Transportation of Columbia River Salmonids from McNary Dam:

Final Adult Returns from the 2002-2004 Hatchery Spring Chinook and 2003-2005 Hatchery Steelhead Juvenile Migrations

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EXECUTIVE SUMMARY

In 2002, the National Marine Fisheries Service began multi-year studies to evaluate transport of upper Columbia River hatchery spring Chinook salmon smolts from McNary Dam. In 2003, NMFS began similar studies for upper Columbia hatchery steelhead. Smolts of each species were marked each year with passive integrated transponder (PIT) tags and released to migrate in the river or transported and released below Bonneville Dam. Here we report complete results from adult returns of Columbia River hatchery yearling spring Chinook salmon marked in 2002-2004 and steelhead smolts marked in 2003-2005.

At McNary Dam, the PIT-tag detection system in the full-flow bypass pipe was available only on a limited basis during the 2002 study. Therefore, all fish collected at the dam that year were sent over the separator. At the A and B Raceway Diversion gates, the separation-by-code system was set to divert 80% of Chinook study fish to transport. The remaining 20% were returned to the river via the juvenile facility bypass. From 2003 to 2005, transportation of our study fish from McNary Dam was conducted on alternate days. On the day study fish were collected for transportation, all fish entered the juvenile collection system where fish tagged for this study were diverted to transport holding raceways while the remaining (non-targeted fish) were returned to the river through the facility bypass system.

Hatchery Yearling Chinook. Juvenile yearling Chinook were collected and tagged at hatcheries in the Columbia River Basin upstream from McNary Dam. All fish were released directly from the hatchery at which they were tagged. As shown below, the number and proportion of the total release was similar at each hatchery among years. The exception was at Leavenworth, where the number varied from 216,698 to 267,533 (66.6 to 77.1%).

	Winthrop	Methow	Entiat	Leavenworth
2002	5.8%	n/a	17.1%	77.1%
2003	5.9%	10.2%	17.3%	66.6%
2004	5.9%	10.2%	17.3%	66.6%

In all study years, transported fish were barged and released below Bonneville Dam, bypassed fish completed their juvenile migration in the river, and inriver migrants were only those fish that passed via spillways or turbines at McNary Dam (i.e., without being detected).

For Chinook salmon, smolt-to-adult ratios (SARs) were poor for all 3 years, ranging from 0.19 to 0.43%. Ratios of SARs are shown below (with 95% CIs). Bypass SARs were for the juvenile facility bypass in 2002 and full-flow bypass in 2003 and 2004.

	Transport/Inriver	Bypass/Inriver	Transport/Bypass
2002	0.95 (0.78-1.13)	1.02 (0.79-1.28)	0.93 (0.71-1.24)
2003	0.74 (0.60-0.91)	0.62 (0.50-0.75)	1.20 (0.90-1.58)
2004	0.82 (0.62-1.03)	0.52 (0.37-0.68)	1.57 (1.09-2.27)

Patterns in the relationship between juvenile migration timing of Chinook salmon and SARs were different among all 3 study years. Even though the patterns were different, study years 2002 and 2003 were similar in that there were multiple peaks in both bypass and transport relative to juvenile timing, while study year 2004 had only one peak related to juvenile timing for both bypass and transport SARs.

The conversion rates of returning Chinook salmon adults (the percentage of adults detected at Bonneville Dam and subsequently detected at McNary Dam; not adjusted for any take in the Zone 6 fishery) ranged from 81% for study year 2004 to 86% for study year 2002. Differences between the transport and migrant groups varied between years, with the largest difference (three percentage points) occurring in 2003 (transport was the lower group).

Based on overall study results, Columbia River hatchery Chinook salmon that passed McNary Dam via the spillway/turbine route had higher SARs than fish collected and transported (geomean of 0.83 with 95% CI, 0.72-0.93). However, if a hatchery Chinook was guided into the juvenile collection system, transport provided a benefit over returning the fish to the river via the full-flow bypass pipe (geomean of 1.39 with 95% CI, 1.04-2.14).

Hatchery Steelhead. From 2003 to 2005, juvenile steelhead used in this study were tagged in the following proportions at the five hatcheries listed below:

	Wells	Winthrop	Chelan	Eastbank	Ringold
2003-2005	50.2%	10.3%	6.8%	12.8%	19.9%

Fish from Wells Hatchery were outplanted to the Methow and Okanogan Rivers; fish from Winthrop were released to the Methow River; and fish from Chelan and Eastbank Hatcheries were outplanted to the Wenatchee River. Fish from Ringold Hatchery were released to the Columbia River.

Numbers of fish tagged and proportions of the juvenile migration tagged were similar in all 3 years. However, fewer Ringold Hatchery fish were used in the 2005 study. Detections of Ringold Hatchery study fish in the adult ladder at McNary Dam in February 2005 (two months prior to the planned release date) led to the discovery of a hole in the tail screen of the holding pond. After repairing the screen, a PIT-tag detector was installed on the outflow from the pond so study fish could be detected when they were released in April. Only those Ringold Hatchery fish detected leaving the pond (64.3% of the steelhead tagged) were used in the 2005 study.

In adult returns from all three release years, SARs of steelhead were higher than those of Chinook salmon, ranging from 1.51 to 2.44%. Ratios of SARs are shown below for the three study groups (with 95% CIs).

	Transport/Inriver	Bypass/Inriver	Transport/Bypass
2003	0.96 (0.86-1.06)	0.80 (0.72-0.89)	1.20 (1.04-1.38)
2004	1.28 (1.11-1.45)	0.96 (0.84-1.09)	1.33 (1.11-1.57)
2005	1.09 (0.99-1.22)	1.01 (0.91-1.12)	1.08 (0.95-1.24)

Patterns of steelhead SARs in relation to juvenile migration timing were similar for transport groups from 2003 and 2004 and for full-flow bypass groups from 2003 to 2005. Steelhead that migrated as juveniles early in the season (mid-April) had the highest SARS. A decline in SARs was observed for steelhead that migrated after mid-April, with a second, smaller peak occurring after this 2- to 3-week decline. Finally, SARs declined to zero for fish that migrated as juveniles from the end of May to early June. The 2005 transport group was different in that there was only one peak, which occurred for fish migrating the first week of May.

Conversion rates of returning steelhead adults ranged from 65% in 2003 to 76% in 2005 and showed little difference between the groups within a year. Differences between the transport and inriver groups varied between years, with the largest difference (four percentage points) occurring in 2004 (transport was the lower group). In both 2003 and 2005, transported steelhead converted at slightly higher rates than inriver migrants, but the difference was less than 0.5% in both years. The loss between McNary and Bonneville Dam was due to some combination of straying, harvest, and mortality, but we have no data to determine percentages of loss from these three sources, or whether they differed between the study groups.

In contrast to results for spring Chinook salmon, overall results from studies of Columbia River hatchery steelhead transported from McNary Dam showed that transportation provided a benefit over fish that passed the dam through the spillway/turbine route (geomean of 1.10 with 95% CI, 1.02-1.18). Also, for fish that had already been guided into the juvenile collection system at a dam, transport provided a benefit over returning to the river, regardless of whether the river return route was through the full-flow bypass pipe (geomean of 1.20 with 95% CI, 1.10-1.31) or the facility bypass pipes (geomean of 1.39 with 95% CI, 1.15-1.72).

Thus, different results were obtained for the two species evaluated, with hatchery steelhead showing greater benefit from transport at McNary Dam and hatchery spring Chinook salmon showing greater benefit from inriver migration. For both species, if a fish was collected, it was better to transport the fish than return it to the river via the full-flow bypass pipe. The response to transport of wild Chinook salmon, wild steelhead, sockeye salmon, or any other species, was not evaluated during this study.

CONTENTS

INTRODUCTION

In 2007, we completed studies to evaluate transportation of juvenile Pacific salmon *Oncorhynchus* spp. from McNary Dam. Salmon are transported to mitigate for losses on the Lower Columbia River from migration through hydropower projects operated by the U.S. Army Corps of Engineers (USACE). Our primary objective was to compare adult returns of Chinook salmon *O. tshawytscha* and steelhead *O. mykiss* smolts transported and released below Bonneville Dam to those of their cohorts that migrated inriver. Additionally, we compared adult returns for fish that were transported and released below Bonneville Dam to those that were returned to the river and allowed to migrate downstream. Detections of inriver migrant study fish also provided data for annual estimates of juvenile survival between various points of release and Bonneville Dam tailrace (Muir et al. 2001).

In 2002, we began marking Columbia River spring Chinook salmon with passive integrated transponder (PIT) tags (Marsh et al. 2006). Fish were tagged at various upper Columbia River hatcheries to evaluate spring transport from McNary Dam. In 2003, we began marking hatchery steelhead for the same evaluations (Marsh et al. 2007). PIT-tagged study smolts collected at McNary Dam were either transported to below Bonneville Dam, returned to the river through the facility bypass pipes (2002), or returned to the river through the full-flow bypass pipe (2003-2005). Their cohorts that passed through spillways or turbines at McNary Dam (i.e., not detected) served as the inriver migrant group for comparisons.

The full-flow bypass PIT tag detection system was completed at McNary Dam in 2002 (Axel 2005; Figure 1). The PIT tag detectors are located on the large-diameter (91.4-cm) fish transport pipe that runs between the end of the collection channel in the dam to the facility switch gate located downstream of the dam at the juvenile fish facility. If the facility switch gate is closed, the fish transition to a slightly smaller-diameter (76-cm) pipe (with no mechanical dewatering) and continue to the dam's tailrace. If the facility switch gate is open, the fish are diverted into the juvenile fish facility where they are subjected to mechanical dewatering so they can be shunted through smaller-diameter (25-cm) pipes and flumes to holding raceways, to await transportation, or to the dam's tailrace.

After adult returns were complete, we compared smolt-to-adult return rates (SARs) of transported smolts to those of full-flow bypassed fish and migrants. Here we summarize the final results from the 2002-2004 spring Chinook salmon and 2003-2005 steelhead tagging years. Detailed results from individual study years, including results for each hatchery, are presented in Appendices A and B for yearling Chinook and Appendices C and D for steelhead. A detailed explanation of the statistical methodology is contained in Appendix E.

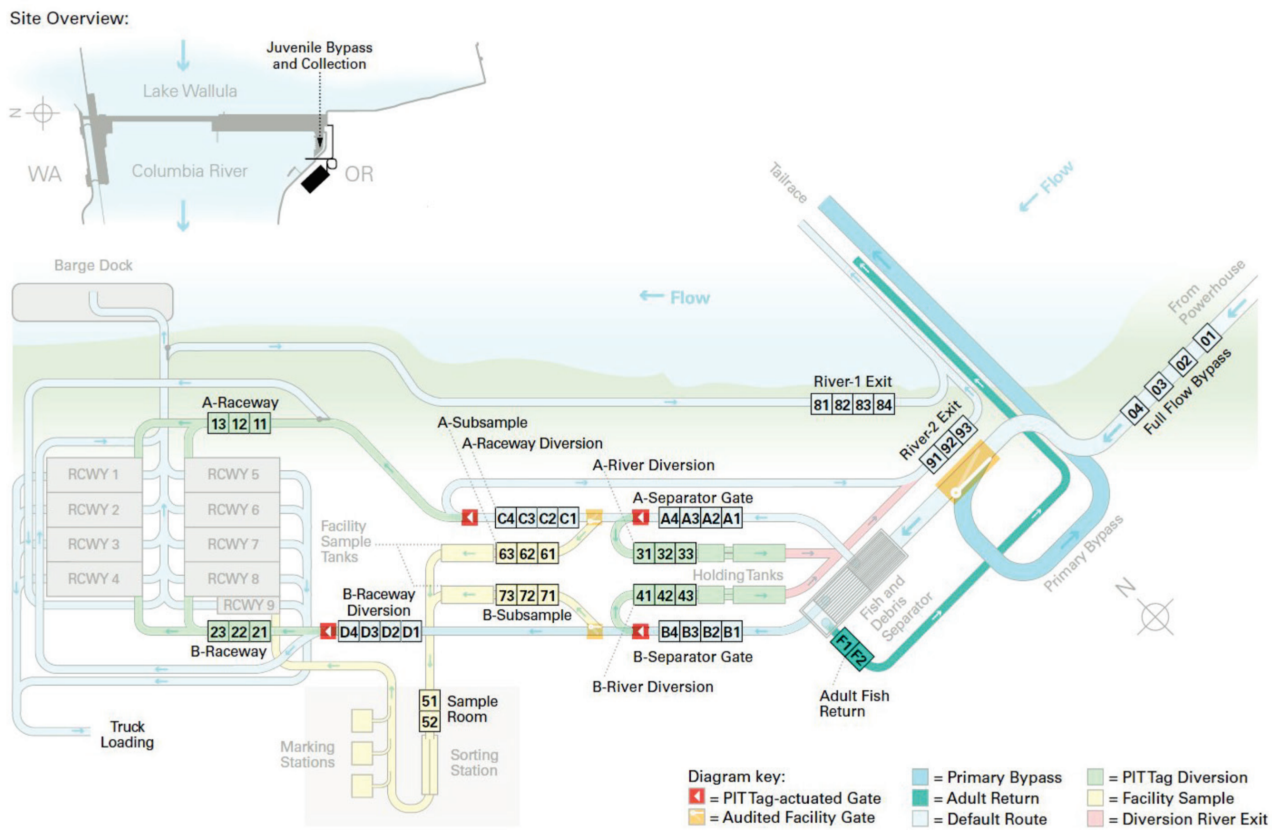

Figure 1. Configuration of juvenile fish facilities at McNary Dam showing location of the following PIT tag monitors: Adult Fish Return (AFR), A and B River Diversion (DIV), Full Flow Bypass (FFB), A and B Raceway Diversion (RAC), River 1 and River 2 Exits (RIV), A and B Separator Gate (SEP), A and B Subsample/Sample Room (for smolt monitoring sample SMP), A and B Raceway (for transportation loading TRA). Also shown are PIT-tag actuated gates (SbyC gates). Diagram courtesy of Pacific States Marine Fisheries Commission.

METHODS

Juvenile Collection and Tagging

To evaluate transport of fish originating in the Columbia River upstream from McNary Dam, spring Chinook salmon (2002-2004) and steelhead (2003-2005) were PIT-tagged and released from hatcheries in this area. We attempted to tag numbers at each hatchery to approximate the proportion that each respective hatchery population represented in the general population of Columbia River spring Chinook salmon and steelhead. Passage-route treatment groups were established when the fish arrived at McNary Dam. We planned for three passage-route treatments: a transport group, an inriver migrant group, and a bypass group to evaluate the full-flow bypass pipe at McNary Dam.

PIT-tag detectors in the full-flow bypass were first installed in 2002. However, we were not able to form a full-flow bypass treatment group that year because of tests being conducted in the new system. Therefore, all yearling Chinook salmon collected in 2002 were sent over the separator, with 80% of our study fish diverted to raceways for transport and 20% returned to the river. Fish returned to the river were routed with non-study fish through the facility bypass lines. Because of the design of the McNary Dam juvenile fish facility, fish had to be diverted to the tailrace through the full-flow bypass system during the loading of barges; therefore, there were a small number (2,435) of study fish that passed through that route over the course of the 2002 outmigration.

Beginning in 2003, on alternate days of the study period, all study fish collected were either returned to the river through the full-flow bypass or passed over the separator and on to the separation-by-code (SbyC) diversion gates (Downing et al. 2001). On days fish were collected to form the transport group, we set the SbyC system to divert 100% of PIT-tagged study fish to the transportation holding raceways. All other fish were returned to the tailrace through the facility bypass pipes.

Bypassed(full-flow and facility) fish were used to create survival estimates based on their downstream detections. These estimates were used in calculations of differential delayed mortality, *D*, of transported fish

Calculating Sample Size for Tagged Juveniles

Yearling Chinook

We calculated the number of fish needed to test both the null hypothesis, that there was no difference between the SARs of transported vs. inriver migrant fish, and the alternate hypothesis, that the ratio of transport-to-inriver SARs (T/I ratio) was at least 1.2 (that is, at least 20% more transported than inriver fish returned as adults). For given type I error rate ($t_{\alpha/2}$, rejection of a true null hypothesis) and type II error rate (t_β, acceptance of a false null hypothesis), the number of fish needed was determined as follows:

$$\ln\left(\frac{T}{I}\right) - \left(t_{\frac{\alpha}{2}} + t_\beta\right) \times SE\left(\ln\left(\frac{T}{I}\right)\right) \approx 0 \qquad (1)$$

and

$$SE\left(\ln\ \left(\frac{T}{I}\right)\right) = \sqrt{\left(\frac{1}{n_T} + \frac{1}{n_I}\right)} = \sqrt{\frac{2}{n}} \qquad (2)$$

where n is the number of adult returns per treatment (for either n_T transport or n_M inriver migrant groups). The previous two statements imply the number of adults needed were:

$$n = \frac{2\left(t_{\frac{\alpha}{2}} + t_\beta\right)^2}{\left(\ln\left(\frac{T}{I}\right)\right)^2} \qquad (3)$$

Therefore, if $\alpha = 0.05$ and $\beta = 0.20$, and if we wish to discern a difference of 20% ($T/I \geq 1.2$) between transported and inriver fish, and if we expect a SAR for the hatchery spring Chinook salmon transport group of at least 1.0%, then sample sizes required at McNary Dam were:

$n = 473$
$N_T = 47{,}300$
$N_I = 56{,}760$
Total juveniles = 104,060

Where N_T was the number of juvenile Chinook salmon needed for the transport cohort, NB was the number needed for the bypass cohort, and N_I was the number needed for the inriver migrant cohort (47,300 × 1.2).

The equations above provided numbers of juvenile Chinook salmon juveniles needed to form the transport and bypass groups at McNary Dam. However, to assure detection of these numbers at the dam, larger numbers were needed for release from upstream hatcheries. To determine the number of Chinook salmon needed to tag at the hatcheries, we calculated the probability of survival from release to McNary Dam and the probability of detection in the collection system at McNary Dam.

For these calculations, we used survival estimates from PIT-tagged fish released from Leavenworth Hatchery in spring 2000. Most of these fish arrived at McNary Dam in May, and nearly all had passed the dam by early June 2000. During this passage period, spill at the dam averaged a relatively constant 40% of total river flow. Estimated survival was 0.586 (SE = 0.015), and detection probability was 0.229 (SE = 0.015). Therefore, we needed to release roughly 355,000 (47,300/0.586/0.229) PIT-tagged yearling spring Chinook salmon from hatcheries to collect the number of study fish required for the transport and bypass groups at McNary Dam.

This study was changed in 2003 to include an evaluation of fish bypassed back to the river through the full-flow bypass system. For this evaluation, an additional 355,000 tagged fish would be needed to provide another 47,300 fish for the bypass group. It was decided by the region not to increase the numbers of fish for tagging but to split the collected fish into transport and bypass groups (23,650 in each).

Hatchery Steelhead

Having developed the hatchery steelhead evaluation to include transport, bypass, and inriver migrant groups, we used the same assumptions as those used for hatchery Chinook salmon ($\alpha = 0.05$ and $\beta = 0.20$, $T/I \geq 1.2$) except that the expected transport SAR was 2% (rather than the 1% expected for yearling Chinook). Thus, the sample sizes needed for steelhead collected at McNary Dam were:

$$n = 473$$
$$N_T = 23{,}650$$
$$N_B = 28{,}380$$
$$N_I = 28{,}380$$
$$\text{Total juveniles collected} = 52{,}030$$
$$\text{Total juveniles} = 80{,}410$$

Where N_T was the number of steelhead juveniles needed for the transport cohort, N_B was the number needed for the full-flow bypass cohort (23,650 × 1.2), and N_I was the number needed for the inriver migrant cohort (23,650 × 1.2).

To determine the number of steelhead we needed to tag at the hatcheries, we calculated the probability of survival from release to McNary Dam and the probability of detection in the collection system at McNary Dam. We estimated these numbers using detections at McNary Dam from a previous study, where PIT-tagged hatchery steelhead smolts were released into the Wells Dam tailrace between 24 April and 16 May, 2000. These fish had passed McNary Dam primarily in May, when the percentage of water spilled was fairly constant, at 40% of the total river flow. Survival of these fish to McNary Dam was 0.578 (SE 0.016) and detection probability at the dam was 0.170 (SE 0.006). Using these values for a conservative estimate, we calculated that roughly 480,000 (52,030/0.578/0.170) PIT-tagged hatchery steelhead would need to be released from this area to satisfy the study design.

To track migrating study fish as they passed through the collection systems at dams, we used methods similar to those described by Marsh et al. (1996) for studies at Lower Granite Dam. Prior to the beginning of general transportation (between 23 June and 11 July, depending on the year), McNary Dam was in bypass mode, wherein all collected fish, whether tagged or not, were bypassed to the river after passing through PIT-tag detectors (except tagged fish from our Columbia River hatchery study). Thus, the only fish transported were our tagged fish plus any by-catch of non-targeted fish.

Adult Recoveries and Data Analysis

Adult returns of Chinook salmon were complete in 2007, and adults returns of steelhead in 2008. Numbers of fish in the inriver migrant groups were estimated using a modification of the procedures of Marsh et al. (1996). Because few steelhead return as age-3-ocean adults (<0.3% for any 1 year), smolt-to-adult return ratios (SARs) and ratios of SARs between treatments were based on age-1 and age-2-ocean adults only. Because age-3-ocean returns were complete for 2 of the 3 study years reported here, we included age-3-ocean information in specific areas of interest (e.g., when discussing kelts).

SARs were calculated for transport, facility bypass/full-flow bypass, and inriver migrant cohorts as the number of adults returning and passing McNary Dam divided by the number of juveniles migrating past McNary Dam each study year. Calculating SARs for the transport and bypass groups was straightforward, since it was based on actual detections of juveniles and adults at McNary Dam. However, determining the juvenile number used in SAR calculations for the inriver migrant groups was more complicated, since there were no juvenile detections of these fish. We estimated this number of non-netected (nd) fish as:

$$\hat{N}_{nd} = N \times \hat{S}(1 - \hat{p})$$

where N was the number of fish released at mid-Columbia River hatcheries, $\hat{S}$ was estimated survival from release to McNary Dam, and $\hat{p}$ was the estimated detection probability at McNary Dam. As noted at the end of Appendix E, S and p were estimated using the single-release Cormack-Jolly-Seber model (Cormack 1964; Jolly 1965, Seber 1965) using the statistical software SURPH (Skalski et al. 1993, Smith et al. 1994). Calculation of SARs for the inriver migrant group of both species was based on these numbers. Survival estimates from release to McNary Dam tailrace was done by hatchery or release location. All surviving fish were then grouped at McNary Dam to estimate survival from McNary Dam to Bonneville Dam.

Ratios of SARs were calculated for transport and bypass groups relative to the inriver migrant group. To test the null hypotheses, that there was no difference in SARs between transport and inriver migrant fish or between bypassed and inriver migrant fish, we calculated 95% confidence intervals for these ratios. If the value 1.0 was outside the CI, the two passage routes were considered to have significantly different SARs.

To construct confidence intervals, the estimates were natural-log transformed, and intervals were calculated on the transformed scales as ±1.96 SEs (1.96 = the *z*-value for $\alpha = 0.05$). Endpoints of the CIs were then back-transformed, since we assumed a log-normal distribution of the ratios. Derivation of the standard errors is shown in Appendix E.

Combining estimates of survival with SARs for the transport and bypass groups, we were able to estimate annual and temporal values for differential delayed mortality, *D*. Differential delayed mortality is a measure of how mortality differs for the transport group vs. the inriver migrant or bypass group once fish arrive below Bonneville Dam. *D* is calculated by multiplying the ratio of SARs (T/I, transport-to-inriver or T/B transport-to-bypass) by the survival rate from McNary Dam to Bonneville Dam. Because there were no juvenile detections of fish in the inriver migrant groups we could not determine when specific fish passed McNary Dam through either spill or the turbines. Therefore, we could not estimate an overall annual *D* value for the transport-to-inriver comparison. For the transport and bypass groups, we had detection dates at McNary Dam, so we were able to estimate survival and SARs based on juvenile migration timing. This allowed us to examine patterns of survival and SARs related to juvenile timing, as well as to extract an annual value for *D*.

RESULTS

Juvenile Tagging and Release

Yearling Chinook

Chinook salmon were PIT-tagged at Winthrop, Entiat, and Leavenworth hatcheries in all 3 years, with tagging at Methow Hatchery occurring in 2003 and 2004. All fish were released directly from the hatchery at which they were tagged (Table 1 and Appendix Table A1). The number of fish tagged at Winthrop, Entiat, and Methow hatcheries was similar for all 3 years, while the number of fish tagged at Leavenworth Hatchery varied from 216,698 to 267,533.

Table 1. PIT tag release numbers by hatchery of origin for yearling spring Chinook salmon released from Columbia River hatcheries to evaluate transport from McNary Dam in 2002-2004. All fish were released directly from the hatchery at which they were tagged.

Release location	Study year	Total released
Winthrop Hatchery	2002	19,970
	2003	19,962
	2004	19,887
Entiat Hatchery	2002	59,401
	2003	59,251
	2004	58,625
Leavenworth Hatchery	2002	267,533
	2003	237,491
	2004	216,698
Methow Hatchery	2002	*
	2003	34,923
	2004	34,844

* No study fish were tagged at Methow Hatchery in 2002.

Steelhead

Steelhead were PIT tagged at Wells, Winthrop, Chelan, Eastbank, and Ringold hatcheries. With the exception of 80,418 steelhead tagged at Wells Hatchery in 2003, tagged steelhead were not released directly from Wells, Chelan, and Eastbank hatcheries, but were outplanted to various drainages (Methow, Okanogan, and Wenatchee Rivers) throughout the mid-Columbia River (Table 2 and Appendix Table C1). Steelhead tagged at Winthrop Hatchery were released directly from the hatchery into the Methow River, while fish tagged at Ringold Hatchery were released directly from the hatchery into the Columbia River.

Table 2. PIT tag release numbers by hatchery of origin and outplant location for steelhead released from Columbia River hatcheries to evaluate transport from McNary Dam in 2003-2005.

		Hatchery					
Release location	Study year	Wells[a]	Winthrop	Chelan	Eastback	Ringold	Totals
Methow Drainage	2003	121,016	49,241				170,257
	2004	197,121	49,476				246,597
	2005	193,865	49,233				243,098
Okanogan Drainage	2003	44,622					44,622
	2004	41,576					41,576
	2005	45,648					45,648
Wenatchee Drainage	2003			33,147	61,981		95,128
	2004			29,916	63,397		93,313
	2005			34,807	59,791		94,598
Ringold Hatchery	2003					95,161	95,161
	2004					96,494	96,494
	2005[b]					60,971	60,971

[a] In 2003, 80,418 steelhead were not detected during outplanting and were, therefore, reported as being released from Wells Hatchery.

[b] The number of fish tagged was 94,875. However, an undetermined number of fish escaped the holding raceway through a hole in the tail screen prior to the scheduled release. To determine which fish were still in the pond, a set of PIT tag detectors was installed along the release line and only those fish detected leaving the pond at the scheduled time (60,971) were included in the study.

Migration History

As migrating juvenile Chinook salmon passed McNary Dam, 21, 20, and 16% were detected during 2002, 2003, and 2004, respectively. Passage routes for all detected fish are shown in Table 3 (and Appendix Table A2). Because yearling Chinook were released directly from the respective hatcheries at which they were tagged we tracked juvenile migration routes for these fish by hatchery. Based upon PIT-tag detections at John Day and Bonneville Dam, and in the estuary pair-trawl system, we estimated overall survival for fish from each hatchery (Table 3 and Appendix Table A3).

As migrating juvenile steelhead passed McNary Dam, 7.5, 6.3, and 10.7% were detected during 2003, 2004, and 2005, respectively. Passage routes for all detected steelhead are shown in Table 4 and Appendix Table C2. Because some steelhead were outplanted to one or more river drainages, we compute survival estimates based on point of release (river drainage or hatchery) rather than by the hatchery at which the fish were tagged. Based upon PIT-tag detections at John Day and Bonneville Dams, and on estuary detections in the pair-trawl system, we calculated estimates of survival for releases to the Methow, Okanogan, and Wenatchee River drainages, as well as for the on-site release from Ringold Hatchery (Table 4 and Appendix Tables C3).

As noted above, migration history data was analyzed to estimate numbers of fish in the inriver migrant group and to determine the actual number of fish in the bypass and transport groups for both juvenile spring Chinook salmon and steelhead (Table 5 and Appendix Tables A4 and C4). Calculation of SARs for the three groups of both species was based on these numbers.

At McNary Dam, our initial goal during study years 2003 to 2005 was to divert 100% of the study fish collected and passed over the separator (i.e., not returned to the river via full-flow bypass) to transport raceways (Figure 1). However, because of large numbers of fish simultaneously passing the separation-by-code diversion gates, the actual percentage of fish detected crossing the separator that were transported ranged from 85.7 to 91.3% for spring Chinook salmon and from 76.6 to 87.2% for steelhead. In 2002, our goal was to transport 80% of the collected fish; however, only 72.3% were actually transported. In 2005, steelhead tagged at Winthrop Hatchery were inadvertently left out of the separation-by-code list, and this omission resulted in very few Winthrop Hatchery steelhead being transported that year.

Table 3. Final dispositions and survival estimates for hatchery spring Chinook salmon released from Columbia River hatcheries and collected at McNary Dam to evaluate transportation, 2002-2004. Survival was estimated from release to McNary Dam tailrace, McNary to Bonneville tailrace, and release to Bonneville Dam tailrace.

		Passage route						Reach survival (%)		
Release location	Study year	Transport	Full-flow bypass	Facility bypass	Adult bypass	Unknown*	Totals	Release to McNary Dam	McNary Dam to Bonneville Dam	Release to Bonneville Dam
Winthrop Hatchery	2002	2,499	119	888	--	8	3,514	50.22	81.18	40.77
	2003	1,879	2,167	46	0	0	4,092	55.13	70.10	38.65
	2004	1,267	1,162	114	22	3	2,568	49.38	77.09	38.07
Entiat Hatchery	2002	8,704	381	3,364	--	41	12,490	53.53	81.18	43.46
	2003	6,181	6,881	188	1	0	13,251	66.23	70.10	46.43
	2004	6,133	6,586	1,187	4,33	6	14,345	57.13	77.09	44.04
Leavenworth Hatchery	2002	37,172	1,935	17,538	--	131	56,776	56.79	81.18	46.10
	2003	21,316	25,873	2,392	130	0	49,711	64.60	70.10	45.28
	2004	15,298	15,067	1,743	339	34	32,481	48.49	77.09	37.38
Methow Hatchery	2002	--	--	--	--	--	--	--	--	--
	2003	1,953	2,410	313	24	0	4,700	51.60	70.10	36.17
	2004	1,586	1,729	136	36	1	3,488	49.04	77.09	37.80

* Fish with an "Unknown" disposition were not detected on a monitor that would indicate whether they entered a raceway or returned to the river. All detections were at entrance (A/B-Separator Gate) or intermediate (A/B-Raceway Diversion) monitors (Figure 1).

Table 4. Final dispositions and survival estimates for hatchery steelhead released from Columbia River hatcheries and collected at McNary Dam to evaluate transportation, 2003-2005. Survival was estimated from release to McNary Dam tailrace, McNary to Bonneville tailrace, and release to Bonneville Dam tailrace.

		Disposition						Reach survival (%)		
Release location	Study year	Transport	Full-flow bypass	Facility bypass	Adult bypass	Unknown*	Totals	Release to McNary Dam	McNary Dam to Bonneville Dam	Release to Bonneville Dam
Methow Drainage	2003	5,262	6,553	475	263	11	12,564	40.61	77.09	31.31
	2004	5,416	6,052	900	358	12	12,738	36.17	38.96	14.09
	2005	7,132	9,628	1,726	405	10	18,901	34.72	64.28	22.32
Okanogan Drainage	2003	1,575	2,044	263	122	5	4,009	46.18	77.09	35.60
	2004	1,105	1,341	174	81	5	2,706	47.26	38.96	18.41
	2005	1,998	2,436	182	151	3	4,770	41.94	64.28	26.96
Wenatchee Drainage	2003	3,263	3,775	235	241	3	7,517	48.15	77.09	37.12
	2004	2,092	2,635	256	167	6	5,156	34.32	38.96	13.37
	2005	3,963	4,745	424	332	10	9,474	48.28	64.28	31.03
Ringold Hatchery	2003	2,967	3,747	267	8	14	7,003	66.50	77.09	51.26
	2004	3,879	4,820	820	183	5	9,707	44.85	38.96	17.47
	2005	4,640	7,670	1,929	236	11	14,486	69.52	64.28	44.69

* Fish with an "Unknown" disposition were not detected on a monitor that would indicate whether they entered a raceway or returned to the river. All detections were at entrance (A/B-Separator Gate) or intermediate (A/B-Raceway Diversion) monitors (Figure 1).

Table 5. Estimated numbers of hatchery spring Chinook salmon arriving at McNary Dam tailrace from 2002 to 2004 and hatchery steelhead arriving from 2003 to 2005 for McNary Dam transport evaluations.

