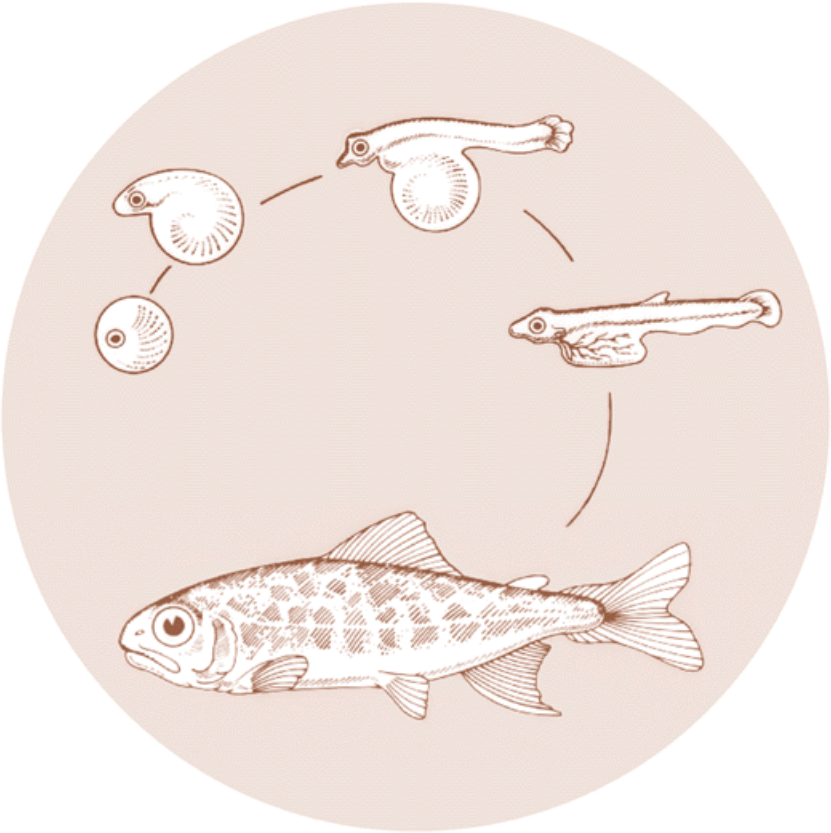
July 1997

RESEARCH AND RECOVERY OF SNAKE RIVER SOCKEYE SALMON

Annual Report:
April 1995 - April 1996



DOE/BP-21065-7

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views of this report are the author's and do not necessarily represent the views of BPA.

This document should be cited as follows:

Johnson, Keith A., J. J. Pravecek, Idaho Dept. of Fish and Game, Research and Recovery of Snake River Sockeye Salmon, Annual Report to Bonneville Power Administration, Portland, OR, Contract 91-BI-21065, Project 91-72, 37 electronic pages (BPA Report DOE/BP-21065-7)

This report and other BPA Fish and Wildlife Publications are available on the Internet at:

http://www.efw.bpa.gov/cgi-bin/efw/FW/publications.cgi

For other information on electronic documents or other printed media, contact or write to:

Bonneville Power Administration
Environment, Fish and Wildlife Division
P.O. Box 3621
905 N.E. 11th Avenue
Portland, OR 97208-3621

Please include title, author, and DOE/BP number in the request.

RESEARCH AND RECOVERY OF SNAKE RIVER SOCKEYE SALMON

ANNUAL REPORT FOR APRIL, 1995 - APRIL, 1996

Prepared by:

Jay J. Pravecek, Fish Culturist

and

Keith A. Johnson, Principal Fisheries Research Biologist

Idaho Department of Fish and Game
Eagle, ID 836 16

Prepared for:

U. S. Department of Energy
Bonneville Power Administration
Environment, Fish and Wildlife
P.O. Box 3621
Portland, OR 97208-362 1

IDFG 97-17
Project Number 9 l-72
Contract Number DE-BI79-91 BP2 1065

JULY 1997

TABLE OF CONTENTS

	Page
ABSTRACT	1
INTRODUCTION	2
EAGLE FISH HATCHERY	2
GOAL STATEMENT AND PROJECT OVERSIGHT	4
OBJECTIVES	5
ADDITIONAL PRACTICES TO ACHIEVE THESE OBJECTIVES	6
Hatchery Production	6
PERFORMANCE OF CULTURED GROUPS	6
Outmigrants 1991 (OM91)	6
Brood Year 1991 (BY91)	9
Outmigrants 1992 (OM92)	10
Outmigrants 1993 (OM93)	10
Residual Brood Year 1992 (RESBY92)	10
Residual Brood Year 1993 (RESBY93)	10
Anadromous Brood Year 1993 (ANBY93)	10
Outmigrants Brood Year 1993 (OMBY93)	10
Anadromous Brood Year 1994 (ANBY94)	11
Brood Year 1995 (BY95)	11
ADULT TRAPPING ACTIVITIES FOR 1995	11
RESIDUAL SOCKEYE TRAPPING ACTIVITIES FOR 1995	11
SPAWNING ACTIVITIES FOR 1995	12
CULTUREOFBROODYEARI995..	13
EGG QUALITY INVESTIGATIONS OF OUTMIGRANT 1991, BROOD YEAR 1991, AND OUTMIGRANT 1992 BROODSTOCKS	13
DETECTION AND SIGNIFICANCE OF ANOMALIES IN BROOD YEAR 1994	14
RELEASES TO REDFISH LAKE	14
CRYOPRESERVATION	15
RESEARCH AND ENHANCEMENT ACTIVITIES PLANNED FOR 1996	15

TABLE OF CONTENTS (C o n t .)

	Page
FACILITY MODIFICATIONS	16
ACKNOWLEDGMENTS	17
LITERATURE CITED	18
APPENDICES	19

LIST OF TABLES

Table 1.	Recent run sizes of sockeye salmon passing Lower Granite Dam and reaching the Redfish Lake Creek trap	4
Table 2.	List of existing facilities for incubating and rearing fish at the Eagle Fish Hatchery	4
Table 3.	Abbreviations used in the text	7
Table 4.	Summary of causes and magnitude of losses to OM91, BY91, OM92, OM93, RESBY92, and RESBY93 captive broodstocks reared at the Eagle Fish Hatchery during April 1995 - April 1996	8
Table 5.	Summary of causes and magnitude of mortality for the ANBY93, OMBY93, ANBY94 captive broodstocks and production groups of Redfish Lake sockeye salmon reared at the Eagle Fish Hatchery for April- 1995 - April 1996	8
Table 6.	Summary of causes and magnitude of mortality for production BY94 Redfish Lake sockeye salmon by genetic type and origin during April 1995 - April 1996	9
Table 7.	Performance of female broodstock for 1995	13

LIST OF FIGURES

Figure 1.	Stanley Basin study area map	3

LIST OF APPENDICES

		Page
Appendix A.	Growth rates for broodstocks	20
Appendix B.	Mating crosses made with anadromous, captive broodstock, and residual adults of Redfish Lake stock during the period of April 1994 through November 1994. Number of females listed first, followed by the number of males used by genetic origin	29
Appendix C.	Summary of 1995 Eagle Fish Hatchery sockeye salmon supplementation by release strategy, broodstock lineage, and brood year	29
Appendix D.	Results of cryopreservation tests conducted on fresh kokanee eggs at the Eagle Fish Hatchery. Each male is listed first along with the last three numbers from the PIT tag. Percent eye was based on an initial inventory of 95 eggs per lot	30

ABSTRACT

In 1991, the National Marine Fisheries Service listed Snake River sockeye salmon *Oncorhynchus nerka* as endangered under the Endangered Species Act of 1973. Initial steps to recover the species include the establishment of captive broodstocks at the Idaho Department of Fish and Game's Eagle Fish Hatchery in Eagle, Idaho. Research and recovery activities for sockeye conducted by the Idaho Department of Fish and Game at the Eagle Fish Hatchery during the period of April 1, 1995 to April 1, 1996 are covered by this report.

The performance of all captive broodstock groups held at Eagle Fish Hatchery is included in this report.

No anadromous adults returned to Redfish Lake in 1995. Three adult residual males were captured in a merwin trap and used in the spawning of captive residual females held at Eagle Fish Hatchery.

Four captive broodstock females produced viable eggs in 1995. This report contains information on all spawning activities for the period and includes an investigation conducted on female maturation condition to uncover reasons for poor egg development and subsequent fertilization. Brood year 1995 fish were given an opportunity to feed on newly hatched *Artemia* nauplii for the first 30 days after swim-up. Thirty days before release into net pens, fish were again given an opportunity to feed on a variety of invertebrate organisms.

Approximately 95,000 fish of brood year 1993.5 and brood year 1994 origin were released throughout the spring, summer, and fall of 1995. Release strategies included yearling smolt releases below the evaluation weir on Redfish Lake Creek, presmolt releases directly into the lake, and presmolt releases into Redfish Lake after an acclimation period in net pens in Redfish Lake.

We cryopreserved sperm from mature captive broodstock. Subsequent quality testing of cryopreserved sperm proved unsuccessful due to the poor quality of eggs used in fertilization trials. Information on eye-up percentages is included in this report.

Authors:

Jay J. Pravecek
Fish Culturist

Keith A. Johnson
Principal Fisheries Research Biologist

INTRODUCTION

Historically, large numbers of adult sockeye salmon *Oncorhynchus nerka* were reported making the nearly 1,500 km journey from the ocean to the Stanley Basin lakes of central Idaho. Redfish Lake (Figure 1) is now the only lake in the basin which still supports a run of sockeye salmon (Bjornn et al. 1968). In 1991, as a result of only six fish returning to Redfish Lake during the previous three years, the National Marine Fisheries Service (NMFS) declared the Snake River sockeye salmon "endangered'* under the Endangered Species Act (ESA) of 1973. The history of the Stanley Basin sockeye runs from 1982-l 995 is provided in Table 1.

A technical committee has been established to coordinate efforts to recover this distinct population. The Stanley Basin Sockeye Technical Oversight Committee (SBSTOC) includes representatives of the Idaho Department of Fish and Game (IDFG), NMFS, Bonneville Power Administration (BPA), the Shoshone-Bannock Tribes (SBT), University of Idaho, and other state and federal agencies as well as private groups involved in sockeye salmon restoration in Idaho.

