

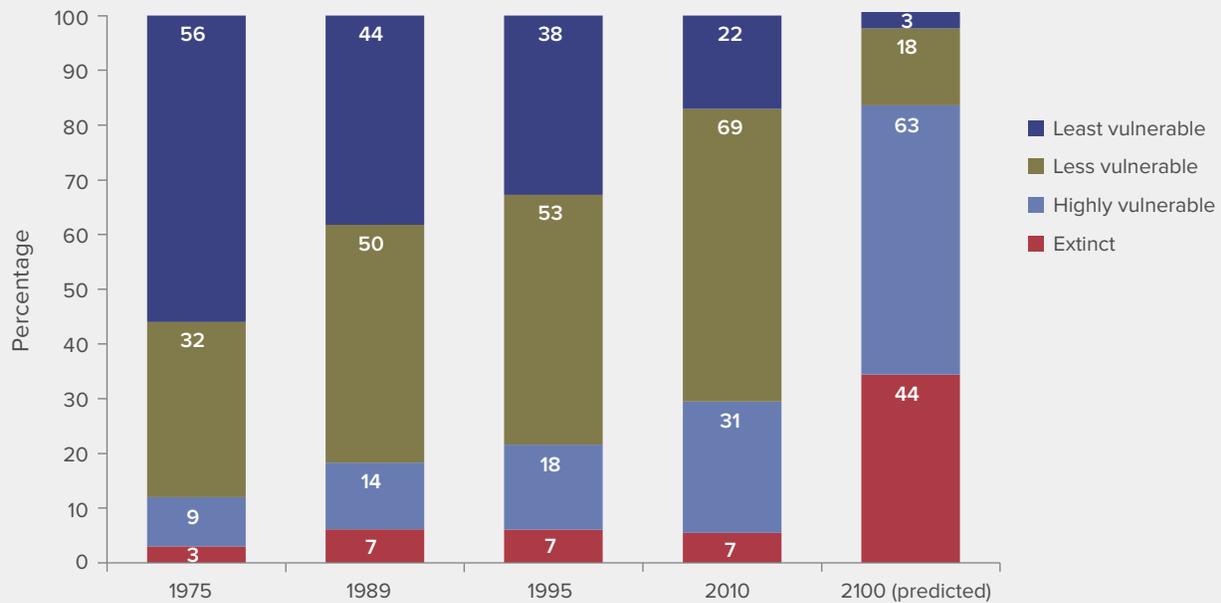
Water is vital for California’s diverse and troubled ecosystems

California’s diverse landscape and climate make it a biodiversity hot spot—home to more endemic plants and animals than any other state. It is also an important stop on the Pacific Flyway, providing habitat for millions of migratory birds. The state’s rivers, lakes, wetlands, and estuaries support this rich biodiversity.

Dramatic changes in water and land use since statehood in 1850 have transformed California’s freshwater landscape. Today, nearly 1,500 dams cut off most spawning habitat for salmon and steelhead. About 95 percent of the native vegetation that once lined Central Valley rivers and creeks has been eliminated, along with wetlands that hosted migratory waterfowl. Farms and cities use about half of the state’s available water, and they discharge harmful pollutants into waterways.

Four decades after the enactment of major state and federal environmental laws, California’s freshwater biodiversity remains at risk. Populations of native freshwater fishes—key indicators of aquatic ecosystem health—have dramatically declined. A quarter of these species are listed as threatened or endangered under state or federal endangered species acts, and many others are vulnerable. For both economic and social reasons, California must improve its stewardship of freshwater ecosystems. Climate change and population growth bring a great challenge: to strike a balance between improving ecosystem health and providing reliable water supplies, flood control, and hydropower.

CALIFORNIA’S NATIVE FRESHWATER FISHES ARE AT RISK



SOURCES: R. M. Quiñones and P. B. Moyle, "California's Freshwater Fishes: Status and Management," *FISHMED Fishes in Mediterranean Environments* (2015). P. B. Moyle, J. D. Kiernan, P. K. Crain, and R. M. Quiñones, "Climate Change Vulnerability of Native and Alien Freshwater Fishes of California: A Systematic Assessment Approach," *PLoS One* 8 (5) (2013), doi:10.1371/journal.pone.0063883.

