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SMOLT MONITORING ACTIVITIES AT LITTLE GOOSE DAM IN 1996

ANNUAL REPORT

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CONTENTS

ABSTRACT

The juvenile fish facility at Little Goose Dam is operated seasonally to collect and bypass downstream migrating smolts and keep them from passing through the turbine blades. Fish are diverted from turbines by traveling screens as they sound in the forebay to pass the dam. A small percentage of the passing fish are sampled on a daily basis to provide information on fish condition, species composition, migration timing, and size distribution.

Oregon Department of Fish and Wildlife personnel perform daily fish sampling and data collection. Physical operation of the facility is the responsibility of the US Army Corps of Engineers. Data is reported to the Fish Passage Center daily by means of electronic data transfer. Funding for this project was provided through the Smolt Monitoring Program administered by the Fish Passage Center.

Overall, the number of fish collected and sampled in 1996 was a reduction from the previous years of operation. The 1996 migration season was characterized by higher than average flows and greater spill frequency at the dam. It was the first year that coho salmon were obtained in the sample. The predominant species collected was steelhead with hatchery fish outnumbering wild fish by a ratio of 8:1.

An increased emphasis was placed on gas bubble trauma examination and a routine, consistent effort was implemented using 'a protocol established by the Fish Passage Center. The objective of the gas bubble trauma (GBT) examinations was to document the relative incidence of symptoms throughout the migration season.

INTRODUCTION

A program is implemented annually through the Fish Passage Center (FPC) in Portland, OR to monitor smolt outmigration on the Snake and Columbia Rivers. The smolt monitoring program serves as a means to identify and collect data relevant to salmonid passage around the hydropower facilities of both river systems. The FPC plays a principal role in the collection, processing, and dissemination of the data on a routine basis for use in river management policy by the relevant parties. Various agencies and tribes participate at a variety of facilities in this coordinated effort to document the migration timing and general characteristics of the downstream migrants.

The Oregon Department of Fish and Wildlife performs smolt monitoring currently at one of four dams on the Snake River, while similar activities are performed at the other sites by Washington Department of Fish and Wildlife. Oregon has been a participant in a Smolt Monitoring Program 'at Little Goose Dam since 1993. Prior to this time smolt monitoring activities at Little Goose had been performed by the Washington Department of Fish and Wildlife. Oregon Fish and Wildlife has however been present at Little Goose in the role of salmonid monitoring as it relates to fish passage and transportation since 1982 funded through the U. S. Army Corps of Engineers (USACOE) Transportation and Oversight Program.

The 1996 operation of the juvenile fish facility was similar'in timing to other years with fish collection beginning April 1 and ending October 28. Operations were terminated several days early due to the small numbers of fish passing and the prediction for very cold weather.

PIT tag diversion was in operation throughout the season to bypass any marked fish that were collected. A subsequent PIT tag override was operated by PSMFC above the sample tanks during the latter part of the season.

The primary objectives for this report are to review methods associated with fish and GBT sampling and summarize data collected during the 1996 monitoring program. Specifically, the report provides a summary of smolt monitoring operations and selected aspects of fish sampling at the juvenile fish facility at Little Goose Dam (JCBS).

Routine daily sampling efforts were altered on several occasions due to other agencies' research efforts that involved the facility. The National Marine Fisheries Service (NMFS) used hatchery steelhead to conduct a dissolved gas exposure study. The Idaho Cooperative Fishery Research Unit examined and sacrificed hatchery steelhead from the sample to determine if stress was related to the amount of descaling.

The United States Fish And Wildlife Service (USFWS) selectively collected PIT tagged chinook salmon using the diversion by code system for their survival study. The National Biological Service (NBS) radio tagged sub-yearling chinook salmon to track movement.

During 1996, Submersible Traveling Screens (STS's) were still in place below all gatewells for all six turbine units at Little Goose. The STS's are scheduled to be replaced by extended length screens (ESBS) prior to the 1997 migration season. New Vertical Barrier 'Screens (VBS's) were installed during the spring of 1996 with greater porosity to accommodate the increased quantity of water which will pass up the bulkhead slot when ESBS's are installed at a later time.

METHODS

Fish are collected from the top portion of water passing into the turbine intakes from the forebay. The migrating smolts are initially guided by the STS and subsequently the VBS as the water moves vertically up the bulkhead slot. Fish exit the gatewell area near the top of the intake slot through 12" orifice openings that pass the fish and water into the collection channel. The collection channel runs both across and within the powerhouse structure. It is a concrete tunnel that serves to move fish and water toward a metal flume that exits the powerhouse. The flume links the collection channel to the juvenile sampling facility and provides enroute other operational functions. Immediately after exiting the powerhouse, the flume enters a dewatering structure. The dewatering structure has two components, a primary and a secondary section. In 1996, only the primary section was utilized to eliminate excess water which had been collected with the fish from the gatewells. -The remaining water along with the fish continue downstream through a smaller metal flume with a light penetrating cover to the wet separator. The separator is a series of parallel pipes spaced to entice fish in a specific size range to dive and exit. There are two sections, termed A & B. The submerged exits from each section are routed differentially toward the respective sample tanks, A & B. The "A" section is the first section fish pass through and is designed to pass small fish (target size is that of yearling spring/summer chinook salmon). The "B" section is immediately below the "A" section and designed to pass larger fish (i.e. steelhead smolts). Debris and adult fish collect at the downstream end of section "B" and are manually removed to a bypass flume that exits back into the river.

After exiting the separator from either the "A" or "B" compartment fish pass through a PIT tag interrogation unit and subsequently encounter a slide gate triggered if a PIT tag has been detected. During 1996, all PIT tagged fish were diverted below this initial coil unit. After diversion, PIT tagged fish were reinterrogated and directed through a diversion by code apparatus prior to being bypassed back into the river. On June 14th, the sample diversion gate override was disabled so that PIT tagged fish were always diverted regardless of whether a sample was in progress. Fish not diverted by the slide gate pass through a metal flume to the raceways for holding prior to transportation. At intervals determined by project staff, a sample gate is triggered to open and all fish are passed into a downstream holding tank. The duration of time the gate stays open is correlated closely with the target number of fish to be collected. At one hour intervals these holding tanks are drained and fish exit through a counting tunnel into the daily sample tank.

Fish Sampling

At 0700 each day fish are crowded to one end of the sample tank. Beginning with tank "A", a subsample (25-50 fish) is moved into the preanesthetic chamber and dosed with anesthetic. A flat meshed paddle is used to move a portion of fish from the crowded area into the preanesthetic chamber. This was the first year that MS-222 (Tricaine methanesulfonate) was used for anesthetic purposes at Lower Granite Dam (LGD). The average dose was 4 g administered from a stock solution of 100 grams per liter and further diluted with approximately 0.5 gallons of water prior to being poured into the preanesthetic chamber. Fish remained in this chamber for 4 minutes under close visual observation. At the end of this time interval, fish were moved from the chamber through a small flume inside to the sample trough. There is a small dewatering structure just above entry to the sampling trough that serves to minimize dilution of the water in the recirculating sample trough. The sample trough water is supplied by a temperature controlled recirculating pump system which has been dosed with approximately 28-30 grams of MS-222 from the standard stock solution.

