In Yosemite, a New, High-Tech Tool for Mapping Changing Vegetation Patterns

Researchers stitch years of data into model that simulates how climate influences the kind of plants growing in the park's Tuolumne Meadows

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Summary:

-- A new model simulates how climate impacts vegetation patterns in Yosemite National Park's Tuolumne Meadows.

-- As climate change threatens to reduce snowpack in the Sierra Nevada mountains, the next step is to use the model to predict how changes, such as falling groundwater levels, might impact the kind of plants growing in mountain meadows.

BUFFALO, N.Y. -- Researchers from three universities have partnered to create a new, high-tech tool for mapping changing plant patterns at Tuolumne Meadows, a mountain meadow in Yosemite National Park.

The tool is a model that stitches together years of data from the study area, including meteorological observations, stream gage measurements, water levels at 55 wells, and vegetation surveys that the National Park Service conducted at 222 locations.

By combining these and other factors, the model successfully simulated how past groundwater levels influenced the type of plants growing in the meadow.

A paper describing the new model, which generates "probabilistic vegetation maps," was published online in the journal Water Resources Research on Sept. 24.

The next step is to use the model to predict how future climate change could affect vegetation patterns, and to test the effectiveness of potential, future restoration strategies.

"Our work confirms what John Muir wrote back in 1911 about his journey through Yosemite, which is, 'When we try to pick out anything by itself, we find it hitched to everything else in the universe,'" said Chris Lowry, the University at Buffalo geologist who led the study.

"Our results showed that the distribution of vegetation in Tuolumne Meadows is controlled by cascading hydrologic flows, starting with rain and snow and moving through the watershed to the meadow and finally discharging to the stream," Lowry said. "Each of these elements -- climate, hillslope, riparian zone and stream -- contributes to the distribution of water within Tuolumne Meadows.
and as a result controls the type of vegetation within the meadow."

Lowry's partners on the project included Steven Loheide II of the University of Wisconsin-Madison, and Courtney Moore and Jessica Lundquist of the University of Washington at Seattle. The research is part of a larger study on mountain meadow restoration in a changing climate that the University of Wisconsin and University of Washington are heading. A National Science Foundation grant supports that work.

The reason groundwater levels are so important in determining meadow vegetation patterns is because different plants have evolved to flourish in different environments. Where the water table is low, drought-tolerant species dominate because of their superior skills in acquiring and conserving water. Where the water table is high, in contrast, plants that flourish are those whose internal machinery enables them to survive under wet conditions. These include species that have developed something called an "aerenchyma" -- a spongy tissue that allows for exchange of gases between root and shoot, enabling a plant's roots to "breathe" even when limited air is directly available.

With climate change threatening to reduce snowpack and encourage earlier melting in the Sierra Nevada, groundwater levels at Tuolumne Meadows and other parts of Yosemite could rise or fall enough to influence vegetation patterns.

In the face of such changes, predictive modeling could "save time and financial resources by identifying both meadows that will be most affected by climate change, as well as restoration techniques most suitable to maintain or enhance ecological function," Lowry and his colleagues wrote in their paper.

The University at Buffalo is a premier research-intensive public university, a flagship institution in the State University of New York system and its largest and most comprehensive campus. UB's more than 28,000 students pursue their academic interests through more than 300 undergraduate, graduate and professional degree programs. Founded in 1846, the University at Buffalo is a member of the Association of American Universities.