Scientists are at odds over whether to save the Salton Sea, an engineering mistake that has become a deathtrap for wildlife; the remedy they choose could influence how environmental debacles are dealt with around the world

Battle Over a Dying Sea

SALTON SEA, CALIFORNIA—The thousands upon thousands of shards of barnacle shells heaped along the shore are one clue that something bizarre is happening to this vast desert lake 150 kilometers east of San Diego. "It's not normal to have barnacles in inland lakes," says San Diego State University limnologist Stuart Hurlbert. Other dead giveaways are the washed-up tilapia, their eyes plucked out by seagulls, and the moody water: "The color goes from black coffee, to orange, to red, to green depending on the algae," Hurlbert says. The bitter water stinks in summertime, thanks to rotting algae and fish. And desert gales sometimes stir currents that dredge up pockets of hydrogen sulfide and ammonia, a toxic brew that can kill fish by the ton.

DYING SEAS

This special Focus section explores the high-stakes dramas to rescue —or condemn—two devastated seas. Both stories highlight the hard choices that confront society when preserving human health and prosperity clashes with protecting wildlife and the environment.

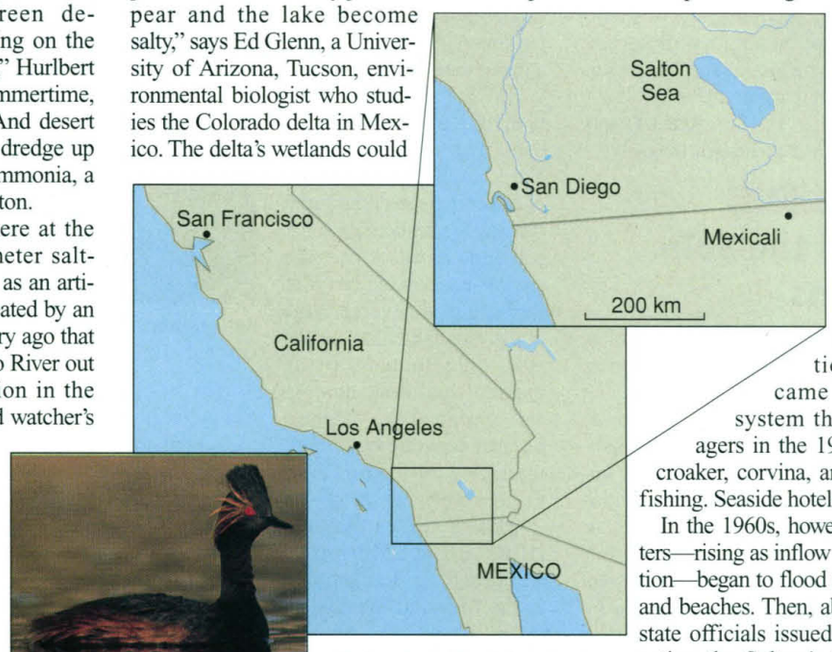
▶ SALTON SEA

ARAL SEA

Nothing, in fact, is normal here at the Salton Sea, a 984-square-kilometer salt-ridden lake that biologists describe as an artificial ecosystem gone haywire. Created by an engineering debacle almost a century ago that redirected the entire lower Colorado River out of its banks and into a depression in the desert, the Salton Sea is now a bird watcher's winter paradise. It is a migratory pit stop or wintering ground for millions of birds, including the brown pelican and several other threatened or endangered species. Lately, however, the sea has become a deathtrap for the birds, too: Over 200,000 have succumbed to avian cholera, botulism, and unknown causes since 1992. "We'll see a lot more birds and fish dying," predicts Tonie Rocke, a wildlife disease specialist at the U.S. Geological Survey (USGS) in Madison, Wisconsin. No wonder, then, that the Audubon Society has taken to calling the Salton Sea "an environmental Chornobyl."

What to do about this widening ecological tragedy has become a major controversy. Last year, Congress ordered the Department of Interior to consider ways to restore the sea to its former glory, but some of the possible fixes could cost billions of dollars. Officials are contemplating such sums because they believe the Salton's salvation would spur tourism and create fisheries, as well as provide crucial protection for wildlife. Developers have drained over 91% of Southern California's wetlands; the sea compensates for lost habitat. "This sea sits in a critical pathway," says wildlife disease specialist Milton Friend, executive director of the federal Salton Sea Science Subcommittee. The birds can't "just go somewhere else."

But others question whether the accidental sea should be saved at all. Given the uncertainties and huge costs of trying to manage it as a stable ecosystem, "it might be a safer place all around if they just let the fish disappear and the lake become salty," says Ed Glenn, a University of Arizona, Tucson, environmental biologist who studies the Colorado delta in Mexico. The delta's wetlands could become a new and safer home for migratory species, he says.



