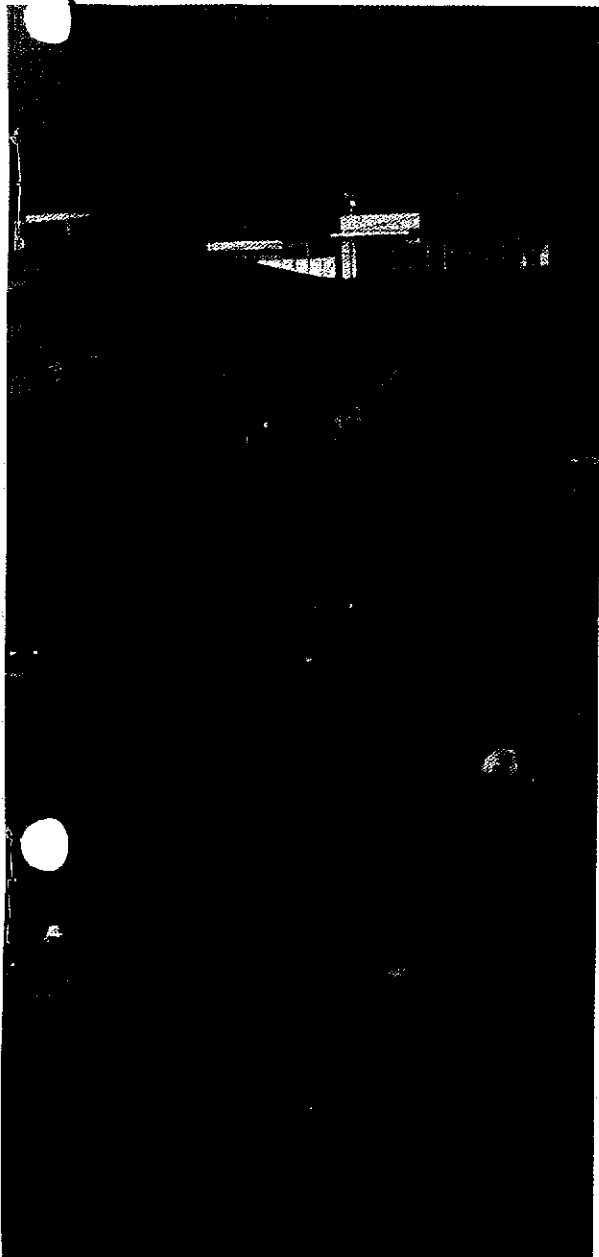




SOLD DOWN THE RIVER

Dried up, dammed, polluted, overfished—freshwater habitats around the world are becoming less and less hospitable to wildlife.

By Eleanor J. Sterling and Merry D. Camhi



Boat traffic at a floating market near the city of Can Tho, Vietnam, jams a branch of the Mekong River. Some 65 million people live in the 300,000-square-mile Mekong River Basin, also home to a diverse freshwater fauna.

The banks of the Mekong River in Vientiane, the capital of Laos, can be a lovely retreat at sunset. The river sweeps alongside the city in a wide elbow curve, offering a panoramic view of tranquil waters and tree-lined shores. Thailand rests on the opposite bank, seeming farther away than its half-mile distance. And as the setting sun lights the water ablaze, birds skim the surface, and fish make themselves known with the occasional splash, making an evening walk along the riverbank a pure delight.

At the start of a recent visit to Vientiane, however, one of us (Sterling) wound her way through the city to the river, anticipating a cool breeze and a quiet walk after a sweltering workday, only to stare into a scene from the desert. Clouds of dust rose from the riverbed, where a group of kids were playing soccer. Beyond that bone-dry sandbar, a vestige of the river was just visible as a thin stream along the far bank. By all appearances, one could easily have walked across to Thailand.

