US Army Corps of Engineers
North Pacific Division

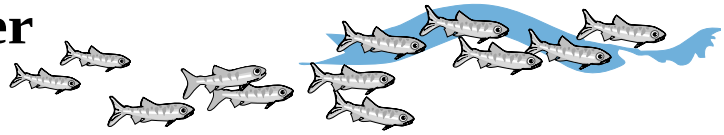
Salmon Passage Notes

Snake and Columbia River Fish Programs April 1997

Operating for Fish and Flood Control

at the Reservoir Control Center

By Sarah Thomas, freelance writer, Portland OR



The National Weather Service predicts the highest water runoff volume in 60 years this spring on the Snake River—150 percent of normal. For the Columbia River, the March water volume forecast predicts runoff at 129 percent of normal. This may be good news after years of drought, but what does it mean for the 1997 salmon migration and flood control operations?

The juvenile fish passage season begins early in April and will continue through August, and those responsible for Columbia Basin dam management are preparing to provide the best possible conditions for fish. But the high runoff forecasts have triggered flood control procedures for the Columbia River Basin; these flood control actions need to be balanced with operations for endangered salmon.

The Reservoir Control Center at the Corps of Engineers in Portland, Oregon, monitors and coordinates—every day, every hour—operation of over 100 dams in the Columbia River system. This includes dams owned and operated by the Corps and Bureau of Reclamation, four public utility districts, eight private utilities, as well as numerous irrigation districts. A Canadian crown corporation, B.C. Hydro, controls projects on the upper Columbia that contain over one-third of the storage capability in the whole system. Treaties between the United States and Canada allocate water and power distribution between the two countries.

During the first seven days of each month the National Weather Service forecasts runoff volume. The amount of snow pack in the basin is added to expected precipitation, for an estimate of runoff volume, which in turn dictates flood control operations. The high runoff and flows expected for this year could mean flooding in the Basin. Just how much flooding occurs will depend on rainfall in the spring and the timing of snowmelt, and how well we can manipulate existing flood control storage capacity.

The Center's challenge is how best to release water from storage dams (called draft or drawdown) to bring the reservoir pools to a low enough level to provide flood control storage capacity for the huge spring snow melt, while at the same time reserving water for assisting juvenile fish migrating downstream in the spring and summer. In addition, there must be water to maintain power generation for the region, keep navigation going from the mouth of the Columbia to Lewiston, Idaho, and provide for irrigation needs. For all these uses, not only is enough water needed, there must be enough water at the right time.

Cindy Henriksen, head of the Reservoir Control Center, watches the weather very closely. "You use your own experience and skill to figure out the best way to handle each unique weather system," Henriksen says.

The Pacific Northwest experiences two principle flood seasons—rain-produced flooding, usually between November and March (most frequently on streams west of the Cascades) and flooding caused by snow melt, usually in late May or early June. Most of the water in the basin comes down during spring snow melt. As a result of the destructive Vanport Flood over Memorial Day in 1948, the Corps of Engineers developed a multiple-use reservoir storage plan for the Columbia Basin with flood control as its major objective.

Except for Grand Coulee, which was completed in 1941, the Columbia system's major storage dams were built after the Vanport flood: Hungry Horse, 1952; Albeni Falls, 1955; Dworshak, 1973; and Libby, 1975. Even so, these dams, along with the three Canadian storage dams, Duncan, Keenleyside, and Mica, provide storage for less than 25 percent of the basin's total annual runoff. In contrast the Colorado River has about four times as much storage capacity as its yearly runoff, and the Missouri has over twice as much.

Most of the other mainstem dams on the Columbia system are run-of-river dams with hydroelectric generating plants, and navigation locks to enable boat passage. They operate based on available stream flow and have little storage capacity. The John Day Dam on the lower Columbia River is a run-of-river dam that also provides about a half million acre feet of flood control storage capacity.

The system of dams in the Columbia River Basin, while providing power, flood control, irrigation, recreation and other uses beneficial to humans, greatly alters fish habitat. Run-of-river dams create barriers for anadromous fish as they migrate to and from upstream spawning and rearing areas and the ocean. Upstream storage dams block fish passage and alter the flow regime that fish adapted to over the millennia before human interference. Reservoirs behind the dams slow water velocity and can alter water temperatures.

Fish passage systems help get fish safely past the dams. The way the dams are operated can also assist migration. An above average runoff year is generally beneficial for fish, especially for the outmigration of juvenile salmon. But very high flows this year are expected to create problems in the system such as excessive dissolved gas and high levels of debris.

In accordance with the biological opinion issued by the National Marine Fisheries Service (NMFS) in March 1995 to protect endangered Snake River salmon species, the Corps augments stream flows, spills for fish at the dams, transports juvenile fish, and operates

reservoirs at lowered levels during the juvenile fish migration. To provide flows for fish, Henriksen says, one goal is to start the fish passage season with the reservoirs as full as possible without violating flood control requirements, so there is as much water in storage as possible to use for fish.