Sitting duck. The Salton Sea has become a deathtrap for wildlife, including the eared grebe.

The steps taken in the coming months to deal with the Salton mess will test whether the government can undo the environmental damage it has wrought over the past century by damming and diverting scarce Western waters to spur development, observers say. It could also offer lessons for dealing with other calamities, from Florida's Everglades to central Asia's Aral Sea (see p. 30). Like those ailing watersheds, the Salton's "entire ecosystem has been damaged, and we need to bring a lot of science and policy to bear to see if the situation can be addressed," says David Hayes, counselor to Interior Secretary Bruce Babbitt. "How our country deals with the Salton Sea tells us a lot about who we are as a people," says fisheries scientist Barry Costa-Pierce of the University of Southern Mississippi in Ocean Springs. "We destroyed all the wetlands and created the sea. Are we willing to let the areas we have left go away?"

A gruesome soup

The Salton Sea began life as an accident. In 1905, engineers, trying to tap the Colorado River to replenish irrigation canals, lost control of the swirling waters. The entire river spilled into the Salton Trough for 16 months before engineers managed to steer it back into its bed. Fed by salty runoff from irrigated fields and drained only by evaporation, the lake became a marine ecosystem that wildlife managers in the 1950s stocked with croaker, corvina, and sargo for sport fishing. Seaside hotels prospered.

In the 1960s, however, the lake's waters—rising as inflow outpaced evaporation—began to flood many of the docks and beaches. Then, about 10 years ago, state officials issued warnings against eating the Salton's fish, found to be tainted with selenium, an essential mineral in tiny doses but a liver toxin in larger ones. Health officials also sounded alarms over the risk of pathogens such as coliform bacteria, dumped into the lake by a polluted stream from Mexico.

Most of the fish that survive in this soup are tilapia, an African species raised in fish farms and released into irrigation ditches to

PHOTO: BARBARA GERLACH/VISUALS UNLIMITED

eat exotic weeds, that found their way into the sea in the early 1960s. But even this hardy breed can be overwhelmed: During frequent die-offs, fish sometimes pile up on the shore as far as the eye can see. With most tourists scared off by the lake's maladies, the boarded-up hotels and gas stations today lend the sea an eerie feeling of failure.

It took some massive bird die-offs to put the Salton Sea on the nation's radar screen. First 150,000 eared grebes, a black ducklike bird, died mysteriously in 1992. Then about 3 years ago, botulism felled several thousand American white pelicans—10% of their western population—and more than 1000 endangered brown pelicans. Newcastle virus, a paralyzing pathogen better known for its devastating effects on poultry, recently wiped out many double crested cormorants, too.

Bring out your dead. Pelicans poisoned by botulism were carted off for incineration in summer 1996.

The Salton's morbid reputation stirred federal officials to action in December 1997, when Babbitt launched a multiagency review of options for restoring the sea. A few months earlier, Congress had formed a Salton Sea Task Force, co-chaired by Sonny Bono, who reminisced about water skiing on the lake as a teenager. Spurred by Bono's death last year, Congress passed the Salton Sea Reclamation Act, which requires Interior's Bureau of Reclamation to prepare a study on how to help the sea and submit it by 1 January 2000. Congress also earmarked $5 million to reconnoiter the lake's biology and geochemistry.

One point on which most scientists agree is that more data must be gathered on the Salton's ecology before engineers forge ahead with any fixes. After mostly ignoring the lake since the mid-1950s, scientists are now pouring in to sample its sediments and creatures, working out of a six-person trailer in the state park. The lake can be an unsettling place to do science. "It's really strange to be out sampling and see a fish just die in front of you, just pop up," says Brandon Swan, a graduate student of Hurlbert's.

Some of the Salton's ailments are obvious. It's 25% saltier than ocean water, which stresses the tilapia. "The fish community is doomed" if the salinity level rises much higher, says Costa-Pierce. The lake is also choked with algae fed by a surfeit of nitrogen and phosphorus from fertilizers and sewage—classic eutrophication that sucks up oxygen and suffocates other life-forms. Fueling the algal blooms is the Salton's peculiar geometry: Just 15 meters at its deepest, the lake's water layers turn over, or mix, every few weeks in the summer (a time when most lakes are stable). When layers of warm water form near the surface and cooler, oxygen-poor water pools at the bottom, winds sweeping across the shallow lake whip up nutrients and a toxic brew of ammonia, hydrogen sulfide, and deoxygenated water. The sea may be edging toward catastrophe, but at the moment, "it's not a dying lake," says Hurlbert. "It has too *much* life."

