

EVALUATION OF JUVENILE SALMONID OUTMIGRATION AND SURVIVAL IN THE LOWER UMATILLA RIVER BASIN 8902401

SHORT DESCRIPTION:

This project will determine migration characteristics, migrant abundance, survival, and health of outmigrating natural and hatchery juvenile salmonids in the lower Umatilla River; investigate relationships between environmental and biological parameters and migration and survival; determine effectiveness of passage routes at Three Mile Falls Dam and monitor passage and migration via photonic tags and detectors.

SPONSOR/CONTRACTOR: ODFW

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SUB-CONTRACTORS:

N/A

GOALS

GENERAL:

Supports a healthy Columbia basin, Increases run sizes or populations, Adaptive management (research or M&E)

ANADROMOUS FISH:

Habitat or tributary passage

NPPC PROGRAM MEASURE:

7.4I.1

RELATION TO MEASURE:

Evaluation of juvenile salmonid outmigration and survival in the lower Umatilla River Basin is necessary to determine, in part, the overall effectiveness and success of fisheries rehabilitation projects in enhancing and reestablishing salmonid populations in the Umatilla River basin. This evaluation provides knowledge for adaptive management of hatchery, river, and canal operations, and supplements and compliments ongoing or completed evaluations of specific rehabilitation projects.

BIOLOGICAL OPINION ID:

No biological opinions have addressed the Umatilla River Outmigration Study.

OTHER PLANNING DOCUMENTS:

Monitoring activities are called for in A Comprehensive Plan for Rehabilitation of Anadromous Fish Stocks in the Umatilla River Basin (Boyce 1996); the Umatilla Hatchery Master Plan (ODFW and CTUIR 1989); the Umatilla River Subbasin Salmon and Steelhead Plan (ODFW and CTUIR 1990); and, Umatilla Basin Project-Initial Project Workplan (USBR and BPA 1989). The Wy Kan Ush Me Wa Kish Wit plans calls for continuation of current monitoring of all artificial production actions in the Umatilla basin (volume II, page 45).

TARGET STOCK

LIFE STAGE

MGMT CODE (see below)

Spring Chinook Salmon- Carson Stock	Fry to Smolt	A,E,S
Summer Steelhead- Umatilla River stock	Fry to Smolt	A,P,S,W
Fall Chinook Salmon-Upriver Bright stock	Fry to Smolt	A,E,S
Coho Salmon-Tanner Creek stock	Fry to Smolt	A,E,S

BACKGROUND

STREAM AREA AFFECTED

Stream name:

Umatilla River

Stream miles affected:

LAND AREA INFORMATION

Subbasin:

Umatilla River sub-basin

Land ownership:

100 miles

38% Public, 11% Tribal, 51% Private

Hydro project mitigated:

Acres affected:

This project mitigates for damages caused by the following federal dams: Bonneville, The Dalles, and John Day dams on mainstem Columbia River

401,465,600 acres

Habitat types:

N/A Fish project only.

HISTORY:

This project is a follow-up to the project to evaluate the loss of juvenile salmon due to passage through screening and bypass facilities at Umatilla River diversion canals and at fish ladder facilities. Non-biological products included the construction of numerous migrant traps. Minor subsequent tasks relevant to passage evaluation have been included in current research objectives. Current research developed out of the need to enlarge the scope of evaluating juvenile salmonid passage success (migration and survival) to the basin as a whole and to supplement and compliment other ongoing monitoring and evaluation projects. Project is currently in its third year of implementation.

BIOLOGICAL RESULTS ACHIEVED:

Measurable biological outcomes include bypass efficiencies at differing canal operations and diversion rates; velocities at canal and ladder facilities; video documentation of juvenile fish passage at Three Mile Falls Dam; migration rates, timing, duration, and magnitude (time of day and day) for naturally and hatchery produced species of juvenile salmonids and brand groups of hatchery species; estimates of migrant abundance of each salmonid species passing Three Mile Falls Dam; determination of fish condition, smoltification indices, and length frequency distributions through time; determination of partial life history characteristics and lower river rearing for natural salmonids; relationships between migration characteristics and environmental variables (river flow and temperature); survival indices for hatchery released fish and marked natural fish; documentation of piscivorous and avian predators; information on composition of fish species during trapping at Westland Canal, and on salmonid injury and survival during and after transport. Seasonal presence of resident fish species and their life stages.

