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MONITORING OF DOWNSTREAM SALMON AND STEELHEAD AT FEDERAL HYDROELECTRIC FACILITIES

ANNUAL REPORT 1993

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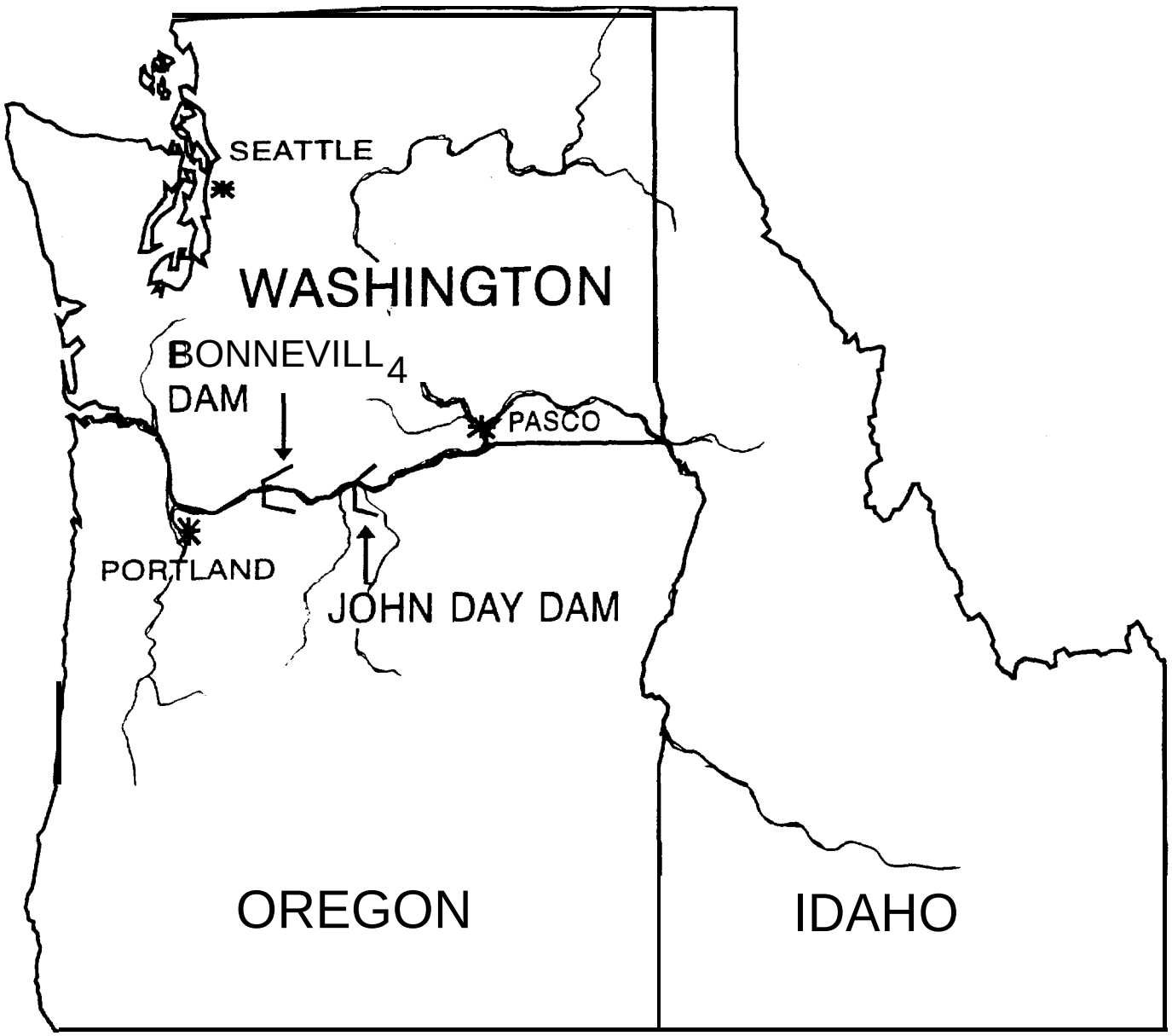

FIGURE 1. National Marine Fisheries Service Smolt Monitoring Sites at John Day and Bonneville Dams on the Columbia River.

INTRODUCTION

The seaward migration of juvenile salmonids was monitored by the National Marine Fisheries Service (NMFS) at Bonneville and John Day Dams on the Columbia River in 1993 (river mile 145 and 216, respectively, Figure 1). The NMFS Smolt Monitoring Project is part of a larger Smolt Monitoring Program (SMP) coordinated by the Fish Passage Center (FPC) for the Columbia Basin Fish and Wildlife Authority. 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.

The purpose of the SMP is to index Columbia Basin juvenile salmonid stocks and develop and implement flow and spill requests intended to facilitate fish passage. Data is also used for travel time, migration timing and relative run size magnitude analysis. The purpose of the NMFS portion of the program is to provide FPC with species specific data; numbers, condition, length, brand recaptures and flow data from John Day and Bonneville Dams on a daily basis.

METHODS AND MATERIALS

JOHN DAY DAM

Two airlift pump systems of the type described by Brege et al. (1990), were operated in gatewells 3B and 3C (Figure 2). Collected fish were examined hourly, or bihourly -when numbers were low, over the 24 hour sample day (7AM to 7AM), seven days per week throughout the 1993 sampling season, 6 April to 29 October. Fish were collected in a 450 gallon tank suspended at water level in the gatewell. Each hour this collection tank was raised and fish were gravity fed to holding tanks in a fish handling building via a 6" PVC pipe.

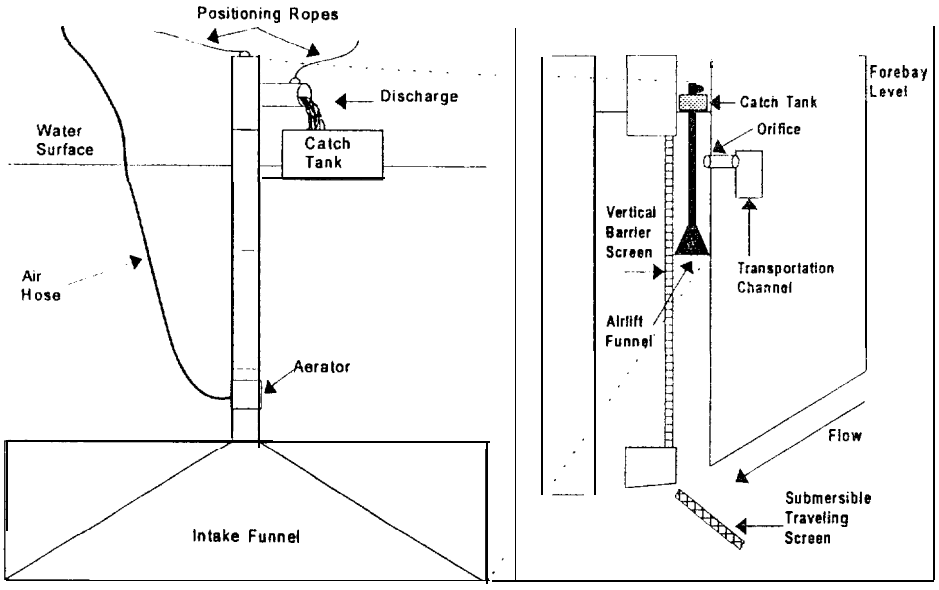

Figure 2. Components of a funnel airlift system. The inset shows its location within John Day Dam

Approximately 40 fish at a time were then preanesthetized with about 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 minimize stress during examination. Fish were then placed in a recovery tank and eventually routed through a PIT tag detector and back to the bypass system. All fish holding containers have a constant exchange of river water. Except for periods of maintenance, unit 3 was in continuous operation, though turbine loading was variable through the sampling season.

BONNEVILLE DAM

Between 17 March and 24 November, samples were collected in the bypass channels of the first and second powerhouses (PH1 & 2) using the downstream migrant traps (DSM1 & 2) at Bonneville Dam. 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.

First Powerhouse

As in 1992, the bypass channel of PH1 was sampled 24 hours per day. Samples are collected by positioning an aluminum tank at the end of the channel and then diverting the fish into it via a wedge wire screen type flume (Figure 3). Samples were collected hourly, from 0700hrs to 0700hrs, seven days per week.

Through 9 July, the sample rate was adjusted on a daily basis depending on smolt numbers, and was generally set from 6 to 12 minutes per hour (10 - 20%). After 9 July, the sample rate varied from 18 to 40 minutes (30 - 67%). The increase was an attempt to compensate for the reduced guidance resulting from the removal of the submersible traveling screens (STS). Sample time was split into two samples of equal duration per hour. During periods of high smolt passage, the sample rate was adjusted on an hourly basis to a minimum of 1 minute per hour as necessary to avoid overcrowding the trap. Enroute to the recovery tank, sampled fish pass through a PIT tag detector.

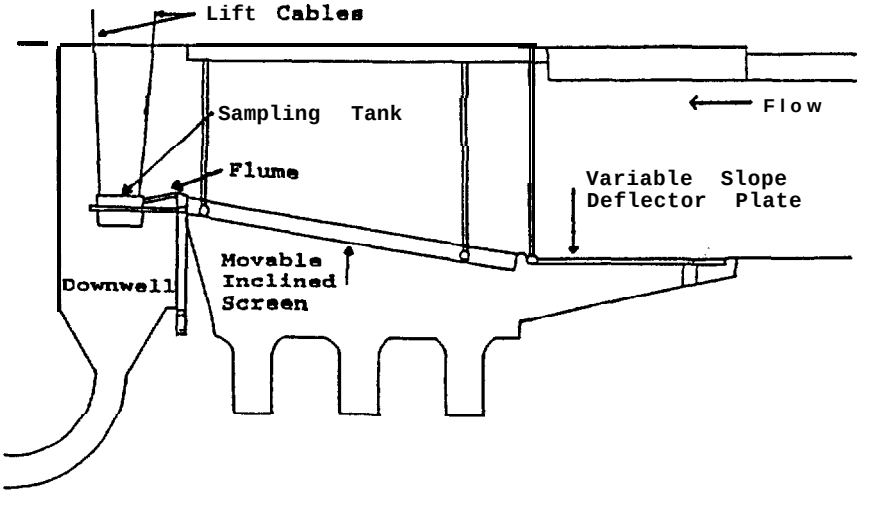

Figure 3. Inclined screen sampling system in the bypass channel of the first powerhouse at Bonneville Dam.

Second Powerhouse
Sampling was limited to subsampling for fish condition only. The DSM#2 was operated up to 24 hours per day, three days per week (M,W,F), to obtain a representative sample to monitor fish condition. The DSM#2 sampler operates at a fixed 10% sample rate. These fish were routed to and held in raceways until they were examined.

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, fish were placed in recovery tanks and eventually routed back to their respective bypass channels.

DATA COLLECTED

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

1) **species specific hourly and daily sample totals;**
2) **brands and fin clips;**
3) **descaling, general fish condition and mortality;**
4) **length frequencies by species;**
5) **project, river, turbine and spill flow data;**
6) **PIT tag detection.**

RESULTS AND DISCUSSION

The results of the hands-on assessments of smolt movement into or through John Day and Bonneville hydroelectric facilities are summarized in Table 1 for the 1993 field season. Three types of fish counts are presented in the table:

1) **Total Sample, actual fish counts.**

2) **Estimated Collection, total sample counts adjusted for sample rate (Bonneville Dam only).**

3) **Estimated Passage Indices, estimated collection counts divided by the proportion of flow passing through the sampled system to adjust for daily fluctuations in project operations.**

As stated in the Fish Passage Center Annual Reports, estimated Fish Passage Indices (FPI) are used as relative indicators of population abundance, and assumes that fish pass through spill and powerhouse units in numbers proportional to the flow through those passage routes. Indices are not estimates of total daily passage, but rather a relative measure of how the migration is progressing over the season for a given species.

Since monitoring at John Day and Bonneville generate hourly as well as daily catch data, fish passage indices can be estimated by two methods;

Hourly Resolution FPI divides hourly collection counts by the proportion of river flow through the sampled unit or powerhouse for that hour, then sums these hourly passage indices for the daily total.

Daily Resolution FPI divides daily collection counts by the proportion of daily average river flow through the sampled unit or powerhouse for the day.

All other SMP sites can only produce daily FPI, so this method is retained for comparison at John Day and Bonneville, but the hourly method tends to more accurately reflect fish passage for the day and season at these two sites.

Included in this report is graphic coverage of the diel and seasonal passage patterns and flow at John Day and Bonneville Dams. The monthly and seasonal diel graphs for Bonneville were adjusted to eliminate the effect of first powerhouse flow fluctuations on fish passage by multiplying the hourly collection count by the percent hourly deviation from the average flow over the 24 hour period.

TABLE 1. SUMMARYOF 1993 SMOLT MONITORING ACTIVITIES AT JOHN DAY AND BONNEVILLE DAMS.

SPECIES	SITE	TOTAL SAMPLE	TOTAL PIT TAGS[5]	TOTAL BRANDS	DAILY EST. COLL.[1]	DAILY EST. FPI[2]	HOURLY[6] EST. COLL.	HOURLY[6] EST. FPI[3]
YEARLING CHINOOK	JOHN DAY (3B)	41,767			41,767	720,361	41,767	715,853
	JOHN DAY (3B+3C)	52,821	222	1,069	52,821	865,063	52,821	
	BONNEVILLE PH#1	52,623	91	349	715,905	2,168,019	707,748	2,255,149
	BONNEVILLE PH#2[4]	5,468	---	42			---	---
SUBYEARLING CHINOOK	JOHN DAY (3B)	66,561			66,561	717,434	66,561	671,625
	JOHN DAY (3B+3C)	116,804	41	1,920	116,804	1,256,087	116,804	---
	BONNEVILLE PH#1	130,615	3	360	1,181,615	4,339,394	1,190,261	4,872,526
	BONNEVILLE PH#2	5,545		10	---		---	---
WILD STEELHEAD (UNCLIPPED)	JOHN DAY (3B)	11,374	---		11,374	189,400	11,374	186,696
	JOHN DAY (3B+3C)	16,042	62	24	16,042	249,202	16,042	
	BONNEVILLE PH#1	4,025	5	6	74,138	226,120	77,143	258,236
	BONNEVILLE PH#2	255	---	0	---		---	---
HATCHERY STEELHEAD (CLIPPED)	JOHN DAY (3B)	45,520		---	45,520	882,474	45,520	879,844
	JOHN DAY (3B+3C)	52,936	195	1,463	52,936	988,121	52,936	---
	BONNEVILLE PH#1	7,456	18	57	185,240	563,884	190,608	618,692
	BONNEVILLE PH#2	462	---	4	---		---	---
COHO	JOHN DAY (3B)	9,727	---	---	9,727	173,193	9,727	170,849
	JOHN DAY (3B+3C)	13,164	---		13,164	226,055	13,164	---
	BONNEVILLE PH#1	28,243	---	---	392,627	1,250,698	421,432	1,596,578
	BONNEVILLE PH#2	3,621	---	---	---			
SOCKEYE	JOHN DAY (3B)	14,072	---	---	14,072	272,869	14,072	267,763
	JOHN DAY (3B+3C)	14,885	36	39	14,885	287,321	14,885	---
	BONNEVILLE PH#1	4,939	10	19	178,245	538,837	184,129	575,586
	BONNEVILLE PH#2	624	---	3	---			---
SEASON TOTALS	JOHN DAY (3B)	189,018	---		189,018	2,955,731	189,018	2,892,631
	JOHN DAY (3B+3C)	266,652	632	4,515	266,652	3,871,849	266,652	---
	BONNEVILLE PH#1	227,901	158	791	2,727,770	9,086,952	2,771,321	10,176,767
	BONNEVILLE PH#2	15,972		59	---	---		

Data Source: Fish Passage Center.

[1] Daily Est. Collection= Sample # adjusted by sample rate at Bonneville Dam
[2] Daily Est. FPI= Daily collection counts adjusted by daily ave. flows.
[3] Hourly Est. FPI= Hourly collection counts adjusted by hourly ave. flows.
[4] PH#2 sampled for fish condition only.
[5] PIT tag data does not total correctly because individual fish of unknown origin (example: yearling or subyearling chinook) are not included in the subtotals.
[6] Hourly seasonal index totals were calculated for 3B only due to gag in 3C operation

JOHN DAY DAM

Sampling Season

The 3B airlift operated continuously throughout the sampling season except for 221 hours (about 4.5% of total sampling time) when unit 3 was shut down for maintenance and periodic screen inspections. The airlift in 3C was taken out of service from 13 May to 18 June (about 23% of the season) when the Fish Passage Center decided two airlifts were catching more fish than necessary for index and travel time estimates. See Appendix A, Table 3 for detail on biased sample days. Catch data from each airlift where recorded separately.

Sample Numbers

Between 6 April and 29 October, a total of 266,652 fish were sampled from both airlifts. Twice as many fish captured this year over 1992 despite the inoperation of the 3C airlift from 13 May to 18 June, the peak spring migration period. The greatest increase was 82% for sockeye, with other species ranging from 20% to 77%.

Sample numbers are divided by the proportion of river flow through the sample unit to get a Fish Passage Index (FPI). The "daily" expansion method index total for 3B was 2,955,731 and the "hourly" method generated an index total of 2,892,631, a 10% difference. The large increase in sample and passage index numbers is primarily due to high flows and spill levels, and reduced transportation at upriver collector dams resulting in more smolts migrating in river below McNary Dam in 1993 than most years since 1984. A breakdown by species for sample, collection , brand and PIT tag totals can be found in Table 1.

Flows and Spill

River flows were high over the spring migration, averaging 229.9 KCFS from April to May, peaking on 18 April at 400.3 kcfs. For June and July, River flow averaged 192.8 kcfs, and for August through October, 103.2 kcfs (Figure 4).

Over-generational spill averaged 23% of daily average river flow from 9 May to 6 June and comprised 7.6% of daily average river flow during the period specified in the Fish Spill Memorandum of Agreement, 7 June through 22 August. Authorized spill under this agreement is 20% of instantaneous flow for 10 hours per day (2000h - 0600), which equals 8.3% of the daily average flow.

Seasonal Passage Patterns

Seasonal passage patterns for each species are presented in Figure 4 and 4a. Peak passage for all spring migrants occurred in May in response to high river flows during that month. The majority of subyearling chinook passage occurred from late June through August with no dominant peaks but rather several minor peaks.

Estimated dates for the 10 and 90 percent segment of smolt passage by species for 1993 are listed in Table 2 below.

Table 2. Estimated 10 and 90 percent passage dates for John Day Dam, 1993.

Species	10%	90%
Yearling Chinook	5/6	6/1
Subyearling Chinook	6/21	8/17
Wild Steelhead	4/30	5/26
Hatchery Steelhead	5/10	5/26
Coho	5/9	5/30
Sockeye	5/16	5/31

A graphic comparison of historical passage dates for John Day is presented in Appendix A, Figure 1. The high river flows in May decreased travel time and compressed passage for all spring migrants resulting in the middle 80% of the runs passing John Day in fewer days than any recent year. Subyearling chinook passage started earlier and lasted longer with 80% of the run passing in 58 days vs. 52 days in 1992.

