



BY TOM FITZHUGH

Quenching

Urban Thirst: Cities and Their Effects on Freshwater Ecosystems



As we enter the twenty-first century, the management of water resources is emerging as one of humanity's most significant challenges. Population growth is projected to continue around the globe, with much of it occurring in urban

areas. Future urban water demands are likely to place increasing pressure on available water supplies, which will have serious implications not only for human welfare but also for the health of the world's freshwater ecosystems. To demonstrate the ecological degradation that could potentially result from future expansion of urban water supplies, the history of water resource development for five large US cities—Los Angeles, Phoenix, New York, San Antonio, and Atlanta—was assessed. The following case studies demonstrate the ecologic impacts of water development practices common in the twentieth century and also point the way toward a new paradigm for water manage-

ment that attains a better balance between human needs and ecosystem needs.

Los Angeles, Calif. Los Angeles' pursuit of water supplies during the twentieth century is a classic case of a growing urban area outstripping its local supplies and going outside its river basin to acquire more. After exhausting supplies from the Los Angeles River, the city moved to acquire additional water from the Owens Valley and then the Mono Basin, each located hundreds of miles northeast of the city. Additional supplies were also obtained from the Colorado River and the rivers of the Central Valley in California. Dams and other water supply infrastructure have had serious and widespread effects on each of these source areas. An example is in the Owens River Valley, where streamflows were substantially altered and three of the four native fish species have had major declines in their historical ranges and abundance. Only recently have conditions improved in the Owens River and Mono Lake because environmental litigation has led to restoration and reversal of some of the damage to these ecosystems.

Phoenix, Ariz. Water resources development in and around Phoenix during the second half of the twentieth century was driven

One of the great challenges of modern-day demands for water supply is balancing the human needs for water with ecosystem needs for water.

in great part by urban demands. Water supplies from irrigation dams built on the Salt River during the early twentieth century were transferred to municipal use starting in the 1950s. In the 1980s this water was supplemented by water from the Central Arizona Project, whose source is the Colorado River. Dams have had a profound effect on the Salt River ecosystem, with severe alteration of streamflows and riparian vegetation, and extirpation of almost all native fish species from a lengthy stretch of the river. The Colorado River, affected by water development in Los Angeles and Phoenix, has also experienced declines in native fish populations and in the health of its downstream estuary.

New York, N.Y. The water supply system for the city of New York extends more than 100 miles to the northwest of the city. After exhausting supplies in the nearby Croton River watershed, the city expanded its system first into the Catskill Mountains and then into the upper tributaries of the Delaware River, where four large reservoirs were constructed between 1937 and 1965. Ecological effects of this water supply infrastructure include alteration of streamflows and temperature conditions below the dams and reductions in the populations of American shad, mussels, and benthic invertebrates in the Delaware River.

San Antonio, Texas. San Antonio's sole source of water has historically been the Edwards Aquifer. Withdrawals from the aquifer tripled from



the early 1930s to the 1980s, with municipal water use accounting for more than half of current use. These increasing withdrawals have had substantial environmental consequences for the species that inhabit the aquifer, and there are currently eight federally endangered or threatened aquatic species for which a primary threat is loss of spring flow caused by groundwater pumping. To mitigate further damage to the ecosystem, in the early 1990s a limit was set on withdrawals from the aquifer, and a drought management plan was instituted to restrict water use when aquifer levels drop below critical thresholds.

Atlanta, Ga. The fast-growing metropolitan area of Atlanta depends on the nearby Chattahoochee and Etowah rivers for most of its water supplies. Projected population growth, however, has made it necessary to investigate building additional reservoirs and increasing withdrawals from existing sources. Initial plans to increase withdrawals from the Chattahoochee River, and also the Flint River were immediately controversial because of the potential effects of lower flows during drought periods on the downstream Apalachicola Bay estuary, which accounts for 90% of Florida's oyster production.

MAKING WATER MANAGEMENT ECOLOGICALLY SUSTAINABLE

A problem common to each of these case studies, and typical of many twentieth-century water development projects, is a lack of attention to the water needs of freshwater ecosystems. In order to better maintain the health of native freshwater ecosystems and the valuable ecosystem services that they provide, water management needs to attain a better balance between human needs for water and ecosystem needs for water. Recent developments in these five cities highlight at least two ways in which water management can be made more ecologically sustainable.

First, there are huge gains to be made in water productivity that can in turn reduce the stress on available water supplies and their source ecosystems. In recent decades, Los Angeles, New York, and San Antonio have all made great strides in implementing water conservation programs that reduce per capita water use. This increased productivity has helped New York maintain its water supply system without further expansion since 1965 and has made it possible for Los Angeles and San Antonio to deal with reductions in water supply that accompanied ecosystem restora-

tion in the Owens Valley and Mono Lake and better management of the Edwards Aquifer. Planning documents for Atlanta indicate that there is also huge potential there for more efficient water use.

Second, opportunities exist to store and extract water in less ecologically damaging ways than in the past. A proactive planning process that examines the economic and ecologic trade-offs among water conservation, options for increasing supply, and the integrity of freshwater and estuarine systems will lead to improved environmental performance. Even where water supply increases are needed, options are available to increase supply in less ecologically damaging ways than have been used in the past, such as

reallocating existing reservoir storage from other purposes, conjunctive use of groundwater and surface water, and off-channel storage facilities that do not block the natural flows of water, sediment, and nutrients on which freshwater ecosystems depend. Finally, it will be necessary at times to set limits on human alteration of river flows to protect ecosystems; this has been done in river basins in both South Africa and Australia. Within the constraints set by such limits, water conservation and water markets can still ensure that human water needs will be provided for appropriately.

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