THE Atlantic online The Atlantic Monthly | Digital Edition

August 1995

The Trouble With Dams

Some 100,000 dams regulate America's rivers and creeks, often at the expense of ecosystems--and of taxpayers, who are subsidizing handouts to a large number of farmers, floodplain occupants, hydro-electricity users, and river-transportation interests

by Robert S. Devine

SEVERAL years ago I spent a spring day looking around Lower Granite Dam, a concrete behemoth that stifles the Snake River as it winds through hilly farm country in southeastern Washington. A burly workhorse, Lower Granite bears little resemblance to graceful Hoover Dam and the other poster boys of the realm of dams.

The U.S. Army Corps of Engineers finished Lower Granite in 1975, making it one of the last monumental water projects completed in the United States. By 1980, after a fifty-year flurry of construction, the golden age of dam building was coming to an end, and

with it most of society's interest in dams. But the impact of those dams didn't end in 1980: every day we live with their effects, both beneficial and destructive.

When I looked upriver from Lower Granite, I saw a broad expanse of water extending up the canyon and out of sight. That water is the Snake River, of course, but it's also Lower Granite Lake. The Corps gave it that name after Lower Granite turned the thirty-three-mile stretch of river between itself and Lewiston, Idaho, into a reservoir. The new name conveys reality better than the old one; the nearly still water resembles a lake more closely than it does a river.

When I looked downriver, I saw another wide, sluggish body of water. This Snake River reservoir also has another name: Lake Bryan. Lake Bryan stretches thirty-seven river miles west to the back of Little Goose Dam. Beyond Little Goose two more dams make two more lakes out of the final seventy miles of the Snake, down to its meeting with the mighty Columbia River. At this confluence the Columbia, too, bears a second name: Lake Wallula. Of the 600 miles of the Columbia between the dam nearest the ocean and the Canadian border, only forty-seven miles have not been transformed by dams from healthy river ecosystems to impoverished reservoirs.

The extensive damming of the lower Snake and the Columbia is not exceptional. According to Arthur Walz, the chief of the Corps's Geotechnical and Materials Branch,

slightly more than 100,000 dams regulate American rivers and creeks. Some 5,500 are more than fifty feet high. Nationwide, reservoirs have inundated an area equivalent to New Hampshire and Vermont combined. Of the major rivers in the Lower Forty eight states ("major" meaning those more than 600 miles in length), only the Yellowstone still flows freely. "It's hard to find a river without a dam or one that hasn't been channelized," says Arthur Benke, a freshwater ecologist at the University of Alabama who has conducted widely cited research on the status of the nation's rivers. America is close to being the most dammed nation on earth, second only to China.

Being the world leader in dams was a point of pride during the go-go years of dam building. Dams epitomized progress, Yankee ingenuity, and humankind's impending triumph over nature. According to a children's book from the 1960s, we need dams to make rivers "behave." A 1965 Bureau of Reclamation booklet summed up the prevailing philosophy: "Man serves God. But Nature serves Man." The very success of the dam-building crusade accounts in part for its decline; by 1980 nearly all the nation's good sites--and many dubious sites--had been dammed. But two other factors accounted for most of the decline: public resistance to the enormous cost and pork-barrel smell of many dams, and a developing public understanding of the profound environmental degradation that building dams can cause.

Unfortunately, the fiscal mischief and environmental harm don't end when the construction of a dam ends; they just become harder to see.

HELPING RIVER BARGES

WHILE being shown the Lower Granite lock by John McKern, a biologist with the Corps, I witnessed a minor but telling example of our tax dollars at work. A lone fourteen-foot pleasure craft motored into the eighty-six foot-by-675-foot lock and tied up. The colossal gates closed, and the lock operator pumped in 43 million gallons of water to raise that little boat up to Lower Granite Lake--water that could have helped dying salmon survive, or could have generated enough electricity (about $700 worth) to supply an average house in the Northwest for one year. McKern said the lock operator tries to group boats together to reduce such prodigality, but usually that's not possible. Looking down on the boat, McKern shook his head and said, "It's crazy, isn't it?"

