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SPRING OUTMIGRATION OF WILD AND HATCHERY CHINOOK  
SALMON AND STEELHEAD TROUT SMOLTS FROM THE  
IMNAHA RIVER, OREGON,  
FEBRUARY 23-JUNE 24, 1996

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## ABSTRACT

For the third consecutive year, the Nez Perce Tribe, in conjunction with the Fish Passage Center, participated in the smolt monitoring program in the Imnaha River. A rotary screw trap was used to collect emigrating wild and hatchery chinook salmon (Oncorhynchus tshawytscha) and steelhead trout (Oncorhynchus mykiss) smolts from February 23 to June 24, 1996.

A total of 1,797 wild chinook salmon, 11,896 hatchery chinook salmon, 3,786 wild steelhead trout, and 3 1,094 hatchery steelhead trout smolts were captured during outmigration studies on the Imnaha River in 1996. Mortality associated with trapping, handling and tagging was low, being 1.4% for wild chinook, 0.18% for hatchery chinook, 0.2 1% for wild steelhead and 0.28% for hatchery steelhead trout smolts.

Wild chinook salmon smolts emigrated from the Imnaha River from February 23 to June 24 and had a mean length of 101 mm, average weight of 11.4 g and mean condition factor of 1.1. The peak period of wild chinook smolt outmigration, based on number of fish collected, occurred between April 30 and May 10, with most smolts having emigrated by May 16. Hatchery reared chinook salmon smolts were collected from April 3 through June 4, with 98% of the smolts estimated to have passed the trap by April 13, 11 days after release. A total 92,759 hatchery chinook were estimated to have emigrated from the Imnaha River. This estimate was 1.7% higher than the estimated number of hatchery fish released in the Imnaha River. Emigration of wild steelhead smolts in the Imnaha River occurred between March 1 and June 19. Peak outmigration occurred from April 30 to May 15. Wild steelhead smolts averaged 175 mm in fork length, 56.9 g in weight and had a mean condition factor of 1.03. Hatchery steelhead smolts emigrated from the Imnaha River between April 29 and June 24. Catch rates peaked on May 1, two days after release.

We PIT tagged and released 1,3 11 wild chinook salmon smolts, 698 hatchery chinook salmon smolts, 1,504 wild steelhead trout smolts and 1,346 hatchery steelhead trout smolts. Cumulative interrogation percentages at **mainstem** Snake and Columbia River dams were 62.5% for wild chinook salmon, 48% for hatchery chinook salmon, 70.8% for wild steelhead trout, and 49.8% for hatchery steelhead trout. A total of 502 (10.6%) previously PIT tagged hatchery chinook salmon smolts were interrogated at the Imnaha River trap site. These fish averaged 130 mm in fork length, 25 g in weight and had an average condition factor of 1.12.

Peak outmigration of PIT tagged wild Imnaha River chinook salmon smolts occurred from early to mid-May at Lower Granite, Little Goose, and Lower Monumental Dams. Median and 90% passage dates for wild chinook salmon smolts at Lower Granite Dam were April 30 and May 18, respectively. Spill occurred at Lower Granite Dam for the entire study period except for three days. The 90% passage date of wild chinook salmon smolts at Lower Granite Dam (May 18) preceded peak Snake River and Lower Granite (June 10) flows by 23 days. Hatchery chinook salmon exhibited a shorter outmigration period through the Snake River than their wild counterparts, with a median Lower Granite Dam passage date of May 7 and 90% passage date of May 16. Median and 90% passage dates at Lower Granite Dam for other PIT tagged groups were: wild steelhead trout - May 6 and June 4; and hatchery steelhead trout - May 28 and June 14. Hatchery steelhead trout displayed small peaks in arrival timing at Lower Granite, however, the general trend at each dam was a long protracted emigration.

## ACKNOWLEDGMENTS

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## INTRODUCTION

The Nez Perce Tribe (NPT) conducted a smolt monitoring study on the Imnaha River in cooperation with the Fish Passage Center (FPC) in 1996. This study was designed to provide information to conduct the annual Smolt Monitoring Program (SMP), mandated in the Northwest Power Planning Council's (NPPC) Program for flow and spill management. Information collected will be used to guide future decisions for flow and spill management in the Snake River and proposed drawdowns of Lower Granite Reservoir.

The Pacific States Marine Fisheries Commission contracted the Nez Perce Tribe (NPT) to monitor outmigration timing and PIT (passive integrated transponder) tag 2,400 actively outmigrating wild and hatchery steelhead trout smolts (*O. mykiss*) from the Imnaha River during the spring outmigration period (March 1 - May 31). Wild and hatchery chinook salmon smolts were PIT tagged as part of a separate NPT investigation during this same period.

The objectives of this study were to:

1. Determine spring outmigration timing of chinook salmon and steelhead trout smolts collected at the Imnaha River trap.
2. Evaluate effects of flow, smolt condition and other environmental factors on outmigration timing.
3. Collect biological information on Imnaha River emigrants, such as length, weight, and condition factors.
4. Determine outmigration timing and/or travel time of PIT tagged hatchery chinook smolts released at the Imnaha Acclimation Pond.
5. Determine arrival timing, travel time and recovery rate (as an index of smolt survival) of hatchery chinook and wild and hatchery steelhead trout smolts PIT tagged from the mouth of the Imnaha River to Snake and Columbia river dams.

## METHODS

### Study Area Description

The Imnaha River subbasin is located in northeastern Oregon (Figure 1) and encompasses an area of approximately 2,538 square kilometers. The mainstem Imnaha River flows in a northerly direction for 129 km from its headwaters in the Eagle Cap Wilderness Area (ECWA) to its confluence with the Snake River at river kilometer (rkm) 308.4 (James 1984; Kucera 1989). The river drains the eastern escarpment of the Wallowa mountains and part of an adjacent plateau located between the Wallowa River drainage to the west and Hells Canyon of the Snake River to the east (Kucera 1989). Elevations in the watershed vary from 3,048 m at the headwaters to about 260 m in lower elevations (Kucera 1989).

The 64 year (1929 - 1993) mean annual discharge of the Imnaha River is 172 cms (6,060 cfs) at Imnaha, Oregon, USGS gauge 13292000. Maximum river discharge generally occurs from April to June with minimum flows from August to February (Kucera 1989).

### Equipment Description

A floating rotary screw trap manufactured by E.G. Solutions Inc., Corvallis, Oregon, was used to capture outmigrating salmonid smolts for this study. Similar traps have been used to capture migrating salmonid species in New York and Alaska (Kennen et al. 1994; Thedinga et al. 1994) and throughout the Pacific Northwest. The trap consisted of a non-standard 2.1 m diameter trapping cone supported by a metal A-frame and two six meter pontoons that provided flotation (Figure 2). Fish entering the trapping cone move through to a custom oversize live box (1.68 m wide x 1.25 m long x 0.55 m deep). The live box was fitted with a removable baffle to dissipate water velocity during high flows (Figure 2).

Water temperature information for this study was collected using a constant recording Ryan TempMentor which was located approximately 150 m upstream from the trap.

Discharge information used in this report was provided by the U.S. Geological Survey, USGS gauge 13292000 at Imnaha, Oregon (rkm 32).

### Trap Operations

The Imnaha River trap was operated from February 24 to June 24, 1996. The SMP project began on March 1 and was completed on May 31, 1996. The trap was operated 24 hours a day, five days a week during this period. Exceptions to this occurred on several occasions when trap repair was necessary or high flows or debris load in the river precluded safe trap operation.

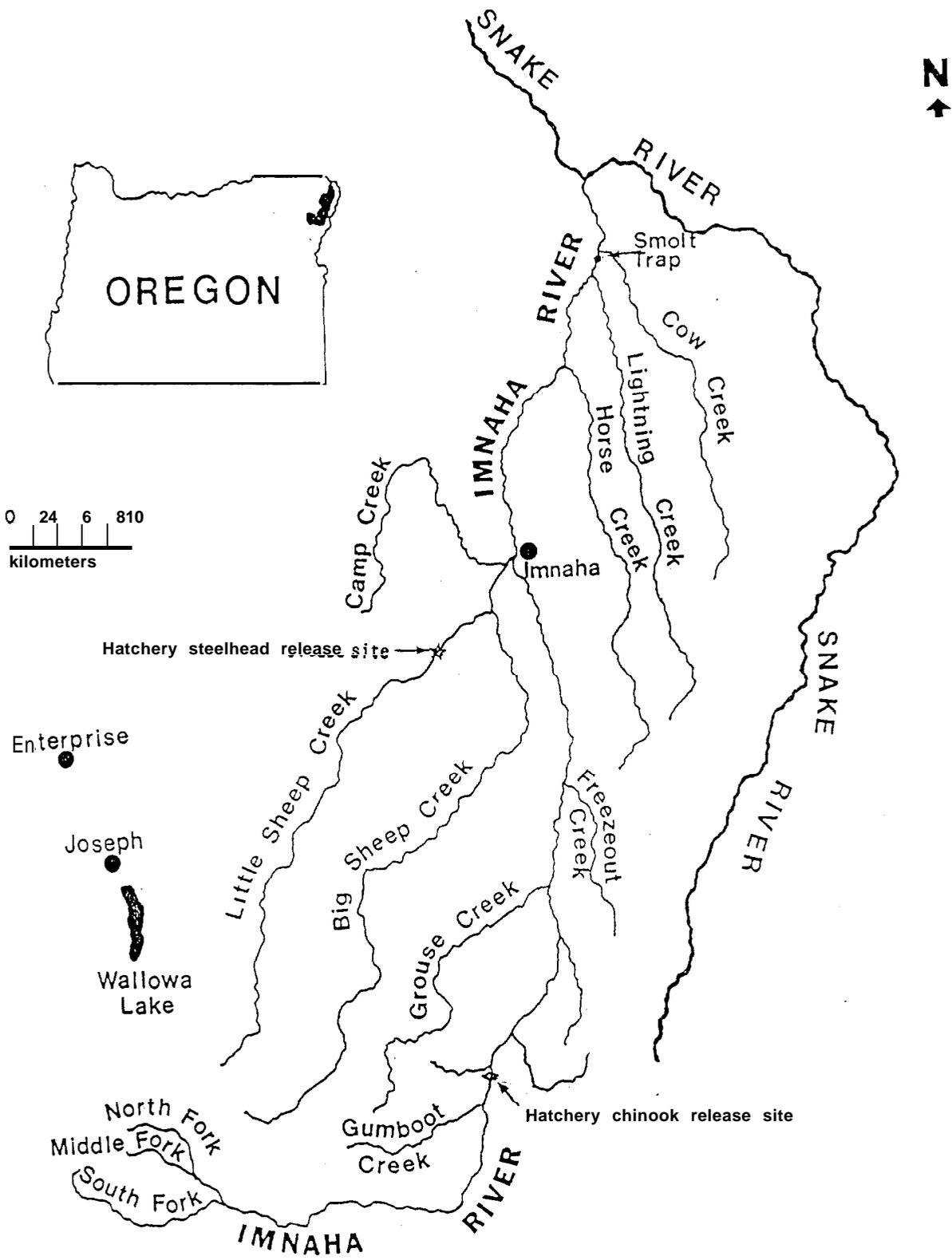


Figure 1. Map of study area.

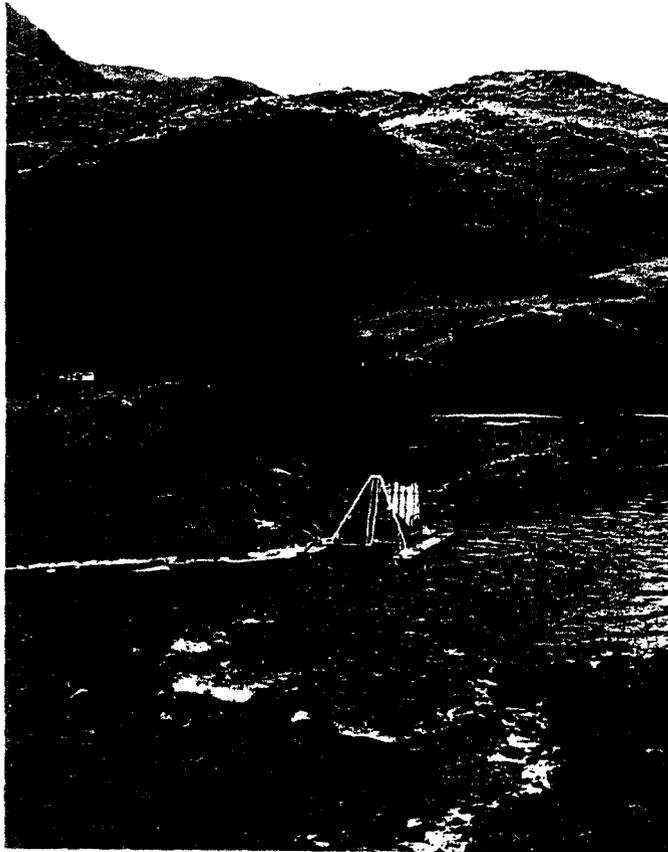


Figure 2. Photograph of lower screw trap in the Imnaha River.

The floating rotary screw trap was secured on the west bank of the Imnaha River, below the Cow Creek bridge, 6.6 kilometers **from the confluence** with the Snake River (Figure 1). The trap position in the river was adjusted by manipulating a cable suspension system (Figure 2) which allowed side to side and upstream/downstream movement of the trap. This setup allowed the trap to be backed slightly out of the main current and fished during high flows. The trap was fished in one of three positions depending on daily readings **from** the staff gauge located approximately one kilometer upstream of the trap (Table 1).

Table 1. Position in which screw trap was fished dependent upon staff gauge reading.

Staff Gauge	Trap Position
< 0.9 m	Forward
0.9 - 1.0 m	Intermediate
> 1.0 m	Rear

The live box of the screw-trap was checked at 0800 every morning and several times throughout each night and day. Non-target piscivorous fish and large numbers of other non-target fish were removed **from** the live box first. Non-target piscivorous fish were scanned for PIT tags and then released 30-50 meters downstream. Wild juvenile chinook salmon were processed first, followed by hatchery chinook salmon, wild steelhead trout and hatchery steelhead trout smolts, respectively.

Daily processing procedures were similar to those **reported** by **Ashe** et al. (1995) and were as follows: 1) Fish were **anaesthetized** in a MS-222 bath (3 mL MS-222 stock solution (100 g/L) per 19 L of water) buffered with propolyaqua (PRO-NOVAQUA), 2) Each fish was examined for existing marks (e.g. fm clips), and PIT tag insertion scars, 3) Fish with PIT tag scars were scanned with a PIT tag scanner, 4) Up to 100 hatchery chinook salmon **smolts** were selected for trap efficiency trials, 5) A specified number of each species were selected for PIT tag insertion, 6) All other fish were enumerated and released 30-50 m downstream **from** the trap, 7) All fish mortality was recorded.

Exceptions to this procedure occurred after hatchery releases when potential existed for capture of large numbers of fish in one night. On these occasions **netfulls** of fish were removed **from** the live box and released through a remote PIT tag scanner (Biomark model **RM-DC400-6**) into the river. Subsampling occurred when tallying fish by hand could not keep up with the rate of fish accumulation into the live box of the trap. Daily catch estimates were made by subsampling 10% of the total number of **netfulls** for species number and composition. Fish were held in net pens until processed.

## Trap Efficiency

Trap efficiency trials for hatchery chinook salmon were conducted as often as possible with the requirement that at least 25 healthy individuals were available. Special efforts were made to conduct trials when changes in stream discharge occurred. Hatchery chinook salmon selected for trap efficiency trials were measured (FL) to the nearest mm, weighed to the nearest 0.1 g, and marked by clipping the distal portion of one of seven possible fins (Table 2).

Table 2. Fin clip applied to hatchery chinook salmon smolts used in trap efficiency trials.

Day of the week	Fin clip applied
Sunday	Dorsal fin (DC)
Monday	Top caudal fin (TCC)
Tuesday	Lower caudal fin (LCC)
Wednesday	Left ventral fin (LVC)
Thursday	Right ventral fin (RVC)
Friday	Left pectoral fin (LPC)
Saturday	Right pectoral fin (RPC)

Fish marked for trap efficiency trials were held in covered live nets during daytime hours (approximately 12 h) and then transported upstream approximately one km to the release site during evening hours. Fish were released after dark on the day they were marked.

Trap efficiency was determined by:  $E = R/M$

where E is estimated trap efficiency, R is number of marked fish recaptured, and M is number of fish marked and released.

Outmigration numbers were estimated by:  $N = U/E$ ;

where N is estimate of total number of emigrants, and U is number of unmarked fish.

## Smolt Yield

The hatchery chinook salmon smolt outmigration period was visually divided into three flow periods based on discharge. Smolt yield was determined for each flow period using the bootstrap method (Efron and Tibshirani 1986; Murphy et al. in prep). Total smolt yield and 95% confidence intervals were calculated by summing flow period smolt yield estimates and variances.

Bootstrap period estimates ( $N_p$ ) were calculated by:  $N_p = U_p / E_p$

where  $U_p$  is the total number of unmarked fish captured during the period and  $E_p$  is the mean trap efficiency for the period. Variance for bootstrap estimates were calculated using a program developed by Murphy et al. (in prep).

Hatchery chinook smolt yield, during periods of trapping interruption of less than three days, was estimated by extrapolating daily catch using equal increments at an ascending or descending rate. Estimated numbers of daily outmigration and smolt yield was not estimated during trapping interruptions greater than three days. All hatchery chinook smolts were enumerated by hand (no netfuls of fish were released to the river).

### Biological Characteristics

Length frequency distributions were created and condition factors calculated for each fish species and origin. Condition factor was calculated using Fulton's condition factor:  $(W/L^3) \times 10^5$  (Bagenal and Tesch 1978). Wild steelhead less than 120 mm were believed not to be smolts and therefore were not used in smolt length, weight and condition factor calculations.

Student's t-test was used to test for significant differences in fork length between various groups of fish (i.e. wild versus hatchery steelhead trout smolts, previously PIT tagged hatchery chinook salmon smolts versus those not previously PIT tagged, hatchery chinook marked and released for trap efficiency versus trap efficiency recaptures, etc.). Differences were considered significant at  $p < 0.05$ .

### PIT Tagging

Fish selected for passive integrated transponder (PIT) tagging were examined for previous PIT tagging, descaling and general health before being tagged, measured (FL-mm) and weighed (0.1 g). For chinook salmon, only healthy fish greater than 65 mm were selected for tagging. Steelhead were tagged irrespective of health. Fish were PIT tagged using hand injector units following the general methods described by Prentice et al. (1986, 1990b) and Matthews et al. (1990, 1992). Hypodermic injector units were sterilized after each use in ethanol alcohol for at least 10 minutes prior to tagging. PIT tags were also sterilized for 10 minutes and allowed to air-dry prior to their use. Tagging was discontinued when water temperatures exceeded 15°C.

Weekly steelhead smolt tagging goals were set by FPC (Table 3). These goals were modified as the season progressed based upon catch and interruptions in trapping due to equipment repairs. Up to 200 additional wild and hatchery chinook salmon and 150 wild steelhead smolts were tagged each week as part of a separate Nez Perce Tribe (NPT) investigation. Steelhead trout smolts tagged for FPC and NPT investigations were held for a minimum of one hour after tagging until fully recovered and then released as a group. Chinook salmon smolts tagged for NPT investigations were held in net pens for a minimum of 12 hours and released as a group after dark. The latter methodology is a standard practice employed by the NPT aimed at allowing chinook smolts to

recover from tagging stress and increasing predator avoidance. Mortality due to tagging was recorded.

Table 3. PIT tag schedule for wild and hatchery steelhead trout smolts as detailed by the Fish Passage Center.

Rearing Type	Tagging Dates	Weekly Goal
Wild	April 14-20	200
	April 21-27	200
	April 28-May 4	200
	May 5-11	<b>200</b>
	May 12-18	200
	May 19-25	200
Hatchery	April 14-20	200
	April 21-27	200
	April 28-May 4	200
	May 5-11	<b>200</b>
	May 12-18	200
	May 19-25	200

Tagging data were proofed for mistakes using PITVAL software program. Tagging and interrogation files were submitted to the Pacific States Marine Fisheries Commission (PSMFC) PIT Tag Information System (PTAGIS) database via modem the day following collection. PIT tag interrogation data were downloaded from the PTAGIS database.

#### Travel Timing to Tran Site and Lower Snake River Dams

Outmigration timing of wild chinook salmon and steelhead trout smolts was determined by daily collection numbers at the rotary screw trap site. Arrival timing and travel time of PIT tagged hatchery chinook salmon smolts released at the Imnaha River Acclimation Facility and hatchery steelhead trout smolts released at the Little Sheep Creek Acclimation Facility was determined by daily collection numbers and PIT tag interrogation at the rotary screw trap site (Figure 1).

Arrival timing, travel time and cumulative interrogation percents to Lower Granite Dam, and diel passage at hydroelectric facilities through the Snake River to McNary **Dam** was determined for wild and hatchery chinook salmon and steelhead trout smolts. Single coil detections or negative travel time individual fish were deleted from all analysis. Release groups of fish were pooled weekly to determine travel time to Lower Granite Dam. First time PIT tag observations, from all dams, were used to calculate and report the cumulative interrogation percents to Lower Granite Dam by species and origin. Cumulative interrogation percents of each species was determined by

dividing the sum of first tag code observations by the total number of fish tagged and released. Fork lengths were compared between length at tagging and lengths, at tagging, detected at Lower Granite Dam for each species and origin.

Arrival timing at each dam during this report period are based on first-time observations of individual tag codes at each dam. Arrival timing estimates do not include subsequent detections of fish that were captured in the Snake River trap, held in sample rooms or raceways, had negative travel times or single coil detections. Arrival timing analysis does not include 245 wild steelhead released on May 14. These fish were tagged for survival estimation purposes and including these fish would bias the arrival timing analysis. Spill was occurring at Lower Granite, Little Goose, Lower Monumental, and McNary dams before any PIT tagged Imnaha River smolts were released.

Average weekly diel smolt passage at Lower Granite, Little Goose, Lower Monumental, and McNary dams were summarized by three passage periods (midnight to sunrise, sunrise to sunset, and sunset to midnight) provided that 30 or more fish were detected at a dam. Passage periods were delineated using a United States Naval Observatory sunrise and sunset table for Lewiston, Idaho. All times used were Pacific Standard Time. Weekly diel passage was further broken down into hourly passage frequencies. Fish detections not used in the analysis were those previously caught in the Snake River trap or those detected going to a raceway or sample room.

Travel time estimates to Lower Granite Dam during this report period do not include fish captured in the Snake River trap. Differences in mean travel time, from weekly PIT tag release groups, were analyzed by means of a t-test (Statgraphics Plus 1995). In some instances the distributions of travel time were skewed with some kurtosis. It was assumed with independent samples and a combined sample size  $n_1+n_2 \geq 30$ , that t-methods were reasonably accurate even with modest skewness in the two populations (Ott 1984). T-test values were calculated and reported from samples with unequal variance. Differences in means were tested and considered significant at the 0.05 level. When the assumption of normality was violated, the t-test was abandoned in favor of the Wilcoxon rank sum test statistic (Ott 1984). This test compared median travel times of hatchery and wild smolts. Travel time between mainstem dams was not calculated due to time constraints.

## RESULTS AND DISCUSSION

### Imnaha River Subbasin Outmigration

#### Imnaha River Discharge

Imnaha River mean daily discharge during spring outmigration ranged from 12.4 cms (436 cfs) on March 7 to 88.3 cms (3,120 cfs) on May 18 at USGS gauge 13292000, Imnaha, OR (Figure 3). Three distinct peaks in discharge were apparent during the study period (Figure 3). The first occurred from March 3 1 to April 10 when the river discharge increased from 466 cfs to 1,990 cfs then dropped to 1,000 cfs on April 22. After April 22 river discharge increased by 1,410 cfs in two

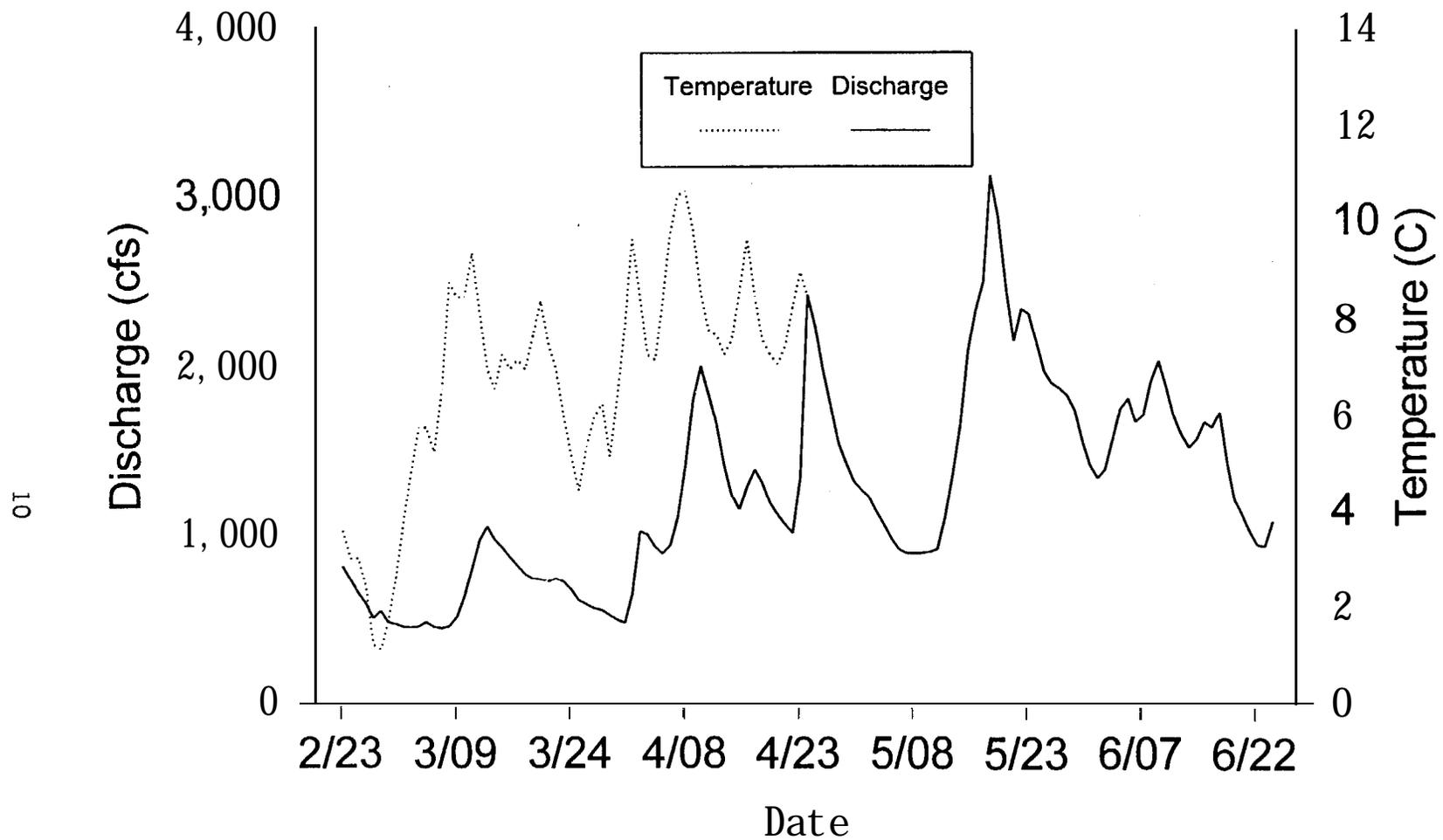


Figure 3. Mean daily discharge (USGS Gauge 13292000 at Imnaha, OR) and mean daily water temperature of Imnaha River during the spring outmigration period, February 23 - June 24, 1996. Temperature data not available after April 24.

days to 2,410 cfs. From April 24, river discharge decreased to 879 cfs on May 8. The third major increase in discharge occurred from May 12 (1,090 cfs) to May 18 (3,120 cfs). River discharge decreased after May 18 but remained above 900 cfs for the remainder of the study period. Mean daily water temperatures during the study period ranged from 1.1°C on February 28 to 12.3°C on June 22 (Figure 3). Temperature data for April 25 - June 19 is not available due to a downloading error. Appendix Table A contains daily discharge readings and daily minimum, maximum and mean water temperatures during the study period.

### Trap Operation

The Imnaha River screw trap was operated for 79 days during the 123 day spring outmigration period (February 23 - June 24). There were 57 occasions (effecting 24 days) during which the trap did not operate continuously. These interruptions were due either to high flows, trap malfunction, or high debris load in the river (Table 4). The trap was operated for 56.2% of the total possible hours during the spring outmigration period.

### Outmigration Timing and Trends at Trap Site

A total of 1,797 wild chinook salmon, 11,896 hatchery chinook salmon, 3,786 wild steelhead trout and 3,109 hatchery steelhead trout smolts were captured in the Imnaha River during the study period (Table 5). See Appendix B for daily catch summaries of wild and hatchery fish for both species.

Wild chinook salmon smolts emigrated from the Imnaha River from February 23 to June 24, and comprised 3.7% of the total fish catch. Wild chinook smolt outmigration, based on number of fish collected, gradually increased throughout the migration period peaking on May 3 (155 collected) and declined rapidly thereafter (Figure 4). The peak period of wild chinook smolt outmigration, April 30 - May 10, coincided with the hatchery steelhead release from the Little Sheep Creek facility on April 29. A smaller spike in fish catch was observed on April 4 which coincided with the initial pulse of hatchery chinook smolt arrival at the trap. The majority of wild chinook smolts had migrated from the Imnaha River system by May 16 (Figure 4) with small numbers caught through June 24 (Table 5).

Oregon Department of Fish and Wildlife (ODFW) released 91,240 hatchery reared chinook salmon smolts into the Imnaha River from the Imnaha River Acclimation Pond (rkm 73) on April 2 (Mike Flesher, ODFW, pers. comm.). Hatchery chinook releases preceded a major increase in river discharge by five days.

Approximately 13 % of the hatchery chinook smolts released were captured during the study period which comprised 24.5 % of the total catch. Hatchery chinook salmon smolts were first captured in the trap the same night of release (Figure 5). Approximately 94 % (11,181) of the hatchery chinook salmon collected were captured within six days of release. Small numbers of hatchery chinook salmon smolts were caught throughout the remainder of the study period (Table 5). Appendix Table G summarizes the ODFW spring release schedule for hatchery chinook salmon and steelhead trout smolts in 1996.

Table 4. Dates the rotary screw was not operated during the study period, February 23 - June 24, 1996.

Date	Reason
2/24 - 2/25	Weekend
2/26	Training
2/27 - 3/01	Freezing conditions
3/02 - 3/03	Weekend
3/09 - 3/10	Weekend
3/16 - 3/17	Weekend
3/23 - 3/24	Weekend
3/30 - 3/31	Weekend
4/13 - 4/14	Weekend
4/20 - 4/21	Weekend
4/27 - 4/28	Weekend
5/04 - 5/05	Weekend
5/11 - 5/12	Weekend
5/17	Excessive river flow
5/18 - 5/19	Weekend
5/20	Excessive river flow
5/25 - 5/26	Weekend
5/27	Tribal holiday
6/01 - 6/02	Weekend
6/08 - 6/09	Weekend
6/15 - 6/16	Weekend
6/17 - 6/18	Tribal holiday
6/22 - 6/23	Weekend

Wild steelhead trout smolts were first sampled at the trap on March 1. Wild steelhead trout smolts made up 7.8% of the total catch. The peak movement occurred from April 30 - May 15 with the highest single day catch (431) occurring on May 13 (Figure 6). Outmigrating wild steelhead trout smolts were captured throughout the rest of the reporting period, although only small numbers were trapped in June (Table 5).

ODFW released 322,103 (53,566 direct stream release and 268,537 acclimated release, Appendix G) hatchery steelhead trout smolts into the Imnaha River subbasin, at the Little Sheep

Table 5. Weekly catch composition of wild and hatchery chinook salmon and steelhead trout smolts collected in the Imnaha River screw trap, February 23 - June 24, 1996.

W e e k	Chinook			Subtotal	Steelhead			Subtotal	Total
	Wild	Hatchery	Unknown		Wild	Parr/W	Hatchery		
2/22 - 2/24	13	0	0	13	0	0	0	0	13
2/25 - 3/02	49	0	0	149	3	0	0	3	52
3/03 - 3/09	23	0	0	23	7	0	0	7	30
3/10 - 3/16	59	0	0	59	14	0	0	14	73
3/17 - 3/23	83	0	0	83	11	0	0	11	94
3/24 - 3/30	114	0	0	114	11	0	0	11	125
3/31 - 4/06	155	10,283	0	10,447	20	0	0	20	10,467
4/07 - 4/13	82	1,173	0	1,255	126	0	0	126	1,381
4/14 - 4/20	203	205	0	408	216	0	1	217	625
4/21 - 4/27	115	53	0	168	242	0	4	246	414
4/28 - 5/04	454	85	0	539	799	0	21,741	22,540	23,079
5/05 - 5/11	331	84	0	415	1,154	0	1,743	2,897	3,312
5/12 - 5/18	75	11	0	86	945	0	5,718	6,663	6,749
5/19 - 5/25	5	0	0	5	34	1	178	213	218
5/26 - 6/01	23	1	0	24	115	0	734	849	873
6/02 - 6/08	6	1	0	7	80	5	682	767	774
6/09 - 6/15	4	0	0	4	2	0	244	246	250
6/16 - 6/22	2	0	0	2	1	0	37	38	40
6/23 - 6/29	1	0	0	1	0	0	12	12	13
<b>Total</b>	<b>1,797</b>	<b>11,896</b>	<b>9</b>	<b>13,702</b>	<b>3,780</b>	<b>6</b>	<b>31,094</b>	<b>34,880</b>	<b>48,582</b>

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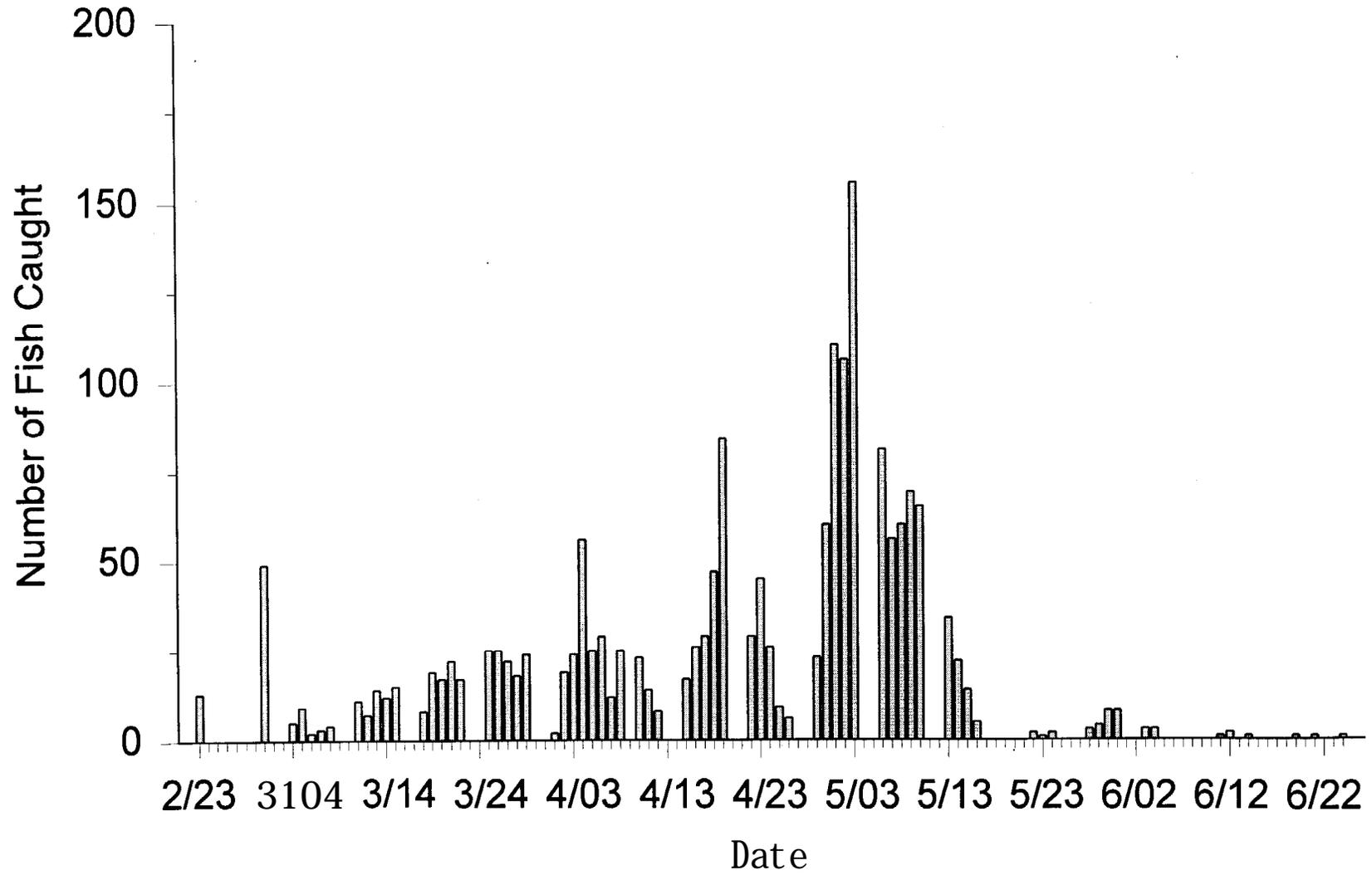


Figure 4. Outmigration timing, based on daily catch at the Imnaha River screw trap, <sup>of wild</sup> chinook salmon smolts. See Table 4 for dates trap not operated.

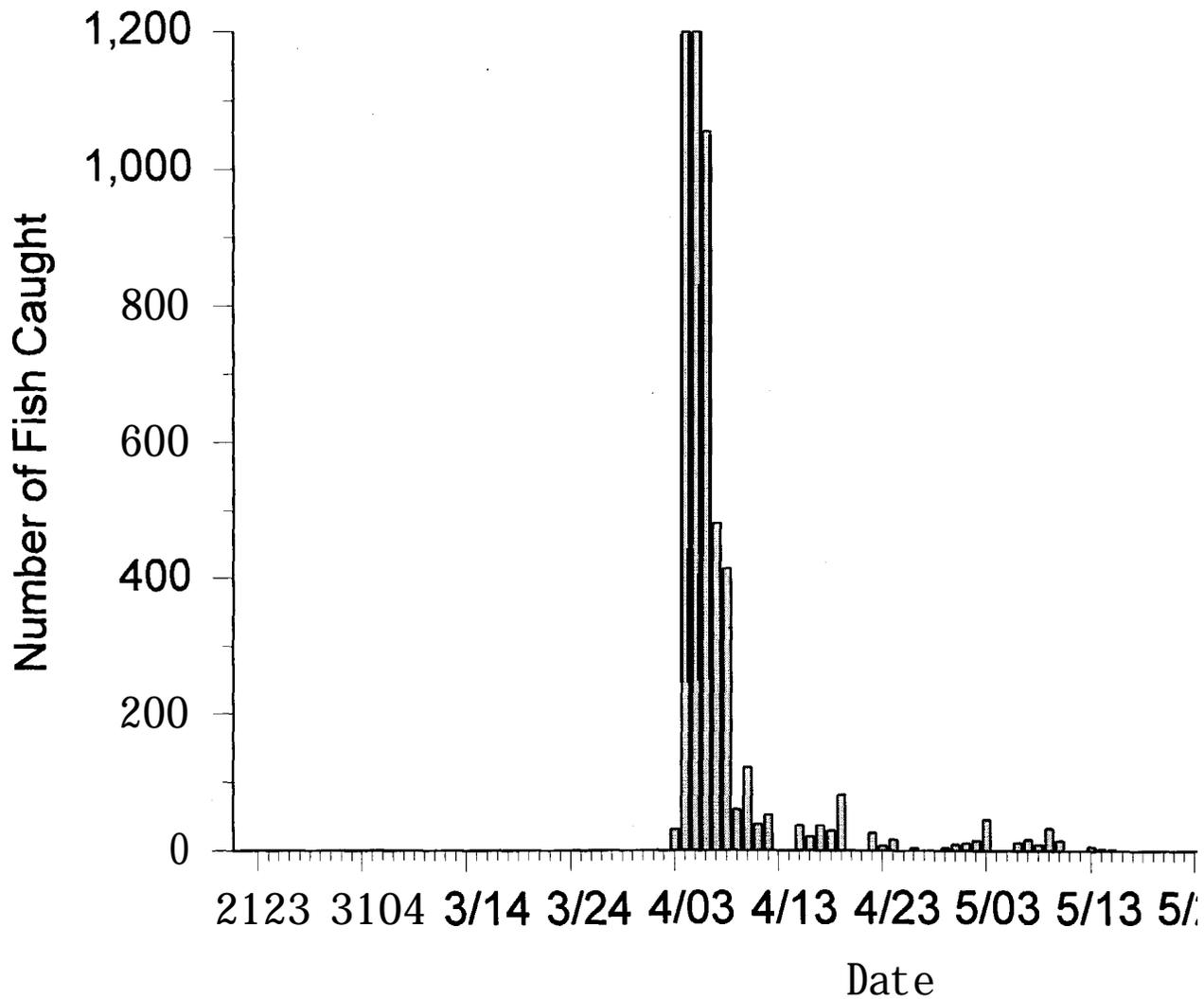


Figure 5. Outmigration timing, based on daily catch at the Imnaha River screw trap, of hat released from the Imnaha River Acclimation Facility. See Table 4 for dates trap not opera April 4 and 2,808 on April 5..

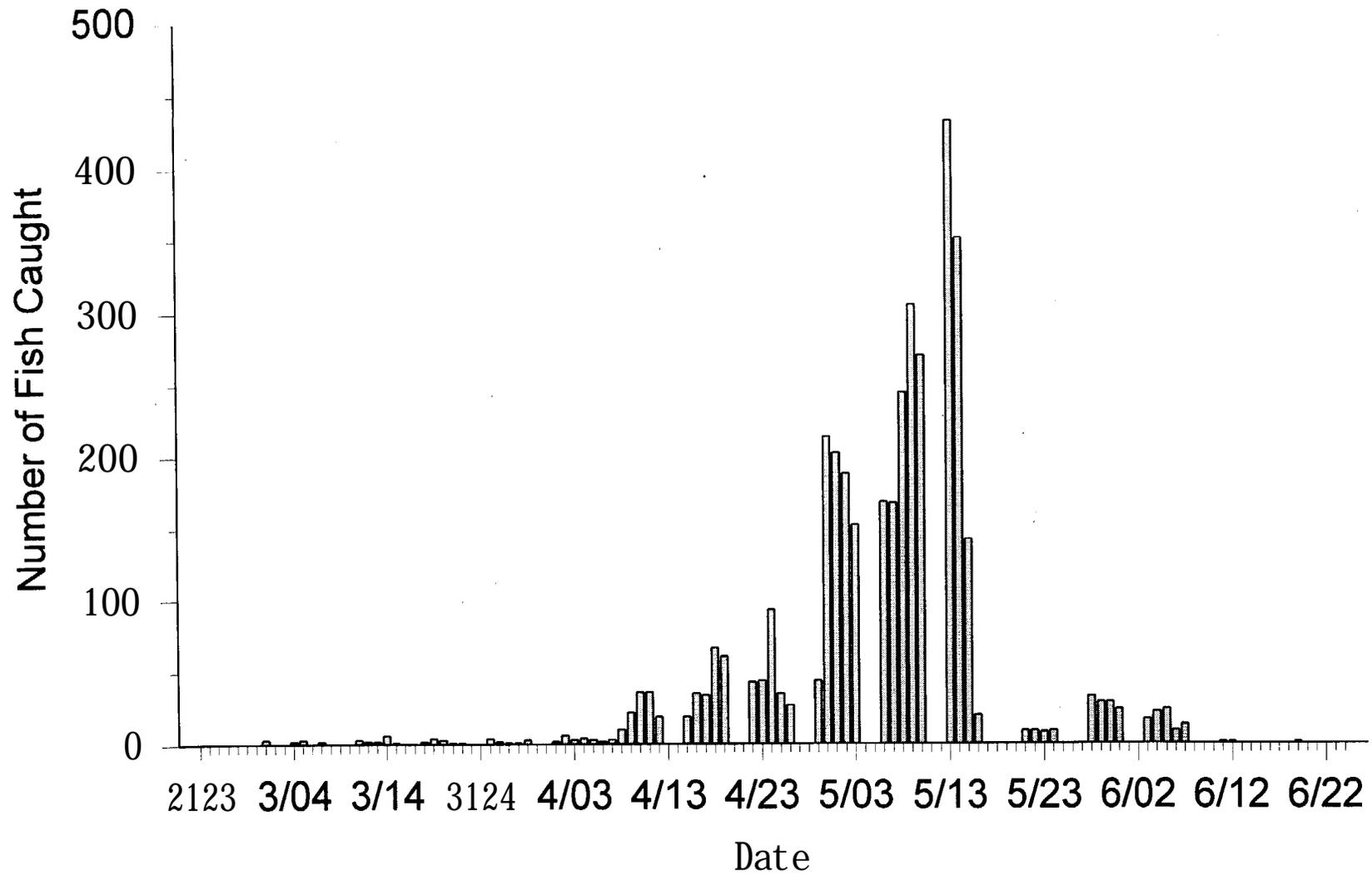


Figure 6. Outmigration timing, based on daily catch at the Imnaha River screw trap, of wild steelhead trout smolts. See Table 4 for dates trap not operated.

Creek Acclimation Facility (rkm 45), on April 29 (Mike Flesher, ODFW, pers. comm). Hatchery steelhead trout smolts began arriving at the trap the evening of April 29 as 2,481 hatchery steelhead trout smolts were captured the morning of April 30. Approximately 31,090 hatchery steelhead trout were collected in the trap between April 30 and June 24 (Table 5). Catch rates peaked on May 1 when an estimated 9,998 hatchery steelhead trout smolts were collected. Hatchery steelhead smolt emigration was very protracted in 1996, as was observed in 1994 and 1995 (Ashe et al. 1995, Blenden et al. 1996) (Figure 7). During late June, hatchery steelhead smolts were still being caught at an average of 25 fish per week. Approximately 9.7% of the hatchery released smolts were captured during the study period and represented 64.0% of the total catch.

### Trap Efficiency and Smolt Yield

In 1996, unlike previous years, trap efficiency trials were conducted only for hatchery chinook salmon smolts due to low fish numbers and emphasis on other project objectives. Nine successful trap efficiency trials were conducted during the spring outmigration period. Trap efficiencies were conducted for six consecutive days, after hatchery chinook smolts first arrived at the trap, when approximately 94% of all hatchery chinook smolt catch occurred.

Flow periods are shown in (Figure 8). Mean trap efficiency rates for hatchery chinook salmon ranged from 6.8 % in flow period two to 21.8 % in flow period three (Table 6). Trap efficiency averaged 13.7% during the first flow period. Both hatchery chinook PIT tag recaptures (10.6 %) and percent capture of total released hatchery chinook smolts (13.6 %) further indicate that trap efficiency trials provide reliable indicators of percent fish sampled.

There appears to be no size bias due to trapping. Mean fork length of hatchery chinook smolts marked and released for trap efficiency trials was 131.4 mm (n=546), which was not significantly different ( $p > 0.05$ ) than the mean fork length of 133.3 mm for hatchery chinook smolt trap efficiency recaptures (n=79).

Estimated hatchery chinook salmon smolt yield at the Imnaha River outmigrant trap site was 92,759 fish (Table 7). This smolt yield point estimate was slightly greater (1.7%) than the estimated number of smolts (91,240) released from the acclimation facility, with a 95 % confidence interval of  $\pm 23,782$  fish ( $\pm 25.6\%$ ). Smolt yield was estimated for the period of April 13 through April 23 when over 94% of the hatchery chinook smolts collected were captured (Table 7). The highest single day of estimated outmigration occurred on April 4, two days after hatchery fish were released, when 47,775 smolts were projected to have emigrated out of the Imnaha River (Figure 9). Hatchery chinook smolt yield was not estimated after April 23 due to low catches, lack of trap efficiency trials, and increased river flow. For the remainder of the study period, April 24 to June 24, 190 hatchery chinook were caught at the Imnaha River trap.

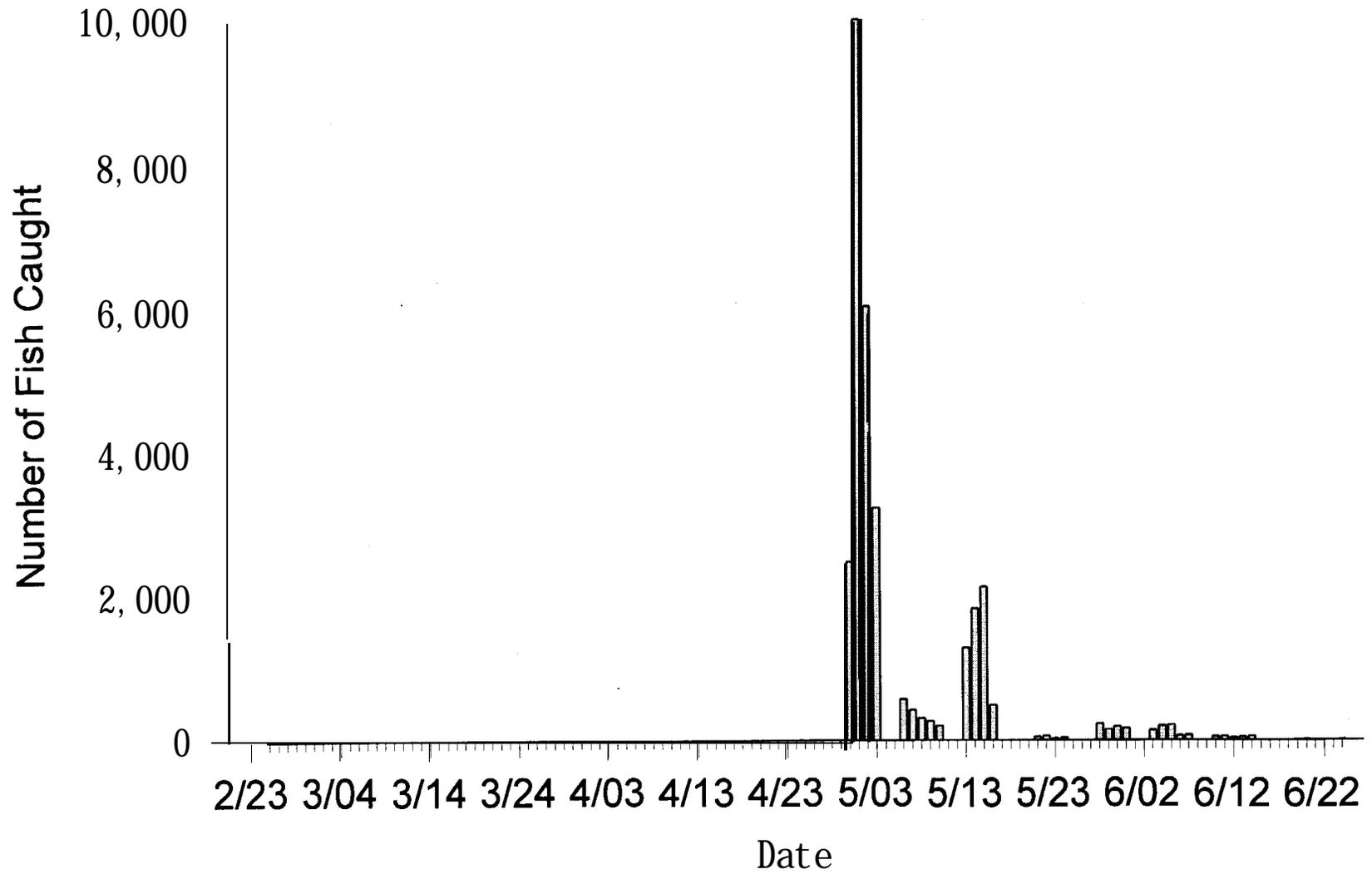


Figure 7. Outmigration timing, based on daily catch at the Imnaha River screw trap, of hatchery steelhead trout smolts released at the Little Sheep Creek Facility. See Table 4 for dates trap not operated.

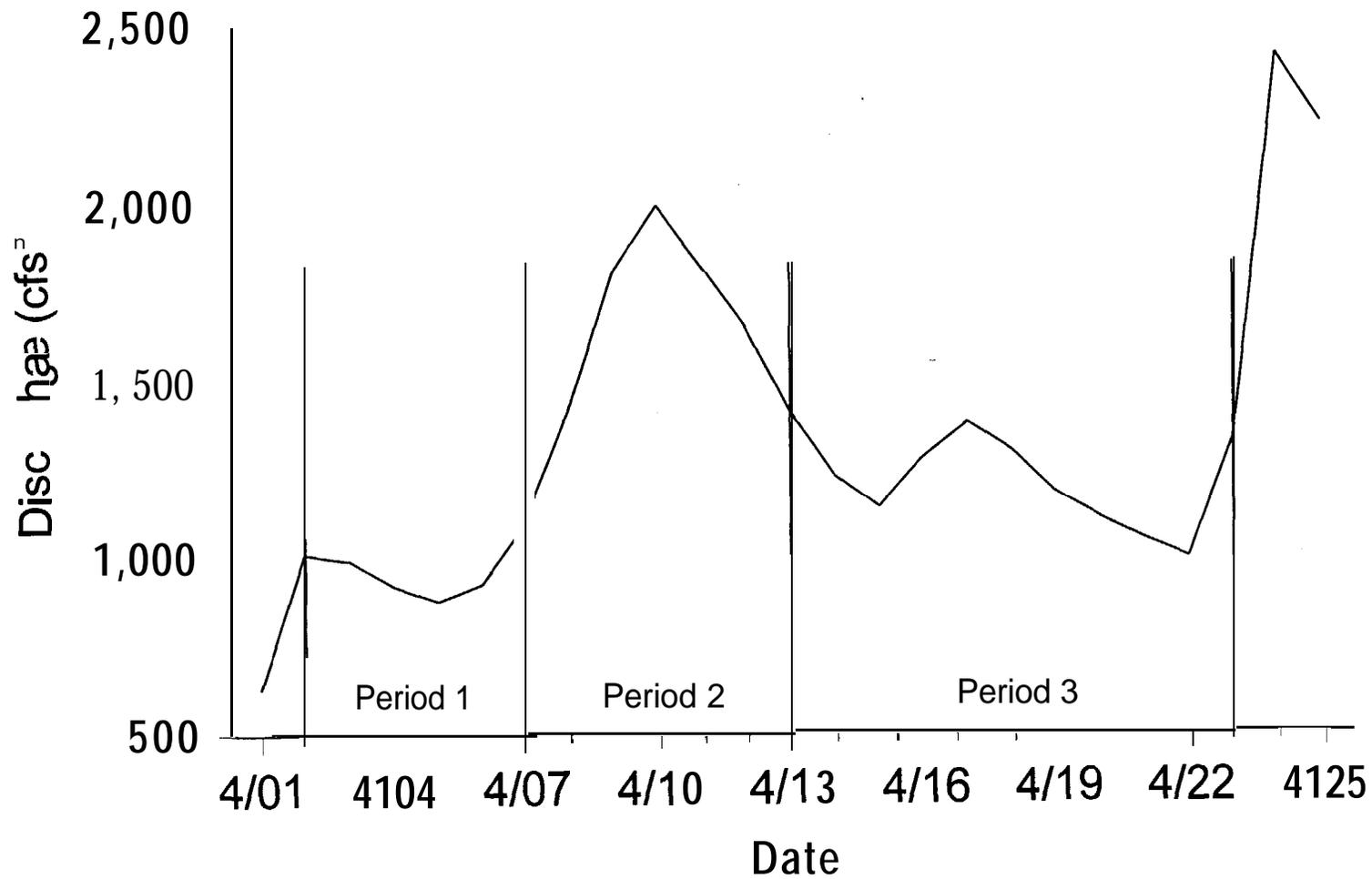


Figure 8. Flow periods, based on Imnaha River mean daily discharge (USGS Gauge 13292000 at Imnaha, OR), for the peak hatchery chinook salmon smolt outmigration.

Table 6. Trap efficiency trials and mean trap efficiency for hatchery chinook salmon smolts captured in the Imnaha River trap in 1996.

Flow Period	Date	Number Marked and Released	Number Recaptured	Trap Efficiency
Period 1	4/05	100	19	0.190
	4/06	100	4	0.040
	4/07	100	18	0.180
Period 2	4/08	100	12	0.120
	4/09	100	4	0.040
	4/10	50	1	0.020
Period 3	4/18	30	4	0.133
	4/19	25	8	0.320
Total		605	70	0.116

Table 7. Smolt yield point estimates and 95% confidence interval for hatchery chinook salmon smolts captured in the Imnaha River trap during the spring of 1996.

