

**Emigration of Natural and Hatchery Nacó'x̂ (Chinook Salmon; *Oncorhynchus tshawytscha*)
and Héeyey (Steelhead; *Oncorhynchus mykiss*) Smolts from the Imnaha River, Oregon
from 2 October 2005 to 19 June 2006**

2006 Annual Report

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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 2, 2005, to June 19, 2006 (migration year 2006, Brood Year 2004). The studies have been ongoing for the past 15 years and have contributed information to the Fish Passage Center's Smolt Monitoring Program for the past 13 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 continues to use 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 higher than average hydrologic conditions in the Imnaha River for April, average for March, May and June. Average monthly discharge from March to June ranged from 502 cfs (March) to 1,585 cfs (June). Snake River run-off recorded the highest month on record with 92,900 cfs in April of 2006. The average monthly discharge in the Snake River ranged from 42,940 cfs in March to 67,420 cfs in June. 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 1,239 natural origin Nacó'x̂ (Chinook salmon), 22,982 hatchery origin Nacó'x̂ (Chinook salmon), 2,334 natural origin Héeyey (steelhead), and 13,313 hatchery origin Héeyey (steelhead) were captured in the spring of 2006. The studies PIT tagged a total of 1,128 natural Nacó'x̂ (Chinook salmon), 0 hatchery Nacó'x̂ (Chinook salmon), 2,284 natural Héeyey, and 1,494 hatchery Héeyey. The catch of hatchery Nacó'x̂ (Chinook salmon) included 961 previously PIT tagged fish. Hatchery Nacó'x̂ (Chinook salmon) had a mean fork length (105 mm) that was significantly different ($p < 0.05$) than the mean fork length of natural Nacó'x̂ (Chinook salmon) (90 mm). Previously PIT tagged hatchery Héeyey (steelhead) had a mean fork length (215 mm) that was significantly larger ($p < 0.05$) than the mean fork length of natural produced Héeyey (steelhead) (170 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 $63.3\% \pm 2.1\%$ (95% C.I.) in spring 2006. The post-release survival estimate was significantly below previous estimates from 1994 to 2005 of 82.9% to 100%. The survival estimate of natural Nacó'x̂ (Chinook salmon) tagged in the fall was 16.5% to LGD. Past survival estimates from the trap to LGD for fall tagged Imnaha River natural Nacó'x̂ (Chinook salmon) have ranged from 21.6% to 60.4% from 1994 to 2005, again the lowest on record.

Imnaha River smolts estimated survivals from release at the Imnaha trap to LGD in 2006 were 76.7% for natural Nacó'x̂ (Chinook salmon), 68.7% for hatchery Nacó'x̂ (Chinook salmon), 91.9% for natural Héeyey (steelhead), and 86.1% for hatchery Héeyey (steelhead). The estimated survival from the Imnaha trap to LMO was 63.9% for natural Nacó'x̂, 48.5% for hatchery Nacó'x̂ (Chinook salmon), 72.0% for natural Héeyey (steelhead) and 73.6% 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 2001 (migration years 1998 to 2003). 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 3.11% (BY 2001). The LGD to LGD SAR index for spring tagged natural Nacó'x̂ (Chinook salmon) is low compared to previous averages which ranged from 0.29% (BY 1999) to 2.94% (BY 1998). The LGD to LGD SAR index for BY 2001 was 0.32%.

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 12: 13 days earlier than the median arrival timing for spring tagged natural Nacó'x̂ (Chinook salmon) smolts. A total of 9 years of arrival data for fall tagged natural Nacó'x̂ (Chinook salmon), 14 years of arrival data for spring tagged natural and hatchery Nacó'x̂ (Chinook salmon), and 15 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 2006), April 28 (± 8 days) for spring tagged natural Nacó'x̂ (Chinook salmon) smolts (1993 to 2006), May 3 (± 9 days) for hatchery Nacó'x̂ (Chinook salmon), May 10 (± 13 days) for natural Héeyey (steelhead) (1993 to 2006) and May 19 (± 15 days) for hatchery Héeyey (steelhead) (1993 to 2006).

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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 2006 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 is 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 recorded 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'x (Chinook salmon) and Héeyey (steelhead) smolts from the Imnaha River with passive integrated transponder (PIT) tags.

The completion of trapping in the spring of 2006 marked the 15th year of emigration studies on the Imnaha River, and the 13th year of participating in the FPC smolt monitoring program. Monitoring and evaluation objectives were to:

1. Determine spring emigration timing of Nacó'x (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'x (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'x (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'x (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'x (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 was 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 2 to November 22, 2005, and from March 1 to June 19, 2006. The trap was located 7 rkm 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.

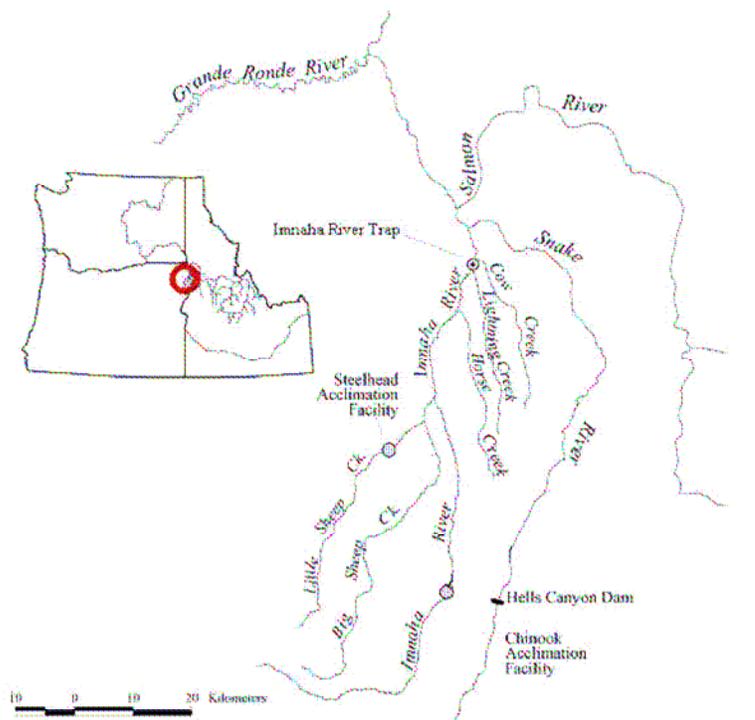


Figure 1. Map of the Imnaha River study area.

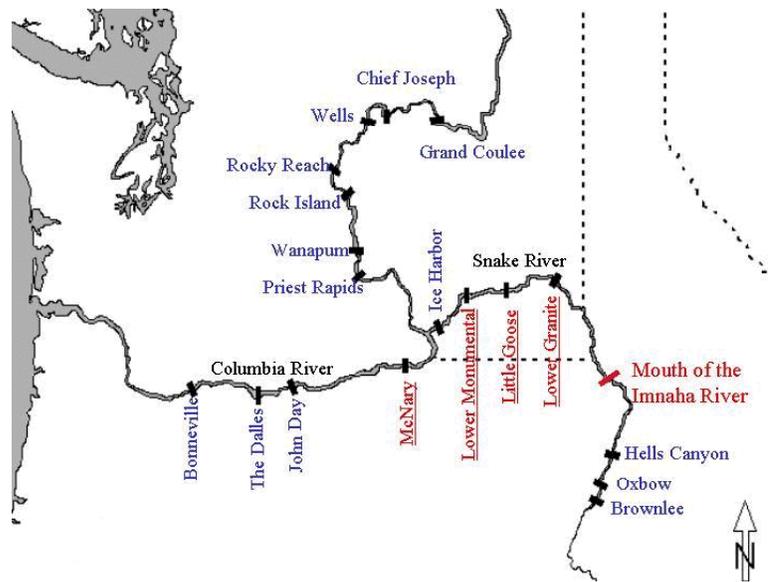


Figure 2. Map of the Columbia River Basin. Dams underlined indicate monitoring points for the Imnaha Smolt Monitoring Program.



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 2006 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 early March to June 19. 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 4.9 (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, it was 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 2006. 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 2003. 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 the Imnaha River to LGD and LGD to LGD. SARs are calculated using the ratio of PIT tags leaving the Imnaha River to the number of adults detected at LGD and the 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 totaled over the three return years to provide the entire brood year SAR. The 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 STATAGRAPHICS 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

Innaha River

The mean daily discharge during the study period, unaffected by potential freezing water, ranged from 105 cfs on December 18, 2005, to 3,530 cfs (1 cfs = 0.283168 cms) on May 20, 2006 (Figure 4). Daily mean water temperatures ranged from -0.6 °C on December 7, 2005, to 16.3 °C on June 16, 2006.

Monthly average discharge for the Innaha River for the months of March, April, May, and June were, 502, 1,643, 2,203, and 1,585 cfs respectively (Figure 5). The spring run off for the Innaha River was within the range of monthly average discharge values observed from 1929 to 2006.

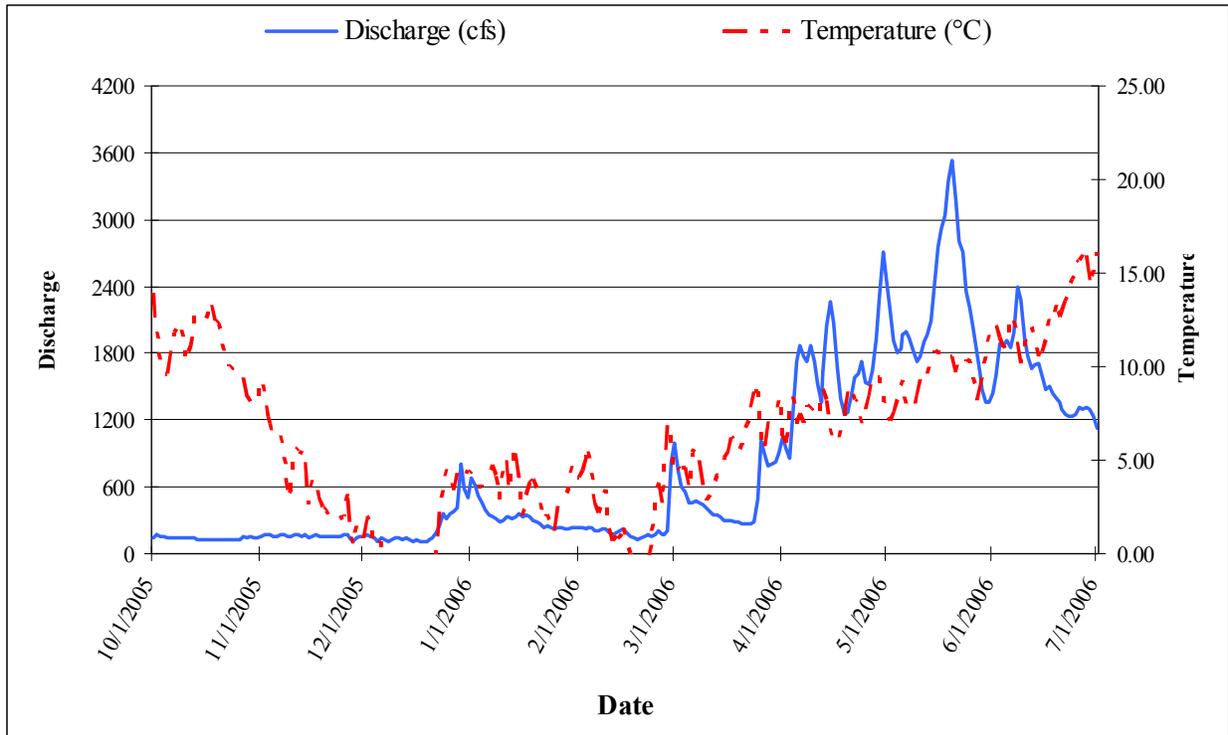


Figure 4. The average daily discharge at the Innaha River USGS gauge 13292000 and the average daily temperature from October 1, 2005, to July 1, 2006, at the Innaha River juvenile migration trap. USGS discharge data is provisional.

Mean monthly discharge 2006

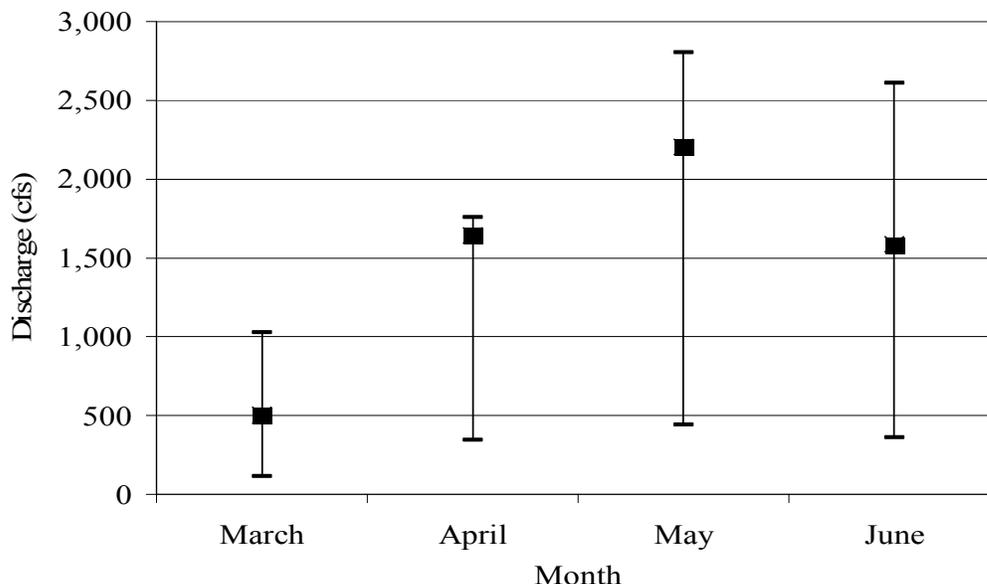


Figure 5. The average monthly discharge for the months of March, April, May, and June for 2006, at the Imnaha River USGS gauge 13292000. Bars indicate the minimum and maximum average monthly discharge values observed from 1929 to 2006. USGS discharge data is provisional.

