MONITORING OF DOWNSTREAM SALMON AND STEELHEAD AT FEDERAL HYDROELECTRIC FACLITIES - 1991

Annual Report

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TABLE OF CONTENTS

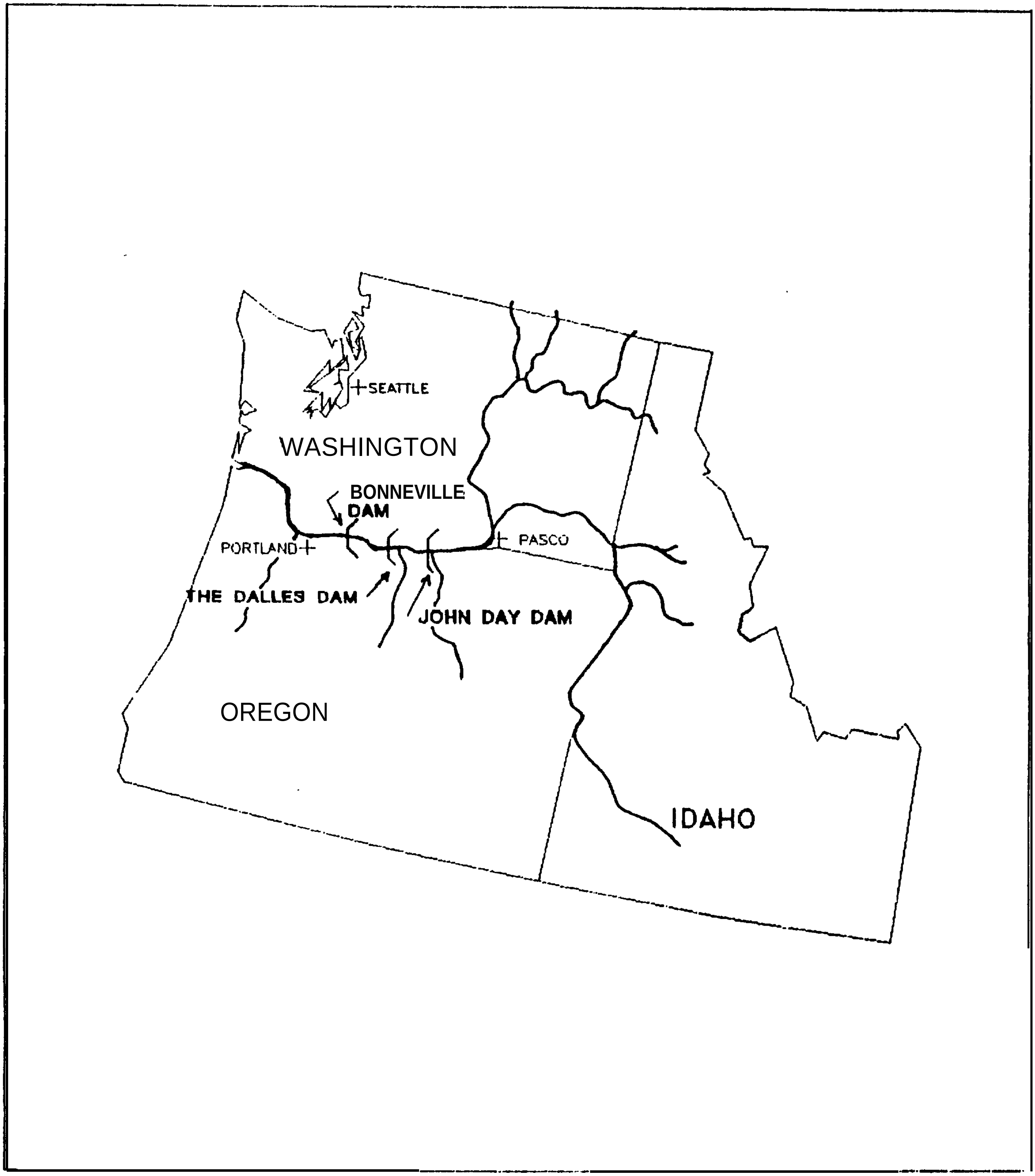

FIGURE 1. N.M.F.S. Smolt Monitoring Sites on Columbia River.

INTRODUCUTION

The seaward migration of salmonid smolts was monitored by the National Marine Fisheries Service (NMFS) at three sites on the Columbia River in 1991. The NMFS Smolt Monitoring Program (SMP) is part of a larger effort to index Columbia Basin juvenile salmonid stocks. It is coordinated by the Fish Passage Center (FPC) for the Columbia Basin Fish and Wildlife Agencies and Tribes. Its purpose is to facilitate.fish passage through reservoirs and at dams by providing FPC with timely smolt migration data used for flow and spill management. Data is also used for travel time, migration timing and relative run size magnitude analysis. This program is carried out under the auspices of the Northwest Power Planning Council Fish and Wildlife Program and is funded by the Bonneville Power Administration (BPA).

Sampling sites were John Day and Bonneville Dams under the Smolt Monitoring program, and The Dalles Dam under the "Fish Spill Memorandum of Agreement" for 1991 (Figure 1). All pertinent fish capture, condition and brand data, dam operations and river flow data, were reported daily to FPC. These data were incorporated into the FPC's Fish Passage Data Information System (FPDIS).

METHODS AND MATERIALS

JOHN DAY DAM

Sampling at John Day Dam was accomplished with an airlift pump system of the type described by Brege et al. (1990). With the overhaul of unit 3 complete, sampling returned to gatewell 3-B for the 1991 season. Fish were examined hourly over the 24 hour sample day (noon to noon) seven days per week throughout the sampling season, April 7 - October 31.

Each hour, captured fish were gravity transported from the airlift to holding tanks via a 6" PVC pipe. Approximately 50 fish at a time were then preanesthetized with approximately 67 mg/L. of a Benzocaine/Alcohol solution, using the method described by Mathews et al. (1985). Once anesthetized, fish were net-transferred to the examination trough which contained about 13mg/L of Tricaine (MS 222) to keep fish calm during examination. Fish were then placed in a recovery tank and eventually routed back to the bypass system for return to the river. Except for periods of maintenance, unit 3 was in continuous operation, though turbine loading was variable through the sampling season.

THE DALLES DAM

Sampling at The Dalles Dam was accomplished with an airlift pump system identical to the one used at John Day Dam. Vertical barrier screens and the airlift were installed into the middle gatewell slot #2 of unit 2. Unit 2 was operated as consistently as possible throughout the duration of sampling, April 1 - August 31. The 24 hour sample day ranged from 0600h to 0600h, seven days per week, with samples examined every hour. Processing details were identical to those described for John Day Dam. After examination and recovery, fish were routed to the ice/trash sluiceway for return to the river.

BONNEVILLE DAM

At Bonneville Dam, samples were collected in the bypass channels of the first and second powerhouse using the downstream migrant traps (DSM 1 & 2) over the sampling season, March 15 - November 30. The DSM trap operation is described by Gessel (1986) for the first powerhouse, and by McConnell and Muir (1982), and Krcma et al. (1984), for the second powerhouse.

The DSM 1 sampler was manually operated eight hours per day (1600h - 2400h), seven days per week. The hourly sampling rate was adjusted on a daily basis depending on smolt numbers and was generally set from 6 to 15 minutes per hour (10 - 25%). During unusually high smolt passage, the sample rate was adjusted on an hourly basis to a minimum of 1 minute per hour as necessary. Seven 24 hour die1 samples were also conducted during the spring and summer migrations.

The DSM 2 automatic sampler was normally operated 24 hours per day, seven days per week. The sample day ran from 2400h - 2400h. This sampler travels at a constant rate back and forth across the width of the channel and randomly intercepts approximately 10% of the smolts passing through the bypass channel. These fish were routed to and held in raceways until they could be examined after the end of each 24hr sample period.

At both sampling locations, fish were net-transferred directly from the holding tanks to the sorting troughs, which contained about 42mg/L of Tricaine (MS-222). After examination, sample fish from both DSM 1 and 2 were placed in recovery tanks and then routed back to their respective bypass channels.

SAMPLE PERIODS AND DATA COLLECTED

Specific data collected and reported to FPC at the end of the 24 hour sample period at each of the three sample sites include:

1) Total sample numbers for each salmonid species;
2) Hourly die1 passage information where possible;
3) Recording of all marks and brands;
4) Descaling, general fish condition and mortality;
5) Subsample for lengths by species; and
6) Project, river, turbine and spill flow data.

Sampling periods and frequencies for each sample site are shown in Figure 2.

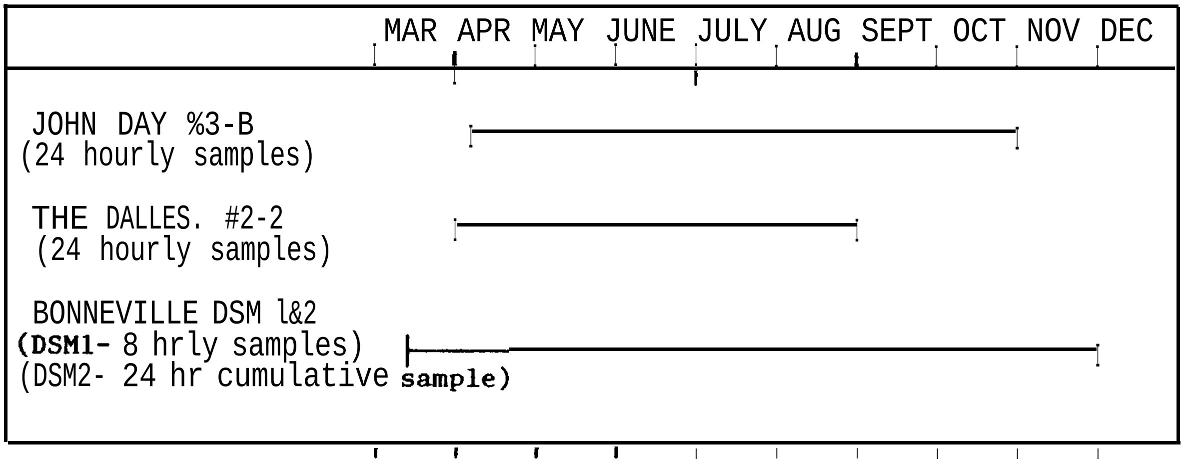

FIGURE 2. Smolt Monitoring Season, by Site, 1991

RESULTS AND DISCUSSION

The results of the hands-on assessments of smolt movement into or through the hydroelectric facilities at the listed sites are summarized in Table 1 for the 1991 field season. Three types of fish counts are presented in the table:

1) Total Sample fish counts;
2) Estimated Collection counts which are sample counts adjusted for sample rate where applicable; and
3) Estimated Passage Indices which are collection counts divided by the proportion of flow passing through the sampled system to adjust for daily fluctuations in project operations.

Included in the appendices is a graphic coverage of the die1 and seasonal passage patterns and flow at John Day, The Dalles, and Bonneville Dams. All die1 patterns have been adjusted to eliminate the effect of the sampled unit flow fluctuations on fish passage by multiplying the hourly sample count by the percent hourly deviation from average flow over the 24 hour period through the sampled unit.

TABLE 1. SUMMARY OF 1991 SMOLT MONITORING ACTIVITIES AT JOHN DAY, THE DALLES AND BONNEVILLE DAMS.

SPECIES	SITE	TOTAL SAMPLE	BRANDS IN SAMPLE	KSTINATKD COLLKCTION	KSTINATKD" PPI
YEARLING CHINOOK	JOHN DAY	26,878	576	26,878	374,387
	THK DALLKS	647	10	674	11,993
	BONNEVILLE PH#1 DSM 2/	29,374	258	242,016	609,411
	BONNEVILLE PH#2 DSM	18,372	71	183,720	N/A
SUBYBARLING CHINOOK	JOHN DAY	46,785	773	46,785	568,206
	THE DALLBS	1,936	4	1,936	33,275
	BONNEVILLE PH#1 DSN	83,189	235	604,368	1,257,388
	BONNKVILLK PH#2 DSM	19,050	5	190,500	N/A
WILD STEELHEAD (UNCLIPPKD)	JOHN DAY	5,456		5,456	75,687
	THE DALLBS	207		207	4,012
	BONNEVILLE PH#1 DSM	2,775		26,295	74,438
	BONNEVILLE PH#2 DSN	952		9,520	N/A
HATCHEERY STELHEAD (CLIPPED]	JOHN DAY	11,166	1,134 3/	11,166	158,305
	THE DALLKS	422	41	422	8,493
	BONNEVILLE PH#1 DSN	5,504	204	54,528	155,734
	BONNEVILLE PHt2 DSM	1,630	32	16,300	N/A
COHO	JOHN DAY	5,106	0	5,106	72,725
	THE DALLKS	111	0	111	2,203
	BONNEVILLE PH#1 DSM	23,842	2	216,330	575,098
	BONNEVILLE PH#2 DSM	8,070	0	80,700	N/A
SOCKKYE	JOHN DAY	3,450	85	3,450	52,203
	the DALLKS	270	9	270	3,692
	BONNKVILLK PH#1 DSM	4,462	48	47,722	147,174
	BONNEVILLE PH#2 DSM	2,592	11	25,920	N/A
TOTAL CATCH	JOHN DAY	98,841	2,568	98,841	1,301,511
	THB DALLBS	3,593	64	3,593	65,668
	BONNKVILLE PH#1 DSN	149,146	747	1,191,259	2,819,263
	BONNEVILLE PH#2 DSM	50,666	119	506,660	N/A

Data Source: Fish Passage Data Information Service.
1/. PPI is Fish Passage Index; collection counts are adjusted for river flow.
2/. DSM is DownStream Migrant facility.
3/. Any wild steelhead brands are counted with hatchery steelhead.

JOHN DAY DAM

The usual start of the sampling season (March 25th) was delayed until April 7th due to problems the Corps of Engineers had in getting unit 3 back in service after the extended shut down for overhaul. Sampling was shut down approximately 604 hours or 11% of the sampling season due to outages of unit 3. Besides the initial delay in start-up there was one extended shutdown during the season (Sept 22-Oct. 4). This scheduled three day shut down for maintenance was extended over six additional days because of problems getting line 1 (units 1-4) back in service. This was the second year in a row sampling has been interrupted for an extended period due to various problems with the sampled unit.

There were no major operational problems with the airlift system during the 1991 sampling season. operations were improved in 1991 by acquiring the use of CoE compressed air. This eliminated the need to rent compressors which were costly, bulky, and a safety hazard.

Sample Numbers'

In 1991, John Day Dam catch numbers generated an index total of 1,301,511. This .is about 47% less than the 5 year average (1985-1989) of 2,673,119 from unit 3 gatewell B since submersible traveling screens (STS) were installed in 1985. Passage indices were lower for all species in 1991, with levels half that of the 5 year average for yearling and subyearling chinook.

Compared to the 1990 index total of 1,117,384 obtained from gatewell 5B, there were 14% more smolts caught during the 1991 season. The increase in smolt numbers this year over 1990 may be due in part to the return to gatewell 3B from gatewell 5B, since unit 5 collects a smaller proportion of the fish passing the project than unit 3. Also, 1990 indices were depressed because of the 11 day powerhouse shutdown (May 29 - June lo), and the resulting spill that passed many late spring and early summer migrants that may have otherwise been collected.

Flows and Spill

River flow, Unit 3 discharge and spill are presented in Appendix A, Figure 1 for the 1991 season. Total river flow increased sharply in mid-May and averaged about 320 kcfs through mid-June, peaking on May 21 at 364.5 kcfs. These flows dramatically decreased travel time for yearling Chinook and Steelhead through the John Day reservoir (1991 FPC Annual Report).

Overgeneration spill first occurred on May 9 and continued (except for May 12-15, & 18) into the summer spill season. The spill season at John Day Dam runs from June 7 to August 23. The "Fish Spill Memorandum of Agreement" authorizes 20% of instantaneous flow for 10 hours per day (2000h - 0600), which equals 8.3% of the daily average flow. Over the spill season, daily spill averaged 11.6 % of daily average flow.

Seasonal Passage Patterns

Estimated dates for the 10 to 90% segment of smolt passage by species are listed below.

	10%	90%
Yearling chinook - - - - - -	4/26	6/7
Subyearling chinook - - - -	6/6	8/15
Steelhead, wild - - - - - -	4/29	s/29
Steelhead, hatchery - - - -	5/5	5/29
coho - - - - - - - - - - - -	5/11	6/4
Sockeye - - - - - - - - - - -	5/16	6/l

Seasonal passage patterns for John Day Dam are presented by species in Appendix A, Figures 2 - 7. Peak passage of all spring migrants occurred in the last half of May coinciding with peaking river flow and spill. Subyearling chinook passage peaked the first of August in 1991 (Appendix A, Figure 3) which was considerably later than the end of June peak in 1990 at John Day Dam.

Diel Patterns

Weekly die1 passage patterns are presented for each species in Appendix A, Figures 8 - 48 and were adjusted to eliminate the effect of unit 3 hourly fluctuations on fish capture." Patterns were consistent with previous years in that the majority of passage (75 to 95%) occurs during night time hours at John Day Dam. Typically, juvenile salmonids move into the forebay during daylight hours, then sound and move through the spillways and powerhouse at dusk reaching a peak during the night and dropping off sharply after sunrise (Sims et al. 1976 and 1981).

This year we observed two reversals of this pattern. Both reversals involved subyearling chinook. On August 4th, 71% of the daily passage occurred during daylight hours, and on August 6th, 75% of passage was during the day (Appendix A, Figure 27). The fish appeared to be in good condition and capable of active passage rather than passive passage due to higher daytime flows.

Descaling

The percentage of descaling and morltality in the sample at John Day Dam for 1989 through 1991, are listed by species below;

YEAR	YEARLING CHINOOK DESC	YEARLING CHINOOK MORT	SUBYKARLING CHINOOK DBSC	SUBYKARLING CHINOOK MORT	STEELHEAD DISC	STEELHEAD MORT	COHO DESC	COHO HORT	SOCKEYE DESC	SOCKEYE MORT
1989	10.7	2.0	5.0	2.6	7.7	0.8	6.4	0.2	12.1	0.7
1990	7.8	1.5	5.9	5.1	9.7	1.5	6.5	0.1	8.1	1.8
1991	16.6	1.2	5.8	1.7	11.0	0.2	8.6	0	17.6	1.7

[1]/ Die1 passage is shown for a minimum catch of 500 fish per week for all species except Sockeye where a minimum of 400 per week is used.

In 1991, spring migrants at John Day Dam had a higher descaling rate than in any previous year (Figure 3). Of specific concern are the elevated descaling rates for yearling chinook and sockeye which were almost double the last 3 year average (1988-1990) of 8.6% for yearlings and 8.4% for sockeye,

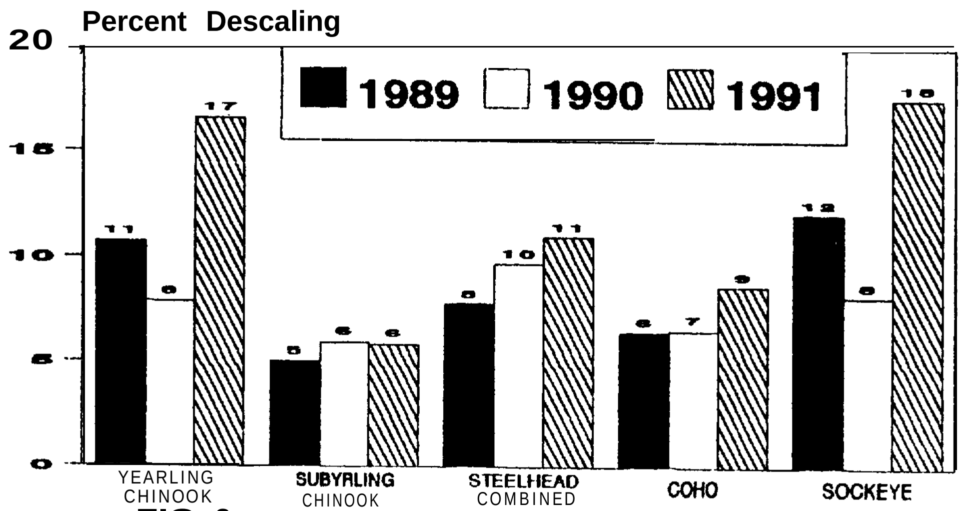

FIG 3: Percent Descaling, John Day Dam 1989-I 991

From late April through mid June in 1991, daily descaling rates for yearling chinook and sockeye were averaging 17 and 18 percent respectively. Trash racks, STS and VBS screens, and the airlift system were repeatedly checked for debris or other problems and none were found. It was decided on May 30th to dipnet smolts from adjacent gatewells 2B and 5B to discern if fish that were not exposed to the airlift sampler were similarly descaled. Descaling rates on dipnetted smolts (Table 2) were found to be comparable to that in airlift samples indicating that the high descaling rates were not specific to unit 3.

TABLE 2. Descaling rates of dipnet and airlift collected fish at John Day Dam.

GATEWELL	YRLG CHIN	SUBYRLG CHIN	STEELHEAD wild	STEELHEAD hatch	COHO	SOCK
2B - DIPNET	14.0	8.1	3.7"	22.1	5.1"	42.1*
3B - AIRLIFT	12.0	11.5	4.3*	18.6	11.0*	20.7"
5B - DIPNET	12.2	13.3	5.7x	11.6	14.6*	35.0"

* = sample size of less than 100 fish
Note: Dipnet totals do not include clean-out fish

Descaling rates on fish passing through the McNary Dam bypass during this same time period averaged 9.7% for yearling chinook, and 11% for sockeye. This meant there was a 40% increase in descaling seen in the samples at John Day Dam. It was observed that approximately 60% of all descaled fish examined at John Day during this time had regenerated a slime layer over the descaled area, indicating that the descaling may be "old". Since only 40% of the descaling seen at John Day was "fresh" or raw, and subsequent holding tests indicated that formation of this protective slime layer took about two days to develop, it was suspected that the descaled fish that had time to generate a slime layer had been originally descaled at some point upriver and were showing up at John Day Dam.

The month of May was a time of high river flows, spill levels, and debris loads at upriver projects. The Umatilla and John Day river tributaries feeding the John Day pool were in full flood, all of which have a detrimental effect on fish condition.

Over the spring migration the percentage of descaled fish in the sample steadily increases for every species through May. For the summer subyearling migration, typically the incidence of descaling, mortality and disease peaks from late June through July and then begins to drop.

Delayed Mortality Testing

In an effort to evaluate the impacts of fish handling and anesthetizing procedures on sampled fish at John Day Dam, a series of tests were conducted to measure short term delayed mortality (48 hr. holding) rates on handled and control groups. Tests were conducted onyearling chinook and steelhead in May, and on subyearling chinook in July and August. The details and expanded results of these tests are presented in Appendix D.

Delayed mortality tests results at John Day Dam are as follows;

species	H20 oF Temp.	# of Rep Tests	HANDLED Morts/Total	HANDLED % Morts	CONTROL Morts/Total	CONTROL % Morts	COMBINED Morts/Total	COMBINED % Morts
yearling Chinook	51-56	24	15/1276	1.2%	38/979	3.9%	53/2255	2.4%
Steelhead	51-54	8	1/360	0.3%	0/366	0	1/726	0.1%
subyearling Chinook	65-71	11	100/547	18.3%	88/535	16.5%	188/1082	17.4%

The mortality in combined handled and control tests were very low overall for yearling chinook (2.4%) and steelhead (0.1%). Test results for yearling chinook showed higher mortality in control groups than handled groups. The effects of the additional stress of handling may be very small and requires more replicate tests performed to be conclusive. Test data for steelhead showed no significant difference in mortality between handled (0.3%) and non-handled groups (0%).

Subyearling chinook suffer high mortality rates in the samples at John Day during late July to early August, when water temperatures peak. This high background mortality on sampled fish that were not handled prior to holding makes it difficult to obtain clear test results on subyearlings. Combined handled and control test mortality was high (17.4%) although there was no significant difference between handled (18.3%) and controls (16.5%).

Brand Recovery Tests

A continuing effort to measure the brand recognition and recording efficiency of fish handlers at John Day Dam was also conducted this season. Three brand recovery tests were done using yearling chinook and six tests were conducted using subyearling chinook. For each test approximately 20 to 30 fish collected from the hourly sample were branded with a >Y brand using a variety of standard locations and rotations. The fish were held for 48 hours and then introduced into the airlift trap.

Combined brand detection test results are as follows;

Species	# of Tests	Total # Branded	Total # Recovered	Percent Recovered
Yearling Chinook	3	89	82	92%
Subyearling Chinook	6	139	135	97%
Total	9	228	217	95%

Fish handlers at John Day Dam were able to detect and record a total of 217 out of 228 branded chinook introduced into the sample for a detection rate of 95%.

Fry Incidence

The incidence of summer/fall chinook fry (< 60mm) in the sample this season was small (1% of all subyearling chinook captured), totalling 513 fish captured from May through June.

Adult Catch

A total of 43 adult salmonids were incidentally captured over the sample season 34 steelhead and 9 chinook.

Incidental Catch

Incidental capture of juvenile American shad (Alosa sapidissima) at John Day Dam is presented in Appendix E, Figure 1. Shad capture began to occur regularly near the end of July and peaked through late August. The 1991 sample count for shad was about half of the 1990 count (1991-169,747; 1990-327,621). It should be noted that sampling ends in the latter half of the juvenile shad migration, therefore annual counts are affected by migration timing.

Juvenile pacific lamprey (Entosphenus tridentatus) first appeared in samples from April 25th through June 15th peaking on May 20th. The 1991 sample count for lamprey was 9,338 (see Appendix E, Figure 3).

THE DALLES DAM

Catch Numbers and Influences

The 1991 monitoring season for spill at The Dalles Dam experienced a 77.5% decline in total catch numbers in the same gatewell over approximately the same time period compared to 1990, (1991= 15,946; 1990= 3,593).

Several factors may contribute to the decline in catch; there was 26% more spill in 1991 diverting fish away from the sampled unit; the 50 percent decline in index totals at John Day Dam may be reflected at The Dalles; and the chance that a lower percentage of smolts found the entrance to the unscreened sampled gatewell 2-2 at The Dalles Dam this year.

Catch numbers have been very low since the installation of the airlift on July 4th of 1990. As in 1990, the 1991 numbers raise more questions about the efficiency of airlift sampling at The Dalles. Although it is impossible to confirm a difference in sampling efficiency between dipbasket and airlift sampling without tests, the following factors may be affecting airlift efficiency at The Dalles Dam;

1) The funnel is placed higher up in the gatewell due to a constriction in the gatewells at The Dalles. With the absence of a strong up-welling effect created by STS screens this may leave a sanctuary area for fish below the funnel.

2) There is some noise associated with the compressed aerator at the funnel, and the funnel blocks all attracting light filtering down the gatewell. Fish could be avoiding the funnel from the sanctuary area by sounding down and back out the gatewell entrance. This could be avoided if the funnel were modified so it could be placed lower near the gatewell entrance, or STS screens were installed in the sampled unit.

Die1 Catch Patterns

Another complicating factor to the usefulness of catch data at the Dalles is the heavy influence of the ice trash sluiceway operation on the diel catch pattern illustrated by Figure 4. The total diel catch pattern in figure 4, as well as the seasonal die1 patterns ² presented for each species in Appendix B Figures 8-13, show an increase in catch numbers at sunset for all species except Sockeye. This rise coincides with the closing of the sluiceway, as was discussed in Hawkes et al. (1990). Sluiceway operations remained virtually identical to last year with gates at the west end of the powerhouse opening at 0400h and closing at 2100h. The sharp rise in catch numbers just after sluiceway gates close for the evening suggests that the sluiceway may be a very important bypass system during daylight migration hours.