PROJECT REPORTS AND PAPERS:

The following reports are a result of this project: Annual progress reports for 1995 and 1996 (in preparation) on Evaluation of Juvenile Salmonid Outmigration and Survival in the Lower Umatilla River Basin. Previous annual reports from Passage Evaluation Study (Evaluation of Juvenile Fish Bypass and Adult Fish Passage Facilities at Three Mile Falls Dam, Umatilla River 1990; Evaluation of Juvenile Fish Bypass and Adult Fish Passage Facilities at Water Diversions on the Umatilla River 1992, 1993, 1994, 1995). Project completion report for Passage Evaluation Study (1997).

ADAPTIVE MANAGEMENT IMPLICATIONS:

Based on previous year's results and knowledge gained, approaches to trap efficiency tests, video monitoring, trap capture, and fish marking have been modified. Findings on migration parameters, bypass efficiencies, fish condition, ladder passage, and the presence of wild salmonids in the lower river can be applied toward management of river, canal, and passage facility operations and water release and flow enhancement strategies to improve outmigration, passage, survival, and rearing conditions for juvenile salmonids. Survival results may necessitate a change in approach to fisheries restoration efforts to increase effectiveness. Alteration of hatchery rearing and release strategies is partly based on outmigration and survival results for specific strategies. Information on natural production in the lower river will assist managers in determining natural production potential or limitations. Successful natural production enhancement efforts for summer steelhead are contingent on understanding life history characteristics of natural and hatchery stocks. Information on predators could facilitate predator control measures to increase salmonid survival. Results of transport tests will help improve transport operations and conditions. Results from pathological analysis of migration mortalities contribute to understanding in-river disease dynamics for specific species and stocks of fish. Observations of juvenile fish behavior at ladder diffusers and measurements of velocity could affect a change in ladder operations or structures. Effectiveness of feasibility studies on photonic marking and remote detection could alter marking strategies and provide additional migrational information. Results of this project will clarify the success of outmigration survival for hatchery and natural stocks and contribute to an understanding of how survival could be improved. Good survival is critical toward fisheries restoration efforts in the Umatilla Basin and in the system-wide doubling goal.

PURPOSE AND METHODS

SPECIFIC MEASUREABLE OBJECTIVES:

1. Determine species-specific collection efficiencies of the bypass facility at West Extension Canal under differing operations, diversion rates, and river flows; determine impact of Phase I pumping and canal shutdown on bypass effectiveness.
2. Determine migration parameters, migrant abundance, and survival of hatchery-released spring and fall chinook salmon, coho salmon, and summer steelhead in the lower Umatilla River; determine above for specific rearing and release strategies of Umatilla production groups.
3. Determine migration parameters, life history characteristics, migrant abundance, and survival of naturally-produced juvenile salmonids migrating within the lower Umatilla River.
4. Determine species composition, condition, and total weight of collected fish at Westland Canal during trap and transport operations.
5. Investigate relationships between river flow/temperature and migration parameters of hatchery and natural fish.
6. Evaluate cumulative injury to hatchery and natural salmonids emigrating through the lower Umatilla River; determine contributing factors of fish disease and mortality.
7. Determine biological and environmental variables that may affect in-river survival for juvenile salmonids; determine prevalence of avian and piscivorous predators and document presence of resident fish species.
8. Evaluate condition and post-transport mortality of juvenile salmonids subjected to crowding, loading, and transport from Westland Canal to the mouth of the Umatilla River.
9. Document fish behavior at the fish exit gate at Three Mile Falls Dam using an underwater video camera; estimate juvenile fish passage at the viewing window, using video.
10. Participate in planning and coordination activities associated with anadromous fish passage in the Umatilla basin.
11. Evaluate the feasibility of using Photonic tags and hand and remote detectors to monitor migrating juvenile salmonids in the Umatilla basin.

