Bonneville Power Administration
Fish and Wildlife Program FY98 Watershed Proposal Form

Section 1. General administrative information

Title Evaluate Juvenile Salmonid Outmigration And Survival In The Lower Umatilla

Bonneville project number, if an ongoing project 8902401

Business name of agency, institution or organization requesting funding
Oregon Department of Fish and Wildlife

Business acronym (if appropriate) ODFW

Proposal contact person or principal investigator:

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Subcontractors.

Organization	Mailing Address	City, ST Zip	Contact Name

NPPC Program Measure Number(s) which this project addresses.
7.0C.4, 7.1C, 7.2D, 7.2D.1, 7.4I, 7.4I.1, 7.4L, 7.4L.1, 7.10, 7.10A.2

NMFS Biological Opinion Number(s) which this project addresses.
No biological opinions have addressed the Umatilla River Outmigration Study

Other planning document references.
Response: Monitoring activities are called for in A Comprehensive Plan for Rehabilitation of Anadromous Fish Stocks in the Umatilla River Basin (Boyce 1986); the Umatilla Hatchery Master Plan (ODFW and CTUIR 1990); the Umatilla River Subbasin Salmon and Steelhead Plan (ODFW and CTUIR 1989); and, Umatilla Basin Project-Initial Project

Workplan (USBR and BPA 1989). The Wy Kan Ush Me Wa Kush Wit plan calls for continuation of current monitoring of all artificail production actions in the Umatilla basin (volume II, page 45). Support for Watershed project provided by USBR, CTUIR, Umatilla Basin Watershed Council, ODOT, local irrigation districts, OWRD, and NMFS.

Subbasin.
Umatilla River subbasin

Short description.
Determine migration patterns, evaluate health, estimate abundance and survival of outmigrating juvenile salmonids in the Umatilla River; investigate affect of environmental variables on fish migration and video-document passage at Three Mile Falls Dam.

Section 2. Key words

Mark	Programmatic Categories	Mark	Activities	Mark	Project Types
X	Anadromous fish		Construction	X	Watershed
+	Resident fish		O & M		Biodiversity/genetics
	Wildlife		Production		Population dynamics
	Oceans/estuaries	+	Research		Ecosystems
	Climate	X	Monitoring/eval.	+	Flow/survival
	Other		Resource mgmt		Fish disease
			Planning/admin.		Supplementation
			Enforcement		Wildlife habitat en-
			Acquisitions		hancement/restoration

Other keywords.
Response: life history, sampling, predation, passage, fish health, natural production, flow enhancement, passage facilities, trap efficiency

Section 3. Relationships to other Bonneville projects

Project #	Project title/description	Nature of relationship
9000500	Umatilla Hahery Monitoring and Evaluation - hatchery effectivenessi	Migration monitoring provides data on in-basin migration success of different rearing/release strategies
8343600	Umatilla Passage O&M -passage facility O&M	Study results provide information on juvenile fish passage problems at Three Mile Falls Dam
9000501	Natural Production Monitoring and Evaluation - natural production success	Lower river monitoring provides information on species life history, abundance, survival; supplements PIT tagging of natural steelhead.l

88022	Umatilla River Basin Trap and Haul Program-collect/transport juvenile fish	Sampling at Westland Canal trap provides species composition and weight data for transport operations

Section 4. Objectives, tasks and schedules

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Determine migration parameters, migrant abundance, health, survival of juvenile salmonids	a	Determine trap efficiencies, migrant abundance, migration patterns, life history characteristics, and survival by species/race of juvenile fish
1		b	Evaluate injury, health of natural and hatchery fish; document predators.
1		c	Investigate effects of flow, temperature, turbidity on fish migration and survival
2	Sample fish at Westland Canal during Trap and Haul operations	a	Determine species composition, condition, total weight of collected fish at Westland Canal
3	Determine passage routes of juvenile fish at Three Mile Falls Dam	a	Video monitor juvenile migrant passage at the east-bank fish ladder; review recorded tapes.
4	Participate in PIT tag studies on hatchery and natural fish	a	PIT tag hatchery and natural fish and interrogate captured fish for tags; conduct study to determine release site effects on survival.

Objective schedules and costs

Objective #	Start Date mm/yyyy	End Date mm/yyyy	Cost %
1	10/1997	6/1998	60.00%
2	7/1998	8/1998	10.00%
3	5/1998	9/1998	10.00%
4	1/1998	9/1998	20.00%
			TOTAL 0.00%

Schedule constraints.
Extended time required to review video tapes (Obj. 3) may extend date beyond 9/1998

Completion date.
1999

Section 5. Budget

FY99 budget by line item

Item	Note	FY98
Personnel	Costs are for FY98	$131,802
Fringe benefits	Costs are for FY98	$51,153
Supplies, materials, non-expendable property	Costs are for FY98	$6,500
Operations & maintenance	Costs are for FY98	$10,416
Capital acquisitions or improvements (e.g. land, buildings, major equip.)	Costs are for FY98	$2,500
PIT tags	# of tags: NA	$ 0
Travel	Costs are for FY98	$9,520
Indirect costs	Costs are for FY98	$47,951
Subcontracts	NA	$ 0
Other		$ 0
TOTAL		$ 0

