



OXBOW FISH HATCHERY

2006 Fall Chinook Salmon Production Brood Year Report



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ABSTRACT

The production of sub-yearling fall Chinook salmon smolts at Oxbow Fish Hatchery (OFH) partially fulfills Idaho Power Company's (IPC) mitigation responsibility for impacts to anadromous fish associated with the construction and operation of the Hells Canyon Dam Complex. Brood Year 2006 was the seventh year of fall Chinook salmon production at OFH utilizing eggs provided by Lyons Ferry Hatchery (LFH).

On December 20, 2006 OFH staff picked up 127,564 eyed eggs at LFH. They were transported to OFH and placed in incubation trays with ten trays in each stack. Well water was supplied to each stack at a rate of 5 gallons per minute (gpm). The well water was aerated to decrease the dissolved gas pressure with the goal of decreasing fry mortality. The resulting fry were moved to two outdoor raceways on February 6, 2007. They were reared on water from well #2 that had a temperature range of 52° F – 54 F A density index of 0.30 lbs/ft³/inch and a flow index of 1.0 gpm/inch were used to set upper limits for adjusting flows and raceway volumes.

The fish were fed a diet of Skretting feed from swim-up to release as smolts. They were started on Nutra Plus Mash and ended consuming 1.5-mm pellets. Skretting 1.2 Pro Active feed was used for two weeks before fin clipping. The automated marking trailer was used again this year to adipose fin clip and coded wire tags all of the fingerlings. On May 8, 2007, a total of 124,539 smolts were transported for release into the Snake River below Hells Canyon Dam. They averaged 55.03 fish per pound and 3.87 inches in length at release. Total weight was 2,263 pounds. On the day of release, the raceway water volume was 2836 ft³. The flow was 325 gpm of well water and 200 gpm of river water. The density index was 0.20 lbs/ft³/inch and the flow index was 1.05 gallons/minute/inch. Survival from eyed egg to release was 97.6%.

The Oregon Department of Fish and Wildlife did not receive any eyed-eggs from LFH this year due to low adult returns.

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HATCHERY OVERVIEW

Introduction

The Oxbow Fish Hatchery (OFH) is part of the Idaho Power Company (IPC) hatchery system and has been in operation since 1962. The OFH is owned and funded by IPC and operated by the Idaho Department of Fish and Game (Department). The OFH was constructed by IPC as part of mitigation required by the Federal Energy Regulatory Commission for impacts to anadromous fish resulting from the construction and ongoing operation of Brownlee, Oxbow, and Hells Canyon dams on the Snake River. Adult steelhead (*Oncorhynchus mykiss*) trapped below Hells Canyon Dam are held, spawned, and the resulting eggs incubated at OFH. Eyed eggs and button-up fry are then transported to the Niagara Springs Fish Hatchery (NSFH) for final rearing to smolt. Adult spring Chinook salmon (*Oncorhynchus tshawytscha*) are trapped and held at OFH until they can be shipped to Rapid River Fish Hatchery (RRFH) in Riggins, Idaho for spawning. Fall Chinook salmon (*O. tshawytscha*) are reared to sub-yearling smolts from eyed eggs received from the Washington Department of Fish and Wildlife's Lyons Ferry Hatchery (LFH). The sub-yearling smolts are released into the Snake River below Hells Canyon Dam.

Location

OFH is located in Eastern Oregon and is adjacent to the confluence of Pine Creek and the Snake River on the Oregon shore of the Snake River at the IPC village known as Oxbow, Oregon. It is located at the eastern most end of Oregon State Highway 86 and is approximately 67 highway miles east of Baker City, Oregon and approximately 150 highway miles northwest of Boise, Idaho. The Hells Canyon trap, which is used for interrogating adult fish for the OFH, is located 23 miles downstream at the base of Hells Canyon Dam on the Oregon shore of the Snake River.

Objectives

The primary purpose for OFH is to meet the Hells Canyon mitigation requirements for adult anadromous fish returns to the upper Snake River. This involves three main objectives:

1. Trap and spawn adult steelhead to provide eggs and fry to NSFH to produce two hundred thousand pounds of smolts annually.
2. Trap adult spring Chinook salmon for transfer to RRFH to supplement broodstock needed to release three million smolts annually.

3. Rear one million sub-yearling fall Chinook salmon smolts annually for release into the Snake River.

Facility Description

The OFH facility consists of the following: A hatchery building which houses the office, shop, and incubation room; four adult holding ponds including fish loading and off-loading facilities; an incubation water chiller; a spawning building; a dormitory; an Assistant Fish Hatchery Manager's residence; two concrete raceways; and an off-site fish trap. A more detailed description of the main components of the facility follows.

