WATER SECURITY IN THE WEST

A science briefing on water for people and nature

Fresh water security is one of the most important and pressing issues facing the Nation today. Drought and changes in snowpack, runoff, and recharge threaten water supplies for millions of people, especially in the West. Short-term fixes can lead to long-term declines in water supply and environmental changes that exacerbate drought conditions, harm the ecosystems upon which people depend, and intensify the risks of other hazards like wildfire.[1] Planning, investing in infrastructure, and incorporating nature-based solutions can help sustain and increase the supply of water for people and nature.

Hydrologic Change

The amount of available freshwater and the way it moves through watersheds in the American West is fundamentally changing. Already-arid regions like the Southwest face increasingly persistent water shortages. Decreases in precipitation, changes in how it falls (as rain versus snow), and shifts in when and where it runs off are already affecting water availability for people and nature.

Key Terms

Hydrologic change affects the amount, timing, and distribution of available freshwater.

Drought is a prolonged period of water shortage driven by factors such as rainfall, temperature, or water usage in excess of available supply.

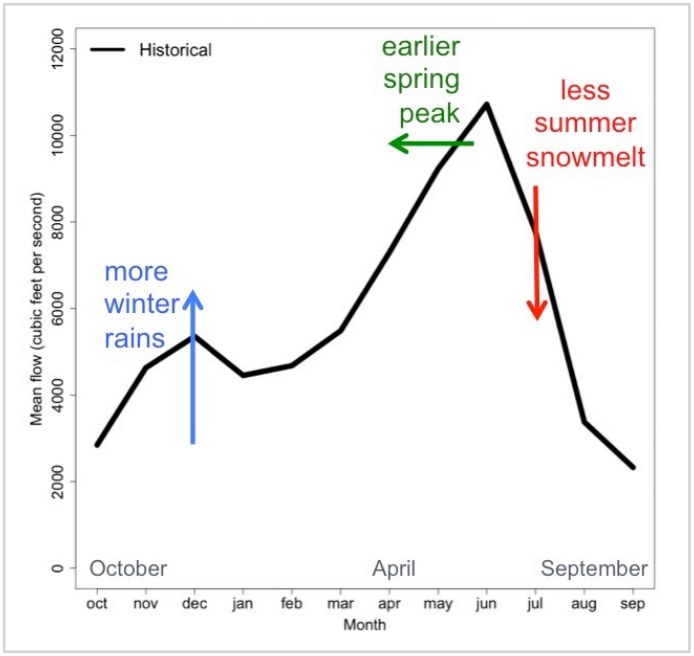
Megadrought is an extensive, persistent, multi-decadal drought.

Ecological drought is a type of drought that drives ecosystem change, impacts ecosystem services, and triggers feedbacks in natural and human systems.

These hydrologic changes have implications for how we manage water resources. Our water infrastructure and institutions (for example, the size and operation of dams) were created around expectations of water flows and timing that are no longer accurate. The combined threats of drought and hydrologic change present new challenges for policy and management.[2] Scientific insights can shed light on these vulnerabilities and inform adaptive planning and policies to sustain water resources into the future.

Case Study: Yakima River, WA

The Yakima River basin in central Washington State relies on a reservoir system to supply irrigation water to over 450,000 acres in an agriculturally-important region. In a typical year, winter snowpack in the mountains melts and flows into reservoirs in spring and summer. Hydrologic change is expected to lead to more winter rain as opposed to snow, earlier spring snowmelt, and reduced summer flows, meaning prolonged water shortages in the coming years.[3] Our ability to predict hydrologic change and assess drought risk provides important information for resource planning and infrastructure investment decisions.



Hydrologic change will likely mean more winter rain, earlier spring snowmelt, and reduced summer flows.

Water for People

Despite popular belief, social science shows that when faced with a water crisis, people tend toward compromise and collaboration. Research on the relationship between people and water reveals how networks of governments and organizations are adapting to hydrologic change. The negotiation of a large-scale water agreement in the Klamath Basin in Oregon and California has been accompanied by a shift in the community's ability to respond quickly and effectively to surprises such as water scarcity, changes in water distribution, and conflict among multiple water uses.[4]

Water for Nature

21st century droughts are hotter, longer, and exacerbated by human water use. Ecosystems are increasingly vulnerable to drought-driven risks, like tree mortality, increased wildfire risks, and abrupt changes in ecosystems that impact the benefits nature provides to people. Drought-related impacts on nature can ripple through human communities that depend on ecosystems for goods and services. Research, management, and policy perspectives could better evaluate the high costs of drought to both people and nature. Understanding how the ecological impacts of drought has consequences for people can help us better incorporate the benefits of healthy ecosystems into decisions.

Federal agencies and legislation relevant to water resource management in the West

Water law and federal water projects in the West were developed under past hydrologic conditions, but there are opportunities to adapt.

