RESEARCH ON A SYSTEM FOR BYPASSING JUVENILE SALMON & TROUT AROUND LOW-HEAD DAMS

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Young Pacific salmon (genus Oncorhynchus) and steelhead trout (Salmo gairdneri) from the upper Snake and Columbia Rivers must now pass through 6 to 9 low-head dams (such as Bonneville) on their journey to the sea. Although these dams are equipped with fish ladders to aid them when they return as adults, only recently have facilities for safe guarding them as juveniles begun to receive attention. Juvenile fish are subject to mortality from turbines and from predators immediately downstream from the dams.

BCF and the U.S. Army Corps of Engineers are now modifying existing facilities to protect juvenile fish. The method provides for diverting most of the fish that enter turbine intakes into a bypass. This report explains the nature of the modification, how it may protect fish, and the type of research needed to prove the adequacy of the system.

FISH-BYPASS SYSTEM AND ITS APPLICATIONS

Figure 1 is a cross section of the power-use at Ice Harbor Dam, cut through the nter of a main turbine and intake. The oposed fish-bypass system would employ self-cleaning traveling screen for inter-pting fish in the intake and diverting them o a gatewell. Fish would pass from the ewell, via a submerged port (fig. 2) to the sluice (fig. 3). The ice sluice, designed carry ice and debris from the forebay und the dam, would also carry the fish ely to the tailrace. In more recently con-ucted dams, such as John Day, the ice ice was not incorporated. Instead, the ps of Engineers installed a special bypass erve fish passage needs.

This fingerling-bypass system could be ployed to protect young salmon and trout one of two ways. The more costly applica-n would be the use of traveling screens in ery intake of every dam to guide fish around h dam. A less costly application would be use the bypass system to capture all fish the first (uppermost) dam reached by the h and transport them by truck or barge around the rest of the dams. Under the latter plan, the fingerling-bypass system would incorporate a suitable trap in the ice sluice or fingerling bypass, which would collect the fish rather than let them pass into the tailrace.

Before the collection-and-transportation method can be adapted, we must demonstrate that fish transported around many miles of river can find their way back to their home streams. BCF has several transportation studies underway to provide an answer to this question.

Meanwhile, we can proceed with the development of the fingerling-bypass system with the understanding that, no matter which system is finally used, the basic fish-bypass system will apply.

RESEARCH REQUIRED

Verification of the adequacy of this fish-bypass system requires research on several aspects of its construction and use.

The traveling screen for guiding fish must be proved adequate, both biologically and mechanically. The device must be efficient

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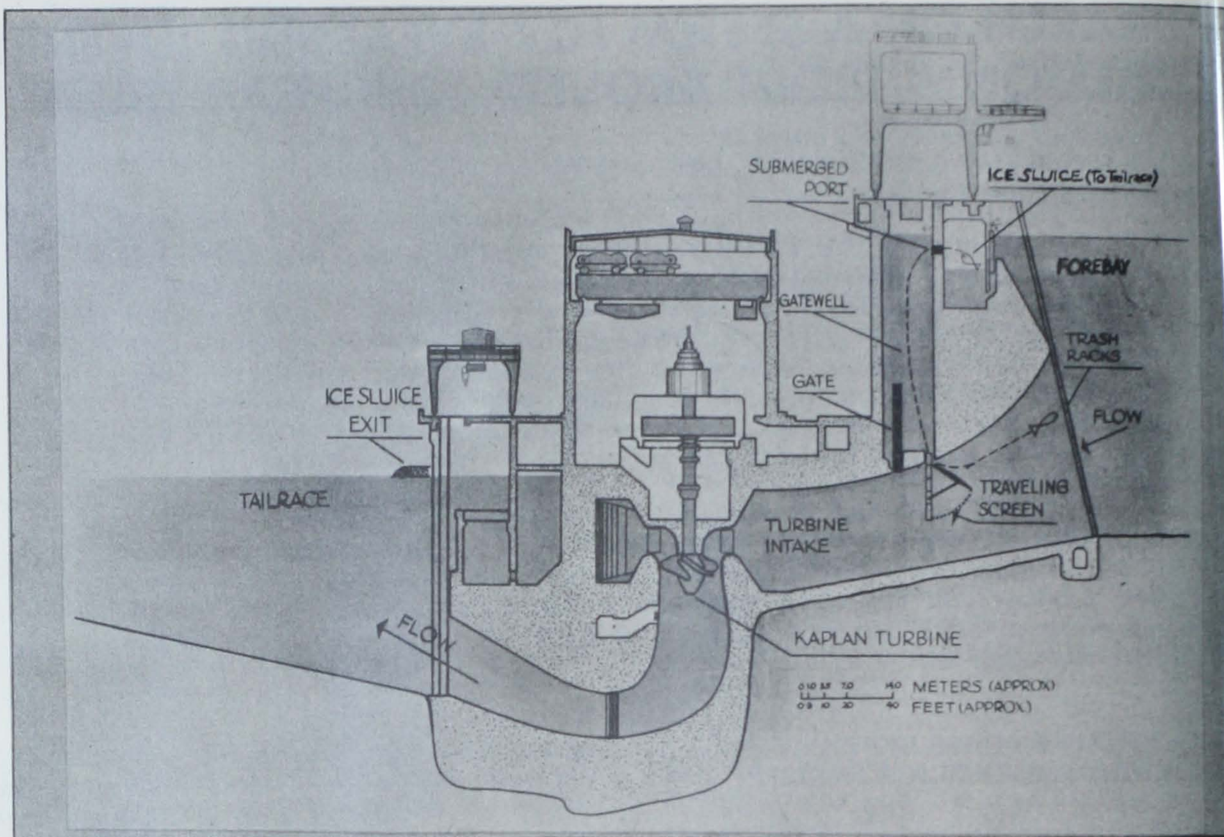