NMFS is developing a plan to recover Snake River salmon (Snake River Salmon Recovery Plan 1993). This plan includes goals and delisting criteria for Snake River sockeye salmon. Currently, one draft goal is for at least 1,000 naturally-produced adults to return to Redfish Lake and at least 500 naturally-produced adults to return to each of two other lakes in the Stanley Basin.

Initial steps by IDFG to recover the species include the establishment of captive broodstocks at the Eagle Fish Hatchery in Eagle, Idaho. Eight distinct broodstocks have been established consisting of progeny from Redfish Lake outmigrating smolts, anadromous adults, and residual sockeye salmon. The current report summarizes activities from April 1995 through April 1996 by IDFG at Eagle Fish Hatchery.

EAGLE FISH HATCHERY

The Eagle Fish Hatchery was recommissioned in 199 1 for rearing ESA-listed Snake River sockeye salmon captive broodstocks and their resulting progeny. The site is shared with the IDFG Eagle Fish Health Laboratory. Eight broodstocks have been developed for recovery from smolts, anadromous adults, and residual stocks (Johnson 1992; Johnson and Pravecek 1995; Johnson and Pravecek 1996).

Seven artesian wells are available for fish culture. The water supply was renovated in 1994 to add pumping capability and an intertie between two rearing areas. Effective volume available is approximately 0.2 m^3/s^{-1}. All culture is with first-use water in semi-square or round fiberglass tanks. Table 2 lists the inventory of tanks available for culture use.

Rearing capacity for broodstock is limited by the capacity of a water chiller (~600 adults per year held at 10°C). Production capacity has yet to be determined, but is estimated to be 150,000 presmolts per year, consisting of two size/time classes.

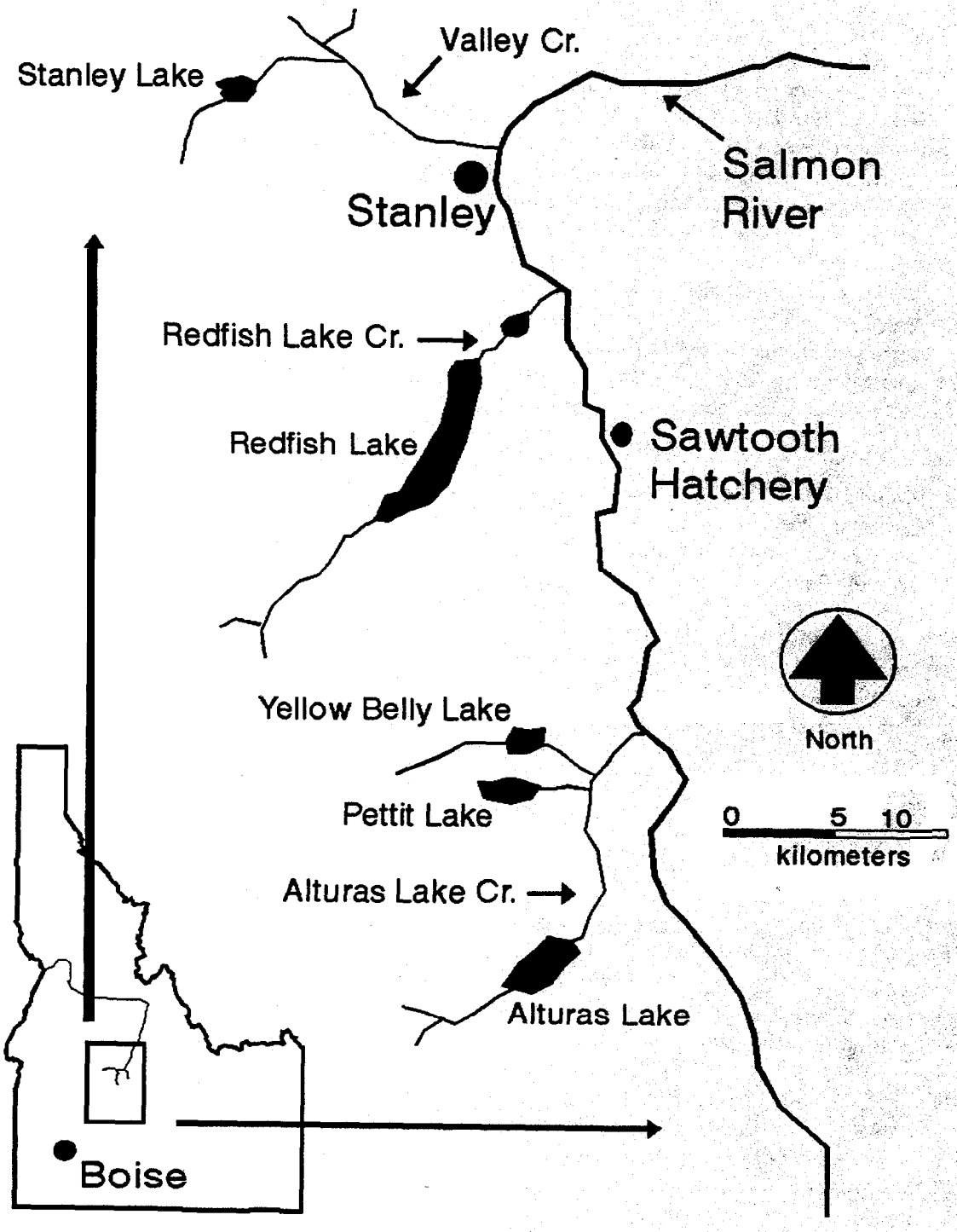


Figure *1.* Stanley Basin study area map.

Table 1. Recent run sizes of sockeye salmon passing Lower Granite Dam and reaching the Redfish Lake Creek trap.

Date	Number of fish	Number trapped
1982	211	
1983	122	
1984	49	
1985	35	
1986	15	
1987	29	
1988	23	
1989	2	
1990	1"	
1991	8	4
1992	1	1
1993	12	8
1994	2	1
1995	4	0

*Seen only at Ice Harbor Dam, Washington.

Table 2. List of existing facilities for incubating and rearing fish at the Eagle Fish Hatchery.

Hatchery rearing unit [a]	Unit volume (m^3)	Number of units	Construction
Incubator	NA	1,370	Plastic
R & D	0.09	48	Fiberglass
1 Meter	0.30	52	Fiberglass
2 Meter	1.42	34	Fiberglass
3 Meter	6.50	38	Fiberglass
4 Meter	8.89	4	Fiberglass

"Multiple, small rearing units are used to satisfy program genetic goals.

GOAL STATEMENT AND PROJECT OVERSIGHT

The ultimate goal of IDFG captive broodstock development and evaluation efforts is to reestablish sockeye salmon runs to Stanley Basin waters and to provide for utilization of sockeye salmon and kokanee 0. *nerka kennerlyi* resources. In the near-term, our goal is to maintain Snake River sockeye salmon and prevent species extinction while long-term solutions in smolt-to-adult survival are sought. IDFG has agreed to establish captive broodstocks through a single generation to limit the influence of domestication. Beyond 1996, we anticipate that

no broodstock-produced juveniles will be cultured at Eagle Fish Hatchery to produce further parental broodstocks. Anadromous adults that return to Redfish Lake beyond 1996 (up to 20 annually) may be spawned to produce progeny for direct release to Stanley Basin waters and for "safety net" rearing at NMFS facilities in Washington state.

The project is designed to meet the needs of SBT, NMFS, IDFG, and BPA under guidelines set forth by the Endangered Species Act.

OBJECTIVES

Objective 1: Develop broodstocks and determine the effects of captive rearing on. sockeye salmon.

Task 1.1: Acquire fish for broodstocks by capturing outmigating smolts, returning anadromous adults, and adult residual sockeye.

Task 1.2: Quantify survival, maturation rates, age at maturity, sex ratio, and-, gamete quality of captively-reared fish.

Task 1.3: Evaluate the length of time broodstock adults are held on chilled water in relation to gamete quality, fertilization rates, and anomalies in broodstock progeny.

Objective 2: Maximize genetic diversity within captively-reared sockeye salmon broodstocks and progeny.

Task 2.1: Establish a spawning matrix in consultation with NMFS and SBSTOC to direct spawn pairings for captive broodstock and anadromous adults.

Task 2.2: Produce genetically-defined progeny for use in multiple release strategies to Redfish Lake and other Stanley Basin lakes.

Task 2.3: Identify individuals in the broodstock with Passive Integrated Transponder (PIT) tags for family identity.

Task 2.4: Take genetic and pathology samples from spawned fish to establish the suitability of progeny for broodstock and release purposes.

Objective 3: Determine the efficacy of cryopreservation at the Eagle Fish Hatchery as a tool for recovery.

Task 3.1: Conduct fertilization trials using cryopreserved milt. from captive broodstock adults.

Task 3.2: Compare test fertilization results and procedures with similar trials conducted at the University of Idaho and Washington State University..

ADDITIONAL PRACTICES TO ACHIEVE THESE OBJECTIVES

Hatcherv Production

1. All broodstocks originating from anadromous adults are duplicated at the NMFS Big Beef Creek and Manchester facilities in Washington state to guard against a single-facility disaster. Progeny from the Big Beef Creek and Manchester programs are returned to Eagle Fish Hatchery only as iodophor-disinfected eyed eggs.

2. Maintain rearing densities at or below 8 kg/m^3 at least through smolt size.

3. Fin clip all production fish released to Stanley Basin lakes for identification purposes upon return as adults. Appropriate numbers of progeny are PIT-tagged for evaluation of smolt performance at migration.

4. All rearing units are maintained separately to prevent disease transfer.

5. Currently up to 20 adults which return to the weir on Redfish Lake Creek may be used for hatchery broodstock. All adults in excess of 20 are to be released upstream for natural spawning.

PERFORMANCE OF CULTURED GROUPS

No mature adults were released to Redfish Lake in 1995.

Three broodstocks which were cultured at Eagle Fish Hatchery over the last four years were terminated in 1995 (OM91, BY91, and OM92). All fish which matured normally were used in spawning activities. However, many individuals were culled due to a lack of normal gonadal development. Normal maturity occurred more frequently with females than males. It is apparent that not all adults are capable of producing viable gametes when reared in captivity at Eagle Fish Hatchery. Meristics and degree of gonadal development were evaluated for all individuals culled, and selected individuals were sampled further to document the atresic condition of ovaries. Table 3 provides the family lineage definition for each of the broodstocks.