The hatchery building is a 28-ft x 60-ft, single-story metal structure partitioned into two main rooms. Half of the building consists of shop and office space, and the other half is space for egg incubation. The incubation room has the capacity to incubate 4.6 million eggs, by placing eggs from two females in each of the 448 vertical stack incubator trays. Two 64 ft² sheds provide storage.

Adult trapping and holding facilities include four holding ponds and a fish trap. The four holding ponds are actually two large ponds separated into four sections. The two larger divisions each measure 105-ft x 35-ft x 5-ft providing 36,750 ft³ of holding space. The two smaller divisions measure 55-ft x 35-ft x 5-ft, providing 19,250 ft³ of holding space. Two electric crowding racks provide the ability to move the fish into a center raceway, which is 4.5-ft wide x 70-ft long. It has a small crowd rack that is used to move the fish into the spawning building. The OFH uses a fish transport truck to transport fish from the fish trap to OFH.

The fish trap is located 23 road-miles downstream of OFH on the Oregon shore of the Snake River immediately below Hells Canyon Dam. It consists of an attraction channel with approximately 150 ft of fish ladder, the holding area (trap), and a loading hopper. During processing, the fish move from the trap into the loading hopper and are hoisted up 80 feet to a transport truck.

A 60-horsepower (hp) water chiller allows regulation of well water temperature for incubating eggs and fry. The chiller is enclosed by a 12-ft x 17-ft metal building to the west of the hatchery building. It has the capacity to chill 120 gpm of well water from a temperature of 52 °F or 54 °F to 40 °F.

The spawning building is located adjacent to the holding ponds. It is partially recessed into the ground to provide holding areas for fish that are to be spawned. The remaining portion is at ground level where the adult steelhead are spawned and the eggs fertilized and processed.

Two concrete raceways provide rearing space for juvenile fall Chinook salmon. They each measure 130-ft long x 6-ft wide x 4-ft deep. A concrete wall divides the first 30 feet of each raceway into two smaller units. The head-box and outlet of the raceways reduce the useable length of rearing space to 109 feet. The capacity of the raceways is 156,309 sub-yearling smolts at 42 fish per pound (fpp). Well water and river-water are plumbed to the raceways in order to achieve required flows and to allow limited control of water temperature.

Water Supply

Outside Operation Water Source

Water for adult holding and spawning is pumped from the Snake River. A platform adjacent to the hatchery supports two 100-hp production pumps. They each produce 20 ft³/s. One pump is powered from the Pine Creek substation, and the second is powered from the Oxbow power plant substation. Only one pump operates at a time. The other pump serves as an emergency backup. Water from the production pumps passes over two aeration pump platforms before entering the four adult holding ponds. In the spring of 2001, a filtration system was installed at the north water inflow pipes to prevent debris from entering the adult holding ponds and salmon raceways. Water temperatures range from a winter low of 34°F to a late summer high of 72°F.

Water from well #2 is used for the fall Chinook salmon fry when they are placed in the outside raceways. Once they reach 100 fpp, Snake River water is introduced. As the fry grow, more river water is added and raceway volume is increased to maintain targeted flow and density indices.

Incubation Water Source

Two wells provide water for egg incubation. One well (#1) serves as a primary water source, while the other (#2) is an emergency backup with a separate power source. The well water temperatures are fairly stable in a range of 52° F – 54 F. Both wells have 10-hp pumps and together provide approximately 750 gpm for incubation and the salmon raceways. Water used for incubation is chilled to approximately 42°F before entering an elevated surge tank in the hatchery building, where it is distributed via gravity flow through two 4-inch PVC water lines to the 28 incubator stacks. Non-chilled well water is piped directly to 25 of the incubator stacks to provide warmer water if desired.

Staffing

One permanent Assistant Fish Hatchery Manager staffs OFH. Two four-month Biological Aides, one eight-month Biological Aide, and one eight-month Fishery Technician share 3,760 hours budgeted for temporary help to assist with hatchery operation and maintenance. The eight-month Biological Aide position assists with steelhead production, but is primarily assigned to fall Chinook salmon production.

Hatchery Improvements

Accomplished

Over the last few years, IPC Oxbow maintenance personnel have been responsible for work related to several hatchery improvements. There were no specific improvements made during the rearing period for Brood Year 2006 Fall Chinook.

