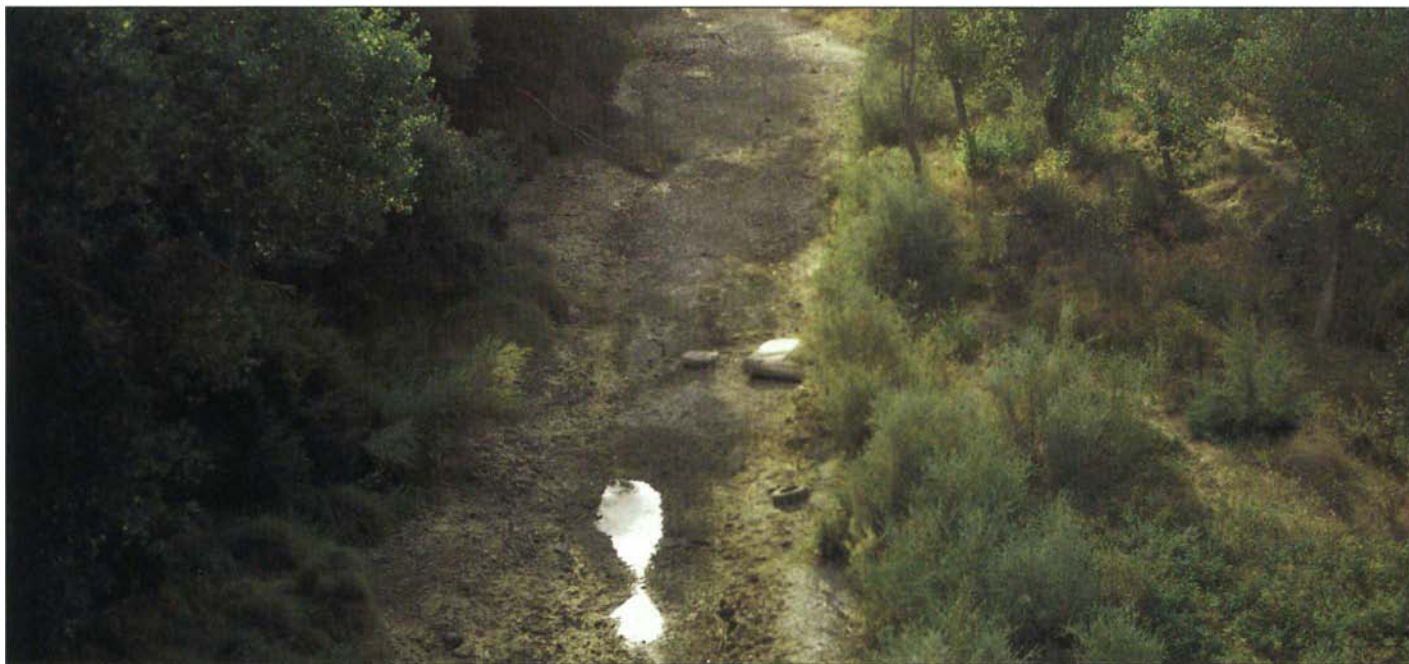


The case of Putah Creek . . .



As Putah Creek dried out during a recent drought, the people of Davis bought water to save the surviving fish.

Conflicting values complicate stream protection

Michael P. Marchetti □ Peter B. Moyle

Increasing human demands for water in California have led to a decline in the diversity and abundance of native aquatic organisms, including valuable salmon and steelhead. Declines worsen during drought years, a fact demonstrated in 1989 when lower Putah Creek dried out in the third year of the state's most recent drought. That year, the Putah Creek Council (a local environmental group), UC Davis and the City of Davis joined forces to purchase more water from the Solano Irrigation District, thereby saving the fish that had survived in a few isolated pools. Since then, these parties and numerous others have filed lawsuits to establish rights to the waters of Putah Creek. While legal questions about these water rights remain to be settled, the events surrounding Putah Creek