The causes and magnitude of mortality of each broodstock group, as well as the production groups, are summarized in Table 4, Table 5, and Table 6. Growth rates can be found in Appendix A. The disposition of these groups at Eagle Fish Hatchery for this reporting period follows.

Outmigrants 1991 (OM91)

The initial inventory of OM91 on January 1, 1995 was 81 fish. Of these, 24 died during the year, 4 spawned, and 53 were culled with signs of secondary maturity but atresic gonads. No fish remained after October 1995.

Table 3. Abbreviations used in the text.

Broodstock Designation	Parental Origin
OM91	Obtained as outmigrants from Redfish Lake in April, May, and June 1991. Cultured at Eagle Fish Hatchery from May 1991 until the present and spawned in 1993, 1994, and 1995. No fish remained in this broodstock at the end of the report period.
BY91	Obtained as eggs by spawning a single female and three male anadromous sockeye which returned in 1991. These were divided between NMFS and IDFG as eggs and reared at Eagle Fish Hatchery, Manchester, and Big Beef Creek hatcheries. Maturation occurred in 1993 and 1994. No fish remained in this broodstock at the end of the report period.
OM92	Outmigrants from Redfish Lake obtained in 1992 and cultured at Eagle Fish Hatchery to the present. Limited maturation occurred in 1994. No fish remained in this broodstock at the end of the report period.
RESBY92	Progeny of three residual sockeye trapped from Redfish Lake in November 1992 and reared at Eagle Fish Hatchery until the present. Maturation occurred in 1994 and 1995. A single fish of this group remains and may mature in 1996.
OM93	Outmigrants from Redfish Lake obtained in 1993 and cultured at Eagle Fish Hatchery to the present. Maturation occurred in 1995.
ANBY93	The progeny of the matings of two female and six male sockeye which returned in 1993. These fish were also crossed with captive OM91 adults to create a safety net broodstock. The eggs were divided between Eagle Fish Hatchery and Big Beef Creek Hatchery. Those at Eagle Fish Hatchery were destined for broodstock and release, while those at Big Beef Creek were for broodstock only. Maturation occurred in 1995.
OMBY93	The progeny of matings of captive OM91 females and six wild anadromous adult males which returned in 1993. These fish were used to create a safety-net broodstock. The eggs were divided between Eagle Fish Hatchery and Big Beef Creek Hatchery.
RESBY93	Progeny of residual sockeye trapped from Redfish Lake in November 1993 and reared at Eagle Fish Hatchery until the present.
ANBY94	Progeny of a single female anadromous adult which returned to Redfish Lake in 1994 mated with BY91 and OM91 captive broodstock males. The eggs were divided between Eagle Fish Hatchery and Big Beef Creek Hatchery. Those at Eagle Fish Hatchery were destined for broodstock and release, while those at Big Beef Creek were destined for broodstock only.
BY94	The progeny of matings of captive broodstock at Eagle Fish Hatchery. These fish were released into Redfish Lake (N=91,700) during the summer and fall of 1995.
BY95	The progeny of matings of captive broodstock at Eagle Fish Hatchery. These fish will be reared in net pens at Redfish Lake (N=1,985) until October 1996 and then released directly into Redfish Lake.

Table 4. Summary of causes and magnitude of losses to OM91, BY91, OM92, OM93, RESBY92, and RESBY93 captive broodstocks reared at the Eagle Fish Hatchery during April 1995 - April 1996.

	Broodstock					
	OM91	BY91	OM97	OM93	RESBY92	RESBY93
Starting Inventory	81	133	61	19	14	34
Loss Type						
Mechanical						
Handling	0	3	1	0	0	0
Jump-out	0	0	1	1	0	1
Non-infectious						
Tumors	1	2	1	0	0	0
Infectious				1		
Undetermined	23	14	19	0	0	1
Fungus	0	13	8		0	2
Enterocytozoa	0	0	1	0	0	0
Maturation						
Spawned	4	54	7	5	10	1
Prespawn loss	0	12	1	0	1	0
Culled	53	35	22	0	0	0
Ending Inventory April 1996	0	0	0	13	3	29

Table 5. Summary of causes and magnitude of mortality for the ANBY93, OMBY93, and ANBY94 broodstock and production groups of Redfish Lake sockeye salmon reared at the Eagle Fish Hatchery for April 1995 - April 1996.

	Broodstock		
	ANBY93	OMRY93	ANBY94*
Starting Inventory	728	457	1,114
Loss Type			
Mechanical			
Handling	3	2	7
Jump-Out	4	0	
Non-Infectious			
Tumors	5	0	
Nephrocalcinosis	I	0	
Cultural abnormalities			33
Infectious			
Undetermined	24	1	9
Fungus	2	0	
Released	171	346	831
Maturation			
Spawned	14	1	
Atresic	6	0	
Ending Inventory April 1996	498	107	1,114

*ANBY94 are eyed eggs.

Table 6. Summary of causes and magnitude of mortality for production BY94 Redfish Lake sockeye salmon by genetic type and origin during April 1995 - April 1996. See key to abbreviations below.

	Genetic type by parental origin and location					
	OMBY FAG	BYBY FAG	ANBYOM FAG	BYBY[a] BBC	BYBY[b] BBC	OMOM SFH
Starting Inventory	50,693	24,466	2,001	10,121	8,867	337
Loss type						
Mechanical						
Transport	20	47	0	15	0	0
Dewater	0	1,620	0	0	0	263
Handling	173	21	7	30	0	0
Sampling	0	0	0	0	230	50
Non-Infectious						
Pin-Heads	0	0	33	0	0	0
Anomalies (%)	3.2	3.8	0.4	1.7	0	7.1
Infectious						
Aeromonads	416	236	0	20	35	0
Undetermined	240	115	9	50	30	0
Released						
Redfish Lake	49,844	22,427	831	9,971		0
Pettit Lake					8,572	
Ending Inventory, April 1996	0	0	1,115	0	0	0

Abbreviations:
OMBY = Progeny of outmigrant and broodyear sockeye crosses.
BYBY = Progeny of femaie and male broodyear crosses.
ANBYOM = Progeny of anadromous female crossed with either BY or OM males.
O M O M = Progeny of outmigrant male and female crosses.
EAG = Eagle Fish Hatchery (IDFG) - origin of parents and progeny.
BBC = Big Beef Creek Hatchery (NMFS) - parental origin, progeny reared at EAG.
SFH = Sawtooth Fish Hatchery (IDFG).

[a] Progeny originate from parents with BKD ELISA OD <0.1.
[b] Progeny originate from parents with BKD ELISA OD 0.1 to 0.2.

Brood Year 1991 (BY91)

The initial inventory of BY91 on January 1, 1995 was 133 fish. Of these; 54 matured and soawned, 47 matured with atresic gonads, and 32 died. The primacy cause of death of

those that died was internal fungus infections and associated accumulation of fluid in the stomach. No fish remained after October 1995.

Outmigrants 1992 (OM92)

The initial inventory of OM92 on January 1, 1995 was 61 fish. Seven matured, 23 were culled due to atresic gonads, 2 were lost due to mechanical causes, and 29 died from internal fungal infections or other causes. No fish remained after October 1995.

Outmigrants 1993 (OM93)

The initial inventory of OM93 on January 1, 1995 was 19 fish. Of these, 5 matured, 2 died, and 13 remain at Eagle Fish Hatchery for maturity in 1996. Performance of spawners is reported in the SPAWNING ACTIVITIES FOR 1995 section of this report.

R id l Brood Year 1997 (RESBY92)

The initial inventory of RESBY92 on January 1, 1995 was 14 fish. Of these, 11 matured and 3 remain at Eagle Fish Hatchery for maturity in 1996.

Residual Brood Year 1993 (RESBY93)

The initial inventory of RESBY93 on January 1, 1995 was 34 fish. Of these, three died and one male matured. Twenty-nine remain for maturity in 1996.

Anadromous Brood Year 1993 (ANBY93)

The initial inventory of ANBY93 on January 1, 1995 was 728 fish. A release of 171 smolts was made to Redfish Lake Creek in April 1995 from the initial inventory. Twenty males matured, 11 were lost to disease, and 5 died from mechanical causes. At the end of the reporting period, there were 521 fish at Eagle Fish Hatchery with most expected to mature in 1996.

Outmigrants Brood Year 1993 (OMBY93)

The initial inventory of OMBY93 on January 1, 1995 was 457 fish. Of these, 346 were released to Redfish Lake Creek on April 21, 1995, 3 died, and 1 male matured. Those expected to mature at Eagle Fish Hatchery in 1996 total 107.

Anadromous Brood Year 1994 (ANBY94)

The initial inventory of ANBY94 on January 1, 1995 was 2,001 fish. This broodstock was divided into two groups with one group being fed at the normal rate and the second being fed at 75% of the normal rate. Our objective is to spread the number of spawning fish out over two spawning years. Expected maturity is in 1997 and 1998. Ending inventory totaled 1,121.

Brood Year 1995 (BY95)

The initial inventory of BY95 on January 1,1995 was 1,897 fish of both OM and RES broodstock origins. This group was part of a trial to investigate the possibility that live feed training may improve survival to outmigration. For the trial, live *Artemia* nauplii were hatched and fed to 50% of each genetic type as a supplement, while the remaining fish were fed a normal dry diet only. More details are included in the CULTURE OF BROOD YEAR 1995 section of this report.

ADULT TRAPPING ACTIVITIES FUR 1995

In 1995, the adult sockeye salmon trap was installed on Redfish Lake Creek in the same location as in previous years. The trap was operated from July 25 through October 25, 1995. High spring runoff prevented an earlier installation date while one report of an adult sockeye salmon passing Lower Granite Dam in late September necessitated the late removal date.

No anadromous adult sockeye were trapped during this period. An employee of the Sawtooth Fish Hatchery lived at the trap site for the entire time and no evidence of vandalism was ever noted.

