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 2
October 2014

Sierra Nevada Monitor

Newsletter of the Sierra Nevada Inventory & Monitoring Network

Clean Air Act and Improved Water Quality in Sierra Nevada Lakes

Moat Lake, Humboldt-Toiyabe National Forest, on the eastern slope of the Sierra Nevada.

Emerald Lake, Sequoia National Park, on the west side of the Sierra Nevada. NPS photo.

In these times when scientific studies and the media commonly report new evidence of environmental degradation, it is heartening to learn that a government policy has helped improve water quality in Sierra Nevada lakes. Recent research has found that air pollution affected lakes in the Sierra Nevada as early as the 1920s, including in Sequoia National Park, but lake water quality improved following implementation of the Clean Air Act and Amendments.

The Clean Air Act (1970) and subsequent amendments (1977 and 1990) established the primary policy for improving air quality and reducing atmospheric deposition in the United States. This legislation targets decreases in acid deposition and recovery of surface waters from acidification. It also prohibits any deterioration of air quality in many national parks and wilderness areas, where a large proportion of mountain lakes occur.

The Sierra Nevada is exposed to air pollution that originates from agricultural, urban, and industrial sources in California's Central Valley, the San Francisco Bay Area, and as far away as Asia. Air currents transport nutrients and acids from these sources into the mountains and deposit them via rain, snow, and dry deposits. These inputs acidify sensitive mountain lakes, decreasing their acid neutralizing capacity (ANC), and altering their biotic communities.

James Sickman, Associate Professor with the University of California, Riverside, is the principal investigator of a study investigating long-term changes in Sierra Nevada lake chemistry. He and colleagues reconstructed historic acidification trends using a Sierra Nevada lake sediment core. They found the lake was changing as early as the 1920s with acidification increasing through 1970. However, in the later 20th

...Continued on page 2

In This Issue

Web Page Changes.....2

Program Manager Moves to Klamath Network..... 3

Honoring Two Biologists.....4

Field Project Updates.....5

Nature Feature.....6
Bats: Underappreciated, Misunderstood

Thanks to Field Crews.....8

Devils Postpile Report.....9

Climate Change Exposure of National Parks.....9

Reports & Publications.....9

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) 565-3788
alice_chung-maccoubrey@nps.gov
(left for Klamath Network, Oct. 19, 2014)

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

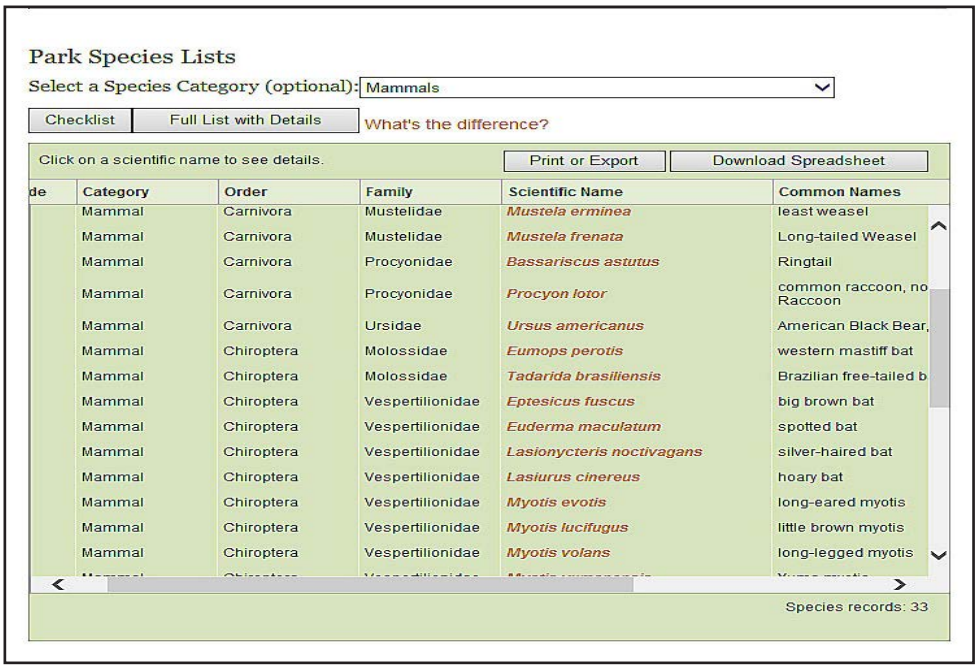
Administrative Assistant
Jenny Matsumoto (559) 565-3787
jenny_matsumoto@nps.gov

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.