Release location	Study year	Number released	Estimated survival to McNary Dam	Estimated numbers arriving at McNary Dam[a]	Transport	Facility/ Full-flow bypass[b]	Inriver migrants[a]
			Yearling Chinook Salmon				
Winthrop Hatchery	2002	19,970	50.22	10,029	2,499	888	6,634
	2003	19,962	55.13	11,005	1,879	2,216	6,910
	2004	19,887	49.38	9,820	1,267	1,162	7,263
Entiat Hatchery	2002	59,401	53.53	31,797	8,704	3,364	19,692
	2003	59,251	66.23	29,241	6,181	7,094	25,959
	2004	58,625	57.13	33,492	6,162	6,586	19,195
Leavenworth Hatchery	2002	267,533	56.79	151,932	37,172	17,538	97,100
	2003	237,491	64.60	153,425	21,316	28,395	103,711
	2004	216,698	48.49	105,077	15,372	15,067	72,682
Methow Hatchery	2002	--	--	--	--	--	--
	2003	34,923	51.60	18,020	1,953	2,748	13,319
	2004	34,844	49.04	17,087	1,586	1,729	13,614
			Hatchery steelhead				
Methow Drainage	2003	170,257	40.61	69,141	5,262	6,553	57,037
	2004	246,597	36.17	89,194	5,416	6,052	76,484
	2005	243,098	34.72	84,404	7,132	9,628	65,548
Okanogan Drainage	2003	44,622	46.18	20,606	1,575	2,044	16,652
	2004	41,576	47.26	19,649	1,105	1,341	16,949
	2005	45,648	41.94	19,145	1,998	2,436	14,385
Wenatchee Drainage	2003	95,128	48.15	45,804	3,263	3,775	38,303
	2004	93,313	34.32	32,025	2,092	2,635	26,879
	2005	94,598	48.28	45,672	3,963	4,745	36,232
Ringold Hatchery	2003	95,161	66.5	63,282	2,967	3,747	56,277
	2004	96,494	44.85	43,278	3,879	4,820	33,579
	2005	60,971	69.52	42,387	4,640	7,670	27,056

[a] Numbers are estimates of the proportion released that arrived at McNary Dam and of those that passed the dam without being detected. Estimates vary due to differences in estimated survival and arrival timing at McNary Dam for the various release sites.

[b] The full-flow bypass pipe was not available during 2002, so bypass groups in 2002 were formed from fish returned to the river through the facility bypass pipes.

Adult Recoveries and Data Analysis

For yearling Chinook salmon, we began adult recoveries at McNary Dam starting in 2003 with jacks from the 2002 study year and finished in 2007 with age-3-ocean adults from the 2004 study year. For hatchery steelhead, we began adult recoveries in 2004 with age-1-ocean adults from the 2003 study year and finished in May 2008 with age-2-ocean adults from the 2005 study year. Returns by study year and study group are shown for both species in Table 6 (and Appendix Tables A5 and C5).

Table 6. Returns by study year and treatment group of hatchery spring Chinook salmon from 2002 to 2004 and hatchery steelhead from 2003 to 2005. Fish were collected at McNary Dam and originated from Columbia River hatcheries.

	SARs			SAR ratios (95% CI)					
Study year	Transport	Full-flow bypass	Inriver migrants	Transport/Inriver		Full-flow/Inriver		Transport/Full flow	
				Yearling Chinook salmon					
2002*	0.33	0.36	0.35	0.95	(0.79-1.14)	1.02	(0.79-1.30)	0.94	(0.71-1.23)
2003	0.32	0.27	0.43	0.74	(0.60-0.92)	0.62	(0.50-0.76)	1.20	(0.91-1.60)
2004	0.30	0.19	0.36	0.82	(0.63-1.06)	0.52	(0.38-0.71)	1.58	(1.11-2.24)
				Steelhead					
2003	2.34	1.94	2.45	0.96	(0.78-1.13)	0.79	(0.82-1.33)	1.21	(1.04-1.40)
2004	2.00	1.51	1.56	1.28	(1.12-1.46)	0.96	(0.84-1.11)	1.32	(1.10-1.59)
2005	2.14	1.98	1.95	1.09	(0.98-1.22)	1.01	(0.92-1.12)	1.08	(0.94-1.24)

* The full-flow bypass pipe was not available during 2002, so bypass groups in 2002 were formed from fish returned to the river through the facility bypass pipes.

Relationship between Juvenile Migration Timing and SARs

Yearling Chinook. For this study, the inriver migrant group included only tagged fish that had not been detected at McNary Dam after release from a hatchery upstream from the dam. Therefore, for inriver migrant adults, we had no data on juvenile passage timing with which to ascertain potential relationships between juvenile timing and SARs. We were able to evaluate SARs by juvenile migration timing for transported and bypassed fish.

While the overall pattern of SARs in relation to juvenile timing was different among all 3 years for transported vs. bypassed spring Chinook salmon, there were some similarities (Table 7; Figure 2). Within each of the 3 juvenile migration years, both transported and bypassed fish had the same number of SARs peaks in relation to timing, although the peaks were out of phase with one another. Bypass SARs were usually falling or in a trough when the transport SARs were peaking. For fish released in 2003 and 2004, transport SARs were relatively high for early juvenile migrants, fell dramatically and swiftly, then rebounded with one or more peaks over the rest of the juvenile migration season. Fish released in 2002 and 2004 had multiple peaks and troughs in SARs in relation to juvenile timing, while those released in 2003 had one main rise and fall, which was spread over most of the juvenile migration season (Figure 2).

Steelhead. The transport and full-flow bypass hatchery steelhead groups had similar temporal SAR patterns in the 2003 and 2004 study years (Table 8; Figure 3). These were characterized by the highest SARs (4.0-6.5%) occurring at the beginning of the outmigration (late April in 2003 and mid-April in 2004). Following a decline over the next two weeks, a second, smaller peak was observed, followed by a gradual decline to zero by the end of May or early June. In both years, the second peak occurred just prior to the peak in steelhead passage at McNary Dam.

The 2005 steelhead full-flow bypass SAR pattern also showed two peaks, while the transport SAR had only one peak (Table 8; Figure 3). The first full-flow bypass peak occurred in mid-April as the transport SARs were still rising. The second full-flow bypass peak occurred during the first week of May, two days earlier than the transport peak. Neither of the bypass peaks reached the level of the transport peak, and the bypass SAR dropped below 1.0% a week before the transport SAR. Both transport and bypass SARs reached zero the first week of June. As in both 2003 and 2004, the peaks in SARs for both groups occurred prior to the peak in steelhead passage at McNary Dam.

Table 7. Estimates of transport and full-flow bypass SARs, survival (McNary Dam tailrace to Bonneville Dam tailrace), and differential delayed mortality (*D*) over time for tagged spring Chinook salmon smolts transported or bypassed from McNary Dam in 2002-2004. Grouping is based on having adequate numbers of smolts to estimate survival of bypassed fish between McNary and Bonneville Dams.

	Spring Chinook adult return metrics in relation to weekly releases during the juvenile migration season									
	13-19 April	20-26 April	27 April to 3 May	4-10 May	11-17 May	18-24 May	25-31 May	1-7 June	8-14 June	15-21 June
2002										
Transport SAR	0.00	0.17	0.28	0.40	0.32	0.33	0.34	0.00	--	--
Facility bypass SAR	0.00	0.29	0.42	0.42	0.43	0.38	0.46	0.37	--	--
Survival	0.812*	0.812*	0.812*	0.645	0.764	0.903	1.018	0.327	--	--
Delayed mortality (*D*)	--	0.49	0.54	0.61	0.58	0.78	0.76	--	--	--
Collection**	23,968	24,732	159,415	213,147	279,785	151,741	132,839	23,012	14,573	5,026
2003										
Transport SAR	--	1.16	0.38	0.09	0.17	0.46	0.65	0.14	0.43	--
Full-flow bypass SAR	--	0.37	0.19	0.13	0.26	0.36	0.37	0.06	0.41	--
Survival	--	0.242	0.785	1.016	0.813	0.728	0.831	0.492	0.701*	--
Delayed mortality (*D*)	--	0.75	1.60	0.70	0.54	0.92	1.44	1.05	0.73	--
Collection**	14,381	44,375	167,523	88,258	165,416	64,505	51,672	24,699	21,308	4,443
2004										
Transport SAR	--	0.53	0.40	0.21	0.22	0.28	0.48	0.18	--	--
Full-flow bypass SAR	--	0.33	0.15	0.16	0.13	0.31	0.20	0.15	--	--
Survival	--	1.217	0.669	0.582	0.577	0.480	0.949	0.750	--	--
Delayed mortality (*D*)	--	1.97	1.83	0.75	0.95	0.44	2.25	0.94	--	--
Collection**	6,617	12,665	52,342	138,427	276,571	104,119	69,157	19,467	8,653	6,819

* This value is the yearly average as no weekly estimate could be made due to too few detections below Bonneville Dam.

** Collection numbers are totals from 3 or 4 days of collection as counts were made every other day.

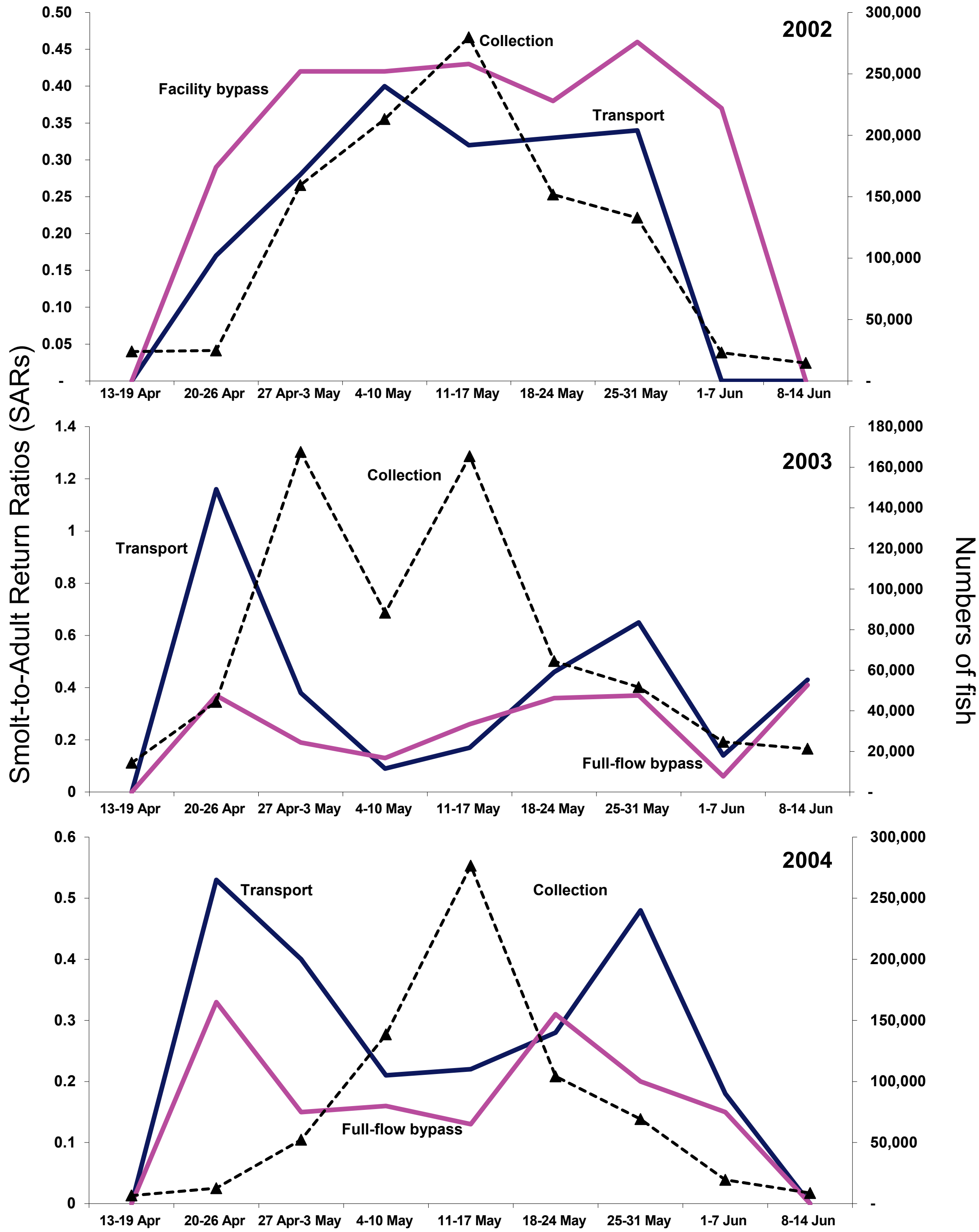

Figure 2. Spring Chinook salmon smolt-to-adult return rates by week of detection for fish bypassed or transported from McNary Dam in 2002, 2003, and 2004. Also shown is the weekly collection of juvenile Chinook at McNary Dam. Note that for bypass fish, passage in 2002 was via the juvenile facility bypass, passage in 2003 and 2004 was via full-flow bypass flume.

Table 8. Estimates of transport and full-flow bypass SARs, survival (McNary Dam tailrace to Bonneville Dam tailrace), and differential delayed mortality (*D*) over the juvenile release period for tagged steelhead smolts transported or bypassed from McNary Dam in 2003-2005. Grouping is based on having adequate numbers of smolts to estimate survival of bypassed fish between McNary and Bonneville Dams.

	Steelhead adult return metrics in relation to weekly releases during the juvenile migration season									
	13-19 April	20-26 April	27 April to 3 May	4-10 May	11-17 May	18-24 May	25-31 May	1-7 June	8-14 June	15-21 June
2003										
Transport SAR	--	2.77	5.96	3.28	2.29	3.40	2.65	0.87	0.00	0.00
Full-flow bypass SAR	--	3.48	3.43	2.40	2.67	2.55	1.80	0.16	0.00	0.00
Survival	0.232	1.181	0.884	0.629	0.358	0.855	1.006	0.846	0.408	0.408
Delayed mortality (*D*)	--	0.94	1.54	0.86	0.31	1.14	1.48	4.55	--	--
Collection**	4,776	5,728	8,660	12,607	18,513	14,210	64,350	18,416	2,114	600
2004										
Transport SAR	5.26	3.71	1.74	2.26	1.70	1.14	0.22	0.00	--	--
Full-flow bypass SAR	3.77	3.41	2.46	1.21	0.81	0.59	0.00	0.00	--	--
Survival	0.750	0.374	0.390*	0.390*	0.390*	0.253	0.299	0.272	--	--
Delayed mortality (*D*)	1.05	0.41	0.27	0.73	0.81	0.49	--	--	--	--
Collection**	2,524	9,494	9,741	11,040	23,384	6,055	5,448	3,700	2,311	301
2005										
Transport SAR	1.04	2.62	4.83	5.48	2.73	1.28	0.41	0.19	--	--
Full-flow bypass SAR	3.24	4.23	2.67	3.00	2.34	0.45	0.16	0.00	--	--
Survival	0.404	0.418	0.643*	0.847	0.470	0.919	0.799	0.643*	--	--
Delayed mortality (*D*)	0.13	0.26	1.16	1.55	0.55	2.61	2.00	--	--	--
Collection**	7,640	5,262	5,778	9,874	38,526	26,918	12,992	1,610	402	400

* This value is the yearly average as no weekly estimate could be made due to too few detections below Bonneville Dam.

** Collection numbers are totals from 3 or 4 days of collection as counts were made every other day.

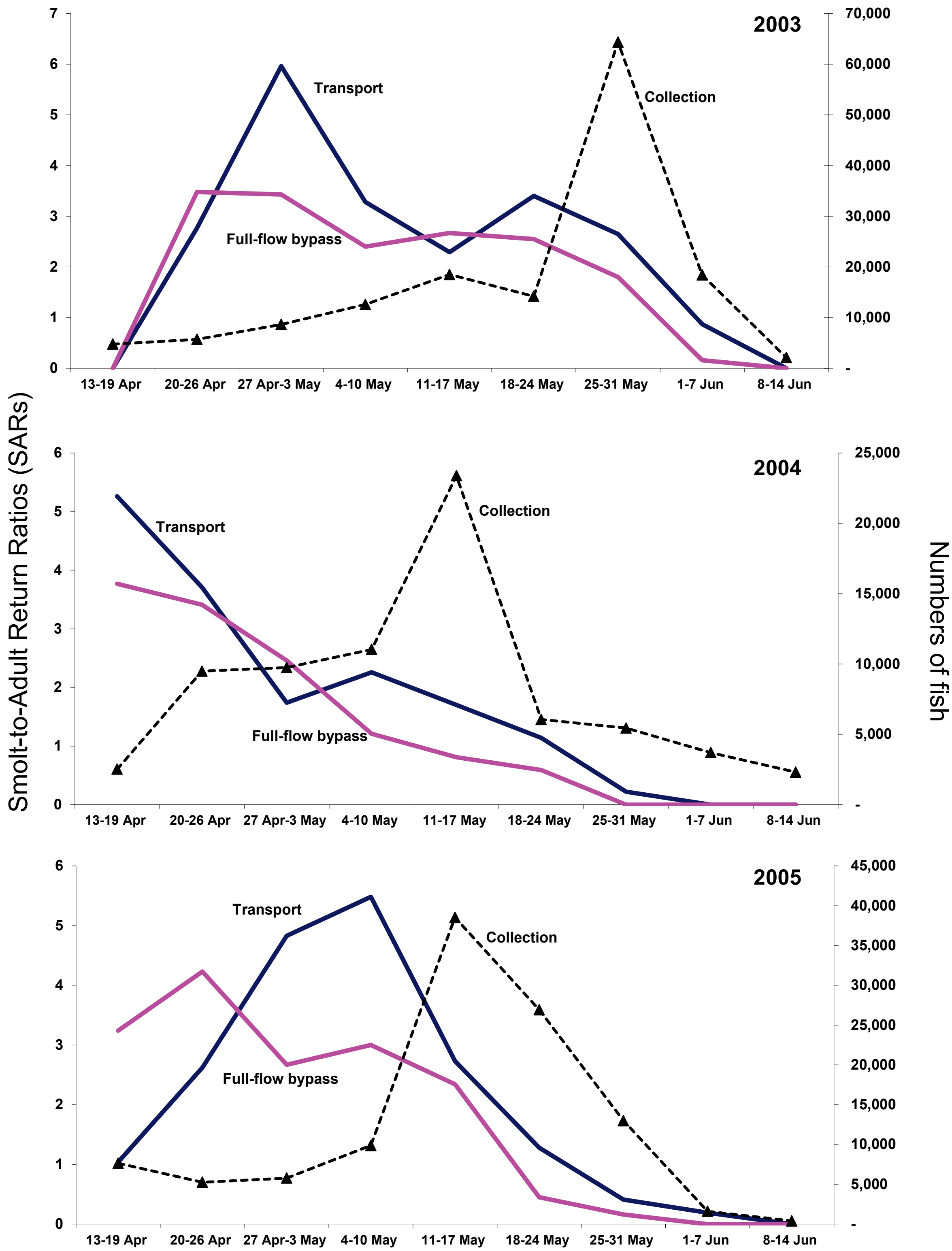

Figure 3. Smolt-to-adult return rates by week of juvenile detection for steelhead smolts transported from McNary Dam compared with SARs of smolts bypassed through the McNary Dam full-flow bypass flume in 2003, 2004, and 2005. Also shown is the weekly collection of juvenile fish at McNary Dam.

Delayed Mortality (*D*)

As explained in the methods section, because inriver migrant fish were not detected as juveniles, we had no data on their passage timing at dams and thus could not determine whether relationships existed between juvenile migration timing and SARs. For the same reason, we were unable to calculate temporal differential delayed mortality, *D* for fish in the inriver migrant group (i.e., we had no detections and therefore no basis for estimates of short-term survival and mortality). Therefore, we could make no comparisons of *D* between transported and inriver migrant fish. We were, however, able to compare *D* between transported and full-flow bypass fish.

For spring Chinook salmon, SAR patterns in relation to juvenile migration timing were not similar to patterns for *D*, except in 2004 (Table 11 and Figure 4). Neither peaks nor troughs aligned between SARs and *D*. For spring Chinook tagged in 2004 (Figure 4), SARs and *D* followed similar patterns in juvenile timing.

The pattern of seasonal variation of *D* for steelhead was similar to that of SARs for study years 2002 and 2003 (Table 12 and Figure 5), with peaks in transport SARs occurring at the same time as peaks in the values of *D*. The pattern of seasonal variation for *D* was similar to that of SARs for study year 2005 during the first half of the juvenile migration (Figure 5), but, while SARs declined after peaking the first week of May, the values of *D* reached their highest peak during the third week of May and remained high. The difference in *D* between the non-weighted and general population was due to differences between the tagging and passage distributions. To estimate the general population *D* value, we weighted the daily study results by the daily passage distribution.

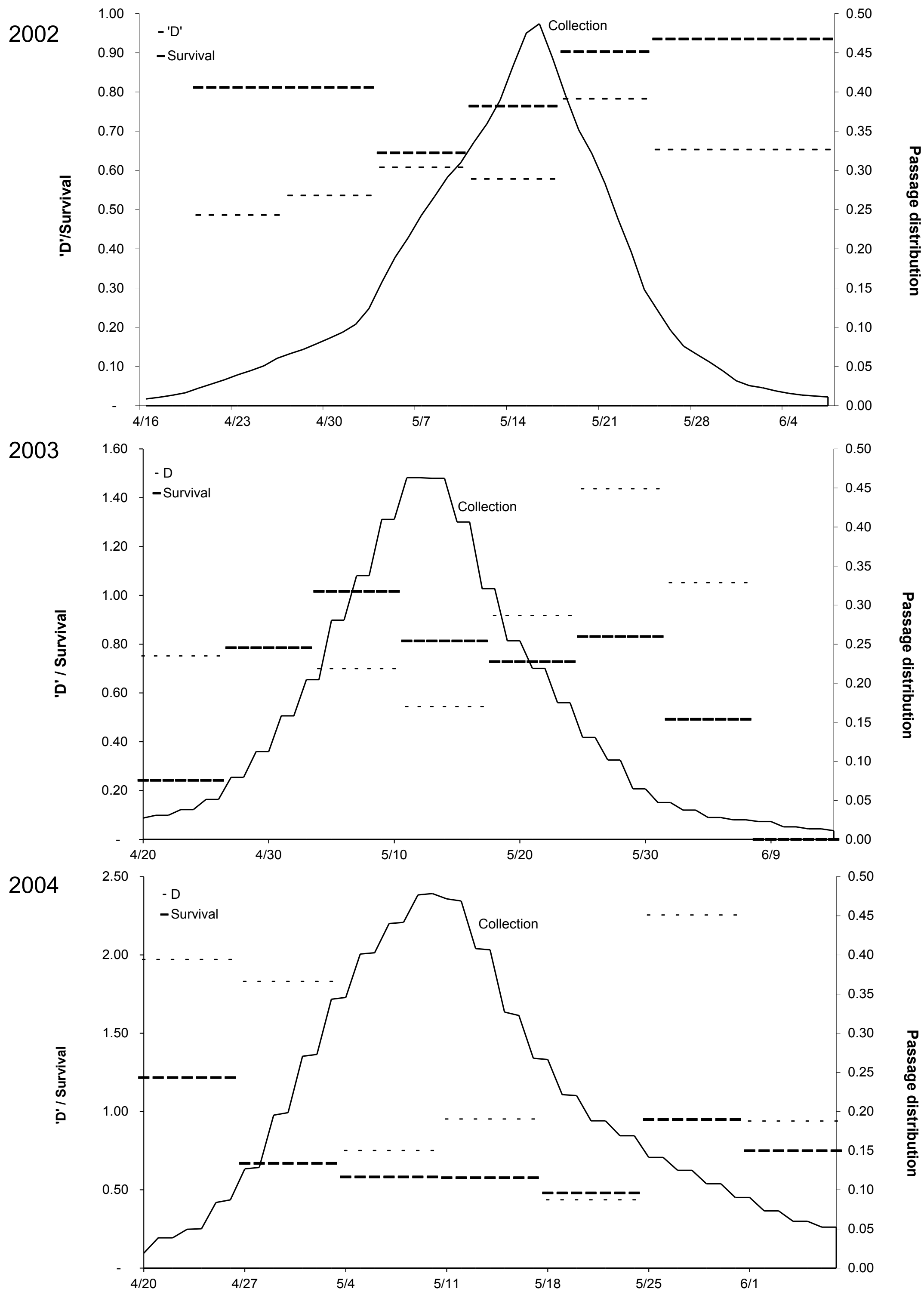

Figure 4. Estimates of differential delayed mortality (*D*) for spring Chinook salmon smolts transported or bypassed from McNary Dam. Grouping is based on having adequate numbers of smolts to estimate inriver survival of bypassed fish between McNary and Bonneville Dams. Overall *D* for tagged fish vs. the general population was 1.00 vs. 0.98 for 2002, 0.87 vs. 1.01 for 2003, and 1.18 vs. 1.29 for 2004.

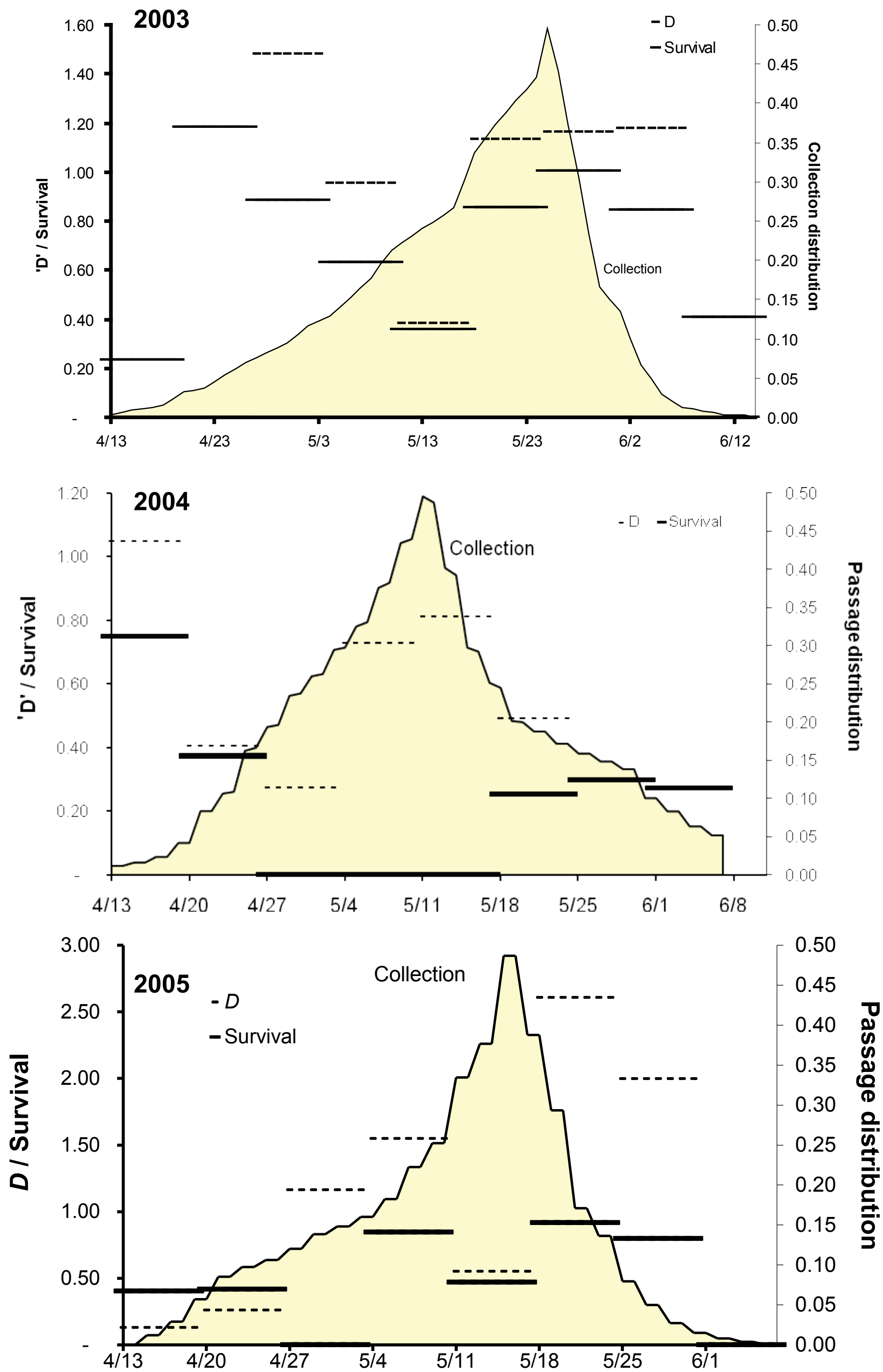

Figure 5. Estimates of differential delayed mortality *D* for steelhead smolts transported or bypassed from McNary Dam in 2003. Grouping is based on having adequate numbers of smolts to estimate inriver survival of bypassed fish between McNary and Bonneville Dams. Overall *D* of tagged fish vs. the general population was 0.97 vs. 1.21 in 2003, 0.56 vs. 0.51 in 2004, and 0.70 vs. 0.84 in 2005.

Conversion Rate

The numbers of returning spring Chinook salmon adults observed at Bonneville Dam and subsequently observed at McNary Dam (conversion rate) were similar for inriver migrant, transport, and bypass groups each year during all 3 years (Table 9; Figure 6; Appendix Table A6). Age at return seemed to have no impact on conversion rates within study years.

Conversion rates for returning steelhead adults were also similar for inriver migrant, transport, and full-flow bypass groups each year during all 3 years (Table 9; Figure 6 Appendix Table C6). Age-1-ocean adults from all groups and over all 3 years converted at a slightly higher rate than the age-2-ocean adults. Loss between the two dams was due to some combination of straying, harvest, and mortality, but there was no data available to determine if the percentages of these three sources of loss were different between the study groups.

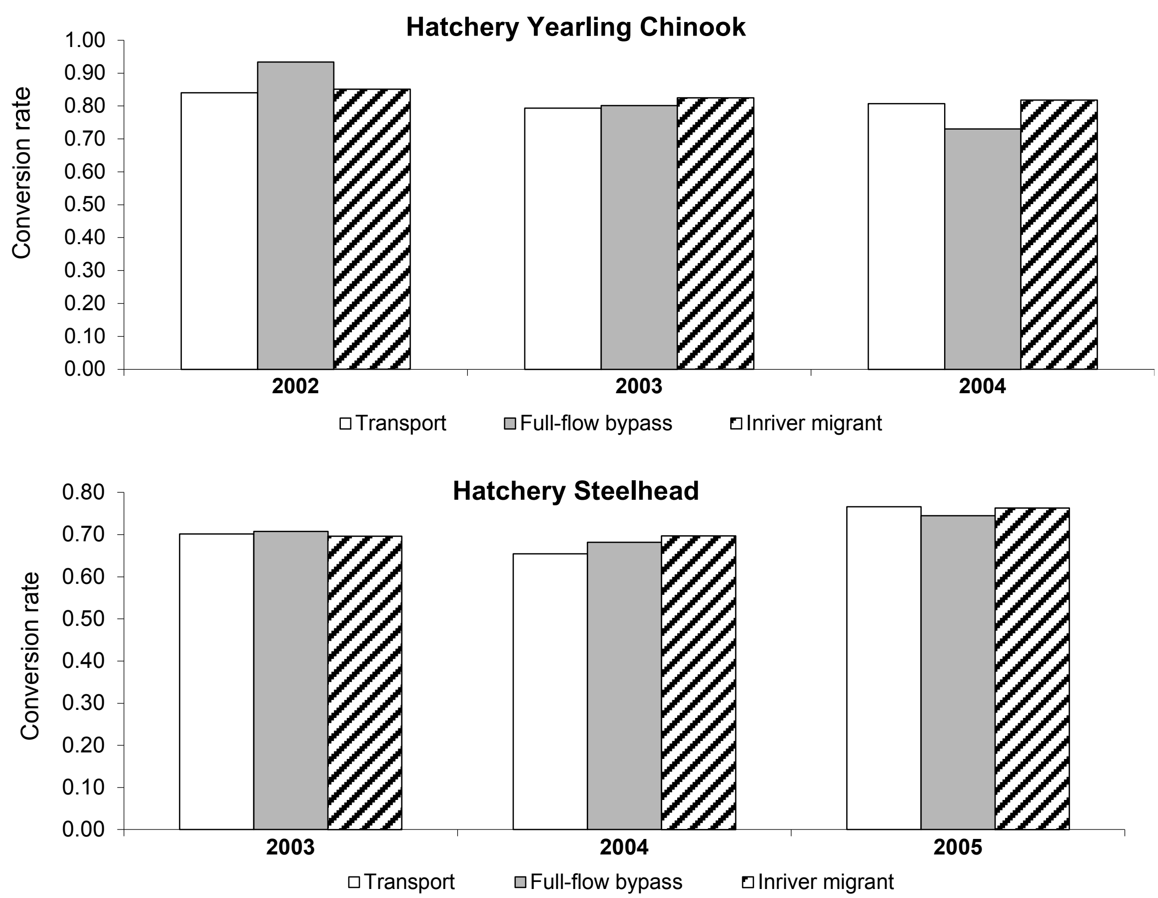

Figure 6. Conversion rates of mid-Columbia River hatchery Chinook (upper chart) and steelhead (lower) between Bonneville Dam and McNary Dam during evaluations of transportation from McNary Dam.

Table 9. Percentage of adult hatchery spring Chinook salmon and steelhead observed at Bonneville Dam and subsequently observed at McNary Dam (the conversion rate, not adjusted for fishery) from releases of Chinook salmon in 2002-2004 and steelhead in 2003-2005 for transportation studies at McNary Dam.

Study year	Age class	Observed at Bonneville Dam	Observed at McNary Dam	Conversion rate
		Hatchery yearling Chinook		
2002	Jack	24	23	95.8
	Age-2-ocean	692	588	85.0
	Age-3-ocean	31	29	93.6
	Totals	747	640	85.7
2003	Jack	96	90	93.8
	Age-2-ocean	770	623	80.9
	Age-3-ocean	124	97	78.2
	Totals	990	810	81.8
2004	Jack	60	59	98.3
	Age-2-ocean	522	409	78.4
	Age-3-ocean	72	60	83.3
	Totals	654	528	80.7
		Hatchery steelhead		
2003	Age-1-ocean	3,464	2,492	71.9
	Age-2-ocean	4,144	2,813	67.9
	Totals	7,608	5,305	69.7
2004	Age-1-ocean	1,978	1,423	71.9
	Age-2-ocean	2,298	1,532	66.7
	Totals	4,276	2,955	69.1
2005	Age-1-ocean	4,210	3,219	76.5
	Age-2-ocean	794	589	74.2
	Totals	5,004	3,808	76.1

Adult Travel and Arrival Time

For adult spring Chinook salmon, travel time from Bonneville to McNary Dam ranged from 3 to 41 d (Table 10; Appendix Table A7). There were no differences in median travel time between groups within or among years. For adult steelhead, travel time from Bonneville to McNary Dam ranged from 4 to 260 d (Table 10; Appendix Table C7). Comparisons between study groups based on age class were mixed, but overall, transported adults took 1-5 d longer to make the trip than did the other groups.