RESIDUAL SOCKEYE TRAPPING ACTIVITIES FOR 1995

The merwin trap was operated on Sockeye Beach (Redfish Lake) from October 17 through October 26, 1995 to obtain residual sockeye males for use in matings with maturing female RESBY92 captive broodstock at Eagle Fish Hatchery. Three mature males were captured, transferred to Eagle Fish Hatchery, and given a unique tag for identification. Documentation of use is given in the SPAWNING ACTIVITIES FOR 1995 section of this report. Dates of collection are as follows:

Date	Sex	Fork Length (mm)	Weight (g)	Transferred to
10/21	Male	230	106	Eagle Fish Hatchery 10/23
10/24	Male	225	91	Eagle Fish Hatchery 10/26
10/24	Male	237	120	Eagle Fish Hatchery 10/26

SPAWNING ACTIVITIES FOR 1995

A lack of returning adults combined with a missing yearclass of broodstock (BY92) resulted in very few adults to spawn for this season (Appendix B). Although most adults did show signs of maturity, only four females produced viable eggs. Much of the spawning season consisted of cryopreservation of maturing males and the quality testing of selected groups. We also began an investigation into reasons for poor egg quality in female broodstock. Events of BY95 are presented below:

May 23 - All adults expected to mature were moved to chilled water.

August 7 - Spawned single OM93 female with cryopreserved sperm. Eggs were dead within 48 h.

August 16 - Diurnally fluctuating water system was applied to broodstocks.

September 15 - Spawned a single OM92 female. All eggs looked of poor quality and were not fertilized.

September 25 - Precocial ANBY93 males were sorted to cold water.

October 10 - Sorted all maturing fish to assess maturity stage. Most females were found to be of poor quality while most males were ready to spawn.

October 17 - Sixteen BY91 males were selected for cryopreservation. Samples were shipped to Washington State University. Pathology samples were also taken.

October 19 - Sixteen BY91 males were selected for cryopreservation. Samples were shipped to University of Idaho. Five of the samples were discarded due to low motility. Pathology samples were also taken.

October 24 - Spawned a single RESBY92. Incubation was done at 10°C. Samples were taken for egg quality and pathology. See Table 7 for details.

October 25 - Milt was harvested from 15 BY91, 2 OM91, and 2 OM92 males. Samples were divided into two groups and shipped to both University of Idaho and Washington State University.

October 27 - Spawned a single RESBY92. The three wild males captured earlier this year were used to fertilize the eggs. Incubation was done at 10°C. Samples were taken for egg quality and pathology. See Table 6 for details.

November 22 - A single OM93 female which appeared to be maturing earlier in the fall was induced with a 25 ug/kg GnRH pellet and moved to chilled water.

December 4 - The single female previously induced was spawned with milt from cryopreserved males. See Table 7 for details.

Table 7. Performance of female broodstock for 1995.

Female	Male	Spawn Date	Fecundity	%Eye	%Hatch	#Hatch
RES92 #110	RES wild (2) OM93 (1) RES93 (1)	10/24/95	1,882	11.0	3.0	62
RES92 #326	RES wild (1)	10/27/95	1,407	81.2	77.0	1,085
OM91 #879	ANBY93 (1) OM93 (1)	10/30/95	2,079	55.6	30.0	625
OM93 #F50	ANBY93 (Cryopreserved)	12/04/95	1.080	46.4	17.1	185
Average			1.597	48.6	319	489

CULTURE OF BROOD YEAR 1995

At the recommendation of the SBSTOC, the personnel at Eagle Fish Hatchery assisted with an experiment to determine whether post-release survival and outmigration of juvenile hatchery sockeye salmon could be improved by feed training fry and pre-smolts to accept live prey items as a supplement to their normal pelletized diet. Under laboratory conditions, chinook salmon *Oncorhynchus tshawytscha* have been found to feed on twice the prey as unconditioned fish (Maynard et al. 1996). We divided the fry from each female into two groups. We then hatched *Artemia* nauplii each day for 30 d. The nauplii were distributed to one group of fry by way of the water system as a first feeding. The distribution took approximately 15 min. The second group received only the pelletized diet. Both groups were fed a pelletized diet for the remainder of the day. Later in the year, the live feed-trained group will receive another 30 d exposure to a more varied selection of live food. Evaluation&f this experiment will be conducted in both laboratory conditions and in the net pens throughout the summer. Results will be discussed in the next annual report.

EGG QUALITY INVESTIGATIONS OF OUTMIGRANT 1991, BROOD YEAR 1991, AND OUTMIGRANT 1992 BROODSTOCKS

Chilled water constraints at Eagle Fish Hatchery limit our ability to hold more than 650 broodfish prior to maturation. BY93 broodstocks total about 670 individuals which are expected to mature in 1996. To accommodate this number of adults on chilled water, all adults from OM91,BY91, and OM92 broodstocks which remained after the spawning season in 1995 would be culled from the program. This situation was anticipated after the spawning in- 1994' and NMFS was informed of the need for this action. These three groups were moved to chilled. water on May 23, 1995 after incubation of BY94 was complete. Maturation rate. in 1995 was

very poor. Most females had atresic ovaries indicated by low ovary weight and reabsorption. Eggs which were free of the skeins were small and variable in size, often appeared to have yolk oils clustered at one pole, and have failed to fertilize in the past two spawning seasons. Sperm quality, however, was acceptable and most of the milt was cryopreserved.

Samples of selected females were taken to document ovary condition, endocrine status, and nutritional state. These samples have been sent to Dr. Penny Swanson and Dr. Ron Hardy at NMFS for examination. The results of this study may yield direction on procedures to improve gamete quality and performance for future spawning seasons.

DETECTION AND SIGNIFICANCE OF ANOMALIES IN BROOD YEAR 1994

During the culture of progeny from captive broodstocks reared to maturity at Eagle Fish Hatchery, a higher than normal percentage of congenital anomalies has been observed. Under culture conditions, we expect a rate of less than 0.5% of progeny to express anomalies such as Siamese twins, bi-headed condition, spinal curvature, deformed or missing fins, and pinched body condition. These were noticed at a rate estimated to be 5% in BY93. When these conditions were also noticed in BY94, we quantified the occurrence at the time presmolts were PIT tagged (about 7 g in weight). Recorded anomaly rates observed in BY94 are probably at a minimal rate because deformed fish did not survive well to this stage. Also, deformities were noticed at swim-up and many were discarded before data could be recorded. These developmental deformities may also be associated with the low fertilization rate of eggs and subsequent poor swim-up percentage. The reason for the high rate of congenital deformities remains undetermined, but several observations may yield clues to the occurrence:

1. Anomalies are not seen in progeny of anadromous females irrespective of whether the male used to fertilize the eggs was anadromous or captive origin.

2. Anomalies seem to occur at a similar frequency in egg groups incubated at water temperatures of 6°C to 13°C.

3. There did not appear to be a difference in occurrence of anomalies between matings of parents in the diet trial conducted in 1994.

4. Anomalies do not seem to be related to inbreeding since they occurred in progeny of both inbred matings (BYBY) and out-crossed matings (OMBY) raised at Eagle Fish Hatchery regardless of which OM broodstock year was used.

5. Anomalies were detected at a much lower occurrence in BYBY (inbred) lots from parents reared at Big Beef Creek than similar BYBY groups from parents reared at Eagle Fish Hatchery.

RELEASES TO REDFISH LAKE

Approximately 91,700 fish were released from Eagle Fish Hatchery during this report period. See Appendix C for dates, release strategy, broodstock lineage, and brood year.

CRY OPRESERVATION

Cryopreserving sperm from donor males has been used in fish culture for many years to preserve gametes for future use. In the captive broodstock program at Eagle Fish Hatchery, cryopreservation has been successfully used since the inception of the project in 1991. The objective of this activity is to preserve a large quantity of sperm from each subfamily type for use in future years. Sperm of BY93 and RES92 origin was harvested- from 18 males in October and November during the report period. Approximately 10 ml of sperm was harvested from each male and initial motility was high. Sperm was mixed with extender solution as follows:

Crvooreservation Extender	
9.0% Dimethyl Sulfoxide	9.0 ml
5.4% Glucose	5.4 g
10.0% Hen's egg yolk	10.0 ml
Distilled water (balance)	

Mix 3 parts extender with 1 part sperm.

After mixing with extender, sperm was loaded into 0.25 ml straws and frozen in liquid nitrogen at Eagle Fish Hatchery.

On November 28, 1995, quality of cryopreserved sperm was tested by using a sample from each male to fertilize fresh kokanee eggs. Eggs were obtained from the IDFG Cabinet Gorge Fish Hatchery and separated into equal groups of 95 eggs. One straw from each male was added to each egg lot. Two fresh samples from kokanee males served as controls. Sperm was allowed 3 min to fertilize the eggs and then eggs were rinsed in fresh water. Eggs were then water-hardened in iodine for 30 min and then placed into fresh. water for the duration of the test. Incubation was carried to the eyed stage and percent eyed eggs determined.

Overall eye-up for cryopreserved samples was extremely low (3.4%). Eye-up for controls was similar (4.8%). Eye-up ranged from 0.0% to 9.5%. It is probable the eggs used for these tests had water hardened before fertilization could take place.

RESEARCH AND ENHANCEMENT ACTIVITIES PLANNED FOR 1996

- Trapping, holding, and spawning of adult sockeye that return to trap facilities at Redfish Lake Creek and the upper Salmon River.
- Spawning of captive broodstock adults that mature in the fall of 1996. These should include ANBY93, OMBY93, RESBY92, RESBY93, and ANBY94.
- Evaluation of the effect of time of entry into chilled water on gamete performance of captive sockeye salmon broodstocks.
- Cryopreservation of sperm from males of captive broodstocks which mature in 1996.
- Rearing of progeny from BY95 for release into Redfish Lake in 1'996..

FACILITY MODIFICATIONS

The following modifications were made to the hatchery during this report period.

1. Electric valves were installed in the broodstock tanks to allow variable water temperatures.

2. Sound dampening material was placed around the water chiller to alleviate excess noise.

3. Siding for residence #2 is currently being installed.

4. An overhead door was replaced on garage #2.

5. An electrical line was installed in raceway D to provide outlets for equipment.

6. A heat exchanger was placed in the well house to maintain cooler temperatures during the summer months.

7. The freezer door was replaced.

8. A major PVC joint was repaired at the junction of wells 1 and 2.

9. Preliminary work began on the remodeling of our septic system.

ACKNOWLEDGEMENTS

Funding for the captive broodstock program has come from the Bonneville Power Administration. The efforts of our contract officer, Dr. Jeffrey Gislason, in solving budget issues in a timely manner have always been appreciated.