The spillway is opened at about the same time that the sluiceway is closed (2000h - 0400h) but the effect on the catch pattern seems to be delayed 3 to 4 hours. After 2300h, catch decreases as spill reaches its highest values. In conclusion, the die1 catch patterns at The Dalles Dam seem to be heavily influenced by project operation.

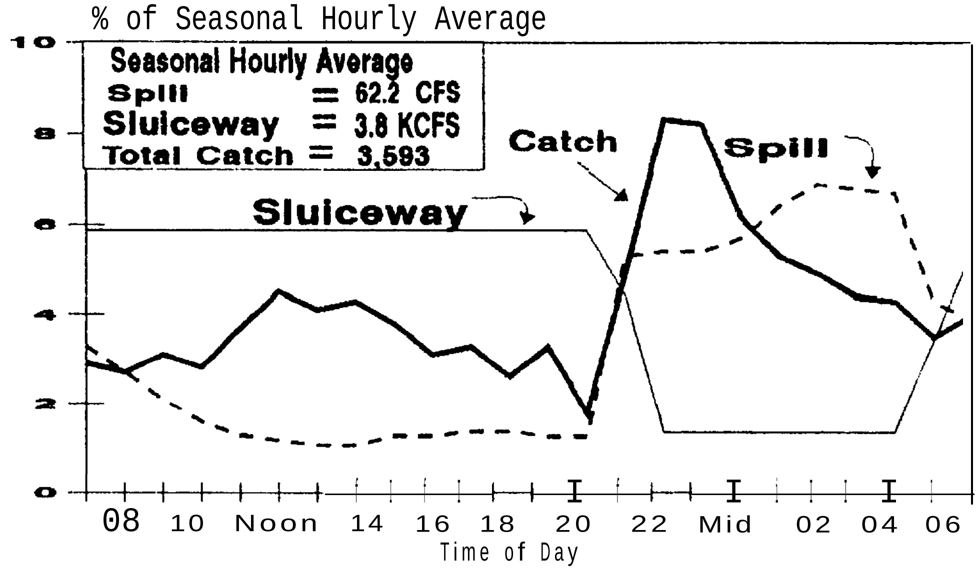

Figure 4. Slulceway and Spill Flows vs. Total Catch Seasonal Dlel Pattern, The Dalles Dam, 1991

<u>Flows and Spill</u>

River flow, average sampled unit discharge and spill for The Dalles Dam are shown in Appendix B, Figure 1. The sampled unit #2 was taken off line a total of 20 hours over the monitoring season.

To facilitate smolt passage, the respective 10 and 5 percent of daily average flow authorized to be spilled under the "Fish Spill Memorandum of Agreement" during the spring and summer spill

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²/ Hourly sample counts are adjusted to eliminate the effect of unit 2 flow fluctuations on fish passage.

season at The Dalles, was concentrated into 8 hours per day. The spring spill season ran from May 1st through June 7th. Hours of concentrated spill for fish took place from 2000h - 0400h. Substantial overgeneration spill occurred from mid May to mid June, resulting in spill averaging 20.9% of daily average flow over the spring period. The summer spill season lasted from June 7th through August 23rd. Hours of daily spill continued to run from 2000h - 0400h, with an overall 10.2% of daily average flow being spilled.

Total spill volume (including overgeneration spill) was 26% higher in 1991 (3848.5 ksfd) compared to 1990 (2845 ksfd) at The Dalles Dam. Most of this increased spill came as overgeneration spill primarily occurring in mid-May to mid June, during the period of peak passage of spring migrants. Last year, substantial overgeneration spill occurred slightly later in the season, June 1 - 20; after the peak passage of spring migrants.

Seasonal Passage

The seasonal passage patterns for all species are graphed in Appendix B, Figures 2-7. The percentage of total catch for each species were similar to 1990. The low numbers of fish captured, (3,593 total catch) and the influences of project operations affect the usefulness of the data as a true indicator of passage patterns.

Subyearling chinook passage (Appendix B, Figure 3) through April and most of May were fry, < 60mm. These fish are not migrating but merely being swept down river by the current (533 total fry).

Estimated dates for the 10 to 90% segment of smolt passage at The Dalles are difficult to develop with confidence because of the low numbers of fish captured and the many influences at this site on fish capture. Dates for the 10 and 90% of passage estimated after the season for yearling chinook were 4/23 and 5/19; and for steelhead 5/10 and 6/7.

Descaling and Mortality

The increase in descaling at The Dalles Dam was reflective of the higher descaling percentages seen at upriver projects in the spring of 1991. Descaling and mortality in the samples for each species are shown below;

SPECIES	PERCENT DESCALED	MORTALITY
Yearling Chinook - - - -	10.7	0.9
Subyearling Chinook - -	2.8	0.9
Steelhead Wild - - - - -	5.8	0.0
Hatchery - - - - -	20.1	0.2
Coho - - - - - - - - - - -	2.7	0.9
Sockeye - - - - - - - - -	10.7	1.1

Summary

The lack of submersible traveling screens (STS), low catch numbers, the heavy influence of the ice and trash sluiceway on the die1 monitoring data, and the effectiveness of spill, combine to make the data gained from gatewell sampling marginally useful at The Dalles Dam. The small sample size (3,593 total catch) is not a reliable indicator of passage patterns. For these reasons, The Dalles Dam is being dropped from the 1992 Smolt Monitoring Program.

BONNEVILLE DAM

Sample Numbers

Catch numbers from the downstream migrant channel sampler in the first powerhouse (DSM 1) generated an index total of 2,819,263 at Bonneville Dam in 1991. This is a 13.5% increase over the 1990 DSM 1 index total of 2,439,268, and within 5.6% of the three year average since 1988.

Water control and sampling equipment in the downstream migrant channel in the first powerhouse completed another relatively uninterrupted monitoring season. Equipment failure resulted in just three hourly samples missed out of a total of 2,112 for the monitoring season.

Flows and Spill

Daily river flow, spill and discharge from the first and second powerhouse are presented in Appendix C, Figures 1-2. River flows ranged from a high of 349.7 kcfs on May 25th to a low of 86.7 kcfs October 16th. Spill occurred from the 22nd to the 28th of March for the passage of Spring Creek N.F.Hatchery release of tule fall chinook, and again from April 15th to August 20th. Spill peaked on May 26th at 155.6 kcfs. Spill averaged 33.9% of the daily average flow through the spill season at Bonneville Dam (April 15 through August 20). First powerhouse discharge ranged from 134.7 kcfs on March 22nd to 59.2 kcfs on September 12th.

As in previous years, operation of the second powerhouse was restricted during the primary part of the monitoring season due to low fish guidance efficiency. During the spring water budget period several units were operated during daylight hours when total river flow exceeded the maximum generation of the first powerhouse plus 75 kcfs daily spill. In addition, the second powerhouse was operated in July during the NMFS tests and again in September for adult collection purposes.

Seasonal Passage Patterns

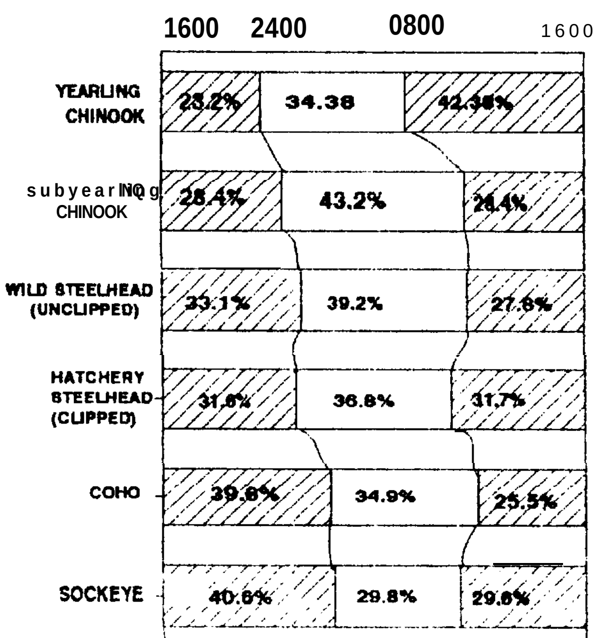
Fish passage patterns for the first and second powerhouse are presented in Appendix C, Figures 3 - 14. The spring passage pattern for subyearling chinook mainly represents large releases of Spring Creek hatchery reared tule stock into the Bonneville Pool. These releases occurred March 21th, April 18th, and May 16th. The summer passage pattern for subyearlings after June 1st mainly represents the portion of the run which is primarily upriver bright stock. It should be noted that the capture patterns for the second powerhouse (Appendix C, Figures 9 - 14) more strongly reflect the second powerhouse discharge than relative fish abundance at this point in the river. The dates are noted on these graphs when the sampler was taken out of service to avoid intercepting research test fish or massive Spring Creek Hatchery releases.

Dates for the 10 to 90% segment of smolt passage for each species measured at the DSM 1 are presented below:

	10%	90%
Yearling Chinook - - - - - - - - -	4/22	5/31
Subyearling Chinook		
"tule" (before June 1) -	3/24	7/23
"brights" (after June I)-	6/5	8/5
Steelhead, wild - - - - - - - - - -	5/9	6/1
hatchery - - - - - - - - -	5/9	5/30
Coho - - - - - - - - - - - - - - - - - -	5/3	6/1
Sockeye - - - - - - - - - - - - - - - -	5/19	5/31

Die1 Passage

Seven die1 tests were conducted with the DSM 1 this season; three tests in May, two in June, and two in July. The DSM 1 sampler was operated hourly for 24 hours during these tests. The resulting hourly collection counts for each species are adjusted to account for hourly changes in flow through powerhouse 1 and are presented in Appendix C, Figures 15 - 38.[3] Peak passage for most species generally took place at or just after sunset with a lesser peak near sunrise.



DIEL DATES; Mar 25; May 9, May 23, May 30, June 6, June, 27. July 14. July 21.

FIGURE 6. DIEL PASSAGE, DSM#1 - 1991. PERCENT CONTRIBUTION, BY species DURING DIEL PASSAGE.

On these die1 test dates the percent of daily smolt passage during the normal sampling hours (1600h - 2400h) can be appraised. Figure 5 compares the percent of daily passage for the combined die1 tests during three eight hour periods for each species. If

[3] Diel passage is shown for a estimated collection based on a minimum catch of 100 fish per day for each species.

normal sampling hours were in effect for these dates, 23.2% of yearling chinook, 28.4% of subyearling chinook, 32.4% of steelhead, 39.6 of coho, and 40.6% of sockeye would have been collected out of the 24 hour period.

Descaling and Mortality

The incidence of descaled fish sampled in the DSM 1 over the 1991 season increased somewhat over the 1989 and 1990 levels. Percentages of descaling and mortality in the sample at DSM 1 and 2 for the past three years are listed by species below.

BONNEVILLE DAM DSM#l

YEAR	YEARLING CHINOOK % DKSC	% NORT	SUBYEARLING CHINOOK % DISC	% NORT	STEELHEAD % DESC	% MORT	COHO % DESC	% NOR:T	SOCK % DESC	% MORT
1989	4.3	0.1	2.3	0.4	4.4	1.1	3.3	0.02	17.2	0.1
1990	7.1	0.1	2.4	0.5	11.2	0.3	5.4	0.1	37.7	1.0
1991	9.4	0.1	2,8	0.3	15.0	0.06	4.5	0.03	27.0	0.2

BONNEVILLE DAM DSM#2

YBAR	YEARLING CHINOOK % DESC	% MORT	SUBYEARLING CHINOOK %, DESC	% MORT	STEELHEAD % DESC	% MORT	COHO % DESC	% MORT	SOCK % DESC	% MORT
1989	4.7	3.1	0.6	1.1	4.8	1.6	3.2	2.1	18.7	16.5
1990	5.4	0.7	1.7	1.4	7.8	4.6	4.0	0.3	21.3	3.1
1991	10.1	0.8	1.9	0.7	16.1	0.9	5.9	0.4	29.4	2.7

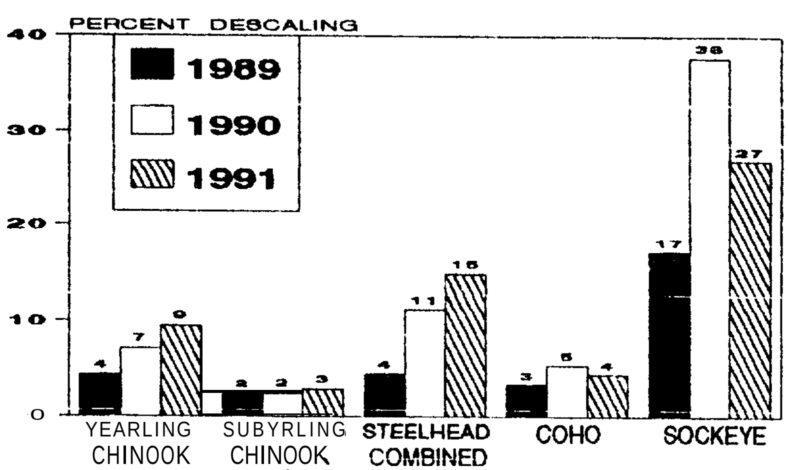


FIG 1: Percent Descaling, Bonneville Dam, DSM#1 1888-l 991

The elevated descaling rates during the spring of 1991 were reflected in the DSM 1 samples. Yearling chinook (10.1%) and steelhead (16.1%) hit record highs for descaling at this site. Al though sockeye rates remain extremely high at Bonneville (27.0%), it is down from last years record high of 37.7% (Figure 6).

Delayed Mortality Tests

Forty-eight hour delayed mortality tests were conducted again this year to evaluate our fish handling procedures. Tests were conducted on yearling chinook and steelhead in May and on subyearling chinook in June and July. The details and expanded results of these tests are presented in Appendix D.

Delayed mortality tests results at Bonneville Dam are as follows;

SPECIES	H2O °F Temp.	# of Rep Tests	HANDLED Morts Total	% Morts	CONTROL Morts Total	% Morts	COMBINED Morts Total	% Morts
Yearling Chinook	51-53	27	6/890	0.7%	11/940	1.2%	17/1830	0.9%
Steelhead	51-53	24	6/731	0.8%	2/430	0.5%	8/1161	0.7%
Subyearling Chinook	56-65	27	28/895	3.1%	20/1455	1.4%	48/2350	2.0%

As in previous years, no significant difference in short term mortality was found to exist between handled and non-handled groups of yearling chinook and steelhead. Handled and control groups of yearling chinook resulted in a total mortality of 0.7% and 1.2% respectively. For steelhead, test results were 0.8% for handled and 0.5% for controls.

For subyearling chinook, overall mortality was low (handled = 3.1%, controls = 1.4%), but handled groups technically had double the amount of mortality over controls which is statistically a significant difference. This is in contrast to the 1989 and 1990 tests where no significant differences were found between handled and non-handled groups.

Physical condition played an important role in smolt survival for all species tested in both handled and control groups with 67.7% of all mortalities being descaled. This suggests that fish may have died from being descaled and not from handling.

Brand Recovery Tests

An effort was made this year to measure the brand recovery efficiency of fish handlers at Bonneville Dam. A total of 10 recovery tests were conducted using 7 to 15 fish per test. In all, 25 yearling chinook, 60 subyearling chinook and 20 steelhead were used for a total of 105 test fish. These fish were collected from the DSM 2 samples and branded with a >Y brand using a variety of rotations and locations. The fish were held for 48 hours to allow brands to become visible. Test fish were introduced into the first powerhouse DSM 1 holding tank immediately after the trap had been raised and the sample had been dumped into the holding tank. This could not be done without the fish handlers knowledge, but fish handlers were not aware of the number and species branded or the rotation and location of brands. Combined brand detection test results are as follows:

Species	Total # Branded	Total # Recovered	Percent Recovered
Yearling Chinook	25	24	96%
Subyearling Chinook	60	56	93%
Steelhead	20	20	100%
combined Total	105	100	95%

Fish handlers at Bonneville Dam were able to detect 100 out of 105 branded salmonids introduced into the DSMl holding tank for a detection rate of 95%.

Incidental Catch

The juvenile American shad collection count began increasing in the DSM 1 in mid August and peaked on November 13th with minor peaks in mid September and late October. (see Appendix E, Figure 2) . The cumulative juvenile shad collection count for 1991 was half of the 1990 count (1991- 1,481,768; 1990-2,934,762), which may be due in part to the 35% decrease in the 1991 adult shad run (Bonneville Dam fish ladder counts).

The collection count of juvenile pacific lamprey for 1991 in the DSM 1 (see Appendix E, Figure 4) was about 2.6 times greater than the 1990 count (1991 - 4568; 1990 - 1,780). Incidental catch of juvenile lamprey started on March 15th and ended on October 17th with peak passage occurring on May 23rd.

SUMMARY

The 1991 smolt monitoring project of the National Marine Fisheries Service provided data on the seaward migration of juvenile salmon and steelhead at John Day, The Dalles and Bonneville Dams. All pertinent fish capture and condition data as well as dam operations and river flow data were provided to Fish Passage Center for use in developing fish passage indices and migration timing, and for water budget and spill management.

ACKNOWLEDGMENTS

Support for this smolt monitoring project comes from the region's electrical ratepayers through the Bonneville Power Administration under the Northwest Power Planning Council Fish and Wildlife Program.

The success of this program continues to involve cooperative interaction with NMFS Coastal Zone and Estuarine Studies Division and the U.S. Army Corps of Engineers on-site biologists, assistants and others who provided valuable guidance and assistance at each sampling site: John Day, The Dalles and Bonneville Dams.

We acknowledge the very capable efforts of our biologists, technicians, maintenance and contract persons; their work was vital. Key people were Scott Carlon and Dan Avery at Bonneville, Randy Absolon at John Day, Randy Smith at The Dalles, and Doug Frantum and his assistants for assembling and keeping the airlift sampling components at The Dalles Dam and John Day Dam in working order.

LITERATURE CITED

Brege, Dean A., R.C. Johnsen, and W.E. Farr, 1990. An airlift pump for sampling juvenile salmonids at John Day Dam. North American Journal of Fisheries Management 10:481-483.

Fish Passage Manager, 1992. 1991 Fish Passage Center Annual Report (Draft). Columbia Basin Fish and wildlife Authority, Portland, OR. 53p plus Appendicies.

Gessel, M.H., L.G. Gilbreath, W.D. Muir, and R.F. Krcma, 1986. Evaluation of the Juvenile Collection and Bypass Systems at Bonneville Dam-1985. U.S. Dept. Comm., NOAA, NMFS, NW&AFC, Seattle, Wa. 63p plus Appendix. (Report to U.S. Army Corps of Engineers, Contract DACW57-83-H-001).

Hawkes, L.A., R.C. Johnsen, W.W. Smith, R.D. Hartinson, W.A. Hevlin, R.F. Absolon, 1991. Monitoring of Downstream Salmon and Steelhead at Hydroelectric Facilities - 1990. Dept. Comm., NOAA, NMFS, ETSD, Portland, OR. 17p plus Appendicies. (Report to BPA, Project No. 84-14, Contract DE-AI79-85BP20733).

Krcma, R. F., M. H. Gessel, W. D. Muir, S. C. McCutcheon, L. G. Gilbreath, B. H. Monk, 1984. Evaluation of the Juvenile Collection and Bypass System at Bonneville Dam-1983. U.S. Dept. Comm., NOAA, NMFs, NW7AFC, Seattle, Wa. 56p plus Appendix. (Report to U.S. Army Corps of Engineers, Contract DACW57-83-F-0315).

Matthews, G.M., D.L. Park, T.E. Ruehle, and J.R. Harman, 1985. Evaluation of Transportation of Juvenile Salmonids and Related Research on the Columbia and Snake Rivers, 1984. U.S. Dept. of Comm., NOAA, NMFS, NW7AFC, Seattle, WA., 27p. plus Appendix. (Report to U.S. Army Corps of Engineers, March 1985, Contract DACW68-84-H-0034).

McConnell, R-J, and W.D. Muir, 1982. Preliminary Evaluation of the Bonneville Juvenile Bypass System - Second Powerhouse. U.S. Dept. of Comm., NOAA, NMFS, NW7AFC, Seattle, Wa. 8p. (Report to U.S. Army Corps of Engineers, Contract DACW57-82-F-0398).

Sims, C.W., R.C. Johnsen, and W.W. Bentley, 1976. Effects of Power Peaking Operations on Juvenile Salmon and Steelhead Trout Migrations, 1975. U.S. Dept. of Comm. NOAA, NMFS, NW&AFC, Seattle, Wa. (Report to U.S. Army Corps of Engineers, Contract DACW 57-F-0303).

Sims, C.W., J.G. Williams, D.A. Faurot, R.C. Johnsen, and D.A. Brege, 1981. Migrational Characteristics of Juvenile Salmon and Steelhead in the Columbia River Basin and Related Research at John Day Dam. Vol.I, U.S. Dept. of Comm., NOAA, NMFS, NW&AFC, Seattle, Wa., 61p. (Report to U.S. Army Corps of Engineers, Contract DACW 57-80-F-0394).

APPENDIX A
JOHN DAY DAM - 1991

FIGURES	TITLES	PAGES
1	RIVER, SAMPLED UNIT AND SPILL FLOWS	A-1
	PASSAGE PATTERNS	
2	YEARLING CHINOOK	A-2
3	SUBYEARLING CHINOOK	A-2
4	WILD STEELHEAD (UNCLIPPED)	A-3
5	HATCHERY STEELHEAD (CLIPPED)	A-3
6	COHO	A-4
7	SOCKEYE	A-4
	WEEKLY DIEL PATTERNS	
8-16	YEARLING CHINOOK	A-5-6
17-31	SUBYEARLING CHINOOK	A-7-9
32-35	WILD STEELHEAD (UNCLIPPED)	A-11
36-40	HATCHERY STEELHEAD (CLIPPED)	A-12
41-45	COHO	A-13
46-48	SOCKEYE	A-14

RIVER, SAMPLED UNIT, SPILL

DAILY AVERAGE FLOW

JOHN DAY DAM - 1991

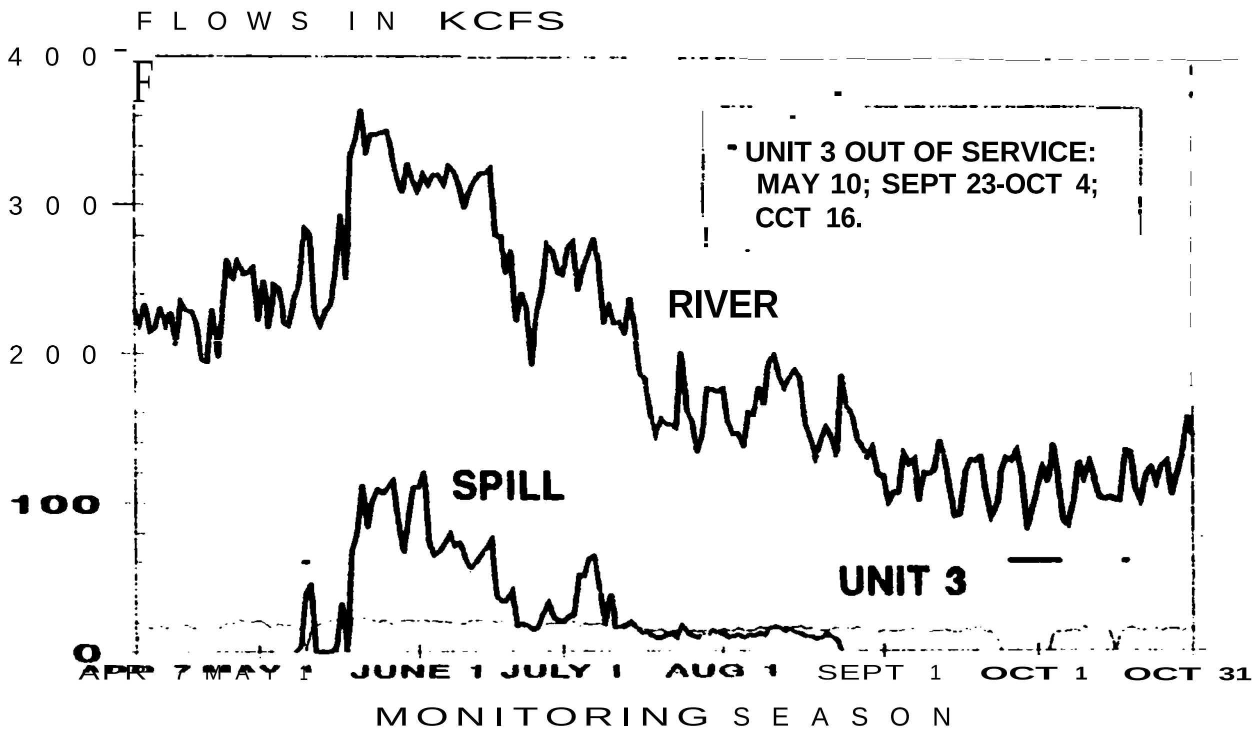


FIGURE 1

YEARLING CHINOOK

PASSAGE PATTERN
JOHN DAY DAM - 1991

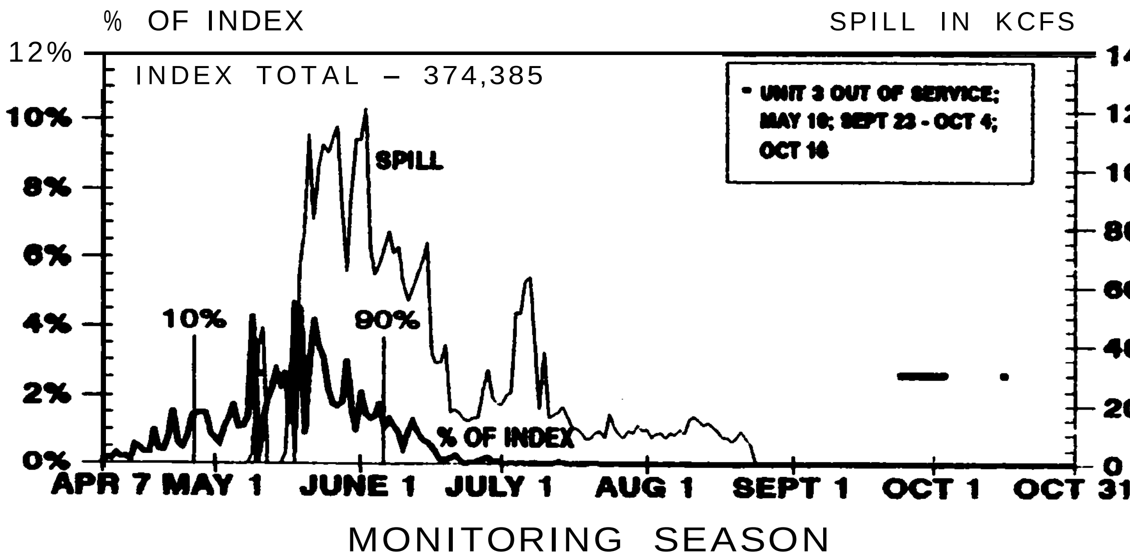


FIGURE 2

SUBYEARLING CHINOOK

PASSAGE PATTERN
JOHN DAY DAM - 1991

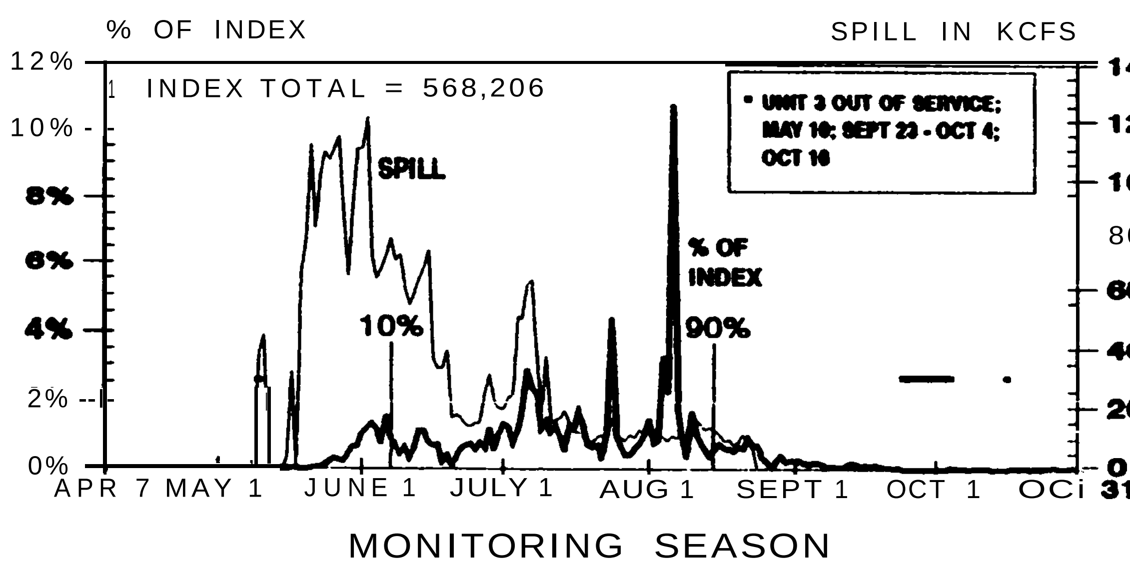


FIGURE 3

WILD STEELHEAD (UNCLIPPED)