NOTES: The figure shows freshwater native fish status based on field surveys. Bars display the number of species for which information for evaluation was available in the specified time period. Predicted status in 2100 assumes continuation of current trends, with added stress from climate change. Extinct means no longer found in California; highly vulnerable means high risk of extinction by 2100; less vulnerable means lower risk of extinction than the previous group; least vulnerable means very low risk of extinction.

Environmental water use is not well understood

Water the state counts as “environmental” serves a variety of purposes—including supporting freshwater ecosystems and maintaining water quality for farm and urban uses. Although most of it is not in direct competition with other uses, a growing amount goes toward protecting endangered species. This causes controversy because it can reduce water available for other purposes. A better understanding of environmental water use can inform future management decisions.

- **Water that stays in rivers, streams, and wetlands is assigned to the environment.**
There are four broad types of environmental water: water that flows in rivers protected as “wild and scenic” under federal and state laws, water needed to maintain aquatic habitat within streams, water that supports wetlands for migratory birds, and water needed to manage salinity and fish habitat in the Sacramento–San Joaquin Delta. On average, water categorized as environmental accounts for half of state use; farms (40%) and cities (10%) make up the other half. But the share of environmental water use varies widely, from 65 percent in the wettest years to 35 percent in the driest.
- **Most environmental water does not affect other uses.**
Half of all environmental water occurs in remote North Coast rivers, with little competition for use. In the rest of California, where water is shared by all three sectors, environmental water represents about 33 percent of all uses on average (versus 53% for farms and 14% for cities). In these regions, some water dedicated to the environment may limit water available for other uses.
- **Environmental water often achieves multiple benefits.**
Water quality and flow standards that protect fish and other species also maintain quality for human uses. This is especially true in the Delta, where freshwater outflows are required to maintain water quality for farms and cities as well as fish. Water that flows in wild and scenic rivers provides recreational opportunities. And in the Central Valley, downstream reservoirs then capture it for distribution to farms and cities.
- **Droughts heighten conflict over environmental water allocations.**
A common misperception is that the environment receives a disproportionate share of water during drought. Because the environment relies principally on surface water, it actually experiences larger reductions during droughts than farms and cities, which can often pump additional groundwater when rivers are low. In some places, this extra pumping further reduces streamflows and harms fish. Droughts also put pressure on regulators to relax environmental standards to boost supplies. In 2014 and 2015, for example, the state approved multiple requests to reduce environmental flows and relax salinity standards in the Delta to increase water exports for farms and cities.

California needs to use environmental water more efficiently

Although additional freshwater flows will likely be required to improve ecosystem conditions in some regions, new strategies to improve the efficiency and effectiveness of environmental water management are also needed.

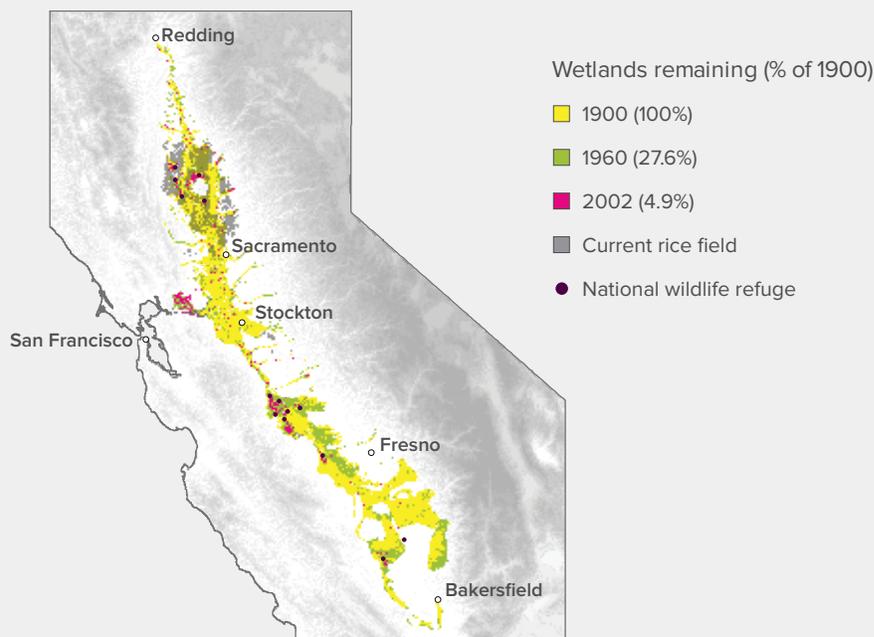
- **Reduced flows are not the only source of ecosystem stress.**
Habitat loss, water pollution, invasive species, and fishery and wildlife management practices also need to be addressed. It is not possible to undo all the ecological changes that have occurred over decades of human water and land use. Environmental managers and regulators need to find strategies that adapt to changing conditions.
- **Environmental water can get more “pop per drop.”**
Managing environmental water to mimic the variability of natural flows can produce significant ecosystem improvements, even with smaller flow volumes than would occur under natural conditions. Where and when water is used also matters. A little applied in the right place at the right time can go a long way, such as providing adequate flows and cool waters for salmon spawning, or expanding wetland acreage during bird migrations.
- **Restoring habitat requires water *and* land.**
Riparian zones, floodplains, and wetlands require periodic flooding to provide high-quality habitat. Changing the timing of releases from reservoirs and removing or setting back levees can accomplish this. Removing dams no longer useful for water supply, flood control, or hydropower can restore fish access to good upstream habitat.

