National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
Sierra Nevada Network

DEVILS POSTPILE • SEQUOIA & KINGS CANYON • YOSEMITE

Volume 4, Issue 1
May 2014

Sierra Nevada Monitor

Newsletter of the Sierra Nevada Inventory & Monitoring Network

When Do the Flowers Bloom?

Learning about Change from Plants



From left to right, breaking leaf bud, open flowers, and ripe fruit of California Buckeye, one of the plants selected for monitoring of phenology in Sequoia National Park. Photo credits: Terrie Schweitzer, Dawn Endico, and randomtruth (Flickr).

Phenology, often called the 'science of the seasons', is the study natural events like bird migration, flower blooming, insect hatching, autumn leaf fall. Phenology provides insights on how seasonal and long-term climate changes affect plant and animal cycles.

Each week, Sequoia & Kings Canyon National Parks staff members check on 41 individual plants in the foothills and near Giant Forest to record information about the status of leaves, flowers, and fruits. They are interested in how plant life cycle events like leaf-out, flowering, and fruiting change through the seasons and from year-to-year in response to climate and other environmental factors like elevation or specific site conditions.

Phenology also helps us understand how the timing of one species' life cycle events can be important to the survival of another species. With warming global temperatures, some flowering plants are blooming earlier in the year. If the insects that pollinate these plants respond to different cues, and they are either too early or too late, these plants will not be pollinated or be able to produce seed. These kinds of timing mismatches affect wild plants as well as those raised for crops.

The phenology project at the parks is part of the California Phenology Project (CPP). This project was funded by the NPS Climate Change Response Program. It was launched in 2010 to develop and test methods, select appropriate plant species for monitoring, and to create tools and infrastructure to support long-term phenological monitoring and educational activities in California's national parks and University of California Reserves. A primary focus of the effort is to recruit and to engage citizen scientists (or "community" scientists) in the collection and interpretation of phenological data.

Sequoia and Kings Canyon National Parks (SEKI) were among the seven national parks in California that served as pilot parks in developing and implementing monitoring protocols, and developing educational programs and outreach approaches associated with this monitoring.

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In This Issue

Sierra Nevada Network Inventory & Monitoring

As part of the National Park Service's effort to "improve park management through greater reliance on scientific knowledge," a primary role of the Inventory and Monitoring (I&M) Program is to collect, organize, and make available natural resource data and to contribute to the Service's institutional knowledge by facilitating the transformation of data into information through analysis, synthesis, and modeling.

Parks in the network are: Devils Postpile National Monument (DEPO), Sequoia & Kings Canyon National Parks (SEKI), and Yosemite National Park (YOSE).

Sierra Nevada Network
Sequoia and Kings Canyon National Parks
47050 Generals Highway
Three Rivers, California 93271
http://science.nature.nps.gov/im/units/sien/

Program Manager
Alice Chung-MacCoubrey (559) 565-7888
alice_chung-maccoubrey@nps.gov

Data Manager
Les Chow (209) 379-3268
les_chow@nps.gov

Ecologist
Jonny Nesmith (559) 565-3765
jonathan_nesmith@nps.gov

Physical Scientist
Andi Heard (559) 565-3786
andi_heard@nps.gov

GIS/Logistics Technician
Sandy Graban (559) 565-3178
sandy_graban@nps.gov

Administrative Assistant
Jenny Matsumoto (559) 565-3787
jenny_matsumoto@nps.gov

Science Communication Specialist
Linda Mutch (559) 565-3174
linda_mutch@nps.gov

Please distribute this newsletter to any person or group who is interested. Contact Editor Linda Mutch to be added to the mailing list.

Phenology Monitoring

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Plant Selection

One of the challenging tasks for the CPP was to select a manageable subset of plant species for monitoring. With guidance from NPS staff and dozens of California botanists and ecologists, the CPP identified over 60 plant species as having potential for phenological monitoring across California. These species were selected based on their ability to address key scientific questions and to inform natural resource management, as well as their ability to engage the public (charisma and easy identification were important criteria).

The scientific questions that helped inform species selection were:

- How do iconic, widespread species respond to environmental variation and climate change?
- Which taxa or functional groups are most sensitive to climate change?
- Do communities or habitats differ in their general responses to climate change?
- Are relationships between plant and animal mutualists disrupted by climate change?

Four different species are monitored at SEKI (beginning in 2011):

Mountain pride (*Penstemon newberryi*). Photo: Jeff Abbas, 2001.

