Drowning in Water Worries

By Leon Kolankiewicz

> "One thing is certain in the drinking water profession — the demand for water will continue to grow as our population grows."[1]

Whys and wherefores of water

Water is essential to all life — human and non-human alike. Both economies and ecosystems wither without water. And fortunately, the Earth is blessed with an unfathomably enormous volume of it: 332,500,000 cubic miles (mi^3) to be exact.[2] That's 252 million cubic yards for each of the 7.2 billion inhabitants of the planet, or about 70,000 Olympic-sized swimming pools. This quantity of water has remained essentially unchanged for billions of years, even as it is circulated and recirculated through the endless loop known as the hydrologic cycle. All that changes over geologic time are the relative proportions of water that are saline, fresh, or frozen.

In Figure 1 of a globe sans seas, the larger sphere, 860 miles in diameter, includes all of the water in the world's oceans, ice caps, lakes, rivers, aquifers (groundwater), atmospheric water, and every living organism to boot. It would cover the contiguous United States to a depth of 107 miles. The smaller sphere above Kentucky represents the world's entire volume of freshwater, and it has a diameter of 170 miles.

Indeed, the Earth has so much water that it has been called an "ocean planet," and 70 percent of its surface is covered with water. With so much of the stuff, it seems paradoxical that, even with a global population of 7.2 billion thirsty human beings making ever greater claims on this water, so many of them should be water-stressed, and destined to become even more so as this "century of limits" tightens its grip. And yet that is indeed the case. We are drowning in water worries.

Part of this seeming paradox is resolved by studying Figure 2. For starters, only 3 percent of the Earth's water is fresh, while 97 percent is saline, that is, in the oceans. While saltwater can be converted to potable freshwater, or desalinated, through reverse osmosis and other processes, these are costly economically, energetically, and environmentally, and thus are unlikely to be practicable on a grand scale. Of the 3 percent of the water on Earth that is fresh, nearly 70 percent is frozen as ice in Antarctica, Greenland, and thousands of glaciers.

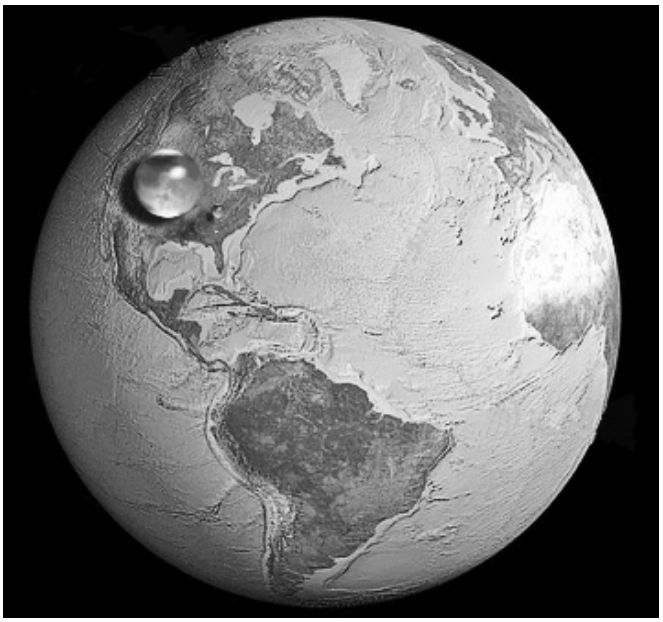

Figure 1. All of Earth's water combined and freshwater alone shown as a big bubble and a small bubble, respectively
Credit: **Jack Cook, Woods Hole Oceanographic Institution**

The United States is comparatively well endowed with water resources and uses prodigious quantities of both surface water (withdrawn from reservoirs and rivers) and groundwater (pumped from subterranean aquifers) to supply agriculture, industry, and municipalities.

In 2005, about 410,000 million gallons of water — more than a thousand gallons per person — was withdrawn for use in the United States every day — over four million swimming pools' worth or about 5,000

Leon Kolankiewicz *is an environmental scientist and national natural resources planner. He has a B.S. in forestry and wildlife management from Virginia Tech and an M.S. in environmental planning and natural resources management from the University of British Columbia. He is the author of* Where Salmon Come to Die: An Autumn on Alaska's Raincoast.

