PART I - ADMINISTRATIVE

Section 1. General administrative information

Title of project

Snake River Fall Chinook Salmon Studies (Umbrella Proposal)

BPA project number: 20541
Contract renewal date (mm/yyyy): ☒ **Multiple actions?**

Business name of agency, institution or organization requesting funding
Nez Perce Tribe, U.S. Fish and Wildlife Service, U.S. Geological Survey-Biological Resources Division, National Marine Fisheries Service

Business acronym (if appropriate) NPT, USFWS, USGS-BRD, NMFS

Proposal contact person or principal investigator:

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NPPC Program Measure Number(s) which this project addresses
9102900: 7.5B.3, 7.3B.5
9302900: 5.0F, 5.8A.8
9403400: 7.3B.2, 7.4B.1, 7.5B.1, 7.5B.3
9801003: 7.3B.2
9801004: 7.0A, 7.3B.2, 7.5B.1
9801005: 7.3B, 7.3B.7, 7.4F, 7.5B

FWS/NMFS Biological Opinion Number(s) which this project addresses
9102900: NMFS BO RPA 13f, NMFS Consult. #0682
9302900: NMFS BO RPA 13f
9403400: Section 10, Permit 1134
9801003:
9801004: NMFS BO 1995-1998 Hatchery Ops. in the Col. R. Basin, Sec. X.
9801005: See subproposal.

Other planning document references
Wy-Kan-Ush-Mi Wa-Kush-Wi (CRITFC 1995):

1) Artificial Production Actions for the Snake River Mainstem Action 8.
2) Draft Plan (June 1995). Pages 3-20, 5B-25.
3) Volume 2. Page 97-99, 108-110.

Snake River Salmon Recovery Plan:
Ch. V, Sec. 4: p V-4-15; pV-4-22; p V-4-40; p V-4-42 4.7.d; p V-4-43 4.8.

NMFS RP 2.1.d.3

Clearwater Subbasin Plan:
p. 115

Short description
Implement Tribal and Federal Snake River fall chinook recovery plans by assessment and M&E of attributes and survival of natural juveniles, Lyons Ferry Hatchery yearlings and subyearlings, and returning adult Snake River fall chinook.

Target species
Snake River Fall Chinook Salmon (Oncorhynchus tshawytscha)

Section 2. Sorting and evaluation

Subbasin
Clearwater, Grande Ronde, Imnaha, Lower Snake Mainstem, Salmon

Evaluation Process Sort

CBFWA caucus	Special evaluation process	ISRP project type
Mark one or more caucus	If your project fits either of these processes, mark one or both	Mark one or more categories
☒ Anadromous fish ☐ Resident fish ☐ Wildlife	☐ Multi-year (milestone-based evaluation) ☐ Watershed project evaluation	☐ Watershed councils/model watersheds ☐ Information dissemination ☒ Operation & maintenance ☐ New construction ☒ Research & monitoring ☐ Implementation & management ☐ Wildlife habitat acquisitions

Section 3. Relationships to other Bonneville projects

Umbrella / sub-proposal relationships. List umbrella project first.

Project #	Project title/description

20541	Snake River Fall Chinook Salmon Studies
9102900	Life History and Survival of Fall Chinook Salmon in the Columbia R. Basin
9302900	Survival Estimates for Passage of Juv. Salmonids Through Dams and Reservoir
9403400	Assessing Summer and Fall Chinook Restoration in the Snake River Basin
9801003	Monitor and Evaluate Spawning Distribution of Snake R. Fall Chinook Salmon
9801004	M&E of Yearling Snake R. Fall Chinook Released Upstream of L. Granite Dam
9801005	Pittsburg Ldg., Capt. John Rapid, & Big Canyon Fall Chinook Acclimation Fac
20149	Develop Research Priorities For Fall Chinook In The Columbia River Basin

Other dependent or critically-related projects

Project #	Project title/description	Nature of relationship
8335000	Nez Perce Tribal Hatchery	Hatchery supplementation program to assist in the recovery of fall chinook in the Clearwater R. Subbasin.
9406900	A Spawning Habitat Model to Aid Recovery Plans for Snake River Fall Chinook	Investigates interactions influencing Columbia and Snake River spawning site selection to predict spawning habitat and improved production estimates for Snake River fall chinook.
9401806	Enhance Habitat for Spring & Fall Chinook, Summer Steelhead, and Bull Trout	Restore, protect, and enhance fish habitat, riparian, and upland areas along the Tucannon River, a tributary of the Lower Snake River.
9401807	Enhance Habitat for Fall Chinook, Steelhead, and Bull Trout	Enhance fish habitat along Pataha Creek, a tributary of the Tucannon (and Snake) River.
9603301	Supplement and Enhance the Two Existing Stocks of Yakima River Fall Chinook	Tests new supplementation techniques to increase natural production while maintaining genetic fitness to provide critical knowledge to resource managers throughout the Columbia River Basin.
8805301	Northeast Oregon Hatchery	Will provide hatchery supplementation program to assist in the recovery of fall chinook in the Grande Ronde and Imnaha sub-basins.

