Characterize and quantify residual steelhead in the Clearwater River, Idaho

Bonneville project number, if an ongoing project 9011

Business name of agency, institution or organization requesting funding
U.S. Fish and Wildlife Service, Idaho Fishery Resource Office

Business acronym (if appropriate) USFWS, IFRO

Proposal contact person or principal investigator:

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Subcontractors. N/A

NPPC Program Measure Number(s) which this project addresses. Refer to 1994 Fish and Wildlife Program as amended in 1995

.

5.7A.4, 5.7B.17, 7.2A.6, 7.2D, 7.2D.1, 7.2D.3

NMFS Biological Opinion Number(s) which this project addresses.

Endangered Species Act Section 7 Biological Opinion on 1995-1998 Hatchery Operations in the Columbia River Basin, Consultation Number 383, April 5, 1995. Section VIII, Number 1 (page 64), Section X, Numbers 1, 3, and 4 (page 66).

Other planning document references.

Snake River Salmon Recovery Plan (page V-4-38) recommends evaluating strategies to reduce residualism, particularly size at release, in steelhead.

NMFS= *Status review of west coast steelhead from Washington, Idaho, Oregon, and California* (1996) points out the need for information pertaining to questions addressed by this project: interactions between hatchery and natural stocks within the ESU (page 171), relation between anadromous and non-anadromous forms (possibly residualized) of *Oncorhynchus mykiss* (pages

70, 171).
Wy-Kan-Ush-Mi Wa-Kush-Wit (Volume I), page 5B-16: ADevelop experimental and monitoring programs in association with these projects to study the relationships between natural and supplemented components of populations.≅

Subbasin.

Clearwater River

Short description.

Data characterizing unsuccessful smolts will enable us to modify hatchery practices, such as size at release, rearing strategy, or release site, to rear a more effective smolt and reduce negative interactions with wild steelhead produced in the subbasin.

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	X	Ecosystems
	Climate	X	Monitoring/eval.		Flow/survival
	Other		Resource mgmt		Fish disease
			Planning/admin.		Supplementation
			Enforcement		Wildlife habitat en-
			Acquisitions		hancement/restoration

Other keywords.

Hatchery-wild interactions, residualism, steelhead

Section 3. Relationships to other Bonneville projects

N/A

Section 4. Objectives, tasks and schedules

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Estimate emigration success of	a	PIT tag steelhead smolts, stratified

	Dworshak NFH smolts		by size, release site, rearing system
		b	Monitor emigration success via Ptagis database system
2	Estimate number of unsuccessful smolts	a	Multiple sampling of Clearwater mainstem and tributaries
		b	Estimate population using mark/recapture techniques (PIT tags used as mark)
3	Describe unsuccessful smolts	a	Monitor movement and growth of recaptured steelhead
		b	Determine sex and maturity level
		c	Determine rearing system and other pertinent rearing information
		d	Compare characteristics of successful versus unsuccessful smolts (analyze differences between groups using mark/recapture techniques, PIT tag data, coded-wire tag data)
		e	Assess relation between residualism and hatchery practices. If possible recommend changes in hatchery practices to reduce residualism
4	Determine if relations exist between residualism rate, persistence of residuals, and in-river conditions	a	Collect in-river conditions data on water flow and temperature
		b	Analyze relation of residualism to and to in-river conditions

Objective schedules and costs

Objective #	Start Date mm/yyyy	End Date mm/yyyy	Cost %
1	3/1999	2/2002	34.0
2	4/1999	2/2002	33.6
3	4/1999	2/2002	19.1
4	10/1999	2/2002	13.3

Schedule constraints.

Major milestones: Annual reports describing information obtained and data analysis will be distributed early each fiscal year following data collection. Annual reports will contain, at a minimum, emigration success, estimate of residual steelhead, and a summary of characteristics and capture time of residual steelhead. Final project report will include analysis of relations between residualism rate, persistence of residuals, hatchery practices, and in-river conditions. If possible, we will report changes in hatchery practices which can be used to reduce residualism of steelhead smolts.

Completion date.

