MONITORING OF DOWNSTREAM SALMON AND STEELEHEAD AT FEDERAL HYDROELECTRIC FACILITIES

Annual Report

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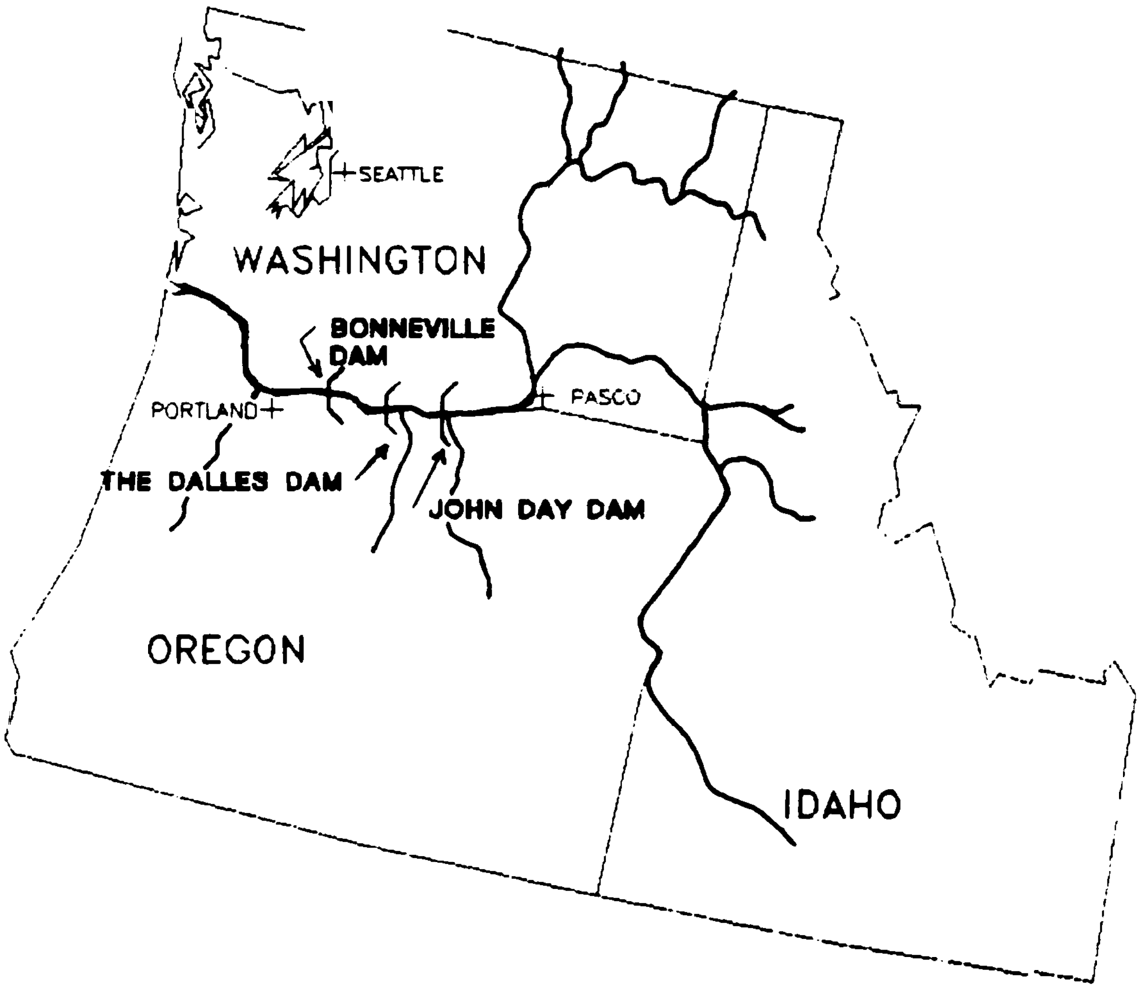

:GURE 1. N.M.F.S. Smolt Monitoring Sites on Columbia River.

INTRODUCTION

The seaward migration of salmonid smolts was monitored by the National Marine Fisheries Service (NMFS) at three sites on the Columbia River system in 1990. This project is a part of the continuing Smolt Monitoring Program to monitor Columbia Basin salmonid stocks coordinated by the Fish Passage Center (FPC) for the Columbia Basin Fish and Wildlife Agencies and Indian Tribes. It's purpose is to provide timely data to the Fish Passage Managers for in season flow and spill management for fish passage and post-season analysis for travel time, relative magnitude and timing of the smolt migration. 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 1990 (Figure 1). All pertinent fish capture, condition and brand data, as well as dam operations and river flow data were reported daily to FPC. These data were incorporated into the FPC Fish Passage Data Information System (FPDIS).

METHODS AND MATERTIALS

JOHN DAY DAM

sampling at John Day Dam was accomplished by a funnel airlift pump system of the type described by Brege et al. (1990). Samples were taken from unit 5 (gatewell B) this year as unit 3, our normal sample unit, was down for overhaul. The 24 hr sampling period ran from 1200h-1200h seven days per week throughout the sampling period. Captured fish were examined hourly, and routed into the gatewell bypass channel for return to the river. Except for periods of maintenance and the powerhouse electrical fire that shut down unit 5 from May 29th until June l0th, unit 5 was in continuous operation, though turbine loading was variable.

THE DALLES DAM

Sampling at The Dalles Dam from April 10th to July 4th was by dipnetting fish from unit 2 gatewell 2 using a crane and a dip basket of the type described by Swan et al. (1973). The fish escape orifice was blocked and vertical barrier screens were installed into the middle gatewell slot of unit 2, which was operated as consistently as possible through the duration of the season, August 31st. The gatewell was dipped hourly, 24 hours per day for seven days each week during the sampling period. For each hourly sample two dips of 4 minutes each were made to insure gatewell cleanout. The sampling day was from 0600h - 0600h. After processing, sampled fish were then released into the ice-trash sluiceway for downstream passage.

A funnel airlift pump sampling system identical to the type used at John Day Dam was installed at The Dalles gatewell 2-2 on July 4th, after the fabricated funnel and components were delivered from the BPA shop, Sampling from July 5th to August 31st was by using this airlift system, under the same criteria as the dipnetting; 24 hrs/day, 7 days/week, examining the catch hourly.

BONNEVILLE DAM

At Bonneville Dam observations of smolt passage throughout the season were made from catches in the downstream migrant (DSM) trap in the bypass channel in powerhouse 1 and 2 (DSM l&2). The DSM traps and sampling methods used were described by Gessel (1986)for powerhouse 1, and by McConnell and Muir (1982), and Krcma et al. (1994), for powerhouse 2.

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 dally basis depending on smolt numbers, but was generally set at 6 to 15 minutes per hour (l0-25%) at which time the trap would be raised and all fish examined. During unusually high smolt passage, the sample rate was adjusted on an hourly basis to a minimum of 1 minute per hour as necessary.

The DSM 2 automatic sampler was normally operated 24 hours per day, seven days per week. 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 DSM. These fish were routed to holding raceways where they were examined after the end of each sample period (2400h - 2400h). After examination, sample fish from both DSM 1 and 2 were routed back to their respective bypass channels.

SAMPLING PROCEDURES

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) Descallng, general fish condition and mortality;
5) Subsample for lengths by species; and
6) Project, river, turbine and spill flow data.

Salmonid smolts at John Day and The Dalles were preanesthetized using a solution of benzocaine and alcohol (method as described by Matthews et al. 1985) prior to handling to reduce stress and then transferred to an examination trough containing a small amount of tricaine (MS-222) anesthetic to keep fish calm during examination. At Bonneville, fish were net-transferred directly into the anesthetic in the examination trough. Fish were then routed to recovery tanks before being released to continue their migration. All flow data for each sample site were obtained from the Corps of Engineers **(CoE).**

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

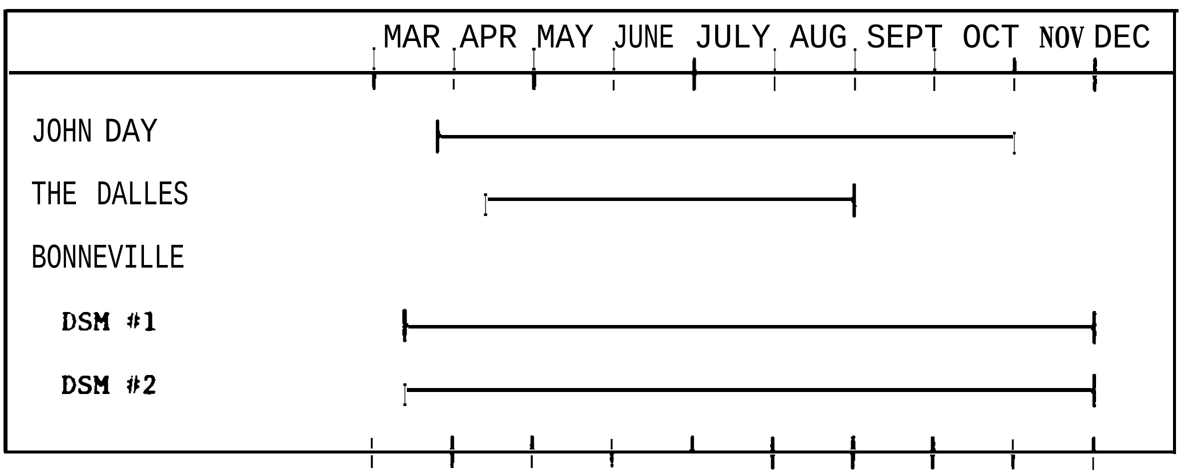

FIGURE 2. Smolt Monitoring Season, by Site, 1990

Sampling frequencies are as follows:

John Day Dam ------ **Daily;** 24 hourly samples, 3/27 to 10/31.

The Dalles Dam ---- Daily; 24 hourly samples.
Gatewell Dipnet, 4/10 to 7/4.
Airlift Pump, 7/4 to 8/31.

Bonneville Dam
PH 1, DSMl --- Seven days per week; 8 hourly samples plus die1 samples, 3/12 to 11/30.
PH 2, DSM2 --- Seven days per week; 24-hour cumulative sample, 3/12 to 11/30.

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 1990 field season. Three types of fish counts are presented in the table: Total Sample fish counts; Estimated Collection counts which are sample counts adjusted for sample rate where applicable; and Passage Indices which are collection counts divided by the proportion of flow passing through the sampled system to adjust for daily fluctuations in project operation. 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. Some duplication may occur in other summaries. 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.

JOHN DAY DAM

Based on the catch from the airlift pump sampling system operated in gatewell 5-B, there was an index total of 1,117,384 smolts over the 1990 season at John Day Dam. This is about 44% less than the total index of 1,979,670 for the 1989 season, and is about 58% less than the 5 year average of 2,636,802; since 1985 when submersible traveling screens (STS) were installed.

This significant decrease in smolt numbers may be largely attributed to the change in the sampled unit, as past indices are based on samples from unit 3 which collects a higher proportion of fish passing the powerhouse than unit 5. Another factor was the shutdown of the sampled unit 5 on April 16-19; June 21-22; August 13-15; and the eleven day shutdown when the John Day Dam electrical fire occurred from 1700h on May 29th until 1900h on June 9th. This period alone represents approximately 5% of the sampling season during a time when significant numbers of fish were being flushed out of the river system due to increased river flows. The unfortunate timing of this shutdown, occurring during the latter part of the spring migration and the beginning of the summer migration, had a definite impact on the total fish numbers sampled.

River flow, Unit 5 discharge and spill are presented in Appendix A, Figure 1 for the 1990 season. Total river flow increased sharply in late May through early June from an average of 212 KCFS, to a high of 375 KCFS on June 10th, necessitating overgeneration spill through the system. Spill began when the powerhouse was shut down on the evening of May 29th and reached a peak of 277 KCFS two days later. The powerhouse was completely shut down until May 31st when two units were restarted; and by June 2nd seven units were operational.

TABLE 1. SUMMARY OF 1990 SMOLT MONITORING ACTIVITIES AT JOHN DAY, THE DALLES AND BONNEVILLE DAMS.

SPECIES	SITE	TOTAL SAMPLE	BRANDS IN SAMPLE	ESTIMATED COLLECTION	ESTIMATED[1/] FPI
YEARLING CHINOOK	JOHN DAY	26,992	732	26,992	361,968
	THE DALLES	3,310	62	3,310	60,725
	BONNEVILLE PH#1 DSM[2/]	23,843	286	196,216	332,792
	BONNEVILLE PH#2 DSM	5,463	23	54,630	N/A
SUBYEARLING CHINOOK	JOHN DAY	39,602	337	39,602	513,669
	THE DALLES	8,895	52	8,895	177,335
	BONNEVILLE PH#1 DSM	90,422	189	658,702	1,219,778
	BONNEVILLE PH#2 DSM	20,469	27	204,690	N/A
WILD STEELHEAD (UNCLIPPED)	JOHN DAY	5,028	3/	5,028	68,428
	THE DALLES[5/]	918		918	14,889
	BONNEVILLE PH#1 DSM[5/]	3,894		36,812	62,826
	BONNEVILLE PH#2 DSM	238		2,380	N/A
HATCHERY STEELHEAD (CLIPPED)	JOHN DAY	7,921	599	7,921	65,349
	THE DALLES	2,101	49	2,101	13,004
	BONNEVILLE PH#1 DSM	5,525	218	64,400	65,056
	BONNEVILLE PH#2 DSM	205	9	2,050	N/A
COHO	JOHN DAY	6,261	1	6,261	94,342
	THE DALLES	473	0	473	9,188
	BONNEVILLE PH#1 DSM	43,030	0	365,926	677,413
	BONNEVILLE PH#2 DSM	6,300	0	63,000	N/A
SOCKEYE	JOHN DAY	1,755	9	1,755	23,592
	THE DALLES	249	1	249	5,093
	BONNEVILLE PH#1 DSM	4,537	6	42,633	81,403
	BONNEVILLE PH#2 DSM	164	0	1,640	N/A
TOTAL CATCH	JOHN DAY[4/]	87,559	1,678	87,559	1,117,384
	THE DALLES	15,946	164	15,946	280,234
	BONNEVILLE PH#1 DSM	161,251	699	1,364,589	2,439,268
	BONNEVILLE PH#2 DSM	32,839	59	328,390	N/A

Data Source: Fish Passage Data Service.

1/. FPI 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.

4/. Outages of Unit 5 make all 1990 John Day Dam indices an underestimate. 1990 indices at John Day Dam should not be compared to historical indices based on Unit 3.

5/. FPI for yearling chinook and steelhead at The Dalles and Bonneville Dam were adjusted down because of unplanned barge releases above John Day Dam on May 30.

The summer spill season at John Day ran from June 7th through August 23nd. The 20% of instantaneous flow for 10 hours each day authorized under the "Fish Spill Memorandum of Agreement" for John Day Dam took place from 2000h - 0600h during this period. The seasonal average flow spilled over the season was 10.7% including both overgeneration and authorized spill.

Outages of unit 5 over the season make estimated percent of passage dates either gross approximations or impossible (noted by N/A). Estimated dates for the 10 to 90% segment of smolt passage by species are listed below.

	10%	90%
Yearling chinook - - - - - -	4/25	N/A
Subyearling chinook - - - -	N/A	N/A
Steelhead, wild - - - - - -	4/26	N/A
Steelhead, hatchery - - - -	5/2	N/A
Coho - - - - - - - - - - - - - -	4/27	N/A
Sockeye - - - - - - - - - - - -	5/4	N/A

Seasonal passage patterns for John Day Dam are presented by species in Appendix A, Figures 2-7. When these passage patterns are compared with those at The Dalles, it is obvious that significant numbers of fish of all species passed John Day during the period of shutdown; May 30th through June 9th.

Weekly diel passage patterns are presented for each species in Appendix A, Figures 8-40 and were adjusted to eliminate the effect of unit 5 hourly fluctuations on fish capture.[1] Patterns were consistent with previous years in that the majority of passage (75 to 95%) occurs during night time hours at John Day Dam (Sims et al. 1976 and 1981). 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. There were no reversals of this pattern during the 1990 season.

There were no major operational problems with the airlift system during the 1990 sampling season. Due to the improved design of the airlift funnel installed last year, there were no debris plugs encountered the entire season. The fish handling building was expanded to accommodate two new aluminum fish holding tanks and the old fiberglass tank which can now be used for delayed mortality testing.

The percentage of descaling and mortality in the sample at John Day Dam for 1988 through 1990 are listed by species as follows;

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[1]/ Diel 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.

YEAR	YEARLING CHINOOK DESC	YEARLING CHINOOK MORT	SUBYEARLING CHINOOK DESC	SUBYEARLING CHINOOK MORT	STEELHEAD DESC	STEELHEAD MORT	COHO DESC	COHO MORT	SOCKEYE DESC	SOCKEYE MORT
1988	6.93	3.52	1.98	2.76	8.69	1.72	4.18	1.79	5.08	0.73
1989	10.72	2.01	4.96	2.75	7.77	0.41	6.40	0.19	12.08	0.67
1990	7.83	1.50	6.20	4.96	9.62	1.37	6.52	0.10	8.09	1.82

A graphic presentation of the percent of descaled fish in the sample for 1990 compared to 1989 and 1988 levels is shown in Figure 3.

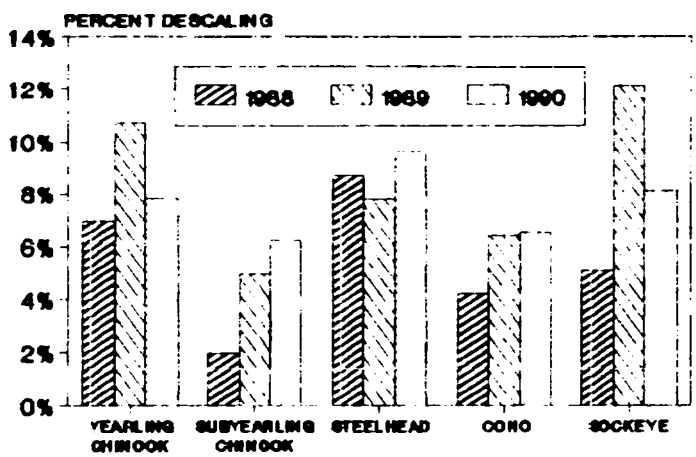

FIGURE 3. PERCENT DESCALING, JOHN DAY DAM, 1988, 1989, 1990.

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.

In an effort to evaluate the background mortality of sampled fish at John Day, a series of delayed mortality tests (48 hr. holding) were conducted in May on yearling chinook and steelhead, and in June through July on subyearling chinook. Fish were not handled beyond the collection in the airlift basket and gravity flow delivery into the holding tank. There was a range of 25 to 60 fish per test group and the fish were not disturbed during the 48hr holding period. Combined delayed mortality tests results are as follows;

Species	Month	Ave H_2O °F Temp.	# of Tests	Total Fish	% Desc.	% Mort.	% of Yorts Descaled
Yrlg. Chin.	May	57	6	194	11.8	2.1	75
Steelhead	May	58	2	73	17.8	1.4	0
Subyrlg. Chin.	June	66	5	245	2.9	0.8	50
Subyrlg. Chin.	July	71	6	228	0.9	8.3	0

Mortality for subyearllng chinook peaked along with water temperatures in late July. Descaled fish had a higher incidence of mortality than healthy fish in these tests.

An effort to measure the brand recovery efficiency of fish handlers at John Day Dam using yearling and subyearling chinook war also conducted this season. Ten brand recovery tests were done using yearling chinook and three 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 rotations and locations. The fish were held for 48 hours and then introduced, without the fish handler's knowledge, into the airlift basket. The fish were either introduced immediately prior to emptying the basket into the fish handling building or just before it was lowered back into the gatewell to be left until the next hourly sample for recovery evaluation. Combined brand detection test results are as follows;

Species	ci of Tests	Total rt Branded	Total # Recovered	Percent Recovered
Yearling Chinook	10	273	246	90%
Subyearling Chinook	3	64	57	89%
Total	13	337	303	90%

Fish handlers at John Day Dam were able to detect and record a total of 303 out of 337 branded chinook introduced into the rample for a detection rate of 90%. We intend to continue this evaluation for the 1991 sample season at John Day Dam, and institute a similar series of evaluations at Bonneville Dam.

The incidence of subyearling Chinook fry (< 60mm) in the sample this season was virtually non-existent, totalling 30 fish captured from May through mid June.

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 1990 sample count for shad was 5.3 times greater than the 1989 count(1990-327,621; 1989-61,543). Juvenile Pacific Lamprey (Entosphenus tridentatus) first appeared in samples from March 26th through July 12th with two distinct peaks on May 4th and June 6th (see Appendix E, Figure 3).

THE DALLES DAM

Due to uncontrollable set-backs, sampling at The Dalles Dam with the proposed airlift pump system for the 1990 spill monitoring season was delayed until installation on July 4th. Gatewell dipnetting was chosen as an interim sampling method starting April 10th. Both are considered gatewell clean-out methods, Sims et al. (1981) therefore the data will be treated equally. Due to the majority of fish (55.7%) being caught in unit 2-2 out of the three gatewells sampled in 1989, and the decision to monitor with a single airlift pump system, sampling was restricted to unit 2-2 during the 1990 season.

Numbers of fish captured in the gatewell at The Dalles Dam are relatively low because there are no STS screens to guide fish up the gatewells at this project. Based on vertical distribution tests conducted at The Dalles Dam (Monk et al. 1986) the percentage of fish passing through a turbine unit that will enter unscreened gatewells ranges between 14-43% for spring migrants and 4% for subyearling chinook.

River flow, average sampled unit discharge and spill are shown in Appendix B, Figure 1. River flows ranged from a high of 366.5 KCFS on June 6th to a low of 93.8 KCFS on August 8th. Unit 2 discharge went from a low of 7.7 KCFS on April 15th to a high of 14 KCFS on June 10th. Spill varied greatly from a high of 159.2 KCFS on June 10th when substantial overgeneration flows were being spilled, to a low of 5.5 KCFS on August 7th.

The seasonal passage pattern by species is graphed in Appendix B, Figures 2-7. The peak passage for hatchery steelhead on June 2nd and 3rd (App. B, Figure 5) was exaggerated by the John Day Lock closure due to the power house failure. Two barges, loaded with nearly 600,000 fish, 85% of which were Snake River steelhead, were forced to release their cargo into the head of the John Day Pool. This, and the coincidental high flows flushing many of the fish still in the system down river, resulted in passage peaks for every species on or around the first of June.

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 for yearling chinook were 4/17 and 5/28; and for steelhead were 4/26 and 6/2.

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 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 took place from 2000h - 0400h, averaging 14% 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.

The apparent relation between spill and daily count at The Dalles Dam is shown in Figure 4. Total fish count rose steadily to a peak of 1,170 fish on June 3rd, when spill was increased from an hourly average of 64.2 KCFS to 159.2 KCFS to handle excess overgeneration flow through the system. Sample numbers then fell to a total count of only 55 fish on June 4th. This inverse relationship is consistent for the entire period graphed in Figure 4.

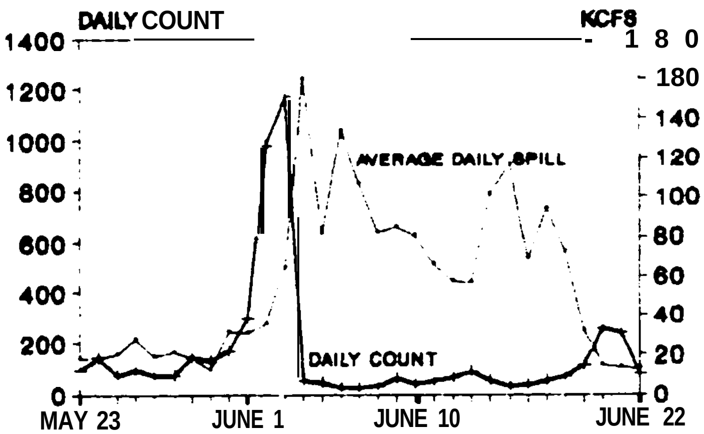

FIGURE 4. AVERAGE DAILY SPILL VERSUS DAILY COUNT, THE DALLES DAM, JUNE 1990.

