United States Department of the Interior

FISH AND WILDLIFE SERVICE
334 Parsley Boulevard
Cheyenne, Wyoming 82007

In Reply Refer to:

January 17, 2023

Memorandum

To: Assistant Regional Director, U.S. Fish and Wildlife Service, Ecological Services, Lakewood, Colorado

From: *for* Field Supervisor, U.S. Fish and Wildlife Service, Wyoming Field Office, Cheyenne, Wyoming NATHAN DARNALL Digitally signed by NATHAN DARNALL Date: 2023.01.17 14:40:48 -07'00'

Subject: Standing Analysis for Effects to Whitebark Pine (*Pinus albicaulis*) from Low Effect Projects and Whitebark Pine Restoration and Recovery Activities within Montana and Wyoming

On December 15, 2022, the U.S. Fish and Wildlife Service (Service) published a final rule to list the whitebark pine (*Pinus albicaulis*) as threatened under the Endangered Species Act of 1973, as amended (Act; 16 U.S.C. 1531 *et seq.*) (87 FR 76882). The attached Standing Analysis was developed to expedite the consultation process for ongoing maintenance and management actions, new development or construction projects that will damage or kill small numbers of live whitebark pine, and for activities that are beneficial for the restoration or recovery of whitebark pine within Montana and Wyoming. The Standing Analysis considers the range-wide status of the species, the status of whitebark pine within Montana and Wyoming, including threats and the impact of ongoing activities and conservation efforts. The Standing Analysis evaluates these factors and the effects to whitebark pine from recovery activities and other actions considered to have low effects, along with cumulative effects. Based on the Standing Analysis, we developed a determination key to be used in the Service's online Information for Planning and Consultation (IPaC) system.

Federal agencies or their designated representatives may use the determination key in IPaC for consultation. Information submitted online (e.g., project description and location, responses to questions about the project) is evaluated by a determination key in IPaC to ensure that projects fall within the scope of what is analyzed in the Standing Analysis. The Standing Analysis provides the basis for Service concurrence with "may affect but not likely to adversely affect" determinations. The Standing Analysis documents the Service's analysis for a wide variety of small effect actions and activities, and the Standing Analysis can be readily updated with new information.

The determination key in IPaC will be used to evaluate potential effects to whitebark pine from individual projects. Based on the information provided in IPaC, the determination key may confirm that a project either (1) is not anticipated to have any effect on the whitebark pine, or (2) "may affect but is not likely to adversely affect" the whitebark pine. Projects falling into these categories will receive a response either acknowledging the "no effect" determination or concurring with the "may affect but is not likely to adversely affect" determination. Projects that fall outside the bounds of the Standing Analysis and projects that "may affect and are likely to adversely affect" whitebark pine, even if they are addressed in the Standing Analysis, are not part of the online determination key in IPaC at this time.

No Effect (NE) Determination

Based on the Standing Analysis, projects within the area of influence (species range) but for which whitebark pine are not present and projects involving only dead trees (no live seedling, sampling, or mature trees) will have no effect (NE) on whitebark pine. Concurrence from the Service is not required for NE determinations; however, IPaC will deliver a letter documenting the outcome of the determination key.

May Affect, Not Likely to Adversely Affect (NLAA) Determination

The Standing Analysis concludes that projects occurring more than 10 meters (33 feet) from any live whitebark pine trees (seedling, sapling, and mature trees) will result in insignificant, discountable, or wholly beneficial effects to the whitebark pine, resulting in a "may affect, not likely to adversely affect" (NLAA) determination (more specifically described in the Standing Analysis). We also anticipate that agencies will implement the appropriate conservation measures from the Standing Analysis and adhere to the most recent best management practices to minimize impacts to whitebark pine.

It is the federal agency's responsibility to make a final effect determination for potential impacts resulting from actions they conduct or permit and to confirm that the project is consistent with the determination key's questionnaire and output. This letter only addresses whitebark pine. If other listed species or critical habitat occur within a project area or may be affected by a project, a separate consultation with the Service may be necessary.

Questions regarding this memo or responsibilities under the Act should be directed to the Wyoming Ecological Services Field Office at the letterhead address, by email at WyomingES@fws.gov, or by phone at (307) 772-2374.

EXECUTIVE SUMMARY

On December 15, 2022, the U.S. Fish and Wildlife Service (Service) published the final rule to list the whitebark pine (WBP) (*Pinus albicaulis*) as a threatened species (87 FR 76882) under the Endangered Species Act of 1973, as amended (Act; 16 U.S.C. 1531 et seq.). The Service also published a final 4(d) rule for WBP that identified actions necessary for the conservation and recovery of the species and included prohibited acts as well as a limited number of exceptions to the prohibited acts (87 FR 76882). Previously, on December 2, 2020, the Service published a proposed rule to list the WBP as threatened with a proposed 4(d) rule under the Act (85 FR 77408). No critical habitat was proposed for WBP. Section 4(d) rules cannot and do not absolve federal agencies of their consultation requirements under section 7 of the Act.

