Dams and Migratory Fish

(An excerpt from **Silenced Rivers: The Ecology and Politics of Large Dams**, by Patrick McCully)

"You fish people are very skilful in getting these fish into cans. Cannot you be just as skilful in getting these fish to be raised up over a dam?"
- Comment at public hearing on a proposal for the first dam on the mainstream of the Colombia River, 1924

The annual run of adult salmon and steelhead trout in the huge Columbia River basin — which covers an area larger than France — is estimated to have averaged between 10 and 16 million fish before non-native settlers first arrived in the 19th century. Today, after decades of decline due overwhelmingly to the 130 or so dams in the basin, only some 1.5 million salmon and steelhead enter the Columbia each year, and around three-quarters of these are hatchery-reared, rather than wild, river-spawned fish. The National Marine Fisheries Service have estimated the cost of salmon fishery losses due to dams in the Colombia Basin for the period between 1960 and 1980 alone at $6.5 billion.

Salmon and steelhead are anadromous fish, meaning that they are born in freshwater, migrate to the ocean to mature and then return to rivers to spawn, and, in the case of most salmon, die. Salmon always return to the same stretch of river or shallow lake bed where they hatched. Fish which return to different rivers at different times of the year are known as 'stocks'; different stocks are genetically distinct and generally only breed with other fish from the same stock. Out of the original 400 or so salmon and steelhead stocks of the US Pacific coast only 214 remain, out of which 169 are at high or moderate risk of extinction.

The simplest way to wipe out large numbers of salmon stocks is to build a dam without fish ladders or other means of allowing salmon to surmount it and reach spawning sites upstream. The massive Grand Coulee Dam was built without any fish passage facilities and cut off from the sea nearly two thousand kilometres of salmon spawning grounds on the upper Columbia, eliminating a fishery worth a quarter of a million dollars a year. An estimated 30 to 50 per cent of the original anadromous spawning habitat on the Colombia Basin is now either submerged under reservoirs or blocked by dams without adequate bypass facilities.

While most adult salmon swimming upstream can negotiate their way up fish ladders, the slackwater of reservoirs faces a much more formidable barrier to their offspring. The downstream migration of the juvenile salmon, or smolts, can be fatally delayed by the time needed to drift and swim through multiple reservoirs — if the smolts do not reach the sea within around 15 days after spawning they may lose their downstream swimming behaviour and their ability to switch from a freshwater to saltwater environment. During years of relatively low flow, smolts from the upper Snake River, the Columbia's main tributary, can now take up to 39 days to swim to the sea, compared with less than three days before the dams were built.

Besides the effects of a delayed journey to the sea, the smolts also face the threat of being eaten by the many predator fish in reservoirs or by birds which find rich-pickings where the often stunned fish emerge at the foot of dams. The surface layer of a reservoir can become so warm that it is lethal to young salmon, while the cooler, deep water can be fatal due to oxygen depletion. The concentration of pollutants in reservoirs can also add to the stress suffered by migrating smolts and increase their susceptibility to disease. Yet another lethal obstacle to both adults and smolts is 'gas-bubble disease', the piscine version of the 'bends' suffered by scuba divers, which is caused by the supersaturation of water with atmospheric gases at the bottom of spillways during high flow years. The cumulative impact of these threats is that more than 95 per cent of upper Snake River smolts may die before reaching the ocean.

The pattern of destruction on the Columbia and the other rivers of the US Pacific seaboard has been repeated elsewhere. The Atlantic salmon population in the United States declined from half a million in the early 18th century to a few thousand, mainly hatchery-reared, fish in the 1990s. By the end of the 19th century, dams had eliminated Atlantic salmon from France's Dordogne, Meuse and Moselle. During the 20th century salmon have disappeared from the Garonne and the Seine. The Loire and its tributary the Allier are now the only long French rivers which can sustain wild salmon.

Other anadromous species such as lamprey eels and sturgeon have also suffered calamitous declines due to the loss of habitat behind dams. The number of lampreys in the Colombia has fallen to less than one per cent of the 400,000 recorded when dams were first built in the lower basin. Dams and pollution have reduced the numbers of the pallid sturgeon of the Mississippi-Missouri to such low levels that it is no longer certain they are reproducing in the wild.

The impacts of dams on migratory fish other than salmon and a handful of other species are largely unknown but have probably been just as severe as those on salmonids. The hilsa, a migratory fish of great commercial importance in South Asia, was deprived of 60 per cent of its previous spawning areas on the Indus by Pakistan's Gulam Mohammed Dam; while the Stanley Dam wiped out the hilsa from the Cauvery River in south India. The Sardar Sarovar Dam is likely to eradicate the Narmada hilsa fishery, probably the most productive left in India. Although the hilsa is not thought to migrate as far upstream as the dam, the drastic reduction in river flow due to diversions for irrigation would make its spawning migration impossible. The giant freshwater prawn, another commercially important migratory species found in the Narmada would likely suffer a similar fate. The other important hilsa fishery in western India, in the estuary of the Tapi River, just south of the Narmada, has already been affected by the Ukai Dam.

The long term survival of river dolphins, which are found in South America and Asia, is seriously threatened by dams which form impassable barriers and fragment the already small populations of dolphins into genetically isolated groups. The drowning of river habitat, downstream changes in river water quality, and the reduction in the numbers of their fish prey are also killing dolphins. The population of the Indus dolphin, the bhulan, is now split up by dams and barrages into five or less isolated groups of which only two may be genetically viable. The Three Gorges Dam could deal the final blow to the Yangtze river dolphin, the baiji, one of the world's most endangered species, with only 150 to 300 animals left. Other aquatic mammals such as the manatee also suffer habitat fragmentation and other harmful impacts when dams are built.

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