A large dam was recently removed on the Carmel River, and four more are planned to come down on the Klamath River. Habitat restoration should focus on areas of significant value for fish and wildlife. For example, the North Delta Habitat Arc, extending from the Yolo Bypass to Suisun Marsh, may be the best place to conserve and recover several salmon runs and other endangered Delta fishes.

- **Farming can be wildlife friendly.**

Central Valley rice farms provide essential habitat for migratory waterfowl. Corn and alfalfa fields support many other types of birds. The Yolo Bypass creates habitat for birds and juvenile salmon, supports farming, and protects Sacramento from flooding. Throughout the region, farmers face economic pressure to shift to crops that have low habitat value but earn higher profits, such as fruits, nuts, and vegetables. Conservation easements, property tax reductions, and other financial incentives can help encourage farmers to practice wildlife-friendly land and water management.

CENTRAL VALLEY RICE FIELDS AND MANAGED WETLANDS PROVIDE WILDLIFE HABITAT



SOURCE: Updated from E. Hanak et al., *Managing California's Water: From Conflict to Reconciliation* (PPIC, 2011), Figure 1.2.

NOTES: Wetlands in 1900 include yellow, green, and red areas; the 1960 wetlands include green and red areas. Rice field acreage is from 2014. Rice fields perform some seasonal wetland functions for migrating birds and terrestrial and riparian species such as the giant garter snake.

Looking ahead

California has a long-term economic and social interest in supporting native biodiversity in freshwater ecosystems. But new approaches are needed to make environmental water allocations more effective and resilient to a changing climate.

Develop environmental stewardship plans. Adapting to a warmer, more variable climate requires watershed-level planning for freshwater ecosystems. These plans should inform water supply and flood management decisions and identify actions to be taken in advance of droughts. Examples include water acquisitions, habitat restoration, and investments in environmental strongholds that can support species during dry and warm periods (such as streams fed by cold water springs). Plans should also identify actions to speed recovery after drought.

Give the environment a water budget. Current methods of allocating water to support ecosystem health rely on minimum flow standards that are unevenly enforced and often insufficient during drought. Ecosystem water budgets, which allocate a portion of water to the ecosystem within watersheds, could enable more flexible and effective environmental management. This approach creates new opportunities for partnerships with other water users and can help reduce conflict over scarce supplies.

Reform environmental permitting. Environmental restoration projects often require multiple (and sometimes conflicting) permits, which can limit incentives for participation and the amount of habitat restored. The Habitat Restoration and Enhancement Act of 2014 reduces permitting hurdles for private landowners seeking to improve habitat—a model worth expanding.

Promote projects with multiple benefits. Water can simultaneously provide benefits to people and nature. For example, wildlife-friendly farming can support ecosystems while maintaining the economic viability of farms. Cooperation on storing and releasing water from reservoirs can benefit fish and meet downstream users' needs. Investing in healthy watersheds can protect drinking water and provide recreational opportunities.

Improve accounting for environmental water. More timely, transparent tracking of water use and availability is key to reducing misunderstandings and conflict over the use of water for different environmental purposes.

Provide reliable funding for ecosystem stewardship. California has relied heavily on state general obligation bonds to support freshwater ecosystems. Although helpful, bond funding is short-lived and project-based. California needs a new approach to funding ecosystem management, such as a small surcharge on water use.

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