**John Van Gundy student scholarship awarded for 2022**

*The proposals were reviewed by the Evaluations Committee, composed of former board members Bryan Donner, Cyndi Smith, and Kathy Tonnessen, and* Nutcracker Notes *editor and associate director Bob Keane. We are pleased to announce the 2022 recipient of the John Van Gundy student scholarship, administered by the WPEF:* ***KATHERINE SPARKS****, an MS student with Dr. Danielle Ulrich of the Faculty of Biological Sciences at Montana State University.*

**Whitebark pine carbon allocation under drought stress**

***Background and objectives***

Climate change has been rapidly altering the frequency and intensity of precipitation within the last decade (Hoover and Rogers 2016). Due to thess unprecedented changes in precipitation pattern, it is important to understand species' response to drought stress. Drought stress often leads to mortality, either directly through carbon starvation and hydraulic failure or indirectly through increasing susceptibility to stressors such as insect invasions, pathogen exposure, and species competition (Anderegg *et al*. 2013). One species of particular importance is the whitebark pine (*Pinus albicaulis*: WBP), which is a member of the high-elevation, five-needle fascicled white pines (Howe *et al*. 2021).

WBP is a keystone species within alpine ecosystems, providing necessary hydrological, geological, and food chain functions (Baumeister and Callaway 2006, Tomback and Achuff 2010). However, this species is currently experiencing extreme dieback, causing it to be placed on the USFWS's list of endangered species (USFWS 2020). Current research is focusing predominantly on two threats: the mountain pine beetle (*Dendroctonus ponderosae*: MPB) and white pine blister rust (*Cronartium ribicola*: WPBR), but very little research has been conducted on WBP's physiological response to drought stress or how drought stress alters the susceptibility of WBP to other stressors, such as MPB (Dudney *et al*. 2020, Shanahan *et al*. 2022). A recent study of ponderosa pine (*P. ponderosa*) showed drought stress to have significantly increased bark beetle mortality (Erbilgin *et al*. 2021). This highlights the possibility that drought may be playing a bigger role in WBP dieback than currently acknowledged.

How an organism allocates its carbon resources can give us invaluable insight into their ability to tolerate drought conditions and defend against MPB and WPBR (Erbilgin *et al*. 2021). Non-structural carbohydrates (NSCs) can allow researchers a glimpse of how a plant is allocating its carbon to different organs (needles, stems, roots), and therefore how it may respond to drought stress (Raffa *et al*. 2017). NSCs can also show how a plant may respond in defense against pests and pathogens, such as MPB, when under drought stress conditions (Bentz *et al*. 2016). Volatile organic compounds (VOCs) are another method for measuring a plant's ability to defend against pathogens (Runyon *et al*. 2020). VOCs are the compounds which give pines their distinct smell, but they also act as a responsive defense against pathogens such as MPB and WPBR (Runyon *et al*. 2020). Understanding how the concentration and composition of both NSCs and VOCs are affected by drought stress will give us a clearer picture of how drought affects these trees and how it may increase their susceptibility to the common threats now affecting them.

***Study Plan***

In order to build this understanding of plant response, we will impose a severe, short-term drought treatment to WBP seedlings from families from contrasting climates and measure responding NSC and VOC concentrations and compositions. Our experiment will consist of 2-

and 3-yr old WBP seedlings (donated by the USFS and Coeur d'Alene Nursery) established in the greenhouse of the Plant Growth Center at Montana State University. Before treatment, we will measure baseline physiological metrics of drought tolerance and response to create a comparison of pre-treatment vs. post-treatment. We will then impose drought conditions on one group of seedlings while properly watering the remaining seedlings (control). This treatment will begin in May of 2022 and end in August of 2022. After treatment, we will repeat baseline metrics and sample plant tissues for NSC and VOC analysis. We will measure both the total concentration of NSCs and VOCs as well as the composition and distribution of the NSCs and VOCs throughout the seedling (i.e., roots, stem, branches, and leaves).

***Measures of Success***

A dominant strategy for conservation of WBP is major plantings of seedlings. In order for this strategy to be effective, it is important that seedlings most adapted to drought stress be preferentially planted, and that we examine the physiological mechanisms of seedling establishment and seedling capacity to withstand drought and stress. This study aims to provide knowledge needed to determine a seedling's ability to survive through drought stress, thereby creating a foundation to be used in identifying which seedlings should be planted.

***Literature Cited***


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