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**SPRING OUTMIGRATION OF WILD AND HATCHERY
CHINOOK SALMON AND STEELHEAD TROUT SMOLTS
FROM THE IMNAHA RIVER, MARCH 1 - JUNE 15, 1994**

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ABSTRACT

in 1994, the Nez **Perce** Tribe began a smolt monitoring study on the Imnaha River in cooperation with the Fish Passage Center (FPC). A rotary screw trap was used to collect emigrating wild and hatchery chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Oncorhynchus mykiss*) smolts from March 1 to June 15, 1994. Estimated smolt yield from the Imnaha River system was calculated to be 90,358 wild chinook salmon, 382,908 hatchery chinook salmon, 107,826 wild steelhead trout, and 250,126 hatchery steelhead trout during the study period. Smolt yield estimates did not include wild chinook salmon that emigrated before March 1 or hatchery steelhead trout smolts that outmigrated after June 15. Outmigration trends of the emigrating salmonids were compared to mean daily discharge, mean daily water temperature and biological characteristics in the Imnaha River. An evaluation of gill (Na+K) **ATPase** samples for each species was also conducted.

We **PIT** tagged and released 956 wild chinook salmon, 661 hatchery chinook salmon, 1,432 wild steelhead trout and 2,029 hatchery steelhead trout. Cumulative interrogation rates at **mainstem** Snake and Columbia River dams were 62.2% for wild chinook salmon, 45.2% for hatchery chinook salmon, 51.3% for wild steelhead trout, and 34.3% for hatchery steelhead trout.

Peak outmigration of wild Imnaha River chinook salmon occurred in late-April at Lower Granite, Little Goose and Lower Monumental dams and in early May at McNary Dam. Median and 90% passage dates for wild chinook salmon smolts at Lower Granite Dam were April 24 and May 11, respectively. Ninety percent of the wild chinook salmon passage at Lower Granite Dam had already occurred when the water spill period was initiated on May 10. Median and 90% passage dates for wild chinook at McNary Dam were May 12 and May 28, respectively. In comparison to the wild fish, hatchery chinook salmon exhibited a shorter outmigration period through the Snake River with peaks occurring later in the season. Median and 90% passage dates at Lower Granite Dam for other PIT tagged groups were: hatchery chinook salmon - May 12 for both; wild steelhead trout - May 8 and June 1; and hatchery steelhead trout - May 29 and July 15. Hatchery steelhead trout displayed small peaks in arrival at Lower Granite Dam and McNary Dam in early to mid-May, however, the general trend at each dam was a long protracted emigration.

ACKNOWLEDGMENTS

The Nez **Perce** Tribe extended the administrative support necessary to complete this project and report. Project funding from the U.S. Fish and Wildlife Service's Lower Snake River Compensation Plan (LSRCP) program initiated the Imnaha River outmigration project investigation. **Smolt** monitoring project funds for the Imnaha River were added on to the ongoing LSRCP investigation, and was provided by the Bonneville Power Administration through the Pacific States Marine Fisheries Commission (PSMFC). We wish to thank the following people for their dedicated work in the field: John Joyce, Todd Marr, Charles Snow, Jean Harmon and Phyllis Wrtherspoon. Alec Maule and the National Biological Survey crew were responsible for smolt gill **ATPase** sampling. Tom Berggren and the Fish Passage Center provided helpful comments on the project statement of work and provided necessary PIT tagging schedules. Thanks are due to Carter Stein (PSMFC) for his assistance with the many PIT tag information system questions we asked. Nellie **Axtell** assisted with report preparation and typing of the final report. The United States Forest Service allowed us the use of the Thorn Creek guard station facilities. Finally, we would like to thank Jack **McClaran** for allowing us to access his land for trapping purposes.

TABLE OF CONTENTS

	Page
ABSTRACT	i
ACKNOWLEDGEMENTS	ii
TABLE OF CONTENTS	iii
LIST OF TABLES	v
LIST OF FIGURES	viii
INTRODUCTION	1
METHODS	2
Study Area Description	2
Equipment Description	2
Trap Operations	2
Trap Efficiency	6
Smolt Yield	7
Biological Characteristics	7
Gill ATPase	7
Pit Tagging	8
RESULTS AND DISCUSSION	10
Imnaha River Subbasin Outmigration	10
Trap Operation	10
Outmigration Trends	10
Trap Efficiency and Smolt Yield	15
Biological Characteristics	16
Gill ATPase	21
Mortality	21
Incidental Catch	21
Outmigration of PIT Tagged Fish	24
Imnaha River Outmigration	24
PIT Tag Release Groups	24
Snake River Flows	29
Interrogation Rates	29
Arrival Timing	33

Travel Time to Lower Granite Dam	44
SUMMARY	46
LITERATURE CITED	50
APPENDIX A	52
APPENDIX B	56
APPENDIX C	60
APPENDIX D	63
APPENDIX E	64
APPENDIX F	70
APPENDIX G	74

LIST OF TABLES

		Page
Table 1.	Position in which screw trap was fished dependent upon staff gauge reading	5
Table 2.	Fin clip applied to wild and hatchery chinook salmon and wild steelhead trout smolts used in trap efficiency trials	6
Table 3.	Minimum number of fish to be PIT tagged per day for wild and hatchery steelhead trout and hatchery chinook salmon as detailed by the Fish Passage Center	9
Table 4.	Dates screw trap was not operated during the study period, March 1 -June 15, 1994..	11
Table 5.	Weekly catch composition of wild and hatchery chinook salmon and steelhead trout smolts collected in the Imnaha River screw trap, March 1 -June 15, 1994..	12
Table 6.	Number of trap efficiency trials, mean trap efficiency and standard deviation during each flow period for each species	16
Table 7.	Smolt yield estimates (\pm 95% C.I.) for wild and hatchery chinook salmon and steelhead trout smolts using the Lincoln program (Smith pers. comm.) and bootstrap method (Murphy et al., in prep). Estimates are from March 1 to June 15, 1994	17
Table 8.	Mean fork length (mm), weight (g) and condition factor (K) of chinook salmon and steelhead trout smolts collected in the Imnaha Rivertrap, March 1 -June 15, 1994	19
Table 9.	Results of gill Atpase samples including sample size (n), mean fork length (mm), and mean weight (g) for wild and hatchery chinook salmon and steelhead trout smolts. ATPase units are in $\mu\text{molesPi/mgProt/hr}$. Collection and analysis was conducted by the National Biological Survey Lab, Cook, WA	22
Table 10.	Mortality of each species due to trapping and PIT tagging	23
Table 11.	Weekly catch composition of incidental species collected in the Imnaha River trap, March 1 - June 15, 1994	23

Table 12.	Mean fork length (mm), weight (g) and condition factors for each weekly release group of PIT tagged wild and hatchery chinook salmon released at the Imnaha River trap, March 1 -June 15, 1994..	26
Table 13.	Mean fork length (mm), weight (g) and condition factors for each weekly release group of PIT tagged wild steelhead trout released at the Imnaha River trap, March 1- June 15, 1994. NPT=released at dark, FPC=released immediately	27
Table 14.	Mean fork length (mm), weight (g) and condition factors for each weekly release group of PIT tagged hatchery steelhead trout released at the Imnaha River trap, March 1 - June 15, 1994. NPT=released at dark, FPC=released immediately	28
Table 15.	Interrogation rates (based on first observations) of weekly release groups of PIT tagged wild chinook salmon at Lower Granite, Little Goose, Lower Monumental and McNary dams	31
Table 16.	Interrogation rates (based on first observations) of weekly release groups of PIT tagged hatchery chinook salmon at Lower Granite, Little Goose, Lower Monumental and McNary dams	31
Table 17.	Interrogation rates (based on first observations) of weekly release groups of NPT PIT tagged wild steelhead trout at Lower Granite, Little Goose, Lower Monumental and McNary dams	34
Table 18.	Interrogation rates (based on first observations) of weekly release groups of FPC PIT tagged wild steelhead trout at Lower Granite, Little Goose, Lower Monumental and McNary dams.	34
Table 19.	Interrogation rates (based on first observations) of weekly release groups of NPT PIT tagged hatchery steelhead trout at Lower Granite, Little Goose, Lower Monumental and McNary dams	36
Table 20.	Interrogation rates (based on first observations) of weekly release groups of FPC PIT tagged hatchery steelhead trout at Lower Granite, Little Goose, Lower Monumental and McNary dams	36

Table 21. First, median and 90% observation dates of PIT tagged
Imnaha River wild and hatchery chinook salmon and steelhead
trout smolts at Lower Granite, Little Goose, Lower Monumental
and **McNary** dams from April through August, 1994 38

LIST OF FIGURES

	Page
Figure 1. Map of study area	3
Figure 2. Diagram of screw trap	4
Figure 3. Mean daily discharge (USGS Gauge 13292000 at Imnaha, OR) and mean daily water temperature of Imnaha River during the spring outmigration period, March 1 - June 15, 1994	11
Figure 4. Wild and hatchery chinook salmon smolt daily outmigration versus mean daily water discharge (upper graph) and mean daily water temperature (lower graph) from the Imnaha River, March 1 - June 15, 1994. Estimated hatchery chinook smolt outmigration on April 13 was 141,177; on April 14 was 102,707; and on April 15 was 47,544	13
Figure 5. Wild and hatchery steelhead trout smolt daily outmigration versus mean daily water discharge (upper graph) and mean daily water temperature (lower graph) from the Imnaha River, March 1 - June 15, 1994. Estimated hatchery steelhead smolt outmigration on April 27 was 65,375; and on April 28 was 29,078	14
Figure 6. Length frequency of wild (n=3,190) and hatchery (n=9,034) chinook salmon smolts trapped in the Imnaha River, March 1 - June 15, 1994	18
Figure 7. Length frequency of wild (n=2,228) and hatchery (n=3,229) steelhead trout smolts trapped in the Imnaha River, March 1 - June 15, 1994	18
Figure 8. Weekly mean length and condition factor of wild and hatchery chinook salmon smolts trapped in the Imnaha River, March 1 - June 15, 1994	20
Figure 9. Weekly mean length and condition factor of wild and hatchery steelhead trout smolts trapped in the Imnaha River, March 1 - June 15, 1994	20

Figure 10.	Outmigration timing of PIT tagged hatchery chinook salmon smolts released on April 11 at the Imnaha River acclimation pond	25
Figure 11.	Outmigration timing of PIT tagged hatchery steelhead trout smolts released on April 25 at the Little Sheep Creek acclimation pond	25
Figure 12.	Total water discharge at Lower Granite Dam (LGR), water spill period at LGR and Snake River discharge at the Anatone gauge station, March-August, 1994	30
Figure 13.	Cumulative interrogations, by weekly PIT tag release group, of NPT tagged wild chinook salmon smolts from the Imnaha River to Lower Granite, Little Goose, Lower Monumental and McNary Dams, May 1-August 30, 1994	32
Figure 14.	Cumulative interrogations, by weekly PIT tag release group, of FPC tagged hatchery chinook salmon smolts from the Imnaha River to Lower Granite, Little Goose, Lower Monumental and McNary Dams, May 1-August 30, 1994	32
Figure 15.	Cumulative interrogations, by weekly PIT tag release group, of NPT tagged wild steelhead trout smolts from the Imnaha River to Lower Granite, Little Goose, Lower Monumental and McNary Dams, May 1-August 30, 1994	35
Figure 16.	Cumulative interrogations, by weekly PIT tag release group, of FPC tagged wild steelhead trout smolts from the Imnaha River to Lower Granite, Little Goose, Lower Monumental, and McNary Dams, May 1-August 30, 1994	35
Figure 17.	Cumulative interrogations, by weekly PIT tag release group, of NPT tagged hatchery steelhead trout smolts from the Imnaha River to Lower Granite, Little Goose, Lower Monumental and McNary Dams, May 1 -August 30, 1994	37
Figure 18.	Cumulative interrogations, by weekly PIT tag release group, of FPC tagged hatchery steelhead trout smolts from the Imnaha River to Lower Granite, Little Goose, Lower Monumental and McNary Dams, May 1-August 30, 1994	37

Figure 19.	Daily arrival timing frequency of NPT PIT tagged Imnaha River wild chinook salmon smolts at Lower Granite, Little Goose, Lower Monumental and McNary Dams, April 14-July 26 , 1994	39
Figure 20.	Daily arrival timing frequency of FPC PIT tagged Imnaha River hatchery chinook salmon smolts at Lower Granite Dam, April 24-May 18, 1994	40
Figure 21.	Daily arrival timing frequency of FPC PIT tagged Imnaha River hatchery chinook salmon smolts at McNary Dam, May 6-June 17, 1994*	40
Figure 22.	Daily arrival timing frequency of NPT and FPC PIT tagged Imnaha River wild steelhead trout smolts at Lower Granite, Little Goose, and Lower Monumental Dams, May 3-August 20, 1994	42
Figure 23.	Daily arrival timing frequency of NPT and FPC PIT tagged Imnaha River hatchery steelhead trout smolts at Lower Granite Dam, April 29-August 21, 1994	43
Figure 24.	Daily arrival timing frequency of NPT and FPC PIT tagged Imnaha River hatchery steelhead trout smolts at Little Goose Dam, May 2-August 29, 1994	43
Figure 25.	Mean travel time, by weekly PIT tag release group, of wild and hatchery chinook salmon smolts from the Imnaha River to Lower Granite Dam, March 1-August 30, 1994	44
Figure 26.	Mean travel time, by weekly PIT tag release group, of NPT and FPC tagged wild steelhead trout smolts from the Imnaha River to Lower Granite Dam, March 1-August 30, 1994	45
Figure 27.	Mean travel time, by weekly PIT tag release group, of NPT and FPC tagged hatchery steelhead trout smolts from the Imnaha River to Lower Granite Dam, March 1-August 30, 1994	45

INTRODUCTION

The Nez Perce Tribe (NPT) conducted a smolt monitoring study on the Imnaha River in cooperation with the Fish Passage Center (FPC) in 1994. This study was designed to provide the FPC with information necessary to conduct the annual Smolt Monitoring Program (SMP), which is mandated in the Northwest Power Planning Council's (NPPC) Program for Water Budget 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 FPC contracted the Nez Perce Tribe (NPT) to monitor outmigration timing and PIT (passive integrated transponder) tag 1,500 actively outmigrating hatchery chinook salmon smolts (*Oncorhynchus tshawytscha*), and 2,400 wild and hatchery steelhead trout smolts (*O. mykiss*) from the Imnaha River during the spring outmigration period (1 March - 15 June). An additional 1,000 wild 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. Determine smolt yield from the Imnaha River Basin.
 3. Evaluate effects of flow, smolt condition and other environmental factors on outmigration timing.
 4. Collect biological information on Imnaha River emigrants, such as length, weight, condition, and degree of smoltification based on gill **ATPase** analysis.
 5. Determine outmigration timing and/or travel time of PIT tagged hatchery chinook smolts released at the Imnaha Acclimation Pond, and wild chinook PIT tagged in the upper Imnaha River through interrogation at the Imnaha River trap.
 6. Determine outmigration 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.
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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 screw trap manufactured by E.G. Solutions Inc., Corvallis, Oregon was used to capture outmigrating **salmonid** smolts for this study. 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 moved through to a custom oversize **livebox** (1.68 m wide x 1.25 m long x 0.55 m deep). The **livebox** was fitted with a removable baffle to reduce velocities 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

Trapping for this project began on March 1, 1994 and was completed on June 15, 1994. The trap was operated 24 hours a day, seven days a week during this period. Exceptions to this occurred on several occasions when trap repair was necessary or the debris load in the river was dangerous to trap operation.

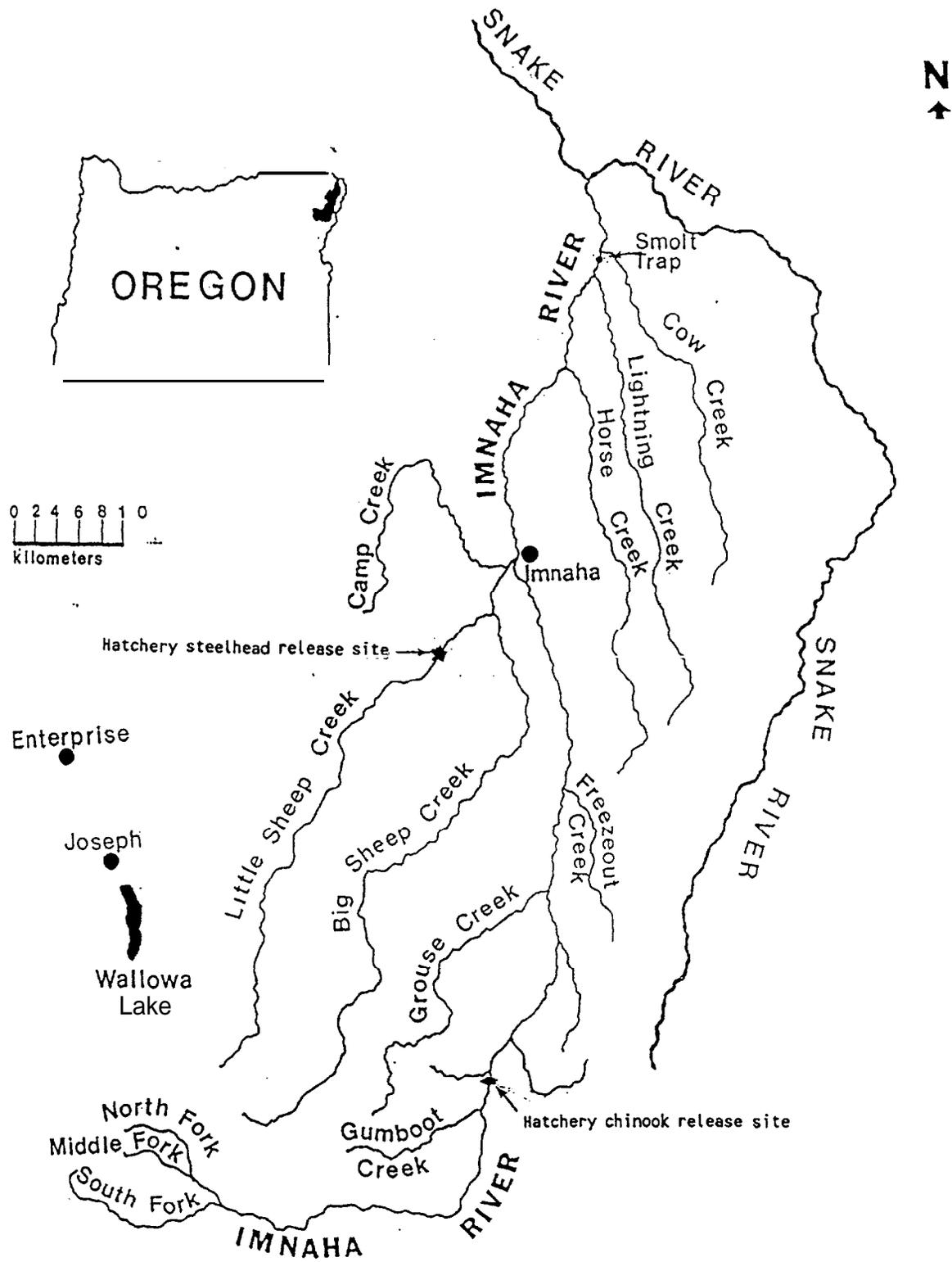


Figure 1. Map of study area.

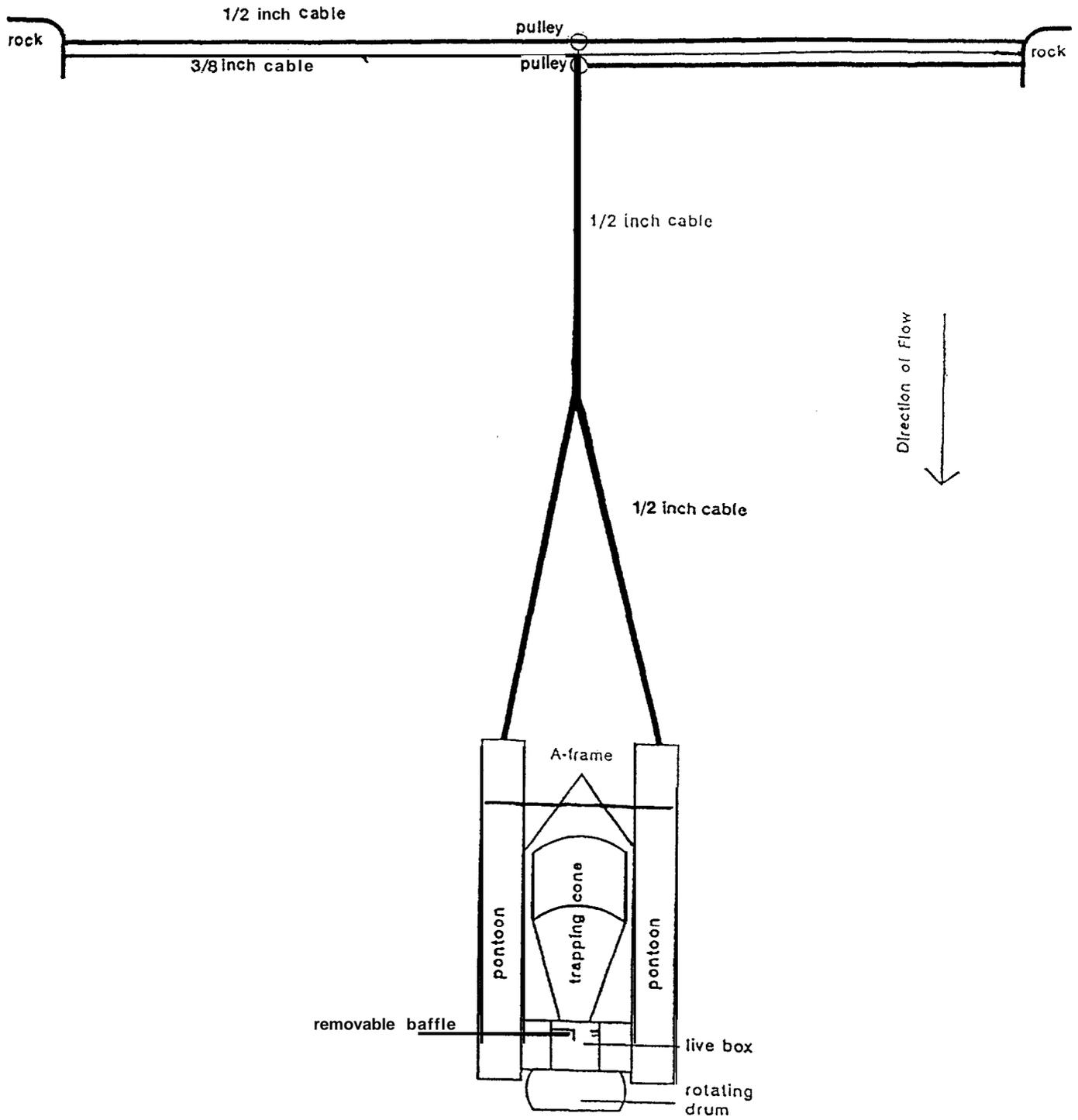


Figure 2. Diagram of screw trap.

The floating screw trap was secured on the west shore of the lower Imnaha River, below Cow Creek bridge, 6.6 kilometers from the confluence with the Snake River (Figure 1). The trap position in the river was adjustable 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 **livebox** of the screw-trap was checked at 0800 every morning. Piscivorous fish and large numbers of incidentally captured fish were removed from the **livebox** first. 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.

Processing procedures were as follows: 1) Fish were anaesthetized in a **MS-222** bath (standardized concentration) buffered with propolyaqua (**PRO-NOVAQUA**), 2) Each fish was examined for existing marks (e.g. fin clips, brands), and PIT tag insertion scars, 3) Fish with PIT tag scars were scanned with a PIT tag scanner, 4) Up to 100 fish of each group of 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) Mortality due to trapping was noted and recorded.

Exceptions to this procedure occurred after hatchery releases when upwards of 20,000 fish were captured in one night. On these occasions **netfulls** of fish were removed from the **livebox** and released through a remote PIT tag scanner (**Biomark model RM-DC400-6**) into the river. Catch estimates were made by subsampling 10% of the total number of **netfulls** for species composition. Fish were held in net pens until being processed.

Trap Efficiency

Trap efficiency trials for each species were conducted as often as possible with the requirement that at least 10 healthy individuals were available. Special efforts were made to conduct trials during changes in stream discharge. Wild and hatchery chinook salmon and wild steelhead trout smolts selected for trap efficiency trials were measured (FL) to the nearest 1.0 mm, weighed to the nearest 0.1 g, and marked by clipping the distal portion of one of eight possible clips (Table 2).

Hatchery steelhead trout smolts were marked with either a top caudal fin (TCC) or a lower caudal fin (LCC) clips on alternating days. This was necessary due to the erosion or absence of all other fins.

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

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

Marked fish were held in live pens 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. Size of recaptured smolts was compared with size of marked smolts released to determine whether trap efficiency differed by fish size within each species. Daily 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 spring outmigration period was divided into three flow periods based on trap efficiency correlated with discharge. The total number of fish captured, fish marked, and fish recaptured were summed within each flow period. During breaks in operation the total number of fish captured was estimated by taking an average of the catch the day before and after the break. During interruptions greater than one day catch was estimated in equal increments at an ascending or descending rate.

