Bonneville Power Administration
Fish and Wildlife Program FY99 Proposal Form

Section 1. General administrative information

Captive Rearing Initiative for Salmon River Chinook Salmon

Bonneville project number, if an ongoing project 9700100

Business name of agency, institution or organization requesting funding
Idaho Department of Fish and Game

Business acronym (if appropriate) IDFG

Proposal contact person or principal investigator:

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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
Idaho Dept. Of Fish and Game 9801002	1414 E. Locust Ln.	Nampa, ID 83686	Pete Hassemer
National Marine Fisheries Service 9606700	Box 130	Manchester, WA 98353	Tom Flagg
National Marine Fisheries Service 8909600	2725 Montlake Blvd. East	Seattle, WA 98112	Robin Waples

NPPC Program Measure Number(s) which this project addresses.
7.4D.2, 7.4E

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

N/A

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.

1) NMFS pre decisional Snake River Salmon Recovery Plan, Chapter 7 (Artificial Production). Discusses intervention techniques to maintain or boost naturally spawning populations. This discussion includes numerous references to the maintenance of "captive reserves" for some populations. Strategies A, B, and C (pages 106 and 107) specifically reference the use of artificial reserves or captive populations to accomplish spring/summer chinook objectives identified in the plan.

2) NMFS T.M. #NWFSC-2 Pacific Salmon and Artificial Propagation Under the Endangered Species Act. Discussion of the utility of hatchery conservation programs under the Endangered Species Act. The memorandum also states the viability of the comprehensive Snake River spring/summer chinook salmon ESU is dependent on the continued existence of the population units that comprise it.

3) NWPPC Return to the River. Chapter 8, Conclusion 10 under Hatcheries identifies hatchery programs for severely depressed stocks important sources of genetic information. Evaluations called for by the ISG are essential and active components of this program and of the M & E component (9801002).

Subbasin.

Salmon River (Lemhi River, East Fork Salmon River, and West Fork Yankee Fork Salmon River)

Short description.

Establish captive rearing protocols for Salmon River Chinook salmon. Rear juveniles to maturation, release mature adult chinook back into streams of origin. Monitor spawning success of released adults.

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	X	Population dynamics
	Oceans/estuaries	X	Research		Ecosystems
	Climate	+	Monitoring/eval.		Flow/survival
	Other		Resource mgmt	+	Fish disease
			Planning/admin.	+	Supplementation

_____ Enforcement _____ Wildlife habitat en-
_____ Acquisitions hancement/restoration

Other keywords.

Stock structure, hatchery-wild interactions, captive propagation, captive brood stock, metapopulation.

Section 3. Relationships to other Bonneville projects

Project #	Project title/description	Nature of relationship
9801002	Salmon River Chinook Salmon M & E	IDFG monitoring and evaluation of captive rearing program Salmon River chinook salmon
9305600	Assessment of Captive Brood stock Techniques	NMFS guidance for the refinement and use of captive brood stock technology for Pacific salmon.
9606700	Manchester Captive Brood stock O & M	Duplicate Salmon River chinook salmon rearing program at NMFS Manchester Experimental Station.
9107200	Redfish Lake Sockeye Salmon Captive Brood stock Program	IDFG program at Eagle Fish Hatchery to establish captive brood stocks of Redfish Lake sockeye salmon.
8909600	Genetic Monitoring and Evaluation of Snake River Salmon and Steelhead	NMFS protein gel electrophoretic analysis of brood stock and wild chinook salmon.

Section 4. Objectives, tasks and schedules

Objectives and tasks

Obj 1,2, 3	Objective	Task a,b,c	Task
1	Produce adult chinook salmon with appropriate morphological, physiological, and behavioral characteristics to satisfy program needs.	a	Develop facilities and propagation technology to attain objective.
1		b	Document propagation protocols including: formulation of feed used, feed rates, rearing temperatures, rearing densities, rearing container sizes, handling

			frequencies, disease treatments, and transportation methods.
1		c	Track growth and development in relation to objective.
1		d	Document maturation events.
1		e	PIT tag and visual implant tag all captive chinook to facilitate population isolation and tracking.
1		f	Cryopreserve milt from male captive chinook salmon as needed to preserve future options.
2	Technology transfer.	a	Participate in Chinook Salmon Captive Propagation Technical Oversight Committee process.
2		b	Prepare annual reports to satisfy NMFS Permit 1010 reporting requirements.
2		c	Prepare annual reports to satisfy BPA reporting requirements.
2		d	Participate in seminars, workshops and professional meetings.

