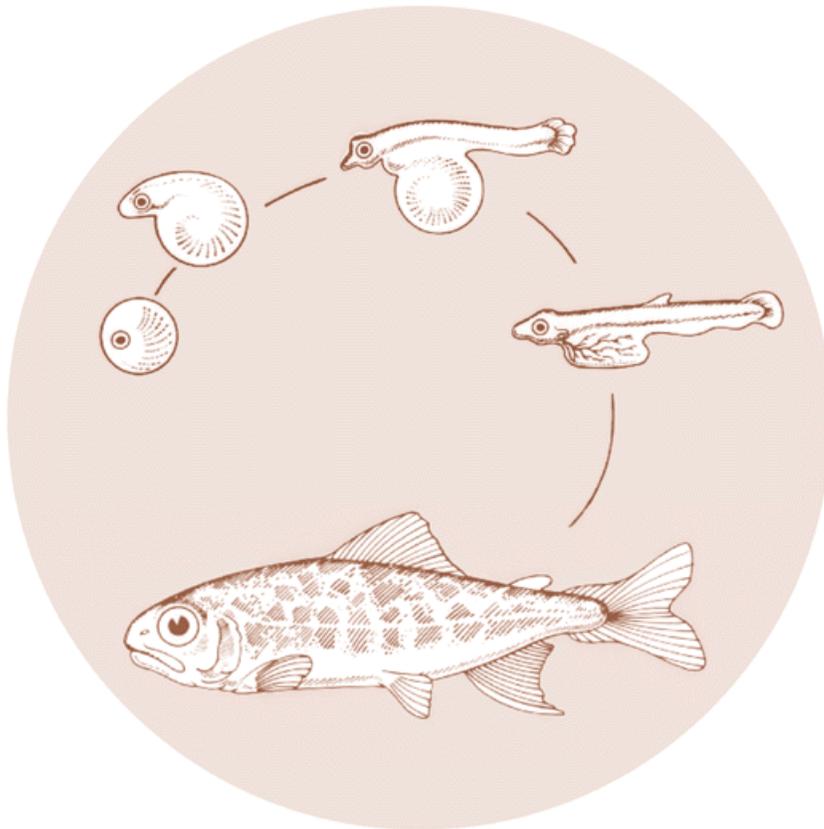


May 1989

STATE OF IDAHO AUGMENTED ANADROMOUS FISH HEALTH MONITORING

Annual Report 1988



DOE/BP-65903-2



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STATE OF IDAHO AUGMENTED ANADROMOUS
FISH HEALTH MONITORING

Annual Report 1988

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ABSTRACT

This report documents the progress in the assigned tasks which have occurred during the second year of the Augmented Anadromous Fish Health Monitoring Project. Fish at seven Idaho Department of Fish and Game facilities were monitored for various pathogens and organosomatic analyses were performed on smolts prior to their release in the Spring of 1989.

A disease database has been developed and facility impediments to fish health have been identified.

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INTRODUCTION

Columbia river basin anadromous fish populations have suffered a significant decline during the last century, in part from the effect of hydroelectric development. Successive low water years in 1987 and 1988 seriously impacted smolt survival. Upriver salmonid stocks represent an unique gene pool as well as a significant resource to the region. The Pacific Northwest Electric Power Planning and Conservation Act of 1980 created a basin-wide fish and wildlife program to mitigate, protect, and enhance Columbia basin fish and wildlife. Fish mitigation programs have centered on smolt production, providing safe passage, and harvest management (Columbia River Basin Fish & Wildl. Program, 1987).

The health and quality of hatchery produced smolts are major factors in overall survival, and one area which can be controlled by man. This study will provide Bonneville Power Administration with a fish health database from Idaho which when combined with data from other contractors will provide a consistent basin-wide picture of fish health. The ability to document health problems and production impediments will serve as important first steps for increasing the smolt-to-adult survival rate.

Bonneville Power Administration funding has enabled the Idaho Department of Fish and Game (IDFG) to institute a monitoring program for health parameters at its anadromous facilities to a level consistent with other basin fishery programs.

DESCRIPTION OF STUDY AREA

Seven hatcheries are included in the monitoring contract (Table 1 and 2). These facilities produce chinook and steelhead smolts (except Oxbow Hatchery, which is an adult holding and egg incubation facility) for release into the Salmon and Snake River drainages. The South Fork trap and East Fork trap are satellite facilities for McCall and Sawtooth hatchery, respectively. All laboratory work was conducted at the Eagle Fish Health Laboratory, Eagle Idaho.

METHODS AND MATERIALS

Methods and materials are described in the 1987 annual report (Foott & Hauck, 1988). The selection of the ovarian fluid pellet for detection of Renibacterium salmoninarum in broodstock and the use of polyethylene glycol (PEG) in viral assay began in April and September of 1988, respectively. These modifications to Table 2.1 of the contract arose from the March 29, 1988 meeting of the Technical Steering Committee.

Ovarian Fluid Pellet (OP). Following the removal of 200 μ l for viral assay, ovarian fluid was centrifuged at 2,000 x G, 10 min, 15 C and the supernatant discarded. A smear was made from the ovarian fluid pellet and processed for direct FAT examination (Appendix A). The OP was selected by the Technical Steering Committee due to its ease of collection and relevancy to vertical transmission.

Table 1.

SPECIES AND STOCKS MONITORED

Hatchery	Species (abbreviation*)	Stocks (abbreviation*)
Rapid River+ Riggins, ID	Spring Chinook (SC)	Hell's Canyon & Rapid R. mixed (RR)
McCall McCall, ID	Summer Chinook (SU)	S. Fork Salmon R. (SF)
Sawtooth Stanley, ID	Spring Chinook (SC)	E. Fork Salmon R. (EF) Salmon R.-Sawtooth (SWT)
Pahsimeroi+ Ellis, ID	Summer Chinook (SU)	S.Fork Salmon R. (SF) Pahsimeroi R. (PAH)
Niagara Springs+ Wendell, ID	Steelhead-A (ST)	Hell's Canyon (HC) Pahsimeroi R. (PAH)
Magic Valley Filer, ID	Steelhead-A (ST) Steelhead-B (ST)	Pahsimeroi R. (PAH) E. Fork Salmon R. (EF)
Oxbow+ Oxbow, OR	Steelhead-A (ST) broodfish only	Hell's Canyon (HC)

* As defined by Idaho Dept. of Fish & Game
f Idaho Power Company funded facility

Table 2. Fish and hatchery background information:
 Juvenile (400 - 1000 fish/kg) production data

LOCATION	STOCK	REUSE %	No. UNITS	UNIT TYPE	UNIT CONSTRUC.	WATER SUPPLY
SAWTOOTH	87-SWT-SC	0	12	RACEWAY	CONCRETE	SURFACE
	87-EF-SC	0	2	RACEWAY	CONCRETE	SURFACE
(Well water available for early rearing)						
PAHSIMEROI	87-PAH-SU	0	1	POND	EARTHEN	SURFACE
	87-SF-SU	0	1	POND	EARTHEN	SURFACE
(Well water available for incubation) (Concrete raceways used for early rearing)						
McCALL	87-SF-SU	0	2	POND	CONCRETE	SURFACE
RAPID R.	87-RR-SC	0	2	POND	EARTHEN	SURFACE
NIAGARA S.	88-PAH-ST	0	8	RACEWAY	CONCRETE	SPRING"
	88-HC-ST	0	6	RACEWAY	CONCRETE	SPRING"
MAGIC V.	88-PAH-ST	0	13	RACEWAY	CONCRETE	SPRING+
	88-EF-ST	0	3	RACEWAY	CONCRETE	SPRING+

9; Uncovered spring
 + Covered spring

Polyethylene Glycol (PEG). A stock solution of 25% PEG (w/v) was prepared by adding enough Eagle's Minimum Essential Media (MEM-0) to 25 g PEG 20000 (Sigma Chemical Co.) to produce 100 ml of solution. This solution was then autoclaved at 120 c for 20 min., cooled, and mixed with an anti-microbial solution (Appendix A) to reach a 7% concentration (v/v) of PEG. One milliliter aliquots were frozen until needed for microbial decontamination of tissue and ovarian fluid samples. After 24 h incubation in antimicrobial/PEG, samples were inoculated onto preformed cell sheets. Pre-treatment of cell monolayers with PEG is reported to increase sensitivity to IHNV (Batts & Winton, 1988). The inclusion of PEG in anti-microbial solution was based on work by Ray Brunson (LJSFWS - Olympia Fish Health Center) and results from a trial conducted at the Eagle Laboratory by Sharon Wavra.

