Bonneville Power Administration
Fish and Wildlife Program FY99 Proposal

Section 1. General administrative information

Umatilla Hatchery Monitoring And Evaluation

Bonneville project number, if an ongoing project 9000500

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, 7.2D, 7.2D.1, 7.4I, 7.4I.1, 7.4L, 7.4L.1

NMFS Biological Opinion Number(s) which this project addresses.
This project relates to the Biological Opinion for 1995-98, hatchery operations in the Columbia River, section 7 consultation, Endangered Species Act: 1) wire tag 100% of fall chinook, 2) provide straying information, 3) implement fish health inspections.

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 artificial production actions in the Umatilla basin (volume II, page 45

Subbasin.
Umatilla River subbasin

Short description.
Evaluate juvenile rearing, marking, tagging, survival, stock life history, fish health, mass marking, straying, sport fishing and catch contribution for salmon and steelhead reared in oxygen supplemented and standard raceways at Umatilla Hatchery

Section 2. Key words

Mark	Programmatic Categories	Mark	Activities	Mark	Project Types
X	Anadromous fish		Construction		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.	X	Supplementation
			Enforcement		Wildlife habitat en-
			Acquisitions		hancement/restoration

Other keywords.
Response: oxygen supplementation, water reuse, rearing densities, acclimation, size and time of release, straying, effects of marking, fish health evaluation , life history, hatchery and wild interactions.

Section 3. Relationships to other Bonneville projects

Project #	Project title/description	Nature of relationship
8902401	Juvenile salmonid outmigration and survival in the Umatilla River	Migration monitoring assist in evaluating in-basin migration success of different rearing/release strategies
8903500	Umatilla Hatchery	Umatilla Hatchery provides the majority of the production for restoring salmon and supplementing steelhead populations in the Umatilla River.

9000501	Natural Production Monitoring and Evaluation - natural production success	This study evaluates the amount and extent of salmonid natural production in the Umatilla Basin. Identification is critical to determining the success of hatchery programs designed to restore and supplement natural populations.l
8802200	Umatilla River Basin Trap and Haul Program-collect/transport juvenile fish	This project provides low water passage for fish in the Umatilla River by trapping fish and hauling to sections of the river with adequate flow

Section 4. Objectives, tasks and schedules

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Determine and compare smolt-to-adult survival, life history characteristics, and cost effectiveness of subyearling fall chinook salmon reared in Michigan and Oregon raceways	a	Recover coded-wire tag data to assess survival, life history information, fishery contribution, and cost effectiveness
2	Determine and compare smolt-to-adult survival, life history characteristics, and cost effectiveness of subyearling fall chinook salmon reared at three densities in Michigan raceways	a	Sample raceways to determine growth, food conversion, and smolt condition.
		b	Mark and release fish to determine juvneile migration success in the Umatilla and Columbia Rivers
		c	Wire tag juveniles to determine adult survival, fishery contribution, and straying.
3	Determine and compare smolt-to-adult survival, life history characteristics, and cost effectiveness of yearling fall chinook salmon reared at three densities in Michigan raceways	a	Sample raceways to determine growth, food conversion, and smolt condition
			Mark and release fish to determine

			juvneile migration success in the Umatilla and Columbia Rivers
		c	Wire tag juveniles to determine adult survival, fishery contribution, and straying.
4	Determine and compare straying of fall chinook salmon into the Snake and upper Columbia Rivers for all groups	a	Mark subyearlings and yearlings, recover marked and tagged data and determine straying by group and release strategy
5	Determine the effects of tagging and marking on smolt-to-adult survival of subyearling fall chinook salmon	a	Interrogate adults chinook returning to the Umatilla River and determine survival by mark group
6	Determine and compare smolt-to-adult survival of subyearling spring chinook salmon reared in Michigan and Oregon raceways	a	Recover coded-wire tag data to determine adult survival, fishery contribution, and straying.
7	Determine and compare smolt-to-adult survival, life history characteristics, and cost effectiveness of spring chinook salmon reared in raceways at Umatilla and Bonneville hatcheries and released in the fall	a	Recover coded-wire tag data to determine adult survival, fishery contribution, and straying.
8	Determine and compare rearing performance, smolt condition, juvenile migration, smolt-to-adult survival, life history characteristics, and cost effectiveness of yearling spring chinook salmon reared at Umatilla and Bonneville hatcheries	a	Determine eyeing and hatching survival, fertilization success, hatching survial, and swim-up lengths among groups incubated at different temperatures
		b	Sample raceways to determine growth, food conversion, and smolt condition
		c	Mark and release fish to determine juvneile migration success in the Umatilla and Columbia Rivers
		d	Recover coded-wire tag data to determine adult survival, fishery contribution, and cost effectiveness.
		e	Test survival and blood sodium of

			salmon challanged with seawater
9	Monitor rearing performance, smolt condition, juvenile migration performance, smolt-to-adult survival, life history characteristics, and cost effectiveness of summer steelhead reared in Michigan raceways	a	Sample raceways to determine growth, food conversion, and smolt condition
		b	Mark and release fish to determine juvneile migration success in the Umatilla and Columbia Rivers
		c	Recover coded-wire tag data to determine adult survival, fishery contribution, and cost effectiveness.
10	Monitor water quality in Michigan and Oregon raceways	a	Monitor temperature, pH, oxygen, gas pressure, ammonia, and alkalinity to evaluate rearing conditions in standard and high density, multi-pass raceways
11	Determine annual recreational fishery for salmon and steelhead in the Umatilla River	a	Identify recreational fishery for all groups; estimate effort, catch, harvest, and number harvested by tag code for all fisheries
12	Participate in planning and coordination activities in the Umatilla basin	a	Participate in technical work groups and task teams to enusre research coordination, experimental, and sampling needs are met
13	Montior and evaluate the health and disease status of salmon and steelhead reared at Umatilla Hatchery and adult broodstock providing gametes for the Umatilla program	a	Monitor and evaluate the health of fish reared at Umatilla Hatchery
		b	Implement disease control measures and recommend adjustments to reareing strategies
		c	Monitor returing adults for R. salmoninarum.

