National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
Klamath Inventory and Monitoring Network

The Klamath Kaleidoscope

Newsletter of the Klamath Inventory & Monitoring Network

Fall/Winter 2019

Making Sense of Monitoring Data: Whitebark Pine Conditions in the Southern Cascades

Year after year, NPS scientists head out into the field to sample lake water, measure trees, and collect other kinds of data about park health. The rewards come when they can periodically step back and explore what they've learned.

Klamath Network botanist, Sean Smith, has been monitoring whitebark pine (*Pinus albicaulis*) conditions in two network parks since 2012. Jenell Jackson, the graduate student he worked with early on, recently co-authored a paper with Smith and other scientists in the journal *Forests* sharing what they've learned about whitebark pine. Their study aims to support park managers grappling with how best to protect this increasingly threatened tree in the southern Cascades. Their paper is titled, "Whitebark Pine in Crater Lake and Lassen Volcanic National Parks: Assessment of Stand Structure and Condition in a Management and Conservation Perspective."

Why do we care?

Whitebark pine trees are a keystone species of high elevation forests throughout the West (Figure 1). The nutritious seeds in their cones feed bears and other wildlife. Their branches provide shade that prolongs snowmelt and their roots stabilize the thin, rocky subalpine soil. But whitebark pine are in severe decline across their range. Multiple stressors include mountain pine beetle infestation, white pine blister rust infection, fire suppression, and climate change. With the Pacific Northwest projected to become warmer and drier, park managers in high elevation parks across the West face a complex problem in a potentially rapidly changing environment.

What questions did this paper ask and why?

The paper addressed two underlying questions relevant to park managers:

What is the current status of whitebark pine populations in Lassen Volcanic and Crater Lake National Parks? With the possibility of rapid change, knowing where these stressors are hitting hardest helps managers prioritize where to act.

How do these stressors interact with each other and possibly other environmental factors to influence the survival of whitebark pine trees? Managers need to understand how pests, pathogens, and possibly other factors, like climate or competition with other tree species, may interact to worsen or lessen damage to whitebark pine.

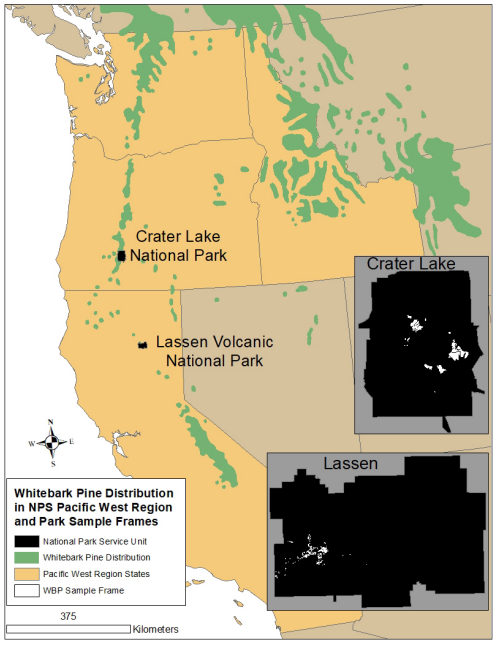


Figure 1. Whitebark pine distribution in the western United States and NPS Pacific West Region. Insets show the whitebark pine sampling frames from Crater Lake National Park and Lassen Volcanic National Park.

In This Issue

Whitebark Pine *(continued)*

How did they collect the data?

For three years between 2012 and 2014, Smith and Jackson (lead author of the paper and also the field crew lead on this project in 2013-2014), collected data in thirty 50 × 50 m plots in each park. They recorded tree species, size, and health, as well as evidence of blister rust infection or pine beetle infestation. They then combined that information with external climate data to do the analyses. These three years of data were part of the Klamath Network's ongoing long-term monitoring of whitebark pine as a vital sign related to each park's health.

What did they learn?

- About half of the whitebark pine trees sampled in each park were infected with white pine blister rust (Figures 2, 3). This was somewhat surprising in Lassen Volcanic National Park, where little blister rust had been observed previously, and certainly alarming, as most trees infected with blister rust eventually die.