Diel Patterns

Diel passage patterns are quite consistent over the season and with previous years in that the majority of passage (74 to 95 percent) occurs at night, between the hours of 8pm and 6am (2001-0600 PDT) as'shown in Table 3.

Table 3. Total percent passage for day and night hours.

Species	Day (0601-2000)	Night (2001-0600)
Yearling Chinook	19.3%	80.7%
Subyearling Chinook	14.4%	85.6%
Steelhead - Wild	20.2%	79.8%
- Hatchery	21.4%	78.6%
Coho	5.6%	94.4%
Sockeye	21.0%	79.0%
Combined	17.5%	82.5%

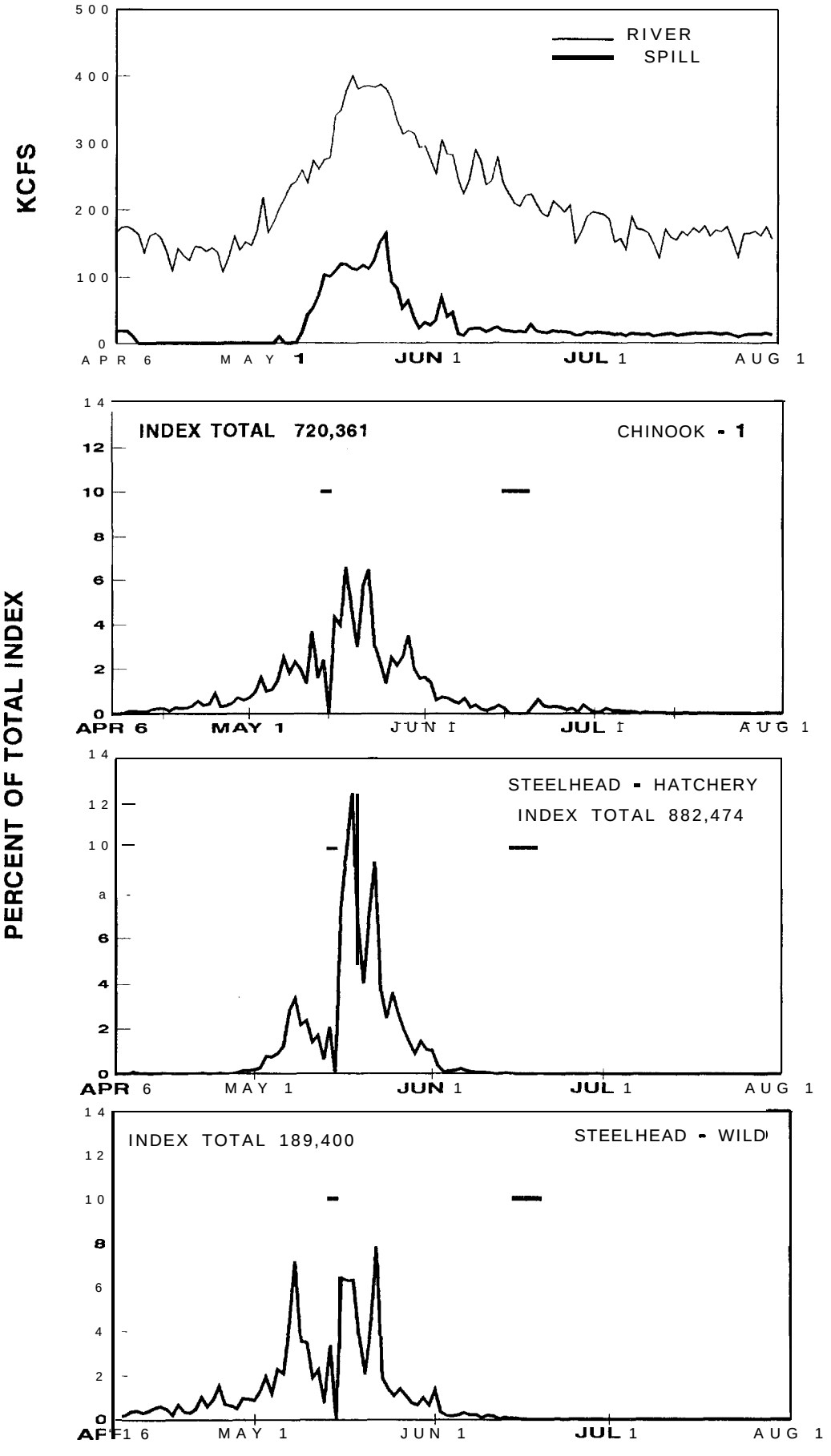

Figure 4. Seasonal Passage Patterns and daily average flows for John Day Dam, 1993. Based on "Daily" Indices from 3B.

▪ Indicates Sample Days Less Than 24 Hours.

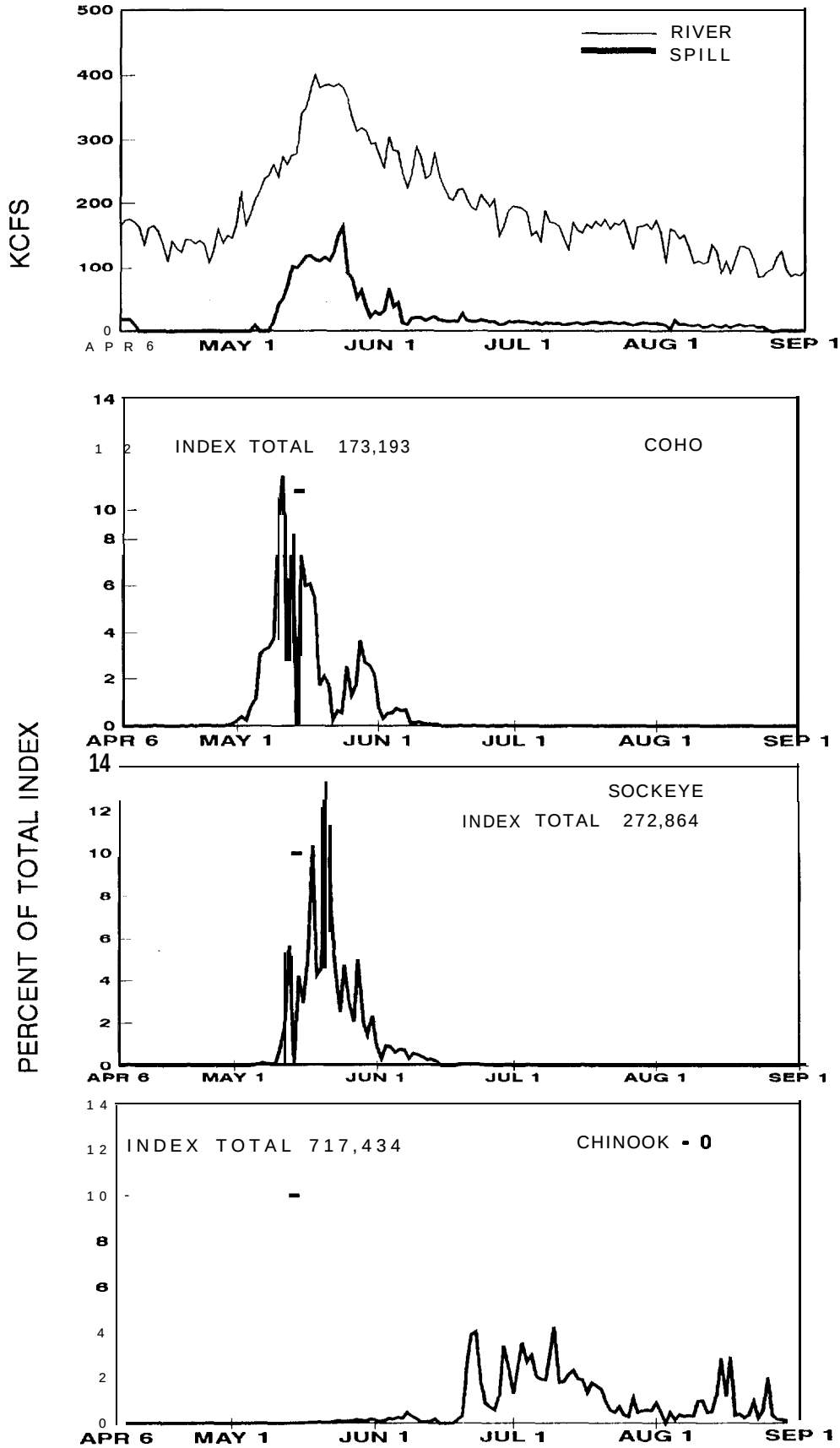

Figure 4a. Seasonal Passage Patterns and daily average flows for John Day Dam, 1993. Based on "Daily" Indices from 3B.

. Indicates Sample Days Less Than 24 Hours.

Seasonal diel patterns for spring migrants are characterized by a sharp increase in numbers at 2200hrs, staying elevated until about 0100hrs, then a lower but fairly constant level for the rest of the night. Sample numbers for all species dropped off sharply after sunrise and remained low throughout the day (Figure 5).

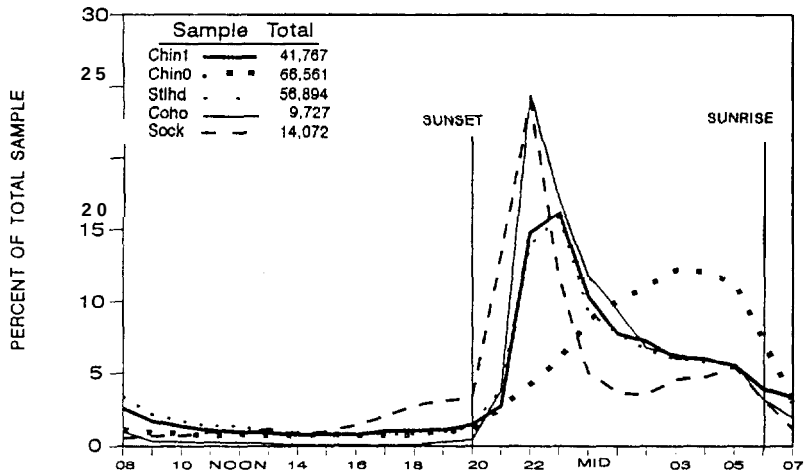

Figure 5. 1993 Seasaonal Diel Passage Pattern from 3B at John Day Dam.

Subyearling chinook passage peaked later, typically around 0300 hrs. A graphic presentation of the percentage of night time passage over the season is presented in Appendix ,A, Figure 2. There can be considerable variability in the percent of night passage day to day, but the overall diel pattern is fairly consistent over the season and between years. Since passage is fairly consistent at this project, graphing of weekly diel patterns to show in season variation was discontinued this year.

The average daily flow discharge through the sampled unit 3 generally ranged between 12.2 and 16.7 kcfs over the season. The average diel flow variance was minimal, generally declining at night at roughly at the same time as fish passage increased.

Fish Condition

A determination was made on every fish captured as to whether it was descaled or not, based on the criteria of 20% or more scale loss on one side of the fish. The percentages of descaling and mortality in the samples at John Day Dam for 1993 and the comparison to previous years are listed by species in Table 4.

Table 4. Percent descaling and mortality at John Day Dam in 1993 compared to 1992 and the historical average, (1985-1992).

	Chinook 1		Chinook 0		STHD-W		STHD-H		Coho		Sockeye	
Year	%D	%M	%D	%M	%D	%M	%D	%M	%D	%M	%D	%M
1993	10.6	4.7	3.6	5.5	3.4	1.8	12.6	2.0	5.1	0.8	11.3	2.7
1992	10.5	4.3	2.1	5.2	6.5	1.1	14.4	3.2	6.6	1.6	7.1	1.5
85-92	8.0	1.8	2.8	2.1	4.1	0.8	10.9	1.3	5.9	0.7	8.1	0.7

The 1993 descaling for wild and hatchery steelhead and coho was lower than 1992 levels. Wild steelhead and coho were also lower than the 9 year average. Yearling and subyearling chinook and sockeye rates were higher in 1993 than both 1992 and historical rates (Figure 6).

Mortality rates were higher in 1993 than 1992 for all species except for hatchery steelhead and coho. Mortality rates for all species were higher in 1993 than the historical average (Figure 7).

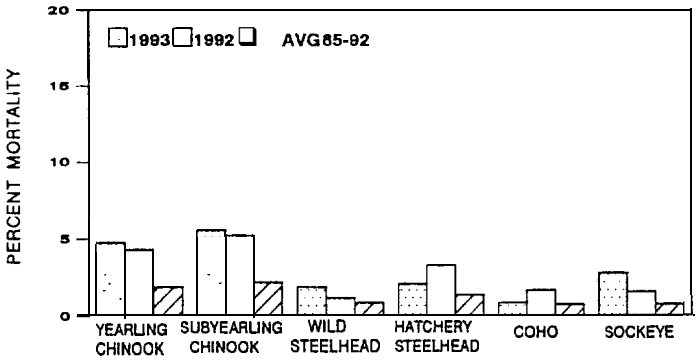

Figure 7. Total Mortality for 1993, compared to 1992 and the 85-92 Average, John Day Dam.

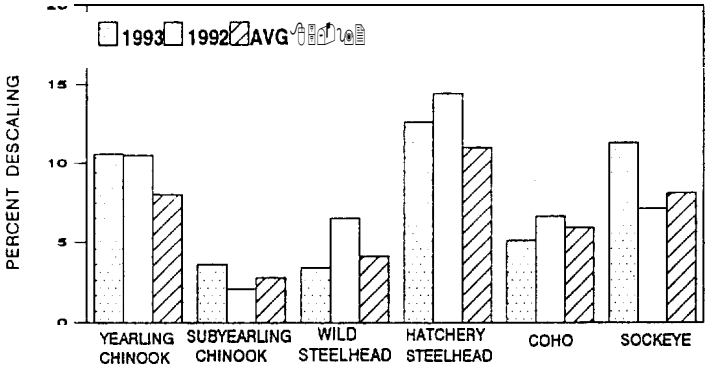

Figure 6. Total Descaling for 1993, compared to 1992 and the 85.92 Average, John Day Dam.

High runoff flows into the John Day pool in early spring transported more debris into the forebay than has been seen in previous years. Rafts of debris in front of the powerhouse were a problem from late March through late May. From the start of sampling on 5 April, descaling rates were high for all species through late May, particularly for yearling chinook and steelhead, which routinely exceeded 10% and ranged as high as 20

Descaling rates in the samples at McNary Dam were much lower than those recorded at John Day during this same time period (Figure 8). This suggests that the high debris loads at John Day dam at this time contributed to the deteriorating fish condition.

In response to high descaling and debris loads at the project, the following actions were taken;

1. The Corps of Engineers (CoE) removed some forebay debris in May.
2. CoE raked trash racks (generally on units 1-5).
3. CoE removed gatewell debris accumulation, and inspected VBS and STS screens.
4. NMFS routinely inspected airlift funnel for debris.
5. NMFS/ CoE dipnetted fish for comparison.
6. NMFS/CoE removed airlifts for funnel, STS and VBS screen inspection and repair in unit 3.

Only small short term improvements in fish condition resulted from funnel debris plug removal and trash rack raking. None of these efforts resulted in a sustained improvement. A graph of daily descaling and mortality rates for each species over the season is presented in Appendix A, Figure 3 and 4.

Gatewell dipnetting for comparison was done on three occasions, 22 April, 12 and 13 May. Those results indicated that descaling in the dipnetted gatewells was similar to descaling in 3B, but 3C descaling was higher. This suggested a problem specific to 3C. The funnel was removed and inspected on 12 May revealing a deteriorated metal surface on the top shoulders of the airlift funnel. The capability of this surface to descale fish was demonstrated on 13 May when 3c was dipnetted and descaling was comparable or lower than 3B and the other dipnetted fish (Figure 9).

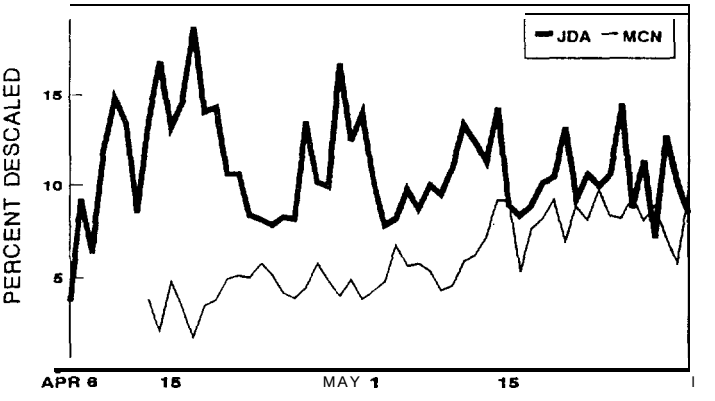

Figure 8. Spring Descaiing rate comparison, all species combined, at John Day and McNary Dams, 1993.

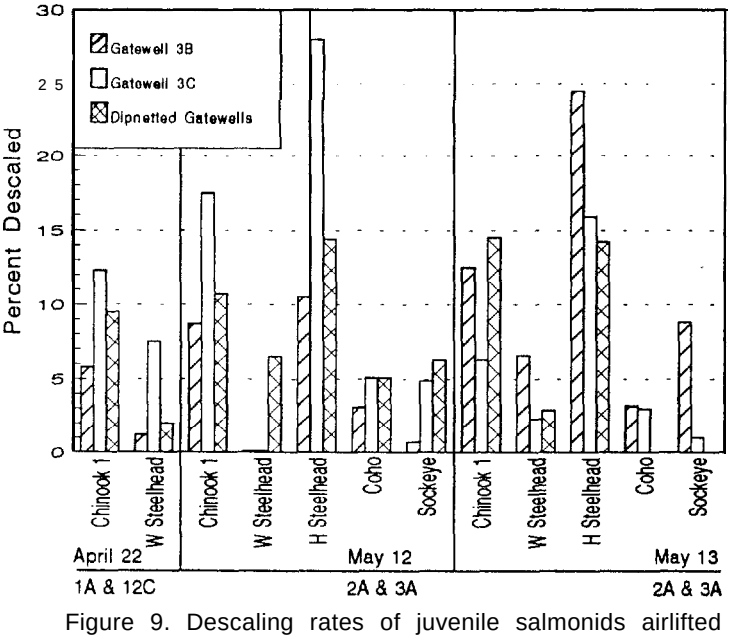

Figure 9. Descaling rates of juvenile salmonids airlifted (3B + 3C) and dipnetted (gatewells indicated) at John Day Dam. Note: Gatewell 3C was dipnetted on the May 13th sample.

On 13 May, it was decided to not reinstall the 3C airlift but to continue to monitor the rest of the spring migration with only the one airlift in 3B. It was determined that the project was capturing more fish than originally anticipated, and that the samples from one airlift were sufficient for brand recoveries and indexing.

The repaired funnel from 3C was returned to service after the spring migration on 18 June. No significant difference was noted in descaling rates between the two funnels after this time during the fall migration.