Objective schedules and costs

	Start Date	End Date	

Objective #	mm/yyyy	mm/yyyy	Cost %
1	11/1997	10/2002	5.00%
2	11/1997	10/2005	33.00%
3	11/1997	10/2001	5.00%
4	11/1997	10/2005	2.50%
5	11/1997	10/1999	2.50%
6	11/1997	10/1999	2.50%
7	11/1997	10/1999	5.00%
8	11/1997	10/2002	10.00%
9	11/1997	10/2002	5.00%
10	11/1997	10/2005	5.00%
11	11/1997	10/2005	5.50%
12	11/1997	10/2005	5.00%
13	11/1997	10/2005	12.50%
			TOTAL 98.50%

Schedule constraints.
Hatchery water shortages and low egg availability may restrict the number of experiments conducted each year. Risks to Snake River stocks are unknown. Poor adult returns and low tag recoveries may necessitate additional releases.

Completion date.
2006

Section 5. Budget

FY99 budget by line item

Item	Note	FY99
Personnel	Costs are for FY98	$196,745
Fringe benefits	Costs are for FY98	$73,207
Supplies, materials, non-expendable property	Costs are for FY98	$197,442
Operations & maintenance	Costs are for FY98	$ 0
Capital acquisitions or improvements (e.g. land, buildings, major equip.)	Costs are for FY98	$2,500
PIT tags	# of tags: NA	$37,700
Travel	Costs are for FY98	$ 780
Indirect costs	Costs are for FY98	$107,212
Subcontracts	NA	$ 0
Other		$ 0
TOTAL		$615,586

Outyear costs

Outyear costs	FY2000	FY01	FY02	FY03
Total budget	$653,074	$672,666	$692,846	$713,631
O&M as % of total	41.00%	41.00%	41.00%	41.00%

Section 6. Abstract

Response:
Umatilla Hatchery is the foundation for rehabilitating chinook salmon and enhancing steelhead in the Umatilla River. Fish released in the Umatilla River are expected to contribute significantly to the NPPC doubling goal in the Columbia basin. Monitoring and evalauation of hatchery rearing is essential to achieving basin goals and include: 1) provide information for culture and release of hatchery fish, harvest regulations, and natural escapement that will lead to the accomplishement of long-term natural and hatchery production goals in the Umatilla River basin in a manner consistent with provisions of the Council's Fish and Wildlife program; and 2) assess the success of achieving the managment objectives in the Umatilla River basin that are presented in the Master Plan and the Comprehensive Rehabilitation Plan. Hatchery studies focus on the production of fish in Michigan raceways using oxygen supplementation, and the success of different rearing and release strategies. This Michigan system has not been throughly evaluated and may have systemwide application in the Columbia basin. Experiments and methods follow the criteria established in the comprehensive study plan. Outcomes produced from this project will be: measurement and analyses of juvenile rearing performance, juvenile and adult survival, fish health, catch contribution to comercial, tribal, and sport fisheries, effects of mass marking and straying for chinook salmon and steelhead. The expected performance is 21,000 fall chinook, 11,000 spring chinook, and 9,670 steelhead. A minimum of 15 years is expected to be required to meet goals for fall chinook salmon (2006)

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 spring and fall races of chinook salmon *O. tshawytscha*, and supplementation of summer steelhead *O. mykiss* (Boyce 1986). Increased populations of Umatilla River salmon and steelhead have 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 produced adult returns that partially mitigate for lost fisheries (Keefe et al. 1993, 1994; Hayes et al. 1996a, 1996b; Focher et

al. 1997; Groberg 1996a 1996b, CTUIR 1994; Contor et al. 1995, 1996, 1997). Monitoring and evaluation studies have been implemented to determine the success of different hatchery rearing and release strategies that are ongoing and will require adult survival information before each study can be completed. The Comprehensive Plan (Boyce 1986) identified the need for evaluating survival 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 focuses on hatchery rearing factors that affect fish condition and health, the success of juvenile migration, adult survival, and fisheries contributions (Keefe et al. 1993, 1994; Hayes et al. 1996a, 1996b; Focher et al. 1997, Groberg 1996ab). Specific objectives concentrate on the success of rearing fish at high densities using the "Michigan style" raceways that incorportate oxygen supplementation. If successful, the Michigan system will provide a method to rear more fish using less water at a lower cost. Additional studies focus on the success of fish released at different sizes, the effects of rearing fish at different densities, rearing using acclimation ponds, and an extensive marking program that is managed in consulation with section 7 of the Endangered Species Act for Snake River fall chinook salmon. Current project research developed out of the need to determine which rearing methods and strategies were appropriate for each stock used in the restoration program. We are currently in the sixth year of monitoring and evaluation activities.

The lead project biologist has worked on the project since 1992. Previous work consisted of research related fish feeding success and management evaluations to determine the success of fishing regulations and fish stocking programs with the Minnesota Department of Natural Resources for a total 14 years in fisheries work. The assistant project biologist began work with the project in 1995 and has extensive experience in evaluating hatchery programs related to early rearing . The second assistant began work in 1993 and has experience associated with creel and spawning ground surveys and 5 years of hatchery monitoring and evaluation studies on the Umatilla River.

b. Proposal objectives.

Response:

Individual program objectives are designed to answer specific problems that were described as biological critical uncertainites in the Umatilla Master Plan as follows:

Primary:

1. Can fish return goals to Threemile Falls Dam be achieved using hatchery production and supplementation?

2. To what extent can we use oxygen supplementation during rearing to increase the efficiency of producting summer steelhead and fall chinook for hatchery and natural production?

3. Will releases of subyearling and yearling spring chinook smolts produced at Umatilla Hatchery achieve the desired level of adult production?

4. To what extent can we use oxygen supplementation during rearing to increase the efficiency of producing spring chinook adults for for hatchery and natural production?

5. Will returning adult fall chinook salmon from releases made in the Umatilla River stray beyond acceptable limits into the Snake River system?

6. To what extent are harvest objectives being achieved?

Secondary:

1. To what extent will acclimation of summer steelhead, fall chinook, and spring chinook smolts enhance smolt-to-adult survival and homing.

2. To what extent will rearing density influence efficiency of producing summer steelhead, fall chinook, and spring chinook adults in the standard and oxygen supplementation systems

Biological need and priorities were establihsed based on their effect on achievment of program goals and the sytemwide application of results. At present there is limited natural reproduction of fall or spring chinook salmon in the basin, however, the success of restoration efforts to a large extent wil be determined by the hatchery program. A substantial proportion of the production at Umatilla Hatchery is produced in the Michigan supplementation system. This rearing system has not been throughly evaluated to determien the effects on smolt-to-adult survival. Disease monitoring and evaluationis also a critical component.