FY 2002

Section 5. Budget

FY99 budget by line item

Item	Note	FY99
Personnel	0.5 FTE GS-11 biologist, 0.5 FTE GS-7 biologist, 0.5 GS-5 technician	34,300
Fringe benefits		4,400
Supplies, materials, non-expendable property	Snorkeling gear, CODED-WIRE TAG recovery, miscellaneous	1,000
Operations & maintenance	Truck, boat fuel, PIT tagging	3,800
Capital acquisitions or improvements (e.g. land, buildings, major equip.)	Electrofishing equipment	40,000
PIT tags	# of tags: 6,000	17,400
Travel		500
Indirect costs	USFWS overhead	31,900
Subcontracts		
Other		
TOTAL		133,300

Outyear costs

Outyear costs	FY2000	FY01	FY02	FY03
Total budget	80,700	80,700	25,000	
O&M as % of total	5%	5%	0%	

Section 6. Abstract

A substantial portion of hatchery steelhead released into the Clearwater basin do not successfully

emigrate. Region wide there is a growing concern hatchery steelhead may be having negative impacts on wild fish. Yet, little is known about characteristics of hatchery steelhead which tend to residualize. Our project goals are to maximize efficiency of hatchery operations and minimize impacts to wild fish in the basin. Specific objectives include characterizing successful smolts, unsuccessful smolts (or residuals), and comparing the differences. Sampling will be done by snorkeling and electrofishing. By sampling areas of the mainstem Clearwater and it=s tributaries for coded-wire tagged residuals (approximately 10% of production), we will obtain information on hatchery rearing system and techniques, and sex, maturity, and piscivory of steelhead which fail to emigrate. By PIT tagging all unmarked steelhead and utilizing mark/recapture techniques, we will estimate numbers and growth rates of residuals in the basin below Dworshak National Fish Hatchery. Length, weight, and emigration history will be obtained from all steelhead captured and released. Differences in hatchery practices will be tested using a chi-square statistic. Growth rates of emigrants and residuals will be compared by ANOVA. Other characteristics of residuals will be descriptive. Expected results include information leading to the production of more effective hatchery smolts, maximizing our hatchery program and minimizing negative impacts to the threatened wild steelhead and fall chinook stocks in the basin. We also expect to determine if unsuccessful smolts are residing in the Clearwater River or simply expiring after their release to the wild.

Section 7. Project description

a. Technical and/or scientific background.

The B-run steelhead program at Dworshak National Fish Hatchery (NFH) mitigates for spawning habitat lost when the completion of Dworshak Dam in 1973 denied access to this run=s historic spawning grounds. This genetically unique steelhead is maintained by Dworshak NFH by releasing 1.2 million smolts directly into the Clearwater River and another 1.1 million off-site. Clearwater Hatchery also releases over .5 million steelhead annually in the upper portions of the Clearwater basin. In many years, a high percentage of hatchery smolts never arrive at Lower Granite Dam 116 km downstream of the hatchery (Bigelow 1995a, Bigelow 1997). Some of these non-migrating B-run fish, termed residuals, have been found in tributaries cohabitating with wild A-run steelhead (Connor 1989, Bigelow 1995b, Schriever 1995, Bigelow and Bowen 1997). Residuals have also been found in the Clearwater River mainstem throughout the summer (Arnsberg et al. 1992, Cochnauer 1995, Cochnauer 1996, Cochnauer and Putnam 1997).
In order to operate the most effective hatchery program possible we need to closely evaluate hatchery practices. Proper size at release for steelhead smolts is an issue which has been debated by several management agencies recently (Schmitten et al. 1995, Rhine et al. 1997). Previous work has demonstrated that smaller fish in a hatchery cohort have a greater tendency to residualize than the general population (Whitesel et al. 1993, Jonasson et al. 1994, Bigelow 1995a, Jonasson et al. 1995, Schuck et al. 1995, Bigelow 1997). What is not known is the optimum size at release to minimize residualism. Residualism rate may also increase if release size is too large (Partridge 1985, Partridge 1986).