Descaling rates dropped in the middle of June at the end of the spring migration. Descaling on chinook subyearlings was much lower

at 3.6% but mortality remained high, at 5.5%, increasing over the migration through the end of August (Appendix A, Figure 4). This is a common pattern for subyearling chinook at John Day dam as water temperatures rise and flows decrease, migrations conditions deteriorate resulting in chronic cumulative stress and high mortality. Water temperatures ranged from 67-71 degrees over the summer migration.

Subsampled Fish Condition

In addition to the determination of weather or not a fish was descaled made on every fish handled, detailed fish condition information was taken on a subsample (target n=100) of each species three times each week. Approximately 16,600 smolts were examined this season for partial descaling (3<>20% loss on a side), injuries, parasites and obvious disease symptoms including gas bubble disease. The results are presented in Appendix A, Table 2.

Partial descaling ranged from 8% in coho to 37% for hatchery steelhead, and averaged 16% overall. Hatchery steelhead had the highest incidence of injuries and fungus and wild steelhead had the highest levels of external parasites. Subyearling chinook had the highest incidence of columnaris symptoms which increased along with water temperatures and subyearling mortality in the samples over the summer. Less than 2% of the sampled chinook and steelhead had external gas bubble disease symptoms. These were observed during high flows and corresponding supersaturated water in late May.

Length Frequency

Length frequencies are presented in Figure 10 to show relative size differences and trends throughout the season. Other than wild steelhead, and subyearling chinook,. the patterns are the result of different hatchery stocks.

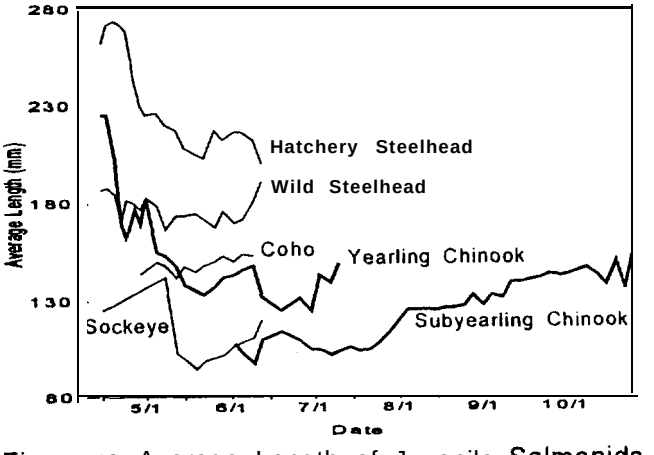

Figure IQ Average Length of Juvenile Salmonids at John Day Dam, 1993.

Freeze Brands and PIT Tass

A total of 4,515 brands were recovered this season from 3B and 3C, a 34% increase over 1992 recoveries. Subyearling chinook had the most brands (1,920), followed by hatchery steelhead (1,463) and yearling chinook (1,069) . Branded fish from McNary, used in FPC travel time studies, were given a "quality" rating upon recovery at John Day. That information was sent back to the McNary marking program for use in their quality control program.

A total of 632 PIT tags were detected this season. This is about 10 times as many as in 1992 when only 64 tags were detected. A summary of the PIT tags detected, including species and travel time estimates can be found in Appendix A, Table 1.

Brand Recovery Tests

Tests to evaluate brand recognition and recording efficiency of fish handlers at John Day dam were conducted. In June, thirteen tests were completed using a mix of chinook and coho. For each test, approximately 10 to 20 fish were collected from the hourly sample and branded with a >Y brand using a variety of locations and rotations. A total of 206 fish (131 chinook and 75 coho) were branded and held for 48 hours for the brand to develop and seeded back into the sample for each unannounced test. Combined test results are summarized in Table 5.

Table 5. Brand detection and recording test results.

Brands Released	Brands Recovered	Correct Species	Correctly Recorded	Overall Accuracy
		181	179	179
206	188 = 91%	188= 96%	188= 95%	206= 87%

Fish handlers were able to detect 91% (188 out of 206) of the branded fish released into the samples. Of the branded fish they detected, 96% were correctly identified as to species, and 95% were recorded accurately as to the brand, location and rotation. Of the total brands released, 87% were recovered and accurately recorded overall.

These types of species and recording errors would normally be flagged by the computer's brand interactive program when the brand is processed, allowing them to be corrected while the fish is still in hand.

Fry Incidence

The incidence of summer/fall chinook fry (≤ 60mm) in the 3B samples this season was almost 2% of all subyearling chinook sampled from 3B, totalling 1,317. Only 23 fry were captured from 3C since the 3C airlift was removed in May, for a total of 1,340 for the season. The fry total from 3B in 1993 was about 20 times as many as were caught from 3B in 1992. Fry were most abundant around the end of May.

Adult Catch

A total of 257 adult salmonids were captured by our airlift system (Table 6). No condition information was recorded as our goal was to return these fish to the forebay as quickly as possible. However, any tag numbers found on these fish were recorded and the information sent to the appropriate research unit.

Table 6. Adult Salmonid Fallbacks at John Day Dam, 1993.[1]

Gatewell	Chinook	Sthd-W	Sthd-H	Coho	Sockeye	Total
3B	12	54	91	1	a	166
3c	a	30	49	0	4	91
Total	20	84	140	1	12	257

Incidental Catch

A summary of the seasonal total incidental catch of non-salmonid species is presented in Appendix C, Table 1.

American shad (Alosa sapidissima) were by far the most common incidental species captured by our facility (Appendix C, Figure 1). The catch of juvenile shad in gatewell 3B for 1993 (160,703) was about 79% of the catch for 1992 (203,780). In both years sampling ended before the juvenile shad migration was completed, therefore between year comparisons are questionable.

The total number of juvenile Pacific Lamprey (Entoshpenus tridentatus) captured in gatewell 3B and 3C was much higher this year (7,645, Appendix A, Figure 3) than last year (410). This number is still far below the 9,338 lamprey caught from only one gatewell in 1991.

BONNEVILLE DAM

Sampling Season

At PH1, a total of 66 hours of sampling were missed, about 1% of the season. Eleven hours were due to a recurrent cable failure problem on the new (spring 92) single shaft hoist system. The problem could not be conclusively identified, but several possibilities exist;

1. Lowering trap too far, resulting in slack cables which can bind or cross drum ridges when tension is returned.
2. Inadequate tensile strength resulting in cable fatigue and eventual failure.
3. Stainless steel cable being to brittle.
4. Cable tracking on grooved drum at too steep an angle when the trap is lowered. This causes cable to abrade against the ridge between grooves.

Attempts to correct the problem (limit switch, different cable) were unsuccessful. The other 57 hours were missed due to inclined screen and trash sweep repair, or National Marine Fisheries Service bypass research. For a complete list of biased sample days due to missed samples, see Appendix B, Table 3.

The PH2 sampler had minor problems with a motor and the trash sweep, resulting in 2 sample days being missed. The DSM#2 was taken out of service during large hatchery releases and for NMFS survival tests.

Sample Numbers and Passage Indices

In 1993, our second year of 24 hour monitoring in the First Powerhouse (PH1), 227,901 juvenile salmon and steelhead were sampled from 17 March to 24 November. This resulted in an expanded (by sample rate) collection estimate of 2,727,770 using the daily method, and 2,771,321 using the hourly method. These collection estimates were further expanded by the percent of river flow through PH1 to generate passage indices. The daily expansion method generated an index total of 9,086,952 and the hourly expansion method generated an index total of 10,176,767 (Table 1).

The two methods varied by as little as 4% for yearling chinook and as much as 22% for coho. For all species, the hourly method produced a larger index total. This difference is primarily due to the high level of spill that occurs at night at this project. With these high spill levels, the daily method of calculating the passage index, based on daily average powerhouse flow and spill may under-estimate passage. The hourly expansion method may more accurately reflect passage because it accounts for the changing flow distribution by calculating indices hourly and summing for the day. Passage indices were 2 to 6 times greater in 1993 than in

1992 due primarily to the higher flows increasing bypass and spill passage at collector dams.

For the first time this year, the submersible traveling guidance screens in the first and second powerhouse were removed at the start of the "upriver bright" portion of the subyearling chinook migration between 10-16 July. An increased sample rate was implemented in an effort to compensate for the decrease in bypassed fish and to maintain reasonable sample sizes. Caution should be used as the subyearling chinook run after this date is probably under represented in the Bonneville samples, effecting passage indices and patterns. About 80% of the total subyearling chinook passage occurred before June 1 and consists of "tule" subyearling chinook from three Spring Creek National Fish Hatchery (SCNFH) releases in March, April and May.

At the Second Powerhouse a total of 15,972 smolts were sampled from the bypass system to assess fish condition in 1993. No fish collection or passage index numbers were calculated for this site.

Flows and Spill

River flow averaged 223.1 kcfs from 18 March to 31 May, peaking on 18 May at 395.2 kcfs. From 1 June through July, river flow averaged 198.6 kcfs. Flows continued to decline throughout the summer and fall, averaging 107.4 kcfs between 1 August and 24 November.

Spill for the 18 March release of 6,856,282 tule fall chinook from SCNFH, averaged about 36% of river flow for the period 20 March through 27 March. Spill resumed on 16 April to flush the 15 April SCNFH release of 3,978,719 tule fall chinook past the project. From 16 April to 7 June spill averaged about 41% of river flow. During the summer spill for juvenile fish passage, 8 June to 23 August, spill averaged 47% of river flow.

Discharge from PH2 was much higher this year than in 1992, averaging nearly 100 kcfs through 16 April. From then until the first of May, PH2 discharge was minimal but from then on, through June, PH2 was almost as much as PH1 discharge (Figure 11).

Seasonal Passase Patterns

Fish passage patterns for the first powerhouse are presented in Figure 11 and lla. Estimated dates for the 10 and 90 percent segment of smolt passage by species for 1993 are listed in Table 7. A graphic comparison of historical passage dates at Bonneville is presented in Appendix B, Figure 1.

The majority of spring migrants, with the exception of yearling chinook, passed Bonneville Dam over a relatively short time period in May. Passage for all spring migrants peaked in late May, in response to high river flows over 300 KCFS moving the migration quickly through the lower Columbia River.

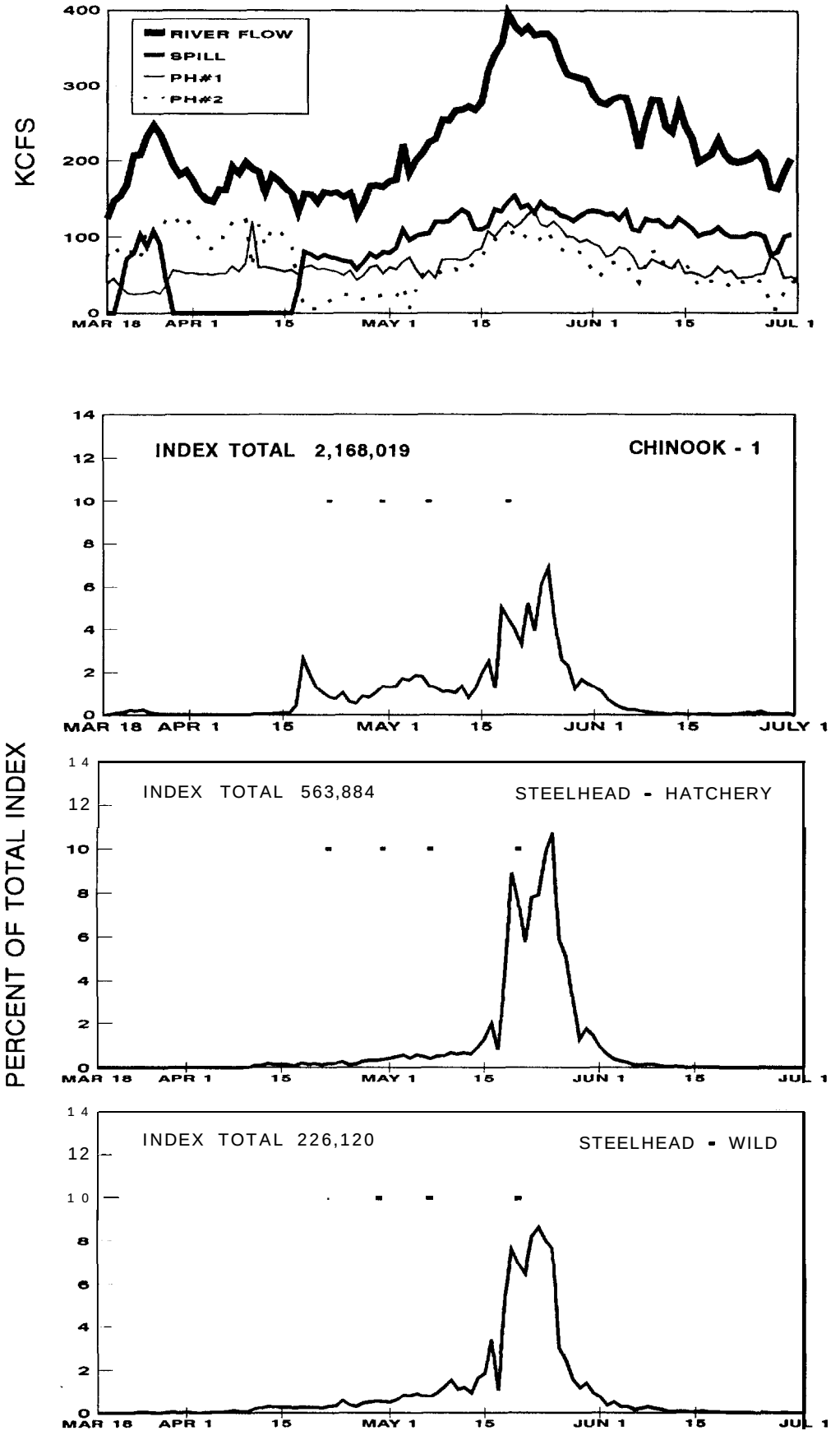

Figure 11. Daily Passage Patterns and Average flows for Bonneville Dam, 1993.

▬ Indicates Sample Days Less than 24 Hours.

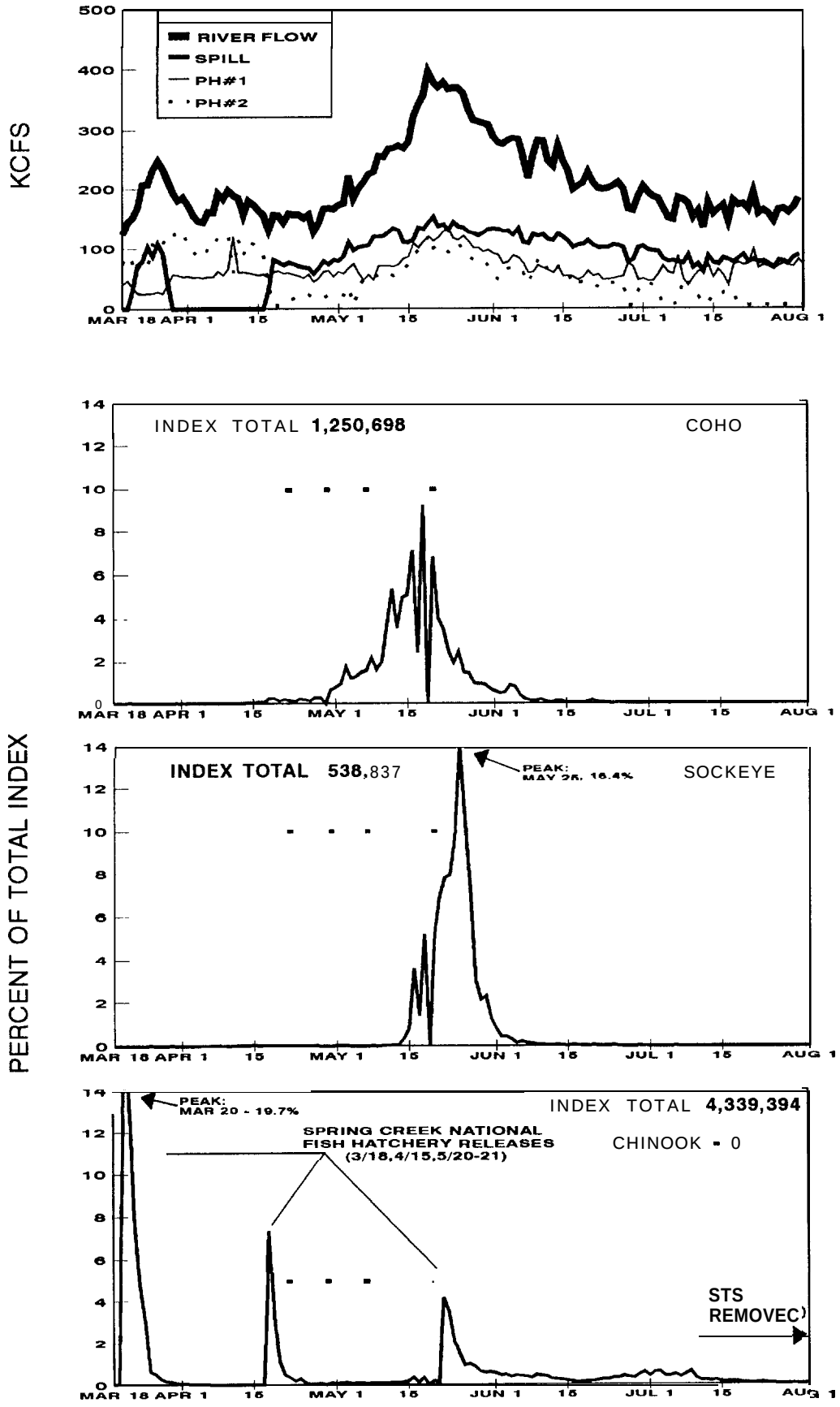

Figure IIq. **Daily Passage Patterns and Average Flows for Bonneville Dam, 1993.**

I **Indicates Sample Days Less than 24 Hours.**

Table 7. 10 and 90% passage dates at PH1, Bonneville Dam, 1993.

Species	10%	90%
Yearling Chinook	4/22	5/28
Subyearling Chinook	n/a	n/a
Steelhead - Wild	5/4	5/26
Hatchery	5/10	5/26
Coho	5/5	5/25
Sockeye	5/17	5/27

n/a= no dates calculated due to STS removal.

The middle 80% of the migration for wild and hatchery steelhead, coho and sockeye passed Bonneville in 23, 16, 22, and 11 days respectively. In 1992, the same species took 35, 34, 40 and 21 days respectively. For yearling chinook, the timing and duration were similar to 1992, but the distribution was very different. In 1992 yearling chinook passage peaked earlier, reaching the 50% mark almost a month earlier, but reaching the 90% mark a week later (Appendix B, Figure 3).

The spring passage pattern (before June 1) for subyearling chinook mainly represents large releases of SCNFH "tule" stock into the Bonneville pool (Table 8).

Table 8. 1993 Spring Creek National Fish Hatchery releases.

RELEASE DATE	RELEASE SIZE	PEAK PH1 PASS.	AVG. RIV. FLOW (KCFS)	SPILL AS % OF RIV
March 18	6,856,282	March 19	213.3	36.3
April 15	3,978,719	April 16	156.1	45.3
May 20-21	3,694,700	May 21	356.2	37.9

The summer passage pattern for subyearlings (after June 1) mainly represents that portion of the run which is "upriver bright" stock. Guidance screens were pulled for this portion of the subyearling migration at Bonneville, causing a monitoring bias. Estimating the 10 and 90 percent passage dates for subyearling bright stock are not appropriate for this reason.

