MONITORING AND EVALUATION OF SMOLT MIGRATION IN THE COLUMBIA BASIN

VOLUME XVII

Evaluation of the 2008 Predictions of the Run-Timing of Wild and Hatchery-Reared Salmon and Steelhead Smolts to Rock Island, Lower Granite, McNary, John Day, and Bonneville Dams using Program RealTime

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Volume XI: Burgess, C., J.R. Skalski. 2004. Evaluation of the 2003 Predictions of the Run-Timing of Wild and Hatchery-Reared Migrant Salmon and Steelhead Trout migrating to Lower Granite, Rock Island, McNary, and John Day Dams using Program Real-Time. Technical Report to BPA, Project 91-051-00, Contract 00004134.

Volume XII: Townsend, Richard L., C. Burgess, J.R. Skalski. 2005. Evaluation of the 2004 Predictions of the Run-Timing of Wild and Hatchery-Reared Salmon and Steelhead Smolt to Rock Island, Lower Granite, McNary, John Day and Bonneville Dams using Program Real-Time. Technical Report to BPA, Project 91-051-00, Contract 00004134.

Volume XIII: Griswold, James D., Townsend, Richard L., J.R. Skalski. 2006. Evaluation of the 2005 Predictions of the Run-Timing of Wild and Hatchery-Reared Salmon and Steelhead Smolt to Rock Island, Lower Granite, McNary, John Day and Bonneville Dams using Program Real-Time. Technical Report to BPA, Project 91-051-00, Contract 00004134.

Volume XIV: Griswold, James D., Townsend, Richard L., J.R. Skalski. 2007. Evaluation of the 2006 Predictions of the Run-Timing of Wild and Hatchery-Reared Salmon and Steelhead Smolt to Rock Island, Lower Granite, McNary, John Day and Bonneville Dams using Program Real-Time. Technical Report to BPA, Project 91-051-00, Contract 00004134.

Volume XV: Griswold, J., R. L. Townsend, and J. R. Skalski. 2007. Evaluation of the 2007 Predictions of the Run-Timing of Wild and Hatchery-Reared Salmon and Steelhead Smolts to Rock Island, Lower Granite, McNary, John Day, and Bonneville Dams using Program RealTime. Technical report to BPA, Project 91-051-00, Contract 29676.

Volume XVI: Buchanan, R. A., J. R. Skalski, J. L. Lady, P. Westhagen, J. Griswold, and S. G. Smith. 2007. Survival and Transportation Effects for Migrating Snake River Hatchery Chinook Salmon and Steelhead: Historical Estimates From 1996-2003. Technical report to BPA, Project 91-051-00, Contract 0025093.

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1997

Townsend, R. L., D. Yasuda, and J. R. Skalski. 1997. Evaluation of the 1996 predictions of run-timing of wild migrant spring/summer yearling Chinook in the Snake River Basin using program RealTime. Technical Report (DOE/BP-91572-1) to BPA, Project 91-051-00, Contract 91-BI-91572.

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1995

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Smith, S. G., J. R. Skalski, and A. E. Giorgi. 1993. Statistical evaluation of travel time estimation based on data from freeze-branded Chinook salmon on the Snake River, 1982-1990. Technical Report (DOE/BP-35885-4) to BPA, Project 91-051-00, Contract 87-BI-35885.

Preface

Project 91-051 was initiated in response to the Endangered Species Act (ESA) and the subsequent 1994 Council Fish and Wildlife Program (FWP) call for regional analytical methods for monitoring and evaluation. This project supports the need to have the "best available" scientific information accessible to the BPA, fisheries community, decision-makers, and public by analyzing historical tagging data to investigate smolt outmigration dynamics, salmonid life histories and productivity, and providing real-time analysis to monitor outmigration timing for use in water management and fish operations of the hydrosystem. Primary objectives and management implications of this project include: (1) to address the need for further synthesis of historical tagging and other biological information to improve understanding and identify future research and analysis needs; (2) to assist in the development of improved monitoring capabilities, statistical methodologies and software tools to aid management in optimizing operational and fish passage strategies to maximize the protection and survival of listed threatened and endangered Snake River salmon populations and other listed and non-listed stocks in the Columbia River Basin; (3) to develop better analysis tools for monitoring evaluation programs; and (4) to provide statistical support to the Bonneville Power Administration and the Northwest fisheries community.

The following report addresses measure 4.3C of the 1994 Northwest Power Planning Council's Fish and Wildlife Program with emphasis on improved monitoring and evaluation of smolt migration in the Columbia River Basin. This report represents the sixteenth in a series of technical reports presenting results of applications of statistical program RealTime to present inseason predictions of the status of smolt migrations in the Columbia River Basin. Results and evaluation of program RealTime 2007 predictions of the run-timing of wild and hatchery-reared salmon and steelhead trout to Lower Granite, Rock Island, McNary, John Day, and Bonneville dams are presented. It is hoped that making these real-time predictions and supporting data available on the internet for use by the Technical Management Team (TMT) and members of the fisheries community will contribute to effective in-season population monitoring and assist in-season management of river and fisheries resources. Having the capability to more accurately predict smolt outmigration status improves the ability to match flow augmentation to the migration timing of ESA listed and other salmonid stocks and also contributes to the regional goal of increasing juvenile passage survival through the Columbia River system.

Abstract

Program RealTime provided monitoring and forecasting of the 2008 inseason outmigrations via the internet for 16 PIT-tagged stocks of wild ESU Chinook salmon and steelhead to Lower Granite and/or McNary dams, one PIT-tagged hatchery-reared ESU of sockeye salmon to Lower Granite Dam, one PIT-tagged wild stock of sockeye salmon to McNary Dam, and 20 passage-indexed runs-at-large, five each to Rock Island, McNary, John Day, and Bonneville dams. Thirteen stocks are of wild yearling Chinook salmon which were captured, PIT-tagged, and released at sites above Lower Granite Dam in 2007 and have at least three year's historical migration data previous to the 2008 migration. These stocks originate in tributaries of the Salmon, Grande Ronde and Clearwater Rivers, all tributaries to the Snake River, and are subsequently detected through tag identification and monitored at Lower Granite Dam.

Seven wild PIT-tagged runs-at-large of Snake or Upper Columbia River ESU salmon and steelhead were monitored at McNary Dam. Three wild PIT-tagged runs-at-large were monitored at Lower Granite Dam, consisting of the yearling and subyearling Chinook salmon and the steelhead runs. The hatchery-reared PIT-tagged sockeye salmon stock from Redfish Lake was monitored outmigrating through Lower Granite Dam. Passage-indexed stocks (stocks monitored by FPC passage indices) included combined wild and hatchery runs-at-large of subyearling and yearling Chinook, coho, and sockeye salmon, and steelhead forecasted to Rock Island, McNary, John Day, and Bonneville dams.

Executive Summary

2008 Objectives

1. Apply Program RealTime to provide in-season predictions of the run-timing of Fish Passage Center (FPC) passage-index counts of runs-at-large of subyearling and yearling Chinook salmon, sockeye salmon, and coho salmon and steelhead to Rock Island, McNary, John Day, and Bonneville dams (20 stocks total) and to provide in-season predictions of the run-timing of PIT-tagged stocks to Lower Granite and McNary dams (26 runs total). The PIT-tagged stocks include 16 wild runs-at-large of yearling and subyearling Chinook salmon, and steelhead, and one hatchery-reared stock of sockeye salmon from the Salmon River drainage. Specific tasks were to predict and report in real-time the "percent run-to-date" and "date" to specified percentiles" of the outmigrations to the dams.

2. Post on-line predictions on outmigration status and trends in order to improve in-season population monitoring information available for use by the Technical Management Team and the fisheries community to assist river management.

Accomplishments

Runs-at-large of FPC passage indices of combined hatchery and wild salmon and steelhead were monitored and forecasted by Program RealTime in 2008 to Rock Island, McNary, John Day, and Bonneville dams. Runs-at-large of wild PIT-tagged salmon and steelhead were monitored and forecasted by Program RealTime in 2008 to Lower Granite and McNary dams. These runs included Snake River steelhead, Upper Columbia steelhead, the composite of these two steelhead runs, Snake River yearling Chinook salmon, Snake River sockeye salmon, Snake River subyearling Chinook salmon, and Upper Columbia River subyearling Chinook salmon. The release/recovery stocks of wild PIT-tagged yearling Chinook salmon tracked to Lower Granite Dam included Big Creek, Catherine Creek, Grande Ronde River, Imnaha River, Imnaha Trap, Johnson Creek Trap, Lemhi River, Lemhi River Weir, Lookingglass Creek, Lostine River, Meadow Creek, Minam River, and Valley Creek (13 total). Two release/recovery stocks of wild PIT-tagged subyearling Chinook salmon tracked to Lower Granite Dam are a stock marked and released by William Connor (Dvorshak Fish Complex) between river kilometers 224 and 268 on the mainstem Snake River or released into the Clearwater River. The release/recovery stock of hatchery-reared PIT-tagged sockeye salmon tracked to Lower Granite Dam was Redfish Lake.

Since 1999, unmarked hatchery salmon have been released into the Snake River. To provide run-timing information on wild runs-at-large since then, the RealTime forecasting project has monitored and forecasted wild, PIT-tagged subpopulations of salmon and steelhead to Lower Granite Dam, and beginning in 2001, to McNary Dam.

On-line run-timing predictions were provided via the Internet at *www.cbr.washington.edu/crisprt* to the fisheries community throughout each smolt outmigration. The types of graphical displays available

for each stock in the RealTime project are included throughout this report. Also available (and included in the appendices to this report) are detailed tabular displays of historical run-timing information and expected rates of detection for each stock (Appendices B and D).

Findings

Program RealTime performance is evaluated using MADs (*mean absolute differences*, the average of the absolute difference between predicted and true passage percentiles), calculated for the first and last halves of the outmigration, and for the season-wide outmigration.

The run-at-large of wild PIT-tagged Snake River yearling Chinook salmon smolts monitored at McNary Dam was predicted very well in 2008, with a season-wide MAD of 2.8%. Program RealTime predictions for the run-at-large of wild PIT-tagged yearling Chinook salmon from the Snake River drainage outmigrating to Lower Granite Dam were comparable to the previous years (MAD = 6.0%). Stocks from release sites that were monitored individually by Program RealTime in 2008 varied in prediction errors as reflected by the all-stocks composite run (season-wide MAD = 4.1%) and on the average (mean MAD over all stocks for the entire season was 7.7%). Four of 16 stocks had a season-wide MAD larger than 10%. The larger prediction errors in 2008 are mostly due to later, quicker migrations this year for those stocks.

RealTime predictions of the run-timing of wild PIT-tagged Snake River steelhead trout to Lower Granite and McNary Dams were slightly worse than last year (season-wide MADs of 3.5% and 3.7%, respectively, compared to 2.8% and 1.4% last year). The numbers of Upper Columbia River steelhead trout outmigrating to McNary Dam were far below expected, but well-predicted this year (season-wide MAD was 3.1% compared to 33.5% in 2007).

The monitoring and forecasting at McNary Dam of the run of wild PIT-tagged Snake River sockeye salmon was slightly poorer in 2008, with a season-wide MAD of 5.1% versus 3.1% last year. Though the predicted number of detections was close to the actual count, this run was more extended than historically at McNary Dam. The season-wide MAD for PIT-tagged hatchery sockeye salmon from Redfish Lake was 6.2%, comparable to 3.1% last year. Wild PIT-tagged Snake River subyearling fall Chinook passage at Lower Granite Dam had greater MADs than last year (season-wide MAD = 5.4 % versus last year's 3.4%). The runs of wild PIT-tagged Upper Columbia and Snake River subyearling fall Chinook salmon monitored at McNary Dam had season-wide MAD's of 4.5% and 6.1% respectively.

The results of Program RealTime in forecasting run-timing and passage percentiles of FPC passage-indexed runs-at-large to Rock Island, McNary, John Day, and Bonneville Dams were excellent this year. In particular, only 3 of 20 stocks had season-wide MADs above 5%; 4 were between 3-5%, 7 had MADs 2-3%; and 6 had season-wide MADs within 2% of the true end-of season distribution.

Management Implications

The ability to accurately predict the outmigration status of composite or individual salmon and steelhead stocks at different locations in the Federal Columbia River Power System (FCRPS) can provide valuable information to assist water managers. Since the 1994 outmigration, Program RealTime has been applied to provide in-season predictions of smolt outmigration timing for individual and aggregates of listed threatened and endangered Snake River salmon stocks, and, since 2000, of listed Mid-Columbia River stocks. These predictions have been made publicly available to the fisheries community to assist in-season river management in real time throughout the course of the smolt outmigration.

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Acknowledgments

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Appreciation is extended to Chris Van Holmes and Susannah Iltis of the School of Aquatic & Fishery Sciences at the University of Washington for providing critical technical, data management, and computer programming support.

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1.0 Introduction

Regulating the timing and volume of water released from storage reservoirs (often referred to as flow augmentation) has become a central mitigation strategy for improving downstream migration conditions for juvenile salmonids in the Columbia River Basin. Snake River and Upper Columbia River water managers have used flow augmentation to improve the outmigration survival of stocks listed as threatened or endangered under the Endangered Species Act (ESA). Timing the release of water so that the listed stocks are in place to encounter these augmented flows requires knowledge of the status and trend of the stocks' outmigration timing.

In 1993, work was begun under this project to develop real-time predictions of smolt outmigration dynamics for ESA-listed stocks from the Snake and Columbia Rivers. Program RealTime was developed as a statistical software program which predicts run-timing of individual stocks of salmonids (Skalski et al. 1994). It uses historical data to predict the percentage of the outmigration that will reach an index site in real-time, and it forecasts the elapsed time until some future percentage is observed at that site. The first in-season predictions were of wild spring/summer Chinook salmon smolts from the Snake River drainage above Lower Granite Dam during the 1994 outmigration. These fish originate in streams listed by the National Marine Fisheries Service (NMFS) as evolutionarily/ecologically significant units (ESUs). As parr, a portion of these fish are annually implanted with passive integrated transponder (PIT, Prentice et al., 1990a, b, c) tags, and released back into their natal streams (Achord et al., 1994, 1995, 1996, 1997, 1998, 2000) where they overwinter until their outmigration as yearlings in the spring and summer. During outmigration, PIT-tag detectors at Lower Granite Dam read the tag codes so individual stocks can be monitored.

University of Washington fisheries scientists subsequently incorporated Program RealTime predictions into their CRiSP model to move the forecasted runs of these stocks down the Snake and Columbia rivers to McNary Dam (e.g., Hayes et al. 1996, Beer et al. 1999, *http*://www.cqs.washington.edu/crisprt).

Since 1994, the RealTime forecasting project has expanded its scope to monitor and forecast other NMFS-listed populations of Columbia River Basin salmonids. In 1997, Program RealTime began forecasting the run-timing of hatchery-reared PIT-tagged summer-run sockeye salmon released into remote lakes and streams in Idaho over 700 kilometers upriver from Lower Granite Dam. *Release-recovery* data was used for the first migration forecasts by RealTime, and beginning with the 1997 migration year, Program RealTime was adapted to utilize *index-count* data such as Fish Passage Center (FPC) passage indices (e.g., FPC, 1999). The distinction between these two types of data is important for understanding how RealTime makes initial predictions early in the season, and are described in detail in the models section (Section 2.4.1). Release-recovery counts consist only of those detections of fish that are identified as part of a specific release group, i.e., fish with PIT-tags identifying their release to a specific time or place

(or both). By contrast, index-count stock data consist of all detections at the dam of a particular species, regardless of their release details, i.e., regardless of when or where they were released. Index-count stocks using FPC passage indices were included in the RealTime project to provide run-timing forecasts for wild runs-at-large of yearling and subyearling Chinook salmon and steelhead trout to Lower Granite Dam. These runs were predicted with considerable accuracy (Townsend et al. 1998, Burgess et al. 1999) but were discontinued in 1999 and 2000 when hatcheries ceased their practice of marking their fish to distinguish them from wild fish (Burgess et al. 1999). To continue providing run-timing information on wild Snake River runs-at-large of yearling and subyearling Chinook salmon and steelhead trout, the RealTime project began to monitor PIT-tagged wild fish. The first such stock was a release-recovery stock of wild subyearling fall Chinook tagged for doctoral research by William Connor (Burgess et al., 1999), a subpopulation whose run-timing characteristics were believed to mimic those of the larger wild population. In 2000, RealTime began monitoring two wild index-count stocks of PIT-tagged salmon and wild steelhead trout at Lower Granite Dam, and in 2001, seven new such stocks were monitored at McNary Dam, including runs from the Upper Columbia River as well as the Snake River, reflecting concern about water management during a predicted drought year (Burgess and Skalski, 2001).

While releasing unmarked hatchery fish into the Snake River spelled the demise of the RealTime project's capability of monitoring wild runs-at-large to Lower Granite (because hatchery releases swamp the signature passage patterns of wild fish), the same is not true for all Columbia River Basin dams. In 2000, the RealTime project began monitoring and forecasting runs-at-large of combined hatchery and wild salmon and steelhead to Rock Island Dam on the upper Columbia River and to McNary Dam on the mainstem Columbia. For these forecasts, Program RealTime used FPC passage indices. In 2001, out of concern about passage status in a low flow year, the run-at-large of combined wild and hatchery subyearling fall Chinook salmon was monitored and forecasted to John Day Dam on the Columbia River, using FPC passage indices (Burgess and Skalski 2001). In 2002, we expanded RealTime's John Day forecasting to include all species of salmonid, and added Bonneville Dam in 2004.

This report presents a post-season analysis of Program RealTime performance for 2008. RealTime predictions are compared with end-of-season observed distributions of passage indices or PIT-tag detections at Lower Granite, Rock Island, McNary, John Day, and Bonneville dams. During the outmigration season, predictions were accessible daily, via the internet at address mailto:http://www.cbr.washington.edu/crisprt. The website's end-of-season graphical and tabular displays of Program RealTime results, by stock, are included in Appendices A through D. Appendix A contains the daily record of RealTime predictions compared with the end-of-season observed distributions for all runs monitored by Program RealTime in 2008. Appendix B contains graphical and tabular displays of historical run-timing characteristics, including the dates of the first and last detections of the season, and dates of the 5th, 10th, 50th, 90th and 95th percentiles of passage, the middle 80% passage period (in days), the total numbers of fish counted inseason annually, and for the release-recovery stocks, the expected number of

annual detections. Appendix C contains records of daily flow, spill, and spill-adjustment parameters (Section 2.4). Appendix D displays the record of RealTime performance since 1995 of all stocks included in the 2008 project.

2.0 Methods

2.1 Description of Data

2.1.1 *PIT-Tagged Stocks*

PIT-tag data are made available by the Pacific States Marine Fisheries Commission's PIT Tag Information System (PTAGIS) project. In 2008, the outmigration status was monitored and forecasted at Lower Granite Dam for release sites of wild PIT-tagged subyearling and 13 yearling Chinook salmon and one release site of hatchery sockeye salmon. In addition, a number of composites of Snake River and Upper Columbia River release sites for steelhead trout, yearling Chinook, sockeye, and subyearling Chinook salmon were monitored at both Lower Granite and McNary Dams.

Release-Recovery Stocks

The RealTime project provided run-timing information on 16 release-recovery stocks, all monitored at Lower Granite Dam. These were: (1) 13 stocks of wild spring/summer yearling Chinook salmon captured, tagged and released into streams above Lower Granite during the spring, summer and fall of 2008, (2) two populations of wild subyearling fall Chinook salmon PIT-tagged by William Connor and released into the Snake River near its confluence with the Salmon River, or into Clearwater River, and (3) one hatchery-reared, summer-run sockeye salmon stock outmigrating from Redfish Lake in Idaho. Table 2.1 displays the U.S. Geological Survey hydro-unit numbers for these release sites.

Release-recovery stocks originating from tag/release sites have additional filters on the data that index-count stocks do not. Originally, tag/release sites were chosen on the basis of their consistent recovery numbers (PIT-tag detections at LGR)[1], and by virtue of having at least three years of historical data, each with at least 30 PIT-tag detections. As the number of historical years available has increased, the number of PIT-tag detections was increased to 50 to smooth the predictions in 2008. Finally, detections of fish tagged May 31 – November 1 of the previous year are used, as fish marked later may have different migrational timing characteristics (Keefe et al. 1995, 1996). Over the years, stocks with less historical information were added, as it was found that the program was able to provide good predictions for these as well. From 1998 through 2001, only stocks PIT-tagged by experienced taggers Steve Achord or Paul

[1] Detections of PIT-tagged smolts at Lower Granite Dam are seen as recaptures or recoveries in a tag-release-recapture experiment, so the terms "recapture," "recovery," and "detection" may be used interchangeably.

Sankovitch were included in the project. This criterion was dropped for the 2002 RealTime Project as these taggers did not tag fish in the summer and fall of 2001. Since 2003, only the seasonal criteria were kept in place.

In addition, a number of "composite runs" (combined data from several streams treated as a single stock) were forecasted at Lower Granite Dam. Composite runs tend to produce good predictions, as the larger number of fish in the combined group smooth and dampen the randomness observed in individual stock release groups. They can be useful for providing general run-timing information for broad geographical regions. The RealTime Composite consists of all the individual release sites of yearling Chinook used in Program RealTime. (Table 2.1).

Table 2.1: The GIS hydro-units of the 13 PIT-tag/release sites for spring/summer yearling Chinook salmon, one PIT-tag/release site for fall subyearling Chinook salmon, and one PIT-tag release site for sockeye salmon. These are all release sites for the 16 release-recovery stocks included in the 2008 Program RealTime forecasting project, monitored at Lower Granite Dam.

Release Site					GIS Hydrounit[2]
Abbreviation	Long Name	Rearing	Run	Species	
BIGC	Big Creek	W	Sp/Su	Chinook	17060206
CATHEC	Catherine Creek	W	Sp/Su	Chinook	17060104
CLWR	Clearwater River	W	Fall	Chinook	17060306
GRAND2	Grande Ronde	W	Sp/Su	Chinook	17060104
IMNAHR	Imnaha River	W	Sp/Su	Chinook	17060102
IMNTRP	Imnaha Trap	W	Sp/Su	Chinook	17060102
JOHTRP	Johnson Creek Trap	W	Sp/Su	Chinook	17060208
LEMHIR	Lemhi River	W	Sp/Su	Chinook	17060204
LEMHIW	Lemhi River Weir	W	Sp/Su	Chinook	17060204
LOOKGC	Lookingglass Creek	W	Sp/Su	Chinook	17060104
LOSTIR	Lostine River	W	Sp/Su	Chinook	17060105
MEADOC	Meadow Creek	W	Sp	Chinook	17060302
MINAMR	Minam River	W	Sp/Su	Chinook	17060106
REDFL	Redfish Lake	H	Su	Sockeye	17060201
SNAKER	Snake River (RK 224 to 268)	W	Fall	Chinook	17060110
VALEYC	Valley Creek	W	Sp/Su	Chinook	17060201

[2] Geographical Information System (GIS) designations established by the U.S. Geological Survey.

PIT-tagged wild fall subyearling Chinook salmon were monitored at Lower Granite and McNary dams to provide run-timing information about the wild run-at-large of Snake River fall subyearling Chinook salmon, as FPC passage indices for the wild run were unavailable after June 6, 1999 (Burgess et al., 1999). Since 1993, subyearling fall Chinook salmon smolts have been sampled, PIT-tagged, and released into the Snake River between river kilometers 224 and 268. These smolts are tagged and released at regular intervals, from April into July or until water temperatures approach 20^{o}C or catch counts near zero. They begin to appear in the detection facility at Lower Granite Dam around June 1 and continue through September or October. This subpopulation mimics passage of the run-at-large well during the first and middle portions of the run.

One release-recovery stock of sockeye salmon was included in 2007. The hatchery-reared summer-run sockeye salmon from Redfish Lake was monitored at Lower Granite Dam.

Index-Count Stocks

Composite stocks of run-at-large groups pose a challenge in estimating the outmigration status at a dam. While analyses of individual releases could provide a historical percentage of the release size observed at a dam, these individual releases are usually quite small and variable. In addition, release sizes change annually, further muddling the contribution each group adds to the expected number of total fish to be observed at a dam. Instead of focusing on the total number of fish released, index-count stocks estimate the status of the outmigration upon the number of fish observed at a dam compared to the total expected to be observed, based on historical counts. For example, a release-recapture stock may have 10% of the total released historically appear at Lower Granite Dam; so of 1000 fish released this year, we would expect that 100 fish total will show up. For an index-count stock, we don't know what percent of the fish released has been observed historically, but do know that on average, 100 total fish have been counted, and so expect the same again this year.

Run-at-large composites were created for a number of species. Each composite consists of PIT-tagged wild fish released in either the Snake River drainage or the Upper Columbia River. Table 2.2 lists which species run-at-large composites were monitored at Lower Granite and McNary Dams.

Table 2.2: Migration status at Lower Granite and McNary dams was monitored and forecasted for the indicated PIT-tagged, wild species released in the Snake River drainage, Upper Columbia River, or combination of the two. An "X" indicates that that group was included in 2008.

		Detection Site	
Species	Composite Run-at-Large	Lower Granite Dam	McNary Dam
Yearling Chinook salmon	Snake River	X	X
Steelhead trout	Snake River	X	X
	Upper Columbia River		X
	Combined		X
Sockeye salmon	Snake River		X
Subyearling Chinook salmon	Snake River[3]	X	X
	Upper Columbia River		X

2.1.2 *Fish Passage Center (FPC) Passage-Indexed Stocks*

Passage index data were made available by the Northwest Power and Conservation Council's (NWPCC) Fish Passage Center (FPC). Passage indices are sample counts in the bypass system at the dam divided by the proportion of water passing through the sampling system. They are collected according to FPC sampling plans (e.g., Fish Passage Center, 1999), and are intended to reflect the size of the run. All FPC passage-indexed stocks are index-count stock. Timing characteristics of these runs of mid-Columbia and mainstem Columbia River yearling and subyearling Chinook salmon, coho, and sockeye salmon and steelhead trout runs were monitored and forecasted to Rock Island, McNary, John Day and Bonneville dams. The migration status can be very accurately predicted, provided large hatchery releases do not overwhelm the normal signature pattern of fish passage run-timing (Burgess and Skalski, 2000).

2.2 Preprocessing of Data

Raw PIT-tag detections are adjusted for spill fraction (Section 2.3) and smoothed using three 5-day smoothing passes to filter out statistical randomness before input to the RealTime forecaster algorithm. Raw passage index data are smoothed the same as PIT-data.

2.3 Adjustment of Raw Smolt Counts for Spill or Flow.

2.3.1 *PIT-Tagged Stocks*

PIT-tagged stocks are detected at a dam by passing through a PIT-tag interrogation system, usually set up in bypass routes. However, this is not the only route past a dam—fish that pass through the

[3] The subyearling Chinook run-at-large composite migration forecasts at Lower Granite Dam use fish PIT-tagged and released into the Snake River between river kilometers 224 and 268, and are not an *index-count* stock.

spillway are not detected, so formulas are devised to upwardly adjust the raw counts of PIT-detections. To get an estimate of the total fish passing through a dam on a particular day. Daily numbers of fish detected, "raw counts," are multiplied by an expansion factor, resulting in "adjusted counts" according to the formula

raw counts x expansion factor = adjusted counts.

The expansion factor is $$\frac{1}{1-SE}, \tag{2.1}$$

where *SE* is *spill effectiveness,* the fraction of smolts passing through the spillway (NMFS 2000). Different formulations for *SE* are required for different species of salmonids (Skalski and Perez-Comas 1998) and for different dam configurations (NMFS 2000). The formula for spill effectiveness for Chinook and sockeye salmon at Lower Granite Dam is given by Smith et al. (1993) as

$$SE_{chinook\_sockeye} = 1.667\left(\frac{S}{F}\right)^3 - 3.25\left(\frac{S}{F}\right)^2 + 2.583\left(\frac{S}{F}\right) \tag{2.2a}$$

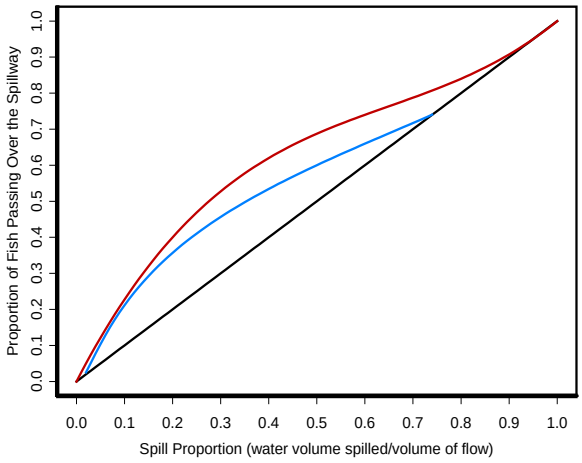
(Figure 2.1, red), and the formula for steelhead is given by Skalski and Perez-Comas (1998) as

$$SE_{steelhead} = 0.6001^{\exp\left(-0.5063 \cdot \log\left(\frac{S/F}{1-S/F}\right)\right)}. \tag{2.2b}$$

In the figure, *S* is the daily volume of water spilled and *F* is daily outflow volume. For 2000, the formulation of *SE* as a function of spill proportion at McNary Dam was a one-to-one function (NMFS 2000) of *SE* to spill proportion (i.e., the volume of water spilled divided by volume of outflow) (Figure 2.1, black),

$$SE = \frac{S}{F} = \text{spill volume / flow volume = spill proportion.} \tag{2.2c}$$

Figure 2.1: Spill effectiveness (SE) functions (Equations 2.2a, b, c) used by Program RealTime to upwardly adjust raw PIT-tag detections. Shown are the 2006 RealTime spill effectiveness curves as functions of spill proportion (S/F, the proportion of spill, S, relative to outflow, F) at Lower Granite Dam (red, blue) and at McNary Dam (black).



2.3.2 *FPC Passage-Indexed Stocks*

Raw passage index data are adjusted for the spill fraction by the Fish Passage Center.

2.4 The RealTime Forecaster

2.4.1 *Models and Algorithm*

The RealTime forecaster is essentially a pattern-matching algorithm. However, at the beginning of the outmigration there is very little in the way of a pattern to match. To optimize predictions for all phases of the outmigration, the forecaster utilizes three models: a start-up model for initial predictions, the pattern-matching model, and a switching model to govern the timing of the switch between the start-up and pattern-matching models.

The pattern-matching portion is accomplished by a least-squares (LS) model, where the patterns are cumulative percentage curves of outmigrating smolts. Current-year data are compared with historical cumulative percentage curves by comparing their slopes at each percentile, $j = 1,\ldots, 100$, using the measure

$$\sum_j \left(s_j - s_{ijp} \right)^2, \tag{2.3}$$

where s_j is the slope at the j^{th} percentile of current-year data to-date and s_{ijp} is slope at the j^{th} percentile of p percent of historical year i's outmigration. The value p of that minimizes (2.3), i.e.,

$$\min_p \left[\sum_{j=1} \left(s_j - s_{ijp} \right)^2 \right], p = 0,...,100 \tag{2.4}$$

is the best predictor from the point of view of pattern-matching to historical year i.

The start-up model produces run-percentage (RP) estimates

$$p_{RP} = \frac{x_d}{\widehat{E(S)}}, \tag{2.5}$$

where x_d = total number of fish observed by day d of the outmigration, and

$\widehat{E(S)}$ = the total expected outmigration through the detection facility.

How the expected total migration is estimated depends on the type of data. For tagged stocks that have reliable annual release/recapture data (i.e., the 19 release-recovery stocks monitored at Lower Granite Dam, Section 2.1.1), $\widehat{E(S)} = \overline{r} \times N$, where $\overline{r}$ is the average annual historical recapture percentage[4] at the detection facility, and N is total number of fish released from a release site the previous year (for yearling Chinook salmon) or earlier in the year (for subyearling Chinook and sockeye salmon). Table 2.3 displays $N, \overline{r}$, and $\widehat{E(S)}$ for each release-recovery stock. For index-count data such as FPC passage indices and PIT-tagged aggregates (Section 2.1.1), $\widehat{E(S)}$ is the average number of historical detections. Table 2.4 displays expected observed counts for each index-count stock. The RP estimates (2.5), are more accurate than LS (pattern-matching) estimates (2.4) initially, but are quickly outperformed by LS model as the season progresses (Townsend et al. 1995, 1996, 1997).

The switching model is an age-of-run (AR) model based on mean fish-run-age (MFRA). This switching model weights the predictions from the LS and RP models differentially as the outmigration season progresses. Thus, each model provides its unique estimate for the true passage percentile for the day, and the algorithm minimizes a complex formula weighting estimates from each model and their respective error calculations (see Burgess et al. 1998 for complete algorithm details). The forecaster effectively combines age-of-run (AR) and run percentage (RP) indicators together with the least-squares (LS) pattern-matching principle into a single, more accurate and robust predictor.

[4] Annual recapture percentage is the number of unique fish detected divided by the total number released.

Table 2.3: Data used by Program RealTime in 2008 to compute initial predictions (Equation 2.5), for PIT-tagged, release-recovery stocks of wild Snake River spring/summer yearling Chinook salmon, hatchery sockeye salmon, and wild PIT-tagged Clearwater and Snake River subyearling fall Chinook salmon[5]. The number of PIT-tagged parr released by site (*N*), the historical average of annual recapture percentage for each site ($\bar{r}$), and the expected number of detections for the 2008 migration year.

Tagging Location	# parr released (N)	Avg. Historical % ($\bar{r}$)	$\hat{E}(S)$
Big Creek	6362	11.6	738.45
Catherine Creek	1950	10.2	199.87
Clearwater River subyearling Chinook	1096	36.7	402.75
Grande Ronde	1242	13.9	172.02
Imnaha River	1000	15.7	157.12
Imnaha Trap	8152	10.7	869.38
Johnson Creek Trap	2711	15.8	428.16
Lemhi River	1272	19.3	245.78
Lemhi River Weir	952	15.0	142.68
Lookingglass Creek	2000	12.9	258.94
Lostine River	1999	11.0	219.46
Meadow Creek	1728	16.9	291.70
Minam River	1500	13.3	198.88
Redfish Lake Sockeye	989	6.8	67.67
Snake River (RK 224 to 268) wild subyearling Chinook salmon	6756	25.3	1709.79
Valley Creek	2524	6.8	172.24

[5] Data Sources: PTAGIS and FPC Smolt Index Databases and RealTime program output as of December 2008

Table 2.4: Data used by Program RealTime in 2008 to compute predictions (Equation 2.5) for index-count stocks at the beginning of the migration. Average historical observed counts[6] of index-count stocks (runs-at-large) monitored and forecasted by RealTime in 2008 are used to predict current year expected numbers of counts, $\widehat{E(S)}$, (Section 2.4.1) using the run percentage (RP) model.

Rearing	Type of Data	Predicted Passage at	Stock	$\widehat{E(S)}$
Wild	PIT-tag	Lower Granite Dam	Spring/Summer Yearling Chinook	3,993
			Steelhead Trout	7,144
		McNary Dam	Snake River Yearling Chinook Salmon	11,171
			Snake River Steelhead	3,500
			Upper Columbia River Steelhead	6,373
			Snake & Upper Columbia River Steelhead	9,340
			Snake River Sockeye Salmon	453
			Snake River Subyearling Chinook Salmon	14,633
			Upper Columbia River Subyearling Chinook Salmon	700
Combined Wild & Hatchery	FPC Passage Indices	Rock Island Dam	Yearling Chinook Salmon	25,399
			Steelhead	19,719
			Coho Salmon	44,408
			Sockeye Salmon	14,437
			Subyearling Chinook Salmon	18,921
		McNary Dam	Yearling Chinook Salmon	2,066,716
			Steelhead	557,767
			Coho Salmon	220,431
			Sockeye Salmon	607,229
			Subyearling Chinook Salmon	7,360,807
		John Day Dam	Yearling Chinook Salmon	1,387,100
			Steelhead	796,900
			Coho Salmon	311,970
			Sockeye Salmon	380,612
			Subyearling Chinook Salmon	1,981,149
		Bonneville Dam	Yearling Chinook Salmon	1,386,901
			Steelhead	470,648
			Coho Salmon	987,447
			Sockeye Salmon	236,720
			Subyearling Chinook Salmon	1,681,339

[6] Data Sources: PTAGIS and FPC Smolt Index Databases and RealTime program output as of December 2007

2.4.2 *Precision of Estimator: Confidence Intervals for* $\hat{P}$

Each day of the run, a jackknife confidence interval is constructed for the daily prediction estimate, $\hat{P}$ (Section 2.4.1). Jackknifing is a computer-intensive method of extracting sampling distribution information about an estimator by recomputing the estimator from different subsets of the historical data. A jackknife subset consists of the complete set of historical years minus one year. If a release site has, say, six years of historical data, there will be 6 subsets of 5 years each. A prediction is estimated from each subset, and these jackknife predictions provide a measure of dispersion on which the daily confidence interval is based.

2.4.3 *Evaluating RealTime Performance*

The true outmigration percentile on day, P_d, can only be observed after the run is finished and all the fish that will be detected have passed (i.e., $P_{last} = 100\%$). When the run is over, we evaluate program RealTime's performance using the mean absolute difference (MAD) between observed outmigration percentiles, P_d, and their estimates, $\hat{P}_d$, for all days, *d*, until both predicted and observed runs are at 100%:

$$MAD = \frac{\sum_{d=1}^{n} \left| \hat{P}_d - P_d \right|}{d} \times 100\%$$

where *n* is the total number of days from the appearance of the first fish to the day where both the observed and predicted run has reached 100%. This is a slight change from previous years, but more accurately reflects those occasions where Program RealTime has continued to forecast less than 100% passage at a dam after the last fish has, in fact, been observed for the current migration season. Historical MADs presented in this report have been updated to reflect this change, and to give legitimate comparisons to past performance.

3.0 Results

3.1 Wild ESUs

3.1.1 *PIT-Tagged Yearling Chinook Salmon*

Release-Recovery Stocks Monitored at Lower Granite Dam

An overall indicator of Program RealTime forecasting performance for the 13 wild PIT-tagged yearling Chinook salmon release-recovery stocks is the RealTime Select composite stock (Figure 3.1, see section 2.1.1 for definition). The RealTime Composite performance was similar to last year with a season-wide MAD this year of 4.11% compared to last year's value of 2.86%. Table 3.1 displays MADs for the yearling Chinook salmon release/recovery stocks tracked at Lower Granite Dam, the average MADs of all these stocks, and the MAD for the RealTime Select Composite stock. Nine stocks were dropped from last year's composite, due to insufficient PIT-tag releases, and five new stocks were added. Of the eight stocks that were continued from last year, five individual stocks improved in prediction performance. All three stocks (Big Creek, Minam River, and Valley Creek) having greater MAD's than last year, had runs that started later and ended earlier than historically.

Figure 3.1: Comparison of RealTime daily predictions vs. actual year-end distribution of the RealTime Select Composite fish passage through Lower Granite Dam (Section 2.1.1). The RealTime Select Composite is made up of 13 PIT-tagged spring/summer yearling Chinook salmon release-recovery stocks.

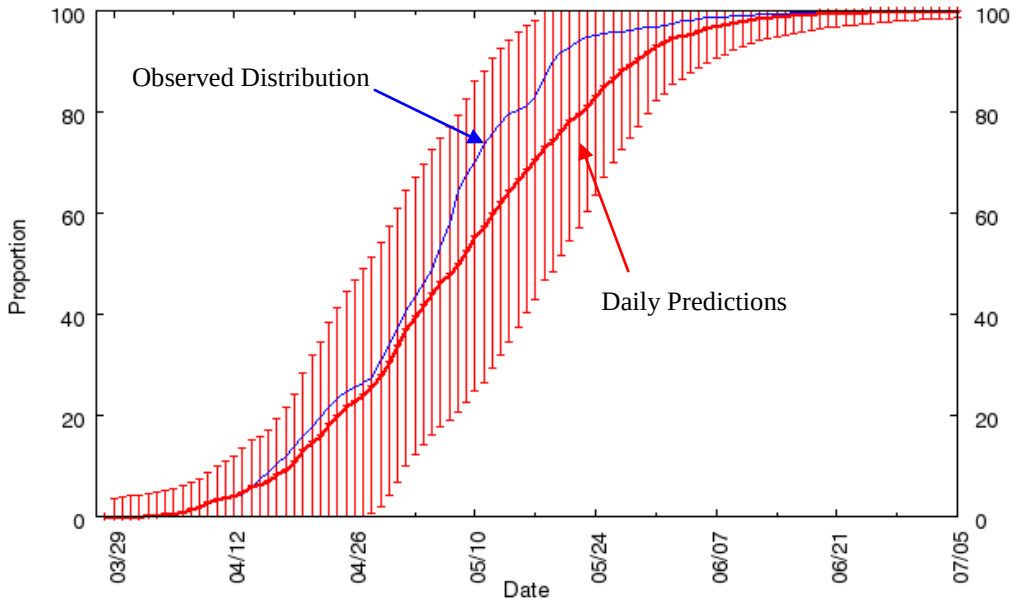


Table 3.1: Mean absolute differences (MADs, Section 2.4.3) for the 2007 and 2008 outmigrations to Lower Granite Dam of 19 and 13, respectively, of wild PIT-tagged Snake River spring/summer, spring, and summer yearling Chinook salmon ESUs, and the RealTime Select Composite (section 2.1.1). Columns show MADs for the entire run, the first 50% of the run, and the last 50% of the run. All sites met the RealTime historical data criteria.

