

**Emigration of Natural and Hatchery Nacó'x̂ (Chinook Salmon; *Oncorhynchus tshawytscha*)
and Héeyey (Steelhead; *Oncorhynchus mykiss*) Smolts from the Imnaha River, Oregon
from 18 October 2004 to 21 June 2005**

2005 Annual Report

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U.S. Fish and Wildlife Service
Lower Snake River Compensation Plan
1387 Vinnell Way
Boise, Idaho 83709
Cooperative Agreement for FY 2005: 14110-5-J009

BPA Project Number: 1997-015-01
BPA 2004 Contract Number: 00004004

May 2007

EXECUTIVE SUMMARY

This report summarizes the Nez Perce Tribe's Imnaha River juvenile Nacó'x̂ (Chinook Salmon; *Oncorhynchus tshawytscha*) and Héeyey (steelhead; *O. mykiss*) emigration studies conducted from October 18, 2004, to June 21, 2005 (migration year 2005, Brood Year 2003). The studies have been ongoing for the past 14 years and have contributed information to the Fish Passage Center's Smolt Monitoring Program for the past 12 years. The study collected and tagged fish in the Imnaha River at rkm 7 during the fall and spring. Tagged fish were detected downstream as they passed through Snake and Columbia River dams. The project evaluated the survival, biological characteristics, and migration performance of natural and hatchery spring/summer Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) at Lower Granite Dam (LGD), Little Goose Dam (LGS), Lower Monumental Dam (LMD), and McNary Dam (MCD). This report also re-introduces the Nez Perce names for these fish species. These traditional names pre-date both the common and scientific nomenclature.

Imnaha River Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) smolts migrating in the spring had average hydrologic conditions in the Imnaha River for May and lower than average for March, April and June. Average monthly discharge from March to June ranged from 330 cfs (March) to 1,749 cfs (May). Snake River run-off was lower than average based on the forty-six year record. The average monthly discharge in the Snake River ranged from 18,490 cfs in March to 60,690 cfs in May. Spill at LGD, LGS, LMD, and MCD began from April 1 to May 1 and lasted until September 1. Maximum water temperatures in the tailraces of LGD, LGS, LMD, and MCD exceeded 18 °C after July 1.

A total of 11,302 natural origin Nacó'x̂, 38,197 hatchery origin Nacó'x̂ (Chinook salmon) 5,441 natural origin Héeyey (steelhead), and 29,765 hatchery origin Héeyey (steelhead) were captured in 2005. The studies PIT tagged a total of 9,655 natural Nacó'x̂ (Chinook salmon), 5 hatchery Nacó'x̂ (Chinook salmon), 4,503 natural Héeyey, and 6,574 hatchery Héeyey. The catch of hatchery Nacó'x̂ (Chinook salmon) included 1,016 previously PIT tagged fish. Hatchery Nacó'x̂ (Chinook salmon) had a mean fork length (117 mm) that was significantly different ($p < 0.05$) than the mean fork length of natural Nacó'x̂ (Chinook salmon) (91 mm). Previously PIT tagged hatchery Héeyey (steelhead) had a mean fork length (202 mm) that was significantly larger ($p < 0.05$) than the mean fork length of natural produced Héeyey (steelhead) (169 mm).

The estimated post release survival of PIT tagged hatchery Nacó'x̂ (Chinook salmon) from release at the Gumboot acclimation site to the Imnaha River juvenile migrant trap was $87.7\% \pm 4.6\%$ (95% C.I.) in spring 2005. The post-release survival estimate was significantly below previous estimates from 1994 to 2004 of 88.4% to 100%. The survival estimate of natural Nacó'x̂ (Chinook salmon) tagged in the fall was 21.6% to LGD. Past survival estimates from the trap to LGD for fall tagged Imnaha River natural Nacó'x̂ (Chinook salmon) have ranged from 25.6% to 60.4% from 1994 to 2004.

Imnaha River smolts estimated survivals from release at the Imnaha trap to LGD in 2005 were 73.9% for natural Nacó'x̂ (Chinook salmon), 60.8% for hatchery Nacó'x̂ (Chinook salmon), 80.8% for natural Héeyey (steelhead), and 82.8% for hatchery Héeyey (steelhead). The estimated survival from the Imnaha trap to LMD was 63.0% for natural Nacó'x̂, 47.7% for hatchery Nacó'x̂ (Chinook salmon), 55.1% for natural Héeyey (steelhead) and 64.1% for hatchery Héeyey (steelhead).

A smolt-to-adult return rate (SAR) index from LGD to LGD was calculated for migrating fall and spring tagged natural Nacó'x̂ (Chinook salmon) for brood years 1996 to 2000 (migration years 1998 to 2002). These SARs characterize Imnaha natural Nacó'x̂ (Chinook salmon) that were mostly bypassed when detected at the dams and traveled in-river (i.e. not barged). The LGD to LGD SAR index for fall tagged natural Nacó'x̂ (Chinook salmon) has ranged from 0.61% (BY 1999) to 3.08% (BY 1996). The LGD to LGD SAR index for fall tagged natural Nacó'x̂ (Chinook salmon) in BY 2000 was 2.84%. The LGD to LGD SAR index for spring tagged natural Nacó'x̂ (Chinook salmon) is lower than previous averages ranging from 0.29% (BY 1999) to 2.94% (BY 1998). The LGD to LGD SAR index for BY 2000 was 0.79%.

Significant difference ($p < 0.05$) in the median arrival timing of fall and spring PIT tagged natural Nacó'x̂ (Chinook salmon) was observed at LGD. Median arrival timing of fall tagged natural Nacó'x̂ (Chinook salmon) at LGD occurred on April 17: 49 days earlier than the median arrival timing for spring tagged natural Nacó'x̂ (Chinook salmon) smolts. A total of 8 years of arrival data for fall tagged natural Nacó'x̂ (Chinook salmon), 13 and 14 years of arrival data for spring tagged natural and hatchery Nacó'x̂ (Chinook salmon), and 14 years of arrival data for natural and hatchery Héeyey at LGD, LGS, LMD, and MCD was summarized for this report. The estimated median arrival time at LGD is as follows: April 16 (± 8 days) for fall tagged natural Nacó'x̂ (Chinook salmon) (1998 to 2005), April 28 (± 8 days) for spring tagged natural Nacó'x̂ (Chinook salmon) smolts (1993 to 2005), May 3 (± 10 days) for hatchery Nacó'x̂ (Chinook salmon), May 10 (± 13 days) for natural Héeyey (steelhead) (1993 to 2005) and May 20 (± 12 days) for hatchery Héeyey (steelhead) (1993 to 2005).

TABLE OF CONTENTS

EXECUTIVE SUMMARY	ii
TABLE OF CONTENTS	iv
LIST OF TABLES	vi
LIST OF FIGURES	viii
LIST OF APPENDICIES	x
INTRODUCTION	12
METHODS	14
Study Area Description	14
Equipment Description	14
Trap Operations	15
PIT Tagging	17
Trap Efficiencies	17
Biological Characteristics	17
Survival Estimation	18
Spring Emigration Index	18
Smolt to Adult Return Rates (SARs)	19
Arrival and Travel Timing to Trap Site and Lower Snake River Dams	19
RESULTS AND DISCUSSION	20
River Discharge and Water Temperature	20
Imnaha River	20
Snake River	21
Hatchery Releases	25
Nacó'x̂ (Chinook salmon).....	25
Héeyey (Steelhead).....	25
Juvenile Nacó'x̂ (Chinook salmon) and Héeyey (Steelhead) Catch	26
Catch for Migration Year 2005	26
PIT Tagging	28
Recaptures of Previously PIT Tagged Smolts	29
Biological Characteristics	31
Annual Biological Characteristics.....	31
Abundance and Survival	35
Natural Nacó'x̂ (Chinook salmon) and Héeyey (Steelhead) Abundance	35
Post Release Survival of Hatchery Nacó'x̂ (Chinook salmon).....	36
Estimated Season Wide Smolt Survival from the Imnaha Trap	37
Estimated Weekly Smolt Survival	41
Smolt to Adult Return Rates	42
Arrival Timing at Dams	43
Natural and Hatchery Nacó'x̂ (Chinook salmon) Arrival Timing for 2005	43
Natural and Hatchery Héeyey (Steelhead) Arrival Timing for 2005	45
Average Arrival Timing	45

Travel Time to Lower Granite Dam.....	48
Mortality	49
Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) Mortality	49
Incidental Catch	49
Incidental Catch for Migration Year 2005.....	49
ACKNOWLEDGMENTS	51
LITERATURE CITED	52
APPENDICES	55

LIST OF TABLES

Table 1. Releases of hatchery reared Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) smolts in the Imnaha River Subbasin during migration year 2005 (D. Eddy, Oregon Fish and Wildlife, personal communication)	26
Table 2. The weekly mean discharge (cfs), temperature (°C), and catch of natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) at the Imnaha River juvenile migration trap from 18 October 2004 to 21 June 2005.....	27
Table 3. The number of natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) PIT tagged weekly at the Imnaha River juvenile migration trap from 18 October 2004 to 21 June 2005.....	28
Table 4. Averages, ranges, and standard deviations of fork lengths (mm), weights (g), and condition factors (K) with minimum, maximum, and sample size values for recaptures of previously PIT tagged natural and hatchery Nacó'x̂ (Chinook salmon), and hatchery Héeyey (steelhead) observed during the 2005 migration year, 18 October 2004 to 21 June 2005, at the Imnaha River juvenile migration trap.	30
Table 5. Averages, ranges, and standard deviations of fork lengths (mm), weights (g), and condition factors (K) with minimum, maximum, and sample size values for natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) captured during the 2005 migration year, 18 October 2004 to 21 June 2005, at the Imnaha River juvenile migration trap.	33
Table 6. Weekly mean fork lengths (FL) and condition factors (K) for natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) captured at the Imnaha River juvenile migration trap during the spring of 2005.....	35
Table 7. Estimated survival probabilities for season-wide PIT tag release groups of natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) smolts released from the Imnaha River juvenile migration trap from February 27 to June 21, 2005. Estimates are from release at the trap to Lower Granite Dam and tail race to tail race for all other sites. Abbreviations: LGD - Lower Granite Dam, LGS - Little Goose Dam, LMD - Lower Monumental Dam.	38
Table 8. Season-wide estimates of survival from the Imnaha River juvenile migration trap to Lower Granite Dam from 1993 to 2005. Ninety-five percent confidence intervals are shown in parentheses.....	39
Table 9. Season-wide estimates of survival from the Imnaha River juvenile migration trap to Lower Monumental Dam from 1997 to 2005. Ninety-five percent confidence intervals are shown in parentheses.....	39

Table 10. Season-wide estimates of survival from the Imnaha River juvenile migration trap to McNary Dam from 1998 to 2005. Ninety-five percent confidence intervals are shown in parentheses.....40

Table 11. Estimated survival probabilities for weekly PIT tag release groups of 300 or more natural and hatchery Nacó'x (Chinook salmon) smolts released from the Imnaha River juvenile migration trap from March 27 to May 1, with 95% confidence intervals in parentheses. Estimates are from release at the trap to Lower Granite Dam and tailrace to tailrace for all other sites. Abbreviations: LGD - Lower Granite Dam, LGS - Little Goose Dam, LMD - Lower Monumental Dam.41

Table 12. Estimated survival probabilities for weekly PIT tag release groups of 300 or more natural and hatchery Héeyey (steelhead) smolts released from the Imnaha River juvenile migration trap from April 10 to May 29, with 95% confidence intervals in parentheses. Estimates are from release at the trap to Lower Granite Dam and tailrace to tailrace for all other sites. Abbreviations: LGD - Lower Granite Dam, LGS - Little Goose Dam, LMD - Lower Monumental Dam.42

Table 13. Smolt to adult return rate indices (SARs) from LGD to LGD of PIT tagged Imnaha River natural Nacó'x (Chinook salmon) for brood years 1996 to 2000. In-river migrating fish were tagged at the Imnaha River juvenile migration trap.43

Table 14. Averaged mean first, median, 90%, and last arrival timing for fall and spring tagged natural Nacó'x juveniles, hatchery Nacó'x smolts, and natural and hatchery Héeyey (steelhead) smolts, at Lower Granite Dam (LGD), Little Goose Dam (LGS), Lower Monumental Dam (LMD) and McNary Dam (MCD). All fish were captured in the Imnaha River juvenile migration trap. Mean arrival timing is presented with the 95% C.I. ± days.47

Table 15. A comparison of median travel times of natural and hatchery Nacó'x (Chinook salmon) smolts released from the Imnaha River screw trap, March 27 to June 26, 2005, at Lower Granite Dam.....48

LIST OF FIGURES

Figure 1. Map of the Imnaha River study area.	15
Figure 2. Map of the Columbia River Basin. Dams underlined indicate monitoring points for the Imnaha Smolt Monitoring Program.	16
Figure 3. The Imnaha River juvenile migration trap site with a rotary screw trap operating.	16
Figure 4. The average daily discharge at the Imnaha River USGS gauge 13292000 and the average daily temperature from October 1, 2004, to July 1, 2005, at the Imnaha River juvenile migration trap. USGS discharge data is provisional.	20
Figure 5. The average monthly discharge for the months of March, April, May, and June for 2005, at the Imnaha River USGS gauge 13292000. Bars indicate the minimum and maximum average monthly discharge values observed from 1929 to 2005. USGS discharge data is provisional.	21
Figure 6. The average daily discharge and temperature at the Snake River gauge 13334300 from October 1, 2004, to July 1, 2005. USGS discharge data is provisional.	22
Figure 7. The average monthly discharge for the months of March, April, May, and June for 2005 at the Snake River USGS gauge 13334300. Bars indicate the minimum and maximum average monthly discharge values observed from 1959 to 2005. USGS discharge data is provisional.	22
Figure 8. Measurements of outflow, spill, and mean temperature at Lower Granite Dam from March 1 to September 1, 2005. Data obtained online at http://www.cbr.washington.edu/dart/	23
Figure 9. Measurements of outflow, spill, and mean temperature at Little Goose Dam from March 1 to September 1, 2005. Note that temperature did not begin recording until March 28. Data obtained online at http://www.cbr.washington.edu/dart/	24
Figure 10. Measurements of outflow, spill, and mean temperature at Lower Monumental Dam from March 1 to September 1, 2005. Note that temperature did not begin recording until March 28. Data obtained online at http://www.cbr.washington.edu/dart/	24
Figure 11. Measurements of outflow, spill, and mean temperature at McNary Dam from March 1 to September 1, 2005. Data obtained online at http://www.cbr.washington.edu/dart/	25
Figure 12. The arrival frequency of previously PIT tagged hatchery Nacó'x̂ (Chinook salmon) captured in the Imnaha River juvenile migration trap during the spring of 1998 to the spring of	

2005. The release strategy in 1998 was an acclimated forced release and the remainder of the releases were acclimated volitional releases.31

Figure 13. Length frequency distribution of natural Nacó'x̂ (Chinook salmon) pre-smolts trapped in the Imnaha River juvenile migration trap from October 18 to November 18, 2004.32

Figure 14. Length frequency distribution of natural and hatchery Nacó'x̂ (Chinook salmon) trapped in the Imnaha River juvenile migration trap, February 27 to June 21, 2005.34

Figure 15. Length frequency distribution of natural and hatchery Héeyey (steelhead) trapped in the Imnaha River juvenile migration trap, February 27 to June 21, 2005.....34

Figure 16. Estimated post release survival of hatchery Nacó'x̂ (Chinook salmon) from the Imnaha River Gumboot acclimation facility to the Imnaha River juvenile migration trap from 1994 to 2005. The error bars indicate the 95% C.I.36

Figure 17. Estimated survival from the Imnaha River juvenile migration trap to Lower Granite Dam of natural Nacó'x̂ (Chinook salmon) tagged in the fall, for migration years 1994 to 2005. Error bars indicate the 95% C.I.37

Figure 18. The cumulative arrival timing of fall and spring tagged natural Nacó'x̂ (Chinook salmon) and tailrace spill at Lower Granite Dam during the 2005 migration year. Fall and spring tagged natural Nacó'x̂ (Chinook salmon) were released in the fall of 2004 and the spring of 2005.....44

LIST OF APPENDICIES

Appendix A. The number of hours sampled and the catch of natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) at the Imnaha River juvenile migration trap from 18 October 2004 to 21 June 2005. Sampling periods exceeded 24 hours when trapping continued past the hour the trap was started from the previous day (e.g. 8:30 am on October 18 to 11:00 am on October 19). N/A indicates the trap was not operated on that date.....	56
Appendix B. The number of Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) PIT tagged at the Imnaha River juvenile migration trap from 18 October 2004 to 21 June 2005. N/A indicates the trap was not operated on that date.....	60
Appendix C. Previously PIT tagged natural Nacó'x̂ (Chinook salmon) recaptured in the Imnaha River juvenile migration trap during the fall of 2004 and spring 2005.	64
Appendix D. Statistical comparisons of median fork lengths between groups of smolts captured in the Imnaha River smolt trap during the spring of migration year 2005.....	64
Appendix E. Gauss population estimates by group for natural Nacó'x̂ (Chinook salmon) captured in the Imnaha River juvenile migration trap during the spring 2005.....	65
Appendix F. Gauss population estimates by group for natural Héeyey (steelhead) captured in the Imnaha River juvenile migration trap during the spring 2005.	65
Appendix G. A statistical comparison of median arrival date at LGD between natural Nacó'x̂ (Chinook salmon) pre-smolts released in the fall of 2004 and smolts released in the spring of 2005 from the Imnaha River juvenile migration trap during migration year 2005.	65
Appendix H. Arrival timing of fall PIT tagged Imnaha River natural Nacó'x̂ (Chinook salmon) smolts to Lower Granite, Little Goose, Lower Monumental, and McNary dams from 1998 to 2005.....	66
Appendix I. Arrival timing of spring PIT tagged Imnaha River natural Nacó'x̂ (Chinook salmon) smolts at Lower Granite, Little Goose, Lower Monumental, and McNary dams from 1993 to 2005.....	67
Appendix J. Arrival timing of PIT tagged Imnaha River hatchery Nacó'x̂ (Chinook salmon) smolts at Lower Granite, Little Goose, Lower Monumental, and McNary dams from 1992 to 2005.....	69
Appendix K. Arrival timing of spring PIT tagged Imnaha River natural Héeyey (steelhead) smolts at Lower Granite, Little Goose, Lower Monumental, and McNary dams from 1993 to 2005.....	71

Appendix L. Arrival timing of ODFW spring PIT tagged Imnaha River hatchery Héeyey (steelhead) smolts at Lower Granite, Little Goose, Lower Monumental, and McNary dams from 1993 to 2005.73

Appendix M. Mortality of Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) smolts due to trapping, handling, PIT tagging and Dead on Arrival at the Imnaha River juvenile migration trap from October 18 to November 18, 2004.74

Appendix N. Mortality of Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) smolts due to trapping, handling, PIT tagging and Dead on Arrival at the Imnaha River juvenile migration trap from March 2 to June 21, 2005.....75

Appendix O. The catch of incidental fish during the fall, 18 October to 18 November 2004, and the spring, 3 March to 21 June 2005, at the Imnaha River juvenile fish trap for the 2005 migration year.76

INTRODUCTION

This report summarizes the Nez Perce Tribe (NPT) Department of Fisheries Resources Management (DFRM) results for the Lower Snake River Compensation Plan (LSRCP) Hatchery Evaluation studies and the Imnaha River Smolt Monitoring Program (SMP) for the 2005 smolt migration from the Imnaha River, Oregon. These studies are closely coordinated and provide information about juvenile natural and hatchery spring/summer Nacó'x̂ (Chinook Salmon; *Oncorhynchus tshawytscha*) and Héeyey (steelhead; *O. mykiss*) biological characteristics, emigrant timing, survival, arrival timing and travel time to the Snake River dams and McNary Dam (MCD) on the Columbia River. These studies provide information on listed Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) for the Federal Columbia River Power System (FCRPS) Biological Opinion (NMFS 2000).

The Lower Snake River Compensation Plan program's goal is to maintain a hatchery production program of 490,000 Nacó'x̂ (Chinook salmon) and 330,000 Héeyey (steelhead) for annual release in the Imnaha River (Carmichael et al. 1998, Whitesel et al. 1998). These hatchery releases occur to compensate for fish losses due to the construction and operation of the four lower Snake River hydroelectric facilities. One of the aspects of the LSRCP hatchery evaluation studies in the Imnaha River was to determine natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) smolt performance, emigration characteristics and survival (Kucera and Blenden 1998). A long term monitoring effort was established to document smolt emigrant timing and post release survival within the Imnaha River, estimate smolt survival downstream to McNary Dam, compare natural and hatchery smolt performance, and collect smolt-to-adult return information.

This project collects information for, and is part of, a larger effort entitled Smolt Monitoring by Federal and Non-Federal Agencies (BPA Project No. 198712700). This larger project provides data on movement of smolts out of major drainages and past dams on the Snake River and Columbia River. In season indices of migration strength and migration timing are provided for the run-at large at key monitoring sites. Marked smolts are utilized to measure travel time and estimate survival through key index reaches. Fish quality and descaling measures are taken at each monitoring site and provide indicators of the health of the run.

Co-managers in the Imnaha River subbasin (Ecovista 2004) have identified the need to collect information on life history, migration patterns, juvenile emigrant abundance, reach specific smolt survivals, and Smolt-to-Adult Return rates (SAR's) for both Héeyey (steelhead) and Nacó'x̂ (Chinook salmon) smolts. The current study provides information related to the majority of the high priority data needs. Current funding does not allow for determination of a total (annual) juvenile emigrant abundance and installation of adult passive integrated transponder (PIT) tag detectors at the mouth of the Imnaha River to calculate tributary specific SAR's.