Willis (1982) estimated the maximum bypass efficiency of The Dalles Dam sluiceway to be 40% when there is no spill, and that it was inversely proportional to spill. Since flow through the sluiceway is not incorporated into the index formula, it is possible that the passage index is low by as much as 40% during those hours of sluiceway operation when there is no spill. Fish travel higher in the water column during the day than at night, Willis (1982), and since the sluiceway is closed from about 2000h to 0430h, this may amplify the under-estimation of daytime passage, and increase night time smolt interception. This could be creating diel pattern generated by sluiceway and spill operation, not fish behavior.

The weekly die1 passage patterns shown in the Appendix B Figures 8-36, seem to reflect this." They show an increase in fish count shortly after 2000h, and a decline in fish count shortly after 0500h which roughly coincides with the operation of the ice and trash sluiceway. This is true even during periods of spill. No die1 pattern is presented for sockeye due to the low capture rate. The die1 passage patterns have been adjusted to eliminate the effect of unit 2 fluctuations in flow.

Subyearling chinook catch results at The Dalles indicate that the majority of the passage seemed to have occurred while dipnetting, with sample numbers dropping off sharply around the time of the airlift installation (Figure 5). Project operation and sampled unit discharge did not change significantly during this period,

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*/ Die1 passage is shown for a minimum catch of 100 fish per week.

therefore an analysis of the data along with the differences in sampling efficiency between airlift and dipnetting methods should be considered. When the percent of total subyearling chinook passage for June through July is plotted for John Day and The Dalles in Figure 5, it shows that the largest decline in fish numbers (82%) occurred on the two days prior to the airlift installation (596 to 109) at The Dalles. When the airlift was installed during the July 4th-5th sample period, ten hours of which included gatewell dipnetting (this was a full 24 hr. sample period with no significant fish loss), there was a 65% drop in sample numbers (109 to 38).

Furthermore, Figure 5 shows that the peak passage period at John Day precedes that of The Dalles by about 5 days. Both occur before the July 4th installation of the airlift at The Dalles.

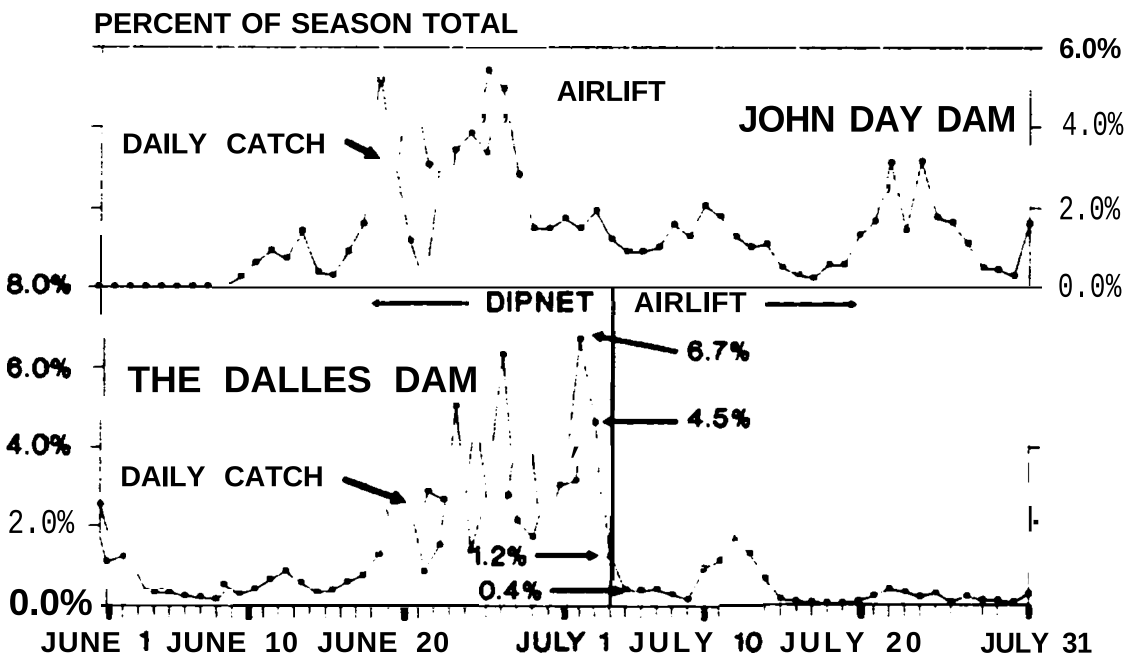

FIGURE 5. COMPARISON OF DAILY CATCH,
THE DALLES/JOHN DAY DAMS, JUNE-JULY

studies conducted at John Day Dam (Sims et al. 1981) before STS's where installed have shown that airlifting is quite efficient, averaging 94% over 16 tests involving 6,847 fish. Conditions at The Dalles Dam are similar except that the funnel is placed higher in the gatewell which, with the absence of a strong up-welling effect usually created by STS screens, may leave a sanctuary area for fish below the funnel. Fish could possibly avoid capture in this sanctuary area and so contribute to the low numbers of fish captured at this site. However, both the dipnet and the airlift were operated at the same depth, approximately 35 feet above the bottom of the gatewell due to a constriction at this point. Die1 patterns between airlift and dipnetting methods were identical.

The data seems to indicate that the subyearling fall chinook run had peaked prior to the installation of the airlift. It is also likely that the high runoff flows at the start of the summer migration, necessitating high spill levels, flushed most of the fish down river prior to the first of July.

Descaling and mortality in the samples at The Dalles Dam for each species are shown below;

SPECIES	PERCENT DESCALED	PERCENT MORTALITY
Yearling Chinook - - - -	6.6	.2
Subyearling Chinook - -	2.5	7
Steelhead Wild - - - - -	7.0	.'2
Hatchery - - - - -	14.7	.a
Coho - - - - - - - - - - -	8.8	.2
Sockeye - - - - - - - - -	8.4	.6

The May 29th John Day Dam powerhouse failure and subsequent spilling of all inflow resulted in dissolved gas levels of about 135% below the project for several days until it dropped to 120% by June 5th. From May 31st through June 4th, symptoms of gas bubble disease such as bubbles on fins, operculum or mouth and hemoraging at the fin base of fish in the sample at The Dalles Dam were observed in 5.7% of 246 yearling chinook; 10.9% of 46 sockeye; 17.4% of 23 coho; and 5.0% of 1,727 steelhead.

BONNEVILLE DAM

Catch numbers from the DSM sampler in powerhouse 1 generated an index total of 2,439,268 at Bonneville Dam. This is a 19.5% overall decrease from the 1989 DSM 1 index total of 3,028,403. Subyearling upriver brights, however, appeared to fare well this year with a 160% increase in index based on counts after June 1st (1990 929,100; 1989- 357,522).

Daily river flow, spill and discharge from powerhouse 1 and 2 are presented in Appendix C, Figures l-2. River flows ranged from a high of 371 KCFS on June 9th to a low of 89 KCFS September 16th. Spill peaked on April 23rd at 140 KCFS. Powerhouse 1 discharge ranged from 140 KCFS on April 23rd to 38 KCFS on September 9th.

As in previous years, operation of powerhouse 2 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 PH 1 plus 75 KCFS daily spill. In addition, powerhouse 2 was operated in July during the NMFS tests and again in September for adult collection purposes.

Water control and sampling equipment in the downstream migrant channel of powerhouse 1 completed another relatively uninterrupted monitoring season. Equipment failure resulted in just three hourly samples to be missed out of a total of 2,112 for the monitoring season.

Fish capture patterns for DSM 1 and DSM 2 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 15th, April 12th, and May 17th. The summer passage pattern for subyearlings after June 1st mainly represents the portion of the run which are primarily upriver bright stock. It should be noted that the capture patterns for DSM 2 (Appendix C, Figures 9-14) more strongly reflect powerhouse 2 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- - - -	4/16	5/22
Subyearling Chinook - -	4/21	7/8
"Brights" -	6/7	7/12
Steelhead, wild - - - -	4/30	6/2
hatchery - -	5/1	6/5
Coho- - - - - - - - - - - -	4/23	6/9
Sockeye - - - - - - - - -	5/8	6/5

A series of tests were conducted again this year to evaluate our fish handling procedures by measuring short-term mortality rates (48 hour holding) of handled and non handled test groups. As in 1989, tests were conducted on yearling chinook in May and subyearling chinook in July. In addition, tests were conducted on sockeye smolts in May. The details and expanded results of these tests are presented in Appendix D.

As was the case in 1989, no significant difference in short term mortality was found to exist between handled and non handled groups of both yearling and subyearling chinook. For yearling chinook, handled and non handled groups resulted in a total mortality of 1.88% and 1.49% respectively. For subyearling chinook, tests results were 1.62% handled and 2.72% for non handled groups.

In contrast, the mortality of handled sockeye smolts was found to be significantly greater than the non-handled groups. Of the 18 replicate tests, sockeye suffered a 15.9% mortality on handled **groups,** while non handled groups averaged 11.7%. Of the total sockeye sampled in DSM 1 this season, 37.7% were descaled as compared to 7.1% of yearling chinook and 2.4% of subyearlings **(see Figure 6).** This high descaling is indicative of the poor condition of sockeye smolts upon capture and was reflected in the sockeye collected for the delayed mortality tests with 35% being descaled. Physical condition played an important role in smolt survival for all species tested in both treatment and control groups with 86% of the total mortalities in each group being descaled, indicating that most fish died from being descaled, not from handling.

An abnormally high rate of descaling for sockeye (67.8%) in the normal June 1 sample led to an investigation of the health of these fish at USFWS National Fishery Research Center at Willard. The gills of these sockeye were found to be heavily infested with Trichophrya and the body descaled enough to cause mortality.

For the 1990 season, incidence of descaled fish sampled in the **DSM** 1 increased somewhat over the 1988 and 1989 levels. Percentages of descaling and mortality in the sample at DSM 1 and 2 for 1988, 1989, and 1990 are listed by species below.

BONNEVILLE DAM **DSM#1**

YEAR	YEARLING CHINOOK % DESC	% MORT	SUBYEARLING CHINOOK % DESC	% MORT	STEELHEAD % DESC	% MORT	COHO % DESC	% MORT	SOCK % DESC	% MORT
1988	4.4	0.0	1.7	0.3	6.:	0.2	3.3	0.1	23.5	6.8
1989	4.3	0.1	2.3	0.4	4.4	1.1	3.3	0.02	17.2	0.14
1990	7.:	0.1	2.4	0.5	11.2	0.3	5.4	0.1	37.7	1.0

BONNEVILLE DAM **DSM#2**

YEAR	YEARLING CHINOOK % DESC	% MORT	SUBYEARLING CHINOOK % DESC	% MORT	STEELHEAD % DESC	% MORT	COHO % DESC	% MORT	SOCK % DESC	% MORT
1988	4.6	2.4	2.2	4.1	7.6	1.8	3.4	1.3	13.8	15.1
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

Of specific concern are this year's elevated descaling rates in the DSM 1 sample for both steelhead and sockeye smolts. The incidence of descaling for steelhead was 11.2% this year, more than twice the previous two year average of 5.3%. Sockeye rates averaged **37.7%,** nearly double the previous two year average of 20.3% (Figure 6, page 15).

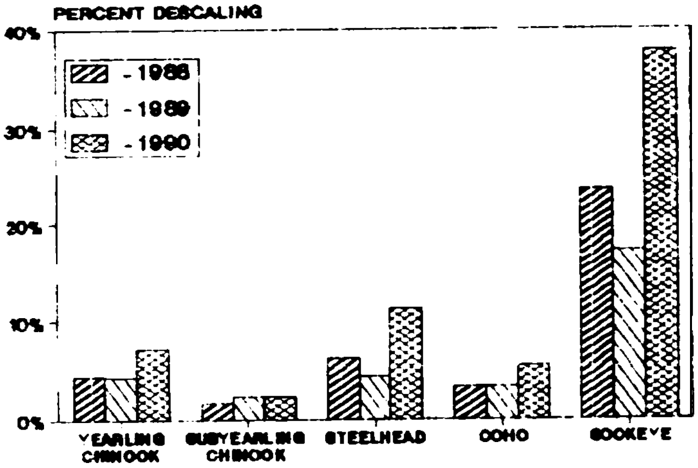

FIGURE 6. PERCENT DESCALING, BONNEVILLE DAM DSM#1, 1988, 1989, 1990.

Sockeye have a consistently higher overall incidence of descalIng over the years at Bonneville, possibly due in part to this delicate species having to pass several projects before reaching Bonneville Dam which amplifies cumulative stress and descalIng. The daily incidence of descalIng for sockeye sampled at Bonneville, John Day, and McNary dams is plotted in Figure 7. The dramatic increase in the rate of descaling recorded at Bonneville indicates more of a problem than cumulative descalIng, however. The data seems toindicate that sockeye are being impacted either at The Dalles and/or Bonneville projects.

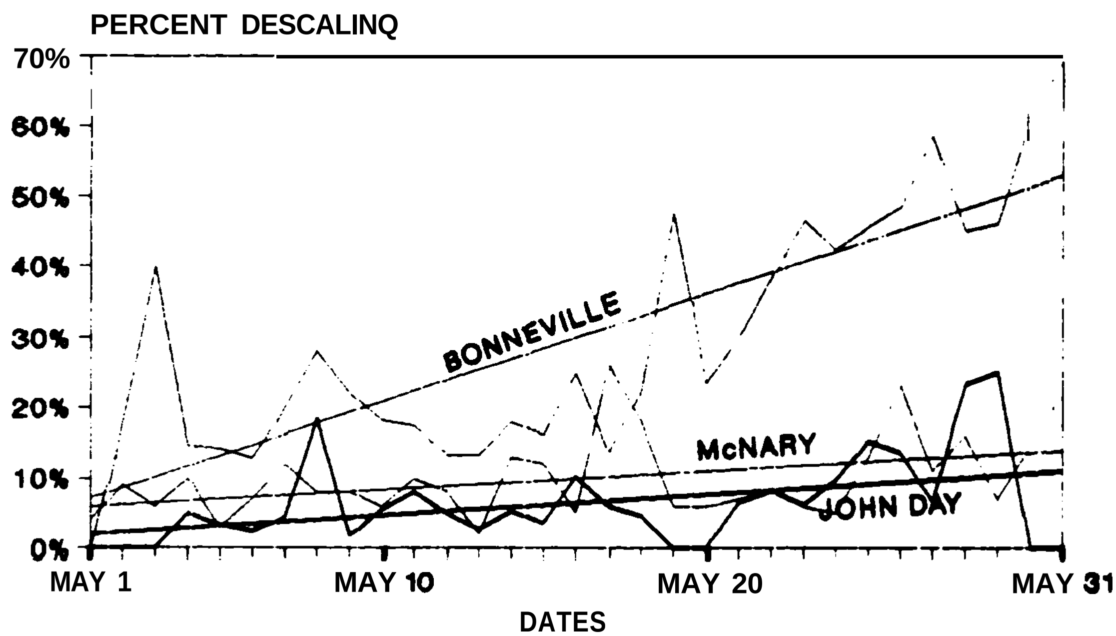

FIGURE 7. PERCENT OF DAILY DESCALING FOR SOCKEYE. BONNEVILLE DMS#I, JOHN DAY AND McNARY DAMS, MAY 1990

The daily incidence of descaling for all species sampled at Bonneville increases over the latter half of the spring migration.

The resultant spill from the John Day powerhouse shutdown on May 29th raised dissolved gas levels to around 135% below the project for several days. A level of 120% saturation reached Bonneville by May 31st and symptoms of gas bubble disease were first observed in the June 1 sample. The incidence of gas bubble disease symptoms in the sample at the DSM 1 are as follows;

	YEARLING CHINOOK		SUBYEARLING CHINOOK		STEELHEAD		SOCKEYE		COHO	
DATES	# sample	% gas disease	# sample	% gas disease	# sample	% gas disease	# sample	% gas disease	# sample	% gas disease
June 1	115	3.0	638	0.2	189	29.0	199	2.5	358	8.0
June 2	104	0.0	466	0.0	663	23.0	102	0.0	212	1.0
June 3	108	4.0	461	0.2	1314	74.0	76	14.0	223	38.0
June 4	100	5.0	791	0.0	227	37.0	102	5.0	214	11.0
June 5	73	0.0	487	0.0	147	22.0	131	3.0	301	1.0
June 6	55	2.0	611	0.0	121	25.0	218	1.0	259	2.0

Incidence of the disease symptoms were highest in steelhead smolts, affecting 74% of the sample on June 3rd. Many of these steelhead traveled downstream with the super-saturated water as a result of being dumped into the John Day pool. The downstream progress of two transport barges carrying these fish was thwarted when the navigation locks shutdown after the fire. Incidence of gas bubble disease decreased after the June 3rd high and by June 13th symptoms were no longer observed in smolts captured at Bonneville Dam.

Six diel tests were conducted with the DSM 1 this season; three tests were conducted in May, one in June, one in July, and one in August. The DSM 1 sampler was operated hourly for 24 hours during these tests. The resulting hourly sample counts are adjusted to account for hourly changes in flow through powerhouse 1 and are presented in Appendix C, Figures 15-34.[3/] Peak passage for most species generally took place at or just after sunset with a lesser peak near sunrise.

On these diel test dates the percent of daily smolt passage during the normal sampling hours (1600h - 2400h) can be appraised. Figure 8 compares the percent of daily passage for

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[3/] Diel passage is shown for a minimum catch of 100 fish per day.

the combined die1 tests during three eight hour periods for each species. If normal sampling hours were in effect for these dates, 25.6% of yearling chinook, 38.9% of subyearllng chinook, 29.4% of steelhead, 40% of coho, and 67.4% of sockeye would have been collected out of the 24 hour period.

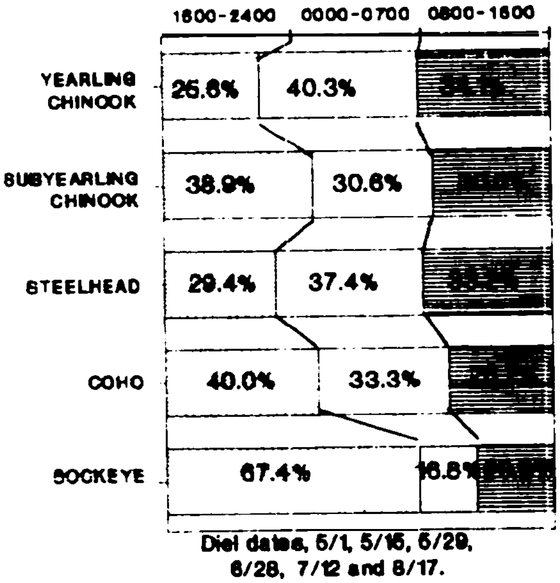

FIGURE 8. DIEL PASSAGE, DSM#1. % CONTRIBUTION, BY SPECIES DURING MEL PASSAGE.

The juvenile American shad collection count began increasing in the DSM 1 in mid August and peaked on November 23rd with minor peaks at the end of August and through October. (see Appendix E, Figure 2). The incidental catch of juvenile shad for 1990 was almost seven times greater than in 1989 (1990-2,934,762; 1989-435,441)) which may be due in part to the 36% increase in the 1990 adult run (Bonneville fish ladder counts).

The collection count of juvenile pacific lamprey for 1990 in the DSM 1 (see Appendix E, Figure 4) was only about 1/20th of the 1989 count (1,780 for 1990; 34,747 for 1989). Lamprey counts peaked on June 13th and elevated counts lasted only 6 days, in contrast to the 1989 peak which occurred on March 30th.

SUMMARY

The 1990 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 the FPDIS for use by Fish Passage Center 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.

The success of this program continues to involve cooperative interaction with the Northwest and Alaska Fisheries Center, Coastal Zone and Estuarine Studies Division in both personnel and facilities of the Pasco and North Bonneville Field Stations. It is appreciated.

On-site biologists, assistants and others of the Corps of Engineers provided valuable guidance and assistance at each sampling site: John Day, The Dalles and Bonneville Dams. Corps personnel at The Dalles Dam were especially helpful while we were preparing new sampling facilities and during the season.

We acknowledge the very capable efforts of our biologists, technicians, maintenance and contract persons; their work was vital. Key people were Bill Hevlin and Scott Carlon at Bonneville, Randy Absolon at John Day, Rick Martinson at The Dalles, and Doug Frantum and his assistants for assembling most of the sampling components at The Dalles Dam and keeping those at John Day Dam in working order. Special commendation goes to Richard C. Johnsen who retired as head of the NMFS Smolt Monitoring Project this year after a long and distinguished career.

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APPENDIX A
JOHN DAY DAM – 1990