- In both parks, whitebark pine trees produced fewer cones when crowded by other tree species. Mountain hemlock (*Tsuga mertensiana*) was the main competitor, and this species seems to have expanded into the subalpine zone due to fire suppression or climatic changes, or both (Figure 4).

- In Crater Lake National Park, trees growing in drier areas experiencing water stress were more likely to be infected with blister rust and were less likely to have cones.

- In Crater Lake National Park, the combination of pest and pathogen seemed to make matters worse. Trees with blister rust were more likely to be attacked by mountain pine beetle.

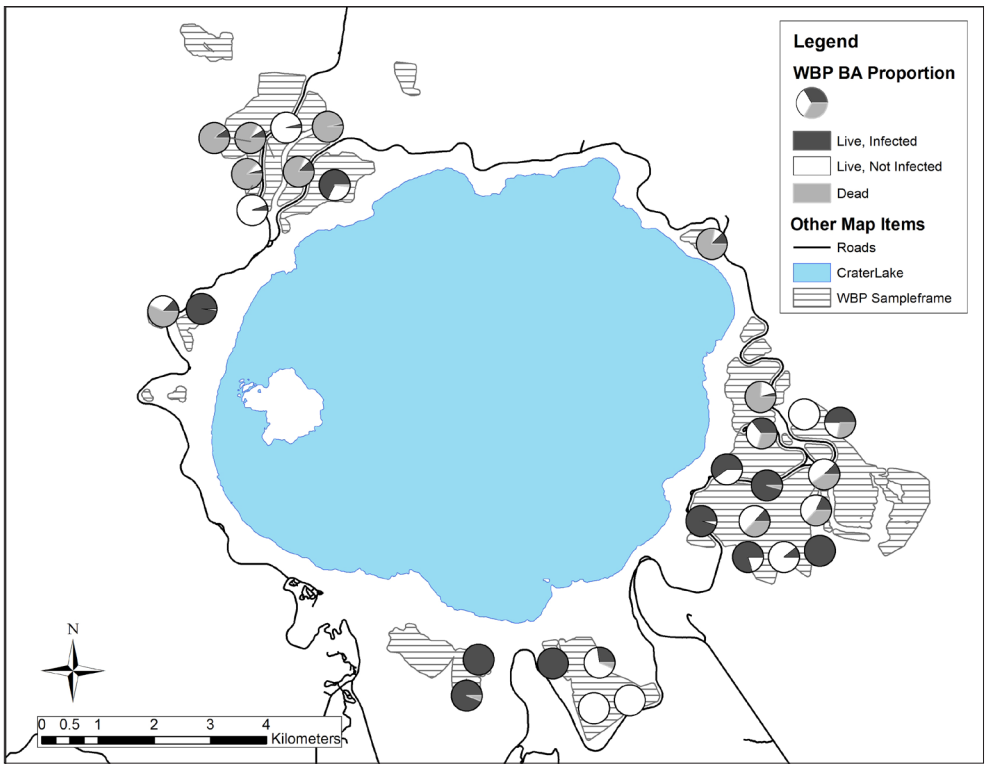


Figure 2. The whitebark pine sampling frame from Crater Lake National Park. Circular symbols represent the 30 plots installed between 2012 and 2014. Each circle is divided into the basal area (BA) of whitebark pine that is live and infected with blister rust (black), live and not infected with blister rust (white), and dead (gray).

