#### 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 Spring/Summer 2019

## UV-C Light Could Control White-Nose Syndrome, but First Let's Ask the Cave Biota

If you suffer from germophobia or chiroptophobia, the fear of germs or bats, I can relate. However, if you enjoy mosquito-free campfires, food, and have a general dislike for insect borne diseases like West Nile virus, please read on!

A single bat can eat 7,000 mosquitoes every night. This ferocious appetite for insects reduces the spread of insect borne diseases, saves your backyard barbeque from becoming a forehead slapping party, and saves farmers \$3.7 billion in pest control each year. Sadly, many species of the world's only flying mammals are experiencing 90-100% decline in some areas due to Pseudogymnoascus destructans (Pd), the fungus that causes white-nose syndrome. White-nose syndrome causes bats to wake up more frequently during hibernation, wasting precious fat reserves, which often leads to starvation. It was first detected in New York in 2006 and has been steadily spreading westward across the United States. In 2016 the fungus jumped several states to King County, Washington. This range expansion came as an unpleasant surprise—like opening that container from the back of the fridge and vaguely remembering spaghetti night. With the spread of the fungus to the West Coast, Klamath

Inventory and Monitoring Network scientists and park staff are checking the health of local bat populations and collaborating with researchers to find a treatment before the fungus potentially turns up at the network's two cave parks: Oregon Caves National Monument and Preserve and Lava Beds National Monument.

A promising control is on the horizon. Pseudogymnoascus destructans has been evolving in dark caves for millions of years and is unable to repair cells after exposure to Ultraviolet C (UV-C) light. Low dosages of UV-C light have an antimicrobial effect without harming animal tissues. This method is showing great promise for bats in laboratory settings. If applying UV-C light to cave walls turns out to be the most effective method, rather than treating individual bats, the impact of UV-C light on other cave organisms needs to be investigated. This is because many cave species are still a mystery, and the National Park Service is committed to protecting all species, including those whose functions are not fully understood.

Caves may appear sterile to the novice spelunker. However, caves are chock full of microorganisms, such as



Tail membrane and feet of a Brazilian freetailed bat (*Tadarida brasiliensis*) under UV light to check for presence of Pd at Whiskeytown National Recreation Area. Note the extra toe hairs on the edges of the feet, which is a unique feature of this species. Photo by Katrina Smith

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# UV-C Light (continued)

Proteobacteria (a phylum that includes pathogens such as salmonella) and Bacteroidetes (a phylum of bacteria that includes many species that inhabit the intestinal tracts, feces, and oral cavities of mammals, including humans). I liken it to the kitchen sink sponge that needs replacing. You can't see the bacteria, but they're there! Cave microorganisms make up the base of the cave food web. According to Pat Seiser (Physical Scientist at Lava Beds NM), larger animals like lizards, coyotes, and woodrats wander through the cave. Droppings from these animals bring nutrients into the cave and provide food for bacteria and fungi. In return, fungus eating insects feed on cave fungi and bacteria, linking together the subterranean and above ground world. A fun fact for all you germophobes, many

cave microorganisms are used in the medical field. For example, Actinobacteria produce about two-thirds of all naturally derived antibiotics. Given their importance in the cave ecosystem and their potential value to humans, the effects of UV-C on native cave microorganisms need to be understood before any widespread treatment for white-nose syndrome.

Beyond their work monitoring longterm trends in natural resource "vital signs" in parks, Klamath Network scientists are sometimes called upon to apply their expertise to emerging park issues. Park visitors almost never see network crews, but behind the scenes they work hard to help parks protect their resources. With Pd knocking at the door, John Roth, Natural Resource Specialist at Oregon Caves, reached out to several scientists for help. He asked, "How can we treat our caves to reduce Pd, and what might be the side effects to other cave inhabitants?" Alice Chung-MacCoubrey (Klamath Network) was part of the team that quickly came together to help answer this question, along with Katrina Smith (Lava Beds), Rick Toomey (Mammoth Cave in Kentucky), and cave researcher Diana Northrup (University of New Mexico). Together they are studying the effects of UV-C light on cave microorganisms, and how effective it is at reducing Pd at Mammoth Cave.