Whirling Disease Assay. The heads of juvenile fish were cut in half along the dorsal-ventral plane. Sections from five heads were pooled for the pepsin - trypsin digest assay (Amos, 1985) and the other corresponding sections were fixed in 10% buffered formalin for histological confirmation.

Two cores were taken from each adult head by use of an electric drill with a 1 inch diameter holesaw attachment. Five cores were pooled for the digest assay, and the other corresponding cores fixed in 10% buffered formalin for histology. The cores were drilled approximately 3 - 6 cm posterior to the eye

on a dorsal - ventral orientation. The cores were taken on either side of the fish's midline axis, the objective being to include the otolith region in each core (Lorz & Rohovec, 1988).

Samples were defleshed by first heating them in an 80-90 F waterbath for 20 min followed by the removal of soft tissue with forceps. This method was laborious and resulted in the contamination from myxozoan spores found in nervous tissue. Beginning in February 1989, heated samples were placed in wire strainers and sprayed with a stream of water to remove tissue. Wash water was sterilized with 400 ppm. bleach. The small quantity of tissue remaining (primarily fragments of skin and heart) was then picked out with forceps. Bone and cartilage samples were then processed as outlined by Amos (1985). This procedure produced a sample devoid of tissue and vastly reduced the number of myxozoan spores other than those of Myxobolus cerebralis seen in the digest concentrate. Spore concentrates were stained with 0.1% malachite green. A small drop of the concentrate was placed on a slide coated with 1.5% agar, a coverslip was placed on the drop and the slide was examined at 1000X oil immersion for critical measurements. If histological confirmation was necessary, fixed tissue was decalcified in 10% hydrochloric acid for 6-12 h, checked for rigidity, washed in tap water for 30 min, and processed for paraffin sections. Five micron sections from two locations in each core were stained with a modified May-Grucnwald Gicmsa (Yasutake and Wales, 1983).

RESULTS AND DISCUSSION

Objective 1.0 Complete Start-up Phase

Task 1.1 Acquire Competent Staff

Completed December 2, 1987. Personnel funded under this contract are:

- 1) Scott Foott, Fishery Pathologist
- 2) Sharon Wavra, Fish Health Laboratory Technician

Other personnel at Eagle Fish Health Laboratory include a fishery pathologist, two fish health technicians, and a secretary, all of whom are funded under other means. The fish health technologists assist in BPA funded lab work as needed.

Task 1.2 Acquire all necessary equipment and supplies.

A summary of expenditures is listed in Appendix B.

Task 1.3 Install equipment and complete BPA approved facility renovations.

Not applicable.

Objective 2.0 Serve on the Project Technical Steering Committee (TSC).

Task 2.1 Technical Steering Committee.

Scott Foott attended the June 1, 1988 EIBS workshop at Evergreen College and June 2 meeting of the TSC at

Washington Department of Wildlife, Olympia Office. Kent Hauck attended the September 20, 1988 TSC meeting in Coeur d'Alene. The TSC meetings on January 19, 1989, and April 20, 1989, were attended by Scott Foott.

Task 2.2 Technology transfer.

- 1) A presentation on the use and current legal status of chemotherapeutics was presented by Scott Foott to hatchery personnel at a February 22, 1989, hatchery coordination meeting. Individual hatchery presentations on current research findings regarding whirling disease, EIBS, and BKD as well as necropsy technique demonstrations were given during May 1989 by Scott Foott.
- 2) Organosomatic data from the 1989 smolt release groups was supplied to the Fish Passage Center in Portland.
- 3) A cooperative effort with Ronald Pascho (USFWS National Fishery Research Center, Seattle) on BKD testing of Sawtooth hatchery spring chinook broodstock produced an interesting comparison of methodology sensitivities (see broodstock testing).
- 4) Blood and tissues samples from EIBS positive chinook at Rapid River hatchery were sent to Dr. Ronald Hedrick, University of California, Davis for electron microscopy work.

- 5) Isolates from an IHNV outbreak at Niagara Springs hatchery were supplied to Dr. Sandra Ristow at Washington State University for use in her viral typing research, and EIBS data from Rapid River hatchery was assembled for inclusion in: Holt, R.A. and Piacentini, S. 1989. Erythrocytic Inclusion Body Syndrome. PNFHPC Informational Report No. 1.
- 6) An interview regarding Salmon river anadromous fish health and the BPA monitoring project was published in the September 29, 1988 issue of The Challis Messenger.

Task 2.3 Facility Impediments.

Several changes have been made to the facility impediment correction list found in the 1987 annual report (Foott & Hauck, 1988). Cost estimates have not been included in the following list. The IDFG Bureau of Fisheries feels that the development of valid cost estimates will be undertaken after BPA has commented on the following correction list (pers. comm. B. Hutchinson with Scott Foott).

A draft of the following facility impediment correction list was sent on June 12, 1989 to Mr. Paul Abbott (Idaho Power Co.), Mr. Ed Crateau (U.S. Fish & Wildlife Ser.- Lower Snake River Comp. Plan Office) and Mr. Joe McMichael (U.S. Army Corp. of Engineers) for review and comment. At the time of this writing, Idaho Power Co. (IPC) and U.S. Fish & Wildlife had responded. In

both a February 1989 and a July 1989 phone conversation with L. Wimer and P. Abbott respectively (Fisheries Program, IPC), no objection to the corrections list for Rapid River, Oxbow, Pahsimeroi, and Niagara Springs hatchery was made, however, it was communicated that financial constraints would limit the number of corrections implemented and timing of their implementation.

SITE SPECIFIC RECOMMENDATIONS

A. Rapid River Hatchery

1 IMPEDIMENT - The earthen adult pond 2 has poor flow characteristics which impact any chemical flush treatments (hot spots). It also receives effluent from production pond 1 which can subject the adults to disease transmission from and chemotherapeutics being presented to the juveniles.

CORRECTION - Remodel adult pond 2 into a multiple section concrete unit with an independent well or river water source (well water cooler than river).

2) IMPEDIMENT - The water supply for production pond 1 must pass through the nursery raceway system prior to entering the pond. The raceways do not contain fry when the production pond is in operation. Stagnant water and organic accumulations in the idle raceways are thought to contribute to bacterial gill disease epizootics at this station.

CORRECTION - Build a pipeline to pond 1 which bypasses the raceways.

- 3) IMPEDIMENT - The accumulation of organic matter and fish carcasses in the ponds act as a reservoir for fungal, parasitic, and bacterial pathogens.

CORRECTION - Cover earthen pond bottoms.

- 4) IMPEDIMENT - The hatchery receives its entire water supply from Rapid River, which contains resident fish and migratory adults that are allowed to spawn above the hatchery trap. Several horizontally-transmitted diseases (EIBS, BKD, Saprolegnia, bacterial gill disease) have a major impact on smolt production.