CRITICAL UNCERTAINTIES:

1. Uncertainty of handling affects on survival of juvenile salmonids during collection; fish are necessarily handled to derive biological information.
2. Uncertainty of trap efficiency marking on survival and behavior of released fish which may detrimentally impact good trap efficiency estimates.
3. Risk of detrimental affects to resident fish species during collection.
4. Uncertainty on river flows and/or diversion rates during migration monitoring which could curtail collections of migrating fish.
5. Risk of using photonic marks, affecting fish and human health; risk of installing remote detectors at ladder facilities which could impact adult passage.
6. Uncertainty on successful marking of hatchery production groups affecting monitoring or rearing and release strategies.
7. Uncertainty as to whether photonic tag detectors will be installed on time and operate satisfactorily; uncertainty as to effectiveness of photonic tags.
8. Uncertainty toward theft, tampering, or vandalism of sampling equipment.
9. Uncertainty of successful trapping operations during sudden high flow events, without incurring damage to traps.

BIOLOGICAL NEED:

Ongoing monitoring and evaluation projects in the Umatilla basin do not include an evaluation of the overall migration success and survival of hatchery-released and naturally-produced salmonids to the lower river. Long-term monitoring is necessary to obtain reliable information on outmigration characteristics, survival, and passage problems for both hatchery and natural salmonids. This information will be used to make management decisions to enhance in-river survival and facility passage at irrigation diversions. Passage problems for juvenile salmonids currently exist at Three Mile Falls Dam; differing operations of West Extension Canal under Phase I pumping affect bypass effectiveness and juvenile passage past the dam. Information on migration rates and timing, overall survival in relation to river conditions and canal operations, and canal bypass collection efficiencies for juvenile salmonids is necessary for decisions on canal operations, water release strategies, and flow enhancement strategies. Information on fish needs for passage, rearing, and survival is vital to further "tweak" the Umatilla Basin Project. Although smolt-to-adult survival is being assessed through the Umatilla Hatchery Monitoring and Evaluation project, results are broad in scope and long-term in being fully analyzed. Fine-tuning of hatchery practices can be accomplished with basin-specific information on the outmigration of specific rearing and release strategies. Monitoring of natural juvenile salmonids in the lower river is necessary to address critical uncertainties related to natural production monitoring and evaluation and to ascertain life history characteristics in the lower river. Uncertainties related to the success of summer steelhead and fall chinook salmon

production groups require a closer in-basin look at survival and migration factors. Degradation of river conditions during summer low flows exacerbate survival problems for subyearling fall chinook salmon. Pathological assessment of hatchery and natural mortalities will further our understanding of fish health in river.

Predation by avian and fish predators may significantly impact the survival success of juvenile salmonids. Information on predators is important to understand the potential for loss of juvenile salmonids at passage facilities and to develop predator deterrence strategies to improve fish survival. Information on health and survival of transported fish is necessary to improve transport practices. Loading procedures and transport conditions may be affecting juvenile fish survival.

HYPOTHESIS TO BE TESTED:

1. Null: There is no significant correlation between canal diversion rate and canal bypass efficiency.
Alternative: There is a significant correlation between river flow or canal operations and canal bypass efficiency.
2. Null: There is no significant correlation between river flow/temperature and migration magnitude.
Alternative: There is a significant correlation between river flow/temperature and migration magnitude.
3. Null: There is no significant difference in fish injury levels with time or between species.
Alternative: There is a significant difference in fish injury between fish species and with time.
4. Null: There is no significant difference in injury or mortality between transported and non-transported fall chinook subyearlings.
Alternative: There is a significant difference in injury mortality between transported and non-transported fall chinook subyearlings.
5. Null: There is no significant correlation between level of smoltification and fish length.
Alternative: There is a significant correlation between level of smoltification and fish length.
6. Null: There is no significant difference between mean lengths of hatchery and wild fish species.
Alternative: There is a significant difference between mean lengths of hatchery and wild fish species.
7. Null: There is no significant correlation between fish condition during transport tests and water temperature or loading density in the transport vehicle.
Alternative: There is a significant correlation between fish condition during transport tests and water temperature and loading density in the transport vehicle.