Phase one of this research project is looking at the effects UV-C has on cave microorganisms in a laboratory setting. In 2018 park staff swabbed



It takes a team to catch this many bats! We captured bats using a funnel trap at the Klamath Fish Hatchery in Chiloquin, Oregon, to swab them for Pd. The funnel trap method works by clipping a net to the bottom of a bat box. When the bats wake up and are ready to take flight for the night, they fly right into the net on their way out of the box! On this particular night Alice Chung-MacCoubrey, Andrew Lyons-Gould, and Brittany Stamps (Klamath Network), and Katrina Smith (Lava Beds) managed to catch 97 bats in the funnel trap! Photo by Emily Lind



### Klamath Network Inventory & Monitoring Division

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 National Monument

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# UV-C Light (continued)



Klamath Inventory and Monitoring staff swab a bat wing. The sample will later be tested for *Pseudogymnoascus destructans*, the fungus that causes white-nose syndrome. Photo by Emily Lind

caves to collect microorganisms at two parks free of Pd: Oregon Caves and Lava Beds, and one park with Pd: Mammoth Cave in Kentucky. Collaborator Diana Northup will dilute the samples until each bacteria species is isolated from the others. These isolates will be exposed to the same levels of UV-C light that will be used to reduce Pd in caves. If the treatments have any negative impacts on the bacteria, researchers will examine how long it takes for native cave bacteria to recover following UV-C treatment. In fall 2019, phase two will look at the effects of UV-C on microorganisms in their natural cave settings. They will assess effects immediately following UV-C treatment, and one year after treatment. This will tell researchers

how quickly cave microorganisms recover after being exposed to UV-C light. According to Chung-MacCoubrey, "project results will help cave managers understand the costs and benefits of UV-C treatments, allowing them to make informed decisions about the use of UV-C to control the fungus and disease."

Results of this research won't be known for a few years, but the clock is ticking. I don't know about you, but I'm going to savor every bug-free barbeque until an effective control for Pd, that is safe for all organisms, is found.

Article by Emily Lind SOU science communication intern linde1@sou.edu

# **Research on Focal Bird Species**

"Focal species," "surrogate species," "indicator species," "umbrella species." What do these terms all have in common? They are variations on the theme of choosing a part to describe the whole. They are a single species or a subset of species that theoretically represents a larger community in nature. Sure we'd like to know *exactly* how every species in a valuable habitat, like wetlands, is doing, but we don't have the resources to do that.

The bird conservation organization, Partners in Flight, relies on a select list of focal bird species to assess the health of associated ecosystems. But how well do those lists, which are typically based on expert opinion, represent very specific groups, like songbirds in decline, or actual vegetation features?

A newly published study based on the Klamath Network's growing dataset on birds in network parks helped scientists examine that question. The paper, Established and Empirically Derived Landbird Focal Species Lists Correlate with Vegetation and Avian Metrics was published in Ecological Applications this spring. Eric Dinger, network quantitative ecologist, coauthored the study with Jaime Stephens and John Alexander from the Klamath Bird Observatory (KBO). Through a partnership, KBO does the bird monitoring fieldwork for the network. The authors used data collected from all 6 network parks, including vegetation characteristics measured at each bird sampling point, to do the analyses. One of the results of the research included some finetuning of focal species lists for this region.



The Mountain Chickadee was selected for the focal species list at Lassen Volcanic National Park when data from park-specific bird surveys were used. Photo credit James Livaudais.

To learn more about the study, view

- <u>the article</u> (needs journal subscription)
- <u>KBO's public-friendly blog post</u> <u>about the article</u>
- the press release

## **Indirect Effects of the Carr Fire**

One year after the Carr Fire burned over 90% of Whiskeytown National Recreation Area, some of the more obvious effects of the fire are clearly visible. Ash coats the ground. Upslope sediment thickens the streams. Brown needles or bare branches remain where new spring growth should be. But the indirect effects of the fire are equally impactful, especially in streams, and will affect the park's restoration strategy. Knowing this, ecologists, Jen Gibson from Whiskeytown NRA, and Eric Dinger, from the Klamath Network, secured \$30,000 from regional NPS sources for stream monitoring this year at Whiskeytown. The park was not due for its next round of stream monitoring until 2020. With the extra funding, however, Dinger was able to hire his lake monitoring crew 6

weeks early to collect a full round of stream monitoring data in the park. Their work will help guide restoration by documenting plant, animal, and stream conditions that respond right away to both direct and indirect effects of fire. Indirect effects of fire include

- warming water temperature from the loss of riparian plant shade, which affects whether fish, amphibians, and aquatic macroinvertebrates can survive in the stream
- increased run-off after rain storms, sometimes as severe flooding, from burned soils and the lack of upland plants to slow down and absorb the water

\*Images to the right show colorful signs of life returning to the burned landscape.



Leopard lily (Lilium pardalinum).



Pipevine swallowtail caterpillar (*Battus philenor*) near Oak Bottom.

