Fish Passage Center

Columbia Basin Fish and Wildlife Authority

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FISH PASSAGE CENTER

ANNUAL REPORT

2002

This report responds to the Fish Passage Center annual reporting requirements to the Northwest Power Planning Council under its Columbia River Basin Fish and Wildlife Program, and the annual reporting requirements to the Bonneville Power Administration under its funding contracts which supported this work.

BPA Project No. 1994-033-00

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FINAL

Fish Passage Center 2002 Annual Report

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We appreciate the efforts of the field crews at each of the monitoring sites. Sampling and reporting were carried out by WDFW at Ice Harbor, McNary, Lower Monumental, and Lower Granite dams; by ODFW at Little Goose Dam and Grande Ronde River trap; by Pacific States Marine Fisheries Commission (PSMFC) at John Day and Bonneville dams; by ODFW (subcontractor for Chelan County Public Utility District (PUD) at Rock Island Dam); by NPT at Imnaha River trap; and by IDFG at the traps on the Salmon and Snake rivers.

In addition to the aforementioned monitoring supported under the SMP, related activities by others, such as the fish transportation program supported by the U.S. Army Corps of Engineers (COE), provided valuable information at various monitoring sites. The COE also provided facilities and accommodations for smolt monitoring activities at their projects. This report was prepared by the Fish Passage Center (FPC) staff: Michele DeHart, Tom Berggren, Margaret Filardo, Larry Basham, David Benner, Henry Franzoni, Sergei Rassk, Jerry McCann, Deidre Wood, Chris McCarty and Dona Watson.

The project was funded by Bonneville Power Administration (BPA), under the Northwest Power Planning Council (NWPPC) Fish and Wildlife Program, Section 303 (d) (1), BPA Project #1994-03300 and Research Action #1136 of Appendix H of the Biological Opinion as part of the activities necessary to implement NMFS Biological Opinon Reasonable and Prudent Alternatives (RPAs) 9.6.1.3.3, 9.6.1.3.4., and 9.6.1.4.6.

Executive Summary

The runoff volumes in 2002 were near average for the January to July period above Lower Granite Dam (80%) and The Dalles Dam (97%). The year 2002 hydrosystem operations and run-off conditions resulted in flows that were less than the seasonal Biological Opinion (Opinion) flow objectives at Lower Granite Dam for both the spring and summer period. The seasonal flow objectives for Priest Rapids and McNary dams were exceeded for the spring period, but at McNary Dam summer flow objectives were not met. While seasonal flow objectives were exceeded for the spring at McNary Dam, the 2002 season illustrated that Biological Opinion management to seasonal flow targets can result in conditions where a major portion of the juvenile fish migration migrates in conditions that are less than the flow objectives. The delay in runoff due to cool weather conditions and the inability of reservoirs to augment flows by drafting lower than the flood control elevations, resulted in flows less than the Opinion objectives until May 22, 2002. By this time approximately 73% of the yearling chinook and 56% of steelhead had already passed the project.

For the most part, spill in 2002 was managed below the gas waiver limits for total dissolved gas levels and the NMFS action criteria for dissolved gas signs were not exceeded. The exception was at Lower Monumental Dam where no Biological Opinion spill occurred due to the need to conduct repairs in the stilling basin.

Survival estimates obtained for PIT tagged juveniles were similar in range to those observed prior to 2001. A multi-year analysis of juvenile survival and the factors that affect it was conducted in 2002. A water transit time and flow relation was demonstrated for spring migrating chinook and steelhead of Snake River and Mid Columbia River origin.

Returning numbers of adults observed at Bonneville Dam declined for spring chinook, steelhead and coho, while summer and fall chinook numbers increased. However, all numbers were far greater than observed in the past ten years averaged together.

In 2002, about 87 million juvenile salmon were released from Federal, State, Tribal or private hatcheries into the Columbia River Basin above Bonneville Dam. This represents an increase over the past season, when only 71 million juvenile fish were released into the same area.

I. 2002 WATER SUPPLY

A. *Precipitation/Snowpack*

Precipitation was near average during the 2002 Water Year (WY). Precipitation at the start of the WY (October) was 128%, 133%, and 146% of average (1971-2000) at the Columbia River above Grand Coulee, the Snake River above Ice Harbor, and the Columbia River above The Dalles. At the same locations, accumulated seasonal precipitation between October and the end of December remained approximately average at 91%, 110%, and 104%. Throughout the remainder of the Water Year both the Columbia River above Coulee, and the Columbia above the Dalles continued to record approximately average precipitation, ending the water year at 97% and 94%. Between January and August precipitation began to decline slightly at the Snake River above Ice Harbor, ending the water year at 86% of average.

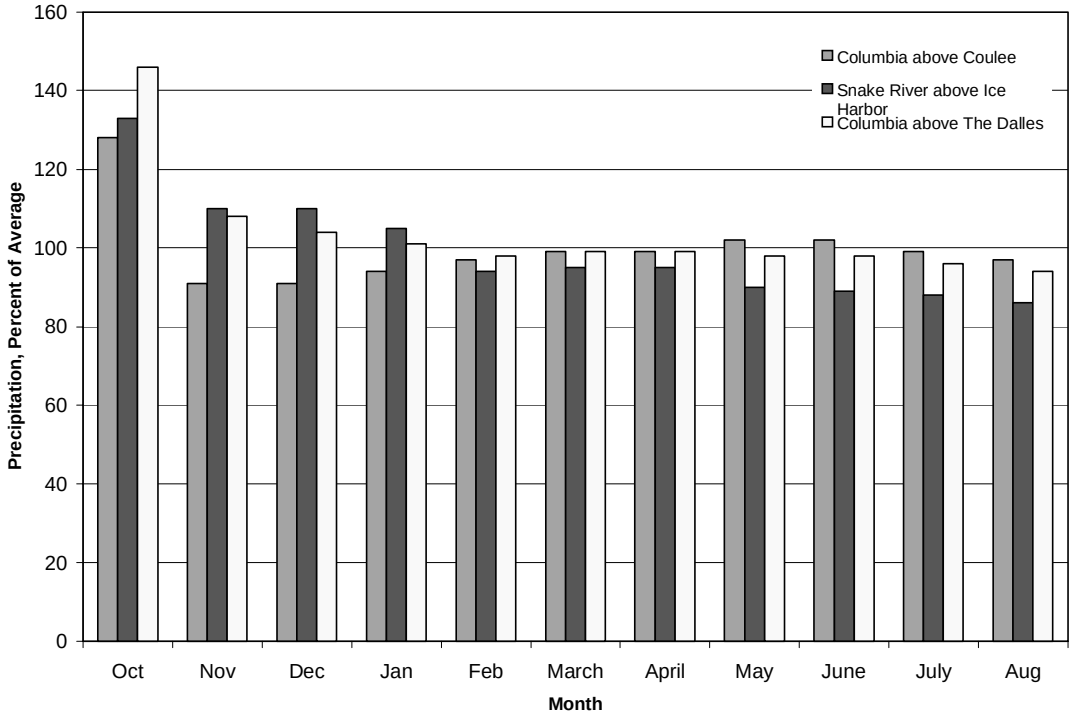

FIGURE 1. WY 2002 seasonal precipitation (as % of average) at various locations within the Columbia Basin.

Columbia Basin snowpack over the 2002 WY was above average. By the end of December, snow water equivalents[1] were either very close to or above average. The Kootenai, Clearwater and Salmon, Deschutes and John Day, and the Lower Columbia regions contained snow water equivalents that were 99%, 96%, 137%, and 165% of average. Throughout the remainder of the snow season, snowpacks remained near or above average. Snow water equivalents at the end of April for the Kootenai, Clearwater and Salmon, Deschutes and John Day, and the Lower Columbia regions were 126%, 103%, 93%, and 205%, respectively.

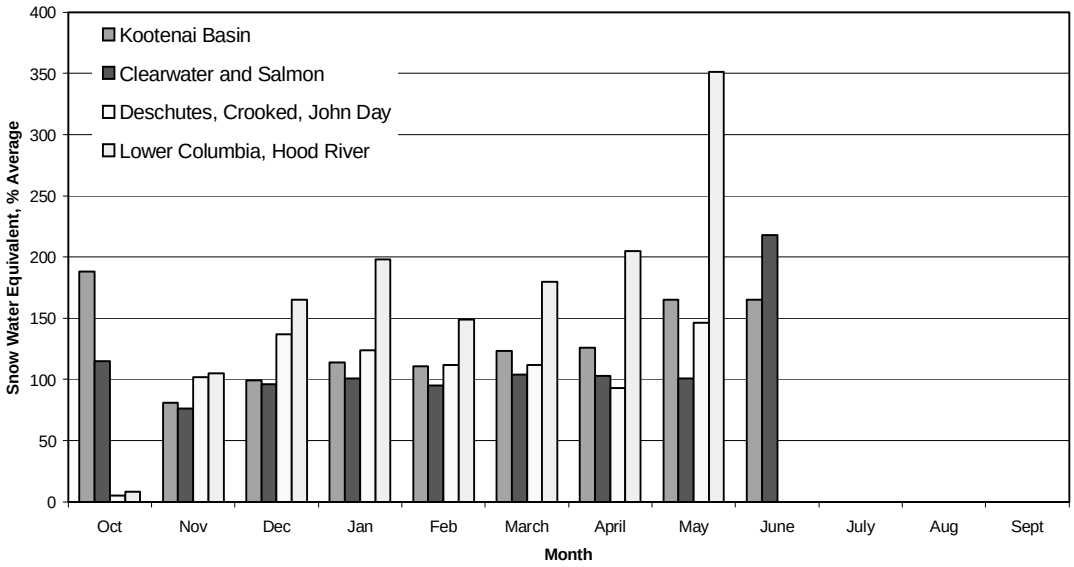

FIGURE 2. WY 2002 seasonal snow water equivalents (as % of average) at various locations within the Columbia Basin. According to the NRCS, values at the start and end of the snow season (October and May/June) may not be accurate.

Overall, Water Year 2002 was average in terms of precipitation and snowpack.

1. Snow water content (snow water equivalent) is the depth of water that would be obtained by melting the snowpack. Snow depth is the measurement from the top of the snow to ground level. The amount of water produced by a snowpack of a given depth varies depending on the density of the snowpack. Definition taken from http://www.wcc.nrcs.usda.gov.

B. Water Supply Forecasts/Actual Runoff Volumes

Table 1 displays the final water supply forecasts issued by the Northwest River Forecast Center (NWRFC) for January, February, March, April, May, and June for Grand Coulee, Libby, Dworshak, Lower Granite, Hungry Horse, and The Dalles over WY 2002. Also included in Table 1 are the normal runoff volumes along with the actual runoff volume observed at the specified location and time period.

TABLE 1. 2002 Water Supply Forecasts issued by the Northwest River Forecast Center (NWRFC) for Grand Coulee, Libby, Dworshak, Brownlee, Hungry Horse, and The Dalles. Also the normal runoff volumes along with the actual runoff volume observed at the specified location and time period.

Site	2002 Final Water Supply Forecasts (Maf)								
	Jan	Feb	March	April	May	June	Average (1971-2000)	Actual	% Actual To Average
G. Coulee (Jan-July)	59.3	60.8	60.0	61.0	62.3	65.3	62.9	68.0	108
Libby (Apr-Sept)	6.4	6.5	6.3	6.6	6.8	7.7	6.6	7.4	112
Dworshak (Apr-July)	2.7	3.0	3.0	3.1	3.1	3.1	2.6	3.7	140
L. Granite *(Apr-Aug)*	21.2	22.1	20.7	20.2	20.2	19.0	22.9	20.0	87
H. Horse (Apr-Sept)	1.8	1.9	1.9	2.1	2.2	2.3	2.3	2.1	108
The Dalles (Jan-July)	98.7	101.0	97.3	96.4	98.2	100.0	107.3	103.8	97

Table 2 presents a comparison of the historic run-off volumes at major sites within the Columbia Basin. From Table 2, the actual runoff volume recorded at Lower Granite between January and July was 80% of average; the runoff volume recorded at The Dalles between January and July was 97% of average.

TABLE 2. Actual runoff volumes between January and July above Lower Granite Dam and The Dalles Dam between 1990 and 2002. Between 1990-2001, the runoff volumes were compared to the average runoff for the 1961-1990 period. However, beginning in 2002, the baseline for comparison was adjusted to a more recent period, 1971-2000. Both averages are provided in the table.

Year	Lower Granite January-July		The Dalles January-July	
	Runoff MAF	Percent Average	Runoff MAF	Percent Average
1990	20.2	68	99.8	94
1991	20.1	68	107.1	101
1992	14.1	47	70.4	66
1993	26.7	90	88.0	83
1994	15.9	53	75.0	71
1995	29.4	99	104.0	98
1996	42.4	143	139.3	132
1997	49.5	166	159.0	150
1998	31.3	105	104.0	98
1999	36.1	121	124.1	117
2000	24.6	83	98.0	93
2001	14.4	48	58.2	55
2002	***24.0***	***80***	***103.8***	***97***
Ave 1961-1990	29.7	na	105.9	na
Ave 1971-2000	30.0	na	107.3	na

C. Operational Environment

Water year 2002 was approximately average in terms of runoff volume (97% of average above The Dalles, January-July). However, in spite of near average runoff volumes, relatively low spring and summer flows occurred on both a weekly and seasonal basis. The Biological Opinion flow objectives were met only periodically during the spring and summer flow objective periods.

1. Spring Flows

Based upon the April 2002 final water supply forecasts, flow objectives were 97 kcfs at Lower Granite between 4/3/02 and 6/20/02, 246 kcfs at McNary between 4/10/02 and 6/30/02,

and 135 kcfs at Priest Rapids from 4/10/02 and 6/30/02. Table 3 displays average weekly flows at Lower Granite, McNary, and Priest Rapids over the spring BiOp period. Several points are important to note concerning Table 3 and the 2002 Spring BiOp flow objectives.

- Nine of eleven week long periods contained flows at Lower Granite below the 2002 Spring BiOp Flow Objective.
- The average seasonal (4/3 to 6/20) flow at Lower Granite was 83.4 Kcfs, 13.6 Kcfs below the 97 Kcfs objective.
- Five of twelve week long periods contained flows less than the Spring BiOp Flow Objective at McNary.
- The average seasonal (4/10 to 6/30) flow at McNary was 269.3 Kcfs, 23.3 Kcfs above the 246 Spring BiOp flow objective.
- Only one of 12 week long periods at Priest Rapids contained flows less than the Spring BiOp Objective of 135 Kcfs.

From Table 3, it is clear that both Lower Granite and McNary struggled to achieve BiOp flow objectives between April 24th and May 21st of 2002. Between 4/24/02 and 5/21/02, Lower Granite and McNary average weekly flows were between 0.7 and 41.2 Kcfs below the BiOp flow objectives as a result of a spring freshet stalled by cool temperatures. During this low flow period, TMT meetings focused on liberating additional water from storage reservoirs to supplement river flows; however, operators were reluctant and delayed decision making until the freshet had started. This low flow period occurred at an important phase for spring migrants.

According to 9.6.1.2.1 Action 14 (Page 9-55) of the National Marine Fisheries Service (NMFS) 2000 Biological Opinion:

"The Action Agencies shall operate Federal Columbia River Power System (FCRPS) dams and reservoirs with the intent of meeting the flow objectives on both a seasonal and weekly average basis for the benefit of migrating juvenile salmon."

Currently, the Federal Columbia is operated to meet flow objectives on a seasonal basis, but not a weekly basis.

TABLE 3. 2002 weekly average flows at Lower Granite, McNary, and Priest Rapids in comparison to the Spring Biological Opinion Flow Objectives. Week long periods that did not meet the BiOp Objectives are bolded.

Week WY 2002	***Lower Granite*** Weekly Average Flow (Flow Obj. = 97Kcfs)	***McNary*** Weekly Average Flow (Flow Obj. = 246 Kcfs)	***Priest Rapids*** Weekly Average Flow (Flow Obj. = 135 Kcfs)
4-3 to 4-9	**64.4**	na	na
4-10 to 4-16	**89.6**	**214.0**	**123.6**
4-17 to 4-23	**80.8**	286.0	196.4
4-24 to 4-30	**60.9**	**223.5**	154.9
5-1 to 5-7	**73.4**	**223.0**	149.8
5-8 to 5-14	**60.8**	**204.8**	144.8
5-15 to 5-21	**79.5**	**221.6**	138.6
5-22 to 5-28	**96.3**	260.8	160.1
5-29 to 6-4	128.0	318.4	188.3
6-5 to 6-11	98.3	347.5	243.4
6-12 to 6-18	**82.6**	298.7	213.6
6-19 to 6-25	N/A	325.9	230.2
6-26 to 6-30	N/A	322.7	239.9
Seasonal Total	**83.4**	**269.3**	**180.6**

Table 4 through Table 6 compare spring and summer monthly average and BiOp period average flows between 1995 and 2002 at Lower Granite, McNary and Priest Rapids.

TABLE 4. Lower Granite Dam: Spring/Summer Monthly Average Flows in 1995-2002.

Month/Period	Flow (Kcfs)							
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
April Average	61.1	114.5	122.0	65.5	93.9	90.2	35.1	73.9
May Average	108.9	127.2	169.0	141.0	112.5	84.0	63.2	82.1
June Average	114.8	144.9	161.3	113.6	133.7	63.4	35.7	94.2
July Average	60.8	54.4	68.9	61.7	54.7	37.8	26.6	38.3
August Average	37.2	37.2	46.1	32.9	37.7	25.9	23.8	29.4
Spring BiOp Target	95.0	100.0	100.0	90.0	100.0	96.3	Na	97.0
Spring Average	101.1	138.3	162.5	115.6	117.0	85.1	47.5	83.4
Summer BiOp Target	52.0	53.5	55.0	50.6	54.0	51.3	Na	51.0
Summer Average	55.3	52.7	66.3	53.2	56.0	39.6	25.4	41.0

TABLE 5. McNary Dam: Spring/Summer Monthly Average Flows in 1995-2002.

Month/Period	Flow (Kcfs)							
	1995	1996	1997	1998	1999	2000	2001	2002
April Average	169.0	311.9	313.0	154.9	245.7	254.9	108.3	241.2
May Average	251.1	338.7	449.0	320.4	281.0	255.4	129.6	234.9
June Average	277.6	379.2	482.2	292.0	331.0	206.4	129.1	324.5
July Average	191.2	245.9	274.6	197.2	247.9	166.7	85.0	230.4
August Average	138.2	183.0	198.3	142.2	208.5	140.4	96.8	147.8
Spring BiOp Target	249.0	260.0	260.0	228.0	260.0	260.0	Na	246
Spring Average	253.0	357.1	454.8	287.8	303.6	243.4	123.9	269.3
Summer BiOp Target	200.0	200.0	200.0	200.0	200.0	200.0	Na	200
Summer Average	164.7	214.5	237.0	169.7	228.2	153.6	90.9	189.1

TABLE 6. Priest Rapids Dam: Spring/Summer Monthly Average Flows in 1995-2002.

Month/Period	Flow (Kcfs)							
	1995	1996	1997	1998	1999	2000	2001	2002
April Average	101.8	194.5	179.8	86.3	145.4	160.0	71.0	158.3
May Average	136.5	216.3	279.0	175.5	164.3	166.2	64.1	150.6
June Average	154.8	241.3	328.0	175.3	192.3	130.5	93.8	227.0
July Average	131.5	189.6	201.6	133.7	185.2	127.0	59.6	190.0
August Average	101.5	148.2	151.9	113.2	162.0	115.7	75.3	118.7

2. Spring Reservoir Operation

Reservoirs were generally drafted below the established flood control elevations during the winter/early spring months. Figure 3 through Figure 7 display operations at each of five major storage reservoirs within the Columbia Hydrosystem: Grand Coulee, Dworshak, Brownlee, Hungry Horse, and Libby. At all locations, with the exceptions of Dworshak and Libby, reservoirs were drafted below their winter/spring flood control elevations, which necessitated decreasing March flows in order to refill and attempt to meet the April 10th Biological Opinion target. If the reservoirs had been operated to the winter/spring Flood Control Elevations (FCE), rather than drafted below the FCE, the operation would have been to draft or slightly refill to the respective

April 10th targets. Drafting reservoirs below FCE in the winter/early spring make it difficult to meet the April 10th BiOp elevations, and results in lower flows during the early season migration.

The 2000 NMFS Biological Opinion, 9.6.1.2.1. Action 14 (Page 9-55), directly states:

" The Flow-management program uses three strategies:

- Limit the winter/spring drawdown of storage reservoirs to increase spring flows and the probability of reservoir refill.

… Before the 1995 Biological Opinion, FCRPS storage reservoirs routinely drafted well below these levels (flood control) to maximize hydropower generation during the fall and winter. Meeting the spring flow objectives occasionally requires reservoir drafting, but the spring flow objectives are primarily met by limiting winter drafting and refill rates. This operation allows for a more natural spring hydrograph by passing spring runoff through storage reservoirs."

According to the BiOp, the drafting of reservoirs below FCE in the winter/spring directly influences the likelihood of meeting the April 10th target, possibly limiting the ability to meet the flow objectives. Therefore, extreme drafting in the winter/early spring contradicts the intent of the Biological Opinion.

Grand Coulee

Figure 3 displays operations at Grand Coulee, the largest of the storage reservoirs within the Federal Columbia River Hydrosystem (5,185,500 acre-feet of active storage), during the first one-half of 2002. Grand Coulee was drafted heavily over the winter months of 2002, when the demand for electricity was high. During the winter months, Grand Coulee was drafted over 30 feet below its flood control elevations (Figure 3). By the middle portion of March, Grand Coulee had dropped nearly thirty feet to 1255.0 feet, and subsequently had to refill to meet the April 10th Biological Opinion target. After meeting the April 10th BiOp target, Grand Coulee immediately began drafting water to meet flood control targets.

Before the start of the spring freshet (Mid-May), the Bureau of Reclamation (BOR) was reluctant to draft Grand Coulee below 1240 feet, despite the fact that river flows were well below the Biological Opinion objectives. In general, reservoirs met their end of April flood control tar-

gets and there was reluctance to draft further; however, Grand Coulee had routinely drafted well below the flood control elevations earlier in the winter/spring. In 2002, the spring freshet was delayed (due to temperature) and the river was dependent on the storage reservoirs to release water to meet the BiOp flow objectives.

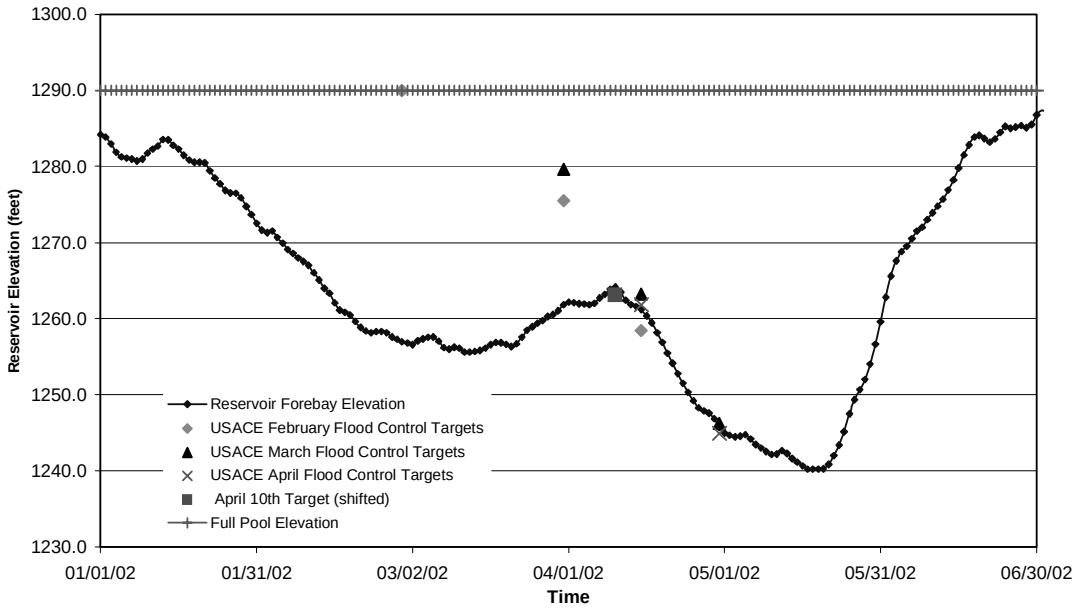

FIGURE 3. Reservoir operations at Grand Coulee over the first one-half of 2002.

Winter/Early Spring Chum Operation

On November 28, 2002, the Action Agencies agreed to maintain a minimum tail water elevation of 11.4-11.6 feet below Bonneville. Generally a discharge of 125 kcfs at Bonneville is needed to maintain a tail water elevation of between 11.4-11.6 feet at Bonneville. Figure 4 displays the actual recorded discharge at Bonneville from 10-01-01 to 4-15-02, in addition to reservoir elevations at Grand Coulee. Using an incomplete hourly dataset spanning from 12-1-01 to 3-31-02, an 11.5-foot Bonneville project tailwater elevation was not met 214 of 2180 hours, approximately 10% of the time. From inspection of Figure 4, it appears that water was relatively abundant at Bonneville Dam, and if flows had been better moderated during peak periods, the 11.5 tailwater elevation could likely have been met 100% of the time. Furthermore, Figure 4 empha-

sizes that the draft seen at Grand Coulee over the spring of 2002 was not entirely necessary to meet the chum flow obligations, much of the draft was likely for power generation purposes.