CORRECTION - Conduct feasibility study on the engineering requirements for a filtration and disinfection system for the entire hatchery.

B. McCall Hatchery

- 1) IMPEDIMENT - Sediment deposition in the incubators which causes egg suffocation.

CORRECTION - Build a sediment trough for incubator water supply.

- 2) IMPEDIMENT - Low flows and high water temperatures at the South Fork trap increase prespawning adult mortality due to Saprolegnia.

CORRECTION - Decreasing water temperature via well water

may be a possible solution, although the danger of electrical power loss and the unknown effect of well water on homing may make this option unfeasible.

C. Sawtooth Hatchery

- 1) IMPEDIMENT - Adult trap and spawning facility receives its water supply from the hatchery effluent pond. This situation exposes the adult broodstock to chemotherapeutic effluent, pathogens shed by the juveniles, and low quality water (warmer temperatures than river, high organic content, low dissolved oxygen).
CORRECTION - Direct settling pond effluent to the river and supply adult ponds with well (lower temperature and pathogen load than river water) or river water. Well water could affect homing and may not be a viable substitute for river water.
- 2) IMPEDIMENT - The river supplies the majority of the hatchery's outside raceways and selected inside vats. Resident fish and migratory adults, which are allowed to spawn above the hatchery trap, are present in the river. Several horizontally-transmitted diseases (BKD, Saprolegnia, external parasites, Myxobolus cerebralis, bacterial gill disease) have an impact on smolt production.
CORRECTION - Conduct feasibility study on the

engineering requirements for a filtration and disinfection system for the entire hatchery.

- 3) IMPEDIMENT - Solid waste removal activities (sweeping) cause both injury and a stress reaction in juveniles. The high altitude (6,500 ft) increases sunburn problems.
CORRECTION - Install baffles in outside raceways to both flush wastes and provide shade.

D. Pahsimeroi Hatchery

- 1) IMPEDIMENT - A high prevalence and intensity of infection for Myxobolus cerebralis occurs in the production chinook. Tubifex worms have been documented to be the intermediate hosts for this parasite (Wolf & Markiw, 1984), and are ubiquitous fauna to earthen ponds. The accumulation of organic matter and fish carcasses in the ponds acts as a reservoir for fungal, parasitic, and bacterial pathogens.

CORRECTION - Cover earthen pond bottoms.

- 2) IMPEDIMENT - Transmission of fish pathogens (M. cerebralis, BKD, external parasites) from river water to juveniles.

CORRECTION - Conduct feasibility study on the engineering requirements for a filtration and disinfection system for the entire hatchery.

E. Oxbow Hatchery

- 1) IMPEDIMENT - The high temperatures and sediment loads of

the Snake River in the spring are detrimental to egg incubation.

CORRECTION - Supply well water for all early rearing.

- 2) IMPEDIMENT - The hatchery is located below Oxbow dam and is thus potentially subjected to gas supersaturation in times of high spills. A chronic septicemia problem (see Task 3.2, Adults) may have been related to the debilitation effects of subacute gas supersaturation.

CORRECTION - Measure supersaturation and provide facility corrections as needed. Continuous monitoring equipment situated in-line is recommended to detect shifts in gas supersaturation and correlate them with mortality.

F. Niagara Springs Hatchery

- 1) IMPEDIMENT - High densities in the nursery vats due to inadequate space.

CORRECTION - Increase nursery space (building & tanks).

- 2) IMPEDIMENT - Potential horizontal transmission of fish pathogens to steelhead by birds moving between adjacent commercial facility with history of IHNV outbreaks and Niagara Springs hatchery.

CORRECTION - Bird wires and fencing of raceway area.

- 3) IMPEDIMENT - The facility experiences chronic myxobacterioses throughout the rearing cycle, and the springs which supply the hatchery contain resident fish

which are potential sources of pathogens.

CORRECTION - Conduct feasibility study on the engineering requirements for a filtration and disinfection system for the entire hatchery. Alternate: eradicate fish from springs and cover springs,

G. Magic Valley Hatchery

1) IMPEDIMENT - Higher than optimal gas supersaturation levels (106-109%) detected in 1988 constitute a potential stressor to steelhead stocks (see Task 4.1).

CORRECTION - Engineering study to determine the cause of this situation and provide measures to decrease gas supersaturation level of water supplied to raceways.

H. General recommendations applicable to all anadromous stations:

1) All facilities using surface water have the capacity for filtration and disinfection of their entire water supply. Water disinfection is recommended for such facilities to optimize fish health. The ultimate goal is for a water supply free of Class A and B pathogens (Pacific Northwest Fish Health Protection Committee categories).

2) Well water supplies for all early rearing and broodstock facilities in order to reduce chemical usage and improve water quality.

3) Each earthen pond be converted to a rearing container

- which can be cleaned of organic matter and fish carcasses on a periodic basis during the rearing cycle.
- 4) Baffles be installed in all rearing units where practical.
 - 5) Bird and animal protection be given to all outside rearing containers.
 - 6) Formalin delivery systems be installed at all broodstock and egg incubation facilities to meet OSHA standards and optimize treatment efficiency.

Objective 3.0 Conduct Augmented Fish Health Monitoring

Task 3.1 Physiological assessment (Organosomatic analysis) of smolts.

The organosomatic assessment system developed by Goede (1988) was employed for the pre-liberation smolt checks. Methodology was described in the 1987 annual report (Foott & Hauck, 1988). Tables 3 - 5 illustrate the results obtained from the 1989 smolt release groups. A key to the category symbols in Table 5 is found in Table 6. Petechial hemorrhage of the thymus was prevalent (35-40%) in the 1988 BY steelhead stocks at Magic Valley hatchery and to a lesser degree (5-15%) at Niagara Springs hatchery (Table 5). A similar situation (15-30% prevalence) occurred in 1988 to the 1987 BY steelhead. Chinook stocks showed a lower prevalence (2-5%)

in this category than the steelhead with the exception of the East Fork Spring Chinook (10%).

The majority of pyloric fat scores were in the number 3 category (Table 6), however, the chinook stocks showed a larger variation than the steelhead stocks (Table 5). Steelhead are reared on constant 14 C spring water while all chinook stocks receive surface water supplies which subject these fish to cold water temperatures in the winter. The effect of winter conditions on mesentery fat accumulation was exemplified by the difference in fat scores between the fall release SWT-SC (3# = 80%, #4 = 20%) versus the same stock released in March (#2 = 13%, #3 = 87%). The prevalence of "fatty" livers (category c) varied from 2 - 20% in the chinook smolts. Several chinook stocks demonstrated a low prevalence of swollen or mottled kidneys (2 - 8%), exophthalmia (2 - 15%), and enlarged spleens (2 - 12%): Bacterial kidney disease was the most likely cause of the kidney abnormalities, exophthalmia and splenomegaly (enlarged spleens) observed in chinook at Sawtooth, McCall, and Rapid River hatcheries. EIBS may have also been a contributing factor in the occurrence of enlarged spleens at Rapid River hatchery (Table 8).

No abnormalities in blood values, pseudobranch structure, gall bladder content, or hind gut condition was observed in any of the stocks.

Table 3. Organosomatic analysis of 1989 smolt release groups: mean values (SD) of length (mm), weight (g), and condition factor (K-Factor x 105).

