



2014 Whitebark Pine Conservation Program

Annual Report





ON THIS PAGE

A healthy group of whitebark pines growing on Cloudcap.
Photograph by: Jen Beck

ON THE COVER

Whitebark pine growing inside the Crater Lake caldera.
Photograph by: Jen Beck

2014 Whitebark Pine Conservation Program

Annual Report

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Abstract

Major activities of Crater Lake National Park's Whitebark Pine Conservation Program in 2014 supported the Park's goals and objectives for conserving and restoring whitebark pine. Annual Collection tree monitoring detected no new mortality of Collection trees, one new white pine blister rust infection, and one new mountain pine beetle attack. Sixty-nine trees of management importance were treated with verbenone to help ward off attack by the mountain pine beetle. Despite a poor cone year for whitebark pine, cones were collected from 13 new trees throughout the Park. Eleven of these trees expressed phenotypic resistance to the disease white pine blister rust and two were infected with white pine blister rust and will be used as controls; these trees will enter rust-resistance screening at the USFS Dorena Genetic Resource Center. Results from the Park's long-term monitoring plots indicate that whitebark pine is continuing its decline within plot areas, as mature whitebark pine have been reduced by 23.4% from 2003 – 2014. The leading mortality agent of whitebark pine within plot areas continues to be the mountain pine beetle. The Park's four whitebark pine restoration plantings were monitored with survival rates ranging from 77 – 90% two to five years after planting. Planning is underway for the Park's next whitebark pine restoration outplanting, scheduled for 2016.

Acknowledgments

The Crater Lake National Park Whitebark Pine Conservation Program received assistance this year with tree climbing and cone collection from Deschutes National Forest staff. This effort was made possible through funding by the United States Forest Service Forest Health Protection program. The Dorena Genetic Resource Center continued to assist the Park with blister rust resistance screening and growing whitebark pine seedlings for restoration. Assistance with monitoring the Park's whitebark pine restoration plantings was received from the Dorena Genetic Resource Center and Oregon State University.

Introduction

Whitebark pine (*Pinus albicaulis* Engelm.) is a hardy, long-lived species that tolerates the severe conditions found at the highest elevations of Crater Lake National Park (CRLA). Whitebark pine is considered a foundation and a keystone species due to the important ecological niche it fills (Tomback et al. 2014). Whitebark pine seedlings can tolerate full sun and are able to establish in previously tree-less areas, earning the reputation of a colonizing or pioneer species (Tomback et al. 2001). Once established, they ameliorate harsh site conditions and facilitate the establishment of a diverse suite of subalpine species. Whitebark pine stands serve important functional roles such as shading and retaining snowpack and thereby regulating snowmelt; and slowing erosion by anchoring soils in place. Whitebark pine shares a mutualistic, co-evolved relationship with the Clark's nutcracker (*Nucifraga columbiana*). Whitebark pine is considered a "stone pine" as it bears cones that remain closed at maturity and require animal assistance (typically from Clark's nutcrackers – Figure 1, but also from squirrels, bears, and other mammals) to open cones and extract seeds. The Clark's nutcracker stores whitebark pine seeds in "caches" for future use, relying on a complex spatial memory to enable it to retrieve seeds at a later date. Caches that are not utilized can develop into whitebark pine stands and forests.

Whitebark pine has been in decline within the Park for decades. A non-native pathogen, *Cronartium ribicola*, that causes the disease white pine blister rust (WPBR), was introduced to western North America in 1910. Since that introduction, WPBR has spread throughout the range of whitebark pine with devastating results. Few whitebark pines have genetic resistance to WPBR, and the disease is progressive and fatal. Warming temperatures and milder winters at high elevations have facilitated a prolonged outbreak of the native mountain pine beetle (MPB - *Dendroctonus ponderosae*). At CRLA, MPB has surpassed WPBR as the lead mortality agent for whitebark pine (Smith et al. 2011).

Projected suitable habitat for whitebark pine under different climate change scenarios declines steeply, especially in the Cascade Range (Warwell et al. 2007; Littell et al. 2013). In 2011, the U.S. Fish and Wildlife Service determined that listing whitebark pine as threatened or endangered was warranted, but precluded by higher priority work. Whitebark pine remains a Candidate species for listing under the Endangered Species Act.

In 2003, CRLA applied the first actions in what would become a Whitebark Pine Conservation Program (WPCP). The Terrestrial Ecology team began by implementing a long-term monitoring program and collecting cones from whitebark pines so that seedlings could be grown and tested for resistance to WPBR at the USFS Dorena Genetic Resource Center (DGRC). Since then, CRLA's



Figure 1. A Clark's nutcracker extracts whitebark pine seeds from within the Park. Photo by Jen Beck.

