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Klamath Inventory and Monitoring Network

The Klamath Kaleidoscope

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Sean Smith – Vegetation Ecologist

Sean Smith's job offers a hefty dose of variety, which is just how he likes it. As the Vegetation Ecologist for the Klamath Inventory and Monitoring Network, based in southern Oregon, he gets up close and personal with a wide mix of plant communities in the six parks served by the network. From dense, wet redwood forest tangles in Redwood National Park, to the high desert lava rock landscape of Lava Beds National Monument, to the windy, wide-open mountain slopes of Crater Lake and Lassen Volcanic National Parks, Smith has constant variety in his fieldwork. His office work is equally diverse, from data analysis and report writing, to hiring and training crews, to collaborating with scientists outside the National Park Service. He's never doing one thing for too long.

Early Years

Smith grew up in Bellingham, Washington, always connected to plants and dirt in some way or another. His grandparents used to take him camping and fishing in the nearby mountains. He recalls digging dirt and moving plants around to help his mother and grandmother in their beloved gardens. He has also loved mountain biking from an early age—buying his first mountain bike at age 14 at the cost of an entire summer's worth of earnings.

Education and Foundational Work

At Western Washington University, Smith studied biology, with a special interest in mosses and fungi. He attributes this to his first plant biology class being taught by an inspiring mycologist who infused the entire class with a "flavor of fungi" while glossing over (!) vascular plants. Near the end of his college days, he had a memorable experience that cemented his interest in botany. Sick with a fever while studying for a final exam, he dreamed he was trapped inside a plant cell, watching all the organelles at work, almost as if he could reach out and touch them. Not surprisingly, he aced the final exam and came to the conclusion that plants were in his brain to stay.

In This Issue

Sean Smith *(continued)*

Smith went on to work seasonally as a field botanist and eventually completed his MS from Southern Oregon University. He created a dichotomous key to the plants of Lava Beds National Monument for his master's thesis, which became its official, published flora. Writing *A Flora of Lava Beds National Monument* opened the door to his first permanent job with NPS as the Klamath Network's botanist. Throughout those early years, he felt fortunate to find himself in the right place at the right time, again and again.

Current Job

Smith keeps busy leading three different vital sign monitoring protocols: vegetation communities, whitebark pine, and early detection of invasive plant species. Summer fieldwork involves training field crews for the vegetation and invasive species programs, and then collecting data himself with one intern for the whitebark pine monitoring protocol.

"Doing the whitebark pine is the best. You're at Crater Lake or Lassen in August, at high elevation. *Hopefully* it's not smoky. You've got nice air quality, good views, good temperature—typically not very hot. Not a lot of bushwacking. No insects, no ticks, no poison oak. Usually mosquitoes are not that big of a deal."

Hooked on bikes from an early age.

In contrast, some of the hardest fieldwork takes place in a much lower elevation park, Whiskeytown National Recreation Area. While blessed with a large lake and enticing streams and waterfalls, Whiskeytown can be a challenging place for outdoor work. Summer temperatures regularly reach 105° and higher, while ticks, poison oak and dense bushwhacking try the patience of even the most hardy field techs. He describes his crew's experience two summers ago:

"It's just insanely hot and there's bushwhacking through poison oak all the time. People were starting to get right on the edge of their physical and emotional wellbeing. Not sleeping well, having poison oak. Being really itchy."

Field crews haul with them an assortment of instruments to collect data in the field. (Given the range of conditions field crews might face, one obvious tool of the trade is *Tecnu* – poison oak relief cream!) Field gear includes a hand lens for magnifying miniscule plant parts, plot layout tapes, a clinometer for measuring tree height, a densiometer to measure canopy closure, the Jepson manual for plant identification, a field tablet for data entry, an emergency radio, and a plant press to collect unusual specimens.