This Standing Analysis provides a basis for section 7 consultation for activities that are not prohibited by the 4(d) rule (see Appendix A for more information on the 4(d) rule). The analysis in this Standing Analysis (SA) evaluates effects to WBP from a variety of actions across Montana and Wyoming, including ongoing maintenance and management actions, new development or construction projects that will damage or remove no more than 125 total WBP trees (seedlings, saplings, and mature trees combined), livestock grazing, right-of-way maintenance, and activities that are beneficial for the restoration or recovery of WBP. Specifically, activities considered in the framework include:

a. Livestock management and range improvements: livestock management and range infrastructure improvements (*e.g.*, grazing, gathering and moving, fencing, stock ponds and tanks, and spring development);
b. Infrastructure actions: infrastructure maintenance, upgrades, and replacement activities for existing pipelines, communication towers, utility lines, renewable energy facilities, trails, and highway infrastructure (*e.g.*, to roads, bridges, culverts, bike and pedestrian facilities, fencing, lighting, and all other distinct aspects of a highway project); construction of new pipelines, communication towers, utility lines, renewable energy projects, and highway infrastructure;
c. Mineral and conventional oil and gas exploration and development: maintenance of existing locatable and leasable mining and conventional oil and gas projects; new development of existing mineral and conventional oil and gas leases; and new development of new mineral and conventional oil and gas leases;
d. Vegetation management actions: vegetation (forest) management activities that take into account age class prescriptions, genetic variability within and among WBP populations, and activities that may impact the adaptive potential and the forest trajectories of WBP (salvage harvests and pest control that remove dead and diseased trees and encourage natural WBP recruitment and are not in existing WBP restoration areas); timber harvest projects, hazardous fuel removal (in Wildland Urban Interface (WUI) areas), and precommercial thinning and group selection projects;
e. Recreation activities: maintenance of existing trail systems (hiking and biking specifically); maintenance of existing recreational development projects (*e.g.*, ski resorts and campgrounds), and other recreational activities (*e.g.*, off-highway vehicles (OHV) and over-snow vehicles (OSV) use); upgrades, replacement, expansion, or new construction outside the existing disturbance footprint of existing recreation projects, and outfitter and guide permit programs;

may remove no more than 125 trees, thus providing an additional buffer. However, we will continue to evaluate development projects that remove more than 125 WBP trees separately (outside of this SA), even if the aggregate number of trees removed per year is less than 12,500 (of which, 5,000 are assumed to be rust-resistant). We anticipate the recovery efforts (*e.g.*, planting rust-resistant trees) will either remain the same or are likely to increase after the species has been listed under the Act; however, we will continue to use the approach described above and its thresholds rather than increasing the number of projects and trees. We will re-evaluate this SA at least annually and will reconsider its application, use, thresholds, and efficacy at a minimum of five years after implementation.

2.f. Conservation Measures

To fully understand the extent of the effect that individual project activities analyzed by the SA will have on WBP trees (seedlings, saplings, and mature trees), and to avoid and minimize these impacts, the SA provides a detailed list of successfully-implemented conservation measures from which project applicants can choose. We consider the damage of a WBP to include, but is not limited to, soil tilling, disking, plowing, excavating, raking, sod rolling, soil compaction, soil disturbance, weed management, revegetation, crushing, bumping, and scraping WBP, root damage, mycorrhizal damage, nicks and opening wounds on WBP bark, and pruning.

The following conservation measures are considered part of the actions under the SA. The commitments and implementation of the following conservation measures and exploration of additional opportunities to reduce impacts made by the federal action agencies will reduce adverse effects of the proposed actions to the WBP. These conservation measures will become commitments by federal action agencies where appropriate and practicable. Many of these conservation measures are to be applied throughout the action area, though others specify the location or distance from WBP trees for application. Not all conservation measures are applicable or reasonable for all actions that are covered under this SA. The Determination Key includes a section where project applicants must select which of the following conservation measures they plan to implement as part of their action, which will be repeated back to the applicant in our IPaC generated response letter or memo:

General

CM 1. Conduct pre-project surveys to identify WBP individuals of all age classes. If not feasible, conduct surveys using appropriate agency protocols to estimate the number of WBP individuals of all age classes.

CM 2. When marking is appropriate, all mature WBP trees or clusters of other age class trees will be marked in a manner that does not cause damage to the tree or introduce disease.

CM 3. Damaging or killing a plus, elite, or phenotypically resistant tree will only occur in situations where human health and safety are at risk or when restoration actions such as pruning are occurring.

3. Status of the Species

This SA provides a general background on the status of the species and its habitat, relying on the Service's 2021 SSA (USFWS 2021, entire). No critical habitat has been designated for this species. A detailed status of the WBP's biology, range, habitat, needs, stressors, and conservation can be found in Appendix C.

The WBP is a five-needle conifer species placed in the subgenus *Strobus,* which also includes other five-needle white pines. Recent phylogenetic studies (Liston *et al.* 1999; Syring *et al.* 2005, 2007; as cited in Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2010) showed no difference in monophyly (ancestry) between subsection *Cembrae* and subsection *Strobi* and merged them to form subsection *Strobus.* No taxonomic subspecies or varieties of WBP are recognized (COSEWIC 2010). Based on this taxonomic classification information, we recognize WBP as a valid species (USFWS 2021).