Monitoring and evaluation of the hatchery provides critical information on all life stages of anadromous salmonids in the Umatilla basin. Broodstock developments and egg-to-fry survival is evaluated to improve hatchery techniques. Fish reared at the hatchery are monitore for performance measures including health, ability to respond to stress, migration success, and achievment of size-at-release goals. Adults returns are monitored to determine success of different rearing methods and profiles, adult survival, appropriateness of stocks, straying of fish to other basins, and contribution of hatchery releases to commercial, tribal, and sport fisheries in the Columbia basin.

Program objectives:

1. Determine and compare smolt-to-adult survival, life history characteristics, and cost effectiveness of subyearling fall chinook salmon reared in Michigan and Oregon raceways
   Null hypothesis: Smolt-to-adult survival is not significantly different among fall chinook salmon reared in first, second, and third pass Michigan raceways.
   Null hypothesis: Smolt-to-adult survival is not significantly different among fall chinook salmon reared in first and second pass Oregon raceways.
   Null hypothesis: Smolt-to-adult survival is not significantly different among fall chinook salmon reared in Michgian or Oregon systems.
   Assumptions: Ability to rear fish to equal sizes in Michigan and Oregon passes and raceways. Ability to collect 35 wire-tagged fish per replicate to analyze life history and survival success. Expected survival rate to the Umatilla River is 0.30%. We expect to produce 11,500 adults for freshwater and ocean fisheries per million fish released.
   Products: Comparison of adult survival, fishery contribution, age at return, and cost for fish reared in Michigan and Oregon raceways.

2. Determine and compare rearing performance, smolt condition, juvenile migration performance, smolt-to-adult survival, life history characteristics, and cost effectiveness of subyearling fall chinook salmon reared at three densities in Michigan raceways
   Null hypothesis: Length, weight, condition factor, and food conversion are not significantly different among fall chinook salmon reared at three densities in Michigan raceways.
   Null hypothesis: Mean length, weight, condition factor, smoltification, and descaling are not significantly different among fish reared at three densities within Michigan raceways.
   Null hypothesis: Migration success and duration are not significantly different among fish reared at three densities within Michigan raceways.
   Null hypothesis: Smolt-to-adult survival is not significantly different among fall chinook salmon reared at three densities within Michigan raceways.
   Assumptions: Ability to rear fish to equal sizes in Michigan passess. Ability to collect 35 juveniles and wire-tagged fish per replicate to analyze migration, life history, and survival success.
   Products: Comparison of juvenile growth and condtion, juvenile migration success, adult survival, fishery contribution, age at return, and cost for fish reared at three densities in Michigan. Expected survival rate to the Umatilla River is 0.30%. We expect to produce 11,500 adults for freshwater and ocean fisheries per million fish released.

3. Determine and compare rearing performance, smolt condition, juvenile migration performance, smolt-to-adult survival, life history characteristics, and cost effectiveness of yearling fall chinook salmon reared in Michigan or Oregon raceways at Umatilla, Bonneville, and Little White Salmon hatcheries.
   Null hypothesis: Smolt-to-adult survival is not significantly different among fall chinook salmon reared at in first, second, and third pass Michigan raceways.
   Null hypothesis: Smolt-to-adult survival is not significantly different among fall chinook salmon reared at in first and second pass Oregon raceways.
   Null hypothesis: Smolt-to-adult survival is not significantly different among fall chinook salmon reared in Michigan and Oregon raceways.
   Null hypothesis: Smolt-to-adult survival is not significantly different among fall chinook salmon reared at Umatilla, Bonneville, and Little White Salmon hatcheries.
   Assumptions: Ability to collect 35 wire-tagged fish per replicate to analyze life history and survival success.
   Products: Comparison of adult survival, fishery contribution, age at return, and cost for fish reared at Umatilla, Bonneville, and Little White Salmon hatcheries. Expected survival rate to the Umatilla River is 0.75%.

4. Determine and compare straying of fall chinook salmon into the Snake and upper Columbia rivers for all groups
   Assumptions: Ability to effectively collect wire tagged fish in the Columbia and Snake River systems
   Products: Estimates of straying of fall chinook released into the Snake River ESA unit. Estimates of effectiveness of wire-tagging, acclimation, and flow manipulation as means to reduce straying and the effects of straying.

5. Determine the effects of tagging and marking on smolt-to-adult surivival of subyearling fall chinook salmon

Assumptions: Ability to effectively collect wire tagged fish in the Columbia and Snake River systems.
Products: Estimates of tag retention for blank-wire taggs and smolt-to-adult survival of fish with different fin marks based on recoveries in the Umatilla River.

6. Determine and compare smolt-to-adult survival, life history characteristics, and cost effectiveness of subyearling spring chinook salmon reared in Michigan and Oregon raceways
Null hypothesis: Smolt-to-adult survival is not significantly different among spring chinook salmon reared in first, second, and third pass Michigan raceways.
Null hypothesis: Smolt-to-adult survival is not significantly different among spring chinook salmon reared in first and second pass Oregon raceways.
Null hypothesis: Smolt-to-adult survival is not significantly different among spring chinook salmon reared in Michgian or Oregon systems.
Assumptions: Ability to rear fish to equal sizes in Michigan and Oregon passes and raceways. Ability to collect 35 wire-tagged fish per replicate to analyze life history and survival success. Expected survival rate to the Umatilla River is 0.30%. We expect to produce 3,900 adults for freshwater and ocean fisheries per million fish released.

   Products: Comparison of adult survival, fishery contribution, age at return, and cost for fish reared in Michigan and Oregon raceways.

7. Determine and compare smolt-to-adult survival, life history characteristics, and cost effectiveness of spring chinook salmon reared in Michigan or Oregon raceways at Umatilla and Bonneville hatcheries and released in the fall.
Null hypothesis: Smolt-to-adult survival is not significantly different among spring chinook salmon reared in first, second, and third pass Michigan raceways.
Null hypothesis: Smolt-to-adult survival is not significantly different among spring chinook salmon reared in first and second pass Oregon raceways.
Null hypothesis: Smolt-to-adult survival is not significantly different among spring chinook salmon reared in Michgian or Oregon systems.
Null hypothesis: Smolt-to-adult survival is not significantly different among spring chinook salmon reared at Umatilla or Bonneville hatcheries.
Assumptions: Ability to collect 35 wire-tagged fish per replicate to analyze life history and survival success. Expected survival rate to the Umatilla River is 0.50%.

   Products: Comparison of adult survival, fishery contribution, age at return, and cost for fish reared in Michigan or Oregon raceways at Umatilla or Bonneville hatcheries.