Unlike salmon, steelhead may overwinter during adult migration through the hydropower system, resuming migration the following spring. In the Snake River, we have noted that a significant portion of adults (up to 13%) can overwinter in the migration corridor and cross Lower Granite Dam the following spring. A majority of steelhead adults passing Lower Granite Dam in spring are from transport groups. Over the course of this 3-year study, only seven adults were detected for the first time during the spring.

Results from the 2002-2004 spring Chinook salmon studies (Table 11; Appendix Figures A1-A3) and 2003-2005 steelhead studies (Table 12; Appendix Figures C1-C3) showed differences in arrival timing of adults from the study groups at both Bonneville and McNary Dams. These differences varied between age classes and study years. Differences in arrival timing can affect both conversion rates and travel time because harvest rates and river conditions vary over the course of the adult return.

Table 10. Median travel times from Bonneville Dam to McNary Dam for adult hatchery spring Chinook salmon and steelhead PIT tagged for the 2002-2004 and 2003-2005 McNary Dam transport evaluations.

		Bonneville to McNary Dam		
			Travel time (d)	
Study year		Number of adults	Median	Range
		Hatchery yearling Chinook salmon		
2002	Transport	154	5.0	4-37
	Bypass	70	5.5	4-19
	Inriver migrant	418	6.0	4-20
2003	Transport	96	6.0	4-11
	Bypass	93	6.0	4-22
	Inriver migrant	610	6.0	4-41
2004	Transport	70	6.0	4-27
	Bypass	46	6.0	4-20
	Inriver migrant	396	6.0	4-22
		Hatchery steelhead		
2003	Transport	347	15.0	5.0-156.0
	Bypass	347	13.0	4.0-69.0
	Inriver migrant	4,577	13.0	4.0-230.0
2004	Transport	250	17.0	5.0-74.0
	Bypass	225	16.0	5.0-64.0
	Inriver migrant	2,421	12.0	4.0-116.0
2005	Transport	375	14.0	4.0-260.0
	Bypass	481	11.0	4.0-133.0
	Inriver migrant	2,851	11.0	4.0-228.0

Table 11. Adult passage date percentiles at Bonneville and McNary Dams for adult hatchery spring Chinook salmon PIT tagged for the 2002-2004 McNary Dam transport evaluation.

			Hatchery Yearling Chinook							
			Bonneville Dam passage date percentiles				McNary Dam passage date percentiles			
Study year			Adults (N)	10th	50th	90th	Adults (N)	10th	50th	90th
2002	Jack	Transport	9	5/1/03	5/13/03	5/19/03	10	5/7/03	5/16/03	5/22/03
		Bypass	3	5/3/03	5/11/03	8/7/03	3	5/10/03	5/16/03	5/17/03
		Inriver	23	4/28/03	5/11/03	5/23/03	22	5/4/03	5/17/03	5/27/03
	Age-2-ocean	Transport	170	4/15/04	4/22/04	5/5/04	148	4/20/04	4/27/04	5/11/04
		Bypass	69	4/13/04	4/22/04	5/3/04	66	4/19/04	4/27/04	5/9/04
		Inriver	440	4/15/04	4/22/04	5/4/04	384	4/21/04	4/28/04	5/9/04
	Age-3-ocean	Transport	2	4/16/05	4/19/05	4/22/05	2	4/27/05	4/28/05	4/29/05
		Bypass	4	4/11/05	4/22/05	5/1/05	3	4/21/05	5/1/05	5/7/05
		Inriver	25	4/20/05	4/28/05	5/5/05	26	4/26/05	5/4/05	5/17/05
2003	Jack	Transport	10	4/27/04	5/12/04	5/20/04	11	5/4/04	5/18/04	5/26/04
		Bypass	11	5/2/04	5/15/04	5/31/04	13	5/6/04	5/20/04	6/5/04
		Inriver	74	5/4/04	5/13/04	5/20/04	84	5/9/04	5/18/04	5/26/04
	Age-2-ocean	Transport	94	4/21/05	4/30/05	5/10/05	74	4/28/05	5/6/05	5/17/05
		Bypass	91	4/22/05	4/30/05	5/13/05	76	4/29/05	5/7/05	5/22/05
		Inriver	574	4/22/05	4/29/05	5/12/05	488	4/28/05	5/6/05	5/19/05
	Age-3-ocean	Transport	17	4/27/06	5/9/06	5/21/06	15	5/10/06	5/16/06	5/31/06
		Bypass	14	4/20/06	5/7/06	5/30/06	10	4/29/06	5/12/06	6/12/06
		Inriver	92	4/27/06	5/7/06	5/17/06	78	5/7/06	5/14/06	5/30/06
2004	Jack	Transport	2	5/5/05	5/10/05	5/15/05	2	5/10/05	5/15/05	5/21/05
		Bypass	5	5/3/05	5/14/05	5/23/05	5	5/8/05	5/21/05	5/28/05
		Inriver	53	5/5/05	5/15/05	5/28/05	57	5/10/05	5/21/05	6/2/05
	Age-2-ocean	Transport	74	4/29/06	5/8/06	5/19/06	61	5/9/06	5/15/06	5/28/06
		Bypass	56	4/28/06	5/7/06	5/15/06	40	5/10/06	5/14/06	5/21/06
		Inriver	378	4/30/06	5/8/06	5/15/06	302	5/9/06	5/14/06	5/21/06
	Age-3-ocean	Transport	12	4/14/07	4/23/07	5/27/07	10	4/23/07	5/1/07	6/22/07
		Bypass	2	4/27/07	5/7/07	5/17/07	1	5/25/07	5/25/07	5/25/07
		Inriver	58	4/14/07	4/24/07	5/6/07	51	4/21/07	5/1/07	5/13/07

Table 12. Adult passage date percentiles at Bonneville and McNary Dams for adult hatchery steelhead PIT tagged for the 2003-2005 McNary Dam transport evaluation.

		Hatchery steelhead							
		Bonneville Dam Passage Date Percentiles				McNary Dam Passage Date Percentiles			
		Adults (N)	10th	50th	90th	Adults (N)	10th	50th	90th
2003									
Age-1-ocean	Transport	213	7/20/04	8/10/04	9/6/04	167	8/4/04	9/8/04	9/26/04
	Bypass	192	7/18/04	8/11/04	9/7/04	147	8/10/04	9/7/04	9/18/04
	Inriver	3,041	7/21/04	8/10/04	9/5/04	2,322	8/8/04	9/6/04	9/16/04
Age-2-ocean	Transport	282	7/8/05	8/1/05	9/6/05	193	7/14/05	8/31/05	9/28/05
	Bypass	299	7/7/05	8/2/05	9/6/05	218	7/12/05	8/29/05	9/20/05
	Inriver	3,538	7/8/05	8/3/05	9/3/05	2,416	7/16/05	9/1/05	9/24/05
2004									
Age-1-ocean	Transport	178	7/20/05	8/9/05	9/8/05	115	7/27/05	9/10/05	10/3/05
	Bypass	176	7/23/05	8/9/05	9/5/05	127	8/1/05	9/5/05	9/26/05
	Inriver	1,594	7/22/05	8/6/05	9/3/05	1,150	7/30/05	9/1/05	9/20/05
Age-2-ocean	Transport	223	7/13/06	8/10/06	8/29/06	139	7/21/06	9/7/06	9/28/06
	Bypass	154	7/13/06	8/9/06	8/26/06	97	7/19/06	9/6/06	9/19/06
	Inriver	1,879	7/12/06	8/9/06	8/30/06	1,257	7/19/06	9/2/06	9/21/06
2005									
Age-1-ocean	Transport	418	7/28/06	8/15/06	9/4/06	327	8/14/06	9/8/06	10/1/06
	Bypass	557	7/28/06	8/16/06	9/4/06	425	8/11/06	9/5/06	9/23/06
	Inriver	3,126	7/26/06	8/13/06	9/2/06	2,420	8/10/06	9/3/06	9/19/06
Age-2-ocean	Transport	72	7/14/07	8/13/07	9/7/07	52	7/27/07	9/4/07	9/27/07
	Bypass	89	7/27/07	8/16/07	9/7/07	60	8/7/07	9/5/07	9/28/07
	Inriver	618	7/16/07	8/14/07	9/3/07	468	7/25/07	9/1/07	9/22/07

Iteroparity

Unlike most salmon, some steelhead are interoparous, that is, they may migrate to the ocean as adults (kelts) after spawning and return for second or third spawning runs. In gathering information on kelts, we included the few age-3-ocean adults that were detected from the 2003-2005 study years. Over the course of the 3-year study, a total of 47 adults were detected in the McNary Dam ladder during fall of one year and detected again either during the following spring or on returning 1-2 years later (Table 13). Of these 47 adults, 8 were not kelts, since they were detected re-ascending the ladder early in the spring after either descending the ladder during late fall or falling back during winter. The remaining 39 adults were most likely kelts.

Of the 39 kelts, 11 descended ladder and never returned, 15 returned a second time with 1 year between return migrations, and 13 returned a second time with 2 years between return migrations. Number of kelts from the 2003, 2004, and 2005 study years were 9, 12, and 26, respectively. While most kelts were from the inriver migrant group, the vast majority of returning adults were also from the inriver migrant group, so no relationship between kelts and juvenile passage history could be discerned.

Table 13. Kelt observations at McNary Dam for adult hatchery steelhead PIT tagged for the 2003-2005 McNary Dam transport evaluation. Adults re-ascending (i.e., after being detected ascending the ladder the previous fall) the ladder early in spring were not kelts. Adults detected descending the ladder in spring or returning with 1-2 years between spawning runs were considered kelts.

		Kelts		
Study year	Fall-back, re-ascension	Descended ladder, never returned	Descended, returned after 1 year	Descended, returned after 2 years
2003	0	0	7	2
2004	5	3	1	3
2005	3	8	7	8

Size at Tagging

Because both spring Chinook salmon and steelhead were tagged 1-8 months before release, no comparisons of adult return age and size at tagging could be made.

Multiyear Analysis of Study Results

To summarize the results from this 3-year study, we performed a bootstrap analysis (re-sampling the data with replacement) to provide an overall geomean SAR value for each year. We then compared bootstrapped SAR values between groups within each year. Overall, SARs for mid-Columbia River hatchery spring Chinook salmon were very low, with all values below 0.45%. In contrast, SARs for mid-Columbia River hatchery steelhead were higher, with all values above 1.50%. Final results for the 3 study years showed that hatchery spring Chinook that were not detected as juveniles returned at higher rates than those transported from McNary Dam. However, fish that were transported returned as adults at higher rates than those collected at McNary Dam and returned to the river via the full-flow bypass system (Table 14).

In contrast, hatchery steelhead transported from McNary Dam performed significantly better than non-detected fish (i.e., those that passed the dam via the spillway or turbines (Table 15). Also, transported steelhead performed better than those that were bypassed and returned to the river, either via the full-flow or the facility bypass system. However, non-detected hatchery steelhead performed better than steelhead that had been collected and returned to the river.

Table 14. Bootstrap analyses of ratios of mid-Columbia River hatchery spring Chinook salmon based on passage route at McNary Dam, 2002-2004. The four groups were transport (T), full-flow bypass (F), facility bypass (B), and inriver migrant passage via spillway or turbine (I). Shaded cells show significant differences.

	Hatchery spring Chinook salmon			
	Ratio of median SARs from bootstrap	SE	95% CI	Better passage route
Transport vs. full-flow bypass (T/F)				
2002	1.40	1.14	0.69-4.63	Transport
2003	1.20	0.17	0.90-1.58	
2004	1.57	0.31	1.09-2.27	
Geomean	1.39	0.27	1.04-2.14	
Transport vs. spillway/turbine (T/I)				
2002	0.95	0.09	0.78-1.13	Spillway/ turbine
2003	0.74	0.08	0.60-0.91	
2004	0.82	0.10	0.62-1.03	
Geomean	0.83	0.05	0.72-0.93	
Transport vs. facility bypass (T/B)				
2002	0.93	0.13	0.71-1.24	--
2003	0.80	0.36	0.47-1.87	
2004	1.06	0.57	0.56-2.71	
Geomean	0.95	0.19	0.68-1.39	
Full-flow bypass vs. spillway/turbine (F/I)				
2002	0.68	0.29	0.22-1.32	Spillway/ turbine
2003	0.62	0.07	0.50-0.75	
2004	0.52	0.08	0.37-0.68	
Geomean	0.60	0.10	0.39-0.78	
Full-flow bypass vs. facility bypass (F/B)				
2002	0.67	0.30	0.20-1.36	--
2003	0.68	0.30	0.39-1.55	
2004	0.68	0.37	0.36-1.72	
Geomean	0.68	0.17	0.41-1.08	
Facility bypass vs. spillway/turbine (B/I)				
2002	1.02	0.12	0.79-1.28	--
2003	0.91	0.28	0.41-1.50	
2004	0.76	0.27	0.32-1.36	
Geomean	0.87	0.15	0.60-1.17	

Table 15. Bootstrap analyses of ratios of mid-Columbia River hatchery steelhead based on how they passed McNary Dam, 2003-2005. The four groups were transport (T), full-flow bypass (F), facility bypass (B), and inriver migrant passage via spillway or turbine (I). Shaded cells show significant differences.

	Hatchery steelhead			
	Ratio of median SARs from bootstrap	SE	95% CI	Better passage route
Transport vs. full-flow bypass (T/F)				
2003	1.20	0.09	1.04-1.38	Transport
2004	1.33	0.12	1.11-1.57	
2005	1.08	0.07	0.95-1.24	
Geomean	1.20	0.06	1.10-1.31	
Transport vs. spillway/turbine (T/I)				
2003	0.96	0.05	0.86-1.06	Transport
2004	1.28	0.09	1.11-1.45	
2005	1.09	0.06	0.99-1.22	
Geomean	1.10	0.04	1.02-1.18	
Transport vs. facility bypass (T/B)				
2003	1.56	0.39	1.07-2.54	Transport
2004	1.31	0.25	0.92-1.92	
2005	1.29	0.17	1.03-1.66	
Geomean	1.39	0.15	1.15-1.72	
Full-flow bypass vs. spillway/turbine (F/I)				
2003	0.80	0.04	0.72-0.89	Spillway/ turbine
2004	0.96	0.07	0.84-1.09	
2005	1.01	0.05	0.91-1.12	
Geomean	0.92	0.03	0.86-0.98	
Full-flow bypass vs. Facility bypass (F/B)				
2003	1.30	0.32	0.90-2.11	--
2004	0.99	0.20	0.69-1.46	
2005	1.19	0.16	0.94-1.55	
Geomean	1.16	0.12	0.95-1.45	
Facility bypass vs. spillway/turbine (B/I)				
2003	0.62	0.13	0.39-0.87	Spillway/ turbine
2004	0.97	0.17	0.67-1.33	
2005	0.85	0.10	0.66-1.06	
Geomean	0.79	0.08	0.64-0.95	

DISCUSSION

Based on the bootstrap analyses, mid-Columbia River hatchery spring Chinook salmon performed better when they passed McNary Dam through the spillway/turbine route than when transported or returned to the river through the full-flow bypass pipe. However, if a hatchery spring Chinook salmon was collected at the dam, it was better off being transported than returned to the river through the full-flow bypass pipe. For mid-Columbia River hatchery steelhead, transported fish performed better than any other migration treatment group, while inriver migrants performed better than bypassed fish.

Results from this evaluation were similar to those from transport evaluations at Snake River dams, which have also shown greater transport benefit for steelhead than spring Chinook salmon. However, transport from Snake River dams has generally been more beneficial than transport from McNary for both hatchery Chinook salmon and steelhead (CSSOC 2007; Williams et al. 2005). One would expect more transport benefit from Snake River dams than from McNary Dam, since there are more dams and reservoirs to pass, and thus more potential passage mortality, for inriver fish from these dams (5-7 vs. 3 for McNary Dam). However, because the distance fish are transported from McNary Dam is also much less (236 km vs. up to 461 km for Snake River dams), travel and arrival timing in the estuary are more similar between transported and inriver migrant groups. This could result in more similar survival below Bonneville Dam (higher *D*) for fish transported from McNary Dam.

Transport studies using PIT-tag technology began in 1995 at Lower Granite Dam on the Snake River. An important finding from these studies was that arrival timing of juvenile fish in the estuary was a major factor in determining whether barge transport provided a benefit over inriver migration for both spring/summer Chinook salmon and steelhead (Muir et al. 2006; Williams et al. 2005). However, no consistent pattern in terms of specific timing has been found, with higher SARs shifting both within and among years between earlier and later juvenile transport timing. We found no consistent pattern of SARs and juvenile timing for either transported or bypassed hatchery spring Chinook salmon over the 3 years of study at McNary Dam.

For fish tagged in 2002, there were four peaks in SARs related to juvenile timing, with most SARs ranging between 0.20 and 0.60. For fish tagged in 2003, the pattern was more volatile, with big swings between high and low SARs. SARs peaked both for fish that migrated in mid-May, at the beginning of the 2003 juvenile migration season, and for those that migrated at the end of the season. For fish from 2004, SARs spiked for early season juveniles, dropped almost as abruptly, then rose and fall multiple times, ranging between 0.10 and 0.40 over the remainder of the season.

For Columbia River steelhead, transportation from McNary Dam produced similar SAR patterns for transported fish, but different patterns for bypassed fish. For both transport and bypass groups, steelhead tagged in 2003 exhibited a bimodal pattern of SARs. For transport fish, the first SAR peak was nearly twice as high as the second, while for bypass fish, the first peak was only slightly higher than the second. The SARs of bypassed and transported groups seemed slightly out of phase, with high points in transport SARs coinciding with decreases in bypass SARs, although differences were generally small. Transport SARs were lower than those of fish bypassed early in the juvenile migration, similar to results from the Snake River.

For steelhead transported as juveniles in 2004, SAR patterns were similar to those of steelhead transported in 2003, with the first peak nearly twice the value of the second peak. In contrast to 2003, the SAR pattern for fish bypassed in 2004 did not have a second peak; rather, there was a steady decrease after the first peak. In both transport and bypass groups from 2004, SARs reached zero for fish that migrated by the end of May. For Columbia River steelhead transported in 2005, the SAR pattern was different from those of the previous 2 years. Instead of two peaks corresponding with juvenile timing, as in fish from 2003 and 2004, there was one peak. This peak corresponded with fish transported during 4-10 May, roughly the same period corresponding with the second peak in 2004.

The study design used during both 2002-2004 for yearling Chinook and 2003-2005 for steelhead had a major disadvantage in that it produced no detection data with which to determine the relationship between juvenile migration timing and SARs for the inriver migrant group. We had hoped that SAR patterns in the full-flow bypass group might provide insight into possible SAR patterns in the inriver migrant group. However, for the 2003 and 2004 Chinook salmon study years and for the 2003 steelhead study year, the SAR of full-flow bypass fish was significantly lower than that of inriver migrants. Overall SARs for steelhead in full-flow bypass and inriver migrant groups were more similar in both the 2004 and 2005 study years. However, given the contrast in SARs between inriver and bypassed steelhead from 2003, it is uncertain whether these two groups share similar patterns. Therefore, any patterns observed in the SARs of bypassed fish may or may not indicate patterns in SARs for the inriver migrant group, even though the two groups experienced identical passage conditions below McNary Dam tailrace.

There are several possible reasons why bypassed fish may have a different SAR pattern than inriver migrants. These range from direct bypass system effects to the effect of bypass on normal fish behaviors, such as schooling. Possible direct bypass system effects could include physical or physiological impacts to the fish from the bypass route itself, including inadequate placement of the outfall pipe used to return the fish to the river. Furthermore, bypass systems, including the McNary Dam bypass system, have been shown to select for smaller fish, and this would also affect SARs (Zabel et al. 2005; Zabel and Williams 2002; Williams et al. 2005). Because smolts for this study were PIT tagged at the hatcheries months prior to release, we were unable to evaluate potential size-selectivity of the bypass system at McNary Dam.

Using SARs from the full-flow bypass group, we were able to estimate *D* values in relation to juvenile timing. A value of *D* less than one means that the ratio of transport and full-flow bypass SARs was lower than expected given the full-flow bypass group's survival to below Bonneville Dam and the assumption of 100% survival for transport fish. This can result if survival during the juvenile migration to Bonneville Dam is lower for transported than bypassed fish (negative transport benefit). However, it can also result if survival to Bonneville Dam is higher or equal for transported fish (positive or neutral transport effect), but subsequent survival (below Bonneville Dam) is higher for bypassed fish that survived to Bonneville Dam.

In other words, because *D* is estimated from adult returns to McNary Dam, it includes mortality incurred during both ocean residency and the 470-km adult migration. Thus differences in *D* represent differences in survival that manifested in either the juvenile or adult life stages, or both. Differences in juvenile survival could be due to differential predation rates or differential exposure to pathogens as well as to increased stress related to migration history. Returning adults have to be detected in the McNary Dam ladder to be counted as having survived, so differences in straying, harvest rates, and adult mortality between the two groups would also affect *D*.

For fish that cross the separator, there are two passage routes that return the general population of fish directly to the river. While evaluation of these passage routes was not an objective of this study, and thus fewer smolts utilized them, we believed it worthwhile to examine SAR data for possible trends related to these routes.

The first of these two routes is the adult return pipe, which leads from the end of the separator to the river (and terminates closer to the shoreline than the full-flow and facility bypass pipes). The purpose of this route is to return adults to the tailrace that have fallen back through the juvenile bypass system; however, juvenile fish have been observed leaving the separator through this route. During the 3 years of testing, approximately 2% of the study fish passed by this route. The 2003 SAR of steelhead smolts that returned to the river via this route was very low, at 0.13% (one adult from 766 juveniles), indicating a potential problem for juveniles returning to the river through this route. However, we did not see this problem with the 2004 data. The SAR of steelhead utilizing this passage route back to the river was 1.52%: virtually the same SAR as for fish passing via the full-flow bypass (1.51%). A difference was again noted in the 2005 data when steelhead passing via the full-flow bypass had a SAR of 1.98% while fish that bypassed the facility via the adult return pipe had a SAR of 0.98%. These differences were statistically significant in 2003 and 2005.

The second passage route back to the river for fish crossing the separator is through the flumes and out the return-to-river pipes (which terminate at the same location as the full-flow bypass pipe). The SAR of steelhead smolts utilizing this passage route was lower than that of smolts passing via the full-flow bypass in 2 of the 3 years (2003 and 2005), but in no year were these differences significant. Conversely, juvenile Chinook salmon passing through the full-flow bypass route had lower SARs than those going out the return-to-river pipe. Although not statistically significant, return rates of Chinook salmon juveniles passing through this route were, on average, only two-thirds as high as those passing through the facility bypass. Soon after the new facility was constructed, part of the full-flow bypass pipe was damaged and replaced. Originally, it was thought that problems might exist for small fish passing through this area; however, the COE ran a camera through this section in early 2009 and no problem areas were observed. While the location of the outfall (near turbine boils) has been discussed as a possible problem, given that both the facility and full-flow bypass pipes exit at the same location and that the facility bypass hatchery Chinook salmon consistently, but not significantly, outperformed the full-flow bypass fish, it would seem that something occurring in the full-flow bypass system must be detrimental to smaller fish (full-flow bypassed steelhead outperformed facility bypassed steelhead). It could be that a combination of the location and the large volume of water exiting the outfall may have produced prolonged disorientation for smaller fish exposing them to predation for a longer period of time.

Our studies were directed at determining potential benefits of transport of hatchery spring Chinook salmon and steelhead. During these studies, only study fish were transported, therefore, barge loading densities were much lower than would be expected under a general transportation scenario. Also, we did not collect any information during this research regarding the efficacy of transport from McNary Dam of wild Chinook salmon, wild steelhead, or sockeye salmon, or how operation of the bypass system in a transport mode affects lamprey juveniles. Further, as we evaluated only PIT-tagged fish for this study, barge densities of smolts were much lower than would occur if the non-marked population was also transported.

Finally, the configuration and operation of dams in the lower Columbia River have changed considerably since this study was conducted. This includes operational change, such as the 24-h spill used at both McNary and John Day Dams, as well as the installation of surface passage routes at both of these dams. While these changes may result in further survival improvements for inriver migrants, they will not eliminate the apparent problem with the bypass at this facility. We encourage further evaluation of the bypass at McNary Dam after improvements have been made.

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APPENDIX A

Hatchery Spring Chinook Salmon Tagging Data, 2002-2004

Appendix Table A1. Tag dates, releases dates, release numbers, and average tag lengths for spring Chinook salmon released from Columbia River hatcheries to evaluate transport from McNary Dam in 2002, 2003, and 2004.

Hatchery	Tagging dates	Release date	Release number	Average length (mm)
		2002		
Winthrop	24-27 January 2002	15 April 2002	19,970	114.7
Entiat	5-13 February 2002	8 April 2002	59,401	124.3
Leavenworth	26 Feb-29 March 2002	24 April 2002	267,533	118.7
Total released			346,904	
		2003		
Winthrop	7-8 Jan 2003	14 Apr 2003	19,962	116.8
Methow	4-7 Sep 2002	14 Apr 2003	34,923	96.1
Entiat	16-24 Oct 2002	10 Apr 2003	59,251	87.6
Leavenworth	17 Oct-5 Nov 2002	21 Apr 2003	237,491	117.4
Total released			351,627	
		2004		
Winthrop	6-8 Jan 2004	13 Apr 2004	19,887	116.1
Methow	7-8 Oct 2003	12-14 Apr 2004	34,844	101.3
Entiat	11-19 Nov 2003	14 Apr 2004	58,625	98.1
Leavenworth	15-30 Oct 2003	19 Apr 2004	216,698	122.1
Total released			330,054	

Appendix Table A2. Final dispositions at McNary Dam for spring Chinook salmon released from Columbia River hatcheries to evaluate transport from McNary Dam in 2002, 2003, and 2004.

Hatchery	Transported	Bypassed	Unknown	Not detected
2002				
Winthrop	2,499	888	8	16,575
Entiat	8,704	3,364	41	47,292
Leavenworth	37,172	17,538	131	212,692
Totals	48,375	21,790	180	276,559
2003				
Winthrop	1,879	2,216	0	15,867
Methow	1,953	2,748	0	30,222
Entiat	6,181	7,094	7	45,969
Leavenworth	21,316	28,395	3	187,777
Totals	31,329	40,453	10	279,835
2004				
Winthrop	1,269	1,162	139	17,317
Methow	1,584	1,729	173	31,358
Entiat	6,162	6,586	1,626	44,251
Leavenworth	15,372	15,067	2,116	184,143
Totals	24,387	24,544	4,054	277,069

Appendix Table A3. Downstream survival estimates from release to McNary Dam tailrace, from McNary to Bonneville Dam tailrace, and from release to Bonneville Dam tailrace for spring Chinook salmon tagged for transport evaluations at McNary Dam, 2002, 2003, and 2004.

		Estimated survival		
Release site	Number released	Release to McNary Dam	McNary to Bonneville Dam	Release to Bonneville Dam
2002				
Winthrop	19,970	0.5022	0.8118	0.4077
Entiat	59,401	0.5353	0.8118	0.4346
Leavenworth	267,533	0.5679	0.8118	0.4610
Totals	346,904	0.5579	0.8118	0.4529
2003				
Winthrop	19,962	0.551	0.701	0.386
Methow	34,923	0.516	0.701	0.362
Entiat	59,251	0.662	0.701	0.464
Leavenworth	237,491	0.646	0.701	0.453
Totals	351,627	0.630	0.701	0.442
2004				
Winthrop	19,887	0.4938	0.7463	0.3685
Methow	34,844	0.4904	0.7463	0.3660
Entiat	58,625	0.5713	0.7463	0.4264
Leavenworth	216,698	0.4849	0.7463	0.3619
Totals	330,054	0.5083	0.7463	0.3793

Appendix Table A4. Estimated numbers (based on survival to McNary Dam) of migrating hatchery spring Chinook salmon arriving at the McNary Dam tailrace in 2002, 2003, and 2004 for McNary Dam transport evaluations. Fish were returned to the river via the facility bypass in 2002 and the full-flow bypass in 2003 and 2004.

Hatchery	Number released	Estimated survival to McNary Dam	Estimated number arriving at McNary Dam*	Transported (n)	Collected and returned to the river (n)	Estimated number of migrating fish*
2002						
Winthrop	19,970	0.5022	10,029	2,499	888	6,634
Entiat	59,401	0.5353	31,797	8,704	3,364	19,692
Leavenworth	267,533	0.5679	151,932	37,172	17,538	97,100
Totals	346,904	0.5579	193,771	48,375	21,790	123,426
2003						
Winthrop	19,962	0.551	11,005	1,879	2,167	6,910
Methow	34,923	0.516	18,020	1,953	2,410	13,319
Entiat	59,251	0.662	29,241	6,181	6,881	25,959
Leavenworth	237,491	0.646	153,425	21,316	25,873	103,711
Totals	351,627	0.630	221,567	31,329	37,331	149,899
2004						
Winthrop	19,887	0.4938	9,820	1,267	1,162	7,263
Methow	34,844	0.4904	17,087	1,586	1,729	13,614
Entiat	58,625	0.5713	33,492	6,162	6,586	19,195
Leavenworth	216,698	0.4849	105,077	15,372	15,067	72,682
Totals	330,054	0.5083	167,766	24,387	24,544	112,753

* Number is an estimate of the proportion released that arrived at McNary Dam, not the sum of releases from each site. These estimates vary due to differences in survival rates and arrival timing at McNary Dam for the various release sites.

Appendix Table A5. Adult returns by study group and age-class of hatchery spring Chinook salmon from McNary Dam transport study releases in 2002, 2003, and 2004.

	Juvenile	Returns by Age-class					95%
	numbers	Jack	2-ocean	3-ocean	SAR	T/I	C.I.
2002							
Transported	48,375	10	148	2	0.33	0.94	(0.78, 1.13)
Bypassed	21,790	3	74	3	0.37	1.04	(0.82, 1.33)
Inriver	123,426	23	386	26	0.35		
2003							
Transported	31,329	11	74	15	0.32	0.74	(0.60-0.92)
Bypassed	37,331	13	76	10	0.27	0.62	(0.50-0.76)
Inriver	149,899	82	486	78	0.43		
2004							
Transported	24,387	2	60	10	0.30	0.82	(0.63-1.06)
Bypassed	24,544	5	40	1	0.19	0.52	(0.38-0.71)
Inriver	112,536	54	301	51	0.36		

Appendix Table A6. Percentage of adult hatchery spring Chinook salmon observed at Bonneville Dam that were subsequently observed at McNary Dam (the conversion rate, not adjusted for fishery) from releases of transportation study fish in 2002, 2003, and 2004.

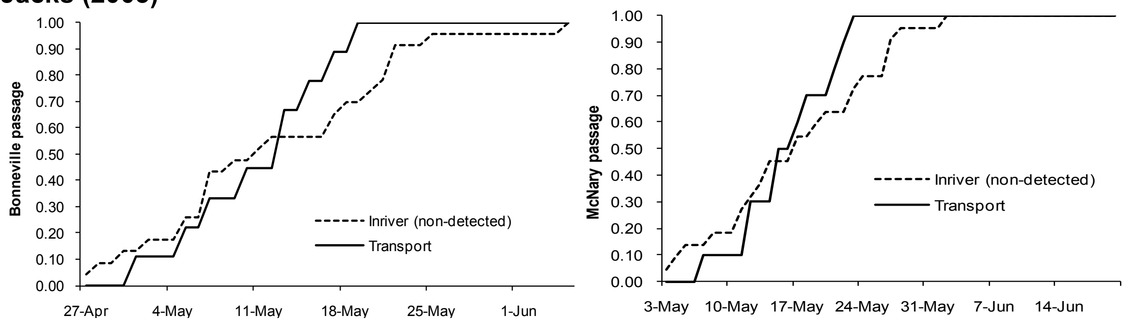
Age class	Migration history	Detected at Bonneville Dam (n)	Detected at McNary Dam (n)	Conversion rate (%)
2002				
Jacks	Transport	6	6	100.00
	Bypassed	2	2	100.00
	Inriver	16	15	93.75
Age-2-ocean	Transport	174	145	83.33
	Bypassed	69	65	94.20
	Inriver	449	378	84.19
Age-3-ocean	Transport	2	2	100.00
	Bypassed	4	3	75.00
	Inriver	25	24	96.00
Totals	Transport	182	153	84.07
	Bypassed	75	70	93.33
	Inriver	490	417	85.10
2003				
Jacks	Transport	10	10	100.0
	Bypassed	11	11	100.0
	Inriver	74	68	91.9
Age-2-ocean	Transport	94	72	76.6
	Bypassed	91	72	79.1
	Inriver	574	470	81.9
Age-3-ocean	Transport	17	14	82.4
	Bypassed	14	10	71.4
	Inriver	92	72	78.3
Totals	Transport	121	96	79.3
	Bypassed	116	93	80.2
	Inriver	740	610	82.4
2004				
Jacks	Transport	2	2	100.0
	Bypassed	5	5	100.0
	Inriver	53	52	98.1
Age-2-ocean	Transport	74	59	79.7
	Bypassed	56	40	71.4
	Inriver	378	299	79.1
Age-3-ocean	Transport	12	10	83.3
	Bypassed	2	1	50.0
	Inriver	58	49	84.5
Totals	Transport	88	71	80.7
	Bypassed	63	46	73.0
	Inriver	489	400	81.8

Appendix Table A7. Median travel times from Bonneville Dam to McNary Dam for adult hatchery spring Chinook salmon PIT tagged for McNary Dam transport evaluations in 2002, 2003, and 2004.