Rose Bowls filled to the rim. About 80 percent of our water supply is from surface water and the remaining 20 percent from groundwater.[3]

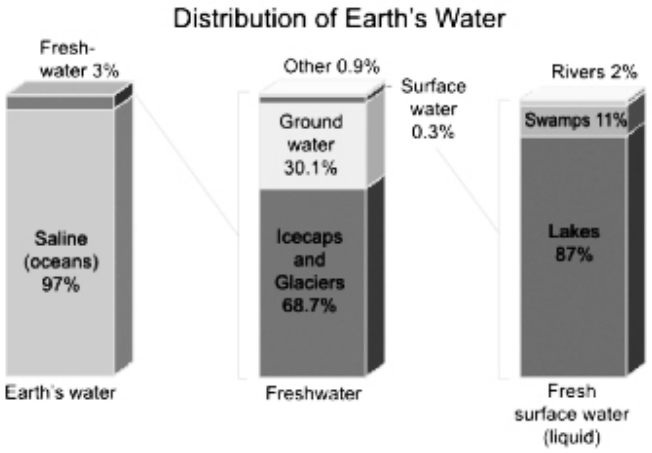

Figure 2. Distribution of the Earth's Water

Water is used to irrigate our crops, to manufacture all manner of products ranging from steel to silicon chips to soft drinks, to water our lawns, fill our cooking pots, wash away our wastes, and even to cool our thermal (nuclear and coal) power plants. About 80 percent of water used in the U.S. is for agriculture,[4] which is very water-intensive because crops (like all plants) need it for photosynthesis and transpiration. All plants demand huge amounts of water during the growing season; much of this water is transpired, that is, evaporated back to the atmosphere through pores in leaves called stomata.

Worldwide, crop irrigation alone claims 70 percent of all water withdrawn from all sources, and of this, two-thirds is used up by the vegetation itself in what water managers call "consumptive water use"[5]; that is, it is non-recoverable and does not flow back into the water source it came from, unlike the return flows from cooling thermal power plants or the water that passes through penstocks and turbines to generate electrical power at hydroelectric facilities. A corn crop that yields about four tons/acre/year uses about 750,000 gallons of water per acre during the growing season.[6]

The worldwide distribution of water resources is extremely uneven. While the global hydrologic cycle provides enough freshwater in aggregate to meet minimum human requirements, the great bulk of this total water in circulation is concentrated in particular regions, leaving other regions with water shortages or deficits.[7] By 1993, water demands already exceeded supply in nearly 80 nations worldwide.[8] Figure 3 shows the distribution of water scarcity around the globe according to the United Nations (U.N.).

The U.N. defines water scarcity as the point at which the combined impact of all water users "impinges on the supply or quality of water under prevailing institutional arrangements to the extent that the demand by all sectors, including the environment, cannot be satisfied fully." By 2025, the U.N. predicts that there would be *1.8 billion* people in countries or regions with absolute water scarcity, and two-thirds of the world's population could be living under water-stressed conditions. By 2030, water scarcity in some arid and semi-arid regions could cause the displacement of between 24 million and 700 million people.[9]

More than 300 cities in China suffer from inadequate water supplies,[10] and the problem is worsening as population increase continues (albeit at a diminishing rate because of China's draconian one-child policy), aquifers are overdrawn, water is polluted, industrial and municipal demand for water intensifies, and climate change reduces snowmelt from the Himalayas.

In the world's arid regions, such as the Middle East and portions of northern Africa, annual rainfall is low and irrigation is costly. Here, the prognosis for future water-dependent agricultural production is dismal and becoming ever more so as populations continue to grow unchecked.[11]

Egypt is a case in point. Its population in 1960 was 28 million. By 2013, it had tripled in a mere 53 years to 84 million. By 2050 there are projected to be 126 million Egyptians,[12] unless the death rate rises as a consequence of the dire future the country faces. Egypt averages just two inches of rainfall annually and its arable land — almost entirely in the Nile Valley and irrigated by the Nile River — is only 3 percent of the country's surface area. Arable land per capita is little more than 400 square yards (or 20 by 20 yards, about the size of a classroom) and shrinking. It's no wonder that Egypt already imports 40 percent of its food overall and 60 percent of its grain. Its oil exports are falling and tourism has tanked because of political instability and

