

Whitebark Pine
Management Guidelines for Idaho BLM
November 18, 2014
Attachment 2

Overview:

These guidelines provide direction on how to manage whitebark pine (*Pinus albicaulis*) found on BLM administered lands in Idaho. Our goal is to conserve and maintain whitebark pines and associated habitats on BLM lands with the associated impacts of changing climates, disease (white pine blister rust (*Cronartium ribicola*) and mountain pine beetle (*Dendroctonus ponderosae*) outbreaks. Priority actions are to:

- A. Restore areas where whitebark pine habitat has been affected by mountain pine beetle (MPB), fire, or white pine blister rust (WPBR) by planting whitebark seed or seedlings, thinning competing trees, or pruning tree infected limbs. Seedlings for planting shall be from rust resistant stock from appropriate seed/breeding zones or from phenotypically rust-free individuals.
- B. Increase levels of genetic resistance in whitebark pine populations through tree selection, blister rust resistance screening, scion and pollen collection, and by planting rust resistant seedlings.
- C. Collect whitebark pine seed samples across BLM habitats and protect in long-term storage. Coordinate collections with BLM Seeds of Success, USFS Whitebark Pine Restoration Genetics Program, and Plant Genetic Resources Preservation Program-National Center for Genetic Resources Preservation.
- D. Evaluate areas where health, stand condition, and restoration needs are unknown. Complete FORVIS compliant forest inventory, install and monitor disease (e.g., WPBR) insect (e.g., MPB) and recruitment on belt transects, use remote sensing methods for landscape scale assessments and inventory.
- E. Work collaboratively with research scientist and land managers in other agencies to increase understanding of the non-linear and synergistic impacts of blister rust, fire, mountain pine beetles and climate change. Address unknown impacts to whitebark pines through research.

The ecology, threats and strategies to restore whitebark pine have been documented in peer reviewed literature, publications by the USFS Research Stations, volumes and on-line resources. Some important references include:

- a. A Rangewide Restoration Strategy for Whitebark Pine (*Pinus albicaulis*), (Keane et al. 2012).
- b. The Silvics of Whitebark Pine, (Arno and Hoff 1989, 1990)

- c. *Whitebark Pine Communities, Ecology and Restoration* (Tomback et al. 2001)
- d. *Whitebark Pine Restoration Strategy for the Pacific Northwest Region, 2009-2013* (Aubry et al. compilers, USDA-FS 2008a)
- e. *Land Managers Guide to Whitebark Pine Restoration in the Pacific Northwest Region 2009-2013* (Shoal et al. USDA-FS 2008b).
- f. *Whitebark Pine in Peril, A Case for Restoration* (Schwandt, USDA-FS 2006a)
- g. *Management Guide to Ecosystem Restoration Treatments: Whitebark Pine Forests of the Northern Rocky Mountains, USA* (USDA-FS 2009 in prep)
- h. *Whitebark Pine Conservation for the Canadian Rocky Mountain National Parks* (Wilson and Stuart-Smith, 2002)
- i. *Options for the Management of White Pine Blister Rust in the Rocky Mountain Region* (Burns, et al.-USDA-FS 2008b)
- j. *Mountain Pine Beetle Impacts in High-elevation Five-Needle Pines: Current trends and Challenges* (Gibson et al. USDA-FHP, 2008).
- k. *The Future of High-Elevation Five-Needle White Pines in Western North America. Proceedings of the High Five Symposium, 28-30 June, 2010. Missoula, MT. Proceedings RMRS-P-63. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 376 p. (Keane, Robert E.; Tomback, Diana F.; Murray, Michael P.; Smith, Cyndi M., eds. 2011)*
- l. *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. 29 p. (Shanahan et al. 2014)*

BLM foresters, botanists, Threatened & Endangered specialists and ecologists should refer to online resources for ecological background, research, monitoring methods and suggested management applications. “*A Restoration Strategy for Whitebark Pine (Pinus albicaulis) on Bureau of Land Management Administered Lands in the Western United States*” is in preparation for 2015 release.

Project Review:

Silvicultural prescriptions, cone collections and plantings shall be reviewed by the Idaho BLM State Forester and/or Idaho BLM Five-Needle Pine Coordinator during the NEPA planning stage, and before implementation. Field Offices need to evaluate the objectives of projects that involve whitebark pines to ensure that maintaining this sensitive species on the landscape is evaluated with other management objectives.