Information is shared with the Fish Passage Center (FPC) on a real time basis during the spring emigration period. The Bonneville Power Administration (BPA) and the United States Fish and Wildlife Service (USFWS) contracted the NPT to monitor emigration timing and tag up to 19,000 emigrating natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) smolts from the Imnaha River with passive integrated transponder (PIT) tags.

The completion of trapping in the spring of 2005 marked the 14th year of emigration studies on the Imnaha River, and the 12th year of participating in the FPC smolt monitoring program. Monitoring and evaluation objectives were to:

1. Determine spring emigration timing of Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) smolts collected at the Imnaha River juvenile migration trap.
2. Evaluate effects of flow, temperature and other environmental factors on emigration timing.
3. Monitor the daily catch and biological characteristics of juvenile Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) smolts collected at the Imnaha River screw trap.
4. Determine emigration timing, travel time, and in-river survival of PIT tagged hatchery Nacó'x̂ (Chinook salmon) smolts released at the Imnaha River acclimation facility to the Imnaha River juvenile migration trap.
5. Determine arrival timing, travel time and estimated survival of PIT tagged natural and hatchery Nacó'x̂ (Chinook salmon) and natural and hatchery Héeyey (steelhead) smolts from the Imnaha River to Snake and Columbia river dams.
6. Compare emigration characteristics and survival rates of natural fall and spring tagged juvenile Nacó'x̂ (Chinook salmon).

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 to its confluence with the Snake River (James 1984; Kucera 1989). The Snake River is 1,607 km long and is the longest tributary to the Columbia River. The Columbia River is the largest river system in the Pacific Northwest, 1,953 km in length, and drains an area of 667,931 square kilometers from the Cascade Mountains to the west, Rocky Mountains to the east, and the Great Basin to the south (Anonymous 2003a). The source of the Columbia River is north of Oregon in Canada and is at an elevation of 809 m. The Columbia River runs south of the Canadian border and turns west at the confluence of the Snake River (Figure 2). Annual average discharge at the mouth is approximately 7,787 cms (275,000 cfs; 1 cfs = 0.283168 cms).

Reservoirs encountered by migrating Imnaha River Nacó'x (Chinook salmon) and Héeyey (steelhead) smolts are formed by Lower Granite Dam (LGD), Little Goose Dam (LGS), Lower Monumental Dam (LMD), Ice Harbor Dam (IHD), McNary Dam (MCD), John Day Dam (JDD), The Dalles Dam (TDD), and Bonneville Dam (BON). Juvenile emigration monitoring described in this report occurs at LGD, LGS, LMD, and MCD. Juvenile emigration at Ice Harbor Dam is not monitored because IHD lacks the necessary facilities. The four lower Snake River dams became operational between 1961 and 1975. MCD became operational in 1953 (Anonymous 2003b).

The Imnaha 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).

Equipment Description

A floating rotary screw traps manufactured by E.G. Solutions Inc., Corvallis, Oregon, was used to capture migrating salmonids (Figure 3). Similar traps have been used to capture migrating salmonid species in New York and Alaska (Kennen et al. 1994; Thedinga et al. 1994). The screw trap used in the spring and fall consists of a 2.1 m diameter-trapping cone supported by a metal A-frame and two six-meter pontoons that provided flotation. Fish entering the trapping cone moves through to a live box (1.68 m wide x 1.25 m long x 0.55 m deep). The live box was fitted with a removable baffle to dissipate water velocity during high flows.

Imnaha river water temperature information for this study was collected using a thermograph placed 150 m upstream from the screw trap. The U.S. Geological Survey provided Imnaha River discharge information; USGS gauge 13292000 at Imnaha, Oregon. Snake River water discharge and temperature information were provided by the USGS for the Anatone stream

gauge, 13334300. Measurements of outflow, spill, and temperature at LGD, LGS, LMD, and MCD were obtained online from DART at <http://www.cbr.washington.edu/dart/>.

Trap Operations

The trap was operated from October 17 to November 18, 2004, and from March 2 to June 21, 2005. The trap was located 7 km from the confluence of the Snake River. The live box of the screw trap was checked at 0800 every morning and several times throughout each night and day. Non-target piscivorous fish and large numbers of other non-target fish were removed from the live box first. Non-target piscivorous fish were scanned for PIT tags and then released 30-50 m downstream. Fish were processed as they were removed from the trap.

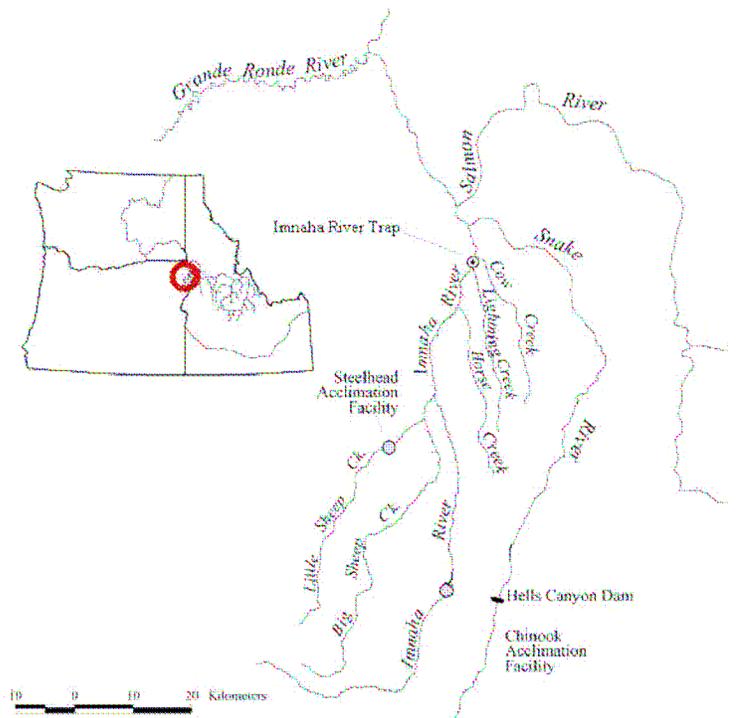


Figure 1. Map of the Imnaha River study area.

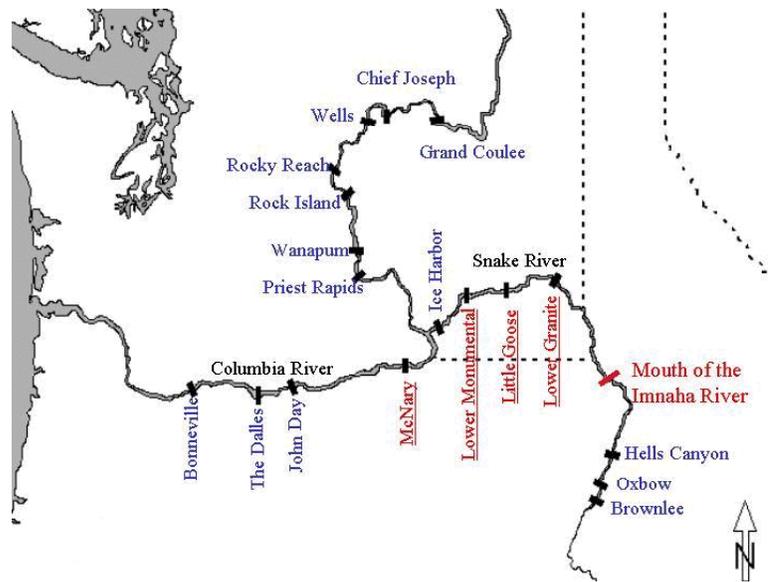


Figure 2. Map of the Columbia River Basin. Dams underlined indicate monitoring points for the Imnaha Smolt Monitoring Program.



Figure 3. The Imnaha River juvenile migration trap site with a rotary screw trap operating.

Daily processing procedures were as follows: 1) fish were anaesthetized in a MS-222 bath (6 ml MS-222 stock solution (100 g/L) per 19 L of water) buffered with Propolyaqua, 2) each fish was examined for existing marks (e.g. fin clips), and PIT tag insertion scars, 3) Nacó'x

(Chinook salmon), Héeyey (steelhead) and large piscivorous fish were scanned with a PIT tag scanner, 4) fifty randomly selected natural Nacó'x̂ (Chinook salmon) and natural Héeyey (steelhead) smolts were targeted for use in daily trap efficiency trials, 5) a specified number of each species was selected for PIT tag insertion, 6) all other fish were enumerated and released 30-50 m downstream from the trap after recovering from the anesthetic, and 7) all fish mortality was recorded.

PIT Tagging

Fish selected for PIT tagging were examined for previous PIT tags, descaling and general health. All PIT tagged fish were measured for fork length and weighed. All Nacó'x̂ (Chinook salmon) selected for tagging were greater than 60 mm. Fish were PIT tagged using hand injector units following the methods described by Prentice et al. (1986, 1990) and Matthews et al. (1990, 1992). Hypodermic injector units and PIT tags were sterilized after each use in ethanol for at least 10 minutes and allowed to dry prior to reuse. Tagging was discontinued when water temperatures exceeded 15° C. Héeyey (steelhead) smolts were held until fully recovered and then released as a group. Nacó'x̂ (Chinook salmon) smolts were held in perforated aquatic containers and released after dark. Mortality due to tagging was recorded.

Trap Efficiencies

Daily trap efficiency trials using natural Nacó'x̂ (Chinook salmon) and natural Héeyey (steelhead) smolts were conducted during the spring. The daily goal was to randomly tag up to 50 natural Nacó'x̂ (Chinook salmon) and Héeyey (steelhead). The fork length of all marked fish were measured to the nearest mm and weighed to the nearest 0.1 g. Fish selected for trap efficiency trials in 2005 were marked with PIT tags. Fish marked for trap efficiency trials were held in perforated containers in the river during daytime hours (up to 12 h) and then transported upstream, approximately 1 km, during evening hours and released after dark.

Daily trap efficiency trials for natural Nacó'x̂ (Chinook salmon) and natural Héeyey (steelhead) were grouped into weekly periods consisting of at least seven marked recaptures under similar flow conditions from mid-March to June 21. Weeks with less than seven recaptures were grouped with either the preceding week or the following week depending on similarity of flow conditions. 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. The reported 95% confidence intervals are based on a bootstrap calculation within the Gauss program (Aptech Systems Inc., Maple Valley, Washington).

Biological Characteristics

Length frequency distributions and condition factors were calculated for each fish species and origin. Length frequencies were based on five mm classes. Condition factors were calculated using Fulton's condition factor: $(W/L^3) \times 10^5$ (Bagenal and Tesch 1978). Natural

Héeyey (steelhead) less than 120 mm were assumed not to be actively migrating and therefore were not used in length, weight and condition factor calculations and were reported to the FPC as rainbow trout. Adult Héeyey (steelhead) and large Héeyey (steelhead) that had the characteristics of resident rainbow trout were not reported as juvenile Héeyey (steelhead) or used in length, weight, and condition factor calculations.

All statistics that compared fish captured and tagged during the spring were performed with STATISTIX7 developed by Analytical Software (2000). A student t-test was used to test for significant differences in mean fork length between various groups of fish. Differences were considered significant at $p < 0.05$. Median fork lengths were compared with the Wilcoxon rank sum test statistic (Ott 1984). Differences were considered significant at $p < 0.05$.

Survival Estimation

Survival probabilities were estimated by the Cormack, Jolly and Seber methodology (1964, and 1965, respectively, as cited in Smith et al. 1994) with the Survival Using Proportional Hazards (SURPH) model (Smith et. al. 1994). The data files for season wide and weekly release groups were created using the program PITPRO version 4.4 (Westhagen and Skalski, 2006). Data for PITPRO and SURPH was obtained directly from Pit Tag Information System (PTAGIS).

Survival estimates from the trap to downstream dams were calculated for hatchery and natural Héeyey (steelhead) and Nacó'x̂ (Chinook salmon). Season-wide and weekly release groups of natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) were treated as single release groups. Only weekly release groups of 300 or more fish were analyzed for survival on a weekly basis. The assumptions for the methodology can be found in Smith et al. (1994) and Burnham et al. (1987). When tagging Nacó'x̂ (Chinook salmon) in the fall, we assumed that fish did not migrate past LGD before PIT tag interrogation facilities became operational.

Spring Emigration Index

Spring emigration index of juvenile abundance for natural Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) smolts migrating past the trap were estimated using the Gauss program (Aptech Systems Inc., Maple Valley, Washington) with a Bailey trap efficiency estimation method (Steinhorst et al. 2004). The Bailey estimate is a version of the Lincoln-Peterson method and is used to develop the point estimate. The Gauss program utilizes a bootstrap method with 1000 iterations to calculate the confidence intervals and utilizes stratified data when appropriate. This does not represent a total juvenile production estimate from the Imnaha River, as trapping periods are limited. This estimate is a minimum estimate based on trap efficiency trials in the spring of 2005. To maintain robustness for analysis, we set a lower limit of seven mark recaptures for any period (Steinhorst et al. 2004).

Smolt to Adult Return Rates (SARs)

Smolt-to adult return rate indices (SAR) were calculated for two groups of PIT tagged juvenile natural Nacó'x̂ (Chinook salmon) emigrants from the Imnaha River, for brood years 1996 through 2000. The two groups were represented by: 1) juvenile natural Nacó'x̂ (Chinook salmon) tagged during the fall of the migration year which emigrated past the Imnaha River juvenile migration trap, and 2) natural Nacó'x̂ (Chinook salmon) smolts which emigrated past the Imnaha River juvenile migration trap during the spring. There is not a comprehensive adult detection facility at the Imnaha River, so SAR rates are calculated from LGD to LGD. SARs are calculated using the ratio of estimated PIT tagged juvenile smolts surviving from the Imnaha River to LGD to the number of PIT tag adults detected at LGD. Smolt populations to LGD are determined by multiplying the number of fish tagged at the Imnaha River by their estimated survival (either fall or spring) to LGD. PIT tagged adults return at ages three, four, and five and detections are summed over the three return years to provide the entire brood year SAR. SARs characterize largely bypassed fish and do not represent the population as a whole because a majority of the unmarked fish were transported.

Arrival and Travel Timing to Trap Site and Lower Snake River Dams

Arrival timing to LGD, LGS, LMD, and MCD were determined for natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) smolts. Detections and arrival timing at each dam for this report period are based on first-time observations of individual tag codes at each dam. The cumulative distributions of arrival times between fall and spring tagged juvenile natural Nacó'x̂ (Chinook salmon) were compared using a Kolmogorov-Smirnov test (Steel et al. 1997 and STATAGRAPHS 1995).

Travel time is the time it takes an individual tagged fish to travel from either the acclimation facilities or the Imnaha trap to juvenile detectors at specific dams. Weeks with at least 30 PIT tag interrogations at LGD were used to determine median travel time to LGD. A Wilcoxon rank sum test statistic (Ott 1984) was then used to compare medians of each group.

RESULTS AND DISCUSSION

River Discharge and Water Temperature

Imnaha River

The mean daily discharge during the study period, unaffected by potential freezing water, ranged from 125 cfs on November 21, 2004, to 2,540 cfs (1 cfs = 0.283168 cms) on May 16, 2005 (Figure 4). Daily mean water temperatures ranged from 4.4 °C on November 18, 2004, to 17.2 °C on June 22, 2005.

Monthly average discharge for the Imnaha River for the months of March, April, May, and June were, 330, 841, 1749, 889 cfs respectively (Figure 5). The spring run off for the Imnaha River was normal and within the range of monthly average discharge values observed from 1929 to 2005.

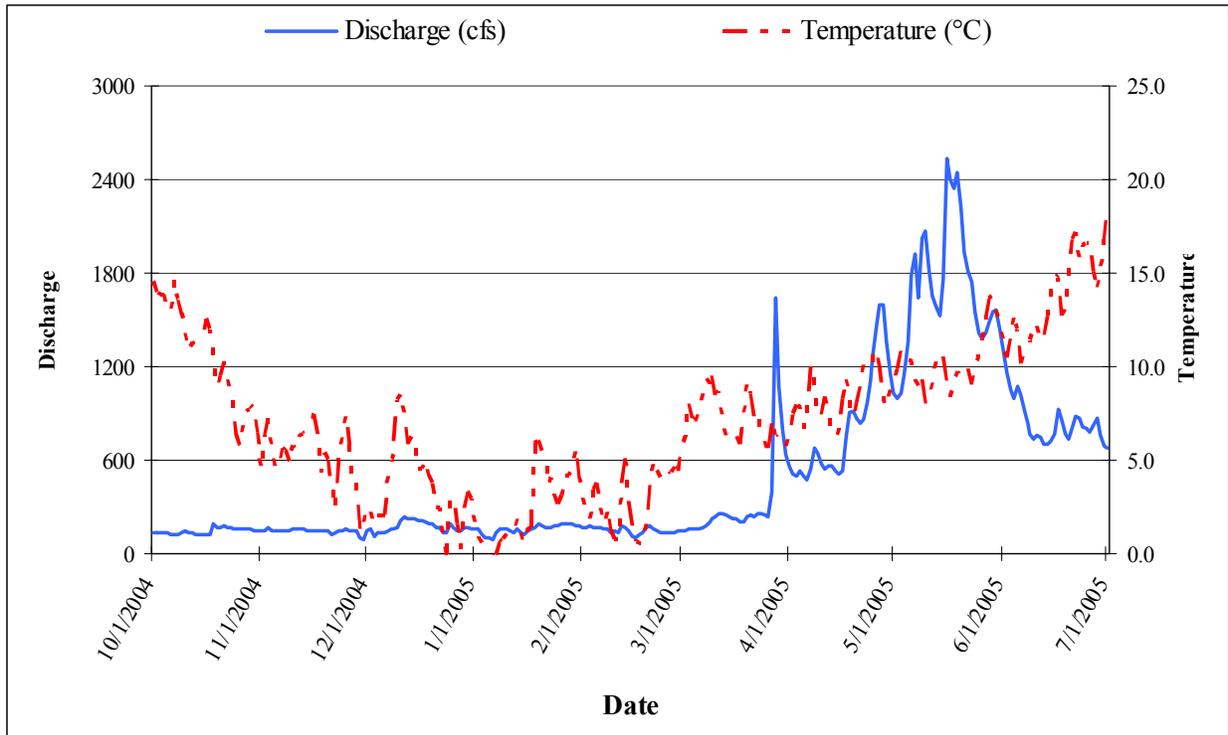


Figure 4. The average daily discharge at the Imnaha River USGS gauge 13292000 and the average daily temperature from October 1, 2004, to July 1, 2005, at the Imnaha River juvenile migration trap. USGS discharge data is provisional.

Mean monthly discharge 2005

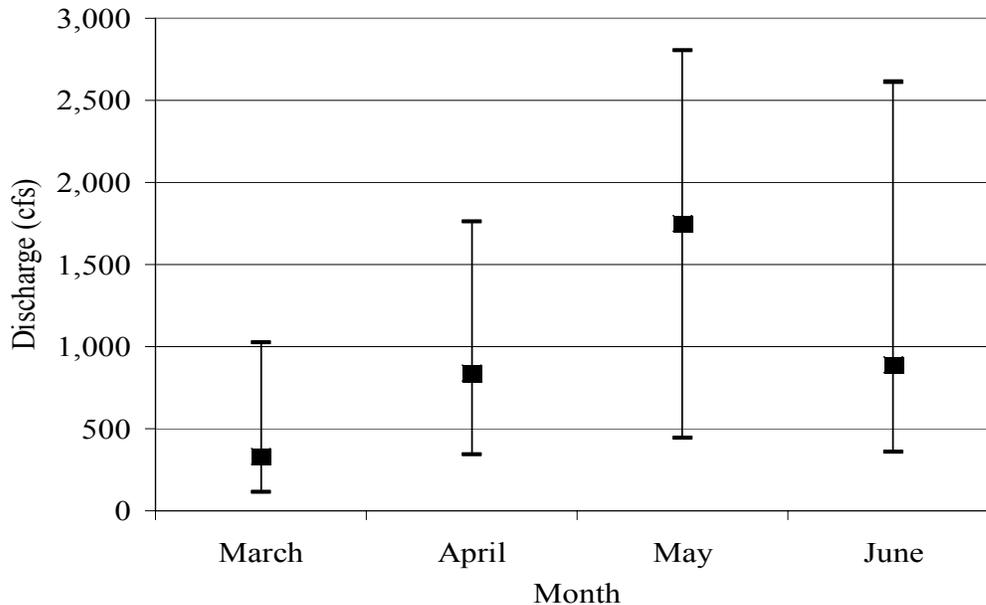


Figure 5. The average monthly discharge for the months of March, April, May, and June for 2005, at the Imnaha River USGS gauge 13292000. Bars indicate the minimum and maximum average monthly discharge values observed from 1929 to 2005. USGS discharge data is provisional.

Snake River

Snake River mean daily discharge during the study period ranged from 13,700 cfs on December 2 and 6, 2004, to 98,900 cfs on May 21, 2005 (Figure 6). Daily mean water temperatures ranged from 2.6 °C on February 18 and 19, 2005, to 18.9 °C on June 26, 2005.

Monthly average discharge for March, April, May, and June were as follows: 38,900 cfs, 47,800 cfs, 65,800 cfs, and 70,200 cfs (Figure 7). Discharge in the Snake River at Anatone during the month of March 2005 was the lowest on record at 38,900 cfs. The discharge in the Snake River for the month of March is characterized as below average for the period of record. The discharge in the Snake River for the months of April, May and June have been characterized as slightly below average by this study.

