REDFISH LAKE SOCKEYE CAPTIVE BROODSTOCK PROGRAM 9204000

SHORT DESCRIPTION:
Incubate and rear Redfish Lake sockeye salmon captive broodstocks. Provide pre-spawning adults, eyed eggs, and juveniles to aid recovery of this ESA-listed endangered stock in Idaho.

SPONSOR/CONTRACTOR: NMFS
National Marine Fisheries Service
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SUB-CONTRACTORS:
N/A

GOALS

GENERAL:
Supports a healthy Columbia basin, Maintains biological diversity, Maintains genetic integrity, Increases run sizes or populations

ANADROMOUS FISH:
Production

NPPC PROGRAM MEASURE:
7.5A.1

RELATION TO MEASURE:
The Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program (Section 7.5A) addresses specific actions to assist weak salmonid stocks such as the Snake River sockeye salmon. This project assists with the protection and rebuilding of Snake River sockeye salmon through such activities as maintaining several lines of captive broodstocks, releasing progeny into lakes of parental origin, and monitoring and evaluating captive broostock production technologies.

OTHER PLANNING DOCUMENTS:
Proposed Recovery Plan for Snake River Salmon; 4.1.a.; 4.1.c

TARGET STOCK	LIFE STAGE	MGMT CODE (see below)
Sockeye, Salmon River, Redfish Lake	Egg-to-adult	S,L,W,

BACKGROUND

Stream name:
Salmon River

Subbasin:
Stanley Basin

HISTORY:
The Coastal Zone and Estuarine Studies Division, National Marine Fisheries Service (NMFS), in collaboration with the Idaho Department of Fish and Game and the Shoshone-Bannock Tribes, has been conducting research to prevent extinction of Snake River sockeye salmon. NMFS listed the Snake River sockeye salmon as endangered under the U.S. Endangered Species Act (ESA) in December 1991. NMFS recovery efforts for this stock center on captive broodstocks for production of juveniles for supplementation. Implementation and refinement of captive broodstocks for recovery of Snake River sockeye salmon are identified as a priorities [4.1.a; 4.1.c in the proposed Recovery Plan for Snake River salmon.
Snake River sockeye salmon are a prime example of a species on the threshold of extinction. The last known remnants of this stock return to Redfish Lake in the Sawtooth Basin of Idaho at the headwaters of the Salmon River. Only a few sockeye salmon adults (zero to eight per year) have returned to Redfish Lake in each of the last 6 years. On the basis of these critically low population numbers, NMFS implemented captive broodstocks as an emergency measure for Redfish Lake sockeye salmon. Redfish Lake sockeye salmon captive broodstocks are being maintained in captivity throughout their life and their offspring will be released to supplement the wild population. Each yearclass will be maintained for only a limited number of generations to help assure that adaptability to native habitats is preserved. Mating strategies for fish reared in captivity have been established to

maintain and enhance genetic diversity.
Theoretically, the relatively high fecundity of anadromous Pacific salmon, coupled with potentially high survival in protective culture, should allow captive broodstocks to produce large numbers of juveniles in a single generation to help "jumpstart" the population. Supplementation with juveniles from captive broodstocks should result in substantial returns of adults sockeye salmon to Redfish Lake and should lead to rebuilding of the natural run and delisting.

BIOLOGICAL RESULTS ACHIEVED:
The NMFS captive broodstock program for Redfish Lake sockeye salmon focuses on: 1) adults that returned to Redfish Lake in 1991, 1993, 1994, and 1996; 2) residual fish captured in the lake; and 3) captive broodstocks reared and spawned in captivity. Fish are reared to adult either full term in fresh well water or from smolt to adult in pumped, filtered, and UV sterilized seawater. Pre-spawning adults and eyed eggs are returned to Idaho to aid recovery efforts for Snake River sockeye salmon. The first group of captive-reared fish (1991 brood) spawned in fall 1994; producing almost 50,000 viable eggs. Spawning of 1993 brood in fall 1996, produced almost 400,000 viable eggs. NMFS captive broodstocks are projected to produce up to 500,000 eggs yearly between 1997-2002.