PASSAGE PATTERN

JJOHN DAY DAM - 1991

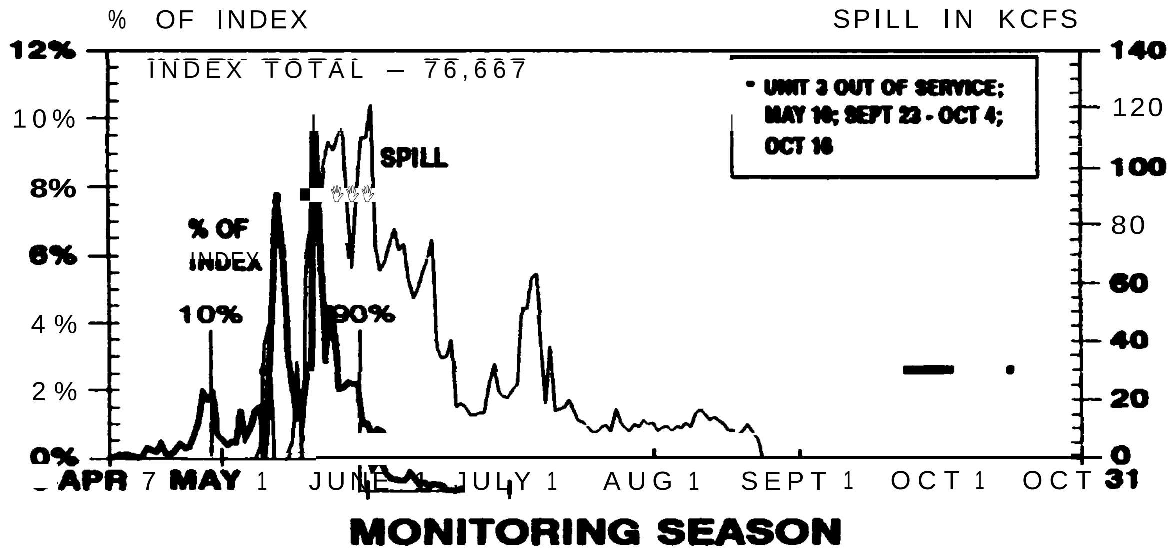


FIGURE 4

HATCHERY STEELHEAD (CLIPPED)

PASSAGE PATTERN

JOHN DAY DAM - 1991

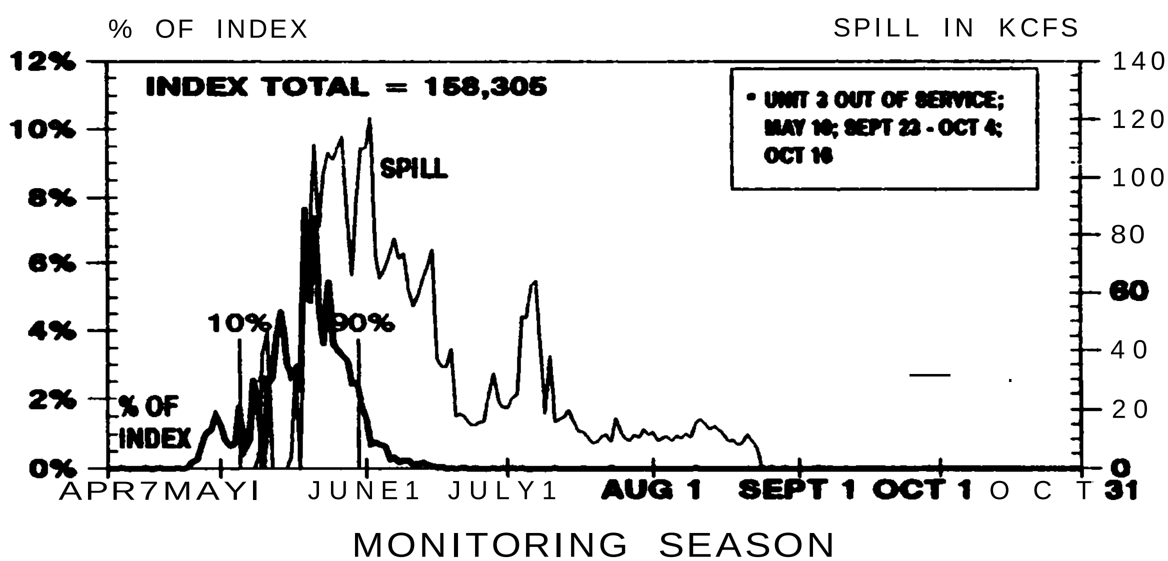


FIGURE 5

COHO

PASSAGE PATTERN
JOHN DAY DAM - 1991

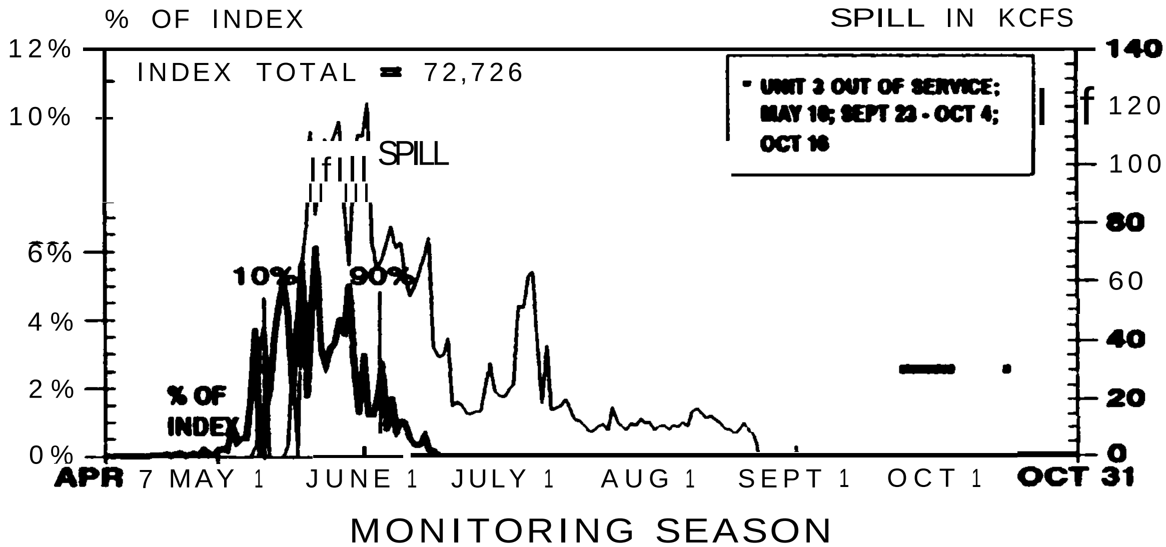


FIGURE 6

SOCKEYE

PASSAGE PATTERN
JOHN DAY DAM - 1991

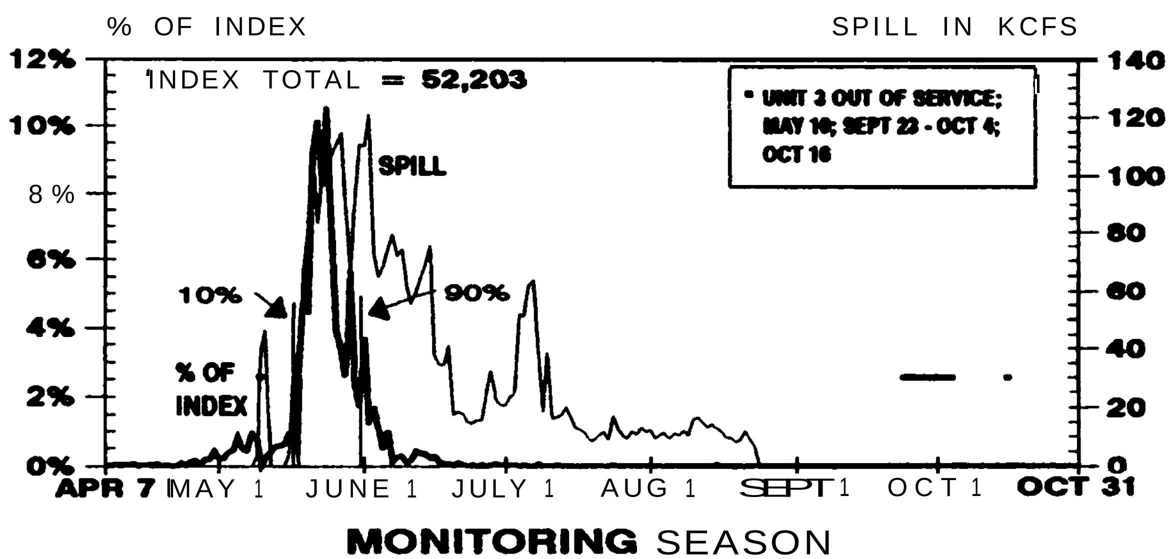
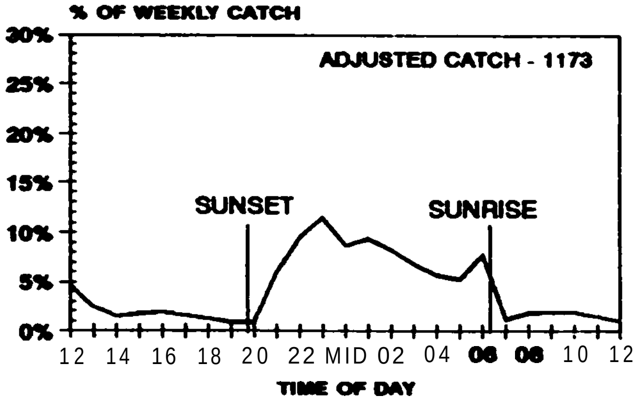