WPCP has grown to include not only long-term monitoring and rust-resistance screening, but outplanting seedlings grown from rust-resistant trees for restoration; applying verbenone, a bark beetle repellent, to whitebark pines that have had their cones collected for rust-resistance screening (called “Collection Trees”); monitoring rust-resistant trees; and conducting sanitation pruning of branches infected with dwarf mistletoe (*Arceuthobium cyanocarpum*) and WPBR. This report summarizes major activities of the WPCP in 2014 including: (1) Collection tree monitoring and verbenone application, (2) cone collection, (3) CRLA’s long-term whitebark pine monitoring, and (4) monitoring of the Park’s four whitebark pine restoration plantings.

The 2014 season marked the second consecutive summer the Park and region suffered through a drought. The Park received only 257” of snow (average is 523”) during the 2013—2014 water year (October 1 – September 30), which is 49% of average (Figure 2). Snowmelt occurred over two weeks earlier than average; with the first snow-free date at Park headquarters achieved on June 3rd (average date is June 20th).

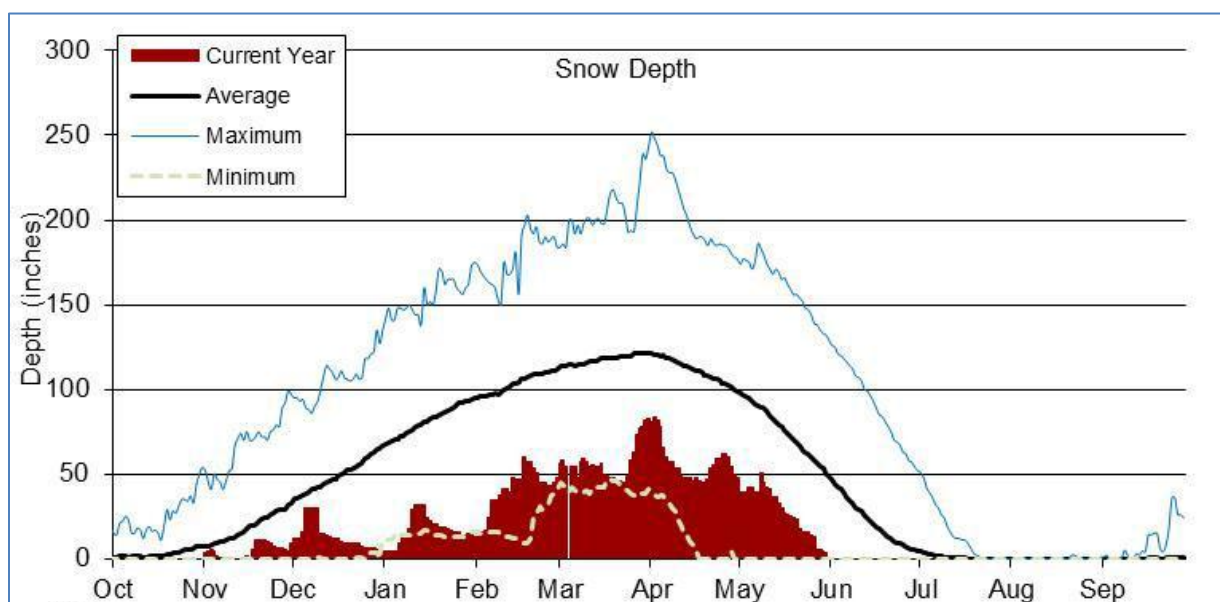


Figure 2. Snow depth data for the 2013-2014 water year, collected at Crater Lake National Park headquarters.

Methods

Methods are discussed separately for each of the four major components of the 2014 WPCP.

Collection Tree Monitoring and Verbenone Application

The DGRC has been assisting CRLA with identifying rust-resistant whitebark pines since 2003. Cones from CRLA trees are harvested and sent to the DGRC, who then extract and stratify seeds and grow seedlings for rust-resistance trials and/or for restoration. The rust-resistance screening process currently takes seven years to complete; two year old seedlings are inoculated with *C. ribicola* at the DGRC, monitored for five years, and then assigned a resistance rating of A-F (much like grades in

school) with “A” being the most resistant and “F” the least. All CRLA whitebark pines that have had cones collected and sent to the DGRC are called Collection trees; trees that receive A-C rust-resistance ratings are deemed Resistant trees; trees that receive D and F ratings are Susceptible trees; and trees whose progeny is currently in rust-resistance screening trials are Candidate trees. All Resistant and Candidate trees are monitored on an annual basis.

Annual Collection Tree Monitoring consists of assessment for WPBR, MPB, dwarf mistletoe, or other damage; assessing the cone crop; and photographing the tree and any notable features (e.g., cankers). Parameters such as diameter at breast height (DBH), tree height, assessment of non-whitebark pine conifer competitors, and spatial coordinates are updated every five years. A complete account of the Collection Tree Monitoring program is available in the Crater Lake National Park Whitebark Pine Conservation Plan (Beck and Holm *in draft*).