Stock	2007			2008		
	Entire Run	First 50%	Last 50%	Entire Run	First 50%	Last 50%
Bear Valley Creek	7.20	6.79	7.41	NA	NA	NA
Big Creek	6.36	5.95	6.59	12.63	10.15	13.6
Camas Creek	6.48	7.78	5.84	NA	NA	NA
Cape Horn Creek	4.88	3.02	6.41	NA	NA	NA
Catherine Creek	9.51	8.67	9.89	7.24	7.17	7.27
Elk Creek	9.44	9.08	9.61	NA	NA	NA
Grande Ronde	NA	NA	NA	6.83	5.33	9.20
Herd Creek	12.11	2.56	13.34	NA	NA	NA
Imnaha River	3.77	1.62	4.82	2.30	1.21	2.91
Imnaha Trap	NA	NA	NA	10.16	14.98	6.67
Johnson Creek Trap	NA	NA	NA	6.11	6.87	5.70
Lake Creek	6.80	6.12	6.93	NA	NA	NA
Lemhi River	16.47	24.65	9.20	6.85	5.07	7.71
Lemhi River Weir	NA	NA	NA	10.69	8.50	11.65
Lookingglass Creek	10.05	9.07	10.74	2.13	2.39	1.94
Lostine River	8.73	10.69	6.88	8.44	14.35	4.99
Marsh Creek	NA	NA	NA	9.34	12.18	4.28
Meadow Creek	4.74	6.12	4.05	NA	NA	NA
Minam River	3.32	1.89	4.12	6.04	9.19	3.43
Newsome Creek	10.11	17.69	5.17	NA	NA	NA
Secesh River	4.03	3.08	4.27	NA	NA	NA
Valley Creek	7.62	3.88	9.48	11.20	6.57	13.46
Mean MAD	7.74	7.57	7.34	7.69	8.00	7.14
Select Composite Run	2.86	1.25	3.57	4.11	1.61	5.75

The mean first-half MAD over all 13 spring/summer Chinook salmon release/recovery stocks was 8.0 %, the mean last-half MAD was 7.1%, and the mean season-wide MAD was 7.7%. These statistics reflect a fairly uniform distribution of prediction error over the season.

Table 3.2: Comparison of observed versus expected total (spill-adjusted) fish detected (columns 1 and 2) at Lower Granite Dam for each release-recovery stock of yearling Chinook salmon stocks monitored by Program RealTime in 2008, and comparison of observed versus historical average recapture percentages (columns 3 and 4). Average recapture percentages are fundamental to making initial fish passage predictions (Section 2.4). Most stocks showed higher-than-average recapture percentages (more than expected fish) in 2008.

Tagging Location	Observed # Detections	Expected # Detections $\widehat{E(S)}$	Observed Recapture %	Average Historical % $\overline{r}$
Big Creek	2311.1	738.45	36.3	11.6
Catherine Creek	132.5	199.87	6.8	10.2
Grande Ronde	201.4	172.02	16.2	13.9
Imnaha River	148.0	157.12	14.8	15.7
Imnaha Trap	2379.7	869.38	29.2	10.7
Johnson Creek Trap	871.2	428.16	32.1	15.8
Lemhi River	310.9	245.78	24.4	19.3
Lemhi River Weir	316.8	142.68	33.3	15.0
Lookingglass Creek	322.1	258.94	16.1	12.9
Lostine River	433.6	219.46	21.7	11.0
Meadow Creek	625.9	291.70	36.2	16.9
Minam River	331.4	198.88	22.1	13.3
Valley Creek	261.6	172.24	10.4	6.8

Index-Count Stocks Monitored at Lower Granite and McNary Dams

Ten of the thirteen individual release-recovery ESUs of wild Snake River yearling Chinook salmon had larger-than-average rates of detection. The wild PIT-tagged run-at-large of these fish to Lower Granite Dam had a larger rate of detection in 2008 than expected and the observed outmigration distribution was later than predicted for the first half of the run and earlier than predicted for the second half (Appendix A). The MAD for this stock was higher than last year (Table 3.3). This year's season-wide MAD was 6.0% compared to 4.0% last year. The quality of prediction for the run-at-large of wild PIT-tagged Snake River yearling Chinook salmon monitored at McNary also showed a small increase of MAD over that of 2007, with a MAD of 2.8% vs. last year's season-wide MAD of 2.4%.

Table 3.3: Mean absolute deviations (MADs) for the 2007 and 2008 outmigration to Lower Granite and McNary dams, of the PIT-tagged population of wild Snake River spring/summer yearling Chinook salmon. Columns show MADs for the entire run, the first 50% of the run, and the last 50% of the run.

	2007			2008		
Detection Location	Entire Run	First 50%	Last 50%	Entire Run	First 50%	Last 50%
Lower Granite Dam	3.96	5.22	3.51	6.02	9.24	4.93
McNary Dam	2.36	4.23	2.01	2.78	2.50	2.84

3.1.2 *PIT-Tagged Steelhead Trout*

The run-timing predictions of wild PIT-tagged Snake River steelhead were about the same compared to last year at both Lower Granite and McNary dams (Table 3.4). The season-wide MAD increased from 1.4% to 3.5% at Lower Granite, and from 2.8% to 3.7% at McNary Dam. The PIT-tagged run-at-large of Upper Columbia wild steelhead at McNary Dam was predicted much better this year, with the season-wide MAD at 3.1% compared to last year's 33.5%. The Snake River steelhead stock at Lower Granite had much higher detections than expected, and less than expected at McNary Dam. The detetions of Upper Columbia River steelhead at McNary were only 21% of the historical average, but had greatly improved prediction.

Table 3.4: Mean absolute deviations (MADs) for the 2007 and 2008 outmigrations of the PIT-tagged subpopulations of wild Snake and Upper Columbia Rivers steelhead detected at Lower Granite and McNary Dams. Columns show MADs for the entire run, the first 50% of the run, and the last 50% of the run.

	2007			2008		
Stock	Entire Run	First 50%	Last 50%	Entire Run	First 50%	Last 50%
Snake River steelhead detected at Lower Granite Dam	1.35	2.07	0.89	3.53	6.09	2.21
Snake River steelhead detected at McNary Dam	2.75	4.99	1.69	3.69	4.61	3.21
Upper Columbia River steelhead detected at McNary Dam	33.49	10.11	52.09	3.12	3.22	3.07
All wild steelhead detected at McNary Dam	1.73	1.35	1.95	2.20	0.84	3.04

3.1.3 *PIT-Tagged Sockeye Salmon*

MADs for the wild PIT-tagged run-at-large of Snake River sockeye salmon smolts (an index stock) forecasted at McNary Dam was larger that of last year. The season-wide MAD was 5.1% compared to 3.1 % last year (Table 3.5). The expected count was quite close to the adjusted observed count (453.4 vs. 480.8), but the predicted migration ended 20 days after the last fish was detected.

Table 3.5: Mean absolute deviations (MADs) for the 2007 and 2008 outmigrations to McNary Dam of the PIT-tagged population of wild Snake River sockeye salmon. Columns show MADs for the entire run, the first 50% of the run, and the last 50% of the run.

	2007			2008		
Detection Location	Entire Run	First 50%	Last 50%	Entire Run	First 50%	Last 50%
McNary Dam	3.05	5.24	2.19	5.11	7.22	4.42

3.1.4 *PIT-tagged Subyearling Chinook Salmon*

Release-Recovery Stock Monitored at Lower Granite Dam

The stock of subyearling fall Chinook salmon smolts captured, PIT-tagged and released during April through July into the Snake River, near its confluence with the Salmon River (Section 2.1.1) has been monitored by the RealTime project since 1999. The first half of the migration was not as well-predicted (MAD = 10.2%) but improved greatly for the last half (Table 3.6).

Table 3.6: Mean absolute deviations (MADs) for the 2007 and 2008 outmigrations to Lower Granite Dam of PIT-tagged populations of wild Snake River fall subyearling Chinook salmon. Columns show MADs for the entire run, the first 50% of the run, and the last 50% of the run.

	2007			2008		
Detection Location	Entire Run	First 50%	Last 50%	Entire Run	First 50%	Last 50%
Lower Granite Dam	3.40	4.95	2.95	5.38	10.23	3.17

Index-Count Stocks Monitored at McNary Dam

Snake River predictions of subyearling Chinook salmon runs to McNary Dam were consistent with 2007 showing a small decrease in MAD of 3.9 percentage points over 2007 (Table 3.7). The season-wide MAD for the Upper Columbia subyearling Chinook salmon runs to McNary Dam, also decreased from 6.5% to 4.5%. Passage timing for the Snake River was earlier than historically, with the Upper Columbia River timing being earlier but closer to the average.

Table 3.7: Mean absolute deviations (MADs) for the 2007 and 2008 outmigrations of PIT-tagged populations of wild Snake River fall subyearling Chinook salmon and wild Upper Columbia River subyearling Chinook salmon monitored at McNary Dam. Columns show MADs for the entire run, the first 50% of the run, and the last 50% of the run.

Stock	2007			2008		
	Entire Run	First 50%	Last 50%	Entire Run	First 50%	Last 50%
All Wild PIT-tagged Snake River Subyearling Chinook Salmon detected at McNary Dam	9.98	22.39	2.09	6.06	13.30	2.79
All Wild PIT-tagged Upper Columbia River Subyearling Chinook Salmon detected at McNary Dam	6.47	21.33	4.01	4.52	20.59	1.86

3.2 Hatchery-Reared ESUs

The only hatchery-reared PIT-tagged stocks monitored by Program RealTime have been summer-run sockeye. In 2001 and 2002, the stock was a composite of smolts released into Alturas Lake Creek, Redfish Lake Creek Trap, and Sawtooth Trap. Since then, only the stock from Redfish Lake was tracked. The season-wide MAD for this year (6.2%) increased from last year (3.1%), with the observed migration timing very similar to last year. Predictions closely followed the observed outmigration, but only 21 fish were detected. This inflated the associated MAD estimate.

Table 3.8: Mean absolute deviations (MADs, section 2.4.3) for the 2007 and 2008 outmigrations to Lower Granite Dam of the PIT-tagged hatchery-reared sockeye from Redfish Lake. Columns show MADs for the entire run, the first 50% of the run, and the last 50% of the run.

Detection Location	2007			2008		
	Entire Run	First 50%	Last 50%	Entire Run	First 50%	Last 50%
Lower Granite Dam	3.14	5.92	2.08	6.16	7.57	5.86

3.3 Combined Wild and Hatchery Runs-at-Large

The runs of yearling Chinook salmon and steelhead forecasted to Rock Island, McNary, John Day, and Bonneville dams were all improved from 2007 (Table 3.9). Coho and Sockeye Chinook had season-wide MADs within ±4% of the year prior. Subyearling Chinook salmon predictions performed well this year at John Day and Bonneville, but had increased MAD's at Rock Island and McNary Dam.

Table 3.9: Mean absolute deviations (MADs, Section 2.4.3) for the 2007 and 2008 outmigrations to Rock Island, McNary, John Day, and Bonneville dams of FPC passage indices of the combined wild and hatchery runs-at-large of salmon and steelhead. Columns show MADs for the entire run, the first 50% of the run, and the last 50% of the run.

Detection Site	Stock	2007			2008		
		Entire Run	First 50%	Last 50%	Entire Run	First 50%	Last 50%
Rock Island Dam	Yearling Chinook Salmon	3.64	6.03	2.54	2.17	0.39	3.18
	Steelhead	2.41	0.61	3.25	1.32	1.03	1.44
	Coho Salmon	0.87	1.28	0.56	0.62	0.56	0.65
	Sockeye Salmon	8.06	12.30	5.78	7.21	3.76	8.44
	Subyearling Chinook Salmon	2.13	2.36	1.93	3.20	2.25	3.83
McNary Dam	Yearling Chinook Salmon	2.68	1.86	2.98	2.42	2.54	2.36
	Steelhead	3.28	2.36	3.57	2.61	1.09	3.23
	Coho Salmon	4.88	6.58	3.97	1.58	0.78	2.07
	Sockeye Salmon	1.96	0.55	2.53	5.20	3.41	5.91
	Subyearling Chinook Salmon	2.09	3.35	1.63	7.07	7.26	6.99
John Day Dam	Yearling Chinook Salmon	7.04	8.55	6.24	3.56	3.80	3.41
	Steelhead	3.10	1.69	3.62	2.15	2.01	2.23
	Coho Salmon	1.81	1.22	2.19	2.53	1.51	3.38
	Sockeye Salmon	3.12	3.15	3.10	3.42	0.60	4.87
	Subyearling Chinook Salmon	6.81	4.90	7.73	0.95	0.63	1.11
Bonneville Dam	Yearling Chinook Salmon	4.14	5.08	6.24	1.95	2.03	1.90
	Steelhead	2.45	2.23	2.57	2.44	0.38	3.39
	Coho Salmon	1.60	1.93	1.45	4.08	3.64	4.31
	Sockeye Salmon	1.39	1.23	1.46	2.72	1.07	3.61
	Subyearling Chinook Salmon	3.35	4.70	2.93	1.85	1.27	2.03

4.0 Discussion

The RealTime Program 2008 performance in predicting run-timing of FPC passage-indexed stocks and PIT-tagged stocks was similar to 2007. An adjustment to the selection criteria of historical years to be included in the RealTime program was made to improve the predictions. The minimum number of detections required was raised from 30 to 50 detections at a dam site. While the majority of the predictions improved in accuracy from the previous year, newly added runs had much higher MADs. The increased detections requirement provided a better outmigration pattern for the program to match to, but reduced the number of historical years available. If PIT-tag releases continue in these additional sites, it is anticipated that accuracy will improve in time.

The addition of new release sites and removal of others that had been forecasted by RealTime emphasizes that PIT-tag release sites change as determined by the information needs of the region. While the run-at-large and passage indexed forecasts were fairly consistent in performance, the source of fish the making up the outmigration run has changed through time. Because of this fluidity of the outmigration composition, the RealTime website will be enhanced in 2009 to better convey the stock arrangement of the index stocks.

Table 4.1 displays the observed versus predicted counts of fish at each of the dams for all the index-count stocks used by RealTime in 2008. These expected counts are based on the historical average of counts at each site for each species, and it was rare that they were close to what actually was observed. In determining the status of outmigration for these stocks at each site, the simple method of using the historical average to gauge the present year's migration status is woefully inadequate. Program RealTime has shown that incorporating the additional information of a stock's historical outmigration characteristics (length of run, percentage of fish observed daily, etc.) dramatically improves the status predictions. This program has proven to be an excellent tool in the determination of migration status, and as the historical data accumulates, will continue to improve.

Table 4.1: Comparison of expected number of detections for passage indices and the observed numbers for all index-count stocks monitored by Program RealTime in 2008.

Rearing/ Data Type	Detection Site	Stock	Expected 2008 Counts	Observed 2008 Counts
Wild/PIT-tag	Lower Granite Dam	Spring/Summer Yearling Chinook	3,993	3,837
		Steelhead Trout	7,144	6,174
	McNary Dam	Snake River Yearling Chinook Salmon	11,171	7,864
		Snake River Steelhead Trout	3,500	3,822
		Upper Columbia River Steelhead Trout	6,373	711
		Snake & Upper Columbia River Steelhead Trout	9,340	4,898
		Snake River Sockeye Salmon	453	217
		Snake River Subyearling Chinook Salmon	14,633	21,651
		Upper Columbia River Subyearling Chinook Salmon	700	1,130
Combined Wild & Hatchery/FPC Passage Indices	Rock Island Dam	Yearling Chinook Salmon	25,399	22,427
		Steelhead Trout	19,719	22,438
		Coho Salmon	44,408	52,052
		Sockeye Salmon	14,437	39,205
		Subyearling Chinook Salmon	18,921	13,909
	McNary Dam	Yearling Chinook Salmon	2,066,716	1,360,623
		Steelhead Trout	557,767	507,299
		Coho Salmon	220,431	169,476
		Sockeye Salmon	607,229	223,002
		Subyearling Chinook Salmon	7,360,807	2,315,541
	John Day Dam	Yearling Chinook Salmon	1,387,100	1,694,103
		Steelhead Trout	796,900	1,132,951
		Coho Salmon	311,970	362,536
		Sockeye Salmon	380,612	331,861
		Subyearling Chinook Salmon	1,981,149	1,702,202
	Bonneville Dam	Yearling Chinook Salmon	1,386,901	1,291,084
		Steelhead Trout	470,648	450,290
		Coho Salmon	987,447	358,756
		Sockeye Salmon	236,720	145,402
		Subyearling Chinook Salmon	1,681,339	1,725,307

5.0 Recommendations

It is recommended that wild PIT-tagged runs-at-large of subyearling fall Chinook salmon, yearling Chinook salmon, sockeye salmon, and steelhead continue to be monitored and forecasted at both Lower Granite and McNary dams, for the purpose of estimating outmigration timing of ESUs. It is also recommended that the individual stocks from the Salmon, Grande Ronde, and Clearwater River drainages continue to be monitored and forecasted to Lower Granite Dam. The large combined wild and hatchery-reared runs-at-large of Chinook, coho, and sockeye salmon and steelhead should also be monitored at Rock Island, McNary, John Day, and Bonneville dams. The RealTime project supplied critical information about passage and run-timing for these stocks in 2008.

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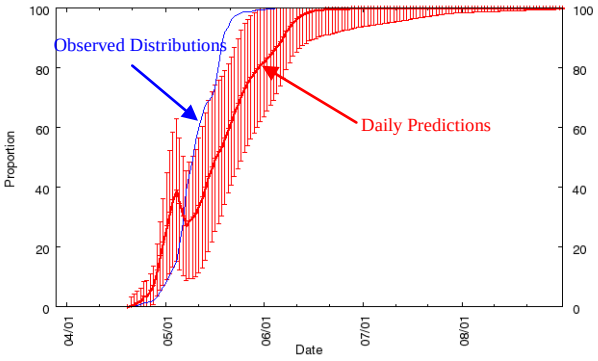
Appendix A

Performance Plots for the 2008 Outmigration Season

RealTime Daily Predicted vs. Observed Run-timing using PIT-Tagged Fish

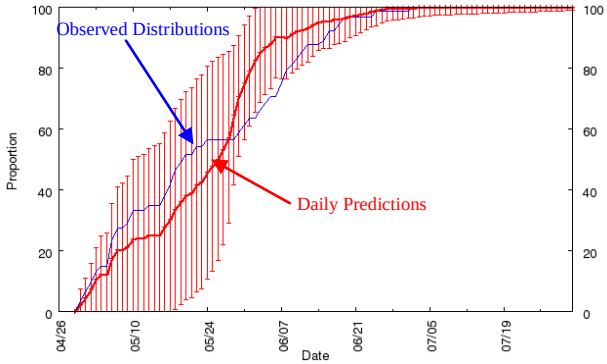
Figure A.1: Daily predictions of run-timing at Lower Granite Dam of PIT-tagged wild yearling Chinook salmon from Big Creek, Grande Ronde, Imnaha River, and Johnson Creek Trap.

Big Creek



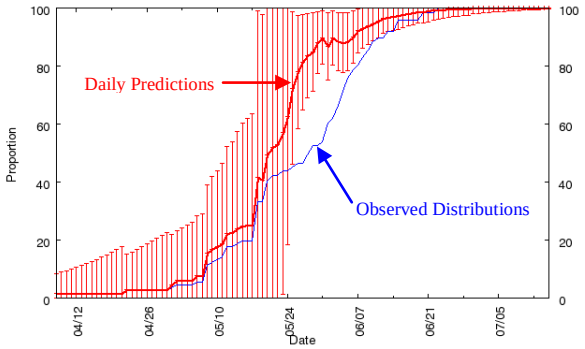
Passage Date at Lower Granite

Catherine Creek



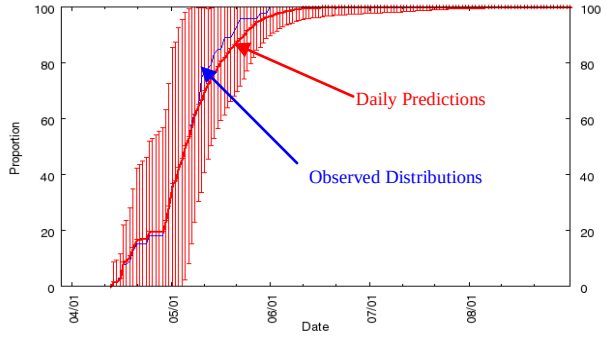
Passage Date at Lower Granite

Grande Ronde



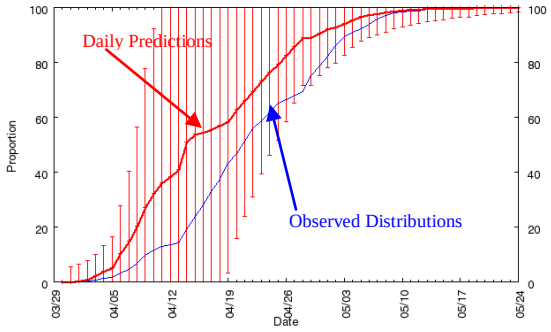
Passage Date at Lower Granite

Imnaha River



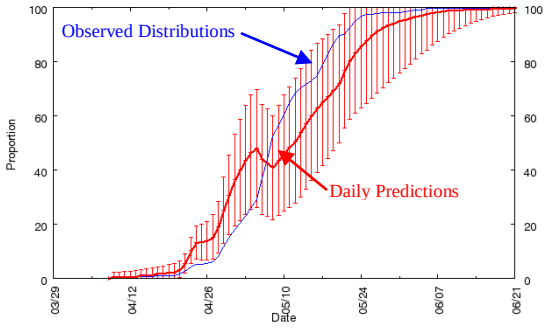
Passage Date at Lower Granite

Imnaha Trap



Passage Date at Lower Granite

Johnson Creek Trap



Passage Date at Lower Granite

Figure A.2: Daily predictions of run-timing at Lower Granite Dam of PIT-tagged wild yearling Chinook salmon from Lemhi River, Lemhi River Weir, Lookingglass Creek, Lostine River, Meadow Creek, and Minam Creek.

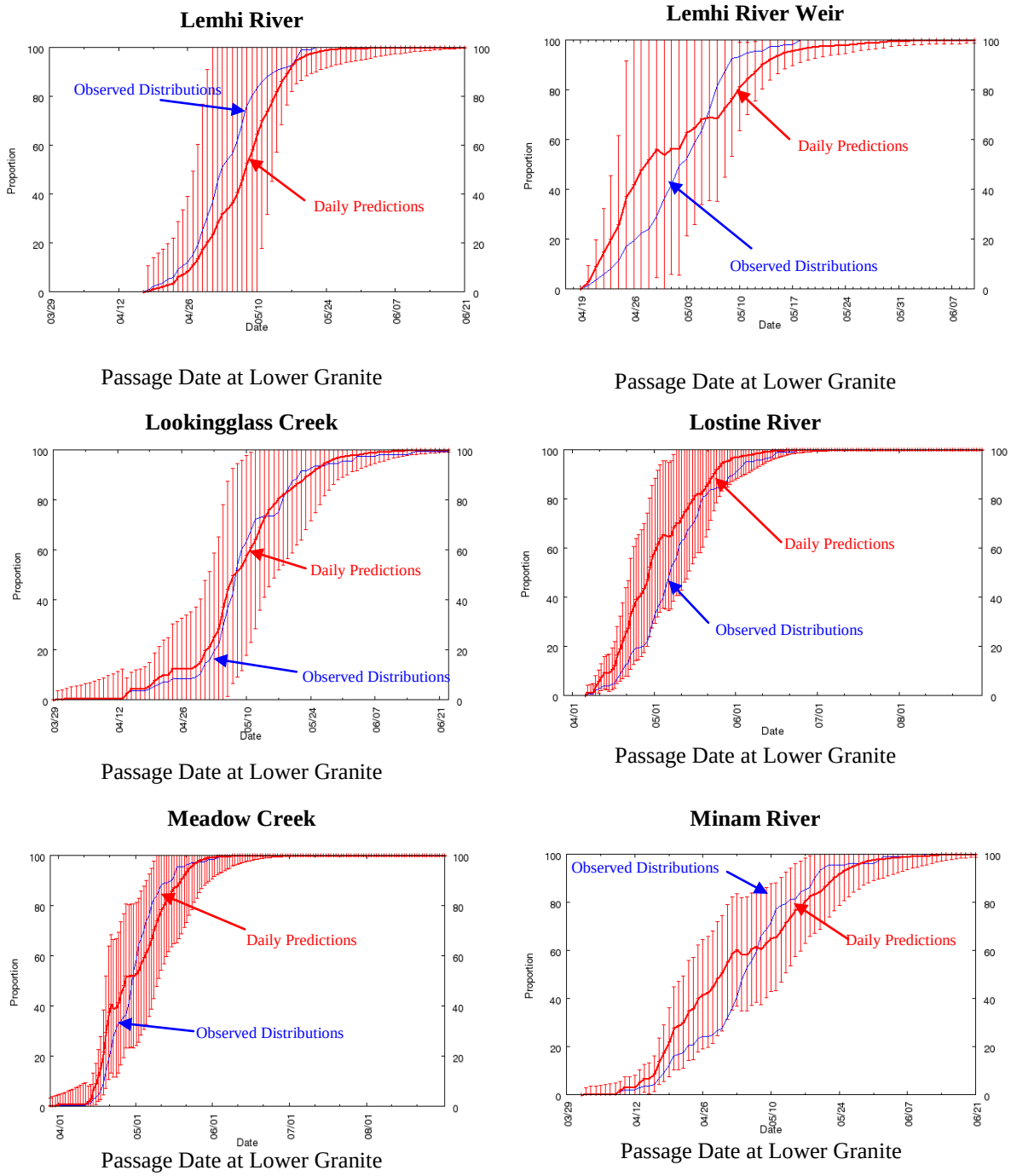


Figure A.3: Daily predictions of run-timing at Lower Granite Dam of PIT-tagged wild yearling Chinook salmon from Valley Creek.

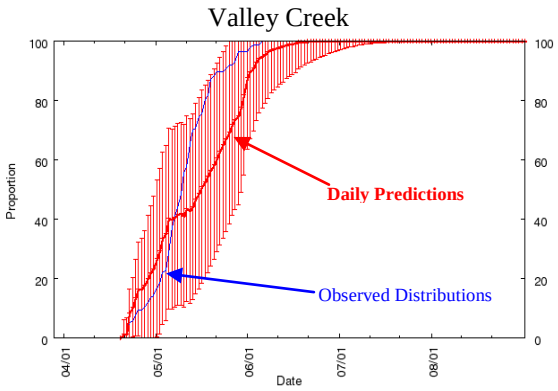
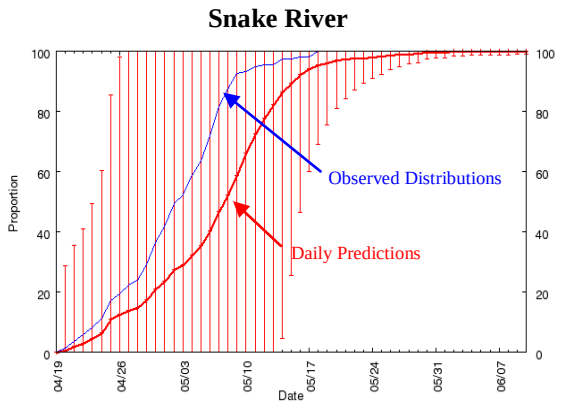
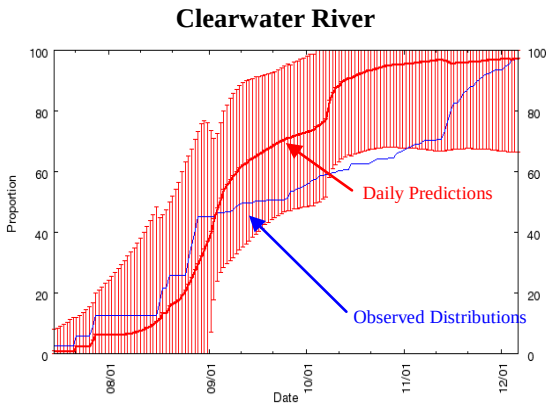
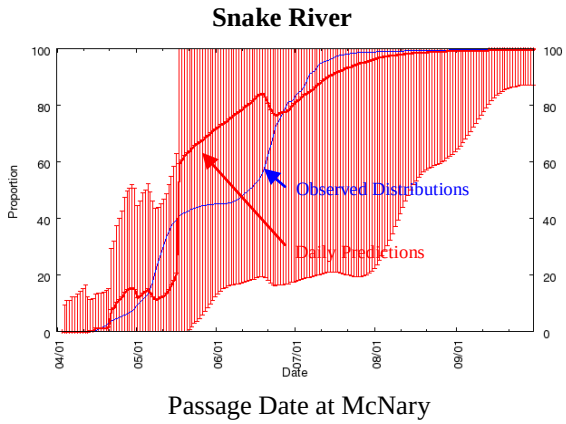


Figure A.4: Daily predictions of run-timing at Lower Granite and McNary Dams of PIT-tagged wild subyearling Chinook salmon from Snake, Clearwater, and Upper Columbia Rivers.







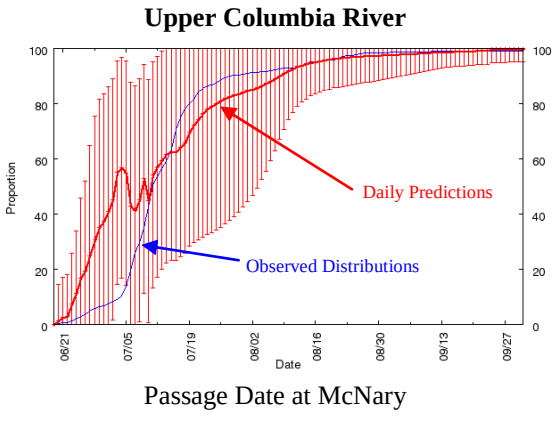
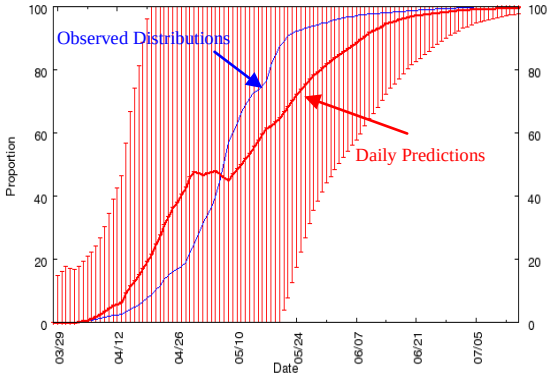


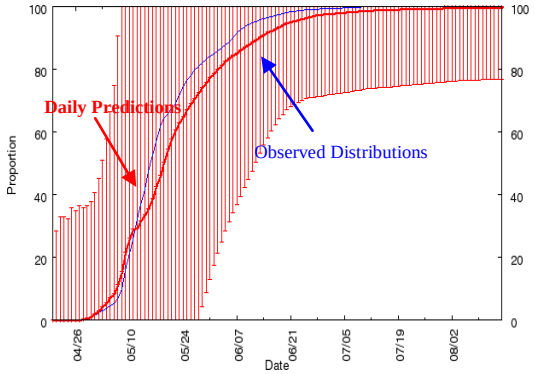
Figure A.5: Daily predictions of run-timing at Lower Granite Dam of PIT-tagged wild yearling Chinook salmon from a composite of all wild yearling Chinook, and from a composite of only the Snake River drainage at McNary Dams.

PIT-tagged Run-at-large at Lower Granite



Passage Date at Lower Granite

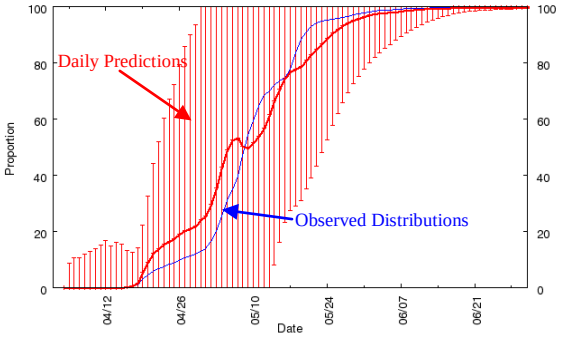
Snake River Run-at-large at McNary Dam



Passage Date at McNary Dam

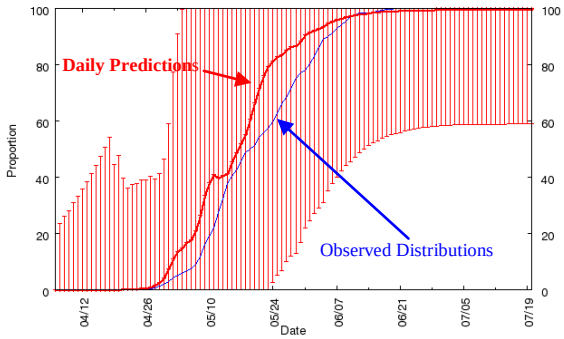
Figure A.6: Daily predictions of run-timing of PIT-tagged wild steelhead trout from the Snake River drainage at Lower Granite Dam, and PIT-tagged wild steelhead from the Snake River drainage, Upper Columbia River, and a composite of the two sources at McNary Dam.

Snake River Run-at-large at Lower Granite



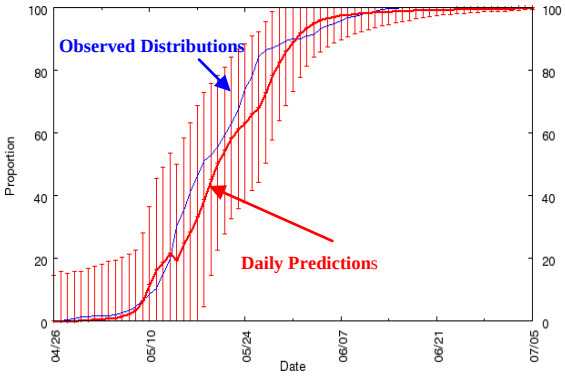
Passage Date at Lower Granite

Snake River Run-at-large at McNary Dam



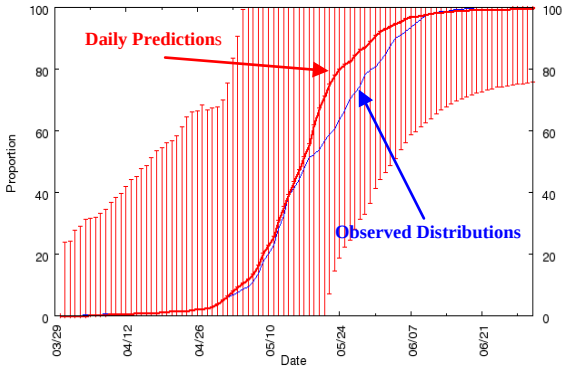
Passage Date at McNary

Upper Columbia River Run-at-large at McNary Dam



Passage Date at McNary

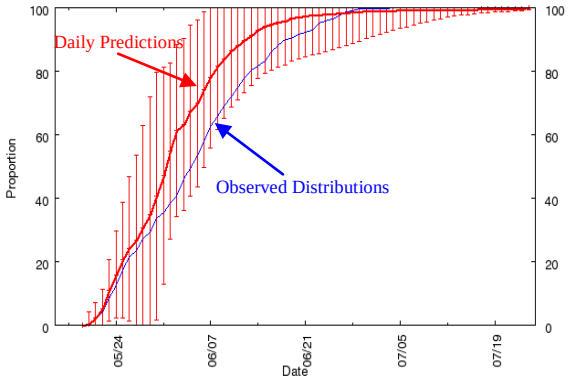
Composite Run-at-large at McNary Dam



Passage Date at McNary

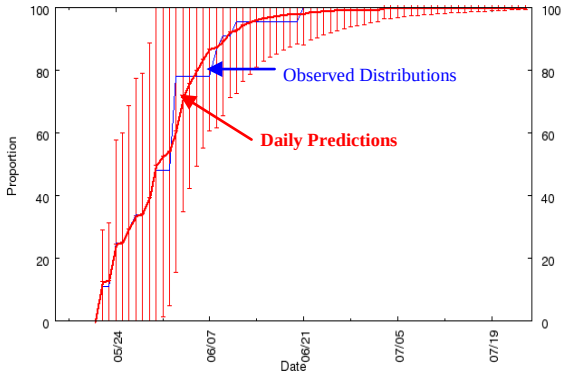
Figure A.7: Daily predictions of run-timing of PIT-tagged wild sockeye salmon from the Snake River drainage at McNary Dam, and PIT-tagged hatchery sockeye from the Redfish Lake at Lower Granite Dam.

Snake River Wild Run-at-large at McNary



Passage Date at McNary Dam

Redfish Lake Hatchery at Lower Granite

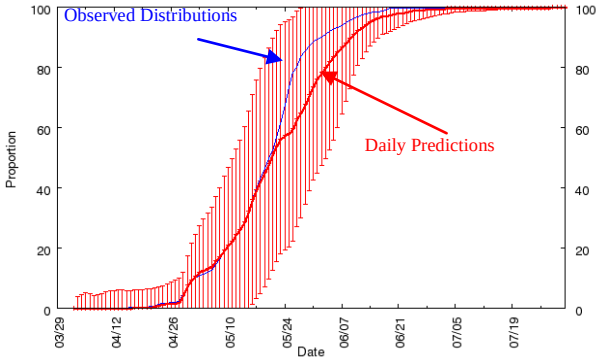


Passage Date at Lower Granite Dam

RealTime Daily Predicted vs. Observed Run-timing using FPC Passage-Indexed Fish

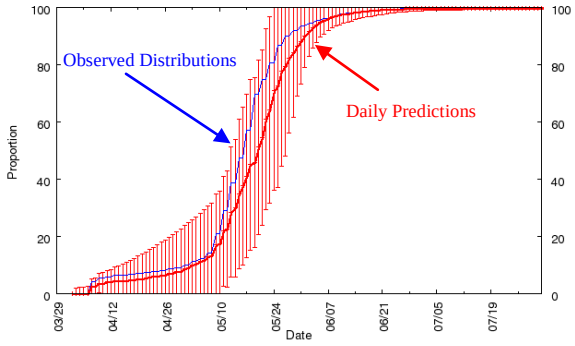
Figure A.8: Daily predictions of run-timing of FPC passage-indexed combined wild and hatchery runs-at-large yearling Chinook salmon at Rock Island, McNary, John Day, and Bonneville dams.

Rock Island



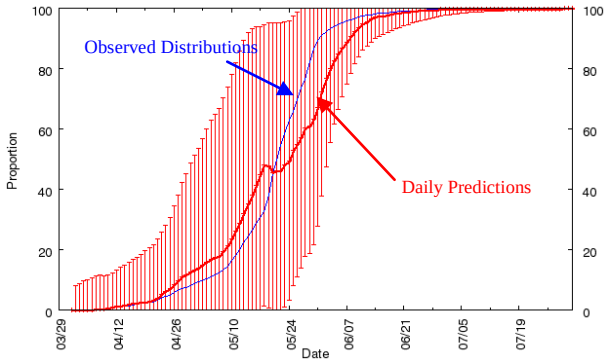
Passage Date at Rock Island Dam

McNary



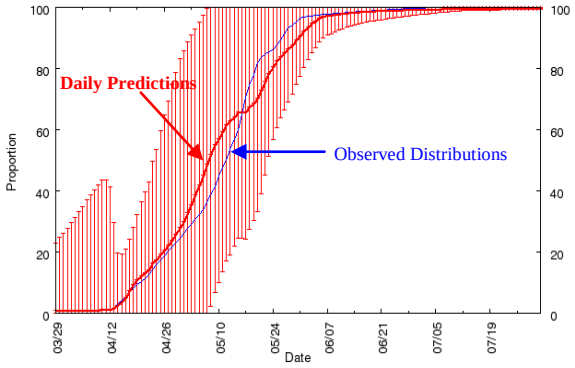
Passage Date at McNary Dam

John Day



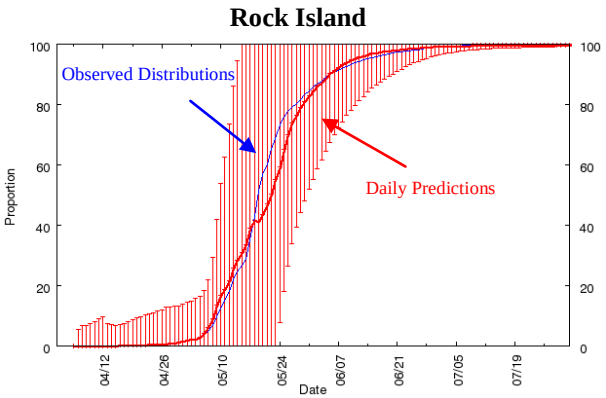
Passage Date at John Day Dam

Bonneville

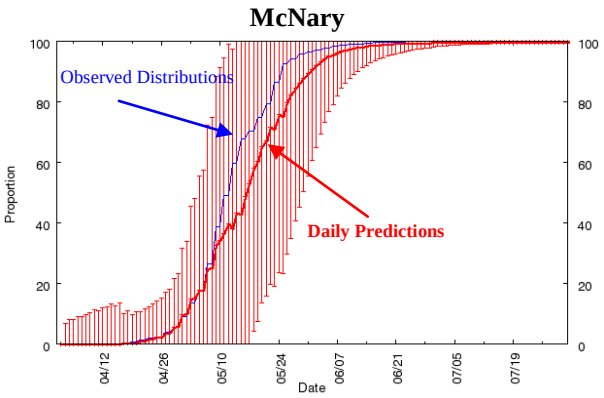


Passage Date at Bonneville Dam

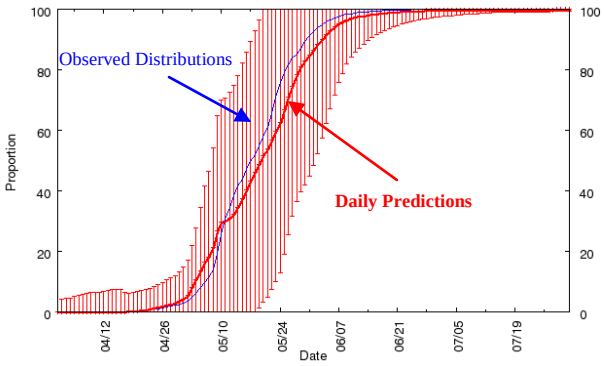
Figure A.9: Daily predictions of run-timing of FPC passage-indexed combined wild and hatchery runs-at-large steelhead trout at Rock Island, McNary, John Day, and Bonneville dams.