Species/Origin	Flow Period	Point Estimate	± 95% C.I.
Hatchery Chinook	4/03 - 4/07	79,519	23,068
	4/08 - 4/13	11,355	5,668
	4/14 - 4/23	1,885	1,149
Total	4/03 - 4/23	92,759	23,782

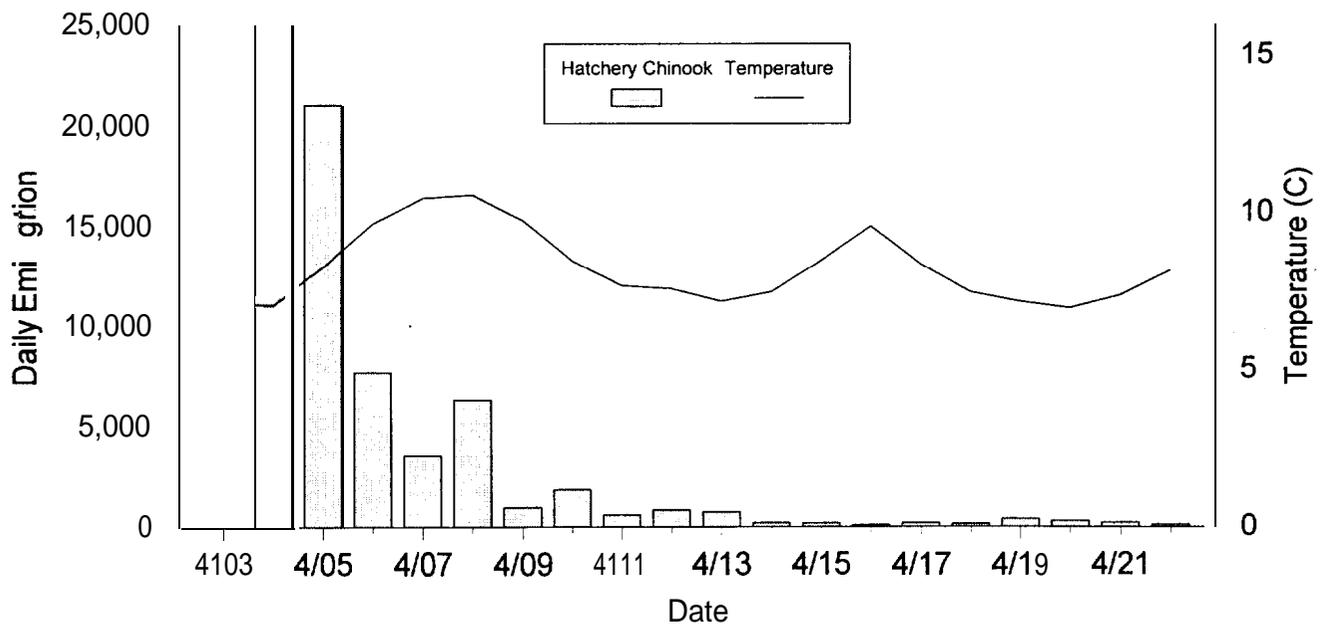
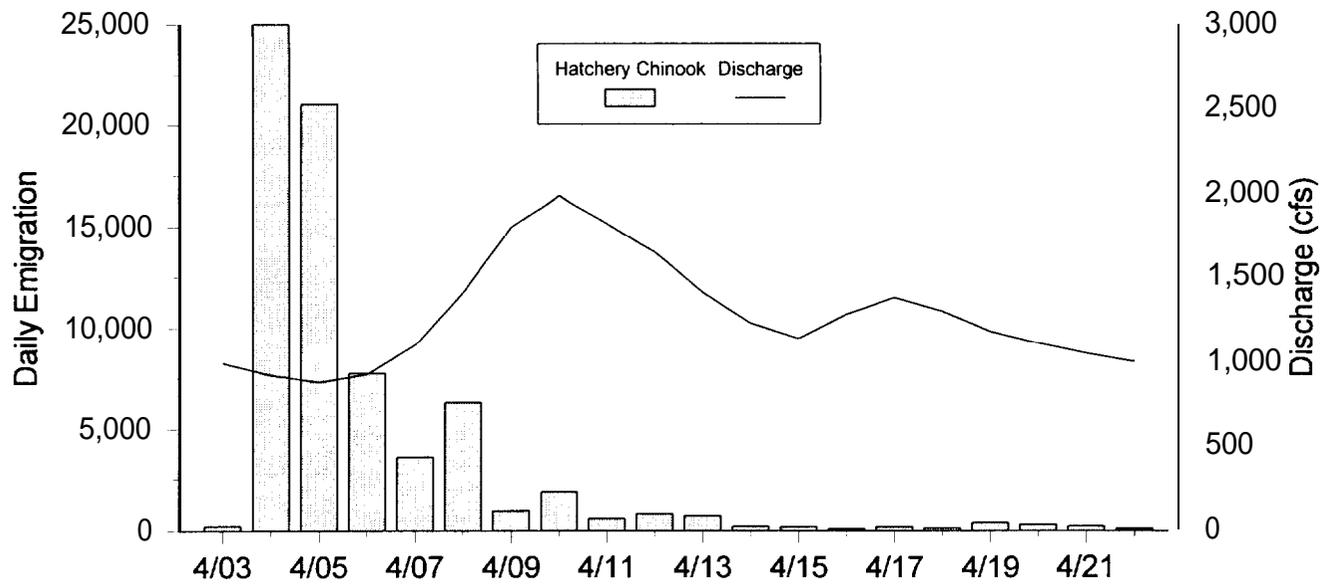


Figure 9. Estimated hatchery chinook salmon smolt outmigration, using the bootstrap method (Murphy et al., in prep), versus mean daily water discharge (upper graph) and mean daily water temperature (lower graph) from the Imnaha River, April 3 - April 23. Estimated outmigration on April 4 was 47,775.

**Biological Characteristics**

Based on length frequency data, the majority of chinook salmon and steelhead trout emigrants collected in the screw trap were age 1' and 2' respectively (Figure 10). Four age 0<sup>+</sup> chinook salmon were captured on March 20-21. Mean length of wild chinook salmon emigrants was 101 mm, mean weight was 11.4 g, and mean condition factor (K) of 1.10 (Table 8). Weekly mean length of wild chinook salmon, throughout the spring outmigration, ranged from 92 to 106 mm (Figure 11). Weekly mean condition factors of wild chinook salmon ranged from 0.99 to 1.43 with a increasing trend from February to early June (Figure 11).

Table 8. Mean and range of fork length (mm), weight (g), and condition factor for wild and hatchery chinook salmon and steelhead trout smolts collected in the Imnaha River screw trap, February 23 - June 24, 1996.

	Chinook		Steelhead	
	Wild	Hatchery	Wild	Hatchery
Number Collected	1,797	11,896	3,786	31,094
Mean Fork Length	101	131	175	201
Standard Deviation	8.4	8.6	19.0	18.3
Range	65 - 140	102 - 198	99 - 263	134 - 299
Mean Weight	11.4	26.0	56.9	80.9
Standard Deviation	3.0	6.1	17.8	24.0
Range	3.8 - 29.4	11.4 - 91.1	9.5 - 155.9	27.0 - 270.7
Mean K	1.10	1.14	1.03	0.97
Standard Deviation	0.13	0.13	0.10	0.09
Range	0.62 - 1.75	0.62 - 1.97	0.64 - 1.91	0.60 - 1.70

Hatchery chinook salmon smolts were notably larger than their wild counterparts. Mean length was 131 mm, mean weight was 26.0 g, and mean condition factor (K) was 1.14 (Table 8). Weekly mean length of hatchery chinook salmon ranged from 131 to 135 mm (Figure 11). Weekly mean condition factors of hatchery chinook ranged from 1.10 to 1.23 and were comparable to wild chinook salmon outmigrating at the same time (Figure 11).

Mean fork length of previously PIT tagged hatchery chinook salmon smolts (n=490) captured in our trap was 130.3 mm (Table 9). The mean fork length of all non-PIT tagged

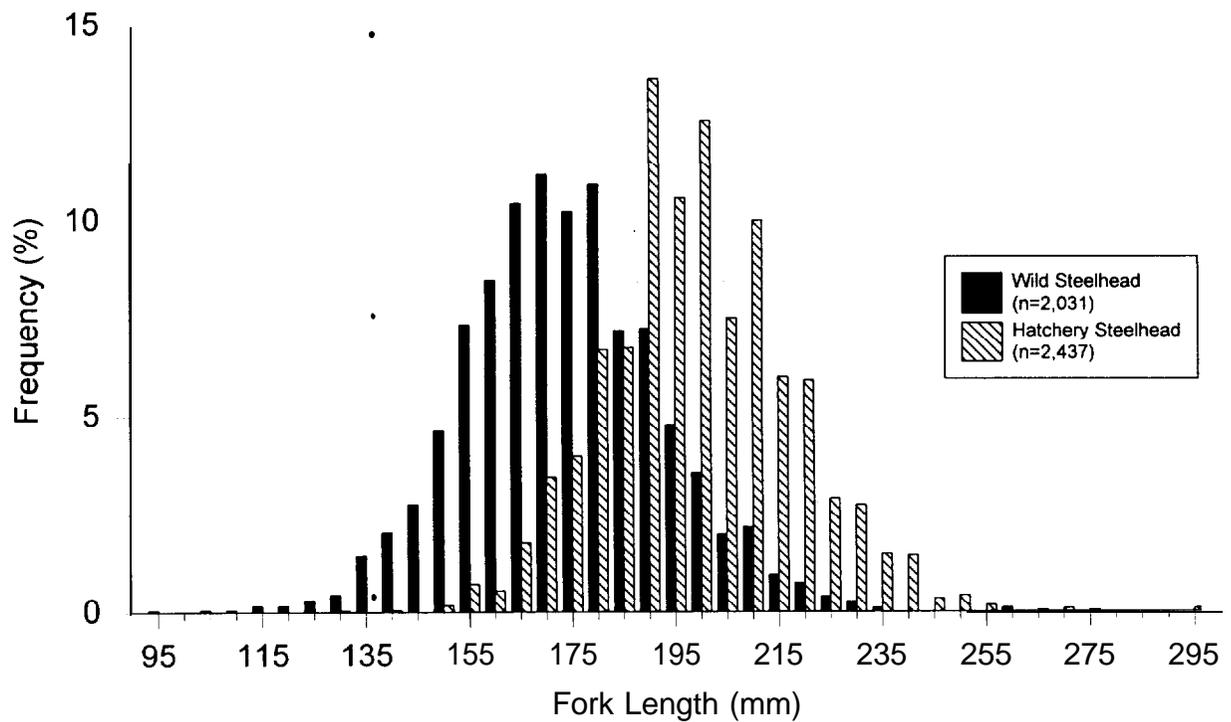
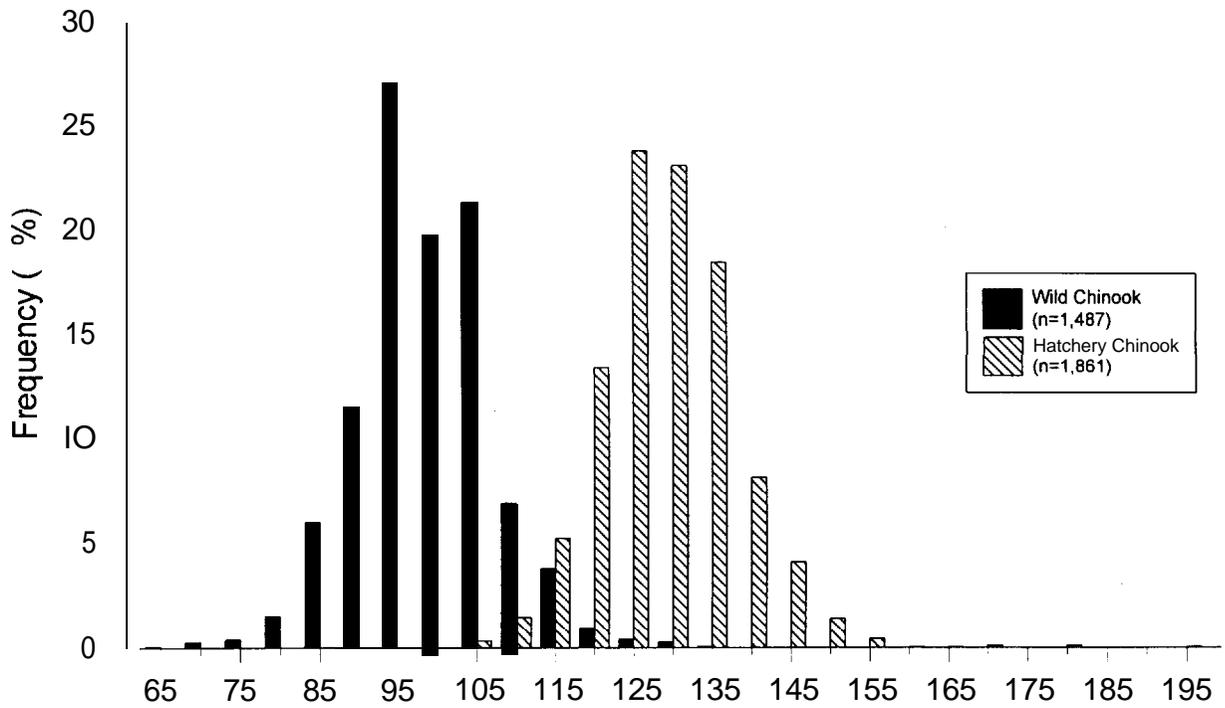


Figure IO. Length frequency of wild and hatchery chinook salmon (upper graph) and steelhead (lower graph) smolts trapped in the Imnaha River, February 23 - June 24, 1996.

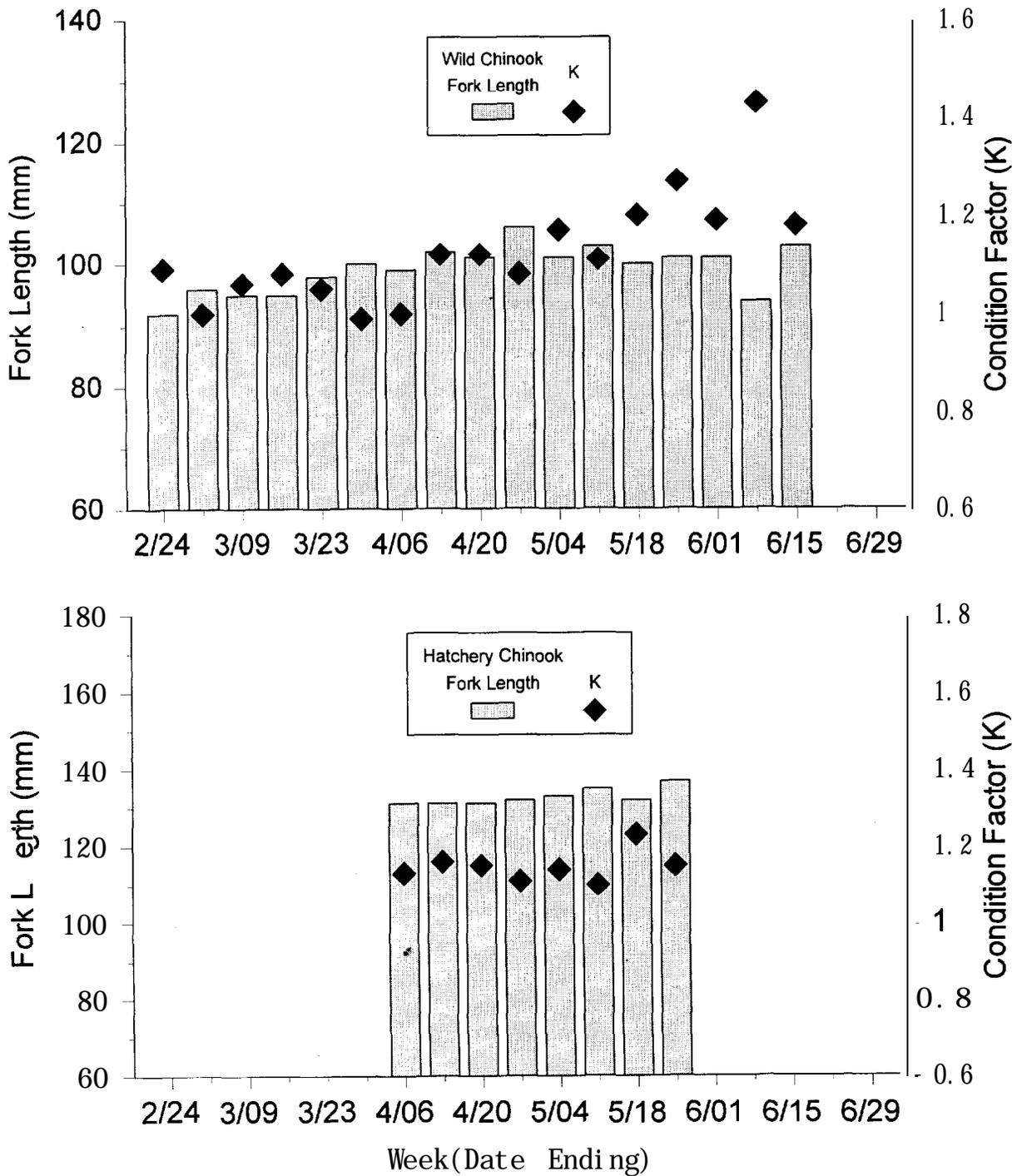


Figure 11. Weekly mean length and condition factor of wild (upper graph) and hatchery (lower graph) chinook salmon smolts trapped in the Imnaha River, February 23 - June 24, 1996.

hatchery chinook smolts (n=1,371) captured was 13 1.5 mm.

Table 9. Mean and range of fork length (mm), weight (g), and condition factor for previously PIT tagged wild and hatchery chinook salmon and steelhead trout smolts interrogated at the Imnaha River screw trap, February 23 - June 24, 1996.

	Chinook		Steelhead
	Wild	Hatchery	Hatchery
Number Interrogated	30	502	64
Mean Fork Length	98	130	195
Standard Deviation	7.4	9.0	14.1
Range	84 - 111	102-198	180-212
Mean Weight	10.5	25.0	74.9
Standard Deviation	2.7	6.8	20.1
Range	5.8 - 17.4	11.4 - 91.1	52.8 - 100.9
Mean Condition Factor	1.11	1.12	1 .00
Standard Deviation	0.15	0.17	0.07
Range	0.72 - 1.45	0.62 - 1.87	0.91 - 1.09

Wild steelhead trout smolt mean length was 175 mm, mean weight was 56.9 g, and mean condition factor was 1.03 (Table 8). Weekly mean fork length of wild steelhead trout ranged from 136 to 190 mm (Figure 12). Condition factors of wild steelhead trout ranged from 0.90 to 1.12 (Figure 12). Mean weekly condition factors for wild steelhead trout remained notably higher than their hatchery reared counterparts for every week that hatchery steelhead were collected.

Hatchery steelhead trout were about 34 mm longer than their wild counterparts, with a mean length of 201 mm, mean weight of 80.9 g, and mean condition factor (K) of 0.97 (Table 8). Weekly mean lengths of hatchery steelhead trout ranged from 197 to 216 mm (Figure 12). Condition factors of hatchery steelhead trout declined after the third week of release, and remained at lower levels through mid-June. In comparison to wild steelhead trout, condition factors of hatchery fish were generally lower, ranging from 0.88 to 1.02 (Figure 12). A substantial number of hatchery steelhead smolts appeared to be in poor general health due to loss of mucous coating and descaling.

Lengths were recorded for only six of the previously PIT tagged hatchery steelhead trout smolts that we captured. Therefore, an acceptable comparison of mean fork length could not be made with the non-PIT tagged smolts.

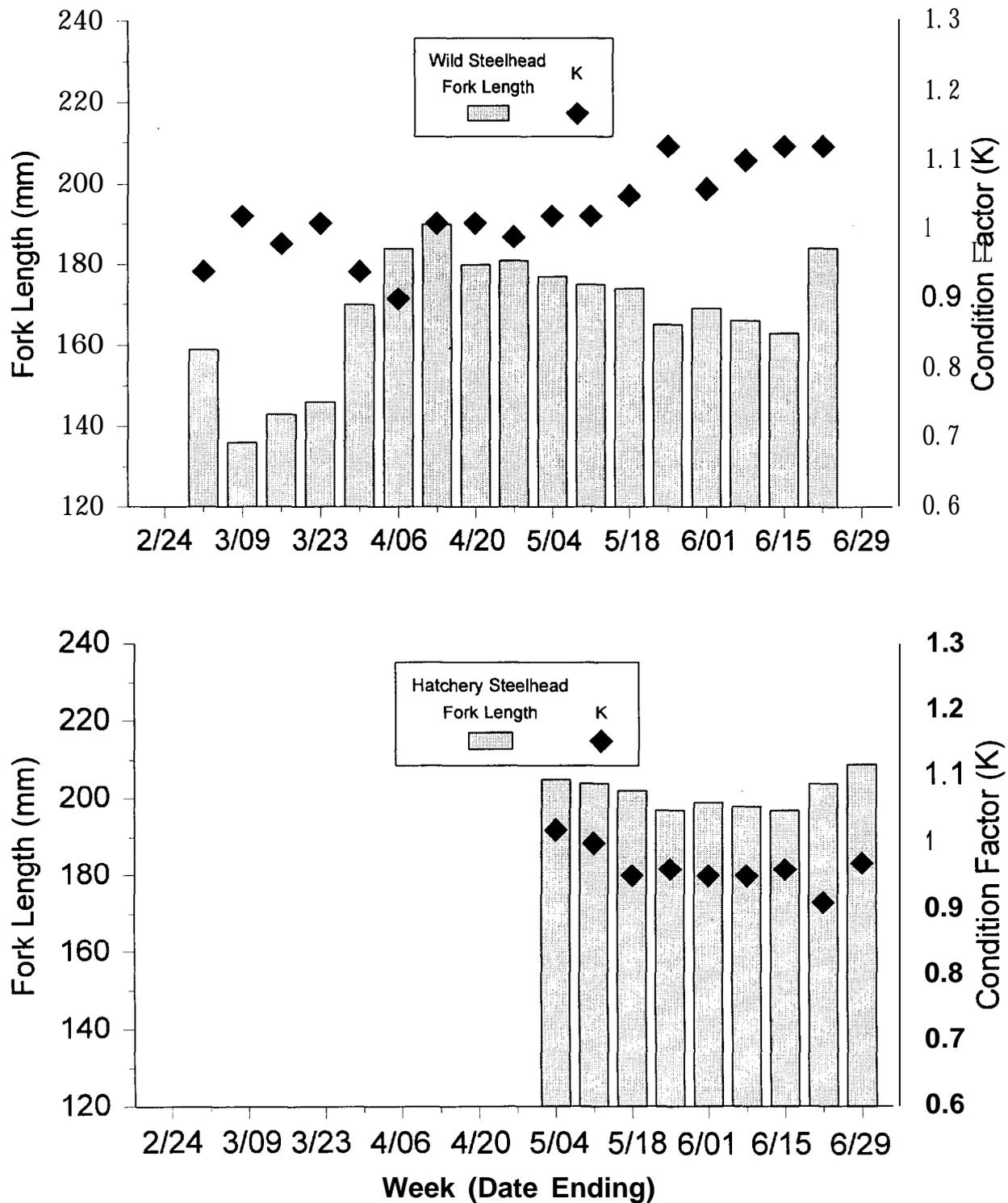


Figure 12. Weekly mean length and condition factor of wild (upper graph) and hatchery (lower graph) steelhead trout smolts trapped in the Imnaha River, February 23 - June 24, 1996.

Daily sample size, mean and standard deviation for length, weight and condition factor for wild and hatchery chinook salmon and steelhead trout smolts are contained in Appendix D.

Mortality

Mortality was tallied for each anadromous salmonid species of wild and hatchery origin to determine the effects of trapping, handling and tagging on the fish. Total mortality rates were 1.39% for wild chinook salmon, 0.18% for hatchery chinook salmon, 0.21% for wild steelhead trout, and 0.28% for hatchery steelhead trout smolts (Table 10). Handling was the major cause of mortality for each group of fish except wild steelhead (Table 10).

Table 10. Mortality of chinook salmon and steelhead trout smolts due to trapping, handling, and PIT tagging.

	Chinook		Steelhead					
	Wild	Hatchery	Wild	Hatchery				
Number Captured	1,797	11,896	3,780	31,094				
	Mortality							
Source	n	%	n	%	n	%	n	%
Trapping	5	0.28	7	0.06	5	0.13	34	0.11
Handling	16	0.89	15	0.13	1	0.03	48	0.15
PIT Tagging	4	0.08	0	0.00	2	0.05	6	0.02
Total	25	1.39	22	0.18	8	0.21	88	0.28

Incidental Catch

Non-target game fish species incidentally captured during our investigation included: 13 adult steelhead, six bull trout (*Salvelinus confluentus*), and six mountain whitefish (*Prosopium williamsoni*) (Table 11). Non-game fish captured included longnose dace (*Rhinichthys cataractae*), bridgelip sucker (*Catostomus columbianus*), reddsider shiner (*Richardsonius balteatus*), northern squawfish (*Ptychocheilus oregonensis*) and sculpin (*Cottus sp.*) (Table 11). Appendix E contains daily incidental catch information.

Table 11. Weekly catch composition of incidental fish species collected in the Imnaha River trap, February 23 - June 24, 1996.

Week	BLS	BT	LND	MWH	NSQ	RSS	SC	STHD	Total
2/18 - 2/24	0	1	0	0	0	0	0	0	1
2/25 - 3/02	0	0	0	0	0	0	1	0	1
3/03 - 3/09	0	0	0	1	0	0	1	0	2
3/10 - 3/16	1	0	2	0	2	0	2	0	7
3/17 - 3/23	0	0	6	0	0	0	1	0	7
3/24 - 3/30	0	1	0	1	2	0	3	0	7
3/31 - 4/06	0	0	21	1	1	0	1	0	24
4/07 - 4/13	2	0	9	1	0	0	0	0	12
4/14 - 4/20	2	0	0	1	1	0	0	1	5
4/21 - 4/27	1	1	0	0	0	0	0	1	3
4/28 - 5/04	3	0	1	0	0	0	2	1	7
5/05 - 5/11	0	0	5	1	0	1	3	3	13
5/12 - 5/18	3	1	1	0	1	0	0	2	8
5/19 - 5/25	1	0	0	0	0	0	0	0	1
5/26 - 6/01	3	0	3	0	0	0	0	4	10
6/02 - 6/08	12	0	22	0	0	0	0	0	34
6/09 - 6/15	15	2	49	0	1	0	0	1	68
6/16 - 6/22	29	0	54	0	0	1	0	0	84
6/23 - 6/29	8	0	0	0	0	0	0	0	8
<b>Total</b>	<b>80</b>	<b>6</b>	<b>173</b>	<b>6</b>	<b>8</b>	<b>2</b>	<b>14</b>	<b>13</b>	<b>302</b>

BLS     Bridgelip Sucker  
 BT      Bull Trout  
 LND     Longnose Dace  
 MWH    Mountain Whitefish

NSQ     Northern Squaw&h  
 RSS     Redside Shiner  
 SC      Sculpin  
 STHD   Adult Steelhead Trout

## Outmigration of PIT Tagged Fish

### Innaha River Outminration

ODFW released a total of 4,715 PIT tagged hatchery chinook salmon smolts from the Innaha River acclimation ponds on April 2, 1996. We recaptured 502 (10.6%) in our trap (Table 12 and Figure 13). The majority (55%) were interrogated overnight April 3-4, one day after release (Figure 14). Mean travel time for hatchery chinook salmon smolts to the Innaha trap was 3.1 days with the 90% arrival date occurring on April 6 (Table 13).

A total of 1,518 PIT tagged hatchery steelhead trout smolts were released by ODFW at the Little Sheep Creek Acclimation Facility on April 29, 1996. We captured 65 (4.3%) previously PIT tagged steelhead smolts in our trap (Table 12 and Figure 13). Of those interrogated, 49% (32) were sampled on May 1 (Figure 14). We interrogated 32 (3.2% of total released) acclimated steelhead trout smolts and 33 PIT tagged direct stream released steelhead trout smolts (6.6% of total released). Mean travel time to the Innaha trap for acclimated steelhead trout smolts was 5.1 days with a 90% arrival date of May 15. Direct stream released steelhead trout smolts had a mean travel time of 3.3 days with a 90% arrival date of May 3 (Table 13).

Table 12. Weekly catch composition of previously PIT tagged wild and hatchery chinook salmon and steelhead trout smolts interrogated at the Innaha River screw trap, February 23 - June 24, 1996.

Week	Chi nook			Steel head			Total
	Wild	Hatchery	Subtotal	Wild	Hatchery	Subtotal	
2/18 - 2/24	1	0	1	0	0	0	1
2/25 - 3/02	0	0	0	0	0	0	0
3/03 - 3/09	0	0	0	0	0	0	0
3/10 - 3/16	2	0	2	0	0	0	2
3/17 - 3/23	0	0	0	0	0	0	0
3/24 - 3/30	3	0	3	0	0	0	3
3/31 - 4/06	2	459	461	0	0	0	461
4/07 - 4/13	10 <sup>1</sup>	32	42	0	0	0	42
4/14 - 4/20	3	6	9	0	0	0	9
4/21 - 4/27	1	3	4	0	0	0	4
4/28 - 5/04	3	0	3	0	58	58	61
5/05 - 5/11	4	2	6	0	1	1	7
5/12 - 5/18	1	0	1	2	2	4	5
5/19 - 5/25	0	0	0	0	1	1	1
5/26 - 6/01	0	0	0	1	1	2	2
6/02 - 6/08	0	0	0	0	1	1	1
6/09 - 6/15	0	0	0	0	1	1	1
6/16 - 6/22	0	0	0	0	0	0	0
6/23 - 6/29	0	0	0	0	0	0	0
<b>Total</b>	<b>30</b>	<b>502</b>	<b>532</b>	<b>3</b>	<b>65</b>	<b>68</b>	<b>600</b>

<sup>1</sup> One wild chinook tagged by the Confederated Tribes of the Umatilla Indian Reservation in Lookingglass Creek, Oregon was interrogated on April 8. See text for explanation.

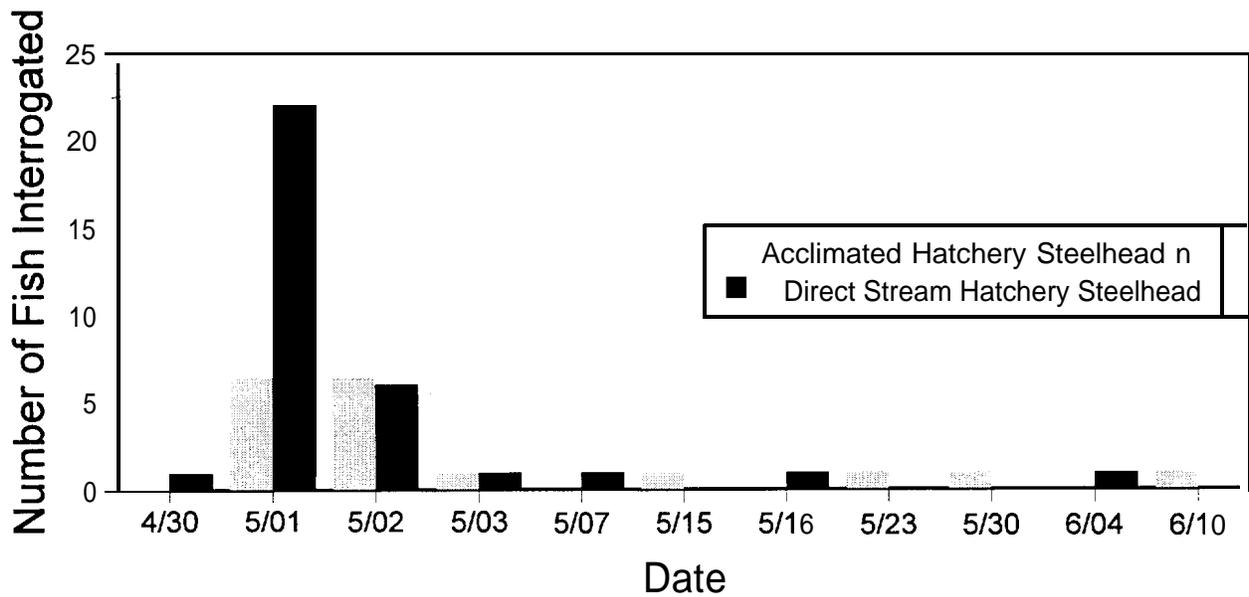
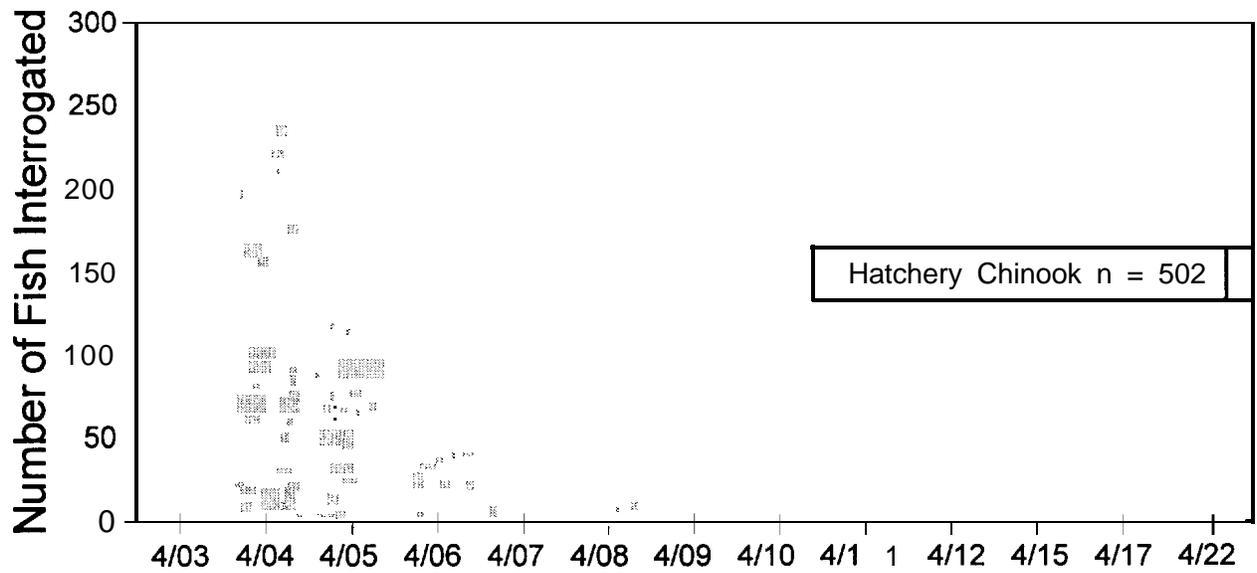


Figure 13. Outmigration timing of PIT tagged acclimated hatchery chinook salmon (upper graph) and acclimated and direct stream released steelhead trout (lower graph) smolts released on April 2 (from the Imnaha River Acclimation Facility) and April 29 (from the Little Sheep Creek Acclimation Facility), 1996, respectively.

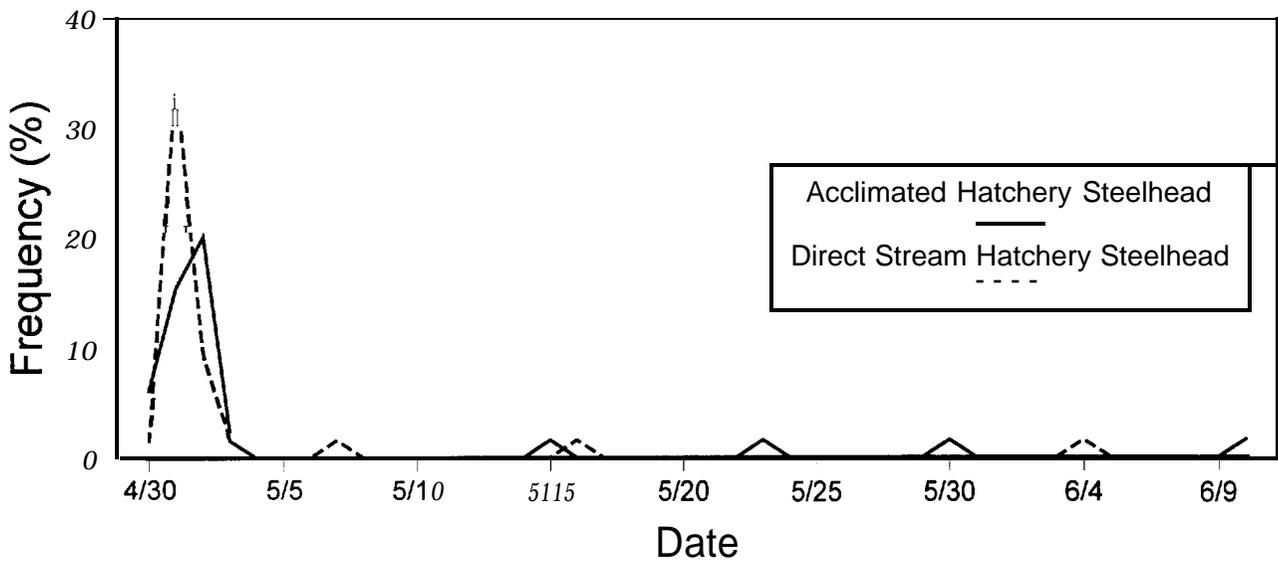
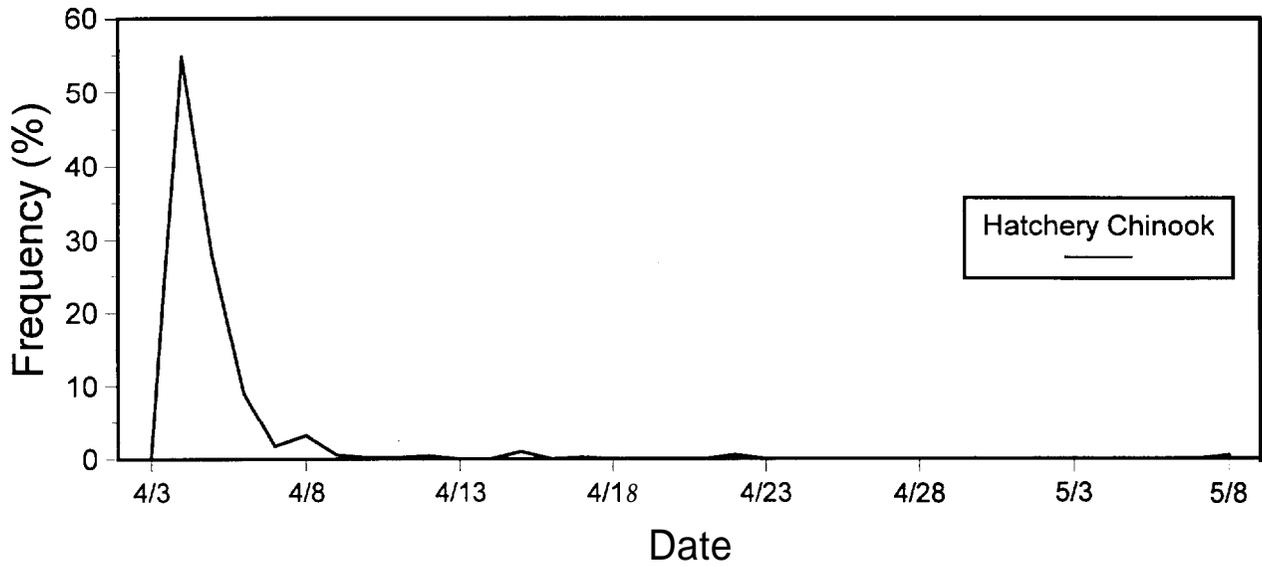


Figure 14. Daily arrival timing frequency to the NPT Imnaha River trap site of PIT tagged acclimated hatchery chinook salmon (upper graph) and acclimated and direct stream released steelhead trout (lower graph) smolts released by ODFW into the Imnaha River and Little Sheep Creek, respectively, in 1996.

Table 13. Mean travel time, travel time range and 90% arrival dates for previously PIT tagged hatchery chinook salmon and steelhead trout smolts at the Imnaha River trap site, 1996.

Species	Release Strategy	Sample Size (n)	90% Arrival Date	Mean Travel Time (Days)	Travel Time Range (Days)
Chinook	Acclimated	502	April 6	3.1	1 - 3 7
Steelhead	Acclimated	32	May 15	5.1	1 - 4 2
Steelhead	Direct stream	33	May 3	3.3	1 - 3 6

Thirty previously PIT tagged wild chinook salmon were captured at the trap during the study period (Table 12). Seventeen were tagged by the Nez Perce Tribe during the fall of 1995. Twelve wild chinook salmon tagged by ODF W during the summer of 1995 were interrogated at the trap during the study period. One wild chinook tagged in Lookingglass Creek by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) was interrogated at our trap on April 8. The fish tagged by CTUIR apparently entered Lookingglass Hatchery and was transported to the Imnaha Acclimation Facility and released into the Imnaha River with the Imnaha hatchery chinook smolts.

#### PIT Tag Release Groups

We PIT tagged and released 1,311 wild chinook salmon smolts at the Imnaha River screw trap during the spring emigration period from March 2 to June 15. Mean lengths of weekly release groups ranged (excluding those with  $n < 10$ ) from 95 to 107 mm, weights from 8.9 to 13.4 g, and condition factors from 0.99 to 1.19 (Table 14). Weekly release groups consisted of over 50 wild chinook salmon from March 16 to May 11, 1996 (Table 14).

A total of 698 hatchery chinook salmon smolts were PIT tagged and released during the study period from April 6 to June 1. Mean lengths of weekly release groups ranged from 131 to 136 mm, weights from 25.4 to 28.3 g, and condition factors from 1.07 to 1.23 (Table 15). Weekly release groups consisted of over 100 hatchery chinook salmon from April 6 to April 20, 1996 (Table 15).

We PIT tagged 1,504 wild steelhead trout smolts during the study period from April 20 to June 22. Mean lengths of weekly release groups ranged from 167 to 180 mm, weights from 51.6 to 60.3 g, and condition factors from 0.99 to 1.11 (Table 16). Weekly release groups consisted of over 100 wild steelhead from April 20 - June 1, 1996, with the exception of May 25 (Table 16).

Table 14. Mean fork length (mm), weight (g), and condition factor for each weekly release group of NPT PIT tagged wild chinook salmon smolts released at the Imnaha River screw trap February 23 - June 24, 1996 (na=not available).

Release Week Date n d i n g	Sample Size (n)	Mean Length (S.D.)	Mean Weight (S.D.)	Mean Condition (SD.)
Mar 2	49	<b>96</b> (8.5)	8.9 (2.3)	<b>1.00</b> (0.06)
Mar 9	18	<b>95</b> (9.6)	9.1 (2.9)	1.04 0.04
Mar 16	57	<b>95</b> (8.8)	9.4 (2.7)	1.08 (0.18)
Mar 23	79	<b>98</b> (8.6)	10.0 (2.7)	1.06 (0.10)
Mar 30	<b>110</b>	<b>100</b> (8.6)	<b>9.9</b> (2.6)	0.99 (0.08)
Apr 6	124	100 (8.2)	9.7 (2.6)	1.00 (0.16)
Apr 13	96	101 (7.8)	11.6 (2.9)	1.10 0.09
Apr 20	198	<b>101</b> (7.3)	11.5 (2.5)	1.12 (0.11)
Apr 27	87	107 (8.9)	13.4 (3.5)	1.07 (0.11)
May 4	<b>200</b>	102 (7.3)	12.4 (2.6)	1.16 (0.10)
May 11	216	104 (8.0)	12.4 (2.8)	1.10 (0.12)
May 18	<b>43</b>	100 (6.0)	11.9 (2.3)	1.19 (0.08)
May 25	<b>5</b>	101 (6.0)	13.3 (3.1)	1.28 (0.09)
Jun 1	<b>22</b>	101 (7.6)	12.2 (2.9)	1.18 (0.10)
Jun 8	6	<b>94</b> (5.7)	12.1 (2.6)	1.43 (0.16)
Jun 15	<b>1</b>	100 na	12.9 na	1.29 na
<b>Total</b>	<b>1,311</b>	<b>101</b> (8.4)	<b>11.4</b> (3.0)	1.09 (0.13)

Table 15. Mean fork length (mm), weight (g), and condition factor for each weekly release group of PIT tagged hatchery chinook salmon smolts released at the Imnaha River screw trap, February 23 - June 24, 1996 (na=not available).

Release Week Date Ending	Sample Size (n)	Mean Length (S.D.)	Mean Weight (S.D.)	Mean Condition (S.D.)
Apr 6	230	132 (7.3)	26.5 (4.9)	1.14 (0.08)
Apr 13	175	131 (9.2)	26.2 (6.1)	1.16 (0.11)
Apr 20	128	131 (8.8)	26.2 (5.5)	1.15 (0.11)
Apr 27	32	132 (7.2)	25.4 (4.2)	1.09 (0.08)
May 4	72	133 (9.2)	27.2 (6.4)	1.14 (0.14)
May 11	50	136 (9.8)	26.9 (5.8)	1.07 (0.09)
May 18	10	132 (10.3)	28.3 (5.6)	1.23 (0.12)
Jun 1	1	137 na	29.6 na	1.15 na
Total	698	132 (8.6)	26.4 (5.5)	1.14 (0.11)

Table 16. Mean fork length (mm), weight (g), and condition factor for each weekly release group of PIT tagged wild steelhead trout smolts released at the Imnaha River screw trap February 23 - June 24, 1996 (na=not available). Fish released after recovery from tagging, (approximately one hour).

Wild Steelhead								
Release Week Date Ending		NPT Investigations			n	FPC Investigations		
		Mean Length (S.D.)	Mean Weight (S.D.)	Mean Condition (S . D . )		Mean Length (S.D.)	Mean Weight (S . D . )	Mean Condition (SD.)
Apr 20	0				197	180 (20.0)	60.3 (19.3)	1.00 (0.10)
Apr 27	0				232	180 (18.2)	59.6 (17.8)	0.99 (0.07)
May 4	0				199	177 (16.1)	57.4 (15.2)	1.02 (0.09)
May 11	0				200	175 (17.0)	55.5 (15.1)	1.02 (0.13)
May 18	293	173 (17.4)	57.0 (27.9)	1.05 (0.12)	153	173 (16.2)	55.0 (15.8)	1.03 (0.08)
May 25	0				34	167 (15.7)	52.1 (14.7)	1.11 (0.09)
Jun 1	0				114	169 (14.3)	51.6 (12.4)	1.06 (0.09)
Jun 8	79	168 (15.0)	53.4 (13.2)	1.11 (0.10)	0			
Jun 15	2	163 (22.6)	49.3 (17.4)	1.12 (0.06)	0			
Jun 22	1	184 na	69.6 na	1.12 na	0			
<b>TOTAL</b>	<b>375</b>	<b>172 (16.8)</b>	<b>55.0 (15.5)</b>	<b>1.06 (0.11)</b>	<b>1,129</b>	<b>176 (17.5)</b>	<b>56.9 (16.4)</b>	<b>1.02 (0.10)</b>

We PIT tagged 1,346 hatchery steelhead trout smolts during the study period. Mean lengths of weekly release groups ranged from 197 to 201 mm, weights from 75.1 to 88.7 g, and condition factors from 0.91 to 1.03 (Table 17). Weekly release groups consisted of over 150 hatchery steelhead from May 4 - June 15, 1996, with the exception of May 18 (Table 17).

### Snake River Flows

River discharge during the study period, measured at the **Anatone** gauge station (Figure 15), fluctuated from 46.9 kcfs on May 8 to 146.7 kcfs on June 11. Flows declined steadily after the peak discharge on June 11. Fluctuations in flows at the **Anatone** gauge station are a result of springtime freshets and operations at Hells Canyon Dam.

Spring runoff water conditions in 1996 provided above average flows for outmigrating anadromous salmonid smolts. River discharge measured at Lower Granite Dam (LGR) ranged from 76 kcfs on April 18 to 202.2 kcfs on June 10 (Figure 15) and paralleled increases in Snake River flows observed at the **Anatone** gauge station. Flows at LGR were generally greater than 100 kcfs during the majority of the spring period, and river discharge exceeded 120 kcfs from May 14 to June 20. Flows declined steadily after the peak discharge on June 11.

Continuous spill started on February 5 and occurred at LGR for the entire study period with the exception of three days (March 29-31). Water spill ranged from 0 kcfs on March 29-31 to 110.4 kcfs on April 12. Spill continued at LGR until July 8 except on June 29 and July 1.

### Smolt Interrogation Percentages

Interrogation percentages were based on cumulative first observation detections at the mainstem Snake River (Lower Granite, Little Goose and Lower Monumental) and Columbia River (McNary) dams.

A total of 819 (62.5%) of the 1,311 PIT tagged wild chinook salmon smolts released at the Imnaha River trap were interrogated (or detected) at mainstem dams (Table 18). Cumulative interrogation percentages for weekly release groups ranged from 53.2% for the March 23 release group to 71.2% for the April 27 release group (Figure 16). The highest percentage of smolts that were observed at Lower Granite Dam (40.2%) occurred from the April 27 weekly release group. The March 2, March 9, and release groups tagged on or after May 12 had less than 30 PIT tagged wild chinook interrogated, which did not provide a sufficient sample size to base analysis on (Table 19). Cumulative interrogation percentages for the migration years 1993-1996 have ranged from 62.2% in 1994 to 78.4% in 1995. Wild chinook smolt cumulative interrogations have ranged from 14.5% to 20.4% higher than hatchery chinook smolt interrogations from 1994-1996 (Table 18).

Table 17. Mean fork length (mm), weight (g), and condition factor for each weekly release group of PIT tagged hatchery steelhead trout smolts released at the Imnaha River screw trap February 23 - June 24, 1996 (na=not available). Fish released after recovery from tagging, (approximately one hour).

Hatchery Steelhead								
Release Week Date Ending	n	NPT Investigations			n	FPC Investigations		
		Mean Length (S.D.)	Mean Weight (S.D.)	Mean Condition (S.D.)		Mean Length (S.D.)	Mean Weight (S.D.)	Mean Condition (S.D.)
Apr 20	0				1	212 na	81.9 na	0.86 na
Apr 27	0				4	216 (10.8)	8.77 (16.5)	0.88 (0.14)
May 4	0				202	204 (17.9)	88.7 (24.5)	1.03 (.09)
May 11	0				199	202 (17.6)	85.7 (23.2)	1.02 (0.09)
May 18	0				128	204 (18.2)	85.8 (25.8)	0.98 (0.07)
May 25	0				170	197 (19.3)	75.5 (23.8)	0.96 (0.07)
Jun 1	0				199	198 (18.9)	77.2 (26.2)	0.96 (0.07)
Jun 8	198	197 (18.3)	76.3 (22.9)	0.97 (0.08)	0			
Jun 15	196	197 (17.8)	75.1 (20.5)	0.96 (0.09)	0			
Jun 22	37	204 (18.2)	79.2 (20.9)	0.91 (0.07)	0			
Jun 29	12	<b>209</b> <b>(9.0)</b>	88.3 (11.2)	0.97 (0.06)	0			
<b>TOTAL</b>	<b>443</b>	<b>198</b> <b>(18.0)</b>	<b>76.3</b> <b>(21.5)</b>	<b>0.96</b> <b>(0.08)</b>	<b>903</b>	<b>201</b> <b>(18.6)</b>	<b>82.6</b> <b>(25.1)</b>	<b>0.99</b> <b>(0.09)</b>

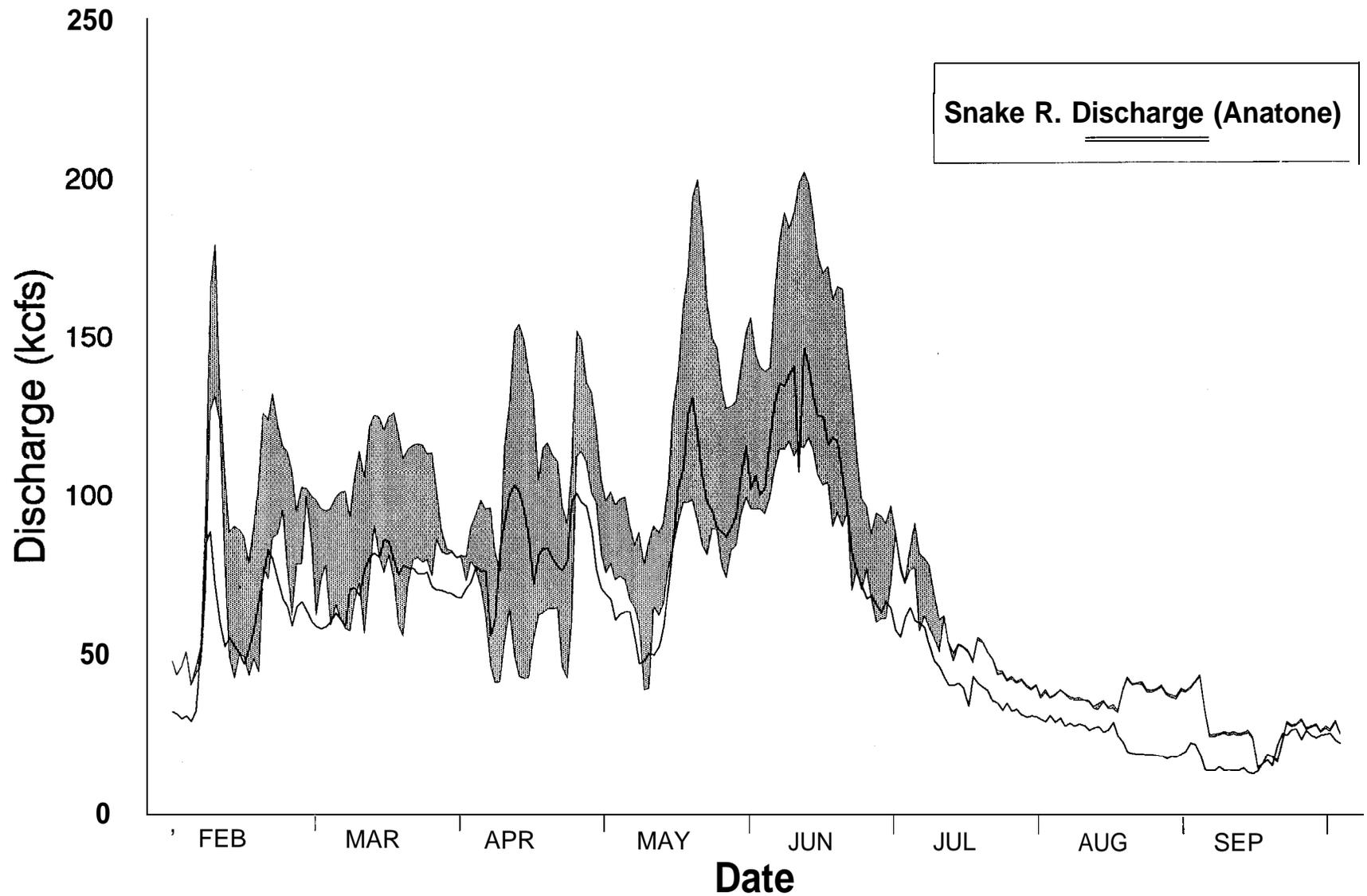


Figure 15. Total water discharge at Lower Granite Dam (top line), spill (shaded) and Snake River discharge at the **Anatone** gauge station, February 1 - September 30, 1996.

Table 18. Cumulative interrogations at Lower Granite, Little Goose, Lower Monumental and McNary Dams, by year, of Imnaha River chinook salmon and steelhead trout smolts.

Year	Number Released	Number Interrogated	Cumulative Interrogations (%)
<b><u>Wild Chinook</u></b>			
<b>1996</b>	<b>1,311</b>	<b>819</b>	62.5
1995	421	330	78.4
1994	956	595	62.2
1993	249	160	64.2
<b><u>Hatchery Chinook</u></b>			
<b>1996</b>	698	335	48.0
1995 <sup>a</sup>	445	262	58.9
<b>1995<sup>b</sup></b>	302	171	56.6
1994	661	299	45.2
1992 <sup>c</sup>	928	450	48.5
<b><u>Wild Steelhead</u></b>			
<b>1996</b>	<b>1,504</b>	<b>1,065</b>	70.8
1995	227	173	76.2
1994 <sup>d</sup>	846	443	52.4
<b>1994<sup>d</sup></b>	586	292	49.8
1993	184	131	71.2
<b><u>Hatchery Steelhead</u></b>			
<b>1996</b>	<b>1,346</b>	<b>671</b>	49.8
1995	1,296	897	69.2
1994 <sup>e</sup>	793	216	27.3
<b>1994<sup>d</sup></b>	1,236	479	38.8
1993	525	279	53.1

<sup>a</sup> HXW crossed chinook salmon smolts PIT tagged for the Nez **Perce** Tribe and released at dark.

<sup>b</sup> HXH crossed chinook salmon smolts PIT tagged for the Fish Passage Center and released one hour after tagging and recovery.

<sup>c</sup> NPT PIT tagged fish

<sup>d</sup> FPC PIT tagged fish

<sup>e</sup> Lower Monumental Dam was not an interrogation site

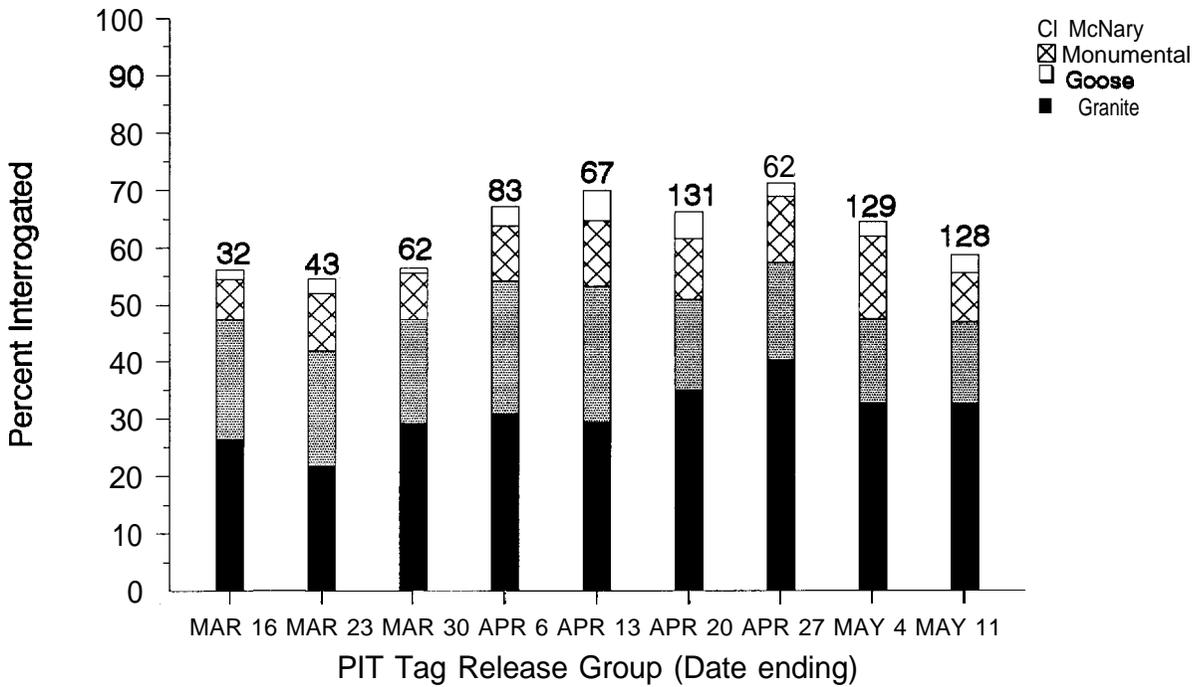


Figure 16. Cumulative interrogations, by weekly PIT tag release group, of wild chinook salmon smolts from the Imnaha River to Lower Granite, Little Goose, Lower Monumental and McNary Dams, April 6 - June 8, 1996 (sample size on top).