Fig. 1 - Proposed fish-bypass system for low-head dams would employ a traveling screen capable of diverting 70-80 percent of the young seagoing salmon and trout from intakes into gatewells. Fish would then pass through submerged ports to the ice sluice (or special bypass), where they could be collected for transport or allowed to pass on to the tailrace.

in diverting fish from intakes into gatewells. Small fish may impinge on the screen but will be carried by the screen up into the gatewell. Although present information suggests that brief periods of impingement will not harm the fish, additional work is required.

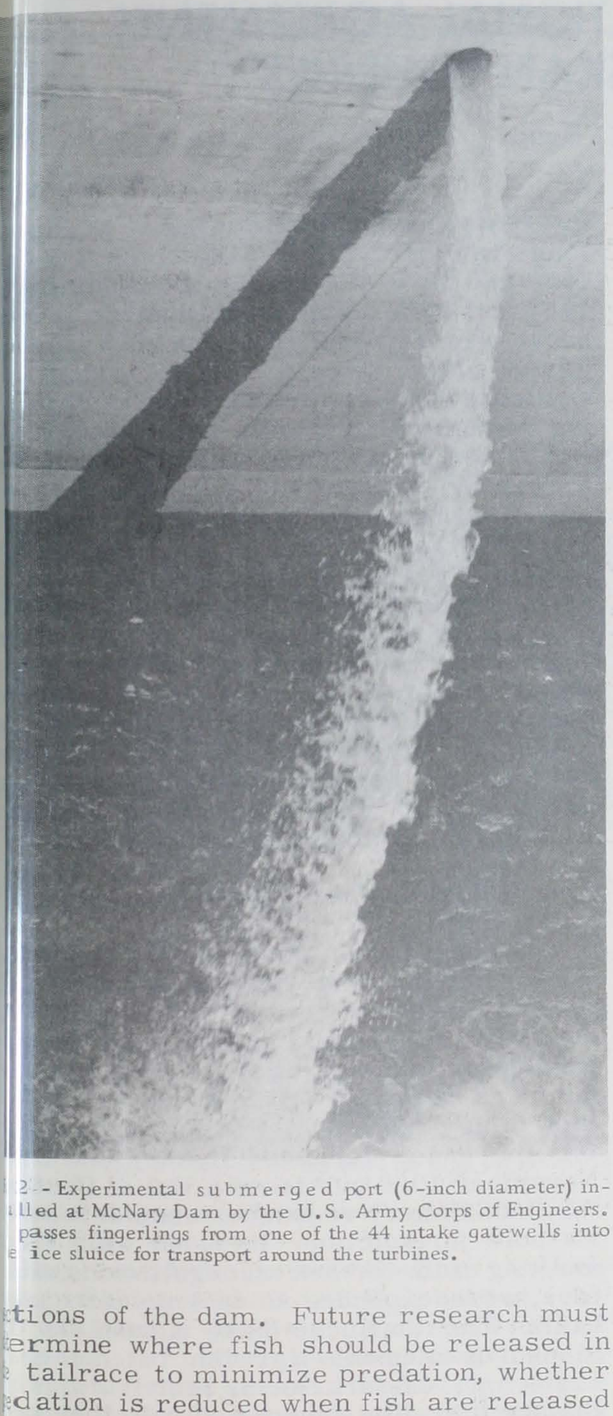
Laboratory studies will answer the question of impingement, but guiding efficiency can be determined only in turbine intakes. Hydraulic model studies, now being conducted for BCF by the Albrook Hydraulic Laboratory, Washington State University, can aid materially in describing the flows in the intake and gatewell created by the screen. From these studies, we can determine how to achieve hydraulic flow patterns that should produce maximum guiding efficiency and retention of guided fish in the gatewell.