Outyear costs

Outyear costs	FY99	FY00	FY01	FY02
Total budget	$172,000			
O&M as % of total	5.10%			

Section 6. Abstract

Response:
Projects to enhance and reestablish salmonid populations in the Umatilla River are addressed in the FWP as contributers to the Council's goal of increasing Columbia River basin salmon returns. This project's goal is to determine the overall effectiveness of the fisheries rehabilitation plan by evaluating the outmigration success of hatchery and natural juvenile salmonids in the lower Umatilla River. It provides knowledge for adaptive management of hatchery, river, and canal operations and supplements and complements ongoing or completed evaluations of specific rehabilitation projects. Specific project objectives include 1) determining migrant abundance, migration patterns, health, and survival of species or races of fish respresenting different hatchery rearing and release strategies and natural production groups, and investigating relationships between

environmental variables and fish migration, 2) sampling fish during summer transport operations, 3) determining routes used by juvenile fish to pass Three Mile Falls Dam, and 4) conducting PIT tag studies to determine release site effects on fish survival. Year-round monitoring uses various traps for which species-specific efficiencies are determined to estimate migrant abundance and survival of juvenile fish. Fish are sampled daily to obtain biological information and assess seasonal trends. We use video and sampling to assess passage routes of juvenile fish past Three Mile Falls Dam. Results will provide estimates of abundance and survival for specific groups of fish, descriptions of daily and seasonal migration patterns, the relationships between fish movement and river variables, determinations of fish health and condition, and an overview of passage dynamics at Three Mile Falls Dam.

Section 7. Project description

a. Technical and/or scientific background.

Response:
Rehabilitation of anadromous fish stocks in the Umatilla River basin in northeastern Oregon requires the restoration of coho salmon *Oncorhynchus kisutch* and spring and fall races of chinook salmon *O. tshawytscha*, and enhancement of summer steelhead *O. mykiss* (Boyce 1986). Increased populations of Umatilla River salmon and steelhead has resulted from artificial and natural production (CTUIR and ODFW 1990). These efforts were intended to provide offsite mitigation for Columbia River basin salmon losses (NPPC 1987). The Fisheries Restoration Program in the Umatilla River basin has resulted in increasing numbers of juvenile salmonid outmigrants as artificial production is increased and natural production is enhanced (Keefe et al. 1993, 1994; Hayes et al. 1996a, 1996b; Focher et al. 1997; CTUIR 1994; Contor et al. 1995, 1996, 1997). Monitoring and evaluation efforts to fine-tune specific restoration projects are ongoing or near completion. However, these efforts did not include an evaluation of the overall migration success and survival of hatchery-released and naturally-produced juvenile salmonids to the lower Umatilla River. The Comprehensive Plan (Boyce 1986) identified the need for an overall evaluation, including outmigration monitoring of hatchery and natural smolts thoughout the entire river basin. In addition, the FWP (NPPC 1994) specified that biological monitoring is needed to provide information for updating subbasin plans, for improving management and conservation of natural populations, for assessing the effectiveness of hatchery rearing and release strategies (including acclimation), and for supplementation research.

The project was initially focused on evaluating screening and bypass facilities for juvenile fish at irrigation diversions on the Umatilla River (Knapp and Ward 1990, Hayes et al. 1992, Cameron and Knapp 1993, Cameron et al. 1994, 1995). The evaluations were necessary to ensure that fish were adequately protected at newly reconstructed passage facilities (Boyce 1986; NPPC 1994). Current project research developed out of the need to enlarge the scope of evaluating the success of juvenile salmonid passage to the basin as

a whole and to supplement and complement other ongoing monitoring and evaluation projects. Current research recently completed its third year of activities.

The lead project biologist has worked on the project since its inception in 1989. Previous work was mostly affiliated with juvenile fish passage, collection, and transport operations at U.S. Army Corps of Engineers dams, for a total of 12 years in passage/migration-related work. The assistant project biologist began work with the project in 1992, during the passage evaluation phase. Previous work was mostly associated with population assessments and limnological studies.

b. Proposal objectives.

Response:

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; determine trap efficiency of the rotary-screw trap.
   Null hypothesis: There is no significant correlation between canal diversion rate and canal bypass efficiency.
   Null hypothesis: There is no significant correlation between canal river flow and canal bypass efficiency.
   Null hypothesis: These is no significant relationship between rotary trap efficiency and percentage of the river flow sampled.
   Assumptions: Ability to successfully collect fish and conduct collection efficiency tests at West Extension Canal and the rotary screw trap during all operations, diversion rates, and river flows.
   Products: Collection efficiencies for the canal trap, by species and hatchery and natural fish, during all flow regines and canal operations; trap efficiencies for the rotary screw trap, by species, origin, and flow regimes.

