



The Klamath Kaleidoscope

Newsletter of the Klamath Inventory & Monitoring Network

Fall/Winter 2017

Boosting Natural Selection: A Conservation Tool for the Whitebark Pine

In Cottage Grove, Oregon, a giant garden sprouting rows of green and brown tree seedlings is part of an ongoing genetic experiment. Researchers at the US Forest Service's Dorena Genetic Resource Center are methodically searching for whitebark pine (*Pinus albicaulis*) seedlings showing natural resistance to a major fungal disease, white pine blister rust. Their success could play an important role in conserving this keystone species. Some Western parks with whitebark pine habitat, including Crater Lake National Park, are pitching in to help.

The iconic whitebark pine thrives in harsh subalpine climates, feeding wildlife with the nutritious seeds in its cones, stabilizing the thin rocky soil with its roots, and prolonging snowmelt with its shade. But white pine blister rust, a disease caused



Whitebark pine seedlings inoculated with the fungal pathogen, *Cronartium ribicola*, show greater (green) and lesser (brown) resistance to the disease it causes. USFS/R. Snieszko.



White pine blister rust cankers.

by the nonnative fungal pathogen, *Cronartium ribicola*, and mortality caused by the mountain pine beetle have taken a toll on these trees. Declines have been so severe that in 2011 the US Fish and Wildlife Service declared it a candidate for listing under the Endangered Species Act. A final decision is expected in 2019. In response, federal agencies, university scientists, and conservation organizations have been taking a

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Whitebark Pine *(continued)*

multipronged conservation approach:

- **Research** the tree's ecology, genetics—including natural rust resistance—and vulnerability to different stressors.
- **Monitor** the status of whitebark pine, along with the presence of white pine blister rust and mountain pine beetles across the tree's range, to keep track of the spread of these threats and their impacts.
- **Protect** existing stands through direct action and by maintaining genetic diversity. Some direct action examples are placing pheromones on trees to prevent mountain pine beetle attack, clearing debris from tree understories to reduce fire risk, and pruning branches of trees with blister rust cankers.
- **Restore** whitebark pine by planting rust-resistant seedlings in targeted locations, as well as promoting natural ecological processes, such as wildland fire, which creates openings for seedling regeneration, among other benefits.

The Dorena Genetic Resource Center began researching the effects of white pine blister rust on five-needle pines 50 years ago, in 1966. The focus on whitebark pine, however, began in 2002 and has progressed to planting rust-resistant trees in a handful of parks and national forests. Crater Lake National Park staff got on board with the initial trials and began sending cones from healthy, older trees for testing at Dorena in 2003. The entire process from start to finish is costly (\$1000/tree, not including cone collection) and complex, but provides new stock that will hopefully withstand blister rust attack. Identifying rust-resistant individuals takes up to seven years:

1. In rust-infected areas, identify

healthy whitebark pine trees with no sign of blister rust—these are the individuals most likely to have some genetic resistance to the disease.

2. Protect these individuals using a mountain pine beetle pheromone—verbenone—to stave off beetle attack. The pheromone says, “This tree is already full of beetles – go somewhere else!”
3. Cage the developing cones in midsummer from hungry Clark's nutcrackers.
4. In early October, remove the cages, harvest the cones, extract the seeds and grow them at Dorena.
5. At two-years-old, infect the seedlings with blister rust and monitor for five more years to identify which are most resistant—this often leaves just a small percentage of the original batch alive.
6. Plant the most rust-resistant survivors (graded from A to F for degree of resistance) in areas targeted for recovery. As of 2016, 87% of seedlings planted at the Rim Village parking area in Crater Lake have survived so far—in part due to the lack of hungry gophers in the area!



Whitebark pine seedlings (top) before planting at North Junction, and (bottom) after planting at Rim Village in Crater Lake National Park.