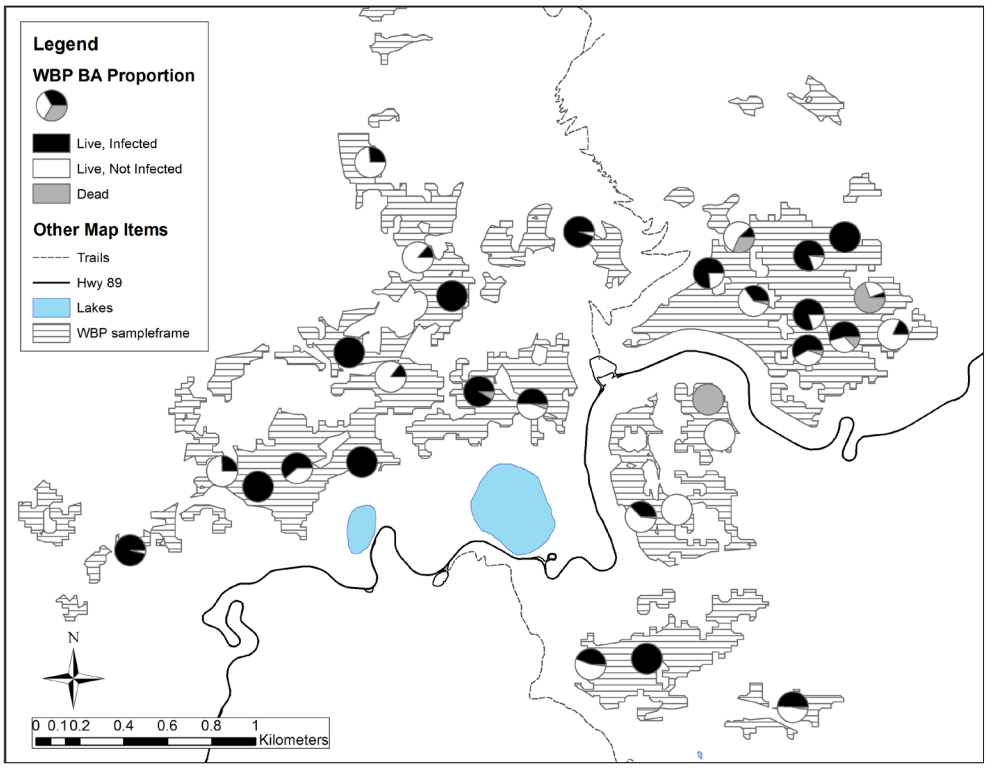


Figure 3. The whitebark pine sampling frame from Lassen Volcanic National Park. Circular symbols represent the 30 plots installed between 2012 and 2014. Each circle is divided into the basal area (BA) of whitebark pine that is live and infected with blister rust (black), live and not infected with blister rust (white), and dead (gray).

Whitebark Pine *(continued)*

Figure 4. Mountain hemlock crowding a lone whitebark pine (circled) at Lassen Volcanic National Park. NPS/Sean Smith

How might park managers use this information?

Because of the serious threats whitebark pine populations face across the West, scientists have already identified range-wide conservation principles. Knowledge gained from this 3-year data set in southern Cascade national parks aligns with these principles, but has the added benefit of being tailored to park-specific conditions.

1. Promote resistance to white pine blister rust.

Other studies have shown that only an estimated 1% of whitebark pine trees are resistant to white pine blister rust. The high level of infection (~55%) of whitebark pine found by this study in both parks reveals how significant this stressor currently is and will be in the future. That's because most trees don't survive blister rust infection, especially when exacerbated by beetle infestation, drought, or competition from other species. Thus, the authors stressed the importance of promoting rust resistance as a conservation tool. One example (though not specifically mentioned in the paper) is ongoing genetic manipulation trials, such as those conducted at the Dorena Genetic Resources Center in Oregon, which aim to identify rust-resistant genotypes and propagate their seedlings for planting.

2. Conserve genetic diversity.

The study's finding that trees in drier (water-stressed) sites at Crater Lake National Park were associated with higher blister rust infection prompted the need for further research into this relationship. Were other factors involved? Should managers target wetter areas to plant whitebark pine seedlings? Is there potential value in finding and protecting whitebark pine genotypes that currently survive in drier, more southerly slopes just outside of the park?

3. Protect declining seed sources.

The study recommended using verbenone at both Crater Lake and Lassen Volcanic National Parks to protect valuable cone producing whitebark pine. Verbenone mimics a pheromone made by mountain pine beetles to stave off beetle attack. Once a tree is infested, beetles release a pheromone to tell other beetles, "This tree is full – go find another tree!" Verbenone is not used currently at Lassen for two reasons.

