National Park Service
U.S. Department of the Interior

Inventory & Monitoring Division
Natural Resource Stewardship and Science

Whitebark Pine Monitoring in the Greater Yellowstone Ecosystem: 2022 Data Summary

Whitebark pine (*Pinus albicaulis*) is a keystone species in subalpine communities throughout the western United States. It provides high-energy food for birds and mammals. Its broad canopy provide shade that helps to prolong spring snowmelt. Once established, this slow growing conifer creates favorable habitat to support forest succession. However, over the last 2 decades, whitebark pine forests have been steadily declining in response to infection by white pine blister rust (*Cronartium ribicola*), periodic mountain pine beetle (*Dendroctonus ponderosae*) outbreaks, and the suppression of low severity fires that historically pass through these forests. As a result of these population decreases, the whitebark pine was listed as threatened under the Endangered Species Act by the U.S. Fish and Wildlife Service in January 2023.

Since 2004, the Greater Yellowstone Network has been monitoring whitebark pine in national parks and forests at 176 transects (divided across 4 panels) in the Greater Yellowstone Ecosystem as part of an interagency whitebark pine long-term monitoring program. The objectives are to document the current status and changes in

- Infection of whitebark pine by white pine blister rust
- Severity of white pine blister rust infection on whitebark pine
- Mortality of whitebark pine
- Recruitment into the reproducing population of whitebark pine

In 2013, the Wyoming Bureau of Land Management began monitoring whitebark pine and limber pine, providing more contiguous information for evaluating the overall health of five-needle pine species in the region. Those results are reported separately in the NPS.gov article series, "Five-Needle Pine Monitoring on Wyoming Bureau of Land Management Forests in the Greater Yellowstone Ecosystem."

This brief summarizes results from visiting Panel 3 transects on national park and forest lands in the Greater Yellowstone Ecosystem.

Key Findings—2022—Panel 3 Trees

- Of the 943 live, tagged trees examined on transects, 339 (36%) showed signs of blister rust infection. Of these 339 infected trees, 155 (46%) had bole (trunk) infections.
- The majority of live trees (60%) had no evidence of blister rust infection between 2018 to 2022, although 15% transitioned from uninfected to infected.
- We observed 52 newly dead trees since 2018.
- Of the 42 Panel 3 transects, 5 visited in 2022 no longer had live, tagged trees since monitoring first began at the panel.
- 54 new trees were added to the tagged, >1.4 m tall population.
- We counted 2,373 five-needle pines ≤1.4 m tall in understory plots across all transects. (Whitebark pine cannot be distinguished from limber pine (*Pinus flexilis*) as seedlings.)

Detailed Findings for Panel 3 Trees

Infection Status

We examined 943 live tagged trees in 42 Panel 3 transects for signs of blister rust infection in 2022. This number includes 54 new live trees added during the 2022 survey. Of the 943 live trees, 339 (36%) showed signs of blister rust infection. Of these 339 infected trees, 155 (46%) had bole (trunk) infections (Figure 1).

Change in Infection Status

Comparing only trees surveyed in both 2018 and 2022 (888 trees), we found these changes in infection status:

- 532 (60%) remained free of blister rust infection evidence
- 198 (22%) had sign of infection in both years
- 131 (15%) developed evidence of infection over the 4 years
- 27 (3%) no longer showed evidence of infection by 2022 (this can result from observer error, a change in evidence criteria, or infected branches self-pruning)

Infection Severity

We chronicled if and when infection location changed in the canopy (branches) and bole of infected, tagged trees between time-steps. A bole infection is considered more consequential than a canopy canker. A bole infection compromises not only the overall longevity of the tree, but its functional capacity for reproductive output because blister rust can lead to the loss of the cone-bearing branches above the infected site.

Infection location changed for trees that were documented with blister rust in 2018 and again in 2022 (Figure 2). Thirty-one trees (16%) with canopy-only infections in 2018 that remained infected in 2022 transitioned to a more severe state of infection in the bole by 2022. This transition occurred predominantly in the larger size class trees >10 cm DBH.

