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Robert Glennon, Water Follies: Groundwater Pumping and the Fate of America's Fresh Waters

Travis Keenan

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Gold Medal waters of the South Platte River. Denver Water previously constructed several other dams on the South Platte and its headwaters, including Cheesman Dam, built in 1905. The Two Forks Dam, which would back up the river for another twenty miles, would have resulted in devastating effects on the fishery and other rare species that inhabit the area. In the mid 1980s, TU formed a coalition of local and state interest groups and lobbied the EPA to recommend prohibiting Two Forks Dam. In March 1990, the group got its wish. In 2004, Denver Water joined forces with TU to develop the South Platte Protection Plan, which will force water providers to consider alternative methods of supplying thirsty municipalities, such as Denver, while mandating consideration of the environmental and economic benefits of Gold Medal trout water.

Chapter 22, *History of Trout Unlimited*, expands on the history of TU that the book touched on in Chapter 2. In the summer of 1950, George Mason, George Griffith, Al Hazzard, Opie Titus, Jim McKenna, and Don McLouth met at Mason's house on the South Branch of the Au Sable River in Michigan. That night they developed TU's core philosophy: perpetuating wild trout for future generations. Though TU did not officially form for another nine years, the idea of trout fisheries conservation had taken hold. Mason died a few years later, and Griffith eventually joined with fourteen others to found TU in 1959. Soon after, TU chapters began forming all over the United States. TU's first real conservation effort culminated in 1952, when the state implemented fly fishing catch-and-release regulations on the South Fork of the Au Sable River. Thus began TU's storied history of coldwater fisheries conservation. The author then notes "TU Milestones" by decade from the 1960s to the present. Lastly, the author defines the future goals of TU as four broad themes: 1) *Protect* watersheds to ensure the highest quality habitat for native and wild fish; 2) *Reconnect* fragmented streams to sustain healthy populations of native and wild fish; 3) *Restore* degraded coldwater habitat through collaboration with landowners and other stakeholders; and 4) *Sustain* conservation efforts by building capacity within all levels of TU with a particular emphasis in enabling young people to successfully engage in long-term conservation efforts so that TU's legacy will endure beyond the current generation.

Peter Johnson

Robert Glennon, *Water Follies: Groundwater Pumping and the Fate of America's Fresh Waters*, Island Press (2004); 314 pp; \$18.95; ISBN 1-55963-400-6; paperback.

Robert Glennon's *Water Follies: Groundwater Pumping and the Fate of America's Fresh Waters* discusses the relationship between humans and groundwater in the United States, tells numerous stories about how

that relationship has developed in localities across the country, and proposes changes to help provide a more sustainable relationship between humans and groundwater.

In the first chapter, *The Worth of Water in the United States*, Glennon lays out a short history of water development in the United States. He begins by explaining how the nation's waters have provided a valuable natural resource for economic growth during the past three centuries. He discusses the roles played by the federal government, agriculture, and industry in developing the nation's water resources. Glennon also analyzes the legal doctrines of riparianism and prior appropriation.

Chapter 2, *Human Reliance on Groundwater*, provides a historical overview of groundwater pumping. Various human civilizations have constructed wells since 2000 B.C. During the late nineteenth century, High Plains farmers used windmills to pump groundwater for irrigation, while the City of Tucson burned wood to fuel steam engines to pump groundwater for municipal use. In the early twentieth century, improved drilling and pumping technology as well as the development of the internal combustion engine allowed people to pump larger quantities of water from ever-increasing depths. The widespread availability and quality of groundwater and permissive legal doctrines that fail to recognize groundwater's role in the hydrologic cycle have led to an increasingly unsustainable reliance on groundwater for various uses.

Chapter 3, *How Does a River Go Dry?*, tells the story of the Santa Cruz River in Tucson, Arizona. Human civilizations have relied on the Santa Cruz River to support subsistence farming since 8,000 B.C. However, in the late nineteenth century, European settlers began raising cattle and wheat in the area, requiring increased irrigation. Increases in surface and groundwater irrigation, along with the destruction of riparian habitats, led to entrenchment of the Santa Cruz. Eventually, in the 1940s, the Santa Cruz's perennial flows ended. Glennon uses the Santa Cruz River as an example to explain the hydrologic cycle. Specifically, Glennon explains the concepts of a "gaining stream" and a "losing stream," using the Santa Cruz and its underlying aquifer as an example. Ultimately, Glennon concludes, groundwater pumping killed the Santa Cruz.