There are four stages in the life cycle of the WBP: seed, seedling, sapling and mature trees, also referred to as reproductive adults. Seeds are produced in female cones and once on the ground may take two years or more, up to 11 years in some cases, to germinate. Germinated seeds become seedlings that are between 3 to 4 inches tall (8 and 10 centimeters) with a taproot that can measure between 5 to 7 inches (13 to18 centimeters), with 7 to 9 cotyledons, also known as the embryonic first leaves, as documented by (Arno and Hoff 1989). WBP seedlings may persist for multiple years, depending on growing conditions, until reaching the sapling stage of the life cycle. WBP saplings persist for few to many years, depending on growing conditions, until they produce male and female cones. Mature reproductive WBPs contain both female and male cones, which is known as monoecious reproduction, and can survive on the landscape for hundreds of years. This slow-growing long-lived tree with a life span between 500 years and 1,000 years (Arno and Hoff 1989; Perkins and Swetnam 1996), provided it is located in an area with lower competition, such as a more open canopy with low litter depth and high rock cover (Maloney 2014). Therefore, in addition to the four general needs for all life stages, mature WBP trees require a more open canopy, dispersal of seeds by Clark's nutcracker, two summers of suitable temperatures and precipitation for pollinated cones to mature, as well as levels of nitrogen and phosphorus that are adequate to restore values after being depleted in masting year (USFWS 2021).

The WBP is a five-needle pine that lives in windy, cold, high-elevation or high-latitude environments across the western United States and southern Canada. The WBP pine has a broad range both latitudinally, occurring from a southern extent of approximately 36° north in California to 55° north latitude in British Columbia, Canada, and longitudinally, occurring from approximately 128° in British Columbia, Canada to an eastern extent of 108° west in Wyoming. It also occurs in scattered areas of the warm and dry Great Basin. As a result, many stands are geographically isolated as documented by (Arno and Hoff 1989).

Most current management and research focus on producing and planting white pines (including WBP) with genetic resistance to white pine blister rust, but also include natural regeneration (e.g., those areas identified in Appendix B, Tables A, B, and C) and silvicultural treatments, such as appropriate site selection and preparation, pruning, and thinning (Zeglen *et al.* 2010).

5.d. Forest (Vegetation) Management Actions

Forest (vegetation) management includes a variety of methods and techniques used to manage healthy forests, and known previous projects that fall within this action type are summarized in Table D of Appendix C. These types of forest management activities include timber harvest (using chainsaws and using machinery which may create skid trails) and management/hazardous fuels reduction (using chainsaws and using machinery which may create skid trails, to remove dead and dying trees and understory vegetation that may carry wildfire), salvage harvest (removing dead trees either by hand or using machinery which may create skid trails), pest control (use of Verbenone or Carbaryl insecticide), precommercial thinning (thinning trees that are too small for a commercial timber harvest), silviculture stand improvement projects (using a planned set of treatments such as thinning, harvesting, planting, pruning, prescribed burning, and site preparation designed to change the current stand structure and composition to one that meets a management goal), and silvicultural reforestation activities (planning for natural regeneration or tree planting).

Forest management related road construction, maintenance, and use may also be part of vegetation management projects. Harvest of WBP has not been well tracked as records often group it with other species and incorrectly identify it as another species. Silviculture approaches create a system that excludes regeneration opportunities and increases competition by planting faster-growing species, and consequently, stands that contain WBP prior to harvest are not routinely replanted with WBP.

Projects that implement resetting the successional stage of the forest stands need to be carefully thought out and planned to increase WBP recruitment. Campbell and Antos (2003) noted that successional patterns in WBP forests are more complex than others have reported, finding that subalpine fir readily established after fire in their British Columbia study areas, and although subalpine fir density was increasing in older WBP stands with relatively open canopies, they estimated that succession to subalpine fir would take more than 500 years. Campbell and Antos (2003) reported that WBP in their study area was stress-tolerant (able to persist under conditions that restrict production), was capable of surviving long periods of suppressed growth, and was able to release upon reaching the main canopy after more than 150 years of low growth rates. The results of these studies indicate that the loss of WBP due to succession to subalpine fir and Engelmann spruce in some areas may be an extremely slow process and that WBP may be more shade-tolerant and resilient to suppression than previously suggested. Further, thinning and timber harvest projects intended to improve WBP recruitment may increase WBP susceptibility to mountain pine beetle infestation, if the beetles do not have their preferred food sources during outbreak years. The densification of and succession of subalpine fir and Engelmann spruce co-occurred with WBP mortality caused by bark beetle outbreaks and/or blister rust; therefore, disentangling the effects of blister rust- and bark beetle-mortality on succession from the effects of fire suppression in these studies is difficult (Hartwell *et al.* 1997; Arno *et al.* 1993 in Keane *et al.* 1994; Flanagan *et al.* 1998).