Snake River

Snake River mean daily discharge during the study period ranged from 11,400 cfs on December 10 and 11, 2005, to 144,000 cfs on May 21, 2006 (Figure 6). Daily mean water temperatures ranged from 1.9 °C on February 18, 2006, to 20.2 °C on June 28, 2006.

Monthly average discharge for March, April, May, and June were as follows: 42,940, 92,900, 103,600, and 67,420 cfs respectively (Figure 7). Discharge in the Snake River at Anatone during the month of April 2006 was the highest on record at 92,900 cfs. The discharge in the Snake River for the months of April and May is characterized as significantly above average for the period of record. The discharge in the Snake River for the months of March and June have been characterized as average by this study.

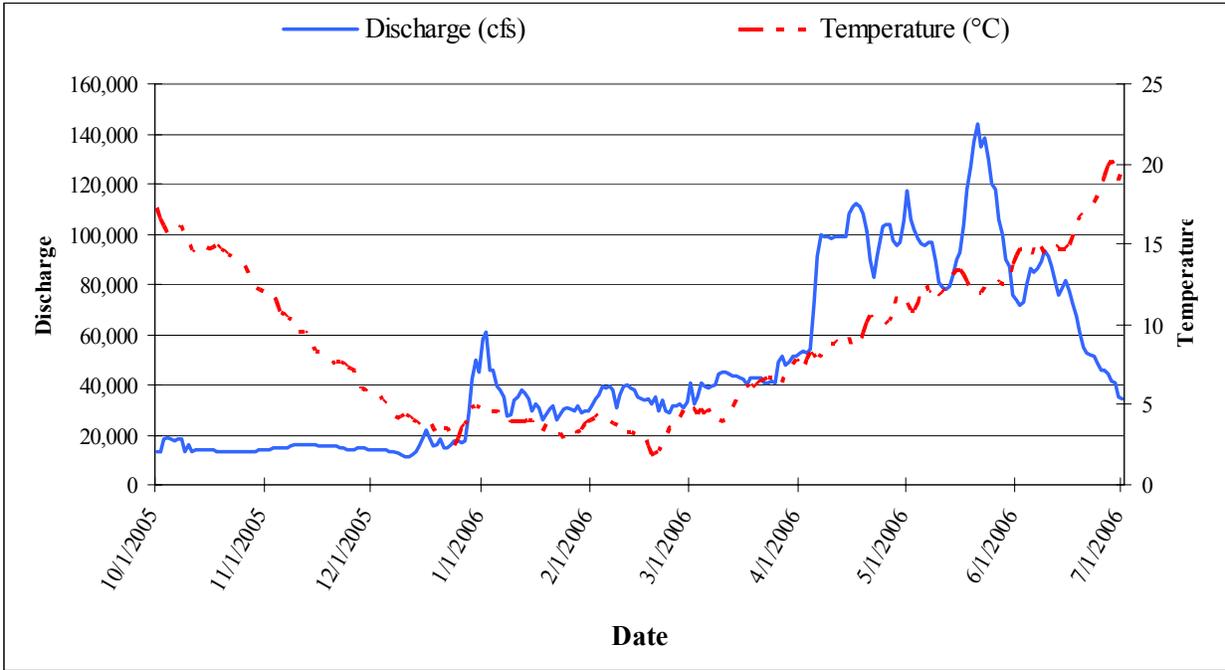


Figure 6. The average daily discharge and temperature at the Snake River gauge 13334300 from October 1, 2005, to July 1, 2006. USGS discharge data is provisional.

Mean monthly discharge 2006

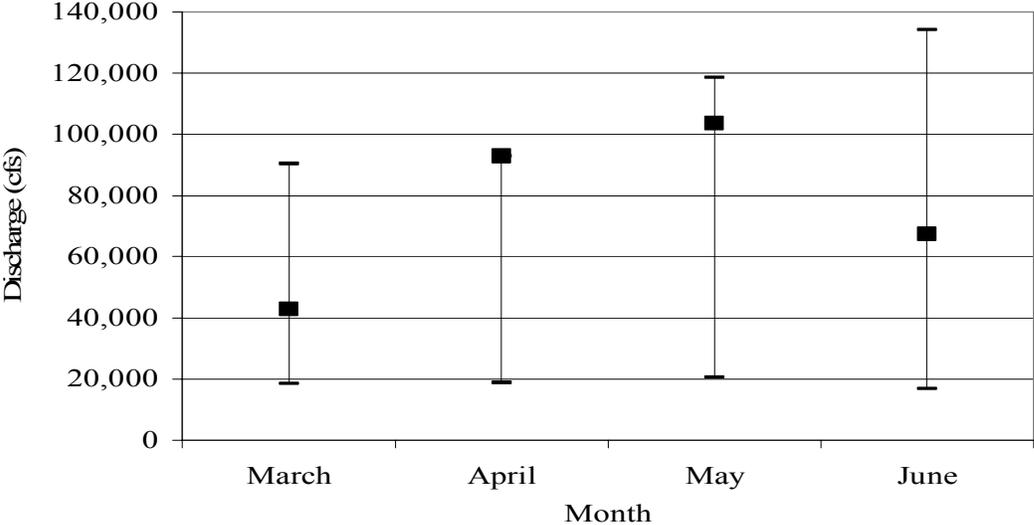


Figure 7. The average monthly discharge for the months of March, April, May, and June for 2006 at the Snake River USGS gauge 13334300. Bars indicate the minimum and maximum average monthly discharge values observed from 1959 to 2006. USGS discharge data is provisional.

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: 3.9 °C at LGD on March 1, 5.8 °C at LGS on March 23, 5.39 °C at LMD on March 24, and 3.7 °C at MCD on March 1. Maximum water temperatures in the tailraces were as follows: 20.6 °C at LGD on July 7, 21.2 °C at LGS on July 11 and August 1, 21.3 °C at LMD on July 16 and August 6, and 21.5 °C at MCD on July 27.

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.

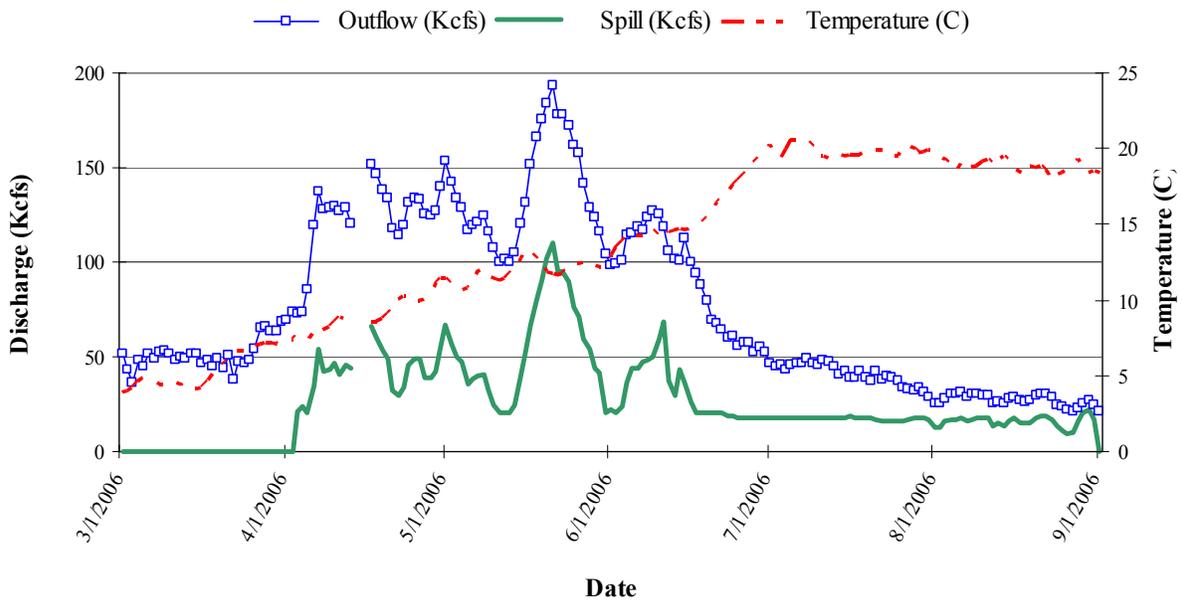


Figure 8. Measurements of outflow, spill, and mean temperature at Lower Granite Dam from March 1 to September 1, 2006. Data obtained online at <http://www.cbr.washington.edu/dart/>.

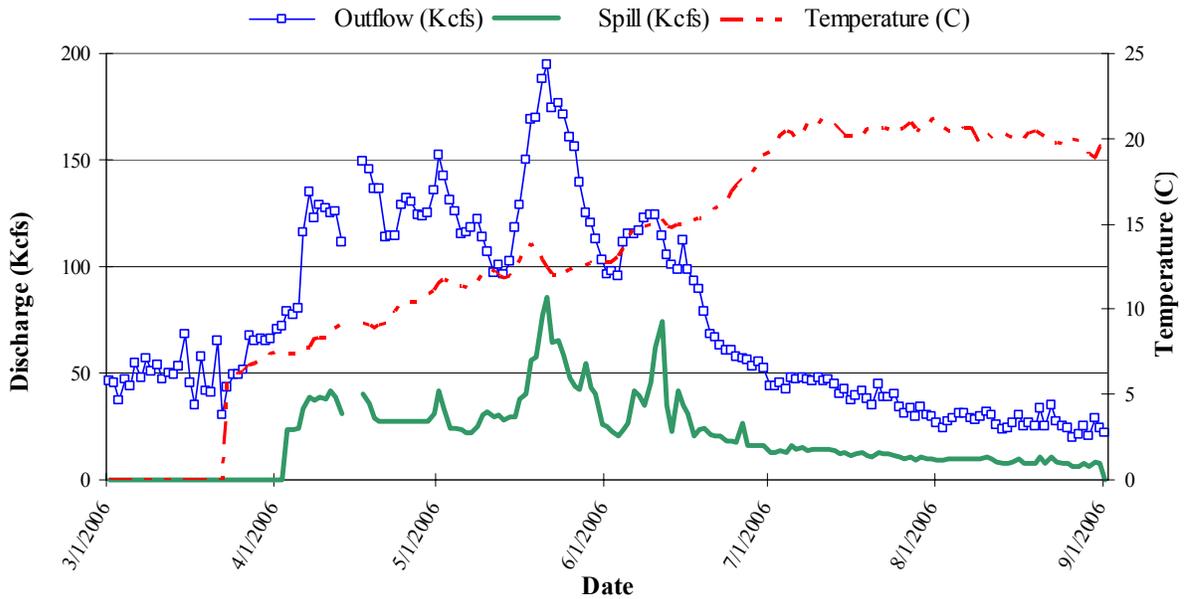


Figure 9. Measurements of outflow, spill, and mean temperature at Little Goose Dam from March 1 to September 1, 2006. Note that temperature did not begin recording until March 28. Data obtained online at <http://www.cbr.washington.edu/dart/>.

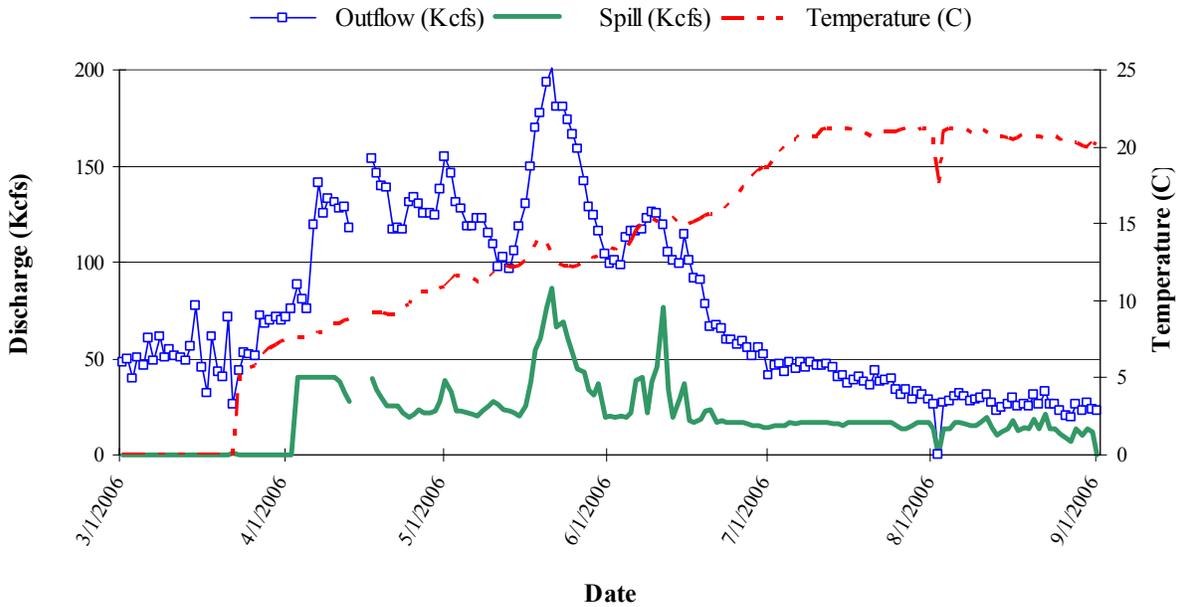


Figure 10. Measurements of outflow, spill, and mean temperature at Lower Monumental Dam from March 1 to September 1, 2006. Note that temperature did not begin recording until March 28. Data obtained online at <http://www.cbr.washington.edu/dart/>.