Klamath Network Inventory & Monitoring Program

The National Park Service has implemented natural resource inventory and monitoring on a servicewide 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

Klamath I&M Network
Southern Oregon University
1250 Siskiyou Boulevard
Ashland, Oregon 97520-5011

https://www.nps.gov/im/klmn/index.htm

Program Manager
Alice Chung-MacCoubrey
(541) 552-8575
alice_chung-maccoubrey@nps.gov

Ecologist
Eric Dinger (541) 552-8574
eric_dinger@nps.gov

Botanist
Sean Smith (541) 552-8570
sean_b_smith@nps.gov

Data Manager
Allison Snyder (541) 552-8576
allison_snyder@nps.gov

SOU Cooperators
Dennis Odion (541) 552-9624
odiond@sou.edu
Dominic DiPaolo (541) 552-8577
dipaolod@sou.edu
Kasey Rolih
rolihk@sou.edu

Newsletter writing, editing, and design
Sonya Daw, I&M Science Writer/Editor,
sonya_daw@nps.gov

Whitebark Pine *(continued)*

First, mountain pine beetle attack has been relatively sparse in Lassen compared with Crater Lake. Second, most whitebark pine stands at Lassen are in wilderness areas, which have more management restrictions. The study's recommendation, however, is based on the potential for Lassen trees to eventually experience the same interactive effect between pest and pathogen as happened in Crater Lake. Because pine beetles were more likely to attack trees previously infected with blister rust at Crater Lake, the same pattern could occur in Lassen if and when mountain pine beetle populations expand at high elevations in the park.

4. Employ restoration treatments.

Based on this study's finding that competition from other tree species, especially mountain hemlock, lowered cone production in whitebark pines at Crater Lake, the authors promote addressing this stressor directly. Fire (natural managed or prescribed) and mechanical thinning are both restoration tools for reducing competition. The authors offer some discussion of the relative merits of each tool depending on the park, but overall conclude that reducing competition appears important to conserving this species over the long term in both parks.

Learn More

Read the published article to learn more details about differences between the two parks, additional knowledge gained, and a more comprehensive discussion of management implications: https://www.mdpi.com/1999-4907/10/10/834

The lead author of this paper, Jenell Jackson, was supported by a cooperative agreement with Humboldt State University to collect the whitebark pine data as the crew lead for the Klamath Network. She analyzed the data for her master's thesis, which then served as the basis for an NPS natural resource report publication, and finally, this journal article.

Mountain pine beetle hole in whitebark pine, exuding the tree's defensive pitch mixed with frass (like fine saw dust), at Lassen Volcanic National Park. NPS/Sean Smith

White pine blister rust (*Cronartium ribicola*) cankers on a whitebark pine tree, showing the yellow-orange spores of the fruiting bodies. NPS/Sean Smith

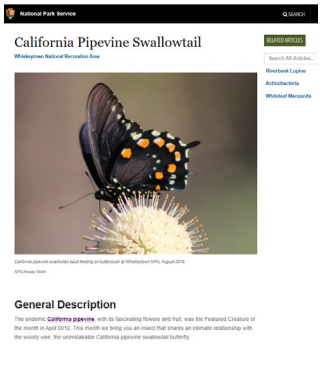
Featured Creatures Now Online!

Our monthly Featured Creature natural history articles are now available as shared content web articles! This helps us offer some science literacy content on NPS. gov, where the articles may pop up in NPS subject sites or display on park websites. So far, we've partnered with Redwoods NSP and Whiskeytown NRA (thanks!) to share some of these Featured Creatures on social media as well, helping us reach a much larger audience!


Featured Creature

California Pipevine Swallowtail

Battus philenor


National Park Service

California Pipevine Swallowtail

Whiskeytown National Recreation Area

General Description


Whiskeytown National Recreation Area

From pdf to web article to Facebook post, this Featured Creature article on pipevine swallowtail has taken flight!

Bat Science and Outreach

Overview

The Klamath Network has a full plate of bat projects these days! Since the 2016 arrival in Washington State of *Pseudogymnoascus destructans* (Pd), the fungus that causes the deadly white-nose syndrome (WNS) in bats, scientists and land managers have ramped up efforts to stay ahead of its spread in the West. Confirmation of its existence in northern California this spring by a Klamath Network-led crew accelerated the need for information. Across the region, a variety of research, monitoring and outreach projects are currently in motion to address the threat from white-nose syndrome, many involving the Klamath Network.

The Klamath Network bat team this year comprised Dr. Alice Chung-MacCoubrey, program manager, along with two technicians: Brittany Stamps and Andrew Lyons-Gould. Stamps brought experience with cave hibernacula surveys and swabbing for white-nose syndrome in bats in Texas. This fall, she began a master's program on ultrasonic acoustic deterrents of bats near wind turbines at Texas State University. Lyons-Gould joined Klamath Network after a several seasons as a climbing ranger working to educate the public and protect bats at Devils Tower National Monument.