RIVER, SAMPLED UNIT, SPILL
DAILY AVERAGE FLOW
JOHN DAY DAM

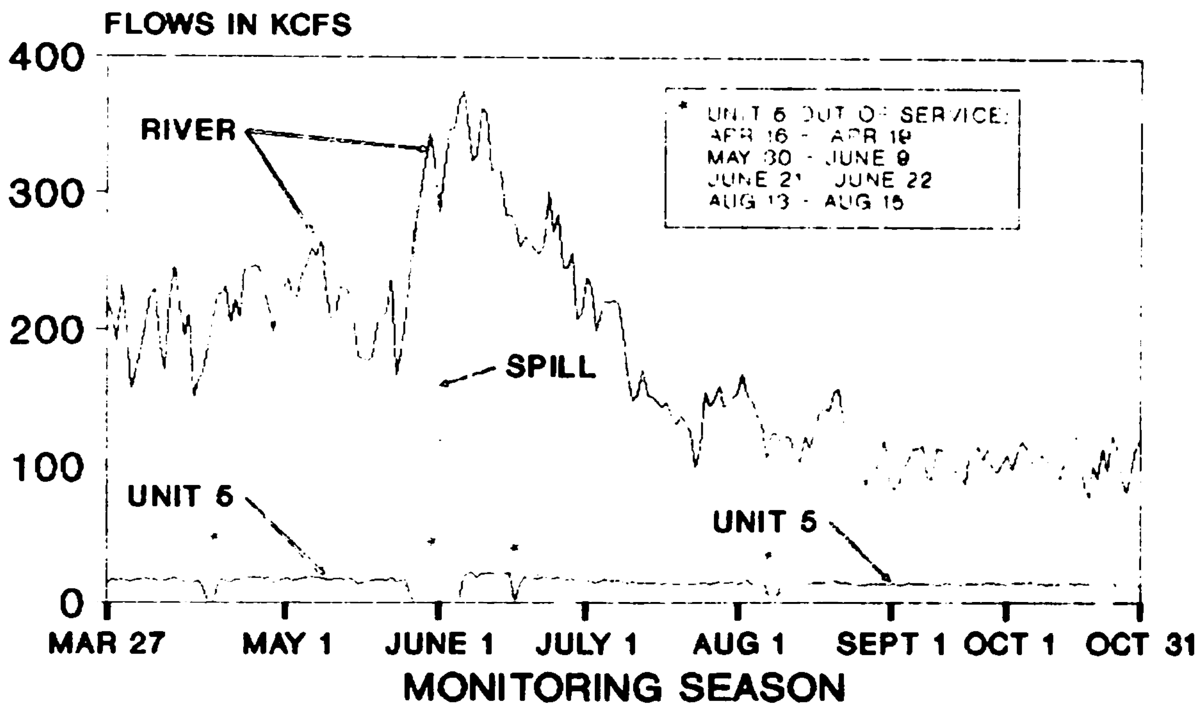


FIGURE 1

YEARLING CHINOOK
PASSAGE PATTERN
JOHN DAY DAM

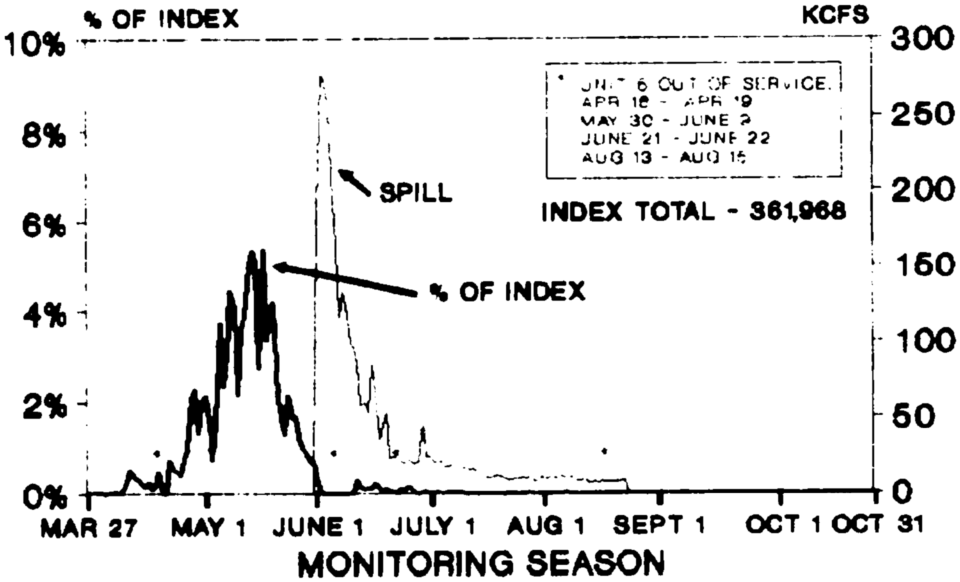


FIGURE 2

SUBYEARLING CHINOOK
PASSAGE PATTERN
JOHN DAY DAM

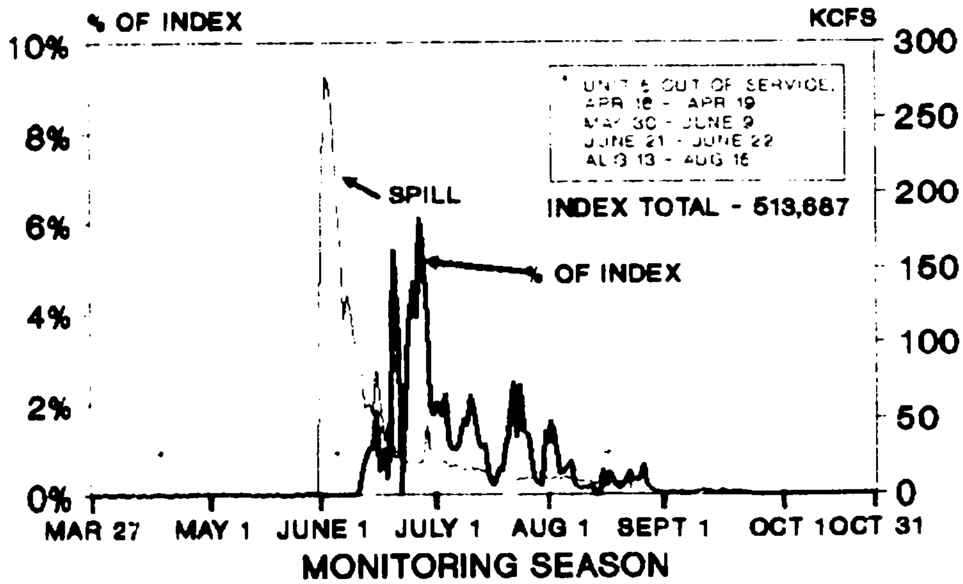


FIGURE 3

WILD STEELHEAD (UNCLIPPED)
PASSAGE PATTERN
JOHN DAY DAM

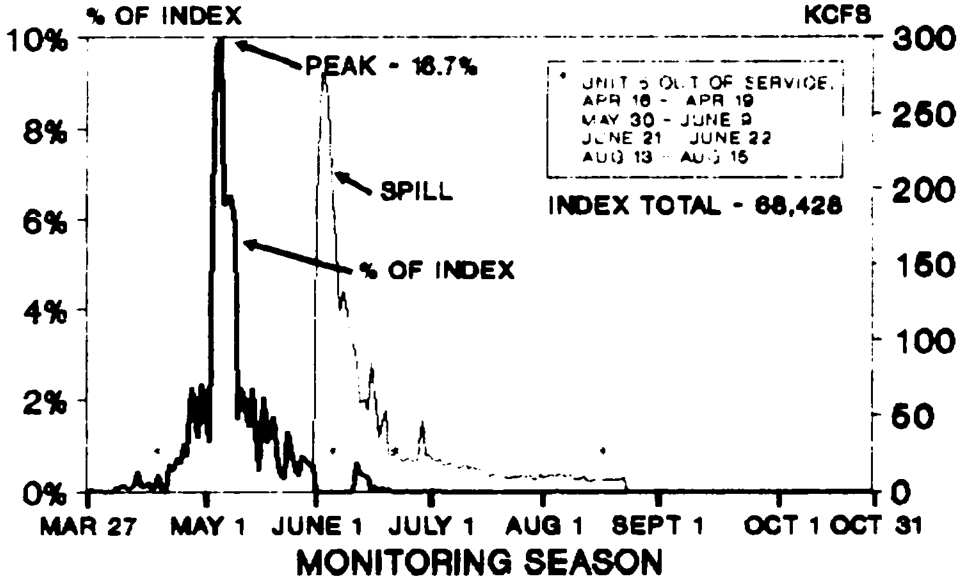


FIGURE 4

HATCHERY STEELHEAD (CLIPPED)
PASSAGE PATTERN
JOHN DAY DAM

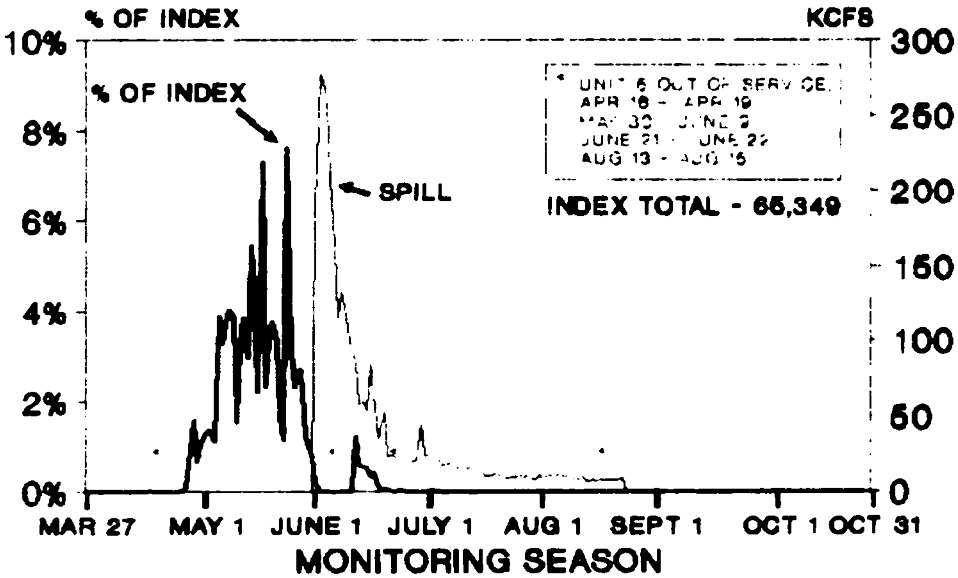


FIGURE 5

COHO
PASSAGE PATTERN
JOHN DAY DAM

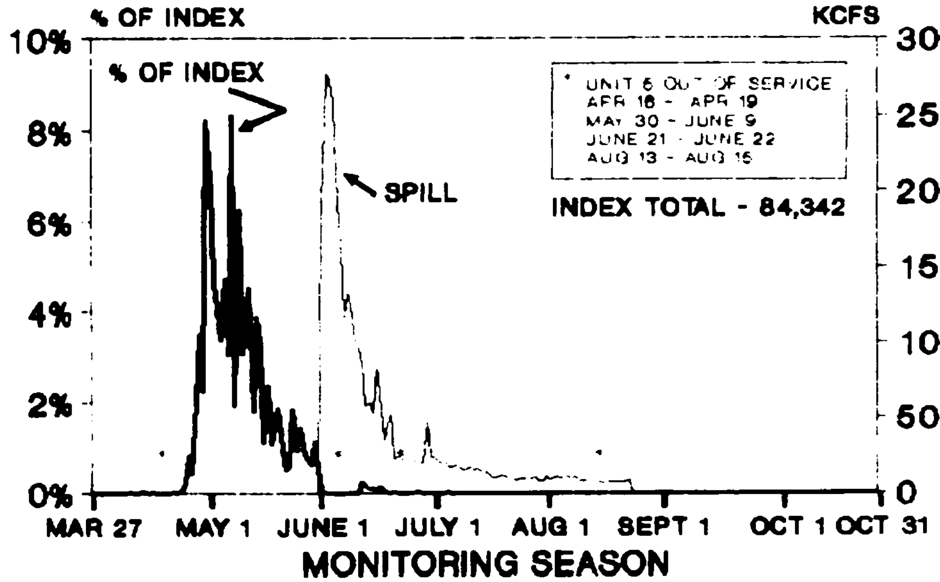


FIGURE 6

SOCKEYE
PASSAGE PATTERN
JOHN DAY DAM

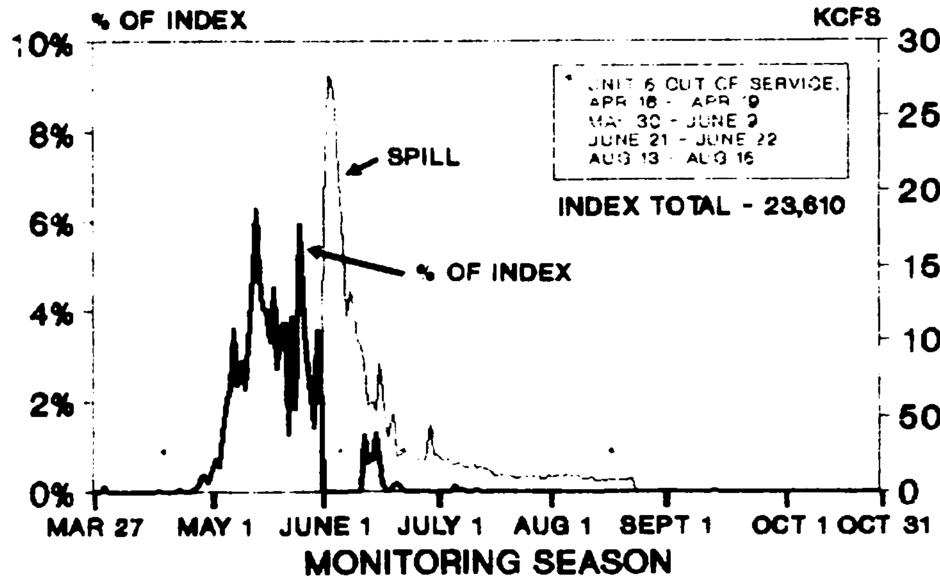
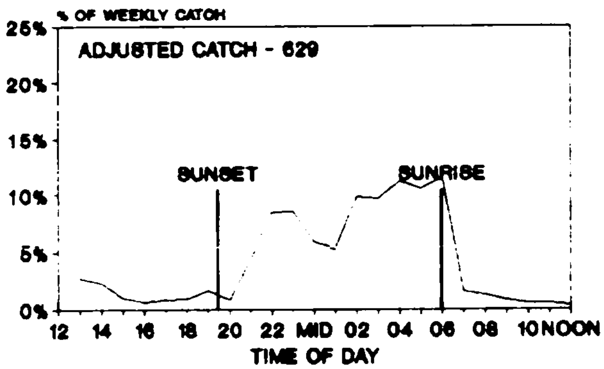


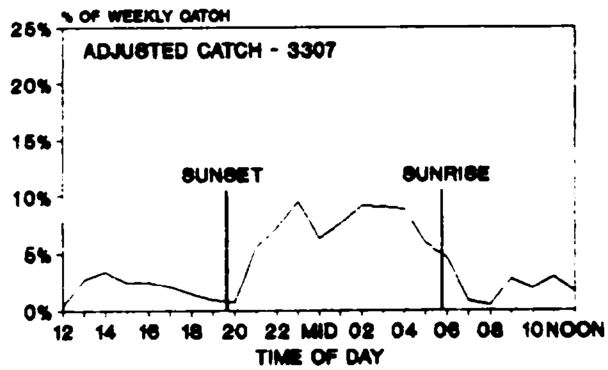
FIGURE 7

YEARLING CHINOOK

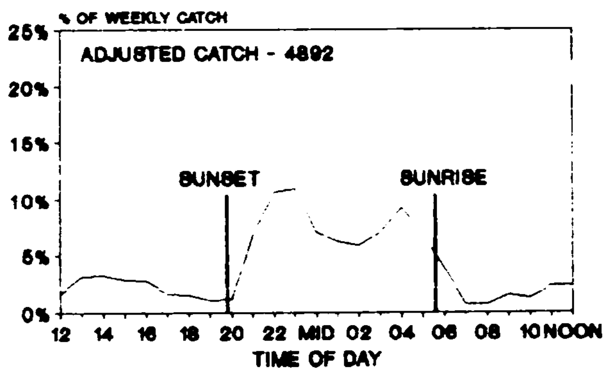
WEEKLY DIEL PATTERN
JOHN DAY DAM



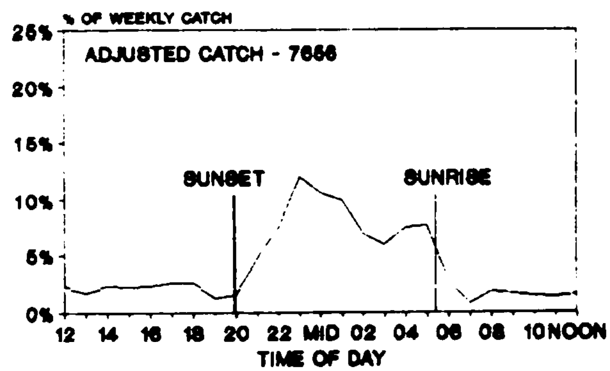
APR 16 - APR 22
FIGURE 8



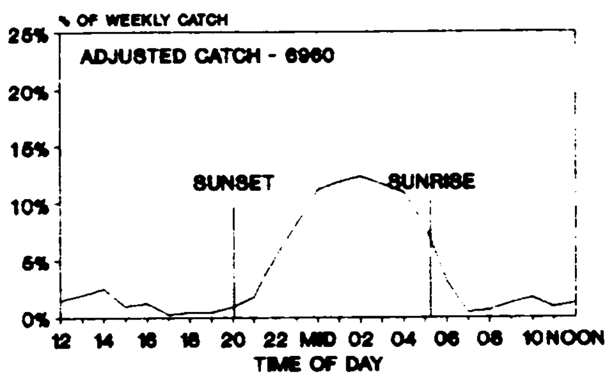
APR 22 - APR 29
FIGURE 9



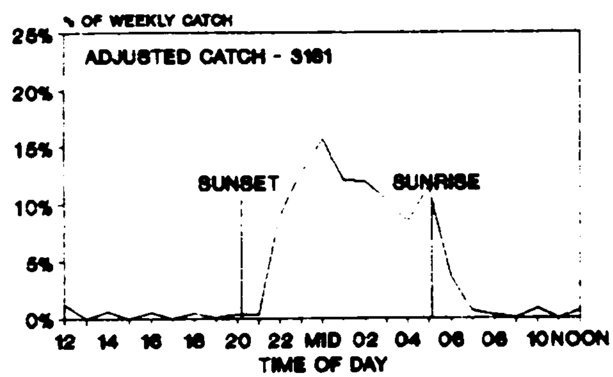
APR 29 - MAY 6
FIGURE 10



MAY 6 - MAY 13
FIGURE 11



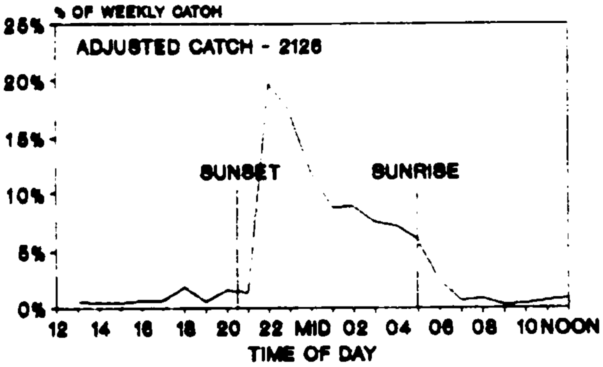
MAY 13 - MAY 20
FIGURE 12



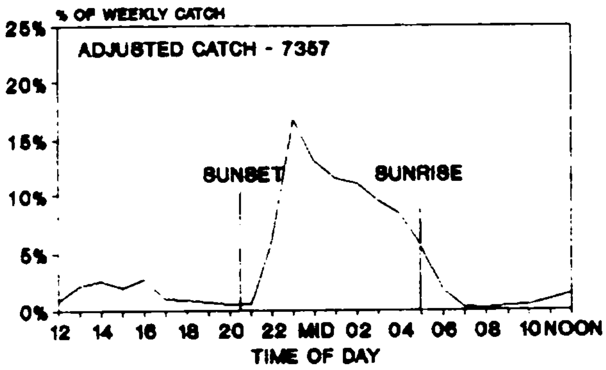
MAY 20 - MAY 27
FIGURE 13

SUBYEARLING CHINOOK

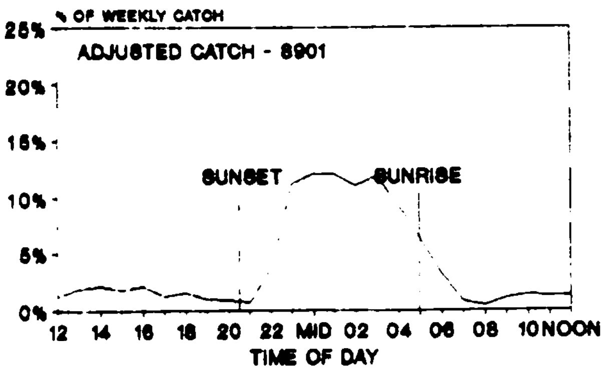
WEEKLY DIEL PATTERN
JOHN DAY DAM



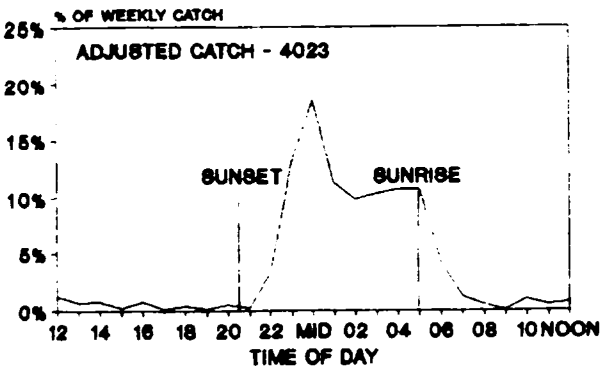
JUNE 10 - JUNE 17
FIGURE 14



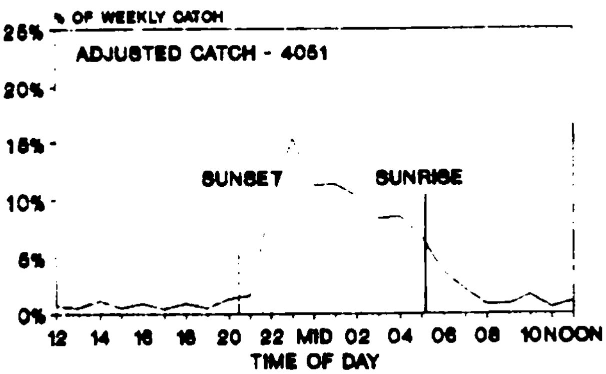
JUNE 17 - JUNE 24
FIGURE 15



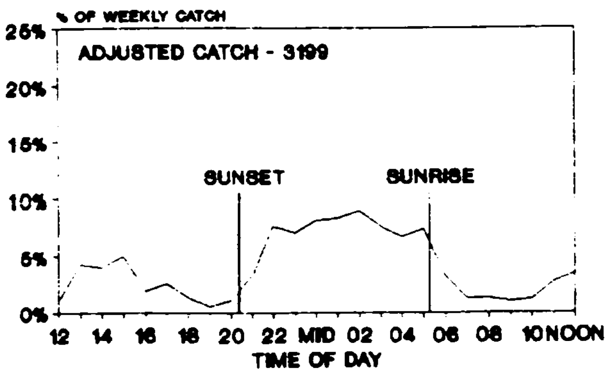
JUNE 24 - JULY 1
FIGURE 16



JULY 1 - JULY 8
FIGURE 17



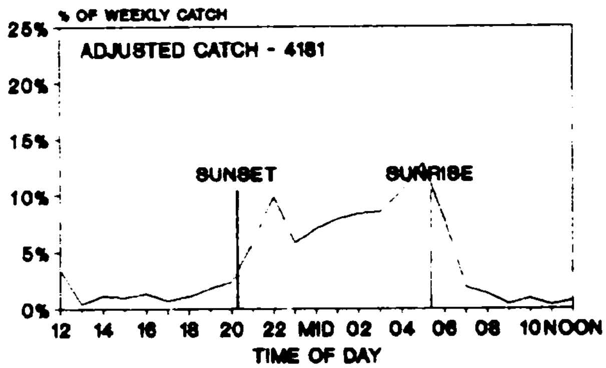
JULY 8 - JULY 15
FIGURE 18



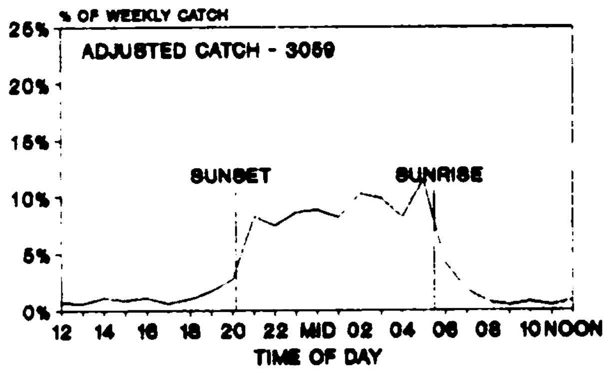
JULY 15 - JULY 22
FIGURE 19

SUBYEARLING CHINOOK

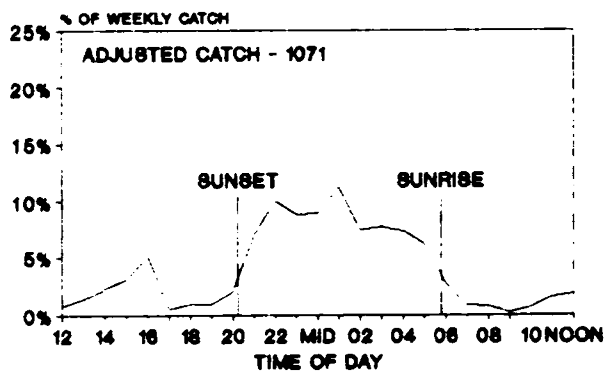
WEEKLY DIEL PATTERN
JOHN DAY DAM



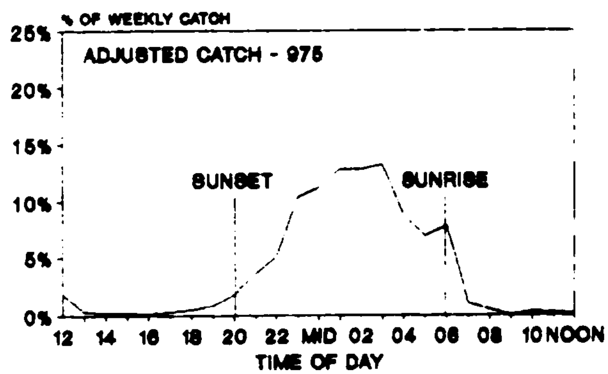
JULY 22 - JULY 29
FIGURE 20



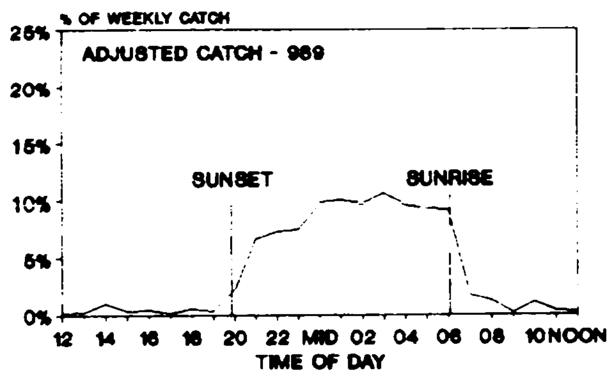
JULY 29 - AUG 5
FIGURE 21



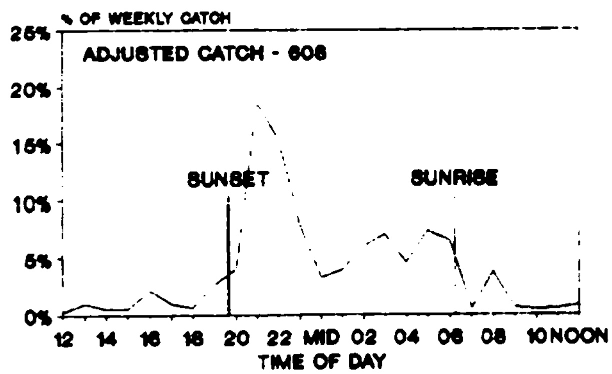
AUG 5 - AUG 12
FIGURE 22



AUG 12 - AUG 19
FIGURE 23



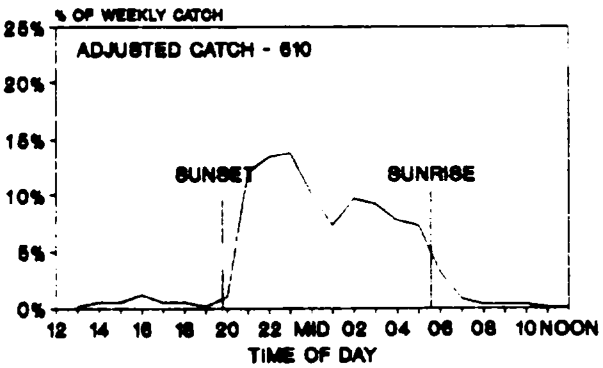
AUG 19 - AUG 26
FIGURE 24



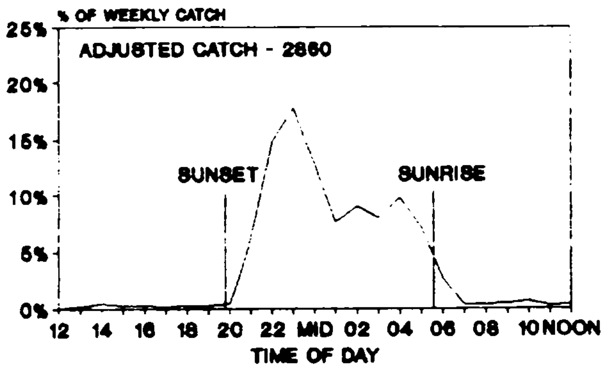
AUG 26 - SEPT 2
FIGURE 25

WILD STEELHEAD (UNCLIPPED)