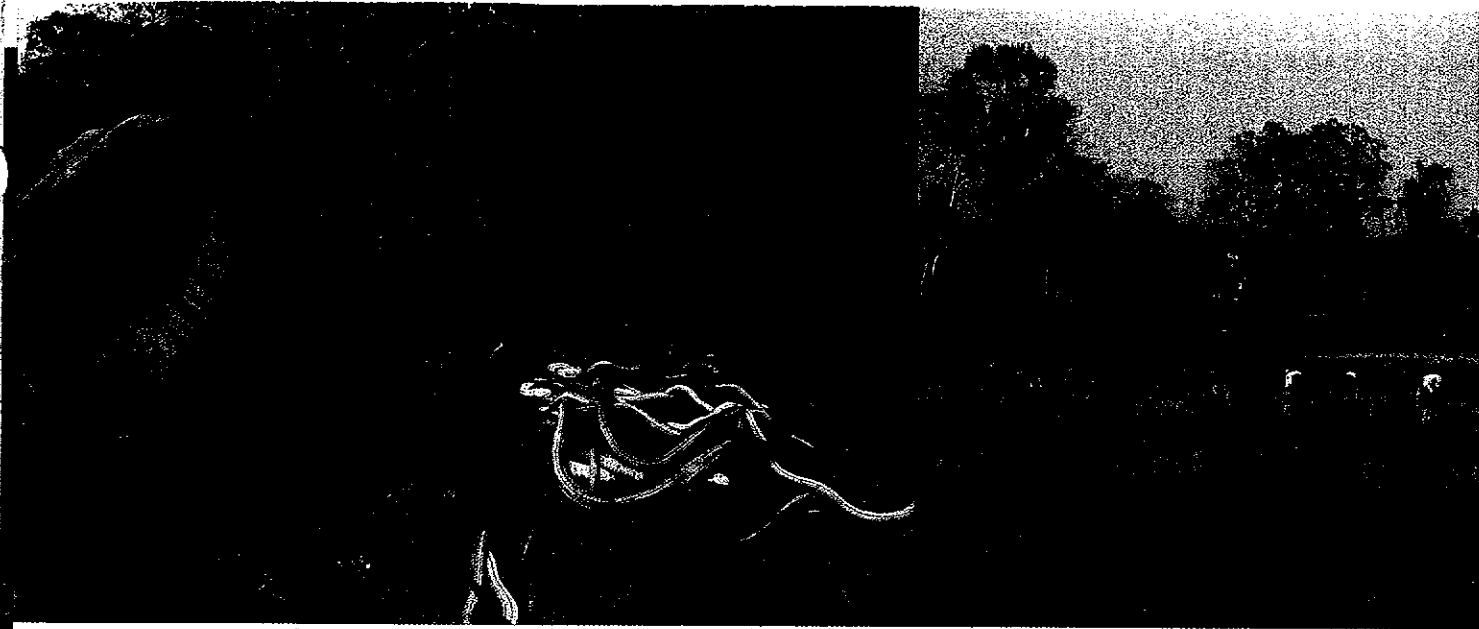


Such radical fluctuations are natural to the Mekong, and whole communities—human and wild—are adapted to its periodic floods and droughts. The river swells when rainfall rushes down its tributaries and shrinks again in drier weather. But the rise and fall of the Mekong is increasingly dictated by energy use in China and Thailand. Upriver hydroelectric dams dampen the fluctuations and change the timing of floods and dry spells, affecting water-dependent wildlife

hundreds of miles away. The extent of those changes is likely to grow as more dams, scheduled for construction, make their mark on the river.

The dams are just one of the many troubles that confront the river and its denizens; water extractions, pollution, invasive species, and overfishing also threaten the ecosystem's health. And the Mekong's woes mirror those of freshwater systems worldwide, which are increasingly pressured by a growing human population that makes ever-greater water demands. The scale is enormous: people now appropriate more than half of the world's accessible surface freshwater, leaving precious little for natural systems and other species to thrive.

As a result, even as the human population of the globe has doubled, many species that depend on freshwater ecosystems have suffered steep declines. The list would bring tears to a conservationist's eyes: in the past three decades, a fifth of the world's water birds, a third of freshwater mammals,



a third of amphibians, and more than half of freshwater turtles and crocodiles have become either threatened, endangered, or extinct. Freshwater fishes represent a quarter of the world's living vertebrate species, and yet more than a third are threatened or endangered. The ecology of freshwater systems may be irreversibly damaged if we humans don't improve the way we treat them.