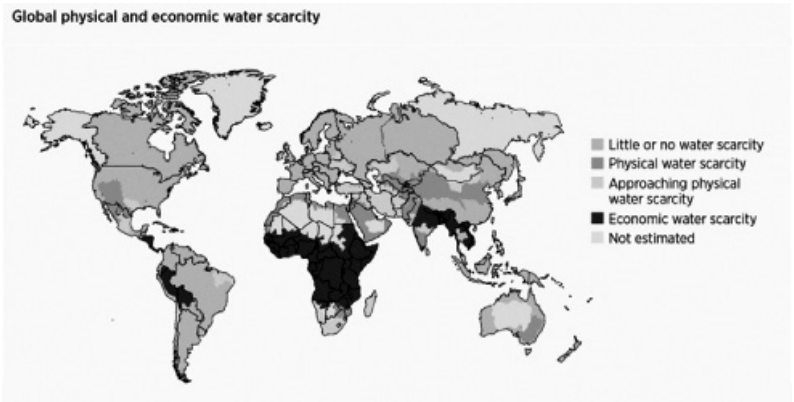

Figure 3. Distribution of water scarcity globally *Source*: United Nations

violence. Thus, Egypt is losing its very ability to pay for these rising food imports even as the country suffers through political, social, cultural, and religious turmoil, revolution, counter-revolution, resurgent Islamic fundamentalism, and renewed military dictatorship. Sadly, this ancient and storied land has become a failed state – a basket case headed toward a casket case.

Three years ago, when there was still hope, however far-fetched, that the Arab Spring might lead to positive outcomes across northern Africa and the Middle East, Australian scientist and politician John Coulter had the gloomy prescience (or perhaps just scientific acumen) to make this observation:

> It is this failure of Egypt's resources to sustain the present population much less sustain a population that is still growing at close to 2 percent per annum and with very large numbers of young still to enter their reproductive years that underlies (and will maintain) Egypt's unsustainable and socially disruptive trajectory. The calls for democracy are almost irrelevant in the longer term.

In some water-stressed areas, tensions over access to water strain international relations. This has happened between India and Bangladesh over the Ganges River. It has occurred in the Middle East with Israel, Syria, Turkey, Jordan, and Iraq over the Tigris, Euphrates, and Jordan Rivers. There have been tensions between the U.S. and Mexico over diminished flow and impaired water quality in the Rio Grande and Colorado River. In 2013, before he was deposed by the military, Egyptian President Mohammed Morsi told an Islamist audience that Egyptians must "stand united" in the face of potential threats to their water resources. These comments were in response to the potential for reduced flows in the Nile River and Egypt's water supply from the Grand Ethiopian Renaissance Dam project now under construction upstream. This dam will divert the Blue Nile and almost certainly decrease Egypt's historic share of Nile water, affecting not only the amount of water available for irrigation but also for hydroelectric output at the Aswan High Dam.

Water diversions via dams and reservoirs typically have drastic downstream effects on river hydrology, morphology, and aquatic life. When the Glen Canyon Dam was constructed on the Colorado River beginning in 1956, the flow downstream in the Grand Canyon was significantly modified: seasonal flooding stopped, bank vegetation proliferated, beaches disappeared, and the river water was clearer (less turbid or muddy) and colder, negatively impacting native fish populations.

Diversions from the Jordan River have led to a "dying" Dead Sea in Israel, at the lowest spot on Earth, 1,400 ft. below sea level. Mono Lake and Owens Lake in California were drained by diversions into the Los Angeles Aqueduct, although the former is making a slow comeback. The saddest case of all though is that of the late Aral Sea, once one of the four largest lakes in the world, situated between the former Soviet republics of Kazakhstan and Uzbekistan. Before the Soviets began diverting its tributary rivers into irrigation projects, the Aral Sea had an area of 26,300 square miles (between Lake Michigan and Lake Superior in size) and supported a prosperous commercial fishery. By 2007, it had shrunk to 10 percent of its former area and split into four lakelets, one of which has since disappeared. The fate of the Aral Sea has been called "one of the planet's worst environmental disasters" (figures 4 and 5). Residents of the region have been plunged into poverty and face respiratory health problems from air polluted by pesticide and salt-laden fugitive dust particles kicked up off the dry lakebed by the wind.