The professionalism of the members of the Stanley Basin Sockeye Technical Oversight Committee has contributed in a great measure to the progress in this program. We routinely receive constructive debates and resolve contentious problems. The relationships between agencies have been very positive as the result of the process. Research on the genetics of sockeye salmon and kokanee of Redfish Lake has been particularly useful to our program at spawning time since it allowed for matings to be made without concern for issues of kokanee genetics.

The staff of Sawtooth Fish Hatchery played an important role in setting up net pens and installation and removal of traps on Redfish Lake Creek. Their help has made this work consistently enjoyable and efficient.

We would like to thank those whose responsibilities include the daily culture of the broodstock and production sockeye salmon. The responsibilities can become overwhelming, but we appreciate the cheerfulness of the staff. Each group of presmolts that we put into Redfish Lake lessens the anxiety level of all of us in the program and we want to commend the fish culturists for their quality work on recovery of this stock.

Special thanks to Paul Kline for his never-ending help during spawning and other important fish related projects. We would also like to thank him for his critical review of this manuscript.

At the end of the reporting period the staff at Eagle Fish Hatchery consisted of Keith Johnson, Project Leader; Steve Wingert, Assistant Hatchery Manager; Jay Pravecek, Fish Culturist; and two part-time temporary technicians, Steve Lee and Megan Heinrich.

LITERATURE CITED

Bjornn, T.C., D.R. Craddock, and D.R. Corley. 1968. Migration and survival of Redfish Lake, Idaho, sockeye salmon, *Oncorhynchus nerka*. Transactions of the American Fisheries Society, 97(4):360-373.

Flagg, T.A., and W.C. McAuley. 1994. Redfish Lake Sockeye Salmon Captive Broodstock Rearing and Research, 1994. National Marine Fisheries Service Annual Report, 1994 to US DOE, Bonneville Power Administration, Division of Fish and Wildlife. Contract No. DE-AI 79-92BP41841. Portland, Oregon. 99 pp.

Johnson, K.A. 1993. Research and Recovery of Snake River Sockeye Salmon. Idaho Department of Fish and Game Annual Report, 1992 to US DOE, Bonneville Power Administration, Division of Wildlife. Contract No. DE-BI79-91 BP21 065. Portland, Oregon. 38 pp.

Johnson, K.A., and J.J. Pravecek. 1995. Research and Recovery of Snake River Sockeye Salmon. Idaho Department of Fish and Game Annual Report, 1993 to US DOE, Bonneville Power Administration, Division of Wildlife. Contract No. DE-BI79-91BP21065. Portland, Oregon. 42 pp.

Johnson, K.A., and J.J. Pravecek. 1996. Research and Recovery of Snake River Sockeye Salmon. Idaho Department of Fish and Game Annual Report, 1994 to US DOE, Bonneville Power Administration, Division of Wildlife. Contract No. DE-BI79-91 BP21065. Portland, Oregon. In press.

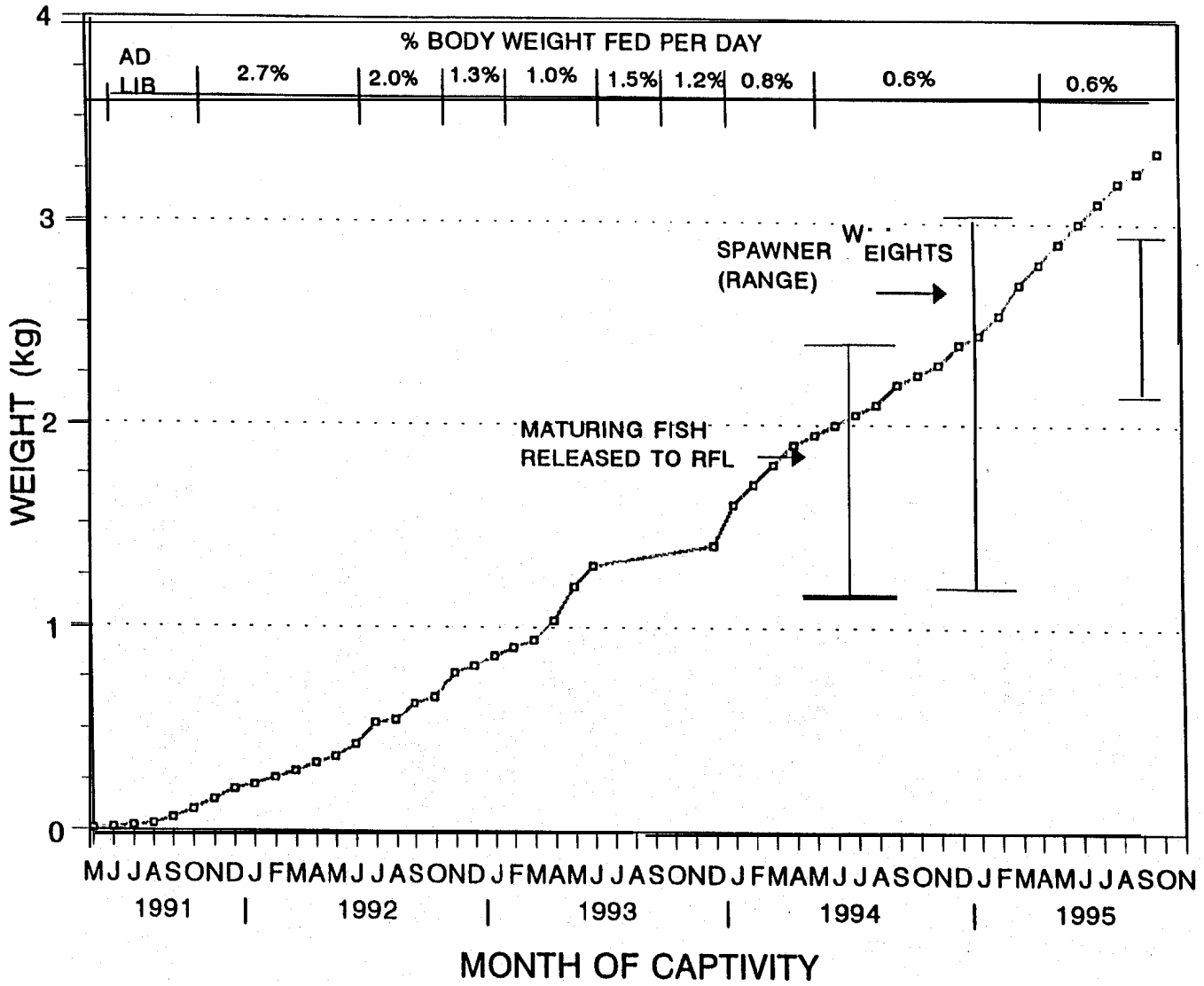
Maynard, D.J., G.C. McDowell, E.P. Tezak, and T.A. Flagg. 1996. The Effect of Diets Supplemented with Live-Food on the Foraging Behavior of Cultured Fall Chinook Salmon. *In:* Progressive Fish-Culturist, 58:187-191.

McDaniel, T.R., K.M. Pratt, T.R. Meyers, T.D. Ellison, J.E. Follett, and J.A. Burke. 1994. Alaska Sockeye Salmon Culture Manual. Special fisheries report number 6. Alaska Department of Fish and Game, Juneau.

McNeil W.J., and J.E. Bailey. 1975. Salmon Rancher's Manual. Northwest Fisheries Center Processed Report. National Marine Fisheries Service. Auke Bay, Alaska.

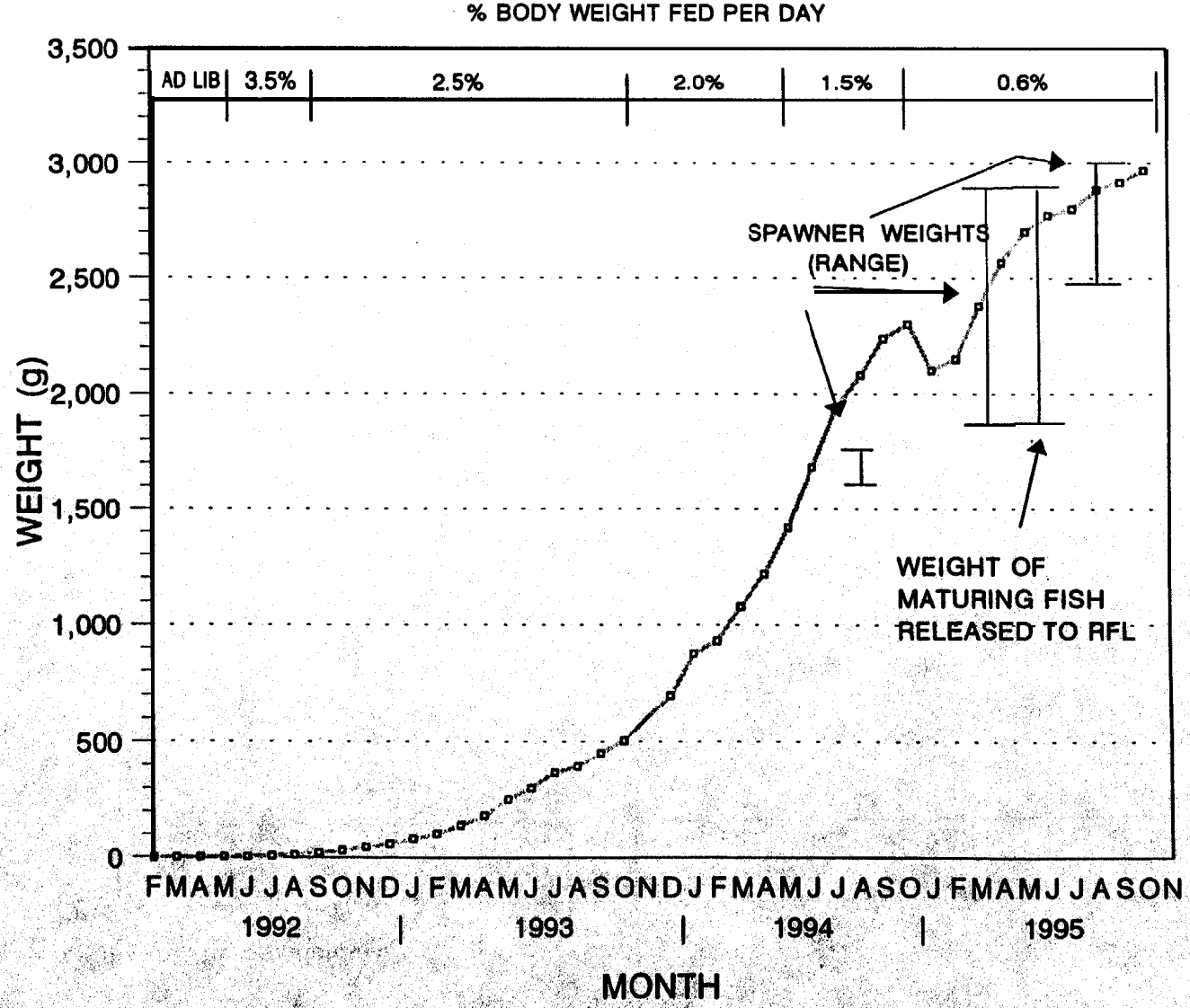
A P P E N D I C E S

Appendix A. Growth rates for broodstocks.