Ecology:

Whitebark pine is a long-lived, slow growing, five-needle pine of high elevation ecosystems in North America. It is often the only conifer to occur near tree-line in cold, windswept subalpine

areas. It is considered both a keystone and a foundation species, stabilizing soils, providing watershed protection and creating habitats that support a wide diversity of animals and plants. The large wingless seed is a nutritious food source, (52% fat) to both black and grizzly bears and numerous birds and animals. Whitebark pine seeds are not wind dispersed; they develop in indehiscent cones (i.e. cones scales do not open) that are harvested by Clark's nutcracker (*Nucifraga columbiana*). Nutcrackers cache or consume seeds and those not retrieved from caches may germinate and become established as seedlings.

Whitebark pine occurs as climax alpine species (self-replacing after disturbance), a krummholz form in communities above tree line, or as a seral species or climax co-dominant with other conifers such as subalpine fir (*Abies lasiocarpa*), lodgepole pine (*Pinus contorta*), Douglas-fir (*Pseudotsuga menziesii*), Engelmann spruce (*Picea engelmannii*), and other conifers. Whitebark pine is moderately shade-intolerant and faster growing conifers may replace whitebark pine over time in natural succession process. Whitebark pine is monoecious conifer (both male and female reproductive structures occur on the same individual) and reaches reproductive age at approximately 50 years. Small size may be a poor indicator of recent establishment.

Threats and Disturbance:

White Pine Blister Rust

Whitebark pines (and limber pine) are declining throughout most of their range from a combination of disease, insects and succession. The accidental introduction of WPBR from France in the early twentieth century has resulted in severe mortality to nearly all of our five-needled pines including whitebark pine. This introduced fungus completes its lifecycle with the most common alternate hosts, currant shrubs (*Ribes spp.*) creating a re-infection cycle between alternate host and pine. Years of high levels of infestation (“wave years”) are influenced by environmental factors, including, precipitation, temperature, and proximity to alternate hosts. Individual stands vary in their resistance to WPBR due to local genetic material and environmental conditions. WPBR often takes 25-35 years to kill a mature tree but only five years to kill a sapling. WPBR severely reduces cone crop production, often eliminating a living tree from the reproductive pool by killing the cone producing limbs long before the tree actually dies. Thus the disease impacts reproduction in two ways: by killing the upper reproductive seed bearing portion of the crown and by killing trees outright.

Mountain Pine Beetle

While the *non-native* fungus, white pine blister rust, is recognized as primary threat to whitebark pine persistence, the principal *native* mortality agent of whitebark pine is the mountain pine beetle (MPB), a bark beetle of western pines. It is recognized as an aggressive forest insect responsible for tree mortality across large areas, and an integral component of forest ecosystem dynamics for its role in stand thinning and redistribution of resources and nutrients for tree regeneration. Periodic outbreaks are known from the historic and prehistoric record in several host species including whitebark pine. The current ca. 2000 west-wide North American outbreak is devastating high elevation five -needled pines throughout most of their range. Over six million high elevation five needle pines (whitebark, limber, Rocky Mountain bristlecone, Great Basin bristlecone (*Pinus longaeva*) and foxtail pine (*Pinus balfourinana*) have been killed in the past

five years across nine western states; whitebark pine losses are the greatest, followed by limber pine; and the epidemic is expected to continue (Gibson 2009). Epidemiological theory and epidemic history indicates that mortality levels could increase until most of the suitable hosts (prey) are killed and the predator population level collapses.

Mountain pine beetles complete most of their life cycle under the bark where they disrupt the connectivity of the water transport system of the tree, killing the tree by mechanically girdling the stem with adult and larvae galleries in the phloem, and introducing a blue stain fungus that inhibits water transport. Beetles have a complex chemical interaction with each other and with the tree to develop a mass attack strategy to overpower host tree defenses. Beetle life cycles generally take one to two years, and much research (empirical, laboratory and modeling) has been undertaken to understand the causes of life cycle variability and to forecast life cycle changes with changing climate. Once mass attacked by mountain pine beetles, indicated by scores of pitch tubes on the bole and boring dust (frass) at the base of the tree, foliage fades to a red or orange color the following year. Some individuals may not fade for two years.

Silvicultural Considerations (Actions):

Mechanical Stand Structure Treatment: Mechanical treatments including eliminating or thinning competing species such as lodgepole pine, subalpine fir, and Douglas-fir are recommended to release and maintain whitebark pine dominance in some stands. Whitebark pines that appear to be rust resistant should not be harvested. Trees with WPBR symptoms may still have resistance, so careful evaluation thinning versus retention is needed.