Fish were identified by species and race and fork lengths were measured for the first 100 fish of each race. The fork lengths were recorded in five millimeter increments. Descaling data were collected from the first 100 fish of each species with a two character descriptor code to identify the location of descaling. Criteria used in 1996 considered only fish with greater than 20% of body surface descaled. In 1996, weights were taken from a total of 100 randomly chosen fish taken from both A & B tanks. Generally, five samples of 20 fish were weighed utilizing 40 fish from tank A and 60 fish from tank B. After standard processing for data collection, fish were routed out to the raceway (10) via a PVC pipe nearest to the wet lab for recovery prior to transport. When sampling was completed, the raceway was checked to assure that fish were successfully recovering from the anesthesia. Late in the season, when daily fish collection numbers had dwindled, fish were routed to the three minitanks inside to recover prior to being transported. Hand tallied data were compared with the electronic board counter after each sample tank had been emptied. Data were then compiled and entered into several spreadsheets (currently Quattro Pro) and the RSDEP program and transmitted daily to the Fish Passage Center.

Gas Bubble Trauma Sampling

Gas Bubble Trauma (GBT) sampling occurred between 9 April and 30 June 1996. The sampling schedule was determined by the Total Dissolved Gas Saturation (TDGS) levels.

When TDGS levels were below 115% in the forebay and 120% in the tailrace, sampling occurred three days a week (normally Friday, Sunday, and Tuesday). When TDGS levels were above these values, sampling occurred every other day. A combined total of 100 juvenile chinook salmon and 100 juvenile steelhead were examined each sampling day.

Fish were taken from the separator with a hand net and placed into a solution of 10 liters of water and 30 ml of MS-222. No more than seven fish (two minutes per fish examined) were placed into this solution at a time. After fish succumbed to the anesthetic, they were scanned for a PIT tag. If no tag was present, the fish was placed into a solution of 10 liters of water and 80 ml of MS-222 in order to sedate the fish long enough for an exam. Any fish encountered with a PIT tag was placed into a recovery bucket-and returned to the separator after it had recovered sufficiently from the anesthetic. Recaptures of PIT tagged fish required the creation of an electronic file for information transfer to the PTAGIS database.

The examination for GBT involved inspection of unpaired fins, eyes, and the lateral line for the presence of bubbles. Fish were placed on a aerated dish and examined with a dissecting scope. The dorsal, anal, and caudal fins were inspected for bubbles with a dissecting scope at a 15X magnification. Fins with bubbles were given a rating from 1 to 4 based on the quantity of bubbles present, 1 being the least amount of bubbles and4 being the greatest (1 = 1 to 5 %, 2 = 8 to 25%, 3 = 26 to 50%, and 4 = greater than 50%). Due to the subjectivity of the evaluation, the same personnel performed the evaluation throughout the project duration to provide consistency in the ratings.

The lateral line was examined with a dissecting scope for occlusions using 25X magnification. A transparent plastic ruler with a uniform grid was used to measure the total length of the lateral line in bubble units. All occlusion measurements were recorded using bubble units. A percent occlusion was calculated by dividing total length occluded by the total lateral line length times 100. After the examination was completed, the fish were placed into a five gallon recovery bucket with aeration. Once revived, the fish were moved to a raceway for transportation.

Data were collected on a standardized form provided by FPC. Fork and lateral line length, species, sample time, presence or absence of fins, fish condition, rank of GBT in unpaired fins and eye, length of lateral line occlusion, and percent of occlusion of lateral line were recorded on the form. Fish examined for GBT were tallied separately from the daily collection sub-sample, and counted as a separate batch of fish sampled at 100% sample rate. Data collected from the fish sampled were transferred to FPC in two ways. The GBT raw data was faxed immediately to the FPC, and then entered into a Quattro Pro spreadsheet file and electronically transmitted to the FPC.

In 1996, two new groups were sampled and both were of hatchery origin: hatchery sub-yearling chinook salmon, and hatchery coho salmon. These fish deviated from typical previous hatchery releases in the basin.

Adult Fishway Inspections

A walk through inspection of the adult fish passage facility was undertaken for compliance with hydraulic criteria specified in the Annual Fish Passage Plan. This monitoring took place once a month at Little Goose Dam and Lower Granite Dam. The primary purpose for these inspections was to document adherence by the dam operators to required criteria for specific weir gate depths, head differentials, and surface velocities. The criteria are meant to provide optimum adult fish passage conditions for upstream migrants.

RESULTS

Fish Sampling

The low numbers of chinook salmon predicted to outmigrate were reconfirmed by the passage collection totals at Little Goose (JCBS) during 1996. Yearling spring/summer chinook salmon collection was 18.1% of the 1995 total and subyearling fall run chinook salmon had cumulative passage statistics down 49% from the previous year. The total combined collection for both wild and hatchery steelhead increased 21.9 % from 1995. The sample rate for the season on steelhead was reduced from 1995. Overall, average river flow was higher during the peak migration period in 1996, but the number of fish sampled was similar with several exceptions. Comparing 1995 and 1996, the yearling chinook salmon numbers passing Little Goose were drastically reduced. The percent of hatchery yearling chinook salmon sampled from the collection was 1.5% - 1.7% during both years. Wild yearling chinook salmon however, were sampled at a higher rate in 1995. The percent of wild sockeye salmon sampled was lower in 1996 than 1995, while the percent of wild subyearling chinook salmon sampled in 1996 was higher. The numbers of fish sampled versus the total number collected for all salmonid subgroups during 1996 are presented in Table 1.

Table 1. Number of fish sampled and collected by species at Little Goose Dam in 1996.

	Yearling chinook salmon	Sub-yearling chinook salmon	Hatchery steelhead	Wild steelhead	Coho salmon	Hatchery sockeye salmon	Wild sockeye salmon
Sampled	5,162	6,404	24,087	2,998	505	188	390
Collected	332,755	9,989	1,372,019	164,217	3,862	1,265	5,384

The average fork length for specific species and races was: hatchery yearling chinook salmon (145.7 mm), wild yearling chinook salmon (122.2 mm), subyearling fall chinook salmon (168.3 mm), hatchery steelhead (214.4 mm), wild steelhead (181.5 mm), coho salmon (132.5 mm), hatchery sockeye salmon (122.0 mm) 'and wild sockeye salmon (119.4 mm). Peak daily collection dates for each subgroup were chronologically assembled and were as follows: yearling chinook salmon (wild - April 25; hatchery - April 28), sub-yearling chinook salmon (June 21), steelhead (wild - May 18; hatchery - May 19), coho salmon (June 7), and sockeye salmon (May 26).

Daily-average flow through the Little Goose dam facility peaked on June 10, 1996 at a volume of 196.5 kcfs. The lowest daily average flow during the collection season was l-5.5 kcfs and this occurred on 1 0/21/96. The daily collection peaked on 5/18/96 with 111,560 fish and hatchery steelhead were predominate in the collection (Figure 1).