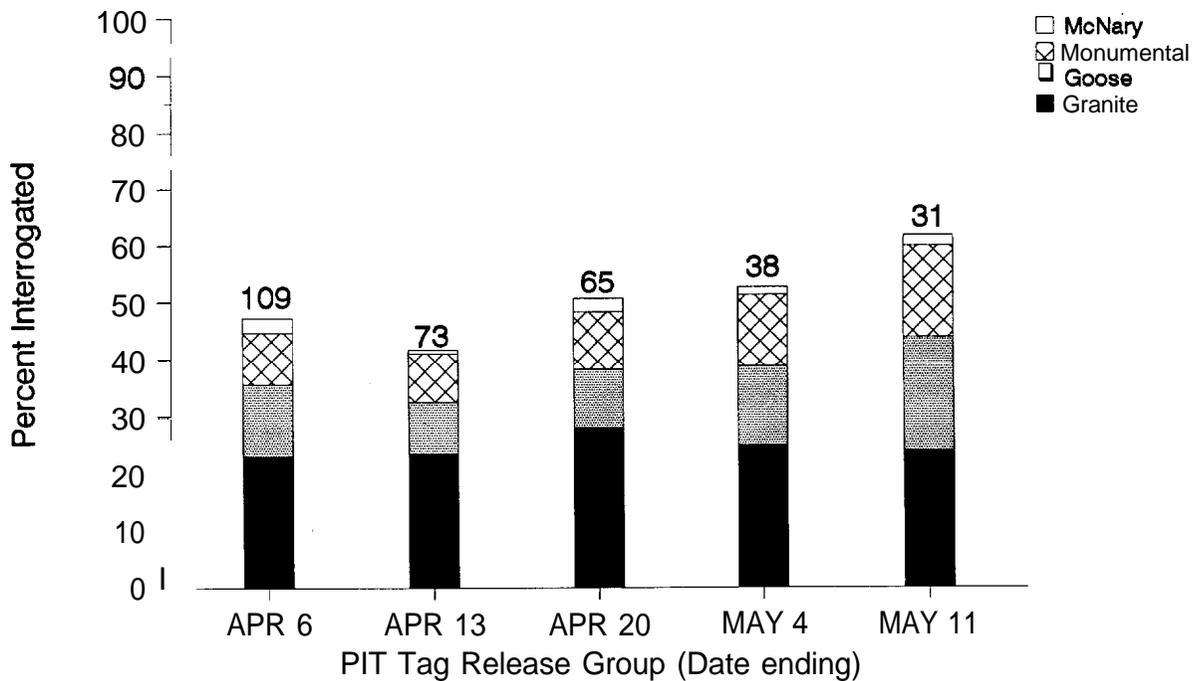


Figure 17. Cumulative interrogations, by weekly PIT tag release group, of hatchery chinook salmon smolts from the Imnaha River to Lower Granite, Little Goose, Lower Monumental and McNary Dams, April 13 - May 29, 1996 (sample size on top).

Table 19. Interrogation percents (based on first observations) of wild chinook salmon smolt weekly PIT tag release groups from the Imnaha River to Lower Granite, Little Goose, Lower Monumental and McNary Dams.

Release Week Date Ending	Number Tagged	Lower Granite		Little Goose		Lower Monumental		McNary		Total	
		n	%	n	%	n	%	n	%	n	%
Mar 2	49	15	30.6	6	12.2	6	12.2	0	0	27	55.0
Mar 9	18	7	38.9	1	5.6	3	16.7	0	0	11	61.2
Mar 16	57	15	26.3	12	21.1	4	7.0	1	1.8	32	56.2
Mar 23	79	17	21.5	16	20.3	8	10.1	2	2.5	43	53.2
Mar 30	110	32	29.1	20	18.2	9	8.2	1	0.9	62	56.4
Apr 6	124	38	30.6	29	23.4	12	9.7	4	3.2	83	66.9
Apr 13	96	28	29.2	23	24.0	11	11.5	5	5.2	67	69.9
Apr 20	198	69	34.8	32	16.2	21	10.6	9	4.5	131	61.6
Apr 27	87	35	40.2	15	17.2	10	11.5	2	2.3	62	71.2
May 4	200	65	32.5	30	15.0	29	14.5	5	2.5	129	64.5
May 11	216	71	32.9	31	14.4	19	8.8	7	3.2	128	59.3
May 18	43	13	30.2	6	14.0	3	7.0	2	4.7	24	55.9
May 25	5	3	60.0	0	0	0	0	0	0	3	60.0
Jun 1	22	10	45.5	2	9.1	2	9.1	0	0	14	63.6
Jun 8	6	2	33.3	0	0	1	16.7	0	0	3	50.0
Jun 15	1	0	0	0	0	0	0	0	0	0	0

Of the 698 PIT tagged hatchery chinook salmon smolts released at the Imnaha River trap, 335 (48.0%) were interrogated (Table 18). Cumulative interrogation percentages for weekly release groups ranged from 4 1.7% for the April 13 release group to 62% for the May 11 release group (Figure 17). The percentage of hatchery chinook smolts first observed at Lower Monumental Dam was almost identical to the percent first observed at Little Goose Dam for the April 13, April 20 and May 4 release groups. Hatchery chinook PIT tag release groups which had less than 30 interrogations were April 27, May 18, and June 8 (Table 20). Migratory year cumulative interrogation percentages for hatchery chinook have ranged from 45.2% in 1994 to 58.9% (HxW crossed chinook salmon smolts) in 1995 (Table 16). No PIT tagged hatchery chinook salmon smolts were released from the Imnaha River trap in 1993. In 1992, cumulative interrogation percentages did not include Lower Monumental Dam as it was not yet an interrogation site.

Table 20. Interrogation percents (based on first observations) of hatchery chinook salmon smolt weekly PIT tag release groups to Lower Granite, Little Goose, Lower Monumental and McNary Dams.

Release Week Date Ending	Number Tagged	Lower Granite		Little Goose		Lower Monumental		McNary		Total	
		n	%	n	%	n	%	n	%	n	%
Apr 6	230	53	23.0	29	12.6	21	9.1	6	2.6	109	47.4
Apr 13	175	41	23.4	16	9.1	1.5	8.6	1	0.6	73	41.7
Apr 20	128	36	28.1	13	10.2	13	10.2	3	2.3	65	50.8
Apr 27	32	7	21.9	5	15.6	2	6.3	1	3.1	15	46.9
May 4	72	18	25.0	10	13.9	9	12.5	1	1.4	38	52.8
May 11	50	12	24.0	10	20.0	8	16.0	1	2.0	31	62.0
May 18	10	2	20.0	0	0	0	0	1	10.0	3	30.0
June 8	1	0	0	1	100.0	0	0	0	0	1	100.0

A total of 1,065 (70.8%) of the 1,504 PIT tagged wild steelhead trout smolts released at the Imnaha River trap were interrogated at mainstem dams (Table 18). Cumulative interrogation percentages of weekly release groups ranged from 62.1% for the May 18 release group to 84.8% for the April 20 release group (Figure 18). We observed a higher percentage of wild steelhead smolts first observed at Little Goose Dam from the April 20, May 11, and May 18 release groups. A higher percentage of smolts was also first observed at Lower Monumental Dam from the May 11 release group. It is believed that the higher percentage of smolts first observed at Little Goose and Lower Monumental Dams is attributed to spill or dam operations at Lower Granite Dam. The May 25, June 15, and June 22 release groups had less than 30 interrogations and were not used for analysis (Table 21). Cumulative interrogation percentages, by migratory year, for wild steelhead trout smolts have ranged from 49.8% (fish tagged for the Fish Passage Center and released one hour after tagging) in 1994 to 76.2% in 1995. Wild steelhead trout smolt cumulative interrogations have been 7-25.1% higher than hatchery steelhead trout smolt cumulative interrogations from 1993 to 1996.

Of the 1,346 PIT tagged hatchery steelhead trout smolts released at the Imnaha River trap, 671 (49.8%) were interrogated (Table 18). Weekly cumulative interrogation percentages for hatchery steelhead trout ranged from 35.9% for the May 18 release group to 69.3% for the May 4 release group (Figure 19). The percentage of smolts first observed at Little Goose and Lower Monumental dams for the May 4 and May 11 release groups were almost identical (Table 22). Release groups with less than 30 interrogations, and not used for analysis, occurred on April 20, April 27, June 22, and June 29. Cumulative interrogation percentages for the migratory years 1993 to 1996 have ranged from 27.3% (fish tagged for the Nez Perce Tribe and released at dark) in 1994 to 69.2% in 1995. The low interrogation percentage in 1994 may be due to the extended holding of fish before release and the protocol has been changed to releasing steelhead approximately one hour after tagging.

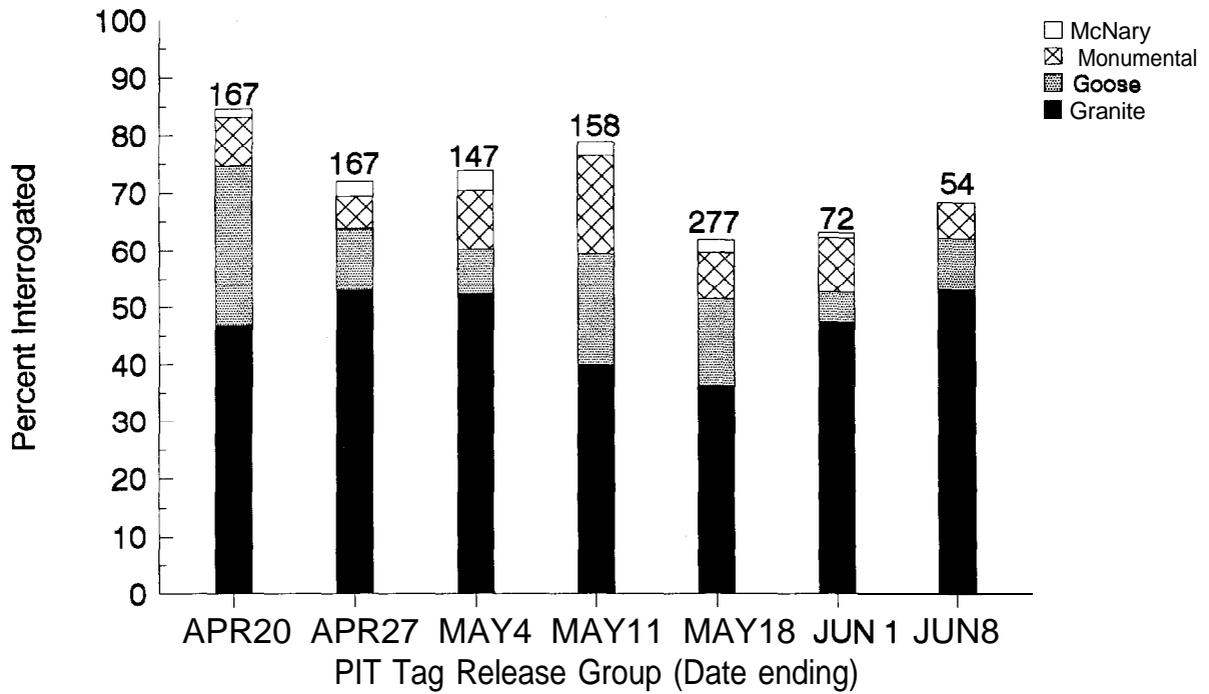


Figure 18. Cumulative interrogations, by weekly PIT tag release group, of wild steelhead trout smolts from the Imnaha River to Lower Granite, Little Goose, Lower Monumental and McNary Dams, April 19 - June 12, 1996 (sample size on top).

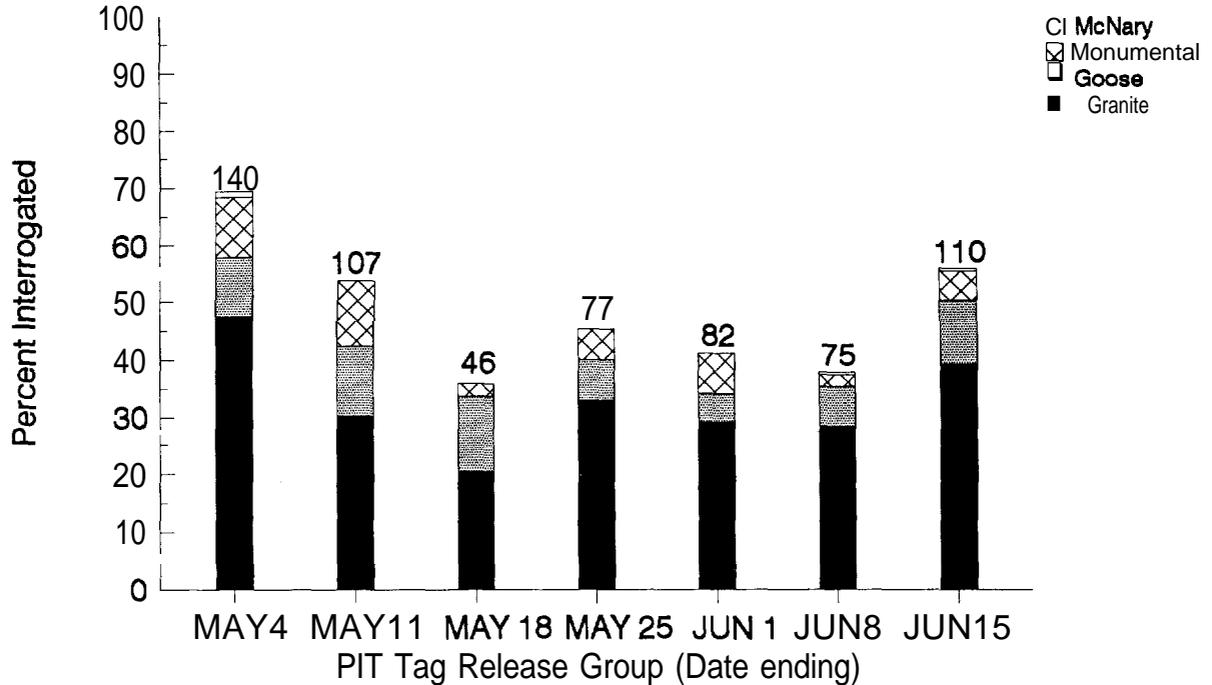


Figure 19. Cumulative interrogations, by weekly PIT tag release group, of hatchery steelhead trout smolts from the Imnaha River to Lower Granite, Little Goose, Lower Monumental and McNary Dams, May 2 - July 6, 1996 (sample size on top).

Table 21. Interrogation percents (based on first observations) of wild steelhead trout smolt weekly PIT tag release groups from the Imnaha River to Lower Granite, Little Goose, Lower Monumental and McNary Dams.

Release Week Date Ending	Number Tagged	Lower Granite		Little Goose		Lower Monumental		McNary		Total	
		n	%	n	%	n	%	n	%	n	%
Apr 20	197	92	46.7	55	27.9	17	8.6	3	1.5	167	84.8
Apr 27	232	123	53.0	25	10.8	13	5.6	6	2.6	167	72.0
May 4	199	104	52.3	16	8.0	20	10.1	7	3.5	147	73.9
May 11	200	80	40.0	39	19.5	34	17.0	5	2.5	158	79.0
May 18	446	162	36.3	68	15.2	37	8.3	10	2.2	277	62.1
May 25	34	15	44.1	7	20.6	1	2.9	0	0	23	67.6
June 1	115	54	47.0	6	5.2	11	9.6	1	0.9	72	62.6
June 8	79	42	53.2	7	8.9	5	6.3	0	0	54	68.4
June 15	2	0	0	0	0	0	00	0	0	0	0
June 22	1	0	0	0	0	0	00	0	0	0	0

Table 22. Interrogation percents (based on first observations) of PIT tagged hatchery steelhead trout smolt weekly release groups from the Imnaha River to Lower Granite, Little Goose, Lower Monumental and McNary Dams.

Release Week Date Ending	Number Tagged	Lower Granite		Little Goose		Lower Monumental		McNary		Total	
		n	%	n	%	n	%	n	%	n	%
Apr 20	1	1	100.0	0	0	0	00	0	0	1	100.0
Apr 27	4	2	50.0	0	0	0	00	0	0	2	50.0
May 4	202	96	47.5	21	10.4	21	10.4	2	1.0	140	69.3
May 11	199	60	30.2	24	12.1	23	11.6	0	0	107	53.8
May 18	128	26	20.3	17	13.3	3	2.3	0	0	46	35.9
May 25	170	56	32.9	12	7.1	9	5.3	0	0	77	45.3
June 1	198	58	29.3	10	5.1	14	7.1	0	0	82	41.4
June 8	198	56	28.3	14	7.1	4	2.0	1	0.5	75	37.9
June 15	196	77	39.3	22	11.2	10	5.1	1	0.5	110	56.1
June 22	37	11	29.7	5	13.5	5	13.5	0	0	21	56.7
June 29	12	5	41.7	5	41.7	0	0	0	0	10	83.4

Average fork length of PIT tagged Imnaha River wild chinook salmon smolts was 101 mm. The average fork length, at tagging, of wild chinook ultimately detected at Lower Granite Dam was also 101 mm (Figure 20). There appeared to be no size related mortality effects due to the effects of PIT tagging as no significant difference in mean fork length existed between the two groups ( $p > 0.05$ ). Average fork length of Imnaha River hatchery chinook salmon smolts tagged and released and average fork length, at tagging, detected at Lower Granite were both 132 mm. Wild and hatchery PIT tagged steelhead trout smolts had average fork lengths of 175 mm and 200 mm, respectively (Figure 21). Average fork lengths, of smolts at tagging, detected at Lower Granite Dam was 176 mm and 199 mm, respectively. No significant difference ( $p > 0.05$ ) was observed between mean tagging length and mean lengths at tagging of fish detected at Lower Granite Dam for wild chinook, hatchery chinook, wild steelhead or hatchery steelhead smolts. Mean fork lengths for PIT tagged wild and hatchery chinook smolts, detected at Lower Granite Dam, released the weeks of April 6, 13, and 20 were significantly different ( $p < 0.05$ ) (Table 23). There was a significant difference ( $p < 0.05$ ) in mean fork lengths of PIT tagged wild and hatchery steelhead smolts, detected at Lower Granite Dam, for the weekly release groups of May 4, May 11, May 18, June 1, and June 8 (Table 24).

Table 23. Comparison of mean fork length between weekly PIT tag release groups of Imnaha River wild and hatchery reared chinook salmon smolts detected at Lower Granite Dam in 1996.

Week	Sample Size (n)		Average Fork Length (mm)		t-Value	Significance
	Wild Chinook	Hatchery Chinook	Wild Chinook	Hatchery Chinook		
April 6	38	53	99.6	133.9	22.56	$p < 0.05$
April 13	28	40	100.6	130.8	15.76	$p < 0.05$
April 20	69	35	100.5	130.5	17.79	$p < 0.05$

Table 24. Comparison of mean fork length between weekly PIT tag release groups of Imnaha River wild and hatchery reared steelhead trout smolts detected at Lower Granite Dam in 1996.

Week	Sample Size (n)		Average Fork Length (mm)		t-Value	Significance
	Wild Steelhead	Wild Steelhead	Hatchery Steelhead	Wild Steelhead		
May 4	104	95	177.2	202.7	11.41	$p < 0.05$
May 11	80	60	174.2	206.6	10.88	$p < 0.05$
May 18	162	26	172.4	198.5	6.08	$p < 0.05$
June 1	54	58	169.1	197.5	8.48	$p < 0.05$
June 8	42	56	170.4	191.7	6.40	$p < 0.05$

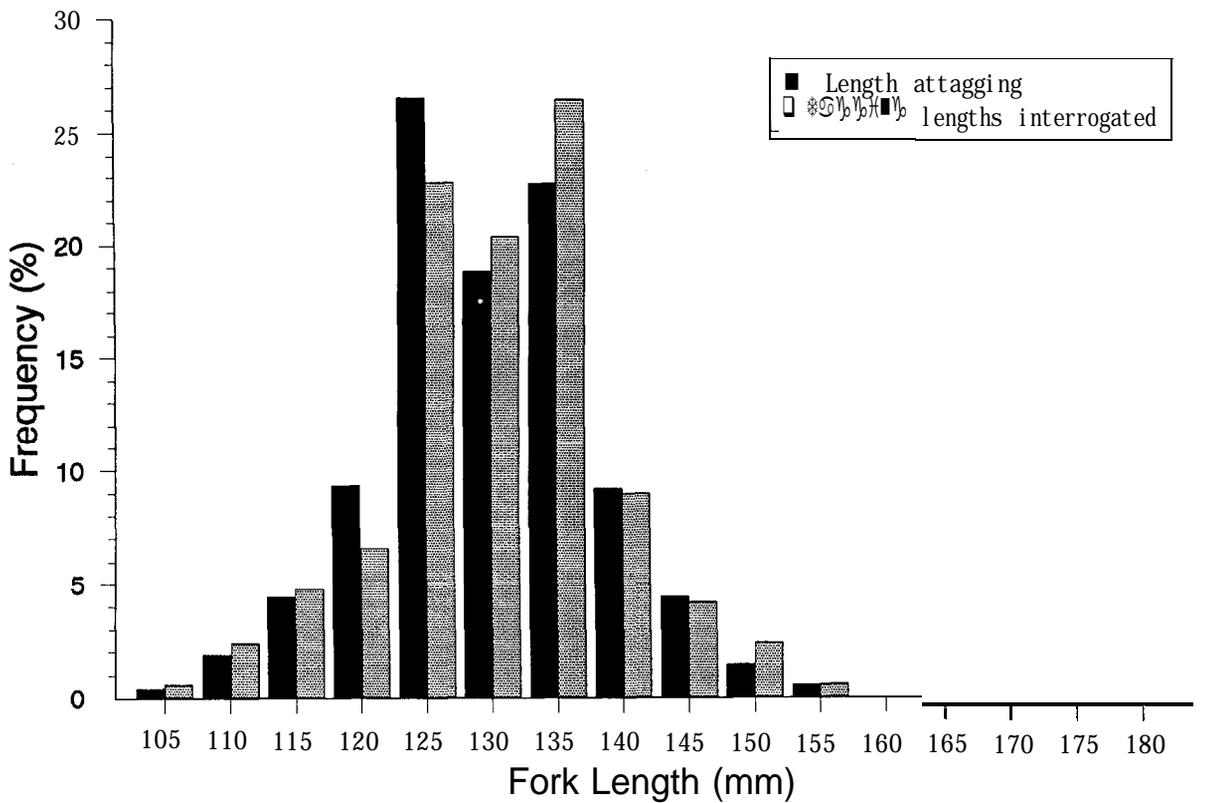
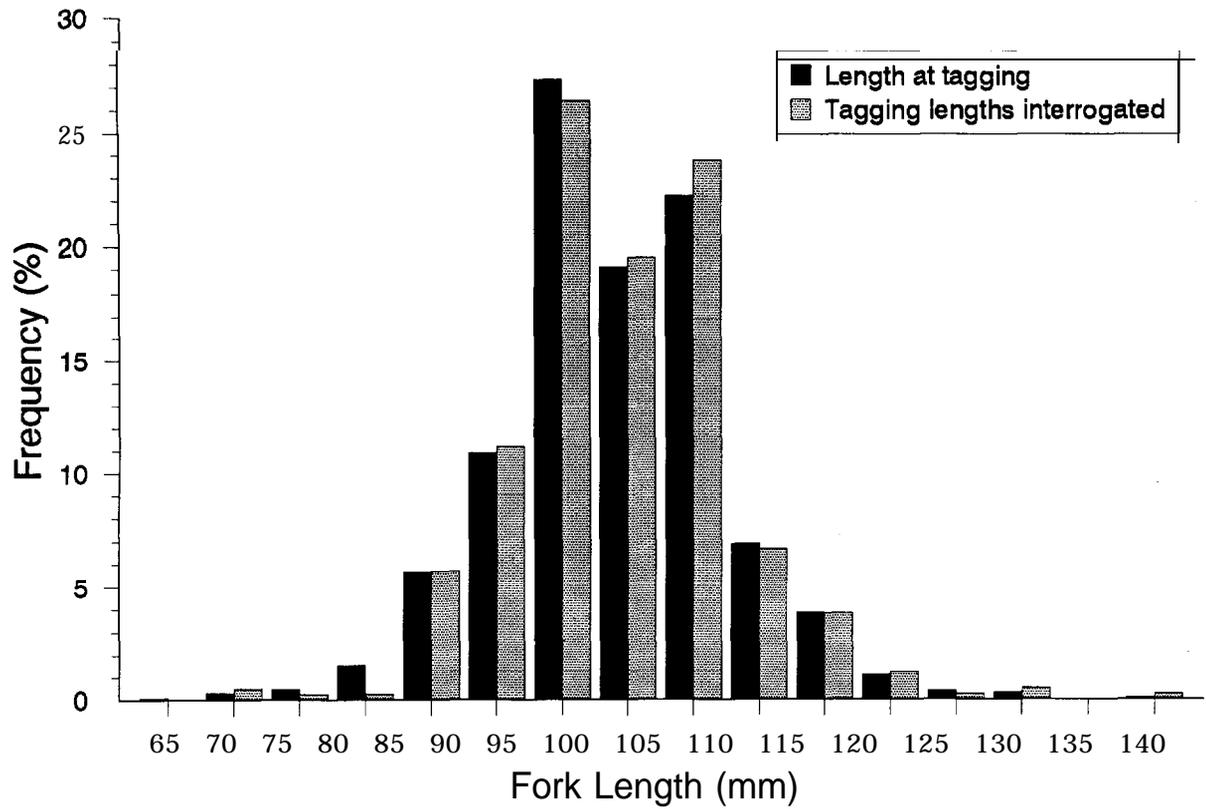


Figure 20. Fork length frequency for PIT tagged wild (upper graph) and hatchery (lower graph) chinook salmon smolts released in the Imnaha River from March 1 - June 11, 1996 and length frequency of fish ultimately detected at Lower Granite Dam in 1996.

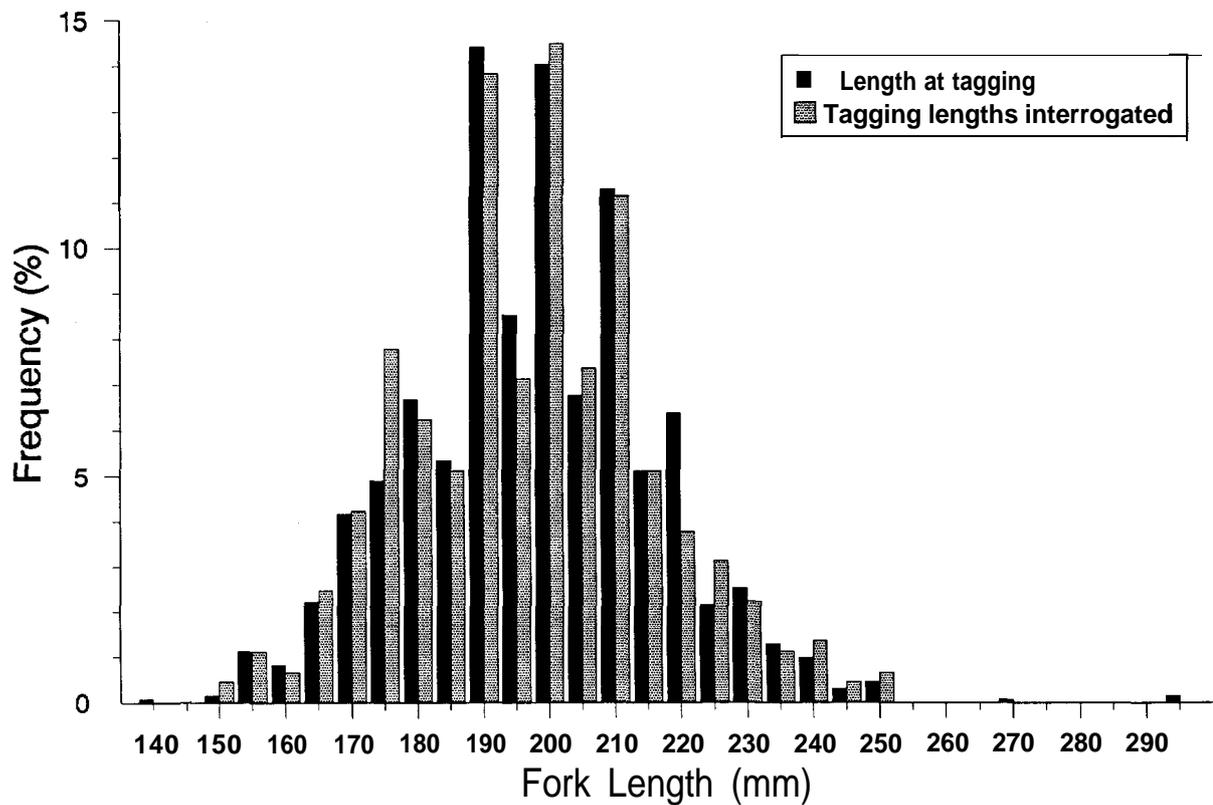
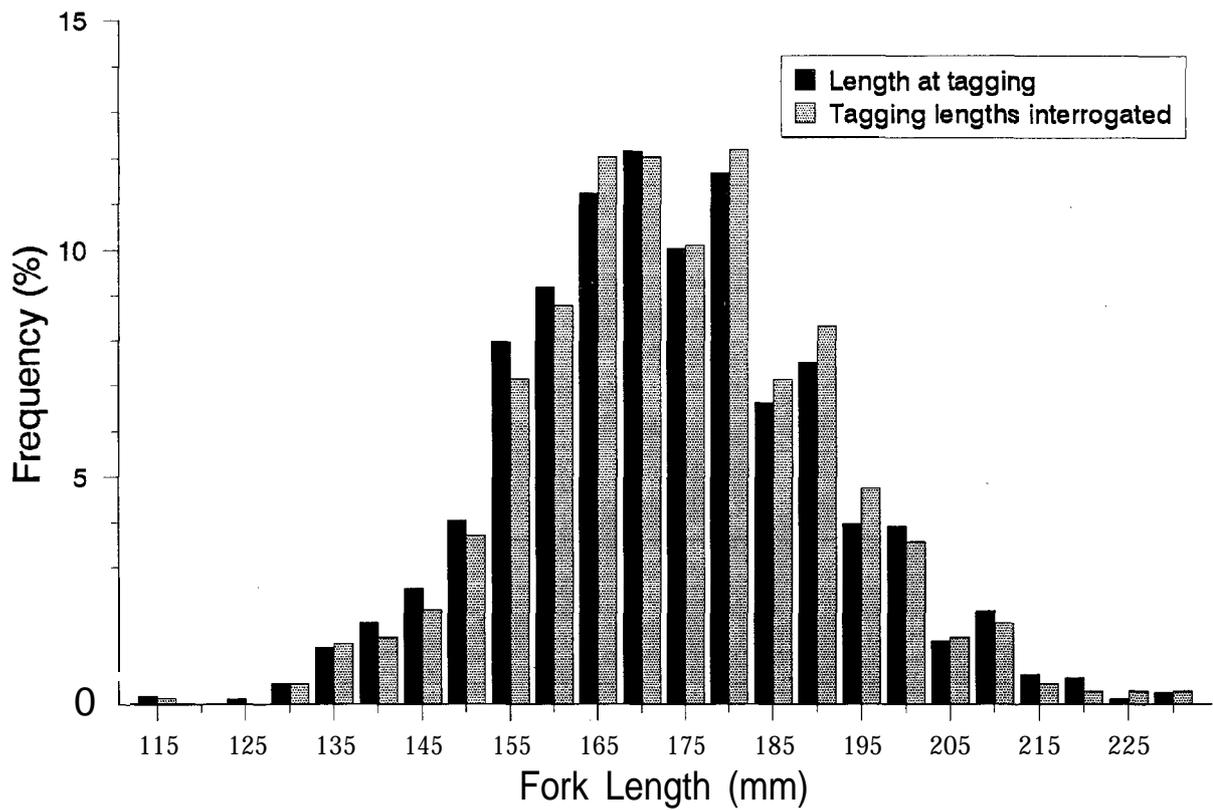


Figure 21. Fork length frequency for PIT tagged wild (upper graph) and hatchery (lower graph) steelhead trout smolts released in the Imnaha River from April 16 - June 24, 1996 and length frequency of fish ultimately detected at Lower Granite Dam in 1996.

## Arrival Timing

PIT tagged Imnaha River wild chinook salmon smolts arrived at Lower Granite Dam (LGR) from April 6 to June 12 with median and 90% passage dates of April 30 and May 18, respectively (Table 25). The 90% passage date for wild chinook at LGR in 1996 (May 18) preceded peak Snake River and LGR flows (June 10) by 23 days. Spill at Lower Granite Dam was occurring before the first group of PIT tagged Imnaha River wild chinook was released on March 1. Median arrival dates at LGR have ranged between April 24 and May 4 from 1993 to 1996. The 90% arrival dates for the years 1993- 1996 have all fallen within a one week period from May 11 - 18 at Lower Granite Dam. Wild chinook smolts passed Little Goose Dam between April 12 and June 16. The median passage date at Little Goose Dam was April 27 and 90% of wild chinook smolt passage occurred by May 20. The 90% passage date at Little Goose (1994- 1996) has occurred over a two week period from May 7 to May 20. Wild chinook smolt movement past Lower Monumental Dam and McNary Dams occurred between April 13 to June 15 and April 19 to June 8, respectively (Table 25). Passage of 90% of wild chinook smolts at Lower Monumental Dam occurred between May 13 and June 4 from 1993 to 1996. Timing of 90% passage at McNary Dam was observed from May 21 to May 28 (1993-1996). Peaks in arrival occurred in late April at Lower Granite, Little Goose, Lower Monumental and McNary Dams. These peaks in arrival timing and the smaller peaks that occurred at all four dams in mid-May were closely associated with increased river discharge at the dams (Figures 22 - 25).

Arrival timing of PIT tagged Imnaha River hatchery chinook salmon smolts occurred between April 13 and May 26 at Lower Granite Dam, April 23 and June 6 at Little Goose Dam, and April 23 and May 29 at Lower Monumental Dam. The small number of detections at McNary Dam (55) precluded further arrival timing analysis. Median and 90% arrival dates of hatchery chinook salmon at Lower Granite and Little Goose occurred on May 7 and May 16, and May 13 and May 20, respectively (Table 25). The 90% passage date at Lower Granite Dam of hatchery chinook preceded peak Lower Granite flows by 28 days. May 15 and May 23 were the median and 90% passage dates for hatchery chinook salmon smolts at Lower Monumental Dam. Peaks in arrival of hatchery chinook salmon at Little Goose, Lower Monumental and McNary Dams occurred during a substantial rise in river discharge in mid-May (Figures 26 - 29). For the migratory years 1994-1996 the median and 90% arrival dates at LGR ranged from May 2-12 and May 12-16, respectively. The 90% passage date at Little Goose Dam (1994-1996) has occurred over a four day period from May 20-23. The 90% arrival dates (1994- 1996) at Lower Monumental occurred over a seven day period (May 20-26). Hatchery chinook smolts in 1992 were PIT tagged and released over two days after their arrival at the Imnaha River trap and are not intended to represent the entire emigration.

PIT tagged wild steelhead trout smolts from the Imnaha River arrived at Lower Granite Dam from April 19 to June 10, at Little Goose Dam from April 20 to June 14, at Lower Monumental Dam from April 22 to June 15, and at McNary Dam from April 25 to June 11 (Table 26). Median and 90% arrival dates of wild steelhead trout occurred on May 6 and June 4 at Lower Granite, May 9 and May 28 at Little Goose, May 14 and May 29 at Lower Monumental, and May 11 and May 21 at McNary (Table 26). The 90% arrival date of June 4 at Lower Granite Dam preceded peak river

Table 25. Arrival timing of PIT tagged Imnaha River wild and hatchery chinook salmon smolts at Lower Granite, Little Goose, Lower Monumental, and McNary Dams from 1992-1996.

Dam	Year	Sample Size (n)	Arrival Timing		
			Date Range	Median	90%
<b><u>Wild Chinook</u></b>					
Lower Granite	1996	421	April 6-June 12	April 30	May 18
	1995	184	April 11-July 11	May 1	May 11
	1994	348	April 14-June 23	April 24	May 11
	1993	109	April 21-June 12	May 4	May 14
Little Goose	1996	358	April 12-June 16	April 27	May 20
	1995	144	April 15-July 15	May 7	May 20
	1994	194	April 23-June 17	April 28	May 7
	1993	46	April 27-June 2	May 3	May 16
Lower Monumental	1996	359	April 13-June 15	May 10	May 22
	1995	142	April 19-August 4	May 8	June 4
	1994	215	April 25-July 26	May 1	May 24
	1993	37	May 3-June 2	May 8	May 13
McNary	1996	148	April 19-June 8	May 14	May 24
	1995	89	April 28-July 9	May 12	May 21
	1994	229	April 29-July 16	May 12	May 28
	1993	20	May 3-June 15	May 9	May 21
<b><u>Hatchery Chinook</u></b>					
Lower Granite	1996	169	April 13-May 26	May 7	May 16
	1995 <sup>a</sup>	128	April 13-June 7	May 2	May 13
	1995 <sup>b</sup>	83	April 16-May 22	May 8	May 15
	1994	129	April 24-May 18	May 12	May 12
	1992 <sup>c</sup>	273	April 12-June 6	April 21	May 6
Little Goose	1996	131	April 23-June 6	May 13	May 20
	1995 <sup>a</sup>	114	April 26-June 11	May 10	May 20
	1995 <sup>b</sup>	67	April 27-June 7	May 12	May 23
	1994	65	April 28-June 2	May 14	May 21
	1992	116	April 17-May 22	April 27	May 5
Lower Monumental	1996	136	April 23-May 29	May 15	May 23
	1995 <sup>a</sup>	106	April 27-June 10	May 12	May 21
	1995 <sup>b</sup>	71	April 29-June 9	May 17	May 26
	1994	73	April 30-June 7	May 14	May 20
McNary	1996	55	May 1-May 27	May 16	May 23
	1995 <sup>a</sup>	67	April 29-June 9	May 16	May 23
	1995 <sup>b</sup>	36	May 3-May 30	May 16	May 22
	1994	119	May 6-June 17	May 21	May 26
	1992	61	April 27-June 1	May 8	May 17

<sup>a</sup> HXW crossed chinook salmon smolts PIT tagged for the Nez Perce Tribe and released at dark.

<sup>b</sup> HXH crossed chinook salmon smolts PIT tagged for the Fish Passage Center and released one hour after tagging and recovery.

<sup>c</sup> Hatchery chinook salmon smolts PIT tagged and released in 1992 were over a two day period only for survival estimation.

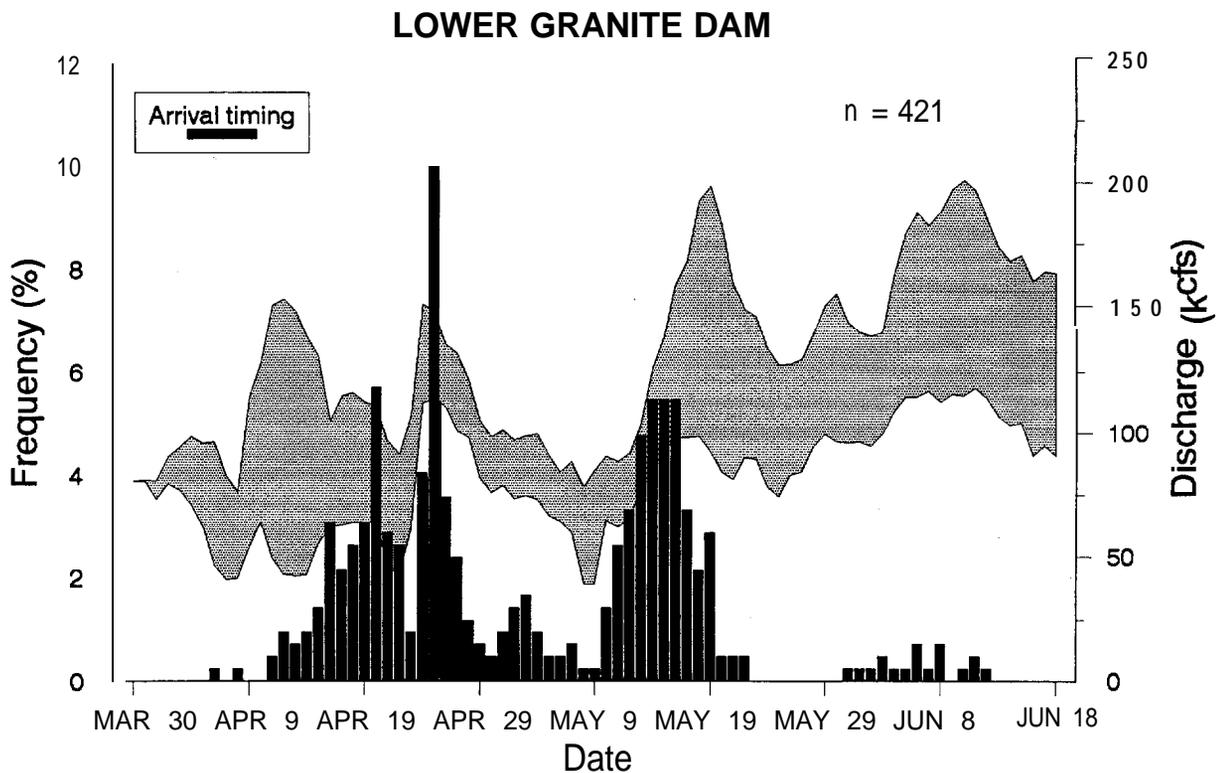


Figure 22. Daily arrival timing frequency of PIT tagged Imnaha River wild chinook salmon smolts at Lower Granite Dam, April 6 to June 12, 1996. Total project discharge is represented by top line, spill (shaded) and turbine discharge (lower line).

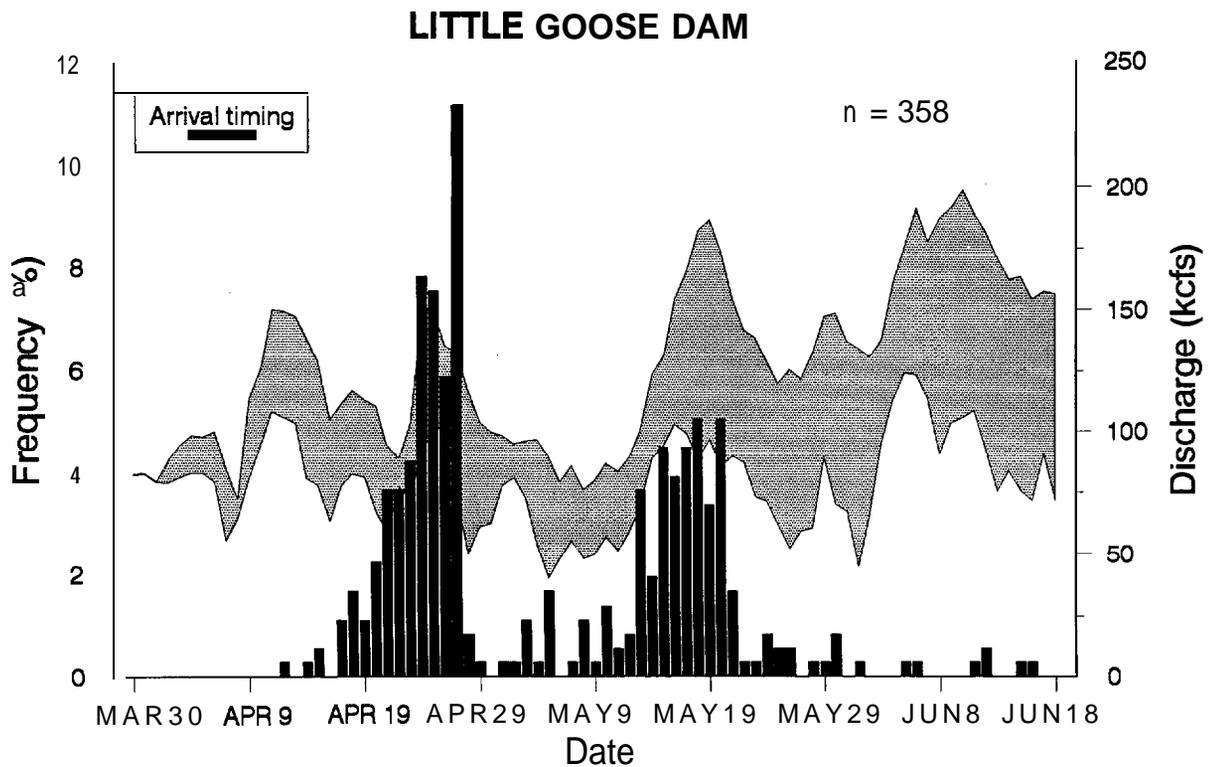


Figure 23. Daily arrival timing frequency of PIT tagged Imnaha River wild chinook salmon smolts at Little Goose Dam, April 12 to June 16, 1996. Total project discharge is represented by top line, spill (shaded) and turbine discharge (lower line).

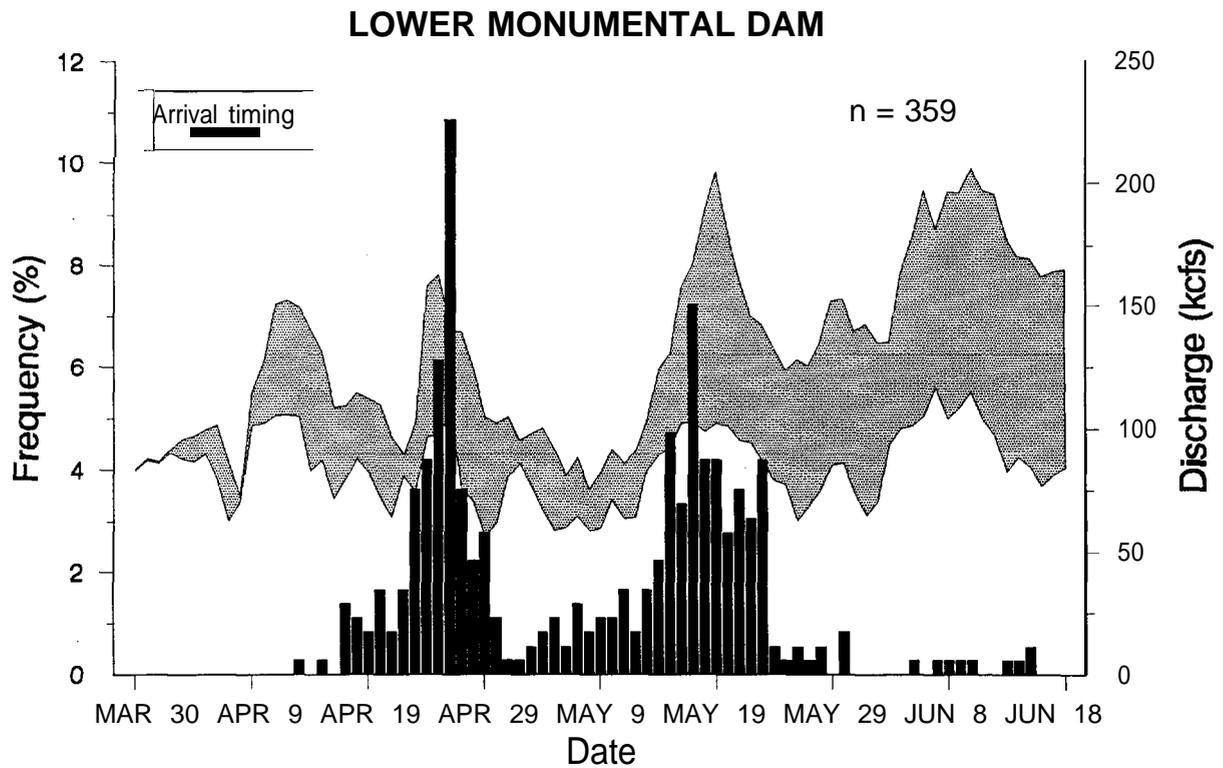


Figure 24. Daily arrival timing frequency of PIT tagged Imnaha River wild chinook salmon smolts at Lower Monumental Dam, April 13 to June 15, 1996. Total project discharge is represented by top line, spill (shaded) and turbine discharge (lower line),

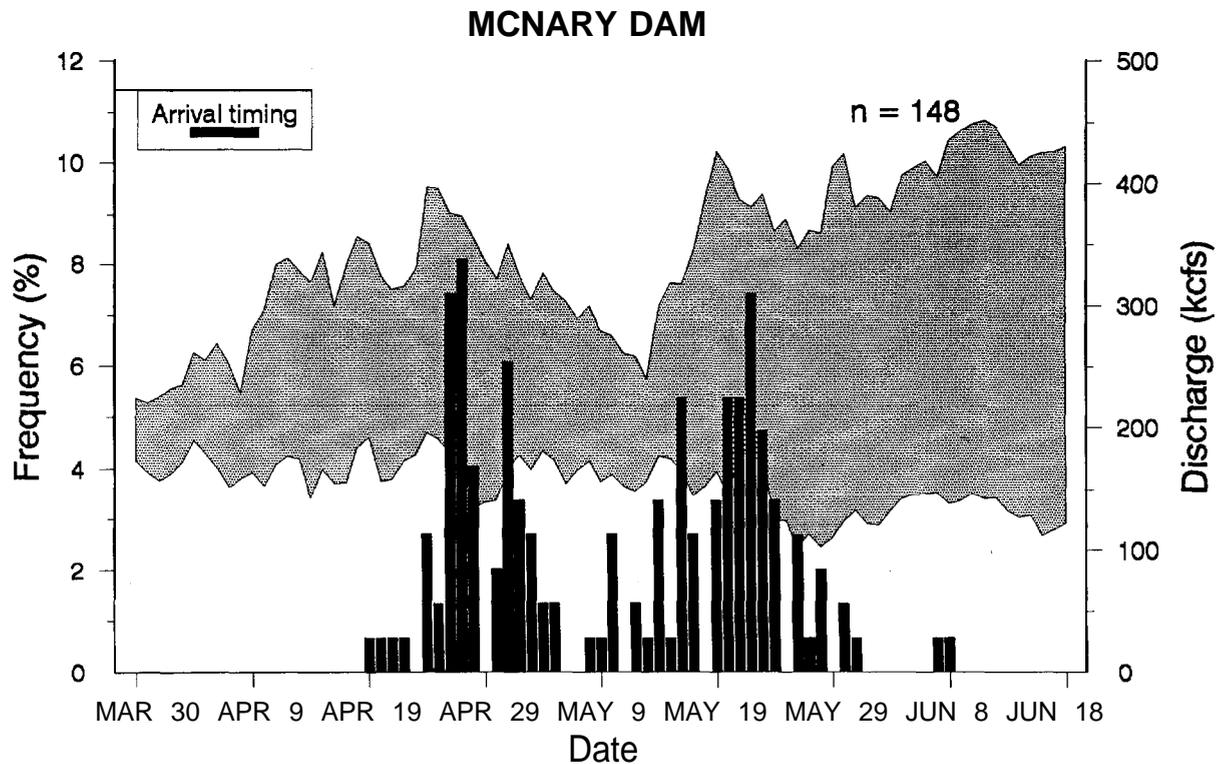


Figure 25. Daily arrival timing frequency of PIT tagged Imnaha River wild chinook salmon smolts at McNary Dam, April 19 to June 8, 1996. Total project discharge is represented by top line, spill (shaded) and turbine discharge (lower line).

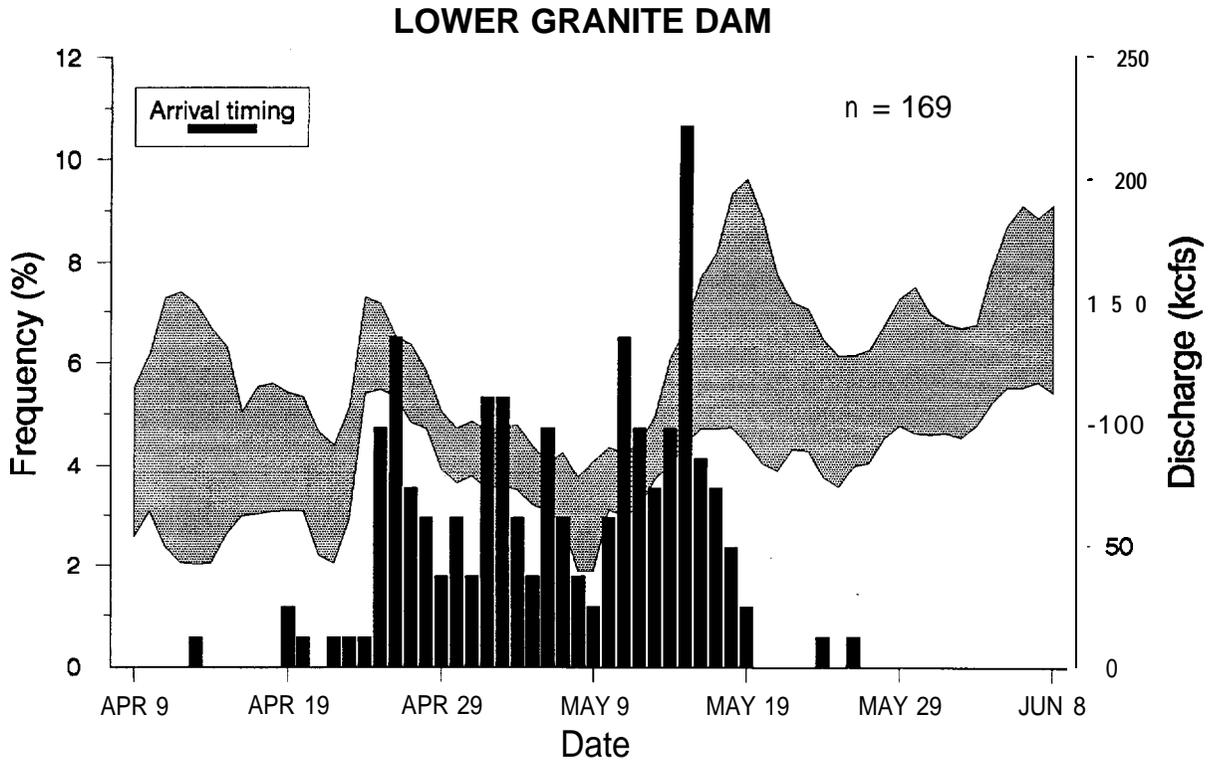


Figure 26. Daily arrival timing frequency of PIT tagged Imnaha River hatchery chinook salmon smolts at Lower Granite Dam, April 13 to May 26, 1996. Total project discharge is represented by top line, spill (shaded) and turbine discharge (lower line).

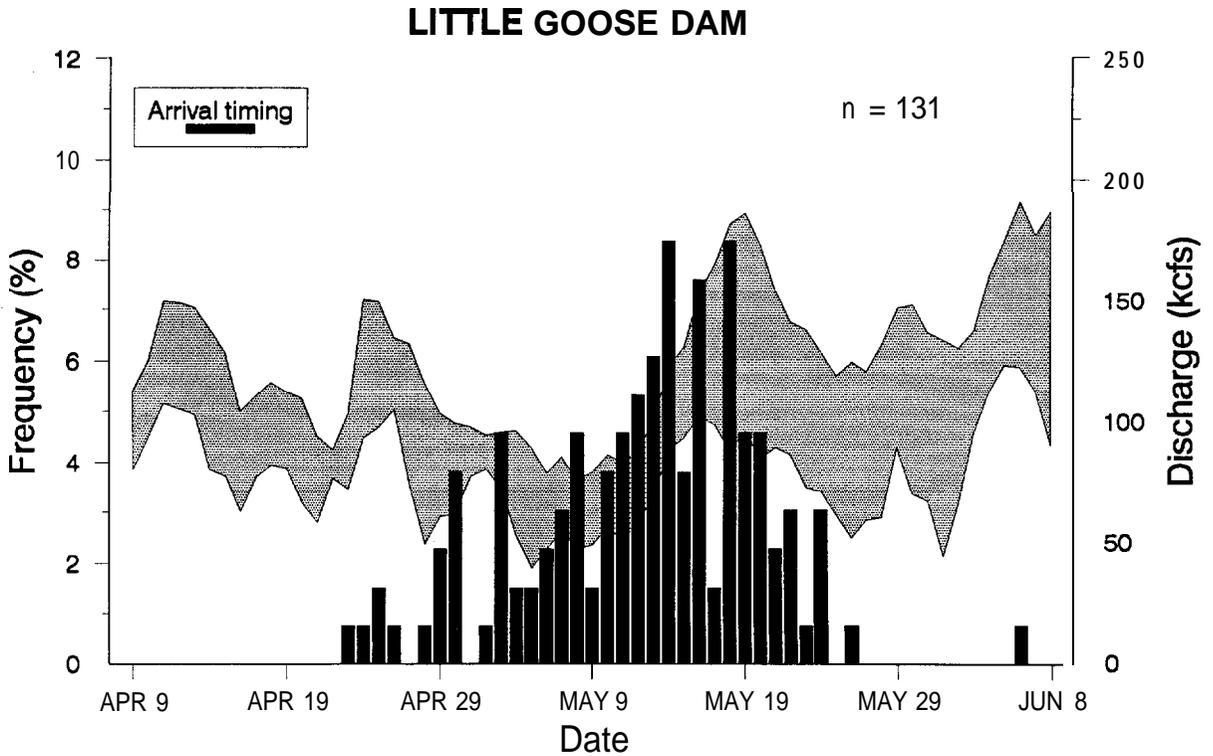


Figure 27. Daily arrival timing frequency of PIT tagged Imnaha River hatchery chinook salmon smolts at Little Goose Dam, April 23 to June 6, 1996. Total project discharge is represented by top line, spill (shaded) and turbine discharge (lower line).