The MPB utilizes a group attack strategy to kill a host tree. When a female beetle finds a suitable host, she emits an aggregating pheromone that invites other beetles to colonize the host (Figure 3). Conversely, when the host tree has been fully colonized, beetles produce an anti-aggregating pheromone to signal to other beetles that the host is fully occupied. Verbenone is a synthetic form of the anti-aggregating pheromone, and it has been applied as a bark beetle repellent to high-value whitebark pine at CRLA since 2004. Presently, CRLA staples two 7 g pouches (Figure 3) to the north side of the bole as high up as the applicator can reach while spacing the pouches at least one vertical foot apart. Verbenone is applied in June (often July for new Collection trees). Pouches remain attached until the following June, when they are removed and replaced with fresh pouches.



Figure 3. A verbenone pouch (left); MPB attack on an untreated whitebark pine (right). Photos by Jen Beck.

Since many Collection trees are found near trails, pullouts, overlooks, etc., a small laminated note is attached with the pouches alerting Park visitors of the pouches' purpose and warns them to not touch the pouches. All living Resistant and Candidate trees are treated with verbenone annually (with the exception of trees with DBH < 15 cm). In years with low verbenone supplies due to budgetary constraints, "C" rated Resistant trees may not be treated. Trees with DBH > 100 cm often have four verbenone pouches attached when supplies allow. The full CRLA Verbenone Treatment Plan is available in the Park's Whitebark Pine Conservation Plan (Beck and Holm *in draft*).

Cone Collection

2014 was a poor cone year for CRLA whitebark pine, with very few cones observed park-wide. Whitebark pine produces an irregular cone crop, with poor years, moderate years, and strong or mast years occurring at unpredictable intervals (Ward et al. 2006). It is thought that this is the tree's strategy to outwit cone predators such as cone weevils by producing an unreliable food source (Lanner 1996). Despite the poor cone year, CRLA benefitted from USFS Forest Service Forest Health Protection (FHP) program funds that facilitated the collection of cones from 13 new trees using certified tree climbers (Figure 4) from the Deschutes National Forest (DNF). DNF personnel have been assisting the CRLA WPCP since 2011 with cone collection and restoration outplanting activities.

To collect cones from whitebark pine, cages are installed around developing cones early in the summer to protect the seeds from wildlife species such as the Clark's nutcracker. In fall, cages are removed, and cones harvested and sent to the DGRC. While cones can be reached from the ground by hand, using a cone hook, or orchard ladder, most trees need to be climbed to facilitate cone collection. CRLA follows cone collection guidelines outlined in Ward et al. (2006). This includes selecting whitebark pines from areas with moderate to high WPBR infection levels; selecting trees that are safe to climb; selecting trees that appear free of disease, of good vigor, and with sufficient cones; and collecting from only one bole in a cluster of whitebark pine stems. In 2014, 12 of the 13 new Collection trees were climbed to cage and harvest cones. Cones from these 12 new Collection trees were caged on July 15 – 16, and cages removed and cones harvested on September 22. One tree was caged and harvested from the ground by hand (CRLA-14-HP04). Cones from this tree were caged on July 24 and harvested on September 23. Out of the 13 new Collection trees, 11 appeared free of WPBR; 2 trees



Figure 4. A tree climber from the Deschutes National Forest installs cone cages to protect developing whitebark pine seeds from wildlife species. Photo by Jen Beck.

(CRLA-14-CC10 and CRLA-14-GC05) were infected with WPBR and selected as controls for the rust-resistance screening process.

CRLA's Long-Term Whitebark Pine Monitoring

Crater Lake National Park implemented a long-term monitoring program in 2003 to track changes in whitebark pine communities. Seven plots were strategically placed in areas representing different whitebark pine vegetation types throughout the park (Figure 5). With the exception of 2008, plots have been sampled annually since 2003. Protocol for CRLA's whitebark pine long-term monitoring plots is available in WPCP files. In 2014, plots were sampled from July 22—August 28. This effort is separate from and complementary to the Vital Sign long-term monitoring of whitebark pine implemented in 2012 by the National Park Service (NPS) Klamath Inventory and Monitoring Network (KLMN). The KLMN effort established 30 whitebark pine long-term monitoring plots within the Park utilizing a peer-reviewed protocol employed by several NPS units in the Pacific West region. Information on this effort is available here:

<http://science.nature.nps.gov/im/units/klmn/monitor/whitebark.cfm>

Whitebark Pine Restoration Plantings

Four whitebark pine restoration plantings have occurred at CRLA: the 2009 Rim Village, 2009 Horse Trail, 2012 Dutton Ridge, and 2012 North Junction plantings. Each planting utilized three year old seedlings from CRLA parent trees grown by the DGRC. Seedlings are monumented with small metal tags inserted at ground level and mapped to ease relocation using a sub-meter accuracy Trimble GPS unit and ArcMap software. Seedlings are monitored annually for WPBR infection, vigor, growth, and damage as a joint effort between CRLA and the DGRC.