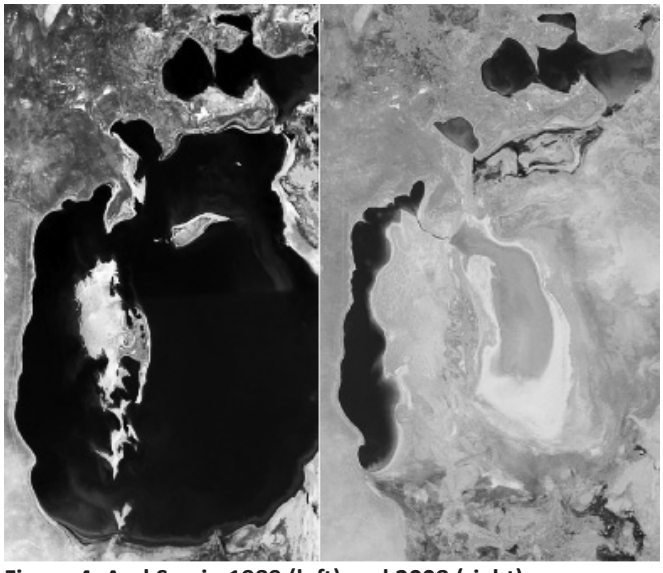

Figure 4. Aral Sea in 1989 (left) and 2008 (right)

Fig. 5. The former Aral Sea: a portent for other water bodies?

It is not only surface water supplies that are at risk from overuse and mismanagement as a result of human overshoot of the Earth's carrying capacity. Worldwide, critical groundwater supplies are also threatened not just with overpumping but contamination by toxic pollutants. It has been estimated that several hundred million of India's 1.3 billion people are being fed grains irrigated by aquifers that will be depleted over the coming decades. Because groundwater is relatively inaccessible and moves so slowly, contamination of aquifers is almost irreversible, or at least very persistent.[13] More groundwater is pumped or extracted from the ground than any other raw material in the world, an estimated 236 cubic miles every year, about 60 percent of which is used for agricultural irrigation.[14]

Two Other Big Global Water Issues

I would be remiss in this review of the world's water issues if I didn't mention two other phenomena, even though neither one fits comfortably into the general narrative of increasing scarcity of this precious resource. The first is global sea level rise and the second is ocean acidification. Both are important side effects of increasing concentrations of carbon dioxide and other greenhouse gases in the atmosphere from anthropogenic activities, primarily the combustion of fossil fuels (coal, oil, natural gas) and the clearing and burning of forests.

The sea level is rising at an accelerated rate due primarily to thermal expansion (liquid matter at higher temperatures expands to occupy more space) and the melting of ice sheets on Greenland and Antarctica and thousands of glaciers in North America and Eurasia. The rate of rise since the mid-19th century is greater than the mean rate during the previous two thousand years. During the period from 1901 to 2010, the global mean sea level rose by about 7.5 inches. There was a transition in the late 19th to early 20th Centuries from relatively low mean rates of sea level rise over the previous two millennia to higher rates, and these rates have continued to increase since the early 20th century.[15]

Maximum global mean sea level during the last interglacial period (129,000 to 116,000 years ago) was at least 16 feet higher than at present. In the Intergovernmental Panel on Climate Change (IPCC)'s most recent assessment, under four different climate scenarios considered, by 2100, the likely range of sea level rise varies from just under a foot (10.2 inches) to almost three feet (32.3 inches).[16]

These seemingly innocuous rises — phased in over nearly a century to give us time to adapt — would still have dire consequences for hundreds of millions of coastal residents, especially in overpopulated, impoverished countries like Bangladesh but also along America's much wealthier East and Gulf coasts. Cities such as Miami and Miami Beach, Norfolk, New York City, and New Orleans will be hard pressed just to survive, no less thrive. While expensive investments in infrastructure like sea walls, dikes, and levees are technically feasible, finding the political will and financial resources to pay for them may be a stretch even for this high-value real estate packed with powerful people. There will probably be some degree of partial protection rather than complete abandonment, though the term "sunken assets" may acquire new meaning. All of the cities just mentioned are already starting to feel both the pinch and the wetness of the rising tide. The combination of higher mean sea level and more frequent, ferocious hurricanes may be a one-two punch that sends these cities reeling. New Orleans and New York have already been put on notice with Hurricanes Katrina and Superstorm Sandy, respectively.

Figure 6. Lower Manhattan masquerading as Venice in the future.

While the IPCC's projections go only to 2100, the Earth's climate system does not come to a screeching halt in that year; it continues on, and so will sea level rise. Even if humanity were to achieve Mission Impossible and stop all greenhouse gas emissions tomorrow, the ocean will continue to expand and rise for centuries to come because of what we have already collectively released into the atmosphere. The World Bank warns that even if eventual global warming were limited to 2°C, which is becoming less and less plausible, global mean sea level could continue to rise by as much as 13 feet above present-day levels by the year 2300.[17] This accidental, unchosen future that man has inadvertently wrought will require continuous adaptations, adjustments, and readjustments on our part for as long as civilization persists.