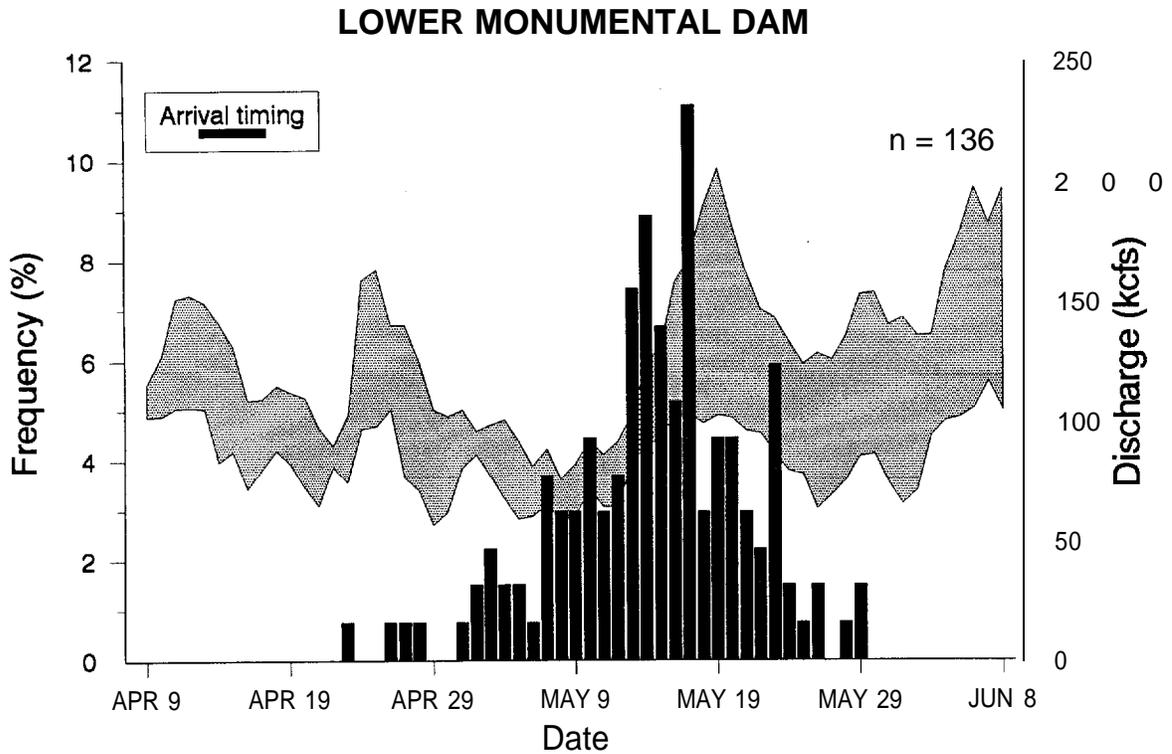


Figure 28. Daily arrival timing frequency of PIT tagged Imnaha River hatchery chinook salmon smolts at Lower Monumental Dam, April 23 to May 29, 1996. Total project discharge is represented by top line, spill (shaded) and turbine discharge (lower line).

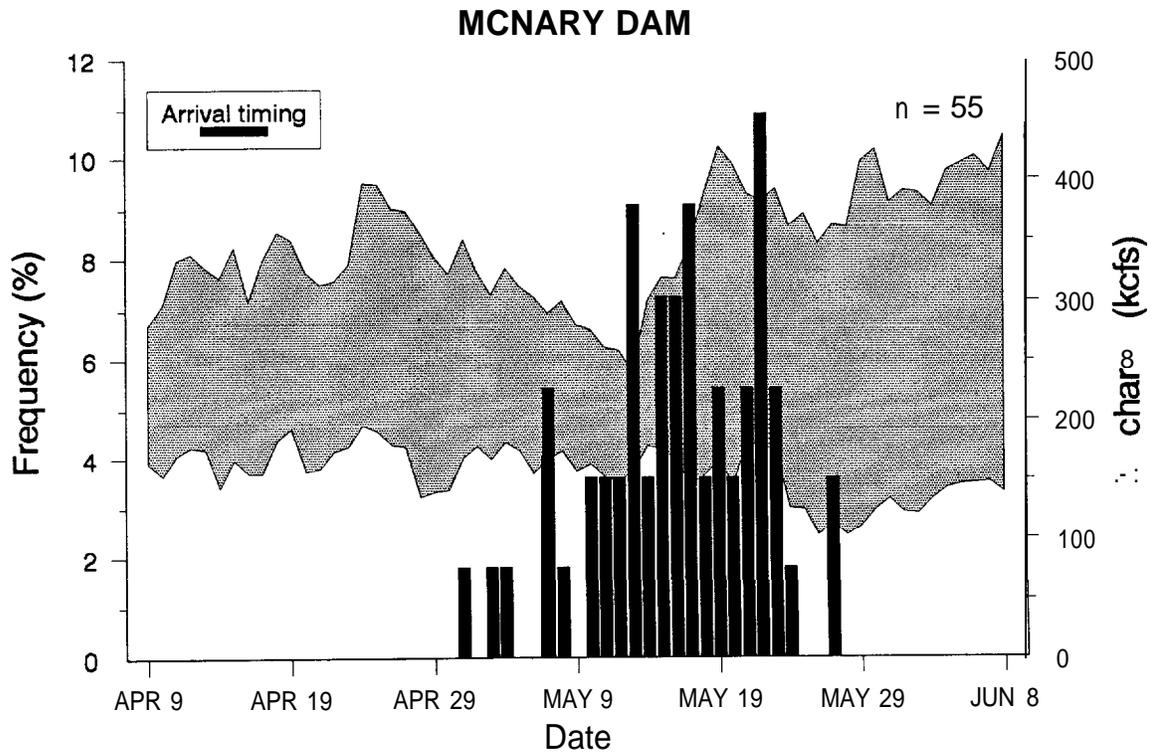


Figure 29. Daily arrival timing frequency of PIT tagged Imnaha River hatchery chinook salmon smolts at McNary Dam, May 1 to May 27, 1996. Total project discharge is represented by top line, spill (shaded) and turbine discharge (lower line).

Table 26. Arrival timing of PIT tagged Innaha River wild and hatchery steelhead trout smolts at Lower Granite, Little Goose, Lower Monumental, and McNary Dams from 1993-1996.

Dam	Year	Sample Size (n)	Arrival Timing		
			Date Range	Median	90%
<b><u>Wild Steelhead</u></b>					
Lower Granite	1996	537	<b>April 19-June 10</b>	<b>May 6</b>	<b>June 4</b>
	1995	128	April 28-June 19	May 2	May 9
	1994 <sup>1</sup>	332	April 25-August 15	May 8	June 1
	1994 <sup>2</sup>	207	May 3-August 20	May 9	May 30
	1993	101	May 3-June 13	May 26	June 8
Little Goose	1996	365	<b>April 20-June 14</b>	<b>May 9</b>	<b>May 28</b>
	1995	70	May 1-June 23	May 7	May 12
	1994 <sup>1</sup>	159	April 29-July 29	May 12	May 31
	1994 <sup>2</sup>	121	May 6-July 26	May 15	June 1
	1993	48	May 6-June 11	May 24	June 7
Lower Monumental	1996	397	<b>April 22-June 15</b>	<b>May 14</b>	<b>May 29</b>
	1995	81	May 3-May 17	May 9	May 14
	1994 <sup>1</sup>	148	May 1-August 8	May 12	July 8
	1994 <sup>2</sup>	91	May 9-July 31	May 15	July 10
	1993	43	May 6-June 15	May 30	June 11
McNary	1996	157	<b>April 25-June 11</b>	<b>May 11</b>	<b>May 21</b>
	1995	35	May 8-May 27	May 11	May 17
	1994 <sup>1</sup>	66	May 5-June 22	May 18	June 9
	1994 <sup>2</sup>	42	May 13-June 25	May 18	June 6
	1993	17	May 11-June 13	May 25	May 31
<b><u>Hatchery Steelhead</u></b>					
Lower Granite	1996	440	<b>April 23-July 14</b>	<b>May 28</b>	<b>June 14</b>
	1995	661	May 6-July 12	May 31	June 16
	1994 <sup>1</sup>	164	April 29-August 20	May 29	July 15
	1994 <sup>2</sup>	306	May 6-August 21	May 25	June 23
	1993	224	May 3-June 28	May 17	May 31
Little Goose	1996	261	<b>April 24-July 11</b>	<b>May 25</b>	<b>June 16</b>
	1995	409	May 8-July 13	June 3	June 20
	1994 <sup>1</sup>	86	May 2-July 30	May 31	July 17
	1994 <sup>2</sup>	165	May 10-August 12	May 27	July 9
	1993	106	May 5-July 8	May 25	June 2
Lower Monumental	1996	232	<b>May 6-July 7</b>	<b>May 27</b>	<b>June 15</b>
	1995	410	May 9-July 13	June 6	June 16
	1994 <sup>1</sup>	30	May 5-August 5	June 3	July 17
	1994 <sup>2</sup>	75	May 11-August 24	June 18	July 21
	1993	92	May 7-June 14	May 26	June 5
McNary	1996	30	<b>April 27-July 3</b>	<b>May 23</b>	<b>June 7</b>
	1995	69	May 15-July 17	June 5	June 27
	1994 <sup>1</sup>	22	May 17-July 14	June 5	July 10
	1994 <sup>2</sup>	56	May 20-July 11	June 17	July 8
	1993	7	May 11-June 5	May 19	May 30

<sup>1</sup> - NPT PIT tagged fish

<sup>2</sup> - FPC PIT tagged fish

discharge there by 6 days. Peak arrival of wild steelhead trout smolts at Lower Granite and McNary Dams occurred during late April (Figures 30 and 33) with smaller peaks occurring through mid-May. Peak arrival at Little Goose and Lower Monumental Dams occurred in mid-May with smaller peaks in late April (Figures 31 and 32). May 2 to May 26 was the median arrival date range at LGR for wild steelhead from 1993 to 1996 while the 90% arrival date range for those years was May 9 to June 8. Wild steelhead smolt arrival timing at Little Goose Dam (90% arrival) transpired, in a more constricted time frame, between May 12 and June 1 (1994-1996). Lower Monumental Dam has experienced a more protracted 90% arrival timing of wild steelhead smolts from May 14 to July 10 in the years from 1994-1996. Ninety percent arrival timing at McNary Dam (1994 and 1996) occurred between the dates of May 21 and June 9.

Imnaha River hatchery steelhead trout smolt dam arrival timing was generally very protracted and occurred between April 23 to July 14 at Lower Granite Dam, at Little Goose Dam from April 24 to July 11 and at Lower Monumental Dam from May 6 to July 7 (Table 26). Interrogation sample size at McNary Dam ( $n=30$ ) was too small to allow further arrival timing analysis. Median passage for PIT tagged hatchery steelhead trout smolts occurred at Lower Granite Dam on May 28 and 90% passage was observed on June 14 (Table 26). This 90% passage date was observed 4 days after peak river discharge. For the years 1993-1996 the median and 90% arrival date ranges at LGR were May 17 to May 31 and May 31 to June 23, respectively. Median and 90% passage times for hatchery steelhead trout smolts at Little Goose Dam in 1996 occurred on May 25 and June 16, respectively. The 90% passage date at Little Goose Dam (1993-1996) has occurred over a seven week period from June 2 to July 17. Median arrival dates at Little Goose dam (1993-1996) were more constricted from May 25 to June 3. Median and 90% passage dates for hatchery steelhead trout smolts at Lower Monumental Dam were May 27 and June 15 (Table 26). The median and 90% arrival dates at Lower Monumental Dam (1993-1996) were May 26 to June 18 and June 5 to July 21, respectively. Although small peaks in arrival were observed at Lower Granite Dam, the general trend was a long protracted emigration (Figure 34). A smaller peak in arrival occurred at Little Goose and Lower Monumental Dams in mid-May and were closely associated with an increase in Snake River discharge (Figures 35 and 36) but the general trend was a protracted emigration.

### Diel Smolt Passage at Hydroelectric Facilities

Average weekly wild and hatchery chinook salmon and steelhead trout smolt diel passage timing patterns were examined at Lower Granite, Little Goose and Lower Monumental Dams. The data were summarized by three passage times. These passage times included two nighttime (dark) periods, midnight to sunrise and sunset to midnight, and a daytime (light) period of sunrise to sunset. Appendix G contains weekly diel passage figures for wild and hatchery chinook salmon and steelhead trout smolts at Lower Granite, Little Goose, Lower Monumental, and McNary Dams provided that 30 or more fish were detected at a site within the week.

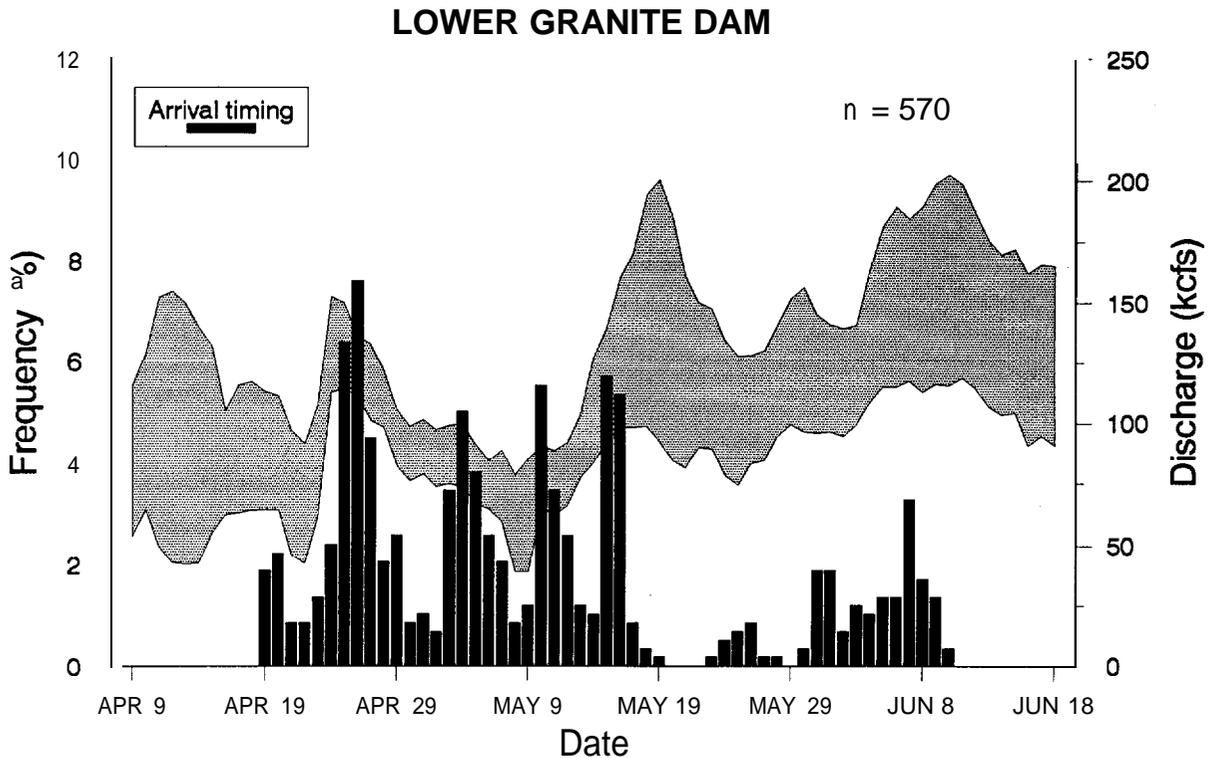


Figure 30. Daily arrival timing frequency of PIT tagged Imnaha River wild steelhead trout smolts at Lower Granite Dam, April 19 to June 10, 1996. Total project discharge is represented by top line, spill (shaded) and turbine discharge (lower line).

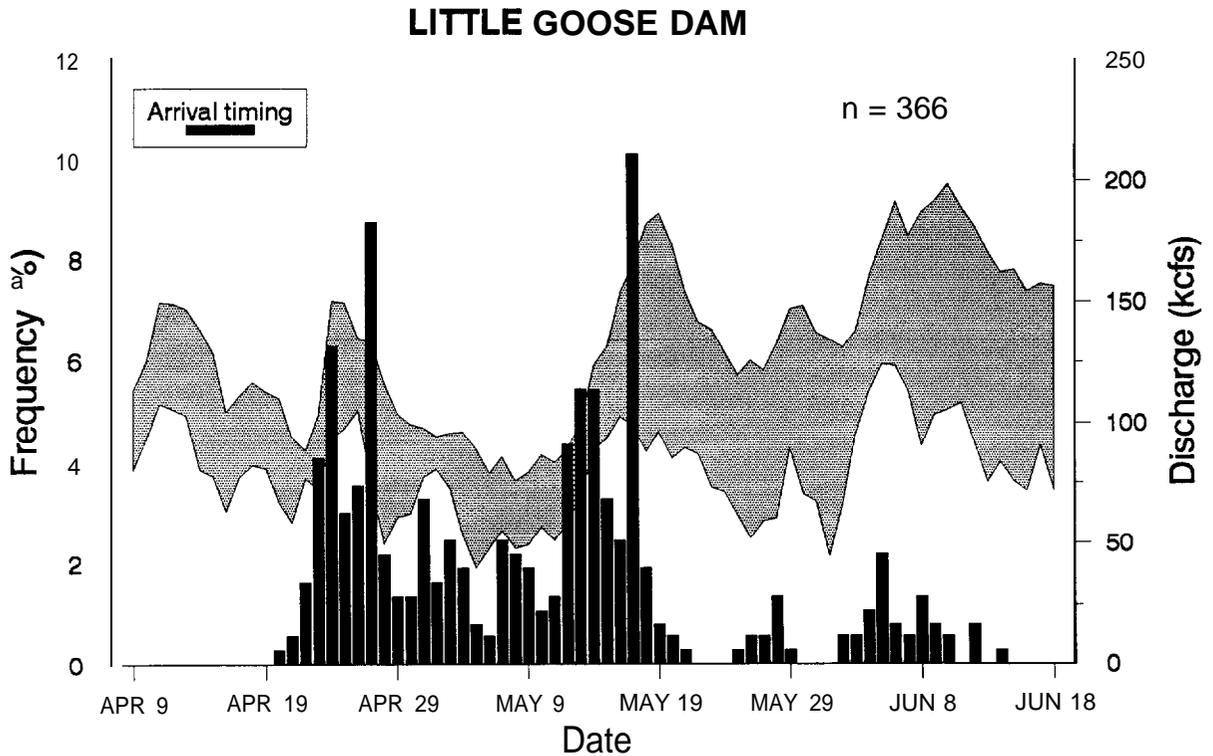


Figure 31. Daily arrival timing frequency of PIT tagged Imnaha River wild steelhead trout smolts at Little Goose Dam, April 20 to June 14, 1996. Total project discharge is represented by top line, spill (shaded) and turbine discharge (lower line).

### LOWER MONUMENTAL DAM

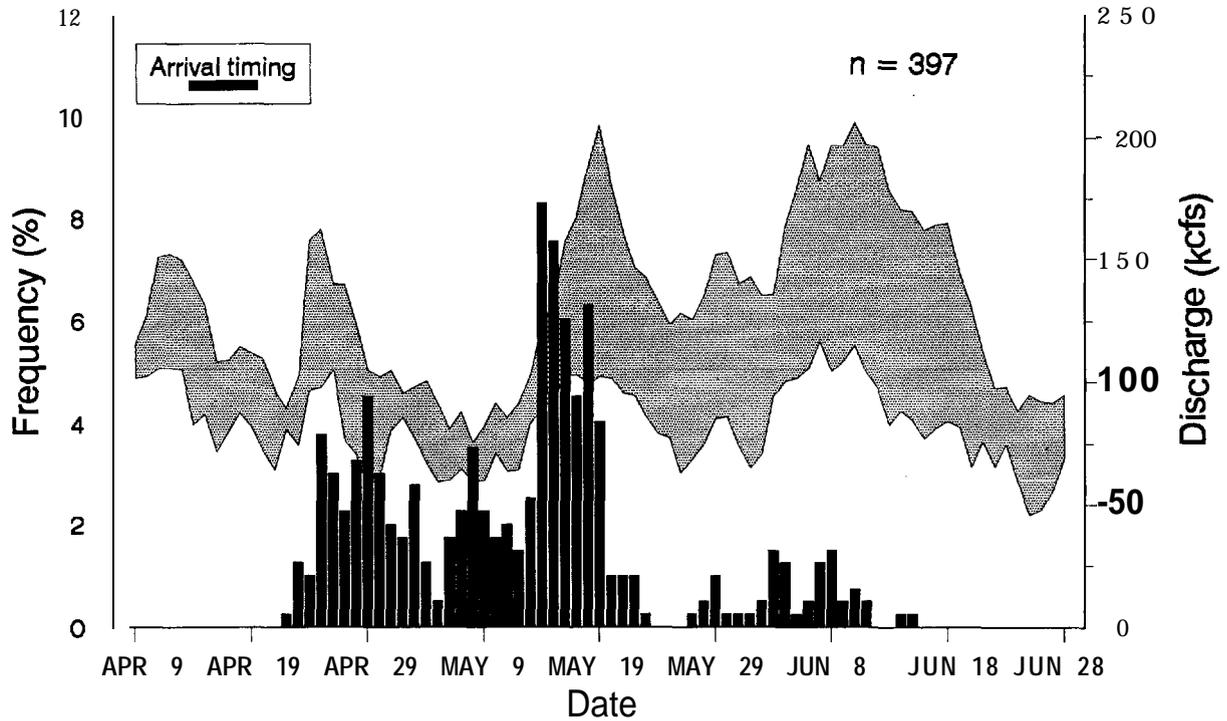


Figure 32. Daily arrival timing frequency of PIT tagged Imnaha River wild steelhead trout smolts at Lower Monumental Dam, April 22 to June 15, 1996, Total project discharge is represented by top line, spill (shaded) and turbine discharge (lower line).

### MCNARY DAM

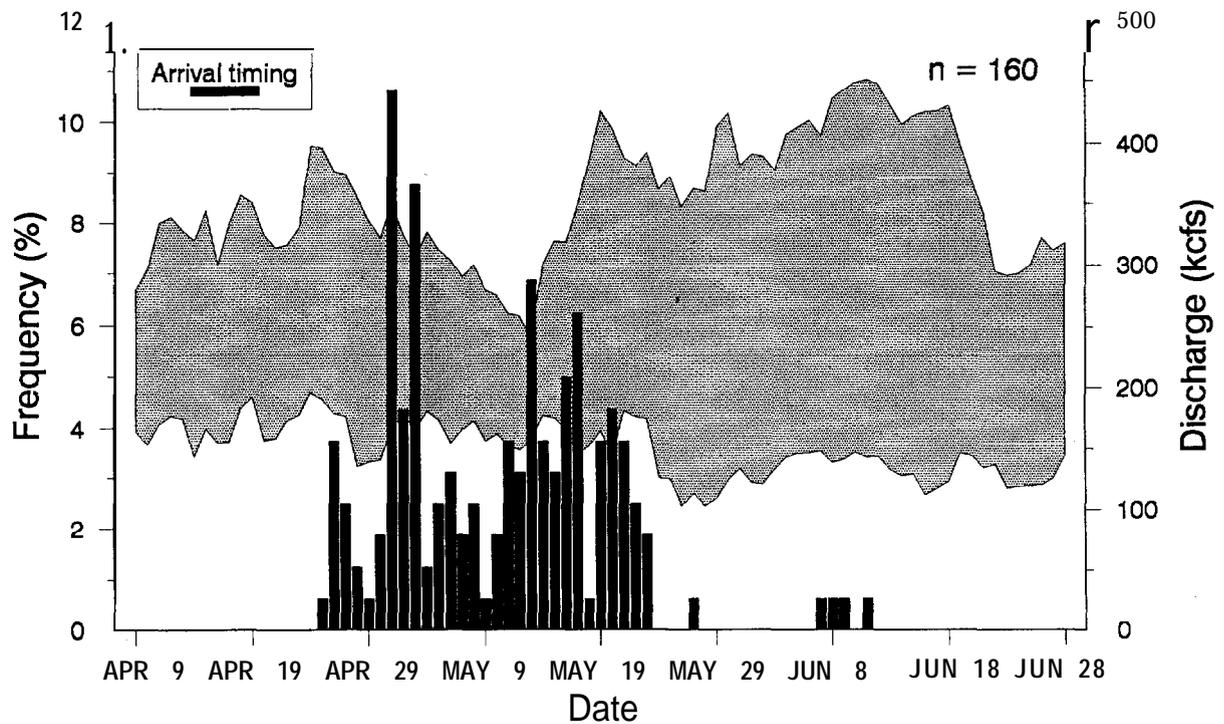


Figure 33. Daily arrival timing frequency of PIT tagged Imnaha River wild steelhead trout smolts at McNary Dam, April 25 to June 11, 1996. Total project discharge is represented by top line, spill (shaded) and turbine discharge (lower line).

### LOWER GRANITE DAM

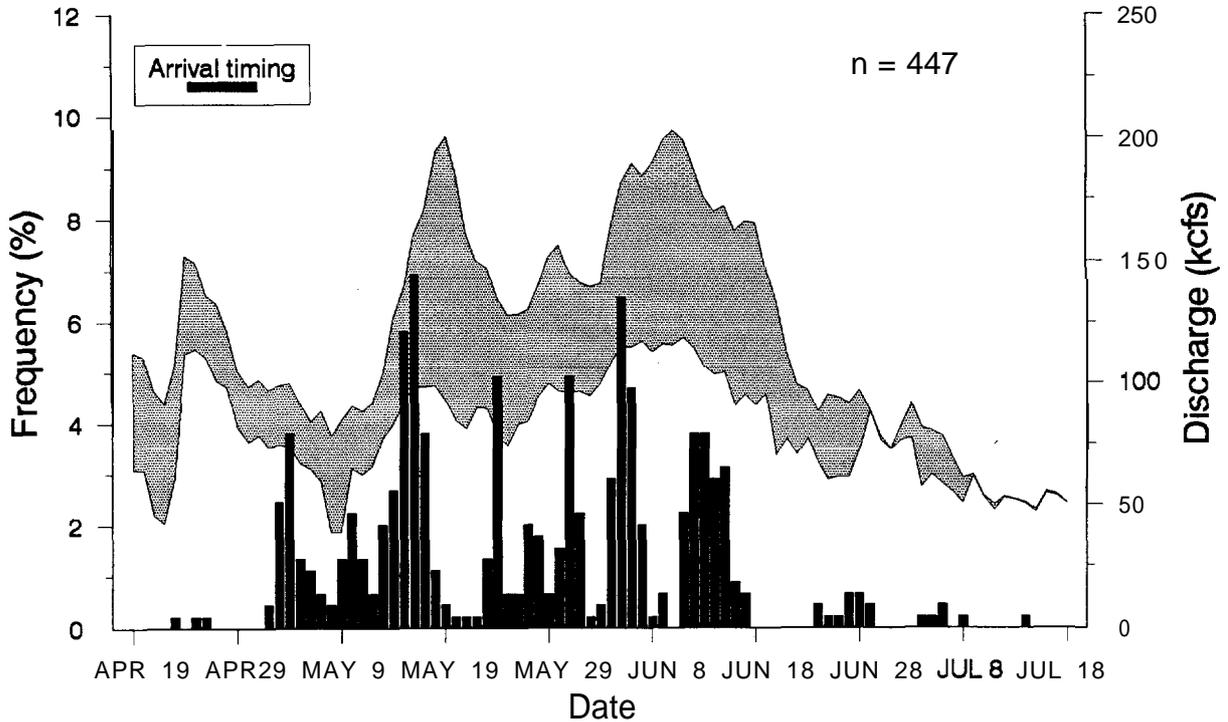


Figure 34. Daily arrival timing frequency of PIT tagged Imnaha River hatchery steelhead trout smolts at Lower Granite Dam, April 23 to July 14, 1996. Total project discharge is represented by top line, spill (shaded) and turbine discharge (lower line).

### LITTLE GOOSE DAM

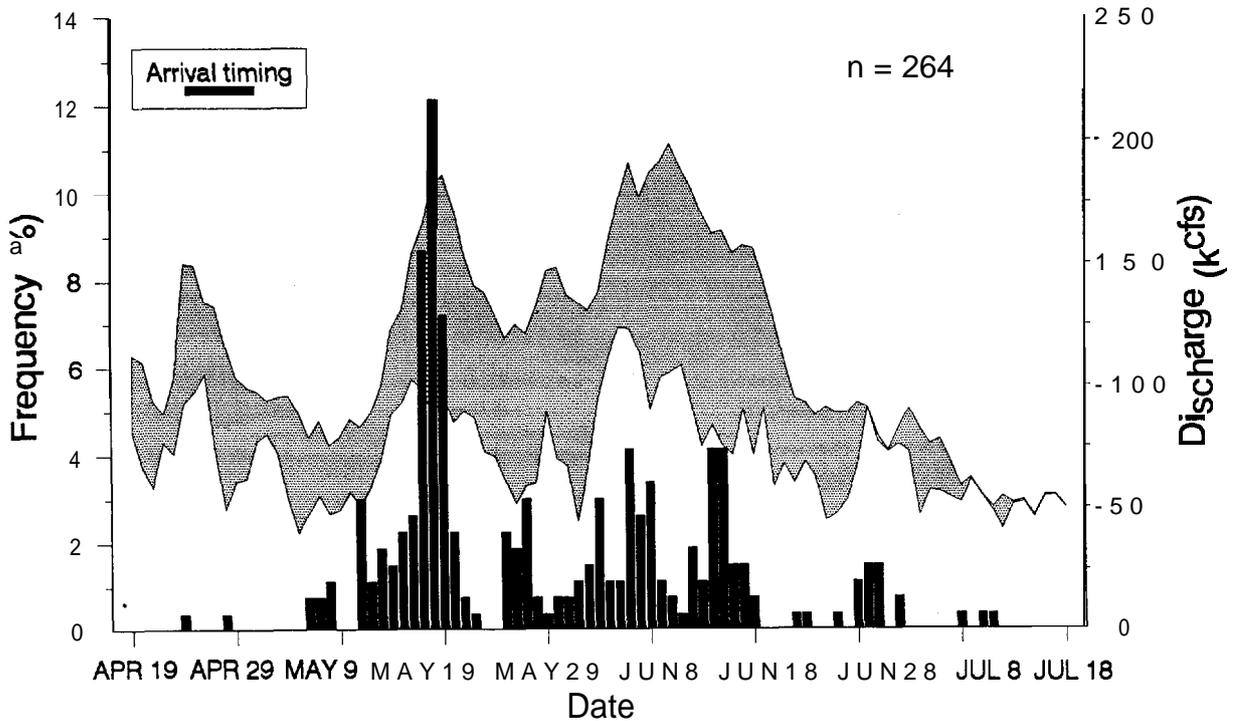


Figure 36. Daily arrival timing frequency of PIT tagged Imnaha River hatchery steelhead trout smolts at Little Goose Dam, April 24 to July 11, 1996. Total project discharge is represented by top line, spill (shaded) and turbine discharge (lower line).

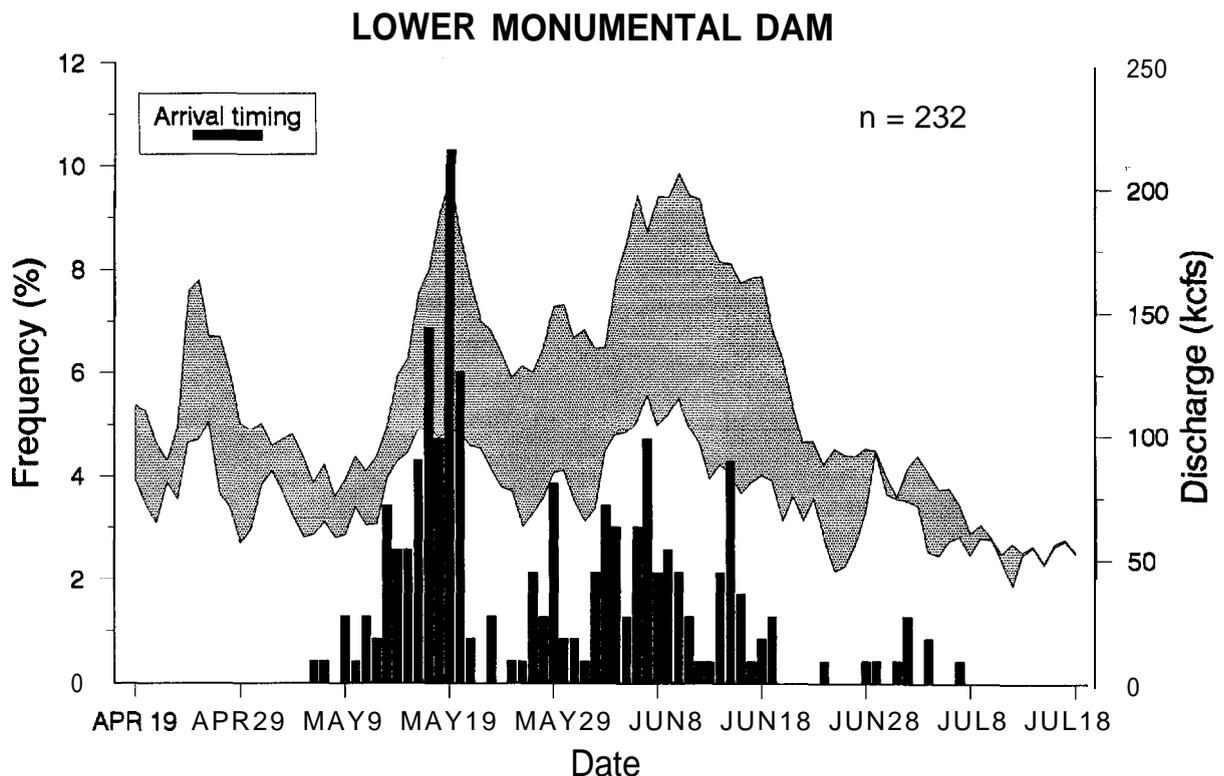
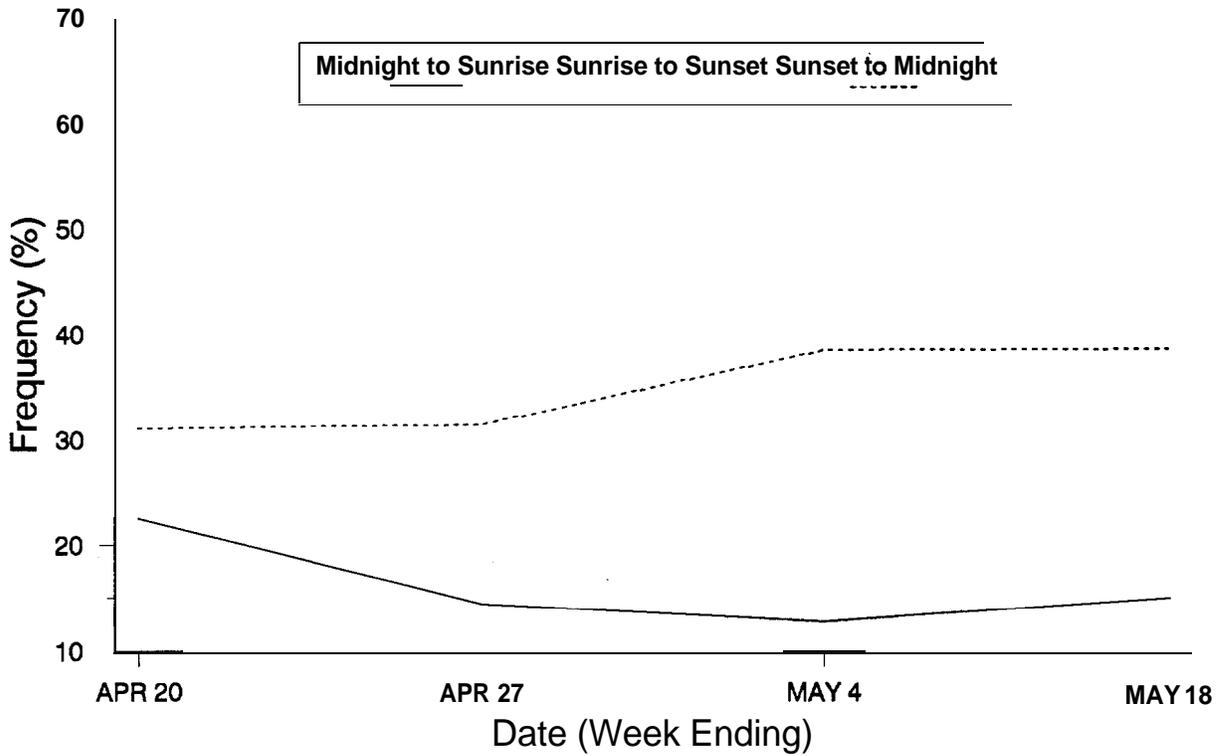


Figure 36. Daily arrival timing frequency of PIT tagged Imnaha River hatchery steelhead trout smolts at Lower Monumental Dam, May 6 to July 7, 1996. Total project discharge is represented by top line, spill (shaded) and turbine discharge (lower line).

Average weekly wild chinook salmon smolt diel passage timing patterns were examined at Lower Granite, Little Goose and Lower Monumental Dams (Appendix G.1-6 and Figures 37 and 38). Diel passage of wild chinook smolts at Lower Granite Dam was analyzed during a four week period between April 14 and May 18, 1996 (Table 27). Comparison of diel passage during nighttime (dark) periods, midnight to sunrise and sunset to midnight, indicated that substantially more wild chinook smolts moved between the sunset to midnight time frame. More than twice the percentage of smolts moved between sunset and midnight in three out of the four weeks examined (Table 27). Average weekly diel passage ranged between 12.9 to 22.5% from midnight to sunrise, compared to a 31.1 to 38.9% frequency from sunset to midnight. When both nighttime (dark) periods were combined it showed that 48.6 to 54% of the wild chinook smolts emigrated past Lower Granite Dam during nighttime periods. In general, a peak in average diel passage seemed to occur from one to four hours after sunset (Appendix G. 1 and 2). Conversely, 46 to 51.4% of the average weekly wild chinook smolt diel passage occurred during the daytime (sunrise to sunset). No apparent patterns in daytime diel movement was observed.

### LOWER GRANITE DAM



### LOWER GRANITE DAM

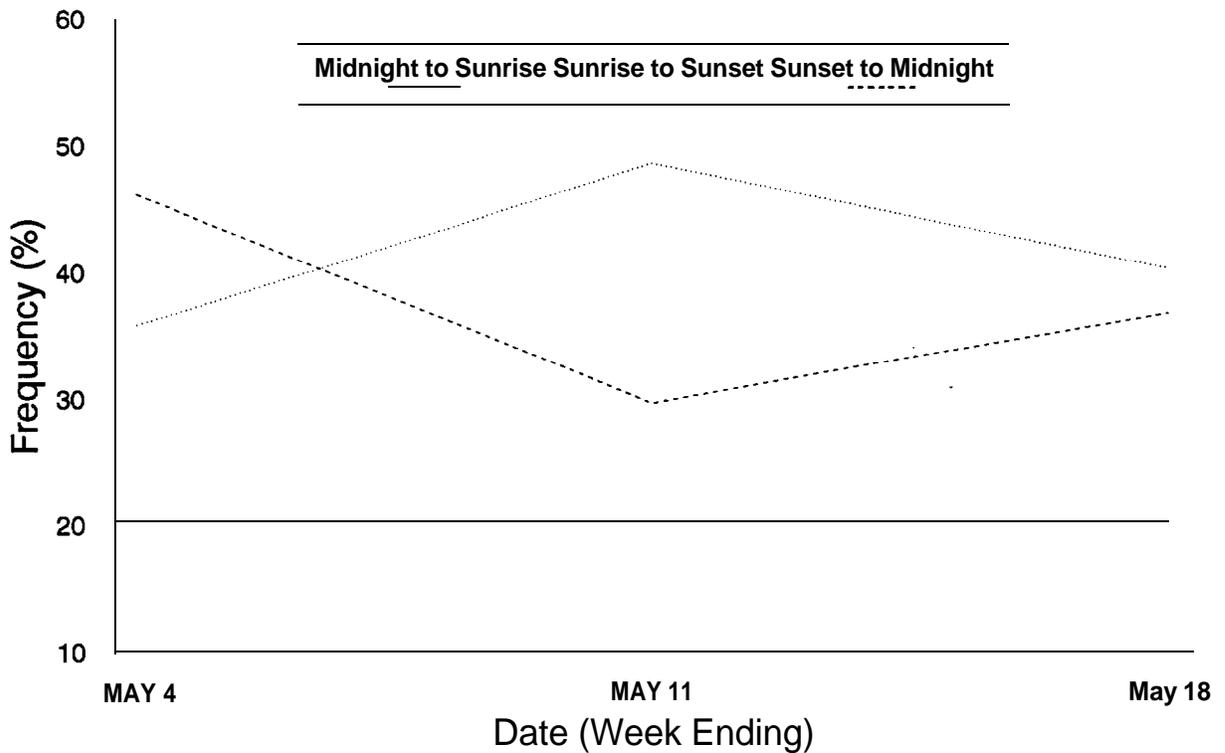


Figure 37. Midnight to sunrise, sunrise to sunset, and sunset to midnight weekly passage frequency of PIT tagged Imnaha River wild (upper graph) and hatchery (lower graph) chinook salmon smolts at Lower Granite Dam during the spring of 1996.

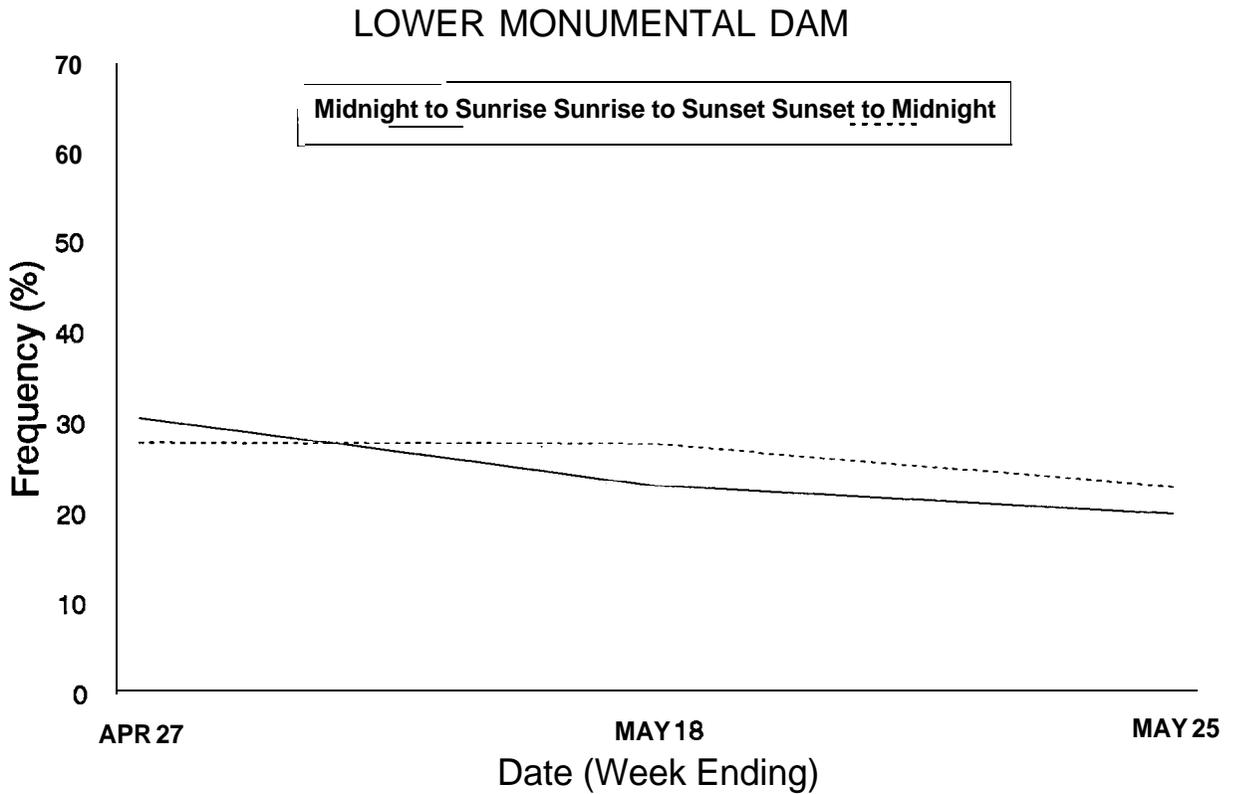
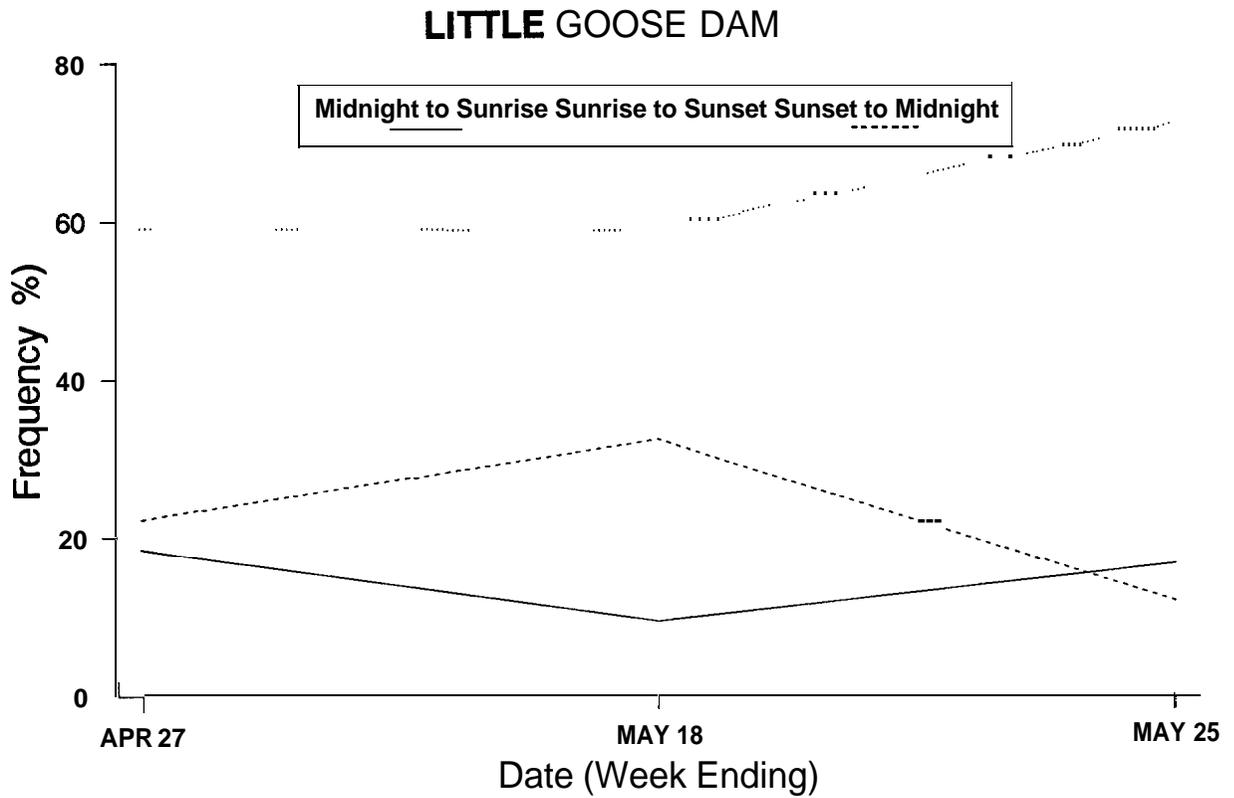


Figure 38. Midnight to sunrise, sunrise to sunset, and sunset to midnight weekly passage frequency of PIT tagged Imnaha River wild chinook salmon smolts at Little Goose (upper graph) and Lower Monumental (lower graph) dams during the spring of 1996.

Table 27. Midnight to sunrise, sunrise to sunset and sunset to midnight weekly passage frequency of PIT tagged Imnaha River wild and hatchery chinook salmon smolts at Lower Granite, Little Goose, Lower Monumental and McNary Dams, 1996.

Dam	Week	Sample Size (n)	Passage Frequency		
			-Midnight to Sunrise (%)	Sunrise to Sunset (%)	Sunset to Midnight (%)
<b><u>Wild Chinook</u></b>					
Lower Granite	April 14-20	80	22.5	46.2	31.2
	April 21-27	111	14.4	51.4	31.5
	April 28-May 4	31	12.9	48.3	38.7
	May 12-18	126	15.1	46.0	38.9
Little Goose	April 21-27	157	18.5	59.2	22.2
	May 12-18	87	9.2	58.6	32.2
	May 19-25	43	16.3	72.1	11.6
Lower Monumental	April 21-27	111	30.6	41.4	27.9
	May 12-18	88	22.7	50.0	27.3
	May 19-25	67	19.4	58.2	22.4
McNary	April 21-27	31	3.2	70.9	25.8
	May 19-25	44	13.6	61.3	25.0
<b><u>Hatchery Chinook</u></b>					
Lower Granite	April 28-May 4	39	17.9	35.9	46.1
	May 5-11	37	21.6	48.6	29.7
	May 12-18	57	22.8	40.4	36.8
Little Goose	May 12-18	53	13.2	69.8	16.9
Lower Monumental	May 12-18	62	20.9	35.4	43.5
	May 19-25	30	23.3	50.0	26.7

Average diel passage of wild chinook salmon at Little Goose Dam, over a three week period, indicated that 59.2 to 72.1% of the smolts emigrated past the dam during the daytime (Table 27). The high daytime diel passage (72.1%) that occurred during the week of May 19 was notable because it was the highest wild chinook daytime passage observed at any dam in 1996, but was represented by a relatively small sample size (n = 43). Diel passage from midnight to sunrise averaged 9.2 to 18.5% compared to a range in average diel passage of 11.6 to 32.2% during the sunset to midnight period (Table 27). Generally, more wild chinook smolts emigrated past Little Goose Dam during the sunset to midnight (dark) period compared to the midnight to sunrise (dark) period (Figure 38). No clear patterns in hourly diel passage was observed at Little Goose Dam in the spring of 1996 (Appendix G.3 and 4).

Information on wild chinook salmon average weekly diel smolt passage at Lower Monumental Dam, from a three week period, showed that nighttime (dark) passage ranged from 41.8 to 58.6% (Table 27). Average daytime diel passage ranged from 41.4 to 58.2% and consistently increased from the week of April 21 through the week of May 19. During the same period the observed midnight to sunrise diel passage percentages declined from 30.6% to 19.4%. It was beyond the scope of the present study to determine why this pattern in emigration occurred. Passage percentage during the sunset to midnight (dark) period remained relatively stable between 22.4 to 27.9% (Figure 38). During each of the three weeks, a small peak in diel passage occurred just before or after sunset and at 2400 hours (midnight) (Appendix G.5 and 6). No observable patterns in daytime diel emigration past Lower Monumental Dam was evident.

Average weekly diel passage of hatchery reared chinook salmon smolts was evaluated over a three week period at Lower Granite Dam, from April 28 through May 18 (Figure 37). The reader is cautioned that observed sample sizes are relatively small, making conclusions tenuous (Table 27). Nighttime diel passage, midnight to sunrise and sunset to midnight combined, ranged from 51.4 to 64.1%. The majority of nighttime passage occurred from sunset to midnight and ranged from 29.7 to 46.2% of the total average weekly observed passage (Table 27). A smaller peak in nighttime diel passage occurred during all three weeks just at or one to three hours after sunset (Appendix G.8 and 9). Daytime diel passage frequency, sunrise to sunset, ranged from 35.9 to 48.6% during the three week period. No apparent patterns were evident in timing of hatchery chinook salmon smolt diel movement through Lower Granite Dam.

Only one week and two weeks worth of information was available on hatchery chinook smolt diel movement past Little Goose and Lower Monumental Dams, respectively (Appendix G. 10 and 11). Passage past Little Goose Dam during the week of May 12 was primarily daytime movement as 69.8% of the fish moved during that time period. Diel passage frequency past Lower Monumental Dam ranged between 50-64.5% during nighttime (dark) periods. Daytime passage percentages at Lower Monumental Dam ranged from 35.5 to 50% during the two week period.

Wild steelhead trout smolt **diel** passage was examined over a six week period at Lower Granite Dam (Table 28). Passage during the daytime, sunrise to sunset, ranged between 41.7 to 64.7% over the six week period. Nighttime passage, sunset to midnight, ranged from 18 to 41.9% compared to midnight to sunrise passage of 9.7 to 29%. Observed passage from sunset to midnight (dark) period was greater than the midnight to sunrise (dark) passage during five out of six weeks (Figure 39). Diel passage during both dark periods combined ranged between 35.3 to 58.2%. A peak in diel movement generally occurred at sunset or shortly thereafter (Appendix G. 12-14).

Information on diel passage of wild steelhead trout smolts at Little Goose Dam was available over a four week period from April 21 to May 18. Emigration past the Little Goose Dam facility during the daytime, sunrise to sunset, ranged from 42.1 to 68.4% (Table 28). Passage during nighttime hours, midnight to sunrise and sunset to midnight combined, ranged from 3 1.5 to 57.8% over the four week period. Diel passage during nighttime hours declined from 57.8% during the week of April 21 to 37.5% the week of May 12 (Figure 40) as the percent daytime passage increased from 42.1 to 62.5%. During the first two weeks, April 21 and April 28, peaks in **diel** passage were observed just before and after sunset. This pattern did not occur during the last two weekly periods of May 5 and May 12 (Appendix G. 15 and 16).

Average weekly diel passage data at Lower Monumental Dam, for wild steelhead smolts, was available for a five week period from April 21 through May 25, 1996 (Appendix G. 17-19). Nighttime passage, midnight to sunrise and sunset to midnight combined, ranged from 44.6 to 61.7% during the five week period. Passage percentages during the sunset to midnight (dark) period exceeded the passage frequency during the midnight to sunrise (dark) period for four out of the five weeks (Figure 41). Daytime emigration through the Lower Monumental Dam facility ranged from 38.3 to 55.4% (Table 28).

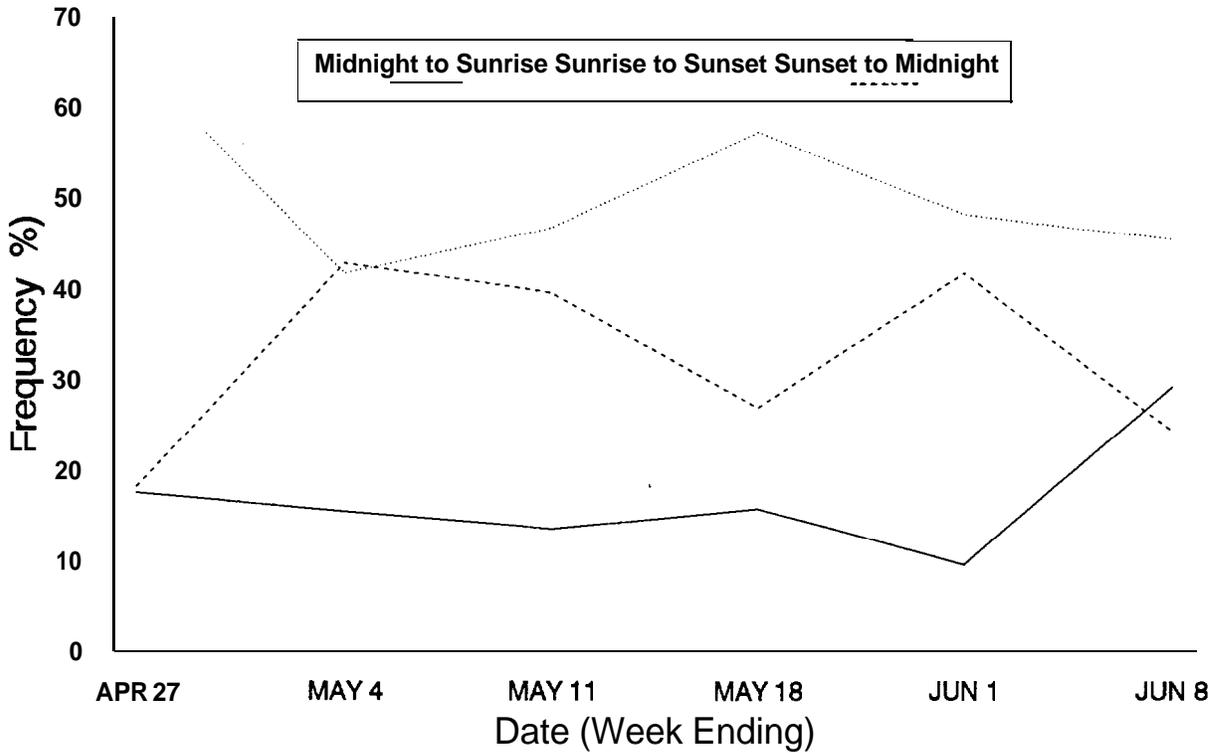
Hatchery reared steelhead trout smolt **diel** passage at Lower Granite Dam was summarized for a seven week period from April 28 through June 15, 1996 (Appendix G.20-23). Daytime passage percentages ranged from 26.7 to 75%. Daytime passage steadily increased from the week of April 28 (26.7%) to May 19 (75%) and then decreased again (Table 28). An opposite trend occurred with combined nighttime (dark) period passage which steadily decreased from the week of April 28 (73.4%) to the week of May 19 (25%). Sunset to midnight **diel** passage of hatchery reared steelhead was more prominent than midnight to sunrise passage in six out of the seven weeks (Figure 39).

Diel passage at Little Goose Dam, for hatchery reared steelhead smolts, was evaluated over four weeks from May 12 through June 15 (Appendix G.24 and 25). Daytime passage was a dominant occurrence for the first three weeks, May 12 to June 2, with average frequencies ranging from 62.2 to 64.7% (Table 28). Combined nighttime (dark) period passage ranged from 35.5 to 52.7% over the four week period. Passage from sunset to midnight exceeded the midnight to sunrise passage in three out of the four weeks (Figure 40). Sample size at Little Goose Dam for the week of May 12 was considered adequate, and sample sizes for the remaining three weeks provided trend information only (Table 28).

Table 28. Midnight to sunrise, sunrise to sunset and sunset to midnight weekly passage frequency of PIT tagged Imnaha River wild and hatchery steelhead trout smolts at Lower Granite, Little Goose and Lower Monumental Dams, 1996.

