Investigating the trajectory of Whitebark Pine understory populations in the Greater Yellowstone Ecosystem - a pilot study.

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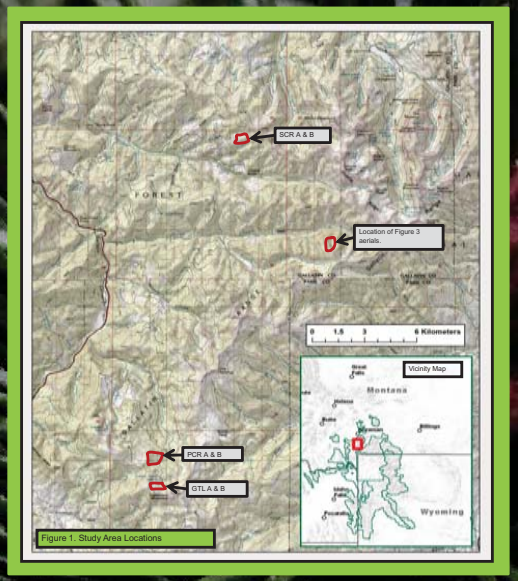
Abstract

Whitebark pine, in mixed and dominant stands, occurs in over 2 million acres within the six national forests and two national parks that comprise the Greater Yellowstone Ecosystem (Greater Yellowstone Coordinating Committee Whitebark Pine Subcommittee [GYCCWPS] 2010). In its mature growth form, whitebark pine fills a significant niche in subalpine communities. Numerous studies have examined the regenerative properties of whitebark pine following burns, treatment thinning and logging practices. However, there is a paucity of information on the morphology, physiology and overall fate of post- regenerative (>10 cm tall) understory populations of whitebark pine that exist beneath intact canopies and the variety of growth characteristics these trees may exhibit following natural gap creations in the canopy due to insect mortality of overstory associates. By confirming or refuting the occurrence of historical, positive, and rapid growth response events in whitebark pine following canopy disturbances, we will improve our understanding of stand replacement potentials and be better prepared to monitor emerging trends in regenerating and recruiting WbP communities as they undergo stand transition. The data collected through this project will be used to determine the likelihood of this foundation species persisting as a functional and vital part of the ecosystem and as a tool for guiding management decisions in restoration efforts to areas of highest priority.



Introduction

Climate change, forest insect and pathogen upsurges, and changing disturbance regimes have altered Rocky Mountain forest ecosystem structure, function, and species composition (McKinney et al. 2010). Whitebark pine (*Pinus albicaulis*) is a keystone species in high elevation forests and alpine communities of the northern Rockies. It can exist under extreme conditions tolerated by few other tree species and is an important food source for a variety of wildlife, including grizzly bears, red squirrels, and Clark's nutcrackers. Currently whitebark pine (WbP) is being impacted by white pine blister rust (WpB), mountain pine beetle (MpB), and wildfire conjoining to pose significant threats to the persistence of healthy WbP populations on the landscape. Substantial declines in WbP have been documented throughout its range, and the USFWS has listed WbP as a candidate species for protection under the Endangered Species Act. Losses in WbP have the potential to cause major secondary losses in biological diversity, causing critical and possibly irrevocable community instabilities (Ebenman and Jonsson 2005).

Based on current, long-term monitoring work taking place in the GYE, high rates of mortality have been observed in mature overstory WbP individuals (>30-140 cm diameter breast height (DBH)) due to a MpB epidemic (GYWPMWG 2011). At the same time, monitoring has documented widespread regeneration of WbP with the density and age distribution of these individuals varying greatly among stands. With the decline in reproductive WbP trees, of particular concern is the prospective replacement of cone-producing trees from understory individuals. Using ring width patterns taken from WbP individuals, this project examines evidence for growth suppression and a hypothetical growth release event in WbP understory individuals located in stands that have historically experienced a change in canopy composition due to the Mpb outbreak that occurred in the late 1970s/early 1980s in the Gallatin Range of the Gallatin National Forest (pers. comm. Roy Renkin). In addition, seedling WbP (< 1.4m tall) are being collected throughout the GYE in association with the Interagency Whitebark Pine Long-term monitoring plots and will be aged to determine the overall age distribution of the understory population.

