Bonneville Power Administration
Fish and Wildlife Program FY99 Proposal Form

Section 1. General administrative information

Monitor and Evaluate the Spawning Distribution of Snake River Fall Chinook Salmon

Bonneville project number, if an ongoing project 9801003

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

Business acronym (if appropriate) USFWS

Proposal contact person or principal investigator:

Name	Aaron Garcia
Mailing Address	USFWS-Idaho Fishery Resource Office P.O. Box 18
City, ST Zip	Ahsahka, ID 83520
Phone	208-476-7242
Fax	208-476-7228
Email address	aaron_garcia@fws.gov

Subcontractors. List one subcontractor per row; to add more rows, press Alt-Insert from within this table

Organization	Mailing Address	City, ST Zip	Contact Name
Washington Department of Fish and Wildlife	401 S. Cottonwood Street	Dayton, WA 99328	Glen Mendel
Northwest Biological Science Center, USGS-Biological Resources Division	6505 N.E. 65th Street	Seattle, WA 98115	Linda Parks or R. Rodriguez

NPPC Program Measure Number(s) which this project addresses.
7.3B.2

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

Other planning document references.

If the project type is "Watershed" (see Section 2), reference any demonstrable support from affected agencies, tribes, local watershed groups, and public and/or private landowners, and cite available documentation.

The Snake River Salmon Recovery Plan (Task 4.1.d., page V-4-22) recommends that fisheries agencies help develop and implement supplementation programs, and through careful evaluation, determine if supplementation in areas upstream of Lower Granite Reservoir can assist in fall chinook recovery. In addition, the *Wy-Kan-Ush-Mi-Wa-Kish-Wit* (Volume II, page 98) recommends fall chinook supplementation actions upstream of Lower Granite Dam be monitored and evaluated.

Subbasin.

Snake River, Clearwater River, Imnaha River, Salmon River, Grande Ronde River

Short description.

Monitor and evaluate the spawning distribution of fall chinook salmon to determine if supplemented yearling hatchery fish spawn where intended, document redd distribution, and collect information on the spawning distribution of subyearling releases and natural fish.

Section 2. Key words

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.

spawning, radio-telemetry, fall chinook, redds, Snake River, out-planting, migration, fish passage

Section 3. Relationships to other Bonneville projects

9102900	Life History of Fall Chinook in Columbia River Basin	Provide data on the life history of fall chinook salmon in the Snake River basin
8335000	Nez Perce Tribal Hatchery - O&M	Provide data on spawning distribution in the Clearwater River
9403400	Assessing Summer/Fall Chinook Restoration in the Snake River Basin	Provide data on use of spawning habitat in the Snake River
9406900	Spawning Habitat Model for Snake River Fall Chinook	Provide data for comparisons between Snake and Columbia river fall chinook salmon habitat use
9801004	Monitoring and Evaluation of Yearling Snake River Fall Chinook	Provide data necessary to perform a thorough evaluation

Section 4. Objectives, tasks and schedules

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Describe the spawning distribution of hatchery fall chinook released as yearlings above Lower Granite Dam, and present data on the migration and spawning characteristics of subyearling releases and natural fish.	a	Radio-tag supplemented and natural adult fall chinook salmon at the Lower Granite Dam fish trap.
		b	Track radio-tagged fish using fixed stations.
		c	Track radio-tagged fish from airplane, helicopter, automobile, and boat.
		d	Collect data on fish origin from spawned-out fish and carcasses.
		e	Carry out Objective 1 using data collected in Tasks 1.a. - 1.d.
2	Describe the differences in spawning distribution within,	a	Using non-parametric statistics, determine if release groups spawn

	and between, release groups of yearling fall chinook salmon (and subyearlings if possible).		nearer their corresponding acclimation/release locations than in other river segments.
		b	Test for uniformity between the spawning distribution of fish returning at different ages.
		c	If possible, test for uniformity between the spawning distribution of fish released as yearlings and subyearlings.
		d	Carry out Objective 2 using data collected Tasks 2.a. - 2.c.
3	Document the distribution of fall chinook salmon redds above Lower Granite Dam.	a	Conduct redd searches over the Snake, Grande Ronde, and Imnaha rivers using a helicopter.
		b	Conduct redd searches in potential deep-water (>3m) spawning areas of the Snake River using underwater video cameras.
		c	Compile redd distribution data from all other redd searches conducted above Lower Granite Dam.
		d	Carry out Objective 3 using data collected in Tasks 3.a. to 3.c.
4	Conclude whether or not a widespread spawning distribution is achieved for fish released as yearlings, and supplemented fish spawn in areas normally used by fall chinook salmon.	a	Use the information obtained in Objectives 1-3, and existing information on spawning habitat distribution and redd distribution to carry out Objective 4.

