US Army Corps of Engineers
North Pacific Division

Salmon Passage Notes

Snake and Columbia River Fish Programs January 1994

AGENCIES PREPARE FOR 1994 OPERATIONS

Nineteen-ninety-four is here and the federal agencies are preparing for another year of coordinated operation of the Columbia River Federal Power System.

On December 2, the Corps of Engineers, Bureau of Reclamation and Bonneville Power Administration (BPA) submitted joint biological assessments of the proposed operation of Columbia and Snake Rivers Projects for 1994 through 1998. The biological assessments were submitted to National Marine Fisheries Service (NMFS) which has responsibility for listed Snake River salmon stocks, and to US Fish and Wildlife Service (USFWS) which is responsible for listed bald eagle, grizzly bear, peregrine falcon, gray wolf and middle Snake River aquatic snail species, and the Kootenai River white sturgeon which is proposed for listing.

With the 1991 and 1992 listings of the Snake River sockeye salmon as endangered and the Snake River spring/summer and fall chinook salmon as threatened under the Endangered Species Act (ESA), the Corps and other agencies entered into formal consultation with NMFS. Under the ESA, agencies must consult with NMFS and USFWS on proposed activities that might have an adverse impact on listed species and submit a Biological Assessment of the effects of proposed actions on those species.

Operation of the Columbia River Federal Power System is one such activity. The Corps and Bureau of Reclamation operate the federal dams on the Columbia and Snake Rivers and BPA markets the power from the system.

Biological Assessment for Salmon

The dams may have substantial effects on the ability of juvenile and adult salmon to migrate through the river system to and from spawning and rearing areas and the ocean. Some of the Columbia basin dams—such as Dworshak on the Clearwater River, Grand Coulee on the Columbia and Brownlee, a non-Federal project on the Snake—cut off habitat altogether. The eight lower Columbia and Snake river dams provide passage for migrating fish.

Juvenile fish can negotiate these eight dams in three ways: over spillways when water is channeled through spillways rather than generating power through the turbines; through the juvenile bypass system if the fish are diverted away from the turbines by mechanical diversion screens; or through the turbine area where rotating turbine blades might directly strike the fish or create pressure changes that cause injury and death. Fish that go through the juvenile bypass systems are channeled either directly back to the river below the dam or to barges or trucks for transport past all remaining dams. At two of the dams, ice and trash sluiceways act as bypass systems. Adult fish use special ladders built alongside the dams when returning upriver to spawn.

The dams also create a series of reservoirs which slow the flow velocities and can affect the temperature of the rivers, which in turn can affect fish behavior. By some estimates, the series of dams may add up to 20-30 days to the travel time for juvenile fish.

The biological assessments for 1994 through 1998 propose operations for the Columbia and Snake River projects that are similar to 1992 and 1993 operations. These proposed operations are designed to provide a mix of measures to improve the survival of migrating fish.

Under the proposed operations, water from upstream Columbia River storage dams would be released at certain times during the juvenile migration periods to increase river flows and help move the fish downriver. At least 3.45 million acre feet (MAF) of water would be released with possibly an additional three MAF depending upon runoff volume forecasts. Also, releases of approximately one MAF or more, depending upon runoff forecasts, would be made from Dworshak Reservoir. Additional water would come from above Brownlee Dam. An in-season management team consisting of representatives from NMFS, BPA, Reclamation and the Corps would closely monitor and shape this "flow augmentation" based on information on fish migration and water availability gathered throughout the fish passage season. Water releases during the latter part of the summer may also be made in an effort to enhance juvenile and adult fall chinook migration.

The proposed operation plan would continue spill operations contained in the Northwest Power Planning Council Fish and Wildlife program, and additional spill could be provided for hatchery releases and other special circumstances. It has been estimated that juvenile survival through the spillways is about 98 percent, compared to an estimate of about an 85 to 90 percent survival rate through turbines. However, too much spill can generate high levels of gas supersaturation in the river, which in turn causes gas bubble disease in fish. Under the proposed plan of operations, gas supersaturation levels would be minimized, fish conditions monitored, and fish spill subject to further consultation with NMFS to reduce fish health problems.