What's New on Web Pages?

Thanks to some helpful new search tools developed by the National Park Service Inventory & Monitoring Division, it is now possible to visit the park sections of the Sierra Nevada Network web pages (http://science.nature.nps.gov/im/units/sien/parks/index.cfm), and conduct bibliographic keyword searches that return dates, titles and links to reports, resource briefs, and other documents related to a park and a subject area. All documents served on our website now live in the Integrated Resource Management Applications (IRMA) on-line system.



Park Species Lists

Select a Species Category (optional): Mammals

Checklist | Full List with Details | What's the difference?

Click on a scientific name to see details. Print or Export | Download Spreadsheet

de	Category	Order	Family	Scientific Name	Common Names
	Mammal	Carnivora	Mustelidae	*Mustela erminea*	least weasel
	Mammal	Carnivora	Mustelidae	*Mustela frenata*	Long-tailed Weasel
	Mammal	Carnivora	Procyonidae	*Bassariscus astutus*	Ringtail
	Mammal	Carnivora	Procyonidae	*Procyon lotor*	common raccoon, no Raccoon
	Mammal	Carnivora	Ursidae	*Ursus americanus*	American Black Bear,
	Mammal	Chiroptera	Molossidae	*Eumops perotis*	western mastiff bat
	Mammal	Chiroptera	Molossidae	*Tadarida brasiliensis*	Brazilian free-tailed b
	Mammal	Chiroptera	Vespertilionidae	*Eptesicus fuscus*	big brown bat
	Mammal	Chiroptera	Vespertilionidae	*Euderma maculatum*	spotted bat
	Mammal	Chiroptera	Vespertilionidae	*Lasionycteris noctivagans*	silver-haired bat
	Mammal	Chiroptera	Vespertilionidae	*Lasiurus cinereus*	hoary bat
	Mammal	Chiroptera	Vespertilionidae	*Myotis evotis*	long-eared myotis
	Mammal	Chiroptera	Vespertilionidae	*Myotis lucifugus*	little brown myotis
	Mammal	Chiroptera	Vespertilionidae	*Myotis volans*	long-legged myotis

Species records: 33

In addition to the bibliographic search, it is also now possible to do searches of the NPSpecies on-line database that documents vascular plants and vertebrate animals in the parks. While a few updates are needed to these lists, this search tool is a positive step toward making it easy for web visitors to generate lists of plants and animals that have been formally documented in the parks. Above is a partial list of the animals returned for Devils Postpile under the "mammals" category.

Lake Water Quality

continued from page 1

century (1970-mid 2000s), the trend reverses and the lake becomes less acidified.

Andi Heard, Sickman's graduate student and Sierra Nevada Network physical scientist, further investigated these acidification trends as part of her doctoral research to determine if the observed changes in lake chemistry had resulted from air pollution and subsequent deposition of pollutants high in the Sierra Nevada Mountains. Andi and colleagues examined multiple lines of evidence to better understand the effect that human actions have had on Sierra Nevada lakes throughout the 20th century.

Aspects of a lake's history can be revealed by examining biological and chemical measures that are preserved in sediment layers through time. In this study, researchers measured spheroidal carbonaceous particles (SCPs), by-products of industrial fossil fuel combustion that are transported and deposited with pollutants in mountain lakes where they are preserved in the sediments. There

...Continued on page 3

Program Manager Migrates North to Klamath

Alice Chung-MacCoubrey near Granite Pass, Kings Canyon National Park.

In the hustle and bustle of closing out and reporting on the past year and preparing for my move to a different Inventory & Monitoring (I&M) network, I pause to reflect on how far Sierra Nevada Network (SIEN) has come, how much we've learned, how impressed with and proud I am of our team, and how honored I am to have been part of this network.

