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Fuel Treatments in Whitebark Pine Forests: Limiting Whitebark Pine Mortality During Burning

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Whitebark pine and fire: The basics

Whitebark pine (WBP) is a federally threatened species that is easily killed by fire but also dependent on fire. In WPB forests, prescribed burning and mechanical fuel treatments can reduce competition from shade-tolerant conifers, improve vigor of surviving WBP, create openings to foster regeneration of WPB seedlings, and mitigate the risk of large, high-severity wildfires. Burning in WBP stands requires careful planning to avoid killing reproductively mature, cone-bearing WBP, as many of these may have some level of genetic resistance to the exotic pathogen that causes white pine blister rust. It is challenging to burn an area to reduce the density of competing understory and overstory trees, but not kill too many WBP trees. This document suggests ways to mitigate WBP mortality during burns and provides guidance on designing prescriptions for fuel treatments in WBP stands. These recommendations are geared for areas where the main objectives include WBP restoration and mitigating the likelihood of high WBP mortality in the event of a wildfire.

Fires can kill WBP immediately or contribute to delayed mortality in the years afterwards from injuries to the crowns, stems, and roots. Because WBP has thin bark, even light charring may kill the cambium and girdle the tree. Fire-caused injuries may also increase susceptibility to mountain pine beetle (MPB), especially during an outbreak. When planning prescribed burns, it is important to think about canopy and surface fuels and how the ignition pattern and season will affect fire intensity; this will minimize injuries to WBP. To reduce WBP mortality during burns, keep fire-caused injury below these thresholds:

- DBH less than 20 inches: limit crown scorch to less than 10 percent
- DBH greater than 20 inches: limit crown scorch to less than 20 percent
- Limit bark charring to less than 50 percent of a stem's circumference, regardless of char height

Trees with higher fire-caused injury values than these thresholds have a greater than 50 percent chance of dying within 3 years of a fire.

Crown scorch (orange needles) on a whitebark pine. This effect occurs when heated air from the fire is high enough to kill needles. USDA Forest Service photo by Sharon Hood, Rocky Mountain Research Station.

Bark char is a sign that the underlying cambium has been killed. USDA Forest Service photo by Sharon Hood, Rocky Mountain Research Station.

Deciding where to prescribed burn

Prioritize areas for prescribed burning based on the abundance and condition of existing WBP.

Good Candidate Areas

Whitebark pine forests that have dead and dying mature WBP, few or no cone-bearing living WBP, and lots of competing conifers are the best candidates for prescribed burning. If these areas have abundant, vigorous WBP regeneration, then mechanical treatment prior to burning is recommended where feasible. See *Landscape-scale treatment considerations* section if mechanical treatment is not feasible. Open areas and grasslands with encroaching conifers and scattered WBP are also good candidate areas if fuels are patchy.

- Rationale
  - Treatments are recommended in these areas because they are clearly WBP habitat, and burning will kill competing conifers and create caching or planting microsites to facilitate successful reproduction and stand resiliency. Also, few cone-bearing WBP trees are present to be killed.
  - If WBP regeneration exists but growth is suppressed by other conifers, they are likely very old and may not release to become cone-bearing trees in the future. In this case, it may not be worth trying to keep them. However, if vigorous WBP regeneration exists, these small trees could be released with prescribed burning if surrounding, competing conifers are killed.
  - In areas with this WBP condition, burning fosters future WBP regeneration without sacrificing many of the living WBP.
  - Maintaining openings creates landscape heterogeneity that fosters mixed-severity wildfires.

Marginal Candidate Areas

Prescribed burning should be avoided in areas with more than approximately 10 living, cone-bearing WBP per acre, unless extensive preparations are done prior to treatment to mitigate WBP mortality (see *Design features* sections below).