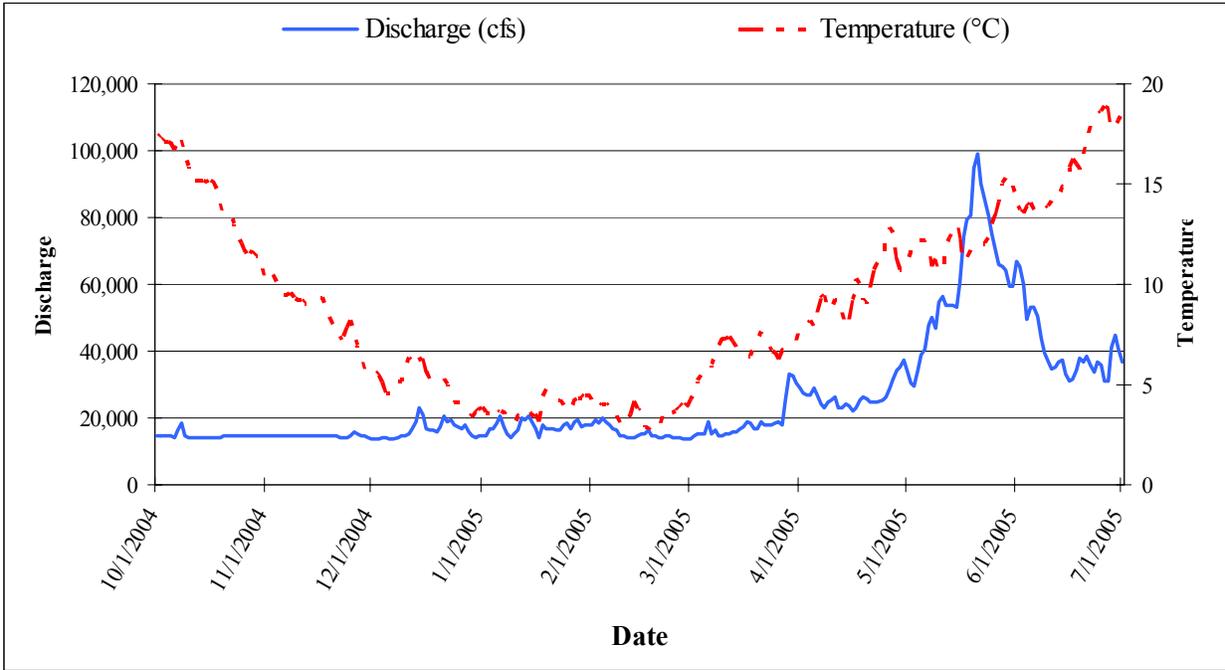


Figure 6. The average daily discharge and temperature at the Snake River gauge 13334300 from October 1, 2004, to July 1, 2005. USGS discharge data is provisional.

Mean monthly discharge 2005

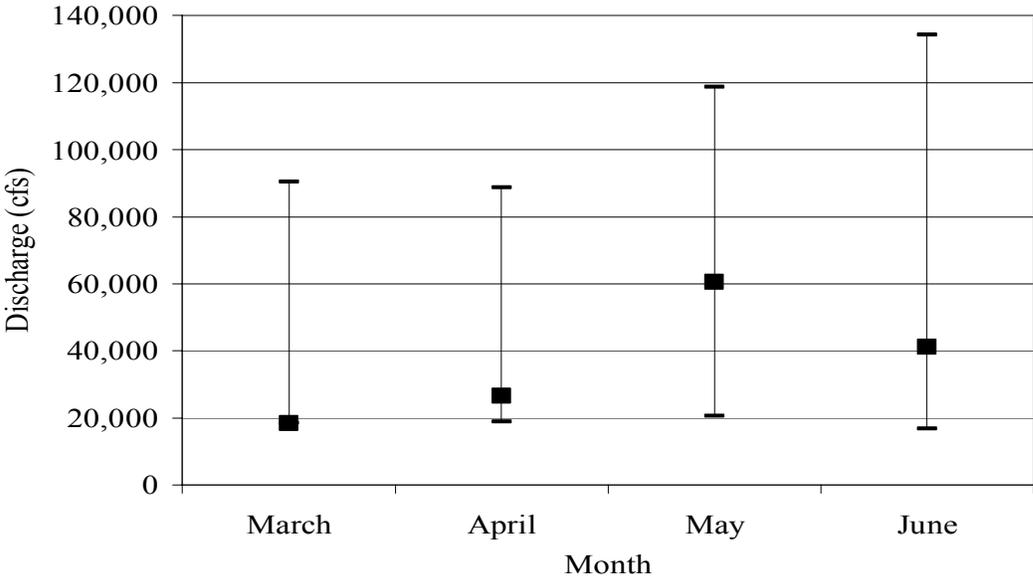


Figure 7. The average monthly discharge for the months of March, April, May, and June for 2005 at the Snake River USGS gauge 13334300. Bars indicate the minimum and maximum average monthly discharge values observed from 1959 to 2005. USGS discharge data is provisional.

Water temperatures measured in the tailraces of LGD, LGS, LMD, and MCD were lowest in March and highest in July and August. Minimum water temperatures in the tailraces were as follows: 3.5 °C at LGD on March 1, 7.8 °C at LGS on March 31, 7.0 °C at LMD on March 28, and 3.9 °C at MCD on March 1. Maximum water temperatures in the tailraces were as follows: 19.8 °C at LGD on July 10 and 11, 20.7 °C at LGS on August 13, 21.1 °C at LMD on August 13, and 21.7 °C at MCD on August 25.

Assuming that spill is beneficial to the survival of emigrating smolts (Berggren and Filardo 1993) and that water temperatures in excess of 18 °C may increase mortality due to increased activity by Qiyexs (northern pikeminnow, *Ptychocheilus oregonensis*) (Mesa and Olson 1993), the best environmental conditions for smolt emigration through LGD, LGS, and LMD occurred from early May to late June when spill occurred in the lower Snake River (before water temperatures reached 18 °C) (Figures 8-11). The smolt emigration period for MCD was from early April through late June.

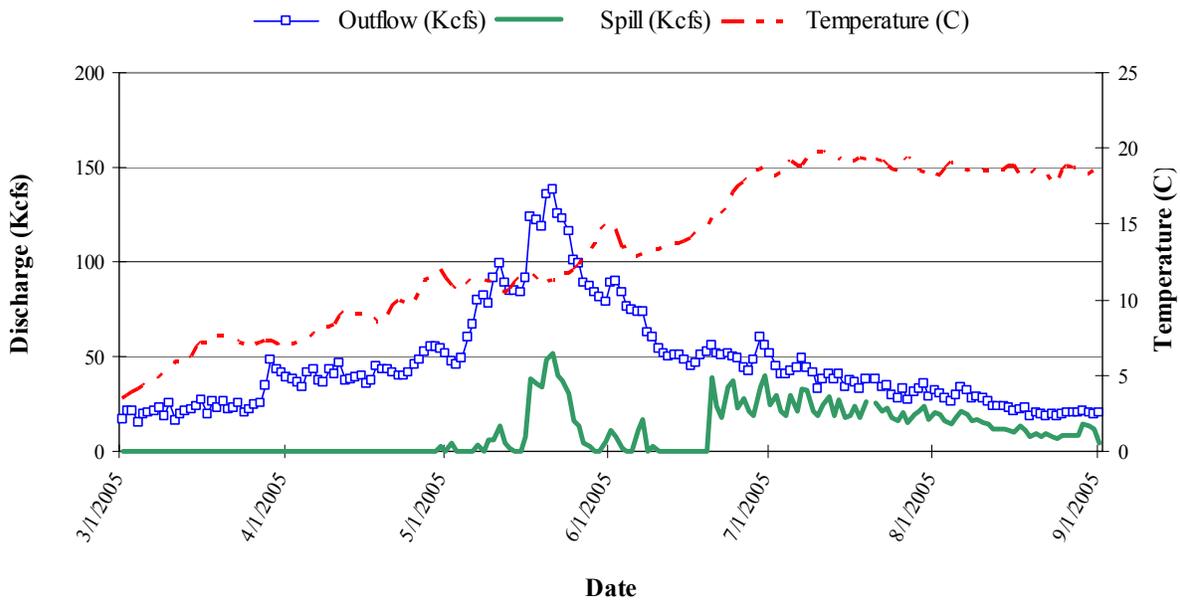


Figure 8. Measurements of outflow, spill, and mean temperature at Lower Granite Dam from March 1 to September 1, 2005. Data obtained online at <http://www.cbr.washington.edu/dart/>.

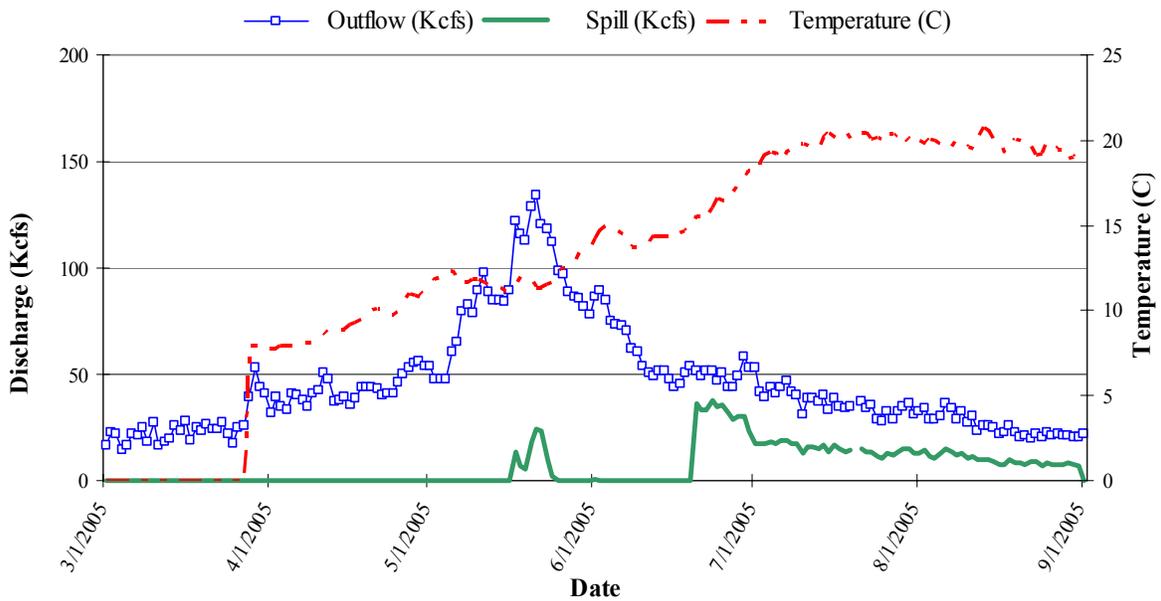


Figure 9. Measurements of outflow, spill, and mean temperature at Little Goose Dam from March 1 to September 1, 2005. Note that temperature did not begin recording until March 28. Data obtained online at <http://www.cbr.washington.edu/dart/>.

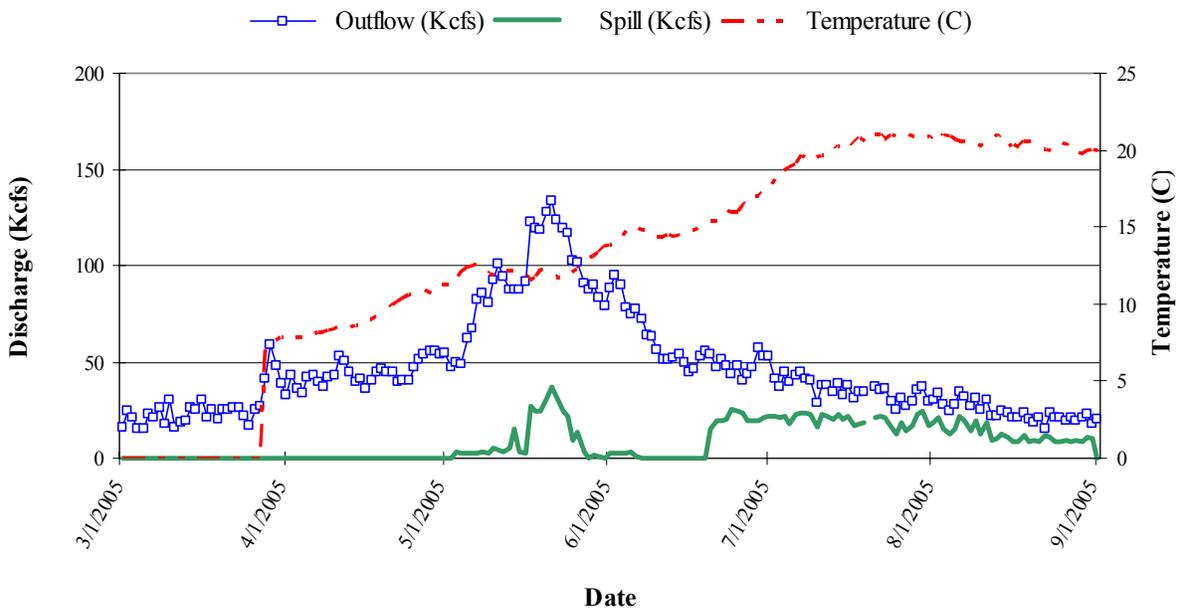


Figure 10. Measurements of outflow, spill, and mean temperature at Lower Monumental Dam from March 1 to September 1, 2005. Note that temperature did not begin recording until March 28. Data obtained online at <http://www.cbr.washington.edu/dart/>.

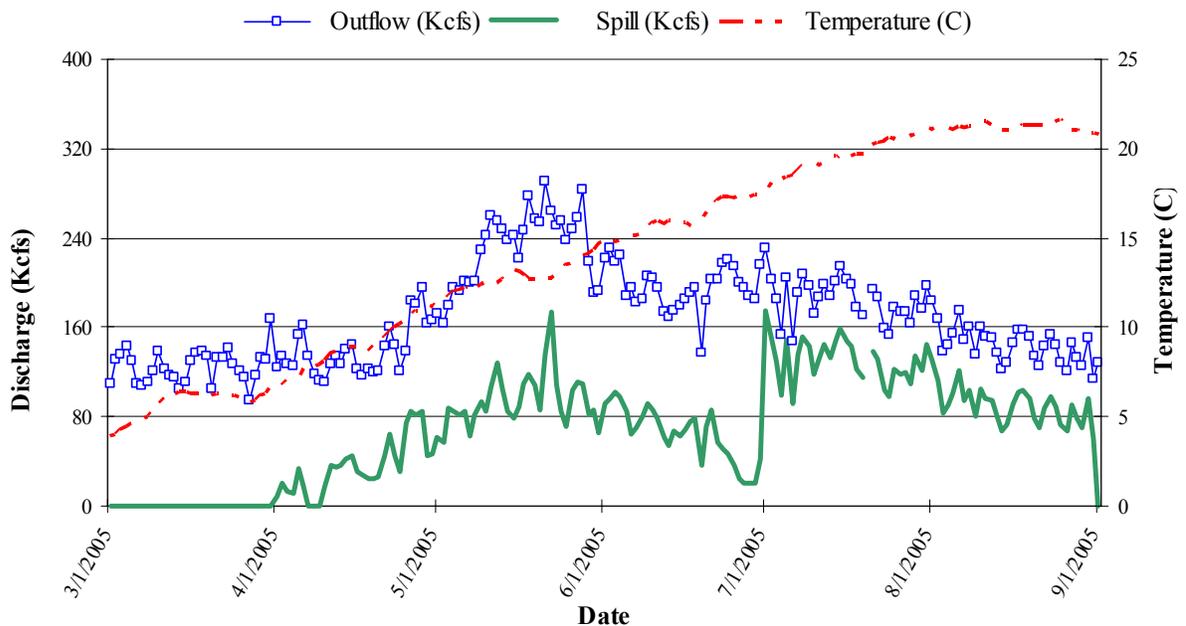


Figure 11. Measurements of outflow, spill, and mean temperature at McNary Dam from March 1 to September 1, 2005. Data obtained online at <http://www.cbr.washington.edu/dart/>.

Hatchery Releases

Nacó'x̂ (Chinook salmon)

A total of 435,186 *Nacó'x̂* (Chinook salmon) were released from the Imnaha River Gumboot acclimation facility at rkm 74 (Table 1). Two separate releases of *Nacó'x̂* (Chinook salmon) occurred during the 2005 migration season, one volitional and one direct to the stream. The volitional release of 289,444 *Nacó'x̂* (Chinook salmon) arrived at the acclimation facility on March 9 and 10. Hatchery personnel began pulling dam boards on March 21 and fish left volitionally until April 8 when the remaining fish were forced into the river. The direct stream release of 145,742 *Nacó'x̂* (Chinook salmon) occurred on March 29. All *Nacó'x̂* (Chinook salmon) were marked with an adipose fin clip, 219,849 (49 %) had a coded wire tag, and 20,910 (4.8%) were marked with a PIT tag (D. Eddy, Oregon Fish and Wildlife, personal communication).

Héeyey (Steelhead)

Héeyey (steelhead) were released at two locations in the Imnaha River Subbasin in 2005 and releases totaled 288,601 fish (Table 1). A total of 152,048 *Héeyey* (steelhead) arrived between March 3 and March 7 at the LSRCP Little Sheep Creek acclimation facility and volitionally released between April 11 and May 5. A total of 26,765 were marked with adipose and left ventral fin clips, coded wire tags (CWT), and 250 PIT tags. An additional 76,644 were

marked only with adipose fin clips. An additional 48,639 were marked with blank coded wire tags and no fin clip, 250 of which were PIT tagged. A second release of 136,553 Héeyey (steelhead) occurred from April 11 to April 13, 2004. These fish were released directly into Big Sheep Creek, 52,435 were marked with adipose and left ventral fin clips, CWT, and 252 PIT tags. Unmarked Héeyey (steelhead) were also released into Big Sheep Creek and totaled 46,854 (D. Eddy, Oregon Fish and Wildlife, personal communication).

Table 1. Releases of hatchery reared Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) smolts in the Imnaha River Subbasin during migration year 2005 (D. Eddy, Oregon Fish and Wildlife, personal communication)

Release Year	Species	Arrival at Acclimation Site	Number Released	Release Dates	Tags / Marks	Release Site
2005	Nacó'x̂ (Chinook salmon)	March 9 - 10	289,444	March 21 – April 8	100% adipose fin clipped with 147,602 (51%) CWT and 13,949 PIT tags	Imnaha River (Gumboot)
2005	Nacó'x̂ (Chinook salmon)	Direct Stream	145,742	March 29	100% adipose fin clipped with 72,247 (50 %) CWT and 6,961 PIT tags	Imnaha River (Gumboot)
2005	Héeyey (steelhead)	March 3 - 7	152,048	April 11 – May 5	76,644 adipose fin clipped, 26,765 adipose and left ventral fin clips with CWT and 250 PIT tags, 48,639 blank CWT with no fin clip and 250 PIT tags.	Little Sheep Creek
2005	Héeyey (steelhead)	Direct Stream	136,553	April 11 - 13	37,264 adipose fin clip, 52,435 adipose and left ventral fin clips with CWT and 252 PIT tags, 46,854 with no external or internal mark.	Big Sheep Creek

Juvenile Nacó'x̂ (Chinook salmon) and Héeyey (Steelhead) Catch

Catch for Migration Year 2005

The catch of natural Nacó'x̂ (Chinook salmon) for migration year 2005 (fall and spring) totaled 11,302 fish. The largest weekly catch during fall trapping occurred during the week of October 17 (n = 2,188). The largest weekly catch during spring trapping occurred during the week of March 27 (n = 1,291). The weekly mean discharge and water temperature during the week of October 17 was 132 cfs and 13.6 °C, (Table 2). The weekly mean discharge and water temperature during the week of March 27 was 800 cfs and 6.4 °C. During the fall of 2004 the weekly catch of natural Nacó'x̂ (Chinook salmon) smolts exceeded 1,000 for three weeks

between October 17 and October 31. During the spring of 2005 the weekly catch of natural Nacó'x̂ (Chinook salmon) smolts exceeded 1,000 for only the week of March 27. A total of 38,197 hatchery Nacó'x̂ (Chinook salmon) were captured, with the first captures occurring during the week of March 20 (Appendix C). More than half (n = 23,896) were captured during the week of March 27.

Table 2. The weekly mean discharge (cfs), temperature (°C), and catch of natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) at the Imnaha River juvenile migration trap from 18 October 2004 to 21 June 2005.

Week	Average Discharge (cfs)	Average Temperature (°C)	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)
10/17/2004	131.6	13.6	2188	0	57	0
10/24/2004	131.3	11.5	1898	0	0	0
10/31/2004	169.0	9.9	1978	0	1	0
11/7/2004	155.7	7.2	146	0	0	0
11/14/2004	151.4	5.7	183	0	9	0
2/27/2005	151.9	6.2	4	0	0	0
3/6/2005	206.9	8.8	126	0	2	1
3/13/2005	230.4	6.5	277	0	1	0
3/20/2005	248.1	7.2	180	2464	1	0
3/27/2005	799.6	6.4	1291	23896	262	1
4/3/2005	552.6	8.1	404	8115	103	1
4/10/2005	546.7	7.3	613	2173	238	12984
4/17/2005	873.3	8.9	554	902	608	7936
4/24/2005	1362.9	9.5	197	227	746	2097
5/1/2005	1328.0	10.1	340	342	1404	3232
5/8/2005	1760.0	9.3	64	23	489	1067
5/15/2005	2234.3	9.5	37	11	175	444
5/22/2005	1541.4	11.1	148	24	614	844
5/29/2005	1296.4	12.2	245	14	526	566
6/5/2005	875.1	11.4	182	5	129	300
6/12/2005	776.7	13.2	192	1	73	257
6/19/2005	813.3	16.0	55	0	3	35
Totals			11302	38197	5441	29765

The catch of natural Héeyey (steelhead) totaled 5,441 fish (Table 2 and Appendix A). The largest weekly catch occurred during the week of May 1 and totaled 1,404 fish. The mean weekly discharge and water temperature during the week of May 1 was 1328 cfs and 10.1 °C. The catch of hatchery Héeyey (steelhead) was 29,765 fish with the largest weekly catch of

hatchery Héeyey (steelhead) (n = 12,984) occurring during the week of April 10. The mean weekly discharge and water temperature was 547 cfs and 7.3 °C.

