Managing the Columbia River system to help fish

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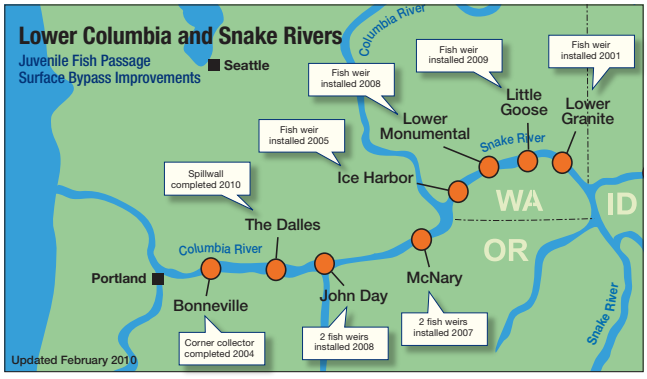
Fish migrating through the Columbia and Snake rivers today must pass up to eight federal dams built in the last century to provide hydropower, flood control, irrigation, navigation and public recreation.

In recent decades, the U.S. Army Corps of Engineers, which owns and operates these dams, has dramatically improved fish passage through them. Working together with federal and state fish and wildlife agencies and Northwest tribes, the Corps has added juvenile fish passage systems to these dams and reconfigured the way water is passed through them. Most of these improvements have been funded by Bonneville Power Administration ratepayers, that is, by Northwest residents through their electric bills.

As a result, downstream juvenile salmon and steelhead passage through the federal hydro system today is as good as or better than it was when there were only four dams on the lower Columbia and Snake rivers, according to the National Oceanic and Atmospheric Administration. Returning adult survival through the dams is similar to or better than levels observed in natural rivers.

Here's an overview of how the river system has been remodeled and is managed today to help fish migrate.



Custom water-surface routes through each dam are proving highly successful for safe fish passage.

Federal Columbia River dams have been revamped and their operation overhauled to help juvenile salmon survive their downstream migration.

Spring and summer fish operations

Salmon and steelhead are born in fresh water, migrate to the sea as juveniles, spend their adult lives in the ocean and return to their natal waters to spawn.

As juvenile fish approach each dam in their downstream migration, they either pass through the dam via one of several routes or are collected, transported by barge and released below Bonneville Dam. River routes past each dam include spillways, a new surface bypass system, an older bypass system or the turbines. Throughout the year, the Columbia River system is carefully operated to help juvenile fish survive passage through the dams and reservoirs.

Salmon and steelhead have several ways to pass each dam, including new systems that make passage safer for fish.

The biggest push occurs from April through August during the downstream migration when river flows are managed to help juvenile fish reach the ocean in a timely and safe manner. Specifically, river operations support protection and recovery efforts for 13 salmon and steelhead species in the Columbia, Snake and Willamette rivers listed as endangered or threatened under the Endangered Species Act (see map on page 3).

In addition to listed fish, these operations also generally aid all migrating smolts in the river as well as some resident (nonmigrating) fish.

A 2008 biological opinion on Columbia River hydropower operation issued by NOAA Fisheries lays out the steps that are carried out by what are called the "action agencies," the U.S. Army Corps of Engineers, U.S. Bureau of Reclamation and BPA. These operations are not static. They are carefully choreographed to respond quickly to changing water and temperature conditions and to the migratory patterns of the fish. The idea is to provide the greatest benefit when the most fish are present in the river.

Key river operations include:

Spill: Spill is used to help fish in the river pass through a fish weir or spillway instead of a dam's turbines or older bypass systems. A portion of the river's flow is spilled during spring and summer for salmon migrating in the river. More spill is not necessarily better, because too much falling water can trap nitrogen bubbles and cause an illness in fish similar to "the bends" in humans.

Flow augmentation: Each year, coordinated water releases from upstream storage reservoirs augment flows during the juvenile salmon migration. Flow augmentation is designed to simulate a natural freshet that helps speed fish on their journey between dams and to the sea.

Transportation: While many smolts make their downstream journey in the river, in most years roughly half the smolts arriving at four dams are collected and transported through the hydro system on barges. These fish are released below Bonneville Dam to complete their migration to the sea. Approximately 98 percent of the transported juveniles survive to the point of release below Bonneville Dam. There is evidence that transportation especially improves juvenile survival in dry years, such as 2001. During such years, spill may be decreased and more fish transported.

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Help for resident fish: In addition to these efforts for salmon passage, BPA and the U.S. Army Corps of Engineers manage spring flows from Montana's Libby Dam to benefit the endangered Kootenai River white sturgeon and for other fish that reside in that river.

Winter fish flows and reservoir operations

From chum below Bonneville to burbot below Libby, major dams throughout the region also are operated throughout each winter to help fish.