8. Determine and compare rearing performance, smolt condition, juvenile migration performance, smolt-to-adult survival, life history characteristics, and cost effectiveness of yearling spring chinook salmon reared in Michigan and Oregon raceways.
Null hypothesis: There is no significant difference in eyeing survival, fertilization success, hatch survival, and swim-up lengths among embryos incubated at different tempeartures.
Null hypothesis: Mean length, weight, condition factor, food conversion, smoltification, and descaling are not significantly different among spring chinook salmon reared in Michigan and Oregon raceways.
Null hypothesis: Migration success and duration are not significantly different among fish reared at in Michigan and Oregon raceways.
Null hypothesis: Smolt-to-adult survival is not significantly different between spring chinook salmon reared in Michigan and Oregon raceways.

Assumptions: Ability to rear fish to equal sizes in Michigan and Oregon raceways and passess. Ability to collect 35 juveniles and wire-tagged fish per replicate to analyze migration, life history, and survival success. Expected survival rate to the Umatilla River is 0.75%. We expect to produce 2,800 adults for freshwater and ocean fisheries per 210,000 fish released.

Products: Comparison of juvenile growth and condtion, juvenile migration success, adult survival, fishery contribution, age at return, and cost for fish reared in Michigan and Oregon raceways.

9. Determine and compare smolt condition, smolt migration performance, smolt-to-adult survival, and life history characteristics between yearling spring chinook salmon reared at Umatilla, Bonneville, and Little White Salmon hatcheries.
   Null hypothesis: Smoltification and descaling are not significantly different among spring chinook salmon reared at different hatcheries.
   Null hypothesis: Survival and blood sodium are not significantly different between fish reared at different hatcheries.
   Null hypothesis: Migration success and duration are not significantly different among fish reared at different hatcheries.
   Null hypothesis: Smolt-to-adult survival is not significantly different between spring chinook salmon reared at different hatcheries.
   Assumptions: Ability to collect 35 juveniles and wire-tagged fish per replicate to analyze migration, life history, and survival success.
   Products: Comparison of juvenile growth and condtion, juvenile migration success, adult survival, fishery contribution, age at return, and cost for fish at different hatcheries. Expected survival rate to the Umatilla River is 0.75%. We expect to produce 2,800 adults for freshwater and ocean fisheries per 210,000 fish released.

10. Monitor rearing performance, smolt condition, smolt migration performance, smolt-to-adult survival, life history characteristics, and cost effectiveness of summer steelhead reared in Michigan raceways.
    Assumptions: Ability to collect 35 juveniles and wire-tagged fish per group to compare migration, life history, and survival success. Expected survival rate to the Umatilla River is 0.30%. We expect to produce 2,000 adults for freshwater and ocean fisheries per 210,000 fish released. Expected survival rate to the Umatilla River is 2.70%. We expect to produce 7,000 adults for freshwater and ocean fisheries per 210,000 fish released.
    Products: Comparison of juvenile growth and condtion, juvenile migration success, adult survival, fishery contribution, age at return, and cost for fish reared in Michigan raceways.

11. Monitor water quality in an index series of Michigan and Oregon raceways.
    Null hypothesis: Water quality parameters are not not significantly in Michigan and Oregon raceways used to rear salmon or steelhead
    Null hypothesis: Water quality parameters are not not significantly in Michigan passes used to rear salmon or steelhead
    Assumptions: Weekly collection of water quality data.
    Products: Comparison of inlet and outlet water temperture, oxygen, nitrogen, total pressure, pH, ammonia, and alkalinity in Michigan or Oregon raceways.

12. Coordinate in the development of a water quality sampling and monitoring program in the Umatilla basin..
    Assumptions: None.

Products: Review of existing data to establishment of a water sampling program in the Umatilla basin.

13. Determine annual recreational fishery for chinook salmon and summer steelhead in the Umatilla River including estimates of catch by tag code.
Null hypothesis: None
Assumptions: We assume effort and catch data obtained from interviewing a subsample of anglers is representative of the fishery. Ability to count and interview anglers in river sections open to recreational fishing.
Products: Estimates of effort, catch, harvest, and number harvested by tag code for coho salmon, fall and spring chinook salmon, and steelhead fisheries.

14. Participate in planning and coordination activities associated with anadromous fish production and monitoring and evaluation in the Umatilla basin.
Null hypothesis: None
Assumptions: None.
Products: Participation in technical work groups to ensure coordination, experimental, and sampling needs are met.

15. Monitor and evaluate the health and disease status of spring and fall chinook salmon and summer steelhead juveniles reared at Umatilla Hatchery, adult broodstocks providing gametes for the Umatilla program, and CWT marked adults reared as juveniles at Umatilla Hatchery where possible.
Null hypothesis: None
Assumptions: Ability to collect representative samples of fish at hatchery to monitor fish health.
Products: Preliberation health examination for specific fish pathogens and parasites; implementation of disease control measures and recommendations of adjustments to rearing strategies; examinations of returning adults, including spawned fish, sacrificed fish, mortaility, and cracasses on the spawning grounds for R. salmoninarum.

c. Rationale and significance to Regional Programs.

Response:
Results of research on the effectiveness of rearing salmon and steelhead in Michigan and Oregon raceways at Umatilla Hatchery may have significance to restoration and rearing programs throughout the Columbia basin. The Michigan system is designed to rear fish at high densities using oxygen supplementation; however, this system has not been throughly evaluated to determine the effects on smolt-to-adult survival for chinook salmon and steelhead. If fish can be reared efficiently at high densities in Michigan raceways, significant savings may result in the form of reduced construction, water, and production costs. Additional studies on size and time of release and acclimation will have application to other restoration and supplementation programs

The evaluation of rearing and survival success is critical to the restoration program in the Umatilla River and to the NNPC's doubling goal for the Columbia basin. Umatilla Fish Hatchery is the foundation for rehabilitating chinook and salmon and enhancing steelhead in the Umatilla River; therefore, analysis of the factors affecting juvenile and adult survival are needed to ensure program success.