Folks from many other organizations also contributed to these bat projects, as you'll see by scanning the "Who" section of the projects. All told, a remarkable multiagency collaboration supports this effort to protect bats in the face of the threat from white-nose syndrome.

Here's an update on a few bat projects in which Klamath Network staff play an important role:

Brittany Stamps (left) and Andrew Lyons-Gould (right) from the Klamath Network bat crew.

Ghostbusters? Well…more like White-Nose Syndrome Busters! These folks wear the white outercoat to prevent spreading Pd (the fungus that causes white-nose syndrome) from site to site. Left to right: Brittany Stamps, Dr. Alice Chung-MacCoubrey, Andrew Lyons-Gould, and Dr. Scott Osborn of California Department of Fish and Wildlife.

Bats *(continued)*

North American Bat Monitoring Program (NABat)

Who

The first year of comprehensive monitoring throughout Northern California was led by Brittany Stamps and Andrew Lyons-Gould (Klamath Network). They surveyed for bats on lands managed by a variety of agencies and organizations, including Bureau of Land Management, US Forest Service, California Department of Fish and Wildlife, California Department of Parks and Recreation, and private lands.

What

Spread out across public and private land in North America is a grid of 10 km × 10 km cells in which people are collecting bat data. Stamps and Lyons-Gould drove dusty, rutted roads across northern California to set up acoustic monitoring equipment inside 21 of these cells. Within the four quadrants in each cell, they set up a microphone and recorder system and left it on overnight to capture bat calls. Northwest Bat Hub experts later analyzed the recordings to confirm any bat species detected. The crew was setting up equipment in high priority areas that had never been monitored before, and not surprisingly, found some of these remaining areas tough to access by car!

One of four recording stations inside an NABat 10 km × 10 km grid cell that documented overnight bat activity in the Modoc National Forest, California. NPS/Brittany Stamps

Why

The North American Bat Monitoring Program (NABat) designed this large-scale survey to provide scientifically rigorous estimates of how bat populations are faring over time, by region. Information on which species occur, and where, within a region supports bat conservation and will specifically help guide management decisions in response to white-nose syndrome. A wide range of parties (e.g., land managers, researchers, contractors), including the National Park Service, contribute data to a national database managed by the USGS.

Learn more about NABat at: https://sciencebase.usgs.gov/nabat/#/home

Springtime Surveillance for Pd or Evidence of White-Nose Syndrome

As part of this project, the Klamath Network detected the first incidence of Pd in California, at a site near Lassen Volcanic National Park.

Who

This project is led by Dr. Chung-MacCoubrey, with assistance from Stamps and Lyons-Gould (Klamath Network), staff and interns from Lassen Volcanic NP, Lava Beds NM, and Whiskeytown NRA, as well as California Department of Fish and Wildlife and US Fish and Wildlife Service staff. Bat Conservation International served in a general advisory role and lab samples were analyzed by Northern Arizona University.

What

One form of surveillance for WNS includes catching bats, looking for visible signs of white-nose syndrome, and testing bat skin swabs for the genetic markers of Pd. The best time to detect it is during the winter because the fungus that causes WNS only grows on cold surfaces, and bat body temperatures are lowest during winter hibernation. However, we don't know where most bats hibernate in the West, so the next best option is to catch them as soon as possible after they emerge from hibernation.

Therefore, the Klamath Network field crew spent May and June in search of bats, mostly at maternity colonies where the bats gather to complete pregnancy and to birth their single pups. Though evidence is strongest in late winter, spring surveillance may detect lingering traces of the fungus because it is shed through the summer for bats that survive it. Wing membranes damaged by WNS heal shortly after spring emergence, and most of the physical evidence is likely gone by summer.

In southern Oregon and northern California, the crew sampled around 300 bats at 12 sites. They used mist nets, funnel traps, sweep nets, and the plain old reach-and-pluck technique to capture bats for testing. Efforts were focused on little brown bats (*Myotis lucifugus*) and the Yuma myotis (*Myotis yumanensis*), both of which are affected by WNS.