Objective schedules and costs

Objective #	Start Date mm/yyyy	End Date mm/yyyy	Cost %
1	10/1998	09/1999	80%
2	10/1998	09/1999	20%
		TOTAL	100%

Schedule constraints.

No known constraints - Start/stop dates identified above reflect FY99 only.

Completion date.

2005 is the expected end date for the current demonstration project. The project may continue if the demonstration process is successful and leads to a recovery program.

Section 5. Budget

FY99 budget by line item

Item	Note	FY99
Personnel		$26,935
Fringe benefits		$9,319
Supplies, materials, non-expendable property		$10,300
Operations & maintenance		$32,010
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		$41,200
PIT tags	# of tags: 500	$1,450
Travel	Includes all costs associated with travel, field per diem, and lodging.	$5,550
Indirect costs	21.3% of all costs except capital aquis.	$18,225
Subcontracts		
Other		
TOTAL		$144,989

Outyear costs

Outyear costs	FY2000	FY01	FY02	FY03
Total budget	$145,000	$145,000	$145,000	$145,000
O&M as % of total	22%	22%	22%	22%

Section 6. Abstract

To maintain Snake River chinook salmon metapopulation or stock structure, the within and among population variability, IDFG initiated a captive rearing program for populations at high risk of extinction. Captive rearing is a short term approach to species preservation. The main objective of the captive rearing approach is to avoid demographic and environmental risks of cohort extinction; maintaining the genetic identity of the breeding unit is an important but secondary objective. The strategy of captive rearing is to prevent cohort collapse of the specified target populations by providing captively reared adult spawners to the natural environment, which, in turn, maintain the continuum of generation to generation smolt production. Each generation of smolts, then, provides the opportunity for population maintenance or increase should environmental conditions prove favorable for that cohort.

The primary goal of this project is to develop the technology for captive

propagation of chinook salmon that satisfy program needs. This is a demonstration project as identified in section 7.4D.2 of the Council's Fish and Wildlife program. Project 9801002 (IDFG) provides for some monitoring and evaluation during the captive rearing phase. The most important element of 9801002 is to monitor and evaluate the post-release behavior and spawning success of mature adult salmon produced through captive rearing. Success of the overall captive rearing program is dependent on the development of rearing technology and the biological performance of fish produced in the program.

The year 2005 is the expected end date for the current demonstration project. The project may continue if the demonstration process is successful and leads to a recovery program.

Section 7. Project description

a. Technical and/or scientific background.

The combined counts of returning spring and summer chinook salmon to the Snake Basin were the lowest on record in 1994 (4,475) and again in 1995 (2,787). For perspective, from 1962 to 1971 an average of 148,000 adult anadromous salmonids per year crossed Ice Harbor Dam into the Snake River Basin. Most of these returnees were produced in and destined for production areas located upstream of Lower Granite Dam. The spring/summer component of the run was comprised primarily of wild fish and accounted for about 40 percent of the run, an average of 59,900 fish annually. In contrast, 3,915 adult spring and summer chinook salmon passed upstream of Lower Granite Dam in 1994, including 1,517 and 305 naturally produced springs and summers, respectively.

IDFG's long-term objective for salmon management is to maintain Snake River salmon populations at levels that will provide sustainable harvest (IDFG 1992). Restoring the number of returning chinook salmon to historic levels is a prerequisite to this condition. Artificial propagation of spring and summer chinook salmon in the Salmon River basin, through Lower Snake River Compensation Plan (LSRCP) and Idaho Power Company hatcheries, was initiated to compensate for lost production and productivity caused by the construction and operation of private and federal hydroelectric facilities in the Snake River. The mitigation approach was to trap, spawn, and rear a portion of the historically productive local brood stock to produce a large number of smolts (Bowles 1993). When chinook salmon trapping began in 1981 as part of the LSRCP, it was assumed that enough chinook salmon adults would return for harvest and continued hatchery production needs. It was also assumed that hatchery programs would not negatively impact the productivity or genetic viability of target or other populations, and that natural populations would remain self-sustaining even with hydropower dams in place. In reality, productivity (survival rates) of wild Snake River chinook salmon declined abruptly with completion of the federal hydroelectric system by the mid-1970's (Petrosky and Schaller 1994). Survival rates used in the hatchery mitigation program models were substantially overestimated. Hence, hatchery programs have been unable to

mitigate for the dams or stem the decline of target populations, and numbers of naturally produced salmon declined at various rates throughout the Snake River Basin. Spring/summer chinook salmon returns have been insufficient to meet artificial and natural smolt and adult production predictions, much less provide a consistent harvestable surplus of adults.