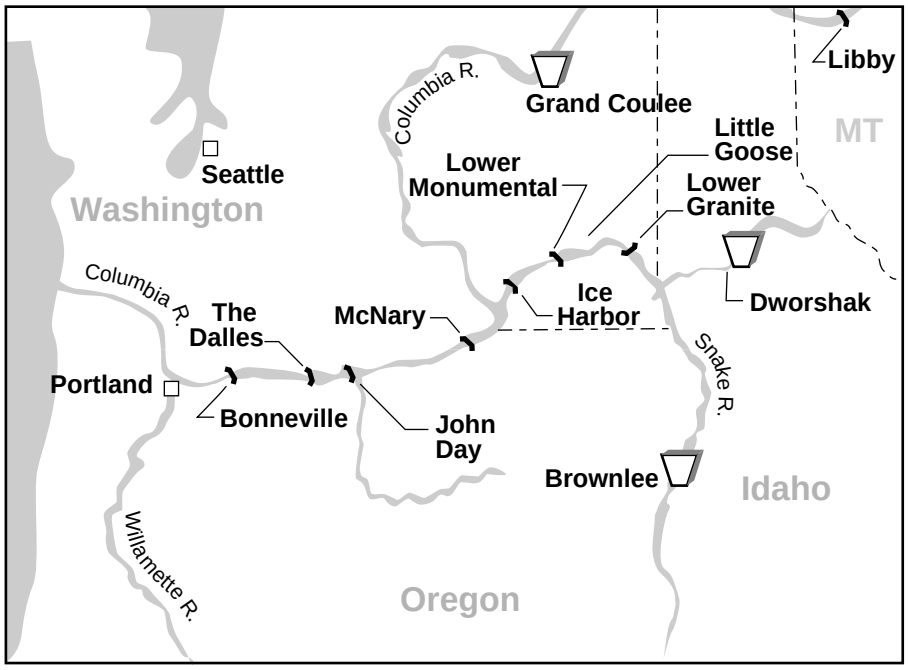
The Corps has requested a Section 10 permit to continue the Juvenile Fish Transportation Program (barging or trucking collected juveniles past the dams to below Bonneville Dam). Such a permit is required under the ESA. The extent of transport depends on whether NMFS grants the necessary permit and what stipulations NMFS may include.

To increase flow velocities in the river, the four lower Snake River projects would be operated near minimum operating pool (MOP). This is the lowest level for which the projects were designed to operate. The John Day pool on the Columbia River would be operated near its minimum irrigation pool, about five feet below its normal operating level. The idea is to reduce the cross-sectional area of the reservoir so that the same volume of water is forced to travel faster through a smaller space.

Best available data indicates that operating turbines at highest efficiency levels provides the best survival chances for juvenile fish passing through the turbines. Under the proposed operating plan, the Corps would operate its turbines within one percent of peak efficiency except where it causes unacceptable impacts to the reliability or stability of the system, ability to provide firm energy

requirements, or other measures being implemented for fish.

The Squawfish Management Plan will enter its fourth year in 1994. Nearly 580,000 squawfish were harvested under this program during 1991-1993. Preliminary evaluation data indicates that mortality from these predators may have been reduced by as much as 18 percent among 1993 migrating juveniles. BPA will continue to fund implementation of the program. BPA will also continue to provide funding for a fisheries law-enforcement program to curtail illegal harvest of salmon.



And finally, the Corps Project Improvements for Endangered Species program would continue with a number of structural improvements to the adult and juvenile fish passage facilities at the dams.

The Biological Assessment for salmon concludes that the proposed actions for 1994 and future years provide conditions that should lead to greater numbers of Snake River sockeye salmon and spring/summer chinook and fall chinook salmon over baseline conditions. The baseline condition used is the operation of the system before the listings of the Snake River salmon species, generally considered to be the years 1986 to 1990.