Locks on the Columbia-Snake system were built not for pleasure boats, of course, but for commercial vessels, primarily grain barges. Though giving a pleasure boat a $700 boost seems extravagant, rendering the Columbia and the Snake navigable for barges costs taxpayers a great deal more: tens of millions of dollars a year in direct

and indirect subsidies. Barge operators pay none of the dams' operation-and-maintenance costs, and until 1981 made no contribution toward construction costs. Now users are supposed to foot half the bill for any new construction, but loopholes effectively lower bargers' share of the cost. Nationwide the Corps budgeted $786 million in fiscal year 1995 for inland waterways. Taxpayers will provide about $700 million of that, most of which benefits firms with deep pockets, such as those of Cargill, ConAgra, and Continental Grain. Some 80 percent of the barges that ply our inland waterways are owned by twenty bulk-commodity and shipping heavyweights, whose combined revenues exceeded $160 billion last year.

Barging companies and their customers assert that the national interest is served by the subsidy, because it stimulates competition; in the absence of barges, surely the railroads, the other major transporters of bulk commodities, would heedlessly gouge their customers. David Forkenbrock, the director of the Public Policy Center at the University of Iowa, and an authority on inland transportation, doesn't buy this argument. He says, "To subsidize one mode of transportation so that another mode won't charge too much to the user is pretty perverse in terms of economic theory." Besides, Forkenbrock says, even if barges vanished and railroads did raise their rates, the amount of the price increase wouldn't begin to approach the amount of

the subsidy.

Forkenbrock sees the subsidy as a matter of simple avarice, abetted by Congress. He points to a 1992 proposal to reduce the subsidy: "That went over like a lead balloon in Congress, because states that benefit from cheap transportation objected strenuously, and water projects always have been pork-barrel efforts." Forkenbrock observes that the subsidy may soon rise. Some barging concerns are pressing Congress to fund the construction of bigger locks, which altogether would cost taxpayers billions. Lobbying by a coalition of river interests in the Ohio River system alone has secured more than $1.5 billion from Congress since 1986, nearly all of it earmarked for enlarging locks. Bargers say they need larger locks to ease the heavy traffic that is projected to occur during peak periods. Forkenbrock argues that barge traffic will be heavy only because it's subsidized. "If you charged a fair user fee to bargers, their competitive advantage would wither," he says.

THE DOWNSIDE OF FLOOD CONTROL

SOME of the least-noticed subsidies occur in the name of flood control. According to data collected by the Federal Interagency Floodplain Management Task Force in 1992, flood-control expenditures from 1960

to 1987 drained some $35-$40 billion from the U.S. Treasury. Much of that money was spent on storage dams, which waylay some of the down rushing water during floods, and on levees, which are meant to shield particular sites from rising floodwaters. The Army Corps of Engineers built most of the multi-state projects in the early years of the flood control program, which got rolling in 1917. More-recent projects typically serve much narrower interests, such as a few farmers, a small town, or developers who crave floodplain land. "In the nineteen fifties, sixties, and seventies projects got more and more local," says David Conrad, a water resources specialist for the National Wildlife Federation. "Now virtually no new flood-control projects have interstate elements." Congress's appetite for flood-control spending might be curbed if members had to vote openly on their pet projects instead of being able to tuck them deep inside hefty omnibus bills.