Recommendations

Several improvements to equipment and structures at OFH are recommended to improve the overall operation of the facility. These recommendations include:

1. The spawning building needs to be enlarged and lowered four feet. This would reduce potential falls or injuries while climbing ladders within the building. It would also enable release of unripe fish into the ponds without dropping them over a fence; thus lowering potential injury and stress to the fish. Finally, an enlarged work space would make the collection of fish health samples more efficient.
2. The hatchery needs more maintenance space. The current office building contains the office, a workshop, a freezer, and a small conference area. The result is very limited space for working on equipment and projects. Construction of a shop and removal of shop items from the office and conference area would solve this. The addition of a concrete slab (approximately 15-ft x 40-ft) is needed in front of the hatchery building for performing vehicle maintenance and other hatchery projects.
3. The holding ponds need to be modified to create a better holding environment and to reduce fish stress and injuries during routine handling.
4. The hatchery alarm system should be modified to directly sense the holding pond water level and to be able to register multiple alarm signals.
5. Both aeration towers need to be sand blasted and repainted.
6. The hatchery needs gravel on the driveways and application of a dust abatement material.
7. A walk-in cooler should be placed in the outside storage area to provide storage for salmon food.
8. Six cinder block raceways located behind the office should be removed and the remaining hole filled.

9. To increase operating efficiency, and reduce the chance of chiller failure during the summer months, we recommend two modifications; build a shade structure over the chiller building and paint it white.

FALL CHINOOK SALMON PRODUCTION

Egg Development

Brood Year 2006 marks the seventh consecutive year that OFH has produced sub-yearling fall Chinook salmon smolts from eyed-eggs provided from LFH. This year, the Department received 127,564 eyed eggs from the LFH in Starbuck, WA. Eyed eggs with 720 temperature units (TU) were picked up by OFH personnel and transported to the OFH on December 20, 2006. Five coolers were used to transport the eggs at approximately 25,000 eyed eggs per cooler. Well-water from LFH was used for transporting the eggs at 52° F. When they arrived at OFH, they were disinfected for approximately 30 minutes in a 100 ppm solution of well water and iodophore. After disinfection, the temperature of the water in the coolers was measured and warmed with well water as needed. Then the eggs were placed in 36 vertical stack incubator trays. Each tray received approximately 3,500 eggs. The eggs were incubated with 52° F – 54° F well water at 5 gpm. Dead eggs were picked at 1,141 TU, and again at 1,162 TU. A total of 900 dead eggs and fry were removed before fry were placed in the raceways. Survival from eyed egg to hatch was 99.3%.

Fry to Smolt Development

This year, fall Chinook salmon eggs were received eight days later than in 2005. In the first year of production, button-up fry were placed in the raceways and started on feed January 30, 2001. Brood Year 2006 was started on feed February 6, 2007. Rearing flows and densities were lower than in 2006. The Integrated Hatchery Operations Team (IHOT) recommends a maximum flow index of 1.0 lb/gpm /inch and a maximum density index of 0.30 lb/ft³/inch at this facility. These recommendations were followed as closely as possible; however, the recommended flow index was exceeded in three samples (Appendix 1). Pound count and length frequency data were collected weekly to monitor fish growth (Appendix 2). Fish were raised in the outside raceways on well water until reaching 95.48 fpp on April 4, 2007. On this date, 200 gpm of river water (48 °F) was introduced to the raceways to supplement the supply of well water. As a result, the water temperature in the raceways decreased from 53° F to 52° F. During the rearing period, water temperatures were monitored at the hatchery adult head box for river water, at the well for well water, and at the raceway head box for mixed water (Appendix 4).

Fall Chinook salmon were fed Skretting feed from button-up to release (Appendix 3). Skretting feed that contained beta glucan was fed for two weeks prior to marking. Skretting research indicates that beta glucan helps promote activation of the fish's immune system and may

reduce infection due to stress such as fin-clipping or marking. The smaller inventory of fish this year allowed hatchery personnel to hand feed. Belt feeders were not used this season. Skretting feed was fed this season to evaluate growth and for comparison with data collected the past four years. The feed conversions were improved this year due to better river water quality right before fin clipping and to increased quality and a slower sink rate of the Skretting Pro Active feed. This gave the fish appropriate time to consume the feed in the water column (Appendix 5). We had an increase in mortality while feeding the Pro Active and lower feed conversion during that time period. Hatchery personnel are considering not feeding Pro Active in 2008 or just feeding it to one raceway to compare survival and feed conversion.

On May 8, 2007, OFH released 124,539 sub-yearling fall Chinook salmon smolts at 3.87 inches average fork length and 55.03 fpp. This release included 9,954 sub-yearlings that were marked with Passive Integrated Transponder (PIT) tags and 114,585 with coded wire tags (CWT). They were released into the Snake River at the U.S. Forest Service boat ramp located one mile below Hells Canyon Dam. Fish disposition is shown in Appendix 6 and a summary of production data is shown in Appendix 7. The release weight for Brood Year 2006 was higher than for Brood Year 2005 due to higher feed conversion and increased feed availability. In response to warmer than expected water temperatures, the release target date of June 1, which was used for preliminary project design, was not used. Depending on conditions next year, we will adjust release timing as we become more familiar with the affect water temperature has on movement of sub-yearling smolts down the migration corridor.