Chapter 4, *A River at Risk*, tells the story of the Upper San Pedro River in Arizona. This river, which is one of the last perennial, dam-free streams in the Southwest, supports a spectacularly diverse riparian habitat utilized by a wide array of migratory birds. In 1988, Congress designated the San Pedro Riparian Natural Conservation Area and expressly reserved a federal water right sufficient to protect this riparian habitat. Pro-development local government officials funded numerous studies in an effort to show that expansion of a nearby military base would not affect the San Pedro's flow. All of these studies, however, concluded that existing groundwater pumping already affected the river's flow negatively, and that further development would only

exacerbate these problems. Although the proposed military base expansion never occurred, both incremental growth of the civilian population and increased agricultural irrigation continue to threaten the San Pedro flow. The ongoing battle between local officials, the federal government, private conservation organizations, and international agencies will only continue unless the concerned parties find a solution.

Chapter 5, *Tampa Bay's Avarice*, describes how the growing population in the cities of St. Petersburg and Tampa has negatively affected the lakes and other waterways in surrounding counties. In 1996, in order to meet growing demand in these cities, local water officials developed three major well fields, pumping a total of 255 million gallons per day ("mgd") from aquifers in neighboring counties. These wells degraded ninety-five percent (95%) of the area's lakes, causing nearly half to dry up completely or suffer other serious impacts, resulted in extensive property damage due to subsidence, and caused environmental degradation from reduced water flows in the area's creeks, streams, and wetlands. These negative effects led to conflict between local and regional water authorities, as well as extensive litigation between various parties. Furthermore, drought, minimum flow requirements, and development of wells for bottled water suppliers are adding to the pressure on the area's aquifers.

Chapter 6, *The Tourist's Mirage*, explains how San Antonio's River Walk has affected the Edwards Aquifer and several endangered species. The San Antonio River, which was once navigable, dried up due to groundwater pumping decades ago. For nearly a century, San Antonio has pumped up to 10 mgd of water from the Edwards Aquifer to create the illusion of a natural river through its now thriving downtown area. Texas courts still abide by the English rule of capture, which grants overlying landowners the right to pump as much water as they want. This rule results in seemingly absurd uses, such as large-scale catfish farms. Groundwater pumping has resulted in litigation to protect endangered species that inhabit the area's springs and have suffered from declining water levels.

Chapter 7, *Suburban Development and Watershed Initiatives*, describes how groundwater pumping for domestic use affects Massachusetts' relatively water-rich Ipswich River Basin. Beginning in the 1990s, like the Santa Cruz River in Chapter 3, stretches of the Ipswich went dry for the first time. Conflict exists between historical towns that have well-established riparian rights to surface waters during high flows and newer suburban communities that must rely on groundwater. A study funded by a new state-sponsored watershed initiative group concluded that groundwater pumping, not surface diversions, caused the Ipswich to go dry. Glennon highlights the disparity between the water use restrictions and pricing between different localities, and discusses efforts to use treated municipal wastewater to recharge the river. However, in

order to restore historic flows to the Ipswich, newer developments must dramatically reduce their groundwater pumping, if not shut down altogether, during summer and fall months.

Chapter 8, *A Game of Inches for Endangered Chinook Salmon*, tells the story of California's Cosumnes River. A century's worth of the U.S. Army Corp of Engineers' flood control projects, as well as massive population growth, have left the Cosumnes River as the Northern California's last major river without a dam. Largely unregulated, groundwater pumping has lengthened the amount of time the river is dry, thereby threatening to destroy the Chinook salmon's fall breeding grounds. Incremental development constantly threatens to drain even more groundwater from beneath the Cosumnes; however, augmentation plans and private conservation efforts offer some hope for sustaining a sufficient flow for the Chinook to survive.

Chapter 9, *Wild Blueberries and Atlantic Salmon*, describes how irrigation for blueberries in Southern Maine affects the Atlantic salmon's breeding season and the areas groundwater supplies. Wild blueberries grow easily without irrigation in Eastern Maine, which receives over four feet of rainfall annually. Farmers, however, learned that irrigation can triple, and even quadruple, their blueberry harvest. Until recently, farmers relied almost exclusively on surface waters from Maine's rivers to irrigate their crops. Then, environmental groups surmounted opposition from local political officials and successfully petitioned to have the Atlantic salmon categorized as an endangered species. As a result, farmers are evaluating surface storage solutions, groundwater recharge, and groundwater mining as possible substitutes for surface water. The problem with groundwater mining, according to Glennon, is that Eastern Maine's porous topography will cause rivers to quickly feel the effects of groundwater pumping. As a result, the salmon may still have inadequate flows.