My departure is not the first time SIEN has experienced turnover in staff and leadership, and I've seen the network respond by welcoming newcomers, investing in relationships, and trusting that we are all working towards a common goal: developing the best possible monitoring program that will support the network parks and visitors. We've been wonderfully successful in moving toward that goal! We celebrated 2014 as the network's first year with all of our monitoring projects up and running. This would not have been possible if not for the successful collaboration among and contributions by network and park staff and our numerous cooperators.

Over these past years, we've also faced a number of challenges, such as re-ordering our protocol development priorities, budget cuts, and a serious accident on a field crew. I'm glad to say that each time, we've emerged a better program, having learned from our mistakes and channeled our energies towards making course corrections, innovations, and improvements. I'm excited to see the SIEN Vital Signs Monitoring Program taking off and am proud to have been part of it. I'll miss these amazing parks and the talented and dedicated park and network staff. Fortunately, I'll be close-by at Klamath I&M Network, watching Sierra Nevada Network continue to prosper and hopefully, fostering collaborations between our networks!

-Alice Chung-MacCoubrey

Lake Water Quality

continued from page 2

are no natural sources of SCPs so they are an excellent indicator of human-caused atmospheric deposition. SCP patterns were strongly correlated with the acidification trends, as were 20th century sulfur emissions. These correlations between acidification, air pollution, and deposition suggest that acid deposition caused early 20th century acidification.

As the century and industrialization progressed, acidification from sulfur dioxide and nitrogen emissions increased. However, in 1970, concurrent with enactment of the Clean Air Act, sulfur emissions and SCPs in lake sediments began to decline and lake acidification trends reversed. The late 20th century recovery observed in lake sediment cores is further supported by water samples collected from Emerald Lake in Sequoia National Park from 1983 through present day that show decreases in acidification.

Scientists have previously attributed recovery of lakes from acid deposition to the Clean Air Act, although research and success stories have been focused in the northeastern United States where acid deposition has received the most attention. This study expands on previous research and demonstrates that the Clean Air Act has also reduced the effects of acid deposition on Sierra Nevada aquatic ecosystems.

The Sierra Nevada Network monitors lake chemistry trends, including acidification, in Sequoia, Kings Canyon, and Yosemite National Parks. These data enable us to continue to track long-term trends and evaluate the effectiveness of environmental policies on resources in these parks.

This research was recently published in the journal *Environmental Science and Technology* - see page 9 of this newsletter for the reference.

Example of a sediment core extracted from a Sierra Nevada lake. Cores are sliced into one-centimeter-thick segments and the chemical composition of each segment is analyzed to determine how lake chemistry has changed over long periods of time. Photo: Bob Meadows.

Honoring Two Wildlife Biologists

This past year, we lost two wildlife biologists who made significant contributions to our program. Here we remember them.

Steve Thompson

Steve Thompson worked as a wildlife biologist in Yosemite National Park for 25 years, retiring in January from his position as the Branch Chief for Wildlife Management. Steve is particularly noted for his efforts on behalf of black bears, great gray owls, peregrine falcons, bighorn sheep, and mountain yellow-legged frogs. He died suddenly on August 26, 2014 in a car accident.

Steve Thompson on a wilderness trip in Yosemite National Park. Photo: Heather McKenny.

Here we highlight Steve's contributions to the Sierra Nevada Network (SIEN) Inventory & Monitoring Program. Steve was involved with our program from the time it got started 15 years ago. He helped with the wildlife portion of the inventory plan; he was a dedicated member of the science committee of local staff who helped us make key decisions about our monitoring program. Despite his full workload in Yosemite, Steve always found the time to show up at our meetings in windowless conference rooms in Fresno and workshops where we generated and prioritized long lists of potential vital signs.

Our program benefitted from Steve's broad knowledge of the Sierra and his ability to think beyond his discipline and the Yosemite boundary. Through stressful times, Steve kept his smile and sense of humor and stayed focused on what mattered – the natural resources of the parks, his colleagues and staff, his family and friends.

Elizabeth "Dixie" Pierson

Dixie Pierson and her husband Bill Rainey are noted for their extensive work to better document and understand Sierra Nevada bats. Selected as a high-priority inventory in the SIEN Biological Inventory Plan, Dixie and Bill conducted the first broadscale bat inventories in Sequoia & Kings Canyon National Parks and the first inventory of bats in Devils Postpile National Monument. They documented 17 bat species for Sequoia & Kings Canyon National Parks and ten for Devils Postpile.