The 2009 Rim Village planting utilized an opportunity to restore the site of an old parking lot between the Rim Café and Gifts building and the Rim Village promenade. Three hundred and thirty one seedlings were planted from 17 Resistant and Susceptible CRLA parent trees. Susceptible seedlings were included in the restoration planting as a field validation of rust-resistance results

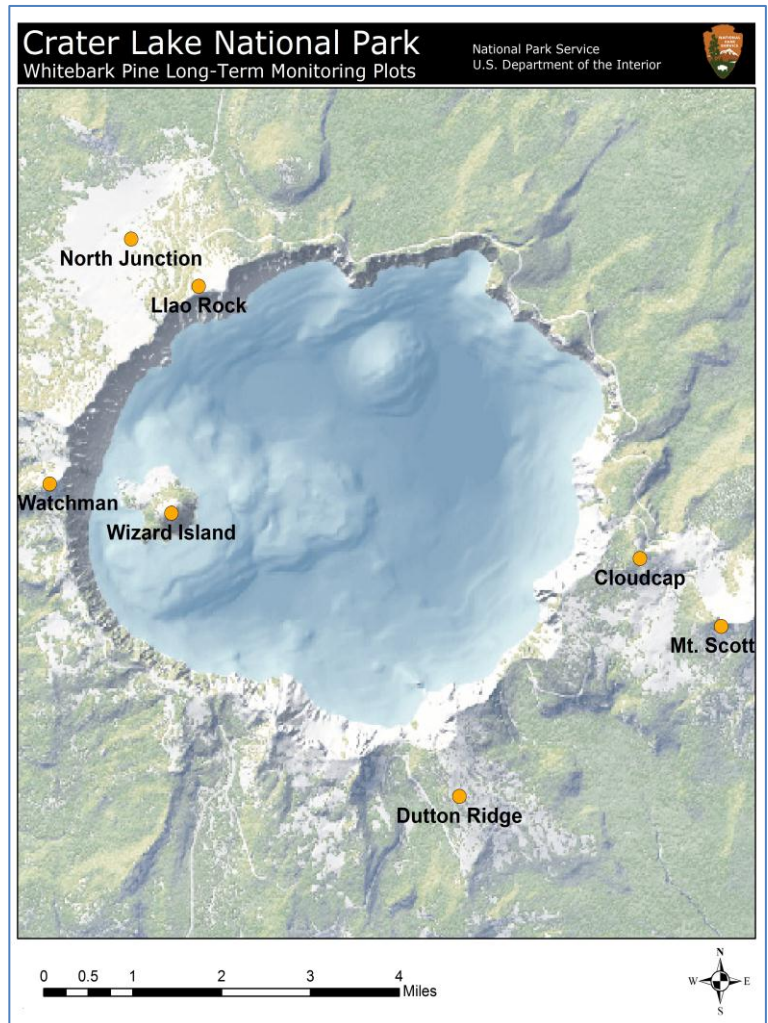


Figure 5. Locations of CRLA's long-term whitebark pine monitoring plots. Map by Jen Beck.

determined by the DGRC. Since the planting site was a former parking lot, soils were highly compacted and a backhoe and auger were brought in to drill planting holes. Boulders, woody debris, and forest litter and duff were added to ameliorate the harshness of the planting site. Seedlings were planted 1 - 3 to a planting hole. Seedlings were planted from September 15 - 23, 2009, and watered as needed until snowfall on October 1.

The 2009 Horse Trail planting, located just south of Rim Village, is both a restoration project and an experiment to determine if inoculating seedlings with a beneficial fungal endophyte increases their chance of survival. Endophytes are fungal species that live inside plants and may confer benefits to their host such as resisting infection from WPBR. One hundred ninety two seedlings were planted at the Horse Trail site from five Resistant and Susceptible CRLA parent trees. One half of the seedlings were inoculated with the endophyte *Myrothecium roridum*, the other half were treated with distilled water as controls. Seedlings were randomized and planted in five circular “family” (i.e., from the same parent tree) plots; seedlings were planted one or two to a planting hole and seedlings with differing treatments were not planted in the same planting hole. No ameliorations were made to the site prior to planting. Seedlings were planted on September 28, 2009, and watered immediately after planting. It has not been confirmed if the inoculation of whitebark pine seedlings with *M. roridum* was successful; a graduate student is currently investigating this matter.