<u>Hatchery</u>	<u>Stock</u>	<u>No.</u>	<u>Length</u>	<u>Weight</u>	<u>K-Fact.</u>
Sawtooth*	SWT-SC+	60	125.7 (11.8)	19.8 (5.9)	1.00 (0.08)
	Fall 1988 Release Group				
	SWT-SC	60	128.6 (16.6)	19.3 (10.2)	0.91 (0.00)
	EF-SC	60	147.9 (20.9)	33.1 (20.0)	1.02 (0.65)
McCall*	SF-SU	60	129.7 (9.6)	20.9 (4.4)	0.96 (0.12)
Rapid R.*	RR-SC	60	127.5 (8.2)	18.5 (4.4)	0.89 (0.22)
Pahsimeroi	SF-SU	20	148.8 (28.7)	33.1 (24.2)	1.00 (0.01)
Magic Valley	EF-ST	20	213.6 (21.3)	113.0 (52.2)	1.16 (0.28)
	PAH-ST	20	224.9 (21.3)	112.3 (33.2)	0.99 (0.11)
Niagara Springs	PAH-ST	20	229.4 (25.8)	121.9 (37.0)	1.01 (0.09)
	HC-ST	20	226.2 (27.7)	117.6 (51.0)	1.02 (.011)

* Index hatcheries.

t Experimental release group of a million fish in October 1988

Table 4. Organosomatic analysis of 1989 smolt release groups: mean values (SD) of hematocrit (Hct), leukocrit* (Lct), and plasma protein (g/dl).

Hatchery	Stock	No.	Hct (%)		Lct (%)		Pl. Protein	
Sawtooth+	SWT-SC++	60	42.3	(5.4)	0.65	(0.35)	6.5	(0.9)
	Fall 1988 Release Group							
	SWT-SC	60	39.9	(6.1)	0.35	(0.35)	4.6	(1.2)
	EF-SC	60	42.6	(5.6)	0.57	(0.40)	5.5	(1.2)
McCall+	SF-SU	60	46.9	(7.9)	0.43	(0.37)	7.5	(1.7)
Rapid R.+	RR-SC	60	38.8	(9.8)	0.51	(0.50)	6.2	(1.0)
Pahsimeroi	SF-SU	20	41.7	(3.6)	0.55	(0.43)	5.8	(0.8)
	PAH-SU	20	41.2	(3.2)	0.63	(0.35)	6.2	(0.8)
Magic Valley	EF-ST	20	47.9	(4.2)	1.21	(0.37)	5.6	(0.7)
	PAH-ST	20	43.3	(3.4)	1.44	(0.52)	5.5	(0.9)
Niagara Springs	PAH-ST	20	47.3	(4.3)	1.29	(0.41)	4.8	(1.1)
	HC-ST	20	44.1	(5.6)	1.03	(0.20)	4.5	(0.8)

⁷: Leukocrit qualitatively measured in units of 0.5.

t Index hatchery as specified in task 3.1.

++ Experimental release group of a million fish in October 1988

Table 5. Organosomatic analysis of 1989 smolt release groups Percentage of sample population in selected tissue score groups.

Hatchery	Stock	EYE		THYMUS		FAT			SPLEEN		KIDNEY		LIVER		
		N	Elf2	0	1	2	3	4	R	E	N	M/S	B	C	E
SAWTOOTH	SWT-SC" FALL RELEASE GROUP	95	5	100	0	0	80	20	100	0	98	2	87	13	0
	SWT-SC	90	10	98	2	13	87	0	100	0	97	3	78	20	0
	EF-SC	100	0	90	10	15	75	10	98	2	95	5	87	12	1
McCALL	SF-SU	85	15	98	2	32	68	0	90	10	92	8	92	5	3
RAPID R.	RR-SC	97	2	98	2	25	70	5	88	12	95	5	98	2	0
PAHSIMEROI	SF-SU	100	0	100	0	40	60	0	100	0	100	0	95	5	0
	PAH-SU	100	0	95	5	5	95	0	100	0	100	0	100	0	0
MAGIC VALLEY	EF-ST	100	0	65	35	0	90	10	100	0	100	0	100	0	0
	PAH-ST	100	0	60	40	0	80	20	100	0	100	0	100	0	0
NIAGARA SPRINGS	HC-ST	100	0	85	15	3	65	30	100	0	100	0	100	0	0
	PAH-ST	100	0	95	5	0	80	20	100	0	100	0	100	0	0

* Experimental release of a million fish in October 1988.

Table 6. Organosomatic analysis: Key for selected qualitative organ ratings.

Eyes		Gill		Pseudobranch	
N	Normal	N	Normal	N	Normal
B1	One blind	F	Fray	S	Swollen
B2	Two blind	C	Clubbed	L	Lithic
E1	One exophthalmic	M	Marginate	I	Inflamed
E2	Two exophthalmic	P	Pale	OT	Other
H1	One hemorrhagic	OT	Other		
H2	Two hemorrhagic				
OT	Other				

Thymus		Spleen		Kidney	
0	No hemorrhage	B	Black	N	Normal
1	Mild hemorrhage	R	Red	S	Swollen
2	Severe hemorrhage	G	Granular	M	Mottled
		NO	Nodular	U	Urolithiasis
		E	Enlarged	OT	Other
		OT	Other		

Mesentery Fat		Liver	
0	None	A	Red
1	< 50 % of each pyloric cecum covered	B	Light Red
2	50 % of each pyloric cecum covered	C	Fatty liver
3	> 50 % < 100% " " " " "	D	Nodules
4	Ceca completely covered	E	Focal Discoloration
		OT	Other

Task 3.2 Test for specific pathogens

JUVENILES

Prevalence of infection data for 1987 BY chinook and 1988 BY steelhead juveniles are listed in Tables 7 & 8. Bacterial kidney disease was quite prevalent at both McCall (27% in October 1988, 47% in February 1989), and Sawtooth (0% in October 1988, 23-53% in March 1989) hatcheries.

The chinook stock at Rapid River hatchery was severely impacted by infection with the virus responsible for Erythrocytic Inclusion Body Syndrome (EIBS) and secondary infection by Saprolegnia spp. It is estimated that 80-90% of the total fry-to-smolt mortality (12%) of this stock was related to the debilitating effects of EIBS infection. Transmission electron micrographs (TEM) revealed viral particles (70-75 nm) within erythrocyte inclusions (TEM work courtesy of Dr. Ronald P. Hedrick, University of California, Davis). Inclusions were first observed in one of two production ponds (pond 2) in September 1988. The prevalence of EIBS inclusions and number of fungus-related mortalities in pond 2 peaked in October 1988. EIBS infected fish were first detected in pond 1 on October 6, 1988 (prevalence of infection = 14%). When sampled in February for the pre-liberation check, pond 1 chinook had a 53% prevalence of infection (versus 24% in Pond 2). Clinical signs included anemia, fungal infection of the caudal region, and splenomegaly. Subclinical IHN was detected in 1 of 5 pools of brain tissue from

EIBS infected chinook.

Myxobolus cerebralis spores were detected in chinook at Pahsimeroi and Sawtooth hatcheries. The intensity of infection was greater in the Pahsimeroi stocks than the Sawtooth fish. A Myxobolus spp. spore was detected by the digest method in Rapid River chinook juveniles. This spore had a thicker spore wall and was larger than M. cerebralis. Histological examination of corresponding head samples showed spores within brain tissue, not in cartilage as is the characteristic location for M. cerebralis spores.

Significant Diagnostic Cases: 1987 BY chinook & 1988 BY steelhead.