PIT Tagging

A total of 9,655 natural Nacó'x̂ (Chinook salmon) were PIT tagged for the 2005 migration year. About two-thirds of the PIT tagged natural Nacó'x̂ (Chinook salmon) (n = 6,102) were tagged in the fall of 2004 (Table 3 and Appendix B). At no time during the spring of 2005 did any of the weekly release groups exceed 1,000 fish.

Table 3. The number of natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) PIT tagged weekly at the Imnaha River juvenile migration trap from 18 October 2004 to 21 June 2005.

Week	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)	Unknown Origin Héeyey (steelhead)
10/17/2004	2006	0	3	0	0
10/24/2004	1845	0	0	0	0
10/31/2004	1932	0	0	0	0
11/7/2004	139	0	0	0	0
11/14/2004	180	0	0	0	0
2/27/2006	4	0	0	0	0
3/6/2006	91	0	2	0	0
3/13/2006	245	0	0	0	0
3/20/2006	180	0	1	0	0
3/27/2006	539	1	99	0	0
4/3/2006	400	0	99	0	0
4/10/2006	346	0	144	1000	0
4/17/2006	368	0	378	1008	0
4/24/2006	182	0	725	978	0
5/1/2006	317	0	1065	994	0
5/8/2006	57	0	484	997	387
5/15/2006	35	0	175	425	0
5/22/2006	140	3	607	838	0
5/29/2006	237	1	517	334	0
6/5/2006	173	0	129	0	0
6/12/2006	185	0	72	0	0
6/19/2006	54	0	3	0	0
Totals	9655	5	4503	6574	387

PIT tagged natural Héeyey (steelhead) totaled 4,503 fish (Table 3), three of which were tagged in the fall. Tagging efforts resulted in one weekly release group of more than 1,000 fish that occurred during the week of May 1 (n = 1,065). An effort was made to produce weekly release groups of hatchery Héeyey (steelhead) of 600 fish. Weekly release groups of hatchery Héeyey (steelhead) from the week of April 10 to the week of May 29 ranged from 334 (week of May 29) to 1,008 (week of April 17). A total of 6,574 hatchery origin Héeyey (steelhead) were PIT tagged (Table 3). An additional 387 Héeyey (steelhead) of unknown origin were tagged during the week of May 8. These fish were not included in our analysis of natural or hatchery Héeyey (steelhead) numbers at the Imnaha River juvenile migration trap.

Recaptures of Previously PIT Tagged Smolts

Several organizations have PIT tagged both natural and hatchery Nacó'x̂ (Chinook salmon) and hatchery Héeyey (steelhead) prior to our spring trapping efforts. During the course of the trapping season, we recaptured a portion of these fish.

We recaptured 4 of the 880 natural Nacó'x̂ (Chinook salmon) that were previously PIT tagged by Oregon Department of Fish and Wildlife (ODFW) from August 31 to September 1, 2004, (Appendix C). Recaptured fish averaged 90.8 mm in fork length, 8.5 g in weight, and 1.1 for a condition factor (Table 4). Fork length, weight, and condition factor sample sizes in Table 4 represent the number of times each attribute was recorded and summarized for this report.

A total of 1,016 PIT tagged hatchery Nacó'x̂ (Chinook salmon) released from the Imnaha River Gumboot acclimation facility were recaptured at the Imnaha juvenile migration trap. They averaged 117.2 mm in fork length, 19.0 g in weight, and a 1.2 condition factor. The first occurrence of a previously PIT tagged hatchery Nacó'x̂ (Chinook salmon) occurred on March 27, two days after the volitional release at the Gumboot acclimation facility began. Fifty and ninety percent of the fish arrived thirteen and twenty days, respectively, after the volitional release began (Figure 12).

The earliest 90% arrival time for hatchery Nacó'x̂ (Chinook salmon) occurred in 1998. The release strategy in 1998 was an acclimated forced release. Ninety percent of all previously PIT tagged hatchery Nacó'x̂ (Chinook salmon) arrived eight days after the release in 1998 (Figure 12). Migratory year 2005 was earliest 90% arrival time for an acclimated volitional release, which occurred 20 days after the volitional release began. The latest 90% arrival time (34 days) occurred in 1999. The majority of the hatchery Nacó'x̂ (Chinook salmon) in 1999 (n = 184,567) were acclimated and released volitionally. A small number of hatchery Nacó'x̂ (Chinook salmon) in 1999 (n = 10,242) were directly released into the Imnaha River (Cleary et al. 2003).

A total of 39 PIT tagged hatchery Héeyey (steelhead) released from the Little Sheep Creek and Big Sheep Creek acclimation facilities were recaptured at the Imnaha trap. They averaged 202 mm in fork length, 87.2 g in weight, and a 1.0 condition factor (Figure 12).

Table 4. Averages, ranges, and standard deviations of fork lengths (mm), weights (g), and condition factors (K) with minimum, maximum, and sample size values for recaptures of previously PIT tagged natural and hatchery Nacó'x̂ (Chinook salmon), and hatchery Héeyey (steelhead) observed during the 2005 migration year, 18 October 2004 to 21 June 2005, at the Imnaha River juvenile migration trap.

Attribute	Statistic	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Hatchery Héeyey (steelhead)
Fork Length (mm)	Average	90.8	117.2	202.0
	Standard Deviation	25.6	8.2	20.4
	Sample Size (n)	4	975	38
	Minimum	63	94	128
	Maximum	120	162	240
Weight (g)	Average	8.5	19.0	87.2
	Standard Deviation	5.0	4.2	26.4
	Sample Size (n)	4	976	39
	Minimum	3.1	7	23.6
	Maximum	13.2	47.3	159.4
Condition Factor (K)	Average	1.1	1.2	1.0
	Standard Deviation	0.2	0.1	0.1
	Sample Size (n)	4	966	38
	Minimum	0.8	0.6	0.9
	Maximum	1.2	1.7	1.2

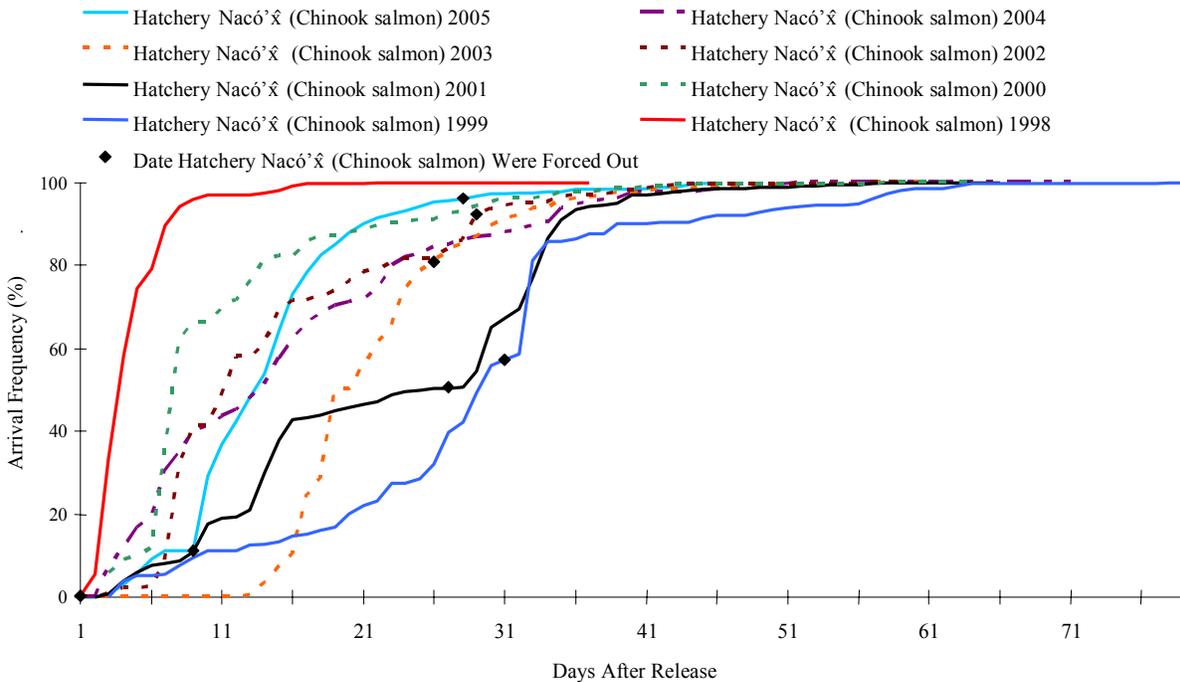


Figure 12. The arrival frequency of previously PIT tagged hatchery Nacó'x̂ (Chinook salmon) captured in the Imnaha River juvenile migration trap during the spring of 1998 to the spring of 2005. The release strategy in 1998 was an acclimated forced release and the remainder of the releases were acclimated volitional releases.

Biological Characteristics

Annual Biological Characteristics

The length frequency distribution of fall tagged natural Nacó'x̂ (Chinook salmon) (defined as pre-smolts within this document) is shown in Figure 13. These fish averaged 82.5 mm in fork length, 6.7 g in weight, and had an average condition factor of 1.14 (Table 5). Natural Nacó'x̂ (Chinook salmon) smolts captured in the spring averaged 97.9 mm, 11.1 g, and a condition factor of 1.15. Hatchery Nacó'x̂ (Chinook salmon) had a larger fork length of 117.8 mm. Hatchery Nacó'x̂ (Chinook salmon) had an average weight of 18.9 g and a condition factor of 1.14. The 117.8 mm median fork length of hatchery Nacó'x̂ (Chinook salmon) was significantly different from the 97.9 mm median fork length of natural Nacó'x̂ (Chinook salmon) ($p < 0.05$) (Figure 14 and Appendix D).

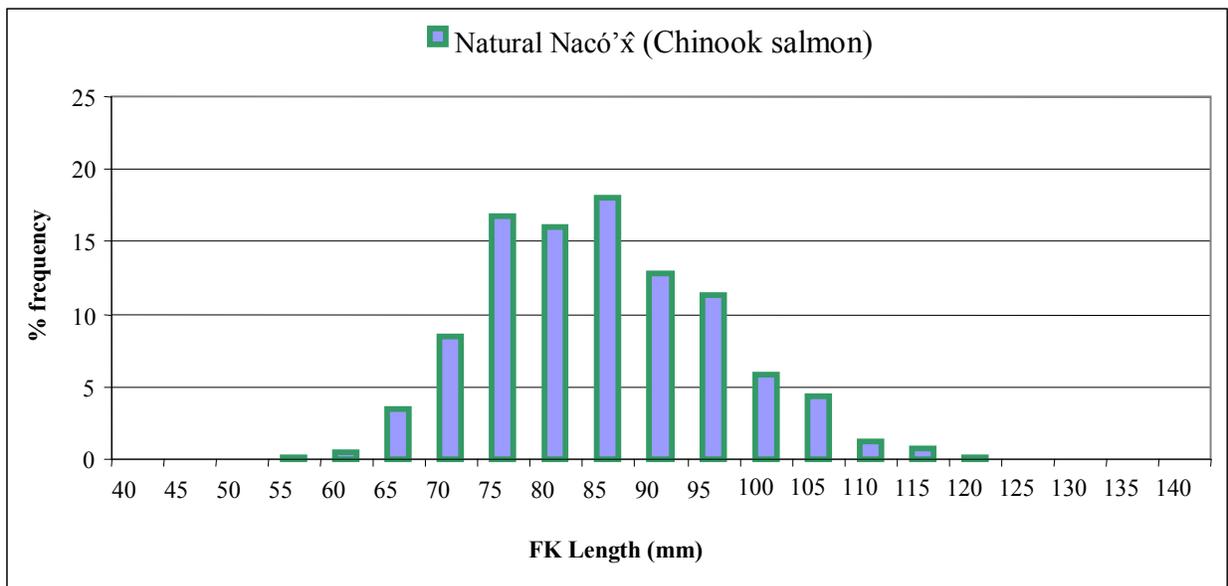


Figure 13. Length frequency distribution of natural Nacó'x̂ (Chinook salmon) pre-smolts trapped in the Imnaha River juvenile migration trap from October 18 to November 18, 2004.

Spring captured natural Héeyey (steelhead) had an average fork length and weight of 168.5 mm and 51.4 g and a condition factor of 1.04 (Figure 15 and Table 5). Hatchery Héeyey (steelhead) were significantly larger ($p < 0.05$) with an average fork length of 216.9 mm, weight of 107.5 g and a condition factor of 1.02 (Figure 15 and Appendix D).

Hatchery programs from 1994 to 2005 for the Imnaha River tended to produce significantly larger smolts than in nature. The differences in size should be a concern if differences in downstream survival due to size and adult age structure become apparent.

There were no distinct weekly trends in the size or condition factors of captured natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead). The largest weekly mean fork lengths of natural Nacó'x̂ (Chinook salmon) (102.6 mm) occurred during the week of May 22 (Table 6). The largest weekly mean fork lengths for hatchery Nacó'x̂ (Chinook salmon) (141 mm) was measured during the final week of trapping on June 12 and reflects a sample size of one fish. Hatchery Nacó'x̂ (Chinook salmon) averaged in the 110 mm range for 6 weeks and in the 120 mm range for 6 weeks. Natural Héeyey (steelhead) had weekly mean fork lengths greater than 170 mm for 4 weeks from April 17 to the week of May 1 and the week of June 19. The largest weekly mean fork lengths for hatchery Héeyey (steelhead) were 240 mm during the week of June 5 (Table 6).

Table 5. Averages, ranges, and standard deviations of fork lengths (mm), weights (g), and condition factors (K) with minimum, maximum, and sample size values for natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) captured during the 2005 migration year, 18 October 2004 to 21 June 2005, at the Imnaha River juvenile migration trap.

Attribute	Statistic	Fall 2004	Spring 2005			
		Natural Nacó'x̂ (Chinook salmon) (Pre-Smolts)	Natural Nacó'x̂ (Chinook salmon) (Smolts)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)
Fork Length (mm)	Sample Size (n)	5515	3472	2418	4541	6596
	Average	82.5	97.9	117.8	168.5	216.9
	Maximum	124	160	162	256	310
	Minimum	48	55	80	73	112
	Standard Deviation	10.9	9.8	8.2	18.6	22.1
	Weight (g)	Sample Size (n)	5515	3473	2416	4530
	Average	6.7	11.1	18.9	51.4	107.5
	Maximum	20.2	43.8	47.3	183	369.2
	Minimum	1.6	1.7	7.0	4.4	17.7
	Standard Deviation	2.6	3.4	4.4	17.1	35.5
Condition Factor (K)	Sample Size (n)	5515	3465	2415	4521	6513
	Average	1.14	1.15	1.14	1.04	1.02
	Maximum	1.58	1.48	1.50	1.38	1.39
	Minimum	0.63	0.63	0.61	0.69	0.72
	Standard Deviation	0.12	0.12	0.12	0.08	0.08

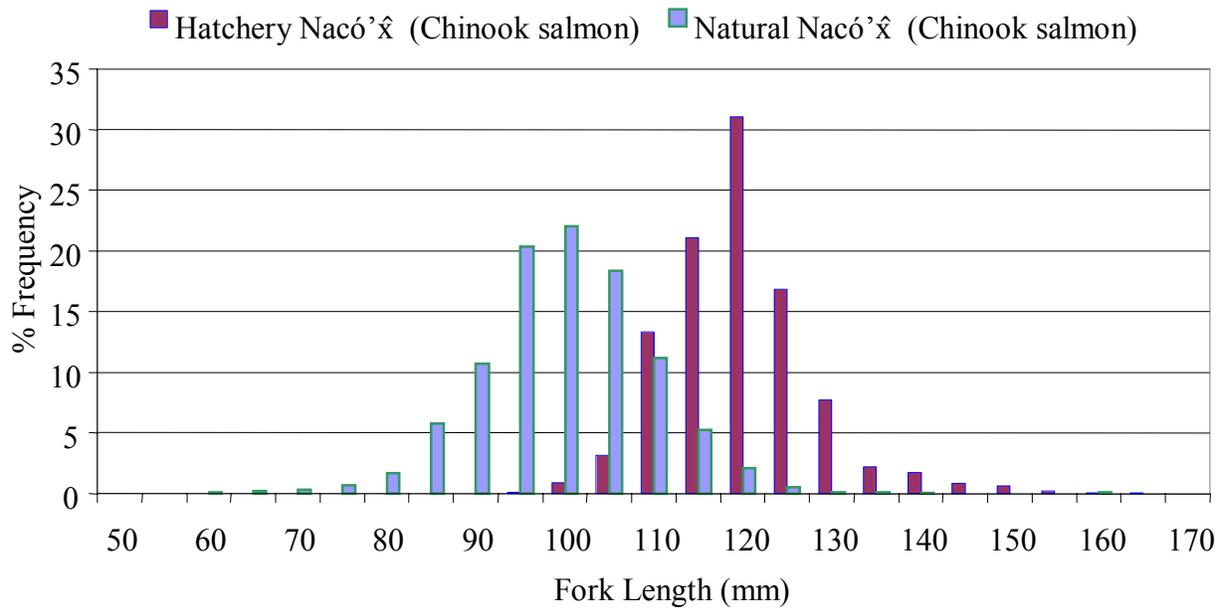


Figure 14. Length frequency distribution of natural and hatchery Nacó'x̂ (Chinook salmon) trapped in the Imnaha River juvenile migration trap, February 27 to June 21, 2005.

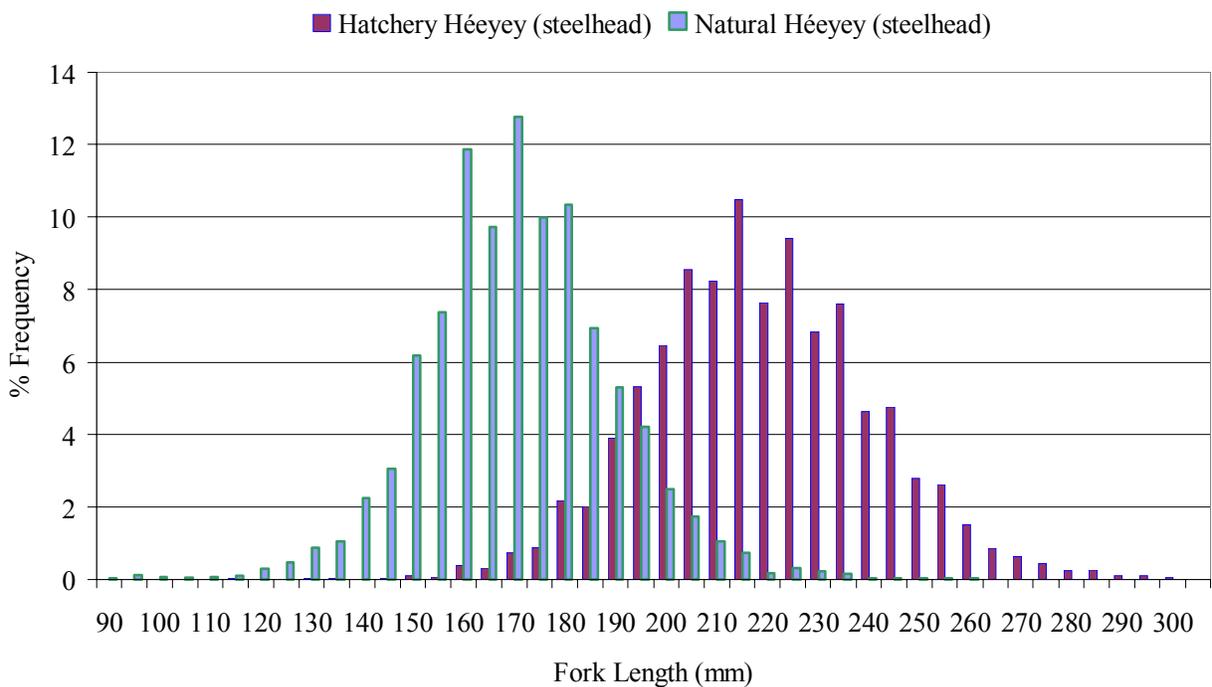


Figure 15. Length frequency distribution of natural and hatchery Héeyey (steelhead) trapped in the Imnaha River juvenile migration trap, February 27 to June 21, 2005.

Table 6. Weekly mean fork lengths (FL) and condition factors (K) for natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) captured at the Imnaha River juvenile migration trap during the spring of 2005.

Week	Natural Nacó'x̂ (Chinook salmon)		Hatchery Nacó'x̂ (Chinook salmon)		Natural Héeyey (steelhead)		Hatchery Héeyey (steelhead)	
	FL (mm)	K	FL (mm)	K	FL (mm)	K	FL (mm)	K
2/27/2005	95.5	1.03						
3/6/2005	96.1	1.14			130	1.03		
3/13/2005	95.2	1.13			155	0.97		
3/20/2005	100.6	1.10	122.2	1.18	152	0.86		
3/27/2005	95.7	1.15	117.5	1.19	169	1.07	182	1.01
4/3/2005	95.5	1.10	117.3	1.14	159	1.04	131	1.01
4/10/2005	96.2	1.11	114.4	1.10	169	1.03	217	1.06
4/17/2005	99.6	1.17	118.0	1.12	170	1.05	219	1.06
4/24/2005	98.3	1.21	116.3	1.13	174	1.07	220	1.08
5/1/2005	102.3	1.10	119.2	1.10	171	1.00	224	1.00
5/8/2005	101.6	1.18	122.2	1.08	169	1.00	218	0.97
5/15/2005	100.3	1.12	122.9	1.04	169	1.03	216	0.98
5/22/2005	102.6	1.20	121.8	1.12	164	1.07	209	0.98
5/29/2005	100.1	1.19	123.9	1.07	164	1.05	202	0.94
6/5/2005	96.8	1.23	123.0	1.09	165	1.11	240	0.98
6/12/2005	97.3	1.23	141.0	1.05	169	1.08	190	0.96
6/19/2005	92.6	1.30			176	1.10		

Abundance and Survival

Natural Nacó'x̂ (Chinook salmon) and Héeyey (Steelhead) Abundance

Trap efficiencies for natural Nacó'x̂ (Chinook salmon) ranged from 4.0% during early March and late April to 17% and 18% in late May and early June, and averaged 10.0%. Trap efficiencies for natural Héeyey (steelhead) ranged from 3% in early April to 18% during the first week of June, and averaged 11.4%. The overall spring emigration abundance estimate for natural Nacó'x̂ (Chinook salmon) smolts was 62,266 with a lower 95% C.I. of 51,137 and an upper 95% C.I. of 78,049. The overall spring emigration abundance estimate for natural Héeyey (steelhead) smolts was 51,991 with a lower 95% C.I. of 43,331 and an upper 95% C.I. of 65,339. These emigration abundance estimates are minimum estimates based on incomplete efficiency trials. An attempt is made to run efficiency calculations continuously while trapping however high flow events and the associated flood damage will force a temporary discontinuation of trials. Additionally, due to the seasonal nature of the Imnaha River trapping, we can only make

abundance estimates for the time period trapped. Grouped Gauss population estimates were calculated for several periods during the spring trapping period and are presented in Appendixes E and F.