The only way to prevent further decline and secure eventual recovery of Snake River stocks is to provide historical levels of survival in the migration corridor. Pending changes in the mainstem hydroelectric system, our immediate challenge becomes one of preserving the existing metapopulation structure of Snake River chinook salmon, so future recovery actions are possible. The listed Snake River spring/summer chinook salmon evolutionary significant unit (ESU) consists of 38 subpopulations (i.e. breeding units or stocks), 28 of which exist in the Salmon River Drainage (Schmitten et al. 1997). Preserving the current stock or metapopulation structure is consistent with the pre decisional Snake River Salmon Recovery Plan (Schmitten et al. 1997), and also supports the Council's goal of maintaining biological diversity while doubling salmon and steelhead runs as identified in their Fish and Wildlife Program (FWP). Metapopulation structure (or biodiversity) can be maintained by preventing local or demographic extinctions.

The IDFG initiated a captive rearing approach for populations at high risk of extinction to maintain metapopulation structure. Captive rearing is a short term approach to species preservation. The main objective of the captive rearing approach is to avoid demographic and environmental risks of cohort extinction; maintaining the genetic identity of the breeding unit is an important but secondary objective. The strategy of captive rearing is to prevent cohort collapse of the specified target populations by providing captively reared adult spawners to the natural environment, which in turn, maintain the continuum of generation to generation smolt production. Each generation of smolts, then, provides the opportunity for population maintenance or increase should environmental conditions prove favorable for that cohort. The issue paper "Recovery Plan Recommendations for Hatchery Production" (IDFG 1994), provides the background, objectives, options, and approach relative to the captive rearing concept.

The captive rearing approach was developed primarily as a way to maximize the number of breeding units that could be addressed while minimizing intervention impacts. Under these guidelines we collect only enough juveniles from the target populations to provide what we feel are adequate spawners, about 20, to meet our demographic spawner goals. (According to members of the Snake Basin Sockeye Technical Oversight Committee, it is not unreasonable to assume that 20 fish could encompass 95 percent of the genetic diversity of the population.) The appropriate number of juveniles to collect remains somewhat speculative at this time because of the uncertainty associated with the ability of the captive rearing approach to produce adults with desired characteristics for release into the wild (Fleming and Gross 1992, 1993: Joyce et al. 1993: Flagg and Mahnken 1995a). Juveniles would be collected each year from cohorts of low resiliency populations, those not expected to return at least 10 spawning pair to their respective spawning areas. In order for this approach to provide the desired outcome we must be able to produce an adequate number of adults with the proper morphological, physiological, and behavioral attributes to successfully spawn and produce viable

offspring in their native habitats. The successful evaluation of the captive rearing approach would require the synchronous development of successful propagation techniques while the fish are in captivity.

Little scientific information regarding captive propagation techniques for Pacific Salmonids was available at the inception of this program. This lack of information was also acknowledged in the Council's FWP measure 7.4d.1, calling for a scoping study to identify captive brood stock research needs. To address measure 7.4d.1, Flagg and Mahnken (1995b) completed a review of the status of captive brood stock technology.

Measure 7.4d.2 of the FWP called for funding captive brood stock demonstration projects. Following Flagg and Mahnken's (1995b) work and to address the need identified in Measure 7.4d.2, the IDFG captive rearing program was initiated, in part, as such a demonstration project. Monitoring and evaluation of this project is accomplished through BPA project #9801002. The primary goal of 9801002 is to provide monitoring and evaluation during the rearing phase, and the post-release phase including; behavior and spawning success of mature adult salmon produced through captive rearing. The primary goal of this project (#9700100) is to develop the technology for captive propagation of chinook salmon to satisfy program needs. Success of the overall captive rearing program is dependent on the development of rearing technology and the biological performance of fish produced in the program.