In April 1988, an outbreak of Phoma herbarum occurred in 87SFS1J fry at McCall hatchery, but mortality was very low. An IHNV epizootic occurred in May 1988 in steelhead fry at Niagara Springs hatchery and resulted in a 23% mortality (351,400 88HC fry). A low prevalence of IHNV infection and related mortality continued throughout the summer in this population. Bacterial gill disease in chinook juveniles at Rapid River hatchery resulted in a 0.86% (3.2 million in ponds at this time, 81 fish/kg size) monthly mortality in August 1988. IPNV was detected in steelhead juveniles at Magic Valley hatchery in November 1988, and IHNV was isolated from moribund fish in February 1989. In both cases, mortalities were light. There was no detection of proliferative

kidney disease, furunculosis, Yersinia ruckeri, or Ceratomyxa Shasta in any of the monitored production stocks.

ADULTS: Chinook

Prevalence of infection data for the 1988 chinook broodstocks is listed Table 9. The Rapid River chinook were the only broodstock in which IHNV was isolated. EIBS inclusions were not observed in bloodsmears from any of the surveyed stocks. Renibacterium salmoninarum was found in ovarian fluid pellet (OP) samples taken from all stocks with the prevalence of infection ranging from 2 - 47%. A ten percent prevalence of BKD infection was detected in kidney smears from pre-spawn mortalities at the South Fork trap. A low level infection of Myxobolus spp. spores were found in digest preparations from broodstocks at Pahsimeroi, Rapid River, and Sawtooth hatcheries. The spores ranged in size from 7-12 μm in length and 8-10 μm in width. From histological examination of corresponding cores, we failed to detect spores in bone or cartilage, however, one core from a Rapid River fish contained Myxobolus spp. spores within brain tissue.

ADULTS: Steelhead

Prevalence of infection data for the 1988 steelhead broodstocks is Listed in Table 10. The Hell's Canyon stock (Oxbow) was the only broodstock in which virus was detected. The isolation of IHNV from tissue and ovarian fluid (combined

prevalence of infection = 63%) correlates with the IHNV outbreaks which occurred in steelhead fry (Hell's Canyon) at Niagara Springs hatchery in May 1988. Hell's Canyon stock eggs are sent to Niagara Springs hatchery for rearing.

Spores of Ceratomyxa Shasta were found in two of eighteen lower intestine smears taken from the Hell's Canyon broodstock. There were no signs of ceratomyxosis in these fish nor any other stocks surveyed.

The prevalence of infection results for a few samples checked for Renibacterium salmoninarum are in question, as a retrospective check of the FAT conjugate (original stock from USFWS Leetown Biologics Laboratory) showed it was contaminated. This low level bacterial contamination could have produced false positive results in samples from the Hell's Canyon, East Fork, and Pahsimeroi stocks (Table 10).

Spores of a Myxobolus spp. were detected in the broodstocks at Sawtooth and Pahsimeroi hatcheries (Table 10). The size and morphology of some of these spores were consistent with M. cerebralis, however, a larger spore (12 x 10 urn) was the predominant isolate from digest preparations. Both Sawtooth and Pahsimeroi hatcheries are endemic sites for whirling disease.

The prevalence of infection data for the 1989 steelhead broodstock is listed in Table 11. IHNV was detected in the Sawtooth stock (1 of 35 pools) and IPNV in the East Fork fish (2 of 12 pools). Only the East Fork stock tested positive for R.

salmoninarum (2 of 57 Ovarian Fluid Pellets). A presumptive identification of M. cerebralis infection has been made from digest assay results from the Pahsimeroi stocks. Histological examination of core sections revealed one Myxobolus spore within brain tissue but no spores within cartilage, Histological examination of core sections from Sawtooth adults revealed Myxobolus spores within cartilage and brain tissue. It appears that Myxobolus cerebralis and at least one other Myxobolus species is present in the Sawtooth fish. Confirmation by histology has been labor intensive. Spores have been observed in only a few sections out of the hundred-plus sections cut to date. A better method for identification is needed whether it be serological (Halliday, 1976; Griffin, B. & E. Davis, 1978) or the selection of a tissue site which has the highest probability of spore infection.

Steelhead broodstock at Oxbow hatchery experienced a prespawn mortality of 21% due to infections with Aeromonas hydrophilia and various Pseudomonas spp. In comparison, 1988 prespawn mortality was only seven percent. Mortalities began in January 1989, and oxytetracycline treatments (5 mg/kg fish subcutaneous injection) were given in February and March. Broodstock is trapped both in the fall and again starting in February up through the spawning in March. Fish captured in the spring were held in a pond separate from the overwintered group. Bacterial infections occurred in both groups. A low prevalence of saprolegniosis also occurred in March.

Table 7. 1988 Midcycle Samples: Prevalence of Infection

HATCHERY	STOCK	SAMPLE DATE	EIBS	BKD	<u>FIVE FISH POOLS</u> M. CEREBRALIS
PAHSIMEROI	87-PAH-SU	10-22-88	0/60	1/60	41/12
	87-SF-SU	10-22-88	0/60	1/60	5/12
SAWTOOTH	87-SWT-SC	9-15-88	0/60	0/60	0/12
	87-EF-SC	9-15-88	0/60	0/60	0/12
McCALL	87-SF-su	10-07-88	ND	16/60	0/12
RAPID R.	87-RR-SC	11-10-88	33/88	0/60	0/12*
NIAGARA	88-HC-ST	12-12-88	0/60	0/60	0/12
SPRINGS	88-PAH-ST	12-12-88	0/60	0/60	0/12
MAGIC	88-PAH-ST	12-13-88	0/60	0/60	0/12
VALLEY	88-EF-ST	12-13-88	0/60	0/60	0/12

* 6/12 pools contained spores of a Myxobolus spp. which differed in size and morphology from M. cerebralis. Histological samples showed spores in brain tissue.

ND Not done

Table 8. 1989 Pre-liberation Samples: Prevalence of Infection

HATCHERY	STOCK	SAMPLE DATE	5 Fish Pools			EIBS	BKD
			IPNV	IHNV	WD+		
PAHSIMEROI	87-SF-SU	3-9-89	0/12	0/12	ND	ND	5/60
	87-PAH-SU	3-9-89	0/12	0/12	6/6	ND	2/60
SAWTOOTH	87-SWT-SC	3-8-89	0/12	0/12	5/6	ND	32/60
	87-EF-SC	3-8-89	0/12	0/12	6/6	ND	14/60
McCALL	87-SF-SLJ	2-28-89	0/12	0/12	ND	ND	28/60
RAPID R.	87-RR-SC	2-24-89	0/12	0/12	0/6*	23/60	16/60
NIAGARA S.	88-HC-ST	4-5-89	0/12	0/12	ND	ND	0/60
	88-PAH-ST	4-5-89	0/12	0/12	ND	ND	0/60
MAGIC V.	88-PAH-ST	4-6-89	0/12	0/12	ND	ND	0/60
	88-EF-ST	4-6-89	0/12	0/12	ND	ND	0/60

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+ Digest assay for Myxobolus cerebralis.
* 1/6 pools contained spores of a Myxobolus spp. which was different in size and morphology from M. cerebralis. No spores were detected in histological samples.
ND Not done

Table 9. 1988 Chinook broodstock prevalence of infection for IHN, IPNV, EIBS, WD (Myxobolus cerebralis) and BKD (Renibacterium salmoninarum). Samples of ovarian fluid (OF), kidney and spleen (KS) processed for viral assay, and kidney (KD) and ovarian fluid pellet (OP)* for BKD.