Post Release Survival of Hatchery Nacó'x̂ (Chinook salmon)

Two separate release groups provided an estimated $381,571 \pm 17,500$ (95% C.I.) hatchery Nacó'x̂ (Chinook salmon) which emigrated past the Imnaha River juvenile migration trap during the spring of 2005. The population estimate is based on a post release survival estimate of $87.7\% \pm 4.6\%$ (95% C.I.) from the acclimation facility to the trap. This survival estimate is the second lowest estimate since the Imnaha SMP project began. Past post release survival estimates from the acclimation facility at Gumboot to the Imnaha River juvenile migration trap have ranged from $82.9\% \pm 2.6\%$ (95% C.I.) in 2004 to $100.9\% \pm 14.3\%$ (95% C.I.) in 1994 (Figure 16). The post release survival estimates are useful for evaluating the mortality that occurred within the Imnaha River and comparing that reach specific mortality to other reaches within the Snake and Columbia rivers.

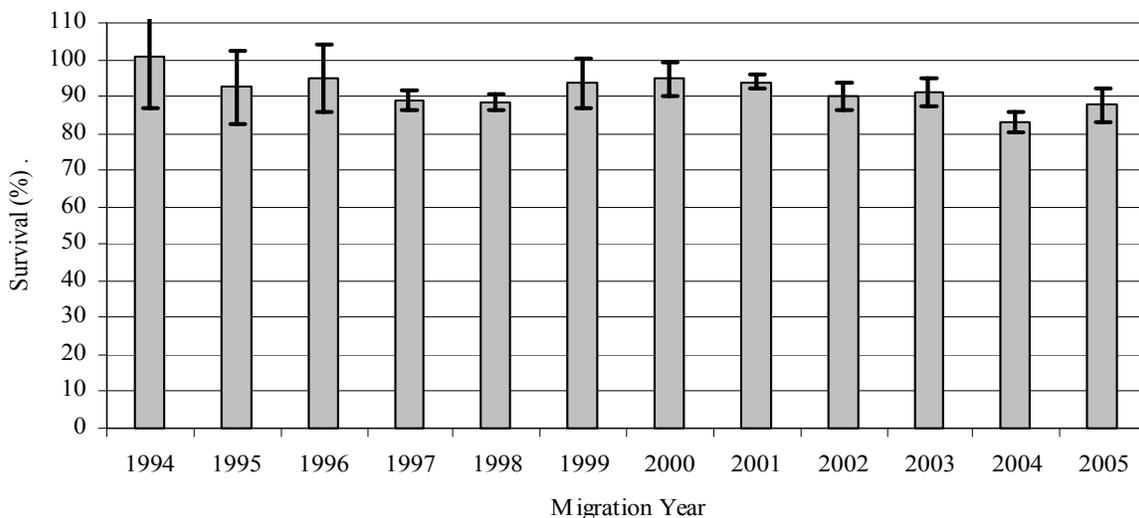


Figure 16. Estimated post release survival of hatchery Nacó'x̂ (Chinook salmon) from the Imnaha River Gumboot acclimation facility to the Imnaha River juvenile migration trap from 1994 to 2005. The error bars indicate the 95% C.I.

A separate survival analysis compared the survival of the two hatchery Nacó'x̂ (Chinook salmon) release groups to the Imnaha River juvenile migration trap (Table 1). The first group of 289,444 smolts with 13,949 PIT tagged fish was acclimated at the Gumboot acclimation facility in early March of 2005. The second group of 145,742 smolts with 6,961 PIT tagged fish was a direct release on March 29. The acclimated group displayed a survival to the Imnaha River juvenile migration trap of $87.5\% \pm 5.3\%$ (95% C.I.). The direct release group displayed a survival to the Imnaha River juvenile migration trap of $93.6\% \pm 11.6\%$ (95% C.I.). By the time these two groups reached LGD they both displayed similar survival rates, from release at the

acclimation facility to LGD, of $54.3\% \pm 1.0\%$ (95% C.I.) and $52.5\% \pm 1.6\%$ (95% C.I.) respectively.

Estimated Season Wide Smolt Survival from the Imnaha Trap

The survival of fall PIT tagged natural Nacó'x̂ (Chinook salmon) pre-smolts from the Imnaha River juvenile migration trap to LGD have been measured for migration years 1994 to 2005. All season wide and weekly survival estimates presented in this and the next section of the report are with 95% confidence intervals in parentheses. The migration year 2005 survival estimate for fall tagged natural Nacó'x̂ (Chinook salmon) pre-smolts from the trap to LGD was $21.6\% (\pm 1.1\%)$ (Figure 17). Fall PIT tagged natural Nacó'x̂ (Chinook salmon) survival from the trap to LMD was $16.7\% (\pm 2.8\%)$. Fall PIT tagged natural Nacó'x̂ (Chinook salmon) sample sizes have ranged from 442 (1997) to 6,102 (2005). The historic survival estimates have ranged from $25.6\% (\pm 4.3\%)$ for migration year 1995 to $60.4\% (\pm 4.1\%)$ for migration year 1998 (Figure 17).

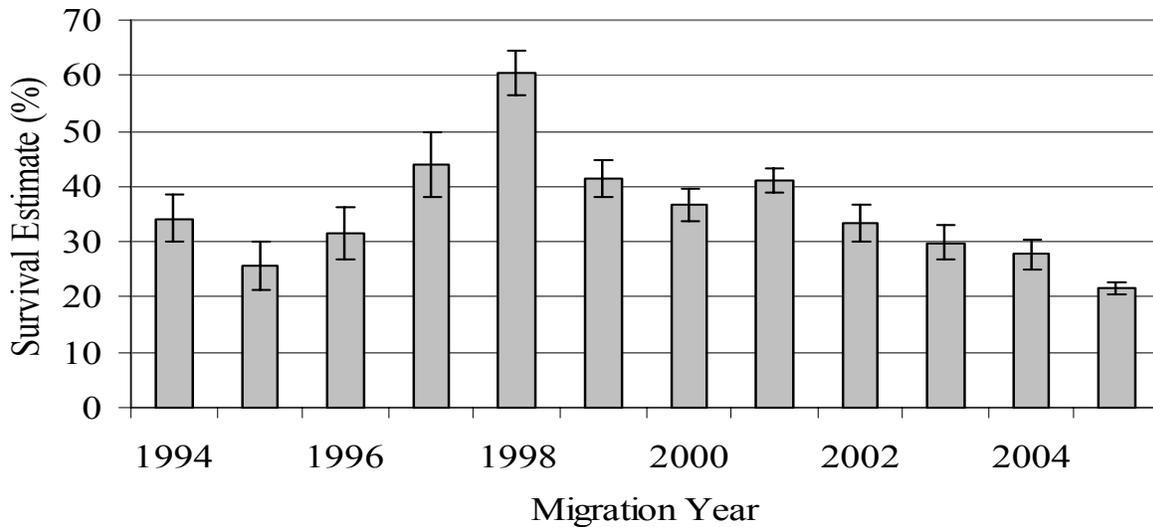


Figure 17. Estimated survival from the Imnaha River juvenile migration trap to Lower Granite Dam of natural Nacó'x̂ (Chinook salmon) tagged in the fall, for migration years 1994 to 2005. Error bars indicate the 95% C.I.

The estimated survival of natural Nacó'x̂ (Chinook salmon) smolts, PIT tagged in the spring, from the juvenile migration trap to LGD in 2005 was $73.9 (\pm 1.7\%)$ (Table 7). The hatchery Nacó'x̂ (Chinook salmon), captured and released at the Imnaha River juvenile migration trap had an estimated survival of $60.8\% (\pm 3.7\%)$ to LGD. The estimated survival of natural and hatchery Héeyey (steelhead) from the trap to LGD was $80.8\% (\pm 1.4\%)$, and $82.8\% (\pm 1.2\%)$, respectively. The estimate of survival from the Imnaha trap to LGD for natural Nacó'x̂ (Chinook salmon) smolts was the second lowest observed since the initiation of our

study (Table 8). Natural Nacó'x̂ (Chinook salmon) survival from the trap to LGD (1993 to 2005) has ranged from 73.9% in 2005 to 90.9% in 1995. Hatchery Nacó'x̂ (Chinook salmon) estimated survival from release at the trap to LGD was also the lowest observed since the initiation of our study. Natural Héeyey (steelhead) estimated survival was the second lowest of all estimates from 1995 to 2005. Natural Héeyey (steelhead) survival estimates have historically ranged from 79.0% in 2004 to 90.1% in 1997. The estimated survival from release at the Imnaha trap to LGD for hatchery Héeyey (steelhead) was within the historic range of previous estimates of 64.6% in 1996 to 89.4% in 2003.

Estimated survival from the Imnaha River juvenile migration trap to LMD in 2005 was as follows: natural Nacó'x̂ (Chinook salmon) was 63.0% (\pm 5.2%), hatchery Nacó'x̂ (Chinook salmon) was 47.7% (\pm 9.2), natural Héeyey (steelhead) was 55.1% (\pm 3.5%), and hatchery Héeyey (steelhead) was 64.1% (\pm 3.3%). The estimated survival for natural Nacó'x̂ (Chinook salmon) from the trap to LMD was within the historic recorded range. Previous survival estimates for natural Nacó'x̂ (Chinook salmon) from the trap to LMD ranged from 53.0% in 2004 to 78.3% in 1999 (Table 9).

Table 7. Estimated survival probabilities for season-wide PIT tag release groups of natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) smolts released from the Imnaha River juvenile migration trap from February 27 to June 21, 2005. Estimates are from release at the trap to Lower Granite Dam and tail race to tail race for all other sites. Abbreviations: LGD - Lower Granite Dam, LGS - Little Goose Dam, LMD - Lower Monumental Dam.

Release Group	Number Released	Trap to LGD (%)		LGD to LGS (%)		LGS to LMD (%)		LMD to MCD (%)		Trap to LMD (%)		Trap to MCD (%)	
		(95%) C.I.	(95%) C.I.	(95%) C.I.	(95%) C.I.	(95%) C.I.	(95%) C.I.	(95%) C.I.	(95%) C.I.	(95%) C.I.	(95%) C.I.		
Natural Nacó'x̂ (Chinook salmon)													
	3,552	73.9	(1.7)	89.0	(2.9)	95.8	(7.8)	84.7	(13.9)	63.0	(5.2)	53.9	(7.8)
Hatchery Nacó'x̂ (Chinook salmon)													
	1,006	60.8	(3.7)	92.6	(7.8)	84.7	(16.6)	1.4	(68.3)	47.7	(9.2)	65.8	(30.8)
Natural Héeyey (steelhead)													
	4,496	80.8	(1.4)	85.5	(1.8)	79.9	(4.9)	75.1	(16.5)	55.1	(3.5)	41.6	(8.7)
Hatchery Héeyey (steelhead)													
	6,549	82.8	(1.2)	88.8	(1.5)	87.2	(4.4)	73.1	(12.7)	64.1	(3.3)	44.7	(7.4)

Table 8. Season-wide estimates of survival from the Imnaha River juvenile migration trap to Lower Granite Dam from 1993 to 2005. Ninety-five percent confidence intervals are shown in parentheses.

Migration Year	Natural Nacó'x̂ (Chinook salmon) (%)		Hatchery Nacó'x̂ (Chinook salmon) (%) ¹		Natural Héeyey (steelhead) (%)		Hatchery Héeyey (steelhead) (%)	
1993	80.9	(11.8)						
1994	76.2	(5.3)	67.1	(10.2)				
1995	90.9	(6.7)	72.1	(6.3)	83.7	(7.1)	77.5	(3.1)
1996	81.2	(5.3)	71.4	(9.4)	86.5	(3.9)	64.6	(4.7)
1997	89.5	(12.9)	80.4	(8.0)	90.1	(3.9)	81.4	(2.0)
1998	85.2	(2.0)	75.7	(3.1)	86.0	(2.2)	82.9	(2.3)
1999	88.5	(2.0)	71.6	(4.7)	87.7	(3.1)	85.4	(2.0)
2000	84.8	(2.3)	74.4	(4.3)	84.4	(2.7)	85.8	(2.4)
2001	83.7	(0.8)	80.3	(1.6)	82.7	(1.4)	82.0	(1.6)
2002	86.9	(4.4)	77.3	(4.4)	83.0	(5.4)	81.8	(3.5)
2003	75.9	(2.3)	72.4	(6.8)	82.0	(2.5)	89.4	(3.3)
2004	73.4	(1.2)	74.0	(2.6)	79.0	(1.2)	85.9	(1.3)
2005	73.9	(1.7)	60.8	(3.7)	80.8	(1.4)	82.8	(1.2)

¹ Hatchery Nacó'x̂ (Chinook salmon) estimates based on the re-release of captured PIT tagged fish originating from the Nacó'x̂ (Chinook salmon) Gumboot acclimation facility on the Imnaha River.

Table 9. Season-wide estimates of survival from the Imnaha River juvenile migration trap to Lower Monumental Dam from 1997 to 2005. Ninety-five percent confidence intervals are shown in parentheses.

Migration Year	Natural Nacó'x̂ (Chinook salmon) (%)		Hatchery Nacó'x̂ (Chinook salmon) (%) ¹		Natural Héeyey (steelhead) (%)		Hatchery Héeyey (steelhead) (%)	
1997					73.0	(12.0)	64.0	(6.5)
1998	75.3	(4.7)	64.5	(6.7)	67.0	(5.7)	63.2	(4.9)
1999	78.3	(2.4)	61.1	(5.9)	75.1	(4.6)	73.9	(3.3)
2000	73.2	(4.3)	54.9	(7.5)	50.9	(4.7)	57.8	(7.8)
2001	65.6	(1.3)	69.0	(2.5)	49.2	(3.5)	42.8	(6.0)
2002	76.8	(4.5)	68.1	(4.2)	69.9	(4.5)	78.0	(8.4)
2003	60.0	(4.3)	61.5	(20.4)	68.1	(4.8)	82.1	(5.5)
2004	53.0	(2.9)	54.2	(5.1)	62.0	(8.1)	62.0	(6.0)
2005	63.0	(5.2)	47.7	(9.2)	55.1	(3.5)	64.1	(3.3)

¹ Hatchery Nacó'x̂ (Chinook salmon) estimates based on the re-release of captured PIT tagged fish originating from the Nacó'x̂ (Chinook salmon) Gumboot acclimation facility on the Imnaha River.

Table 10. Season-wide estimates of survival from the Imnaha River juvenile migration trap to McNary Dam from 1998 to 2005. Ninety-five percent confidence intervals are shown in parentheses.

Migration Year	Natural Nacó'x̂ (Chinook salmon) (%)		Hatchery Nacó'x̂ (Chinook salmon) (%) ¹		Natural Héeyey (steelhead) (%)		Hatchery Héeyey (steelhead) (%)	
1998	78.7	(6.8)	54.3	(8.0)	64.0	(10.1)	63.8	(10.5)
1999	68.5	(4.3)	53.8	(9.8)	71.6	(12.0)	58.8	(7.6)
2000	67.9	(6.3)	54.1	(9.7)	49.9	(12.2)	40.2	(12.5)
2001	47.4	(1.5)	52.1	(5.3)	18.4	(3.1)	13.9	(3.9)
2002	61.9	(5.3)	56.0	(5.6)	37.0	(4.8)	48.7	(13.2)
2003	57.1	(5.6)	49.0	(11.8)	42.0	(5.6)	63.0	(14.5)
2004	52.7	(5.1)	44.8	(4.06)	47.4	(25.3)	29.4	(11.2)
2005	53.9	(7.8)	65.8	(30.8)	41.6	(8.7)	44.7	(7.4)

¹ Hatchery Nacó'x̂ (Chinook salmon) estimates based on the re-release of captured PIT tagged fish originating from the Nacó'x̂ (Chinook salmon) Gumboot acclimation facility on the Imnaha River.

A possible explanation for the poor survival of natural pre-smolt and smolt Nacó'x̂ (Chinook salmon) to LGD and LMD could be that survival was affected by the below average discharge during March and April in both the Snake River and the Imnaha. The average monthly discharge for March of 2005 in the Snake River at Anatone was 18,490 cfs, the lowest recorded in the 47-year history of the gauging station. Past monitoring of Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) estimated survival from LGS and LGD to the Dalles Dam as ranging from 5% during the low-flow year of 1973 to as high as 42% during more favorable passage conditions of 1975 (Raymond 1979). However, this implies a relationship between flow and survival, which may not have a strong correlation (Smith et al. 2002). The 2005 survival estimates for hatchery Nacó'x̂ (Chinook salmon) from release to LMD was also the lowest recorded yet and may have been affected by the below average discharge in the Snake River. Previous survival estimates for hatchery Nacó'x̂ (Chinook salmon) from release to LMD have ranged from 54.2% in 2004 to 69.0% in 2001. Both estimates of survival from the trap to LMD for natural and hatchery Héeyey (steelhead) were on the low end of the range of estimates obtained from 1997 to 2004. Natural Héeyey (steelhead) survival from release to LMD has ranged from 49.2% in 2001 to 75.1% in 1999 and hatchery Héeyey (steelhead) survival from release to LMD has ranged from 42.8% in 2001 to 82.1% in 2003 (Table 9).

Survival estimates for natural Nacó'x̂ (Chinook salmon), natural Héeyey (steelhead) and hatchery Héeyey (steelhead) from the Imnaha trap to MCD were within the range of estimates from 1998 to 2004 (Table 10). Natural Nacó'x̂ (Chinook salmon) survival from the trap to MCD has ranged from 47.4% during the drought year of 2001 to 78.7% in 1998. Natural Héeyey (steelhead) survival from release to MCD has ranged from 18.4% in 2001 to 71.6% in 1999. Hatchery Héeyey (steelhead) survival from release to MCD has ranged from 13.9% in 2001 to 63.8% in 1998. The lowest estimates of survival for Héeyey (steelhead) from release to MCD, like natural Nacó'x̂ (Chinook salmon), occurred during the drought year of 2001. Hatchery

Nacó'x̂ (Chinook salmon) survival from the Imnaha trap to MCD was the highest recorded (65.8%) during the course of this study, however the 95% C.I is ±30.8 due to a low number of recaptures at MCN. Hatchery Nacó'x̂ (Chinook salmon) survival from the Imnaha trap to MCD has historically ranged from 49.0% in 2003 to 56.0% in 2002.

Estimated Weekly Smolt Survival

Weekly release groups of more than 300 fish resulted in estimates from the trap to LGD for natural Nacó'x̂ (Chinook salmon) that ranged from 75.4% (± 4.1%) released during the week of March 27 to 83.6% (± 4.8%) released during the week of May 1 (Table 11). Recaptured hatchery Nacó'x̂ (Chinook salmon) provided two weekly release groups for the weeks of March 27 and April 3. Estimated survival of these groups from the trap to LGD was 56.9% (± 6.9%) and 61.6% (± 5.8%), respectively. Weekly estimates of survival from the trap to LGD for natural Héeyey (steelhead) ranged from 76.5% (± 4.6%) during the week of May 22 to 87.2% (± 2.1%) during the week of May 1 (Table 12). Hatchery Héeyey (steelhead) survival estimates ranged from 65.2% (± 4.9%) during the week of May 22 to 91.1% (± 2.1%) during the week of May 1. The ranges of weekly estimates from the trap to LMD were as follows: 61.4% to 82.0% for natural Nacó'x̂ (Chinook salmon), 39.9% to 50.6% for hatchery Nacó'x̂ (Chinook salmon), 14.7% to 76.3% for natural Héeyey (steelhead), and 18.7% to 82.5% for hatchery Héeyey (steelhead).

Table 11. Estimated survival probabilities for weekly PIT tag release groups of 300 or more natural and hatchery Nacó'x̂ (Chinook salmon) smolts released from the Imnaha River juvenile migration trap from March 27 to May 1, with 95% confidence intervals in parentheses. Estimates are from release at the trap to Lower Granite Dam and tailrace to tailrace for all other sites. Abbreviations: LGD - Lower Granite Dam, LGS - Little Goose Dam, LMD - Lower Monumental Dam.

