Greater Yellowstone Network
RESOURCE BRIEF

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: 2021 Data Summary

Whitebark pine (*Pinus albicaulis*) are a keystone species in subalpine communities throughout the western United States. They provide high-energy food for birds and mammals. Their broad canopies 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, whitebark pine was proposed for listing as threatened under the Endangered Species Act by the U.S. Fish and Wildlife Service in December 2020.

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.

This brief summarizes results from visiting Panel 2 transects on national park and forest lands in the Greater Yellowstone Ecosystem.

Key Findings—2021—Panel 2 Trees

- Of the 844 live, tagged trees examined on transects, 318 (37%) showed signs of blister rust infection. Of these 318 infected trees, 196 (61%) had bole infections.
- The majority of live trees (57%) had no evidence of blister rust infection between 2017 and 2021, although 15% transitioned from uninfected to infected.
- We observed 40 newly dead trees since 2017.
- Of the 45 Panel 2 transects, 4 visited in 2021 no longer had live, tagged trees since monitoring first began at the panel.
- 53 new trees were added to the tagged, >1.4 m tall population.
- We counted 1,555 five-needle pines $\leq$1.4 m tall in understory plots. (Whitebark pine cannot be distinguished from limber pine (*Pinus flexilis*) as seedlings.)

Detailed Findings for Panel 2 Trees

Infection Status

We examined 844 live tagged trees in 45 Panel 2 transects for signs of blister rust infection in 2021. This number includes 53 new live trees added during the 2021 survey. Of the 844 live trees, 318 (37%) showed signs of blister rust infection. Of these 318 infected trees, 196 (61%) had bole infections (Figure 1).

Change in Infection Status

Comparing only trees surveyed in both 2017 and 2021 (786 trees), we found these changes in infection status:

- 447 (57%) remained free of blister rust infection evidence
- 200 (25%) had sign of infection in both years
- 113 (15%) developed evidence of infection over the 4 years
- 26 (3%) no longer showed evidence of infection by 2021 (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 (trunk) 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 2017 and again in 2021 (Figure 2). Twenty-seven (42%) of the 64 trees with canopy-only infections in 2017 that remained infected in 2021 transitioned to a more severe state of infection in the bole by 2021. This transition occurred in the larger size class trees >10 cm DBH.

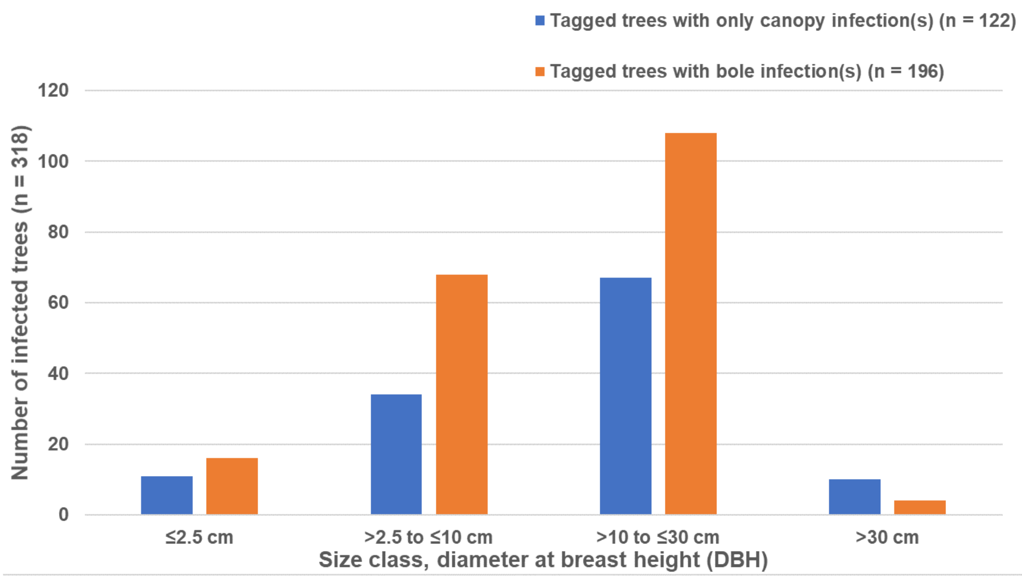

Figure 1. Blister rust infection was detected on 318 live whitebark pine trees during 2021 surveys of Panel 2 transects. Trees are grouped by size class and blister rust location (canopy only or bole infection).