Various release sites and rearing strategies also need to be evaluated. Also unknown are the impacts our hatchery programs may be having on listed species in the basin. Both the Snake River fall chinook and steelhead are listed as threatened under the Endangered Species Act. Ten tributaries of the lower Clearwater River produce wild steelhead. Snake River fall chinook has also been documented spawning in the lower Clearwater River (Arnsberg et al. 1992). Effects of straying and residualizing juveniles released from the hatchery thus far have not been adequately evaluated. Although likely insignificant in northeast Oregon, Jonasson et al. (1996), did find larger residuals do prey on both juvenile chinook and steelhead. Data characterizing unsuccessful smolts will enable us to modify hatchery practices, such as size at release, rearing strategy, or release site, to rear a more effective smolt and reduce any negative interaction with wild steelhead and chinook which may be occurring.

b. Proposal objectives.

Our objectives are to:

1. Estimate emigration success of Dworshak National Fish Hatchery steelhead smolts, evaluated by size at release, release site, and rearing system.
2. Estimate number of unsuccessful smolts residing in the Clearwater Basin throughout the summer.
3. Describe hatchery-reared steelhead which are residualizing in the basin, by size, sex, sexual maturity, and relevant hatchery practices (e.g. release site, rearing system, release size, health history).

Annual reports, summarizing emigration success, estimate of residualism rate throughout the summer, and characteristics of residualized steelhead, will be produced. A final project report will summarize these data over the three year period and include a fourth objective:

4. Determine if a relation exists between in-river conditions (flow and temperature) to emigration success, residualism rate, and persistence of residual steelhead over time.

The proposed study will test these null hypotheses:

- Dworshak NFH B-run steelhead residualism rate is not related to hatchery practices such as size at release, release site, or rearing system;
- Steelhead residualism in the Clearwater River is not related to sex or maturity; and
- Dworshak NFH B-run steelhead residualism rate is not related to mainstem Clearwater River or tributary discharge or temperature during the migration period.

c. Rationale and significance to Regional Programs.

Columbia River Basin Fish and Wildlife Program

5.7A.4XThis project directly evaluates the extent of residualism occurring in the lower Clearwater River and its tributaries and attempts to determine hatchery practices contributing to residualism.

5.7B.17XAlthough not a specific objective of this project, fish health data for each raceway will be available and may lend insight into health impacts on residualism and emigration.

7.2A.6XThis project will document the extent of potential interactions between hatchery-reared and wild steelhead in the lower Clearwater River.

7.2DXOur data on emigration success and residualism rate will be correlated with in-river conditions such as water temperature and flow.

7.2D.1XResults from this research will allow modification of hatchery practices to rear a more effective smolt, thus increasing survival to adulthood.

7.2D.3XWe will be testing effects of size at release, release site, and rearing strategy on the emigration success and residualism rate.

NMFS= Biological Opinion on 1995-1998 Hatchery Operations in the Columbia River Basin, Consultation Number 383, April 5, 1995:

Section VIII, Number 1: Restricting lengths of hatchery steelhead released in the Snake River basin is listed as a reasonable and prudent alternative to reduce predation on and competition with listed stocks. This project will directly address the question of optimum size at release with respect to maximizing emigration and minimizing residualism (and therefore competition and predation). We will document numbers and length of hatchery steelhead which residualize.

Section X, Numbers 1, 3, and 4: Conservation recommendations listed under numbers 1, 3, and 4 will all be addressed by this project. Other hatchery practices besides size at release which will be directly evaluated include rearing strategies and release sites. We will examine stomachs of all sacrificed residual steelhead for evidence of predation.

Snake River Salmon Recovery Plan (page V-4-38) recommends evaluating strategies to reduce residualism, particularly size at release, in steelhead. This project directly evaluates size at release, rearing system, and release site strategies with the purpose of evaluating emigration success and effects on residualism.

NMFS= *Status review of west coast steelhead from Washington, Idaho, Oregon, and California* (1996) points out the need for information pertaining to questions addressed by this project. Interactions between hatchery and natural stocks within the ESU (page 171) will be addressed by documenting the extent of residualism occurring, characterizing the steelhead residualizing, and recommending practices to limit residualism, and therefore interactions, of hatchery steelhead. This project will also contribute to the knowledge base of the relation between anadromous and non-anadromous forms (possibly residualized) of *Oncorhynchus mykiss* (pages 70, 171).