This data was used to calculate point estimates and confidence intervals of smolt yield for each species of each origin using two methods; the LINCOLN computer program (Steven Smith, U of W, pers. comm.) and the bootstrap method (Efron and Tibshirani 1986; Murphy et al. in prep). We reported results from Model One of the LINCOLN program, which is also known as the Peterson estimate (Smith, pers. comm.).

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).

An estimate of smolt yield for each species for the study period was accomplished by summing the point estimates for each flow period. Variance for each study period was summed to obtain an overall variance for the study period.

Biological Characteristics

Length frequency distributions were created and condition factors calculated for each species and origin. Condition factor was calculated using Fulton's condition factor (Bagenal and **Tesch** 1978).

Gill ATPase

Non-lethal gill ATPase samples were collected by the National Biological Survey (NBS) on a weekly basis from April 4 to May 5. Samples were collected from wild and hatchery chinook salmon and steelhead trout smolts and analyzed following the methods described in **Schrock** et al. (1994). Results were summarized by

species, origin and sample date.

PIT Tagging

Fish selected for passive integrated transponder (PIT) tagging were measured (FL), weighed, and examined for descaling and general health before being tagged. Only healthy fish greater than 60 mm were selected for tagging. 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). PIT tags and hypodermic injector units were sterilized after each use in ethanol alcohol for at least 10 minutes prior to tagging. Tagging was discontinued when water temperatures exceeded 15°C.

Weekly 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. An additional 150 wild chinook salmon smolts were tagged each week as part of a separate Nez **Perce** Tribe (NPT) investigation. Tagging methodology was the same for FPC and NPT fish. Fish tagged for FPC investigations were held for a minimum of one hour until fully recovered and then released as a group. Fish 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 fish to recover from tagging stress and increasing predator avoidance. Mortality due to tagging was noted and reported.

Tagging data were proofed for mistakes using **PITVAL** software program and 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.

Outmigration timing and travel time of PIT tagged hatchery chinook salmon smolts released at the Imnaha Acclimation Pond and wild chinook salmon parr PIT tagged in the upper Imnaha River was determined by interrogation through our screw trap.

Outmigration timing, travel time and recovery rate to Lower Granite Dam through the Snake River to **McNary** dam was determined for wild and hatchery chinook salmon and steelhead trout smolts. Release groups of fish were pooled weekly to determine outmigration timing and travel time to Lower Granite Dam. Wild and hatchery steelhead smolts were pooled by release strategy (i.e., immediate release vs. evening release). Travel time between **mainstem** dams was not calculated due to time constraints.

Table 3. Minimum number of fish to be PIT tagged per day for wild and hatchery steelhead trout and hatchery chinook salmon as detailed by the Fish Passage Center.

Species/rearing type	Tagging Dates	Daily Goal	Weekly Maximum
Wild Steelhead	April 25-29	50	250
	May 2-6	50	250
	May 9-13	50	250
	May 16-20	50	250
	May 23-26	50	250
Hatchery Steelhead	April 27-29	60	300
	May 2-6	60	300
	May 9-13	60	300
	May 16-20	60	300
Hatchery Chinook	April 5-9	100	500
	April 11-15	100	500
	April 18-22	100	500

Interrogation rates and outmigration timing during this report period are based on first-time observations of individual tag codes. Cumulative detection rate of each species was determined by dividing the sum of first tag code observations by the total number of fish tagged and released.

RESULTS AND DISCUSSION

Imnaha River Subbasin Outmigration

Imnaha River mean daily discharge during spring outmigration ranged from 4.5 **cms** (160 cfs) on March 1 to 41.9 **cms** (1,480 cfs) on May 12 at USGS gauge 13292000, Imnaha, OR (Figure 3). Mean daily water temperatures during the study period ranged from 4.2°C on March 7 to 16.6°C on June 12 (Figure 3). Appendix 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 92 days during the 107 day spring outmigration period (March 1 - June 15). There were seven occasions (effecting 15 days) during which the trap did not operate continuously. These interruptions were due either to trap malfunction or high debris load in the river (Table 4).

A total of 7,249 wild chinook salmon, 46,674 hatchery chinook salmon, 5,332 wild steelhead trout and 33,567 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.

Outmigration Trends

Wild chinook salmon were collected throughout the study period and comprised 8% of the total fish catch. Four pulses in wild chinook smolt outmigration from the Imnaha River were observed during the study period (Figure 4). The initial pulse in downstream movement occurred from March 4 - 10. Small numbers of chinook outmigrated through the end of March until a second spike in movement was observed between March 31 - April 10. These spikes in emigration occurred prior to the release of hatchery chinook and corresponded with smaller increases in stream discharge (Figure 4). The third observed pulse was the largest. Up to 5,000 fish/day emigrated from the Imnaha River between April 18 - May 10. This increase in emigration followed a sharp increase in discharge from 736 cfs on April 17 to 1370 cfs on April 21 and a decrease in water temperature from 12.6°C on April 17 to 9.6°C on April 22. The fourth spike in wild chinook downstream movement occurred from May 15 - 30 and appeared to follow the second major increase and peak in stream discharge (Figure 4). **Wild** chinook salmon were collected throughout the rest of the study period with 124 wild chinook being caught from June 12 to June 15.

Oregon Department of Fish and **Wildlife (ODFW)** released 438,699 hatchery chinook salmon smolts, of which 271,353 were acclimated and 167,346 were a direct

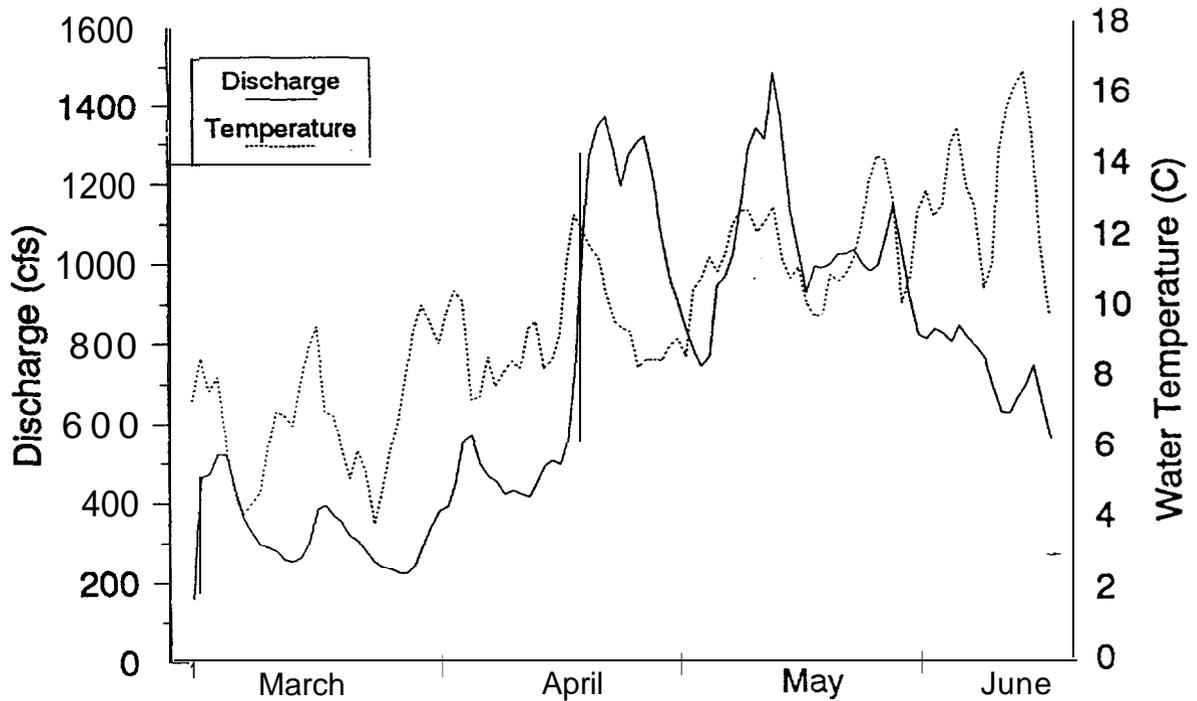


Figure 3. Mean daily discharge (USGS Gauge 13292000 at **Imnaha**, OR) and mean daily water temperature of **Imnaha** River during the spring outmigration period, March 1 - June 15, 1994.

Table 4. Dates screw trap was not operated during the study period, March 1 - June 15, 1994.

Date	Reason
3/04	High debris load in river
3/13 - 3/15	Trap not operated
3/21 - 3/22	Debris drum being repaired
4/19	High debris load in river
4/20	High debris load in river trap operated for 15 minutes (2030 - 2045).
4/25	Trap not operated-preparing for hatchery steelhead release
4/27	Trap pulled at 2030.
5/10 - 5/12	Debris drum shaft broken
5/22 - 5/23	Front shaft on screw broken
5/27	High debris load. Trap pulled at 2030.
6/2	Trap pulled at 2400.

Table 5. Weekly catch composition of wild and hatchery chinook salmon and steelhead trout smolts collected in the Imnaha River screw trap, March 1 – June 15, 1994.

Date	Chinook			Steelhead			Total Catch
	Wild	Hatchery	Total	Wild	Hatchery	Total	
Mar 1 – Mar 5	227	0	227	31	0	31	258
Mar 6 – Mar 12	1,099	0	1,099	129	0	129	1,228
Mar 13 – Mar 19	214	0	214	12	0	12	226
Mar 20 – Mar 26	178	0	178	8	0	8	186
Mar 27 – Apr 2	475	0	475	9	0	9	484
Apr 3 – Apr 9	1,739	0	1,739	94	0	94	1,833
Apr 10 – Apr 16	663	44,290	44,953	62	0	62	45,015
Apr 17 – Apr 23	287	1,171	1,458	389	3	392	1,850
Apr 24 – Apr 30	597	553	1,150	978	15,904	16,882	18,032
May 1 – May 7	618	543	1,161	1,655	2,651	4,306	5,467
May 8 – May 14	103	64	167	622	2,570	3,192	3,359
May 15 – May 21	339	35	374	671	3,393	4,064	4,438
May 22 – May 28	142	5	147	324	3,098	3,422	3,569
May 29 – Jun 4	196	9	205	262	3,315	3,577	3,782
Jun 5 – Jun 11	248	4	252	75	1,792	-1,867	2,119
Jun 12 – Jun 15	124	0	124	11	84	852	976
TOTAL	7,249	46,674	53,923	5,332	33,567	-38,899	92,822

stream release, into the Imnaha River at the Imnaha River acclimation pond (rkm 73) on April 11 (Mike Flesher, ODFW, pers. comm.). Hatchery chinook releases preceded the first major increase in river discharge by six days. Roughly 11% of the hatchery chinook smolts were captured during the study period which comprised 50% of the total catch. The first hatchery chinook salmon smolts (3) were captured in the trap the day following release (Figure 4). The majority (95%) of spring emigrants were captured from two to four days following release (April 13-16). Two large pulses were observed on April 18 and April 23 when an estimated 11,056 and 9,861 hatchery chinook salmon emigrated, respectively. These movements were closely associated with the first substantial increase in river discharge from 736 cfs to 1370 cfs and a corresponding decrease in water temperature. The last hatchery chinook was caught on June 11.

Wild steelhead were not sampled at the trap until March 5 which coincided with a spike in discharge. Wild steelhead trout smolts were then captured throughout the rest of the outmigration period, making up 6% of the total catch. The peak in migration occurred from April 18 to May 11 (Figure 5) with the highest single day of outmigration being 8,207 fish on May 5. Outmigrating wild steelhead trout smolts were captured throughout the rest of the reporting period, although only small numbers were trapped in June.

ODFW released about 332,000 hatchery steelhead trout smolts into the Imnaha River **subbasin** (Mike Flesher, ODFW, pers. comm.). On April 25, approximately 282,000 steelhead trout smolts were released at the Little Sheep

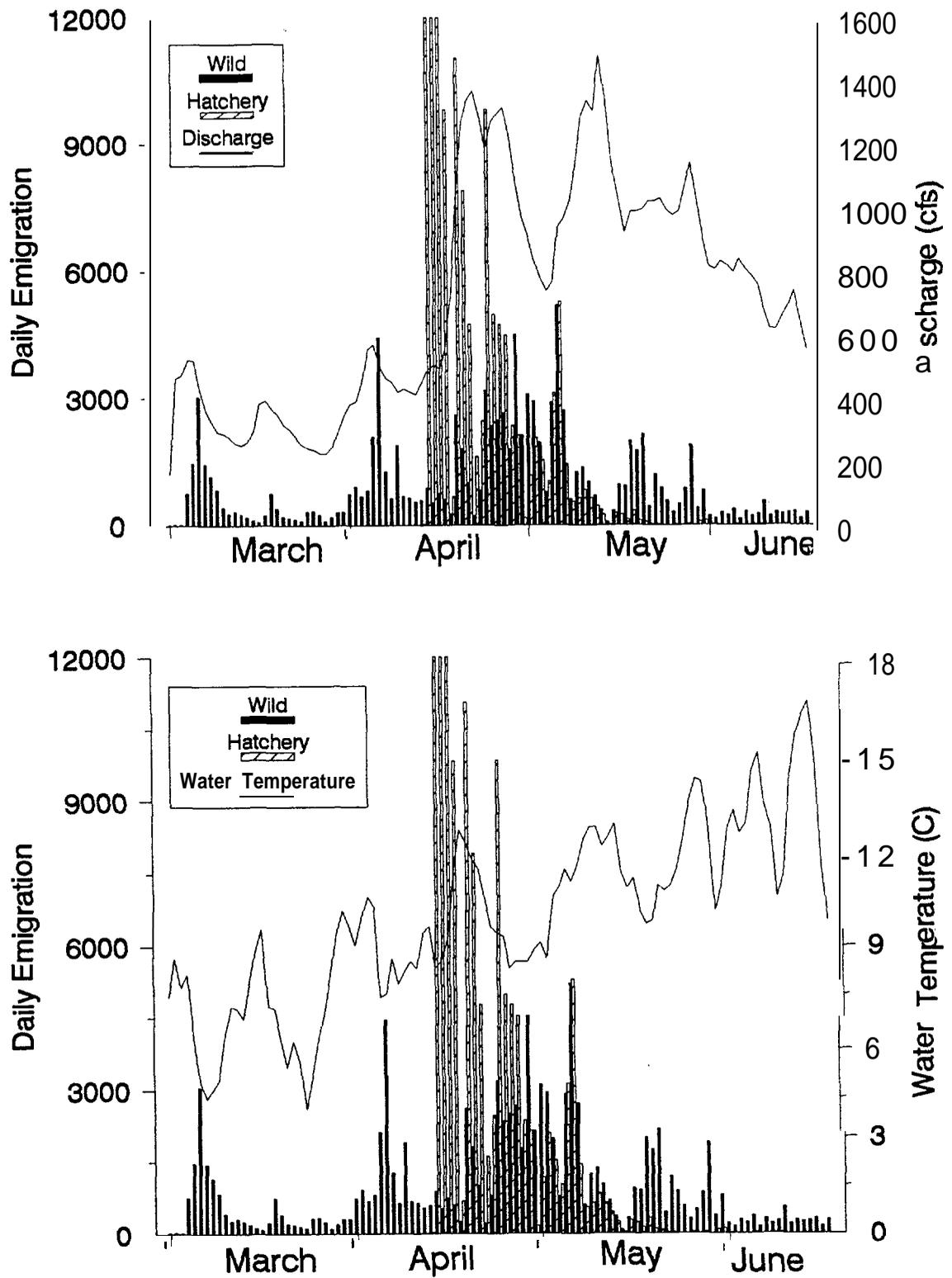


Figure 4. Wild and hatchery chinook salmon smolt daily outmigration versus mean daily water discharge (upper graph) and mean daily water temperature (lower graph) from the Imnaha River, March 1-June 15, 1994. Estimated hatchery chinook smolt outmigration on April 13 was 141,177; on April 14 was 102,707; and on April 15 was 47,544.

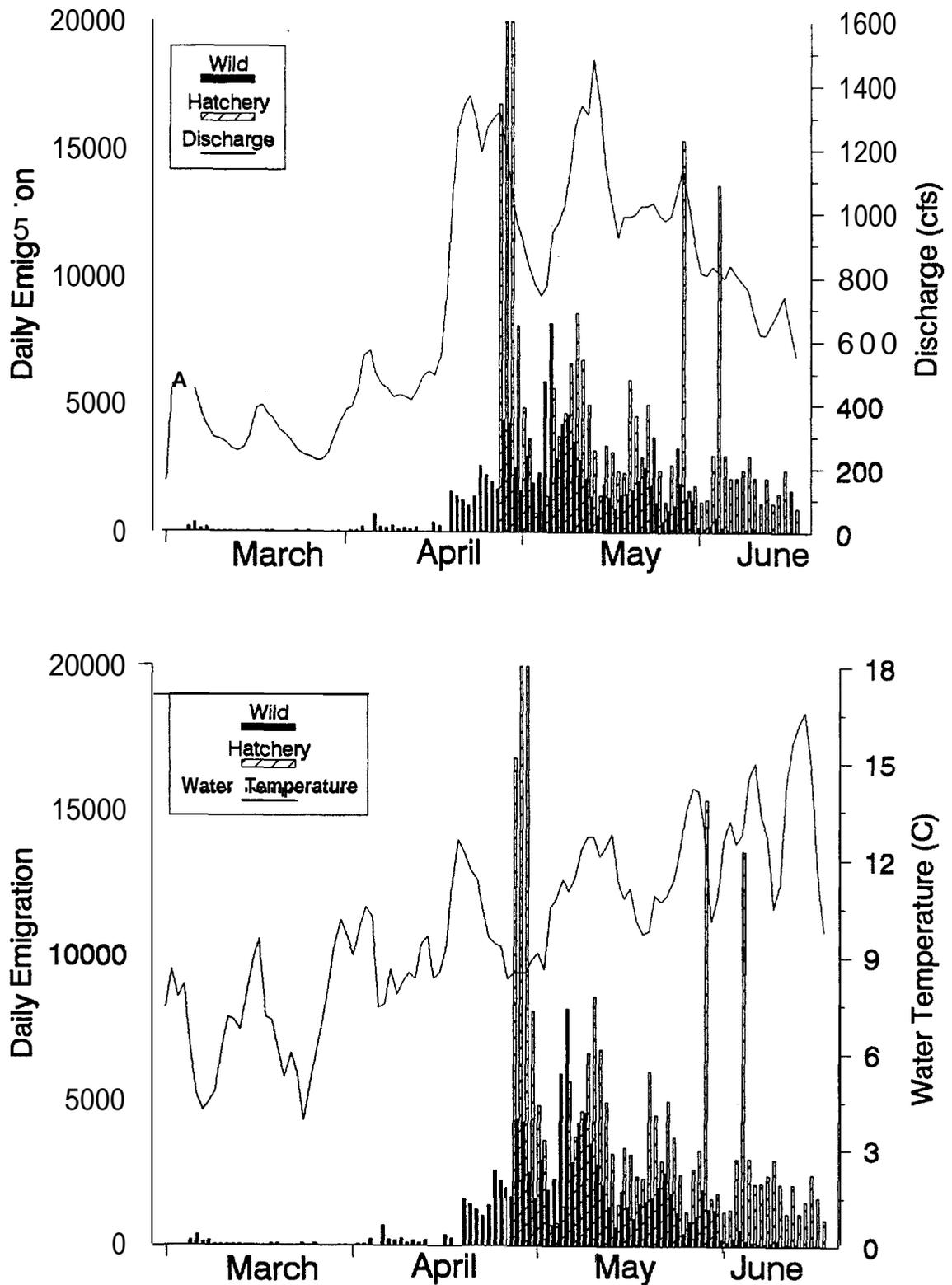


Figure 5. Wild and hatchery steelhead trout smolt daily outmigration versus mean daily water discharge (upper graph) and mean daily water temperature (lower graph) from the Imnaha River, March 1-June 15, 1994. Estimated hatchery steelhead smolt outmigration on April 27 was 65,375; and on April 28 was 29,078.

Creek acclimation pond (approximately 38 km upstream from the trap). On April 26, about 50,000 more were released at the town of Imnaha (rkm 32). Hatchery steelhead trout smolts began arriving at the trap at approximately 2200 hrs on April 25. On April 26, 682 hatchery steelhead trout smolts were captured. During the study period, 45% of the hatchery steelhead had migrated past the trap location by April 29. Catch rates remained around several hundred fish per day for the rest of the season with two exceptions. On May 27 and June 2 large numbers of hatchery steelhead smolts were captured in the trap with an estimated emigration past the trap of 15,359 and 13,606 smolts, respectively (Figure 5). These movements corresponded with intense rainstorms which resulted in high turbidity. At the conclusion of the study period hatchery steelhead smolts were still being caught at an average of 213 fish per day. Approximately 10% of the hatchery released emigrants were captured during the study period and represented 36% of the total catch.

Trap Efficiency and Smolt Yield

A total of 84 successful trap efficiency trials were conducted during the spring outmigration period. Trap efficiency rates during the first period (March 1 - April 17) were 14.7% (\pm 5.3%) for wild chinook salmon, 13.8% for hatchery chinook salmon and 16.3% (\pm 9.3%) for wild steelhead trout (Table 6). During the second period (April 18 - May 29) when flows were the highest (Figure 3) trap efficiency rates were the lowest; 3.6% (\pm 4.3%) for wild chinook salmon, 5.8% (\pm 5.7%) for wild steelhead trout and 12.8% (\pm 8.4%) for hatchery steelhead trout. Trap efficiency rates during the third period (May 30 - June 15) were 11.8% (\pm 13.2%) for wild chinook salmon, 12.7% (\pm 11.5%) for wild steelhead trout, and 22.8% (\pm 4.4%) for hatchery steelhead trout. Mark and recapture data for each trap efficiency trial are contained in Appendix C.

We were able to complete only one successful trial for hatchery chinook salmon due to the large numbers of hatchery chinook salmon smolts trapped and the compressed migration time frame. Conflicting sample size requirements for healthy smolts for PIT tagging and trap efficiency trials were an additional constraint. Wild chinook salmon trap efficiency rates were used to estimate smolt yield for hatchery chinook salmon.

Lincoln computer program and bootstrap method smolt yield estimates were very similar for each group of fish (Table 7). In most cases the bootstrap estimates were slightly higher than those derived from the Lincoln program. Confidence intervals for each estimate overlapped in all cases.

Table 6. Number of trap efficiency trials, mean trap efficiency and standard deviation during each flow period for each species.

	Flow period		
	Mar 1 -Apr 17	Apr 18–May 29	May 30-Jun 15
Wild Chinook			
Trials (n)	22	13	4
Mean trap efficiency	0.147	0.036	0.118
Standard deviation	0.053	0.043	0.132
Hatchery Chinook			
Trials (n)	1	0	0
Mean trap efficiency	0.138		
Standard deviation			
Wild Steelhead			
Trials (n)	8	9	3
Mean trap efficiency	0.163	0.058	0.127
Standard deviation	0.093	0.057	0.115
Hatchery Steelhead			
Trials (n)	0	11	13
Mean trap efficiency		0.128	0.228
Standard deviation		0.084	0.044

The total smolt yield estimate for wild chinook salmon during the study period (March 1 - June 15) was $90,358 \pm 26,042$ (95% C.I.) (Lincoln program) and $97,683 \pm 35,906$ (bootstrap method) (Table 7). For hatchery chinook salmon, the total estimate was $382,908 \pm 65,109$ using the Lincoln model and $386,693 \pm 55,685$ (bootstrap method). These estimates were 87% and 88%, respectively, of the total hatchery release.

Total smolt yield estimate for wild steelhead trout was $107,826 \pm 39,378$ (95% C.I.) (Lincoln program) and $105,040 \pm 40,485$ (bootstrap method) (Table 7). For hatchery steelhead trout, the total estimate was $250,126 \pm 43,570$ (Lincoln model) and $261,359 \pm 46,435$ (bootstrap method) which was 75% and 79%, respectively of the total hatchery release. Smolt yield data for each period are contained in Appendix D.

Biological Characteristics

Based on length frequency data the majority of chinook salmon and steelhead trout emigrants collected in the screw trap were 1' and 2' respectively (Figure 6 and 7). Three wild chinook, captured on March 31 and April 1, had lengths ranging from

Table 7. Smolt yield estimates ($\pm 95\%$ C.I.) for wild and hatchery chinook salmon and steelhead trout smolts using the Lincoln program (Smith pers.comm.) and bootstrap method (Murphy *et al.*, in prep). Estimates are from March 1 to June 15, 1994.

