SIERRA NEVADA NETWORK

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DEVILS POSTPILE • SEQUOIA & KINGS CANYON • YOSEMITE

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Mapping Wetlands in Sierra Nevada Parks

The Sequoia and Kings Canyon National Parks (SEKI) Plant Ecology Program and the Sierra Nevada Network (SIEN) recently collaborated to map wetlands across the entire parks' landscape. The mapping used aerial photointerpretation, vegetation datasets related to wetlands, field knowledge, and ArcGIS to classify and map three wetland types. A total of 2,307 wetland polygons were mapped: 2,030 wet meadows, 260 fen-meadow complexes, and 17 fens. An additional 615 fen "points" were mapped. SIEN hopes to extend this work to Yosemite National Park this fall.

Why Map Wetlands?

Although wet meadows and fens occupy only a small area (<1 percent) of the Sierra Nevada, they support a large number of plant and animal species. They are important hydrologically, regulating water flow and recharging groundwater.

The types of wetlands targeted in this project included:

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 they accumulate peat (decayed vegetation), enabling them to sequester carbon. Sierra Nevada fens support a disproportionately high number of rare plant species.

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.

Fen-meadow complexes - most often, fens occur as a portion of a meadow. If meadows contained a substantial amount of fen, they were classified as "fen-meadow complexes".

This project is of high value for SEKI and the SIEN Inventory & Monitoring Program. SEKI will use this map to evaluate the effects of the different

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Yosemite National Park wetland. Photo: Jennifer Rains Jones.

Mapping Wetlands

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Wilderness Stewardship Plan alternatives on park wetlands. SIEN will use this map to inform sample site selection for its wetland ecological integrity monitoring project and to better understand the resulting inferences about wetland status and trends among the network parks.

This new inventory of SEKI wet meadows and fens is a valuable resource for the parks and general public as it has applications for many ecological topics including carbon storage, hydrology, trophic interactions, and many more. It also makes possible a regional analysis of fens across the southern Sierra Nevada: NPS and US Forest Service wetlands data could be combined to examine the effects of climate and abiotic factors on the distribution of fens.

Who Did This Work?

Corie Cann and Natalie Pyrooz, the mapping technicians, performed the bulk of the photointerpretation and mapping, as well as documenting the criteria and process they used. Erik Frenzel, Ecologist with the SEKI Plant Ecology Program and Jonny Nesmith, Ecologist with the Sierra Nevada Network worked together to plan and oversee the project.

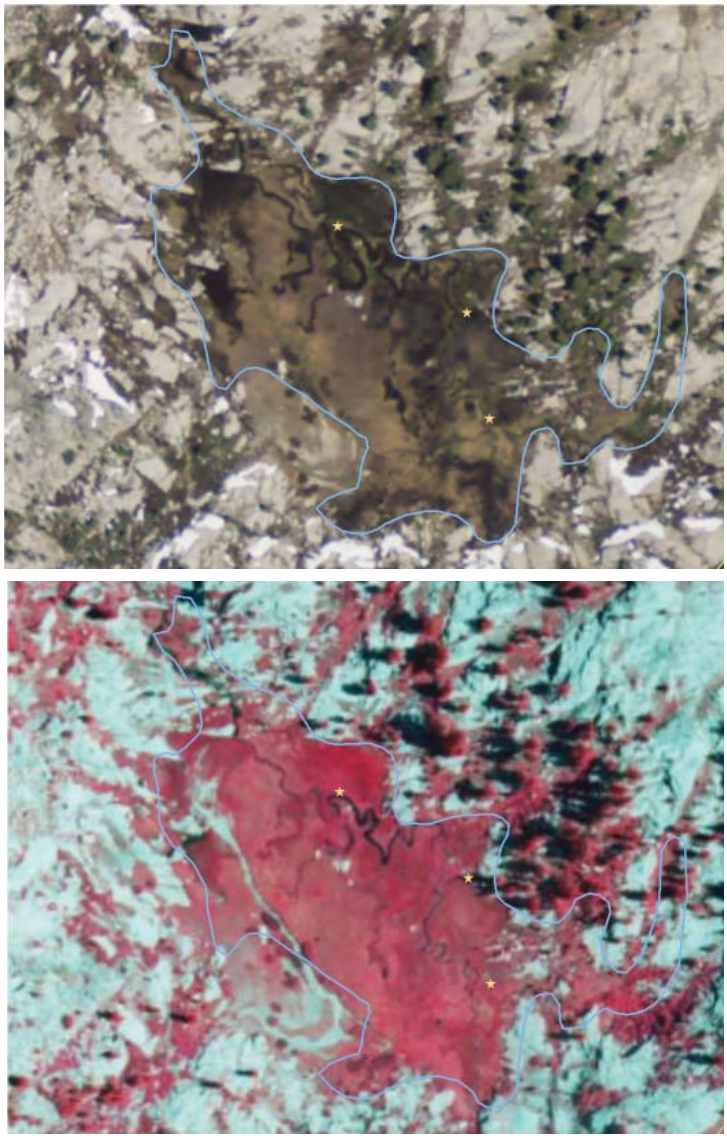
Paul Hardwick, SEKI GIS & Data Coordinator, used this project as an opportunity to implement a new work flow process in ArcGIS. The process, known as "editing in a versioned environment", allowed the two technicians to work on the same layer concurrently. This enabled more review and reduced the amount of conflicts and errors in the draft document before a quality control check was done. Paul said it will be a good model for future projects in which people need to work together on the same spatial layers.