Week of Release	Number Released	Estimated Survival							
		Trap to LGD % (95% C.I.)		LGD to LGS % (95% C.I.)		LGS to LMD % (95% C.I.)		Trap to LMD % (95% C.I.)	
Natural Nacó'x̂ (Chinook salmon)									
27-Mar	539	75.4	(4.1)	84.4	(7.0)	96.4	(19.0)	61.4	(12.6)
3-Apr	400	78.5	(4.4)	91.4	(7.3)	87.2	(17.5)	62.6	(12.6)
10-Apr	346	80.0	(4.7)	90.8	(7.3)	89.5	(20.9)	65.0	(15.3)
17-Apr	328	83.0	(4.8)	91.2	(7.8)	100.0	(24.8)	75.7	(18.8)
1-May	317	83.6	(4.8)	95.0	(6.8)	103.2	(22.0)	82.0	(17.6)
Hatchery Nacó'x̂ (Chinook salmon)									
27-Mar	389	56.9	(6.9)	82.5	(14.6)	84.9	(27.9)	39.9	(13.3)
3-Apr	403	61.6	(5.8)	97.4	(13.5)	84.2	(28.2)	50.6	(16.2)

Table 12. Estimated survival probabilities for weekly PIT tag release groups of 300 or more natural and hatchery Héeyey (steelhead) smolts released from the Imnaha River juvenile migration trap from April 10 to May 29, with 95% confidence intervals in parentheses. Estimates are from release at the trap to Lower Granite Dam and tailrace to tailrace for all other sites. Abbreviations: LGD - Lower Granite Dam, LGS - Little Goose Dam, LMD - Lower Monumental Dam.

Week of Release	Number Released	Estimated Survival							
		Trap to LGD % (95% C.I.)		LGD to LGS % (95% C.I.)		LGS to LMD % (95% C.I.)		Trap to LMD % (95% C.I.)	
Natural Héeyey (steelhead)									
17-Apr	301	86.4	(4.4)	88.0	(5.4)	100.4	(28.9)	76.3	(22.3)
24-Apr	724	83.9	(3.0)	94.8	(3.7)	77.9	(12.1)	61.9	(9.7)
1-May	1,063	87.2	(2.1)	97.7	(1.9)	82.8	(7.1)	70.5	(6.2)
8-May	484	81.5	(4.4)	97.6	(4.7)	94.8	(21.6)	75.4	(17.3)
22-May	607	76.5	(4.6)	67.4	(5.9)	59.4	(17.9)	30.7	(9.5)
29-May	517	77.5	(7.4)	52.3	(8.4)	36.2	(14.3)	14.7	(5.8)
Hatchery Héeyey (steelhead)									
10-Apr	995	89.1	(2.2)	96.6	(2.6)	95.8	(11.3)	82.5	(9.8)
17-Apr	900	88.3	(2.5)	95.9	(3.3)	79.5	(9.1)	67.3	(7.7)
24-Apr	974	88.6	(2.4)	95.8	(3.0)	86.6	(10.3)	73.5	(8.8)
1-May	988	91.1	(2.1)	94.2	(2.7)	88.3	(10.1)	75.7	(8.7)
8-May	997	79.7	(4.1)	86.5	(4.8)	82.0	(12.7)	56.6	(8.9)
15-May	527	83.1	(4.9)	92.7	(5.8)	85.8	(16.4)	66.1	(12.8)
22-May	838	65.2	(4.9)	56.9	(7.3)	50.3	(20.6)	18.7	(7.6)
29-May	330	72.5	(12.4)	58.5	(18.1)	137.0	(247.5)	58.1	(104.3)

Smolt to Adult Return Rates

Smolt-to adult return rate indices (SAR) were calculated for two groups of PIT tagged juvenile natural Nacó'x̂ (Chinook salmon) emigrants from the Imnaha River, the fall and spring migration groups for brood years 1996 through 2000. The total number of Nacó'x̂ (Chinook salmon) adults detected at LGD for spring PIT tagged Nacó'x̂ (Chinook salmon) from brood years 1996 through 2000 were 59, 105, 109, 24 and 14 fish, respectively. Adult detections from fall PIT tagged Nacó'x̂ (Chinook salmon) from brood years 1996 through 2000 were 27, 20, 22, 5 and 19, respectively (Table 13). Fall tagged natural Nacó'x̂ (Chinook salmon) evidenced a higher LGD to LGD SAR index for all brood years examined when compared to spring tagged Nacó'x̂ (Chinook salmon) (Table 13). The LGD to LGD SAR index for fall tagged Nacó'x̂ (Chinook salmon) ranged from 0.61% to 3.08%. The LGD to LGD SAR index for spring tagged Nacó'x̂ (Chinook salmon) ranged from 0.29% to 2.94% for the same brood years. Observed

differences between fall and spring tag group SAR indexes for brood years 1997 and 1998 were relatively small. The differences between fall and spring tag group SAR indexes for brood year 2000 are much larger.

Estimated SAR indices for these two groups characterize in-river migrating fish (although a few smolts were inadvertently diverted to the transportation system) defined as those fish that migrated by either spill, turbine routes or diverted back to the river during sampling. The estimated SAR provides a SAR index of inriver migrating Imnaha River Nacó'x̂ (Chinook salmon). The LGD to LGD SAR was calculated as it provides a SAR comparable to other tributaries with similar study designs.

Table 13. Smolt to adult return rate indices (SARs) from LGD to LGD of PIT tagged Imnaha River natural Nacó'x̂ (Chinook salmon) for brood years 1996 to 2000. In-river migrating fish were tagged at the Imnaha River juvenile migration trap.

Brood Year	Season Tagged	Number PIT Tagged	Estimated Smolts at LGD	Number of Adult Detections at LGD	<u>Age at Return</u>			SAR LGD to LGD (%)
					III	IV	V	
	Fall							
1996		1,453	878	27	5	15	7	3.08
1997		2,000	830	20	3	16	1	2.41
1998		1,966	723	22	2	12	8	3.04
1999		2,009	826	5	0	3	2	0.61
2000		2,011	670	19	0	15	4	2.84
	Spring							
1996		3,956	3,371	59	3	41	15	1.75
1997		5,306	4,696	105	8	69	28	2.24
1998		4,369	3,705	109	3	62	44	2.94
1999		10,005	8,374	24	0	16	8	0.29
2000		2,321	2,017	16	3	10	3	0.79

Arrival Timing at Dams

Natural and Hatchery Nacó'x̂ (Chinook salmon) Arrival Timing for 2005

Fall tagged pre-smolt natural Nacó'x̂ (Chinook salmon) had statistically significant earlier median and cumulative arrival timing at LGD than spring tagged natural Nacó'x̂ (Chinook salmon) smolts ($p < 0.05$). Statistical test results are presented in Appendix G. The

April 17 median arrival date for fall tagged Nacó'x̂ (Chinook salmon) was earlier than the April 30 median arrival date for spring tagged Nacó'x̂ (Chinook salmon) ($p < 0.05$).

Fall tagged natural Nacó'x̂ (Chinook salmon) arrived at LGD in 2005 from March 30 to May 24, median arrival on April 17 and a 90% arrival timing of April 27. Arrival at the remaining dams occurred during the following times: April 15 to June 9 at LGS, April 22 to June 12 at LMD, and May 2 to June 16 at MCD. Median arrivals occurred April 30, May 2, and May 8 at LGS, LMD, and MCD, respectively. Ninety percent arrival occurred on the following dates: May 8 at LGS, May 9 at LMD, and May 11 at MCD (Appendix H).

Spring tagged natural Nacó'x̂ (Chinook salmon) smolts arrived at LGD from April 2 to July 2 and had a 90% arrival time of June 4 (Appendix I). Arrival at LGS, LMD, and MCD occurred from April 13 to July 2, April 22 to June 19, and April 28 to July 2, respectively. Median arrival timing at these three dams was as follows: May 7 at LGS, May 9 at LMD, and May 16 at MCD. The 90% arrival time at LGS was June 2, May 26 at LMD, and June 28 at MCD.

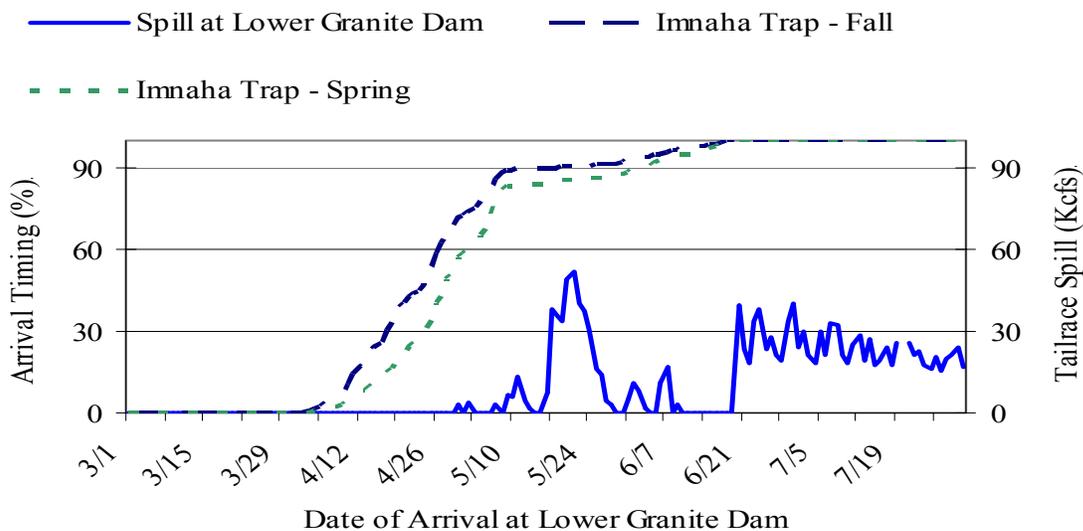


Figure 18. The cumulative arrival timing of fall and spring tagged natural Nacó'x̂ (Chinook salmon) and tailrace spill at Lower Granite Dam during the 2005 migration year. Fall and spring tagged natural Nacó'x̂ (Chinook salmon) were released in the fall of 2004 and the spring of 2005.

PIT tagged hatchery Nacó'x̂ (Chinook salmon) smolts recaptured at the Innaha River juvenile migration trap had the following arrival times at the four dams in 2005: April 4 to June 13 at LGD, April 16 to June 9 at LGS, April 20 to June 13 at LMD, and April 26 to June 25 at MCD (Appendix J). Median arrival timing occurred May 2 at LGD, May 8 at LGS, May 10 at

LMD and May 14 at MCD. Ninety percent arrival timing occurred May 7 at LGD, May 12 at LGS, May 15 at LMD and May 19 at MCD.

Natural and Hatchery Héeyey (Steelhead) Arrival Timing for 2005

Natural Héeyey (steelhead) arrived at LGD, LGS, LMD, and MCD from April 7 to June 30, April 14 to June 26, April 17 to June 20, and May 1 to August 1 (Appendix K). Median arrival timing occurred May 8 at LGD, May 11 at LGS, May 13 at LMD, and May 15 at MCD. The 90% arriving timing occurred on June 4 at LGD, June 3 at LGS, June 1 at LMD, and May 25 at MCD.

Hatchery Héeyey (steelhead) had the following range of arrival times: April 18 to May 17 at LGD, April 22 to June 22 at LGS, April 22 to June 22 at LMD, and May 4 to June 29 at MCD (Appendix L). Median arrival times for hatchery Héeyey (steelhead) migrating in 2005 were May 7 at LGD, May 10 at LGS, May 7 at LMD, and May 18 at MCD. Ninety percent arrival times are as follows: May 10 at LGD, May 31 at LGS, June 2 at LMD, May 27 and MCD.

Average Arrival Timing

This project has collected eight to fourteen years of arrival timing data for natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) from the Imnaha River. The annual first, median, 90%, and last arrival times from all years were averaged (Table 14). The mean arrival timing range for fall tagged natural Nacó'x̂ (Chinook salmon) pre-smolts from 1998 to 2005 at LGD is from March 30 (± 7 days) to May 16 (± 18 days), with mean median and 90% arrival timing of April 16 (± 8 days) and April 27 (± 7 days), respectively. Mean median arrival times at LGS, LMD, and MCD for fall tagged natural Nacó'x̂ (Chinook salmon) are April 24 (± 11 days), April 23 (± 12 days), and April 29 (± 11 days), respectively. Mean 90% arrival timing for fall tagged natural Nacó'x̂ (Chinook salmon) was May 2 (± 12 days) at LGS, May 2 (± 16 days) at LMD, and May 6 (± 11 days) at MCD.

Spring tagged natural Nacó'x̂ (Chinook salmon) smolt mean arrival times at LGD from 1993 to 2005 are as follows: mean arrival time range of April 4 (± 15 days) to July 4 (± 47 days), mean median arrival time of April 28 (± 8 days), and mean 90% arrival of May 16 (± 15 days). Mean median arrival times at LGS, LMD, and MCD for natural Nacó'x̂ (Chinook salmon) smolts are May 1 (± 9 days), May 5 (± 14 days), and May 9 (± 11 days). Mean 90% arrival timing is May 18 (± 14 days) at LGS, May 22 (± 14 days) at LMD, and May 25 (± 22 days) at MCD.

Hatchery Nacó'x̂ (Chinook salmon) smolt mean arrival times at LGD from 1993 to 2005 are as follows: mean arrival time range of April 11 (± 14 days) to May 28 (± 19 days), mean median arrival time of May 3 (± 10 days), and mean 90% arrival of May 12 (± 7 days). Mean median arrival times at LGS, LMD, and MCD for hatchery Nacó'x̂ (Chinook salmon) smolts are

May 8 (± 9 days), May 12 (± 7 days), and May 14 (± 7 days). Mean 90% arrival timing is May 16 (± 9 days) at LGS, May 21 (± 7 days) at LMD, and May 22 (± 6 days) at MCD.

Natural Héeyey (steelhead) have a fourteen-year mean arrival date range of April 13 (± 26 days) to July 11 (± 56 days) at LGD. The mean arrival date range for LGS, LMD, and MCD is as follows: April 17 (± 23 days) to July 8 (± 50 days) at LGS, April 22 (± 23 days) to July 6 (± 73 days) at LMD, and April 27 (± 25 days) to June 18 (± 41 days) at MCD. The fourteen-year median arrival time at LGD, LGS, LMD, and MCD is as follows: May 10 (± 13 days) at LGD, May 13 (± 11 days) at LGS, May 17 (± 14 days) at LMD, and May 17 (± 12 days) at MCD. The mean 90% arrival timing for natural Héeyey (steelhead) is as follows: May 27 (± 16 days) at LGD, May 28 (± 12 days) at LGS, June 4 (± 32 days) at LMD, and May 28 (± 14 days) at MCD.

The fourteen-year mean range of arrival for hatchery Héeyey (steelhead) at LGD is April 22 (± 17 days) to July 21 (± 61 days). Downstream mean arrival ranges for hatchery Héeyey (steelhead) are as follows: April 26 (± 16 days) to July 31 (± 82 days) at LGS, April 29 (± 17 days) to August 1 (± 81 days) at LMD, and May 7 (± 18 days) to July 6 (± 40 days) at MCD. The fourteen-year median arrival time at LGD, LGS, LMD, and MCD is as follows: May 20 (± 13 days), May 24 (± 11 days), May 28 (± 18 days), and May 31 (± 24 days), respectively. Mean 90% arrival occurred on June 7 (± 32 days) at LGD, June 15 (± 30 days) at LGS, June 17 (± 33 days) at LMD, and June 15 (± 34 days) at MCD.

Arrival times are frequently expressed as median arrival times within this document. One aspect of median arrival times is that on occasion dams further downstream will have an earlier arrival time than those upstream. Median arrival times are highly influenced by flow conditions and detection probabilities at each dam. Throughout the migration season, there are variable detection probabilities at each dam and between dams. Early in the monitoring season dams will have a lower detection probability due to high spring flow. As the migration season progresses the detection probabilities will increase as the flows decrease. In examining the SURPH output there is a significant number of smolts undetected until McNary dam. These smolts have passed through the upper three dams undetected due to low detection probabilities.

Table 14. Averaged mean first, median, 90%, and last arrival timing for fall and spring tagged natural Nacó'x juveniles, hatchery Nacó'x smolts, and natural and hatchery Héeyey (steelhead) smolts, at Lower Granite Dam (LGD), Little Goose Dam (LGS), Lower Monumental Dam (LMD) and McNary Dam (MCD). All fish were captured in the Imnaha River juvenile migration trap. Mean arrival timing is presented with the 95% C.I. ± days.

Rearing, Species, Life Stage, Dam	<u>First Arrival</u>		<u>Median Arrival</u>		<u>90% Arrival</u>		<u>Last Arrival</u>	
	Mean	± days	Mean	± days	Mean	± days	Mean	± days
<u>Fall Tagged Natural Nacó'x (Chinook salmon) Pre-Smolts (1998 to 2005)¹</u>								
LGD	Mar-30	7	Apr-16	8	Apr-27	7	May-16	18
LGS	Apr-11	12	Apr-24	11	May-02	12	May-22	28
LMD	Apr-18	15	Apr-23	12	May-02	16	May-23	23
MCD	Apr-20	17	Apr-29	11	May-06	11	May-22	25
<u>Spring Tagged Natural Nacó'x (Chinook salmon) Smolts (1993 to 2005)</u>								
LGD	Apr-04	15	Apr-28	8	May-16	15	Jul-04	47
LGS	Apr-14	10	May-01	9	May-18	14	Jul-05	53
LMD	Apr-18	15	May-05	14	May-22	14	Jul-03	48
MCD	Apr-23	11	May-09	11	May-25	22	Jun-22	40
<u>Hatchery Nacó'x (Chinook salmon) Smolts (1992 to 2005)</u>								
LGD	Apr-11	14	May-03	10	May-12	7	May-28	19
LGS	Apr-19	11	May-08	9	May-16	9	Jun-01	13
LMD	Apr-24	10	May-12	7	May-21	7	Jun-03	14
MCD	Apr-27	12	May-14	7	May-22	6	Jun-04	18
<u>Natural Héeyey (steelhead) Smolts (1993 to 2005)²</u>								
LGD	Apr-13	26	May-10	13	May-27	16	Jul-11	56
LGS	Apr-17	23	May-13	11	May-28	12	Jul-08	50
LMD	Apr-22	23	May-17	14	Jun-04	32	Jul-06	73
MCD	Apr-27	25	May-17	12	May-28	14	Jun-18	41
<u>Hatchery Héeyey (steelhead) Smolts (1993 to 2005)²</u>								
LGD	Apr-22	17	May-20	13	Jun-07	32	Jul-21	61
LGS	Apr-26	16	May-24	11	Jun-15	30	Jul-31	82
LMD	Apr-29	17	May-28	18	Jun-17	33	Aug-01	81
MCD	May-07	18	May-31	24	Jun-15	34	Jul-06	40

¹ Median and 90% arrival timing does not include data from migration year 2001 due to the small sample size.

² Median and 90% arrival timing does not include data from migration year 2002 due to the small sample size.

Travel Time to Lower Granite Dam

Weekly comparison of median travel times between natural and hatchery stocks are limited to weeks that had more than 30 interrogations per category (Table 15). Weekly comparisons for Nacó'x̂ (Chinook salmon) occur for three weeks between April 24 and May 8. Natural Nacó'x̂ (Chinook salmon) weekly median travel times to LGD ranged from seven days (May 8) to twenty-one days (April 24). On average natural Nacó'x̂ (Chinook salmon) median travel times were twenty-six days earlier than hatchery Nacó'x̂ (Chinook salmon) released in the same week.

Table 15. A comparison of median travel times of natural and hatchery Nacó'x̂ (Chinook salmon) smolts released from the Imnaha River screw trap, March 27 to June 26, 2005, at Lower Granite Dam.

Species	Release Week	<u>Number Interrogated</u>		<u>Median Travel Time (Days)</u>	
		Hatchery	Natural	Hatchery	Natural
Nacó'x̂ (Chinook salmon)	4/24/2005	119	519	32	21
	5/1/2005	182	387	38	14
	5/8/2005	46	238	43	7
Héeyey (steelhead)	4/17/2005	260	76	7	10
	4/24/2005	513	358	10	6
	5/1/2005	721	627	10	6
	5/8/2005	932	544	9	6
	5/15/2005	452	226	5	4
	5/22/2005	92	72	4	4
	5/29/2005	402	379	4	4
6/5/2005	45	128	10	5	

Weekly comparisons for Héeyey (steelhead) occur for an eight-week period between April 17 and June 5. Natural Héeyey (steelhead) weekly median travel times to LGD ranged from four days (May 15, 22 and 29) to ten days (April 17) to (Table 14). Hatchery Héeyey (steelhead) travel times during this period ranged from four days (May 22 and May 29) to ten days (April 24, May 1 and May 29). The differences in median travel time ranged from zero to five days during the week of June 5. On average natural Héeyey (steelhead) median travel times were two days earlier than hatchery Héeyey (steelhead) released in the same week. Median travel times to LGD, for all groups, decreased with an increase in the calendar date. The relationship between the decrease in travel times and increase in calendar date has been

previously described (Berggren and Filardo 1993) and is probably due to increased river discharge and smoltification (Groot et al. 1995).

Mortality

Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) Mortality

A total of 113 natural Nacó'x̂ (Chinook salmon), 30 hatchery Nacó'x̂ (Chinook salmon), 8 natural Héeyey (steelhead), and 9 hatchery Héeyey (steelhead) mortalities occurred during the study. Nineteen of the natural Nacó'x̂ (Chinook salmon) mortalities occurred during the fall; 0.3% of all natural Nacó'x̂ (Chinook salmon) captured in the fall of 2004 (Appendix M). Trapping caused 14 mortalities, handling caused none, PIT tagging was the source of 2, and 2 additional dead on arrival. No other mortalities occurred during the fall. Ninety-four natural Nacó'x̂ (Chinook salmon) mortalities occurred during the spring: 71 due to trapping, 13 due to handling, 9 from to PIT tagging and 1 was dead on arrival at the Imnaha screw trap (Appendix N). The total number of mortalities accounted for 1.9 % of the natural Nacó'x̂ (Chinook salmon) captured in the spring of 2005. Nineteen trapping, no handling, 1 PIT tagging, and 10 dead on arrival mortalities occurred to hatchery Nacó'x̂ (Chinook salmon) with the total mortality accounted for 0.08 % of the catch in the spring of 2005.