2. Determine migration parameters, migration 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; obtain biological data on collected fish.
   Null hypothesis: There is no significant difference in survival of different rearing and release strategies of Umatilla production groups.
   Null hypothesis: There is no significant correlation between level of smoltification and fish length.
   Assumptions: Ability to effectively collect fish at West Extension Canal and the lower river screw trap during most of the year.
   Ability to recapture marked fish and obtain valid trap efficiency estimates for computation of migrant abundance and survival estimates; ability to meet the assumptions of standard mark-recapture experiments.
   Ability of sampling personnel to effectively mark fish for trap efficiency tests, to correctly identify fish and marks and obtain biological information.
   Products: Estimates of lower river migrant abundance, migration rate, timing, and duration, migration magnitude, and survival for each species or race of juvenile salmonid from Michigan and Oregon raceways at Umatilla Hatchery and from Oregon raceways at Bonneville, Carson, and Little White Salmon hatcheries. Length-frequency distributions through time.

3. Determine migration parameters, life history characteristics, migrant abundance, and survival of naturally-produced juvenile salmonids migrating within the Umatilla River; obtain biological data on collected fish.
   Null hypothesis: There is no significant correlation between level of smoltification and fish length.
   Null hypothesis: There is no significant difference between mean lengths of hatchery and natural fish species.
   Assumptions: Same as #2.
   Products: Estimates of total migrant abundance for natural summer steelhead in the lower river. Total number of natural fall and spring chinook and coho salmon collected. Determination of migration duration and magnitude for the naturally-produced species of juvenile salmonids. Differences in migration parameters between hatchery and naturally-produced species of fish. Indices of smoltification and length-frequency distribution through time. Individual length and weight measurements on PIT-tagged fish. Total number of PIT-tagged natural fish intercepted at lower river trapping sites. Estimates of survival for PIT-tagged natural fish.

4. Determine species composition, condition, and total weight of collected fish at Westland Canal during trap and transport operations.
   Null hypothesis: None
   Assumptions: Ability to obtain a representative sample for biological information.
   Products: Counts and relative proportions of hatchery and natural fish per net load, mean lengths of fish, individual lengths and weights of PIT-tagged fish, assessment of fish condition, and net-load weights for salmonid and non-salmonid species; findings of pathological analysis.

5. Investigate relationships between river flow/temperature/turbidity and migation parameters of hatchery and natural fish.
   Null hypothesis: There is no significant correlation between river flow/temperature and migration patterns.
   Assumptions: Ability to obtain valid environmental and hydraulic data.
   Products: Relationship between environmental variables and migration parameters; association between water temperature and fish mortality.

6. Evaluate cumulative injury to hatchery and natural salmonids emigrating through the lower Umatilla River; determine contributing factors of fish disease and mortality.
   Null hypothesis: There is no significant difference in fish injury levels with time or among species.
   Assumptions: Ability of sampling personnel to correctly evaluate condition.
   Products: Counts and proportions of hatchery and natural fish species with specific types of injury, disease, or that have died. Chi-square test results on injury data. Findings of pathological analysis.

7. Determine prevalence of avian and piscivorous predators.
   Null hypothesis: None
   Assumptions: Ability to continually observe and correctly identify bird and fish species.
   Products: Documentation of fish predators through time at the sampling sites.

8. Estimate juvenile fish passage through the east-bank fish ladder at Three Mile Falls Dam, using video at the viewing window.
   Null hypothesis: There is no significant difference in passage rates of juvenile salmon through the east-bank ladder or through the west-bank bypass facility.
   Assumptions: Ability to effectively video monitor fish passage and review video tapes

Ability to carry out assumptions in #2.
Products: Counts of juvenile fish passing by the viewing window; diurnal movement patterns of juvenile fish.

9. Participate in planning and coordination activities associated with anadromous fish passage in the Umatilla basin.
Products: Effective and coordinated conduct of research projects and dissimination of information necessary for adaptive fisheries management in the basin.

10. Evaluate the utility of using PIT tags to monitor migrating juvenile salmonids in the Umatilla basin; conduct tests to evaluate release-site effects on migration success and survival.
Null hypothesis: There is no significant difference in survival among fish groups released at different locations.
Assumptions: Ability to effectively tag and efficiently detect PIT tagged fish at monitoring sites.
Assumptions: Ability to effectively hold, transport, and release fish during tests.
Products: Database of PIT tag interrogations at all sampling sites to assess affect of release site on survival.

c. Rationale and significance to Regional Programs.

Response:
Fourth year results in outmigration monitoring will provide a solid database from which valid conclusions can be made in regard to testable hypotheses and correlations. This information will be used to make management decisions to enhance in-river survival and facility passage at irrigation diversions. Passage problems for juvenile fish currently exist at Three Mile Falls Dam. Use of underwater and above water video has provided great insight into fish behavior at ladder structures. Differing operations at 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 and ladder operations, water release strategies, and flow enhancement strategies. Information on fish needs for passage, rearing, and survial is vital to further refine 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 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.