PROJECT REPORTS AND PAPERS:
Flagg, T. A., C. V. W. Mahnken, and K. A. Johnson. 1995. Captive broodstocks for recovery of depleted populations of Pacific salmon. Amer. Fish. Soc. Symp. 15:81-90.

Flagg, T. A., K. A. Johnson, and J. C. Gislason. 1994. Redfish Lake sockeye salmon broodstock programs. In Proceedings of the 1993 Alaska Department of Fish and Game Sockeye Culture Workshop. Cooper Landing, Alaska. 10 p. (Available from Northwest Fisheries Science Center, 2725 Montlake Boulevard East, Seattle, WA 98112.)

Flagg, T. A. 1993. Redfish Lake sockeye salmon captive broodstock rearing and research, 1991-1992. Report to Bonneville Power Administration, Contract DE-AI79-92BP41841. 16 p. (Available from Northwest Fisheries Science Center, 2725 Montlake Boulevard East, Seattle, WA 98112.)

Flagg, T. A., and W. C. McAuley. 1994. Redfish Lake sockeye salmon captive broodstock rearing and research, 1991-1993. Report to Bonneville Power Administration, Contract DE-AI79-92BP41841. 99 p. (Available from Northwest Fisheries Science Center, 2725 Montlake Boulevard East, Seattle, WA 98112.)

Flagg, T. A., W. C. McAuley, M. R. Wastel, D. A. Frost, and C. V. W. Mahnken. 1996. Redfish Lake sockeye salmon captive broodstock rearing and research, 1991-1994. Report to Bonneville Power Administration, Contract DE-AI79-92BP41841. 98 p. (Available from Northwest Fisheries Science Center, 2725 Montlake Boulevard East, Seattle, WA 98112.)

ADAPTIVE MANAGEMENT IMPLICATIONS:
Because of the critically low population size of Redfish Lake sockeye salmon, captive broodstocks appear to offer the only hope to maintain the species while habitat improvements are underway. Maintaining geographically separate captive brood populations will help reduce the risk of catastrophic loss of the Redfish Lake sockeye salmon gene pool from mechanical failure, human error, or disease. In upcoming years, the Redfish Lake captive broodstock programs should provide hundreds of thousands of eggs for use in recovery efforts. It is virtually certain that without the boost provided by these captive broodstock projects, Redfish Lake sockeye salmon would soon be extinct.

PURPOSE AND METHODS

SPECIFIC MEASUREABLE OBJECTIVES:
Rear endangered groups of Redfish Lake sockeye salmon captive broodstocks to maturity and spawn fish. Incubate eggs and make eggs available to Idaho for use in recovery efforts for this endangered species.

CRITICAL UNCERTAINTIES:
Whether endangered Redfish Lake sockeye salmon captive broodstocks will continue to produce gametes in sufficient numbers and of sufficient quality to aid recovery efforts.

BIOLOGICAL NEED:

Both first and Asafety-net second generation captive broodstocks are identified as priorities [4.1.a] to aid recovery in the Proposed Recovery Plan for Snake River Salmon. Because of the critically low population size of Redfish Lake sockeye salmon, captive broodstocks appear to offer the only hope to maintain the species while habitat improvements are underway. Maintaining geographically separate captive brood populations will help reduce the risk of catastrophic loss of the Redfish Lake sockeye salmon gene pool from mechanical failure, human error, or disease. In upcoming years, the Redfish Lake captive broodstock programs should provide hundreds of thousands of eggs for use in recovery efforts. It is virtually certain that without the boost provided by these captive broodstock projects, Redfish Lake sockeye salmon would soon be extinct.

HYPOTHESIS TO BE TESTED:

1. Endangered Redfish Lake sockeye salmon grown to maturity in freshwater have similar growth, survival, and reproductive success as fish grown in seawater. Ho: no difference. H1: dissimilar difference. •
2. Endangered Redfish Lake sockeye salmon captive broodstocks will continue to produce gametes in sufficient numbers and of sufficient quality to aid recovery efforts. Ho: no eggs produced. H1: eggs will be produced in sufficient numbers and quality.