"But here's the dichotomy in a big water year," Henriksen explains. "In a big water year like this one will be, reservoirs have to be empty at the beginning of April for flood control. But that's about the time the juvenile fish migration begins. Hopefully, the snow will begin to melt and water will start coming down at about the time when the fish do. If it's a really cold spring, then we'll have a problem because the snow won't melt and there will be less water feeding into the system when the fish need it most.

"Then, of course, we want the storage dams to be full again by July 1," Henriksen says. "so we can begin drafting in August for the summer fish migration. Last year some of the dams didn't fill until late July."

Coordinating Operations

The Technical Management Team (TMT) consists of representatives from the Corps, Bureau of Reclamation, NMFS, Bonneville Power Administration (BPA), US Fish and Wildlife Service, Columbia River Basin Tribes, the Northwest Power Planning Council and the States of Idaho, Oregon, Washington and Montana. The TMT coordinates river operations in weekly meetings during fish migration season. Any interested party can participate in the meetings. Before the season starts, the team develops an annual water management plan that will incorporate flood control operations and runoff forecasts. The main drivers for the plan are the NMFS biological opinion for endangered salmon and the US Fish and Wildlife Service biological opinion for sturgeon. "During the planning process we look for places where we can do things better than last year," Henriksen says.

"We develop a plan," she adds, "knowing that we'll have to make adjustments every week once we get into the fish passage season, to reflect conditions in the river or the numbers of juvenile fish migrating."

During the weekly fish passage season meetings, the TMT discusses flows and flow projections, hears reports on juvenile and adult fish numbers and condition, and makes adjustments to operation plans where needed. The National Weather Service supplies runoff volume forecasts and the expected amount of water that will flow into each dam. The Reservoir Control Center operators overlay the reservoir operation plans on those dam inflows in a computer-simulated system operation. Every week the TMT looks at the new simulated operation to determine appropriate operations to best utilize the existing storage and runoff.

Managing Spill and Gas Supersaturation

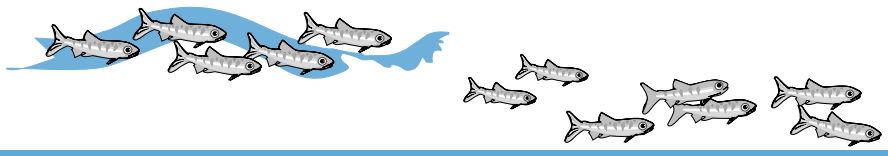
One of the biggest concerns this year is the potential for high levels of gas supersaturation in the river from high flows. Flows may reach 250,000 to 345,000 cubic feet per second (cfs) in the lower Snake River and over 500,000 cfs in the lower Columbia River. That means flows will exceed the turbine capacities of the dams and large amounts of water will go over the dam spillways.

While spill is a good way to divert the juvenile fish away from turbines, too much spill can increase total dissolved gas in the river above what are considered safe levels for fish. Water that is spilled plunges deep into the stilling basins on the downstream face of the dams, entraining air and gases. These can enter the vascular systems of fish that pass through or inhabit the water, causing injury or death. Dissolved gas levels this spring are expected to exceed 130 and even 140 percent, well above the 120 percent maximum requested by NMFS and approved in the state water quality waivers.

Again this year the Corps, Bureau of Reclamation, BPA and other utilities will work together to manage spill. A spill priority list will provide guidance on distribution of spill throughout the dams within and outside the Columbia Basin to minimize overall gas supersaturation in the river system. BPA strategies include discounting prices, sales of power outside the region, and arranging to displace other resources with hydroelectric power. Turbines cannot be run without an energy load, that is, a demand for the energy produced. These actions will increase the amount of water that can be sent through the turbines, lessening the need to spill. BPA also plans to shut down the Washington Nuclear Plant #2 and transfer demand to the hydro facilities until dissolved gas levels are within state standards.

To maximize flexibility to put water through the turbines, the Corps makes every effort to have turbine units up and running during high flow periods. Extended maintenance outages are scheduled to best fit fish and power needs; outages during these times are scheduled only where unavoidable, such as for equipment failure or as part of a major rehabilitation of a dam.

The above photos show John Day and Ice Harbor dams spilling water to divert juvenile fish away from turbines.



Unit 5 at Ice Harbor Dam on the lower Snake River has been out of service for several years due to equipment failure. One of six power units at the dam, unit 5 failed again in May 1996 during testing prior to return to service. While the Corps is working to return this unit to service as soon as possible, it will be out during the 1997 fish migration, decreasing capacity to put water through turbines from 96,000 cfs to about 82,000 cfs at Ice Harbor.