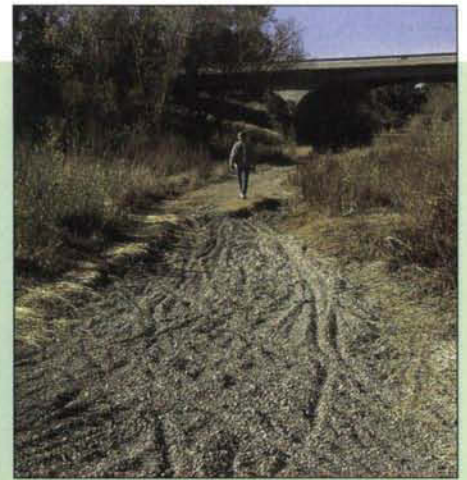
underscore the need for communities and irrigation districts to develop long-term water policies that recognize environmental needs in the context of California's frequent droughts. Such problem-solving will depend on balancing the conflicting value systems of different groups of water users.

Water is California's most limiting resource: Much of the state is semi-arid and 20% of the land receives less than 5 inches of rain per year. Paradoxically, the state uses nearly a quarter of the water delivered to consumers annually in the United States. Water is essential to the cities, farms and industries that make California prosperous; to the lakes and streams that make the natural environment so attractive to humans; and to the rich variety of endemic aquatic species.

An average of 60% of California's total available water (34 million acre-feet delivered yearly) comes from surface flow and 40% is taken from groundwater. In 1985 California allocated 80% of this developed water supply to agriculture, 16% to urban areas and only 2% to wildlife and recreation, according to the California Department of Water Resources.

Because water is a limiting resource in California, it is subject to intense competition among users and all too often seems to be in short supply. As early as the 1890s, San Joaquin Valley farmers wrangled over water, often guarding their ditches from each other with shotguns. Today, the natural environment receives much less water than it did before the agricultural industry developed.

This fact has contributed to the dramatic decline of California's native fish. Of the 113 native fish taxa — species, subspecies and distinct runs of



Watershed degradation is caused by human activities that alter stream channels and greatly reduce their ability to support fish.

The decline of sea-run fishes in California: An ongoing tragedy

Michael P. Marchetti □ Peter B. Moyle

California has the southernmost West Coast populations of sea-run or "anadromous" fish, which spawn in fresh water but spend part of their lives in the ocean. The 13 anadromous fish species native to California include chinook salmon, steelhead trout, river lamprey, white sturgeon and longfin smelt.

In California, pink salmon have gone extinct and most remaining fish are declining. At least 10 species seem to meet state criteria for threatened species (Moyle et al. 1996.) For example, chum salmon have been reduced to three tiny populations in Northern California, and coho salmon with probably less than 5,000 wild fish in scattered populations are being considered for listing as a federally threatened species. In addition, California is on the verge of losing a number of distinct runs of the more abundant species. For example, winter run chinook salmon in the Sacramento River are listed as an endangered species, while Sacramento spring run and late fall run chinook salmon are down to a few thousand fish. In Southern California, the southern steelhead has disappeared

from most of the now-urbanized streams that used to support it.

Not surprisingly, once valuable sport, commercial and Native American subsistence fisheries for these anadromous species have all but disappeared. While perhaps a million chinook salmon spawned in Central Valley streams at the turn of the century, by 1992 the spawning population was down to 128,000. Many of these chinook salmon were returnees to hatcheries and are genetically and behaviorally different from wild fish. Likewise, coho salmon have declined from about 400,000 in the 1940s to about 30,000 today, and only 5,000 are of wild origin.

Hatchery-raised fish were intended to keep wild populations from declining. But, arguably, hatcheries have made the problems worse for salmon and steelhead and done nothing for species that are not cultured.