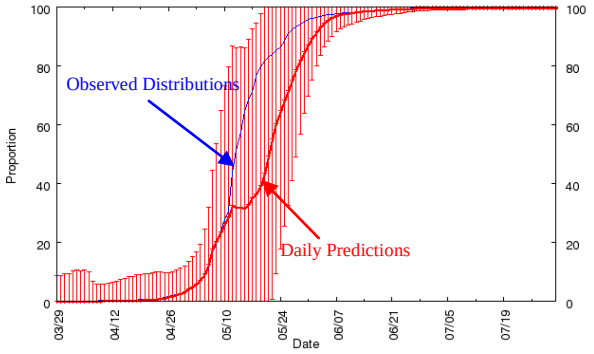
Passage Date at Rock Island Dam



Passage Date at McNary Dam



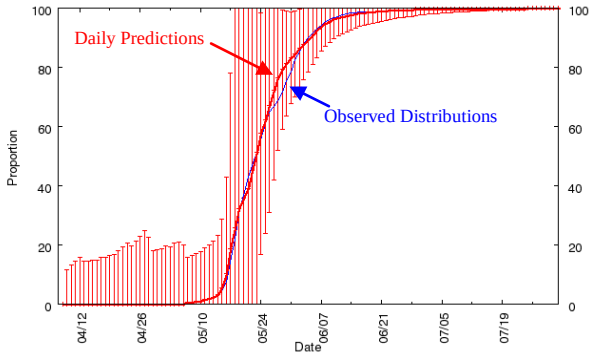
Passage Date at John Day Dam



Passage Date at Bonneville Dam

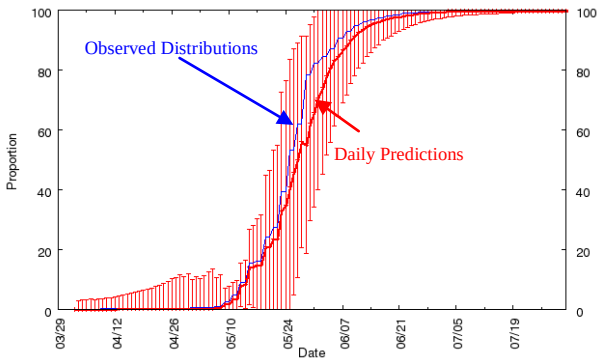
Figure A.10: Daily predictions of run-timing of FPC passage-indexed combined wild and hatchery runs-at-large coho salmon at Rock Island, McNary, John Day, and Bonneville Dams.

Rock Island



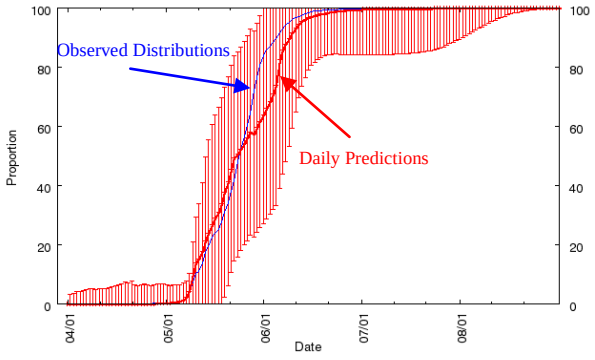
Passage Date at Rock Island Dam

McNary



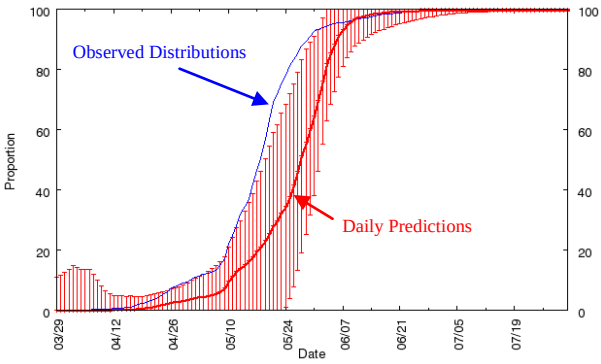
Passage Date at McNary Dam

John Day



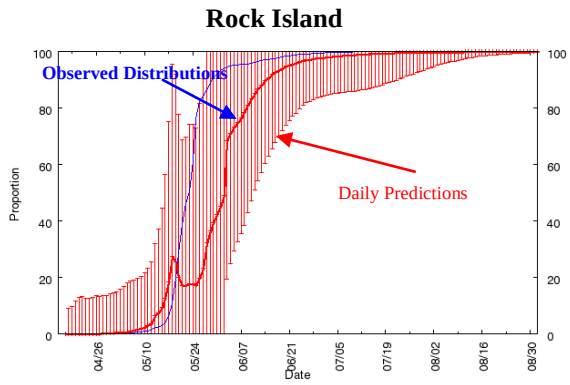
Passage Date at John Day Dam

Bonneville

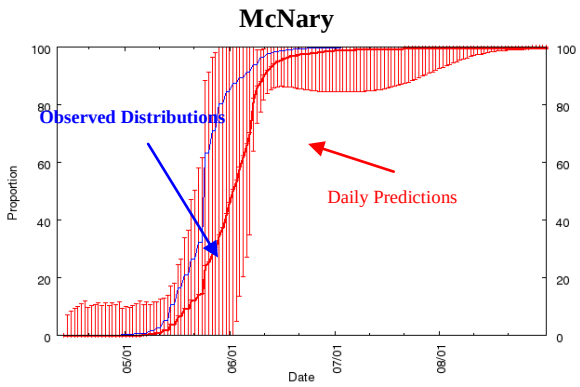


Passage Date at Bonneville Dam

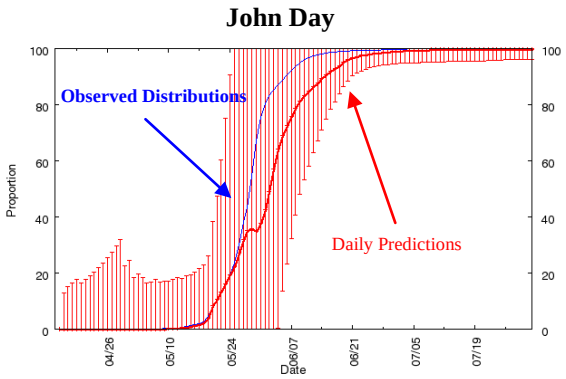
Figure A.11: Daily predictions of run-timing of FPC passage-indexed combined wild and hatchery runs-at-large sockeye salmon at Rock Island, McNary, John Day, and Bonneville dams.



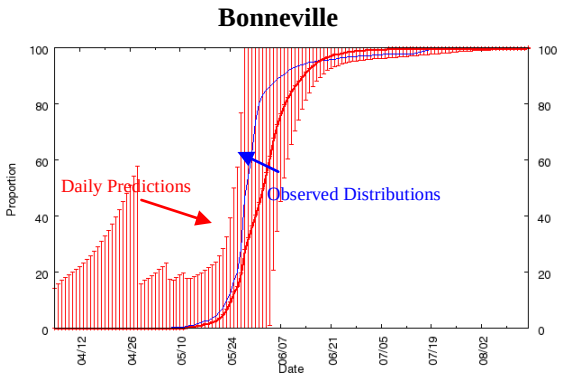
Passage Date at Rock Island Dam



Passage Date at McNary Dam

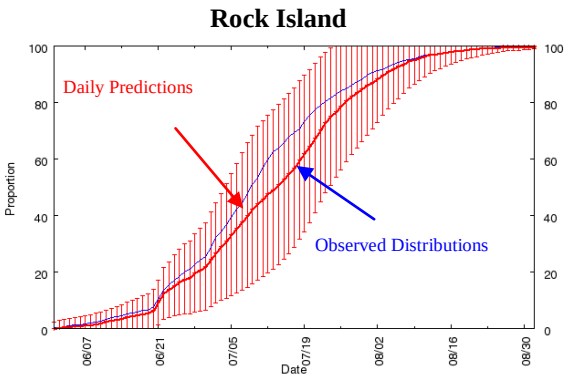


Passage Date at John Day Dam

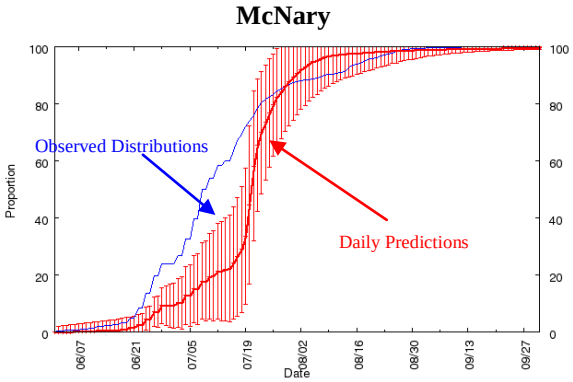


Passage Date at Bonneville Dam

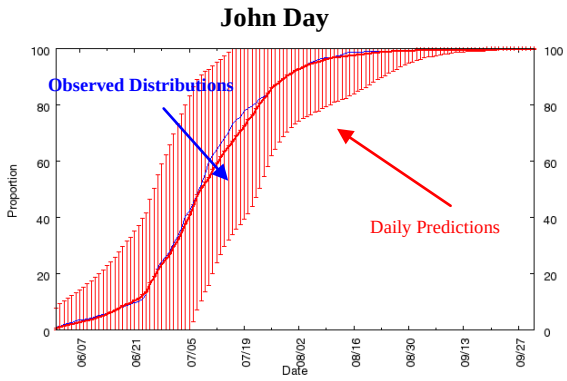
Figure A. 12: Daily predictions of run-timing of FPC passage-indexed combined wild and hatchery runs-at-large subyearling Chinook salmon at Rock Island, McNary, John Day, and Bonneville Dams.



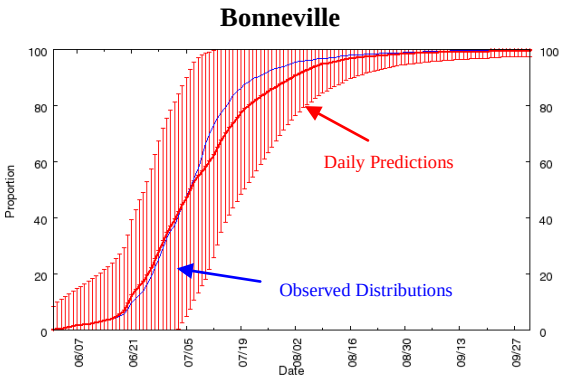
Passage Date at Rock Island Dam



Passage Date at McNary Dam



Passage Date at John Day Dam



Passage Date at Bonneville Dam

Appendix B

Historical Timing Plots and Dates of Passage for the Stocks used in the RealTime Forecaster 2008 Outmigration Season

Figure B.1: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling Chinook salmon from Big Creek.

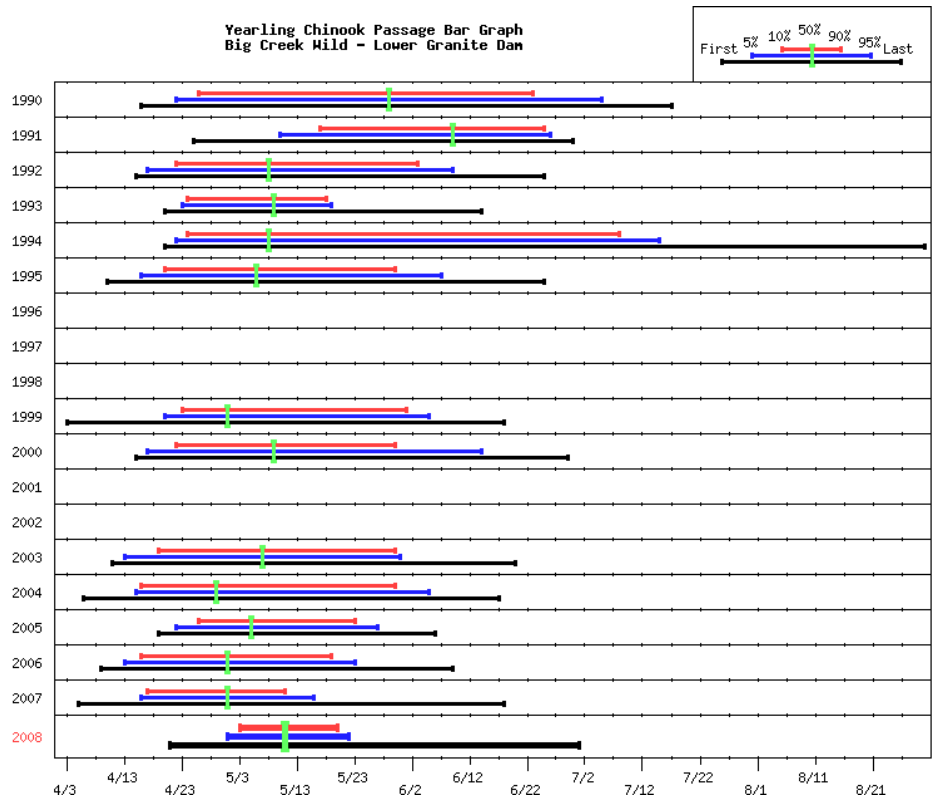


Table B.1: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling Chinook salmon from Big Creek.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1990	04/21	04/21	04/23	04/25	05/31	06/26	07/10	07/18	63	1134	75	75.0	6.6
1991	04/26	04/26	05/11	05/18	06/10	06/26	06/27	07/01	40	724	67	67.8	9.4
1992	04/15	04/15	04/17	04/22	05/08	06/03	06/09	06/26	43	1002	57	57.0	5.7
1993	04/21	04/21	04/25	04/26	05/10	05/19	05/20	06/15	24	733	65	84.7	11.6
1994	04/21	04/21	04/23	04/25	05/09	07/09	07/17	08/30	76	721	56	68.7	9.5
1995	04/11	04/13	04/17	04/21	05/07	05/30	06/08	06/26	40	1482	164	220.2	14.9
1999	04/04	04/10	04/21	04/24	05/02	06/02	06/06	06/19	40	1427	100	242.1	17.0
2000	04/15	04/15	04/17	04/22	05/09	05/30	06/14	06/29	39	1090	92	177.2	16.3
2002	04/12	04/12	04/15	04/15	04/26	05/09	05/19	05/22	25	409	32	74.9	18.3
2003	04/12	04/12	04/14	04/20	05/08	05/31	06/01	06/21	42	1724	100	205.8	11.9
2004	04/06	04/06	04/15	04/16	04/29	05/30	06/05	06/17	45	2403	193	245.3	10.2
2005	04/20	04/20	04/23	04/27	05/06	05/24	05/28	06/07	28	1890	125	143	7.6
2006	04/10	04/10	04/14	04/17	05/02	05/20	05/24	06/10	34	2505	132	318.5	12.7
2007	04/06	04/08	04/17	04/18	05/02	05/12	05/17	06/19	25	2045	161	347.8	17.0
2008	04/21	04/25	05/01	05/03	05/11	05/20	05/22	07/01	18	6346	1030	2311.1	36.4

Figure B.2: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling Chinook salmon from Catherine Creek.

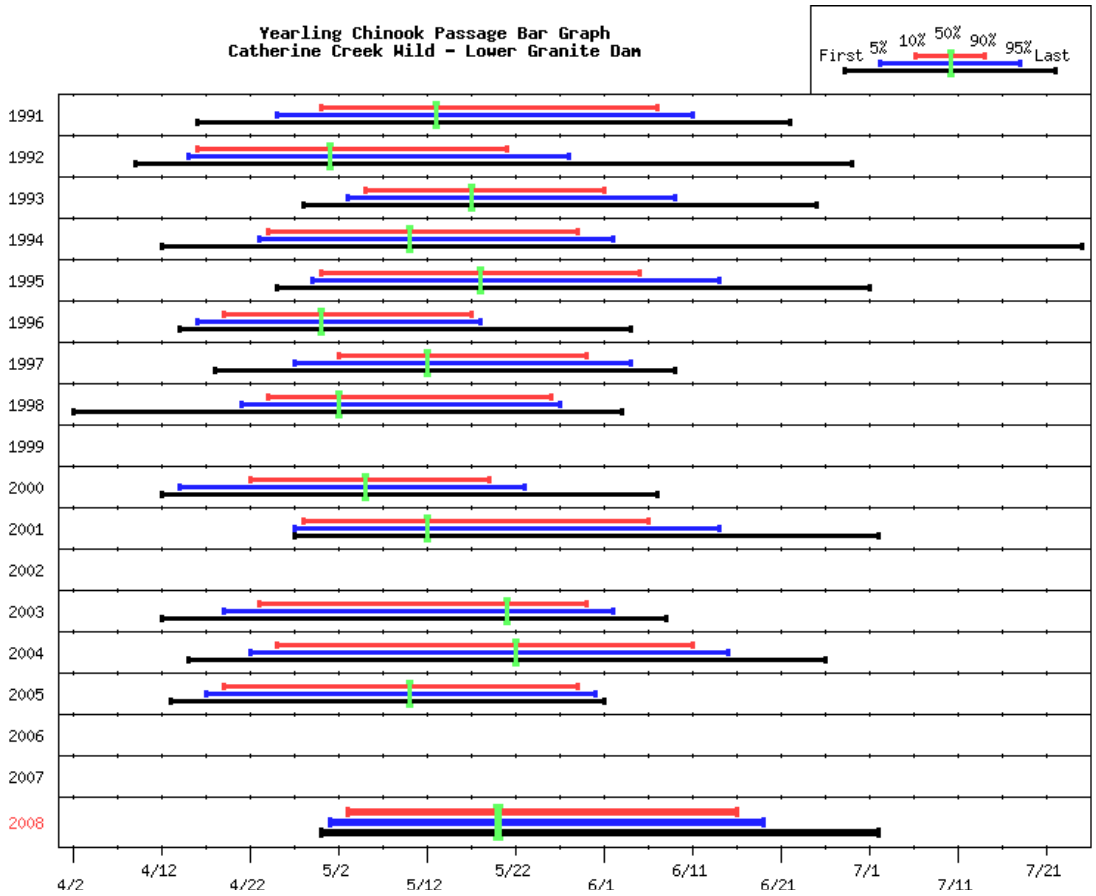


Table B.2: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling Chinook salmon from Catherine Creek.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1991	4/17	4/17	4/26	5/1	5/14	6/8	6/12	6/23	39	1012	77	77.8	7.7
1992	4/9	4/9	4/15	4/16	5/1	5/21	5/28	6/29	36	940	67	67.0	7.1
1993	4/29	4/29	5/4	5/6	5/18	6/2	6/10	6/26	28	1093	102	158.2	14.5
1994	4/13	4/21	4/24	4/25	5/11	5/30	6/3	7/26	36	1000	76	110.5	11.0
1995	4/26	4/28	4/30	5/1	5/19	6/6	6/15	7/2	37	1301	115	153.8	11.8
1996	4/14	4/14	4/16	4/19	4/30	5/17	5/18	6/4	29	499	40	86.2	17.3
1997	4/19	4/19	4/28	5/3	5/13	5/31	6/5	6/10	29	585	51	120.2	20.6
1998	4/3	4/5	4/22	4/25	5/3	5/27	5/28	6/4	33	500	43	91.3	18.3
2000	4/12	4/12	4/14	4/22	5/5	5/19	5/23	6/7	28	499	30	57.2	11.5
2001	4/28	4/28	4/28	4/29	5/13	6/7	6/15	7/3	40	501	33	33.0	6.6
2003	4/13	4/14	4/20	4/24	5/22	5/31	6/3	6/9	38	2501	99	217.5	8.7
2004	4/15	4/15	4/22	4/25	5/22	6/11	6/15	6/26	48	1340	106	124.8	9.3
2005	4/14	4/14	4/18	4/20	5/11	5/30	6/1	6/2	41	946	55	72.9	7.7
2008	4/30	4/30	5/1	5/3	5/20	6/16	6/19	7/2	45	1950	54	132.5	6.8

Figure B.3: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling Chinook salmon from Grande Ronde.

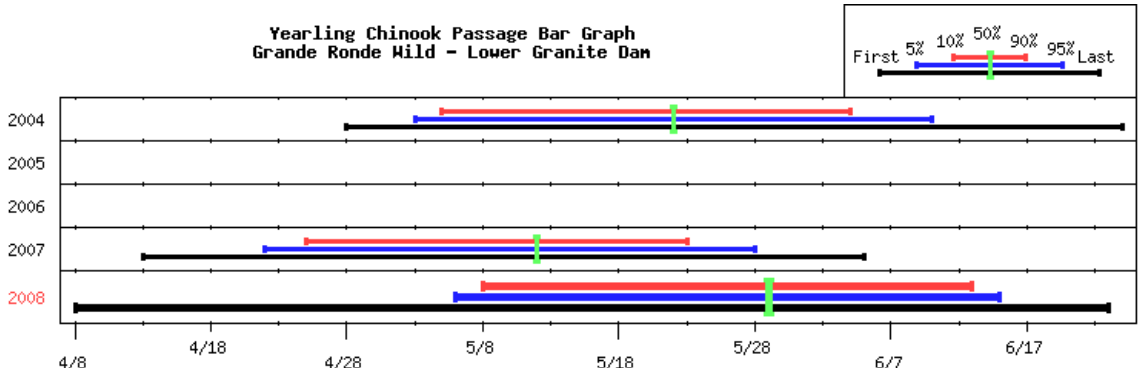


Table B.3: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling Chinook salmon from Grande Ronde.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
2004	4/28	4/28	5/3	5/5	5/22	6/4	6/10	6/24	31	916	86	96.8	10.6
2007	4/14	4/14	4/23	4/26	5/13	5/24	5/29	6/6	29	1016	91	174.1	17.1
2008	4/8	4/8	5/6	5/8	5/29	6/13	6/15	6/23	37	1242	74	201.4	16.2

Figure B.4: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling Chinook salmon from Imnaha River.

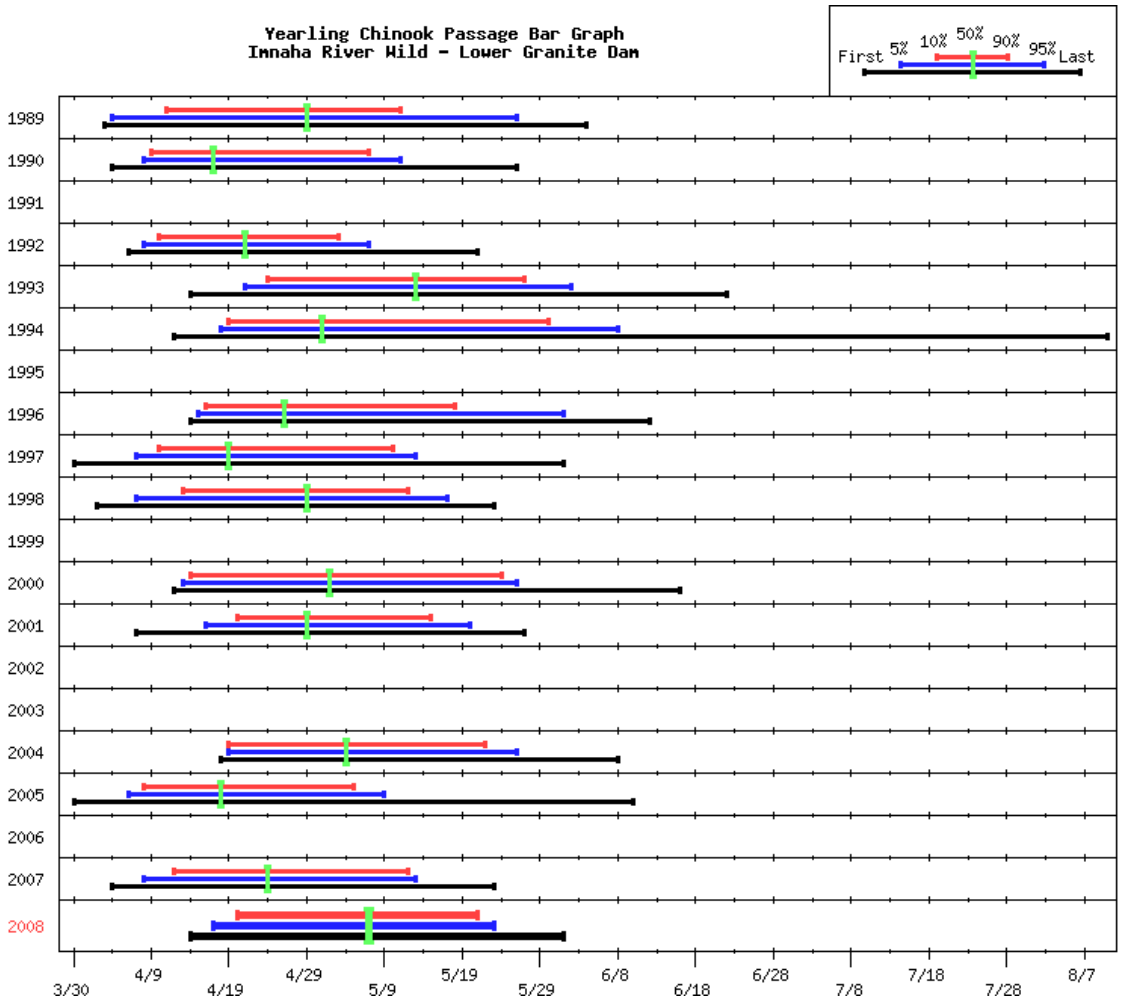


Table B.4: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling Chinook salmon from Imnaha River.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1989	4/4	4/4	4/5	4/12	4/30	5/12	5/27	6/5	31	588	36	36.0	6.1
1990	4/5	4/6	4/9	4/10	4/18	5/8	5/12	5/27	29	897	69	69.0	7.7
1992	4/6	4/6	4/8	4/10	4/21	5/3	5/7	5/21	24	758	73	73.0	9.6
1993	4/15	4/15	4/22	4/25	5/14	5/28	6/3	6/23	34	1003	63	88.3	8.8
1994	4/13	4/13	4/19	4/20	5/2	5/31	6/9	8/11	42	1167	91	104.2	8.9
1996	4/14	4/14	4/15	4/16	4/26	5/18	6/1	6/12	33	997	97	233.5	23.4
1997	3/31	4/3	4/8	4/11	4/20	5/11	5/14	6/2	31	1017	98	191.1	18.8
1998	4/3	4/3	4/8	4/14	4/30	5/13	5/18	5/24	30	1010	159	283.5	28.1
2000	4/12	4/12	4/13	4/14	5/2	5/24	5/26	6/16	41	982	63	119.5	12.2
2001	4/8	4/10	4/17	4/21	4/30	5/16	5/21	5/28	26	1000	159	159.0	15.9
2004	4/18	4/18	4/19	4/19	5/4	5/22	5/26	6/8	34	998	81	90.5	9.1
2005	3/31	4/4	4/7	4/9	4/19	5/6	5/10	6/11	28	2846	441	451.0	15.8
2007	4/5	4/5	4/9	4/13	4/25	5/13	5/14	5/24	31	1000	59	131.7	13.2
2008	4/14	4/14	4/17	4/20	5/7	5/21	5/23	6/1	32	1000	68	148.0	14.8

Figure B.5: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling Chinook salmon from Imnaha Trap.

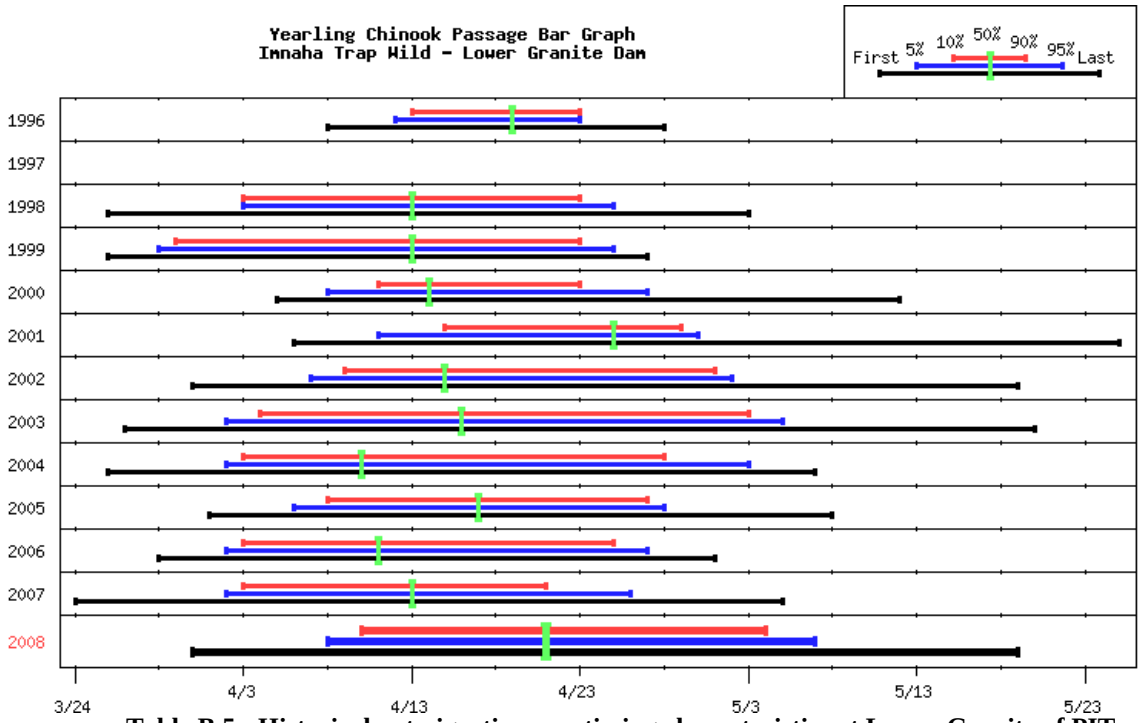


Table B.5: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling Chinook salmon from Imnaha Trap.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1996	4/8	4/8	4/12	4/13	4/19	4/23	4/23	4/28	11	1025	50	137.7	13.4
1998	3/27	3/28	4/4	4/4	4/14	4/24	4/26	5/4	21	1453	144	217.8	15.0
1999	3/27	3/27	3/30	3/31	4/14	4/24	4/26	4/28	25	2004	56	116.9	5.8
2000	4/5	4/6	4/8	4/11	4/14	4/23	4/27	5/12	13	2105	139	262.4	12.5
2001	4/7	4/9	4/12	4/16	4/26	4/30	5/1	5/26	15	2152	445	445.0	20.7
2002	4/1	4/1	4/8	4/10	4/16	5/2	5/3	5/20	23	2158	80	179.4	8.3
2003	3/28	4/1	4/3	4/5	4/17	5/4	5/6	5/21	30	7202	325	640.2	8.9
2004	3/26	3/28	4/2	4/3	4/10	4/28	5/3	5/7	26	3780	86	153.7	4.1
2005	4/2	4/5	4/7	4/9	4/18	4/28	4/29	5/9	20	6757	253	253.8	3.8
2006	3/30	4/1	4/3	4/4	4/12	4/26	4/28	5/2	23	3238	89	196.1	6.1
2007	3/25	3/30	4/3	4/4	4/14	4/22	4/27	5/6	19	3990	295	751.4	18.8
2008	3/31	4/4	4/8	4/10	4/21	5/4	5/7	5/19	25	8152	1048	2379.7	29.2

Figure B.6: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling Chinook salmon from Johnson Creek Trap.

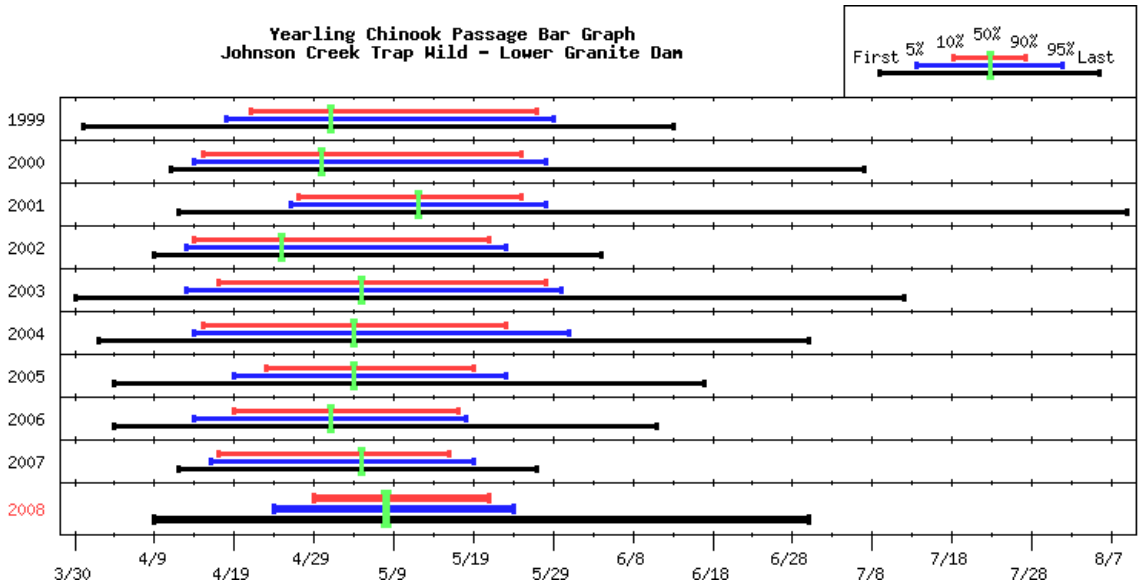


Table B.6: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling Chinook salmon from Johnson Creek Trap.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1999	4/1	4/11	4/19	4/22	5/2	5/28	5/30	6/14	37	4268	252	608.0	14.2
2000	4/11	4/12	4/14	4/15	4/30	5/25	5/28	7/7	41	4314	346	663.3	15.4
2001	4/13	4/23	4/27	4/28	5/13	5/26	5/29	8/10	29	3495	897	897.0	25.7
2002	4/10	4/12	4/14	4/15	4/26	5/22	5/24	6/5	38	6474	393	896.4	13.8
2003	3/31	4/7	4/14	4/18	5/6	5/29	5/31	7/13	42	7980	436	916.5	11.5
2004	4/2	4/6	4/14	4/15	5/4	5/23	5/31	6/30	39	6986	674	787.2	11.3
2005	4/5	4/12	4/20	4/24	5/5	5/20	5/24	6/18	27	10907	1233	1355.7	12.4
2006	4/5	4/9	4/15	4/20	5/2	5/18	5/19	6/12	29	5424	452	1089.1	20.1
2007	4/13	4/14	4/17	4/18	5/6	5/17	5/20	5/28	30	2248	201	402.6	17.9
2008	4/9	4/19	4/24	4/29	5/8	5/21	5/24	6/30	23	2684	390	871.2	32.5

Figure B.7: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling Chinook salmon from Lemhi River.

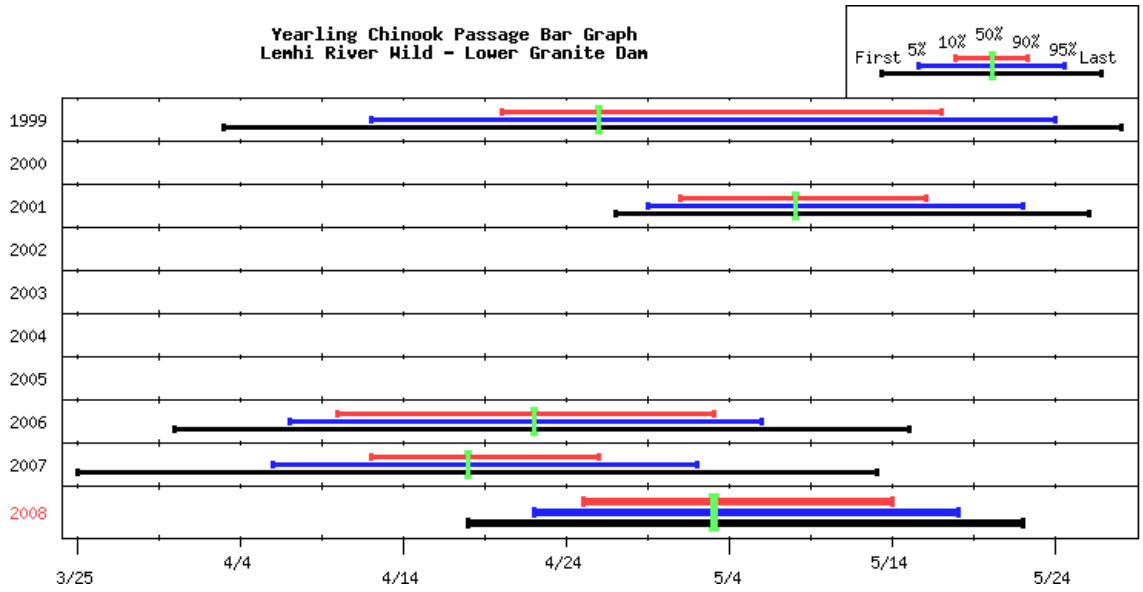


Table B.7: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling Chinook salmon from Lemhi River.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1999	4/4	4/4	4/13	4/21	4/27	5/18	5/25	5/29	28	699	55	129.5	18.5
2001	4/28	4/28	4/30	5/2	5/9	5/17	5/23	5/27	16	700	99	99.0	14.1
2006	4/1	4/4	4/8	4/11	4/23	5/4	5/7	5/16	24	1873	187	436	23.3
2007	3/26	3/31	4/7	4/13	4/19	4/27	5/3	5/14	15	268	137	345.3	1.0
2008	4/18	4/19	4/22	4/25	5/3	5/14	5/18	5/22	20	268	137	345.3	1.0

Figure B.8: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling Chinook salmon from Lemhi River Weir.

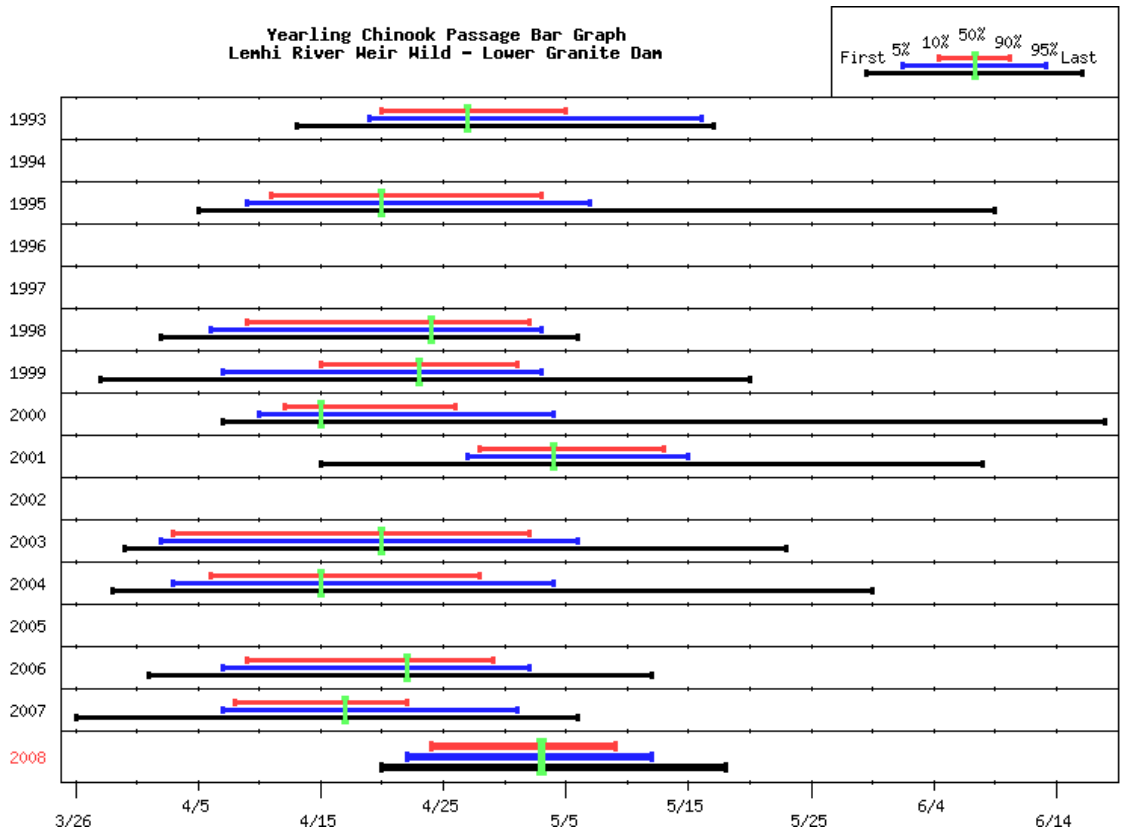


Table B.8: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling Chinook salmon from Lemhi River Weir.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1993	4/14	4/14	4/20	4/21	4/28	5/6	5/17	5/18	16	629	75	78.5	12.5
1995	4/6	4/8	4/10	4/12	4/21	5/4	5/8	6/10	23	1766	213	226.2	12.8
1998	4/3	4/4	4/7	4/10	4/25	5/3	5/4	5/7	24	697	78	130.7	18.8
1999	3/29	4/1	4/8	4/16	4/24	5/2	5/4	5/21	17	2999	255	581.4	19.4
2000	4/7	4/7	4/10	4/12	4/15	4/26	5/4	6/18	15	1432	83	161	11.2
2001	4/16	4/19	4/28	4/29	5/5	5/14	5/16	6/9	16	1426	227	227.0	15.9
2003	3/31	4/1	4/3	4/4	4/21	5/3	5/7	5/24	30	2864	78	150.7	5.3
2004	3/29	4/2	4/3	4/6	4/15	4/28	5/4	5/30	23	3546	185	321.7	9.1
2006	4/2	4/4	4/8	4/10	4/23	4/30	5/3	5/13	21	1396	151	345.8	24.8
2007	3/27	4/4	4/8	4/9	4/18	4/23	5/2	5/7	15	1189	92	239.9	20.2
2008	4/20	4/20	4/22	4/24	5/3	5/9	5/12	5/18	16	952	149	316.8	33.3

Figure B.9: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling Chinook salmon from Lookingglass Creek.