- Blue Oak (*Quercus douglasii)* and California Buckeye (*Aesculus californica*) are monitored near the Foothills Visitor Center area.
- Greenleaf Manzanita (*Arctostaphylos patula*)and Mountain Pride (*Penstemon newberryi*) are monitored at the Lower Kaweah Air Quality Monitoring site at the west edge of Giant Forest.

These sites were selected for their accessibility and their proximity to long-term weather stations. The plants at SEKI were selected for their distinctive and readily identifiable 'phenophases' (or developmental stages), their accessibility for sampling, and their distribution across multiple national parks. Blue oak and manzanita are good food sources for wildlife, which was another consideration for their inclusion.

Sylvia Haultain monitors greenleaf manzanita at the Lower Kaweah site. Photo: NPS.

Blue oak acorn. Photo: loarie (*flickr).*

Phenology Monitoring

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Engaging Citizen Scientists

The parks have a special program for young students known as "SPROUTS" (Student Phenologists Researching Oaks to Understand Trees and Science). This program engages students in recording and observing phenological events of oak species in their school yard.

Students upload their data to Nature's Notebook to share their findings with CPP scientists. The program teaches students important skills such as observing, estimating, recording, and sharing their data with the scientific community. Teachers find the program a great opportunity for students to get outside to and make field observations. Local teachers can learn about this program at: http://www.nps.gov/seki/forteachers/sprouts.htm.

This year the Foothills Interpretive District/Education Branch has presented several series of SPROUTS education programs in local classrooms, presented a brownbag on SPROUTS at Sequoia National Park, conducted facilitated dialogue around phenology and climate change, hosted a two-day teachers' workshop, and updated the phenology web pages. Evening programs or walks may also occur this summer.

Benefits for the Public

Denise Robertson, Sequoia South District Interpreter, who also manages the Education and Volunteer Programs said, "One benefit for students and visitors is that they are looking at the world in which they live through different eyes. It is also a tangible way to learn about climate change. Our goal is to continue to weave it into every corner of how we communicate climate change to visitors, students, staff, partners and community members.

Dani Crawford monitors a California buckeye at Ash Mountain (left), and Joshua Schultz works with students at a Visalia school to monitor oak phenology with the parks' SPROUTS program (right). NPS photos.

"While I believe the data sets are valuable, getting people inspired to care and be a part of the process is the most valuable part of our participation in the CPP. Our goal is to get people to not just monitor in these parks but monitor in their community, schoolyard, and back yard!"

You can learn more about this project by visiting the CPP website: https://www.usanpn.org/cpp. There you can download local data and use tools to visualize the pattern of life cycle events through the season. If you are interested in monitoring phenology, you can sign up as a citizen scientist, get information about how to monitor the plants you are interested in, and enter your data on the Nature's Notebook website managed by the USA-National Phenological Network: https://www.usanpn.org/natures_notebook.

Who are the 'phenologists'?

The seven pilot parks worked with scientists at UC Santa Barbara and the USA-National Phenological Network to develop monitoring approaches as well as educational programs to

This project provided a great opportunity for collaboration between the Divisions of Interpretation, Education and Resources Management and Science, as well as among park staff and K-12 students and teachers.

Park staff members Sylvia Haultain, Stephanie Sutton, Denise Robertson, and Joshua Schultz helped develop the monitoring and education programs.

Drs. Susan Mazer and Liz Matthews were the lead project scientists from UC Santa Barbara, while Dr. Angie Evenden of the California Ecosystem Studies Unit was the National Park Service lead.

Staff from the Foothills Visitor Center and the Plant Ecology and Air Quality Programs implement the monitoring or education programs. Particularly involved are Dani Crawford, Alysia Schmidt, Sylvia Haultain, Erik Meyer and Ariane Sarzotti with the help of seasonal staff and volunteers. A local cooperator, Ann Huber, provided assistance in protocol development, data analysis, and reporting.