Predators

There were no known predators associated with the Brood Year 2006 fall Chinook salmon program.

Fish Marking

Marking operations commenced on April 17 and were completed on April 19, 2007. All fall Chinook salmon were adipose fin clipped. Once all the smolts were clipped and counted, hatchery inventory records were adjusted from 123,798 to 124,682 (Appendix 6). A total of 9,970 fish received PIT tags while the remaining 114,712 sub-yearlings were implanted with CWT. On April 27, 2007, a clip evaluation was performed on 500 fish. The results were 2 no clip (0.4%), 88 partial fin clips (17.6%), and 37 over clipped (7.4%). The remaining 373 (74.6%) were clipped satisfactorily. A total of 422 CWT tagged fish were evaluated for tag loss. A total of 421 (99.8%) tags were found and 1 (.2%) had been shed.

Fish Health

Disease Testing

Personnel at the Department's Eagle Fish Health Lab performed health examinations on these fish prior to release. Disease events were not encountered during the reporting period. Treatments were not applied to Brood Year 2006 fall Chinook salmon at OFH.

Organosomatic Index

The Organosomatic Index in this context is a measure of fish health developed as part of the Autopsy-Based Fish Health/Condition Assessment System (Goede, R. W., and S. Houghton. 1987) Results of organosomatic scoring for Brood Year 2006 fall Chinook salmon are presented in Appendix 8.

Acute Losses/Chronic Losses

Neither acute nor chronic losses were experienced during the 2006-2007 rearing cycle.

Other Assessments

The eggs received this year were from females that were spawned a week later than in 2005. We observed a lower early mortality, and the average mortality was lower than in previous years. This can be attributed to better feed quality. We also started out with a smaller number of eggs and the fish were hand fed throughout the rearing cycle. Release size this year was larger than in 2006.

Well water was degassed before use on the eggs in the incubation room again this year. All eggs were disinfected when they arrived at OFH and eggs were isolated into small groups during incubation.

Ceratomyxa shasta (CS) has not been isolated from these fish. In April 2004, the Eagle Fish Health Laboratory initiated a series of exposure trials using sentinel rainbow trout (*Oncorhynchus mykiss*) to establish the onset of parasitism by CS. This myxosporean parasite has been established as a main source of mortality for migrating Chinook salmon and it is present in the Snake River. Since OFH utilizes Snake River water to rear fall Chinook salmon, it is imperative that the Department and IPC are informed about the timing of CS in this portion of the river. The objectives of this research project are to obtain data pertaining to timing of emergence and prevalence of CS. We will make recommendations about timing of release for the fall Chinook salmon and investigate increasing the availability of well water at this facility.

Season Mortality

Mortalities were recorded on a daily basis. As previously stated, 776 dead eggs were removed prior to hatch. After hatch, 124 dead sac fry were removed. After being placed in the raceways, 3,009 fry died and were removed. Weekly mortality after placement in the raceways is listed in Appendices 9 and 10.

Smolt Transport

A total of 124,539 marked sub-yearling fall Chinook salmon smolts survived to release and were transported by Niel Ring Trucking Company, Inc. These sub-yearlings were released into the Snake River below Hells Canyon Dam.

Cost of Fall Chinook Salmon Production

The cost of fall Chinook salmon production is calculated as a portion of IPC's total monthly expenditures for the operation of OFH for the months that fall Chinook salmon are on station (December through the first part of May). A portion of the monthly expenditure is used because adult steelhead are also on station when fall Chinook salmon are present. Total personnel costs for one Biological Aide and a percentage of the remaining staff expenses during the fall Chinook salmon rearing period are included in these calculations. The total amounts for other specific expenditures (e.g. feed and transportation) are also included. The remaining monthly expenditures (letter dated July 2, 2007, from Paul Abbott, IPC Hatchery Biologist, P.O. Box 70, Boise, Idaho) are reduced by a percentage that reflects a proportion of expenditures allocated to fall Chinook salmon production. Production cost of Brood Year 2006 fall Chinook salmon at OFH totaled \$49,143.37 or \$21.72 per pound of fish (Appendix 11).

IPC Fall Chinook Salmon at Umatilla Fish Hatchery

Due to low adult return numbers to the Lyons Ferry Hatchery in 2006, there were no eggs available for rearing at the Umatilla Fish Hatchery.

ACKNOWLEDGEMENTS

The OFH staff would like to thank the staffs from LFH, IPC and the Department who have contributed to the successful operation of OFH this year.

LITERATURE CITED

Goede, R. W., and S. Houghton. 1987. ASUM: A Computer Program For The Autopsy-Based Fish Health/Condition Assessment System. Utah Division of Wildlife Resources Fisheries Experiment Station, 1465 West 200 North, Logan, Utah 84321.

