



The fight is on to save Mesopotamia's drained marshes. But it's not easy finding a realistic and salable plan—or gathering data in a dangerous environment

## Reviving Iraq's Wetlands

*"Redeeming a swamp ... comes pretty near to making a world."*

—Henry David Thoreau

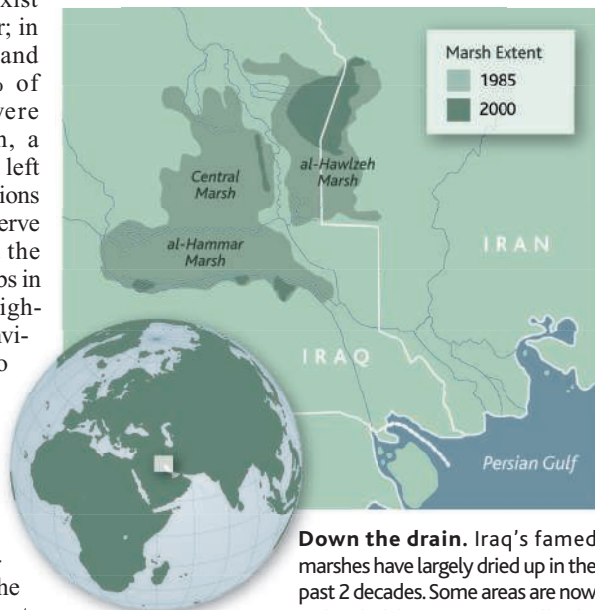
Azzam Alwash enjoys kayaking with his wife in southern California. But his real dream is to paddle among the high reeds of Mesopotamia's ancient marshes near where he was born. Those marshes exist mostly in his memory, however; in an unprecedented ecological and human disaster, some 90% of the famed Iraqi wetlands were destroyed by 2000. Alwash, a 49-year-old civil engineer who left Iraq a quarter-century ago, envisions a full restoration that would preserve both the vibrant wildlife and the unique culture of the Marsh Arabs in the region. He even quit his high-paying job as a partner in an environmental consulting firm to drum up international support for his effort, which he grandly dubbed Eden Again.

Alwash has helped energize a coterie of donors, scientists, local leaders, and politicians who are hotly debating the future of the marshes. The first scientific studies of the wetlands in decades appear in this week's issue of *Science* (see p. 1307), and foreign nations have pledged a total of \$30 million. The Iraqi government recently set up an interagency center to draw a blueprint for revitalizing this desperately poor and ecologically battered area. But coming up with a common vision—and financing—in an unstable nation may prove even harder than collecting data. "This is a scientifically difficult and tremendously complex effort," says Edwin Theriot, a U.S. Army Corps of Engineers official who has advised the Iraqi government. "We're having difficulties with the Everglades and in Louisiana—and we're supposed to have all the resources we need."

The sheer scale of the destruction is of biblical proportions. In one generation, some 20,000 square kilometers of marsh

shrank to a tenth of that size, as did a population that once numbered a half-million. Three wars and one insurrection played a big role, as did a concerted effort in the 1990s by Saddam Hussein to drain the marshes.

As the marshes turned to desert, local peoples fled or were forced from their homes. Left behind were vast salt flats laced



**Down the drain.** Iraq's famed marshes have largely dried up in the past 2 decades. Some areas are now reflooded, but recovery will take time—and require lots of water.

with insecticides and landmines. The fisheries—which provided a large share of Iraq's overall catch—crashed, while animals from the Goliath heron to the pygmy cormorant face extinction.

The effects of the destruction radiate far beyond southern Iraq. No longer cleansed by the marshes, the salty and polluted waters flowing into the Persian Gulf from the Tigris and Euphrates rivers are playing havoc with marine life there, including the lucrative shrimp business. And Asian migratory birds have lost a major staging and wintering area on the western Siberian-Caspian-Nile flyway. "The impact on biodiversity has also been catastrophic," states a 2004 United Nations study on the marshes.