The biggest causes of anadromous fish decline are dams, water diversions and watershed degradation. Dams and diversions block access to the spawning areas above them and change the quality of the water and habitat below

the dams. In the Central Valley, for example, salmon once had access to several thousand miles of spawning habitat; today they have access to less than 300 miles. Watershed degradation is caused by logging, agriculture, grazing, urbanization and other human activities that alter stream channels and greatly reduce their ability to support fish. When anadromous fish also face overfishing and natural disasters such as drought, their populations can plunge downward rapidly.

Restoration of California's anadromous fishes will require different strategies for each species and often for each run within each species. The key for most species, however, either lies in increasing water releases below dams or in restoring watersheds that support spawning streams. Because activities such as logging, mining, grazing and urbanization have degraded many spawning streams severely, restoration will require not only active restoration programs (such as watershed reforestation and removal of roads from riparian areas), but also changes in the way we presently behave in watersheds (e.g., logging and grazing practices).

For further reading

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anadromous fish — more than 70% are either extinct, listed as endangered or in serious decline (fig. 1). (Some of this decline is also due to introductions of exotic game and nongame fish.) The declining fish include all of the state's anadromous species (those which migrate from the sea to breed in fresh water) such as Chinook salmon, coho salmon and steelhead trout, which are important to fisheries (see sidebar, p. 74). Increasing numbers of California's fishes are being listed or proposed for listing as endangered, intensifying water conflicts and often pitting fishermen and environmentalists against farmers and urban water developers.

These disputes reflect how values shift in society, as communities re-evaluate the priorities they've assigned to water use. In some cases, society has favored allocating a greater share of California's water to environmental needs (see sidebar, p. 77). A case in point which has yet to be resolved is the dispute over the waters of lower Putah Creek, which flows through the UC Davis campus.

Putah Creek, a refuge

Putah Creek originates high in the Coast Range near Mt. Cobb in Lake County and winds its way east into Berryessa Reservoir. Lower Putah Creek (below Berryessa Reservoir) flows through approximately 30 miles of rich agricultural land in Yolo and Solano counties before terminating in the Yolo By-pass, a large flood-control channel that drains into the Sacramento River. While nearly every scrap of land around lower Putah Creek is



Above, as lower Putah Creek dried out, fish died in large numbers.

cultivated or urbanized, the creek itself has a thin border of cottonwoods, sycamores, willows and other riparian plants.

The creek and its riparian vegetation are a refuge for wildlife that is otherwise rare or declining in the region including the giant garter snake, the valley elderberry longhorn beetle, the northwestern pond turtle and Swainson's hawk. During the spring and fall, the bushes along the creek are rich with migrating warblers and sparrows. Wood ducks raise their broods in the large, shaded pools of the creek.

Putah Creek also contains a large number of fish species. While the majority of these are introduced game fish, the creek still supports remnants of the once-abundant Central Valley native fish. Both these stream fish and the anadromous fish that historically spawned in the creek were a source of food for the Patwin Indians who lived in the region prior to 1850 where the UC Davis campus now stands.

Putah Creek changed dramatically in 1948 when the Secretary of the Interior authorized plans for the Solano Project. The impetus for the Solano Project was that Solano County felt its prosperity rested on an adequate and dependable source of water. The project's goal was to provide water to the newly created Solano Irrigation District (SID), which supplies the rich agricultural lands, as well as the military, industrial and urban area of

Below, a bullhead struggles to survive in a diminishing pool of water.



Solano County. The project was also designed to provide a measure of flood control.

The Solano Project consists of two major parts: the main water-storage structures are Berryessa Reservoir and Monticello Dam, and the diversion structures that send water south to Fairfield and Vacaville (Solano Diversion Dam and the Putah South Canal).

