Elevating Freshwater Ecosystems in 30x30

Ted Grantham, Lucy Andrews, and Jessie Moravek
University of California, Berkeley
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Freshwater ecosystems play a unique and important role in supporting the health and vitality of California's communities. Freshwater ecosystems also sustain species of significant economic, recreational, and cultural value. At the same time, these ecosystems are uniquely threatened. At least 90% of the state's wetlands have been lost and over 100 freshwater-dependent plants and animals, including most of California's iconic salmon species, are at risk of extinction. This is a direct result of the extraordinary pressures that people have placed on California's freshwater resources. Dams and diversions impact nearly all of the state's rivers to satisfy water demands, limit flood risk, and generate electricity. Land-use practices, including forestry, agriculture, and urbanization, also degrade freshwater ecosystems and affect the quality and quantity of water in the state's rivers, streams, lakes, meadows, and wetlands. The impairment of California's freshwater ecosystems not only places native freshwater species at a higher risk of extinction compared to their terrestrial counterparts, it also threatens the valuable ecosystem services and cultural resources that freshwater ecosystems provide—including clean water supplies for communities, industry, and agriculture; sustainable sources of food and fiber; and climate resilience benefits. Moreover, impacts to freshwater ecosystems limit recreational opportunities and the ability of Californians to enjoy the state's public trust resources.

Elevating freshwater conservation principles in 30x30 will substantially enhance the state's ability to address climate change risks, protect and restore biodiversity, and ensure equitable access to nature for all Californians. Freshwater is essential for protecting terrestrial ecosystems and the failure to consider the unique needs of freshwater ecosystems will limit the effectiveness of 30x30 in achieving its ambitious goals. Fortunately, the strategies needed for freshwater ecosystem conservation are consistent with—and would increase the effectiveness of—traditional, area-based approaches to land conservation.

An integrated approach to terrestrial-freshwater conservation under 30x30 will require planning and implementation at the watershed scale. Particular attention should be given to the connectivity of freshwater ecosystems, especially the maintenance of river corridors essential to fish and wildlife movement and that also serve as climate refugia for native species. River connectivity should be enhanced by removing unsafe and non-functional dams and barriers, reconnecting rivers to their floodplains, and restoring groundwater-surface water interactions.

Effective conservation of freshwater ecosystems will require active, adaptive management. Because many of the state's rivers, lakes, and wetlands have been degraded, restoration is needed before they can be considered conserved. Restoration strategies should focus on the recovery of ecosystem processes that dynamically create and sustain habitat for native species and support ecosystem services. For example, the protection of environmental flows—the natural variability of flowing water required to sustain the health and services of rivers—is particularly important for maintaining vital ecological functions and will necessitate changes in dam operations and limits on water withdrawals. Sustained effort to protect cold-water sources, limit pollution, and control the spread of invasive aquatic species will also be required to protect freshwater ecosystems.

Strategies for conserving freshwater ecosystems should balance human and ecosystem needs and be informed by, and tailored to, community preferences. The goals of conservation actions should also vary

across the state in response to local and regional histories and conditions. In less developed watersheds, strategies should prioritize biodiversity conservation and source water protection. In urbanized watersheds, freshwater conservation should prioritize actions to limit pollution, "naturalize" engineered channels, improve public access, and strengthen connections between people, freshwater, and nature. The revitalization of urban waterways in particular has the potential to deliver multiple benefits and offers an opportunity to redress historical inequities in land and water use policies that have harmed marginalized communities. In all watersheds, conservation programs should be oriented towards the enhancement of public access and partnerships with Indigenous communities to guide management of ancestral lands and waters. All watershed conservation programs should partner with California Indian Tribes at the local and statewide level to ensure that they are given opportunities to meaningfully inform strategies for planning, implementation, and monitoring.

How do freshwater ecosystems contribute to California's 30x30 goals?

Improved management and conservation of freshwater ecosystems will support the objectives of California's 30x30 initiative to: (1) safeguard economic sustainability and food security; (2) protect and restore biodiversity; (3) enable enduring conservation programs across a variety of landscapes, including working landscapes; (4) build climate change resilience; and (5) expand equitable outdoor access and recreation.

Freshwater ecosystems are the source of drinking water for most communities in California and provide water that supports many economically important activities, including fisheries, agriculture, and manufacturing. Furthermore, they are an important source of both economic investment and accessible and culturally meaningful food and fiber, especially for California's Indian Tribes, as well as disadvantaged communities. California's freshwater ecosystems support a disproportionately high diversity of native plant and animal species, many of which are not found outside the state.

Rivers, lakes, and wetlands are a primary draw for Californians seeking to access nature in both urban and rural environments, including working landscapes. Freshwater ecosystems support unique recreational opportunities such as boating, swimming, hiking, and fishing that also sustain the economies of many rural communities. Many green spaces in cities are centered around rivers and streams, providing critical access to nature for urban populations.