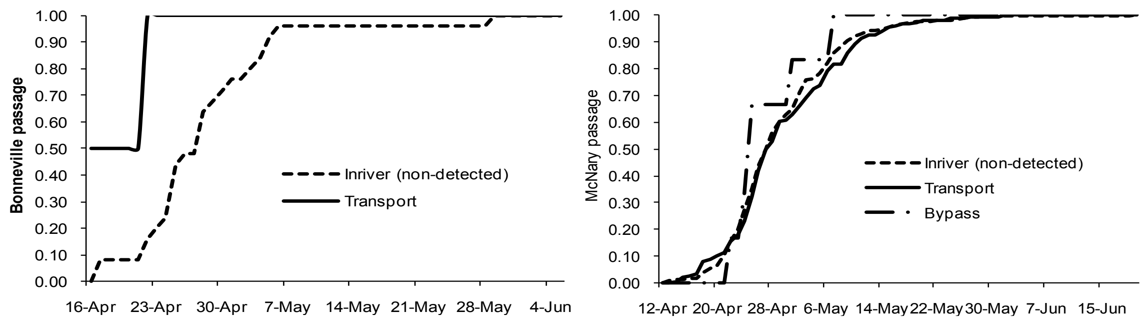
Age class	Migration history	Number of adults	Median travel time from Bonneville Dam to McNary Dam (days)
2002			
Jacks	Transport	6	5.0
	Bypassed	2	6.0
	Inriver	15	6.0
Age-2-ocean	Transport	145	5.0
	Bypassed	65	5.0
	Inriver	378	6.0
Age-3-ocean	Transport	2	9.0
	Bypassed	3	9.0
	Inriver	24	7.0
2003			
Jacks	Transport	10	6.0
	Bypassed	11	6.0
	Inriver	68	5.0
Age-2-ocean	Transport	72	6.0
	Bypassed	72	6.0
	Inriver	470	6.0
Age-3-ocean	Transport	14	7.0
	Bypassed	10	9.0
	Inriver	72	7.0
2004			
Jacks	Transport	2	5.5
	Bypassed	5	5.0
	Inriver	52	5.5
Age-2-ocean	Transport	59	6.0
	Bypassed	40	6.5
	Inriver	299	6.0
Age-3-ocean	Transport	10	8.0
	Bypassed	1	8.0
	Inriver	49	6.0

Passage at Bonneville and McNary Dam for Yearling Chinook migrating in 2002

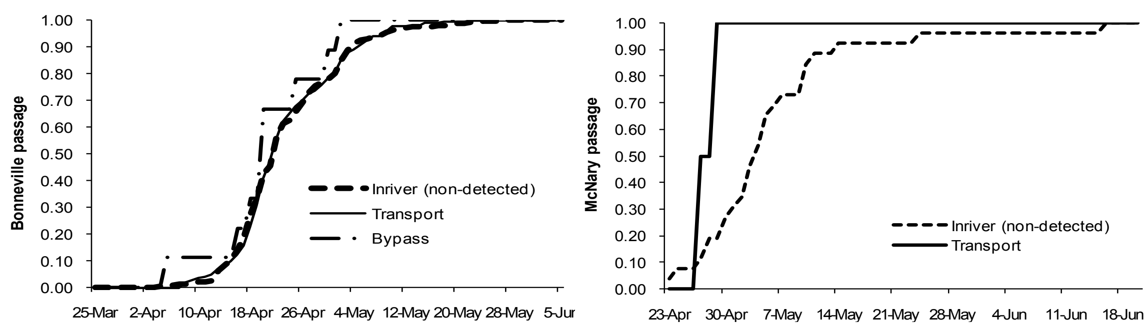
Jacks (2003)



Age-2-ocean adults (2004)

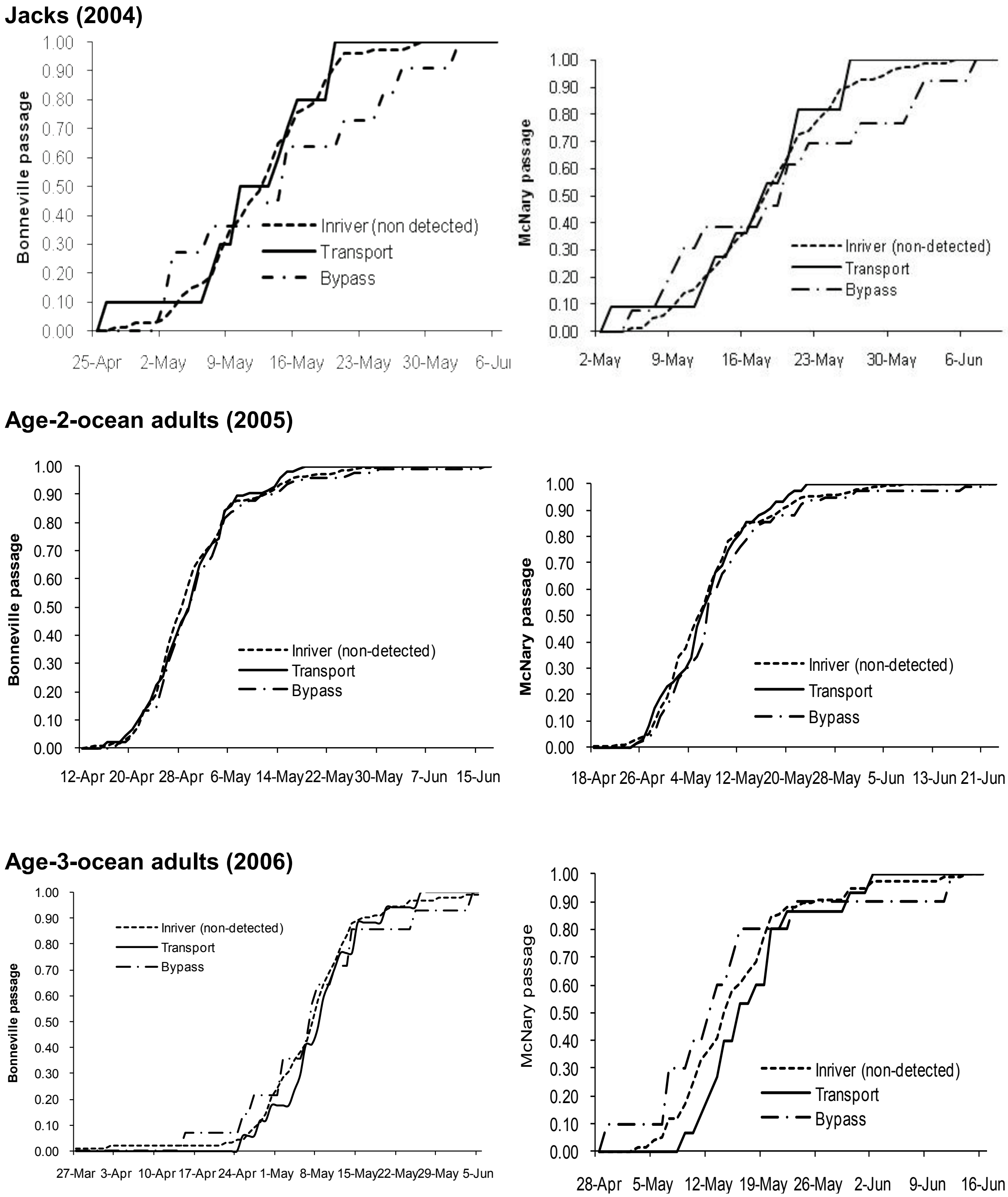


Age-3-ocean adults (2005)



Appendix Figure A1. Distribution of hatchery spring Chinook salmon tagged as smolts in 2002 and detected as jacks, 2-ocean, or 3-ocean adults passing Bonneville (left) and McNary Dams (right) from 2003 to 2004.

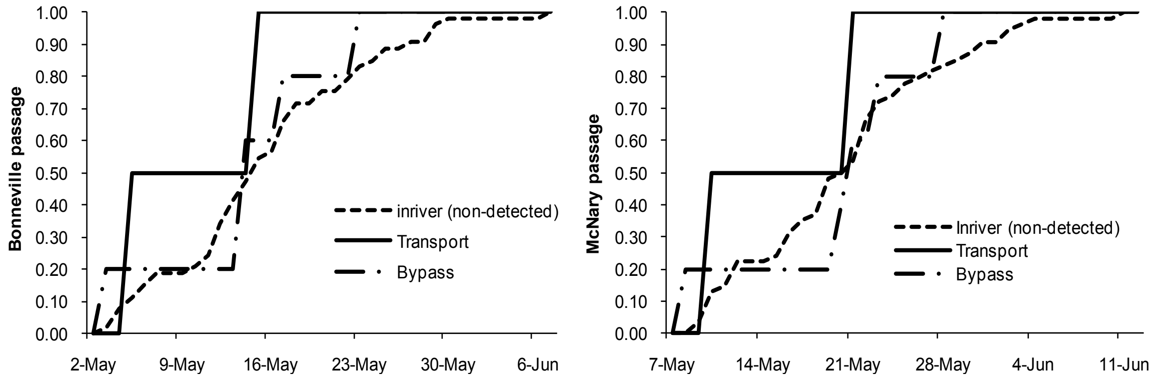
Passage at Bonneville and McNary Dam for Yearling Chinook migrating in 2003



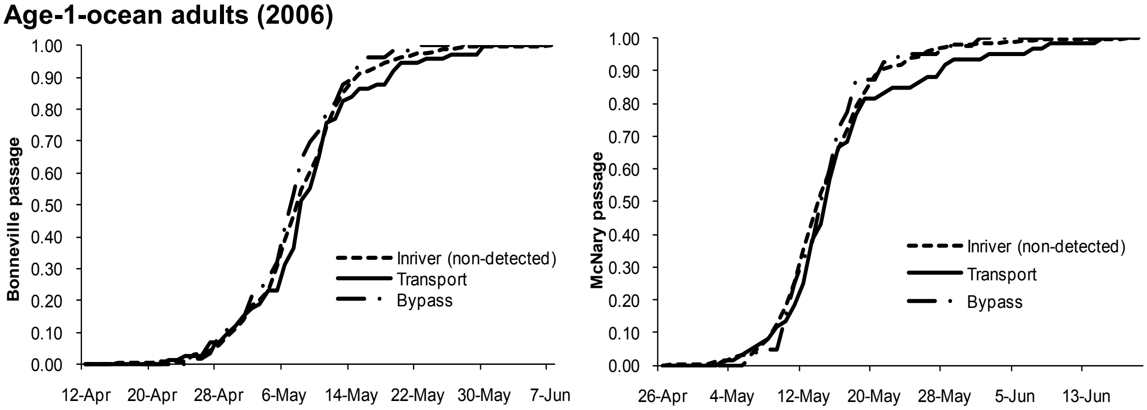
Appendix Figure A2. Distribution of hatchery spring Chinook salmon tagged as smolts in 2003 and detected as jacks, 2-ocean, or 3-ocean adults passing Bonneville (left) and McNary Dams (right) from 2004 to 2006.

Passage at Bonneville and McNary Dam for Yearling Chinook migrating in 2004

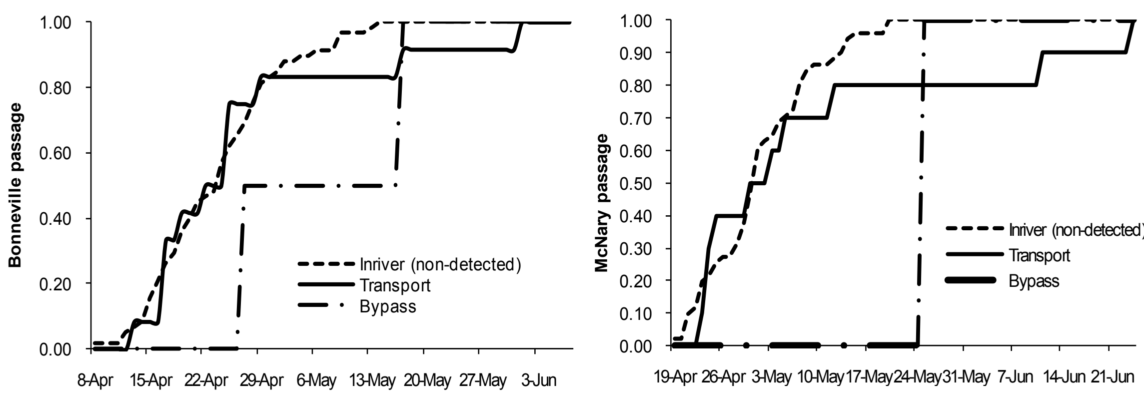
Jacks (2005)



Age-1-ocean adults (2006)



Age-2-ocean adults (2007)



Appendix Figure A3. Distribution of hatchery spring Chinook salmon tagged as smolts in 2003 and detected as jacks, 2-ocean, or 3-ocean adults passing Bonneville (left) and McNary Dams (right) from 2005 to 2007.

Appendix Table A8. Locations of observations (detections) of PIT-tagged hatchery spring Chinook salmon within the McNary Dam juvenile fish facility, 2002. Monitor locations (shown in Figure 1): Full Flow Bypass (FFB), River 1 and River 2 Exits (RIV) , A and B Separator Gate (SEP), A and B Subsample/Sample Room (for smolt monitoring sample SMP), A and B Raceway (for transportation loading TRA).

Date at McNary	Detected once (coil location)					If detected on separator, final coil (coil location)		
2002	FFB	RIV	TRA	SMP	SEP	RIV	TRA	SMP
16 Apr	-	-	-	-	-	6	-	-
17 Apr	-	-	-	-	-	14	12	-
18 Apr	1	-	-	-	1	29	41	-
19 Apr	8	-	-	-	-	83	88	-
20 Apr	4	-	-	-	1	91	114	-
21 Apr	5	-	-	-	1	128	135	-
22 Apr	3	-	-	-	1	110	145	-
23 Apr	13	1	-	-	-	111	142	-
24 Apr	5	-	-	-	-	77	195	2
25 Apr	17	1	-	-	1	58	219	-
26 Apr	6	-	-	-	-	56	199	-
27 Apr	6	-	-	-	2	60	204	-
28 Apr	5	-	-	-	-	57	178	-
29 Apr	8	-	-	-	-	56	183	-
30 Apr	7	2	5	-	3	58	191	-
01 May	10	1	-	-	1	67	233	-
02 May	12	1	1	-	3	153	518	-
03 May	23	1	-	-	1	191	664	1
04 May	44	-	1	-	3	325	1,149	-
05 May	46	-	-	-	1	246	876	-
06 May	36	1	3	-	2	282	1,014	2
07 May	45	-	-	-	10	317	1,188	1
08 May	73	1	2	-	5	332	1,247	-
09 May	40	1	7	-	6	233	852	-
10 May	35	-	-	-	1	309	1,206	1
11 May	79	1	6	-	3	432	1,589	4
12 May	30	1	-	-	1	410	1,605	2
13 May	94	5	4	-	14	543	2,206	1
14 May	50	1	7	-	10	688	2,706	1
15 May	161	3	4	-	8	595	2,296	1
16 May	44	2	-	-	3	599	2,309	1
17 May	73	6	19	-	22	629	2,450	4
18 May	63	1	-	-	2	677	2,497	4
19 May	155	1	1	-	6	754	2,727	1
20 May	527	1	3	-	15	713	2,758	2
21 May	148	5	2	-	14	818	2,970	3
22 May	23	1	3	-	7	820	2,910	1
23 May	130	5	-	-	9	1,489	429	2

Appendix Table A8. Continued.

Date at McNary 2002	Detected once (coil location) FFB	RIV	TRA	SMP	SEP	If detected on separator, final coil (coil location) RIV	TRA	SMP
24 May	24	-	-	-	1	1,280	-	-
25 May	26	5	6	-	10	649	1,547	-
26 May	14	-	2	-	5	554	1,672	3
27 May	58	-	-	-	1	281	823	1
28 May	21	-	-	-	1	343	1,002	4
29 May	30	-	-	-	1	315	751	1
30 May	19	1	-	-	3	265	682	1
31 May	10	-	3	-	-	207	495	-
01 Jun	16	-	-	-	-	99	227	-
02 Jun	8	-	-	-	-	81	200	4
03 Jun	4	1	-	-	-	69	160	2
04 Jun	5	-	-	-	-	81	23	1
05 Jun	2	-	-	-	-	93	3	-
06 Jun	16	2	-	-	-	32	36	-
07 Jun	6	-	-	-	-	22	47	-
08 Jun	4	-	-	-	1	28	64	-
09 Jun	46	-	-	-	-	10	21	-
10 Jun	63	-	-	-	-	-	-	-
11 Jun	20	-	-	-	-	-	-	-
13 Jun	9	-	-	-	-	1	-	-
14 Jun	1	-	-	-	-	9	12	-
15 Jun	2	-	-	-	-	2	5	-
16 Jun	-	-	-	-	-	4	7	-
17 Jun	-	-	-	-	-	4	9	-
18 Jun	-	-	-	-	-	1	5	-
19 Jun	-	-	-	-	-	-	2	-
20 Jun	-	-	-	-	-	1	-	-
21 Jun	1	-	-	-	-	-	-	-
26 Jun	-	-	-	-	-	1	1	-
27 Jun	-	-	-	-	-	-	1	-
28 Jun	1	-	-	-	-	-	-	-
11 Apr 03	-	1	-	-	-	-	-	-

Appendix Table A9a. Detection coil locations of detected of PIT-tagged hatchery spring Chinook salmon within the McNary Dam juvenile fish facility (MCJ), 2003. Monitor locations (shown in Figure 1) are: Adult Fish Return (AFR), Full Flow Bypass (FFB), A and B Raceway Diversion (RAC), River 1 and River 2 Exits (RIV), A and B Separator Gate (SEP), A and B Raceway (for transportation loading TRA).

MCJ	Detection coil location(s)						Detection on FFB and additional coil(s)						
date 2003	FFB	AFR	SEP	RIV	RAC	RAC TRA	AFR	SEP	RIV	RAC	RAC TRA	TRA	RAC RIV
22 Apr	0	0	0	0	0	0	0	0	0	0	0	0	0
23 Apr	29	0	0	0	0	0	0	0	0	0	0	0	0
24 Apr	10	0	0	0	0	0	0	0	0	0	0	0	0
25 Apr	174	0	0	0	0	0	0	0	0	0	0	0	0
26 Apr	51	0	0	0	0	0	0	2	0	3	7	2	0
27 Apr	325	0	0	0	0	0	0	2	0	0	0	2	0
28 Apr	91	0	0	0	0	0	0	0	0	0	0	3	0
29 Apr	681	0	0	0	0	0	0	0	0	0	0	4	0
30 Apr	269	0	1	0	0	1	0	0	0	3	2	14	0
1 May	1,378	0	0	0	0	0	0	0	0	0	1	3	0
2 May	261	0	0	0	0	0	0	0	0	0	0	0	0
3 May	1,787	0	0	0	0	0	0	0	0	0	0	0	0
4 May	262	0	0	0	2	0	0	0	0	0	0	1	0
5 May	2,115	0	0	0	0	0	0	0	0	0	0	0	0
6 May	285	0	0	0	0	0	0	0	0	0	0	1	0
7 May	1,826	0	0	0	0	0	0	0	0	0	0	0	0
8 May	434	0	0	0	0	0	0	1	2	0	1	5	0
9 May	2,232	0	0	0	0	0	0	0	0	0	0	2	0
10 May	559	0	0	0	0	0	0	0	0	0	0	1	0
11 May	1,677	0	1	0	0	0	0	0	0	1	0	1	0
12 May	270	0	0	0	0	0	0	0	0	0	0	1	0
13 May	1,592	0	0	0	0	0	0	0	0	0	0	0	0
14 May	392	0	0	1	0	0	0	0	0	0	0	4	0
15 May	2,064	0	0	1	0	0	0	0	0	0	0	1	0
16 May	536	0	1	0	0	0	0	0	2	0	0	0	0
17 May	2,327	0	0	0	0	0	0	0	0	0	0	0	0
18 May	377	0	0	0	0	0	0	0	2	0	0	2	0
19 May	1,866	0	0	0	0	0	0	0	0	0	0	1	0
20 May	305	0	0	2	0	0	0	0	0	0	0	1	0
21 May	1,441	0	0	0	0	0	0	0	0	0	0	0	0
22 May	413	0	0	0	0	0	0	0	1	0	0	0	0
23 May	1,662	0	0	0	0	0	0	0	0	0	0	1	0
24 May	275	0	0	0	0	0	15	0	0	1	0	0	1
25 May	1,069	0	0	0	0	0	0	0	0	0	0	0	0
26 May	274	0	0	0	0	0	7	0	0	1	1	4	0
27 May	1,350	0	0	0	0	0	1	0	0	0	0	0	0
28 May	404	0	0	0	0	0	2	0	0	0	0	0	0
29 May	2,004	0	0	0	0	0	0	0	0	0	0	1	0

Appendix Table A9a. Continued.

MCJ	Detection coil location(s)					Detection on FFB and additional coil(s)						
date					RAC					RAC		RAC
2003	FFB	AFR	SEP	RIV	RAC	TRA	AFR	SEP	RIV	RAC	TRA	TRA	RIV
30 May	327	0	0	0	0	0	21	0	0	0	0	0	0
31 May	999	0	0	0	0	0	1	0	0	0	0	0	0
1 Jun	152	0	1	0	0	0	8	0	0	0	0	1	0
2 Jun	404	0	0	0	0	0	3	0	0	0	0	0	0
3 Jun	90	0	0	0	0	0	10	0	0	0	0	0	0
4 Jun	396	0	0	1	0	0	5	0	0	0	0	1	0
5 Jun	172	1	0	0	0	0	15	0	0	0	0	0	0
6 Jun	250	0	0	0	0	0	8	0	0	0	0	0	0
7 Jun	115	0	0	0	0	0	17	0	0	0	0	0	0
8 Jun	346	0	0	0	0	0	3	0	0	0	0	0	0
9 Jun	254	0	0	0	0	0	24	0	0	0	0	0	0
10 Jun	326	0	0	0	0	0	0	0	0	0	0	0	0
11 Jun	104	0	0	0	0	0	6	0	0	0	0	0	0
12 Jun	96	0	0	0	0	0	0	0	0	0	0	0	0
13 Jun	24	0	0	0	0	0	1	0	0	0	0	0	0
14 Jun	57	0	0	1	0	0	0	0	0	0	0	0	0
15 Jun	8	0	0	0	0	0	3	0	0	0	0	0	0
16 Jun	15	0	0	0	0	0	1	0	0	0	0	0	0
17 Jun	20	0	0	0	0	0	1	0	0	0	0	0	0
18 Jun	27	0	0	0	0	0	1	0	0	0	0	0	0
19 Jun	8	0	0	0	0	0	0	0	0	0	0	0	0
20 Jun	5	0	0	0	0	0	0	0	0	0	0	0	0
21 Jun	10	0	0	0	0	0	0	0	0	0	0	0	0
22 Jun	9	0	0	0	0	0	0	0	0	0	0	0	0
23 Jun	2	0	0	0	0	0	0	0	0	0	0	0	0
24 Jun	11	0	0	0	0	0	0	0	0	0	0	0	0
25 Jun	3	0	0	0	0	0	0	0	0	0	0	0	0
26 Jun	5	0	0	0	0	0	0	0	0	0	0	0	0
27 Jun	1	0	0	0	0	0	0	0	0	0	0	0	0
28 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0
29 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0
30 Jun	1	0	0	0	0	0	0	0	0	0	0	0	0
1 Jul	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Jul	1	0	0	0	0	0	0	0	0	0	0	0	0
3 Jul	0	0	0	0	0	0	1	0	0	0	0	0	0
5 Jul	1	0	0	0	0	0	0	0	0	0	0	0	0
9 Jul	0	0	0	0	0	0	0	0	0	0	0	0	0
15 Jul	0	0	0	0	0	0	0	0	0	0	0	0	0
16 Jul	0	0	0	0	0	0	0	0	0	0	0	0	0
24 Jul	0	0	0	0	0	0	0	0	0	0	0	0	0
9 Aug	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix Table A9b. Locations of observations (detections) of PIT-tagged hatchery spring Chinook salmon within the McNary Dam juvenile fish facility (MCJ), 2003. Monitor locations are (shown in Figure 1): Adult Fish Return (AFR), A and B River Diversion (DIV), Full Flow Bypass (FFB), A and B Raceway Diversion (RAC), River 1 and River 2 Exits (RIV), A and B Separator Gate (SEP), A and B Subsample/Sample Room (for smolt monitoring sample SMP), A and B Raceway (for transportation loading TRA).

	Detection on FF, SEP, and additional coil(s)								Detection SEP and additional coil(s)				
MCJ date (2003)	RIV	SMP	RAC	TRA	RAC RIV	SMP RIV	RAC TRA	RAC TRA RIV	RIV	RAC	RAC RIV	RAC TRA	SMP RIV
22 Apr	0	0	1	0	0	0	8	0	0	0	0	0	0
23 Apr	0	0	0	0	0	0	0	0	0	0	0	0	0
24 Apr	0	0	0	0	1	5	49	0	0	0	0	0	0
25 Apr	0	0	0	0	0	0	11	0	0	0	0	1	0
26 Apr	0	0	1	2	4	5	262	0	0	0	0	2	0
27 Apr	0	0	2	1	1	0	54	0	0	0	0	0	0
28 Apr	0	0	2	0	3	1	427	0	1	0	0	1	0
29 Apr	0	0	1	1	3	4	149	0	0	0	0	0	0
30 Apr	0	0	1	0	4	12	1,190	0	2	1	0	6	0
1 May	0	0	1	0	1	0	179	0	0	0	0	0	0
2 May	2	1	3	0	2	11	1,441	0	1	0	0	7	0
3 May	0	0	0	0	3	0	161	0	0	0	0	2	0
4 May	0	1	3	1	5	11	1,476	0	0	0	0	3	0
5 May	0	0	0	0	2	1	216	0	0	0	0	1	0
6 May	0	0	4	1	2	14	1,677	0	1	0	0	4	0
7 May	0	0	1	0	1	6	468	0	0	0	0	0	0
8 May	2	0	4	1	7	12	1,814	0	0	1	0	2	0
9 May	0	0	0	0	0	1	487	0	3	0	0	1	0
10 May	1	0	2	1	6	11	1,676	0	3	0	0	2	0
11 May	0	0	2	0	0	0	303	0	0	0	0	1	0
12 May	0	0	1	0	3	18	1,256	0	0	0	0	7	0
13 May	0	0	0	0	1	7	284	0	0	0	0	0	1
14 May	0	0	0	1	3	15	1,674	1	0	0	0	4	0
15 May	0	0	0	0	1	2	305	0	0	0	0	2	0
16 May	1	0	0	0	61	17	2,079	0	2	0	0	2	0
17 May	0	0	1	0	37	3	410	0	0	1	0	2	0
18 May	1	2	2	0	181	18	1,759	0	1	0	3	4	0
19 May	0	0	2	1	54	6	391	0	0	0	0	0	0
20 May	0	1	1	1	145	7	976	0	1	0	1	2	0
21 May	0	0	0	1	17	3	147	0	0	0	1	0	0
22 May	3	0	0	0	283	14	1,333	0	0	0	0	1	0
23 May	1	0	1	0	70	6	363	0	0	0	0	1	0
24 May	0	0	0	1	235	11	924	0	1	0	0	2	0
25 May	0	0	0	0	47	2	166	0	0	0	0	0	0
26 May	0	1	2	0	279	12	826	0	0	0	0	4	0
27 May	0	0	2	0	73	1	249	0	0	0	0	0	0
28 May	2	0	3	1	368	14	1,873	0	0	0	1	3	0
29 May	0	0	0	0	110	7	666	0	1	0	0	0	0
30 May	0	0	0	1	247	8	870	0	0	0	0	1	0
31 May	1	0	0	0	62	3	293	0	2	0	0	0	0

Appendix Table A9b. Continued.

MCJ date (2003)	Detection on FF, SEP, and additional coil(s) RIV	SMP	RAC	TRA	RAC RIV	SMP RIV	RAC TRA	RAC TRA RIV	Detection SEP and additional coil(s) RIV	RAC	RAC RIV	RAC TRA	SMP RIV
1 Jun	0	0	0	0	110	4	386	0	0	0	0	0	0
2 Jun	0	0	0	0	49	2	134	0	0	0	0	1	0
3 Jun	0	0	0	0	36	4	371	0	0	0	0	0	0
4 Jun	0	0	0	0	17	2	206	0	0	0	0	2	0
5 Jun	0	0	0	0	6	2	167	0	0	0	0	0	0
6 Jun	0	0	1	0	8	1	94	0	0	0	0	0	0
7 Jun	0	0	0	0	3	1	115	0	0	0	0	0	0
8 Jun	0	0	0	0	4	0	75	0	0	0	0	0	0
9 Jun	0	0	1	0	9	4	299	0	0	0	0	0	0
10 Jun	0	0	0	0	5	1	106	0	0	0	0	0	0
11 Jun	0	0	0	0	6	0	89	0	0	0	0	0	0
12 Jun	0	0	0	0	2	0	15	0	0	0	0	0	0
13 Jun	0	0	0	0	5	0	93	0	0	0	0	0	0
14 Jun	0	0	0	0	2	0	23	0	0	0	0	0	0
15 Jun	0	0	0	0	1	0	25	0	0	0	0	0	0
16 Jun	0	0	0	0	1	0	9	0	0	0	0	0	0
17 Jun	0	0	0	0	1	0	18	0	0	0	0	0	0
18 Jun	0	0	0	0	1	0	5	0	0	0	0	0	0
19 Jun	0	0	0	0	1	0	7	0	0	0	0	0	0
20 Jun	0	0	0	0	0	0	5	0	0	0	0	0	0
21 Jun	0	0	0	0	1	0	5	0	0	0	0	0	0
22 Jun	0	0	0	0	0	0	3	0	0	0	0	0	0
23 Jun	0	0	0	0	0	0	4	0	0	0	0	0	0
24 Jun	0	0	0	0	0	0	3	0	0	0	0	0	0
25 Jun	0	0	0	0	0	0	5	0	0	0	0	0	0
26 Jun	0	0	0	0	0	0	1	0	0	0	0	0	0
27 Jun	0	0	0	0	0	0	3	0	0	0	0	0	0
28 Jun	0	0	0	0	0	0	1	0	0	0	0	0	0
29 Jun	0	0	0	0	0	0	2	0	0	0	0	0	0
30 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0
1 Jul	0	0	0	0	0	0	1	0	0	0	0	0	0
2 Jul	0	0	0	0	0	0	0	0	0	0	0	0	0
3 Jul	0	0	0	0	0	0	0	0	0	0	0	0	0
5 Jul	0	0	0	0	0	0	0	0	0	0	0	0	0
9 Jul	0	0	0	0	0	0	1	0	0	0	0	0	0
15 Jul	0	0	0	0	0	0	1	0	0	0	0	0	0
16 Jul	0	0	0	0	0	0	1	0	0	0	0	0	0
24 Jul	0	0	0	0	0	0	1	0	0	0	0	0	0
9 Aug	0	0	0	0	0	0	1	0	0	0	0	0	0

Appendix Table C10a. Locations of observations (detections) of PIT-tagged hatchery spring Chinook salmon within the McNary Dam juvenile fish facility (MCJ), 2004. Monitor locations are (shown in Figure 1): Adult Fish Return (AFR), A and B River Diversion (DIV), Full Flow Bypass (FFB), A and B Raceway Diversion (RAC), River 1 and River 2 Exits (RIV), A and B Separator Gate (SEP), A and B Subsample/Sample Room (for smolt monitoring sample SMP), A and B Raceway (for transportation loading TRA).

MCJ	Detection coil location(s)								Detection on FFB and additional coil(s)							
date (2004)	FFB	AFR	SEP	RIV	SMP	RAC	TRA	RAC TRA	AFR	SEP	RIV	SMP	SMP DIV	RAC	RAC TRA	TRA
14 Apr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15 Apr	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16 Apr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17 Apr	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18 Apr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19 Apr	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 Apr	4	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
21 Apr	85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22 Apr	21	0	0	0	0	0	0	0	4	0	1	0	0	0	0	0
23 Apr	309	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
24 Apr	112	0	0	0	0	0	0	0	56	0	0	0	1	0	0	0
25 Apr	993	0	0	0	0	0	0	0	25	0	0	0	3	0	0	0
26 Apr	306	0	0	0	0	0	0	0	63	0	1	1	19	0	0	0
27 Apr	825	0	1	0	0	0	0	0	11	0	1	2	31	0	2	0
28 Apr	246	1	0	0	0	0	0	0	94	0	0	0	0	0	2	0
29 Apr	697	0	0	0	0	0	0	0	26	0	0	0	0	0	0	0
30 Apr	155	0	0	1	0	1	0	0	48	0	2	0	0	0	0	0
1 May	1,464	0	0	0	0	0	0	0	35	0	0	0	1	0	1	1
2 May	541	0	0	0	0	1	1	0	40	0	0	0	0	1	0	1
3 May	1,496	0	0	0	1	0	0	0	9	0	0	0	0	0	0	0
4 May	240	0	0	0	0	0	0	1	36	0	0	0	0	0	0	0
5 May	1,067	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0
6 May	202	0	1	0	0	0	0	1	22	0	0	0	0	0	1	0
7 May	775	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
8 May	224	0	0	0	0	0	0	0	51	0	0	0	0	0	4	0
9 May	1,010	0	0	0	0	0	0	0	13	0	0	0	0	0	3	0
10 May	211	0	0	0	0	0	0	0	18	1	0	0	0	0	0	0
11 May	1,345	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0
12 May	250	0	0	0	0	0	0	0	19	0	0	0	0	0	0	0
13 May	1,261	0	1	0	0	1	0	0	5	0	0	0	0	0	0	0
14 May	260	0	0	1	0	0	0	0	58	2	0	0	0	0	3	0
15 May	1,830	0	0	0	0	0	0	0	16	0	0	0	0	0	1	0
16 May	356	0	0	0	0	0	0	0	28	0	0	0	0	0	0	0
17 May	1,539	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0
18 May	314	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0
19 May	1,210	0	2	0	0	0	0	0	2	0	0	0	0	0	1	0
20 May	222	0	0	0	0	0	0	0	26	0	2	0	0	0	0	0
21 May	950	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0
22 May	124	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
23 May	913	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
24 May	103	0	0	0	0	1	0	0	1	0	0	0	0	0	2	0
25 May	354	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0

Appendix Table C10a. Continued.