Diel Passage

The diel patterns generated in our second year of 24 hour monitoring strongly confirm the patterns established in 1992, and by previous years "spot" diels. Peak passage for all species occurred between 2100 and 2300hrs. After 2300hrs, passage declined to lower levels but remained fairly constant until sunrise. At sunrise, there is a minor increase in passage with a decline thereafter, throughout the day (Figure 12).

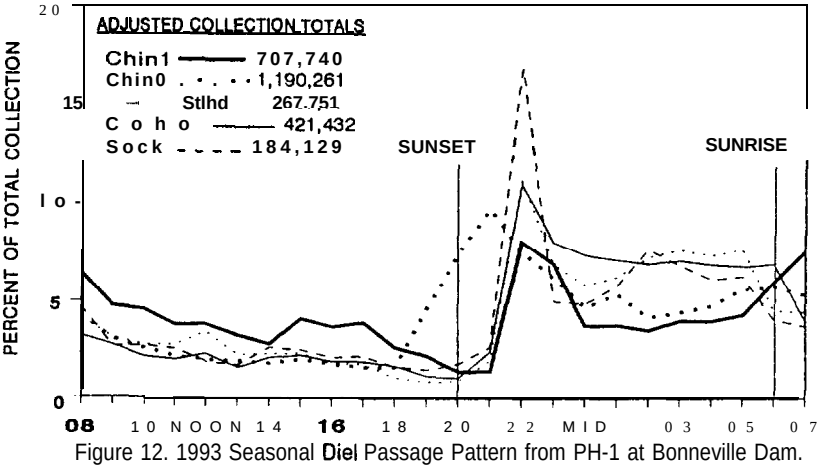

Figure 12. 1993 Seasonal Diel Passage Pattern from PH-1 at Bonneville Dam.

The passage patterns of "tule" and "bright" stocks of subyearling chinook mirror one another closely in that both peak sharply after sunset, with a minor peak at sunrise (Figure 13). The patterns are offset by about 2 hours due to the differences in sun set/rise time from spring to summer.

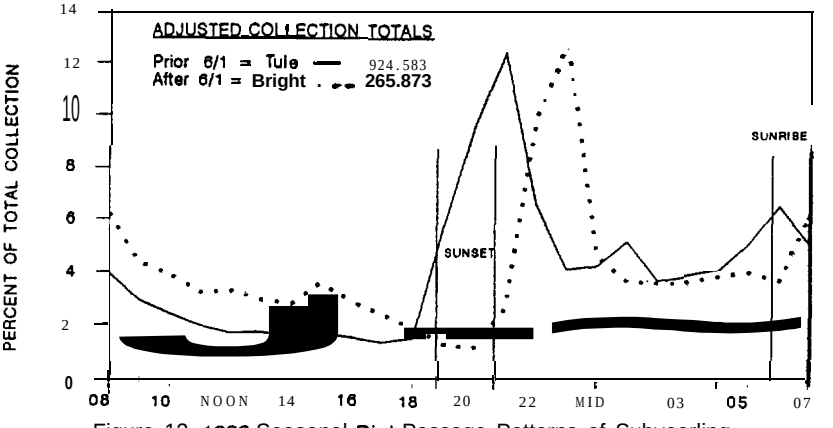

Figure 13. 1993 Seasonal Diel Passage Patterns of Subyearling Chinook Stocks from PH-1 at Bonneville Dam.

Monthly diel passage patterns at PH1 are presented for each species to show seasonal variation in Appendix B, Figures 3-9. Catch numbers were adjusted in both the monthly and seasonal passage patterns to eliminate the effect of fluctuations in powerhouse discharge, in effect showing passage under flat loaded conditions.

Table 9 lists the percent total daytime (06:01 - 20:00 hrs) and nighttime (20:01 - 06:00 hrs, P.D.T.) passage for the season at PH1. Although yearling chinook passage peaked at night, the majority of passage occurred during daytime hours. All other species had a greater percent of total passage during nighttime hours.

Table 9.
Percent Day and night passage at Bonneville PH1, 1993.

Species	Day (0600-1900)	Night (2000-0500)
Yearling Chinook	56.8%	43.2%
Subyearling Chinook-	43.8%	56.2%
"Tule"	43.2%	56.8%
"Bright"	46.6%	53.4%
Steelhead - Wild	32.9%	67.1%
Hatchery	37.6%	62.4%.
Coho	31.9%	68.1%
Sockeye	36.4%	63.6%
Combined	44.1%	55.9%

There is considerable daily variability in the percent of nighttime passage over the season for all species at Bonneville, as shown in Appendix B, Figure 2).

Descalins and Mortality

The percent of total fish that were descaled and dead in the samples over the 1993 season and the comparison to 1992 and historical levels (1987-1992) are presented in Table 10 below.

Table 10. Percent descaling and mortality at Bonneville Dam, PH1.

	Chinook 1		Chinook 0		STHD-W		STHD-H		Coho		Sockeye	
Year	%D	%M	%D	%M	%D	%M	%D	%M	%D	%M	%D	%M
1993	3.9	0.1	1.2	0.5	2.4	0	8.3	0	2.3	0	16.9	0.3
1992	4.6	0.1	2.2	0.3	6.8	0.1	12.9	0.1	6.2	0.1	13.0	0
85-92	5.2	0.1	2.4	0.4	6.5	0.1	15.9	0.2	4.4	0.1	21.5	2.1

Daily descaling and mortality rates as seen in the PH1 samples over the 1993 season are presented in Appendix B, Figures 10 and 11.

Descaling in 1993 was lower than 1992 and the historical average for all species except sockeye (Figure 13). Descaling rates on sockeye are historically very high at Bonneville Dam, averaging about 21.5% from 1987 - 1992. The specific cause for this is unknown. The incidence of descaling on sockeye in 1993 (16.9%) was lower than the historical average, but

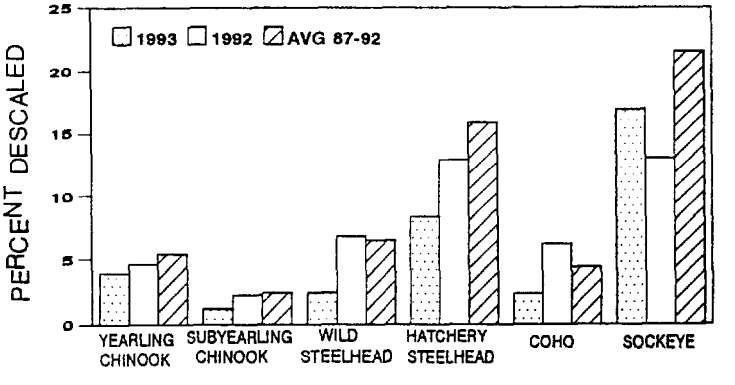

Figure 13. Total Descaling, for 1993, compared to 1992 and the 87-92 Average, Bonneville Dam.

higher than the 1992 rate of 13%. It should be noted that 1992 sockeye descaling, the lowest on record for this site, was based on a very reduced sample size of 638 fish, the lowest on record.

Daily descaling rates in 1993 are quite variable over the season for yearling chinook and hatchery steelhead ranging up to 15%. Sockeye descaling was consistently higher than the other species, ranging up to 25% , (Appendix B, Figure 10). Overall mortality rates on sampled fish were less than 1% for all species.

Percent average descaling and mortality seen in the samples taken at the second powerhouse in 1993 are presented in Table 11. Chinook 1 and coho descaling in PH2 samples was almost twice Phl rates. Sockeye descaling was also higher by about 4%. Chinook O's and steelhead had lower overall descaling. Mortality on sampled fish was similar to PH1, less than 1% for all species.

Table 11. Descaling and Mortality from PH2 at Bonneville Dam.

	CHINOOK-l	CHINOOK-O	STEELHEAD	COHO	SOCK
TOTAL SAMPLED	5,468	5,545	717	3,621	624
% DESCALED	7.2%	0.9%	0.13%	4.5%	20.2%
% MORTALITY	0.7%	0.6%	0.28%	0.2%	0.7%

Subsampled Fish Condition

Three times a week a subsample (target n= 100) of each species was inspected for detailed fish condition information. Of all the categories looked at, partial descaling (3<>20%) was the most prevalent, ranging as high as 16% for hatchery steelhead. Frequency of other conditions was very low for all species (Appendix B, Table 2). Gas bubble disease symptoms were seen on a small percentage (<2%) of all species in the samples from 5 May - 4 June.

Length Frequency

In conjunction with the fish condition subsampling described above, average lengths are derived for each species. On average, hatchery steelheadwere longer than wild, 218 and 189mm respectively, and "bright" subyearling chinook were longer than "tules", 112 and 83mm respectively (Figure 15).

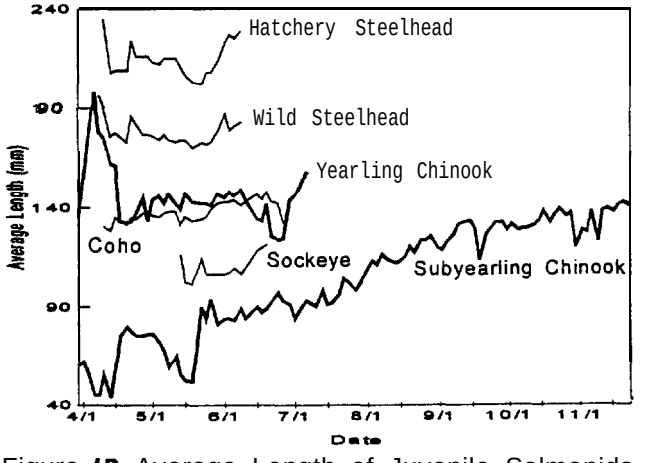

Figure 15. Average Length of Juvenile Salmonids at Bonneville Dam, 1993.

Freeze Brands and PIT Tass

A total of 782 brands were detected and recorded from the PH1 samples with 89% of those found on yearling and subyearling chinook (Table 1). A total of 158 PIT tags were detected in the samples at PH1, which is about 0.07% of all the sampled fish. A summery of PIT recapture detail at PH1 is presented in Appendix B, Table 2.

Brand Recovery Tests

Continuing tests to evaluate brand recognition and recording efficiency of fish handlers were conducted at Bonneville Dam in 1993. A total of 17 recovery tests were conducted using 10 fish per test. In all, 107 yearling chinook, 27 hatchery steelhead and 36 Coho were used for a total of 170 test fish. Each test usually consisted of a mix of the three species used. These fish were collected from the PH2 samples, 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. After 48 hours, test fish were introduced into the PH1 holding tank prior to the end of a sample period. Of the 17 tests, 10 were conducted without the crews prior knowledge. Table 12 summarizes the combined brand detection test results.

Table 12. Brand detection efficiency test results, 1993.

Species	Brands Released	Brands Recovered	Percent Recovered
Yearling Chinook	107	101	94%
Hatchery Steelhead	27	23	85%
Coho	36	31	86%
Total	170	155	91%

Fish handlers at Bonneville Dam were able to detect and properly record 155 of 170 branded salmonids introduced into the PH1 holding tank for a detection rate of 91%.

These tests may have been compromised due to poor brand quality on test fish. Out of 390 fish branded, only 170, or 56%, were readable. Of the 170 branded fish used, 30 brands, or almost 18% were of "questionable" quality. However, this approximates "in-river" brand conditions and makes the test more realistic.

Fry Incidence

Sample catches for subyearling chinook fry and coho fry (<60mm) were 5,641 and 64, respectively. Approximately 4.3% of all subyearling chinook and 0.23% of all coho captured were fry. Chinook fry were captured from 17 March to 27 July with the majority passing in late March, early May and early June. Coho fry

were captured between 29 April and 14 May with the majority passing between 7 and 14 May.

Adult Incidence

Although the PH1 trap is designed to exclude adults, 4 adult chinook were recorded as incidentals during the 1993 season. These fish were evidently small enough to fit through the size separator bars and are proof of a fallback situation occurring at PH1.

Incidental Catch

The total catch of incidental non-salmonid species for the season is presented in Appendix C, Table 2.

American Shad (Alosa sapidissima) juvenile collection count began increasing in the PH1 samples in late August and peaked on 31 October (Appendix C, Figure 2). The cumulative juvenile shad collection count for 1993 was only 297,725, compared to 4,504,033 for 1992. This discrepancy is probably due to the removal of the submersible traveling screens after July 6 at PH1.

Table 13. Adult and juvenile shad collection totals at Bonneville Dam, 1989-1993.

	AMERICAN SHAD		
YEAR	ADULTS	JUVENILES	SAMPLE HRS.
1989	3,105,300	435,441	8
1990	4,012,000	2,934,762	8
1991	2,363,100	1,481,768	8
1992	3,073,000	4,504,033	24
1993	2,154,938	297,725	24 w/o STS's

Pacific Lamprey (Entosphenus tridentatus) juveniles appeared in PH1 samples in low numbers from the start of sampling to July (Appendix C, Figure 4). Collections totalled 6,204 fish for 1993. Collection counts for 1992, 91 and 90 were 526, 4,568 and 1780, respectively.

ACKNOWLEDGMENTS

Support for this 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 John Day 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 Diane Carroll at Bonneville Dam, Tom Shearer and Ritchie Graves at John Day Dam, and Doug Frantum for keeping the airlift operating and Sue Killins for keeping us "on and in" line.

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APPENDIX A
JOHN DAY DAM - 1993

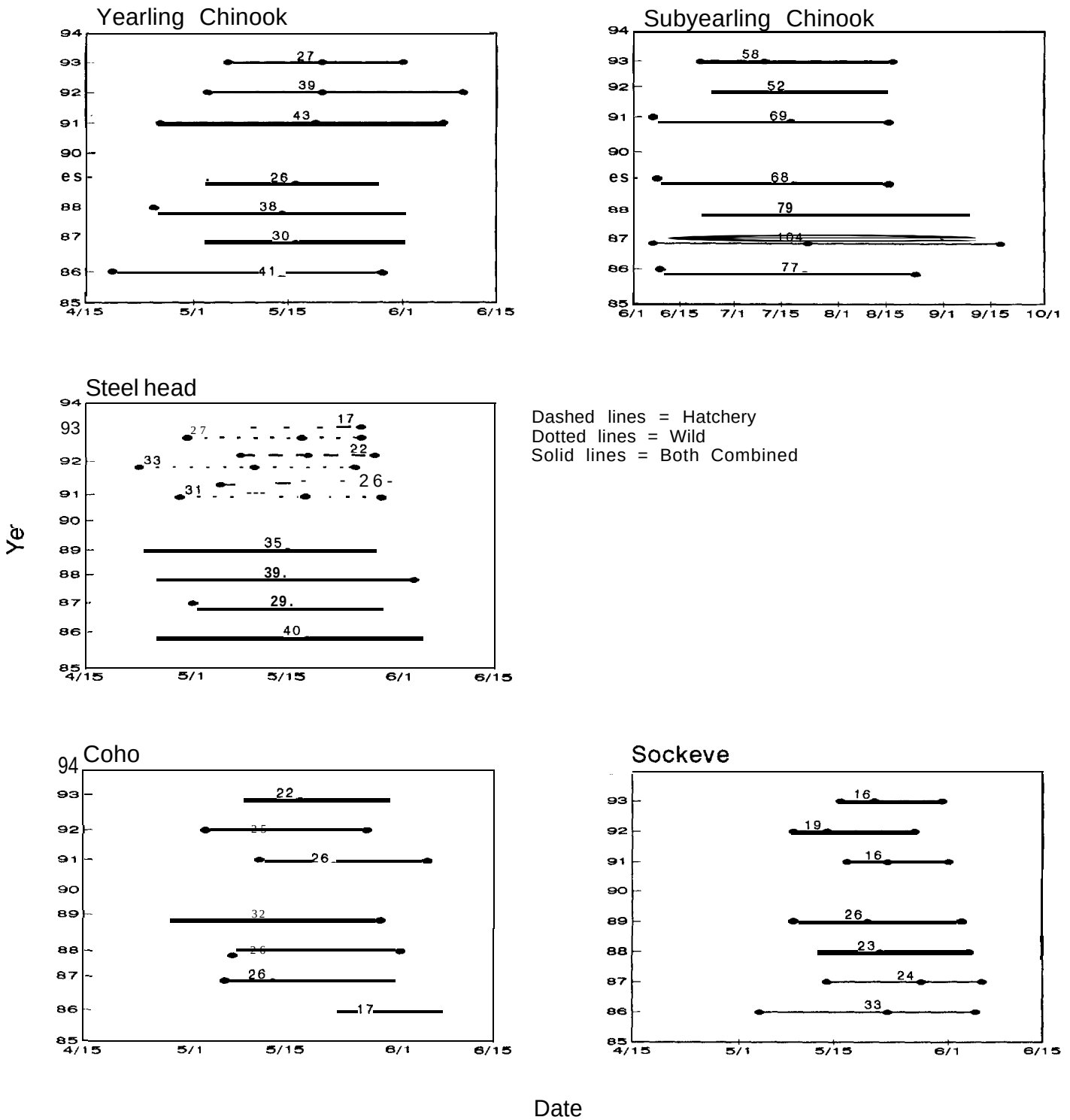

Figure 1. 10%, 50%, and 90% Passage Dates for each season at John Day Dam, by species, 1986-1993. The duration between 10-90% dates (in days) are indicated above each line. (No passage dates were calculated for 1990 due to biased sample season.)