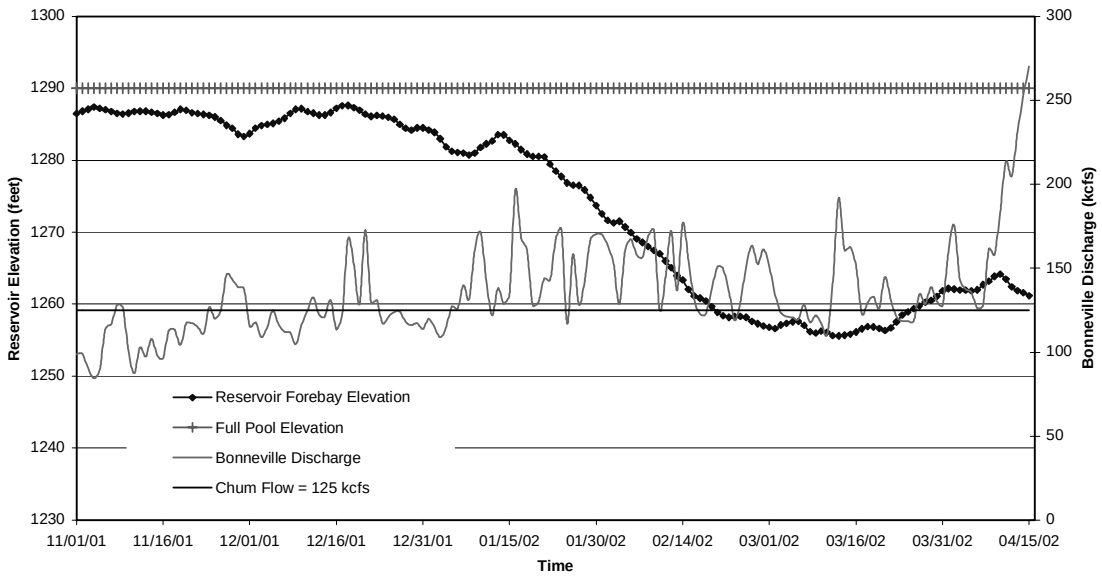

FIGURE 4. Reservoir operations at Grand Coulee in addition to discharges recorded at Bonneville Dam From 11-01-01 to 4-15-02.

Dworshak

Figure 5 displays the operation of the Dworshak reservoir (usable storage = 2,015,000 acre-feet) over the first six months of 2002. For most of the year, Dworshak was operated above the FCE, as a result of a shift that traded some flood control space with Grand Coulee. During the spring of 2002, Dworshak was used to supplement flows during the low flow period before the onset of the freshet. At the time, COE was concerned that releasing water to supplement flows would negatively impact the probability of refill by June 30th. As it turned out, Dworshak was less than one foot from full by June 20, 2002 (Figure 5).

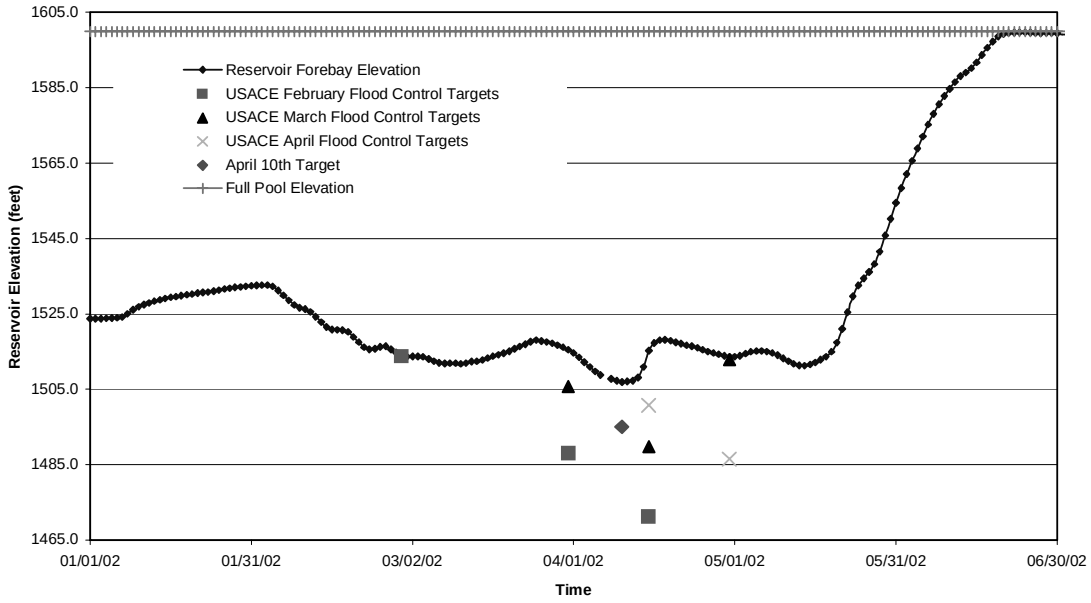

FIGURE 5. Reservoir operations at Dworshak over the first one-half of 2002.

Brownlee

Figure 6 displays the operation of the Brownlee reservoir from the start of 2002. Brownlee was drafted nearly ten feet below February and March flood control elevations. Brownlee began refilling around the beginning of April and essentially was within one foot of full by mid to late May. As mentioned earlier, the low flow period along the Columbia River that occurred before the onset of the spring freshet took place predominantly between 4-24-02 and 5-21-02. During this period, System Operation Requests (SOR's) were submitted (SOR 2002-03 and SOR 2002-04) that requested Brownlee reduce its rate of refill and pass inflow at a time when water was needed to meet BiOp Flow Objectives in the Hydrosystem. In a letter addressed to the Technical Management Team (TMT), Idaho Power Company (IPC) requested that TMT reject the SOR. Coincidentally, Brownlee began releasing more water at approximately the same time as the beginning of the spring freshet. Brownlee remained within one and one half feet of full from 4/29/02 to 7/3/02.

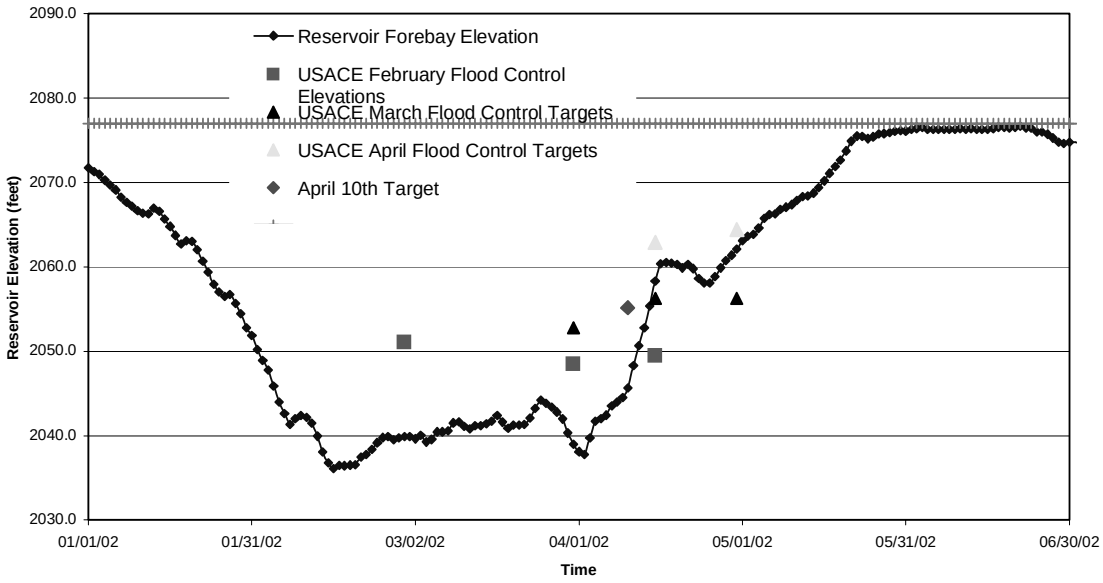

FIGURE 6. Reservoir operations at Brownlee over the first six months of 2002.

Actions by the operators of the Brownlee reservoir did not fulfill the flow management objectives outlined in the Biological Opinion (see 9.6.1.2.1 Action 14, page 9-55). Brownlee was removing water from the system during the BiOp flow period, when the objectives were not being met. If Brownlee had passed inflows, flows would have come closer to meeting the BiOp objectives. Instead, Brownlee was either refilling or full during the entire spring migration period.

Hungry Horse

Figure 7 displays operations at the Hungry Horse storage reservoir (active storage = 3,161,000 acre-feet) over the first one-half of 2002. Hungry Horse was drafted over the winter months of 2002 to meet Columbia Falls Minimum flows. During this period, Hungry Horse was drafted more than 25 feet below its flood control elevations (Figure 7). By April 10th, the Hungry Horse Reservoir was at an elevation of approximately 3509 feet, over 20 feet below its Biological Opinion Target.

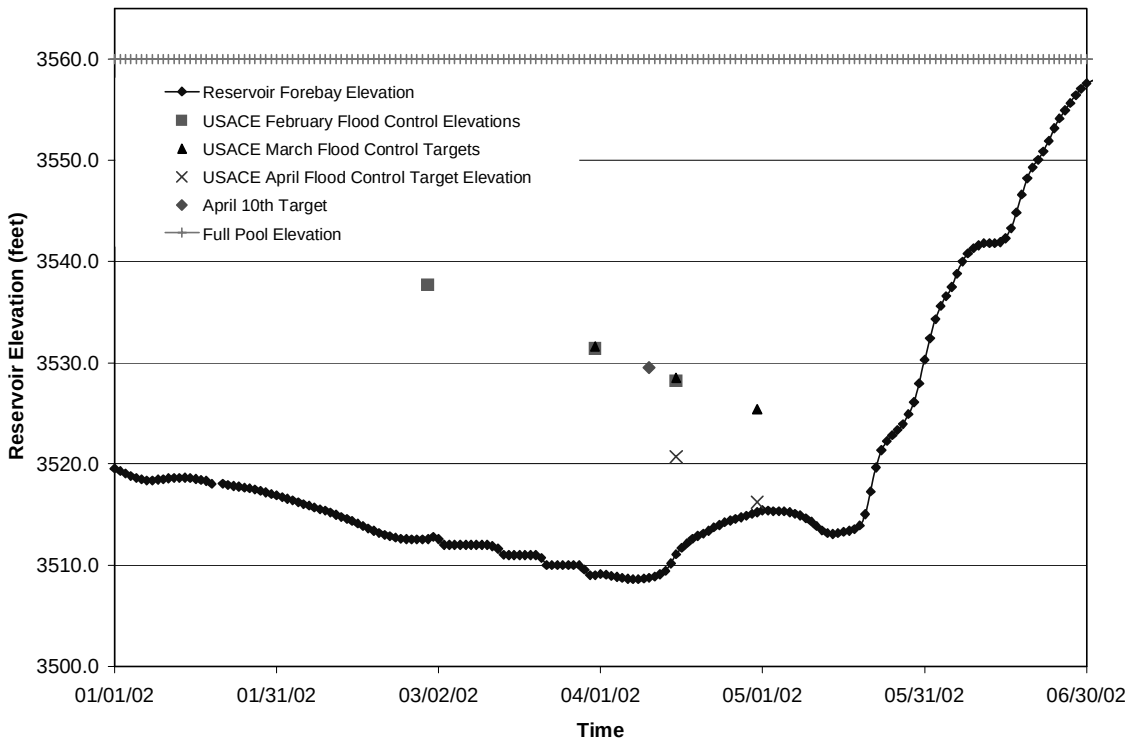

FIGURE 7. Reservoir operations at Hungry Horse over the first six months of 2002.

Libby

Figure 8 displays operations at the Libby storage reservoir (useable storage = 4,979,500 acre-feet) over the first one-half of 2002. Libby was drafted in accordance with its flood control elevations over the winter months of 2002. At the Technical Management Team meeting held on 2-27-02, the COE presented modeling results that predicted the probability of several reservoirs refilling by June 30th, as suggested in the BiOp. The results showed Libby to have a 7% chance of refilling by June 30th of 2002. Later into the spring, at the March 27, 2002 TMT Meeting, the COE released documents that again indicated, "…it is unlikely Libby will refill by the end of July…" Early spring flows in the Columbia River would have benefited greatly from flow augmentation releases from Libby. Instead, Libby was operated conservatively to increase the probability of refill. The Libby reservoir was within less than three feet of full by June 30th, 2002 and

would have easily filled if extremely high inflows over the last portion of June did not force the COE to leave flood space in the reservoir. During the high flow event, the COE were involuntarily forced to spill water at Libby, leading to relatively high levels of total dissolved gas TDG. In retrospect, if Libby water were used to supplement flows in the early spring of 2002, extra room in the reservoir would have been available for flood control purposes. This would have led to higher overall spring flows and less (if any) involuntary spill in the late spring/early summer.

From Figure 8, it is apparent that the Water Supply Forecast (WSF) above Libby increased dramatically, as flood control elevations dropped approximately 15 feet between the March 31st and April 15th, 2002. If an April 10th Biological Opinion target were interpolated between the mentioned flood control elevations, it would have been approximately 2359.9 feet. On the 10th of April, 2002 the Libby reservoir was at an elevation of 2370.7 feet, approximately 11 feet above the April 10th BiOp target. If the COE would have operated Libby to its April flood control targets, more water would have been available for fish and water would have likely not have been involuntarily spilled during the high flow period.

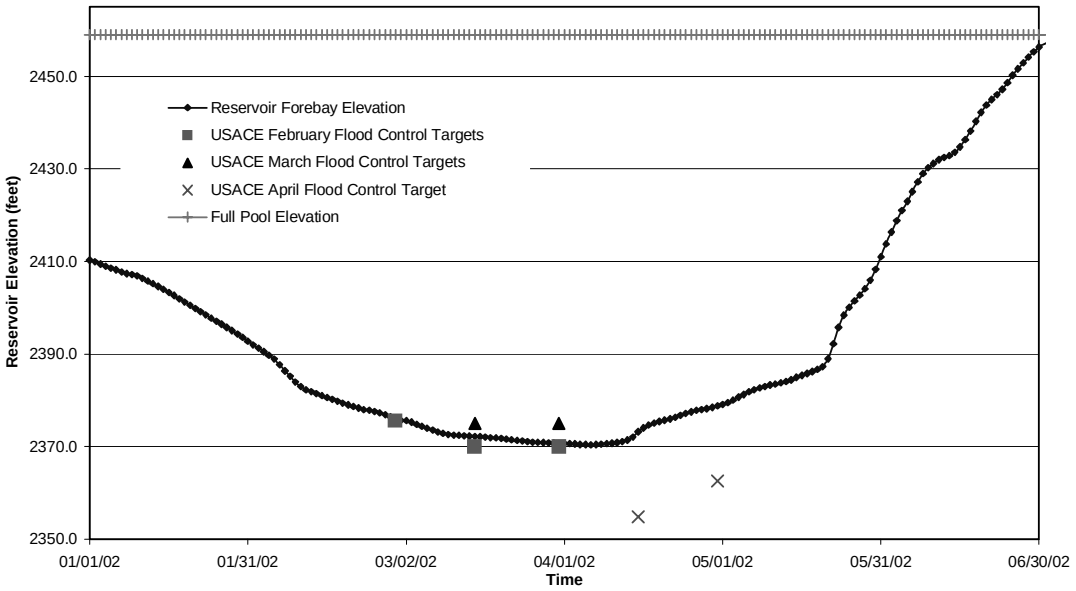

FIGURE 8. Reservoir operations at Libby over the first six months of 2002.

Summary - Winter/Spring Operations

Over the winter/spring of 2002 reservoirs were generally drafted below their FCE, limiting the likelihood of achieving their April 10th BiOp elevation and of meeting spring flow objectives. Furthermore, during the period of time before the runoff began, operators were reluctant to release water needed for flow augmentation, directly contradicting 9.6.1.2.1 Action 14 of the BiOp (page 9-55) calling for objectives to be met on both a seasonal and weekly basis.

The Bureau of Reclamation drafted the Grand Coulee and Hungry Horse reservoirs in the winter/early spring of 2002; however, did manage to meet the April 10th target at Grand Coulee by capturing early season flows and limiting downstream flows. Additionally, the BOR did not operate Grand Coulee with the intent of meeting the flow objectives on both a seasonal and weekly average basis for the benefit of migrating juvenile salmon. BOR declined to draft Grand Coulee below 1240 feet AMSL due to tribal trust responsibilities (May 2, 2002 TMT minutes).

The Idaho Power Company also drafted the Brownlee reservoir intensely over the winter/early spring of 2002; however, it met the April 10th elevation target. Additionally, Brownlee was actively refilling at a time when Columbia and Snake River flows were below the BiOp objectives. Between 4-24-02 and 5-21-02, water was desperately needed in the Columbia River; at this time, Brownlee was predominantly refilling. In situations such as 2002 when the spring freshet is delayed, the refilling of reservoirs during times when the BiOp objectives are not being met should be a consideration. More so, this should be reinforced when a reservoir is within ten feet of full with extremely minimal chances of not filling.

Despite the fact that the Action Agencies were worried about the probability of refill, all projects either refilled or were very close to full by the 30th of June (Figures 3, 5,6,7,8).

3. Summer Flows

The BiOp summer flow objective season began at Lower Granite on 6-21-02 and at McNary on 7-1-02. Both the BiOp summer flow objective seasons at Lower Granite and McNary ended on the 31st of August. The summer objectives were 51 Kcfs at Lower Granite and 200 Kcfs at McNary. Table 7 displays the weekly average flows at each of the mentioned projects.

TABLE 7. 2002 weekly average flows at Lower Granite and McNary in comparison to the Summer Biological Opinion Flow Objectives. Week long periods that did not meet the BiOp Objectives are bolded.

Week WY 2002	**Lower Granite** Weekly Average Flow (Flow Obj. = 51 Kcfs)	**McNary** Weekly Average Flow (Flow Obj. = 200 Kcfs)
6-21 to 6-27	86.0	na
6-28 to 7-4	68.5	na
7-5 to 7-11	**41.4**	238.0
7-12 to 7-18	**38.7**	245.1
7-19 to 7-25	**31.6**	212.4
7-26 to 8-1	**28.3**	**166.3**
8-2 to 8-8	**26.9**	**156.3**
9-9 to 8-15	**30.2**	**155.7**
8-16 to 8-22	**30.6**	**141.9**
8-23 to 8-29	**29.7**	**138.9**
Seasonal Total	**41.0**	**189.1**

From Table 7, it is clear that both Lower Granite and McNary struggled to achieve BiOp flow objectives over the last five weeks of the summer flow objective period. At Lower Granite, river flows were below the 51 Kcfs objective for 8 of the 10 weeks encompassing the summer BiOp flow period. On a seasonal basis, neither Lower Granite nor McNary met their summer BiOp flow objectives.

4. Summer Operations

Grand Coulee

The Grand Coulee reservoir began the summer (7-1-02) at 1287.4 feet and began drafting near the end of the third week in July (Figure 9). Grand Coulee continued to draft to 1280.5 feet on 8-22-02, then essentially held steady until the BOR agreed to draft Grand Coulee from approximately 1280.0 feet to 1279.5 feet by the 30th of August, liberating 35 Kaf of water in a few days to offset water lost in the Libby/Canadian swap. Grand Coulee ended the summer draft period at 1280.1 feet on August 31, 2002.

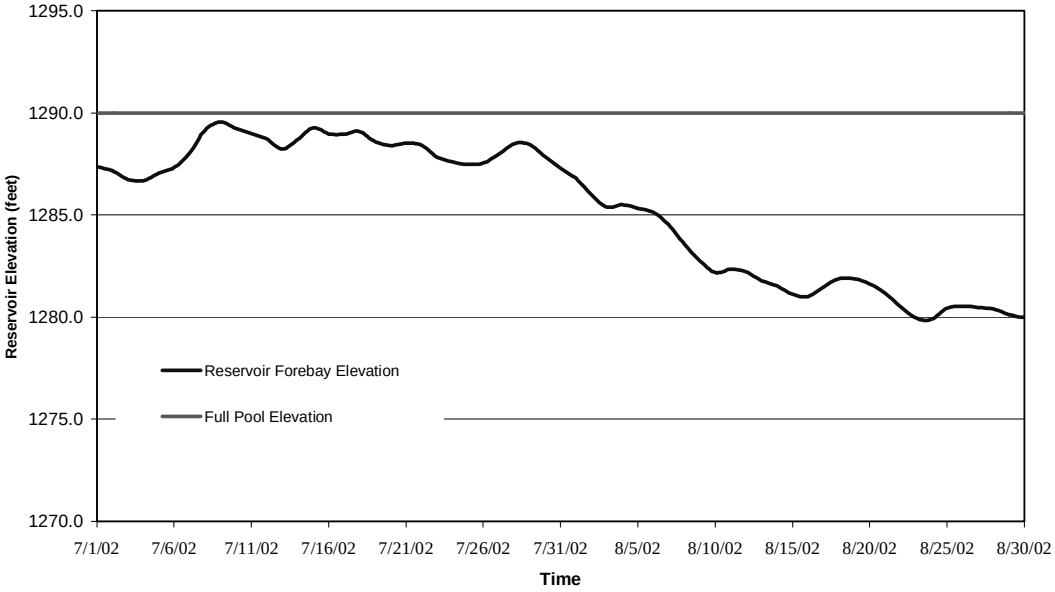

FIGURE 9. Reservoir operations at Grand Coulee over the summer months of 2002.

Brownlee

On June 25, 2002, SOR 2002-5 asked the Idaho Power Company to pre-draft USBR summer flow augmentation water out of Brownlee during July. In a letter addressed the COE (July 9, 2002), in response to SOR 2002-5, the IPC stated:

"The SOR recommends that the Company operate the Hells Canyon Complex (HCC) to facilitate the delivery of U.S. Bureau of Reclamation (USBR) water released from the Upper Snake River basin, as well as provide additional water from the HCC during July and August to assist in meeting the "summer flow objective of 51 Kcfs at Lower Granite Reservoir." This is not only an inappropriate recommendation, but one that implies that the Company bears some responsibility for meeting those flow objectives and assisting with the migration of juvenile salmonids through the lower Snake River federal projects. The Company does not."

During the second week of August, Brownlee began to draft water for power production purposes at a rate of more than a few feet of water per week; by 8-31-02 Brownlee was at an elevation of 2056.0 feet (Figure 10).

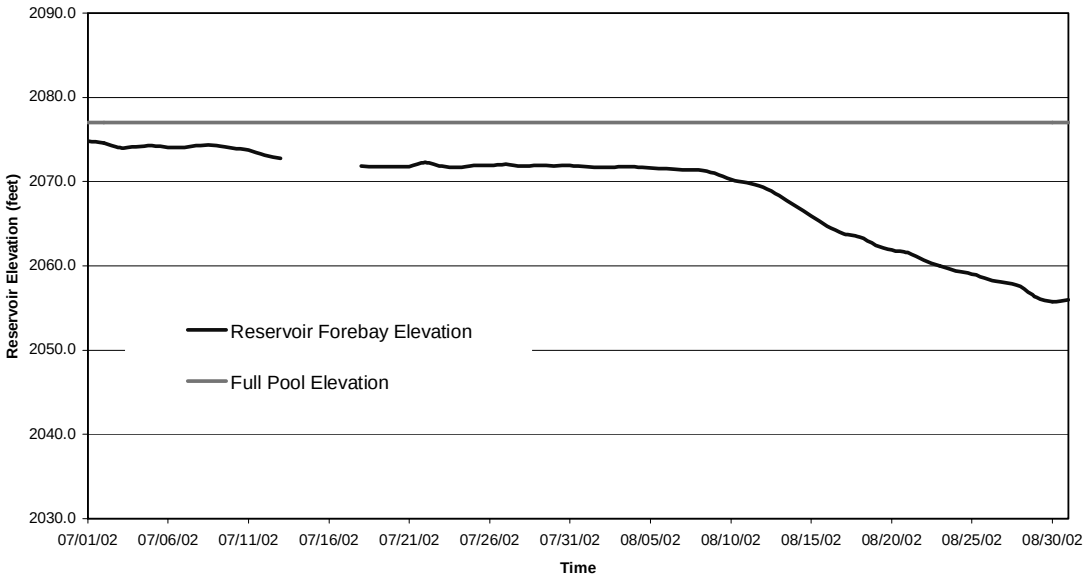

FIGURE 10. Reservoir operations at Brownlee over the summer months of 2002.

Hungry Horse

According to the 2000 Biological Opinion, the Hungry Horse reservoir can draft to elevation 3540 feet by August 31st for summer flow augmentation. By midnight of August 31st 2002, Hungry Horse drafted to an elevation of 3544.9 feet, nearly five feet above the BiOp draft limit of 3540 feet (Figure 11). The remaining five feet of water in Hungry Horse was released during the month of September. According to the reservoir storage table for the Hungry Horse Reservoir, 2793.6 Kaf of useable storage is available at a reservoir elevation of 3544.9 feet; at an elevation of 3540 feet, 2680 Kaf of useable storage is available. Therefore, the volume of water that was held back at the Hungry Horse reservoir for September flows was 113.6 Kaf, this volume of water could have been used during the summer BiOp flow objective period.

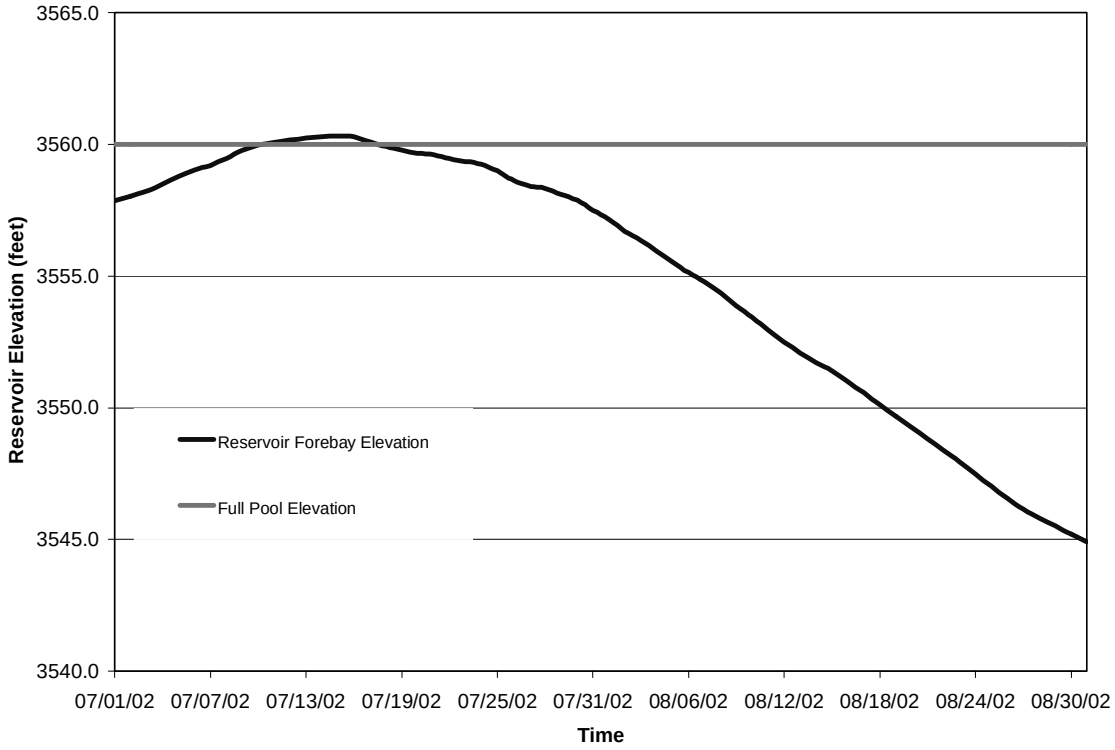

FIGURE 11. Reservoir operations at Hungry Horse over the summer months of 2002.