ALTERNATIVE APPROACHES:

The alternate approach to captive broodstock intervention for Redfish Lake sockeye salmon appeared to be extinction of this ESA-listed stock.

JUSTIFICATION FOR PLANNING:

N/A

METHODS:

1. Replicated groups of endangered Redfish Lake sockeye salmon will be reared to maturity in 4.1-m circular fiberglass tanks supplied with either fresh well water or filtered and sterilized seawater. At maturity, fish will be spawned and individual families incubated in isolation.
2. Between 400-1,000 fish of each brood year and brood type of Redfish Lake sockeye salmon will be reared in protective culture.
3. Pre-spawning adults, eyed eggs, and/or juveniles will be returned to Idaho for use in recovery efforts for this ESA-listed endangered Redfish Lake sockeye salmon.
4. Appropriate statistical analysis will be conducted to compare growth, survival, and reproductive success of fish grown in freshwater and seawater.

PLANNED ACTIVITIES

SCHEDULE:

Planning Phase **Start** 1991 **End** ongoing **Subcontractor**

Task 1. Participate in Stanley Basin Technical Oversight Committee and other forums to coordinate recovery efforts for Snake River sockeye salmon.

Implementation Phase **Start** 1991 **End** ongoing **Subcontractor**

Task FY 1998; Participate in recovery efforts for ESA-listed endangered Snake River sockeye salmon. Rear 1993-, 1994, and 1996-broods of Redfish Lake sockeye salmon as captive broodstock, including:

1. Fall 1997 - spawn 1993- and 1994-broods of Redfish Lake sockeye salmon maturing as 3- and 4-year-old fish from both freshwater and seawater. Compare reproductive success.
2. Fall 1997-winter 1998 - incubate eggs spawned from captive broodstocks and make eggs available to Idaho for recovery efforts at Redfish Lake.
3. Begin captive broodstock sourced from sockeye salmon captured returning to Redfish Lake Idaho.
4. Begin second generation Asafety-net captive broodstock from 1997 spawning of captive broodstocks.
5. Write reports and scientific papers. Similar project activities are expected in 1999-2002.

CONSTRAINTS OR FACTORS THAT MAY CAUSE SCHEDULE OR BUDGET CHANGES:

No known critical risks are associated with captive broodstock rearing for Redfish Lake sockeye salmon. In fact, as described abov

e, it is virtually certain that without the boost provided by these captive broodstock projects, Redfish Lake sockeye salmon would soon be extinct.

OUTCOMES, MONITORING AND EVALUATION

SUMMARY OF EXPECTED OUTCOMES

Expected performance of target population or quality change in land area affected:
Maintaining geographically separate captive brood populations will help reduce the risk of catastrophic loss of the Redfish Lake sockeye salmon gene pool. In upcoming years, the Redfish Lake captive broodstock programs should provide hundreds of thousands of eggs for use in recovery efforts.

Present utilization and convservation potential of target population or area:
No utilization; Redfish Lake sockeye salmon listed as endangered under ESA.

Assumed historic status of utilization and conservation potential:
Up to 5,000 adult sockeye salmon returned to Redfish Lake in the 1950s.

Long term expected utilization and conservation potential for target population or habitat:
Recovery to delisting under ESA.

Contribution toward long-term goal:
Snake River sockeye salmon

Indirect biological or environmental changes:
Recovery and ESA delisting for Snake River sockeye salmon.

Physical products:
Full seeding of three sockeye salmon lake habitats in the Stanley Basin (e.g., approximately 100,000 smolt unit equivalents in Redfish Lake, 50,000 in Alturas Lake, and 20,000 in Pettit Lake).

Environmental attributes affected by the project:
N/A

Changes assumed or expected for affected environmental attributes:
N/A

Measure of attribute changes:
N/A

Assessment of effects on project outcomes of critical uncertainty:
Statistical analysis.