Section 4. Objectives, tasks and schedules

Past accomplishments

Year	Accomplishment	Met biological objectives?
	See individual subproposals	

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Supplement natural populations of Snake River fall chinook salmon with fish from Lyons Ferry Hatchery.	A	Transport 150,000 yearling fall chinook salmon from Lyons Ferry Hatchery to each of the following three acclimation facilities: Pittsburg Landing and Captain John on the Snake River, and Big Canyon on the Clearwater River, on or about March 1.
		B	Release fish at 10 fish/lb. after six weeks of acclimation on or about April 15.
		C	To mimic the natural life history of fall chinook salmon, acclimate and release subyearlings at Snake and Clearwater river acclimation facilities as recommended by fishery managers and the M&E group
2	Describe the rearing and early life history of natural and hatchery juvenile fall chinook salmon.	A	Capture and PIT tag natural and hatchery fall chinook to determine emergence timing, growth, subyearling holdover, emigration timing and movement patterns, and stock structure in the Snake River basin.
		B	Conduct rearing habitat surveys throughout the Snake River basin.
		C	Conduct weekly fish health assessments of 100 fish/week and document fish size and condition at each yearling acclimation facility.

3	Describe the migratory behavior of hatchery yearling and natural subyearling fall chinook salmon.	a	Release radio-tagged/PIT-tagged yearling fall chinook salmon at the Big Canyon acclimation facility and use mobile and fixed-site telemetry to track fish through the Clearwater River and Lower Granite Reservoir.
		b	Release natural subyearling fall chinook salmon at Lower Granite Dam that have been tagged with temperature-sensitive radio tags, and use mobile and fixed-site telemetry to track fish through Little Goose Reservoir.
		c	Analyze data collected in Tasks a and b to determine migration rates, thermal exposure histories, and identify where migrational delays are occurring.
4	Estimate smolt survival and identify factors affecting survival of hatchery and natural fall chinook salmon through free-flowing reaches and lower Snake River reservoirs.	a	Capture, PIT tag, and release natural and hatchery fall chinook at various locations in free-flowing rivers and reservoirs in the Snake River basin. PIT tag and release 10,000 yearlings at each acclimation facility.
		b	Compile PIT tag interrogation data from the PTAGIS database for use in survival estimation. Estimate survival of release groups using the SURPH model (Smith et al. 1994).
		c	Use correlation and multivariate analyses to examine relations between survival and emergence timing, growth, fish size, temperature, flow, migration timing, and rearing habitats.
5	Document the distribution of hatchery and natural fall chinook salmon redds, and describe migratory behavior of adults in the Snake River basin.	a	Conduct spawning surveys by helicopter and underwater video from October through December to determine fall chinook redd locations and numbers, spawn timing, and post-spawn carcass locations in the Snake River basin.
		b	Collect tags and biological information from post-spawning fall chinook carcasses (length, percent

			spawned, scales, genetic tissue samples).
		c	Use radio telemetry to describe the spawning distribution and migratory behavior of both supplemented hatchery and natural adult fall chinook salmon.
6	Determine adult escapement, smolt-to-adult survival, and spawning success of hatchery fall chinook salmon released for supplementation.	a	Enumerate the number of adults that originated from yearling and subyearling supplementation releases based on PIT-tag interrogations at Lower Granite Dam and CWT, PIT, and elastomer tag recoveries on the spawning grounds during redd surveys in objective 5
		b	Calculate the smolt-to-adult survival of hatchery fish based on recovery of tags and passage of hatchery adults past Lower Granite Dam.
		c	Enumerate the number of hatchery-origin carcasses on spawning grounds to determine the proportion of hatchery fish spawning in relation to natural fish, and the proportion of hatchery fish spawning in relation to the number passing Lower Granite Dam.

Objective schedules and costs

Obj #	Start date mm/yyyy	End date mm/yyyy	Measureable biological objective(s)	Milestone	FY2000 Cost %
				Total	0.00%

Schedule constraints

9102900: Environmental concerns such as floods; difficulty in obtaining hatchery fish.
9302900: Delays in installation of PIT tag interrogation systems at dams; availability of fish for PIT tagging due to low number or allocation to other uses.

9403400: Availability of Lyons Ferry subyearlings, environmental concerns such as turbidity for aerial redd counts
9801003: Low adult return rates, environmental concerns in field
9801004: Availability of Lyons Ferry yearlings; weather concerns for field activities
9801005: Availability of Lyons Ferry yearlings

Completion date
Dependent upon supplementation adult returns. Anticipate at least 5 life cycles will be required which would make the completion date 2022. However, juvenile and adult M&E results could dictate modifications to release sites and methods by 2001.