Dworshak

According to the 2000 Biological Opinion, the Dworshak Reservoir can draft to elevation 1520 feet by August 31st for summer flow augmentation. According to SOR 2002-07 (which was discussed and accepted at TMT), the August 31st draft limit at Dworshak was elevated in an attempt to provide approximately 200 Kaf of water into September for an adult fish study. On August 31st, 2002, Dworshak was at an elevation of 1534.7 feet, 14.7 feet above the BiOp end of August draft limit (Figure 12). According to the reservoir storage table for the Dworshak Reservoir, 982.5 Kaf of useable storage is available at a reservoir elevation of 1534.0 feet; at an elevation of 1520 feet, 786.0 Kaf of useable storage is available. Therefore, the volume of water held back at the Dworshak reservoir for September flows was 196.5 Kaf, this amount of water would have increased outflows from Dworshak by 3.2 Kcfs in August. From Table 4, on a weekly basis in August, outflows at Lower Granite Dam averaged between 26.9 and 30.6 Kcfs, the amount of

water held for summer flows (196.5 Kaf) would have increased flows in the Lower Snake River by more than 10%.

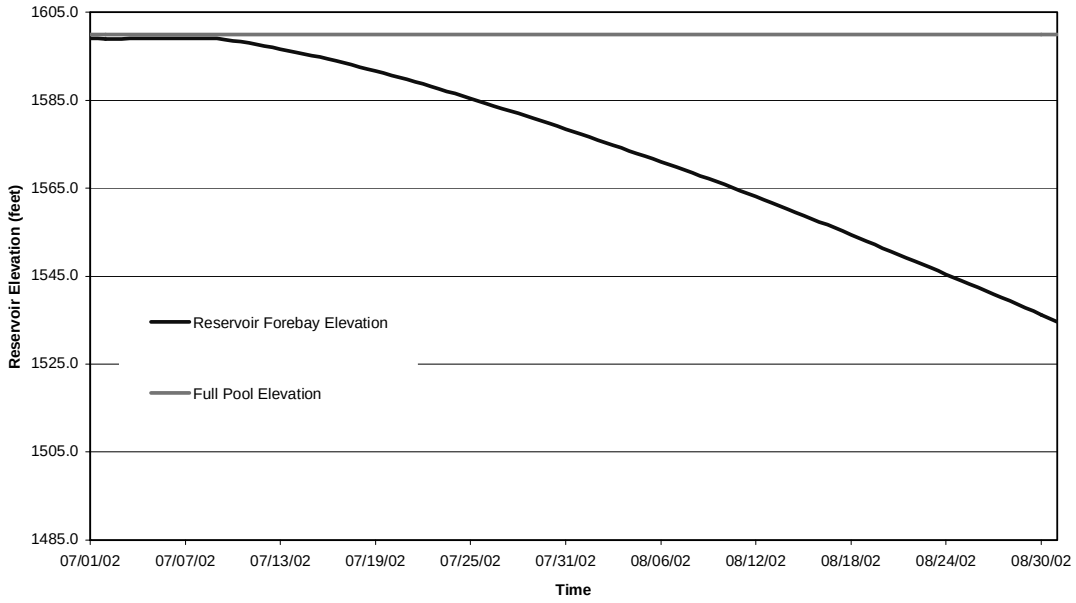

FIGURE 12. Reservoir operations at Dworshak over the summer months of 2002.

Libby

At the July 7th, 2002 TMT meeting an operation was outlined that included drafting Libby between elevations 2442.2 and 2442.3 feet by August 31st, 2002. The BiOp draft limit at Libby is 2439 feet by August 31st; therefore, more than three feet of water was projected to remain in the reservoir after August 31st. According to the operation, an amount of water equivalent to the difference in storage between elevation 2442.2-2442.3 and 2439 feet (140 Kaf) was to be released from Canadian Storage. This operation was in response to SOR #2002-MT-1 drafted by the State of Montana. On August 31st, 2002 Libby was at an elevation of 2442.1 feet (Figure 13).

Discussions at the August 28, 2002 TMT Meeting were focused upon the Libby/Canadian swap. At this meeting, it was learned that the Canadian projects would be releasing zero of the 140 Kaf that was originally agreed upon. BPA did point out that outflows were increased from 58 to 64 Kcfs from the Arrow reservoir as a result of a required provisional draft because of reduced inflows between the August 8th and August 22nd TSR (Treaty Storage Regulation). The men-

tioned increases at Arrow resulted in approximately 80 Kaf of additional water at the Canada/US border. However, this water would have been released regardless of the Libby/Canadian swap agreement; therefore, the provisional draft water should not count toward the Libby/Canada swap volume. In light of the Canadian operations, TMT agreed to continue operations at Libby as outlined in the agreement, however, asked the Action Agencies if any water was available to offset the Libby/Canadian swap deficit. The BOR agreed to draft Grand Coulee from approximately 1280.0 feet to 1279.5 feet by the 30th of August, liberating 35 Kaf of water over a two-day period. All in all, the Libby/Canadian swap resulted in a loss of 105 Kaf of summertime water.

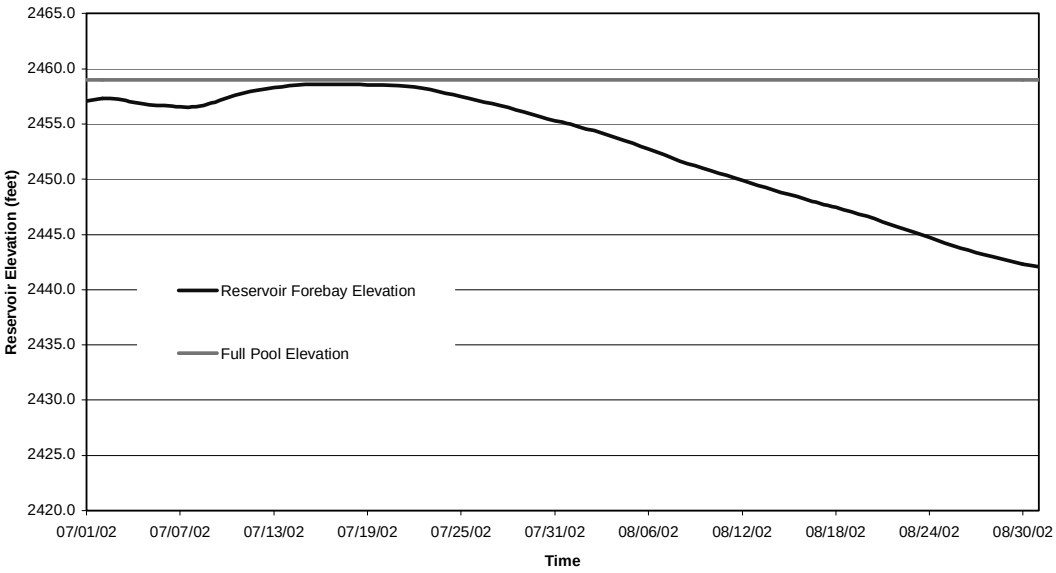

FIGURE 13. Reservoir operations at Libby over the summer months of 2002.

Canadian/United States Non-Treaty Storage

Coordination of the Pacific Northwest and British Columbia (BC) Hydro systems was initiated in 1964 with the ratification of the Columbia River Treaty (Treaty). Under the Treaty, Canada was required to construct 15.5 Maf of storage at the Mica, Arrow and Duncan projects for optimum power generation and flood control downstream in Canada and the United States. The Treaty also allowed the US to construct the Libby project on the Kootenai River in Montana for flood control and other benefits. BC Hydro also built storage on the Columbia River system

beyond what was required by the Treaty, termed Non-Treaty Storage (NTS). The Canadian storage projects are Mica, with 7 Maf of usable Treaty Storage and 5 Maf of Non-Treaty Storage, Arrow Lakes, with 7.1 Maf of Treaty Storage and 0.26 Maf of Non-Treaty Storage, and Duncan, with 1.4 Maf of Treaty Storage.

Non-Treaty Storage Operations

The NTS agreement allows BC Hydro and BPA to adjust Treaty flows on a daily basis to improve the coordination of the combined system. Non-Treaty transactions are zero-sum over time (i.e. in the long run, releases must equal storage transactions). There is an agreement between the Federal and Canadian parties that allows Canadian projects to store water in the spring (May 1 to June 30) for release in the summer (July 1 to August 31). Water releases are limited to not cause spill at either Mica or Revelstoke, or create flooding downstream of Arrow Dam. In the spring of 2002, 340 Ksfd (673 Kaf) was stored for the US and 340 Ksfd (673 Kaf) was stored by BC Hydro. According to the agreement, all of the US water and one-half of the BC Hydro water must be released in July and August of 2002. The 2002 total release volume between the US and BC Hydro water was 510 Ksfd (1010 Kaf) in July and August. According to BPA accounting, all of the non-treaty storage water was released from Canada by the 31st of August 2002.

Treaty Storage Operations

The Treaty requires Canada to operate at least 8.45 MAF of storage for flood control in Canada and the United States. The U.S. downstream power benefits from Canadian Treaty storage are to be shared equally between the two countries. Each year the U.S. and Canadian Entities (BC Hydro, BPA and the COE) prepare an Assured Operating Plan with agreed Determinations of Downstream Power Benefits for the sixth succeeding year. Beginning with the 1997 through 1998 Assured Operating Plans, additional loads were included in June to assist meeting U.S. flow augmentation objectives. Each year a Detailed Operating Plan is prepared for the upcoming operating year that implements the Assured Operating Plan. Since 1993, the Entities have agreed only to mutual beneficial deviations from the Detailed Operating Plan, generally to meet U.S. salmon

flow augmentation and Vernita Bar needs, in return for meeting Canadian trout and white fish spawning and for blowing dust.

Snake River

The BOR contracted and released approximately 238 Kaf of water for summer flow augmentation by the end of August. The NMFS Biological Opinion and the NWPPC Fish and Wildlife program call for the BOR to provide up to 427 Kaf of volume from Upper Snake River Reservoirs for summer flow augmentation. Therefore, during the summer months of 2002, 189 Kaf less water was released from Upper Snake Reservoirs.

Summary - Summer Operations

During the 2002 summer BiOp flow objective period, significant volumes of water were either not released or held back for September releases. In total, 744.1 Kaf less water was released during the 2002 summer flow objective period, a combined result of operations at Hungry Horse, Dworshak, Libby, and the Upper Snake Reservoirs. If the water either not released or held back along the Snake River were distributed evenly over the summer BiOp period (June 21 to August 31) at Lower Granite, flows would have increased continually by approximately 2.7 kcfs. If the water either not released or held back along both the Snake and Columbia Rivers were distributed evenly over the summer BiOp period at McNary (July 1 to August 31), flows would have increased continually by approximately 6.0 kcfs.

D. Conclusions

- Water Year 2002 was relatively average in terms of precipitation and snowpack.
- The actual runoff volume recorded at Lower Granite between January and July was 80% of average; the runoff volume recorded at The Dalles between January and July was 97% of average.

- Neither seasonal/nor weekly 2002 Spring BiOp Flow Objectives were met at Lower Granite Dam.
- Nine of eleven weeklong periods contained flows at Lower Granite that were below the 2002 Spring BiOp Flow Objective.
- The average seasonal (4-3 to 6-20) flow at Lower Granite was 83.4 Kcfs, 13.6 Kcfs below the 97 Kcfs objective.
- While the seasonal 2002 Spring BiOp Flow Objectives were met at McNary, the flow objectives were not met on a weekly basis.
- Five of twelve weeklong periods contained flows less than the Spring BiOp Flow Objective at McNary.
- The average seasonal (4-10 to 6-30) flow at McNary was 269.3 Kcfs, 23.3 Kcfs above the 246 Spring BiOp flow objective.
- The 2002 Spring BiOp Flow Objective at Priest Rapids was met on a seasonal basis and nearly always on a weekly basis, only one of 12 week long periods contained flows less than the Spring BiOp Objective of 135 Kcfs.
- Over the winter/spring of 2002 reservoirs were generally drafted below their FCE, limiting the likelihood of achieving their April 10th BiOp elevation and of meeting spring flow objectives. During the period of time before the peak runoff occurred, operators were reluctant to release water needed for flow augmentation from storage reservoirs.
- The summer objectives were 51 Kcfs at Lower Granite and 200 Kcfs at McNary.
- At Lower Granite, river flows were below the 51 Kcfs objective for 8 of the 10 weeks encompassing the summer BiOp flow period. At McNary, river flows were below the 200 Kcfs objective for 5 of the 8 weeks of the summer BiOp flow period. On a seasonal basis, neither Lower Granite nor McNary met their summer BiOp flow objectives.
- During the 2002 summer BiOp flow objective period, significant volumes of water were either not released or held back for September releases for various reasons. In total, 744.1 Kaf less water was released during the 2002 summer flow objective period, a combined result of operations at Hungry Horse, Dworshak, Libby, and the Upper Snake Reservoirs. If this water were distributed evenly over the summer BiOp period (June 21 to August 31) at Lower Granite,

flows would have increased by approximately 2.7 kcfs per day. If the water either not released or held back along both the Snake and Columbia Rivers were distributed evenly over the summer BiOp period at McNary (July 1 to August 31), flows would have increased by approximately 6.0 kcfs per day.

II. 2002 SPILL MANAGEMENT

A. *Spill*

1. Overview

In March of 1995, an ESA Section 7 Biological Opinion on the operation of the Federal Columbia River Power System was issued. The Opinion established a set of reasonable and prudent alternatives (RPA) with the objective of improving the operation and configuration of the federal power system to meet a no jeopardy requirement of the Endangered Species Act (ESA), and to fulfill the United States commitment to uphold tribal treaty fishing rights. One of the RPA established a Biological Opinion spill program for fish passage.

A Supplemental Biological Opinion (Supplemental Opinion) was signed on March 2, 1995 in part to address the needs of the newly listed as threatened Snake River steelhead and the Lower Columbia River steelhead, as well as the endangered Upper Columbia River steelhead. The Supplemental Biological Opinion called for additional spill to the gas caps on a system-wide basis and modified the planning dates for the initiation and duration of the spill program. To the extent that the fish passage efficiency (FPE) at some projects exceeded 80%, the additional spill supplemented 1995 RPA Measure 2 for an interim period pending decisions regarding biologically based performance standards for project passage.

The National Marine Fisheries Service again modified spill in the 2000 Biological Opinion issued in December of 2000. In the Biological Opinion, spill at Lower Monumental Dam was increased from a 12-hour period to a 24-hour period. At The Dalles Dam, the instantaneous spill level was decreased from 64% of instantaneous flow to 40% of instantaneous flow. Spill at John Day and Bonneville dams remained unchanged from the 1998 Supplemental Opinion, but called for the initiation of a daytime spill test at John Day Dam and a test of increasing daytime spill volume at Bonneville Dam.

The purpose of the spill program is to improve the downstream passage of Endangered Species Act (ESA) listed stocks by providing a route with less associated mortality than turbine passage. It is recognized that spilling water generates atmospheric gas supersaturation of the river that can have detrimental effects on fish. In providing spill as an alternate passage route the associated mortality due to dissolved gas supersaturation needs to be balanced against mortality of turbine passage.

2. Spill Planning

The 2002 water year was characterized at the April 1 forecast to be 81% of average (1971-2000) runoff volume above Lower Granite Dam, and 90% of average above The Dalles Dam for the January to July time period. This runoff volume trend continued through the spring with the final July runoff volume forecast calling for 80% of average above Lower Granite and 96% of average runoff volume above The Dalles. The flows during the 2002 migration season were substantially greater than observed during the drought year of 2001 but less than those observed during recent past years. In 2002 the runoff was delayed which resulted in higher flows later in the season. The dissolved gas levels observed in 2002 reflect the range of low to high flows observed. The average monthly flows that occurred at Lower Granite and McNary Dams are contained in Table 8.

TABLE 8. Average monthly flows at Lower Granite and McNary dams in 2002.

Month	Average Monthly Flow (kcfs)	
	Lower Granite	McNary
April	73.3	207.9
May	82.1	234.9
June	94.2	324.5
July	38.3	230.4
August	29.4	147.8

3. Total Dissolved Gas Waivers

In 2002, as in previous years, a waiver for the total dissolved gas standard was requested from the Oregon Department of Environmental Quality (DEQ), and the Washington Department of Ecology (DOE). The Idaho Department of Environmental Quality and the Nez Perce Tribe did not consider a waiver of the water quality standard for total dissolved gas supersaturation (TDGS). Because of the risk associated with dissolved gas supersaturation, the requested waiver was for a twelve-hour average of 115 and 120 percent TDGS in the forebay and tailrace of a project, respectively. The waivers were granted for the 2002 season by the Oregon and Washington state water quality agencies. Without a waiver the total dissolved gas levels were limited to the 110% level below Dworshak Dam.

The Oregon DEQ granted a waiver request from the USFWS on March 8 for the ten day spill period associated with the Spring Creek Hatchery fall chinook March 11th release, as did the Washington Department of Ecology for the provision of spill up to the 120% total dissolved gas criteria.

4. Spill Implementation

The water conditions during 2002 were near average in terms of volume runoff. In general, except for a short period of uncontrolled flow, spill was managed to meet the TDGS waivers. Spill during the spring passage season was manipulated such that total dissolved gas levels were generally at, or below, the waivers during most all of the migration season.

Snake and Clearwater Rivers

The allowable levels of TDGS below the project dictated spill at Dworshak. Those levels were limited to 110% TDGS because of the lack of a dissolved gas waiver from Idaho or the Nez Perce Tribe. Spill began early in April and for the most part ended in early June at Lower Granite and Little Goose dams, while continuing through August at Ice Harbor Dam. Testing of the removable spillway weir affected operations at Lower Granite Dam and stilling basin repairs precluded spill operations at Lower Monumental Dam in 2002.

Dworshak

No spill occurred at this project throughout March for flood control. Spill occurred in April as the project was lowered to its end of April flood control elevation (Figure 14). Spill began early in April so as not to exceed the 110% waiver, and continued through May 15, 2002. There was no spill from May 15 to about June 15, when the project reached full pool and spill became necessary. This spill ended on July 2, 2002. The total dissolved gas levels exceeded 110% and a temporary dissolved gas waiver was issued. Spill occurred again during flow augmentation during the summer period when outflow exceeded the hydraulic capacity of the project.

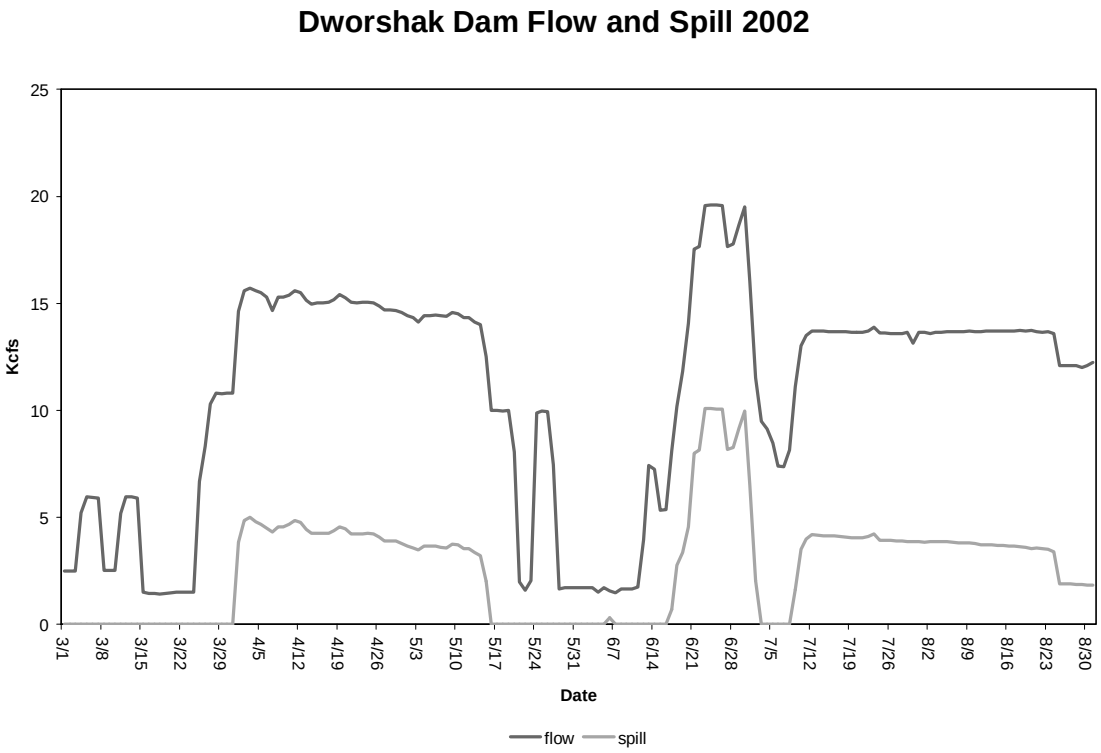

FIGURE 14. Dworshak Dam flow and spill for spring and summer of 2002.

Lower Granite Dam

Spill was initiated on April 3, 2002 based on increasing numbers of juvenile migrants passing Lower Granite Dam. In the 2000 Biological Opinion NMFS set a spill equal to the gas cap at a level of 60 Kcfs for 12 hours (1800 to 0600 hours) (Figure 15). Spill was implemented at about this level (limited by total dissolved gas concentrations) until the removable spillway weir (RSW) testing began on April 15, 2002. After the initiation of the test spill was more variable based on the test condition. There is no spill requirement for summer spill at this project, as transportation is maximized for subyearling migrants. However, the delayed spring runoff and excess energy market conditions resulted in spill continuing into July at this project.

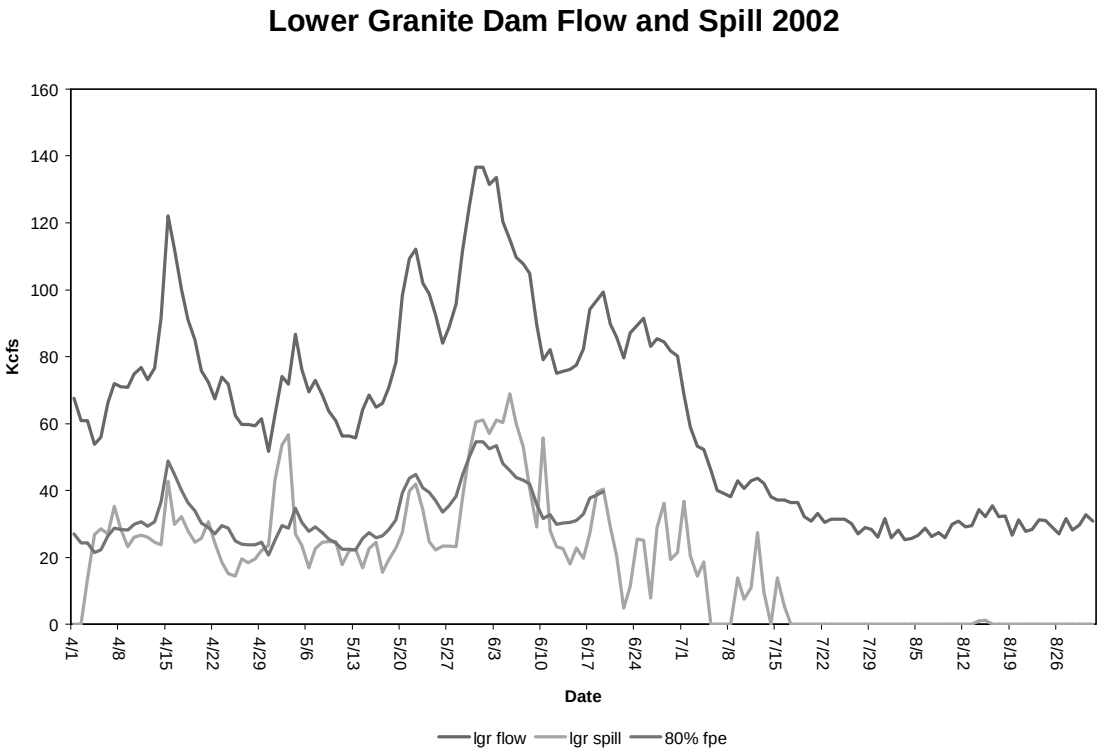

FIGURE 15. Lower Granite Dam flow and spill for spring and summer of 2002.

Little Goose Dam

The 2000 Biological Opinion sets spill at this project to 45 Kcfs for a 12-hour period. In pre-season discussions it was decided to mitigate for the lack of spill at Lower Monumental Dam by implementing a period of 24-hour spill at Little Goose Dam. Spill was initiated on April 5, 2002. Spill occurred for a 24-hour period (while managing dissolved gas) until May 1, then for a 12-hour spill from 6 p.m. to 6 a.m. for the remainder of the spill period. At this project the 80 % FPE was only met during the 24-hour spill period (Figure 16), and again during early June. There is no Biological Opinion spill requirement for this project during the summer. Again, the delayed spring runoff and excess energy market conditions resulted in spill continuing into July at this project.