Monitoring has shown that adult fall chinook salmon from releases made into the Umatilla River stray into the Snake River system. The tagging program annually wire-tags more than 3 million fish and early results show that significant numbers of fish can be removed before straying pas Lower Granite Dam. Removal of strays assists the resotoration program for the listed stocks of fall chinook salmon in the Snake River. Marking studies are incomplete, but have provided valuable information on the use of body-tags as a mass mark.

d. Project history

Response:
This project (9000500) has continued uninterupted since 1992. Research was developed out of needs addressed in the hatchery technical work group meetings, the Umatilla Hatchery Master Plan (CTUIR and ODFW 1990), and the comprehensive plan for monitoring and evaluation (Carmichael 1990). We have completed 6 years of monitoring and evaluation of fish reared at Umatilla Hatchery (Keefe et al. 1993, 1994; Hayes et al. 1996a, 1996b; Focher et al. 1997; Hayes et al. 1997, Carmichael, in press). Additional studies have been conducted for groups released in the Umatilla River, but reared at other facilities, including Bonneville, Cascade, Irrgion, Little White Salmon, and Willard hatcheries. A considerable amount of information has been obtained on juvenile rearing and migration success however the information on adult survival which is critical to evaluating the success of rearing and release studies is still being collected.

Results of completed studies suggest that subyearling fall chinook salmon can be successfully reared in Michigan raceways. The number of fish produced per gallon of water was approximately three times greater in Michigan than in standard Oregon raceways. Smolt condition evaluations showed no difference in the stress responses of fish reared in either system; but fish reared in Michigan raceways were more descaled than in Oregon raceways. Data from branded fish suggested the proportion of juveniles that successfully migrated to the John Day dam were approximatley equal. We have preliminary adult survival data for one brood year that suggests equal survival between fish reared in Michigan and Oregon raceways and within Michigan passes. Comparisons with fall chinook salmon released as yearlings have showed that both release strategies are valuable and contribute significant numbers of adult salmon in some years. More than 3 million fall chinook salmon have been wire-tagged since 1994 to assist in the removal of strays from Lower Granite Dam. Initial data indicates that strays are being successfully removed. Hatchery groups released in the Umatilla River prior to the construction of Umatilla Hatchery have contributed as many as 28,000 fish from a single brood year to ocean and freshwater fisheries.

Spring chinook salmon have been reared as spring release subyearlings, fall release subyearlings, and spring release yearlings at Umatilla Hatchery. Subyearlings were reared for two years to utilize the high growth rates that were predicted for the warm water at Umatilla Hatchery. However, growth rates were not as great as predicted and survival from these groups has been poor. Spring chinook were reared for fall release to capitalize on unused rearing space at Umatilla and Bonneville hatcheries. Comparisons of fish reared in Michigan and Oregon raceways showed similar responses to stress for this group. Adult return data suggests similar survival for Michigan and Oregon reared fish, but greater survival for fish reared at Bonneville hatchery. Yearlings reared at Umatilla Hatchery are incubated at cold temperature to reduce the final size-at-release. These fish have been compared to standard reared groups at Bonneville Hatchery. There appeared to be no correlation between ATPase levels, smolt development, and migration success for yearlings. Although data suggests that juveniles reared at each hatchery have similar

survival rates to John Day dam, adult survival has been 3-4 times greater for fish reared at Bonneville Hatchery. Recent releases have produced as many as 2,200 adults to the Umatilla River, and an associated recreational and tribal fisheries.

Six brood years (1991-1996) of Umatilla stock summer steelhead have been reared at Umatilla Hatchery, acclimated at upriver sites, and released into the Umatilla River. Rearing densities were reduced after the first year because of severe caudal fin erosion. The condition of smolts reared in first, second, and third pass Michigan raceways has been similar and comparable to smolts reared in Oregon raceways at Irrigon Hatchery. To improve health, fish were reared in one Michigan raceway without baffles in 1996-97. Adult returns indicate greater success for groups released in April compared to groups released in May. The original hatchery plan was to rear Wallowa stock summer steelhead at UFH in Oregonder to test rearing between Michigan and Oregon raceways. Because of water shotages and program goals these tests have been delayed, but may be conducted in the future.

Studies of water quality have shown that measured parameters were similar in Michigan and Oregon raceways. Effects of poor water quality and rearing fish at high densities were reduced by using high turnover rates and oxygen supplementation at the head of each raceway. Under adaptive management we have removed the baffles from some Michigan raceways to improve water quality.

Surveys of the recreational fishery have shown that significant fisheries have been developed in the Umatilla River for salmon and steelhead. More than 12,000 angler-hours have been measured annually. Annual fisheries have been developed for coho and fall chinook salmon. In addition, sport seasons for spring chinook salmon have been possible in 5 of 8 years as runs size goals were achieved.

After five years of intensive monthly and preliberation monitoring no ectoparasites or viral agents have been detected on or in any juvenile salmonids reared at Umatilla Hatchery. Nor have environmental or bacterial gill disease been indicated at any time even though high density rearing occurs each year in Michigan raceways. Examinations of spring chinook salmon and steelhead has suggested little evidence for vertical transmission. There have been losses of fish from bacterical kidney disease in juvenile spring chinook salmon at Umatilla Hatchery and data indicates that 100% sampling of females in a segregation or culling program may be warranted. Studies of the cold-water disease bacterium, *Flexibacter psychrophilus,* suggested that fish were becoming infected through abrasions of the skin, possibly from the baffles in Michigan raceways. Based on this information, baffles have been removed from some raceways to measure changes in fish health.

e. Methods.

Response:
Detailed methods are available in the Umatilla Hatchery Master Plan (CTUIR and ODFW 1990), and in annual reports (Keefe et al. 1993, 1994; Hayes et al. 1996a, 1996b; Focher et al. 1997; Hayes et al. 1998 in press, Grober 1996ab).

Methods follow criteria detailed in the Master Plan, these criteria are:

1. Uncertainties should be evaluated in priority order.
2. Each treatment should be replicated twice within a year, preferably, three or four times.

3. Each treatment should be replicated for four years to ensure that performances are observed under a variety of environmental conditions. This should allow us to distinguish a minimum of 50% difference among treatments with 95% certainty.
4. At least one treatment (rearing and release strategy) for each species must be used as the standard control and maintained through time.
5. To minimize variation we require 35 observed coded-wire tag (CWT) mark recoveries per test group. This should give a coefficient of variation for smolt-to-adult survival of .25 (de Libero 1986; Mobrand 1987).
6. The same species must be reared in a raceway series where water is reused and each pass must be considered a separate treatment because of potential differences in water quality as water is modified by the degree of reuse.