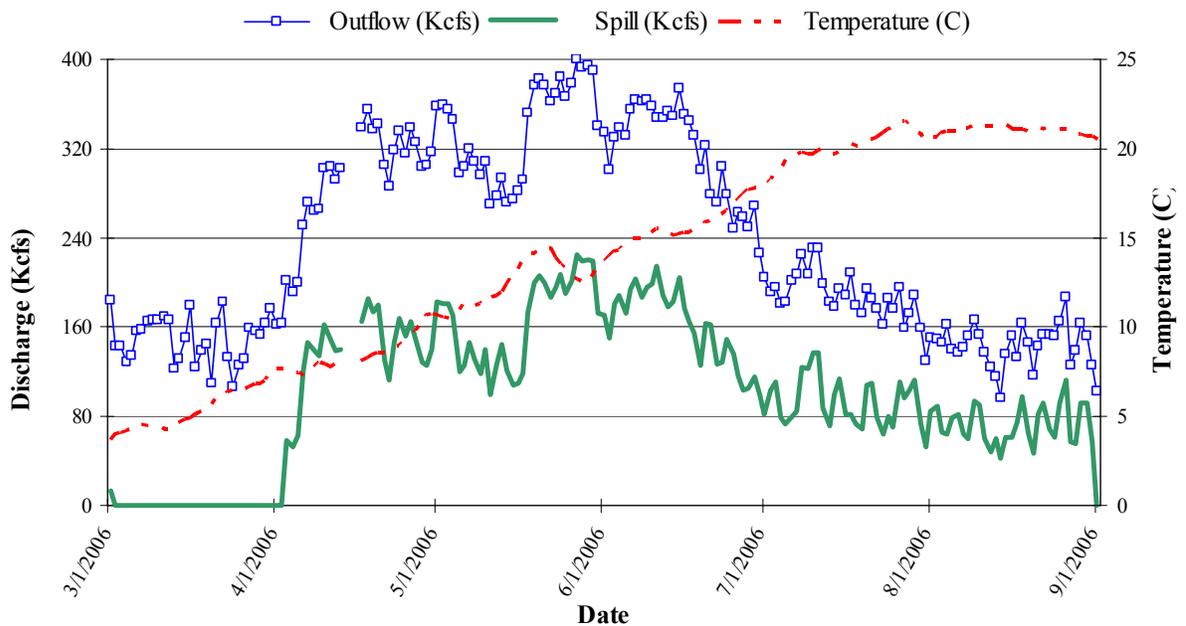


Figure 11. Measurements of outflow, spill, and mean temperature at McNary Dam from March 1 to September 1, 2006. Data obtained online at <http://www.cbr.washington.edu/dart/>.

Hatchery Releases

Nacó'x̂ (Chinook salmon)

A total of 441,680 *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 2006 migration season, one volitional and one direct to the stream. The volitional release of 320,752 *Nacó'x̂* (Chinook salmon) arrived at the acclimation facility on March 8 and 10. Hatchery personnel began pulling dam boards on March 21 and fish left volitionally until April 6 when the remaining fish were forced into the river. The direct stream release of 120,928 *Nacó'x̂* (Chinook salmon) occurred on March 30. All *Nacó'x̂* (Chinook salmon) were marked with an adipose fin clip, 187,445 (42.4 % of total releases) had a coded wire tag, and 20,632 (4.7%) 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 2006 and releases totaled 279,904 fish (Table 1). A total of 151,860 *Héeyey* (steelhead) arrived between March 3 and March 10 at the LSRCP Little Sheep Creek acclimation facility and volitionally released between April 11 and May 2. A total of 26,230 were marked with adipose and left ventral fin clips, coded wire tags (CWT), 283 of which had PIT tags. The remaining

125,630 were marked only with adipose fin clips only. A second release of 128,044 Héeyey (steelhead) occurred from April 10 to April 11, 2006. These fish were released directly into Big Sheep Creek, 49,084 were marked with adipose fin clips, 300 of which also had PIT tags. An additional unmarked group of Héeyey (steelhead) was released into Big Sheep Creek and totaled 78,960 (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 2006 (D. Eddy, Oregon Fish and Wildlife, personal communication, July 13, 2007)

Release Year	Species	Arrival at Acclimation Site	Number Released	Release Dates	Tags / Marks	Release Site
2006	Nacó'x̂ (Chinook salmon)	March 8 - 10	320,752	March 21 - April 6	100% adipose fin clipped with 187,445 CWT (58%) and 14,926 PIT tags	Imnaha River (Gumboot)
2006	Nacó'x̂ (Chinook salmon)	Direct Stream	120,928	March 30	100% adipose fin clipped with NO CWT and 5,706 PIT tags	Imnaha River (Gumboot)
2006	Héeyey (steelhead)	March 3 - 10	151,860	April 11 - May 2	26,230 adipose and left ventral fin clipped with CWT (17%) and 283 PIT tags; 125,630 adipose fin clipped, NO CWT	Little Sheep Creek
2006	Héeyey (steelhead)	Direct Stream	128,044	April 10 - 11	49,084 adipose fin clipped only (NO CWT) and 300 PIT tags; 78,960 with NO external mark or PIT tag	Big Sheep Creek

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

Catch for Migration Year 2006

The catch of natural Nacó'x̂ (Chinook salmon) for migration year 2006 (fall and spring) totaled 4,090 fish. The largest weekly catch during fall trapping occurred during the week of October 2 (n = 964). The largest weekly catch during spring trapping occurred during the week of March 26 (n = 421). The weekly mean discharge and water temperature during the week of October 2 was 150 cfs and 10.9 °C, (Table 2). The weekly mean discharge and water temperature during the week of March 26 was 898 cfs and 6.9 °C. During the fall of 2005 and

spring of 2006 the weekly catch of natural Nacó'x̂ (Chinook salmon) smolts did not exceeded 1,000 for any weeks. High water flow and large amounts of debris prevented us from trapping for 14 days and 4 days were short sampling hours due to trap damage. A total of 22,982 hatchery Nacó'x̂ (Chinook salmon) were captured, with the first captures occurring during the week of March 19 (Appendix C). More than a third (n = 8,984) were captured during the week of March 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 2 October 2005 to 20 June 2006.

Week	Average Discharge (cfs)	Average Temperature (°C)	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)
10/2/2005	150	10.9	964	0	0	0
10/9/2005	137	11.8	578	0	0	2
10/16/2005	131	12.1	45	0	10	0
10/23/2005	138	9.4	238	0	2	0
10/30/2005	158	7.8	445	0	5	0
11/6/2005	169	5.1	172	0	18	3
11/13/2005	161	3.8	139	0	11	0
11/20/2005	161	2.3	270	0	0	0
2/26/2006	586	5.1	39	0	7	0
3/5/2006	440	4.1	12	0	5	0
3/12/2006	317	4.9	13	0	3	0
3/19/2006	305	7.1	105	3,910	6	0
3/26/2006	898	6.9	421	8,984	121	1
4/2/2006	1,451	7.3	157	4,817	37	1
4/9/2006	1,776	7.8	99	4,316	137	5,863
4/16/2006	1,523	7.5	195	136	374	525
4/23/2006	1,756	8.5	61	386	461	2,203
4/30/2006	2,126	8.1	33	141	445	1,406
5/7/2006	1,873	8.7	30	188	514	2,438
5/14/2006	2,870	10.6	4	22	96	436
5/21/2006	2,441	9.7	5	11	14	25
5/28/2006	1,539	10.9	28	65	94	277
6/4/2006	2,034	11.5	3	4	5	55
6/11/2006	1,629	11.5	23	2	10	53
6/18/2006	1,319	13.4	11	0	5	30
Totals			4,090	22,982	2,380	13,318

The catch of natural Héeyey (steelhead) totaled 2,380 fish (Table 2 and Appendix A). The largest weekly catch occurred during the week of May 7 and totaled 514 fish. The mean weekly discharge and water temperature during the week of May 7 was 1,873 cfs and 8.7 °C. The catch of hatchery Héeyey (steelhead) was 13,318 fish with the largest weekly catch of hatchery Héeyey (steelhead) (n = 5,863) occurring during the week of April 9. The mean weekly discharge and water temperature was 1,776 cfs and 7.8 °C.

PIT Tagging

A total of 3,814 natural Nacó'x̂ (Chinook salmon) were PIT tagged for the 2006 migration year. Seventy percent of the PIT tagged natural Nacó'x̂ (Chinook salmon) (n = 2,684) were tagged in the fall of 2005 (Table 3 and Appendix B). At no time during MY 2006 did any of the weekly release groups exceed 1,000 fish.

PIT tagged natural Héeyey (steelhead) totaled 2,291 fish (Table 3). The largest weekly release group was 514 fish during the week of May 7. An effort was made to produce weekly release groups of hatchery Héeyey (steelhead) of 250 fish. Tagging efforts resulted in 2 weekly release groups of more than 250 fish that occurred during the week of April 9 (n = 250) and April 23 (n=252). The other weeks were close to the goal and only short by a few of fish. A total of 1,494 hatchery origin Héeyey (steelhead) were PIT tagged (Table 3).

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 2 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, 2005, (Appendix C). Recaptured fish averaged 90.5 mm in fork length, 8.3 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 961 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 120.5 mm in fork length, 20.0 g in weight, and a 1.1 condition factor. The first occurrence of a previously PIT tagged hatchery Nacó'x̂ (Chinook salmon) occurred on March 23, two days after the volitional release at the Gumboot acclimation facility began. Fifty and 90 percent of the fish arrived 12 and 27 days, respectively, after the volitional release began (Figure 12).

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 1 October 2005 to 20 June 2006.

Week	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)
10/2/2005	856	0	3	0
10/9/2005	548	0	0	0
10/16/2005	38	0	0	0
10/23/2005	225	0	0	0
10/30/2005	441	0	0	0
11/6/2005	170	0	0	0
11/13/2005	138	0	0	0
11/20/2005	268	0	0	0
2/26/2006	42	0	11	0
3/5/2006	10	0	5	0
3/12/2006	13	0	3	0
3/19/2006	75	0	5	0
3/26/2006	362	0	105	0
4/2/2006	156	0	35	0
4/9/2006	85	0	114	250
4/16/2006	194	0	374	247
4/23/2006	61	0	459	252
4/30/2006	31	0	444	249
5/7/2006	30	0	514	248
5/14/2006	4	0	96	248
5/21/2006	5	0	13	0
5/28/2006	27	0	90	0
6/4/2006	3	0	5	0
6/11/2006	21	0	10	0
6/18/2006	11	0	5	0
Totals	3,814	0	2,291	1,494

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 2006 was an average arrival time for an acclimated volitional release, which occurred 20 days after the volitional release began. The direct release mimicked the 1999 release.