How were wetlands mapped?

Corie and Natalie used a variety of technical materials to map wetlands. The primary materials were:

- Natural Agriculture Imagery Program (NAIP) imagery from the USDA Farm Service Agency, and lower resolution aerial imagery
- Supporting datasets - national wetlands inventory, the rivers and streams, and the 15-minute topographic feature classes; the SEKI vegetation map; and a former survey of a subset of fens in the parks
- I&M pilot project that included mapping a subset of wetlands by Jennifer Rains Jones of Colorado State University
- Geographic information system software (ESRI ArcMap 10.1)

When asked what some of the challenges of the project were, Corie and Natalie said it was challenging to develop the list of criteria that ensured accuracy and consistency between them in relation to how and what vegetation was included and excluded. Examples of criteria they developed included defining key visible differences among the wetland types, the minimum mapping unit size, minimum vegetation density, and slope-related criteria.



Subalpine fen-meadow complex in the Granite Pass area of Kings Canyon National Park. The upper image is natural color and the lower image is color infrared. Yellow stars indicate fen signatures. Natural Agricultural Image Program imagery (USDA Farm Service Agency).

While being able to interpret aerial imagery and other vegetation datasets is important, it is also critical to have on-the-ground knowlege of wetlands. The time that project participants had spent hiking to wilderness wetlands and collecting vegetation data increased their ability to visualize the wetlands and accurately interpret the wetland types.

This summer, SEKI's plant ecology crew will visit a subset of wetlands that were mapped as well as those that were excluded for not meeting the criteria, in order to evaluate the accuracy of the photointerpretation.

Bird Enthusiasts Migrate Back for a Second Season

The Institute for Bird Population (IBP) and the Sierra Nevada Network (SIEN) have initiated the third season of a collaborative bird monitoring project in SIEN parks. IBP hires and supervises the bird monitoring crews, and works with SIEN staff to provide training and support to field staff. This year, two crew members returned for a second season: Jade Ajani and Tyler Stuart.

"I really love the Range of Light and exploring its many facets!" Jade commented, explaining why he returned. "Also as a climber the Sierra parks offer so much wonderful granite and incredible peaks that working here is just too good to pass up. Plus I love the supportive nature of working closely with the NPS and IBP. And of course being directly involved in avian conservation and park resource management is great, not to mention it feels like a really meaningful way to earn a livelihood."

"The opportunity to combine important data collection of breeding birds with hundreds of miles of backpacking in the Sierra Nevada was too good to pass up last year," Tyler said. "After completing last season, I knew what I would be missing if I didn't return. Also, the people at SIEN and the IBP make the work flow and provide a great experience. Waking up in the dark beside an alpine lake or beneath giant sequoias, and watching the sun fill the Range of Light while finding birds trumps about any other way I could think to spend summer mornings."

Bird monitoring requires skill in identifying many species of birds by both visual appearance and by each species' characteristic calls and songs.