Today water is collected behind Monticello Dam during the rainy season and is released down a 10-mile stretch of stream as needed to the Solano Diversion Dam. Water from the diversion dam is both transferred southward through the Putah South Canal and released downstream into lower Putah Creek according to a monthly schedule. The downstream release schedule is exactly the same

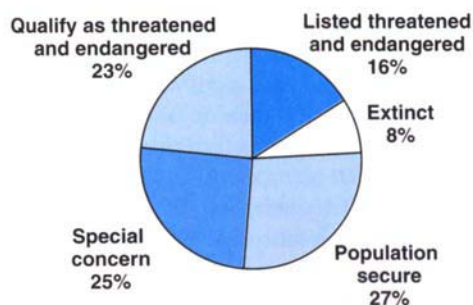


Fig. 1. Status of native fishes of California. Total number of native species = 113.

every year, except in years of low rainfall (and low inflow into Berryessa Reservoir) when releases are reduced. During most years, the amount of water allocated for the lower creek is only about 10% of the water diverted down the Putah South Canal—although during periods of high rainfall—spills over the diversion dam can increase the downstream flows.

In addition to having reduced flows as the result of the diversion, the amount of water in lower Putah Creek has been reduced by groundwater pumping in the region. The combination disrupted the creek's natural hydrologic cycle. Historically, during the hottest summer months the lowest reaches of the creek often lost surface flow and isolated pools formed. However, groundwater provided these pools with substantial cool-water recharge, thereby maintaining the integrity of the entire native stream community.

Unfortunately, the current hydrological regime allows portions of the creek to dry completely during drought years that formerly supported pools and short stretches of surface flow. Notably, in the summer of 1989, which was the third consecutive year of the latest drought, most of the water released by the Solano Irrigation District was removed by the pumps of streamside farmers or sank into the streambed, replenishing groundwater.

As lower Putah Creek dried out, fish died in large numbers. Herons and egrets congregated along the shrinking pools, feasting themselves on stranded fish. Later that summer, most of the creek dried up. Miles of dry channel were littered with the decaying bodies of fish, crayfish and tadpoles, while hardy catfish struggled to survive as isolated pools became smaller and smaller. Eventually only a few large, deep pools remained.

The fish in these large pools were saved when the Putah Creek Council, a local environmental group, joined UC Davis and the City of Davis to purchase more water for the creek from the Solano County water agency. The water purchased was just enough to keep the pools from drying out or stagnating to the point where the fish would die.

Conflict continues

The wrangling over lower Putah Creek's water continues to this day and epitomizes the people-versus-fish water-use conflicts throughout California.

Water disputes like that over Putah Creek and the seemingly intractable disagreements they pose are often the result of fundamentally different worldviews. Historically, many Californians have seen water largely as a resource to support mining, agriculture, urban development and other activities. This view is reflected in the names of California's principal water agencies: the Department of Water Resources and the Water Resources Control Board.

In this view, water is seen as a commodity to be bought and sold, and the emphasis is economic. For example, agriculture values water mainly for its role in producing crops to meet market demands and industry values water mainly for manufacturing and producing goods. The view of water as a commodity is implicit in terms such as "water rights" and "water uses." When water is thought of this way, certain conclusions follow: water should be used to produce the greatest gain for the greatest number of people; water can be bought, sold, moved and partitioned; and water can be used as currency.

While this monetary interpretation of water is not fundamentally wrong, a number of alternative viewpoints extend water's value beyond economic considerations. One of these views is that water has value for maintaining natural ecological processes. To fully appreciate this view, it is necessary to examine the role water plays in natural ecosystems, especially aquatic and riparian systems. Fish and other aquatic organisms obviously require water because that is where they live. But the issue is more complex than simply providing aquatic organisms with adequate amounts of water. Other aspects of water are also essential such as the quality of the water and the yearly pattern of flows.

For example, the flows of Central Valley streams are highly variable from year to year because the amount

of winter rain is irregular. However, in a given year the basic seasonal pattern of flow is fairly predictable: high flows occur in the late winter and early spring, and low flows occur in late summer and fall. The fish native to Central California evolved under these demanding hydrologic conditions and therefore are uniquely adapted to thrive there. These fish have fairly narrow spawning windows that are timed to the high flows created by rainfall or snowmelt. They also have fairly long lives so they can survive through dry years and spawn again during wet years.