One last bitter irony associated with sea level rise is that it is happening as a result of the conversion of scarce, drinkable freshwater into already abundant,

undrinkable seawater. Nature gets the last laugh, indeed.

Rising atmospheric CO_2 levels are increasing the acidity of seawater, a process known as ocean acidification, which has been dubbed the "evil twin" of climate change. Historically, the seas have absorbed approximately 30 percent of all CO_2 humanity has poured into the atmosphere since the start of the industrial revolution two centuries ago. This has resulted in a 26 percent increase in the acidity of the ocean.[18] Ocean acidification is causing ecosystems and marine biodiversity to change at an unprecedented rate and in ways that are both predictable and unpredictable. It is likely to affect food security, and it will also limit the future ability of the ocean to absorb additional CO_2 from human emissions. The economic impact of ocean acidification could be substantial, and this may be an understatement.

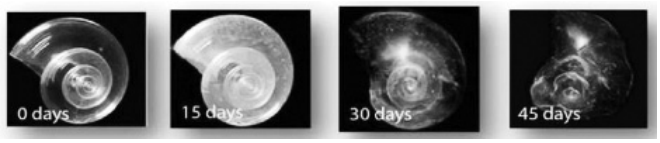

Figure 7. In a lab experiment, pteropods — an important food source for krill, whales, and juvenile salmon — dissolve when placed in seawater with levels of acidity expected in 2100.

Water in the U.S. — is the glass half full or half empty?

Three decades ago, author Marc Reisner argued in his masterwork *Cadillac Desert* that massive population growth and development in the American Southwest were on an inexorable collision course with the implacable hydrology of a parched region. Climate change models predict that in the twenty-first century, the region will become even drier.[19] As one recent paper puts it:

> The region that is projected to experience the severest climate change impacts is the Southwest. This, the driest and hottest region of the country, is projected to become drier and hotter with greater evaporation and more extremes of both rainfall and droughts. These conditions are leading to more tree death, super forest fires, loss of species, and more dust in the atmosphere.[20]

Subtitled *The American West and Its Disappearing Water, Cadillac Desert* presented the history of two powerful federal bureaucracies in the West: the Bureau of Reclamation and the U.S. Army Corps of Engineers. In the latter half of the twentieth century, both agencies were loved by their beneficiaries and loathed by their detractors, and both materially affected the lives of millions for better and worse. Reisner's book chronicles their grand scheme to tame and harness wild water resources in the West — all in the service of relentless ambition first to settle this once nearly empty land and then to build upon it an enduring and ever greater empire of perpetual progress.

In the magnificent and timeless phenomenon we call the hydrologic cycle, life-giving water courses through natural ecosystems and human economies like blood through a living organism. *Cadillac Desert* recounted dramatically how patterns of natural water flow in the Southwest were fundamentally reengineered to serve human aims. Defying nature, water was coaxed to flow uphill against gravity and willed to be present during dry seasons when normally it was absent.

The topics covered in *Cadillac Desert* are a veritable Who's Who of iconic Western Water personalities, places, achievements, aphorisms, and acrimonies — John Wesley Powell, William Mulholland, Floyd Dominy, "rain follows the plow," "whiskey is for drinking and water is for fighting," Colorado River, Owens Valley, California water wars, Hoover Dam, Central Arizona Project, Los Angeles Department of Water and Power, etc.

For the past century, as shown in Figure 8 (below), California, Nevada, Utah, Arizona, and New Mexico have undergone some of the most explosive, unsustainable population growth in the entire country. The Census Bureau and the various state demographic agencies all project continued substantial population increase as far as the eye can see.

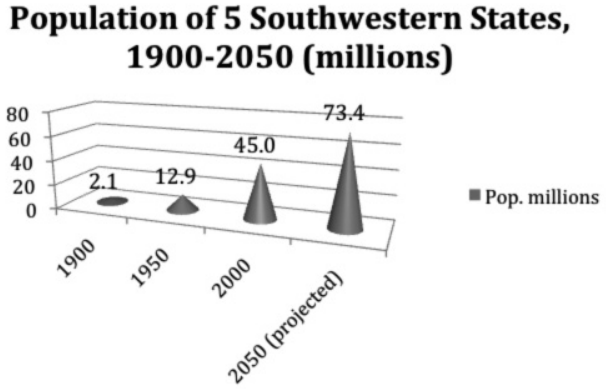

Figure 8 graphically shows past and projected population growth of five Southwestern states (California, Nevada, Arizona, Utah, New Mexico).