ALTERNATIVE APPROACHES:

The multiple-capture history protocol for estimating reach-specific survival was rejected due to limited personnel to staff a multitude of capture facilities (Burnham et al.1987); lack of PIT tag technology required hands-on marking and detection.

JUSTIFICATION FOR PLANNING:

(N/A) Project in implementation phase.

METHODS:

1. Collection of outmigrating juvenile salmonids through daily, hourly, or periodic monitoring throughout the day of trap catches using a rotary-screw trap during late summer, fall, winter, and spring and the canal bypass facility at West Extension Canal during late spring and early summer. Fish will be identified to species and origin, counted, and examined for marks, clips, condition, and smoltification level. Lengths will be collected on a representative subsample of hatchery fish and all natural fish collected.
2. Estimation of species-specific collection efficiencies using an acrylic paint mark; daily marking and releasing of fish species for species-specific efficiency estimates over wide range of river flows. Holding of fish after marking and prior to release to estimate marking survival. Abundance estimates based on number collected and efficiency estimates with Bootstrap derived variance estimates for 95% confidence intervals.
3. Bi-weekly subsampling of fish at Westland Canal holding pond during trap and transport operations; sampling to back-fill CTUIR sampling. Subsampling of fish from holding pond and transport vehicle whenever fish are transported to evaluate condition and delayed mortality of transported and non-transported fish.
4. Recording of juvenile fish passage and behavior at ThreeMile Dam fish ladder using an underwater video camera at the fish exit gate and a video camera at the fish viewing window.
5. Acquisition of environmental data from USGS and Water Resources records; daily acquisition of secchi disk readings and max-min temperature at collection sites. Documentation of canal facility operations and meteorological data.
6. Daily observation of avian predators at sample sites; documentation of resident fish species and piscivorous fish in collection samples and measurement of lengths.

9. Installation of detectors, and detection of photonically-tagged fish using hand-held detectors at traps and remote detectors at canal and ladder facilities. Downloading of data from remote detectors on regular basis.

PLANNED ACTIVITIES

SCHEDULE:

Planning Phase **Start** 6/94 **End** 10/94 **Subcontractor**

Task Initial planning of project

Implementation Phase **Start** 10/1/96 **End** 9/30/97 **Subcontractor**

Task 1. Monitor outmigration of juvenile salmonids year-round; examine for species, origin, injury, smolt level, marks, and clips.

PROJECT COMPLETION DATE:

1999

CONSTRAINTS OR FACTORS THAT MAY CAUSE SCHEDULE OR BUDGET CHANGES:

Prolonged delay in installation of remote photonic tag detectors. Additional, unforeseen costs associated with photonic tag study.

OUTCOMES, MONITORING AND EVALUATION

SUMMARY OF EXPECTED OUTCOMES

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

Results of monitoring will be used to better understand the affects of specific hatchery rearing and release strategies, to guide decisions on passage facility and canal operations, flow enhancement strategies, and transport practices, and to augment knowledge of natural production life history characteristics. Results will inform managers of outmigration success within the Umatilla basin of natural and hatchery salmonids. With potential implementation of strategies to improve outmigration and passage, survival of outmigrating target populations should provide an increase in adult returns.

Present utilization and conservation potential of target population or area:

Present use of chinook salmon and steelhead populations are for commercial, sport, and tribal fisheries, in the Columbia and Umatilla river basins. Present use contributes more than 6,000 hours of sport fishing recreation annually in the Umatilla basin. The conservation potential is present to reestablish naturally reproducing salmon stocks and to supplement steelhead stocks.

Assumed historic status of utilization and conservation potential:

Historic use was major fisheries which supported Indian and non-Indian fisheries (Boyce 1986). Historic numbers of fish are unknown, but are believed to be major contributors to Columbia River fisheries.

