

PRELIMINARY RESEARCH PROPOSAL (FY07)

TITLE: Evaluate the effectiveness of transporting Chinook Salmon and Steelhead from McNary Dam

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PROJECT SUMMARY

The goal of this project is to provide statistically valid information on the smolt-to-adult return rates (SAR) of Columbia River anadromous salmonids that migrate in-river compared to those transported around dams of the Federal Columbia River Power System (FCRPS). We propose to evaluate transportation of hatchery-reared yearling Chinook salmon (*Oncorhynchus tshawytscha*) and hatchery-reared steelhead (*O. mykiss*) and subyearling Chinook salmon at McNary Dam on the Columbia River.

Evaluations of transportation from McNary Dam were delayed until adult PIT-tag detectors became operational in the fish ladders at the dam, which occurred in 2002. In summer 2001 and 2002, we PIT-tagged subyearling Chinook salmon at McNary Dam to evaluate the efficacy of transporting them from this site. In 2007, we will continue to collect adult returns from the 2002 tagging year. We also propose to continue an evaluation of transportation vs. full-flow bypass at McNary Dam begun in 2002 using hatchery-reared steelhead and spring Chinook salmon PIT tagged and released from Columbia River hatcheries located upstream from McNary Dam. During 2007, we will continue the collection of adult returns from study years 2004-2005.

Analyses of data based on this research and research conducted under various other contracts will provide critical information to compare overall SARs of transported and in-river-migrating or bypassed anadromous salmonids, to examine potential seasonal effects of transportation, to evaluate the effects of transportation on homing of adults, and to estimate differential mortality (“D”) of transported fish.

Relevance

This study addresses needs identified in NOAA’s 2004 Biological Opinion (BiOp) “*The Action Agencies will continue to conduct RM&E to provide information on juvenile fish transportation and delayed mortality*”, and the 2005-2007 Implementation Plan for the Federal Columbia River Power System Endangered Species Act Updated Proposed Action of the U.S. Army Corps of Engineers, Bureau of Reclamation, and Bonneville Power Administration (dated May 2005). Specifically, the Implementation Plan, under the Hydropower Action Effectiveness Research section (page 40), they state “*Advance the understanding of the effectiveness of flow augmentation, spill, **transportation**, and system configuration changes on fish survival for each ESU*”.

This study also addresses RPAs identified in NOAA's 2000 BiOp including *Action 45* addressing the response of upper Columbia River spring Chinook and Steelhead to transportation, *Action 47* the need for an evaluation of delayed mortality (D) of transported versus inriver migrating juvenile anadromous salmonids, *Action 48* addressing the effects of prior transport as smolts on the homing of adults, and *Action 185* aimed at defining juvenile migrant survival for both transported and nontransported migrants including a comparison of SARs of both groups to estimate *D*.

BACKGROUND

Research to evaluate the effects of transporting juvenile salmonids around dams began over 30 years ago (Ward et al. 1997). Evaluation of transport of yearling Chinook salmon and steelhead was conducted from various Snake River dams from 1968 through 1980. In addition, transport of subyearling Chinook salmon and steelhead were evaluated at McNary Dam on the Columbia River from 1978 through 1983.

From these early studies, the apparent benefits of transportation varied by species. For subyearling Chinook salmon and steelhead, results consistently showed that more marked/transported fish returned to the point of release than did marked fish released to migrate in-river. However, for yearling Chinook salmon, study results were less consistent. Results from the 1968-1973 studies demonstrated conclusively that significantly more marked fish that were transported returned to the point of marking than did marked fish released to migrate in-river (Ebel et al. 1973, Slatick et al. 1975, Ebel 1980). However, studies conducted between 1976 and 1980 were inconclusive as very low numbers of marked adults returned from either group (Park 1985).

Matthews (1992) postulated that severe physical traumas suffered by many smolts during collection and marking were a primary cause of low returns of yearling Chinook salmon adults during the 1976-80 studies. From 1981 through 1984, the COE and fisheries agencies addressed this problem by modifying or otherwise improving many features of the smolt collection and bypass systems at dams, particularly at Lower Granite Dam. Moreover, the preanesthetic system of handling and marking smolts (Matthews et al. 1997) was introduced at Lower Granite Dam in 1983. This system eliminated much of the major physical traumas associated with the handling and marking process. All indications suggest that the modifications and improvements increased survival substantially.