A total of 34 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 219.8 mm in fork length, 113.6 g in weight, and a 1.05 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 2006 migration year, 2 October 2005 to 20 June 2006, 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)	Sample Size (n)	2	906	34
	Average	90.5	120.5	219.8
	Minimum	91	169	257
	Maximum	90	90	172
	Standard Deviation	0.7	9.7	19.3
Weight (g)	Sample Size (n)	2	904	34
	Average	8.3	20.0	113.6
	Minimum	9.2	52.1	189.7
	Maximum	7.4	7.4	57.2
	Standard Deviation	1.3	5.0	31.2
Condition Factor (K)	Sample Size (n)	2	904	34
	Average	1.12	1.13	1.05
	Minimum	1.26	1.54	1.20
	Maximum	0.98	0.66	0.93
	Standard Deviation	0.20	0.10	0.08

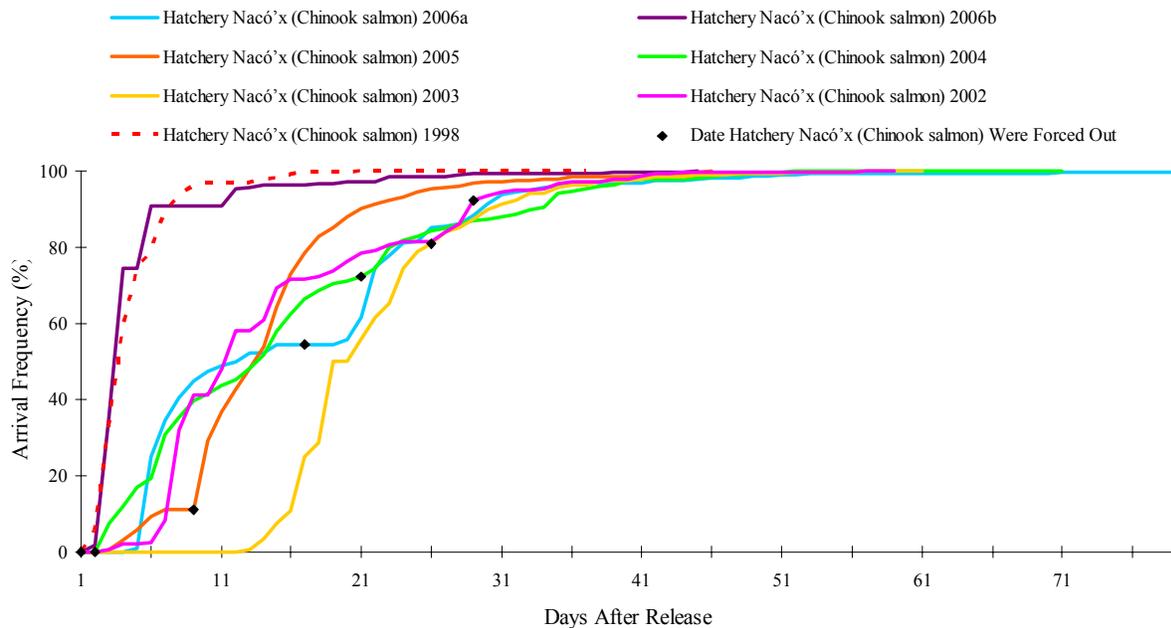


Figure 12. The arrival frequency of previously PIT tagged hatchery Nacó'x̂ (Chinook salmon) captured in the Imnaha River juvenile migration trap during the spring of 1998 to the spring of 2006. The release strategy in 1998 was a direct stream release. The releases in 2006 were an acclimated volitional release (2006a) and a direct stream release (2006b). The remainder of the releases was 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 80.2 mm in fork length, 5.9 g in weight, and had an average condition factor of 1.07 (Table 5). Natural Nacó'x̂ (Chinook salmon) smolts captured in the spring averaged 97.8 mm, 10.6 g, and a condition factor of 1.10. Hatchery Nacó'x̂ (Chinook salmon) had a larger fork length of 121.0 mm. Hatchery Nacó'x̂ (Chinook salmon) had an average weight of 20.1 g and a condition factor of 1.12. The 105 mm median fork length of hatchery Nacó'x̂ (Chinook salmon) was significantly different from the 90 mm median fork length of natural Nacó'x̂ (Chinook salmon) ($p < 0.05$) (Figure 14 and Appendix D).

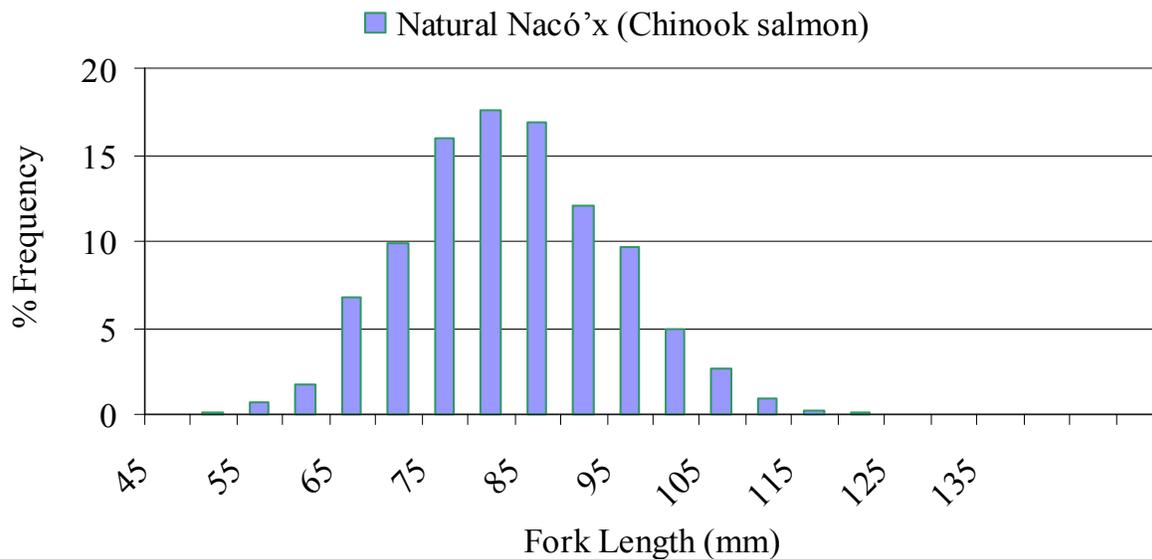


Figure 13. Length frequency distribution of natural Nacó'x (Chinook salmon) pre-smolts trapped in the Imnaha River juvenile migration trap from October 2 to November 23, 2005.

Spring captured natural Héeyey (steelhead) had an average fork length and weight of 171.4 mm and 53.7 g and a condition factor of 1.03 (Figure 15 and Table 5). Hatchery Héeyey (steelhead) were significantly larger ($p < 0.05$) with an average fork length of 217.9 mm, weight of 109.9 g and a condition factor of 1.03 (Figure 15 and Appendix D).

Hatchery programs from 1994 to 2006 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'x (Chinook salmon) and Héeyey (steelhead). The largest weekly mean fork lengths of natural Nacó'x (Chinook salmon) (104.8 mm) occurred during the week of May 21 (Table 6). The largest weekly mean fork lengths for hatchery Nacó'x (Chinook salmon) (124.3 mm) was measured during the week of May 21. Hatchery Nacó'x (Chinook salmon) averaged from the 116 mm to 124 mm range for the entire trapping period. Natural Héeyey (steelhead) had weekly mean fork lengths greater than 170 mm for 8 weeks from March 12 and 19 and April 9 to the week of May 14. The largest weekly mean fork lengths for hatchery Héeyey (steelhead) were 196 mm during the week of March 12 (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 2006 migration year, 2 October 2005 to 20 June 2006, at the Imnaha River juvenile migration trap.

		Fall 2005	Spring 2006			
Attribute	Statistic	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)	2834	1158	1462	2298	1993
	Average	80.2	97.8	121.0	171.4	217.9
	Maximum	117	147	169	256	313
	Minimum	49	72	90	114	136
	Standard Deviation	10.9	9.5	9.6	19.5	22.4
Weight (g)	Sample Size (n)	2749	1158	1462	2298	1993
	Average	5.9	10.6	20.1	53.7	109.9
	Maximum	16.9	30.9	52.1	164.5	343.7
	Minimum	1.7	3.7	7.4	11.3	26.5
	Standard Deviation	2.4	3.4	5.0	18.0	35.0
Condition Factor (K)	Sample Size (n)	2744	1158	1462	2298	1993
	Average	1.07	1.10	1.12	1.03	1.03
	Maximum	1.48	1.56	1.56	1.45	1.50
	Minimum	0.67	0.67	0.66	0.75	0.67
	Standard Deviation	0.09	0.12	0.09	0.08	0.08

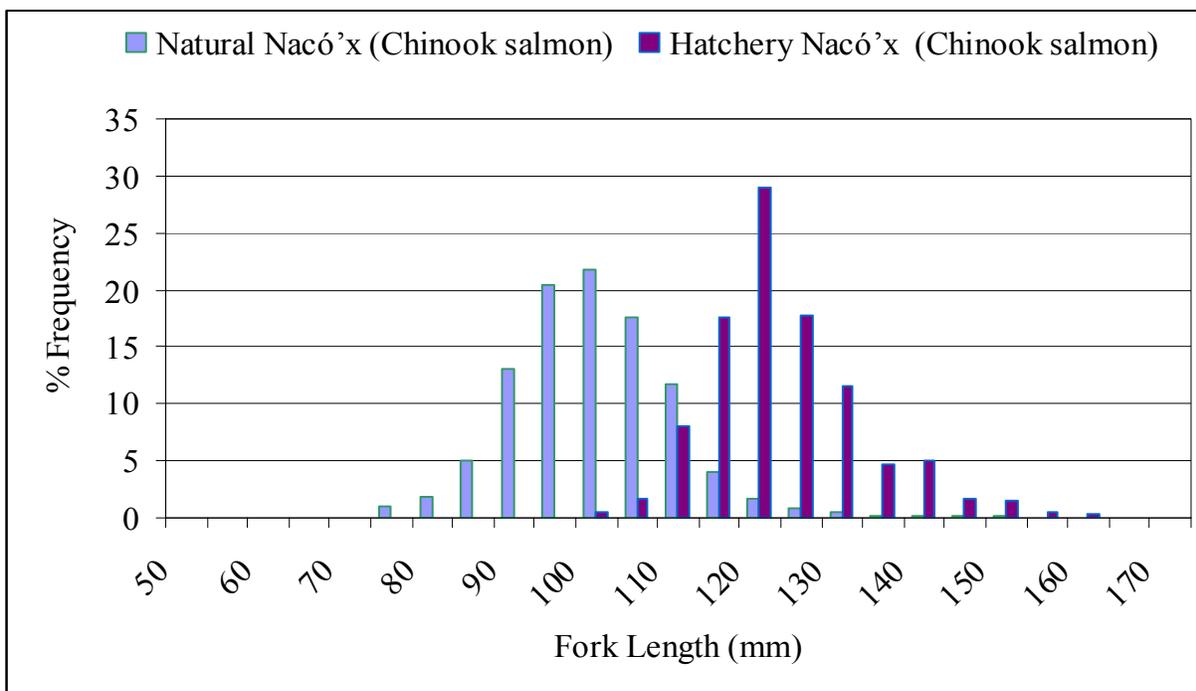


Figure 14. Length frequency distribution of natural and hatchery Nacó'x (Chinook salmon) trapped in the Imnaha River juvenile migration trap, March 1 to June 20, 2006.

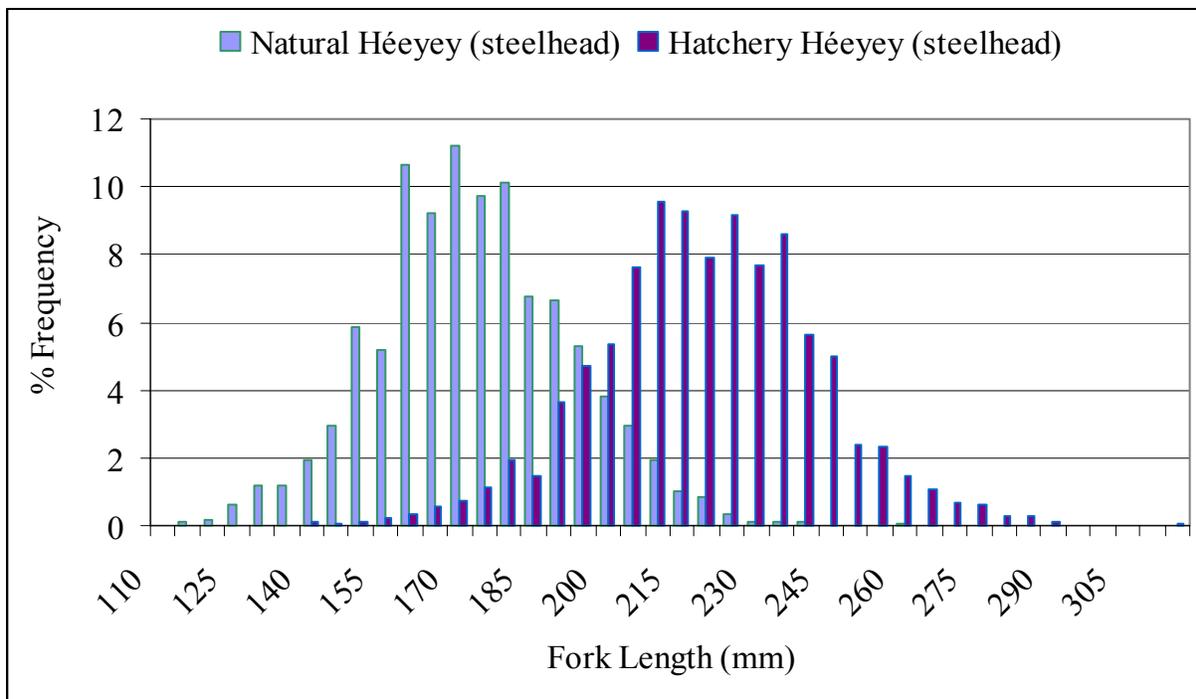


Figure 15. Length frequency distribution of natural and hatchery Héeyey (steelhead) trapped in the Imnaha River juvenile migration trap, March 1 to June 20, 2006.

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 2006.

