

SURVIVAL ESTIMATION FOR DAM/RESERVOIR PASSAGE 9302900

SHORT DESCRIPTION:

Provide measurements of survival of juvenile salmon as they pass through dams and reservoirs

SPONSOR/CONTRACTOR: NMFS

National Marine Fisheries Service

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SUB-CONTRACTORS:

University of Washington

GOALS

GENERAL:

Supports a healthy Columbia basin, Adaptive management (research or M&E)

ANADROMOUS FISH:

Research, M&E

NPPC PROGRAM MEASURE:

5.0F

RELATION TO MEASURE:

The Columbia River Basin Fish and Wildlife Program states that the relationship between flow, travel time, and survival of migrating juvenile salmon should receive highest priority in the region's research efforts.

BIOLOGICAL OPINION ID:

NMFS BO RPA Sec. 13f

TARGET STOCK

All Snake River stocks

LIFE STAGE

Juvenile

MGMT CODE (see below)

BACKGROUND

Project is an office site only

HISTORY:

A great deal of work was completed prior to 1993 laying the foundation for survival studies to proceed. This included the development of PIT-tag technology for use in fish, installation and testing of PIT-tag detection and slide gate systems at Snake and Columbia River dams, and the development of the statistical models used to estimate survival through BPA-funded workshops and contracts.

BIOLOGICAL RESULTS ACHIEVED:

From 1993 through 1995, the methodologies used to measure survival of juvenile salmonids as they pass through Snake River dams and reservoirs were successfully tested. In 1993, a series of precise estimates of survival from near the head of Lower Granite Reservoir to the tailrace of Little Goose Dam were obtained during the peak of the hatchery yearling chinook salmon migration. During 1994 and 1995, a series of precise survival estimates were obtained for this species from the head of Lower Granite Reservoir to the tailrace of Lower Monumental Dam during the majority of their outmigration. Similar estimates were obtained in 1994 and 1995 for hatchery steelhead in a related study funded by the U.S. Army Corps of Engineers. Secondary releases were made at Lower Granite, Little Goose, and Lower Monumental Dams to measure post-detection bypass survival (a test of a model assumption), survival through turbines, and through spillways. Slide gates at Snake River dams returned approximately 85% of the PIT-tagged smolts back to the Snake River allowing multiple detections at downstream dams from releases at the head of Lower Granite Reservoir, at the dams, and from hatcheries and traps upstream. The Single-Release Model was used to estimate survival for releases from the head of Lower Granite Reservoir, hatcheries, and traps. The Paired-Release

model was used to estimate survival for releases at the Snake River dams.

PROJECT REPORTS AND PAPERS:

FY 1994: Quarterly Progress Reports; Progress Report to the Northwest Power Planning Council (NPPC) July 1993; Draft Annual Report November 1993; Annual report 1993 "Survival Estimates for the Passage of Juvenile Salmonids through Snake River Dams and Reservoirs, 1993" DOE/BP-10891 March 1994

FY 1995: Quarterly Progress Reports; Draft 1994 Annual Report December 1994; progress Report to the NPPC February 1995; Annual report 1994 "Survival Estimates for the Passage of juvenile Salmonids through Snake River Dams and Reservoirs, 1994 DOE/BP-10891-2 March 1995.

FY 1996: Annual Report 1995 "Survival Estimates for the Passage of Juvenile Salmonids through Snake River Dams and Reservoirs, 1995 DOE/BP-10891-3 March 1996.

ADAPTIVE MANAGEMENT IMPLICATIONS:

The survival estimation methods developed and tested in this study can be used to evaluate various management strategies for the Snake River such as drawdown, flow augmentation, or spill programs by comparing changes in survival within and across years. The paired-release methods can be used to evaluate structural modifications at the dams such as flow deflectors on spillways, surface bypass collectors, and changes in turbine operation.