Dixie and Bill also did extensive bat inventories and research in and around Yosemite National Park with other funding sources for 20 years. They did basic inventories of bats to generate well-documented species lists and conducted radio-tracking of western mastiff and spotted bats (documenting the first roosting record of spotted bats). Additional projects included: effects of road corridors on bats, how bats use giant sequoias for roosting, and the elevational distribution of bats in response to the timing of aquatic insect emergence. Beyond their Sierra Nevada work, Dixie and Bill contributed substantially to bat conservation initiatives at regional, national, and global levels.

Dixie died April 2, 2014. She saw her multi-year journey trying to beat cancer as similar to a wilderness trip, with mystery, uncharted terrain, and much to learn. In 2011, she wrote "*I suddenly realized my journey with cancer suits me perfectly. The available 'maps' are totally inadequate, and because of the rarity of my condition, the territory is unexplored. Being in this place awakens my curiosity. It gives me energy and focus. The more I learn the more I am fascinated (as opposed to frightened) by the amazing phenomenon of cancer – a trickster par excellence that has figured out how to put on a 'cloak' (its cell wall) that fools and confuses our very sophisticated, so finely tuned immune systems. I cannot say it stirs my soul in the same way the Alaskan wilderness does, but I am deeply engaged by the mystery of it all.*"

Dixie Pierson setting up mist nets to sample bats at Dog Lake in Yosemite National Park. Photo: William Rainey.

Dixie loved the Sierra Nevada parks and wilderness, and worked at minimal cost to learn as much as she could about bats and their habitat needs and share her knowledge and enthusiasm about these amazing flying mammals with others. Her work will remain an important body of knowledge for park managers.

Field Season 2014 Highlights

Wetlands Monitoring Off to a Successful Start

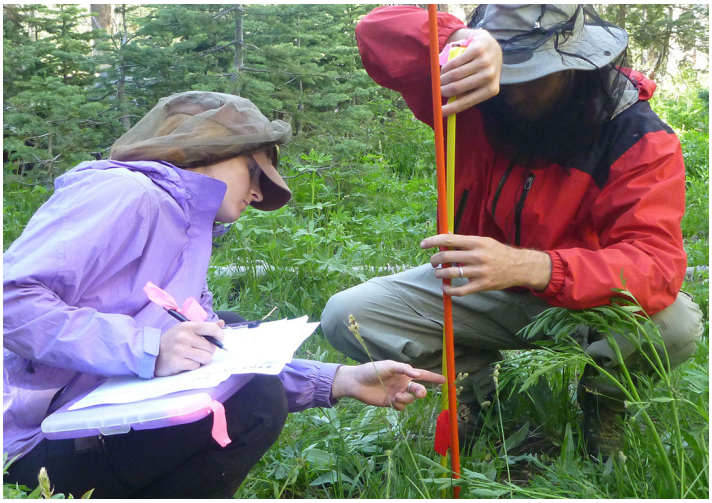
This summer was the inaugural field season for the wetlands ecological integrity monitoring project. The protocol was revised and submitted for peer review in January. The crew included: Corie Cann, crew lead, and Alexa Armstrong, who installed and sampled the first set of 11 sites in Sequoia and Kings Canyon National Parks (SEKI), as well as a previously installed index site at Devils Postpile National Monument. The project monitors wetland plant communities, groundwater levels, and macroinvertebrates, 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 map.

During the initial year of sampling in SEKI, the crew installed 17 groundwater monitoring wells, collected 400 vascular plant vouchers from 152 different plant species, and sorted hundreds of macroinvertebrates, which will be identified by subject matter experts over the winter. These data will provide an accurate assessment of the current condition of wetlands in the parks and will – over time – lead to a better understanding of their ecological functions and environmental drivers.