Other Species

Biological assessments were also prepared on listed species under the USFWS jurisdiction. The grizzly bear, peregrine falcon, and gray wolf are not affected by the proposed operation. However, the assessments determine that there may be adverse effects on the Kootenai River white sturgeon which is proposed for listing, bald eagles around Lake Roosevelt and Cascade Reservoir, and the five middle Snake River aquatic snails, and recommend specific actions and monitoring.

For the Kootenai River white sturgeon, releases from Libby Reservoir in May through July are proposed in three out of the next ten years. The releases would be made in years where sufficient runoff is forecasted, and the operation for sturgeon is compatible with operations for listed salmon. The Biological Assessment concludes that this operation would create conditions for successful spawning, incubation and initial rearing, and provide a major contribution to improving the overall health of the Kootenai River white sturgeon.

The proposed action would not jeopardize the continued existence of the bald eagle, and monitoring would continue for bald eagles at Lake Roosevelt and Cascade Reservoir, as recommended by USFWS in 1993. Recommendations for the middle Snake River aquatic snails include development and implementation of a monitoring plan to better understand potential impacts to the aquatic snails and recommend future actions.

Debate Continues

Submitting the biological assessments to NMFS and USFWS starts formal consultation. During consultation, there is an exchange and debate of scientific and technical information. Additional analysis may be necessary and potential changes in the proposed actions may be required based on the best available scientific information.

Most of these actions have been scrutinized and implemented in previous years, so agreement should be reached quickly. There are several action areas, however, which will need to be addressed in additional detail. The Biological Assessment proposes flow augmentation measured in terms of "stored" volumes of water that can be used to supplement natural river flows. This permits more effective planning and implementation by the system operators. NMFS has stated a preference for a "flow target" measurement that requires a given level of in-river flow, regardless of natural river flows. This latter approach improves the probability that the fish will have increased flows but can have serious impacts on storage reservoirs and other system operations.

The issue of how much spill can be provided will also be a focal point of discussions. All parties recognize the dangers of gas bubble disease caused by supersaturated water but the offsetting benefits of putting fish through the spillway rather than passing them through the turbines needs to be addressed.

After appropriate review and consideration, both NMFS and USFWS will issue separate, but coordinated Biological Opinions on the proposed actions. NMFS will address the listed Snake River salmon species and USFWS will address all other proposed and listed species. In the end, the action agencies will consider all the information available, including the Biological Opinions, and make their respective decisions. The goal is to complete this process by February 1994.

An Executive Summary of the biological assessments of Proposed Operation of Columbia and Snake Rivers Projects is available to interested persons. The summary gives a more detailed and technical explanation of the proposed operations and their expected effects.
For a copy of the Executive Summary or other information on the biological assessments please contact one of the following:
*Dave Ponganis, Corps of Engineers, North Pacific Division, P.O. Box 2870, Portland OR 97208-2870, phone 503-326-3862;
*Richard Prange, Bureau of Reclamation, Pacific Northwest Region, 1150 North Curtis Rd, Boise ID 83706-1234, phone 208-378-5031; or
*Chuck Korson, Bonneville Power Administration, P.O. Box 3621, Portland OR 97208, phone 503-230-5182. Or call BPA's Document Request Line at 1-800-622-4520

DRAFT SALMON RECOVERY PLAN RELEASED

While the region prepares for 1994 operation of the Columbia River system, work on a comprehensive Recovery Plan for listed species progresses.

In late October 1993, a Recovery Team chosen by National Marine Fisheries Service, released for peer review its Draft Snake River Salmon Recovery Plan Recommendations. The team of seven scientists, led by Dr. Donald E. Bevan, Professor Emeritus and Past Associate Dean at the University of Washington, was tasked with developing recovery plan recommendations for three Snake River salmon species listed under the Endangered Species Act.

The team's report considers all phases of the complex life cycle of the salmon which takes it from gravel spawning beds and rearing areas in rivers, lakes and tributaries, to a freshwater migratory path that can be hundreds of miles long, to the ocean where it spends one to four years before returning upriver to its natal area to spawn.