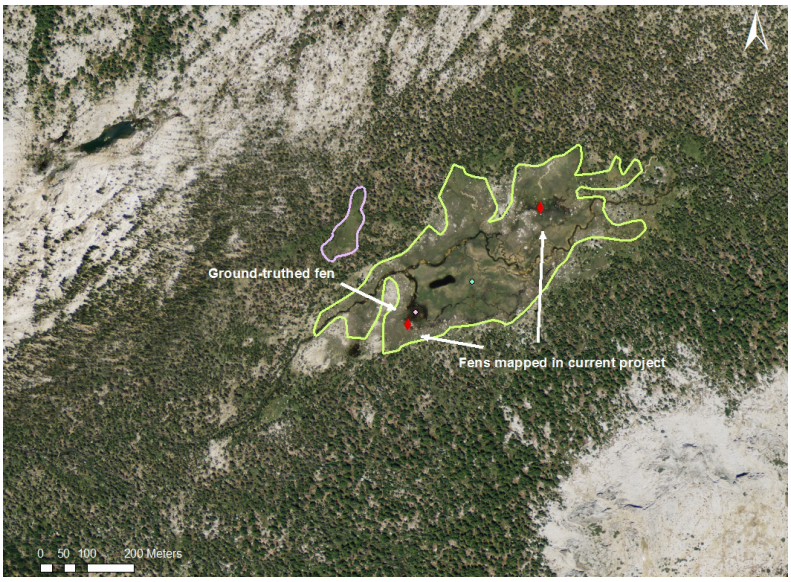
Yosemite Wetlands Map Underway

The Sierra Nevada Network Inventory & Monitoring Program (SIEN) has completed the initial phase of a wetlands mapping project for Yosemite National Park. All wet meadows and fens within park boundaries were identified and classified into three wetland types using aerial photointerpretation, vegetation datasets related to wetlands, field knowledge, and ArcGIS. Mapping Technicians Natalie Pyrooz and Adam Dickenson mapped a total of 1,607 wetland polygon types: 1,293 wet meadows, 297 fen-meadow complexes, and 17 fens. An additional 557 fen "points" were mapped. These points represent areas of suspected peat accumulation within the wetlands.

This project is an extension of a wetlands mapping effort which was initiated and completed at SEKI in 2013. See the Spring 2013 *Sierra Nevada Monitor* newsletter for a more detailed story on this effort.

SIEN is using these maps to inform sample site selection for its wetland ecological integrity monitoring and to better understand the resulting inferences about wetland status and trends among the network parks. The maps will also be valuable to park managers and research scientists as they represent a comprehensive assessment of the location and extent of wet meadows and fens throughout the SIEN parks.

The next phase of the project will begin this summer with help from the Yosemite Resources Management and Science staff and will focus on validating results from the mapping effort to assess classification accuracy and associated error rates.



High-elevation fens mapped in Yosemite National Park. Fens are indicated by red dots. Natural Agricultural Image Program imagery (USDA Farm Service Agency).

Wetland Type Definitions

Wet meadows: *often found in stream valleys and have fine-textured soils with high organic content but little peat. Wet meadows have seasonally high water tables and may include both surface and groundwater sources.*

Fens: *develop in areas of perennial high water tables and low sediment inputs. As such, they are often associated with groundwater discharge and basins. A major identifying trait of fens is their capacity to accumulate peat, which enables them to sequester carbon. Sierra Nevada fens support a disproportionately high number of rare plant species.*

Fen-meadow complexes *- Fens often occur as part of a meadow. If such meadows contained a significant proportion of fens, they are defined as "fen-meadow complexes".*

Yosemite National Park wetland. Photo: Jennifer Rains Jones.

What's Happening in the Field?

Wetlands Monitoring Starts!

This summer is the first season the wetlands monitoring project will be implemented. The protocol was revised and submitted for peer review in January. The inaugural crew includes: Corie Cann, crew lead, and Alexa Armstrong. The crew will install and sample the first set of 12 sites in Sequoia and Kings Canyon National Parks, as well as monitor an established site at Devils Postpile National Monument. The project monitors wetland plant communities, groundwater levels, and invertebrates, and targets two types of wetlands: wet meadows and fens. Monitoring will start in Yosemite after accuracy assessment is finalized on the recently completed wetlands maps.

Contact: Jonny Nesmith

Liz Ballenger and Jennifer Rains Jones install a wetlands monitoring site in Devils Postpile National Monument. Photo: Linda Mutch.

Birds

For a fourth season, bird monitoring crews will travel park trails to reach starting points for transects, where every bird is identified by sight or song within the early to mid-morning hours. One crew includes Tyler Stuart (field crew lead) and Jared Taylor, who will work at Yosemite (YOSE)and Devils Postpile (DEPO), and the other crew includes Sarah Hendrickson and Liz Bartholomew, who will work at Sequoia and Kings Canyon (SEKI). We are excited to have Tyler back for a third year and Sarah for her second year on this project! This year, our crew will complete the fourth rotating panel of transects, thus completing a full rotation through all panels at SEKI and YOSE and allowing us to begin preparation of our first comprehensive report. This project is conducted in collaboration with The Institute for Bird Populations.