Dam	Week	Sample Size (n)	Passage Frequency		
			Midnight to Sunrise (%)	Sunrise to Sunset (%)	Sunset to Midnight (%)
<b><u>Wild Steelhead</u></b>					
Lower Granite	April 21-27	139	17.3	64.7	18.0
	April 28-May 4	91	16.5	41.7	41.7
	May 5-11	113	13.3	46.0	40.7
	May 12-18	188	16.5	55.8	27.7
	May 26-June 1	31	9.7	48.4	41.9
	June 2-8	62	29.0	46.8	24.2
Little Goose Dam	April 21-27	102	24.5	42.1	33.3
	April 28-May 4	52	17.3	44.2	38.5
	May 5-11	38	18.4	68.4	13.1
	May 12-18	168	16.7	62.5	20.8
Lower Monumental	April 21-27	46	15.2	50.0	34.8
	April 28-May 4	74	18.9	55.4	25.7
	May 5-11	56	21.4	48.2	30.3
	May 12-18	162	14.8	38.3	46.9
	May 19-25	67	23.9	55.2	20.9
<b><u>Hatchery Steelhead</u></b>					
Lower Granite Dam	April 28-May 4	30	16.7	26.7	56.7
	May 5-11	38	21.0	44.7	34.2
	May 12-18	103	19.4	52.4	28.1
	May 19-25	36	2.8	75.0	22.2
	May 26-June 1	62	9.7	66.1	24.2
	June 2-8	76	32.9	42.1	25.0
	June 9-15	74	21.6	45.9	32.4
Little Goose Dam	May 12-18	88	12.5	62.5	25.0
	May 19-25	34	14.7	64.7	20.6
	June 2-8	45	20.0	62.2	17.8
	June 9-15	36	19.4	47.2	33.3
Lower Monumental Dam	May 12-18	59	13.6	39.0	47.4
	May 19-25	44	27.3	43.2	29.5
	June 2-8	46	6.5	56.5	37.0
	June 9-15	31	12.9	54.8	32.2

### LOWER GRANITE DAM



### LOWER GRANITE DAM

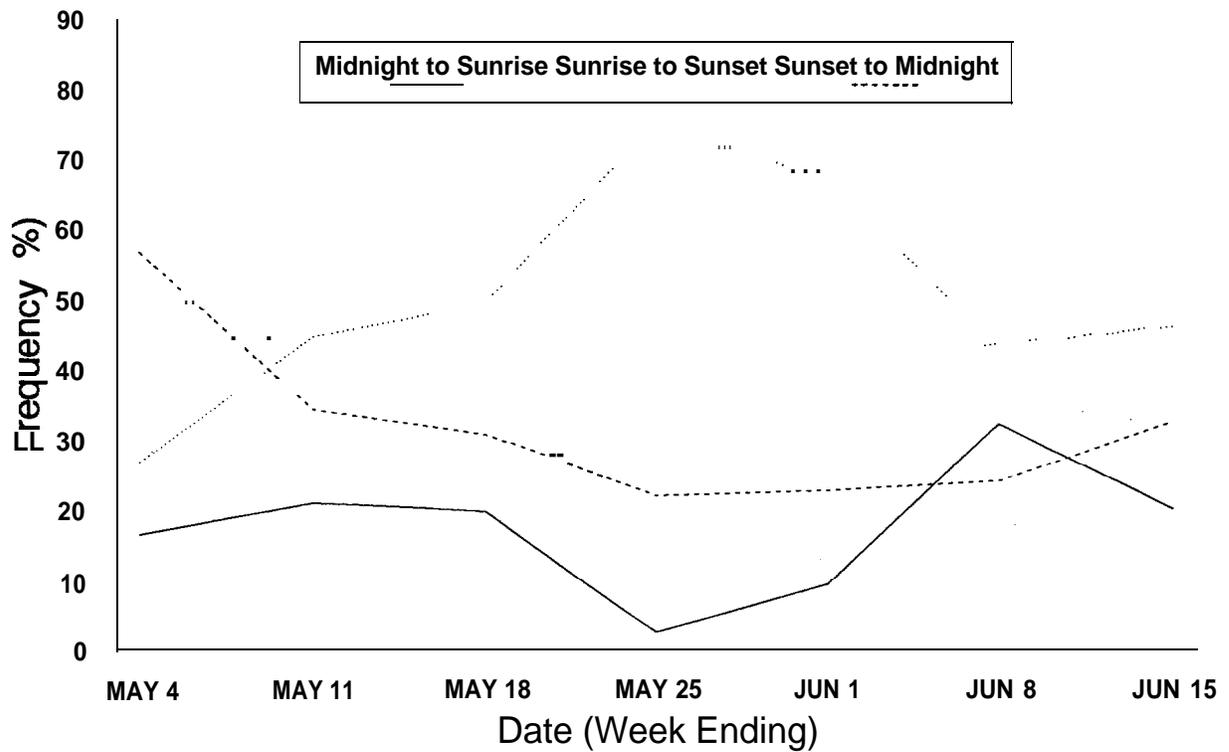
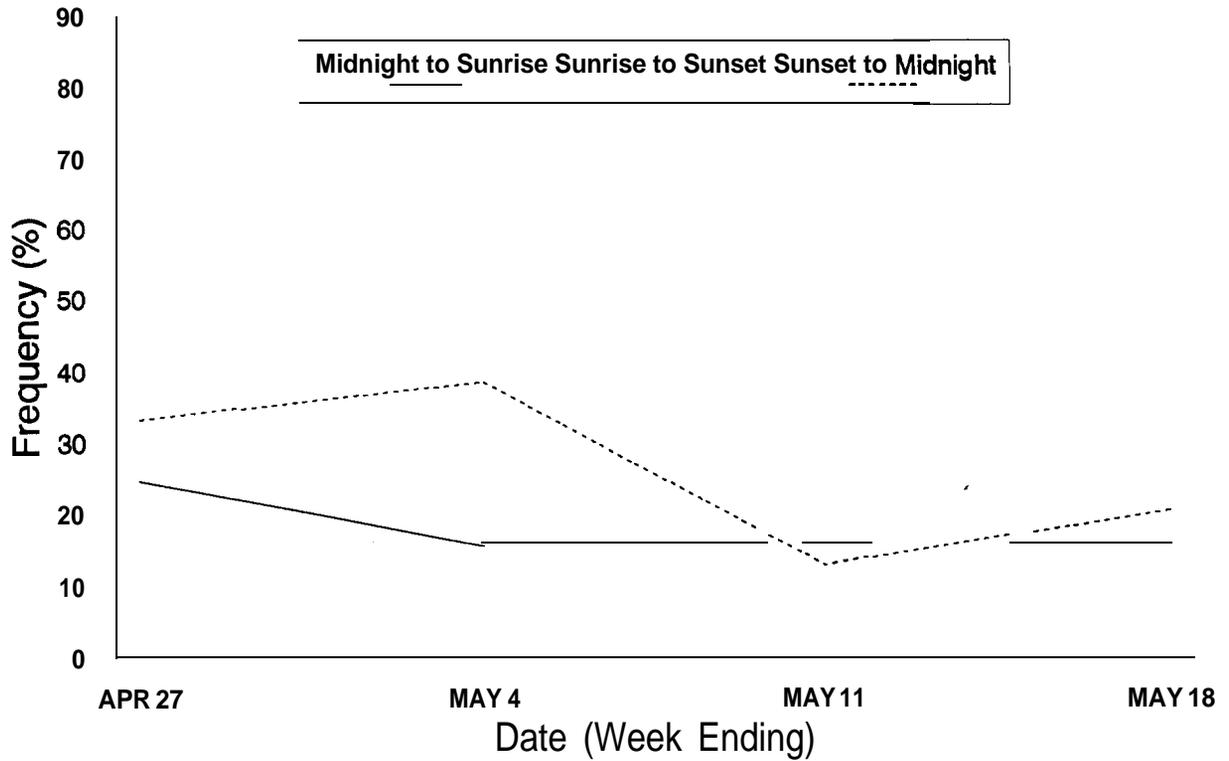


Figure 39. Midnight to sunrise, sunrise to sunset, and sunset to midnight weekly passage frequency of PIT tagged Imnaha River wild (upper graph) and hatchery (lower graph) steelhead trout smolts at Lower Granite Dam during the spring of 1996.

### LITTLE GOOSE DAM



### LITTLE GOOSE DAM

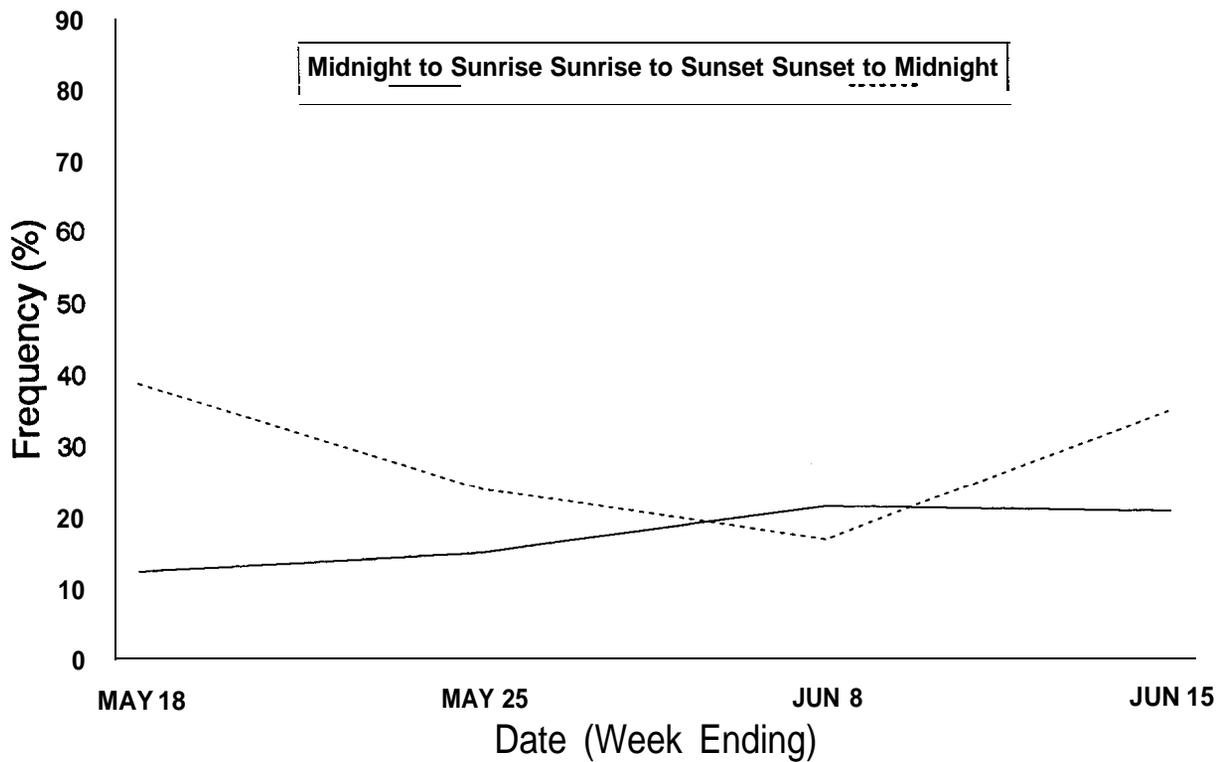
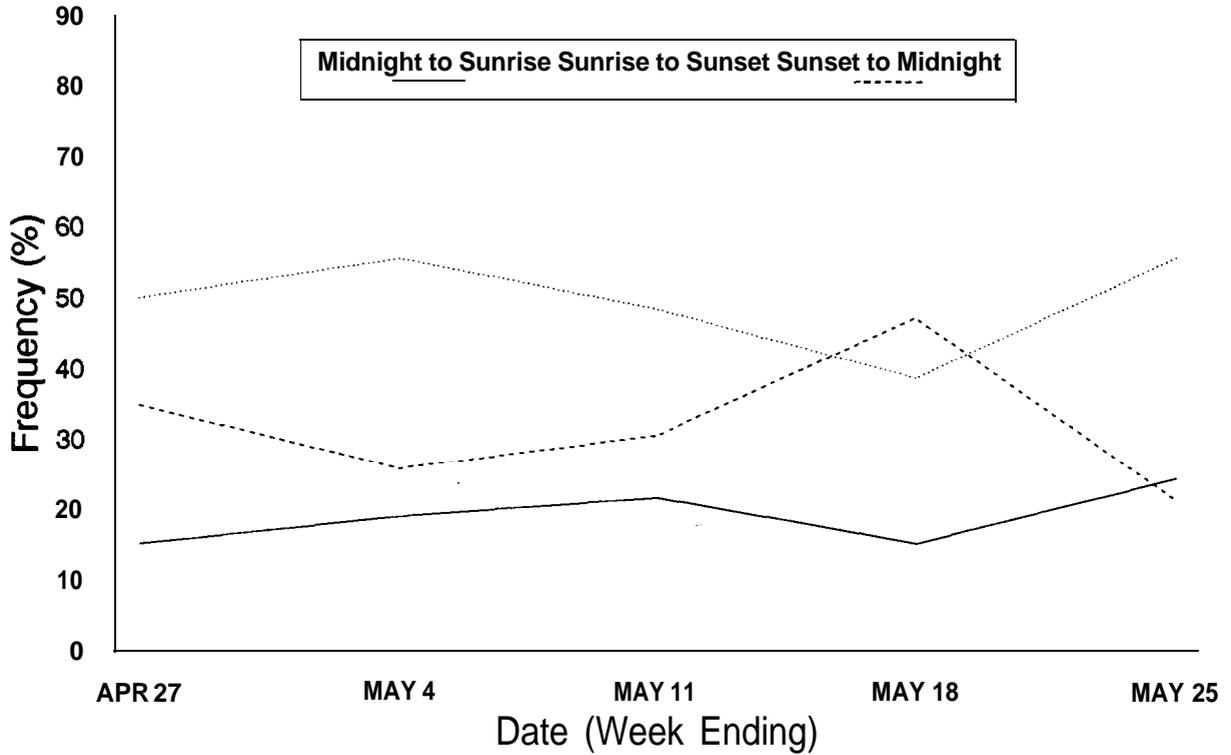


Figure 40. Midnight to sunrise, sunrise to sunset, and sunset to midnight weekly passage frequency of PIT tagged Imnaha River wild (upper graph) and hatchery (lower graph) steelhead trout smolts at Little Goose Dam during the spring of 1996.

### LOWER MONUMENTAL DAM



### LOWER MONUMENTAL DAM

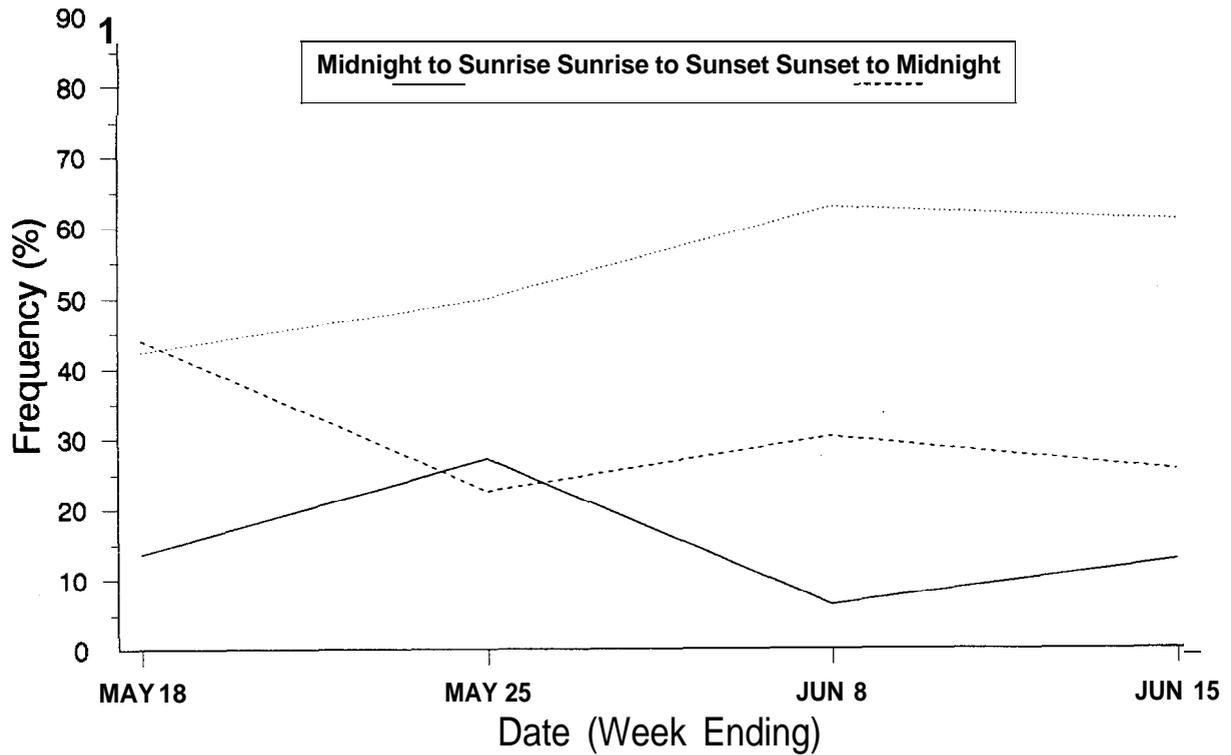


Figure 41. Midnight to sunrise, sunrise to sunset, and sunset to midnight weekly passage frequency of PIT tagged Imnaha River wild (upper graph) and hatchery (lower graph) steelhead trout smolts at Lower Monumental Dam during the spring of 1996.

Data for average weekly diel passage at Lower Monumental Dam were available for a four week period and were based on relatively small sample sizes (Appendix G.26 and 27). Combined nighttime passage for hatchery reared steelhead trout, midnight to sunrise and sunset to midnight, ranged between 43.5 to 61% (Table 28). Daytime passage ranged from 39 to 56.5%. Passage during the daytime increased slightly during the four week period (Figure 41).

### Travel Time to Lower Granite Dam

Wild chinook salmon smolts were PIT tagged and released over a sixteen week period from March 1 to June 11. Mean travel time of PIT tagged wild chinook salmon smolts from the Imnaha River screw trap (IMTRP) to Lower Granite Dam (LGR) ranged from 8.0 d for the May 11 release group to 26 d for the March 30 release group. A consistent trend in decreasing mean travel time was evident between the March 2 weekly release group and the April 13 release group. Wild chinook salmon smolts PIT tagged and released on March 2 took an average of 53 days to reach LGR, whereas the April 13 release group averaged 10 days travel time to LGR. Mean travel times from April 13 to June 1 were much less variable ranging from 8 to 10 days to reach LGR. Mean travel time was lower in every case for wild chinook salmon compared to hatchery chinook salmon PIT tagged and released at the same time (Figure 42). PIT tag release groups of March 2, March 9, March 16, March 23, May 18, May 25, June 1, June 8, and June 15 had less than 30 interrogated fish and were used for trend information analysis. The April 13 release group had 28 interrogations and was utilized for statistical analysis of mean travel times.

Hatchery chinook salmon smolts were PIT tagged and released during eight weeks of trapping from April 3 to June 3. Mean travel time trends of PIT tagged hatchery chinook salmon to LGR ranged from 7.5 d for the May 11 weekly release group to 27.3 d for those fish released during the week of April 6 (Figure 42). The weekly release groups of April 27, May 4, May 11, May 18, and June 8 had less than 30 interrogations. Hatchery chinook smolt mean travel time steadily declined throughout the spring emigration season.

Wild chinook salmon smolt mean or median travel time from the Imnaha River to Lower Granite Dam was significantly ( $p < 0.05$ ) faster compared to hatchery chinook smolt movement during three consecutive weeks between April 6 and April 20 (Table 29). Wild chinook smolts emigrated significantly faster during this time even though they were significantly smaller in fork length ( $p < 0.05$ ) than their hatchery reared counterparts (Table 23).

Wild steelhead trout smolts were PIT tagged and released during ten weeks of trapping. Mean travel time from the IMTRP to LGR ranged from 2.5 d for the June 8 release group to 6.2 d for the April 20 release group (Figure 43). Travel time to Lower Granite Dam decreased throughout the outmigration period. The May 25, June 15 and June 22 PIT tag release groups had less than 30 interrogations which precluded further travel time analysis.

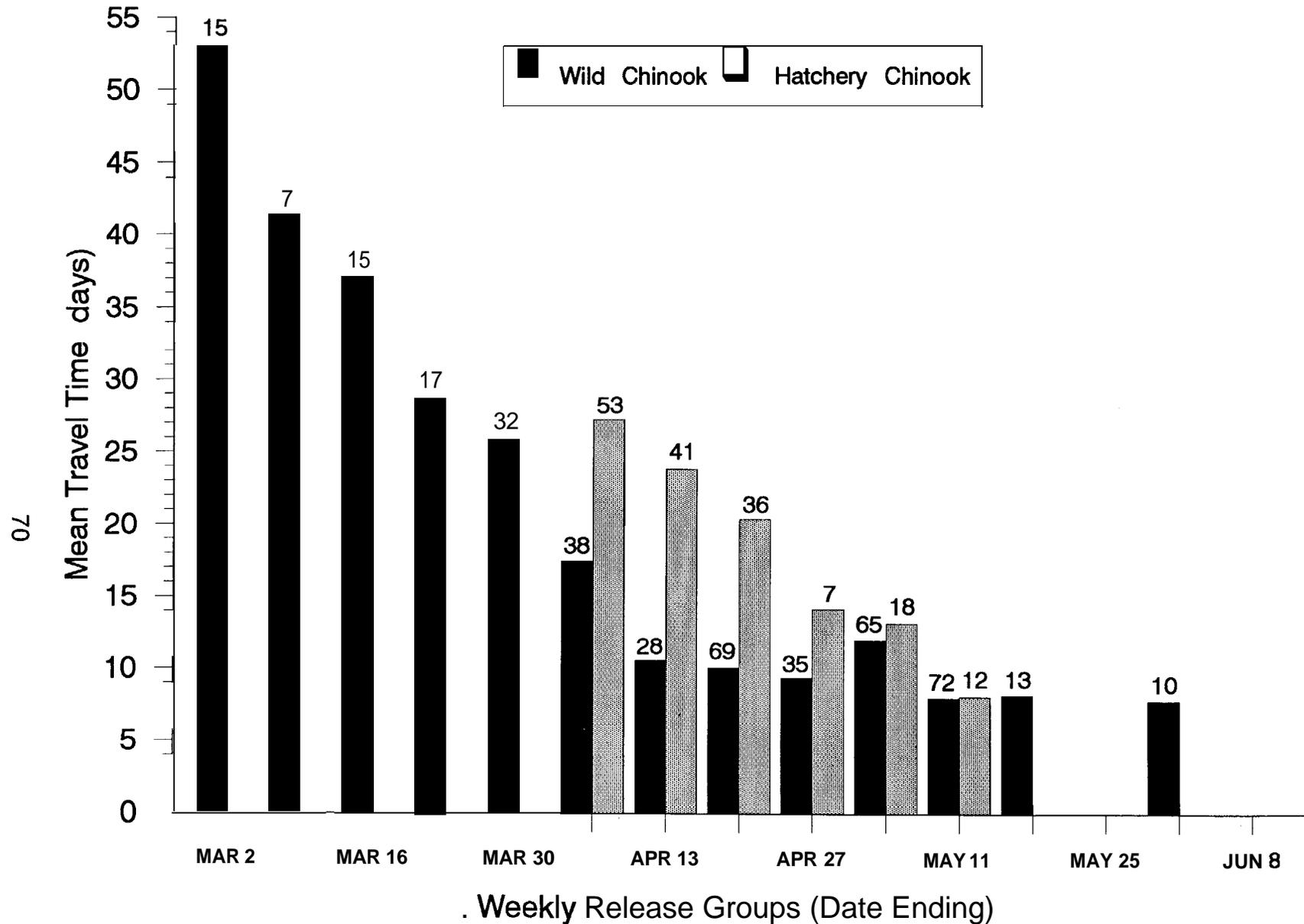


Figure 42. Mean travel time, by weekly PIT tag release group, of wild and hatchery chinook salmon smolts from the Imnaha River to Lower Granite Dam, April 6 to June 12, 1996 (sample size on top).

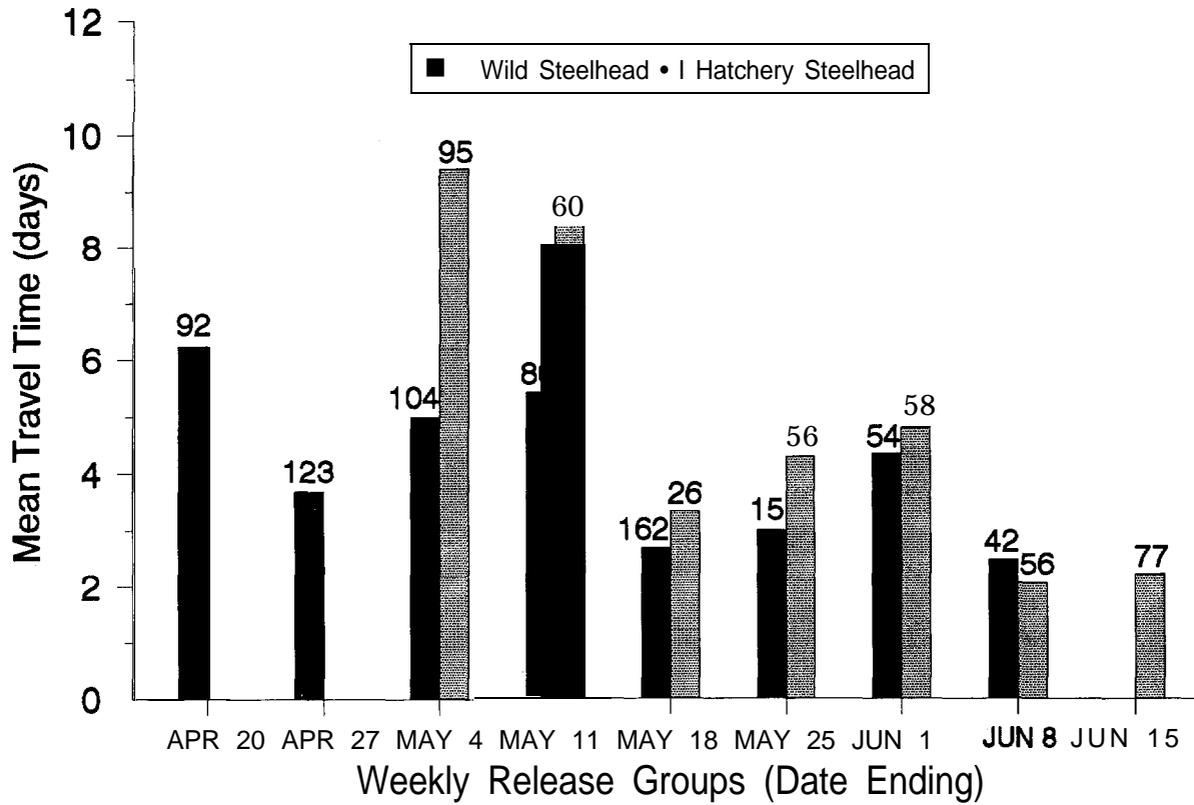


Figure 43. Mean travel time, by weekly PIT tag release group, of wild and hatchery steelhead trout smolts from the Imnaha River to Lower Granite Dam, April 19 to June 29, 1996.

Table 29. Comparison of mean and median travel time between weekly PIT tag release groups of Imnaha River wild and hatchery reared chinook salmon smolts from the Imnaha River trap to Lower Granite Dam in 1996.

Week Ending	<u>Sample Size (n)</u>		<u>Mean Travel Time (days)</u>		Statistical Test	Significance
	Wild Chinook	Hatchery Chinook	Wild Chinook	Hatchery Chinook		
April 6	38	53	17.47	27.30	Wilcoxon	p < 0.05
April 13	28	41	10.56	23.87	t-test	p < 0.05
April 20	69	36	10.09	20.40	Wilcoxon	p < 0.05

Hatchery steelhead trout smolts were PIT tagged during eleven weeks of trapping. Mean travel time from the IMTRP trap to LGR ranged from 2.1 d for fish released the week ending June 8 to 9.4 d for fish released the week ending May 4 (Figure 43). The weekly release groups of June 22 and June 29 had less than 30 interrogations and were not used in travel time analysis. The May 18 release group had 26 interrogations and was utilized for statistical analysis of mean travel times. Mean travel time to LGR from weekly PIT tag release groups of hatchery steelhead fluctuated throughout the spring outmigration period, but generally decreased over time.

Wild steelhead trout smolt median travel time, from the Imnaha River to Lower Granite Dam, was significantly faster ( $p < 0.05$ ) than hatchery steelhead smolts during three out of the five weeks when comparisons were made (Table 30). This occurred even though wild steelhead smolts were significantly smaller in fork length ( $p < 0.05$ ) than hatchery reared smolts (Table 24). Wild steelhead smolt average fork length ranged between 169-177 mm compared to 192-207 mm for hatchery smolts during the five week period (Table 24). Wild steelhead smolt emigration was significantly faster for two consecutive weeks from May 4 to May 11 and during the week ending on June 8. However, there was only a 0.4 day difference in mean travel time between the two groups on June 8 (Table 30), when a significant statistical difference was indicated. There was no significant difference ( $p > 0.05$ ) between hatchery and wild steelhead median travel time for the May 18 and June 1 release groups (Table 30).

Table 30. Comparison of median travel time (Wilcoxon test) between weekly PIT tag release groups of Imnaha River wild and hatchery reared steelhead trout smolts from the Imnaha River trap to Lower Granite Dam in 1996.

Week Ending	<u>Sample Size (n)</u>		<u>Mean Travel Time (days)</u>		Statistical Significance Test
	Wild Steelhead	Hatchery Steelhead	Wild Steelhead	Hatchery Steelhead	
May 4	104	95	4.99	9.41	Wilcoxon $p < 0.05$
May 11	80	60	5.42	8.40	Wilcoxon $p < 0.05$
May 18	162	26	2.68	3.32	Wilcoxon $p > 0.05$
June 1	54	58	4.34	4.80	Wilcoxon $p > 0.05$
June 8	42	56	2.48	2.07	Wilcoxon $p < 0.05$

## SUMMARY

For the third consecutive year, the Nez Perce Tribe, in conjunction with the Fish Passage Center, participated in the smolt monitoring program in the Imnaha River. The Nez Perce Tribe's continuing efforts were aimed at providing the Fish Passage Center with in-season information regarding wild and hatchery chinook salmon and steelhead trout smolt outmigration from the Imnaha River. This tributary specific information is then used to make flow recommendations and spill requests in the Snake and Columbia River to benefit survival of emigrating anadromous smolts. A rotary screw trap was used to capture outmigrating smolts from February 23 to June 24, 1996.

A total of 1,797 wild chinook salmon, 11,896 hatchery chinook salmon (HxW), 3,786 wild steelhead trout and 3 1,094 hatchery steelhead trout smolts were captured during the study. Emigrating wild chinook salmon smolts averaged 101 mm in fork length, 11.4 g in weight and the mean condition factor was 1.10. Weekly mean fork lengths of wild chinook salmon smolts ranged from 92 to 106 mm during the outmigration period. Wild chinook smolts were also significantly smaller ( $p < 0.05$ ) in fork length than hatchery reared chinook smolts. Hatchery chinook salmon smolts (HxW) were noticeably larger than their wild counterparts having a mean length of 131 mm, mean weight of 26 g and mean condition factor of 1.14. Wild steelhead trout smolts averaged 17.5 mm in length, 56.9 g in weight and had a mean condition factor of 1.03. Hatchery steelhead trout were significantly larger than their wild counterparts ( $p < 0.05$ ) averaging 201 mm in length, 80.9 g in weight and 0.97 in condition factor. Condition factors of hatchery steelhead declined the third week after release in the Imnaha River and remained at comparatively lower levels through late June.

Peak wild chinook smolt emigration from the Imnaha River, based on number of fish collected, occurred between April 30 and May 10. A smaller spike in fish catch was observed on April 4 which coincided with hatchery chinook smolt arrival at the trap. The emigration period for wild chinook smolts was very protracted with the majority of smolts having migrated out of the Imnaha River by May 16. Wild chinook salmon smolts made up 3.7% of the total fish catch.

Estimated hatchery chinook smolt yield at the Imnaha River trap site was 92,759 fish ( $\pm 23,782$ ). The smolt yield point estimate was slightly greater (1.7%) than the estimated smolt release (91,240 fish) from the Imnaha River Acclimation Facility. Smolt yield was estimated for the period of April 13 through April 23 when over 94% of the hatchery chinook smolts were collected. The largest single day of emigration occurred two days after release, when an estimated 47,775 hatchery chinook smolts were projected to have outmigrated out of the Imnaha River. Hatchery chinook smolts comprised 24.5% of the total trap catch.

Wild steelhead trout smolt emigration occurred from March 1 to mid-June. Steelhead smolt catch comprised 7.8% of the total sample. The peak in emigration (from trap catch) occurred from April 30 to May 15 with the highest single days trap catch (431) occurring on May 13. Small numbers of emigrating wild steelhead smolts were captured in June.

ODFW released approximately of 332,103 hatchery reared steelhead trout smolts in Little Sheep Creek on April 9. During the study period, 9.7% of the hatchery reared steelhead smolts were

captured representing 64% of the total catch. Hatchery steelhead smolts arrived at the trap the evening after release and peak catch was observed on May 1 when an estimated 9,998 fish were captured. River conditions precluded accurate sampling and smolt yield estimation of hatchery steelhead trout. At the conclusion of the study period hatchery steelhead trout smolts were still being caught at an average of 25 fish per week.

Mortality rates associated with trapping, handling and PIT tagging were low, being 1.4% for wild chinook salmon, 0.18% for hatchery chinook salmon(HxW), 0.21% for wild steelhead trout, and 0.28% for hatchery steelhead trout smolts. Handling related mortality was most significant for chinook (0.89%) and resulted mainly from holding in net pens in the river.

We interrogated 502 (10.6%) of the 4,715 PIT tagged hatchery chinook salmon smolts, released by ODFW from the Imnaha River acclimation pond on April 2. The majority of observations (55%) were interrogated one day after release. Mean travel time for hatchery chinook salmon smolts to the Imnaha trap was 3.1 days with the 90% arrival date occurring on April 6. We also interrogated 65 (4.3%) of the 1,518 PIT tagged hatchery steelhead trout released from the Little Sheep Creek site on April 29. The majority of hatchery steelhead interrogations (49%) occurred on May 1. We interrogated 32 (3.2% of total released) acclimated steelhead smolts and 33 PIT tagged direct stream released steelhead trout smolts (6.6% of total released). Mean travel time to the Imnaha trap for acclimated steelhead trout smolts was 5.1 days with a 90% arrival date of May 15. Direct stream released steelhead trout smolts had a mean travel time of 3.3 days with a 90% arrival date of May 3. Thirty previously PIT tagged wild chinook were also captured.

Spring runoff water conditions in 1996 provided above average flows for emigrating anadromous salmonid smolts. Snake River discharge measured at the Anatone gauge station, ranged from 46.9 to 146.7 kcfs from May 8 to June 11. Flows declined after June 11. River discharge at LGR ranged from 76 kcfs on April 18 to 202.2 kcfs on June 11. Flows at LGR were generally greater than 100 kcfs during most of the spring runoff period, and discharge exceeded 120 kcfs almost continuously from May 14 to June 20. Steady decline in flows at LGR was observed after June 11 but remained above 88 kcfs through the remainder of the study period. The water spill period at LGR was initiated on February 5 and occurred continuously through July 8, except on March 29-31, when spill ended.

We PIT tagged and released 1,311 wild chinook salmon smolts during the study period. Cumulative interrogations at Snake River and Columbia River dams were 62.5% (n = 819). Cumulative interrogations ranged from 53.2% for fish tagged in late March to 71.2% for fish tagged in late April. Imnaha River wild chinook salmon smolts arrived at LGR between April 6 and June 12 with median and 90% passage dates of April 30 and May 18, respectively. Wild chinook smolts emigrated past Little Goose Dam between April 12 and June 16. The median passage date at LGO was April 27 and 90% of wild chinook smolt passage occurred by May 20. Peaks in arrival timing occurred in early to late April at the three Snake River dams. Average weekly wild chinook smolt diel passage at Lower Granite Dam showed that 48.6 to 54% of the smolts emigrated during nighttime hours. More than twice the percentage of smolts moved between sunset and midnight compared to the midnight to sunrise period in three out of the four weeks examined. Diel passage

of wild chinook salmon smolts at Little Goose Dam, over a three week period, indicated that 59.2 to 72.1% of the smolts emigrated past the dam during the daytime. Wild chinook smolt diel passage at Lower Monumental Dam indicated that nighttime passage ranged from 41.8 to 58.6% over a three week period. Conversely, smolt passage during the daytime period similarly ranged from 41.4 to 58.2% at Lower Monumental Dam. Mean travel time of PIT tagged wild chinook salmon from the Imnaha River screw trap to LGR ranged from 8 days for the May 11 release group to 26 days for fish tagged and released by March 30. Wild chinook salmon smolt mean or median travel time to LGR was significantly faster ( $p < 0.05$ ) than hatchery chinook smolt travel time even though wild chinook were significantly smaller in fork length ( $p < 0.05$ ) than their hatchery counterparts.

A total of 698 hatchery chinook salmon smolts were PIT tagged and released in the Imnaha River during the study period. Of the 698 PIT tagged hatchery chinook salmon smolts released at the Imnaha River trap, 48% ( $n=335$ ) of the fish were cumulatively interrogated at Snake River and Columbia River dams. Cumulative interrogation percentages for weekly release groups ranged from 41.7% for the April 13 release group to 62% for the May 11 release group. Hatchery chinook salmon smolts arrived at Lower Granite Dam from April 13 to May 26, at Little Goose Dam from April 23 to June 6, and at Lower Monumental Dam from April 23 to May 29. \*Median and 90% passage dates for hatchery reared chinook occurred at Lower Granite and Little Goose Dams on May 7 and May 16, May 13 and May 20, respectively. May 15 and May 23 were the median and 90% passage dates for hatchery chinook smolts at Lower Monumental Dam in 1996. Peak in arrival of hatchery chinook salmon at Little Goose, Lower Monumental and McNary dams occurred during a substantial increase in river discharge in mid-May. Sample sizes for hatchery chinook salmon smolt average weekly diel passage were relatively small, providing trend information only. Nighttime diel passage at Lower Granite Dam ranged from 51.4 to 64.1% over a three week period. The majority of nighttime passage occurred from sunset to midnight (29.7-46.2%), as compared to passage between midnight to sunrise. Mean travel time of PIT tagged hatchery chinook salmon smolts to Lower Granite Dam ranged from 7.5 days for the May 11 weekly release group to 27.3 days for those fish released the week of April 6. Hatchery chinook smolt mean travel time to LGR steadily declined throughout the spring emigration season

A total of 1,065 (70.8%) of the 1,504 PIT tagged wild steelhead trout smolts released at the Imnaha River trap were interrogated at mainstem dams. Cumulative interrogation of weekly release groups ranged from 62.1% for the May 18 release group to 84.8% for the April 20 release group. Wild steelhead trout smolts arrived at Lower Granite Dam from April 19 to June 10 with median and 90% passage dates of May 6 and June 4, respectively. Wild steelhead smolt arrival occurred at Little Goose from April 20 to June 14, at Lower Monumental from April 22 to June 15 and at McNary Dam from April 25 to June 11. The 90% passage date at Little Goose was on May 28, at Lower Monumental was May 29 and at McNary Dam occurred by May 21. Average weekly diel smolt passage indicated that wild steelhead emigrated past Lower Granite Dam almost equally between daytime and nighttime periods. Daytime passage ranged from 41.7 to 64.7% over a six week period. Nighttime diel passage occurred at a 35.3 to 58.2% rate. Passage from sunset to midnight was greater than passage from midnight to sunrise during five out of six weeks. A peak in diel movement at Lower Granite Dam generally occurred at sunset or shortly thereafter. Diel emigration past Little

Goose Dam during daytime hours ranged from 42.1 to 68.4% over a four week period, and increased from the week of April 21 to May 12. Nighttime passage at LGO ranged from 31.5 to 57.8%. Average weekly diel passage of wild steelhead smolts at Lower Monumental Dam ranged from 44.6 to 61.7% during the nighttime. Smolts emigrated through the Lower Monumental facility almost equally between daytime and nighttime periods. Mean travel time from the Imnaha River trap to Lower Granite Dam for wild steelhead smolts ranged from 2.5 days for the June 8 release group to 6.2 days for the April 20 release group. Wild steelhead trout smolt median travel time was significantly faster ( $p < 0.05$ ) than hatchery steelhead smolts during three out of five weeks when comparisons were made. This occurred even though wild steelhead smolts were significantly smaller in fork length ( $p < 0.05$ ) than hatchery reared smolts.

We PIT tagged 1,346 hatchery steelhead trout smolts in the Imnaha River during the study period. Cumulative interrogations observed at Snake River and Columbia River dams represented 49.8% ( $n=671$ ) of the PIT tagged hatchery steelhead trout. Cumulative interrogations of weekly PIT tag release groups for hatchery steelhead trout smolts ranged from 35.9% to 69.3% over a seven week period. Imnaha River hatchery steelhead trout smolts arrived at Lower Granite Dam from April 23 to July 14, at Little Goose Dam from April 24 to July 11, and at Lower Monumental Dam from May 6 to July 7. The median and 90% passage dates for hatchery steelhead smolts at LGR occurred on May 28 and June 14. The 90% passage date for PIT tagged hatchery steelhead trout at Little Goose Dam and Lower Monumental Dam occurred on June 16 and June 15, respectively. Peak in arrival timing occurred in mid-May at Little Goose and Lower Monumental dams. The general trend at each dam was a long protracted emigration. Only 30 PIT tagged hatchery steelhead trout smolts were detected at McNary Dam during the outmigration period. Average weekly diel passage of hatchery steelhead smolts indicated that daytime passage at LGR steadily increased from April 28 (26.7%) to May 19 (75%) and then declined. Sunset to midnight passage was more prominent at LGR than midnight to sunrise passage for hatchery steelhead smolts over a seven week period. Diel passage at Little Goose Dam was largely daytime passage (62.2-64.7%) for the weekly periods between May 12 and June 2. Diel passage at Little Goose Dam from sunset to midnight exceeded the midnight to sunrise passage during three out of four weeks. Sample sizes to calculate hatchery steelhead smolt diel passage at Lower Monumental Dam were small providing trend information only. Nighttime diel passage at Lower Monumental Dam ranged between 43.5 to 61% over a four week period. Mean travel time of hatchery steelhead trout smolts from the Imnaha River trap to Lower Granite Dam ranged from 2.1 days for the June 8 weekly release group to 9.4 days for fish released the week ending May 4.

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Table A. 1. Innaha River daily minimum, maximum, and mean water temperatures in degrees Celsius. February 23 - April 24 and June 20-24, 1996.

DATE	MEAN	MAX	MIN	DATE	MEAN	MAX	MIN
02/23/96	3.6	3.9	3.3	03/22/96	6.9	7.6	6.2
02/24/96	3.0	3.3	2.5	03/23/96	5.9	6.6	5.3
02/25/96	3.0	4.3	2.0	03/24/96	5.1	5.6	4.3
02/26/96	2.4	3.0	1.9	03/25/96	4.4	6.3	2.5
02/27/96	1.2	2.4	0.0	03/26/96	5.3	7.3	3.6
02/28/96	1.1	2.5	-0.1	03/27/96	5.9	6.4	5.2
02/29/96	1.7	3.3	0.2	03/28/96	6.2	7.9	4.9
03/01/96	2.6	4.4	0.8	03/29/96	5.1	6.4	3.7
03/02/96	3.8	5.7	1.9	03/30/96	6.4	8.4	4.5
03/03/96	4.8	5.7	4.0	03/31/96	7.8	9.9	5.9
03/04/96	5.7	7.0	4.3	04/01/96	9.6	11.1	8.5
03/05/96	5.7	6.7	4.9	04/02/96	8.4	9.5	7.6
03/06/96	5.2	6.6	4.0	04/03/96	7.2	8.1	6.2
03/07/96	6.5	8.0	5.1	04/04/96	7.1	9.1	5.1
03/08/96	8.7	10.6	7.2	04/05/96	8.3	10.3	6.3
03/09/96	8.4	9.2	7.3	04/06/96	9.7	11.3	8.1
03/10/96	8.4	9.5	7.2	04/07/96	10.5	12.0	8.9
03/11/96	9.3	10.5	8.4	04/08/96	10.6	12.1	8.9
03/12/96	8.1	8.8	7.4	04/09/96	9.8	11.1	8.5
03/13/96	6.9	7.8	6.2	04/10/96	8.5	10.0	7.1
03/14/96	6.5	7.9	5.1	04/11/96	7.7	9.2	6.3
03/15/96	7.2	8.5	6.1	04/12/96	7.6	8.7	6.7
03/16/96	6.9	8.0	5.7	04/13/96	7.2	8.3	6.2
03/17/96	7.1	8.5	5.7	04/14/96	7.6	9.7	5.4
03/18/96	6.9	8.5	5.3	04/15/96	8.5	10.0	7.4
03/19/96	7.6	9.6	5.7	04/16/96	9.6	10.5	8.9
03/20/96	8.3	9.5	7.2	04/17/96	8.4	9.7	7.0
03/21/96	7.4	8.5	5.9	04/18/96	7.5	8.4	6.8

Table A.1. (continued)

DATE	MIN	MAX	MEAN	DATE	MIN	MAX	MEAN
04/19/96	1.2	8.7	5.7	05/17/96	NA	NA	NA
04/20/96	7.0	8.0	6.2	05/18/96	NA	NA	NA
04/21/96	7.4	9.7	5.4	05/19/96	NA	NA	NA
04/22/96	8.2	9.8	6.5	05/20/96	NA	NA	NA
04/23/96	8.9	9.5	8.2	05/21/96	NA	NA	NA
04/24/96	8.4	9.1	7.7	05/22/96	NA	NA	NA
04125196	NA	NA	NA	05/23/96	NA	NA	NA
04/26/96	NA	NA	NA	05/24/96	NA	NA	NA
04/27/96	NA	NA	NA	05/25/96	NA	NA	NA
04/28/96	NA	NA	NA	05/26/96	NA	NA	NA
04/29/96	NA	NA	NA	05/27/96	NA	NA	NA
04/30/96	NA	NA	NA	05/28/96	NA	NA	NA
05/01/96	NA	NA	NA	05/29/96	NA	NA	NA
05/02/96	NA	NA	NA	05/30/96	NA	NA	NA
05/03/96	NA	NA	NA	05/31/96	NA	NA	NA
05/04/96	NA	NA	NA	06/01/96	NA	NA	NA
05105196	NA	NA	NA	06102196	NA	NA	NA
05/06/96	NA	NA	NA	06/03/96	NA	NA	NA
05/07/96	NA	NA	NA	06/04/96	NA	NA	NA
05/08/96	NA	NA	NA	06/05/96	NA	NA	NA
05/09/96	NA	NA	NA	06/06/96	NA	NA	NA
05/10/96	NA	NA	NA	06/07/96	NA	NA	NA
05/11/96	NA	NA	NA	06/08/96	NA	NA	NA
05/12/96	NA	NA	NA	06/09/96	NA	NA	NA
05/13/96	NA	NA	NA	06/10/96	NA	NA	NA
05114196	NA	NA	NA	06/11/96	NA	NA	NA
05/15/96	NA	NA	NA	06/12/96	NA	NA	NA
05/16/96	NA	NA	NA	06/13/96	NA	NA	NA

Table A. 1. (continued)

DATE	MIN	MAX	MEAN	DATE	MIN	MAX	MEAN
06/14/96	NA	NA	NA				
06/15/96	NA	NA	NA				
06/16/96	NA	NA	NA				
06/17/96	NA	NA	NA				
06/18/96	NA	NA	NA				
06/19/96	NA	NA	NA				
06/20/96	11.5	12.6	10.6				
06/21/96	11.3	12.5	9.7				
06/22/96	12.3	13.8	11.2				
06/23/96	11.8	12.3	11.1				
06/24/96	12.2	13.4	11.1				

Table A.2. Imnaha River daily staff gauge measurements and discharge readings from USGS gauge 13292000 at Imnaha, OR. February 23 - June 24, 1996 (NR=NO READING, Q=DISCHARGE, STAFF MEASURE- IN METERS).

DATE	STAFF	Q	DATE	STAFF	Q
02/23/96	0.84	810	04/01/96	0.71	632
02/24/96	NR	730	04/02/96	0.89	1010
02/25/96	NR	650	04/03/96	0.88	993
02/26/96	NR	585	04/04/96	0.86	921
02/27/96	NR	498	04/05/96	0.85	878
02/28/96	NR	540	04/06/96	0.86	927
02/29/96	NR	474	04/07/96	0.90	1100
03/01/96	0.72	463	04/08/96	0.95	1410
03/02/96	NR	446	04/09/96	1.05	1800
03/03/96	NR	443	04/10/96	1.11	1990
03/04/96	0.70	447	04/11/96	1.13	1820
03/05/96	0.72	472	04/12/96	1.07	1650
03/06/96	0.70	444	04/13/96	NR	1410
03/07/96	0.70	436	04/14/96	NR	1230
03/08/96	0.70	448	04/15/96	0.92	1140
03/09/96	NR	503	04/16/96	0.92	1280
03/10/96	NR	622	04/17/96	0.99	1380
03/11/96	0.87	789	04/18/96	0.98	1300
03/12/96	0.87	961	04/19/96	0.94	1180
03/13/96	0.90	1040	04/20/96	NR	1110
03/14/96	0.90	962	04/21/96	NR	1050
03/15/96	0.86	914	04/22/96	0.89	1000
03/16/96	NR	857	04/23/96	0.88	1330
03/17/96	NR	802	04/24/96	1.18	2410
03/18/96	0.87	755	04/25/96	1.24	2220
03/19/96	0.81	726	04/26/96	NR	1960
03/20/96	0.80	722	04/27/96	NR	1760
03/21/96	0.80	709	04/28/96	NR	1540
03/22/96	0.80	727	04/29/96	1.00	1420
03/23/96	NR	707	04/30/96	0.97	1310
03/24/96	NR	661	05/01/96	0.96	1260
03/25/96	0.77	598	05/02/96	0.93	1220
03/26/96	0.75	575	05/03/96	0.93	1130
03/27/96	0.73	551	05/04/96	NR	1050
03/28/96	0.73	540	05/05/96	NR	965
03/29/96	0.72	510	05/06/96	0.87	904
03/30/96	NR	484	05/07/96	0.86	880
03/31/96	NR	466	05/08/96	0.86	879

Table A. 2. (continued)

DATE	STAFF	Q	DATE	STAFF	Q
05/09/96	0.85	880	06/13/96	1.01	1510
05/10/96	0.85	887	06/14/96	1.04	1560
05/11/96	NR	903	06/15/96	NR	1660
05/12/96	NR	1090	06/16/96	NR	1630
05/13/96	0.95	1350	06/17/96	NR	1720
05/14/96	1.02	1640	06/18/96	NR	1420
05/15/96	1.02	2090	06/19/96	0.94	1200
05/16/96	1.21	2320	06/20/96	0.90	1110
05/17/96	NR	2490	06/21/96	0.88	1010
05/18/96	NR	3120	06/22/96	NR	928
05/19/96	NR	2880	06/23/96	NR	922
05/20/96	NR	2450	06/24/96	0.90	1070
05/21/96	1.24	2140			
05/22/96	1.28	2330			
05/23/96	1.29	2300			
05/24/96	1.22	2130			
05/25/96	NR	1960			
05/26/96	NR	1890			
05/27/96	NR	1860			
05/28/96	1.13	1820			
05/29/96	1.09	1730			
05/30/96	1.05	1550			
05/31/96	1.02	1410			
06/01/96	NR	1330			
06/02/96	NR	1380			
06/03/96	1.05	1560			
06/04/96	1.10	1740			
06/05/96	1.12	1800			
06/06/96	1.07	1660			
06/07/96	1.06	1700			
06/08/96	NR	1900			
06/09/96	NR	2020			
06/10/96	1.13	1870			
06/11/96	1.08	1700			
06/12/96	1.05	1590			

Table B.I Fish catch composition of Imnaha River screw trap, February, 1996.

Date	Chinook		T o t a l	Steelhead		Total	Total Catch
	Wild	Hatchery		Wild	Hatchery		
23	13	0	13	0	0	0	13
<b>*24</b>							
• 25							
<b>*26</b>							
'27							
<b>*28</b>							
<b>*29</b>							
Total	13	0	13	0	0	0	13

\*Trap not operated. See detail in Table 4.

Table 6.2. Fish catch composition of Imnaha River screw trap, March, 1996.

Date	Chi nook			Steel head			Total Catch
	Wild	Hatchery	Total	Wild	Hatchery	Total	
1	49	0	<b>49</b>	3	0	<b>3</b>	52
*2							
'3							
4	5	0	<b>5</b>	2	0	<b>2</b>	7
5	9	0	<b>9</b>	3	0	<b>3</b>	12
6	2	0	<b>2</b>	0	0	<b>0</b>	2
7	3	0	<b>3</b>	2	0	<b>2</b>	5
8	4	0	<b>4</b>	0	0	<b>0</b>	4
*9							
*10							
-11	11	0	<b>11</b>	3	0	<b>3</b>	14
-12	7	0	<b>7</b>	2	0	<b>2</b>	9
-13	14	0	<b>14</b>	2	0	<b>2</b>	16
14	12	0	<b>12</b>	6	0	<b>6</b>	18
15	15	0	<b>15</b>	1	0	<b>1</b>	16
*16							
*17							
-18	8	0	<b>8</b>	2	0	<b>2</b>	10
-19	19	0	<b>19</b>	4	0	<b>4</b>	23
-20	17	0	<b>17</b>	3	0	<b>3</b>	20
21	22	0	<b>22</b>	1	0	<b>1</b>	23
22	17	0	<b>17</b>	1	0	<b>1</b>	18
*23							
*24							
25	25	0	<b>25</b>	4	0	<b>4</b>	29
26	25	0	<b>25</b>	2	0	<b>2</b>	27
27	22	0	<b>22</b>	1	0	<b>1</b>	23
28	18	0	<b>18</b>	1	0	<b>1</b>	19
29	24	0	<b>24</b>	3	0	<b>3</b>	27
*30							
*31							
<b>Total</b>	<b>328</b>	<b>0</b>	<b>328</b>	<b>46</b>	<b>0</b>	<b>46</b>	<b>374</b>

\* Trap not operated. See details in Table 4.  
 ~ Irregular trap operation.

Table B.3 Fish catch composition of Imnaha River screw trap, April, 1996. Estimated catch appear in italics.

Date	Chinook			T o t a l	Steelhead		Total	Total Catch
	Wild	Hatchery	Unknown		Wild	Hatchery		
1	2	0		2	2	0	2	4
2	19	0		<b>19</b>	6	0	6	25
3	24	31	9	<b>64</b>	3	0	3	67
4	56	6,389		6445	4	0	4	6,449
5	25	2,808		2833	3	0	3	2,836
6	29	1,055		1084	2	0	2	1,086
7	12	482		494	3	0	3	497
-8	25	416		441	10	0	<b>10</b>	451
** -9	0	61		61	22	0	22	83
-10	23	122		145	36	0	<b>36</b>	181
-11	14	39		<b>53</b>	36	0	<b>36</b>	89
-12	8	53		61	19	0	<b>19</b>	80
'13								
*14								
-15	17	37		54	19	0	<b>19</b>	73
16	26	20		<b>46</b>	35	0	<b>35</b>	81
17	29	37		<b>66</b>	34	0	34	100
18	47	29		76	67	0	67	143
19	84	82		166	61	1	62	228
• 20								
'21								
22	29	26		<b>55</b>	43	3	46	101
23	45	7		<b>52</b>	44	0	<b>44</b>	96
-24	26	16		42	93	1	<b>94</b>	135
25	9	0		9	35	0	35	44
26	6	4		10	27	0	27	37
*27								
• 28								
29	23	4		27	44	0	44	71
#30	60	9		69	213	2,481	<b>2,694</b>	2,763
T o t a l	638	11,727	9	12,374	861	2,486	3,347	15,720

\* Trap not operated. See details in Table 4.

~ Irregular trap operation.

# Expanded counts from subsample.

\*\* Significant fish loss from livebox due to high water levels.

Table B. 4. Fish catch composition of Imnaha River screw trap, May, 1996. Estimated catch appear in italics.

Date	Chinook			Steelhead			Total Catch
	Wild	Hatchery	Total	Wild	Hatchery	Total	
#1	110	11	121	202	9,998	10,200	10,321
#2	106	15	121	188	6,032	6,220	6,341
#3	155	46	201	152	3,230	3,382	3,583
#4							
*5							
6	81	12	93	168	565	733	826
7	56	16	<b>72</b>	167	413	580	652
8	60	9	<b>69</b>	244	303	547	616
9	69	32	101	305	262	567	668
10	65	15	80	270	200	470	550
*11							
*12							
13	34	6	40	432	1,277	1,709	1,749
14	22	3	25	351	1,828	2,179	2,204
-15	14	2	16	142	2,128	2,270	2,286
-16	5	0	5	20	485	505	510
*17							
*18							
#19							
*-20							
-21	0	0	0	9	50	59	59
-22	2	0	2	9	61	70	72
23	1	0	<b>1</b>	8	26	34	35
24	2	0	2	9	41	50	52
*25							
*26							
'27							
-28	3	0	3	33	227	260	263
29	4	0	4	29	151	<b>180</b>	184
30	8	1	9	29	192	221	230
31	8	0	<b>8</b>	24	164	188	196
Total	805	168	<b>973</b>	2,791	27,633	30,424	31,397

\* Trap not operated. See details in Table 4.

~ Irregular trap operation.

# Expanded counts from subsample.

Table B.5. Fish catch composition of Imnaha River screw trap, June, 1996.