The Mekong's name translates from Lao as "mother of the waters." It's no wonder: the river snakes some 3,000 miles from its headwaters on the Tibetan Plateau to its outlet through the Mekong River Delta into the South China Sea. It and the uncountable "feeder" rivers and streams in Cambodia, China, Laos, Myanmar, Thailand, and Vietnam make up the 300,000-square-mile Mekong River Basin [see map on preceding page].

That mesh of waterways is one of the most productive and diverse ecosystems on Earth, supporting more than 6,000 species of vertebrates alone. Its fish fauna, with some 2,000 species, of which sixty-two are endemic, exceeds all but those of the Amazon and Congo river basins. The wetlands harbor several threatened and endangered birds and mammals, including the eastern sarus crane, *Grus antigone sharpii*; the Bengal florican, *Houbaropsis bengalensis*; and the hairy-nosed otter, *Lutra sumatrana*, which was recently rediscovered after having been feared extinct. Sixty-five million people live there, too, 80 percent of them dependent on the river for their livelihood as farmers and fishers.

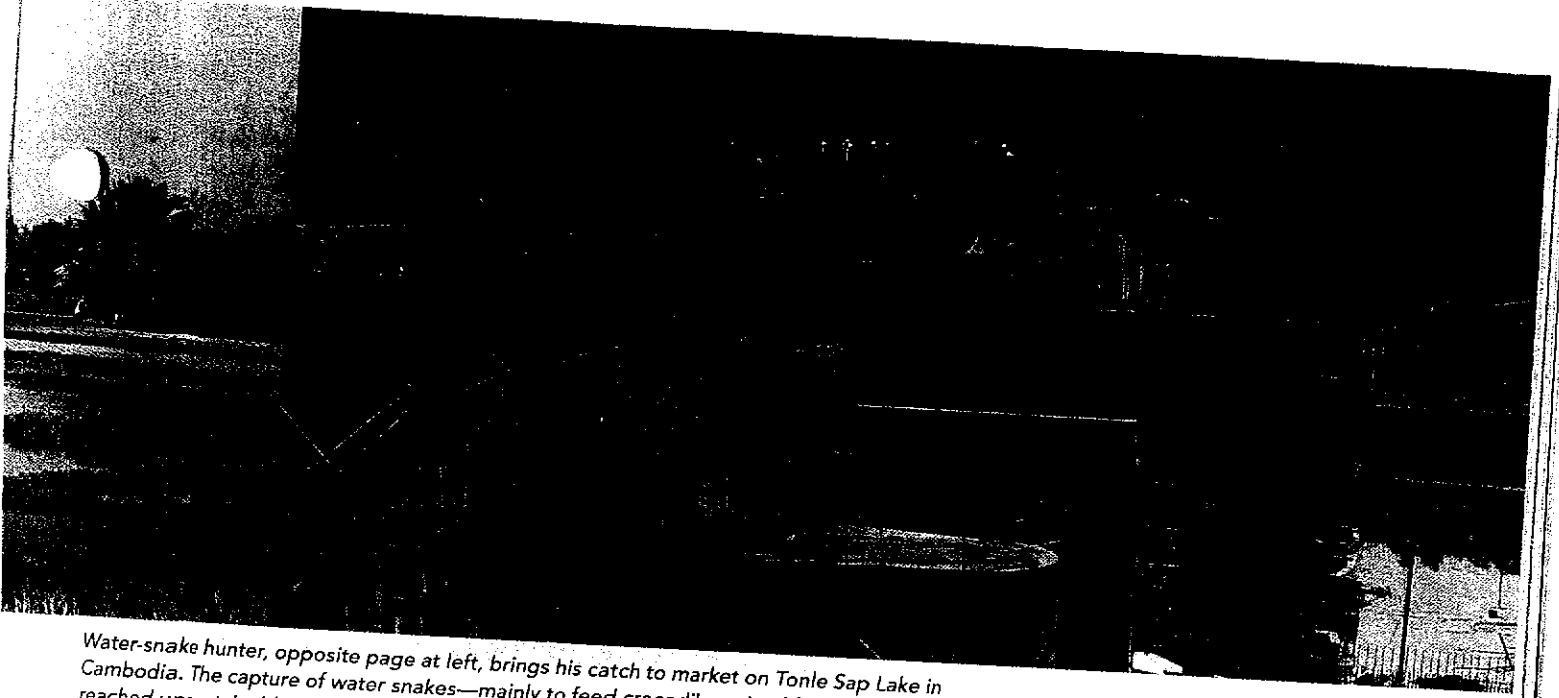
The Mekong River Basin is a microcosm of the Earth's freshwater resources—it includes almost all of the natural forms freshwater takes on Earth: groundwater, lakes, ponds, streams, and wetlands. (Wetlands are defined as shallow, often intermittently wet habitats, such as bogs, floodplains, marshes, and swamps.) Together, freshwater ecosystems cover less than 1 percent of the Earth's surface and hold a mere 0.008 percent of its water, but they support about