Contact: Alice Chung-MacCoubrey

Lakes

The lakes project embarks on its seventh field season this year. Crews will sample water chemistry, record lake temperature profiles , and conduct lakeshore amphibian surveys at lakes throughout SEKI and YOSE. The SEKI crew will include Sarah Hendrickson, migrating over from the bird crew, and Tressa Gibbard who worked on the forest crew last year. The Yosemite crew, shared with the Yosemite Physical Sciences program, will be Dannique Aalbu and Laura Walkup. A comprehensive report is underway summarizing and interpreting the first five years of lake monitoring data.

Contact: Andi Heard

High-elevation Forests

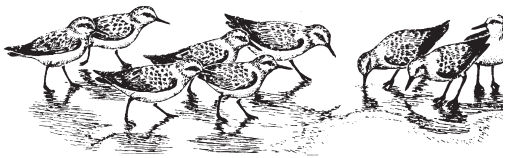
Sarah Hoff (crew lead), Sean Auclair, Roxanne Kessler, and Brianne Permar will travel to high-elevation whitebark and foxtail pine forests in SEKI and YOSE for the third season of monitoring forest structure, demography, and incidence and severity of disease and insect occurrence. An annual report from the 2013 season has been drafted and is in-review.

Contact: Jonny Nesmith

Rivers

SIEN is supporting hydrologic monitoring at three river gages: Middle Fork of the San Joaquin in Devils Postpile, Tuolumne River at Tioga Bridge, and Lyell Fork of the Tuolumne below Maclure. The USGS and DEPO staff will continue conducting monthly streamflow measurements at the DEPO gage. Monitoring will continue at the Tuolumne River sites as part of ongoing research projects, while SIEN and YOSE work on upgrading them to permanent long-term monitoring stations. Spring and summer activities at Yosemite include bringing field and data management activities in-line with I&M protocols, conducting a minimum requirement analysis for the Lyell Fork site located in wilderness, surveying sites, and upgrading equipment. The Rivers protocol is being resubmitted following peer-review and we anticipate an approved protocol later this year.

Contact: Andi Heard



Western Pond Turtles

The often overlooked and understudied foothill ecosystems of the Sierra Nevada serve as local havens of biodiversity. No other area of this vast mountain range contains a native fish and aquatic wildlife assemblage that includes multiple species from three cold blooded vertebrate classes-fish, amphibians, and reptiles. One reptile of the foothills that has garnered interest to scientists and land managers is the western pond turtle (*Emys marmorata*). Although their common name suggests they regularly inhabit lakes and ponds, such habitats are incredibly rare in the Sierra Nevada, and these turtles are most commonly found in streams up to 5000 feet elevation. The western pond turtle is California's only widespread native turtle, but is currently listed as a State Species of Special Concern.

Figure 1. Arrows point to annual rings that are used to age turtles. This turtle is four years old. Photo: Erik Meyer.

Western pond turtles are adapted to both permanent and intermittent waters, and display amphibious life history traits. They may often be found in low gradient pool habitat hiding under banks, boulders, and submerged vegetation, or basking primarily on logs and boulders. They will also bask while on land, but the terrestrial environment is largely used for nesting, estivation (similar to hibernation), and travel. It is in their aquatic habitat that western pond turtles consume much of their diet. As feeding generalists, they primarily consume a variety of insects.

Figure 2. Growth rings are no longer visible on this turtle, which is estimated to be more than 40 years old. Photo: Erik Meyer.

In 1991, in response to growing concerns regarding the range-wide status of western pond turtles, Sequoia and Kings Canyon National Park (SEKI) wildlife ecologist Harold Werner began monitoring turtle populations at two foothill streams in SEKI-Sycamore Creek and the North Fork Kaweah River. Park staff still monitor these populations nearly a quarter of a century later, making this one of the longest running vertebrate datasets in SEKI. In addition to obtaining population estimates, we gain information on age structure, gender ratios, size relationships, body condition, and state of turtle habitat.

We use snorkeling and visual searches at both monitoring sites and give captured turtles a unique identification number by notching the outer sections of the top of the turtle shell. In addition to weight and length measurements, we identify turtle gender by observing gender-specific features, and determine age by counting shell rings on the bottom of the shell, much like aging a tree (Figure 1).

In Sycamore Creek, a small intermittent stream, 175 unique turtles have been captured since 1991, including 24 females, 49 males, and 102 juvenile or unknown turtles. At the North Fork Kaweah River, a perennial stream, 389 unique turtles have been captured since 1991, including 102 females, 127 males, and 160 juvenile or unknown turtles.