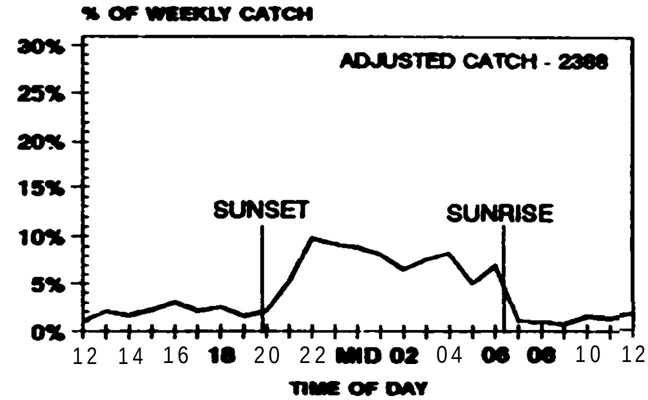
FIGURE 7

YEARLING CHINOOK

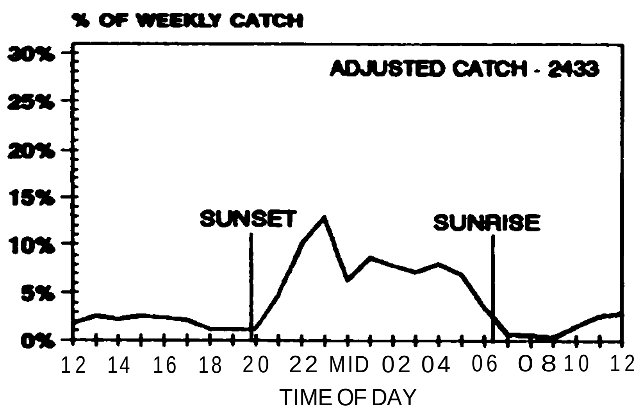
WEEKLY DIEL PATTERN
JOHN DAY DAM, 1991



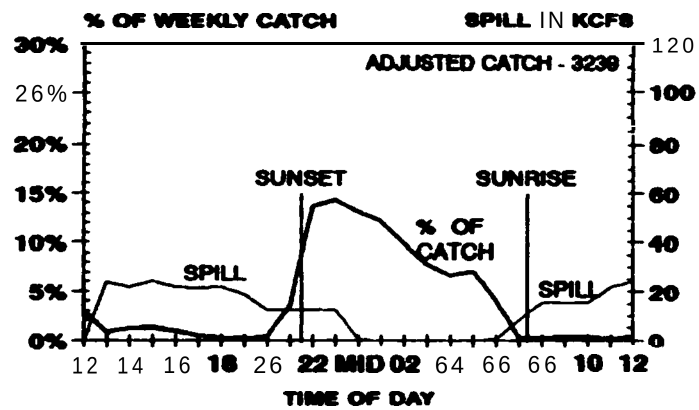
APR 14 - APR 21
FIGURE 8



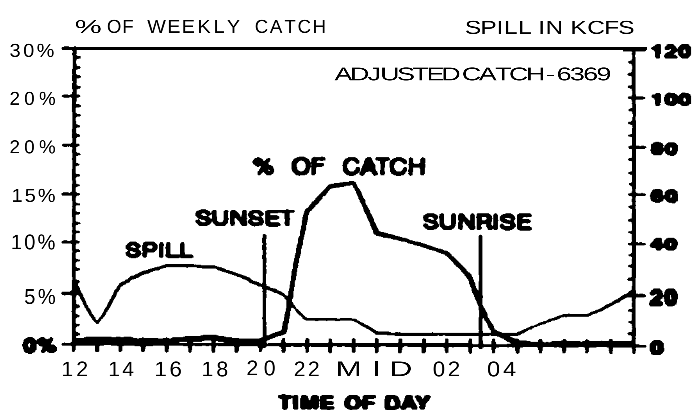
APR 21 - APR 28
FIGURE 9



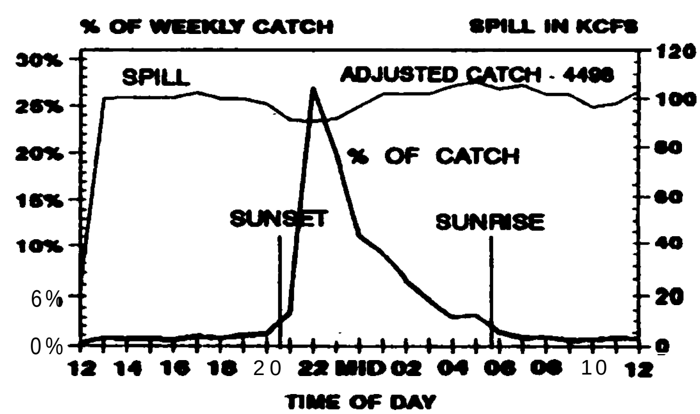
APR 28 - MAY 5
FIQURE 10



MAY 5 - MAY 12
FIGURE 11

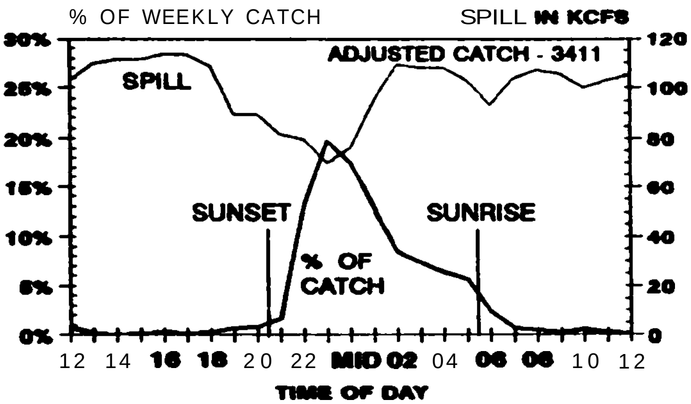


MAY 12 - MAY 19
FIGURE 12

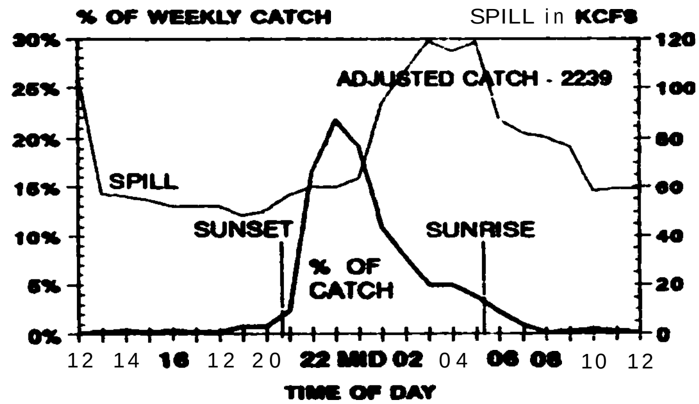


MAY 19 - MAY 26
FIGURE 12

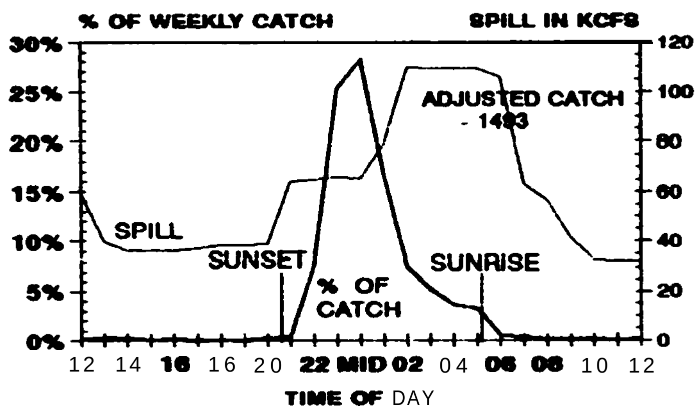
YEARLING CHINOOK
WEEKLY DIEL PATTERN
JOHN DAY DAM



MAY 26 - JUNE 2
FIGURE 14



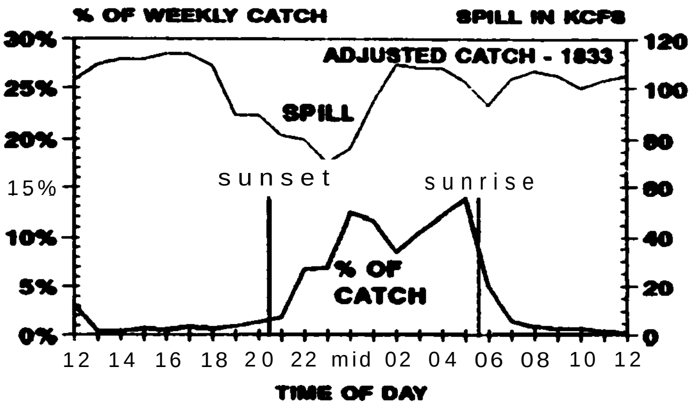
JUNE 2 - JUNE 9
FIGURE 16



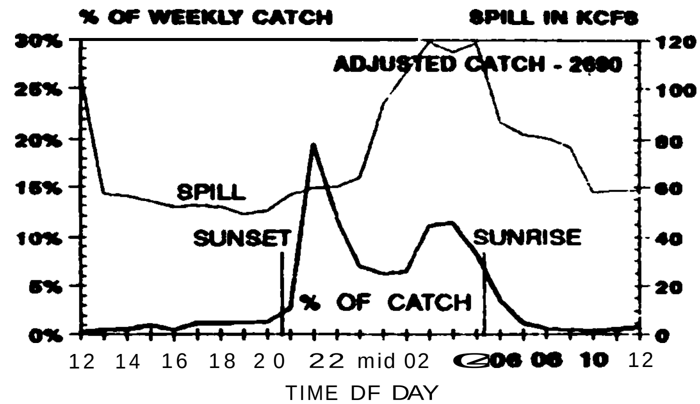
JUNE 9 - JUNE 16
FIQURE 16

subyearling chinook

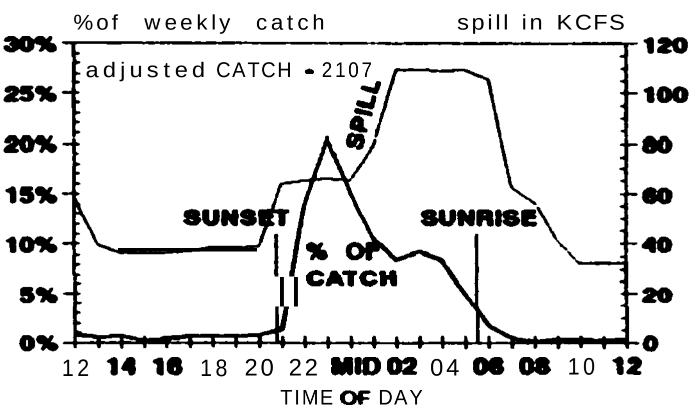
WEEKLY diel PATTERN
JOHN DAY DAM - 1991



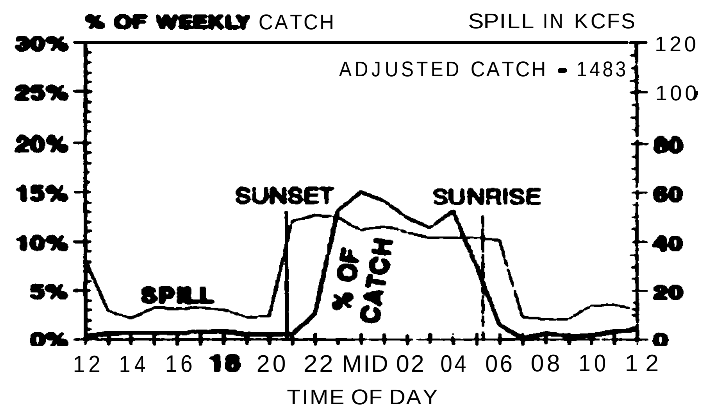
MAY 26 - JUNE 2
FIGURE 17



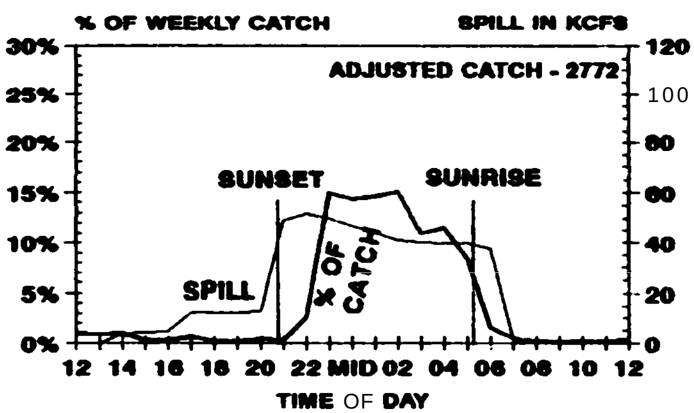
JUNE 2 - JUNE 9
FIGURE 18



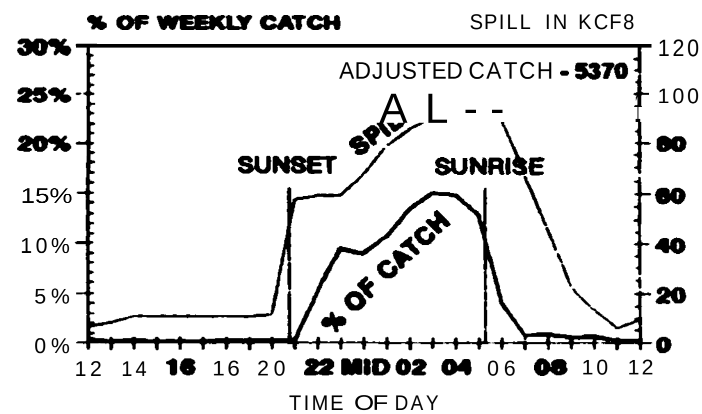
JUNE 9 - JUNE 16
FIGURE 19



JUNE 16 - JUNE 23
FIQURE 20



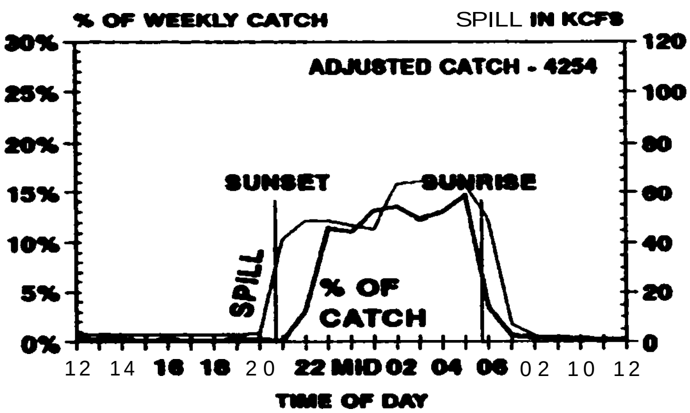
JUNE **23** - JUNE **30**
FIGURE 21



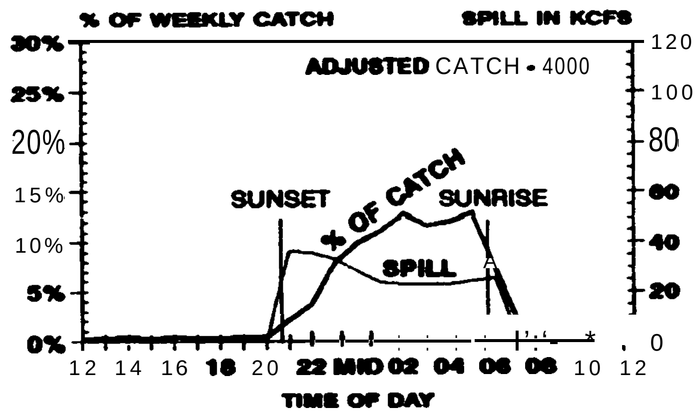
WEEK OF JUNE **30** - JULY 7
FIGURE 22

subyearling chinook

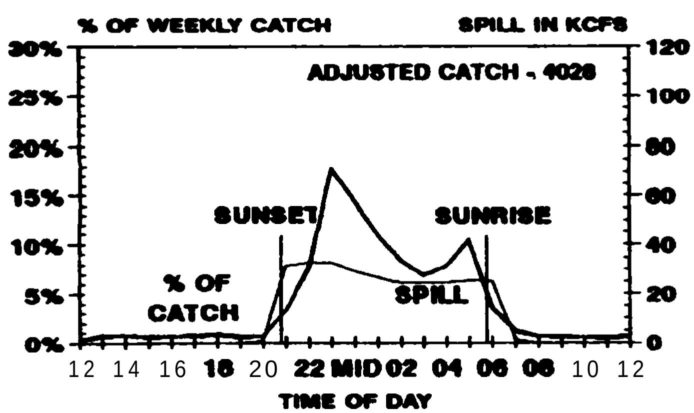
WEEKLY DIEL PATTERN
JOHN DAY DAM - 1991



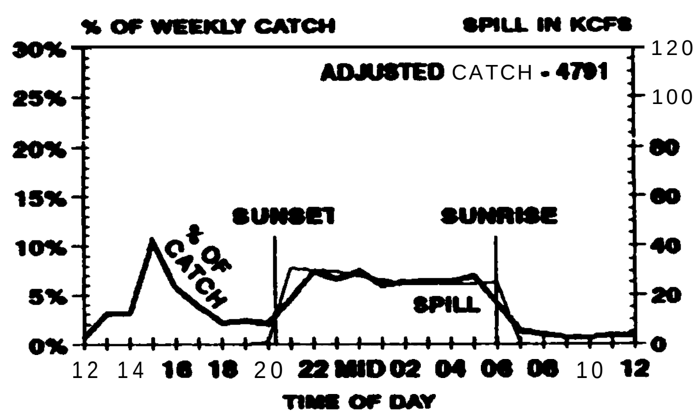
JULY 7 - JULY 14
FIGURE 23



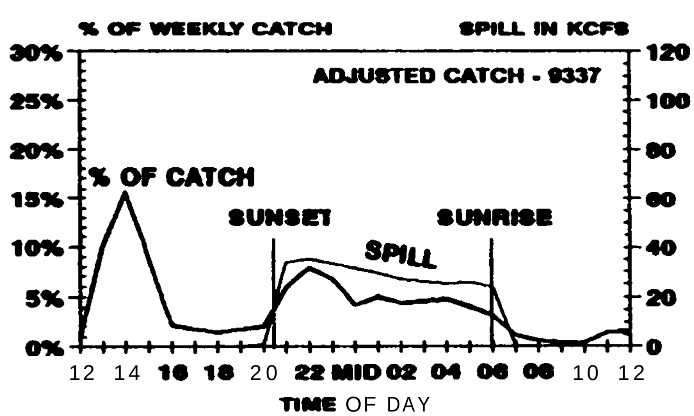
JULY 14 - JULY 21
FIGURE 24



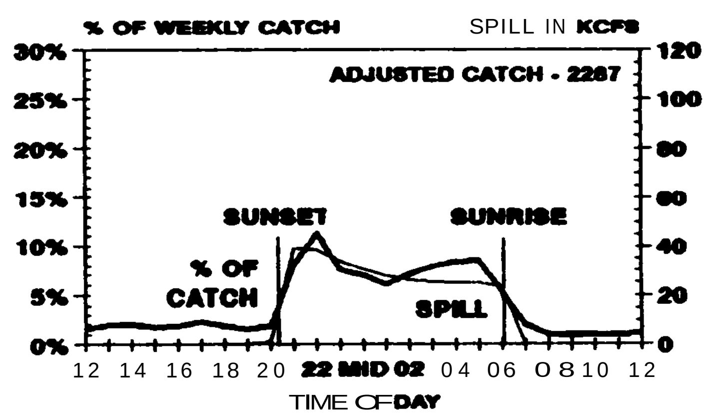
JULY 21 - JULY 28
FIGURE 26



JULY 28 - AUG 4
FIGURE 26



AUG 4 - AUG 11
FIGURE 27

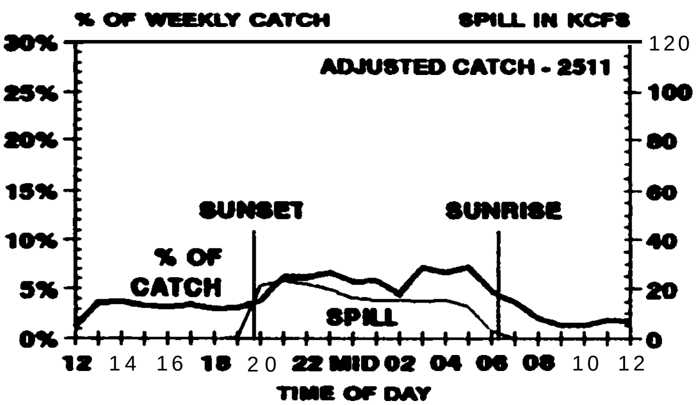


AUG 11 - AUG 18
FIGURE 28

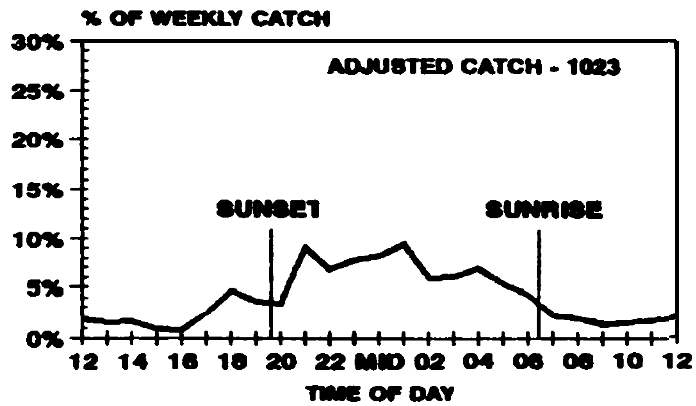
SUBYEARLING CHINOOK

WEEKLY DIEL PATTERN

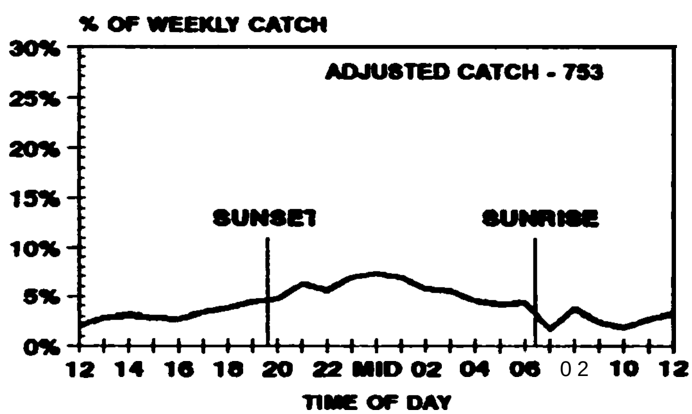
JOHN DAY DAM - 1991



AUG 19 - AUG 25
FIGURE 29

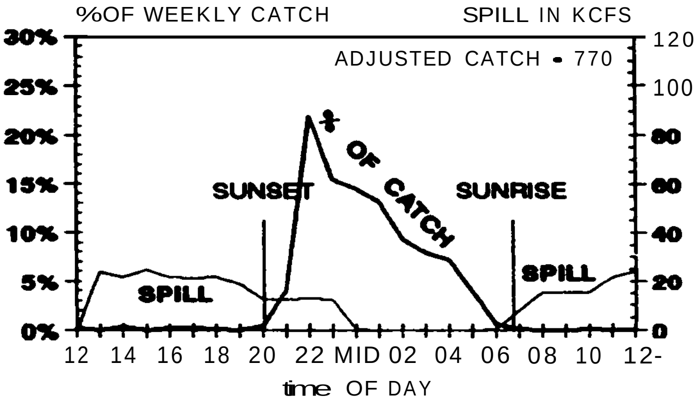


AUG 25 - SEPT 1
FIGURE 30

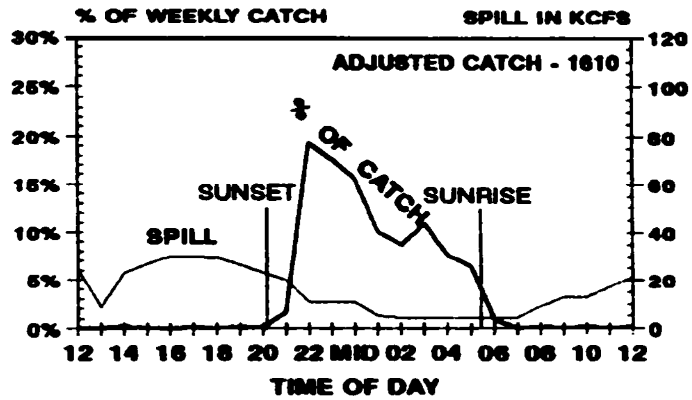


SEPT 1 - SEPT 8
FIGURE 31

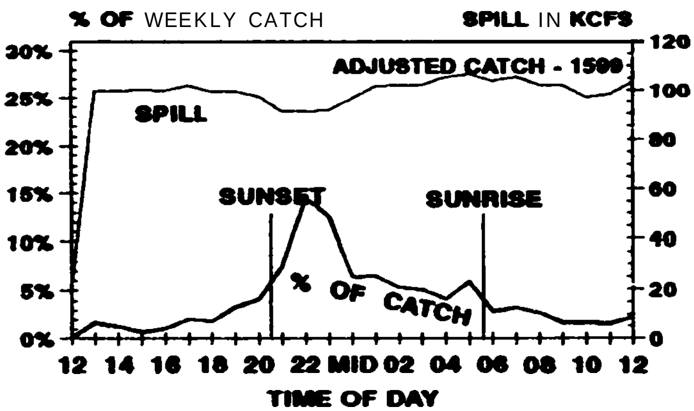
WILD STEELHEAD (UNCLIPPED)
WEEKLY DIEL PATTERN
JOHN DAY DAM, 1991



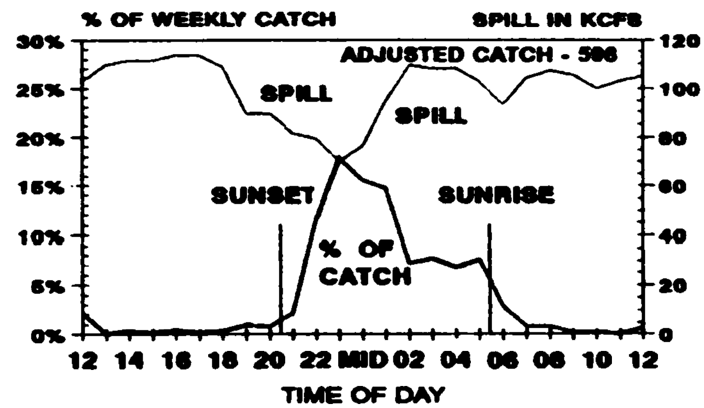
MAY 5 - MAY 12
FIGURE 32



MAY 12 - MAY 19
FIGURE 33



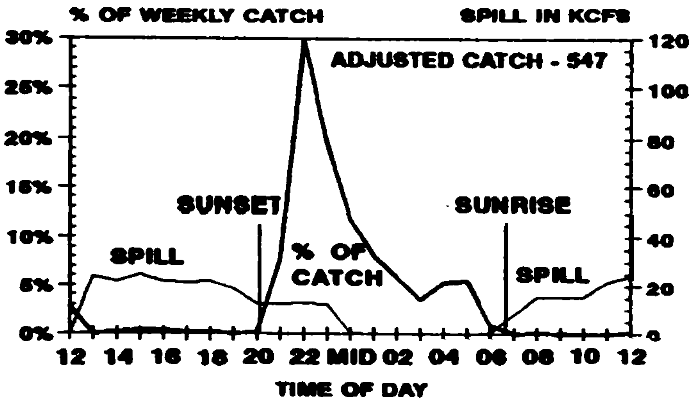
MAY 19 - MAY 26
FIGURE 34



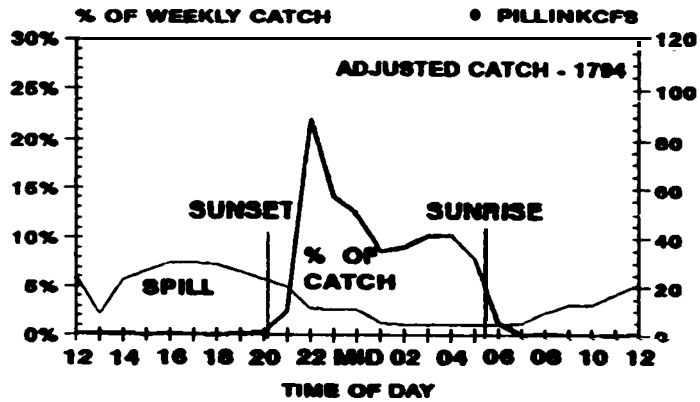
MAY 26 - JUNE 2
FIGURE 35

coho

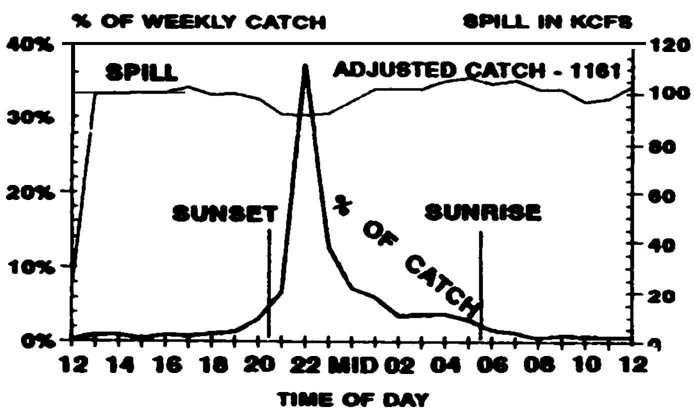
WEEKLY diel PATTERN
JOHN DAY DAM - 1991



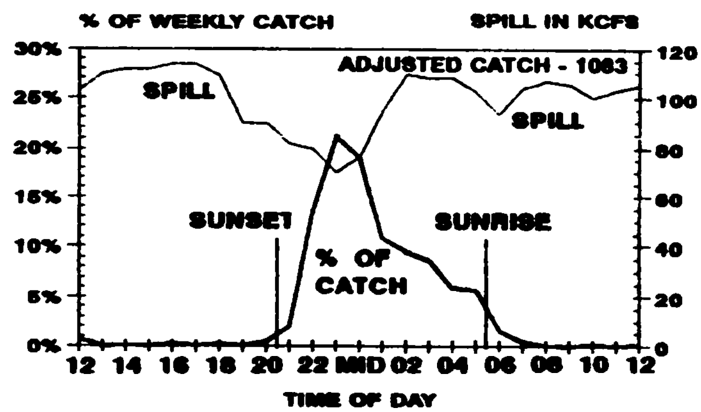
MAY 5 - MAY 12
FIGURE 41



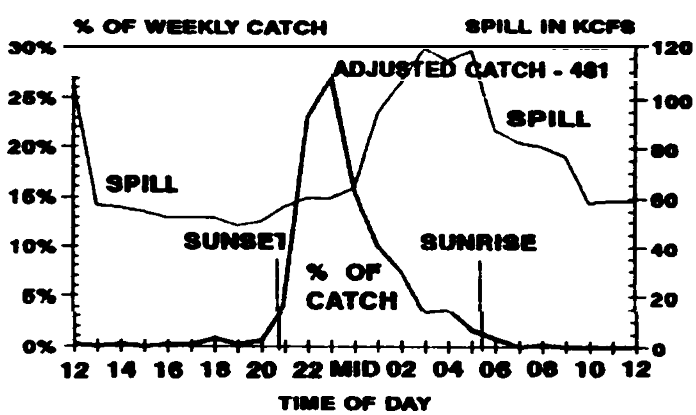
MAY 12 - MAY 19
FIGURE 42



MAY 19 - MAY 26
FIGURE 43



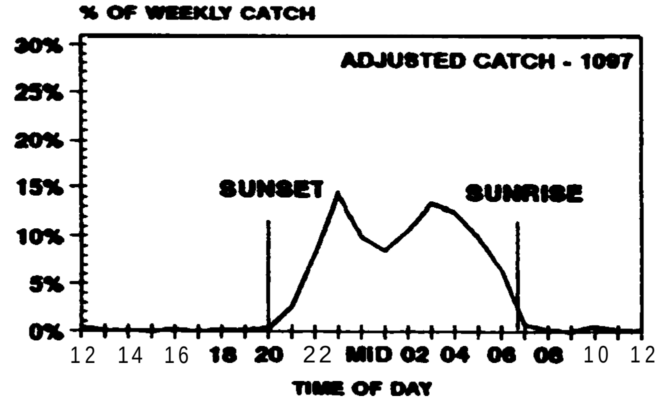
MAY 26 - JUNE 2
FIGURE 44



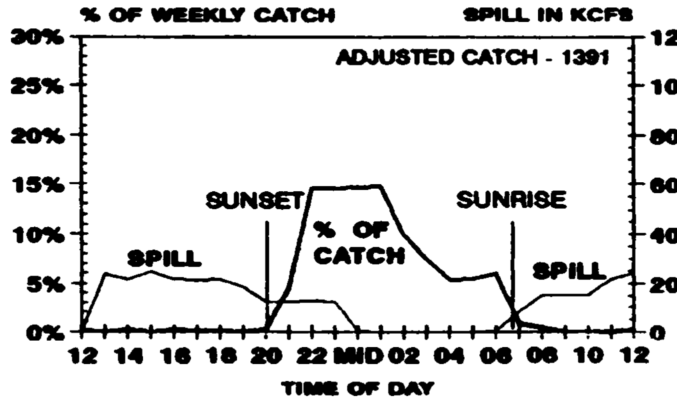
JUNE 2 - JUNE 9
FIGURE 48

HATCHERY STEELHEAD (clipped)

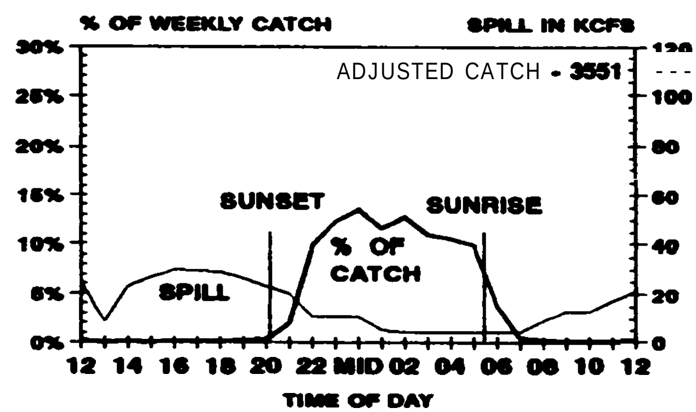
WEEKLY DIEL PATTERN
JOHN DAY DAM - 1991



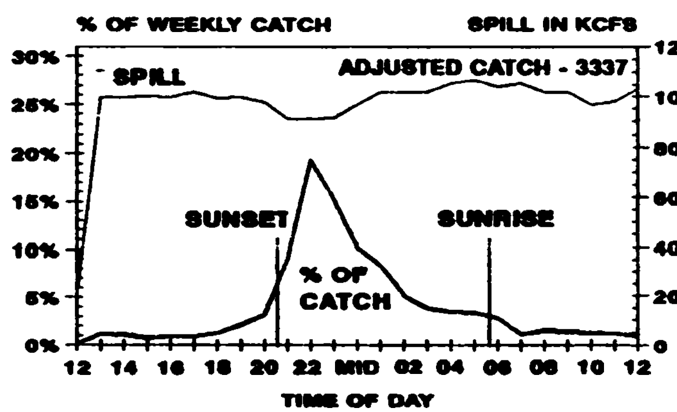
APR 28 - MAY 5
FIGURE 36



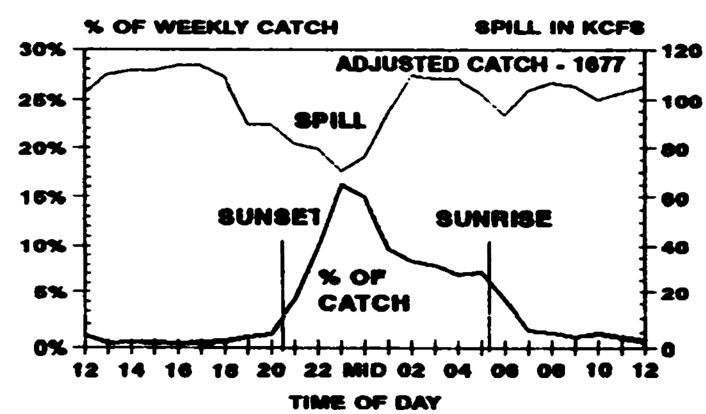
MAY 5 - MAY 12
FIGURE 37



MAY 12 - MAY 19
FIGURE 38

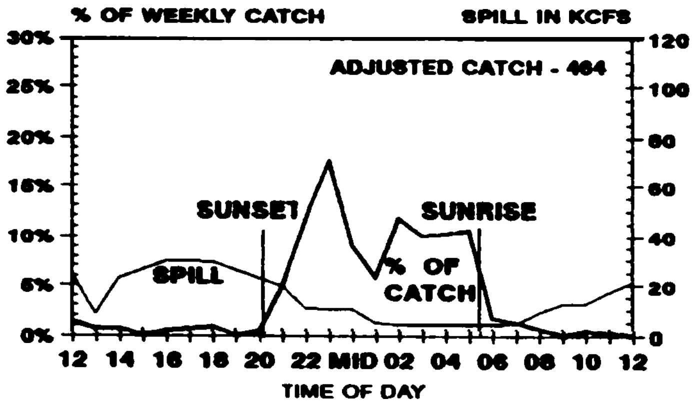


MAY 19 - MAY 26
FIGURE 34

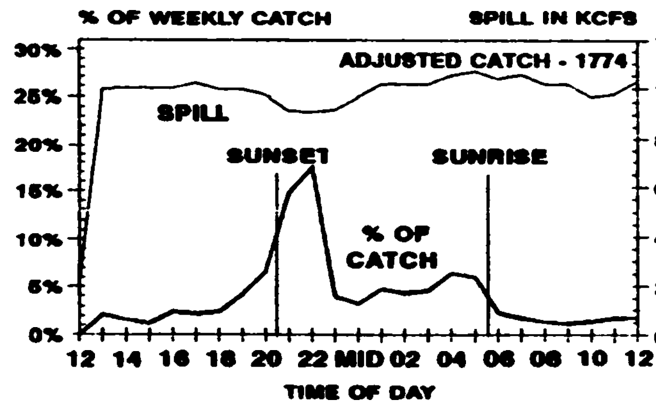


MAY 26 - JUNE 2
FIGURE 40

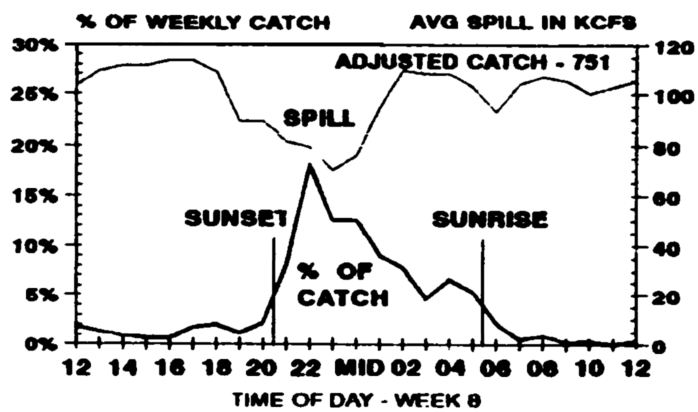
SOCKEYE
WEEKLY DIEL PATTERN
JOHN DAY DAM - 1991