The advent of 134.2 kHz PIT tags and detectors at mainstem dams provides the impetus to use this improved technology in the Umatilla Basin for answering critical uncertainties related to natural production success and hatchery effectiveness. Use of the PIT tag technology in the Umatilla basin would improve our research and enhance our understanding of juvenile salmonid life history and migrational characteristics and their success at growth, passage, and survival..

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; reestablishment of anadromous fisheries in the Umatilla River; the Columbia River doubling goal; and knowledge of fish behavior and environmental affects on migration.

Study activities will involve coordination and consultation with projects involved in the Umatilla Basin, including the Umatilla Trap and Haul program, Umatilla Hatchery operation, Umatilla Hatchery Monitoring and Evaluation, Bonifer-Minthorn Springs Acclimation Facilities Program, Umatilla River Natural Production Monitoring and Evaluation, Umatilla Passage O&M, and Umatilla River Habitat Enhancement Project.

d. Project history

Response:
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 ladders (Knapp and Ward 1990; Hayes et al. 1992; Cameron and Knapp 1993; Cameron et al. 1994, 1995). This research was conducted from 1990 to 1995. 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 complement other ongoing monitoring and evaluation projects. Within the current project, tasks were performed at Three Mile Falls Dam and West Extension Canal to complete the passage evaluation study (Cameron et al. 1997).

Monitoring and evaluating the outmigration of juvenile salmonids has been conducted for three years. During the first year evaluation, we obtained preliminary data on juvenile salmonid migration, abundance, and survival by sampling at numerous sites with various traps (Knapp et al. 1996). Through these experiences, we refined study methods and identified logistical and operational constraints. During the second year, we monitored the salmonid outmigration year-round either at the West Extension Canal or at a lower river rotary-screw trap. We also initiated an evaluation of juvenile fish transport, tested the use of VI-jet tags, and augmented our data collection at Three Mile Falls Dam, including video monitoring at the east-bank ladder (Knapp et al. 1997). During the third year, we used only the rotary-screw trap to monitor the outmigration in an effort to obtain more reliable trap efficiency and fish abundance estimates. We also continued the evaluation of juvenile fish transport, video monitored juvenile fish passage at Three Mile Falls Dam, and tested the use of Photonic tags in outmigration monitoring (Knapp et al., in preparation).

Findings on migration paremeters, bypass efficiencies, fish condition, ladder passage, and the presence of natural 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 juvenils 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 from pathological analysis of migration mortalities contribute to understanding in-river disease dynamics and specific species and stocks of fish. Observations of juvenile fish at ladder structures could affect a change in ladder operations or structures to improve survival. Effectiveness of pilot studies on PIT tag use could alter marking /tagging strategies and provide additional migrational information.

e. Methods.

Response:
During this fourth year's effort, we will monitor the outmigration and health of hatchery and natural juvenile salmonids and estimate survival to the lower river for these fish, conduct ancillary survival estimation studies, determine trap and bypass efficiencies, investigate environmental variables related to smolt migration, survival, and health, video document fish passage at the east-bank fish ladder at Three Mile Falls Dam, and participate in the use and detection of PIT-tagged fish. We will continue the data gathering process, incorporating additional methods and new technologies, and conduct new tasks.

Trapping (Obj1, 2, 3) : To monitor the outmigration in the lower river and capture fish for migrant abundance and survival estimation, we will operate the West Extension Canal sampling facility (RM 3) during the primary outmigration period (April - June 1998) and the rotary-screw trap or floating net trap (RM 1.2) most of the remaining contract period (October 1997 - March 1998). In July, we will subsample fish at Westland Canal that have been collected for transport. We will not monitor in August or September 1998 because of extremely low flow conditions in the lower river. We will use an incline plane trap at Feed or Furnish canals to collect yearling and subyearling fish for additional survival estimation marking in spring 1998.

Trap Efficiencies (Obj 1): Trap efficiencies will be determined for both the West Extension Canal facility and the rotary trap, whenever either one is used. On a daily basis, we will mark and release a known sample of fish (M) above the trap or facility, and recover them in the trap or facility (m) to obtain trap efficiencies ($TE = m/M$). We will attempt to mark from 50 to 200 fish; number marked will also be based on number captured. Fish used will be non-CWT, non-PIT tagged, and unmarked fish from the trap or facility. For trap efficiency estimates at the lower river rotary trap, fish releases will be made 2 miles upriver near the west-bank fish ladder at Three Mile Falls Dam. At West Extension Canal, we will release fish approximately 2 miles above Three Mile Falls Dam at the Hermiston Wastewater Treatment Plant. Following transport to the release site, fish will be held for 24 hours in net pens to facilitate stress reduction and mortality estimation prior to release. Released marked fish will be recaptured at the lower river traps for an indefinite period. Since trap efficiencies can vary for each species and for natural and hatchery outmigrants, we will attempt to estimate species-specific and production-specific trap efficiencies as frequently as possible. Capture retention of the rotary trap will also be evaluated by releasing a known number of fish directly into the trap live box and counting the number that are retained over a specific period.