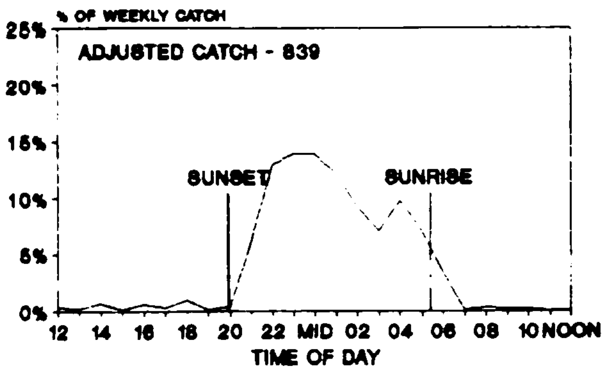
WEEKLY DIEL PATTERN
JOHN DAY DAM



APR 22 - APR 29
FIGURE 26



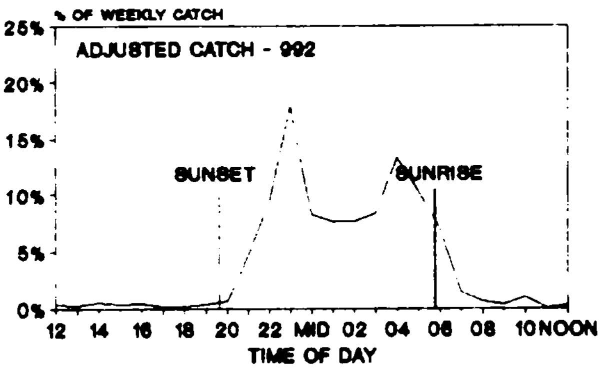
APR 29 - MAY 6
FIGURE 27



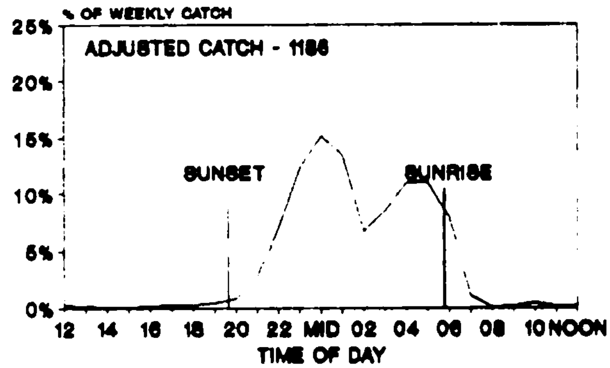
MAY 6 - MAY 13
FIGURE 28

HATCHERY STEELHEAD (CLIPPED)