There were 8 natural Héeyey (steelhead) mortalities during the spring of 2005. Five mortalities were attributed to trapping, none for handling, 3 for PIT tagging, and none were dead on arrival at the Imnaha screw trap. Hatchery Héeyey (steelhead) had 9 trapping mortalities; 4 from handling, none from PIT tagging and 3 from tagging, and 2 hatchery Héeyey (steelhead) were dead on arrival. The 8 natural Héeyey (steelhead) mortalities were 0.15 % of the total catch, where the 9 hatchery Héeyey (steelhead) mortalities accounted for 0.03 %.

Incidental Catch

Incidental Catch for Migration Year 2005

The incidental catch during the fall and spring of migration year 2005 totaled 1,539 fish. It was comprised of six families of fishes: Salmonidae, Centrarchidae, Catostomidae, Cyprinidae, Cottidae, and Petromyzotidae (Appendix O). The catch of Salmonidae consisted of 54 adult Héeyey (steelhead), 2 adult Nacó'x̂ (Chinook salmon), 767 rainbow trout, 53 Cimey (mountain whitefish; *Prosopium williamsoni*), and 30 Islam (bull trout; *Salvelinus confluentus*). The juvenile rainbow were resident fish based on morphological characteristics and are not a subset of the catch of natural Héeyey (steelhead) reported in earlier sections of this report. The 3 Centrarchidae captured were smallmouth bass (*Micropterus dolomieu*). A total of 40 Muq'uc (bridgelip suckers; *Catostomus columbianus*), 10 Muq'uc (largescale suckers; *Catostomus macrocheilus*), and 137 unidentified Muq'uc species represented the family Catostomidae. The catch of Cyprinidae was as follows: 32 Tite'wxc (chislemouth; *Acrocheilus alutaceus*), 236

longnose dace (*Rhinichthys cataractae*), 73 Qiyex (northern pikeminnow; *Ptychocheilus oregonensis*), and 64 redbelt shiner (*Richardsonius balteatus*). Thirty-five *Cottus* species (sculpins) of the family Cottidae were captured during the spring of 2005. Additionally 2 Heesu (Pacific Lampreys; *Lampetra tridentata*) of the family Petromyzotidae were caught in the spring of 2005; 1 adult and 1 juvenile.

ACKNOWLEDGMENTS

The Nez Perce Tribe extends the administrative support necessary to complete these projects and this report. Project funding from the U.S. Fish and Wildlife Service's Lower Snake River Compensation Plan program initiated the Imnaha River emigration project investigations in 1992 and the project continues today. The Bonneville Power Administration also provides significant project cost share funding for the Imnaha Smolt Monitoring Program. We wish to thank the following NPT employees for their hard work and dedication gathering the necessary data for this report: Cameron Albee, Mike Blenden, David Bright, Gregory Crow, David Cunningham Jr., Katie Frenyea, Joe McCormack, Neal Meshell, Jeff Nehls, Steve Senter, Stephanie Trullinger and Jason Vogel. Jay Hesse and Jason Vogel provided technical support and advice for these studies. We also acknowledge the Oregon Department of Fish and Wildlife for PIT tagging under BPA program number 199602000 and releasing the hatchery Nacó'x from the acclimation facility. We extend our gratitude to the United States Forest Service for allowing us the use of the Thorn Creek guard station facilities, and Scott McClaren of McClaran Ranch Inc. for access to their land for trapping purposes. The Fish Passage Center's Data System Administrative Manager, Henry Franzoni, and Senior Data Analyst, Sergie Rasskazov provided software that assisted with daily tasks.

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APPENDICES

Appendix A. The number of hours sampled and the catch of natural and hatchery Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) at the Imnaha River juvenile migration trap from 18 October 2004 to 21 June 2005. Sampling periods exceeded 24 hours when trapping continued past the hour the trap was started from the previous day (e.g. 8:30 am on October 18 to 11:00 am on October 19). N/A indicates the trap was not operated on that date.

Sample End Date	Hours fished	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)
10/18/2004	21	38	0	0	0
10/19/2004	20	232	0	0	0
10/20/2004	26	765	0	1	0
10/21/2004	25	796	0	1	0
10/22/2004	15	183	0	1	0
10/23/2004	N/A	N/A	N/A	N/A	N/A
10/24/2004	N/A	N/A	N/A	N/A	N/A
10/25/2004	19.5	254	0	0	0
10/26/2004	13.75	713	0	0	0
10/27/2004	22.25	209	0	0	0
10/28/2004	25	529	0	0	0
10/29/2004	21	149	0	0	0
10/30/2004	N/A	N/A	N/A	N/A	N/A
10/31/2004	N/A	N/A	N/A	N/A	N/A
11/1/2004	14	115	0	0	0
11/2/2004	21.5	109	0	0	0
11/3/2004	24.5	307	0	0	0
11/4/2004	26.5	801	0	0	0
11/5/2004	23.5	602	0	0	0
11/6/2004	N/A	N/A	N/A	N/A	N/A
11/7/2004	N/A	N/A	N/A	N/A	N/A
11/8/2004	16	30	0	0	0
11/9/2004	23	55	0	0	0
11/10/2004	24.5	54	0	0	0
11/11/2004	N/A	N/A	N/A	N/A	N/A
11/12/2004	N/A	N/A	N/A	N/A	N/A
11/13/2004	N/A	N/A	N/A	N/A	N/A
11/14/2004	N/A	N/A	N/A	N/A	N/A
11/15/2004	20.5	11	0	0	0
11/16/2004	20	79	0	0	0
11/17/2004	23	46	0	0	0
11/18/2004	23.5	44	0	0	0
3/4/2005	24	3	0	0	0
3/5/2005	24	1	0	0	0

Sample End Date	Hours fished	Natural Nacó'x (Chinook salmon)	Hatchery Nacó'x (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)
3/6/2005	24	1	0	0	0
3/7/2005	24	3	0	0	0
3/8/2005	24	2	0	0	0
3/9/2005	23	14	0	1	0
3/10/2005	25	19	0	0	0
3/11/2005	24.25	62	0	0	1
3/12/2005	24	25	0	0	1
3/13/2005	24	27	0	0	0
3/14/2005	24	81	0	0	0
3/15/2005	24	53	0	0	0
3/16/2005	23	17	0	0	0
3/17/2005	25.75	34	0	0	1
3/18/2005	24	25	0	0	0
3/19/2005	22.5	40	0	0	0
3/20/2005	24	20	0	0	0
3/21/2005	24.5	31	0	0	0
3/22/2005	24.5	16	0	0	0
3/23/2005	23.5	16	178	0	1
3/24/2005	19	5	474	0	0
3/25/2005	23.5	34	695	0	0
3/26/2005	24.5	58	1,117	0	0
3/27/2005	23.5	13	365	1	0
3/28/2005	17.5	0	0	0	0
3/29/2005	N/A	N/A	N/A	N/A	N/A
3/30/2005	13.5	250	4,266	0	62
3/31/2005	22	411	11,342	0	71
4/1/2005	23.5	331	4,603	0	47
4/2/2005	24	286	3,320	0	82
4/3/2005	25.5	89	1,282	0	13
4/4/2005	25.5	28	1,957	0	11
4/5/2005	23	55	1,809	0	11
4/6/2005	23.5	81	1,116	1	18
4/7/2005	28	55	808	0	12
4/8/2005	21.5	32	508	0	17
4/9/2005	26	64	635	0	21
4/10/2005	24.5	76	520	2	31
4/11/2005	23	52	263	0	19
4/12/2005	23.5	31	179	1	42
4/13/2005	23	74	364	1,538	30
4/14/2005	22.5	126	422	3,737	3

Sample End Date	Hours fished	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)
4/15/2005	24	167	289	4,247	34
4/16/2005	24	87	136	3,459	79
4/17/2005	25	28	55	754	35
4/18/2005	23	83	216	2,985	185
4/19/2005	24	90	304	1,829	165
4/20/2005	24	177	180	1,786	47
4/21/2005	23.5	79	40	323	40
4/22/2005	24.5	56	75	168	62
4/23/2005	27	41	32	91	74
4/24/2005	23.5	73	62	291	156
4/25/2005	23	39	40	240	138
4/26/2005	11	25	37	576	192
4/27/2005	N/A	N/A	N/A	N/A	N/A
4/28/2005	9	7	22	326	99
4/29/2005	N/A	N/A	N/A	N/A	N/A
4/30/2005	20.5	53	66	664	161
5/1/2005	10.5	46	33	574	220
5/2/2005	24.5	112	96	608	238
5/3/2005	24	77	83	405	203
5/4/2005	23.5	86	77	994	527
5/5/2005	10	17	46	618	184
5/6/2005	0	2	7	33	32
5/7/2005	N/A	N/A	N/A	N/A	N/A
5/8/2005	N/A	N/A	N/A	N/A	N/A
5/9/2005	N/A	N/A	N/A	N/A	N/A
5/10/2005	N/A	N/A	N/A	N/A	N/A
5/11/2005	12	19	3	0	1
5/12/2005	25.5	7	2	302	143
5/13/2005	25.5	24	11	447	190
5/14/2005	21	14	7	318	155
5/15/2005	24	36	11	415	170
5/16/2005	14	1	0	29	5
5/17/2005	N/A	N/A	N/A	N/A	N/A
5/18/2005	N/A	N/A	N/A	N/A	N/A
5/19/2005	N/A	N/A	N/A	N/A	N/A
5/20/2005	N/A	N/A	N/A	N/A	N/A
5/21/2005	N/A	N/A	N/A	N/A	N/A
5/22/2005	N/A	N/A	N/A	N/A	N/A
5/23/2005	15	28	8	114	111
5/24/2005	15.5	10	6	86	75

Sample End Date	Hours fished	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)
5/25/2005	23	19	0	177	126
5/26/2005	24	28	0	184	114
5/27/2005	25	42	6	202	137
5/28/2005	22.5	21	4	81	51
5/29/2005	23	33	3	119	106
5/30/2005	23	36	1	127	103
5/31/2005	24	31	4	96	106
6/1/2005	23	54	3	76	89
6/2/2005	25.5	39	1	77	70
6/3/2005	24.5	32	2	56	31
6/4/2005	23.25	20	0	15	21
6/5/2005	24	23	1	28	13
6/6/2005	24.5	29	1	82	33
6/7/2005	24	31	1	39	25
6/8/2005	21.5	24	1	39	21
6/9/2005	26	43	1	34	15
6/10/2005	23.5	18	0	31	13
6/11/2005	24	14	0	47	9
6/12/2005	24	31	1	28	13
6/13/2005	25	31	0	66	22
6/14/2005	23.5	29	0	29	8
6/15/2005	23.5	21	0	22	5
6/16/2005	24	28	0	38	9
6/17/2005	23	21	0	28	3
6/18/2005	24.5	31	0	46	13
6/19/2005	23.5	21	0	25	2
6/20/2005	23.5	16	0	5	0
6/21/2005	24	18	0	5	1
Total	2,647.25¹	11,030	38,197	29,768	5,374

¹ We fished 2647.25 hours out of a possible total of 3432 hours (143 days) or 77.13%

Appendix B. The number of Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) PIT tagged at the Imnaha River juvenile migration trap from 18 October 2004 to 21 June 2005. N/A indicates the trap was not operated on that date.

Date	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)
10/18/2004	38	0	0	0
10/19/2004	232	0	0	0
10/20/2004	765	0	1	0
10/21/2004	796	0	1	0
10/22/2004	183	0	1	0
10/23/2004	N/A	N/A	N/A	N/A
10/24/2004	N/A	N/A	N/A	N/A
10/25/2004	254	0	0	0
10/26/2004	713	0	0	0
10/27/2004	209	0	0	0
10/28/2004	529	0	0	0
10/29/2004	149	0	0	0
10/30/2004	N/A	N/A	N/A	N/A
10/31/2004	N/A	N/A	N/A	N/A
11/1/2004	115	0	0	0
11/2/2004	109	0	0	0
11/3/2004	307	0	0	0
11/4/2004	801	0	0	0
11/5/2004	602	0	0	0
11/6/2004	N/A	N/A	N/A	N/A
11/7/2004	N/A	N/A	N/A	N/A
11/8/2004	30	0	0	0
11/9/2004	55	0	0	0
11/10/2004	54	0	0	0
11/11/2004	N/A	N/A	N/A	N/A
11/12/2004	N/A	N/A	N/A	N/A
11/13/2004	N/A	N/A	N/A	N/A
11/14/2004	N/A	N/A	N/A	N/A
11/15/2004	11	0	0	0
11/16/2004	79	0	0	0
11/17/2004	46	0	0	0
11/18/2004	44	0	0	0
3/4/2005	3	0	0	0
3/5/2005	1	0	0	0
3/6/2005	1	0	0	0
3/7/2005	3	0	0	0

Date	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)
3/8/2005	2	0	0	0
3/9/2005	13	0	0	0
3/10/2005	19	0	0	0
3/11/2005	38	0	1	0
3/12/2005	15	0	1	0
3/13/2005	27	0	0	0
3/14/2005	61	0	0	0
3/15/2005	53	0	0	0
3/16/2005	16	0	0	0
3/17/2005	25	0	0	0
3/18/2005	24	0	0	0
3/19/2005	39	0	0	0
3/20/2005	20	0	0	0
3/21/2005	31	0	0	0
3/22/2005	16	0	0	0
3/23/2005	16	0	1	0
3/24/2005	5	0	0	0
3/25/2005	34	0	0	0
3/26/2005	58	0	0	0
3/27/2005	13	0	0	0
3/28/2005	0	0	0	0
3/29/2005	N/A	N/A	N/A	N/A
3/30/2005	216	0	52	0
3/31/2005	70	0	15	0
4/1/2005	141	1	10	0
4/2/2005	99	0	22	0
4/3/2005	89	0	11	0
4/4/2005	27	0	11	0
4/5/2005	53	0	10	0
4/6/2005	81	0	17	0
4/7/2005	55	0	12	0
4/8/2005	32	0	17	0
4/9/2005	63	0	21	0
4/10/2005	76	0	31	0
4/11/2005	52	0	19	0
4/12/2005	31	0	42	1
4/13/2005	54	0	19	200
4/14/2005	41	0	3	245
4/15/2005	55	0	9	285
4/16/2005	37	0	21	269

Date	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)
4/17/2005	26	0	35	251
4/18/2005	40	0	77	102
4/19/2005	56	0	43	300
4/20/2005	75	0	47	255
4/21/2005	77	0	40	100
4/22/2005	55	0	62	0
4/23/2005	39	0	74	0
4/24/2005	73	0	156	201
4/25/2005	39	0	138	237
4/26/2005	20	0	171	166
4/27/2005	N/A	N/A	N/A	N/A
4/28/2005	3	0	99	76
4/29/2005	N/A	N/A	N/A	N/A
4/30/2005	47	0	161	298
5/1/2005	45	0	220	242
5/2/2005	111	0	238	217
5/3/2005	77	0	203	243
5/4/2005	65	0	209	215
5/5/2005	17	0	163	77
5/6/2005	2	0	32	0
5/7/2005	N/A	N/A	N/A	N/A
5/8/2005	N/A	N/A	N/A	N/A
5/9/2005	N/A	N/A	N/A	N/A
5/10/2005	N/A	N/A	N/A	N/A
5/11/2005	16	0	0	0
5/12/2005	7	0	143	290
5/13/2005	23	0	188	400
5/14/2005	11	0	153	307
5/15/2005	34	0	170	406
5/16/2005	1	0	5	19
5/17/2005	N/A	N/A	N/A	N/A
5/18/2005	N/A	N/A	N/A	N/A
5/19/2005	N/A	N/A	N/A	N/A
5/20/2005	N/A	N/A	N/A	N/A
5/21/2005	N/A	N/A	N/A	N/A
5/22/2005	N/A	N/A	N/A	N/A
5/23/2005	26	0	111	113
5/24/2005	9	0	75	86
5/25/2005	19	0	124	177
5/26/2005	26	0	111	180

Date	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)
5/27/2005	40	3	135	201
5/28/2005	20	0	51	81
5/29/2005	29	0	102	118
5/30/2005	35	0	99	120
5/31/2005	31	0	106	96
6/1/2005	53	1	88	0
6/2/2005	38	0	70	0
6/3/2005	31	0	31	0
6/4/2005	20	0	21	0
6/5/2005	23	0	13	0
6/6/2005	29	0	33	0
6/7/2005	31	0	25	0
6/8/2005	22	0	21	0
6/9/2005	37	0	15	0
6/10/2005	18	0	13	0
6/11/2005	13	0	9	0
6/12/2005	30	0	13	0
6/13/2005	29	0	22	0
6/14/2005	27	0	8	0
6/15/2005	21	0	5	0
6/16/2005	26	0	8	0
6/17/2005	21	0	3	0
6/18/2005	31	0	13	0
6/19/2005	21	0	2	0
6/20/2005	15	0	0	0
6/21/2005	18	0	1	0
Total	9,674	5	4,503	6,574

Appendix C. Previously PIT tagged natural Nacó'x̂ (Chinook salmon) recaptured in the Imnaha River juvenile migration trap during the fall of 2004 and spring 2005.

Migration Year	Tagging Agency	Recapture file	Tag ID	Date Tagged	Date Recaptured	Travel Time (Days)
2005	ODFW	JAH04295.NT1	3D9.1BF1A753CD	09/02/04	10/21/04	49
2005	ODFW	JAH04301.NT1	3D9.1BF1CA5CC2	09/02/04	10/27/04	55
2005	ODFW	JAH04310.NT1	3D9.1BF1CA662C	09/01/04	11/05/04	65
2005	ODFW	JAH05123.NT1	3D9.1BF1CC1E8F	09/01/04	05/03/05	244

Appendix D. Statistical comparisons of median fork lengths between groups of smolts captured in the Imnaha River smolt trap during the spring of migration year 2005.

Group 1	Group 2	Sample Sizes		Median Fork Length (mm)		Wilcoxon Value (W)	Significance Level p = 0.05
		Group 1	Group 2	Group 1	Group 2		
Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	3,472	2,418	95	115	58.7	0.000
Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)	6,596	5,825	175	215	78.6	0.000

Appendix E. Gauss population estimates by group for natural Nacó'x̂ (Chinook salmon) captured in the Imnaha River juvenile migration trap during the spring 2005.

Week		Group	Caught	Marked	Recaptured	Trap Efficiency	Population	Lower 95% C.I.	Upper 95% C.I.	SE
3/13/05	to 3/27/05	1	457	269	10	4	11,217	6,416	20,700	3,849.9
3/27/05	to 4/3/05	2	1,291	332	29	9	14,330	9,930	21,533	2,901.3
4/3/05	to 4/10/05	3	404	326	17	5	7,339	4,500	12,921	2,178.5
4/10/05	to 4/17/05	4	613	312	49	16	3,837	2,927	5,089	560.6
4/17/05	to 4/24/05	5	554	224	8	4	13,850	8,070	26,325	4,740.7
4/24/05	to 5/1/05	6	197	246	23	9	2,028	1,365	3,038	430.5
5/1/05	to 5/29/05	7	589	382	30	8	7,277	5,031	11,008	1,578.9
5/29/05	to 6/5/05	8	245	193	35	18	1,320	996	1,758	190.3
6/5/05	to 6/21/06	9	182	175	29	17	1,068	781	1,448	168.8
Totals			4,532	2,459	230	10	62,266	51,137	78,049	6,856.6

Appendix F. Gauss population estimates by group for natural Héeyey (steelhead) captured in the Imnaha River juvenile migration trap during the spring 2005.

Week		Group	Caught	Marked	Recaptured	Trap Efficiency	Population	Lower 95% C.I.	Upper 95% C.I.	SE
3/27/05	to 4/9/05	1	365	257	8	3	10,463	5,584	20,511	4,043.1
4/10/05	to 4/16/05	2	238	208	20	10	2,369	1,620	3,612	494
4/17/05	to 4/23/05	3	608	243	24	10	5,934	4,185	8,600	1,133.4
4/24/05	to 4/30/05	4	746	250	37	15	4,928	3,725	6,531	727
5/1/05	to 5/14/05	5	1,893	246	25	10	17,984	12,738	26,058	3,432.8
5/15/05	to 5/21/05	6	175	146	19	13	1,286	903	1,816	222.4
5/22/05	to 5/28/05	7	614	347	41	12	5,087	3,696	7,036	873
5/29/05	to 6/4/05	8	526	194	34	18	2,931	2,249	3,877	4,16.1
6/5/05	to 6/21/05	9	129	85	10	12	1,009	690	1,458	194
Totals			5,371	1,976	218	11.4	51,991	43,331	65,339	5,828.1

Appendix G. A statistical comparison of median arrival date at LGD between natural Nacó'x̂ (Chinook salmon) pre-smolts released in the fall of 2004 and smolts released in the spring of 2005 from the Imnaha River juvenile migration trap during migration year 2005.

Group 1	Group 2	Sample Sizes		Median Arrival Date		Wilcoxon Value (W)	Significance Level p = 0.05
		Group 1	Group 2	Group 1	Group 2		
Pre-Smolts	Smolts	1,087	1,962	4/17/05	4/30/05	30.8	0.000

Appendix H. Arrival timing of fall PIT tagged Imnaha River natural Nacó'x̂ (Chinook salmon) smolts to Lower Granite, Little Goose, Lower Monumental, and McNary dams from 1998 to 2005.