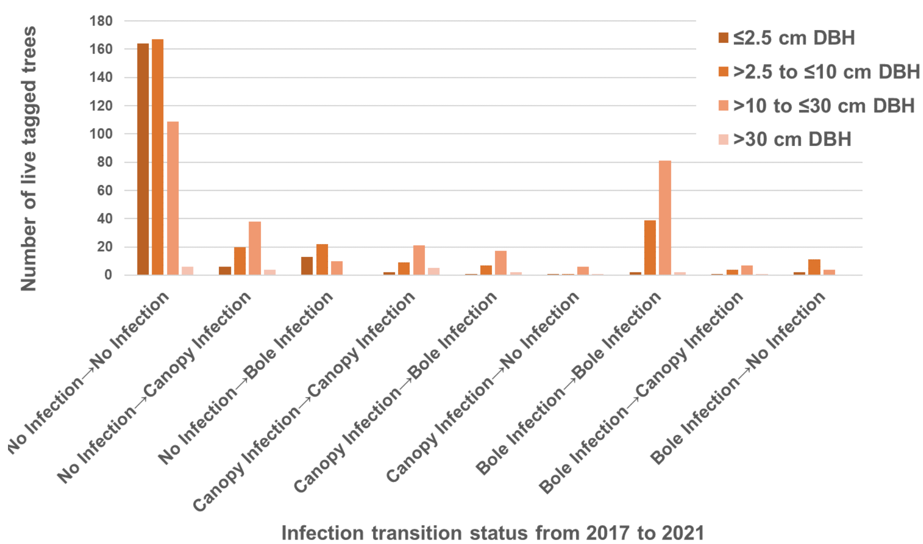

Figure 2. Infection transition status by DBH (diameter at breast height) category for live, tagged whitebark pine trees on Panel 2 transects surveyed in 2017 and again in 2021. The total count of live tagged trees surveyed in both years was 786. One tree in the "No Infection>No Infection" category had an unknown DBH measurement and is therefore not included in this figure.

Mortality

In 2021, we observed 40 newly dead tagged trees on Panel 2 transects (Figure 3). Of these, 12 (30%) were ≤2.5 cm DBH, 16 (40%) were >2.5 to ≤10 cm DBH, and 12 (30%) were >10 cm DBH. Thirty (75%) 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. One dead tree (3%) in the >10 cm DBH category had signs of both blister rust and mountain pine beetle. Of the remaining 9 trees, 6 (15%) died with sign from other causes and 3 (7%) died of unknown causes. Seven (18%) of the dead trees had previously been recorded with evidence of cone production. Four Panel 2 transects no longer had live, tagged trees, and only 1 was documented with five-needle pine regeneration (≤1.4 m tall). Three of these transects experienced stand replacing burns: 2 burned in the 2012 Millie Fire (Custer Gallatin National Forest), and 1 burned in the 2011 Norton Point Fire (Shoshone National Forest).

Recruitment and Understory Individuals

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 2021, 123 live tagged whitebark pine trees on Panel 2 had cone production evidence (current year cones or previous year cone scars) and the majority of these reproducing trees (96%) had a DBH >10 cm (Figure 4). Of the trees with cone evidence, 58 (47%) had signs of blister rust infection, with 27 (47%) noted as bole infected.