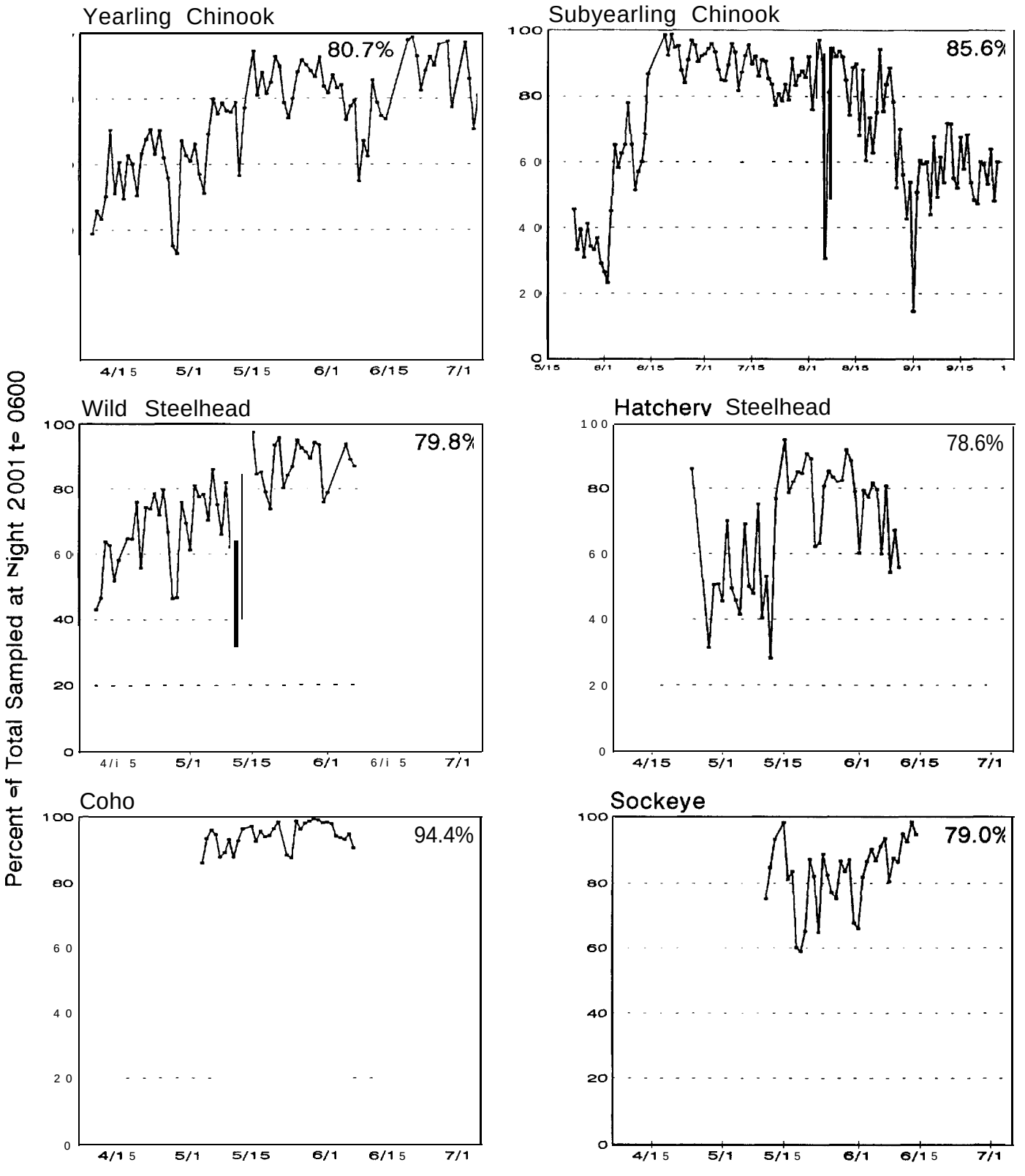

Figure 2. Percent of daily total sampled at night, 2001 - 0600 hours, (P.D.T.) at John Day Dam. Daily samples < 35 were excluded. The season Total Night Passage Percentage is indicated in the upper right corner.

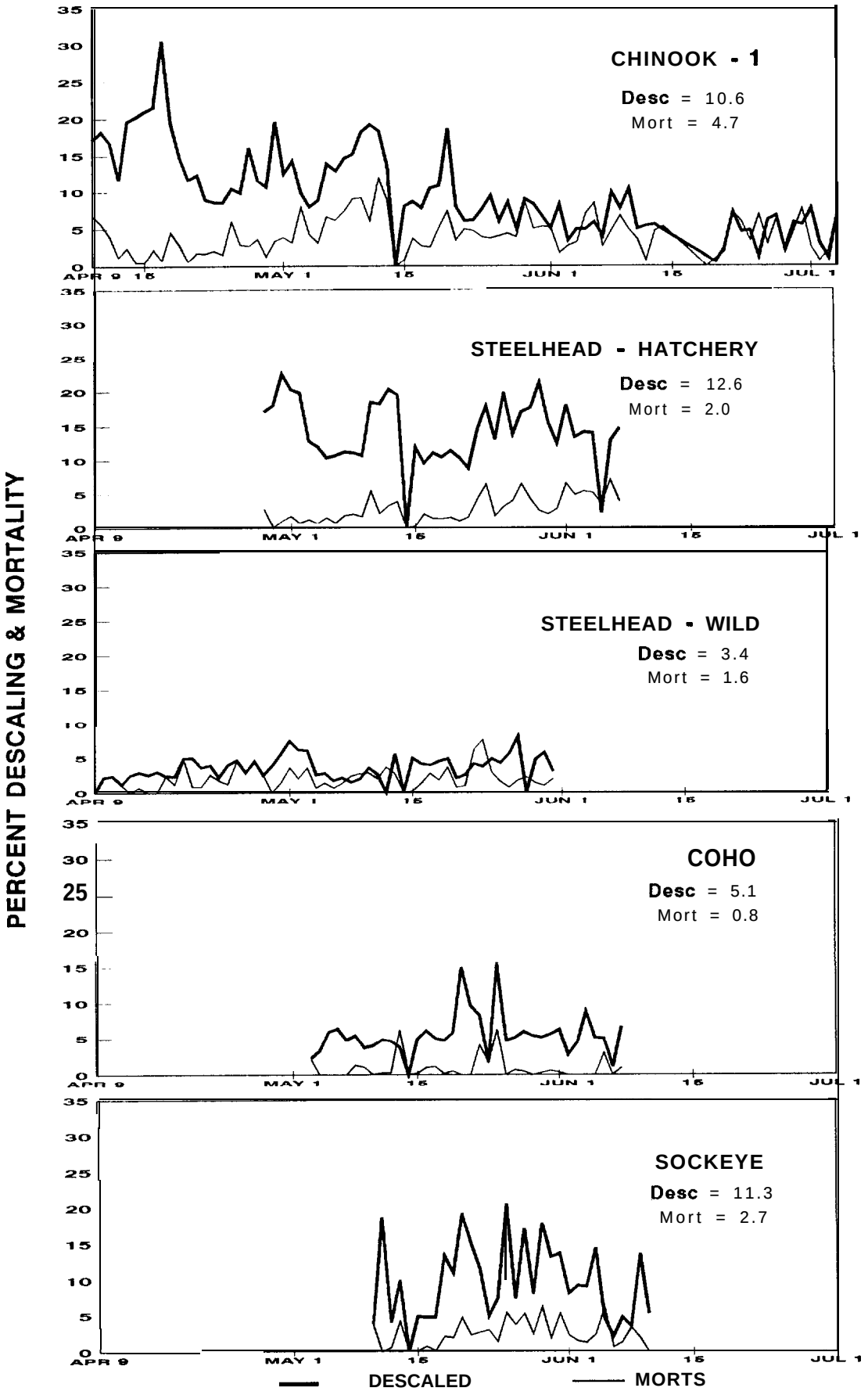

Figure 3. Daily Descaling and Mortality Rates for Spring Migrants at John Day Dam, 1993. Samples<35 were excluded. (Seasonal Descaling & Mortality is indicated on each graph.)

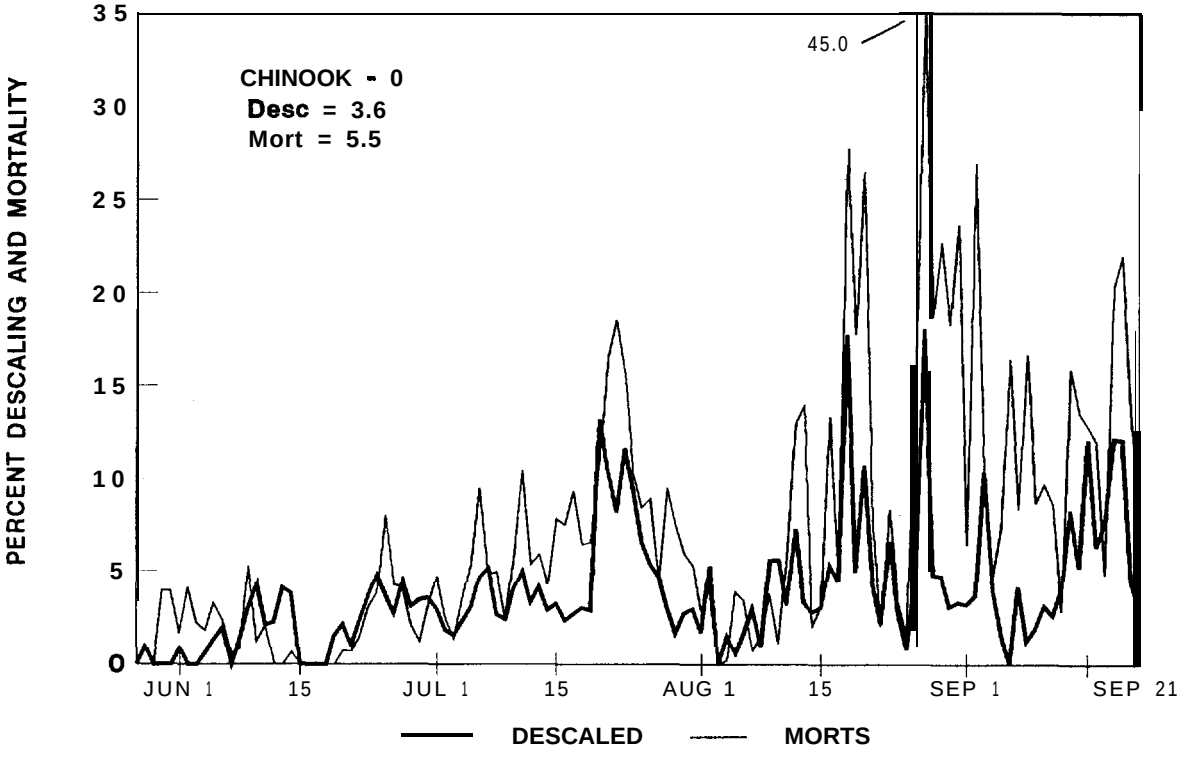

Figure 4. Daily Descaling and Mortality Rates for Subyearling Chinook at John Day Dam, 1993. Samples<35 were excluded.

(Seasonal Descaling & Mortality is indicated)

Table 1. PIT Tag recovery detail at John Day Dam, 1993.

RELEASE SITE	n	SPECIES	RUN	REARING	TRAVEL TIME IN DAYS Min TT	Max TT	AVG TT	Total km Upstream of JDA	Average Speed (km/day)
Big Canyon Fac.	10	Steelhead	Summer	Hatchery	21.6	27.6	24.3	596	24.5
Big Creek Hatchery	1	Chinook	Spring	Wild			288.5	826	2.9
Catherine Creek	2	Chinook	Spring	Wild	285.5	294.6	290.1	854	2.9
Clearwater River, SI	7	Steelhead	Summer	Hatchery	25.4	38.4	32.1	519	16.2
Clearwater Trap	2	Chinook	Unknown	Hatchery	21.6	24.9	23.3	409	17.6
	11	Steelhead	Summer	Hatchery	14.6	29.5	20.1		20.3
	2	Steelhead	Summer	Wild	10.7	16.6	13.7		29.9
Cle Elum River	6	Sockeye	Spring	Hatchery	14.1	24.9	18.2	491	27
	11	Sockeye	Spring	Hatchery	13.7	29.6	20.2		24.3
Columbia River	9	Chinook	Fall	Wild	33.6	100.8	64.9		
Crooked Fork Creek	3	Chinook	Spring	Wild	199.8	212.7	205.3	669	3.3
	2	Steelhead	Summer	Wild	15	19.4	17.2		38.9
Crooked River	2	Steelhead	Summer	Wild	281.6	658.6	470.1	613	1.3
Crooked River Trap	1	Chinook	Spring	Wild			67.7	614	9.1
Dworshak Hatchery	14	Chinook	Spring	Hatchery	14.5	42.6	28.2	464	16.5
	14	Steelhead	Summer	Hatchery	11.6	20.5	14.6		31.8
Entiat Hatchery	3	Chinook	Spring	Hatchery	43.9	54.7	47.8	448	9.4
Hazard Creek	5	Steelhead	Summer	Hatchery	24.3	37.4	28.3	649	22.9
Hells Canyon Dam	4	Steelhead	Summer	Hatchery	19.5	29.3	23.9	572	23.9
Imnaha River	3	Steelhead	Summer	Hatchery	14.3	19.1	17.5	483	27.6
	2	Steelhead	Summer	Wild	8.1	11.1	9.6		50.3
Imnaha River, W	10	Chinook	Summer	Hatchery	32.6	38.7	35.7	557	
Johnson Creek	1	Chinook	Spring	Wild			279.1	777	2.8
Knox Bridge	5	Chinook	Summer	Hatchery	27.4	58.5	42.3	805	19
Kooskia Hatchery	4	Chinook	Spring	Hatchery	28.4	33.7	31.3	524	16.7
Leavenworth Hatchery	11	Chinook	Spring	Hatchery	24.2	36.3	29	453	15.6
Lemhi River	2	Steelhead	Summer	Hatchery	32.4	33.4	32.9	894	27.2
Lemhi Weir	2	Chinook	Spring	Wild	20.9	238	129.5	943	7.3
Little Goose Dam	84	Chinook	Spring	Hatchery	5.1	11.4	7.8	288	36.9
	10	Chinook	Unknown	Hatchery	6.4	13.4	10		28.8
	23	Steelhead	Summer	Hatchery	5	15.6	8.2		35.1
	10	Steelhead	Summer	Wild	5.1	9.1	6.7		43
Little Sheep Fac	13	Steelhead	Summer	Hatchery	18.7	29.9	23.8	528	22.2
Lolo Creek	3	Chinook	Spring	Wild	14.9	243.9	151.2	486	3.2
	3	Steelhead	Summer	Wild	15.1	17	16		30.4
Lookingglass Hatchery	4	Chinook	Spring	Hatchery	30.5	37.5	33.3	583	17.5
Lostine River	2	Chinook	Spring	Wild	261.1	276.6	268.9	619	2.3
Lower Granite Dam	24	Chinook	Spring	Hatchery	7.2	19.3	11.1	348	31.4
	3	Chinook	Spring	Hatchery	14.3	14.4	14.4		24.2
Lower Monumental Dam	7	Chinook	Spring	Hatchery			Unknown	242	
	16	Steelhead	Summer	Hatchery			Unknown		
Marsh Creek	3	Chinook	Spring	Wild	29.1	60	40.3	967	24
	1	Steelhead	Summer	Wild			22		44
Pahsimeroi Pond	3	Steelhead	Summer	Hatchery	27.4	28.3	27.8	978	35.2
Pahsimeroi River	5	Steelhead	Summer	Hatchery	35.3	40.5	37.6	967	25.7
Rapid River Hatchery	9	Chinook	Spring	Hatchery	22.5	43.6	30.8	631	20.5
Red River	3	Chinook	Spring	Wild	44	56.9	51.3	620	12.1
Red River Rearing Pond	1	Chinook	Spring	Hatchery			225.2	647	2.9
Relief Creek	1	Chinook	Spring	Wild			288.9	626	2.2
Rock Island Dam	6	Chinook	Unknown	Hatchery	8.5	46.4	16.4	383	23.4
	15	Chinook	Unknown	Unknown	6.3	84.4	30.9		12.4
	18	Steelhead	Summer	Hatchery	6.6	20.9	10.6		36.1
	5	Steelhead	Summer	Wild	6.4	16.5	10.9		35.1
	19	Sockeye	Unknown	Wild	6.2	22.3	13.1		29.2
Salmon River	1	Chinook	Spring	Hatchery			45.8	478	10.4
	2	Steelhead	Summer	Hatchery	18.5	37.5	28		17.1
	1	Steelhead	Summer	Wild			22		21.7
Salmon River, E FK	2	Steelhead	Summer	Hatchery	42.3	44.4	43.4	1030	23.7
Salmon River, N FK	2	Steelhead	Summer	Hatchery	30.6	31	30.8	859	27.9
Salmon River, S FK	8	Chinook	Summer	Hatchery	42.9	61.8	51.6	693	13.4
	1	Chinook	Spring	Wild	44.8	240.7	163.4		4.2
	3	Chinook	Summer	Wild			294.5		2.4
Salmon River Trap	15	Chinook	Unknown	Hatchery	16.6	36.8	26.1	563	21.6
	13	Chinook	Unknown	Wild	12.6	50.5	27.7		20.3
	19	Steelhead	Summer	Hatchery	9.6	33.2	18.5		30.4
	5	Steelhead	Summer	Wild	8.6	15.2	12.5		45
Sawtooth Hatchery	3	Steelhead	Summer	Hatchery	38.4	50.5	45.2	1095	24.2
Snake River	30	Chinook	Spring	Hatchery	17.5	32.5	25	175	7
Snake Trap	10	Chinook	Unknown	Hatchery	8.5	38.2	18.3	400	21.9
	5	Chinook	Unknown	Wild	11.7	29.4	17.9		22.3
	27	Steelhead	Summer	Hatchery	7.6	335.3	27.5		14.5
	28	Steelhead	Summer	Wild	6.6	22.9	10.5		38.1
Turtle Rock Hatchery	2	Chinook	Fall	Hatchery	46	52.8	49.4	418	8.5
Wallowa Hatchery	5	Steelhead	Summer	Hatchery	25.8	39.5	32.3	641	19.8
Wells Hatchery, WDF	1	Chinook	Summer	Hatchery			39.6	483	12.2
Wenaha River, S FK	1	Chinook	Spring	Wild			254.4	554	2.2
Winthrop Nat. Fish Hatcher	5	Chinook	Spring	Hatchery	31.5	43.5	36.7	577	15.7
	629								

Table 2 Summary of smolt condition subsampling for 1993 at John Day Dam, expressed as percents.

Species	Sample Size	Partial Desc. (3-20%)	Condition						
			Injury	Gill	Fungus	Bird	Para	Colu	GBD
Chin-l	3995	16	3	1	<.5	1	c.5	<.5	<.5
Chin-O	4046	10	3	<.5	2	<.5	<.5	7	0
Sthd-W	2265	11	1	1	<.5	2	3	c.5	0
Sthd-H	2371	37	6	4	2	6	1	1	<.5
Coho	2166	8	1	1	<.5	1	<.5	<.5	<.5
Sockeye	1764	15	2	1	c.5	<.5	<.5	0	0
TOTALS	16607	16%	3%	1%	1%	2%	1%	2%	<.5%

Criteria for Subsampling

Partial Descaling: between 3 and 20% descaling on one side of the fish.

Injury: injury (cut, puncture, etc) to the eye, head, or body.

Gill: a folded or torn operculum (gill cover).

Fungus: presence of an external fungal infection.

Bird Mark: an injury inflicted by a bird.

Parasite: presence of an external parasite.

Columnaris: presence of yellow rimmed sores, ulcers, or open lesions on the body.

Gas Bubble Disease: presence of gas bubbles in the fins or head. All 4 levels of GBD are combined in this table,

Table 3 Interruptions in the sampling season due to Unit 3 shutdowns (in hours). Biased sample days are marked (*).

End Date	Batch #	Unit 3 outages (# of hours)	
5/05	93030	1	The hours that Gatewell 3B
5/13	93038	3	was out of operation are
5/14	93039	22 *	identical to those for
5/15	93040	14 *	Unit 3, i.e. 2210r 4.5% of
5/22	93047	2	the season.
5/26	93051	1	
6/15	93071	23 *	
6/16	93072	24 *	The hours that Gatewell 3C
6/17	93073	24 *	was out of operation equals
6/18	93074	24 *	1,145 or 23% of the season.
6/19	93075	16 *	This is because 3C was
7/08	93094	1	shut down from 0700 13 May
7/09	93095	1	to 0700 18 June for a total
8/03	93120	24 *	of 924 hours. Otherwise
8/04	93121	8 *	its hours out of operation
9/01	93149	2	were identical to those of
10/06	93194	24 *	3B.
10/07	93185	7 *	
Total Hours Down		221 / 4,968 = 4.5% of season (3B).	