In addition to being considered a demonstration project for captive propagation technology, the IDFG program also addresses population dynamics and population persistence concerns. The population level concerns may be further defined as 1) maintaining a minimum number of spawners in high risk populations, and 2) maintaining metapopulation structure by preventing local extinctions. These population level concerns were addressed by identifying those populations at the highest risk of extinction.

We have prioritized population for hatchery preservation actions based on assumed relative importance to the Snake River spring/summer chinook salmon ESU, assumed retention of native population characteristics, estimated imminent extinction risk, and risk of exposure to experimental techniques. High priority populations have: 1) annual escapements of less than 20 fish; 2) adequate habitat for successful spawning and rearing; and 3) poor resiliency from the last survival bottleneck (1979-1984). An analysis of population status, history, isolation and resiliency determined that several spring and summer chinook salmon populations in the Salmon River are unlikely to remain viable beyond this current survival bottleneck (IDFG 1994).

B. Proposal objectives.

The primary goal of this project is to develop the technology for captive brood stock propagation of chinook salmon that satisfy program needs (see proposal for 9801002).

Objective 1. Produce adult chinook salmon with appropriate morphological,

physiological, and behavioral characteristics to satisfy program needs.

Hypothesis: No testable hypotheses.

Products: Sexually mature brood stocks representing three populations of the Snake River ESU. Adequate facilities development and propagation technology to enable the development of mature brood stocks. Cryopreserved milt to preserve future options.

Objective 2. Technology transfer.

Hypothesis: No testable hypotheses.

Products: Participation in the Chinook Salmon Captive Propagation Technical Oversight Committee process. Preparation of annual reports to satisfy NMFS Permit 1010 reporting requirements. Preparation of annual reports of program activities to satisfy BPA reporting requirements.

c. Rationale and significance to Regional Programs.

Anadromous fishery managers in the basin are increasingly faced with two disparate objectives in their management programs, increasing the numbers of fish and maintaining the genetic and biological diversity of natural populations. The Council has noted the need to balance these two needs in Section 4.1 of its FWP. The Council further notes that actions aimed at increasing fish numbers and conserving biological diversity are both important to maintaining a healthy ecosystem. In the pre decisional Snake River Salmon Recovery Plan (Schmitten et al. 1997), NMFS discusses the importance of metapopulation structure and recognizes the importance of conserving smaller local populations in their Delisting Criterion 1. Also, the National Research Council (1995) described the need of recovery plans to include the creation of multiple subpopulations to ensure population viability.

Fishery managers in the Snake River basin convened to discuss possible means of maintaining overall stock structure of the Snake River chinook population by protecting small populations or stocks at high risk of extinction. It was agreed that a form of captive propagation may be appropriate for some stocks. However, it was not known how captive propagation could be best used to ensure the continued existence of the stocks and at the same time maintain the genetic and/or biological diversity of these same stocks. Two approaches were identified: a conventional captive brood stock program and a captive rearing program. The two approaches share a similar goal, in general to maintain Snake River chinook salmon metapopulation structure, by preventing local extinctions of high risk populations. Future population rebuilding opportunities can be exercised if this goal is met.

The Snake River basin Fishery managers agreed to test the utility of each captive propagation approach (brood stock versus rearing) by implementing each strategy in a separate basin. The Oregon Department of fish and Wildlife has initiated a captive brood stock program with brood year 1994 Grande Ronde Basin chinook salmon (BPA 9604400). The IDFG initiated the captive rearing program with brood year 1994 Salmon River Basin chinook salmon. Collectively, the two approaches aim at maintaining the entire Snake River Basin chinook salmon metapopulation structure, while investigating

two forms of captive propagation and determining their future utility.

d. Project history

Fiscal year 1998 was the first year this project received funding through the basin Fish and Wildlife Program. An ESA Section 10 Report for activities from 1 January – 31 December, 1997 was submitted to the NMFS in January, 1998.

We collected brood year 1994 juvenile chinook salmon from three spring chinook salmon populations, Lemhi River, East Fork Salmon River, and West Fork of the Yankee Fork Salmon River in 1995 to initiate the captive rearing program. These populations had 20 or fewer redds counted in 1994 and are expected to have annual escapements of less than 20 fish during the next several years. After the fish were collected in the summer of 1995 they were transported to the Sawtooth Fish Hatchery for rearing until they could be transferred to other rearing locations. In the spring of 1996 all fish were transferred to IDFG's Eagle Fish Hatchery. One-half of the fish will be reared to maturity at the Eagle facility. The remaining fish were transferred to NMFS' Manchester facility, west of Seattle, Washington, for saltwater rearing to maturity.