We counted 1,555 understory five-needle pines (≤1.4 m tall) on 42 transects; small trees were not counted on 2 transects due to snow cover, and on 1 transect likely supporting only limber pine. This equates to a density of approximately 37 small trees per transect. Of the small trees, we observed 26 (2%) to be infected with blister rust.

We tagged 53 new trees over 15 transects that had surpassed 1.4 m tall since the last survey. Three (6%) of the newly tagged trees had evidence of blister rust infection.

Whitebark Pine Protection and Restoration

Results from 2021 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 proposal in 2020 to list the whitebark pine as threatened under the Endangered Species Act.

More Information

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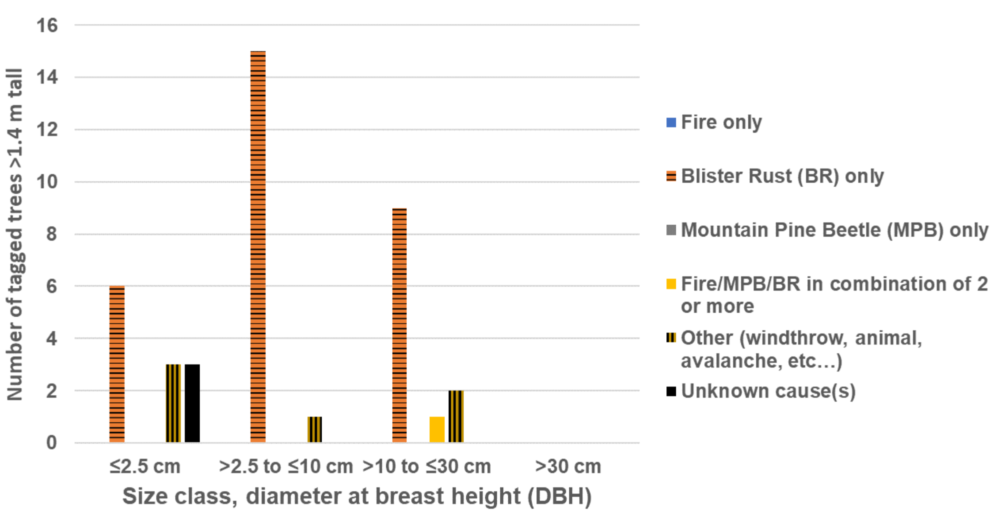


Figure 3. Forty tagged whitebark pine trees were recorded as newly dead on Panel 2 transects in 2021. These trees are categorized by DBH size class (diameter at breast height) and mortality influencing agent. Note that "fire only" and "MPB only" as a mortality agents were not observed in 2021.

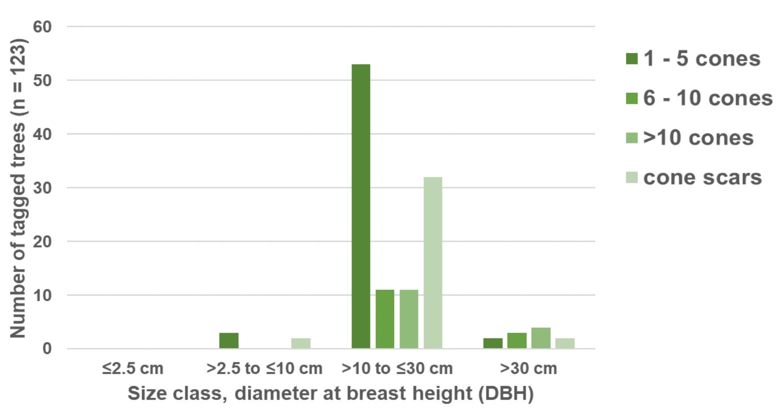


Figure 4. Number of cone-producing whitebark pine trees (123 total) grouped by number of cones visible (cone bin) and DBH category on Panel 2 transects in 2021. We observed no trees ≤2.5 cm DBH with evidence of cone production.