Sample Season (4/6 - 10/29).

APPENDIX B
BONNEVILLE DAM - 1993

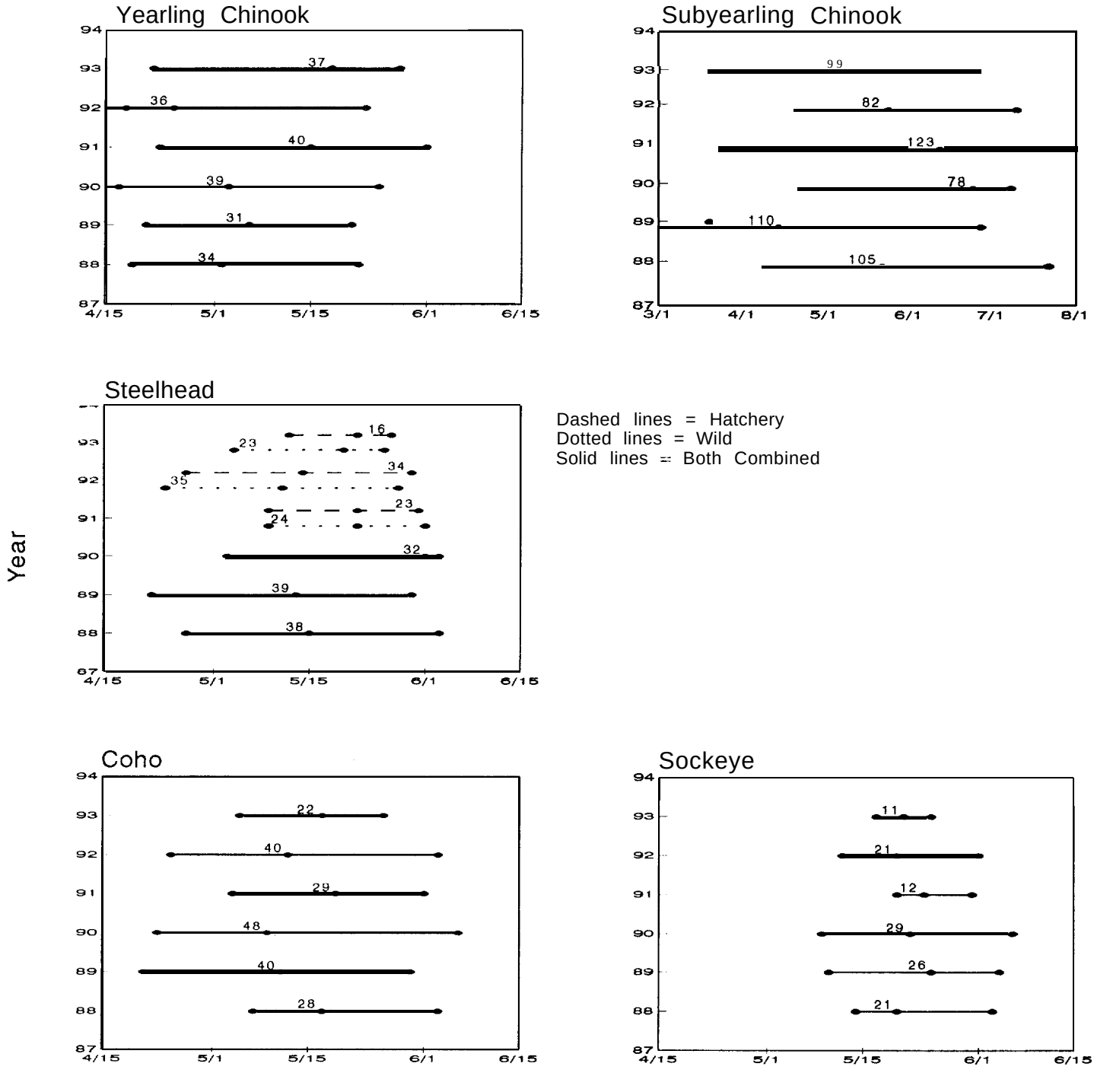

Figure 1. 10%, 50%, and 90% Passage Dates for each season at Bonneville Dam, by species, 1988-1993. The duration between 10-90% dates (in days) are indicated above each line.

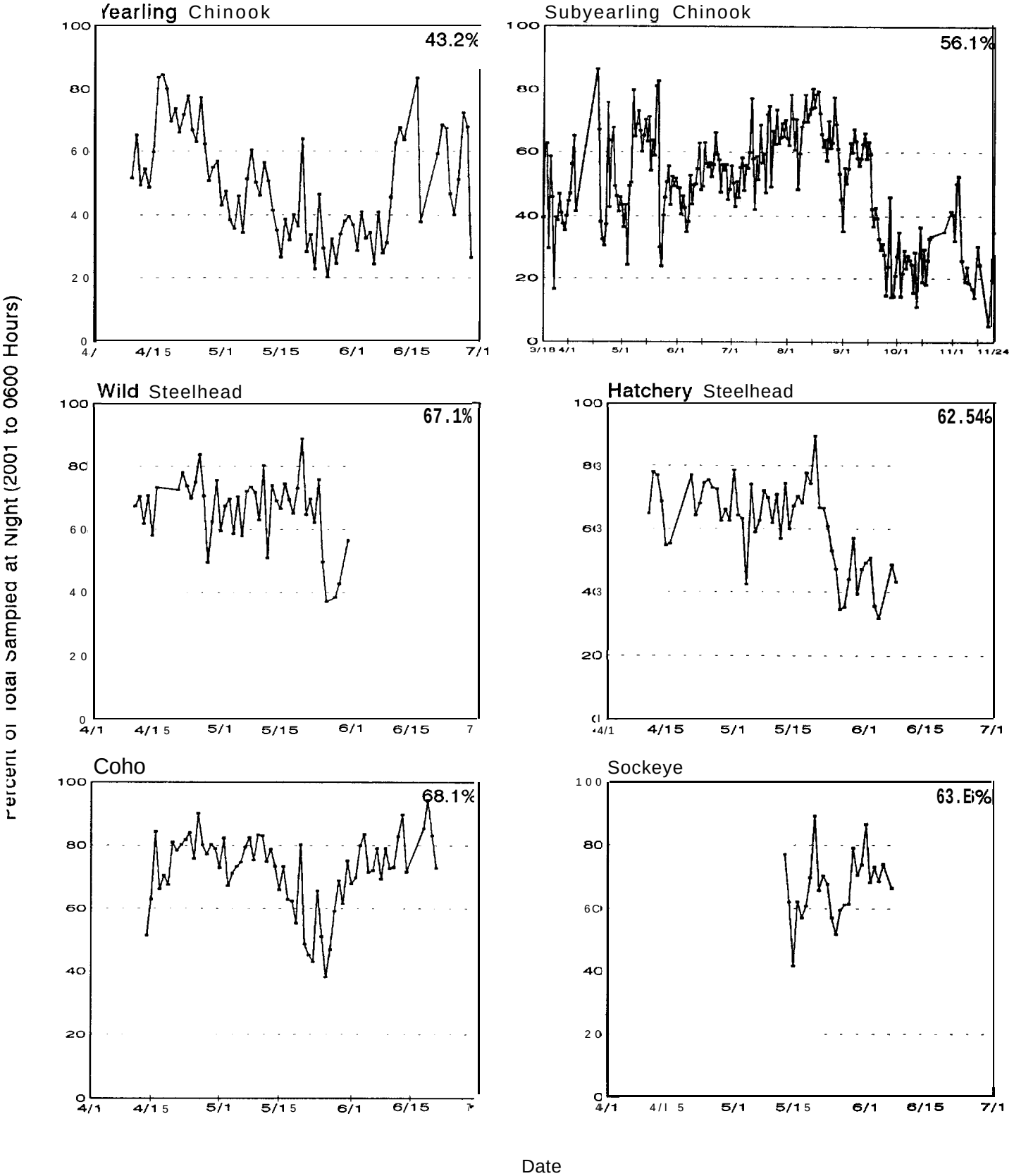

Figure 2. Percentage of daily total sampled at night, 2001 to 0600 hours, (P.D.T.) at John Day Dam. Daily samples < 35 were excluded. The season Total Night Passage Percentage is indicated in the upper right corner.

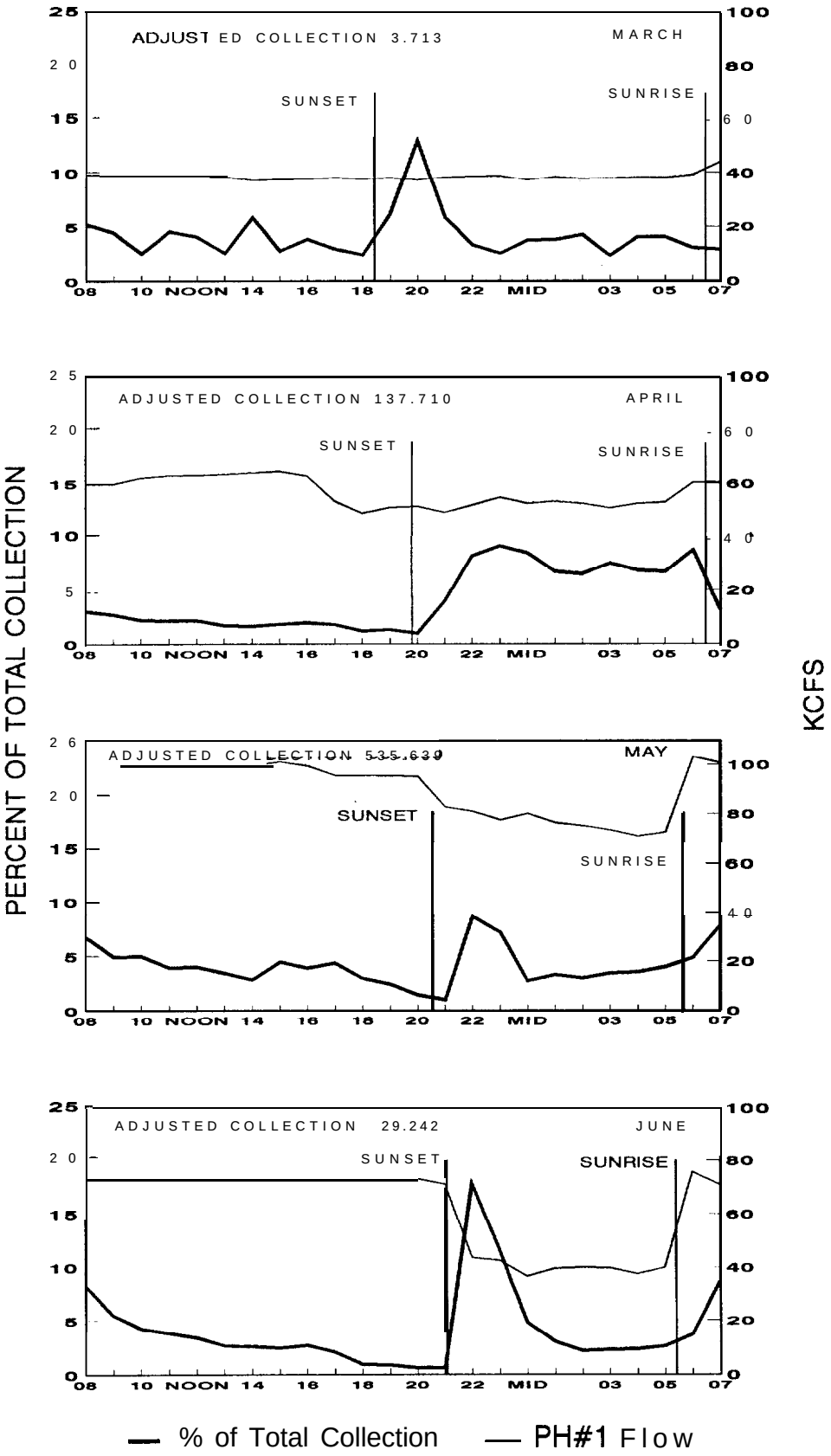

Figure 3. Monthly Diel Passge Patterns for Yearling Chinook at Bonneville Dam, PH#1, 1993.

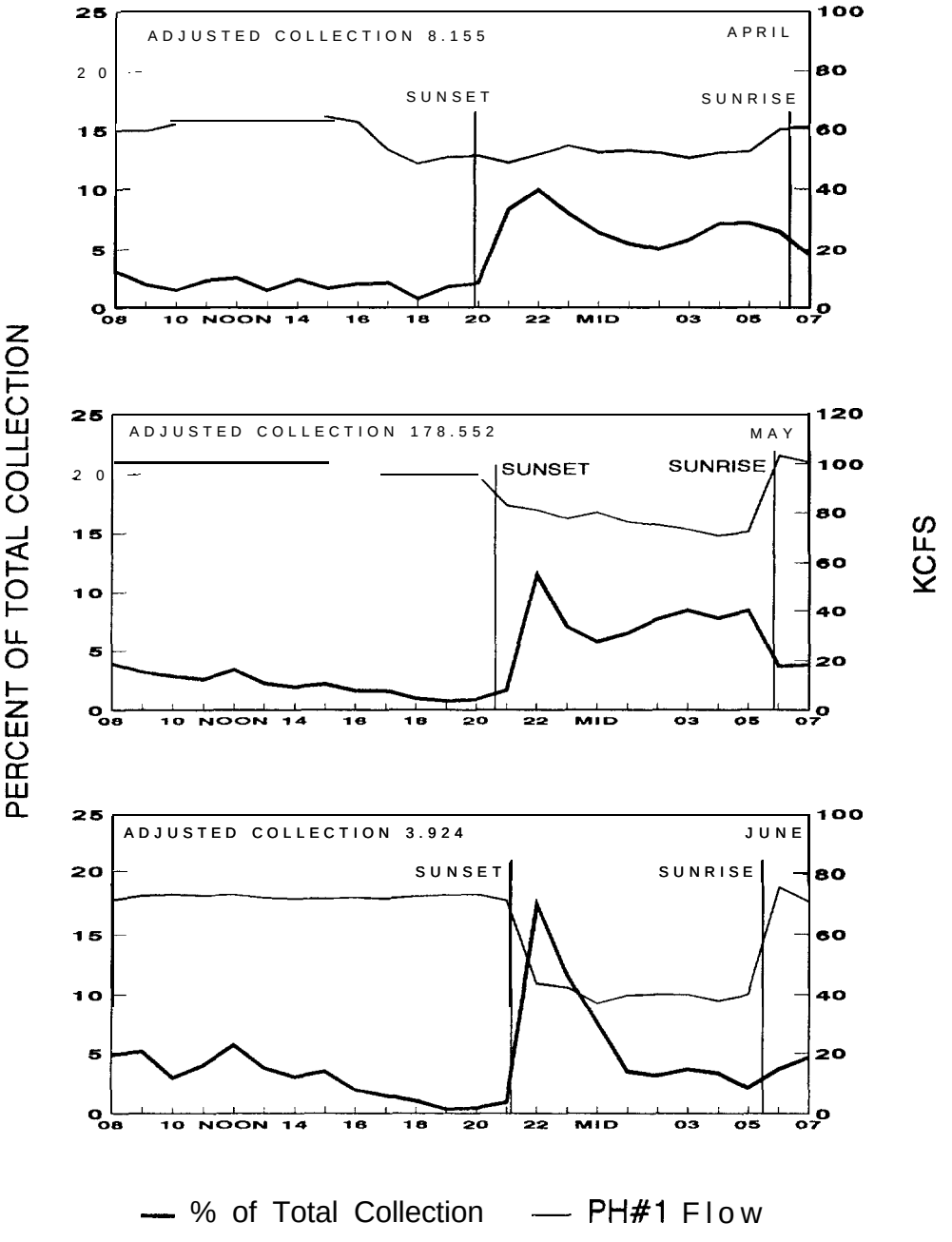

Figure 4. Monthly Diel Passage Patterns for Hatchery Steelhead at Bonneville Dam, PH#1, 1993.

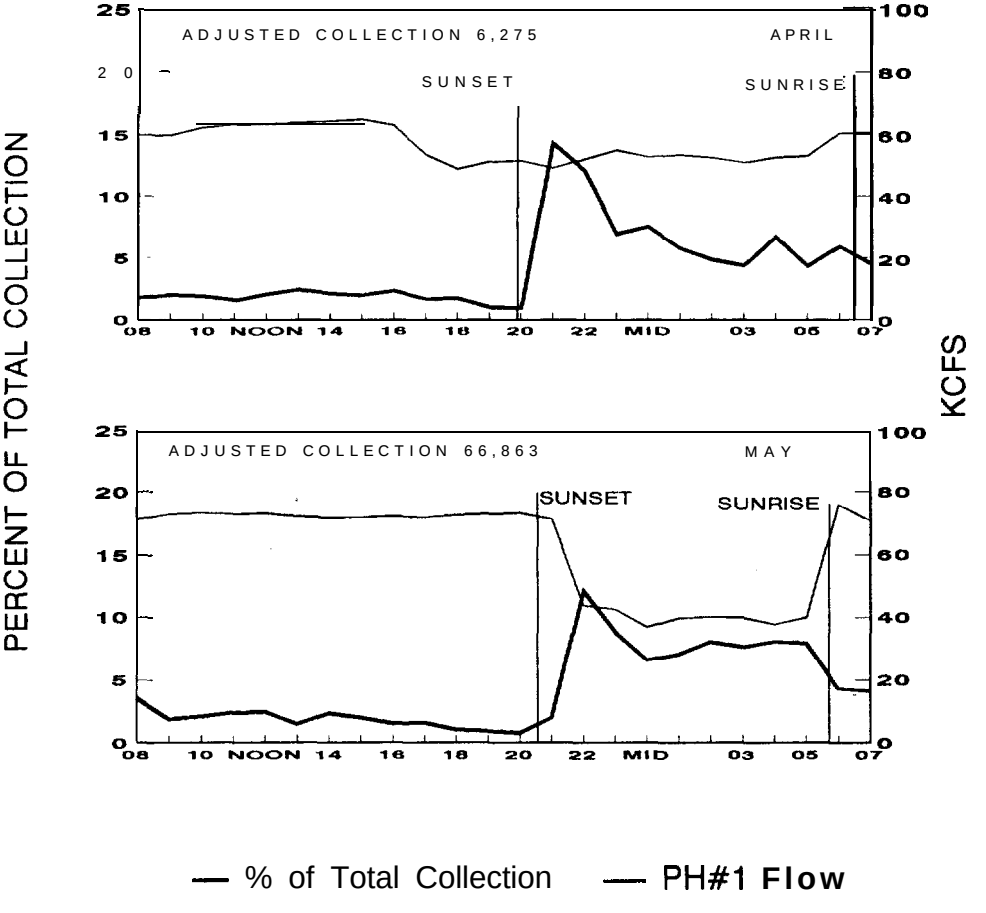

Figure 5. Monthly Diel Passage Patterns for Wild Steelhead at Bonneville Dam, PH#1, 1993.