Species and Origin By Time Period	Lincoln Program		Bootstrap Method	
	Point Estimate	95% C.I.	Point Estimate	95% C.I.
Wild Chinook Salmon				
Mar 1 - Apr 17	36,909 \pm	4,666	34,821 \pm	4,584
Apr 18 - May 29	50,864 \pm	20,166	60,025 \pm	35,551
May 30 - Jun 15	2,585 \pm	1,210	2,837 \pm	2,094
TOTAL	90,358 \pm	26,042	97,683 \pm	35,906
Hatchery Chinook Salmon				
Mar 1 - Apr 17	323,923 \pm	41,718	317,071 \pm	42,192
Apr 18 - May 29	58,879 \pm	23,360	69,575 \pm	36,340
May 30 - Jun 15	106 \pm	31	47 \pm	42
TOTAL	382,908 \pm	65,109	386,693 \pm	55,685
Wild Steelhead Trout				
Mar 1 - Apr 17	2,145 \pm	580	2,325 \pm	781
Apr 18 - May 29	103,838 \pm	38,002	100,600 \pm	40,449
May 30 - Jun 15	1,843 \pm	796	2,115 \pm	1,522
TOTAL	107,826 \pm	39,378	105,040 \pm	40,485
Hatchery Steelhead Trout				
Mar 1 - Apr 17				
Apr 18 - May 29	223,887 \pm	40,900	236,515 \pm	46,358
May 30 - Jun 15	26,239 \pm	2,670	24,844 \pm	2,681
TOTAL	250,126 \pm	43,570	261,359 \pm	46,435

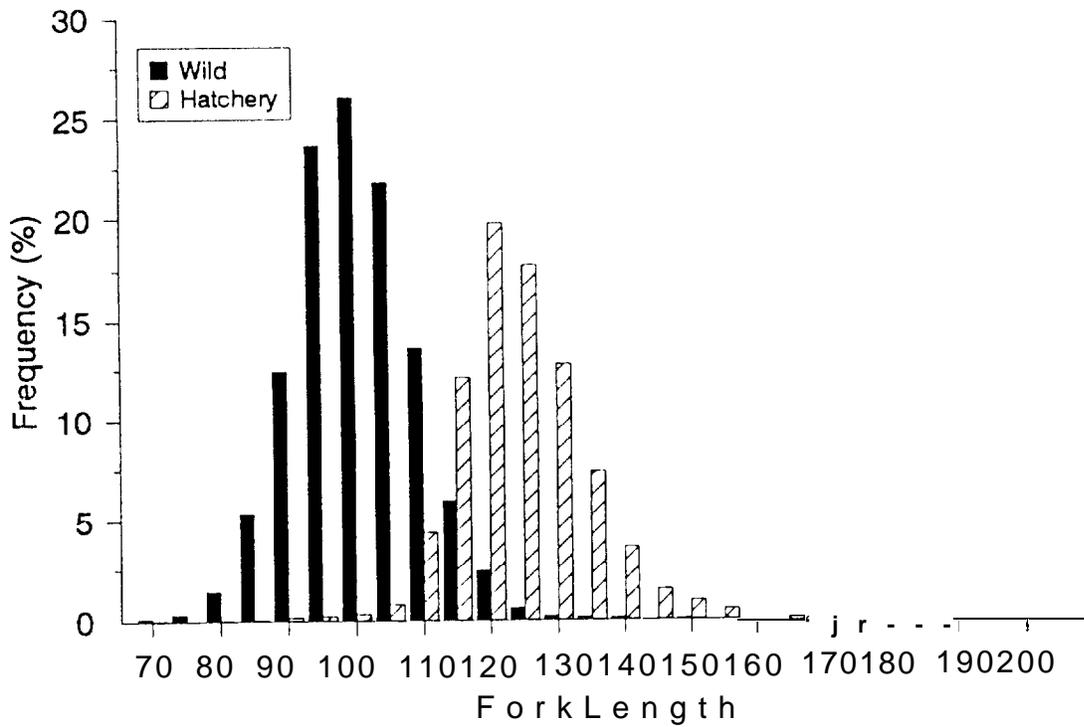


Figure 6. Length frequency of wild (n=3,190) and hatchery (n=9,034) chinook salmon smolts trapped in the Imnaha River, March 1-June 15, 1994.

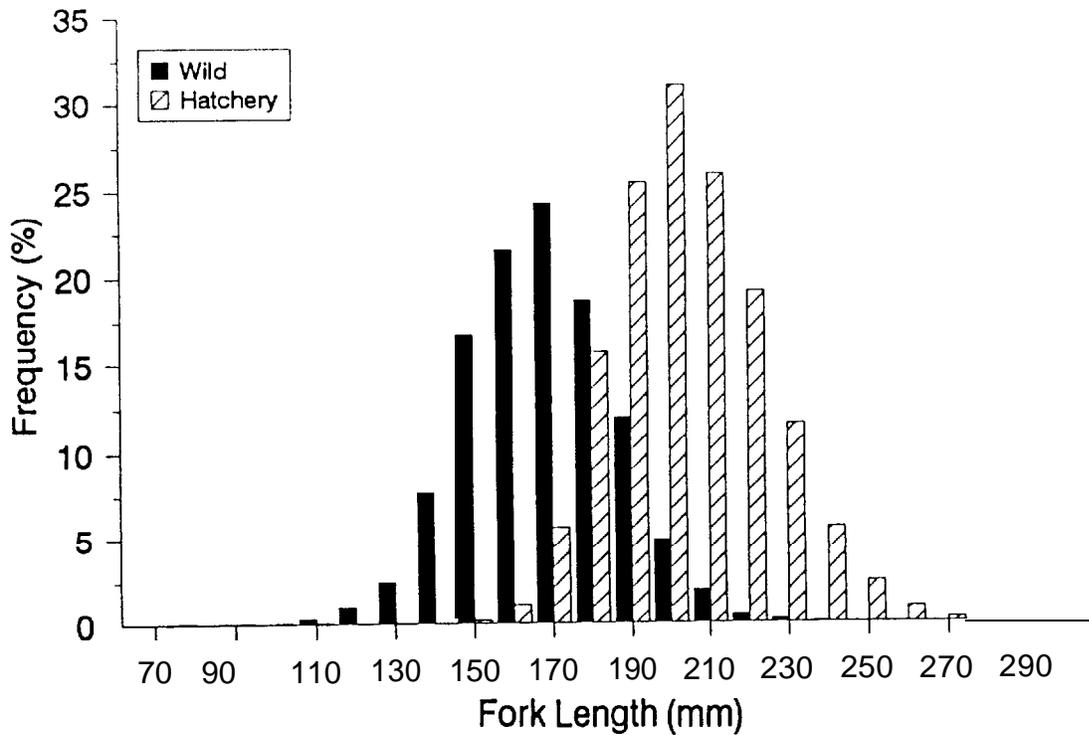


Figure 7. Length frequency of wild (n=2,228) and hatchery (n=3,229) steelhead trout smolts trapped in the Imnaha River, March 1-June 15, 1994.

38 to 39 mm. These fish were either fall chinook fry or early emerging spring chinook fry. They were not included in the length, weight and condition factor summaries.

Mean length of wild chinook salmon emigrants was 102 mm, mean weight was 11.7 g, and mean condition factor (K) of 1.07 (Table 8). Weekly mean length of wild chinook salmon was similar throughout the spring outmigration, ranging from 96.3 to 106.7 mm (Figure 8). Condition factors of wild chinook salmon ranged from 1.02 to 1.23 with a increasing trend from March to June (Figure 8).

Hatchery chinook salmon smolts were notably larger than their wild counterparts. Mean length was 126 mm, mean weight was 21.6 g, and mean condition factor (K) was 1.07 (Table 8). Weekly mean length of hatchery chinook salmon ranged from 115.0 to 129.2 mm (Figure 8). Condition factors of hatchery chinook ranged from 1 .00 to 1 .12 and were generally lower when compared to wild chinook salmon outmigrating at the same time (Figure 8). ODFW conducted a size release experiment with hatchery chinook salmon smolts by releasing two size groups; 15 fish/lb. (129 mm mean fl) and 25 fish/lb (112 mm mean fl) (Rhine Messmer, ODFW, pers. comm). We did not observe a bimodal distribution of hatchery chinook salmon smolt lengths captured in our trap (Figure 6).

Wild steelhead trout mean length was 172 mm, mean weight was 52.4 g, and mean condition factor (K) was 1.00 (Table 8). Weekly mean fork length of wild steelhead trout was similar throughout the spring outmigration, ranging from 156.4 to 180.5 mm (Figure 9). Condition factors of wild steelhead trout ranged from 0.96 to 1.07 (Figure 9).

Table 8. Mean fork length (mm), weight (g) and condition factor (K) of chinook salmon and steelhead trout smolts collected in the Imnaha River trap, March 1 - June 15, 1994.

Species/ Rearing	Type	n	Mean Fork Length	S.E.	Mean Weight	S.E.	Mean K	S.E.
Chinook-W		3,190	102	0.16	11.7	0.06	1.07	0.001
Chinook-H		9,034	126	0.14	21.6	0.05	1.07	0.001
Steelhead-W		2,228	172	0.41	52.4	0.36	1.00	0.002
Steelhead-H		3,229	209	0.34	89.0	0.49	0.95	0.004

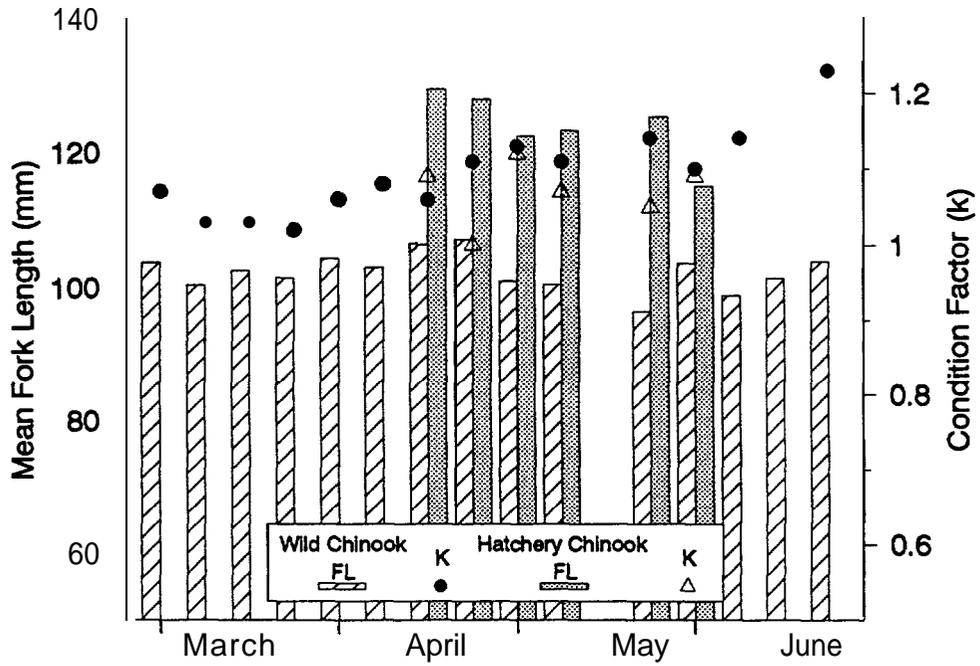


Figure 8. Weekly mean length and condition factor of wild and hatchery chinook salmon smolts trapped in the Imnaha River, March 1 - June 15, 1994.

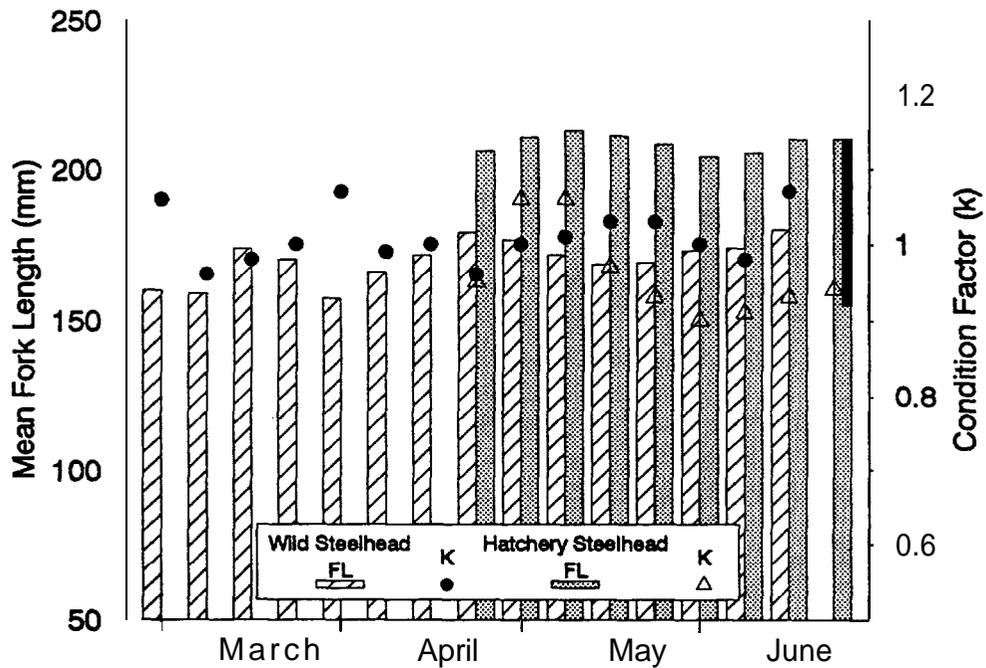


Figure 9. Weekly mean length and condition factor of wild and hatchery steelhead trout smolts trapped in the Imnaha River, March 1 - June 15, 1994.

Hatchery steelhead trout were about **40-50** mm larger than their wild counterparts, with a mean length of 209 mm, mean weight of 89.0 g, and mean condition factor (K) of 0.95 (Table 8). Weekly mean lengths of hatchery steelhead trout ranged from 204.0 to 212.8 mm (Figure 9). Condition factors of hatchery steelhead trout declined the fourth week after release in the Imnaha River, and remained at lower levels through mid-June. In comparison to wild steelhead trout, condition factors of hatchery fish were generally lower, ranging from 0.90 to 1.06 (Figure 9).

Daily sample size, mean and standard error for length, weight and condition factor details for both species of each origin are contained in Appendix E.

Gill ATPase

Gill ATPase samples were collected from 213 wild chinook salmon, 260 hatchery chinook salmon, 116 wild steelhead trout, and 126 hatchery steelhead trout smolts from April 5 to May 4 by National Biological Survey (NBS) personnel. Mean ATPase values for each date (or release group) ranged from 8.1 to 11.7 $\mu\text{molesPi/mg protein/hr}$ for wild chinook and from 6.9 to 10.4 $\mu\text{molesPi/mg protein/hr}$ for hatchery chinook (Table 9). No consistent increases in mean ATPase levels were evident for wild chinook salmon smolts over the sample period. Mean ATPase values ranged from 7.8 to 12.5 $\mu\text{molesPi/mg protein/hr}$ for wild steelhead trout and from 5.6 to 8.0 $\mu\text{molesPi/mg protein/hr}$ for hatchery steelhead trout.

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. Mortality rates were 1.42% for wild chinook salmon, 0.27% for hatchery chinook salmon, 0.45% for wild steelhead trout, and 0.44% for hatchery steelhead trout smolts (Table 10). Trapping was the major cause of mortality for each group of fish except for wild steelhead trout (Table 10).

Incidental Catch

Species incidentally captured during our investigation included: six adult steelhead, three smallmouth bass (*Micropterus dolomieu*), two bull trout (*Salvelinus confluentus*), and two mountain whitefish (*Prosopium williamsoni*) (Table 11). Non-game fish captured included **longnose dace** (*Rhinichthys cataractae*), bridgelip sucker (*Catostomus columbianus*), chiselmouth (*Acrocheilus alutaceus*), **redside shiner** (*Richardsonius balteatus*), northern squawfish (*Ptychocheilus oregonensis*) and sculpin (*Cottus sp.*) (Table 11). Appendix E contains daily incidental catch data.

Table 9. Results of gill ATPase samples including sample size (n), mean fork length (mm), and mean weight (g) for wild and hatchery chinook salmon and steelhead trout smolts. ATPase units are in $\mu\text{molesPi/mgProt/hr}$. Collection and analysis was conducted by the National Biological Survey Lab, Cook, WA.

Date	Wild Chinook							Hatchery Chinook						
	n	ATPase	SE.	Mean FL	S. E.	Mean WT	SE.	n	ATPase	S. E.	Mean FL	S.E.	Mean WT	SE.
Apr 5	19	8.3	0.8	105.6	1.1	11.4	0.7							
Apr 12	67	11.7	0.4	110.1	1.0	13.6	0.4							
Apr 13								38	7.4	0.3	130.3	1.8	24.7	1.1
Apr 14								39	8.2	0.3	129.1	1.1	21.8	0.5
Apr 15								37	8.0	0.3	131.8	1.6	23.6	1.0
Apr 26	51	8.1	0.4	103.1	1.2	12.7	0.4	40	6.9	0.2	124.2	1.3	21.3	0.7
Apr 27														
Apr 28														
May 3	25	11.3	0.6	101.3	1.4	11.2	0.4	31	7.7	0.4	122.6	1.6	21.2	0.8
May 4	51	11.1	0.5	104.5	1.9	11.5	0.3	34	9.5	0.5	125.0	1.7	20.7	0.9
TOTAL	213							260						

	Wild Steel head				Hatchery Steel head									
	n	ATPase	S.E.	Mean FL	SE.	Mean WT	SE.	n	ATPase	S.E.	Mean FL	S.E.	Mean WT	S.E.
Apr 26														
Apr 27	27	8.1	0.5	174.6	3.0	51.8	2.6	28	5.6	0.3	216.2	2.7	104.0	4.4
Apr 28	29	9.2	0.5	180.9	3.6	63.0	3.6	30	6.1	0.4	211.8	3.5	62.9	9.5
May 3	12	12.5	1.1	162.0	4.1	45.8	3.3	13	8.0	0.7	214.1	4.4	104.5	8.0
May 4	20	10.6	0.7	17.3	4.2	54.6	4.7	26	7.3	0.5	216.7	2.2	111.6	7.2
TOTAL	116							126						

Table 10. Mortality of each species due to trapping and PIT tagging.

	Wild Chinook		Hatchery Chinook		Wild Steelhead		Hatchery Steelhead	
Number captured	7,249		46,674		5,332		33,567	
Mortality								
Source	n	%	n	%	n	%	n	%
Trap	80	1.10	122	0.26	7	0.13	80	0.24
PIT tagging	23	0.32	2	co.01	17	0.32	67	0.20
TOTAL	103	1.42	124	0.27	24	0.45	147	0.44

Table 11. Weekly catch composition of incidental species collected in the Imnaha River trap, March 1 - June 15, 1994.

Date	STHD	BT	MWF	SMB	CHSL	RSS	LND	NSF	BLS	SC	Catch
Mar 11 - Mar 5	0	0	0	0	0	1	26	1	10	0	38
Mar 6 - Mar 12	0	0	0	0	0	0	0	0	0	0	0
Mar 13 - Mar 19	0	0	0	0	0	0	44	0	7	3	54
Mar 20 - Mar 26	0	0	0	0	2	0	12	0	0	2	16
Mar 27 - Apr 2	1	0	0	1	2	5	187	0	8	2	206
Apr 3 - Apr 9	0	0	0	0	0	2	18	2	24	6	52
Apr 10 - Apr 16	0	0	0	0	0	0	7	0	3	5	15
Apr 17 - Apr 23	0	1	0	0	3	1	5	-2	44	1	57
Apr 24 - Apr 30	0	0	0	0	2	0	1	1	5	1	10
May 1 - May 7	0	0	1	0	2	2	6	0	9	1	22
May 8 - May 14	1	0	0	0	0	2	4	0	12	0	19
May 15 - May 21	2	0	0	0	1	0	17	0	21	2	43
May 22 - May 28	1	1	0	0	3	0	109	0	32	0	146
May 29 - Jun 4	1	0	0	1	2	0	201	0	148	0	353
Jun 5 - Jun 11	0	0	1	0	16	0	187	0	103	1	308
Jun 12 - Jun 15	0	0	0	0	1	0	50	0	53	0	104
TOTAL	6	2	2	3	34	13	874	6	479	24	1,443

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

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

Outmigration of PIT Tanned Fish

Imnaha River Outmigration

ODFW released 2,976 PIT tagged hatchery chinook salmon smolts from the Imnaha River acclimation ponds on April 11, 1994. We captured 135 (4.5%) of these fish in our trap. The majority (67%) were interrogated on April 13, two days after release (Figure 10).

A total of 1,515 PIT tagged hatchery steelhead trout smolts were released by ODFW at the Little Sheep Creek acclimation pond on April 25, 1994. We interrogated 27 (1.8%) PIT tagged hatchery steelhead trout; 15 on April 26, 9 on April 27, and 3 on April 28 (Figure 11).

PIT Tag Release Groups

We PIT tagged and released 956 wild chinook salmon smolts at the Imnaha River screw trap during the spring emigration period. Mean lengths of weekly release groups ranged from 99.3 to 108.4 mm, weights from 10.7 to 14.3 g, and condition factors from 0.98 to 1.22 (Table 12). Weekly release groups consisted of over 100 wild chinook salmon from March 26 to May 21, 1994 with two exceptions; weeks ending April 23 and May 14 (Table 12).

We PIT tagged 661 hatchery chinook salmon smolts during the study period. Mean lengths of weekly release groups ranged from 122.2 to 129.1 mm, weights from 20.5 to 23.1 g, and condition factors from 1.00 to 1.32 (Table 12). Weekly release groups consisted of over 100 hatchery chinook salmon from April 16 to April 30, 1994 (Table 12).

We PIT tagged 1,432 wild steelhead trout smolts during the study period; 846 were held a minimum of 12 hours and released at dark (NPT investigations) and 586 were released approximately one hour after tagging (FPC investigations) (See Methods for details). Mean lengths of weekly release groups ranged from 167.7 to 180.3 mm, weights from 49.2 to 64.0 g, and condition factors from 0.87 to 1.10 (Table 13).

We PIT tagged 2,029 hatchery steelhead trout smolts during the study period; 793 were held a minimum of 12 hours and released at dark (NPT investigations) and 1,236 were released approximately one hour after tagging (FPC investigations). Mean lengths of weekly release groups ranged from 196.0 to 212.8 mm, weights from 70.3 to 102.9 g, and condition factors from 0.84 to 1.37 (Table 14).

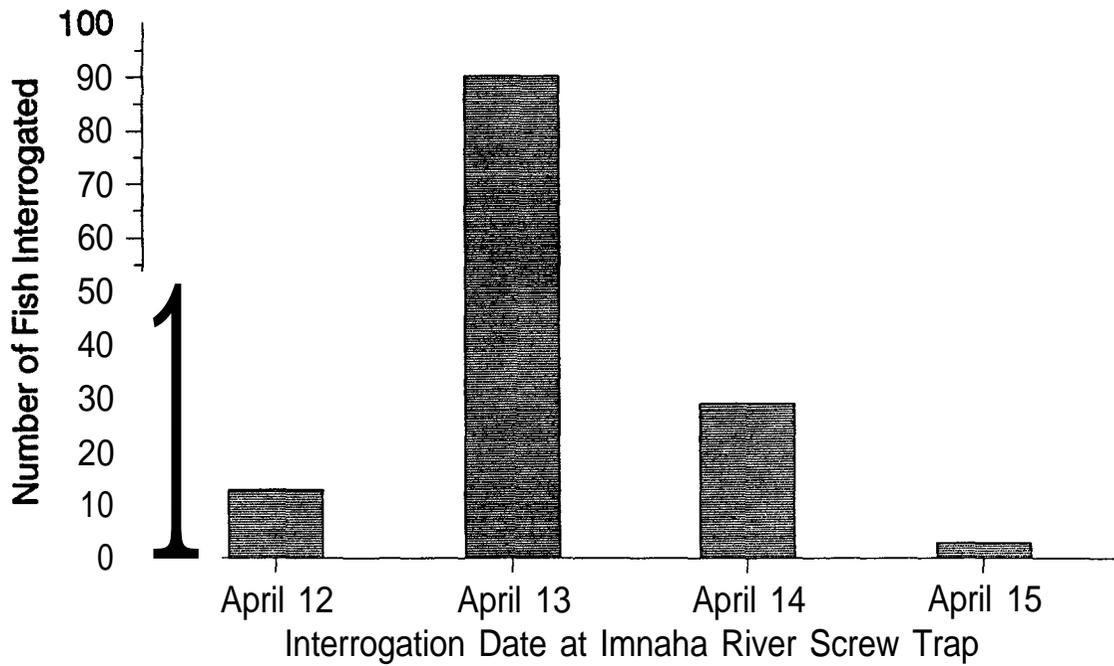


Figure 10. Outmigration timing of PIT tagged hatchery chinook salmon smolts released on April 11 at the Imnaha River acclimation pond.

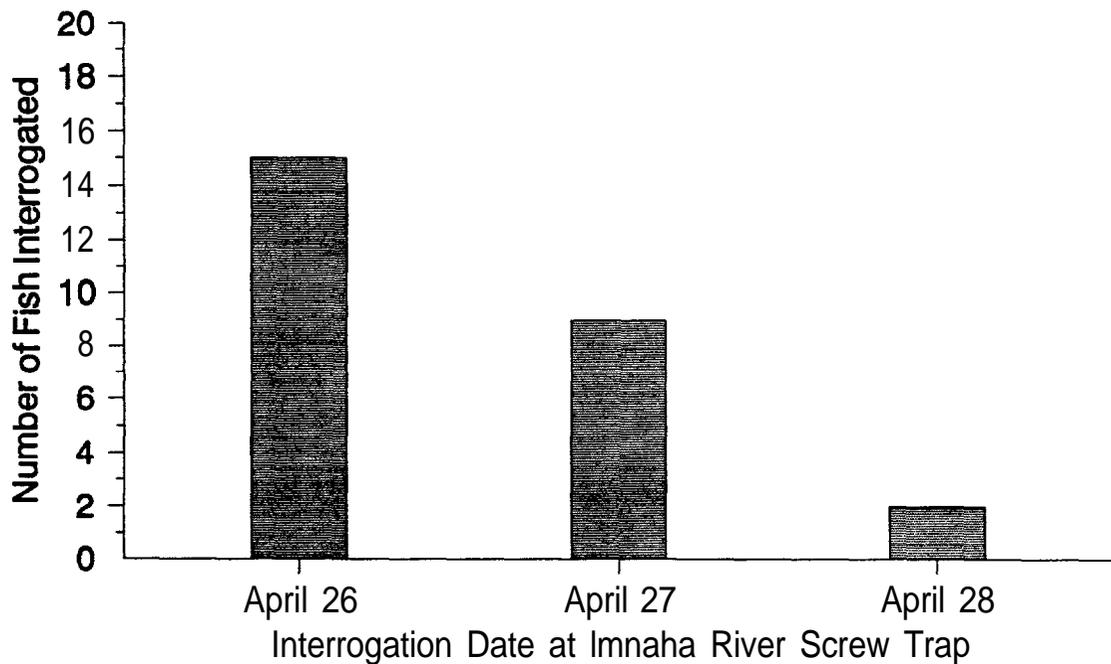


Figure 11. Outmigration timing of PIT tagged hatchery steelhead trout smolts released on April 25 at the Little Sheep Creek acclimation pond.

