RIVERS MONITORING

IMPORTANCE — The Sierra Nevada Network (SIEN) parks contain the headwaters and large portions of seven major Sierra Nevada watersheds—the Tuolumne, Merced, San Joaquin, Kings, Kaweah, Kern and Tule (Figure 1). The distribution and movement of water and its interactions with the surrounding environment, or hydrology, will be monitored in a subset of major rivers to better understand how water dynamics change seasonally and over long time periods. Water in the Sierra Nevada influences plant and animal distributions as well as providing a large percentage of the state's water supply. The effects of climate change on streamflow, water storage in snowpack and lakes, and evapotranspiration rates will undoubtedly have a profound impact on natural systems within SIEN park units and on the water infrastructure that supplies communities and agriculture across California.

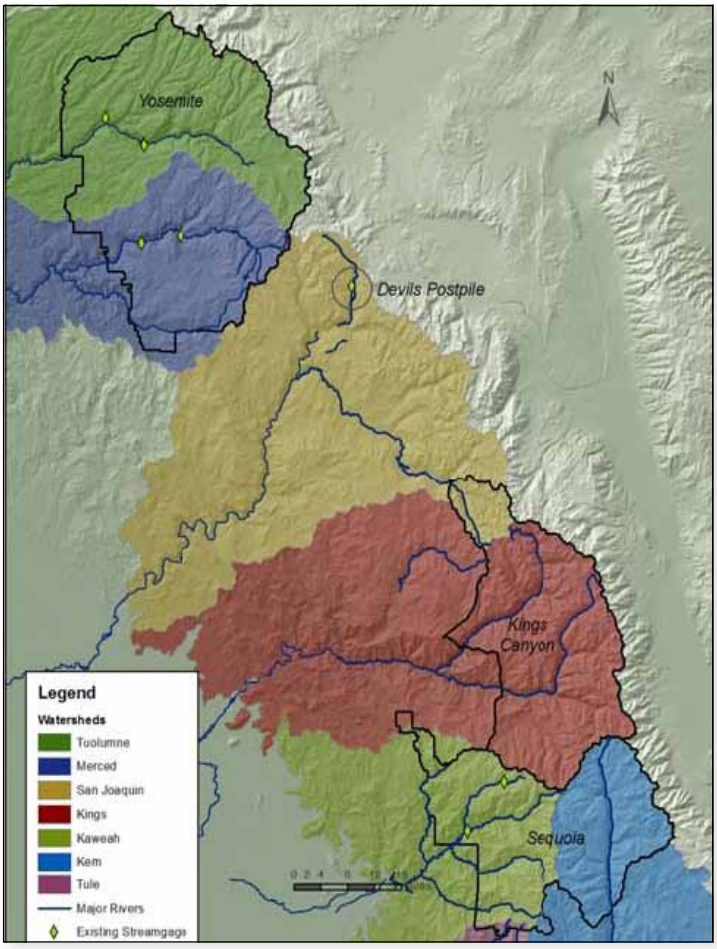

Figure 1. The main SIEN watersheds. Extant streamgages shown are operated by USGS, San Francisco Water or Southern California Edison. Additional streamgages, not shown here, are operated throughout the parks by researchers; in many cases, the continued operation of these gages is based on grant funding and is not ensured.

EXISTING AND PLANNED MONITORING

Hydrologic monitoring in the SIEN is primarily conducted through a network of streamflow gages that continuously measure discharge, the volume of water passing a given point, and snow courses and snow pillows, which measure snow depth and volume. Streamgages in the parks are operated by a number of organizations including the USGS, academic researchers, utility and irrigation districts, and hydroelectric companies. The streamgages currently in operation are not well distributed across the elevation gradient in the parks and in many cases their long-term operation is not assured. The SIEN is developing a rivers monitoring protocol with the following goals:

- Detect long term trends in timing and volume of streamflow using fixed, continuous, water stage recording stations at multiple elevations in selected major watersheds of the SIEN.
- Determine status and detect long-term trends in water chemistry at selected locations in Sierra Nevada Network rivers.

TRENDS IN HYDROLOGY

Surface water and groundwater, air temperature, precipitation, and snowpack in the Sierra Nevada are intricately linked. Peak snow runoff usually occurs from mid-May to early June. Annual peak discharge usually occurs during spring runoff, though it can occur during other times of the year when big rainstorms occur (Figure 2).

In the Sierra Nevada, most of the annual precipitation falls in the form of snow above 5900 feet in elevation which accounts for 86% of the total area of Yosemite and Devils Postpile and 91% of Sequoia and Kings Canyon.