Objective schedules and costs

1	10/1998	9/2002	35
2	10/1998	9/2002	15
3	10/1998	9/2002	45
4	10/1998	9/2002	5

Schedule constraints.

Progress may be slowed due to low return rates.

Completion date.

FY 2001

Section 5. Budget

FY99 budget by line item

Item	Note	FY99
Personnel		$53,440
Fringe benefits		$11,920
Supplies, materials, non-expendable property		$5,200
Operations & maintenance		$9,910
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		$0
PIT tags	# of tags:	
Travel		$7,180
Indirect costs		$30,068
Subcontracts		$7,800
Other		
TOTAL		$125,520

Outyear costs

Outyear costs	**FY2000**	**FY01**	**FY02**	**FY03**
Total budget	$126,046	$119,240		
O&M as % of total	8%	8%		

Section 6. Abstract

Yearling Snake River fall chinook salmon from Lyons Ferry Hatchery are to be acclimated and released above Lower Granite Dam for three consecutive years (1996-1998) to test whether or not supplementation can be used to artificially increase natural production. Three acclimation/release sites will be used in an attempt to widely distribute spawners, and ensure supplemented fish spawn in areas normally used by fall chinook salmon. In accordance with the Snake River Recovery Plan (4.1.d.), FWP (7.3B.2.), and *Wy-Kan-Ush-Mi-Wa-Kish-Wit* (Volume II, page 98), our project will monitor and evaluate the current release strategy with the goal of confirming whether or not spawning adults that were released as yearlings distribute throughout the areas normally used by fall chinook. We will use data collected from radio-tagged fish, spawned-out fish and carcasses, and redd searches, to achieve 4 objectives: (1) describe the spawning

distribution of fall chinook released as yearlings above Lower Granite Dam, and present data on the migration and spawning characteristics of subyearling releases and natural fish, (2) describe the differences in spawning distribution within, and between, release groups of yearling fall chinook salmon, and subyearlings, if possible, (3) document the distribution of fall chinook salmon redds above Lower Granite Dam, and (4) use the information we collected to conclude whether or not a widespread spawning distribution is achieved for fish released as yearlings, and supplemented fish spawn in areas normally used by fall chinook salmon. Based on the current release schedule, return timing, and expected return rates, this project will require five years (FY 1997-2001) to obtain conclusive results.

Section 7. Project description

a. Technical and/or scientific background.

In 1996, about 114,000 yearling fall chinook salmon from Lyons Ferry Hatchery were released in the Snake River. This release marked the beginning of an experiment to determine if supplementation can be used to artificially increase natural production above Lower Granite Dam. Additional releases of yearling hatchery fish were scheduled for the next two years and were to include up to 450,000 yearling fish divided among three release locations: (1) in the Snake River at Pittsburg Landing, 1997-1998; (2) in the Clearwater River near Big Canyon Creek, 1997-1998; and (3) in the Snake River between the Grande Ronde River and Asotin, 1998. Three release locations were used in an attempt to widely distribute spawning, and ensure supplemented fish spawn in suitable areas normally used by fall chinook salmon. Releases of subyearling fall chinook salmon were also scheduled, although the numbers to be released, and the release locations, are not well defined.

As called for in the Snake River Recovery Plan (4.1.d.), FWP (7.3B.2.), *and Wy-Kan-Ush-Mi-Wa-Kish-Wit* (Volume II, page 98), supplementation above Lower Granite Dam is being evaluated (WDFW et al. 1996). Our part in this evaluation is to conclude whether or not a widespread spawning distribution is achieved for fish released as yearlings, and supplemented fish spawn in areas normally used by fall chinook salmon. Our project will focus on releases of yearling fall chinook salmon, although we will collect and analyze comparable data from fish released as subyearlings, and natural fish, when possible.