Wy-Kan-Ush-Mi Wa-Kush-Wit relies heavily on hatchery programs to restore fisheries to the Snake River Basin. Included in their plan is increased hatchery steelhead production in the Clearwater Basin. In reference to hatchery production, *Wy-Kan-Ush-Mi Wa-Kush-Wit* (Volume I), page 5B-16, states: ADevelop experimental and monitoring programs in association with these projects to study the relationships between natural and supplemented components of populations.≅ Our project will contribute to the understanding of the relation between natural and >supplemented= populations. It will also aid in understanding effects of hatchery practices on emigration success.

d. Project history (for continuing projects).

N/A

e. Methods.

*Critical assumptions.*XCoded-wire tagged steelhead do not perform differently than non-coded-wire tagged steelhead. PIT tagging steelhead does not effect their behavior or performance. Electrofishing will yield adequate recaptures for a Jolly-Seber estimate. However, if this assumption is not met each year, we will still have valuable trend data.

*Sampling.*XSampling and data collection will be conducted on three levels: at the hatchery prior to steelhead releases, sampling in the mainstem Clearwater River beginning just prior to hatchery releases and continuing throughout the summer (April through August), and in tributaries downstream of release sites beginning just prior to hatchery releases and continuing until stream water temperatures increase beyond safe salmonid handling conditions (likely April through June). Emigration and growth (of subsampled fish) will be monitored through the Ptagis database information system. Field sampling will be conducted bi-weekly and no sampling will be done during hatchery releases or the following week.

Approximately 4,000 steelhead, stratified by size at release, release site, and rearing system, will be sampled at the hatchery. Each steelhead will be PIT tagged. Length will be measured on all steelhead and weight will be measured on a subsample of these steelhead. We expect very few of these fish will be resampled in the mainstem or tributary sampling. They will, however, provide excellent information on emigration success and timing based on the stratified factors.

Electrofishing will be employed to sample steelhead on the mainstem Clearwater River. Approximately 10% of all hatchery-released steelhead receive coded-wire tags. Steelhead collected which are coded-wire tagged will be sacrificed to determine hatchery rearing container, sex, maturity level, and stomach contents will be examined to determine piscivory. Length data will also be obtained from these fish. We expect to capture between 100 and 300 coded-wire tagged steelhead each season. These fish will provide detailed data on rearing strategy, egg take, fish health treatments, release site, and target release size.

All steelhead captured without a coded-wire tag will be measured for length and precociousness and checked for a PIT tag. Those not already PIT tagged will be PIT tagged. All of these steelhead will be released. Recaptured steelhead will provide population and growth data for those fish residing in the mainstem.

Tributaries will also be sampled using electrofishing. Steelhead captured in the tributaries will be handled the same as those captured in the mainstem. We expect to capture an additional 30 to 50 coded-wire tagged steelhead during tributary sampling. If time permits, range of residuals up tributaries will be documented.

Snorkeling may be used at selected sites to verify electrofishing distribution data.

*Analysis.*XChi-square tests will be used to test emigration success and residualism rate of hatchery steelhead based on rearing strategy, size at release, and release site. Growth rates of wild, residual, and emigrating steelhead will be compared using ANOVA. Descriptive characteristics of residuals will include sex, maturity, and piscivory.

The open population Jolly-Seber method will be used to estimate the number of residuals in the lower Clearwater River.

In-river conditions, including flow and temperature in the Clearwater River, will be correlated with residual rates and emigration success based on the stratifying factors over the three year period.

*Expected results.*XWe expect to determine if hatchery practices such as size at release, release site, and rearing strategy can be modified to reduce the number of residuals produced and improve emigration success. We expect to determine whether the majority of hatchery steelhead not successfully emigrating are residing in the Clearwater Basin or simply not surviving their release to the wild. We also expect to determine characteristics (sex, length, maturity, or pertinent hatchery practices) which tend to be exhibited by hatchery steelhead which residualize.

f. Facilities and equipment.