Table 12. Mean fork length (mm), weight (g) and condition factors for each weekly release group-of PIT tagged wild and hatchery chinook salmon released at the Imnaha River trap, March 1 - June 15, 1994.

Release Week Date	Ending	Wild Chinook			Hatchery Chinook				
		n	Mean Length (S.E.)	Mean Weight (S.E.)	Mean Condition (S.E.)	n	Mean Length (S.E.)	Mean Weight (S.E.)	Mean Condition (S.E.)
Mar. 26		111	102.1 (0.77)	10.7 (0.26)	1.02 (0.007)				
Apr. 2		147	106.0 (0.70)	12.7 (0.24)	1.13 (0.007)				
Apr. 9		148	104.8 (0.59)	11.8 (0.20)	1.20 (0.007)				
Apr. 16		155	107.5 (0.67)	13.0 (0.24)	0.98 (0.006)	200	129.1 (0.64)	23.1 (0.37)	1.14 (0.006)
Apr. 23		7	108.4 (2.57)	14.3 (1.10)	1.17 (0.019)	152	126.4 (0.63)	21.0 (0.35)	1.02 (0.006)
Apr. 30		138	100.4 (0.61)	11.9 (0.21)	1.05 (0.008)	133	123.1 (0.70)	21.1 (0.51)	1.06 (0.006)
May 7		121	102.8 (1.02)	12.0 (0.24)	1.06 (0.017)	164	123.4 (0.69)	20.7 (0.38)	1.00 (0.012)
May 14		0				0			
May 21		129	99.3 (1.14)	11.9 (0.60)	1.22 (0.007)	12	122.2 (3.64)	20.5 (1.53)	1.32 (0.035)
TOTAL		956	103.5 (0.31)	12.1 (0.12)	1.07 (0.004)	661	125.7 (0.35)	21.6 (0.20)	1.07 (0.004)

Table 13. Mean fork length (mm), weight (g) and condition factors for each weekly release group of PIT tagged wild steelhead trout released at the Imnaha River trap, March 1 - June 15, 1994. NPT=held 12 hours and released at dark, FPC=released after recovery from tagging (approximately one hour).

Wild Steelhead Trout									
Release Week Date Ending		NPT Investigations			FPC Investigations			n	
		Mean Length (S.E.)	Mean Weight (S.E.)	Mean Condition (S.E.)	Mean Length (S.E.)	Mean Weight (S.E.)	Mean Condition (S.E.)		
Apr. 23		144	180.3 (1.36)	56.1 (1.32)	0.87 (0.005)				
Apr. 30		147	175.8 (1.36)	56.5 (1.33)	0.97 (0.006)	101	176.4 (1.90)	55.4 (1.80)	0.96 (0.008)
May 7		127	172.1 (2.16)	53.0 (1.57)	0.98 (0.014)	160	169.3 (1.82)	50.0 (1.26)	0.88 (0.010)
May 14		134	167.7 (1.36)	49.4 (1.17)	0.96 (0.013)				
May 21		151	169.8 (1.21)	51.5 (1.06)	1.01 (0.005)	278	168.4 (0.86)	49.2 (0.77)	1.00 (0.004)
May 28		52	173.5 (2.11)	54.7 (1.98)	1.10 (0.008)	47	172.8 (1.71)	52.2 (1.61)	0.94 (0.007)
Jun. 4		55	175.1 (2.11)	53.5 (2.03)	0.92 (0.010)				
Jun. 11		36	180.3 (2.96)	64.0 (3.73)	1.02 (0.021)				
TOTAL		846	173.5 (0.62)	53.7 (0.54)	1.01 (0.004)	586	170.0 (0.74)	50.4 (0.59)	1.01 (0.004)

Table 14. Mean fork length (mm), weight (g) and condition factors for each weekly release group-of PIT tagged hatchery steelhead trout released at the Imnaha River trap, March 1 - June 15, 1994. NPT=held 12 hours and released at dark, FPC=released after recovery from tagging (approximately one hour).

Hatchery Steelhead Trout									
Release Week		NPT Investigations				FPC Investigations			
Date	Ending	n	Mean Length (S.E.)	Mean Weight (S.E.)	Mean Condition (S.E.)	n	Mean Length (S.E.)	Mean Weight (S.E.)	Mean Condition (S.E.)
Apr. 23		2	205.5 (8.84)	82.8 (9.76)	0.93 (0.007)				
Apr. 30		158	208.2 (1.34)	100.9 (2.66)	1.01 (0.007)	288	209.8 (1.53)	99.8 (2.25)	0.92 (0.006)
May 7		117	212.8 (2.02)	102.9 (3.17)	1.07 (0.007)	169	211.6 (1.58)	100.6 (2.31)	0.98 (0.061)
May 14		116	206.7 (1.75)	88.9 (2.49)	0.88 (0.006)	60	209.2 (2.76)	93.8 (3.85)	1.01 (0.008)
May 21		149	209.5 (2.44)	87.7 (3.68)	1.37 (0.012) 1.04	357	207.7 (0.96)	86.3 (1.33)	0.89 (0.003)
May 28		51	196.0 (6.03)	70.3 (6.87)	0.97 (0.023)	362	206.3 (0.95)	80.7 (11.26)	0.84 (0.003)
Jun. 4		60	207.4 (2.75)	85.1 (3.72)	0.91 (0.008)				
Jun. 11		142	209.2 (1.58)	84.2 (2.08)	0.97 (0.005)				
TOTAL		793	209.5 (0.62)	91.5 (0.54)	0.97 (0.004)	1236	208.2 (0.57)	88.8 (0.82)	0.97 (0.010)

Snake River Flows

Stream discharge during the spring **smolt** outmigration period, measured at the **Anatone** gauge station (Figure 12), ranged from 16.4 to 25.2 kcfs from March 1 to mid-April. Beginning April 16, discharge increased steadily to 50 kcfs on April 24 and peaked at 64.3 kcfs on May 11. Flows generally declined after May 28 (44.8 kcfs) ranging downward from 25.1 kcfs on June 15, to a low of 9.66 kcfs on August 9.

Stream discharge measured at Lower Granite Dam (LGR) ranged from 21.3 to 43.4 kcfs from March 1 to April 13, 1994 (Figure 12). Discharge at LGR, paralleled increases in Snake River flows observed at the **Anatone** gauge station, steadily increasing from April 16 (33.4 kcfs) to April 24 (80.9 kcfs). Peak discharge of 93.4 kcfs was observed at LGR on May 11. A steady decline in flows at LGR was observed from 79.4 kcfs on May 25 downward to 36.4 kcfs measured on June 11. This decline occurred during the water spill time frame. Discharge at LGR was 45.6 kcfs on June 15 and flows generally declined from then until July 1 when a 22.3 kcfs flow was observed.

The water spill period at LGR was initiated on May 10 and occurred continuously through June 15, when spill ended. Water spill occurred again on August 23-25 when stream discharge at LGR ranged between 11.5-18.5 kcfs.

Interroaation Rates

Interrogation rates were based on first observation detections at the **mainstem** Snake River (Lower Granite, Little Goose and Lower Monumental dams) **and** Columbia River (**McNary** Dam) dams. Interrogation rates are most likely biased as an unknown percentage of the PIT tagged fish are barged and subsequently not detected. This percentage has been estimated to be as high as IO-15% (B. Sandford, pers. **comm.**).

A total of 595 (62.2 %) of the 956 PIT tagged wild chinook salmon smolts released at the Imnaha River trap were interrogated (or detected) at **mainstem** dams (Table 15). Cumulative interrogation rates for weekly release groups ranged from 65 to 80% for fish tagged in late March-early April to 31 to 50% for fish tagged in early to late May (Figure 13). The April 23 release group contained only seven PIT tagged wild chinook which did not provide a sufficient sample size to base analysis on.

A total of 299 (45.2 %) of the 661 PIT tagged hatchery chinook salmon released at the Imnaha River trap were interrogated at **mainstem** dams (Table 16). Cumulative interrogation rates for weekly release groups decreased from 53% for the first group (released in mid-April) to 40.2% for the group released in early May (Figure 14). The May 21 release group contained only 12 PIT tagged fish which precluded analysis on that group.

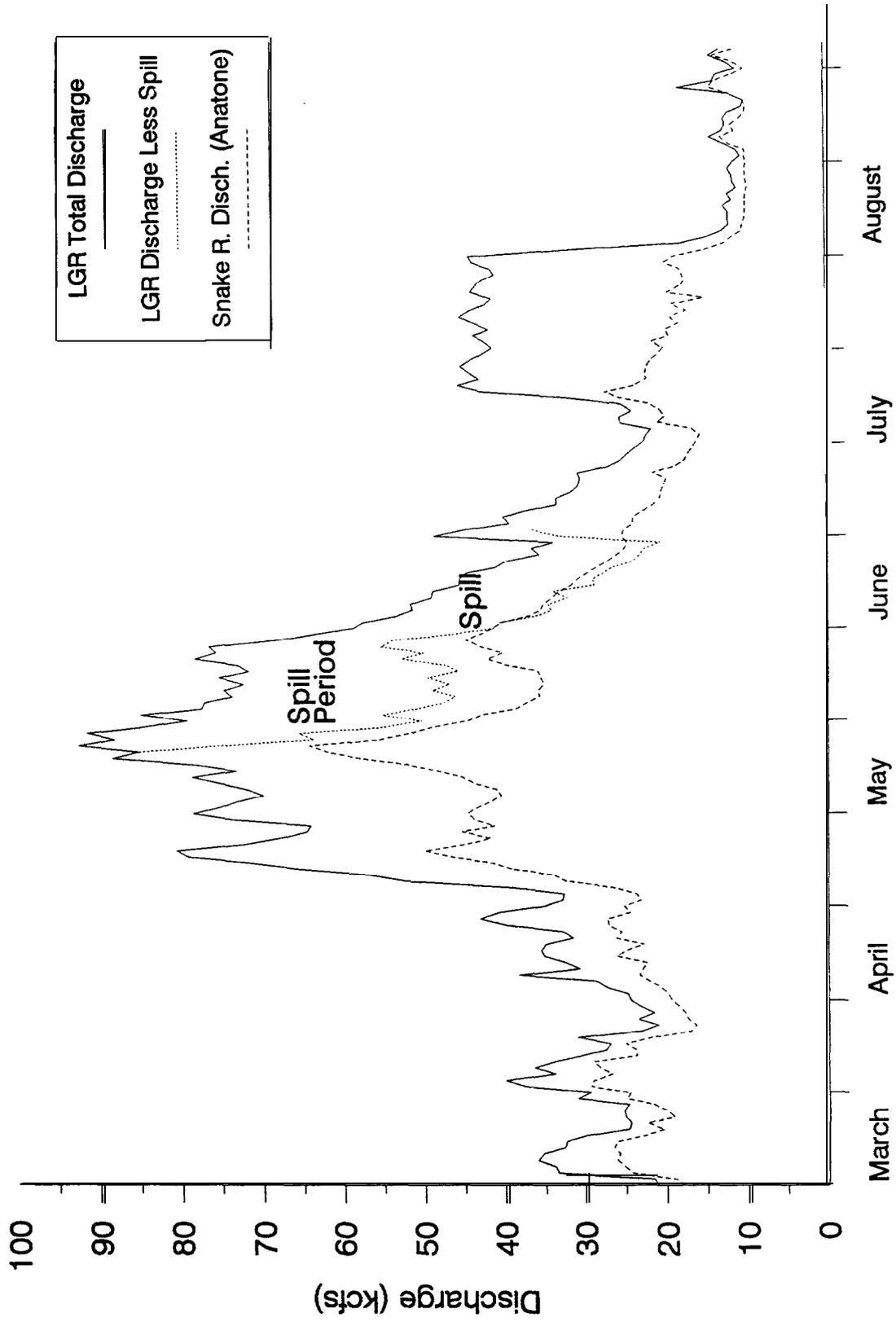


Figure 12. Total water discharge at Lower Granite Dam (LGR), water spill period at LGR and Snake River discharge at the Anatone gauge station, March-August, 1994.

Table 15. Interrogation rates (based on first observations) of weekly release groups of PIT tagged wild chinook salmon at Lower Granite, Little Goose, Lower Monumental and McNary dams.

Release Week Date Ending	Number Tagged	Granite		Goose		LoMo		McNary		Total	
		n	%	n	%	n	%	n	%	n	%
Mar 26	111	47	42.3	14	12.6	7	6.3	4	3.6	72	64.9
Apr 2	147	70	47.6	20	13.6	10	6.8	4	2.7	104	70.7
Apr 9	148	70	47.3	23	15.5	16	10.8	9	6.1	118	79.7
Apr 16	155	72	46.5	26	16.8	14	9.0	9	5.8	121	78.1
Apr 23	7	2	28.6	0		0		1	14.3	3	42.9
Apr 30	138	45	32.6	8	5.8	10	7.2	13	9.4	76	55.1
May 7	121	23	19.0	16	13.2	12	9.9	10	8.3	61	59.4
May 21	129	19	14.7	6	4.7	10	7.8	5	3.9	40	31.0
TOTAL	956	348	36.4	113	11.8	79	8.3	55	5.8	595	62.2

Table 16. Interrogation rates (based on first observations) of weekly release groups of PIT tagged hatchery chinook salmon at Lower Granite, Little Goose, Lower Monumental and McNary dams.

Release Week Date Ending	Number Tagged	Granite		Goose		LoMo		McNary		Total	
		n	%	n	%	n	%	n	%	n	%
Apr 16	200	52	26.0	14	7.0	21	10.5	18	9.0	105	52.5
Apr 23	152	36	23.7	8	5.3	9	5.9	8	5.3	61	40.1
Apr 30	133	36	27.1	11	8.3	10	7.5	6	4.5	63	47.4
May 7	164	23	14.0	15	9.1	11	6.7	17	10.4	66	40.2
May 21	12	0		2	16.7	1	8.3	1	8.3	4	33.3
TOTAL	661	147	22.2	50	7.6	52	7.9	50	7.6	299	45.2

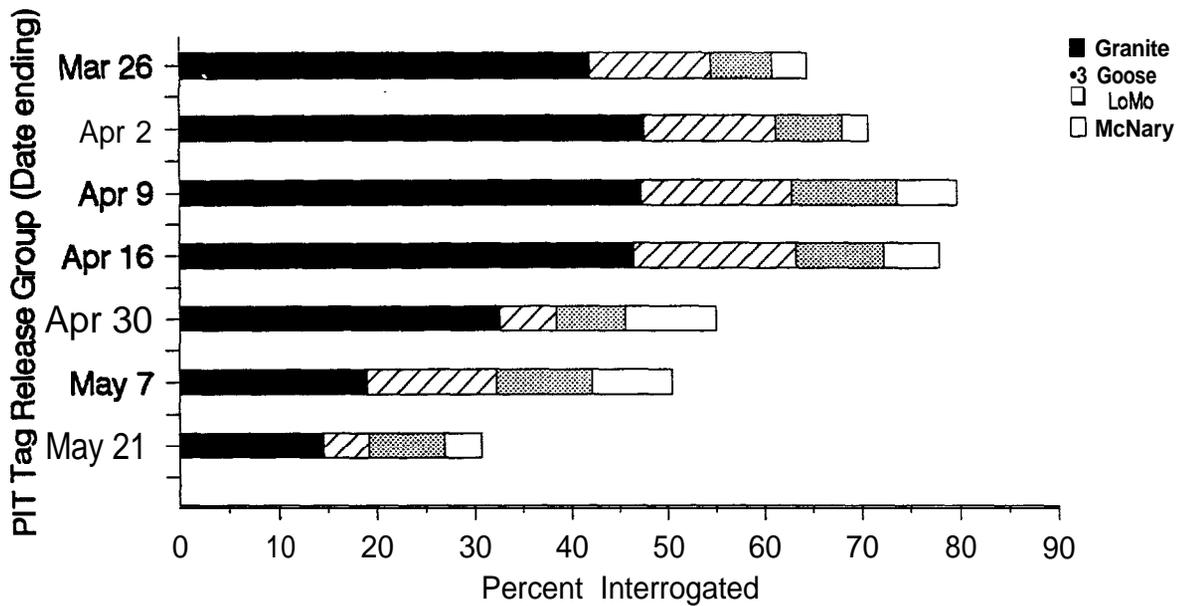


Figure 13. Cumulative interrogations, by weekly PIT tag release group, of NPT tagged wild chinook salmon smolts from the Imuha River to Lower Granite, Little Goose, Lower Monumental and McNary Dams, May 1- August 30, 1994.

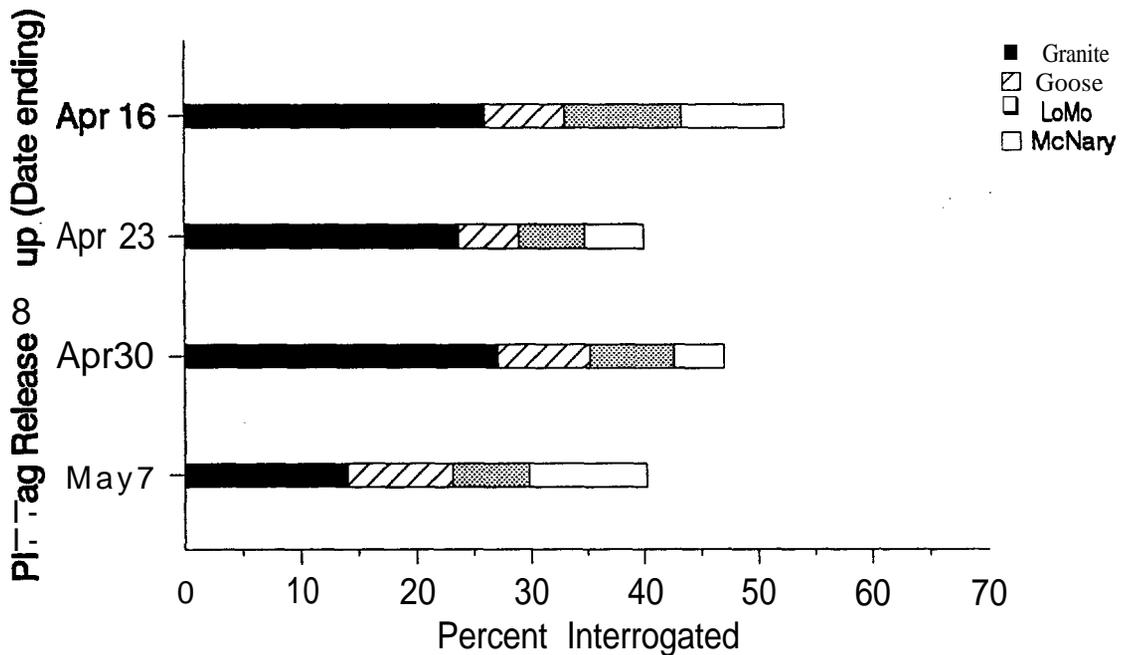


Figure 14. Cumulative interrogations, by weekly PIT tag release group, of FPC tagged hatchery chinook salmon smolts from the Innaha River to Lower Granite, Little Goose, Lower Monumental and McNary Dams, May 1- August 30, 1994.

Of the 1,432 PIT tagged wild steelhead trout smolts released at the Imnaha River trap 443 (52.4%) of the 846 NPT fish were interrogated, compared to 292 (49.8%) of the 586 FPC fish (Tables 17 and 18). Trends in cumulative interrogation rates for weekly release groups were similar for both NPT and FPC fish over time. **Wild** steelhead trout tagged in late April were interrogated at a higher rate than those tagged in late May and June (Figures 15 and 16) which may be due, in part, to the small sample size of release groups from May 28 on (Tables 17 and 18).

Of the 2,029 PIT tagged hatchery steelhead trout smolts released at the Imnaha River trap 216 (27.3%) of the 793 NPT fish were interrogated, compared to 479 (38.8%) of the 1,236 FPC fish (Tables 19 and 20). Weekly cumulative interrogation rates for NPT hatchery steelhead trout fluctuated around 30% throughout the season (Figure 17). Weekly cumulative interrogation rates for FPC hatchery steelhead trout showed a decreasing trend from 43% in late April to 37% in late May (Figure 18). Cumulative interrogations of comparable NPT and FPC weekly release groups showed that NPT tagged fish were consistently interrogated at lower rates (Tables 19 and 20). We believe that this was partially due to the relatively poor post-release condition of the hatchery steelhead smolts in the Imnaha River, and additional stress of holding these fish for up to 12 hours (NPT investigations) versus holding time of approximately one hour (FPC investigations). We did not observe this problem with NPT and FPC PIT tagged wild steelhead trout smolts.

Arrival Timing

PIT tagged Imnaha River wild chinook salmon smolts arrived at Lower Granite Dam from April 14 to June 23 with median and 90% passage dates of April 24 and May 11 respectively (Table 21). The 90% passage date for wild chinook at LGR (May 11) coincided exactly with peak Snake River and LGR flows that occurred on May 11. **Wild** chinook smolts passed Little Goose Dam between April 23 and June 17. The median passage date at LGO was April 28 and 90% of wild chinook smolt passage occurred by May 7. **Wild** chinook smolt movement past Lower Monumental Dam occurred between April 25 to July 26 with median and 90% passage dates of May 1 and May 24. McNary Dam passage was from April 29 to July 16 (Figure 19), with a median passage date of May 12 and 90% passage time of May 28. Peaks in arrival occurred in late-April at the three Snake River dams and in early-May at McNary Dam (Figure 19).

Arrival of PIT tagged Imnaha River hatchery chinook salmon smolts ranged from April 24 to May 18 at Lower Granite Dam, April 28 to June 2 at Little Goose Dam, April 30 to June 7 at Lower Monumental Dam and May 6 to June 17 at McNary Dam. Median and 90% passage occurred at LGR on May 12 for hatchery chinook (Table 21). Median and 90% passage occurred at McNary Dam on May 21 and May 26. Peaks in arrival occurred in early-May at Lower Granite Dam (Figure 20) and in late-May at McNary Dam (Figure 21). In comparison to the wild chinook salmon,

Table 17. Interrogation rates (based on first observations) of weekly release groups of NPT PIT tagged wild steelhead trout at Lower Granite, Little Goose, Lower Monumental and McNary dams.

Release Week Date Ending	Number Tagged	Granite		Goose		LoMo		McNary		Total	
		n	%	n	%	n	%	n	%	n	%
Apr 23	144	80	55.6	11	7.6	5	3.5	0		96	66.7
Apr 30	147	91	61.9	7	4.8	7	4.8	2	1.4	107	72.8
May 7	127	67	52.8	7	5.5	2	1.6	1	0.8	77	60.6
May 14	134	26	19.4	16	11.9	14	10.4	5	3.7	61	46.5
May 21	151	34	22.5	22	14.6	3	2.0	0		59	39.1
May 28	52	16	30.8	2	3.8	5	9.6	0		23	44.2
Jun 4	55	9	16.4	0		1	1.8	0		10	18.2
Jun 11	36	8	22.2	2	5.6	0		0		10	27.8
TOTAL	846	331	39.1	67	7.9	37	4.4	8	0.9	443	52.4

Table 18. Interrogation rates (based on first observations) of weekly release groups of FPC PIT tagged wild steelhead trout at Lower Granite, Liile Goose, Lower Monumental and McNary dams.