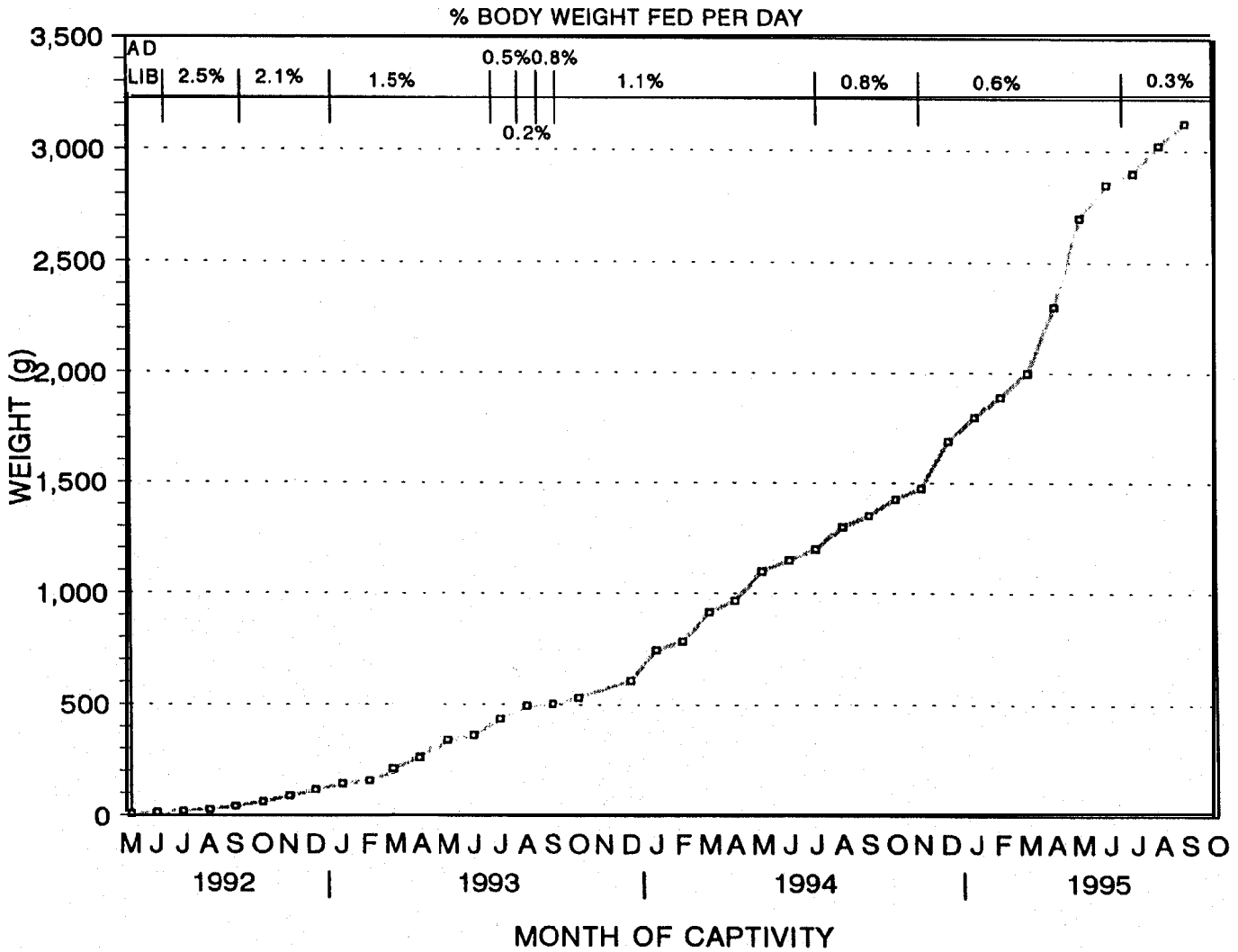
Growth and feed rate for the OM91 broodstock.

Appendix A. Continued.



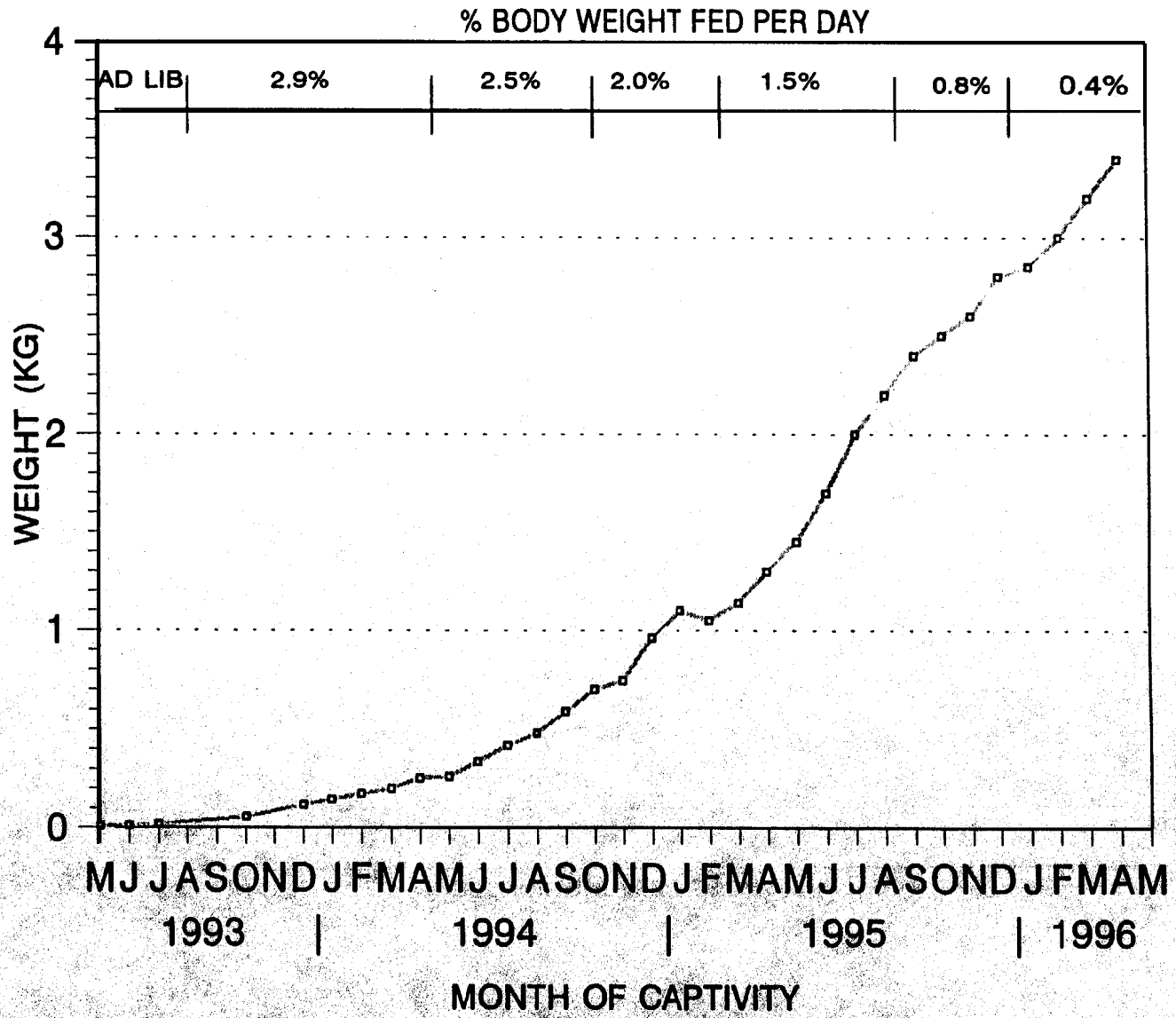
Growth and feed rate for the BY91 broodstock.

Appendix A. Continued.



