diseases, resulting from changing climate patterns and environmental conditions (1). However, despite the ample research on climate change and plant growth patterns, little is known on the effect of such environmental changes on seed germination and seedling survival for plant species with narrow habitat specificity at early stages of their life cycles. Further research investigating the response of these species to the environmental fluctuations predicted by climate change models is thus essential to better understand their population reproductive biology and to provide useful management information for their conservation and restoration. My research project will investigate the effect of temperature on the germination of Pitcher's thistle (*Cirsium pitcheri*), a threatened plant species found on the open sand dunes along the Great Lakes of Lake Michigan, Lake Huron and Lake Superior. I will conduct germination trials under current and future predicted climate conditions, with the objective of understanding and minimizing the species' mortality at its early life stages.

While objectives are present, rephrasing to an explicit research questions would strengthen the proposal

Cirsium pitcheri is a monocarpic perennial plant that grows vegetatively for four to eight years, subsequently flowering and setting seeds only once in its lifetime (2). The species' survival is dependent on successful seed production, seed dispersal by its wind-swept environment, seed germination and seedling establishment. However, despite *C. pitcheri's* suitability to its wind-swept, dune environment, this species was added to the List of Endangered and Threatened Wildlife and Plants in 1988 (2). Since then, six *C. pitcheri* populations in the southern Great Lake regions and two from Lake Huron have dwindled as a result of lake level fluctuations, seed predation, apical meristem damage from insects and human disturbances including shoreline recreation activities and coastal road construction (3). Further extensive habitat destruction is also expected to occur due to climate change, as temperatures are predicted to increase by 1.4°C ±0.6°C for the Chicago and Great Lakes region between 2010 and 2039 (4). Hence, in order to better understand the potential effects of the changing temperatures on *C. pitcheri* populations, the species' germination responses under future predicted climatic conditions must be considered for adequate restoration and management purposes. Research centers like the Chicago Botanic Garden have consequently made the conservation and restoration of threatened species like *C. pitcheri* a major focus. I will conduct this research in the lab of Dr. Pati Vitt, a Conservation Scientist at the Chicago Botanic Garden, who has been studying the plant-pollinator interactions, genetics and demographics of *C. pitcheri.*

Jargon not defined in simple terms

Identifies gap in knowledge

Justifies why gap in knowledge should be filled

Situates project within the work of the lab

The first part of my project will consist of fresh seed collection and seed preparation. Fresh seeds will be collected in early July 2016 (when flowering takes place), from the Whitefish Dunes State Park in Wisconsin, along the shores of the Door Peninsula and the Sturgeon Bay Ship Canal Nature Preserve. However, it is important to note that only approximately 200 fresh seeds are expected to be collected due to substantial seed predation by weevils, small herbivorous beetles, low *C. pitcheri* flowering rates, and governmental protection permit restrictions that allow 30 flowering heads to be collected per year (5). Previously collected seeds (400 seeds from 4 populations in Door County and areas around Lake Michigan) are also currently being stored at the Chicago Botanic Garden in the Dixon National Tallgrass Prairie Seed Bank at -20°C and will be used to supplement the seeds that I will collect. A sample of these seed will be placed into cold stratification at 3°C, simulating natural winter conditions that a seed must overcome prior to germinating. This will allow for the comparison of germination rates between fresh and stored seeds under the various temperatures investigated.

Limitations of methods addressed, explained with evidence, and work-arounds proposed

Pattern of describing a step of methodology then explaining why the step is taken and connecting back to research aim

Once collected, fresh seeds will be cleaned by removing plant debris. Seeds will be weighed for future covariate analysis as past studies have shown that seeds with higher mass have increased probabilities of germinating (3). The seeds will then be prepared for germination testing by removing foreign materials and will be washed using deionized autoclaved sterile water. Cleaned seeds will be surface-sterilized using 90% ethanol in order to ensure the removal of contaminating microbes. Any excess moisture from the seeds after surface sterilization will be removed using sterilized paper towels in the hood to avoid any contamination.

Collected seeds and previously stored seeds will then be placed in Petri dishes containing a 1.5% agar medium that will provide adequate moisture conditions for seed germination. The number of trials and seeds placed in each Petri dish, however, will be determined based on seed availability, seed size and Petri dish spatial limitations. The germination of these seed sets will then be investigated under temperature ranges that simulate current and future climate predictions, setting temperatures that are a little cooler and a little warmer than the current Chicago spring temperatures. Petri dishes containing the seed sets will be placed in light-controlled incubators alternating between the temperatures of 15°C-6°C, 20°C-10°C, and 25°C-10°C every 12 hours, with corresponding 12 hour photoperiods that replicate average day lengths (6). A 30°C-15°C temperature trial may also be conducted depending on seed availability. The germination of previously stored seeds and fresh seeds, defined as a radicle emergence greater than 1mm, will be monitored for approximately 2 weeks - a time period that is expected to result in the germination of the majority of seeds, followed by a comparison of germination rates of the two sets of seeds under the different temperatures and t-test analysis. The results from my proposed research will be integrated with previous demographic data collected over the last 6 years by Dr. Pati Vitt and will establish parameters for a larger population viability analysis. The investigated effect of temperature on the germination of *C. pitcheri* will thus provide insight into the current and future impacts of climate change which will further inform the study of plant-pollinator and plant-predator interactions under future climatic changes. Additionally, the findings of this research project are expected to be published in a scientific journal.

Methodology is accompanied by a rough timeline, showing feasibility of the project in 8 weeks

Author should describe what the results will look like and justify the type of analysis that is being done

In preparation for this research opportunity at the Chicago Botanic Garden, I have been frequently meeting with Dr. Pati Vitt to plan and prepare the research project. Furthermore, despite the fact that I was not awarded the REU, I will be allowed to participate in their research preparation training program in June that provides interns with training in all stages of research, ranging from hypothesis construction to experimental design, data collection, and analysis.

I am also currently in the NU Bioscientist program, which has allowed me to further my skills and knowledge in data analysis and research ethics. Likewise, as a plant biology and environmental sciences double major, I am currently finishing the chemistry 171-172 sequence and will be taking Environmental Sciences 201, Biology 215, and a climate change and sustainability course in the spring.

Good to mention specific course numbers

My past research experience working in the African Crop Consortium laboratory at the World Agroforestry Center in Nairobi, Kenya, where I conducted a variety of DNA extractions for different tree species and performed several analyses of the quality and quantity of extracted DNA, has also sparked my interest in plant biology and conservation. This research opportunity at the Chicago Botanic Garden will thus enable me to continue expanding my knowledge on agriculture and plants as well as develop the skills needed to conduct more advanced research in the future when I pursue a Ph.D.

References

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