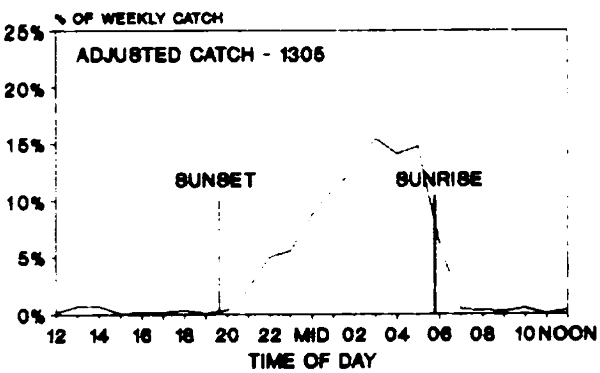
WEEKLY DIEL PATTERN
JOHN DAY DAM



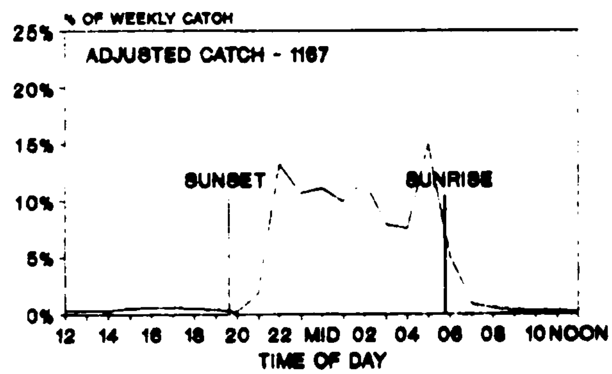
APR 29 - MAY 6
FIGURE 29



MAY 6 - MAY 13
FIGURE 30



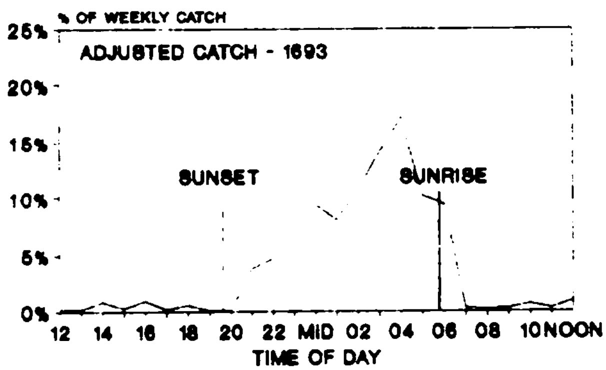
MAY 13 - MAY 20
FIGURE 31



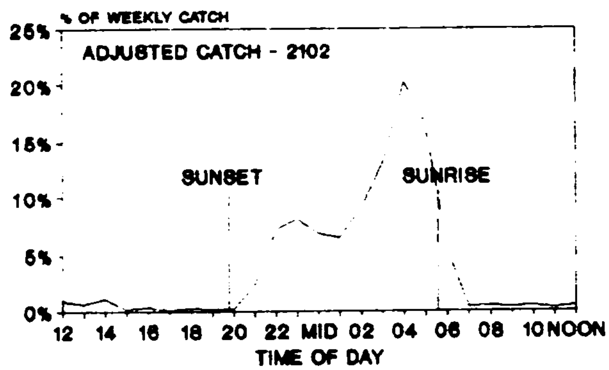
MAY 21 - MAY 27
FIGURE 32

COHO

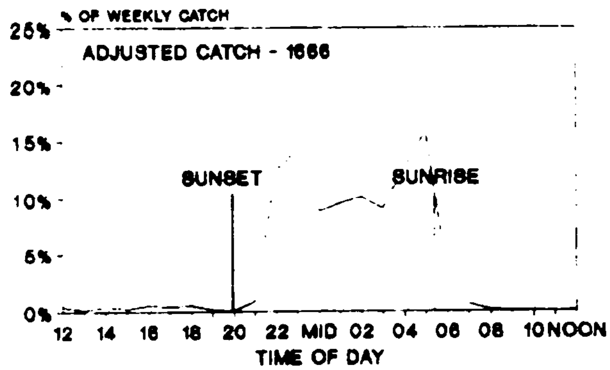
WEEKLY DIEL PATTERN
JOHN DAY DAM



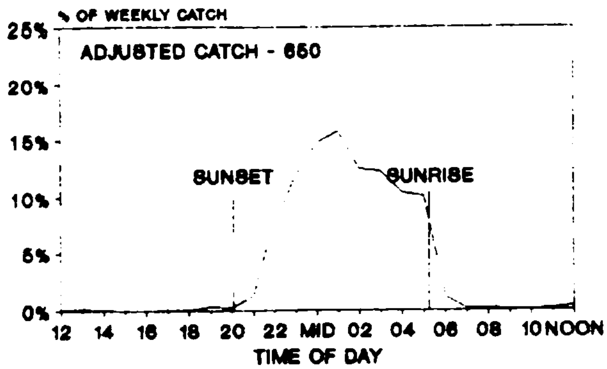
APR 22 - APR 29
FIGURE 33



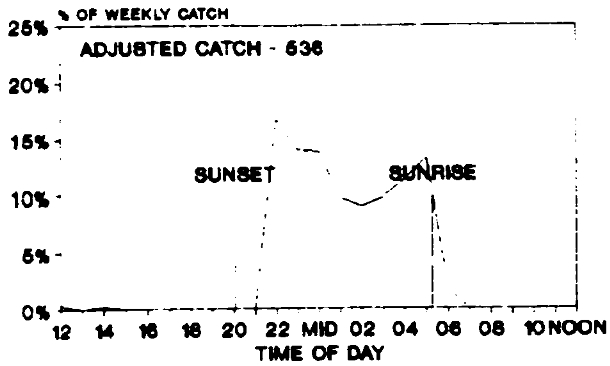
APR 29 - MAY 6
FIGURE 34



MAY 6 - MAY 13
FIGURE 35



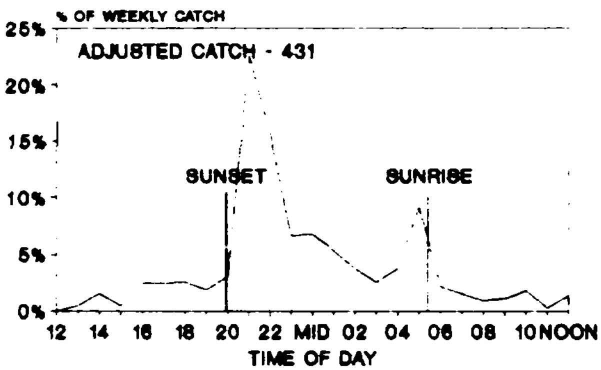
MAY 13 - MAY 20
FIGURE 36



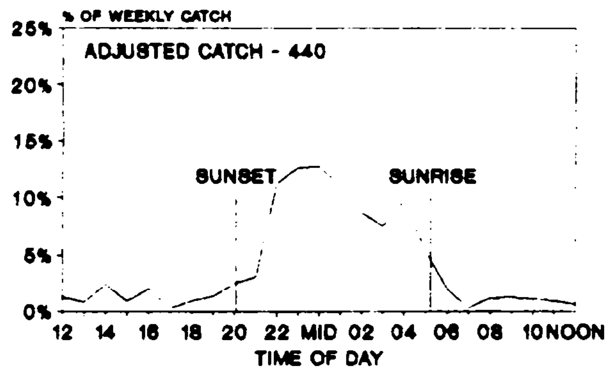
MAY 20 - MAY 27
FIGURE 37

SOCKEYE

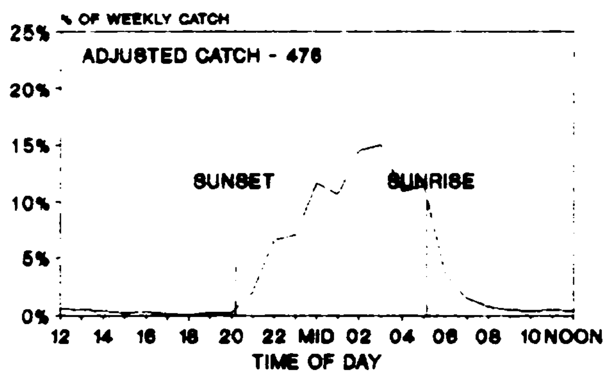
WEEKLY DIEL PATTERN
JOHN DAY DAM



MAY 6 - MAY 13
FIGURE 38



MAY 13 - MAY 20
FIGURE 39



MAY 20 - MAY 27
FIGURE 40

APPENDIX B
THE DALLES DAM - 1990

RIVER, SAMPLED UNIT, SPILL

DAILY AVERAGE FLOW

THE DALLES DAM

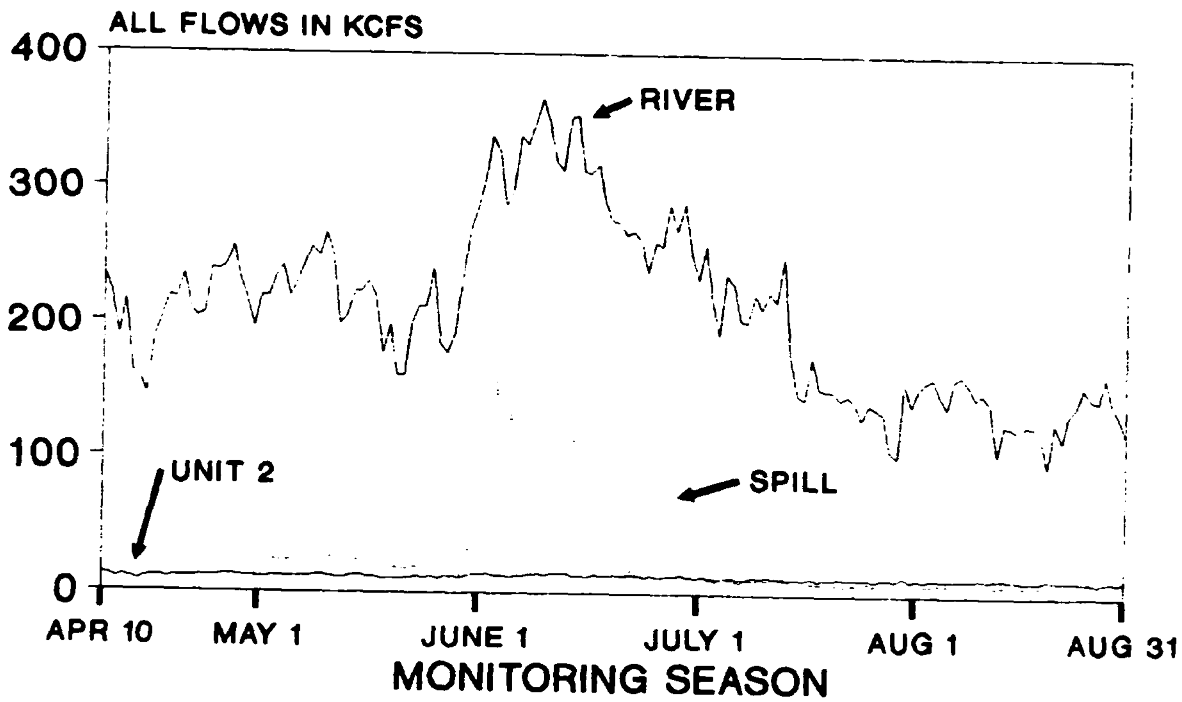


FIGURE 1

YEARLING CHINOOK
PASSAGE PATTERN
THE DALLES DAM

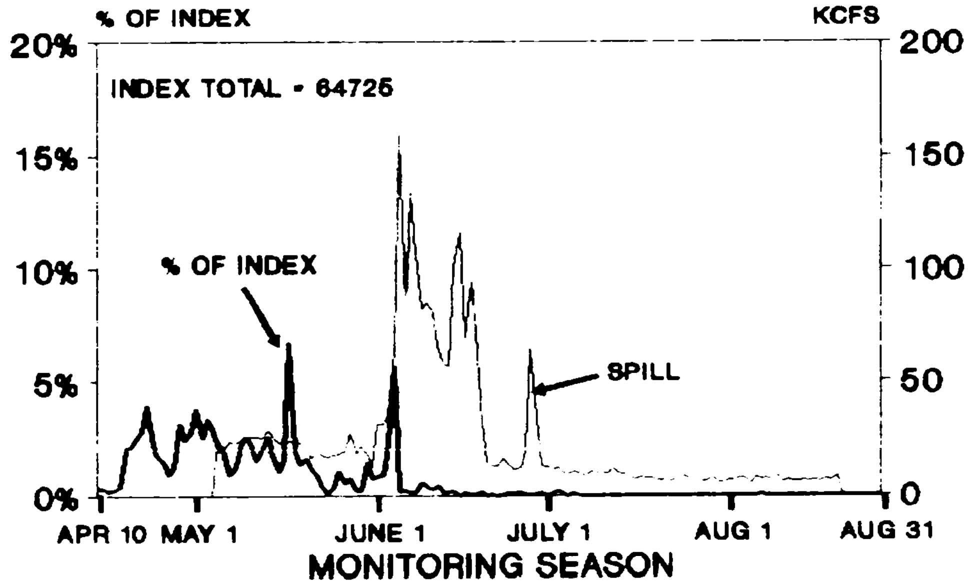


FIGURE 2

SUBYEARLING CHINOOK
PASSAGE PATTERN
THE DALLES DAM

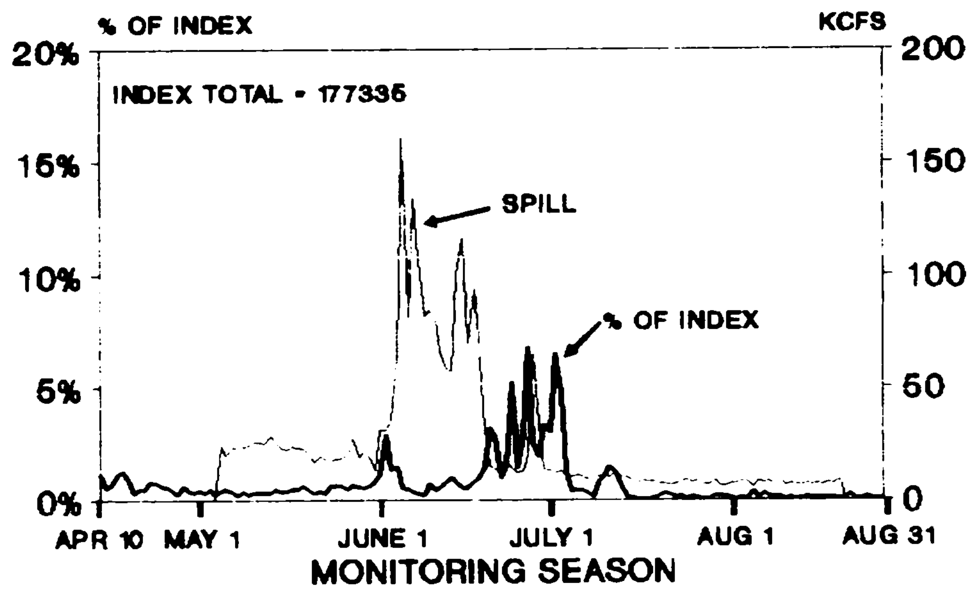


FIGURE 3

WILD STEELHEAD (UNCLIPPED)
PASSAGE PATTERN
THE DALLES DAM

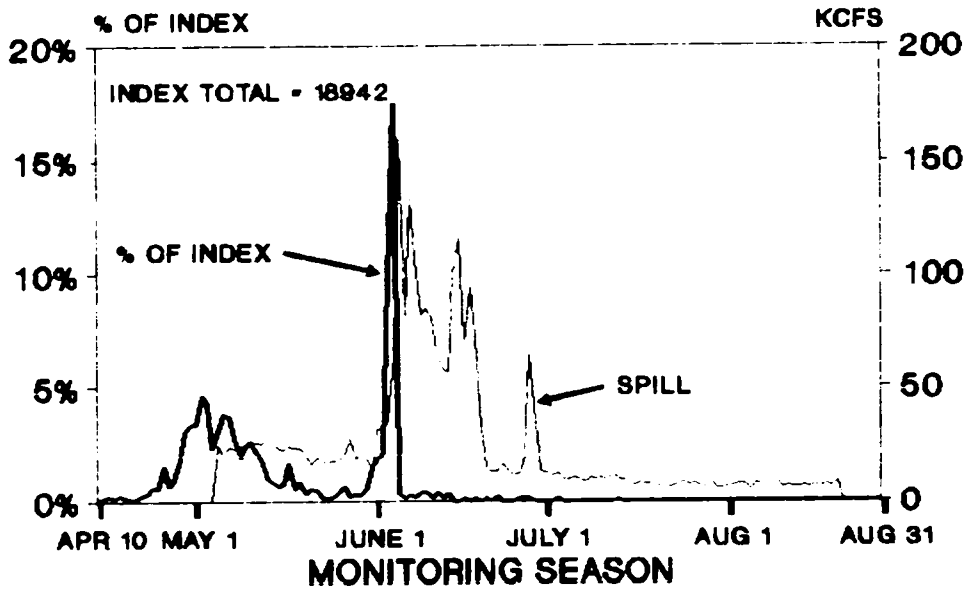


FIGURE 4

HATCHERY STEELHEAD (CLIPPED)
PASSAGE PATTERN
THE DALLES DAM

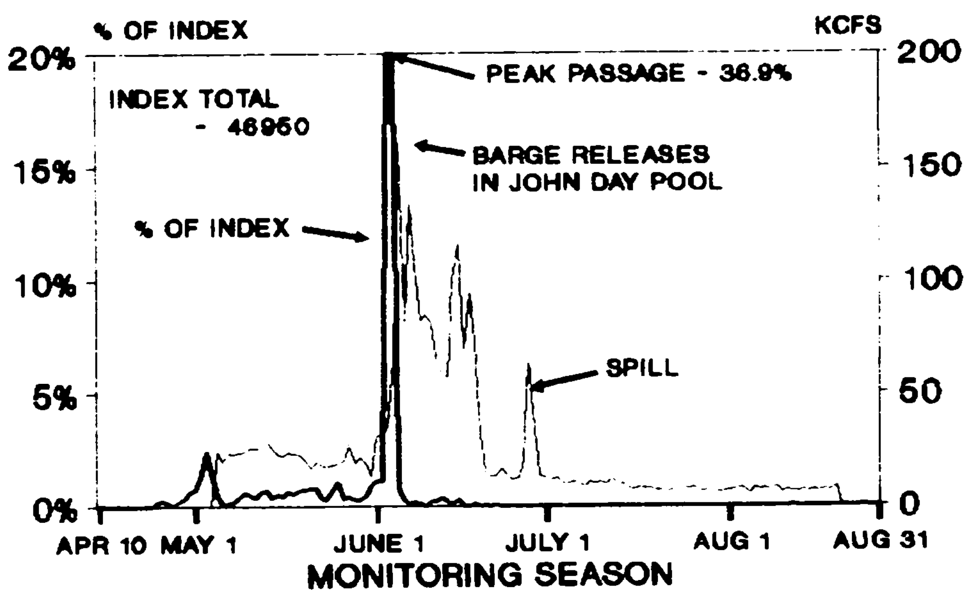


FIGURE 5

COHO
PASSAGE PATTERN
THE DALLES DAM

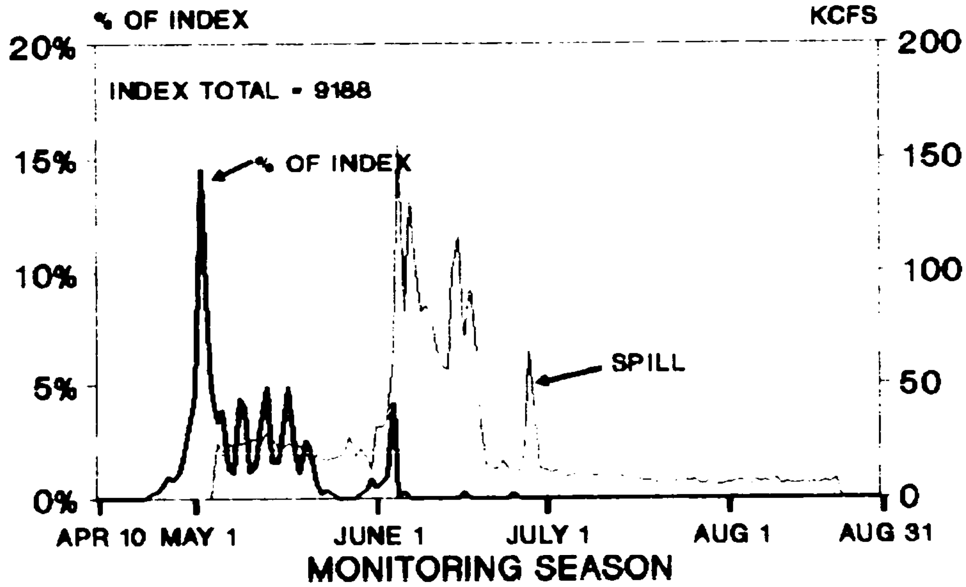


FIGURE 6

SOCKEYE
PASSAGE PATTERN
THE DALLES DAM

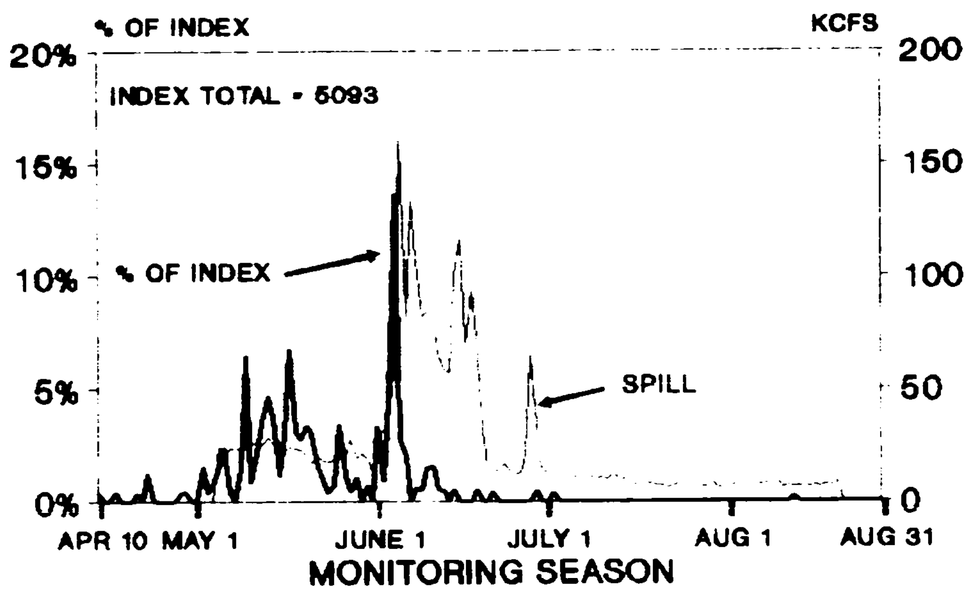
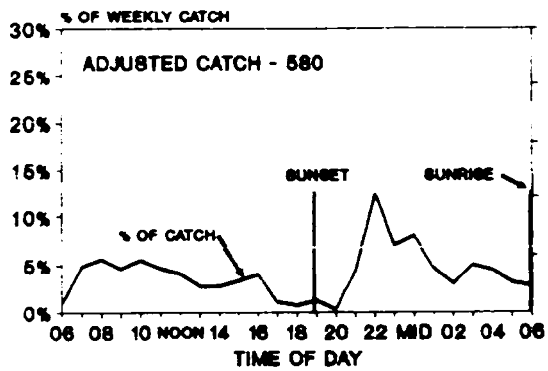


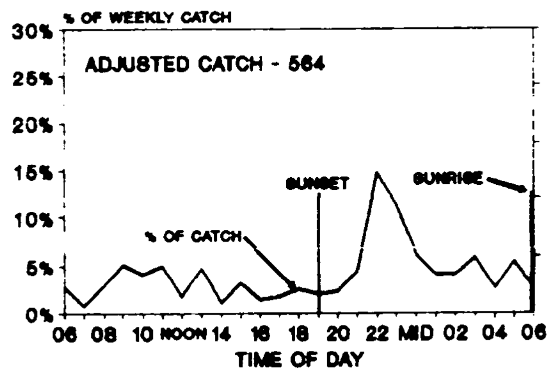
FIGURE 7

YEARLING CHINOOK

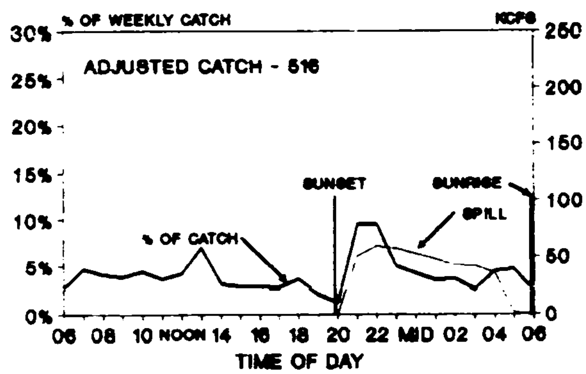
WEEKLY DIEL PATTERN
THE DALLES DAM



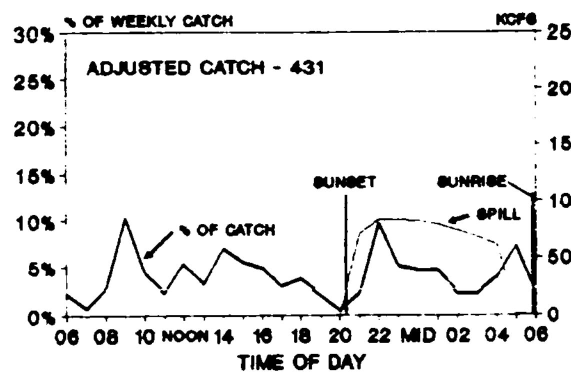
APR 15 - APR 22
FIGURE 8



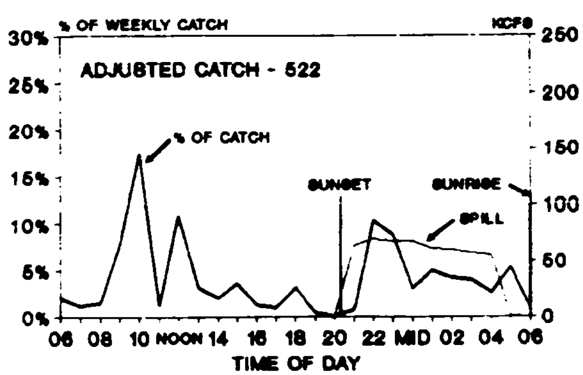
APR 22 - APR 29
FIGURE 9



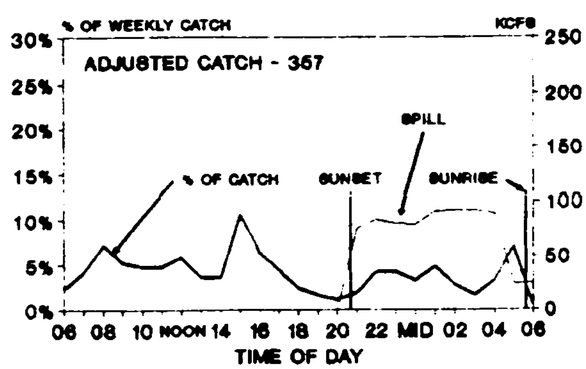
APR 29 - MAY 6
FIGURE 10



MAY 6 - MAY 13
FIGURE 11



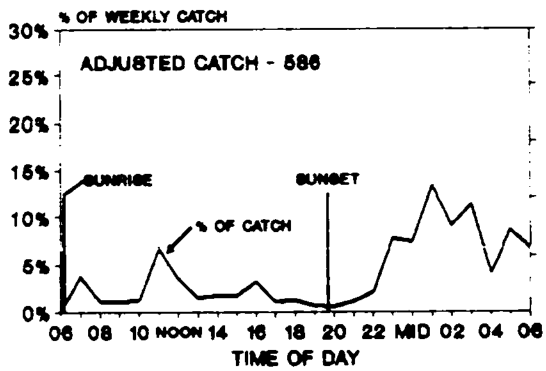
MAY 13 - MAY 20
FIGURE 12



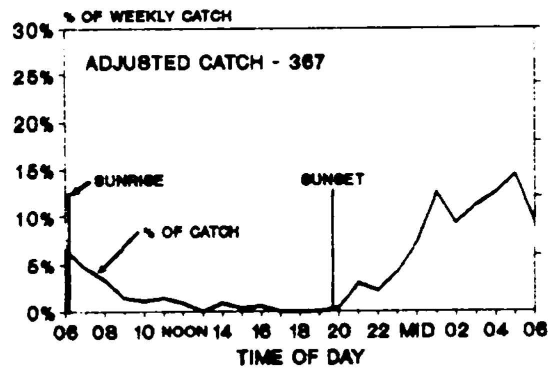
MAY 27 - JUNE 3
FIGURE 13

SUBYEARLING CHINOOK

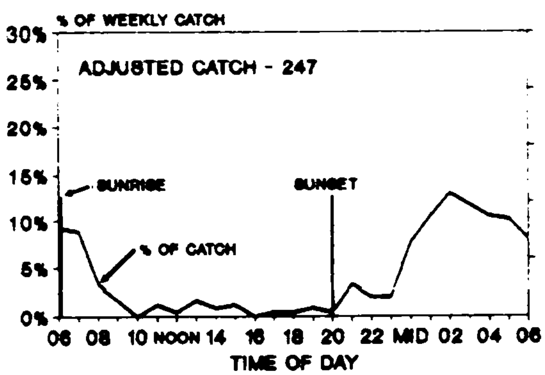
WEEKLY DIEL PATTERN
THE DALLES DAM



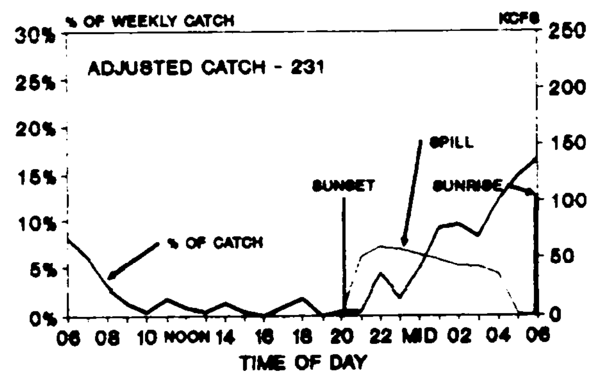
APR 10 - APR 15
FIGURE 14



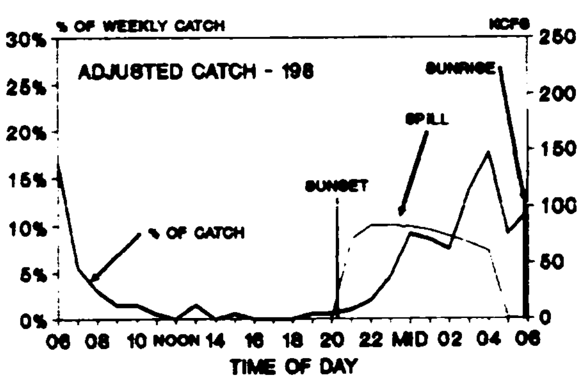
APR 15 - APR 22
FIGURE 15



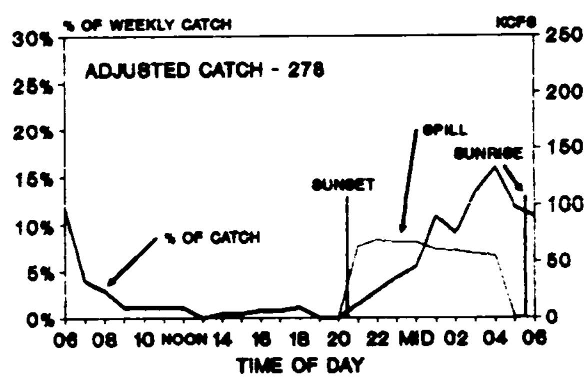
APR 22 - APR 29
FIGURE 16



APR 29 - MAY 6
FIGURE 17



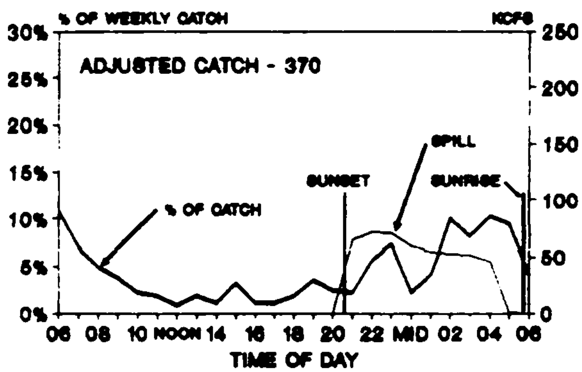
MAY 6 - MAY 13
FIGURE 18



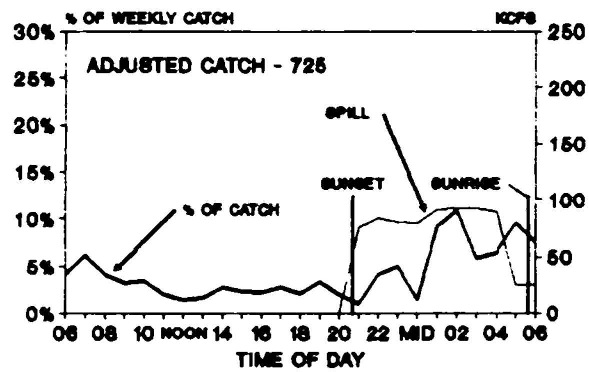
MAY 13 - MAY 20
FIGURE 19

SUBYEARLING CHINOOK

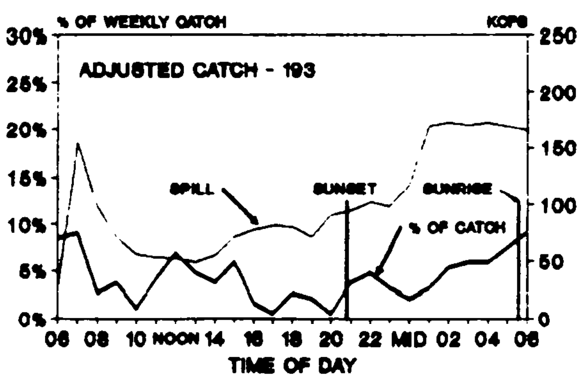
WEEKLY DIEL PATTERN
THE DALLES DAM



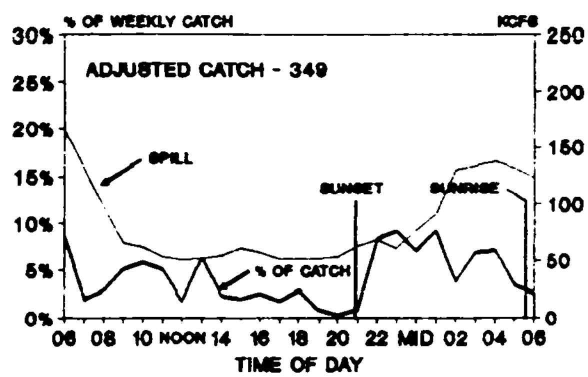
MAY 20 - MAY 27
FIGURE 20



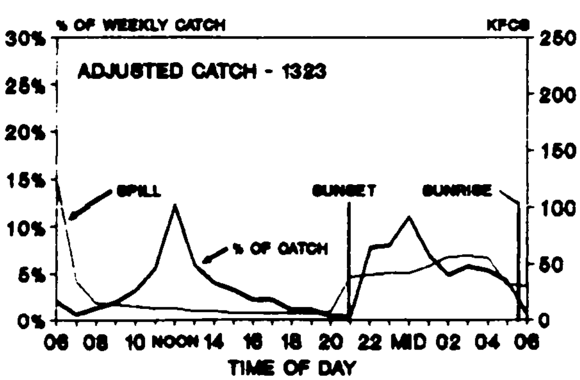
MAY 27 - JUNE 3
FIGURE 21



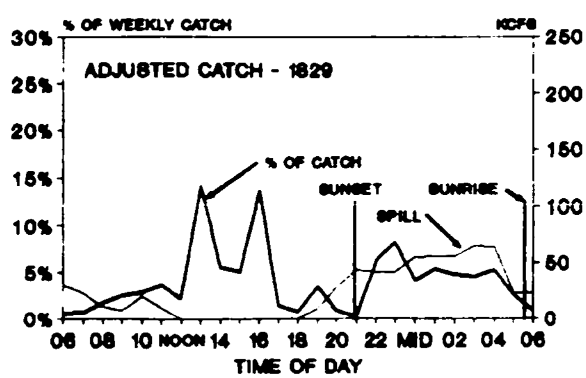
JUNE 3 - JUNE 10
FIGURE 22



JUNE 10 - JUNE 17
FIGURE 23



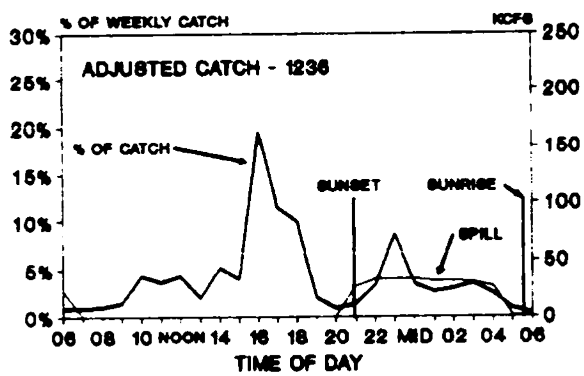
JUNE 17 - JUNE 24
FIGURE 24



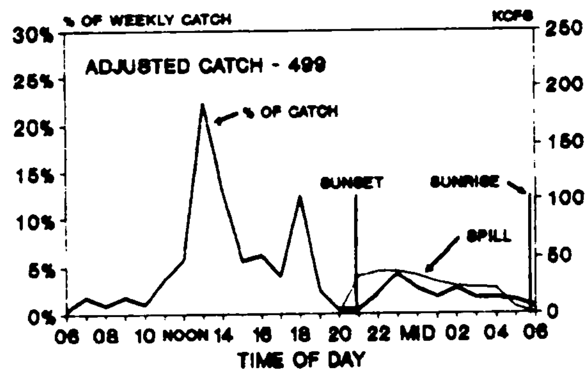
JUNE 24 - JULY 1
FIGURE 25

SUBYEARLING CHINOOK

WEEKLY DIEL PATTERN
THE DALLES DAM



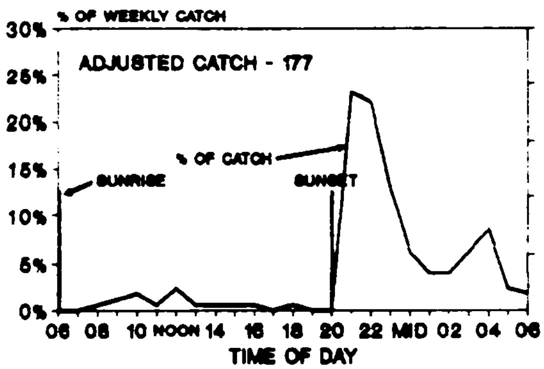
JULY 1 - JULY 8
FIGURE 26



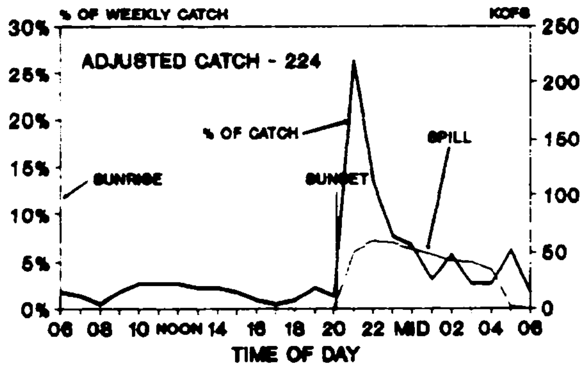
JULY 8 - JULY 15
FIGURE 27

WILD STEELHEAD (UNCLIPPED)

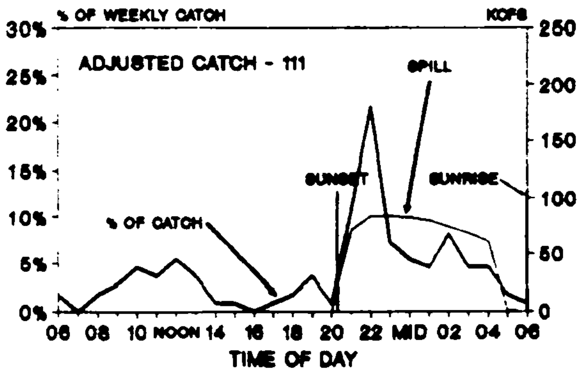
WEEKLY DIEL PATTERN
THE DALLES DAM



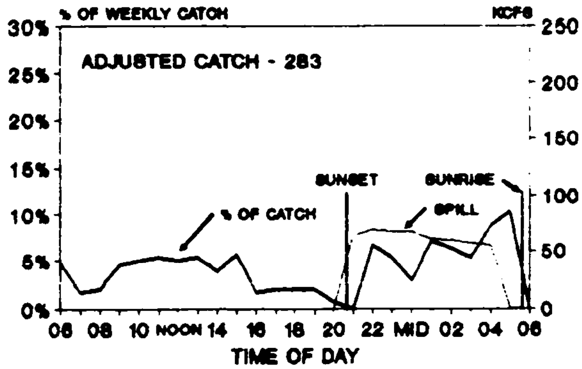
APR 22 - APR 29
FIGURE 28



APR 29 - MAY 6
FIGURE 29



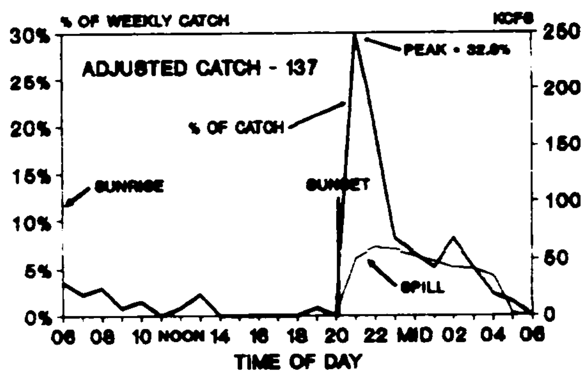
MAY 6 - MAY 13
FIGURE 30



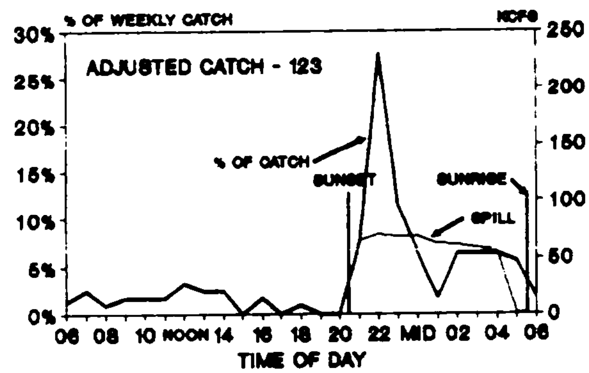
MAY 27 - JUNE 3
FIGURE 31

HATCHERY STEELHEAD (CLIPPED)