MCJ date (2004)	Detection coil location(s)								Detection on FFB and additional coil(s)							
	FFB	AFR	SEP	RIV	SMP	RAC	TRA	RAC TRA	AFR	SEP	RIV	SMP	SMP DIV	RAC	RAC TRA	TRA
26 May	48	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
27 May	697	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
28 May	119	0	1	0	0	0	0	0	13	0	2	0	0	0	0	0
29 May	500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30 May	71	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0
31 May	197	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0
1 Jun	77	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0
2 Jun	186	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
3 Jun	128	0	0	0	0	0	0	0	6	0	3	0	0	0	0	0
4 Jun	137	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
5 Jun	62	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
6 Jun	71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7 Jun	26	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
8 Jun	78	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
9 Jun	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10 Jun	27	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
11 Jun	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12 Jun	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13 Jun	6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
14 Jun	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15 Jun	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16 Jun	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17 Jun	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18 Jun	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19 Jun	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
20 Jun	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22 Jun	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23 Jun	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24 Jun	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
25 Jun	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 Jun	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
27 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28 Jun	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29 Jun	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15 Jul	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Aug	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3 Aug	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4 Aug	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix Table C10b. Locations of observations (detections) of PIT-tagged hatchery spring Chinook salmon within the McNary Dam juvenile fish facility (MCJ), 2004. Monitor locations are (shown in Figure 1): A and B River Diversion (DIV), Full Flow Bypass (FFB), A and B Raceway Diversion (RAC), River 1 and River 2 Exits (RIV), A and B Separator Gate (SEP), A and B Subsample/Sample Room (for smolt monitoring sample SMP), A and B Raceway (for transportation loading TRA).

	Detection on FFB, SEP, and additional coil(s)										Detection on SEP and additional coil(s)						
MCJ date (2004)	DIV	RIV	SMP	RAC	TRA	DIV RIV	RAC RIV	SMP RIV	RAC TRA	RAC TRA RIV	RIV	DIV	RAC	RAC RIV	RAC TRA	SMP RIV	TRA
14 Apr	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
15 Apr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16 Apr	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0
17 Apr	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
18 Apr	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0
19 Apr	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
20 Apr	0	0	0	0	0	0	2	5	35	0	0	0	0	0	0	0	0
21 Apr	0	0	0	0	0	0	3	1	2	0	0	0	0	0	0	0	0
22 Apr	0	0	1	0	0	0	17	5	151	0	0	0	0	0	0	0	0
23 Apr	0	0	0	0	0	0	23	7	54	0	0	0	0	0	1	0	0
24 Apr	10	0	5	0	0	0	28	49	478	0	0	0	0	0	0	0	0
25 Apr	0	0	1	1	0	0	39	53	228	0	0	0	0	0	0	1	0
26 Apr	0	1	2	1	0	0	48	17	558	0	0	0	0	0	0	0	0
27 Apr	0	0	1	0	0	0	53	16	243	0	1	0	0	0	2	0	0
28 Apr	25	1	3	2	0	0	100	22	1,054	0	0	1	0	0	3	0	0
29 Apr	1	0	7	0	0	0	75	45	399	0	0	0	0	1	2	0	0
30 Apr	2	1	1	0	0	0	72	21	825	0	0	0	0	0	3	0	0
1 May	0	0	4	0	0	0	75	58	402	0	0	0	0	0	3	1	0
2 May	0	0	0	1	1	0	97	26	1,398	0	1	0	0	0	8	0	0
3 May	0	1	5	0	0	0	73	37	355	0	0	0	0	0	4	1	0
4 May	19	0	0	0	0	0	95	24	1,028	0	0	0	0	0	4	0	0
5 May	1	2	5	0	0	0	45	21	192	0	0	0	0	0	0	0	0
6 May	6	0	3	1	2	0	107	12	976	0	0	0	0	0	1	0	0
7 May	0	0	4	0	0	0	36	26	187	0	0	0	0	0	0	0	0
8 May	16	1	0	0	0	0	42	11	857	0	1	0	0	0	0	0	0
9 May	1	0	6	1	0	0	25	41	209	0	0	0	0	0	1	0	0
10 May	1	0	1	0	0	0	82	25	867	0	0	0	1	0	4	1	0
11 May	2	0	9	0	0	0	49	44	220	0	0	0	0	1	0	0	0
12 May	2	0	7	4	1	0	89	11	1,562	0	0	0	0	0	5	0	0
13 May	2	0	11	3	0	0	31	23	321	0	0	0	0	0	3	0	0
14 May	37	0	3	5	0	0	76	17	2,492	0	1	0	0	0	9	0	0
15 May	1	1	8	2	0	0	47	35	457	0	0	0	0	0	1	0	1
16 May	0	0	6	3	0	0	74	19	1,826	1	3	0	0	0	7	0	0
17 May	0	0	19	0	0	0	31	34	459	0	0	0	0	0	1	0	0
18 May	25	0	2	7	0	0	57	12	1,402	1	0	0	0	0	4	1	0
19 May	0	0	2	1	0	0	22	32	214	1	0	0	0	0	1	0	0
20 May	2	0	0	0	0	0	33	25	971	1	0	0	0	0	2	0	0
21 May	0	0	0	0	0	0	20	2	174	0	0	0	0	0	2	0	0
22 May	0	0	0	1	0	0	42	13	684	0	1	0	0	0	2	0	0
23 May	0	0	0	0	0	0	13	3	114	0	0	0	0	0	0	0	0
24 May	0	1	0	0	0	0	56	28	650	0	0	0	0	0	1	0	0

Appendix Table C10b. Continued.

	Detection on FFB, SEP, and additional coil(s)										Detection on SEP and additional coil(s)						
MCJ date (2004)	DIV	RIV	SMP	RAC	TRA	DIV RIV	RAC RIV	SMP RIV	RAC TRA	RAC TRA RIV	RIV	DIV	RAC	RAC RIV	RAC TRA	SMP RIV	TRA
25 May	0	0	1	0	0	0	3	3	58	0	0	0	0	0	1	0	0
26 May	0	0	0	0	0	0	28	11	368	0	0	0	0	0	0	0	0
27 May	0	0	0	0	0	0	13	1	62	0	0	0	0	0	1	0	0
28 May	0	1	0	0	0	1	22	8	482	0	0	0	0	0	0	0	0
29 May	0	0	0	0	0	0	11	1	80	0	0	0	0	0	0	0	0
30 May	0	0	0	1	1	0	27	2	347	0	0	0	0	0	0	0	0
31 May	0	0	0	0	0	0	4	1	63	0	0	0	0	0	0	0	0
1 Jun	0	0	0	0	0	0	16	3	181	0	0	0	0	0	1	0	0
2 Jun	0	0	0	0	0	0	1	1	43	0	0	0	0	0	0	0	0
3 Jun	0	0	0	0	0	0	14	2	135	1	0	0	0	0	1	0	0
4 Jun	0	0	0	0	0	0	7	1	20	0	0	0	0	0	0	0	0
5 Jun	0	0	0	0	0	0	6	0	70	0	0	0	0	0	1	0	0
6 Jun	0	0	0	0	0	0	5	0	40	0	0	0	0	0	0	0	0
7 Jun	0	0	0	0	0	0	3	1	56	0	0	0	0	0	0	0	0
8 Jun	0	0	0	0	0	0	2	0	16	0	0	0	0	0	0	0	0
9 Jun	0	0	0	0	0	0	5	0	36	0	0	0	0	0	0	0	0
10 Jun	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0
11 Jun	0	0	0	0	0	0	2	0	17	0	0	0	0	0	0	0	0
12 Jun	0	0	0	0	0	0	1	0	4	0	0	0	0	0	0	0	0
13 Jun	0	0	0	0	0	0	1	1	6	0	0	0	0	0	0	0	0
14 Jun	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
15 Jun	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
16 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17 Jun	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
18 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19 Jun	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
20 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23 Jun	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
24 Jun	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
25 Jun	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
26 Jun	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
27 Jun	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
28 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29 Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15 Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3 Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4 Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX B

Adult Return Data for Spring Chinook Salmon Tagged in 2002-2004

Appendix Table B1. Juvenile numbers, adult return numbers, and smolt-to-adult return rates by hatchery of origin from Upper Columbia River hatchery spring Chinook salmon transportation studies, 2002-2004. Full-flow bypass (FFB): fish were fish collected and returned to the river through a 78-cm diameter outfall pipe without entering the collection facility. Juvenile facility bypass: fish crossed the separator and were returned to the river through the facility bypass pipe (30-cm diameter). Adult return: fish dropped over the end of the separator (as an adult salmonid would), and were returned to the river through the facility adult-return pipe (30-cm).

	Juvenile fish numbers					Returns by Age-class			SAR (95% CI)				
Hatchery of origin	Transport	FFB	Bypass	Inriver	Adult return	Jacks	2-ocean	3-ocean	Transport	Full-flow bypass	Bypass	Inriver	Adult return
2004													
Entiat	6,133	6,586	1,187	19,195	433	4	85	10	0.34 (0.20-0.49)	0.17 (0.07-0.27)	0.34 (0.01-0.67)	0.32 (0.24-0.40)	0.23 (0.00-0.68)
Leavenworth	15,298	15,068	1,743	72,682	339	7	239	49	0.31 (0.22-0.40)	0.11 (0.06-0.17)	0.29 (0.04-0.54)	0.31 (0.27-0.35)	0.59 (0.00-1.41)
Methow	1,577	1,729	136	13,614	36	48	79	2	0.25 (0.01-0.50)	0.93 (0.47-1.38)	–	0.78 (0.63-0.93)	–
Winthrop	1,263	1,162	114	7,263	22	2	13	1	–	0.17 (0.00-0.41)	–	0.19 (0.09-0.29)	–
2003													
Entiat	6,181	6,881	188	25,959	1	10	115	21	0.34 (0.19-0.49)	0.22 (0.11-0.33)	–	0.42 (0.34-0.50)	–
Leavenworth	21,316	25,873	2,392	103,711	130	36	462	75	0.30 (0.23-0.37)	0.26 (0.19-0.32)	0.42 (0.16-0.68)	0.42 (0.38-0.46)	–
Methow	1,953	2,410	313	13,319	24	62	64	7	0.67 (0.30-1.03)	0.75 (0.40-1.09)	0.64 (0.00-1.52)	0.75 (0.60-0.90)	–
Winthrop	1,879	2,167	46	6,910	0	1	6	2	0.11 (0.00-0.25)	–	–	0.10 (0.03-0.18)	–
2002													
Entiat	8,704	381	3,364	19,692	--	5	103	2	0.29 (0.17-0.40)	0.52 (0.00-1.25)	0.45 (0.22-0.67)	0.36 (0.27-0.44)	–
Leavenworth	37,172	1,935	17,538	97,100	--	26	455	29	0.34 (0.28-0.40	0.21 (0.00-0.41)	0.35 (0.26-0.44)	0.33 (0.29-0.37)	–
Winthrop	2,499	119	888	6,634	--	5	20	0	0.28 (0.07-0.49)	–	0.45 (0.01-0.89)	0.66 (0.47-0.86)	–

Appendix Table B2a. Total number of adults, conversion rates, and median travel times for returning adults PIT-tagged at Entiat Hatchery for Upper Columbia River hatchery spring Chinook salmon transportation studies, 2002-2004. Full-flow bypass fish were fish collected and returned to the river through a 78-cm diameter outfall pipe without entering the collection facility. Bypass fish crossed the separator and were returned to the river through the facility bypass pipe (30-cm diameter). Adult return fish dropped over the end of the separator (as an adult salmonid would), and were returned to the river through the facility adult-return pipe (30-cm).

		Entiat Hatchery Spring Chinook											
		Bonneville to McNary				McNary to Priest Rapids				Bonneville to Priest Rapids			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate (%)	Median travel time	McNary adults	PRD adults	Conversion rate (%)	Median travel time	Bonn adults	PRD adults	Conversion rate (%)	Median travel time
2004	Transport	27	21	77.8	6.0	21	21	100.0	4.0	27	22	81.5	11.0
	Full-flow bypass	17	11	64.7	7.0	11	11	100.0	5.0	17	11	64.7	12.0
	Bypass	3	3	100.0	9.0	4	4	100.0	5.0	3	3	100.0	14.0
	Inriver	80	62	77.5	6.0	62	62	100.0	4.0	80	63	78.8	10.0
	Adult return	4	1	25.0	10.0	1	1	100.0	5.0	4	1	25.0	15.0
2003	Transport	25	19	76.0	6.0	21	16	76.2	4.0	25	14	56.0	11.0
	Full-flow bypass	18	14	77.8	6.0	15	13	86.7	4.0	18	12	66.7	11.0
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	118	102	86.4	6.0	110	92	83.6	5.0	118	85	72.0	10.0
2002	Transport	32	25	78.1	6.0	25	11	44.0	4.0	32	11	34.4	10.0
	Full-flow bypass	4	2	50.0	5.5	2	1	50.0	6.0	4	1	25.0	12.0
	Bypass	14	13	92.9	6.0	13	4	30.8	4.0	14	4	28.6	9.0
	Inriver	78	69	88.5	5.0	70	33	47.1	5.0	78	31	39.7	10.0

Appendix Table B2b. Number of adults, conversion rates, and median travel times from Bonneville Dam to McNary Dam by age class for returning adults PIT-tagged at Entiat Hatchery for Upper Columbia River hatchery spring Chinook salmon transportation studies, 2002-2004.

		Entiat Hatchery spring Chinook											
		Jacks				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time
2004	Transport	--	--	--	--	23	18	78.3	6.0	4	3	75.0	5.0
	Full-flow bypass	1	1	100.0	5.0	16	10	62.5	7.0	--	--	--	--
	Bypass	--	--	--	--	3	3	100.0	9.0	--	--	--	--
	Inriver	3	3	100.0	6.0	68	52	76.5	6.5	9	7	77.8	5.0
	Adult return	--	--	--	--	4	1	25.0	10.0	--	--	--	--
2003	Transport	2	2	100.0	6.0	21	15	71.4	6.0	2	2	100.0	6.0
	Full-flow bypass	--	--	--	--	13	10	76.9	6.0	5	4	80.0	7.5
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	9	8	88.9	5.0	94	81	86.2	6.0	15	13	86.7	8.0
2002	Transport	3	3	100.0	5.0	29	22	75.9	6.0	--	--	--	--
	Full-flow bypass	--	--	--	--	4	2	50.0	5.5	--	--	--	--
	Bypass	--	--	--	--	14	13	92.9	6.0	--	--	--	--
	Inriver	2	2	100.0	7.0	74	65	87.8	5.0	2	2	100.0	5.0

Appendix Table B2c. Number of adults, conversion rates, and median travel times from McNary Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at Entiat Hatchery for Upper Columbia River hatchery spring Chinook salmon transportation studies, 2002-2004.

		Entiat Hatchery spring Chinook											
		Jacks				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time
2004	Transport	--	--	--	--	18	18	100.0	4.0	3	3	100.0	4.0
	Full-flow bypass	1	1	100.0	5.0	10	10	100.0	4.5	--	--	--	--
	Bypass	--	--	--	--	4	4	100.0	4.0	--	--	--	--
	Inriver	3	3	100.0	4.0	52	52	100.0	5.0	7	7	100.0	5.0
	Adult return	--	--	--	--	1	1	100.0	5.0	--	--	--	--
2003	Transport	2	1	50.0	6.0	17	14	82.4	4.0	2	1	50.0	4.0
	Full-flow bypass	--	--	--	--	11	9	81.8	4.0	6	5	83.3	4.0
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	8	5	62.5	5.0	87	78	89.7	5.0	15	9	60.0	5.0
2002	Transport	3	2	66.7	4.5	22	9	40.9	4.0	--	--	--	--
	Full-flow bypass	--	--	--	--	2	1	50.0	6.0	--	--	--	--
	Bypass	--	--	--	--	13	4	30.8	4.0	--	--	--	--
	Inriver	2	2	100.0	5.0	66	31	47.0	5.0	2	0	0.00	--

Appendix Table B2d. Number of adults, conversion rates, and median travel times from Bonneville Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at Entiat Hatchery for Upper Columbia River hatchery spring Chinook salmon transportation studies, 2002-2004.

		Entiat Hatchery Spring Chinook											
		Jacks				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time
2004	Transport	--	--	--	--	23	19	82.6	11.0	4	3	75.0	19.0
	Full-flow bypass	1	1	100.0	10.0	16	10	62.5	12.5	--	--	--	--
	Bypass	--	--	--	--	3	3	100.0	14.0	--	--	--	--
	Inriver	3	3	100.0	10.0	68	53	77.9	11.0	9	7	77.8	10.0
	Adult return	--	--	--	--	4	1	25.0	15.0	--	--	--	--
2003	Transport	2	1	50.0	12.0	21	12	57.1	10.5	2	1	50.0	11.0
	Full-flow bypass	--	--	--	--	13	8	61.5	10.5	5	4	80.0	12.0
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	9	5	55.6	11.0	94	72	76.6	10.0	15	8	53.3	13.5
2002	Transport	3	2	66.7	9.5	29	9	31.0	10.0	--	--	--	--
	Full-flow bypass	--	--	--	--	4	1	25.0	12.0	--	--	--	--
	Bypass	--	--	--	--	14	4	28.6	9.0	2	0	0.00	--
	Inriver	2	2	100.0	12.0	74	19	39.2	10.0	2	0	0.00	--

Appendix Table B3a. Total number of adults, conversion rates, and median travel times by adult age class for returning adults PIT-tagged at Leavenworth Hatchery for Upper Columbia River hatchery spring Chinook salmon transportation studies, 2002-2004.

		Leavenworth Hatchery Spring Chinook											
		Bonneville to McNary				McNary to Priest Rapids				Bonneville to Priest Rapids			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time
2004	Transport	57	45	79.0	7.0	47	47	100.0	4.0	57	45	79.0	10.0
	Full-flow bypass	28	17	60.7	6.0	17	17	100.0	4.0	28	17	60.7	10.0
	Bypass	5	5	100.0	7.0	5	5	100.0	4.0	5	5	100.0	11.0
	Inriver	272	219	80.5	6.0	224	223	99.6	4.0	272	219	80.5	11.0
	Adult return	2	2	100.0	8.0	2	2	100.0	4.0	2	2	100.0	12.0
2003	Transport	78	63	80.8	6.0	64	51	79.7	4.0	78	50	64.1	11.0
	Full-flow bypass	80	62	77.5	6.5	66	55	83.3	5.0	80	54	67.5	11.0
	Bypass	12	10	83.3	6.0	10	6	60.0	4.0	12	6	50.0	9.5
	Inriver	519	418	80.5	6.0	433	337	77.8	4.0	519	326	62.8	11.0
2002	Transport	144	122	84.7	5.0	128	58	45.3	4.0	144	54	37.5	10.0
	Full-flow bypass	5	4	80.0	5.5	4	1	25.0	5.0	5	1	20.0	10.0
	Bypass	57	53	93.0	5.0	55	24	43.6	5.0	57	22	38.6	11.0
	Inriver	360	307	85.3	6.0	318	159	50.0	5.0	360	155	43.1	11.0

Appendix Table B3b. Number of adults, conversion rates, and median travel times from Bonneville Dam to McNary Dam by age class for returning adults PIT-tagged at Leavenworth Hatchery for Upper Columbia River hatchery spring Chinook salmon transportation studies, 2002-2004.

		Leavenworth Hatchery Spring Chinook											
		Jacks				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time
2004	Transport	--	--	--	--	49	38	77.6	6.0	8	7	87.5	8.0
	Full-flow bypass	--	--	--	--	26	16	61.5	6.0	2	1	50.0	8.0
	Bypass	--	--	--	--	5	5	100.0	7.0	--	--	--	--
	Inriver	8	6	75.0	6.0	218	174	79.8	6.0	46	39	84.8	7.0
	Adult return	--	--	--	--	2	2	100.0	8.0	--	--	--	--
2003	Transport	4	4	100.0	5.5	61	48	78.7	6.0	13	11	84.6	7.0
	Full-flow bypass	5	5	100.0	6.0	66	51	77.3	6.0	9	6	66.7	9.5
	Bypass	1	1	100.0	4.0	4	5	80.0	6.0	1	1	100.0	7.0
	Inriver	26	24	92.3	5.0	423	342	80.9	5.5	70	52	74.3	7.0
2002	Transport	6	2	33.3	5.0	136	116	85.3	5.0	2	2	100.0	9.0
	Full-flow bypass	--	--	--	--	5	4	80.0	5.5	--	--	--	--
	Bypass	2	2	100.0	6.0	51	48	94.1	5.0	4	3	75.0	9.0
	Inriver	16	14	87.5	6.0	321	268	83.5	6.0	23	22	95.7	7.0

Appendix Table B3c. Number of adults, conversion rates, and median travel times from McNary Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at Leavenworth Hatchery for Upper Columbia River hatchery spring Chinook salmon transportation studies, 2002-2004.

		Leavenworth Hatchery Spring Chinook											
		Jacks				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time
2004	Transport	--	--	--	--	40	40	100.0	4.0	7	7	100.0	6.0
	Full-flow bypass	--	--	--	--	16	16	100.0	3.5	1	1	100.0	4.0
	Bypass	--	--	--	--	5	5	100.0	4.0	--	--	--	--
	Inriver	7	7	100.0	4.0	176	175	99.4	4.0	41	41	100.0	6.0
	Adult return	--	--	--	--	2	2	100.0	4.0	--	--	--	--
2003	Transport	4	1	25.0	4.0	48	39	81.3	5.0	12	11	91.7	4.0
	Full-flow bypass	6	4	66.7	5.5	54	46	85.2	5.0	6	5	83.3	6.0
	Bypass	1	1	100.0	4.0	8	4	50.0	4.5	1	1	100.0	3.0
	Inriver	25	7	28.0	5.0	352	292	83.0	4.0	56	38	68.9	4.0
2002	Transport	7	7	100.0	4.0	119	49	41.2	4.0	2	2	100.0	4.0
	Full-flow bypass	--	--	--	--	4	1	25.0	5.0	--	--	--	--
	Bypass	3	3	100.0	4.0	49	19	38.8	5.0	3	2	66.7	4.0
	Inriver	15	13	86.7	5.0	279	126	45.2	5.0	24	20	83.3	4.5

Appendix Table B3d. Number of adults, conversion rates, and median travel times from Bonneville Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at Leavenworth Hatchery for Upper Columbia River hatchery spring Chinook salmon transportation studies, 2002-2004.

		Leavenworth Hatchery Spring Chinook											
		Jacks				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time
2004	Transport	--	-	--	--	49	38	77.6	10.0	8	7	87.5	17.0
	Full-flow bypass	--	--	--	--	26	16	61.5	10.0	2	1	50.0	12.0
	Bypass	--	--	--	--	5	5	100.0	11.0	--	--	--	--
	Inriver	8	7	87.5	11.0	218	173	79.4	10.0	46	39	84.8	13.0
	Adult return	--	--	--	--	2	2	100.0	12.0	--	--	--	--
2003	Transport	4	1	25.0	9.0	61	39	63.9	11.0	13	10	76.9	11.5
	Full-flow bypass	5	4	80.0	12.5	66	45	68.2	11.0	9	5	55.6	15.0
	Bypass	1	1	100.0	8.0	10	4	40.0	9.5	1	1	100.0	10.0
	Inriver	26	7	26.9	11.0	423	284	67.1	11.0	70	35	50.0	12.0
2002	Transport	6	6	100.0	10.0	136	46	33.8	10.0	2	2	100.0	13.0
	Full-flow bypass	--	--	--	--	5	1	20.0	10.0	--	--	--	--
	Bypass	2	2	100.0	12.5	51	18	35.3	10.5	4	2	50.0	12.0
	Inriver	16	13	81.3	11.0	321	123	38.3	11.0	23	19	82.6	12.0

Appendix Table B4a. Total number of adults, conversion rates, and median travel times by adult age class for returning adults PIT-tagged at Methow Hatchery for Upper Columbia River hatchery spring Chinook salmon transportation studies, 2003-2004. No fish were tagged at Methow Hatchery in 2002.

		Methow Hatchery Spring Chinook											
		Bonneville to McNary				McNary to Priest Rapids				Bonneville to Priest Rapids			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time
2004	Transport	4	4	100.0	5.0	4	4	100.0	4.5	4	4	100.0	10.0
	Full-flow bypass	16	16	100.0	6.0	16	16	100.0	4.0	16	16	100.0	11.0
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	121	101	83.5	6.0	106	105	99.1	4.0	121	102	84.3	10.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2003	Transport	15	12	80.0	6.0	13	6	46.2	4.0	15	5	33.3	10.0
	Full-flow bypass	19	17	89.5	6.0	18	15	83.3	4.0	19	14	73.7	10.5
	Bypass	2	2	100.0	4.5	2	2	100.0	4.0	2	2	100.0	8.5
	Inriver	95	83	87.4	6.0	100	74	74.0	4.0	95	61	64.2	11.0

Appendix Table B4b. Number of adults, conversion rates, and median travel times from Bonneville Dam to McNary Dam by age class for returning adults PIT-tagged at Methow Hatchery for Upper Columbia River hatchery spring Chinook salmon transportation studies, 2003-2004. No fish were tagged at Methow Hatchery in 2002.

		Methow Hatchery Spring Chinook											
		Jacks				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time
2004	Transport	2	2	100.0	5.5	2	2	100.0	5.0	--	--	--	--
	Full-flow bypass	4	4	100.0	5.5	12	12	100.0	6.5	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	40	38	95.0	5.0	79	61	77.2	6.0	2	2	100.0	7.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2003	Transport	4	4	100.0	5.5	9	7	77.8	6.0	2	1	50.0	11.0
	Full-flow bypass	6	6	100.0	5.5	13	11	84.6	7.0	--	--	--	--
	Bypass	--	--	--	--	1	1	100.0	6.0	1	1	100.0	3.0
	Inriver	38	35	92.1	5.0	52	43	82.7	6.0	5	5	100.0	6.0

Appendix Table B4c. Number of adults, conversion rates, and median travel times from McNary Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at Methow Hatchery for Upper Columbia River hatchery spring Chinook salmon transportation studies, 2003-2004. No fish were tagged at Methow Hatchery in 2002.

		Methow Hatchery Spring Chinook											
		Jacks				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time
2004	Transport	2	2	100.0	6.0	2	2	100.0	3.5	--	--	--	--
	Full-flow bypass	4	4	100.0	6.0	12	12	100.0	4.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	42	42	100.0	4.5	62	61	98.4	4.0	2	2	100.0	8.5
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2003	Transport	5	1	20.0	4.0	7	4	57.1	4.0	1	1	100.0	7.0
	Full-flow bypass	7	6	85.7	4.0	11	9	81.8	4.0	--	--	--	--
	Bypass	--	--	--	--	1	1	100.0	5.0	1	1	100.0	3.0
	Inriver	50	27	54.0	4.0	45	42	93.3	4.0	5	5	100.0	4.0

Appendix Table B4d. Migration history, conversion rates, and median travel times from Bonneville to Priest Rapids Dam (PRD) by age class for adult spring Chinook PIT-tagged as juveniles at Methow Hatchery for Upper Columbia River transportation studies, 2003-2004. No fish were tagged at Methow Hatchery in 2002.

		Methow Hatchery Spring Chinook											
		Jacks				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time
2004	Transport	2	2	100.0	11.5	2	2	100.0	8.5	--	--	--	--
	Full-flow bypass	4	4	100.0	11.5	12	12	100.0	11.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	40	40	100.0	10.0	79	60	76.0	10.0	2	2	100.0	15.5
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2003	Transport	4	0	0.0	--	9	4	44.4	9.5	2	1	50.0	18.0
	Full-flow bypass	6	5	83.3	10.0	13	9	69.2	11.0	--	--	--	--
	Bypass	--	--	--	--	1	1	100.0	11.0	1	1	100.0	6.0
	Inriver	38	16	42.1	10.0	52	40	76.9	11.0	5	5	100.0	10.0

Appendix Table B5a. Total number of adults, conversion rates, and median travel times by adult age class for returning adults PIT-tagged at Winthrop Hatchery for Upper Columbia River hatchery spring Chinook salmon transportation studies, 2002-2004.

		Winthrop Hatchery Spring Chinook											
		Bonneville to McNary				McNary to Priest Rapids				Bonneville to Priest Rapids			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time
2004	Transport	--	--	--	--	--	--	--	--	--	--	--	--
	Full-flow bypass	2	2	100.0	7.5	2	2	100.0	3.5	2	2	100.0	11.0
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	16	14	87.5	6.0	14	14	100.0	4.0	16	14	87.5	10.5
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2003	Transport	3	2	66.7	4.5	2	2	100.0	3.0	3	2	66.7	7.5
	Full-flow bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	8	7	87.5	5.0	7	5	71.4	4.0	8	5	62.5	9.0
2002	Transport	9	7	77.8	5.0	7	4	57.1	12.5	9	4	44.4	17.5
	Full-flow bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Bypass	5	4	80.0	5.5	4	0	0.0	--	5	0	0.0	--
	Inriver	54	44	81.5	5.0	44	21	47.7	5.0	54	21	38.9	10.0

Appendix Table B5b. Number of adults, conversion rates, and median travel times from Bonneville Dam to McNary Dam by age class for returning adults PIT-tagged at Winthrop Hatchery for Upper Columbia River hatchery spring Chinook salmon transportation studies, 2002-2004.

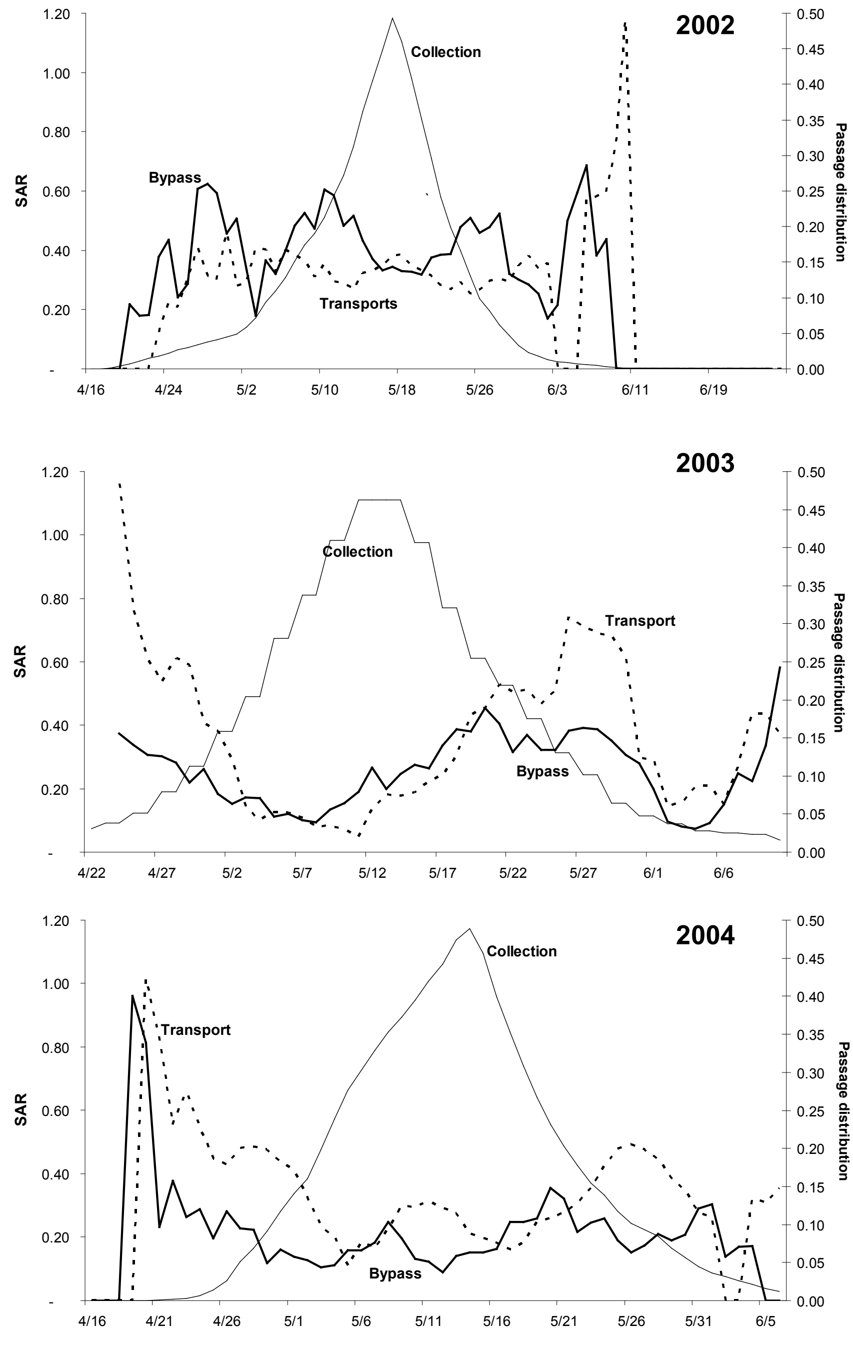
		Winthrop Hatchery Spring Chinook											
		Jacks				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time
2004	Transport	--	--	--	--	--	--	--	--	--	--	--	--
	Full-flow bypass	--	--	--	--	2	2	100.0	7.5	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	2	2	100.0	7.0	13	11	84.6	6.0	1	1	100.0	6.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2003	Transport	--	--	--	--	3	2	66.7	4.5	--	--	--	--
	Full-flow bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	1	1	100.0	5.0	5	4	80.0	5.5	2	2	100.0	6.5
2002	Transport	--	--	--	--	9	7	77.8	5.0	--	--	--	--
	Full-flow bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Bypass	1	0	0.0	--	4	4	100.0	5.5	--	--	--	--
	Inriver	5	5	100.0	5.0	49	39	79.6	5.0	--	--	--	--

Appendix Table B5c. Number of adults, conversion rates, and median travel times from McNary Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at Winthrop Hatchery for Upper Columbia River hatchery spring Chinook salmon transportation studies, 2002-2004.