PURPOSE AND METHODS

SPECIFIC MEASUREABLE OBJECTIVES:

1. Estimate survival over longer distances after installation of the PIT-tag interrogation system at John Day Dam is completed. This includes survival estimates from the Snake River Basin and from areas in the upper Columbia River Basin.
2. Release PIT-tagged yearling chinook salmon upstream from Lower Granite Reservoir to partition where mortality occurs between release from hatcheries and the head of the reservoir.
3. Estimate survival for hatchery-reared fall chinook salmon from Lyons Ferry Hatchery released into the free-flowing Snake River and the head of lower Granite Reservoir.
4. Explore relationships between smolt survival through the Snake River and flow, travel time, and dam operations using a long-term data set.

CRITICAL UNCERTAINTIES:

1. Whether adequate numbers of fish can be collected during the different time frames with available gear and methods.
2. Whether the predetermined number of releases and release sizes will provide the necessary precision for the survival estimates.
3. Whether the detectors and diverters will be operational during the duration of the study.
4. For paired releases, whether the assumption of random mixing of treatment and control releases will be satisfied.
5. Whether the assumption that survival and detection probabilities are independent of previous detection history will be satisfied.

BIOLOGICAL NEED:

Survival estimates through Snake River dams and reservoirs are needed to evaluate the success of strategies to improve smolt survival (i.e., drawdown, flow augmentation, spill program, or dam passage improvements). Historical estimates are outdated and were conducted in a river system considerably different than the present system.

HYPOTHESIS TO BE TESTED:

Ho1: The effects of environmental conditions (e.g. flow, water temperature, turbidity) have no influence on smolt survival through the Snake River.

If rejected, alternate hypotheses are that some of these factors do influence smolt survival

Ho2: The effects of project operations (e.g. increased spill, potential reservoir drawdown) have no influence on smolt survival through the Snake River.

If rejected, alternate hypotheses are that some of these factors do influence smolt survival

Ho3: The effects of project improvements (e.g. installation of surface collectors, changes in turbines and bypass systems to improve survival) have no influence on smolt survival through the Snake River.

If rejected, alternate hypotheses are that some of these factors do influence smolt survival

Ho4: There are no relationships between traits of individual fish (e.g. length, condition index) and survival probabilities and

travel times.

If rejected, alternate hypotheses are that some of these factors do influence smolt survival

METHODS:

To estimate survival for yearling chinook salmon and steelhead migrating through the Snake River, we will continue to purse seine fish at the head of Lower Granite Reservoir during the major portion of their migrations, PIT tag, and release them after sufficient recovery. We will explore other release locations, such as the free-flowing Snake River, in an effort to further partition mortality within the migration corridor. We will also continue to estimate survival for releases of PIT-tagged smolts from hatcheries, traps, and other PIT-tag studies in the Snake River Basin, and will expand efforts to estimate survivals from the upper Columbia River Basin. We will use the Single-Release model to estimate survival for these releases and the Paired-Release Model to estimate survival through specific passage routes (i.e., spillways, surface collectors, etc.) as the need arises. These studies will use hatchery yearling chinook salmon, hatchery steelhead, and hatchery subyearling chinook salmon from Lyons Ferry Hatchery when sufficient numbers are available for research. The increased number of dams with PIT-tag interrogation/diversion systems and their improved efficiency, coupled with the discontinuation of our post-detection bypass releases has allowed us to greatly reduce the number of fish needed for these studies.

PLANNED ACTIVITIES

SCHEDULE:

Planning Phase **Start** ongoing **End** 2010 **Subcontractor** Ongoing

Task 1. Continue primary releases of hatchery yearling chinook salmon and steelhead purse-seined at the head of Lower Granite Reservoir. 2. Continue releases of hatchery yearling chinook salmon from the free-flowing Snake River when sufficient numbers of fish are available. 3. Begin releases of PIT-tagged Lyons Ferry Hatchery fall chinook salmon subyearlings when sufficient numbers are available for research. 4. Make secondary paired releases at Snake and Columbia River dams as needed. Evaluate post-detection bypass mortality (test of a model assumption) at McNary Dam after completion of the John Day Dam PIT-tag interrogation system. This will permit survival estimation to the tailrace of McNary Dam. Make survival estimates for all PIT-tagged fish release from upstream areas and at dams in the Snake and upper Columbia River Basins.

