

# Greater Yellowstone Network

## RESOURCE BRIEF

National Park Service  
U.S. Department of the Interior  
Inventory & Monitoring Program



### Whitebark Pine in the Greater Yellowstone Ecosystem *Trend Analysis Comparing 2004-2007 to 2008-2011*

Whitebark pine (*Pinus albicaulis*) is a foundation and keystone species in upper subalpine environments of the northern Rocky Mountains that strongly influences the biodiversity and productivity of high-elevation ecosystems. Throughout its historic range, whitebark pine has decreased significantly as a major component of high-elevation forests. As a result, it is critical to understand the challenges to whitebark pine—not only at the tree and stand level, but also as these factors influence the distribution of whitebark pine across the Greater Yellowstone Ecosystem (GYE). Throughout the past decade in the GYE, monitoring has helped document impacts to whitebark pine forests by insect, pathogen, wildland fire, and other disturbance events.

*This interagency monitoring program is supported by the National Park Service, U.S. Forest Service, U.S. Geological Survey, Bureau of Land Management, U.S. Fish and Wildlife Service, and Montana State University in coordination with the Greater Yellowstone Coordinating Committee.*

#### Purpose and Objectives

The purpose of the whitebark pine monitoring program is to detect changes in the health and status of whitebark pine populations across the Greater Yellowstone Ecosystem.

Objectives include:

1. estimating the proportion of live whitebark pine trees infected with white pine blister rust (blister rust) and the rate at which infection changes over time;
2. determining the relative severity of blister rust infection in whitebark pine trees;
3. estimating the survival of whitebark pine trees, taking into account effects of blister rust, mountain pine beetle, and fire; and
4. assessing and monitoring whitebark pine recruitment in the understory.

#### Methods

Details of the sampling design and field methodology can be found in the 2011 Interagency Whitebark Pine Monitoring Protocol for the GYE (listed below). From 2004 to 2007, we established 176 permanent transects in 150 whitebark pine stands in the GYE that are resurveyed every four years. Within each transect, all live whitebark pine trees >1.4 m tall are tagged in order to monitor changes in blister rust infection and survival rates.



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Monitoring whitebark pine in the Greater Yellowstone Ecosystem.

The first time period was the initial transect visit from 2004-2007 and the second time period occurred from 2008-2011. The number of live tagged trees for both time periods is represented in Figure 1.

#### Results

The following results summarize the past eight years (2004-2011) of whitebark pine monitoring in the GYE. More details on this analysis are provided in the 2014 status and trend report (listed below).

Shanahan, E., K. M. Irvine, D. Roberts, A. Litt, K. Legg, and R. Daley. 2014. Status of whitebark pine in the Greater Yellowstone Ecosystem: A step-trend analysis comparing 2004-2007 to 2008-2011. Natural Resource Technical Report NPS/GRYN/NRTR—2014/917. National Park Service, Fort Collins, Colorado. <https://irma.nps.gov/App/Reference/Profile/2216554>

Greater Yellowstone Whitebark Pine Monitoring Working Group. 2011. Interagency whitebark pine monitoring protocol for the Greater Yellowstone Ecosystem, version 1.1. Greater Yellowstone Coordinating Committee, Bozeman, Montana. <https://irma.nps.gov/App/Reference/Profile/660369>

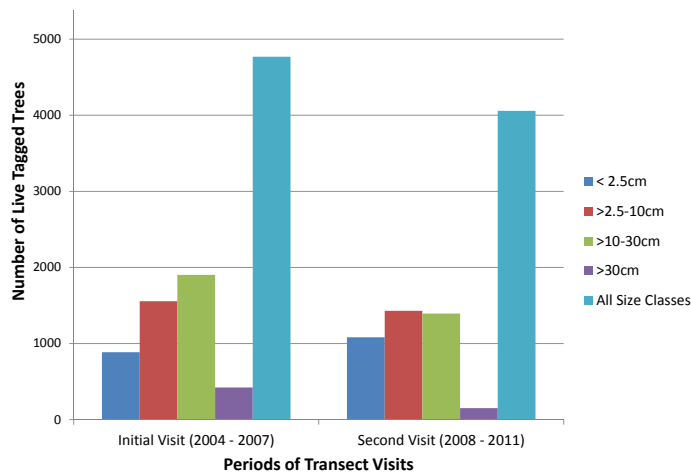


**Figure 1.** Distribution of tagged live whitebark pine trees >1.4 m tall by DBH size class for both time periods.

### Status of White Pine Blister Rust Infection

Using a combined ratio estimator, we estimated the proportion of live trees infected in the GYE in the initial time period to be 22% and the proportion of live trees infected in the second time period to be 23%. We detected no significant change in the proportion of trees infected between the two time periods.