Projects including those in WUI, salvage harvests, and pest control efforts remove dead and diseased trees, and may encourage natural WBP recruitment. In large acreages of dead trees, salvage harvest and firewood cutting projects can be designed to avoid damaging or killing live

WBP, which may be resistant to blister rust. Projects where the removal of surface and ladder fuels through hand cutting, piling of project generated materials, and burning the piles with the purpose of increasing stand resilience to fire may also be beneficial for the recruitment of WBP. Felling trees and creating skid trails for salvage harvests may damage or kill WBP seedlings and saplings and compress the soil and undetected seeds. Implementation of the conservation measures (*e.g.*, CM 1-10, 12-14, and 16-21) in the project design that avoid impacts to WBP seedlings, saplings, and live mature trees, and that minimizes soil disturbance and compaction that may destroy microsites for cached seeds, interrupts drainage, and limits tree rooting will have beneficial long-term impacts to WBP.

Vegetation management includes many project types (*e.g.*, WUI, salvage harvest of dead trees, harvest of Christmas trees, pest control, firewood collection) and sizes (less than 1 acre to thousands of acres). In this SA, we evaluated the effects of smaller forest management projects that damage or kill fewer than 125 live WBP of all age classes. Effects of larger project will be addressed by a standalone consultation or may be covered by a future standing analysis. We have elected to use a limit of 125 WBP of all age classes as a threshold for forest (vegetation) management projects, based on our understanding of the stressors to WBP, the level of ongoing restoration efforts, and our commitment to track and re-evaluate project impacts and restoration efforts for the life of this SA. While forest management projects will result in adverse effects to WBP, these should not result in population level effects for the reasons described above.

5.e. Recreation Development and Activities

The following recreational activities commonly occur in WBP habitat: construction and maintenance of hiking trails and roads (analyzed in the Infrastructure section); motorized use of trails year-round; (snow machines, all-terrain vehicles (ATV), utility task vehicles (UTV), motorcycles, electric bikes, and mountain bikes); operation of facilities (snow making, lift chairs analyzed in the Infrastructure section); firewood consumption; special use permits (hunting, photography); and horseback riding.

There are 91 recreation sites within WBP habitat in the action area, including developed campsites, horse corrals, trail heads, parking areas, toilets, staging areas, scenic overlooks, and primitive campsites. Back country campers and hikers may burn WBP for campfires, cause ground compression, climb on trees, or remove WBP when clearing trails. Motorized recreation activities, hiking, use of pack animals, and construction equipment used for trail maintenance and construction, may cause soil disturbance and compaction, destroy microsites for cached seeds, interrupt drainage, limit tree rooting, and damage seedlings. Over snow vehicles (OSV) could break the tops of trees or could damage branches or seedlings and saplings. We acknowledge that there may be some damage and death to WBP seedlings and saplings from authorized and unauthorized off-road motorized recreation activities which could affect individuals or local areas. Overall, impacts from all recreation activities could affect less than one percent of the species wide range (based on IUCN threats summary for WBP in Canada) (USFWS 2021) and are not considered a significant threat to WBP.

We conclude that, while not all adverse effects can be avoided, the implementation of the conservation measures (*e.g.*, CM 1-14, and 16-21) will minimize impacts to WBP and that between one and 29 years of age and, on average, are 1.37 m (4.5 ft), which is the height assessed at dbh (Tomback and Pansing 2018). WBP seedlings have highly variable survival rates; seedlings originating from nutcracker caches ranged from 56 percent survival over the first year to 25 percent survival by the fourth year (Tomback 1982). Seedlings of WBP may persist for multiple years, depending on growing conditions, until reaching the sapling stage of the life cycle. Saplings are non-reproductive trees greater than 1.37 m (4.5 ft) in height; for WBP, the average age of reproductive maturity is 29 to 40 years of age (Tomback and Pansing 2018). Saplings of WBP persist for few to many years, depending on growing conditions, until they produce male and female cones and are considered reproductive at approximately 60 years of age. Some WBP individuals are capable of producing limited amounts of seed cones at 20 to 30 years of age, although large cone crops usually are not produced until 60 to 80 years (Krugman and Jenkinson 1974, as cited in McCaughey and Tomback 2001), with average earliest first cone production at 40 years (Tomback and Pansing 2018). Therefore, the generation time of WBP is approximately 40 to 60 years (Tomback and Pansing 2018; COSEWIC 2010). Mature WBP trees require two summers of suitable temperatures and precipitation for fertilized cones to mature (Rapp *et al.* 2013). Years with high seed production (mast years) typically occur once every three to five years; however, that time interval can vary by geographic location and health condition of the stand (McCaughey and Tomback 2001). After such a masting year, each individual WBP is depleted of nitrogen and phosphorus and so those nutrients must be replaced during the three to five years between masting events (Sala *et al.* 2012). Mature reproductive WBP trees contain both female and male cones (*i.e.*, monoecious reproduction), and can survive on the landscape for hundreds of years.