MAY 12 - MAY 19
FIGURE 46



MAY 19 - MAY 26
FIGURE 47



MAY 26 - JUNE 2
FIGURE 48

APPENDIX B
THE DALLES DAM - 1991

RIVER, UNIT 2 AND SPILL
DAILY AVERAGE FLOW
THE DALLES DAM - 1991

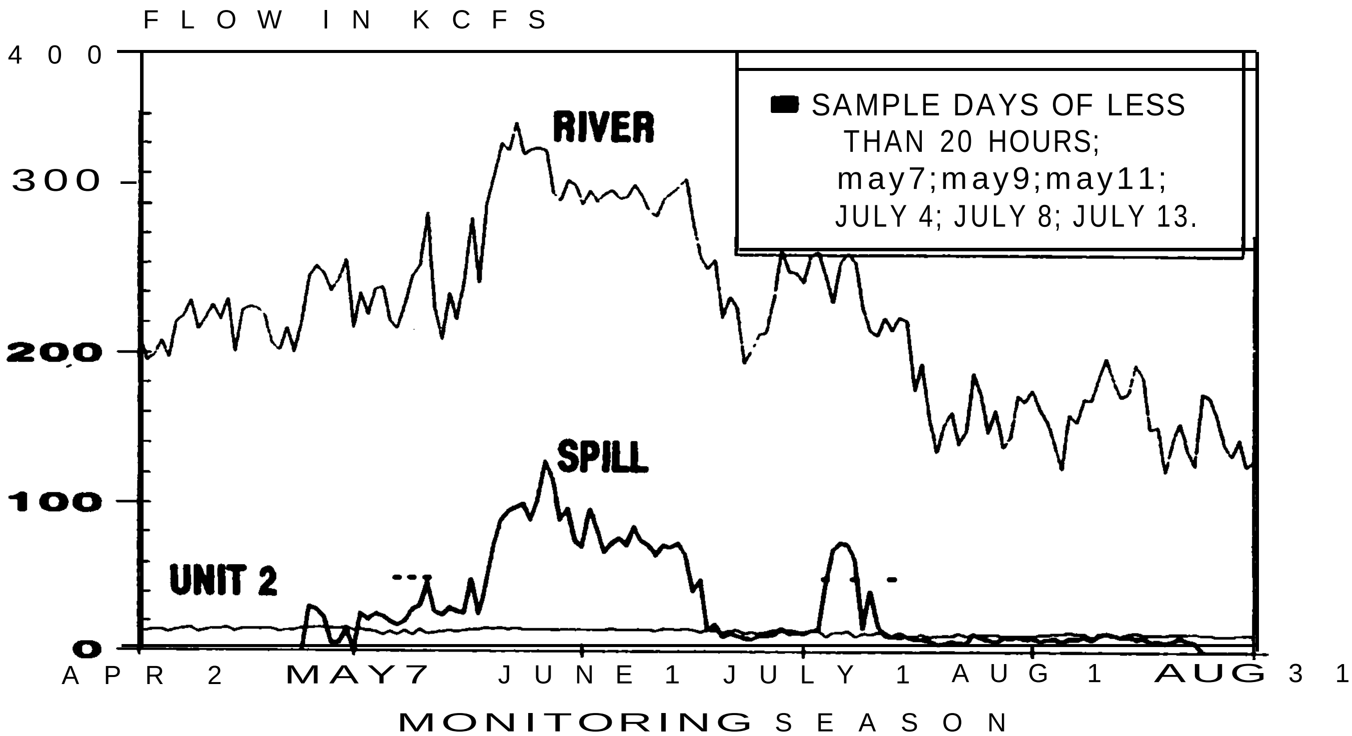


FIGURE 1

YEARLING CHINOOK
PASSAGE PATTERN
THE DALLES DAM - 1991

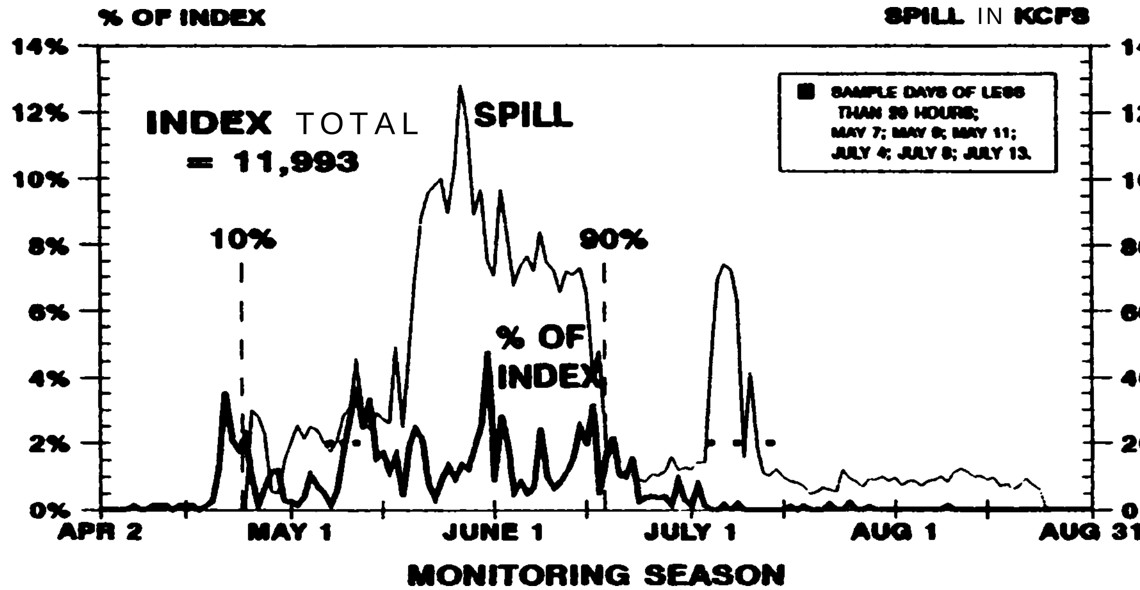


FIGURE 2

SUBYEARLING CHINOOK
PASSAGE PATTERN
THE DALLES DAM - 1991

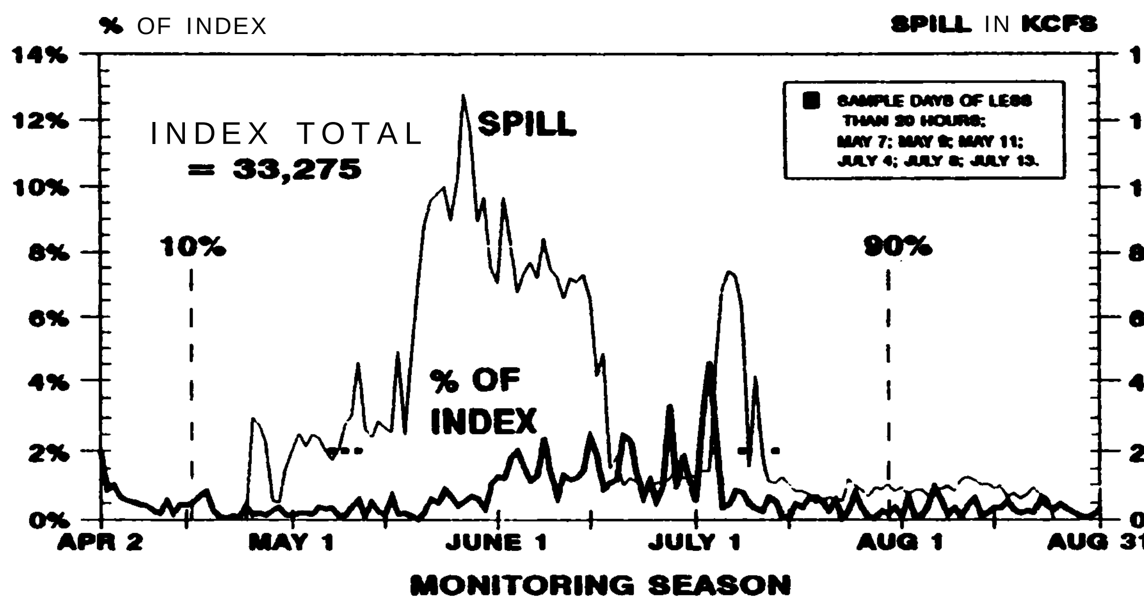


FIGURE **3**

WILD STEELHEAD (UNCLIPPED)

PASSAGE PATTERN

THE DALLES DAM - 1991

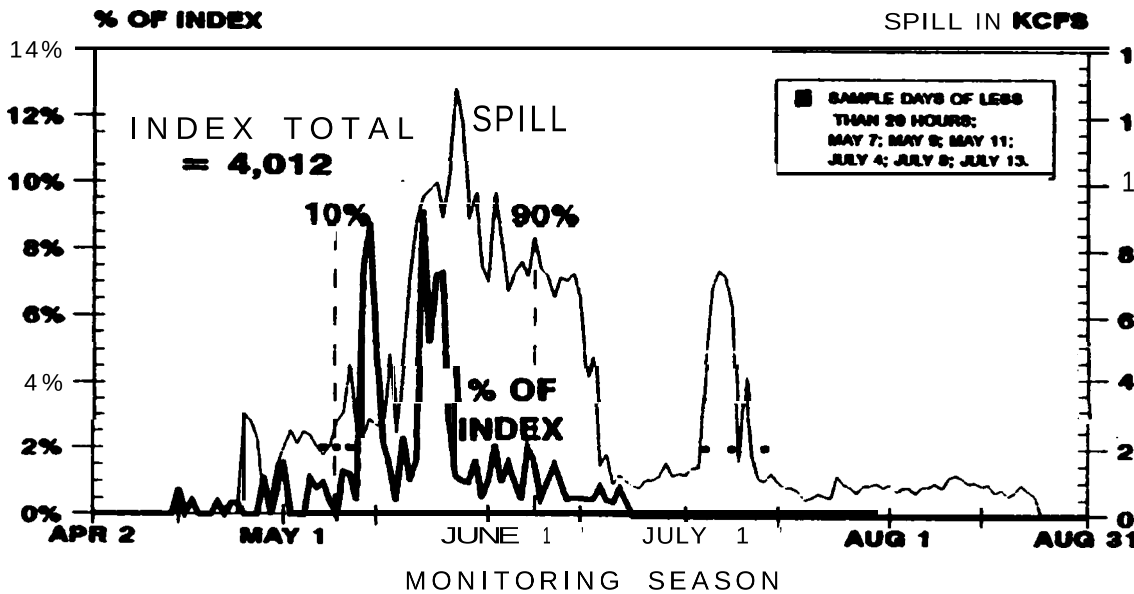


FIGURE 4

HATCHERY STEELHEAD (CLIPPED)

PASSAGE PATTERN

THE DALLES DAM - 1991

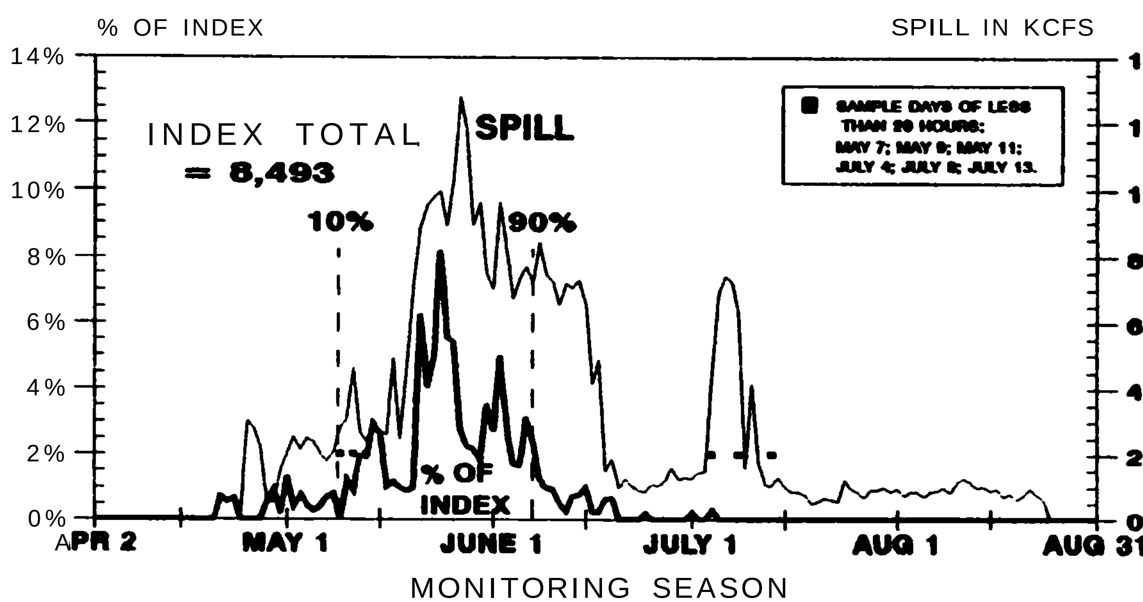


FIGURE 5

COHO
PASSAGE PATTERN
THE DALLES DAM - 1991

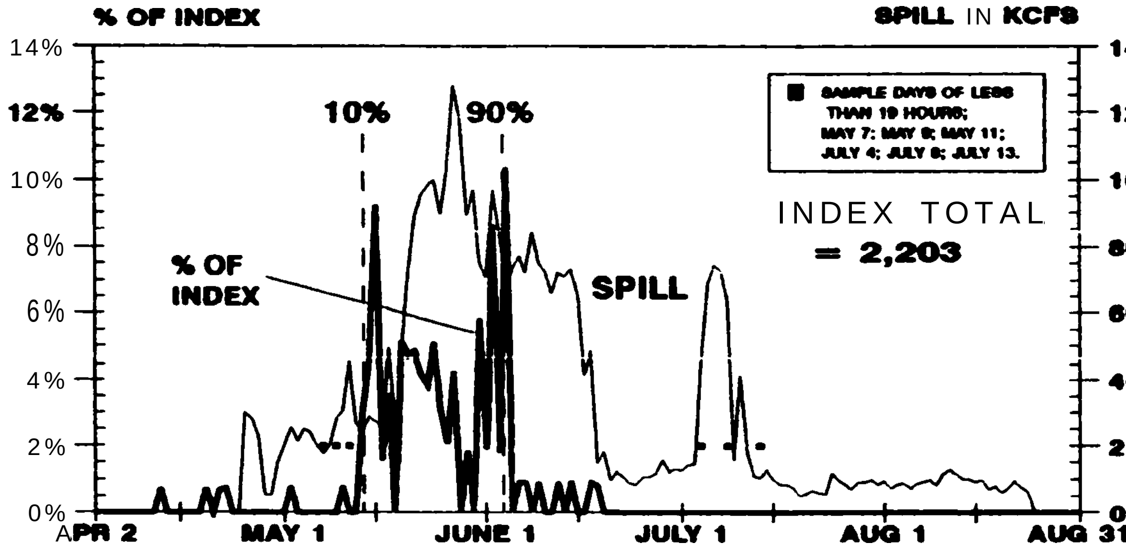


FIGURE 6

SOCKEYE
PASSAGE PATTERN
THE DALLES DAM - 1991

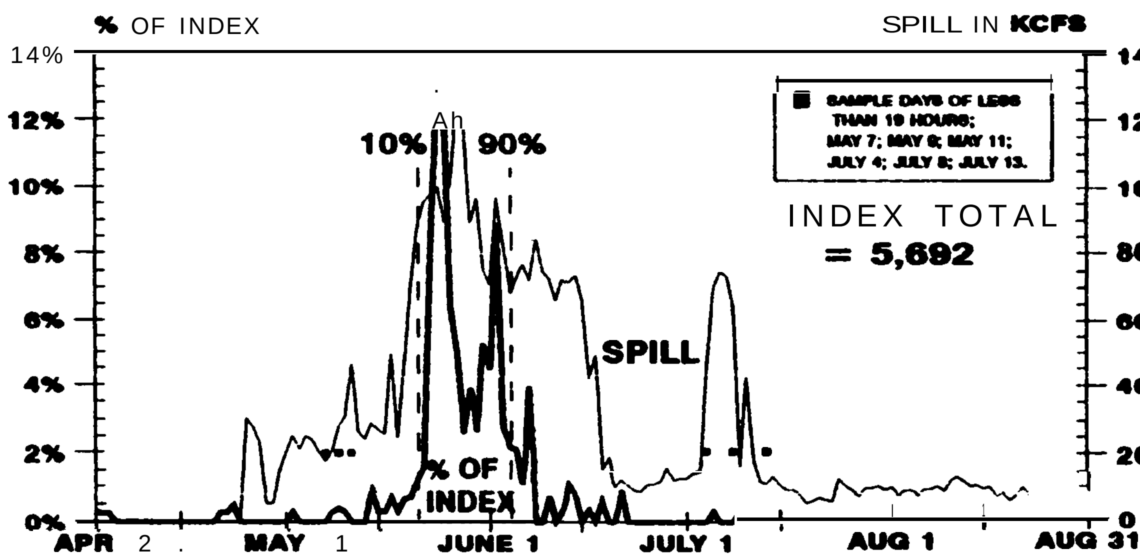


FIGURE 7

DIEL **PASSAGE PATTERNS**

APRIL 2 THROUGH AUGUST 31

THE DALLES DAM - 1991

YEARLING CHINOOK

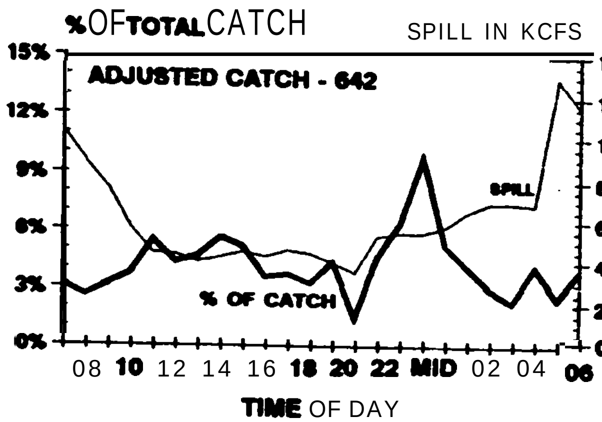


FIGURE 8

SUBYEARLING CHINOOK

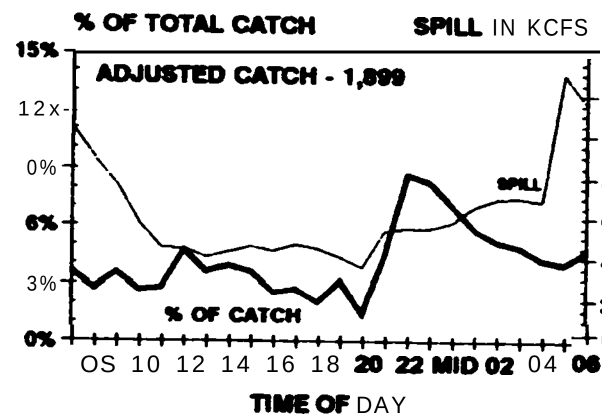


FIGURE 9

WILD STEELHEAD (UNCLIPPED)

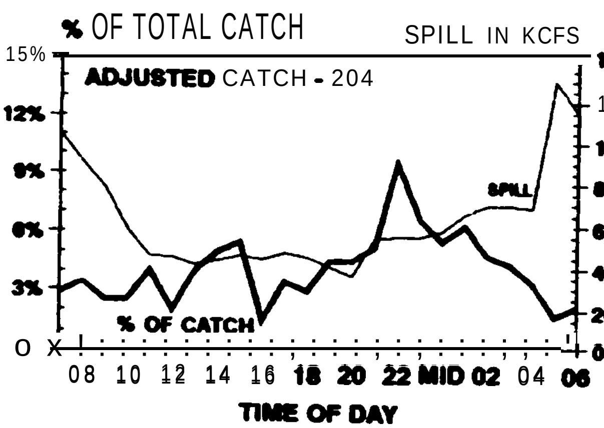


FIGURE 10

HATCHERY STEELHEAD (CUPPED)