Indeed, microscopic life is abundant. "It's sort of a parasite microbial haven," says Costa-Pierce. Hurlbert's group has identified an algae called *Chatonella* that's blamed for fish kills off Japan and Australia; another San Diego State group has found a parasite thought to live only in aquaria, *Amyloodinium ocellatum*, plastered on tilapia gills. The Salton "is like an aquarium that nobody has cleaned," says USGS water chemist Jim Setmire.

USGS wildlife biologists are trying to pin down which diseases are felling the birds. The botulism outbreaks are Type C, which is rarely seen in fish-eating fowl (it's usually spread through maggots). Apparently the tilapia, their immune systems stressed from fighting off bacteria, are prone to infection by botulism spores, which grow in their gut and produce toxin. But "we're still really puzzled as to what the mechanism is," says Rocke. Another utter mystery is the grebe die-off; some suspect toxic algae, but Rocke says nobody has fingered a species.

No simple fix

The scientific data are meant to inform a hellishly complex management problem. To lower the salinity, engineers want to give the sea an outlet so that it can be diluted by relatively fresh drainage water. The bureau and the local Salton Sea Authority are now leaning toward diking off part of the lake to form evaporation ponds. By pumping water from the salty lake into these ponds while drainage kept flowing in, the sea's level and salinity could be stabilized. Then, within a couple of decades, engineers would build a canal to import fresher water—perhaps wastewater from San Diego or Arizona. Authorities are also considering carving a second canal to pump Salton water to the Gulf of California. However, this scheme is controversial, because brine and nutrients might harm the ecology of a Mexican biosphere reserve.

Other problems are waiting in the wings. Choking off the flow of phosphorus and nitrogen compounds that fuel algal growth, for one, would require a politically touchy plan to clean up agricultural runoff and city wastewater. Cleansing the sea itself is a different story. "Even if you significantly control the inflow, you have all these nutrients that can recycle for years and years," Setmire says. One proposal for removing nutrients is to mount a fishing operation to harvest tons of tilapia, which sequester nutrients in their tissues.

Although the leading plan has several potential showstoppers, experts say fixing the Salton is neither a scientific nor a political quagmire. Restoration proponent Patrick Quinlan, an engineer on the staff of Representative George Brown (D–CA), points to projects like the $8 billion Everglades restoration in Florida and an even more ambitious plan under way to restore wetlands and improve water quality in the vast delta that feeds San Francisco Bay. Like these projects, the Salton Sea restoration would be a major hydrological undertaking buffeted by competing agricultural and ecological interests. "It's going to take a lot of work, but I don't think it's totally intractable," Quinlan says. Others are more skeptical. "The idea that one can manage something as large as the Salton Sea seems awfully daunting to me," says USGS hydrologist Roy Schroeder.

Many experts doubt that it's possible to come up with a scientifically sound solution by January. Scientists "haven't answered some of the key questions," like the connection between pollution and the die-offs, says Phil Pryde, an environmental policy expert at San Diego State and chair of the California Audubon Society's Salton Sea task force.

Croaked. Thousands of gulf croakers washed ashore last year, apparently victims of anoxia.

CREDITS: (TOP TO BOTTOM) KEN STURM/FWS; MILT FRIEND

"They're rushing it." Others are also worried that the goals laid out by Congress—to lower the lake's salinity and stabilize its level—are skewed, when a more serious threat to ecology may be the high nutrient levels.

Some observers argue that the crisis has been overblown and that it might be better to allow the sea to grow even saltier. This strategy, coupled with efforts to draw off nitrogen and other nutrients, got major play in a report co-authored by Glenn and released last February by The Pacific Institute, a policy think tank in Oakland, California. Skeptics also point out that previous seas that formed centuries ago in the sizzling Salton basin all evaporated, in a natural cycle. "This is a situation where you're really fighting nature," says aquatic ecologist Eugenia McNaughton of the U.S. Environmental Protection Agency in San Francisco, who's overseeing the environmental assessment of Interior's evolving plans. She favors "a management strategy that takes into account the history of the place."

If the Salton's salinity increases and the fish disappear, the sea would turn into a brine shrimp lake—like Utah's Great Salt Lake—that would still support plenty of wildlife, says Glenn. Other birds, he contends, could find habitat if steps were taken to manage wetlands in the Colorado delta in Mexico. The Salton Sea, agrees grebe expert Joe Jehl of the Hubbs–Sea World Research Institute in San Diego, "wouldn't be a dead lake, it would be a different lake."