To assess blister rust severity, we recorded blister rust infection by location in the canopy (less severe) or the bole (more severe) of a tree. We found 1,217 out of 3,635 live trees infected with blister rust at the end of the second time period. Trees with canopy-only cankers made up approximately 43% of the total number of trees infected with blister rust at the end of the second time period, while trees with bole-only cankers comprised 20%, and those with both canopy and bole cankers included 37% of the infected sample.

### Tree Mortality

We recorded 975 dead tagged trees during the second time period and identified all potential mortality-influencing conditions (blister rust, mountain pine beetle, fire, and other factors). The estimated overall proportion of dead whitebark pine trees >1.4 m tall was approximately 20% at the end of 2011. Approximately 40% of the dead trees died with evidence of mountain pine beetle infestation and no evidence of other factors. The majority of these trees were within the >10-30 cm DBH size class. The remaining 60% of dead trees died with signs of fire; blister rust; a combination of fire, mountain pine beetle, or blister rust; or with other factors such as structural or animal damage (Figure 2).

### New and Reproducing Trees

We assessed regeneration and recruitment by tracking the number of cone-producing tagged trees and recording whitebark pine seedlings and saplings in the understory. Reproducing trees made up approximately 24% of the total live tagged trees at the end of the second time period. We tagged 287 trees that grew to >1.4 m tall since the initial time period, which is a 6% increase in the number of live, tagged trees. The density of understory trees  $\leq 1.4$  m tall averaged 53 trees per 500 m<sup>2</sup>.

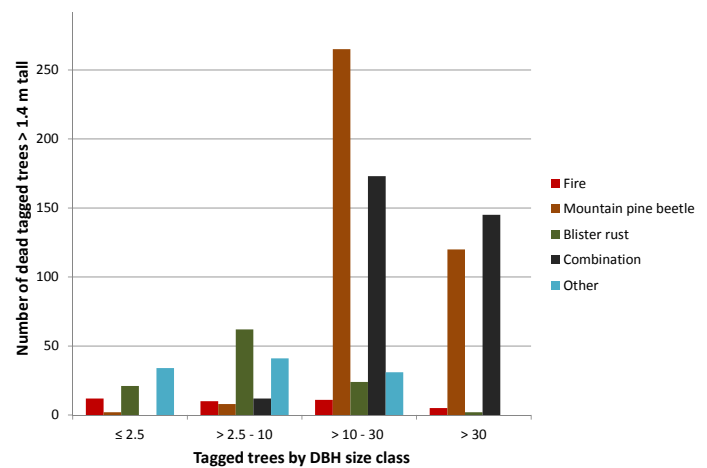


**Figure 2.** Mortality of tagged trees (2008-2011) by DBH size class and indicators such as fire, mountain pine beetle, blister rust, and other factors.

### Discussion

When we initiated the monitoring program in 2004, mountain pine beetle populations were just beginning to increase in the GYE. At the time, whitebark pine mortality levels attributable to mountain pine beetle were relatively low and the beetles were considered a secondary threat compared to the ubiquitous pathogen, blister rust. As monitoring efforts continued from initial transect establishment to revisits, field data captured the shift in magnitude from endemic levels of mountain pine beetle infestation to those of epidemic proportions.

Comparing the two time periods, the estimated proportion of whitebark pine trees infected with blister rust in the GYE was similar. The overall percentage of whitebark pine trees >1.4 m tall infected with blister rust was estimated to be between 20% and 30% to account for variation of level of infection across the GYE. Mortality was higher in trees within the >10 cm DBH size class, congruent with mountain pine beetle preferences, although fire was also found to be a major driver of mortality. We continue to explore the relationships between mountain pine beetle and blister rust as factors in the mortality of whitebark pine, along with the relevance of climatic conditions over time.

Although approximately 20% of the tagged tree population has died, we have observed regeneration in the understory, and growth of whitebark pine trees into the >1.4 m tall tagged-tree population. In addition, we documented 26% of the live tagged trees as producing cones.

The monitoring program continues to impart meaningful ground-based information to the broader regional assessment of whitebark pine in the GYE. The monitoring program acts as an important resource for a variety of organizations embarking on five-needle pine monitoring and has provided insights into past and ongoing research endeavors. Through sustained implementation of the monitoring program, we will continue to document and quantify whitebark pine forest dynamics during insect, pathogen, fire, and other climatic events in the GYE.