Long term expected utilization and conservation potential for target population or habitat:

The target populations are expected to significantly contribute to Columbia River doubling goals and the establishment or supplementation of naturally reproducing populations in the Umatilla River. Uses include commercial, sport, and tribal fisheries in the Columbia and Umatilla river basins. Long term goals for adult returns to the mouth of the Umatilla River are: 11,000 natural and 10,000 fall chinook salmon, 1,000 natural and 10,000 hatchery spring chinook salmon, 4,000 natural and 5,670 hatchery steelhead, and an undetermined number of natural and 6,000 hatchery coho salmon.

Contribution toward long-term goal:

Products of the project will contribute to: evaluating critical uncertainties about survival potential and migration success of hatchery and natural stocks, leading to restoration and supplementation of salmon and steelhead populations in the Umatilla River; to reestablishment of anadromous fisheries in the Umatilla River; the Columbia River doubling goal; evaluation of new marking technology that will have potential application throughout the Columbia basin.

Indirect biological or environmental changes:

None

Physical products:

Physical products will include the installation of approximately 4 remote photonic tag detectors, archival video images of juvenile fish within ladder sections, and the collection of approximately 400 scale samples and various samples of fish species.

Environmental attributes affected by the project:

Information on migration patterns as related to flow may effect a change in flow release strategies.

Changes assumed or expected for affected environmental attributes:

Flow enhancement strategies will be fine-tuned toward specific needs for fish migration and provide minimum in-stream flows during all months of the year.

Measure of attribute changes:

N/A

Assessment of effects on project outcomes of critical uncertainty:

Uncertainty of handling effects will be assessed by holding samples of fish for delayed mortality tests.

Information products:

Information products will include relationship between diversion rate and canal bypass efficiency; fish behavior, impacts at ladder diffusers; fish counts at viewing window; migration timing, rates, magnitude and duration; median capture data; diel movement patterns; fish condition by species through time; pathology of diseased and dead fish; collection efficiencies; migrant abundance estimates; survival indices/estimates; velocity measurements; trends in smoltification through time; length frequency distributions and mean lengths; migration/flow relationships; identification of resident fish species and avian predators; documentation of environmental and hydraulic parameters; collection numbers of salmonid species and brand groups; numbers of photonically marked fish passing through canal bypass or east-bank ladder.

Coordination outcomes:

Coordination outcomes of the project include regular coordination of activities with various agencies and entities and coordination of equipment loans and information needs.

MONITORING APPROACH

Product outcomes should be measured by assessing whether they address objectives specified in the annual contract and whether outcomes contribute to the specified intent of the process.

Provisions to monitor population status or habitat quality:

Population status of target stock is specifically monitored by outmigration trapping of juvenile life stages in the lower river. Natural production M&E monitors juvenile population status in upper river reaches and conducts spawning escapement surveys. Adult returns of salmonid stocks are monitored at Three Mile Falls Dam trapping facility. Remote detection capabilities will monitor photonically tagged fish at Three Mile Dam. Coded wire tag recoveries in commercial and sport fisheries provide ocean and river harvest information.

Data analysis and evaluation:

Project data will be analyzed and evaluated through descriptive statistics, chi-square goodness of fit and tests of independence, parametric t-tests, analysis of variance and correlation analysis. Trend data will be compared between years.

Information feed back to management decisions:

Information from project findings is transferred to management via cooperative meetings, memos, reports (annual, quarterly, monthly), and research reviews.

Critical uncertainties affecting project's outcomes:

Resolution of critical uncertainties could be addressed by anticipation of uncertainty events and allowing for a greater degree of preparedness.

EVALUATION

Overall project performance could be assessed through the provision of new knowledge to increase understanding of migration dynamics and survival factors; by reduction in fish delay and potential injury at critical ladder areas; by workable recommendations for flow release strategies to stimulate migrational movement; through statistically valid abundance estimates, successful use of photonic tags to monitor fish migrations; and, through workable recommendations on canal and ladder operations to effectively route fish.