Section 5. Budget

FY99 project budget (BPA obligated):

FY2000 budget by line item

Item	Note	% of total	FY2000
Personnel		%0	
Fringe benefits		%0	
Supplies, materials, non-expendable property		%0	
Operations & maintenance		%0	
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		%0	
NEPA costs		%0	
Construction-related support		%0	
PIT tags	# of tags:	%0	
Travel		%0	
Indirect costs		%0	
Subcontractor		%0	
Other		%0	
TOTAL BPA FY2000 BUDGET REQUEST			$ 0

Cost sharing

Organization	Item or service provided	% total project cost (incl. BPA)	Amount ($)
		%0	
		%0	

		%0	
		%0	
Total project cost (including BPA portion)			$ 0

Outyear costs

	FY2001	FY02	FY03	FY04
Total budget				

Section 6. References

Watershed?	Reference
☐	Arnsberg, B.D., W.P. Connor, and E. Connor. 1992. Mainstem Clearwater River Study: assessment for salmonid spawning, incubation, and rearing. Nez Perce Tribe Department of Fisheries Resources Management Final Report to the BPA, Project 88-15.
☐	Bevan, D. and several other co-authors. 1994. Snake River Salmon Recovery Team: Final Recommendations to the National Maine Fisheries Service.
☒	Bjornn, T.C. and N. Horner. 1980. Biological criteria for classification of Pacific salmon and steelhead as threatened or endangered under the Endangered Species Act.
☐	Bugert, R.M., G.W. Mendel, and P.R. Seidel. 1997. Adult returns of subyearling and yearling fall chinook salmon released from a Snake River hatchery or transplanted downstream. North American Journal of Fisheries Management 14: 638-651.
☐	Muir, W.D., S.G. Smith, E.E. Hockersmith, M.B. Eppard, W.P. Connor, and B.D. Arnsberg. 1998. Passage and survival of hatchery subyearling fall chinook salmon to Lower Granite, Little Goose, and Lower Monumental Dams, 1996 in BPA Project 9102900.
☐	National Marine Fisheries Service. 1995. Proposed recovery plan for Snake River Salmon. U.S. Department of Commerce, National Oceanographic and Atmospheric Administration. Portland, Oregon.

PART II - NARRATIVE

Section 7. Abstract

The goal of these umbrella projects is to help recover Snake River fall chinook salmon populations (for ESA de-listing and harvest opportunities) through supplementation with Lyons Ferry Hatchery (currently) and Nez Perce Tribal Hatchery (future) Snake River stock fall chinook salmon and by providing real-time data and published, peer-reviewed information for adaptive management.

The objectives of this umbrella project are: 1) Supplement natural populations of Snake River fall chinook salmon with fish from Lyons Ferry Hatchery; 2) Describe the rearing and early life history of natural and hatchery juvenile fall chinook salmon; 3) Describe the migratory behavior of hatchery yearling and natural subyearling fall chinook salmon; 4) Estimate smolt survival and identify factors affecting survival of hatchery and natural fall chinook salmon through free-flowing reaches and lower Snake River reservoirs; 5) Document the distribution of hatchery and natural fall chinook salmon redds, and describe migratory behavior of adults in the Snake River basin; 6) Determine adult escapement, smolt-to-adult survival, and spawning success of hatchery fall chinook salmon released for supplementation.

BPA projects 9102900 and 9403400 are currently assessing fall chinook habitat, early life history attributes, and survival throughout the Snake River basin above Lower Granite Dam. BPA project 9302900 estimates survival of groups of all chinook through various reaches of the Snake River basin to partition mortality and identify areas of excessive mortality or migrational delay. Supplementation with Lyons Ferry Hatchery Snake River stock fall chinook yearlings began in 1996 at Pittsburg Landing. As of spring 1998 all three acclimation facilities (Pittsburg Landing, Capt. John Rapids, and Big Canyon) were operational under BPA project 9801005. In 1996-1998 monitoring and evaluation of supplementation yearlings was cooperative between BPA projects 9801004 and 9102900 along with some assistance from the Washington Department of Fish and Wildlife (WDFW) (USFWS-LSRCP funded). Beginning in 1999 BPA project 9801004 will conduct exclusive M&E operations at Pittsburg Landing and Big Canyon while assisting the WDFW at Capt. John Rapids. BPA projects 9403400 and 9801003, with a high level of interagency coordination, conduct research and M&E on adult fall chinook returning past Lower Granite Dam and through spawning.

While certain subprojects under this umbrella proposal will have earlier completion dates, as the National Marine Fisheries Service (NMFS) Proposed Recovery Plan Monitoring and Evaluation Strategy (V-4-15) states: "supplementation studies are long-term and may extend for 15 years and preliminary information should be available after five years." As stated under the "Completion Date" section above, supplementation (BPA project 9801005) may continue for five life cycles or more depending on adult return rates while preliminary results from juvenile (BPA project 9801004) and adult (BPA project 9801003) fall chinook from all three facilities in 2001.