STOCK	FIVE FISH POOLS					INDIVIDUAL FISH		
	IHN		IPNV		WD	EIBS	BKD-OP	BKD-KD
	OF	KS	OF	KS				
SAWTOOTH	0/12	0/12	0/12	0/12	7/9 ^P	0/60	11/60	16/60 ⁺
EAST FORK	0/12	0/12	0/12	0/12	0/6 ^P	0/60	28/60	ND
SOUTH FORK	0/12	0/12	0/12	0/12	0/5	0/60	13/60	18/176
RAPID R. ++	13/83	ND	0/83	ND	5/7 ^P	0/60	24/60	ND
PAHSIMEROI	0/12	0/12	0/12	0/12	4/9 ^P	0/60	1/60	0/9

* Ovarian fluid was centrifuged at 2,000 X G, 20 min and a FAT smear prepared from the pellet.
P Presumptive identification of M. cerebralis based on presence of Myxobolus spores of various sizes in digest assay.
+ Kidney homogenates assayed by ELISA in conjunction with a USFWS study (Ron Pascho, Seattle).
++ Two fish pools (Viral work by W. Groberg, ODFW).
ND Not done

Table 10. 1988 Steelhead broodstock prevalence of infection for IHNV, IPNV, EIBS, WD (Myxobolus cerebralis) and BKD (Renibacterium salmoninarum). Samples of ovarian fluid (OF), kidney and spleen (KS) processed for viral assay, and kidney (KD) and ovarian cell pellet (OP) for BKD.

STOCK	FIVE FISH POOLS					INDIVIDUAL FISH		
	IHNV		IPNV		WD	EIBS	BKD-OP*	BKD-KD*
	OF	KS	OF	KS				
SAWTOOTH**	0/30	0/30	0/30	0/30	6/6 ^P	0/60	0/58	ND
EAST FORK+	0/60	0/60	0/60	0/60	0/5	0/60	10/58	1/20
PAHSIMEROI	0/13	0/13	0/13	0/13	4/7 ^P	0/60	15/65	5/11
HELLS CAN.	9/12	6/12	0/12	0/12	0/6	0/60	28/60	9/22

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- * Anti-Renibacterium salmoninarum FAT conjugate used was contaminated and may have produced some false positives. Ovarian fluid was centrifuged at 2,000 X G, 20 min and a FAT smear prepared from the pellet.
- ** Viral samples were run in two fish pools in order to coordinate with USFWS culling program.
- + Viral samples were run individually.
- P Presumptive identification of M. cerebralis based on presence of Myxobolus spores of various sizes in digest assay.
- ND Not done

Table 11. 1989 Steelhead broodstock prevalence of infection for IHN, IPNV, EIBS, WD (Myxobolus cerebralis) and BKD (Renibacterium salmoninarum). Samples of ovarian fluid (OF), kidney and spleen (KS) processed for viral assay, and ovarian fluid pellet" (OP) for BKD.

STOCK	FIVE FISH POOLS						INDIVIDUALS	
	<u>IHN</u>		<u>IPNV</u>		<u>1-OCEAN</u>	<u>2-OCEAN</u>	EIBS	BKD-OP
	OF	KS	OF	KS	WD	WD		
SAWTOOTH**	0/35	1/35	0/35	0/35	1/6 ^P	6/6 ⁺	0/60	0/60
EAST FORK++	0/12	0/12	0/12	2/12	4/6 ^P	0/6	0/60	2/57
PAHSIMEROI	0/12	0/12	0/12	0/12	6/6 ^P	3/6 ^P	NC	0/60
HELLS CAN.	0/12	0/12	0/12	0/12	0/4	0/6	0/60	0/60

+ Myxobolus spp. spores found in brain tissue and M. cerebralis spores observed in cartilage.
P Presumptive identification of M. cerebralis based on presence of Myxobolus spores of various sizes in digest assay. Histological examination unable to detect spores in cartilage.
* Ovarian fluid was centrifuged at 2,000 X G, 20 min and a FAT smear prepared from the pellet.
** Viral samples were run in two fish pools in order to coordinate with USFWS culling program.
NC Not completed, work in progress.

Objective 4.0 Conduct studies of hatchery water supplies

Task 4.1 & Task 4.2. A water sampling plan was submitted to BPA in 1988, and the IDFG is awaiting BPA solicitation of a laboratory contractor.

Monthly monitoring of gas supersaturation levels at contract facilities revealed an increase in this parameter (106-109%, total dissolved gas) at Magic Valley hatchery beginning in October 1988. It is unclear how this situation is occurring as saturation levels run at 100-102% in the water supply prior to reaching the stripping tower. From the stripping tower, water runs in a underground pipeline until it reaches the headrace canal of the production ponds. No overt signs of gas bubble trauma have been observed in the stocks to date; however, current research indicates that chronic exposure to sublethal supersaturation levels can effect the immune response of salmonids (Krise, 1988).

Task 4.3 Record flow and density index data.

Production data recorded in a Lotus 1-2-3 spreadsheet are listed in Table 12. Definitions of abbreviations in Table 12 are listed below:

MO/YR	month/year
STOCK abbreviation	broodyear, egg source abbreviation, species (see Table 1)
No. FISH	number of fish in the stock

FISH/kg number of fish to make one kilogram (size index)

AVG TEMP (C) average monthly water temperature in degrees C

FLO. IND. flow index of entire stock (Piper et al., 1986)

DEN. IND. density index of entire stock (Piper et al.,1986)

% MORT number of monthly mortalities/ total number x 100

Objective 5.0 Record, analyze and report fish health monitoring and related data.

Task 5.1 Data forms submitted to BPA in January 1988.

Task 5.2 The reporting template of the disease database program is shown in Appendix C. The program is based on DBase III+ and written with the Clipper software program.

Task 5.3 Data summaries have been submitted in quarterly reports. Work with this task is on-going.

Objective 6.0 Estimate projects benefits

Task 6.1.1 & Task 6.2.1 Historical records of disease severity and causative agents are being collected and analyzed.

Task 6.1.3 Number and causative agent of epizootics

Table 12. Monthly production summaries of anadromous stocks.

SAWTOOTH		AVG						
MO/YR	STOCK	No.FISH	FISH/kg	TEMP(C)	FLO.IND.	DEN.IND.	%MORT	
JAN88	87SWTSC	2459955	1157.4	2.6	ERR	ERR	0.31	
JAN88	87EFSC	333537	1250.1	2.8	ERR	ERR	0.04	
FEB88	87SWTSC	2454082	985.5	3.4	ERR	ERR	0.24	
FEB88	87EFSC	332713	1009.8	3.4	ERR	ERR	0.25	
MAR88	87SWTSC	2448923	650.4	4.5	ERR	ERR	0.00	
MAR88	87EFSC	330424	ERR	4.5	ERR	ERR	0.00	
APR88	87SWTSC	2418821	385.8	7.3	0.93	0.17	1.23	
APR88	87EFSC	323957	445.3	7.3	0.17	0.12	1.96	
MAY88	87SWTSC	2383430	228.7	9.2	1.31	0.24	0.78	
MAY88	87EFSC	316374	227.9	9.2	0.76	0.19	0.65	
JUN88	87SWTSC	2323915	158.7	10.6	0.97	0.15	0.48	
JUN88	87EFSC	315056	156.5	10.6	0.70	0.12	0.42	
JUL88	87SWTSC	2320510	86.0	11.8	1.31	0.23	0.15	
JUL88	87EFSC	314601	63.8	11.8	1.00	0.19	0.14	
AUG88	87SWTSC	2316193	63.9	13.4	1.52	0.27	0.19	
AUG88	87EFSC	314019	61.7	13.4	1.18	0.22	0.18	
SEP88	87SWTSC	2309224	48.5	14.4	1.88	0.33	0.30	
SEP88	87EFSC	313300	44.1	14.4	1.58	0.30	0.23	
OCT88	87SWTSC	1313965	46.3	7.8	2.54	0.33	0.21	
OCT88	87EFSC	312794	39.7	7.8	2.48	0.31	0.16	
NOV88	87SWTSC	1313322	48.4	2.2	2.43	0.32	0.05	
NOV88	87EFSC	312359	44.0	2.2	2.24	0.28	0.14	
DEC88	87SWTSC	1312433	46.3	1.7	2.54	0.33	0.07	
DEC88	87EFSC	311863	39.7	1.7	2.47	0.31	0.16	
JAN89	87SWTSC	1310239	46.3	1.1	2.54	0.33	0.17	
JAN89	87EFSC	310758	44.1	1.1	2.22	0.28	0.35	
FEB89	87SWTSC	1306130	52.9	1.6	2.21	0.29	0.31	
FEB89	87EFSC	309146	48.5	1.6	2.01	0.25	0.52	
MAR89	87SWTSC	1299833	49.8	2.8	2.34	0.31	0.48	
MAR89	87EFSC	305269	43.5	2.8	2.21	0.28	1.25	