It has been well established that tree size, age, and stand density are factors correlated with tree mortality. High stand density, basal area of whitebark pines greater than 44 ft²/acre, and tree size (DBH > 7") were correlated with the probability that individual whitebark pines and stands were attacked during reconstructed historic mountain pine beetle outbreak from 1909-1940. Although density thresholds were different, this result was consistent with studies of other pines. The implication for management is that a reduction in stand density increases resilience and vigor of whitebark (and limber) pines and perhaps increases their probability of surviving a MPB outbreak.

Stand Density Index (SDI) diagrams from Forest Service, Forestry Analysis Inventory data have recently been developed to provide thresholds for density management regimes for whitebark pine (e.g. self-thinning trajectory, maximum relative density, etc.). Specific silvicultural operations, treatments and prescriptions for seral and climax five needle pine stands have been described in Wyoming BLM's Management Guidelines at <http://www.blm.gov/style/medialib/blm/wy/programs/forestry.Par.89552.File.dat/wb-lp-MgmtStrat.pdf>. Density management by elimination of whitebark pines, ostensibly to make stands more resistant to mountain pine beetles, constitutes a trade-off with the potential loss of WPBR resistant individuals, and if proposed in Idaho, would need approval from the State Forester or Five-Needle Pine Coordinator.

Because whitebark pine and Clark's nutcracker are evolved in a mutualistic relationship, the occurrence of whitebark pine is dependent on the caching behavior of the nutcracker. Research has indicated that Clark's nutcrackers prefer areas with cone production of approximately 400

cones per acre (1000 cones/ha) with a live whitebark pine minimum basal area (BA) of 22 ft² / acre (5m²/ha). In areas with a BA of less than 22 ft², or a production of less than 120 cones per acre, there is a rapid decline in the frequency of the nutcracker, until at less than 53 cones per acre; Clark's nutcracker activity becomes negligible. This results in a significant decline in the probability of seed dispersal. The current scientific recommendation is that a threshold of approximately 400 cones per acre is needed for a high probability of nutcracker presence for seed dispersal.

Cone (Seed) Collection: Cone collection efforts are central to whitebark pine restoration for three reasons: (1) blister rust resistance testing, (2) restoration plantings, and (3) *ex-situ* gene conservation. The collection of blister rust resistant seed has been the focus of genetic restoration. Idaho BLM participates in the USFS - Whitebark Pine Genetic Restoration Project (Mahalovich and Dickerson 2004-http://www.fs.fed.us/rm/pubs/rmrs_p032/rmrs_p032_181_187.pdf.) identifying and collecting seed from whitebark pines in the Bitterroot-Idaho Seed Zone. This restoration program was initiated in 2001 as a multi-statewide effort (Idaho, Montana, Oregon, Nevada, Washington and Wyoming) designating permanent leave-trees (plus trees), emphasizing live un-attacked trees in areas of high mountain pine beetle incidence or blister rust-free or nearly free, trees in areas of high white pine blister rust incidence. Cone collections from these trees will provide a source of seed for fire restoration, reforestation, *ex-situ* and *in-situ* genetic conservation, and seedlings to be screened for blister rust resistance.

Seed tree selection involves finding, marking and assigning identification number to trees that are free of both white pine blister rust and have not been attacked by MPBs. Trees need to be marked and located with a Global Positioning System so that they can be relocated for further collections if testing determines that these trees are WPBR resistant. This information will be stored on a Geographic Informational Systems data layer at the Districts, and State Office. The entire process, from cone collection to rust resistance determination, takes approximately five years, so these trees need to be protected from both natural and human disturbance until the determination is made. Trees either tentatively or positively identified as "plus" trees need to be protected by pheromones or insecticides (see next page) if MPB pressure is evident. Live and dead fuels around trees shall be removed to protect potential plus trees from wild fire. Trees and shrubs (except for other whitebark pines) would be cleared for a distance of 20 feet around each plus tree that is in a forested stand to prevent high-residence fire capable of girdling these trees, or providing ladder fuels that could result in the tree crowning out. Small trees and brush would be cut and scattered outside the 20 foot perimeter, larger trees would be directionally felled to deposit the crowns as far outside the 20 foot perimeter as possible. Trees in meadows and rocky areas may not need to be treated with fuel reduction.

Whitebark pine seed collection procedures can be found in the on-line five needle pine references. Collections are normally conducted, dependent on site and climatic conditions, in late August or early September when seed embryo fills at least 80% of the seed cavity.