In July of 1996 the fish were examined for signs of sexual maturity (precocial males). The rate of precocial male development was very low, less than six percent for each of the three stocks. This was a very positive finding as early maturity is a concern in captive propagation programs. No difference was found in maturation rate for fresh water or salt water rearing and fish health was good.

In July 1997 fish were again sorted to separate out maturing jacks (three year old males). Maturing jacks from the saltwater rearing were transferred back to Eagle Fish Hatchery for final maturation in freshwater to correspond with normal life history events. Although the rate of jack maturation varied among the three stocks, it was not regarded as excessively high. A small number of jacks (up to four) from each stock were equipped with radio transmitters while in captivity. These fish were then outplanted to their source streams and their movement and behavior was monitored. The purpose of outplanting the jacks was only to observe and gain insights on their behavior in the wild. The ultimate objective of captive rearing is to provide mature females (and males) for natural spawning to maintain a base level of natural production. Mature (four-year-old) males and females will be outplanted in 1998. Information learned in 1997 will be used in the decision making process for 1998 outplants. The 1997 (jack) outplanting was considered successful. In general the fish remained in the streams where they were released, and exhibited searching and movement patterns typical of natural origin fish. It was encouraging to observe that even though the fish had been reared almost entirely in captivity, with no opportunity for normal migration and homing behaviors, they remained within their source streams after release. Milt from mature males (jacks) not released into the streams was cryopreserved for potential future use in captive brood stock programs. In addition to the brood year 1994 collections, we collected brood year 1995 juveniles from the Lemhi River. Brood Year 1995 adult spawner numbers in the East Fork Salmon River and West Fork Yankee Fork Salmon River were too low to effectively collect juveniles from these systems. Collection of brood year 1996 juveniles from each system

is currently underway.

Past costs: 1997- $246,871, 1998- $145,000

e. Methods.

This project is concerned with methods associated with the propagation of chinook salmon to meet overall captive rearing program needs. Methods associated with monitoring and evaluating the natural spawning performance of fish produced in the program are detailed in BPA project application 9801022. Methods associated with both components of this project are also described in NMFS Section 10 permit #1010 issued to IDFG for research and enhancement activities. Specific methods for pertinent objectives are summarized below. However, the reviewers should be aware that some of the methods may change during the course of this study. The captive propagation of chinook salmon is a relatively new field and because of this, the role of the Chinook Salmon Captive Propagation Technical Oversight Committee (CSCPTOC) is very important to the success of the program. The CSCPTOC provides a forum of peer review and discussion of all activities and propagation protocols associated with this program. This allows for an adaptive management approach to all phases of the program and ultimately improves program success as new and better information becomes available.

Objective 1. Produce adult chinook salmon with appropriate morphological, physiological, and behavioral characteristics to satisfy program needs. The IDFG and its cooperators on the chinook captive rearing program have played the lead role in developing program methodologies, especially with respect to fish culture techniques. From the inception of the program, project personnel and regional fish culture experts have participated in workshops and planning sessions that have lead to the development of culture protocols in place today. Adaptively managed through the technical oversight committee process, culture practices remain flexible to achieve maximum program success. Routine protocols including; diet and rations, rearing densities, chemical therapeutant treatments, sample counts, marking and tagging, and frequency of handling are constantly reviewed to maintain consistency between IDFG and NMFS culture locations and achieve the best program results.

IDFG provides daily staffing for the propagation of Snake River captive chinook salmon. The fish are reared using standard fish culture practices and approved therapeutants (for an overview of standard methods see Leitritz and Lewis 1976; Piper et al. 1982; Erdahl 1994; Bromage and Roberts 1995; McDaniel et al. 1996; Pennell and Barton 1996). The fish are fed a commercial diet produced by Bioproducts (Warrenton OR). The standard diet formulation is used until fish reach approximately 75 g after which time they receive a special brood diet enhanced with natural flavors from fish and krill. Rearing tank size varies with fish age. Rearing densities, diet ration, and tank size are managed to promote optimum growth and for the attainment of program objectives and goals (see 9801022). Mortalities, both natural and maturation-related, are typically

examined by a fish pathologist. Tissues are analyzed for common bacterial and viral pathogens. In addition, tissue samples are removed, frozen (- 80 °C), and transferred to NMFS for subsequent genetic analysis (project 8909600).