Birds

The Institute for Bird Populations (IBP) and Sierra Nevada Network (SIEN) staff successfully finished a fourth season of monitoring bird distribution and abundance in SIEN parks. Returning for his third year, IBP staff Tyler Stuart led IBP crew members Sarah Hendrickson, Liz Bartholomew, Jared Taylor, and Maria Goller in identifying bird species by sight and sound along 26 transects in Sequoia & Kings Canyon, 27 transects in Yosemite, and at 40 stations in Devils Postpile. A member of the IBP bird crew at North Coast and Cascades Network, Maria arrived in July to pinch hit for Jared, whose knee would not make it through the season. Support by several other IBP staff (Program Manager, Project Lead, and three other staff) was critical to accomplishing the season's monitoring objectives. As part of a planned rotation cycle, SIEN bird monitoring will take a one-year hiatus in 2015 and resume in 2016. In 2015, IBP will be conducting analyses and synthesizing data from the SIEN's first four years of monitoring.

Contact: Alice Chung-MacCoubrey



Alexa Armstrong and Jonny Nesmith examining peat depth in one of the wetland monitoring plots near Cahoon Gap in Sequoia National Park. Photo by Alice Chung-MacCoubrey.

High-elevation Forests

2014 was the third season of plot installations for the high elevation white pine monitoring protocol. A four person crew (Sarah Hoff – lead, Sean Auclair, Roxanne Kessler, Brie Permar) installed nine whitebark plots in Yosemite, and 10 whitebark plots and 10 foxtail plots is Sequoia & Kings Canyon (SEKI). Re- visits will begin on the first set of monitoring sites in 2015. In addition, a USGS crew will collaborate with SIEN staff to continue re-measuring permanent plots installed in SEKI in the 1990s to assess the current status of white pine blister rust – a disease caused by a non-native pathogen – in all white pine species found in SEKI.

Contact: Jonny Nesmith

Rivers

The Rivers protocol was resubmitted after addressing peer-review comments and we anticipate an approved protocol later this winter. In the meantime, SIEN has been dipping its toes into implementation and increasing support of hydrologic monitoring at the three SIEN-supported gages: Middle Fork of the San Joaquin in Devils Postpile (DEPO), Tuolumne River at Tioga Bridge, and Lyell Fork of the Tuolumne below Maclure. DEPO staff collected streamflow measurements on the San Joaquin through the summer and will continue monthly measurements through February when USGS takes over to capture late winter and spring runoff flows. SIEN and Yosemite Wilderness staff are working on a wilderness minimum requirement analysis aimed at improving data quality at the Lyell Fork gage so we can detect hydrologic changes and preserve wilderness character. Yosemite staff are incorporating SIEN protocols into their field work and data management procedures for the Tioga Bridge and Lyell Fork stations in anticipation of fully transitioning to SIEN protocols in the next year.

Contact: Andi Heard

...continued on page 7

Bats: Underappreciated and Misunderstood

Bats suffer from a bad public image in much of the world; misconceptions and superstitions about them are numerous. They are considered symbols of doom and darkness, close associates of Count Dracula, and various parts of their anatomies are considered magical ingredients in witches brews. . .

--Michael J. Harvey, J. Scott Altenbach, and Troy L. Best, *Bats of the United States*

Almost all of the bats in the United States, and 70 percent of bat species worldwide, feed almost exclusively on insects. Bats are the only major predators of night-flying insects. Bats typically consume one-third to one-half of their body weight in insects each night. As an example, Mexican free-tailed bats (which occur in the Sierra Nevada) consume large quantities of several moth species whose larvae are known agricultural pests (e.g. corn earworm) and provide significant economic value in pest control services to the agriculture industry.

In some instances, bats pollinate flowers and scatter the seeds of plants. The guano bats deposit in caves and at other roost sites is rich in nutrients, and bats contribute significantly to the re-distribution and cycling of nutrients in their habitats. Despite the numerous benefits bats provide to natural environments as well as human communities and businesses such as agriculture and tourism, bats remain underappreciated and misunderstood in our society.

Bill Rainey setting up a bat detector to record bat calls. A solar panel charges the battery that powers the AnaBat detector, and bat calls are stored on a small memory card. Photo: Elizabeth Pierson.

Little brown bat (*Myotis lucifugus*). Photo by William Rainey.

Townsend's big-eared bat (*Corynorhinus townsendii).* Photo © J. Scott Altenbach.

One misconception about bats is that they are blind ('blind as a bat'). Although bats have relatively good eyesight, most depend on their echolocation system (or sonar) to navigate and capture insects in the dark. They emit pulses of very high-frequency sound. By listening to the echoes reflect back to them, they can detect objects in their path.

