WPEF student research grant 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 that* ***JEREMY GREENBERG****, a MS student with Dr. Lori Daniels of the Department of Forest and Conservation Sciences at University of British Columbia, was chosen as this year's grant recipient.*

Pining for change: Can whitebark pine be restored in Canada's interior rainforest?

Background, objectives, and justifications

Whitebark pine (*Pinus albicaulis*: WBP) is an endangered keystone conifer species in high-elevation forests of the mountain ranges of western North America (Resler and Tomback 2008, Smith and Collingwood 2014, Environment and Climate Change Canada 2017). Cascading disturbances have dramatically reduced WBP numbers throughout its range. Biotic disturbances by invasive white pine blister rust (*Cronartium ribicola*), native mountain pine beetle (*Dendroctonus ponderosae*), and *Ips* beetles interact to drive mortality (Smith *et al.* 2014, Wong and Daniels 2017, Howe *et al.* 2021). Abiotic disturbances, including climate change and fire suppression, allow shade-tolerant but fire-susceptible Engelmann spruce (*Picea engelmanii*) and subalpine fir (*Abies lasiocarpa*) to encroach on and suppress the moderately shade- and fire-tolerant WBP (Minore 1979, Keane and Parsons 2010a).

Restoration ecologists employ various strategies to regenerate WBP and bolster blister-rust resistance (Environment and Climate Change Canada 2017). One strategy is to mechanically thin competing species from WBP forests, to emulate natural disturbance by fire (Keane and Parsons 2010a). The rationale is two-fold: (1) by releasing WBP from competition with other tree species, immature trees have a greater chance at reaching maturity and producing seeds (Keane *et al*. 2007), and (2) the role that Clark's nutcracker (*Nucifraga columbiana*), which has co-evolved as the primary seed distributor for WBP, plays (Retzlaff *et al.* 2018). The Clark's nutcracker preferentially selects open, recently-burned sites to cache WBP pine seeds for its winter food source (Retzlaff *et al.* 2018). Forgotten seed caches become the main locales for WBP regeneration (Retzlaff *et al.* 2018). Thus, thinned sites are expected to have greater regeneration potential for WBP by increasing seed production and suitable caching sites.

Prior research has examined the effectiveness of thinning as a restoration strategy for WBP through experiments and comparisons with natural regeneration following wildfire (Keane *et al.* 2007, Keane and Parsons 2010a, Keane and Parsons 2010b, Maher *et al.* 2018, Retzlaff *et al.* 2018, Salvador 2018). Similar thinning strategies have been initiated by Parks Canada Agency in the Columbia Mountains: however, this region differs from previous study sites as inland rainforests have unique climatic regimes and historically had long fire rotations (Coxson *et al.* 2020). These ecological differences raise questions about whether restoration thinning is equally effective for enhancing WBP regeneration in inland rainforests.

Study Plan

My research asks this question: How does WBP regeneration differ in areas that were mechanically thinned in 2017/8 compared to nearby areas that burned in 2017/8 and undisturbed (control) areas in Canada's inland rainforests? This leads to three sub-questions: Relative to undisturbed forests, how do mechanical thinning and wildfire impact (1) the biophysical

environment? (2) the growth rates of cone-producing trees? and, (3) the composition and abundance of tree regeneration?

Study Area

The Bald Hills is a long ridgeline running north-south on the eastern boundary of Glacier National Park, BC, Canada. The subalpine areas are characterized by a forest dominated by WBP, Engelmann spruce, and subalpine fir. Several WBP in this area have been identified as putatively resistant to white pine blister rust, and many more are currently in resistance testing. These trees are known colloquially as "plus trees." In 2018, stand thinning operations were conducted around plus trees in the Bald Hills with the combined goal of fire protection, creating nutcracker openings, and releasing the trees from competition. In the same year a large, mixed severity wildfire burned through the Bald Hills, including subalpine areas. The fire burned adjacent to, and in some cases over, the treatment area.

Methods

We will have 10 plots each of the three treatments (burned, mechanically thinned, burned and thinned), plus control plots, al with similar elevation, aspect and (pre-treatment) plant communities. This will be accomplished by combining spatial data from existing digital elevation models, Vegetation Resource Inventory layers, and fire history layers. Within each site, a randomly-selected location will be sampled using the National Forest Inventory protocol (Gillis *et al.* 2005), adapted to calculate composite burn index scores (Lutes *et al.* 2006). The cover of live and dead trees (height >140 cm), subcanopy vegetation, and ground substrates (un/burned forest floor, coarsewood, exposed mineral soil) will quantify biophysical impacts. Living/surviving trees will be assessed for new cone production and their radial growth rates will be quantified by analyzing increment cores for post-disturbance growth releases (Retzlaff *et al.* 2018). The species, height, and diameter of all tree regeneration (height ≤140 cm) will be sampled in four subplots per site (Lutes *et al.* 2006). Biophysical attributes, tree growth, and regeneration abundance will be compared across treatments using analysis of variance. Mixed-effects likelihood models will be used to identify factors affecting WBP regeneration.

Anticipated Outcomes and Significance

Evidence that thinning is an effective restoration strategy will include: (1) biophysical attributes and tree growth rates in thinned areas are more similar to burned areas than controls, and (2) WBP regeneration will be greatest in burned areas followed by thinned areas, while shade-tolerant species will dominate control areas. Identifying factors facilitating regeneration and tree growth will help refine the recovery strategy for endangered WBP.

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