The WBP is the only stone pine (so-called for their stone-like seeds) in North America of the five species worldwide (McCaughey and Schmidt 2001). Characteristics of stone pines include five needles per cluster, indehiscent seed cones (scales remain essentially closed at maturity) that stay on the tree, and wingless seeds that remain fixed to the cone and cannot be dislodged by the wind. Because WBP seeds cannot be wind disseminated, primary seed dispersal occurs almost exclusively by Clark's nutcrackers in the avian family Corvidae (whose members include ravens, crows, and jays) (Lanner 1996; Schwandt 2006). Consequently, Clark's nutcrackers facilitate WBP regeneration and influence its distribution and population structure through their seed caching activities (Tomback *et al.* 1990).

The WBP may occur as a climax species, early successional species, or seral (mid-successional stage) codominant associated with other tree species. Although it occasionally occurs in pure or nearly pure stands at high elevations, it more typically occurs in stands of mixed species in a variety of forest community types. WBP is typically 5 to 20 m (16 to 66 ft) tall with a rounded or irregularly spreading crown shape. On higher density conifer sites, WBP tends to grow as tall, single-stemmed trees, whereas on open, more exposed sites, it tends to have multiple stems (McCaughey and Tomback 2001). Above the tree line, it grows in a krummholz form (stunted, shrub-like growth) (Arno and Hoff 1989). Production of male and female cones in mature trees will begin sometime from June to September depending on environment (McCaughey and Tomback 2001; Sala *et al.* 2012). Female cones take 2 years to fully develop (Weaver 2001). Its characteristic dark brown to purple seed cones are 5 to 8 cm (2 to 3 in.) long and grow in clusters of 2 to 4 cones at the outer ends of upper branches (Hosie 1969).

Ensuring future generations of WBP are genetically resistant to white pine blister rust is the most critical action for achieving long-term recovery of this species (Mahalovich and Dickerson 2004; Perkins *et al.* 2016). Genetic management of white pine blister rust is actively conducted for WBP, including the USFS white pine blister rust resistance screening programs (Mahalovich 2016; Sniezko 2016). Seeds and pollen sourced from plus trees or elite trees are used for screening and selective breeding for white pine blister rust resistance (not immunity), molecular genetics studies, assessing levels of inbreeding, growing compatible rootstock for grafting in seed orchards, clone banking and gene conservation, and identifying genetic macro-refugium (Mahalovich 2016; Perkins *et al.* 2016; Sniezko 2016).

Eventually, the long-term goal is to establish WBP seed orchards in situ across the spectrum of WBP habitat to provide reliable and accessible sources of genetically resistant seed (Mahalovich 2017). Scions (*i.e.*, living branches) taken from trees with proven genetic resistance to white pine blister rust are grafted onto established root stocks, enabling them to develop the capability to produce cones much sooner than the time required for out planted seedlings to reach reproductive maturity (approximately 60 years).

Seeds from cone collections in the northwest (*i.e.*, Washington, Oregon) are now stored at the United States Department of Agriculture (USDA) National Center for Genetic Resources Preservation in Fort Collins, Colorado for long-term ex situ gene conservation (Sniezko and Kegley 2017). Seven separate white pine blister rust screening trials are occurring at the USFS Coeur d'Alene Nursery in Idaho using over 100,000 seedlings (Mahalovich 2016, 2017).

4.c. Fuel Reduction Treatment

Silvicultural practices, such as thinning, are frequently employed to treat existing stands of WBP to modify surface and ladder fuels and improve their chances of surviving fire. Table D of Appendix C describes the silvicultural and restoration activities in WBP habitat within Montana between 2009 and 2021 and Wyoming between 1991 and 2020. Most thinning treatments are designed to mimic non-lethal mixed-severity fire (Keane and Arno 2001), reduce or eliminate competition from other conifer species such as subalpine fir (*Abies lasiocarpa*), and to increase regeneration space for potentially rust-resistant seedlings. Approaches include creating openings wherein all trees except live WBPs are cut within a 1- to 5-ac opening to provide open growing space for WBP regeneration and existing WBP trees (Keane and Arno 2001; Keane and Parsons 2010); thinning of all non-WBP trees below a certain diameter (Chew 1990); and fuel enhancement treatments where other competing trees are directionally felled to modify fire behavior and reduce fire intensity (Keane and Arno 2001; Keane and Parsons 2010). Reducing tree density within WBP stands may result in increased vigor (*i.e.*, growth rate) of remaining sapling to mature-class trees (Keane *et al.* 2007; Retzlaff *et al.* 2018); however, counterintuitively, increased WBP vigor may not impart increased resistance to mountain pine beetle, as some evidence suggests that mountain pine beetles select faster growing trees for attack (Six *et al.* 2021). In addition to or in place of treating fuels within WBP stands, managers should consider conducting fuel reduction treatments in non-WBP stands adjacent to WBP, thereby reducing the intensity of fire as it moves from the adjacent stand into the WBP stand.

Considered a keystone, or foundation species in western North America, WBP it increases biodiversity and contributes to critical ecosystem functions (Tomback *et al.* 2001). As a pioneer or early successional species, it may be the first conifer to become established after disturbance, subsequently stabilizing soils and regulating runoff (Tomback *et al.* 2001). At higher elevations, snow drifts around WBP trees, thereby increasing soil moisture, modifying soil temperatures, and holding soil moisture later into the season (Farnes 1990). These higher elevation trees also shade, protect, and slow the progression of snowmelt, essentially reducing spring flooding at lower elevations. The WBP also provides nutritious seeds for a number of birds and mammals (Tomback *et al.* 2001).