Fish will be marked for trap efficiency tests using florescent photonic or VI-jet marks on the anal, dorsal, or caudal fins. Marks will be applied with CO_2-activated injectors. A combination of mark locations and colors will provide an adequate number of unique marks to differentiate various release groups. We will hold marked fish from 16 to 24 hours after marking and prior to transport to ascertain handling affects on survival.

Outmigration Monitoring(Obj 2, 3, 6, 10): Fish will be sampled at the rotary-screw trap throughout the day in March and on a daily or intermittent basis at other times. Fish will be sampled at the bypass collection facility at West Extension Canal on a 24-h

basis from April to early June and once daily thereafter. We will concentrate our efforts at the traps according to periods of peak movement determined by monitoring from 1995 to 1997. We will identify fish to species and origin (hatchery vs wild) and count the number of fish collected during the specific sampling interval. Fish numbers will be expanded for non-sampled and undersampled periods. All hatchery fish will be differentiated from natural fish via fin clips. All sampled fish will be inspected for trap efficiency marks. A subsample of hatchery fish will be examined for condition, fin clips, and measured to fork length (mm). All natural fish will be examined and measured. Fish condition will be determined following Keefe et al. (1994). Body damage will include bruises, head, eye, body, or operculum injury, lacerations, and torn fins. We will also note parasites, fungal infections, and evidence of BKD or other diseases. All mortalities of natural fish or fish with unusual signs of disease will be frozen or saved fresh for pathological analysis. We will use a chi-square test of independence (Snedecor and Cochran 1989) to test injury differences through time (week) for each fish species. All fish will be placed in a mild anesthetic (MS-222) prior to handling.

All sampled fish will be interrogated for PIT tags using a hand loop detector. Natural fish that are individually PIT tagged will be weighed and measured.

Survival Estimates (Obj 2, 3 10): Survival estimates for hatchery and natural fish will be primarily based on the migrant abundance method (Dauble et al. 1993). The migrant abundance survival estimate will be derived from data collected during standard outmigration monitoring and trap collection efficiencies ($S = N^r/N^I$, where N^I = number of fish released at the "initial site", and N^r = estimate of migrant abundance at the recovery site. Release sites for hatchery fish will represent the initial site. Recovery will occur at the rotary-screw trap or West Extension Canal. Use of the lower river trap will provide a survival estimate for fish that passed Three Mile Falls Dam. Migrant abundance for each species will be estimated by expanding the total number of each fish species captured by the reciprocal of the pooled trap efficiency estimate for a specific interval of time (Dauble et al. 1993). We will use the Bootstrap method (Murphy et al. in prep) to compute a variance for the migrant abundance estimate.

Validation of the migrant abundance survival estimate for hatchery fish will be achieved with two variations of the single release-recapture model coupled with the unknown capture history protocol (Burnham et al. 1987). This protocol is essentially an expanded version of the migrant abundance method, using tagged or marked fish. The first variation will use PIT-tagged hatchery fish from the initial release. These fish will be tagged based on rearing strategy or rearing hatchery. The second variation will use untagged fish captured downstream after initial release, and then color marked and re-released. Final capture for all fish will be at the lower river trap site. With the known number of tagged or marked fish released (N^I) and a migrant abundance estimate for tagged or marked fish at the recovery site (N^r), a survival estimate will be computed for each tag or mark group within a fish species. This method will be dependent on mark detection and readability. Fish will be marked with a flourescent mark on the fins. The same procedure will be used on fin clips detected to determine survival differences between AD+ventral-clipped and ventral-clipped fish alone. Differences in collection and survival among various groups will be tested for significance with the Chi^2 test of independence.

To estimate survival of natural outmigrants, fish will be captured upriver, PIT tagged, and released by CTUIR (N^I) and recaptured by ODFW at the lower river rotary trap or West Extension Canal. The CTUIR rotary traps will be located on the mainstem Umatilla River near rivermile 80. CTUIR will PIT tag fish beginning in winter 1997. Migrant abundance of PIT-tagged wild fish at the recovery site (N^r) will be determined using trap efficiency data for non-tagged wild fish and number of tagged wild fish collected.

Environmental Monitoring (Obj 5): To evaluate environmental factors that may influence smolt migration or survival, we will measure daily the minimum and maximum water temperatures at the collection sites and obtain upper river temperature data from USBR thermograph stations. Flow data from West Extension Canal and the lower river will be obtained from the U.S. Geological Survey and the Oregon Water Resources Department. Weather data will be obtained from the National Weather Service in

Pendleton, Oregon. We will measure Secchi depth daily to determine changes in water turbidity.