Even if all the turbines at the dams are running, there will be high levels of spill when flows exceed the capacity of the powerhouses. For example, at John Day Dam with all turbines running, 320,000 cfs of water can pass through the powerhouse. Another 55,000 cfs can be passed over the spillway without exceeding the state standards for total dissolved gas. But with peak flows of 500,000 cfs expected this year in the lower Columbia River, efforts to manage spill may not be able to make a significant difference in gas levels at the dam.

Another way to help control gas supersaturation is to alter the dam stilling basins. Spillway flow deflectors, or "flip lips," can be installed in the stilling basin to direct the falling water in a more horizontal flow, and decrease supersaturation. Lower Granite, Little Goose, and Lower Monumental dams on the lower Snake River, and Bonneville and McNary dams on the Columbia have flow deflectors in place. However, very high flows as expected this year may overwhelm the flow deflectors' ability to affect gas supersaturation levels.

Effects on Returning Adult Fish

As the juvenile fish are making their way downstream, the adult salmon that have been maturing in the ocean for two to five years are beginning to make their way back up to the spawning grounds. At just about any time of the year, there will be some adult anadromous fish migrating upriver. With the high flows expected this spring, there may be some delays for the adults.

Effects on adult fish migration will be most noticeable at the dams, where high flows and spill can interfere with the adult attraction flows that are created at the fish ladder entrances, causing delays in passage.

Maintenance and Construction

Maintenance activities and construction at the dams must be coordinated through the Reservoir Control Center to ensure minimal interference with fish passage and maximum operating capacity of the turbines when high flows are expected in the system. Navigation locks, power equipment and fish facilities need regular maintenance. Turbines and navigation locks have scheduled outages for routine and major maintenance. Fish ladders are dewatered and cleaned yearly. Guidance screens in juvenile passage systems are cleaned periodically throughout the season depending on debris in the system.

Sometimes, weather and conditions in the river can interfere with construction schedules. Last September the Corps began installing spillway flow deflectors at Ice Harbor Dam to help control gas supersaturation. Deflectors were to have been installed by the start of the juvenile fish migration season. In January 1997, installation of four spillway deflectors was complete with work begun on two more, when progress was interrupted by very high water in the river. The huge bulkheads that held back water to allow work in the basins were washed away. Installation of the remaining flow deflectors will resume after the fish season is over. Eight, and possibly all ten, bays at Ice Harbor will have deflectors prior to the 1998 fish season. At John Day Dam two to three spillway flow deflectors will be complete by this May. Eighteen of 20 bays at that dam are scheduled to have deflectors by the 1998 fish season.

Keeping up with the added debris from high flows will be another challenge this year. Debris can at times overwhelm the cleaning systems for the juvenile fish bypass facilities. Maintenance crews will be working overtime to keep the systems free of debris and the bypasses operating efficiently.

Power, Navigation, Other Uses

The Corps also prepares power operating plans in cooperation with BPA and the electric power companies. The plans take into account water spilled for fish, reservoir drawdowns when fish need water, and operation of some reservoirs at their minimum operating pools. Certain minimum flows need to be maintained out of Grand Coulee from December through April to protect a major fall chinook spawning site at Vernita Bar; the Bureau of Reclamation and BPA factor that into the power plans.

Another important consideration is providing for navigation. Last year, because of the February 1996 floods, sandbars built up in the lower Snake River. The biological opinion says that the dams on the lower Snake should be lowered to their minimum operating pool during fish season to decrease the water's cross-sectional area and thereby increase water velocity to speed fish downstream. But had the reservoirs been lowered all the way to minimum operating pool at Ice Harbor, Little Goose and Lower Granite dams, barge operators would not have had the needed 14-foot navigation channel. The flexibility in the biological opinion allowed the Corps to operate at minimum operating pool 'plus one' (foot). Navigation requirements were met while some drawdown of the reservoirs for fish migration was still provided.

This year, high currents may interrupt barge traffic, including barges that haul juvenile fish past the dams. This could mean fewer fish barged and more fish migrating in-river.

While many of the decisions made at the Reservoir Control Center are determined by such things as federal flood control regulations, the NMFS biological opinion, power supply demands, and navigation and irrigation requirements, sometimes decisions are more subjective. When heavy rain and snow occurred at the end of 1996 in the Willamette River Basin, the Corps held back water to avoid major flooding. Once the rain quit after the first of this year, the Center began to release water from the dams to prepare for more rain and snow that was sure to come. After evacuation began, a call came in from a farmer downstream from Fern Ridge Dam on the Long Tom River, a Willamette River tributary. "He had some cows that had gotten stranded on an island," Henriksen says, "and the farmer wanted to get them off the island because they needed to feed their calves. So we made a reduction in the outflow from Fern Ridge so that the cows could come home."

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Technical Management Team information including meeting information is available on the Internet at:
http://www.npd-wc.usace.army.mil/TMT/welcome.html.

The Pacific Salmon Coordination Office at the Corps provides salmon information on the Internet at:
http://www.npd.usace.army.mil.