3. Population Dynamics, Status and Distribution

The WBP has persisted in high elevation sites in western North America for the past 8,000 years (McCaughey and Schmidt, 2001). WBP has a broad range both latitudinally (occurring from approximately 36 degrees in south California to 55 degrees north latitude in British Columbia, Canada) and longitudinally (occurring from approximately 128 degrees in British Columbia, Canada to 108 degrees east in Wyoming). For the SSA, we developed an updated WBP range map based on the best available occurrence and distribution data (Figure 2 of the SA). This range map is at a coarse scale but encompasses the known distribution of the species' occurrences.

The WBP typically occurs on cold and windy high-elevation or high-latitude sites in western North America, although it also occurs in scattered areas of the warm and dry Great Basin. As a result, many stands are geographically isolated (Arno and Hoff 1989; Keane *et al.* 2010). The distribution of WBP includes coastal and Rocky Mountain ranges that are connected by scattered populations in northeastern Washington and southeastern British Columbia (Arno and Hoff 1990; Keane *et al.* 2010). The coastal distribution of WBP extends from the Bulkley Mountains in northwestern British Columbia to the northeastern Olympic Mountains and Cascade Range of Washington and Oregon, to the Kern River of the Sierra Nevada Range of east-central California (Arno and Hoff 1990). Isolated stands of WBP are known from the Blue and Wallowa Mountains in northeastern Oregon and the subalpine zone of mountains in northeastern California, south-central Oregon, and northern Nevada (Arno and Hoff 1990; Keane *et al.* 2010). The Rocky Mountain distribution of WBP ranges from northern British Columbia and Alberta to Idaho, Montana, Wyoming, and Nevada (Arno and Hoff 1990; Keane *et al.* 2010), with extensive stands occurring in the Yellowstone ecosystem (McCaughey and Schmidt 2001).

In general, the upper elevational limits of WBP decrease with increasing latitude throughout its range (McCaughey and Schmidt 2001). The elevational limit of the species ranges from approximately 900 m (2,950 ft) at its northern limit in British Columbia to 3,660 m (12,000 ft) in the Sierra Nevada (McCaughey and Schmidt 2001). WBP is typically found growing at the subalpine treeline or with other high-mountain conifers just below the treeline and subalpine zone (Arno and Hoff 1990; McCaughey and Schmidt 2001). In the Rocky Mountains, common associated tree species include lodgepole pine (*P. contorta* var. *latifolia)*, Engelmann Spruce (*Picea engelmannii)*, subalpine fir (*Abies lasiocarpa)*, and mountain hemlock (*Tsuga mertensiana)*. Common associated tree species are similar in the Sierra Nevada and Blue and Cascade Mountains, except lodgepole pine is present as Sierra-Cascade lodgepole pine (*P.*

contorta var. murrayana) and mountain hemlock is absent from the Blue Mountains (Arno and Hoff 1990; McCaughey and Schmidt 2001).

Rangewide, WBP occurs on an estimated 32,616,422 ha (80,596,935 ac) in western North America (Figure 2 of the SA). Roughly 70 percent of the species' range occurs in the United States, with the remaining 30 percent of its range occurring in British Columbia and Alberta, Canada (USFWS 2018). In Canada, the majority of the species' distribution occurs on federal or provincial crown lands (COSEWIC 2010). In the United States, approximately 88 percent of land where the species occurs is federally owned or managed (Figure 2 of the SA). The majority is located on USFS lands (approximately 74 percent, or 17,391,455 ha (42,975,220 ac)). The bulk of the remaining acreage is located on NPS lands (approximately 10 percent, or 2,275,746 ha (5,623,490 ac)). Small amounts of WBP also can be found on BLM lands (approximately 4 percent, or 1,002,152 ha (2,476,371 ac)). The remaining 12 percent of the range is under non-federal ownership, on State, private, and Tribal lands. In the United States, 29 percent of the range is designated as wilderness under the Wilderness Act of 1964 (16 U.S.C. 1131-1136). This designation limits management options and conservation efforts in those areas to some degree.

Populations are typically defined by the potential for genetic exchange among their members, to the exclusion of members of other populations (in the absence of immigration or emigration). For WBP, genetic exchange is limited by the dispersal distance of pollen, which is carried by wind, and the seed caching behavior of Clark's nutcracker (Lorenz *et al.* 2011; Keane *et al.* 2017b). Both pollen dispersal and Clark's nutcracker seed dispersal can occur at a scale of few to many kilometers (km) (*e.g.*, up to 30 km in the case of Clark's nutcracker seed dispersal). To promote a greater than 75 percent probability of occurrence of Clark's nutcracker at a site, recommended management plans that achieves landscape composition of a minimum 12,500-25,000 ha of cone bearing WBP habitat within a 32.6-km radius. The optimal Clark's nutcracker habitat mosaic includes moderate levels of Douglas-fir habitat (Douglas-fir seeds are another important food source for Clark's nutcracker in the GYE) (Schaming 2016 and Schaming and Sutherland 2020). WBP is a long-lived species that exhibits masting, where years of high seed production are synchronized within a population approximately every 3 to 5 years (McCaughey and Tomback 2001). This masting strategy is an adaption to heavy seed predation; during masting years seed consumers are satiated, resulting in excess seeds that escape predation (Lorenz *et al.* 2008). WBP populations need a certain density of reproductive individuals to produce sufficient pollen clouds that facilitate the synchronization of masting, and thus increased probability of regeneration (Rapp *et al.* 2013).