While the Dorena Genetic Resource Center handles **research and development**, and Crater Lake staff work on **protecting and restoring** rust-resistant trees, the Klamath Network contributes to the overall conservation strategy through its long-term **monitoring** program. Whitebark pine are one of the Network's “vital signs” of park health. Every summer, Klamath Network botanist, Sean Smith, works with an intern from our host campus, Southern Oregon University, to monitor the status of whitebark pines at Crater Lake and Lassen Volcanic National Parks. They count seedlings, measure diameters, document dead trees, and record evidence of blister rust and mountain pine beetles. Some of this information feeds a regional dataset housed by the US Forest Service that can be shared with cooperators. More locally, however, it supplies Crater Lake and Lassen Volcanic park scientists with a regular checkup on this vital sign of montane ecosystem health.



SOU intern, Erica Rudolph, counting seedlings (a mountain hemlock here) in a whitebark pine sampling plot at Crater Lake National Park.

Learn more about whitebark pine conservation in the West:

[Dorena Genetic Resource Center](#)

[Whitebark Pine Ecosystem Foundation](#)

[Whitebark Pine Restoration at Crater Lake National Park](#)

[Klamath Network Whitebark Pine Monitoring Program](#)



Klamath Network Inventory & Monitoring Program

The National Park Service has implemented natural resource inventory and monitoring on a service-wide basis to ensure all park units possess the resource information needed for effective, science-based management, decision-making, and resource protection.

Parks in the Klamath I&M Network:

- Crater Lake National Park
- Lassen Volcanic National Park
- Lava Beds National Monument
- Oregon Caves National Monument and Preserve
- Redwood National and State Parks
- Whiskeytown National Recreation Area
- Tule Lake Unit of WWII Valor in the Pacific National Monument

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Bat Ambassadors



Annalyn Chia and Kimber Godfrey talk about bats with visitors to the Lassen Volcanic National Park Dark Sky Festival last summer. NPS/Alison Taggart-Barone

Bats became a little more familiar and a little less scary to park visitors this summer. Two Geoscientists-in-the-Parks interns worked with Alice Chung-MacCoubrey at the Klamath Network this summer to develop an evening interpretive program about bats and white-nose syndrome, the deadly disease threatening North American bats. Kimber Godfrey and Annalyn Chia, both recent college graduates, spent the early summer studying bats and weaving this knowledge into an educational presentation. By midsummer, they took their show on the road, presenting it at Whiskeytown National Recreation Area, and Crater Lake and Lassen Volcanic National Parks. During the first part of the evening program, the audience passed bat fact “cards” around and asked questions about these mysterious creatures. The hands-on, live bat

monitoring began at dusk, with each intern donning a backpack sporting a microphone and tablet computer loaded with special software (SonoBat). This equipment allowed the audience to see and hear echolocation calls of bats flying overhead, and the software told them which bat species were likely passing by. Seeing and hearing the bat calls was a highlight for the audience! Kimber was especially excited to teach folks about white-nose syndrome, a very important issue that most people knew little about. Towards the end of the summer, Kimber and Annalyn presented their well-honed program at the three-day Lassen Volcanic National Park Dark Sky Festival. In the company of storytellers, astronomers, and astrobiologists, they did their part to kindle a deeper understanding and appreciation of the natural world.



Annalyn Chia. NPS/Alison Taggart-Barone



Kimber Godfrey. NPS/Alison Taggart-Barone

Final Season for the Crater Lake Vegetation Map

Dodging fires at Crater Lake National Park this summer, the Klamath Network vegetation mapping crew gathered the last season of field data. This summer's plots check the accuracy of the final map, setting the stage for publication next year.

Dominic DiPaolo, the current project lead, has been involved since data collection began in 2011, along with Dennis Odion, one of the original planners in 2008. The final map meets important accuracy thresholds, and DiPaolo is excited about what it can contribute to park management:

“The vegetation map is more like a digital atlas than simply a static map of park vegetation types. It can be a geographic reference for planning, and can also house geographic data for just about anything you’d want to locate in the park.”

Why map?

Vegetation maps were one of 12 inventories representing the first component of the National Park Service’s “Inventory and Monitoring Program.” These surveys catalogued current resources or conditions in parks, like air quality, species lists, and soil maps—basic information that was often lacking. Park managers need to know what natural resources exist in their parks and where to find them to do their jobs effectively. The Crater Lake National Park vegetation map will offer more detail and higher accuracy than the existing coarser scale LANDFIRE vegetation data previously available to the park.