What is the Sierra Nevada Network?

The Sierra Nevada Network (SIEN) is a collaborative Inventory & Monitoring program among Devils Postpile National Monument (DEPO), Sequoia and Kings Canyon National Parks (SEKI), and Yosemite National Park (YOSE).

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Snowpack in the Sierra Nevada acts as a natural reservoir, storing water that is released during the drier spring and summer months to feed wetlands and other natural systems within the parks and communities and agriculture throughout California. Changes in the timing of snowmelt and a shift to more rain and less snow, in part due to human -induced climate change, have been documented and are expected to continue.

A recent status and trends analysis of SIEN hydrology examined data from 20 streamflow gaging stations (Figure 3, example gage) and 68 snow courses with records of 25 to 94 years within and near the SIEN parks. The report found that there were no trends in the mean annual discharge – the total volume of water per year - at any of the gages. However, the following weak but consistent trends were observed:

- Less of the total annual discharge is occurring between April and July, the time of year when most of the snowmelt runoff has historically occurred.
- The number of calendar days to snowmelt onset and the date when half of the total annual discharge has been observed (center of mass) are occurring earlier in the year, indicating an earlier snowmelt, in watersheds on the west slope of the Sierra Nevada.

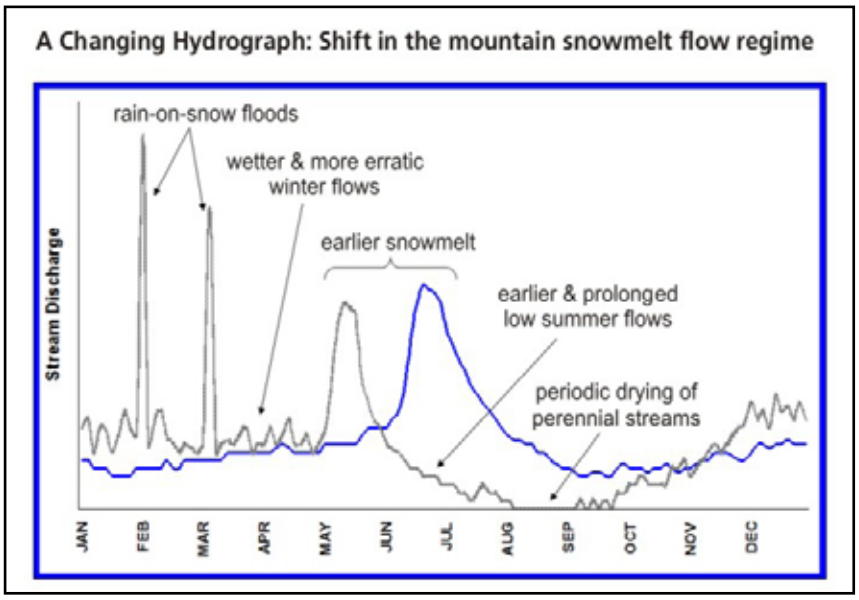

Figure 2. Developing and anticipated changes to water resources in the Sierra Nevada. Adapted from David Herbst, Sierra Nevada Aquatic Research Lab.

DISCUSSION

The most pronounced observed and anticipated effects of climate changes are earlier snowmelt runoff due to rising temperatures, a lower snowpack volume at mid-elevations, and greater climatic variability and extremes (Figure 2). These changes will likely have profound effects on ecosystems within the parks and national forest lands as well as effects on communities throughout California.

Figure 3. Stream gage at USGS Hydrologic Benchmark monitoring site along the Marble Fork of the Kaweah River, Sequoia National Park. Photo by Kevin Skeen.

Some consequences may include:

- forced releases from reservoirs or flooding during the winter, particularly when a significant amount of the precipitation falls as rain rather than snow and when rain falls on an accumulated snowpack
- shifts in ecology, such as earlier drying of wetlands and meadows, due to decreased or early delivery of water from the snowpack

Changes in precipitation type and timing will result in longer and drier summers with less water available during the months it is most needed. Water quality and aquatic life will likely be threatened by increased flooding and erosion and lower summer flows. Streamflow data, including the volume of water in the parks' rivers and streams, can help park and water managers to better understand and predict the timing of the delivery of snow runoff as well as the effects of climate change.

WHERE MONITORED:

Devils Postpile National Monument, Sequoia National Park, and Yosemite National Park.

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Webpage where more information is available: http://science.nature.nps.gov/im/units/sien/monitoring/Rivers/Rivers.cfm