## Monitoring after Fire in Southern Klamath Network Parks

As wildfire intensity and frequency increases in Klamath Network parks, ecologists and managers use monitoring data to assess park health and inform both wildfire and prescribed fire management plans.

When the summer air is thick with fog-like toxic smoke, people have lost their homes, and forests are burning in multiple directions, it can be difficult to remember that wildfires are historically a natural and cultural part of western North America.

According to Lassen Volcanic National Park Ecologist Steve Buckley, it wasn't until 1910 that it became common policy to both exclude and suppress fire throughout the country. Before these policies, both natural and human-started fires of varying intensities burned through the park. They created a mosaic of old growth and secondary growth forests, shrublands, and grasslandmeadow habitats in Lassen. With the removal of fire, researchers have seen the advance of conifers into meadows and shrublands. Additionally, over a century of suppression policy has allowed for fuels such as dried vegetation to build up. Increase in fuels combined with climatic warming has created a recipe for intense, long-burning fires. Tom Garcia, Fire Management Officer for the Whiskeytown National Recreation Area (NRA) Wildland Fire Program, said that fire, "is one of a very few disturbance processes that has the potential to interrupt and change landscape ecological processes and communities within a relatively short and drastic manner."

As wildfire patterns begin to change from our century's baseline, it's crucial that ecologists and managers in Klamath Network parks understand the dynamics and influences of current fire regimes on their park's ecosystems. They gain this understanding by collecting data from monitoring plots in burned areas. These data are then used to help managers and ecologists plan for the most effective prescribed fire and mechanical thinning projects. They also help inform the best wildfire management practices.

Knowing baseline data is important when reintroducing fire to restore the previously mentioned habitat mosaic in the park. Managers and ecologists must be able to tell what effects the restorative treatments

have on the park ecology. Currently Buckley and Jason Mateljak, Chief of Resource Management at Lassen Volcanic National Park (NP), and NPS Regional Fire Ecologist Calvin Farris, are trying to prevent the frequent rate of high intensity, longburning wildfires in Lassen. They do this by using prescribed fire and mechanical thinning to reduce extra fuels. They describe the project as both a "restoration" and a "resiliency" treatment to Lassen's vegetated ecosystems. The project is restorative because the reintroduction of fire brings back the mosaic of fire-adapted habitats. The project helps with forest resiliency by reducing fuels that



Vegetation monitoring plot in Dersch Meadows near Summit Lake in Lassen Volcanic National Park in 1995 (top) and 2018 (bottom). Fire suppression has allowed the encroachment of conifers into the meadow so that the road is no longer visible in 2018.

# Monitoring after Fire (continued)

may cause frequent, high intensity wildfires. In order to adapt fuel management strategies to changing fire regimes, scientists will need to collect data on the ground. According to Buckley and Mateljak, monitoring of both prescribed and wildfire burn areas is imperative. "[Fire and burned areas are] important to monitor because it helps us understand how we're going to act and perform in the future. If we don't know how the fire acted and what the outcomes of burns were, we will never know whether or not it is worth doing," Mateljak said.

While managers and ecologists at Lassen Volcanic NP seek to prevent regular high intensity fires, the folks at Whiskeytown NRA are beginning to look at how high intensity fire disturbance may change the ecology of the park. According to Garcia, last year the Carr Fire burned 97% of Whiskeytown NRA vegetated land area. A fire this large or intense is unknown in the history of Whiskeytown NRA. In the wake of the fire, Garcia said the park will utilize stream monitoring plots established in 2011 by the Klamath Network scientists. The stream data will help them track changes in stream morphology and sedimentation that can affect habitat for both terrestrial and aquatic organisms. Garcia believes that monitoring the landscape is vital to understanding the historical regimes and ecology of the park and current ecosystem health. It will also provide managers and scientists with "educated and reasonable" ideas of where management plans should direct resources.

Eamon Engber, an Interagency Fire Ecologist who monitors Oregon

Long-term vegetation monitoring plot at a site burned by the 2012 Reading Fire in Lassen Volcanic National Park. Top is prefire in 2012, middle is 2015, and bottom is 2018, showing the increase in coarse woody debris.



Caves National Monument and Preserve, Redwood National and State Parks, and Whiskeytown NRA, works with fire throughout the region. He knows how valuable science is to understanding fire. "If we can understand the conditions under which fires have negative consequences... monitoring data will help anchor the management decisions in reality," he said. Understanding when wildland fires will have positive forest thinning and fuels reduction outcomes is just as important.