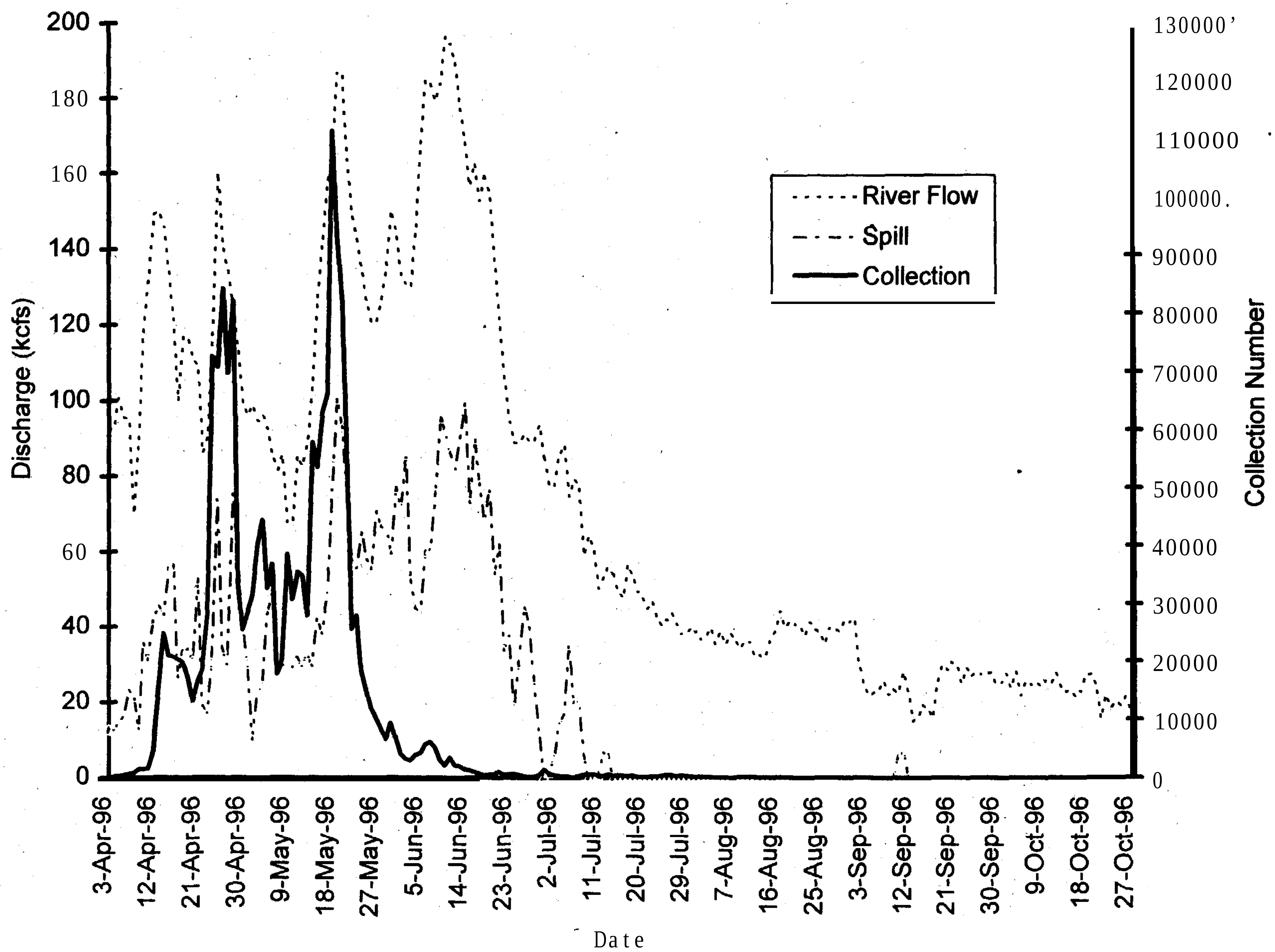

Figure 1. Daily collection of salmonids, total river flow, and spill at Little Goose Dam, 1996.

Daily descaling rates averaged higher for hatchery steelhead throughout the collection season than for the other salmonid groups regardless of flow level. Figure 2 illustrates the descaling incidence by flow and is heavily influenced by hatchery steelhead due to their abundance. At most flow levels, both yearling chinook salmon and wild sockeye salmon showed significant descaling.

Sample rates varied between 0.8 - 25% from April 2 through June 20. From June 21st through August 1 they progressively climbed higher beginning at 33% and ending at 83% The sample rate was 100% for the remainder of the migration season. Sample rates were adjusted frequently while collection numbers of salmonids were high in order to minimize excessive handling.

The percent efficiency of the separator for chinook salmon on the A side increased over 1994-l 995 for hatchery and wild yearling chinook salmon and over the 1993-l 995 percent efficiencies for subyearling chinook salmon. Percent separation for both hatchery and wild steelhead into the B side decreased from the previous three years (1993-1995) (Baxter et al. 1995).

Downstream transport was routine for the collected fish and they were trucked for the periods April 2 - April 13, barged April 14 - June 10 and trucked again for the remainder of the collection season. On June 13 fish were bypassed due to mechanical difficulties with the truck-trailer. PIT tagged fish triggered a slide gate and were bypassed back to the river the entire season after exiting the separator.

Gas Bubble Trauma Examination

In 1996 at Little Goose Dam, a total of 5,733 fish were examined for signs of GBT. The group was comprised of 1,927 yearling chinook salmon and 3,806 steelhead. Only 3.0% of the yearling chinook salmon sampled showed noticeable signs of GBT. Steelhead showed signs of GBT at a rate of 4.6%, slightly higher than chinook salmon. The yearling chinook salmon and steelhead exhibited signs of GBT in different locations and variable combinations of locations. In yearling chinook salmon, the number of occurrences recorded during 1996 was 85 in 58 fish. There were 25 occurrences in the lateral line, 27 in the caudal fin, 15 in the anal fin, and 18 in the dorsal fin (Figure 3). The total number of occurrences recorded for steelhead was 227 in 177 fish. We observed 39 occurrences in the lateral line, 88 in the caudal fin, 52 in the anal fin, 46 in the dorsal fin, and two in the eye. (Figure 4). There was no correlation from our sub-sample between location of-GBT occurrence and time of year in either steelhead or yearling chinook salmon. We also tested the location of GBT symptoms and spill volume at Lower Granite Dam for a correlation and found none for either steelhead or yearling chinook salmon.

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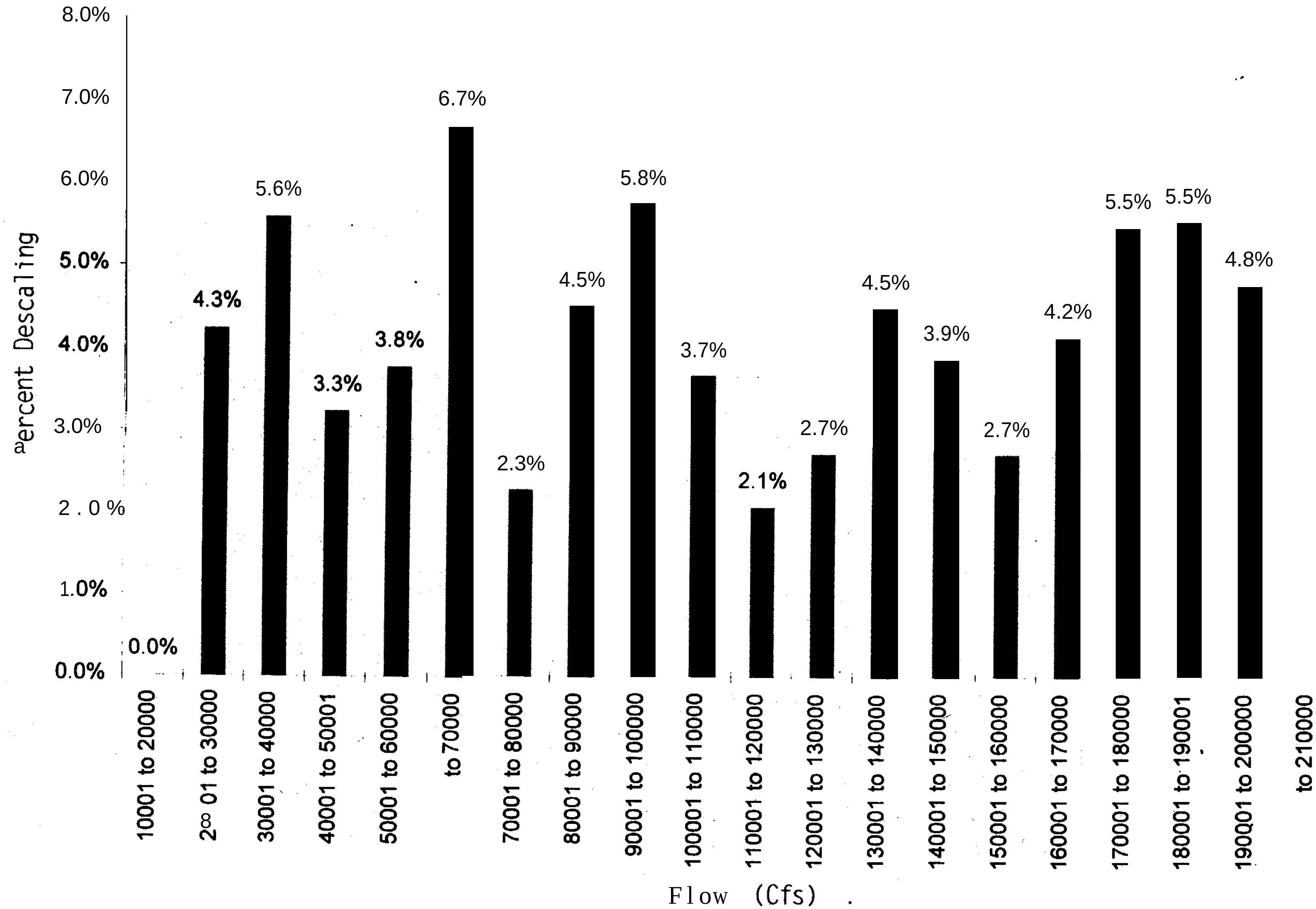