Chapter 10, *Size Does Count, at Least for French Fries*, explains how Minnesota's Straight River suffers the negative effects of groundwater pumping. Beginning in the late twentieth century, farmers in this area began producing potatoes for McDonalds, which requires growers to produce large, consistently sized potatoes. In order to meet McDonalds' standards, growers began irrigating their fields, usually using groundwater. In addition, McDonald's requires its potato processors to store potatoes in a 95% humidity environment so they do not lose their white color. In order to create such an environment, processors withdraw water from the aquifer below the Straight River. In response to concerns raised by environmental groups, the potato industry has made significant efforts to reduce its impact on the Straight River. Ultimately, however, it appears that the consumer's demand for perfectly shaped and colored french-fries may be too much for the Straight River.

Chapter 11, *The Black Mesa Coal Slurry Pipeline*, tells the story of how groundwater pumping to operate the nation's only coal slurry pipeline affects the Hopi Indian Reservation in Arizona. Peabody Energy Company's ("Peabody") coal slurry pipeline utilizes groundwater from the Hopi Indian Reservation to transport crushed coal, mined from a nearby Navajo reservation, 273 miles to the Mohave Generating Station in Nevada. During the past century, 90 percent of the springs located on the Hopi Indian Reservation have gone dry. Controversy exists over how much Peabody's groundwater use has affected the springs, but the coal mining provides valuable economic support to the Hopi tribe and Navajo nation. Nonetheless, with the pipeline in growing need of repair or replacement, the Hopi tribe, the Navajo nation, Peabody, and the federal government are trying to find a solution for everyone.

Chapter 12, *Is Gold or Water More Precious?*, examines the mining industry's use of groundwater in Nevada. Open-pit gold mines, like those owned by Barrick Gold Corporation ("Barrick"), essentially require mining companies to lower the water table in order to reach ore that water would otherwise saturate. For mining companies, this water is a waste product. By 2010, Barrick will have pumped 4 or 5 million acre-feet of groundwater in fifteen years. Nearby springs and the Humboldt River could feel the resulting decrease in flows for a century or more. However, the powerful economic interests behind mining operations have outweighed environmental concerns thus far.

Chapter 13, *All's Fair in Love and Water*, tells the story of how groundwater pumping to support Atlanta's growing population is negatively affecting oysters in the Apalachicola Bay. In addition, groundwater pumping for increased irrigated agriculture has negatively affected the Chattahoochee River's flow. A dispute between Georgia, Florida, and Alabama led to an interstate compact governing the use of surface waters, but groundwater use is largely unregulated. Furthermore, dredging reduced the amount of nutrients that make it to the estuary. In order to maintain a healthy environment for oysters and other marine life in Apalachicola Bay's estuary, the Chattahoochee River must provide enough nutrients and fresh water to feed the oysters and keep salt-water predators at bay. Georgia instituted a market-based program to reduce agricultural irrigation during low flows, but Florida would like to see more effective measures put into place.

Chapter 14, *The Future of Water*, describes innovative plans to provide water for the increasingly inevitable development near Grand Canyon National Park ("Park"). Canyon Forest Village Corporation ("CFV") wants to develop 212 acres of land near Tusayan, Arizona, the gateway to the Grand Canyon. The increasing number of tourists to the Grand Canyon has created high demand for new development in Tusayan, which lies inside a national forest just outside of the Park. However, the Havasupai Indian Reservation, which contains beautiful natural springs, lies just to the west. CFV proposed to create four sepa-

rate water systems, including a water harvesting system to capture runoff from roves and parking lots. In addition, CFV proposed a complicated augmentation plan involving surface water from the Colorado River as well as groundwater recharge. Finally, the plan called for private covenants to restrict groundwater pumps to emergency use only. Unfortunately, in Glennon's opinion, voter referendums and litigation on the state and federal level have delayed CFV's innovative plan.

In chapter 15, *The Tragedy of Law and the Commons*, Glennon argues that because individuals usually act to maximize their individual welfare, which simultaneously reduces the social welfare, we must stop allowing limitless groundwater use. He contends that most states have failed to "eliminate the gap between law and science" when it comes to groundwater. Furthermore, our population growth and excessive water use are incompatible. Glennon balances the pros and cons of regulatory versus market-based solutions for addressing environmental concerns. In conclusion, Glennon recommends a mixture of improved regulations, market-based solutions, and conjunctive management. In fact, he gives a specific list of recommended societal, as well as individual, changes we could make to improve the current situation.

In *Water Follies*, Glennon masterfully tells stories of how groundwater affects our lives every day, and vice-a-versa. *Water Follies* is an enjoyable read for both water professionals and laypersons. Moreover, it will help educate any reader by promoting groundwater awareness, reform, and conservation.

Travis Keenan