Another subsidy kicks in after floods occur. Taxpayers foot most of the bill for flood damage, in the form of disaster relief and subsidized federal insurance. But the very availability of government relief and insurance has caused costs to spiral. Before the government began bailing out flood victims, and before dams and levees promised protection, most people steered clear of floodplains. "No one built permanent structures on floodplains, because the risk was too great," says Scott Faber, the director of floodplain programs

for American Rivers, a conservation group. "Flood insurance and flood relief have interfered with the normal functioning of the market." Operating in actuarial reality, private insurers refused to issue flood insurance. "That should have told us something," Faber says. Farms, factories, and subdivisions, backed by the government, have poured onto floodplains--and floods have thus caused increasingly great losses. Annual flood damage to property has almost tripled in constant dollars since 1951, and currently averages $3 billion a year. As a congressional report states, "Floods are an act of God. Flood damages result from acts of men." In 1968 and 1973 Congress passed legislation that set up the National Flood Insurance Program. It hoped to legislate greater responsibility on the part of floodplain occupants--building houses that are less vulnerable to flood damage, for example, or avoiding floodplain development altogether--but the law's provisions were widely ignored. Congress amended the program in 1994, adding some teeth to the enforcement provisions, but the program still falls short of ensuring that those who benefit from federal programs have made a serious effort to avoid flood damage.

Disaster relief and insurance subsidies wouldn't be an issue if flood control projects controlled floods--but often they don't, as the Mississippi River floods of 1993 so forcefully demonstrated. Before rivers were controlled by engineers,

floodwaters spread out over floodplains, soaked in, and slowly drained back into the river. Now levees cut rivers off from their floodplains, sending floodwater down the straitjacketed main channel. The water flows unnaturally high and fast until it encounters a lower or weaker levee or an unprotected spot where it can burst from its confines. In many cases levees simply shift the site of flood damage. Jonathan Ela, a Mississippi River specialist for the Sierra Club, writes, "The touching pictures of volunteers placing sandbags on levees on either side of the Mississippi River in 1993 were essentially images of communities at war with each other."

In addition to the usual post-flood demands for higher levees and more dams, the 1993 floods prompted a widespread interest in solutions that don't involve structures--solutions that also cost much less. Some breached levees may not be rebuilt, and some of the remaining levees may be moved farther back, in order to restore part of the floodplain. For the first time, substantial federal disaster funds are being used for the voluntary relocation of residences and businesses--more than 8,000 have been moved so far--rather than solely for rebuilding on the same flood prone sites. "We've got this stock of older housing in the floodplain that gets repeatedly damaged," Faber says. "Texas, for example, got nailed again last fall. Texas gets nailed all the time. They have thousands and thousands of homes that have collected relief three or

more times." According to the General Accounting Office, nearly half of the billions of dollars paid out under the National Flood Insurance Program has gone to repeat flood victims who make up a mere two percent of the policyholders.

SUBSIDIZING IRRIGATION WATER

IRRIGATORS receive perhaps the largest and most varied subsidies of all, though just how much money these amount to is a notoriously arcane matter, and the figure is often contorted to serve political goals. Some of the most reliable information comes from Richard Wahl, who was for many years a natural-resource economist with the Department of the Interior and who left the government in 1992 to become a research associate at the University of Colorado. Wahl and his colleague Benjamin Simon estimate that from 1902 to 1986 Bureau of Reclamation irrigation projects cost taxpayers close to $20 billion in 1986 dollars. (The BR builds and operates most of America's public irrigation dams.) Wahl and Simon believe that the federal irrigation subsidy for 1989 was about $2.2 billion.

Most of this subsidy stems from the repayment deal enjoyed by irrigators. Their payments for BR water are supposed to reimburse the government for the irrigators' share of the initial capital expenses and for operation and-maintenance costs. But

repayments have been drastically reduced, by accounting stratagems and by congressional largesse--expressed most vividly by the fact that irrigators are exempt from paying interest. Wahl and Simon calculate that on average, BR irrigators end up paying only 12- 15 percent of the construction costs allocated to irrigation.