APPENDICES

Appendix 1. Weekly flow and density indices during rearing of Brood Year 2006 fall Chinook salmon at Oxbow Fish Hatchery.

Date	Raceway Volume (ft ³)	Flow (gpm)	Flow Index	Density Index
2/06/07	582.3	160	0.24	0.07
2/12/07	582.3	160	0.58	0.16
2/19/07	582.3	160	0.79	0.22
2/26/07	582.3	325	0.49	0.27
3/05/07	1327	325	0.61	0.15
3/12/07	1327	325	0.74	0.18
3/19/07	1327	325	0.93	0.23
3/26/07	2,527.5	325	1.09	0.14
4/02/07	2,527.5	525	1.29	0.17
4/09/07	2,527.5	525	0.87	0.18
4/16/07	2,527.5	525	0.85	0.18
4/23/07	2,527.5	525	0.90	0.19
4/30/07	2,836	525	0.95	0.18
5/07/07	2,836	525	1.05	0.20

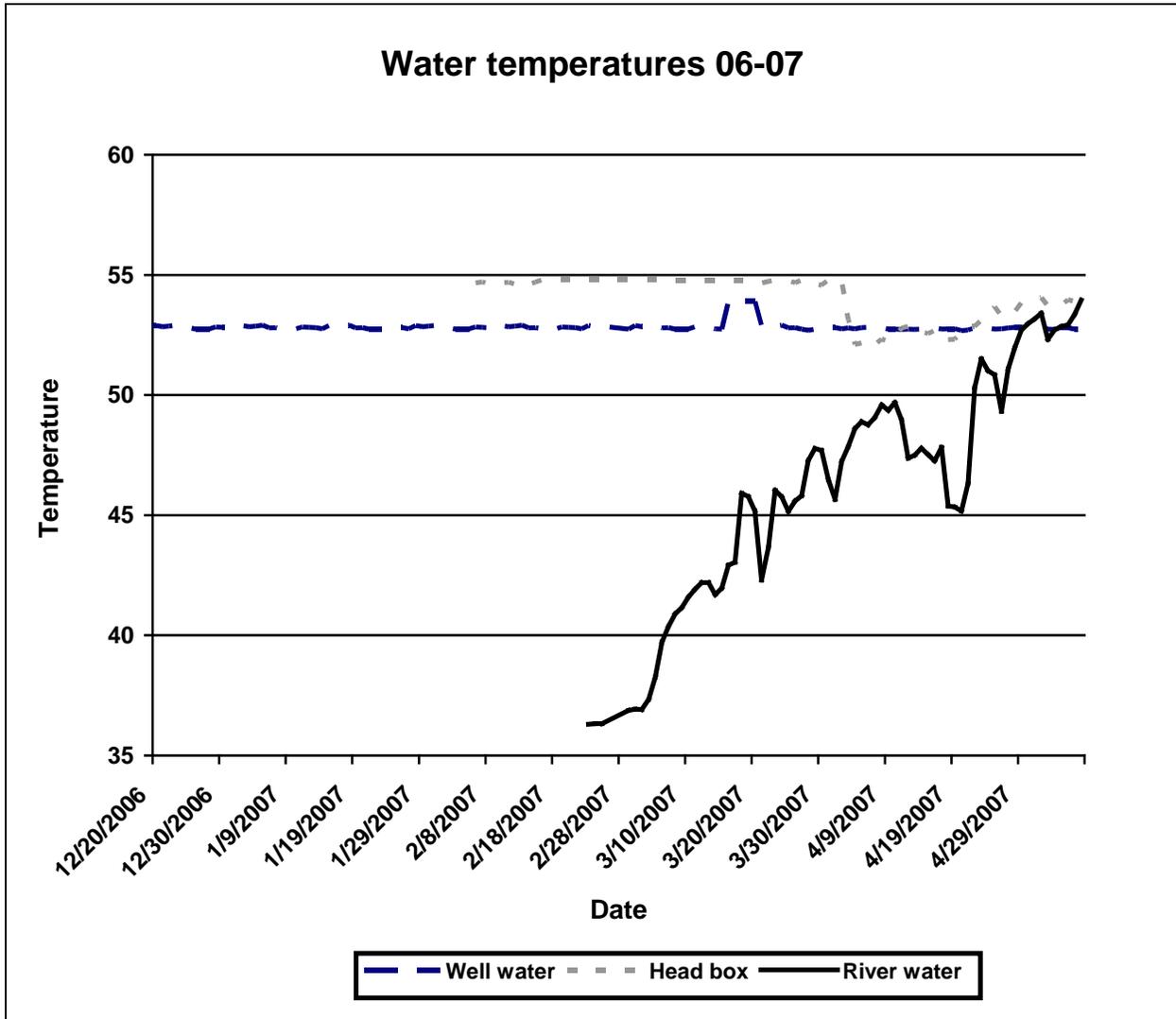
Appendix 2. Weekly length and weight data for Brood Year 2006 fall Chinook salmon reared at Oxbow Fish Hatchery.