Video Monitoring (Obj 8): Passage of juvenile salmonids at the east-bank ladder at Three Mile Falls Dam will be recorded using a video camera at the viewing window. We will use CTUIR's Panasonic D-5000 camera and a VCR for image recording. Counts of fish passing the east-bank viewing window (primarily subyearling fall chinook salmon) will be compared with counts at the west-bank bypass to determine the major route of passage and estimate total passage.

PIT Tagging (Obj 1, 10): In 1998, we will assist with PIT tagging of all production groups at Umatilla Hatchery, and interrogate all sampled fish for PIT tags, using hand-held loop detectors. PIT tagging of hatchery fish will begin in January and end in May at Umatilla Hatchery. Number of fish to be tagged for release site tests will be 250 for each of 3 groups of spring chinook salmon and for each of 7 groups of summer steelhead, and 500 for each of 3 groups of subyearling fall chinook salmon. Tagged fish for release site tests will be held separately at the hatchery to determine tag loss and for test use later on. Test releases within specific river reaches will occur in March (spring chinook salmon), April (summer steelhead), May (summer steelhead and subyearling fall chinook salmon), and June/July (subyearling fall chinook salmon). Detection of PIT-tagged fish will occur at the lower river rotary trap, at West Extension Canal, and at Westland Canal during transport operations. Data obtained through hand interrogation will be manually or electronically recorded. All tagged natural fish will be measured for length and weighed to assess individual fish growth and condition.

We will use data from trap efficiency tests at the rotary trap or canal trap to ascertain the proportion of the outmigration being sampled; abundance and survival estimates can then be derived. All PIT tag work will be of a cooperative nature between ODFW and CTUIR.

*Planning and Coordination (Obj 9)***:** We will use coordination and information exchange processes currently established within the Umatilla Basin (Umatilla River Operations Group, Umatilla Passage Technical Work Group, Umatilla Monitoring and Evaluation Oversight Committee) to assist in project planning and coordination

f. Facilities and equipment.

Response:

1. *Traps*: Traps for collection of fish include a 5-ft rotary screw trap (E.G. Solutions, Corvallis, OR), a permanent fish collection facility built into the juvenile fish bypass at West Extension Canal, and several inclined plane traps. The sampling facility has been modified to allow continuous sampling and/or bypassing of fish, the ability to easily retrieve and process sampled fish, and separate holding facilities for fish recovery from anesthetic. A sheltered work station has been built at the rotary-screw trap site to process fish with the provision of a gravity flow system for water inflow. The screw trap has been securely anchored to bridge support pillars. The inclined plane traps were built for usein specific canal bypasses.

2. *Transport:* Transport of fish for release during trap efficiency tests or for release-site tests is provided by a 250-gal slip tank loaded into the bed of a 3/4-ton pickup truck. The tank has an auxilliary aeration system for increased oxygenation.

3. *Offices:* Office space at the sampling sites is provided through the use of a travel trailer borrowed from the U.S. Fish and Wildlife Service. Office space in Hermiston currently occupies a 2,600 ft^2 suite.

4. *Technical Equipment:* Water velocities are measured with a Marsh McBirney electromagnetic flowmeter (Model 2000). Video monitoring is done with a Sony (model HMV-352) underwater video camera and Sony (model EV-A50) 8-mm video cassette recorder as well as a Panasonic D-5000 camera connected to an RCA VR-503 (VHS) video cassette recorder. Two PIT tag detectors (hand-held loop) will be purchased with current project funds. Detectors will be used during tagging operations

and in the field to interrogate collected fish. PIT tags will be supplied through another project (#9000500).

5. *Computer Equipment*: Two desk-top (386 + 486) and one lap-top computer (486) are available for word processing, data summarization and analysis, and graphics development. MS Office is the standard software used.

6. *Marking Equipment*: CO_2-activated injectors will be used to mark trap efficiency fish with either photonic or VI-jet marks on the fins. PIT tag injectors will be purchased on another project (#9000500).

7. *Vehicles*: One year-round 3/4 pickup truck and two seasonal 1/2 ton trucks will be used for personnel, fish, and equipment transport; trucks are obtained from DAS.

g. References.

Response:

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Section 8. Relationships to other projects

Response:
Study scope and approach of this project was developed in conjunction with CTUIR's Umatilla Basin Natural Production Monitoring and Evaluation Plan and ODFW's Umatilla Hatchery Monitoring and Evaluation Plan. This project supplements monitoring efforts of the Natural Production M&E by monitoring and collecting biological information on natural migrants in the lower river, including supplemented summer steelhead populations. This activity meets measures 7.0C.4, 7.1C, and 7.4L.1 of the FWP. This project also supplements monitoring efforts of the Umatilla Hatchery M&E by monitoring the migration characteristics and estimating in-basin survival of fish production groups from different hatchery rearing and release strategies. Such information can be used in adaptive management decisions to improve new and existing hatchery effectiveness. This activity meets measures 7.2D.1, 7.4I, and 7.4I.1 of the FWP.