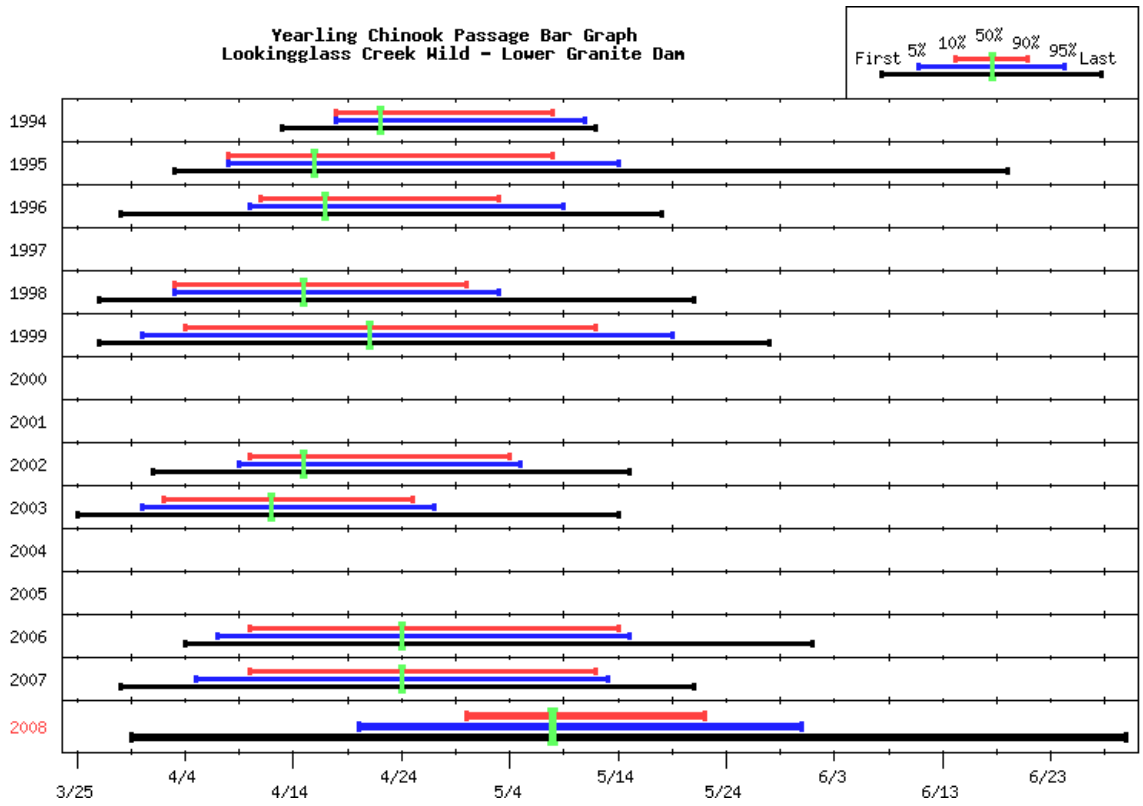


Table B.9: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling Chinook salmon from Lookingglass Creek.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1994	4/14	4/17	4/19	4/19	4/23	5/9	5/12	5/13	21	1957	131	135.1	6.9
1995	4/4	4/7	4/9	4/9	4/17	5/9	5/15	6/20	31	3572	244	275.5	7.7
1996	3/29	4/6	4/10	4/11	4/17	5/3	5/9	5/18	23	2009	110	304.2	15.1
1998	3/28	4/2	4/4	4/4	4/16	5/1	5/4	5/22	28	1632	181	287.8	17.6
1999	3/28	3/28	4/1	4/5	4/22	5/13	5/20	5/29	39	2839	134	294.3	10.4
2002	4/2	4/9	4/10	4/11	4/16	5/5	5/6	5/16	25	2034	71	157.8	7.8
2003	3/26	3/27	4/1	4/3	4/13	4/26	4/28	5/15	24	576	80	149.3	25.9
2006	4/5	4/5	4/8	4/11	4/25	5/15	5/16	6/2	35	1102	62	145.6	13.2
2007	3/30	4/2	4/6	4/11	4/25	5/13	5/14	5/22	33	1677	137	298.0	17.8
2008	3/30	4/14	4/20	4/30	5/8	5/22	5/31	6/30	23	2000	145	322.1	16.1

Figure B.10: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling Chinook salmon from Lostine River.

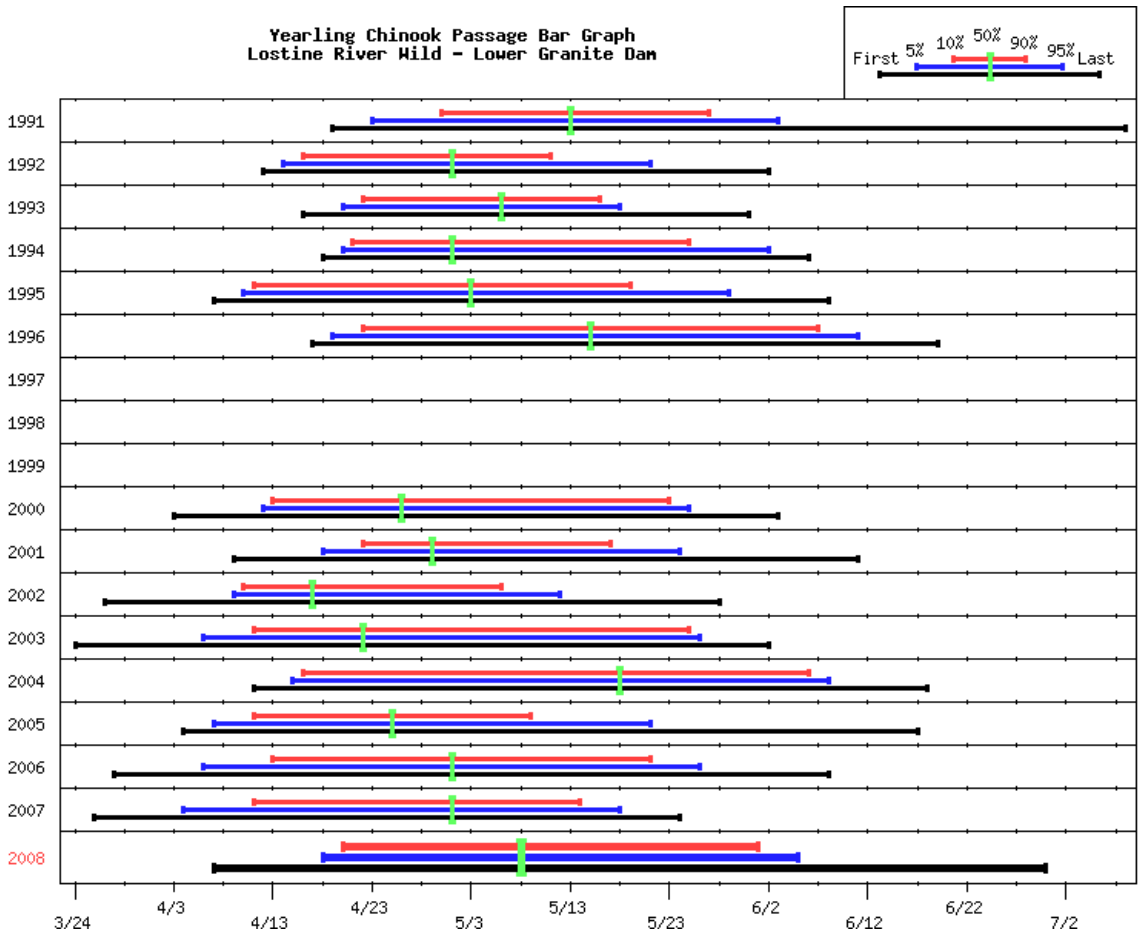


Table B.10: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling Chinook salmon from Lostine River.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1991	4/20	4/20	4/24	5/1	5/14	5/28	6/4	7/9	28	1006	90	90.8	9.0
1992	4/12	4/12	4/14	4/16	5/1	5/11	5/21	6/2	26	1107	92	92.0	8.3
1993	4/17	4/18	4/21	4/23	5/7	5/17	5/19	6/1	25	997	123	154.3	15.5
1994	4/19	4/19	4/21	4/22	5/2	5/26	6/3	6/7	35	725	69	85.0	11.7
1995	4/8	4/10	4/11	4/12	5/4	5/20	5/30	6/9	39	1002	112	142.4	14.2
1996	4/17	4/17	4/19	4/22	5/15	6/7	6/11	6/19	47	977	81	188.0	19.2
2000	4/3	4/7	4/12	4/13	4/26	5/23	5/25	6/3	41	1030	71	134.6	13.1
2001	4/10	4/12	4/19	4/23	4/30	5/18	5/25	6/12	26	1489	138	138.0	9.3
2002	3/28	3/30	4/10	4/11	4/18	5/7	5/13	5/29	27	1566	51	112.4	7.2
2003	3/25	4/3	4/7	4/12	4/23	5/26	5/27	6/3	45	2842	111	224.7	7.9
2004	4/11	4/11	4/15	4/16	5/18	6/6	6/8	6/18	52	1950	89	110.0	5.6
2005	4/5	4/5	4/8	4/12	4/26	5/10	5/22	6/18	29	1500	129	134.7	9.0
2006	3/29	4/2	4/7	4/14	5/2	5/22	5/27	6/9	39	2101	85	196.7	9.4
2007	3/27	3/31	4/5	4/12	5/2	5/15	5/19	5/25	34	1500	103	218.2	14.5
2008	4/7	4/10	4/18	4/20	5/8	6/1	6/5	6/30	43	1999	187	433.6	21.7

Figure B.11: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling Chinook salmon from Meadow Creek.

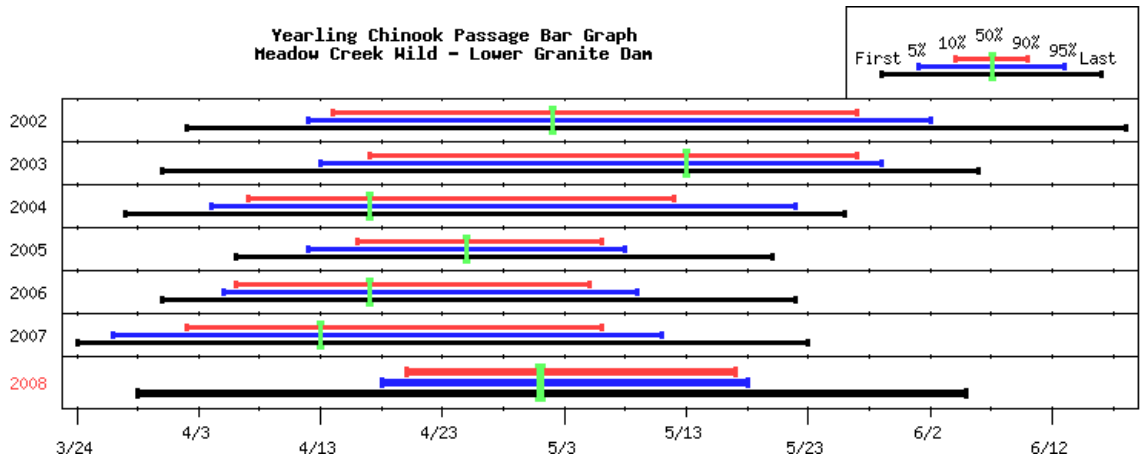


Table B.11: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling Chinook salmon from Meadow Creek.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
2002	4/3	4/9	4/13	4/15	5/3	5/28	6/3	6/19	44	2004	127	293.9	14.7
2003	4/1	4/2	4/14	4/18	5/14	5/28	5/30	6/7	41	1981	91	186.6	9.4
2004	3/28	3/28	4/4	4/7	4/17	5/12	5/22	5/26	36	834	62	94.2	11.3
2005	4/7	4/9	4/13	4/17	4/26	5/7	5/9	5/21	21	1762	281	290.0	16.5
2006	4/1	4/3	4/6	4/7	4/18	5/6	5/10	5/23	30	3085	363	845.4	27.4
2007	3/25	3/26	3/28	4/3	4/14	5/7	5/12	5/24	35	1767	167	392.3	22.2
2008	3/29	4/14	4/18	4/20	5/1	5/17	5/18	6/5	28	1728	283	625.9	36.2

Figure B.12: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling Chinook salmon from Minam River.

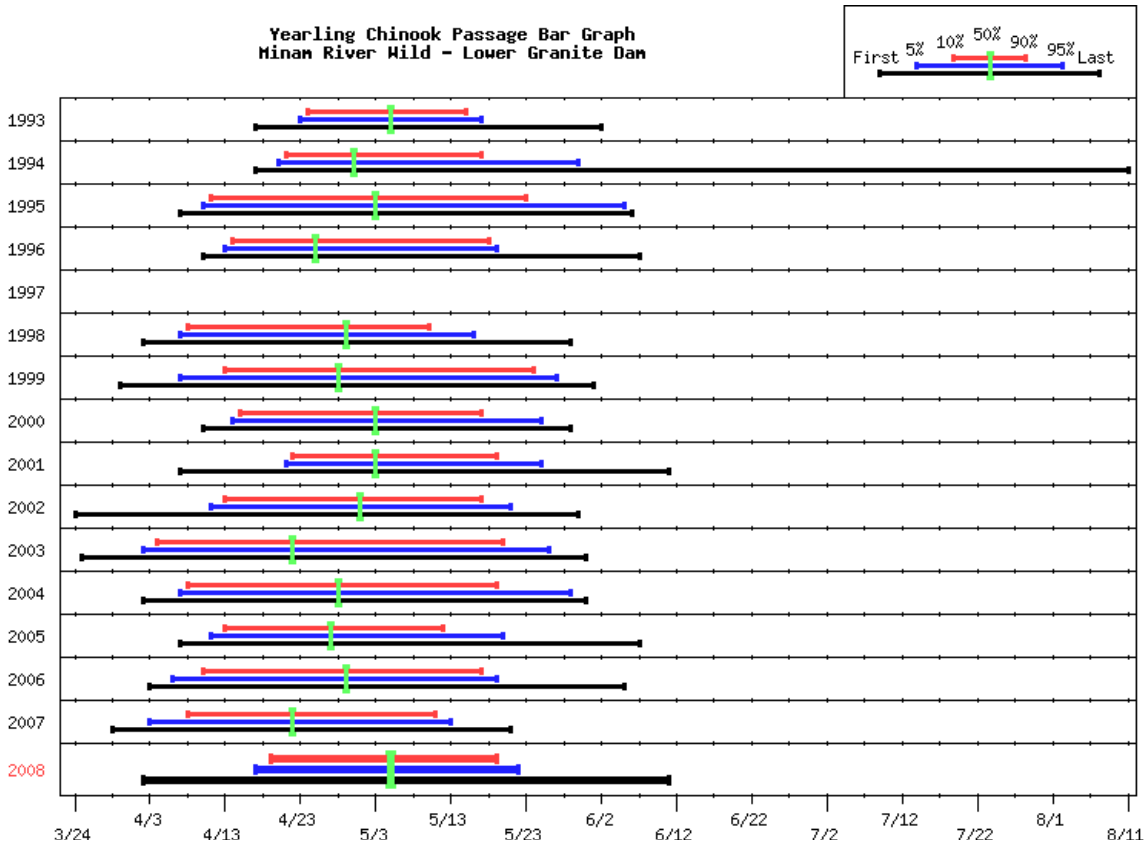


Table B.12: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling Chinook salmon from Minam River.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1993	4/18	4/21	4/24	4/25	5/6	5/16	5/18	6/3	22	994	105	124.7	12.5
1994	4/18	4/20	4/21	4/22	5/1	5/18	5/31	8/12	27	997	112	132.7	13.3
1995	4/8	4/8	4/11	4/12	5/4	5/24	6/6	6/7	43	996	70	89.6	9.0
1996	4/10	4/10	4/13	4/14	4/25	5/18	5/19	6/7	35	998	68	165.3	16.6
1998	4/3	4/4	4/8	4/9	4/30	5/11	5/17	5/30	33	998	123	221.9	22.2
1999	3/31	4/3	4/8	4/14	4/29	5/25	5/28	6/2	42	1006	51	120.4	12.0
2000	4/10	4/10	4/14	4/15	5/3	5/17	5/25	5/29	33	998	74	142.1	14.2
2001	4/8	4/15	4/22	4/23	5/4	5/20	5/26	6/12	28	1300	234	234.0	18.0
2002	3/25	4/10	4/12	4/14	5/2	5/18	5/22	5/31	35	1533	65	149.9	9.8
2003	3/26	3/31	4/3	4/5	4/23	5/21	5/27	6/1	47	1849	81	159.2	8.6
2004	4/2	4/7	4/7	4/8	4/28	5/19	5/29	5/31	42	1496	82	100.0	6.7
2005	4/8	4/9	4/12	4/14	4/28	5/13	5/21	6/8	30	1500	189	204.2	13.6
2006	4/4	4/5	4/7	4/11	4/30	5/18	5/20	6/6	38	1506	96	230.0	15.3
2007	3/30	4/4	4/4	4/9	4/23	5/12	5/14	5/22	34	1500	93	207.4	13.8
2008	4/2	4/9	4/17	4/19	5/5	5/19	5/22	6/11	31	1500	148	331.4	22.1

Figure B.13: Historical outmigration run-timing at Lower Granite of PIT-tagged wild yearling Chinook salmon from Valley Creek.

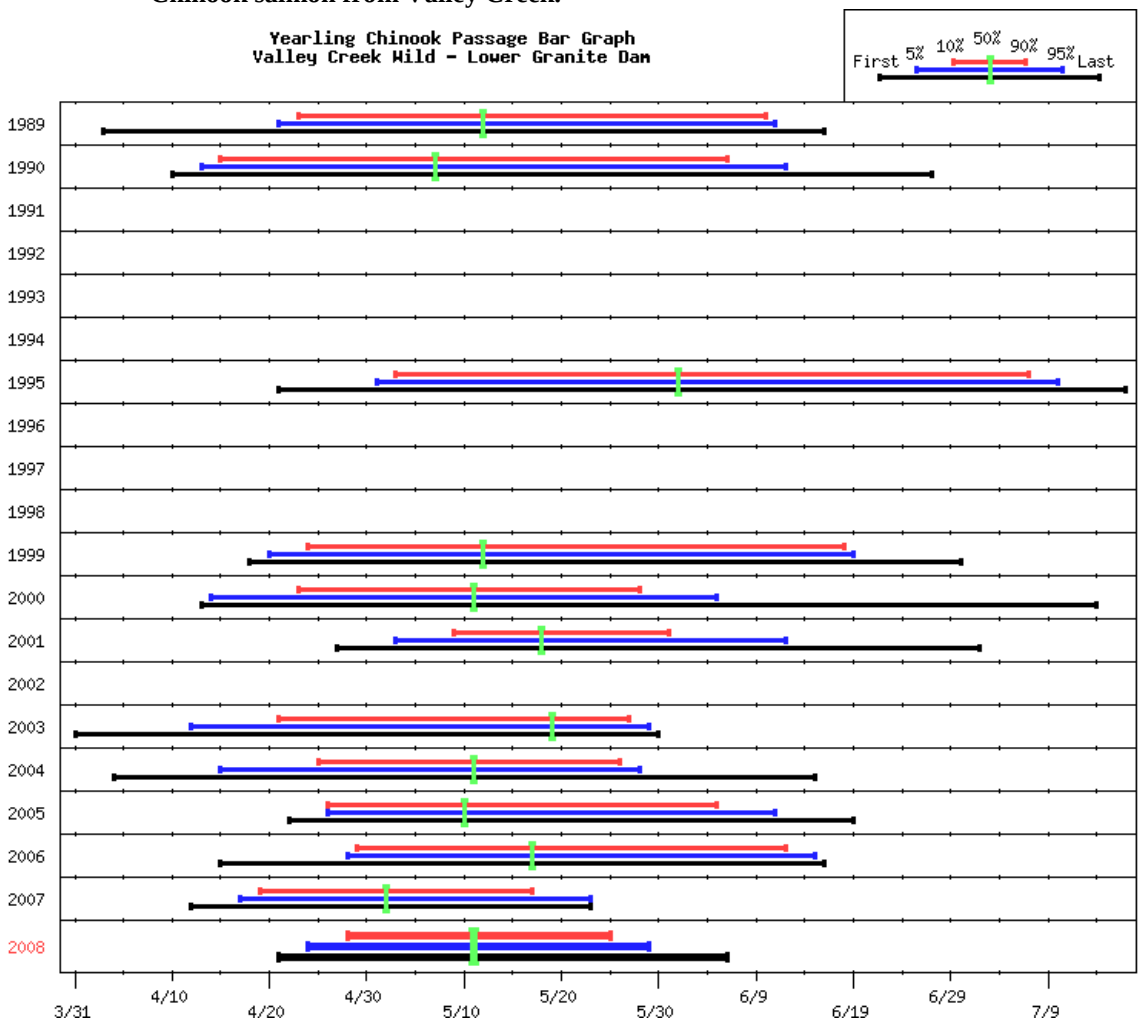


Table B.13: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild yearling Chinook salmon from Valley Creek.

Detection Year	Detection Date								Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
	First	1%	5%	10%	50%	90%	95%	Last					
1989	4/4	4/4	4/22	4/24	5/13	6/11	6/12	6/17	49	2188	65	65.0	3.0
1990	4/11	4/11	4/14	4/16	5/8	6/7	6/13	6/28	53	2496	76	76.0	3.0
1995	4/22	4/22	5/2	5/4	6/2	7/8	7/11	7/18	66	1551	50	64.1	4.1
1999	4/19	4/19	4/21	4/25	5/13	6/19	6/20	7/1	56	1001	50	118.3	11.8
2000	4/13	4/13	4/14	4/23	5/11	5/28	6/5	7/14	36	1009	51	95.7	9.5
2001	4/28	4/30	5/4	5/10	5/19	6/1	6/13	7/3	23	1004	135	135.0	13.4
2003	4/1	4/2	4/13	4/22	5/20	5/28	5/30	5/31	37	2266	50	104.2	4.6
2004	4/4	4/4	4/15	4/25	5/11	5/26	5/28	6/15	32	2498	108	116.6	4.7
2005	4/23	4/26	4/27	4/27	5/11	6/6	6/12	6/20	41	2511	95	116.2	4.6
2006	4/16	4/16	4/29	4/30	5/18	6/13	6/16	6/17	45	2218	86	198.1	8.9
2007	4/13	4/13	4/18	4/20	5/3	5/18	5/24	5/24	29	1856	67	136.3	7.3
2008	4/21	4/23	4/24	4/28	5/11	5/25	5/29	6/6	28	2188	65	65.0	3.0

Figure B.14: Historical outmigration run-timing at Lower Granite of the Realtime composite of PIT-tagged wild yearling Chinook salmon.

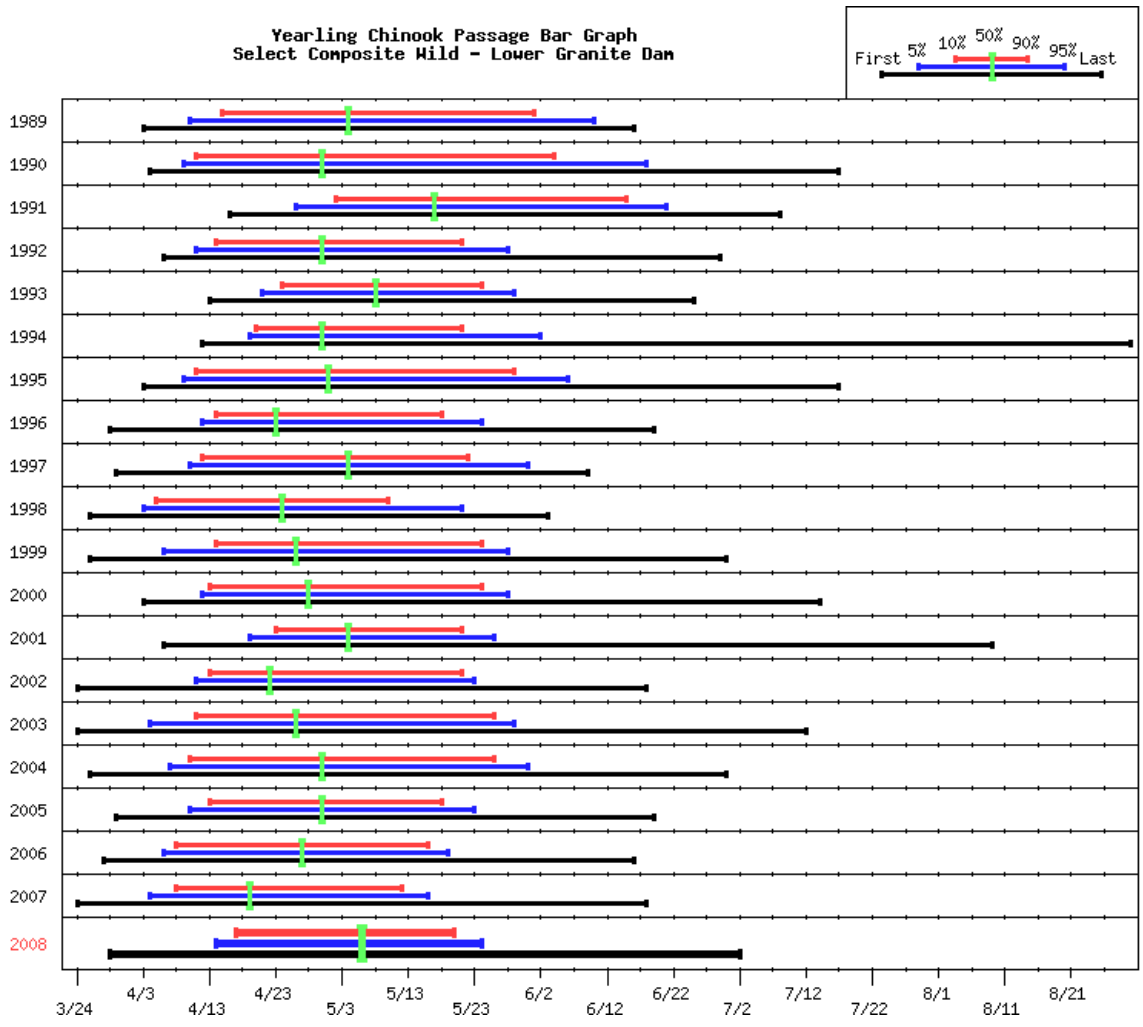


Table B.14: Historical outmigration run-timing characteristics at Lower Granite of the Realtime composite of PIT-tagged wild yearling Chinook salmon.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1989	4/4	4/4	4/11	4/16	5/5	6/2	6/11	6/17	48	3343	135	135.0	4.0
1990	4/5	4/7	4/10	4/12	5/1	6/5	6/19	7/18	55	6178	361	361.0	5.8
1991	4/17	4/20	4/27	5/3	5/18	6/16	6/22	7/9	45	2741	234	237.0	8.6
1992	4/6	4/6	4/11	4/14	4/30	5/21	5/28	6/29	38	3807	289	289.0	7.6
1993	4/14	4/19	4/22	4/25	5/9	5/25	5/30	6/26	31	5447	533	689.4	12.7
1994	4/13	4/17	4/20	4/21	5/1	5/22	6/3	8/31	32	7153	533	632.3	8.8
1995	4/4	4/8	4/10	4/12	5/2	5/30	6/7	7/18	49	12355	968	1172.4	9.5
1996	3/29	4/9	4/12	4/14	4/23	5/18	5/24	6/19	35	7141	513	1268.2	17.8
1997	3/31	4/6	4/11	4/13	5/5	5/23	6/1	6/10	41	2005	164	346.3	17.3
1998	3/27	4/3	4/4	4/6	4/25	5/11	5/22	6/4	36	7052	785	1339.2	19.0
1999	3/27	3/31	4/7	4/15	4/27	5/25	5/29	7/1	41	16245	953	2210.8	13.6
2000	4/3	4/8	4/12	4/13	4/28	5/24	5/28	7/14	42	14139	984	1880.0	13.3
2001	4/7	4/12	4/20	4/24	5/5	5/22	5/27	8/10	29	14140	2407	2407.0	17.0
2002	3/25	4/9	4/12	4/14	4/23	5/22	5/24	6/19	39	15790	787	1789.9	11.3
2003	3/25	4/2	4/5	4/12	4/27	5/27	5/30	7/13	46	32699	1451	2954.7	9.0
2004	3/26	4/2	4/7	4/10	4/30	5/26	5/31	6/30	47	27587	1752	2240.9	8.1
2005	3/31	4/6	4/11	4/14	5/1	5/19	5/24	6/20	36	29417	2801	3021.4	10.3
2006	3/29	4/3	4/7	4/9	4/28	5/17	5/20	6/17	39	24463	1703	4001.3	16.4
2007	3/25	3/29	4/5	4/9	4/20	5/13	5/17	6/19	35	21414	1603	3645.1	17.0
2008	3/29	4/7	4/14	4/17	5/6	5/20	5/24	7/2	34	33392	3837	8646.0	25.9

Figure B.15: Historical outmigration run-timing at Lower Granite of a run-at-large of PIT-tagged wild subyearling Chinook salmon from the Snake River drainage.

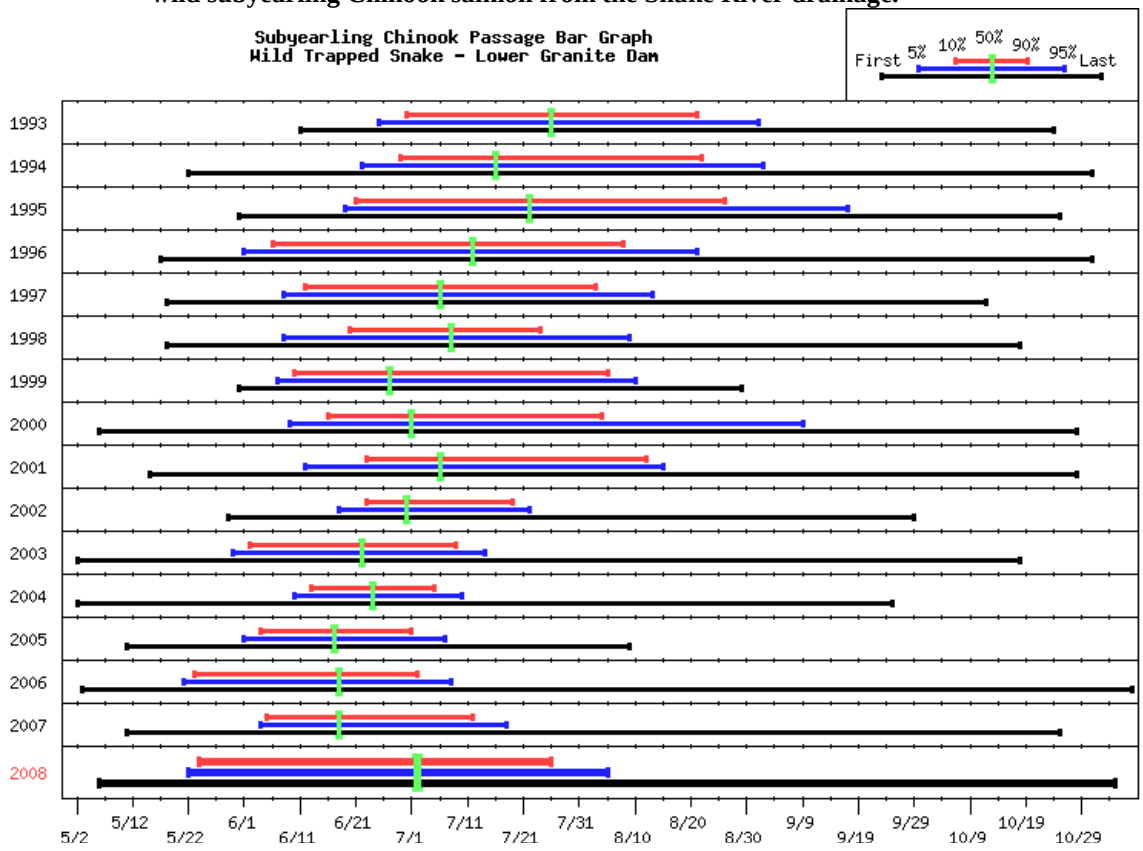


Table B.15: Historical outmigration run-timing characteristics at Lower Granite of a run-at-large of PIT-tagged wild subyearling Chinook salmon from the Snake River drainage.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1993	6/12	6/20	6/26	7/1	7/27	8/22	9/2	10/25	53	1770	172	172.1	9.7
1994	5/23	5/23	6/23	6/30	7/17	8/23	9/3	11/1	55	3040	193	199.1	6.5
1995	6/1	6/4	6/20	6/22	7/23	8/27	9/18	10/26	67	1828	440	454.0	24.8
1996	5/17	5/17	6/1	6/6	7/12	8/8	8/21	10/31	64	464	146	186.1	40.1
1997	5/19	5/19	6/9	6/13	7/7	8/4	8/14	10/13	53	641	124	164.4	25.6
1998	5/19	5/26	6/9	6/21	7/9	7/25	8/10	10/19	35	2060	549	676.1	32.8
1999	6/1	6/3	6/8	6/11	6/28	8/6	8/11	8/30	57	1761	559	802.5	45.6
2000	5/6	5/18	6/9	6/16	7/1	8/4	9/9	10/28	50	1209	327	376.0	31.1
2001	5/16	6/4	6/13	6/24	7/7	8/13	8/16	10/29	51	1392	195	196.8	14.1
2002	5/30	6/2	6/19	6/24	7/1	7/20	7/23	9/30	27	2405	493	790.5	32.9
2003	5/3	5/30	5/31	6/3	6/23	7/10	7/15	10/19	38	4740	1130	1459.0	30.8
2004	5/2	5/31	6/10	6/13	6/24	7/5	7/10	9/25	23	5534	1786	1809.8	32.7
2005	5/12	5/31	6/2	6/5	6/18	7/2	7/8	8/10	28	9426	1044	1658.0	17.6
2006	5/4	5/20	5/22	5/24	6/19	7/3	7/9	11/8	41	2186	203	466.8	21.4
2007	5/12	5/28	6/5	6/6	6/19	7/13	7/19	10/26	38	4096	214	567.0	13.8
2008	5/6	5/16	5/22	5/24	7/2	7/26	8/5	11/4	64	6756	570	1379.7	20.4

Figure B.16: Historical outmigration run-timing at Lower Granite of a run-at-large of PIT-tagged wild subyearling Chinook salmon from the Clearwater River drainage.

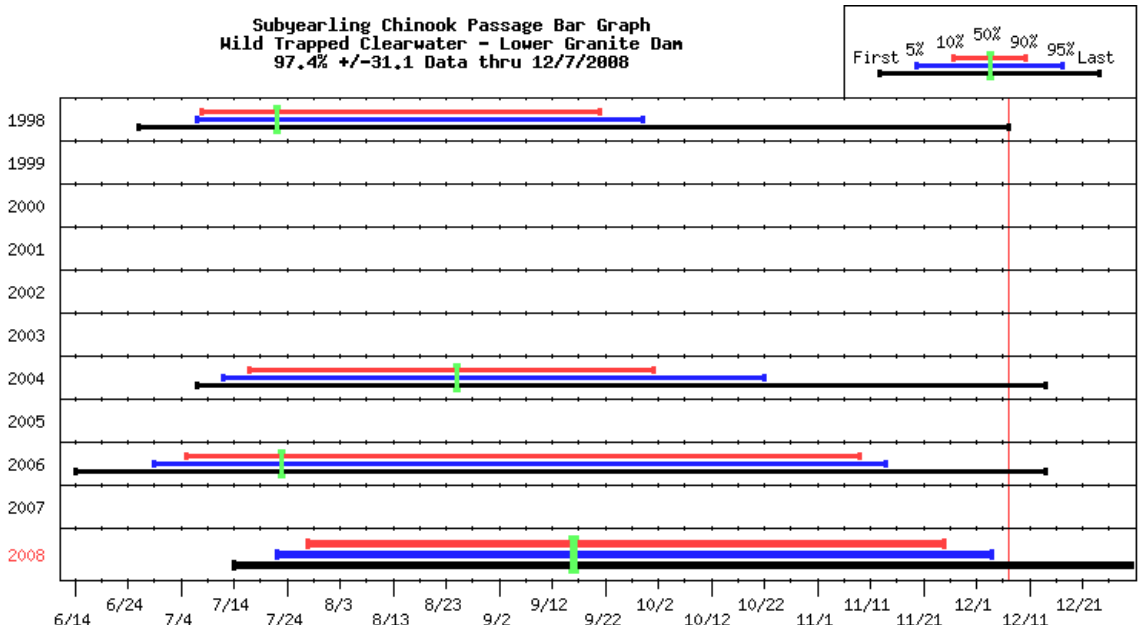


Table B.16: Historical outmigration run-timing characteristics at Lower Granite of a run-at-large of PIT-tagged wild subyearling Chinook salmon from the Clearwater River drainage.

Detection Year	Detection Date								Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
	First	1%	5%	10%	50%	90%	95%	Last					
1998	6/27	7/7	7/8	7/9	7/23	9/22	9/30	12/8	76	391	239	264.8	67.7
2004	7/7	7/9	7/12	7/17	8/25	10/1	10/22	12/14	77	2019	432	432.0	21.4
2006	6/15	6/15	6/30	7/6	7/24	11/10	11/15	12/15	128	1587	130	335.3	21.1
2008	7/14	7/14	7/22	7/28	9/16	11/25	12/4	00/00	121	1096	105	175.5	16.0

Figure B.17: Historical outmigration run-timing at McNary of a run-at-large of PIT-tagged wild subyearling Chinook salmon from the Snake River drainage.