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
2/26/2006	90.3	1.11			166.3	1.04		
3/5/2006	88.5	1.08			154.8	1.01		
3/12/2006	95.2	1.04			196.3	0.95		
3/19/2006	99.4	1.05	121.4	1.12	170.8	0.94		
3/26/2006	96.4	1.05	122.6	1.12	153.3	0.99		
4/2/2006	97.5	1.07	122.3	1.11	157.6	0.96		
4/9/2006	101.0	1.14	118.4	1.12	174.4	1.02	220.7	1.08
4/16/2006	100.5	1.15	116.6	1.15	176.7	1.02	215.7	1.07
4/23/2006	98.3	1.13	115.9	1.08	177.4	1.02	223.0	1.06
4/30/2006	101.0	1.23	119.9	1.12	170.8	1.05	219.6	1.04
5/7/2006	101.1	1.19	121.6	1.11	170.8	1.04	221.9	1.01
5/14/2006	99.3	1.20	122.1	1.09	173.2	1.03	219.3	0.99
5/21/2006	104.8	1.26	124.3	1.07	160.1	1.09	202.0	0.94
5/28/2006	100.2	1.25	121.3	1.12	158.8	1.09	202.1	0.97
6/4/2006	106.0	1.17			158.4	1.08	202.0	0.99
6/11/2006	91.9	1.19			128.0	1.18	210.1	0.97
6/18/2006	90.5	1.24			146.6	1.10	208.5	1.02

Abundance and Survival

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

Trap efficiencies for natural Nacó'x̂ (Chinook salmon) ranged from 0.0% to 25.0% through the season, and averaged 9.0%. Trap efficiencies for natural Héeyey (steelhead) ranged from 0.0% in to 10% in late March, and averaged 9.5%. The overall spring emigration abundance estimate for natural Nacó'x̂ (Chinook salmon) smolts was 5,121 with a lower 95% C.I. of 3,679 and an upper 95% C.I. of 7,454. The overall spring emigration abundance estimate for natural Héeyey (steelhead) smolts was 172,605 with a lower 95% C.I. of 108,852 and an upper 95% C.I. of 287,537.

These emigration abundance estimates are 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. As a

result, only one period for each species had enough recaptures to facilitate a population estimate. Due to the sporadic recapture rates these estimates are to be considered minimal and not comprehensive and are presented in Appendixes E and F for review.

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

Two separate release groups provided an estimated $279,407 \pm 5,805$ (95% C.I.) hatchery Nacó'x̂ (Chinook salmon) which emigrated past the Imnaha River juvenile migration trap during the spring of 2006. The population estimate is based on a post release survival estimate of $63.3\% \pm 2.1\%$ (95% C.I.) from the acclimation facility to the trap. This survival estimate is the 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.

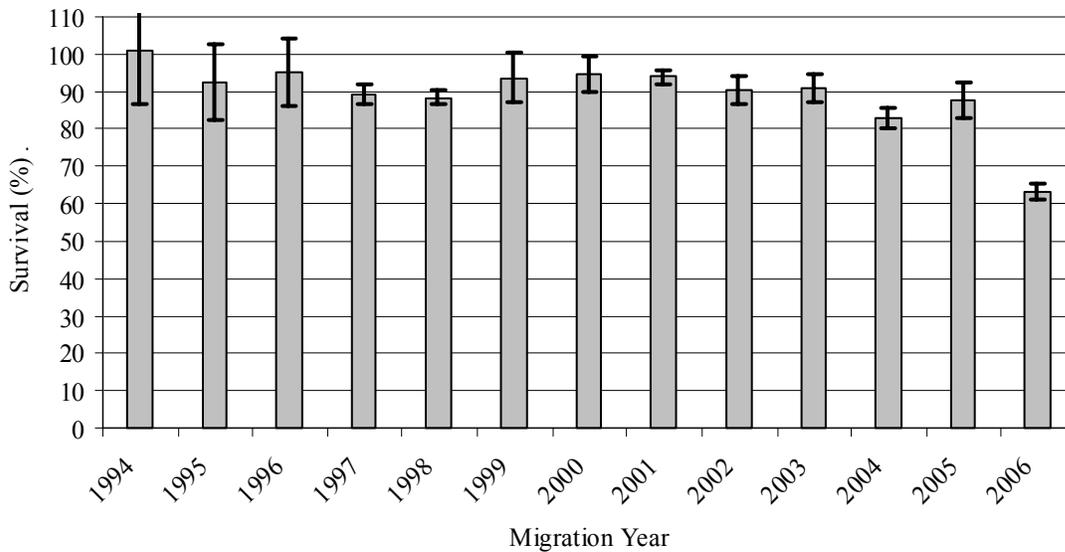


Figure 16. Estimated post release survival of hatchery Nacó'x̂ (Chinook salmon) from the Imnaha River Gumboot acclimation facility to the Imnaha River juvenile migration trap from 1994 to 2006. The error bars indicate the 95% C.I.

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 320,752 smolts with 14,926 PIT tagged fish was acclimated at the Gumboot acclimation facility in early March of 2006. The second group of 120,928 smolts with 5,706 PIT tagged fish was a direct release on March 30. The acclimated group displayed a survival to the Imnaha River juvenile migration trap of $64.4\% \pm 2.4\%$ (95% C.I.). The direct release group displayed a survival to the Imnaha River juvenile migration trap of $60.3\% \pm 4.2\%$ (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 $54.5\% \pm 1.5\%$ (95% C.I.) and $50.5\% \pm 2.5\%$ (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 2006. 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 2006 survival estimate for fall tagged natural Nacó'x̂ (Chinook salmon) pre-smolts from the trap to LGD was $16.5\% (\pm 1.8\%)$ (Figure 17), as with hatchery fish is the lowest on record since the beginning of the SMP project. Fall PIT tagged natural Nacó'x̂ (Chinook salmon) survival from the trap to LMD was $14.6\% (\pm 1.7\%)$. This low survival may be biased due to fall tagged fish migrating through the hydro system while the automated PIT tag readers are off in late fall. There is some evidence of this in PIT tag queries however many of the fall tagged fish simply disappear. 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).

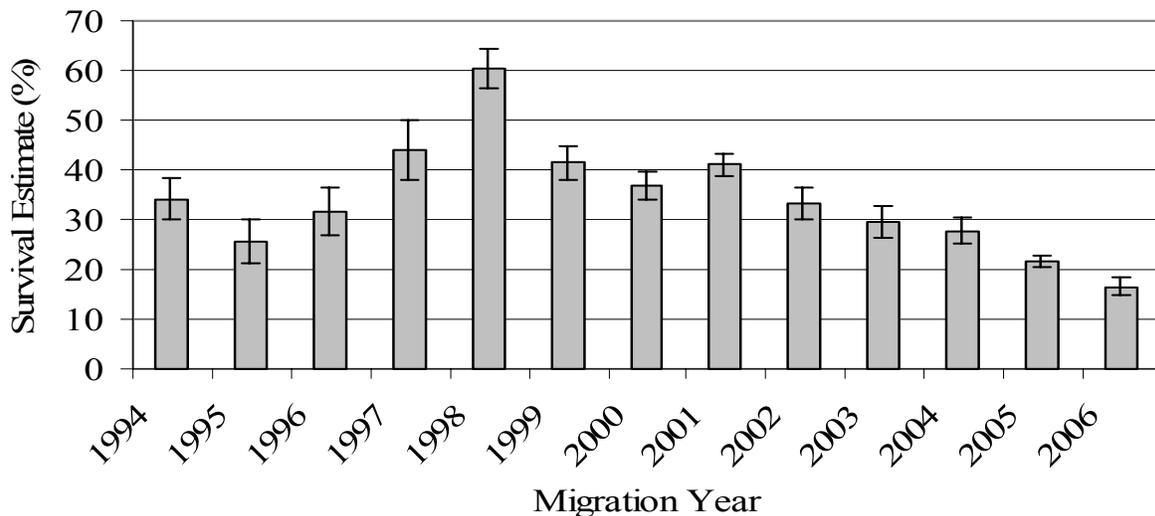


Figure 17. Estimated survival from the Imnaha River juvenile migration trap to Lower Granite Dam of natural Nacó'x̂ (Chinook salmon) tagged in the fall, for migration years 1994 to 2006. Error bars indicate the 95% C.I.

The estimated survival of natural Nacó'x̂ (Chinook salmon) smolts, PIT tagged in the spring, from the juvenile migration trap to LGD in 2006 was $76.7 (\pm 8.2\%)$ (Table 7). The hatchery Nacó'x̂ (Chinook salmon), captured and released at the Imnaha River juvenile migration trap had an estimated survival of $68.7\% (\pm 5.0\%)$ to LGD. The estimated survival of

natural and hatchery Héeyey (steelhead) from the trap to LGD was 91.9% (\pm 5.1%), and 86.1% (\pm 3.8%), respectively. Natural Nacó'x̂ (Chinook salmon) survival from the trap to LGD (1993 to 2006) has ranged from 73.9% in 2005 to 90.9% in 1995. Natural Héeyey (steelhead) estimated survival was the highest of all estimates from 1995 to 2006. 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 second highest on record.

Estimated survival from the Imnaha River juvenile migration trap to LMD in 2006 was as follows: natural Nacó'x̂ (Chinook salmon) was 63.9% (\pm 10.5%), hatchery Nacó'x̂ (Chinook salmon) was 48.5% (\pm 3.5), natural Héeyey (steelhead) was 72.0% (\pm 8.2%), and hatchery Héeyey (steelhead) was 73.6% (\pm 6.3%). 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 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 March 1 to June 19, 2006. 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, MCN – McNary Dam.

Release Group	Number Released	Trap to LGD (%)		LGD to LGS (%)		LGS to LMD (%)		LMD to MCN (%)		Trap to LMO (%)		Trap to MCN (%)	
		(95%)	C.I.	(95%)	C.I.	(95%)	C.I.	(95%)	C.I.	(95%)	C.I.	(95%)	C.I.
Natural Nacó'x̂ (Chinook salmon)													
	1,127	76.7	8.2	103.0	16.9	80.9	16.4	119.4	44.2	63.9	10.5	76.3	24.6
Hatchery Nacó'x̂ (Chinook salmon)													
	824	68.7	5.0	83.3	3.8	91.1	4.9	92.0	8.5	48.5	3.5	44.5	3.5
Natural Héeyey (steelhead)													
	2,283	91.9	5.1	89.2	8.3	87.9	11.6	85.8	25.0	72.0	8.2	61.8	16.2
Hatchery Héeyey (steelhead)													
	1,494	86.1	3.8	92.0	5.2	92.8	8.4	87.3	19.6	73.6	6.3	64.2	13.5

Table 8. Season-wide estimates of survival from the Imnaha River juvenile migration trap to Lower Granite Dam from 1993 to 2006. 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)
2006	76.7	(8.2)	68.7	(5.0)	91.9	(5.1)	86.1	(3.8)

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 2006. 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)
2006	63.9	(10.5)	48.4	(2.4)	72.0	(8.2)	73.6	(6.3)

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 2006. 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)
2006	76.3	(24.6)	44.5	(3.5)	61.8	(16.2)	64.2	(13.5)

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.

The average monthly discharge for April of 2006 in the Snake River at Anatone was 92,900 cfs, the highest 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 2006 survival estimates for hatchery Nacó'x̂ (Chinook salmon) from release to LMD was the second lowest recorded yet and may have been affected by the higher than average discharge in the Snake River. Previous survival estimates for hatchery Nacó'x̂ (Chinook salmon) from release to LMD have ranged from 47.7% in 2005 to 69.0% in 2001. Both estimates of survival from the trap to LMD for natural and hatchery Héeyey (steelhead) were on the high end of the range of estimates obtained from 1997 to 2005. 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 2005 (Table 10). Low sample sizes restricted our ability to provide an estimate with small confidence limits. 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 Innaha trap to MCD was the lowest recorded (44.5%, ± 6.3%). Hatchery Nacó'x̂ (Chinook salmon) survival from the Innaha 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 a single estimate from the trap to LGD for natural Nacó'x̂ (Chinook salmon) that was 86.5% (± 23.9%) released during the week of March 26 (Table 11). There were no release groups of more than 300 fish for hatchery Nacó'x̂ (Chinook salmon). Weekly estimates of survival from the trap to LGD for natural Héeyey (steelhead) ranged from 85.8% (± 7.6%) during the week of April 30 to 94.2% (± 9.7%) during the week of April 23 (Table 11). There were no release groups of more than 300 fish 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) and natural and hatchery Héeyey (steelhead) smolts released from the Innaha 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)									
26-Mar	417	86.5	(23.9)	88.0	(34.6)	76.3	(28.7)	58.1	(16.7)
Hatchery Nacó'x̂ (Chinook salmon)									
None									
Natural Héeyey (steelhead)									
16-Apr	374	91.9	(9.5)	91.6	(14.3)	102.0	(17.0)	85.9	(13.6)
23-Apr	459	94.2	(9.7)	89.6	(15.2)	86.5	(18.5)	73.0	(14.2)
30-Apr	443	85.8	(7.6)	100.2	(19.5)	72.3	(25.1)	62.1	(16.8)
7-May	514	93.6	(15.7)	118.1	(47.9)	59.4	(41.0)	65.7	(34.1)
Hatchery Héeyey (steelhead)									
None									

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 2001. 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 2001 were 59, 105, 109, 24, 16 and 13 fish, respectively. Adult detections from fall PIT tagged Nacó'x̂ (Chinook salmon) from brood years 1996 through 2001 were 27, 20, 22, 5, 19 and 19, respectively (Table 12). Fall tagged natural Nacó'x̂ (Chinook salmon) had now conclusive results from the Imnaha River to LGD SAR index for all brood years examined when compared to spring tagged Nacó'x̂ (Chinook salmon) (Table 12). 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 12). Analyzing the stream back to LGD factors in the overwinter mortality and results in no real evident trends. Thus, when looking at the higher trends for the fall tagged fish from LGD to LGD that could be explained by the fact that fish tagged in the fall migrate out of the Imnaha River and over winter on lower potentially warmer waters than the headwaters of the Imnaha River. They also have to migrate less in the spring and tend to arrive earlier at LGD. The Imnaha to LGD SAR index for fall tagged Nacó'x̂ (Chinook salmon) ranged from 0.25% to 1.86%. The Imnaha to LGD SAR index for spring tagged Nacó'x̂ (Chinook salmon) ranged from 0.24% to 2.49%. The LGD to LGD SAR index for fall tagged Nacó'x̂ (Chinook salmon) ranged from 0.61% to 3.11%. 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 and 2001 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.