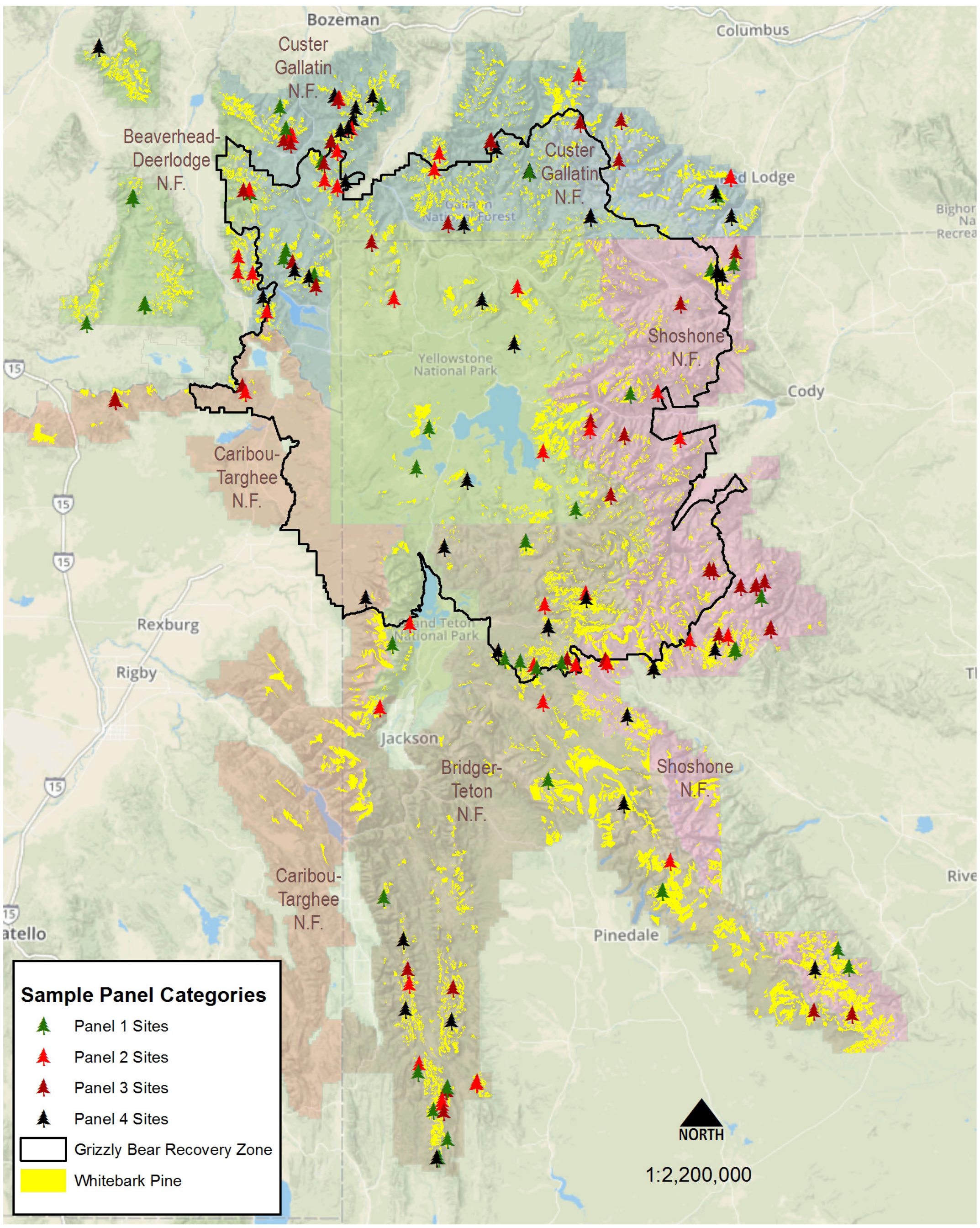
Methods and Study Area

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 2 transects were last surveyed in 2017.

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.