Objectives

The objectives of this project are to determine the age structure and recruitment potential of WbP understory trees following the creation of canopy gaps such as those that are occurring across the GYE as a result of mountain pine beetle infestation, wildland fire, and other ecological disturbances.

Specifically, we seek

1. To determine if live 10 to 25 cm diameter breast height WbP were a component of the understory during the last major canopy disturbance (late 1970's, early 1980's) and if so, did they experience a relatively sudden and rapid growth release following the creation of canopy opening in the stand.

2. To determine the age distribution among <1.4 m tall WbP seedlings in the understory of WbP long-term monitoring stands.

Cores from control and treatment areas

Methods

Using aerial photo interpretation and aerial detection surveys from U.S. Forest Service and National Park Service archives, five WbP stands were selected for sampling in the Gallatin Range on the Gallatin National Forest based on their logistical practicality and disturbance histories (Figures 1 and 2). A total of 50 trees were selected for sampling from each stand with 25 from a control area (intact canopy) and 25 from a treatment area (canopy disruption from MpB documented in 1981). Trees with obvious signs of distress such as blister rust infection, MbB infestation, odd growth form, and mechanical or animal damage were avoided. Two cores were taken per tree with one at approximately breast height and the second 30 cm or greater below the first. Measurements for diameter at core height, core height from the ground, presence or absence of blister rust, number of cankers and location, and any pertinent information about each tree were recorded. Tree rings from cores will be counted and tested for potential suppression and growth release by comparing ring widths from both within and between control and treatment groups using two-sample t-tests. Stand basal area was estimated by angle gauge after every fifth tree sampled for a total of ten basal area samples per stand. The center point for determining basal area was located approximately 7.62 meters downslope at a randomly selected azimuth from the fifth tree. To document recruitment potential ten belt transects measuring 15.24 m x 0.9 m were examined for presence of WbP downslope along a randomly selected azimuth, after every fifth tree cored. Whitebark pine trees were recorded in bins by height of <10 cm, 10-49.9 cm, 50-99.9 cm, 100-140 cm, >140 cm, mid canopy >140 cm, and upper canopy >140 cm. To augment the sample size, representative seedlings, including shrub-form "bonsai" plants, were also collected in a subset of the 150 Interagency Whitebark Pine Monitoring stands.

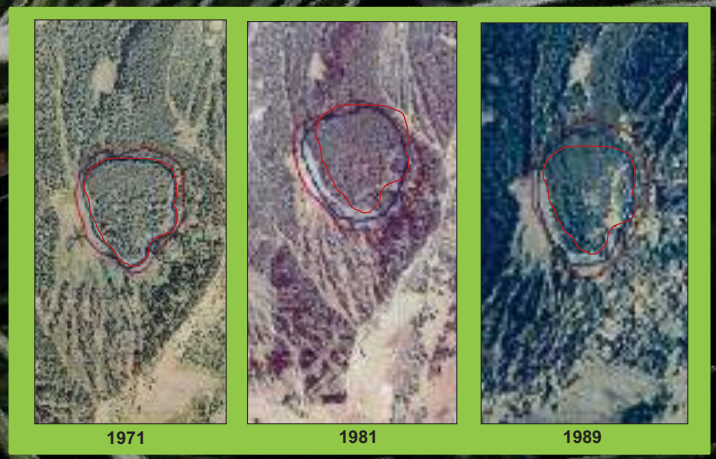


Figure 2. U.S. Forest Service aerial imagery used to select sample collection areas with historic MpB canopy disturbance.

Preliminary Results

Control and treatment cores have been collected for two stands and cores from control trees have been collected from a third stand. In total, approximately 284 cores have been collected and prepared for ring counting and width examination. Seedling collection in association with Interagency Whitebark Pine monitoring plots has been below expectations due to lack of seedling availability in the stand or time constraints. Collected samples are currently drying and await mounting and processing.

Discussion

At this time, field crews are continuing to collect tree core and seedling samples. After all field work is completed for the season, samples will be processed and assessed in the laboratory. This study serves as a pilot effort intended to gather baseline data and increase our overall knowledge and understanding of understory demographics and dynamics in evolving WbP communities. Outcomes from this pilot project will help direct future research in WbP forests as stand transition continues to occur throughout the GYE.

Acknowledgments

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