Arrival Timing at Dams

Natural and Hatchery Nacó'x̂ (Chinook salmon) Arrival Timing for 2006

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 12 median arrival date for fall tagged Nacó'x̂ (Chinook salmon) was earlier than the April 25 median arrival date for spring tagged Nacó'x̂ (Chinook salmon) ($p < 0.05$).

Fall tagged natural Nacó'x̂ (Chinook salmon) arrived at LGD in 2006 from March 29 to May 2, median arrival on April 11 and a 90% arrival timing of April 26. Arrival at the remaining dams occurred during the following times: April 8 to May 4 at LGS, April 7 to May 7 at LMD, and April 13 to May 9 at MCD. Median arrivals occurred April 18, April 19, and April 24 at LGS, LMD, and MCD, respectively. Ninety percent arrival occurred on the following dates: April 29 at LGS, April 30 at LMD, and May 6 at MCD (Appendix H).

Table 12. Smolt to adult return rate indices (SARs) from Imnaha River to LGD and LGD to LGD of PIT tagged Imnaha River natural Nacó'x̂ (Chinook salmon) for brood years 1996 to 2001. 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 Imnaha to LGD (%)	SAR LGD to LGD (%)
					III	IV	V		
	Fall								
1996		1,453	878	27	5	15	7	1.86	3.08
1997		2,000	830	20	3	16	1	1.00	2.41
1998		1,966	723	22	2	12	8	1.12	3.04
1999		2,009	826	5	0	3	2	0.25	0.61
2000		2,011	670	19	0	15	4	0.94	2.84
2001		2,052	611	19	0	15	4	0.93	3.11
	Spring								
1996		3,956	3,371	59	3	41	15	1.49	1.75
1997		5,306	4,696	105	8	69	28	1.98	2.24
1998		4,369	3,705	109	3	62	44	2.49	2.94
1999		10,005	8,374	24	0	16	8	0.24	0.29
2000		2,321	2,017	16	3	10	3	0.69	0.79
2001		5,311	4,031	13	3	8	2	0.24	0.32

Spring tagged natural Nacó'x̂ (Chinook salmon) smolts arrived at LGD from April 6 to June 6, median arrival on April 6, and had a 90% arrival time of May 6 (Appendix I). Arrival at LGS, LMD, and MCD occurred from April 7 to June 21, April 10 to June 9, and April 14 to July 7, respectively. Median arrival timing at these three dams was as follows: April 27 at LGS, April 25 at LMD, and April 29 at MCD. The 90% arrival time at LGS was May 9, May 11 at LMD, and May 16 at MCD.

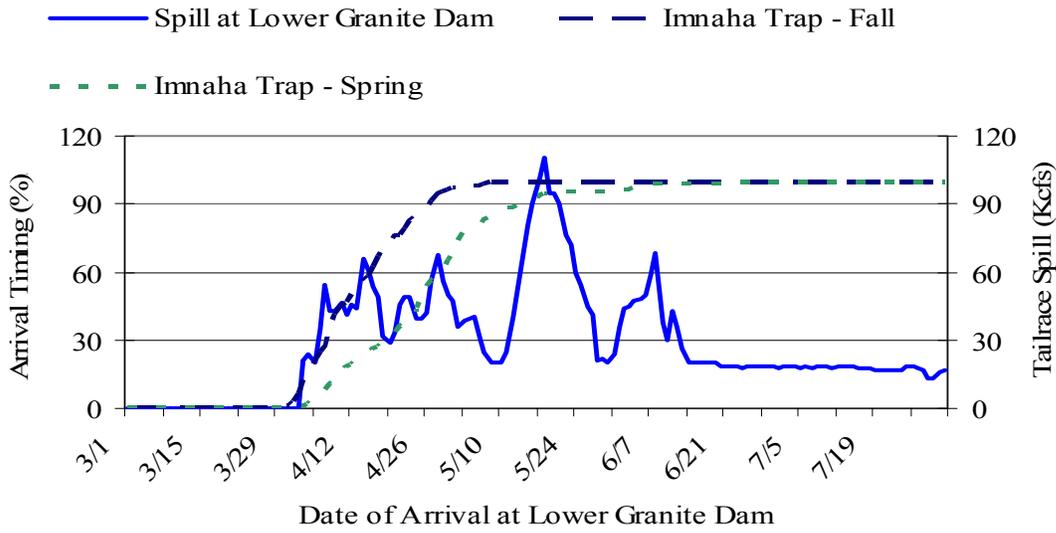


Figure 18. The cumulative arrival timing of fall and spring tagged natural Nacó'x (Chinook salmon) and tailrace spill at Lower Granite Dam during the 2006 migration year. Fall and spring tagged natural Nacó'x (Chinook salmon) were released in the fall of 2005 and the spring of 2006.

PIT tagged hatchery Nacó'x (Chinook salmon) smolts recaptured at the Innaha River juvenile migration trap had the following arrival times at the four dams in 2006: March 31 to May 14 at LGD, April 6 to June 25 at LGS, April 8 to June 10 at LMD, and April 13 to June 26 at MCD (Appendix J). Median arrival timing occurred May 2 at LGD, May 4 at LGS, May 7 at LMD and May 10 at MCD. Ninety percent arrival timing occurred May 9 at LGD, May 16 at LGS, May 7 at LMD and May 10 at MCD.

Natural and Hatchery Héeyey (Steelhead) Arrival Timing for 2006

Natural Héeyey (steelhead) arrived at LGD, LGS, LMD, and MCD from March 28 to June 19, April 1 to June 25, April 3 to June 11, and April 6 to June 6 (Appendix K). Median arrival timing occurred May 5 at LGS, May 2 at LGS, May 3 at LMD, and May 6 at MCD. The 90% arriving timing occurred on May 16 at LGD, May 17 at LGS, May 18 at LMD, and May 6 at MCD.

Hatchery Héeyey (steelhead) had the following range of arrival times: April 14 to June 16 at LGD, April 15 to June 17 at LGS, April 16 to May 28 at LMD, and April 21 to June 3 at MCD (Appendix L). Median arrival times for hatchery Héeyey (steelhead) migrating in 2006 were May 6 at LGD, May 7 at LGS, May 11 at LMD, and May 11 at MCD. Ninety percent arrival times are as follows: May 17 at LGD, May 19 at LGS, May 20 at LMD, May 23 and MCD.

Average Arrival Timing

This project has collected nine to fifteen 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 13). The mean arrival timing range for fall tagged natural Nacó'x̂ (Chinook salmon) pre-smolts from 1998 to 2006 at LGD is from March 30 (± 7 days) to May 14 (± 20 days), with mean median and 90% arrival timing of April 16 (± 8 days) and April 27 (± 6 days), respectively. Mean median arrival times at LGS, LMD, and MCD for fall tagged natural Nacó'x̂ (Chinook salmon) are April 23 (± 11 days), April 24 (± 12 days), and April 29 (± 11 days), respectively. Mean 90% arrival timing for fall tagged natural Nacó'x̂ (Chinook salmon) was May 2 (± 11 days) at LGS, May 2 (± 15 days) at LMD, and May 6 (± 10 days) at MCD.

Spring tagged natural Nacó'x̂ (Chinook salmon) smolt mean arrival times at LGD from 1993 to 2006 are as follows: mean arrival time range of April 3 (± 14 days) to July 4 (± 46 days), mean median arrival time of April 28 (± 8 days), and mean 90% arrival of May 16 (± 14 days). Mean median arrival times at LGS, LMD, and MCD for natural Nacó'x̂ (Chinook salmon) smolts are May 1 (± 9 days), May 4 (± 14 days), and May 8 (± 12 days). Mean 90% arrival timing is May 17 (± 14 days) at LGS, May 22 (± 15 days) at LMD, and May 24 (± 22 days) at MCD.

Hatchery Nacó'x̂ (Chinook salmon) smolt mean arrival times at LGD from 1992 to 2006 are as follows: mean arrival time range of April 10 (± 14 days) to May 27 (± 19 days), mean median arrival time of May 3 (± 9 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 7 (± 9 days), May 11 (± 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 12 (± 27 days) to July 9 (± 55 days) at LGD. The mean arrival date range for LGS, LMD, and MCD is as follows: April 16 (± 23 days) to July 7 (± 48 days) at LGS, April 21 (± 24 days) to July 4 (± 71 days) at LMD, and April 25 (± 25 days) to June 18 (± 40 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 (± 12 days) at LGS, May 16 (± 15 days) at LMD, and May 16 (± 14 days) at MCD. The mean 90% arrival timing for natural Héeyey (steelhead) is as follows: May 26 (± 16 days) at LGD, May 27 (± 13 days) at LGS, June 3 (± 32 days) at LMD, and May 27 (± 15 days) at MCD.

The fourteen-year mean range of arrival for hatchery Héeyey (steelhead) at LGD is April 21 (± 17 days) to July 18 (± 61 days). Downstream mean arrival ranges for hatchery Héeyey (steelhead) are as follows: April 25 (± 17 days) to July 28 (± 82 days) at LGS, April 28 (± 17 days) to July 28 (± 85 days) at LMD, and May 6 (± 19 days) to July 4 (± 42 days) at MCD. The fourteen-year median arrival time at LGD, LGS, LMD, and MCD is as follows: May 19 (± 15

days), May 23 (± 13 days), May 27 (± 20 days), and May 30 (± 25 days), respectively. Mean 90% arrival occurred on June 5 (± 33 days) at LGD, June 13 (± 32 days) at LGS, June 15 (± 35 days) at LMD, and June 14 (± 35 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 13. Averaged mean first, median, 90%, and last arrival timing for fall and spring tagged natural Nacó'x̂ (Chinook salmon) juveniles, hatchery Nacó'x̂ (Chinook salmon) 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'x̂ (Chinook salmon) Pre-Smolts (1998 to 2006)¹</u>								
LGD	Mar-30	7	Apr-16	8	Apr-27	6	May-14	20
LGS	Apr-11	11	Apr-23	11	May-02	11	May-20	28
LMD	Apr-17	15	Apr-24	12	May-02	15	May-21	24
MCD	Apr-19	17	Apr-29	11	May-06	10	May-21	25
<u>Spring Tagged Natural Nacó'x̂ (Chinook salmon) Smolts (1993 to 2006)</u>								
LGD	Apr-03	14	Apr-28	8	May-16	14	Jul-04	46
LGS	Apr-14	11	May-01	9	May-17	14	Jul-04	51
LMD	Apr-17	15	May-04	14	May-22	15	Jul-01	48
MCD	Apr-22	11	May-08	12	May-24	22	Jun-23	39
<u>Hatchery Nacó'x̂ (Chinook salmon) Smolts (1992 to 2006)</u>								
LGD	Apr-10	14	May-03	9	May-12	7	May-27	19
LGS	Apr-18	13	May-07	9	May-16	9	Jun-03	18
LMD	Apr-23	13	May-11	7	May-21	7	Jun-04	14
MCD	Apr-26	14	May-14	7	May-22	6	Jun-05	21
<u>Natural Héeyey (steelhead) Smolts (1993 to 2006)²</u>								
LGD	Apr-12	27	May-10	13	May-26	16	Jul-09	55
LGS	Apr-16	23	May-13	12	May-27	13	Jul-07	48
LMD	Apr-21	24	May-16	15	Jun-03	32	Jul-04	71
MCD	Apr-25	25	May-16	14	May-27	15	Jun-18	40
<u>Hatchery Héeyey (steelhead) Smolts (1993 to 2006)²</u>								
LGD	Apr-21	17	May-19	15	Jun-05	33	Jul-18	61
LGS	Apr-25	17	May-23	13	Jun-13	32	Jul-28	82
LMD	Apr-28	17	May-27	20	Jun-15	35	Jul-28	85
MCD	May-06	19	May-30	25	Jun-14	35	Jul-04	42

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 14). Weekly comparisons for Nacó'x (Chinook salmon) occur for five weeks between April 2 and May 6. Natural Nacó'x (Chinook salmon) weekly median travel times to LGD ranged from ten days (April 2) to seventeen (April 16 & 30). On average natural Nacó'x (Chinook salmon) median travel times were twelve days earlier than hatchery Nacó'x (Chinook salmon) released in the same week.

Table 14. A comparison of median travel times of natural and hatchery Nacó'x (Chinook salmon) and Héeyey (steelhead) smolts released from the Imnaha River screw trap, April 2 to June 18, 2006, at Lower Granite Dam.