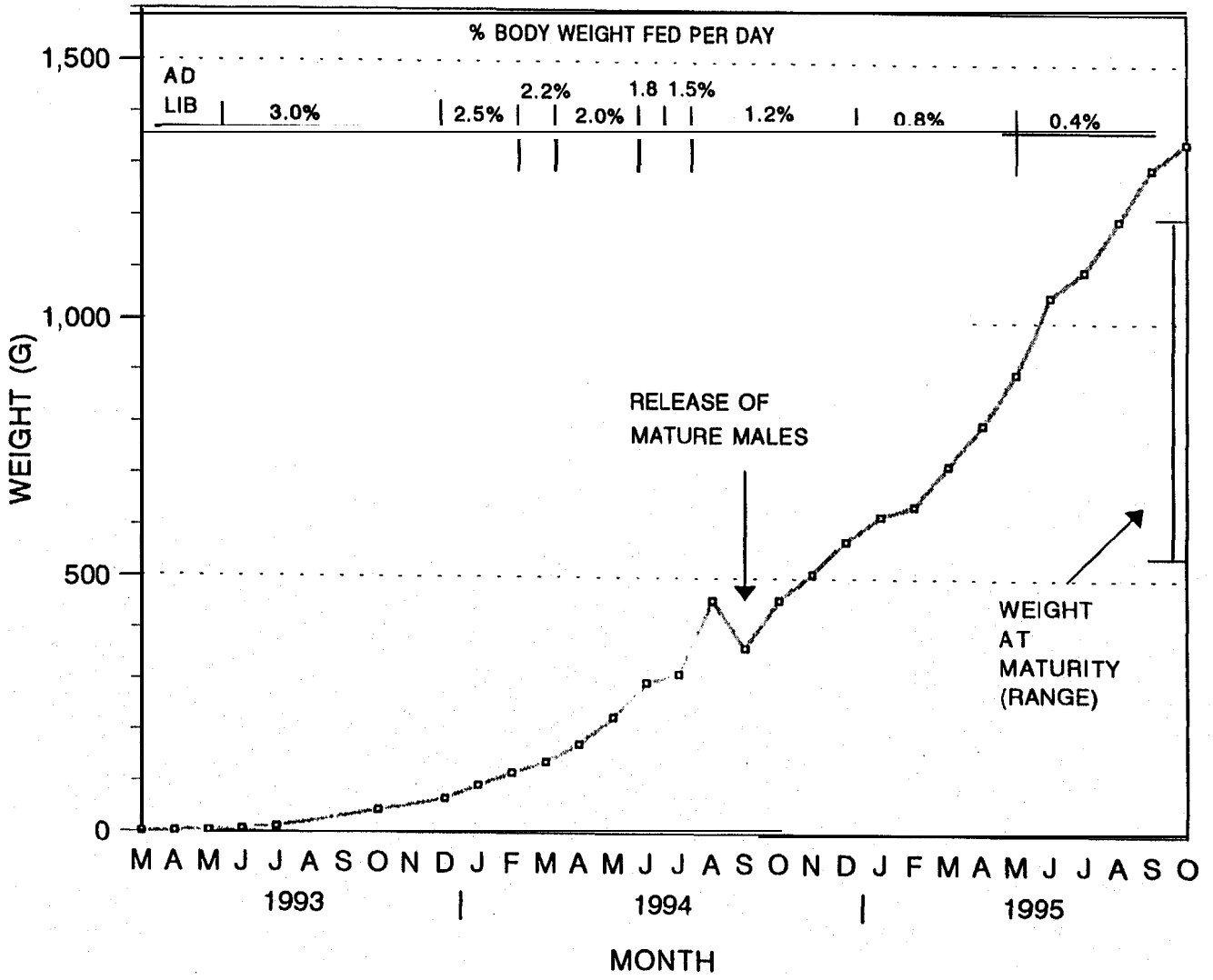
Growth and feed rate for the OM92 broodstock.

Appendix A. Continued.



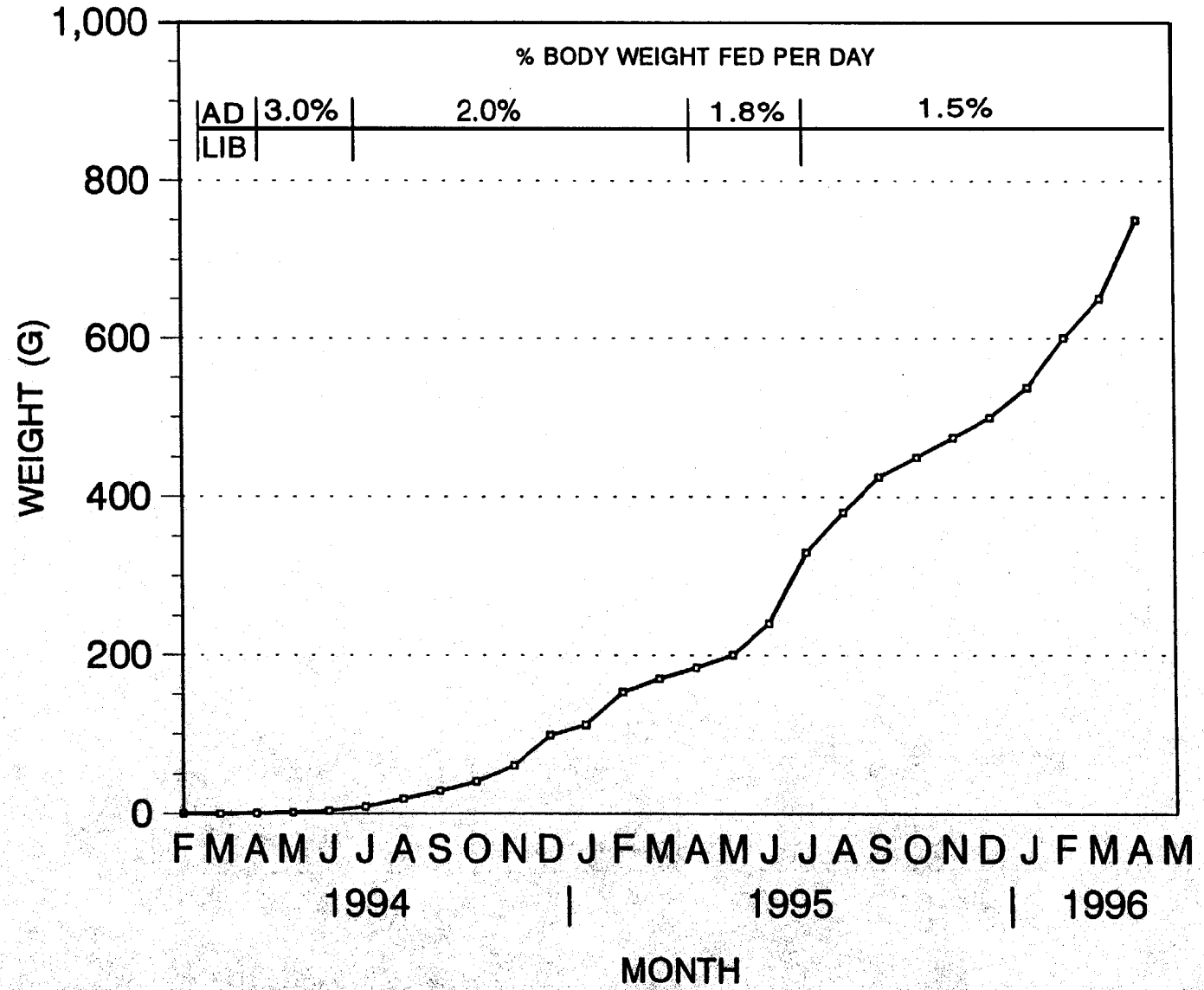
Growth and feed rate for the OM93 broodstock.

Appendix A. Continued.



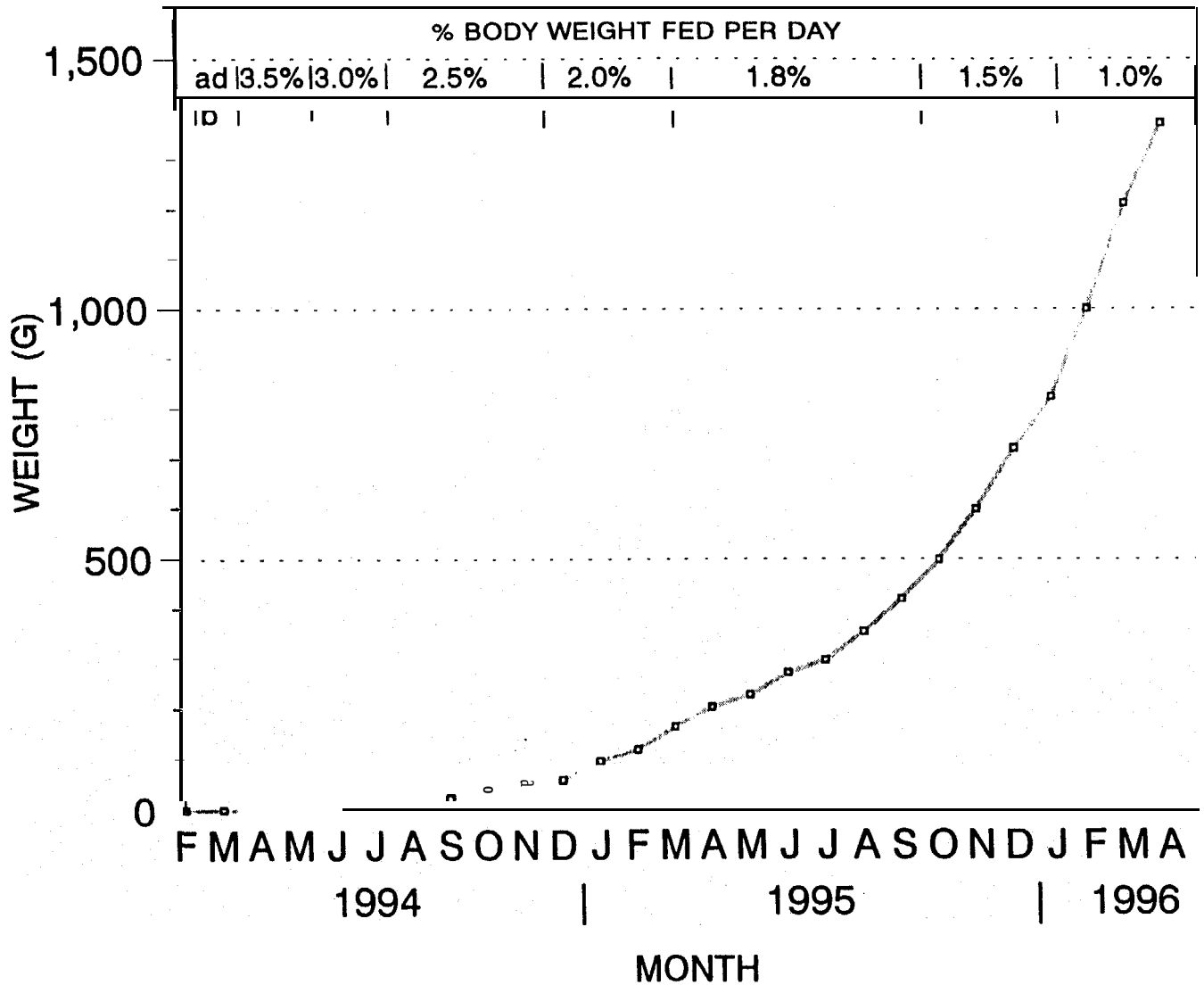
Growth, feed rate, and size at maturity for the RESBY92 broodstock.

Appendix A. Continued.