The 2012 Dutton Ridge and North Junction plantings were part of a FHP funded project involving CRLA, DGRC, DNF, and Oregon State University. These two sites were selected due to their contrasting climatic regimes; North Junction is located northwest of the Crater Lake caldera and Dutton Ridge is southeast of the caldera. Typically, the west side of the Park intercepts more precipitation from incoming Pacific storms than does the east side. Additionally, the North Junction site (2085 – 2103 m) is lower in elevation than the Dutton Ridge site (2195 – 2286 m). A total of 416 seedlings were planted at both sites. Seedlings originated from ten CRLA parent trees; eight of these Parent trees were Resistant and two were Susceptible. The rationale for including Susceptible trees in the restoration planting is again to field-validate rust-resistance results determined by the DGRC. This project incorporated a randomized block design with the number of seedlings from each parent tree divided as equally as possible among the blocks. Due to more area available for planting at Dutton Ridge vs. North Junction, five blocks were placed at Dutton Ridge with three blocks at North Junction. Fifty two seedlings were assigned to each block. Seedlings were planted one to a planting hole, and planting hole locations were determined based on proximity to naturally occurring ameliorating microsite features such as downed wood. Seedlings were planted on October 18, 2012, and received no watering. Immediately after planting, the Park experienced a series of fronts and received 27” of snow from October 19 – 25, 2012. In 2013, natural whitebark pine regeneration of similar size to planted whitebark pine seedlings at the Dutton Ridge and North Junction sites were tagged, mapped, and assessed for height, vigor, WPBR infection, and damage. These “natural regeneration” seedlings are included in the annual monitoring of this restoration project.

Results

Results are presented separately for each component of 2014 WPCP activities.

Collection Tree Monitoring and Verbenone Application

In 2014, a total of 69 Resistant and Candidate whitebark pines were treated with verbenone to help ward off MPB attack. No new mortality was observed of any Resistant or Candidate tree. This was good news, considering that the Park has lost 22% of its Resistant whitebark pine; all have been killed by the MPB. One new active WPBR infection was detected on a Candidate tree at the Watchman Overlook (CRLA-13-WM04 – Figure 6). Three MPB pitch tubes were observed on Candidate tree CRLA-14-NJ05 in the North Junction area on 9/22/14 despite the fact that two verbenone pouches had been attached to this tree earlier in the summer. Candidate tree CRLA-11-CC03 at Cloudcap, which has been annually treated with verbenone since 2012, was the only tree unaffected by MPB in a group of trees that had been killed or was under attack by MBP.



Figure 6. The old, gnarled CRLA-13-WM04 with an active WPBR infection. Photos by Jen Beck.

The MPB outbreak that has been impacting CRLA whitebark pine since at least 2003 is still active, and its impacts are becoming more apparent at the Park's highest elevations. While the annual MPB-caused mortality of WBP is concerning, the cumulative impacts of over a decade of MPB attack have been quite devastating to the Park's whitebark pine communities. The Park uses Aerial Detection Survey (ADS) data provided by USFS Region 6 (Oregon and Washington) as an estimate of MPB activity in the Park on an annual basis (Figure 7). These data are not field-verified, and are used by the Park to detect rough trends in MPB activity. 2014 ADS data show the MPB continuing to have an impact on forest health at the Park.