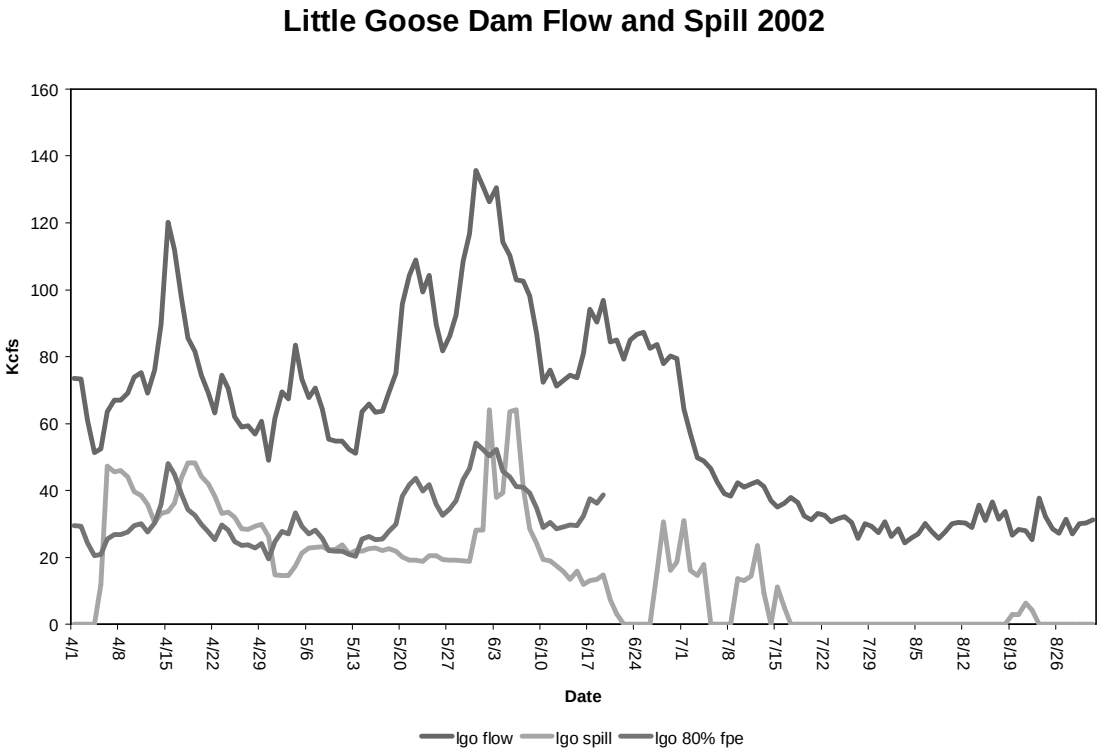

FIGURE 16. Little Goose Dam flow and spill for spring and summer of 2002.

Lower Monumental Dam

Required repairs to the stilling basin below the Lower Monumental project necessitated that spill be terminated at this project for the season. The juvenile fish passage facility operated in direct bypass until April 30, 2002, coincident with the 24-hour spill at Little Goose Dam. Smolts in the bypass channel were routed directly back to the river, bypassing the collection/dewatering system except for periodic sub-samples obtained for fish condition monitoring. Regular fish collection resumed 0900 hours, April 30. A unit outage on May 22 resulted in spill in excess of hydraulic capacity for several days (Figure 17).

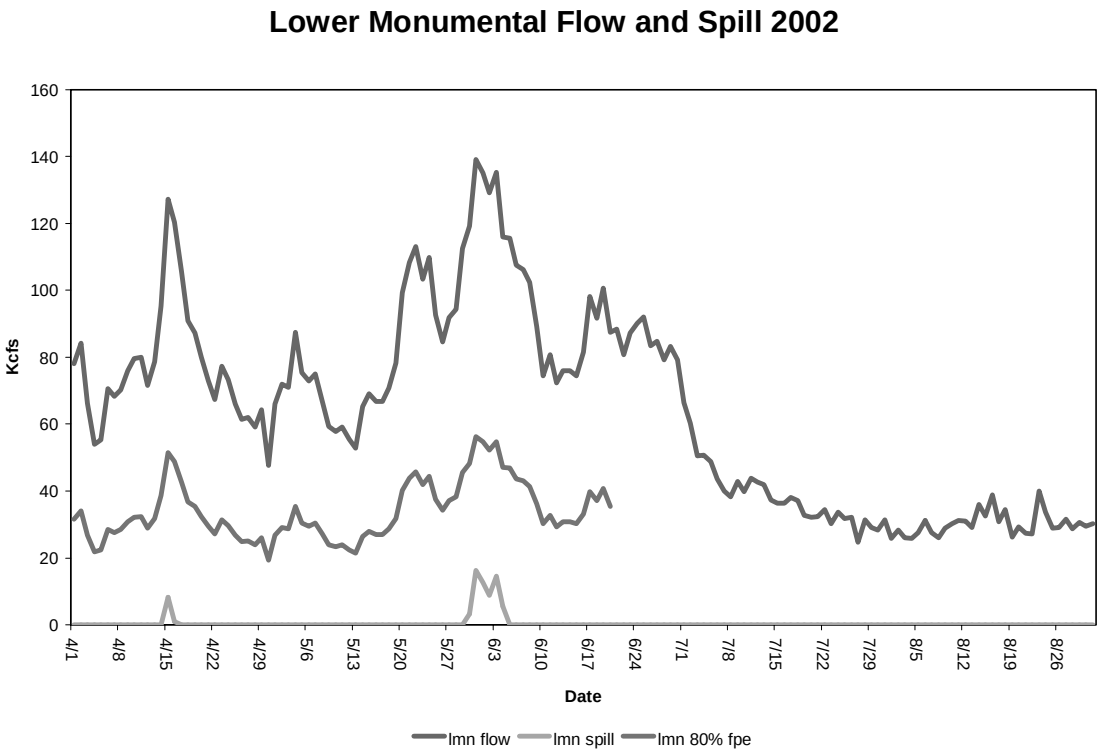

FIGURE 17. Lower Monumental Dam flow and spill for Spring and Summer of 2002.

Ice Harbor Dam

The Biological Opinion specifies an instantaneous spill level of 100 Kcfs during nighttime hours and 45 Kcfs during the day. Spill began on April 10, 2002 because of observed fish passage. The 80% FPE was exceeded through most of the spring migration (Figure 18) and met during most of the summer period.

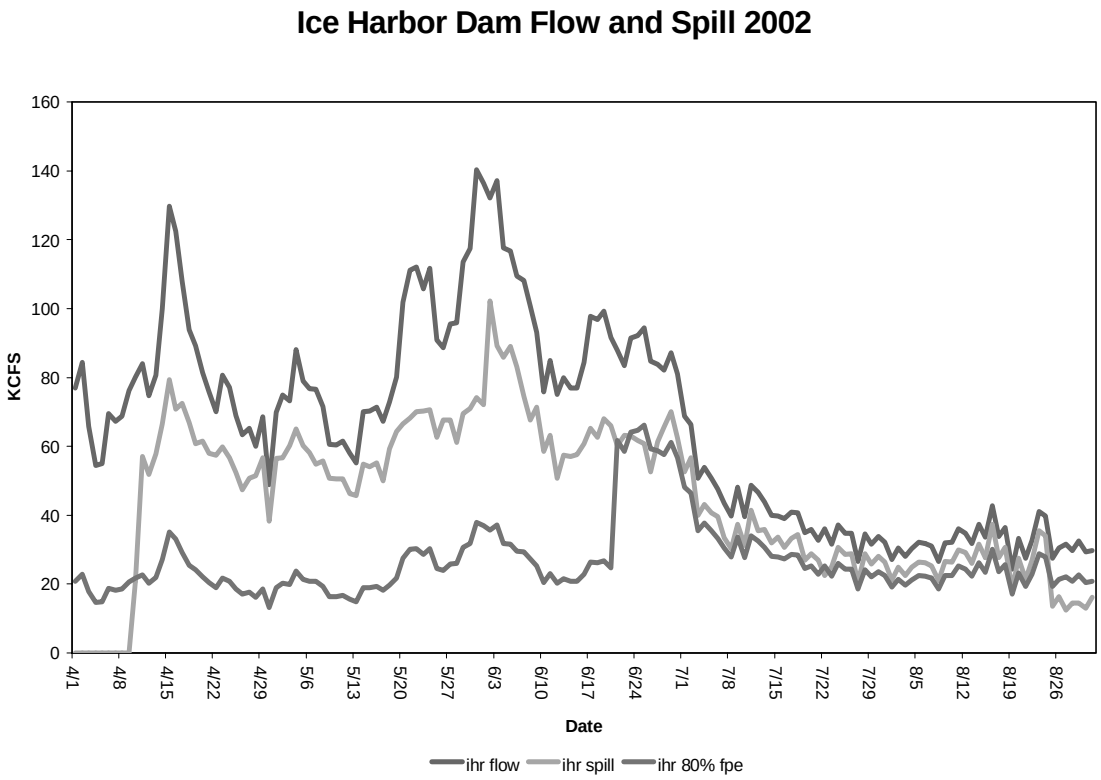

FIGURE 18. Ice Harbor Dam flow and spill for spring and summer of 2002.

Lower Columbia River

The 2002 water year was near average in the lower Columbia River. Peak flow was later than usual. Spill was a product of Biological Opinion planned spill and over generation spill.

McNary Dam

Spill for fish passage began on April 10. Spill occurred at this project throughout both the spring and during some part of the summer migration mostly due to a limitation on the hydraulic capacity of this project (Figure 19). The Biological Opinion specifies that spill will occur at an instantaneous rate of 120 to 150 Kcfs from 1800 to 0600 hours daily. During the spring migration

the project exceeded the 80% FPE for almost 100% of the time. There is no summer spill requirement in order to maximize transportation but, because of the delayed runoff, spring-like river conditions persisted and spill continued into the summer.

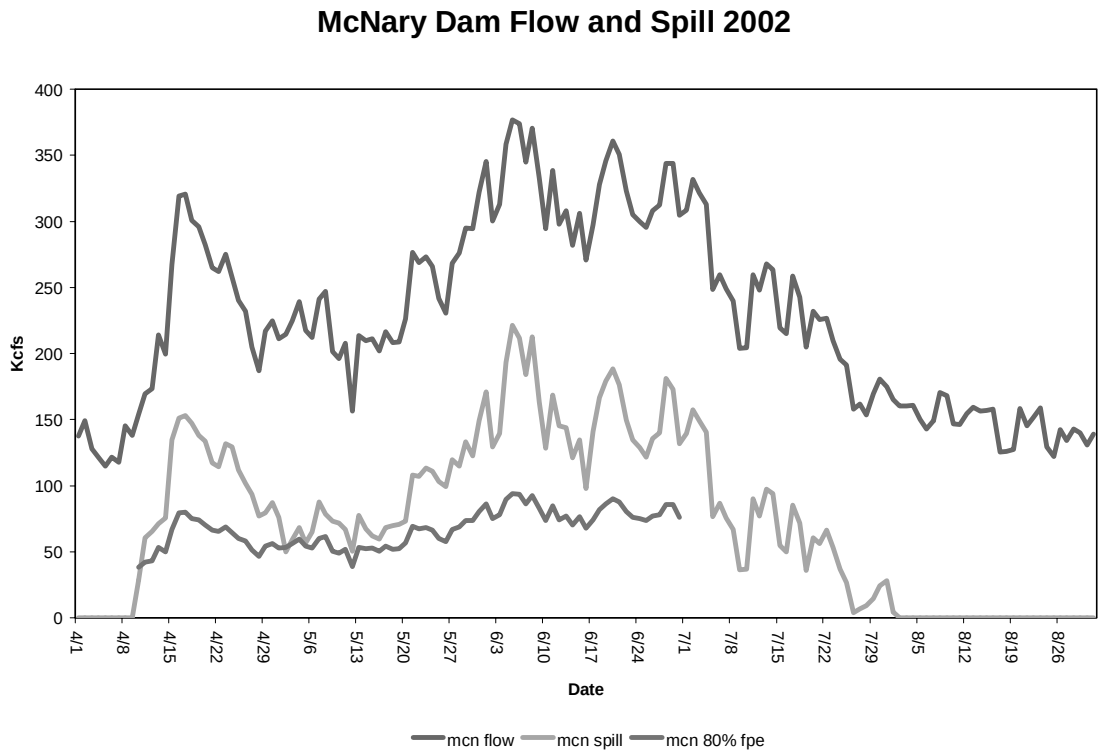

FIGURE 19. McNary Dam flow and spill for spring and summer of 2002

John Day Dam

Spill began April 10. The Biological Opinion specifies a level of spill up to the gas cap (approximately 160 Kcfs) for a period from one hour before sunrise to one hour after sunset. Because of dissolved gas limitations spill almost never achieved the 80% FPE (Figure 20) except on days when daytime spill occurred.

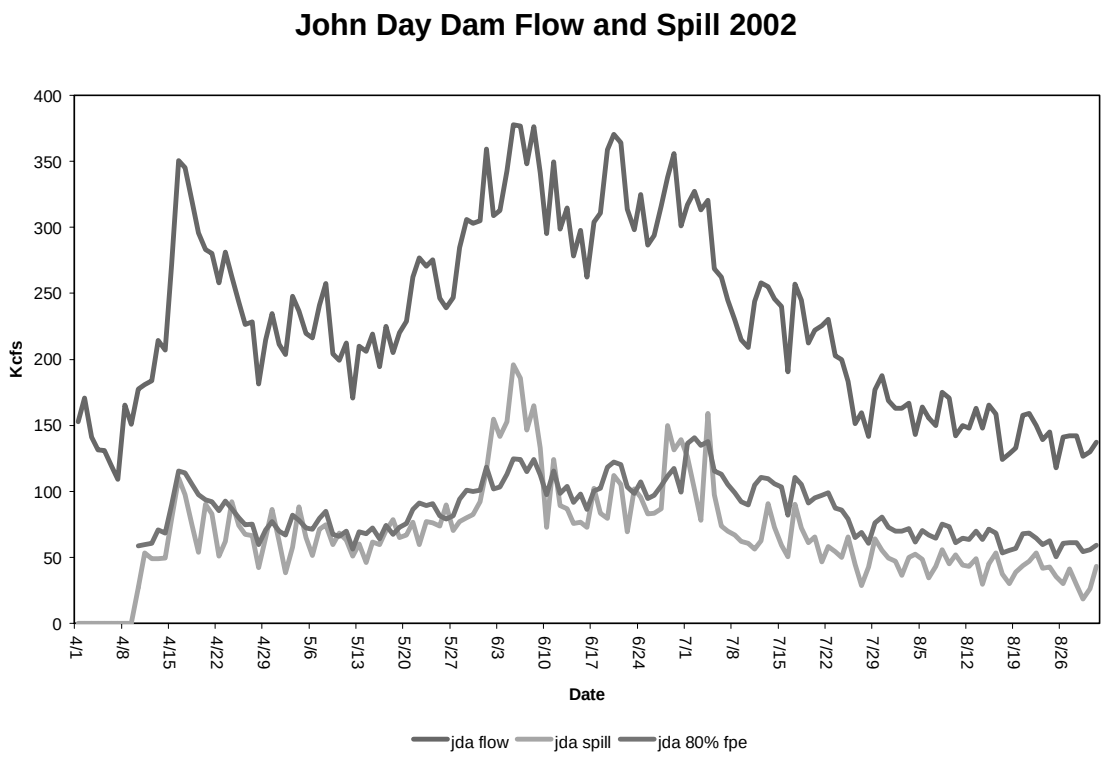

FIGURE 20. John Day Dam flow and spill for spring and summer of 2002.

The Dalles Dam

Spill at The Dalles Dam was 40% of instantaneous flow and began on April 10, 2002. As seen in the graph (Figure 21) spill never came close to the 80% FPE.

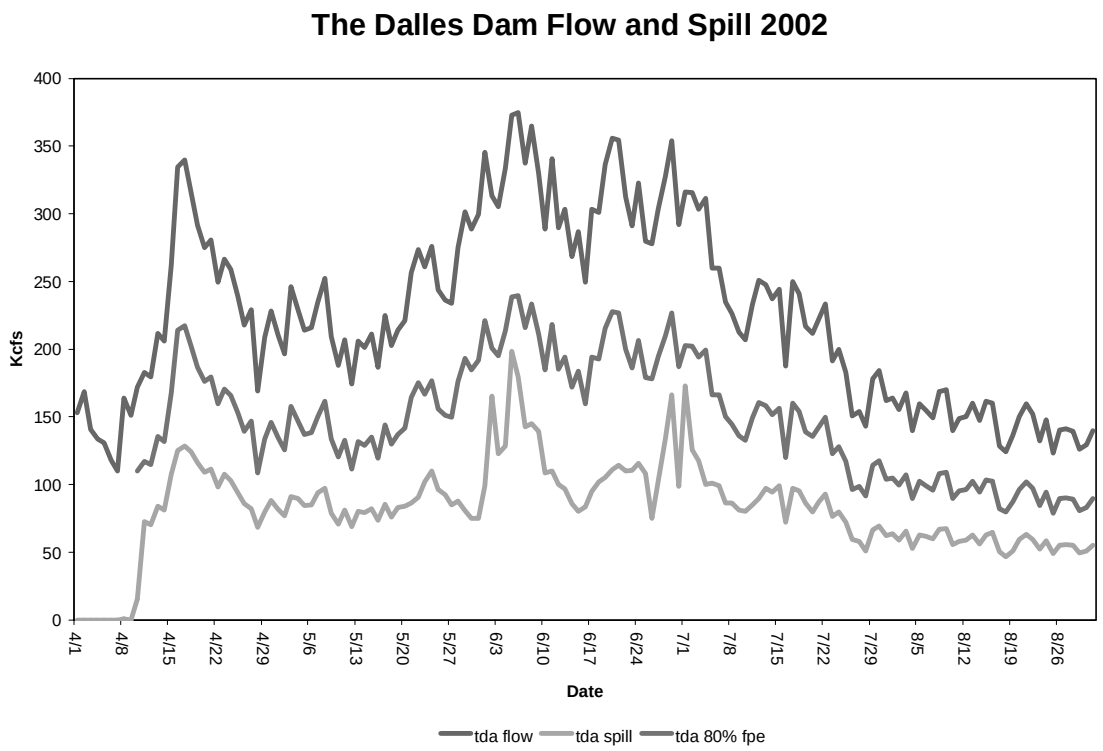

FIGURE 21. The Dalles Dam flow and spill for spring and summer of 2002.

Bonneville Dam

Spring Creek Pre-Biological Opinion Season Spill

Spill to facilitate the passage of Spring Creek subyearling fall chinook was requested subsequent to the March hatchery release. Listed chum redds below the Bonneville project prompted a request from the state, tribal and federal fishery managers for an increase in flow to allow for adequate depth compensation to assure that gas levels over the redds was not lethal to emerging chum. The operation was requested for a ten-day period following the release, with a check-in and assessment of need for continued operations after a five-day period. The Action Agencies did not agree the request was feasible and implemented an alternative operation for slightly less than three days, which had associated with it a potential risk of drafting 200 KAF from Grand Coulee Reservoir. Natural flows increased during the implementation of the alternative operation and

drafting of the reservoir to increase flows was not necessary. After the 69-hour operation requests to extend the operation were denied by the Action Agencies.

The Biological Opinion calls for spill levels to the gas cap during nighttime hours (90-150 Kcfs) and limiting spill to 75 Kcfs during daylight hours. At Bonneville Dam the spill is limited to prevent adult fallback. Under these restrictions the 80% FPE is not achievable. During the 2002 migration season the 80% FPE was not achieved (Figure 22). Spill of 50 kcfs began on April 10 at 6 p.m. and continued until April 12. Spill was then adjusted to the gas cap while providing depth compensation for emerging chum salmon at redds downstream of the project. Spill continued through August 31.

Special Operations:

A spill test was proposed for October at The Dalles Dam. This test was not considered in planning, but the conduct of the test in 2002 would facilitate the implementation of fish protection measures in the near term. However, since the test was not planned the Bonneville Power Administration required that the conduct of the test be revenue neutral. In order to accomplish the revenue neutral aspect, some spill during the fish migration season had to be curtailed. The following was agreed to for the implementation of the spill test; (1) continue Bonneville flow deflector test and credit that spill reduction toward the swap; (2) curtail daytime spill at John Day for the last two 30/30% spill days, 28 - 29 August; and (3) end daytime spill at Ice Harbor on 25 August. This spill test was completed in late October.

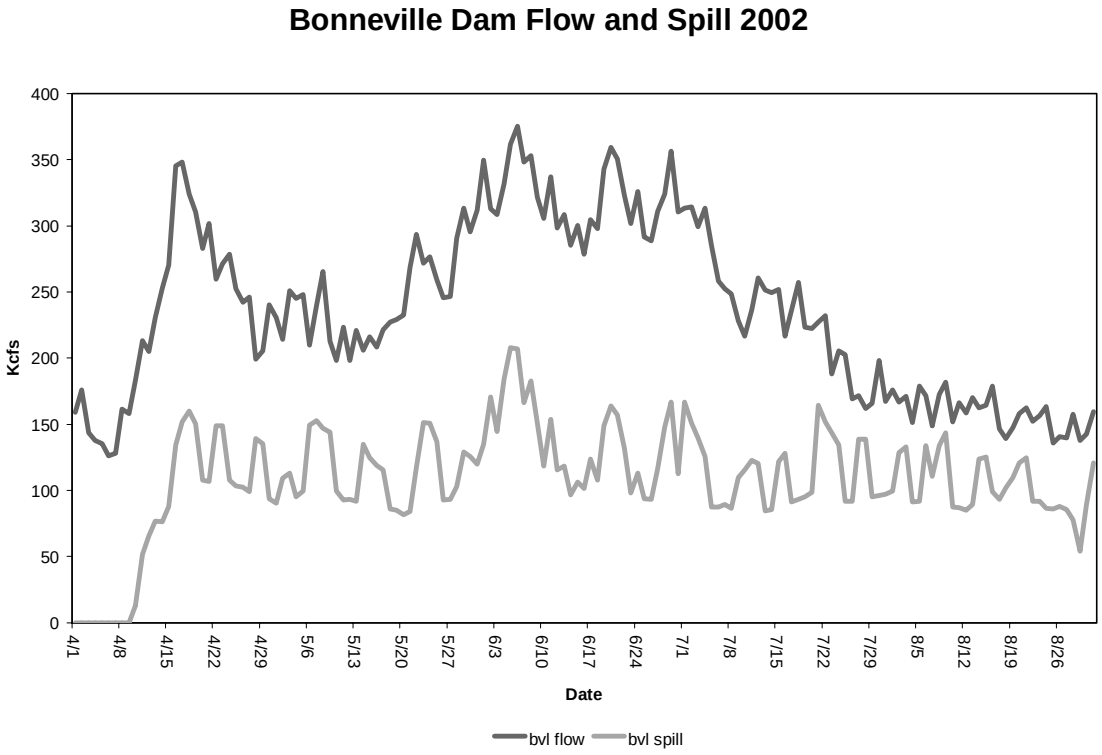

FIGURE 22. Bonneville Dam flow and spill for spring and summer of 2002.

B. Gas Bubble Trauma Monitoring and Data Reporting for 2002

1. Overview

Monitoring of juvenile salmonids in 2002 for gas bubble trauma (GBT) was conducted at Bonneville Dam and McNary Dam on the Lower-Columbia River, and at Rock Island Dam on the Mid-Columbia River. The Snake River monitoring sites were Lower Monumental Dam, Little Goose Dam, and Lower Granite Dam. Sampling of fish began the first full week of April at all sites and continued through mid-June at the Snake River sites, when the numbers of steelhead and yearling chinook were too few to sample effectively. Subyearling chinook were not sampled in the Lower Snake River due to their endangered status and because the Biological Opinion does not call for the implementation of summer spill at the Snake River collector projects. Sampling of subyearling chinook did occur at Columbia River sites to the end of August.

Sampling occurred two days per week at the Lower Columbia sites and once a week at Lower Granite, Little Goose and Lower Monumental in the Snake River. In previous years fish were sampled every other day (3 to 4 days per week) at most facilities. The number of sampling days was reduced in 1999 in order to decrease the number of fish handled. It was determined that the reduced sampling effort would not significantly diminish the capability to detect the presence of GBT in the migrating population.

The goal was to sample 100 salmonids of the most prevalent species (limited to chinook and steelhead) during each day of sampling at each site, the proportion of each species dependent upon their prevalence at the time of sampling. Examinations of fish were done using variable magnification (6x to 40x) dissecting scopes. The eyes, and unpaired fins were examined for the presence of bubbles. The bubbles present in the fins were quantified using a ranking system based on the percent area of the fins covered with bubbles. A rank of 0 was recorded when no bubbles were present; rank 1 was recorded when up to 5% of a fin area was covered with bubbles; rank 2 was for 6% to 25%; rank 3 indicated 26% to 50% fin area was bubbled; and rank 4 indicated greater than 50% of a fin was covered with bubbles. The eyes of the fish were also examined and the eye with the highest amount of bubbles in it was ranked using the same criteria as was used for the fins. Additional information was recorded for each fish including, species, age,

race, rearing disposition, fork length, fin clips, and tags. The examination procedures were similar to those used in past years of the program (see the GBT Monitoring Protocol for details of exam procedures).

Sampling techniques varied somewhat based on the location. This year all sampling sites were at dams, where fish could be collected from the juvenile fish bypass system. At those dams where fish crossed separators the fish were collected as they entered the separator. At Bonneville Dam fish are collected at Powerhouse 1 (PH1) when it is operational, from the bypass trap. However, operations of Bonneville Dam prioritize Powerhouse 2 (PH2) turbine operation, where sampling occurs at the juvenile collection facility below PH2. Rock Island Dam is the only site where fish were held in a tank (up to 24 hours) prior to examination.

2. Results

A total of 13,477 juvenile salmonids were examined for GBT between April and August (Table 9). A total of 150 fish (or 1.2%) showed some signs of GBT in fins or eyes (Table 10).

TABLE 9. Number of juvenile salmonids examined for signs of GBT at dams on the Lower Snake River and on the Columbia River from April to August 2002 as part of the GBT Monitoring Program.

	Site						
Species	BON	MCN	LMN	LGS	LGR	RIS	Total
Chinook Subyearlings	1,852	2,202	0	0	0	1,659	5,713
Chinook Yearlings	941	1,123	418	398	306	1,047	4,233
Steelhead	213	393	692	640	808	785	3531
Total	3,006	3,718	1110	1,038	1,114	3,491	13,477

Fin signs were found in 150 (or 1.1%) of the fish sampled at all sites. Two fish were found with severe fin signs (rank 3 or higher) while, 8 fish had fin rank 2, with the remainder (140 having rank 1 signs). The prevalence of GBT signs at Rock Island Dam was higher than any other Columbia River site during the 2002 monitoring season as is typically the case each season. Because the Rock Island data may obscure other interannual trends in the occurrence of GBT signs among sites, it will be treated separately in the remainder of this report.

TABLE 10. Number of juvenile salmonids found with fin GBT at dams on the Lower Snake River and on the Columbia River from April to August 2002 as part of the GBT Monitoring Program.