Section 8. Project description

a. Technical and/or scientific background

Snake River fall chinook salmon were listed as "threatened" under the Endangered Species Act in 1992. The primary historical spawning range of fall chinook salmon extended into the uppermost accessible reaches of the Snake River basin. The Hells Canyon hydroproject complex limited spawning range to the areas below Hells Canyon dam.

Historical estimates of Snake River fall chinook abundance averaged 72,000 annually between 1938 and 1949 and declined to 29,000 from 1950 through 1959 (Bjornn and Horner 1980). The decline continued to an average of 12,700 annually at Ice Harbor Dam from 1964 through 1968, 3,400 at Lower Monumental Dam from 1969 through 1974, and only 600 at Lower Granite Dam from 1975 through 1980 (NMFS Proposed Recovery Plan). Recent abundance at Lower Granite Dam has ranged from a low of 78 fish in 1990 (Snake River Salmon Recovery Team 1994) to a high of 1,904 (as of 11/18) in 1998.

The FWP goal is "a healthy Columbia River Basin", in part, through ecological health assessment, support of native species in native habitat, assessment of program measures, and learning from implementation. The *NMFS Proposed Recovery Plan* recommends to "implement, with careful monitoring and evaluation, those actions that are necessary for the immediate conservation and recovery of the species...", in part, through improvements in downstream survival through flow and spill management, modification of dams and operations for juvenile and adult salmon passage, and controlled propagation to preserve stocks.

Lyons Ferry Hatchery was built in 1982 below Little Goose Dam on the Snake River as part of the Lower Snake River Compensation Plan. Lyons Ferry Hatchery fall chinook salmon stock was originally of Snake River origin and is currently the only hatchery program for Snake River fall chinook. The goal of the hatchery program is to "restore dam-related losses of wild steelhead and chinook salmon." The Snake River Salmon Recovery Team (SRSRT) (Bevan et al. 1994), *NMFS Proposed Recovery Plan* (1995), *Wy-Kan-Ush-Mi Wa-Kish-Wit*, and FWP specifically call for fall chinook supplementation with monitoring and evaluation above Lower Granite Dam.

The Recovery Team and NMFS recommended outplanting Lyons Ferry subyearling fall chinook salmon to mimic the life history of natural fall chinook in the Snake River above Lower Granite Dam. Conversely, the WDFW advocated outplanting yearling fall chinook based on higher smolt-to-adult survival from on-station releases (Bugert et al. 1997). An agreement between federal agencies, tribes, and state agencies gave the yearling program top priority at Lyons Ferry. An annual production goal of 900,000 yearlings was established, of which half are to be outplanted above Lower Granite Dam. Supplementation with yearlings in the Snake River above Lower Granite Dam (BPA Project 9801005) at the Pittsburg Landing Acclimation Facility began in the spring of 1996. The acclimation facility at Big Canyon Creek on the Clearwater River came on line in 1997 and a third facility at Captain John Rapids (Snake River) came on line in 1998.

Although yearling fall chinook is the primary age class being used for supplementation, research on natural and hatchery subyearlings is essential because returning adults will produce progeny with a subyearling life history strategy.

In 1988 the Nez Perce Tribe (NPT) began a study of fall chinook spawning, incubation, and rearing habitat (Arnsberg et al. 1992). The current study (BPA Project 9403400) is a

follow-up study on Clearwater River juvenile fall chinook life history and survival in relation to environmental variables (i.e. water releases from Dworshak Dam) along with evaluation of vacant and potential habitat in the upper Clearwater, Middle Fork Clearwater, South Fork Clearwater, Lochsa, Selway, Grande Ronde, Imnaha, and Salmon Rivers. The U.S. Geological Survey – Biological Resources Division (USGS-BRD) began a similar project (BPA Project 9102900) in 1991 focusing primarily on fall chinook in the mainstem Snake River. BPA Project 9302900 focuses on determining survival of both yearling and subyearling fall chinook salmon as they pass through lower Snake River dams and reservoirs.

Monitoring and evaluation of the yearling fall chinook released from the acclimation facilities began in 1996 and was funded under the Lower Snake River Compensation Plan through 1997. Direct funding from BPA began in 1998. Evaluation of the supplementation yearlings falls under two separate BPA projects. The yearlings are evaluated by the NPT under BPA Project 9801004 and the returning adults are evaluated under BPA Project 9801003.

b. Rationale and significance to Regional Programs

The Northwest Power Planning Council (NPPC) has identified a variety of programs to address the needs of fish and wildlife within the Columbia River basin. Section 2.2A states the FWP "…preference is to support and rebuild native species in native habitats, where feasible. This means that remaining fish and wildlife habitat should be protected and restored to promote production of native species, especially habitat that supports weak populations of fish and wildlife." All of the projects under this umbrella proposal are working toward in kind and in place mitigation for Snake River fall chinook salmon stocks. The overall goal for these umbrella projects is to enhance or reestablish naturally spawning populations of Snake River fall chinook salmon. FWP measure 7.4F states "…as weak stocks or populations of salmon and steelhead are identified and assessed, supplementation will be one option to consider to help rebuild these stocks."