Date	Chinook		Total	Steelhead		Total	Total Catch
	Wild	Hatchery		wild	Hatchery		
*1							
'2							
3	3	0	3	17	137	154	157
4	3	1	4	22	200	222	226
-5	0	0	0	24	210	234	234
6	0	0	0	9	63	72	72
7	0	0	0	13	72	85	85
*8							
*9							
10	0	0	0	0	50	50	50
11	1	0	1	1	52	53	54
12	2	0	2	1	39	40	42
13	0	0	0	0	46	46	46
14	1	0	1	0	57	57	58
*15							
*16							
*17							
*18							
19	1	0	1	1	13	14	15
20	0	0	0	0	15	15	15
21	1	0	1	0	9	9	10
*22							
'23							
24	1	0	1	0	12	12	13
<b>Total</b>	<b>13</b>	<b>1</b>	<b>14</b>	<b>88</b>	<b>975</b>	<b>1,063</b>	<b>1,077</b>

\* Trap not operated. See details in Table 4.  
 ~ Irregular trap operation.

Table C.1. Mean daily length, weight, and condition factor of wild chinook salmon smolts sampled at the Innaha Riverscrewtrap, February 23 - June 24, 1996 (na=information not available).

Date	Number Sampled	Mean Length	Standard Deviation	Mean Weight	Standard Deviation	Mean Condition	Standard Deviation
2/23	13	92	7.6	8.7	2.4	1.09	0.05
3/01	48	96	8.5	8.9	2.3	1.00	0.06
3/04	4	95	2.9	10.0	2.2	1.16	0.18
3/05	9	95	10.1	9.3	3.1	1.04	0.05
3/06	2	90	7.1	7.9	1.5	1.08	0.05
3/07	3	95	0.0	8.8	0.2	1.02	0.02
3/08	4	95	14.9	9.5	4.3	1.06	0.02
3/11	10	93	9.3	8.2	2.2	0.99	0.14
3/12	7	97	6.3	10.9	3.1	1.19	0.27
3/13	14	93	9.9	9.1	2.9	1.13	0.23
3/14	12	93	6.7	9.0	1.5	1.13	0.16
3/15	15	99	9.4	10.0	2.9	1.01	0.06
3/18	8	91	8.4	8.7	1.5	1.18	0.19
3/19	19	97	5.6	9.4	1.7	1.02	0.06
3/20	14	99	10.6	10.6	4.0	1.02	0.10
3/21	21	96	9.3	9.6	2.7	1.05	0.08
3/22	17	102	7.0	11.3	2.4	1.06	0.08
3/25	25	96	5.8	9.1	1.6	1.02	0.06
3/26	25	98	9.0	9.9	2.6	1.02	0.10
3/27	22	97	8.2	10.0	2.9	1.06	0.07
3/28	18	106	10.3	11.2	3.4	0.93	0.04
3/29	24	102	7.3	10.0	2.3	0.91	0.05
4/01	2	98	0.7	9.6	0.5	1.03	0.07
4/02	19	105	8.7	11.7	3.0	0.98	0.05
4/03	24	101	5.9	na	na	na	na
4/04	55	97	9.1	8.9	2.5	0.98	0.21
4/05	25	99	4.7	9.7	1.5	0.99	0.07
4/06	29	99	8.5	10.5	2.9	1.05	0.07
4/07	12	101	8.6	11.0	2.8	1.05	0.05
4/08	24	101	7.9	11.8	2.9	1.13	0.10
4/10	22	102	7.9	11.9	2.9	1.11	0.07
4/11	14	101	6.7	12.0	2.8	1.15	0.17
4/12	7	104	4.1	12.8	1.7	1.15	0.04
4/15	17	103	8.8	11.1	2.7	1.01	0.14
4/16	25	101	7.4	11.8	2.4	1.12	0.08
4/17	29	101	7.9	12.2	3.1	1.15	0.11
4/18	47	101	7.5	11.7	2.4	1.13	0.12

Table C.1 (continued).

Date	Number Sampled	Mean Length	Standard Deviation	Mean Weight	Standard Deviation	Mean Condition	Standard Deviation
4/19	83	99	6.7	11.2	2.3	1.12	0.10
4/22	29	105	7.4	12.9	2.9	1.11	0.07
4/23	43	108	9.8	13.2	3.8	1.05	0.12
4/24	19	101	5.4	12.2	2.3	1.15	0.13
4/25	9	112	9.5	14.5	3.9	1.03	0.18
4/26	6	106	6.2	12.8	2.2	1.08	0.04
4/29	23	99	7.4	11.8	2.5	1.19	0.09
4/30	58	102	7.1	12.4	2.4	1.16	0.11
5/01	48	103	6.7	12.4	2.2	1.11	0.12
5/02	68	101	7.4	12.5	2.6	1.18	0.08
5/03	73	100	8.9	12.6	3.3	1.22	0.10
5/06	80	102	7.8	12.4	2.8	1.16	0.15
5/07	56	105	8.3	12.9	3.1	1.11	0.07
5/08	42	103	6.9	11.8	2.3	1.07	0.11
5/09	39	103	7.8	12.7	2.5	1.15	0.10
5/10	33	106	8.9	12.2	3.2	1.01	0.06
5/13	24	101	6.0	12.3	2.0	1.19	0.07
5/14	14	99	6.4	11.7	2.8	1.18	0.06
5/15	10	98	4.7	11.5	2.6	1.21	0.10
5/16	4	102	7.3	13.5	1.6	1.29	0.22
5/22	2	97	2.1	10.9	1.8	1.21	0.13
5/23	1	104	na	14.7	na	1.31	na
5/24	2	104	8.5	15.0	4.0	1.32	0.03
5/28	3	102	7.5	14.0	3.2	1.29	0.08
5/29	4	103	9.5	12.9	3.5	1.18	0.10
5/30	8	101	7.8	12.1	2.9	1.16	0.08
5/31	8	100	8.4	12.1	3.2	1.18	0.11
6/03	3	95	8.4	12.3	3.5	1.40	0.20
6/04	3	93	2.9	11.9	2.2	1.45	0.16
6/11	1	100	na	12.9	na	1.29	na
6/12	2	100	2.8	12.3	0.2	1.23	0.08
6/14	1	113	na	14.1	na	0.98	na
6/19	1	101	na	12.6	na	1.22	na
6/21	1	87	na	8.4	na	1.28	na
6/24	1	88	na	8.1	na	1.19	na

Table C.2. Mean daily **length, weight**, and condition factor of hatchery chinook salmon smolts sampled at the Imnaha River screw trap, April 3 -June 4, 1996 (na=information not available).

Date	Number Sampled	Mean Length	Standard Deviation	Mean Weight	Standard Deviation	Mean Condition	Standard Deviation
4/03	31	133	7.6	na	na	na	na
4/04	263	131	9.5	<b>24.2</b>	<b>8.0</b>	<b>1.06</b>	<b>0.02</b>
4/05	439	131	7.8	26.5	4.8	1.17	0.09
4/06	146	130	7.6	25.4	4.8	1.17	0.08
4/07	115	130	8.3	26.7	5.9	1.18	0.11
4/08	216	131	8.0	26.7	5.6	1.16	0.08
4/09	59	132	10.0	27.4	6.2	1.15	0.10
4/10	105	131	7.7	25.3	4.1	1.12	0.11
4/11	39	130	12.4	27.2	9.3	1.22	0.14
4/12	49	131	8.7	26.9	5.5	1.18	0.06
4/15	37	131	7.0	26.0	4.8	1.15	0.12
4/16	20	133	10.1	25.9	6.1	1.09	0.07
4/17	32	131	9.5	27.0	6.3	1.18	0.09
4/18	26	129	7.3	25.1	4.0	1.16	0.10
4/19	75	131	9.2	26.1	5.6	1.16	0.11
4/22	26	130	7.8	24.3	4.2	1.10	0.08
4/23	7	135	4.0	25.9	1.7	1.06	0.08
4/24	7	132	9.8	27.3	6.4	1.16	0.05
4/26	2	140	0.0	33.2	2.3	1.21	0.08
4/29	4	127	4.2	22.2	2.4	1.08	0.08
4/30	9	136	7.1	28.7	6.5	1.14	0.13
5/01	11	135	7.7	27.7	6.3	1.10	0.1
5/02	15	131	8.9	25.6	5.5	1.12	0.07
5/03	33	133	10.5	28.0	6.9	1.18	0.17
5/06	12	130	9.7	25.2	4.9	1.13	0.06
5/07	16	133	6.1	24.8	4.5	1.05	<b>0.07</b>
5/08	9	136	12.2	27.6	7.3	1.08	0.10
5/09	32	135	11.6	28.8	8.2	1.15	0.07
5/10	15	141	10.3	28.9	6.9	1.01	0.10
5/11	5	134	11.6	30.3	5.2	1.26	0.15
5/14	3	132	9.8	27.4	7.5	1.17	0.05
5/15	2	125	9.9	24.6	3.1	1.27	0.13
5/30	1	137	na	29.6	na	1.15	na
6/04	0	na	na	na	na	na	na

Table C.3. Mean daily length, weight, and condition factor **of wild** steel head troutsmolts sampled **at the** Innaha Rivertrap, March 1 - June 19, 1996 (na= information not available).

Date	Number Sampled	Mean Length	Standard Deviation	Mean Weight	Standard Deviation	Mean Condition	Standard Deviation
3/01	3	159	12.2	38.2	8.2	<b>0.94</b>	0.04
3/04	2	139	4.2	28.3	2.5	1.05	0.00
3/05	3	135	14.0	24.3	5.2	0.98	0.10
3/07	2	136	2.1	26.1	3.4	1.05	0.09
3/11	3	139	0.6	26.3	1.4	0.98	0.06
3/12	2	144	4.9	28.5	0.9	0.97	0.06
3/13	2	145	9.2	29.1	5.0	0.96	0.01
3/14	6	148	16.8	32.4	10.3	0.97	0.05
3/15	1	126	<b>na</b>	21.2	<b>na</b>	1.06	<b>na</b>
3/18	2	143	<b>33.2</b>	28.3	<b>14.8</b>	0.96	<b>0.15</b>
3/19	4	148	16.2	34.8	11.7	1.05	0.06
3/20	3	147	8.7	32.8	6.8	1.02	0.03
3/21	1	144	na	23.4	na	0.78	na
3/22	1	145	<b>na</b>	36.8	<b>na</b>	1.21	<b>na</b>
3/25	4	164	<b>16.7</b>	43.9	<b>15.6</b>	0.97	<b>0.05</b>
3/26	2	191	7.8	53.0	17.6	0.76	0.16
3/27	1	177	na	62.9	na	1.13	na
3/28	1	175	<b>na</b>	48.3	<b>na</b>	0.90	<b>na</b>
3/29	3	160	<b>7.8</b>	40.5	<b>6.1</b>	0.98	<b>0.02</b>
4/01	2	168	12.7	46.1	7.6	0.97	0.06
4/02	6	201	37.3	78.5	44.9	0.89	0.07
4/03	3	182	20.8	61.2	16.2	1.00	0.07
4/04	2	155	14.1	24.7	7.1	0.65	0.01
4/05	3	184	31.4	60.2	29.5	0.91	0.08
4/06	2	178	41.7	58.8	41.1	0.96	0.05
4/07	3	151	0.1	32.3	2.3	0.95	0.06
4/08	10	199	26.2	68.4	22.3	0.84	0.08
4/09	21	193	19.9	75.2	28.3	<b>1.01</b>	0.15
4/10	20	191	21.9	71.1	20.5	1.00	0.13
4/11	21	188	16.8	71.8	19.1	1.07	0.09
4/12	19	187	18.5	75.4	22.1	1.09	0.10
4/15	19	175	17.8	56.8	14.6	1.05	0.12
4/16	35	177	18.8	56.1	17.6	0.99	0.09
4/17	34	186	16.5	65.6	16.6	<b>1.00</b>	0.07
4/18	67	178	19.9	59.0	18.8	1.02	0.13
4/19	61	181	22.0	61.1	21.6	0.99	0.09
4/22	43	181	17.9	58.6	16.2	0.97	0.06
4/23	43	176	20.3	55.1	19.0	0.97	0.06

Table C. 3. (continued).

Date	Number Sampled	Mean Length	Standard Deviation	Mean Weight	Standard Deviation	Mean Condition	Standard Deviation
4/24	86	181	19.1	60.4	19.4	0.98	0.07
4/25	35	182	15.5	63.8	15.6	1.04	0.08
4/26	26	183	15.9	62.6	17.0	0.99	0.08
4/29	30	177	17.6	58.1	15.3	1.03	0.08
4/30	102	177	17.3	56.5	14.8	1.01	0.11
5/01	68	179	15.4	60.0	15.5	1.02	0.07
5/02	31	173	14.7	54.6	15.1	1.04	0.05
5/03	29	178	16.1	59.9	14.4	1.05	0.08
5/06	100	175	16.8	55.3	15.2	1.02	0.11
5/07	100	175	17.2	55.6	15.0	1.03	0.15
5/08	30	180	19.6	62.2	21.7	1.03	0.05
5/09	100	175	18.3	55.9	17.3	1.01	0.07
5/10	30	173	18.9	54.0	17.4	1.02	0.06
5/13	202	176	17.3	56.4	17.5	1.01	0.07
5/14	245	171	16.2	54.3	14.3	1.07	0.10
5/15	101	177	16.3	59.2	16.1	1.05	0.08
5/16	18	182	21.4	65.2	22.5	1.04	0.07
5/21	9	169	12.2	51.5	11.3	1.05	0.04
5/22	9	157	26.4	47.0	23.0	1.16	0.14
5/23	8	169	12.6	54.3	10.7	1.12	0.12
5/24	9	166	13.1	53.0	13.4	1.13	0.09
5/28	33	162	15.6	46.5	12.4	1.07	0.14
5/29	29	168	16.8	50.6	10.9	1.06	0.06
5/30	29	175	12.1	55.7	11.5	1.03	0.06
5/31	24	172	14.0	55.2	13.0	1.07	0.05
6/03	17	170	10.6	53.4	9.1	1.08	0.10
6/04	22	168	12.5	53.5	9.5	1.12	0.13
6/05	24	162	25.0	54.0	21.1	1.11	0.09
6/06	9	161	17.6	47.5	12.9	1.13	0.11
6/07	13	170	37.2	56.6	35.6	1.05	0.07
6/11	1	147	na	37.0	na	1.16	na
6/12	1	179	na	61.6	na	1.07	na
6/19	1	184	na	69.6	na	1.12	na

Table C.4. Mean daily length, weight, and condition factor of hatchery steelhead trout smolts sampled at the Imnaha River trap, April 19 - June 24, 1996 (na=information not available).

Date	Number Sampled	Mean Length	Standard Deviation	Mean Weight	Standard Deviation	Mean Condition	Standard Deviation
4/19	1	212	na	81.9	na	0.86	na
4/22	3	212	8.4	79.5	2.7	0.84	0.15
4/24	1	226	na	112.3	na	0.97	na
4/30	81	200	17.4	87.1	21.6	1.08	0.12
5/01	122	206	17.9	89.7	26.2	1.00	0.05
5/02	202	207	16.2	90.8	23.3	1.01	0.06
5/03	0	na	na	na	na	na	na
5/06	103	203	16.6	85.9	21.9	1.00	0.07
5/07	97	200	18.6	85.4	24.5	1.04	0.10
5/08	31	202	20.5	88.8	28.9	1.07	0.20
5/09	30	205	15.0	87.2	20.5	0.99	0.08
5/10	190	207	17.8	87.6	24.6	0.97	0.06
5/13	29	203	17.9	82.7	23.4	0.97	0.04
5/14	102	204	18.7	86.7	26.3	0.99	0.08
5/15	19	206	25.4	83.0	28.0	0.92	0.10
5/16	201	200	19.3	76.7	24.1	0.93	0.08
5/21	48	200	17.2	77.0	20.9	0.94	0.06
5/22	60	197	18.1	74.4	20.8	0.96	0.07
5/23	25	192	19.1	72.3	23.5	0.98	0.06
5/24	39	196	23.2	78.2	31.0	0.99	0.08
5/28	100	199	19.5	78.8	29.8	0.97	0.08
5/29	100	198	18.3	75.6	22.0	0.95	0.06
5/30	100	201	19.1	76.8	23.6	0.92	0.05
5/31	99	197	18.3	73.3	22.6	0.93	0.09
6/03	100	196	18.4	74.7	21.6	0.96	0.09
6/04	101	198	18.2	78.1	23.9	0.98	0.07
6/05	100	200	15.9	75.3	19.4	0.92	0.05
6/06	59	198	15.9	73.8	17.6	0.94	0.07
6/07	41	199	14.8	74.5	15.8	0.94	0.07
6/10	50	198	18.7	75.1	23.0	0.94	0.06
6/11	51	195	19.1	76.2	23.2	0.99	0.09
6/12	39	196	16.3	76.6	17.2	1.00	0.09
6/13	46	198	17.9	71.7	18.3	0.91	0.06
6/14	17	202	11.6	74.6	15.2	0.89	0.04
6/19	13	204	20.6	79.8	24.6	0.91	0.06
6/20	15	201	17.4	77.0	18.5	0.93	0.10
6/21	9	208	17.1	81.8	21.0	0.89	0.05
6/24	12	209	9.0	88.3	11.2	0.97	0.06

Table D.1. Composition of incidental fish species captured in the Imnaha River screw trap, February, 1996.

Date	Species										Total Catch	
	STHD	BT	MFW	SMB	CHSL	RSS	LND	NSF	BLS	SC		
23		1										
24												
25												
26												
27												
28												
29												
<b>Total</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>								

STHD	Adult steelhead trout	RSS	Redside shiner
BT	Bull trout	LND	Longnose dace
MWF	Mountain whitefish	NSF	Northern squawfish
SMB	Smallmouth bass	BLS	Bridgelip sucker
CHSL	Chiselmouth	SC	Sculpin

Table D.2. Composition of incidental fish species captured in the Imnaha River screw trap, March, 1996.

Date	Species										Total Catch
	STHD	BT	MFW	SMB	CHSL	RSS	LND	NSF	BLS	SC	
1										1	
2											
3			1								
4										1	
5											
6											
7											
a											
9											
10											
11											
12											
13								1	1		
14							1	1			
15							1			2	
16											
17											
1a											
19							1			1	
20							3				
21							1				
22							1				
23											
24											
25								2			
26										1	
27										1	
28		1								1	
29			1								
30											
31											
Total	0	1	2	0	0	0	a	4	1	a	0

STHD Adult steelhead trout  
 BT Bull trout  
 MFW Mountain whitefish  
 SMB Smallmouth bass  
 CHSL Chiselmouth

RSS Redside shiner  
 LND Longnose dace  
 NSF Northern squawfish  
 BLS Bridgelip sucker  
 SC Sculpin

Table D.3. Composition of incidental fish species captured in the Imnaha River screw trap, April, 1996.

Date	Species										Total Catch	
	STHD	BT	MFW	SMB	CHSL	RSS	LND	NSF	BLS	SC		
1						5						
2						11	1			1		
3						1						
4												
5			1			1						
6						3						
7						7						
8						2			1			
9			1									
10												
11									1			
12												
13												
14												
15								1				
16			1									
17									2			
18												
19	1											
20												
21												
22												
23			1									
24	1											
25												
26												
27												
28												
29									1			
30	1								1	1		
Total	3	1	3	0	0	0	30	2	7	2		0

STHD Adult steelhead trout  
 BT Bull trout  
 MFW Mountain whitefish  
 SMB Smallmouth bass  
 CHSL Chiselmouth

RSS Redside shiner  
 LND Longnose dace  
 NSF Northern squawfish  
 BLS Bridgelip sucker  
 SC Sculpin

Table D.4. Composition of incidental fish species captured in the Imnaha River screw trap, May, 1996.

Date	Species										Total Catch	
	STHD	BT	MFW	SMB	CHSL	RSS	LND	NSF	BLS	SC		
1												
2							1		1			
3											1	
4												
5												
6												
7	1											
8	1					1	1				1	
9			1				3				2	
10	1						1					
11												
12												
13												
14	2								2			
15							1	1				
16		1							1			
17												
18												
19												
20												
21									1			
22												
23												
24												
25												
26												
27												
28									1			
29	2						1		1			
30							2		1			
31	2											
<b>Total</b>	<b>9</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>10</b>	<b>1</b>	<b>8</b>	<b>4</b>	<b>0</b>	

STHD Adult steelhead trout  
 BT Bull trout  
 MFW Mountain whitefish  
 SMB Smallmouth bass  
 CHSL Chiselmouth

RSS Redside shiner  
 LND Longnose dace  
 NSF Northern squawfish  
 BLS Bridgelip sucker  
 SC Sculpin

Table D.5. Composition of incidental fish species captured in the Imnaha River screw trap, June, 1996.

Date	Species										Total Catch
	STHD	BT	MFW	SMB	CHSL	RSS	LND	NSF	BLS	SC	
1											
2											
3							1		4		
4							4		3		
5							3		2		
6							5		2		
7							9		1		
8											
9											
10							3		4		
11							11		5		
12	1						17		1		
13							5		3		
14		2					13	1	2		
15											
16											
17											
18											
19							2		19		
20						1	21		5		
21							31		5		
22											
23											
24									8		
25											
26											
27											
28											
29											
30											
<b>Total</b>	1	2	0	0	0	1	125	1	64	0	0

STHD Adult steelhead trout  
 BT Bull trout  
 MFW Mountain whitefish  
 SMB Smallmouth bass  
 CHSL Chiselmouth

RSS Redside shiner  
 LND Longnose dace  
 NSF Northern squawfish  
 BLS Bridgelip sucker  
 SC Sculpin

Table E.1. Summary of wild and hatchery chinook smolt PIT tag groups released at the Imnaha River screw trap, March 1 - June 11, 1996 (na = not available).

Release					Release		Mean	Mean
Date	Tag File	Species	Origin	Strategy	Number Released	Length	Weight	
3/01	PAK96061	.NPT CH	W	NPT	49	96	8.9	
3/05	PAK96065	.NPT CH	W	NPT	9	95	9.3	
3/08	PAK96068	.NT1 CH	W	NPT	2	90	7.9	
3/08	PAK96068	.NT2 CH	W	NPT	3	95	8.8	
3/08	PAK96068	.NT3 CH	W	NPT	4	95	9.5	
3/1 2	PAK96072	.NT1 C H	W	NPT	11	93	8.2	
3/12	PAK96072	.NT2 CH	W	NPT	7	97	10.9	
3/14	PAK96074	.NT1 CH	W	NPT	13	94	9.1	
3/14	PAK96074	.NT2 CH	W	NPT	11	93	9.1	
3/15	PAK96075	.NPT C H	W	NPT	15	99	10.0	
3/1 9	PAK96079	.NT1 C H	W	NPT	8	91	8.7	
3/1 9	PAK96079	.NT2 C H	W	NPT	19	97	9.4	
3/20	PAK96080	.NPT CH	W	NPT	14	99	10.6	
3/21	PAK96081	.NPT CH	W	NPT	21	96	9.6	
3/22	PAK96082	.NPT CH	W	NPT	17	102	11.3	
3/26	PAK96086	.NT1 CH	W	NPT	24	96	9.1	
3/26	PAK96086	.NT2 CH	W	NPT	24	99	9.9	
3/27	PAK96087	.NPT CH	W	NPT	21	97	10.0	
3/27	PAK96089	.NT1 CH	W	NPT	17	105	11.1	
3/29	PAK96089	.NT2 CH	W	NPT	24	102	10.0	
4/02	PAK96093	.NT1 CH	W	NPT	2	98	9.6	
4/02	PAK96093	.NT2 CH	W	NPT	19	105	11.7	
4/03	PAK96094	.NT1 CH	W	NPT	24	101	na	
4/04	PAK96095	.NT1 CH	W	NPT	43	97	8.6	
4/05	PAK96095	.NT2 CH	W	NPT	12	87	9.4	
4/05	PAK96096	.NT1 CH	W	NPT	24	99	9.7	
4/07	PAK96098	.NT1 CH	W	NPT	28	99	10.5	
4/07	PAK96098	.NT2 CH	W	NPT	12	101	11.0	
4/08	PAK96099	.NT1 CH	W	NPT	23	102	12.3	
4/10	PAK96101	.NT1 CH	W	NPT	20	102	12.0	
4/11	PAK96102	.NT1 CH	W	NPT	6	102	12.6	
4/12	PAK96103	.NT1 C H	W	NPT	7	104	12.8	
4/15	PAK96106	.NT1 C H	W	NPT	17	103	11.1	
4/16	PAK96107	.NT1 CH	W	NPT	25	101	11.8	
4/17	PAK96108	.NT1 C H	W	NPT	28	101	12.2	
4/1 8	PAK96109	.NT1 C H	W	NPT	47	101	11.7	

Table E.1. (continued).

Release Date	Tag File	Species	Origin	Release Strategy	Number Released	Mean Length	Mean Weight
4/19	PAK96110.NT1	CH	w	NPT	81	100	11.2
4/22	PAK96113.NT1	CH	w	NPT	29	105	12.9
4/23	PAK96114.NT1	CH	w	NPT	44	108	13.3
4/25	PAK96116.NT1	CH	W	NPT	8	113	14.9
4/26	PAK96117.NT1	CH	W	NPT	6	106	12.8
4/29	PAK96120.NT1	CH	W	NPT	22	99	11.8
4/30	PAK96121 .NT1	CH	W	NPT	59	102	12.4
5/01	PAK96122.NT1	CH	W	NPT	46	104	12.4
5/02	PAK96123.NT1	CH	W	NPT	68	101	12.5
5/03	PAK96124.NT1	CH	W	NPT	5	109	15.3
5/06	PAK96127.NT1	CH	W	NPT	80	102	12.4
5/08	PAK96128.NT1	CH	W	NPT	56	105	12.9
5/08	PAK96129.NT1	CH	W	NPT	41	103	11.8
5/09	PAK96130.NT1	CH	W	NPT	8	104	12.4
5/10	PAK96131 .NT1	C H	W	NPT	31	106	12.2
5/13	PAK96134.NT2	C H	W	NPT	23	101	12.4
5/14	PAK96135.NT2	CH	W	NPT	11	99	11.6
5/15	PAK96136.NT1	C H	W	NPT	9	97	11.1
5/22	PAK96143.NT1	CH	W	NPT	2	97	10.9
5/23	PAK96144.NT1	CH	W	NPT	1	104	14.7
5/24	PAK96145.NT1	CH	W	NPT	2	104	15.0
5/28	PAK96149.NT1	CH	W	NPT	2	98	12.2
5/29	PAK96150.NT1	CH	W	NPT	4	103	12.9
5/30	PAK96151 .NT1	CH	W	NPT	8	100	12.1
5/31	PAK96152.NT1	CH	W	NPT	8	100	12.1
6/03	PAK96155.NT2	CH	W	NPT	3	95	12.3
6/04	PAK96156.NT2	CH	W	NPT	3	93	11.9
6/11	PAK96163.NT2	C H	W	NPT	1	100	12.9
<b>TOTAL</b>		<b>CH</b>	<b>W</b>		<b>1,311</b>		

Table E.1. (continued).

Release Date	Tag File	Species	Origin	Release Strategy	Number Released	Mean Length	Mean Weight
4/03	PAK96094.NT1	CH	H	NPT	30	133	na
4/05	PAK96096.NT1	CH	H	NPT	200	132	26.5
4/10	PAK96101.NT1	C H	H	NPT	90	131	25.4
4/11	PAK96102.NT1	C H	H	NPT	38	130	27.2
4/12	PAK96103.NT1	CH	H	NPT	47	132	27.1
4/15	PAK96106.NT1	CH	H	NPT	32	132	26.6
4/16	PAK96107.NT1	C H	H	NPT	20	133	25.9
4/19	PAK96110.NT1	CH	H	NPT	76	131	26.1
4/22	PAK96113.NT1	CH	H	NPT	23	131	24.6
4/23	PAK96114.NT1	CH	H	NPT	7	135	25.9
4/26	PAK96117.NT1	CH	H	NPT	2	140	33.2
4/29	PAK96120.NT1	CH	H	NPT	4	127	22.2
4/30	PAK96121.NT1	CH	H	NPT	9	136	28.7
5/01	PAK96122.NT1	C H	H	NPT	11	135	27.7
5/02	PAK96123.NT1	CH	H	NPT	15	131	25.6
5/03	PAK96124.NT1	CH	H	NPT	33	133	28.0
5/06	PAK96127.NT1	CH	H	NPT	12	130	25.2
5/07	PAK96128.NT1	CH	H	NPT	16	133	24.8
5/08	PAK96129.NT1	CH	H	NPT	7	140	30.5
5/10	PAK96131.NT1	C H	H	NPT	15	141	28.9
5/13	PAK96134.NT2	C H	H	NPT	5	134	30.3
5/14	PAK96135.NT2	CH	H	NPT	3	132	27.4
5/15	PAK96136.NT1	CH	H	NPT	2	125	24.6
6/03	PAK96151.NT1	CH	H	NPT	1	137	29.6
SUBTOTAL					698		
4/03	PAK96094.NT1	C H	U	NPT	9	113	na
SUBTOTAL					9		
TOTAL		CH	All		2,018		

Table E.2 Summary of wild and hatchery steelhead trout smolt PIT tag groups released at the Imnaha River screw trap April 16 - June 24, 1996.

Release Date	Tagfile	Species	Origin	Release Strategy	Number Released	Mean Length	Mean Weight
4/16	PAK96 107.FP1	RBT	W	NPT	35	177	56.1
4/17	PAK96108.FP1	R B T	W	NPT	34	186	65.6
4/18	PAK96109.FP1	R B T	W	NPT	67	178	59.0
4/19	PAK9611 0.FP1	RBT	W	NPT	61	181	61.1
4/22	PAK96113.FP1	R B T	W	NPT	43	181	58.6
4/23	PAK96114.FP1	R B T	W	NPT	44	176	55.1
4/24	PAK96115.FP1	R B T	W	NPT	85	181	59.8
4/25	PAK96116.FP1	R B T	W	NPT	34	182	63.8
4/26	PAK96117.FP1	R B T	W	NPT	26	183	62.6
4/30	PAK96121 .FP1	RBT	W	NPT	100	176	56.5
5101	PAK96122.FP1	R B T	W	NPT	68	179	60.0
5/02	PAK96123.FP1	R B T	W	NPT	31	173	54.6
5/06	PAK96127.FP1	R B T	W	NPT	100	175	55.3
5106	PAK96128.FP1	R B T	W	NPT	100	175	55.6
5/13	PAK96134.FP1	R B T	W	NPT	52	174	55.2
5/13	PAK96134.NT1	R B T	W	NPT	149	176	59.9
5/14	PAK96135.FP1	R B T	W	NPT	101	172	54.7
5/14	PAK96135.NT1	R B T	W	NPT	144	170	54.6
5/21	PAK96142.FP1	R B T	W	NPT	9	169	51.5
5/22	PAK96143.FP1	R B T	W	NPT	8	162	49.6
5/23	PAK96144.FP1	R B T	W	NPT	8	169	54.3
5/24	PAK96145.FP1	R B T	W	NPT	9	166	53.0
5/28	PAK96149.FP1	R B T	W	NPT	33	162	46.5
5/29	PAK96150.FP1	R B T	W	NPT	29	168	50.6
5/30	PAK96151 .FP1	RBT	W	NPT	28	175	55.6
5/31	PAK96152.FP1	R B T	W	NPT	24	172	55.2
6/03	PAK96155.NT1	R B T	W	NPT	17	170	53.4
6/04	PAK96156.NT1	R B T	W	NPT	22	168	53.5
6/05	PAK96157.NT1	R B T	W	NPT	22	167	54.0
6/06	PAK96158.NT1	R B T	W	NPT	9	161	47.5
6/07	PAK96159.NT1	R B T	W	NPT	9	175	57.7
6/11	PAK96163.NT1	R B T	W	NPT	1	147	37.0
6/12	PAK96164.NT1	R B T	W	NPT	1	179	61.6
6/19	PAK96171 .NTI	RBT	W	NPT	1	184	69.6
<b>SUBTOTAL</b>					<b>1.504</b>		

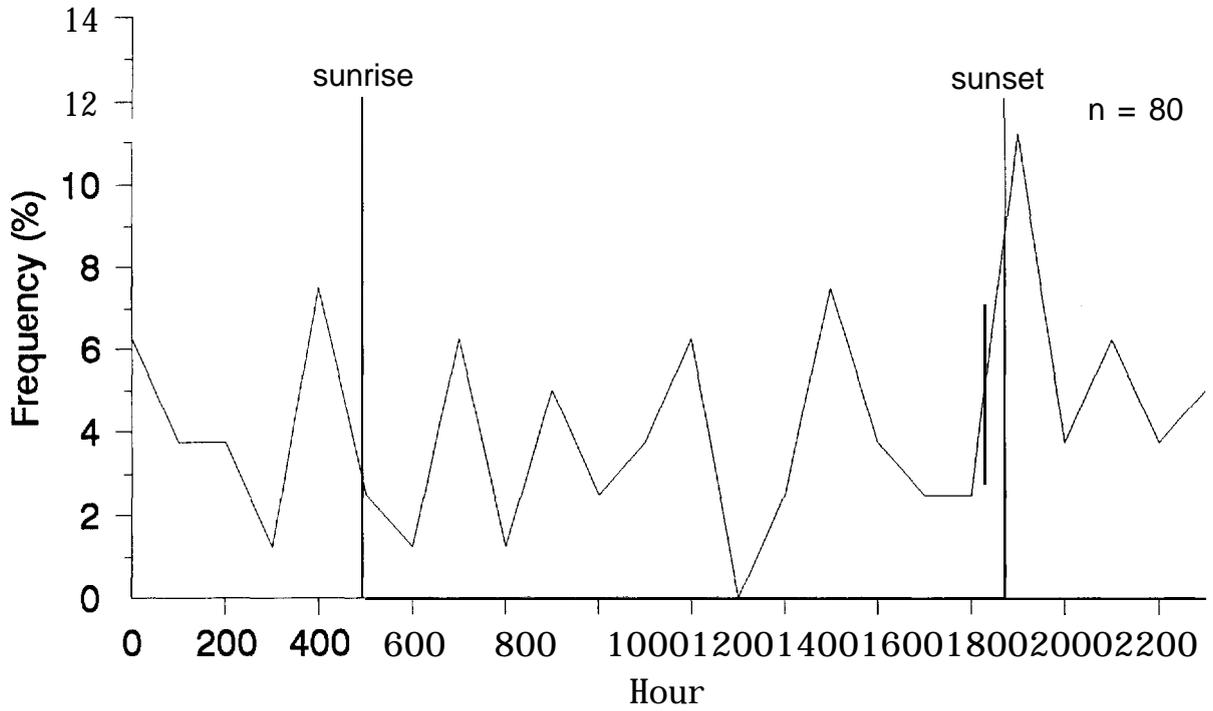
Table E.2. (continued).

Release Date	Tagfile	Species	Origin	Release Strategy	Number Released	Mean Length	Mean Weight
4/19	PAK96110.FP1	RBT	H	NPT	1	212	81.9
4/22	PAK96113.FP1	RBT	H	NPT	3	212	79.5
4/24	PAK96115.FP1	RBT	H	NPT	1	226	112.3
4/30	PAK96121.FP1	RBT	H	NPT	80	200	87.1
5/01	PAK96122.FP1	RBT	H	NPT	122	206	89.7
5/06	PAK96127.FP1	RBT	H	NPT	103	203	85.9
5/06	PAK96128.FP1	RBT	H	NPT	96	200	85.5
5/13	PAK96134.FP1	RBT	H	NPT	28	203	82.6
5/14	PAK96135.FP1	RBT	H	NPT	100	204	86.7
5/21	PAK96142.FP1	RBT	H	NPT	48	200	77.0
5/22	PAK96143.FP1	RBT	H	NPT	59	196	74.4
5/23	PAK96144.FP1	RBT	H	NPT	24	192	71.1
5/24	PAK96145.FP1	RBT	H	NPT	39	196	78.2
5/28	PAK96149.FP1	RBT	H	NPT	99	199	78.8
5/29	PAK96150.FP1	RBT	H	NPT	100	198	75.6
6/03	PAK96155.NT1	RBT	H	NPT	100	196	74.7
6/04	PAK96156.NT1	RBT	H	NPT	98	198	78.0
6/10	PAK96162.NT1	RBT	H	NPT	49	198	75.6
6/11	PAK96163.NT1	RBT	H	NPT	51	195	76.2
6/12	PAK96164.NT1	RBT	H	NPT	37	196	76.5
6/13	PAK96165.NT1	RBT	H	NPT	45	198	72.0
6/14	PAK96166.NT1	RBT	H	NPT	14	203	75.3
6/19	PAK96171.NT1	RBT	H	NPT	13	204	79.8
6/20	PAK96172.NT1	RBT	H	NPT	15	201	77.0
6/21	PAK96173.NT1	RBT	H	NPT	9	208	81.8
6/24	PAK96176.NT1	RBT	H	NPT	12	209	88.3
SUBTOTAL					1,346		
TOTAL		RBT Wand H			2,849		

Table F. Releases of hatchery chinook salmon and steelhead trout smolts by ODFW in the Imnaha River, 1996.

Date	Species	Origin	Number Released	Fin Mark	Release Strategy	Location
04/02/96	C H	H	91,240	Ad+CWT	ACC	Imnaha Acclimation Pond (RK 74.0)
		<u>Total</u>	<u>91,240</u>			
04/29/96	RBT	H	195,536	Ad	ACC	Little Sheep Acclimation Pond (RK 8.0)
			36,371	AdLV		
			9,105	AdLV + LA-A-2 brand		
			9,423	AdLV + RA-A-2 brand		
			8,570	RA-A2 brand only		
			<u>9,532</u>	LA-A-2 brand only		
		subtotal	268,537			
04/29/96	RBT	H	17,307	AdLV + brand	DSR	Little Sheep Creek
			<u>36,259</u>	AdLV		
04/29/96	RBT	H			DSR	Little Sheep Acclimation Pond (RK 8.0)
		<u>Total</u>	<u>322,103</u>			

**LOWER GRANITE DAM  
APRIL 14-20**



**LOWER GRANITE DAM  
APRIL 21-27**

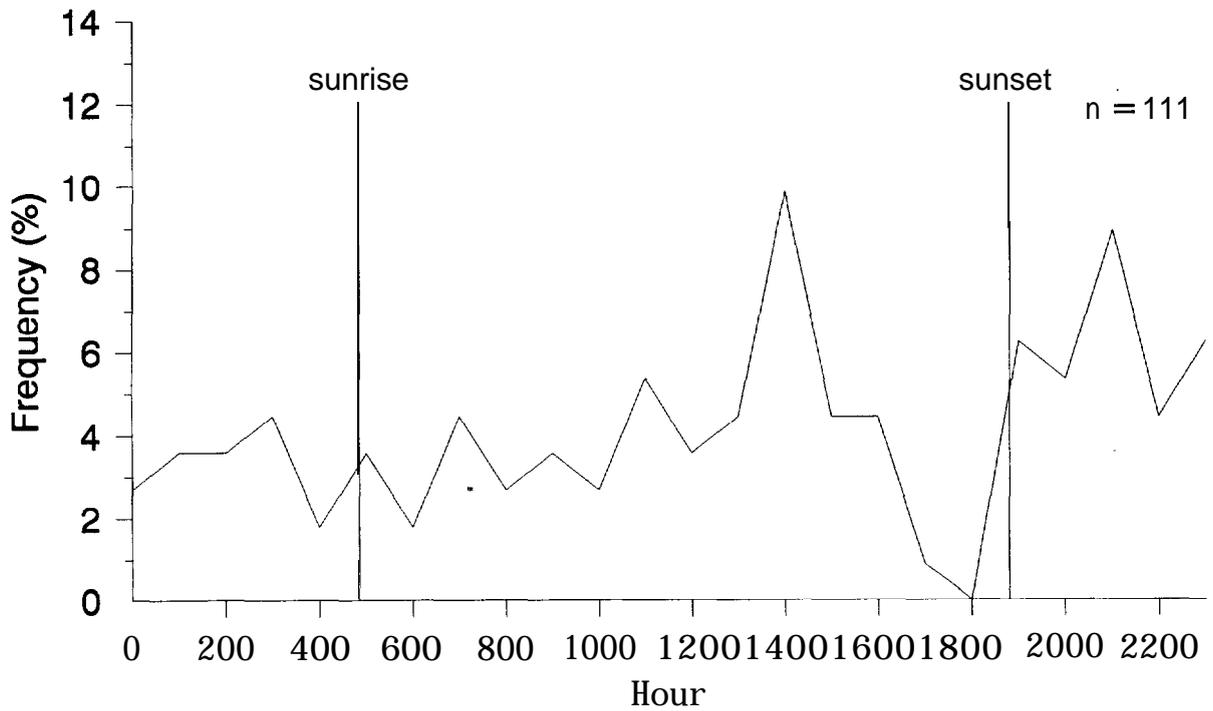
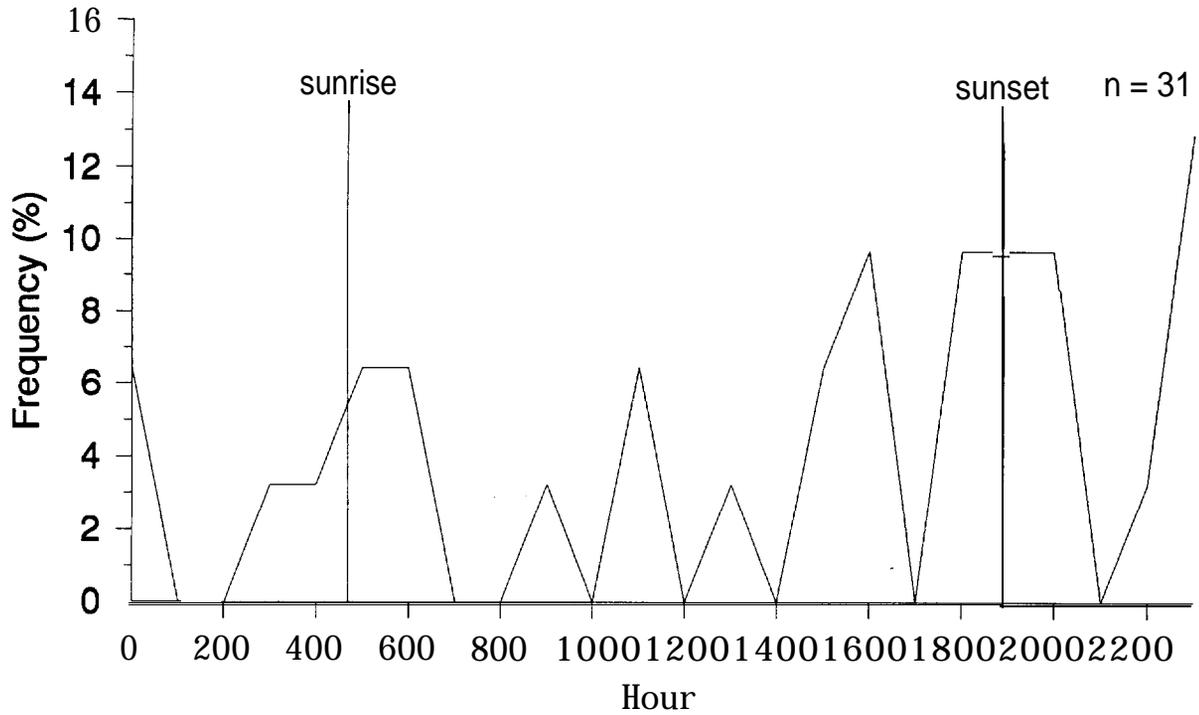


Figure G. 1. Average weekly diel passage of PIT tagged Imnaha River wild chinook salmon smolts at Lower Granite Dam during the weeks of April 14-20 (upper) and April 21-27, 1996 (lower).

**LOWER GRANITE DAM  
APRIL 28-MAY 4**



**LOWER GRANITE DAM  
MAY 12-18**

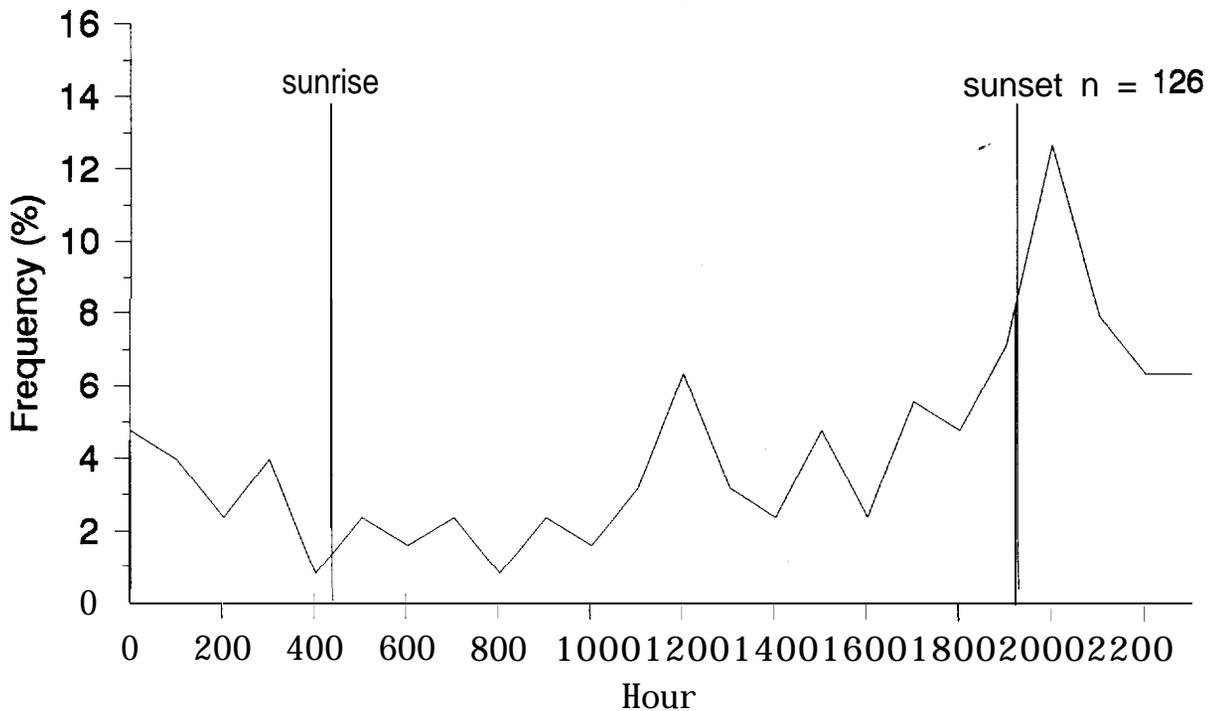


Figure G.2. Average weekly diel passage of PIT tagged Imnaha River wild chinook salmon smolts at Lower Granite Dam during the weeks of April 28-May 4 (upper) and May 12-18, 1996 (lower).

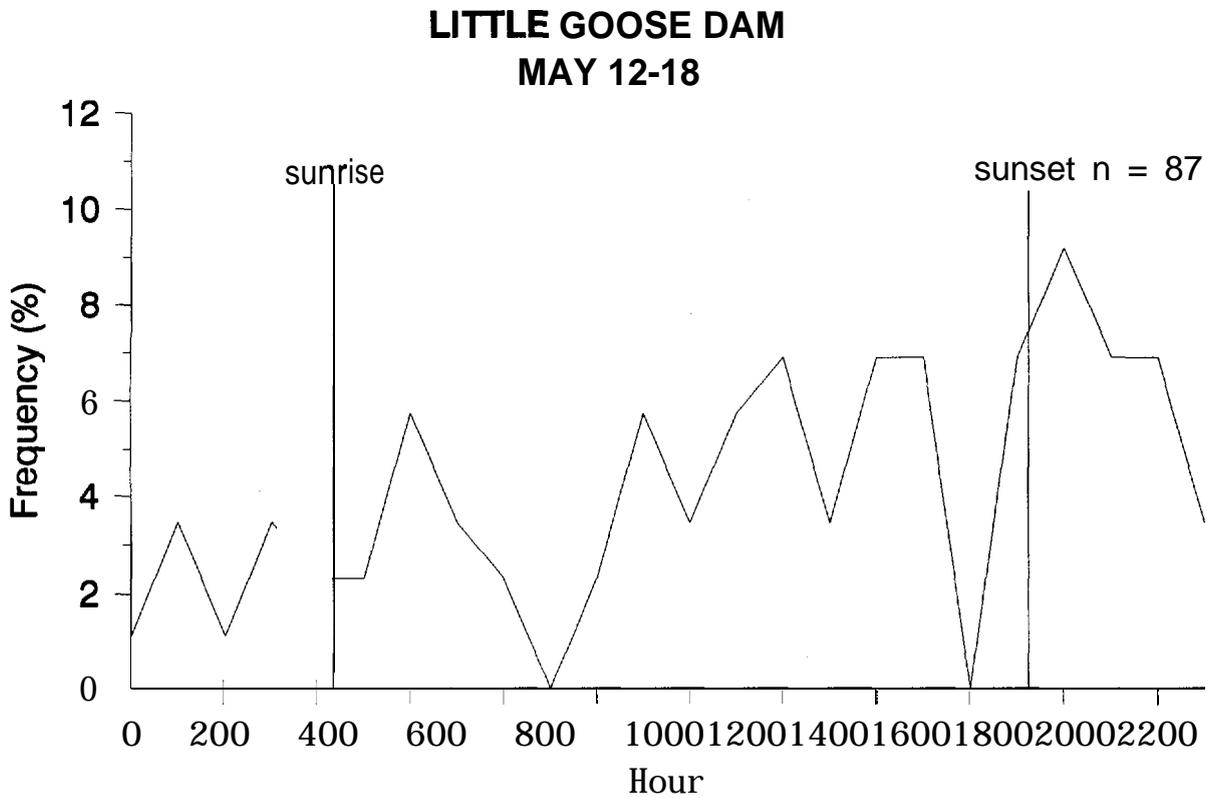
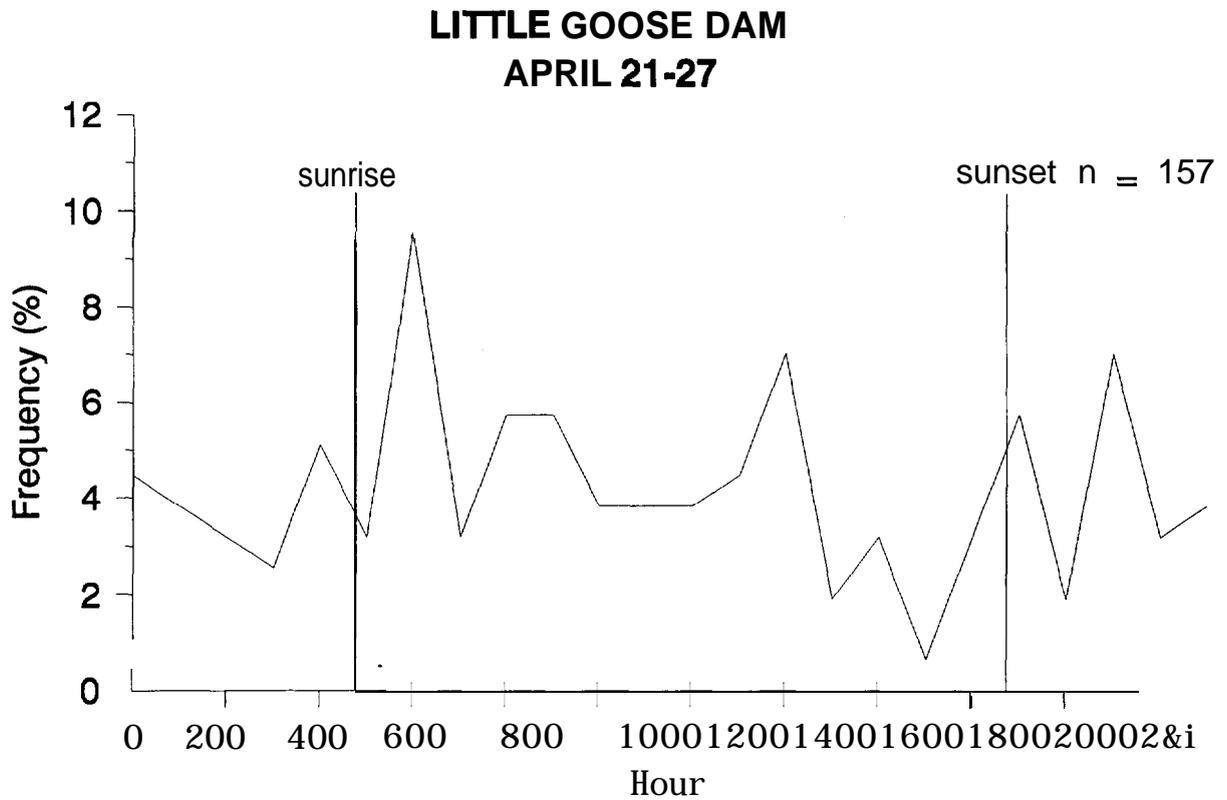


Figure G.3. Average weekly diel passage of PIT tagged Imnaha River wild chinook salmon smolts at Little Goose Dam during the weeks of April 21-27 (upper) and May 12-18, 1996 (lower).

**LITTLE GOOSE DAM  
MAY 19-25**

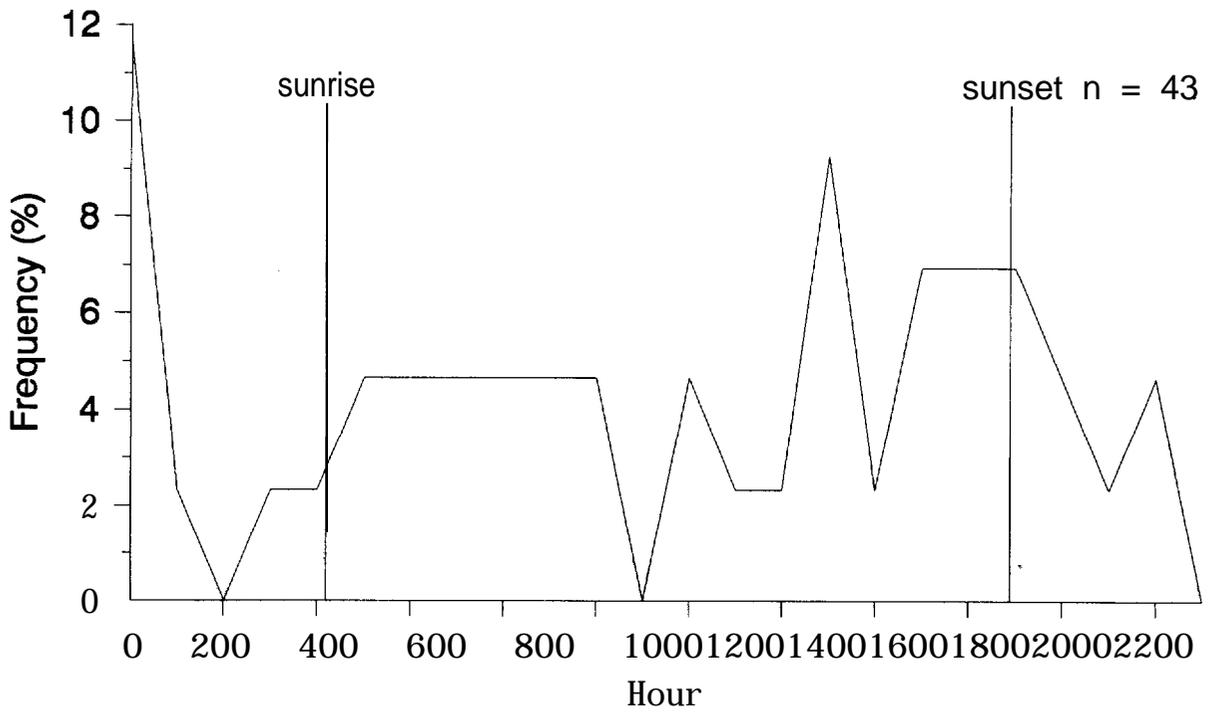
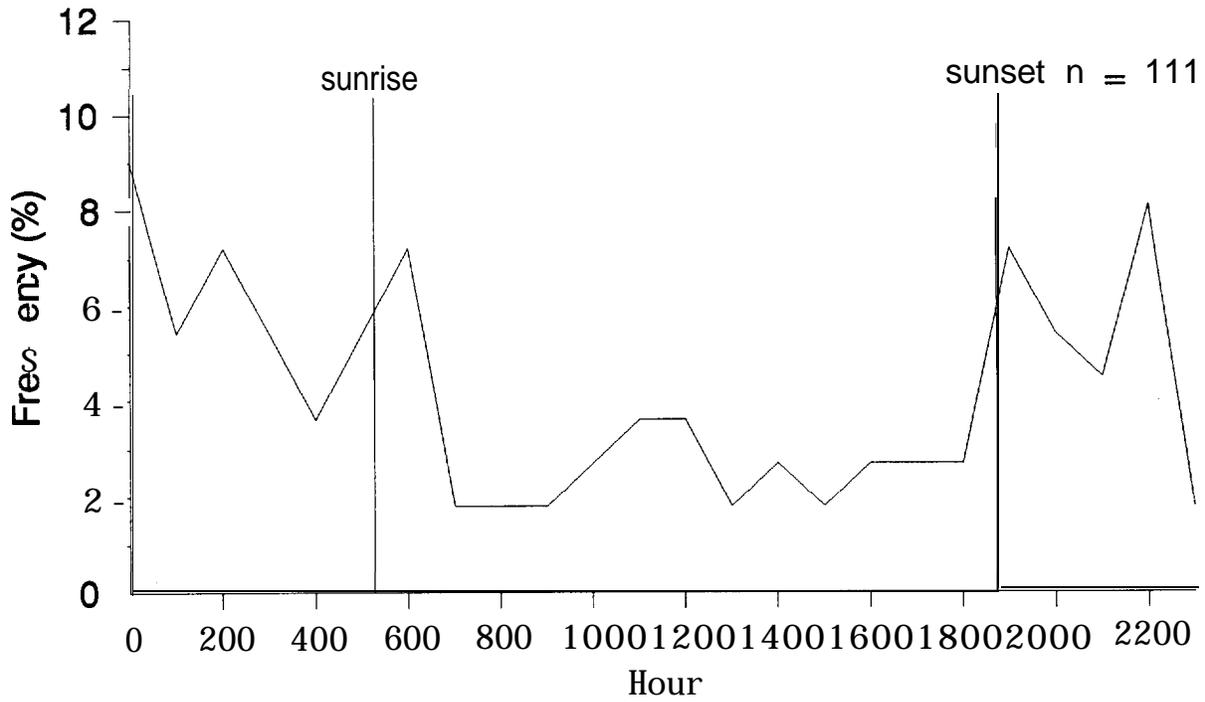


Figure G.4. Average weekly diel passage of PIT tagged Imnaha River wild chinook salmon smolts at Little Goose Dam during the week of May 19-25, 1996.