The Idaho Fishery Resource Office is a very well equipped field office for the U.S. Fish and Wildlife Service. We have adequate personnel, office support, computers, PIT-tagging and reading equipment and facilities, field sampling gear (including back-pack shockers, snorkel equipment, trucks) with the exception of an electrofishing boat, to complete this project. Purchase of an electrofishing boat will enable the project to efficiently, with minimal impact, sample the mainstem Clearwater River.

g. References.

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Section 8. Relationships to other projects

This project will address questions raised by work conducted by the U.S. Fish and Wildlife Service and Nez Perce Tribe in the Clearwater Basin (cited above as: Bigelow 1995a, Bigelow 1995b, Bigelow 1997, Bigelow and Bowen 1997). If this project is conducted, additional data can be collected by coordinating with Idaho Department of Fish and Game=s BPA Project *Gas bubble trauma monitoring in the Clearwater River drainage, Idaho.* All coded-wire tagged hatchery steelhead sampled for gas bubble trauma would be sacrificed to gain additional samples for our characterization of hatchery steelhead which tend to residualize.

The project would also complement information gathered by Oregon Department of Fish and Wildlife (cited above as Whitesel et al. 1993, Jonasson et al. 1994, and Jonasson et al. 1995) on residual hatchery steelhead and potential impacts to spring chinook salmon in the Grande Ronde and Imnaha basins.

Section 9. Key personnel

Principle Investigator: Patricia E. Bigelow, Fishery Biologist, GS-11
Project duties: Oversee field data collection, ensure proper PIT tagging of steelhead, analyze and report data and findings.
Qualifications: Fourteen years of field experience in fisheries biology/ management, including four years in the Clearwater Basin (Resume included)

Section 10. Information/technology transfer

Results will be disseminated annually via interim project reports. A final report, tying together all aspects of the project, will be produced after three years of data collection. Pertinent information on successful smolts, hatchery practices, and steelhead release information will be submitted to appropriate peer-reviewed journals for wider circulation.

Patricia E. Bigelow

EDUCATION

Master of Science MONTANA STATE UNIVERSITY **1991**
Major: Fish and Wildlife Management BOZEMAN, MONTANA
Bachelor of Science COLORADO STATE UNIVERSITY **1985**
Major: Fishery Biology *Minor:* Computer Science FORT COLLINS, COLORADO

EMPLOYMENT

Fishery Biologist **1994-Present**
U.S. FISH AND WILDLIFE SERVICE AHSAHKA, IDAHO

Investigate hatchery/wild interactions of steelhead in the Clearwater Basin. Work with Dworshak and Hagerman national fish hatcheries to evaluate products and successfulness of the program. Coordination Act Report for impacts of removal of four Lower Snake River dams on resident fish.

Fishery Biologist **1991-1994**
U.S. FISH AND WILDLIFE SERVICE RED BLUFF, CALIFORNIA

Evaluate effectiveness of spawning gravel restoration project for winter, spring, fall, and late fall chinook in the Sacramento River. Conduct chinook redd surveys using aerial and SCUBA techniques.

Fishery Biologist **1989-1991**
U.S. FISH AND WILDLIFE SERVICE OLYMPIA, WASHINGTON

Investigate hatchery/wild interactions of coho by conducting density estimates in supplemented and unsupplemented creeks in the Queets River basin. Monitor movements of spring chinook salmon to determine spawning habitat and timing. Work with Quinault, Quilcene, and Makah national fish hatcheries to evaluate products and successfulness of programs. Develop software for fast and easy retrieval of summarized information from coast wide escapement database.

Fishery Biologist **1987-1989**
CONTRACTED BY UNIVERSITY OF WYOMING BOZEMAN, MONTANA

Evaluate potential of scale pattern analysis to differentiate between groups of hatchery trout. Scale patterns were manipulated using varying feed and water temperature regimes.

EXPERTISE Bigelow has worked over eleven years as a fishery biologist plus several years as a fisheries technician in several field office. She has worked with steelhead in the Clearwater Basin since June, 1994 and has experience assisting hatchery personnel evaluate their programs at several hatcheries. She has an excellent knowledge of statistical procedures needed for proper data analysis and has been certified by the U.S. Fish and Wildlife Service to safely and properly operate boats and electrofishing equipment.

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