Whether one laments or celebrates this rampant growth, none of it would have been possible without colossal water projects — dams, reservoirs, and aqueducts of breathtaking scale — to capture, impound, and transport this most precious of resources from where nature put it to where people need it. Where people need it is not necessarily where people live — as noted above, vast volumes of water are used to irrigate crops removed

from towns and cities. But then these crops, 70-90 percent water by weight, are indeed transported to cities to feed their burgeoning populations.

Now, a tenacious, withering drought that may be a harbinger of longer-term climate change is bringing the issues raised in *Cadillac Desert* to a head. The Colorado River is the crux of the crucial, colossal, complex system of waterworks in the Southwest. It furnishes the daily needs of some 40 million people in seven states — California, Arizona, Colorado, Nevada, Utah, New Mexico, and Wyoming. It supplies water to the thirsty cities of Los Angeles, San Diego, Denver, Las Vegas, and Phoenix, as well to farmers and ranchers who use it to irrigate four million acres of cropland, upon which some 15 percent of the nation's food supply is grown.

And the Colorado River is in dire straits. The year 2013 was the fourth-driest in the Colorado River basin in the past century, and 2012 was the fifth driest. By the close of 2013, the river's two largest reservoirs — Lake Powell (impounded by the Glen Canyon Dam upstream of the Grand Canyon), and Lake Mead (impounded by Hoover Dam) near Las Vegas — were at about 45 percent capacity, the lowest they have been in 45 years. Both Lake Powell and Lake Mead now sport notorious "bathtub rings" (Figure 9).

Figure 9 shows Lake Mead's "bathtub ring" just above the Hoover Dam.

The future doesn't look brighter, or wetter. In December 2012, the federal government issued a three-year study warning that drought, climate change, and population growth are rapidly surpassing the ability of the Colorado River to supply water. It reported a "troubling trajectory" of increasing water demand colliding with decreasing water supply.

Of these three factors underlying the crisis, only population growth is within our ability to modify directly. But this was not even on the table when 40-odd water agency officials, environmentalists, farmers, and Indian tribal leaders met in the spring of 2013 in San Diego to consider how to address the crisis. Instead they discussed "techno-fixes" like water sales from agricultural to municipal interests and concocting new and innovative approaches for squeezing still more water from one of the most overexploited rivers on Earth.

Yet another techno-fix proposed to do an end run around water scarcity is desalination. Given that California boasts an 840-mile coastline with the Pacific Ocean — a hypothetically unlimited supply of water — this proven technology is tempting, at least superficially. A $1 billion reverse osmosis desalination plant is being built at Carlsbad in northern San Diego County; when complete it will be the largest plant in the western hemisphere producing fresh water from the ocean's virtually limitless bounty of salt water. Reverse osmosis is an energy-intensive process that separates freshwater (pure H_2O) from both salt molecules (NaCl) and other impurities by forcing the salt water through microscopic sieves inside cylindrical filters.

According to the *New York Times*, at least 48,000 acre-feet of water would be sold from the new Carlsbad plant annually to the San Diego County Water Authority at about $2,000 an acre-foot, or double what the authority pays for other water. (An acre-foot is an acre covered with a foot of water, equivalent to 326,000 gallons, or what two average households consume in a year.) The Water Authority will be paying more than $3 billion over 30 years for only about 7 percent of its needs.

More than a dozen other desalination plants are proposed for the California Coast — at Camp Pendleton, Huntington Beach, and around Monterey and Carmel. How polluting or sustainable the sources of energy needed to power these plants will be is a big unknown. The Carlsbad plant — which alone would consume 240 million kilowatt-hours of electricity a year — is opposed by the Surfrider Foundation and other environmental groups. The other proposed plants further north will surely be opposed as well.

If techno-fixes like desalination temporarily succeed in bypassing limits to population growth imposed by water scarcity – albeit at a high economic and environmental cost – allowing still more of California to be paved over for the foreseeable future, would this be a blessing? Or would it be a blessing in disguise if they did not? The degraded quality of life, environment, landscape, and biodiversity in a California of 50 million, 60 million, or more human inhabitants is not a pleasant thing to contemplate.