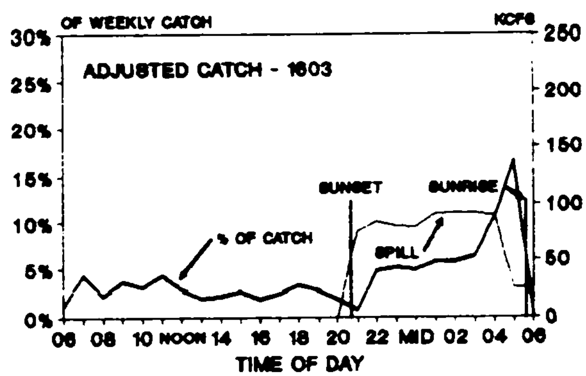
WEEKLY DIEL PATTERN
THE DALLES DAM



APR 29 - MAY 6
FIGURE 32



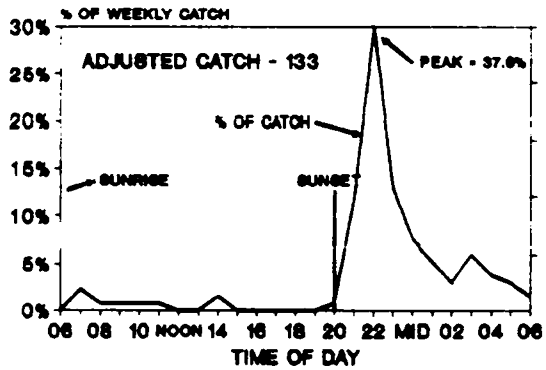
MAY 13 - MAY 20
FIGURE 33



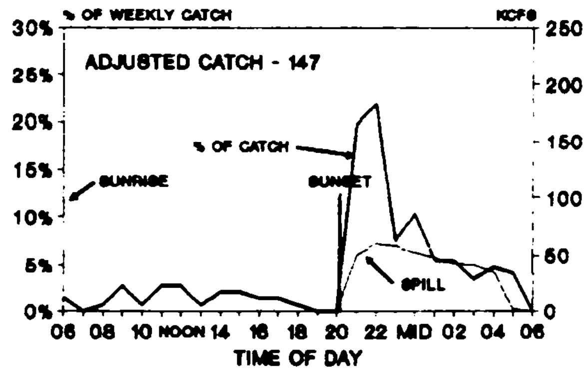
MAY 27 - JUNE 3
FIGURE 34

COHO

WEEKLY DIEL PATTERN
THE DALLES DAM



APR 22 - APR 29
FIGURE 35



APR 29 - MAY 6
FIGURE 36

APPENDIX C
BONNEVILLE DAM – 1990

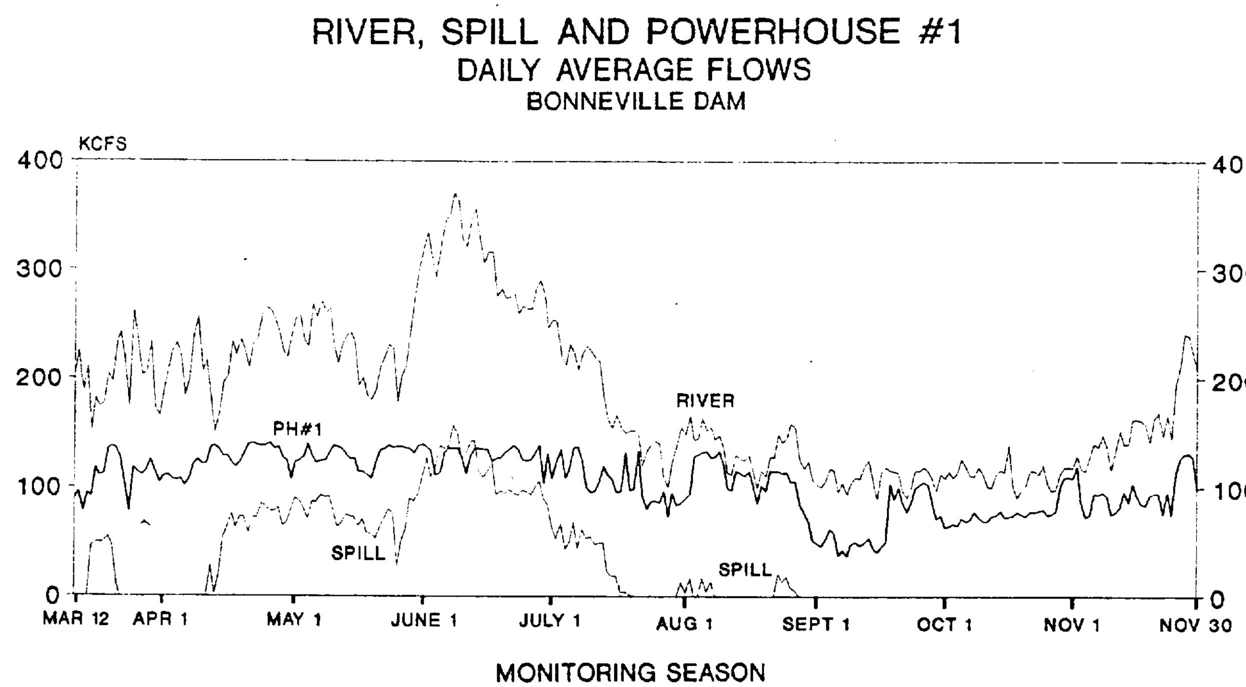


FIGURE 1

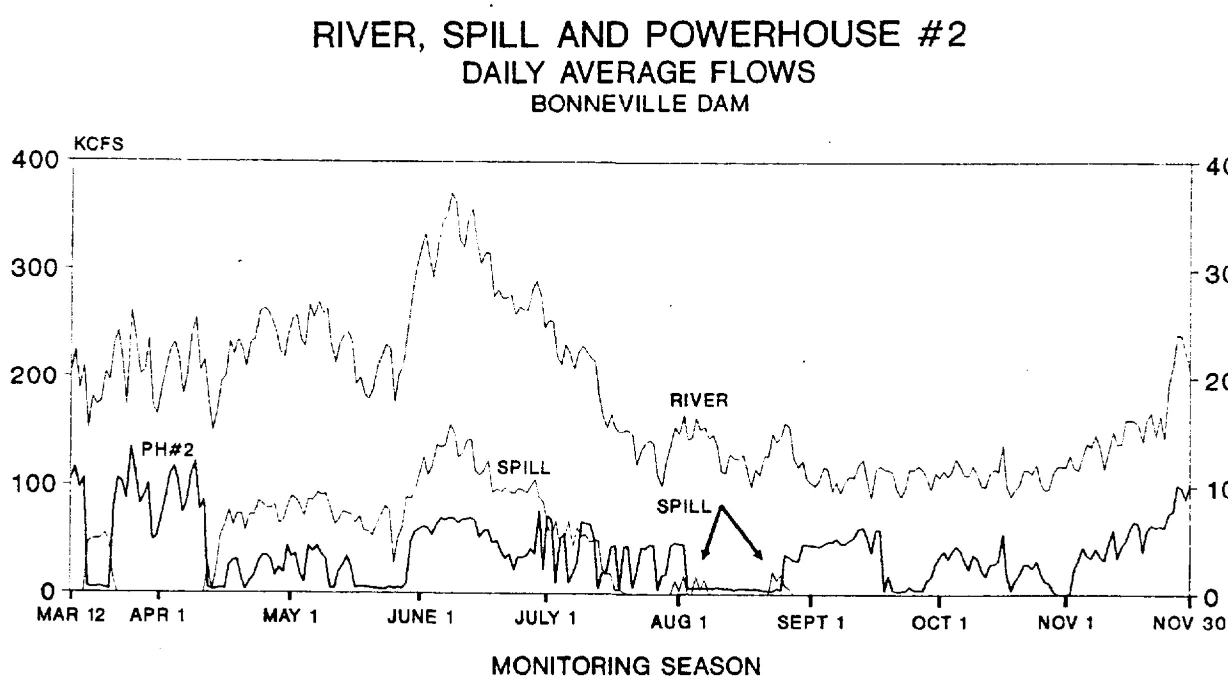


FIGURE 2

YEARLING CHINOOK
PASSAGE PATTERN
BONNEVILLE DAM, DSM#1

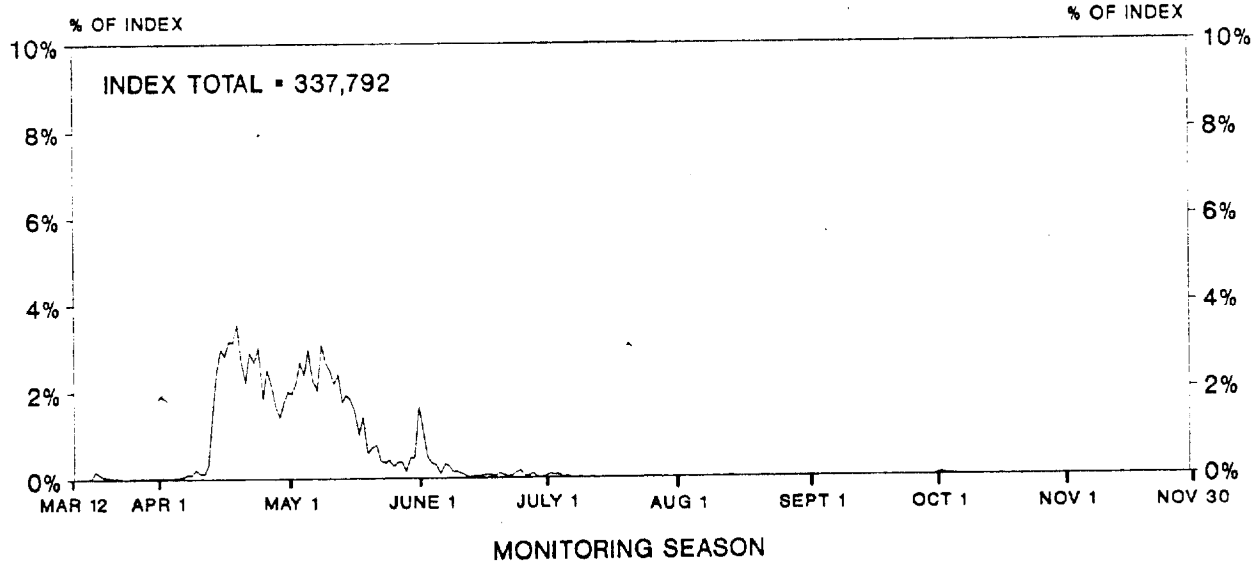


FIGURE 3

SUBYEARLING CHINOOK
PASSAGE PATTERN
BONNEVILLE DAM, DSM#1

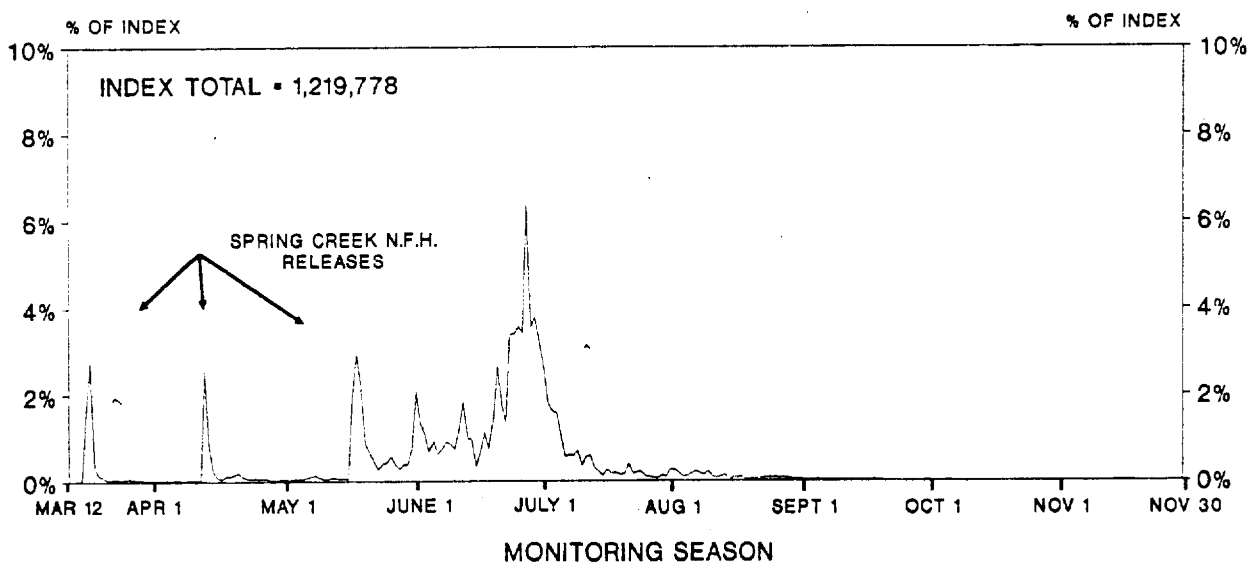


FIGURE 4

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

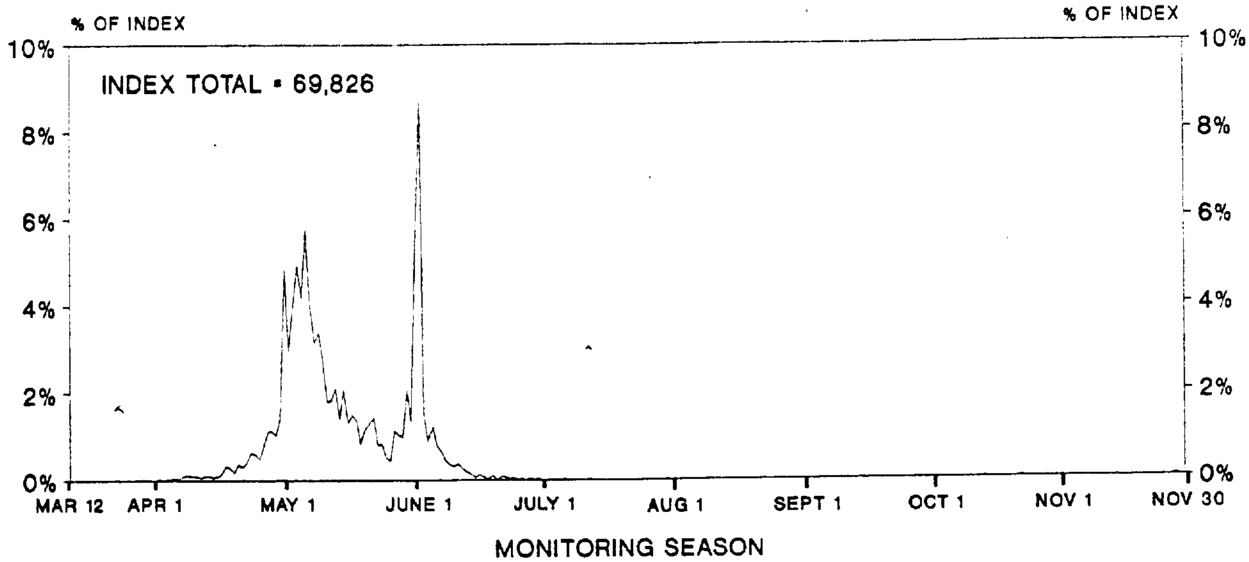


FIGURE 5

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

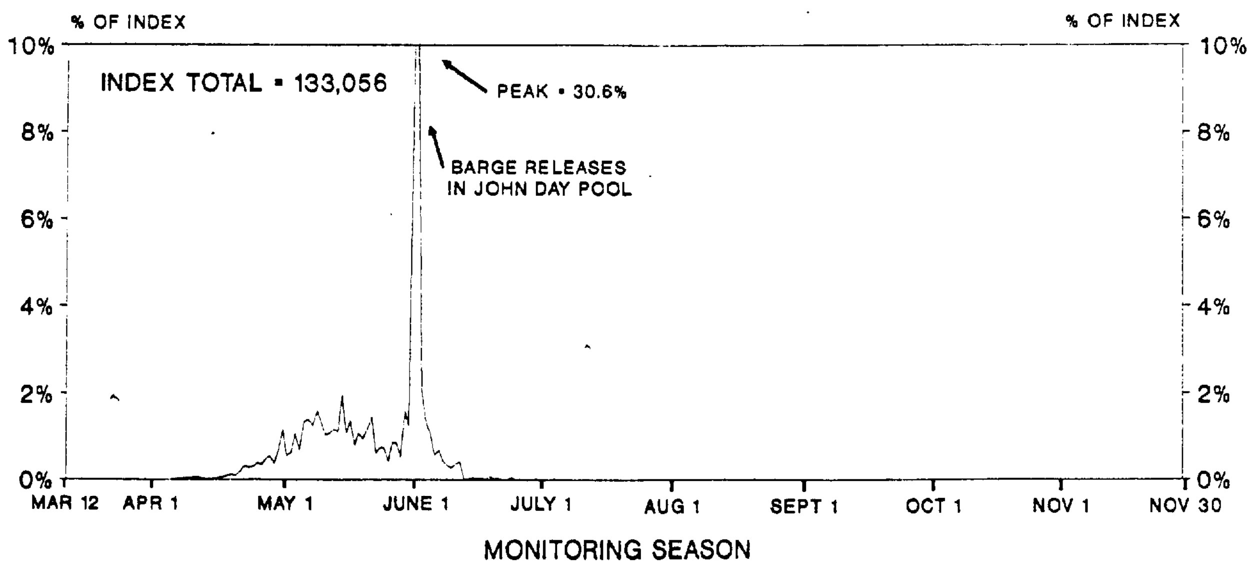


FIGURE 6

COHO
PASSAGE PATTERN
BONNEVILLE DAM, DSM#1

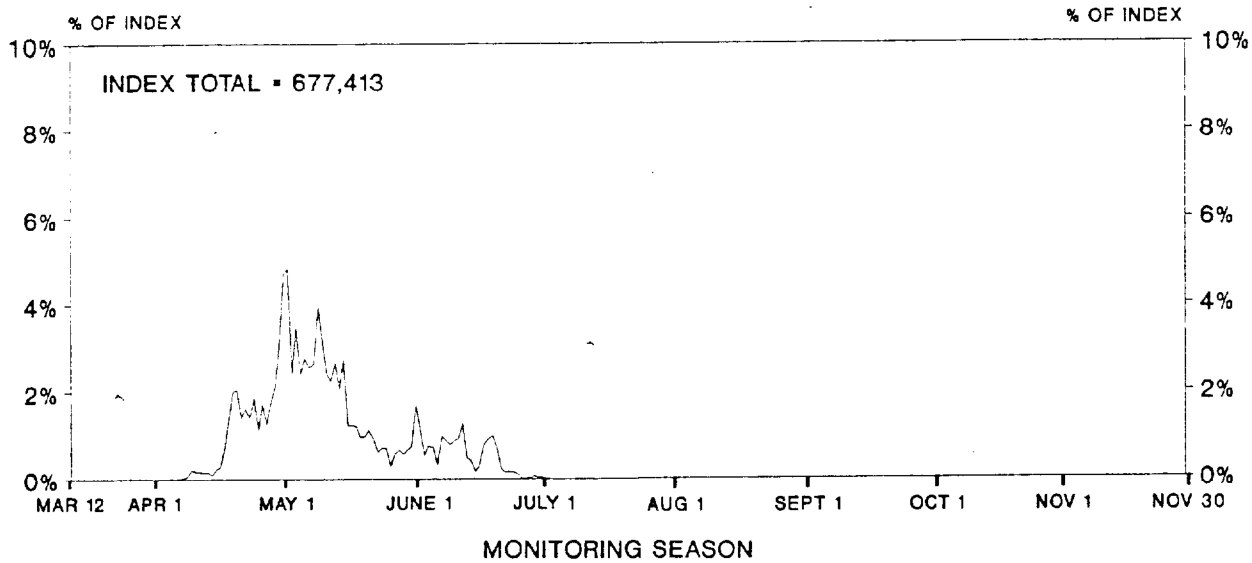


FIGURE 7

SOCKEYE
PASSAGE PATTERN
BONNEVILLE DAM, DSM#1

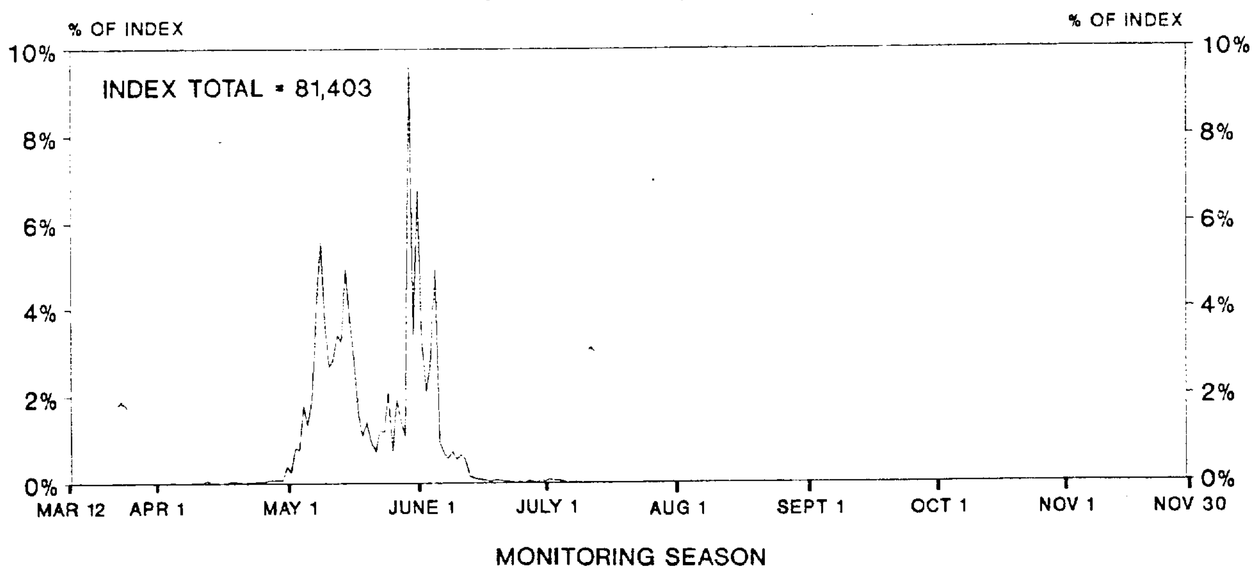


FIGURE 8

YEARLING CHINOOK
PASSAGE PATTERN
BONNEVILLE DAM, DSM#2

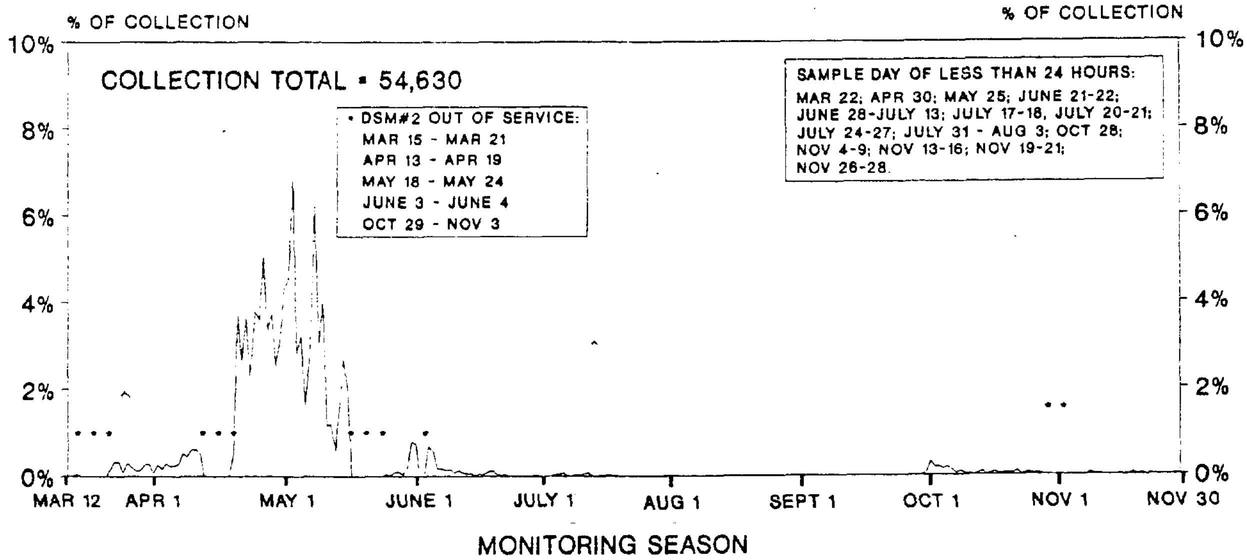


FIGURE 9

SUBYEARLING CHINOOK
PASSAGE PATTERN
BONNEVILLE DAM, DSM#2

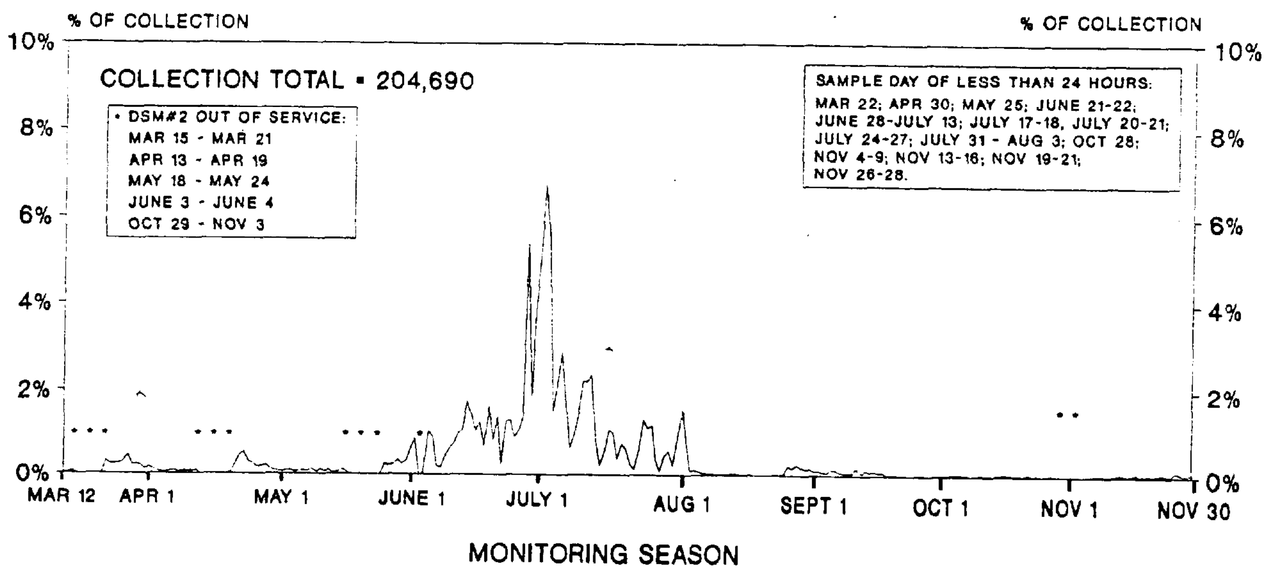