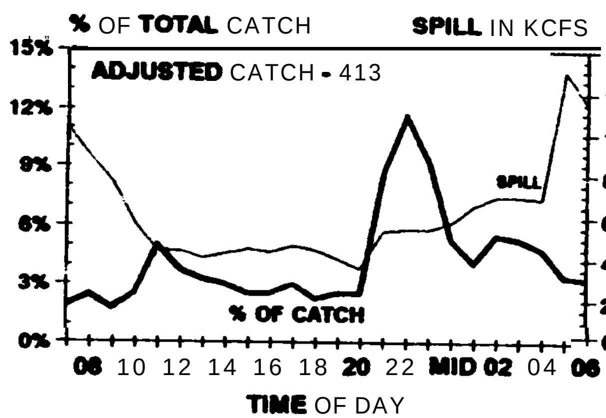


FIGURE 11

COHO

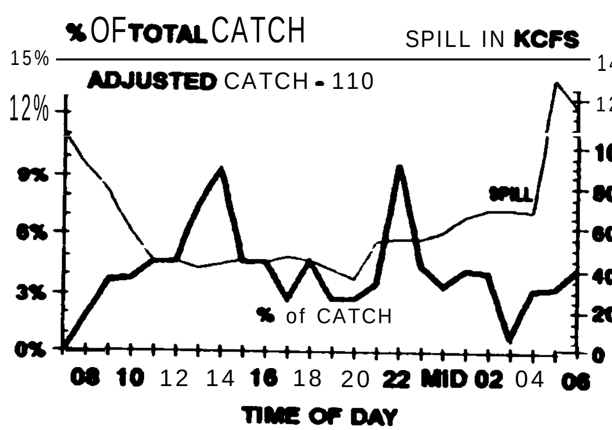


FIGURE 12

SOCKEYE

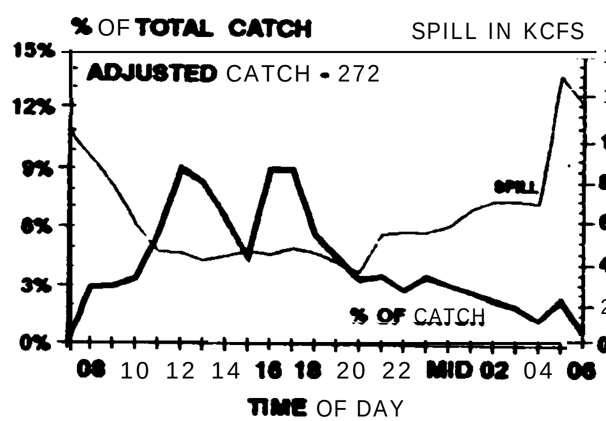


FIGURE 13

APPENDIX C
BONNEVILLE DAM — 1991

RIVER, SPILL AND POWERHOUSE #1
DAILY AVERAGE FLOWS
BONNEVILLE DAM - 1991

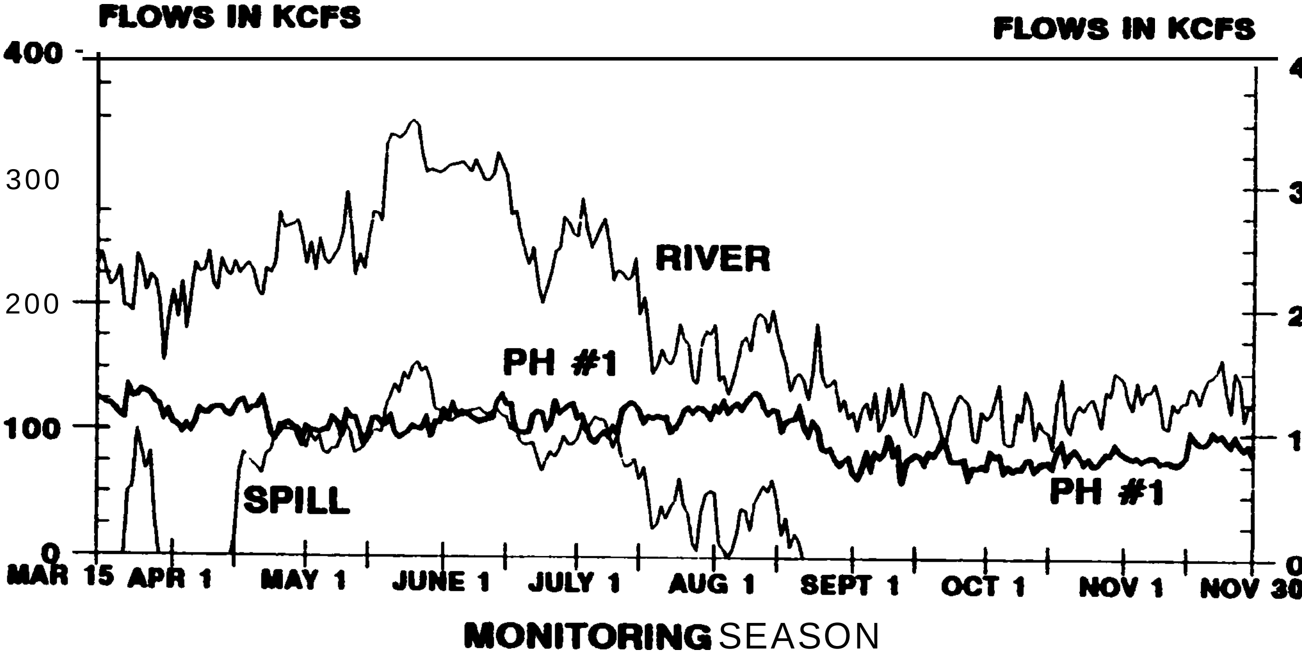


FIGURE 1

RIVER, SPILL AND POWERHOUSE #2
DAILY AVERAGE FLOWS
BONNEVILLE DAM - 1991

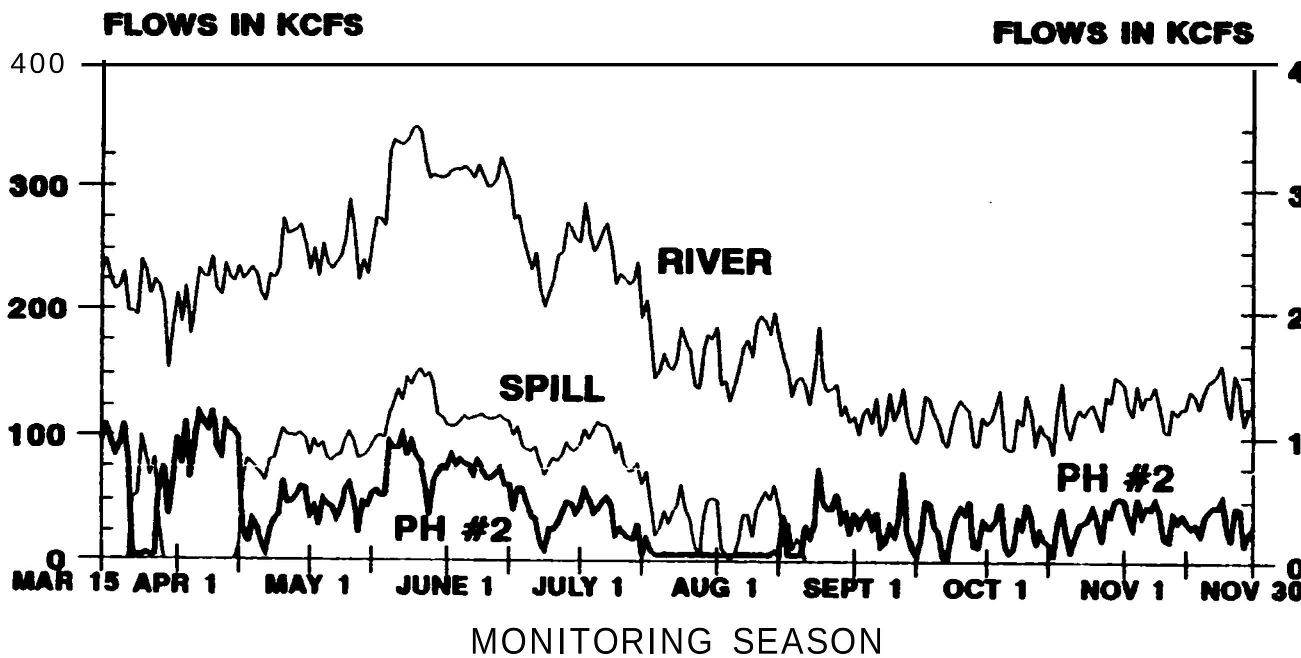


FIGURE 2

YEARLING CHINOOK
PASSAGE PATTERN
BONNEVILLE DAM, **DSM#1** - 1991

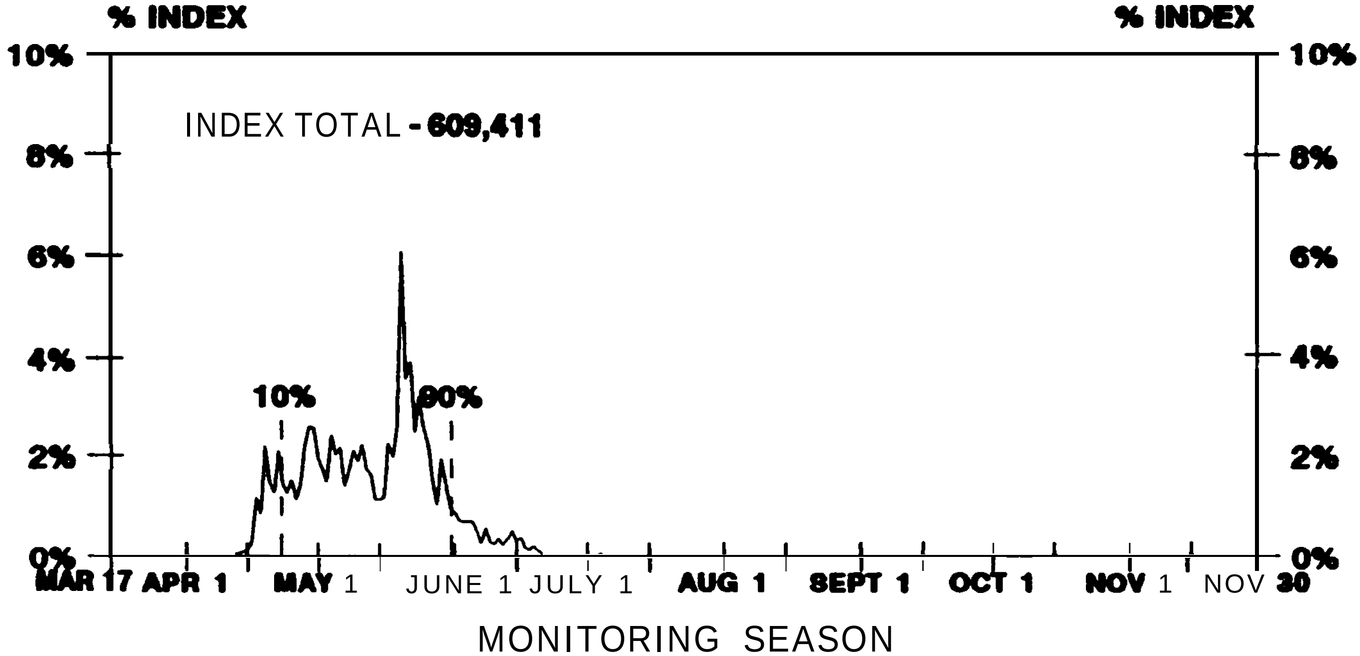


FIGURE 3

SUBYEARLING CHINOOK
PASSAGE PATTERN
BONNEVILLE DAM, **DSM#1** - 1991

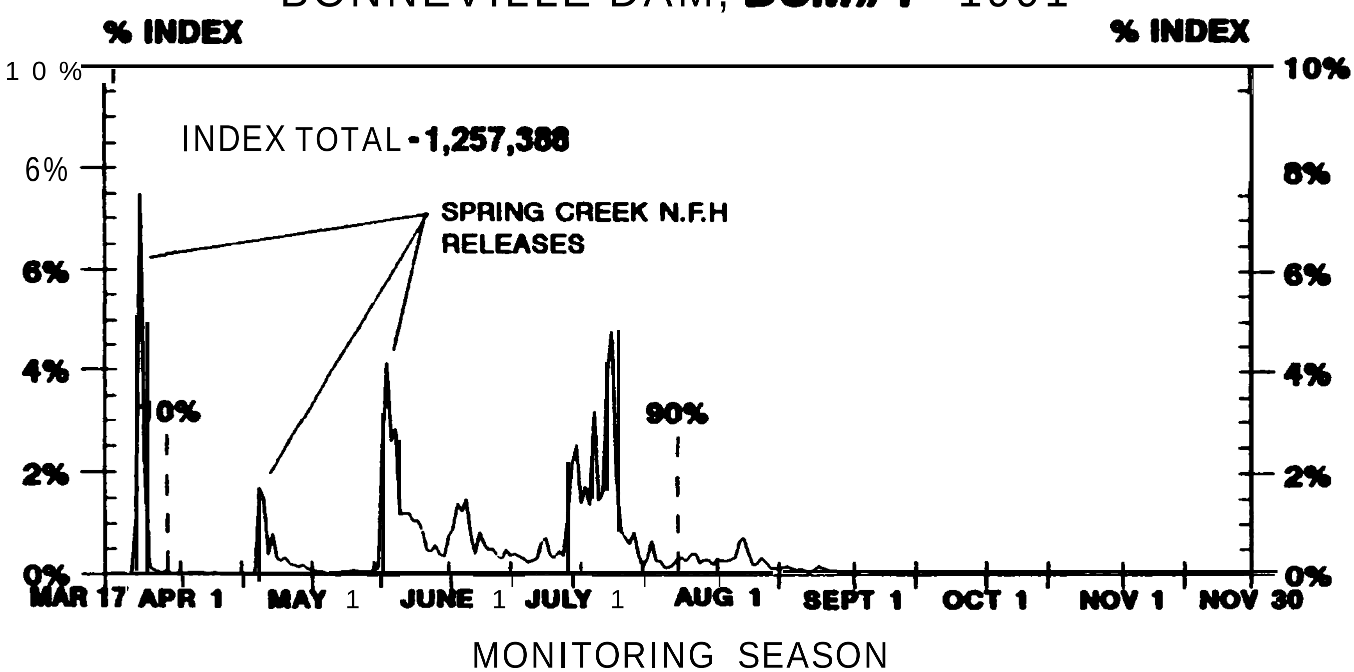


FIGURE 4

WILD STEELHEAD (UNCLIPPED)
PASSAGE PATTERN
BONNEVILLE DAM, **DSM#1 -** 1991

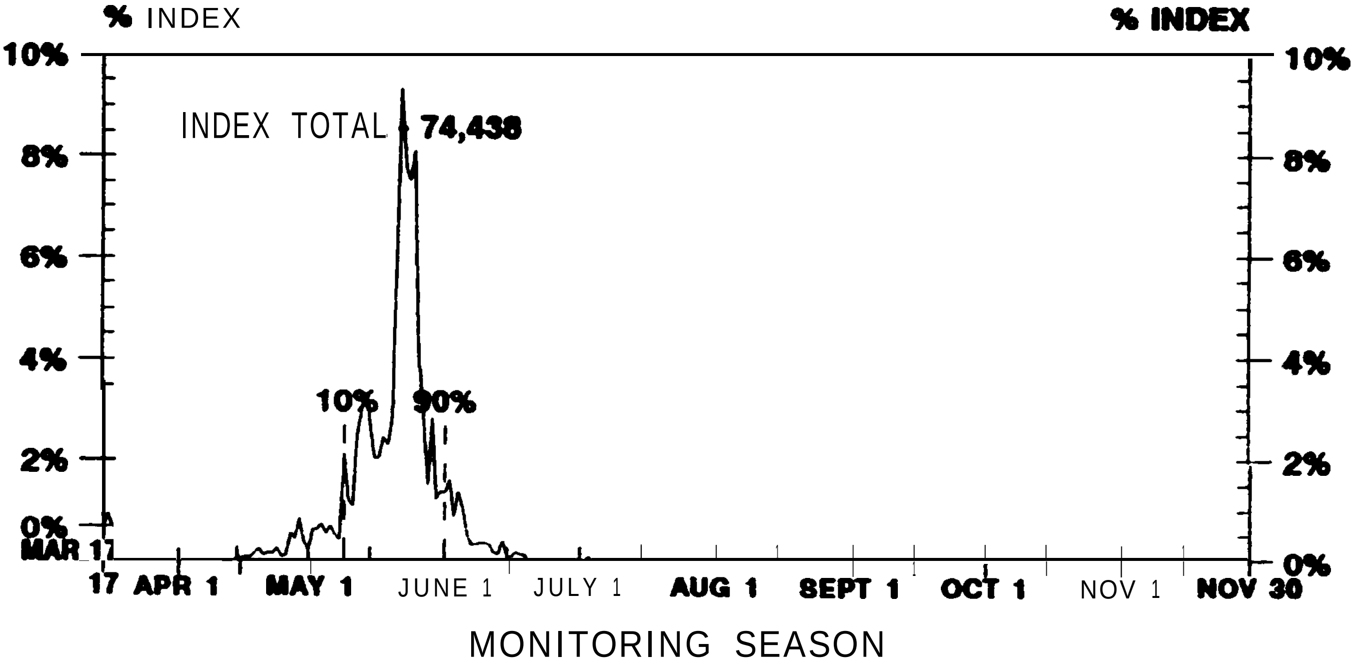


FIGURE 5

HATCHERY STEELHEAD (CLIPPED)
PASSAGE PATTERN
BONNEVILLE DAM, **DSM#1 - 1991**

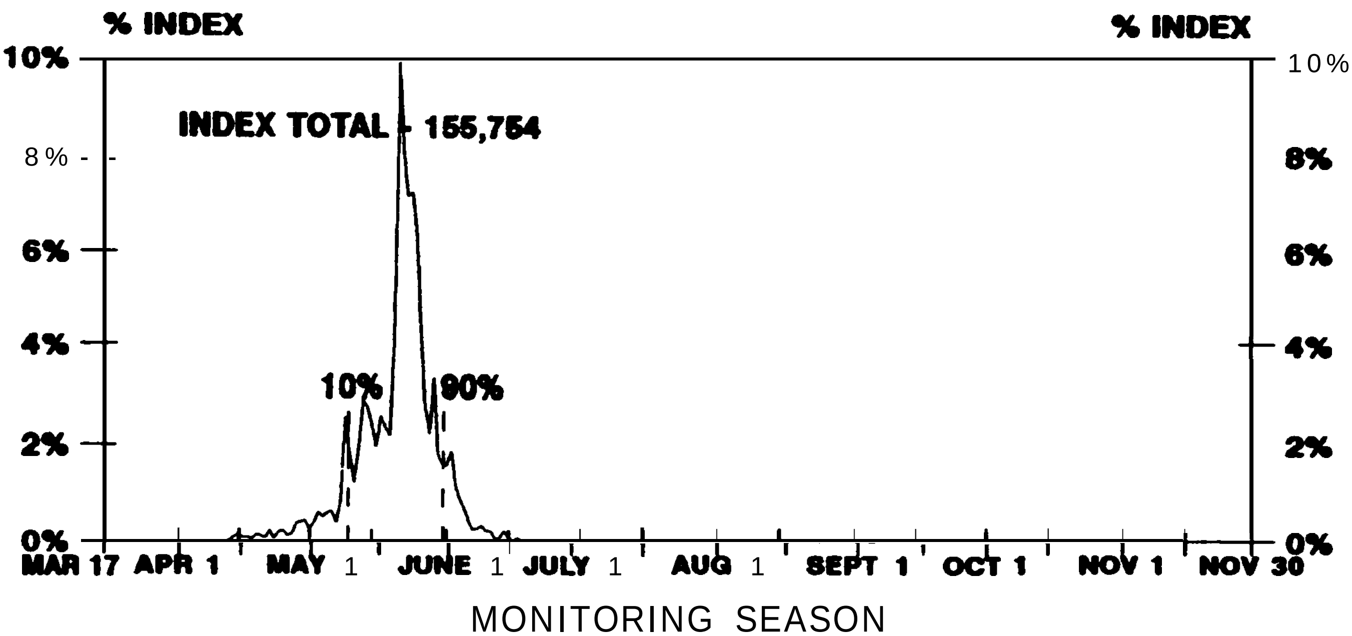


FIGURE 6

COHO
PASSAGE PATTERN
BONNEVILLE DAM, DSM#1 - 1991

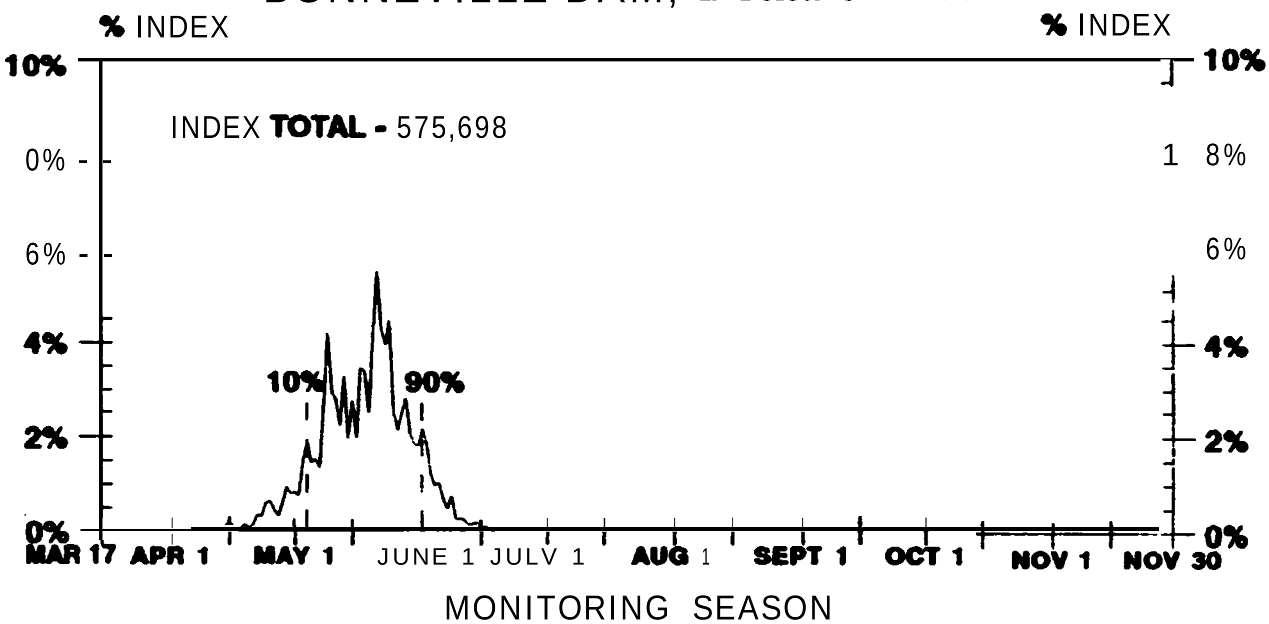


FIGURE 7

SOCKEYE
PASSAGE PATTERN
BONNEVILLE DAM, DSM#1 - 1991

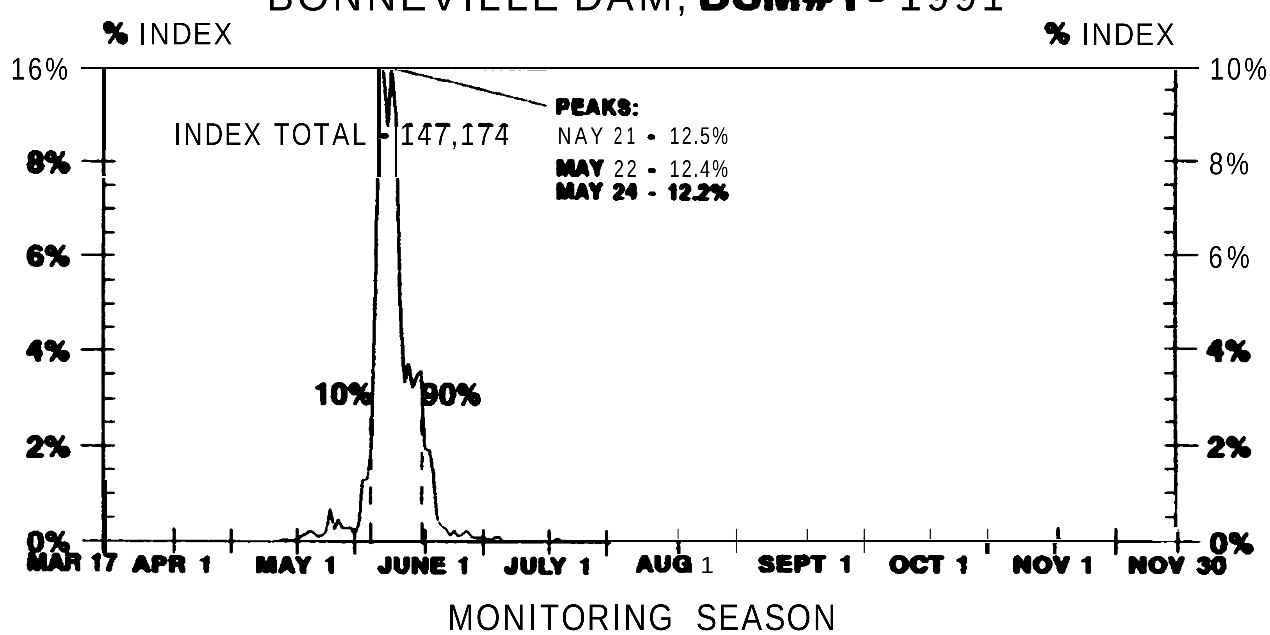


FIGURE 8

YEARLING CHINOOK
PASSAGE PATTERN
BONNEVILLE DAM, DSM#2 - 1991

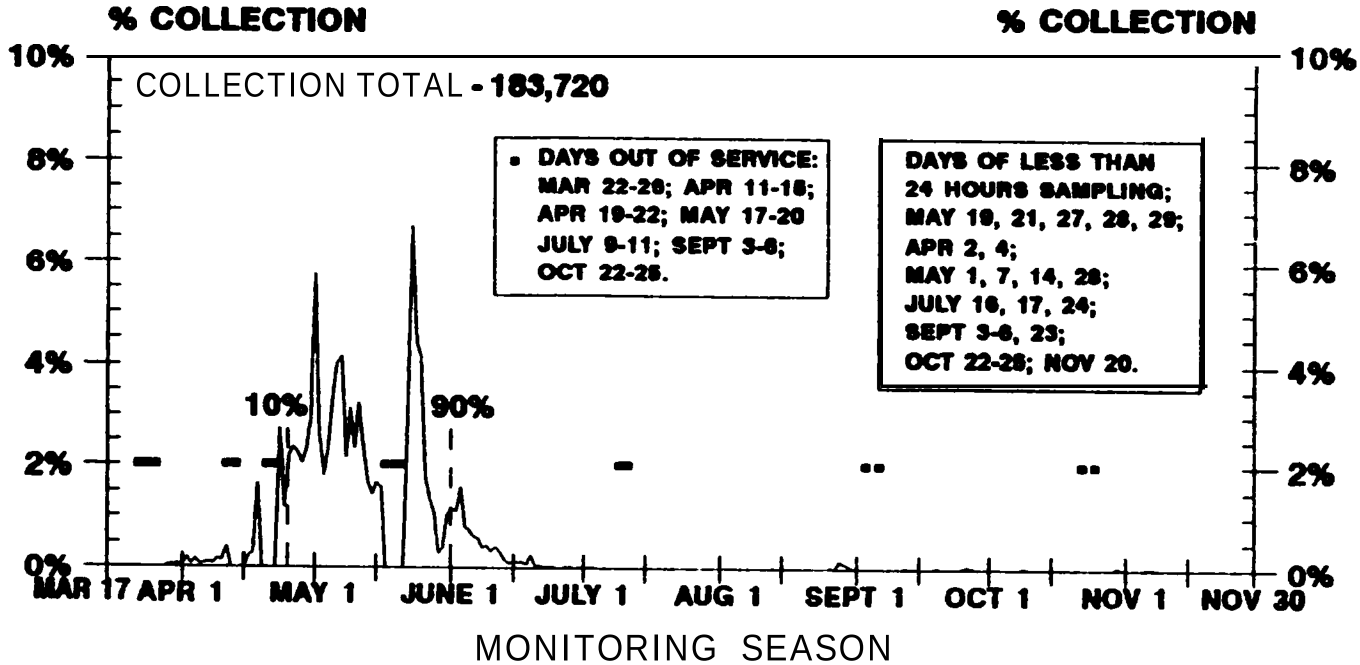


FIGURE 9

SUBYEARLING CHINOOK
PASSAGE PATTERN
BONNEVILLE DAM, DSM#2 - 1991

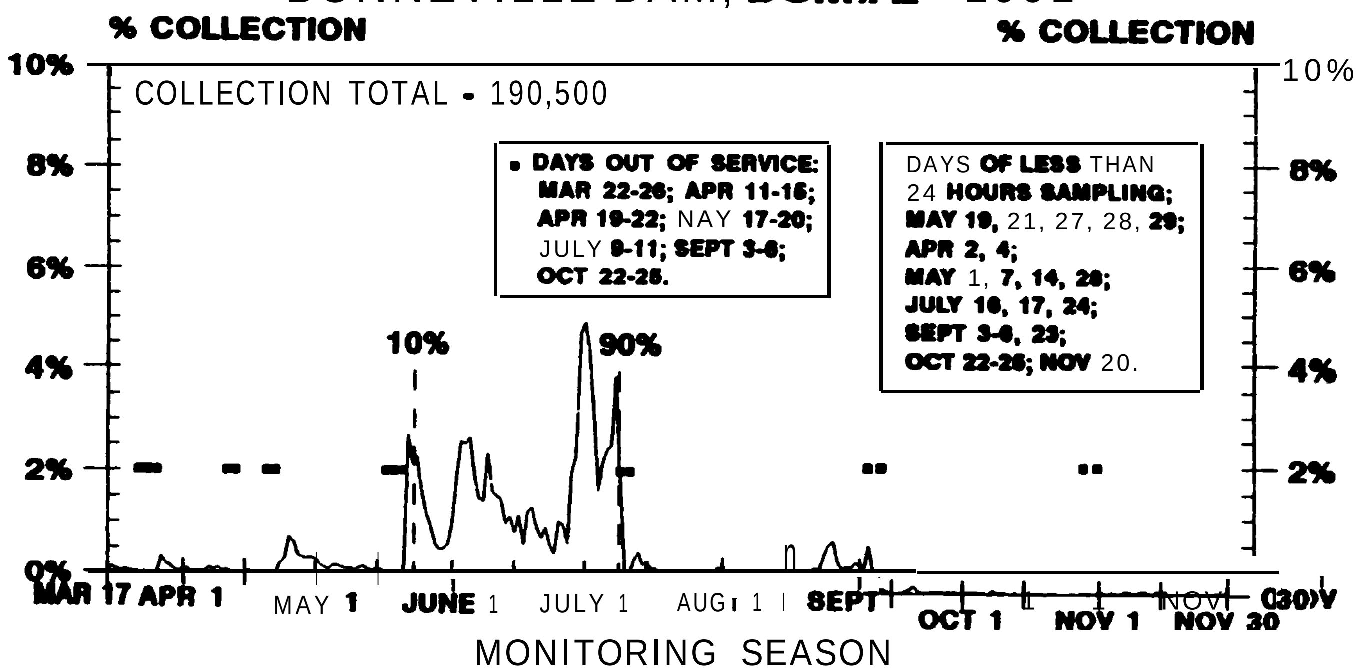


FIGURE 10

WILD STEELHEAD (UNCLIPPED)
PASSAGE PATTERN
BONNEVILLE DAM, DSM#2 - 1991

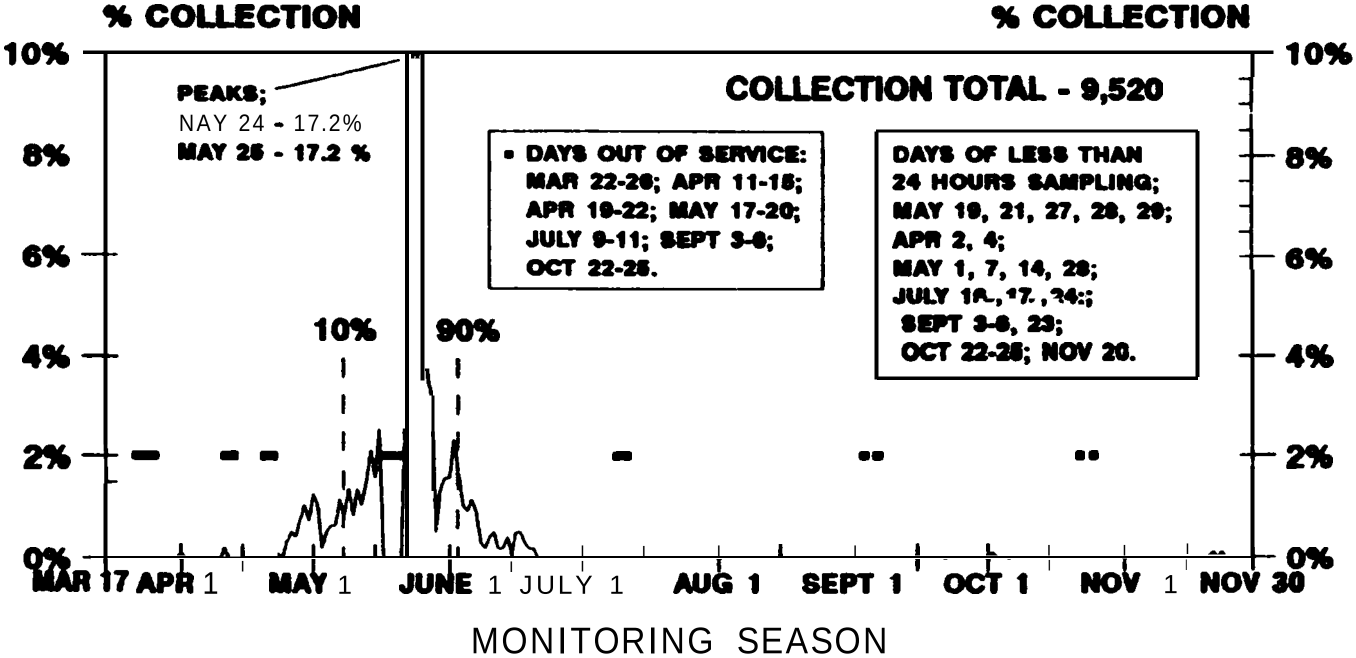


FIGURE 11

HATCHERY STEELHEAD (CLIPPED)
PASSAGE PATTERN
BONNEVILLE DAM, DSM#2 - 1991

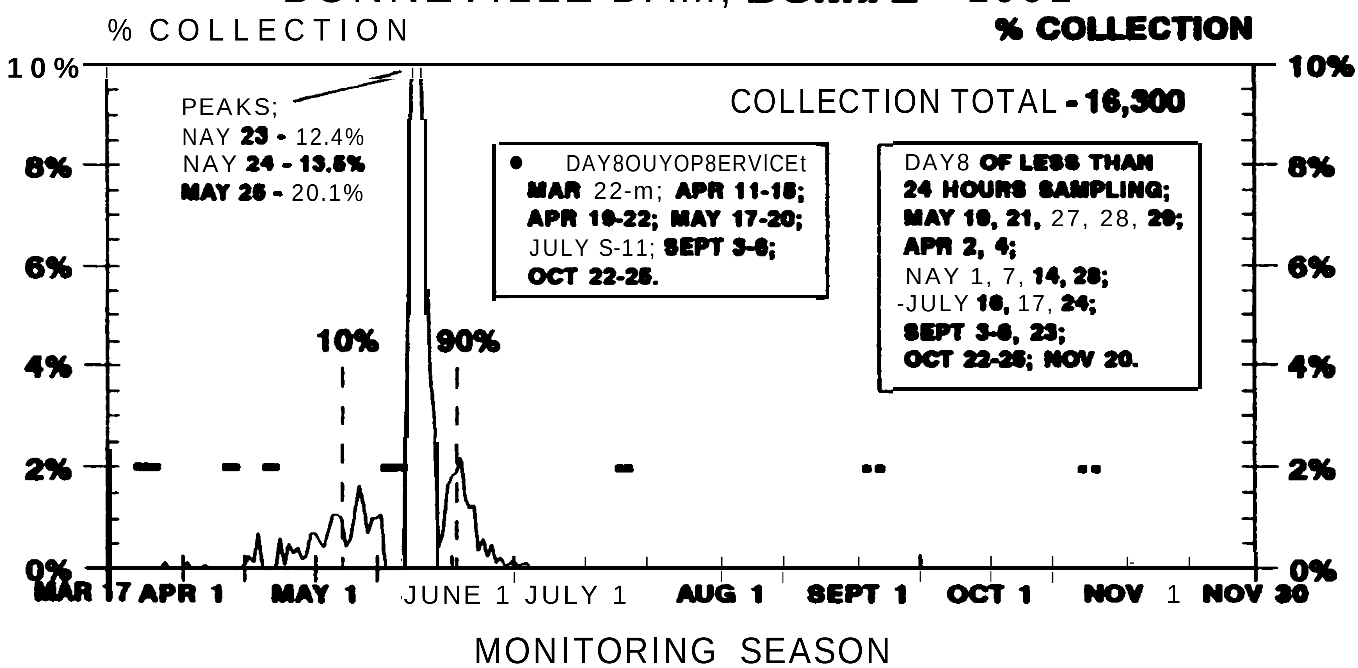


FIGURE 12

COHO
PASSAGE PATTERN
BONNEVILLE DAM, **DSM#2 -** 1991

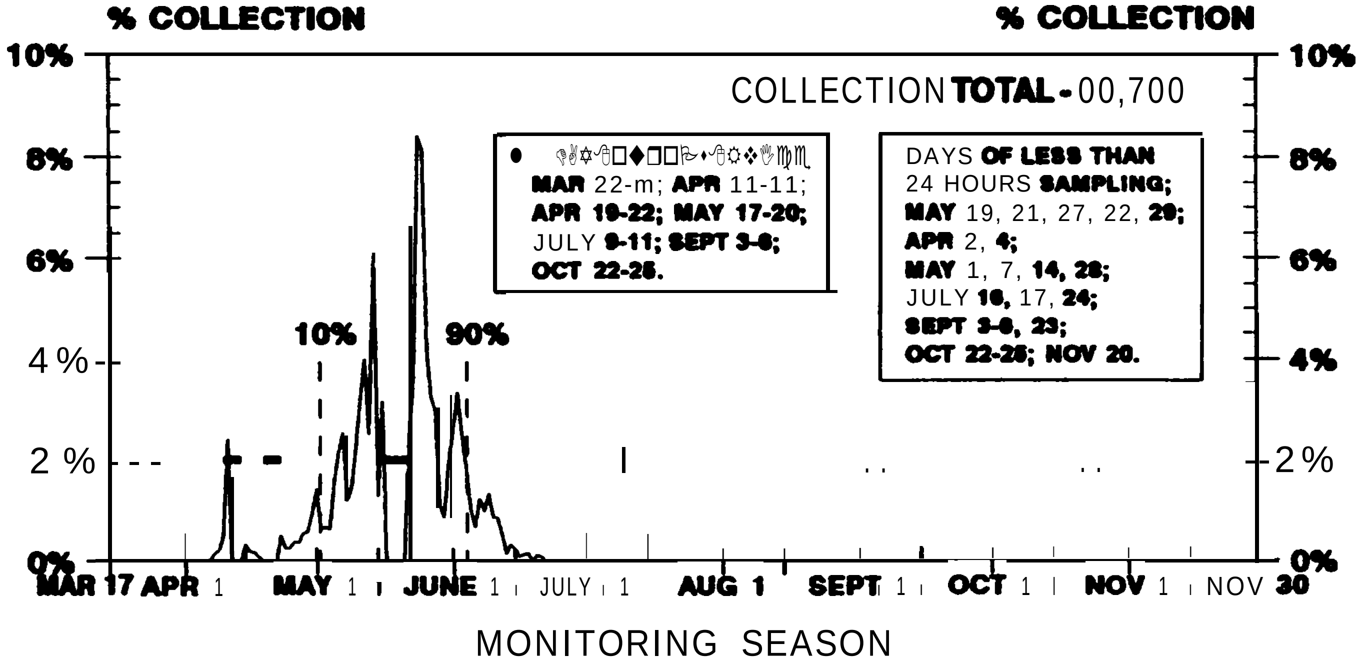


FIGURE 13

SOCKEYE
PASSAGE PATTERN
BONNEVILLE DAM, **DSM#2 -** 1991

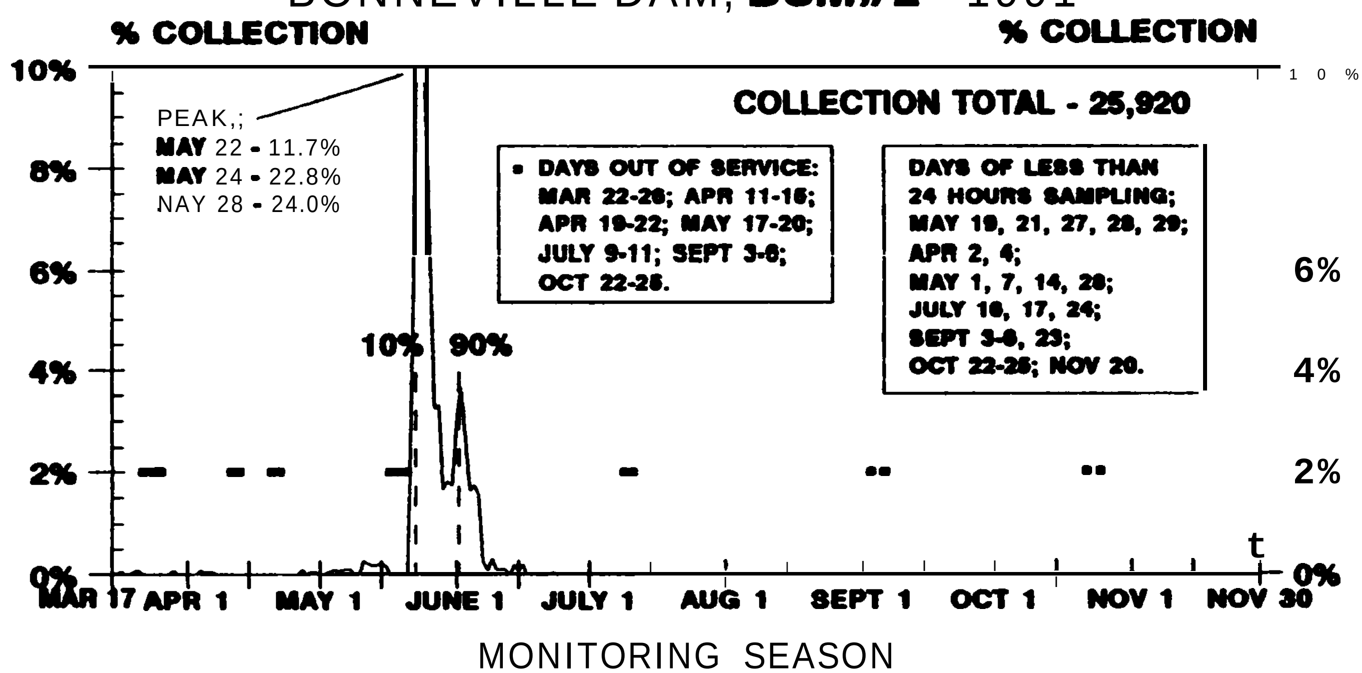
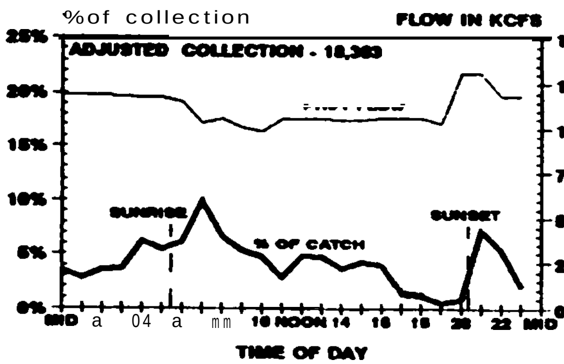


FIGURE **14**

YEARLING CHINOOK

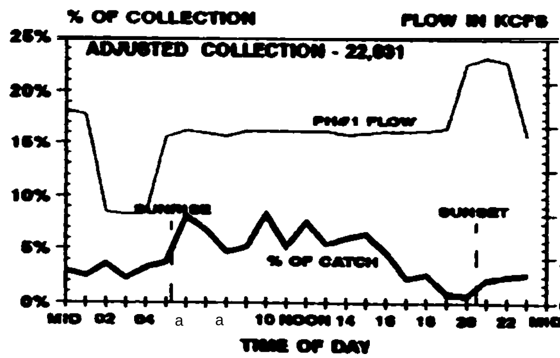
DIEL PATTERNS

BONNEVILLE DAM, DSM#1 - 1991



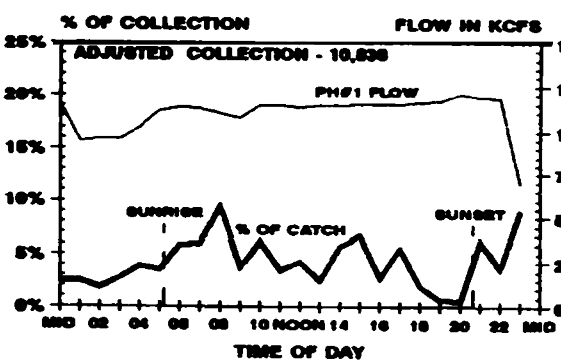
MAY 9

FIGURE 15



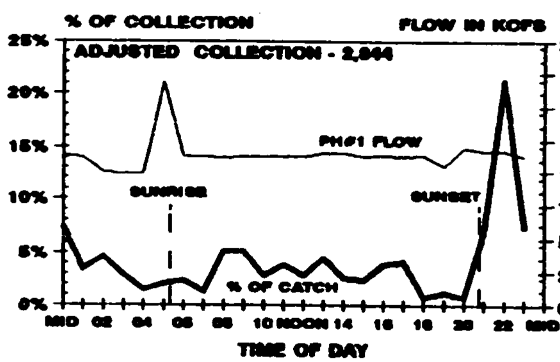
MAY 23

FIGURE 16



MAY 30

FIGURE 17



JUNE 6

FIGURE 18

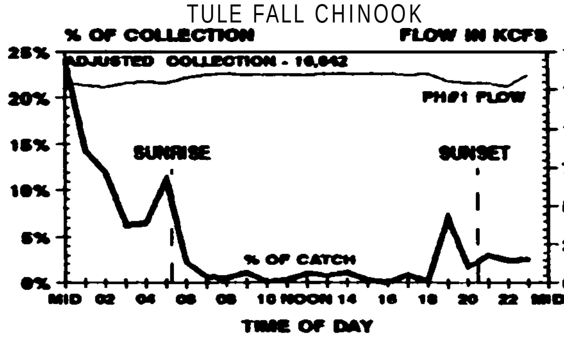
SUBYEARLING CHINOOK

DIEL PATTERNS

BONNEVILLE DAM, DSM#1 - 1991

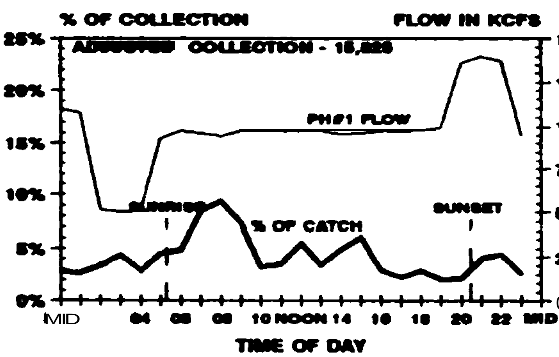
MARCH 21 - SPRING CREEK RELEASE

TULE FALL CHINOOK

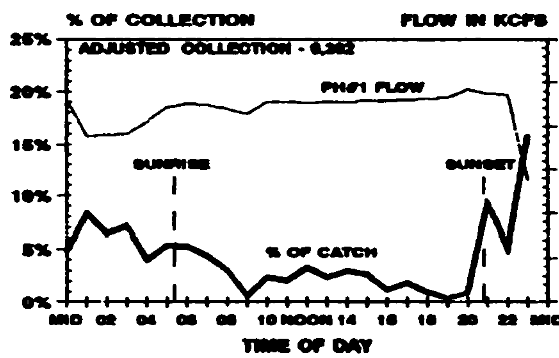


MARCH 25
FIGURE 19

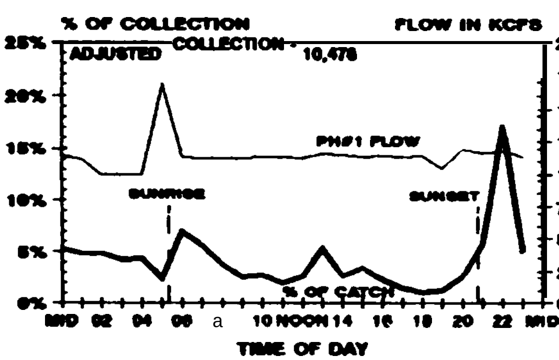
UPRIVER BRIGHT STOCKS



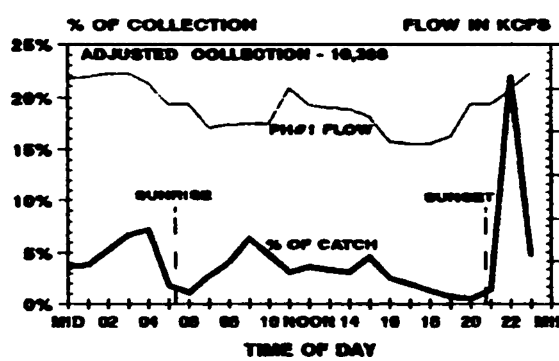
MAY 23
FIGURE 20



MAY 30
FIGURE 21



JUNE 6
FIGURE 22

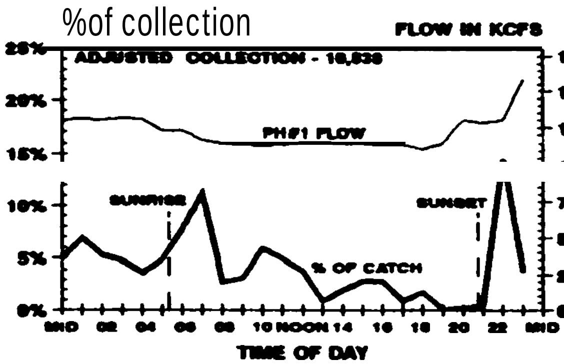


JUNE 27
FIGURE 23

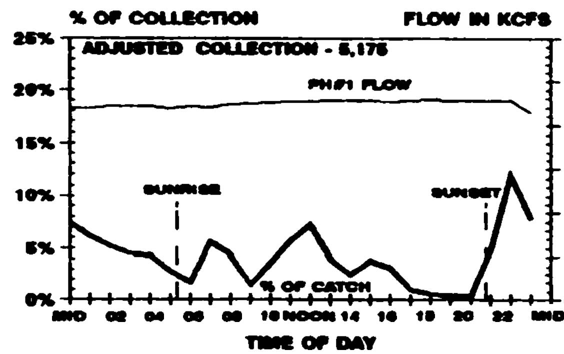
SUBYEARLING CHINOOK

DIEL PATTERNS

BONNEVILLE DAM, DSM#l - 1991



JULY 14
FIGURE 24

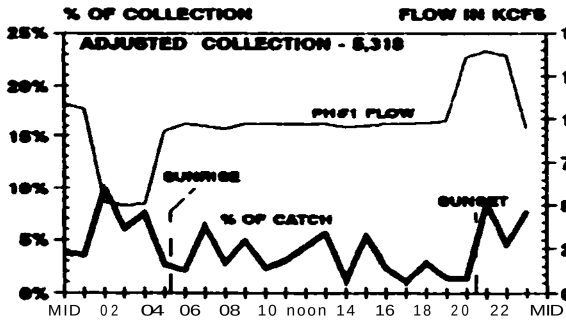


JULY 21
FIGURE 25

WILD STEELHEAD (UNCLIPPED)

DIEL PATTERNS

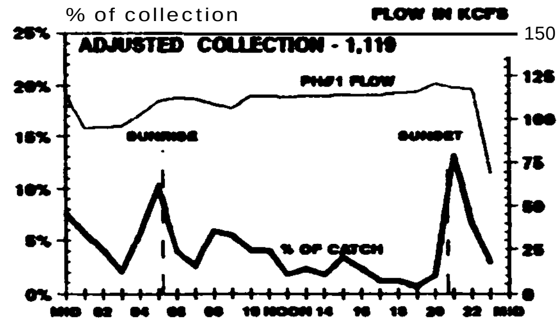
BONNEVILLE DAM, DSM#l - 1991



TIME OF DAY

MAY 23

FIGURE 26

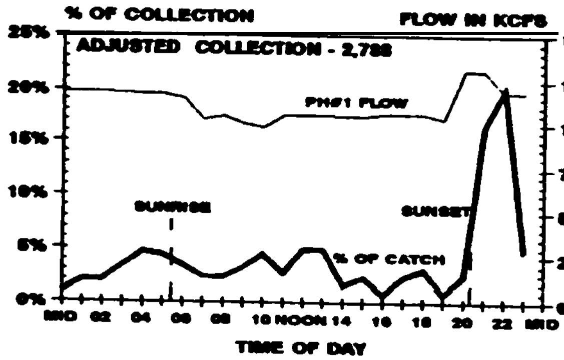


TIME OF DAY

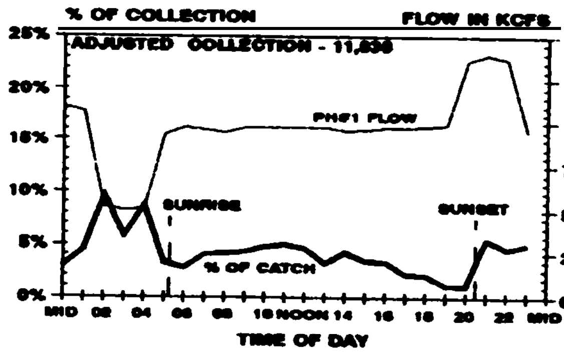
MAY 30

FIGURE 27

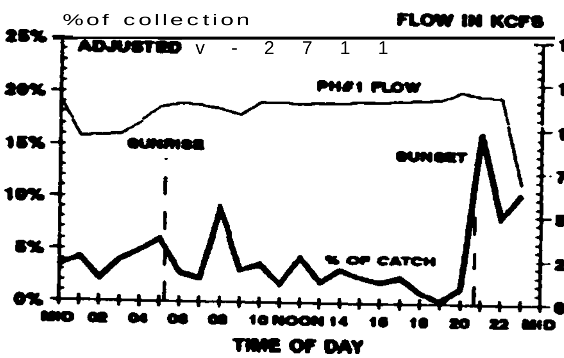
HATCHERY STEELHEAD (CLIPPED)
DIEL PATTERNS
BONNEVILLE DAM, DSM#1 - 1991



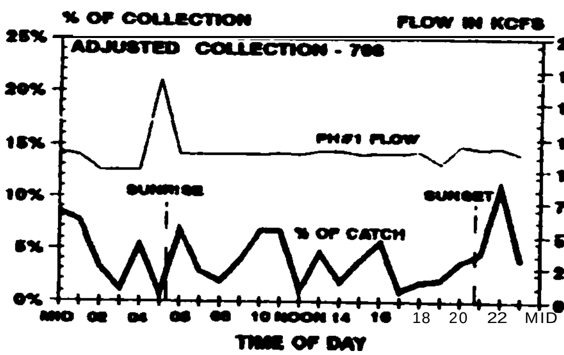
MAY 9
FIGURE 28



MAY 23
FIGURE 29



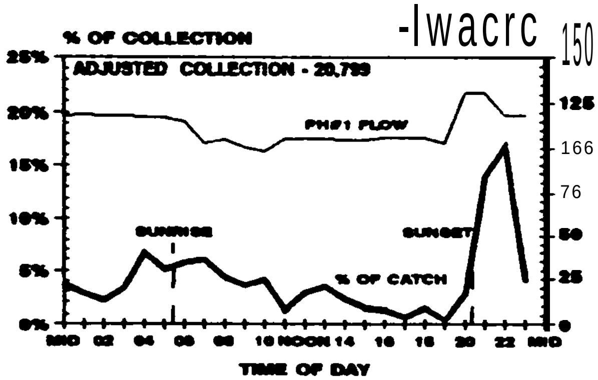
MAY 30
FIGURE 30



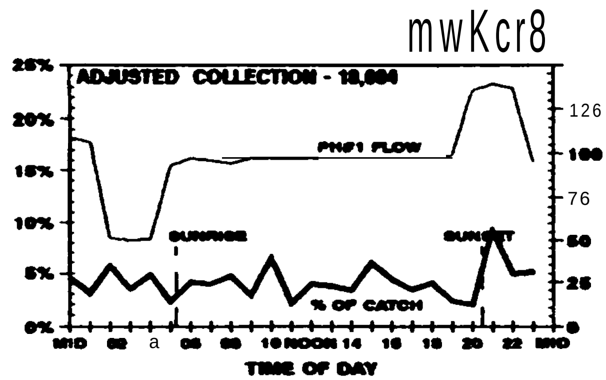
JUNE 6
FIGURE 31

COHO

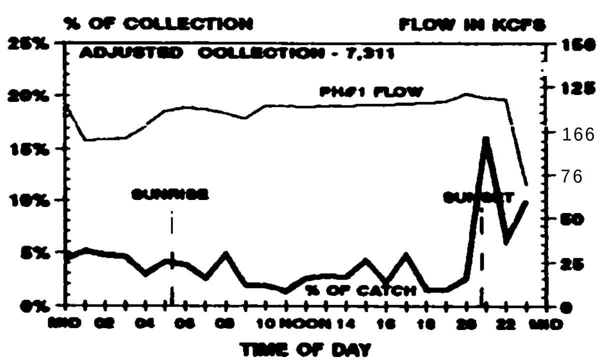
DIEL PATTERNS
BONNEVILLE DAM, DSM#1 - 1991



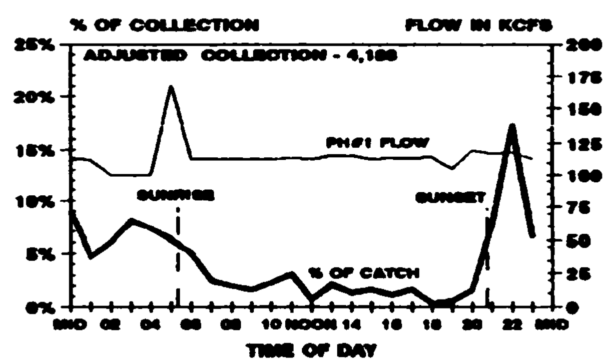
MAY 9
FIGURE 32



MAY 23
FIGURE 33



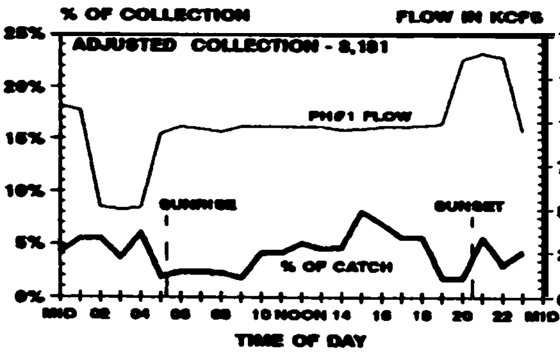
MAY 30
FIGURE 34



JUNE 6
FIGURE 35

SOCKEYE

DIEL PATTERNS
BONNEVILLE DAM, DSM#1 - 1991



MAY 23
FIGURE 36

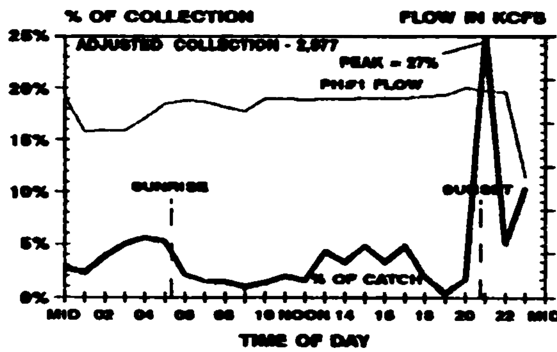
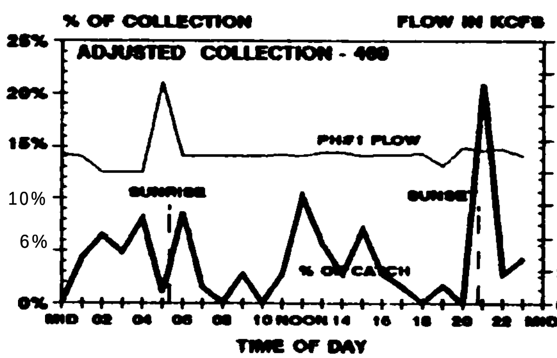


FIGURE 37



JUNE 6
FIGURE 38

APPENDIX D
DELAYED MORTALITY TESTS 1991

BONNEVILLE DAM

JOHN DAY DAM

DELAYED MORTALITY TEST RESULTS BONNEVILLE DAM, 1991

INTRODUCTION

An effort to evaluate the effects of handling on migrating juvenile salmon and steelhead by measuring short term delayed mortality rates (48 hour holding) on handled and non-handled test groups was continued during the 1991 season. Tests were designed to compare the mortality of fish handled using our standard anesthetizing procedure compared to fish that were not handled beyond collection.