### Out of Eden

Few places on Earth have a stronger hold on the imagination than do the Iraq marshes. They are the legendary site of the Garden of Eden and incubator for the first great urban centers, home of the world's first writing system. Its trackless stretches have long hidden both wildlife and rebels. Sumerian princes hunted game there, and Assyrian King Sennacherib led a force into the region in the 7th century B.C.E. to flush out pesky Chaldean rebels.

Isolated, yes, but far from pristine. "This is the oldest and most tinkered-with landscape on Earth," says Iraq's new water resources minister Abdul Latif. For at least 5000 years, humans have widened and dredged channels, dried and flooded fields, and built reed houses atop artificial islands of reed bundles. Its lifeblood was the spring floods. "This pulse of sweet fresh water, laden with sediments, flushes the salt, provides nutrients to revitalize the reed beds, and is key to bird migration," says Alwash.

Most of that water comes from outside Iraq. The Euphrates and Tigris originate in the eastern mountains of Turkey. More than 90% of the water from the Euphrates comes from Turkey, Syria, and Saudi Arabia; the Tigris's basin covers large parts of Turkey, Iran, and a slice of Syria.

Beginning in the 1950s, governments began diverting that flow, first by creating natural lakes within Iraq and later by building large dams on both rivers. There are now nearly three dozen major dams, with eight more under construction and a dozen in the planning stages. Turkey alone can store up to 91 billion cubic meters of water and will need more to irrigate its dry eastern provinces. Iraq and Syria can store as much as 23 billion cubic meters. The 2003 war and its aftermath halted plans to build additional dams in Iraq—there are currently a dozen large ones—but Iran recently embarked on a major dam-building effort on tributaries of the Tigris.

The result of this half-century of water management has been dramatic. The spring

flood is barely noticeable. The maximum flow of the Euphrates during May has dropped by two-thirds since 1974, when dam building began in earnest. Even before the 1991 Gulf War, many experts feared the result would irreparably harm, and eventually destroy, the Iraq marshlands. Severe deforestation from overgrazing upstream, combined with more than a decade of drought in the Middle East, exacerbated the environmental problems to the point at which Minister Latif believes the marshes would soon have been history “even without Saddam.”

### Brutal ecocide

But it was Saddam Hussein's regime that delivered the coup de grâce. Part of the Iran-Iraq border runs through the wetlands, and during the 1980s war, both sides built causeways and drained marshy areas for better access to the front. After the first Gulf War and the unsuccessful uprising of Shiite Muslims in the south, the Iraqi government set about draining the remaining marshes. Its goal was to remove the threat of insurgency and replace the marsh culture of fishing and rice production with dry agriculture. Massive dikes and canals were built to divert water from the marshes, quickly turning them to desert.

“The demise of these once-vast wetlands has been hastened through deliberate drainage by the Iraq regime,” the U.N. study notes. To Latif, Saddam's actions constitute “a brutal ecocide” as well as “a crime against humanity.” Many of the marsh inhabitants are now returning home, although most remain scattered in Iranian refugee camps or in cities.

The marshes are actually three distinct regions, each with its own particular ecosystem. The once vast Central Marsh, which covered more than 3000 square kilometers in 1973, has shrunk by 97%. Most of what remains are reeds growing in irrigation canals. Another marsh, called al-Hammar, lost 94% of its area, and al-Hawizeh, which borders Iran, is two-thirds smaller than 3 decades ago. Even the Hawr al-Azim Marsh, which is the Iranian extension of al-Hawizeh, is less than half its size due to reductions in water flow from Iraq.

Their depletion has led to the extinction of an otter, bandicoot rat, and a long-fingered bat particular to the marshes, and 66 species of water birds are at risk. Aquatic animals also have suffered, from shrimp to fish, with devastating consequences for coastal fisheries. “The wetlands were like a vast sewage treatment plant for the Euphrates and Tigris system,” says Hassan Partow, who helped write the U.N. report. “They were the kidneys.” Without them, the patient is imperiled.