	Site						
Species	BON	MCN	LMN	LGS	LGR	RIS	Total
Chinook Subyearlings						41	41
Chinook Yearlings			3			24	27
Steelhead		7	57	4	2	12	82
Total		7	60	4	2	77	150

At the Lower Columbia and Snake River sites (i.e. excluding Rock Island) a total of 9,986 fish were examined for signs of GBT. Seventy three fish were found with fin signs in 2002, comparable to 1998 when 1% were found with fin signs. The percent signs over the past several years has been 0.001% in 2001, 0.2% in 2000, 0.3% in 1999, 1.0% in 1998, 3.2% in 1997 and 3.3% in 1996. One fish was found with severe fin GBT in Lower Snake and Lower Columbia sampling. This is similar to 2001, 2000 and 1995 when no severe fin GBT was found. Other years showed higher incidence of severe fin GBT; in 1998 four (0.01%) fish displayed severe fin signs, 1997 when 117 fish (0.27%) had severe fin signs (again excluding Rock Island) and 47 fish (0.12%) in 1996 while in 1999 no severe signs were found.

The Biological Opinion Spill Program was managed using the data collected for total dissolved gas levels. However, signs of GBT in fins of juvenile fish, examined as part of the biological monitoring, were used to compliment the physical monitoring program. The NMFS set the action criteria for the biological monitoring program at 15% prevalence of fish having fin signs **or** 5% with severe signs (rank 3 or greater) in fins. The NMFS action criteria were exceeded twice at Lower Monumental Dam on June 17 and June 24 (based on dates when at least 30 fish were sampled). There were no exceedences of the NMFS action criteria in 2001, 2000, 1999 or 1998, but 23 dates when GBT levels surpassed the action criteria in 1997, 20 in 1996, and there were no exceedences in 1995.

The prevalence and severity of fin signs in juvenile salmonids sampled in the Lower Snake and Lower Columbia rivers from 1996 to 2002 reflected changes in TDGS conditions in

the river from year to year. The criteria were not exceeded at any projects between 1998 and 2001 (Table 11). The occurrence of severe signs in 1996 and 1997, and the increase in exceedences of the NMFS action criteria, reflected a significant increase in the number of days when TDGS rose above 125% in the forebays of these dams (see Table 11 and Table 12). In 1998 only 4 fish were found with severe fin GBT and 1 fish in 1999, reflecting the more moderate conditions found in the river.

TABLE 11. The number of days when TDSG levels were above 120% and 125% at representative forebay monitors in the Lower Snake and Lower Columbia Rivers from April 1 to August 31.

	2002		2001		2000		1999		1998		1997		1996	
TDGS Monitor	days >120	days >125	days >120	days >125	days >120	days >125	days >120	days >125	days >120	days >125	days >120	days >125	days >120	days >125
Lower Granite	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Goose	1	0	0	0	0	0	5	0	8	3	23	8	29	6
Lower Monumental	5	0	0	0	0	0	7	2	14	8	61	31	64	33
Ice Harbor	0	0	0	0	1	0	5	1	14	4	52	19	41	11
McNary (Oregon)[a]	0	0	0	0	0	0	3	0	0	0	46	0	30	4
John Day	0	0	0	0	0	0	0	0	7	0	47	15	33	11
Bonneville	0	0	0	0	0	0	0	0	3	0	65	27	45	6
Total	6	0	0	0	1	0	20	3	46	16	294	100	242	60

[a] 2002 data used Washington monitor at McNary due to missing data from Oregon monitor during July and August.

TABLE 12. The number of days when NMFS GBT criteria of 15% prevalence or 5% severe signs were exceeded at sites in the Lower Snake and Lower Columbia rivers from April 1 to August 31.[ab]

Site	2002	2001	2000	1999	1998	1997	1996
Lower Granite	0	0	0	0	0	0	0
Little Goose	0	0	0	0	0	1	1
Lower Monumental	2	0	0	0	0	7	9
Ice Harbor	0	0	0	0	0	3	2
McNary	0	0	0	0	0	2	1
John Day	0	0	0	0	0	1	4
Bonneville	0	0	0	0	0	11	4
Total	2	0	0	0	0	25	21

[a] Based on dates when at least 30 fish of the species exhibiting signs were captured.

[b] More than 5% of fish showed severe signs on only 1 date in each year 1996 & 1997 and on those same dates the prevalence of fin signs was greater than 15%.

3. Discussion

This year, as in previous years, the proportion of fish showing fin signs appears to be proportional to the levels of TDGS experienced by fish. Lower Monumental Dam was the only location in the Lower Snake and Lower Columbia where signs of GBT exceeded NMFS action criteria. It is also the location with the greatest number of days when TDGS exceeded 120% at the forebay monitor (Table 12). There are several factors that may have affected the response of fish to these total dissolved gas levels. First, the fish with signs of GBT were detected late in June, which is well after most of the migrating steelhead have passed the project and our ability to collect an adequate sample decreases. Steelhead that migrate late in the season often revert to parr and do not continue to migrate in that year, spending a longer than normal time in the hydrosystem. Second, there was no voluntary spill program at Lower Monumental Dam this year. Limited spill (flow in excess of hydraulic capacity) only occurred for a short time period (one week) well before these fish with signs were detected. Spill has been shown to decrease the amount of time fish spend in the forebay. Consequently, because of the lack of spill and because of the physiolog-

ical state, these fish may have spent longer periods of time in the forebay. The fish characteristics described and the project operations may have contributed to the occurrence of signs at the gas levels observed this year.

Also, Rock Island Dam continues to have the highest proportion of fish with signs of GBT versus TDGS levels in the reach of river above the dam. With such low spill volume there were few times when total dissolved rose above 120% as measured at forebay monitors (See Table 11). The low percentage of fin signs reflect these conditions, with only 0.7% fish in the Lower Columbia or Snake showing a fin bubble.

C. Summary and Conclusions

- The provision of spill for fish released from the Spring Creek Hatchery continued to be contentious because there are hatchery fish released outside of the Biological Opinion spill program. Spill was allowed for these fish up to the 120% TDGS levels with approval from the States' of Oregon and Washington, but was limited to less than a three-day period by the Action Agencies.
- No Biological Opinion spill occurred at Lower Monumental Dam this year due to repairs of the stilling basin. Some mitigation was provided at Little Goose Dam by providing 24-hour spill until May 1, 2002.
- Otherwise, spring and summer spill were provided as described by the Biological Opinion spill program for fish passage, within the constraints of the State waivers for TDGS.
- Approximately 1.2% of juvenile salmonids examined this year showed some minor signs of GBT reflecting the limited number of days when TDGS exceeded the states’ waiver limits.

III. 2002 SMOLT MONITORING

A. Smolt Monitoring Sites and 2002 Schedules

Information on the juvenile salmon out-migration is collected each year to aid the Fishery Agencies and Tribes in making management decisions beneficial to smolt survival as they move down-river from natal streams, through the hydrosystem and on toward the ocean. The Smolt Monitoring Program provides data on the initiation of the juvenile out-migration, estimates of relative fish abundance at the dams, migration timing at traps and dams, fish travel time through key river reaches both prior to and within the hydrosystem, and estimates of survival for key groups of fish through index reaches. Portions of the data are gathered on the run-at-large migrating population, such as the passage indices, while other data such as travel time and survival estimates is provided by marking specific groups of fish. All of the data is collected for the purpose of providing both in-season information for management of flows and spills and for post-season evaluation of the effects of the year's management actions on migrating juvenile salmonids.

Data was gathered at eleven monitoring sites in the Columbia River Basin (See Table 13 for sites and dates of operation for 2002). Monitoring was conducted at four traps in the Snake River Basin above Lower Granite Dam, at three dams in the Lower Snake River, Rock Island Dam in the mid-Columbia River, and three dams in the Lower Columbia River. Data from all sites was transmitted to FPC daily during the sampling season where it was archived as well as compiled for reporting. The information was made available to all interested parties via the Fish Passage Center's web page at www.fpc.org. Data was also available through the Fish Passage Center's weekly reports or by data requests from Fish Passage Staff.

In addition to the activities described above, fish are also collected and PIT-tagged at SMP traps, Rock Island Dam and at selected hatcheries for further, more specific evaluations.

TABLE 13. Smolt Monitoring Sites and Schedules for 2002.

Site	Sampling Method	Dates of Operation
Bonneville Dam	PH2: Timed subsample from bypass PH1: trap sample	March 11 to October 31
John Day Dam	Timed subsample from bypass	March 18 to September 15
McNary Dam	Timed subsample from bypass	March 25 to December 15
Lower Monumental Dam	Timed subsample from bypass	April 1 to October 31
Little Goose Dam	Timed subsample from bypass	April 1 to October 31
Lower Granite Dam	Timed subsample from bypass	March 25 to October 31
Rock Island Dam	PH2: Census of fish captured in volitional bypass	April 1 to August 31
Snake River Trap (rkm 225)	Dipper Trap	March 10 to May 31
Salmon River Trap (rkm 123)	Scoop Trap	March 10 to May 31
Grande Ronde Trap	Scoop Trap	March 12 to June 2
Imnaha Trap	Screw Trap	March 10 to May 31

B. Collection Counts and Relative Abundance

Fish Passage Center provides daily passage indices from March through October in Weekly Reports for each species and rearing type available in the run-at-large. These data are also available via the FPC web page. The daily passage index is computed by dividing the daily collection by the proportion of water passing through the powerhouse where the sampling takes place (Table 14). The daily passage indices adjust for daily changes in spill proportion under the conservative assumption that the proportion of fish passing through spill will be close to the proportion of water being spilled. The actual value of fish guidance efficiency of the screens or the effectiveness of spill (proportion of fish passing through spill) are not required. As long as the

index remains highly correlated to daily population abundance at each site, the index remains useful for fisheries managers for determining passage timing and magnitude. For these reasons the daily passage index was chosen over attempts to estimate daily absolute abundance. Post-season, the daily passage indices are summed for the season at each site to provide an annual passage index for each species and rearing type available. The passage index is not applicable to trap sites because collection efficiencies of the traps are not calculated; therefore only collection counts are reported for the four SMP traps.

Since 1984 the passage index has been used for calculating within season relative abundance. In the past several years changes in the methods of sampling at Bonneville and John Day dams have evolved to a point where collection methods are very similar to other COE dams. Since 1998, sampling at John Day Dam has been carried out using a timed sample from the entire powerhouse bypass system instead of samples from a single gatewell slot as in prior years. At Bonneville Dam, the index sampling is a timed sample at Powerhouse II bypass since 2000 (previously, the timed trap samples were taken in Powerhouse I's bypass system).

The index is based on an estimate of total daily collection at each monitoring site. Where a sample timer is used to systematically divert a proportion of fish into a sample tank for processing, the resulting enumeration is divided by the sample rate to arrive at the estimated collection number.

TABLE 14. Formulas to compute passage indices (collection/flow expansion factor) at dams.

Sampling Site	Years	Collection	Flow expansion factor
Rock Island Dam (PH 2)	1985-2002	Catch / 1	PH2/(PH1+PH2+SP)
Lower Granite Dam Little Goose Dam Lower Monumental Dam McNary Dam	1984-2002 1984-2002 1993-2002 1984-2002	Catch / sample rate	PH/(PH+SP)
John Day Dam (bypass) John Day Dam Unit 3	1998-2002 1984-97	Catch / sample rate Catch / 1	PH/(PH+SP) Unit3/(PH+SP)
Bonneville Dam (PH 1)	1986-92 1993-95 1996-99	8 hr catch / sample rate 24 hr catch / sample rate 8 hr catch / sample rate	PH1/(PH1+PH2+SP)
Bonneville Dam (PH 2)	2000-2002	24 hr catch / sample rate	PH2/(PH1+PH2+SP)

Legend: PH=powerhouse flow; PH1=first powerhouse flow; PH2=second powerhouse flow; SP=spill flow; and Unit3=turbine unit 3 flow (note: all flows are 24-hr averages over the sample interval).

1. Snake River

The cumulative counts of salmonids at the four traps above Lower Granite Dam were summarized over the scheduled operation dates in 2002 (Table 15). For Smolt Monitoring these traps operated primarily on a five day per week schedule (Sunday afternoon to Friday morning). Sampling on the Imnaha River often involved two traps to increase collection of fish for PIT-tagging. Trap counts reflect total fish collected and handled for either timing, fish condition or pit-tagging purposes. Trap efficiency estimates were not estimated in 2002.

At all monitoring sites, SMP crews reported smolt sample counts at the level of clipped and unclipped fish (Table 16). Because not all hatchery fish were fin clipped in Snake and Columbia River basins, the FPC has, since 2000, reported all sample, collection and passage index data for each species at the level of combined hatchery and wild fish in our weekly reports and annual report tables. However, since all hatchery chinook released in tributaries above Lower Granite Dam are supposed to be either fin clipped or unclipped with a code wire tag implanted to designate a supplementation program fish, we did attempt to collect supplemental data at several sites to help differentiate between hatchery and wild stocks for yearling chinook, and in some cases for steelhead. The supplemental data at the Salmon River trap and Snake River (Lewiston) trap included counts of unclipped yearling chinook with a coded wire tag (CWT) and counts of unclipped yearling chinook and steelhead with fin erosion typical of hatchery fish. These extra data were necessary at the traps in order to provide valid PIT-tag travel time and survival estimates for wild and hatchery yearling chinook and steelhead smolts.

TABLE 15. Sampled numbers of composite wild/hatchery chinook, steelhead, coho, and sockeye at the four traps used in the Smolt Monitoring Program in 2002.

Species	No. of Fish Sampled	Species	No. of Fish Sampled
Salmon River Trap (aboveWhitebird)		**Snake River Trap (at Lewiston)**	
Chinook 1's	38,199	Chinook 1's	7,847
Steelhead	2,833	Steelhead	11,810
Sockeye	18	Sockeye	261
Chinook 0's	0	Coho	101
		Chinook 0's	3,488
Imnaha River Trap		**Grande Ronde River Trap**	
Chinook 1's	36,561	Chinook 1's	8,013
Steelhead	32,050	Steelhead	3,494
Chinook 0's	71	Chinook 0's	26

Coded-wire detectors were also used at Lower Granite, Little Goose and Lower Monumental dams to separate the unclipped hatchery chinook from wild chinook. The FPC makes annual estimates of wild yearling chinook at Lower Granite Dam for IDFG to meet their management need of an estimate of wild yearling chinook migrating past Lower Granite Dam each year (see Table 18). Sockeye data are also presented in this report at the combined hatchery and wild level, although hatchery sockeye were 100% fin clipped, because the numbers of hatchery sockeye collected at SMP sites were small.

TABLE 16. Sample, collection, and passage indices of salmonids at Snake River dams in 2002 and comparison with 2001 and the previous 3-yr average (1998-2000) annual passage indices.

Dam	Species	2002			2001 Passage Index	1998-2000 Average Index
		Sample	Collected	Passage Index		
Lower Granite	Chinook Age 0	48,737	632,284	753,573	740,553	382,929
	Chinook Age 1	24,577	1,537,299	2,460,813	1,958,276	2,931,109
	Coho	1,752	80,777	124,067	58,273	169,905
	Steelhead	28,939	1,698,933	2,603,071	5,580,777	6,311,861
	Sockeye/kokanee	1,130	51,732	77,820	4,851	34,948
Little Goose	Chinook Age 0	38,611	292,124	335,795	178,854	207,725
	Chinook Age 1	18,906	1,907,387	2,847,393	751,911	2,566,948
	Coho	1,419	79,992	104,590	21,893	97,320
	Steelhead	18,096	1,562,847	2,274,786	841,837	2,555,234
	Sockeye/kokanee	868	48,256	66,825	9,857	19,736
Lower Monumental	Chinook Age 0	77,920	306,159	306,204	53,516	132,263
	Chinook Age 1	79,219	2,214,728	2,220,450	553,436	1,305,623
	Coho	2,020	63,081	66,185	2,691	47,944
	Steelhead	39,823	1,754,304	1,793,280	360,511	1,663,729
	Sockeye/kokanee	1,060	38,640	38,999	1,026	15,165

When comparing the 2002 outmigration to average indices of past years' it was useful to exclude 2001 from the average for comparison because, generally, the indices were lower in that year than in other recent years (Table 16). We used the average of 1998 to 2000 for comparison to 2002 in the context of passage indices at the Snake River projects. There were some unusual aspects to the 2002 operations at the Snake River projects that may have affected passage indices. At Lower Granite Dam a raised-crest spillway weir (RSW) was installed and operated for the migration season, and at Lower Monumental there were ongoing repairs to the spillway that required that no spill occur. In addition, at Lower Monumental, sampling was limited to two days per week from April 8 to April 29. On those days when sampling did occur, the sampling period was 1 hour or less, at 100% sample rate, the remainder of the time fish were sent through the sec-

ondary bypass system but routed around the separator and back to the river avoiding both the juvenile collection system and the PIT-tag detection system. Both of these operations changed the resulting passage indices at the respective sites. The RSW at Lower Granite Dam effectively decreased the average collection efficiency of the juvenile bypass system, apparently attracting more fish to the spillway with surface flow in the first spill bay. Based on PIT-tag survival estimates for the Snake River Traps, the average collection efficiency at Lower Granite Dam was substantially lower in 2002 than in other recent years (Table 17 through Table 19).

TABLE 17. Hatchery yearling chinook population estimates at Lower Granite Dam in 2002 with comparison to prior four years and hatchery production.

Year	Collection efficiency	Collection	Passage index	Population estimate	Hatchery release [a]
1998	0.49	1,317,500	1,723,600	2,688,800	3,982,985
1999	0.26	1,762,700	2,768,100	6,779,600	10,424,462
2000	0.38	2,035,000	2,725,400	5,355,300	7,353,364
2001	0.75	1,547,700	1,547,700	2,063,600	4,342,534
2002	0.22	1,288,102	2,075,234	5,855,000	11,782,715

[a] We did not include releases before September 1 of year prior to migration year in either the total hatchery release or the % fall release data.

The estimated population size for yearling wild chinook at Lower Granite Dam was 1,132,700 smolts in 2002. This was approximately double the 2001 population size, and fairly close to the 2000 magnitude (Table 18).

TABLE 18. Wild yearling chinook population estimates at Lower Granite Dam in 2002 with comparison to prior four years.

Year	Collection efficiency	Collection	Passage index	Population estimate (popn)
1998	0.49	287,200	374,500	586,100
1999	0.26	410,800	636,600	1,580,000
2000	0.38	415,100	565,100	1,092,400
2001	0.82	410,600	410,600	500,700
2002	0.22	249,200	385,579	1,132,700

Population estimates were made using estimates of collection efficiency developed with PIT tagged smolts released from SMP traps. The 2002 hatchery steelhead population arriving at Lower Granite Dam was higher than 2001 but at least 14 percentage points lower than the average of 1998 to 2000 (Table 19).

TABLE 19. Steelhead population estimates at Lower Granite Dam in 2002 with comparison to prior three years and hatchery production.

Year	Rear Type[1]	Collection efficiency	Collection	Passage index	Population estimate	Hatchery release
1998	H	0.59	4,527,500	6,163,500	7,673,700	8,956,100
1998	W	0.59	558,000	755,000	945,800	
1999	H	0.37	3,032,100	4,732,400	8,194,900	9,573,500
1999	W	0.31	323,100	502,300	1,042,300	
2000	90% H	0.63	4,535,700	6,104,100	7,199,500	9,568,500
2000	10% W	0.53	504,000	678,200	950,900	
2001	90% H	0.91	5,022,400	5,022,700	5,519,100	9,442,600
2001	10% W	0.87	558,000	558,100	641,400	
2002	90% H	0.23	1,529,000	2,342,800	6,647,800	9,225,257
2002	10% W	0.27	169,900	260,300	625,900	

[1] Since steelhead have not been distinguishable by clip status as hatchery or wild since 2000, the relative average split observed from 1989 to 1999 of 10% wild and 90% hatchery was applied to the total steelhead collections and passage indices in 2000 through 2002.

2. Columbia River

In 2002 the cumulative number of fish sampled at each dam, along with expanded annual collection and passage indices, were summarized for Columbia River dams (Table 20). The 2002 Rock Island Dam annual passage indices of all species, except yearling chinook, were above their respective prior 3-year average (1998-2000) ; while that of yearling chinook was relatively similar to the 1998 to 2000 average. Compared to 2001 all indices were substantially higher except for subyearling chinook, which were similar to 2001. The 2002 subyearling index at McNary was below the average of 1998 to 2000 and lower than the 2001 index as well, while the subyearling index at John Day was higher than both the 3-year average and the 2001 index. Yearling chinook, steelhead and sockeye indices at McNary and John Day dams were above the 2001 and 1998 to 2000 averages. Coho passage indices in 2002 at McNary and John Day were higher than observed in 2001 but below the 1998 to 2000 average. All indices at Bonneville Dam were above the 2001 levels.

TABLE 20. Sample, collection, and passage indices of salmonids at Columbia River dams in 2002 and comparison with 2001 and the 3-yr average (1998-2000) annual passage indices.

Dam	Species	2002			2001 Passage Index	1998-2000 Average Index
		Sample	Collected	Passage Index		
Rock Island	Chinook Age 0	16,687	16,687	25,466	22,639	19,744
	Chinook Age 1	19,820	19,820	28,982	6,572	30,191
	Coho	58,532	58,532	86,227	45,425	45,848
	Steelhead	20,073	20,073	28,714	17,852	28,273
	Sockeye	13,828	13,828	20,632	3,022	14,087
McNary	Chinook Age 0	192,475	5,068,269	7,806,828	10,774,712	9,858,790
	Chinook Age 1	32,323	2,088,932	3,336,001	2,299,417	2,473,747
	Coho	2,664	110,996	200,556	147,051	261,183
	Steelhead	10,406	449,869	771,115	563,078	732,343
	Sockeye	10,995	879,453	1,362,086	285,379	849,925
John Day	Chinook Age 0	127,980	2,357,720	3,465,726	2,849,770	2,599,219
	Chinook Age 1	70,901	1,470,327	2,104,938	1,005,994	1,387,688
	Coho	9,248	205,548	315,280	81,586	459,909
	Steelhead	20,679	381,161	545,814	191,089	945,432
	Sockeye	28,933	653,006	934,108	103,905	385,913
Bonneville Power House #2	Chinook Age 0 Total	47,674	2,950,562	6,993,964	2,940,644	N/A
	Chinook Age 0 "upriver brights"	31,992	1,985,179	5,269,226 [a]	2,451,747[b]	N/A
	Chinook Age 1	16,723	1,367,791	3,328,201	1,687,847	N/A
	Coho	10,572	935,337	2,331,599	2,164,019	N/A
	Steelhead	7,190	562,578	1,455,004	489,400	N/A
	Sockeye	3,372	335,999	848,199	106,965	N/A

a Upper brights annual values were summed commencing May 10 in 2002, since tule chinook releases from Spring Creek Hatchery occurred on March 11, March 29 and April 30).

b Upper brights annual values were summed commencing May 1 in 2001, since only two tule chinook releases from Spring Creek Hatchery (March 8 and April 15).

C. Migration Timing

The distribution of the daily passage indices at the dams provides a measure of migration timing at a given site. From the passage distributions at Lower Granite, Rock Island, McNary, and Bonneville dams, the dates of passage at the key cumulative percentiles of 10%, 50%, and 90% were summarized for each species in Table 21. This passage timing data was also plotted for the run-at-large in Appendix D.

In the Snake River at Lower Granite Dam, the 2002 dates of 10% passage for yearling chinook and steelhead, were reached earlier than in the previous two years on April 18 and April 20 (respectively). The middle 80% passage took longer than the previous two years, with the 90% passage date occurring on May 21 for chinook and May 30 for steelhead. For both species it appeared that relatively low flows during late April and early May might have contributed to a protracted migration, with the increased flows around May 20, chinook and steelhead numbers increased. Steelhead especially showed a late spike in passage with 20% of the migration passing between May 22 and May 25. The middle 80% passage of the coho migration was of shorter duration than the previous two years, occurring over a three week period from May 18 to June 7. The coho also passed in large numbers in late May with 29% of the migration passing between May 21 and May 22. Sockeye and subyearling chinook also exhibited a more condensed migration than historic average and compared to recent years. For subyearling chinook 10% passage occurred on June 18, later than previous 2 years, and 90% had passed by July 27. Migration timing of subyearling chinook at Lower Granite Dam has shifted significantly earlier in recent years as the number of supplementation fish has increased. As a result of supplementation releases at acclimation ponds above Lower Granite of 2.6 million fish from Lyons Ferry Hatchery, between May 27 and June 26, 2002, the passage timing of run-at-large subyearling chinook population was much earlier than in earlier years when the majority of fish were of wild origin. By comparison, average historic passage timing of wild subyearling chinook at Lower Granite Dam for the years 1991 through 1997 were 10% passage by June 24 and 90% passage by August 26.

At Rock Island Dam, in the Mid-Columbia River, yearling chinook migration appeared to be near normal compared to historic averages. While steelhead 10% and 90% passage dates were near historic average, the median passage date of May 24 was 9 days later than historic timing and later than in 2000. The late median date was more comparable to 2001, a late outmigration year.

Steelhead peak passage occurred from May 21 through May 28, with 40% of the migration passing in that eight day period. Sockeye and coho run timing appeared comparable to historic run timing at the project. Subyearling chinook migration timing was about a week later than historic average with the 10% passage date on June 18 and the 90% passage date on August 9.

Yearling chinook passage timing at McNary Dam was temporally compressed compared to historic average, with the 10% passage date of May 1 about 8 days later than historic average, while the 90% passage date of May 27 was a few days earlier than historic timing. Steelhead migration began earlier than historic average with a 10% passage date on April 21, but reached the 90% passage near historic the average date. Subyearling chinook migration timing was near historic average timing.

At Bonneville Dam passage timing of yearling chinook and steelhead were similar to historic averages and to their respective passage dates in 2000. For subyearling chinook the 10% passage date of June 19 was later than 2000 and the historic average 10% date, but the 90% passage date in 2002 was similar to 2000 and earlier than the historic average date of July 27. Coho and sockeye timing was similar to that seen in 2000. For “upriver bright” subyearling chinook the migration was much more condensed than historic average with the 10% passage date of June 19 and 90% date of July 19, compared to historic 10-90 dates of June 7 and July 27.

TABLE 21. Migration timing of salmonids at Lower Granite, Rock Island, McNary, and John Day dams in 2002 compared to 2001 and 2000.