Figure 2. Percent descaling for all species combined throughout the flow range during the migration period at Little Goose Dam in 1996.

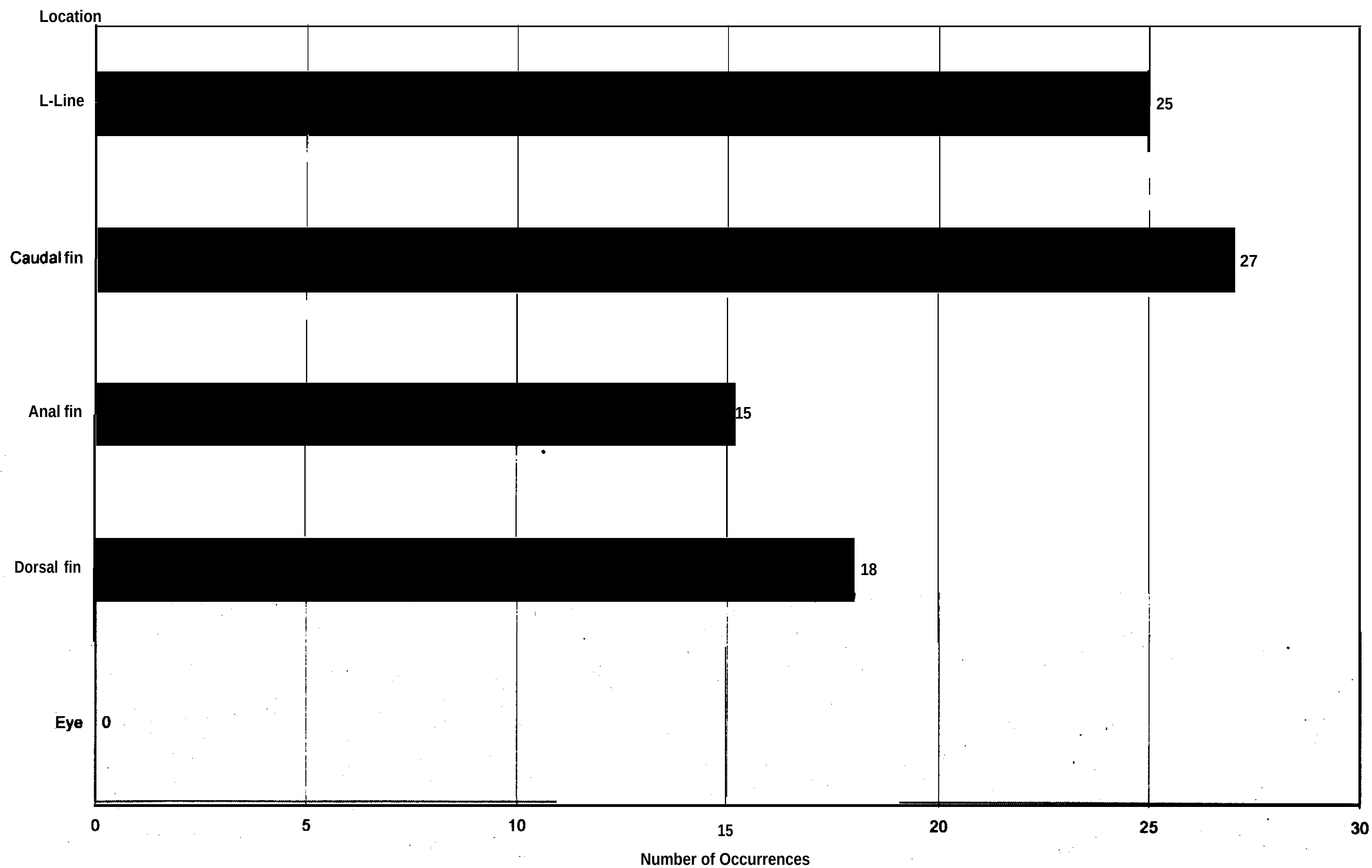

Figure 3. Total number of GBT occurrences and locations for yearling chinook in 1996 at Little Goose Dam. 1,927 yearling chinook were sampled with 58 showing signs (3.0%). Note: Some fish will have more than one GBT location.