The principal investigator (Aaron P. Garcia) participated in fall chinook salmon investigations from 1987-1990 (USFWS 1988, 1990, 1991), and in a study of Snake River fall chinook spawning requirements from 1991-1998 (Connor et al. 1993; Garcia et al. 1994a and b; Garcia et al. 1995). He recently worked on developing new techniques for counting redds in large rivers (Groves and Garcia, in press). In FY97, he started the project proposed in this document.

b. Proposal objectives.

Objective 1. Describe the spawning distribution of fall chinook salmon released as yearlings above Lower Granite Dam, and present data on the migration and spawning characteristics of subyearling releases and natural fish.

Outcomes from objective 1. Data gathered in Objective 1 will be used to determine if supplemented fish spawn in areas normally used by fall chinook salmon. Products in the final report, and/or the annual reports include: (a) graphs and statistics illustrating the number of radio-tagged fish spawning in each river segment for each release group, and for all supplemented fish; (b) graphs and statistics illustrating the number of radio-tagged fish spawning in each river segment for natural fish; and (c) a measure of fallback rates at Lower Granite Dam for supplemented and natural fall chinook salmon; (d) graphs showing the discharge in river reaches within the study area during the spawning period; and (e) a measure of migration rates through river segments.

Objective 2. Describe the differences in spawning distribution within, and between, release groups of yearling fall chinook salmon (and subyearlings if possible).

Outcomes from objective 2. Data gathered in Objective 2 will be used to determine if the current release strategy distributes spawning where intended. Products in the annual and/or final report include: (a) a statistical measure of whether or not release groups of fall chinook salmon spawn nearer their corresponding release locations than in other river segments; (b) a statistical measure of whether or not there is uniformity between the spawning distribution of fish released as yearlings and subyearlings; and (c) a statistical measure of uniformity between the spawning distribution of fish returning at different ages.

Objective 3. Document the distribution of fall chinook salmon redds above Lower Granite Dam.

Outcomes from objective 3. Data gathered in Objective 3 will be used to identify trends and changes in spawning distribution above Lower Granite Dam that may be linked to supplementation. The annual and/or final report will include annual and long-term results from aerial and underwater redd searches conducted above Lower Granite Dam, and include redd distribution, a measure of effort, and observation conditions.

Objective 4. Conclude whether or not a widespread spawning distribution is achieved for fish released as yearlings, and supplemented fish spawn in areas normally used by fall chinook salmon.

Outcomes from objective 4. Objective 4 addresses the overall goal of this project. In the final report we make a determination of whether or not the goal was achieved based on

the outcomes of Objectives 1-3.

c. Rationale and significance to Regional Programs.

As called for in the Snake River Recovery Plan (4.1.d.), FWP (7.3B.2.), and *Wy-Kan-Ush-Mi-Wa-Kish-Wit* (Volume II, page 98), supplementation above Lower Granite Dam is being evaluated (WDFW et al. 1996). One goal of this evaluation is to determine if hatchery adults return to the vicinity of their juvenile acclimation sites to spawn in areas normally used by fall chinook salmon. Our proposed project is designed to provide this information.

We will also provide in-season information on spawning distribution. Since we started redd searches in 1991, we have repeatedly provided in-season redd distribution data that was needed for resolving river flow issues, assessing the impacts of construction activities, and guiding fish production strategies. In addition, redd counts provided researchers and managers with information on the life history of fall chinook salmon, and the status of the fall chinook salmon population.
The project will produce a measure of fall-back at Lower Granite Dam. It is known that some adult fall chinook salmon that pass upstream of Lower Granite Dam "fall back" below the dam prior to spawning, and may repeat all or part of this cycle. However, the rate of this occurrence has not been well defined. Our project will advance our understanding of fall back and allow resource managers to better gage the accuracy of fish counts at Lower Granite Dam.

We will provide radio-tracking records to the University of Idaho as part of this project. The University of Idaho has agreed to provide us with the radio tags (used) we will need to conduct our proposed project. In exchange, we will monitor the movements of University-of-Idaho study fish.

In the course of this project, we will collect information on the migration and spawning locations of known natural fall chinook salmon. As part of project 9102900, Life History of Fall Chinook in the Columbia River Basin, natural fall chinook salmon are PIT tagged in the Snake and Clearwater rivers. By radio-tagging these fish when they return to spawn, we can provide unique information on the origin, race, and stray rates of natural fish.

d. Project history

Project reports and technical papers. - FY98 annual report to be completed by September 1, 1998.