Regardless of heavy equipment loads and challenging conditions, Smith reflects on a certain experience of outdoor work that he often shares with his field crews. Waiting for that moment in each day when something especially thrilling happens, like when the light's just right, almost surreal, shining through a spider web. That moment you remember you are working in a beautiful natural area and it makes all the hard work worthwhile.

Back in the office, during the fall and winter, Smith's "office jockey" duties range from managing and analyzing data, writing reports, repairing and ordering equipment, and preparing to hire for the upcoming field season to various external collaborations. He has taught botany classes for the southern Oregon based Siskiyou Field Institute. He collaborates with other networks and outside researchers to make the most of monitoring data. For example, the whitebark pine protocol is shared among several I&M networks that also selected this keystone species as a vital sign. Working with multiple networks requires more coordination but also offers opportunities to coauthor peer-reviewed journal articles stemming from the large and multifaceted effort to conserve this important species. Additionally, Smith collaborates on complex statistical analyses. Managing three protocols leaves him little time to do the valuable in-depth data analyses of his growing long-term datasets. He partners with statistical wizards at USGS and nearby Humboldt State University to do some of the more complex analyses of vegetation and whitebark pine data, offering them high quality data sets and funding in exchange for their analytical support. An added benefit to both the analyst and NPS is that these projects often result in a peer-reviewed scientific publication, extending the reach of new findings beyond the NPS natural resource report series.

Reflections

Reflecting on what he loves most about his current job, it's the contrast in landscapes, and therefore the

Sean Smith *(continued)*

distinct plant communities that Smith finds so interesting.

"My real passion and focus is plot level species diversity and species richness within parks, as well as turnover from one park to the next. Just looking at the really interesting assortment of plants and how they form different plant communities at different aspects, elevations, climate zones. What is interesting to me is all the change, particularly this area [southern Oregon and northern California] - the vast changes in vegetation community type."

He's particularly excited to see how long-term plant monitoring in the parks can help explain disturbance dynamics. Indeed, one of the most valuable results of long-term monitoring is knowing what conditions were like before and after large disturbances, like the large fires that have swept through Whiskeytown NRA, Lassen Volcanic NP, and just this year, Lava Beds NM. The fires have wreaked havoc on some plots, even melting the aluminum nails used to fasten the steel tree tags (and thus sometimes scattering the tags far from their host trees!). Nonetheless, they present a unique opportunity to understand large disturbances using pre- and post-disturbance monitoring data:

"Are we seeing these plant communities return as they were represented in our baseline data or are we seeing a shift? A shift in species composition? A shift in overall habitat type, as the dominant species change? Are we moving through or even skipping over whole functional groups, such as going from a forest to chaparral to grassland? And what's the trajectory of these community types in the future?"

Fun

Smith is still an avid mountain biker, taking to the forest trails above town as a break from work.

"Biking is one of the few things I do where I actually can't look at plants. If you're staring at a plant for too long, you're probably going to crash!"

Though his two daughters are still a little too young to join him in the field, the family spends plenty of time together with plants, dirt, and rocks, just like he did as a child. His 2-and-a-half-year-old, Wren, is already showing signs of interest in plants, however. Smith reports that she recently found a book on weeds in the house and has been carrying it around for the past few days, showing him pictures of plants.

"She basically has her own botany book now."

Melted aluminum tree tag.

Smith with his daugher, Wren.

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 National Monument

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Fire History Helps Interpret Vegetation Conditions

Understanding if and how parks are changing over time is a core mission of long-term monitoring. But knowing why they are changing is also critical for management. Klamath Network botanist Sean Smith solicited fire history information from parks to add crucial context to the network's long-term vegetation monitoring data sets. Smith collated park fire history data into GIS layers that will support the network's upcoming "Analysis and Synthesis" reports, as well as the next vegetation structure report for parks.

Vegetation structure describes characteristics like the height of vegetation, density and size (including volume, basal area) of live and dead trees, woody debris, and ground cover. Fire affects much of this structure, but, especially if a fire is low intensity, it is not always obvious on the ground if or how long-ago fire was present. By overlaying fire history onto our plot data, we can understand current site conditions more accurately in the context of past disturbances.