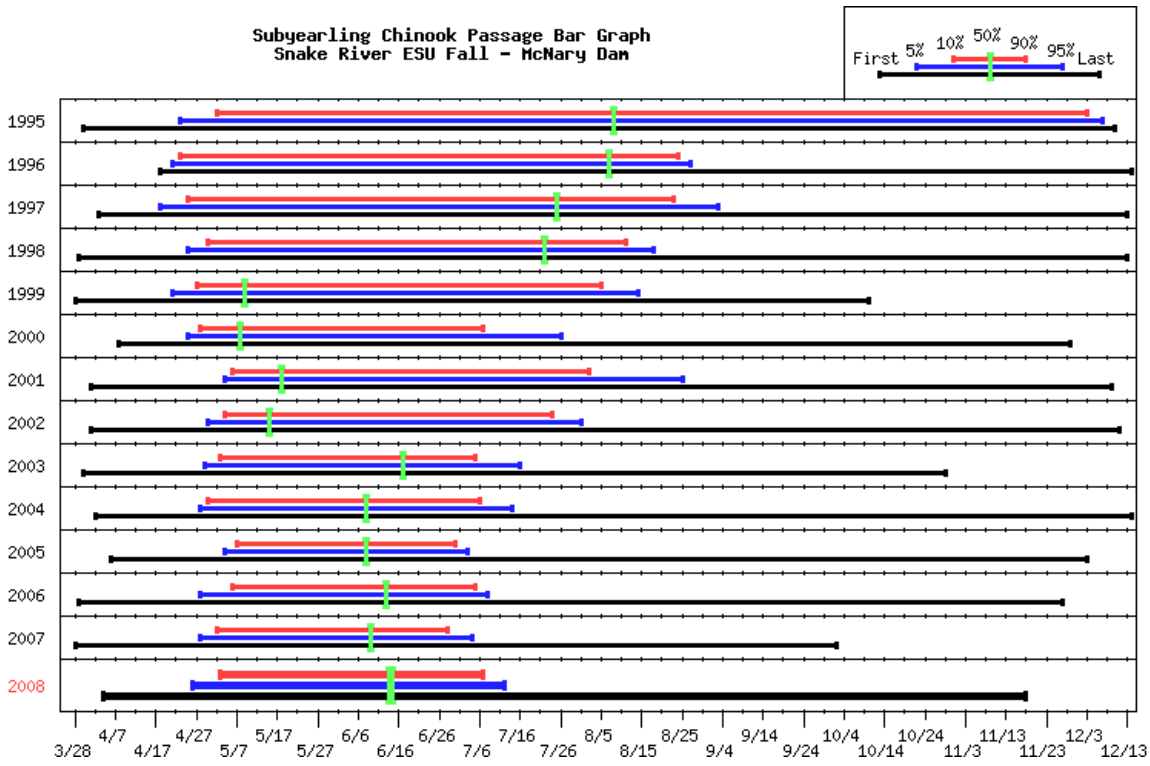


Table B.17: Historical outmigration run-timing characteristics at McNary of a composite of PIT-tagged wild subyearling Chinook salmon from the Snake River drainage.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total LGR Passage
1995	3/31	4/6	4/24	5/3	8/9	12/4	12/8	12/11	216	880.5
1996	4/18	4/19	4/21	4/23	8/7	8/24	8/27	12/14	124	3574.9
1997	4/4	4/6	4/19	4/26	7/26	8/24	9/4	12/14	121	8465.5
1998	3/30	4/17	4/26	5/1	7/23	8/12	8/19	12/14	104	17316.2
1999	3/29	4/4	4/22	4/28	5/10	8/6	8/15	10/11	101	16273.0
2000	4/8	4/17	4/25	4/28	5/8	7/7	7/26	11/29	71	9066.4
2001	4/2	5/2	5/5	5/7	5/19	8/3	8/26	12/10	89	6552.4
2002	4/2	4/18	5/1	5/5	5/16	7/25	8/1	12/12	82	15112.5
2003	3/31	4/13	4/30	5/4	6/18	7/6	7/17	10/30	64	23471.4
2004	4/2	4/25	4/28	4/30	6/8	7/6	7/14	12/14	68	10034.6
2005	4/7	4/30	5/5	5/8	6/9	7/1	7/4	12/4	55	15238.1
2006	3/30	4/19	4/29	5/7	6/14	7/6	7/9	11/28	61	48721.6
2007	3/29	4/13	4/29	5/3	6/10	6/29	7/5	10/3	58	15519.6
2008	4/4	4/18	4/26	5/3	6/14	7/7	7/12	11/18	66	60938.8

Figure B.18: Historical outmigration run-timing at McNary of a run-at-large of PIT-tagged wild subyearling Chinook salmon from the Upper Columbia River drainage.

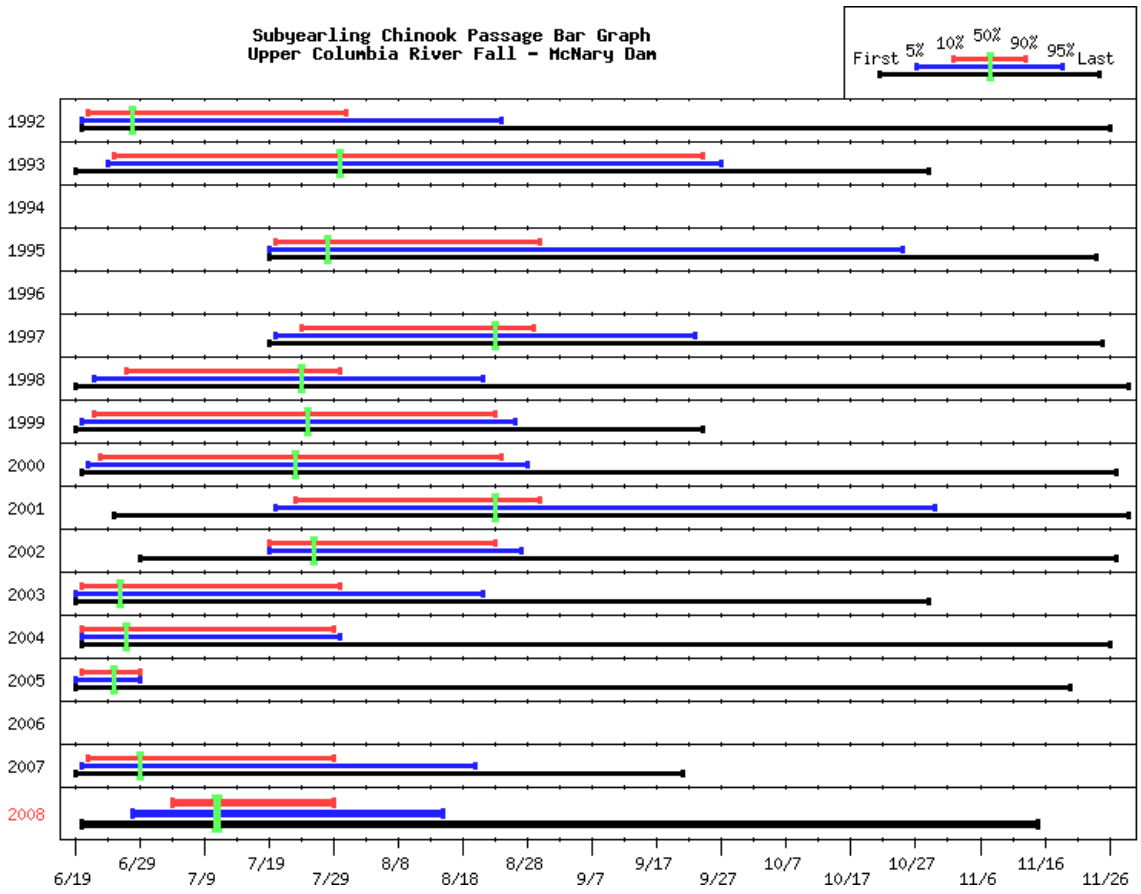


Table B.18: Historical outmigration run-timing characteristics at McNary of a composite of PIT-tagged wild subyearling Chinook salmon from the Upper Columbia River drainage.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total LGR Passage
1992	6/20	6/20	6/20	6/21	6/28	7/31	8/24	11/26	41	253.0
1993	6/20	6/21	6/25	6/26	7/31	9/25	9/28	10/30	92	103.1
1995	7/20	7/20	7/20	7/21	7/29	8/31	10/26	11/25	42	237.0
1997	7/20	7/20	7/21	7/25	8/24	8/30	9/24	11/26	37	592.5
1998	6/20	6/20	6/23	6/28	7/25	7/31	8/22	11/30	34	582.4
1999	6/20	6/20	6/21	6/23	7/26	8/24	8/27	9/25	63	892.0
2000	6/20	6/20	6/21	6/23	7/23	8/24	8/28	11/27	63	931.8
2001	6/26	6/30	7/21	7/24	8/24	8/31	10/31	11/30	39	261.0
2002	6/30	7/20	7/20	7/20	7/27	8/24	8/28	11/28	36	757.4
2003	6/20	6/20	6/20	6/21	6/27	7/31	8/22	10/30	41	689.7
2004	6/20	6/20	6/20	6/20	6/27	7/29	7/30	11/26	40	610.5
2005	6/20	6/20	6/20	6/21	6/26	6/30	6/30	11/21	10	2123.7
2007	6/20	6/20	6/21	6/22	6/30	7/30	8/21	9/22	39	1063.7
2008	6/20	6/23	6/28	7/4	7/11	7/29	8/15	11/15	26	3202.9

Figure B.19: Historical outmigration run-timing at Lower Granite of PIT-tagged wild steelhead from the Snake River drainage.

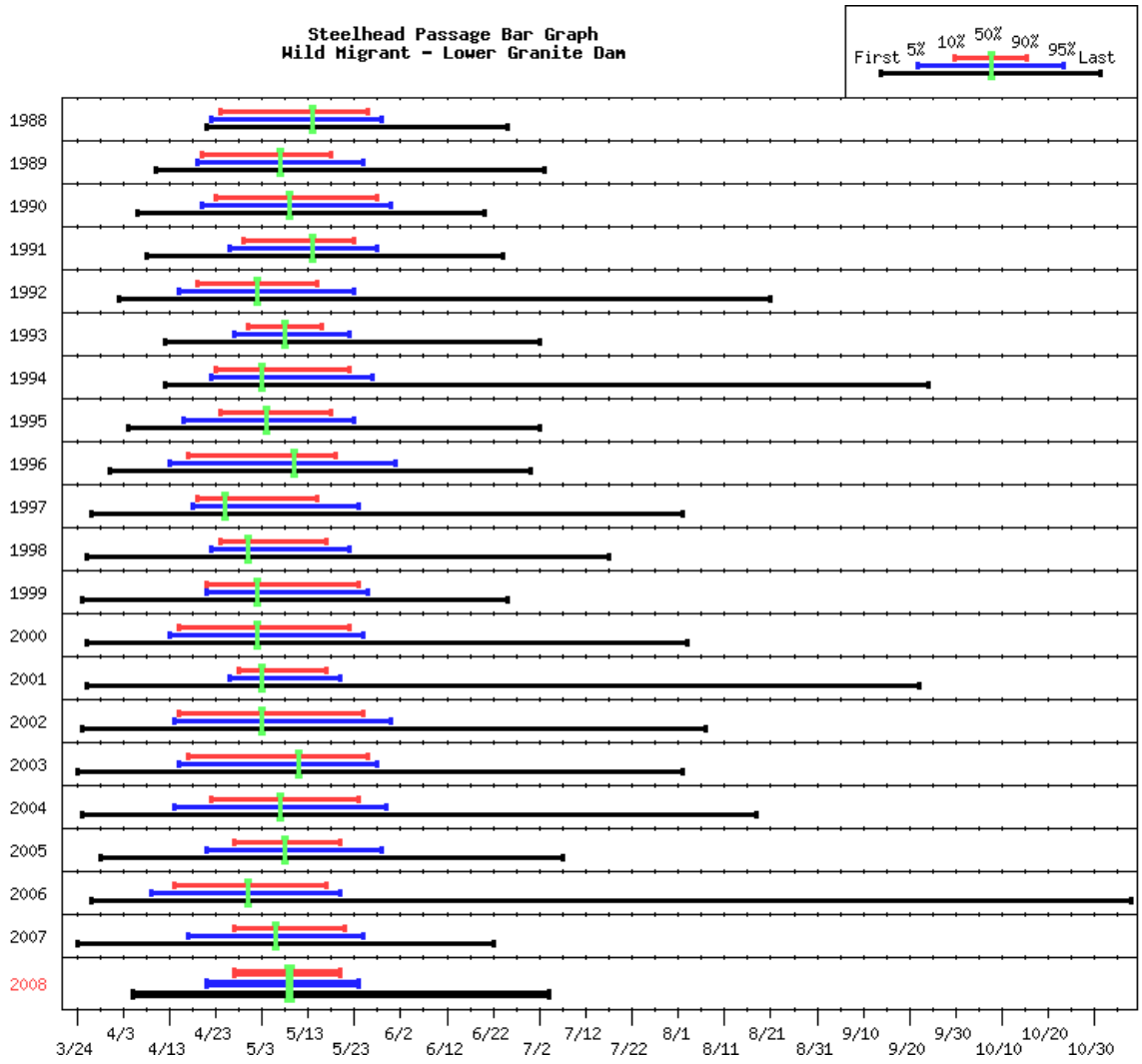


Table B.19: Historical outmigration run-timing characteristics at Lower Granite of PIT-tagged wild steelhead from the Snake River drainage.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total LGR Passage
1988	4/21	4/21	4/22	4/24	5/14	5/26	5/29	6/25	33	671.0
1989	4/11	4/14	4/20	4/21	5/8	5/19	5/26	7/4	29	1318.0
1990	4/7	4/15	4/21	4/24	5/10	5/29	6/1	6/21	36	2818.0
1991	4/9	4/18	4/27	4/30	5/15	5/24	5/29	6/25	25	2914.5
1992	4/2	4/10	4/15	4/19	5/2	5/15	5/23	8/21	27	3638.0
1993	4/13	4/20	4/28	5/1	5/9	5/17	5/23	7/3	17	4465.2
1994	4/13	4/21	4/23	4/24	5/4	5/23	5/28	9/25	30	5333.1
1995	4/5	4/12	4/17	4/25	5/5	5/19	5/24	7/3	25	3893.7
1996	3/31	4/10	4/13	4/17	5/10	5/19	6/1	6/30	33	3718.5
1997	3/28	4/6	4/19	4/20	4/26	5/16	5/25	8/3	27	4453.6
1998	3/27	4/5	4/23	4/25	5/1	5/18	5/23	7/18	24	8522.8
1999	3/26	4/3	4/22	4/22	5/3	5/25	5/27	6/26	34	6988.5
2000	3/26	4/8	4/13	4/15	5/2	5/22	5/25	8/3	38	13604.8
2001	3/27	4/23	4/27	4/29	5/4	5/18	5/21	9/23	20	13625.7
2002	3/26	4/12	4/15	4/16	5/4	5/26	6/1	8/8	41	10274.6
2003	3/25	4/4	4/16	4/18	5/12	5/27	5/29	8/3	40	10465.8
2004	3/25	4/4	4/14	4/22	5/7	5/24	5/30	8/18	33	12785.4
2005	3/30	4/11	4/22	4/28	5/9	5/21	5/30	7/8	24	14428.9
2006	3/28	4/8	4/10	4/15	5/1	5/18	5/21	11/8	34	10342.9
2007	3/25	4/9	4/18	4/28	5/7	5/22	5/26	6/23	25	8608.3
2008	4/5	4/18	4/21	4/27	5/9	5/20	5/24	7/4	24	12084.1

Figure B.20: Historical outmigration run-timing at McNary of PIT-tagged wild steelhead from the Snake River drainage.

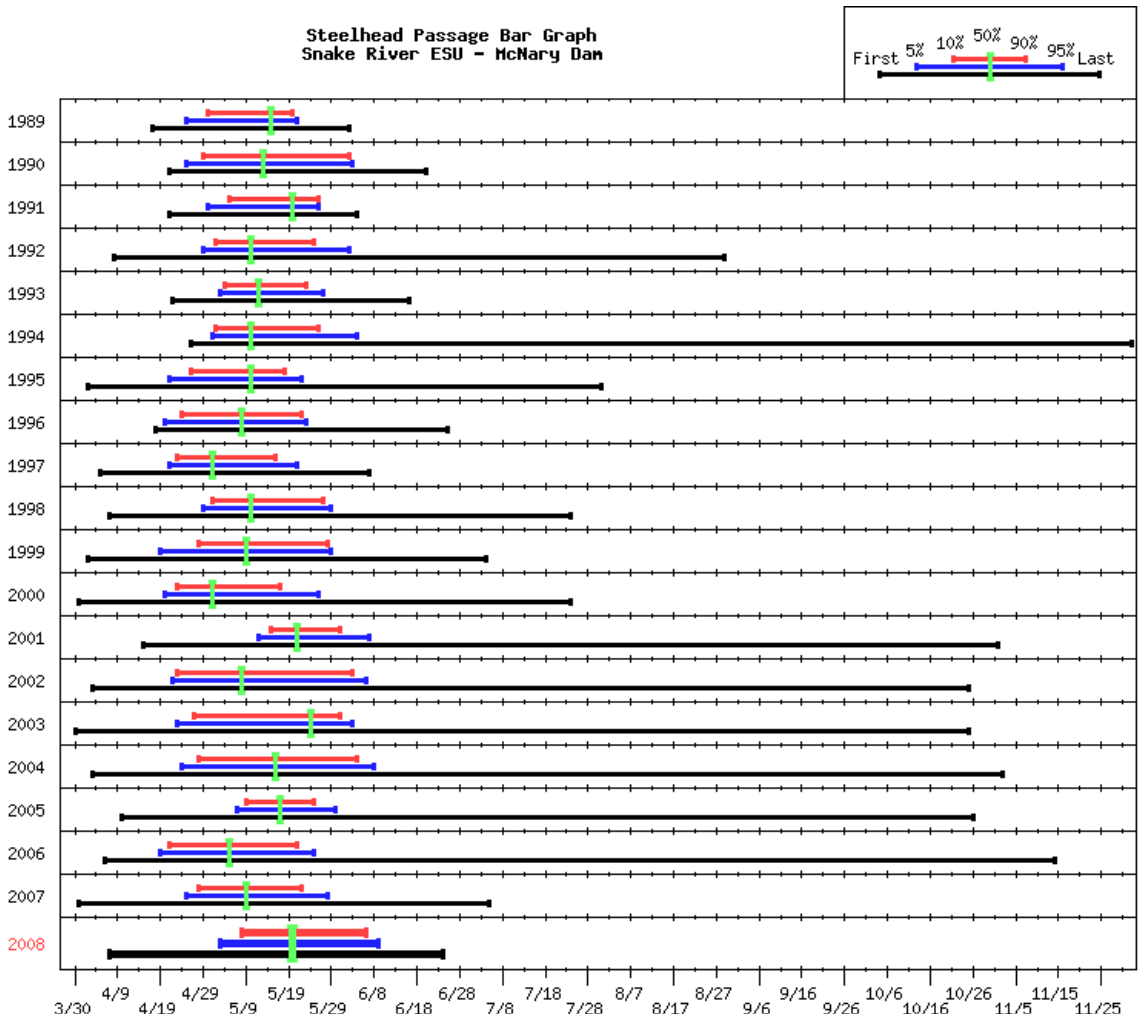


Table B.20: Historical outmigration run-timing characteristics at McNary of PIT-tagged wild steelhead from the Snake River drainage.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
1989	4/18	4/22	4/26	5/1	5/16	5/21	5/22	6/3	21	166.0
1990	4/22	4/23	4/26	4/30	5/14	6/3	6/4	6/21	35	119.6
1991	4/22	4/26	5/1	5/6	5/21	5/27	5/27	6/5	22	160.4
1992	4/8	4/22	4/29	5/2	5/10	5/25	6/2	8/29	24	479.7
1993	4/23	5/1	5/4	5/5	5/13	5/24	5/28	6/17	20	910.7
1994	4/27	5/1	5/2	5/3	5/11	5/27	6/5	12/3	25	1945.7
1995	4/3	4/8	4/22	4/27	5/11	5/19	5/23	8/1	23	1416.4
1996	4/18	4/18	4/20	4/24	5/8	5/22	5/23	6/25	29	1117.1
1997	4/6	4/9	4/22	4/24	5/2	5/17	5/22	6/8	24	1156.3
1998	4/8	4/19	4/30	5/2	5/11	5/28	5/30	7/25	27	2675.0
1999	4/3	4/12	4/20	4/29	5/10	5/29	5/30	7/5	31	4955.8
2000	3/31	4/16	4/20	4/23	5/1	5/17	5/26	7/24	25	12093.5
2001	4/16	5/7	5/13	5/16	5/22	6/1	6/8	11/2	17	2644.3
2002	4/4	4/18	4/23	4/24	5/9	6/4	6/7	10/26	42	10426.0
2003	3/31	4/12	4/24	4/28	5/25	6/1	6/4	10/26	35	6369.6
2004	4/3	4/18	4/24	4/28	5/16	6/4	6/8	11/2	38	2619.7
2005	4/11	5/2	5/8	5/10	5/18	5/26	5/31	10/27	17	4341.3
2006	4/7	4/15	4/20	4/22	5/6	5/22	5/26	11/15	31	7344.4
2007	4/1	4/17	4/26	4/29	5/10	5/23	5/29	7/6	25	5558.3
2008	4/7	4/29	5/3	5/8	5/20	6/6	6/9	6/24	30	7408.5

Figure B.21: Historical outmigration run-timing at McNary of PIT-tagged wild steelhead from the Upper Columbia River.

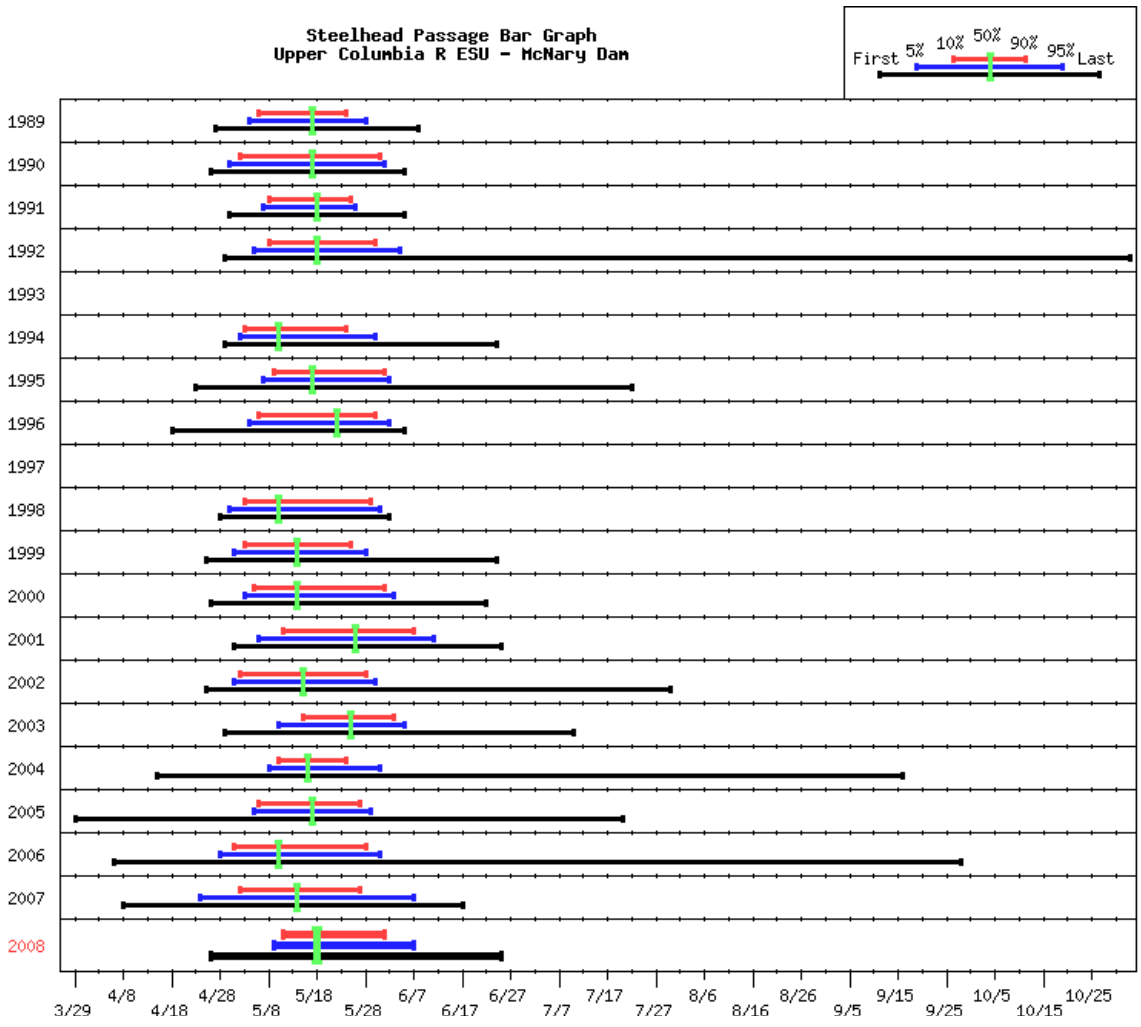


Table B.21: Historical outmigration run-timing characteristics at McNary of PIT-tagged wild steelhead from the Upper Columbia River.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
1989	4/28	5/3	5/5	5/7	5/18	5/25	5/29	6/9	19	262.6
1990	4/27	4/27	5/1	5/3	5/18	6/1	6/2	6/6	30	279.5
1991	5/1	5/5	5/8	5/9	5/19	5/26	5/27	6/6	18	353.0
1992	4/29	5/2	5/5	5/8	5/18	5/30	6/4	11/2	23	395.1
1994	4/30	5/1	5/3	5/4	5/11	5/25	5/31	6/25	22	366.4
1995	4/24	5/7	5/8	5/10	5/18	6/2	6/3	7/23	24	251.9
1996	4/18	5/2	5/4	5/6	5/22	5/30	6/2	6/5	25	262.6
1998	4/29	4/30	5/1	5/4	5/11	5/30	6/1	6/3	27	211.2
1999	4/26	4/28	5/2	5/4	5/15	5/26	5/29	6/25	23	9615.4
2000	4/26	4/30	5/3	5/5	5/14	6/1	6/3	6/22	28	5239.8
2001	5/2	5/3	5/7	5/12	5/27	6/8	6/12	6/26	28	191.8
2002	4/26	4/28	5/2	5/3	5/16	5/29	5/31	7/31	27	329.2
2003	4/30	5/6	5/11	5/16	5/26	6/4	6/6	7/11	20	30300.4
2004	4/15	5/5	5/8	5/10	5/16	5/24	5/31	9/16	15	22326.8
2005	3/30	5/4	5/6	5/7	5/18	5/28	5/30	7/21	22	36229.5
2006	4/7	4/20	4/29	5/2	5/11	5/29	6/1	9/29	28	1030.7
2007	4/9	4/18	4/25	5/3	5/15	5/28	6/8	6/18	26	688.3
2008	4/26	4/30	5/9	5/11	5/18	6/1	6/7	6/25	22	1374.4

Figure B.22: Historical outmigration run-timing at McNary of PIT-tagged wild sockeye salmon from the Snake River drainage.

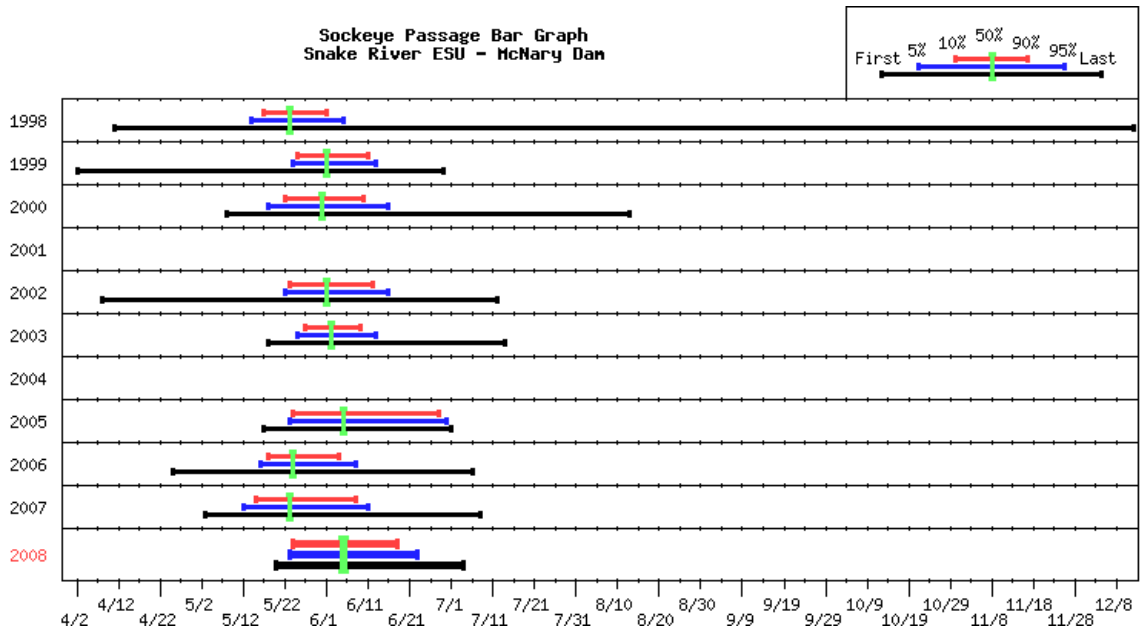


Table B.22: Historical outmigration run-timing characteristics at McNary of PIT-tagged wild sockeye salmon from the Snake River drainage.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
Year	First	1%	5%	10%	50%	90%	95%	Last		
1998	4/12	4/24	5/15	5/18	5/24	6/2	6/6	12/13	16	472.2
1999	4/3	5/4	5/25	5/26	6/2	6/12	6/14	6/30	18	348.1
2000	5/8	5/15	5/18	5/22	5/31	6/10	6/16	8/13	20	600.4
2002	4/9	5/18	5/23	5/24	6/2	6/13	6/17	7/13	21	417.9
2003	5/19	5/22	5/26	5/28	6/3	6/10	6/14	7/15	14	615.6
2005	5/18	5/18	5/24	5/25	6/6	6/29	7/1	7/2	36	162.0
2006	4/26	5/14	5/17	5/19	5/25	6/5	6/9	7/7	18	479.4
2007	5/4	5/10	5/13	5/16	5/24	6/9	6/12	7/9	25	531.6
2008	5/20	5/21	5/23	5/24	6/5	6/18	6/23	7/4	26	480.8

Figure B.23: Historical outmigration run-timing at Lower Granite of a composite of PIT-tagged hatchery sockeye from Redfish Lake.

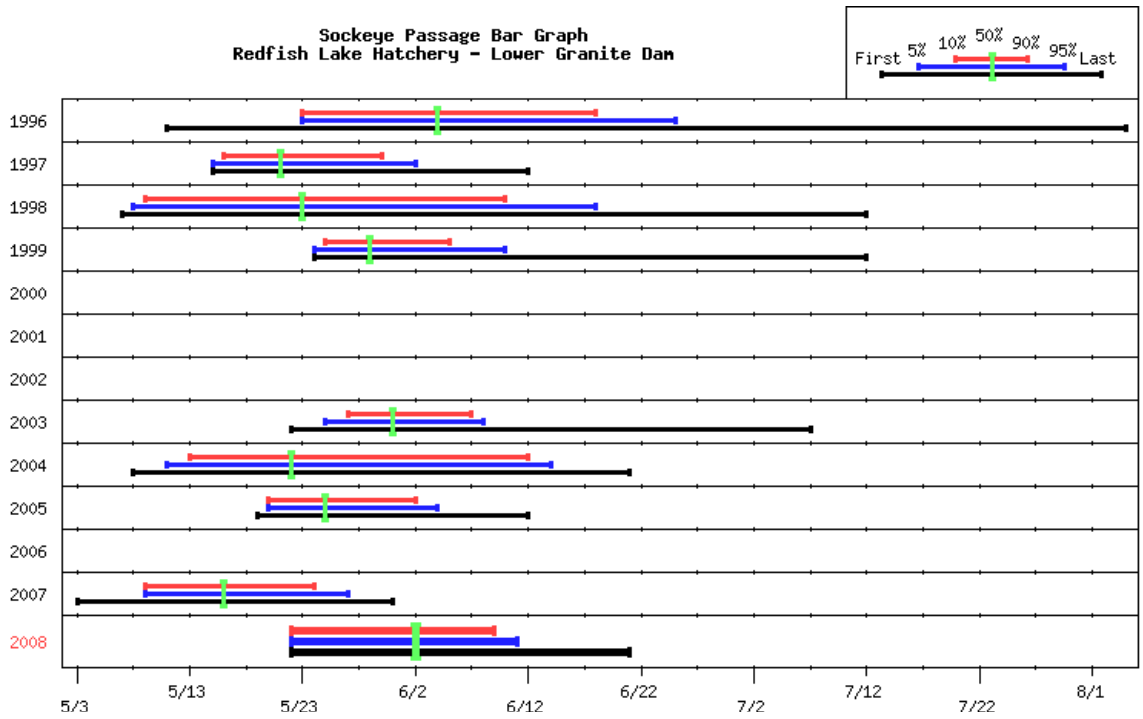


Table B.23: Historical outmigration run-timing characteristics at Lower Granite of a composite of PIT-tagged hatchery sockeye from Redfish Lake.

	Detection Date												
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	# Parr Released	LWG PIT Counts	Adjusted PIT Counts	% Oberserved
1996	5/11	5/17	5/23	5/23	6/4	6/18	6/25	8/4	27	4246	160	377.8	8.9
1997	5/16	5/16	5/16	5/17	5/22	5/31	6/3	6/13	15	1930	53	131.2	6.8
1998	5/8	5/8	5/9	5/10	5/24	6/11	6/19	7/13	33	4692	71	145.6	3.1
1999	5/25	5/25	5/25	5/26	5/30	6/6	6/11	7/13	12	4179	58	143.9	3.4
2003	5/23	5/23	5/26	5/28	6/1	6/8	6/9	7/8	12	2022	51	123.1	6.1
2004	5/8	5/9	5/11	5/13	5/22	6/12	6/14	6/21	31	1519	96	106.9	7.0
2005	5/20	5/20	5/21	5/21	5/26	6/3	6/5	6/13	14	1020	68	99.6	9.8
2007	5/4	5/4	5/10	5/10	5/17	5/25	5/28	6/1	16	1016	53	97.6	9.6
2008	5/22	5/22	5/22	5/22	6/2	6/9	6/11	6/21	19	989	21	63.7	6.4

Figure B.24: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large yearling Chinook at Rock Island Dam.

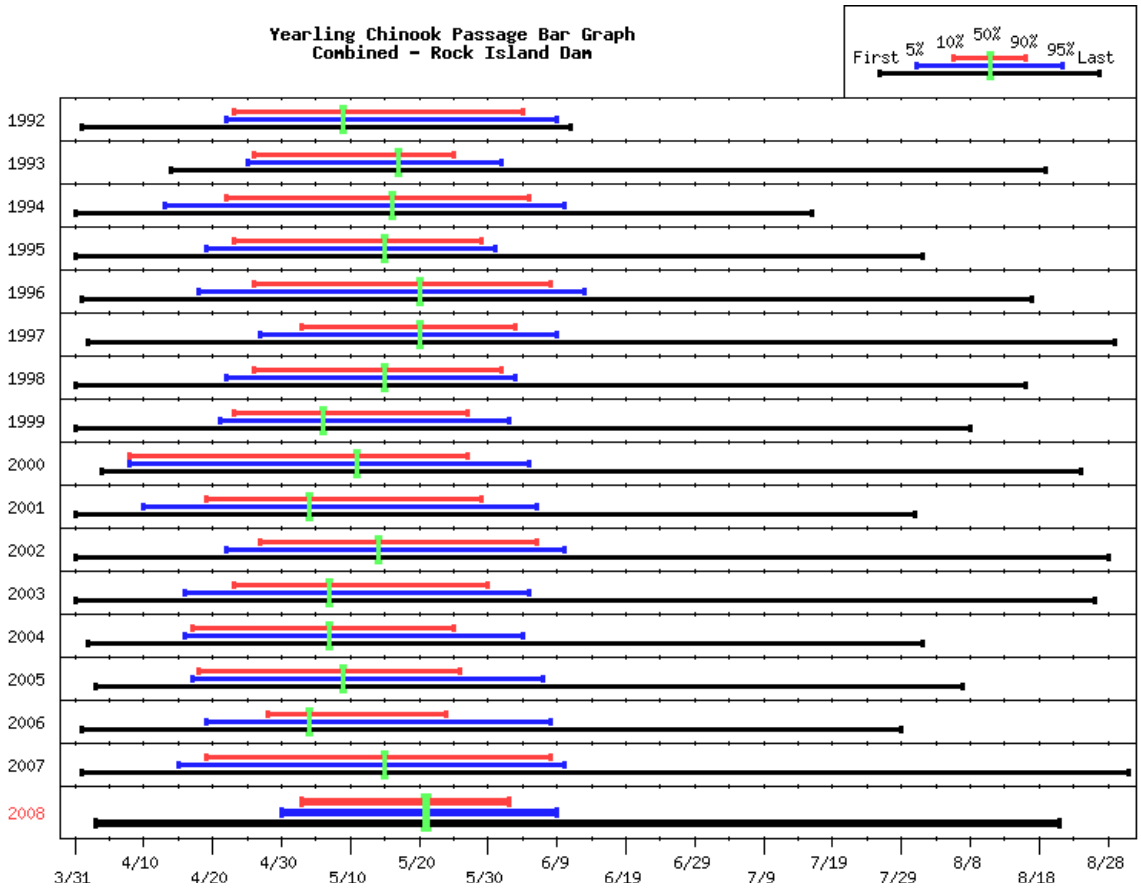


Table B. 24: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large yearling Chinook at Rock Island Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total RIS Passage
1992	4/1	4/17	4/22	4/23	5/9	6/4	6/9	6/11	43	16100
1993	4/15	4/21	4/26	4/27	5/18	5/26	6/2	8/20	30	13514
1994	4/1	4/4	4/14	4/23	5/17	6/6	6/11	7/17	45	12324
1995	4/1	4/9	4/20	4/24	5/16	5/30	6/1	8/2	37	30753
1996	4/1	4/7	4/18	4/26	5/20	6/8	6/13	8/17	44	42478
1997	4/3	4/17	4/28	5/4	5/21	6/4	6/10	8/30	32	53754
1998	4/1	4/3	4/23	4/27	5/16	6/2	6/4	8/17	37	24859
1999	4/1	4/11	4/22	4/24	5/7	5/28	6/3	8/9	35	40320
2000	4/4	4/8	4/8	4/8	5/11	5/27	6/5	8/24	50	32334
2001	4/1	4/6	4/11	4/20	5/5	5/30	6/7	8/1	41	6635
2002	4/1	4/12	4/23	4/28	5/15	6/7	6/11	8/29	41	28982
2003	4/1	4/16	4/17	4/24	5/8	5/31	6/6	8/27	38	15355
2004	4/2	4/7	4/16	4/17	5/7	5/25	6/4	8/1	39	12574
2005	4/4	4/17	4/18	4/19	5/10	5/27	6/8	8/8	39	14795
2006	4/2	4/13	4/20	4/29	5/5	5/25	6/9	7/30	27	37267
2007	4/2	4/14	4/16	4/20	5/16	6/9	6/11	9/1	51	24347
2008	4/3	4/23	4/30	5/3	5/21	6/2	6/9	8/21	31	22427

Figure B.25: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large yearling Chinook at McNary Dam.

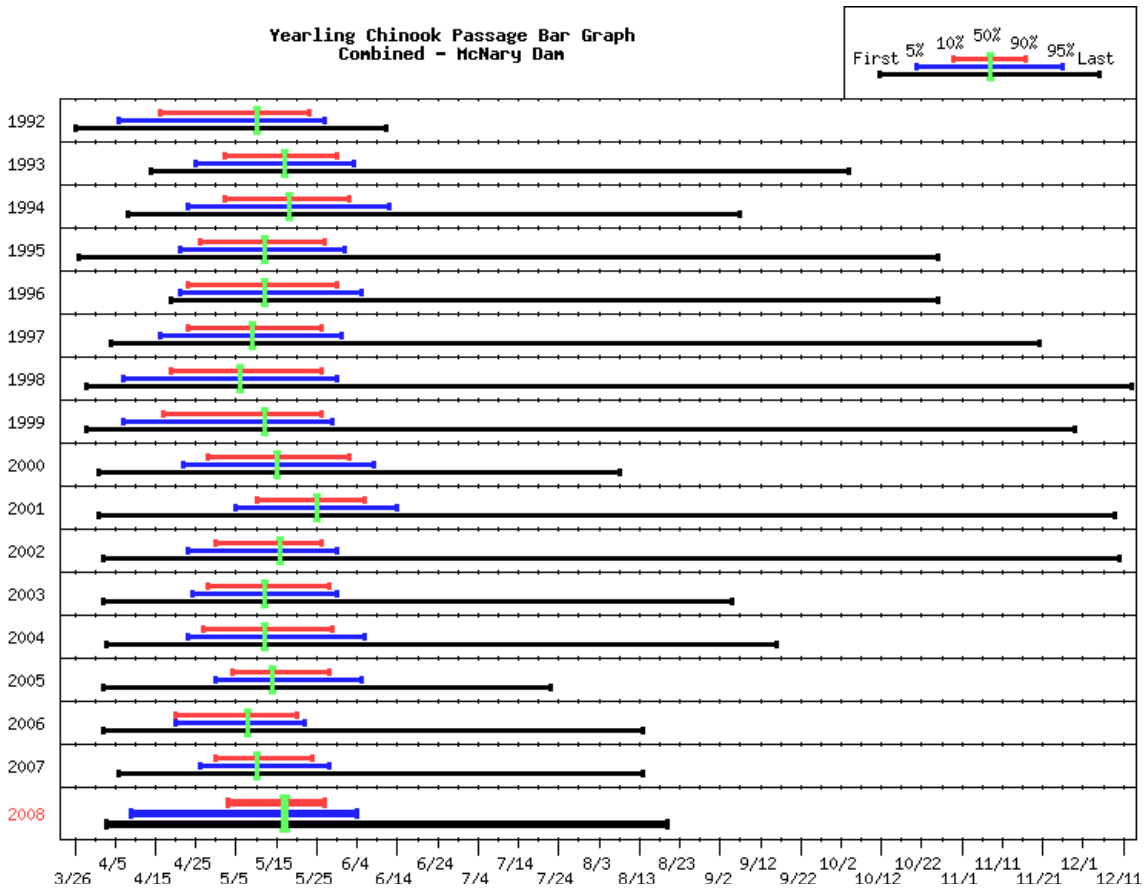


Table B. 25: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large yearling Chinook at McNary Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
1992	3/26	4/4	4/6	4/16	5/10	5/23	5/27	6/11	38	2514319
1993	4/15	4/18	4/26	5/3	5/18	5/31	6/4	10/5	29	1729010
1994	4/9	4/13	4/24	5/3	5/19	6/3	6/13	9/8	32	2572338
1995	3/28	4/8	4/22	4/27	5/13	5/28	6/2	10/27	32	2879069
1996	4/19	4/19	4/21	4/23	5/12	5/30	6/5	10/26	38	1240878
1997	4/5	4/6	4/17	4/24	5/10	5/27	6/1	11/21	34	1184530
1998	3/30	4/5	4/8	4/20	5/7	5/27	5/31	12/14	38	1727071
1999	3/30	4/5	4/8	4/18	5/13	5/27	5/30	11/30	40	3692944
2000	4/1	4/10	4/22	4/28	5/15	6/2	6/8	8/8	36	1986380
2001	4/2	4/26	5/6	5/11	5/26	6/7	6/15	12/10	28	2299563
2002	4/3	4/17	4/24	5/1	5/17	5/27	5/31	12/11	27	3519382
2003	4/3	4/15	4/25	4/29	5/13	5/29	5/31	9/6	31	1624087
2004	4/3	4/17	4/23	4/27	5/12	5/29	6/6	9/16	33	1085821
2005	4/3	4/19	5/1	5/5	5/15	5/29	6/6	7/23	25	1E+06
2006	4/3	4/15	4/21	4/21	5/9	5/21	5/23	8/15	31	1560784
2007	4/7	4/15	4/27	5/1	5/11	5/25	5/29	8/15	25	2224857
2008	4/3	4/7	4/9	5/3	5/17	5/27	6/4	8/20	25	1360623

Figure B.26: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large yearling Chinook at John Day Dam.