Dam	Species	2002			2001			2000		
		10%	50%	90%	10%	50%	90%	10%	50%	90%
Lower Granite	Chinook Age 0	6/18	7/7	7/27	6/11	7/4	8/10	6/14	7/3	8/20
	Chinook Age 1	4/18	5/5	5/21	4/26	5/5	5/18	4/21	5/4	5/15
	Coho	5/18	5/23	6/7	5/18	6/4	7/13	5/12	5/25	6/4
	Steelhead	4/20	5/12	5/30	4/29	5/10	5/27	4/19	5/8	5/24
	Sockeye and kokanee	4/27	5/18	6/1	4/21–5/13[b]	5/23	6/16	4/15	5/24	6/28 - 8/27 [a]
Rock Island	Chinook Age 0	6/18	7/13	8/9	6/25	7/15	7/29	4/19	7/15	8/10
	Chinook Age 1	4/28	5/15	6/7	4/20	5/6	5/30	5/3	5/14	5/31
	Coho	5/20	5/28	6/10	5/19	5/24	6/8	5/20	5/27	6/7
	Steelhead	5/7	5/24	6/3	5/12	5/26	6/17	5/5	5/18	5/28
	Sockeye	4/22	5/10	6/8	5/22	5/25	6/4	4/21	5/13	7/13
McNary	Chinook Age 0	6/20	7/2	8/8	6/20	7/2	7/28	6/21	6/30	7/30
	Chinook Age 1	5/1	5/17	5/27	5/11	5/26	6/7	4/28	5/15	6/2
	Coho	5/15	5/31	6/9	5/24	6/3	6/20	5/27	6/7	6/22
	Steelhead	4/21	5/20	6/4	4/27	5/23	6/9	4/12	5/10	6/6
	Sockeye	5/4	5/14	5/26	5/27	6/1	6/9	5/9	5/30	9/9
Bonneville PH 2	Chinook Age 0 "upriver brights"	6/19[c]	7/2[c]	7/19[c]	5/30[d]	7/6[d]	8/14[d]	6/6[e]	6/22[e]	7/19[e]
	Chinook Age 1	4/25	5/18	6/1	4/26	5/11	6/6	4/23	5/17	6/1
	Coho	5/6	5/19	6/6	5/15	5/24	6/3	5/6	5/22	6/3
	Steelhead	5/2	5/27	6/11	5/4	5/19	6/10	4/27	5/17	6/2
	Sockeye	5/13	5/23	6/9	6/3	6/10	6/25	5/5	5/25	6/7

[a] Low numbers and sporadic collections result in cumulative passage index taking two months to go from 89% to 91%, so the 89% to 91% date range is presented rather than a single 90% passage date.

[b] Low numbers result in cumulative passage index taking over three weeks to collect next fish after 10% point reach on April 21, so "true" date of 10% could occur later during the extended range shown.

[c] Upper brights annual values are summed commencing May 10 in 2002, since tule chinook releases from Spring Creek Hatchery occurred on March 11, March 29 and April 30).

[d] Upper brights annual values are summed commencing May 1 in 2001, since only two tule chinook releases from Spring Creek Hatchery (March 8 and April 15).

[e] Upper brights annual passage index is summed commencing June 1 in 2000, since three tule chinook releases from Spring Creek Hatchery (March 9, April 20, and May 18).

D. Travel Time.

The PIT tag provides a unique alphanumeric code for individual fish that allows determination of date and time of passage of these fish at dams with PIT tag detection equipment in place. From these data, travel times of individual fish within reaches of interest may be computed. Travel time is estimated from release to first detection site, and between series of dams, by subtracting the upstream detection date and time from the downstream detection date and time for PIT tagged fish. From the distribution of travel times for each group of PIT tagged fish, minimum, maximum, and median travel time with associated 95% confidence intervals are computed. Associated with the travel time data are flow and river temperature averages. These environmental parameters are computed at a key dam within the reach of interest as the average across a series of days equal to the number of days estimated as the median travel time. This series of days begin with the date of release for travel times estimated from release to first monitoring site (*e.g.*, Snake River basin sites to Lower Granite Dam or Mid-Columbia River basin sites to McNary Dam), and they begin with the date of re-release at the upstream dam for travel times estimated between two dams (*e.g.*, Lower Granite Dam to McNary Dam, Rock Island to McNary Dam, and McNary Dam to Bonneville Dam). The detailed travel time data for groups of PIT tagged fish released from the four traps, selected hatcheries, and Rock Island Dam or re-released from Lower Granite and McNary dams are presented in Appendix E.

1. Snake River Basin

Hatchery Site to Lower Granite Dam Reach

As part of the SMP, juvenile salmonids are PIT-tagged at several select hatcheries within the Snake River basin. In some cases other tagging studies such as Comparative Survival Study have assumed tagging efforts at these sites. FPC continues to report these data for historic comparison. Travel time of yearling chinook and steelhead from hatcheries in the Snake River basin to Lower Granite Dam are presented in Table 22. Median travel times to Lower Granite Dam for yearling chinook were longer in 2002 than in other recent years, even in comparison to 2001. It is likely that relatively low flows (see Table 23) for among year flow comparison, and cooler river temperatures contributed to the slower migration rate of these fish. The average temperature mea-

sured at the Lower Granite Dam tailwater TDGS monitor in April of 2002 was from 1 to 2 degrees Celsius cooler than in other recent years. Steelhead travel times were longer as well in 2002, again probably due to low flows and cooler temperatures.

TABLE 22. Median travel time from release to Lower Granite Dam for Snake River basin hatchery yearling chinook and steelhead in 2002 compared to the past four years.

Hatchery	Species	Release Date Range	Median travel time release site to Lower Granite Dam				
			2002	2001	2000	1999	1998
Dworshak H	Chinook	3/22-4/6[d]	38.1	30.4	27.3	27.7	28.1
Imnaha AP	Chinook	3/16-4/18	31.7[a]	29.1[a]	29.3[a]	23.7[a]	26.2
McCall H	Chinook	3/25-4/8	51.4	48.5	34.1	39.9	36.5
Rapid River H	Chinook	3/12-4/22	47.4[c]	32.3[c]	29.0[c]	37.1[b]	19.5[b]
Dworshak H	Steelhead	4/22-5/5	7.8	6.8	3.5	6.2	4.7

[a] Midpoint of volitional release period used in calculation.

[b] Projected median date of volitional release period used in calculation.

[c] Monitored median date of volitional release period used in calculation.

[d] 1999 release was late 4/19-4/23

Traps to Lower Granite Dam

Trap releases of PIT tagged yearling chinook and steelhead made between April 10 and May 10 were selected for each of the four recent years, 1998 to 2002, to illustrate effects of flow on travel time during a period beginning late enough so that the smolts appear to have been actively migrating and ending prior to any late spring peak flows. Travel times of daily released PIT tagged smolts within this period for a given year were fairly stable across days for a given species, thus facilitating the use of a single average for each year. A 31-day (April 10-May 10, inclusive) average travel time was computed along with the average flow over this 31-day period for each year from the daily releases of PIT tagged yearling chinook and steelhead from the traps on the lower Salmon, Grande Ronde, and Imnaha rivers, and mainstem Snake River at Lewiston. The results show that migration year 2002, which had higher flows than 2001 but lower flows than 1999 and 2000, had longer travel times for yearling chinook and in some cases longer travel times for steelhead, as compared to 1999, 2000, and 2001 (Table 23). Yearling chinook travel

times to the first dam tend to be long in all years, regardless of flows encountered, indicating that flow was not the only factor determining yearling chinook migration rate to Lower Granite Dam. Temperature is an important factor in determining travel time for these early migrants, with 2002 being a relatively cool year, the yearling chinook appeared to migrate slower than in recent years.

TABLE 23. Average travel time and flow for yearling chinook and steelhead released from traps on the Salmon, Imnaha, Grande Ronde, and Snake rivers to Lower Granite Dam in migration years 1999 to 2002.

Year	Average[1] Flow (kcfs)	Average Travel time (days)[2]							
		Salmon R trap		Imnaha R trap		Grande Ronde R trap		Snake R Trap	
Yrlg. Chinook		H	W	H	W	H	W	H	W
1999	100.4	20.2	9.4	24.3	12.1	23.7	7.2	6.3	4.9
2000	88.5	15.9	11.4	20.7	10.6	11.4	6.8	6.7	5.3
2001	55.4	14.4	11.6	12.4	11.1	13.3	10.4	7.8	5.5
2002	67.8	19.8	17.7	19.6	12.1	25.3	9.1	10.0	7.3
Steelhead		H	W	H	W	H	W	H	W
1999	100.4	6.0	4.7	15.2	4.6	3.0	2.9	1.9	2.0
2000	88.5	4.7	N/A	9.6	4.7	3.5	3.0	2.1	2.1
2001	55.4	9.1	6.5	10.1	8.0	6.5	4.2	5.2	3.9
2002	67.8	5.8	6.1	8.6	7.2	4.2	4.4	2.3	2.7

[1] Flow averaged from April 20 to May 20 at Lower Granite Dam.

[2] Average (weighted by released number) of median travel time estimates from daily releases between April 10 and May 10.

Lower Granite Dam to McNary Dam Index Reach

Yearling chinook travel time

Weighted weekly average travel time estimates were generated for yearling chinook in the Lower Granite Dam to McNary Dam index reach from daily median travel time estimates presented in Appendix F. A weekly averaging of the daily median travel times was made using the number of PIT tagged smolts for each daily median travel time estimate as the weighting factor. Flow was averaged at Ice Harbor Dam over a period of days equal to the travel time estimate and beginning at the midpoint of the weekly block. In 2002, as in the prior three years, the general trend of decreasing average travel time over weeks was observed (Table 24). The average travel time in 2002, at each weekly interval, was higher in most cases, than those estimated for 1999 and 2000 and substantially lower than in 2001, especially as the season progressed.

TABLE 24. Weighted average travel time[1] for weekly blocks for yearling chinook from Lower Granite Dam to McNary Dam, 1999 to 2002.

		1999		2000		2001		2002	
Block	Date range	Travel time	Flow	Travel Time	Flow	Travel time	Flow	Travel time	Flow
1	4/2 – 4/9	16.8	91.9			29.7	41.4	28.4	77.9
2	4/10 - 4/17	12.7	107.3	12.5	109.2	24.9	44.6	19.6	80.8
3	4/18 - 4/24	11.5	116.8	11.7	104.2	21.0	50.6	17.9	73.9
4	4/25 - 5/1	10.6	107.2	10.4	98.7	20.2	61.9	13.0	69.7
5	5/2 – 5/8	10.2	96.1	10.2	86.8	19.5	66.0	12.0	69.7
6	5/9 – 5/15	9.8	89.5	11.1	76.9	15.4	73.6	10.0	72.3
7	5/16 - 5/22	7.8	123.0	8.5	90.2	12.1	69.2	8.5	92.5
8	5/23 - 5/30	6.8	174.0	7.5	90.3	17.0	52.9	9.5	111.7

[1]For each week within a year, weighted average travel times are estimated by weighting the daily median travel time estimates (data in Appendix E) by number of fish used to generate each daily median travel time estimate. Flow is averaged over the number of days equal to the weekly estimated travel time starting at the mid-point of the weekly interval.

Steelhead travel time

Likewise, weighted weekly average travel time estimates were generated for steelhead in the Lower Granite Dam to McNary Dam index reach from daily median travel time estimates presented in Appendix E. The weekly travel time estimates decreased over time in 2002 as well as in 1999, but not to the same extent in 2000 and 2001. Despite this underlying trend, the weekly average travel times of steelhead appear to follow the average flow, being lower when flows are higher, regardless of time of season (Table 25).

TABLE 25. Weighted average travel time[1] for weekly blocks for steelhead from Lower Granite Dam to McNary Dam, 1999 to 2002.

		1999		2000		2001		2002	
Block	Date range	Travel time	Flow	Travel time	Flow	Travel time	Flow	Travel time	Flow
1	4/2 – 4/9								
2	4/10 - 4/17			9.2	108.9				
3	4/18 - 4/24	14.0	116.0	8.6	107.5	25.6	54.7	15.2	72.5
4	4/25 - 5/1	10.1	107.8	9.4	99.1	19.1	60.4	11.6	70.2
5	5/2 - 5/8	10.6	95.2	10.7	85.6	17.5	66.1	9.6	70.9
6	5/9 - 5/15	11.8	94.0	14.6	82.4	14.1	73.5	14	77.2
7	5/16 - 5/22	7.6	123.0	11.5	90.3	16.2	64.7	8.3	92.7
8	5/23 - 5/30	6.1	174.4	10.9	86.0	21.8	50.1	10.5	113.8

[1]For each week within a year, weighted average travel times are estimated by weighting the daily median travel time estimates (data in Appendix E) by number of fish used to generate each daily median travel time estimate. Flow is averaged over the number of days equal to the weekly estimated travel time starting at the mid-point of the weekly interval.

Subyearling chinook travel time

Weighted estimates of travel time were generated for subyearling chinook within Lower Granite Dam passage periods of 17 to 20 days in duration. These temporal blocks were wider than the weekly blocks used with yearling chinook and steelhead because of fewer PIT tagged subyearling chinook available for analysis. PIT tagged Lyons Ferry Hatchery subyearling chinook released in the three acclimation ponds (Captain John Rapids, Pittsburg Landing, and Big Canyon acclimation ponds) and in the weekly direct stream releases near those acclimation ponds were used in the analysis. The average travel time estimates for each temporal block were generated for subyearling chinook in the Lower Granite Dam to McNary Dam index reach from daily median travel time estimates presented in Appendix E. A multi-week averaging of the daily median travel times and their associated Ice Harbor Dam flow data was made using the number of PIT tagged smolts for each daily median travel time estimate as the weighting factor. In 2002, as in the prior six years, the general trend of decreasing average travel time over time was observed (Table 26). In 2002, the average travel time in each period was much lower compared to other recent years.

TABLE 26. Weighted average travel time[1] for subyearling chinook from Lower Granite Dam to McNary Dam within temporal blocks across seven years, 1995 to 2002, and corresponding weighted average flow.

Year	Date of passage at Lower Granite Dam							
	6/5-6/24		6/25-7/11		7/12-7/31		8/1-8/20	
	Travel time	Flow	Travel time	Flow	Travel time	Flow	Travel time	Flow
1995			19.7	63.9	14.1	46.3	14.2	38.1
1996			22.7	49.4	15.2	39.9	14.0	38.3
1997	28.5	98.7	25.4	74.2	17.6	64.1	12.8	54.4
1998	20.1	87.8	12.3	66.9	10.8	58.6	10.9	40.5
1999	21.3	105.1	23.1	63.9	15.6	51.2	13.5	42.9
2000	15.6	52.1	20.3	43.6	16.5	37.7	15.8	30.3
2001	39.5	29.2	27.9	27.4	35.5	26.2	18.1	23.7
2002	17.2	67.4	15.9	47.1	N/A		N/A	

[1]For each block within a year, weighted average travel times and flows are estimated by weighting the daily median travel time estimates and their corresponding flows (data in Appendix E Table 23) by number of fish used to generate each daily median travel time estimate.

2. Mid-Columbia River Basin

Hatchery site to McNary Dam Reach

Travel time of yearling and subyearling chinook from hatcheries in the Mid-Columbia River basin to McNary Dam is presented in Table 27. Median travel times to McNary Dam were approximately 28 days in 2002 for yearling spring chinook from Leavenworth and Winthrop hatcheries. Those estimates were relatively close to what was observed in 1999, but considerably shorter than 2001. Subyearling summer chinook from Wells Hatchery had a median travel time of approximately 26 days in 2002, much lower than in recent years. The median travel time of subyearling chinook released from Priest Rapids and Ringold hatcheries have ranged within a one to two-week period (most often around 12 days) across the four years, with Ringold subyearlings having the fastest travel time estimate of 7.6 days in 2002. The relatively high flows accompanying the subyearling outmigrants likely improved travel times in 2002.

TABLE 27. Median travel time for Mid-Columbia River hatchery chinook from hatchery site to McNary Dam in 2002 compared to 1999 to 2001.

		Migration Year							
		2002		2001		2000		1999	
Hatchery	Age	TT	Flow	TT	Flow	TT	Flow	TT	Flow
Leavenworth	1	28.2	150.6	37.0	64	36.1	185	27.8	171
Winthrop	1	27.8	162.6	36.9	64	30.2	182	26.4	163
Wells	0	25.8	225.4	37.8	71	35.3	133	30.6	193
Priest Rapids[1]	0	12.2	226.7	13.7	95	12.3	137	11.7	189
Ringold	0	7.6	225.0	11.5	94	9.8	140	12.0	183

[1] Priest Rapids Hatchery's median travel time and flow is computed as average of three releases separated 3-5 days apart starting mid-June (individual release data shown in appendix of each annual report).

Rock Island Dam to McNary Dam Index Reach

Weighted estimates of travel time to McNary Dam were generated for yearling chinook and steelhead for two periods of PIT tag smolt releases from Rock Island Dam (an early month long period through May 15 and a later three-week period after May 15). This multi-week aver-

aging of the daily median travel times and their associated Priest Rapids Dam flow data was made using the number of PIT tagged smolts for each daily median travel time estimate as the weighting factor. Yearling chinook and steelhead had relatively short travel times between Rock Island Dam and McNary Dam for both temporal periods in 2002 (Table 28).

TABLE 28. Weighted average travel time[1] (days) for yearling chinook, steelhead, and sockeye (combined hatchery and wild) from Rock Island Dam to McNary Dam within temporal blocks across three years, 1999 to 2002, and corresponding weighted average flow.

Species[2]	Year	Date of release at Rock Island Dam			
		4/16 – 5/15		5/16 – 6/6	
		Travel time (days)	Flow kcfs (PRD)	Travel time (days)	Flow kcfs (PRD)
Yearling Chinook	1999	13.5	173.6	8.6	165.1
	2000	15.2	176.4	12.1	140.4
	2001	25.3	62.1	16.7	84.3
	2002	11.7	149.6	9.3	171.7
Steelhead	1999	6.8	172.1	6.7	157.6
	2000	6.0	180.5	7.5	151.2
	2001	19.8	63.1	16.8	84.4
	2002	7.4	149.7	6.8	177.2
Sockeye	1999	7.2	176.2	5.5	155.2
	2000	14.1	183.6	10.6	149.5
	2001	24.8	61.6	7.4	77.1
	2002	7.9	148.3	7.4	166.1

[1] For each block within a year, weighted average travel times and flows are estimated by weighting the daily median travel time estimates and their corresponding flows (data in Appendix E) by number of fish used to generate each daily median travel time estimate.

[2] Mixture of hatchery and wild fish.

Subyearling chinook had much faster travel times between Rock Island Dam and McNary Dam in 2002 than they did for the prior three years in the month long period before July 15 (Table 29). In the second period travel times were longer, which is an unusual trend for these groups. But it appears that the relatively high flows in the first temporal block reduced travel times for those migrants, while in the second block flows were similar to those in 1999 and 2000 when similar travel times were estimated.

TABLE 29. Weighted average travel time[1] for subyearling chinook (combined hatchery and wild) from Rock Island Dam to McNary Dam within temporal blocks across three years, 1999 to 2002, and corresponding weighted average flow.

Year	Date of release at Rock Island Dam			
	6/16 - 7/15		7/16 - 8/20	
	Travel time (days)	Flow (kcfs)	Travel time (days)	Flow (kcfs)
1999	17.0	188.5	14.8	166.2
2000	20.9	129.6	15.3	128.9
2001	25.9	57.1	22.3	67.1
2002	11.6	206.7	14.2	129.9

[1]For each block within a year, weighted average travel times and flows are estimated by weighting the daily median travel time estimates and their corresponding flows (data in Appendix E) by number of fish used to generate each daily median travel time estimate.

3. Lower Columbia River Basin

McNary Dam to Bonneville Dam Index Reach

Yearling chinook travel time

Weighted weekly average travel time estimates were generated for yearling chinook in the McNary Dam to Bonneville Dam index reach from daily median travel time estimates presented in Appendix E. A weekly averaging of the daily median travel times was made using the number of PIT tagged smolts for each daily median travel time estimate as the weighting factor. Flow was indexed at The Dalles Dam over a period of days equal to the travel time estimate and beginning at the midpoint of the weekly block. In 2002, as in the prior three years, the general trend of decreasing average travel time over weeks was observed (Table 30). However, in 2002, the average travel time at each weekly interval was higher in the earliest block, but comparable to 1999 and 2000 for subsequent blocks.

TABLE 30. Weighted average travel time[1] for weekly blocks for yearling chinook from McNary Dam to Bonneville Dam, 1999 to 2002.

		1999		2000		2001		2002	
Block	Date range	Travel time	Flow	Travel Time	Flow	Travel time	Flow	Travel time	Flow
1	4/11 - 4/17	7.3	215.8						
2	4/18 - 4/24	7.8	303.2	7.3	327.6	22.5	121.1	11.4	231.6
3	4/25 - 5/1	7.1	313.9	7.6	287.9	21.0	129.7	7.8	217.8
4	5/2 - 5/8	6.8	280.9	6.3	276.5	12.8	124.3	6.2	216.5
5	5/9 - 5/15	6.1	249.9	6.3	249.5	10.2	129.7	5.6	202.9
6	5/16 - 5/22	5.2	267.1	5.7	251.7	11.0	133.8	4.6	243.9
7	5/23 - 5/29	4.2	359.1	5.1	216.5	7.2	141.5	4.7	277.5
8	5/30 - 6/5	4.3	366.3	5.2	209.5	6.0	131.2	3.8	338.2
9	6/6 - 6/12	5	326.9	5.3	194.4	6.5	133.1	4.0	326.1

[1]For each week within a year, weighted average travel times are estimated by weighting the daily median travel time estimates (data in Appendix E Table E-24) by number of fish used to generate each daily median travel time estimate. Flow is averaged over the number of days equal to the weekly estimated travel time starting at the mid-point of the weekly interval.

Steelhead travel time

Weighted weekly average travel time estimates were generated for steelhead in the McNary Dam to Bonneville Dam index reach from daily median travel time estimates presented in Appendix E (Table 31). Steelhead travel times were comparable to those observed in 1999 and 2000 with differences in magnitude probably due to differences in flow.

TABLE 31. Weighted average travel time[1] for weekly blocks for steelhead from McNary Dam to Bonneville Dam, 1999 to 2002.

		1999		2000		2001		2002	
Block	Date range	Travel time	Flow	Travel Time	Flow	Travel time	Flow	Travel time	Flow
1	4/11 - 4/17	7.3	215.8	5.1	272.5				
2	4/18 - 4/24	6.7	298.7	5.2	332.7			6.8	249.2
3	4/25 - 5/1	6.2	314.0	5.8	284.7			6.5	216.2
4	5/2 - 5/8	6.1	284.4	5.2	281.2	14.6	126.3	6.0	217.0
5	5/9 - 5/15	6.3	249.9	5.5	249.5	11.7	132.8	6.1	204.6
6	5/16 - 5/22	5.9	263.2	5.4	247.5	11.5	133.8	5.5	244.7
7	5/23 - 5/29	5.4	360.2	5.9	220.0	9.4	134.4	5.1	280.2
8	5/30 - 6/5	5.1	367.8	5.6	212.7	10.3	132.7	4.0	337.3

[1]For each week within a year, weighted average travel times are estimated by weighting the daily median travel time estimates (data in Appendix E Table E-25) by number of fish used to generate each daily median travel time estimate. Flow is averaged over the number of days equal to the weekly estimated travel time starting at the mid-point of the weekly interval.

Subyearling chinook travel time

Weighted monthly average travel time estimates were generated for subyearling chinook in the McNary Dam to Bonneville Dam index reach from daily median travel time estimates presented in Appendix E (Table 32). Travel times in 2002 were comparable to those seen at similar flows in other years.

TABLE 32. Weighted average travel time[1] for subyearling chinook from McNary Dam to Bonneville Dam within temporal blocks across five years, 1997 to 2002, and corresponding weighted average flow.

Year	Date of passage at McNary Dam			
	6/20-7/20		7/21-8/31	
	Travel time (days)	Flow (kcfs)	Travel time (days)	Flow (kcfs)
1997	4.3	277.5	5.8	207.8
1998	5.2	199.5	7.2	159.7
1999	4.6	269.0	5.4	209.9
2000	5.3	170.8	6.1	152.2
2001	17.3	95.2	13.0	86.4
2002	5.3	262.0	N/A	N/A

[1]For each block within a year, weighted average travel times and flows are estimated by weighting the daily median travel time estimates and their corresponding flows (data in Appendix E Table E-26) by number of fish used to generate each daily median travel time estimate.

E. Estimates of Survival:

Methods

Survival is estimated from release to first detection site, and between series of dams, by the Cormack-Jolly-Seber (CJS) release-recapture method outlined in American Fisheries Society Monograph 5, *Design and analysis methods for fish survival experiments based on release-recapture*, by K.P. Burnham, D.R. Anderson, G.C. White, C. Brownie, and K.H. Pollock, 1987. This methodology is used to estimate survivals both to and between the dams in the hydro system possessing PIT tag detection capabilities, along with an estimate of collection efficiency at these dams. The CJS method is based on mark release-recapture theory in which the subsequent detection histories on a known number of marked fish re-released at a particular dam is used to estimate the number of fish that passed that particular dam alive but undetected. The software program MARK (White and Burnham 1999) was used to perform the survival estimates with the

"identity" design matrix and "identity" link function set. The program MARK provides estimates of survival between the tailraces of each detection site. Generating extended multi-dam reach survival estimates requires taking the product of a set of these shorter reach estimates. The associated variance for the extended reach estimate is computed using formulas for propagation of error in products of non-independent estimates (Meyer 1975). Extended reach survival estimates with associated 95% confidence intervals are obtained for each species, and release location and period of interest.

Sets of survival estimates are computed each year for various river reaches. In the Snake River basin, estimates of survival are made from key hatcheries to John Day Dam tailrace, from SMP traps to Lower Monumental Dam tailrace, and from Lower Granite Dam tailrace to McNary Dam tailrace. In the Columbia River basin, estimates of survival are made from key hatcheries to McNary Dam tailrace, from Rock Island Dam (release site) to McNary Dam tailrace, and from McNary Dam tailrace to John Day Dam tailrace, and specifically for yearling chinook from McNary Dam tailrace to Bonneville Dam tailrace utilizing the NMFS trawl in the lower Columbia River as the final detection site. The goal is to have at least 600 PIT tagged smolts released (or detected and re-released at the starting site) in each group for which survival estimates are desired. Generally, release period of a week are attempted, but in some instances release periods of up to 15 consecutive days was required in order to try to achieve the target release size. Detailed results for the individual release (or detected and released) groups of interest are present in Appendix F.