**LOWER MONUMENTAL DAM  
APRIL 21-27**



**LOWER MONUMENTAL DAM  
MAY 12-18**

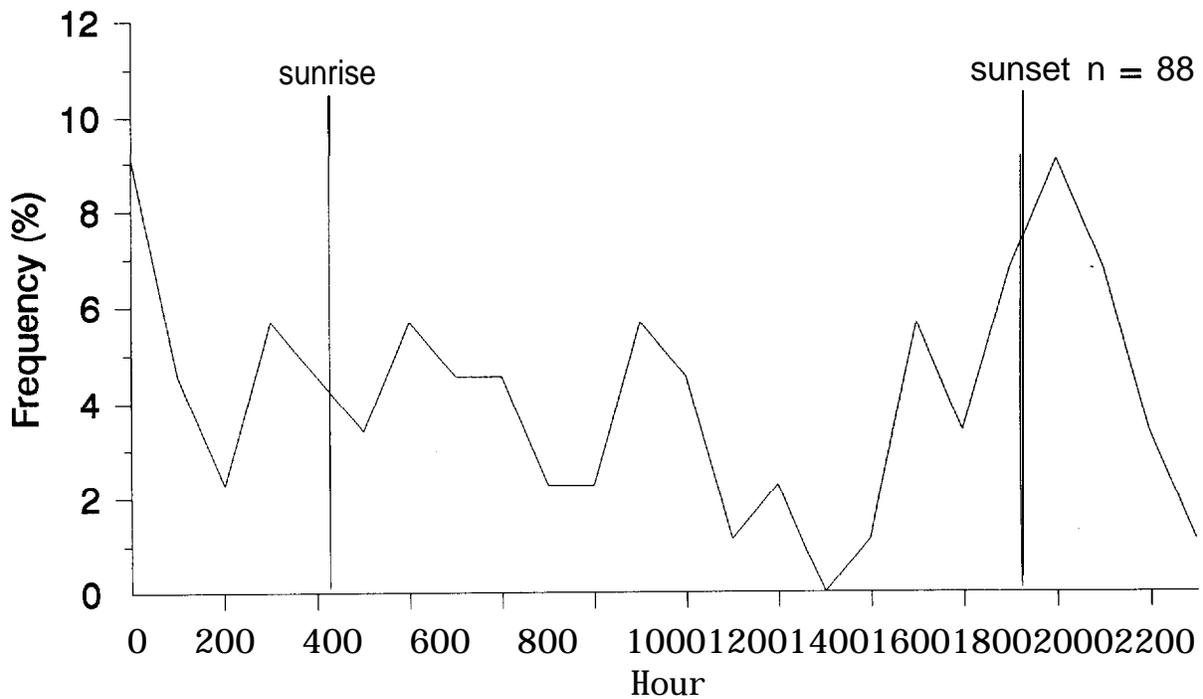


Figure G.5. Average weekly diel passage of PIT tagged Imnaha River wild chinook salmon smolts at Lower Monumental Dam during the weeks of April 21-27 (upper) and May 12-18, 1996 (lower).

**LOWER MONUMENTAL DAM  
MAY 19-25**

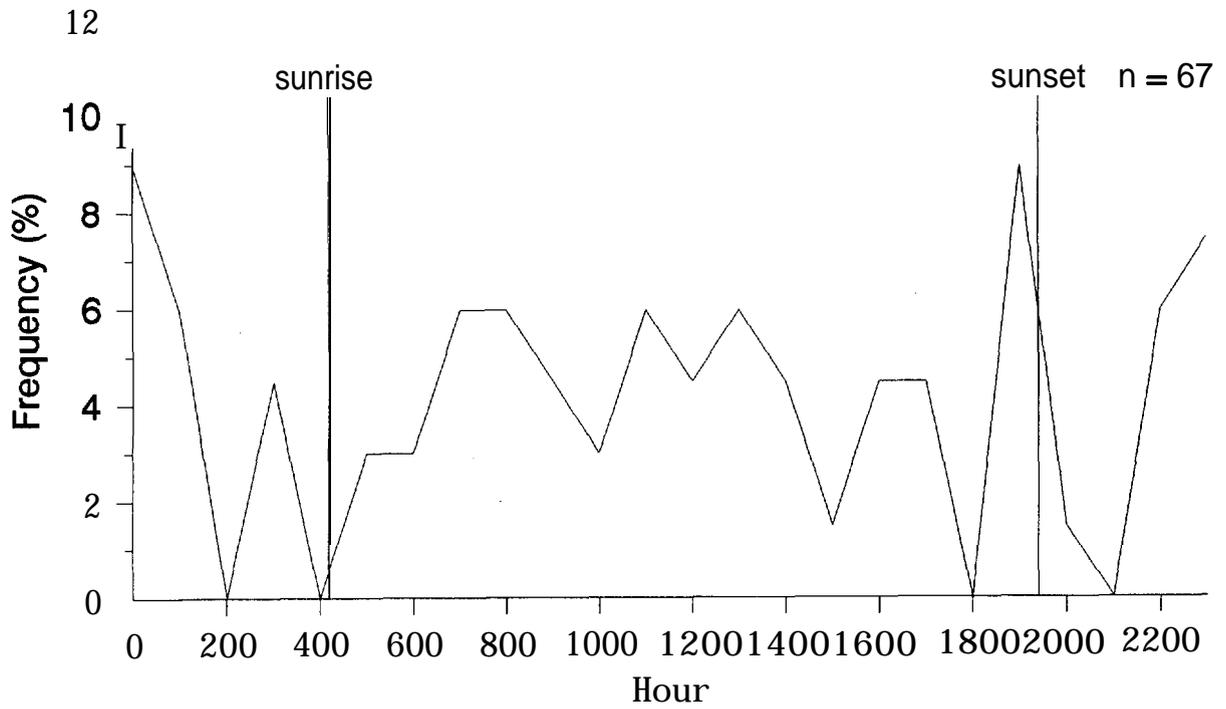
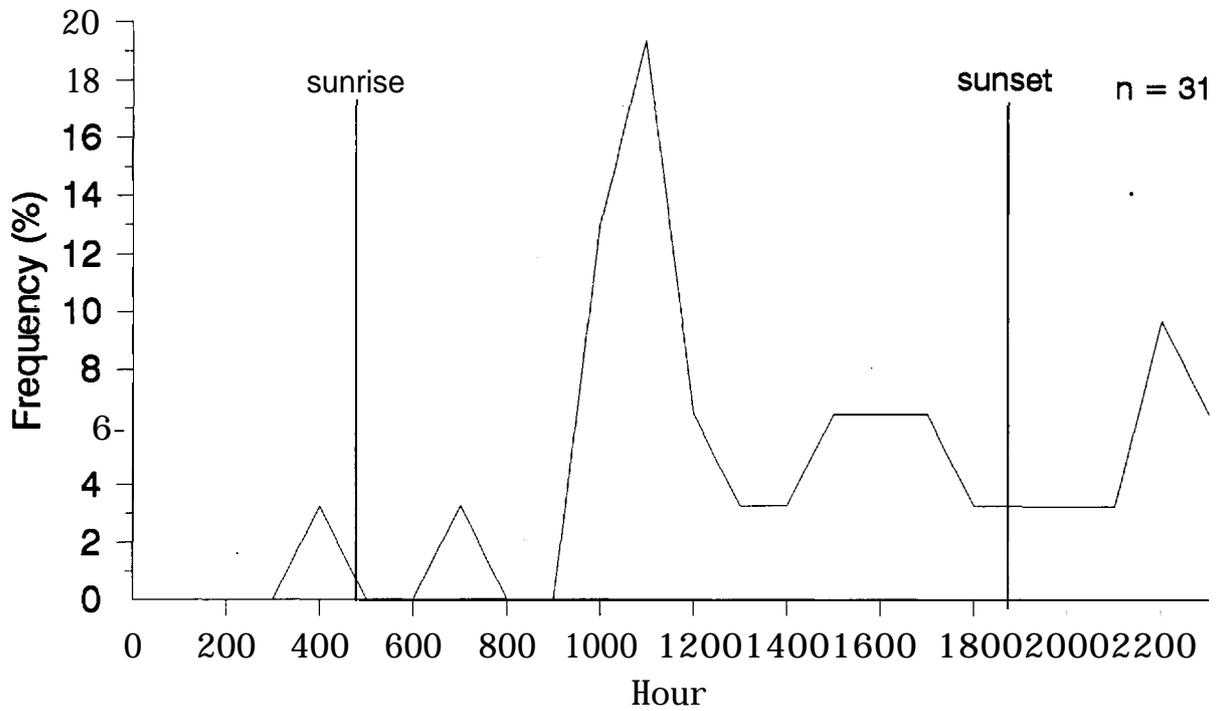


Figure G.6, Average weekly diel passage of PIT tagged Imnaha River wild chinook salmon smolts at Lower Monumental Dam during the week of May 19-25, 1996.

**MCNARY DAM  
APRIL 21-27**



**MCNARY DAM  
MAY 19-25**

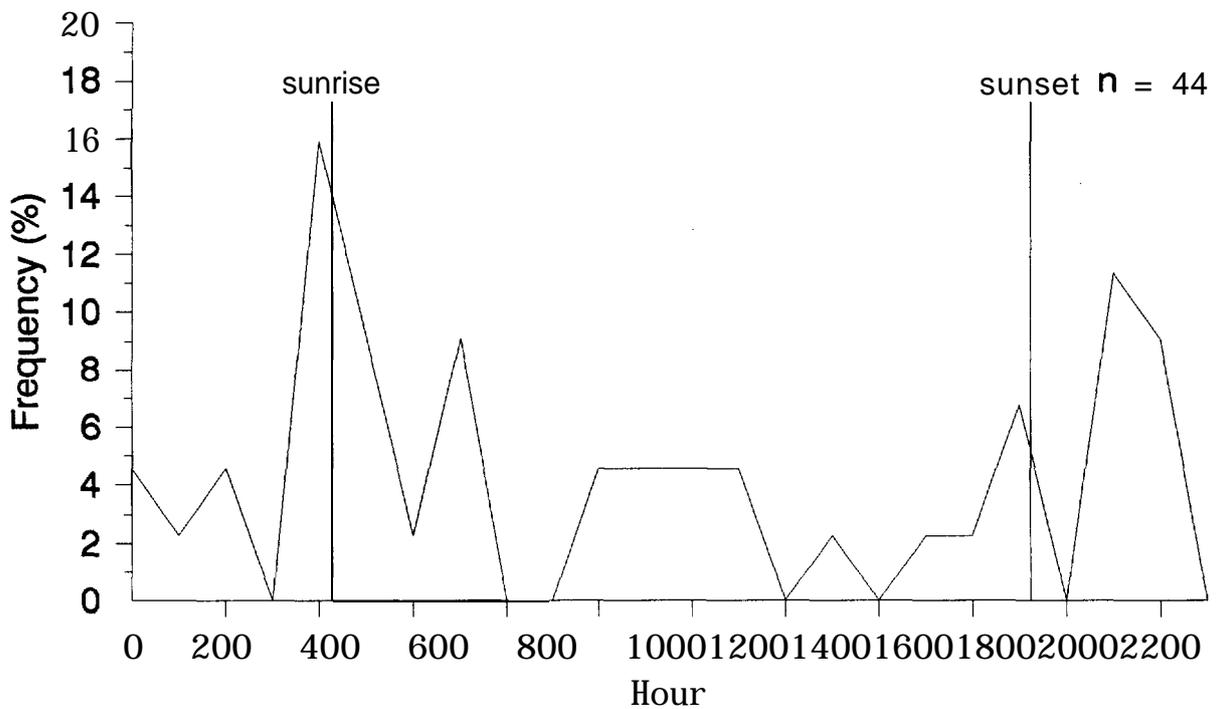
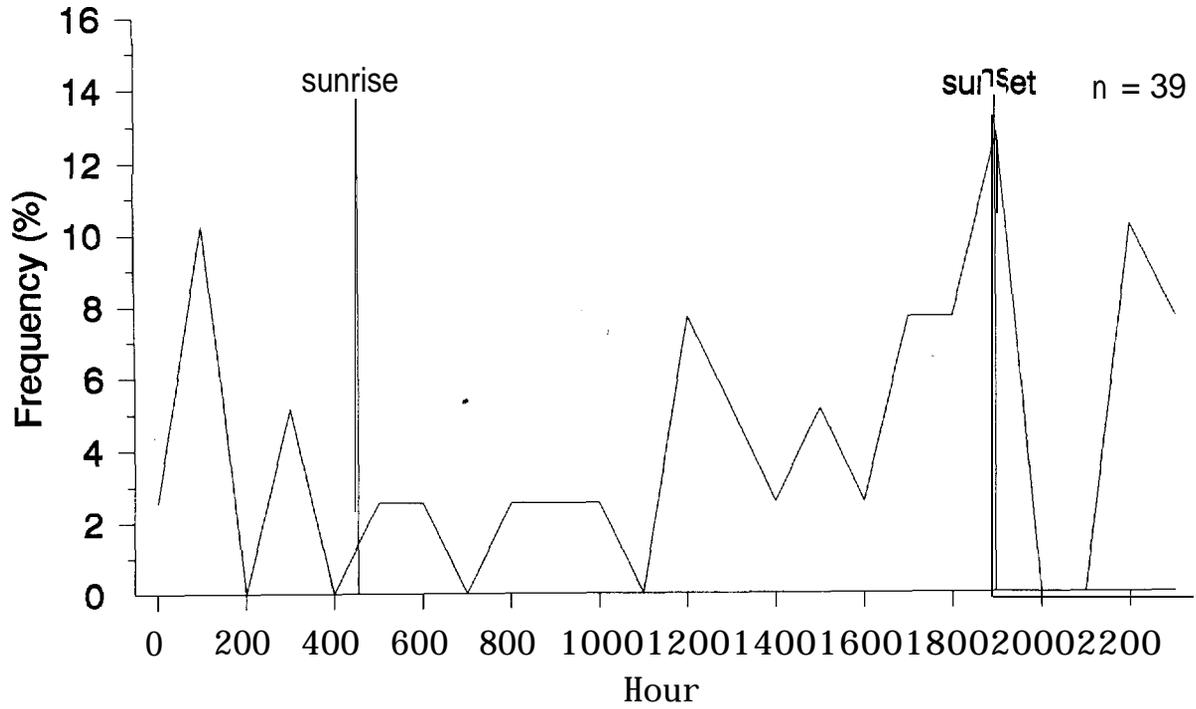


Figure G.7. Average weekly diel passage of PIT tagged Imnaha River wild chinook salmon smolts at McNary Dam during the weeks of April 21-27 (upper) and May 19-25, 1996 (lower).

**LOWER GRANITE DAM  
APRIL 28-MAY 4**



**LOWER GRANITE DAM  
MAY 5-11**

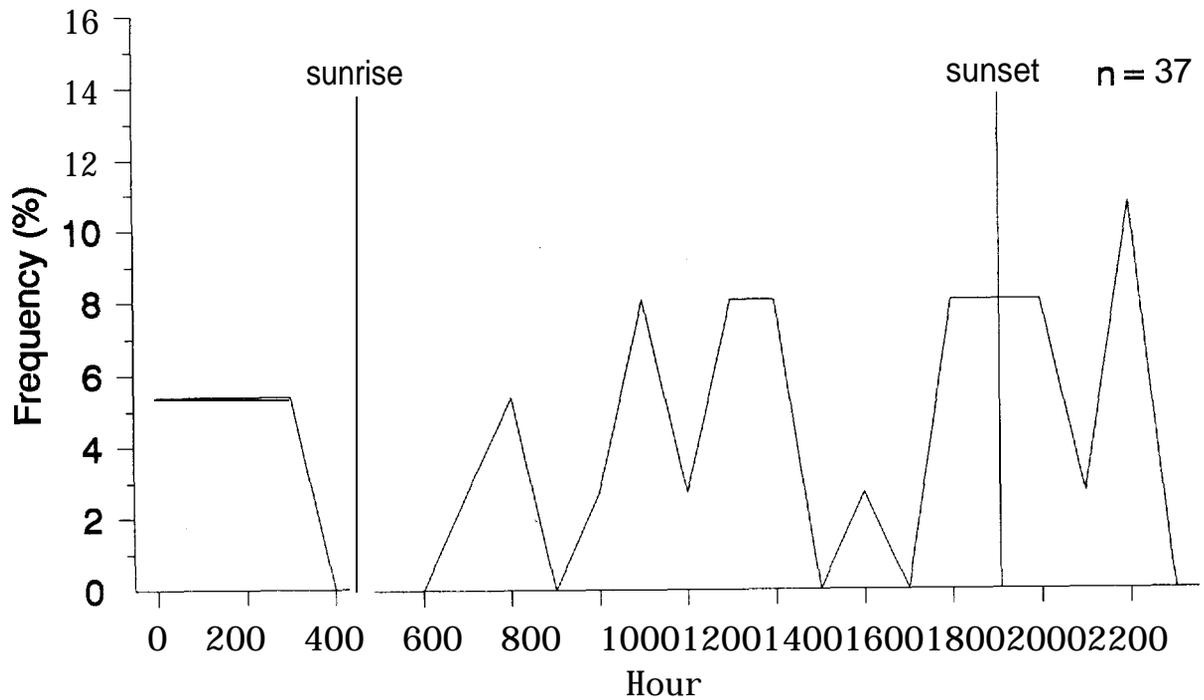


Figure G.8. Average weekly diel passage of PIT tagged Imnaha River hatchery chinook salmon smolts at Lower Granite Dam during the weeks of April 28-May 4 (upper) and May 5-11, 1996 (lower).

**LOWER GRANITE DAM  
MAY 12-18**

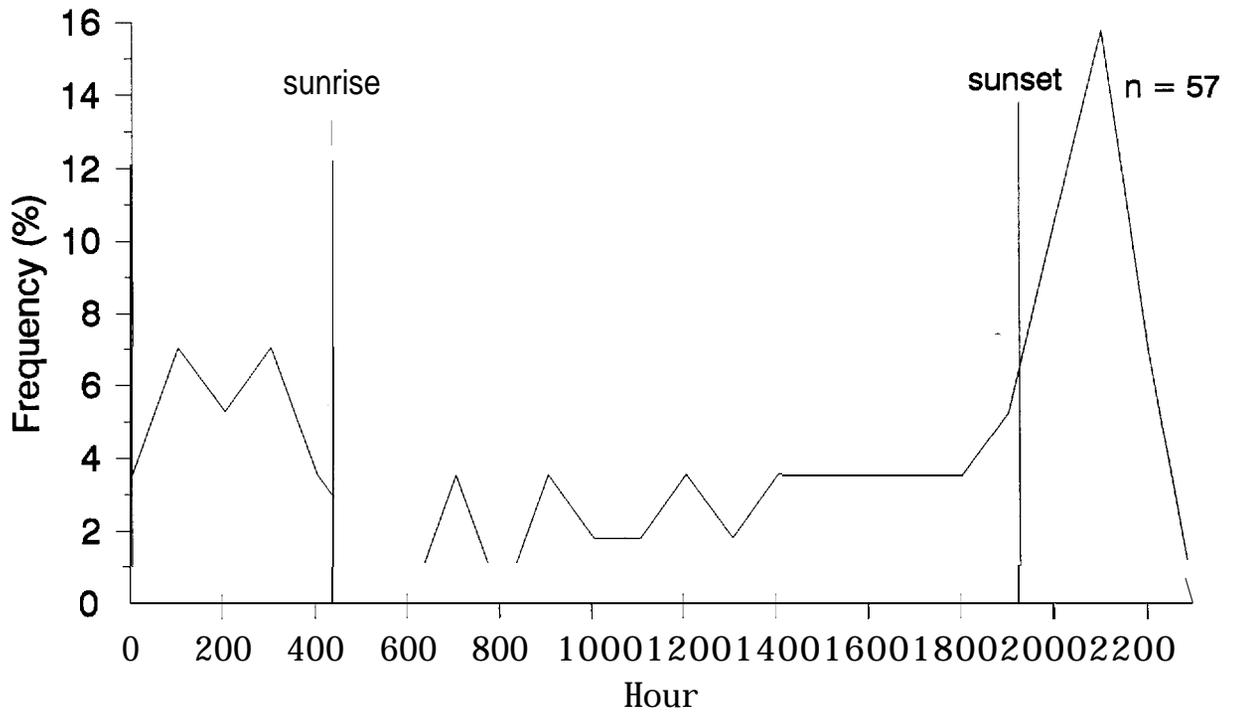


Figure G.9. Average weekly diel passage of PIT tagged Imnaha River hatchery chinook salmon smolts at Lower Granite Dam during the week of May 12-18, 1996.

### LITTLE GOOSE DAM MAY 12-18

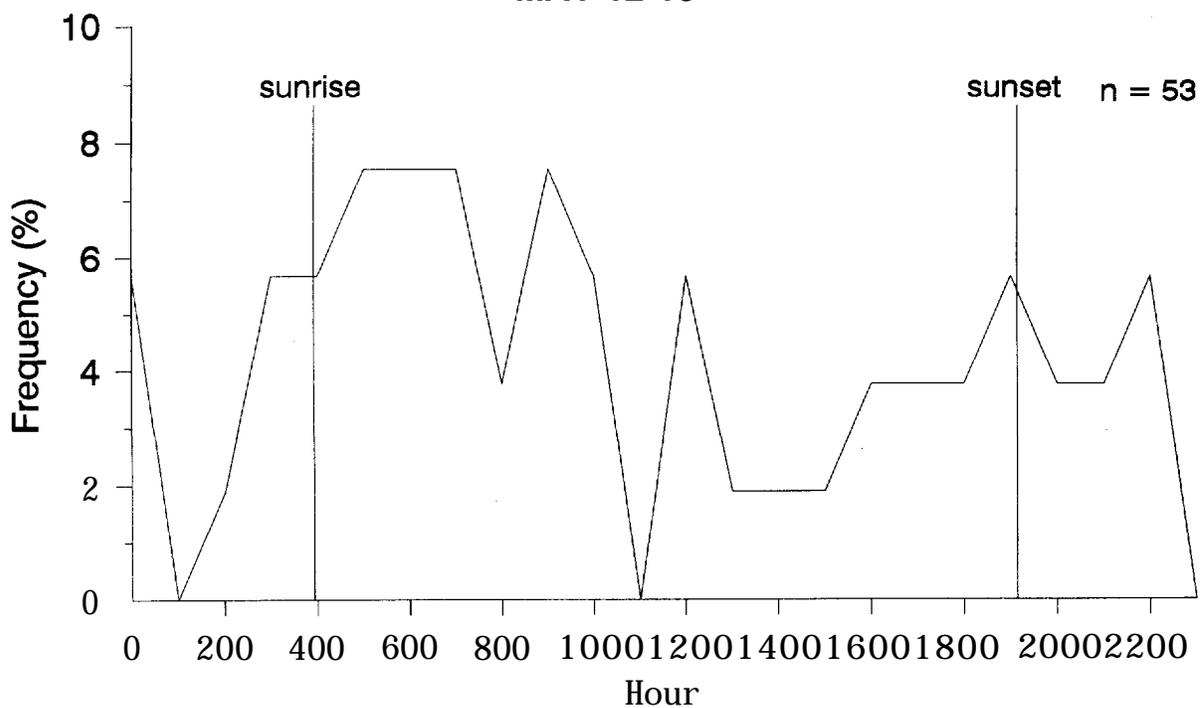
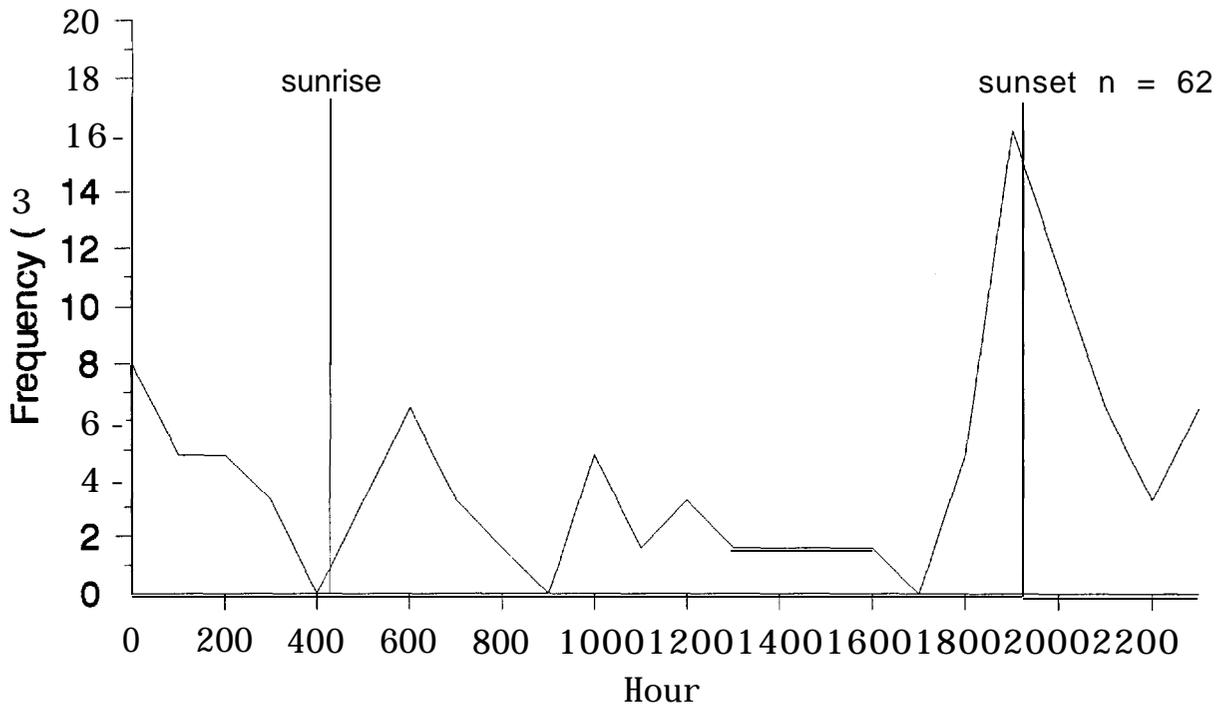


Figure G. 10. Average weekly diel passage of PIT tagged Imnaha River hatchery chinook salmon smolts at Little Goose Dam during the week of May 12-18, 1996.

**LOWER MONUMENTAL DAM  
MAY 12-18**



**LOWER MONUMENTAL DAM  
MAY 19-25**

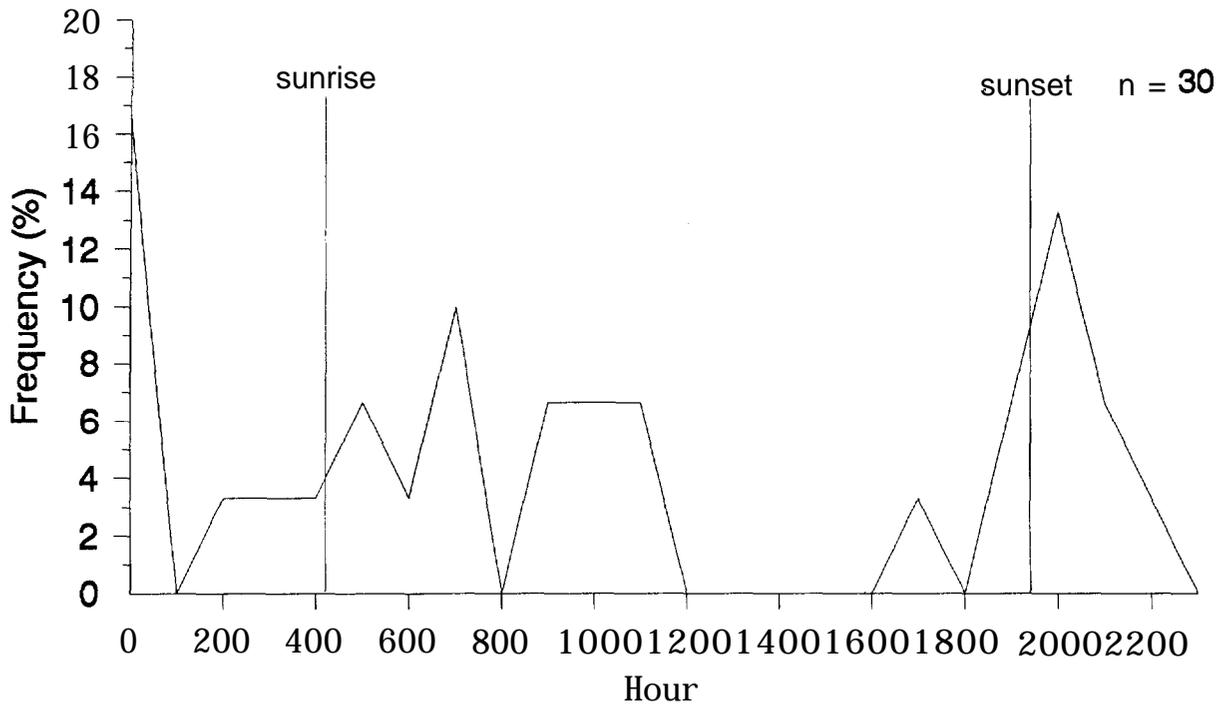
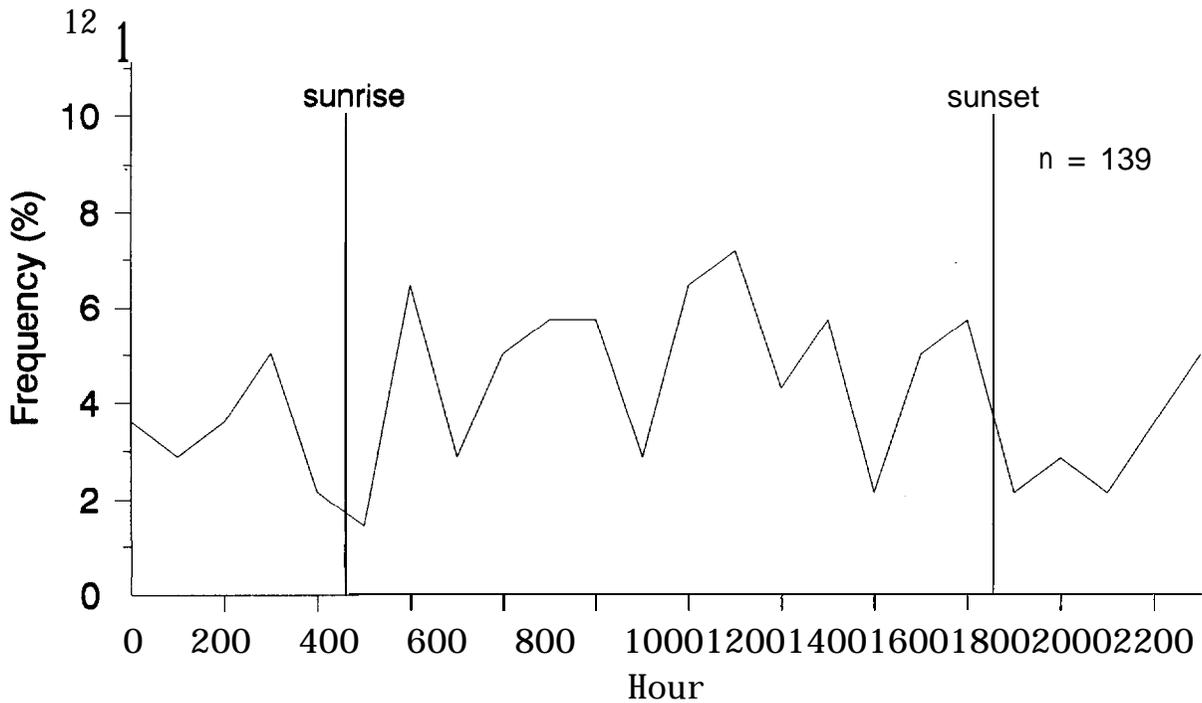


Figure G. 11. Average weekly diel passage of PIT tagged Imnaha River hatchery chinook salmon smolts at Lower Monumental Dam during the weeks of May 12-18 (upper) and May 19-25, 1996 (lower).

**LOWER GRANITE DAM  
APRIL 21-27**



**LOWER GRANITE DAM  
APRIL 28-MAY 4**

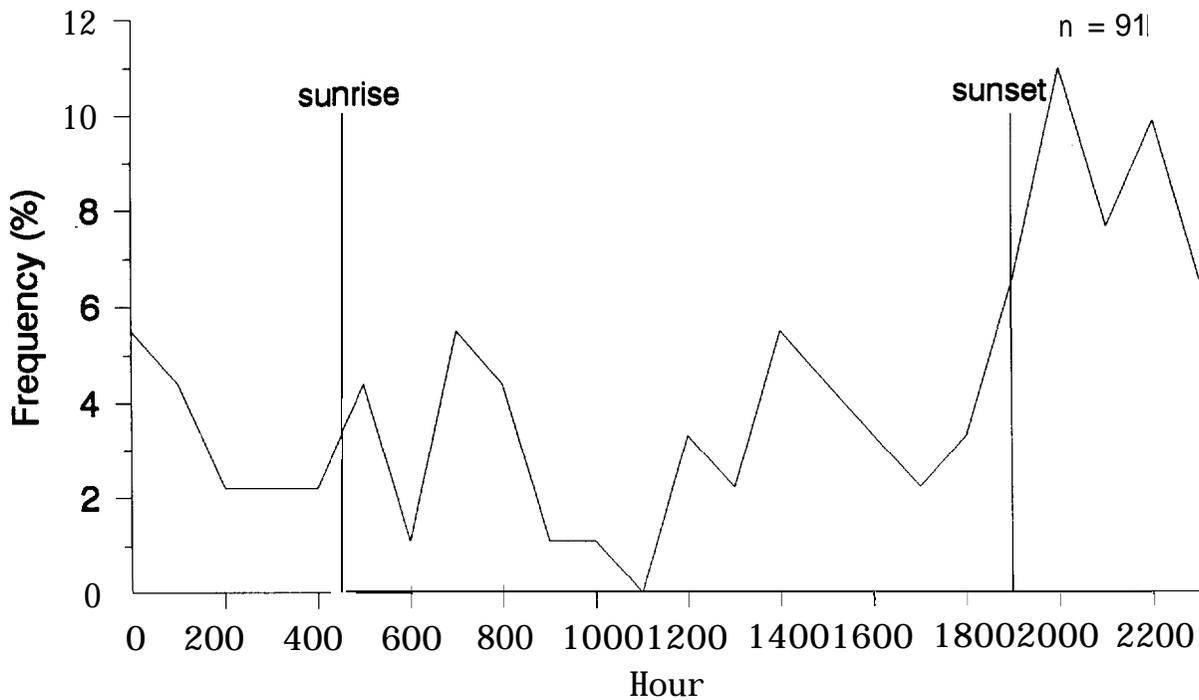
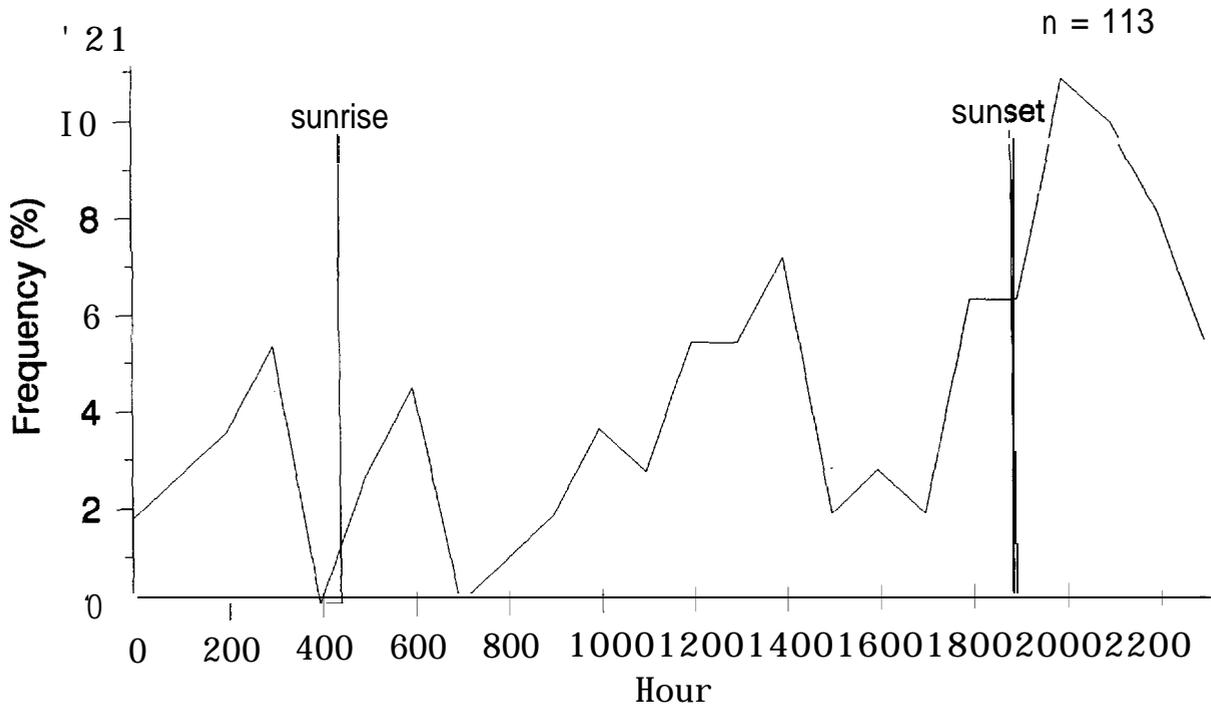


Figure G.12. Average weekly diel passage of PIT tagged Imnaha River wild steelhead trout smolts at Lower Granite Dam during the weeks of April 21-27 (upper) and April 28-May 4, 1996 (lower).

**LOWER GRANITE DAM  
MAY 5-11**



**LOWER GRANITE DAM  
MAY 12-18**

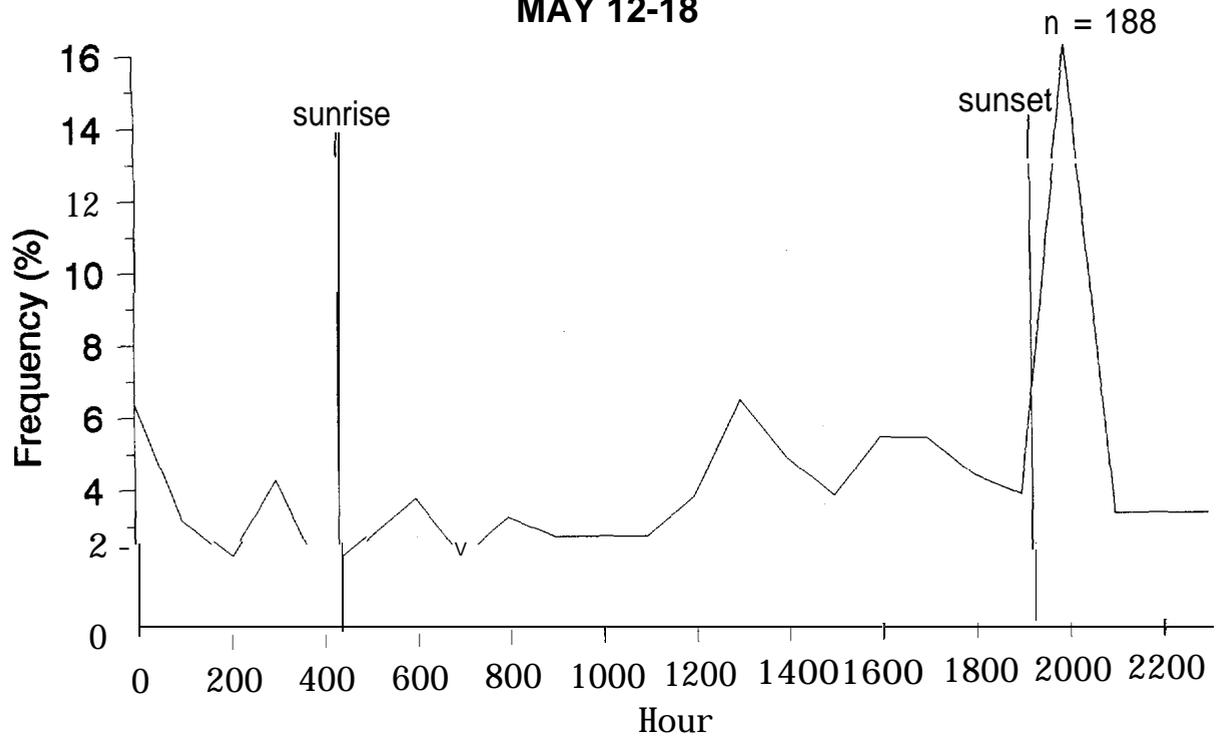
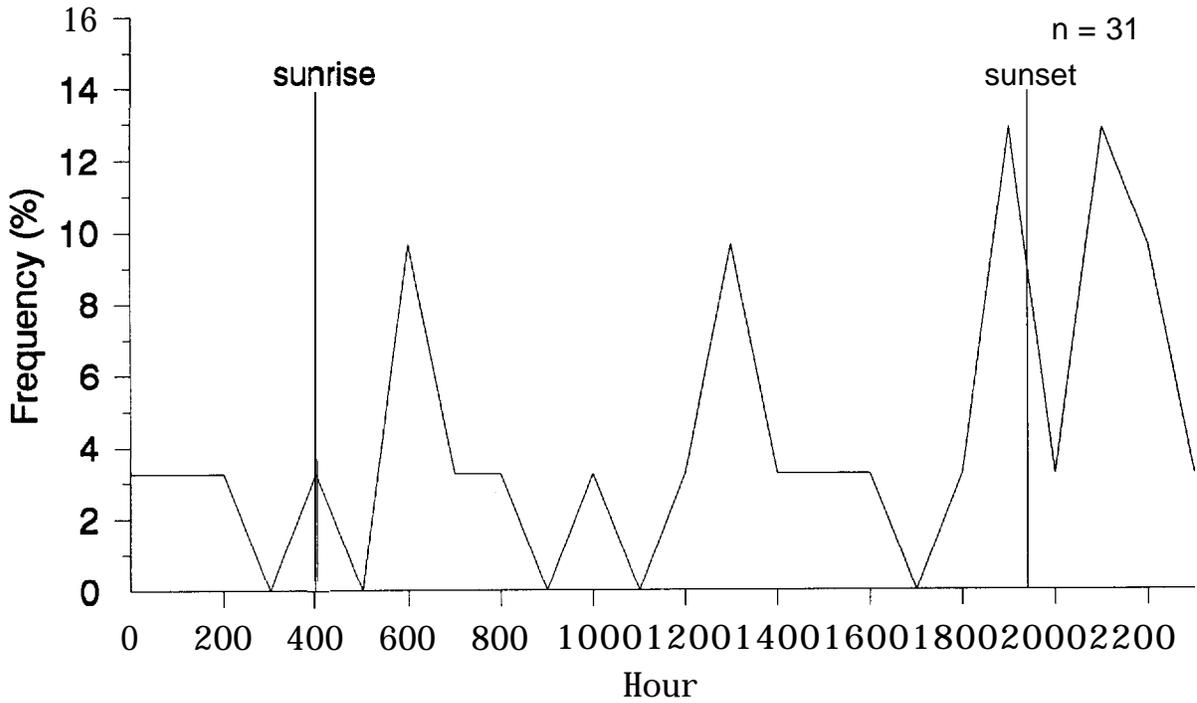


Figure G.13. Average weekly diel passage of PIT tagged Imnaha River wild steelhead trout smolts at Lower Granite Dam during the weeks of May 5-11 (upper) and May 12-18, 1996 (lower).

**LOWER GRANITE DAM  
MAY 26-JUNE 1**



**LOWER GRANITE DAM  
JUNE 2-8**

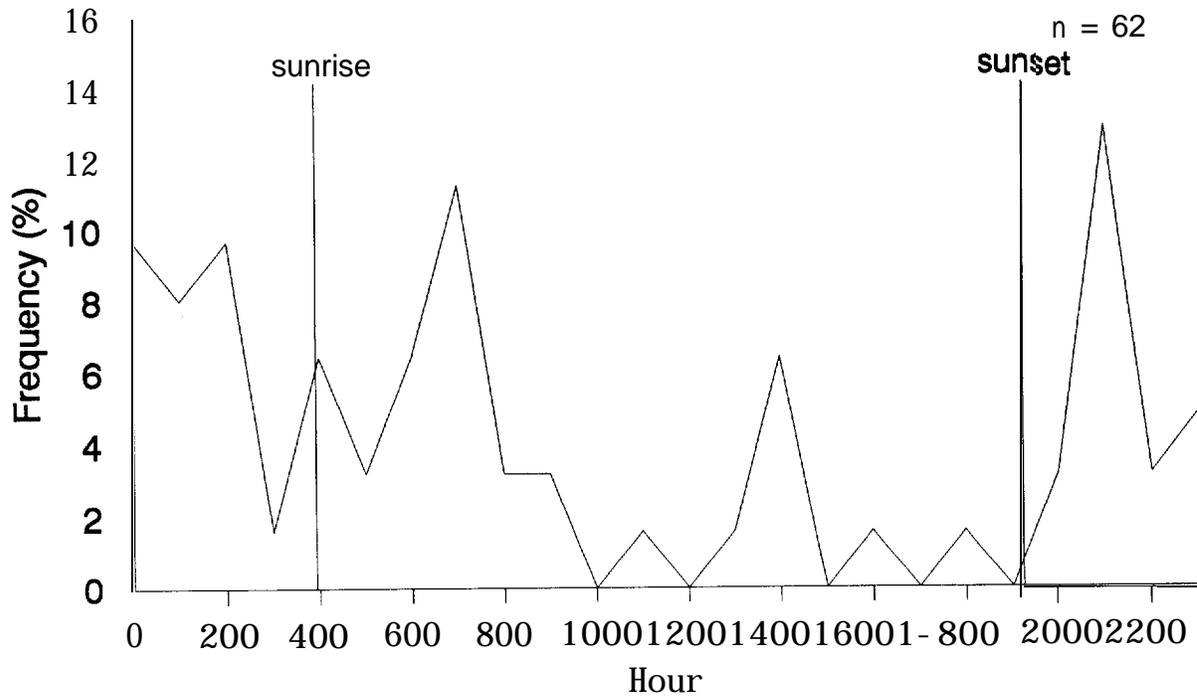
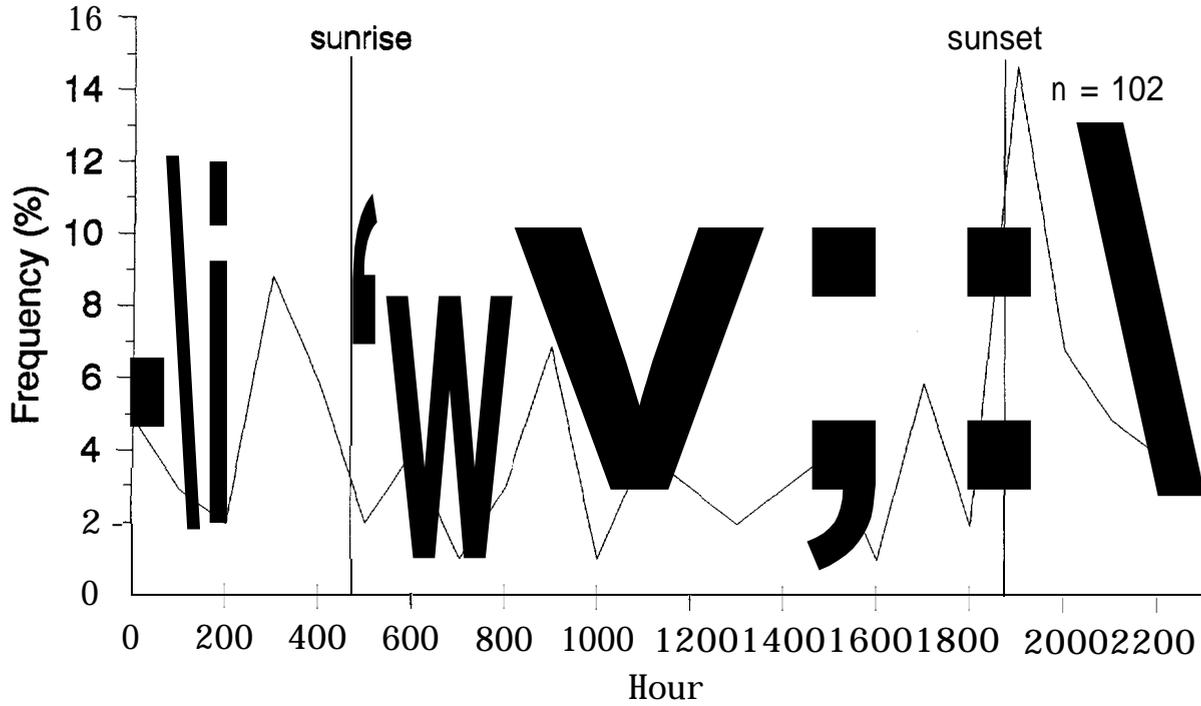


Figure G.14. Average weekly diel passage of PIT tagged Imnaha River wild steelhead trout smolts at Lower Granite Dam during the weeks of May 26-June 1 (upper) and June 2-8, 1996 (lower).

**LITTLE GOOSE DAM  
APRIL 21-27**



**LITTLE GOOSE DAM  
APRIL 28-MAY 4**

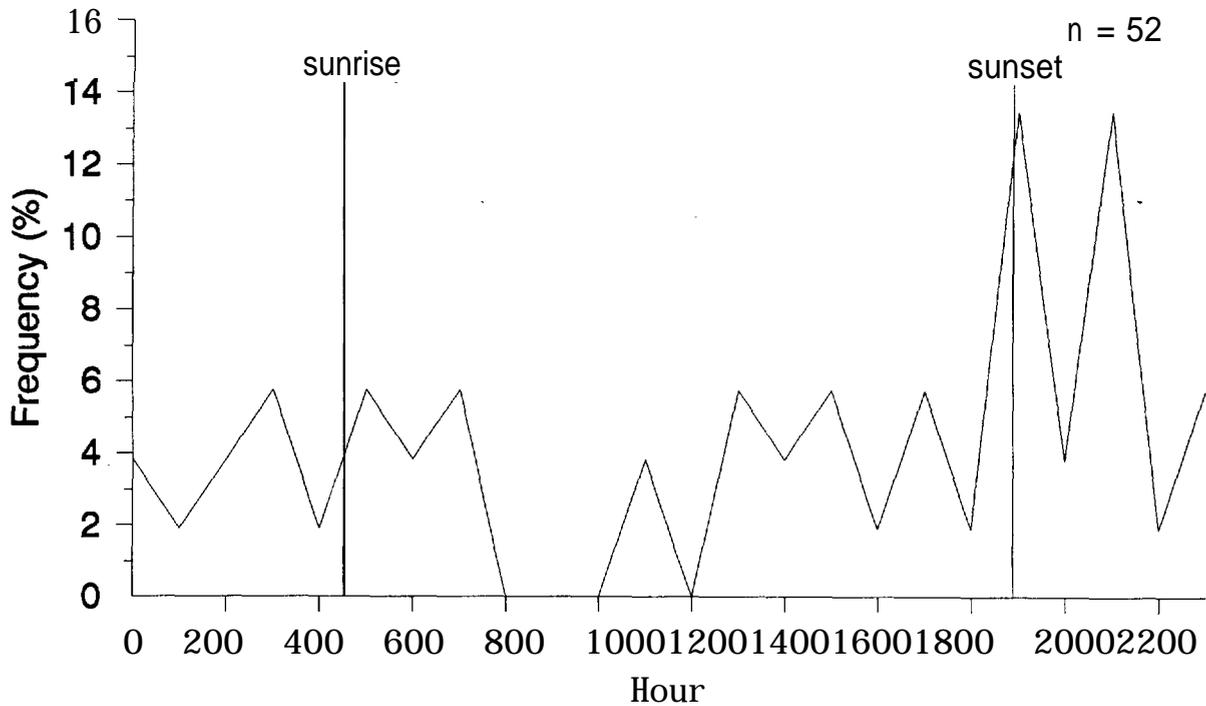
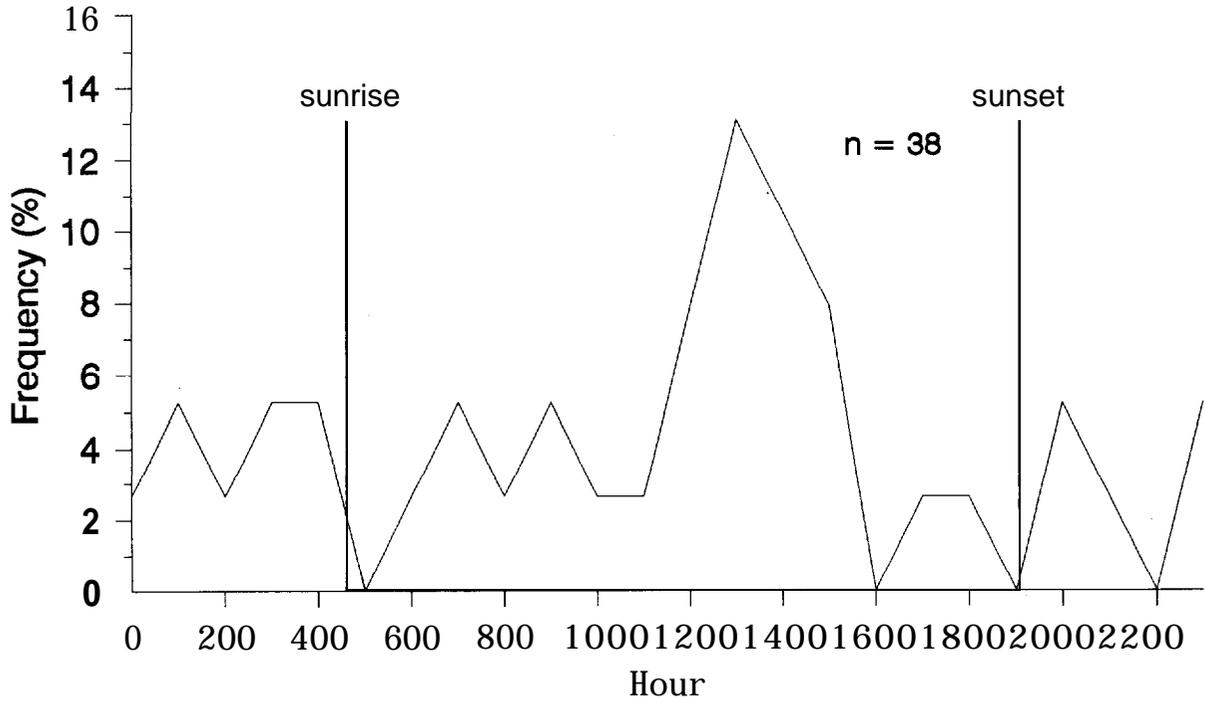


Figure G. 15. Average weekly diel passage of PIT tagged Imnaha River wild steelhead trout smolts at Little Goose Dam during the weeks of April 21-27 (upper) and April 28-May 4, 1996 (lower).