Information products:
Knowledge and refinement of captive broodstock technology for application to depleted stocks of salmonids.

Coordination outcomes:
The project is being coordinated with states and tribes through the Stanley Basin Technical Oversight Committee.

MONITORING APPROACH

(See Methods section)

Provisions to monitor population status or habitat quality:
These uncertainties are being addressed through related projects conducted by IDFG (9107200), the Snoshone-Bannock Tribe (9107100) and the University of Idaho (9009300).

Data analysis and evaluation:
Statistical analysis.

Information feed back to management decisions:
BPA reports and scientific publications. In addition, information from projects related to recovery efforts for ESA-listed endangered Redfish Lake is being coordinated through the Stanley Basin Technical Oversight Committee.

Critical uncertainties affecting project's outcomes:
Captive broodstock research has to be carried out to resolve husbandry uncertainties. Captive broodstocks will prevent extinction of ESA-listed endangered Redfish Lake sockeye salmon. However, captive broodstocks alone will not lead to recovery. Improvements in survival in the migratory corridor, estuary, and ocean are required for full population recovery.

EVALUATION
Interim measures of success should include: 1) efforts are preventing extinction of Redfish Lake sockeye salmon; 2) efforts are resulting in full seeding of juvenile rearing habitats; 3) monitoring is underway to evaluate smolt outmigration and adult return resulting from releases of fish from captive broodstocks for Redfish Lake sockeye salmon.

Incorporating new information regarding uncertainties:
Through adaptive management and coordination at the Stanley Basin Technical Oversight Committee.

Increasing public awareness of F&W activities:
By preventing extinction of ESA-listed endangered Redfish Lake sockeye salmon.

RELATIONSHIPS

RELATED BPA PROJECT	RELATIONSHIP
9009300 Genetic Analyses of Oncorhynchus Nerka	The University of Idaho and Washington State University have been conducting genetic analyses of Snake River sockeye salmon.
9107100 Snake River Sockeye Salmon Habitat and Limnological Research (esa)	The Shoshone-Bannock Tribe of Idaho are conducting habitat and limnological research for rebuilding efforts for Snake River sockeye salmon
9107200 Idaho Department of Fish and Game Sockeye Salmon Captive Broodstock Program	Idaho Department of Fish and Game is also maintaining captive broodstocks for Snake River sockeye salmon to avoid catastrophic loss of the gene pool and for rebuilding efforts

RELATED NON-BPA PROJECT	RELATIONSHIP
	None

OPPORTUNITIES FOR COOPERATION:
NMFS is cooperating with the Idaho Department of Fish and Game in using captive broodstocks to aid rebuilding of Snake River sockeye salmon. Cooperative efforts for restoration of Snake River sockeye salmon are being coordinated through the Stanley Basin Technical Oversight Committee.

COSTS AND FTE

1997 Planned: $499,000

FUTURE FUNDING NEEDS:

FY	$ NEED	% PLAN	% IMPLEMENT	% O AND M
1998	$500,000			
1999	$500,000			
2000	$500,000			
2001	$500,000			

PAST OBLIGATIONS (incl. 1997 if done):

FY	OBLIGATED
1992	$552,900
1993	$425,700
1994	$460,000
1995	$459,300
1996	$496,000
1997	$499,000
TOTAL:	$2,892,900

Note: Data are past obligations, or amounts committed by year, not amounts billed. Does not include data for related projects.

FY	OTHER FUNDING SOURCE	AMOUNT	IN-KIND VALUE
1998			$75,000
1999			$75,000
2000			$75,000
2001			$75,000
2002			$75,000

OTHER NON-FINANCIAL SUPPORTERS:
N/A

LONGER TERM COSTS:
$500,000 continued annual costs for implementation of NMFS captive broodstock programs to aid recovery of ESA-listed Snake River sockeye salmon.

1997 OVERHEAD PERCENT: 45.6% of total direct labor charges.

HOW DOES PERCENTAGE APPLY TO DIRECT COSTS:
Applies to total direct labor charges only.