McCALL		AVG						
MO/YR	STOCK	No.FISH	FISH/kg	TEMP(C)	FLO.IND.	DEN.IND.	%MORT	
FEB88	87SFSU	1857492	2024.2	2.8	0.67	0.27	0.83	
MAR88	87SFSU	1844604	1450.8	4.5	0.67	0.27	0.69	
APR88	87SFSU	1835896	1034.2	6.7	0.25	0.09	0.47	
MAY88	87SFSU	998011	569.9		0.33	0.12	0.30	
JUN88	87SFSU	1001361	257.7	9.0	0.42	0.12	0.27	
JUL88	87SFSU	1079302	126.7	9.5	0.53	0.20	0.40	
AUG88	87SFSU	1032055	93.5	10.6	0.66	0.12	0.80	
SEP88	87SFSU	1023531	78.5	8.4	0.73	0.13	0.83	
OCT88	87SFSU	1016549	64.9	7.3	0.82	0.15	0.68	
NOV88	87SFSU	1009094	53.5	6.2	0.92	0.17	0.55	
DEC88	87SFSU	1003477	49.5	3.4	0.94	0.12	0.52	
JAN89	87SFSU	998232	49.5	3.4	0.96	0.13	0.88	
FEB89	87SFSU	989389	48.4	3.4	1.00	0.19	0.89	
MAR89	87SFSU	975000	45.9	3.4	1.00	0.19	1.45	

Table 12cont.

PHASIMEROI		AVG					
MO/YR	STOCK	No.FISH	FISH/kg	TEMP(C)	FLO.IND.	DEN.IND.	%MORT
JAN88	87PAHSLJ	574241	2676.5	2.9	0.63	0.21	0.31
JAN88	87SFSU	537398	2142.4	2.9	0.69	0.23	0.36
FEB88	87PAHSU	572716	1706.2	4.4	0.86	0.28	0.15
FEB88	87SFSU	536008	1420.3	4.4	0.90	0.30	0.13
MAR88	87PAHSU	570567	1110.2	0.4	0.51	0.38	0.29
MAR88	87SFSU	527788	1003.9	0.4	0.48	0.36	1.36
APR88	87PAHSU	561883	497.9	8.3	0.64	0.02	1.65
APR88	87SFSU	527788	433.0	8.3	0.79	0.02	2.10
MAY88	87PAHSU	565337	275.6	10.4	1.15	0.03	1.08
MAY88	87SFSU	505701	231.5	10.4	1.16	0.03	0.90
JUN88	87PAHSU	559698	165.3	12.7	1.27	0.05	0.56
JUN88	87SFSU	500656	143.3	12.7	1.26	0.05	0.45
JUL88	87PAHSU	554116	105.8	13.2	1.11	0.06	0.56
JUL88	87SFSU	495662	92.6	13.2	1.08	0.06	0.45
AUG88	87PAHSU	548588	72.8	14.3	1.42	0.08	0.56
AUG88	87SFSU	490718	65.0	14.3	1.37	0.08	0.45
SEP88	87PAHSU	543116	58.4	11.1	1.61	0.09	1.12
SEP88	87SFSU	485823	52.9	11.1	1.54	0.09	0.90
OCT88	87PAHSU	537698	47.6	10.5	2.42	0.10	0.56
OCT88	87SFSU	480977	43.4	10.5	2.00	0.10	0.45
NOV88	87PAHSU	537698	43.7	5.7	2.56	0.11	0.04
NOV88	87SFSU	480977	39.9	5.7	2.12	0.10	0.04
DEC88	87PAHSU	537298	42.5	2.2	2.73	0.11	0.04
DEC88	87SFSU	480777	38.8	2.2	2.24	0.10	0.04
JAN89	87PAHSU	537098	41.7	2.6	2.25	0.11	0.08
JAN89	87SFSU	480377	38.0	2.6	2.48	0.10	0.07
FEB89	87PAHSU	536898	39.5	2.6	2.35	0.11	0.04
FEB89	87SFSU	480177	35.9	2.6	2.59	0.11	0.04
MAR89	87PAHSU	536498	36.4	6.6	2.51	0.12	0.04
MAR89	87SFSU	479777	33.5	6.6	2.74	0.12	0.04

RAPID RIVER		AVG					
MO/YR	STOCK	No.FISH	FISH/kg	TEMP(C)	FLO.IND.	DEN.IND.	%MORT
JAN88	87RRSC	1290906	2577.8	2.6	0.49	0.23	1.10
FEB88	87RRSC	3972255	2315.5	3.4	0.46	0.21	0.47
MAR88	87RRSC	4836439	1486.5	5.1	0.82	0.36	0.62
APR88	87RRSC	4813714	695.2	7.2	1.29	0.43	0.47
MAY88	87RRSC	4912684	501.2	7.8	1.50	0.43	0.36
JUN88	87RRSC	3207242	187.4	10.1	0.93	0.09	0.08
JUL88	87RRSC	3199465	118.6	13.4	1.26	0.13	0.24
AUG88	87RRSC	3171827	80.9	13.4	1.61	0.16	0.86
SEP88	87RRSC	3167243	63.0	11.2	1.85	0.19	0.14
OCT88	87RRSC	2948779	57.5	9.7	1.89	0.18	6.90
NOV88	87RRSC	2933909	49.6	5.9	2.16	0.20	0.50
DEC88	87RRSC	2918468	48.8	3.0	2.57	0.20	0.53
JAN89	87RRSC	2901840	52.0	3.1	2.07	0.19	0.57
FEB89	87RRSC	2872355	48.2	2.8	2.20	0.20	1.02
MAR89	87RRSC	2819500	47.5	5.4	2.12	0.17	1.84

Table 1 Zcont.