BPA project numbers 9102900 and 9403400 relate directly to statements in section 7.5.B.3 of the 1994 Fish and Wildlife Program which recommends to "Continue to fund basic life history studies for Snake River fall chinook salmon", which should, "identify the range, limiting factors, effects of flow, temperature, spawning and rearing habitat, and migratory behavior."

BPA project number 9302900 relates directly to FWP section 5.8A.8 which states: "Continue to conduct research on the survival of hatchery, wild, and naturally spawning chinook salmon from headwater production areas to mainstem transport sites to determine the extent of mortality prior to transportation." Subproject 9302900 also relates to the 1995 NMFS Biological Opinion (Section 13f, Reasonable and Prudent Alternatives) which states: "The BPA shall evaluate juvenile survival during downstream migration and desired levels of flow augmentation."

The FWP (section 7.5B.1) also calls on fishery managers "…as quickly as possible and in consultation with the National Marine Fisheries Service, develop an experimental design for implementing, monitoring and evaluating supplementation of…Snake River fall chinook." Measures under section 7.3B all relate specifically to development and construction of portable acclimation facilities. These FWP measures relate directly to BPA projects 9801003, 9801004, and 9801005.

c. Relationships to other projects

The subprojects listed under this umbrella proposal are very complementary and cooperative, not only amongst themselves, but with other BPA projects and non-BPA projects. For more detail on individual subproject relationships please refer to the appropriate subproposal.

BPA projects 9102900 and 9403400 are highly complementary and similar projects. Project 9102900 is assessing fall chinook spawning habitat availability and quality, juvenile life history characteristics and emigration survival in the mainstem Snake River and project 9403400 is doing similar work in the remaining fall chinook production areas above Lower Granite Dam. Project cooperation includes: describing juvenile life history characteristics of wild and Lyons Ferry Hatchery supplemented fall chinook, emigration survival as it relates to environmental conditions, and conducting fall chinook aerial redd surveys and documenting hatchery fish contributions to the natural spawning population. The WDFW's cooperation is critical to the study as they produce and grow research fish to the appropriate size, and allow the use of their facilities at Lyons Ferry Hatchery for PIT tagging.

BPA projects 9102900, 9403400, and 9801004 all estimate survival of different groups of emigrating fall chinook from either point of release for hatchery fish or point of capture and release for natural fish down to the lower Snake River dams. Project 9302900 is very complementary to these studies by making the same type of survival estimates only in finer increments. This study partitions survival through individual dams and reservoirs identifies migrational delay whereas the other projects estimate survival over much longer and comprehensive stretches of river. From 1996-1998, project 9403400 worked cooperatively with the NMFS (9302900) and U.S. Fish and Wildlife Service (USFWS 9102900) to evaluate emigration survival of supplemented Lyons Ferry Hatchery fall chinook (Snake River stock) subyearlings in the Snake and Clearwater Rivers. A cooperative 1996 Annual Report has been submitted to BPA for publication (Muir et al. 1998).

BPA project 9801005 is responsible for operating the supplementation yearling fall chinook acclimation facilities. Acquisition of fall chinook broodstock for project 9801005 will rely on Lyons Ferry Hatchery. In addition, technology transfer and basinwide coordination of hatchery production efforts will make

revisions to annual programs. Close coordination with project 9801004 is mandatory. Project 9801004 conducts M&E activities on the supplementation yearlings.

Project 9801004 cooperates with WDFW (non-BPA project) and BPA project 9801005 staff for PIT tagging operations of the supplementation yearling fall chinook. Health assessments are performed by USFWS (subcontract under BPA project 9102900) during PIT tagging. Project 9403400 also works closely with NPT Project 9801004. These projects share equipment and personnel. Project 9403400 will also be working closely with NPT Project 9801005 at the portable acclimation facilities operated by the NPT. Research subyearling fall chinook salmon from Lyons Ferry Hatchery will be acclimated at the Big Canyon Creek Acclimation Facility on the Clearwater River during a six week period following the release of production yearling fall chinook.