Some individual turtles are encountered frequently, such as a female in Sycamore Creek that was first captured in 1991, weighing 307 grams and growth rings unreadable due to old age (Figure 2). In 2013, after being captured in the same pool for the 11th time and 22 years later, she weighed only 4 grams heavier than in 1991, and is likely greater than 40 years old!

Western Pond Turtles

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Within the last five years, I have worked with outside cooperators and other park staff on ecotoxicology studies for my M.S. thesis research through CSU-Fresno focused on SEKI turtles. These studies identified western pond turtles as appropriate biosentinel species for assessing contaminants in the Sierra Nevada foothills. We collected blood from turtles to measure both the presence and physiological effects of pollutants in natural waterways. This threat was evaluated by measuring biomarkers that diagnose the mechanisms of toxicity of two widespread classes of contaminants.

Nervous system function was depressed in turtles in the southern Sierra Nevada which is consistent with exposure to commonly sprayed enzyme-inhibiting pesticides in nearby agricultural lands. Further, mercury was detected in all turtles, and endocrine activity was significantly altered in turtles with the highest mercury concentrations. Preliminary results from subsequent research found a variety of other pollutants in turtle plasma, including combustion and industrial by-products, as well as historically used pesticides such as DDT.

Western pond turtles in the southern Sierra Nevada tend to be more yellow and lighter in color han those in the north. Photo: Erik Meyer.

Western pond turtle in North Fork Kaweah River, Sequoia National Park. NPS photo.

Although much has been gained by identifying the risks associated with contaminants to turtles in SEKI, basic life history information is still lacking. Therefore, students have recently been recruited to test methods for estimating population size and detecting trends.

Small temperature data loggers affixed to turtle shells are now being used to obtain high resolution behavioral data, such as the time and date of basking and aquatic behaviors, the time and duration turtles are in their burrows, and how they respond to changes to local climate.

Modeling the responses of sensitive species to current and future threats is often challenging due to insufficient data, limited life history information, and lack of information on species response to threats. Fortunately, such data and information are available from past and current studies to facilitate modeling efforts for western pond turtles at Sequoia and Kings Canyon National Parks.

--Erik Meyer
Physical Sciences Branch, SEKI

For additional information, contact Erik Meyer at erik_meyer@nps.gov. Two recent publications are available on Erik's M.S. research:

Meyer, E., D. Sparling, and S. Blumenshine. 2013. Regional inhibition of cholinesterase in free-ranging wester pond turtles (*Emys marmorata*) occuping California mountain streams. Environmental Toxicology and Chemistry 32(3).

Meyer, E., C.A. Eagles-Smith, D. Sparling, and S. Blumenshine. 2014. Mercury exposure associated with altered plasma thyroid hormones in the declining western pond turtle (*Emys marmorata*) from California mountain streams.

Erik Meyer with captured western pond turtle. NPS photo.

Black-backed Woodpeckers in Cedar Grove

Male and female black-backed woodpeckers foraging on beetle larvae on a dead ponderosa pine in Moraine Campground at Cedar Grove. Photo: Nick Ampersee.

Male black-backed woodpecker on a ponderosa pine snag in a Lassen National Forest burned area. Photo: Monica Bond, Institute for Bird Populations.

Pattern of bark removal typical of black-backed woodpeckers when foraging. Photo: Tony Caprio.

Black-backed woodpeckers are most typically associated with recently burned forests, where they feed primarily on wood-boring beetle larvae that are abundant after adult beetles lay their eggs on dying or recently dead trees.

They may also occur in beetle-killed and unburned forests. Recently park staff have observed black-backed woodpeckers in the Cedar Grove area of Kings Canyon National Park where many conifer trees have died during the recent drought years.

Nick Ampersee, while documenting dead trees for the Hazard Tree Management Program was able to observe a pair of these woodpeckers on March 27th in Moraine Campground and saw evidence of others throughout the valley from Roads End to Lewis Creek. Evidence includes large areas of bark removal on dead trees where the birds have foraged.

These observations will be captured in the parks' Wildlife Observation Database. This is a rare opportunity to observe a bird species that tends to be ephemeral, flocking to areas that are burned or otherwise have abundant dead trees.

Bird monitoring training, 2011. Photo: Alice Chung MacCoubrey.

Where Are We?

I&M field monitoring during the next few months includes:

	May	June	July	August	September
Birds	YOSE, SEKI	YOSE, SEKI, DEPO	YOSE, SEKI		
Lakes			YOSE	SEKI, YOSE	SEKI, YOSE
Wetlands		SEKI	SEKI	SEKI, DEPO	SEKI
Rivers	On-going monitoring by cooperators, parks, and SIEN in DEPO, SEKI, and YOSE				