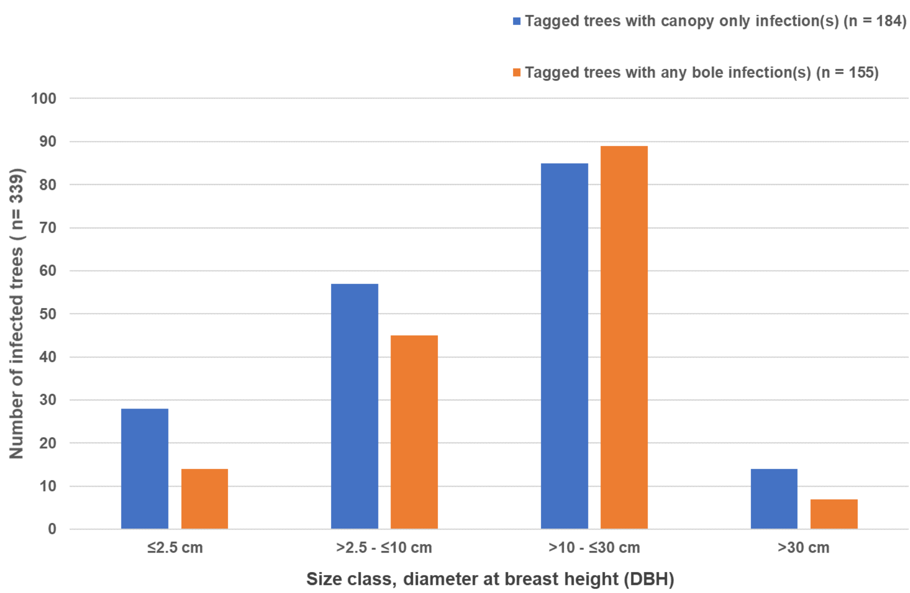


Figure 1. Blister rust infection was detected on 339 live whitebark pine trees during 2022 surveys of Panel 3 transects. Trees are grouped by size class and blister rust location (canopy only or bole infection).

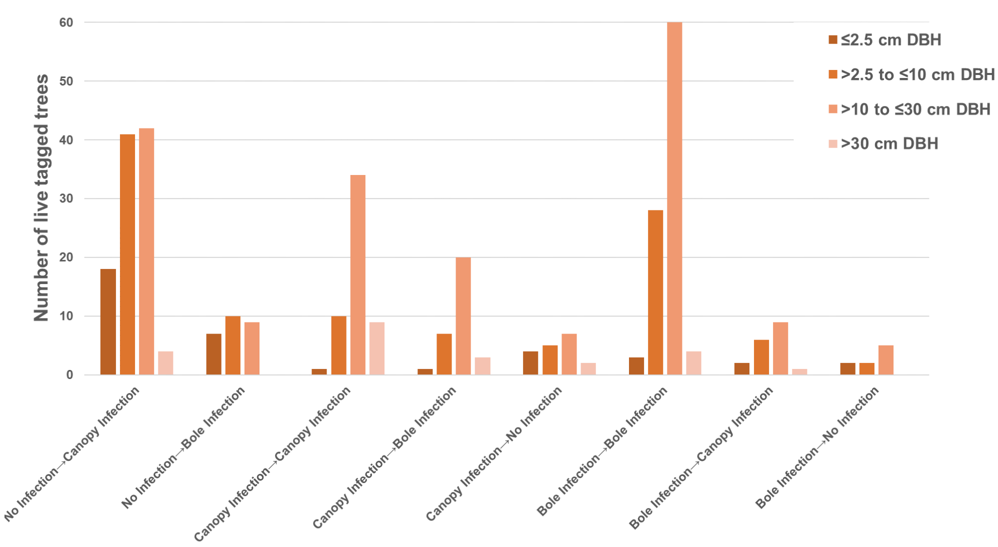


Figure 2. Infection transition status by diameter at breast height (DBH) category for live, tagged white-bark pine trees on Panel 3 transects surveyed in 2018 and again in 2022. The total count of live tagged trees surveyed in both years was 888.