When the flow regime is altered, especially when the spring flows needed for spawning are eliminated, the native fish tend to disappear and be replaced by fish such as carp and green sunfish that were introduced by humans for food or other reasons.

Besides being essential for aquatic organisms, water is necessary for riparian ecosystems. Water helps break down dead organic material, mediates the process of nutrient exchange in soils and is required for plant and animal growth. When most of the water is removed from aquatic and riparian ecosystems, they change dramatically and often disastrously. The evidence for this includes the dead riparian forests along streams in the Mono Basin from which the water was diverted, the sediment and erosion problems in the Trinity River watershed and the diminished fisheries of the Sacramento-San Joaquin estuary.

Water: alternative views

Water plays a vital role in California's environment. Community actions such as the 1989 purchase of water for drought-stricken Putah Creek indicate that some Californians now recognize the value of intact ecosystems. We rely on functional ecosystems for the continued health of our land, air and water, which in turn benefits human health and well-being.

A second alternative to viewing water as a commodity is to value streams and rivers for their educational potential. For example, lower Putah Creek is an important educational asset to UC

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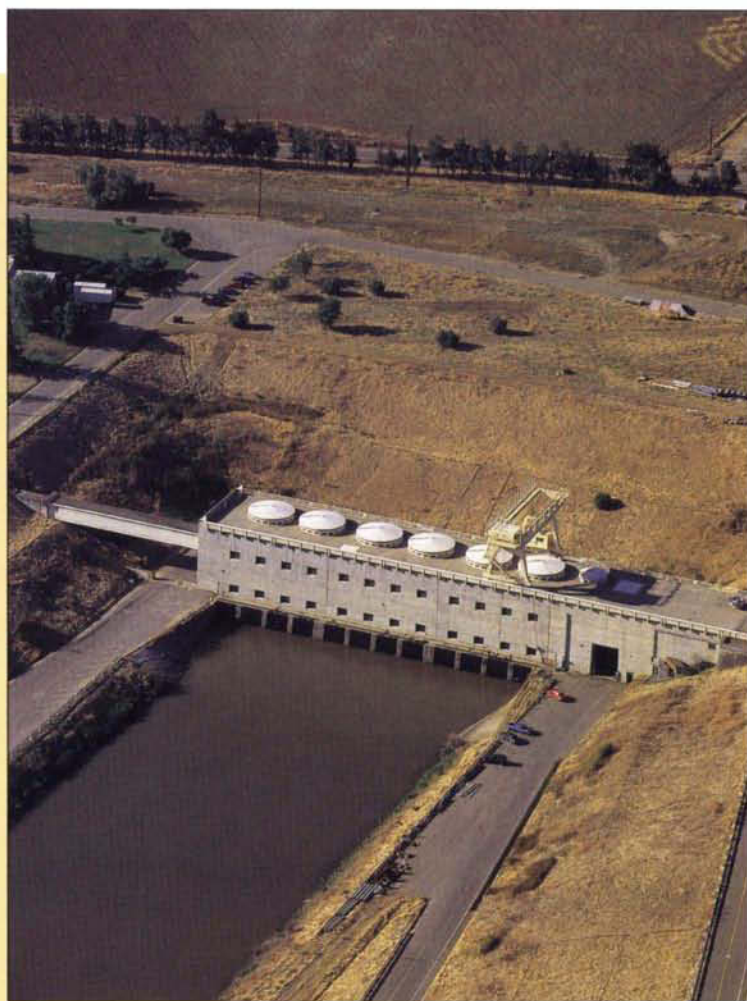
A truce in the water wars