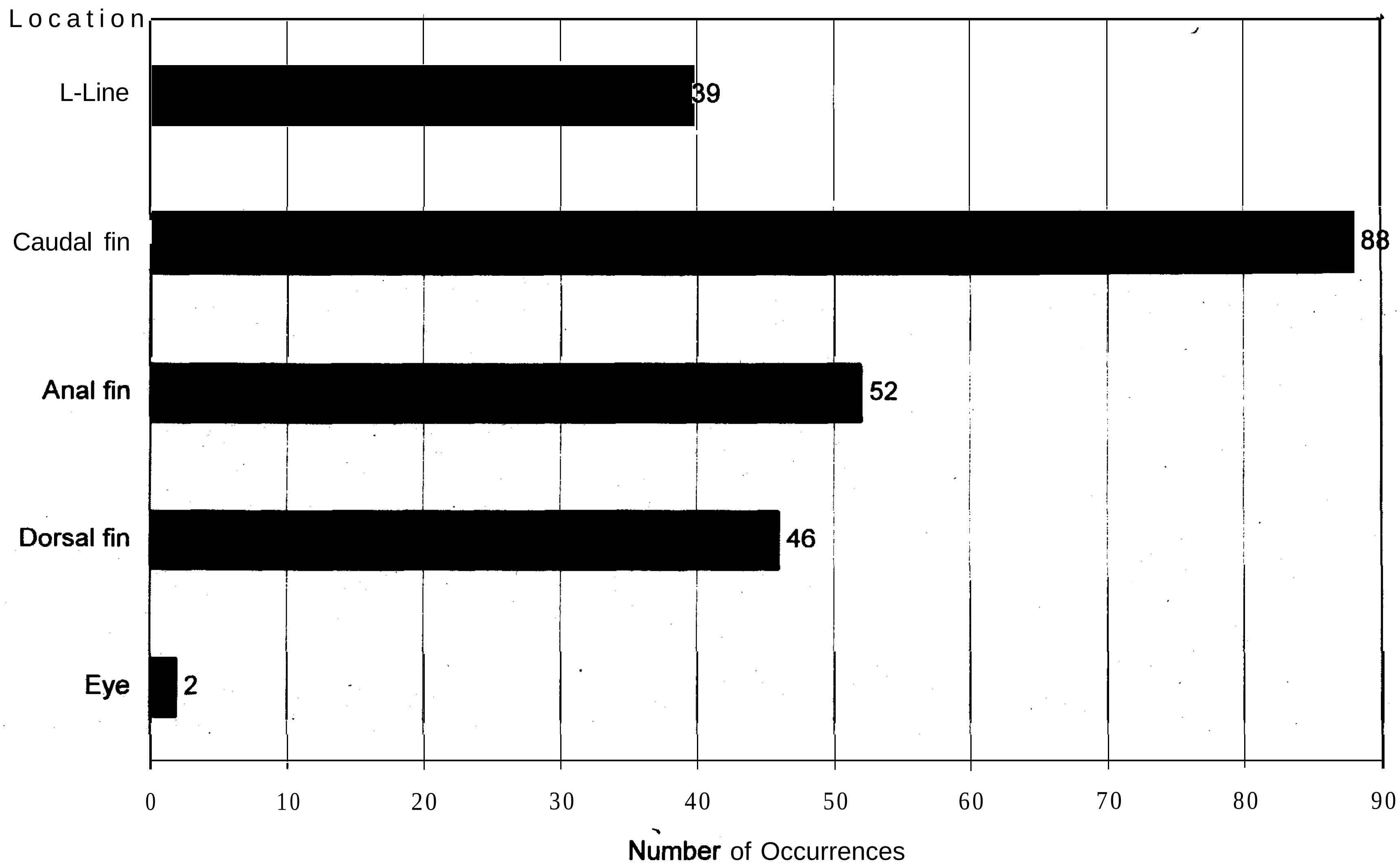

Figure 4. Total number of GBT **occurences** and locations for Steelhead in 1996 at Little Goose Dam. 3,806 steelhead were sampled with 177 showing **signs (4.7%)**. Note: Some fish will have more than one GBT location.

The peak GBT incidence for steelhead in 1996 occurred on April 16 when 33 of 100 fish sampled showed bubbles (Appendix Table B-l). The symptoms observed were three occurrences in the lateral line, 29 in the caudal fin, 19 in the anal fin, and five in the dorsal fin (Appendix Table B-2): The high incidence of GBT on this particular day was probably caused by the high amount of spill that occurred at Lower Granite Dam a few days before (possibly in conjunction with some other undefined factor) (Figure 5). For yearling chinook salmon, the peak incidence of external symptoms occurred on May 21 with eight of 100 fish showing signs of GBT (Appendix Table B- 3). This included six observations in the lateral line, eight in the caudal fin, four in the anal fin, and two in the dorsal fin (Appendix Table B-4). The increased amount of GBT on this day was thought to be related to the large amount of spill from Lower Granite Dam a few days prior (Figure 6). When both species were combined, the peak GBT incidence still occurred on April 16 with the same 33% of fish examined showing signs of GBT, however only steelhead were sampled that day (Appendix Table B-5).

Peak spill volume from Lower Granite Dam occurred on May 19 at 107.1 kcfs. Spill volume and percent GBT incidence were examined for correlation with both the steelhead and yearling chinook salmon GBT incidence data separately and combined. With all three data sets, no significant correlation between spill volume and GBT incidence was detected.

Releases of hatchery coho salmon were made into the Clearwater and Selway drainages during the summer through fall of 1995. A total of 505 hatchery coho salmon were sampled at Little Goose Dam, which was 13.1% of the total coho salmon collected. Descaling rates were low.

Other Research Programs

Several research programs utilized fish collected in the Little Goose Dam daily sample. The NMFS PIT tagged 1,478 hatchery steelhead as part of the Snake River Dissolved Gas Exposure Study. Hatchery steelhead were tagged on May 14, 16, 22 which necessitated adjustments in sample rates to insure enough hatchery steelhead for PIT tagging. The Idaho Cooperative Fishery Research Unit sacrificed a total of 80 hatchery steelhead from the samples of May 4, 5, 6, and 10 to determine if stress was related to the.amount of descaling.

The USFWS conducted a survival study where PIT tagged chinook salmon were collected using the diversion by code system. At the request of USFWS, sample rates were kept low, until the PIT tag slide gate override was initiated on 14 June at 0700 hours. A total of 933 PIT tagged fish were recaptured, 60 of which were mortalities. An additional 300 untagged fish were diverted into the diversion by code system, of which 14 were mortalities. A total of 17 hatchery yearling chinook salmon, 24 wild yearling chinook salmon, 7 hatchery sub-yearling chinook salmon, and 35 wild sub-yearling chinook salmon were sacrificed for electrophoresis and ATPase testing. Of the 24 wild yearling chinook salmon sacrificed, 23 were determined to be sub-yearling fall chinook salmon.

The NBS radio tagged sub-yearling chinook salmon at the Lower Granite Dam juvenile fish facility. Tagged fish recovered in the sample at Little Goose Dam juvenile fish facility were held for tag removal and additional physical data collection, and then fish were transported.