Desalination exemplifies what Uppsala University philosopher Craig Dilworth calls the vicious circle principle.[21] Dilworth writes: "Humankind's development consists in an accelerating movement from situations of scarcity, to technological innovation, to increased

resource availability, to increased consumption, to population growth, to resource depletion, to scarcity once again, and so on." Every time humanity goes round the circle, population swells and environmental stresses mount further. Ultimately, in Dilworth's view, it does not end well.

In the opening pages of *Cadillac Desert*, Marc Reisner chose to put the haunting sonnet "Ozymandias," published in 1818 by Percy Bysshe Shelley (1792-1822). It tells of a "traveler from an antique land," deep in the desert, encountering the half-buried remains of a fallen statue that peered arrogantly across a once-great empire. In light of the Southwest's current predicament, the last five lines give particular pause:

> "My name is Ozymandias, king of kings:
> Look on my works, ye Mighty, and despair!"
> Nothing beside remains. Round the decay
> Of that colossal wreck, boundless and bare
> The lone and level sands stretch far away.

Figure 10. The condition — and fate? — of many reservoirs in the country as of 2014

In the twenty-first century, the specter faced by the East is not so much the extreme water scarcity faced by the West as a result of overpopulation, overuse, and a drying climate. Indeed, climate models predict the eastern states and much of the Mississippi River basin to receive still more precipitation as the century progresses, the climate warms, and overall evaporation increases. Nevertheless, rapid population growth in places such as the Atlanta metro area and much of Florida is pressing surface and groundwater supplies to their limits. Georgia has been wrangling with Alabama and Florida over its ever-increasing withdrawals from surface waters that are then diminished in flow by the time they cross into those two downstream states.

As a result of high population densities, historic concentrations of heavy industry, surface and underground coal mining, and the more recent spread of hydrofracking for shale gas and tight oil, widespread, serious contamination of both groundwater and surface water supplies has been an issue for most of the past century throughout much of the East.

In the early 1970s, I worked beside the grimy, gritty, baking-hot coke ovens of a huge Jones & Laughlin steel mill alongside the polluted Monongahela River in Pittsburgh, Pennsylvania. Long lines of coal trains carrying this fossil fuel from Appalachian coal fields arrived at the mill daily. I helped unload great mounds of shiny, jet-black coal from sturdy, dirty railroad cars onto conveyer belts so it could be carried to the ovens and converted into coke for the steel-making process.

During this experience, I saw firsthand the parlous state of the pathetic Monongahela and the gunk that the mill dumped into it under the unwitting noses of federal and state clean water regulatory agencies. Over my feeble 19-year old protests, other long-time, broken-in, and broken-down workers ("mill-hunkies") threw the empty packaging from their lunches — plastic baggies, paper bags, and empty soda cans — over a railing and right into the sickly river. There the trash bobbed and floated downstream towards the Point, that is, the confluence of the Monongahela and the Allegheny, joining to form the Ohio River, greatest tributary of the Mighty Mississippi. In the four decades since, that century-old mill is now long gone, as are many others, and the river is in a much healthier condition, though still far from pristine or drinkable.

Water quality throughout the East overall (and the West for that matter) is much better than it was half a century ago, though this is due probably as much to the closure and departure of heavy industry as it is to more stringent regulation and improved pollution control technology and implementation. And more generally still, the situation with regard to both water quality and water quantity is mixed, not entirely gloomy. This is because Americans in general and our politicians and regulators in particular have made strides in recent decades in recognizing that freshwater is a crucial, limited resource that needs to be conserved and protected. Water conservation and efficiency are becoming ever more widespread and institutionalized, and depending on how far these measures are taken, they can lead to savings of anywhere (roughly) from 10 to 50 percent.

Water conservation and reuse strategies and technologies have advanced considerably in recent decades, and can be applied in all water use sectors. They include water metering, drip irrigation, low-flush toilets and low-flow showerheads, lawn watering restrictions, xeriscaping (using drought-tolerant plants adapted to arid environments for landscaping), use of grey water for irrigation, water-efficient appliances, and a host of others. With enough engineering and expense, we can liter-

ally cleanse our water "from toilet to tap."