(1-10) Juvenile rearing data will allow us to compare fish performance for groups reared under different rearing profiles. Growth is monitored by measuring 100 lengths and 50 weights of fish in each raceway each month. At pre-release fish 300 lengths and 100 weights and condition factors are measure from fish in each raceway. Smolt condtion, including fin erosion, descaling, and smolt devlopement are measured for 200 fish from each raceway prior to transfer and when the fish are relased from acclimation ponds. To monitor smolt develpment, ATPase has been measured from a sample of 10 fish per raceway. Stress indices were obtained by holding fish out of the water for 30 seconds. These fish were sacrificed immediately and sampled, or held in netpens for 1 hours and sacrificed for sampling. When possible, data on juvenile rearing was analyzed with analysis of variance procedures (Sokal and Rohlf 1981). The response of fish to a seawater challange test will be condutted prior to release using established protocols. Replicate groups of 10 fish (controls and treatments) will be maintained and tested. All fish will be held for 48 hours without feed before testing. Proper seawater levels will be established ushing salinity meters. Blood samples will be collected from each fish, preserved, and analyzed at for blood sodium using standard techniques.

(1-10) Results of juvenile tagging experiements will allow us to determine migration survival and performance for different rearing profiles. Juvenile migration data was collected by branding 5,000-10,000 fish from each raceways. Brand retention was evaluated for each group. Data was collected on migration timing and success by collection programs already in place at the John Day and Bonneville dams. Migration data was evaluated graphically or using binomial comparisons. We will PIT tag fish in 1998 to evaluate juvenile migratiion success of production groups at Umatilla Hatchery. Approximately 250-500 fish per group will be PIT tagged to provide adequate data. Detection of PIT-tagged fish will occur in the Umatilla River at the lower river rotary trap, at West Extension Canal, and at Westland Canal during transport operations. Fish will also be interogated at John Day and Bonneville dams. 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.

(1-10) Adult survival data is collected through a database maintained by the Pacific States Marine Fisheries Commission. Tag data is used to determine contributions by brood year and release strategy We calculate total survival, survival to the Umatilla River, and exploitation based on expanded recovery data. We also use the database and completed brood years to evaluate straying rates from all locations in the Columbia basin.

(13) Monitoring the recreational fishery will provide information of fishery contribution of release groups and econimic value of each program. Fishing is evaluated with standard survey methods. Sampling is conducted on 2-3 weekdays per week and on all weekends and holidays. Anglers are interviewd using a random access survey. Counts of anglers are made three times each day to estimate effort. All data including coded-wire tag expansions of fish caught is made using a statisical program developed by ODFW.

(15) Fish health monitoring provides critical information used to improve rearing stategies and juvenile and adult survival. Health is monitored by collecting fish from all raceways at all rearing facilities on a monthly basis. Kidney samples are colllected from jack and adults salmon returning to the Umatilla River at collection sites or during spawning ground surveys. Analyis of variance is used for statistical analysis of cumulative percent monthly mortality and disease values. Drugs and formaling treatments are administred and tested under Investigational New Animal Drug protocols

(12, 14) Coordination is used to reach goals, improve work efficiency, and avoid duplication of work within the basin. 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. Fish rearing and condition data: We will rear all fish at state, federal, or cooperatively managed hatcheries. Fish condition will be evaluated using measuring boards, scales, and visual evlautions of each fish sampled. Visual evaluation have been standardized to provide continuity between years and observers.

2. Offices*:* Laboratory space is used at Umatilla Hatchery. Office space in Hermiston currently occupies a 2,600 ft^2 suite.

4. Technical Equipment: Water quality is measured with a Common Sensing gas meter (model TBO-F) to monitor oxygen, nitrogen, and total pressure. The pH is measured with a hand-held meter. Alkalinity is determined by titration using standard methods. Ammonia is determined sending water samples to a private laboratory. Hand-loop detectors to interogate PIT tagged fish will be purchased with current project funds or we will use equipment from project number 8902401.

5. *Computer Equipment*: Three desk-top (386 + pentium 233) and one lap-top computer (386) are available for word processing, data summarization and analysis, and graphics development. An additional computer (386) is used to run the PIT tag station. MS Office is the standard software used.

6. *Marking Equipment*: CO_2-activated injectors will be used to provide an additional paint mark so that PIT tag fish can be recognized in the Umatilla basin. PIT tag injectors and needles will be purchased to mark fish. PIT tags will be purchased thgrough the Pacific States Marine Fisheries Commission.

7. *Vehicles*: Two year-round 1/2 ton trucks will be used for personnel, fish, and equipment transport; trucks are obtained from DAS.

g. References.

Response:

Boyce, R.R. 1986. A comprehensive plan for rehabilitation of anadromous fish stocks in the Umatilla River basin. Report DOE/BP-18008-1, Bonneville Power Adminstration, Portland, Oregon.

R.W. Carmichael. In Press. Straying of Umatilla River hatchery origin fall chinook salmon into the Snake River. *In* Genetic Effects of Straying of Non-Native Hatchery Fish into Natural Populations (R.S. Waples, convenor). National Oceanic and Atmospheric Administration, Seattle, WA.

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Contor, C.R., E. Hoverson, P. Kissner, and J. Volkman. 1996. Umatilla basin natural production monitoring and evaluation. Annual progress report 1994-1995 to Bonneville Power Administration, Portland, Oregon.

Contor, C.R., E. Hoverson, P. Kissner, and J. Volkman. 1997. Umatilla basin natural production monitoring and evaluation. Annual progress report 1995-1996 to Bonneville Power Administration, Portland, Oregon.

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CTUIR (Confederated Tribes of the Umatilla Indian Reservation) and ODFW (Oregon Department of Fish and Wildlife). 1990. Umatilla hatchery master plan. Prepared for the Northwest Power Planning Council, Portland, Oregon

CTUIR (Confederated Tribes of the Umatilla Indian Reservation). 1994. Umatilla basin natural production monitoring and evaluation. Annual progress report 1992-1993 to Bonneville Power Administration, Portland, Oregon.

Focher, S.M., R.W. Carmichael, M.C. Hayes, and R.W. Stonecypher, Jr. 1997. Umatilla hatchery monitoring and evaluation. 1996 annual progress report to Bonneville Power Administration, Portland, Oregon.

Hayes, M.C., S.M. Knapp, and A.A. Nigro. 1992. Pages 53-103 *in* S.M. Knapp, editor. Evaluation of juvenile fish bypass and adult fish passage facilities at water diversions in the Umatilla River. Annual and interim progress reports. DOE/BP-10385-2, Bonneville Power Administration, Portland, Oregon.

