Environmental Case Study

Columbia River Salmon

Until about a century ago, as many as 16 million salmon and cutthroat trout migrated every year up the Columbia River system to their breeding grounds in small headwater streams and lakes over a watershed larger than Texas (fig. 13.1). This was probably the greatest anadromous fish (spend part of life cycle in fresh water and part in saltwater) migration in the world. Some fish swam up to 2,000 km (1,250 mi) from the mouth of the Columbia on the Pacific coast to its headwaters in British Columbia or up tributary streams such as the Snake and Salmon Rivers in what is now Idaho. The fish were marvelously adapted to this remarkable journey. At least 420 separate stocks (or ecotypes) differed in the timing of their run and the subtle chemical signals they followed to find the stream where they hatched at exactly the right time for water conditions and food supplies to support their offspring. Adult salmon die after spawning and their decaying bodies nourish the ecosystem on which fry and fingerlings (young fish) will depend. The adults, each weighing as much as 45 kg (100 lbs), represent an enormous influx of nutrients into the small streams where they breed. Studies have shown that up to half of the nitrogen in riparian (stream side) vegetation in some streams comes from migrating fish. Without dead fish, the whole ecosystem is impoverished.

Both native people and wildlife in the Pacific Northwest depended on this prodigious bounty. For a few months every year there were more fish than anyone could eat. The runs were probably never uniform, however. For reasons that we don’t fully understand, the number of fish returning from the ocean often would vary as much as 50 percent from year to year. Even now, we don’t know where salmon go during the 2 to 5 years adults spend in the ocean or exactly what they eat while growing to such enormous sizes. Undoubtedly, changes in ocean temperature, circulation patterns, and food supplies caused by phenomena such as the El Niño/Southern Oscillation (chapter 17) affect population sizes. There seems to be a 40-year cycle, for instance, when salmon runs in Alaska are high and Columbia runs are low or vice versa. Before European settlement, however, these variations didn’t matter much because there were more than enough salmon for everyone.
Salmon runs in the Columbia have undergone a disastrous decline during the past 80 years (fig. 13.2). Total numbers are down nearly 90 percent from historic highs, and only about one-tenth are now wild stocks; the rest are hatchery-reared. There are many reasons for this decrease. Overfishing by commercial operations has taken a toll. Runoff from logging, agriculture, road building, and urban areas carries warm water, sediment, and pollution that kill eggs and fry. Irrigators pump water from the river, reducing its flow. Perhaps the greatest threat to the salmon are dams that block migration. Over the past century 124 huge dams have been built on the Columbia along with 55 more on its tributaries. The river has become a chain of reservoirs. Except at its mouth, only 70 km (44 mi) of the Columbia runs free today. Fish ladders (stair step pools) help some adults move upstream but smolt (young fish), which depend on river currents to help them downstream, get lost in the slack water behind dams. Whole populations of smolt are now being barged downstream to get them past dams and reservoirs but many fail to survive anyway.

Hatchery rearing of salmon began on the Columbia in the 1890s. Rather than stem the decline, unfortunately, releases of hatchery fish often have exacerbated problems. Only a few genetic strains are bred in hatcheries rather than the hundreds of wild stocks. Hatchery fish have been selected for fast growth, early maturity, and aggressive behavior. This allows them to interbreed with and outcompete native stocks. With much of their original genetic diversity gone, the fish now lack the subtle adaptations that are
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needed to migrate to remote streams at just the right time. At least half of the original wild salmon runs on the Columbia are now extinct and almost all that remain are in serious trouble.

In a population that fluctuates as widely as salmon, it is difficult to detect patterns until long after critical events occur. If fewer fish show up this year compared to last, is it just a natural variation or an omen that something is wrong? The last big run on the Columbia River occurred in 1924 when the commercial harvest was nearly 19 million kg (42 million lbs). By the time fishwheels were prohibited in 1935, or when seines, traps, and set nets were banned in 1950, the population was already in a catastrophic decline. By 1991, when the Snake River sockeye was added to the endangered species list, only four of these fish made it to their spawning grounds in Idaho’s Sawtooth Mountains. Since then, five other runs (Snake River spring and fall chinook, Umpqua River cutthroat, and lower Columbia chum and chinook) have been added to the endangered species list while others are under consideration. Fishers and recreationists are urging the government to destroy at least four of the dams on the Snake to allow the river to run free again. Industries and residents of the Columbia River basin, who enjoy some of the lowest electric rates in the nation oppose this plan.