FIGURE 10

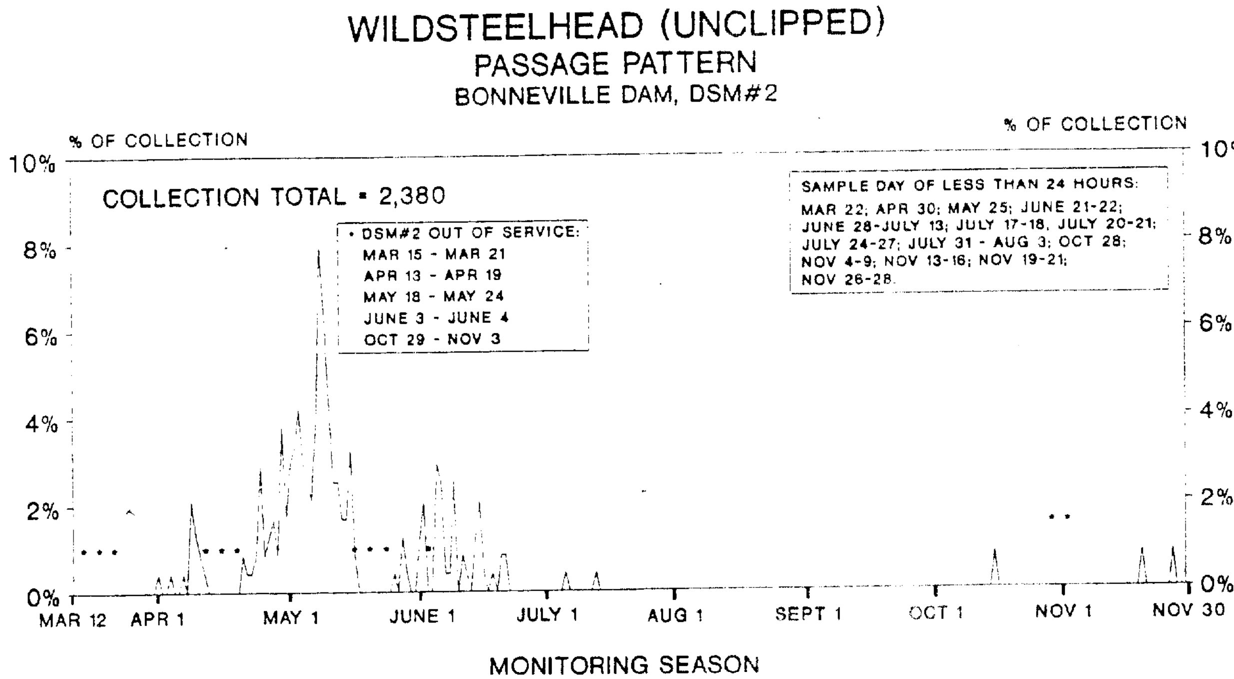


FIGURE 11

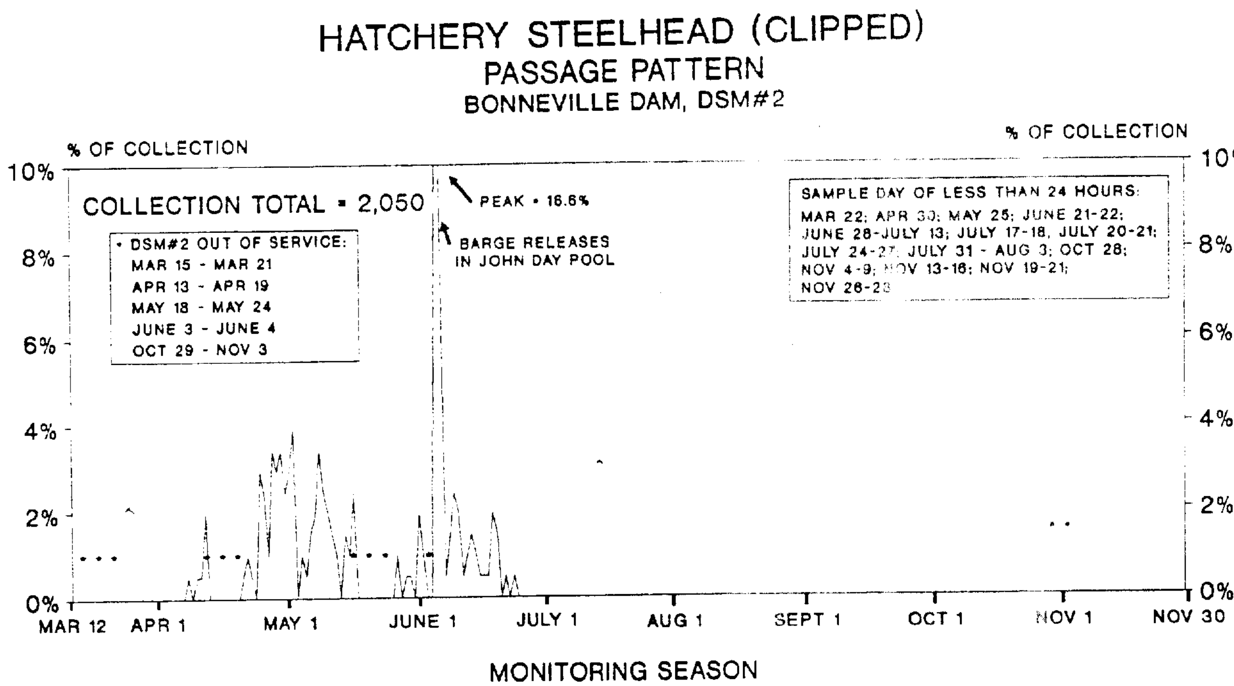


FIGURE 12

COHO
PASSAGE PATTERN
BONNEVILLE DAM, DSM#2

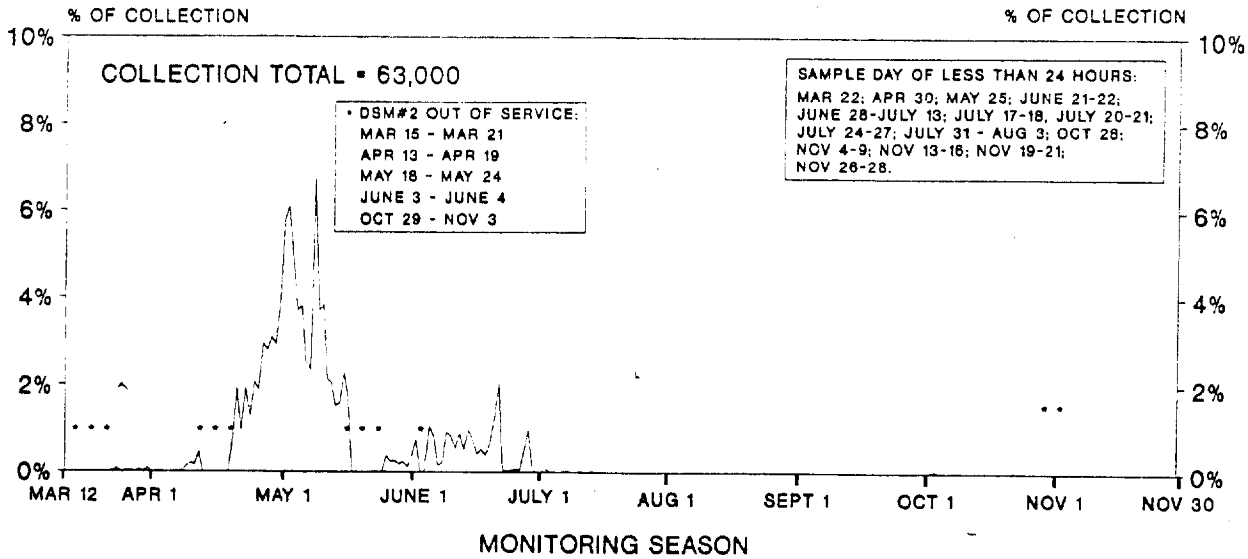


FIGURE 13

SOCKEYE
PASSAGE PATTERN
BONNEVILLE DAM, DSM#2

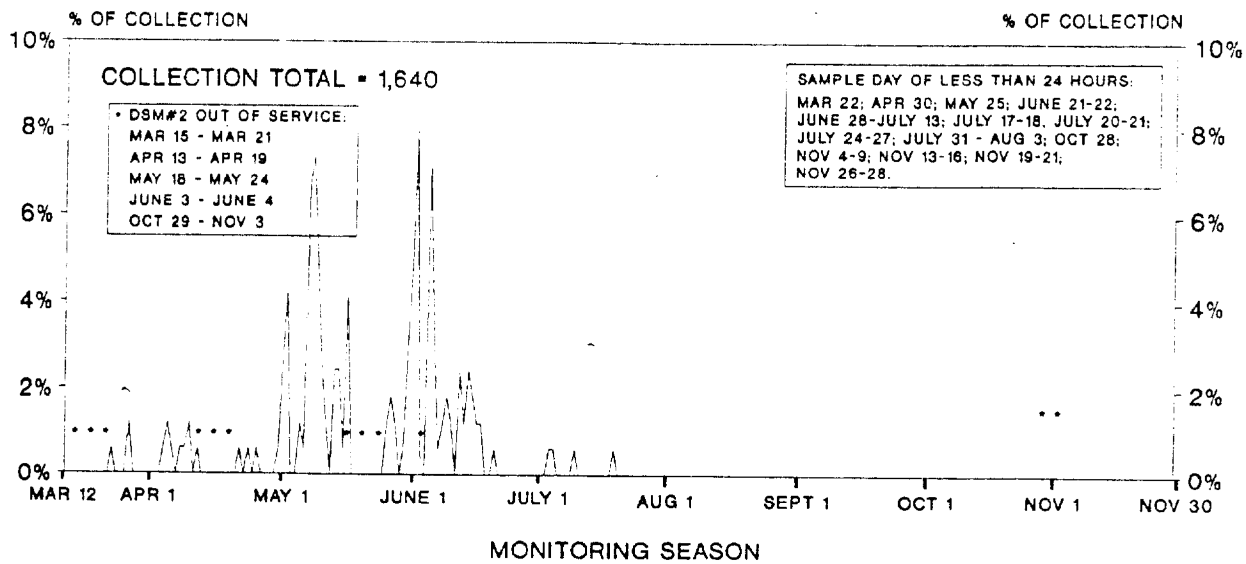
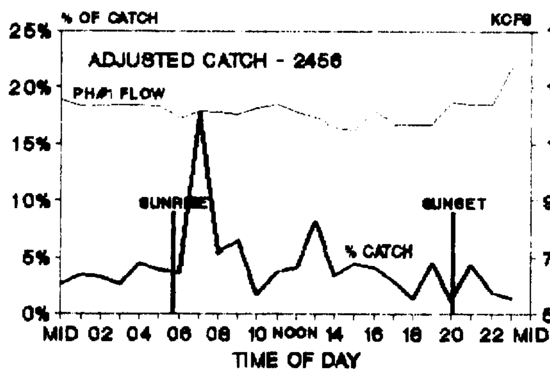


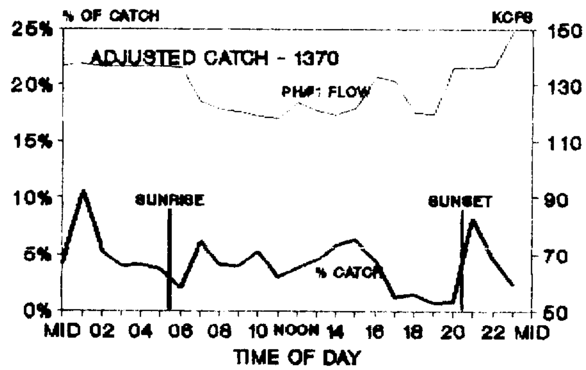
FIGURE 14

YEARLING CHINOOK

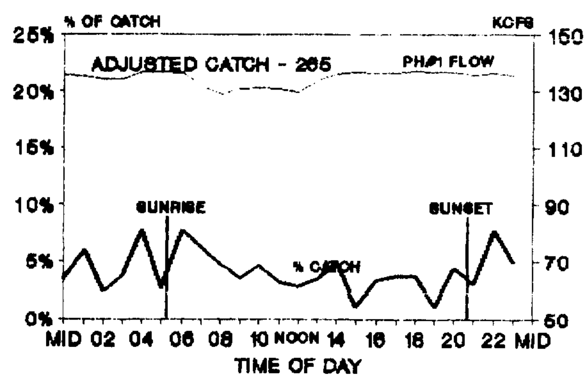
DIEL PATTERNS
BONNEVILLE DAM, DSM#1



MAY 1
FIGURE 15



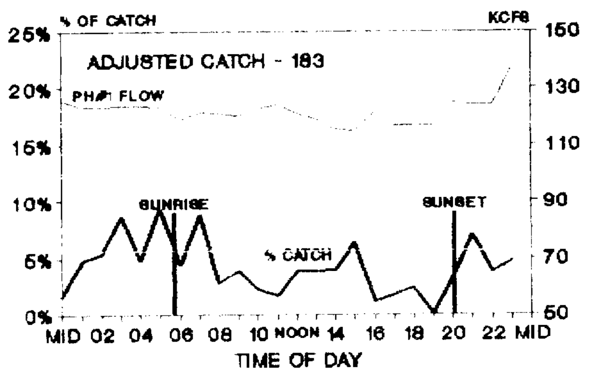
MAY 15
FIGURE 16



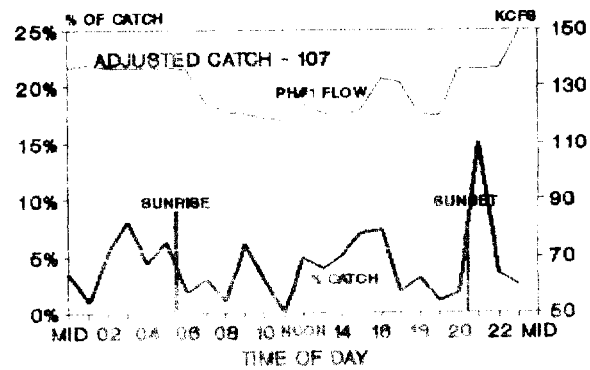
MAY 29
FIGURE 17

SUBYEARLING CHINOOK

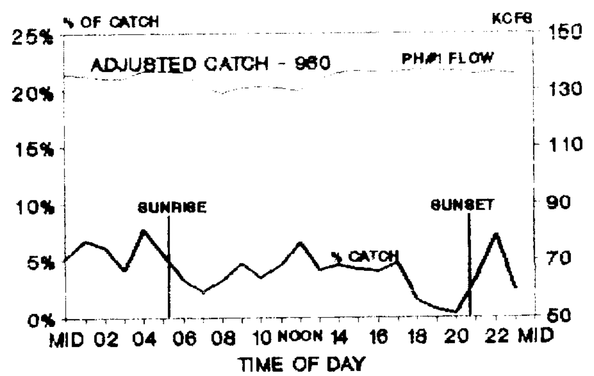
DIEL PATTERNS
BONNEVILLE DAM, DSM#1



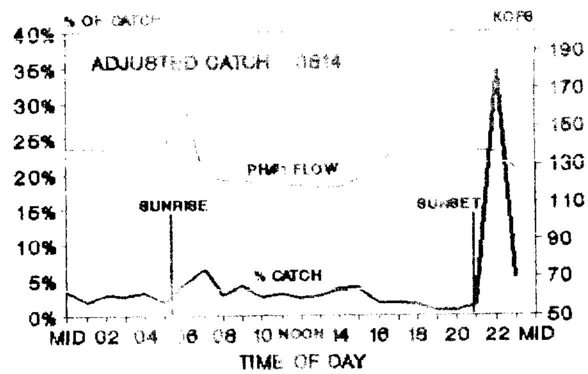
MAY 1
FIGURE 18



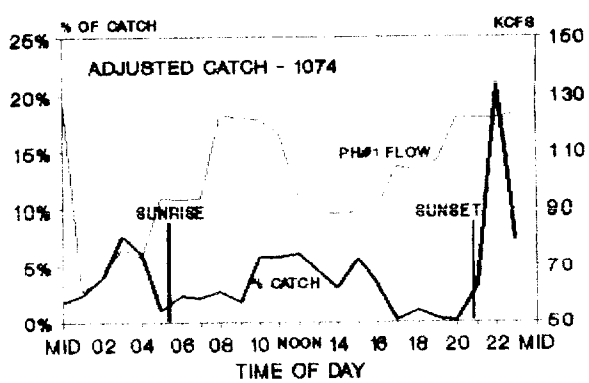
MAY 15
FIGURE 19



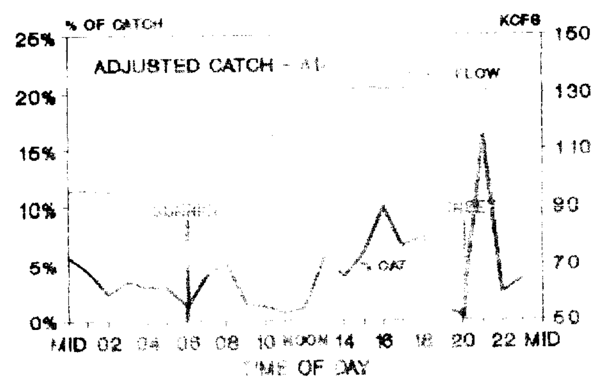
MAY 29
FIGURE 20



JUNE 28
FIGURE 21



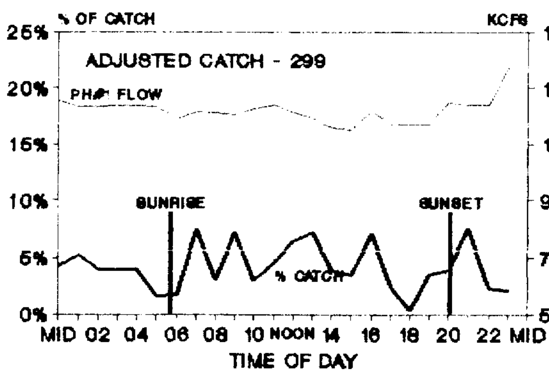
JULY 12
FIGURE 22



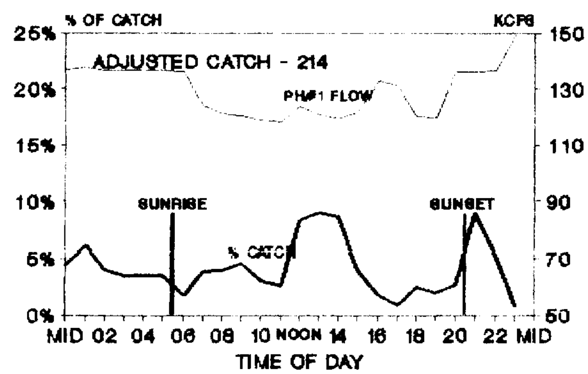
AUG 17
FIGURE 23

WILD STEELHEAD (UNCLIPPED)

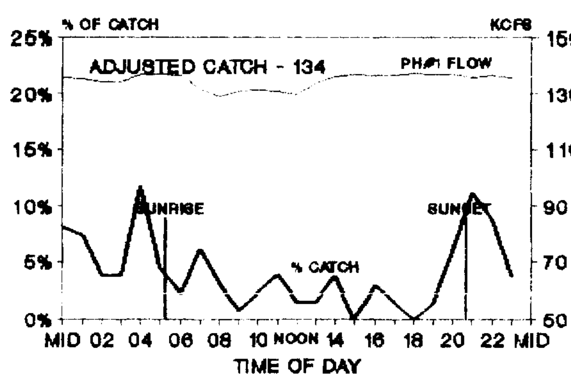
DIEL PATTERNS
BONNEVILLE DAM, DSM#1



MAY 1
FIGURE 24



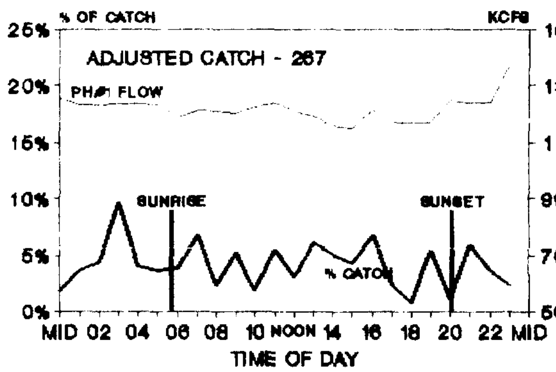
MAY 15
FIGURE 25



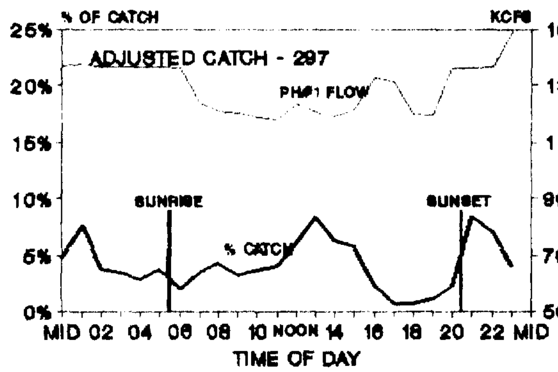
MAY 29
FIGURE 26

HATCHERY STEELHEAD (CLIPPED)