Project 9801003 is a component of a larger monitoring and evaluation effort (BPA
project 9801004) that addresses the efficacy of releasing yearling fall chinook salmon
upstream of Lower Granite Dam. In addition to the USFWS, participants in this project include biologists from the Nez Perce Tribe, Washington Department of Fish and Wildlife, with assistance from University of Idaho, USGS, NMFS, U.S. Forest
Service, BLM, and Idaho Power Company. Project 9801003 will provide information to many related projects. First, this project will continue to provide information to augment studies on the life history of fall chinook salmon (BPA project 9102900). This project will also exchange data with the University of Idaho (BPA project 9204101) to augment data collected for evaluating migration of salmon and steelhead. Information will also be provided to BPA project 9406900, spawning habitat model for Snake River fall chinook, for comparative purposes.

d. Project history (for ongoing projects)

All ongoing projects under this “umbrella” grouping are either an evaluation of existing Snake River fall chinook spawning habitat availability and quality, study of wild fall chinook life history characteristics, spawning escapement, emigration survival through the mainstem dams, genetic monitoring, and/or evaluation of supplementation strategies using Lyons Ferry Hatchery fall chinook to help recover the natural spawning population. All projects includes coordination and collaboration between the Nez Perce Tribe, National Marine Fisheries Service, United States Geological Survey-Biological Resources Division, U.S. Fish and Wildlife Service, and Washington Department of Fish and Wildlife.

Earlier work on Snake River fall chinook included: Adult monitoring by the WDFW of Snake River fall chinook escapement to the basin and initiation of redds counts in the

mainstem Snake below Hell's Canyon Dam in 1986. Escapement monitoring was to assess progress towards the Lower Snake River Compensation Program goal of returning 18,300 adult hatchery fall chinook annually to the Snake River (Blankenship and Mendel 1997). Earlier BPA funded fall chinook studies included: The Mainstem Clearwater Study: Assessment for Salmonid Spawning, Incubation, and Rearing. This study was initiated in 1988 and documented fall chinook spawning in the lower reaches of the Clearwater River and described an abundance of quality mainstem river fall chinook spawning habitat (Arnsberg et al.1992). This project also recommended supplementation of Lyons Ferry Hatchery fall chinook in the lower Clearwater River to enhance the natural spawning population. Upstream Passage, Spawning, and Stock Identification of Fall Chinook Salmon in the Snake River, initiated in 1991, investigated adult fall chinook movements in the Snake River Basin and characterized the Snake River fall chinook genetic stock structure (Blankenship and Mendel 1997).

The following is a brief history of ongoing BPA funded fall chinook studies by project number. Project 9102900 (USGS-BRD), initiated in 1991, intensified and conducted more accurate fall chinook redd surveys in the mainstem Snake, Grande Ronde, and Imnaha Rivers. This project concentrated on estimating spawning habitat carrying capacity for the Snake River and data was used in the NMFS's Recovery Plan. The results of this project have been used in the decision making process to provide summer flows for subyearling chinook salmon in the lower Snake River and a model to show the effects of Hells Canyon Complex flows on fall chinook salmon spawning habitat. This information has been used to provide minimum flows during adult spawning and the winter and spring egg incubation and emergence periods in the Hells Canyon Reach. Genetic information was collected on natural Snake River fall chinook salmon confirming the uniqueness of this stock. Documentation of the early life history, physiology, and habitat requirements of fall chinook salmon and models to relate juvenile emigration rate to water temperature and flow have been produced. This project has shown that factors such as fish size and water temperature are important to subyearling chinook emigration rate and survival. Survival studies have shown that subyearling fall chinook released earlier in the summer survive at a higher rate and larger fish survive better than smaller fish. Radio telemetry work has shown that subyearling chinook salmon tagged at Lower Granite Dam migrate fairly rapidly to the forebay of Little Goose Dam and then can spend considerable time there before passing the dam.

Project 9403400 (NPT), initiated in 1994, is a study to evaluate potential and vacant summer and/or fall chinook salmon habitat in all potential production areas above Lower Granite Dam outside the mainstem Snake River. These production streams include the upper mainstem Clearwater River, its major tributaries (Middle Fork Clearwater, South Fork Clearwater, Lochsa, and Selway), and the lower sections of the Grande Ronde, Imnaha, and Salmon Rivers. From 1994-1998, this study investigated the movement patterns, growth rates, and survival of wild subyearling chinook salmon in the lower Clearwater River to Lower Granite Dam through the use of PIT tags. Results of this project has been used to moderate flow augmentation from Dworshak to enhance fall chinook survival in the lower Clearwater River as well as in the Snake River.

In cooperation with the NMFS and USFWS, emigration survival studies using Lyons Ferry Hatchery subyearling fall chinook began upstream of Lower Granite Dam in 1996. During 1997-1998, existing and potential chinook salmon spawning habitat in the lower Grande Ronde, Salmon, and Imnaha Rivers was quantified and qualified. Life history and survival information on wild fall chinook salmon in the Grande Ronde River was initiated in 1997.

Project 9302900 (NMFS) was initiated in 1993 with fall chinook survival studies (beginning in 1995) as only one objective of a larger study. This study provided estimates of survival for hatchery subyearling fall chinook salmon migrating through the Snake River in 1995 by transporting PIT-tagged Lyons Ferry Hatchery fish upstream and releasing them. In the 1996 annual report, relationships between smolt survival through the Snake and Columbia Rivers and flow, travel time, and dam operations using the estimates of survival obtained from 1993 through 1996 were explored. From 1996 through 1998, this study continued releases of PIT-tagged Lyons Ferry Hatchery subyearling fall chinook salmon above Lower Granite Dam in cooperation with the NPT and USFWS.