Consider the example of Westlands Water District, in California--one of the nation's largest. Westlands irrigators pay $8-$31 for an acre foot of water (the amount that would cover an acre with one foot of water) from the BR's Central Valley Project, a $3.4 billion network of dams and canals. If the irrigators' repayment included interest at modest rates, that acre foot would cost them $61-$80. Even this so-called full-cost figure comes nowhere near market prices in the thirsty West. Many cities pay $200 an acre foot. Avocado farmers near San Diego pay $300-$400. Santa Barbara has built a desalinization plant that will provide converted seawater, should it be needed, at $2,000 an acre foot. And bear in mind that most other growers pay even less for BR water than do Westlands irrigators.

Many in the irrigation community feel that they're just getting their fair share of the federal pie. Furthermore, they say, if their arrangement did constitute a subsidy (and many irrigators contend that it doesn't), the subsidy would be justified because irrigated agriculture has stimulated a great deal of economic activity and tax revenue.

Irrigators also like to remind us of their essential product: "Water on the Farm Is Food on Your Table" reads the metered postage strip on mail sent from Westlands. Apparently our food supply would be imperiled should the irrigation subsidy be reduced. Don Upton, a Westlands spokesman, says that "a full cost rate is not affordable" and would drive many farmers out of business.

David Yardas, a water-resources analyst in the California office of the Environmental Defense Fund, disagrees. He asserts that only a few marginal operations would shut down, most of them on poor land that the BR never expected to be brought under cultivation in the first place. "There are many places in California," Yardas says, "where customers of the Central Valley Project are right across the road from farmers using the state project. The state guy may be paying forty dollars an acre foot, while the CVP guy is paying fourteen or eleven or eight dollars." Yet, Yardas says, the state farmers haven't gone out of business. Typically the subsidy represents a higher profit margin, not the margin of survival.

Irrigation subsidies often contribute to the wasting of water, a major concern given that farmers account for 80--85 percent of the West's water consumption. For instance, earthen canals leak profusely, yet many irrigation districts haven't lined them; the subsidized water that seeps away is so

cheap that losing water is less expensive than paying for lining. A great deal of water vanishes from fields. Instead of using advanced sprinkler systems, drip irrigation, or other frugal means of watering crops, many farmers still rely on inefficient sprinklers or even flood irrigation, surrendering a huge volume of water to evaporation and seepage. According to two government studies of irrigation conducted in the 1970s, such wasteful practices squander more than 20 million acre feet a year in the West--almost twice the average annual flow of the Colorado River. Furthermore, the availability of cheap water encourages farmers to lavish it on inappropriately thirsty crops. For example, Westlands is carved from a desert that gets only six or seven inches of rain a year, yet the district's biggest crop by far is cotton, a plant that guzzles more than thirty inches of water a year.

Cotton figures in the controversy over the "double dip": the use of subsidized water to grow subsidized surplus crops. In addition to receiving Bureau of Reclamation water in some regions, cotton is almost always declared in surplus by the U.S. Department of Agriculture, making cotton growers eligible for certain USDA payments. Since the putative intent of the surplus-crop program is to scale back the production of crops that are overabundant, it seems perverse to stimulate production by allowing growers of surplus crops to use subsidized water. According to the USDA,

farmers use about $85 million worth of subsidized water each year to grow surplus crops for which they also receive about $500 million from the USDA.

Senator Russell Feingold, of Wisconsin, has railed against "paying people not to produce and then, with a different hand, paying them to produce." Feingold is the latest of many who have challenged the double dip. In February he introduced a bill that would either require users to pay full cost or eliminate the USDA portion of the subsidy. Feingold says that he has never heard a reasonable justification for the double dip from its supporters. When asked about it, "they don't respond, they just vote you down," he says. "They don't really want to talk about it." That's putting it mildly. During a phone interview with Congressman Bill Thomas, of California, whose Central Valley district includes major cotton producers, I broached the subject of the double dip. Angrily he cut off my question, asserting--incorrectly--that cotton is not commonly a surplus crop. He curtly added--again incorrectly--that farmers are required by law to pay full cost for federal water. He ignored my follow-up questions and then abruptly ended the conversation.