Information obtained on lamprey and their migrations is shared with CTUIR's Lamprey Investigation Project. Information on flow and fish relatioships is shared with river flow managers involved with the Umatilla Basin Project, including US Bureau of Reclamation, CTUIR, and Oregon Water Resources Department. Information on fish passage problems at screening and ladder facilities, and potential recommendations, is shared with the USBR and local irrigation districts which are responsible for passage facility operations and maintenance in the Umatilla basin, and the National Marine Fisheries Service which is responsible for developing operational criteria (meets measure 7.10A.2 of FWP). This project complements the Habitat Improvement Project in the Umatilla basin by monitoring any changes in fish abundance possibly due to habitat improvement or degradation. Monitoring coho salmon migrants in the lower river and sampling at Westland Canal during summer transport operations supplements activities and provides information to CTUIR's Bonifer-Minthorn Springs Acclimation Facilities Program. Sampling at Westland Canal also provides information for effective operation of the Umatilla River Trap and Haul Program.

Cooperation and collaboration amongst all parties and agencies involved in the Umatilla basin allows sharing of information to fill database gaps among projects and sharing of equipment, provides staff assistance during field sampling, and opportunities for participation in joint studies. 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.

Project staff also involve local schools, organizations, other agencies, and other scientists in their activities, either through field opportunities, classroom lectures, sharing of expertise, equipment, or information, or obtaining permission for specific work. Approval for access and work at the in-river trap site is required of the Oregon Department of Transportation and approval for access to property for release of test fish is required of the Hermiston Wastewater Treament Plant and private landowners. We work with scientists with the National Marine Fisheries Service in sharing information and developing recommendations at passage facilities. An arrangement has been established with the U.S. Fish and Wildlife Service to use their field trailer as an on-site office. We obtain specific database information necessary for project data analysis from the Oregon Water

Resources Department, the National Weather Service, and the U.S. Geological Survey. We assist the Umatilla Basin Watershed Council in their understanding of basin issues through tours of passage facilities and trap sites. We require assistance from the Oregon State Police and the local county sheriff's department when hunting or fishing violations are observed during the course of our work.

Section 9. Key personnel

Response:

Program Leader: Richard W. Carmichael; FTE = 0.08
Project Leader: Suzanne M. Knapp; FTE = 1
Ass't Project Leader: William A. Cameron; FTE = 1
Seasonal workers: FTE = 2

Program Manager
Richard W. Carmichael

EDUCATION

1983 - M.S., Fisheries Science, Oregon State University, Corvallis, OR
1978 - B.S., Fisheries Science, Oregon State University, Corvallis, OR

EXPERIENCE

7/90 - Present **Program Leader - Executive Manager,** Oregon Department of Fish & Wildlife, 211 Inlow Hall, EOU, La Grande, OR 97850

Program leader for NE Oregon Scientific Investigations Program. Primary responsibilities are to develop and direct implementaion of a complex research program to evaluate success of protecting, reestablishing, and restoring ESA listed and non-listed stocks in eastern Oregon, oversee the work of 14 full-time fisheries biologists and up to 8 projects, and represent ODFW on regional and national scientific committees.

12/83 - 7/90 **Fisheries Research Biologist (Project Leader)**, Oregon Department of Fish & Wildlife, La Grande, OR
3/83 - 12/83 **Fisheries Research Biologist (Ass't Project Leader**), Oregon Department of Fish & Wildlife, La Grande, OR

10/82 - 3/83 **Project Assistant (Experimental Biology Aid**), Oregon Department of Fish & Wildlife, La Grande, OR
1/80 - 7/83 **Research Assistant**, Oregon State University, Corvallis, OR

EXPERTISE

Nineteen years of experience in fisheries work. Expertise in fisheries research project development and implementation, personnel management, budget development and tracking, technical report writing, natural production and supplementation research, statistical analysis, coded-wire tag implementation and assessment, bass and trout ecology, creel censusing.

PUBLICATIONS

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Project Leader
Suzanne M. Knapp

EDUCATION

1981 M.S., Biology, Eastern Washington University, Cheney, WA
1976 B.S., Environmental Health, Boise State University, Boise, ID
1974 B.S., Zoology, The College of Idaho, Caldwell, ID
1971 A.A., Liberal Arts, Long Beach City College, Long Beach, CA

EXPERIENCE

11/89 - Present **Fisheries Research Biologist**, Oregon Department of Fish and Wildlife, 80866 Hwy 395 No., Hermiston, OR 97838

Project leader for the Umatilla River Outmigration and Survival Study. Primary responsibilities are to identify and oversee research goals and objectives, administer and coordinate project operations, develop and monitor project budget, conduct data analyses and management, prepare reports, presentations, and proposals, hire, train, and supervise project personnel, participate in collection of scientific data, manage a field office, participate in interagency planning/coordination meetings, and provide technical assistance to agency staff.