In autumn and winter, between juvenile salmon runs, most major storage dams on the Columbia River system and several major run-of-the river projects are still operated to support the needs of fish, such as to protect spawning beds for next year's brood. Fall and winter fish operations establish minimum streamflows for weeks and months at a time on specific river reaches. Natural streamflows vary widely, so maintaining steady streamflows means manipulating water releases from reservoirs upstream to protect fish nests (called redds) and recently emerged fish.

Thirteen runs of Columbia River salmon and steelhead plus resident bull trout and Kootenai River white sturgeon are listed under the Endangered Species Act. The salmon and steelhead listings include nine runs in the mainstem Columbia and Willamette rivers and four in the Snake River. Bull trout populations are listed in several parts of Idaho and Montana.

For example, the hydro system is operated from winter through early spring to protect the eggs and emerging fry of chinook salmon at Vernita Bar on the Hanford Reservation in the mid-Columbia and chum salmon below Bonneville Dam near Portland. Accommodating these needs adds to the operating constraints on the hydro system, but both fish runs are increasing. Vernita Bar now produces the largest naturally spawning salmon run on the Columbia River system.

In addition, specific reservoir operations in fall and winter support burbot, bull trout and kokanee in Lake Pend Oreille in Idaho and in Lake Roosevelt behind Grand Coulee Dam in Washington.

Improving the dams for fish

Northwest electricity ratepayers have invested hundreds of millions of dollars in the last two decades upgrading federal dams to make passage safer for juvenile fish migrating downstream. And it's working. Survival rates have improved dramatically for juvenile fish migrating downstream past the dams.

Fish now have several ways to pass each dam. Generally, the newer the passage route, the higher the success rate.

New surface passage routes for fish: Custom water-surface routes through each dam are proving highly successful for safe fish passage.

Fish weirs, corner collector and a spillway wall: All eight of the major dams on the lower Columbia and lower Snake rivers have been fitted in the last decade with innovative improvements that let young salmon and steelhead pass through each dam near the water's surface, where they prefer

to swim. Six of the eight dams now feature surface fish weirs that let juvenile fish slide over the spillway near the water surface rather than having to submerge up to 50 to 60 feet to reach older spillways or bypass systems. This less-stressful route produces high fish survival while also spilling less water. At Lower Monumental Dam, for example, while more than 97 percent of juveniles survived passage through the regular spillway in 2008, virtually 100 percent survived passage through the new surface-passage fish slide. Similarly, the new "corner collector" fish passage at Bonneville Dam has a nearly 100 percent survival rate.

At The Dalles Dam, the U.S. Army Corps of Engineers has built an 830-foot guiding wall parallel to the river below the dam to assure fish passing through the spillway quickly reach the deepest part of the river downstream, where they'll best be able to avoid predators.

Fish screens and bypass systems:

Nearly all of the lower Snake and Columbia river dams now guide fish away from turbines by submerged screens installed in front of the turbine intakes. The screens guide the fish to channels in the dams that route the fish to the river below or to transportation facilities that allow them to pass the remaining dams in a barge.

Fish weir slide gives safer ride: *The smooth green water of a fish weir (closest spillway) lets young salmon slide over a dam in the surface water they prefer.* (Photo: U.S. Army Corps of Engineers)

Selective water withdrawals:

Two high dams, Dworshak in Idaho and Hungry Horse in Montana, have been fitted with special systems that allow operators to release cold water from deep within the reservoirs. This cold water helps keep downstream rivers cool, a vital aid to salmon and other temperature-sensitive fish.

Fish-friendly turbines:

While, in general, very few salmon and steelhead pass through turbines compared to other routes at the federal dams, over time, dam operators are replacing old turbines with new ones designed to be safer for fish and more efficient. A new turbine is being designed for Ice Harbor Dam to improve survival of any fish that do pass via this route. If this works as expected, it may prove a model for subsequent renovations to other dams.

To see the results, visit a fish ladder

The whole point of helping fish downstream, of course, is to help assure more return as adults to spawn.

Returning adult salmon and steelhead have always passed upstream through the dams easily. All eight lower Columbia and Snake river dams were originally built with fish ladders that fortunately have worked very well. Some 98 percent of the returning adults pass safely through the fish ladder at each dam. Fish are counted at every dam, starting with Bonneville. For more information on federal efforts for Columbia River salmon, see the most recent federal progress report on BiOp implementation.

For more information

To learn more, visit the following websites:

- *www.bpa.gov*
- *www.salmonrecovery.gov*
- 2008 Progress Report on Biological Opinion Implementation: *www.salmonrecovery.gov/Files/11910f_ProgessRep%202008lr.pdf*
- Annual water management plan: *www.nwd-wc.usace.army.mil/tmt/documents/wmp/*