For SMP traps and key dams, the 2002 survival data is summarized to annual averages for comparison to recent past years. A single seasonal average survival estimate is obtained for those PIT tagged groups released over time that do not differ significantly. To determine if any significant differences occurred within a year, a test of whether the "between group" variance component was significantly greater than zero (Burnham 1987 *et al*., Chapter 4). This is a chi-square test equal to [empirical variance of mean survival*(1-degrees of freedom)]/ [theoretical variance of mean survival]. In cases where the chi-square test was not significant at the 95% confidence level, then the average was computed for the season, along with the average theoretical variance. In cases where the chi-square test was significant, then the season was split into periods showing the different survival levels.

Results

The 2002 seasonal survival estimate for PIT tagged wild and hatchery chinook released from the four traps to Lower Monumental Dam tailrace averaged between 70.4% and 89.4% (Table 33), and that of wild and hatchery steelhead averaged between 55.6% and 82.7% (Table 34). The 2002 estimates tended to be similar to those observed prior to 2001. During years of higher flows (*e.g.* 1998 and 1999), seasonal estimated survival of PIT tagged wild and hatchery chinook and steelhead from the traps to Lower Monumental Dam tailrace have typically averaged above 60%. In 2002, with higher flows than 2001, yearling chinook and steelhead released from all traps survived at some of the highest rates estimated in recent years. These high survivals may in part have been attributable to operational changes at Lower Granite Dam, where low collection efficiency estimates suggested that spillway passage was higher due to operation of the raised spillway weir. However, due to the unusual operations at Lower Monumental Dam there was a potential for bias estimates due to changes in operations at Lower Monumental Dam on May 1. Considering the release dates and travel times of the groups of fish from the traps, we removed blocks when those groups would have arrived at Lower Monumental Dam prior to May 1. The resulting changes in seasonal survival estimates for the release to Lower Monumental Dam tailrace were in no cases more than 5 percentage points. It was decided that the effects of the potential bias were minimal so that all blocks were subsequently returned to the seasonal estimates.

TABLE 33. Annual average reach survival estimates and 95% confidence intervals of Snake River basin PIT tagged yearling chinook from trap release sites to Lower Monumental Dam tailrace in 2002 compared to 1999 – 2001.

Tag Site	Species	Rearing type	Year	Date Range	No. of Blocks	Average Survival	Lower Limit	Upper Limit
Salmon River trap								
	Chinook	Wild	1999	3/18-4/30	5	0.809	0.775	0.844
		Wild	2000	3/27-4/21	4	0.763	0.690	0.835
		Wild	2001	3/19-5/4	4	0.583	0.547	0.619
		Wild	2002	3/30-4/22	6	0.808	0.772	0.844
		Hatchery	1999	3/18-5/21	8	0.694	0.660	0.729
		Hatchery	2000	3/13-5/5	8	0.690	0.602	0.777
		Hatchery	2001	3/19-5/17	8	0.629	0.605	0.653
		Hatchery	2002	3/14-5/7	8	0.740	0.706	0.774
Snake River trap								
	Chinook	Wild	1999	3/22-5/25	5	0.861	0.832	0.891
		Wild	2000	4/10-4/28	3	0.916	0.779	1.052
		Wild	2002	4/12-4/18	1	0.887	0.811	0.962
		Hatchery	1999	4/5-5/25	5	0.884	0.842	0.926
		Hatchery	2000	4/10-5/5	4	0.770	0.672	0.868
		Hatchery	2001	4/27-5/4	1	0.745	0.666	0.825
		Hatchery	2002	4/12-4/18	1	0.894	0.808	0.979
Imnaha River trap								
	Chinook	Wild	1999	3/28-5/14	5	0.806	0.775	0.837
		Wild	2000	3/13-4/23	4	0.757	0.699	0.815
		Wild	2001*	3/14-4/27	14	0.683	0.669	0.697
		Wild	2001*	4/29-5/12	1	0.529	0.475	0.583
		Wild	2002	3/25-4/29	3	0.800	0.751	0.849
		Hatchery	1999	4/4-4/16	2	0.610	0.554	0.665
		Hatchery	2000	3/20-4/16	4	0.535	0.445	0.626
		Hatchery	2001*	3/23-3/28	1	0.611	0.556	0.665
		Hatchery	2001*	3/29-4/27	5	0.712	0.684	0.740
		Hatchery	2002	3/23-4/29	4	0.704	0.655	0.753
Grande Ronde River trap								
	Chinook	Wild	1999	4/12-4/30	1	0.825	0.756	0.894
		Wild	2000	4/3-5/5	5	0.775	0.650	0.900
		Wild	2001	3/28-5/3	2	0.764	0.694	0.835
		Wild	2002	4/17-4/24	1	0.839	0.713	0.966
		Hatchery	1999*	3/17-3/26	1	0.580	0.523	0.637
		Hatchery	1999*	3/29-4/9	1	0.706	0.634	0.779
		Hatchery	2001	4/2-4/26	3	0.624	0.578	0.670
		Hatchery	2002	4/8-4/23	2	0.724	0.658	0.790

* Identifies a year with a significant "between blocks (temporal releases)" variance component. For those years, survival estimates are presented separately for each set of blocks that differ significantly. No survival estimates are available for wild chinook from the Snake River trap in 2001 and hatchery chinook from the Grande Ronde River trap in 2000 due to not enough PIT tagged fish being released.

TABLE 34. Annual average reach survival estimates and 95% confidence intervals of Snake River basin PIT tagged steelhead from trap release site to Lower Monumental Dam tailrace in 2002 compared to 1998 – 2001.

Tag Site	Species	Rearing Type	Year	Date Range	No. of Blocks	Average Survival	Lower Limit	Upper Limit
Salmon River trap								
	Steelhead	Wild	2001	4/23-5/4	1	0.476	0.367	0.585
		Hatchery	1999	4/14-5/21	4	0.692	0.651	0.733
		Hatchery	2000	4/17-5/19	4	0.514	0.398	0.629
		Hatchery	2001	4/9-5/18	3	0.413	0.329	0.496
		Hatchery	2002	4/13-5/19	4	0.556	0.483	0.629
Snake River trap								
	Steelhead	Wild	1999	4/19-5/25	2	0.816	0.739	0.893
		Wild	2000	4/17-5/5	3	0.743	0.622	0.865
		Wild	2001	4/27-5/21	2	0.452	0.392	0.513
		Wild	2002	5/20-5/26	1	0.787	0.661	0.913
		Hatchery	1999*	4/19-4/30	2	0.874	0.817	0.930
		Hatchery	1999*	5/3-5/25	2	0.717	0.676	0.758
		Hatchery	2000	4/17-5/26	4	0.692	0.580	0.803
		Hatchery	2001	4/27-5/21	3	0.465	0.365	0.565
		Hatchery	2002	4/12-6/6	6	0.764	0.685	0.844
Imnaha River trap								
	Steelhead	Wild	1999	5/10-5/20	2	0.784	0.733	0.835
		Wild	2000	4/17-5/21	5	0.611	0.508	0.714
		Wild	2001*	3/20-4/1 & 5/1-5/15	5	0.445	0.405	0.484
		Wild	2001*	4/15-4/30	2	0.637	0.555	0.719
		Wild	2002	4/17-5/29	6	0.701	0.656	0.746
		Hatchery	1999	4/11-6/24	5	0.711	0.680	0.742
		Hatchery	2000	4/17-5/21	5	0.551	0.463	0.639
		Hatchery	2001	4/15-5/15	6	0.450	0.376	0.525
		Hatchery	2002	4/12-5/29	3	0.755	0.668	0.843
Grande Ronde River trap								
	Steelhead	Wild	1999	4/19-5/25	2	0.806	0.747	0.866
		Wild	2000	4/5-4/28	4	0.729	0.614	0.843
		Wild	2001*	4/23-5/1	1	0.547	0.401	0.692
		Wild	2001*	5/7-5/21	1	0.298	0.199	0.397
		Hatchery	1999	4/19-5/25	3	0.720	0.678	0.761
		Hatchery	2000	4/10-5/12	4	0.561	0.489	0.633
		Hatchery	2001	4/23-5/17	3	0.511	0.408	0.614
		Hatchery	2002	4/8-5/7	2	0.827	0.688	0.966

* Identifies a year with a significant "between blocks (temporal releases)" variance component. For those years, survival estimates are presented separately for each set of blocks that differ significantly.

Survivals for Mid-Columbia releases of hatchery yearling and subyearling chinook were similar to other recent years with the exception of subyearling chinook released from Wells Hatchery (Table 35). The survival estimate of 0.449 for the Wells release was well above previous years and corresponded with the early season 2002 fast travel times from Rock Island to McNary Dam reported in Table 36. Relatively high flows appear to have had a beneficial effect both on travel time and survival for subyearling migrants passing through the reach before late July.

TABLE 35. Annual average reach survival estimates and 95% confidence intervals of Mid-Columbia River basin PIT tagged yearling and subyearling hatchery chinook from release site to McNary Dam tailrace in 2002 compared to 1998 – 2001.

Tag Site	Species	Age	Year	Release Date Range	Survival	Lower Limit	Upper Limit
Winthrop NFH							
	Chinook	1	1998	4/14	0.608	0.478	0.739
			1999	4/15	0.568	0.527	0.609
			2000	4/10	0.483	0.419	0.546
			2001	4/17	0.427	0.409	0.445
			2002	4/15	0.495[a]	0.468	0.522
Leavenworth NFH							
	Chinook	1	1998	4/20	0.546	0.491	0.602
			1999	4/19	0.586	0.550	0.622
			2000	4/18	0.593	0.520	0.667
			2001	4/17	0.501	0.484	0.517
			2002	4/22	0.518	0.505	0.531
Wells SFH							
	Chinook	0	1998	6/10	0.291	0.241	0.340
			1999	6/19	0.373	0.281	0.465
			2000	6/19	0.210	0.168	0.253
			2001	6/20	0.211	0.166	0.257
			2002	6/17	0.449	0.395	0.503
Priest Rapids SFH							
	Chinook	0	1999	6/14-6/23	0.757	0.679	0.836
			2000	6/15-6/27	0.666	0.577	0.755
			2001	6/11-6/19	0.746	0.670	0.794
			2002	6/11-6/19	0.697	0.627	0.767
Ringold SFH							
	Chinook	0	1999	6/16	0.835	0.740	0.929
			2000	6/17-6/19	0.540	0.475	0.604
			2001	6/20-6/21	0.732	0.684	0.780
			2002	6/18-6/19	0.705	0.641	0.769

[a] Includes releases of SMP and NMFS research PIT-tagged fish.

Survival estimates for fish tagged and released at Rock Island Dam were estimated for the Rock Island to McNary reach. Survival estimates for subyearling chinook were similar to other recent years with the notable exception of 2001. Sockeye survival estimates were lower than most other recent years, including 2001. Yearling chinook and steelhead survival data are provided in Section F below this year as part of a multi-year analysis the Fish Passage Center developed for State, Federal and Tribal comments on the Northwest Power Planning Council Draft Mainstem Amendments.

TABLE 36. Annual average reach survival estimates and 95% confidence intervals of Mid-Columbia River basin PIT tagged smolts (mixture of wild and hatchery fish) from release at Rock Island Dam to McNary Dam tailrace in 2002 compared to 1998 - 2001.

Tag Site	Species	Year	Date Range	No. of Blocks	Average Survival	Lower Limit	Upper Limit
Rock Island Dam							
	Chinook	1998	4/19-6/2	6	0.712	0.555	0.868
	Age 1	1999	4/20-5/31	3	0.750	0.673	0.827
		2000	4/21-6/2	3	0.833	0.674	0.992
		2001	4/23-6/6	2	0.552	0.481	0.623
		2002	4/21-6/1	3	0.639	0.529	0.749
Rock Island Dam							
	Steelhead	1998	4/24-5/22	7	0.595	0.504	0.686
		1999	4/20-5/22	3	0.639	0.578	0.699
		2000	4/21-6/2	3	0.663	0.490	0.837
		2001	5/1-6/3	4	0.186	0.124	0.249
		2002	4/21-6/1	3	0.688	0.514	0.863
Rock Island Dam							
	Sockeye	1998	4/15-5/19	6	0.682	0.559	0.805
		1999*	4/20-5/3	1	0.650	0.561	0.739
		1999*	5/4-5/22	1	0.456	0.381	0.532
		2000	4/21-5/24	2	0.634	0.183	1.085
		2001	5/23-6/1	1	0.636	0.350	0.922
		2002	4/25-5/24	3	0.530	0.433	0.626
Rock Island Dam							
	Chinook	1998	6/24-7/21	5	0.616	0.541	0.690
	Age 0	1999	6/17-7/31	3	0.549	0.469	0.630
		2000	6/19-8/19	5	0.596	0.516	0.676
		2001*	6/26-7/18	3	0.329	0.281	0.377
		2001*	7/20-7/27	1	0.220	0.164	0.277
		2002	7/1-8/5	5	0.618	0.566	0.670

* Identifies a year with a significant "between blocks (temporal releases)" variance component. For those years, survival estimates are presented separately for each set of blocks that differ significantly.

F. Multi-Year Analysis of Juvenile Salmonid Travel-time and Survival in the Lower Snake River and Mid-Columbia and Lower Columbia River

1. Methods of Travel time and Survival Data Analysis for Juvenile Steelhead and Chinook Spring Migrants.

The juvenile migrants considered for these analyses represent groups for which travel time and survival was estimated for the entire Snake River (Lower Granite Dam to McNary Dam) reach using PIT tag technology. The first year that PIT tag data was available for survival estimation in the entire Lower Granite to McNary reach was 1995, however, not until 1998 when installation of full bypass PIT tag detection at John Day Dam was completed did we begin to obtain reliable estimation of survival to McNary Dam. Although survival studies using PIT tags were initiated as soon as the PIT tag detection units were installed at the projects, the reaches covered were limited in the early years. In 1993 survival studies could only be conducted between Lower Granite and Little Goose dams. This was expanded in 1994 to the Lower Granite to Lower Monumental river reach when PIT tag detectors were installed at additional projects. In 1995 to 1997, direct estimates of survival in the Lower Granite to McNary Dam reach were possible; however, due to limited detection capability at John Day Dam (detection of sampled fish from one gatewell slot out of 48) and moderate detection capability at Bonneville Dam due to operational spill levels at that facility, the resulting reach survival estimates had low precision. The detection limitations of the early years necessitated the extrapolation of the shorter river reach survival estimates to the longer reach (Lower Granite to McNary). It is now known that these earlier estimates using extrapolation resulted in a miss-representation of survival when applied to the longer reach. Consequently, we have chosen not to include these estimates in our analysis. Reliable estimation of survival to McNary Dam was not possible until installation of bypass detectors at John Day in 1998. For these reasons we have chosen to use survival estimate from 1998 to 2002 in creating the bivariate and multiple regression models. The above detection limitations below McNary Dam do not impact the quality of the travel time data from Lower Granite Dam to McNary Dam and therefore, travel time analyses use data from 1995 to 2002 for yearling chinook and 1996 to 2002 for steelhead. All juvenile yearling chinook and steelhead marked using PIT tags at hatcher-

ies and fish traps above Lower Granite Dam and subsequently recaptured at the initial site, as well as those fish marked and released at Lower Granite Dam, were used in our analysis.

For the analyses pertaining to the Mid Columbia River, travel time and survival was estimated from Rock Island to McNary dams for releases of yearling chinook and steelhead marked and released at Rock Island Dam from 1998 to 2002. The Mid-Columbia fish used in our analysis were marked at Rock Island as part of the Fish Passage Center's Smolt Monitoring Program.

For the Snake River this study used all juvenile yearling chinook and steelhead marked using PIT tags at hatcheries and fish traps above Lower Granite Dam and subsequently recaptured at the initial site, as well as those fish marked and released at Lower Granite Dam. The accuracy and precision associated with any estimate of survival or travel time will be dependent on the number of fish in a release group (N) and the number of fish subsequently recaptured. The intent of the analysis was to relate the dependent variables (travel time and survival) to a series of independent environmental variables. As fish migrate through the hydrosystem the initial release group disperses over time making the description of an average environmental condition difficult. The best chance of describing the environmental variable for each group was to limit the time frame over which the variable was estimated (before groups became too dispersed) and to reduce the overlap among groups. Consequently, when grouping daily releases of PIT tagged groups together over longer periods of time to provide the most accurate and precise estimate, it is important not to group too large a time period to mask the effect of environmental variables. For smolts originating in the Snake River basin, travel time and survival estimates were developed for each weekly release block in the available years of data. Each year was divided into eight weekly periods for wild and hatchery yearling chinook and into six weekly periods for steelhead. For the Mid Columbia migrants, the season was divided into three two-week blocks for each year.

Smolt travel time is the amount of time needed for juvenile migrants to transit the river system between any two points. For each temporal block, an estimate of median travel time was calculated from the smolts transiting the entire reach of interest.

Survival is estimated using the Cormack-Jolly-Seber tag-recapture methodology (Burnham et al 1987). This method estimates survival components between each dam within the index reach having PIT tag detection equipment such as Little Goose, Lower Monumental, and McNary dams (additional detections at John Day and Bonneville dams downstream of McNary Dam also contribute to process of estimating survival in the upstream reaches). In the case of the Snake

River reach, the survival estimate is the product of survival from Lower Granite Dam tailrace to Little Goose Dam tailrace, Little Goose Dam tailrace to Lower Monumental Dam tailrace, and Lower Monumental Dam tailrace to McNary Dam tailrace. In the case of the Mid-Columbia River reach, the survival estimate is the single estimate from Rock Island Dam tailrace to McNary Dam tailrace. The Snake River reach includes four reservoirs and dams and the Mid-Columbia River reach includes three reservoirs and dams.

Because the recovery of the PIT tags is dependent on being observed in a bypass system at downstream hydroprojects, the river and project operations exert considerable influence on the ability to obtain sufficient tag recoveries to obtain a valid estimate. Several criteria were employed to distinguish among the resulting estimates to assure their validity. Any temporal blocks which contained less than 300 smolts in the release group provided too few recoveries to make valid estimates of survival. Consequently, no estimates of survival and travel time were made when less than 300 smolts were available. In addition, another criterion was applied to the estimates of survival. When the coefficient of variation (standard error divided by estimate) of any component survival estimate exceeded 0.25, the full reach survival estimate was excluded from the analysis. This check was made prior to multiplying the several component survival estimates to create a full reach survival estimate, as was the case in the Snake River basin. Whenever a component survival estimate was greater than 1, then the standard error divided by 1 was used as the threshold criteria. In the years 1998 to 2002, only one wild chinook, two hatchery chinook, and one steelhead temporal block needed to be excluded due to the minimum coefficient of variation criterion. In the Snake River reach, the final survival data set contained 66 estimates of survival for yearling chinook (hatchery and wild combined) and 26 estimates for steelhead. In the Mid Columbia, the final survival data set contained 13 estimates for yearling chinook and 15 estimates for steelhead. All survival estimates were accompanied with associated environmental variables.

Environmental Variables: Water transit time, spill proportion, and water temperature

Predictor variables of in-river survival were considered that are related to how flow or velocity may affect the survival of smolts migrating in-river through the hydro system in specific reaches of the Snake and Columbia rivers. The final set of predictor variables included a water velocity related variable, a spill related variable, and river temperature.

Water Transit Time

Previous analyses suggested that changes in flow produced changes in water velocity, which determined how quickly smolts migrated through the hydrosystem. The actual flow regime experienced by a group of migrating juvenile fish is difficult to quantify. Past analyses have used an index of flow through a specific reach for a period of time around the median passage dates of the migration or an average flow over the entire passage period. Because of the discrete relation between flow and water transit time (WTT) (also known as water particle travel time) and the implication of velocity as the important determining factor, the flow variable was quantified as the summation of water transit times for each reservoir incorporated in a reach (Figure 23 and Figure 24 show the relation between WTT and average flow in the Snake River and McNary Dam reservoir).

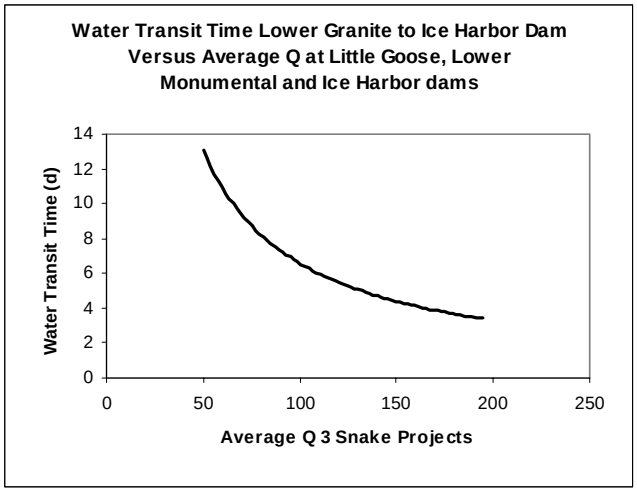

FIGURE 23. Relation between water transit time flow in Lower Snake River.

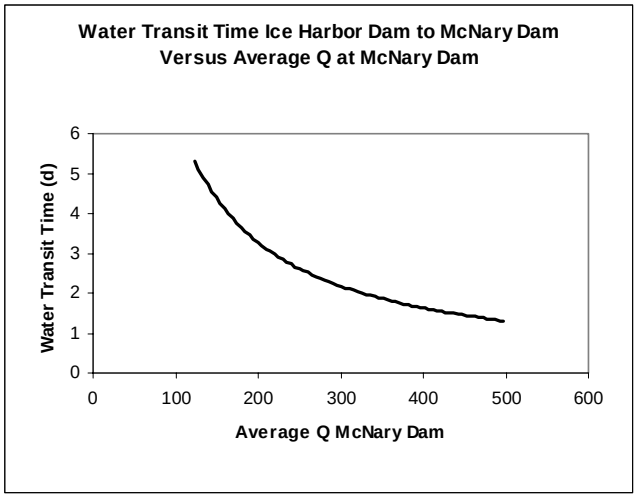

FIGURE 24. Relation between water transit and average time and average flow in McNary Pool.

The water transit time is the estimated amount of time required for a water particle to travel the fixed distance from the start of the reach to the end of the reach (WTT = distance / average water velocity). This fixed distance was 140 miles for the Snake River reach from Lower Granite Dam tailrace to McNary Dam tailrace and 161 miles for the Mid-Columbia River reach from Rock Island Dam tailrace to McNary Dam tailrace. The median travel time was estimated to each down stream project for each weekly block. The mid-date of release from LGR was used and to it was added median travel time for the release group to the downstream project. For each day, WTT is computed by dividing each reservoir volume by its corresponding daily average flow to determine the water particle transit time for that day. Reservoir volumes are obtained using COE tables and current reservoir elevations. For each reservoir, an average WTT is computed over a 7-day window of WTT's around the date of median passage of the fish of interest at the reservoir's downstream dam. These average WTT are then summed over the number of reservoirs in the reach of interest. The dates of median fish passage at each dam are obtained from PIT tagged smolts released from or passing during weekly blocks of time at Lower Granite Dam. This process is repeated for each weekly release group of PIT tagged smolts at Lower Granite Dam. Each weekly (7-day) release, starting April 1 for yearling chinook and April 17 for steelhead, was numbered sequentially from first through last week for each year to create a variable for week of entry into the reach.

Spill Proportion

For each reservoir and dam segment of the reach, survival may be viewed as the product of two components, a reservoir survival component and a dam passage component. In the dam passage component, survival may be viewed as the weighted average survival across each passage route, such as spillway route, turbine route, and bypass channel route (if present), where the weight is equal to the population of smolts using each route. Because the spill passage route has been shown to be the safest route of passage (except during periods of excessively high flows when gas may be a problem), increases in the amount of spill and numbers of fish passing through that route will have a direct effect on the reach survival estimate. Therefore, it is essential to include a spill related variable in all multiple regression models, otherwise the effect of spill will be confounded within the parameter estimates of the other variables in the model (i.e., a case of model misspecification). The variable representing spill at Little Goose, Lower Monumental, Ice Harbor, and McNary between April and June of 1998 and 2002 was the percentage of daily spill to total discharge. It was calculated using daily average spill and daily average total discharge at each project. Each daily percent Spill/Total Discharge was averaged over a seven-day passage window (centered around the median passage date) for each species and project. The average spill proportion is denoted as SPILLPROP in the subsequent text and tables.

Water Temperature

The dates of median fish passage at each dam are obtained from PIT tagged smolts released from or passing during weekly blocks of time at Lower Granite Dam. From these same 7-day windows around the dates of median smolt passage at each dam of interest, averages of river temperature are generated. Initially, a variable for the week of entry into the reach was considered, however, it was felt that the river temperature variable would already include the effect of this temporal variable in two ways. First, the general timing of the smolts at Lower Granite Dam is highly influenced by river temperature. In years of warmer winters and earlier warming of the river, the smolts begin their migration earlier, whereas in years of cooler winter and later snowmelt, the smolts begin their migration later. Second, river temperature increase over time during the migration period, and so any effects of week of entry into the reach is already confounded

within the river temperature variable. Therefore, week of entry into the reach was not used in the multiple regression analyses. The water temperature variable is denoted simply as TEMP in the subsequent text and tables.

2. Results of Travel Time Analysis

Snake River Reach: Lower Granite Dam to McNary Dam

Bivariate relations between smolt travel time and WTT were modeled using linear regression (Table 37). Relations for smolts originating above Lower Granite Dam and migrating between the tailrace of Lower Granite Dam and McNary Dam are shown for wild yearling chinook in Figure 25, hatchery yearling chinook in Figure 26, and steelhead (wild and hatchery) in Figure 27.

TABLE 37. Summary of linear regressions of median travel time versus water transit time for wild and hatchery yearling chinook and steelhead.