		Winthrop Hatchery Spring Chinook											
		Jacks				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time
2004	Transport	--	--	--	--	--	--	--	--	--	--	--	--
	Full-flow bypass	--	--	--	--	2	2	100.0	3.5	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	2	2	100.0	5.5	11	11	100.0	4.0	1	1	100.0	7.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2003	Transport	--	--	--	--	2	2	100.0	3.0	--	--	--	--
	Full-flow bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	1	0	0.0	--	4	3	75.0	5.0	2	2	100.0	4.0
2002	Transport	--	--	--	--	7	4	57.1	12.5	--	--	--	--
	Full-flow bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Bypass	--	--	--	--	4	0	0.0	--	--	--	--	--
	Inriver	5	5	100.0	6.0	39	16	41.0	4.5	--	--	--	--

Appendix Table B5d. Number of adults, conversion rates, and median travel times from Bonneville Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at Winthrop Hatchery for Upper Columbia River hatchery spring Chinook salmon transportation studies, 2002-2004.

		Winthrop Hatchery Spring Chinook											
		Jacks				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time
2004	Transport	--	--	--	--	--	--	--	--	--	--	--	--
	Full-flow bypass	--	--	--	--	2	2	100.0	11.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	2	2	100.0	12.5	13	11	84.6	9.0	1	1	100.0	13.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2003	Transport	--	--	--	--	3	2	66.7	7.5	--	--	--	--
	Full-flow bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	1	0	0.0	--	5	3	60.0	9.0	2	2	100.0	10.5
2002	Transport	--	--	--	--	9	4	44.4	17.5	--	--	--	--
	Full-flow bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Bypass	1	0	0.0	--	4	0	0.0	--	--	--	--	--
	Inriver	5	5	100.0	11.0	49	16	32.7	10.0	--	--	--	--



Appendix Figure B1. Spring Chinook salmon smolt-to-adult return rates by juvenile detection date for fish bypassed or transported from McNary Dam in 2002, 2003, and 2004. Also shown is the distribution of juvenile Chinook collected at McNary Dam each year. Note that for bypass fish, passage in 2002 was via the juvenile fish facility bypass, passage in 2003 and 2004 was via full-flow bypass flume.

APPENDIX C

Hatchery Steelhead Tagging Data, 2003-2005

Appendix Table C1. Tag dates, releases dates, release numbers, and average tag lengths for yearling steelhead released from Columbia River hatcheries to evaluate transport from McNary Dam in 2003, 2004, and 2005.

Hatchery	Tagging date	Hatchery release date	Number released	Average length at tagging (mm)
		2003		
Winthrop	10-17 January 2003	30 April 2003	49,248	150.9
Wells	9 Sept–4 Oct. 2002	15 April–20 May 2003	246,088	94.0
Chelan	7-9 October 2002	4 April–2 May 2003	33,163	96.2
Eastbank	7-9 October 2002	15 April–20 May 2003	61,998	97.2
Ringold	10-15 October 2002	28-30 April 2003	95,159	119.9
Total released			485,656	
		2004		
Winthrop	8-14 January 2004	18 April 2004	49,477	157.7
Wells	3–16 Sept. 2003	21 April–7 May 2004	238,692	83.8
Chelan	12-13 October 2003	19 April 2004	29,916	114.0
Eastbank	9-12 October 2003	19–21 April 2004	63,397	105.9
Ringold	20-24 October 2003	12 April 2004	96,494	99.5
Total released			477,979	
		2005		
Winthrop	4-8 Oct 2004	22 Apr 2005	49,233	98.0
Wells	20 Sep-1 Oct 2004	19 Apr–2 Jun 2005	239,513	89.7
Chelan	16-17 Sept 2004	4 Apr 2005	34,807	94.0
Eastbank	13-15 Sept 2004	2-5 May 2005	59,791	96.7
Ringold	7-12 Sept 2004	11 Apr-15 May 2005	60,971*	74.8
Total released			444,315	

* The number of fish tagged was 94,875. However, an undetermined number of fish escaped the holding raceway through a hole in the tail screen prior to the scheduled release. To determine which fish were still in the pond, a set of PIT tag detectors was installed along the release line and only those fish detected leaving the pond at the scheduled time (60,971) were included in the study.

Appendix Table C2. Final dispositions at McNary Dam for fish released from Columbia River hatcheries to evaluate transport from McNary Dam in 2003, 2004, and 2005.

Hatchery	Diverted to transport	Diverted to full-flow bypass	Facility bypass	Separator adult bypass	Unknown	Not detected
			2003			
Winthrop	1,139	1,468	94	35	4	46,508
Wells	7,985	9,796	861	482	15	226,949
Chelan	1,141	1,195	74	54	0	30,699
Eastbank	2,122	2,590	161	187	3	56,935
Ringold	2,970	3,748	267	8	14	88,152
Total	15,357	18,797	1,457	766	36	449,243
			2004			
Methow	5,560	6,052	903	358	12	233,059
Okanogan	1,126	1,341	174	81	5	38,849
Wenatchee	2,111	2,635	256	167	6	88,138
Ringold	3,924	4,819	820	183	5	86,743
Total	12,721	14,847	2,153	789	28	447,441
			2005			
Methow	7,132	9,628	1,726	405	10	224,197
Okanogan	1,998	2,436	182	151	3	40,878
Wenatchee	3,963	4,745	424	332	10	85,124
Ringold	4,640	7,670	1,929	236	11	46,485
Total	17,733	24,479	4,261	1,124	34	396,684

Appendix Table C3. Survival estimates from release site to the McNary Dam tailrace, from McNary Dam to Bonneville Dam tailrace, and from release site to Bonneville Dam tailrace for steelhead tagged for McNary Dam transport evaluations in 2003, 2004, and 2005.

		Estimated survival		
Release site	Number released	Release to McNary Dam	McNary to Bonneville Dam	Release to Bonneville Dam
		2003		
Drainage				
Methow	131,463	0.4061	0.7709	0.3131
Okanogan	73,528	0.4618	0.7709	0.3560
Wenatchee	95,161	0.4815	0.7709	0.3712
Hatchery				
Wells	90,345	0.3865	0.7709	0.2979
Ringold	95,159	0.6650	0.7709	0.5126
Total	485,656	0.4735	0.7709	0.3650
		2004		
Drainage				
Methow	246,596	36.17	38.96	14.09
Okanogan	41,576	47.26	38.96	18.41
Wenatchee	93,313	34.32	38.96	13.37
Hatchery				
Ringold	96,494	44.85	38.96	17.47
Total	477,979	38.54	38.96	15.02
		2005		
Drainage				
Methow	243,098	34.72	64.28	22.32
Okanogan	45,648	41.94	64.28	26.96
Wenatchee	94,598	48.28	64.28	31.03
Hatchery				
Ringold	60,971	69.52	64.28	44.69
Total	444,315	41.83	64.28	26.89

Appendix Table C4. The estimated number of migrating hatchery steelhead arriving at the McNary Dam tailrace for McNary Dam transport evaluations in 2003, 2004, and 2005.

				Numbers of fish in each study group		
Release site	Number released	Estimated survival to McNary Dam	Estimated numbers arriving at McNary Dam*	Transported from McNary	Full-flow bypassed	Inriver migrant*
			2003			
Drainage						
Methow	131,463	0.4061	53,387	3,956	4,896	44,039
Okanogan	73,528	0.4618	33,955	2,593	3,373	27,429
Wenatchee	95,161	0.4815	45,820	3,263	3,785	38,301
Hatchery						
Wells	90,345	0.3865	34,918	2,575	2,995	28,940
Ringold	95,159	0.6650	63,281	2,970	3,748	56,276
Totals	485,656	0.4735	229,958	15,357	18,797	193,579
			2004			
Drainage						
Methow	246,596	36.17	89,184	5,560	6,052	76,484
Okanogan	41,576	47.26	19,649	1,126	1,341	16,949
Wenatchee	93,313	34.32	32,025	2,111	2,635	26,879
Hatchery						
Ringold	96,494	44.85	43,278	3,924	4,819	33,579
Totals	477,979	38.54	184,213	12,721	14,847	153,890
			2005			
Drainage						
Methow	243,098	0.3472	84,404	7,132	9,628	65,548
Okanogan	45,648	0.4194	19,145	1,998	2,436	14,385
Wenatchee	94,598	0.4828	45,671	3,963	4,745	36,213
Hatchery						
Ringold	60,971	0.6952	42,387	4,640	7,670	27,056
Totals	444,315	0.4183	185,857	17,733	24,479	143,244

* Number is an estimate of the proportion released that arrived at McNary Dam, not the sum of releases from each site. These estimates vary due to differences in survival rates and arrival timing at McNary Dam for the various release sites.

Appendix Table C5. Returns by study group and age-class of hatchery steelhead from fish tagged for McNary Dam transport evaluations in 2003, 2004, and 2005.

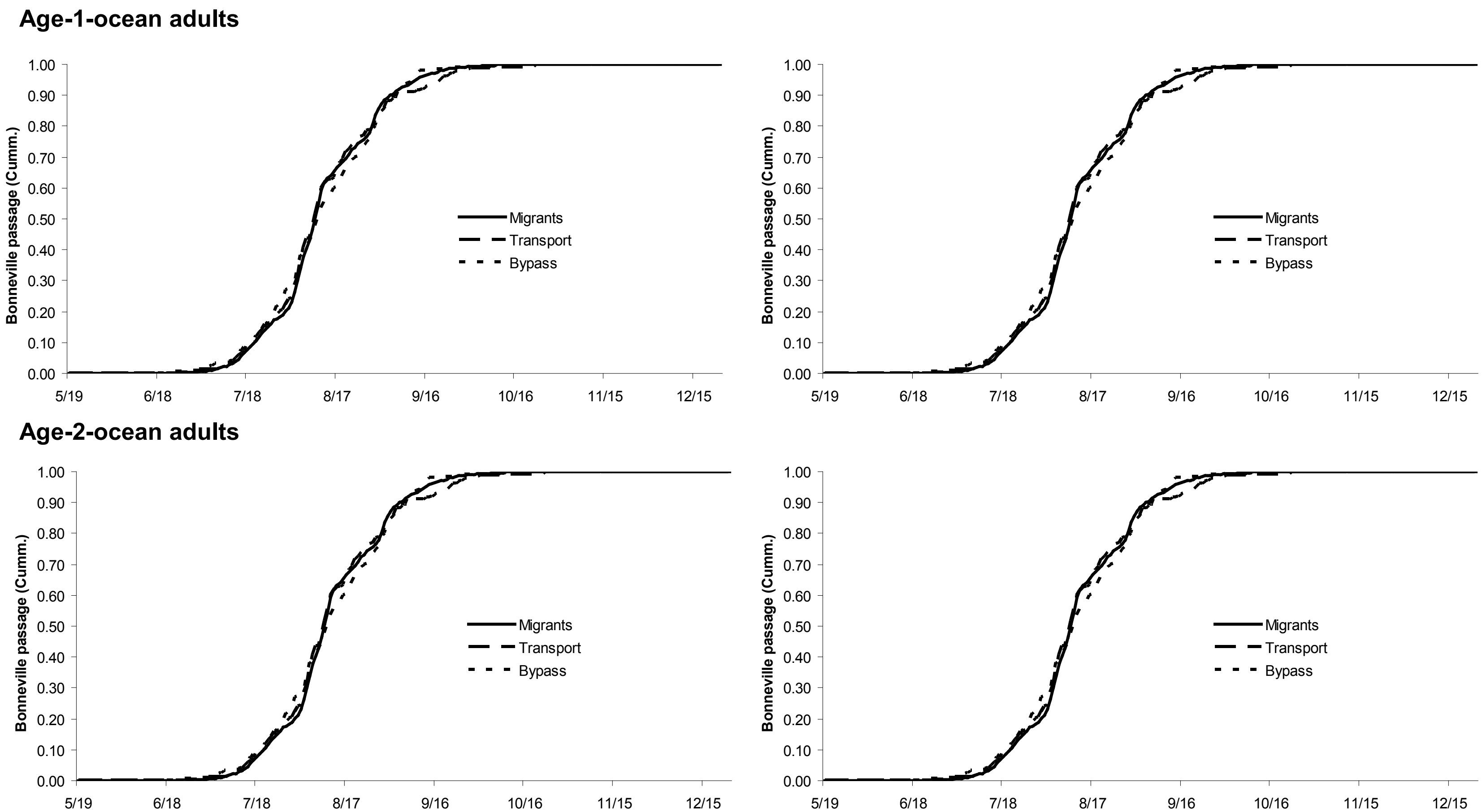
	Juvenile numbers	Returns by age-class		SAR	T/I	95% CI	T/B	95% CI
		1-ocean	2-ocean					
2003								
Transport	15,357	167	193	2.34	0.96	(0.86, 1.07)	1.21	(1.04,1.40)
Bypass	18,797	147	218	1.94	0.80	(0.71, 0.89)		
Inriver	193,579	2,322	2,422	2.45				
2004								
Transport	12,721	115	139	2.00	1.28	(1.12-1.45)	1.32	(1.10, 1.59)
Bypass	14,847	127	97	1.51	0.96	(0.84-1.11)		
Inriver	153,965	1,150	1,257	1.56				
2005								
Transport	17,733	327	52	2.14	1.06	(0.95-1.18)	1.08	(0.94-1.24)
Full-flow bypass	24,479	425	60	1.98	0.98	(0.89-1.08)		
Inriver	143,244	2,420	468	2.02				

Appendix Table C6. Percentage of adult hatchery steelhead observed at Bonneville Dam that were subsequently observed at McNary Dam (the conversion rate, not adjusted for fishery) from 2003 releases.

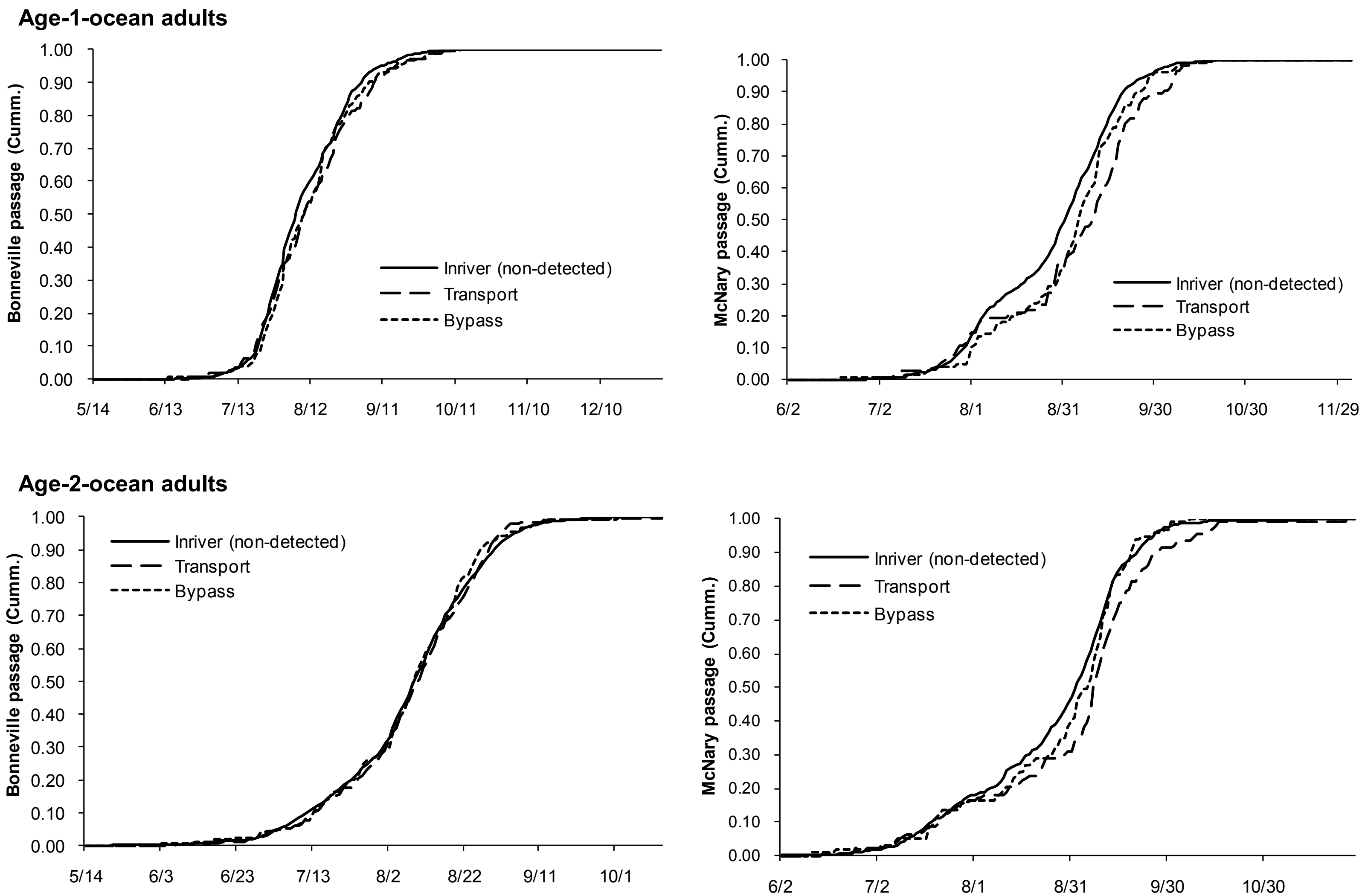
Age class	Migration history	Observed at Bonneville Dam	Observed at McNary Dam	Conversion rate
		2003		
Age-1-ocean	Transport	214	157	73.36
	Full-flow bypass	193	135	69.95
	Inriver	3,047	2,195	72.04
Age-2-ocean	Transport	282	191	67.73
	Full-flow bypass	300	214	71.33
	Inriver	3,542	2,392	67.53
Totals	Transport	496	348	70.16
	Full-flow bypass	493	349	70.79
	Inriver	6,589	4,587	69.62
All adults		7,608	5,305	69.73
		2004		
Age-1-ocean	Transport	179	126	70.39
	Full-flow bypass	176	126	71.59
	Inriver	1,596	1,157	72.49
Age-2-ocean	Transport	223	137	61.43
	Full-flow bypass	154	99	64.29
	Inriver	1,881	1,266	67.30
Totals	Transport	402	263	65.42
	Full-flow bypass	330	225	68.18
	Inriver	3,477	2,423	69.69
All adults		4,209	2,911	69.16
		2005		
Age-1-ocean	Transport	418	323	77.27
	Full-flow bypass	557	421	75.58
	Inriver	3,140	2,402	76.50
Age-2-ocean	Transport	73	53	72.60
	Full-flow bypass	89	60	67.42
	Inriver	622	468	75.24
Totals	Transport	491	376	76.58
	Full-flow bypass	646	481	74.46
	Inriver	3,762	2,870	76.29
All adults		4,899	3,727	76.08

Appendix Table C7. Median travel times from Bonneville Dam to McNary Dam for adult hatchery steelhead PIT tagged for the 2003 McNary Dam transport evaluation.

		Bonneville to McNary Dam	
Age class	Migration history	Number of adults	Median travel time (d)
		2003	
Age-1-ocean	Transport	156	19.0
	Bypass	134	16.5
	Inriver	2,189	17.0
Age-2-ocean	Transport	191	13.0
	Bypass	213	11.0
	Inriver	2,388	11.0
Totals	Transport	347	15.0
	Bypass	347	13.0
	Inriver	4,577	13.0
		2004	
Age-1-ocean	Transport	113	13.0
	Bypass	126	15.5
	Inriver	1,156	11.0
Age-2-ocean	Transport	137	20.0
	Bypass	99	17.0
	Inriver	1,265	13.0
Totals	Transport	250	17.0
	Bypass	225	16.0
	Inriver	2,421	12.0
		2005	
Age-1-ocean	Transport	323	16.0
	Bypass	421	10.0
	Inriver	2,387	11.0
Age-2-ocean	Transport	52	10.5
	Bypass	60	12.5
	Inriver	464	10.0
Totals	Transport	375	14.0
	Bypass	481	11.0
	Inriver	2,851	11.0

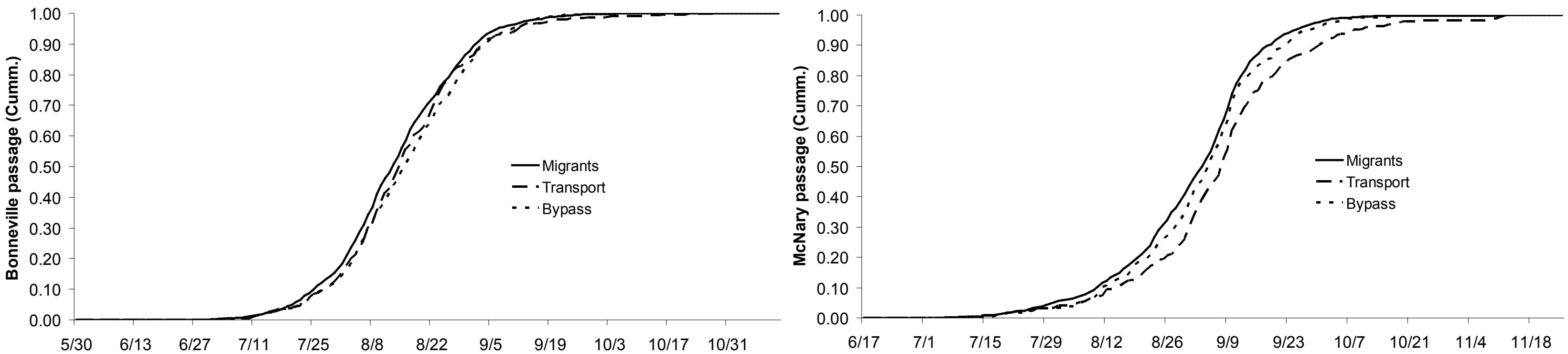


Appendix Figure C1. Distribution of wild steelhead tagged as smolts in 2003 and detected passing Bonneville (left) and McNary Dams (right) as age-1-ocean adults in 2004-2005 and as age-2-ocean adults in 2005-2006.

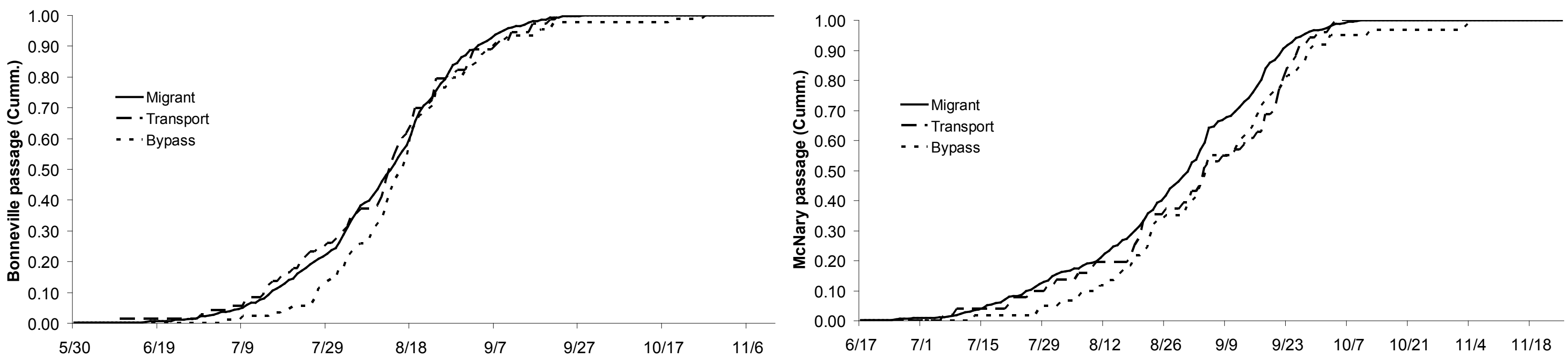


Appendix Figure C2. Distribution of wild steelhead tagged as smolts in 2004 and detected passing Bonneville (left) and McNary Dams (right) as age-1-ocean adults in 2005-2006 and as age-2-ocean adults in 2006-2007.

Age-1-ocean adults



Age-2-ocean adults



Appendix Figure C3. Distribution of wild steelhead tagged as smolts in 2005 and detected passing Bonneville (left) and McNary Dams (right) as age-1-ocean adults in 2006-2007 and as age-2-ocean adults in 2007-2008.

Appendix Table C8. Locations of observations (detections) of PIT-tagged hatchery steelhead within the McNary Dam juvenile fish facility, 2003. Monitor locations (shown in Figure 1): Adult Fish Return (AFR), A and B River Diversion (DIV), Full Flow Bypass (FFB), A and B Raceway Diversion (RAC), River 1 and River 2 Exits (RIV), A and B Separator Gate (SEP), A and B Subsample/Sample Room (for smolt monitoring sample SMP), A and B Raceway (for transportation loading TRA).

					Detected on full-flow and additional coil(s) (coil location)											
									Detected on separator and additional coil(s) (coil location)							
Date at MCJ (2003)	FFB	SEP or RAC	RIV	TRA	AFR	SEP or RAC	RIV	TRA	RAC	RIV	TRA	SMP	SMP RIV	RAC	RIV	TRA
13 Apr	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14 Apr	13	-	-	-	-	-	-	-	-	24	-	-	4	-	-	-
15 Apr	34	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-
16 Apr	3	-	-	-	-	-	-	-	-	29	-	-	1	-	-	-
17 Apr	16	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-
18 Apr	3	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
19 Apr	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20 Apr	4	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
21 Apr	107	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
22 Apr	167	-	-	-	-	-	-	4	-	49	642	-	43	1	-	2
23 Apr	691	-	-	-	-	-	-	3	-	-	192	-	5	-	-	-
24 Apr	317	-	1	-	-	2	4	1	1	3	463	1	25	-	-	2
25 Apr	480	-	-	-	-	-	-	-	-	-	100	-	4	-	-	-
26 Apr	100	-	-	-	-	1	-	4	2	1	210	1	2	-	1	-
27 Apr	276	-	-	-	-	3	-	2	2	-	53	-	1	-	-	-
28 Apr	36	-	-	-	-	-	1	-	-	1	121	-	1	-	-	-
29 Apr	135	-	-	-	-	-	-	-	1	-	30	-	-	-	-	-
30 Apr	46	-	-	-	-	-	-	5	-	1	142	-	-	-	-	-
1 May	141	1	-	-	-	-	-	-	-	-	31	-	-	-	-	-
2 May	28	-	-	-	-	-	-	-	-	-	78	-	1	-	-	-
3 May	97	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-
4 May	49	-	-	-	-	-	-	-	-	-	87	-	-	-	-	-
5 May	125	-	-	-	-	-	-	-	-	-	38	-	-	-	-	-
6 May	69	-	-	-	-	-	-	2	-	4	188	-	4	-	-	-

Appendix Table C8. Continued.

Date at MCJ (2003)	FFB	SEP or RAC	RIV	TRA	Detected on full-flow and additional coil(s) (coil location) AFR	SEP or RAC	RIV	TRA	Detected on separator and additional coil(s) (coil location) RAC	RIV	TRA	SMP	SMP RIV	RAC	RIV	TRA
7 May	268	-	-	-	-	-	-	-	-	-	90	-	1	-	-	1
8 May	86	-	-	-	-	-	-	3	-	3	225	-	3	-	-	-
9 May	400	-	-	-	-	-	-	2	1	-	68	-	1	-	-	-
10 May	210	-	-	-	-	2	-	4	1	5	359	-	1	-	-	-
11 May	250	-	-	-	-	1	-	-	-	-	91	-	-	-	-	-
12 May	67	-	-	-	-	-	1	-	-	1	183	-	2	-	-	-
13 May	234	-	-	-	-	-	-	-	1	-	45	-	1	-	-	-
14 May	115	-	-	-	-	-	-	-	-	1	243	-	4	-	-	-
15 May	459	-	-	-	-	-	-	-	-	2	78	-	-	-	-	-
16 May	328	-	-	-	-	-	-	1	-	23	611	-	6	-	-	2
17 May	944	-	-	-	-	-	-	-	-	14	184	-	-	-	-	1
18 May	420	-	-	-	-	-	-	2	1	66	811	-	9	-	-	1
19 May	1,346	-	-	-	-	-	-	2	1	25	211	-	4	-	-	-
20 May	455	-	-	-	-	-	-	4	-	92	972	-	11	-	-	7
21 May	607	-	-	-	-	-	-	-	-	6	104	-	-	-	2	2
22 May	237	-	-	-	-	-	-	1	-	54	489	-	5	-	-	-
23 May	790	-	-	-	-	-	-	4	-	47	281	-	1	-	-	3
24 May	260	-	-	-	50	-	-	1	-	104	813	-	7	-	2	-
25 May	1,094	-	-	-	38	-	-	-	-	45	261	-	1	-	-	-
26 May	460	-	-	1	37	1	-	24	1	137	850	1	8	-	-	1
27 May	966	-	1	-	25	-	-	-	-	41	335	-	1	-	-	-
28 May	357	-	-	-	2	-	-	1	2	62	570	-	6	-	-	-
29 May	534	-	-	-	-	-	-	-	2	29	194	-	-	-	1	-
30 May	129	-	-	-	21	-	1	-	-	30	222	-	2	-	-	-
31 May	331	-	-	-	1	-	-	-	-	10	72	-	-	-	-	1
1 Jun	225	-	-	-	163	-	-	2	2	129	1,261	-	10	-	-	2
2 Jun	1,123	-	-	-	53	-	-	-	-	82	499	-	2	-	2	2
3 June	390	1	-	-	148	-	-	-	3	35	912	1	5	-	-	1

Appendix Table C8. Continued.

Date at MCJ (2003)	FFB	SEP or RAC	RIV	TRA	Detected on full-flow and additional coil(s) (coil location)											
									Detected on separator and additional coil(s) (coil location)							
					AFR	SEP or RAC	RIV	TRA	TRA	RIV	TRA	SMP	SMP RIV	TRA	RIV	TRA
4 Jun	780	-	-	-	50	-	-	3	1	13	403	-	4	-	1	2
5 Jun	360	-	-	-	61	-	1	-	-	10	320	-	7	-	-	-
6 Jun	239	-	-	-	28	-	-	1	-	4	76	-	-	-	-	-
7 Jun	58	-	-	-	14	-	-	1	-	-	64	-	-	-	-	-
8 Jun	164	-	-	-	2	-	-	-	-	1	22	-	-	-	-	-
9 Jun	118	-	-	-	19	-	-	-	1	3	117	-	-	-	-	-
10 Jun	173	-	-	-	2	-	-	-	-	2	59	-	-	-	-	-
11 Jun	121	-	-	-	9	-	-	-	-	2	99	-	-	-	-	-
12 Jun	133	-	-	-	4	-	-	-	-	1	19	-	-	-	-	-
13 Jun	48	-	-	-	4	-	1	-	-	5	122	-	2	-	-	-
14 Jun	87	-	-	-	1	-	-	-	-	4	38	-	-	-	-	-
15 Jun	15	-	-	-	8	-	-	-	-	1	70	-	-	-	-	-
16 Jun	81	-	-	-	4	-	-	-	-	1	26	-	-	-	-	-
17 Jun	55	-	-	-	3	-	-	-	-	-	57	-	-	-	-	-
18 Jun	41	-	-	-	1	-	-	-	-	1	22	-	1	-	-	1
19 Jun	18	-	-	-	2	-	-	-	-	1	6	-	-	-	-	-
20 Jun	15	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-
21 Jun	18	-	-	-	-	-	-	-	-	1	31	-	-	-	-	-
22 Jun	32	-	-	-	-	-	-	-	-	-	14	-	1	-	-	-
23 Jun	25	-	-	-	-	-	-	-	-	2	21	-	-	-	-	-
24 Jun	34	-	-	-	-	-	-	-	-	-	17	-	-	-	-	-
25 Jun	31	-	-	-	-	-	-	-	-	-	39	-	-	-	-	-
26 Jun	43	-	-	-	1	-	-	-	-	-	18	-	-	-	-	1
27 Jun	29	-	-	-	2	-	-	-	-	2	27	-	-	-	-	1
28 Jun	1	-	-	-	1	-	-	-	-	1	32	-	-	-	-	-
29 Jun	-	-	-	-	3	-	-	-	-	2	23	-	-	-	-	-
30 Jun	1	-	-	-	-	-	-	-	-	1	10	-	-	-	-	-
1 Jul	-	-	-	-	2	-	-	-	-	-	11	-	-	-	-	-
2 Jul	2	-	-	-	-	-	-	-	-	1	5	-	-	-	-	-

Appendix Table C8. Continued.