4. Conservation Actions and Restoration Strategies

Most current management and research focus on producing and planting white pines (including WBP) with genetic resistance to white pine blister rust, but also include natural regeneration (e.g., those areas identified in Appendix B, Tables A, B, and C) and silvicultural treatments, such as appropriate site selection and preparation, pruning, and thinning (Zeglen *et al.* 2010). Genetic management of white pine blister rust is actively conducted for several five-needle white pine species breeding programs (Sniezko 2016, Mahalovich 2015, Mahalovich 2010, Shelley 2016) including the USFS resistance screening programs for WBP. High-elevation pines such as WBP also present management challenges to restoration due to remoteness, difficulty of access, a

WBP both as a stressor that can cause mortality of all life stages of WBP and as a mechanism that may affect forest succession (Arno 2001; Shoal *et al.* 2008; Keane and Parsons 2010). Although WBP has been described as fire-adapted, there is uncertainty surrounding the specifics of these adaptations, including the species' ability to survive fires of differing intensity, the role of low-severity fire, and how fire suppression interacts with fire return intervals to affect forest succession across the range of WBP.

Fire regimes in WBP systems are often characterized as being of mixed severity (Arno *et al.* 2000; Arno 2001, Campbell and Antos 2003; Larson *et al.* 2009). However, some WBP systems are dominated by high-severity fire events (Romme 1982; Campbell and Antos 2003). Low-severity surface fires may also occur in WBP stands, particularly at higher elevations (Barrett 1994). Clark's nutcracker ecology provides further insight into the typical fire regime in WBP ecosystems. The Clark's nutcracker serves as the main dispersal agent for WBP (Tomback *et al.* 2001). Eighty-five percent of the WBP seeds cached are above ground in the trunks of live trees. In most cases Clark's nutcracker avoids caching seeds in forest openings (Brodin and Clark 2007; Lorenz 2011; Lorenz et al 2012. Clark's nutcrackers have been found dispersing seeds farther than the wind-dispersed seeds of other conifers, allowing for the establishment of WBP seedlings in the interior of large patches of high severity fire effects and over broad geographic areas (McCaughey *et al.* 1985; Tomback *et al.* 1990, 1993 in Keane and Parsons 2010). To promote a greater than 75 percent probability of Clark's nutcracker occurrence at a site containing WBP, the landscape composition must contain a minimum 12,500 to 25,000 ha cone bearing WBP within a 32.6-km radius (Schaming and Sutherland 2020). Clark's nutcrackers feed equally on Douglas-fir seeds and WBP seeds, so the optimal habitat mosaic includes moderate levels of Douglas-fir habitat (Schaming 2016).

Although some experts have suggested that WBP is phenotypically adapted to survive low-intensity fire, Stevens *et al.* (2020) found that WBP had relatively thin bark compared to other conifer species and, based on a systematic ranking of numerous traits associated with fire resistance in western conifers, WBP was found to have one of the lowest fire resistance scores of the 29 conifers examined in the study. Others have also observed that WBP trees can be sensitive to bole (main steam of the tree) scorching, resulting in cambium injury or death, even from low-intensity fire (Hood *et al.* 2008). Keane *et al.* (2020) noted several recent reports of prescribed fire and low-intensity fire killing WBP trees, despite pre-fire site preparation activities implemented to reduce or modify surface and ladder fuels and protect the residual WBP trees. Keane and Parsons (2010) studied the effects of seven different fuel treatment combinations on WBP at five treatment sites in Montana and Idaho and found that WBP mortality from low-intensity fire was comparable to subalpine fir under all treatment combinations. As a result, empirical evidence shows that low-intensity fire in WBP can result in higher-severity fire effects. In summary, although it is clear that WBP individuals are capable of surviving some low-intensity fire, based on the presence of multiple fire scars in some areas, the biotic and abiotic (*i.e.*, terrain, weather, and fuel) conditions under which the species is most likely to survive such fires remain largely unknown.