Fish are transported to and from collection locations in truck mounted, insulated tanks (typically 1,136 L capacity) with alarm and back-up oxygen systems on board. For longer duration trips (e.g., from NMFS Washington facilities to Idaho), larger capacity truck mounted tanks may be used (3,785 L and 9,463 L tanks available). IDFG obtains the appropriate permits for interstate transfer of captive chinook salmon to and from NMFS facilities.

The ultimate objective of the captive rearing program is to provide mature females (and males) for natural spawning to maintain a base level of natural production. The 1997 (jack) outplanting was considered successful. In general, the fish remained in the streams where they were released and exhibited searching and movement patterns typical of natural origin fish (see project application 9801022) Mature (four year old) males and females will be outplanted in 1998. Information learned in 1997 will be used in the decision making process for 1998 outplants. Actual outplanting procedures to be employed in 1999 are unknown at this time, and are largely dependent on observations to be made in 1998. Following maturation events, a portion of male chinook salmon, not released, may be selected as donors for milt cryopreservation. Procedures follow standard practices described by Cloud et al. (1990) and Wheeler and Thorgaard (1991). Milt is cryopreserved at the IDFG Eagle Fish Hatchery, the University of Idaho, and Washington State University. Multiple facilities are used to spread the risk of catastrophic loss associated with liquid nitrogen freezer failure.

f. Facilities and equipment.

Eagle Hatchery is the primary Idaho site for the chinook captive rearing program. Artesian water from five wells is currently in use. Artesian flow is augmented through the use of four separate pump/motor systems. Water temperature remains a constant 13.3^{o}C and total dissolved gas averages 100% after degassing. Backup and system redundancy is in place for degassing, pumping, and power generation. Nine water level alarms are in use and linked through an emergency service operator. Additional security is provided by limiting public access and by the presence of three on-site residences occupied by IDFG hatchery personnel.

Facility layout at Eagle Hatchery remains flexible to accommodate culture activities. Several fiberglass tank sizes are used to culture chinook from pre-smolt to the adult stage including: 1) 1 m diameter semi-square tanks (0.30 m^3), 2) 2 m diameter semi-square tanks (1.42 m^3), 3) 3 m diameter circular tanks (6.50 m^3), 4) 4 m diameter semi-square tanks (8.89 m^3) and 5) 6 m diameter circular tanks (44.5 m^3). One meter tanks are used to acclimate pre-smolts to hatchery diets following collections. Two meter tanks are used to rear juveniles, by stream origin, to approximately 20 g. Three and four meter tanks are used to rear juveniles to approximately 1,000 g and to depot fish by stream

origin prior to distribution to natal waters. Six-meter tanks are used to rear fish to age 3+ and 4+. Flows to all tanks are maintained at no less than 1.5 exchanges per hour. Shade covering (70%) and jump screens are used where appropriate. Tank discharge standpipes are assembled in two sections ("half pipe principal") to prevent tank dewatering when removed for tank cleaning.

Sawtooth Hatchery was completed in 1985 as part of the Lower Snake River Compensation Plan and is located on the Salmon river in the Stanley Basin. Sawtooth Hatchery personnel and facilities have been used continuously since 1995 to depot pre-smolts prior to their transfer to the Eagle Fish Hatchery. Following collection, pre-smolts are held in 2 m semi-square fiberglass tanks by stream origin. All fish rearing occurs on well water. Water temperature varies by time of year from approximately 2.5°C in January/February to 11.1°C in August/September. Back-up and redundancy systems are in place.

Live fish transfers occur in a variety of vehicles including customized pick-up trucks and standard fish transportation trucks. The vehicle and containers used will depend upon, among other things, the size and number of fish and the distance to be hauled. Idaho Department of Fish and Game has the following tank capacities available for use in the chinook captive rearing program; 300 gal. (1,136 L), 1000 gal. (3,785 L), and 2,500 gal. (9,463 L). All vehicles are equipped to provide the appropriate conditions (temperature, oxygen, capacity) to facilitate safe transport of fish to the specified destination. All vehicles are equipped with two-way radios or cellular phones to provide routine or emergency communications. Fish are transported by IDFG or cooperator personnel.