"I owe much of my birding ability to working with the Institute for Bird Populations," Jade said. "My first job with IBP was an internship in 2010, doing bird surveys in Sierra Nevada meadows. I remember studying birds really diligently for the three months

Jade Ajani holding a Merlin, from a Hawkwatch International monitoring and banding project in Oregon.

leading up to that job, which involved a lot of time reading field guides and listening to bird song recordings almost every day as well as going out and birding as much as possible. Along with personal studying, the intensive and high quality training I received from IBP in preparation for that job largely formed the foundation of my birding skills, particularly aural identification."

"My interest in birds was sparked by an enthusiastic professor of ecology in college, but really took fire while I studied and researched in Costa Rica," Tyler said. "Costa Rica's geographic position results in an incredible combination of birds of North and South America."

"As with music or athletics or any skill, my bird identification skills didn't appear overnight," Tyler continued. "The best way to learn the birds is to get outside, and carefully watch and listen to them—over and over and over. Building associations between bird species and the habitats they frequent helps in understanding the species I can expect to find in a given place. Other than that, I've spent hours and hours listening to audio files, studying field guides, reading literature about birds, and discussing bird identification with more experienced scientists and birders."

Jade and Tyler find a lot of opportunities to pursue their birding interest in the fall and winter as well.

"The past couple falls I have worked for HawkWatch International at Bonney Butte in Oregon counting and banding migratory raptors," Jade said. "I spend the winter at my home in Portland, Oregon usually volunteering, working on film/video projects, home improvement, and of course birding and climbing regularly."

"Each year varies, but most recently I have been surveying a large wind farm in Colorado to study its effect on migratory birds," Tyler said. "I also developed a project last fall, and began the project, A BIRDiful Year,

Tyler Stuart birding.

on January 1 of this year. In 2013, Jade and I are counting all of the wild bird species we find to raise money for the Institute for Bird Populations' Sierra Nevada bird monitoring projects. Anyone interested in supporting the project and IBP's monitoring efforts can visit http://www.birdifulyear.webs.com, or email tylerhstuart@gmail.com or jadeajani@gmail.com."

Soils Mapping: Looking beneath the Surface

Be it deep or shallow, red or black, sand or clay, the soil is the link between the rock core of the earth and the living things on its surface. It is the foothold for the plants to grow. --Roy W. Simonson, Soil Scientist

A soils map includes the types, characteristics, and distributions of soils in the parks, providing key information to understanding the patterns of vegetation on the landscape and allowing for more informed decisions related to issues such as restoration of disturbed lands, recreational uses, facilities management, watershed planning, and protection of various cultural and natural resources.

The soils inventory is one of the twelve basic inventories that parks acquire through funding from the National Park Service Inventory and Monitoring Division, and for the soils map, the Geological Resources Division also provides support. The soils inventories are coordinated through cooperative agreements with the Natural Resources Conservation Service (NRCS). Park staff in the Physical Sciences and Cultural Resources Branches of the Resources Management and Science Division provide support to the soils mapping field survey efforts.

The eagerly awaited Sequoia and Kings Canyon National Parks (SEKI) soils map got underway in 2012, with NRCS staff doing field work in northern Kings Canyon National Park. This season they will be spending the spring months mapping the lowest and warmest elevations of the park such as Ash Mountain before moving up towards the Giant Forest area during May. From July through September, they plan on working in the high country of Kings Canyon: Goddard Canyon and along the Pacific Crest Trail between Taboose and Baxter Pass.

Soils mapping crew members dig a soil pit in the Sapphire Lake area of Kings Canyon NP to characterize the soil profile. Photo: Jennifer Wood.

A common meadow soil type, indicative of a fluctuating water table, Little Pete Meadow. Photo: Chris Savastio.

Chris Savastio, Soil Scientist with NRCS in Sonora, is the local project leader for the SEKI soils map. He accompanies a rotating crew of soil scientists and vegetation ecologists on all of the work trips into the parks.

"As project leader, I am in charge of determining different soil types and ascertaining how these soils repeat in expected patterns across the landscape based on soil forming factors--climate, parent material, biota, topography and time," Chris explained.

Cathy Scott, NRCS Project Leader for all of the Sierra Nevada soils mapping projects, also provides oversight for the SEKI mapping project. Dave Evans is the lead ecologist, and works to assign ecological site descriptions to these soil types.