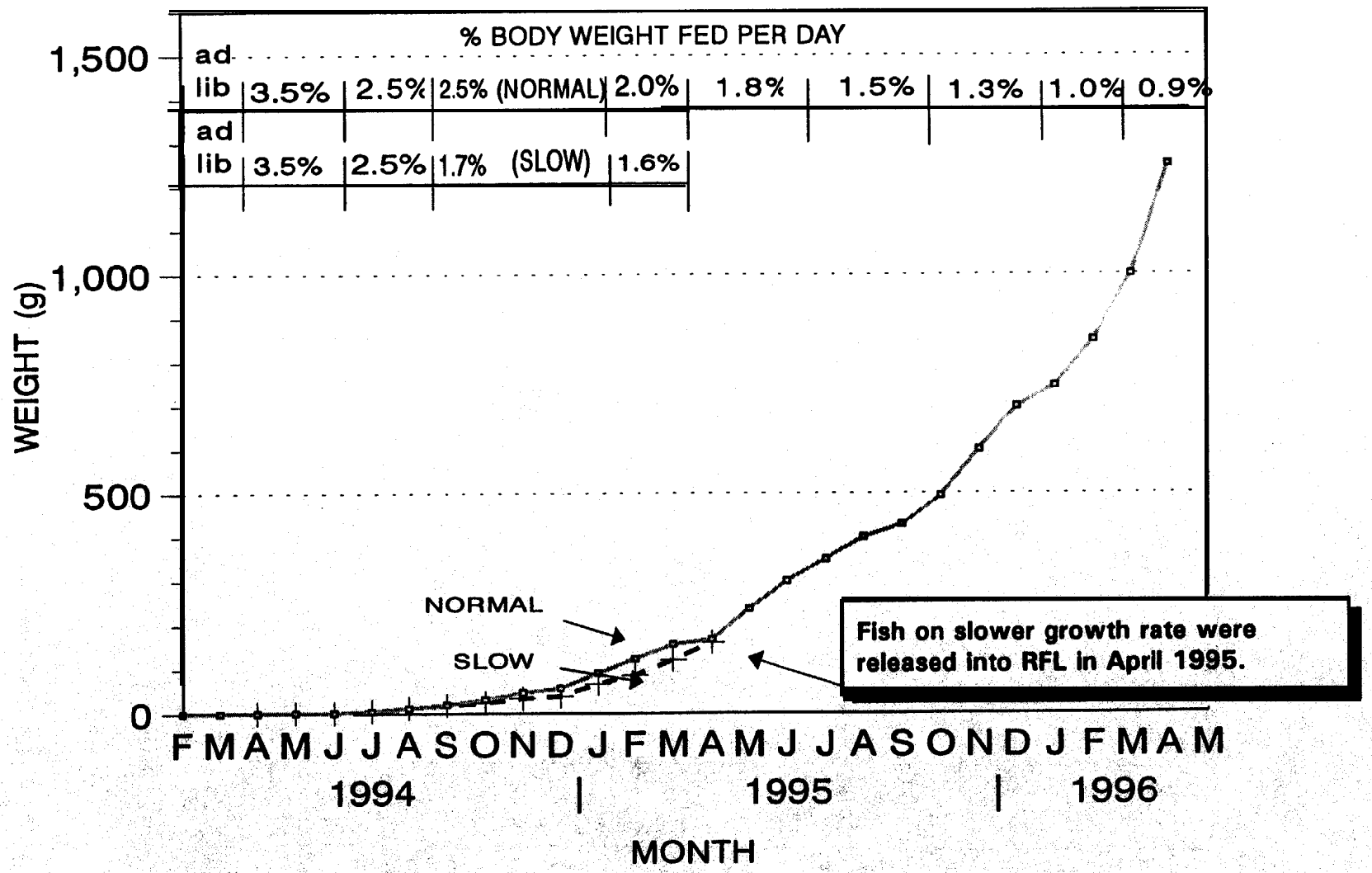
Growth and feed rate for the RESBY93 broodstock.

Appendix A. Continued.



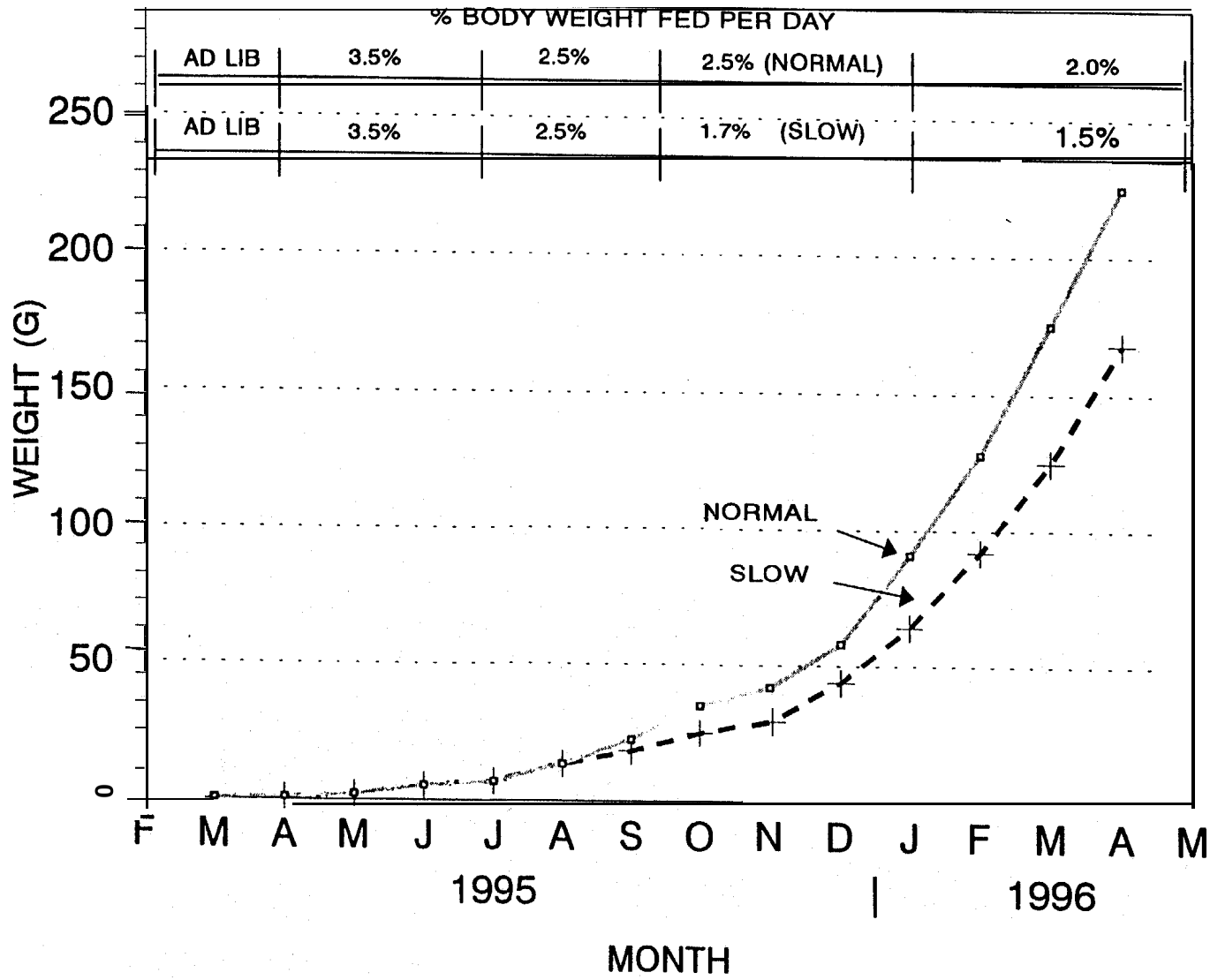
Growth and feed rate for the ANBY93 broodstock.

Appendix A. Continued.



Growth and feed rate for the OMBY93 broodstock.

Appendix A. Continued.



Growth and feed rate for the ANBY94 broodstock.

Appendix B. Mating crosses made with anadromous, captive broodstock, and residual adults of Redfish Lake stock during the period of April 1994 through November 1994. Number of females listed first followed by the number of males used by genetic origin.

Males		Females Spawned					
Broodyear	Spawned	ANAD	OM91	OM92	OM93	BY91	REBY93
BY95	ANAD						
	OM91						
	OM92						
	OM93		1 X 1		1 X 1		
	BY91						
	REBY93						2 X 4

Appendix C. Summary of 1995 Eagle Fish Hatchery sockeye salmon supplementation by release strategy, broodstock lineage, and brood year.

Release Strategy	Lineage/Brood Year	Number Released
4/95 Direct RFL CR [a]	BY91xBY91 (BY93.5)	3,277
	AN93xAN93 (BY93)	171
	OM91xAN93 (BY93)	346
6/95 Direct RFL [b]	OM91xBY91 (BY94)	15,585
	BY91xBY91 (BY94)	11,594
10/95 RFL Net Pens'	OM91xBY91 (BY94)	18,207
	BY91xBY91 (BY94)	9,971
10/95 Direct RFL	OM91xBY91 (BY94)	16,039
	BY91xBY91 (BY94)	10,833
	AN94xOM/BY (BY94)	831
7/95 Pettit Lake [d]	BY91xBY91 (BY94)	8,572

[a] Direct release to Redfish Lake Creek downstream of outmigrant weir.
[b] Direct release to Redfish Lake.
'Release to Redfish Lake from net pens.
[d] Direct release to Pettit Lake.

Appendix D. Results of cryopreservation tests conducted on fresh kokanee eggs at the Eagle Fish Hatchery. Each male is listed first along with the last three numbers from the PIT tag. Percent eye was based on an initial inventory of 95 eggs per lot.

Male/PIT	Number of Eyed Eggs	Percent Eye
ANBY93/A55	6	6.3
OM93/711	8	8.4
ANBY93/264	9	9.5
ANBY93/75B	8	8.4'
ANBY93/B3D	7	7.4
ANBY93/761	0	0.0
ANBY93/F06	4	4.2
ANBY93/E38	4	4.2
ANBY93/45F	3	3.2
RES92/TAG	0	0.0
ANBY93/24D	1	1.0
ANBY93/E35	3	3.2
RES92/24B	3	3.2
RES92/057	1	1.0
RES92/F5A	1	1.0
RES92/876	0	0.0
RES92/662	0	0.0
CONTROL 1	5	5.3
CONTROL 2	4	4.2

AVG CRYO = 3.4
AVG CONTROL = 4.8

Prepared by:

Jay J. Pravecek
Fish Culturist

Keith A. Johnson
Principal Fisheries Research Biologist

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

Steven M. Huffaker, Chief
Bureau of Fisheries

Allan R. Van Vooren
Fisheries Research Manager