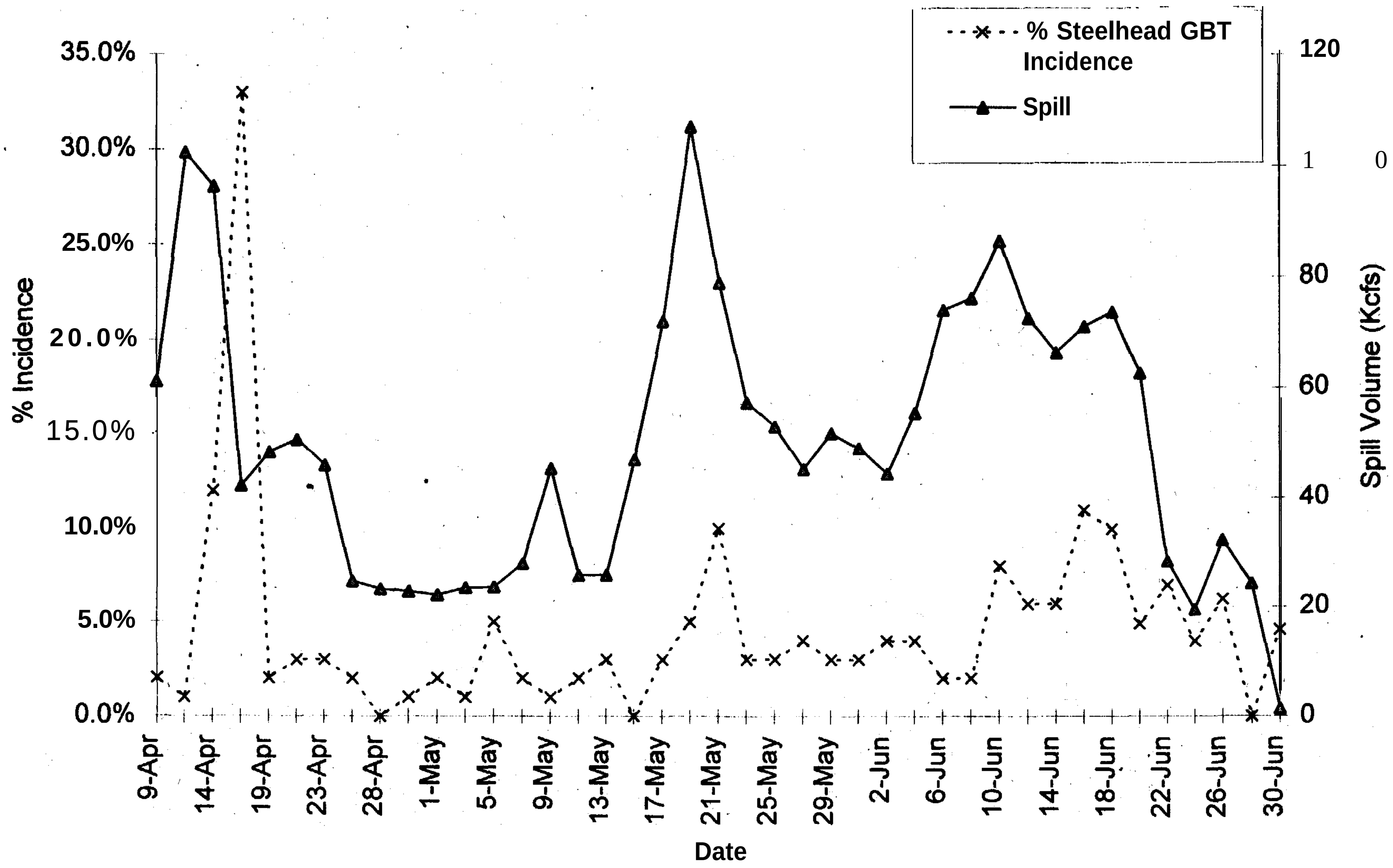

Figure 5. Incidence of gas bubble trauma for summer steelhead and flow at Little Goose Dam,. 1996.

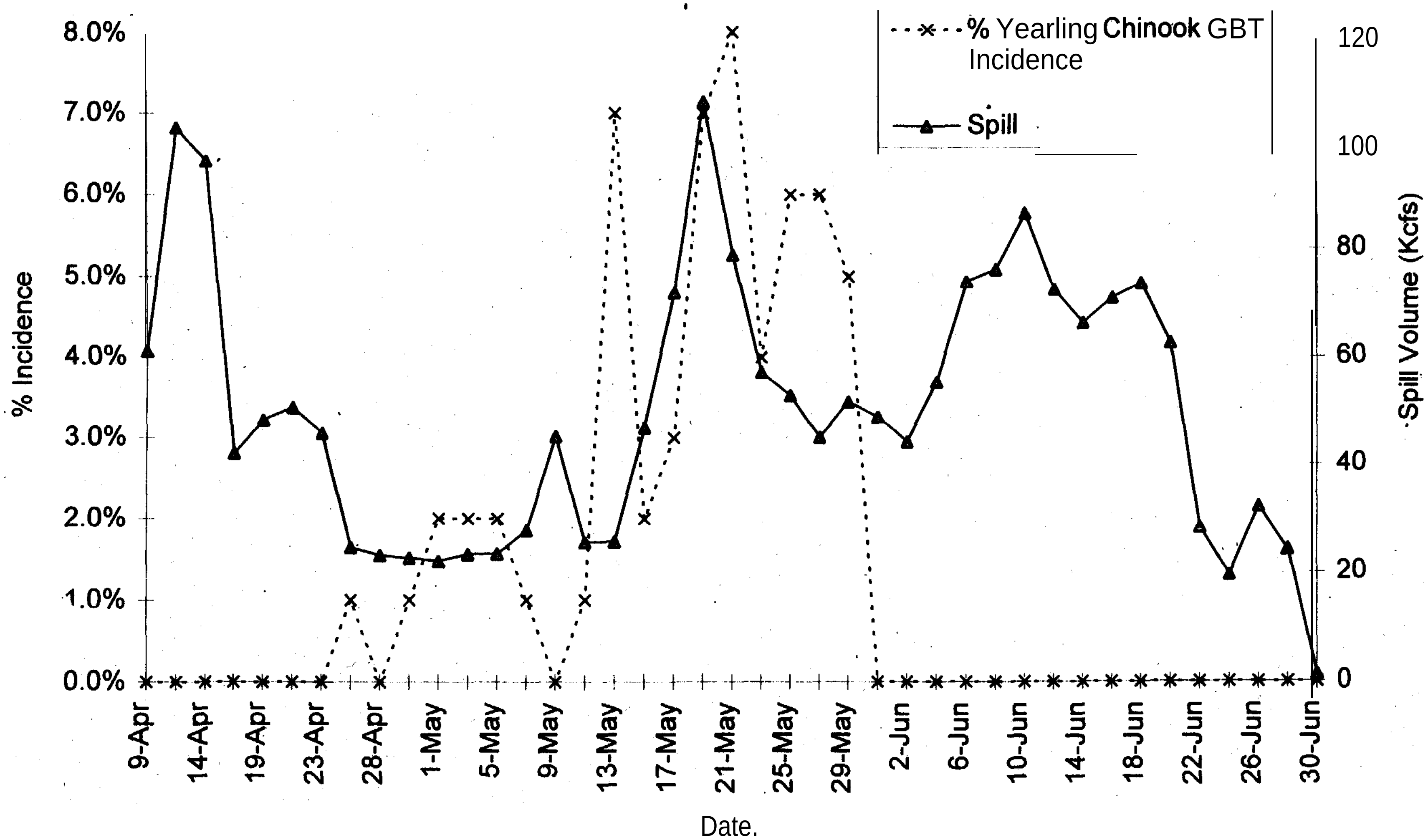

Figure 6. Incidence of gas bubble trauma for yearling chinook and flow at Little Goose Dam in 1996.

Adult Fishway Inspection

The area where both dams were at times outside the established adult fish passage criteria was weir depth at one of the six adult fishway entrances along the tailrace. There are two entrances at each of three locations and most often when depth is out of criteria the weir gate is bottomed out on the sill underneath. At Little Goose during 1996, the North Powerhouse Entrances (NPE 1+2) were unable to meet the established criteria except for several days during June. Lower Granite Dam did not satisfy criteria at all three entrances except early in the migration season. During June through October, the North 'Shore Entrances (NSE 1+2) were out of criteria on every inspection. Throughout the period, June - August, the NPE's did not comply with criteria, and in July even the South Shore Entrances (SSE 1+2) did not meet the required head differential.

DISCUSSION

Fish condition can be adversely impacted when passing through a JCBS if spring runoff is accompanied by high quantities of debris and trash. The debris can become lodged and partially or entirely block orifice passageways for juvenile fish. The buildup of this type of debris is constant throughout most of the period of high water flow and requires additional operational maintenance for removal. The resultant fish injury is usually descaling from abrasion or mortality from a combination of stress, impingement and turbulent conditions within the gatewell. The major obstacle that continues to plague downstream migrants is a better method or mechanism for keeping orifices at the gatewell exits clear during the migration period.

Mortality was minimal after daily sampling, but was uncharacteristically high on two occasions (April 29th and May 6th) during the season due to an unknown circumstance related to the anesthetization process. On the first of these two occasions, a portion of sampled fish never recovered from anesthetization. On May. 6th, the fish went out fast and began floating belly up but eventually recovered after being moved to Raceway 10. There were many questions raised among both onsite and project personnel related to these incidences. The symptoms suggested that overdose with anesthetic could not be ruled out. Our only explanation suggested tampering with the stock solution.

The GBT portion of the Smolt Monitoring Program was expanded to devote one full time person from Oregon Department of Fish and Wildlife and one from NBS. This allowed for the individuals to focus exclusively on gas bubble trauma examination and provided for consistency in the evaluation and data collection. During 1996, all steelhead and chinook salmon were netted as they entered the separator allowing for minimum time to lose any noticeable symptoms from forebay passage to observation.