Steps in making a vegetation map

A vegetation map is a multiyear project that begins with an up-to-date set of baseline imagery. 2011 color aerial photography with 1-meter resolution (1 pixel per square meter) was used as the basis upon which to draw the vegetation map.



The Crater Lake National Park vegetation mapping crew, from left to right: Trevor Griffiths, Jay Johnson, Kasey Rolih, Leela Hickman, Therese Balkenbush, Kaitlyn Wright.

Step 1—Find out what’s there!

Crews sampled plots in the field that captured the full variety of park vegetation. They identified all plant species in a plot, using the dominant and most commonly associated species to generate an initial list of distinct plant associations for the park. This initial list was then matched as closely as possible to existing plant associations in the US National Vegetation Classification (USNVC). (Interestingly, 37 of the 80 final Crater Lake plant associations have not been described yet in the existing USNVC.)

Step 2—Define the map units

Based on what was visually distinguishable in the imagery, they grouped plant associations together—following the USNVC hierarchy—to create a list of the foundational map units.

Step 3—Start mapping

This is the part where lines were

drawn, creating polygons no smaller than 0.5 hectares. Inevitably, the mappers made some adjustments as they grappled with the range of variability they encountered for each map unit in the park.

Step 4—Check the map’s accuracy

You might call this the ground-truthing stage. Staff sampled up to 30 randomly selected points in each map unit category to find out how well conditions on the ground matched the assigned map unit characteristics.

Challenges

Wildfires were a huge challenge for the mappers this summer. The Spruce Lake and Blanket Creek Fires prevented field crews from sampling some of the original accuracy assessment plots. This kept DiPaolo and Odion on their toes, establishing new plots on the fly (though carefully following protocol) to make sure they had enough in each map unit category. It was no small

Vegetation Map *(continued)*

accomplishment! While the map will no longer represent severely burned areas, DiPaolo sees a bright side. Crater Lake has experienced several fires over the past decade, resulting in a range of newly regenerating areas that are currently described in detail by the new vegetation map. These existing postfire vegetation types exhibiting different stages of vegetation succession can be used to help understand conditions as the vegetation redevelops following last summer's fires as well.

All vegetation maps have a range of accuracy across vegetation types. One of the toughest categories to map accurately was “cliff, scree, and rock,” which often contained more vegetation than was visible from the imagery. In contrast, several vegetation types were mapped with 100% accuracy, including ponderosa pine woodland, white fir forest, lodgepole pine forest, montane grassland, and wet meadow and marsh.

End products

The mapping project will ultimately provide several different tools for understanding park vegetation:

- A detailed, color vegetation map
- A geodatabase with all the plot locations and detailed vegetation characteristics
- An accuracy assessment to show managers which vegetation types are most and least accurately mapped
- A dichotomous vegetation key for placing a site into the plant associations described
- A description of each plant association, with photos

Uses of a vegetation map

Vegetation maps are valuable as snapshots in time to help us learn how landscapes change and



Kaitlyn Wright records species in an antelope bitterbrush map unit at Crater Lake National Park.

respond to disturbance over time. They identify unique or sensitive habitats that we might not have known much about. For example, the new vegetation map delineates a community of special interest to the park—subalpine fell fields. These high elevation, windswept habitats support a unique herbaceous plant community, including some rare and endemic species. The map also identifies stands of whitebark pine, a declining keystone species of high elevation ecosystems that is currently a candidate for listing under the Endangered Species Act.

Vegetation maps can tell us where to look for sensitive wildlife by pinpointing the plants they rely on for food, shelter, and nesting habitat. Along those lines, the park's terrestrial ecologist, Sean Mohren, plans to upgrade his spotted owl habitat map with the new, more detailed vegetation data. Mohren conducts compliance surveys for projects near known spotted owl territories. He also collects acoustic data on the distributions of spotted owls and their

competitors, barred owls. Knowing more accurately where to survey and where to place his acoustic detectors will boost Mohren's efficiency.