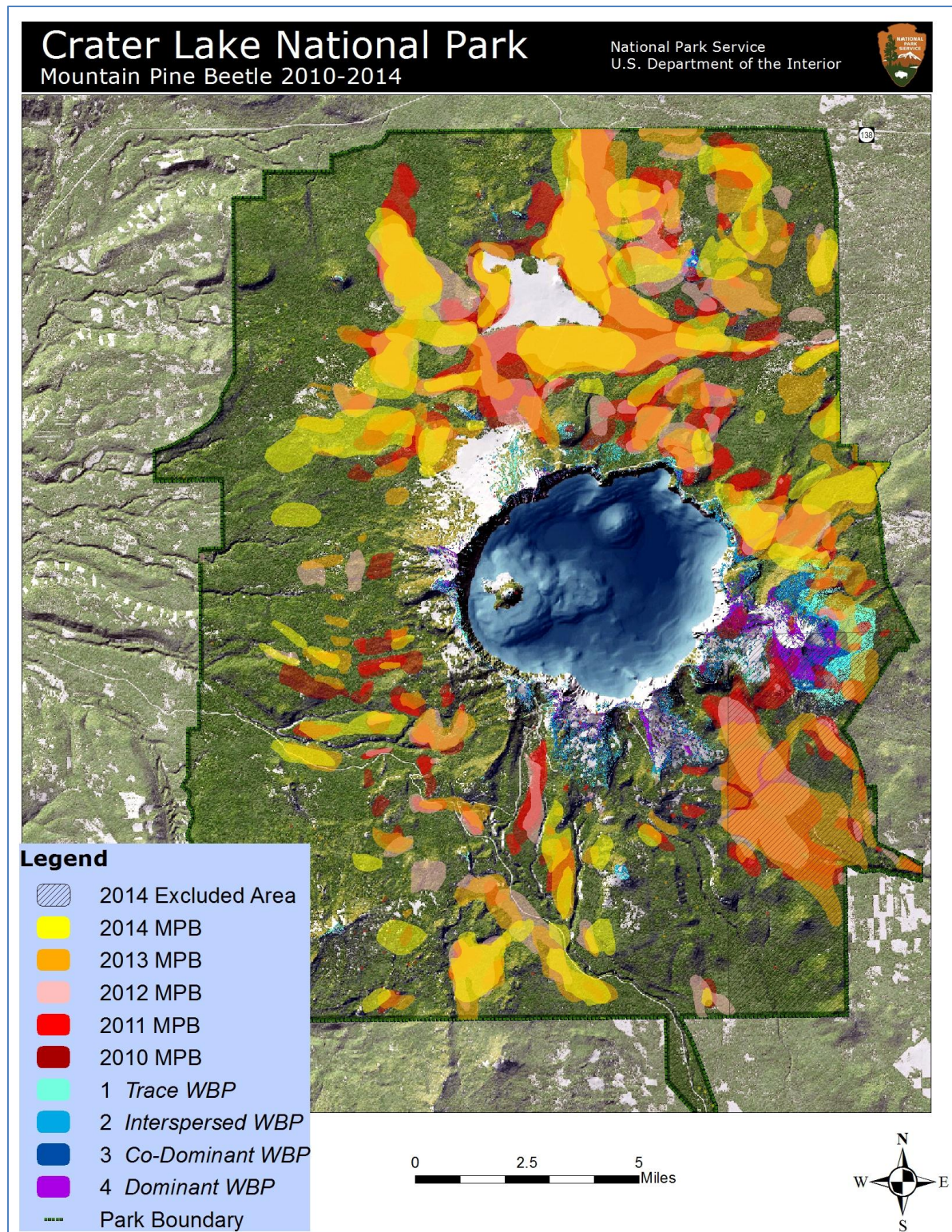


Figure 7. USFS ADS data for MPB activity within CRLA from 2010 - 2014. The purple hashed lines in the southeast portion of the park were not flown in 2014, so data are not available for this area. Whitebark pine distribution is displayed by canopy dominance class. Map by Jen Beck.

Cone Collection

Despite the fact that 2014 was not a good cone year at CRLA, cones were collected from 13 new whitebark pines (Figure 8). Eleven of these trees are new Candidate trees, and two are Susceptible trees (used as controls); progeny of these trees will enter rust-resistance screening at the DGRC. This brings the number of CRLA trees that have either completed or are currently undergoing rust-resistance testing at the DGRC to 112.

To date, the Park has received rust-resistance results from 2003, 2005/6, and 2009 Collection trees (Table 1). All of the dead Resistant trees were killed by the MPB. While rust-resistance results from the first batch of Collection trees (2003) were not very promising, CRLA trees have shown more resistance in subsequent rust-resistance screening trials. “Resistant” trees include trees with a “C” rust resistance rating; this is to increase genetic diversity in restoration efforts. Preliminary rust-resistance results from the 2011 Collection trees should be received by the Park in the near future.