Date	Number	Weight (lbs)	Fish/Pound	Average Length (mm)	Minimum Length (mm)	Maximum Length (mm)	Standard Deviation (mm)
2/06/07	749	0.33	2,243.52	37.94	34	40	1.48
2/12/07	726	0.84	861.26	40.12	36	43	1.56
2/19/07	474	0.86	551.78	45.26	38	50	2.37
2/26/07	356	0.93	384.82	51.30	46	56	2.44
3/05/07	272	0.99	275.64	57.82	52	62	2.69
3/12/07	264	1.26	210.27	62.48	53	70	3.72
3/19/07	151	0.93	163.22	63.50	50	70	3.27
3/26/07	128	1.04	123.64	71.92	60	81	3.92
4/03/07	98	1.03	95.48	78.84	71	89	4.60
4/09/07	100	1.18	85.02	81.38	68	93	5.76
4/16/07	113	1.37	82.48	85.74	73	98	5.79
4/23/07	92	1.27	72.51	87.10	75	105	6.72
4/30/07	84	1.33	63.35	94.96	80	110	7.09
5/07/07	124	2.25	55.03	98.42	85	110	5.76

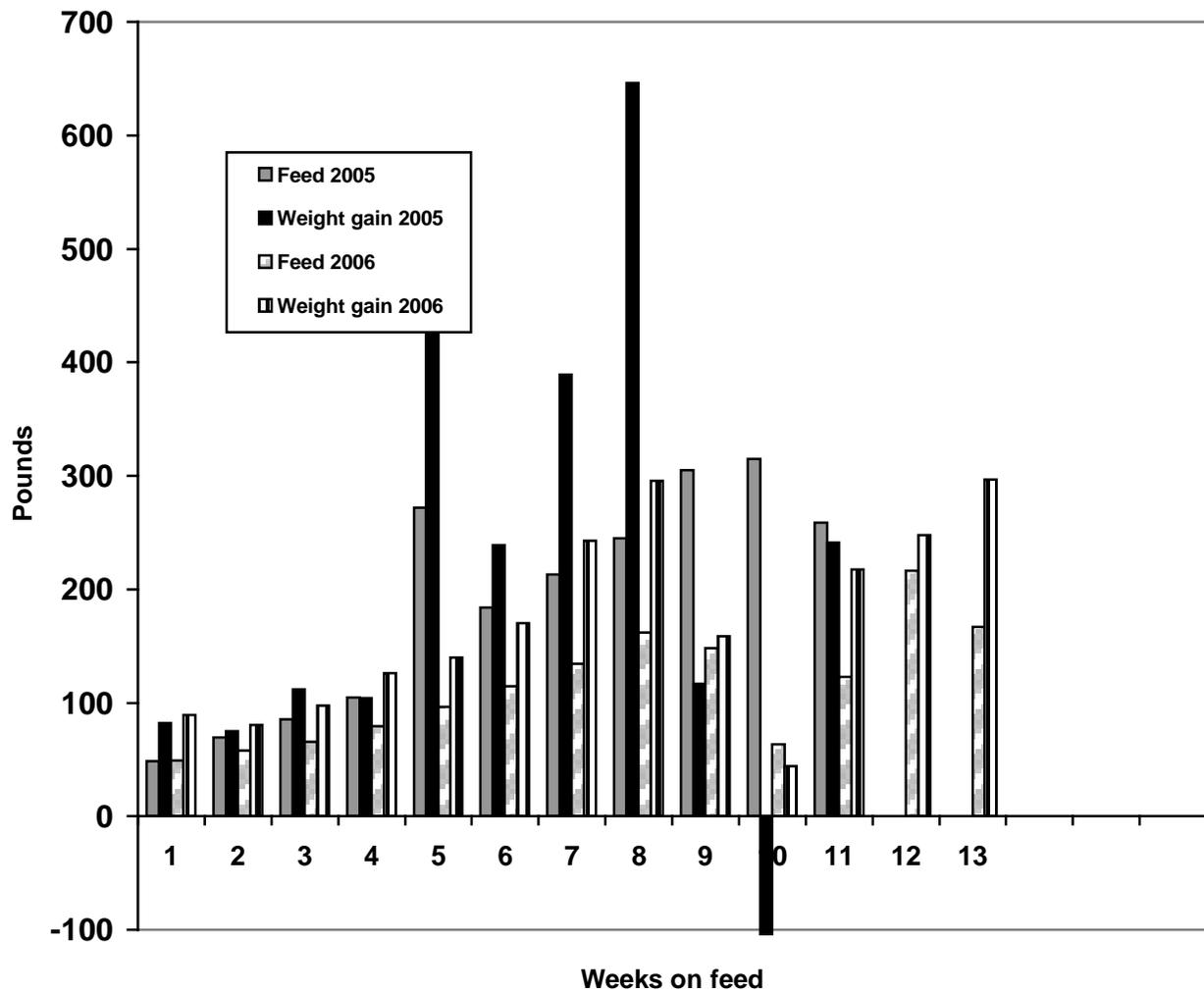
Appendix 3. Feed used during the Brood Year 2006 fall Chinook salmon rearing program,