100,000 animal species—an inordinately large number for their size relative to marine and terrestrial habitats. That freshwater fauna includes a third of all known vertebrates and a whopping 40 percent of all known fish species.

Their rich biodiversity aside, freshwater systems bestow untold—and underappreciated—benefits on people. Indeed, they are the very foundation of our lives and economies. The value of all the services freshwater ecosystems provide worldwide, such as drinking water, irrigation for agriculture, and climate regulation, has been estimated at \$70 billion per year—a figure that assumes, rather delusionally, that one could purchase the services elsewhere if they became unavailable in nature.

Dams are a dramatic example of a human activity that degrades freshwater ecosystems. Built to control flooding, store water, and generate electricity, dams have numerous ecologically disastrous side effects. They impede the movement and migration of aquatic species; some kill animals in turbines; and they change the timing and amount of flow downriver, which interferes with the reproductive cycles of fishes, frogs, and water birds that depend on seasonal flooding.

About a dozen hydroelectric dams in the Mekong River Basin provide the bulk of the region's energy—and another hundred or so are in the planning stages. To date, China has built two dams across the upper mainstream, but there are none across the lower mainstream—in fact, the Mekong is one of the world's few major rivers with so few mainstream dams. That may soon change: local governments view the free-flowing Mekong as an underutilized economic resource. Worldwide, an average of two large dams have gone up each day for the past fifty years, and today there are more than 45,000 dams taller than forty-five feet. Fortunately, increased awareness of the environmental problems they cause has contributed to a slowdown of



Water-snake hunter, opposite page at left, brings his catch to market on Tonle Sap Lake in Cambodia. The capture of water snakes—mainly to feed crocodiles raised for their hides—has reached unsustainable levels. Workers tend a rice paddy in Laos, top center of these two pages; agricultural runoff degrades the Mekong's water quality. About a dozen dams now partition the river and its tributaries and several more are under construction, including the Nam Theun 2 dam in Laos, above right. Dams provide irrigation water and electricity for the region's growing population, but can harm wildlife.

large-dam construction in the United States and Europe. In the Mekong River Basin and elsewhere, however, big dams continue to rise.

Species along the Mekong, as in other freshwater systems, depend on natural flood cycles for nutrients and for transportation to and from spawning grounds. More than 90 percent of the fish species in the Mekong watershed spawn not in rivers, but in seasonal lakes or periodically flooded forests and fields. Flow patterns altered by dams and other projects could prevent those species from reproducing. In addition to building dams, countries along the Mekong are destroying or modifying rapids and other natural features to improve navigation—changes that will disturb critical fish habitats and alter downstream water flow.

Another destructive practice is crop irrigation, the biggest consumer of freshwater both along the Mekong and worldwide. Most of the water withdrawn from the Mekong goes to irrigating crops, mainly rice. Demand for irrigation water has risen dramatically in the past decade, as new acreage has come under cultivation and new irrigation schemes have enabled farmers to produce a second or third rice crop each year. Removing so much water from freshwater systems can be devastating for wildlife, exacerbating flow problems caused by upstream dams.