MAGIC VALLEY				AVG			
MO/YR	STOCK	Nu.FISH	FISH/kg	TEMP(C)	FLO.IND.	DEN.IND.	%MORT
JUN88	88PAHST	1975095	1723.8	14.0	0.60	0.29	2.57
JUN88	88EFST	345090	2312.4	14.0	0.45	0.45	1179
JUL86	88PAHST	178953.3	533.5	14.0	0.16	0.17	2.79
JUL88	88EFST	352634	599.4	14.0	0.13	0.14	1.94
AUG88	88PAHST	1782320	189.6	14.0	0.32	0.19	0.40
AUG88	88EFST	351810	201.2	14.0	0.26	0.16	0.23
SEP88	88PAHST	1840785	103.4	14.0	0.49	0.15	0.38
SEP88	88EFST	351237	104.3	14.0	0.41	0.26	0.16
OCT88	88PAHST	1943030	55.9	14.0	0.65	0.25	0.33
OCT88	88EFST	353175	65.:	14.0	0.46	0.18	0.20
NW88	RBPAHST	1939432	37.0	14.0	0.45	0.20	0.19
NOV88	88EFST	352759	40.2	14.0	0.33	0.25	0.12
DEC88	88PAHST	1938779	24.1	14.0	0.61	0.21	0.05
DEC68	88EFST	351307	27.4	14.0	0.44	0.15	0.28
JAN89	88PAHST	1937395	17.1	14.0	0.83	0.26	0.07
JAN89	88EFST	351048	18.2	14.0	0.63	0.19	0.07
FEB89	88PAHST	1936147	12.7	14.0	1.10	0.31	0.06
FEB89	88EFST	350754	12.9	14.0	0.86	0.24	0.08
MAR89	88PAHST	1933812	9.5	14.0	1.31	0.34	0.12
MAR89	88EFST	350420	9.4	14.0	1.02	0.27	0.10

NIAGARA SPGS				AVG			
MO/YR	STOCK	No.FISH	FISH/kg	TEMP(C)	FLO.IND.	DEN.IND.	%MORT
MAY88	88PAHST	1107462	2039.7	14.3	0.56	0.68	11.80
MAY88	88HCST	804388	2921.5	14.3	0.69	0.62	33.70
JUN88	88PAHST	1037117	538.5	14.3	0.31	0.19	6.35
JUN88	88HCST	782031	737.1	14.3	0.16	0.12	2.78
JUL88	88PAHST	1021566	196.6	14.3	0.40	0.21	1.50
JUL88	88HCST	766249	239.6	14.3	0.29	0.22	2.02
AUG88	88PAHST	898674	94.7	14.3	0.52	0.23	2.53
AUG88	88HCST	727980	100.7	14.3	0.36	0.18	1.37
SEP88	88PAHST	846721	49.6	14.3	0.49	0.21	1.26
SEP88	88HCST	725570	54.7	14.3	0.32	0.17	0.27
OCT88	88PAHST	845384	28.0	14.3	0.50	0.29	0.16
OCT88	88HCST	728204	29.5	14.3	0.45	0.24	0.16
NOV88	88PAHST	844388	19.6	14.3	0.59	0.28	0.12
NOV88	88HCST	937817	22.7	14.3	0.65	0.34	0.14
DEC88	88PAHST	843717	14.6	13.9	0.68	0.34	0.08
DEC88	88HCST	936902	16.9	13.9	0.66	0.34	0.10
JAN89	88PAHST	800461	10.7	13.8	0.85	0.37	0.13
JAN89	88HCST	889520	11.5	13.8	0.87	0.39	0.06
FEB89	88PAHST	799391	9.0	13.7	0.95	0.41	0.13
FEB89	88HCST	888737	9.6	13.7	1.00	0.44	0.09
MAR89	88PAHST	828129	8.7	13.4	1.01	0.44	0.16
MAR89	88HCST	857650	8.9	13.4	1.02	0.44	0.12

and medication used for the 1987 BY chinook and 1988 BY steelhead is listed in Table 13. Historical records are being collected and analyzed for this information and will be listed in a later report.

Task 6.1.4 Feed conversion data for the 1987 BY chinook and 1988 By steelhead is listed in Table 14. Historical records are being collected and analyzed for this information and will be listed in a later report.

Task 6.1.5 Return data from 1986 BY (first year of contract was 1987) chinook reared at the index hatcheries (Sawtooth, McCall, Rapid River) will be available starting in 1990.

SUMMARY

The primary disease problems which affected the 1987 BY chinook and 1988 BY steelhead were due to bacterial gill disease, IHN, BKD, and EIBS. It is unclear at this time what effect M. cerebralis infection in several chinook stocks will have on smolt-to-adult survival. Pre-liberation organosomatic data did not reveal any major abnormalities in the surveyed stocks.

Table 13. Epizootic and medication data for 1987 BY salmon and 1988 BY steelhead stocks.

Hatchery	Stock	Date	Disease Condition	Medication	Dosage level
Rapid R.	87RRSC	8/88	BGD	B.C.	2ppmlh
	87RRSC	8188	Fungus/ETBS	Formalin	167ppm/h
Sawtooth	87-SWT-SC	6188	BKD prophylaxis	Gallimycin 50	41g/100lbs fish/21d
	87-EF-SC	6188	" "	"	"
	87-SWT-SC	8188	Myxobacteria Prophylaxis	TM-50	3g active/100 lbs fish/10d
	87-EF-SC	8188	"	"	"
Oxbow	88-HC-ST	2189	MAS	OTC	5 mg/kg fish injected SQ
Niagara Springs	88-HC-ST	1/89	Finclip Prophylaxis	B.C.	2ppmlh
	88-PAH-ST	1/89	"	"	"

BGD	Bacterial gill disease
B.C.	Benzalkonium Chloride
MAS	Motile aeromonid septicemia
OTC	Oxytetracycline

Table 14. Feed conversion data for 1987 BY salmon and 1988 BY steelhead stocks.

Hatchery	Stock	Feed Conversion
Rapid River	87-RR-SC	1.52
Sawtooth	87-SWT-SC	1.84
	87-EF-SC	1.74
McCall	87-SF-SLJ	1.45
Pahsimeroi	87-PAH-SU	1.59
	87-SF-SU	1.64
Niagara Springs	88-PAH-ST	1.41
	88-HC-ST	1.41
Magic Valley	88-PAH-ST	1.38
	88-EF-ST	1.36

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Appendix A. Viral assay and fluorescent antibody technique (FAT)
reagents.

Microbial disinfectant solution.

Tissue grade water	225 ml
10x HBS	25 ml
Fetal bovine serum	10 ml
Antibiotic-antimycotic (Gibco)	25 ml
Gentamycin	1.25 ml
Sodium bicarbonate solution (7.5%)	4 ml

F.A.T. Conjugate

The conjugate was prepared by adding 10 ml of a 1:10 dilution of anti-Renibacterium salmoninarum (Kirkegaard-Perry Laboratories) in sterile distilled water to 0.5 ml of rhodamine dye, (final dilution of dye to antibody 1:200). Heat-fixed smears are fixed in methanol or xylene, stained with the conjugate solution, incubated in dark, humidified container for 1 h (25 C), washed in PBS (pH 7.4), dried with a hair dryer, and a coverslip mounted with pH 9 immersion oil.

Appendix B.

Summary of expenditures: April 1, 1988 to April 30, 1989.

Personnel	\$44,023
Operation costs	\$32,030
Capital outlay *	\$30,950

* Departmental expenditure data incomplete for latest purchases.

Appendix C. Template of disease database program.

```

F I S H   D I S E A S E
Mode:  MENU/VIEW
SELECT  FILTER  ADD  EDIT  DELETE  REPORT  MGMT  QUIT
-Stock-
First-
Last-
-----m-----Fish Discnse-----
Access No.:  -
Location:
Sample Date:  /  /
Stock:
Lot No.:
Containers:
Exam Type:
Fish/lb: 0.0
No. Fish: 0
Age:
Ave. Length: 0.00 in
Flow: 0.0 gpm
Weight: 0 lb
Flow Index: 0.00
Density Index: 0.00
Cont. Type:
Investigators:
Temperature: 0.0C 0.0F
Diet: -
Percent BW/D: 0.0
Disease Period:  /  /
To:  /  /
Mortality Est.:
Incident Est.: 0.0
Max Loss/Day: 0.000
No. Sampled: 0
Sample Method:
Analysis Type:
Tissue Tested:
Pathogens Tested:
Path  Prev  No/Pool  Sev
/ 0
/ 0
/ 0
/ 0
Comments: F
F1: Help  F5: Comments  F9: Edit  PgUp: Previous  PgDn: Next

```