Michael P. Marchetti □ Peter B. Moyle

The conflict over water diversions from the Sacramento-San Joaquin Delta has been one of the longest and most severe of California's water wars. This conflict developed in 1951 when the massive pumps of the federal Central Valley Project began pumping water from the south Delta to supply water to San Joaquin Valley farms. In 1962, the equally massive pumps of the State Water Project also began pumping water from the south Delta to both farms and urban areas in the southern half of the state. The pumping contributed to drastic changes in the Delta ecosystem. These changes caused practically every aquatic organism to decline in abundance. This decline was most noticeable in the catches of anglers fishing for the Delta's top predator, the striped bass. In 1989 the winter run chinook salmon was listed as a threatened species by the U.S. Fish and Wildlife Service. It is now listed as endangered by both state and federal governments. By 1992 the damage to the Delta was so great that the delta smelt, a species found nowhere else, was put on the federal list of threatened species. A number of other fish species such as longfin smelt, splittail and spring run chinook salmon are likely to be listed if their populations continue to decrease.

Recent disputes over diversions from the Delta led to an unprecedented agreement among state and federal agencies, water users, and environmental groups. Announced on

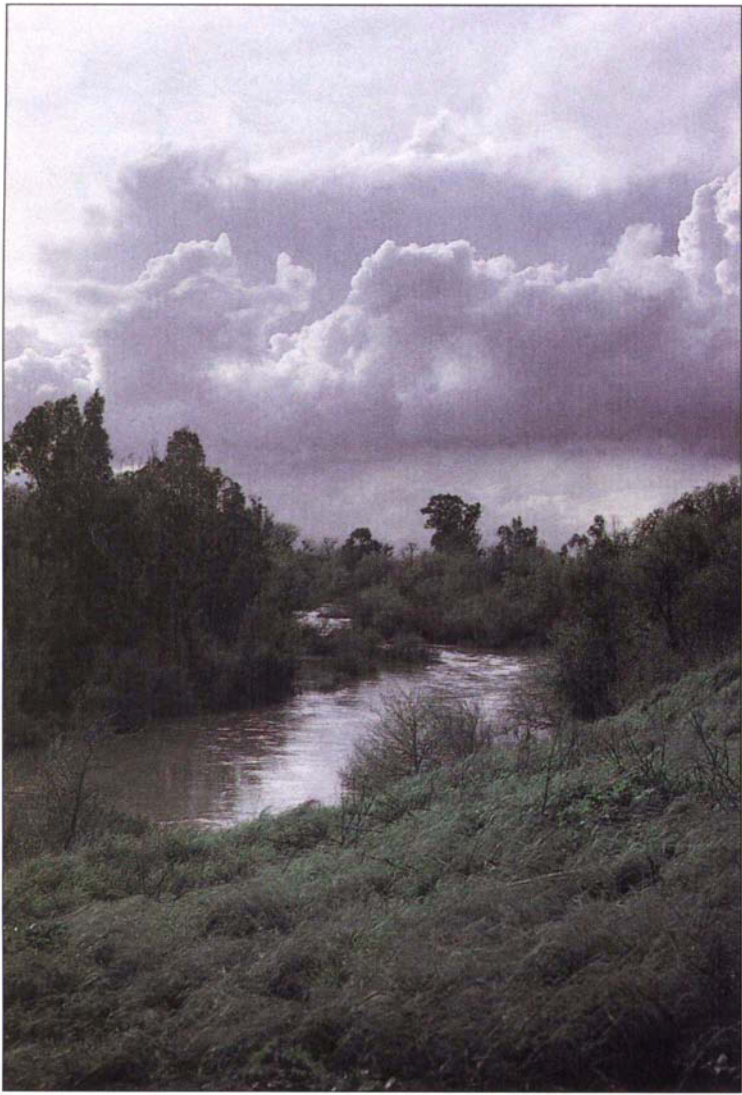
December 15, 1994, it signalled a 3-year truce in the water wars. The provisions of the agreement reflect the aims of the federal Endangered Species Act, and Clean Water Act, as well as the desire of water interests to have a predictable water supply. During the 3-year "truce," efforts will be made by all signatories, according to the agreement, to "provide ecosystem protection to the Bay-Delta estuary" and to "provide habitat protection sufficient for currently listed threatened and endangered species and to create conditions in the Bay-Delta Estuary that avoid the need for any additional listings in the next three years." In the interim, the agreement provides additional water for the estuary, especially during the critical periods (e.g., spring migration times of juvenile salmon) when young fish need to pass through the estuary to reach rearing areas in the middle estuary (Suisun Bay). Besides providing more water to the Delta, the agreement stipulates that the water users will give \$10 million per year for projects involving other ways of improving Delta habitats such as increasing the amount of shallow-water habitat for juvenile fishes. The total cost of these projects is estimated to be about