Hayes, M.C., R.W. Carmichael, S.M. Focher, N.L. Hurtado, M.L. Keefe, G.W. Love, W.J. Groberg, Jr., S.T. Onjukka, and K. Waln. 1996a. Umatilla Hatchery Monitoring and Evaluation. Annual progress report to Bonneville Power Administration, Portland, Oregon.

Hayes, M.C., R.W. Carmichael, S.M. Focher, W.J. Groberg, Jr., S.T. Onjukka, R.W. Stonecypher, Jr., and K. Waln. 1996b. Umatilla Hatchery Monitoring and Evaluation. Annual progress report to Bonneville Power Administration, Portland, Oregon

Hayes, M.C., R.W. Carmichael, M.L. Keefe, and T.A. Whitesel. (1997). Accuracy of length estimates for chinook salmon and steelhead in compartmented and standard hatchery raceways. Progressive Fish Culturist 59:285-292.

Groberg, W.J., Jr., N.L. Hurtado, S.T. Onjukka, and K. Waln. 1996a. Report B: Fish Health Monitoring and Evaluation *in* Umatilla Hatchery Monitoring and Evaluation. Annual progress report to Bonneville Power Administration, Portland, Oregon.

Groberg, W.J., Jr., S.T. Onjukka, and K. Waln. 1996b. Report B: Fish Health Monitoring and Evaluation *in* Umatilla Hatchery Monitoring and Evaluation. Annual progress report to Bonneville Power Administration, Portland, Oregon.

Keefe, M.L., R.W. Carmichael, R.A. French, W.J. Groberg, and M.C. Hayes. 1993. Umatilla hatchery monitoring and evaluation. Annual progress report to Bonneville Power Administration, Portland, Oregon.

Keefe, M.L., R.W. Carmichael, S.M. Focher, W.J. Groberg, and M.C. Hayes. 1994. Umatilla hatchery monitoring and evaluation. Annual progress report to Bonneville Power Administration, Portland, Oregon.

Knapp, S.M., J.C. Kern, W.A. Cameron, S. M. Snedaker, and R.W. Carmichael. 1997. Evaluation of juvenile salmonid outmigration and survival in the lower Umatilla

River basin. Annual progress report to Bonneville Power Administration, Portland, Oregon.

NPPC (Northwest Power Planning Council). 1987. Columbia River basin fish and wildlife program (as amended). Northwest Power Planning Council, Portland, Oregon.

NPPC (Northwest Power Planning Council). 1994. Columbia River basin fish and wildlife program. Northwest Power Planning Council, Portland, Oregon.

Sokal R.R. and F.J. Rohlf. 1981. Biometry. W.H. Freeman and Company, New York.

USBR (U.S. Bureau of Reclamation) and BPA (Bonneville Power Administration). 1989. Umatilla basin project. Initial project workplan presented to the Northwest Power Planning Council, May 1989.

Section 8. Relationships to other projects

Response:

Study scope and approach of this project was developed in conjunction with the Umatilla Hatchery Master Plan, the Umatilla Basin Natural Production Monitoring and Evaluation Plan and the Outmigration and Survival study. This project supplements monitoring efforts of the Natural Production M&E by monitoring and collecting biological information on returning adults 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 Outmigration and Survival study by providing marked groups that can be identified to determine in-basin survival Such information can be used in adaptive management decisions to improve hatchery effectiveness. This activity meets measures 7.2D.1, 7.4I, and 7.4I.1 of the FWP.

Information obtained on juvenile rearing and migration, adults survival, and recreational fishing is shared with other projects, fish managers,and hatcheries. Information on rearing and survival data is used by state and federal agencies to imrpove hatchery programs throughout the Columbia basin. Information on stray fall chinook salmon is used by the state of Washington and the National Marine Fisheries Service to determine if fish releases and adult returns are compatible with the ESA plan for Snake River fall chinook salmon (meets measure 7.10A.2 of FWP). This project complements the Habitat Improvement Project in the Umatilla basin by monitoring any changes in adult fish abundance possibly due to habitat improvement or degradation. Monitoring adults supplements activities and provides information to CTUIR's Bonifer-Minthorn Springs Acclimation Facilities Program and provides information for effective operation of the Umatilla River Trap and Haul Program.

Cooperation and collaboration among 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. We work with the National Marine Fisheries Service in sharing information and developing recommendations on fall chinook salmon programs that affect the Snake River ESA. We obtain specific database information necessary for project data analysis from the CTUIR, Fish Passage Center, Pacific States Marine Fisheries Commission, and the Washington Department of Fish and Wildlife. We require assistance from the Oregon State Police and the local county sheriff's department when hunting or fishing violations are observed during angler surveys.

Section 9. Key personnel

Response:
Program Leader: Richard W. Carmichael; FTE = 0.16
Project Leader: Michael C. Hayes; FTE = 1
Ass't Project Leader: R. Wes Stonecypher; FTE = 1
Ass't Project Leader: William A. Cameron; FTE = 1
Seasonal workers: FTE = 1.0

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 **Fish. Res. Leader**, Oregon Dept. Fish & Wildlife, La Grande, OR
3/83 - 12/83 **Fish Res. Ass't**, Oregon Dept. of Fish & Wildlife, La Grande, OR
10/82 - 3/83 **Project Asst.** Oregon Dept. 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

R.W. Carmichael. In Press. Straying of Umatilla River hatchery origin fall chinook salmon into the Snake River. *In* Genetic Effects of Straying of Non-Native Hatchery Fish into Natural Populations (R.S. Waples, convenor). National Oceanic and Atmospheric Administration, Seattle, WA.

Carmichael, R.W. and R.T. Messmer. 1995. Status of supplementing chinook salmon natural production in the Imnaha River basin. *In* Uses and Effects of Cultured Fishes in Aquatic Ecosystems (H.L. Shramm, Jr., and R.G Piper, eds.).

Whitesel, T.A., P.T. Lofy, R.W. Carmichael, R.T. Messmer, M.W. Flesher, and D.W. Rondorf. 1994. A comparison of the performance of acclimated and direct stream released, hatchery-reared steelhead smolts in Northeast Oregon. Pages 87-92 *in* High Peformance Fish (D.D. MacKinlay, ed.); Fish Physiology Section, American Fisheries Society, Fish Physiology Association, Vancouver, British Columbia, Canada.

Whitesel, T.A. and R.W. Carmichael. 1994. Bimodal development and smoltification in hatchery-reared chinook salmon. Pages 116-121 *in* High Performance Fish (D.D. MacKinlay, ed.); Fish Physiology Section, American Fisheries Society, Fish Physiology Association, Vancouver, British Columbia, Canada.