**Dream boat.** Iraqi expatriate Azzam Alwash envisions Marsh Arabs and ecotourists taking advantage of fully restored wetlands.

### Just add water?

How those kidneys function is uncertain. For decades, foreign and even Iraqi researchers were forbidden to enter the marshes, and in the 1990s the government destroyed a research station in the Hammar. As a result, most studies have relied upon Landsat remote-sensing data.

After the U.S. invasion in 2003, foreign scientists suddenly gained access. As they



**Ancient battleground.** Relief from the palace of Assyrian King Sennacherib, who sent troops to ferret out rebels in the species-rich Mesopotamian marshes in the late 7th century B.C.E.

scramble to create an extensive database, it's hard to stay ahead of the population. When Saddam's regime collapsed, local residents jubilantly broke open the dikes and

dams, reflooding nearly half of the marshes. “They did not wait for us,” says Alwash.

The reflooding has been haphazard, however, and many dikes and dams from the Saddam era remain. But there is now plenty of water available: The U.S. invasion coincided with the end of a long drought in the region. Given the fast pace of dam construction in countries upstream and the possibility of another drought, though, renewed desertification is likely.

Last April a team funded by the Italian government began the first in situ study of the marshes, focusing on a small marsh of about 200 square kilometers called Abu Zirig. Reflooded in 2003 by locals, it has recovered rapidly. “This is a happy example,” says Italian hydrologist Andrea Cattarossi. “The environmental conditions were pretty good.” Carp, trout, smaller fish, and nearly half of the 50 to 60 species of birds that once flourished in the marsh have returned.

Although the marsh appears to be recovering, Cattarossi's data show that the volume of water is preventing light from reaching the roots of aquatic plants, threatening their growth. He says new structures are needed to control water circulation. He also worries about overfishing by a culture grown accustomed to using pesticides, explosives, and electrocution. A drought year will spell doom for Abu Zirig, he warns, because the water source first flows through agricultural areas.

But Abu Zirig is located north of the three main marshes and therefore receives larger quantities of less saline water than wetlands downstream. Those areas to the south will be more difficult to restore, scientists say.

Curt Richardson, an ecologist at Duke University in Durham, North Carolina, and lead author on the *Science* paper, used U.S. Agency for International Development (USAID) funding to examine other marsh regions during two visits. He says that reflooded portions of the eastern Hammar marsh are essentially saltwater deserts. “We’re not quite sure why,” he says. But he found that the area suffers from high salinity and high levels of hydrogen sulfide, which inhibits plant growth. Located close to the Persian Gulf—at the terminus of the “kidneys”—the marsh must be flushed with clean water to remove the salt and hydrogen sulfide. “The real question is whether there is enough water to do so,” says Richardson.

One silver lining to the grim security situation, in which foreigners are often targets, is that Iraqi researchers are taking the lead in gathering data. “We had to train these people,” says Cattarossi—no simple task given the lack of equipment and expertise following nearly 2 decades of Iraqi isolation. “And the situation in the field is very difficult; the vegetation is thick, and the [residents] can be a little bit suspicious.” Richardson says that Alwash helped build trust with locals to ensure a steady flow of data for his study.

More than two dozen Iraqi biologists now help gather data from the Hawizeh, Hammar, and Central marshes for foreign researchers such as Richardson. Iraqi scientists declined to be interviewed, fearing reprisals from insurgents. But Ali Farhan, an Iraqi engineer and adviser to the Iraqi government, explains that two teams visit each marsh every month. They gather data on water quality, phyto- and zooplankton, bottom sediments, fish, and birds. Such practical training, he says, should help the shattered Iraqi scientific establishment gain a place at the table in the marsh discussions. So far, he adds, data gathering has gone smoothly, thanks to careful cultivation of local sheiks. But he says researchers are still harassed at times by the bandits who roam the region.