Project 9801005 (NPT), initiated in 1996 under the LSRCP and BPA in 1998, was the start of supplementation of the Snake River fall chinook above Lower Granite Dam. In 1996, the Pittsburg Landing Fall Chinook Acclimation Facility on the Snake River was operated by NPT and 114,000 fall chinook yearlings were acclimated and released. In 1997, both the Pittsburg Landing facility and the Big Canyon Creek Fall Chinook Acclimation Facility on the Clearwater River were operated and resulted in 147,000 yearlings and 451,000 yearlings and subyearlings released respectively. In 1998, Captain John Rapids Fall Chinook Acclimation Facility on the Snake River was operational and the three acclimation facilities resulted in releases of 336,000 yearlings. Funding for the construction of the three acclimation facilities was secured during deliberations by U.S. Congress over the FY 95 budget, during which they instructed the U.S. Corps of Engineers to construct, under the Lower Snake River Compensation Plan, final rearing and/or acclimation facilities for fall chinook salmon in the Snake River basin above Lower Granite Dam. This was to complement their activities and efforts in compensating for fish lost due to construction of the lower Snake River dams. The LSRCP was to fund the operations and maintenance of facilities constructed under the plan. In 1997 the decision was made for BPA to direct fund O&M for the facilities in the future.

Project 9801004 (NPT), initiated in 1996, was funded through the USFWS Lower Snake River Compensation Plan by BPA for 1996 and 1997. In 1998 direct BPA funding began. This study is to monitor and evaluate Lyons Ferry Hatchery yearling fall chinook released upstream of Lower Granite Dam at the three acclimation facilities. These three facilities are sufficient to acclimate a total of 450,000 Lyons Ferry Hatchery fall chinook (I 50,000 at each of the three facilities). This project is extensively coordinated with the WDFW and USFWS and a cooperative report is currently being compiled. Results from the 1996, 1997, and 1998 monitoring and evaluation of yearling fall chinook released at Pittsburg Landing on the Snake River were encouraging. Fish health assessments were favorable for fish releases, mortality during the six week acclimation period was low

(1998 mortality was somewhat higher due to high incidence of BKD), and 1997 survival rates from PIT tagged fish were higher than expected to the Snake and Columbia River dams. This project is also looking at adult returns and conducting a radio telemetry study in cooperation with Project 9801003 below.

Project 9801003 (USFWS), initiated in 1997 under LSRCP and directly through BPA in 1998, began monitoring fall chinook adult returns from the yearling supplementation efforts above Lower Granite Dam through the use of radio telemetry. There are 4 field components to this project: (1) radio-tag adult fish at Lower Granite Dam; (2) track fish throughout the Snake River and tributaries; (3) collect carcasses and spawned-out fish; and (4) conduct redd searches. Radio-tags was placed in adult fall chinook returning from releases of yearling and subyearling hatchery fish, and natural fish that were PIT-tagged as subyearlings in the Snake and Clearwater rivers. Fix telemetry stations were installed on the Snake, Clearwater, and lower Salmon River. In 1997, adult fall chinook were radio-tagged, most of which were one-ocean males returning from the 1996 release of hatchery yearlings at Pittsburg Landing. In 1998, a subsample of two-ocean adults from the Pittsburg Landing Releases and one-ocean adults from the Big Canyon Creek releases were tagged and followed to the spawning areas. This project is coordinated with the Nez Perce Tribe, Idaho Power Company, and U.S. Forest Service. This project will provide the information needed to determine if supplementation of the yearling fall chinook results in adults returning to the river of release and their contribution to the natural spawning.

e. Proposal objectives

The "comprehensive" objectives of this Snake River fall chinook salmon umbrella proposal are listed below. To investigate more detailed objectives, hypotheses, and assumptions please refer to individual subproposals.

Objective 1. Supplement natural populations of Snake River fall chinook salmon with fish from Lyons Ferry Hatchery.

Objective 2. Describe the rearing and early life history of natural and hatchery juvenile fall chinook salmon.

Objective 3. Describe the migratory behavior of hatchery yearling and natural subyearling fall chinook salmon.

Objective 4. Estimate smolt survival and identify factors affecting survival of hatchery and natural fall chinook salmon through free-flowing reaches and lower Snake River reservoirs.

Objective 5. Document the distribution of hatchery and natural fall chinook salmon redds, and describe migratory behavior of adults in the Snake River basin.

Objective 6. Determine adult escapement, smolt-to-adult survival, and spawning success of hatchery fall chinook salmon released for supplementation.

f. Methods

Please refer to individual subproposals for detailed methodology.