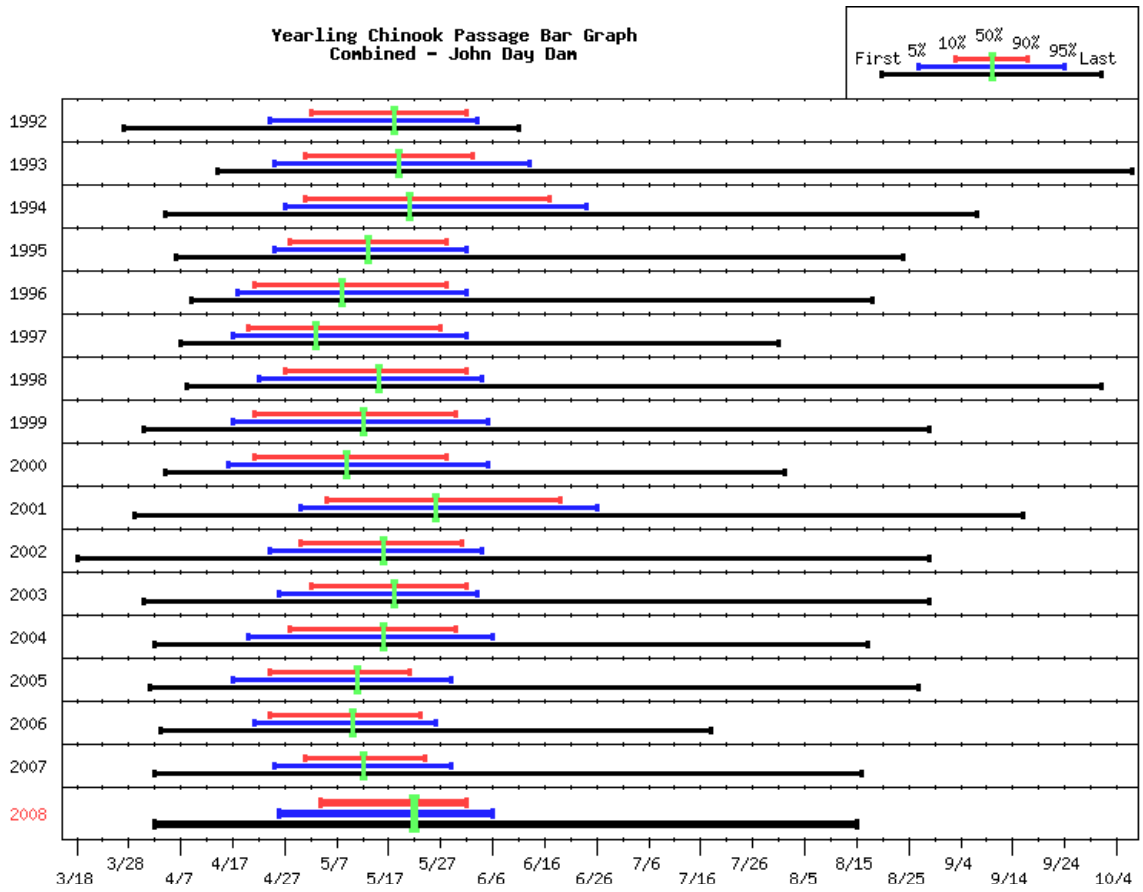


Table B. 26: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large yearling Chinook at John Day Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total JDA Passage
1992	3/27	4/14	4/24	5/2	5/18	6/1	6/3	6/11	31	478132
1993	4/15	4/19	4/26	5/2	5/20	6/3	6/14	10/8	33	762565
1994	4/5	4/18	4/28	5/2	5/22	6/18	6/25	9/8	48	446549
1995	4/7	4/16	4/26	4/29	5/14	5/29	6/2	8/25	31	1328883
1996	4/9	4/14	4/18	4/21	5/8	5/28	6/1	8/18	38	738453
1997	4/8	4/12	4/18	4/21	5/4	5/28	6/2	8/1	38	154493
1998	4/9	4/13	4/23	4/28	5/16	6/2	6/5	10/2	36	1147281
1999	4/1	4/10	4/18	4/22	5/13	5/31	6/6	8/30	40	2193902
2000	4/4	4/10	4/16	4/21	5/9	5/28	6/5	8/1	38	822349
2001	3/30	4/21	5/1	5/6	5/27	6/20	6/27	9/17	46	1006078
2002	3/19	4/18	4/25	5/1	5/17	6/1	6/5	8/30	32	2112370
2003	4/1	4/14	4/27	5/3	5/19	6/2	6/4	8/30	31	2074457
2004	4/2	4/9	4/20	4/28	5/16	5/30	6/6	8/17	33	1005416
2005	4/2	4/5	4/18	4/25	5/12	5/22	5/30	8/28	28	1409350
2006	4/4	4/14	4/22	4/25	5/11	5/24	5/27	7/19	30	2250569
2007	4/3	4/16	4/26	5/2	5/13	5/25	5/30	8/17	24	4262628
2008	4/2	4/12	4/26	5/4	5/22	6/1	6/6	8/15	29	1694103

Figure B.27: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large yearling Chinook at Bonneville Dam.

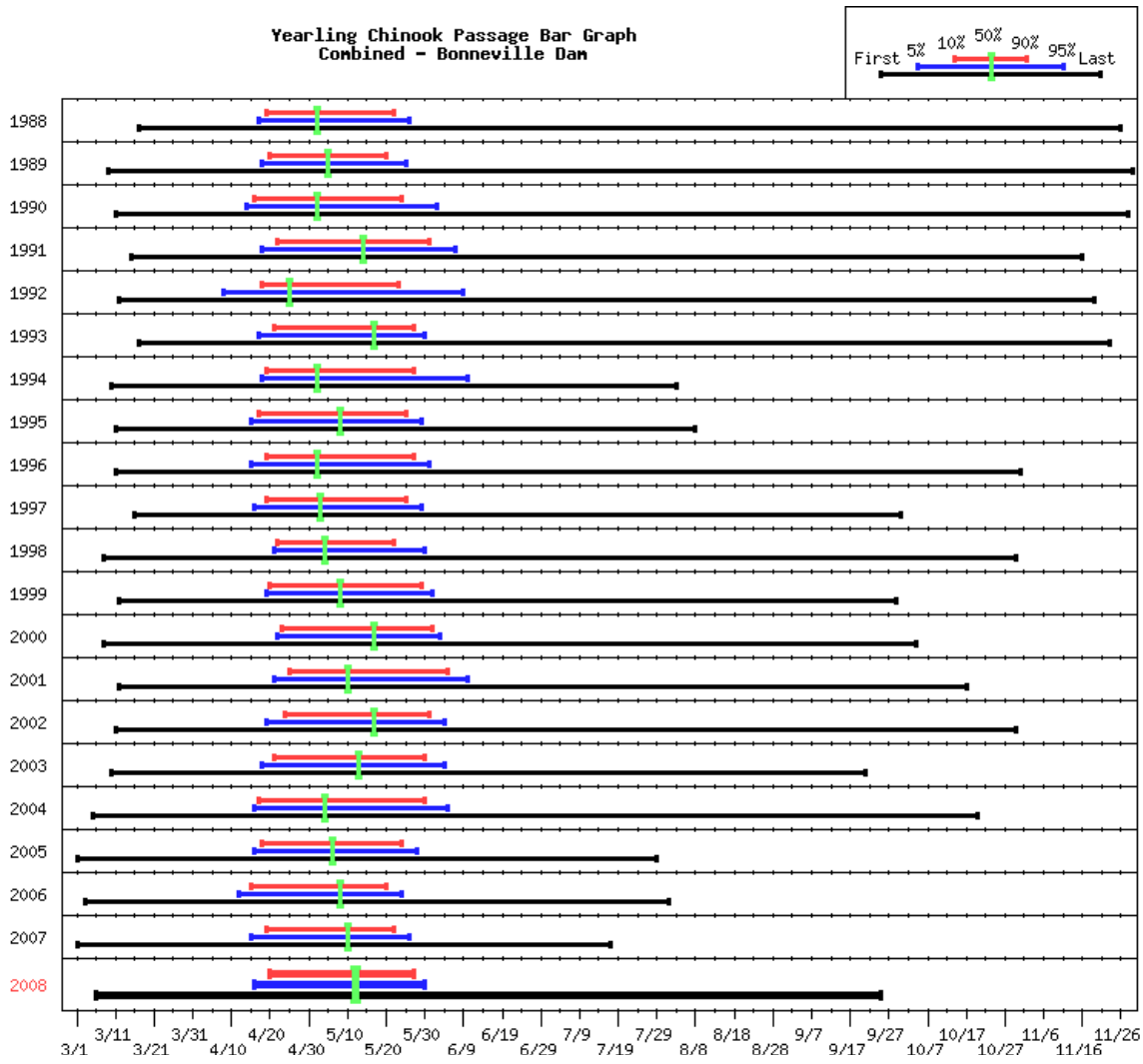


Table B. 27: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large yearling Chinook at Bonneville Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total BON Passage
1988	3/17	4/14	4/17	4/19	5/2	5/22	5/26	11/26	34	365812
1989	3/10	4/11	4/19	4/21	5/6	5/21	5/26	11/30	31	435451
1990	3/12	4/10	4/15	4/17	5/3	5/25	6/3	11/29	39	337787
1991	3/16	4/17	4/19	4/23	5/15	6/1	6/8	11/17	40	609417
1992	3/12	3/16	4/8	4/18	4/25	5/23	6/9	11/19	36	723652
1993	3/18	3/26	4/18	4/22	5/18	5/28	5/31	11/24	37	2168048
1994	3/11	4/15	4/19	4/20	5/3	5/28	6/11	8/4	39	779720
1995	3/12	4/8	4/16	4/18	5/9	5/26	5/30	8/9	39	1776322
1996	3/11	3/15	4/15	4/19	5/2	5/27	5/31	10/31	39	470112
1997	3/17	3/20	4/17	4/20	5/4	5/26	5/30	10/1	37	286142
1998	3/9	3/26	4/22	4/23	5/5	5/23	5/31	10/31	31	346280
1999	3/13	4/1	4/20	4/21	5/9	5/30	6/2	9/30	40	638607
2000	3/8	4/12	4/22	4/23	5/17	6/1	6/3	10/4	40	2535055
2001	3/13	4/14	4/22	4/26	5/11	6/6	6/11	10/18	42	1688673
2002	3/12	4/16	4/20	4/25	5/18	6/1	6/5	10/31	38	3349185
2003	3/11	4/12	4/19	4/22	5/14	5/31	6/5	9/22	40	4043776
2004	3/5	4/9	4/16	4/17	5/4	5/30	6/5	10/20	44	1449398
2005	3/2	4/2	4/17	4/19	5/7	5/25	5/29	7/30	37	1528366
2006	3/4	3/16	4/13	4/16	5/9	5/21	5/25	8/2	36	2256238
2007	3/2	4/2	4/16	4/20	5/11	5/23	5/27	7/18	34	1949994
2008	3/6	4/4	4/16	4/20	5/12	5/27	5/30	9/25	38	1291084

Figure B.28 : Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large steelhead at Rock Island Dam.

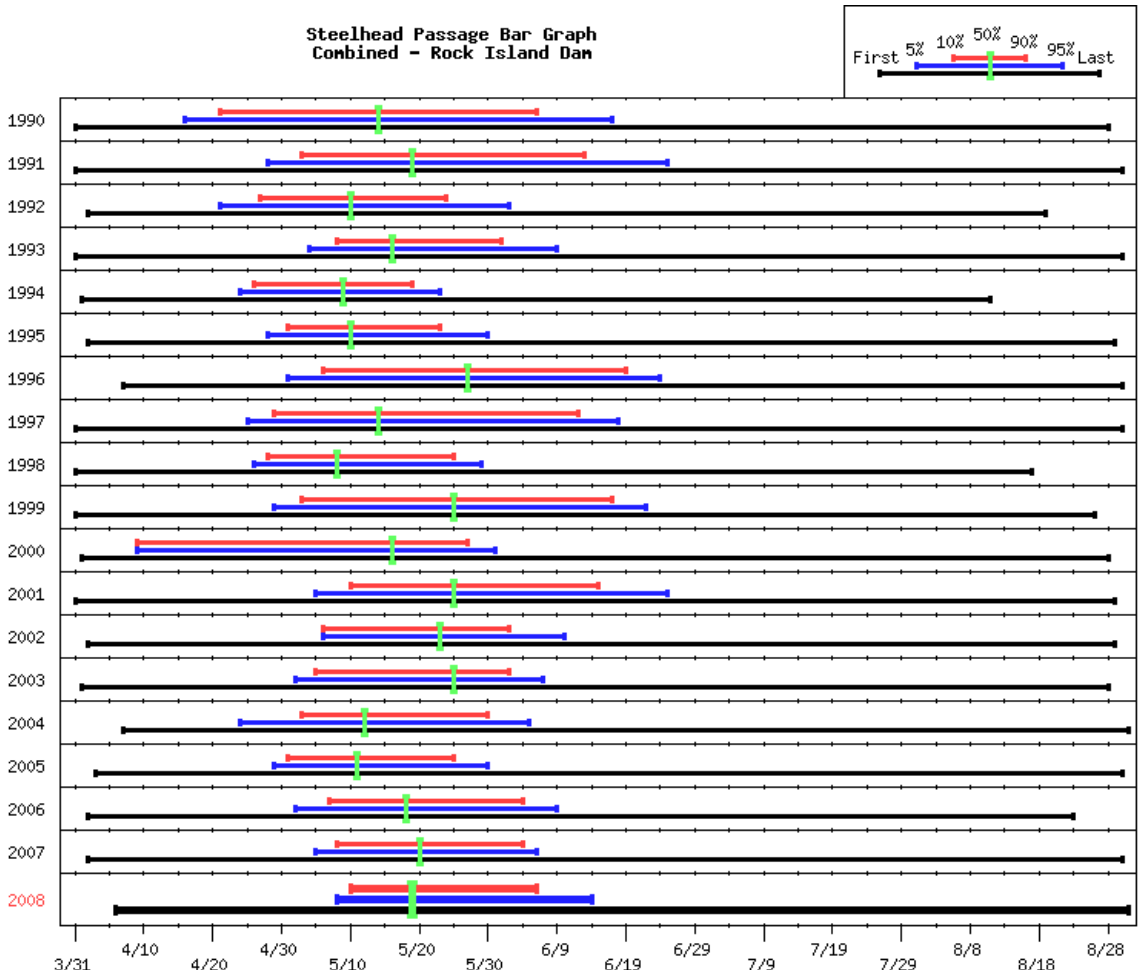


Table B. 28: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large steelhead at Rock Island Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total RIS Passage
1990	04/01	04/06	04/17	04/22	05/15	06/07	06/18	08/29	47	3739
1991	04/01	04/10	04/29	05/04	05/20	06/14	06/26	08/31	42	4953
1992	04/02	04/07	04/21	04/27	05/10	05/24	06/02	08/19	28	4906
1993	04/01	04/21	05/05	05/09	05/17	06/02	06/10	08/31	25	4032
1994	04/02	04/21	04/25	04/27	05/10	05/20	05/24	08/12	24	15323
1995	04/03	04/22	04/29	05/02	05/11	05/24	05/31	08/30	23	18084
1996	04/07	04/21	05/01	05/06	05/27	06/19	06/24	08/30	45	39650
1997	04/01	04/19	04/26	04/30	05/15	06/13	06/19	08/31	45	33979
1998	04/01	04/22	04/27	04/29	05/09	05/26	05/30	08/18	28	21390
1999	04/01	04/23	04/30	05/04	05/26	06/18	06/23	08/27	46	48192
2000	04/01	04/08	04/09	04/09	05/16	05/27	05/31	08/28	49	26297
2001	04/01	04/26	05/06	05/11	05/26	06/16	06/26	08/30	37	17914
2002	04/03	04/20	05/07	05/07	05/24	06/03	06/11	08/30	28	28714
2003	04/02	04/26	05/03	05/06	05/26	06/03	06/08	08/29	29	15507
2004	04/07	04/16	04/24	05/03	05/12	05/30	06/05	08/31	28	10735
2005	04/04	04/26	04/30	05/02	05/12	05/26	05/31	08/08	25	15971
2006	04/03	04/26	05/03	05/08	05/19	06/05	06/10	08/24	29	26931
2007	04/03	04/20	05/06	05/09	05/21	06/05	06/07	08/31	28	18635
2008	4/6	4/30	5/8	5/10	5/19	6/6	6/14	8/31	28	22438

Figure B.29: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large steelhead at McNary Dam.

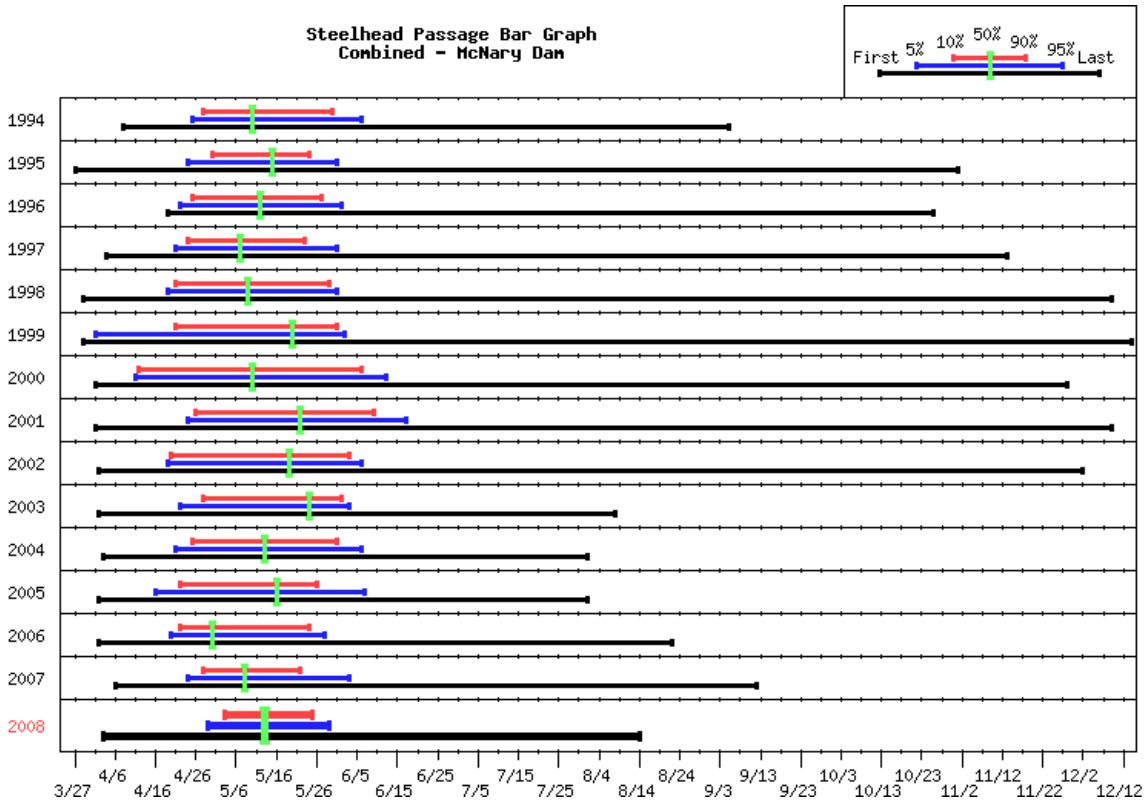


Table B. 29: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large steelhead at McNary Dam.

	Detection Date								Middle 80% (days)	Total MCN Passage
Detection Year	First	1%	5%	10%	50%	90%	95%	Last		
1994	4/9	4/19	4/26	4/29	5/11	5/31	6/7	9/6	33	106520
1995	3/28	4/5	4/25	5/1	5/16	5/25	6/1	11/2	25	734878
1996	4/19	4/20	4/22	4/25	5/12	5/27	6/1	10/26	33	792462
1997	4/5	4/19	4/22	4/25	5/8	5/24	6/1	11/14	30	1234024
1998	3/30	4/16	4/20	4/22	5/10	5/30	6/1	12/10	39	571119
1999	3/30	3/30	4/2	4/22	5/21	6/1	6/3	12/15	41	1004348
2000	4/1	4/9	4/11	4/12	5/10	6/6	6/12	11/28	56	617482
2001	4/2	4/18	4/25	4/27	5/23	6/10	6/18	12/10	45	563299
2002	4/3	4/16	4/20	4/21	5/20	6/4	6/7	12/3	45	794580
2003	4/3	4/9	4/23	4/29	5/25	6/2	6/4	8/9	35	245583
2004	4/3	4/15	4/21	4/25	5/13	5/31	6/6	8/1	37	125285
2005	4/3	4/11	4/17	4/23	5/17	5/27	6/8	8/2	35	196392
2006	4/3	4/13	4/21	4/23	5/1	5/25	5/29	8/23	33	446261
2007	4/7	4/17	4/25	4/29	5/9	5/23	6/4	9/13	25	376506
2008	4/3	4/21	4/29	5/3	5/13	5/25	5/29	8/14	23	507299

Figure B.30: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large steelhead at John Day Dam.

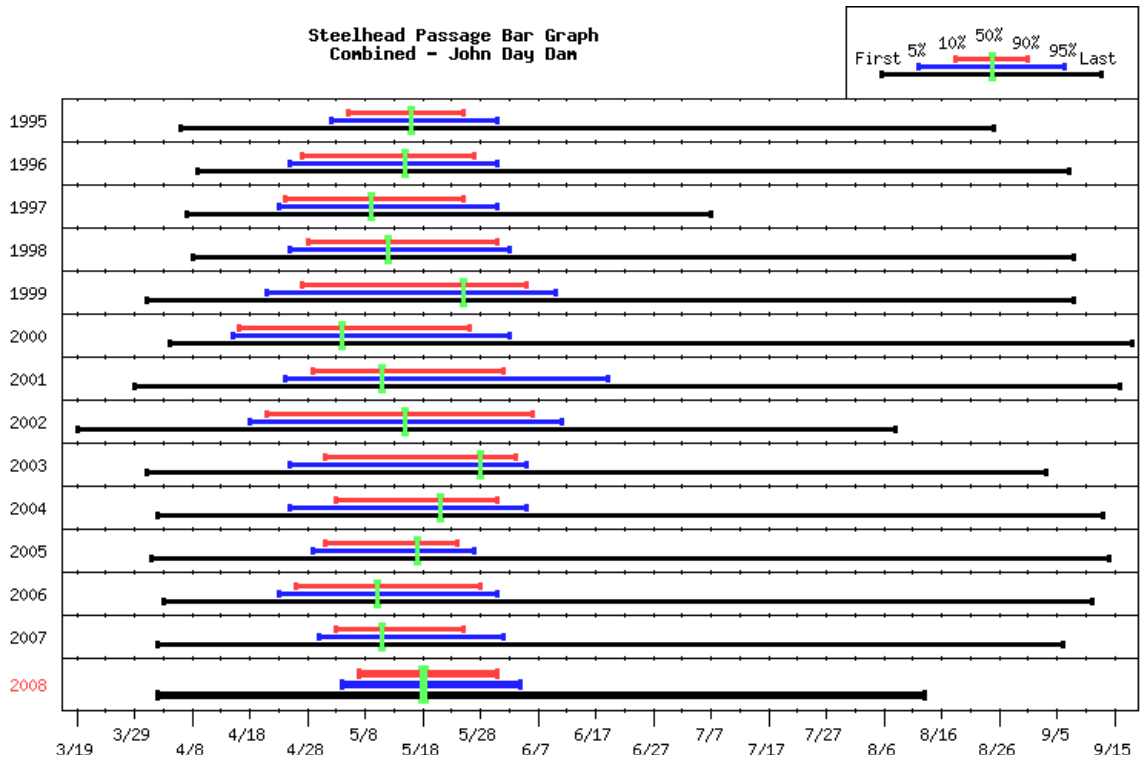


Table B. 30: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large steelhead at John Day Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total JDA Passage
1995	4/7	4/17	5/3	5/6	5/17	5/26	6/1	8/26	21	1089894
1996	4/9	4/18	4/25	4/27	5/15	5/27	5/31	9/7	31	930931
1997	4/8	4/21	4/24	4/25	5/10	5/26	6/1	7/8	32	773788
1998	4/9	4/22	4/26	4/29	5/13	6/1	6/3	9/9	34	1089156
1999	4/1	4/2	4/22	4/28	5/26	6/6	6/11	9/9	40	1238944
2000	4/4	4/12	4/15	4/16	5/4	5/26	6/2	9/18	41	517289
2001	3/30	4/16	4/25	4/30	5/12	6/2	6/20	9/17	34	191132
2002	3/20	4/14	4/19	4/22	5/16	6/7	6/12	8/9	47	547546
2003	4/1	4/11	4/26	5/2	5/29	6/4	6/6	9/4	34	553495
2004	4/2	4/12	4/25	5/3	5/21	5/31	6/5	9/13	29	257272
2005	4/2	4/17	4/30	5/2	5/18	5/25	5/28	9/15	24	526636
2006	4/4	4/17	4/24	4/27	5/11	5/29	6/1	9/12	33	1682247
2007	4/3	4/17	5/1	5/4	5/12	5/26	6/2	9/7	23	961373
2008	4/2	4/25	5/4	5/7	5/18	5/31	6/4	8/13	25	1132951

Figure B.31: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large steelhead at Bonneville Dam.

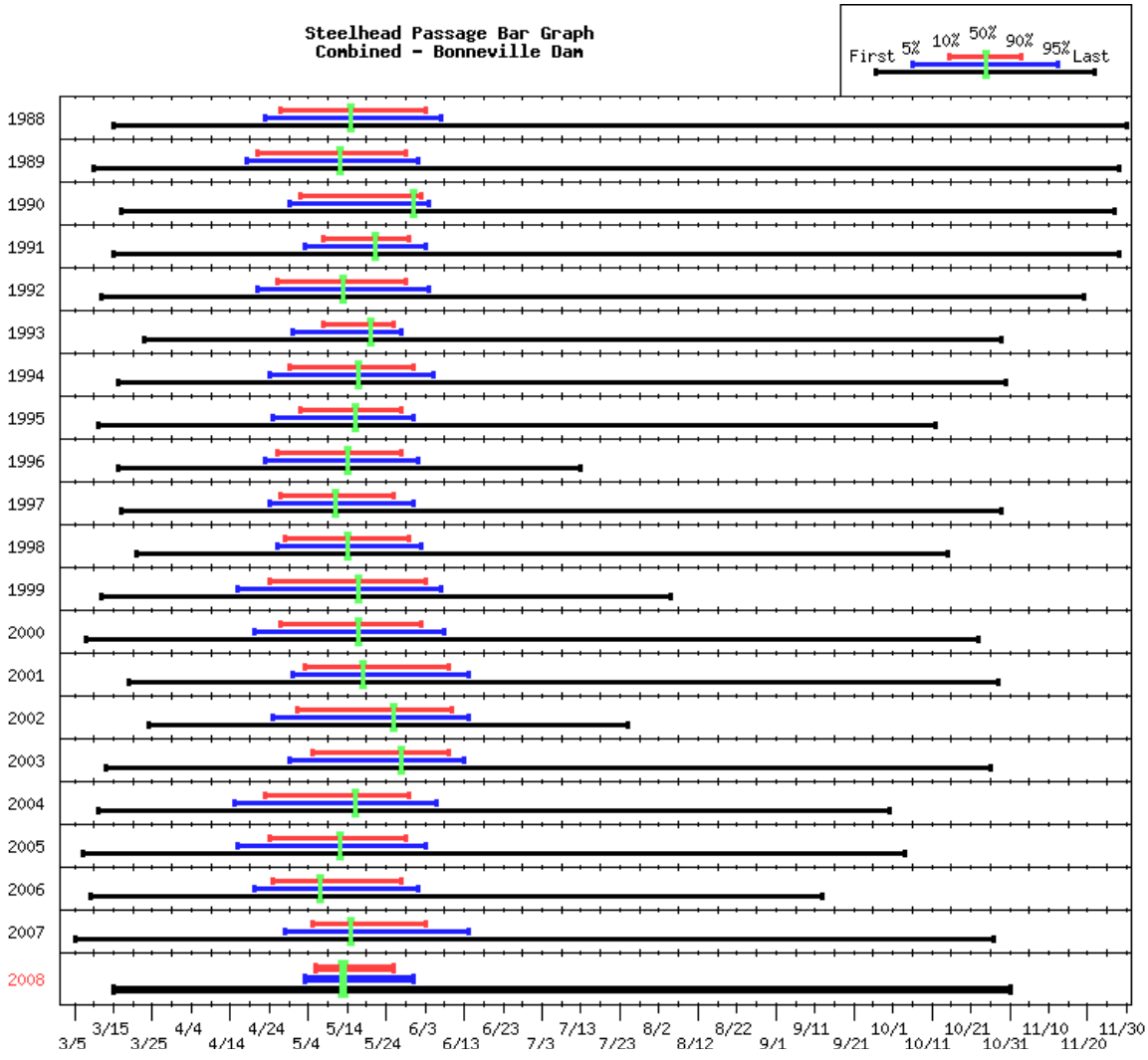


Table B. 31: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large steelhead at Bonneville Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total BON Passage
1988	3/15	4/14	4/23	4/27	5/15	6/3	6/7	11/30	38	103703
1989	3/11	4/13	4/19	4/22	5/13	5/30	6/2	11/29	39	206225
1990	3/18	4/20	4/30	5/3	6/1	6/3	6/5	11/28	32	202891
1991	3/16	4/21	5/4	5/9	5/22	5/31	6/4	11/29	23	230199
1992	3/12	4/11	4/21	4/26	5/13	5/29	6/4	11/19	34	108585
1993	3/24	4/15	5/1	5/9	5/21	5/27	5/29	10/30	19	790024
1994	3/17	4/15	4/25	4/30	5/18	6/1	6/6	10/31	33	199211
1995	3/12	4/12	4/26	5/3	5/17	5/29	6/1	10/13	27	483444
1996	3/16	4/16	4/23	4/26	5/14	5/28	6/1	7/13	33	436835
1997	3/18	4/19	4/25	4/28	5/12	5/27	6/1	10/30	30	780841
1998	3/22	4/19	4/27	4/29	5/15	5/31	6/3	10/16	33	397210
1999	3/13	4/3	4/17	4/25	5/18	6/4	6/8	8/6	41	351309
2000	3/8	4/15	4/20	4/27	5/17	6/2	6/8	10/23	37	657064
2001	3/20	4/20	5/1	5/4	5/19	6/10	6/15	10/29	38	489392
2002	3/25	4/18	4/26	5/2	5/27	6/11	6/15	7/26	41	1462261
2003	3/14	4/19	4/30	5/6	5/29	6/10	6/14	10/27	36	1635181
2004	3/11	4/5	4/15	4/23	5/16	5/30	6/6	9/30	38	153204
2005	3/8	4/6	4/17	4/25	5/13	5/30	6/4	10/5	36	186528
2006	3/10	4/11	4/21	4/26	5/8	5/29	6/2	9/14	34	271628
2007	3/6	4/12	4/29	5/6	5/16	6/4	6/15	10/28	30	267162
2008	3/15	4/25	5/3	5/6	5/13	5/26	5/31	10/31	21	450290

Figure B.32 : Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large coho salmon at Rock Island Dam.

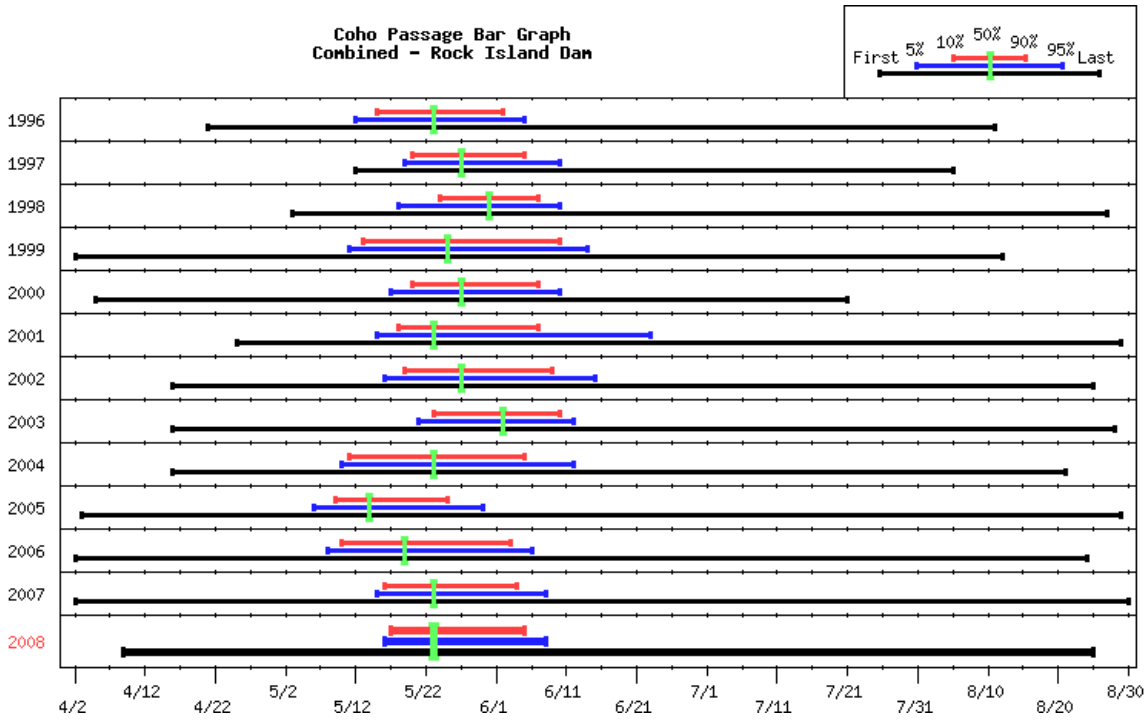


Table B. 32: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large coho salmon at Rock Island Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total RIS Passage
1996	4/21	5/3	5/12	5/15	5/23	6/2	6/5	8/11	19	26521
1997	5/13	5/18	5/20	5/21	5/28	6/6	6/11	8/6	17	4301
1998	5/4	5/7	5/19	5/25	6/1	6/8	6/11	8/28	15	41837
1999	4/3	5/3	5/12	5/14	5/26	6/11	6/15	8/13	29	46173
2000	4/5	5/8	5/17	5/20	5/27	6/7	6/10	7/21	19	49552
2001	4/26	5/12	5/16	5/19	5/24	6/8	6/24	8/30	21	45437
2002	4/17	5/12	5/17	5/20	5/28	6/10	6/16	8/26	22	86227
2003	4/17	5/14	5/22	5/24	6/3	6/11	6/13	8/29	19	41690
2004	4/16	5/7	5/10	5/11	5/23	6/5	6/12	8/21	26	28668
2005	4/4	5/3	5/7	5/10	5/15	5/26	5/31	8/30	17	37190
2006	4/3	5/4	5/9	5/11	5/20	6/4	6/7	8/25	25	61284
2007	4/3	5/4	5/16	5/17	5/24	6/5	6/9	8/31	20	64012
2008	4/9	5/10	5/16	5/17	5/23	6/5	6/8	8/25	20	52052

Figure B.33: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large coho salmon at McNary Dam.

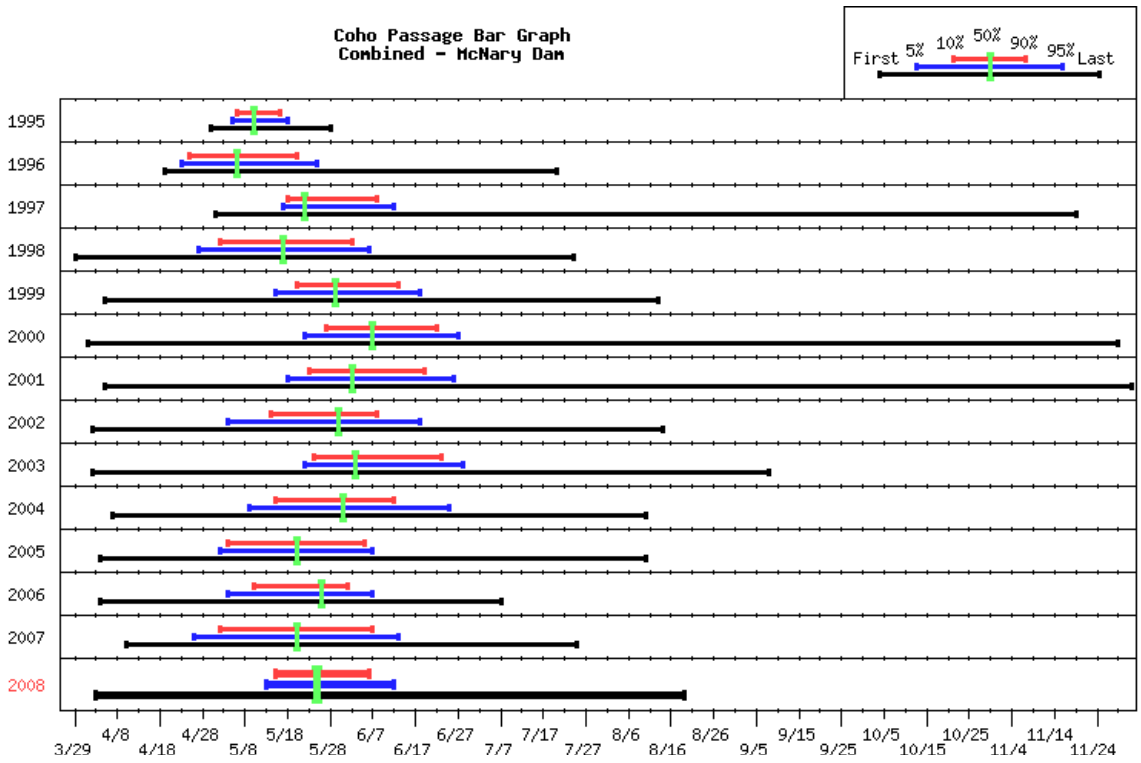


Table B. 33: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large coho salmon at McNary Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
1995	5/1	5/3	5/6	5/7	5/11	5/17	5/19	5/29	11	236480
1996	4/19	4/20	4/23	4/25	5/6	5/20	5/25	7/20	26	647586
1997	5/2	5/15	5/18	5/19	5/23	6/9	6/13	11/20	22	339949
1998	3/30	4/21	4/28	5/3	5/18	6/3	6/7	7/25	32	241239
1999	4/6	5/5	5/16	5/21	5/30	6/14	6/19	8/14	25	281977
2000	4/1	5/1	5/22	5/27	6/7	6/22	6/27	11/29	27	260058
2001	4/6	5/3	5/19	5/24	6/3	6/20	6/27	12/3	28	147063
2002	4/3	4/19	5/5	5/15	5/31	6/9	6/19	8/15	26	201998
2003	4/3	5/7	5/23	5/25	6/4	6/24	6/29	9/9	31	113584
2004	4/7	4/29	5/9	5/15	5/31	6/12	6/25	8/10	29	90681
2005	4/5	4/27	5/3	5/5	5/21	6/6	6/8	8/11	33	103700
2006	4/5	4/27	5/5	5/11	5/27	6/2	6/8	7/8	23	102160
2007	4/11	4/25	4/27	5/3	5/21	6/8	6/14	7/26	37	99127
2008	4/3	5/9	5/13	5/15	5/25	6/6	6/12	8/19	23	169476

Figure B.34: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large coho salmon at John Day Dam.