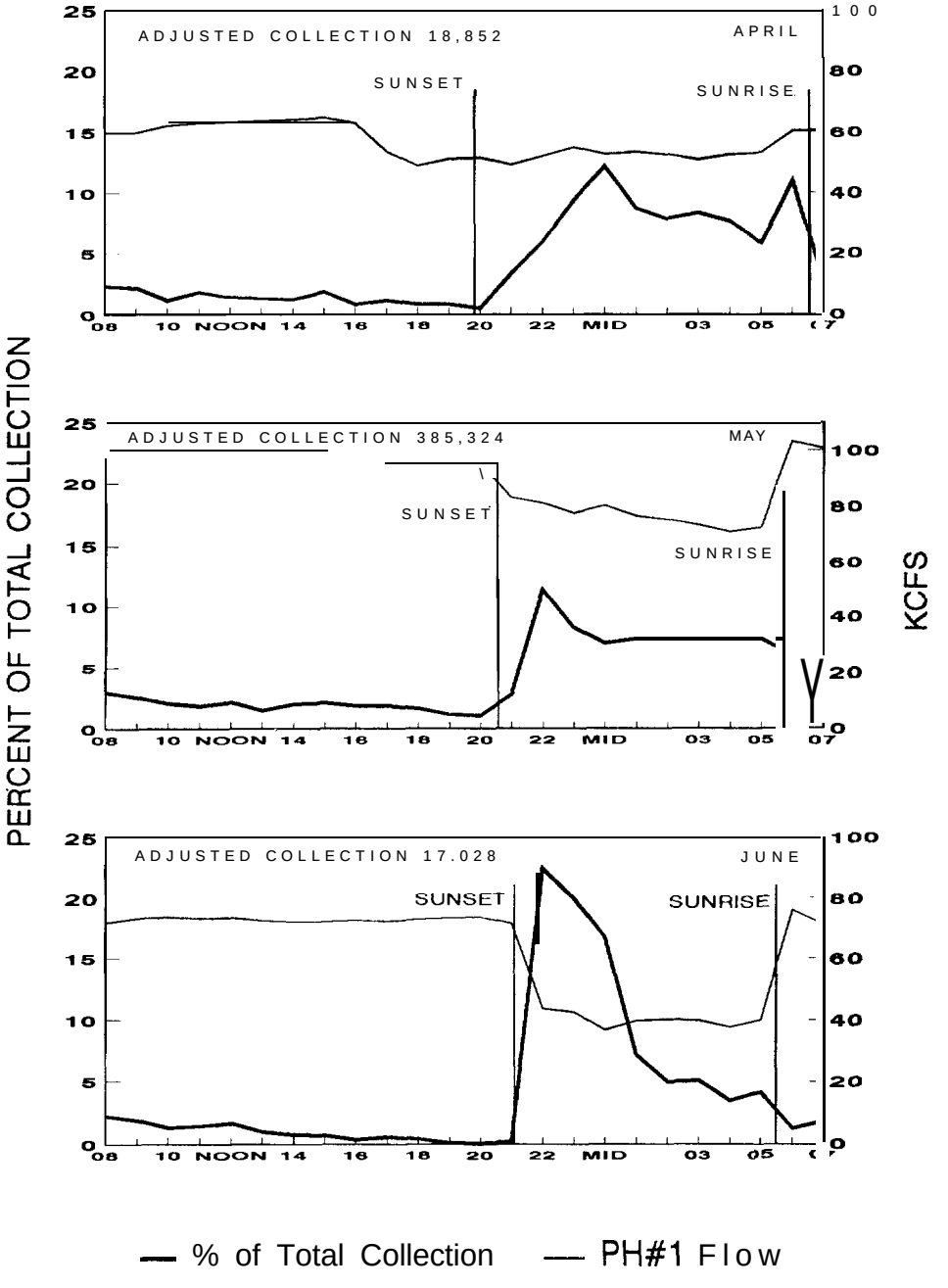

Figure 6. Monthly Diel Passage Patterns for Coho at Bonneville Dam, PH#1, 1993.

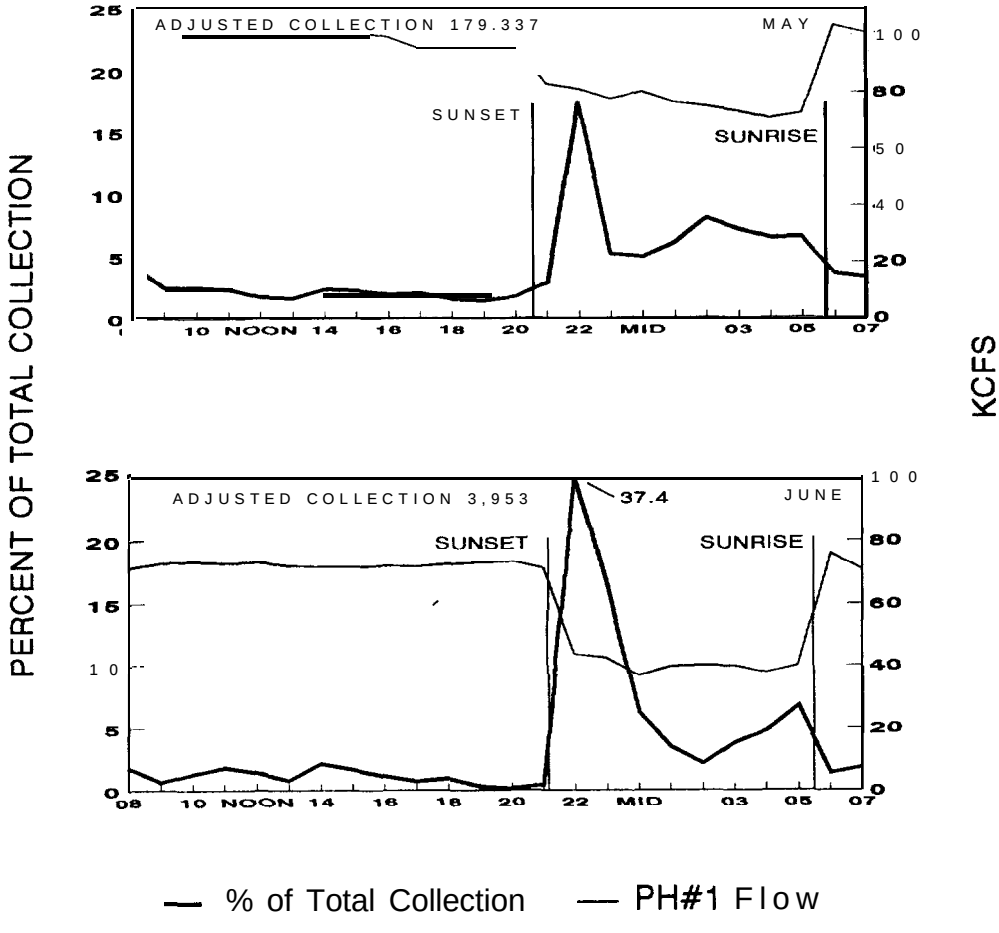

Figure 7. Monthly Diel Passage Patterns for Sockeye at Bonneville Dam, PH#1, 1993.

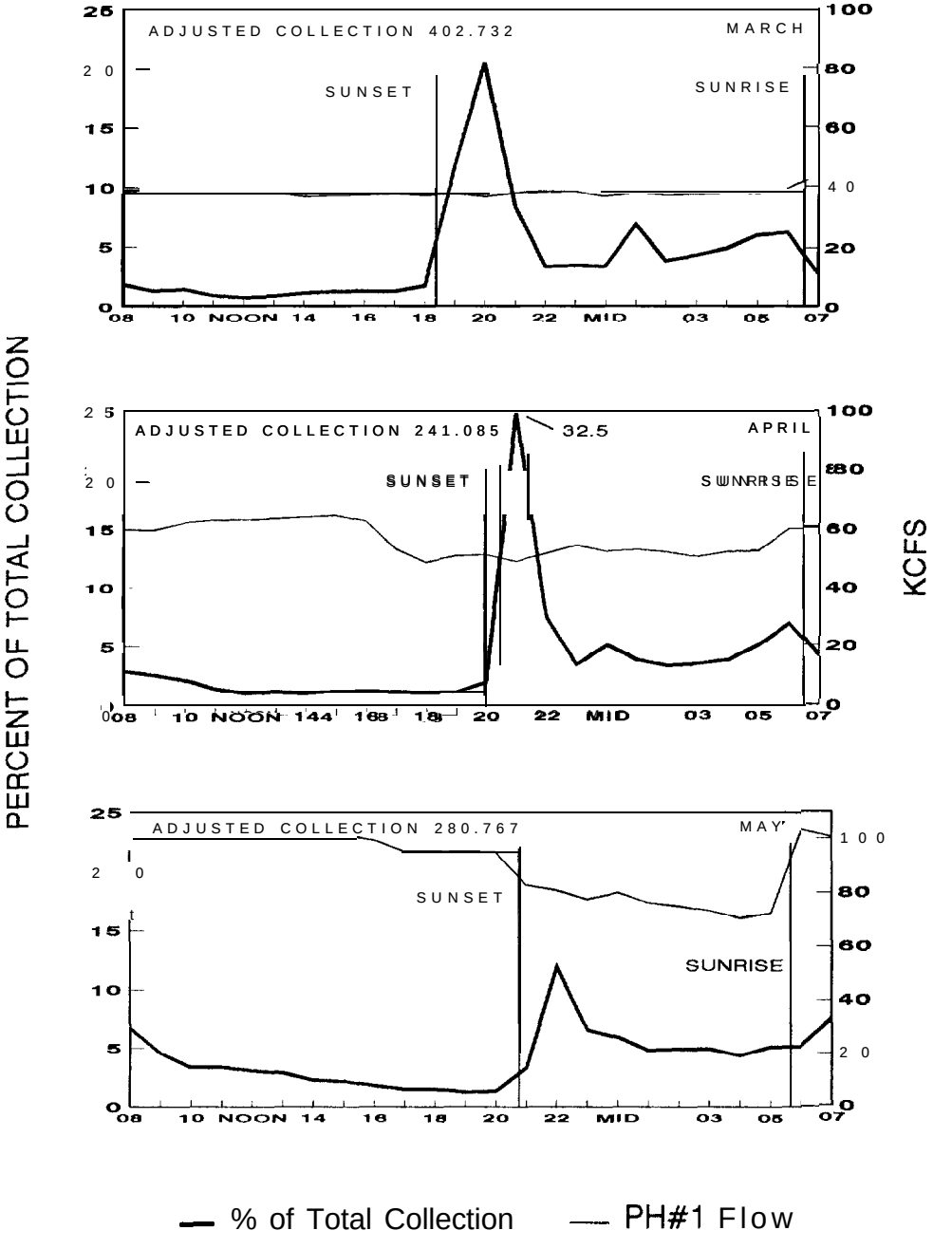

Figure 8. Monthly Diel Passage Patterns for "Tule" Subyearling Chinook at Bonneville Dam, PH#1, 1993.

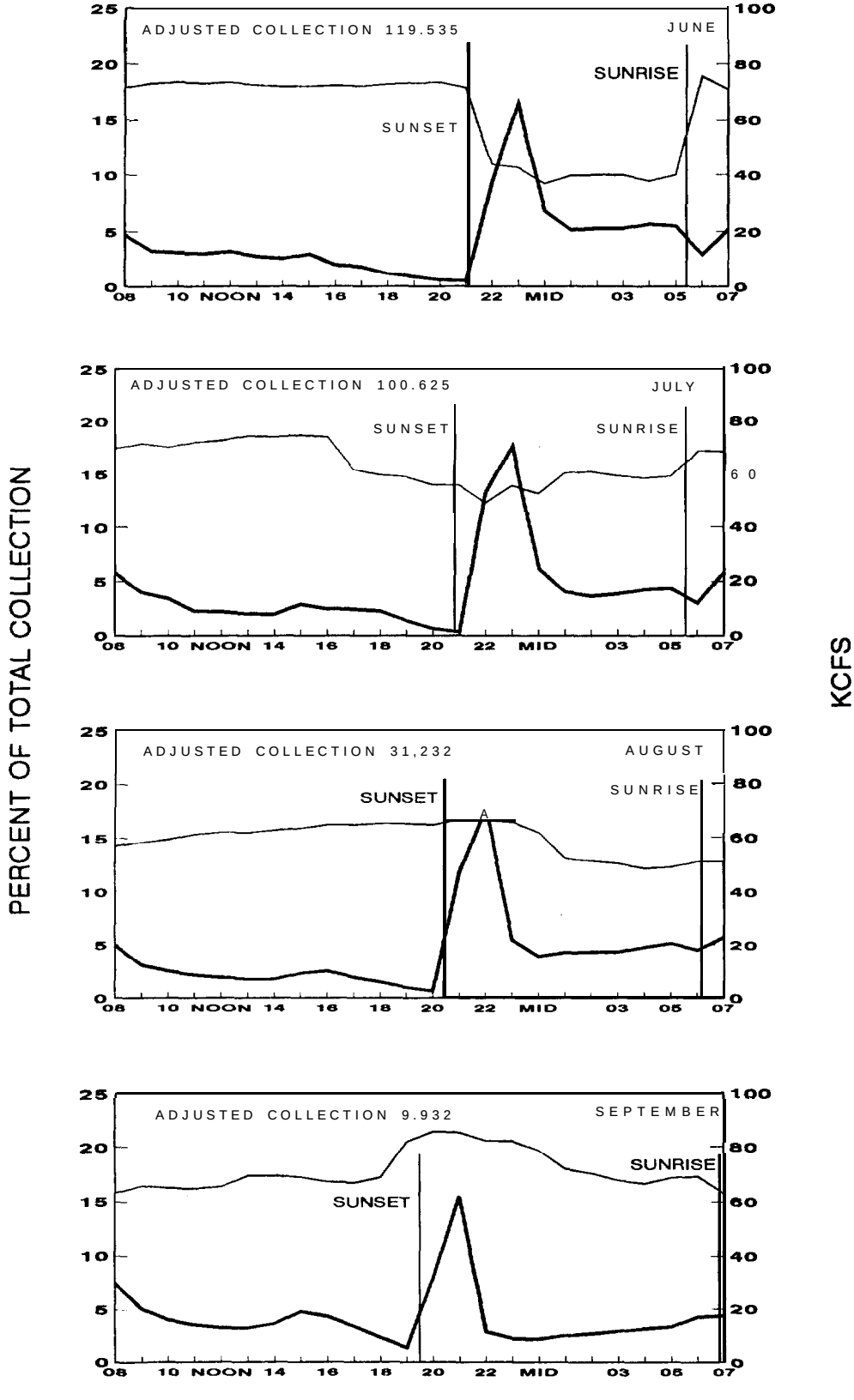

Figure 9. Monthly Diel Passage Patterns for "Upriver Bright" Subyearling Chinook at Bonneville Dam, PH#1, 1993.

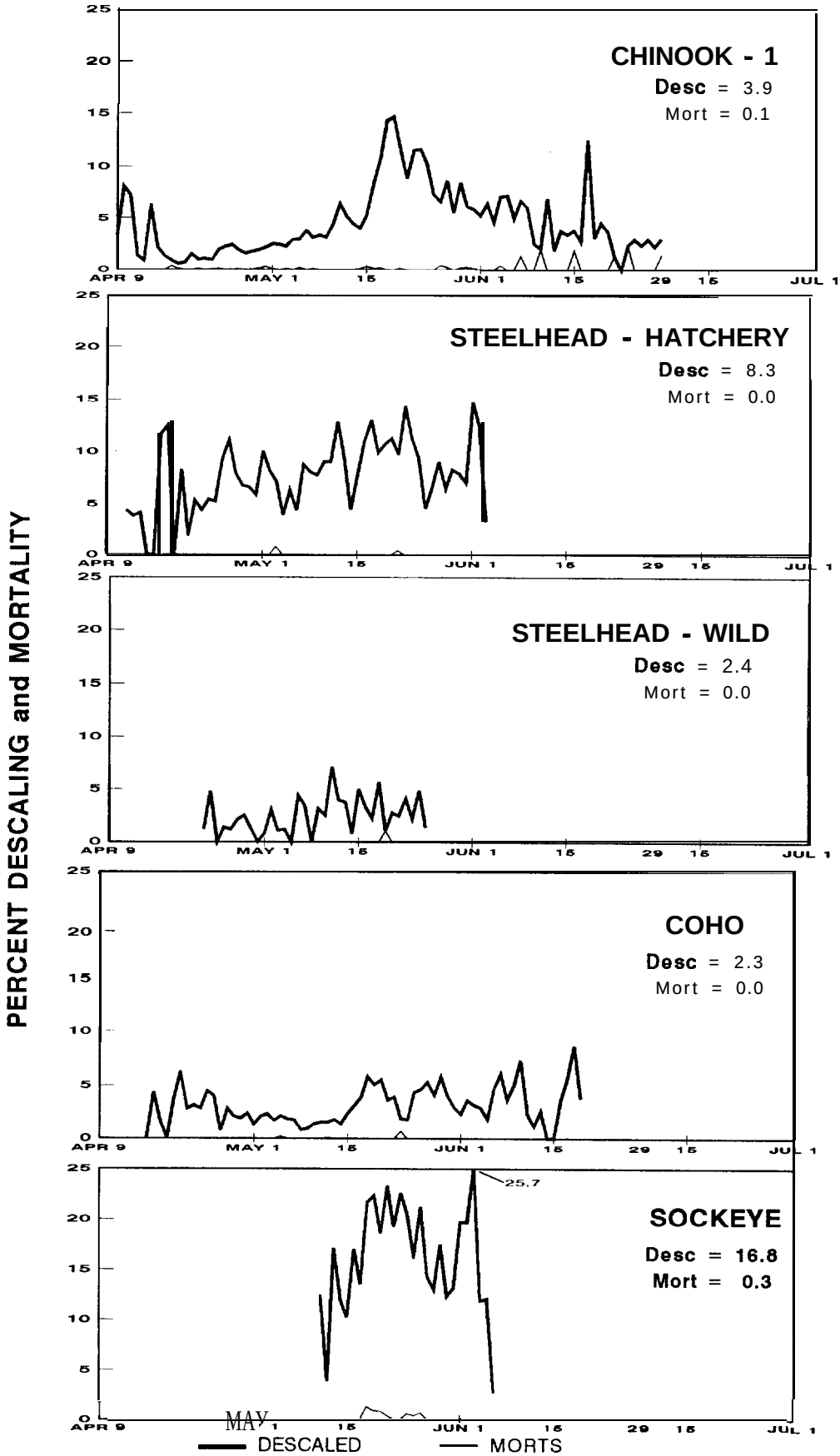

Figure 10. Daily Descaling and Mortality Rates for Spring Migrants at Bonneville Dam, 1993. Daily samples<35 were excluded.
(Seasonal Descaling & Mortality is indicated on each graph.)