Finally, freshwater ecosystems are key to achieving California's climate change goals by contributing to clean energy generation and carbon sequestration. For example, it is estimated that meadows and freshwater wetlands can store six times as much carbon as California forests, per unit area. Freshwater ecosystems also enhance climate resilience by buffering the effects of extreme climate events such as flooding and heat waves, by contributing to groundwater recharge, and by maintaining habitats for fish and wildlife that are less vulnerable to climate change than those found in other ecosystems.

What strategies should be used to conserve freshwater ecosystems under 30x30?

To account for the unique threats and conservation needs of freshwater ecosystems, we recommend the following strategies be implemented as part of the state's 30x30 framework:

- **Establish terrestrial-freshwater protected areas and management plans at the watershed scale.** Watersheds are naturally defined geographic units that include the river network and the landscape that it drains. Conservation planning at the watershed scale will help to ensure that actions can effectively address the stressors that threaten, and protect the natural processes that

support, freshwater ecosystem health and services. As areas of the landscape are identified for potential protection under 30x30, their relationships to watershed boundaries should be considered. Watershed planning units are expected to vary in size, depending on their location and jurisdictional boundaries. Watershed protected areas could be established in small urban catchments or could encompass the headwaters of large river systems. They are also likely to encompass a gradient of land-use practices, ownership, and protected-area status. Therefore, diverse conservation actions, including conservation easements, expansion of protected public lands, and development of regulations that limit harmful human activities within the watershed (in addition to the designation of Outstanding Natural Resource Waters) will be needed. Regardless of size, establishing protected area boundaries and management plans at the watershed scale offers the most effective approach for achieving conservation objectives for both terrestrial and freshwater ecosystems under 30x30.

- **Remove non-functional dams and restore connectivity of inland waters.** Freshwater connectivity is critical for maintaining freshwater ecosystem health and services. Connected river networks are corridors for the movement of fish, wildlife, sediment, and nutrients, as well as climate refugia for native species. The connectivity between rivers and the terrestrial landscape is also important, especially for floodplains and seasonal wetlands that provide productive feeding and breeding habitats for fish, migratory birds, and wildlife. Furthermore, restoring floodplains along rivers has been shown to reduce flood risk. Finally, there is growing recognition that connectivity of rivers and wetlands with groundwater sources is essential to ecosystem health. Actions to maintain and restore connectivity include the removal of dams and other barriers, many of which no longer serve their intended purpose and are a hazard to downstream communities. Efforts should also focus on reconnecting rivers to floodplains and riparian areas (through levee removal and setbacks and channel recontouring) and limiting groundwater withdrawals to restore groundwater-surface water interactions.

- **Protect, restore, and manage for environmental flows.** Streamflow in California's rivers varies naturally throughout the year and between years. Aquatic species have evolved to take advantage of this variability and, in fact, are often dependent on seasonally variable flows to survive and reproduce. The widespread alteration of river flows from dams and diversions is a primary driver of native freshwater fish declines. The protection of environmental flows—flows in rivers and streams necessary to sustain ecosystem health and services—is critical to reversing trends of ecosystem degradation and achieving ecosystem conservation benefits. There is growing recognition that a "functional flows approach" in which environmental flows are managed to sustain critical biological and physical process can improve the efficacy and success of freshwater conservation efforts. Maintaining functional flows in California's rivers will require dedicated water for the environment, physical habitat restoration, and changes in dam operations and water diversion practices.

- **Control invasive species and protect water quality.** Invasive species and water quality impairment are significant limiting factors to ecosystem health and services. Invasive species put California's native freshwater species at risk by altering physical habitat, by competing for food resources, and by direct predation. They can also threaten water infrastructure, fishing, and recreational activities. The presence of invasive species is often associated with water quality impairment. Elevated nutrients and pesticides from agricultural runoff, pharmaceuticals and chemical contaminants from wastewater and stormwater discharges, and elevated temperatures from flow depletion and climate warming all threaten the health of California's freshwater ecosystems. Sustained efforts are needed to restore and protect water quality and must address both point and non-point pollution sources. The protection of cold-water sources and vegetated riparian corridors to limit warming of inland waters will be critical to the persistence of cold-water

dependent species like salmon and also limit the risk of harmful algal blooms. To limit the establishment and spread of invasive species, restoration of functional flows and regulations that limit the risk of invasive species introductions by people should be advanced.

How should California evaluate and enhance freshwater protected areas under 30x30?

California has a large, existing protected area network. However, the effectiveness of this network in protecting freshwater ecosystems has not been systematically evaluated. In fact, many watersheds that have a high richness of native freshwater biodiversity and support valued ecosystem services are located outside of protected areas. Therefore, both improved management of existing protected areas and an expansion of protected lands to new areas are likely needed for freshwater ecosystem conservation under 30x30.