"By having soil scientists and ecologists work in close association with each other, the plant-soil relationship is made with a better understanding of how plant ecology is determined by the attributes of the soil," Chris said.

In addition, a NPS archeologist often accompanies the soils mapping crew to assist with compliance needs. The soils mapping crew digs holes to look at soil profiles, and the archeologist helps ensure that archeological sites are not impacted by this activity.

What does mapping soils involve?

During field mapping, the scientists will work out of a specified area for several days at a time to fully develop an understanding of the relationships among the soils of a given landscape. During a survey, the soil scientist uses a hand auger or a small spade shovel to examine cross sections of selected soil profiles. All soil excavations are

Soils Mapping (continued)

refilled with the same soil immediately after observations are made. Texture, color, structure and reaction of the soil and the relationship and thickness of the different soil layers are documented. Also recorded are the depth of the rooting zones, amount of organic material, pH, and other details related to the formation and appearance of the soil. The data are then summarized and evaluated to develop "map units" that are delineated on a map and labeled.

"Soils are interpreted for many different uses based on their physical and chemical properties in the final soil survey product," Chris said. "While a soil survey offers a description of the soil itself, the true usefulness of the product lies in the interpretations, which are derived from

Drying soil samples collected for full lab analyses. Photo: Chris Savastio.

the soil properties. Park scientists and other researchers will find soil interpretations that are useful for a wide range of practical applications, such as meadow restoration and fire management."

The soils mapping process allows for some finer scale map units that have high management interest. For example, in SEKI, sequoia groves and meadows are mapped at a finer scale as these are ecologically important areas in which a detailed ecological soil survey can better inform specialists on management strategies.

The products (maps, tabular data about soil characteristics, and information about how the maps were made) are all served in a Soils Survey Geographic database. While the final products are some years away, park and Sierra Nevada Network staff already have a variety of ideas about how they would like to use the soils map:

Wetlands/Meadows:

The soils map will give us the first really detailed look at soil profiles in wet meadows, which are important contributors to biodiversity. This information will also help us better understand the variability among these meadow systems and potentially help us anticipate which ones are more stable (Sylvia Haultain, SEKI Plant Ecologist).

*The soils map will be of particular interest for our wetlands ecological integrity monitoring as we try to understand the changes that occur through time. It will also help us better understand at a regional scale what environmental properties are most strongly tied to the occurrence of peat-accumulating wetlands to better assess their vulnerability to changing climate and management (*Jonny Nesmith, SIEN Ecologist*).*

Disturbed Lands Restoration:

The soils map will describe reference conditions which we can compare to soil properties in disturbed sites to determine the extent of departure from reference conditions. This will help managers decide whether soil amendments or other treatments should be considered for restoring soil properties on a disturbed site, or whether soils are intact enough to support the natural recovery (Athena Demetry, SEKI Restoration Ecologist).

Giant Sequoia Conservation:

For giant sequoias, the soils map can be compared with the projections of future climate conditions. We could see where future climate "envelopes" would be suitable for giant sequoia and overlap with suitable soil types (Koren Nydick- SEKI Science Coordinator/Ecologist and Nate Stephenson - USGS Research Ecologist).

Lake Monitoring:

I will incorporate soil characteristics into our lakes analysis as a covariate to help explain spatial variability in lake chemistry (Andi Heard, SIEN Physical Scientist).

Conservation Biology:

By looking at geology, soil, and topography we could identify what some people are calling landscape facets or enduring features. These are critical components of the landscape that are not expected to change much with a changing climate. They form the "stage" on which biodiversity exists. Some conservation biologists are identifying these landscape facets, assessing within each type which areas have the most physical complexity, permeability, and connectivity, and prioritizing those for conservation (Koren Nydick).

Yosemite National Park's soils map was completed in 2007. Jim Lutz from the University of Washington used the soil map to calculate water holding capacity which is enabling him to calculate actual evapotranspiration and water deficit to model species distributions (Peggy Moore, USGS Ecologist).

The soils maps bring a wealth of additional resource knowledge to the parks, with numerous applications to management needs and scientific studies. The soils mapping field work will last through 2016, and the final published map and associated products are expected to be available by 2018.

Chipmunks: Losing Ground?