Implementation Phase **Start** ongoing **End** 2010 **Subcontractor** ongoing

Task 1-6

CONSTRAINTS OR FACTORS THAT MAY CAUSE SCHEDULE OR BUDGET CHANGES:

Handling of listed natural chinook salmon and resulting mortality. We minimize these effects by using safe fish handling techniques and by handling and PIT tagging the fewest possible number of fish to accomplish our research objectives.

OUTCOMES, MONITORING AND EVALUATION

SUMMARY OF EXPECTED OUTCOMES

Expected performance of target population or quality change in land area affected:

1. We will provide estimates of survival for hatchery-reared yearling chinook salmon and hatchery reared subyearling fall chinook salmon from the free-flowing Snake River and the head of Lower Granite Reservoir. We will also provide estimates of survival for hatchery steelhead from the head of Lower Granite Reservoir.
2. We will provide survival estimates for PIT-tagged salmonids released from other studies to evaluate the Single-Release Model for estimating survival from other locations.
3. We will determine whether assumptions of the Single-Release Model are met by data from PIT-tagged salmonid smolts migrating under river conditions and dam operations present during the 1998 migration season.
4. We will obtain auxiliary data that might be useful for the study of the following smolt survival issues:
 - a. survival relationships with individual covariates such as size and condition and group covariates such as bacterial kidney disease incidence and general health profile; and,
 - b. estimating components of variability of travel times and survival probabilities related to flow, spill, bypass efficiencies, etc. at Snake and Columbia River dams..

Contribution toward long-term goal:

Improved information base for management of hydrosystem operations to improve protection and the passage survival of all Columbia River Basin anadromous stocks of salmon and steelhead through the FCRPS.

Coordination outcomes:

As in 1993, assumptions of the Single Release and Paired-Release Models were generally satisfied in 1994-1996. The results indicated that 1) detecting a fish at an upstream site did not influence the probability of its subsequent detection downstream, 2) detection did not influence subsequent survival. Moreover, post-detection bypass releases indicated non-significant mortality occurred after bypass fish were detected in the bypass and before they re-mixed with fish using other passage routes.

Accordingly, the Single- Release Model was used to estimate survival probabilities for the primary release groups.

Precise survival estimates for a large portion of the 1994-1996 hatchery yearling chinook salmon migration were obtained.

Mortality from the head of Lower Granite Reservoir to the tailrace of Lower Granite Dam was approximately 10% for hatchery and wild yearling chinook salmon with low inter-replicate variability. Because this estimate included mortality associated with dam passage via turbines, bypass or spill, as well as reservoir mortality, it appeared that relative little mortality occurred in the reservoir.

The river sections over which survival was estimated represent about 64% of the distance from the head of Lower Granite Reservoir to the confluence of the Snake and Columbia Rivers. The estimated survival probability from Silcott Island to Lower Monumental Dam tailrace (143 km) was 66% for hatchery chinook salmon and 73% for wild chinook salmon.

Survival estimates for PIT-tagged smolts released from hatcheries upstream from Lower Granite Dam were also calculated.

Survival probability estimates to Lower Granite Dam tailrace for hatchery releases were lower than for our primary releases and generally appeared to be inversely proportional to the distance from the hatcheries to Lower Granite Dam.

In conclusion, we believe that accurate and precise estimates of system survival from an upstream release site in the Snake River Basin to the tailraces of Lower Granite, Little Goose, or Lower Monumental Dams are now possible using the Single-Release, Modified Single-Release and Paired-Release methodologies with PIT-tag diversion systems in place and with sufficient release numbers. This will permit exploration of the relationships among smolt survival, smolt travel time, smolt quality, and environmental conditions encountered during migration.