Though the abrasiveness of Thomas's defense was extreme, it has long been common for congressmen to protect influential constituents' dam related subsidies fiercely. But the budget-cutting

fervor of the new Congress may change attitudes toward these subsidies. Members who have crowded aboard the budget-cutting bandwagon will look hypocritical if they "continue to pork it up," as Feingold puts it. Besides, some members of Congress, including a few on key budget committees, seem sincere in their desire to shrink the federal government and reduce the deficit. "Many items that had been sacrosanct . . . are now getting a new look," Feingold says. Still, Feingold and most other critics of dam-related subsidies remain skeptical. David Yardas sums up the prevailing perception: "Increasing attention is being paid to subsidies, but I don't know that that translates into a willingness to do very much about them."

When tax dollars first started paying for dams, they frequently fit one dictionary definition of "subsidy": "a grant of money from a government to a private enterprise considered as beneficial to the public." For example, the Bureau of Reclamation began building irrigation dams in the early 1900s to encourage small farmers to settle the West, a widely approved national goal. But now that California's population roughly equals that of New York and New England combined, and most of the benefits go to prosperous farmers, including many big agribusiness operations, irrigation subsidies are difficult to construe as being in the national interest. Most dam-related subsidies, too, have outlived their original rationales.

DAMAGE TO THE ENVIRONMENT

ON the south side of the Lower Granite complex a Rube Goldberg apparatus of metal chutes and ladders angles from the top of the dam down to a dock a few hundred yards downriver. When I visited the dock that spring day several years ago, workers were loading a shipshape red-and-gray Corps barge. They had positioned a large pipe so that water from the apparatus poured into the hold of the vessel. The gushing water was filled with thousands upon thousands of silvery finger-length fish: young salmon, called smolts. In the spring smolts from innumerable spawning streams spill into the Snake and drift downriver, starting their anadromous life cycle by heading for the Pacific. At Lower Granite the Corps annually funnels, sorts, and pipes 6-9 million of these fish into barges. The barges haul the smolts hundreds of miles, past the seven additional dams that lie between the salmon and the sea, and dump them into the lower Columbia. The Corps calls this procedure "fish transportation."

Whether transportation is the best way to help the salmon is arguable; many scientists think that barging kills more smolts than it saves. But no one questions the need to help the migrating fish. The dams have so transformed the river that, as one Idaho Fish and Game supervisor puts it, "sending them down the river would just be sending them

to their death."

Such transformations lie at the heart of the ongoing environmental harm done by dams. Rivers are rivers because they flow, and the nature of their flows defines much of their character. When dams alter flows, they alter the essence of rivers.

Consider the erstwhile river behind Lower Granite. Although I was there in the springtime, when I looked at the water it was moving too slowly to merit the word "flow"--and Lower Granite Lake isn't even one of the region's enormous storage reservoirs, which bring currents to a virtual halt. In the past, spring snowmelt sent powerful currents down the Snake during April and May. Nowadays hydropower operators on the Columbia and Snake systems store the runoff behind the dams and release it during the winter, when demand--and the price--for electricity rises. Over the ages, however, many populations of salmon had adapted to the spring surge. The smolts used the strong flows to migrate, drifting downstream with the current. During the journey smolts' bodies undergo physiological changes that require them to reach salt water quickly. Before dams backed up the Snake, smolts coming down from Idaho got to the sea in six to twenty days; now it takes from sixty to ninety days, and few of the young salmon reach salt water in time. The emasculated current is the single largest reason that the number of wild adult salmon migrating up the Snake

each year has crashed from predevelopment runs of 100,000 200,000 to what was projected to be 150-175 this year.