How do you swab a bat? By rolling a Q-tip-like swab back and forth on its forearm three times and repeating that on its nose. You then break the tip off into a vial that is sent for DNA testing. How do the bats react? Well, some wiggle and squeak, while others don't seem to mind. The two *Myotis* species our crew worked with were small enough that they fit easily into the nook between the

Trapping bats with a funnel trap as they emerge from bat roost boxes at dusk on the Six Rivers National Forest.

Bats (*continued*)

Swabbing a little brown bat (*Myotis lucifugus*) to sample for DNA evidence of Pd.

biologist's thumb and index finger. To protect themselves, biologists wear leather handling gloves. To protect the bats, biologists wear nitrile gloves overtop and change gloves to prevent spreading potential pathogens among bats.

Why

Regular monitoring, like this white-nose syndrome surveillance project, provides vital early warning of how the fungus is spreading. Having this advanced notice gives land managers more time and options for responding. In response to the Klamath crew's detection of Pd in northern California, new research is already underway to find nearby roosts or winter hibernacula where it might spread.

Maternity colony of *Myotis* sp. bats discovered by Brittany Stamps near the Umpqua River. @Brittany Stamps.

Outreach – Bat Chats

Who

Contributors included Andrew Lyons-Gould, Brittany Stamps, and Dr. Alice Chung-MacCoubrey (Klamath Network); Dr. Joe Szewczak (Humboldt State University); Katrina Smith (Lava Beds National Monument); and park staff at both Lassen Volcanic National Park and Whiskeytown National Recreation Area.

What

Evening bat chat programs have become a summer tradition at Lassen Volcanic National Park and Whiskeytown National Recreation Area. The Klamath crew joined Humboldt State University researcher Joe Szewczak and Katrina Smith from Lava Beds National Monument to engage and educate interested park visitors. While the other team members talked with the audience, Brittany and Andrew and other park staff had the fun job of catching bats in mist nets to bring to the end of the bat chat for a bat show and tell.

Why

Education and outreach is an essential element of the strategy to address the threat of white-nose syndrome. Thus, some funding for these Bat Chats comes from white-nose syndrome project money. Teaching visitors about the value of bats, and recruiting their eyes and ears to report sick or dead bats improves the chances of detecting white-nose syndrome early and building public support for bat conservation. It's also a natural fit for science communication in the parks.

Professor Joe Szewczak, Humboldt State University, presenting a live bat to delighted park visitors at a Whiskeytown National Recreation Area Bat Chat. NPS/Jen Gibson

2019 Vital Sign Monitoring Updates

Redwood National and State Parks

- lake aquatic communities and water quality sampled—sampled the freshwater lagoon; 3rd visit since 2013
- rocky intertidal zone sampled—2nd year of biodiversity protocol; 15th year of targeted species monitoring

Whiskeytown National Recreation Area

- streams sampled post-Carr Fire—extra sampling completed at 14 sites, funded by Region Block NPS funding; results targeted for presenting at *The Wildlife Society* meeting
- terrestrial vegetation—site markers reestablished after Carr Fire at all matrix and high elevation sites and at ~50% of riparian sites

Lassen Volcanic National Park

- lake aquatic communities and water quality sampled—sampled 31 lakes but skipped 1 that remained frozen late in the season; no sign of ranavirus this year; 3rd visit since 2013
- whitebark pine sampled—3rd visit since 2013

Oregon Caves National Monument & Preserve

- terrestrial vegetation sampled—3rd visit since 2013
- landbird mist netting conducted—295 birds of 34 species captured
- landbird point counts conducted—650 birds of 43 species detected; 4th visit since 2010
- caves sampled—winter bat count showed that bats moved further into cave during cold spike to stay in sweet spot just above freezing

Lava Beds National Monument

- caves sampled—5 ice caves sampled by park staff; continuing loss of ice observed in all caves

Crater Lake National Park

- terrestrial vegetation sampled—finished sampling all matrix and riparian sites, but no high elevation sites; 3rd visit since 2013
- landbird point counts conducted—3700 birds of 64 species detected; 4th visit since 2010
- lake aquatic communities and water quality sampled—6 ponds sampled; 3 ponds also sampled for nationwide Dragonfly Mercury Project; 3rd visit since 2013
- whitebark pine sampled—3rd visit since 2013