METHODS.

Fish for this test were collected from the hourly capture (1600 to 2400 hours) at the Bonneville Dam first powerhouse downstream migrant trap (DSH 1) described by Gessel et. al. (1988). Because there are no holding facilities at the first powerhouse, both treatment and control groups were transported by truck to net pens in a raceway at the second powerhouse. Due to limited raceway space, only yearling and subyearling chinook and steelhead were tested. Yearling chinook were captured from April 29 to Hay 20, steelhead from May 13 to June 3 and subyearling chinook from June 17 to July 5.

The treatment groups consisted of fish captured and processed during our normal nightly sampling. These fish were anesthetized in a 42 mg/L solution of tricaine (MS-222), inspected for brands and condition, counted and put into transport tanks. Control groups were captured in a separate sample concurrently with the treatment fish and transferred in water via sanctuary nets into transport tanks.'

There were 27 replicate tests of both handled and non-handled control groups for yearling and subyearling chinook. The shorter peak migration timing for steelhead allowed for only 24 replicate tests. Treatment groups averaged 34 fish per replicate test. All control groups ranged between 50 and 100 unsorted fish. Since these groups could not be handled, it was hoped that by taking this many fish enough of the target species would be collected for comparison with the handled groups. All groups were left undisturbed in the net pens for 48 hours.

A flow of river water was kept at 65 gallons per minute through the holding raceway at the second powerhouse. Water temperatures

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'/ For the first 18 replicates of subyearling chinook the control groups were accumulated over 3 to 5 hours after the treatment groups because not enough of the target species were available.

ranged from 51 to 53 degrees F. for the yearling chinook and steelhead tests and from 56 to 65 degrees F. for the subyearling chinook test. At the end of the 48 hour holding period each group was anesthetized, counted and inspected for condition and all mortalities were inspected for a possible cause of death.

RESULTS AND DISCUSSION

Delayed mortality test result details for each replicate over time for each species are presented in the attached tables 1 - 3 at the end of this report. A summarization of the total percent mortality for handled and control groups, as well as the combined mortality for each species is presented below;

			HANDLED		CONTROL		COMBINED	
SPECIES	H20 oF Temp.	# of Rep Tests	Morts Total	% Morts	Morts Total	% Morts	Morts Total	% Morts
Yearling Chinook	51-53	27	6/890	0.7%	11/940	1.2%	17/1830	0.9%
Steelhead	51-53	24	6/731	0.8%	2/430	0.5%	8/1161	0.7%
Subyearling Chinook	56-65	27	28/895	3.1%	20/1455	1.4%	48/2350	2.0%

A test sensitive in detecting overall differences in data from grouped 2X2 tables as described by Snedecor and Cochran (1980) was used to determine the significance between mortality rates of handled and control groups. Results of this test are given for each species below;

Species	Test Criterion	P Value (2 Tailed)
Yearling Chinook	1.44-	0.15
Steelhead	0.64	0.52
Subyearling Chinook	2.55	0.01

In this case the null hypothesis assumes that there is no difference between the treatment and control groups for each species. The null hypothesis is rejected where the test criteria in table 2 is above the critical value of +1.96 or below -1.96 at the 5% level. These values indicate that, using our normal handling methods, there appears to be no significant difference between mortality rates of handled versus non-handled groups for yearling chinook and steelhead. For subyearling chinook, although mortality was low (3.1% handled and 1.4% control), handled groups had almost double the amount of mortality over control groups which is statistically a significant difference. This result is in contrast to subyearling chinook delayed mortality test results in 1989 and 1990 where there were no significant differences found.