Arguments that nature should take its course "cause my blood to boil," says Friend, who contends that the disruption to wildlife would be far greater than Glenn and others believe. The Salton's birds may not do so well in Mexico's delta wetlands, adds Hurlbert, who points out that these waters have a different mix of vegetation, fish, and invertebrates. Friend argues that the issue of protecting important wetlands is larger than the Salton Sea itself, noting that an "explosion" of bird disease across North America in recent years has been linked to birds forced to live in close quarters. "We should be fighting for all the habitat we can sustain," he says. A Salton success story, Friend says, could set an example for how to use wastewater to provide needed wildlife habitat in other water-scarce regions in the world.

Although the Salton Sea's fate may remain as cloudy as its water—if Interior does opt for an engineering solution, Congress will have to find money to pay for it—scientists agree that steps must be taken to help the area's wildlife. Setmire recalls a visit to the sea during a die-off in August where he helped collect sick and dead birds and wound up holding an injured white pelican in a pillowcase. "I was holding this big bird. Not pretty, but majestic. It really gave you a feeling about wanting to save this ecosystem." —JOCELYN KAISER

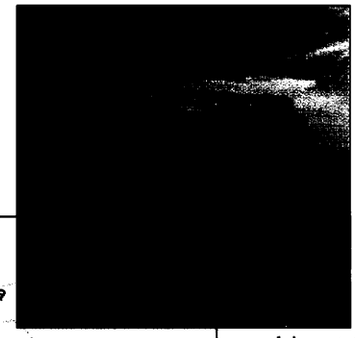
DYING SEAS
ARAL SEA

Coming to Grips With the Aral Sea's Grim Legacy

There's no undoing this sea's demise, perhaps the most notorious ecological catastrophe of human making. But scientists are hoping to soften the impact

NUKUS, UZBEKISTAN—Standing on the roof of the 10-story Uzbek Academy of Sciences (UAS) building, Yusup Kamalov has watched, more times than he would care to remember, the ground-hugging, dirty gray clouds that churn across the salt-streaked desert beyond the city's outskirts. Sometimes the chubby-cheeked engineer has to beat it indoors before one of these dust storms barrels into Nukus. The screaming grit blots out the bronze statue of famed 15th-century Uzbek astronomer Mirzo Ulugbek in front of the academy's local headquarters and chokes anyone unlucky enough to be caught outdoors.

Dust storms are common in deserts, but here in the Republic of Karakalpakstan, a province in the northwestern corner of Uzbekistan, they may also be harbingers of sickness and death. After decades of zealous Soviet efforts to yoke a huge swath of central Asia to the single-minded task of growing cotton, the locals are reaping an ill wind. It carries sulfates, phosphates, chlorinated hydrocarbons, and their ilk—fertilizers and pesticides whipped up from the bare floor of the shriveled Aral Sea and the poisoned land around it. According to the United Nations Development Program (UNDP), the death rate from respiratory illnesses in Karakalpakstan—167 per 100,000 people in 1993—is among the world's highest. "The level of health and the quality of life are profoundly poor, and deteriorating," says Ian Small, country manager for Doctors Without Borders (DWB), a medical relief agency (also known as Médecins Sans Frontières) that has logged high rates of anemia among Karakalpaks. "It is a tragic humanitarian disaster."



The drowning desert. As the Aral shrinks, stranding boats, inefficient irrigation from the Darya rivers is blighting the land.

CREDIT: MUTSUMI STONE

The toxic dust storms are just one symptom of the environmental and social catastrophe that is engulfing this region. After decades of wanton irrigation, once-fertile fields produce next to nothing. And the shrinkage of the Aral Sea from a vast body of fresh water teeming with fish to a salty remnant has marooned ports and killed the fishing industry. Even local officials are resigned to the sea's eventual breakup: "We will be witnesses to the disappearance of the Aral Sea," says Karakalpak health minister Damir Babanazarov.

Ignored by Soviet planners for decades, the 35 million people who live in the Aral Sea's watershed have finally caught the attention of the rest of the world. A major campaign, spearheaded by the World Bank and the UNDP, is under way to improve the region's drinking water, revamp its agricultural practices, and sustain its biodiversity. The goal is not to turn back the clock and restore the Aral to its former grandeur. Rather, the massive cash infusion is meant to assuage the disaster's social consequences and avert a scramble—or even a war—over water among the fledgling democracies in central Asia.

Western water managers are hoping to learn lessons of their own. Central Asia is "attempting to implement many of the sustainable [agricultural] practices that the rest of the world is grappling with," says Daene McKinney of the University of Texas's Center for Research in Water Resources in Austin. Steps to mitigate the Aral's problems,