Month	MASH Starter	#0 Starter	#1 Starter	# 2 Crumb	1.2 mm	1.2 mm Beta Glucan	1.5 mm
Feb	88.0	105.6					
Mar		26.4	308	134.2		46.8	
Apr				301.2	38.3	261.2	
May				4.6	137.7		20.1
Total	88	132	308	440	176	308	20.1

Appendix 4. Well, river, and mixed water temperatures measured at Oxbow Fish Hatchery, February, 2007 through May, 2007.



Appendix 5. Comparison of pounds of food fed and weight gained during production of Brood Years 2005 and 2006 fall Chinook salmon at Oxbow Fish Hatchery.



Appendix 6. Brood Year 2006 fall Chinook salmon disposition.

Number	Disposition
127,564	Eyed eggs received from Lyons Ferry
-900	Dead eggs and sac-fry picked from incubation trays
126,664	Fry placed in raceways
+884	Adjustment from hatchery count to actual clipping counts
127,548	Fry count after clipping without fry mortalities
-3,009	Total fry mortality
124,539	Fry on station
-9,954	PIT tagged fry released
-114,584	CWT tagged fry released
-1	Fry that lost CWT tags and released
0	Fry remaining on station

Appendix 7. Brood Year 2006 fall Chinook salmon production summary.

Fish on hand at end of month					Mortality		Fish Feed		Weight Gain		Feed Conversion	
Month	Number	Weight	Length	Fish/ lb.	Month	To Date	Month	To Date	Month	To Date	Month	To Date
Feb	124,107	356.09	2.10	348.4	2,469	3,369	193.6	193.6	299.8	299.8	0.65	0.65
Mar	123,958	1,197.2	3.03	103.5	149	3,518	515.4	709	841.0	1,141.2	0.61	0.62
Apr	124,562	1,966.25	3.73	63.4	368	3,886	600.7	1,309.7	825.1	1,966.3	0.73	0.67
May	124,539	2,263.1	3.87	55.0	23	3,909	162.4	1,472.1	296.8	1,438.0	0.55	0.63

Eggs were received December 20, 2006.

Sub-yearlings were planted below Hells Canyon Dam on May 8, 2007.

Fry numbers were adjusted after fin clipping in April.

Appendix 8. Summary of Brood Year 2006 fall Chinook salmon pre-liberation fish health examinations.

Accession No:	07-096	Location:	Oxbow Hatchery
Species:	Chinook Fall	Autopsy Date:	04/6/2007
Strain:	Lyon's Ferry	Age:	Juv
Unit:Reason for Autopsy:	Prelib	Sample Size:	60
Investigator:	Munson		

Values As Percents Of Total Sample

Eyes		Gills		Pseudo-branches		Thymus		Mesen. Fat		Spleen		Hind gut		Kidney		Liver		Bile	
N	60	N	60	N	60	0	60	0	0	B	0	0	60	N	60	A	2	0	51
B1	0	F	0	S	0	1	0	1	12	R	60	1	0	S	0	B	58	1	9
B2	0	C	0	L	0	2	0	2	23	G	0	2	0	M	0	C	6	2	0
E1	0	M	0	S&L	0			3	17	NO	0			G	0	D	0	3	0
E2	0	P	0	I	0			4	8	E	0			U	0	E	0		
H1	0	OT	0	OT	0					OT	0			T	0	F	0		
H2	0			O	0			Mean 2.7								OT	0		
M1	0																		Mean=0.15
OT	0																		

Summary of normals

60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
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N = normal

OT = other

Thymus: 0 = no hemorrhage

Mesenteric fat: 0 = none, 1 = < 50% coverage, 2 = 50%, 3 = > 50%, 4 = 100%

Spleen: R = red, E = enlarged (EIBS enlarges spleens)