Mechanically, we must demonstrate that the traveling screen: (1) is completely safe when placed immediately upstream from turbines (structural failure could cause damage to the turbine) and (2) can be operated for long periods without maintenance. Long-term tests in a large flume will be required.

Guided fish must pass readily through th submerged ports leading to the ice sluice. the fish accumulate in the gatewell, alterna tive methods must be devised for more effici ent passage. During tests on the latter ha of the salmon run in 1968, research by BC on 3 submerged ports (installed at McNar Dam by the Corps of Engineers) indicate that fish would pass through the ports with minimum of delay. Further research will b carried out to measure rate of passage dur ing the entire fish run--and to determine i the fish sustain injuries or mortality in pass ing through the ports.

Once fish are in the ice sluice, they must pass safely over a 36-ft. waterfall before they reach the tailrace downstream from the dam. Studies on survival in the ice sluice are required.

Finally, we must determine how bypassed fish should be released to minimize mortality from predation. Predators, such as northern squawfish (Ptychocheilus oregonensis) and seagulls, cause up to 33-percent loss of fish released in slack water below nonoverflow



2 - Experimental submerged port (6-inch diameter) installed at McNary Dam by the U.S. Army Corps of Engineers. passes fingerlings from one of the 44 intake gatewells into e ice sluice for transport around the turbines.

tions of the dam. Future research must ermine where fish should be released in tailrace to minimize predation, whether dation is reduced when fish are released y at night, and whether the spilling of water through a spillway gate near the release e reduces predation. From these and similar studies, BCF and the Corps can develop ystem that will provide juvenile migrating h with best possible protection at minimum cost.

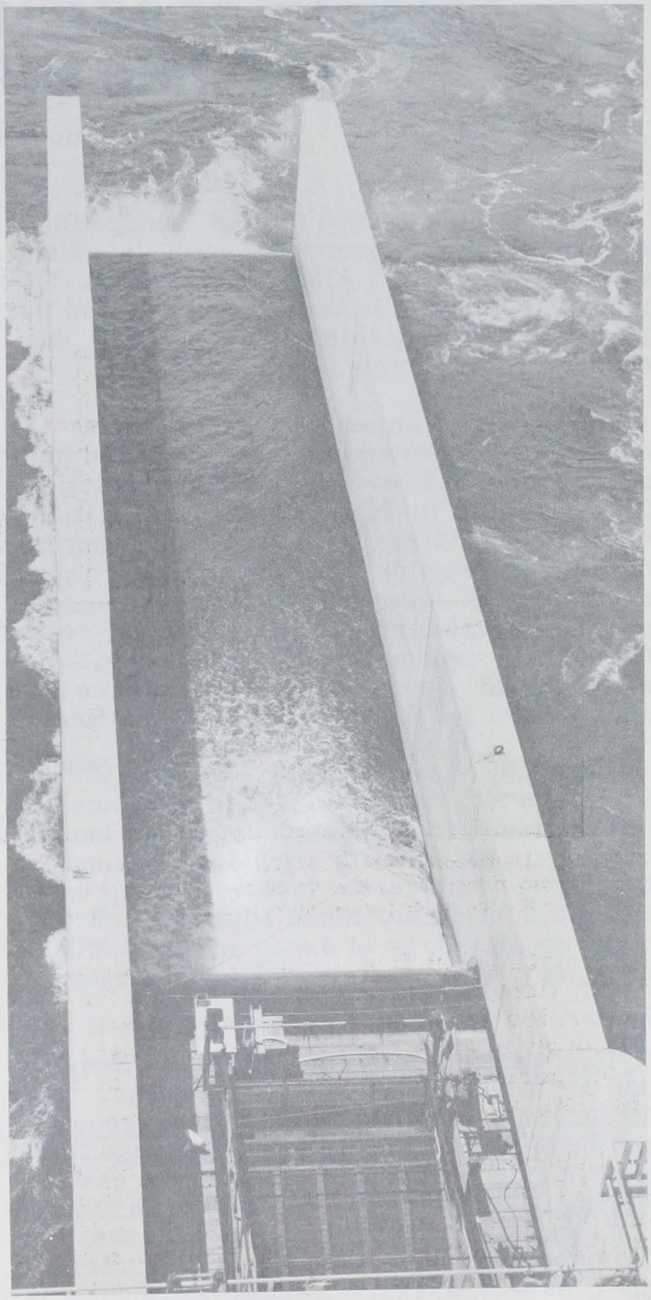


Fig. 3 - The ice sluice, used for transporting young fish around the turbines, discharges the fish in the tailrace about 120 feet downstream from McNary Dam.

The Corps of Engineers has provided BCF with funds to accelerate the development of this fish-bypass system. Moreover, the Corps already has equipped all 44 gatewells at McNary Dam with submerged ports. Research on these ports and on other aspects of bypassing fish are underway.