Calif.'s Sierra a 'living lab' for climate change

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In this Aug. 7, 1903 photo from the U.S. Geological Survey is Lyell Glacier in Yosemite National Park. In parts of California's Sierra Nevada, the incursion of trees is sucking marshy meadows dry. Glaciers are melting into mere ice fields. Wildflowers are blooming earlier. And the optimal temperature zone for Giant Sequoias is predicted to rise several thousand feet higher, leaving existing trees at risk of dying over the next 100 years. As the climate warms, scientists studying one of the largest swaths of wilderness in the Continental U.S. are noting changes across national parks, national forests and 3.7 million acres of federally protected wilderness areas that are a living laboratory. (AP Photo/U.S. Geological Survey, G.K. Gilbert)

In parts of California's Sierra Nevada, marshy meadows are going dry, wildflowers are blooming earlier and glaciers are melting into ice fields.

Scientists also are predicting the optimal temperature zone for giant

sequoias will rise hundreds and hundreds of feet (meters), leaving trees at risk of dying over the next 100 years.

As indicators point toward a warming climate, scientists across 4 million acres (1.62 million hectares) of federally protected land are noting changes affecting everything from the massive trees that can grow to more than two-dozen (7.3 meters) across to the tiny, hamsterlike pika. But what the changes mean and whether humans should do anything to intervene are sources of disagreement among land managers.

"That's the tricky part of the debate: If humans are causing warming, does that obligate us under the laws of the National Park Service to try to counteract those effects?" said Nate Stephenson, a research ecologist with the U.S. Geological Survey.

"How do you adapt to a changing climate if you're a national park?" added Stephenson, who is 30 years into a study of trees in the largest wilderness in the continental U.S., Sequoia-Kings Canyon National Park.

Since 1895, the average temperature across California has increased by 1.7 degrees Fahrenheit (1 degree Celsius), and experts say the most visible effects of that warming occur within the Sierra Nevada, where low temperatures are rising and precipitation increasingly falls as rain rather than snow. Some models show noncoastal California warming by 2.7 degrees (1.5 Celsius) between 2000 and 2050, one of many reasons President Barack Obama pledged last week to use executive powers to cut carbon pollution.

The state's two largest rivers—the Sacramento and San Joaquin—originate in the Sierra. The range also is home to Lake Tahoe, the largest alpine lake in North America; Mount Whitney, the highest peak in the Lower 48; and America's only groves of giant sequoias, the largest living things on earth.

There are mounting concerns about the beloved sequoias, whose sprawling, 10-foot-(three-meter)deep root systems make them especially vulnerable to drought and heat.

Because the trees exist only in such a small region, scientists are debating whether to irrigate the 65 groves in the southern Sierra to help them endure warmer temperatures. Otherwise they fear the trees could die. During the last warm, dry period 4,000 to 10,000 years ago, their numbers were greatly diminished, according to pollen evidence collected by researchers at Northern Arizona University.

"Whether we would water them certainly comes up on our climate change scenario planning," said Koren Nydick, science coordinator at Sequoia-Kings Canyon National Park. "They are a very unusual species because they're also looked on as a social artifact."

In this Sept. 5, 2004 photo provided by Hassan Basagic is Lyell Glacier in Yosemite National Park. In parts of California's Sierra Nevada, the incursion of trees is sucking marshy meadows dry. Glaciers are melting into mere ice fields. Wildflowers are blooming earlier. And the optimal temperature zone for Giant Sequoias is predicted to rise several thousand feet higher, leaving existing trees at risk of dying over the next 100 years. As the climate warms, scientists studying one of the largest swaths of wilderness in the Continental U.S. are noting changes across national parks, national forests and 3.7 million acres of

federally protected wilderness areas that are a living laboratory. (AP Photo/Hassan Basagic)

Stephenson says his decades of studying conifers in Sequoia National Forest have shown they are dying at twice their historic rate, partly because the climate is warmer and dryer. The giant sequoias grow much more slowly than conifers over many hundreds of years so changes have been tougher to recognize, though researchers suspect seedlings already may be having a harder time taking root.

"That's always the million-dollar question," said Stephenson, director of USGS's Sierra Nevada Global Change Research Program. "We just don't have a big enough sample size to know what's going on with the giant sequoias, whereas we monitor thousands of pines and firs and have much more confidence."

So far, the dozens of changes researchers have noted, in everything from earlier songbird fledging dates to greater wildfire intensity, may point to a warming climate. But it's far from understood whether that would mean doom or adaptation for California's ecological heart.

"I don't want to say that because we're seeing one thing, that's how it will play out," said Rob Klinger who is studying alpine mammals for the USGS's Western Ecological Research Center. "The endgame of our study is determining whether there will be uniform change or will it be patchwork. If you look at evolutionary time scales, species have gone through these changes before, and they handle it."

As part of a Ph.D. project at the University of California, Merced, Kaitlin Lubetkin for five summers has hiked the backcountry taking inventory of 350 subalpine meadows formed when glaciers retreated

eons ago. The marshy ground acts as a reservoir that eases flooding after snow melts, and the stored water feeds streams during dry months and sustains wildlife such as the endangered willow flycatcher songbird and the Yosemite toad, which is being considered for threatened species status.

Over the past decade of warmer, drier conditions, however, pine trees have begun to take root, acting like straws to pull the moisture out of the meadows, Klinger and Lubetkin have observed.

"Pretty much right up to the tree line you're getting encroachment in every meadow," said Lubetkin.

In September, Hassan Basagic of the Glaciers of the American West Project will be hiking to 12,000 feet (3,657 meters) elevation to measure the Lyell Glacier in Yosemite National Park and monitor the changes he first began observing in the early 2000s. Scientists from Yosemite National Park and the University of Colorado recently noted that the glacier is no longer moving—and is melting—by using measurements they've made over the past four years, as well as some of Basagic's earlier work.

Basagic's used photos from the 1930s to show that in the early 2000s the rate at which the Sierra's glaciers were receding picked up.

"A lot of people call glaciers the 'canary in the coal mine.' They're an indicator that the alpine climate is changing," said Basagic, who monitors glacial changes for Portland State University research projects. "With that change, other things will change, like the plants and animals that depend on certain climatic conditions."

Already the American pika, a cold-loving rodent, is moving to higher elevations, and a U.S. Fish and Wildlife Service report says, "Climate

change is a potential threat to the long-term survival."

The USGS's Klinger, however, said pikas might be more resilient than the wildlife service predicts. "It doesn't hibernate and it has dealt with expanding and contracting snow packs and changing temperatures—and yet it persists," Klinger said.

If the trends continue, some species are expected to adapt by finding more hospitable environments, scientists say. One potential place is Devil's Postpile National Monument in the eastern Sierra, where 40 data collection devices are showing that temperature inversions caused by atmospheric pressure are filling the region of steep canyons with colder air.

Scientists are studying whether other areas with similar features might serve as refuges for some species. They're looking at establishing seed banks in the 800-acre (324-hectare) park where several climatic regions overlap and more than 400 plants, 100 birds and 35 animals coexist.

"We have an incredible living laboratory to understand what's happening with this cold air pool," said monument Superintendent Deanna Dulen. "We're really trying to get a good baseline of knowledge so we can look at the changes over time. We have the potential to be a refuge, but also to be a place of increased vulnerability. There's so much to learn."