Worldwide, irrigation guzzles about 70 percent of the freshwater people use. To grow food for expanding human populations, people divert rivers, drain inland seas, and extract fossil groundwater collected over thousands of years, often at unsustainable rates. Worse, current agricultural

practices often waste as much water as they use: about half the water that flows through conventional irrigation systems never actually reaches a crop plant. A lesser—though still formidable—amount of water is siphoned off to slake the thirst of cities and industry, and when you add it all together, it's clear that people are using more than their fair share. The Mekong still manages to reach the sea. But at least ten other major rivers, including the Colorado, Ganges, Jordan, Nile, Rio Grande, and Yellow, now regularly run dry before they reach their outlets.

Agriculture, in addition to being the greatest consumer of freshwater, is also a major polluter—another bane for wildlife. In the Mekong River Basin, agriculture relies heavily on pesticides and fertilizers; it also drives deforestation, which causes erosion. Chemical, nutrient, and sediment runoff from farms winds up in the Mekong River Delta, where it degrades water quality, shifts natural nutrient cycles, and alters wildlife habitat. The six nations in the Mekong watershed have initiated a regional program to encourage agricultural development. If not done mindfully, the accelerated development could worsen water quality.

Other countries are already contending with the effects of major pollution. Fertilizer, pesticide, and livestock-waste runoff from farms in the American Midwest, for example, have created a dead zone at the mouth of the Mississippi River in the Gulf of Mexico. There, coastal algae populations thrive on the influx of nutrients and the misfortune of their natural predators, which are often curtailed by the pesticides. From spring until late summer, immense algal blooms rob the Gulf's water of oxygen. Such hypoxic conditions chase

the swimming creatures away and kill clams and other sedentary species on the spot. The Gulf's seasonal dead zone now encompasses more than 8,000 square miles, an area the size of New Jersey, every spring and summer. Much smaller dead zones occur on the Mekong, too. Worldwide, there are 146, every one increasing in size, intensity, and often duration.

Besides agricultural runoff, pollution from industry and municipalities is also a big problem for freshwater systems. In addition to contributing extra nutrients that promote algal overgrowth, municipal wastewater also carries thousands of chemicals from products used in daily life: cosmetics, soaps, pharmaceuticals, cleaning supplies, and more. Most of it winds up in aquatic systems.

The long-term consequences of dumping so many chemicals in the water are just coming to light. More than 200 species are thought to have adverse reactions

to endocrine disruptors—such as estrogen and its chemical mimics—that get into the environment via human and veterinary pharmaceuticals in wastewater and farm runoff. Sightings of frogs with deformities, such as extra legs, mushroomed in the Midwest about a decade ago. Ecologists think chemicals or an interaction between chemicals and parasites could be causing the deformities. Indeed, chemicals in freshwater may be a factor in the alarmingly sharp worldwide decline of amphibians.

Biological introductions to waterways, like chemical introductions, are extremely problematic. In their own communities, most species are held in check by natural predators or other environmental constraints. But organisms from afar can crowd, devour, or outcompete native species in their new neighborhoods, and can even change entire ecosystems. Most biological introductions by people are accidental, but some, such as fishes stocked for anglers or plants brought in to stabilize soils, are intentional.

Mimosa pigra, a spiny shrub native to the Americas and planted abroad as an ornamental or to control erosion, is now one of the world's worst aquatic invasive species. Once established, it quickly forms dense stands and outcompetes native plants. First spotted on the Mekong in 1979, it spreads in floodwaters and in truckloads of construction sand, and is now devastating parts of the watershed. The mimosa has taken over several irreplaceable wetlands,



Laotian fishmonger offers Mekong giant catfish for sale. The giant catfish, which can grow to nine feet long and 600 pounds, is now critically endangered.

protein and income, and they are overfishing numerous species—indeed entire fish assemblages in certain areas—as a result.