As in past tests (1989 and 1990), physical condition played and important role in smolt survival for all test groups. Sixty percent of the mortalities of both handled and non-handled groups were descaled as compared to an overall descaling of only 8.4% in the tests. The relationship between descaling and mortality in the tests are summarized below;

	HANDLED			CONTROL		
SPECIES	Desc./Total	Desc. Mort/Total Mort	Desc. Mort/Total Desc.	Desc./Total	Desc. Mort/Total Mort	Desc. Mort/Total Desc.
Yearling Chinook	70/890= 7.9%	5/6= 83.3%	5/70= 7.1%	58/940= 6.2%	10/11= 90%	10/58= 17.2%
Steelhead	156/731= 21.3%	5/6= 83.3%	5/156= 3.2%	74/430= 17.2%	0/2	0/74
Subyrlng. Chinook	34/895= 3.8%	13/28= 46.4%	13/34= 38.2%	57/1455= 3.9%	11/20= 55%	11/57= 19.6%

Nearly 10% of all descaled fish died. Overall descaling rates in these tests for yearling chinook, subyearling chinook and steelhead were 7.0%, 3.9% and 19.8% respectively. Although steelhead had the highest descaling rate, this species demonstrated the highest tolerance for scale loss with a 2.2% mortality among descaled fish. Subyearling chinook had the lowest descaling rate and demonstrated the lowest tolerance for scale loss with a 26.4% mortality among descaled fish in these tests.

CONCLUSION

Based on these data, the present handling methods at the Bonneville Dam first powerhouse sampler appear to have no significant effect on short-term survival of healthy yearling chinook and steelhead. However, this years test results for subyearling chinook did show a significant difference between mortality rates of handled versus non-handled groups even though overall mortality was low (3.1% handled and 1.4% control).

No change is recommended in the current fish handling methods at the Bonneville Dam first powerhouse DSM 1 at this time, but care should be taken to insure that sample related scale loss be kept at a minimum.

We wish to acknowledge Scott Carlon and Dan Avery for continuing this study in 1991 at Bonneville dam.

Table 1 . 1991 YEARLING CHINOOK DELAYED MORTALITY TEST RESULTS, BONNEVILLE DAM

END DATE	REP #	TEST TOTAL	MORT	%MORT	CONTROL TOTAL	MORT	%MORT
4/29	1	35	0	0.00	44	0	0.00
	2	25	0	0.00	36	0	0.00
	3	32	0	0.00	34	0	0.00
5/01	4	32	0	0.00	35	0	0.00
	5	35	0	0.00	47	0	0.00
	6	34	1	2.94	57	1	1.75
5/03	7	34	0	0.00	30	0	0.00
	8	33	0	0.00	47	0	0.00
	9	33	0	0.00	42	0	0.00
5/06	10	34	0	0.00	50	0	0.00
	11	33	0	0.00	59	0	0.00
	12	33	0	0.00	66	0	0.00
5/08	13	34	0	0.00	12	0	0.00
	14	35	0	0.00	17	0	0.00
	15	32	0	0.00	38	0	0.00
5/10	16	34	1	2.94	28	0	0.00
	17	33	0	0.00	53	1	1.89
	18	33	0	0.00	33	1	3.03
5/13	19	29	0	0.00	19	0	0.00
	20	33	0	0.00	27	0	0.00
	21	33	0	0.00	31	0	0.00
5/15	22	35	0	0.00	48	4	8.33
	23	32	1	3.12	29	2	6.89
	24	34	0	0.00	10	0	0.00
5/20	25	34	0	0.00	16	1	6.25
	26	33	2	6.06	12	0	0.00
	27	33	1	3.03	20	1	5.00
TOTALS		890	G	0.70	940	11	1.20
MEAN		32.96	.22	0.67	34.81	0.41	1.23
STD DEV		1.99	.50	1.50	15.17	0.87	2.40
MIN		25	0	0.00	10	0	0.00
MAX		35	2	6.06	66	4	8.33

Table 2 . 1991 STEELHEAD DELAYED MORTALITY TEST RESULTS, BONNEVILLE DAM

END DATE	REP #	TEST TOTAL	MORT	%MORT	CONTROL TOTAL	MORT	%Mort
5/13	1	34	0	0.00	12	0	0.00
	2	30	0	0.00	27	0	0.00
	3	32	0	0.00	18	0	0.00
5/15	4	32	0	0.00	29	0	0.00
	5	32	0	0.00	17	1	11.11
	6	33	0	0.00	21	0	0.00
5/20	7	30	0	0.00	16	0	0.00
	8	30	1	3.33	22	0	0.00
	9	30	2	6.67	19	0	0.00
5/24	10	29	0	0.00	14	0	0.00
	11	30	0	0.00	15	0	0.00
	12	30	0	0.00	17	0	0.00
5/27	13	30	0	0.00	17	0	0.00
	14	30	0	0.00	27	0	0.00
	15	28	0	0.00	24	0	0.00
5/29	16	30	0	0.00	20	1	5.00
	17	32	0	0.00	17	0	0.00
	18	29	0	0.00	18	0	0.00
5/31	19	30	0	0.00	24	0	0.00
	20	30	1	3.33	21	0	0.00
	21	29	2	6.89	12	0	0.00
6/03	22	30	0	0.00	6	0	0.00
	23	30	0	0.00	12	0	0.00
	24	31	0	0.00	5	0	0.00
TOTALS		731	6	0.80	430	2	0.50
MEAN		30.46	.25	0.84	17.92	0.08	0.67
STD DEV		1.35	.60	2.01	5.94	0.28	2.39
MIN		28	0	0.00	5	0	0.00
MAX		34	2	G.89	29	1	11.11

Table 3. 1991 SUBYEARLING DELAYED MORTALITY TEST RESULTS, BONNEVILLE DAM

END DATE	REP #	TEST TOTAL	MORT	% MORT	CONTROL TOTAL	MORT	%MORT
6/17	1	33	2	6.06	62	1	1.61
	2	33	4	12.12	90	1	1.11
	3	33	1	3.03	121	1	0.83
6/19	4	34	2	5.88	55	0	0.00
	5	35	2	5.71	51	0	0.00
	6	34	1	2.94	41	1	2.44
6/21	7	34	1	2.94	58	1	1.72
	8	32	0	0.00	55	0	0.00
	9	33	0	0.00	59	1	1.69
6/24	10	34	1	2.94	66	0	0.00
	11	33	0	0.00	85	0	0.00
	12	33	3	9.09	57	0	0.00
6/26	13	34	0	0.00	68	0	0.00
	14	33	0	0.00	55	2	3.64
	15	33	0	0.00	56	1	1.79
6/28	16	34	0	0.00	48	0	0.00
	17	31	0	0.00	39	0	0.00
	18	31	1	3.22	55	0	0.00
7/01	19	32	0	0.00	39	0	0.00
	20	33	1	3.03	32	1	3.12
	21	33	0	0.00	34	1	2.94
7/03	22	34	2	5.88	21	0	0.00
	23	32	0	0.00	29	3	10.34
	24	34	3	8.82	30	3	10.00
7/05	25	34	0	0.00	49	1	2.04
	26	33	2	6.06	58	1	1.72
	27	33	2	6.06	42	1	2.38
TOTALS		895	28	3.10	1455	20	1.40
MEAN		33.15	1.04	3.10	53.89	0.74	1.75
STD DEV		.93	1.14	3.41	20.39	0.84	2.64
MIN		31	0	0.00	21	0	0.00
MAX		35	4	12.12	121	3	10.34

DELAYED MORTALITY TEST RESULTS
JOHN DAY DAM, 1991

INTRODUCTION

An effort to evaluate the effects of the handling procedures at John Day Dam on migrating juvenile salmonids by measuring short term delayed mortality rates (48 hour holding) on handled and non-handled test groups was conducted during the 1991 season. Tests were designed to compare the mortality of fish handled using our standard anesthetizing procedure compared to fish that were not handled beyond collection.

METHODS

The fish used in these tests were collected from the hourly capture using the airlift pump system described by Brege et al. (1990) during normal smolt monitoring at John Day Dam. Due to limited holding facilities, only yearling and subyearling chinook and steelhead were tested. Yearling chinook were captured from Hay 4 to June 9, steelhead from May 14 to May 26, and subyearling chinook from July 19 to August 9.

The handled groups consisted of fish captured and processed during our normal nightly sampling. After fish had been gravity fed to the sample holding tank from the raised airlift basket, they were preanesthetlzed in a 67 mg/L solution of benzocaine and alcohol. Once anesthetized, fish were net transferred to the examination trough containing about 13 mg/L of tricalne (MS-222) to keep fish calm during examination. The test species were then placed into holding tanks.

The non-handled (control) groups were collected by adding an extension to the six Inch PVC pipe that delivers the fish from the airlift basket. This diverted the fish Into the test holding tank and any dead fish immediately present were removed.

control groups were captured in the same hour's sample concurrently with the handled groups whenever possible or from the next hours sample. Handled groups averaged 50 fish per replicate test. All control groups ranged between 50 and 100 unsorted fish. Since these groups could not be handled, it was hoped that by taking this many fish enough of the target species would be collected for comparison with the handled groups. All groups were left undisturbed in covered holding tanks for 48 hours. There were 24 replicate tests of both handled and non-handled control groups for yearling chinook, 11 replicates for subyearling chinook, and 8 replicates for steelhead.

Two handled and control groups each were held in a partitioned 6" X 10" holding tank. A constant flow of river water at 60 gallons per minute circulated through the tank. During the tests, water temperatures ranged from 51 to 56 degrees F. for yearling chinook, 51 to 54 degrees for steelhead and 65 to 71 degrees for subyearling chinook. At the end of the 48 hour holding period **each** group was anesthetized, counted and Inspected for condition and all mortalities were inspected for **a** possible cause of death.

RESULTS AND DISCUSSION

Delayed mortality test result details for each replicate over time for each species are presented in the attached tables 1 - 3 at the end of this report. A summarization of the total percent mortality for handled and control groups, **as** well as the combined mortality for each species is presented below;

SPECIES	H2O oF Temp.	# of Rep Tests	HANDLED Morts Total	% Morts	CONTROL Morts Total	% Morts	COMBINED Morts Total	% Morts
Yearling Chinook	51-56	24	15/1276	1.2%	38/979	3.9%	53/2255	2.4%
Steelhead	51-54	8	1/360	0.31	0/366	0	1/726	0.1%
Subyearling Chinook	65-71	11	100/547	18.3%	88/535	16.5%	188/1082	17.4%

The percent holding mortality in combined handled and control tests were very low overall for yearling **chinook (2.4%) and** steelhead (0.1%). Test results for yearling chinook showed more mortalities in control groups than handled groups. The effects of the additional stress of handling may be very small and requires more replicate tests performed to be conclusive. Results for steelhead show that there was a very low mortality (0.3%) for handled groups compared with no rortality for the control groups. Additional test replicates are planned for the 1992 monitoring season.

Each year between late July to early August the general health of subyearling chinook observed in the samples at John Day deteriorates severely. The incidence of body ulcerations, bacterial, fungal infections, and external **parasites Increase in** frequency and/or the fish seem to be in **a** very weakened, stressed **state overall with a high mortality rate for fish observed in the** samples or in the anesthesia recovery tank after handling. We suspect that the high river temperatures, **decrease** in flows, increasing stress from predation and disease during this time combine to render the weaker fish moribund upon arrival at John Day. After mid August the majority of these weaker fish have dropped out of the system.

This high background mortality on sampled fish that were not handled prior to holding makes it difficult to obtain clear test results on subyearlings. Combined handled and control test mortality was high (17.4%). Handled groups of fish did show a slightly higher mortality (18.3%) over non-handled controls (16.5%). Overall, 96% of mortalities in both handled **and control** groups showed signs of disease. The signs Included fungus on the nose and/or tall, and symptoms of columnaris (open sores on the sides of fish).

A test sensitive In detecting overall differences in data from grouped 2X2 tables as described by Snedecor and Cochran (1980) was used to determine the significance between mortality rates of handled and control groups. Results of this test for steelhead and subyearllng chinook are given below;

Species	Test Criterion	P Value (2 Tailed)
Steelhead	1.22	0.22
Subyearling Chinook	0.55	0.58

In this case the null hypothesis assumes that there is no difference between the treatment and control groups for each species. The null hypothesis is rejected where the test criteria is above the critical value of +1.96 or below -1.96 at the 5% level. These values indicate that, using our normal handling methods, there appears to be no significant difference between mortality rates of handled versus non-handled groups for subyearling chinook and steelhead.

Physical condition played and important role in smolt **survival** for all test groups. Descaled fish were more likely to die in both handled and control groups. The relationship between descaling and mortality in the tests are summarized below;

SPICIES	HANDLED Desc. / Total	HANDLED Desc. Mort / Total Mort	HANDLED Desc. Mort / Total Desc.	CONTROL Desc. / Total	CONTROL Desc. Mort / Total llort	CONTROL Desc. Mort / Total Desc.
Yearling Chinook	201 / 1276= 15.8%	14 / 15= 93.3%	14 / 201= 7%	141 / 979= 14.4%	35 / 38= 92.1%	35 / 141: 24.8%
Stleeheade	30 / 360= 8.3%	1 / 1= 100%	1 / 30= 3.3%	19 / 366=5.2%	0	0 / 19= 0
Subyrlng Chinook	5 / 547= 0.9%	1 / 100= 1%	1 / 5= 20%	2 / 535= 0.3%	4 / 88= 4.5%	4 / 2

Descaling rates in these tests for yearling chinook were high **(15.8%),** reflecting the high descaling rate for this species during 1991 at John Day Dam. There was a high incidence (93%) of descaled fish in the total mortality for the yearling chinook tests. Steelhead demonstrated the highest tolerance for scale loss with a 2% mortality among descaled fish, and subyearling chinook had the lowest tolerance for scale loss in the tests.

CONCLUSION

The percent holding mortality in combined handled and control tests were very low overall for yearling chinook (2.4%) and steelhead (0.1%). Test results for yearling chinook showed more mortalities in control groups than handled groups. The effects of the additional stress of handling may be very small and requires more replicate tests performed to be conclusive. Test data for steelhead showed no significant difference in mortality between handled (0.3%) and non-handled groups (0%).

Subyearling chinook seem to suffer high mortality rates in the samples at John Day during late July to early August, when water temperatures peak. This high background mortality on sampled fish that were not handled prior to holding makes it difficult to obtain clear test results on subyearlings. combined handled and control test mortality was high (17.4%) although there was no significant difference between handled (18.3%) and non handled controls (16.5%).

Based on these data, the present handling methods at the John Day Dam appear to have no significant effect on short-term survival of healthy yearling chinook, subyearling chinook and steelhead. **No** change is recommended in the current fish anesthetization and handling methods at John Day Dam airlift sampling at this time, but care should be taken to insure that sample related scale loss be kept at a minimum.

We wish to acknowledge Randy Absolon for conducting this study at John Day dam in 1991.

Table 1. 1991 YEARLING CHINOOK DELAYED MORTALITY TEST RESULTS, JOHN DAY DAM

END DATE	REP #	TEST TOTAL	YORT	XMORT	CONTROL TOTAL	MORT	%MORT
5/04	1	32	0	0.00	30	0	0.00
5/05	2	47	0	0.00	19	0	0.00
5/06	3	35	1	2.86	34	3 2	5.85
5/07	4	40	0	0.00	22	2	9.09
5/09	5	36	0	0.00	48	4	8.33
5/11	6	51	0	0.00	53	0	0.00
5/11	7	65	0	0.00	49	0	0.00
5/18	8	55	1	1.82	24	3	12.50
5/18	9	55	3	5.45	41	0	0.00
5/20	10	67	1	1.49	88	5	5.68
5/20	11	74	0	0.00	66	6	9.09
5/22	12	43	0	0.00	20	1	5.00
5/26	13	53	1	1.89	16	3	18.75
5/28	14	53	3	5.66	41	1	2.44
5/28	15	70	0	0.00	31	2	6.45
5/30	16	50	0	0.00	41	0	0.00
5/30	17	36	2	5.56	26	0	0.00
6/1	18	57	1	1.75	10	1	10.00
6/1	19	40	0	0.00	30	2	6.67
6/3	20	64	1	1.56	52	1	1.92
6/3	21	83	0	0.00	57	1	1.75
6/5	22	56	1	1.79	67	1	1.49
6/7	23	83	0	0.00	50	2	4.00
6/9	24	31	0	0.00	64	1	1.56
TOTALS		1276	15	1.20	979	38	3.90
MEAN		53.17	.62	1.24	40.79	1.58	4.61
STD DEV		14.91		1.84	18.85		4.76
MIN		31	0	0.00	10	0	0.00
MAX		83	3	5.66	88	6	18.75

Table 2. 1991 STEELHEAD DELAYED MORTALITY TEST RESULTS, JOHN DAY DAM

END DATE	REP #	TEST TOTAL	MORT	XMORT	CONTROL TOTAL	HORT	XMORT
5/14	1	41	0	0.00	63	0	0.00
5/14	2	40	0	0.00	51	0	0.00
5/16	3	41	1	0.00	52	0	0.00
5/16	4	40	1	0.00	43	0	0.00
5/22	5	41	1	2.44	60	0	0.00
5/27	6	59	0	0.00	30	0	0.00
5/24	7	55	0	0.00	33	0	0.00
5/26	8	43	1	0.00	34	0	0.00
TOTALS		360	01	0.30	366	0	0.00
MEAN)0		.13 .00	.0.30	0.30	45.75 5.75	0.00 0	00.00
STD DEV)5		.33 .05	.0.81	0.81	11.85 1.85	0.00 0	00.00
MIN 0		0 40	0.00	0.00	30 30	0 0	00.00
MAX 59		1 59	2.44	2.44	63 63	0 0	00.00

Table 3. 1991 SUBYEARLING CHINOOK DELAYED MORTALITY TEST RESULTS, JOHN DAY DAM

END DATE	REP #	TEST TOTAL	MORT	XMORT	CONTROL TOTAL	MORT	%Mort
7/19	1	45	0	0.00	88	3	3.41
7/19	2	57	0	0.00	61	1	1.64
7/25	3	62	3	4.84	41	0	0.00
7/25	4	66	1	1.52	35	0	0.00
7/27	5	40	2	5.00	42	0	0.00
8/02	6	40	8	20.00	37	9	24.32
8/04	7	42	12	28.57	45	13	28.89
8/08	8	59	3	5.08	63	2	3.17
8/08	9	41	13	31.71	38	12	31.58
8/09	10	64	38	58.38	36	21	58.33
8/09	11	31	20	64.52	49	27	55.10
TOTALS		547	100	18.28	535	88	16.45
MEAN		49.73	9.09	20.06	48.64	8.0	18.77
STD DEV		11.51		22.49	15.43		21.35
MIN		31	0	0.00	35	0	0.00
MAX		66	38	64.52	88	27	58.33

APPENDIX E
INCIDENTAL CATCH – 1991

JUVENILE SHAD
CAPTURE PATTERN
JOHN DAY DAM - 1991

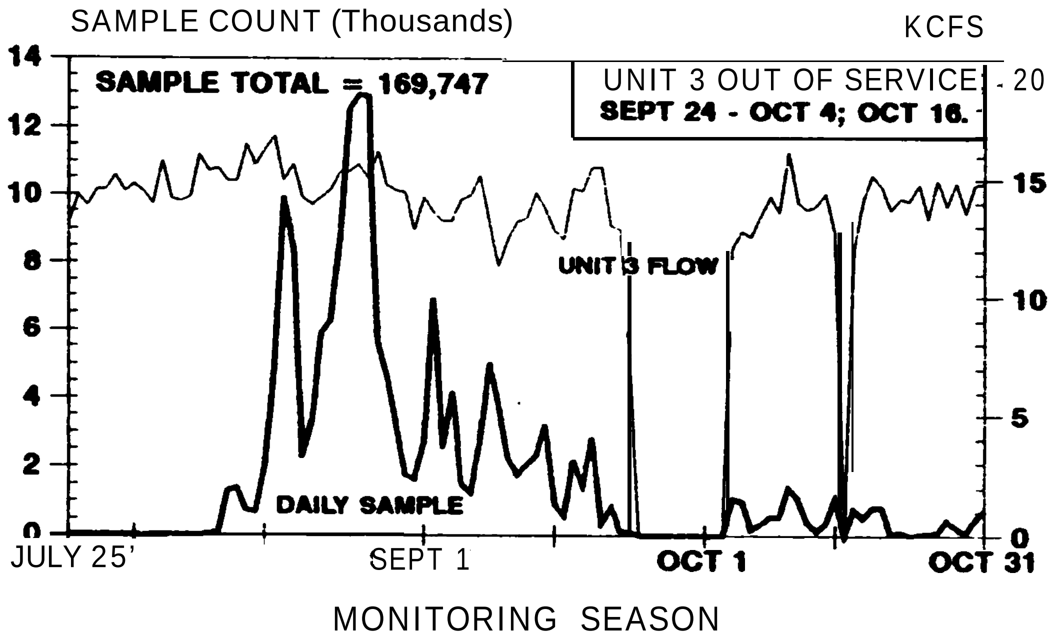

FIGURE 1

JUVENILE SHAD
CAPTURE PATTERN
BONNEVILLE DAM, PH#1 - 1991

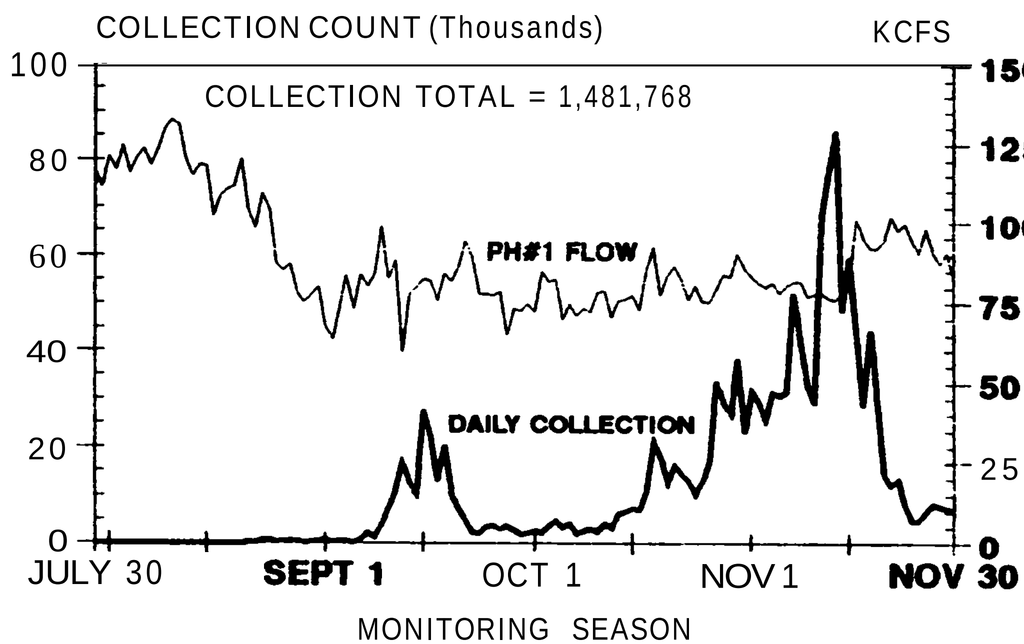

FIGURE 2

JUVENILE PACIFIC LAMPREY
CAPTURE PATTERN
JOHN DAY DAM - 1991

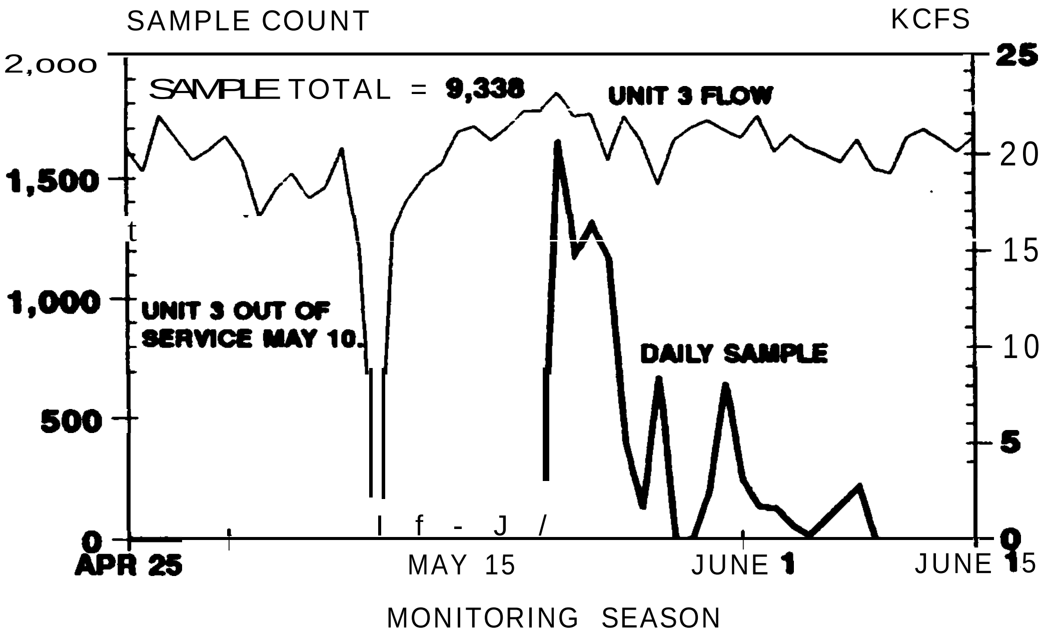

FIGURE 3

JUVENILE PACIFIC LAMPREY
CAPTURE PATTERN
BONNEVILLE DAM, PH#1 - 1991

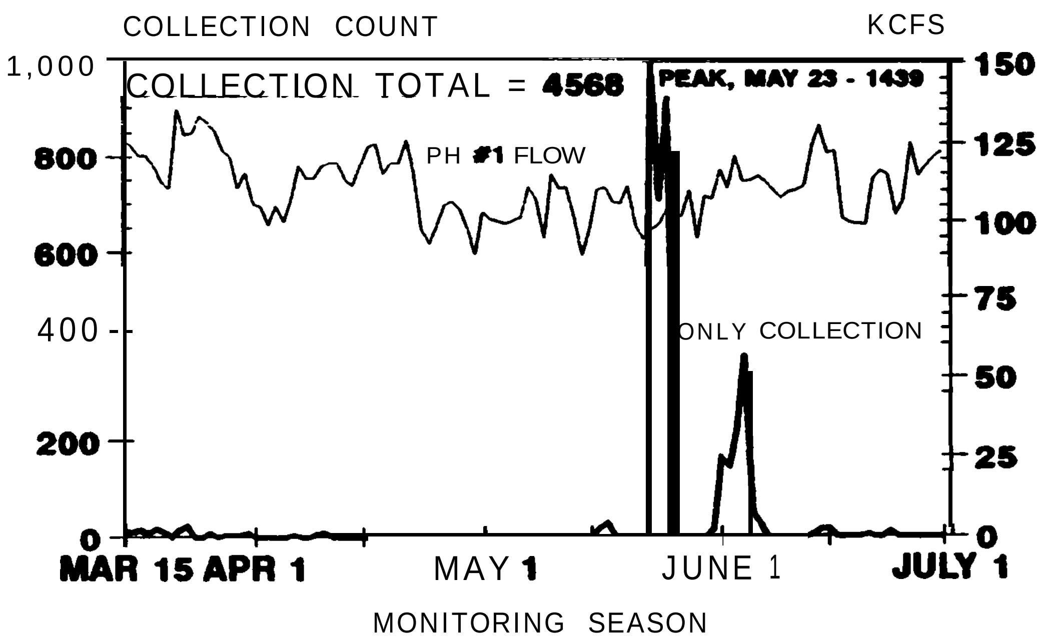

FIGURE 4