Adult fishway inspection results were similar to the previous year (Basham 1995). During 1995, however, the South Shore Entrance was never out of criteria. The fish ladders and collection channel are able to maintain adequate surface velocity; however insufficient collection channel depth often keeps the weirs on sill unable to meet criteria. The diameter of the water conduits that feed the pump chamber are often a restraining factor to increasing channel depth for accommodating low tailwater elevations. This means that improving adherence to recommended criteria may be impossible unless physical modifications are made to the existing facilities or operation of the downstream dam water storage time is adjusted specific to this need.

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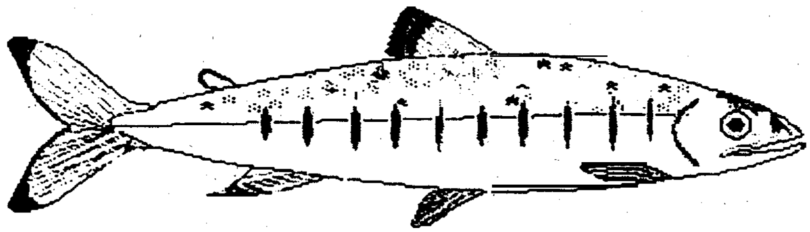
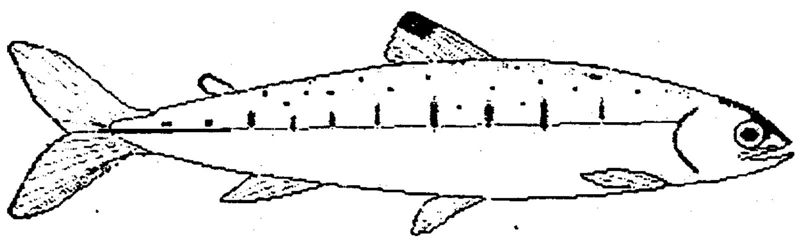
Appendix A

Characteristics used in species identification at Little Goose Dam in 1996



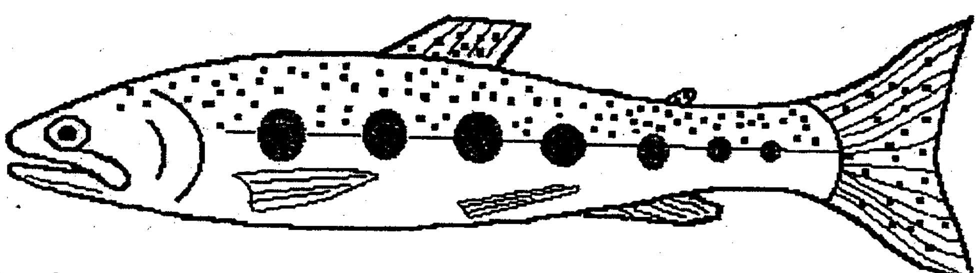
Coho

1. Caudal fin forked, with outer margins tipped in black.
2. Parr marks are narrow vertical bars, centered on lateral line and narrower than interspaces.
3. First anal ray longer, leading edge white, sickle shaped.
4. Small spots on back.
5. Leading pelvic fin ray usually tipped in white.



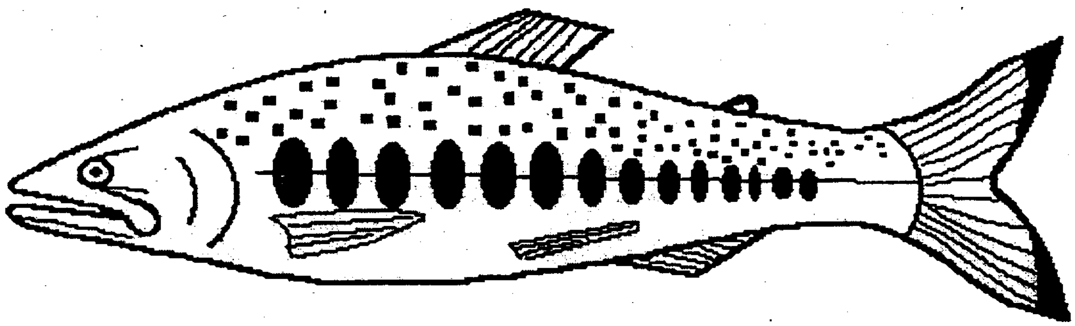
Sockeye

1. Caudal fin forked, light in color.
2. Parr marks short narrow bars, mostly above lateral line.
3. Sides silvery, back may be brownish.
4. Small head.
5. Few, if any, small spots on back.
6. Fins clear, very little color.



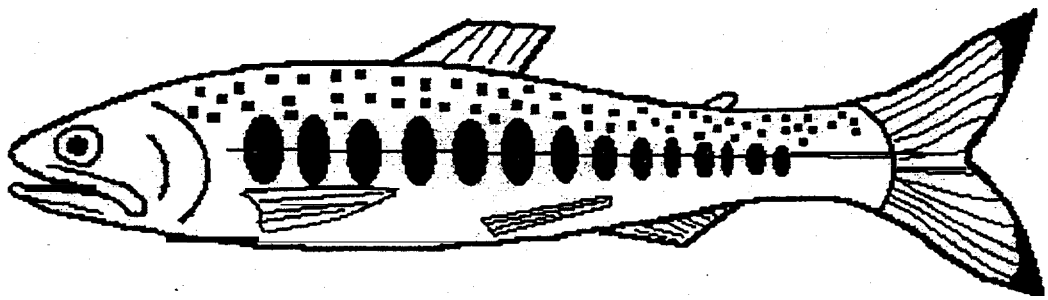
Steelhead Trout

1. Caudal fin square.
2. Parr marks almost round.
3. Head more rounded than salmon when viewed from top.
4. Dorsal has distinct spots.



Sub-Yearling Chinook

1. Caudal fin forked, with outer margin usually black.
2. Parr marks large, vertical oblong shapes centered on lateral line and wider than interspaces.
3. Anal fin rays short, wedge shaped, usually not pigmented.
4. Large spots on back.
5. Body wider, eye smaller, nose more sharp than a yearling chinook (football shape).



Yearling Chinook

1. Caudal fin forked, usually edged in black.
2. Parr marks large, vertical oblong shapes centered on lateral line and wider than interspaces.
3. Anal fin rays short, wedge shaped, usually not pigmented.
4. Large spots on back.
5. Body narrower, eye larger, nose more rounded than sub-yearling chinook.

Appendix B

Gas Bubble Trauma Data

Appendix Table BI . Steelhead collected for GBT sampling and corresponding incidence at Little Goose Dam in 1996.

Date	Total steelhead collected	Steelhead GBT incidence	% Steelhead GBT incidence
9-Apr-96	99	2	2.0%
11-Apr-96	100	1	1.0%
14-Apr-96	100	12	12.0%
16-Apr-96	100	33	33.0%
19-Apr-96	100	2	2.0%
21-Apr-96	100	3	3.0%
23-Apr-96	100	3	3.0%
26-Apr-96	100	2	2.0%
28-Apr-96	100	0	0.0%
29-Apr-96	100	1	1.0%
1-May-96	100	2	2.0%
3-May-96	100	1	1.0%
5-May-96	100	5	5.0%
7-May-96	100	2	2.0%
9-May-96	100	1	1.0%
11-May-96	100	2	2.0%
13-May-96	100	3	3.0%
15-May-96	100	0	0.0%
17-May-96	100	3	3.0%
19-May-96	100	5	5.0%
21-May-96	100	10	10.0%
23-May-96	100	3	3.0%
25-May-96	100	3	3.0%
27-May-96 / 29-May-96	100	3	[illegible]
31-May-96	100	3	3.0%
2-Jun-96	100	4	4.0%
4-Jun-96	100	4	4.0%
6-Jun-96	100	2	2.0%
8-Jun-96	100	2	2.0%
10-Jun-96	50	4	8.0%
12-Jun-96	100	6	6.0%
14-Jun-96	100	6	6.0%
16-Jun-96	100	11	11.0%
18-Jun-96	100	10	10.0%
20-Jun-96	61	3	4.9%
22-Jun-96	100	7	7.0%
24-Jun-96	100	4	4.0%
26-Jun-96	16	1	6.3%
28-Jun-96	15	0	0.0%
30-Jun-96	65	3	4.6%

Appendix Table B2. GBT observations found in steelhead at Little Goose Dam, 1996.