Mortality

In 2022, we observed 52 newly dead tagged trees on Panel 3 transects (Figure 3). Of these, 12 (23%) were ≤2.5 cm DBH, 23 (44%) were >2.5 to ≤ 10 cm DBH, and 17 (33%) were >10 cm DBH. Twenty-five (48%) of the dead trees had evidence of blister rust infection from one or more previous surveys but no evidence of mountain pine beetle or fire effects. Ten dead trees (19%; 3 in the >2.5 to ≤10 cm DBH category and 7 in the >10 to <30 cm DBH category) had signs of a combination of blister rust, mountain pine beetle, and/or fire. The remaining 14 trees (27%) died of unknown causes. Eight (15%) of the dead trees had previously been recorded with evidence of cone production. Five Panel 3 transects no longer had live, tagged trees, but 4 of these were documented with five-needle pine regeneration (trees ≤1.4 m tall). Four of these transects experienced stand replacing burns: two burned in the 2007 Wicked Creek Fire on the Shoshone National Forest, one burned in the 2011 Norton Point Fire on the Shoshone National Forest, and one burned in the Millie Fire of 2012 on the Custer-Gallatin National Forest. The fifth transect with no live trees was documented with extensive mountain pine beetle damage.

Recruitment

We assessed recruitment for whitebark pines by the presence of cone-bearing trees (reproduction), seedlings and saplings in the understory (regeneration), and newly tagged trees surpassing 1.4 m in height.

In 2022, 186 live tagged whitebark pine trees on Panel 3 had cone production evidence (current year cones or previous year cone scars) and the majority of these reproducing trees (95%) had a DBH >10 cm (Figure 4). Of the trees with cone evidence, 91 (49%) had signs of blister rust infection, with 27 (29%) noted as bole infected.

We counted 2,373 understory five-needle pines (≤1.4 m tall) on 42 transects. This equates to a density of approximately 56 small trees per transect. Of the small trees, we observed 21 (1%) to be infected with blister rust.

We tagged 54 new trees over 16 transects that had surpassed 1.4 m tall since the last survey. Ten (18%) of the newly tagged trees had evidence of blister rust infection.

Whitebark Pine Protection and Restoration

Results from 2022 monitoring add to the growing dataset compiled by the Greater Yellowstone Ecosystem Interagency Whitebark Pine Monitoring Program. The program is a collaboration among national parks, national forests, and Bureau of Land Management lands in the Greater Yellowstone Ecosystem. This multiyear, landscape-wide whitebark pine dataset is available to inform management decisions across the region, including the recent US Fish and Wildlife listing of the whitebark pine as threatened under the Endangered Species Act in January 2023.

More Information

Erin Shanahan, National Park Service
Greater Yellowstone Network I&M Program
erin_shanahan@nps.gov, 406-581-0398

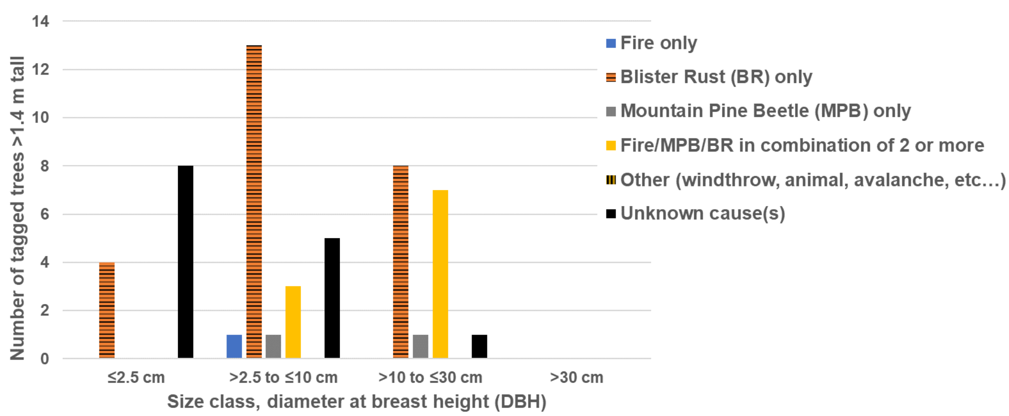


Figure 3. Fifty-two tagged whitebark pine trees were recorded as newly dead on Panel 3 transects in 2022. These trees are categorized by DBH size class and mortality influencing agent.

Figure 4. Reproducing whitebark pine trees grouped by the number of cones (cone bin) and DBH category on Panel 3 transects in 2022.