Determining if periodic fire is necessary to maintain ecosystem integrity in WBP systems may be as important as understanding the conditions under which WBP trees are most likely to survive fire. Experts have suggested that, without periodic low-severity fire in some subalpine forests where WBP co-occurs with subalpine fir and Engelmann spruce, successional pathways can lead to climax communities dominated by these shade-tolerant conifers and the loss of WBP (Arno 1980; Arno 2001; Keane et l. 2017; Keane and Parsons 2010; Flanagan *et al.* 1998). It has further been suggested that, in these WBP systems, fire suppression policies over the past 90 years have resulted in WBP declines due to succession to subalpine fir and Engelmann spruce (Arno 1980; Arno 2001; Keane *et al.* 2017; Keane and Parsons 2010; Flanagan *et al.* 1998). This is supported by the presence of multiple fire scars in WBP trees at some locations, which shows they are capable of surviving repeated low-intensity fires and maintaining dominance or co-dominance in stands for long-periods of time when these fires are occurring periodically (Morgan and Bunting 1990, Barrett 1994). Additional support for the successional theory is based on documented densification of subalpine fir and Engelmann spruce in stands where WBP was once prevalent (Hartwell *et al.* 1997; Arno *et al.* 1993 in Keane *et al.* 1994; Flanagan *et al.* 1998). However, in these studies, the authors noted that the densification of and succession to subalpine fir and Engelmann spruce co-occurred with WBP mortality caused by bark beetle outbreaks and/or blister rust; therefore, disentangling the effects of blister rust- and bark beetle-mortality on succession from the effects of fire suppression in these studies is difficult.

The idea that fire suppression in some whitebark systems has resulted in densification and loss of WBP has been a predominant theory in the WBP literature (Arno 1980; Arno 2001; Keane *et al.* 2017; Keane and Parsons 2010; Flanagan *et al.* 1998). However, some have recently called into question the idea that fire suppression has led directly to forest succession and the loss of WBP. For example, Larson and Kipfmueller (2012) suggested there is uncertainty in the effects of fire suppression on WBP and a relative lack of data supporting the hypothesis. Larson and Kipfmueller (2012) noted that age structure data in their study showed that many of the small subalpine fir trees occurring below the WBP, trees that visually appeared to be young saplings, were more than 100 years of age, suggesting that size class data should not be used as a surrogate for tree age or to determine the rate of succession. Campbell and Antos (2003) also noted that successional patterns in WBP forests are more complex than others have reported, finding that subalpine fir readily established after fire in their British Columbia study areas, and although subalpine fir density was increasing in older WBP stands with relatively open canopies, they estimated that succession to subalpine fir would take more than 500 years. Campbell and Antos (2003) reported that WBP in their study area was stress-tolerant (able to persist under conditions that restrict production), was capable of surviving long periods of suppressed growth, and was able to release upon reaching the main canopy after more than 150 years of low growth rates. The results of these studies indicate that the loss of WBP due to succession to subalpine fir and Engelmann spruce in some areas may be an extremely slow process and that WBP may be more shade-tolerant and resilient to suppression than previously suggested.

The broad range of fire return intervals in WBP ecosystems further complicates theories that fire suppression has caused succession in WBP systems. Fire history studies in WBP forests have identified fire return intervals ranging from 33 years (Morgan and Bunting 1990) to greater than 400 years (Campbell and Antos 2003). Several authors have noted that mean fire return intervals in subalpine forests that include WBP can be much longer than contemporary fire suppression policies (Dolanc *et al.* 2013; Meyer and North 2019; Sibold *et al.* 2006). Over an 80-year period, Dolanc *et al.* (2013) documented an increase in the number of small diameter trees, including WBP, in subalpine forests of the central Sierra Nevada. However, Dolanc *et al.* (2013)

Beetle activity in the phloem mechanically girdles the host tree, disrupting nutrient and water transport and ultimately killing it. Additionally, mountain pine beetles carry symbiotic blue stain fungi on their mouthparts, which are introduced into the host tree upon feeding. These fungi also inhibit water transport and further assist in killing the host tree (Raffa and Berryman 1987; Keane *et al.* 2012).

Mountain pine beetles are considered an important component of natural forest disturbance regimes (Raffa *et al.* 2008; Bentz *et al.* 2010). At endemic, or more typical levels; mountain pine beetles remove relatively small areas of trees, changing stand structure and species composition in localized areas. However, when conditions are favorable (abundant hosts and favorable climate), mountain pine beetle populations can erupt to epidemic levels and create stand-replacing events that may kill 80 to 95 percent of suitable host trees (Berryman 1986 as cited in Keane *et al.* 2012). Such outbreaks are episodic, can have a magnitude of impact on the structure of western forests greater than wildfire (the other major component of natural forest disturbance), and are often the primary renewal source for mature stands of western pines (Hicke *et al.* 2006; Raffa *et al.* 2008; Six *et al.* 2014). Mountain pine beetle outbreaks typically subside only when suitable host trees have been exhausted or temperatures are sufficiently low to kill larvae and adults (Gibson *et al.* 2008).

The range of the mountain pine beetle completely overlaps with the range of the WBP, and mountain pine beetle epidemics affecting WBP have occurred throughout recorded history (Keane *et al.* 2012). Recent outbreaks occurred in the 1930s, 1940s, and 1970s, and numerous ghost forests of dead WBP still dot the landscape as a result (Arno and Hoff 1989; Perkins and Swetnam, 1996, Ward *et al.* 2006). The most recent mountain pine beetle epidemic began in the late 1990s and continues to be a measurable but much reduced source of mortality for WBP (MacFarlane *et al.* 2013; Mahalovich 2013; Shelly 2014) (Figure A).