One untested but promising alternative to barging, termed a drawdown, calls for dam operators to reduce the volume of water in several reservoirs before the main salmon migration. Full reservoirs sprawl far to the sides of the main channel. Currents dissipate in these virtual lakes the way a stream of water from a hose melts into a full swimming pool. If dam operators lower the reservoir levels, the water will contract to a more riverlike depth and breadth. If dams are drawn down just before the spring melt, the flows sweeping down from Idaho will presumably send smolts through the narrowed reservoirs relatively quickly. Another alternative to barging would be for dam operators to release much more water during the spring migration; the greater the volume of water that flows into a reservoir, the faster the current will move. This would leave less water for lucrative winter power production and lead to a rise in utility rates, but because they are generously subsidized, they would still be well below the national average. Even a modest rate increase could be offset by creative marketing. Northwest hydropower-plant operators could run water through their turbines in spring and early summer to help the salmon, and sell the electricity to southern California and the Southwest, where power fetches a good price during the air-conditioning season. In the winter, when demand for power in those

areas slackens, the operators in southern California and the Southwest could sell electricity to the colder Northwest during its period of greatest need.

In the Southeast the Ocoee River, which is managed by the Tennessee Valley Authority, offers an example of another flow problem. On certain days a stretch of the Ocoee roars along, a frothing wild thing beloved by white-water rafters. But on other days and at night TVA dam operators lower the gates and divert the river from that stretch to a flume that leads to a powerhouse, emptying the riverbed. A few other rivers across the nation are dried up by hydropower operations and irrigation withdrawals, and many more suffer from reduced flows. The effects on aquatic life are predictably severe.

Keeping enough water in rivers is especially difficult in the arid West. Western water law in particular stifles reforms that would restore at least moderate in-stream flows. Formulated in the nineteenth century by miners, ranchers, and irrigators, the West's water laws reflect two hoary principles: "First in time, first in right" and "Beneficial use." The first principle means that whoever first claimed a certain amount of water always gets his share ahead of junior claimants--except that claims from Native Americans, who got there long before the pioneers, are rarely sustained.

The second principle narrowly construes "Beneficial use" to mean consumption by

agriculture, industry, or cities. In western-water-law doublespeak water thus used is "conserved," and water that flows down the river to the sea is "wasted." During the past couple of decades the water laws of most western states have reflected a growing understanding that water left in the stream for the welfare of the ecosystem is also beneficial. But the relatively recent legal recognition of the river ecosystem makes it a very junior claimant under the "First in time, first in right" doctrine, so rivers seldom are allowed to retain much water. Given that irrigators use 80-85 percent of the water available in the West, western water law clearly needs to be revised to provide more water to the environment and to the region's booming cities. As Congressman George Miller, of California, has said, "It is not the dead hand from the grave that should dictate water policy today."

Bob Faber, the new staff director for the House Water and Power Resources Subcommittee, says that in some cases dams can solve the problem of low flows. This idea was echoed by the person to whom Faber reports: Congressman John Doolittle, of California, the new chair of the subcommittee and an influential dam booster from a district with considerable irrigation interests. Faber points out that certain uses of dams (irrigation comes to mind) require the release of ample, consistent amounts of water during times when some river flows are naturally low.

He says this release improves the environmental health of those rivers: "Having adequate and predictable water supplies to provide in-stream flows is made possible only by dams. In the pre-dam era a lot of tributaries at times had low flows or went dry, but if they have dams above them, they now can maintain water flows at rates that weren't possible before."

Faber misses the essential ecological point, however. Only low flows caused by dams or other human manipulation should be augmented. Natural low flows should be left low. Our industrial-society minds may associate constancy with productivity, but river animals and plants evolved to wild rhythms that include low flows, high flows, and everything in between. Native river organisms can survive such oscillations, and many can't survive without them. If rivers are to recover, regulated flows must mimic natural flows.

Artificially regulated flows produce many specific problems. Without high flows, silt doesn't get flushed from streambed gravel, and the many species of fish and insects that need clean, well-oxygenated gravel for their eggs and larvae are harmed. Relatively constant flows often lead to relatively constant water temperatures, which affect the many species that rely on natural fluctuations in temperature. For example, the adults of a vital species of stone fly in the Flathead River in Montana don't emerge from their larval stage unless cued by mean

daily water temperatures of 65 Fahrenheit. Late-summer discharges from Hungry Horse Dam keep the water cooler than is natural, so whole generations of this insect never reach adulthood.