The recovery team viewed conditions throughout much of the range of the Snake River salmon and analyzed studies and data on habitat, passage through eight lower Columbia and Snake river dams, hatchery practices, harvest controls and predators. They also met with scientific, cultural and economic experts and consulted with federal, state and tribal agencies and industry and environmental groups. The recovery team and NMFS point out that this report is a draft of recommendations from an advisory team, and that the actions for recovery of salmon stock that are finally adopted by NMFS may differ from the recommendations in the draft plan.

Ecosystem Approach

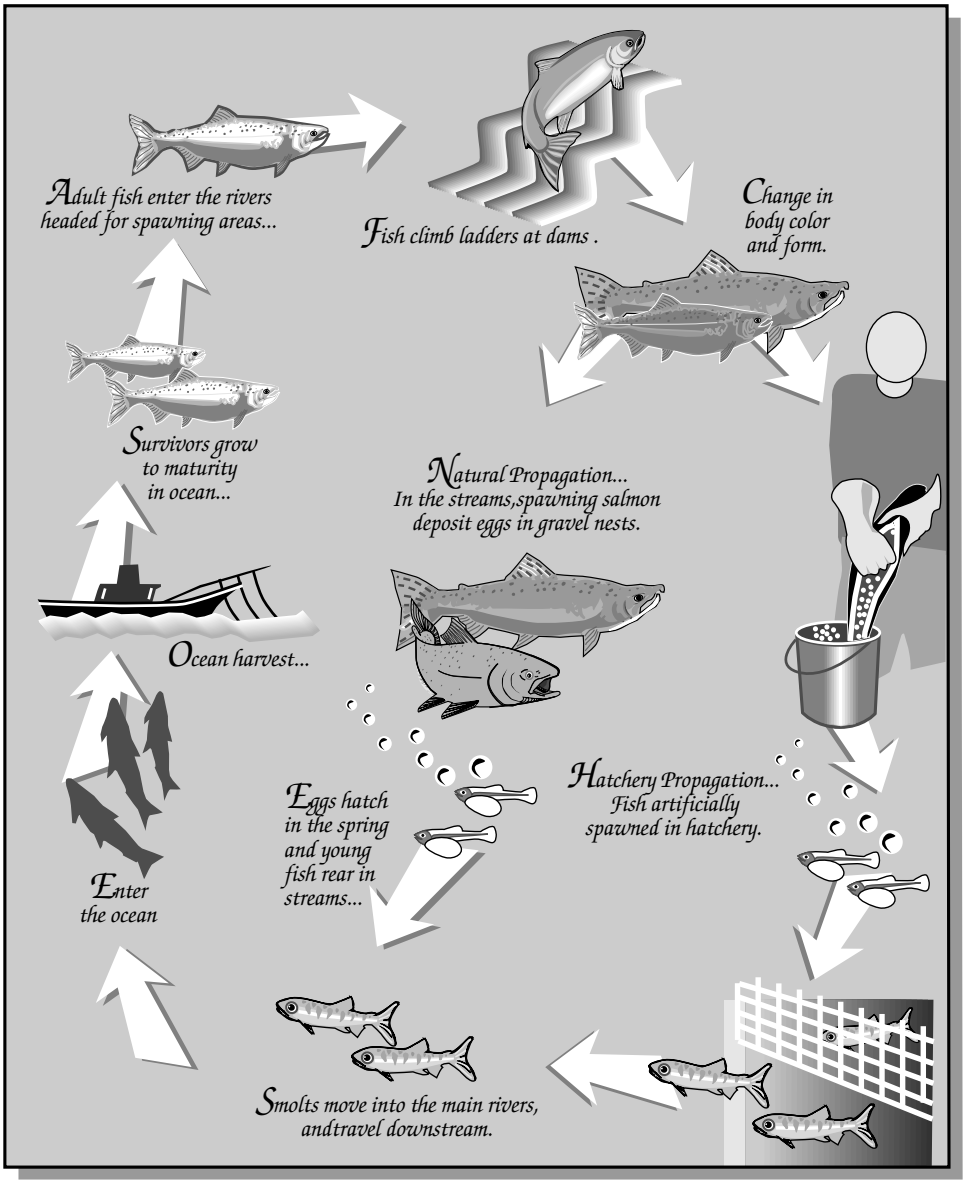
In its report, the recovery team recommends a comprehensive ecosystem approach to rebuilding listed Snake River salmon stocks. While noting that the root cause of the decline of salmon stocks "lies in failing to afford appropriate consideration to [salmon conservation] in past decisions and resource allocations" the report focuses on what can be done now to address the present situation.