Computer equipment includes two desktop and two laptop units. PIT tag equipment includes one self-contained tagging station and two back-up readers and antennas. Two vehicles are assigned to the project with additional IDFG vehicles available as needed (fish transportation). Adequate office and storage space is available at the Eagle Fish Hatchery. The IDFG Fish Health Laboratory is located adjacent to the Eagle Fish Hatchery and provides space for all necropsy work associated with the program. Pathology investigations are carried out, as needed, at this location.

Critical linkages exist between this project and: project 9801022 for monitoring and evaluation of captive chinook released to naturally spawn, project 9606700 for co-culture of captive chinook salmon, project 9107200 for personnel, equipment, and cost sharing between captive sockeye and chinook programs at Eagle Fish Hatchery and, project 8909600 for genetic monitoring and evaluation of captive chinook salmon.

g. References.

Bromage, N. R. and R. J. Roberts. 1995. Broodstock Management and Egg and Larval Quality. Blackwell Science Ltd. Cambridge, MA.

Bowles, E. 1993. Operation of compensation hatcheries within a conservation

framework, an issue paper. Idaho Department of Fish and Game, Boise.

Cloud, J.G., Miller, W. H. and M.J. Levenduski. 1990. Cryopreservation of sperm as a means to store salmonid germ plasm and to transfer genes from wild fish to hatchery populations. The Progressive Fish Culturist 52:51-53.

Erdahl, D. A. 1994. Inland Salmonid Broodstock Management Handbook. United States Department of the Interior Fish and Wildlife Service. 712 FW 1.

Flagg, T.A. and C.V. W. Mahnken. 1995. Captive broodstocks for recovery of Snake River sockeye salmon. American Fisheries Society Symposium 15:81-90.

Fleming, I.A. and M.R. Gross. 1992. Reproductive behavior of hatchery and wild coho salmon (*Oncorhynchus kisutch*): does it differ?. Aquaculture 103:101-121.

Fleming, I.A. and M.R. Gross. 1993. Breeding success of hatchery and wild coho salmon (*Oncorhynchus kisutch*) in competition. Ecological Applications 3(2):230-245.

Hard, J.J., R.P. Jones, M.R. Delarm, and R.S. Waples. 1992. Pacific salmon and artificial propagation under the Endangered Species Act. NOAA (National Oceanic and Atmospheric Administration) Technical Memorandum NMFS (National Marine Fisheries Service) NSFSC-2.

Idaho Department of Fish and Game. 1992. Anadromous fish management plan 1992. Idaho Department of Fish and Game, Boise.

Idaho Department of Fish and Game. 1994. Recovery plan recommendations for hatchery production, an issue paper. Idaho Department of Fish and Game, Boise.

Joyce, J.E., R. M. Martin, and F.P. Thrower. 1993. Sucessful maturation of captive chinook salmon brood stock. Progressive Fish-Culturist. 55:191-194.

Leitritz, E. And R.C. Lewis. 1976. Trout and salmon culture (hatchery methods). California Department of Fish and Game Fish Bulletin 164.

McDaniel, T.R., K.M. Prett, T.R. Meyers, T.D. Ellison, J.E. Follett, and J.A. Burke. 1994. Alaska Sockeye Salmon Culture Manual. Special Fisheries Report No. 6. Alaska Department of Fish and Game, Juneau.

NRC (National Research Council). 1995 Science and the Endangered Species Act. National Academy Press. Washington D.C.

Northwest Power Planning Council. 1994. 1994 Columbia River Basin Fish and Wildlife Program.

Northwest Power Planning Council. 1996. Return to the River: Restoration of Salmonid

Fishes in the Columbia River.

Pennell, W. and B.A. Barton. 1996. Principles of Salmonid Aquaculture. Elsevier Science B.V. Amsterdam, The Netherlands.

Petrosky, C.E. and H.A. Schaller. 1994. A comparison of productivities for Snake River and lower Columbia River spring and summer chinook stocks. *In* Salmon Mamagement in the 21st Century: Recovering Stocks in Decline. Proceedings of the 1992 Northeast Pacific Chinook and Coho Workshop. Idaho Chapter of the American Fisheries Society, Boise.

Piper, G. R., I. B. McElwain, L.E. Orme, J. P. McCraren, L. G. Gowler, and J. R. Leonard. 1982. Fish Hatchery Management. U.S. Fish and Wildlife Service, Washington, D.C.