Release Week Date Ending	Number Tagged	Granite		Goose		LoMo		McNary		Total	
		n	%	n	%	n	%	n	%	n	%
Apr 30	101	61	60.4	8	7.9	2	2.0	1	1.0	72	71.3
May 7	160	85	53.1	15	9.4	4	2.5	1	0.6	105	65.6
May 21	278	50	18.0	33	11.9	14	5.0	3	1.1	100	36.0
May 28	47	9	19.1	4	8.5	2	4.3	0		15	31.9
TOTAL	586	205	35.0	60	10.2	22	3.8	5	0.9	292	49.8

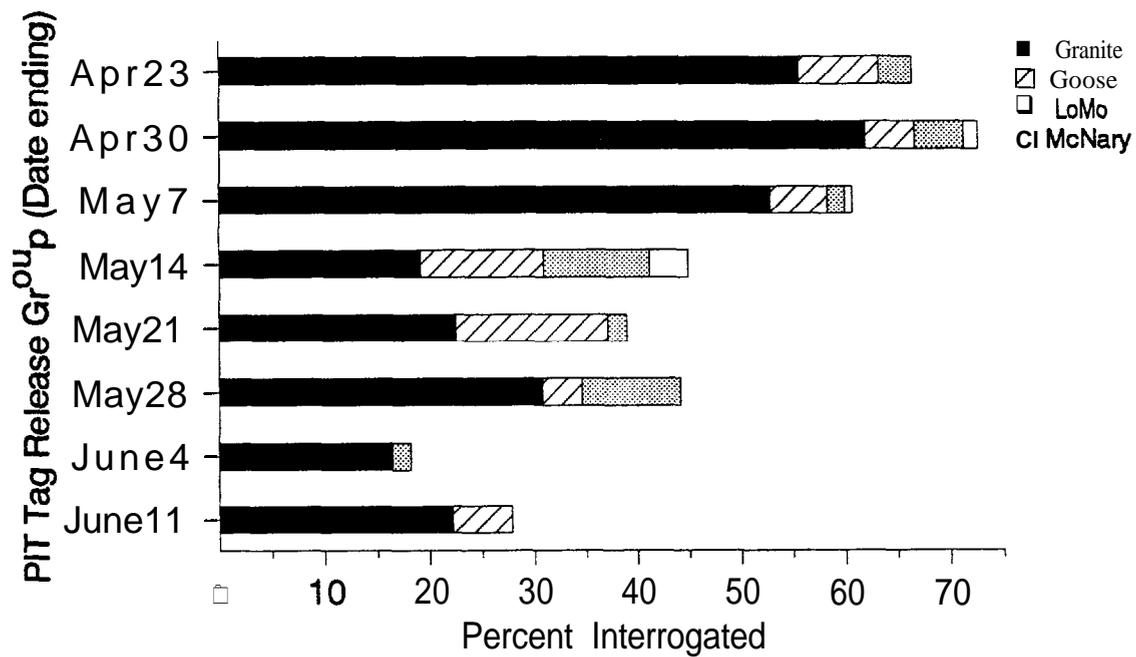


Figure 15. Cumulative interrogations, by weekly PIT tag release group, of NPT tagged wild steelhead trout smolts from the Innaha River to Lower Granite, Little Goose, Lower Monumental and McNary dams, May 1-August 30, 1994.

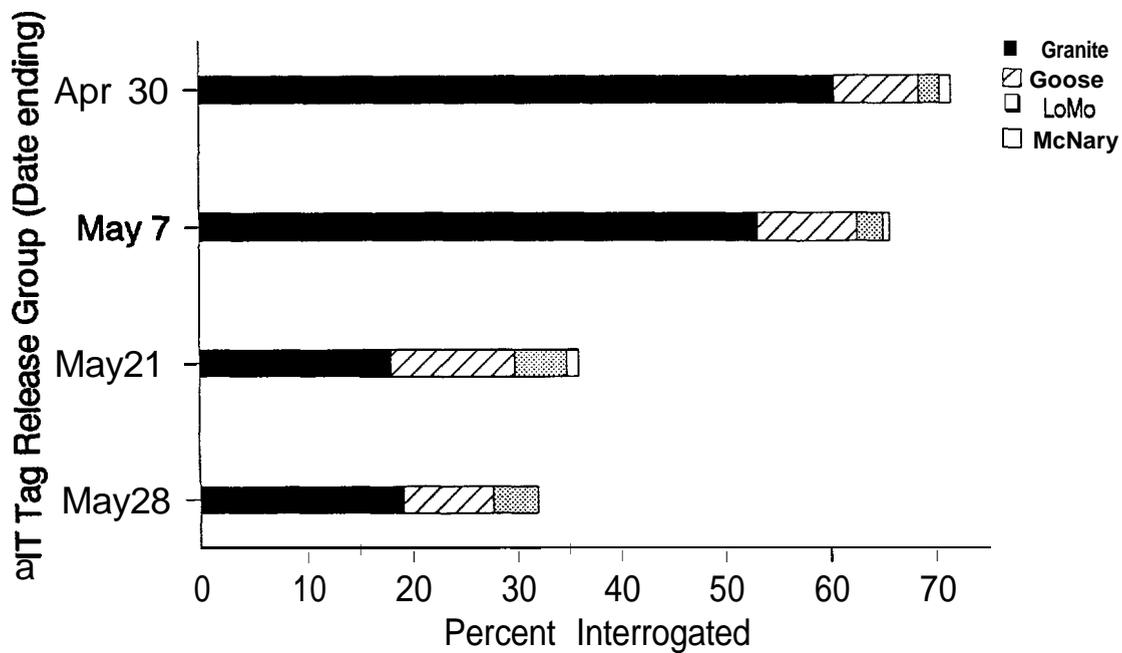


Figure 16. Cumulative interrogations, by weekly PIT tag release group, of FPC tagged wild steelhead trout smolts from the Innaha River to Lower Granite, Little Goose, Lower Monumental and McNary dams, May 1-August 30, 1994.

Table 19. interrogation rates (based on first observations) of weekly release groups of NPT PIT tagged hatchery steelhead trout at Lower Granite, Liile Goose, Lower Monumental and McNary dams.

Release Week Date Ending	Number Tagged	Granite		Goose		LoMo		McNary		Total	
		n	%	n	%	n	%	n	%	n	%
Apr 23	2	1	50.0	0		0		0		1	50.0
Apr 30	156	34	21.8	5	3.2	4	2.6	1	0.6	44	28.2
May 7	117	33	28.2	2	1.7	2	1.7	2	1.7	39	33.3
May 14	116	13	11.2	5	4.3	1	0.9	1	0.9	20	17.2
May 21	149	15	10.1	14	9.4	1	0.7	1	0.7	31	20.8
May 28	51	10	19.6	8	15.7	1	2.0	0		19	37.3
Jun 4	60	13	21.7	5	8.3	1	1.7	0		19	31.7
Jun 11	142	36	25.4	6	4.2	2	1.4	0		44	31.0
TOTAL	793	154	19.7	45	6.7	12	1.5	5	0.6	216	27.2

Table 20. Interrogation rates (based on first observations) of weekly release groups of FPC PIT tagged hatchery steelhead trout at Lower Granite, Little Goose, Lower Monumental and McNary dams.

Release Week Date Ending	Number Tagged	Granite		Goose		LoMo		McNary		Total	
		n	%	n	%	n	%	n	%	n	%
Apr 30	288	83	28.8	23	8.0	11	3.8	8	2.8	125	43.4
May 7	169	54	32.0	13	7.7	1	0.6	5	3.0	73	43.2
May 14	60	9	15.0	6	10.0	1	1.7	0		16	26.7
May 21	357	79	22.1	35	9.8	10	2.8	6	1.7	130	36.4
May 28	362	78	21.5	29	8.0	20	5.5	8	2.2	135	37.3
TOTAL	1236	303	24.5	106	8.6	43	3.5	27	2.2	479	38.8

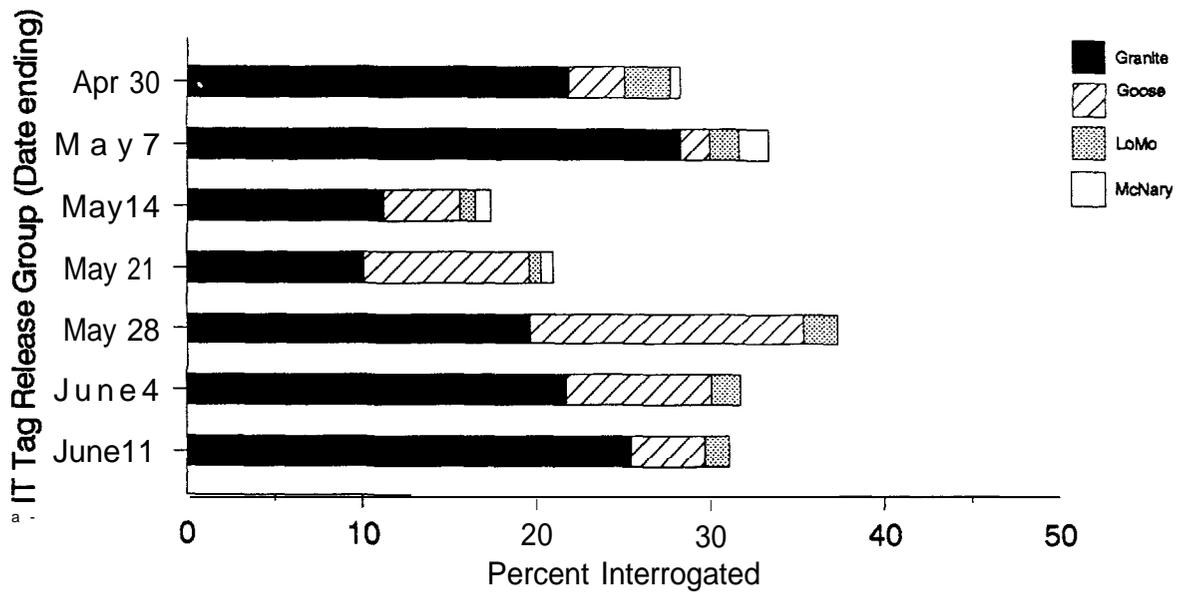


Figure 17. Cumulative interrogations, by weekly PIT tag release group, of NPT tagged hatchery steelhead trout smolts from the Innaha River to Lower Granite, Little Goose, Lower Monumental and McNary Dams, May 1 -August 30, 1994.

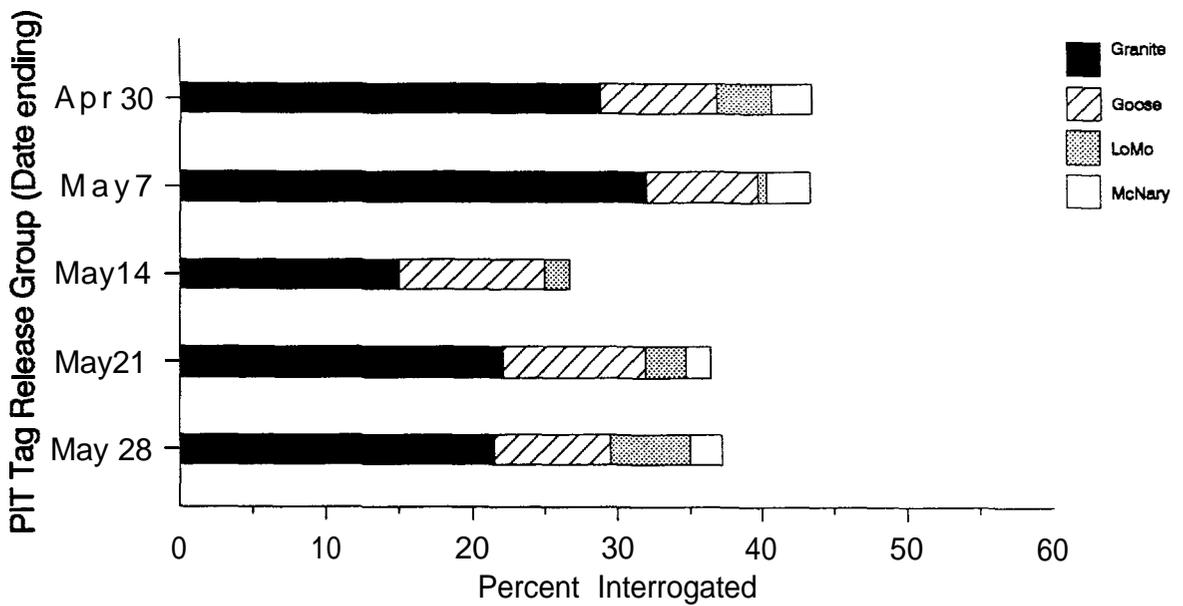


Figure 18. Cumulative interrogations, by weekly PIT tag release group, of FPC tagged hatchery steelhead trout smolts from the Innaha River to Lower Granite, Little Goose, Lower Monumental and McNary Dams, May 1 -August 30, 1994.

Table 21. First, median and 90% observation dates of PIT tagged Imnaha River wild and hatchery chinook salmon and steelhead trout smolts at Lower Granite, Little Goose, Lower Monumental and McNary dams from April through August, 1994.

Species/ Run Type	Release Group	Lower Granite Observation Date			Little Goose Observation Date			Lower Monumental Observation Date			McNary Observation Date		
		First	Median	90%	First	Median	90%	First	Median	90%	First	Median	90%
Chinook-W	NPT	Apr 14	Apr 24	May 11	Apr 23	Apr 28	May 7	Apr 25	May 1	May 24	Apr 29	May 12	May 28
Chinook-H	FPC	Apr 24	May 12	May 12	Apr 20	May 14 ^a	May 21 ^a	Apr 30	May 14 ^a	May 20 ^a	May 6	May 21	May 26
Steelhead-W	NPT	Apr 25	May 8	Jun 1	Apr 29	May 12	May 31	May1	May12	Jul 8	May 5	May 18 ^a	Jun 9 ^a
Steelhead-W	FPC	May 3	May 9	May 30	May 6	May 15	Jun 1	May0	May15	Jul 10	May 13	May 18 ^a	Jun 6 ^a
Steelhead-H	NPT	Apr 20	May 29	Jul 15	May 2	May 31	Jul 17	May 5	Jun 3 ^a	Jul 17 ^a	May 17	Jun 5 ^a	Jul 10 ^a
Steelhead-H	FPC	May 2	May 25	Jun 23	May 10	May 27	Jul 9	May 11	Jun 18 ^a	Jul 21 ^a	May 20	Jun 17 ^a	Jul 8 ^a

^aDate based on <100 detections and therefore may not provide meaningful passage information.

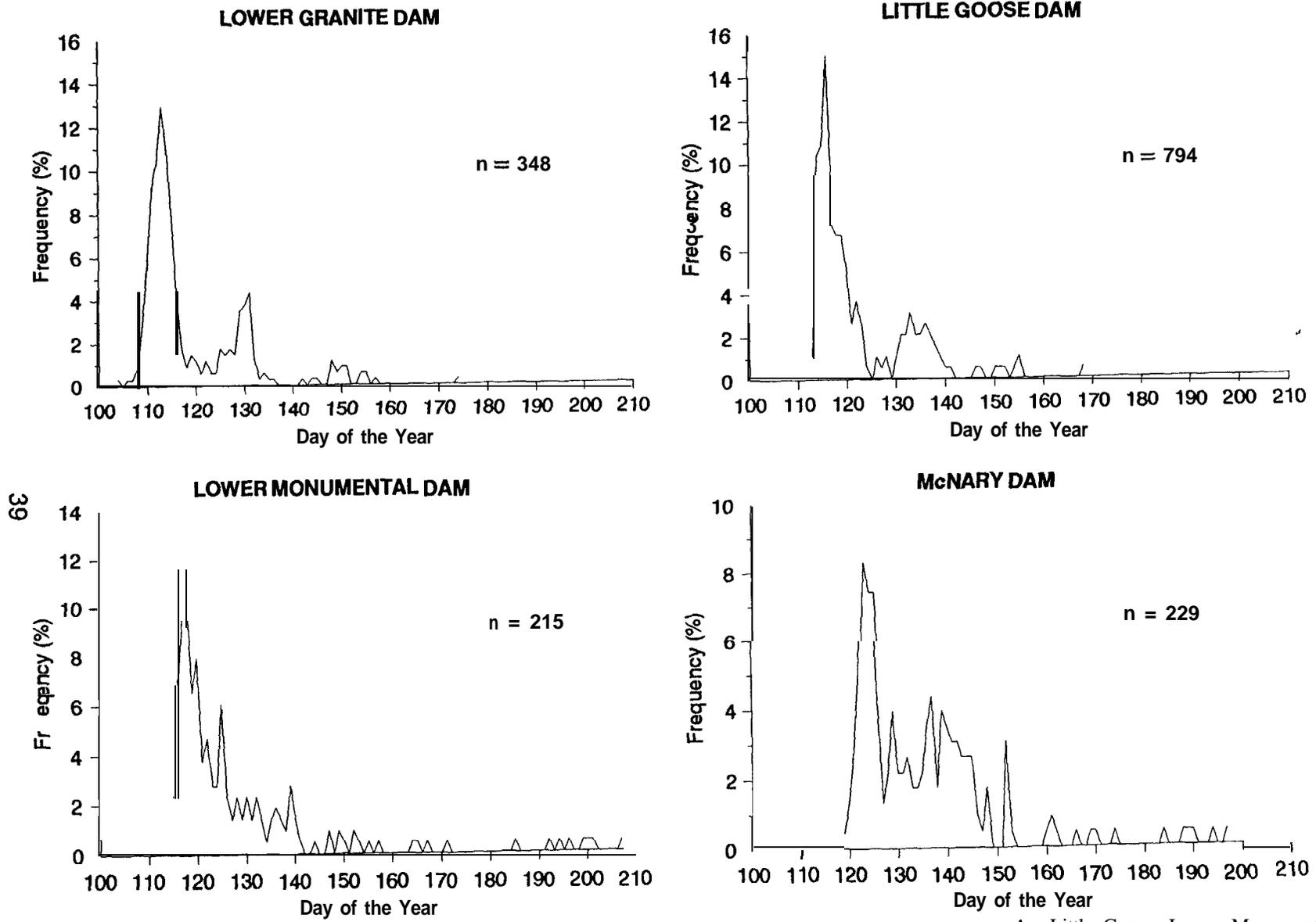


Figure 19. Daily arrival timing frequency of NPT PIT tagged Innaha River wild chinook salmon smolts at Lower Granite, Little Goose, Lower Monumental and McNary Dams, April 14-July 26, 1994.

68

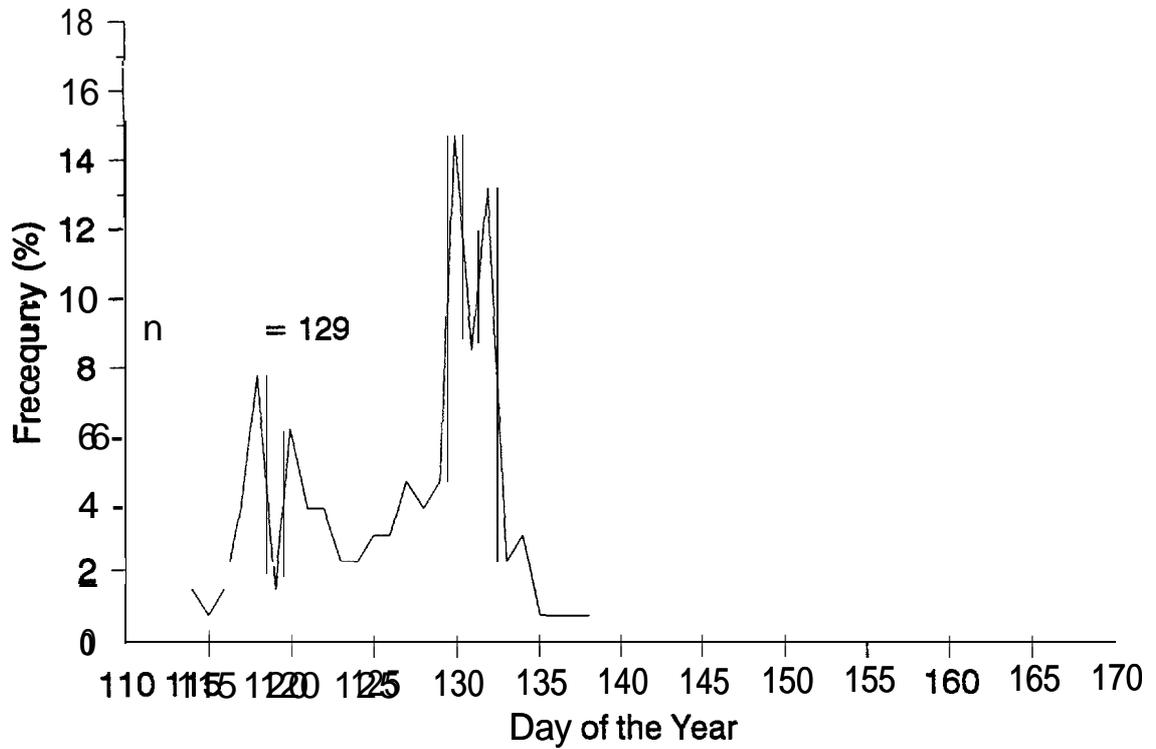


Figure 20. Daily arrival timing frequency of FPC PIT tagged **Imnaha River hatchery** chinook salmon smolts at Lower Granite Dam, April 24-May 18, 1994.

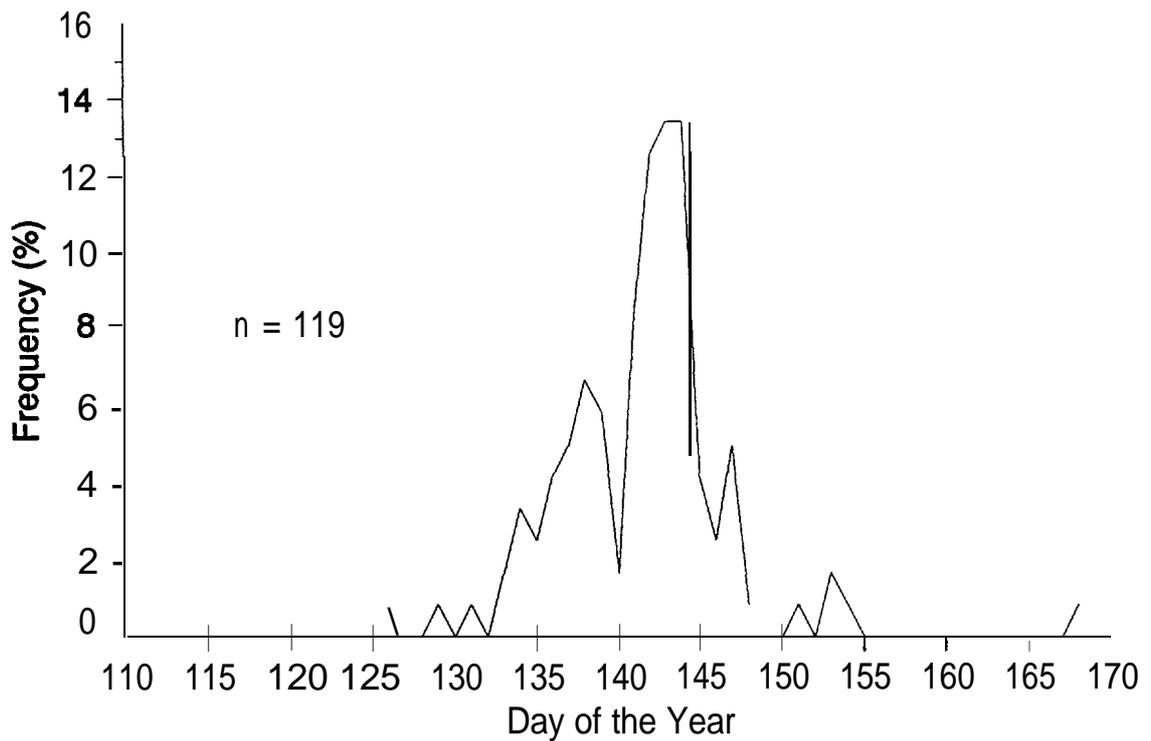


Figure 21. Daily arrival timing frequency of FPC PIT tagged **Imnaha River hatchery** chinook salmon smolts at **McNary Dam**, May 6-June 17, 1994.

hatchery fish appear to **have a** shorter outmigration period with peaks occurring later in the season: An insufficient number of interrogations (<100 fish) at Little Goose and Lower Monumental dams precluded us from providing meaningful median and 90% passage dates (Table 21).

Wild steelhead trout smolts from the Imnaha River arrived at Lower Granite Dam from April 25 to August 20, at Little Goose Dam from April 29 to July 29, at Lower Monumental Dam from May 1 to August 8 and at McNary Dam from May 5 to June 22 (Figure 22). Median and 90% arrival dates of NPT tagged fish at LGR occurred on May 8 and June 1, respectively (Table 21). Median and 90% wild steelhead smolt passage dates at Little Goose Dam was observed on May 12 and May 31 and at Lower Monumental Dam on May 12 and July 8. Arrival timing of FPC investigation fish essentially mirrored that of the NPT fish. An insufficient number of interrogations (<100 fish) at McNary Dam precluded us from providing meaningful median and 90% passage dates (Table 21). Peaks in arrival occurred in early-May at the Snake River dams and in mid-May at McNary Dam (Figure 22). Outmigration timing of NPT fish (released at dark, approximately 12 hours after tagging) and FPC fish (released upon recovery, approximately one hour after tagging) was very similar at each dam and depended upon release date.

Imnaha River hatchery steelhead trout smolts arrived at Lower Granite Dam from April 29 to August 21, at Little Goose Dam from May 2 to August 29, at Lower Monumental Dam from May 5 to August 24 and at McNary Dam from May 17 to July 14. Median passage for hatchery steelhead smolts at LGR was on May 29 and 90% passage occurred on July 15. The 90% passage date for FPC tagged smolts was on June 23 at LGR (Table 21). This discrepancy results from two later PIT tag groups being released under NPT smolt performance investigations. Median and 90% passage times at Little Goose Dam occurred on May 31 and July 17; FPC tagged smolts arrived four days (median) and eight days (90%) earlier at LGO. An insufficient number of interrogations (<100 fish) at Lower Monumental and McNary dams precluded us from providing meaningful median and 90% passage dates (Table 21). Although there were small peaks in arrival during early to mid-May at Lower Granite Dam (Figure 23) and McNary Dam (Figure 24), the general trend at each dam was a long protracted emigration. The shorter range of arrival timing at McNary Dam suggests that the fish detected at the Snake River dams in August probably didn't survive to be detected at McNary. Outmigration timing for similar timed release groups at each dam was generally similar for NPT fish (released at dark, approximately 12 hours **after** tagging) and FPC fish (released upon recovery, approximately one hour after tagging).