Unexpected bonus

One advantage of having “eyes on the ground” as part of any fieldwork is incidental discoveries. The mapping crew stumbled upon a great grig in Shasta red fir forest, which you can read about in our latest [Featured Creature](#).



Male great grig (*Cyphoderris monstrosa*) found on the forested slopes of Crater Lake National Park. NPS/Leela Hickman.

Sharing I&M Science with the Public

What is I&M, anyway?

Working behind the scenes for years, the Klamath Inventory and Monitoring Network has been collecting scientific data in parks to support management decisions. The public, and even some park staff, have little idea who we are or what we do. To raise the profile of our program and reach public audiences more effectively, we've recently published the *Inventory and Monitoring Division Communication Strategy and Resource Guide*. In addition to supporting park management, I&M communication also targets the public:

Public audiences understand, value, and are inspired by the work the Inventory and Monitoring Division does as part of the NPS

Our work has the potential to help boost science literacy in the public and promote greater understanding and valuing of the role of science in caring for our national parks.

New logo and traveling poster

Establishing a public friendly face for our network is a good place to start. We worked with a graphic design student intern from Southern Oregon University, Melissa Donner, to create

a Klamath Network logo and traveling poster. The logo represents at least one vital sign from each park. (Did you notice it at the top of page 3?) Our [poster](#) describes the program and our vital signs. We've begun bringing it with us to park meetings and seasonal orientations as a conversation starter.

I&M video in the works

This past fall we worked with videographer, Michael Durham, to tell our story through film. See below.

Got science content?

We've also been exploring ways to introduce the network and cover park-specific natural resource issues through park venues. We welcomed the opportunity last year to write about rocky intertidal zone monitoring for the [Redwood National and State Parks website](#) and stream monitoring for the [Whiskeytown NRA](#) newspaper.

Partnering with park interpreters

A great way to share I&M science is to collaborate with park interpreters. These professional storytellers are the public face of parks, and we're hoping to make our science more accessible to them as "story nuggets" for public presentations.

Digital face lift

I&M websites will have a new look by next fall. The old network website is soon to be replaced by the [nps.gov](#) website platform currently used by parks. I&M information will receive a refreshing face-lift, with a more public-friendly entrance and more imagery. Have no fear—all the reports and other technical content will still be accessible!

Ideas to share?

Please contact me if you would like to collaborate on science outreach:

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(Science Communication Specialist for the Klamath Network)



Telling Our Story through Film

If you want people to listen, tell a story. Better yet, add interesting visuals. The Klamath Network has been working with videographer, Michael Durham, to tell our story through film. Our network is one of several in the Pacific West I&M Region with support to create an introductory video.

Using the example of long-term cave ice monitoring at Lava Beds National Monument, Durham is helping us craft the story of what long-term

monitoring is and why we do it. He spent a week this past October at Lava Beds gathering footage—hauling camera gear through tight cave openings, interviewing park and network staff, spying on wildlife drinking from pools of melted cave ice, and filming stunning scenery in the park to embellish the central storyline.

We hope to have a final product available by next summer.

Stay tuned!



Michael Durham zooms in on Katrina Smith at Lava Beds NM demonstrating how to monitor cave entrance vegetation along a transect line.

2017 Vital Sign Monitoring Updates



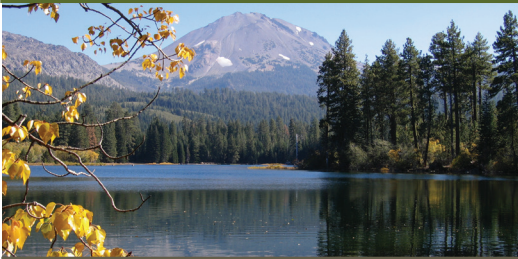
Redwood National and State Parks

- rocky intertidal zone sampled
- exotic invasive plants surveyed
- landbird point counts conducted—4th resurvey since 2008
- terrestrial vegetation sampled—new riparian site installed to replace one overgrown by blackberry