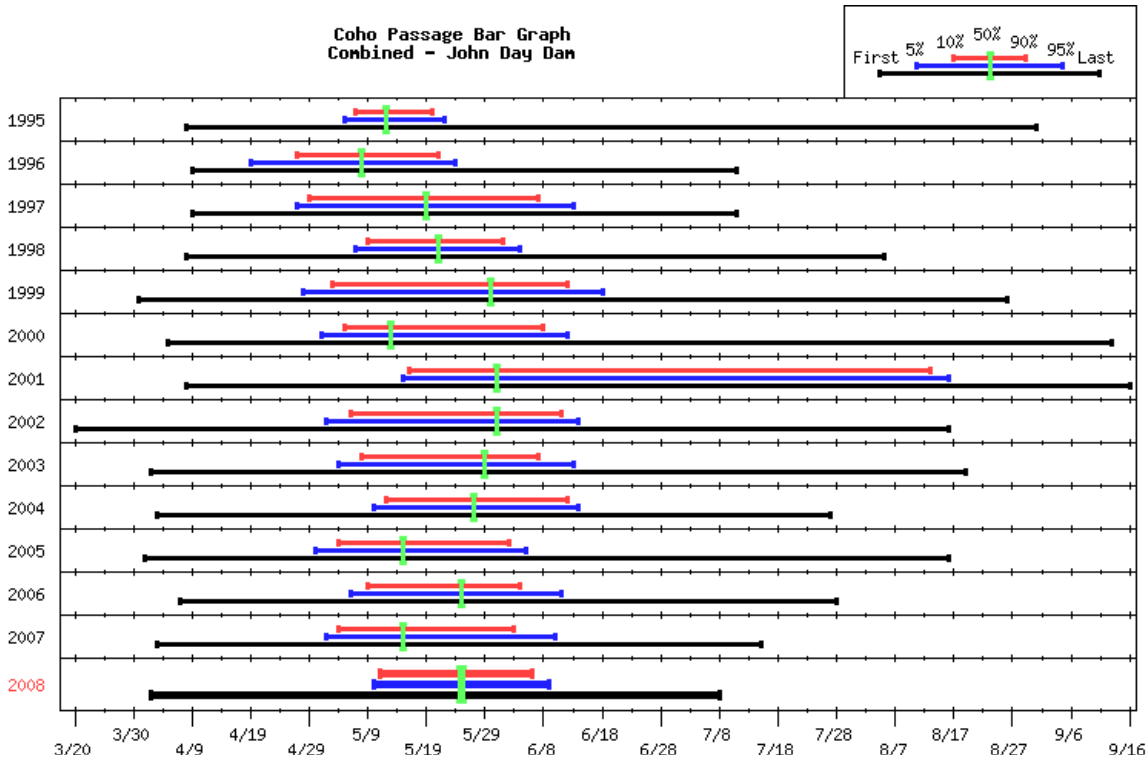


Table B. 34: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large coho salmon at John Day Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total JDA Passage
1995	4/9	5/4	5/6	5/8	5/13	5/21	5/23	9/1	14	335903
1996	4/9	4/14	4/19	4/27	5/8	5/21	5/24	7/11	25	504884
1997	4/10	4/25	4/28	4/30	5/20	6/8	6/14	7/12	40	148139
1998	4/9	5/4	5/8	5/10	5/22	6/2	6/5	8/6	24	572290
1999	4/1	4/22	4/29	5/4	5/31	6/13	6/19	8/27	41	543321
2000	4/5	4/23	5/1	5/5	5/13	6/8	6/12	9/13	35	262656
2001	4/9	5/4	5/16	5/17	6/1	8/14	8/17	9/17	90	81644
2002	3/21	4/24	5/3	5/7	6/1	6/12	6/15	8/17	37	316507
2003	4/3	4/28	5/5	5/9	5/30	6/8	6/14	8/20	31	258239
2004	4/3	4/30	5/10	5/12	5/27	6/12	6/14	7/27	32	175311
2005	4/2	4/27	5/1	5/5	5/16	6/3	6/6	8/17	30	192544
2006	4/8	4/30	5/7	5/10	5/26	6/5	6/12	7/29	27	316789
2007	4/4	4/30	5/3	5/5	5/16	6/4	6/11	7/16	31	347366
2008	4/2	5/7	5/10	5/11	5/25	6/6	6/9	7/8	27	362536

Figure B.35: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large coho salmon at Bonneville Dam.

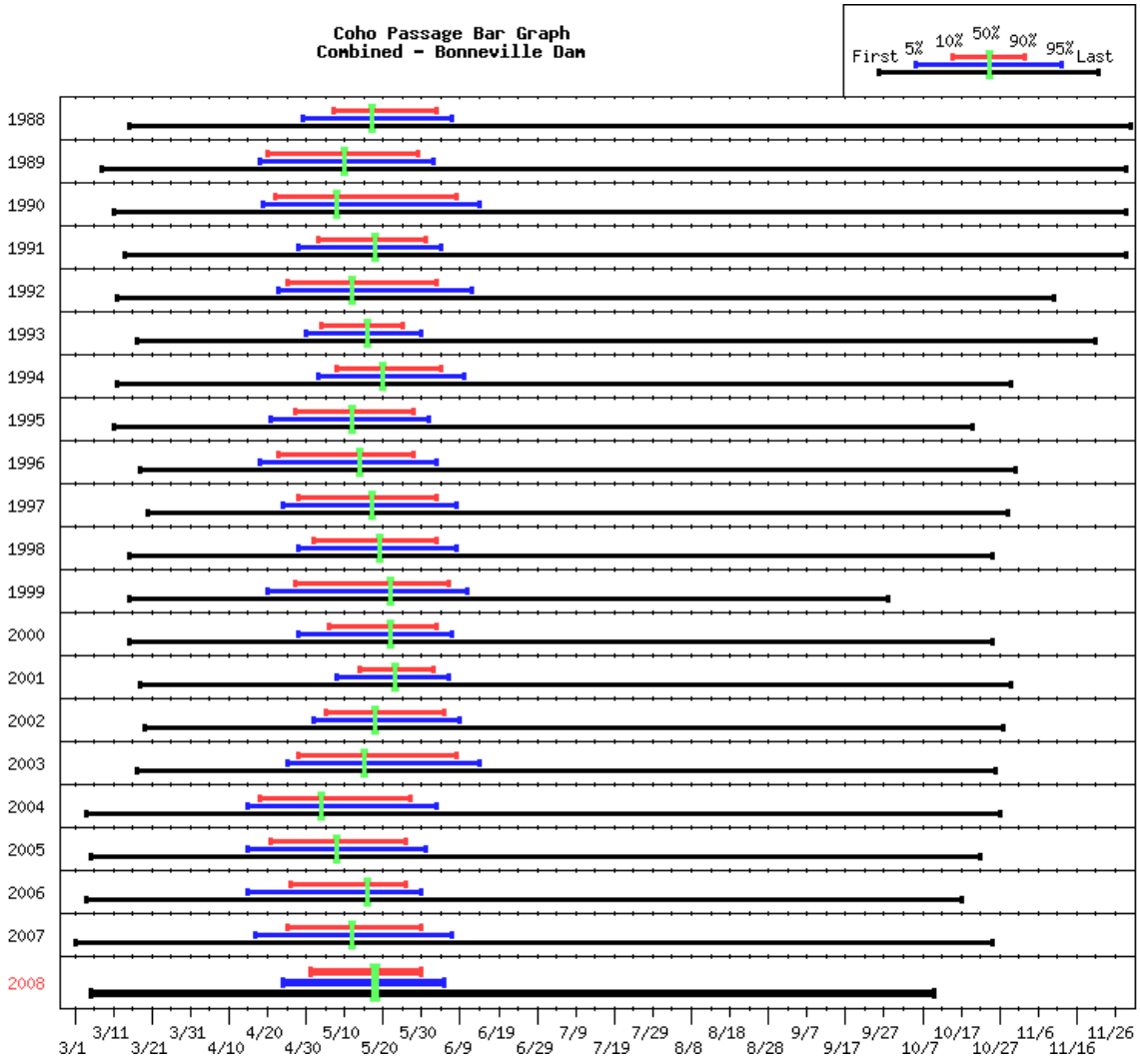


Table B. 35: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large coho salmon at Bonneville Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total BON Passage
1988	3/15	4/21	4/29	5/7	5/17	6/3	6/7	11/30	28	599194
1989	3/9	4/14	4/19	4/21	5/11	5/30	6/3	11/30	40	491615
1990	3/12	4/14	4/20	4/23	5/9	6/9	6/15	11/30	48	677407
1991	3/15	4/18	4/29	5/4	5/19	6/1	6/5	11/30	29	575107
1992	3/12	4/12	4/23	4/25	5/12	6/3	6/12	11/10	40	388807
1993	3/18	4/20	5/1	5/5	5/17	5/26	5/31	11/22	22	1250712
1994	3/13	4/26	5/4	5/9	5/21	6/5	6/11	10/31	28	626437
1995	3/12	4/13	4/22	4/28	5/13	5/29	6/2	10/21	32	1104448
1996	3/18	4/12	4/18	4/23	5/14	5/28	6/3	10/31	36	863814
1997	3/21	4/16	4/25	4/29	5/18	6/4	6/9	10/30	37	706544
1998	3/16	4/22	4/29	5/3	5/20	6/4	6/9	10/26	33	513645
1999	3/16	4/10	4/21	4/28	5/23	6/7	6/12	9/29	41	375644
2000	3/15	4/17	4/28	5/6	5/22	6/3	6/7	10/25	29	1977556
2001	3/19	5/3	5/9	5/15	5/24	6/3	6/7	10/31	20	2164026
2002	3/20	4/18	5/3	5/6	5/19	6/6	6/10	10/29	32	2341191
2003	3/18	4/21	4/26	4/29	5/16	6/9	6/15	10/27	42	2116570
2004	3/4	4/12	4/15	4/18	5/4	5/27	6/3	10/27	40	918385
2005	3/6	4/6	4/16	4/22	5/9	5/27	6/1	10/23	36	192544
2006	3/5	4/8	4/16	4/27	5/17	5/27	5/31	10/18	31	657542
2007	3/2	4/10	4/18	4/26	5/13	5/31	6/8	10/26	36	628618
2008	3/5	4/17	4/24	5/1	5/18	5/30	6/5	10/10	30	358756

Figure B.36: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large sockeye salmon at Rock Island Dam.

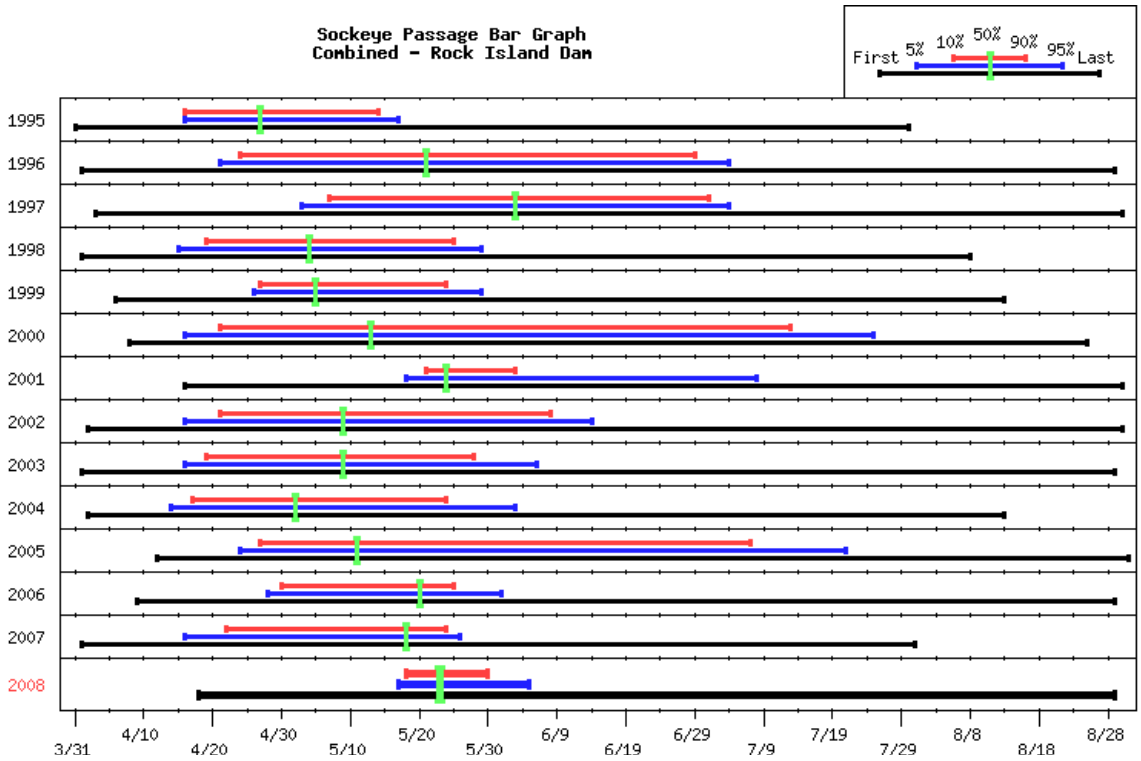


Table B. 36: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large sockeye salmon at Rock Island Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total RIS Passage
1995	4/1	4/13	4/17	4/17	4/28	5/15	5/18	7/31	29	27056
1996	4/1	4/15	4/21	4/24	5/21	6/29	7/4	8/29	67	9995
1997	4/4	4/26	5/4	5/8	6/4	7/2	7/5	8/31	56	13426
1998	4/2	4/14	4/16	4/20	5/5	5/26	5/30	8/9	37	16635
1999	4/7	4/21	4/27	4/28	5/6	5/25	5/30	8/14	28	23371
2000	4/8	4/12	4/16	4/21	5/13	7/13	7/25	8/25	84	2430
2001	4/17	4/24	5/19	5/22	5/25	6/4	7/9	8/31	14	3032
2002	4/3	4/15	4/17	4/22	5/10	6/9	6/15	8/31	49	20629
2003	4/2	4/11	4/17	4/20	5/10	5/29	6/7	8/30	40	10312
2004	4/2	4/11	4/14	4/17	5/2	5/24	6/3	8/13	38	7114
2005	4/13	4/18	4/25	4/28	5/12	7/8	7/22	9/1	72	1946
2006	4/10	4/24	4/29	5/1	5/21	5/26	6/2	8/30	26	34604
2007	4/2	4/12	4/17	4/23	5/19	5/25	5/27	8/1	33	17086
2008	4/18	5/11	5/17	5/18	5/23	5/30	6/5	8/29	13	39205

Figure B.37: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large sockeye salmon at McNary Dam.

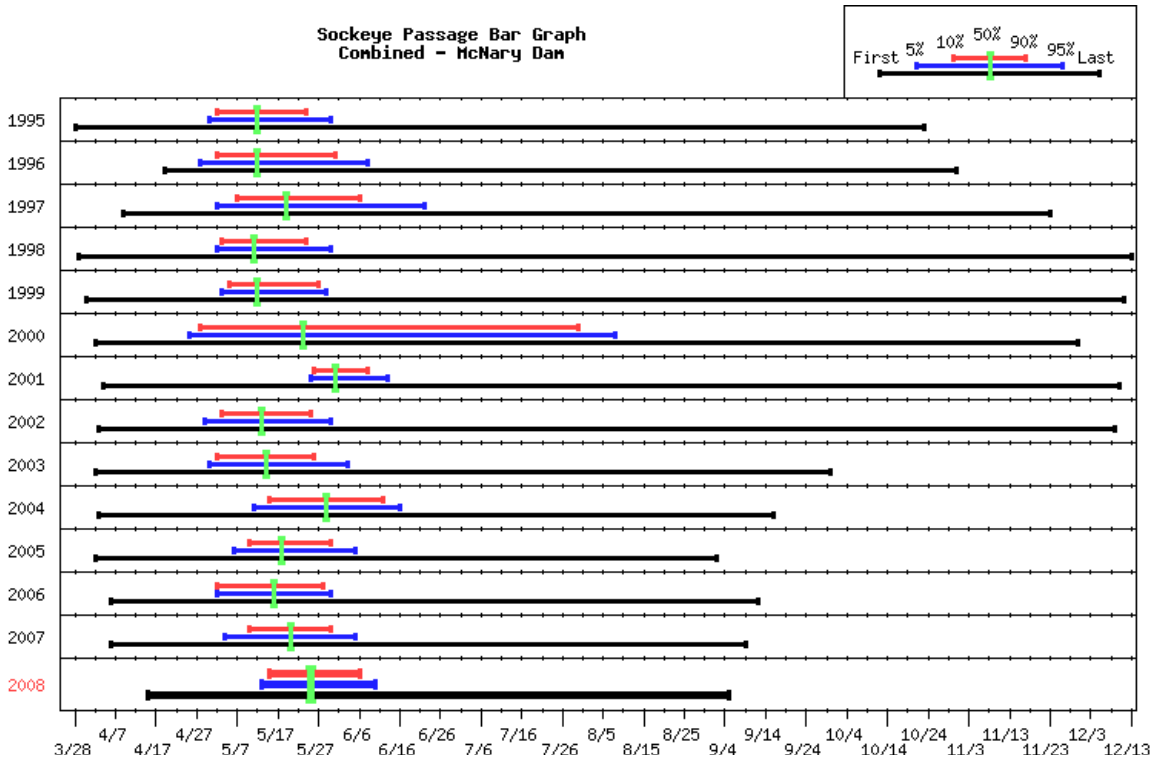


Table B. 37: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large sockeye salmon at McNary Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
1995	3/29	4/28	5/1	5/3	5/13	5/25	5/31	10/24	23	1003494
1996	4/19	4/24	4/28	5/2	5/12	5/31	6/8	10/31	30	155094
1997	4/10	4/29	5/3	5/8	5/20	6/7	6/23	11/24	31	221166
1998	3/30	4/29	5/3	5/4	5/12	5/25	5/31	12/14	22	966549
1999	4/1	4/29	5/4	5/6	5/13	5/28	5/30	12/12	23	1446326
2000	4/2	4/21	4/25	4/28	5/23	7/30	8/8	11/30	94	139909
2001	4/5	5/12	5/26	5/27	6/1	6/9	6/14	12/11	14	285741
2002	4/4	4/23	4/30	5/4	5/14	5/26	5/31	12/10	23	1410496
2003	4/3	4/27	5/1	5/3	5/15	5/27	6/4	10/1	25	841734
2004	4/3	4/29	5/11	5/15	5/29	6/12	6/16	9/16	29	309002
2005	4/3	5/1	5/7	5/11	5/19	5/31	6/6	9/3	21	103598
2006	4/7	4/25	5/3	5/3	5/17	5/29	5/31	9/13	27	497055
2007	4/7	4/29	5/5	5/11	5/21	5/31	6/6	9/10	21	513737
2008	4/15	5/9	5/13	5/15	5/25	6/6	6/10	9/5	23	223002

Figure B.38: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large sockeye salmon at John Day Dam.

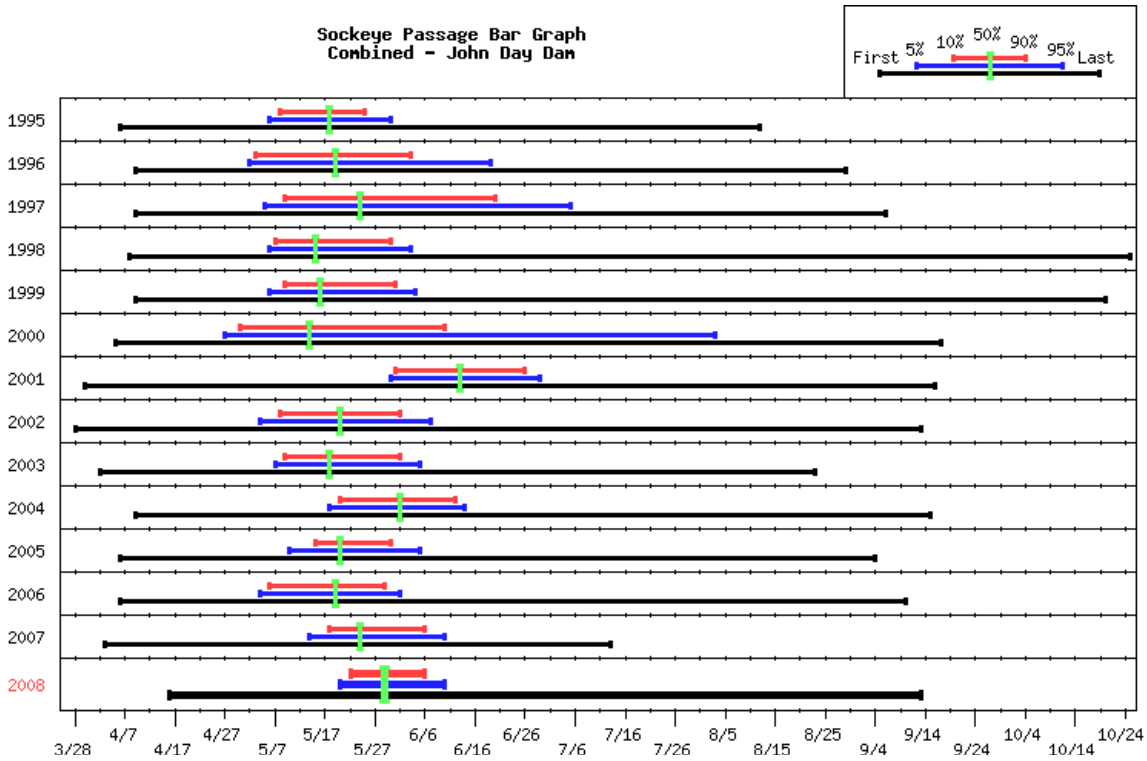


Table B. 38: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large sockeye salmon at John Day Dam.

	Detection Date								Middle 80% (days)	Total JDA Passage
Detection Year	First	1%	5%	10%	50%	90%	95%	Last		
1995	4/7	5/4	5/7	5/9	5/19	5/26	5/31	8/13	18	293076
1996	4/9	4/24	5/2	5/3	5/19	6/3	6/19	8/29	32	64594
1997	4/10	4/30	5/6	5/10	5/25	6/21	7/6	9/7	43	26490
1998	4/9	5/6	5/7	5/8	5/16	5/31	6/4	10/26	24	523673
1999	4/10	5/1	5/7	5/10	5/17	6/1	6/5	10/21	23	574059
2000	4/5	4/25	4/27	4/30	5/14	6/10	8/3	9/17	42	60091
2001	3/31	5/22	5/31	6/1	6/14	6/27	6/30	9/17	27	103971
2002	3/29	4/28	5/5	5/9	5/21	6/2	6/8	9/14	25	936132
2003	4/3	5/6	5/8	5/10	5/19	6/2	6/6	8/24	24	725830
2004	4/9	5/9	5/18	5/20	6/1	6/12	6/14	9/15	24	235929
2005	4/7	5/6	5/11	5/16	5/21	5/31	6/6	9/5	16	84366
2006	4/7	4/29	5/5	5/7	5/20	5/30	6/2	9/11	24	529302
2007	4/4	5/4	5/15	5/19	5/25	6/7	6/11	7/14	20	790330
2008	4/16	5/15	5/20	5/22	5/29	6/6	6/10	9/13	16	331861

Figure B.39: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large sockeye salmon at Bonneville Dam.

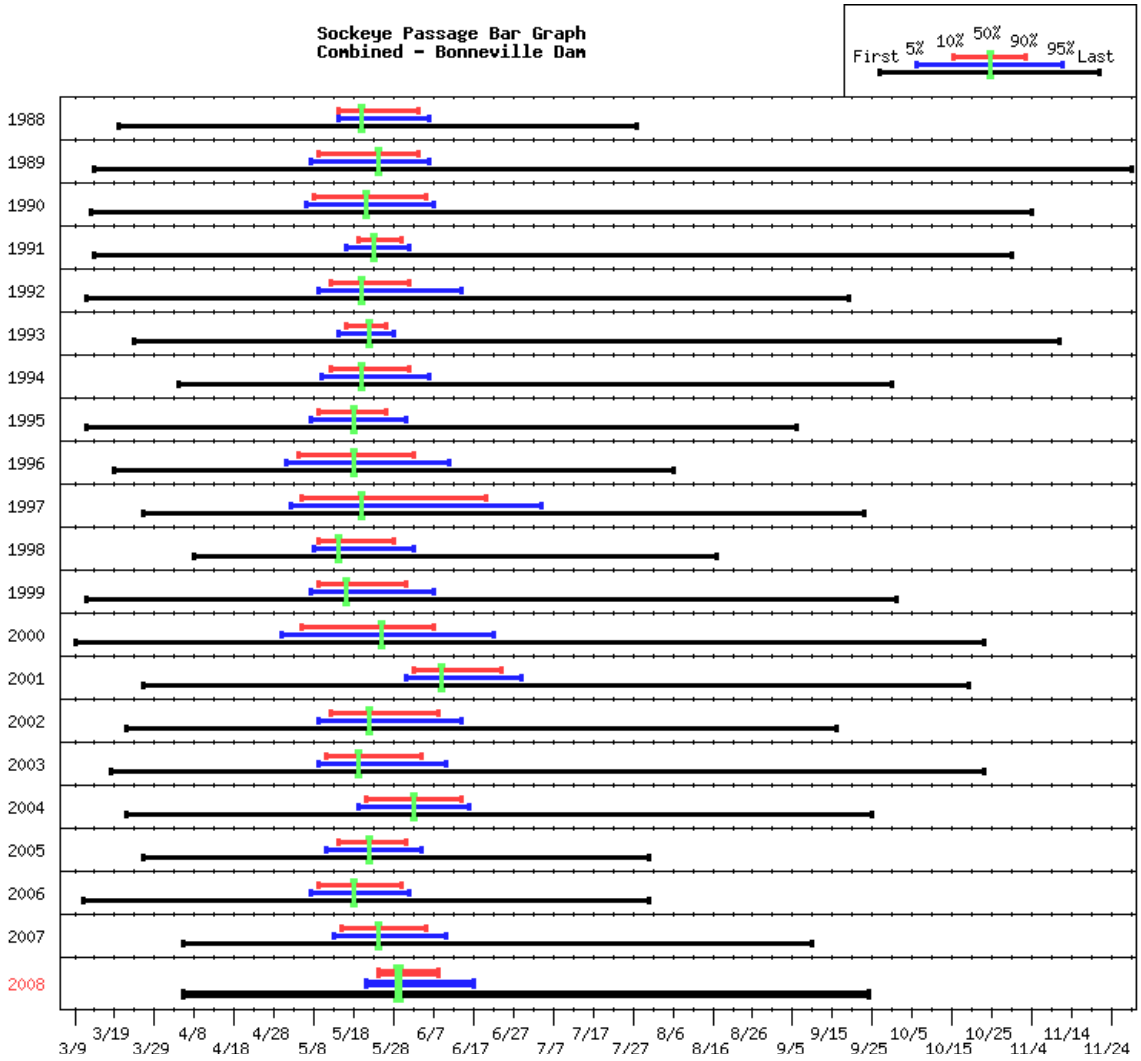


Table B. 39: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large sockeye salmon at Bonneville Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total BON Passage
1988	3/20	5/11	5/14	5/14	5/20	6/3	6/6	7/28	21	77921
1989	3/15	5/2	5/8	5/10	5/25	6/4	6/7	11/30	26	138308
1990	3/14	5/2	5/7	5/9	5/22	6/6	6/8	11/5	29	81403
1991	3/15	5/6	5/17	5/20	5/24	5/31	6/2	10/31	12	147176
1992	3/12	4/7	5/9	5/12	5/20	6/1	6/14	9/19	21	10835
1993	3/25	5/14	5/15	5/17	5/23	5/27	5/29	11/12	11	538861
1994	4/5	5/8	5/11	5/13	5/21	6/2	6/7	10/1	21	87143
1995	3/13	5/6	5/8	5/10	5/19	5/27	6/1	9/7	18	263673
1996	3/19	4/21	5/1	5/4	5/18	6/2	6/11	8/6	30	37412
1997	3/27	4/28	5/3	5/6	5/21	6/21	7/5	9/24	47	31145
1998	4/9	5/7	5/9	5/10	5/15	5/29	6/3	8/18	20	114568
1999	3/13	4/28	5/8	5/10	5/17	6/1	6/8	10/2	23	118207
2000	3/9	4/19	4/30	5/5	5/25	6/7	6/22	10/23	34	65608
2001	3/27	5/23	6/1	6/3	6/10	6/25	6/30	10/20	23	106961
2002	3/23	5/4	5/10	5/13	5/23	6/9	6/15	9/17	28	849129
2003	3/19	5/9	5/10	5/12	5/20	6/5	6/11	10/24	25	1261379
2004	3/22	5/10	5/19	5/21	6/2	6/14	6/16	9/25	25	183774
2005	3/27	5/6	5/12	5/15	5/23	6/1	6/5	8/1	18	41903
2006	3/12	5/5	5/8	5/10	5/19	5/31	6/2	8/1	22	407725
2007	4/6	5/7	5/14	5/16	5/25	6/6	6/11	9/11	22	171272
2008	4/5	5/14	5/21	5/24	5/29	6/8	6/17	9/24	16	145402

Figure B.40: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large subyearling Chinook salmon at Rock Island Dam.

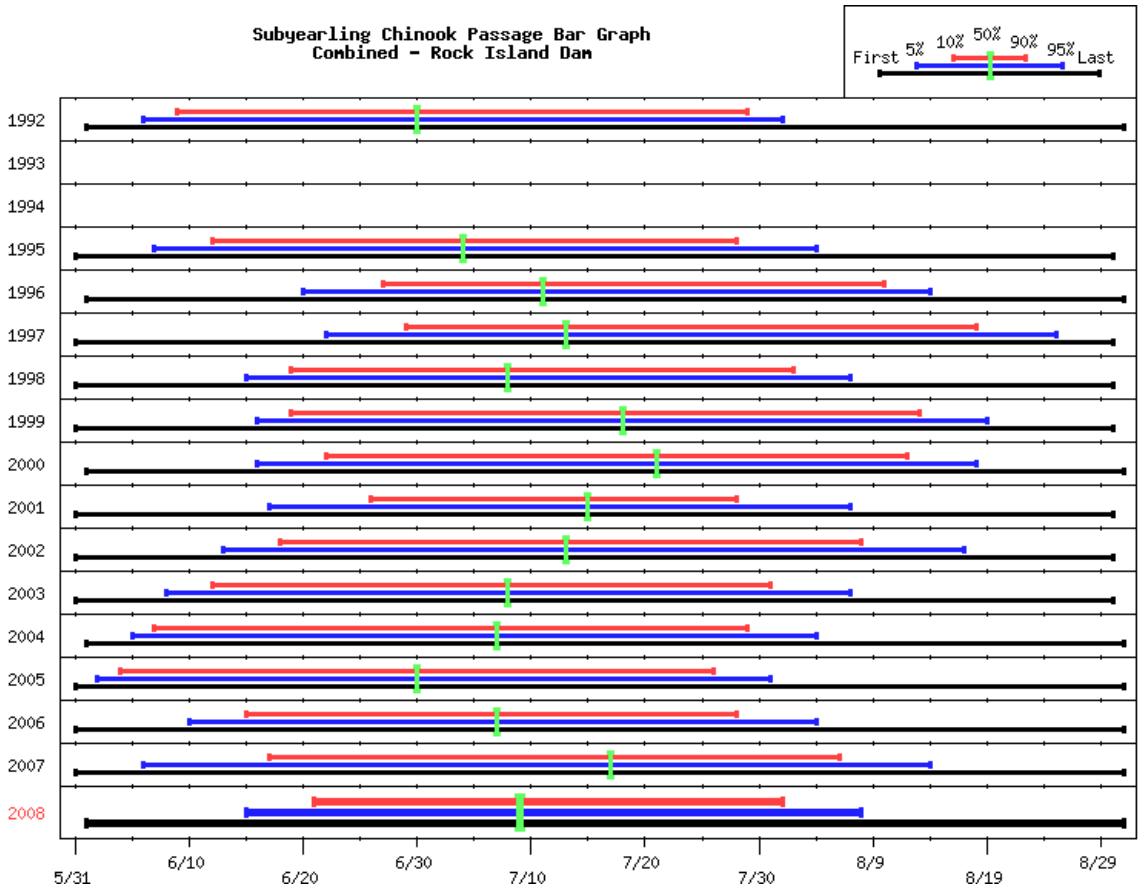


Table B. 40: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large subyearling Chinook salmon at Rock Island Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total RIS Passage
1992	6/1	6/2	6/6	6/9	6/30	7/29	8/1	8/31	51	10339
1995	6/1	6/2	6/8	6/13	7/5	7/29	8/5	8/31	47	14149
1996	6/1	6/8	6/20	6/27	7/11	8/10	8/14	8/31	45	15294
1997	6/1	6/8	6/23	6/30	7/14	8/19	8/26	8/31	51	19246
1998	6/1	6/9	6/16	6/20	7/9	8/3	8/8	8/31	45	17218
1999	6/1	6/4	6/17	6/20	7/19	8/14	8/20	8/31	56	28340
2000	6/1	6/5	6/16	6/22	7/21	8/12	8/18	8/31	52	13693
2001	6/1	6/4	6/18	6/27	7/16	7/29	8/8	8/31	33	22651
2002	6/1	6/4	6/14	6/19	7/14	8/9	8/18	8/31	52	25462
2003	6/1	6/4	6/9	6/13	7/9	8/1	8/8	8/31	50	28113
2004	6/1	6/1	6/5	6/7	7/7	7/29	8/4	8/31	53	25925
2005	6/1	6/1	6/3	6/5	7/1	7/27	8/1	9/1	53	18035
2006	6/1	6/6	6/11	6/16	7/8	7/29	8/5	9/1	44	27107
2007	6/1	6/3	6/7	6/18	7/18	8/7	8/15	9/1	51	14205
2008	6/1	6/5	6/15	6/21	7/9	8/1	8/8	8/31	42	13909

Figure B.41: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large subyearling Chinook salmon at McNary Dam.

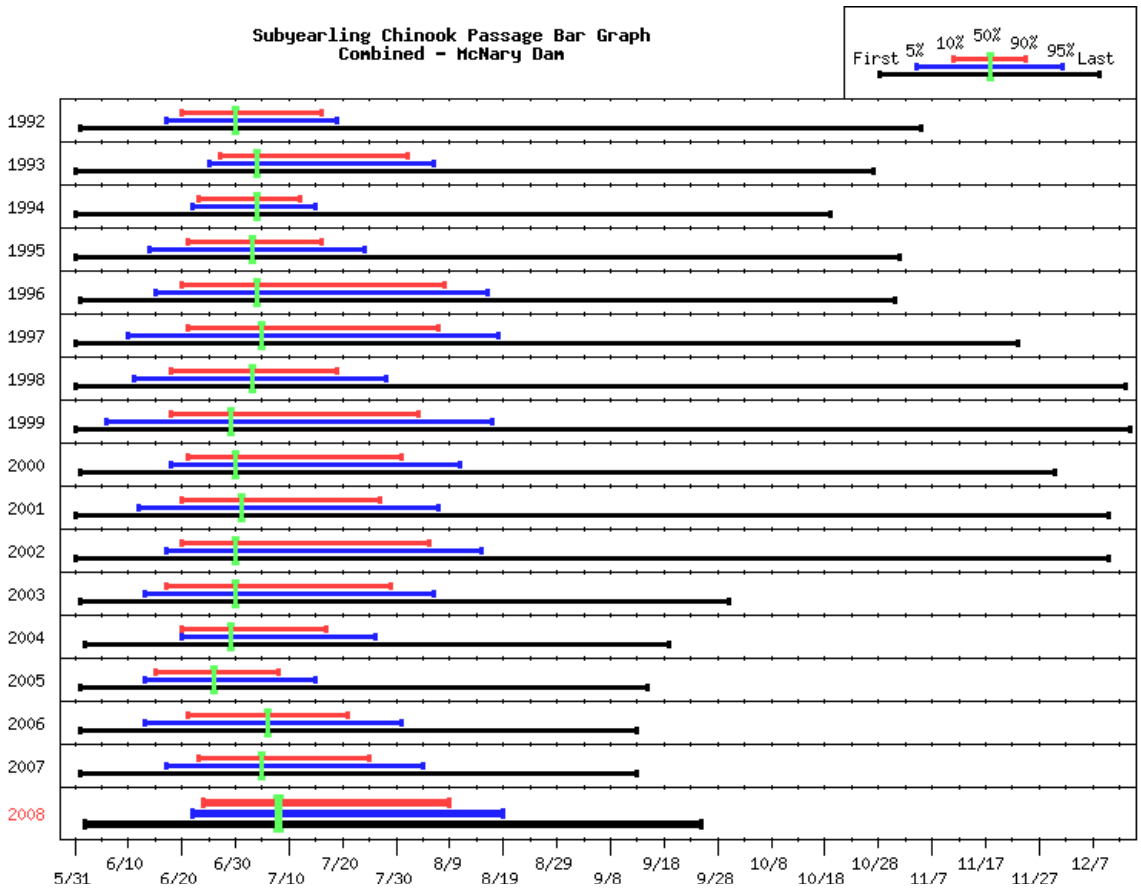


Table B. 41: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large subyearling Chinook salmon at McNary Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total MCN Passage
1992	6/1	6/12	6/17	6/20	6/30	7/16	7/19	11/5	27	6179484
1993	6/1	6/21	6/26	6/28	7/5	8/2	8/7	10/28	36	4283813
1994	6/1	6/17	6/23	6/24	7/5	7/13	7/16	10/20	20	5053511
1995	6/1	6/2	6/15	6/22	7/4	7/17	7/25	11/2	26	8223192
1996	6/1	6/3	6/15	6/20	7/4	8/8	8/16	10/31	50	6072944
1997	6/1	6/3	6/11	6/22	7/6	8/8	8/19	11/24	48	10383928
1998	6/1	6/3	6/12	6/19	7/4	7/20	7/29	12/14	32	11440908
1999	6/1	6/3	6/7	6/19	6/30	8/4	8/18	12/15	47	7645173
2000	6/1	6/7	6/18	6/21	6/30	7/31	8/11	11/30	41	10661814
2001	6/1	6/3	6/13	6/21	7/2	7/28	8/8	12/11	38	10777847
2002	6/1	6/5	6/18	6/21	7/1	8/6	8/16	12/11	47	8397324
2003	6/2	6/4	6/14	6/18	7/1	7/30	8/7	10/1	43	7682087
2004	6/2	6/6	6/20	6/20	6/29	7/17	7/26	9/19	28	8414454
2005	6/2	6/4	6/14	6/16	6/27	7/9	7/16	9/16	24	6747108
2006	6/2	6/4	6/14	6/22	7/7	7/22	8/1	9/14	31	3791653
2007	6/2	6/8	6/18	6/24	7/6	7/26	8/5	9/14	33	4697337
2008	6/2	6/10	6/22	6/24	7/8	8/9	8/19	9/25	47	2315541

Figure B.42: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large subyearling Chinook salmon at John Day Dam.

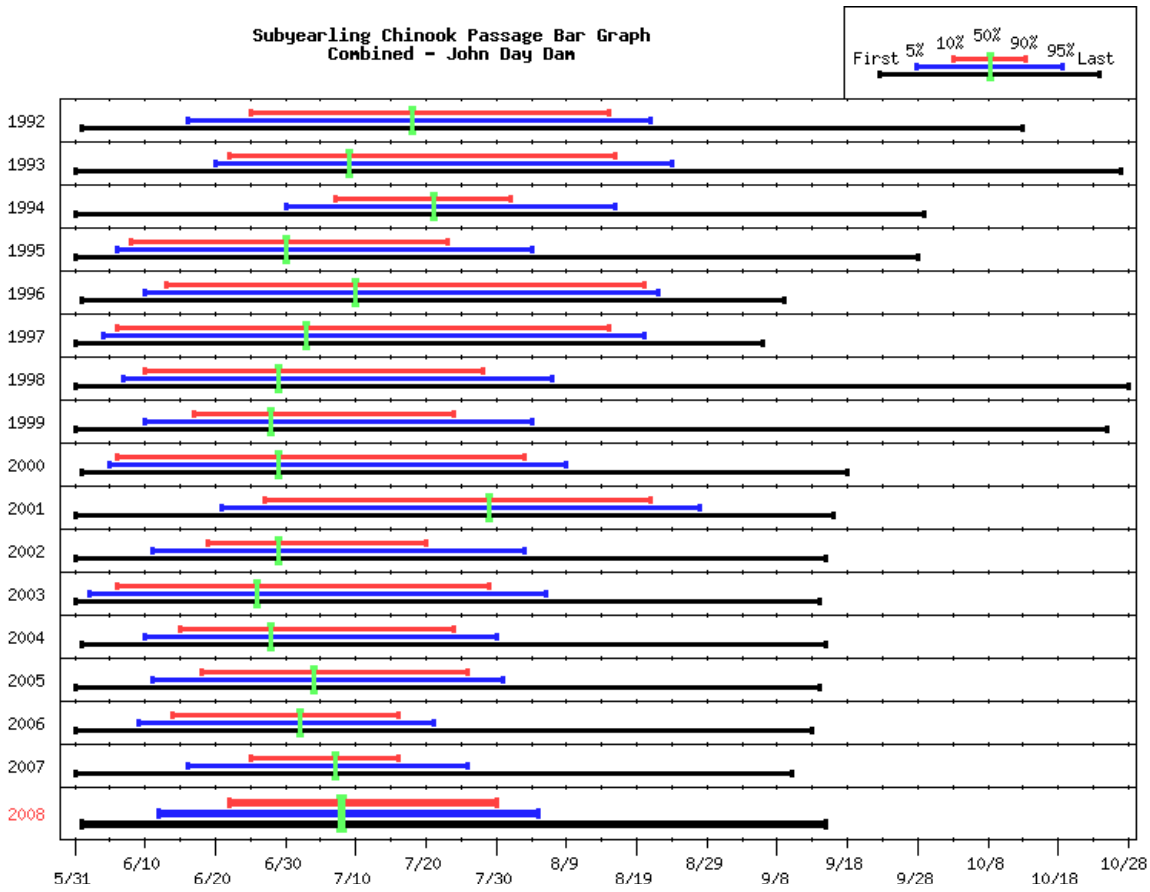


Table B. 42: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large subyearling Chinook salmon at John Day Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total JDA Passage
1992	6/1	6/13	6/16	6/25	7/18	8/15	8/21	10/13	52	548418
1993	6/1	6/6	6/21	6/23	7/10	8/17	8/25	10/28	56	1236816
1994	6/1	6/21	7/1	7/8	7/22	8/2	8/17	9/30	26	1206489
1995	6/1	6/3	6/7	6/9	7/1	7/24	8/5	9/29	46	1214359
1996	6/1	6/6	6/10	6/13	7/10	8/20	8/22	9/9	69	730758
1997	6/1	6/2	6/5	6/7	7/4	8/16	8/21	9/7	71	401671
1998	6/1	6/2	6/8	6/11	6/30	7/29	8/8	10/29	49	2149197
1999	6/1	6/5	6/11	6/18	6/29	7/25	8/5	10/26	38	3937900
2000	6/1	6/2	6/5	6/6	6/29	8/3	8/9	9/18	59	1651050
2001	6/1	6/12	6/22	6/28	7/30	8/22	8/29	9/17	56	2845195
2002	6/1	6/5	6/12	6/20	6/30	7/21	8/4	9/16	32	3448212
2003	6/1	6/2	6/3	6/7	6/27	7/30	8/7	9/15	54	2679137
2004	6/1	6/3	6/10	6/15	6/28	7/24	7/30	9/15	40	1694629
2005	6/1	6/4	6/12	6/19	7/5	7/27	8/1	9/15	39	2262799
2006	6/1	6/3	6/10	6/15	7/3	7/17	7/22	9/14	33	2729628
2007	6/1	6/7	6/17	6/26	7/8	7/17	7/27	9/11	22	2962141
2008	6/1	6/2	6/12	6/22	7/8	7/30	8/5	9/15	39	1702202

Figure B.43: Historical outmigration run-timing of passage-indexed combined wild and hatchery run-at-large subyearling Chinook salmon at Bonneville Dam.