- Rationale
  - Typically, it takes 50 years or more for WBP to begin producing cones. Prescribed burning in stands with lots of cone-bearing WPB risks killing these trees and losing genetic diversity and opportunities for cross-pollination to produce seed for WBP recruitment for generations.
  - These areas may be more suitable for mechanical fuel treatments to reduce competing conifers, but not kill cone-bearing WBP

Areas to Avoid

Areas with highly-valued WBP genetics (e.g., Elite and Plus trees[1], Genetically Diverse Areas[2], plantations, seed collection zones, and seed orchards) should not be prescribed burned. Instead, use mechanical methods to reduce fire hazard by removing competing, non-WBP ladder fuels (lop and scatter slash outside the stand), pruning low-hanging WBP branches, and raking and scattering basal duff from 1 ft around healthy, larger WBP stems.

Whitebark pine stands with low competition from other conifers should not be prescribed burned.

- Rationale
  - Elite trees provide blister rust-resistant seed to grow genetically improved seedlings for planting.
  - Burning in WBP areas with identified rust resistance risks killing these critically important and regionally-designated genetic resources.
  - If these stands have high competition from non-WBP species, they are a high priority for mechanical treatment to reduce the likelihood of intense wildfire and increase the health of Elite and Plus trees by reducing competition and fuels.
  - In areas with low competition, fire is not needed to release WBP and risks killing existing WBP.

1 Trees that show resistance to white pine blister rust

2 As defined by Forest Service Region 1

Design features for mechanical fuel treatments

Mechanical treatments can reduce ladder and canopy fuels around WBP to help protect trees from high crown scorch and bark char during fire. These treatments can involve using harvesting equipment and/or hand crews. But these treatments can also generate high surface fuels that could cause injuries to WBP if burned during prescribed fire or wildfire without additional fuel reduction treatments or activities. Coordinate with the Regional or Forest silviculturist and botanist to develop site-specific silviculture prescriptions (e.g., DBH, slash/pile distance, etc.) for any vegetation treatments. When planning mechanical treatments, consider ways to reduce heavy fuels around larger WBP trees and from clumps of vigorous WBP regeneration, such as:

- Pull back logs (i.e., 1,000-hour fuels) and slash from under the dripline of larger WBP
- Locate slash piles such that the pile edge is at least 15 feet from the dripline of larger WBP
- Cut most non-WBP regeneration surrounding larger WBP and from clumps of vigorous WBP regeneration, making sure to throw slash away from WPB.