The Mekong giant catfish, *Pangasianodon gigas*, is just one of the region's struggling, overfished residents. Reaching nine feet in length and more than 600 pounds, it is the world's largest catfish [see photograph above]. With such grand proportions, a jackpot of succulent flesh that once sold at a premium to urban restaurants, the giant catfish was a fisherman's prize catch. In the mid-twentieth century, hundreds of giant catfish—a naturally rare species—were caught each year, but recently the annual catch has declined to fewer than ten. Overfishing is the main cause of the decline, but habitat fragmentation and alteration of spawning grounds by dams and navigation projects also contribute. Today, the giant catfish is critically endangered, its range is greatly restricted, and the average size of individuals is declining. In recent years, Cambodia, Laos, and Thailand have outlawed catching the giant catfish. But the species is migratory, so a regional agreement may be necessary to prevent its demise.

Fish aren't the only victims of overexploitation. As many as 10,000 water snakes are fished from Tonle Sap Lake each day. The water snakes mainly go to feed hungry crocodiles raised for commercial export; they substitute for fish, whose populations have declined. People are fishing down the food chain in the Mekong River Basin, as in

doubling its area almost every year in some places. Several endangered water birds that depend on native grasses for food and shelter are undergoing population declines as mimosa stands replace their habitat.

Controlling freshwater invaders and mitigating the damage they cause costs some 9 billion dollars each year in the U.S. alone. Yet the rate of invasions everywhere is on the rise as global commerce, trade, and travel increase.

So much for the organisms people add to freshwater systems. What about the ones—too many—that we take out? Overexploitation for food, medicine, and recreation poses a major threat to freshwater birds, crocodiles, fishes, frogs, and turtles, as well as some invertebrates. More than 40 million people rely on the waters of the Mekong River Basin for their

so many freshwater and marine systems. After depleting the top predators and the largest species, fishermen turn their nets on successively smaller organisms.

The upshot of all those assaults is that freshwater organisms rank among the world's most threatened species. Data on global trends are sparse, but what biologists do know paints a bleak picture of striking declines across taxa. Freshwater dragonflies, damselflies, mussels, fishes, amphibians, reptiles, birds, and mammals—all are suffering. To prevent a wave of irreversible extinctions and ecosystem collapses, people need to take better care of fragile freshwater habitats.

Fortunately, there is much people can do. We can remove obsolete dams and design new ones that take into account natural patterns of river flow. We can reduce the need for massive water extractions by changing the way we grow our food and our cities; more efficient irrigation techniques and increased capture of rainwater, even in wet areas, would help. Conservation may be the best "new" source of water, particularly as climate change begins to shift water supplies globally. We can start to reduce our polluting ways by avoiding harmful chemicals in the first place. In the end, keeping more water in freshwater habitats and maintaining its quality must be a top global priority.

The future of the Mekong lies in the balance. Today, it remains one of the world's least-degraded large rivers,

but the primacy of economic growth threatens to tip the balance towards decline across the entire river system. Still, there are hopeful signs. Several transboundary initiatives are in the works among the six nations that share the Mekong, which should help balance the needs of people and wildlife. Then there's the Mekong River Commission. Formed in the 1950s, the commission has moved away from its original focus on dams and irrigation projects toward more holistic management that takes environmental health into consideration. But the MRC is only as strong as the resolve of the governments it represents; China and Myanmar are not members, which may undermine its effectiveness in protecting the basin.

Internationally, the Ramsar Convention on Wetlands, with 155 signatory nations, guides conservation of 1,675 globally important wetland ecosystems. As with the Mekong River Commission, however, Ramsar's strength rests on the decisions of its signatories: it has no enforcement mechanism. It should come as no surprise, then, that—as with conservation choices in general—most decision makers have consistently chosen short-term economic gain over the long-term health of aquatic systems.

Current societies value few things more than gold. But though one can survive, even live well, without gold, the same is not true for water. Ultimately, the true value of gold is reduced to this: it can buy you fresh, clean water—if there's any for sale. □

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