The Sierra Nevada is home to eight of California's 13 chipmunk species. This diversity is explained by geography: the Sierra is situated where six species from three regions of California converge. It is also explained by local speciation: three species are endemic to the Sierra Nevada. The high level of chipmunk diversity is reflected in their occurrence across all elevations from the foothills where Merriam's chipmunk (*Tamias merriami*) lives, to above treeline, where the alpine chipmunk (*T. alpinus*) is found.

Alpine chipmunk in Yosemite National Park. Photo: Les Chow.

In accord with the ecological principle of minimizing competition between closely related species, chipmunks occupy a variety of habitats ranging from mid-elevation, closed canopy forests preferred by the shadow chipmunk (*T. senex*) to high elevation, glacier-scoured slabs used by the alpine chipmunk. And despite their apparent similarity in food habits - all chipmunks eat fungi and seeds - each species exhibits distinct preferences for different kinds of seeds ranging from pine nuts to flowers and grasses.

Lodgepole chipmunk *(Tamias speciosus)*. Photo: © 2013, Ron Wolf.

The rich diversity of chipmunks in the Sierra Nevada is currently being threatened, however. Results from the Grinnell Resurvey (2003-2005), which returned to sites first visited in 1914 and 1915 by Joseph Grinnell and his staff from the Museum of Vertebrate Zoology (MVZ), documented changes in both the distribution and abundance of several chipmunk species. Shadow chipmunks changed the most. This species was recorded 62 times at 17 different locations in the original 1915 survey. The Grinnell Resurvey conducted by Craig Moritz and his colleagues at MVZ found only three shadow chipmunks at only one site, despite sampling at all of the original locations.

The alpine chipmunk has also shown a significant change in distribution. Once common at elevations as low as 8,600 feet, this species now is only found above 10,600 feet. The change in distribution of alpine chipmunks in Yosemite National Park has been accompanied by a 50 percent loss of genetic diversity according to a study led by UC Berkeley graduate student Emily Rubidge. Ongoing surveys in other parts of the High Sierra have failed to find any evidence of the Uinta chipmunk (*T. umbrinus*) another high elevation resident the original Grinnell Survey recorded as common.

Ongoing studies by MVZ staff are seeking answers for why the distribution of alpine chipmunks has changed. Higher temperatures associated with climate change is one possibility according to Rubidge and co-authors of a 2010 study. Unfortunately, a dearth of information about alpine chipmunk physiology makes this difficult to confirm with any certainty. Meanwhile, a study examining competition with lodgepole chipmunks (*T. speciosus*) may offer another potential explanation (R. Walsh pers. comm.). Preliminary analytical results suggest that alpine chipmunks are undergoing rapid evolution. Historic specimens of alpine chipmunks from the Sierra exhibit a steady increase in size from north to south. However, recently collected data show present-day populations are converging on a common size midway between the historic northern and southern specimens (J. Patton pers. comm.).

The disappearance of shadow and Uinta chipmunks from Yosemite and southern Sierra Nevada, and the contracted range distribution and loss of genetic diversity in alpine chipmunks highlight concerns about the potential loss of biodiversity in the Sierra Nevada. These diminutive members of the squirrel family disperse seeds for plants, serve as prey for predators, and provide amusement and enjoyment for park visitors.

--Les Chow

Monitoring Project Updates

Birds

Bird monitoring crew members arrived on April 27 and received training in Sequoia and Kings Canyon and Yosemite until May 14. Crew members in Sequoia and Kings Canyon will be Tyler Stuart and Sarah Hendrickson, and Jade Ajani and Martin Frye will monitor birds in Yosemite and Devils Postpile. Jade and Tyler are returning crew members from last season, and Jade is the field crews' lead. The crews will each sample 12 transects that are sampled annually and a set of 15 transects that are sampled every four years, as well as the 42 point count stations at Devils Postpile. This project is done in collaboration with The Institute for Bird Populations (IBP). The season will run through July 22. The 2012 annual report is in preparation. For questions, contact SIEN Program Manager Alice Chung-MacCoubrey.

Climate Reporting

Les Chow, SIEN Data Manager, is processing the 2012 weather data from eight stations in SIEN parks. He is working with the Desert Research Institute in Reno, NV to obtain corrected and infilled data in order to calculate the 30-year reference period that the 2012 data will be compared to. The first annual climate report will be prepared this fall to early winter.