- U.S. Army Corps of Engineers (USACE) builds major dams and manages reservoirs.
- U.S. Bureau of Reclamation (USBR) has hundreds of water projects in seventeen western states.
- 1992 Drought Relief Act authorized drought planning and various short-term measures to mitigate drought impacts on water uses.
- 2009 SECURE water act established the USBR Climate Change and Water Program.

Solutions for People *and* Nature

Ecosystems provide critical benefits to humans, including increased water storage through groundwater recharge and enhanced resilience to water-related risks such as drought and flood.[5] When we manage water with both people and nature in mind, we can develop solutions that deliver a range of benefits like municipal water supplies, hydropower, habitat protection, irrigation, and recreational opportunities.

For example, agricultural groundwater banking is a promising approach that uses surface water to recharge groundwater aquifers in the winter. Alfalfa, almonds, and pecans can be good crops for groundwater recharge if grown on suitable soils.[6] Developing strategies that target recharge of groundwater can be beneficial to both food production systems and the environment more broadly.

Integrated water resource planning, which often includes nature-based solutions, focuses on meeting human water needs and supplying water for healthy ecosystems. Federal policy makers, water utilities, agricultural and industrial water users, and environmental restoration projects can co-develop mutually beneficial solutions. These solutions for people and nature can reduce drought-related risks and maintain water supplies while protecting and restoring ecosystems.

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SELECTED REFERENCES

[1] Breshears, D.D., Knapp, A.K., Law, D. J., et al. 2016. Rangeland Responses to Predicted Increases in Drought Extremity. *Rangelands,* 38(4), 191-196.

The likelihood of more extreme drought and greater precipitation variability presents challenges for managing rangelands. Different types of plant communities (trees, shrubs, and grasses) have different sensitivities to drought, with trees likely being most sensitive. Rangeland management can adapt to consider new interrelated risks, such as drought-driven changes in vegetation on the landscape, increased wildfire severity, and longer fire seasons.

[2] Benson, R.D. 2012. Federal Water Law and the "Double Whammy": How the Bureau of Reclamation can help the West Adapt to Drought and Climate Change. *Ecology Law Quarterly*, 39, 1047-1080.

The dual threat of drought and climate change presents a significant challenge for federal policy and management. The U.S. Bureau of Reclamation (USBR) plays a key role in managing water resources in the West, with hundreds of water projects in seventeen western states that provide a range of benefits, including irrigation, hydropower, reservoir recreation, and municipal water supply. The 2009 SECURE Water Act and 1992 Drought Relief Act offer some flexibility for federal management to help reduce the impacts of future water shortages.

[3] Elsner, M.M., Cuo, L., Voison, N., et al. 2010. Implications of 21st century climate change for the hydrology of Washington State. *Climatic Change*, 102, 225-260.

The Pacific Northwest is particularly sensitive to hydrologic change because snowmelt over spring and summer is a key source of available water, and temperature changes impact the snow/rain balance. Projected changes in the timing and amounts of snow, runoff, and streamflows indicate a fundamental transformation of the hydrology in Washington State. Shifts in seasonal streamflow toward higher winter flow and lower summer flow have serious implications for water management in these regions.

[4] Chaffin, B.C., Garmestani, A.A., Gosnell, H., Craig, R.K. 2016. Institutional networks and adaptive water governance in the Klamath River Basin, USA. *Environmental Science & Policy*, 57, 112-121.

Research on the human dimensions of water reveals how networks of governments, organizations, and individuals are adapting to hydrologic change. The negotiation of a large-scale agreement to address complex water issues in the Klamath Basin has been accompanied by collaboration and a shift in decision-making. This change improves communities' ability to respond quickly and effectively to surprises such as such as water scarcity, changes in water distribution, and conflict among multiple water uses.

[5] Scott, C., Tiessen, H., Meza, F., et al. 2013. Water Security and Adaptive Management in the Arid Americas. *Annals of the Association of American Geographers*, 103(2), 280-289. Special issue on Geographies of Water.

Water security is "the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies." In arid regions of the western U.S., water security can be strengthened by developing water solutions for people and nature, recognizing hydrologic changes, and using adaptive management (interactive planning that accounts for uncertainties, initiates responses, and iteratively assesses outcomes).

[6] O.Geen, A.T., Saal, M.B.B., Dahlke, H., et al. 2015. Soil suitability index identifies potential areas for groundwater banking on agricultural lands. *California Agriculture*, 69(2), 75-84.

When surface water is available, groundwater can be recharged by deliberately flooding an open area, allowing water to percolate into an aquifer. The suitability for groundwater recharge on agricultural land in California has been assessed with data on soils, topography, and crop type. 3.6 million acres of agricultural land statewide have excellent or good potential for groundwater recharge. The suitability index provides preliminary guidance about the locations where groundwater recharge on agricultural land is likely to be feasible. A variety of institutional, infrastructure, and other issues must also be addressed before this practice can be implemented widely.