Incorporating new information regarding uncertainties:

New information about uncertainties affecting the project will be incorporated into the decision process through coordination meetings and adaptive management.

Increasing public awareness of F&W activities:

The project will assist in increasing public awareness of efforts to enhance wildlife through outreach plans of individual project staff. Such plans include informational signs regarding trapping operations and project goals, school presentations, job shadow and mentoring opportunities, newspaper articles on project activities, regular radio segments, field tours to local students and officials, and cooperative work with landowners.

RELATIONSHIPS

RELATED BPA PROJECT

RELATIONSHIP

8802200 Umatilla River Basin Trap and Haul Program

Sampling at Westland Canal trap provides information needed during transport operations. Results from transport evaluation tests assist the Trap and Haul program in improving juvenile fish transport

8343500 Bonifer-Minthorn Springs Acclimation Facilities Program

Provide outmigration information on hatchery and natural coho salmon and of sampling data at Westland Canal during trap and haul operations

9000501 2. Natural Production Monitoring and Evaluation

Lower river monitoring provides additional information on life history characteristics, abundance and survival of natural salmonids produced in the upper basin; identifies potential rearing of natural production stocks in lower river.

8343600 Habitat Improvement

Instream and riparian habitat improvement on national forest, tribal, and private lands.

8343600 Umatilla Passage O&M

Passage results concern canal and ladder operations at Three Mile Falls Dam; coordination required for research activities and needs at passage facilities; assistance provided to address fish passage problems

9000500 Umatilla Hatchery Monitoring and Evaluation

The Umatilla Hatchery is the source of the hatchery chinook salmon and summer steelhead in the Umatilla River collected during outmigration monitoring. Monitoring provides information on outmigration characteristics and survival of different hatchery rearing and release strategies. Testing of new photonic tag technology will replace branding of rearing and release strategies. Fish health/pathology assessed on hatchery fish that die in-river

OPPORTUNITIES FOR COOPERATION:

Opportunities for cooperation include participation in cooperative forums (Umatilla River Operators Group, Umatilla Passage TWG, Umatilla M&E Oversight Committee) which includes most projects. Ongoing cooperation includes sharing of information to fill database gaps among projects, staff assistance during field sampling, sharing of video and field equipment, and participation in joint studies (mark longevity). Cross-training opportunities are provided to personnel within other projects. Transfer of project information occurs to improve river operations, to fine-tune operating criteria for specific facilities, and to improve management decisions in the adaptive management process.

COSTS AND FTE

1997 Planned: \$292,400

FUTURE FUNDING NEEDS:

<u>FY</u>	<u>\$ NEED</u>	<u>% PLAN</u>	<u>% IMPLEMENT</u>	<u>% O AND M</u>
1998	\$306,219		100%	
1999	\$312,344		100%	

PAST OBLIGATIONS (incl. 1997 if done):

<u>FY</u>	<u>OBLIGATED</u>
1989	\$233,663
1990	\$181,576
1992	\$347,770
1993	\$348,666
1994	\$401,894
1995	\$211,573
1996	\$438,520
1997	\$14,000

TOTAL: \$2,177,662

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

OTHER NON-FINANCIAL SUPPORTERS:

Non-financial supporters of the project include the city of Hermiston, local irrigation districts, National Marine Fisheries Service, Bureau of Reclamation, Oregon Water Resources Dept., Oregon Dept. of Transportation, Washington Dept. of Fish and Wildlife, Confederated Tribes, U.S. Geological Survey, Oregon Dept. of Fish and Wildlife, U.S. Fish and Wildlife Service, NewWest Technology, private landowners, and Oregon State Police.

LONGER TERM COSTS: N/A Project scheduled to end in 1999.

1997 OVERHEAD PERCENT: Overhead is presently set at 20.5% and varies annually.

HOW DOES PERCENTAGE APPLY TO DIRECT COSTS:

Overhead percentage applies to all project costs except capital expenditures and contract services.

CONTRACTOR FTE: 120 FTE's funded in this project is 5.

SUBCONTRACTOR FTE: 0