Dams can alter water temperatures in other deleterious ways. In most places irrigation water is stored until summer. This creates unnaturally shallow flows below dams at other times of the year, which in turn causes the water to become abnormally warm. As the water warms, it loses oxygen, and river organisms begin dying. By the same token, flows are unnaturally deep and therefore abnormally cold during the summer.

Another common problem occurs when dams release water that is significantly colder or warmer than the river water. For example, releases from Glen Canyon Dam render the Colorado River too cold--some 20 degrees colder than is natural--for most native organisms for more than 250 miles downstream. "The river is essentially dead," says Jack Stanford, a professor of ecology and the director of the University of Montana's Flathead Lake Biological Station. Except for one twelve-mile stretch, the river below the dam has lost its ability to support algae, which in turn has led to the collapse of the river's food web. "You can put a drift net in the river for fifteen minutes and catch one or two insects," Stanford says. In a pristine Colorado one would expect to net hundreds, thousands, or even tens of thousands. The cumulative impact of

disrupted temperatures can be dramatic. A study of the Saskatchewan River found that insects from thirty families inhabited a pristine stretch, but insects from only one family survived in a section below a dam. Temperature problems can be mitigated by retrofitting dams with selective water-withdrawal systems. These give dam operators the option of releasing water from whichever stratum of the reservoir best matches the temperature of the water downriver. Hungry Horse Dam, for example, is undergoing this expensive process and by next year should be providing stone flies with the temperatures they need.

Dams not only disrupt the flow of water; they also virtually cut off the flow of sediment. When the current dissipates in the reservoir, its load of suspended particles sinks to the bottom, trapped for the life of the dam. Very little slips by a large dam. Studies show that Glen Canyon Dam captures 99.5 percent of the sediment tumbling down the Colorado. The trapped sediment includes organic matter, which is vital to downriver food webs. Sandbars where plants have grown in and alongside a river- important wildlife habitat--constantly erode; without sediment with which to rebuild, they soon vanish. The same holds for riverbanks.

The loss of replacement sediment also leads to the lowering of the riverbed, which harms the riparian zone--the land along a

river that derives its character from the river. As the channel deepens and the elevation of the river drops, the water table beneath the riparian areas drops correspondingly. This dries up those lush, elongated oases that are such important havens for wildlife--and for human beings.

Cottonwoods, for example, need high groundwater levels. The demise of these riverside staples robs the stream of shade, which can lead to lethally high water temperatures; causes excessive erosion, because the stabilizing influence of the trees' roots is gone; and deprives the fungi and bacteria at the foundation of the aquatic food web of the nutrients provided by cottonwood leaves, a crucial food source.

Even lands far from dams are affected by a radical decline in transported sediment. Without replacement sediment from the Mississippi River, much of the Louisiana coast has sunk below sea level, allowing a disastrous intrusion of salt water. The Army Corps of Engineers estimates that during the next fifty years parts of the Gulf shoreline will advance as much as another thirty miles inland and an additional million acres of coastal wetlands will sink from sight. In addition to the many other benefits they bring, these wetlands are integral to almost half of the nation's shrimp harvest.

Though researchers have discovered numerous examples of environmental disruption caused by dams, they realize that they have barely scratched the surface. The

cliche is apt, because little of what goes on below the surface of rivers has penetrated the landlocked biases of Homo sapiens. The studies that have been done indicate that dams have been disastrous for river ecosystems. Larry Master, the chief zoologist of The Nature Conservancy, says, "Dams have been the dominant factor in the decline of aquatic fauna in this country." He goes on to characterize the current health of America's aquatic fauna as "appalling." Master's judgment carries particular weight, because he has led the most comprehensive study to date on the status of the nation's freshwater animals.