Recent Publications

Available from the Klamath Network website: https://www.nps.gov/im/klmn/reports-publications.htm

Annual Reports

Terrestrial Vegetation

- Vegetation community monitoring: 2017 results from Lava Beds National Monument and Redwood National and State Parks

Lake Water Quality and Aquatic Communities

- Mountain ponds and lakes monitoring: 2016 results from Lassen Volcanic National Park, Crater Lake National Park, and Redwood National Park

Natural Resource Report

- Kellermann, J. L., T. J. Rodhouse, J. C. B. Nesmith, and A. Chung-MacCoubrey. 2019. Setting the stage for climate change scenario planning: Whitebark pine and American pika in the Sierra Nevada, Klamath, and Upper Columbia Basin Inventory and Monitoring Networks. Natural Resource Report NPS/KLMN/NRR—2019/1960. National Park Service, Fort Collins, Colorado.

Journal and Collaborative Publications

- Stephens, J. L., E. C. Dinger, and J. D. Alexander. 2019. Established and empirically derived landbird focal species lists correlate with vegetation and avian metrics. Ecological Applications 29(3):e01865. 10.1002/eap.1865 (online access requires subscription)
- Jackson, J. J., S. B. Smith, J. C. B. Nesmith, L. A. Starcevich, J. S. Hooke, S. Buckley, E. S. Jules. 2019. Whitebark pine in Crater Lake and Lassen Volcanic National Parks: Assessment of stand structure and condition in a management and conservation perspective. Forests 10:834.

Science Communication

- Featured Creature natural history articles on actinobacteria, whiteleaf manzanita, pipevine swallowtail, California groundcone, pileated woodpecker, carpenter ant
- Wings in the Night Sky. Updated version of article on natural history of bats. Whiskeytown Nugget, 2019.

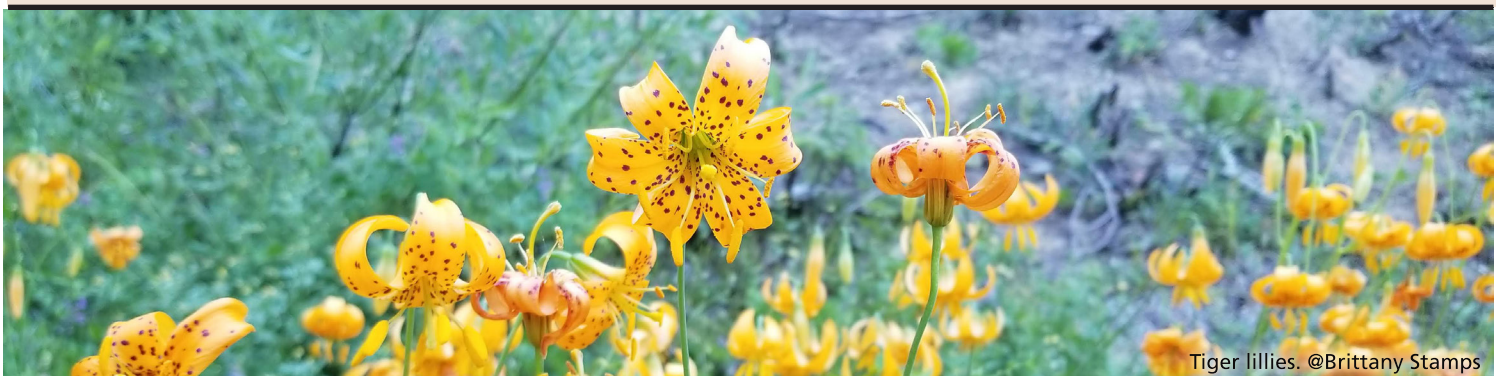
Klamath Network Vital Sign Project Contacts

Eric Dinger · 541-552-8574
- Streams
- Lakes
- Rocky Intertidal Zone

Allison Snyder · 541-552-8576
- Land Cover and Land Use

Alice Chung-MacCoubrey · 541-552-8575
- Landbird Communities, Caves

Sean Smith (541) · 552-8570
- Terrestrial Vegetation
- Exotic, Invasive Plants
- Whitebark Pine



Tiger lillies. @Brittany Stamps