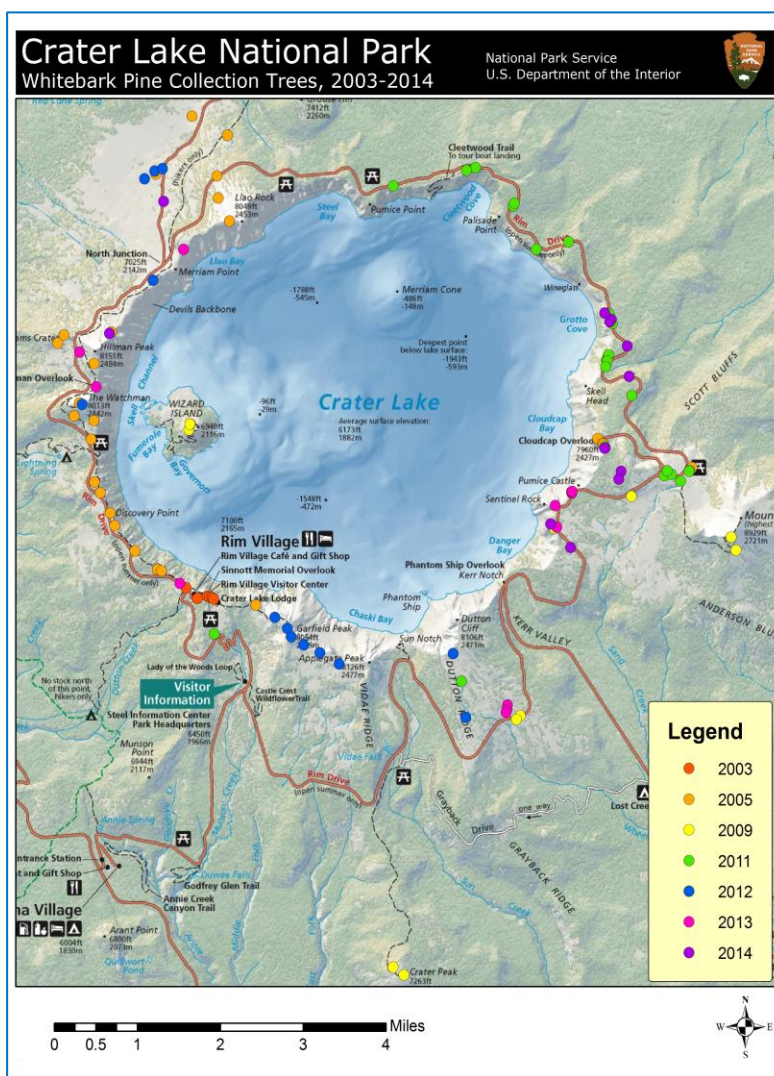


Figure 8. Locations of CRLA whitebark pine that have had cones collected for rust-resistance screening over the years. Map by Jen Beck.

Table 1. Rust-resistance information for CRLA’s whitebark pine Collection trees, 2003-2014. Dead trees are indicated in parentheses; asterisks indicate rust-resistance results are pending.

Collection Year	Resistant	Susceptible	Candidate	Total
2003	1	8 (1)	0	10
2005/6	11 (4)	9 (1)	1	26
2009	6 (1)	2 (2)	0	11
2011	*	*	26 (1)	27
2012	*	*	13	13
2013	*	*	12	12
2014	*	*	13	13

*indicates a Resistant or Susceptible rating has yet to be determined.

CRLA's Long-Term Whitebark Pine Monitoring

The Park's seven long-term monitoring plots were sampled between July 22 and August 28, 2014. Fresh MPB activity was observed at four of the plots: Mt. Scott (2536 m), Watchman (2425 m), Llao Rock (2393 m), and North Junction (2103 m). The MPB activity observed in and just upslope of the Mt. Scott monitoring plot at 2552 m is the highest elevation MPB-caused mortality of whitebark pine that has been recorded by the CRLA Botany program in this recent MPB outbreak (Figure 9). From 2003 - 2013, the Mt. Scott plot had no observed MPB activity or impacts although MPB activity downslope along the Mt. Scott trail was noted in 2007. 2014 marked the first year that MPB were observed attacking trees within this plot; four trees were observed with light MPB activity (one pitch tube per tree in August).



Figure 9. MPB-killed whitebark pine observed at 2552 m on Mt. Scott upslope from the long-term whitebark pine monitoring plot. Photo by Jen Beck.

All plots except the Wizard Island plot continued to be impacted by blister rust; the Wizard Island plot continued to be devastated by dwarf mistletoe. Mortality of seedlings within plot areas in 2014 was caused by animal predation or drought/desiccation.

Overstory whitebark pines (> 15 cm DBH) within plot areas have been reduced by 23.4% from 2003 to 2014; sapling whitebark pines (> 0 and < 15 cm DBH) have been reduced by 7.4% during this period. The MPB remains the leading mortality agent for overstory whitebark pine within plot areas. Total blister rust infection of whitebark pine has changed from 11.5% in 2003 to 23.9% in 2014. Blister rust infection in trees > 15 cm DBH has changed from 12.1% in 2003 to 36.2% in 2014.

Whitebark Pine Restoration Plantings

The Park's four whitebark pine restoration plantings continued to do well two to five years after planting. There was concern about the seedlings planted at Rim Village, as this site is one of the most heavily visited areas of the park year-round, and low snow levels had exposed the seedlings over the winter and made them vulnerable to trampling. During the summer months, the seedlings are protected by ropes, signs, and/or walkways directing pedestrian flow. While some seedlings at Rim Village did suffer damage from trampling, the damage wasn't as great as feared and this site continues to boast the highest survival rate of any of the Park's four restoration planting sites. 2014 survival rates for planted seedlings range from 77.1 – 89.7% and are displayed in Table 2. Data on survival of natural regeneration are also included in this table, as they provide some information on background mortality rates in naturally occurring whitebark pine seedlings.

Table 2. Survival rates for the Park’s four whitebark pine restoration planting sites as of 2014. Natural whitebark pine regeneration was not monitored at Dutton Ridge and North Junction until 2013.