Another common misconception is that many bats are vampire bats, feeding on blood. Only three species of bats out of more than 900 worldwide are vampire bats, and these bats occur only in Central and South America. Depending on the species, they feed on the blood of mammals (with a preference for livestock) or birds. For more details about vampire bats, see http://mentalfloss.com/article/53128/11-bloody-facts-about-vampire-bats.

There is an impression that bats have a higher likelihood of carrying rabies than other animals. This impression occurs because when people do encounter bats they are more likely to be ones that are sick and behaving abnormally. Rabies occurs naturally in many wild animals, and a higher incidence of the disease is found in skunks and foxes than in bats. In the United States the rate of occurrence is so small, barely a fraction of a percent, that there is little danger to humans. While bat bites of humans are uncommon and rabies in humans resulting from such bites is rare, bats can harbor the rabies virus. Therefore, like most wild animals, they should either not be handled at all or handled with appropriate precautions.

In the Sierra Nevada Network parks, bat inventories conducted by Elizabeth Pierson and Bill Rainey documented 17 species of bats in Yosemite and in Sequoia & Kings Canyon, and 10 species in Devils Postpile.

National parks will likely play an increasingly important role in sustaining bat populations as pressures on lands outside of parks (such as urban expansion) reduce habitat or increase mortality. This study used

Bats

-continued from page 4

geographic range, habitat specificity, and population size to assess species status. Species with narrow ranges and low population sizes are likely to be at highest risk from local or regional stressors. Understanding the habitat needs of bats in parks will assist managers in mitigating potential effects of climate change, altered fire regimes, habitat fragmentation, and non-native disease on bat populations.

The disease called white-nose syndrome (WNS) emerged in bats in New York in 2007 and has spread throughout much of the eastern U.S. and as far west as Oklahoma. Should this disease arrive in California, it will be important to understand more about bat hibernation sites (or hibernacula). WNS is caused by a cold-loving fungus that can thrive in the cool, damp conditions that often characterize caves and other types of hibernacula. The fungus infects the skin and membranes of bats, likely causing death by increasing the frequency of arousal during hibernation, damaging wing membranes, and disrupting critical physiological functions.

Over one million bats are estimated to have died from this syndrome, and one of the most common North American species, the little brown bat, is projected to disappear from the eastern region within 16 years.

Sequoia & Kings Canyon National Parks received funding from a National Park Service (NPS) program targeting research to better inform managers about the potential impacts of WNS in national parks. Surveys are underway to locate and characterize winter hibernacula sites and estimate how many individuals of different bat species use these sites.

As we gain more information about bat biology and habitat requirements, the NPS and other organizations can better consider the needs of bats when conducting activities that may affect them (e.g., hazard tree management, cave management, prescribed fire, bridge maintenance, and historic structure restoration).

Pallid bat (*Antrozous pallidus*) catching a June beetle. Photo © J. Scott Altenbach.

Field Season 2014 Highlights

-continued from page 5

Laura Walkup and Dannique Aalbu preparing to collect mid-lake samples in Yosemite National Park. Photo: Eric Smith.

Lakes

The lakes project completed its seventh field season this year. Crews sampled water chemistry, recorded lake temperature profiles, and conducted shoreline amphibian surveys at 25 lakes throughout Sequoia & Kings Canyon and Yosemite national parks. We sampled panels 1 and 3 this summer, which is one of our more challenging years from a lake access and hiking perspective. Dannique Aalbu and Laura Walkup, our Yosemite crew, met the challenge and had an amazing season sampling all the Yosemite sites plus traveled south for two tours to help capture lakes in Sequoia & Kings Canyon.

Tressa Gibbard and Sarah Hendrickson, our Sequoia & Kings Canyon crew, also had a fantastic season, overcoming logistical challenges after Sarah was out injured from back issues following the first tour. Thanks to Tressa's flexibility, Sarah's stellar office support, and field assistance from the network's wetlands project and the parks' Resources Management and Science staff we stayed on track and completed sampling. Crews tested new water safety procedures this year, which we will be incorporating into our lakes protocol this winter and implementing next field season.