Hind gut: 0 = no inflammation

Liver: B = pail red

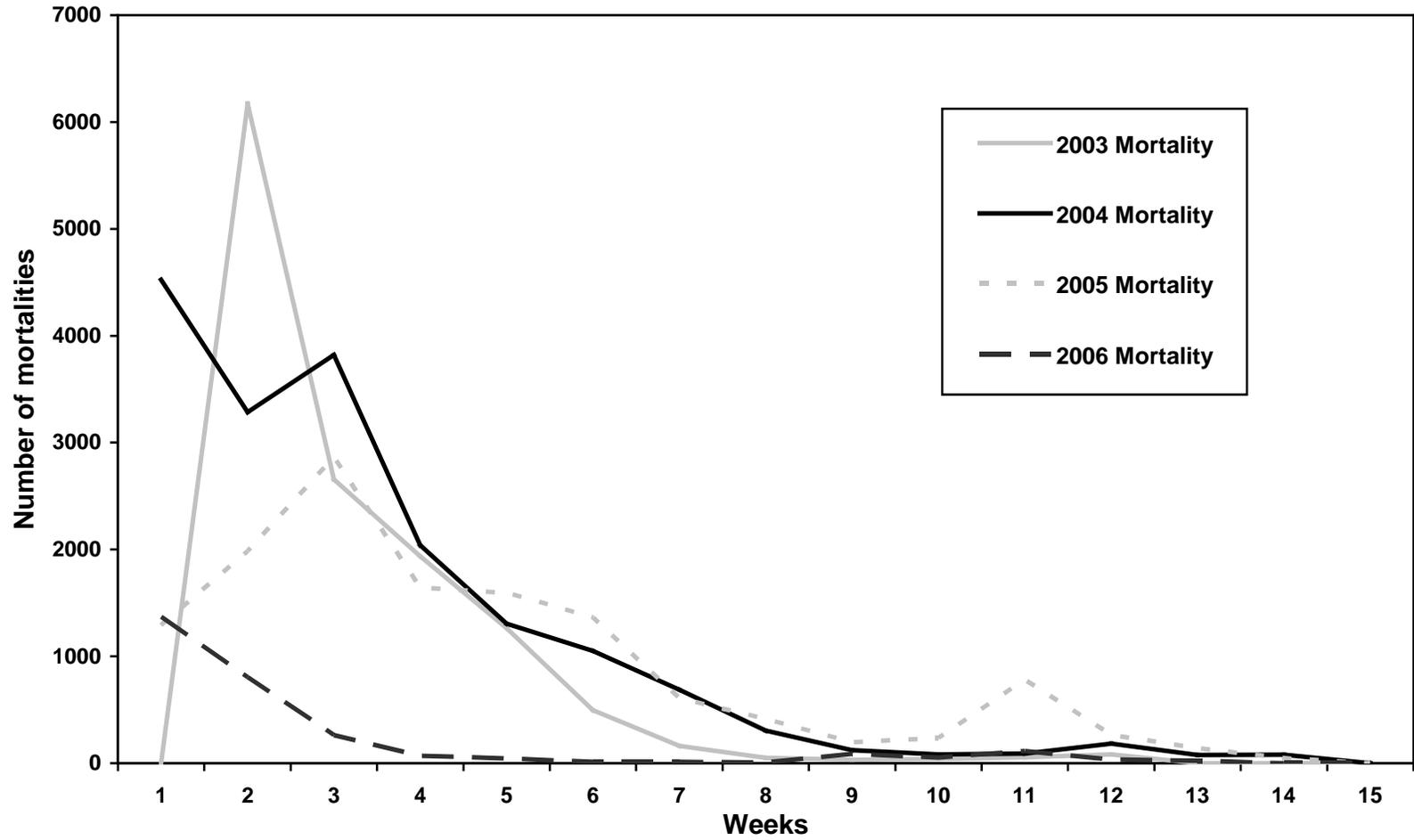
Bile: 0 = yellow bile < full bladder

Appendix 9. Weekly mortality of Brood Year 2006 fall Chinook salmon reared at Oxbow Fish Hatchery.

Week	2/12	2/19	2/26	3/5	3/12	3/19	3/26	4/2
Mortality	2,268	805	263	102	46	14	13	18

Week	4/9	4/16	4/23	4/30	5/8
Mortality	105	89	112	51	23

Appendix 10. Comparison of mortality in fall Chinook salmon for brood years 2003, 2004, 2005, and 2006.



Appendix 11. Cost of production for Brood Year 2006 fall Chinook salmon at Oxbow Fish Hatchery

Number of fish	Weight of fish (lb)	Weight of feed (lb)	Cost of feed	Feed Conversion	^a Total cost	Cost/ thousand fish	Cost/ Pound
124,539	2,263	1,472.1	\$1,910.83	.63	\$49,143.37	\$394.73	\$21.72

^aThe total represents the total cost incurred by IPC from 12/1/06 through 5/8/07. This amount may exceed cost associated with production of Brood Year 2006 due to overlap in the brood year rearing cycle (see discussion in the Cost of Production section). These costs include funds provided to the Department by IPC, as well as internal costs incurred by IPC. It does not include IPC capital outlay expenditures.