Another reason collecting data is important within Klamath Network parks is to track changes in ecosystems when large disturbances such as high severity fires occur. Both Garcia and Engber believe that recurring fire has the potential to change Whiskeytown's ecosystems. Engber stated that the Carr Fire is the second large scale fire at Whiskeytown in 10 years. The Carr Fire burned with much greater fire severity than the previous fire, killing more mature forests. He is concerned this frequency could lead to a lack of tree regeneration in some areas. "If fires do become hotter, larger and occur more frequently, we may see conversion from forests to shrubs," he said. Vegetation types adapted to high-severity fire could become more

common. This presents challenges for park managers in terms of fire risk and potential impacts to high-value resources and infrastructure.

Monitoring plot data can provide a wide variety of information. In order to see what vegetation may be regenerating in the area, Engber is currently setting up plots within Whiskeytown NRA to see what kinds of seedlings will occur. The park will also use vegetation data collected since 2012 from Klamath Network scientists on long-term monitoring plots to learn how the plant community is acting after the fire. Engber said this plot data will help him assess tree mortality, future tree regeneration and hazardous fuel loading. He is specifically interested in seeing if old trees survive the fire. He is also interested in seeing if new tree seedlings will repopulate in high severity burn areas. Another question the data can help answer is whether forest composition will shift to shrubs or trees adapted to high severity fire, such as knobcone pine. He also plans to analyze how understory plants will respond to the Carr Fire. This includes using plot data to assess if native, nonnative or invasive species are establishing in the wake of the fire. This information will help fire managers plan future fuels treatments. All of the monitoring information collected from both Klamath Network scientists and from individual park ecologists will be used to help make important management decisions regarding fire. Carefully designed data collection gathered from plots allows for NPS managers to base their decisions on the best available science. The data gathered from plots will provide park and fire managers with the most up to date and accurate information in order to preserve the parks' cultural and natural resources in changing environmental conditions.

As fires become more frequent within Klamath Network parks, both ecologists and resource managers stated that having more allocated resources for pre- and postfire monitoring is imperative. It is needed for understanding fire's historical, current and potential future role within the parks. As Garcia said, "The value and need for [monitoring] is only becoming greater as we face a very complicated future with climate change superimposed over already very complex and dynamic landscape processes and circumstances."

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### **Recent Publications**

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

### **Annual Reports**

### **Terrestrial Vegetation**

• <u>Vegetation community monitoring: 2017 results from</u> Lava Beds National Monument and Redwood National and State Parks

#### Lakes

• <u>Mountain ponds and lakes monitoring: 2016 results</u> <u>from Lassen Volcanic National Park, Crater Lake Na-</u> <u>tional Park, and Redwood National Park</u>

### **Science Communication**

- Featured Creature natural history articles on <u>Oregon</u> grape, acorn woodpecker, Jerusalem cricket, <u>Anna's</u> hummingbird, riverbank lupine
- <u>Checking Oregon Caves' Vital Signs</u>, 2-page brief describing natural resource vital signs monitored at Oregon Caves

### **Collaborative Publications**

• Established and empirically derived landbird focal species lists correlate with vegetation and avian metrics

# 2019 Field Schedule at Klamath Network Parks

Vital Signs Monitoring	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Landbirds—Mist Netting (KBO) (KLMN contact—A. Chung)					ORCA				
Landbirds—Point Counts (KBO) (KLMN contact—A. Chung)			CRI	A					
			ORCA						
Invasive Species (KLMN—S. Smith)	Deferred until next scheduled sampling in 2021								
Vegetation (KLMN—S. Smith)			OR	CA					
					CRLA				
Whitebark Pine (KLMN—S. Smith)					LAVO				
					CRLA				
Streams (KLMN—E. Dinger)			WH	lis	_				
Lakes (KLMN—E. Dinger)				LA	VO				
					CRLA				
						RNSP			
Rocky Intertidal (UCSC) (KLMN contact—E. Dinger)		RNSP							
Caves (Park staff)	LABE - Ongoing data collection by park staff								
	ORCA - Ongoing data collection by park staff								

#### Park acronyms

Crater Lake National Park (CRLA), Lassen Volcanic National Park (LAVO), Lava Beds National Monument (LABE), Oregon Caves National Monument and Preserve (ORCA), Redwood National and State Parks (RNSP), Whiskeytown National Recreation Area (WHIS)

#### **Cooperator acronyms**

Klamath Bird Observatory (KBO), University of California at Santa Cruz (UCSC), Southern Oregon University (SOU)

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- Terrestrial Vegetation
- Exotic, Invasive Plants
- Whitebark Pine



Smith River, Jedediah Smith Redwoods State Park. @Jessica Weinberg McClosky