Species	Release Week	<u>Number Interrogated</u>		<u>Median Travel Time (Days)</u>	
		Hatchery	Natural	Hatchery	Natural
Nacó'x (Chinook salmon)	4/2/2006	31	34	14	10
	4/9/2006	86	34	19	14
	4/16/2006	248	35	28	17
	4/23/2006	708	74	35	16
	4/30/2006	1193	47	41	17
Héeyey (steelhead)	4/16/2006	53	62	3	4
	4/23/2006	66	174	5	4
	4/30/2006	106	172	9	4
	5/7/2006	92	181	4	3
	5/14/2006	139	160	8	4

Weekly comparisons for Héeyey (steelhead) occur for a five-week period between April 16 and May 20. Natural Héeyey (steelhead) weekly median travel times to LGD ranged from three days (May 3) to four days (April 16, 23, and May 14) to (Table 14). Hatchery Héeyey (steelhead) travel times during this period ranged from three days (April 16) to nine days (April 30). The differences in median travel time ranged from one to five days. 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 23 natural Nacó'x̂ (Chinook salmon), 88 hatchery Nacó'x̂ (Chinook salmon), 8 natural Héeyey (steelhead), and 8 hatchery Héeyey (steelhead), and one unknown origin Héeyey (steelhead) mortalities occurred during the study. Thirteen of the natural Nacó'x̂ (Chinook salmon) mortalities occurred during the fall; 0.46% of all natural Nacó'x̂ (Chinook salmon) captured in the fall of 2005 (Appendix M). Trapping caused 10 mortalities, handling caused one, PIT tagging was the source of one, and one additional dead on arrival. No other mortalities occurred during the fall. Ten natural Nacó'x̂ (Chinook salmon) mortalities occurred during the spring: 7 due to trapping, one due to handling, 2 from to PIT tagging and none was dead on arrival at the Imnaha screw trap (Appendix N). The total number of mortalities accounted for 0.81 % of the natural Nacó'x̂ (Chinook salmon) captured in the spring of 2006. Eighty-three trapping, one handling, no PIT tagging, and four dead on arrival mortalities occurred to hatchery Nacó'x̂ (Chinook salmon) with the total mortality accounted for 0.38 % of the catch in the spring of 2006.

There were 8 natural Héeyey (steelhead) mortalities during the spring of 2006. Six mortalities were attributed to trapping, none for handling, two for PIT tagging, and none were dead on arrival at the Imnaha screw trap. Hatchery Héeyey (steelhead) had six trapping mortalities; one from handling, none from PIT tagging, and one hatchery Héeyey (steelhead) was dead on arrival. One unknown origin Héeyey (steelhead) was dead on arrival. The eight natural Héeyey (steelhead) mortalities were 0.34 % of the total catch, where the eight hatchery Héeyey (steelhead) mortalities accounted for 0.06 %, and the one unknown origin Héeyey (steelhead) accounted for 100% of the catch.

Incidental Catch

Incidental Catch for Migration Year 2006

The incidental catch during the fall and spring of migration year 2006 totaled 2,271 fish. It was comprised of six families of fishes: Salmonidae, Centrarchidae, Catostomidae, Cyprinidae, Cottidae, and Petromyzotidae (Appendix O). The catch of Salmonidae consisted of 151 adult Héeyey (steelhead), 1 adult Nacó'x̂ (Chinook salmon), 1,378 rainbow trout, 153 Cimey (mountain whitefish; *Prosopium williamsoni*), and 78 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 6 Centrarchidae captured were smallmouth bass (*Micropterus dolomieu*). A total of 6 Muq'uc (bridgelip suckers; *Catostomus columbianus*), 10 Muq'uc (largescale suckers; *Catostomus macrocheilus*), and 173 unidentified Muq'uc species represented the family Catostomidae. The catch of Cyprinidae was as follows: 24 Tite'wxc (chislemouth; *Acrocheilus alutaceus*), 76 longnose dace (*Rhinichthys cataractae*), 51 Qiyex (northern pikeminnow; *Ptychocheilus*

oregonensis), 13 redbside shiner (*Richardsonius balteatus*) and 3 Peamouth (*Mylocheilus caurinus*). Sixteen *Cottus* species (sculpins) of the family Cottidae were captured during the migration year 2006. Additionally 6 juvenile Heesu (Pacific Lampreys; *Lampetra tridentata*) of the family Petromyzotidae were caught in the spring of 2006.

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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 2 October 2005 to 20 June 2006. 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)	Unknown Origin Héeyey (steelhead)
10/3/2005	19.5	129	0	0	0	0
10/4/2005	19	72	0	0	0	0
10/5/2005	26.5	318	0	0	0	0
10/6/2005	23.5	235	0	0	0	0
10/7/2005	22	210	0	0	0	0
10/8/2005	N/A	N/A	N/A	N/A	N/A	N/A
10/9/2005	N/A	N/A	N/A	N/A	N/A	N/A
10/10/2005	14	90	0	0	0	0
10/11/2005	24	118	0	0	0	0
10/12/2005	25	102	0	0	0	0
10/13/2005	22.5	213	0	0	0	0
10/14/2005	22.5	55	0	0	2	0
10/15/2005	N/A	N/A	N/A	N/A	N/A	N/A
10/16/2005	N/A	N/A	N/A	N/A	N/A	N/A
10/17/2005	14.75	5	0	1	0	0
10/18/2005	24.25	5	0	1	0	0
10/19/2005	24	14	0	0	0	0
10/20/2005	24	6	0	7	0	0
10/21/2005	24	15	0	1	0	0
10/22/2005	N/A	N/A	N/A	N/A	N/A	N/A
10/23/2005	N/A	N/A	N/A	N/A	N/A	N/A
10/24/2005	15	43	0	0	0	0
10/25/2005	25.25	73	0	0	0	0
10/26/2005	24	17	0	2	0	0
10/27/2005	24.75	23	0	0	0	N/A
10/28/2005	24	2	0	0	0	N/A
10/29/2005	N/A	N/A	N/A	N/A	N/A	N/A
10/30/2005	N/A	N/A	N/A	N/A	N/A	N/A
10/31/2005	16.5	54	0	0	0	0
11/1/2005	22.25	147	0	1	0	0
11/2/2005	25.5	229	0	4	0	0
11/3/2005	22.75	50	0	0	0	0
11/4/2005	23	45	0	0	0	0
11/5/2005	N/A	N/A	N/A	N/A	N/A	N/A
11/6/2005	N/A	N/A	N/A	N/A	N/A	N/A

Sample End Date	Hours fished	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)	Unknown Origin Héeyey (steelhead)
11/7/2005	15.5	9	0	0	0	0
11/8/2005	23.5	89	0	0	2	0
11/9/2005	24	37	0	1	0	0
11/10/2005	24	5	0	10	0	0
11/11/2005	24	32	0	7	1	0
11/12/2005	N/A	N/A	N/A	N/A	N/A	N/A
11/13/2005	N/A	N/A	N/A	N/A	N/A	N/A
11/14/2005	12.5	3	0	0	0	0
11/15/2005	24	5	0	1	0	0
11/16/2005	23.5	1	0	2	0	0
11/17/2005	24.5	40	0	5	0	0
11/18/2005	24	90	0	3	0	0
11/19/2005	N/A	N/A	N/A	N/A	N/A	N/A
11/20/2005	N/A	N/A	N/A	N/A	N/A	N/A
11/21/2005	14	110	0	0	0	0
11/22/2005	25.25	123	0	0	0	0
11/23/2005	23	37	0	0	0	0
3/2/2006	18.5	9	0	0	0	0
3/3/2006	21	30	0	7	0	0
3/4/2006	23.5	0	0	0	0	0
3/5/2006	27	3	0	4	0	0
3/6/2006	23.5	5	0	0	0	0
3/7/2006	22	0	0	0	0	0
3/8/2006	22	1	0	0	0	0
3/9/2006	25	0	0	0	0	0
3/10/2006	24.5	3	0	1	0	0
3/11/2006	24	0	0	0	0	0
3/12/2006	24	1	0	1	0	0
3/13/2006	23.5	1	0	0	0	0
3/14/2006	25	1	0	0	0	0
3/15/2006	22.5	0	0	2	0	0
3/16/2006	21.5	0	0	0	0	0
3/17/2006	25	5	0	0	0	0
3/18/2006	24	5	0	0	0	0
3/19/2006	24	5	0	0	0	0
3/20/2006	24	13	0	0	0	0
3/21/2006	25.5	22	0	0	0	0
3/22/2006	23.25	20	0	1	0	0
3/23/2006	27.25	14	23	3	0	0

Sample End Date	Hours fished	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)	Unknown Origin Héeyey (steelhead)
3/24/2006	22.5	4	191	0	0	0
3/25/2006	29.5	27	3696	2	0	0
3/26/2006	16.5	66	1560	16	0	0
3/27/2006	23.5	125	1033	21	0	0
3/28/2006	27.75	75	538	30	1	0
3/29/2006	23.5	64	346	25	0	0
3/30/2006	32.25	28	633	14	0	0
3/31/2006	14.25	24	198	8	0	0
4/1/2006	24.5	39	4676	7	0	1
4/2/2006	22	55	2945	9	1	0
4/3/2006	25.75	53	1228	15	0	0
4/4/2006	22.25	49	644	13	0	0
4/5/2006	9.5	N/A	N/A	N/A	N/A	N/A
4/6/2006	N/A	N/A	N/A	N/A	N/A	N/A
4/7/2006	N/A	N/A	N/A	N/A	N/A	N/A
4/8/2006	N/A	N/A	N/A	N/A	N/A	N/A
4/9/2006	N/A	N/A	N/A	N/A	N/A	N/A
4/10/2006	13.75	10	1076	11	0	0
4/11/2006	24.25	33	1842	36	766	0
4/12/2006	24	15	667	14	1805	0
4/13/2006	12	14	372	18	2051	0
4/14/2006	25.5	20	351	26	1167	0
4/15/2006	23	7	8	32	74	0
4/16/2006	11.5	5	5	49	1	0
4/17/2006	18	38	16	35	127	0
4/18/2006	22	43	19	76	122	0
4/19/2006	23.5	52	19	48	2	0
4/20/2006	13	22	5	50	0	0
4/21/2006	25	22	6	64	0	0
4/22/2006	22	13	66	52	273	0
4/23/2006	24.5	18	119	71	490	0
4/24/2006	23.5	14	70	69	351	0
4/25/2006	24	7	61	70	502	0
4/26/2006	24	7	64	66	445	0
4/27/2006	15	8	36	67	227	0
4/28/2006	22	7	36	118	188	0
4/29/2006	20.5	N/A	N/A	N/A	N/A	N/A
4/30/2006	N/A	N/A	N/A	N/A	N/A	N/A
5/1/2006	10	0	3	53	102	0
5/2/2006	12.5	1	9	63	164	0

Sample End Date	Hours fished	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)	Unknown Origin Héeyey (steelhead)
5/3/2006	11.5	2	16	35	129	0
5/4/2006	13	3	27	96	312	0
5/5/2006	21	22	60	117	392	0
5/6/2006	26.5	5	26	81	307	0
5/7/2006	24.5	7	36	85	296	0
5/8/2006	24	3	35	100	438	0
5/9/2006	12	1	13	55	355	0
5/10/2006	23.5	6	45	73	425	0
5/11/2006	14	3	14	61	263	0
5/12/2006	25	4	25	79	334	0
5/13/2006	23	6	20	61	327	0
5/14/2006	26.5	4	22	96	435	0
5/15/2006	16	N/A	N/A	N/A	N/A	N/A
5/16/2006	6.5	N/A	N/A	N/A	N/A	N/A
5/17/2006	0	0	0	0	1	0
5/18/2006	N/A	N/A	N/A	N/A	N/A	N/A
5/19/2006	N/A	N/A	N/A	N/A	N/A	N/A
5/20/2006	N/A	N/A	N/A	N/A	N/A	N/A
5/21/2006	N/A	N/A	N/A	N/A	N/A	N/A
5/22/2006	N/A	N/A	N/A	N/A	N/A	N/A
5/23/2006	N/A	N/A	N/A	N/A	N/A	N/A
5/24/2006	N/A	N/A	N/A	N/A	N/A	N/A
5/25/2006	N/A	N/A	N/A	N/A	N/A	N/A
5/26/2006	14.5	2	9	14	18	0
5/27/2006	20	3	2	0	7	0
5/28/2006	24.5	8	10	8	44	0
5/29/2006	24	2	8	11	40	0
5/30/2006	22.5	5	7	16	35	0
5/31/2006	25.5	7	12	23	48	0
6/1/2006	25	3	7	9	32	0
6/2/2006	23.5	3	20	27	69	0
6/3/2006	24	0	1	0	9	0
6/4/2006	14	2	4	4	37	0
6/5/2006	23.5	0	0	1	9	0
6/6/2006	22.5	0	0	0	3	0
6/7/2006	N/A	N/A	N/A	N/A	N/A	N/A
6/8/2006	9	N/A	N/A	N/A	N/A	N/A
6/9/2006	8.5	N/A	N/A	N/A	N/A	N/A
6/10/2006	10.5	1	0	0	6	0
6/11/2006	12.25	1	1	1	2	0

Sample End Date	Hours fished	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)	Unknown Origin Héeyey (steelhead)
6/12/2006	14.25	1	0	0	12	0
6/13/2006	13.25	5	0	1	6	0
6/14/2006	13.5	5	1	2	12	0
6/15/2006	13	3	0	0	5	0
6/16/2006	25	4	0	2	8	0
6/17/2006	25	4	0	4	8	0
6/18/2006	24.25	5	0	3	14	0
6/19/2006	23.75	5	0	0	6	0
6/20/2006	22.5	1	0	2	10	0
Total	2,827.25	11,030	38,197	29,768	5,374	1