2/87 - 10/89 **Fishery Biologist**, U.S. Army Corps of Engineers, Umatilla, OR
4/86 - 6/86 **Hydroacoustic Technician**, Parametrix, Bellevue, WA

9/84 - 4/85 **Fishery Biologist**, U.S. Fish & Wildlife Service, Cook, WA
7/83 - 1/84 **Fishery Biologist**, U.S. Fish & Wildlife Service, Cook, WA
3/83 - 7/83 **Biological Technician**, National Marine Fisheries Ser., Pasco, WA
3/78 - 12/78 **Aquatic Biologist**, Envirosphere Company, Satsop, WA

EXPERTISE

Twelve years experience in salmonid passage and migration on mainstem Columbia River and tributaries. Five years of experience in macroinvertebrate taxonomy and fish food habits. Expertise in technical report writing, personnel management, project planning and development, budget development and tracking, passage/bypass facility designs and operation at dams and canals, smolt monitoring, aquatic entomology, computer usage.

PUBLICATIONS

Cameron, W.C., S.M. Knapp, and R.W. Carmichael. 1997. Evaluation of juvenile salmonid bypass facilities and passage at water diversions on the lower Umatilla River. Final report to Bonneville Power Administration, Portland, Oregon (DOE/BP-01385-7).

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Assistant Project Leader
William A. Cameron

EDUCATION

1990 - M.S., Fisheries Biology, Oregon State University.
1982 - B.S., Fisheries Biology, Humboldt State University.

EXPERIENCE

2/92 - Present **Fishery Biologist** (Assistant Project Leader), Oregon Dept. Fish & Wildlife, 80866 Hwy 395, Hermiston, OR 97838

Current project objectives are to determine the timing, abundance, and survival of juvenile salmonid migrants in the Umatilla River. Duties include assisting with the development and implementation of study plans, coordinating activities with government agencies, tribes, and irrigation districts, procuring equipment and supplies, operating juvenile fish traps in-river and at canal facilities, collecting biological and hydrological data, conducting mark-recapture studies, directing activities of seasonal employees, conducting appropriate scientific analysis of data, conducting literature searches, writing annual progress reports and journal articles, presenting talks at meetings, providing technical assistance to agency staff and managers, maintaining professional development through training opportunities.

5/91 - 2/92 **Fishery Biologist**, U.S. Forest Service, McKenzie Bridge, OR 97413
10/88 - 1/91 **Research Assistant**, NPS Coop. Park Study Unit, O.S.U., Corvallis, OR 97331

6/87 - 10/87 **Experimental Biological Aid**, NPS Coop. Park Study Unit, O.S.U., Corvallis, OR
6/84 - 4/87 **Fisheries Researcher**, Northern SE Regional Aquaculture Assoc., Sitka, AK 99835
5/83 - 9/83 **Biological Aide**, California Dept. Fish & Game, Burney, CA
4/82 - 9/82 **Field Assistant**, City of Arcata, Marsh Pilot Project, Arcata, CA 95221

EXPERTISE

Fourteen years of work experience conducting fisheries and limnological studies. Completed studies and written reports on juvenile salmonid outmigration and survival, juvenile salmonid passage at fish bypasses and ladders, resident fish populations in streams, assessments of bull trout stream restoration projects, effects of warm springs on the physical, chemical, and biological characteristics of lakes and stream, effects of inorganic nutrient additions to the physical, chemical, and biological characteristics of a lake ecosystem and it's capacity to produce salmon smolts. Extensive experience operating juvenile fish traps, marking fish, collecting and analyzing fisheries data and water samples, operating scientific instruments in the field and laboratory, conducting statistical analyses, and writing reports.

PUBLICATIONS

Cameron, W.A., S.M. Knapp, and R.W. Carmichael. 1997. Evaluation of juvenile salmonid bypass facilities and passage at water diversions on the lower Umatilla River. Final report to Bonneville Power Administration, Portland, Oregon (DOE/BP-01385-7).

Cameron, W.A. and G.L. Larson. 1993. Limnology of a caldera lake influenced by hydrothermal processes. Arch. Hydrobiol. 128 (1): 13-38.

Cameron, W.A. and G.L. Larson. 1991. Baseline inventory of the aquatic resources of Aniakchak National Monument, Alaska. Final report to National Park Service, Anchorage, Alaska.

Cameron, W.A. 1990. Responses to fertilization and fish stocking in the pelagic ecosystem of a naturally fishless lake. Final report to Northern SE Regional Aquaculture Assoc, Sitka, AK.

Section 10. Information/technology transfer

Response:

Progress reports will be written annually and distributed to those on the BPA publications distribution list. Final completion reports are written at the conclusion of the project and distributed similar to annual progress reports. Journal articles are being developed on specific aspects of the project and on the final report. Results are presented at Umatilla Passage Technical Work Group meetings, Umatilla Monitoring and Evaluation Oversight Committee meetings, and Umatilla River Operations Group meetings. A Umatilla basin research review is to be held in early 1998, covering most research projects within the basin. Presentations are given at AFS meetings, special workshops, and CBFWA and BPA public reviews.