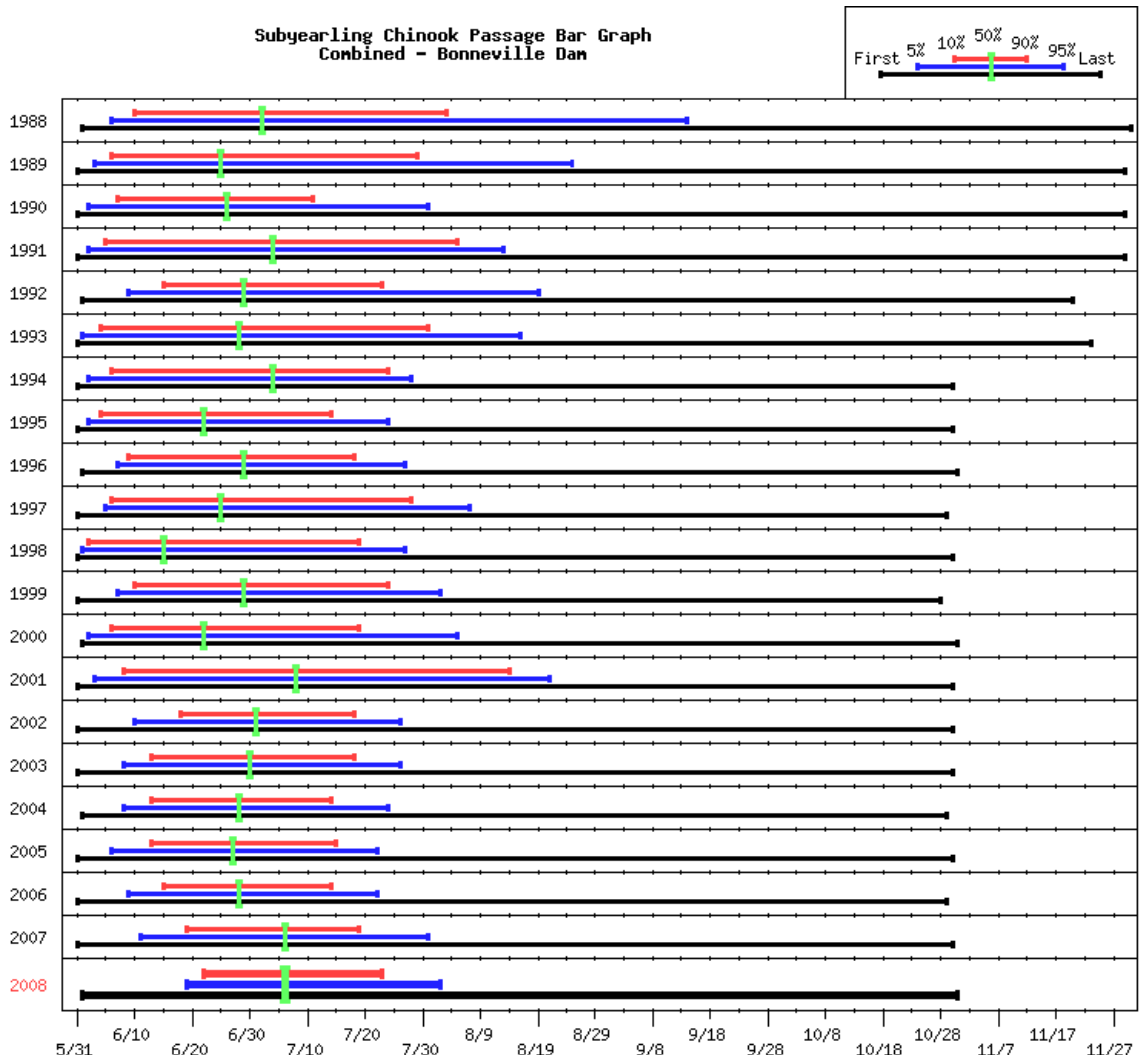


Table B. 43: Historical outmigration run-timing characteristics of passage-indexed combined wild and hatchery run-at-large subyearling Chinook salmon at Bonneville Dam.

	Detection Date									
Detection Year	First	1%	5%	10%	50%	90%	95%	Last	Middle 80% (days)	Total BON Passage
1988	6/1	6/2	6/6	6/10	7/2	8/3	9/14	11/30	55	333582
1989	6/1	6/1	6/4	6/7	6/26	7/30	8/26	11/30	54	361716
1990	6/1	6/2	6/3	6/8	6/27	7/12	8/1	11/30	35	929116
1991	6/1	6/1	6/3	6/6	7/5	8/6	8/14	11/30	62	754560
1992	6/1	6/3	6/9	6/15	6/29	7/23	8/19	11/20	39	985437
1993	6/1	6/1	6/2	6/5	6/29	8/1	8/17	11/24	58	772276
1994	6/1	6/1	6/3	6/7	7/5	7/25	7/29	10/31	49	1127627
1995	6/1	6/1	6/3	6/5	6/23	7/15	7/25	10/31	41	1605396
1996	6/1	6/3	6/7	6/9	6/29	7/18	7/27	10/31	40	696569
1997	6/1	6/3	6/6	6/7	6/26	7/29	8/8	10/30	53	1090472
1998	6/1	6/1	6/2	6/3	6/16	7/20	7/28	10/31	48	928458
1999	6/1	6/4	6/8	6/11	6/30	7/25	8/3	10/29	45	1195205
2000	6/1	6/1	6/2	6/6	6/22	7/19	8/5	10/31	44	772819
2001	6/1	6/1	6/4	6/9	7/9	8/15	8/22	10/31	68	2170478
2002	6/1	6/4	6/11	6/19	7/2	7/19	7/27	10/31	31	5192192
2003	6/1	6/3	6/9	6/14	7/1	7/19	7/27	10/31	36	6015618
2004	6/1	6/2	6/8	6/13	6/28	7/14	7/24	10/29	32	2662730
2005	6/1	6/2	6/7	6/14	6/28	7/16	7/23	10/31	33	1995161
2006	6/1	6/5	6/10	6/16	6/29	7/15	7/23	10/30	30	2107118
2007	6/1	6/5	6/12	6/20	7/7	7/20	8/1	10/31	31	1890669
2008	6/1	6/4	6/19	6/22	7/6	7/23	8/2	10/31	32	1725307

Appendix C

Daily Expansion Factors for Spill-Adjusted, PIT-Tagged Stocks Forecasted by Project RealTime in the 2008 Migration, including Chinook Salmon and Steelhead at Lower Granite Dam and Salmonids tracked to McNary Dam

Table C. 1: Expansion factors used to adjust PIT-tag detections based on outflow and spill at Lower Granite and McNary Dams during 2008 migration. See section 2.1.1. for expansion equations.

	Lower Granite Dam				McNary Dam			
	Outflow	Spill	Expansion factor (Eqs. 2.2a, b, 2.1)		Outflow	Spill	Expansion factor (Eqs. 2.2c, 2.1)	
Date	(kcfs)	(kcfs)	Chinook	Steelhead	(kcfs)	(kcfs)	Chinook	Steelhead
4/1	42.7	0.0	1.00	1.00	149.2	0.0	1.00	1.00
4/2	38.9	0.0	1.00	1.00	149.6	0.0	1.00	1.00
4/3	45.0	20.6	2.95	2.43	122.4	0.0	1.00	1.00
4/4	42.5	20.4	3.08	2.47	130.2	0.0	1.00	1.00
4/5	44.7	20.3	2.93	2.42	120.3	0.0	1.00	1.00
4/6	45.3	20.3	2.90	2.41	135.3	0.0	1.00	1.00
4/7	43.5	20.3	3.00	2.45	116.5	0.0	1.00	1.00
4/8	47.8	20.3	2.77	2.38	131.2	0.0	1.00	1.00
4/9	46.3	20.4	2.86	2.40	113.2	6.5	1.16	1.64
4/10	46.1	20.3	2.85	2.40	112.5	45.1	2.64	2.34
4/11	44.2	20.3	2.96	2.43	139.3	56.0	2.64	2.34
4/12	45.5	20.2	2.87	2.41	154.2	62.2	2.65	2.34
4/13	43.6	20.1	2.97	2.44	121.0	49.0	2.66	2.35
4/14	54.7	20.2	2.47	2.29	141.8	57.1	2.65	2.34
4/15	63.6	20.4	2.22	2.21	160.6	64.6	2.64	2.34
4/16	62.7	20.3	2.23	2.22	178.4	71.8	2.64	2.34
4/17	61.8	20.2	2.25	2.22	160.2	64.5	2.65	2.34
4/18	63.0	20.3	2.23	2.21	140.0	56.3	2.64	2.34
4/19	65.1	20.6	2.20	2.20	151.6	60.9	2.64	2.34
4/20	66.6	20.5	2.15	2.19	152.6	61.6	2.65	2.34
4/21	65.9	20.5	2.17	2.19	168.1	67.8	2.65	2.34
4/22	57.9	20.5	2.39	2.26	176.0	71.2	2.66	2.34
4/23	51.5	20.3	2.60	2.33	181.1	73.0	2.65	2.34
4/24	53.9	20.4	2.52	2.30	193.1	77.6	2.64	2.34
4/25	60.2	20.4	2.31	2.24	219.0	87.7	2.63	2.34
4/26	56.1	20.4	2.44	2.28	210.1	84.3	2.64	2.34
4/27	58.3	20.3	2.36	2.25	169.7	68.0	2.63	2.34
4/28	55.2	20.2	2.45	2.28	179.1	72.0	2.64	2.34
4/29	67.2	20.4	2.13	2.18	184.1	73.9	2.64	2.34
4/30	71.2	20.4	2.05	2.15	191.1	76.4	2.63	2.34
5/1	67.7	20.4	2.12	2.18	200.9	80.4	2.63	2.34
5/2	63.5	20.4	2.22	2.21	195.7	78.3	2.63	2.34
5/3	62.3	20.3	2.24	2.22	182.6	73.5	2.64	2.34
5/4	63.2	20.3	2.22	2.21	154.3	62.3	2.65	2.34
5/5	74.0	20.2	1.99	2.13	190.8	76.5	2.64	2.34

Table C. 1: Expansion factors (continued).

	Lower Granite Dam				McNary Dam			
	Outflow	Spill	Expansion factor (Eqs. 2.2a, b, 2.1)		Outflow	Spill	Expansion factor (Eqs. 2.2c, 2.1)	
Date	(kcfs)	(kcfs)	Chinook	Steelhead	(kcfs)	(kcfs)	Chinook	Steelhead
5/6	83.9	20.1	1.84	2.07	187.6	75.1	2.63	2.34
5/7	87.5	20.3	1.80	2.06	241.4	96.9	2.64	2.34
5/8	101.2	32.8	2.23	2.22	239.8	96.4	2.64	2.34
5/9	97.8	28.6	2.08	2.16	285.6	114.5	2.64	2.34
5/10	93.4	24.2	1.92	2.11	268.1	107.6	2.64	2.34
5/11	89.5	20.5	1.79	2.05	224.1	89.7	2.63	2.34
5/12	88.5	20.7	1.81	2.06	275.7	110.6	2.64	2.34
5/13	87.0	20.7	1.83	2.07	265.6	107.0	2.65	2.34
5/14	76.4	20.6	1.97	2.13	252.6	101.5	2.64	2.34
5/15	79.9	20.5	1.91	2.10	253.1	101.5	2.64	2.34
5/16	97.4	27.6	2.04	2.15	268.3	107.4	2.63	2.34
5/17	121.9	51.2	2.74	2.37	265.7	106.6	2.64	2.34
5/18	149.5	78.2	3.34	2.54	341.3	165.3	3.11	2.47
5/19	177.5	105.4	3.80	2.67	385.0	210.2	3.48	2.58
5/20	197.3	125.8	4.13	2.75	390.6	219.0	3.58	2.61
5/21	198.9	128.6	4.20	2.77	401.1	233.0	3.71	2.64
5/22	182.4	112.0	3.95	2.71	393.5	221.3	3.59	2.61
5/23	154.4	85.0	3.51	2.59	370.0	197.8	3.41	2.56
5/24	135.4	68.7	3.24	2.51	377.3	209.1	3.53	2.59
5/25	130.1	59.7	2.96	2.43	375.2	218.7	3.72	2.65
5/26	127.3	56.4	2.87	2.41	374.4	213.0	3.63	2.62
5/27	130.6	60.4	2.98	2.44	367.4	196.6	3.41	2.56
5/28	131.3	61.4	3.01	2.45	390.9	222.0	3.62	2.62
5/29	144.6	74.9	3.31	2.53	393.1	220.3	3.57	2.61
5/30	151.7	80.3	3.38	2.55	398.2	224.4	3.59	2.61
5/31	152.9	82.3	3.43	2.57	395.9	224.1	3.61	2.62
6/1	154.3	83.4	3.45	2.57	392.1	220.2	3.58	2.61
6/2	158.9	87.6	3.52	2.59	391.3	219.0	3.57	2.60
6/3	160.7	89.0	3.53	2.59	400.1	230.7	3.68	2.64
6/4	152.2	81.9	3.43	2.57	424.0	250.3	3.78	2.66
6/5	149.4	78.9	3.37	2.55	403.9	228.6	3.61	2.62
6/6	140.1	69.5	3.18	2.49	388.3	213.7	3.51	2.59
6/7	138.7	68.1	3.15	2.49	365.7	191.0	3.33	2.54
6/8	125.1	55.4	2.87	2.41	359.8	184.8	3.28	2.52
6/9	121.6	52.2	2.79	2.38	329.6	154.2	3.01	2.45

Table C. 1: Expansion factors (continued).

	Lower Granite Dam				McNary Dam			
	Outflow	Spill	Expansion factor (Eqs. 2.2a, b, 2.1)		Outflow	Spill	Expansion factor (Eqs. 2.2c, 2.1)	
Date	(kcfs)	(kcfs)	Chinook	Steelhead	(kcfs)	(kcfs)	Chinook	Steelhead
6/10	120.8	51.1	2.76	2.37	362.7	200.7	3.53	2.59
6/11	122.4	60.0	3.14	2.48	384.1	223.9	3.72	2.65
6/12	124.2	55.9	2.91	2.42	383.8	224.6	3.74	2.65
6/13	125.2	43.6	2.36	2.25	367.2	209.9	3.65	2.63
6/14	118.0	29.4	1.88	2.09	325.0	162.2	3.19	2.50
6/15	116.5	27.5	1.82	2.07	321.6	158.2	3.15	2.49
6/16	118.1	37.9	2.22	2.21	335.7	168.7	3.21	2.50
6/17	130.7	60.0	2.96	2.43	358.7	183.7	3.27	2.52
6/18	131.9	67.8	3.28	2.52	382.8	208.8	3.48	2.58
6/19	133.0	65.6	3.16	2.49	359.5	186.7	3.32	2.53
6/20	130.9	60.3	2.97	2.44	342.5	167.9	3.14	2.48
6/21	130.1	59.2	2.94	2.43	340.2	165.8	3.12	2.48
6/22	133.9	64.4	3.09	2.47	327.1	165.2	3.23	2.51
6/23	139.5	69.9	3.21	2.50	301.1	166.8	3.53	2.59
6/24	132.1	63.7	3.09	2.47	340.3	184.6	3.46	2.57
6/25	120.0	47.1	2.59	2.33	345.4	173.2	3.21	2.50
6/26	112.5	40.9	2.44	2.28	349.4	174.2	3.19	2.50
6/27	101.7	34.6	2.32	2.24	354.4	183.1	3.30	2.53
6/28	100.2	28.8	2.06	2.16	338.0	174.9	3.30	2.53
6/29	103.5	18.3	1.57	1.96	320.6	155.0	3.10	2.47
6/30	107.0	21.1	1.65	2.00	324.1	153.6	3.05	2.46
7/1	104.6	23.5	1.77	2.05	321.7	154.0	3.07	2.47
7/2	102.1	18.3	1.58	1.96	326.8	150.6	2.97	2.44
7/3	96.6	18.3	1.62	1.98	328.9	159.9	3.12	2.48
7/4	87.9	18.3	1.70	2.02	289.9	162.8	3.58	2.61
7/5	80.8	18.3	1.78	2.05	267.2	119.3	2.89	2.41
7/6	73.0	18.2	1.88	2.09	264.5	106.3	2.64	2.34
7/7	66.8	18.3	1.99	2.13	275.1	147.8	3.43	2.56
7/8	66.9	18.4	2.00	2.13	272.6	161.7	3.80	2.67
7/9	63.9	18.4	2.06	2.16	262.3	127.8	3.12	2.48
7/10	62.2	18.2	2.08	2.16	255.8	105.4	2.70	2.36
7/11	56.2	18.5	2.26	2.22	227.1	124.9	3.51	2.59
7/12	51.1	18.4	2.42	2.27	225.5	135.5	3.85	2.68
7/13	47.2	18.4	2.58	2.32	196.0	117.6	3.84	2.68
7/14	50.0	18.4	2.46	2.29	202.0	121.3	3.85	2.68

Table C. 1: Expansion factors (continued).

	Lower Granite Dam				McNary Dam			
	Outflow	Spill	Expansion factor (Eqs. 2.2a, b, 2.1)		Outflow	Spill	Expansion factor (Eqs. 2.2c, 2.1)	
Date	(kcfs)	(kcfs)	Chinook	Steelhead	(kcfs)	(kcfs)	Chinook	Steelhead
7/15	47.8	18.4	2.55	2.31	194.5	88.4	2.93	2.43
7/16	46.3	18.5	2.63	2.34	166.4	67.3	2.65	2.34
7/17	49.0	18.5	2.51	2.30	166.3	66.0	2.61	2.33
7/18	47.3	18.5	2.58	2.32	178.6	71.6	2.64	2.34
7/19	47.0	18.3	2.57	2.32	180.0	99.1	3.51	2.59
7/20	47.3	18.5	2.58	2.32	171.7	103.2	3.85	2.68
7/21	44.3	18.4	2.71	2.36	161.0	69.7	2.81	2.39
7/22	43.1	18.6	2.80	2.39	152.0	61.1	2.64	2.34
7/23	42.2	18.5	2.84	2.40	162.6	88.0	3.45	2.57
7/24	44.7	18.4	2.69	2.36	140.3	84.4	3.86	2.68
7/25	45.4	18.4	2.66	2.35	191.6	114.0	3.81	2.67
7/26	42.7	18.3	2.79	2.38	193.4	116.2	3.85	2.68
7/27	41.1	18.3	2.88	2.41	153.5	68.5	2.89	2.41
7/28	42.5	18.5	2.83	2.39	159.2	64.0	2.64	2.34
7/29	45.3	18.6	2.69	2.35	150.3	81.3	3.45	2.57
7/30	40.8	18.5	2.93	2.42	181.0	108.9	3.86	2.68
7/31	45.7	18.6	2.67	2.35	168.5	75.3	2.89	2.41
8/1	45.2	18.5	2.68	2.35	155.9	62.6	2.64	2.34
8/2	44.6	18.5	2.71	2.36	131.1	68.2	3.32	2.54
8/3	45.5	18.6	2.68	2.35	130.4	74.9	3.67	2.63
8/4	41.8	18.5	2.87	2.41	139.4	62.3	2.89	2.41
8/5	42.6	18.4	2.81	2.39	148.6	59.8	2.64	2.34
8/6	45.4	18.2	2.64	2.34	136.0	74.9	3.51	2.59
8/7	43.1	18.3	2.77	2.38	153.8	69.4	2.92	2.42
8/8	43.7	18.3	2.73	2.37	141.9	77.1	3.46	2.58
8/9	36.1	18.6	3.29	2.53	105.3	49.2	3.01	2.45
8/10	38.9	18.6	3.07	2.46	125.6	69.9	3.55	2.60
8/11	36.2	18.6	3.28	2.52	137.6	82.7	3.85	2.68
8/12	35.4	18.4	3.32	2.53	143.7	63.6	2.87	2.41
8/13	37.6	18.3	3.12	2.48	130.2	52.3	2.64	2.34
8/14	32.7	18.4	3.59	2.61	130.6	69.6	3.40	2.56
8/15	35.3	18.4	3.33	2.54	139.8	83.9	3.85	2.68
8/16	35.5	18.4	3.31	2.53	119.9	54.2	2.92	2.42
8/17	31.8	18.3	3.67	2.63	122.5	49.5	2.65	2.34
8/18	35.2	18.3	3.32	2.53	137.4	76.6	3.56	2.60

Table C. 1: Expansion factors (continued).

	Lower Granite Dam				McNary Dam			
	Outflow	Spill	Expansion factor (Eqs. 2.2a, b, 2.1)		Outflow	Spill	Expansion factor (Eqs. 2.2c, 2.1)	
Date	(kcfs)	(kcfs)	Chinook	Steelhead	(kcfs)	(kcfs)	Chinook	Steelhead
8/19	37.1	18.4	3.17	2.49	110.6	55.5	3.21	2.50
8/20	36.3	18.6	3.27	2.52	115.1	46.5	2.65	2.34
8/21	34.9	18.8	3.44	2.57	125.2	50.1	2.63	2.34
8/22	38.1	18.6	3.13	2.48	131.0	72.9	3.55	2.60
8/23	36.9	18.4	3.19	2.50	144.8	87.2	3.86	2.68
8/24	32.1	18.2	3.62	2.62	149.5	67.1	2.90	2.42
8/25	31.5	18.4	3.73	2.65	142.8	57.4	2.64	2.34
8/26	32.8	18.6	3.62	2.62	128.7	69.7	3.45	2.57
8/27	32.0	18.5	3.69	2.64	117.4	60.8	3.31	2.53
8/28	31.4	18.4	3.75	2.65	121.0	54.7	2.92	2.42
8/29	34.2	18.4	3.43	2.57	140.6	56.5	2.64	2.34
8/30	34.3	18.3	3.40	2.56	148.8	81.4	3.49	2.58
8/31	31.4	18.3	3.72	2.65	119.3	62.8	3.36	2.55
9/1	27.9	0.0	1.00	1.00	89.4	0.3	1.01	1.20
9/2	26.7	0.0	1.00	1.00	117.6	0.0	1.00	1.00
9/3	32.4	0.0	1.00	1.00	101.4	0.0	1.00	1.00
9/4	32.8	0.0	1.00	1.00	111.1	0.0	1.00	1.00
9/5	37.2	0.0	1.00	1.00	110.6	0.0	1.00	1.00
9/6	31.5	0.0	1.00	1.00	84.8	0.0	1.00	1.00
9/7	30.1	0.0	1.00	1.00	73.7	0.0	1.00	1.00
9/8	27.9	0.0	1.00	1.00	103.8	0.0	1.00	1.00
9/9	26.3	0.0	1.00	1.00	85.0	0.0	1.00	1.00
9/10	25.9	0.0	1.00	1.00	107.1	0.0	1.00	1.00
9/11	24.1	0.0	1.00	1.00	62.8	0.0	1.00	1.00
9/12	25.4	0.0	1.00	1.00	81.0	0.0	1.00	1.00
9/13	22.4	0.0	1.00	1.00	69.8	0.0	1.00	1.00
9/14	21.9	0.0	1.00	1.00	70.0	0.0	1.00	1.00
9/15	20.2	0.0	1.00	1.00	78.2	0.0	1.00	1.00
9/16	23.1	0.0	1.00	1.00	95.0	0.0	1.00	1.00
9/17	17.4	0.0	1.00	1.00	95.5	0.0	1.00	1.00
9/18	23.7	0.0	1.00	1.00	83.2	0.0	1.00	1.00
9/19	20.3	0.0	1.00	1.00	76.9	0.0	1.00	1.00
9/20	14.3	0.0	1.00	1.00	76.2	0.0	1.00	1.00
9/21	12.5	0.0	1.00	1.00	64.4	0.0	1.00	1.00
9/22	16.4	0.0	1.00	1.00	60.8	0.0	1.00	1.00

Table C. 1: Expansion factors (continued).

	Lower Granite Dam				McNary Dam			
	Outflow	Spill	Expansion factor (Eqs. 2.2a, b, 2.1)		Outflow	Spill	Expansion factor (Eqs. 2.2c, 2.1)	
Date	(kcfs)	(kcfs)	Chinook	Steelhead	(kcfs)	(kcfs)	Chinook	Steelhead
9/23	17.0	0.0	1.00	1.00	73.4	0.0	1.00	1.00
9/24	20.4	0.0	1.00	1.00	94.2	0.0	1.00	1.00
9/25	21.2	0.0	1.00	1.00	85.1	0.0	1.00	1.00
9/26	21.7	0.0	1.00	1.00	92.9	0.0	1.00	1.00
9/27	25.9	0.0	1.00	1.00	78.6	0.0	1.00	1.00
9/28	18.2	0.0	1.00	1.00	68.0	0.0	1.00	1.00
9/29	17.2	0.0	1.00	1.00	82.5	0.0	1.00	1.00
9/30	24.6	0.0	1.00	1.00	76.5	0.0	1.00	1.00
10/1	23.1	0.0	1.00	1.00	80.1	0.0	1.00	1.00
10/2	26.3	0.0	1.00	1.00	87.5	0.0	1.00	1.00
10/3	24.0	0.0	1.00	1.00	88.2	0.0	1.00	1.00
10/4	20.7	0.0	1.00	1.00	62.6	0.0	1.00	1.00
10/5	19.7	0.0	1.00	1.00	61.1	0.0	1.00	1.00
10/6	17.8	0.0	1.00	1.00	75.4	0.0	1.00	1.00
10/7	23.6	0.0	1.00	1.00	76.7	0.0	1.00	1.00
10/8	18.4	0.0	1.00	1.00	79.5	0.0	1.00	1.00
10/9	24.1	0.0	1.00	1.00	100.3	0.0	1.00	1.00
10/10	24.7	0.0	1.00	1.00	92.3	0.0	1.00	1.00
10/11	20.3	0.0	1.00	1.00	83.5	0.0	1.00	1.00
10/12	22.9	0.0	1.00	1.00	67.4	0.0	1.00	1.00
10/13	26.0	0.0	1.00	1.00	81.7	0.0	1.00	1.00
10/14	20.4	0.0	1.00	1.00	98.4	0.0	1.00	1.00
10/15	14.6	0.0	1.00	1.00	106.3	0.0	1.00	1.00
10/16	17.4	0.0	1.00	1.00	86.6	0.0	1.00	1.00
10/17	18.4	0.0	1.00	1.00	109.5	0.0	1.00	1.00
10/18	17.8	0.0	1.00	1.00	90.7	0.0	1.00	1.00
10/19	20.6	0.0	1.00	1.00	76.2	0.0	1.00	1.00
10/20	19.6	0.0	1.00	1.00	96.0	0.0	1.00	1.00
10/21	24.5	0.0	1.00	1.00	105.9	0.0	1.00	1.00
10/22	18.6	0.0	1.00	1.00	100.3	0.0	1.00	1.00
10/23	18.8	0.0	1.00	1.00	90.4	0.0	1.00	1.00
10/24	19.2	0.0	1.00	1.00	85.9	0.0	1.00	1.00
10/25	17.4	0.0	1.00	1.00	83.1	0.0	1.00	1.00
10/26	16.5	0.0	1.00	1.00	68.8	0.0	1.00	1.00
10/27	16.2	0.0	1.00	1.00	81.7	0.0	1.00	1.00

Table C. 1: Expansion factors (continued).

	Lower Granite Dam				McNary Dam			
	Outflow	Spill	Expansion factor (Eqs. 2.2a, b, 2.1)		Outflow	Spill	Expansion factor (Eqs. 2.2c, 2.1)	
Date	(kcfs)	(kcfs)	Chinook	Steelhead	(kcfs)	(kcfs)	Chinook	Steelhead
10/28	15.8	0.0	1.00	1.00	89.9	0.0	1.00	1.00
10/29	15.5	0.0	1.00	1.00	86.0	0.0	1.00	1.00
10/30	18.1	0.0	1.00	1.00	110.8	0.0	1.00	1.00
10/31	22.0	0.0	1.00	1.00	98.1	0.0	1.00	1.00
11/1	14.3	0.0	1.00	1.00	85.6	0.0	1.00	1.00
11/2	14.3	0.0	1.00	1.00	68.6	0.0	1.00	1.00
11/3	16.7	0.0	1.00	1.00	80.6	0.0	1.00	1.00
11/4	21.2	0.0	1.00	1.00	83.9	0.0	1.00	1.00
11/5	19.9	0.0	1.00	1.00	118.7	0.0	1.00	1.00
11/6	20.9	0.0	1.00	1.00	105.6	0.0	1.00	1.00
11/7	17.6	0.0	1.00	1.00	87.5	0.0	1.00	1.00
11/8	18.6	0.0	1.00	1.00	101.7	0.0	1.00	1.00
11/9	23.8	0.0	1.00	1.00	100.5	0.0	1.00	1.00
11/10	20.8	0.0	1.00	1.00	112.1	0.0	1.00	1.00
11/11	21.3	0.0	1.00	1.00	105.1	0.0	1.00	1.00
11/12	23.0	0.0	1.00	1.00	108.7	0.0	1.00	1.00
11/13	29.1	0.0	1.00	1.00	121.2	0.0	1.00	1.00
11/14	44.1	0.0	1.00	1.00	152.6	0.0	1.00	1.00
11/15	32.7	0.0	1.00	1.00	92.5	0.0	1.00	1.00
11/16	28.3	0.0	1.00	1.00	106.8	0.0	1.00	1.00
11/17	25.7	0.0	1.00	1.00	90.4	0.0	1.00	1.00
11/18	25.3	0.0	1.00	1.00	102.8	0.0	1.00	1.00
11/19	25.0	0.0	1.00	1.00	121.3	0.0	1.00	1.00
11/20	21.0	0.0	1.00	1.00	123.6	0.0	1.00	1.00
11/21	19.5	0.0	1.00	1.00	115.8	0.0	1.00	1.00
11/22	24.1	0.0	1.00	1.00	103.6	0.0	1.00	1.00
11/23	19.8	0.0	1.00	1.00	109.4	0.0	1.00	1.00
11/24	22.6	0.0	1.00	1.00	99.1	0.0	1.00	1.00
11/25	17.5	0.0	1.00	1.00	127.8	0.0	1.00	1.00
11/26	20.5	0.0	1.00	1.00	122.0	0.0	1.00	1.00
11/27	18.5	0.0	1.00	1.00	123.4	0.0	1.00	1.00
11/28	18.6	0.0	1.00	1.00	96.0	0.0	1.00	1.00
11/29	19.2	0.0	1.00	1.00	98.3	0.0	1.00	1.00
11/30	22.2	0.0	1.00	1.00	107.2	0.0	1.00	1.00
12/1	18.0	0.0	1.00	1.00	118.7	0.0	1.00	1.00

Appendix D

Historical MADs for Stocks Used in the 2008 RealTime Run-Timing Prediction Project

Table D.1: Historical MADs (%) for all wild PIT-tagged yearling Chinook salmon forecasted to Lower Granite Dam and McNary Dam in 2008.

Stock Name	Dam	Year													Hist. Avg.	2008
		###	###	###	###	###	###	###	###	###	###	###	###	###		
Big Creek	Lower Granite	3.8	---	---	---	2.9	6.4	---	7.7	4.0	2.2	10.3	3.2	6.4	5.2	12.6
Catherine Creek		6.6	5.4	6.5	7.5	6.7	5.3	7.8	4.7	3.8	5.8	6.6	5.6	9.5	6.3	7.2
Grande Ronde		6.4	---	---	---	---	---	---	---	---	---	---	---	---	6.4	6.8
Imnaha River		9.0	8.4	3.8	10.2	3.4	3.2	5.9	32.6	3.0	3.1	2.9	1.8	3.8	7.0	2.3
Imnaha Trap		---	---	---	---	---	---	---	---	---	---	---	---	---	---	6.1
Johnson Creek Trap		---	---	---	---	---	---	---	---	---	---	---	---	---	---	10.2
Lemhi River		---	---	---	---	---	---	---	8.5	38.9	17.1	23.7	8.2	16	18.8	6.9
Lemhi River Weir		---	---	---	---	---	---	---	---	---	---	---	---	---	---	10.7
Lookingglass Creek		---	---	---	---	---	---	---	8.0	5.4	5.1	---	---	10	7.1	2.1
Lostine River		9.2	11.6	4.4	---	5.4	2.2	3.7	3.7	5.3	5.7	2.1	2.4	8.7	5.4	8.4
Marsh Creek		3.2	---	---	---	3.5	2.8	---	6.2	7.4	5.9	11.3	4.7	---	5.6	9.3
Minam River		8.9	3.0	7.6	8.6	6.2	2.3	1.8	4.6	5.9	9.1	3.1	6.8	3.3	5.5	6.0
Valley Creek		8.9	---	---	---	8.8	6.4	12.5	3.9	5.9	5.5	3.8	7.9	7.6	7.1	11.2
RT Composite		---	---	---	---	2.1	1.2	4.8	5.6	4.6	2.6	7.4	2.3	2.9	3.7	4.1
All Wild Run-at-large		---	---	---	---	---	---	---	---	---	---	---	---	---	---	6.0
Snake River Run-at-large	McNary	---	---	---	---	---	---	3.4	0.9	2.8	1.5	2.7	3.1	2.4	2.4	2.8

Table D.2: Historical MADs (%) for all wild PIT-tagged steelhead forecasted to Lower Granite Dam and McNary Dam in 2008.

Stock Name	Dam	Year								Hist. Avg.	2008
		2000	2001	2002	2003	2004	2005	2006	2007		
Snake River Run-at-large	LGR	5.4	2.0	7.5	7.2	3.6	3.2	4.7	4.7	4.8	3.5
Snake River Run-at-large	McNary	---	1.5	5.0	7.5	4.4	2.7	3.9	3.9	4.1	3.7
Upper Columbia Run-at-large	McNary	---	5.9	12.1	6.9	6.6	25.6	22.3	22.3	14.5	3.1
Composite Snake River and Upper Columbia Run-at-large	McNary	---	2.5	4.6	5.5	5.7	4.2	2.1	2.1	3.8	2.2

Table D.3: Historical MADs (%) for all wild and hatchery PIT-tagged sockeye salmon forecasted to Lower Granite Dam and McNary Dam in 2008.

Stock Name	Dam	Year											Hist. Avg.	2008
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007		
Wild Snake River Run-at-large	McNary	---	---	---	---	6.7	5.1	11.3	23.6	7.86	6.28	3.1	10.1	9.1
Redfish Lake Hatchery	LGR	6.4	7.7	8.6	7.0	---	---	6.6	7.8	5.65	1.95	6.1	6.5	6.4

Table D.4: Historical MADs (%) for all wild PIT-tagged subyearling Chinook salmon forecasted to Lower Granite Dam and McNary Dam in 2009.

Stock Name	Dam	Year									Hist. Avg.	2008
		1999	2000	2001	2002	2003	2004	2005	2006	2007		
Snake River Run-at-large	LGR	5.0	5.3	5.2	5.4	2.8	5.3	5.0	2.8	3.4	4.5	5.4
Snake River Run-at-large	McNary	---	---	3.6	7.8	3.0	7.2	6.0	8.5	4.1	5.7	6.1
Upper Columbia Run-at-large	McNary	---	---	4.3	3.7	2.3	7.2	8.6	3.2	2.2	4.5	4.5

Table D.5: Historical MADs (%) for the RealTime predicted run-timing using Fish Passage Center passage-indexed combined wild and hatchery runs-at-large of yearling Chinook salmon at Rock Island, McNary, John Day, and Bonneville Dams.

	Year									
Dam	2000	2001	2002	2003	2004	2005	2006	2007	Hist. Avg.	2008
Rock Island	3.8	8.6	1.7	2.8	4.0	2.7	5.1	3.6	4.0	2.2
McNary	0.6	1.9	3.3	1.9	3.6	3.6	1.6	2.7	2.4	2.4
John Day	---	---	3.5	4.1	2.0	4.0	3.5	7.0	4.0	3.6
Bonneville	---	---	---	---	2.1	2.0	4.5	4.1	3.2	2.0

Table D.6: Historical MADs (%) for the RealTime predicted run-timing using Fish Passage Center passage-indexed combined wild and hatchery runs-at-large of steelhead trout at Rock Island, McNary, John Day, and Bonneville Dams.

	Year									
Dam	2000	2001	2002	2003	2004	2005	2006	2007	Hist. Avg.	2008
Rock Island	3.6	4.5	3.0	2.2	2.7	2.0	1.8	2.4	2.8	1.3
McNary	4.1	3.8	4.8	6.3	13.5	7.6	2.6	3.3	6.1	2.6
John Day	---	---	4.2	3.0	7.3	2.6	4.0	3.1	4.2	2.2
Bonneville	---	---	---	---	6.4	4.1	3.3	2.5	4.6	2.4

Table D.7: Historical MADs (%) for the RealTime predicted run-timing using Fish Passage Center passage-indexed combined wild and hatchery runs-at-large of coho salmon at Rock Island, McNary, John Day, and Bonneville Dams.

	Year									
Dam	2000	2001	2002	2003	2004	2005	2006	2007	Historical Avg.	2008
Rock Island	0.6	4.1	2.6	1.3	1.8	0.9	1.6	0.9	1.7	0.6
McNary	1.4	2.0	1.6	4.2	5.8	4.0	5.0	4.9	3.6	1.6
John Day	---	---	3.7	2.3	3.2	2.9	2.6	1.8	2.8	2.5
Bonneville	---	---	---	---	1.7	1.4	2.4	1.6	1.8	4.1

Table D.8: Historical MADs (%) for the RealTime predicted run-timing using Fish Passage Center passage-indexed combined wild and hatchery runs-at-large of sockeye salmon at Rock Island, McNary, John Day, and Bonneville Dams.

	Year									
Dam	2000	2001	2002	2003	2004	2005	2006	2007	Historical	2008

									Avg.	
Rock Island	18.7	14.1	5.5	3.1	3.4	17.6	7.0	8.1	9.7	7.2
McNary	10.1	3.3	1.6	1.7	2.6	13.1	1.5	2.0	4.5	5.2
John Day	---	---	3.5	3.9	1.9	8.8	2.8	3.1	4.0	3.4
Bonneville	---	---	---	---	1.2	12.7	1.7	1.4	4.3	2.7

Table D.9: Historical MADs (%) for the RealTime predicted run-timing using Fish Passage Center passage-indexed combined wild and hatchery runs-at-large of subyearling Chinook salmon at Rock Island, McNary, John Day, and Bonneville Dams.

	Year									
Dam	2000	2001	2002	2003	2004	2005	2006	2007	Historical Avg.	2008
Rock Island	3.0	9.8	6.2	8.1	7.7	2.6	4.6	2.1	5.5	3.2
McNary	1.7	2.1	1.8	2.1	2.8	3.1	4.2	2.1	2.5	7.1
John Day	---	8.5	6.7	4.1	3.5	2.8	5.9	6.8	5.5	1.0
Bonneville	---	---	---	---	5.6	3.5	3.2	3.4	3.9	1.9