Because of the workload associated with identification of potential plus trees, as well as the seed collection, it is recommended that Field Offices pursue one-time funding from sources such as

USFS Forest Health Protection, Health Lands Initiative and Seeds of Success program to assist in funding, coordinating and implementing seed collections.

Seedling Planting: Seedlings from these trees have a fairly low survival rate ranging from less than 30 to approximately 70 percent. Seedlings should be planted in the autumn, to avoid summer drought stress, at approximately 200-250 seedlings per acre with the goal to have a three to five year survival of 85-100 trees per acre. There should be no overstory competition within 20 feet. The planting design should be a patchy pattern with densities similar to that of nearby stands. Microsite placement is critical. The transplants should be placed in a protected microsite in moist to the touch soil on the north side of a log, rock, or stump. Gophers feed on roots and bury trees, so avoid planting the seedlings in areas of deep soils and swales where they burrow. Competing vegetation such as grasses and sedges should be removed from the immediate vicinity of the planted seedling. Avoid planting seedlings within two feet of bear grass (*Xerophyllum tenax*). On more mesic sites, grouse whortleberry (*Vaccinium scoparium* Leib. ex Coville) appears to be beneficial to establishment when growing in association with whitebark pine and should be retained. Lower elevation xeric sites may not have these vegetative components. Current recommendations for planting with WPBR resistant seedlings include: 1- sites where WPBR mortality exceeds 20 percent and; 2- WPBR infection is more than 50 percent.

Chemical Protection From MPB:

Beetle suppression efforts include the use of the insecticide, Carbaryl (1-naphthyl methylcarbamate), which protects trees from beetle for two years when applied to the entire bole. Carbaryl must be applied with high pressure spray devices and accessibility to trees has limited its use in close proximity to roads. This insecticide when properly applied by spraying can provide almost 100 percent protection from MPB attack for up to two years.

Verbenone (4, 6, 6-trimethyl-bicyclo (3.1.1) hept-3-en-2-one) an anti-aggregating pheromone, can be used to protect trees from MPB attack in remote locations. Recent work in central Idaho on whitebark pine shows a 100 percent increase in survival over a control population when verbenone pouches are applied to individual trees. USFS Forest Health Protection entomologist can provide current recommendations for pheromone use.

Pruning White Pine Blister Rust:

Pruning can be used to extend the life of a whitebark infected with WPBR. Pruning should be done by hand, leaving the branch collar (swollen base of the limb) intact. This should only be used on limbs where the WPBR canker is more than 4 inches from the bole (trunk) of the tree. Because pruning is labor intensive it should be used to: 1- to protect high value individual trees in high visibility sites such as recreational/ski areas or, 2- in a small isolated stand with few cone bearing trees and no existing seed source for regeneration. Pruning will not change the WPBR resistance of an individual tree or stand, but will extend the life span and potential reproductive life of the tree. It may also delay the spread of WPBR until known rust resistant families can be planted.

Fire Management: Wildland fire has been an integral component of the whitebark pine ecosystem. At high elevations, low to moderate intensity fires reduce competing vegetation and

reduce fuel loadings. Small areas of high intensity fires create open areas for Clark's nutcracker seed caching activities and therefore create areas where whitebark pine can regenerate naturally. However, when subalpine fir has expanded extensively into, and provides a closed canopy fuel load below them, these stands can burn large areas of five needle pine habitat and reduce or eliminate the available seed source. The potential for natural reseeding of these stands by the Clark's nutcracker is subsequently reduced. Some researchers have found a 40 year lag time between fire and the re-establishment of whitebark pine on these high elevation areas.

At high elevations, wildland fire should be allowed to play a role in maintaining these high elevation five needle pine ecosystems. A combination of mechanical thinning and prescribed fire can also be used to create the patchy mixed severity fire effects in these stands, replicating natural fires. Altering the mixed conifer stands below these high elevation stands may be necessary to break up and reduce the canopy cover by creating patches of younger aged (less flammable stands), and reducing the basal area/SDI of the mature mixed conifer stands to reduce fire behavior before it burns into the high elevation stands. Because many of the Idaho BLM high elevation whitebark pines exist in small isolated stands, careful evaluation of fire potential must be done to ensure that these disjunct stands are not eliminated from the landscape.

At lower elevations, prescribed and wildland fire can be used at low to moderate intensities to reduce accumulated fuels and thin the stands. The best description of this is to "take some and leave some", so that the stand can remain on the landscape and provide for gene conservation and ecosystem services.

Fuel reduction around plus trees is essential to protect them from mechanical damage and fire.