Site	2010	2011	2012	2013	2014
2009 Horse Trail Planting	84.4	82.3	79.7	78.1	77.1
2009 Rim Village Planting	97.0	91.5	91.2	90.9	89.7
2012 Dutton Ridge Planting				88.8	78.5
2012 North Junction Planting				89.1	80.8
Dutton Ridge Natural Regeneration					91.0
North Junction Natural Regeneration					93.6

Out of the four planting sites, only one seedling is confirmed to have died from blister rust with another suspected rust-caused death. These mortalities occurred at Rim Village, and the seedlings were progeny of a “C” rated parent tree. Five seedlings at Rim Village were observed to be infected with blister rust in 2014 (Figure 10); two of these seedlings are from a “D” rated parent tree, and three seedlings are from an “F” rated parent tree. The leading mortality cause of seedlings at the Rim Village site is herbivory. To date, no seedlings have been infected by blister rust at the Horse Trail site; most of the seedling mortality has been attributable to herbivory. At the Dutton Ridge site, three seedlings were observed to be infected with blister rust in 2014; two from “A” rated parent trees and one from a “D” rated tree. No seedlings have been observed to have blister rust infections at the North Junction site. The primary source of seedling mortality at Dutton Ridge and North Junction (for planted seedlings and natural regeneration) has been herbivory and secondarily desiccation from drought.



Figure 10. 2014 active blister rust infection on a whitebark pine seedling planted for restoration at Rim Village. Photo by Jen Beck.

Discussion

The 2014 season marked another year of efforts made by the Park to implement the CRLA Whitebark Pine Conservation Plan. The most disturbing observation made this year was the continued and cumulative impacts made to the Park’s whitebark pine by a relentless MPB outbreak. Since the Park’s whitebark pine often grow in close association with other conifer species that are not

impacted by MPB (e.g, mountain hemlock – *Tsuga mertensiana*), the impacts may be visually softened since the park’s high elevation forested landscapes still appear mostly green. However, over a decade of sustained MPB attack on the Park’s whitebark pine has taken a toll. Since MPB indiscriminately kill whitebark pine with resistance to blister rust, and since the Park’s whitebark pine stands have been impacted by decades of blister rust infection and mortality, this loss has been substantial.

Planning continues for the Park’s next round of whitebark pine restoration outplantings, scheduled for fall of 2016. This project will plant 480 whitebark pine seedlings from 16 CRLA parent trees. Four sites have been selected as possible restoration sites: North Junction, Grouse Hill, Scott Bluffs, and Williams Crater. These sites have all been surveyed for cultural resources but final clearance needs to be obtained from the State Historic Preservation Office. The process of gaining compliance with the National Environmental Preservation Act has been initiated.

Work for the WPCP in 2015 will retain emphasis on Collection Tree Monitoring and verbenone application to all Resistant and Candidate trees; sampling the Park’s seven long-term whitebark pine monitoring plots; and monitoring the Park’s four whitebark pine restoration outplantings. The Whitebark Pine Ecosystem Foundation will be holding their annual meeting on the West Coast for the first time in September 2015; this meeting includes a field trip to CRLA. Many of the Park’s whitebark pine issues and WPCP components will be highlighted on this field trip, including the Park’s monitoring efforts; Collection Tree monitoring program and levels of rust-resistance; MPB impacts and verbenone treatment; WPBR infection and impacts; dwarf mistletoe impacts; and whitebark pine restoration and its associated challenges.

Recommendations for WPCP work in the 2015 season include:

Collection Tree Monitoring and Verbenone Application:

- Request assistance from local FHP staff to treat additional “legacy” whitebark pine with verbenone during this period of high-elevation MPB outbreak.
- Photograph any questionable WPBR symptoms for each Collection tree and include in WPCP files so these can be tracked over time, and also to bolster the WPCP collection of WPBR photos.
- Ensure “Please Do Not Touch” labels are affixed to each tree treated with verbenone to provide for public safety.
- If possible, monitor Susceptible trees so their status can be updated in WPCP files.
- Seek funding to procure 2016 verbenone as opportunities are presented (e.g., Park lapse funds).

Cone Collection:

- Suspend cone collection activities until the whitebark pine cone crop improves.
- In the next good cone years, focus cone collection in unrepresented areas such as Timber Crater, Bald Crater, Red Cone, Grouse Hill, and Union Peak.

Long-term Monitoring Plots:

- When time allows, long-term monitoring plots should have trees tagged at DBH and measured just below the nail; this would reduce errors in recording DBH over time. Tags should face away from trails; otherwise they should face the plot rebar stake.

Restoration Plantings:

- Continue to collaborate with the DGRC on monitoring.
- Continue to update seedling maps annually.
- Begin developing the 2016 Restoration Plan for the upcoming whitebark pine restoration outplantings.

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The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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