Date at					Detected on full-flow and additional coil(s) (coil location)											
MCJ		SEP				SEP			Detected on separator and additional coil(s) (coil location)							
(2003)	FFB	or TRA	RIV	TRA	AFR	or TRA	RIV	TRA	TRA	RIV	TRA	SMP	SMP RIV	TRA	RIV	TRA
3 Jul	-	-	-	-	1	-	-	-	-	-	9	-	-	-	-	-
4 Jul	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
5 Jul	1	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-
6 Jul	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
7 Jul	-	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-
8 Jul	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
9 Jul	-	-	-	-	1	-	-	-	-	-	5	-	-	-	-	-
10 Jul	-	-	-	-	-	-	-	-	-	1	3	-	-	-	-	-
11 Jul	-	-	-	-	1	-	-	-	-	1	2	-	-	-	-	-
12 Jul	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
13 Jul	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
14 Jul	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
15 Jul	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
16 Jul	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-
17 Jul	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18 Jul	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
21 Jul	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
22 Jul	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
23 Jul	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
24 Jul	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-

Appendix Table C9. Locations of observations (detections) of PIT-tagged hatchery steelhead within the McNary Dam juvenile fish facility, 2004. Abbreviations for PIT monitor locations: FFB full-flow bypass, SEP separator, RIV facility bypass, TRN transport raceways, SMP, smolt monitoring program sample, TRA, raceway, DIV sort-by-code diversion gates.

				Detected on full-flow and additional coil(s) (coil location)														
										Detected on separator and additional coil(s) (coil location)								
Date at MCJ (2004)	FFB	AFR	SEP	AFR	SEP	RIV	SMP	TRA	SMP bypass	DIV	RIV	SMP	TRA	RIV TRA	SMP bypass	RIV	SMP	TRA
3 Apr	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10 Apr	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
16 Apr	-	-	-	1	-	-	-	-	-	-	-	-	9	-	4	-	-	-
17 Apr	150	-	-	1	-	-	-	-	-	-	1	-	15	-	5	1	-	-
18 Apr	36	-	-	2	-	-	-	-	-	-	5	2	174	-	32	-	-	-
19 Apr	770	-	-	5	-	-	-	-	-	-	3	-	143	-	22	-	-	1
20 Apr	806	-	-	60	2	10	-	-	-	-	106	31	1,291	-	152	-	-	1
21 Apr	1,108	-	-	34	1	-	-	-	1	-	34	5	363	-	26	-	-	-
22 Apr	250	-	-	8	-	5	-	-	2	-	24	2	388	-	8	-	-	-
23 Apr	426	-	-	3	-	-	-	-	-	-	17	4	173	-	23	-	-	2
24 Apr	139	-	-	18	-	-	-	-	-	2	36	1	362	1	45	-	-	-
25 Apr	245	-	-	14	-	-	-	-	-	-	5	2	92	-	14	-	-	-
26 Apr	78	-	-	8	-	-	-	-	2	-	25	-	158	1	2	-	-	-
27 Apr	197	-	-	7	1	-	1	-	3	-	5	2	43	1	10	-	-	-
28 Apr	49	-	-	6	-	-	-	-	-	2	22	1	165	-	5	-	-	-
29 Apr	138	-	-	3	-	-	-	-	1	-	5	-	64	1	14	-	-	-
30 Apr	32	-	-	3	-	1	-	-	-	-	10	-	98	-	2	-	-	-
1 May	116	-	-	3	-	-	-	-	-	-	7	-	59	-	19	1	-	-
2 May	67	-	-	3	-	-	-	-	-	-	7	-	99	-	1	-	-	-
3 May	92	-	-	6	-	-	-	-	-	-	6	-	46	-	16	-	-	-
4 May	26	-	-	5	-	-	-	-	-	-	8	-	78	1	3	-	-	-
5 May	110	-	-	12	-	-	-	-	-	-	3	-	29	-	13	-	-	-
6 May	51	-	-	8	-	-	-	-	-	-	9	-	130	1	4	-	-	1
7 May	262	-	-	3	-	-	-	-	-	-	7	4	54	-	12	-	-	1
8 May	218	-	-	39	1	-	-	-	-	8	6	2	376	-	12	-	-	1
9 May	405	-	-	26	-	-	-	2	-	-	25	5	214	-	37	1	1	1

Appendix Table C9. Continued.

Date at MCJ (2004)	FFB	AFR	SEP	Detected on full-flow and additional coil(s) (coil location)														
										Detected on separator and additional coil(s) (coil location)								
				AFR	SEP	RIV	SMP	TRA	SMP bypass	DIV	RIV	SMP	TRA	RIV TRA	SMP bypass	RIV	SMP	TRA
10 May	172	-	-	12	-	-	-	-	1	-	24	4	304	-	16	1	-	1
11 May	541	-	-	10	-	-	-	-	-	-	13	3	84	-	25	-	-	-
12 May	285	-	-	36	2	-	-	-	-	2	42	13	894	2	24	-	-	-
13 May	1,269	-	1	46	3	-	-	-	-	-	50	55	404	1	101	2	3	3
14 May	337	-	-	77	5	1	-	-	-	13	67	6	980	-	30	-	-	4
15 May	823	-	1	37	2	-	-	-	-	-	50	12	327	1	56	-	1	1
16 May	266	1	-	50	2	-	-	-	-	-	52	18	828	-	35	-	-	-
17 May	1,408	-	1	40	1	-	-	-	-	-	39	70	479	-	100	-	-	2
18 May	433	-	-	33	2	-	-	1	-	19	27	1	1,128	1	17	-	-	1
19 May	625	-	-	10	1	-	-	2	-	2	20	1	193	1	31	-	-	1
20 May	111	-	-	39	-	2	-	-	-	-	14	-	373	3	9	-	-	1
21 May	370	-	-	5	-	-	-	-	-	-	4	-	110	-	2	-	-	1
22 May	77	-	-	4	-	-	-	-	-	-	6	-	146	-	5	-	-	1
23 May	323	-	-	-	-	1	-	-	-	-	1	-	47	-	4	-	-	-
24 May	108	-	-	2	-	4	-	-	-	-	5	-	183	-	8	-	-	-
25 May	116	-	-	1	-	-	-	-	-	-	-	-	27	-	1	-	-	-
26 May	30	-	-	7	-	-	-	-	-	-	6	-	77	-	1	-	-	-
27 May	172	-	-	6	-	-	-	-	-	-	8	-	34	-	-	-	-	-
28 May	83	-	-	4	-	2	-	-	-	-	9	-	119	-	1	-	-	-
29 May	143	-	-	-	-	-	-	-	-	-	2	-	47	-	-	-	-	-
30 May	45	-	-	16	1	-	-	-	-	-	1	-	101	1	1	-	-	-
31 May	137	-	-	10	-	-	-	-	-	-	4	-	55	-	-	-	-	1
1 Jun	54	-	-	11	-	-	-	-	-	-	3	-	107	-	1	-	-	-
2 Jun	268	-	-	6	-	-	-	-	-	-	1	-	22	1	-	-	-	-
3 Jun	134	-	-	9	-	-	-	-	-	-	5	-	134	-	1	-	-	-
4 Jun	100	-	-	3	-	-	-	-	-	-	-	-	27	-	1	-	-	-
5 Jun	42	-	-	6	-	-	-	-	-	-	4	1	68	-	1	-	-	-
6 Jun	124	-	-	1	-	-	-	-	-	-	-	-	52	-	-	-	-	-
7 Jun	57	-	-	5	-	-	-	-	-	-	3	-	83	-	1	-	-	1
8 Jun	77	-	-	2	-	-	-	-	-	-	1	-	31	-	1	-	-	-

Appendix Table C9. Continued.

Date at MCJ (2004)	FFB	AFR	SEP	Detected on full-flow and additional coil(s) (coil location)														
										Detected on separator and additional coil(s) (coil location)								
				AFR	SEP	RIV	SMP	TRA	SMP bypass	DIV	RIV	SMP	TRA	RIV TRA	SMP bypass	RIV	SMP	TRA
9 Jun	17	-	-	2	-	-	-	-	-	-	-	-	24	-	-	-	-	-
10 Jun	63	-	-	1	-	-	-	-	-	-	1	-	6	-	-	-	-	-
11 Jun	35	-	-	2	1	-	-	-	-	-	-	-	63	1	1	-	-	-
12 Jun	69	-	-	-	-	-	-	-	-	-	2	-	29	-	1	-	-	-
13 Jun	29	-	-	-	-	-	-	-	-	-	2	-	23	-	-	-	-	-
14 Jun	37	-	-	-	-	-	-	-	-	-	1	-	7	-	-	-	-	-
15 Jun	10	-	-	4	-	-	-	-	-	-	2	-	31	1	2	-	-	-
16 Jun	21	-	-	-	-	-	-	-	-	-	2	-	10	-	1	-	-	-
17 Jun	5	-	-	1	-	-	-	-	-	-	1	-	11	-	-	-	-	-
18 Jun	18	-	-	-	-	-	-	-	-	-	1	-	2	-	-	-	-	-
19 Jun	14	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-
20 Jun	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21 Jun	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
22 Jun	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23 Jun	5	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-
24 Jun	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-	-	-	1
25 Jun	1	-	-	1	-	-	-	-	-	-	-	-	9	-	-	-	-	-
26 Jun	6	-	-	1	-	-	-	-	-	-	-	-	11	-	-	-	-	-
27 Jun	-	-	-	1	-	-	-	-	-	-	-	-	21	-	-	-	-	-
28 Jun	-	-	-	3	-	-	-	-	-	1	1	1	35	-	-	-	-	-
29 Jun	-	-	-	1	-	-	-	-	-	1	-	-	12	-	-	-	-	-
30 Jun	3	-	-	3	-	-	-	-	-	-	-	-	7	-	-	-	-	-
1 Jul	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-
2 Jul	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
3 Jul	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
4 Jul	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-
6 Jul	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
17 Jul	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28 Jul	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-

Appendix Table C10. Locations of observations (detections) of PIT-tagged hatchery steelhead within the McNary Dam juvenile fish facility, 2005.

Date at MCJ (2005)	FFB	AFR	SEP	AFR	SEP	RIV	TRA	TRA	DIV	RIV	SMP	TRA	RIV TRA	DIV RIV	SMP RIV	SMP TRA	RIV	TRA
				Detected on full-flow and additional coil(s) (coil location)														
									Detected on separator and additional coil(s) (coil location)									
15 Apr	16	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16 Apr	60	0	0	32	0	0	0	0	0	349	0	84	0	0	33	0	0	0
17 Apr	1238	0	0	25	1	0	0	0	0	385	0	94	0	0	42	0	0	0
18 Apr	1325	0	0	28	3	8	0	26	0	40	25	1353	0	0	226	0	0	1
19 Apr	1280	0	0	48	5	1	0	17	0	13	16	543	0	0	91	0	0	0
20 Apr	833	0	0	32	2	0	0	0	0	28	18	785	0	0	161	1	0	0
21 Apr	1164	0	0	21	0	0	0	0	0	19	19	408	0	0	86	0	0	0
22 Apr	232	0	0	14	0	1	0	0	0	21	3	332	0	0	88	0	0	0
23 Apr	445	0	0	4	0	0	0	0	0	8	1	76	0	0	13	0	0	0
24 Apr	75	0	0	6	0	1	0	0	0	13	8	195	0	0	51	0	0	0
25 Apr	159	0	0	1	0	0	0	0	0	3	1	50	0	0	8	0	0	0
26 Apr	68	0	0	6	0	0	0	0	0	6	1	134	0	0	38	0	0	0
27 Apr	130	0	0	1	0	0	0	0	0	4	0	46	0	0	4	0	0	0
28 Apr	43	0	0	3	0	0	0	0	0	10	1	95	0	0	17	0	0	0
29 Apr	107	0	0	4	0	0	0	0	0	4	0	29	1	0	8	0	0	0
30 Apr	91	0	0	3	0	0	0	0	0	4	0	32	0	0	10	0	0	0
01 May	48	0	0	0	0	0	0	0	0	0	0	20	0	0	7	0	0	0
02 May	10	0	0	0	0	0	0	0	0	5	0	39	0	0	6	0	0	0
03 May	95	0	0	1	0	0	0	0	0	2	0	8	0	0	2	0	0	0
04 May	43	0	0	5	0	0	0	0	0	22	0	188	0	0	13	0	0	0
05 May	290	0	0	2	0	0	0	0	0	13	0	77	0	0	5	0	0	0
06 May	107	0	0	10	1	1	0	2	13	95	1	405	0	0	19	0	0	0
07 May	1298	0	0	12	1	0	0	2	11	42	0	241	0	0	10	0	0	1
08 May	281	0	1	9	0	1	0	0	1	135	0	640	0	0	8	0	0	2
09 May	585	0	0	7	0	0	0	0	0	27	0	94	1	0	0	0	0	0
10 May	229	0	0	35	0	0	0	0	0	166	0	865	0	0	11	0	0	0
11 May	1509	0	0	17	0	0	0	0	0	70	0	408	1	0	2	0	0	3
12 May	359	0	0	57	1	0	0	0	4	97	0	902	3	0	7	0	0	0

Appendix Table C10. Continued.

				Detected on full-flow and additional coil(s) (coil location)														
									Detected on separator and additional coil(s) (coil location)									
MCJ date	FFB	AFR	SEP	AFR	SEP	RIV	TRA	Transport	DIV	RIV	SMP	Transport	RIV transport	DIV bypass	SMP bypass	SMP transport	RIV	Transport
13 May	669	0	0	9	0	0	0	0	1	16	0	138	1	0	0	0	0	0
14 May	193	1	0	54	2	1	0	0	0	106	0	566	0	0	7	0	0	0
15 May	884	3	0	35	1	0	0	0	0	40	0	303	0	0	1	0	1	8
16 May	132	0	1	15	0	1	0	4	3	56	1	474	1	0	8	0	1	1
17 May	536	0	0	6	0	1	1	9	0	13	0	73	0	0	1	0	0	0
18 May	346	0	2	26	3	0	1	0	3	99	0	1015	19	0	12	0	2	47
19 May	2037	2	1	19	0	0	1	0	2	20	0	202	15	0	2	0	1	6
20 May	1263	0	0	193	0	2	1	0	4	176	0	1711	290	0	21	0	2	2
21 May	1455	0	0	79	2	0	1	0	0	75	0	670	47	0	4	0	1	0
22 May	365	0	0	18	0	0	1	0	0	62	1	643	3	0	9	0	0	0
23 May	494	0	0	8	1	0	1	0	0	9	0	101	0	0	0	0	1	1
24 May	252	0	0	54	0	0	1	0	8	62	1	681	2	0	30	0	0	3
25 May	1074	0	0	53	1	0	1	0	2	39	1	356	0	0	7	0	0	0
26 May	295	0	0	63	0	1	1	1	10	26	0	663	2	0	21	0	1	10
27 May	486	0	0	6	1	0	1	0	2	14	0	147	0	0	5	0	0	2
28 May	166	0	0	16	2	0	1	7	5	16	0	444	1	0	20	0	0	1
29 May	676	0	0	7	0	1	1	2	4	15	0	222	2	0	3	0	0	1
30 May	199	0	0	17	2	0	1	0	1	20	1	300	0	0	7	0	0	0
31 May	181	0	0	8	0	0	1	0	0	7	0	59	0	0	0	0	0	0
01 Jun	54	0	0	16	0	0	1	0	0	12	0	157	0	0	4	0	0	0
02 Jun	214	0	0	6	0	0	1	0	0	7	0	77	0	0	0	0	0	0
03 Jun	42	0	0	8	0	0	1	0	2	5	0	87	0	0	3	0	0	0
04 Jun	51	0	0	0	0	0	1	0	0	0	0	14	0	0	0	0	0	0
05 Jun	40	0	0	3	0	0	1	0	1	8	0	70	0	0	2	0	0	0
06 Jun	100	0	0	4	0	0	1	0	0	7	0	44	0	0	0	0	0	0
07 Jun	26	0	0	0	0	0	1	0	0	3	0	70	0	0	2	0	0	0

Appendix Table C10. Continued.

				Detected on full-flow and additional coil(s) (coil location)														
										Detected on separator and additional coil(s) (coil location)								
MCJ date	FFB	AFR	SEP	AFR	SEP	RIV	TRA	Transport	DIV	RIV	SMP	Transport	RIV transport	DIV bypass	SMP bypass	RIV	SMP	Transport
08 Jun	28	0	0	2	0	0	1	0	0	2	0	9	0	0	0	0	0	0
09 Jun	6	0	0	2	0	1	1	0	0	7	0	18	0	0	0	0	0	0
10 Jun	38	0	0	0	0	0	1	0	0	0	0	7	0	0	0	0	0	0
11 Jun	9	0	0	0	0	0	1	0	0	2	0	11	0	0	0	0	0	0
12 Jun	18	0	0	0	0	0	1	0	0	2	0	6	0	0	0	0	0	0
13 Jun	3	0	0	1	0	0	1	0	0	1	0	8	0	0	0	0	0	0
14 Jun	6	0	0	0	0	0	1	0	1	0	0	4	0	0	0	0	0	0
15 Jun	3	0	0	1	0	0	1	0	0	1	0	10	0	0	1	0	0	0
16 Jun	3	0	0	0	0	0	1	0	0	1	0	1	0	0	1	0	0	0
17 Jun	2	0	0	0	0	0	1	0	0	1	0	4	0	0	0	0	0	0
18 Jun	3	0	0	0	0	0	1	0	0	0	0	3	0	0	0	0	0	0
19 Jun	0	0	0	0	0	0	1	0	0	0	0	3	0	0	0	0	0	0
20 Jun	4	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0
21 Jun	2	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0
22 Jun	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
23 Jun	1	0	0	0	0	0	1	0	0	0	0	7	0	0	0	0	0	0
24 Jun	0	0	0	0	0	0	1	0	0	0	0	15	0	0	0	0	0	0
25 Jun	0	0	0	0	0	0	1	0	0	0	0	9	0	0	0	0	0	0
26 Jun	0	0	0	0	0	0	1	0	0	0	0	8	0	1	0	0	0	0
27 Jun	0	0	0	1	0	0	1	0	0	0	0	1	0	1	0	0	0	0
28 Jun	0	0	0	1	0	0	1	0	0	0	0	5	0	0	0	0	0	0
29 Jun	0	0	0	2	0	0	1	0	0	1	0	6	0	3	0	0	0	0
30 Jun	0	0	0	0	0	0	1	0	0	0	1	7	0	0	0	0	0	0

APPENDIX D

Adult Return Data for Steelhead Tagged in 2003-2005

Appendix Table D1a. Juvenile and adult return numbers by hatchery of origin from Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Juvenile fish numbers					Returns by Age-class		
Hatchery of origin	Release location	Transport	Full-flow bypass	Juvenile facility bypass	Inriver migrant	Adult fish return	1-ocean	2-ocean	3-ocean
2005									
Chelan	Wenatchee R	1,371	1,547	110	13,325	86	81	25	-
Eastback	Wenatchee R	2,592	3,198	314	22,889	246	111	32	-
Ringold	Ringold Hat	4,640	7,670	1,929	27,056	236	1,191	144	-
Wells	Methow R	7,056	8,261	534	52,273	354	1,629	314	1
Wells	Okanogan R	1,998	2,436	182	14,385	151	214	53	-
Wintrop	Methow R	76	1,366	1,192	13,275	51	19	21	-
2004									
Chelan	Wenatchee R	677	845	69	8,617	31	30	64	1
Eastback	Wenatchee R	1,434	1,790	187	18,261	136	35	47	-
Ringold	Ringold Hat	3,924	4,819	820	33,579	183	800	603	2
Wells	Methow R	4,444	4,838	717	61,138	274	438	630	5
Wells	Okanogan R	1,126	1,341	174	16,949	81	82	137	-
Wintrop	Methow R	1,116	1,214	183	15,346	84	20	40	-
2003									
Chelan	Wenatchee R	1,141	1,192	74	13,341	54	147	121	1
Eastback	Wenatchee R	2,122	2,584	162	24,961	187	172	130	-
Ringold	Ringold Hat	2,967	3,747	267	56,277	8	1,320	1,051	2
Wells	Methow R	4,124	5,088	382	40,550	228	580	866	3
Wells	Okanogan R	1,575	2,046	263	16,652	122	101	168	1
Wells	Wells Hat	2,286	2,641	217	25,759	132	298	473	2
Wintrop	Methow R	1,138	1,465	94	16,487	35	24	35	1

Appendix Table D1b. Smolt-to-adult return rates by hatchery of origin from Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		SAR (95% CI)				
Hatchery of origin	Release location	Transport	Full-flow bypass	Juvenile facility bypass	Inriver migrant	Adult return
2005						
Chelan	Wenatchee R	1.17 (0.60-1.74)	0.45 (0.12-0.79)	-	0.62 (0.49-0.76)	-
Eastback	Wenatchee R	0.62 (0.31-0.92)	0.47 (0.23-0.71)	-	0.48 (0.39-0.58)	0.41 (0.00-1.20)
Ringold	Ringold Hat	2.07 (1.66-2.48)	3.49 (3.08-3.91)	3.32 (2.50-4.13)	3.33 (3.11-3.55)	2.54 (0.51-4.58)
Wells	Methow R	3.13 (2.72-3.55)	2.00 (1.69-2.30)	0.94 (0.12-1.76)	2.97 (2.82-3.11)	0.85 (0.00-1.81)
Wells	Okanogan R	1.50 (0.96-2.04)	1.11 (0.69-1.53)	0.55 (0.00-1.63)	1.45 (1.25-1.64)	0.66 (0.00-1.96)
Wintrop	Methow R	-	0.22 (0.00-0.47)	0.08 (0.00-0.25)	0.27 (0.18-0.36)	-
2004						
Chelan	Wenatchee R	1.77 (0.77-2.78)	0.47 (0.01-0.94)	-	0.92 (0.71-1.12)	-
Eastback	Wenatchee R	0.49 (0.13-0.85)	0.17 (0.00-0.36)	-	0.39 (0.30-0.49)	-
Ringold	Ringold Hat	3.64 (3.05-4.24)	3.38 (2.86-3.90)	2.93 (1.76-4.10)	3.18 (2.99-3.37)	3.83 (0.99-6.66)
Wells	Methow R	1.58 (1.21-1.94)	0.91 (0.64-1.18)	1.26 (0.44-2.08)	1.55 (1.45-1.65)	1.09 (0.00-2.33)
Wells	Okanogan R	1.42 (0.72-2.12)	0.60 (0.18-1.01)	-	1.14 (0.98-1.31)	1.23 (0.00-3.65)
Wintrop	Methow R	0.54 (0.11-0.97)	0.25 (0.00-0.53)	-	0.33 (0.24 0.42)	1.19 (0.00-3.52)
2003						
Chelan	Wenatchee R	1.93 (1.12-2.73)	2.18 (1.34-3.02)	-	1.66 (1.44-1.87)	-
Eastback	Wenatchee R	0.94 (0.53-1.36)	0.81 (0.47-1.16)	-	1.04 (0.91-1.17)	0.53 (0.00-1.58)
Ringold	Ringold Hat	3.74 (3.05-4.44)	3.15 (2.58-3.72)	3.37 (1.17-5.57)	3.79 (3.63-3.95)	-
Wells	Methow R	2.79 (2.28-3.30)	2.20 (1.79-2.61)	1.31 (0.16-2.46)	3.00 (2.83-3.17)	-
Wells	Okanogan R	2.03 (1.33-2.74)	0.88 (0.47-1.29)	1.52 (0.03-3.01)	1.30 (1.12-1.47)	-
Wells	Wells Hat	2.45 (1.81-3.09)	2.46 (1.86-3.06)	1.84 (0.04-3.65)	2.52 (2.32-2.71)	-
Wintrop	Methow R	0.44 (0.05-0.82)	0.34 (0.04-0.64)	-	0.30 (0.22-0.39)	-

Appendix Table D2a. Total number of adults, conversion rates, and median travel times for returning adults PIT-tagged at Chelan Hatchery and outplanted to the Wenatchee River for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Chelan Hatchery steelhead											
		Bonneville to McNary				McNary to Priest Rapids				Bonneville to Priest Rapids			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate (%)	Median travel time	McNary adults	PRD adults	Conversion rate (%)	Median travel time	Bonn adults	PRD adults	Conversion rate (%)	Median travel time
2005	Transport	20	16	80.00	24.0	16	15	93.75	5.0	20	15	75.00	36.0
	Full-flow bypass	8	7	87.50	25.0	7	7	100.00	9.0	8	7	87.50	31.0
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	103	82	79.61	12.0	83	83	100.00	6.0	103	83	80.58	20.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2004	Transport	16	12	75.00	14.0	12	12	100.00	5.0	16	12	75.00	21.0
	Full-flow bypass	6	4	66.67	21.5	4	4	100.00	7.5	6	4	66.67	37.5
	Bypass	1	0	0.00	--	--	--	--	--	1	0	0.00	--
	Inriver	111	79	71.17	12.0	79	78	98.73	7.0	111	79	71.17	24
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2003	Transport	27	20	74.07	23.0	22	21	95.45	6.0	27	20	74.07	33.0
	Full-flow bypass	31	26	83.87	25.5	26	24	92.31	7.0	31	26	83.87	31.5
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	255	215	84.31	12.0	221	199	90.05	7.0	255	194	76.08	25.0
	Adult return	1	0	0.00	--	--	--	--	--	1	0	0.00	--

Appendix Table D2b. Number of adults, conversion rates, and median travel times from Bonneville Dam to McNary Dam by age class for returning adults PIT-tagged at Chelan Hatchery and outplanted to the Wenatchee River for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Chelan Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time
2005	Transport	17	14	82.35	24.0	3	2	66.67	110.0	--	--	--	--
	Full-flow bypass	8	7	87.50	25.0	--	--	--	--	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	69	59	85.51	13.0	34	23	67.65	12.0	--	--	--	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2004	Transport	5	4	80.00	25.0	11	8	72.73	14.0	--	--	--	--
	Full-flow bypass	1	0	0.00	--	4	3	75.00	10.0	1	1	100.00	33.0
	Bypass	--	--	--	--	1	0	0.00	--	--	--	--	--
	Inriver	36	26	72.22	29.5	75	53	70.67	9.0	--	--	--	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2003	Transport	20	14	70.00	29.5	7	6	85.71	15.5	--	--	--	--
	Full-flow bypass	17	15	88.24	26.0	14	11	78.57	11.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	129	111	86.05	20.0	125	103	82.4	11.0	1	1	100.00	5.0
	Adult return	1	0	0.00	--	--	--	--	--	--	--	--	--

Appendix Table D2c. Number of adults, conversion rates, and median travel times from McNary Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at Chelan Hatchery and outplanted to the Wenatchee River for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Chelan Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time
2005	Transport	14	14	100.00	5.0	2	1	50.00	12.0	--	--	--	--
	Full-flow bypass	7	7	100.00	9.0	--	--	--	--	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	60	60	100.00	6.0	23	23	100.00	8.0	--	--	--	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2004	Transport	4	4	100.00	6.5	8	8	100.00	5.0	--	--	--	--
	Full-flow bypass	--	--	--	--	3	3	100.00	7.0	1	1	100.00	24.0
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	26	26	100.00	7.0	53	52	98.11	7.0	--	--	--	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2003	Transport	16	16	100.00	6.0	6	5	83.33	8.0	--	--	--	--
	Full-flow bypass	15	14	93.33	6.0	11	10	90.91	8.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	116	107	92.24	6.0	104	91	87.5	8.0	1	1	100.00	6.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--

Appendix Table D2d. Number of adults, conversion rates, and median travel times from Bonneville Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at Chelan Hatchery and outplanted to the Wenatchee River for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Chelan Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time
2005	Transport	17	14	82.35	32.0	3	1	33.33	225.0	--	--	--	--
	Full-flow bypass	8	7	87.50	31.0	--	--	--	--	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	69	59	85.51	20.0	34	24	70.59	21.0	--	--	--	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2004	Transport	5	4	80.00	32.5	11	8	72.32	21.0	--	--	--	--
	Full-flow bypass	1	0	0.00	--	4	3	75.00	18.0	1	1	100.00	57.0
	Bypass	--	--	--	--	1	0	0.00	--	--	--	--	--
	Inriver	36	26	72.22	35.5	75	53	70.67	19.0	--	--	--	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2003	Transport	20	15	75.00	35.0	7	5	71.43	20.0	--	--	--	--
	Full-flow bypass	17	15	88.24	31.0	14	11	78.57	32.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	129	103	79.84	31.0	125	90	72.00	21.5	1	1	100.00	11.0
	Adult return	1	0	0.00	--	--	--	--	--	--	--	--	--

Appendix Table D3a. Total number of adults, conversion rates, and median travel times for returning adults PIT-tagged at Eastbank Hatchery and outplanted to the Wenatchee River for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Eastbank Hatchery steelhead											
		Bonneville to McNary				McNary to Priest Rapids				Bonneville to Priest Rapids			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate (%)	Median travel time	McNary adults	PRD adults	Conversion rate (%)	Median travel time	Bonn adults	PRD adults	Conversion rate (%)	Median travel time
2005	Transport	24	16	66.67	9.5	16	16	100.00	5.5	24	16	66.67	17.0
	Full-flow bypass	18	15	83.33	9.0	15	15	100.00	7.0	18	15	83.33	18.0
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	146	110	75.34	9.0	111	110	99.10	6.0	146	112	76.71	17.0
	Adult return	1	1	100.00	36.0	1	1	100.00	4.0	1	1	100.00	40.0
2004	Transport	10	6	60.00	9.0	7	7	100.00	6.0	10	6	60.00	14.5
	Full-flow bypass	5	3	60.00	32.0	3	3	100.00	5.0	5	3	60.00	37.0
	Bypass	2	0	0.00	--	--	--	--	--	2	0	0.00	--
	Inriver	100	72	72.00	14.5	72	71	98.61	5.0	100	73	73.00	20.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2003	Transport	21	19	90.48	14.0	20	19	95.00	5.0	21	19	90.48	24.0
	Full-flow bypass	28	20	71.43	9.5	21	18	85.71	6.0	28	19	67.86	17.0
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	339	252	74.34	15.0	260	244	93.85	6.0	339	248	73.16	21.0
	Adult return	1	1	100.00	6.0	1	1	100.00	4.0	1	1	100.00	10.0

Appendix Table D3b. Number of adults, conversion rates, and median travel times from Bonneville Dam to McNary Dam by age class for returning adults PIT-tagged at Eastbank Hatchery and outplanted to the Wenatchee River for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Eastbank Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time
2005	Transport	20	14	70.00	10.5	4	2	50.00	8.0	--	--	--	--
	Full-flow bypass	12	9	75.00	8.0	6	6	100.00	11.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	112	86	76.79	10.0	34	24	70.59	8.0	--	--	--	--
	Adult return	1	1	100.00	36.0	--	--	--	--	--	--	--	--
2004	Transport	4	2	50.00	17.5	6	4	66.67	9.0	--	--	--	--
	Full-flow bypass	1	1	100.00		4	2	50.00	40.5	--	--	--	--
	Bypass	2	0	0.00	--	--	--	--	--	--	--	--	--
	Inriver	43	31	72.09	14.0	57	41	71.93	15.0	--	--	--	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2003	Transport	7	5	71.43	10.0	14	14	100.00	14.5	--	--	--	--
	Full-flow bypass	19	14	73.68	9.5	9	6	66.67	11.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	197	147	67.04	16.0	142	105	73.94	14.0	--	--	--	--
	Adult return	--	--	--	--	1	1	100.00	6.0	--	--	--	--

Appendix Table D3c. Number of adults, conversion rates, and median travel times from McNary Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at Eastbank Hatchery and outplanted to the Wenatchee River for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Eastbank Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time
2005	Transport	14	14	100.00	5.5	2	2	100.00	5.0	--	--	--	--
	Full-flow bypass	9	9	100.00	7.0	6	6	100.00	6.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	87	86	98.85	6.0	24	24	100.00	5.0	--	--	--	--
	Adult return	1	1	100.00	4.0	--	--	--	--	--	--	--	--
2004	Transport	3	3	100.00	6.0	4	4	100.00	5.0	--	--	--	--
	Full-flow bypass	1	1	100.00	--	2	2	100.00	6.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	31	31	100.00	6.0	41	40	97.56	5.0	--	--	--	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2003	Transport	6	5	83.33	4.0	14	14	100.00	5.5	--	--	--	--
	Full-flow bypass	14	11	78.57	5.0	7	7	100.00	6.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	152	144	94.74	5.0	108	100	92.59	5.0	--	--	--	--
	Adult return	--	--	--	--	1	1	100.00	4.0	--	--	--	--

Appendix Table D3d. Number of adults, conversion rates, and median travel times from Bonneville Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at Eastbank Hatchery and outplanted to the Wenatchee River for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Eastbank Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time
2005	Transport	20	14	70.00	19.0	4	2	50.00	13.0	--	--	--	--
	Full-flow bypass	12	9	75.00	18.0	6	6	100.00	18.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	112	88	78.57	19.5	34	24	70.59	13.5	--	--	--	--
	Adult return	1	1	100.00	40.0	--	--	--	--	--	--	--	--
2004	Transport	4	2	50.00	22.5	6	4	66.67	14.5	--	--	--	--
	Full-flow bypass	1	1	100.00	--	4	2	50.00	46.5	--	--	--	--
	Bypass	2	0	0.00	--	--	--	--	--	--	--	--	--
	Inriver	43	32	74.42	21.5	57	41	71.93	19.0	--	--	--	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2003	Transport	7	5	71.43	18.0	14	14	100.00	24.5	--	--	--	--
	Full-flow bypass	19	13	68.42	14.0	9	6	66.67	19.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	197	149	75.63	21.0	142	99	69.72	19.0	--	--	--	--
	Adult return	--	--	--	--	1	1	100.00	10.0	--	--	--	--