A study to re-evaluate smolt transportation of yearling Chinook salmon and steelhead migrants from the Snake River, after the substantial modifications to collection and bypass facilities were made, was initiated at Lower Granite Dam in 1986. Yearling Chinook salmon and steelhead smolts were marked in 1986 and 1989 at Lower Granite Dam. Approximately one-half of the smolts were placed in barges at Lower Granite Dam and released below Bonneville Dam. The remainder were trucked to a release site downstream from Little Goose Dam to continue their in-river migration. Although significantly more marked adults of both species returned from those fish barged compared to fish that migrated in-river, concern was raised that the studies were flawed because the in-river migrating fish were transported to below Little Goose Dam (Ward et al. 1997). Further, in-river conditions were not considered optimal for the survival of in-river migrating fish; therefore, potential benefits to in-river fish were not fairly evaluated.

In 1994, a new smolt collection and transportation facility became operational at McNary Dam. However, without adult PIT-tag detectors at lower river dams, opportunities for

conducting transportation research at this new facility using PIT tags was limited . However, in 2002, the adult fishways at Bonneville and McNary Dams were equipped with PIT-tag interrogation systems. Therefore, we began transport evaluations with PIT-tagged subyearling Chinook salmon migrating through McNary Dam beginning in summer 2001 and continuing in summer 2002. For 2007, we will continue monitoring returning adults from the 2002 marking year. In 2002, we began a study of spring transportation at McNary Dam using yearling Chinook salmon PIT-tagged at Columbia River hatcheries upstream from the dam to specifically compare the return of transported smolts to the return of fish returned to the river via the new full-flow-bypass pipe at McNary Dam. In 2003, this study was expanded to include steelhead marked at Columbia River hatcheries above McNary Dam. In 2007, we will continue monitoring returning adults from the 2004-2005 marking years.

These evaluations will provide new data to assess the efficacy of transportation from McNary Dam to increase adult returns of anadromous salmonids to the Columbia River. Results will be integrated with results from concurrent in-river-smolt-survival studies (Muir et al. 2001). In combination, these studies will provide the data necessary for estimating the delayed mortality of transported fish, or “*D*”, for the various groups of transported fish.

APPROACH

Objective 1

Compare the SARs of yearling Chinook salmon and steelhead PIT tagged and released from hatcheries above McNary Dam in the Columbia River and either transported from McNary Dam to below Bonneville Dam, collected and returned to the tailrace of the dam via the full-flow-bypass pipe, or that passed McNary Dam without being detected.

Even though several, multi-species transportation studies were conducted from McNary Dam from the late 1970s through the late 1980s, the tests were conducted under conditions that no longer exist. New transportation studies are needed to provide up-to-date information on the efficacy of transportation from McNary Dam for listed anadromous salmonids. In 2002, we began a new transportation study of hatchery yearling spring Chinook salmon transportation from McNary Dam using modern technologies and conducted under contemporary conditions. In 2003, hatchery steelhead were added to the study.

Currently, spring-migrating smolts are not transported from McNary Dam. For fish collected at the dam, there are two options--transport them to below Bonneville Dam or bypass the raceway system completely by returning them to the river through the full-flow-bypass pipe which is now equipped with a PIT-tag detection system. From 2002 to 2005, to evaluate transportation versus return to the river via the full-flow pipe, smolts were PIT-tagged and released upstream from the dam. For those fish detected at McNary Dam, transport or return to the river was conducted on an every-other-day basis.

The marking of juveniles for this series of studies is complete. We are now in the adult detection phase of the studies.

Task 1.1:

Monitor detections of adult yearling Chinook salmon and steelhead previously PIT tagged at Columbia River hatcheries and either transported from McNary Dam or returned to the river through the full-flow-bypass pipe and analyze these data.