MONITORING APPROACH

To estimate survival for yearling chinook salmon and steelhead migrating through the Snake River, we will continue to purse seine fish at the head of Lower Granite Reservoir during the major portion of their migrations, PIT tag, and release them after sufficient recovery. We will explore other release locations, such as the free-flowing Snake River, in an effort to further partition mortality within the migration corridor. We will also continue to estimate survival for releases of PIT-tagged smolts from hatcheries, traps, and other PIT-tag studies in the Snake River Basin, and expand this to include upper Columbia River Basin PIT-tagged fish. We will use the Single-Release Model to estimate survival for these releases and the Paired-Release Model to estimate survival through specific passage routes (i.e. spillways, surface collectors, etc.) as the need arises. These studies will use hatchery yearling chinook salmon, hatchery steelhead, and hatchery subyearling chinook salmon from Lyons Ferry Hatchery when sufficient numbers are available for research. The increased number of dams with PIT-tag interrogation/diversion systems and their improved efficiency, coupled with the discontinuation of our post-detection bypass releases has allowed us to greatly reduce the number of fish needed for these studies.

Data analysis and evaluation:

See comments in above sections.

EVALUATION

Project success is measured by the ability to provide estimates of survival for PIT-tagged fish through the hydropower system under conditions that exist between and within years, and to determine which factors appear to have the greatest effect on survivals.

RELATIONSHIPS

RELATED BPA PROJECT

RELATIONSHIP

86930151 Migrational characteristics of juvenile chinook salmon and steelhead in Lower Granite Reservoir and tributaries, Snake River. Our study provides purse-seine captured fish for radio tagging for this study. Results from t

This is a coordinated project between ODFW and Wasco County Soil and Water Conservation District. Joint participation is key to successful implementation of the Buck Hollow Watershed Enhancement Project. SWCD develops project plans, seeks project funding, convenes interdisciplinary Technical Team to provide internal review and technical recommendations on watershed enhancement and riparian restoration efforts. In addition, SWCD participates on the Technical Team and in all planning activities, shares monitoring data with other participants as requested, meets and coordinates with individual landowners in the project area, schedules technical and coordination meetings as necessary, schedules project areas, and provides overall project leadership and coordination. ODFW participates on the project Technical team and in all planning activities and provides technical leadership in fish habitat project elements, sharing monitoring data with other participants as requested. ODFW also provides training in releva

RELATED NON-BPA PROJECT

see COE funded activities in Related BPA Projects section above

RELATIONSHIP

OPPORTUNITIES FOR COOPERATION:

1. Cooperative research with the USFWS beach-seining in the free-flowing Snake River to provide yearling chinook salmon smolts for PIT tagging.
2. Cooperative research with the USFWS/NBS on fall subyearling chinook salmon survival.
3. Providing purse-seined captured yearling chinook salmon smolts to the NBS for radio-tag studies in Lower Granite Reservoir.
4. Estimating survival for NMFS transportation study river migrants.

COSTS AND FTE

1997 Planned: \$900,000

FUTURE FUNDING NEEDS:

<u>FY</u>	<u>\$ NEED</u>	<u>% PLAN</u>	<u>% IMPLEMENT</u>	<u>% O AND M</u>
1998	\$1,200,000			100%
1999	\$1,200,000			100%
2000	\$1,200,000			100%
2001	\$1,200,000			100%
2002	\$1,200,000			100%

PAST OBLIGATIONS (incl. 1997 if done):

<u>FY</u>	<u>OBLIGATED</u>
1993	\$709,700
1994	\$794,000
1995	\$605,600
1996	\$750,500
TOTAL:	\$2,859,800

Note: Data are past obligations, or amounts committed by year, not amounts billed. Does not include data for related projects.

<u>FY</u>	<u>OTHER FUNDING SOURCE</u>	<u>AMOUNT</u>	<u>IN-KIND VALUE</u>
1998	NMFS	\$100,000	
1999	NMFS	\$100,000	
2000	NMFS	\$100,000	
2001	NMFS	\$100,000	
2002	NMFS	\$100,000	

LONGER TERM COSTS: \$1,200,000 - Continued implementation

1997 OVERHEAD PERCENT: 45.6% of total direct labor.

HOW DOES PERCENTAGE APPLY TO DIRECT COSTS:

Only total direct labor

CONTRACTOR FTE:

8-10 FTEs for permanent staff. Large numbers of seasonal workers are necessary to conduct field portions of the study.

SUBCONTRACTOR FTE: 3