Dam	Year	Sample Size (n)	Date Range	Arrival Timing	
				Median	90%
Lower Granite	1998	428	Mar-27 - May-12	Apr-14	Apr-24
	1999	103	Apr-03 - May-02	Apr-19	Apr-25
	2000	262	Apr-04 - May-12	Apr-14	Apr-23
	2001	644	Apr-03 - May-26	Apr-26	Apr-30
	2002	162	Apr-01 - May-20	Apr-16	Apr-30
	2003	715	Mar-26 - May-28	Apr-16	Apr-30
	2004	360	Mar-26 - May-08	Apr-14	May-02
	2005	1,087	Mar-30 - May-24	Apr-17	Apr-27
Little Goose	1998	228	Apr-11 - May-12	Apr-25	May-02
	1999	364	Apr-08 - May-09	Apr-19	Apr-25
	2000	239	Apr-12 - May-12	Apr-17	Apr-24
	2001	135	Apr-23 - Jun-16	Apr-30	May-11
	2002	159	Apr-13 - May-16	May-01	May-05
	2003	406	Apr-02 - May-16	Apr-21	May-01
	2004	223	Apr-10 - May-26	Apr-24	May-06
	2005	381	Apr-15 - Jun-09	Apr-30	May-08
Lower Monumental	1998	202	Apr-19 - May-19	Apr-25	May-04
	1999	144	Apr-10 - May-21	Apr-19	Apr-25
	2000	62	Apr-13 - May-06	Apr-21	Apr-26
	2001	21	Apr-28 - May-17	NA	NA
	2002	100	Apr-30 - Jun-04	May-05	May-16
	2003	78	Apr-14 - May-18	Apr-22	May-06
	2004	204	Apr-13 - May-28	Apr-19	Apr-25
	2005	138	Apr-22 - Jun-12	May-02	May-09
McNary	1998	239	Apr-20 - May-23	Apr-30	May-04
	1999	64	Apr-10 - May-10	Apr-21	Apr-28
	2000	35	Apr-18 - May-06	Apr-27	May-04
	2001	5	May-05 - May-18	NA	NA
	2002	86	Apr-21 - May-26	May-05	May-15
	2003	314	Apr-17 - May-21	Apr-28	May-09
	2004	182	Apr-13 - May-31	Apr-30	May-07
	2005	105	May-02 - Jun-16	May-08	May-11

Appendix I. Arrival timing of spring PIT tagged Imnaha River natural Nacó'x̂ (Chinook salmon) smolts at Lower Granite, Little Goose, Lower Monumental, and McNary dams from 1993 to 2005.

Dam	Year	Sample Size (n)	Date Range	Arrival Timing	
				Median	90%
Lower Granite	1993	109	Apr-21 - Jun-12	May-04	May-14
	1994	348	Apr-14 - Jun-23	Apr-24	May-11
	1995	184	Apr-11 - Jul-11	May-01	May-11
	1996	421	Apr-06 - Jun-12	Apr-30	May-18
	1997	74	Apr-06 - May-18	Apr-22	May-11
	1998	1,630	Apr-01 - Jun-27	Apr-25	May-06
	1999	1,218	Mar-28 - Jul-15	Apr-27	May-22
	2000	1,291	Apr-02 - Aug-08	Apr-22	May-11
	2001	6,857	Mar-30 - Aug-13	Apr-28	May-12
	2002	489	Apr-02 - Jun-27	May-05	May-20
	2003	1,685	Mar-28 - Jul-25	Apr-29	May-24
	2004	4,438	Mar-26 - Jul-16	May-01	May-18
	2005	1,962	Apr-02 - Jul-02	Apr-30	Jun-04
Little Goose	1993	46	Apr-27 - Jun-02	May-03	May-16
	1994	194	Apr-23 - Jun-17	Apr-28	May-07
	1995	144	Apr-15 - Jul-15	May-07	May-20
	1996	358	Apr-12 - Jun-16	Apr-27	May-20
	1997	70	Apr-15 - May-22	Apr-26	May-11
	1998	837	Apr-14 - Jun-25	May-03	May-12
	1999	2,099	Apr-09 - Aug-01	Apr-29	May-22
	2000	1103	Apr-11 - Jul-14	Apr-23	May-11
	2001	1216	Apr-16 - Jul-23	May-02	May-17
	2002	519	Apr-15 - Jun-20	May-07	May-23
	2003	782	Apr-13 - Aug-04	May-04	May-27
	2004	2,653	Apr-07 - Aug-24	May-05	May-22
	2005	1,165	Apr-13 - Jul-02	May-07	Jun-02

Dam	Year	Sample Size (n)	Date Range	Arrival Timing	
				Median	90%
Lower Monumental	1993	37	May-03 - Jun-02	May-08	May-13
	1994	215	Apr-25 - Jul-26	May-01	May-24
	1995	142	Apr-19 - Aug-04	May-08	Jun-04
	1996	359	Apr-13 - Jun-15	May-10	May-22
	1997	74	Apr-20 - Jun-01	Apr-30	May-14
	1998	289	Apr-19 - Jun-08	Apr-30	May-11
	1999	688	Apr-09 - Aug-04	May-01	May-23
	2000	335	Apr-13 - Jul-12	Apr-25	May-29
	2001	131	Apr-28 - Jul-18	May-13	May-20
	2002	336	Apr-22 - Jun-14	May-13	May-22
	2003	163	Apr-13 - Jul-12	May-14	May-31
	2004	1,106	Apr-05 - Jul-31	Apr-23	May-28
	2005	489	Apr-22 - Jun-19	May-09	May-26
McNary	1993	20	May-03 - Jun-15	May-09	May-21
	1994	229	Apr-29 - Jul-16	May-12	May-28
	1995	89	Apr-28 - Jul-09	May-12	May-21
	1996	148	Apr-19 - Jun-08	May-14	May-24
	1997	24	Apr-22 - May-19	May-01	May-12
	1998	187	Apr-19 - Jun-02	May-01	May-15
	1999	152	Apr-18 - Jun-27	May-06	May-21
	2000	192	Apr-18 - Jul-04	May-07	May-29
	2001	45	Apr-29 - Jun-05	May-18	May-31
	2002	189	Apr-23 - Jun-10	May-14	May-23
	2003	439	Apr-18 - Jun-28	May-08	May-20
	2004	1,058	Apr-18 - Aug-01	May-03	May-24
	2005	413	Apr-28 - Jul-02	May-16	Jun-28

Appendix J. Arrival timing of PIT tagged Imnaha River hatchery Nacó'x̂ (Chinook salmon) smolts at Lower Granite, Little Goose, Lower Monumental, and McNary dams from 1992 to 2005.

Dam	Year	Sample Size	Date Range			Arrival Timing	
		(n)				Median	90%
Lower Granite	1992 ¹	273	Apr-12	-	Jun-06	Apr-21	May-06
	1994	129	Apr-24	-	May-18	May-12	May-12
	1995 ²	128	Apr-13	-	Jun-07	May-02	May-13
	1995 ³	83	Apr-16	-	May-22	May-08	May-15
	1996	169	Apr-13	-	May-26	May-07	May-16
	1997	227	Apr-16	-	May-22	May-05	May-14
	1998	696	Apr-15	-	May-22	May-02	May-09
	1999	267	Apr-18	-	May-25	May-05	May-14
	2000	782	Apr-07	-	May-24	May-03	May-13
	2001	1,725	Mar-31	-	May-27	Apr-29	May-10
	2002	461	Apr-01	-	May-23	May-07	May-19
	2003	475	Apr-14	-	May-25	May-02	May-15
	2004	7,892	Apr-05	-	Jun-19	May-03	May-09
	2005	7,342	Apr-04	-	Jun-13	May-02	May-07
Little Goose	1992 ¹	116	Apr-17	-	May-22	Apr-27	May-05
	1994	65	Apr-28	-	Jun-02	May-14	May-21
	1995 ²	114	Apr-26	-	Jun-11	May-10	May-20
	1995 ³	67	Apr-27	-	Jun-07	May-12	May-23
	1996	131	Apr-23	-	Jun-06	May-13	May-20
	1997	267	Apr-20	-	May-27	May-09	May-18
	1998	391	Apr-25	-	May-26	May-07	May-14
	1999	387	Apr-16	-	Jun-06	May-10	May-19
	2000	450	Apr-14	-	May-24	May-03	May-13
	2001	509	Apr-15	-	May-29	May-07	May-16
	2002	544	Apr-13	-	Jun-01	May-12	May-22
	2003	227	Apr-19	-	May-27	May-06	May-18
	2004	5,378	Apr-10	-	Jun-11	May-06	May-15
	2005	4,596	Apr-16	-	Jun-09	May-08	May-12
Lower Monumental	1994	73	Apr-30	-	Jun-07	May-14	May-20
	1995 ²	106	Apr-27	-	Jun-10	May-12	May-21
	1995 ³	71	Apr-29	-	Jun-09	May-17	May-26
	1996	136	Apr-23	-	May-29	May-15	May-23
	1997	199	Apr-25	-	Jun-03	May-10	May-19
	1998	143	Apr-23	-	May-26	May-08	May-15
	1999	124	Apr-23	-	May-25	May-11	May-20
	2000	107	Apr-19	-	May-26	May-05	May-22
	2001	79	Apr-27	-	Jun-04	May-12	May-25
	2002	457	Apr-30	-	Jun-11	May-14	May-23
	2003	34	Apr-27	-	May-27	May-15	May-22
	2004	801	Apr-11	-	Jun-11	May-15	May-27
	2005	1,532	Apr-20	-	Jun-13	May-10	May-15

Dam	Year	Sample Size (n)	Date Range		Arrival Timing		
					Median	90%	
McNary	1992 ¹	61	Apr-27	-	Jun-01	May-08	May-17
	1994	119	May-06	-	Jun-17	May-21	May-26
	1995 ²	67	Apr-29	-	Jun-09	May-16	May-23
	1995 ³	36	May-03	-	May-30	May-16	May-22
	1996	55	May-01	-	May-27	May-16	May-23
	1997	61	May-01	-	Jun-01	May-10	May-19
	1999	56	May-02	-	May-26	May-19	May-24
	2000	99	Apr-24	-	May-30	May-13	May-27
	2001	25	May-05	-	May-31	NA	NA
	2002	220	Apr-16	-	Jun-10	May-15	May-25
	2003	156	Apr-26	-	May-27	May-15	May-22
	2004	1,301	Apr-17	-	Jun-08	May-10	May-22
	2005	1,291	Apr-26	-	Jun-25	May-14	May-19

¹ Hatchery Nacó'x̂ (Chinook salmon) smolts PIT tagged and released in 1992 were over a two day period only for survival estimation.

² HxW crossed Nacó'x̂ (Chinook salmon) smolts PIT tagged for NPT and released at dark.

³ HxW crossed Nacó'x̂ (Chinook salmon) smolts PIT tagged for the FPC and released one hour after tagging and recovery.

Appendix K. Arrival timing of spring PIT tagged Imnaha River natural Héeyey (steelhead) smolts at Lower Granite, Little Goose, Lower Monumental, and McNary dams from 1993 to 2005.

Dam	Year	Sample Size	Date Range			Arrival Timing	
		(n)				Median	90%
Lower Granite	1993	101	May-03	-	Jun-13	May-26	Jun-08
	1994 ¹	332	Apr-25	-	Aug-15	May-08	Jun-01
	1994 ²	207	May-03	-	Aug-20	May-09	May-30
	1995	128	Apr-28	-	Jun-19	May-02	May-09
	1996	537	Apr-19	-	Jun-10	May-06	Jun-04
	1997	368	Apr-20	-	Jul-10	May-08	May-24
	1998	1,474	Apr-02	-	Jun-12	May-03	May-22
	1999	649	Apr-19	-	Jun-26	May-18	Jun-05
	2000	2,262	Apr-06	-	Aug-03	May-08	May-25
	2001	2,736	Mar-29	-	Sep-09	May-14	May-18
	2002	979	Apr-10	-	Jun-26	May-18	May-31
	2003	1,887	Mar-26	-	Jul-03	May-14	May-25
	2004	3,695	Mar-27	-	Jul-19	May-08	May-22
	2005	2,530	Apr-07	-	Jun-30	May-08	Jun-04
Little Goose	1993	48	May-06	-	Jun-11	May-24	Jun-07
	1994 ¹	159	Apr-29	-	Jul-29	May-12	May-31
	1994 ²	121	May-06	-	Jul-26	May-15	Jun-01
	1995	70	May-01	-	Jun-23	May-07	May-12
	1996	365	Apr-20	-	Jun-14	May-09	May-28
	1997	319	Apr-20	-	Jun-19	May-10	May-26
	1998	481	Apr-14	-	Jun-19	May-08	May-26
	1999	717	Apr-08	-	Jun-24	May-21	May-25
	2000	458	Apr-11	-	Jun-26	May-08	May-29
	2001	219	Apr-07	-	Aug-19	May-16	May-24
	2002	856	Apr-13	-	Aug-28	May-21	Jun-02
	2003	1,085	Apr-04	-	Jun-29	May-18	May-26
	2004	2,280	Apr-01	-	Jul-29	May-13	May-29
	2005	2,683	Apr-14	-	Jun-26	May-11	Jun-03

Dam	Year	Sample Size (n)	Date Range			Arrival Timing	
						Median	90%
Lower Monumental	1993	43	May-06	-	Jun-15	May-30	Jun-11
	1994 ¹	148	May-01	-	Aug-08	May-12	Jul-08
	1994 ²	91	May-09	-	Jul-31	May-15	Jul-10
	1995	81	May-03	-	May-17	May-09	May-14
	1996	397	Apr-22	-	Jun-15	May-14	May-29
	1997	264	Apr-21	-	Jun-06	May-11	May-25
	1998	213	Apr-16	-	Jun-11	May-10	May-27
	1999	342	Apr-19	-	Jun-21	May-23	May-27
	2000	246	Apr-12	-	Aug-12	May-14	May-30
	2001	23	May-06	-	Oct-03	NA	NA
	2002	828	Apr-30	-	Aug-08	May-22	Jun-03
	2003	497	Apr-02	-	Jun-21	May-25	May-28
	2004	871	Apr-05	-	Jun-19	May-25	Jun-02
2005	1,274	Apr-17	-	Jun-20	May-13	Jun-01	
McNary	1993	17	May-11	-	Jun-13	May-25	May-31
	1994 ¹	66	May-05	-	Jun-22	May-18	Jun-09
	1994 ²	42	May-13	-	Jun-25	May-18	Jun-06
	1995	35	May-05	-	May-27	May-11	May-17
	1996	157	Apr-25	-	Jun-11	May-11	May-21
	1997	62	Apr-24	-	Jun-05	May-13	May-18
	1998	53	Apr-20	-	Jun-04	May-07	May-28
	1999	55	Apr-17	-	May-31	May-25	May-27
	2000	58	Apr-15	-	Jun-16	May-24	Jun-07
	2001	4	May-16	-	Aug-05	NA	NA
	2002	124	Apr-29	-	Jun-07	May-22	May-27
	2003	210	Apr-01	-	Jun-14	May-24	May-27
	2004	172	Apr-17	-	Jun-20	May-15	Jun-03
2005	399	May-01	-	Aug-01	May-15	May-25	

¹ NPT PIT tagged fish released at dark

² FPC PIT tagged fish released after recovery

Appendix L. Arrival timing of ODFW spring PIT tagged Imnaha River hatchery Héeyey (steelhead) smolts at Lower Granite, Little Goose, Lower Monumental, and McNary dams from 1993 to 2005.

Dam	Year	Sample Size	Date Range			Arrival Timing	
		(n)				Median	90%
Lower Granite	1993	224	May-03	-	Jun-28	May-17	May-31
	1994 ¹	164	Apr-29	-	Aug-20	May-29	Jul-15
	1994 ²	306	May-06	-	Aug-21	May-25	Jun-23
	1995	661	May-06	-	Jul-12	May-31	Jun-16
	1996	440	Apr-23	-	Jul-14	May-28	Jun-14
	1997	2,346	Apr-19	-	Jul-24	May-23	Jun-13
	1998	1,683	Apr-25	-	Jul-29	May-15	May-26
	1999	1,973	Apr-18	-	Aug-05	May-24	Jun-18
	2000	3,249	Apr-08	-	Jul-24	May-16	May-25
	2001	2,541	Apr-21	-	Sep-23	May-16	May-26
	2002	442	Apr-15	-	Jun-27	May-17	May-31
	2003	1,261	Apr-14	-	Jun-23	May-13	May-26
	2004	3,015	Apr-17	-	Jul-25	May-19	Jun-12
	2005	3,442	Apr-18	-	May-17	May-07	May-10
Little Goose	1993	106	May-05	-	Jul-08	May-25	Jun-02
	1994 ¹	86	May-02	-	Jul-30	May-31	Jul-17
	1994 ²	165	May-10	-	Aug-12	May-27	Jul-09
	1995	409	May-08	-	Jul-13	Jun-03	Jun-20
	1996	261	Apr-24	-	Jul-11	May-25	Jun-16
	1997	1,844	Apr-21	-	Aug-23	May-26	Jun-13
	1998	555	May-03	-	Jul-10	May-25	May-30
	1999	1,593	Apr-20	-	Aug-22	May-25	Jun-18
	2000	309	Apr-13	-	Jul-22	May-22	Jul-01
	2001	121	Apr-28	-	Oct-30	May-20	Jun-21
	2002	326	Apr-19	-	Jun-29	May-24	Jun-03
	2003	1,015	Apr-16	-	Jun-04	May-21	May-27
	2004	2,675	Apr-23	-	Oct-15	May-24	Jun-10
	2005	4,102	Apr-22	-	Jun-22	May-10	May-31
Lower Monumental	1993	92	May-07	-	Jun-14	May-26	Jun-05
	1994 ¹	30	May-05	-	Aug-05	Jun-03	Jul-17
	1994 ²	75	May-11	-	Aug-24	Jun-18	Jul-21
	1995	410	May-09	-	Jul-13	Jun-06	Jun-16
	1996	232	May-06	-	Jul-07	May-27	Jun-15
	1997	1,432	Apr-22	-	Aug-06	May-27	Jun-15
	1998	253	May-05	-	Jul-15	May-26	Jun-03
	1999	790	Apr-21	-	Jul-20	May-26	Jun-19
	2000	243	Apr-16	-	Aug-18	May-25	Jul-03
	2001	28	May-08	-	Oct-25	NA	NA
	2002	406	Apr-30	-	Oct-18	May-28	Jun-09
	2003	734	Apr-21	-	Jun-09	May-26	May-29
	2004	1,425	Apr-23	-	Aug-12	May-29	Jun-11
	2005	2,145	Apr-22	-	Jun-22	May-07	Jun-02

Dam	Year	Sample Size		Date Range		Arrival Timing	
		(n)				Median	90%
McNary	1993	7		May-11	- Jun-05	May-19	May-30
	1994 ¹	22		May-17	- Jul-14	Jun-05	Jul-10
	1994 ²	56		May-20	- Jul-11	Jun-17	Jul-08
	1995	69		May-15	- Jul-17	Jun-05	Jun-27
	1996	30		Apr-27	- Jul-03	May-23	Jun-07
	1997	245		Apr-23	- Aug-12	May-27	Jun-18
	1998	31		May-13	- Jul-02	Jun-01	Jun-19
	1999	79		Apr-27	- Jul-08	May-28	May-31
	2000	58		May-03	- Jul-30	Jul-02	Jul-17
	2001	8		May-21	- Jul-04	NA	NA
	2002	56		May-02	- Jun-16	May-25	Jun-06
	2003	110		Apr-30	- Jun-01	May-25	May-29
	2004	167		May-06	- Jul-28	May-31	Jun-12
	2005	571		May-04	- Jun-29	May-18	May-27

¹ NPT PIT tagged fish released at dark

² FPC PIT tagged fish released after recovery

Appendix M. Mortality of Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) smolts due to trapping, handling, PIT tagging and Dead on Arrival at the Imnaha River juvenile migration trap from October 18 to November 18, 2004.

Source of Mortality	Nacó'x̂ (Chinook salmon)				Héeyey (steelhead)			
	Natural		Hatchery		Natural		Hatchery	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Trapping	14	0.219	0	0.000	0	0.000	0	0.000
Handling	0	0.000	0	0.000	0	0.000	0	0.000
PIT Tagging	2	0.031	0	0.000	0	0.000	0	0.000
DOA	3	0.047	0	0.000	0	0.000	0	0.000
Number Captured	6,393		0		67		0	
Total Mortality (n)	19	0.297	0	0.000	0	0.000	0	0.000

Appendix N. Mortality of Nacó'x̂ (Chinook salmon) and Héeyey (steelhead) smolts due to trapping, handling, PIT tagging and Dead on Arrival at the Imnaha River juvenile migration trap from March 2 to June 21, 2005.

Source of Mortality	Nacó'x̂ (Chinook salmon)				Héeyey (steelhead)			
	Natural		Hatchery		Natural		Hatchery	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Trapping	71	1.446	19	0.050	5	0.093	4	0.013
Handling	13	0.265	0	0.000	0	0.000	0	0.000
Tagging	9	0.183	1	0.003	3	0.056	3	0.010
DOA	1	0.020	10	0.026	0	0.000	2	0.007
Number Captured	4,909		38,190		5,374		29,765	
Total Mortality	94	1.915	30	0.079	8	0.149	9	0.030

Appendix O. The catch of incidental fish during the fall, 18 October to 18 November 2004, and the spring, 3 March to 21 June 2005, at the Imnaha River juvenile fish trap for the 2005 migration year.

Family	Common Name	Fall 2004	Spring 2005	Total
Salmonidae	Adult Héeyey (steelhead)	0	54	54
	Adult Nacó'x̄ (Chinook Salmon)	1	1	2
	Rainbow Trout / Héeyey (steelhead)	492	275	767
	Cimey (Mountain Whitefish)	52	1	53
	Islam (Bull Trout)	27	3	30
Centrarchidae	Smallmouth Bass	1	2	3
Catostomidae	Muq'uc (Bridgelip Sucker)	1	39	40
	Muq'uc (Largescale Sucker)	1	9	10
	Muq'uc (unidentified species)	47	90	137
Cyprinidae	Tite'wxc (Chislemouth)	14	18	32
	Longnose Dace	1	235	236
	Qiyex (Northern Pikeminnow)	35	38	73
	Redside Shiner	48	16	64
Cottidae	Sculpin (unidentified species)	4	31	35
Petromyzotidae	Adult Heesu (Pacific Lamprey)		1	1
	Juvenile Hessu (Pacific Lamprey)		1	1
Unidentified species			1	1
Total Catch		724	815	1,539