Scope

The scope of this work covers the freshwater life cycle of natural and hatchery produced fall chinook salmon including adult spawning, fry emergence, juvenile rearing, and seaward migration. The projects focus on gathering information on life history, habitat, and survival both natural and hatchery reared fall chinook to maximize supplementation success for the goal of restoring naturally spawning Snake River fall chinook salmon populations to levels acceptable to be de-listed from the ESA and to provide harvest opportunity.

Approach

Natural spawning populations of Snake River fall chinook salmon are being supplemented with fall chinook from Lyons Ferry Hatchery. Research and M&E projects evaluate early life history, habitat, survival, and adult spawning data in order to make present and future management decisions regarding supplementation strategies, flow augmentation, de-listing from ESA, and harvest. Juvenile life histories, emigration characteristics, and survival will be determined using PIT tag and radio telemetry technology. Adult migration and spawning attributes will be evaluated through radio telemetry, aerial and underwater video spawning ground surveys, and gathering biological information from post-spawn carcasses.

Objective 1. Supplement natural populations of Snake River fall chinook salmon with fish from Lyons Ferry Hatchery.

Task a. Transport 150,000 yearling fall chinook salmon from Lyons Ferry Hatchery to each of the following three acclimation facilities: Pittsburg Landing and Captain John on the Snake River, and Big Canyon on the Clearwater River, on or about March 1.

Task b. Release fish at 10 fish/lb. after six weeks of acclimation on or about April 15.

Task c. To mimic the natural life history of fall chinook salmon, acclimate and release subyearlings at Snake and Clearwater river acclimation facilities as recommended by fishery managers and the M&E group.

Objective 2. Describe the rearing and early life history of natural and hatchery juvenile fall chinook salmon.

Task a. Capture and PIT tag natural and hatchery fall chinook to determine emergence timing, growth, subyearling holdover, emigration timing and movement patterns, and stock structure in the Snake River basin.

Task b. Conduct rearing habitat surveys throughout the Snake River basin.

Task c. Conduct weekly fish health assessments of 100 fish/week and document fish size and condition at each yearling acclimation facility.

Objective 3. Describe the migratory behavior of hatchery yearling and natural subyearling fall chinook salmon.

Task a. Release radio-tagged/PIT-tagged yearling fall chinook salmon at the Big Canyon acclimation facility and use mobile and fixed-site telemetry to track fish through the Clearwater River and Lower Granite Reservoir.

Task b. Release natural subyearling fall chinook salmon at Lower Granite Dam that have been tagged with temperature-sensitive radio tags, and use mobile and fixed-site telemetry to track fish through Little Goose Reservoir.

Task c. Analyze data collected in Tasks a and b to determine migration rates, thermal exposure histories, and identify where migrational delays are occurring

Objective 4. Estimate smolt survival and identify factors affecting survival of hatchery and natural fall chinook salmon through free-flowing reaches and lower Snake River reservoirs.

Task a. Capture, PIT tag, and release natural and hatchery fall chinook at various locations in free-flowing rivers and reservoirs in the Snake River basin. PIT tag and release 10,000 yearlings at each acclimation facility.

Task b. Compile PIT tag interrogation data from the PTAGIS database for use in survival estimation. Estimate survival of release groups using the SURPH model (Smith et al. 1994).

Task c. Use correlation and multivariate analyses to examine relations between survival and emergence timing, growth, fish size, temperature, flow, migration timing, and rearing habitats.

Objective 5. Document the distribution of hatchery and natural fall chinook salmon redds, and describe migratory behavior of adults in the Snake River basin.

Task a. Conduct spawning surveys by helicopter and underwater video from October through December to determine fall chinook redd locations and numbers, spawn timing, and post-spawn carcass locations in the Snake River basin.

Task b. Collect tags and biological information from post-spawning fall chinook carcasses (length, percent spawned, scales, genetic tissue samples).

Task c. Use radio telemetry to describe the spawning distribution and migratory behavior of both supplemented hatchery and natural adult fall chinook salmon.

Objective 6. Determine adult escapement, smolt-to-adult survival, and spawning success of hatchery fall chinook salmon released for supplementation.

Task a. Enumerate the number of adults that originated from yearling and subyearling supplementation releases based on PIT-tag interrogations at Lower Granite Dam and CWT, PIT, and elastomer tag recoveries on the spawning grounds during redd surveys in Objective 5.

Task b. Calculate the smolt-to-adult survival of hatchery fish based on recovery of tags and passage of hatchery adults past Lower Granite Dam.

Task c. Enumerate the number of hatchery-origin carcasses on spawning grounds to determine the proportion of hatchery fish spawning in relation to natural fish, and the proportion of hatchery fish spawning in relation to the number passing Lower Granite Dam.

g. Facilities and equipment

See individual subproposals for detailed descriptions of facilities and equipment.

h. Budget

See individual subproposals for detailed budgets.

Section 9. Key personnel

See individual subproposals for key personnel details.

Section 10. Information/technology transfer

See individual subproposals for information/technology transfer details.

Congratulations!