The team documents the serious impacts of the lower Columbia and Snake river dams on salmon stocks, but cautions that there is no "silver bullet" to fix the problems and that recovery will only be possible if improvements to harvest and hatchery practices, spawning and rearing habitat, and predation are also addressed.

Getting Past Dams

The report covers near- and long-term actions to improve survival of juvenile salmon during downstream migration. Among the recommended near-term actions are improvements to the Juvenile Fish Transportation Program. For example, the report recommends development of strategies for releasing fish at a variety of places below Bonneville dam or even in the ocean. Also, release strategies and barge designs should be improved to reduce predation and stress on the juvenile salmon as they exit the barges. The addition of more transport barges is recommended to improve ability for direct loading of the smolts at Lower Granite Dam and to reduce crowding when hatchery releases are high.

Improvements to the juvenile bypass systems—which divert juvenile fish away from the turbines and through a bypass channel—are recommended. Current research is looking at the use of forty-foot extended length screens for diverting juveniles away from the turbine intakes, to replace twenty-foot screens now in place.



Salmon Life-Cycle

The Recovery Team believes that experimentation with the longer diversion screens should continue, and that other improvements should be studied to increase efficiency of the systems and reduce stress on the fish. The team is concerned that juvenile fish that normally stay within twenty to thirty feet of the river's surface, must descend seventy feet or so to find the entrances to the bypass systems. They recommend exploring ways to collect the fish nearer the surface.

Flow augmentation was another area where the team suggests improvements could be made. Flow augmentation is the term used for releasing upstream water from storage dams during fish migration seasons, to modify river flow rates and temperatures. The team recommends that flow augmentation measures continue, while such factors as the effects of river flow rates on juvenile survival are studied. Smolt survival through various dam passage routes should be monitored to determine whether water releases improve survival. In the meantime, negotiations should continue to obtain additional sources of water for augmentation.

The team addressed the issue of dissolved gas supersaturation resulting from spill over the dam spillways. The team recommends that: "careful real-time monitoring measurements of dissolved gas levels" should continue; operational methods should be improved where possible to limit spill; and that smolts should be transported where there is likelihood of elevated gas supersaturation levels, since the barges contain systems for de-gassing river water.

Long-Term Improvements

As far as long-term measures to improve survival of downstream migrants, the Recovery Team outlines two distinct approaches. The first option is to improve the Juvenile Fish Transportation Program and either improve existing juvenile collection facilities or build a new collector facility just above Lower Granite Reservoir. The second is to pursue improved in-river migration of juveniles, by modifying or removing the four lower Snake River dams to allow the river to flow at the natural river level for a six month migration period every year. Both options would include continuation of flow augmentation measures.

Based on available information and knowledge of improved collection and transport versus river-level drawdowns for improved juvenile migration survival, the team's analysis indicates that the biological benefit from either option is similar. Because of the social and economic factors involved in the two options the team would choose improved collection and transport over drawdowns. (The report indicates that drawdowns above natural river elevations may not have the potential to increase survival to the extent needed.) The team concludes that the region should proceed with study of both options until a regional decision is made to pursue one or the other.

Improvements in adult passage

The report also covers improvements in migration conditions for returning adult salmon. The team cites study estimates of up to fifty percent annual interdam adult losses in the lower Columbia and Snake rivers. While recognizing the uncertainty of those estimates, they see the problem as significant and recommend improvements to physical and operating conditions of the adult fish ladders. To combat loss from disease the team suggests that possibilities for drug treatment should be investigated. If reservoir drawdowns below project design levels are pursued, great attention should be given to potential effects on adult migration and necessary modifications to adult fishways. The team also recommends study of flow augmentation use for controlling water temperature and diluting pollution in the rivers to better benefit adult salmon.