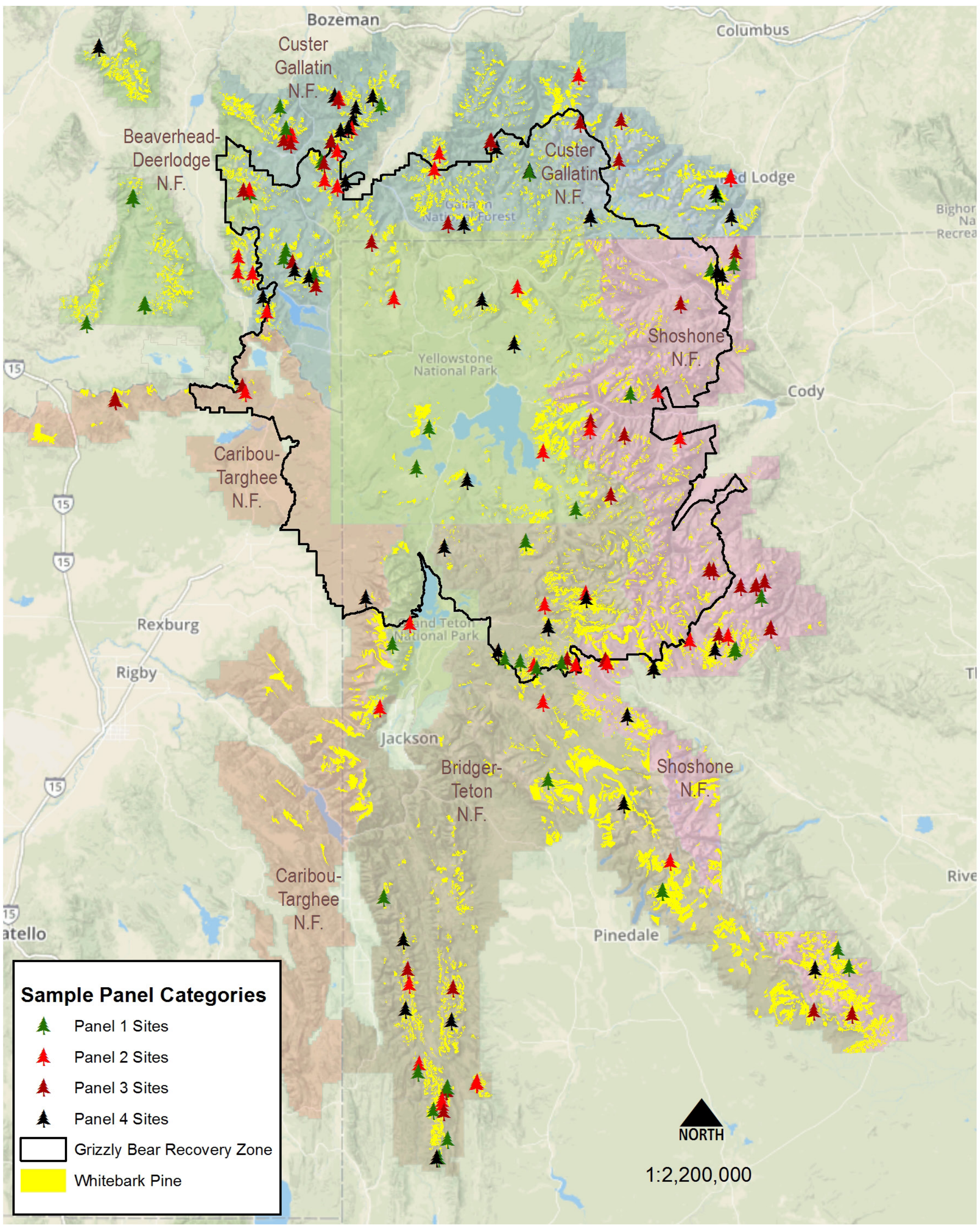
Methods and Study Area

The study area (see map) contains 176 transects, divided into 4 panels of approximately 43 transects each. We sample a panel of transects a year. Panel 3 transects were last surveyed in 2018.

Details of the sampling design and field methodology can be found in the Interagency Whitebark Pine Monitoring Protocol for the Greater Yellowstone Ecosystem, as well as in a web article series on NPS.gov titled, "Whitebark Pine Monitoring in the Greater Yellowstone Ecosystem."

Past monitoring reports are available on the Greater Yellowstone Network website: https://www.nps.gov/im/gryn/whitebark-pine.htm.

Monitoring data are available from the NPS Integrated Resource Management Applications portal at https://irma.nps.gov/DataStore/Reference/Profile/2209186.



Whitebark pine survey transects within the Greater Yellowstone Ecosystem.