Whiskeytown National Recreation Area

- stream aquatic communities and water quality sampled
- exotic invasive plants surveyed—diffuse knapweed (*Centaurea diffusa*) detected in new area of the park



Lassen Volcanic National Park

- stream aquatic communities and water quality sampled
- exotic invasive plants surveyed
- whitebark pine sampled



Oregon Caves National Monument & Preserve

- caves sampled—water pools, climate, visitation, bats
- exotic invasive plants surveyed
- landbird mist netting conducted—179 birds captured; park data used for regional analyses in 2 journal publications (see Rockwell et al. and Alexander et al. papers in *Recent Publications*, next page)



Crater Lake National Park

- whitebark pine sampled—all plots sampled except 1 because of fire proximity and then early snow accumulation
- exotic invasive plants surveyed



Lava Beds National Monument

- caves sampled—ice, climate, visitation, bats
- exotic invasive plants surveyed
- terrestrial vegetation sampled
- landbird point counts conducted—4th resurvey since 2008

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- Exotic, Invasive Plants
- Whitebark Pine

Recent Publications

Available from the Klamath Network website: <http://science.nature.nps.gov/IM/units/klmn/index.cfm>

Annual Reports

Whitebark Pine

- [Whitebark pine monitoring: 2015 results from Crater Lake National Park and Lassen Volcanic National Park](#)
- [Whitebark pine monitoring: 2016 results from Crater Lake National Park and Lassen Volcanic National Park](#)

Landbirds

- [Landbird monitoring: 2016 results from Crater Lake National Park and Oregon Caves National Monument and Preserve](#)

Land Cover and Land Use

- [Land cover and land use monitoring: 2016 results for Crater Lake National Park](#)
- [Land cover and land use monitoring: 2016 results for Lava Beds National Monument](#)
- [Land cover and land use monitoring: 2016 results for Oregon Caves National Monument and Preserve](#)

Rocky Intertidal Communities

- [Rocky intertidal monitoring: 2014 results from Redwood National and State Parks](#)
- [Rocky intertidal monitoring: 2015 results from Redwood National and State Parks](#)

Stream Water Quality and Aquatic Communities

- [Wadeable streams monitoring: 2014 results from Whiskeytown National Recreation Area and Lassen Volcanic National Park](#)

Analysis & Synthesis/Trend Reports

- [Whitebark pine in Crater Lake and Lassen Volcanic National Parks: Initial assessment of stand structure and condition](#)
- [Rocky intertidal monitoring: 2004-2013 trends and synthesis report for Redwood National and State Parks](#)

Journal Publications

- Alexander, J. D., J. L. Stephens, S. Veloz, L. Salas, J. S. Rousseau, C. J. Ralph, and D. A. Sarr. 2017. [Using regional bird density distribution models to evaluate protected area networks and inform conservation planning](#). *Ecosphere* 8:e01799
- DellaSala, Dominick A., Richard L. Hutto, Chad T. Hanson, Monica L. Bond, Timothy Ingalsbee, Dennis C. Odion, and William L. Baker. In press. Accommodating mixed-severity fire to restore and maintain ecosystem integrity, with a focus on the Sierra Nevada of California, USA. *Fire Ecology* 13. 148-171. doi: 10.4996/fireecology.130248173
- Odion, Dennis C., Chad T. Hanson, William L. Baker, Dominick A. DellaSala, Mark A. Williams. 2016. [Areas of agreement and disagreement regarding ponderosa pine and mixed conifer forest fire regimes: A dialogue with Stevens et al.](#) *PLoS ONE* 11(5):e0154579. doi:10.1371/journal.pone.0154579
- Rockwell, S. M., J. D. Alexander, J. L. Stephens, R. I. Frey, and C. J. Ralph. 2017. [Spatial variation in songbird demographic trends from a regional network of banding stations in the Pacific Northwest](#). *The Condor* 119:732-744
- Wiegardt, A., J. Wolfe, C. J. Ralph, J. L. Stephens, and J. D. Alexander. 2017. [Postbreeding elevational movements of western songbirds in Northern California and Southern Oregon](#). *Ecology and Evolution*: ece3.3326