Design features for prescribed burns and wildfire burnout operations

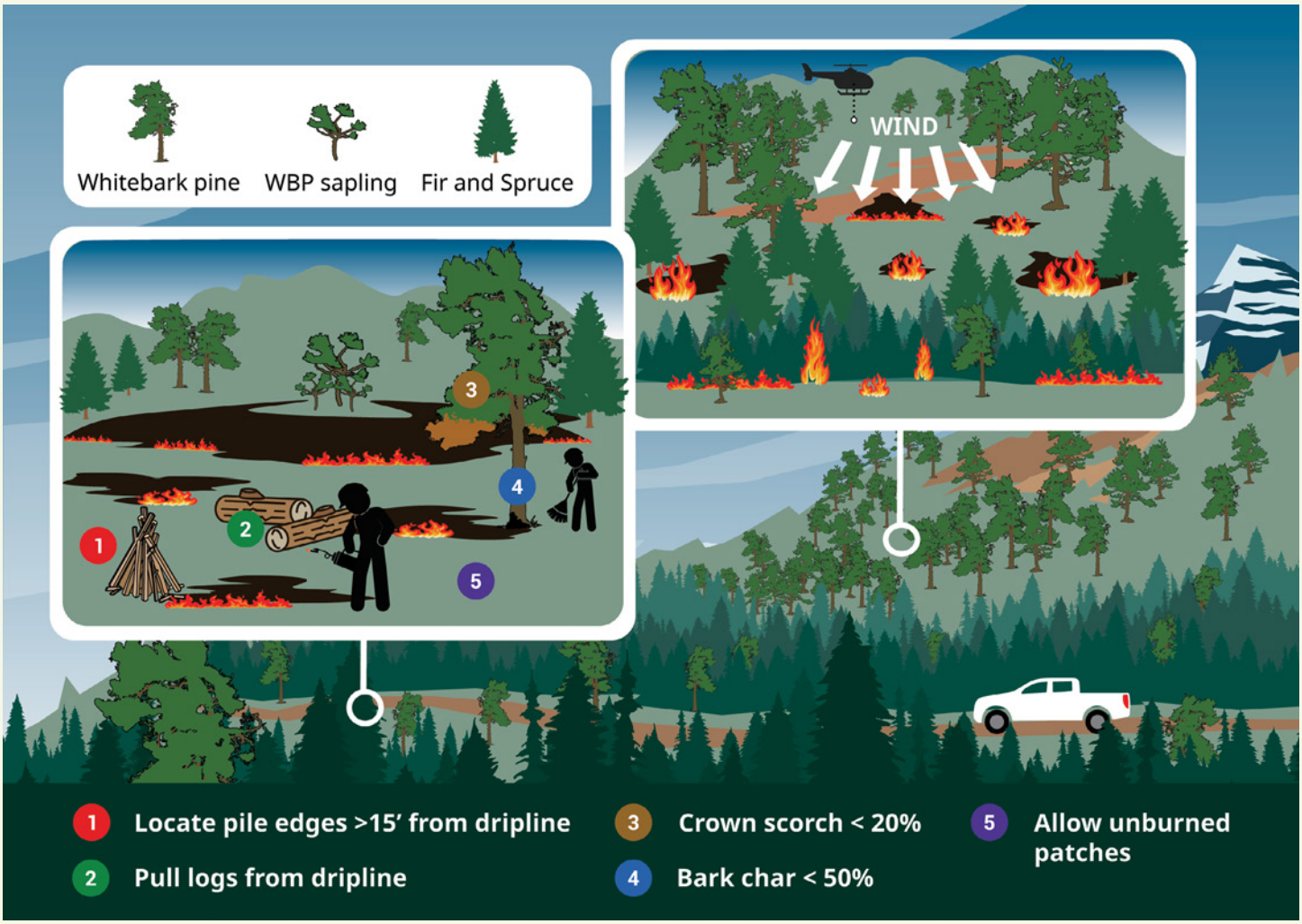
Prescribed burns can kill competing conifers and consume fuels to create good cache sites for WBP seeds and improve WBP forest resilience. However, even low-intensity fires can kill WBP due to thin bark. Other conifer species that typically grow with WBP also have thin bark, and it is possible to also kill these trees with low-intensity burning. When planning prescribed fires, coordinate with the silviculturist and botanist and consider ways to ignite units to limit injuries to WBP and prevent high levels of WBP mortality. If the fuel load is high, pile burns may be better than broadcast burns because there is more control over which areas burn, and heavy fuels can be concentrated away from WBP. In areas with few mature WBP (<10/acre) and lots of non-WBP conifers, broadcast burns may be preferable and more cost effective in reducing competition and creating microsites for seed caching and planting across a larger area.

For broadcast burns:

- Create patchy burns that leave areas of WBP regeneration unburned.
- Spring burns may allow for patchier burns due to higher fuel moistures.
- Create handline around patches of healthy, vigorous WBP regeneration to encourage unburned patches.
- Remove duff from 1 ft around the base of larger, healthy WBP trees with a rake or blower, making sure to scatter the material well away from the base.
- Use ignition techniques that foster low flame lengths.
- Couple mechanical fuel treatments with prescribed burning to remove excessive fuel around WBP trees, especially cone-bearing trees with observable rust resistance.
- Avoid igniting near or around the base of any living WBP tree, regardless of size.
- Avoid cutting WBP, especially healthy cone-bearing trees, when prepping for burns. Reroute fire lines instead.

For pile and jackpot burns:

- Avoid placing piles near heavy fuels that may spread and burn away from the piles.
- Burn in spring when piles are wetter and less likely to spread.
- Burn under colder temperatures to reduce crown scorch to surrounding WBP trees.
- Scratch handlines around piles to prevent spread.
- Locate piles/jackpots in openings at least 15 feet away from larger/cone-bearing WBP and concentrations of WBP regeneration as much as possible to avoid injury to those trees.