Upper left, the Sacramento-San Joaquin Delta has been the subject of long-running water wars. In 1962, massive pumps, above, began pumping water from the south Delta to farms and urban areas in the southern half of the state. (Photo by Jack Kelly Clark)

\$60 million per year. In exchange, the agreement gives the water users a guaranteed water supply. Thus, even if more Delta fish species are listed as endangered during the next three years, no additional water will be allocated to the Delta. Equally important to the water users, all of the federal water used for environmental protection will be credited against the 800,000 acre feet of water that the Central Valley Project Improvement Act allocates to fish and wildlife in the Central Valley.

If all goes as planned, the downward trend in Delta fish populations will be reversed and water users will be able to plan better for water use, even if they have less water to work with than they had in the past.



Streams and their surroundings are increasingly valued simply for their aesthetic qualities.

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Davis. Each year hundreds of students visit the creek on class field trips and to conduct research projects. UC Davis students from urban settings often receive their first introduction to wildlife along the banks of Putah Creek.

A third viewpoint is to value streams and rivers for their nonconsumptive recreation such as boating, swimming and wildlife viewing. Such activities are becoming increasingly popular. Recent U.S. Fish and Wildlife Service surveys have shown that adult Americans engage in nonconsumptive wildlife-related recreation twice as much as they participate in fishing and hunting. Maintaining Putah Creek

as a living stream was so important to the Putah Creek Council, the City of Davis and the University that they were willing to pay for the additional water to keep the creek and its inhabitants alive, even though this water would not directly generate income.

A fourth viewpoint is to value streams and rivers for aesthetic reasons. People can value a stream and its surroundings simply for its beauty and charm. In a 1993 survey by Times-Mirror Magazines, two-thirds of Americans indicated that environmental protection is more important than economic development. Aesthetic values of the environment are in-

creasingly of fundamental importance in the personal philosophies of many people.

Aesthetic values can include valuing qualities inherent to organisms and ecosystems as advocated by wildlife biologist Aldo Leopold. Some people express a profound respect for other creatures and intact watersheds, and they value encounters with native species and functioning ecosystems such as living creeks. They often want to have this experience available not only for themselves but for their children and grandchildren.

Contrasts in worldviews and conflicting values can block communication between parties involved in water disputes. At times, it appears that environmentalists and water resource advocates are speaking different lan-

guages. It is often as difficult for water resource advocates to be sympathetic to environmental concerns as it is for environmental advocates to appreciate the resource values of water. The dialogue breaks down and lawsuits result. For example, the fate of Putah Creek has been entangled in the legal system for close to 5 years. There is still no answer to the main question of how much water is needed downstream.

Resolving water conflicts like the Putah Creek dispute seems destined to be a protracted legal process. Whatever the specific outcome, if we as a society acknowledge the value of preserving natural environments, then we must develop better long-term policies for water allocation that take into account California's frequent droughts, which occur an average of 3 years in every 10.

Competition among water users will increase as population grows. The question of whether or not Putah Creek will survive and thrive as a living representative of our natural waters will have to be balanced with increasing public demands for more food, goods and space. In the end the solutions will come down to a question of balancing conflicting values.

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