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 2 October 2005 to 20 June 2006. 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)
10/3/2005	109	0	0	0
10/4/2005	67	0	0	0
10/5/2005	265	0	0	0
10/6/2005	213	0	0	0
10/7/2005	202	0	0	0
10/8/2005	N/A	N/A	N/A	N/A
10/9/2005	N/A	N/A	N/A	N/A
10/10/2005	87	0	0	0
10/11/2005	113	0	0	0
10/12/2005	99	0	0	0
10/13/2005	194	0	0	0
10/14/2005	55	0	0	0
10/15/2005	N/A	N/A	N/A	N/A
10/16/2005	N/A	N/A	N/A	N/A
10/17/2005	5	0	0	0
10/18/2005	5	0	0	0
10/19/2005	13	0	0	0
10/20/2005	6	0	0	0
10/21/2005	10	0	0	0
10/22/2005	N/A	N/A	N/A	N/A
10/23/2005	N/A	N/A	N/A	N/A
10/24/2005	40	0	0	0
10/25/2005	68	0	0	0
10/26/2005	16	0	0	0
10/27/2005	22	0	0	0
10/28/2005	0	0	0	0
10/29/2005	N/A	N/A	N/A	N/A
10/30/2005	N/A	N/A	N/A	N/A
10/31/2005	53	0	0	0
11/1/2005	147	0	0	0
11/2/2005	226	0	0	0
11/3/2005	50	0	0	0
11/4/2005	45	0	0	0
11/5/2005	N/A	N/A	N/A	N/A
11/6/2005	N/A	N/A	N/A	N/A
11/7/2005	9	0	0	0
11/8/2005	88	0	0	0

Date	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)
11/9/2005	37	0	0	0
11/10/2005	4	0	0	0
11/11/2005	32	0	0	0
11/12/2005	N/A	N/A	N/A	N/A
11/13/2005	N/A	N/A	N/A	N/A
11/14/2005	3	0	0	0
11/15/2005	5	0	0	0
11/16/2005	1	0	0	0
11/17/2005	40	0	0	0
11/18/2005	90	0	0	0
11/19/2005	N/A	N/A	N/A	N/A
11/20/2005	N/A	N/A	N/A	N/A
11/21/2005	110	0	0	0
11/22/2005	122	0	0	0
11/23/2005	37	0	0	0
3/2/2006	9	0	0	0
3/3/2006	30	0	7	0
3/4/2006	0	0	0	0
3/5/2006	3	0	4	0
3/6/2006	5	0	0	0
3/7/2006	0	0	0	0
3/8/2006	0	0	0	0
3/9/2006	0	0	0	0
3/10/2006	2	0	1	0
3/11/2006	0	0	0	0
3/12/2006	1	0	1	0
3/13/2006	1	0	0	0
3/14/2006	1	0	0	0
3/15/2006	0	0	2	0
3/16/2006	0	0	0	0
3/17/2006	5	0	0	0
3/18/2006	5	0	0	0
3/19/2006	5	0	0	0
3/20/2006	13	0	0	0
3/21/2006	10	0	0	0
3/22/2006	10	0	1	0
3/23/2006	6	0	2	0
3/24/2006	4	0	0	0
3/25/2006	27	0	2	0

Date	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)
3/26/2006	58	0	16	0
3/27/2006	108	0	16	0
3/28/2006	72	0	26	0
3/29/2006	57	0	21	0
3/30/2006	26	0	12	0
3/31/2006	22	0	8	0
4/1/2006	19	0	6	0
4/2/2006	55	0	8	0
4/3/2006	52	0	15	0
4/4/2006	49	0	12	0
4/5/2006	N/A	N/A	N/A	N/A
4/6/2006	N/A	N/A	N/A	N/A
4/7/2006	N/A	N/A	N/A	N/A
4/8/2006	N/A	N/A	N/A	N/A
4/9/2006	N/A	N/A	N/A	N/A
4/10/2006	9	0	11	0
4/11/2006	33	0	36	0
4/12/2006	11	0	5	0
4/13/2006	5	0	6	21
4/14/2006	20	0	26	155
4/15/2006	7	0	30	74
4/16/2006	5	0	49	0
4/17/2006	38	0	35	126
4/18/2006	43	0	76	121
4/19/2006	51	0	48	0
4/20/2006	22	0	50	0
4/21/2006	22	0	64	0
4/22/2006	13	0	52	0
4/23/2006	18	0	71	98
4/24/2006	14	0	69	145
4/25/2006	7	0	68	9
4/26/2006	7	0	66	0
4/27/2006	8	0	67	0
4/28/2006	7	0	118	0
4/29/2006	N/A	N/A	N/A	N/A
4/30/2006	N/A	N/A	N/A	N/A
5/1/2006	0	0	53	73
5/2/2006	1	0	63	1
5/3/2006	1	0	35	0
5/4/2006	3	0	96	116

Date	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)
5/5/2006	21	0	116	59
5/6/2006	5	0	81	0
5/7/2006	7	0	85	101
5/8/2006	3	0	100	104
5/9/2006	1	0	55	43
5/10/2006	6	0	73	0
5/11/2006	3	0	61	0
5/12/2006	4	0	79	0
5/13/2006	6	0	61	0
5/14/2006	4	0	96	248
5/15/2006	N/A	N/A	N/A	N/A
5/16/2006	N/A	N/A	N/A	N/A
5/17/2006	N/A	N/A	N/A	N/A
5/18/2006	N/A	N/A	N/A	N/A
5/19/2006	N/A	N/A	N/A	N/A
5/20/2006	N/A	N/A	N/A	N/A
5/21/2006	N/A	N/A	N/A	N/A
5/22/2006	N/A	N/A	N/A	N/A
5/23/2006	N/A	N/A	N/A	N/A
5/24/2006	N/A	N/A	N/A	N/A
5/25/2006	N/A	N/A	N/A	N/A
5/26/2006	2	0	13	0
5/27/2006	3	0	0	0
5/28/2006	8	0	8	0
5/29/2006	2	0	11	0
5/30/2006	4	0	16	0
5/31/2006	7	0	22	0
6/1/2006	3	0	7	0
6/2/2006	3	0	26	0
6/3/2006	0	0	0	0
6/4/2006	2	0	4	0
6/5/2006	0	0	1	0
6/6/2006	0	0	0	0
6/7/2006	N/A	N/A	N/A	N/A
6/8/2006	N/A	N/A	N/A	N/A
6/9/2006	N/A	N/A	N/A	N/A
6/10/2006	1	0	0	0
6/11/2006	0	0	1	0
6/12/2006	0	0	0	0
6/13/2006	5	0	1	0

Date	Natural Nacó'x̂ (Chinook salmon)	Hatchery Nacó'x̂ (Chinook salmon)	Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)
6/14/2006	5	0	2	0
6/15/2006	3	0	0	0
6/16/2006	4	0	2	0
6/17/2006	4	0	4	0
6/18/2006	5	0	3	0
6/19/2006	5	0	0	0
6/20/2006	1	0	2	0
	3,815	0	2,284	1,494

Appendix C. Previously PIT tagged natural Nacó'x̂ (Chinook salmon) recaptured in the Imnaha River juvenile migration trap during the fall of 2005 and spring 2006.

Migration Year	Tagging Agency	Recapture file	Tag ID	Date Tagged	Date Recaptured	Travel Time (Days)
2006	ODFW	JLV05322.NT1	3D9.1BF1CF9C47	08/31/05	11/18/2005	78
2006	ODFW	JLV06084.NT2	3D9.1BF1CF23C6	08/31/05	3/26/2006	206

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 2006.

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)	406	534	90	105	26.6	0.000
Natural Héeyey (steelhead)	Hatchery Héeyey (steelhead)	170	215	841	485	31.5	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 2006.

Week	Group	Caught	Marked	Recaptured	Trap Efficiency	Population	Lower 95% C.I.	Upper 95% C.I.	SE
3/19/06 to 4/02/06	1	526	330	33	9.5	5,121	3,379	7,454	929.7

Appendix F. Gauss population estimates by group for natural Héeyey (steelhead) captured in the Imnaha River juvenile migration trap during the spring 2006.

Week	Group	Caught	Marked	Recaptured	Trap Efficiency	Population	Lower 95% C.I.	Upper 95% C.I.	SE
3/19/06 to 5/14/06	1	2,095	1,482	17	9.0	172,605	108,852	287,537	48,897.3

Appendix G. A statistical comparison of median arrival date at LGD between natural Nacó'x̂ (Chinook salmon) pre-smolts released in the fall of 2005 and smolts released in the spring of 2006 from the Imnaha River juvenile migration trap during migration year 2006.

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	130	276	4/12/06	4/25/06	17.5	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 2006.

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	2006	89	Mar-29 - May-02	Apr-11	Apr-26
	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
Lower Monumental	2005	381	Apr-15 - Jun-09	Apr-30	May-08
	2006	159	Apr-08 - May-04	Apr-18	Apr-29
	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
McNary	2004	204	Apr-13 - May-28	Apr-19	Apr-25
	2005	138	Apr-22 - Jun-12	May-02	May-09
	2006	145	Apr-07 - May-07	Apr-19	Apr-30
	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	
2006	83	Apr-13 - May-09	Apr-24	May-06	

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 2006.

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
	2006	276	Mar-06 - Jun-06	Apr-06	May-06
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
	2006	392	Apr-07 - Jun-21	Apr-27	May-09

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
	2006	224	Apr-10 - Jun-09	Apr-25	May-11
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
	2006	111	Apr-14 - Jul-07	Apr-29	May-16

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 2006.

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
	2006	3,414	Mar-31	-	May-14	May-02	May-09
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	
2006	4,861	Apr-06	-	Jun-25	May-04	May-16	

Dam	Year	Sample Size (n)	Date Range			Arrival Timing	
						Median	90%
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
2006	2,480	Apr-08	-	Jun-10	May-07	May-17	
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
2006	1,542	Apr-13	-	Jun-26	May-10	May-18	

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

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

³ HxW crossed Nacó'x̄ (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 2006.

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
2006	821	Mar-28	-	Jun-19	May-05	May-16	
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
2006	808	Apr-01	-	Jun-25	May-02	May-17	

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
2006	420	Apr-03	-	Jun-11	May-03	May-18	
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
2006	103	Apr-06	-	Jun-06	May-06	May-06	

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 2006.

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
2006	470	Apr-14	-	Jun-16	May-06	May-17	
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
2006	676	Apr-15	-	Jun-17	May-07	May-19	

Dam	Year	Sample Size (n)	Date Range			Arrival Timing	
				-		Median	90%
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
2006	502	Apr-16	-	May-28	May-11	May-20	
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
2006	154	Apr-21	-	Jun-03	May-11	May-23	

¹ NPT PIT tagged fish released at dark

² FPC PIT tagged fish released after recovery

Appendix M. Mortality of Nacó'x (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 2 to November 22, 2005.

Source of Mortality	Nacó'x (Chinook salmon)				Héeyey (steelhead)			
	Natural		Hatchery		Natural		Hatchery	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Trapping	10	0.351	0	0.000	0	0.000	0	0.000
Handling	1	0.035	0	0.000	0	0.000	0	0.000
Tagging	1	0.035	0	0.000	0	0.000	0	0.000
DOA	1	0.035	0	0.000	0	0.000	0	0.000
Number Captured	2,851		0		46		5	
Total Mortality	13	0.456	0	0.000	0	0.000	0	0.000

Appendix N. Mortality of Nacó'x (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 1 to June 20, 2006.

Source of Mortality	Nacó'x (Chinook salmon)				Héeyey (steelhead)			Unknown		
	Natural		Hatchery		Natural		Hatchery		(n)	(%)
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Trapping	7	0.565	83	0.361	6	0.257	6	0.045	0	0.000
Handling	1	0.081	1	0.004	0	0.000	1	0.008	0	0.000
Tagging	2	0.002	0	0.000	2	0.086	0	0.000	0	0.000
DOA	0	0.000	4	0.017	0	0.000	1	0.008	1	100.000
Number Captured	1,239		22,982		2,334		13,313		1	
Total Mortality	10	0.807	88	0.383	8	0.343	8	0.060	1	100.000

Appendix O. The catch of incidental fish during the fall, 2 October to 22 November 2005, and the spring, 1 March to 19 June 2006, at the Imnaha River juvenile fish trap for the 2006 migration year.

Family	Common Name	Fall 2005	Spring 2006	Total
Salmonidae	Adult Héeyey (steelhead)	1	150	151
	Adult Nacó'x̂ (Chinook Salmon)	0	1	1
	Rainbow Trout / Héeyey (steelhead)	137	1,361	1,378
	Cimey (Mountain Whitefish)	152	1	153
	Islam (Bull Trout)	69	9	78
Centrarchidae	Smallmouth Bass	6	6	12
Catostomidae	Muq'uc (Bridgelip Sucker)	0	6	6
	Muq'uc (Largescale Sucker)	0	10	10
	Muq'uc (unidentified species)	22	151	173
Cyprinidae	Tite'wxc (Chislemouth)	14	10	24
	Longnose Dace	1	75	76
	Qiyex (Northern Pikeminnow)	41	10	51
	Redside Shiner	12	1	13
	Peamouth	0	3	3
Cottidae	Sculpin (unidentified species)	2	14	16
Petromyzotidae	Adult Heesu (Pacific Lamprey)	0	0	0
	Juvenile Hessu (Pacific Lamprey)	0	6	6
Total Catch		587	1,684	2,271