Incorporating fire history into our analyses is one example of how long-term monitoring data sets can begin to reveal some of the drivers of change in the parks. Climate and visitor use data are other useful types of information to include in our analyses. Analyzing our growing long-term monitoring data sets in the context of potential change agents like these improves our ability to model what drives natural resource condition in parks, thereby supporting park management.

This series of photographs shows change over time in a forest stand at Crater Lake National Park that has burned twice in the recent past. The top photo, from 2013, had been burned seven years earlier in 2006, though with little remaining evidence. The middle photo was taken in 2016 soon after a fire, and the bottom photo was taken in 2019, showing a relatively quick recovery of the ground vegetation after fire. The quick recovery at this site can obscure the field observer's idea of time since fire. This highlights the importance of using spatial data in conjunction with field observations to fully understand post-fire recovery and vegetation dynamics.

Chasing Bats: Using Telemetry to Find Bat Roosts in Northern California

When white-nose syndrome—the disease that has killed millions of bats in eastern North America—first showed up in the West, bat researchers and land managers sprang into action. The Klamath Network has been part of this multifaceted response through a variety of projects. One of these projects is new graduate research focused on bat movements in northern California—where the fungus (*Pseudogymnoascus destructions*, or Pd) causing this disease was first detected in the state. Knowing where these bats roost gives managers vital information to try and stay ahead of the disease.

Christy Walker masked up for COVID-19 and holding a bat.

Christy Walker, a Humboldt State University graduate student, designed her master's thesis project in collaboration with Klamath Network bat biologist, Dr. Alice Chung-MacCoubrey. Her research tracks radio-tagged little brown bats (*Myotis lucifugus*) and Yuma myotis (*Myotis yumanensis*) using telemetry receivers to better understand their movements and find winter roosts in the Chester, California, area. The two species chosen for the study are common in the area and particularly vulnerable to white-nose syndrome. Unfortunately, little is known about bat movements or fall/winter roosts in northern California, hampering what managers can do to find and contain the fungus. This study aimed to fill in some of those gaps.

In the pilot year of the study, 2019, Walker tracked 15 bats, with support from Chung-MacCoubrey and the California Department of Fish and Wildlife. A tiny radio transmitting tag was glued onto the back of each bat. For the bat's safety and flying ability, the tag weighed no more than 5% of the bats' body mass, following standard protocol. Tags are designed to fall off within 20 to 30 days. After releasing the bats, field crews then drove around with a roof-mounted antenna until a signal was detected, at which point they continued on foot to track the signal with handheld antennas. They also flew over the area in a fixed-wing plane to detect signals. In two key locations near existing roosts, they set up a telemetry tower that could listen for the signals 24 hours a day. Results from all of these tracking efforts did lead Walker to a few new roosting locations, including in town and in some rocky areas. However, fewer signals were detected than expected. That pilot year helped Walker refine her methods.

In the second year of the study, 2020, Walker made some adjustments. Obviously COVID-19 restricted fieldwork, but also required extra precautions by bat handlers to avoid inadvertently passing COVID-19 to bats. Walker extended trapping into late October to make up for early summer (COVID-related) delays, which enabled her to put transmitters on 16 bats for the year. She added more telemetry towers to form a

Chasing Bats *(continued)*

"net" around the area. The towers can pick up signals from bats flying at night, high above the canopy, which is an expected behavior for migratory bat species. Thus, the expanded network could better detect bats that might be leaving the area from any direction for the winter. They could also boost movement detections in general. Curiously, no bats were detected leaving the area, but the signals could not be manually tracked in town either. As with most research, these somewhat unexpected results generated new questions, such as,

"Are the summer bats in this area actually leaving the region for winter roosting, or are they sticking around to overwinter locally?"