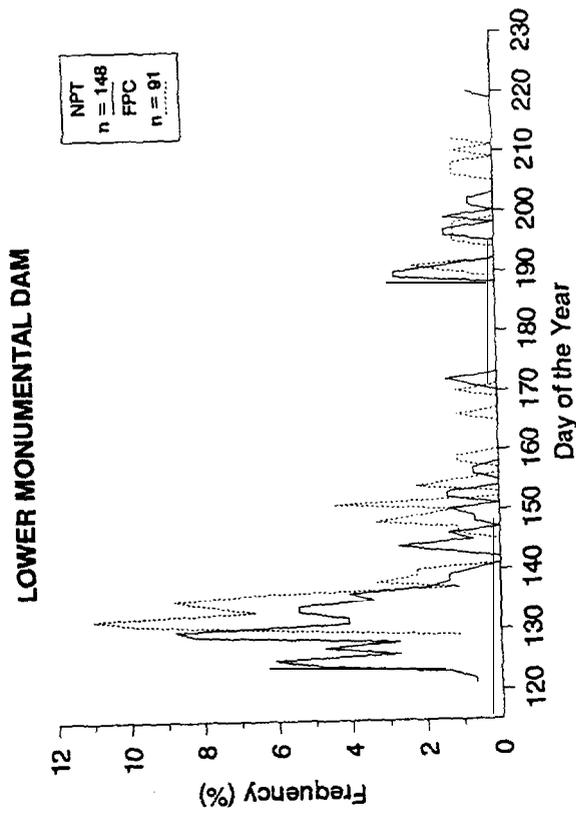
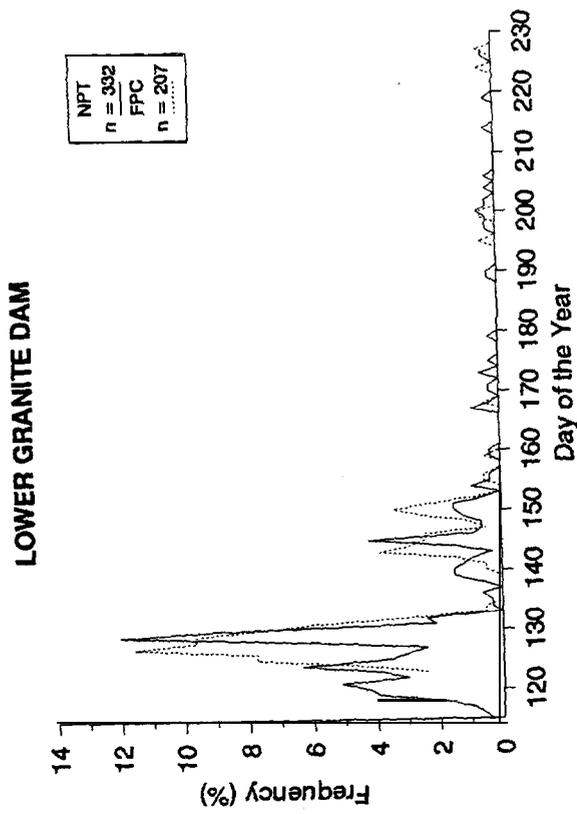
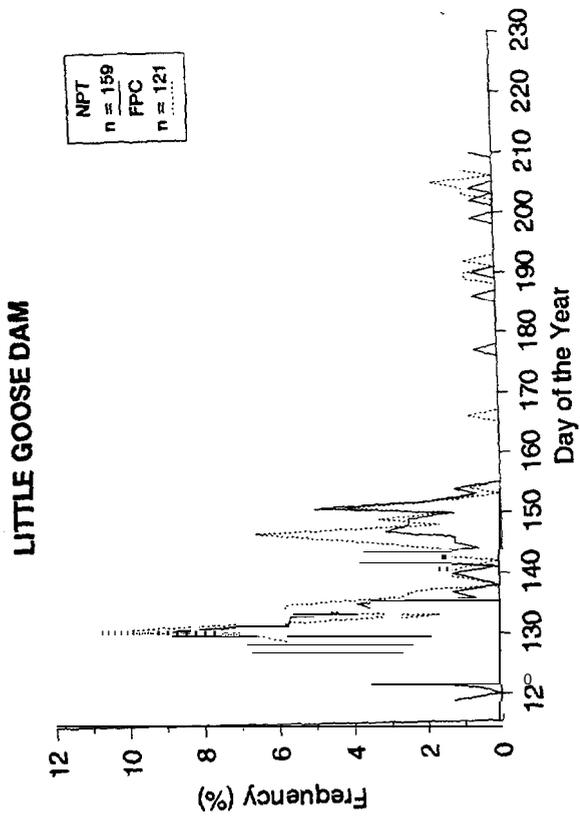


Figure 22. Daily arrival timing frequency of NPT and FPC PIT tagged Innaha River wild steelhead trout smolts at Lower Granite, Little Goose and Lower Monumental Dams, May 3-August 20, 1994.

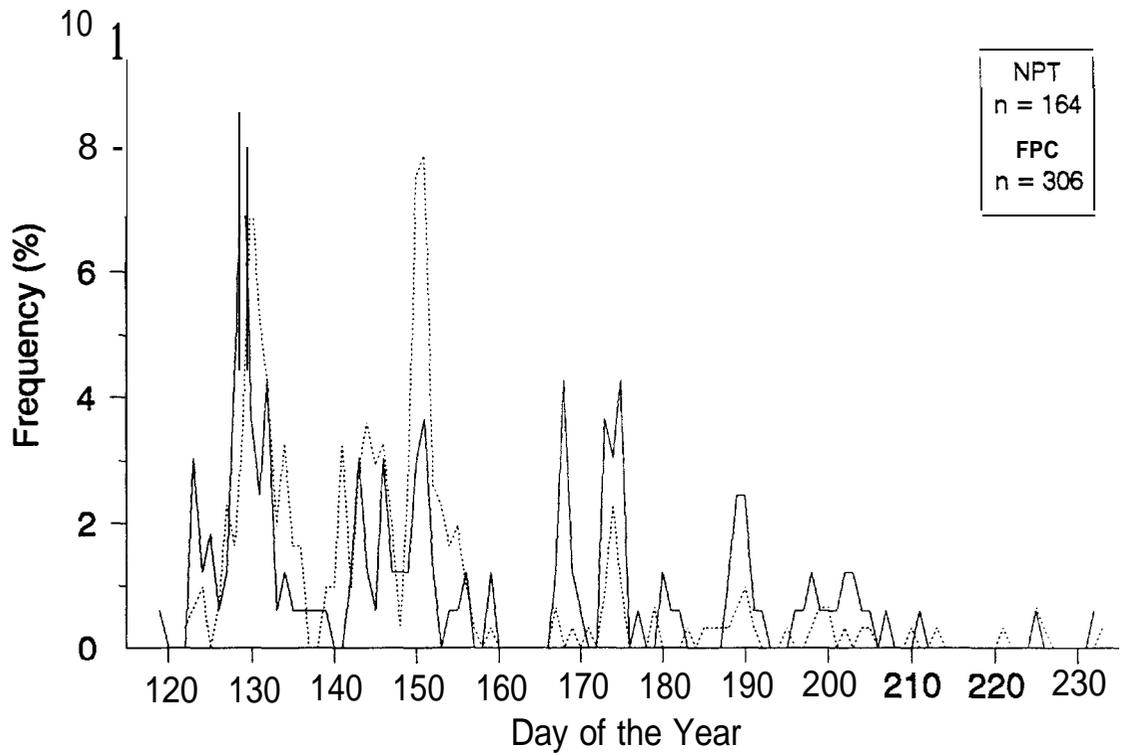


Figure 23. Daily arrival timing frequency of NPT and FPC PIT tagged Imnaha River hatchery steelhead trout smolts at Lower Granite Dam, April 29-August 21, 1994.

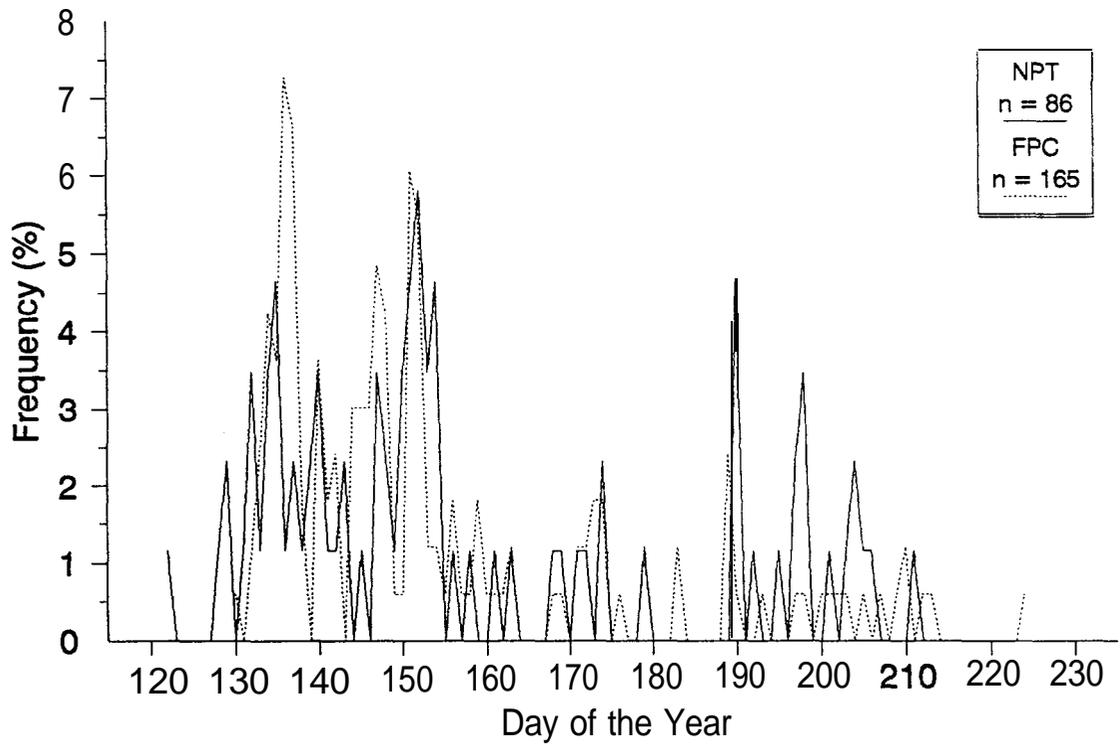


Figure 24. Daily arrival timing frequency of NPT and FPC PIT tagged Imnaha River hatchery steelhead trout smolts at Little Goose Dam, May 2-August 29, 1994.

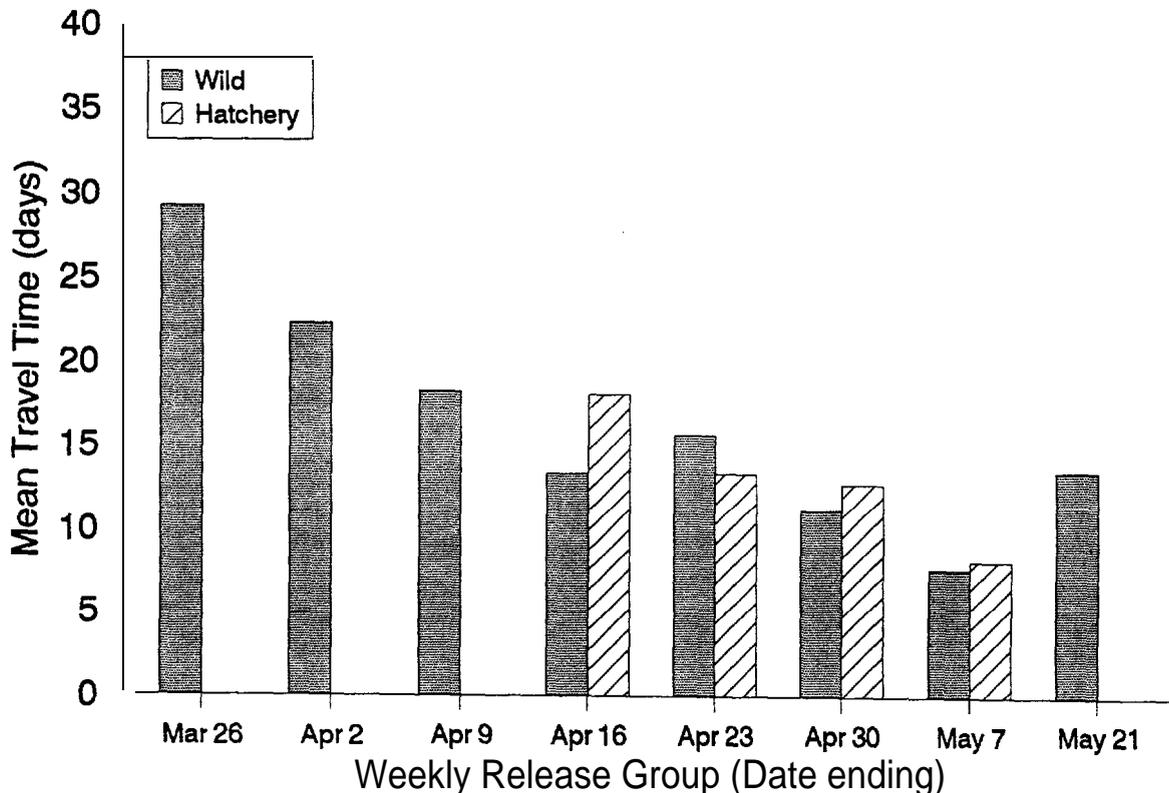


Figure 25. Mean travel time, by weekly PIT tag release group, of wild and hatchery chinook salmon smolts from the Imnaha River to Lower Granite Dam, March 1-August 30, 1994.

Travel Time to Lower Granite Dam

Mean travel time of PIT tagged wild chinook salmon from the Imnaha River screw trap (IMTRP) to Lower Granite Dam (LGR) ranged from 29.2 d for fish tagged in late March to 7.6 d for fish tagged in early May (Figure 25). Mean travel time was less for wild chinook salmon compared to hatchery chinook salmon PIT tagged and released at the same time. The exception to this were fish released the week of April 23 (Figure 25).

Hatchery chinook salmon smolt mean travel time from the IMTRP to LGR ranged from 18.1 d for tag groups released in mid-April to 8.1 d for groups released in early May. Mean travel time for hatchery chinook salmon smolts decreased consistently over time (Figure 25).

Mean travel time of PIT tagged wild steelhead trout held for 12 hours and released at dark (NPT investigations) from the IMTRP to LGR increased over time ranging from 5.4 d for fish tagged in early May to 35.3 d for fish tagged in early June (Figure 26). By comparison, mean travel time of PIT tagged steelhead trout released approximately one hour after tagging (FPC investigations) during the same week was similar to the NPT fish and in some cases less (Figure 26).

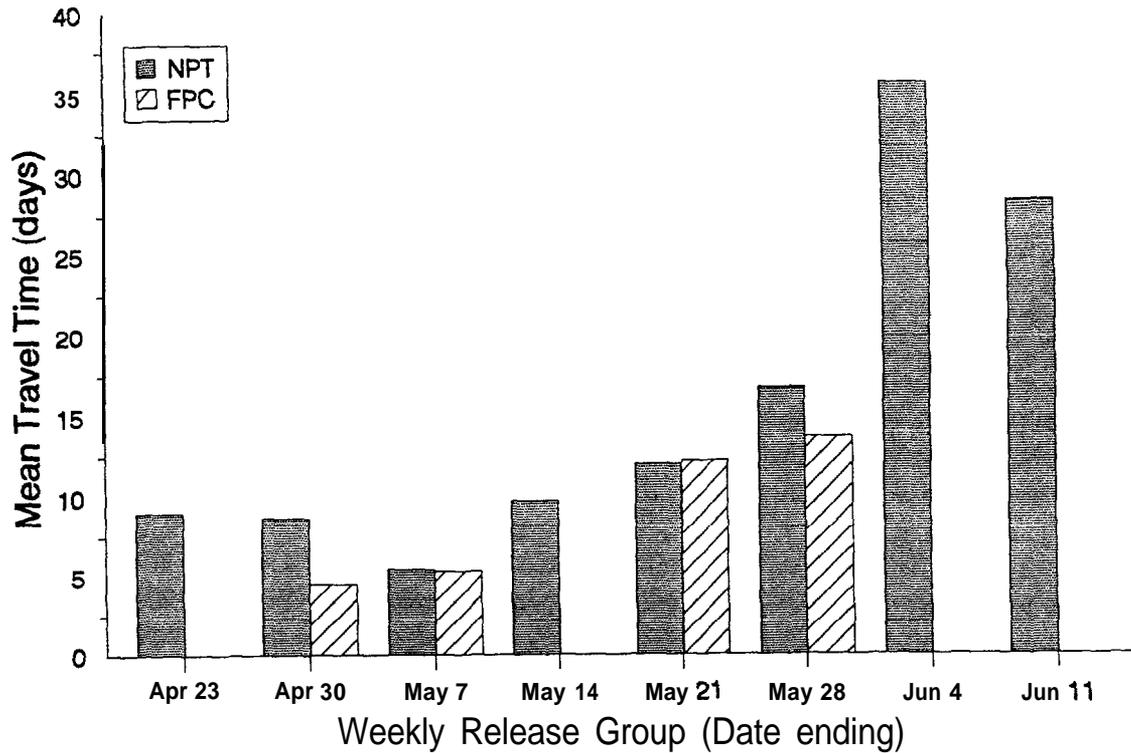


Figure 26. Mean travel time, by weekly PIT tag release group, of NPT and FPC tagged wild steelhead trout smolts from the **Imnaha** River to Lower Granite Dam, March 1-August 30,1994.

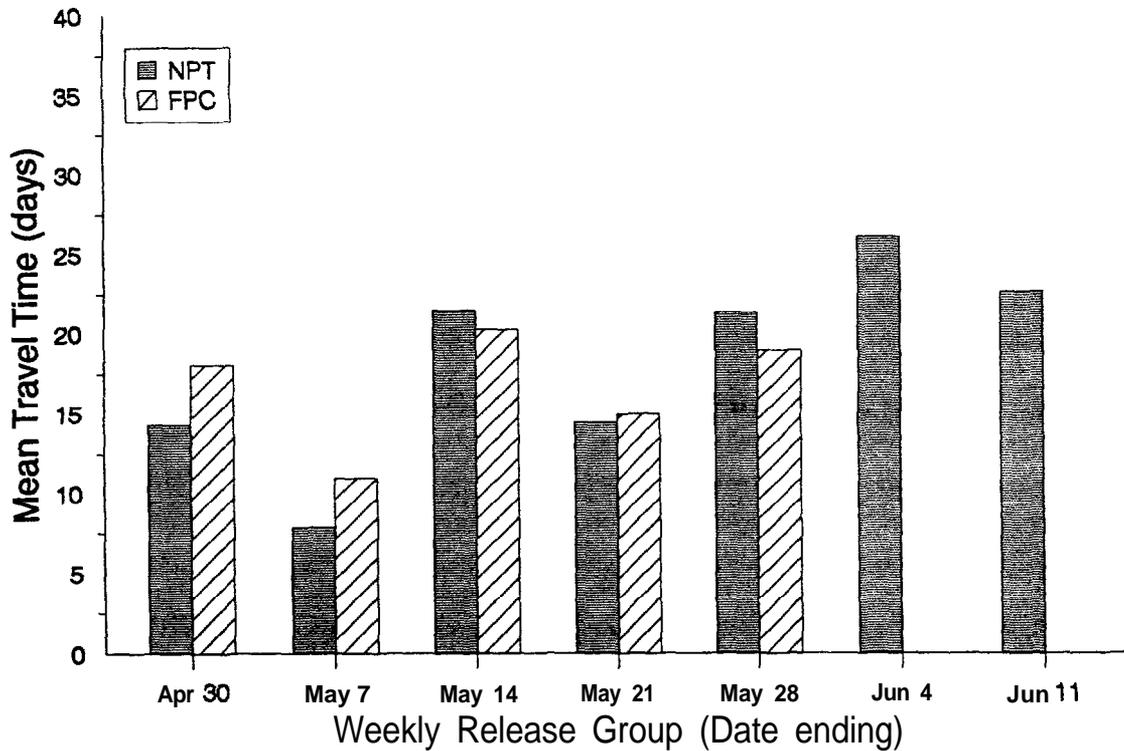


Figure 27. Mean travel time, by weekly PIT tag release group, of NPT and FPC tagged hatchery **steelhead** trout smolts from the Imnaha River to Lower Granite Dam, March 1-August 30,1994.

Nez Perce Tribe PIT tagged hatchery steelhead trout mean travel time from the **IMTRP** to LGR fluctuated from 7.9 d for fish tagged in early May to 26.1 d for fish tagged in early June (Figure 27). FPC PIT tagged hatchery steelhead trout released at the same time displayed similar mean travel time results as NPT fish (Figure 27).

SUMMARY

In 1994, the Nez Perce Tribe initiated the first year of a smolt monitoring program in the Imnaha River in cooperation with the Fish Passage Center. A rotary screw trap was used to capture outmigrating wild and hatchery chinook salmon and steelhead trout smolts from March 1 to June 15, 1994.

A total of 7,249 wild chinook salmon, 46,674 hatchery chinook salmon, 5,332 wild steelhead trout and 33,567 hatchery steelhead trout smolts were captured during the study. **Wild** chinook smolts averaged 102 mm in fork length, 11.7 g in weight and the mean condition factor was 1.07. No discernable trends in wild chinook salmon smolt size over time was observed during the outmigration period. Hatchery chinook salmon smolts were notably larger than their wild counterparts having a mean length of 126 mm, mean weight of 21.6 g and mean condition factor of 1.07. Wild steelhead trout averaged 172 mm in length, 52.4 g in weight and had a mean condition factor of 1.0. Hatchery steelhead trout were larger than their wild counterparts averaging 209 mm in length, 89 g in weight and 0.95 in condition factor. Condition factors of hatchery steelhead consistently declined the fourth week after release in the Imnaha River and remained at lower levels through mid-June.

Estimated smolt yield from the Imnaha River **subbasin** during the study period was calculated to be 90,358 \pm 26,042 wild chinook salmon, 382,908 \pm 65,109 hatchery chinook salmon, 107,826 \pm 39,378 wild steelhead trout and 250,126 \pm 43,570 hatchery steelhead trout smolts using the Lincoln Model. The wild chinook smolt yield estimate did not include fish that emigrated prior to March 1. Hatchery steelhead trout smolts continued to emigrate from the Imnaha River **after** June 15 and likewise are not included in the smolt yield estimate.

Four pulses in wild chinook smolt outmigration from the Imnaha River were observed from March 4 to May 30. The most concentrated period of outmigration occurred between April 18 to May 10 when up to 5,000 wild chinook **smolts/day** emigrated from the Imnaha River. Major movement patterns generally followed increases in stream discharge.

The release of 438,699 hatchery chinook salmon by the Oregon Department of Fish and Wildlife (**ODFW**) into the Imnaha River occurred on April 11. The majority (95%) of spring emigrants were captured from two to four days following release. The last hatchery chinook salmon smolt was captured on June 11.

Wild steelhead trout smolts were not sampled at the trap until March 5 which coincided with a spike in discharge. The peak in emigration occurred from April 18 to May 11 with the highest single day of outmigration being 8,207 fish on May 5. Outmigrating wild steelhead trout smolts were captured throughout the rest of the reporting period, although only small numbers were trapped in June.

ODFW released a total of 332,000 hatchery steelhead trout smolts in Little Sheep Creek and the Imnaha River on April 25 and 26. During the study period, 45% of the hatchery steelhead had migrated past the trap location by April 29. Catch rates remained around several hundred fish per day for the rest of the season with two exceptions. On May 27 and June 2 large numbers of hatchery steelhead smolts were captured in the trap. These movements corresponded with intense rainstorms which resulted in high turbidity. At the conclusion of the study period hatchery steelhead smolts were still being caught at an average of 213 fish per day.

Mean ATPase values for wild chinook ranged from 8.7 to 11.7 $\mu\text{molesPi/mg protein/hr}$ and from 6.9 to 10.4 $\mu\text{molesPi/mg protein/hr}$ for hatchery chinook salmon. No consistent increases in mean ATPase levels were evident for wild chinook salmon smolts sampled at the screw trap over the sample period. Mean ATPase values ranged from 7.8 to 12.5 $\mu\text{molesPi/mg protein/hr}$ for wild steelhead trout and from 5.6 to 8.0 $\mu\text{molesPi/mg protein/hr}$ for hatchery steelhead trout.

Mortality rates due to trapping (handling) and PIT tagging were 1.42% for wild chinook salmon, 0.17% for hatchery chinook salmon, 0.45% for wild steelhead trout, and 0.44% for hatchery steelhead trout smolts. Trapping caused more mortality than PIT tagging for each group of fish except for wild steelhead trout.

We interrogated 4.5% of the PIT tagged hatchery chinook salmon smolts, released by ODFW from the Imnaha River acclimation pond, at our screw trap site. The majority (67%) of observations were within two days after release. We also interrogated 1.8% of the PIT tagged hatchery steelhead trout released from the Little Sheep Creek site. These fish were observed immediately after release on April 26 to 28.