All of these methods and devices taken together are capable of reducing per capita water consumption to such an extent that many regions of the country could accommodate projected population growth and still have enough water both for humans and nature without major new water projects. However, in the driest and one of the most rapidly growing parts of the United States — the American Southwest — the same cannot be said. As noted above, this arid region was formerly thinly populated, but it burst from just two million in 1900 to about 50 million at present. The Southwest could soon be facing, in the words of New Mexico native Kathleene Parker, "twice the people, half the water."[22] This region, served by two over-allocated, over-stressed rivers — the Colorado and the Rio Grande — is both extremely hot and dry, its large-scale settlement made possible only through the advent and spread of air conditioning. Oklahoma-born-and-bred, part-Cherokee, cowboy humorist Will Rogers once quipped that the Rio Grande ("Big River" in Spanish) was "the only river I ever saw that needed irrigation."

Figure 11. Marching deserts in the Owens Valley, California

Incessant population growth will inevitably offset any gains from water conservation, efficiency, and reuse, and ultimately, it will overwhelm them. This is just simple, if remorseless, arithmetic. It is also a hard truth that most Americans and virtually all American politicians, economists, and business elites continue to deny and obfuscate. They will pursue the delusion of perpetual growth for as long as they can.

Back in 1975, around the time another epic drought ravaged California, UC-Santa Barbara professor and ecologist Garrett Hardin penned a poem called "Carrying Capacity" in honor of fellow ecologist and writer Paul Sears (1891-1990), author of *Deserts on the March*, among other books. Here is an excerpt:

Don't speak to me of shortage. My world is vast
And has more than enough — for no more than enough.
There is a shortage of nothing, save will and wisdom;
But there is a longage of people. ■

Endnotes

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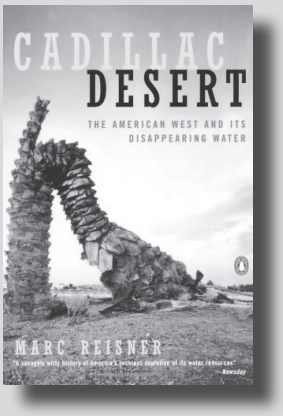
The American West, Marc Reisner, and *Cadillac Desert*

For environmentalists and lovers of the American West, the 1980s were an angst-ridden era thanks to a U.S. president (Ronald Regan) who once joked that if you'd seen one redwood, you'd seen them all, whose kneejerk dogma was that with everything but government, bigger is always better, now and forevermore, and whose fondest hope was to eviscerate or ignore the nation's network of environmental laws that had emerged with bipartisan support in the sixties and seventies.

Yet this same bleak period also produced a powerful film and an insightful book destined to become cult classics among conservationist cognoscenti. The 1982 film was Santa Fe-based director Godfrey Reggio's *Koyaanisqatsi* ("Life Out of Balance" in the Hopi language) accompanied by the somber sound of avant-garde composer Philip Glass. The 1986 book was *Cadillac Desert: The American West and Its Disappearing Water* by Marc Reisner.



A native of Minneapolis and a 1971 graduate of Earlham College, Reisner went to work for the Natural Resources Defense Council as a staff writer and director of communications. Subsequently, he received a fellowship from the Alicia Patterson Foundation, allowing him to research and write *Cadillac Desert*.

One of the things that gave *Cadillac Desert* its enduring appeal was Reisner's long-term perspective. "When archaeologists from some other planet sift through the bleached bones of our civilization, they may well conclude that our temples were dams. Imponderably massive, constructed with exquisite care, our dams will outlast anything else we have built...." he speculated.

A documentary based on *Cadillac Desert* appeared in 1996. Its four parts were titled *Mulholland's Dream*, *An American Nile*, *The Mercy of Nature*, and *The Last Oasis*. "The idea of subduing nature has captivated the whole country," said Reisner, in one of his interviews. "Our great cities stand in a desert that is drier than the plains of North Africa. It would all be impossible without the breathtaking manipulation of water," intoned the narrator solemnly.

I met Reisner at an environmental conference in California in the early nineties, where he had just spoken. I asked him what he thought California's population boom meant for its limited water resources, and vice versa; I don't remember his specific response, but I do remember he agreed that population was a serious problem.

Sadly, Marc Reisner passed away in 2001 of colon cancer at the age of just 51 at his home in San Anselmo, California, in the heart of picturesque Marin County, north of San Francisco. But he left an indelible mark with his captivating and compelling history of the most precious natural resource in the West.

— Leon Kolankiewicz