Project Leader
Michael C. Hayes

EDUCATION

1982 M.S., Fisheries Science, New Mexico State University, Las Cruces, NM
1975 B.S., Natural Resources, University of California, Berkeley, CA

EXPERIENCE

06/95 - Present **Fisheries Research Biologist**, Oregon Department of Fish and Wildlife, 80866 Hwy 395 No., Hermiston, OR 97838

Project leader for the Umatilla Hatchery Monitoring and Evaluation 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, 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.

10/91 - 5/95 **Asst Project Leader**, Oregon Dept. Fish & Wildl., Hermiston, OR
6/85 - 8/91 **Fisheries specialist,** Minnesota DNR, Lake City
9/83 - 5/85 **Biologist**, Aquanautics Corp., Beaufort, N.C.
6/79 - 8/83 **Fishery Research Asst.,** New Mexico St. Las Cruces, N.M.

EXPERTISE

Six years experience in hatchery rearing and release strategies on the Umatilla River focusing on factors affecting smolt condition and juvenile and adult survival. Five years experience in management of coldwater and coolwater streams, specializing in the evaluation of long-term managment plans, stocking, and angling regulations. Four years experience in limnological measurements, invertebrate identification, and food foraging behavior.

PUBLICATIONS

Hayes, M. 1990. Evaluation of special regulations for a winter trout season on the Middle and South Branches of the Whitewater River. Minnesota Department of Natural Resources, F-29-R(P)-9, Study 4, Job 179.

Hayes, M.C., R.W. Carmichael, S.M. Focher, R.W. Stonecypher. 1996b. Annual Report 1995, Umatilla Hatchery Monitoring and Evaluation. Bonneville Power Administration (Project 90-005), Portland, OR.

Hayes, M.C., L.A. Gates, and S.A. Hirsch. (1997). Multiple catches of smallmouth bass special regulation fishery. North American Journal of Fisheries Management, 17:182-187.

Hayes, M.C., R.W. Carmichael, M.L. Keefe, and T.A. Whitesel. (1997). Accuracy of length estimates for chinook salmon and steelhead in compartmented and standard hatchery raceways. Progressive Fish Culturist 59:285-292.

Assistant Project Leader
Shannon M. Focher

EDUCATION

1989 - B.S., Biology, Oregon State University.

EXPERIENCE

2/93 - Present **Fishery Biologist** (Assistant Project Leader), Oregon Dept. Fish & Wildlife, 80866 Hwy 395, Hermiston, OR 97838

Assistant project leader for Umatilla Hatchery Monitoring and Evaluation Study. Duties include monitoring growth, health, juvenile migration success, and adult survival for hatchery reared salmon and steelhead. Additional duties include monitoring marking and tagging stuides and evaluating the recreational fishery. Also conduct data analyses, prepare reports, presentations, and proposals, train and oversee project personnel, participate in collection of scientific data, participate in interagency planning/coordination meetings, and provide technical assistance to agency staff.

9/92 - 2/93 **Assistant project leader,** Oregon Dept. Fish & Wild., Elk River, OR
9/91 - 8/92 **Exp. Biology Aide,** Oregon Dept. Fish & Wild., Clackamas, OR
5/91 - 8/91 **Exp. Biology Aide,** Oregon Dept. Fish & Wild., Clackamas, OR
2/91 - 3/91 **Technician,** National Marine Fish. Service
10/90 - 1/91 **Exp. Biology Aide,** Oregon Dept. Fish & Wild.
5/90 - 10/90 **Exp. Biology Aide,** Oregon Dept. Fish & Wild.
6/89 - 7/89 **Research Assistant,** Oregon St. Univ., Corvallis, OR
3/89 - 6/89 **Research Assistant,** Oregon St. Univ., Corvallis, OR

EXPERTISE

Nine years of work experience conducting fisheries studies. Extensive exerience in marking fish and conductiong and analyzing creel survey data. Additional experience in collecting and analyzing fisheries data, spawning ground surveys, age determination of warmwater species, recording behavior of marine mammals and gillnet interactions. Operation of scientific instruments in the field and laboratory, conducting statistical analyses, and writing reports.

PUBLICATIONS

Focher, S.M., R.W. Carmichael, M.C. Hayes, and R.W. Stonecypher, Jr. 1997. Umatilla hatchery monitoring and evaluation. 1996 annual progress report to Bonneville Power Administration, Portland, Oregon.

Hayes, M.C., R.W. Carmichael, S.M. Focher, N.L. Hurtado, M.L. Keefe, G.W. Love, W.J. Groberg, Jr., S.T. Onjukka, and K. Waln. 1996a. Umatilla Hatchery Monitoring and Evaluation. Annual progress report to Bonneville Power Administration, Portland, Oregon.

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Assistant Project Leader
R. Wes Stonecypher

EDUCATION

B.S., Biology, Washington State University.
M.S. Fisheries, Mississippi State University
M.S. Biology, University of Wyoming

EXPERIENCE

8/95 - Present **Fishery Biologist** (Assistant Project Leader), Oregon Dept. Fish & Wildlife, 80866 Hwy 395, Hermiston, OR 97838

Assistant project leader for Umatilla Hatchery Monitoring and Evaluation Study. Duties include monitoring growth, health, juvenile migration success, and adult survival for hatchery reared salmon and steelhead. Additional duties include monitoring egg survival and database management. Also conduct data analyses, prepare reports, presentations, and proposals, train and oversee project personnel, participate in collection of scientific data, participate in interagency planning/coordination meetings, and provide technical assistance to agency staff.

EXPERTISE

Work experience conducting fisheries studies. Extensive experience in fish culture, egg development and survival. Additional experience in collecting and analyzing fisheries data and conducting spawning ground surveys. Operation of scientific instruments in the field and laboratory, conducting statistical analyses, and writing reports.

PUBLICATIONS

Focher, S.M., R.W. Carmichael, M.C. Hayes, and R.W. Stonecypher, Jr. 1997. Umatilla hatchery monitoring and evaluation. 1996 annual progress report to Bonneville Power Administration, Portland, Oregon.

Hayes, M.C., R.W. Carmichael, S.M. Focher, W.J. Groberg, Jr., S.T. Onjukka, R.W. Stonecypher, Jr., and K. Waln. 1996b. Umatilla Hatchery Monitoring and Evaluation. Annual progress report to Bonneville Power Administration, Portland, Oregon

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.