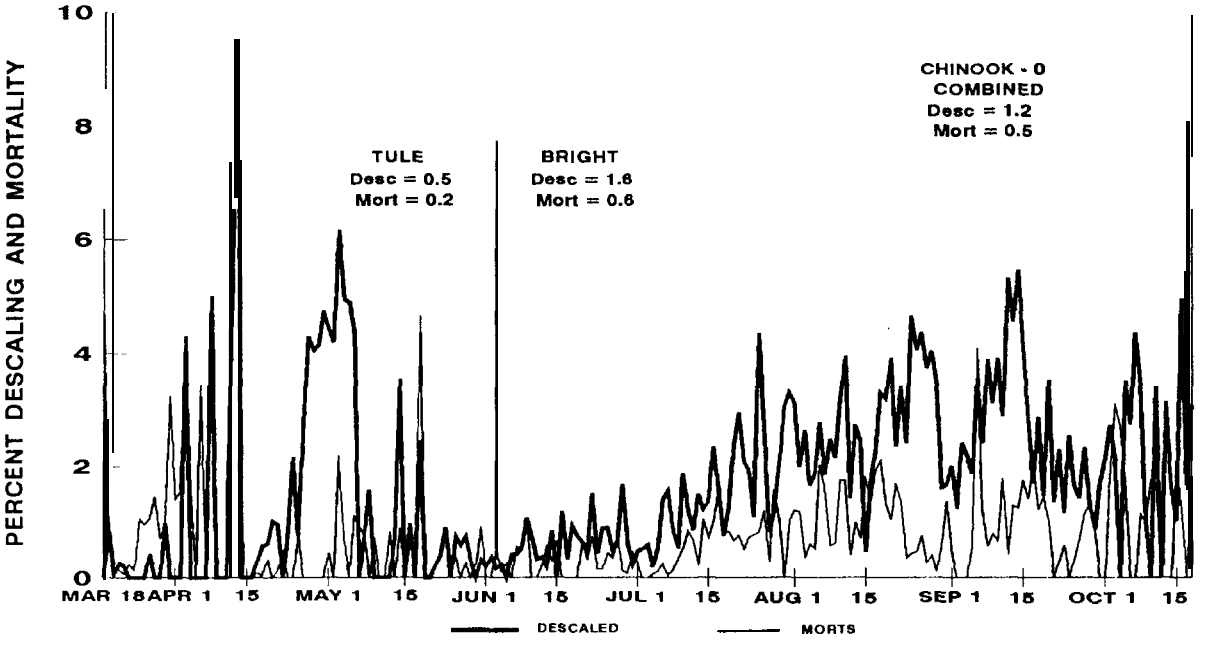

Figure 11. Daily Descaling and Mortality Rates for Subyearling Chinook at Bonneville Dam, 1993. Daily samples<35 were excluded.

(Seasonal Descaling & Mortality is indicated)

Table 1. PIT Tag recovery detail at Bonneville Dam, 1993.

RELEASE SITE	n	SPECIES	RUN	REARING	TRAVEL TIME IN DAYS Min TT	Max TT	AVG TT	Total km Upstream of BON	Average Speed (km/day)
Big Canyon Fac	1	Steel head	Summer	Hatchery			29.4	709	24.1
Clearwater Trap	2	Chlnook	Unknown	Hatchery	36.6	36.5	37.7	522	13.6
Cle Elum River	6	Sockeye	Spnng	Hatchery	16.9	32	21.2	604	26.6
Columbia River	2	Chinook	Fall	Wild	44.6	76.2	60 4		
Crooked Creek	1	Chinook	Spring	Hatchery			227.2	782	3.4
	2	Chlnook	Spnng	Wild	245.5	246.7	246.1		2.2
Dworshak Hatchery	8	Chinook	Spnng	Hatchery	16.2	44	25.6	577	22.4
	1	Steelhead	Summer	Hatchery			20.6		27.7
Hells Canyon Dam	1	Chinook	Spring	Hatchery			32 7	685	20.9
Johnson Creek	1	Chlnook	Summer	Wild			267.4	890	3.1
Knox Bridge	2	Chlnook	Summer	Hatchery	32.6	50 3	41 5	918	22.1
Kooskia Hatchery	1	Chlnook	Unknown	Hatchery			23.2	637	27.5
Leavenworth Hatchery	4	Chlnook	Spring	Hatchery	27.9	41.7	37.4	566	15.1
Lemhi Weir	3	Chlnook	Spnng	Wild	20.3	219.3	91.9	1056	11.5
Little Goose Dam	24	Chinook	Spring	Hatchery	6.5	13.6	9.3	401	43.1
	8	Chlnook	Unknown	Hatchery	9.1	13.1	10.8		37.1
	1	Steelhead	Summer	Hatchery			7.1		56.4
Little Sheep Fac.	2	Steelhead	Summer	Hatchery	21.4	21.6	21.6	641	29.7
Lolo Creek	3	Chlnook	Spring	Wild	17.4	307.3	175.5	599	3.4
Lower Granite Dam	17	Chlnook	Spnng	Hatchery	8.6	24.5	14	461	32.9
Lower Monumental Dam	1	Chlnook	Spnng	Hatchery			Unknown	355	
Lostine River	1	Chlnook	Spnng	Wild			269.6	732	2.7
Marsh Creek	1	Chinook	Spring	Wild			33.9	1080	31.9
Pahsimeroi Pond	1	Chinook	Summer	Hatchery			36.7	1091	29.7
Rock Island Dam	2	Chinook	Unknown	Hatchery	12.4	55.4	33 9	496	14.6
	9	Chinook	Unknown	Unknown	11.6	53.3	27.2		16.2
	6	Steelhead	Summer	Hatchery	7.4	26.6	12.3		40.3
	1	Steelhead	Summer	Wild			6.9		55.7
	1	Steelhead	Summer	Unknown			12.5		39.7
	4	Sockeye	Unknown	Wild	6.5	29.7	17.3		28.7
Salmon River	1	Chinook	Spring	Wild			203.5	591	2.9
Salmon River, E FK	1	Chlnook	Spnng	Hatchery			51.9	1143	22.0
Salmon River, E FK W	1	Chinook	Spring	Wild			24.4	1173	48.1
Salmon River, N FK	1	Chlnook	spring	Wild			306.3	972	3.2
Salmon River, S FK	3	Chinook	Summer	Hatchery	51 4	66.6	56.6	806	14.1
Salmon River Trap	1	Chlnook	Unknown	Hatchery			15.9	676	42.5
	2	Steelhead	Summer	Hatchery	12 9	15.2	14 1		47.9
Sawtooth Hatchery	1	Chinook	Spring	Hatchery			241	1206	5.0
	1	Steelhead	Summer	Hatchery			46		26.3
Sawtooth Trap	1	Chlnook	Spnng	Wild			245	1208	4.9
Snake River	IO	Chlnook	Spnng	Hatchery	20.1	33.6	27.6	288	10.4
Snake River Trap	2	Chinook	Uknown	Hatchery	16.5	31.3	23.9	513	21.5
	6	Chinook	Unknown	Wild	13.7	25.1	17.3		29.7
	3	Steelhead	Summer	Hatchery	12.8	17.4	14.9		34.4
	4	Steelhead	Summer	Wild	8.4	16.6	10.6		47.5
Turtle Rock Hatchery	1	Chlnook	Fall	Hatchery			34.9	531	15.2
Wallowa Hatchery	1	Steelhead	Summer	Hatchery			26.5	754	26.5
Winthrop Nat. Fish Hatch	1	Chinook	Spring	Hatchery			27.3	690	25.3
	156								

Table 2 **Summary of smolt condition subsampling for 1993 at Bonneville Dam, expressed as percents.**

Species	Sample Size	Partial Desc (3-20%)	Condition						
			Injury	Gill	Fungus	Bird	Para	Colu	GBD
Chin-1	2934	14	3	1	1	1	1	0	<.5
Chin-O	8343	8	3	<.5	<.5	<.5	c.5	0	0
Sthd-W	1250	7	2	<.5	1	1	7	c.5	2
Sthd-H	1669	16	3	2	1	4	2	<.5	1
Coho	2227	5	2	<.5	1	c.5	c.5	<.5	0
Sockeye	940	24	3	2	<.5	<.5	c.5	0	<.5
TOTALS	17363	10%	3%	1%	1%	1%	1%	<.5%	<.5%

Criteria for Subsampling

Partial Descaling: between 3 and 20% descaling on one side of the fish.

Injury: injury (cut, puncture, etc) to the eye, head, or body

Gill: a folded or torn operculum (gill cover).

Fungus: presence of an external fungal infection.

Bird Mark: an injury inflicted by a bird.

Parasite: presence of an external parasite.

Columnaris: presence of yellow rimmed sores, ulcers, or open lesions on the body.

Gas Bubble Disease: presence of gas bubbles in the fins or head.
All 4 levels of GBD are combined in this table.

Table 3 Interruptions in the sampling season at DSM#1 first powerhouse sampler.

End Date	Reason for Outage	Hours Missed
Powerhouse #1		
04/19	**Trash sweep repairs & cable replaced**	2
04/29	**Trap structural repairs**	1
05/18	**Process pump failure**	4
05/19	Trap, **trash sweep, & inclined screen repairs**	9
05/27	**Trap cable replaced**	1
06/06	**Abnormal water flow**	3
06/22	**Trap cable replaced**	1
07/19	**Abnormal water flow & trap cable inspection**	1
07/27	**Trap cables replaced**	1
09/20	DSM#1 **electrical work**	3
10/04	**Trap cables replaced**	2
11/17	**Trap cable replaced**	4
04/21	**NMFS survival test**	4
04/22	**NMFS survival test**	1
04/23	**NMFS survival test**	2
04/29	**NMFS survival test**	1
05/06	**NMFS survival test**	4
07/20	**NMFS survival test**	4
07/22	**NMFS survival test**	5
07/29	**NMFS survival test**	1
10/27	**COE flow condition test**	1
10/28	**NMFS survival test**	4
10/29	**NMFS survival test**	1
11/01	**NMFS survival test**	2
11/02	**NMFS survival test**	2
11/03	**NMFS survival test**	1
11/04	**NMFS survival test**	1
	Total	**66**

APPENDIX C
INCIDENTAL CATCH - 1993

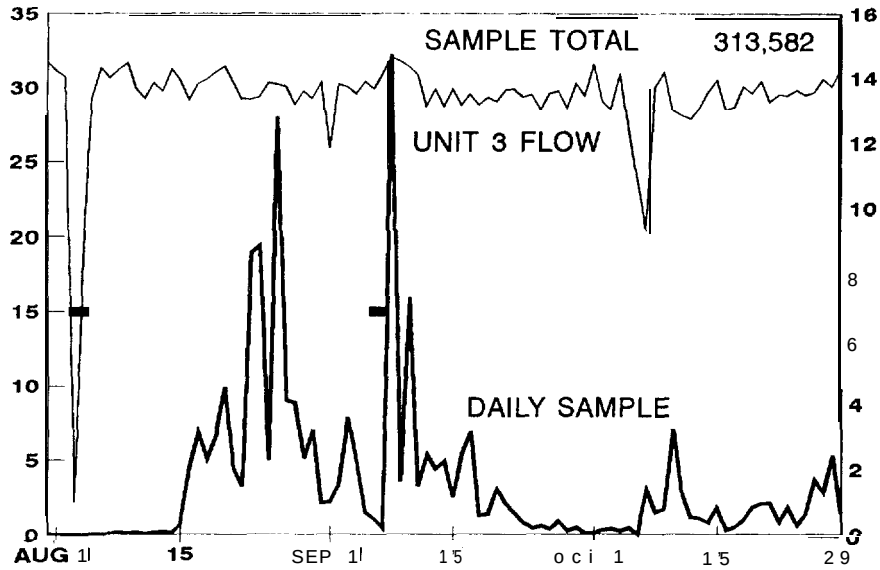

Figure 1. Seasonal **Juvenile** Shad **Count** (3B+3C) at John Day Dam, 1993.

THOUSANDS

KCFS

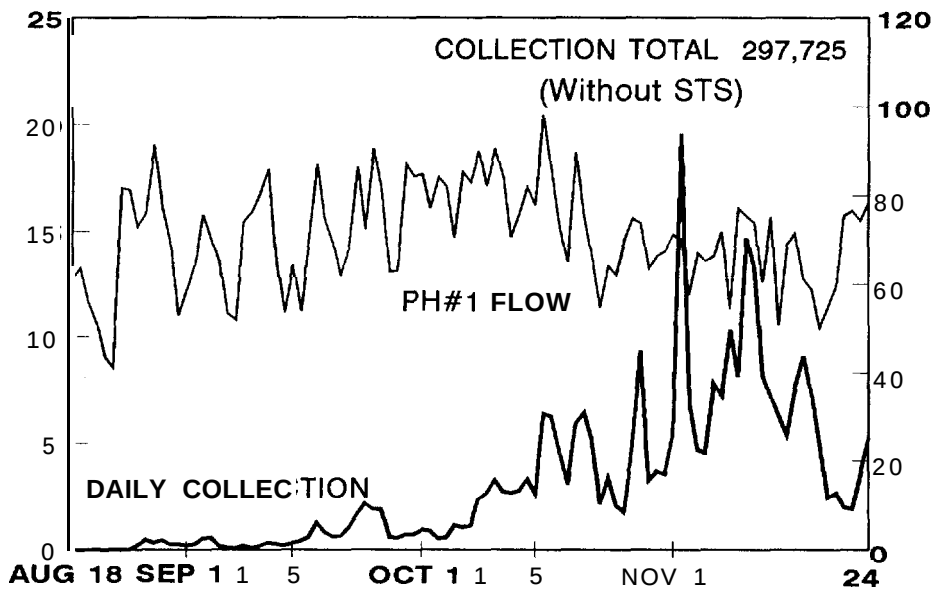

Figure 2. Seasonal Juvenile Shad Count at Bonneville Dam, 1993.

INDICATES SAMPLE DAYS LESS THAN 24 HOURS

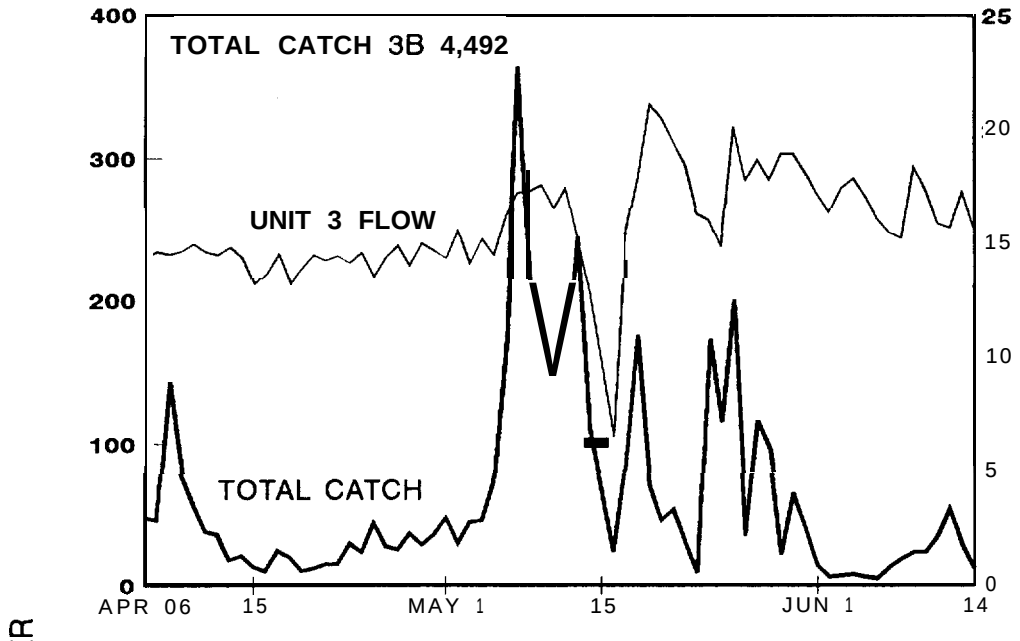

Figure 3. Seasonal Lamprey Count at John Day Dam, 1993.

(Only 3B catch shown as 3C was down from 5/14 - 6/17)

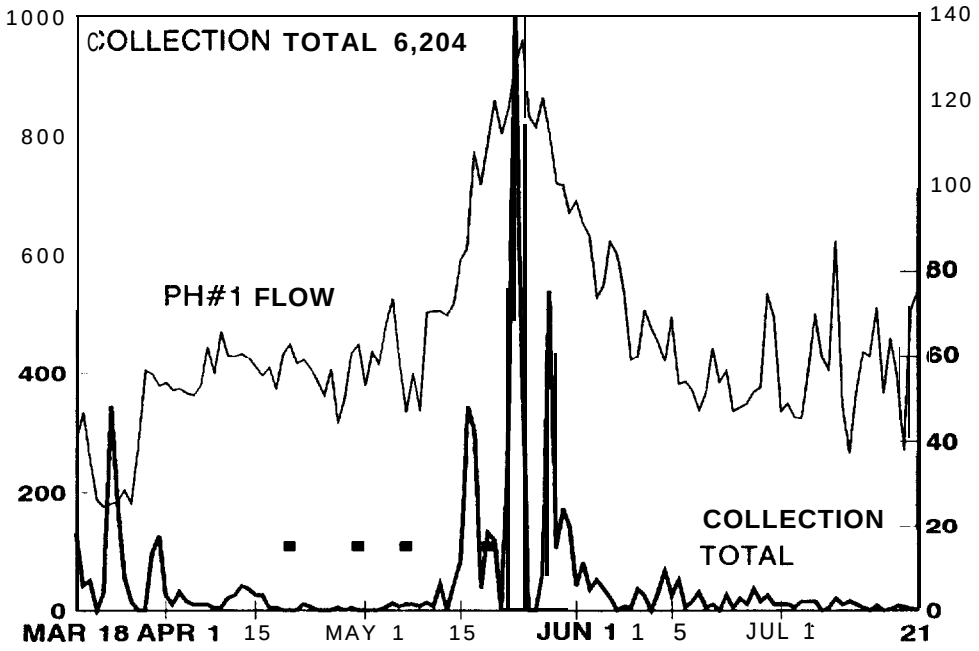

Figure 4. Seasonal Lamprey Count at Bonneville Dam, 1993.

▪ INDICATES SAMPLE DAYS LESS THAN 24 HOURS

Table 1 Incidental species captured at John Day Dam, 1993.

Species	Total Number Gatewell 3B + 3C	Gatewell 3B	Majority of Captures
Shad			
Juvenile	313,582	160,703	August-October
Adult	922	581	July-August
Lamprey			
Juvenile	7,645	4,492	April-June
Mountain			
Whitefish	903	601	June-July
Sculpins	555	264	July-August
Walleye	222	132	all season
Squawfish	66	37	all season

Table 2 Incidental species captured at Bonneville Dam, 1993.

Species	Number Sampled	Number Collected	Majority of Captures
Shad			
Juvenile	193,644	292,601	August-October
Adult	24	75	July-August
Lamprey			
Juvenile	523	6,228	April-June
Sculpins	62	294	all season
Smallmouth Bass	58	263	all season
Squawfish	106	257	Sept.-November
Stickleback	1,971	6,636	all season