We recommend that the evaluation of existing protected areas consider current threats to freshwater ecosystem condition including: dams or other barriers that fragment stream networks and alter flow and temperature regimes; land-use activities and pollution sources that impair water quality; invasive species; and significant physical habitat modifications. In some cases, these threats will occur within protected areas and can be addressed through changes in management. In other cases, threats may occur upstream or downstream of protected area boundaries. Therefore, opportunities to expand and align protected areas with watershed boundaries should be pursued where possible.

Priorities for new protected areas will require development of decision-making criteria to evaluate the relative costs and benefits of alternative scenarios. For freshwater ecosystems, conservation priority areas should include hotspots of freshwater biodiversity and/or ecosystem services, watersheds that provide regional representation of species and habitats, and watersheds that are resilient to climate change. Priority areas for biodiversity conservation might include watersheds that support endemic or rare species with restricted ranges, contain threatened species or habitats, or represent the unique diversity of species and habitats found withing different regions of the state. Protected areas should target watersheds that are more resilient to climate change, conferred by their position in the landscape or heterogeneous environmental conditions that support a diversity of habitats and allow for the adaptive migration of species to new areas. Freshwater ecosystems that provide other climate resilience benefits, such as hotspots of carbon sequestration, flood risk mitigation, or cooling (especially in urban areas), should also be prioritized.

In addition to these guiding criteria, the evaluation, monitoring and management of protected areas under 30x30 should:

- **tailor conservation strategies to local and regional needs and histories**, with a particular focus on stakeholder collaboration and equity in representation, decision-making authority, and access to funding. In particular, 30x30 conservation planning offers an opportunity to redress histories of disinvestment, environmental injustice, and colonial land seizure by focusing resources and conservation benefits on marginalized communities and California's Indian Tribes;

- **enhance access to nature**, particularly for disadvantaged communities in urban areas and for Tribes seeking to reclaim sovereignty over their ancestral territories;

- **adopt an adaptive management framework** where robust monitoring and evaluation of program impacts on freshwater ecosystems iteratively and continuously inform future conservation actions;

- **secure adequate, reliable, and sustained funding** for ongoing monitoring, research, restoration, and adaptive management; and

- **build effective governance structures that have appropriate authority to implement and monitor conservation programs.** This will require interagency collaboration, broad public engagement, and robust decision-making processes to navigate diverse and competing interests among stakeholders.

What are successful models for multi-benefit freshwater conservation in California?

Successful freshwater ecosystem conservation and restoration programs that align with the principles presented in this document are being implemented in California across a diversity of hydrologic settings, ecosystems, land use types, and jurisdictions.

For example, watershed-scale protections addressing freshwater and terrestrial ecosystem needs have been established in the Lower Susan River, the San Juan Creek watershed, the Tahoe Basin, and the Mount Tamalpais watershed. Connectivity has been successfully restored through barrier removals projects on the Carmel River and in the Cleveland National Forest. The largest dam removal project in US history is being undertaken through the Klamath River Renewal Project, an effort that has explored the benefits and challenges of collaborative governance across an entire watershed. The Potter Valley Project on the Eel River is another large-scale dam removal project that is underway and has taken advantage of lessons learned from previous efforts. Environmental flows management and floodplain restoration are centerpieces of projects in the Cosumnes River and Yolo Bypass. The California Environmental Flows Framework is providing guidance for managers to plan and implement environmental flows in many different hydrologic and ecologic contexts across the state. Water quality management and equity in outdoor access are cornerstones of projects in the Sausal Creek watershed in Oakland and the Los Angeles River restoration.

Efforts to advance watershed and freshwater ecosystem conservation through 30x30 can draw on the successes and challenges of these projects to replicate what works and address shortcomings when planning new projects across the state. These existing programs can also be expanded to increase the scale of their impact and accelerate progress towards meeting 30x30 goals.

A Path Forward

To date, the state's 30x30 initiative has concentrated on discussions around land and ocean protections, with little explicit consideration of freshwater ecosystems. If these important ecosystems are overlooked, land-based conservation strategies will fail to protect the unique biodiversity and services that freshwater ecosystems support. To achieve the goals of 30x30, attention to freshwater ecosystems must be elevated in the development of conservation strategies. The recommendations presented here are already being implemented across the state in both rural and urban areas, illustrating that freshwater ecosystem conservation is not only possible, but also delivers significant benefits to people and nature. By building upon these efforts through strategic implementation of 30x30, the state can accelerate its progress in protecting biodiversity, combatting climate change, and enhancing the values that healthy ecosystems provide for all Californians.

For more information, please contact Ted Grantham (tgrantham@berkeley.edu)