### Romance or realism

During the next year, scientists using Italian funding hope to map the current water flow in the Iraq marshes as a first step toward understanding how to stabilize and revitalize the marshes. The U.S. Army Corps of Engineers is working up a model that details the flow of the Tigris and Euphrates. Meanwhile, the Center for Restoration of the Iraqi Marshes (CRIM), an organization of several Iraqi ministries created last fall in Venice, will put together a “master plan.” “We need an international and Iraqi consensus,” says Thomas

Rhodes, an American ecologist and head of USAID’s southern Iraq region based in Basra.

So far that’s been elusive. Marsh advocates such as Alwash yearn for a vast reclamation project, with ecotourism to fuel the anemic local economy. He says it could be done for as little as \$100 million, using Iraqi



**Mud to dust.** The lush marshes around Abu Subat, unproductive desert after Saddam Hussein diverted water in the 1990s (top), are now trying to make a comeback.

labor. Alwash worries that USAID, which is focusing on replanting date palms and ensuring the health of farm animals in southern Iraq, fails to grasp the enormous agricultural and economic benefits to the Marsh Arabs of a successful restoration.

But others dismiss such visions as unrealistic, given the current fiscal, social, and security situation. USAID has recently discontinued its funding of Alwash’s organization, and Andrew Natsios, head of the agency, says, “the marsh people are not interested in restoring all the marshes. They want some restored and some left dry for agriculture.”

Peter Reiff, an anthropologist who works on the marsh issue as a USAID contractor, notes that local Marsh Arabs have abandoned their old way of life cultivating rice and using water buffalo: “They are becoming farmers, and they get better returns with sheep, wheat, and cattle.” And he accuses outsiders such as Alwash of possessing “a wistfulness about the marshes that is almost romantic. You are not going to make this into an ethnographic museum.”

Iraqis themselves are divided. Minister Latif says he is “not very keen on the word ‘restoration’—restoring does not help the

population.” He favors a plan that focuses on health, education, and transportation needs. And the long-suffering local people appear to want it all. During two recent conferences on the marshes held in southern Iraq, participants urged that the wetlands be restored—and that new schools, clinics, and roads be built to lift them out of their dire poverty.

CRIM is supposed to bring all these disparate parties together. But some doubt it has the political and financial muscle to do so. “CRIM is understaffed, under-resourced, undertrained, if well-intentioned,” says one foreign scientist involved in its creation. And negotiating a deal with Turkey, Syria, and Iran on water rights—a crucial element in any restoration plan—poses a daunting diplomatic challenge. “It is quite obvious that there isn’t enough water to restore all the desiccated marshes,” says Farhan.

### Two cultures

There is consensus on the need to preserve at least some of the marsh. “There is great potential to restore a portion,” says Cattarossi. Rhodes sees a scattering of core areas of protected, healthy, and biodiverse marsh surrounded by zones of compatible use. The cores would support ecotourism, provide a haven for animal and bird life, and allow the old marsh life to survive and even flourish alongside a more typical lifestyle of dry farming. “There will be enough room for both cultures,” says Farhan. “In fact, Marsh Arabs are currently practicing both cultures.”

To sell that vision, advocates argue that marsh restoration offers more than environmental and social benefits. “If we can get some of the marshes back, it would [also increase] security and stability,” says Barry Warner, a biologist at the University of Waterloo, Canada, who is organizing a bird count this year in the marshes. Adds Natsios: “U.S. support for the marsh people is also protection for our troops.”

Making that case will be tough, however. Last year, the U.S. Congress rejected spending any money on marsh restoration. But Natsios says his agency will continue to provide modest sums for marsh research and planning.

Even the enthusiastic Alwash—who calls the Eden Again project “his mistress”—acknowledges that full restoration is unrealistic, given the constraints of water, money, and political will. But he has not abandoned his dream of threading his way through endless beds of high reeds. Iraqis and their foreign friends may not be able to reconstruct a Garden of Eden. But they are hoping for the chance to recreate at least a piece of paradise.

—ANDREW LAWLER