One of the weather monitoring stations included in SIEN's climate reporting protocol -- Grant Grove, Kings Canyon National Park. Photo: Kelly Redmond.

Wetlands

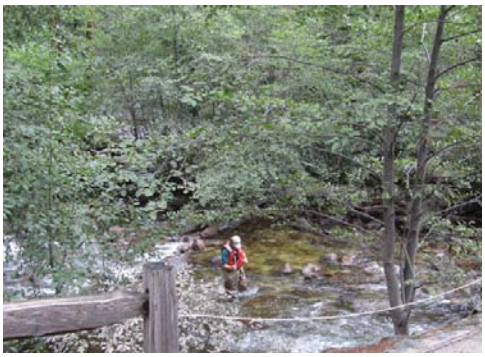
Jonny Nesmith, SIEN Ecologist, and Sequoia and Kings Canyon National Parks staff (Erik Frenzel, Corie Cann, and Natalie Pyrooz) collaborated to map two important wetland types throughout Sequoia and Kings Canyon: fens and wet meadows - see article p. 1-2. SIEN hopes to do the same for Yosemite in the Fall/Winter. Jonny will be selecting monitoring sites in SEKI based on the new map sometime in the next few weeks. The revised wetlands monitoring protocol will be submitted for review in the fall 2013. The field monitoring will begin in the summer of 2014.

Jonny Nesmith at Devils Postpile wetland monitoring site. Photo: Jennie Skancke.

High-Elevation Forests

After a one-year hiatus, the forest project will resume in 2013. The crew will start with a week of training in Sequoia National Park June 24-28. Pete Del Zotto is crew lead, and crew members are Tressa Gibbard, Sienna Hiebert, and Patrick Rizzo. The crew will aim to install 36 plots this summer: 12 whitebark plots in Yosemite, and12 whitebark plots and 12 foxtail plots in Sequoia and Kings Canyon. Within plots, crews map and take diameter of trees, describe tree condition, and identify signs of insects or pathogens. The crew will be working in Yosemite during July and in Sequoia and Kings Canyon during August and September. Jonny Nesmith is project lead.

Rivers



Taking discharge measurements at Happy Isles site in the Merced River in Yosemite. NPS photo.

The river monitoring protocol is being implemented this summer. In Devils Postpile National Monument, the fieldwork of collecting stream gage measurements is on-going and occurs approximately monthly. A combination of USGS, Devils Postpile staff, and SIEN staff share this responsibility. In Yosemite, the transition of management of two Yosemite gages to SIEN will start this summer. It will consist of a joint field work effort among SIEN, Yosemite, and the USGS Water Resources Division. The rivers protocol is being revised in response to peer review comments and will be re-submitted this summer or early fall. The first rivers monitoring annual report will be compiled in the coming year. SIEN Physical Scientist Andi Heard is project lead.

Lakes

The lake monitoring will be scaled back to sampling just the annually sampled set of lakes in order to allow time for initiating the river monitoring project and for data analyses and syntheses for lake monitoring reports. There will not be a lake monitoring crew this year. Other SIEN field crews and long-term staff will sample three lakes sites in Yosemite and five in Sequoia and Kings Canyon. Sampling will occur in August. Two publications focused on atmospheric deposition effects on SIEN lakes are in-progress, associated with Andi Heard's PhD research.

Sierra Nevada Network (SIEN) Inventory & Monitoring Program

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).

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Looking west down Wallace Creek and across the Kern River Trench into the lower portion of the Kern-Kaweah River in Sequoia National Park. To the right (north) of Kern-Kaweah is Kern Point and to the south (left) is an unnamed bench. Two foxtail pine monitoring plots are located in this area. Photo: Tony Caprio.

SIERRA NEVADA NETWORK

The Sierra Nevada Monitor is published twice a year for Sierra Nevada Network park staff, our partners, and others interested in resources management and science in Sierra Nevada national parks.

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Where Are We?

Field monitoring during the next few months includes:

	May	June	July	August	September
Bird Monitoring	YOSE, SEKI	YOSE, SEKI DEPO	YOSE, SEKI		
Forest/Lake Monitoring			YOSE	SEKI	SEKI
River Monitoring	All parks- Monitoring by others with existing river gages.		DEPO - site visit		YOSE - site visit