Summary of major results achieved. - In FY97, five fixed telemetry stations were installed: three on the Snake River, one on the Salmon River, and one on the Clearwater River. Twenty-two adult fall chinook were radio-tagged, most of which were one-ocean

males returning from the 1996 release of hatchery yearlings at Pittsburg Landing. One-ocean fish were tagged primarily to test our tracking system. Although we are in the process of analyzing the data collected in 1997, a preliminary analysis has shown our current study design will allow us to successfully carry out the project.

Redd searches were conducted in FY97 using aerial and underwater search methods. We conducted 9 helicopter searches in cooperation with the Idaho Power Company, U.S. Forest Service, and Nez Perce Tribe. In addition, we conducted underwater searches of 43 potential deep-water spawning sites while assisting the Idaho Power Company with similar work. Redd counts from all searches above Lower Granite Dam were tabulated and distributed to all interested parties throughout the field season.

We obtained a NMFS permit (No. 1058) allowing us to handle natural fall chinook salmon as specified in the methods section of this funding proposal.

Adaptive management implications. - The current supplementation strategy is designed to distribute spawning in specific areas. This is being done using multiple release locations, at considerable expense. Our proposed project will provide the information needed to determine if this strategy actually works, and if not, what alternate release strategy might work.

Years underway. - We are on our second year of the project. The FY98 BPA draft budget is approved at this time. The project was started in FY 1997, with funding through the Lower Snake River Compensation Plan.

Past costs. - FY98 BPA draft budget is approved for $99,000.

e. Methods.

Scope

Our project was designed to determine if spawning location varies with release location for yearling fall chinook salmon acclimated at three locations above Lower Granite Dam. Depending on availability, we will also collect and analyze data on the spawning distribution of hatchery fall chinook salmon released as subyearlings, and returning adults of natural origin that were PIT tagged as subyearlings.

Approach

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. We will radio-tag adult returns from releases of yearling and subyearling hatchery fish, and natural fish that were PIT-tagged as subyearlings in the Snake and Clearwater rivers. Radio-tagged fish will be tracked

using fixed receivers and air and ground tracking methods. The spawning locations of supplemented fish will also be determined through the collection of spawned-out fish and carcasses. Redd searches will be used to locate spawned-out fish and carcasses, describe the overall spawning distribution, track radio-tagged fish, and confirm the spawning locations of radio-tagged fish. Data analysis is divided into 4 components: (1) determine the spawning location of individual fish using radio-tracking data; (2) group spawning-locations by fish origin (hatchery or natural), age at release, and release location; (3) determine if spawning distribution varies between groups; and (4) use the information we collected to conclude whether or not a widespread spawning distribution is achieved for fish released as yearlings, and supplemented fish spawn in areas normally used by fall chinook salmon. In the course of this work, we will also be able to provide information on fall-back rates at Lower Granite Dam, and travel rates and movement patterns in relation to water temperature and river flow.

Methods

Radio-tag adult fall chinook salmon (Objectives 1-4). - We will radio-tag about 50 adults returning from each acclimation/release site, and all natural fish that were PIT-tagged as subyearlings, over the course of the study period. More females than males will be tagged to improve our ability to determine spawning location (Scott and Crossman 1973, Schroder 1981). The gender of each fish will be determined using tissue samples (Subcontract with USGS-BRD DNA Lab). By collecting the spawning location data from at least 50 female fish from each release group we will ensure statistically significant results from comparisons in distribution between groups.

Handling and tagging will be carried out by NMFS personnel in the course of ESA-authorized trapping procedures (Jerry Harmon, NMFS, unpublished protocol). The procedure after fish enter the trap is to: 1) anesthetize the fish, 2) verify the PIT-tag code, 3) measure the fish, 4) remove 1 to 5 scales, 5) remove tissue for genetic analysis, 6) insert a 20-29-g Lotek radio-tag into the esophagus of fish ≥50 cm fork length, 7) allow the fish to recover, and 8) release the fish into the fish ladder.