Walker's thesis will summarize results from these two years, characterizing the newly discovered roosts in terms of roost type, elevation, roost height (for tree roosts), solar exposure, and frequency of use. This new information will help fill in roosting ecology for two vulnerable bat species in northern California. At the community level, it contributes to our understanding of the overall ecology of the region's bats and how white-nose syndrome may affect them.

Chung-MacCoubrey has plans to continue the study in future years, and the "net" of towers will return next fall. She hopes to look more closely at the question of whether Chester bats roost locally for the winter. She will also be monitoring for the arrival of white-nose syndrome in bat populations near or within Klamath Network parks.

Handheld receiver antennas are one way to pick up the signal from a bat's transmitter.

Static receiver antennas are another, less labor-intensive way to pick up a bat's transmitter signals.

Radio transmitter (0.26 g) glued to the back of a little brown bat (*Myotis lucifugus*).

Understanding Fire Impacts on Streams

When fire burns through a riparian area, it sets in motion a cascade of changes to the stream ecosystem. These changes, like the loss of leaves from streamside trees, lead to indirect effects later on, and are complicated by other fire effects, such as erosion from burned watershed soil. To help parks better understand and manage these dynamics, the Klamath Network is partnering with Dr. Kathi Irvine of the US Geological Service, the Southern Colorado Plateau I&M Network, and the NPS Fire program to analyze the impacts of wildland fire on stream ecosystems. The project is titled, "Multi-park fire impacts to aquatic ecosystems" and is expected to take 2 to 3 years to complete.

Methods

Using vital sign monitoring data collected before the Reading Fire in Lassen Volcanic NP (2012), the Carr Fire in Whiskeytown NRA (2018), and the Las Conchas Fire in Bandelier NM (2011), coupled with post-fire monitoring, we will explore the mechanisms of how fires impact aquatic ecosystems. The study has two components: one helps sort out the most important drivers of change from the many different effects of fires, and the other develops a tool to guide management decisions.

Uncovering Mechanisms of Change—Causal Analysis

The first part of the study will use a statistical technique known as Causal Analysis. Multiple potential natural processes can be explored simultaneously to deepen understanding of the how and why a fire impacts aquatic ecosystems. Causal Analysis allows for untangling both direct effects of fire (for example, burning the streamside vegetation) and indirect effects (for example, later deposition of sediments from flooding, or increased sunlight and temperatures due to less shading in the future).

An example of multiple direct impacts is when fire burns the riparian vegetation, which simultaneously removes the leaves that fall in the water, and at the same time allows more sunlight into the water. Both of these "pathways" can alter the food resources in the stream, but our study will look into which is the driver of change, if any, or if another "pathway" is more important. Understanding how fire impacts aquatic insects, habitat, sediments, food resources, woody debris, fish communities, or nutrients helps managers understand which actions are likely to mitigate, reduce, or increase the impacts. By using what we already know about stream ecology, from early foundational work to recent experimental work, we can set up a sound and solid framework for testing which pathway more likely causes the fire impacts.

Cost/Benefit of Different Fire Management Decisions—Bayesian Decision Analysis

The second part of the study will use a statistical technique known as Bayesian Decision Analysis. This kind of analysis helps managers make choices about fire and stream management under uncertainty. A variety of fire management options are often available for parks to choose from, including preventative measures, active fire management, or

This photo series shows a stream in Whiskeytown NRA before the Carr Fire (2017, top), immediately after the fire (2018, middle photo), and a full year after the fire (2019, bottom). As this stream responds to the fire over time, exploring how and why the fire led to the changes we are observing will help managers guide its restoration.

Fire Impacts on Streams *(continued)*

post-fire restorative actions. Existing information from these three parks about prior fuel treatments, fire-fighting activities, and post-fire actions will be incorporated to strengthen the model. And even though fire management decisions are never made with absolute certainty, the Bayesian Decision Analysis couples statistical models with how manager's choose a fire management option to then allow a manager to balance potential gains and losses of chosen actions.

Article by Eric Dinger

Bayesian? What does that mean?