Snake River discharge measured at the **Anatone** gauge station, ranged from 16.4 to 25.2 kcfs from March 1 to mid-April and peaked at 64.3 kcfs on May 11. Flows declined after May 28. Discharge at LGR, paralleled increases in Snake River flows observed at the **Anatone** gauge station, steadily increasing from April 16 (33.4 kcfs) to April 24 (80.9 kcfs) and peaking at 93.4 kcfs on May 11. Steady decline in flows at LGR was observed from 79.4 kcfs on May 25 downward to 36.4 kcfs measured on June 11. This decline occurred during the water spill time frame. The water spill period at LGR was initiated on May 10 and occurred continuously through June 15, when spill ended.

We PIT tagged and released 956 wild chinook salmon smolts during the study period. Cumulative interrogations at Snake River and Columbia River dams were 62.2% (n = 595). Cumulative interrogations ranged from 65-80% for fish tagged in late March to early April to 31-50% for fish tagged in early to late May. Imnaha River wild chinook salmon smolts arrived at LGR between April 14 and June 23 with median and 90% passage dates of April 24 and May 11, respectively. The 90% passage date for wild chinook at LGR (May 11) coincided exactly with peak Snake River and LGR flows that occurred on May 11. Ninety percent of the wild chinook smolt passage at LGR had already occurred when the water spill period was initiated. Wild chinook smolts passed Little Goose Dam between April 23 and June 17. The median passage date at LGO was April 28 and 90% of wild chinook smolt passage occurred by May 7. **Wild** chinook smolt movement past Lower Monumental Dam occurred between April 25 to July 26 with median and 90% passage dates of May 1 and May 24. McNary Dam passage was from April 29 to July 16, with a median passage date of May 12 and 90% passage time of May 28. Peaks in arrival occurred in late-April at the three Snake River dams and in early-May at McNary Dam. Mean travel time of PIT tagged wild chinook salmon from the Imnaha River screw trap to LGR ranged from 29.2 d for fish tagged in late March to 7.6 d for fish tagged in early May. Mean travel time was less for wild chinook salmon compared to hatchery chinook salmon PIT tagged and released at the same time.

A total of 661 hatchery chinook salmon smolts were PIT tagged and released in the Imnaha River during the study period. Cumulative interrogations at Snake River and Columbia River dams represented 45.2 % (n = 299) of all PIT tagged hatchery chinook salmon smolts. Cumulative interrogation rates for weekly release groups decreased from 53% for the first group (released in mid-April) to 40.2% for the tag group released in early May. Hatchery chinook salmon smolts arrived at LGR from April 24 to May 18, with median and 90% passage dates both occurring on May 12. Hatchery chinook arrival timing occurred from April 28 to June 2 at Little Goose Dam, April 30 to June 7 at Lower Monumental Dam and May 6 to June 17 at McNary Dam. Median and 90% passage occurred at McNary Dam on May 21 and May 26. Peaks in arrival occurred in early-May at Lower Granite Dam and in late-May at McNary Dam. In comparison to the wild chinook salmon, hatchery fish exhibited a shorter outmigration period with peaks occurring later in the season. Hatchery chinook salmon smolt mean travel time from the **IMTRP** to LGR ranged from 18.1 d for fish tagged in mid-April to 8.1 d for tag groups released in early May. Mean travel time for hatchery chinook salmon smolts decreased consistently during this time period.

A total of 1,432 wild steelhead trout smolts were PIT tagged and released in the Imnaha River during the study period. Of these, 846 were PIT tagged and released at dark (NPT investigations) and 586 were released immediately after tagging (FPC investigations). Of the 1,432 PIT tagged wild steelhead trout smolts released at the Imnaha River trap 52.4% of the NPT fish were interrogated, compared

to 49.8% of the FPC fish. Trends in cumulative interrogations for weekly release groups were similar for both NPT and FPC fish over time. **Wild** steelhead trout tagged in late April were interrogated at a higher rate than those tagged in late May and June. Wild steelhead trout smolts from the Imnaha River arrived at Lower Granite Dam from April 25 to August 20, at Little Goose Dam from April 29 to July 29, at Lower Monumental Dam from May 1 to August 8 and at McNary Dam from May 5 to June 22. Ninety percent passage dates were observed at LGR on June 1 and at LMO on July 8. Peaks in arrival occurred in early-May at the Snake River dams. Outmigration timing of NPT fish (released at dark, approximately 12 hours after tagging) and FPC fish (released upon recovery, approximately one hour after tagging) was very similar at each dam and depended upon release date. Mean travel time of NPT PIT tagged wild steelhead trout from the IMTRP to LGR increased over time ranging from 5.4 d for fish tagged in early May to 35.3 d for fish tagged in early June. Mean travel time of FPC PIT tagged steelhead trout during the same week was similar to the NPT fish and in some cases less.

We PIT tagged 2,029 hatchery steelhead trout smolts in the Imnaha River during the study period; 793 were PIT tagged for NPT investigations and 1,236 were PIT tagged for FPC investigations. Cumulative interrogations observed at Snake River and Columbia River dams represented 27.3% of the NPT fish compared to 38.8% of the FPC fish. Weekly cumulative interrogations for NPT hatchery steelhead trout fluctuated around 30% throughout the season. Weekly cumulative interrogations for FPC hatchery steelhead trout showed a decreasing trend from 43% in late April to 37% in late May. Imnaha River hatchery steelhead trout smolts arrived at Lower Granite Dam from April 29 to August 21, at Little Goose Dam from May 2 to August 29, at Lower Monumental Dam from May 5 to August 24 and at McNary Dam from May 17 to July 14. The 90% passage date for NPT tagged hatchery steelhead smolts at LGR was on July 15, and the 90% passage date for FPC tagged smolts was on June 23. This discrepancy results from two later PIT tag groups being released under NPT smolt performance investigations. The 90% passage times at Little Goose Dam occurred on July 17; FPC tagged smolts arrived eight days earlier at LGO. Although there were small peaks in arrival during early to mid-May at both Lower Granite Dam and McNary Dam, the general trend at each dam was a long protracted emigration. The shorter range of arrival timing at McNary Dam suggests that the fish detected at the Snake River dams in August probably didn't survive or did not migrate to be detected at McNary. Outmigration timing for similar timed release groups at each dam was generally similar for NPT fish and FPC fish. Nez **Perce** Tribe PIT tagged hatchery steelhead trout mean travel time from the IMTRP to LGR fluctuated from 7.9 d for fish tagged in early May to 26.1 d for fish tagged in early June. FPC PIT tagged hatchery steelhead trout released at the same time displayed similar mean travel times.

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Table A.?. Imnaha River **daily** minimum, maximum, and mean water temperatures, March 1 - June 15, 1994.

DATE	MIN	MAX	MEAN	DATE	MIN	MAX	MEAN
03/01/94	5.6	9.8	7.4	03/29/94	7.4	12.4	10.1
03/02/94	7.0	10.3	8.6	03/30/94	7.0	11.7	9.6
03/03/94	6.4	9.5	7.7	03/31/94	8.2	10.0	9.0
03/04/94	7.3	9.1	8.1	04/01/94	7.3	12.7	9.9
03/05/94	5.0	7.4	6.1	04/02/94	8.2	12.2	10.5
03/06/94	3.2	6.1	4.7	04/03/94	8.7	11.5	10.2
03/07/94	2.5	5.6	4.2	04/04/94	6.7	8.5	7.4
03/08/94	2.7	6.0	4.5	04/05/94	5.6	9.8	7.5
03/09/94	2.6	6.6	4.8	04/06/94	7.8	9.5	8.6
03/10/94	5.1	7.6	6.1	04/07/94	6.6	9.5	7.8
03/11/94	5.7	9.0	7.1	04/08/94	5.7	10.6	8.2
03/12/94	4.9	8.6	7.0	04/09/94	7.9	9.4	8.5
03/13/94	4.9	7.9	6.7	04/10/94	7.2	9.6	8.3
03/14/94	6.0	9.8	7.9	04/11/94	6.5	12.2	9.4
03/15/94	6.8	10.9	8.9	04/12/94	8.2	10.6	9.6
03/16/94	8.6	10.6	9.5	04/13/94	7.1	9.5	8.3
03/17/94	6.4	8.3	7.1	04/14/94	7.1	10.1	8.5
03/18/94	5.8	8.1	7.0	04/15/94	6.3	12.1	9.2
03/19/94	4.9	7.0	6.1	04/16/94	8.9	13.5	11.3
03/20/94	3.6	6.4	5.2	04/17/94	10.8	14.6	12.6
03/21/94	4.9	7.3	6.0	04/18/94	10.9	13.2	12.2
03/22/94	4.2	6.4	5.4	04/19/94	10.6	12.5	11.7
03/23/94	2.8	5.1	3.9	04/20/94	9.9	12.6	11.4
03/24/94	2.4	7.6	4.9	04/21/94	9.8	11.8	10.4
03/25/94	3.4	8.7	6.0	04/22/94	9.2	9.9	9.6
03/26/94	4.2	9.8	6.9	04/23/94	8.1	10.9	9.4
03/27/94	5.3	10.9	8.1	04/24/94	8.5	10.2	9.3
03/28/94	6.6	12.3	9.4	04/25/94	7.7	9.0	8.3

Table A.1. (Cont.)

DATE	MIN	MAX	MEAN	DATE	MIN	MAX	MEAN
04/26/94	7.7	9.3	8.5	05/22/94	10.1	12.9	11.4
04/27/94	7.4	9.8	8.5	05/23/94	10.4	14.5	12.3
04/28/94	7.0	10.0	8.5	05/24/94	11.5	15.7	13.5
04/29/94	7.2	10.5	8.9	05/25/94	12.6	15.8	14.2
04/30/94	8.5	10.0	9.1	05/26/94	13.2	15.0	14.1
05/01/94	6.8	10.5	8.6	05/27/94	11.3	13.6	12.8
05/02/94	9.3	11.8	10.5	05/28/94	9.5	11.1	10.1
05/03/94	9.1	12.5	10.8	05/29/94	10.0	12.1	10.8
05/04/94	11.1	12.1	11.4	05/30/94	10.5	15.2	12.6
05/05/94	9.8	12.6	11.0	05/31/94	12.6	14.0	13.2
05/06/94	10.0	13.2	11.5	06/01/94	11.7	13.6	12.5
05/07/94	10.9	14.0	12.3	06/02/94	10.6	14.9	12.8
05/08/94	11.5	14.3	12.7	06/03/94	12.9	15.8	14.5
05/09/94	11.6	13.6	12.7	06/04/94	13.9	16.6	15.0
05/10/94	11.2	12.9	12.1	06/05/94	12.6	14.1	13.3
05/11/94	11.2	13.7	12.4	06/06/94	11.2	13.6	12.7
05/12/94	12.0	13.4	12.8	06/07/94	9.8	11.2	10.5
05/13/94	10.3	12.1	11.3	06/08/94	8.8	13.6	11.2
05/14/94	9.9	11.5	10.8	06/09/94	12.0	16.8	14.3
05/15/94	10.6	11.9	11.1	06/10/94	12.9	18.2	15.6
05/16/94	9.2	11.1	10.1	06/11/94	14.5	17.5	16.2
05/17/94	8.5	10.3	9.7	06/12/94	14.7	18.8	16.6
05/18/94	7.9	12.1	9.8	06/13/94	12.3	16.6	14.8
05/19/94	10.0	11.7	10.9	06/14/94	10.6	13.3	11.6
05/20/94	10.0	11.3	10.7	06/15/94	9.2	10.3	9.8
05/21/94	9.5	12.6	10.9				

Table A.2. Imnaha River daily staff gauge measurements and discharge readings from USGS guage 13292000 at Imnaha, OR, March 1 - June 15, 1994 (NR=NO READING, Q=DISCHARGE, STAFF MEASURE IN METERS.)

DATE	STAFF	Q	DATE	STAFF	Q	DATE	STAFF	Q
03/01/94	.55	160	03/20/94	.69	319	04/08/94	.74	421
03/02/94	.60	466	03/21/94	NR	305	04/09/94	.73	431
03/03/94	.77	474	03/22/94	NR	280	04/10/94	.74	421
03/04/94	NR	524	03/23/94	.65	254	04/11 /94	.74	414
03/05/94	.80	522	03124194	.64	241	04/12/94	.74	448
03/06/94	.76	433	03/25/94	.64	236	04/13/94	.76	491
03/07/94	.72	362	03/26/94	.62	225	04/14/94	.77	505
03/08/94	.70	326	03/27/94	.61	225	04/15/94	.75	494
03/09/94	.69	295	03/28/94	.62	246	04/16/94	.75	555
03/10/94	.66	290	03/29/94	.64	294	04/17/94	.79	736
03/11/94	.66	279	03/30/94	.68	343	04/18/94	.95	1050
03/12/94	NR	259	03/31/94	.70	382	04/19/94	1.04	1270
03/13/94	NR	253	04/01/94	.71	392	04/20/94	.97	1340
03/14/94	NR	264	04/02/94	.74	449	04/21 J94	1.07	1370
03/15/94	NR	301	04/03/94	.79	554	04/22/94	1.06	1300
03/16/94	NR	385	04/04/94	.79	570	04/23/94	1.00	1200
03/17/94	.72	395	04/05/94	.77	497	04/25/94	1.05	1310
03/18/94	.71	368	04/06/94	.76	465	04126194	1.05	1330
03/19/94	.70	351	04/07/94	.76	453	04/27/94	1.00	1230

DATE	STAFF	Q	DATE	STAFF	Q	DATE	STAFF	Q
04/28/94	.97	1 1 0 0	05/15/94	.95	1060	06/01/94	.90	860
04/29/94	.97	985	05/16/94	.93	953	06/02/94	NR	847
04/30/94	.93	924	05/17/94	.92	1020	06/03/94	.90	825
05/01/94	.90	851	05/18/94	.95	1020	06/04/94	.90	868
05/02/94	.88	795	05/19/94	.95	1030	06/05/94	.89	835
05/03/94	.87	760	05/20/94	.97	1050	06/06/94	.87	813
05/04/94	.84	788	05/21/94	.96	1050	06/07/94	.88	785
05/05/94	.95	965	05/22/94	NR	1060	06/08/94	.85	712
05/06/94	.94	990	05/23/94	NR	1020	06/09/94	.82	646
05/07/94	.97	1040	05/24/94	.96	1010	06/10/94	.81	645
05/08/94	1.00	1180	05/25/94	.96	1020	06/11/94	.84	684
05/09/94	1.08	1310	05/26/94	.98	1090	06/12/94	.85	718
05/10/94	NR	1350	05/27/94	.98	1170	06/13/94	.87	768
05/11/94	NR	1320	05/28/94	.98	1060	06/14/94	.86	673
05/12/94	NR	1480	05/29/94	.95	939	06/15/94	.82	577
05/13/94	1.0	1360	05/30/94	.90	844			
05/14/94	.99	1170	05/31/94	.88	834			

Table 8.1. Catch composition-of Imnaha River screw trap, March, 1994. Estimated catch during days the trap was not operated are in italics.

Date	Chinook			Steelhead			Total Catch
	Wild	Hatchery	Total	Wild	Hatchery	Total	
1	3	0	3	0	0	0	3
2	5	0	5	0	0	0	5
3	3	0	3	1	0	1	4
*4	<i>110</i>	0	<i>110</i>	15	0	15	125
5	216	0	216	30	0	30	246
6	449	0	449	58	0	58	507
7	211	0	211	21	0	21	232
8	169	0	169	28	0	-28	197
9	123	0	123	6	0	6	129
10	61	0	61	6	0	6	67
11	40	0	40	5	0	5	45
12	46	0	46	5	0	5	51
*13	37	0	37	4	0	4	41
"14	28	0	28	3	0	3	31
"15	19	0	19	2	0	2	21
16	12	0	12	1	0	1	13
17	35	0	35	3	0	3	38
18	109	0	109	4	0	4	113
19	58	0	58	4	0	4	62
20	30	0	30	0	0	0	30
*21	26	0	26	0	0	0	26
*22	22	0	22	0	0	0	22
23	17	0	17	4	0	4	21
24	47	0	47	0	0	0	47
25	48	0	48	4	0	4	52
26	36	0	36	0	0	0	36
27	16	0	16	0	0	0	16
28	28	0	28	0	0	0	28
29	45	0	45	1	0	1	46
30	45	0	45	2	0	2	47
31	107	0	107	0	0	0	107
Total	2,201	0	2,201	207	0	207	2,408

*Trap not operated. See details in Table 4.

Table B.2. Catch composition of Imnaha River screw trap, April, 1994. Estimated catch during days the trap was not operated are in italics.

Date	Chinook			Steel head			Total Catch
	Wild	Hatchery	Total	Wild	Hatchery	Total	
1	134	0	134	3	0	3	137
2	100	0	100	3	0	3	103
3	119	0	119	12	0	12	131
4	310	0	310	0	0	0	310
5	653	0	653	40	0	40	693
6	186	0	186	12	0	12	198
7	93	0	93	10	0	10	103
a	278	0	278	14	0	14	292
9	100	0	100	6	0	6	106
10	94	0	94	10	0	10	104
11	79	0	79	6	0	6	85
12	87	3	90	11	0	11	101
13	129	20,753	20,882	0	0	0	20,882
14	77	15,098	15,175	0	0	0	15,175
15	108	6,989	7,097	21	0	21	7,118
16	89	1,447	1,536	14	0	14	1,550
17	38	99	137	0	0	0	137
18	94	398	492	93	0	93	585
*19	65	285	350	82	0	-82	432
" 20	36	172	208	71	0	71	279
21	a	58	66	59	0	59	125
22	29	89	118	81	0	81	199
23	115	355	470	152	3	155	625
24	85	180	265	131	0	131	396
*25	90	172	262	116	0	116	378
26	96	163	259	100	2,152	2,252	2,511
" 27	64	85	149	256	8,368	8,624	8,773
28	163	77	240	248	3,722	3,970	4,210
29	77	6	83	148	1,038	1,186	1,269
30	112	42	154	95	624	719	873
Total	3,708	46,471	50,179	1,794	15,907	17,701	67,880

*Trap not operated. See details in Table 4.

~ Irregular trap operations due to high debris load in river.

Table 8.3. Catch composition-of Imnaha River screw trap, May, 1994. Estimated catch during days the trap was not operated are in italics.

Date	Chinook			Steelhead			Total Catch
	Wild	Hatchery	Total	Wild	Hatchery	Total	
1	106	75	181	172	470	642	823
2	71	55	126	113	93	206	332
3	28	37	65	135	102	237	302
4	105	113	218	345	177	522	740
5	188	191	379	476	728	1,204	1,583
6	98	52	150	168	483	651	801
7	22	20	42	246	598	844	886
a	45	23	68	268	852	1,120	1,188
9	49	30	79	206	1,100	1,306	1,385
"10	37	23	60	164	870	1,034	1,094
"11	25	<i>16</i>	<i>41</i>	<i>122</i>	640	762	803
*12	13	9	22	80	410	490	<i>512</i>
13	3	1	4	38	182	220	224
14	12	10	22	110	436	546	568
15	34	9	43	79	405	484	527
16	33	5	38	55	309	364	402
17	72	12	84	85	301	386	470
18	63	4	67	89	771	860	927
19	78	3	81	97	584	681	762
20	16	1	17	119	379	498	515
21	43	1	44	147	644	791	835
*22	32	0	32	<i>107</i>	480	587	619
*23	<i>21</i>	0	<i>21</i>	67	<i>316</i>	383	404
24	11	1	12	26	153	179	191
25	18	0	18	50	342	392	410
26	31	1	32	60	425	485	517
"27	68	0	68	<i>113</i>	<i>1,966</i>	<i>2,079</i>	2,147
28	14	3	17	75	212	287	304
29	29	4	33	73	235	308	341
30	25	1	26	29	151	180	206
31	78	1	79	18	161	179	198
Total	1,408	701	2,109	3,932	14,975	18,907	21,016

* Trap not operated. See details in Table 4.

~ Irregular trap operations due to high debris load. Trap pulled at 2030.

Table B.4. Catch composition, of Imnaha River screw trap, June, 1994. Estimated catch during days the trap was not operated are in italics.

Date	Chinook			Steel head			Total Catch
	Wild	Hatchery	Total	Wild	Hatchery	Total	
1	34	0	-34	33	384	417	451
" 2	28	0	28	72	1,728	1,800	1,828
3	44	3	47	22	384	406	453
4	1a	0	18	15	272	287	305
5	37	0	37	9	274	283	320
6	25	1	26	a	312	320	346
7	31	2	33	15	379	394	427
a	66	0	66	24	273	297	363
9	25	0	25	5	142	147	172
10	34	0	34	6	270	276	310
11	30	1	31	a	143	151	182
12	33	0	33	1	196	197	230
13	38	0	38	3	313	316	354
14	19	0	19	5	213	218	237
15	34	0	34	2	119	121	155
Total	496	7	503	228	5,402	5,630	6,133

~ Irregular trap operation. Trap pulled at 2400.

Table C. Mark/ recapture data for trap efficiency trials. (MREL = Number marked and released, RCAP = Number recaptured, TREF = Trap efficiency).

DATE	CH-W			CH-H			RBT-W			RBT-H		
	MREL	RCAP	TREF	MREL	RCAP	TREF	MREL	RCAP	TREF	MREL	RCAP	TREF
03/06/94	50	3	0.06				30	5	0.17			
03/07/94	50	7	0.14				54	11	0.20			
03/08/94	94	15	0.16				21	6	0.29			
03/09/94	100	21	0.21				28	5	0.18			
03/10/94	100	17	0.17				6	1	0.17			
03/11/94	61	7	0.11				6	0	0.00			
03/12/94	40	6	0.15									
03/16/94							5	0	0.00			
03/17/94	12	3	0.25									
03/18/94	35	3	0.09									
03/27/94	35	5	0.14									
03/28/94	16	3	0.19									
03/29/94	28	5	0.18									
03/30/94	44	4	0.09									
04/02/94	99	18	0.18									
04/04/94	100	7	0.07									
04/05/94	98	6	0.06									
04/06/94	105	12	0.11				40	7	0.18			
04/07/94	100	22	0.22				12	1	0.08			
04/08/94	92	9	0.10				10	1	0.10			

Table C. (Cont.)

DATE	CH-W			CH-H			RBT-W			RBT-H		
	MREL	RCAP	TREF	MREL	RCAP	TREF	MREL	RCAP	TREF	MREL	RCAP	TREF
04/09/94	100	12	0.12				14	4	0.29			
04/10/94	99	13	0.13				6	0	0.00			
04/17/94	46	9	0.20	87	13	0.15						
04/23/94	25	0	0.00				26	1	0.04			
04/24/94	46	2	0.04				48	7	0.15			
04/29/94												
04/30/94	29	1	0.03									
05/01/94	69	10	0.14									
05/02/94	101	7	0.07				100	0	0.00			
05/03/94	71	0	0.00				38	1	0.03			
05/04/94							48	4	0.08	28	0	0.00
05/07/94	49	0	0.00				50	0	0.00			
05/08/94	10	0	0.00							50	0	0.00
05/14/94							49	0	0.00			
05/15/94										39	8	0.21
05/16/94	32	0	0.00	8	2	0.25	72	9	0.13	97	16	0.19
05/17/94										50	7	0.14
05/18/94										100	7	0.07
05/19/94										99	17	0.17
05/20/94	31	2	0.06							80	18	0.23
05/21/94	16	1	0.06							94	12	0.13
05/25/94	10	0	0.00	1	0	0.00						
05/26/94	15	1	0.07							48	3	0.06

61

Table C. (Cont.)

DATE	CH-W			CH-H			RBT-W			RBT-H		
	MREL	RCAP	TREF	MREL	RCAP	TREF	MREL	RCAP	TREF	MREL	RCAP	TREF
05/29/94	9	0	0.00	1	0	0.00	69	6	0.09	63	13	0.21
05/30/94							66	11	0.17	85	14	0.16
05/31/94	16	3	0.19				28	6	0.21	63	15	0.24
06/01/94	11	0	0.00				14	0	0.00	95	21	0.22
06/05/94										100	33	0.33
06/06/94										100	25	0.25
06/07/94										100	18	0.16
06/08/94										100	25	0.25
06/09/94										100	24	0.24
06/10/94	22	3	0.14									
06/11/94										100	19	0.19
06/12/94							8	2	0.25	100	19	0.19
06/13/94										100	22	0.22
06/14/94										100	22	0.22
06/15/94	17	5	0.29							100	27	0.27

62

Table D. Smolt yield estimate data for each period.

	Number Marked and Released	Number Captured	Number Recaptured
Wild Chinook Salmon			
Period 1	1,504	5,082	207
Period 2	504	2,425	24
Period 3	66	553	14
Hatchery Chinook Salmon			
Period 1	*1,504	44,597	*207
Period 2	*504	2,807	*24
Period 3	*66	27	*14
Wild Steelhead Trout			
Period 1	209	412	40
Period 2	480	6,064	28
Period 3	108	292	17
Hatchery Steelhead Trout			
Period 1	0	0	0
Period 2	748	30,850	103
Period 3	1,243	5,998	284

* **Wild** chinook salmon mark/recapture data was used to estimate hatchery chinook salmon smolt yield due to insufficient mark/recapture data for hatchery fish.

Table E.I Mean daily length, weight and condition factor of wild chinook salmon sampled at the Imnaha River Screw Trap, March 1 - June 15, 1994.