Track radio-tagged fish using fixed stations (Objectives 1-4).- We will collect radio-tag passage records from USFWS and University of Idaho fixed-telemetry stations on the Snake River, on the lower and middle Clearwater River, and on the lower Grande Ronde and Salmon rivers.

Track radio-tagged fish from airplane, auto, and boat (Objectives 1-4).- Radio-tag location records will be collected in the Snake, Clearwater, and Grande Ronde rivers during periodic tracking surveys by airplane, automobile, and boat. Aerial tracking will be conducted by the Nez Perce Tribe (BPA project 9801004), auto tracking by WDFW (as a subcontract in our proposal), and boat tracking by USFWS.

Track radio-tagged fish, count redds, and locate carcasses and spawned-out fish,

from a helicopter, and using underwater video (Objectives 1-4).- We will conduct weekly flights over portions of the Snake, Grande Ronde, and Imnaha rivers, to collect data on redd locations using USFWS standard methods developed for the Snake River basin. In the process, we will collect radio-tag location records, and the location of spawned-out fish and carcasses.

Determine overall redd distribution upstream of Lower Granite Dam (Objective 3).- Redd distribution data from all searches conducted upstream of Lower Granite Dam will be compiled. The date, location, and number of redds observed for all comparable years will be tabulated. In addition, we will compile information of river flows during spawning periods and show in graphic form, and the counts of fall chinook salmon at Lower Granite, and present them in graphic form along with redd counts from comparable years.

Collect data from spawned-out fish and carcasses (Objective 2).- We will capture spawned-out fish using methods specified in NMFS Permit No. 850 (Issued to Lee Blankenship, WDFW, Olympia). The capturing procedure has 7 steps: 1) document the development of redds during weekly redd searches; 2) from a boat or shore, examine individual fish associated with redds that have been observed for > 14 days - about the amount of time it takes a fall chinook to complete a redd; 3) by observing the fish from a boat or shore, determine if the fish is *near natural death* - i.e., the fish is inactive, and fungal growth and fin deterioration are advanced, and the associated redd is fully developed; 4) capture fish that are near natural death by snagging them with a weighted treble hook and conventional fishing gear (rod and reel); 5) once captured, and while the fish is kept in the river, gently massage the side of the fish to determine if the fish is spawned-out; 6) if spawned out, check the fish for tags, remove 1 to 5 scales, measure the fish, remove tissue for genetic analysis, and return the fish to the river, 7) if the fish is not spawned out, return the fish to the river immediately, and unharmed.

Determine the spawning distribution of supplemented fish by release groups (Objectives 1-4).- Tag records from all sources will be entered into a central database (see Bjornn et al. 1994). Radio-tag records will be filtered by signal strength and code, and the movements of individual fish will be summarized by date, time, and location (river and river kilometer). Radio-tag locations will be presented for each radio-tagged fish on a line graph showing date on the x-axis and river kilometer on the y-axis (Pettit and Lindland 1979). We will then determine the spawning location of radio-tagged female salmon based on either direct observation of a radio-tagged fish on a redd, or based on the location (river, and river kilometer) a fish remained at an active spawning site for the longest period. Finally we will, summarize the spawning distribution of fish by category (origin, age at release, release location) and illustrate the results in a bar graph with spawning location (river segment) on the x-axis, and the number of fish by category on the y-axis.

Test for significant difference between spawning distributions by release groups

(Objective 4).- First we will partition river reaches based on fixed-station locations and determine the incidence of release groups in their corresponding release reach. We will then test for differences between release groups spawning within each release reach using the appropriate non-parametric statistical test (e.g. Wilcoxon matched-pairs signed-ranks test). Statistical analysis in the final report will be carried out cooperatively under subcontract with the University of Idaho, Department of Math and Statistics in FY01.

Prepare annual progress reports and a final report (Objectives 1-4).- Submit annual progress reports summarizing the work completed within and between years. Prepare a final report suitable for publication in a professional fisheries journal.

Limitations

The success of our project may be limited by low adult returns. We used the best available data to estimate return rates and planned our study accordingly. Based on the return of jacks in 1997 from the 1996 release at Pittsburg Landing, the fish are keeping pace with our estimates. It is likely releases of yearlings will continue past 1998. If this is the case, even if return rates are lower than expected we could successfully complete the project for yearling releases if we extended the study period.

f. Facilities and equipment.