Adult PIT-tag detection systems located in the Bonneville and McNary Dam fish ladders will serve as the principal monitor sites for adults returning to the Columbia River. We will also gather data from the adult PIT-tag detection systems in the Ice Harbor, Priest Rapids, Rock Island, and Wells Dams fish ladders, as well as hatchery returns. To analyze results, statistical tests will be applied when adult returns for the study are complete. Confidence intervals for the transport/in-river ratio (T/I) will be calculated using the ratio of SAR estimates (Burnham et al. 1987) and their associated empirical variance. The study will produce statistically-bound T/I estimates for tagged hatchery fish returning to the Columbia River. We will also estimate differential transport mortality by comparing T/I to an independent estimate of in-river survival to below Bonneville Dam based on the Single-Release Model. If data allows, this will be done on a weekly basis as D has been shown to vary seasonally at other transport locations (Williams et al. 2005). Because the origin of tagged fish will be known, detections of returning adults as they pass upstream through the dams to the hatcheries will also provide data to compare homing characteristics of transported and in-river-migrating study fish.

Task 1.2:

Examine PIT-tag detection histories of adults as they migrate upstream through the hydropower system.

Currently, Bonneville, McNary, Priest Rapids, Rock Island, Wells, Ice Harbor, and Lower Granite Dams are equipped with adult PIT-tag detection systems and detection systems are planned for installation in other dams in the future. At these dams, all PIT-tagged fish

passing through the fish ladders are likely to be detected. Similar systems are also in place at certain hatcheries in the Columbia River Basin.

To evaluate the potential for transportation as juveniles to influence the homing characteristics of returning adults, we will compare the PIT-tag detection histories of transported and non-transported adult study fish as they pass upstream through PIT-tag detection systems within the Basin.

Objective 2

Compare SARs of subyearling Chinook salmon juveniles PIT tagged at and either transported from McNary Dam to below Bonneville Dam or released into the tailrace to migrate in-river.

For yearling Chinook salmon and steelhead, the great majority of smolts passing McNary Dam originate in hatcheries upstream of the dam. Therefore, a tagging scheme to evaluate transportation that relies on tagging fish in hatcheries above the dam will represent the great majority of the actual population of fish arriving at the dam. The same is not true for subyearling Chinook salmon. The majority of these fish are from natural spawning in the Hanford Reach and further upstream. Additionally, these wild fish have a later timing distribution at the dam than do the hatchery-reared fish. To provide a holistic approach to evaluating transportation of subyearling Chinook salmon from McNary Dam, we believe it would be wise to PIT tag a group that represents the majority of the population arriving at the dam. To this end, we PIT-tagged subyearling Chinook salmon at McNary Dam during summers of 2001 and 2002. Adults from the 2002 marking year will continue returning through 2007.

Task 2.1:

Recover adult subyearling Chinook salmon previously PIT tagged at McNary Dam and analyze adult return data.

Adult PIT-tag detection systems located in the fish ladders of Bonneville and/or McNary Dams will serve as the principal detection sites for adults. Data acquired from other areas will be considered ancillary. To analyze results, statistical tests will be applied when adult returns for the study are complete. Confidence intervals for the T/I will be calculated using the ratio of SAR estimates (Burnham et al. 1987) and their associated empirical variance. The study will produce statistically-bound T/I estimates for PIT-tagged fish returning to the Columbia River.

Task 2.2:

Examine PIT-tag detection histories of adults as they migrate upstream through the hydropower system.

To evaluate the potential for transportation of subyearling fall Chinook salmon as juveniles to influence the homing characteristics of returning adults, we will compare the PIT-tag detection histories of transported and non-transported adult study fish as they pass upstream through the appropriate PIT-tag detection systems within the Basin.

FISH REQUIREMENTS FOR FY 2007

There will be no tagging in 2007, therefore, no fish are required.

SCHEDULE

Activity	FY07	Outyears
Task 1.1		
Adult recovery	April-Aug	Same
Task 2.1		
Adult recovery	Aug-Dec	Same

PROJECT IMPACTS, FACILITIES, AND EQUIPMENT

None

PROJECT PERSONNEL AND DUTIES

Douglas M. Marsh--biologist and principal investigator working on Objectives 1-2.

Steven Smith--statistician working on Objectives 1-2.

Benjamin Sandford--statistician working on Objectives 1-2.

TECHNOLOGY TRANSFER

Technology transfer will be in the form of written and oral research reports as required.

A draft report for spring Chinook salmon will be provided to the COE by 15 November each

year, with a final report provided by 15 March the following spring. A draft report for fall

Chinook salmon and steelhead will be provided to the COE by 15 August each year, with a final

report provided by 15 December. In this way, complete returns for each age class of adults can

be included in the final report for each study year. Results will also be published in appropriate

scientific journals.

REFERENCES

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