So far Master and his colleagues have studied four broad groups of river fauna and have found that all are in trouble: about 20 percent of dragonfly species, 36 percent of fishes, 64 percent of crayfish, and 67 percent of freshwater mussels are either extinct, imperiled, or vulnerable. Embattled though they are, terrestrial fauna are faring comparatively well: 14 percent of birds and 16 percent of mammals are extinct, imperiled, or vulnerable by Master's standards. David Allan, an aquatic ecologist at the University of Michigan, observes that many species not yet officially endangered are in decline--some to the point at which the functioning of their river ecosystems is substantially altered. There is also evidence that the rate of decline is accelerating. Research by the American Fisheries Society suggests that the rate of extinction for North American fish species has doubled during

the past century. From 1979 to 1989 the AFS added 139 species and subspecies of fish to its list of rare and vanishing fishes of North America and removed only twenty-six--sixteen owing to technical adjustments, ten because they had gone extinct, and none because they had recovered.

THE DEMOLITION OPTION

IS there such a thing as a good dam? That's a legitimate question, given the myriad environmental and fiscal problems that dams cause. I asked Larry Stephens, the executive director of the United States Committee on Large Dams, an industry group, to name some good dams, which I broadly defined as dams whose benefits clearly outweigh their monetary and environmental costs. Quickly he cited Hoover Dam and Grand Coulee, and then he paused. Finally he said that of course there were others but they just didn't come to mind. Undoubtedly other good dams do exist, but it is revealing that of the 5,500 large dams in America, only two stood out immediately. Equally telling is the fact that Hoover and Grand Coulee were completed in 1936 and 1941 respectively, which supports the widespread belief that the best sites were used long ago. The U.S. Geological Survey has quantified one aspect of the decline in the quality of sites: the amount of reservoir capacity created by each cubic foot of dam plummeted from

10.4 acre feet for dams built prior to 1930 to 2.1 acre feet for those built in the 1930s and to 0.29 acre feet for those built in the 1960s.

In retrospect, it seems that a number of dams should never have been built. But they were, and they aren't going away anytime soon--at least not many of them. Some egregiously harmful dams that lack influential constituencies may be demolished. Numerous government agencies, Native American tribes, and conservation groups hope to remove two dams from the Elwha River, in Washington, one inside Olympic National Park. But demolition isn't an option in most cases. For one thing, communities and industries are too closely tied to most dams. For another, removing just the two Elwha dams--one is 210 feet high and the other is 100 feet--will cost about $70 million. Omitting the expense of removal from financial calculations constitutes yet another big subsidy. All those aging dams are a fiscal time bomb of many megatons.

Where the demolition of dams won't do the job, we'll have to settle for wise management. Most current practices and policies still hark back to the go-go era and even beyond--to pioneer days. But tremors of reform have been felt in recent years, and the time seems ripe for a major shake-up.

Ironically, if water policy gets dragged kicking and screaming into the age of limits, we'll probably find that we have more than enough water to go around. For

one thing, we squander so much that following through on just the easiest conservation measures would save vast amounts of water. One study estimated that in the West a seven percent reduction in the share used by agriculture (halving irrigation waste would accomplish that goal) would allow a 100 percent rise in all other uses. For another thing, the more than 100,000 dams already out there provide an awful lot of available water.

Should we ever build another dam? Sure. Sometimes, in some places, some kinds of dams will make sense. But when you hear calls for more dams because of global warming, the depletion of oil reserves, a trend toward a drier climate, or the latest flood, think twice: once about your tax dollars and once about your environment.

Robert S. Devine is a freelance writer whose articles have appeared in *Sierra*, *Audubon*, and *Wilderness*. He is writing a book about dams.

The Atlantic Monthly; *August 1995; The Trouble With Dams; Volume 276, No. 2; pages 64-74.*