Our proposed project will be operated out of the USFWS-Idaho Fishery Resource Office, Ahsahka, Idaho. All major equipment for the project was either purchased with funding from Lower Snake River Compensation Plan in FY97, or already existed. We have arranged to obtain free used radio tags from University of Idaho, and borrow fixed-station receivers from USGS-Biological Resources Division. The other major equipment at the Idaho Fishery Resource Office that will be used on this project include three, 22-24 ft., inboard jet boats, underwater video equipment, surveying equipment, radios, mapping software, hardware, five fixed radio-telemetry stations, GPS equipment, and desktop and laptop computers.

g. References.

Bjornn, T.C., J.P. Hunt, K.R. Tolotti, P.J. Keniry, and R.R. Ringe. 1994. Migration of adult chinook salmon and steelhead past dams and through reservoirs in the lower Snake River and into tributaries - 1992. Annual Report to U.S. Army Corps of Engineers, Walla Walla District, Walla Walla, Washington.

Connor, W.P., A.P. Garcia, H.L. Burge, and R.H. Taylor. 1993. Fall chinook salmon spawning in free-flowing reaches of the Snake River. Pages 1-29 *in* D.W. Rondorf and W.H. Miller, editors. Identification of the spawning, rearing, and migratory requirements of fall chinook salmon in the Columbia River basin. 1991 Annual Report to Bonneville Power Administration, Contract DE-AI79-

91BP21708, Portland, Oregon.

Garcia, A.P., W.P. Connor, and R.H. Taylor. 1994. Fall chinook spawning ground surveys in the Snake River. Pages 1-21 *in* D.W. Rondorf and K.F. Tiffan, editors. Identification of the spawning, rearing, and migratory requirements of fall chinook salmon in the Columbia River basin. 1993 Annual Report to Bonneville Power Administration, Contract DE-AI79-91BP21708, Portland, Oregon.

Garcia, A.P., W.P. Connor, and R.H. Taylor. 1994. Fall chinook spawning ground surveys in the Snake River. Pages 1-19 *in* D.W. Rondorf and W.H. Miller, editors. Identification of the spawning, rearing, and migratory requirements of fall chinook salmon in the Columbia River basin. 1992 Annual Report to Bonneville Power Administration, Contract DE-AI79-91BP21708, Portland, Oregon.

Garcia, A.P., W.P. Connor, R.D. Nelle, C. Eaton, R.S. Bowen, P.E. Bigelow, and E.A. Rockhold. 1995. Fall chinook spawning ground surveys in the Snake River, 1994. Pages 1-17 *in* D.W. Rondorf and K.F. Tiffan, editors. Identification of the spawning, rearing, and migratory requirements of fall chinook salmon in the Columbia River basin. 1994 Annual Report to Bonneville Power Administration, Contract DE-AI79-91BP21708, Portland, Oregon.

Groves, P.A., and A.P. Garcia. (In press). Two carriers used to suspend an underwater video camera from a boat. North American Journal of Fisheries Management.

Pettit, S.W., and R.L. Lindland. 1979. Clearwater River steelhead investigations. Idaho Department of Fish and Game. Job performance report, Project F-73-R-1, 1 March 1978 to 28 February 1979.

Schroder, S.L. 1981. The influence of intra sexual competition on the distribution of chum salmon in an experimental stream. Salmon and trout migratory behavior symposium, E.L. Brannon and E.O. Salo, Editors. June 1981.

Scott, W.B., and E.J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada, Ottawa.

USFWS, 1988. Fish passage action program for Red Bluff Diversion Dam. Final report on fishery investigations. Report no. FR1/FAO-88-19, USFWS, Portland, Oregon.

USFWS, 1990. Evaluation of the measure of raising the Red Bluff Diversion Dam gates on improving anadromous salmonid fish passage based on observations of radio-tagged fish. Report no. AFF1-FAO-89-16. USFWS, Portland, Oregon.

USFWS, 1991. Evaluation of the measure of raising the Red Bluff Diversion Dam gates

on improving anadromous salmonid fish passage based on observations of radio-tagged fish. Report no. AFF1-FAO-90-10. USFWS, Portland, Oregon.

