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# Impact of warming climate doesn't always translate to streamflow

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An analysis of 35 headwater basins in the United States and Canada found that the impact of warmer air temperatures on streamflow rates was less than expected in many locations, suggesting that some ecosystems may be resilient to certain aspects of climate change.

The study was just published in a special issue of the journal *BioScience*, in which the Long-Term Ecological Research (LTER) network of 26 sites around the country funded by the National Science Foundation is featured.

Lead author Julia Jones, an Oregon State University geoscientist, said that air temperatures increased significantly at 17 of the 19 sites that had 20- to 60-year climate records, but streamflow changes correlated with temperature changes in only seven of those study sites. In fact, water flow decreased only at sites with winter snow and ice, and there was less impact in warmer, more arid ecosystems.

"It appears that ecosystems may have some capacity for resilience and adapt to changing conditions," said Jones, a professor in OSU's College of Earth, Ocean, and Atmospheric Sciences. "Various ecosystem processes may contribute to that resilience. In Pacific Northwest forests, for example, one hypothesis is that trees control the stomatal openings on their leaves and adjust their water use in response to the amount of water in the soil.

"So when presented with warmer and drier conditions, trees in the

Pacific Northwest appear to use less water and therefore the impact on streamflow is reduced," she added. "In other parts of the country, forest regrowth after past logging and hurricanes thus far has a more definitive signal in streamflow reduction than have warming temperatures."

LTER sites were established to investigate ecological processes over long temporal and broad spatial scales throughout North America, including the H.J. Andrews Experimental Forest in Oregon, as well as sites in Alaska, New Mexico, Minnesota, New Hampshire, Georgia, Puerto Rico, Antarctica and the island of Moorea. Not all were part of the BioScience study.

In that study, warming temperatures at some of the headwater basins analyzed have indeed resulted in reduced streamflow due to higher transpiration and evaporation to the atmosphere. But these changes may be difficult to perceive, Jones said, given other influences on streamflow, including municipal and agricultural water usage, forest management, wildfire, hurricanes, and natural climate cycles.

"When you look at an individual watershed over a short period of time, it is difficult to disentangle the natural and human-induced variations," Jones said, "because hydrologic systems can be quite complex. But when you look at dozens of systems over several decades, you can begin to gauge the impact of changing vegetation, climate cycles and climate trends.

"That is the beauty of these long-term research sites," she said. "They can provide nuanced insights that are crucial to effective management of water supplies in a changing world."

Jones said the important message in the research is that the impacts of climate change are not simple and straightforward. Through continuing study of how ecosystems adapt to changing conditions, resource managers may be able to adapt policies or mimic natural processes that offer the most favorable conditions for humans and ecosystems to thrive.

Provided by Oregon State University

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