Appendix Table D4a. Total number of adults, conversion rates, and median travel times for returning adults PIT-tagged at and released from Ringold Hatchery for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Ringold Hatchery steelhead											
		Bonneville to McNary				McNary to Priest Rapids				Bonneville to Priest Rapids			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate (%)	Median travel time	McNary adults	PRD adults	Conversion rate (%)	Median travel time	Bonn adults	PRD adults	Conversion rate (%)	Median travel time
2005	Transport	125	93	74.40	21.0	96	13	13.54	10.0	125	13	10.40	42.0
	Full-flow bypass	374	266	71.12	10.0	268	61	22.76	12.0	374	60	16.04	22.5
	Bypass	80	64	80.00	12.0	64	13	20.31	11.0	80	13	16.25	20.0
	Inriver	1,213	894	73.70	11.0	901	208	23.09	15.0	1,213	208	17.15	28.0
	Adult return	10	6	60.0	7.5	6	1	16.67	47.0	10	1	10.00	56.0
2004	Transport	236	138	58.47	18.0	143	54	37.76	13.0	236	49	20.76	26.0
	Full-flow bypass	238	162	68.07	17.0	163	78	47.85	13.0	238	81	34.03	26.0
	Bypass	32	22	68.75	11.0	24	14	58.33	22.0	32	13	40.63	33.0
	Inriver	1,581	1,054	66.67	12.0	1,068	503	47.10	13.0	1,581	514	32.51	27.5
	Adult return	12	7	58.33	33.0	7	0	0.00	--	12	0	0.00	--
2003	Transport	166	108	65.06	17.5	111	12	10.81	13.5	166	13	07.83	36.0
	Full-flow bypass	184	110	59.78	18.5	118	18	15.25	19.0	184	17	9.24	45.0
	Bypass	12	9	75.00	28.0	9	3	33.33	10.0	12	3	25.00	37.0
	Inriver	3,225	2,056	63.75	19.0	2,135	379	17.75	14.0	3,225	367	11.38	30.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--

Appendix Table D4b. Number of adults, conversion rates, and median travel times from Bonneville Dam to McNary Dam by age class for returning adults PIT-tagged at and released from Ringold Hatchery for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Ringold Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time
2005	Transport	114	84	73.68	21.5	11	9	81.82	20.0	--	--	--	--
	Full-flow bypass	337	242	71.81	10.0	37	24	64.86	11.0	--	--	--	--
	Bypass	72	58	80.56	11.5	9	7	77.78	20.5	--	--	--	--
	Inriver	1,074	789	73.46	11.0	139	105	75.54	9.0	--	--	--	--
	Adult return	10	6	60.00	7.5	--	--	--	--	--	--	--	--
2004	Transport	124	81	65.32	13.0	112	57	50.89	22.0	--	--	--	--
	Full-flow bypass	152	106	69.74	16.0	86	56	65.12	17.5	--	--	--	--
	Bypass	12	7	58.33	11.0	20	15	75.00	11.0	--	--	--	--
	Inriver	847	586	69.19	12.0	731	466	63.75	12.0	3	2	66.67	29.0
	Adult return	8	4	50.00	29.5	4	3	75.00	34.0	--	--	--	--
2003	Transport	87	60	68.97	18.0	79	48	60.76	16.0	--	--	--	--
	Full-flow bypass	85	51	60.00	13.0	99	56	59.60	22.0	--	--	--	--
	Bypass	3	2	66.67	19.0	9	7	77.78	28.0	--	--	--	--
	Inriver	1,684	1,129	67.04	19.0	1,538	925	60.14	20.0	3	2	66.67	19.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--

Appendix Table D4c. Number of adults, conversion rates, and median travel times from McNary Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at and released from Ringold Hatchery for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Ringold Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time
2005	Transport	87	12	13.79	9.5	9	1	11.11	22.0	--	--	--	--
	Full-flow bypass	244	51	20.90	13.0	24	10	41.67	10.5	--	--	--	--
	Bypass	58	11	18.97	11.0	6	2	33.33	16.0	--	--	--	--
	Inriver	796	179	22.49	16.0	105	29	27.62	11.0	--	--	--	--
	Adult return	6	1	16.67	47.0	--	--	--	--	--	--	--	--
2004	Transport	83	28	33.73	13.0	60	26	43.33	13.0	--	--	--	--
	Full-flow bypass	107	49	45.79	17.0	56	29	51.79	10.0	--	--	--	--
	Bypass	9	5	55.56	24.0	15	9	60.00	22.0	--	--	--	--
	Inriver	597	271	45.39	16.0	469	231	49.25	11.0	2	1	50.00	11.0
	Adult return	4	0	0.00	--	3	0	0.00	--	--	--	--	--
2003	Transport	64	4	6.35	18.5	48	8	16.67	13.0	--	--	--	--
	Full-flow bypass	58	7	12.07	26.0	60	11	18.33	19.0	--	--	--	--
	Bypass	2	0	0.00	--	7	3	42.86	10.0	--	--	--	--
	Inriver	1,197	157	13.12	15.0	936	222	23.72	13.0	2	0	0.00	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--

Appendix Table D4d. Number of adults, conversion rates, and median travel times from Bonneville Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at and released from Ringold Hatchery for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Ringold Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time
2005	Transport	114	12	10.53	45.5	11	1	9.09	29.0	--	--	--	--
	Full-flow bypass	337	50	14.84	23.5	37	10	27.03	21.0	--	--	--	--
	Bypass	72	11	15.28	19.0	8	2	25.00	46.5	--	--	--	--
	Inriver	1,074	178	16.57	29.0	139	30	21.58	21.5	--	--	--	--
	Adult return	10	1	10.00	56.0	--	--	--	--	--	--	--	--
2004	Transport	124	26	20.97	25.0	112	23	20.54	35.0	--	--	--	--
	Full-flow bypass	152	50	32.89	28.0	86	13	36.05	23.0	--	--	--	--
	Bypass	12	4	33.33	41.0	20	9	45.00	33.0	--	--	--	--
	Inriver	847	278	32.82	32.0	731	235	32.15	23.0	3	1	33.33	24.0
	Adult return	8	0	0.00	--	4	0	0.00	--	--	--	--	--
2003	Transport	87	5	5.75	24.0	79	8	10.13	37.5	--	--	--	--
	Full-flow bypass	85	5	5.88	61.0	99	12	12.12	41.5	--	--	--	--
	Bypass	3	0	0.00	--	9	3	33.33	37.0	--	--	--	--
	Inriver	1,684	148	8.79	29.0	1,538	219	14.24	30.0	3	0	0.00	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--

Appendix Table D5a. Total number of adults, conversion rates, and median travel times for returning adults PIT-tagged at Wells Hatchery and outplanted to the Methow River for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Wells Hatchery steelhead											
		Bonneville to McNary				McNary to Priest Rapids				Bonneville to Priest Rapids			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate (%)	Median travel time	McNary adults	PRD adults	Conversion rate (%)	Median travel time	Bonn adults	PRD adults	Conversion rate (%)	Median travel time
2005	Transport	284	220	77.46	14.0	221	218	98.64	5.0	284	219	77.11	21.0
	Full-flow bypass	210	163	77.62	12.0	165	162	98.18	6.0	210	162	77.14	19.0
	Bypass	7	5	71.43	24.0	5	5	100.00	6.0	7	5	71.43	30.0
	Inriver	1,982	1,525	76.94	11.0	1,550	1,518	97.94	6.0	1,982	1,509	76.14	19.0
	Adult return	4	3	75.00	42.0	3	3	100.00	8.0	4	3	75.00	50.0
2004	Transport	107	69	64.49	16.0	70	70	100.00	5.0	107	72	67.29	24.5
	Full-flow bypass	62	44	70.97	14.5	44	42	95.45	5.5	62	42	67.74	21.0
	Bypass	11	9	81.82	9.0	9	8	88.89	6.0	11	8	72.73	16.0
	Inriver	1,339	936	69.90	13.0	947	930	98.20	6.0	1,339	939	70.13	21.0
	Adult return	6	3	50.00	13.0	3	3	100.00	5.0	6	4	66.67	16.0
2003	Transport	157	113	71.97	15.0	115	105	91.30	6.0	157	105	66.88	23.0
	Full-flow bypass	136	106	77.94	11.0	112	103	91.96	6.0	136	98	72.06	22.0
	Bypass	7	4	57.15	8.0	5	4	80.00	6.0	7	3	42.86	16.0
	Inriver	1,593	1,182	74.20	10.0	1,217	1,126	92.52	6.0	1,593	1,131	71.00	19.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--

Appendix Table D5b. Number of adults, conversion rates, and median travel times from Bonneville Dam to McNary Dam by age class for returning adults PIT-tagged at Wells Hatchery and outplanted to the Methow River for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Wells Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time
2005	Transport	237	185	78.06	14.0	47	35	74.47	10.0	--	--	--	--
	Full-flow bypass	172	139	80.81	12.0	38	24	63.16	12.5	--	--	--	--
	Bypass	6	4	66.67	20.0	1	1	100.00	60.0	--	--	--	--
	Inriver	1,646	1,275	77.46	11.0	334	249	74.55	10.0	2	1	50.00	14.0
	Adult return	3	2	66.67	42.5	1	1	100.00	6.0	--	--	--	--
2004	Transport	36	18	50.00	9.0	71	51	71.83	20.0	--	--	--	--
	Full-flow bypass	18	16	88.89	12.0	44	28	63.64	15.0	--	--	--	--
	Bypass	1	0	0.00	--	10	9	90.00	9.0	--	--	--	--
	Inriver	543	397	73.11	10.0	791	534	67.51	15.0	5	5	100.00	7.0
	Adult return	2	1	50.00	44.0	4	2	50.00	9.5	--	--	--	--
2003	Transport	54	39	72.22	23.5	103	74	71.84	13.0	--	--	--	--
	Full-flow bypass	44	32	72.73	18.0	92	74	80.43	9.5	--	--	--	--
	Bypass	2	0	0.00	--	5	4	80.00	8.0	--	--	--	--
	Inriver	608	471	77.47	14.0	980	708	72.24	10.0	5	3	60.00	9.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--

Appendix Table D5c. Number of adults, conversion rates, and median travel times from McNary Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at Wells Hatchery and outplanted to the Methow River for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Wells Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time
2005	Transport	186	183	98.39	6.0	35	35	100.00	5.0	--	--	--	--
	Full-flow bypass	141	138	97.87	60	24	24	100.00	5.0	--	--	--	--
	Bypass	4	4	100.00	6.5	1	1	100.00	5.0	--	--	--	--
	Inriver	1,296	1,267	97.76	6.0	253	250	98.81	6.0	1	1	100.00	11.0
	Adult return	2	2	100.00	10.0	1	1	100.00	7.0	--	--	--	--
2004	Transport	19	19	100.00	5.0	51	51	100.00	5.0	--	--	--	--
	Full-flow bypass	16	16	100.00	6.0	28	26	92.86	5.0	--	--	--	--
	Bypass	--	--	--	--	9	8	88.89	6.0	--	--	--	--
	Inriver	402	399	99.25	6.0	540	526	97.41	5.0	5	5	100.00	5.0
	Adult return	1	1	100.00	5.0	2	2	100.00	5.0	--	--	--	--
2003	Transport	40	37	92.50	6.0	75	68	90.67	6.0	--	--	--	--
	Full-flow bypass	37	35	94.59	5.0	75	68	90.67	7.0	--	--	--	--
	Bypass	1	1	100.00	4.0	4	3	75.00	7.0	--	--	--	--
	Inriver	502	469	93.43	5.0	712	655	91.99	6.0	3	2	66.67	4.5
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--

Appendix Table D5d. Number of adults, conversion rates, and median travel times from Bonneville Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at Wells Hatchery and outplanted to the Methow River for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Wells Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time
2005	Transport	237	183	77.22	22.0	47	36	76.60	16.5	--	--	--	--
	Full-flow bypass	172	137	79.65	19.0	38	25	65.79	19.0	--	--	--	--
	Bypass	6	4	66.67	27.0	1	1	100.00	65.0	--	--	--	--
	Inriver	1,646	1,259	76.49	19.0	334	249	74.55	18.0	2	1	50.00	25.0
	Adult return	3	2	66.67	52.5	1	1	100.00		--	--	--	--
2004	Transport	36	20	55.56	20.5	71	52	73.24	25.5	--	--	--	--
	Full-flow bypass	18	16	88.89	23.0	44	26	59.09	21.0	--	--	--	--
	Bypass	1	0	0.00	--	10	8	80.00	16.0	--	--	--	--
	Inriver	543	404	74.40	20.0	791	530	67.00	22.0	5	5	100.00	13.0
	Adult return	2	2	100.00	32.0	4	2	50.00		--	--	--	--
2003	Transport	54	37	68.52	28.0	103	68	66.02	23.0	--	--	--	--
	Full-flow bypass	44	31	70.45	23.0	92	67	72.83	19.0	--	--	--	--
	Bypass	2	0	0.00	--	5	3	60.00	16.0	--	--	--	--
	Inriver	608	455	74.84	21.0	980	674	68.78	19.0	5	2	40.00	22.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--

Appendix Table D6a. Total number of adults, conversion rates, and median travel times for returning adults PIT-tagged at Wells Hatchery and outplanted to the Okanogan River for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Wells Hatchery steelhead											
		Bonneville to McNary				McNary to Priest Rapids				Bonneville to Priest Rapids			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate (%)	Median travel time	McNary adults	PRD adults	Conversion rate (%)	Median travel time	Bonn adults	PRD adults	Conversion rate (%)	Median travel time
2005	Transport	30	26	86.67	10.5	26	26	100.00	6.0	30	26	86.67	18.0
	Full-flow bypass	25	22	88.00	8.5	22	22	100.00	6.5	25	22	88.00	17.0
	Bypass	2	1	50.00	9.0	1	1	100.00	9.0	2	1	50.00	18.0
	Inriver	204	162	79.41	9.0	164	158	96.34	6.0	204	157	76.96	18.0
	Adult return	1	1	100.00	28.0	1	1	100.00	4.0	1	1	100.00	32.0
2004	Transport	8	5	62.50	25.0	5	5	100.00	5.0	8	5	62.50	30.0
	Full-flow bypass	3	2	66.67	28.5	2	2	100.00	8.0	3	2	66.67	36.5
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	98	73	74.49	9.0	74	73	98.65	7.0	98	72	73.47	18.0
	Adult return	1	1	100.00	41.0	1	1	100.00	7.0	1	1	100.00	48.0
2003	Transport	15	12	80.00	18.0	13	13	100.00	5.0	15	13	86.67	24.0
	Full-flow bypass	5	4	80.00	8.5	4	3	75.00	5.0	5	3	60.00	15.0
	Bypass	1	1	100.00	14.0	1	1	100.00	4.0	1	1	100.00	18.0
	Inriver	94	76	80.85	11.0	83	82	98.80	6.0	94	78	82.98	25.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--

Appendix Table D6b. Number of adults, conversion rates, and median travel times from Bonneville Dam to McNary Dam by age class for returning adults PIT-tagged at Wells Hatchery and outplanted to the Okanogan River for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Wells Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time
2005	Transport	30	26	86.67	10.5	7	4	57.14	16.5	--	--	--	--
	Full-flow bypass	25	22	88.00	8.5	6	5	83.33	18.0	--	--	--	--
	Bypass	2	1	50.00	9.0	--	--	--	--	--	--	--	--
	Inriver	204	162	79.41	9.0	54	44	81.48	11.0	--	--	--	--
	Adult return	1	1	100.00	28.0	--	--	--	--	--	--	--	--
2004	Transport	8	5	62.50	25.0	14	11	78.57	13.0	--	--	--	--
	Full-flow bypass	3	2	66.67	28.5	11	6	54.55	17.5	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	98	73	74.49	9.0	174	118	67.82	12.5	--	--	--	--
	Adult return	1	1	100.00	41.0	--	--	--	--	--	--	--	--
2003	Transport	15	12	80.00	18.0	26	17	65.38	8.0	1	1	100.00	12.0
	Full-flow bypass	5	4	80.00	8.5	23	14	60.87	13.5	--	--	--	--
	Bypass	1	1	100.00	14.0	2	2	100.00	14.0	--	--	--	--
	Inriver	94	76	80.85	11.0	188	132	70.21	10.0	--	--	--	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--

Appendix Table D6c. Number of adults, conversion rates, and median travel times from McNary Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at Wells Hatchery and outplanted to the Okanogan River for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Wells Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time
2005	Transport	26	26	100.00	6.0	4	4	100.00	5.0	--	--	--	--
	Full-flow bypass	22	22	100.00	6.5	5	5	100.00	4.0	--	--	--	--
	Bypass	1	1	100.00	9.0	--	--	--	--	--	--	--	--
	Inriver	164	158	96.34	6.0	44	40	90.91	6.0	--	--	--	--
	Adult return	1	1	100.00	4.0	--	--	--	--	--	--	--	--
2004	Transport	5	5	100.00	5.0	11	11	100.00	5.0	--	--	--	--
	Full-flow bypass	2	2	100.00	8.0	6	6	100.00	5.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	74	73	98.65	7.0	120	118	98.33	5.0	--	--	--	--
	Adult return	1	1	100.00	7.0	--	--	--	--	--	--	--	--
2003	Transport	13	13	100.00	5.0	18	16	88.89	5.0	1	1	100.00	9.0
	Full-flow bypass	4	3	75.00	5.0	14	13	92.86	7.0	--	--	--	--
	Bypass	1	1	100.00	4.0	3	2	66.67	6.0	--	--	--	--
	Inriver	83	82	98.80	6.0	133	118	88.72	6.0	--	--	--	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--

Appendix Table D6d. Number of adults, conversion rates, and median travel times from Bonneville Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at Wells Hatchery and outplanted to the Okanogan River for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Wells Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time
2005	Transport	30	26	86.67	18.0	7	4	57.14	25.0	--	--	--	--
	Full-flow bypass	25	22	88.00	17.0	6	5	83.33	21.0	--	--	--	--
	Bypass	2	1	50.00	18.0	--	--	--	--	--	--	--	--
	Inriver	204	157	76.96	18.0	54	40	74.07	20.5	--	--	--	--
	Adult return	1	1	100.00	32.0	--	--	--	--	--	--	--	--
2004	Transport	8	5	62.50	30.0	14	11	78.57	21.0	--	--	--	--
	Full-flow bypass	3	2	66.67	36.5	11	6	54.55	24.5	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	98	72	73.47	18.0	174	119	68.39	19.0	--	--	--	--
	Adult return	1	1	100.00	48.0	--	--	--	--	--	--	--	--
2003	Transport	15	13	86.67	24.0	26	16	61.54	15.5	1	1	100.00	21.0
	Full-flow bypass	5	3	60.00	15.0	23	13	56.52	23.0	--	--	--	--
	Bypass	1	1	100.00	18.0	2	1	50.00	15.0	--	--	--	--
	Inriver	94	78	82.98	25.0	188	119	63.30	17.0	--	--	--	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--

Appendix Table D7a. Total number of adults, conversion rates, and median travel times for returning adults PIT-tagged at and released from Winthrop Hatchery for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Winthrop Hatchery steelhead											
		Bonneville to McNary				McNary to Priest Rapids				Bonneville to Priest Rapids			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate (%)	Median travel time	McNary adults	PRD adults	Conversion rate (%)	Median travel time	Bonn adults	PRD adults	Conversion rate (%)	Median travel time
2005	Transport	--	--	--	--	--	--	--	--	--	--	--	--
	Full-flow bypass	5	3	60.00	20.0	3	3	100.00	6.0	5	3	60.00	27.0
	Bypass	1	1	100.00	53.0	1	1	100.00	6.0	1	1	100.00	59.0
	Inriver	44	36	81.82	8.0	36	35	97.22	6.0	44	36	81.82	15.5
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2004	Transport	10	6	60.00	32.0	6	6	100.00	4.0	10	6	60.00	35.5
	Full-flow bypass	6	2	33.33	7.0	3	2	66.67	4.5	6	1	16.67	12.0
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	75	49	65.33	11.0	50	47	94.00	5.0	75	46	61.33	16.0
	Adult return	2	1	50.00	17.0	1	1	100.00	23.0	2	1	50.00	40.0
2003	Transport	9	5	55.56	8.0	5	5	100.00	5.0	9	6	66.67	16.0
	Full-flow bypass	5	5	100.00	19.0	5	4	80.00	6.0	5	4	80.00	28.0
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	74	50	67.57	8.0	50	48	96.00	5.0	74	51	68.92	15.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--

Appendix Table D7b. Number of adults, conversion rates, and median travel times from Bonneville Dam to McNary Dam by age class for returning adults PIT-tagged at and released from Winthrop Hatchery for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

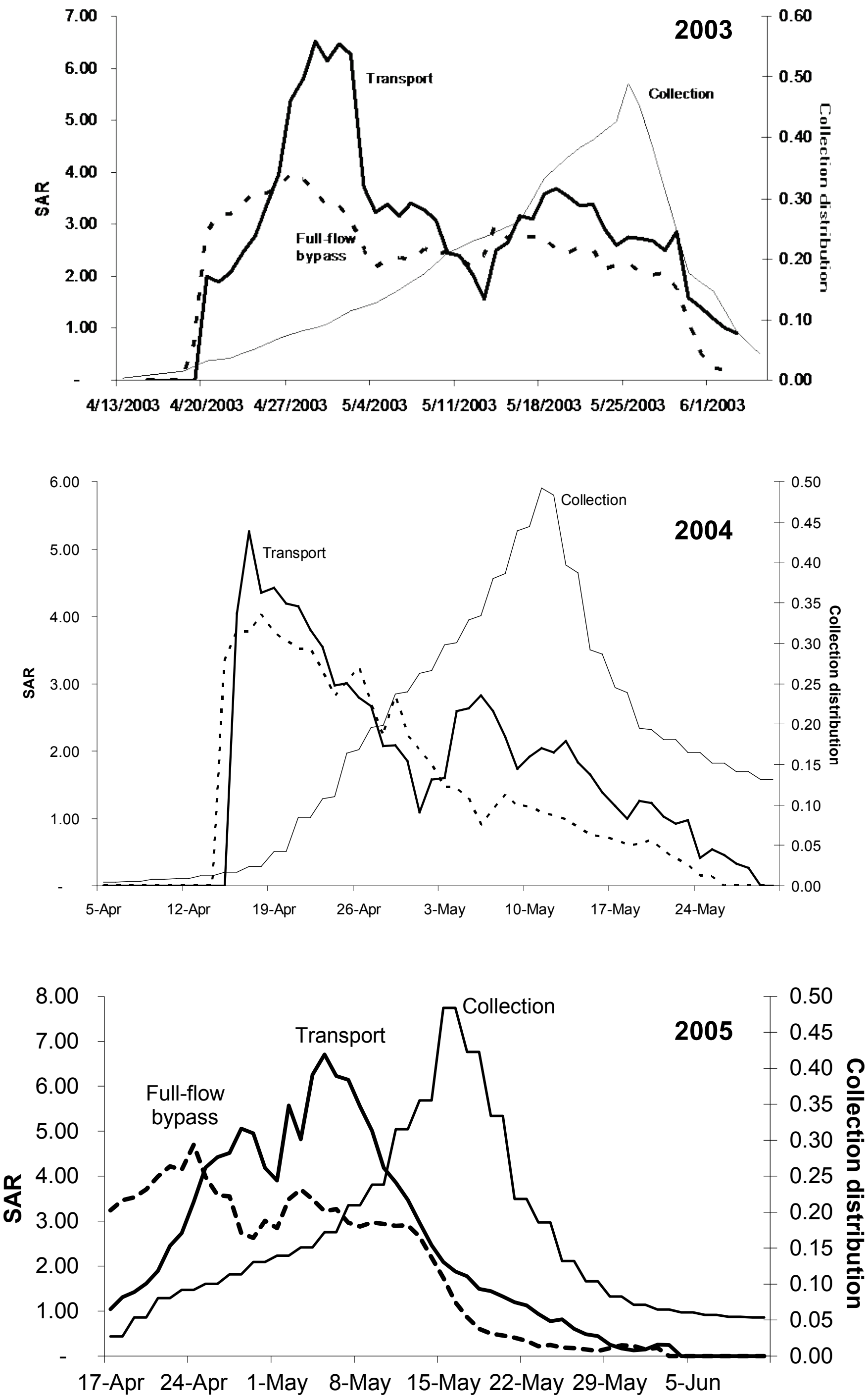
		Winthrop Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time	Bonn adults	McNary adults	Conversion rate	Median travel time
2005	Transport	--	--	--	--	--	--	--	--	--	--	--	--
	Full-flow bypass	3	2	66.67	13.5	2	1	50.00	42.0	--	--	--	--
	Bypass	--	--	--	--	1	1	100.00	--	--	--	--	--
	Inriver	21	17	80.95	20.0	23	19	82.61	8.0	--	--	--	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2004	Transport	1	1	100.00	40.0	9	5	55.56	24.0	--	--	--	--
	Full-flow bypass	1	0	0.00	--	5	2	40.00	7.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	24	18	75.00	8.5	49	31	63.27	11.0	2	0	0.00	--
	Adult return	1	0	0.00	--	1	1	100.00	17.0	--	--	--	--
2003	Transport	1	1	100.00	24.0	8	4	50.00	7.0	--	--	--	--
	Full-flow bypass	1	1	100.00	25.0	4	4	100.00	13.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	30	22	73.33	7.5	43	27	62.79	8.0	1	1	100.00	12.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--

Appendix Table D7c. Number of adults, conversion rates, and median travel times from McNary Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged at and released from Winthrop Hatchery for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Winthrop Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time	McNary adults	PRD adults	Conversion rate	Median travel time
2005	Transport	--	--	--	--	--	--	--	--	--	--	--	--
	Full-flow bypass	2	2	100.00	6.5	1	1	100.00	4.0	--	--	--	--
	Bypass	--	--	--	--	1	1	100.00	--	--	--	--	--
	Inriver	17	17	100.00	5.0	19	18	94.74	6.0	--	--	--	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2004	Transport	1	1	100.00	4.0	5	5	100.00	4.0	--	--	--	--
	Full-flow bypass	1	1	100.00	4.0	2	1	50.00	5.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	18	18	100.00	6.0	32	29	90.63	5.0	--	--	--	--
	Adult return	--	--	--	--	1	1	100.00	23.0	--	--	--	--
2003	Transport	1	1	100.00	4.0	4	4	100.00	5.0	--	--	--	--
	Full-flow bypass	1	1	100.00	7.0	4	3	75.00	5.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	22	22	100.00	5.0	27	25	92.59	5.0	1	1	100.00	5.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--

Appendix Table D7d. Number of adults, conversion rates, and median travel times from Bonneville Dam to Priest Rapids Dam (PRD) by age class for returning adults PIT-tagged and released at Winthrop Hatchery for Upper Columbia River hatchery steelhead transportation studies, 2003-2005. After collection, full-flow bypass fish were returned to the river through the 78-cm full-flow outfall pipe without entering the juvenile facility; bypass fish were separated and returned to the river via the 30-cm facility bypass pipe. Adult return fish dropped over the end of the separator (as adult salmonid would), and were returned to the river via the 30-cm adult return pipe.

		Winthrop Hatchery steelhead											
		Age-1-ocean				Age-2-ocean				Age-3-ocean			
Tagging year	Passage group	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time	Bonn adults	PRD adults	Conversion rate	Median travel time
2005	Transport	--	--	--	--	--	--	--	--	--	--	--	--
	Full-flow bypass	3	2	66.67	20.0	2	1	50.00	46.0	--	--	--	--
	Bypass	--	--	--	--	1	1	100.00	--	--	--	--	--
	Inriver	21	18	85.71	20.5	23	18	78.26	15.5	--	--	--	--
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--
2004	Transport	1	1	100.00	44.0	9	5	55.56	27.0	--	--	--	--
	Full-flow bypass	1	0	0.00	--	5	1	20.00	12.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	24	18	75.00	15.0	49	28	57.14	17.0	2	0	0.00	--
	Adult return	1	0	0.00	--	1	1	100.00	40.0	--	--	--	--
2003	Transport	1	1	100.00	28.0	8	5	62.50	13.0	--	--	--	--
	Full-flow bypass	1	1	100.00	32.0	4	3	75.00	24.0	--	--	--	--
	Bypass	--	--	--	--	--	--	--	--	--	--	--	--
	Inriver	30	25	83.33	12.0	43	25	58.14	15.0	1	1	100.00	17.0
	Adult return	--	--	--	--	--	--	--	--	--	--	--	--



Appendix Figure D1. Steelhead smolt-to-adult return rates by juvenile detection date for smolts transported from McNary Dam compared with SARs of smolts bypassed through the McNary Dam full-flow bypass flume in 2003, 2004, and 2005. Also shown is the distribution of juvenile fish collected at McNary Dam in each year.

APPENDIX E

Overview of Statistical Methodology

Estimated variance of ratio of smolt-to-adult return proportions when one of the release numbers is estimated:

From Mood et al. (1974, page 181), using the delta method for independent x and y,

$$V\left(\frac{x}{y}\right) \approx \left(\frac{\mu_x}{\mu_y}\right)^2 \left(\frac{V(x)}{\mu_x{}^2} + \frac{V(y)}{\mu_y{}^2}\right) \tag{1}$$

For $R = SAR_T/SAR_{ND}$ (for transport vs. non-detected) or $R = SAR_B/SAR_{ND}$ (for bypass vs. non-detected), and using estimated values, this becomes:

$$\hat{V}(\hat{R}) \approx \hat{R}^2 \left(\frac{1}{n_T} - \frac{1}{N_T} + \frac{1}{n_{ND}} - \frac{1}{N_{ND}}\right)$$

where N_i (i = T, B, or ND) are numbers of juveniles and n_i are numbers of adults, since,

$$\frac{\hat{V}(S\hat{A}R_T)}{S\hat{A}R_T{}^2} = \frac{S\hat{A}R_T(1 - S\hat{A}R_T)}{N_T S\hat{A}R_T{}^2} = \frac{1 - S\hat{A}R_T}{N_T S\hat{A}R_T} = \frac{1}{n_T} - \frac{1}{N_T} \tag{2}$$

and similarly for SAR_B and SAR_{ND}.

If, however, N_{ND} is estimated from $NS(1 - p)$ where N is the release number, S is survival from release to some location and p is probability of detection at that location, then:

$$\hat{V}(\hat{R}) \approx \hat{R}^2 \left(\frac{1}{n_T} - \frac{1}{N_T} + \frac{\hat{V}(S\hat{A}R_{ND})}{S\hat{A}R_{ND}{}^2}\right) \tag{3}$$

from (1) and (2). Now,

$$\hat{V}(S\hat{A}R_{ND}) = \hat{V}\left(\frac{n_{ND}}{N_{ND}}\right) = \hat{V}\left(\frac{n_{ND}}{N\hat{S}(1-\hat{p})}\right) = \left(\frac{1}{N^2}\right)\hat{V}\left(\frac{n_{ND}}{\hat{S}(1-\hat{p})}\right) \tag{4}$$

$$\approx \left(\frac{1}{N^2}\right)\left(\frac{n_{ND}}{\hat{S}(1-\hat{p})}\right)^2 \left(\frac{\hat{V}(n_{ND})}{n_{ND}{}^2} + \frac{\hat{V}(\hat{S}(1-\hat{p}))}{\hat{S}^2(1-\hat{p})^2}\right)$$

by (1) and,

$$S\hat{A}R_{ND}{}^{2} = \left(\frac{n_{ND}}{N_{ND}}\right)^2 = \left(\frac{1}{N^2}\right)\left(\frac{n_{ND}}{\hat{S}(1-\hat{p})}\right)^2 \tag{5}$$

So from (4) and (5),

$$\frac{\hat{V}(S\hat{A}R_{ND})}{S\hat{A}R_{ND}{}^{2}} \approx \frac{\hat{V}(n_{ND})}{n_{ND}{}^{2}} + \frac{\hat{V}(\hat{S}(1-\hat{p}))}{\hat{S}^2(1-\hat{p})^2} = \frac{1}{n_{ND}} - \frac{1}{N_{ND}} + \frac{\hat{V}(\hat{S}(1-\hat{p}))}{\hat{S}^2(1-\hat{p})^2} \tag{6}$$

Then from (3) and (6) and substituting the estimate for N_{ND},

$$\hat{V}(\hat{R}) \approx \hat{R}^2\left(\frac{1}{n_T} - \frac{1}{N_T} + \frac{1}{n_{ND}} - \frac{1}{N\hat{S}(1-\hat{p})} + \frac{\hat{V}(\hat{S}(1-\hat{p}))}{\hat{S}^2(1-\hat{p})^2}\right) \tag{7}$$

Now,

$$V(S(1-\ddot{p})) \approx (1-\ddot{p})^2 V(S) + S^2 V(\ddot{p}) + 2(1-\ddot{p}) S C\ddot{o}v(S, 1-\ddot{p})$$

(Mood et al. 1974, page 180), and,

$$C\hat{o}v(\hat{S}, 1-\hat{p}) = -C\hat{o}v(\hat{S}, \hat{p})$$

So,

$$\frac{\hat{V}(\hat{S}(1-\hat{p}))}{\hat{S}^2(1-\hat{p})^2} \approx \frac{\hat{V}(\hat{S})}{\hat{S}^2} + \frac{\hat{V}(\hat{p})}{(1-\hat{p})^2} - \frac{2C\hat{o}v(\hat{S},\hat{p})}{\hat{S}(1-\hat{p})} \tag{8}$$

Then from (7) and (8),

$$\hat{V}(\hat{R}) \approx \hat{R}^2\left(\frac{1}{n_T} - \frac{1}{N_T} + \frac{1}{n_{ND}} - \frac{1}{N\hat{S}(1-\hat{p})} + \frac{\hat{V}(\hat{S})}{\hat{S}^2} + \frac{\hat{V}(\hat{p})}{(1-\hat{p})^2} - \frac{2C\hat{o}v(\hat{S},\hat{p})}{\hat{S}(1-\hat{p})}\right)$$

Note that *S* and p were estimated using the single-release Cormack-Jolly-Seber model (Cormack 1964; Jolly 1965; Seber 1965) using the statistical software SURPH (Skalski et al. 1993; Smith et al. 1994).