Date	Lateral line	Caudal fin	Anal fin	Dorsal fin	Eye	Spill
9-Apr-96	1	1	0	0	0	6i.1
11-Apr-96	0	1	0	0	0	102.4
14-Apr-96	3	10	3	0	0	96.2
16-Apr-96	3	29	19	5	0	42.1
19-Apr-96	0	1	1	0	0	48.2
21-Apr-96	0	Z	Z	0	0	50.5
23-Apr-96	2	0	0	1	0	45.8
26-Apr-96	0	2	0	0	0	24.7
28-Apr-96	0	0	0	0	0	23.3
29-Apr-96	0	1	1	0	0	22.8
1-May-96	1	0	1	0	0	22.2
3-May-96	0	0	1	0	0	23.5
5-May-96	1	1	0	4	0	23.6
7-May-96	0	0	1	1	0	27.9
9-May-96	0	0	1	0	0	45.3
11-May-96	2	0	0	0	0	25.7
13-May-96	1	1	0	1	0	25.8
15-May-96	0	0	0	0	0	46.9
17-May-96	1	0	0	2	0	72.1
19-May-96	2	2	1	1	0	107.1
21-May-96	3	10	5	-2	0	79
23-May-96	0	2	1	2	0	3f.3
25-May-96	0	1	1	1	0	52.9
27-May-96	2	2	0	0	0	45.1
29-May-96	3	0	0	0	0	51.7
31-May-96	2	1	0	0	0	48.9
2-Jun-96	0	3	0	1	0	44.3
4-Jun-96	1	0	0	3	0	55.4
6-Jun-96	Z	0	0	0	0	74
8-Jun-96	1	1	0	0	0	76.2
10-Jun-96	0	2	1	4	0	66.5
12-Jun-96	1	2	3	0	1	72.6
14-Jun-96	2	1	3	1	0	66.4
16-Jun-96	1	3	4	5	0	71.1
18-Jun-96	1	3	1	5	0	73.8
20-Jun-96	n	7	1	0	0	62.7
22-Jun-96	1	2	1	2	1	28.4
24-Jun-96	0	1	0	3	0	19.6
26-Jun-96	1	0	0	0	0	32.3
28-Jun-96	0	0	0	0	0	24.3

30-Jun-96	1	1	0	2	0	1.4

Appendix Table B3. Yearling chinook salmon collected for GBT sampling and corresponding incidence at Little Goose Dam in 1996.

Date	Total yearling chinook collected	Yearling chinook GBT incidence	%Yearling chinook GBT incidence
Q-Apr-96	1	0	0.0%.
11 -Apr-96	0	0	0.0%
14-Apr-96	0	0	0.0%
16-Apr-96	0	0	0.0%
1_0-Am-96	35	0	0.0%
21-Apr-96	41	0	0.0%
26-Apr-96	100	1	0.0%
28-Apr-96	100	0	0.0%
29-Apr-96	100	1	1.0%
1 -May-96	100	2	2.0%
3-Mav-96	100	7	3.0%
5-May-96	100	2	2.0%
7-May-96	100	1	1.0%
9-May-96	100	0	0.0%
11-May-96	100	1	1.0%
13-May-96	100	7	7.0%
15-May-96	100	2	2.0%
17-May-96	100	3	3.0%
1 Q-May-96	100	7	7.0%
21 -May-96	100	8	8.0%
23-May-96	100	4	4.0%
25-May-96	100	6	6.0%
27-May-96	1_0 0	6	6.0%
29-May-96	100	5	5.0%
31 -May-96	24	0	0.0%
2-Jun-96	8	0	0.0%
4-Jun-96	2	0	0.0%

Appendix Table B4. GBT observations in yearling chinook salmon at Little Goose Dam, 1996.

Date	Lateral line	Caudal fin	Anal fin	Dorsal fin	Eye	Spill
9-Apr-96	0	0	0	0	0	61.1
1 I-Apr-96	0	0	0	0	0	102.4
14-Apr-96	0	0	0	0	0	96.2
16-Apr-96	0	0	0	0	0	42.1

19-Apr-96	0	0	0	0	0	48.2
21-Apr-96	0	0	0	0	0	50.5
23-Apr-96	0	0	0	0	0	45.6
26-Apr-96	0	0	0	1	0	24.7
28-Apr-96	0	0	0	0	0	23.3
29-Apr-96	1	0	0	0	0	22.8
1-May-96	0	1	0	1	0	22.2
3-May-96	0	0	0	2	0	23.5
5-May-96	0	2	0	1	0	23.6
7-May-96	0	1	0	0	0	27.9
9-May-96	0	0	0	0	0	45.3
11-May-96	1	0	0	0	0	25.7
13-May-96	2	5	0	1	0	25.8
15-May-96	2	0	0	0	0	46.9
17-May-96	1	0	1	2	0	72.1
19-May-96	3	2	1	1	0	107.1
21-May-96	6'	8	4	2	0	79
23-May-96	4	3	2	0	0	57.3
25-May-96	2	1	3	2	0	52.9
27-May-96	3	2	2	3	0	45.1
29-May-96	0	2	2	2	0	51.7
31-May-96	0	0	0	0	0	48.9
2-Jun-96	0	0	0	0	0	44.3
4-Jun-96	0	0	0	0	0	55.4

Appendix Table B5. Total GBT sample and corresponding incidence at Little Goose Dam in 1996.

Date	Total GBT sample	Total GBT incidence	%Total GBT incidence
9-Apr-96	100	2	2.0%
11-Apr-96	100	1	1.0%
14-Apr-96	100	12	12.0%
16-Apr-96	100	33	33.0%
19-Apr-96	135	2	1.5%
21-Apr-96	141	3	2.1%
23-Apr-96	116	3	2.6%
26-Apr-96	200	3	1.5%
28-Apr-96	200	0	0.0%
29-Apr-96	200	2	1.0%
1-May-96	200	4	2.0%
3-May-96	200	3	1.5%
5-May-96	200	7	3.5%
7-May-96	200	3	1.5%
9-May-96	200	1	0.5%

11-May-96	200	3	1.5%
13-May-96	200	10	5.0%
15-May-96	200	2	1.0%
17-May-96	200	6	3.0%
19-May-96	200	12	6.0%
21-May-96	200	18	9.0%
23-May-96	200	7	3.5%
25-May-96	200	9	4.5%
27-May-96	200	10	5.0%
29-May-96	200	8	4.0%
31-May-96	124	3	2.4%
2-Jun-96	108	4	3.7%
4-Jun-96	102	4	3.9%
6-Jun-96	100	2	2.0%
8-Jun-96	100	2	2.0%
10-Jun-96	50	4	8.0%
12-Jun-96	100	6	6.0%
14-Jun-96	100	6	6.0%
16-Jun-96	100	11	11.0%
18-Jun-96	100	10	10.0%
20-Jun-96	61	3	4.9%
22-Jun-96	100	7	7.0%
24-Jun-96	100	4	4.0%
26-Jun-96	16	1	6.3%
28-Jun-96	15	0	0.0%
30-Jun-96	65	3	4.6%

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