**LITTLE GOOSE DAM  
MAY 5-11**



**LITTLE GOOSE DAM  
MAY 12-18**

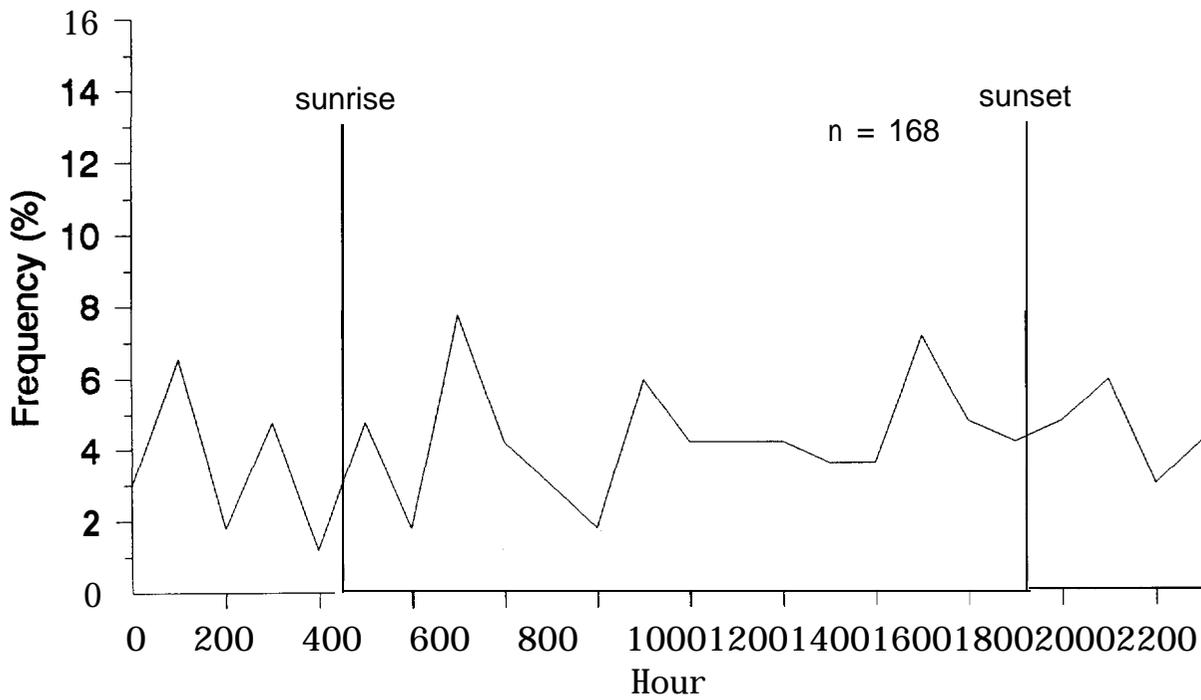
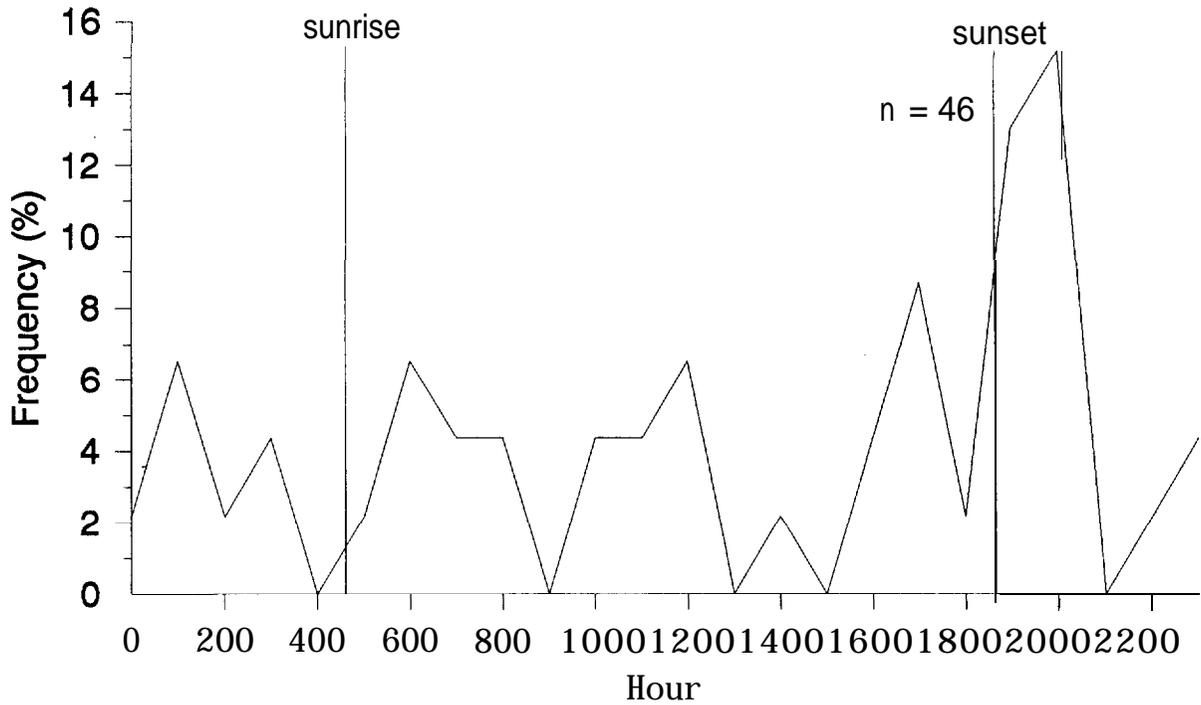


Figure G.16. Average weekly diel passage of PIT tagged Imnaha River wild steelhead trout smolts at Little Goose Dam during the weeks of May 5-11 (upper) and May 12-18, 1996 (lower).

**LOWER MONUMENTAL DAM  
APRIL 21-27**



**LOWER MONUMENTAL DAM  
APRIL 28-MAY 4**

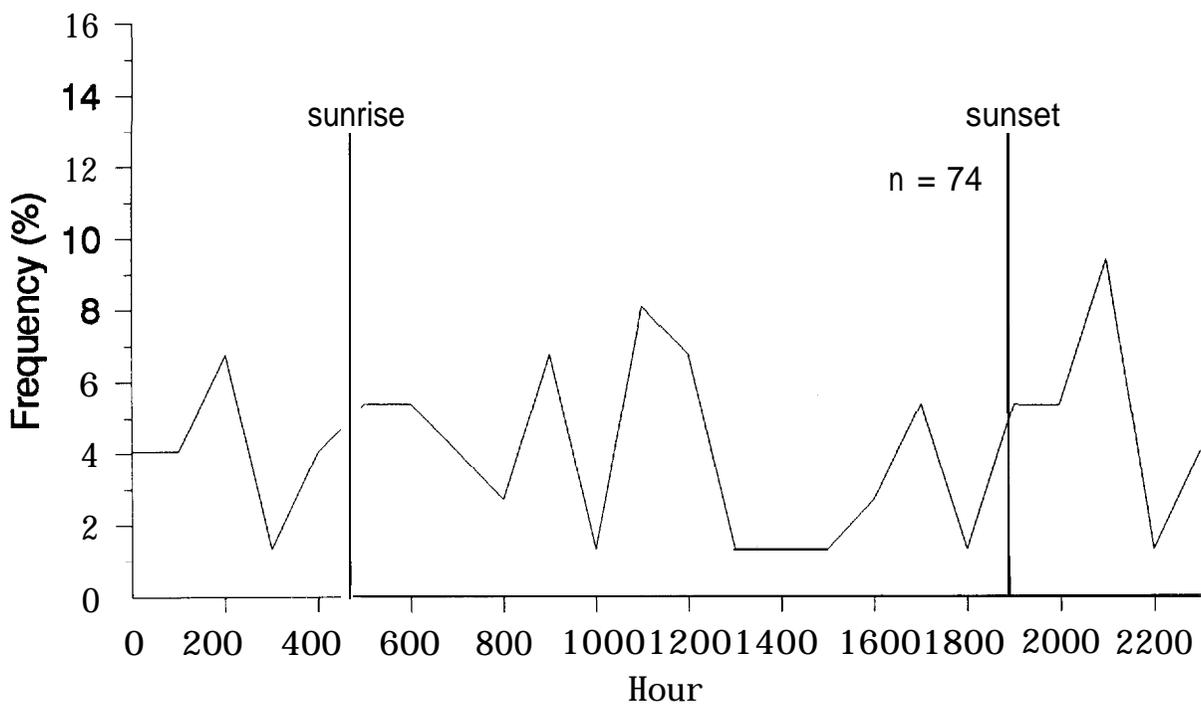
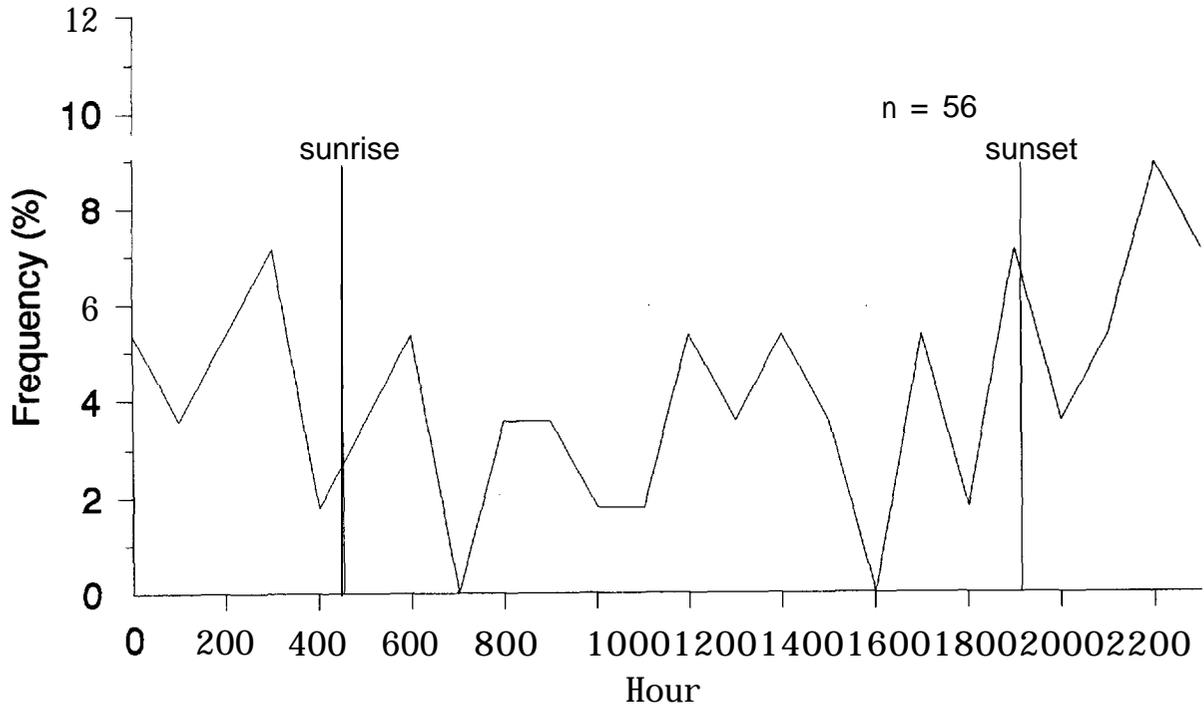


Figure G.17. Average weekly diel passage of PIT tagged Imnaha River wild steelhead trout smolts at Lower Monumental Dam during the weeks of April 21-27 (upper) and April 28-May 4, 1996 (lower).

**LOWER MONUMENTAL DAM  
MAY 5-11**



**LOWER MONUMENTAL DAM  
MAY 12-18**

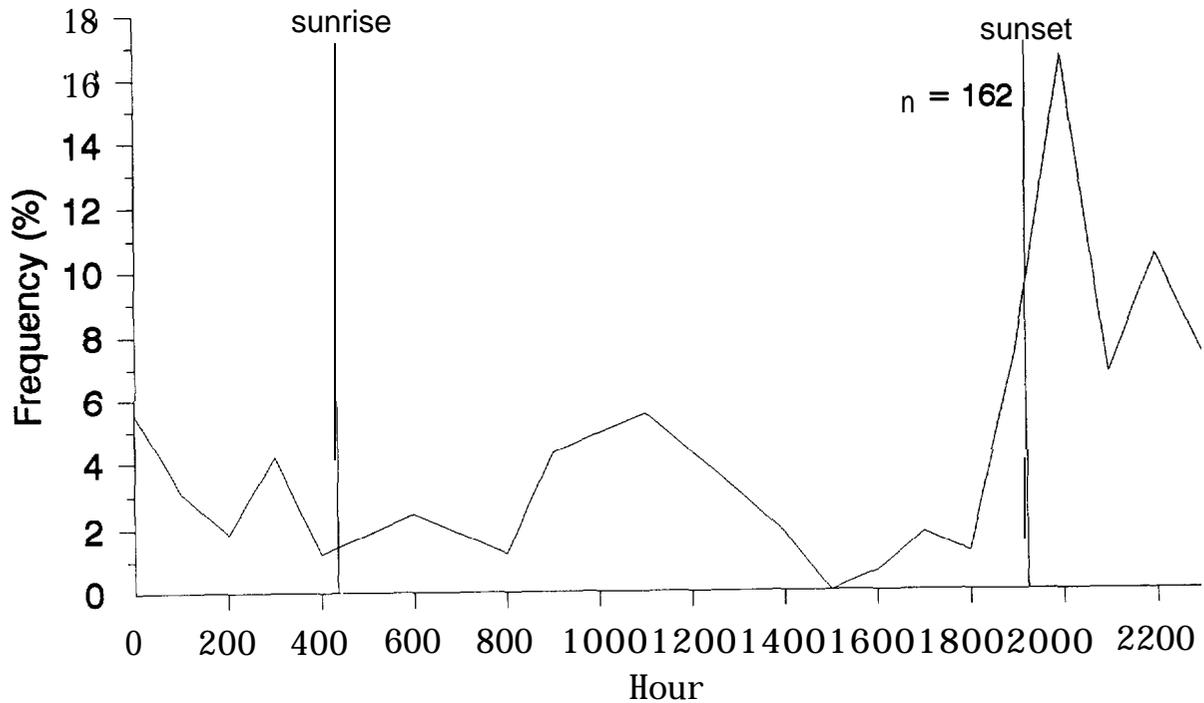


Figure G. 18. Average weekly diel passage of PIT tagged Imnaha River wild steelhead trout smolts at Lower Monumental Dam during the weeks of May 5-11 (upper) and May 12-18, 1996 (lower).

**LOWER MONUMENTAL DAM  
MAY 19-25**

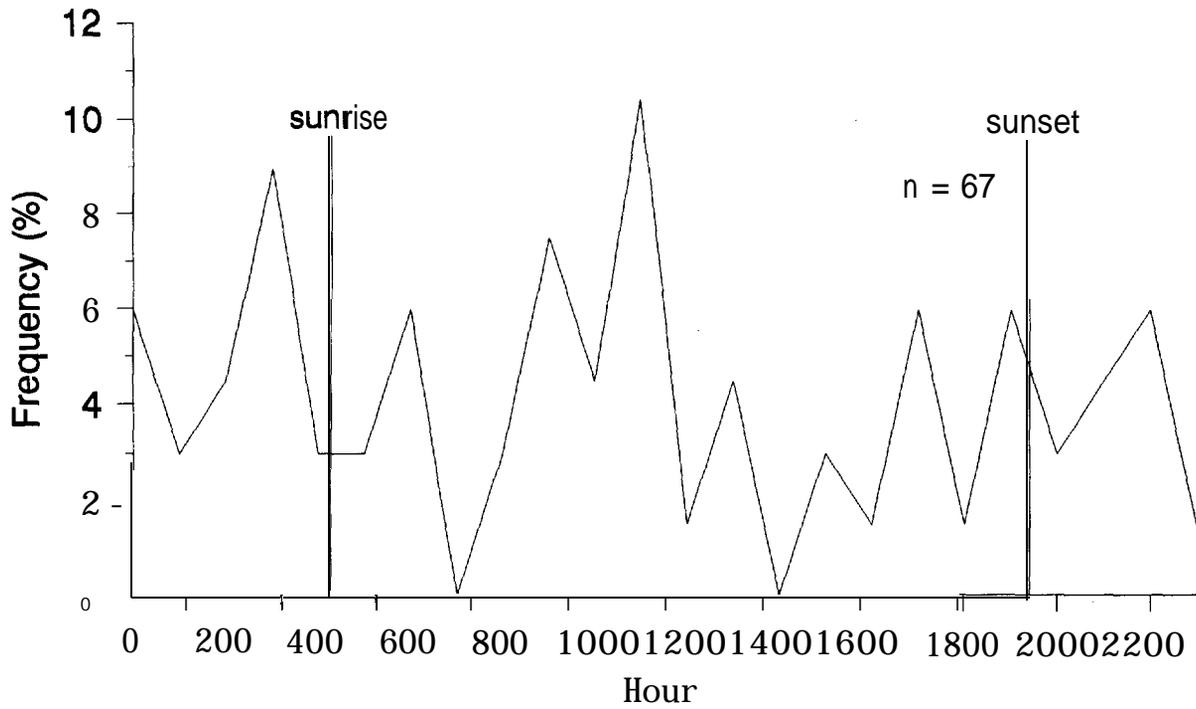
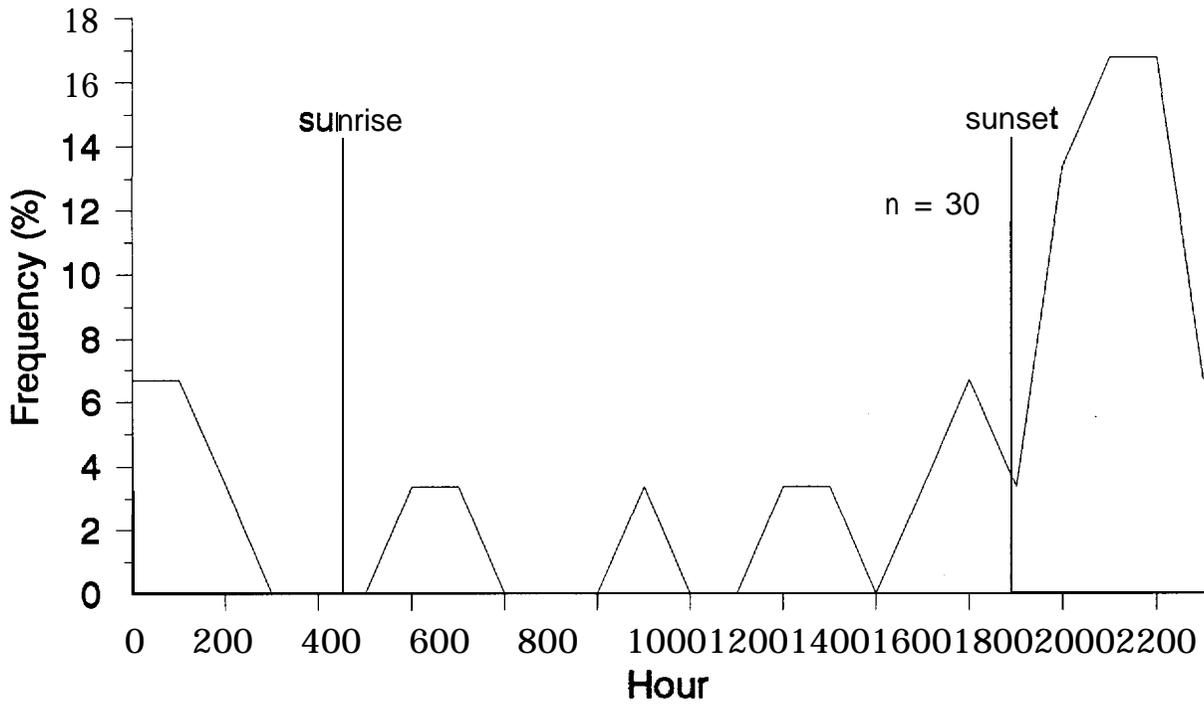


Figure G. 19. Average weekly diel passage of PIT tagged Imnaha River wild steelhead trout smolts at Lower Monumental Dam during the week of May 19-25, 1996.

**LOWER GRANITE DAM  
APRIL 28-MAY 4**



**LOWER GRANITE DAM  
MAY 5-11**

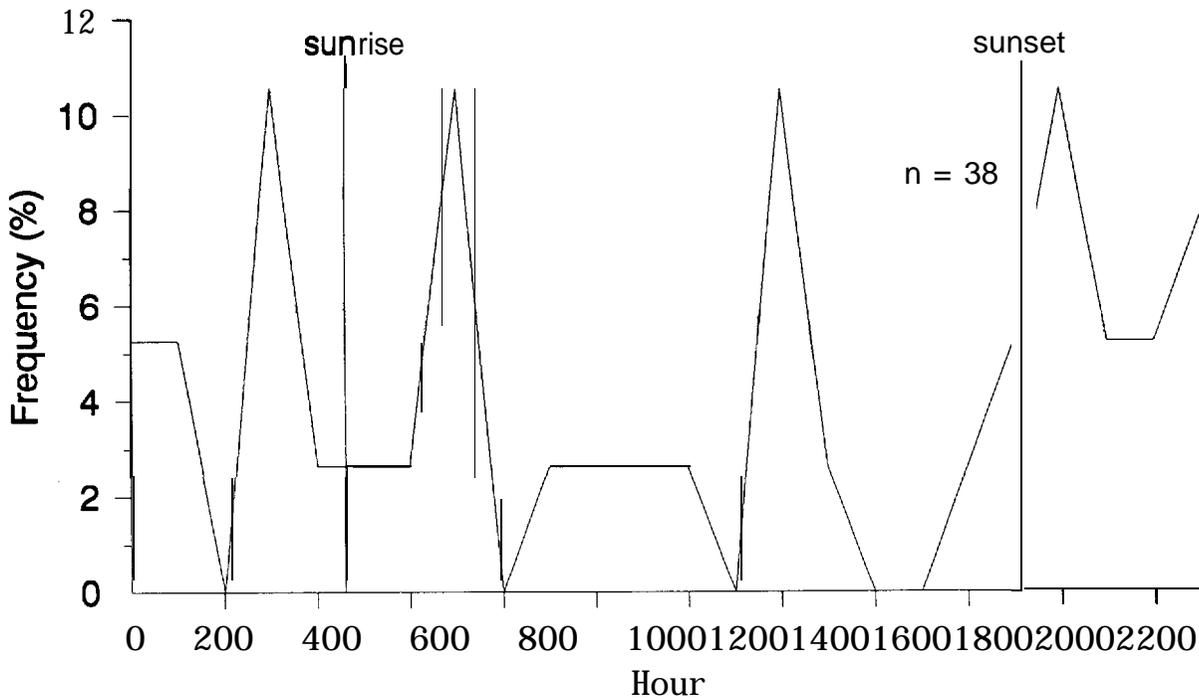
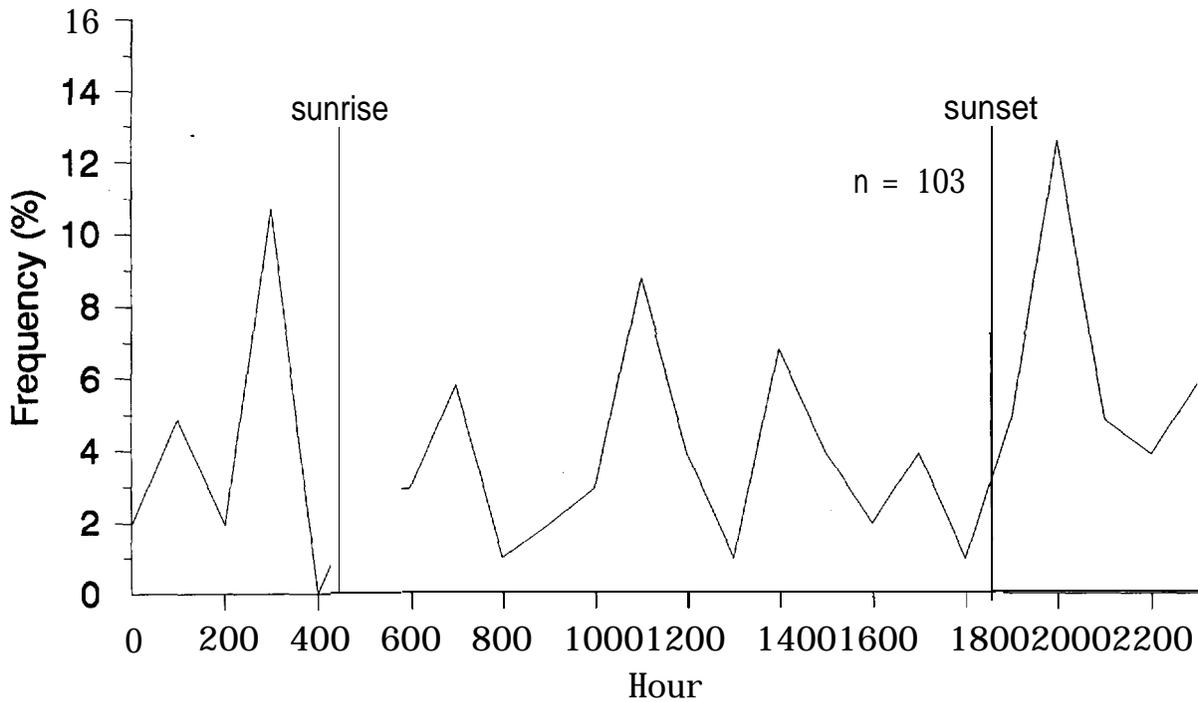


Figure G.20. Average weekly diel passage of PIT tagged Imnaha River hatchery steelhead trout smolts at Lower Granite Dam during the weeks of April 28-May 4 (upper) and May 5-11, 1996 (lower).

**LOWER GRANITE DAM  
MAY 12-18**



**LOWER GRANITE DAM  
MAY 19-25**

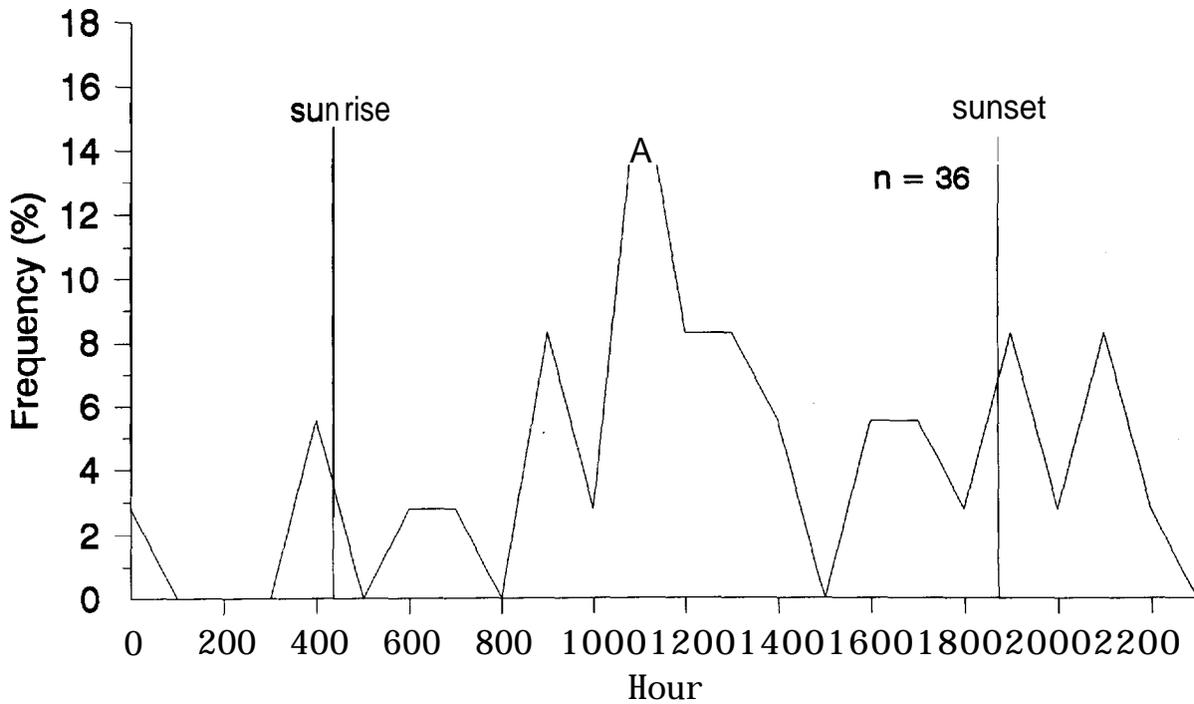
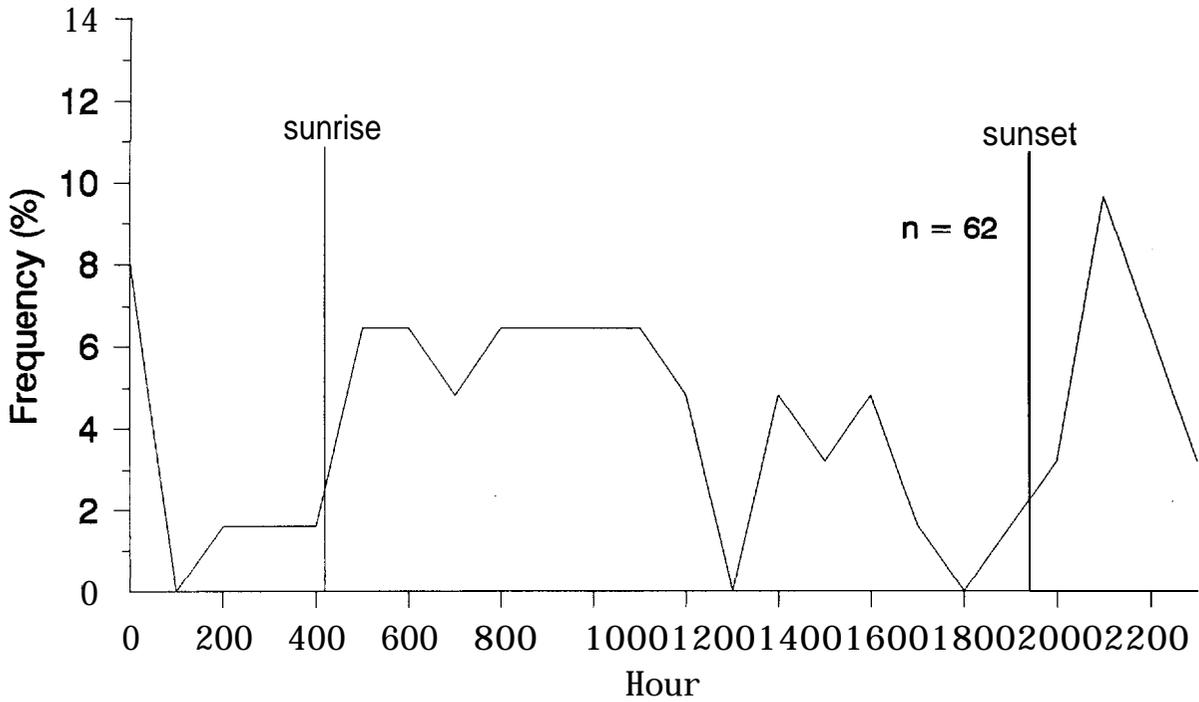


Figure G.21. Average weekly diel passage of PIT tagged Imnaha River hatchery steelhead trout smolts at Lower Granite Dam during the weeks of May 12-18 (upper) and May 19-25, 1996 (lower).

**LOWER GRANITE DAM  
MAY 26-JUNE 1**



**LOWER GRANITE DAM  
JUNE 2-8**

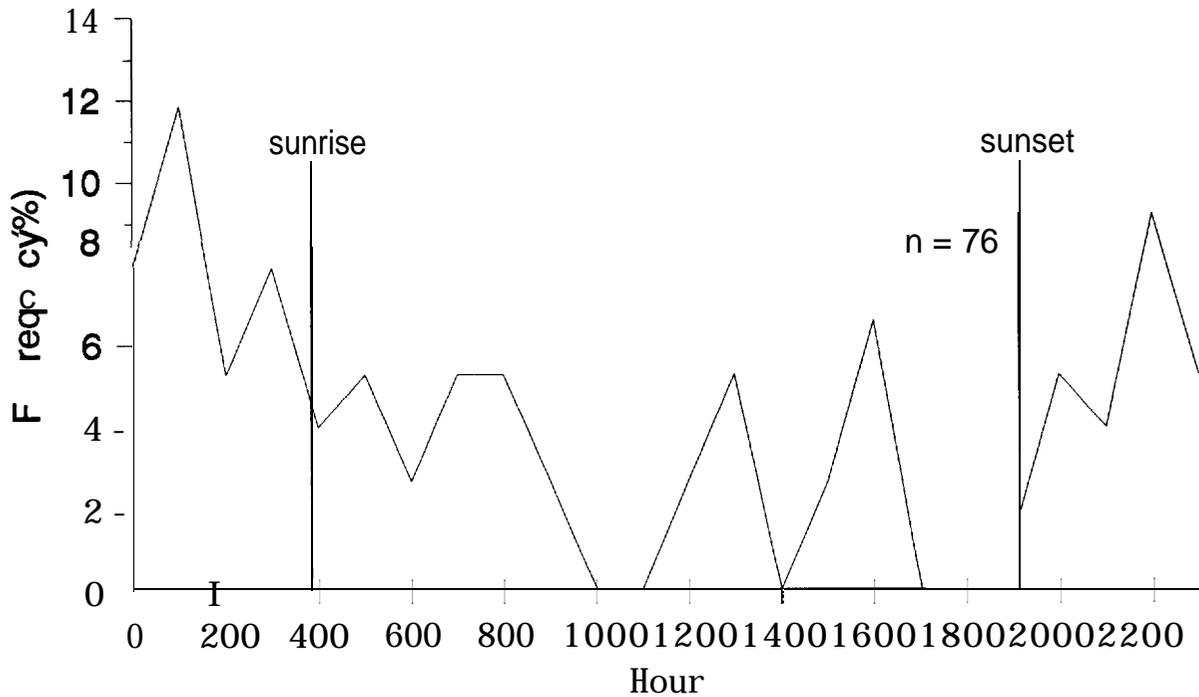


Figure G.22. Average weekly diel passage of PIT tagged Imnaha River hatchery steelhead trout smolts at Lower Granite Dam during the weeks of May 26-June 1 (upper) and June 2-8, 1996 (lower).

**LOWER GRANITE DAM  
JUNE 9-15**

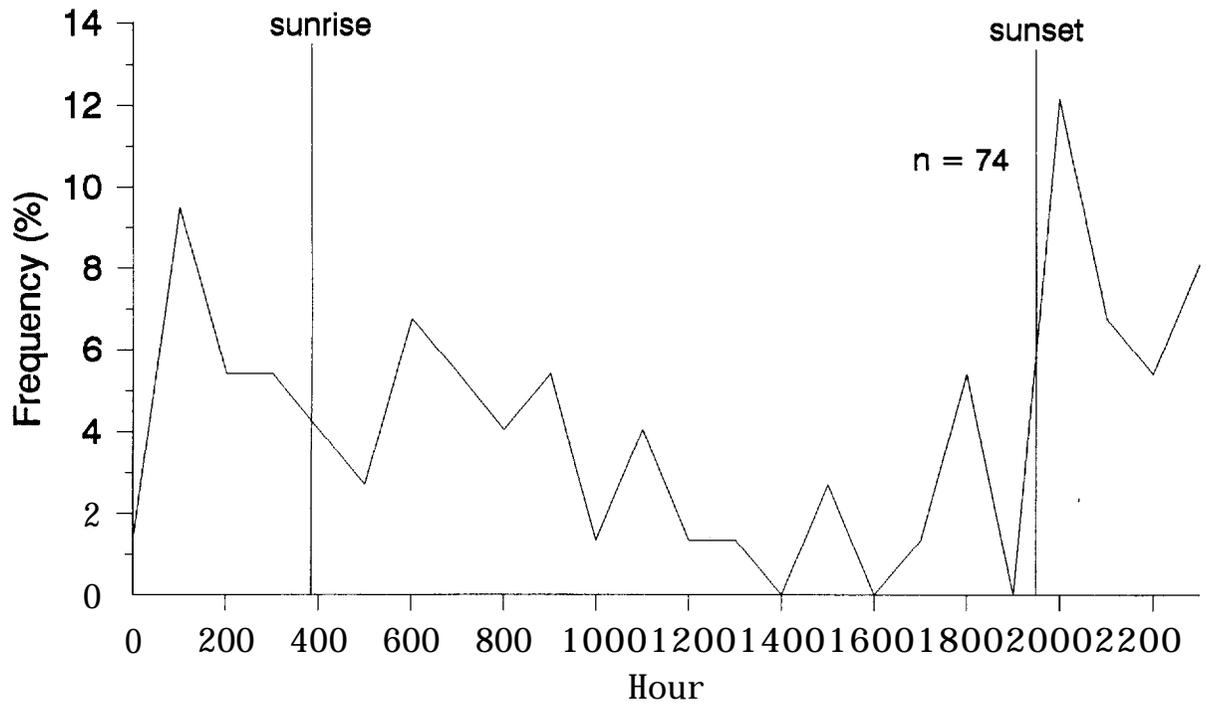


Figure G.23. Average weekly diel passage of PIT tagged Imnaha River hatchery steelhead trout smolts at Lower Granite Dam during the week of June 9-15, 1996.

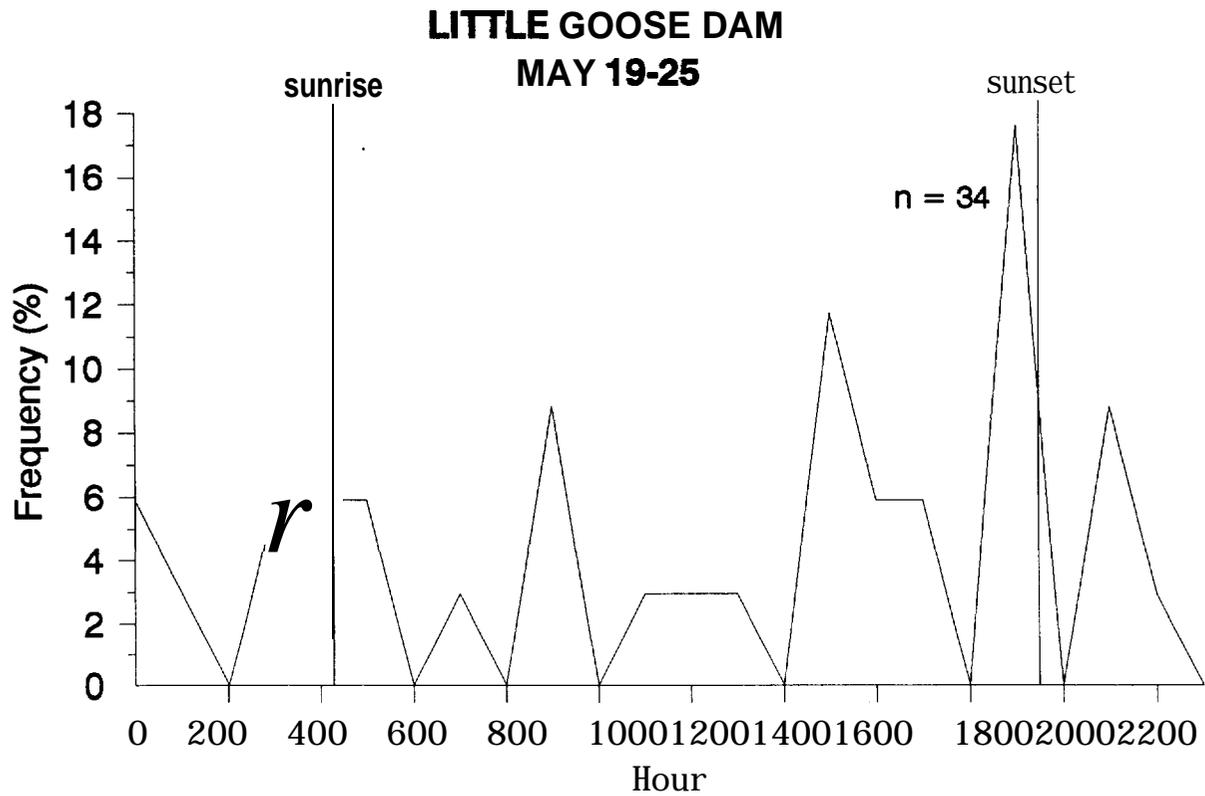
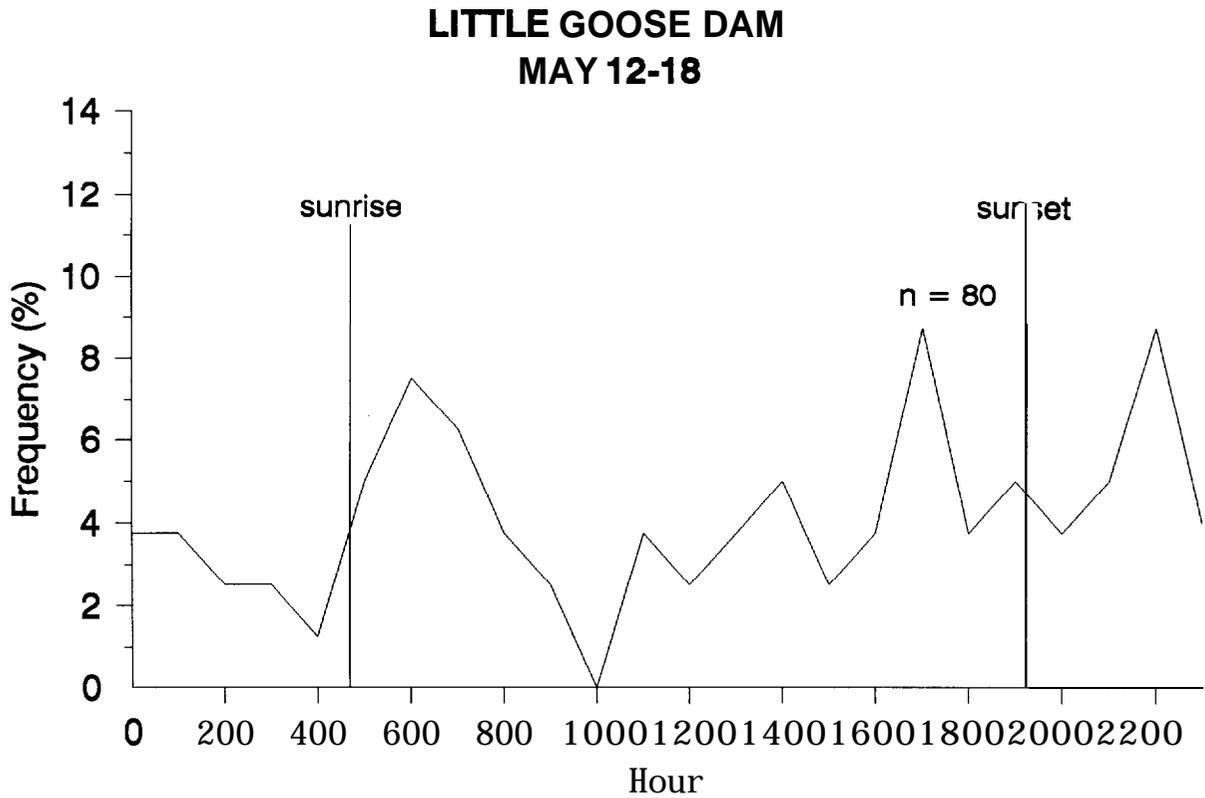
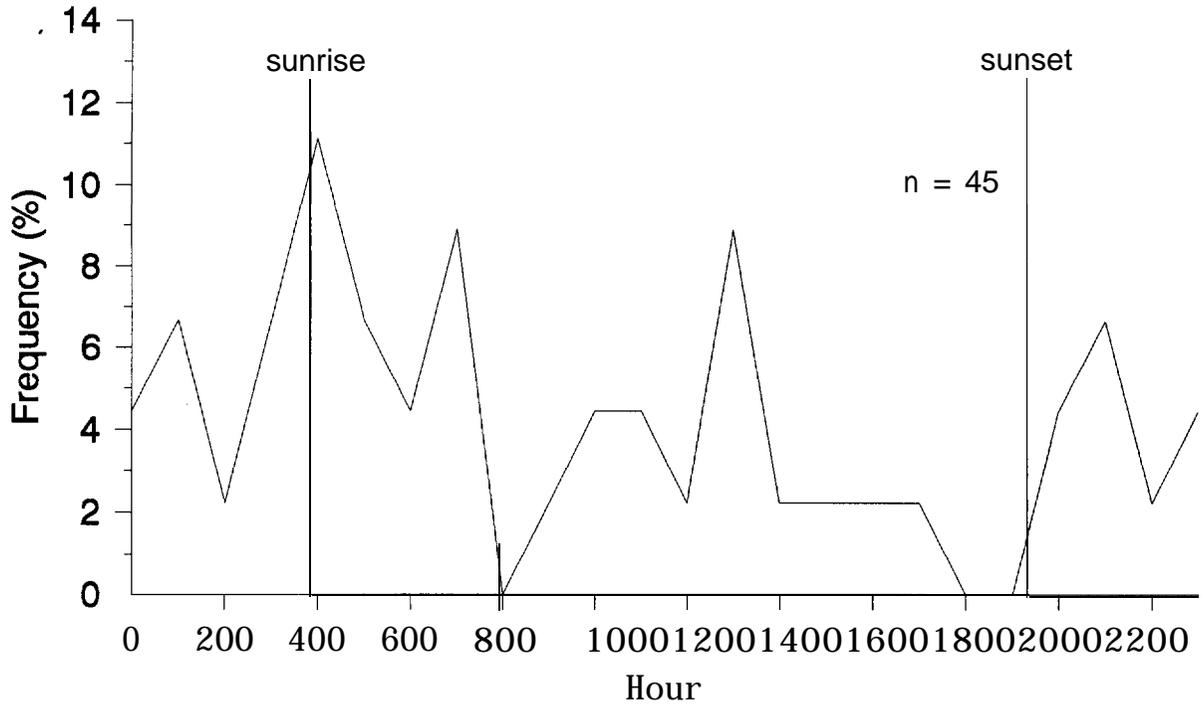


Figure G.24. Average weekly diel passage of PIT tagged Imnaha River hatchery steelhead trout smolts at Little Goose Dam during the weeks of May 12-18 (upper) and May 19-25, 1996 (lower).

**LITTLE GOOSE DAM  
JUNE 2-8**



**LITTLE GOOSE DAM  
JUNE 9-15**

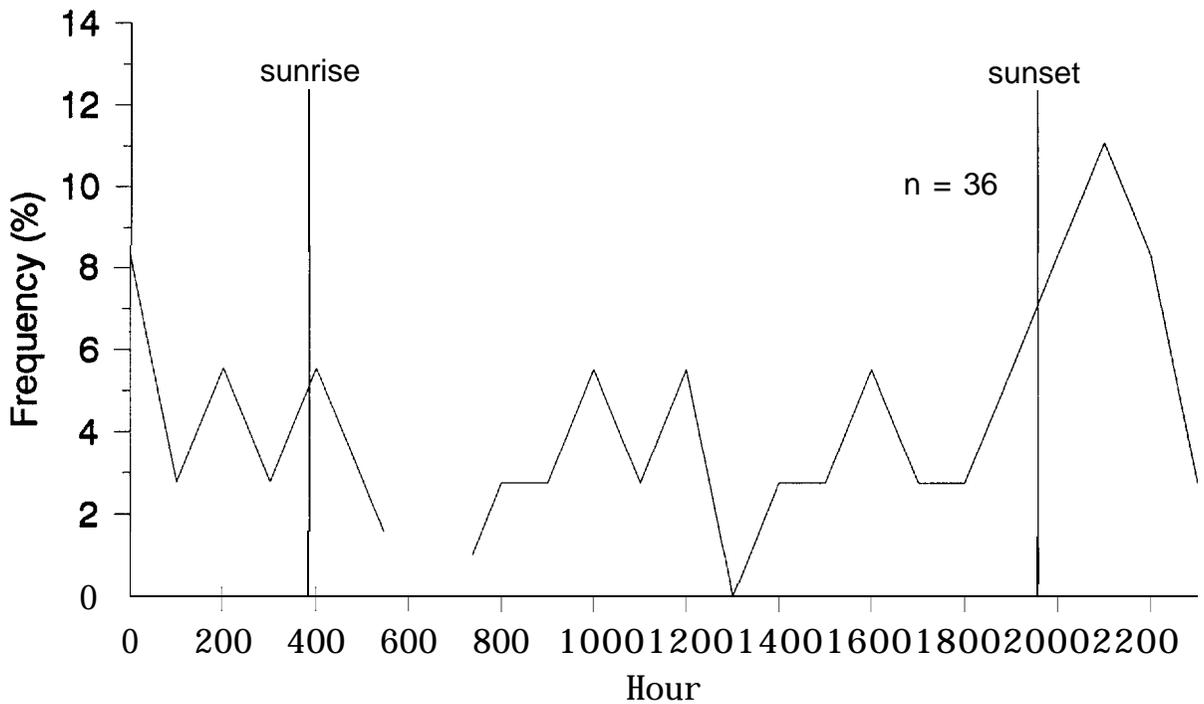
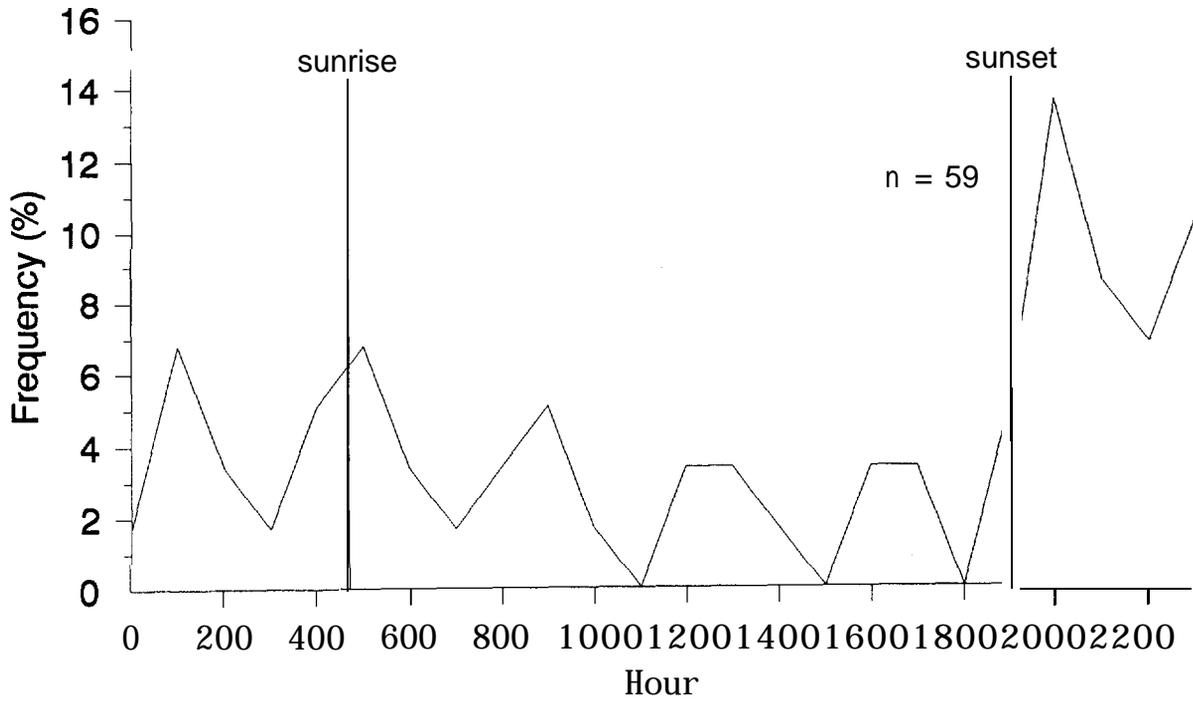


Figure G.25. Average weekly diel passage of PIT tagged Imnaha River hatchery steelhead trout smolts at Little Goose Dam during the weeks of June 2-8 (upper) and June 9-15, 1996 (lower).

**LOWER MONUMENTAL DAM  
MAY 12-18**



**LOWER MONUMENTAL DAM  
MAY 19-25**

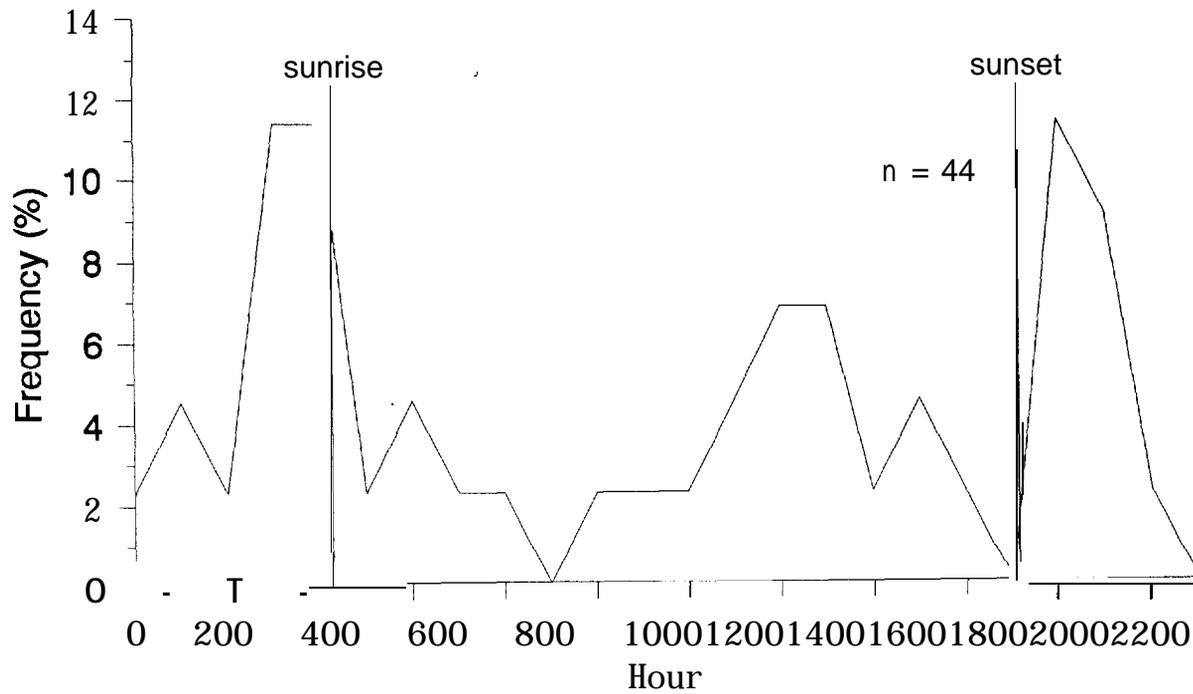
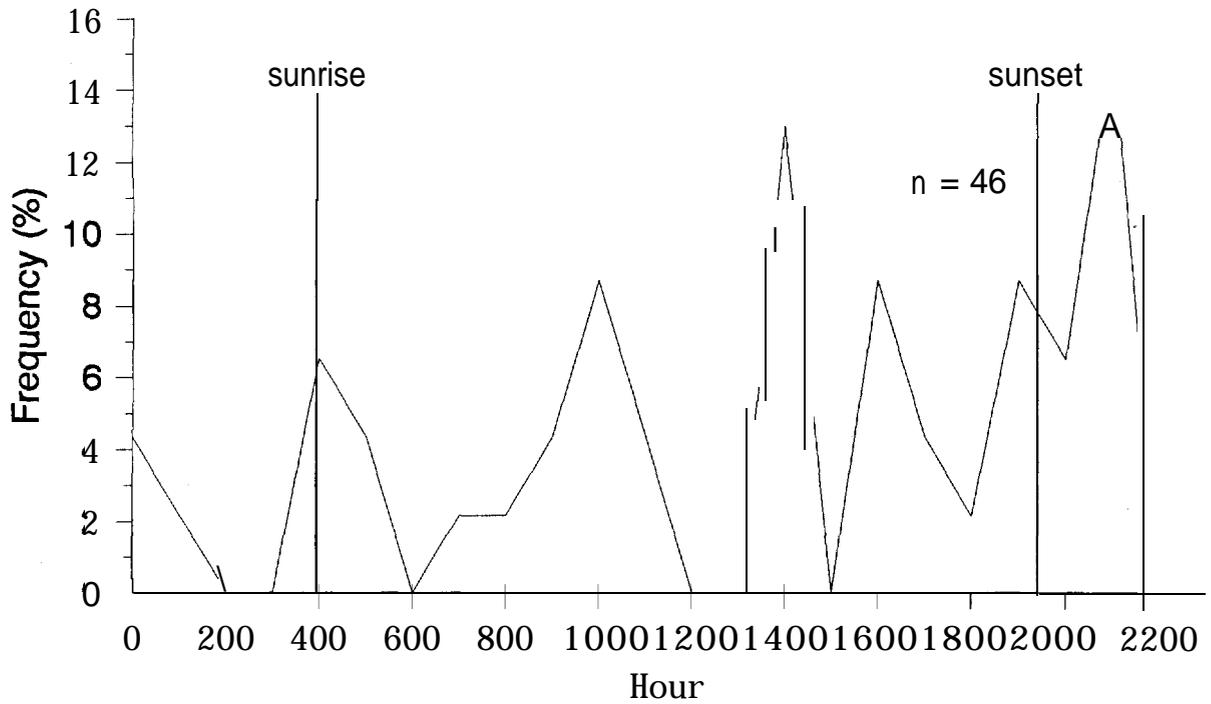


Figure G.26. Average weekly diel passage of PIT tagged Imnaha River hatchery steelhead trout smolts at Lower Monumental Dam during the weeks of May 12-18 (upper) and May 19-25, 1996 (lower).

**LOWER MONUMENTAL DAM  
JUNE 2-8**



**LOWER MONUMENTAL DAM  
JUNE 9-15**

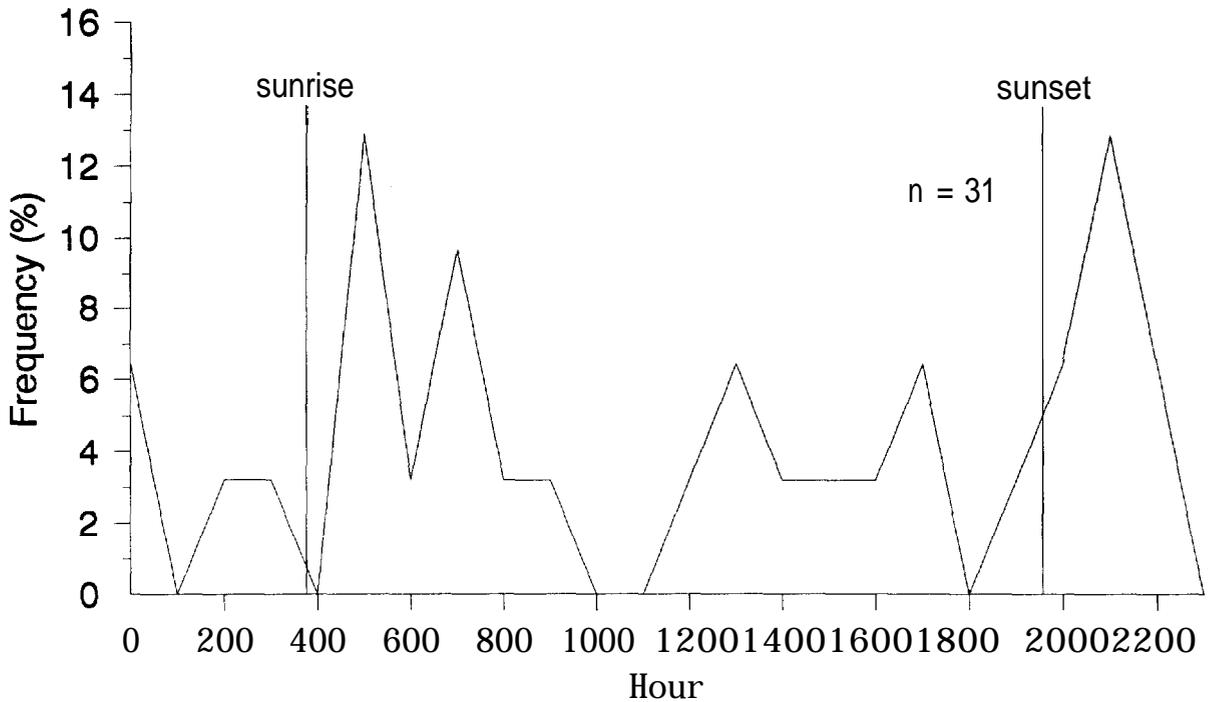


Figure G.27. Average weekly diel passage of PIT tagged Imnaha River hatchery steelhead trout smolts at Lower Monumental Dam during the weeks of June 2-8 (upper) and June 9-15, 1996 (lower).



Bonneville Power Administration

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