Schmitten, R. W. Stelle, and M. Brentwood. 1997 (in review). Snake River Salmon Recovery Plan. U.S. Department of Commerce, national Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Wheeler, P. A. , and G. A. Thorgaard. 1991. Cryopreservation of rainbow trout semen in large straws. Aquaculture 93:95-100.

Section 8. Relationships to other projects

The Oregon Department of Fish and Wildlife has initiated a captive broodstock program with brood year 1994 Grande Ronde Basin chinook salmon (BPA 9604400). This program differs from the IDFG program in that it emphasizes captive broodstock rather than captive rearing methods. Collectively, both programs aim at maintaining Snake River Basin chinook salmon metapopulation structure, While investigating two forms of captive propagation and determining their future utility.

The IDFG Captive Rearing Initiative for Salmon River Chinook Salmon operates in association with the LSRCP funded Sawtooth Fish Hatchery in Stanley Idaho. Juvenile chinook collected from the Lemhi River, East Fork Salmon River, and West Fork Yankee Fork Salmon River are transferred to Sawtooth for initial holding.

Cooperative fish culture activities conducted by NMFS at Washington State locations (BPA 920400) are an integral component of the overall program. Duplicate chinook salmon cohorts are maintained in Idaho and Washington to guard against catastrophic loss at any one facility. In addition, culture activities at the NMFS Manchester site are carried out in sea water.

Genetic investigations of Idaho and regional chinook salmon populations (8909600) provide essential information to the program. Conducted by NMFS, these studies generate baseline information on the genetic variability of target subpopulations. This information is an essential part of the Regional effort presently underway to maintain Snake River Basin chinook salmon metapopulation structure.

IDFG fish propagation activities associated with the chinook salmon captive rearing initiative are conducted at the Eagle Fish Hatchery; a facility presently in use to develop sockeye salmon captive broodstocks (BPA 9107200). Although managed as separate projects, program responsibilities overlap and complement each other.

Section 9. Key personnel

The principal investigator on this project is Paul Kline. Mr. Kline has worked for IDFG since 1992 in resident and anadromous fisheries research sub-sections. He has been affiliated with sockeye salmon recovery efforts since 1993 and with chinook salmon captive rearing efforts since 1994. Prior to assuming the position of principal investigator, Mr. Kline served as sockeye project research biologist. He received a B.S. and M.S. in Natural Resources and Fisheries from Humboldt State University (1975, 1980). Prior to coming to IDFG, Mr. Kline worked for the United States Forest Service and for a private consulting firm in Northern California. As a consultant, Mr. Kline was involved with habitat and population surveys of coastal chinook salmon, coho salmon and steelhead populations.

The principal for the monitoring and evaluation portion of the project (BPA #9801002) is Peter F. Hassemer, Principal Fisheries Research Biologist. He has worked for the Idaho Department of Fish and Game for eight years, with six of those years in fisheries research. He received a B.S. (1979) and M.S. (1984) in Fisheries Science from the University of Idaho.

The Senior Fisheries Technician on this project is Kurtis Plaster. Mr. Plaster has been employed with IDFG since 1989. He received a B.S. in Fisheries Resources from the University of Idaho 1991. Mr. Plaster has worked on several chinook salmon research projects including General Parr Monitoring, Idaho Supplementation Studies, and Hatchery Evaluation Studies. He has co-authored annual reports for Idaho Supplementation Studies (1992-1994), and Hatchery Evaluation Studies (1994-1996).

Section 10. Information/technology transfer

Considerable local attention is drawn to project activities in the upper Salmon River Basin of Idaho. Project cooperators strive to maintain an up-to-date

awareness at this local level. IDFG Sawtooth Hatchery personnel, Salmon Region personnel, and immediate project personnel make public contacts on a regular basis to discuss project-related issues. IDFG information and education and enforcement personnel address different audiences several times each year to distribute project-related information. Idaho and regional news media interview project cooperators frequently contributing to the publics' awareness of regional salmon issues.

Project cooperators meet monthly (CSCPTOC) to discuss findings and review planned activities. BPA chairs this process and develops concise meeting minutes that are available to the public. Annual reports of program activities are written and are available from the BPA library. Annual reports of program activities required by Section 10 of the Endangered Species Act are also prepared. Presentations are made at regional fish culture and fish health conferences and at meetings held by the Idaho Chapter of the American Fisheries Society.