Bayesian refers to Thomas Bayes, a statistician from the early 1700s, who used probability in statistics. Bayes' theorem describes the probability of an event based on prior knowledge. The ability to incorporate prior knowledge from experiments, observations, studies, or even personal belief provides a substantial benefit over traditional "frequentist" statistics that ignore "prior" information. Bayesian statistics allows for an intuitive use of probability, as opposed to traditional statistics that have arcane interpretation of "P" values.

Both the Causal Analysis and Decision Analysis will make use of Bayesian statistics.

Where Are They Now?

The Klamath Network works with a variety of interns to support our program and to offer educational experiences. Interns may find themselves sampling water quality, monitoring whitebark pine, identifying native plants, mist-netting bats, or writing about our science. We highlight where our interns have landed professionally or educationally in this new "Where Are They Now" section of our newsletter. In this newsletter, we feature

Kimber Godfrey

Klamath Network position:
Geoscientist-in-the-Park Intern, 2017

Current job:
Biological Science Technician
Mojave Desert I&M Network
Boulder City, Nevada

Kimber Godfrey holds a nestling prairie falcon during her raptor monitoring internship at Pinnacles National Park in 2018.

"My primary responsibility is implementing our bat monitoring protocol. This includes creating our monitoring schedule, leading field crews, maintaining and purchasing equipment, collaborating with park staff, and working with our data manager to ensure quality data. I also assist our vegetation and hydrology crews with field data collection.

There are several aspects of my job that I find satisfying. White-nose syndrome is a devastating disease that is negatively impacting several bat species in North America. I enjoy knowing that our bat monitoring program contributes valuable data to bat conservation. I also relish the opportunities that arise from doing field work to educate people about bat conservation and the important work performed by I&M networks.

My internship with the Klamath Network was my first position working with bats. It was through my work with KLMN that I built a strong foundation as a field biologist and advocate for bat conservation."

2020 Vital Sign Monitoring Updates

Redwood National and State Parks

- terrestrial vegetation monitoring cancelled this year due to COVID-19
- rocky intertidal zone sampled—3rd year of biodiversity protocol; 16th year of targeted species monitoring
- landbird point counts cancelled this year due to COVID-19

Whiskeytown National Recreation Area

- streams monitoring cancelled this year due to COVID-19

Lassen Volcanic National Park

- streams monitoring cancelled this year due to COVID-19
- whitebark pine sampled—with 2020 data, all sites have now been sampled 3 times during the past 9 years

Oregon Caves National Monument & Preserve

- landbird mist netting cancelled due to COVID-19
- caves—partial 2020 cave data were collected by park staff, but efforts were challenged by disruptions to operations due to COVID-19. Before COVID-19 hit, however, the 2019–2020 winter bat count was the highest on record for the monument.

Lava Beds National Monument

- caves—partial 2020 cave data were collected by park staff, but efforts were challenged by disruptions to operations due to both COVID-19 and the Caldwell Fire, which burned 70% of the monument.
- terrestrial vegetation monitoring cancelled this year due to COVID-19
- landbird point counts cancelled this year due to COVID-19

Crater Lake National Park

- whitebark pine sampled—with 2020 data, all sites have now been sampled 3 times during the past 9 years

Recent Publications

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

Vital Sign Update Briefs

- Vital Sign Update: 2018 Results for Vegetation Community Monitoring at Whiskeytown National Recreation Area
- Vital Sign Update: 2018 Results for Vegetation Community Monitoring at Lassen Volcanic National Park
- Vital Sign Update: 2018 Results for Streams Monitoring at Redwood National and State Parks
- Vital Sign Update: 2018 Results for Streams Monitoring at Crater Lake National Park
- Vital Sign Update: 2018 Results for Streams Monitoring at Oregon Caves National Monument and Preserve

Science Communication

- Featured Creature natural history articles on ladybugs, orange sulphur butterfly, whitebark pine, great gray owl, and ruffed grouse.

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Banana slug. @Charles Schelz