Fuel treatment considerations in whitebark pine forests vary by objectives and location. The left inset describes considerations when burning where mechanical treatment is feasible, the right inset shows considerations in remote areas. See *Design features* and *Landscape-scale treatment considerations* sections for more details.

Examples of ways to increase survivability of high-value trees before burning or in advance of a wildfire. Left photo: Around the Elite tree in the center, the smaller trees were cut and cleared away from the dripline, 1,000-hr fuels were moved outside of the dripline, piles were placed more than 15 ft from the crown edge, and duff was raked away from around the bole. Right photo: lower limbs are pruned, especially on the uphill side of the tree—where flames tend to be higher—to reduce the possibility of crown scorch. USDA Forest Service photos by Erin Hooten, Bridger-Teton National Forest.

Landscape-scale treatment considerations

Where large-scale treatments and/or inaccessibility limit mechanical treatments options, treatment goals should focus on creating a heterogenous forest structure that will foster heterogenous fire behavior should a wildfire occur. A major goal for large-scale prescribed burning treatments in WBP forests is to minimize the risk of large, high-severity wildfires that could potentially have negative effects on hundreds to thousands of acres of WBP habitat. Large-scale prescribed burns can create a mosaic of forest structures (i.e., pattern) that both encourages different fire effects and improves the success of fire suppression operations in the event of a wildfire. Although this type of prescribed fire will undoubtedly kill some existing WBP, it could reduce the likelihood of much higher losses from large wildfires. Good candidate areas for large-scale prescribed burning are generally the same as previously identified, with the focus being on identifying large, continuous seral WBP pine forested areas (i.e., those with high levels of competing conifers compared to climax WBP forests) with a high risk of high-severity wildfire. If there are areas of healthy WBP within the planned landscape-scale burn unit, follow the design feature recommendations to protect the cone-bearing trees to the extent possible. In addition, consider:

- Implementing fall burns within days of an anticipated season-ending weather event. This will allow safe containment while minimizing the need to construct firelines.
- Igniting burns using a patchy, grid pattern toward the top of ridges, predominantly in areas of mixed-conifer/seral WBP forests and away from climax WBP.
- Igniting burns when downslope winds align with the terrain to allow fire to back down the slope and run up in fingers to encourage a range of fire behavior and effects.
- Using plastic sphere dispensers (PSD) ignition to create a range of fire intensities and patches more effectively than helitorch ignition.

Mountain pine beetle considerations

Susceptibility of WBP stands to MPB depends on stand characteristics (e.g., composition, density, and diameter). The risk of stands to MPB attack also depends on local insect pressure. Prescribed burning can cause additional stress to WPB from crown scorch and bark char-related injuries. The resulting effects on volatile organic compounds, insect attraction, and host tree survival vary.

WBP with pitch tubes from mountain pine beetle attack. USDA Forest Service photo by Sharon Hood, Rocky Mountain Research Station.

Conclusion

Prescribed burning in whitebark pine (WBP) stands takes careful planning to mitigate fire-caused tree mortality. WBP is sensitive to fire, so keep crown scorch and bark char levels low and allow for unburned patches. Mechanical treatment prior to fire may be needed. Also, mountain pine beetle populations should be considered prior to burning. Where large-scale prescribed burns are planned and mechanical treatment is not feasible, prioritize large, continuous forested areas that are at risk of burning in a large, high-severity wildfire and implement ignition strategies that create a mosaic of resulting forest structures. Whitebark pine forests are the legacy for the future so it is important that we keep them on the landscape as long as we can.

Further reading and resources

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This document is intended to provide guidance about prescribed burning and other fuel treatments in WBP forests. Further coordination with the silviculturist and botanist is required when developing a burn plan in WBP habitat on USDA's Forest Service lands to ensure that the abundance, condition, and life stage of WBP is adequately evaluated so appropriate design features are deployed. Work with your Forest Health Protection Entomologist to protect larger trees from MPB and to learn if burn timing is appropriate based on the current bark beetle pressure in the area. Resource Advisors knowledgeable of WBP should be used on wildfire incidents.

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Forest Service employees can see the Northern Region WBP website for additional information.