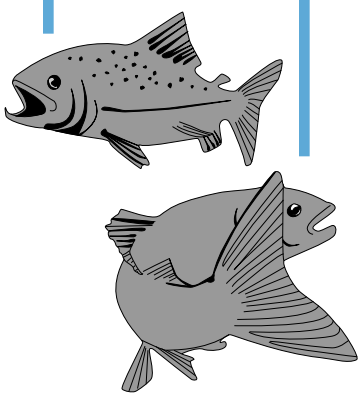
The recovery team examined the Corps Project Improvements for Endangered Species (PIES) program. PIES was begun in 1991 to provide for improvements at the eight mainstem lower Columbia/Snake projects, designed to decrease stress and injury to juvenile and adult fish and to reduce delays in fish passage. The team recommended that priorities for items listed should be adjusted to recognize the immediate need for some of the improvements and the constraints of available funding.

Other Recommendations

As stated earlier, the draft plan addresses all aspects of the salmon life-cycle and contains numerous recommendations for recovery of listed Snake River salmon species besides those discussed above. Some additional recommendations are:

- Place National Marine Fisheries Service in charge of recovery efforts
- Establish a Salmon Oversight Committee to oversee implementation of the recovery plan and collection of data, and set priorities for resources of the Columbia River Basin
- Take specific actions to protect good spawning and rearing habitat and restore damaged habitat
- Improve hatchery practices and management and continue captive broodstock programs, with refinements
- Reduce harvest by lowering allowable harvest, mandatory buy-backs of gillnetting equipment, shifting to gear that permits release of live fish, working toward reduced Canadian take, and others
- Adopt measures to increase harvest of predatory fish, reduce harvest restrictions on non-indigenous fish, study/control bird predation, and study effects of marine mammals on listed fish
- Design and implement a biological drawdown test that will provide biological information sufficient to decide the future of drawdowns

Following the technical (peer) review of the Draft Snake River Salmon Recovery Plan Recommendations, the recovery team will submit a final report to NMFS for use in drafting its recovery plan. NMFS' draft plan will be available for public review and comment. The final recovery plan will provide guidance on policies and actions for restoring Snake River salmon species.



COMPUTER MODELS ANALYZE SYSTEM SALMON SURVIVAL

Computer models have become an integral part of the regional effort to better understand the effects of the Columbia River hydro system on salmon survival. Currently there are three computer models being used. These models allow a more systematic examination of data relating various operating modes for the hydro system to changes in fish survival as the juvenile and adult salmon migrate to and from the ocean through the river corridor.

The models are among the analytical tools used in regional studies and analyses such as the 1992 Columbia River Flow Measures for Salmon Environmental Impact Statement, the ongoing multi-agency Columbia River System Operation Review and the Corps System Configuration Study.

Each modeling system has two components: a downstream passage model that estimates survival of migrating juveniles, and a life-cycle model that estimates the number of adult fish that return to spawn.

The Bonneville Power Administration (BPA) model system includes the Columbia River Salmon Passage Model (CRiSP), which estimates downstream juvenile fish passage survival and was developed by the Center for Quantitative Science, University of Washington; and the Stochastic Life-Cycle Model (SLCM), which estimates adult escapement (number of adults returning to spawn). The BPA models are used to analyze spring, summer and fall chinook survival.

The Northwest Power Planning Council system consists of the Passage Analysis Model (PAM) that estimates downstream juvenile survival, and the System Planning Model (SPM) that estimates adult escapement. This system analyzes only spring chinook survival.

The third modeling system was developed collectively by a group of state and Tribal fisheries agency analysts. Their downstream passage model is called Fish Leaving Under Several Hypotheses (FLUSH). The model that estimates adult returns is the Empirical Life Cycle Model (ELCM). The ELCM uses naturally spawning fish from two upstream tributaries—spring chinook from the Imnaha River and spring/summer chinook from Marsh Creek—to estimate adult returns of spring/summer chinook.

Reservoir drawdowns, river flows, and project modifications such as extended-length bypass screens or other physical alterations to the dams may be modeled to predict benefits to fish.