WDFW (Washington Department of Fish and Wildlife), Nez Perce Tribe, and U.S. Fish and Wildlife Service. 1996. Statement of work for the 1996 through 2004 program for monitoring and evaluation of Snake river fall chinook salmon outplanted from the Pittsburg Landing acclimation facility. Lower Snake River Compensation Plan, Boise, Idaho.

Section 8. Relationships to other projects

Our proposed project 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. The information we will provide is critical to the overall evaluation, since a complete evaluation is not possible without knowledge of the spawning distribution of supplemented fish. 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.

Our project will provide information to many related projects. First, we will continue to provide information to augment studies on the life history of fall chinook salmon (BPA project 9102900). Information on fall chinook salmon redd distribution is needed for this study to determine emergence timing and allocating sampling efforts. In addition, we will provide the only source of information on the spawning locations of adult returns from these study fish. Also, we will 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.

Section 9. Key personnel

The principal investigator, Aaron Garcia, will oversee all facets of the project. Personnel from the Idaho Fishery Resource Office (William P. Connor, Howard Burge), Nez Perce Tribe; Bill Arnsberg, Steve Rocklage), WDFW (Glen Mendel), and University of Idaho (Kirk Steinhorst), will participate in minor project components.

Aaron P. Garcia

Title: Fishery Biologist, GS-11 **Employer:** U.S. Fish and Wildlife Service (USFWS)

Education: B.S. in Fisheries Biology - University of California, Davis, CA., Completion Date - June 1986.

Current responsibilities:
Oversee all phases of the proposed project (in progress since FY97). Supervise three field biologists and

technicians. Manuscript preparation for BPA Project 9102900, life history characteristics of fall chinook salmon. Motorboat operation safety instructor.

Employment:
Fishery Biologist, GS-11 - USFWS, Idaho Fishery Resource Office, Ahsahka, ID, 1991-present.

Fishery Biologist, GS-09 - USFWS, Little White Salmon National Fish Hatchery, Cook, WA, 1990-1991.

Fishery Biologist, GS-07 - USFWS, Northern Central Valley Fishery Resource Office, Red Bluff, CA, 1988-1990.

Biological Technician, GS-05 - USFWS, Northern Central Valley Fishery Resource Office, Red Bluff, CA, 1987-1988.

Graduate Student Assistant, California Department of Fish and Game, Red Bluff, CA, 1986-1987.

Expertise:
For over 10 years now I have been working on projects involving anadromous fish migration and spawning in large western rivers. In that time I have conducted all phases of radio-telemetry studies from welding fixed-station housings to processing data and writing reports. This experience has given me the expertise to successfully carry out the project proposed in this funding request.

Selected Reports:

Garcia, A.P., W.P. Connor, R.D. Nelle, C. Eaton, R.S. Bowen, P.E. Bigelow, and E.A. Rockhold. 1995. Fall chinook spawning ground surveys in the Snake River, 1994. Pages 1-18 *in* D.W. Rondorf and K.F. Tiffan, editors. Identification of the spawning, rearing, and migratory requirements of fall chinook salmon in the Columbia River basin. 1994 Annual Report to Bonneville Power Administration, Contract DE-AI79-91BP21708, Portland, Oregon.

Garcia, A.P., W.P. Connor, and R.H. Taylor. 1994. Fall chinook spawning ground surveys in the Snake River. Pages 1-21 *in* D.W. Rondorf and K.F. Tiffan, editors. Identification of the spawning, rearing, and migratory requirements of fall chinook salmon in the Columbia River basin. 1993 Annual Report to Bonneville Power Administration, Contract DE-AI79-91BP21708, Portland, Oregon.

Garcia, A.P., W.P. Connor, and R.H. Taylor. 1994. Fall chinook spawning ground surveys in the Snake River. Pages 1-19 *in* D.W. Rondorf and W.H. Miller, editors. Identification of the spawning, rearing, and migratory requirements of fall chinook salmon in the Columbia River basin. 1992 Annual Report to Bonneville Power Administration, Contract DE-AI79-91BP21708, Portland, Oregon.

Groves, P.A., and A.P. Garcia. (In press). Two carriers used to suspend an underwater video camera from a boat. North American Journal of Fisheries Management.

Section 10. Information/technology transfer

The final report for this project will be submitted to a professional fisheries journal for publication (e.g. North American Journal of Fisheries Management). In addition, work progress will be presented at fall chinook coordination meetings, and other technical workshops.