Contact: Andi Heard

Field Crews Have Productive Seasons

The Sierra Nevada Network field crews are critical to our program. Their dedication and exceptional work hiking to remote monitoring sites and conducting work safely and with attention to collecting good quality data makes it possible for us have a long-term monitoring program in these wilderness parks. We include a few photos to acknowledge our field crews and their hard work. It was not possible to show all crew members, but this year's crew members are named in the project summaries on pages 5 and 7.

Corie Cann (left) and Alexa Armstrong (right), wetlands crew members, Tyndall area, Sequoia National Park. NPS photos by Alexa Armstrong and Corie Cann.

Sarah Hoff, forest crew lead, taking a compass reading at a high-elevation forest monitoring plot. NPS photo.

Laura Walkup (left) and Tressa Gibbard (above), lake monitoring crew members. NPS photos by Dannique Aalbu and Andi Heard.

Tyler Stuart, bird monitoring crew lead, Milestone Basin, Sequoia National Park. Photo: Jessica Watkins.

Sarah Hendrickson filters water samples. Photo: Tressa Gibbard.

Forest crew members Brianne Permar, Sean Auclair, and Roxanne Kessler look toward next plot. Photo: Sarah Hoff.

Alexa Armstrong sweepnets for wetland invertebrates in the Dusy Basin area of Kings Canyon NP. Photo: Corie Cann.

Laura Walkup (left) samples water chemistry at Tenaya Lake in Yosemitei NP. Photo: Dannique Aalbu.

Bird crew member (right) hikes through a recently burned forest in Yosemite NP. Photo: Tyler Stuart.

Devils Postpile Plant Inventory to be Published

The first phase of the Sierra Nevada Network Inventory & Monitoring program was to conduct high-priority biological inventories. One of those inventories was a vascular plant survey in Devils Postpile National Monument. Melanie Arnett (Environmental Careers Organization) conducted the field surveys, and Sequoia & Kings Canyon NP Plant Ecologist Sylvia Haultain planned and supervised the project. Through a combination of broad and targeted search strategies, the survey yielded a 121 percent increase (from 169 to 373) in the number of documented plant taxa, representing 60 families and 199 distinct genera. Arnett found three rare and eight non-native taxa previously unknown from the monument and documented nine potential range extensions. The inventory results are soon to be published as:

Arnett, M., A.M. Huber, K.M. Stevenson, and S. Haultain. *In press*. Vascular flora of Devils Postpile National Monument, Madera County, California. Madroño.

Penstemon and Indian paintbrush in Devils Postpile National Monument. Photo: Melanie Arnett.

Climate Change Exposure of National Parks

Winter in Giant Forest, Sequoia National Park. Photo: Jennie Skancke.

Climate change is occurring at especially rapid rates in some areas of the U.S. In national parks, climate change challenges the ability of park managers to preserve natural and cultural resources. To understand the "climate change exposure" of national parks—that is, the magnitude and direction of ongoing changes in climate—Bill Monahan (NPS Inventory & Monitoring Division) and Nicholas Fisichelli (NPS Climate Change Response Program) investigated how recent climates compare to historical conditions. This recently published research (Monahan & Fisichelli 2014) resulted in information on climate change exposure for 289 national parks. Monahan and Fisichelli produced two-page resource briefs summarizing their results for individual national parks, and the following three briefs are available for the Sierra Nevada Network parks:

- Recent climate change exposure of Devils Postpile National Monument
- Recent climate change exposure of Sequoia & Kings Canyon National Parks
- Recent climate change exposure of Yosemite National Park

Recent Reports and Publications

Heard, A.M., J.O. Sickman, N.L. Rose, D.M. Bennett, D.M. Lucero, J.M. Melack, and J.H. Curtis. 2014. 20th Century Atmospheric Deposition and Acidificationn Trends in Lakes of the Sierra Nevada, California, USA. Environmental Science and Technology 48: 10054–10061.

Nesmith, J. C. B. 2014. Sierra Nevada Network high elevation white pine monitoring: 2013 annual report. Natural Resource Data Series NPS/SIEN/NRDS—2014/678. National Park Service, Fort Collins, Colorado.

Resource Briefs

High-elevation Forest Monitoring: 2013

Bird Monitoring in Sierra Nevada Network Parks (overview)