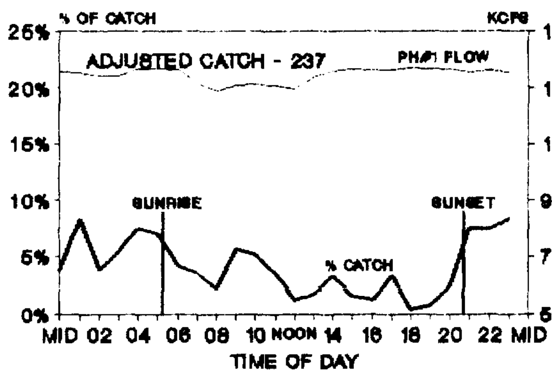
DIEL PATTERNS
BONNEVILLE DAM, DSM#1



MAY 1
FIGURE 27



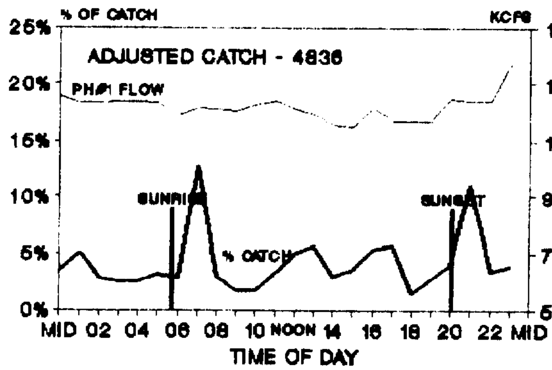
MAY 15
FIGURE 28



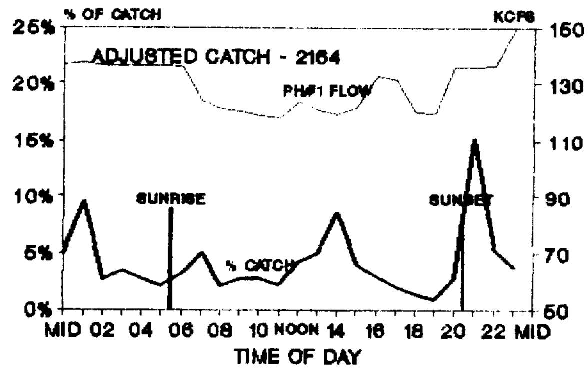
MAY 29
FIGURE 29

COHO

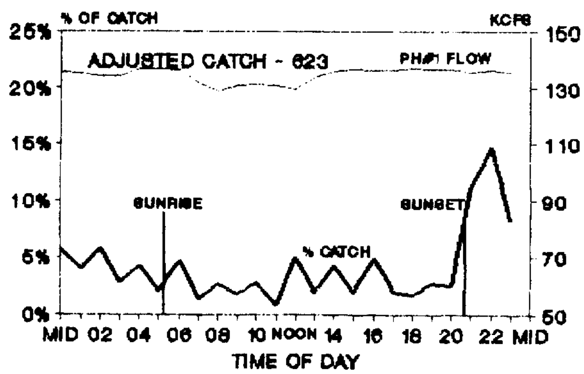
DIEL PATTERNS
BONNEVILLE DAM, DSM#1



MAY 1
FIGURE 30



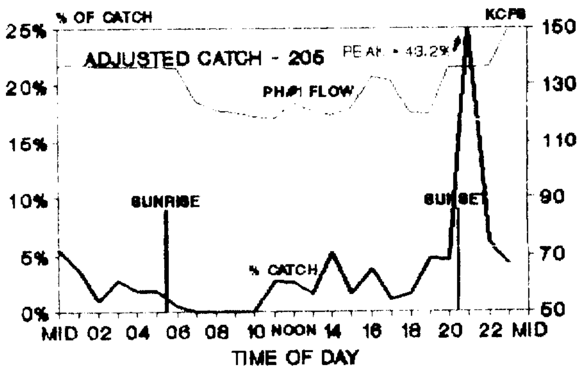
MAY 15
FIGURE 31



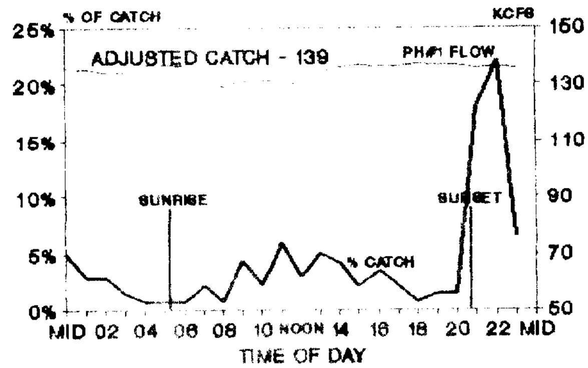
MAY 29
FIGURE 32

SOCKEYE

DIEL PATTERNS
BONNEVILLE DAM, DSM#1



MAY 15
FIGURE 33



MAY 29
FIGURE 34

APPENDIX D
BONNEVILLE DAM – 1990

DELAYED MORTALITY TESTS

DELAYED MORTALITY TEST RESULTS - BONNEVILLE DAM, 1990

METHODS

An effort to evaluate the effects of handling on sampled salmonid smolts by measuring short term delayed mortality rates (48 hour holding) on handled and non-handled test groups was continued this season. Fish used in this test were from the hourly capture (1600 to 2400 hours) at the Bonneville dam first powerhouse downstream migrant trap described by Gessel et al. (1988). Since there are no holding facilities at the first powerhouse, all test fish had to be transported to a raceway in the second powerhouse. Due to the limited raceway space and the complexities of moving and holding the test fish, only yearling and subyearling chinook and sockeye were tested. Yearling chinook were captured from May 2 to May 25, Sockeye from May 11 to June 3, and subyearling chinook from June 17 to August 1.

The handled groups consisted of fish captured and processed during our normal nightly sampling. These fish were anesthetized in a 50 ppm solution of tricaine (MS-222), inspected for brands and condition, counted, and placed in transport tanks. Non-handled 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 yearling and subyearling chinook groups. The shorter peak passage time allowed only 18 sockeye replicates to be collected and tested. Handled groups averaged 34 fish per replicate test. All non-handled test replicates 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 tests.

All groups were transported by truck to net pens in the second powerhouse and left undisturbed for 48 hours in the holding raceway. A flow of river water was kept at approximately 65 gallons per minute through the raceway. Water temperature ranged from 52 to 56 degrees F. during the spring tests and 58 to 69 degrees F. during the summer tests. At the end of the 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

For yearling chinook, a total of 903 handled and 672 non-handled fish were tested with a respective mortality rate of 1.83% and 1.49% (Attachment Table 1). For subyearling chinook, 925 handled and 991 non-handled fish were tested with mortality rates of 1.62% and 2.72% (Attachment, Table 2). For sockeye, 571 handled and 291 non-handled fish produced mortality rates of 15.9% and 11.7% respectively (Attachment, Table 3).

The data was subjected to a test sensitive in detecting overall differences of data from grouped 2X2 tables as described by Snedecor and Cochran (1980). This test was used to determine the significance of the difference between mortality rates of the treatment and control groups. Results of this test are given for each species in Table 1.

TABLE 1. Results of Cochran's test for grouped 2X2 contingency tables.

	Yearling Chinook	Subyearling Chinook	Sockeye
Test criterion (Z)	-0.005	-1.790	2.640
P value (two tailed)	0.996	0.857	0.008

In this case the null hypothesis assumes that there is no difference between the treatment and control groups of each species. To reject the null hypothesis the test criteria in Table 1 must be above the critical value of + (or -) 1.96 at the 5% level. Thus, using our normal handling methods, there appears to be no significant difference between mortality rates of handled verses non-handled yearling and subyearling chinook. There does, however, appear to be a significant difference between mortality rates of handled verses non-handled sockeye.

Physical condition played an important role in smolt survival in all test groups. A much higher incidence of descaled fish occurred in the mortalities of both handled and non-handled groups (Table 2) with 86% of all mortalities being descaled.

TABLE 2. Percentage of descaled fish occurring in the group totals and mortalities for each species. Sample size in parentheses.

	Treatment Total	Treatment Mortalities	Control Total	Control Mortalities
Chinook Yearling	12.7%(903)	94.1%(17)	9.4%(672)	90.0%(10)
Chinook Subyearling	2.1%(910)	46.7%(15)	5.4%(991)	55.6%(27)
Sockeye	39.0%(502)	97.8%(91)	35.4%(291)	91.2%(34)

Thirty percent of all descaled fish died. This high incidence of mortality is reflected in Table 3. Chinook yearlings demonstrated the highest tolerance for scale loss while sockeye appear to be the most sensitive to handling while descaled.

TABLE 3. The percent mortality in the total descaled fish of each test group.

	Yearling Chinook			Subyearling Chinook			Sockeye		
	Test	Control	Total	Test	Control	Total	Test	Control	Total
Total Descaled	115	63	178	19	54	73	196	103	299
Morts Descaled	16	9	25	7	15	22	89	31	120
% Mort.	13.9	14.3	14.0	36.8	27.8	30.1	45.4	30.1	40.1

In 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 and subyearling chinook. However, the results indicate that these handling methods did have a significant impact on the sockeye smolts tested. This appears to be largely due to the lower chance for survival which descaled fish exhibit irrespective of how they are handled. Sockeye tested had an overall descaling rate of 34.7%, while yearling and subyearling chinook had descaling rates of 11.3% and 3.8% respectively. No change is recommended in handling methods at this time but care should be taken to insure that sample related scaled loss be kept at a minimum.

We wish to acknowledge William A. Hevlin and Scott J. Carlon for continuing this study in the 1990 season at Bonneville dam, and Gary L. Fredricks for his help with test procedure.

LITERATURE CITED

Gessel, M.H., B.H. Monk, and J.G. Williams, 1988. Evaluation of the Juvenile Fish Collection and Bypass Systems at Bonneville Dam-1987. U.S. Dept. of Comm., NOAA, NMFS, NW&AFC, Seattle, Wa. 41p plus Appendix. (Report to the U.S. Army Corps of Engineers, contract DACW57-87-F-0322).

Snedecor, G. W. and W. G. Cochran. 1980. Statistical Methods, Seventh Edition. The Iowa State University Press, Ames, Iowa.

ATTACHMENTS

DELAYED MORTALITY TEST RESULTS - BONNEVILLE DAM 1990

TABLE	SPECIES
1.	YEARLING CHINOOK
2.	SUBYEARLING CHINOOK
3.	SOCKEYE

Attachment Table 1. Number of fish captured and statistical data for yearling chinook mortality test.

CAPTURE DATE	REP.	TEST TOTAL	MORT	% MORT	CONTROL TOTAL	MORT	% MORT
5-2	1	30	0	0.00	60	0	0.00
	2	34	0	0.00	33	0	0.00
	3	35	0	0.00	17	0	0.00
5-4	1	33	0	0.00	27	0	0.00
	2	33	0	0.00	17	0	0.00
	3	34	0	0.00	16	0	0.00
5-7	1	35	0	0.00	37	0	0.00
	2	35	0	0.00	48	0	0.00
	3	35	0	0.00	35	0	0.00
5-9	1	33	1	3.03	21	0	0.00
	2	36	1	2.78	14	0	0.00
	3	28	2	7.14	17	0	0.00
5-11	1	34	0	0.00	38	1	2.63
	2	35	0	0.00	20	2	10.00
	3	35	1	2.86	23	1	4.35
5-14	1	35	1	2.86	24	1	4.17
	2	35	0	0.00	30	1	3.33
	3	35	0	0.00	28	0	0.00
5-16	1	35	1	2.86	26	0	0.00
	2	35	0	0.00	21	0	0.00
	3	35	0	0.00	26	1	3.85
5-21	1	35	0	0.00	12	1	8.33
	2	30	2	6.67	17	0	0.00
	3	30	1	3.33	17	0	0.00
5-25	1	33	0	0.00	16	0	0.00
	2	28	3	10.71	17	0	0.00
	3	32	4	12.50	15	2	13.33
TOTALS		903	17	1.88	672	10	1.49
MEAN		33.44	0.63	2.03	24.89	0.37	1.85
STANDARD DEV.		2.25	1.02	3.38	11.00	0.62	3.46
MINIMUM		28	0	0	12	0	0
MAXIMUM		36	4	12.5	60	2	13.33

Attachment Table 2. Number of fish captured and statistical data for subyearling chinook delayed mortality test.

CAPTURE DATE	REP.	TEST TOTAL	MORT	% MORT	CONTROL TOTAL	MORT	% MORT
6-17	1	34	1	2.94	44	1	2.27
	2	35	1	2.86	54	4	7.41
	3	35	0	0.00	50	2	4.00
6-19	1	34	0	0.00	30	0	0.00
	2	35	2	5.71	24	2	8.33
	3	35	1	2.86	26	1	3.85
6-24	1	34	1	2.94	47	1	2.13
	2	35	0	0.00	40	1	2.50
	3	35	1	2.86	51	0	0.00
6-26	1	35	0	0.00	25	1	4.00
	2	35	0	0.00	42	3	7.14
	3	35	0	0.00	20	0	0.00
7-1	1	35	1	2.86	44	1	2.27
	2	35	0	0.00	41	1	2.44
	3	35	0	0.00	44	1	2.27
7-3	1	35	1	2.86	34	2	5.88
	2	35	1	2.86	32	0	0.00
	3	35	1	2.86	62	0	0.00
7-8	1	35	0	0.00	41	0	0.00
	2	35	0	0.00	54	0	0.00
	3	35	0	0.00	48	1	2.08
7-25	1	30	0	0.00	28	2	7.14
	2	33	2	6.06	24	0	0.00
7-29	1	32	0	0.00	22	1	4.55
	2	32	0	0.00	20	0	0.00
8-1	1	32	2	6.25	22	1	4.55
	2	34	0	0.00	22	1	4.55
TOTALS		925	15	1.62	991	27	2.72
MEAN		34.26	0.56	1.63	36.70	1.00	2.87
STANDARD DEV.		1.29	0.68	2.03	12.20	0.98	2.62
MINIMUM		30	0	0	20	0	0
MAXIMUM		35	2	6.25	62	4	8.33

Attachment Table 3. Numb of fish captured and statistical data for sockeye delayed mortality test.

CAPTURE DATE	REP.	TEST TOTAL	MORT	% MORT	CONTROL TOTAL	MORT	% MORT
5-11	1	30	4	13.33	9	0	0.00
	2	35	1	2.86	20	2	10.00
	3	35	0	0.00	19	3	15.79
5-14	1	35	2	5.71	14	1	7.14
	2	36	1	2.78	13	0	0.00
	3	35	0	0.00	8	1	12.50
5-16	1	35	6	17.14	30	2	6.67
	2	35	1	2.86	23	4	17.39
	3	35	1	2.86	7	0	0.00
5-21	1	30	10	33.33	7	1	14.29
	2	35	9	25.71	12	3	25.00
5-25	1	30	8	26.67	28	0	0.00
	2	34	6	17.65	4	0	0.00
	3	20	5	25.00	4	0	0.00
5-27	1	35	8	22.86	10	1	10.00
5-30	1	31	5	16.13	31	1	3.23
6-1	1	33	22	66.67	32	12	37.50
6-3	1	12	2	16.67	20	3	15.00
TOTALS		571	91	15.94	291	34	11.68
MEAN		31.72	5.06	16.57	16.17	1.89	9.69
STANDARD DEV.		6.04	5.18	15.85	9.25	2.75	9.95
MINIMUM		12	0	0	4	0	0
MAXIMUM		36	22	66.67	32	12	37.50

APPENDIX E
INCIDENTAL CATCH - 1990

JUVENILE SHAD
CAPTURE PATTERN
JOHN DAY DAM

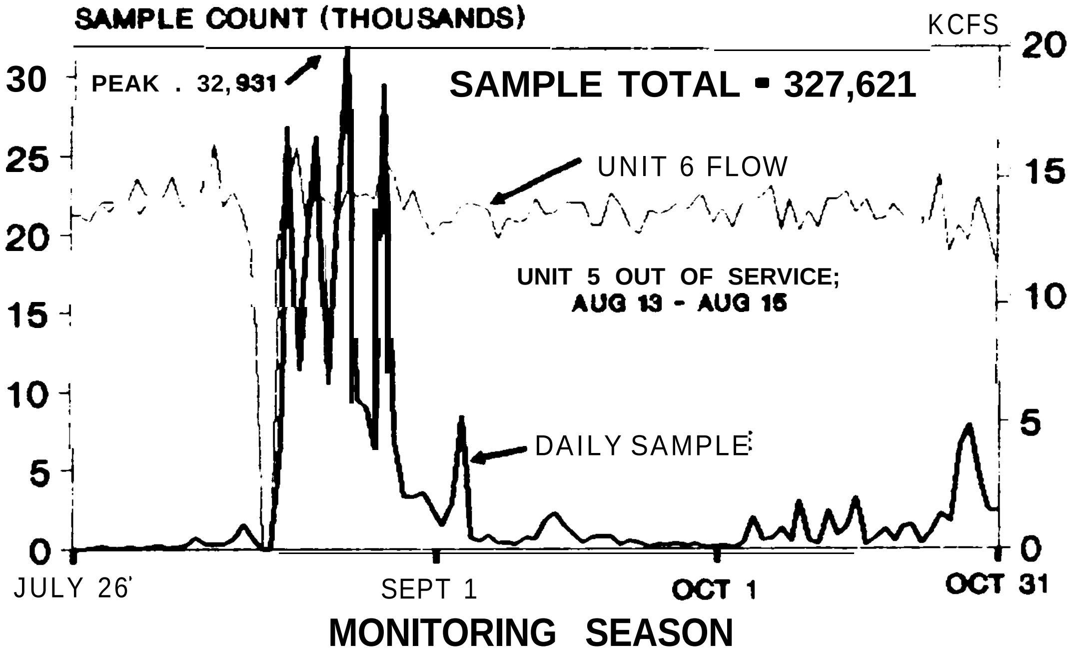


FIGURE 1

JUVENILE SHAD
CAPTURE PATTERN
BONNEVILLE DAM, DSM#1

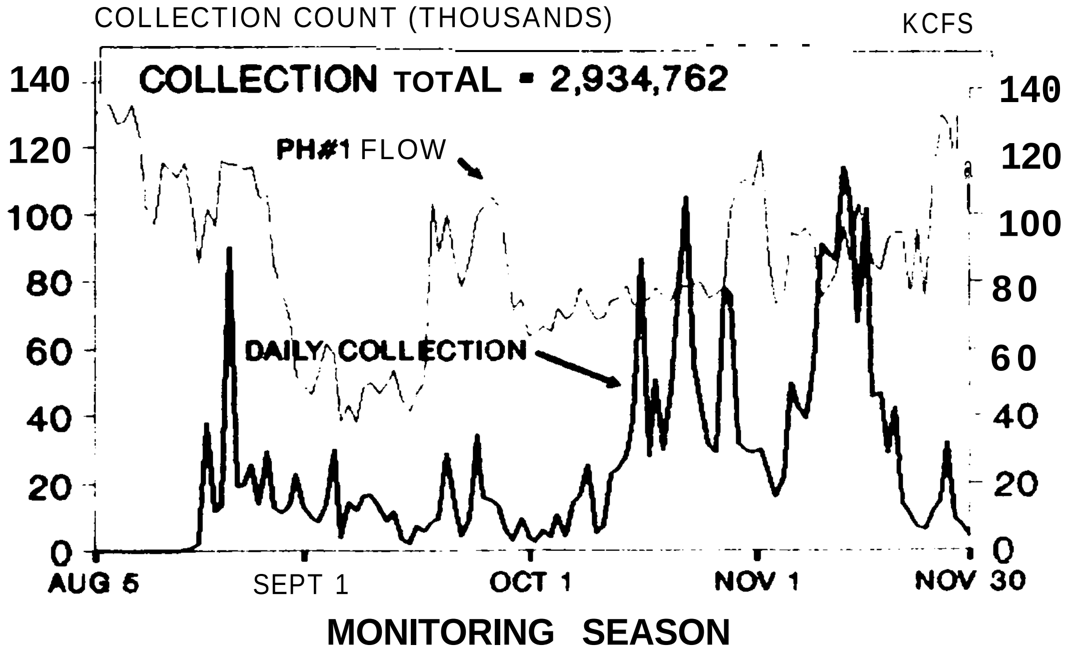


FIGURE 2

JUVENILE PACIFIC LAMPREY
CAPTURE PATTERN
JOHN DAY DAM

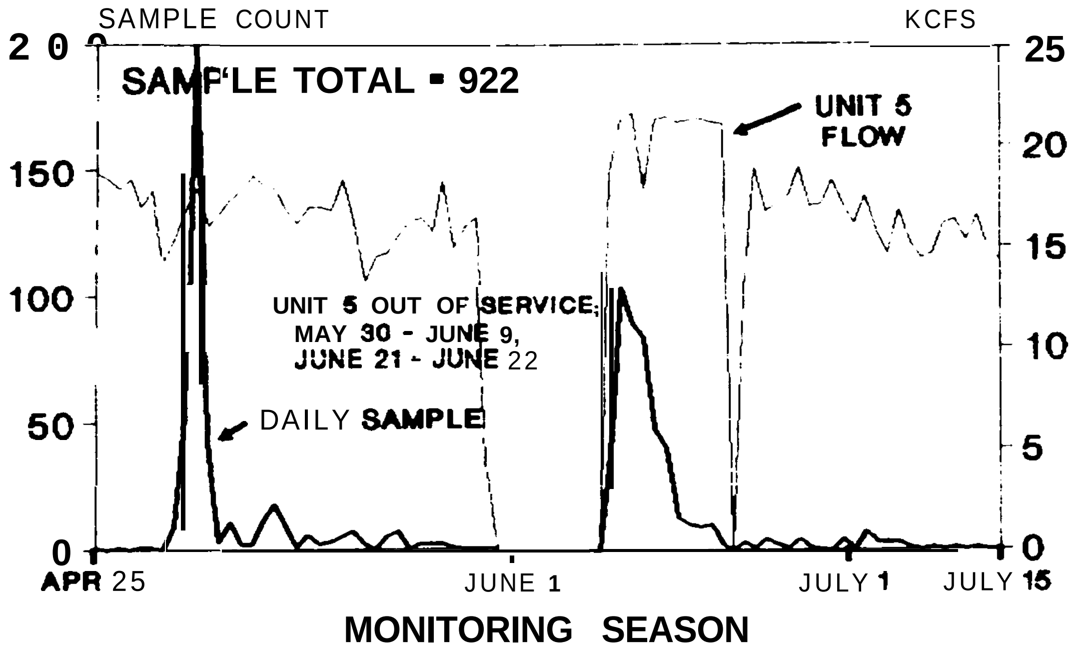


FIGURE 3

JUVENILE PACIFIC LAMPREY
CAPTURE PATTERN
BONNEVILLE DAM, DSM#1

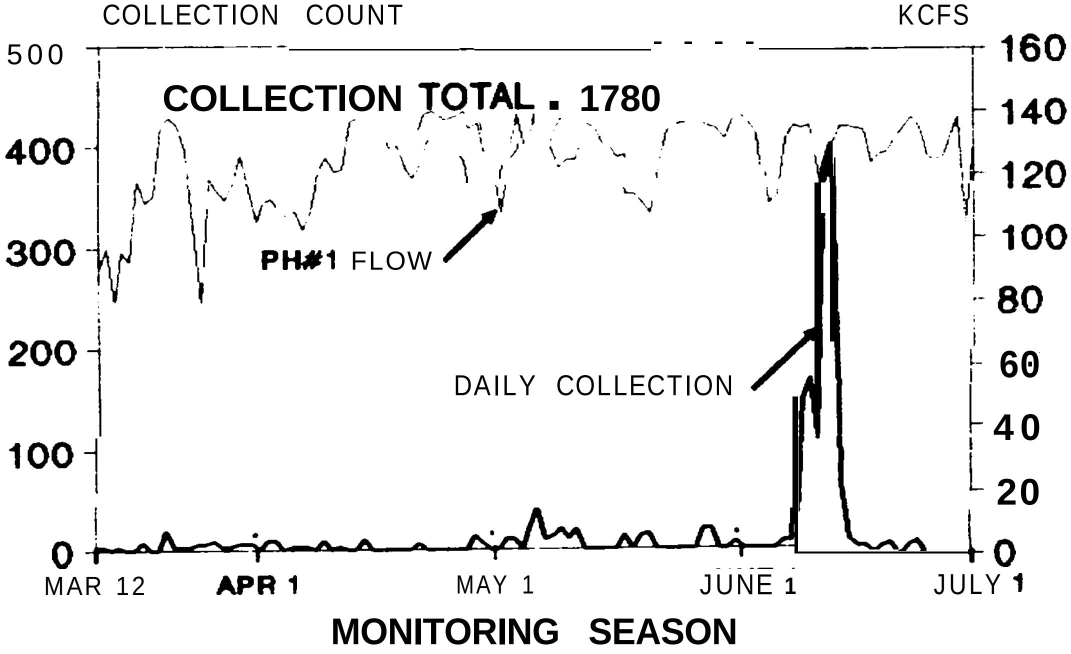


FIGURE 4