Other factors that can be analyzed in addition to flow measures and system improvements include changes in predator control, transportation measures, harvest management, habitat, and the effects of variations in natural flows in the basin. Not all the physical and biological data needed to accurately model fish survival is available. This means that the biologists and modelers must include assumptions in the computer models. The assumptions that are used in each of the three models are important factors in the outcomes. Not everybody agrees on what assumptions should be used.

Assumptions can be optimistic or pessimistic as regards survival of fish under a given set of conditions. For example, one model might include the assumption that recent predator control measures will result in greatly reduced predation on the juvenile fish while another assumes no change at all in predation. Or, effects of dissolved gas supersaturation on fish survival during reservoir drawdown may be included in one model and omitted or minimized in another.

Scientists and analysts note that they do not yet have sufficient data to totally validate salmon life-cycle model assumptions, but the models are useful in conjunction with other analyses.

At the September 1993 Snake/Columbia River Drawdown committee meeting, the Northwest Power Planning Council staff presented results of their life-cycle modeling. They compared reservoir drawdown options to the base condition of operating the existing hydro system with juvenile transportation facilities in place at Lower Granite, Little Goose, Lower Monumental and McNary dams. The drawdown operations eliminated smolt transportation and had all juvenile salmon passing instead through the dams and reservoirs.

To get maximum benefit from drawdown, Council models assumed that the four Snake River dams were removed when running the natural river option, the optimum drawdown condition. All dam-associated mortality (turbine, spill, bypass, etc.) was zeroed out and predator distribution and densities were near the same regardless of reservoir elevations.

Such assumptions may be highly optimistic as it is currently envisioned that the dams would remain in place and river flow would be directed through some sort of a regulating structure, such as a low-level spillway or channel, at each dam. Also, at a natural river stage, numerous natural pools containing and concentrating predators would exist throughout the Lower Snake River project area.

These model studies prompted Council staff to state: The analysis did not indicate that the four pool drawdown option can be expected to provide the greatest benefits for Snake River spring chinook. It did indicate that the four pool drawdown option holds potential for increasing survival in the average or better flow years if a number of uncertainties turn out favorably. It also indicates that drawdown would actually lower survival relative to the baseline in lower flow years, based on what we know about transportation. . . . The analysis also showed that drawdown is extremely vulnerable to uncertainty in a number of key factors such as predator control and fish guidance efficiency.

The Council does not model fall chinook. Other analyses that include fall chinook—such as those from the University of Washington model—had mixed results. They concluded that the natural river option would increase survival for spring chinook but lower fall chinook survival compared to current base-case operations. These conclusions were also based on optimal dam passage survival assumptions. Most models are showing that transportation of juvenile fish from the four collector dams substantially improves survival under all scenarios.

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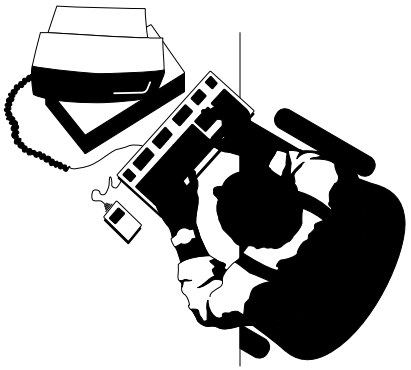

Speakers available

Corps of Engineers professionals are available to address organizations on Corps efforts to preserve and restore Columbia and Snake River salmon species. One of our biologists, engineers or program managers can give the Corps perspective on efforts for salmon and options for the future, and can tailor a talk to meet your needs.

FOR INFORMATION please write to Adele Merchant CENPD-PM-CP, Corps of Engineers, P.O. Box 2870, Portland OR 97280-2870. Or you can call her at 503-326-3417, or send a message by FAX to 503-326-3572.

Your comments invited

We would like to hear from you if you have comments on Salmon Passage Notes, on what the Corps is doing for fish, or on Pacific Northwest salmon issues in general. Let us know if there is a topic you would like to see addressed in future issues.

Contact Adele Merchant at the address, telephone or FAX numbers above, or write to the Editor at the address provided here.

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