Date	Number Sampled	Mean Length	S.E.	Mean Weight	S.E.	Mean Condition	S.E
3/01	3	105	3.0	12.4	0.9	1.06	0.02
3/02	5	103	4.3	11.5	1.4	1.04	0.03
3/03	1	104		12.7		1.03	
3/05	56	102	1.1	11.2	0.3	1.03	0.01
3/06	56	101	1.1	10.9	0.4	1.04	<0.01
3/07	101	100	0.8	10.7	0.2	1.05	<0.01
3/08	102	98	0.8	10.0	0.2	1.03	<0.01
3/09	100	102	1.4	11.5	0.6	1.01	<0.01
3/10	61	99	1.1	10.2	0.3	1.03	<0.01
3/11	40	101	1.6	10.4	0.5	1.00	0.01
3/12	46	100	1.2	10.6	0.4	1.03	0.01
3/16	12	101	2.0	11.2	0.6	1.06	0.02
3/17	35	103	1.3	11.7	0.5	1.04	0.01
3/18	101	103	0.8	11.3	0.3	1.02	<0.01
3/19	58	102	0.9	11.2	0.3	1.04	0.01
3/20	33	102	1.7	11.4	0.5	1.05	0.01
3/23	17	100	2.4	10.5	0.8	1.02	0.02
3/24	47	102	1.1	10.7	0.4	0.99	<0.01
3/25	48	103	1.1	10.8	0.4	0.98	<0.01
3/26	72	100	0.7	10.4	0.2	1.04	<0.01
3/27	32	105	1.2	12.2	0.4	1.05	0.01
3/28	28	99	1.4	10.9	0.4	1.10	0.01
3/29	45	104	2.0	12.0	0.5	1.03	0.01
3/30	43	107	1.3	12.6	0.4	1.01	<0.01
3/31	107	105	0.8	12.7	0.3	1.07	<0.01
4/01	101	104	0.7	12.6	0.2	1.11	<0.01
4/02	100	107	0.8	13.0	0.3	1.06	<0.01
4/04	100	104	0.9	12.4	0.3	1.07	<0.01
4/05	149	105	0.6	11.8	0.2	1.01	<0.01
4/06	100	103	0.9	12.0	0.3	1.08	<0.01
4/07	93	102	1.2	12.1	0.4	1.10	<0.01
4/08	100	103	0.9	12.0	0.3	1.09	0.01
4/09	99	102	0.9	11.7	0.3	1.10	<0.01
4/10	31	105	1.4	13.1	0.6	1.11	<0.01
4/11	77	105	0.9	12.3	0.3	1.06	<0.01
4/12	80	110	1.0	13.6	0.4	1.00	<0.01
4/16	55	105					
4/17	38	109					
4/18	50	109					
4/21	7	108	2.6	14.3	1.1	1.10	0.02
4/22	29	106	1.2	13.3	0.4	1.11	0.02
4/23	53	105	0.9	12.9	0.3	1.11	0.01

Table E.I . - Continued

Date	Number Sampled	Mean Length	S.E.	Mean Weight	S.E.	Mean Condition	S.E
4/24	30	106	1.3	12.8	0.4	1.07	0.01
4/26	68	103	1.0	12.7	0.4	1.14	<0.01
4/28	81	99	0.7	11.5	0.2	1.19	0.01
4/29	29	98				-	-
4/30	69	99				-	-
5/01	100	99	0.8	10.5	0.3	1.08	<0.01
5/02	71	98	1.0	10.5	0.3	1.08	<0.01
5/03	28	102	1.3	11.4	0.5	1.07	0.02
5/04	103	103	1.2	12.0	0.3	1.13	0.02
5/06	51	101					
5/07	13	100	1.5	11.8	0.6	1.18	0.03
5/09	5	96					
5/15	33	98	1.0	10.2	0.3	1.07	<0.01
5/16	1	88		8.6		1.26	
5/17	72	98	0.8	11.2	0.3	1.18	<0.01
5/18	62	101	2.2	12.7	1.2	1.12	<0.01
5/19	31	98	1.2	10.6	0.4	1.11	0.02
5/20	16	95	1.9	9.7	0.7	1.11	0.04
5/24	10	102	2.4	11.2	0.8	1.04	0.02
5/25	16	104	1.6	12.6	0.6	1.12	0.02
5/26	11	103	2.6	12.4	1.0	1.12	0.03
5/28	14	106	1.0	13.4	0.4	1.13	0.01
5/29	3	92	4.4	8.9	1.3	1.13	0.02
5/30	18	96					
5/31	11	102	1.9	12.2	0.6	1.15	0.02
6/09	22	101					
6/14	17	103	2.3	14.0	0.9	1.25	0.03
6/15	31	104	1.4	14.0	0.6	1.21	0.01

Table E.2. Mean daily length, weight and condition factor for hatchery chinook salmon **sampled** at Imnaha River screw trap, March 1 - June 15, 1994.

Date	Number Sampled	Mean Length	S.E.	Mean Weight	S.E.	Mean Condition	S.E
4/12	3	131	1.4	27.3	0.5	1.21	0.04
4/13	49	130	1.5	24.6	0.9	1.09	0.01
4/14	50	129	1.0	21.7	0.5	1.01	<0.01
4/15	51	131	1.3	23.1	0.8	1.01	<0.01
4/16	64	125	1.1	22.4	0.6	1.13	0.01
4/18	99	126	-			-	-
4/18	103	128				-	
4/20	1	135					
4/21	47	124	1.2	21.0	0.6	1.08	<0.01
4/22	62	128	1.0	21.2	0.6	1.00	<0.01
4/23	50	127	1.0	20.8	0.6	1.01	<0.01
4/24	30	125	-				
4/26	50	123	1.2	20.8	0.6	1.10	<0.01
4/28	34	124	1.5	21.7	0.8	1.13	0.01
4/30	1	118	-	-		-	
5/03	37	125	1.6	20.9	0.8	1.05	0.02
5/04	99	123	0.9	21.3	0.5	1.13	0.02
5/06	28	121	1.5	18.2	1.0	1.02	0.03
5/09	6	121					-
5/15	8	125	5.7	20.6	2.7	1.02	0.03
5/16	5	127	3.5	21.2	0.7	1.04	0.04
5/17	12	122	3.6	20.5	1.5	1.10	0.03
5/24	1	125	-	19.9		1.02	-
5/28	1	105	-	13.4		1.16	-

Table E.3. Mean daily length, weight and condition factor of wild steelhead trout sampled at the Imnaha River screw trap, March 1 - June 15, 1994.

Date	Number Sampled	Mean Length	S.E.	Mean Weight	S.E.	Mean Condition	S.E.
3/03	1	163		49.8		1.15	
3/05	29	157	5.5	40.6	4.8	0.96	0.02
3/06	55	161	3.1	42.2	2.3	0.96	<0.01
3/07	21	173	5.8	52.5	4.8	0.94	0.02
3/08	28	169	5.4	49.7	4.6	0.95	0.01
3/09	6	167	8.0	47.6	6.6	0.98	0.02
3/10	6	154	7.0	37.0	5.3	0.98	0.02
3/11	5	138	4.1	24.9	3.3	0.92	0.03
3/12	5	149	8.1	34.5	6.0	1.00	0.01
3/16	1	213		89.8		0.93	
3/17	3	140	12.9	30.3	8.8	1.01	<0.01
3/18	4	172	14.8	51.1	10.4	0.96	0.07
3/19	4	169	6.0	48.8	5.6	1.00	0.06
3/23	4	188	7.2	64.0	6.2	0.96	0.02
3/25	4	153	9.8	38.9	7.5	1.04	0.01
3/29	1	122		17.6		0.97	
3/30	2	176	16.6	58.7	17.0	1.02	0.02
4/01	3	178	18.2	62.1	15.8	1.02	0.01
4/02	3	153	4.4	46.9	7.5	1.27	0.11
4/05	40	179	4.8	59.9	4.3	0.98	0.01
4/06	12	165	7.6	46.7	6.0	0.99	0.02
4/07	10	172	7.8	52.2	6.5	0.98	0.02
4/08	14	167	6.9	48.4	5.9	0.98	0.02
4/09	6	160	9.6	45.7	7.6	1.04	0.02
4/10	10	165	7.3	46.7	5.8	1.00	0.02
4/11	6	171	11.4	52.7	8.9	1.00	0.04
4/12	11	170	5.4	49.3	4.6	0.99	0.04
4/16	2	181					
4/18	30	183	5.0	65.7	4.5	0.98	0.02
4/20	1	174					
4/21	59	178	2.2	56.1	2.1	0.96	<0.01
4/22	77	181	2.0	56.6	1.9	0.93	<0.01
4/23	98	180	1.6	56.9	1.5	0.95	<0.01
4/24	30	179	2.8	56.5	2.4	0.96	0.01
4/26	56	177	1.8	55.2	1.8	0.97	<0.01
4/27	33	176	2.8	57.4	2.9	1.03	0.01
4/28	61	175	2.4	57.3	2.2	1.05	<0.01
4/29	27	175	2.5	55.3	2.2	1.02	0.01
4/30	25	178	2.9	55.3	3.0	0.97	0.01
5/01	100	177	1.7	54.9	1.5	0.97	0.01
5/02	87	169	2.2	50.8	2.0	1.00	<0.01
5/03	55	167	4.0	47.2	2.0	1.03	0.02

Table E.3. - Continued

Date	Number Sampled	Mean Length	S.E.	Mean Weight	S.E.	Mean Condition	S.E
5/04	129	172	2.1	52.9	1.6	1.04	0.01
5/06	55	172	2.2	51.3	1.9	0.98	0.02
5/07	50	170	2.5	52.9	3.4	1.03	0.03
5/08	50	173	2.3	52.7	2.0	1.00	0.01
5/09	1	165					
5/13	38	167	2.7	50.6	2.3	1.07	0.01
5/14	98	168	1.6	49.1	1.4	1.01	0.02
5/15	1	82		5.9		1.07	
5/16	55	166	2.1	47.8	1.8	1.03	<0.01
5/17	81	166	1.4	47.3	1.2	1.01	<0.01
5/18	87	170	1.4	49.4	1.3	0.99	<0.01
5/19	88	170	1.7	51.6	1.4	1.03	<0.01
5/20	63	170	1.7	51.5	1.6	1.03	<0.01
5/21	55	171	2.2	53.1	2.0	1.03	<0.01
5/24	26	171	2.6	49.2	2.2	0.97	<0.01
5/25	40	174	2.2	54.1	2.2	1.00	<0.01
5/26	52	173	2.1	54.7	2.0	1.03	<0.01
5/28	70	174	1.7	52.4	1.6	0.98	<0.01
5/29	66	176	1.6	56.1	1.6	1.01	<0.01
5/30	28	170					
5/31	14	172	2.9	51.0	3.0	0.98	0.02
6/01	25	175	2.9	54.4	3.0	0.98	0.02
6/03	22	175	3.0	52.5	2.7	0.96	0.01
6/07	3	166	1.0	50.0	3.8	1.10	0.09
6/08	20	182	3.1	66.1	4.1	1.06	0.02
6/09	5	176					
6/11	8	179	3.9	60.2	4.8	1.04	0.02

Table E.4. Mean daily length, weight and condition factor of hatchery steelhead trout sampled at the Imnaha River screw trap, March 1 - June 15, 1994.

Date	Number Sampled	Mean Length	S.E.	Mean Weight	S.E.	Mean Condition	S.E
4/23	2	206	8.8	82.8	9.8	0.95	<0.01
4/26	119	213	1.4	102.5	2.1	1.05	<0.01
4/27	34	210	3.7	103.6	5.7	1.09	0.01
4/28	51	207	2.5	93.2	3.3	1.04	<0.01
4/29	37	212	2.7	100.4	3.8	1.04	0.01
4/30	60	209					
5/02	50	211	3.4	105.0	4.2	1.26	0.20
5/03	59	213	2.6	101.7	4.4	1.02	0.01
5/04	125	213	1.9	103.3	3.0	1.04	<0.01
5/06	60	211	2.2	96.0	3.2	1.01	<0.01
5/07	50	216	3.2	102.4	4.6	0.99	0.01
5/08	50	217	3.1	99.4	4.2	0.95	<0.01
5/09	8	224		-			
5/13	98	206	2.1	90.0	2.9	0.99	<0.01
5/14	108	210	1.9	92.9	2.8	0.97	<0.01
5/15	100	211					
5/16	170	208	1.4	87.2	1.9	0.95	<0.01
5/17	158	207	1.5	85.6	2.0	0.93	<0.01
5/18	220	209	1.3	87.3	1.8	0.93	<0.01
5/19	165	209	1.5	86.8	2.2	0.92	<0.01
5/20	153	208	1.7	87.8	2.3	0.94	<0.01
5/21	121	205	1.6	79.9	2.1	0.90	<0.01
5/25	241	207	1.2	81.2	1.6	0.89	<0.01
5/26	9	196	6.0	70.3	6.9	0.91	0.02
5/28	68	208	2.2	83.3	2.8	0.90	<0.01
5/29	85	204	2.2	80.2	3.0	0.91	<0.01
5/30	54	208					
5/31	93	205	2.0	80.0	2.6	0.90	<0.01
6/01	60	207	2.7	85.1	3.7	0.92	<0.01
6/03	100	206					
6/04	100	205					
6/05	103	205					
6/06	100	212					
6/07	60	212	2.3	88.7	3.0	0.91	<0.01
6/08	97	211	2.1	90.3	2.6	0.98	0.05
6/09	129	209	1.6	84.2	2.1	0.90	<0.01
6/10	100	210	1.9	89.2	2.8	0.93	<0.01
6/11	98	208	2.1	85.1	2.9	0.91	<0.01
6/12	59	209	2.4	88.0	3.1	0.94	<0.01
6/13	100	207	1.7	82.3	2.3	0.91	<0.01
6/14	100	210	1.8	89.4	2.6	0.95	<0.01
6/15	100	213	1.9	94.2	2.7	0.95	<0.01

Table F.I. Composition of incidental species captured in the Imnaha River trap, March 1994.

Date	Species										Total Catch
	STHD	BT	MWF	SMB	CHSL	RSS	LND	NSF	BLS	SC	
1							5				5
2							21		8		29
3											0
4											0
5						1		1	2		4
6											0
7											0
8											0
9											0
10											0
11											0
12											0
13											0
14											0
15											0
16							31		3	2	36
17							8		1		9
18							4		3	1	8
19							1				1
20											0
21											0
22											0
23						2					2
24										2	2
25							4				4
26							8				8
27							12				12
28							17				17
29						2	3	22		1	28
30							61		1		62
31	1						42		2		45
Total	1	0	0	0	4	4	236	1	20	6	272

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

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

Table F.2. Composition of incidental species captured in the Imnaha River trap, April 1994.

Date	Species										Total Catch		
	STHD	BT	MWF	SMB	CHSL	RSS	LND	NSF	BLS	SC			
1					1		12		2	1	16		
2							21		3		24		
3							6		7	2	15		
4							7	2	9		18		
5									4	2	6		
6						1	1		2	1	5		
7						1			1		2		
8							1			1	2		
9							3		1		4		
10											0		
11										1	1		
12							5		1	3	9		
13											0		
14											0		
15											0		
16							2		2	1	5		
17											0		
18						1	3		9		13		
19											0		
20							2	1	27	1	31		
21											0		
22						1			4		5		
23			1			1	1		1	4	8		
24						1			1	2	4		
25											0		
26											0		
27											0		
28											0		
29						1			2	1	4		
30							1		1		2		
31											0		
Total	0	1	0	0	1	5	3	6	4	5	81	14	174

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

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

Table F.3. Composition of incidental species captured in the Imnaha River trap, May 1994.

Date	Species										Total Catch
	STHD	BT	MWF	SMB	CHSL	RSS	LND	NSF	BLS	SC	
1									1		1
2									2		2
3									3	1	4
4						2	1	5			8
5											0
6								1	1		2
7							1		2		3
8							1	1	2		4
9							1	1	1		3
10											0
11											0
12											0
13								1	3		4
14	1							1	6		8
15								4			4
16						1					1
17	2							6	1	2	11
18									9		9
19								7	1		8
20									3		3
21									7		7
22											0
23											0
24						1		15			16
25								42	4		46
26	1		1					41	2		45
27											0
28						2		11	26		39
29	1					1		7	30		39
30								45	23		68
31								68	13		81
Total	5	1	0	0	7	4	256	0	140	3	416

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

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

Table F.4. Composition of incidental species captured in the Imnaha River trap, June 1 – 15 1994.

Date	Species											Total Catch
	STHD	BT	MWF	SMB	CHSL	RSS	LND	NSF	BLS	SC		
1							21		42			63
2												0
3				1			4	7	25			73
4					1		13		15			29
5			1		2	1	12		18			34
6					1		39		26	1		67
7							52		30			82
8							1	1	14			16
9					6		39		9			54
10					5		24		3			32
11					2		20		3			25
12					1		12		8			21
13							15		11			26
14							8		31			39
15							15		3			18
Total	0	0	1	1	18	1	318	1	238	1		579

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

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

Table G.I. Survey of wild and hatchery chinook salmon PIT tag groups released at the Imnaha River screw trap, March 1 - June 15, 1994

Release Date	Tag File	Species	Origin	Release Strategy	Number Released	Mean Length	Mean Weight
3/23	PAK94082.NT1	CH	W	NPT	17	100.2	10.5
3/24	PAK94083.NT1	CH	W	NPT	46	101.8	10.6
3/25	PAK94084.NT1	CH	W	NPT	48	103.0	10.8
3/31	PAK94090.NT1	CH	W	NPT	147	108.0	12.7
4/05	PAK94095.NT1	CH	W	NPT	148	104.8	11.8
4/11	PAK94101.NT1	CH	W	NPT	77	104.8	12.3
4/12	PAK94102.NT2	CH	W	NPT	41	109.2	13.1
4/12	PAK94102.NT3	CH	W	NPT	37	111.1	14.1
4/21	PAK94101.NT1	CH	W	NPT	7	108.4	14.3
4/26	PAK94116.NT1	CH	W	NPT	50	103.0	12.6
4/26	PAK94116.NT4	CH	W	NPT	8	99.9	11.3
4/28	PAK94118.NT3	CH	W	NPT	80	98.9	11.5
5/03	PAK94123.NT1	CH	W	NPT	28	101.8	11.4
5/04	PAK94124.NT1	CH	W	NPT	93	103.1	12.1
5/17	PAK94137.NT1	CH	W	NPT	70	97.6	11.2
5/18	PAK94138.NT1	CH	W	NPT	59	101.2	12.7
TOTAL					956		
4/13	PAK94103.FP1	CH	H	FPC	50	130.4	24.6
4/14	PAK94104.FP1	CH	H	FPC	50	126.9	21.7
4/15	PAK94105.FP1	CH	H	FPC	50	131.1	23.1
4/16	PAK94106.FP1	CH	H	FPC	50	125.7	22.7
4/21	PAK94111.FP1	CH	H	FPC	46	124.5	21.0
4/22	PAK94112.FP1	CH	H	FPC	57	126.8	21.2
4/23	PAK94113.FP1	CH	H	FPC	49	126.8	20.8
4/26	PAK94116.FP1	CH	H	FPC	50	123.0	20.8
4/28	PAK94118.FP3	CH	H	FPC	34	123.5	21.7
4/29	PAK94119.FP1	CH	H	FPC	49	122.8	
5/03	PAK94123.FP3	CH	H	FPC	37	125.4	20.9
5/04	PAK94124.FP1	CH	H	FPC	99	123.3	21.3
5/06	PAK94126.FP1	CH	H	FPC	11	121.7	17.3
5/06	PAK94125.FP2	CH	H	FPC	17	120.5	18.8
5/17	PAK94137.FP3	CH	H	FPC	12	122.2	20.5
TOTAL					661		

Table G.2. Summary of wild steelhead trout PIT tag groups released at the Imnaha River screw trap, March 1 - June 15, 1994

Release Date	Tag File	Species	Origin	Release Strategy	Number Released	Mean Length	Mean Weight
4/21	PAK94111.NT2	RBT	W	NPT	48	177.8	55.1
4/22	PAK94112.NT1	RBT	W	NPT	49	183.3	58.0
4/23	PAK94113.NT1	RBT	W	NPT	47	179.9	55.1
4/26	PAK94116.NT2	RBT	W	NPT	54	177.3	55.2
4/27	PAK94117.NT1	RBT	W	NPT	32	175.5	57.6
4/28	PAK94118.NT1	RBT	W	NPT	60	174.8	57.2
4/28	PAK94118.NT2	RBT	W	NPT	1		
4/28	PAK94124.NT2	RBT	W	NPT	1	172.1	53.0
5/04	PAK94124.NT3	RBT	W	NPT	126	171.7	52.6
5/04	PAK94133.NT1	RBT	W	NPT	37	166.5	50.6
5/14	PAK94134.NT1	RBT	W	NPT	97	168.1	48.9
5/19	PAK94139.NT1	RBT	W	NPT	88	169.8	51.6
5/20	PAK94140.NT1	RBT	W	NPT	63	169.9	51.5
5/26	PAK94146.NT1	RBT	W	NPT	52	173.5	54.7
6/01	PAK94152.NT2	RBT	W	NPT	33	175.4	54.4
6/03	PAK94154.NT1	RBT	W	NPT	22	174.8	52.5
6/07	PAK94158.NT1	RBT	W	NPT	15	165.7	50.0
6/08	PAK94159.NT1	RBT	W	NPT	21	1825	66.1
TOTAL					846		
4/29	PAK94119.FP2	RBT	W	FPC	50	174.9	55.3
4/30	PAK94120.FP1	RBT	W	FPC	50	177.7	55.3
5/02	PAK94122.FP1	RBT	W	FPC	50	168.8	51.7
5/03	PAK94123.FP2	RBT	W	FPC	55	166.6	47.2
5/06	PAK94126.FP4	RBT	W	FPC	55	1725	51.3
5/16	PAK94136.FP3	RBT	W	FPC	18	160.2	43.7
5/16	PAK94136.FP4	RBT	W	FPC	37	168.6	49.8
5/17	PAK94137.FP4	RBT	W	FPC	81	166.5	47.3
5/18	PAK94138.FP1	RBT	W	FPC	1	184.0	57.8
5/18	PAK94138.FP2	RBT	W	FPC	89	169.8	49.3
5/24	PAK94141.FP1	RBT	W	FPC	55	171.5	53.1
5/25	PAK94144.FP3	RBT	W	FPC	26	170.8	49.2
5/25	PAK94145.FP5	RBT	W	FPC	21	174.2	54.1
TOTAL					588		

Table G.3. Mean fork length, weight and number of hatchery steelhead trout PIT tagged and released at the Imnaha River screw trap, March 1 - June 15, 1994.

Release Date	Tag File	Species	Origin	Release Strategy	Number Released	Mean Length	Mean Weight
4/23	PAK94113.NT1	RBT	H	NPT	2	205.5	828
4/26	PAK94116.NT3	RBT	H	NPT	51	217.7	107.3
4/27	PAK94117.NT2	RBT	H	NPT	43	203.4	--
4/28	PAK94118.NT2	RBT	H	NPT	62	203.1	100.9
5/04	PAK94124.NT2	RBT	H	NPT	117	212.8	101.1
5/13	PAK94133.NT2	RBT	H	NPT	32	201.6	83.9
5/14	PAK94134.NT2	RBT	H	NPT	84	209.2	91.6
5/19	PAK94139.NT2	RBT	H	NPT	149	209.5	87.7
5/26	PAK94146.NT2	RBT	H	NPT	51	196.0	70.3
6/01	PAK94152.NT1	RBT	H	NPT	60	207.4	85.1
6/09	PAK94160.NT1	RBT	H	NPT	142	209.2	84.2
TOTAL					793		
4/26	PAK94116.FP2	RBT	H	FPC	50	207.3	97.0
4/27	PAK94117.FP1	RBT	H	FPC	60	209.7	103.6
4/28	PAK94118.FP1	RBT	H	FPC	59	212.2	99.4
4/29	PAK94119.FP3	RBT	H	FPC	59	212.1	100.4
4/30	PAK94120.FP2	RBT	H	FPC	60		
5/02	PAK94122.FP2	RBT	H	FPC	50	211.4	105.0
5/03	PAK94123.FP1	RBT	H	FPC	59	212.9	101.7
5/06	PAK94126.FP3	RBT	H	FPC	60	210.5	96.0
5/13	PAK94133.FP1	RBT	H	FPC	60	209.2	93.8
5/16	PAK94136.FP1	RBT	H	FPC	29	209.7	88.1
5/16	PAK94136.FP2	RBT	H	FPC	29	208.5	88.2
5/17	PAK94137.FP1	RBT	H	FPC	60	205.3	83.4
5/17	PAK94137.FP2	RBT	H	FPC	60	206.9	84.2
5/18	PAK94138.FP1	RBT	H	FPC	119	207.8	86.5
5/20	PAK94140.FP1	RBT	H	FPC	60	208.2	89.0
5/24	PAK94144.FP1	RBT	H	FPC	60	206.1	81.4
5/24	PAK94144.FP2	RBT	H	FPC	60	204.4	78.7
5/24	PAK94144.FP3	RBT	H	FPC	1	188.0	62.8
5/25	PAK94145.FP1	RBT	H	FPC	60	209.7	828
5/25	PAK94145.FP2	RBT	H	FPC	63	206.2	826
5/25	PAK94145.FP3	RBT	H	FPC	61	209.5	84.8
5/25	PAK94145.FP4	RBT	H	FPC	57	201.7	73.8
TOTAL					1,236		