Group	Regression Equation	R^2
Wild Chinook	y = 1.245x + 0.8745	0.51
Hatchery Chinook	y = 1.107x + 2.3327	0.58
Steelhead	y = 1.250x - 1.2075	0.87

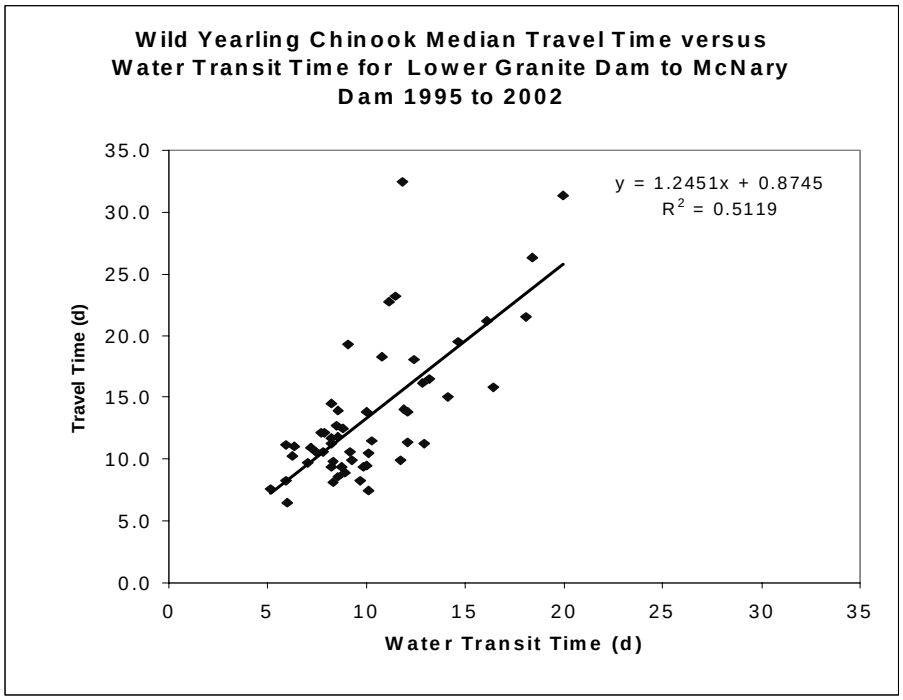

FIGURE 25. Wild yearling chinook travel time versus water transit time.

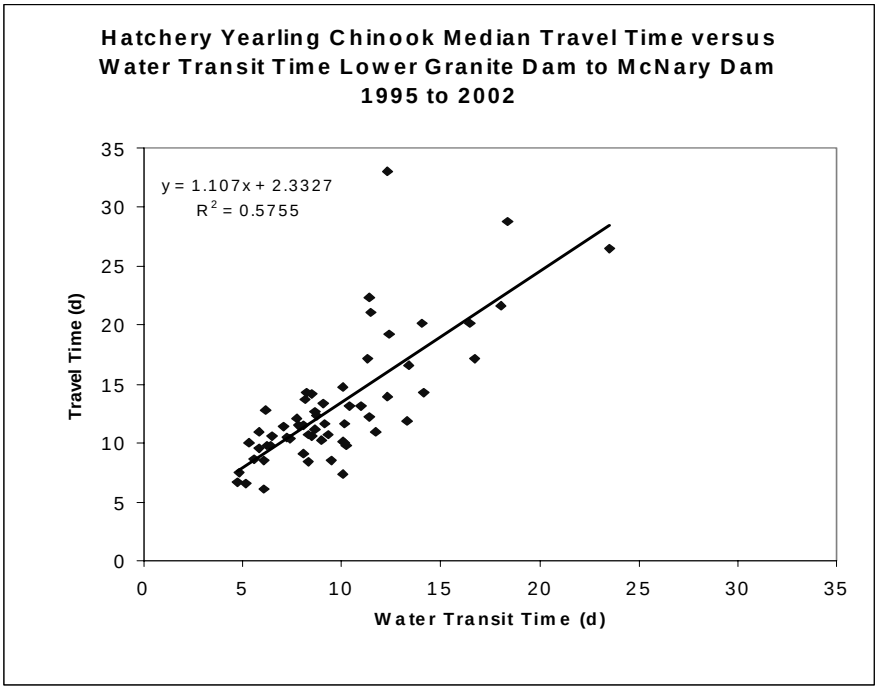

FIGURE 26. Hatchery yearling chinook travel time versus water transit time.

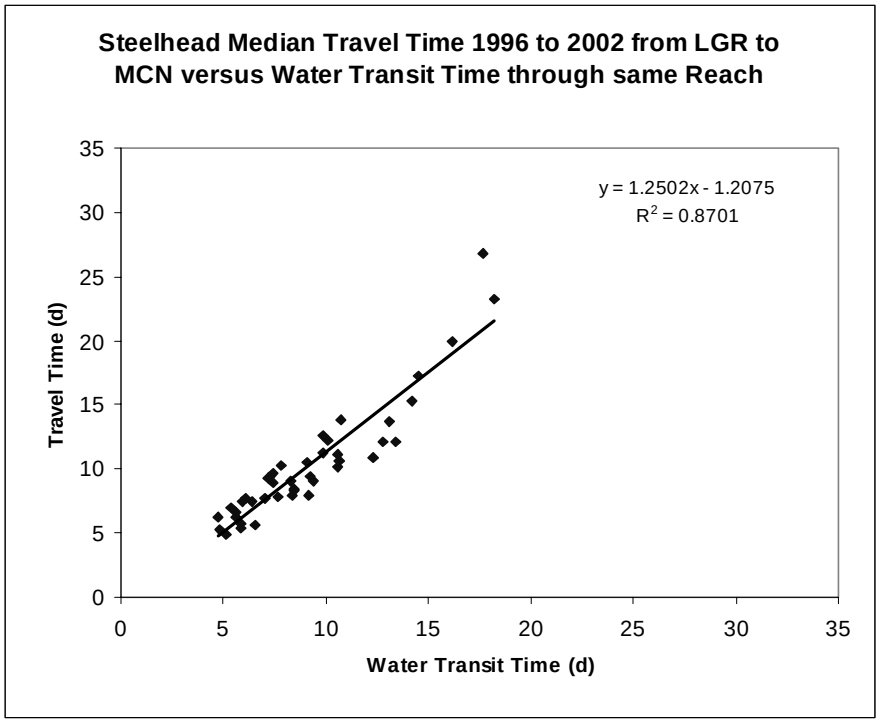

FIGURE 27. Steelhead travel time versus water transit time.

Mid-Columbia River Reach: Rock Island Dam to McNary Dam

Bivariate relations between smolt travel time and WTT were modeled using linear regression (Table 38). Relations for smolts originating above Rock Island Dam and migrating between the tailrace of Rock Island Dam and McNary Dam are shown for yearling chinook in Figure 28 and steelhead in Figure 29. For each species, the data is a mixture of wild and hatchery smolts.

TABLE 38. Summary of linear regressions of median travel time versus water transit time for wild and hatchery chinook and steelhead.

Group	Regression Equation	R^2
Yearling Chinook	y = 2.0797x - 1.8816	0.55
Steelhead	y = 1.8899x - 3.5432	0.93

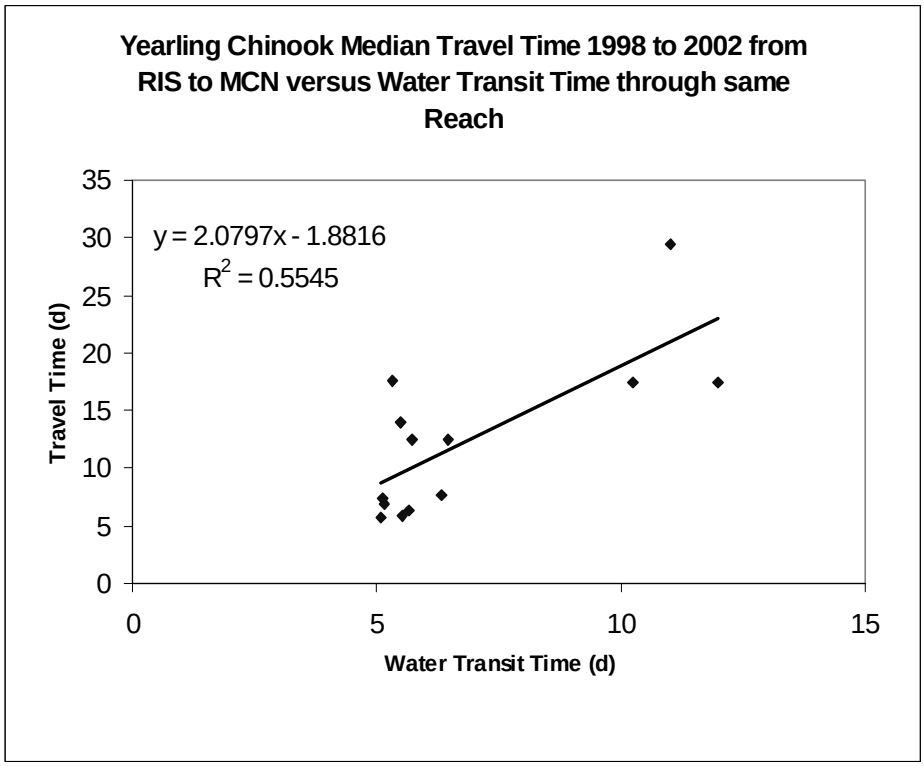

FIGURE 28. Yearling chinook travel time versus water transit time.

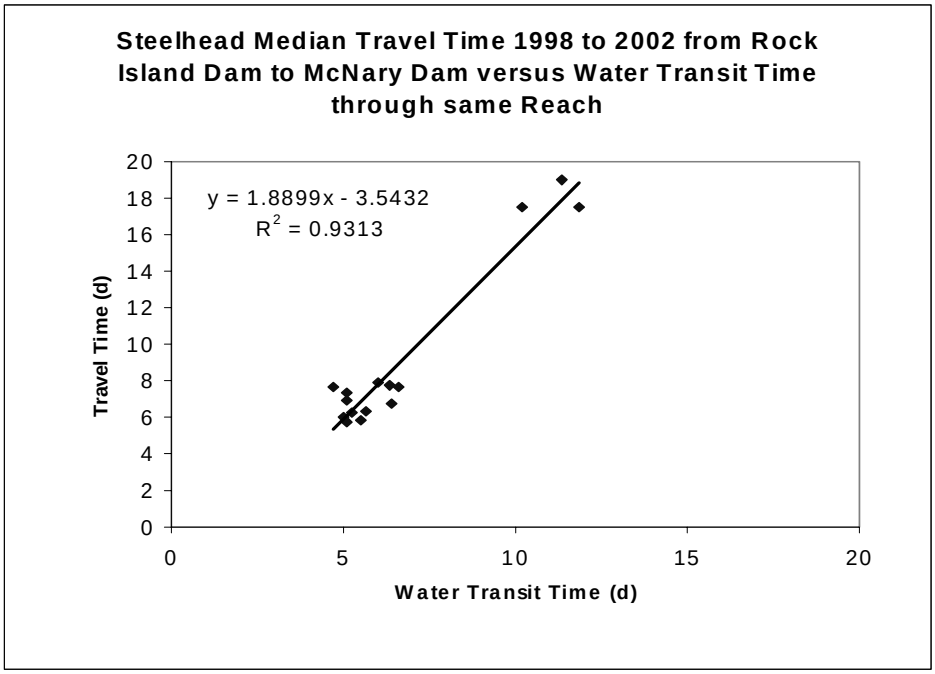

FIGURE 29. Steelhead travel time versus water transit time.

3. Results of Survival Analysis

Snake River Reach: Lower Granite Dam to McNary Dam

Survival Analysis for Steelhead

The water transit time and spill proportion (SPILLPROP) variables both had high correlation with the dependent variable survival (Table 39). Correlation between WTT and SPILLPROP was r = -0.81, a level low enough so that multicollinearity is not a problem. The square root of the variance-inflation factor, sqrt[1/(1-R2)] provides a measure of the extent to which the standard error of the regression coefficients will be inflated due to high correlation between the predictor variables in a model. In the case of our model with WTT and SPILLPROP, the regression coefficient standard error will be inflated by a factor of approximately 1.7. Myers (1990) and Fox (1991) show that multicollinearity doesn't become a problem until the variance-inflation factor exceeds 10, which triples the standard error of the regression parameters. A plot of estimated survival of steelhead from the tailrace of Lower Granite Dam to the tailrace of McNary Dam relative to WTT shows a linear relation in Figure 30.

TABLE 39. Correlation matrix for variables related to steelhead.

	SURVIVAL	WTT	SPILLPROP
WTT	-0.914		
SPILLPROP	0.869	-0.809	
TEMP	-0.430	0.300	-0.464

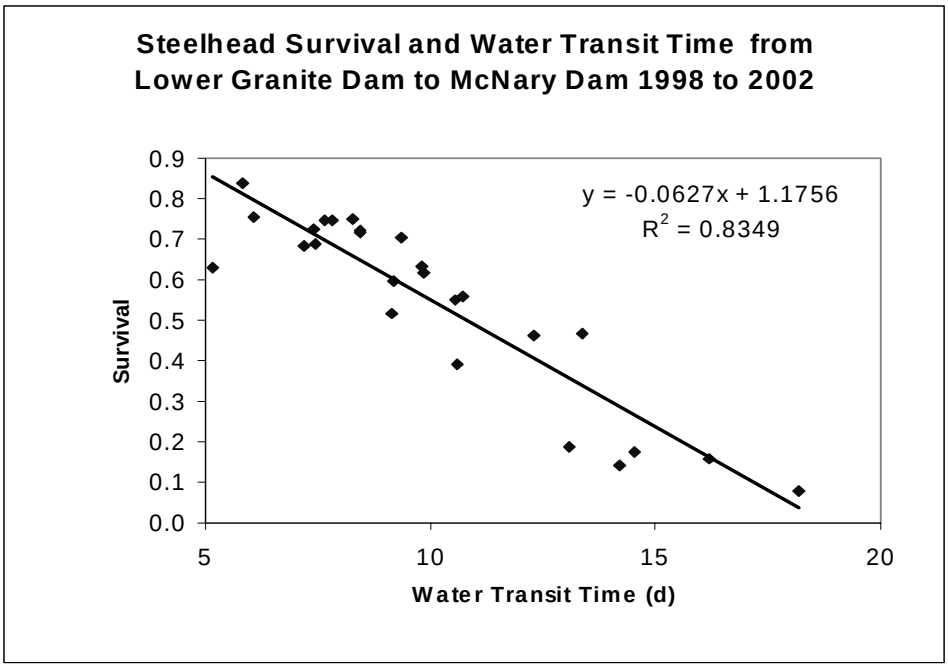

FIGURE 30. Steelhead survival versus water transit time.

In the multiple regression analysis for steelhead, WTT and SPILLPROP were both significant variables in explaining variation in the dependent variable survival (Table 40). In the presence of these two variables, water temperature (TEMP) did not significantly explain any variation in survival. Since the various routes of passage, each with differential rates survival for passing fish, at a particular dam is an integral component of any reach "true" survival rate, it is encouraging to see a spill-related variable remain in the model. Any mechanistic model should always include the influence of spill, and it does so in the steelhead regression model. The joint model of WTT and SPILLPROP provides the best model for predicting steelhead survival in the Snake River reach.

TABLE 40. Multiple regression models for predicting survival of steelhead salmon in the Snake River from the tailrace of Lower Granite Dam to the tailrace of McNary Dam.

	Variable	Coefficient	SE	P	MSE	R^2
N = 26	Constant	0.79901	0.13203	0.00000	0.00639	0.87
	WTT	-0.04184	0.00831	0.00004		
	SPILLPROP	0.00527	0.00117	0.00508		

Survival for Yearling Chinook

Analysis of covariance was used to determine whether hatchery and wild chinook differed in survival response as a function of the predictor variables. Wild and hatchery chinook did not significantly differ with any of the predictor variables (Table 41). Plots of estimated survival of yearling chinook from the tailrace of Lower Granite Dam to the tailrace of McNary Dam relative to WTT shows similar linear relations for hatchery and wild fish (Figure 31 and Figure 32, respectively). All further analyses were conducted on the combined set of wild and hatchery chinook data.

TABLE 41. Analysis of covariance comparison of hatchery and wild yearling chinook survival when all covariates are accounted for in the model.

	Variable	SS	df	MSE	F-ratio	P
N = 66	RearType	0.00191	1	0.00191	0.32314	0.57182
H = 32	WTT	0.05225	1	0.05225	8.81804	0.00426
W= 34	SPILLPROP	0.04096	1	0.04096	6.91232	0.01082
	TEMP	0.06892	1	0.06892	11.63241	0.00115
	Error		61	0.00593		

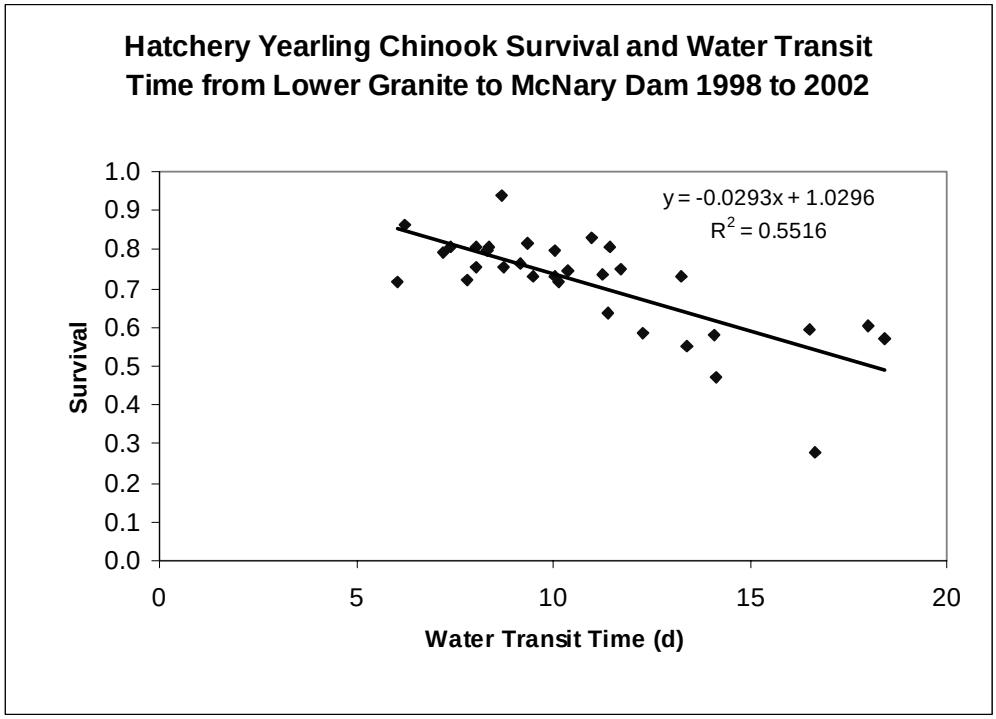

FIGURE 31. Hatchery yearling chinook survival versus water transit time.

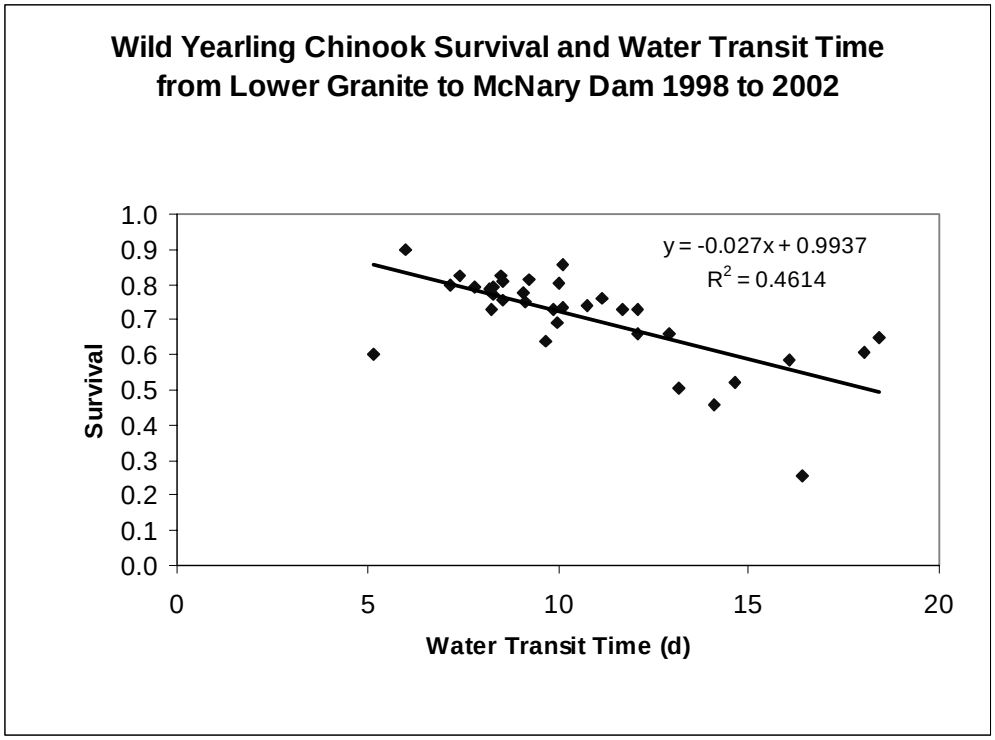

FIGURE 32. Wild yearling chinook survival versus water transit time.

For the combined wild and hatchery yearling chinook, the WTT and SPILLPROP variables both had high correlation with the dependent variable survival (Table 42). As was observed with steelhead, the correlation between WTT and SPILLPROP for yearling chinook was r = -0.81, a level low enough so that multicollinearity is not a problem.

TABLE 42. Correlation matrix for variables related to wild and hatchery yearling chinook salmon.

	SURVIVAL	WTT	SPILLPROP
WTT	-0.70898		
SPILLPROP	0.75498	-0.80546	
TEMP	-0.46136	0.16461	-0.34821

In the multiple regression analysis for yearling chinook, WTT and SPILLPROP were both significant variables in explaining variation in the dependent variable survival (Table 43). In the presence of these two variables, TEMP also was significant in explaining variation in survival. The joint model of WTT, SPILLPROP, and TEMP provides the best model for predicting yearling chinook survival in the Snake River reach.

TABLE 43. Multiple regression models for predicting survival of combined hatchery and wild yearling chinook salmon in the Snake River from the tailrace of Lower Granite Dam to the tailrace of McNary Dam.

	Variable	Coefficient	SE	P	MSE	R^2
N = 66	Constant	1.09264	0.13901	0.00000	0.0586	0.65
	WTT	-0.01497	0.00504	0.0042		
	SPILLPROP	0.00281	0.00106	0.01027		
	TEMP	-0.02624	0.00765	0.00109		

Mid-Columbia River Reach Rock Island Dam to McNary Dam

Survival Analysis for steelhead

For steelhead in the Mid-Columbia River reach, WTT had the highest correlation with the dependent variable survival, while both SPILLPROP and TEMP had similar moderate levels of correlation with survival (Table 44). The correlation between WTT and SPILLPROP for steel-

head was r = -0.87, a level still low enough so that multicollinearity is not a problem. A plot of estimated survival of steelhead from the tailrace of Rock Island Dam to the tailrace of McNary Dam relative to WTT shows a linear relation in Figure 33.

TABLE 44. Correlation matrix for variables related to steelhead salmon.

	SURVIVAL	WTT	AVGSPILLPROP
WTT	-0.808		
AVGSPILLPROP	0.647	-0.870	
AVTEMP	-0.587	0.312	-0.193

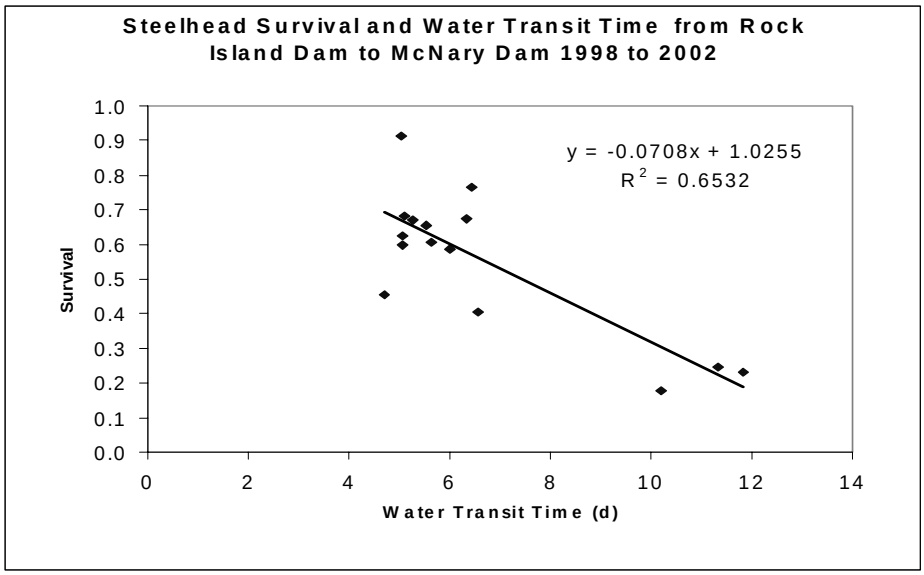

FIGURE 33. Steelhead survival versus water transit time.

In the multiple regression analysis for steelhead, WTT and TEMP were both significant variables in explaining variation in the dependent variable survival (Table 45). In the presence of these two variables, SPILLPROP did not significantly explain any variation in survival. Since the level of spill at Wanapam and Priest Rapids dams remained fairly constant over the years covered in the analysis, it is not surprising that SPILLPROP did not explain additional variation in survival. However, this finding does not reduce the intrinsic benefits of spill. Any mechanistic model should always include the influence of spill, and when it doesn't, the effect of spill becomes

confounded within the coefficients of the other parameters in the model. For survival prediction purposes, the joint model of WTT and TEMP provides the best model for predicting steelhead survival from the tailrace of Rock Island Dam to the tailrace of McNary Dam.

TABLE 45. Multiple regression models for predicting survival of steelhead salmon in the Mid-Columbia River from the tailrace of Rock Island Dam to the tailrace of McNary Dam.

	Variable	Coefficient	SE	P	MSE	R^2
N = 15	Constant	1.6135	0.2425	0.00002	0.01136	0.74
	WTT	-0.06065	0.01256	0.00041		
	TEMP	-0.0553	0.02138	0.02383		

Survival for Yearling Chinook

For yearling chinook in the Mid-Columbia River reach, WTT and SPILLPROP had similar moderate correlation with the dependent variable survival (Table 46). The correlation between WTT and SPILLPROP for steelhead was r = -0.83, a level low enough so that multicollinearity is not a problem, but higher than observed for yearling chinook in the Snake River reach. A plot of estimated survival of yearling chinook from the tailrace of Rock Island Dam to the tailrace of McNary Dam relative to WTT shows a linear relation in Figure 34.

TABLE 46. Correlation matrix for variables related to yearling chinook salmon.

	SURVIVAL	WTT	AVGSPILLPROP
WTT	-0.543		
AVGSPILLPROP	0.461	-0.828	
AVTEMP	-0.230	0.421	-0.211

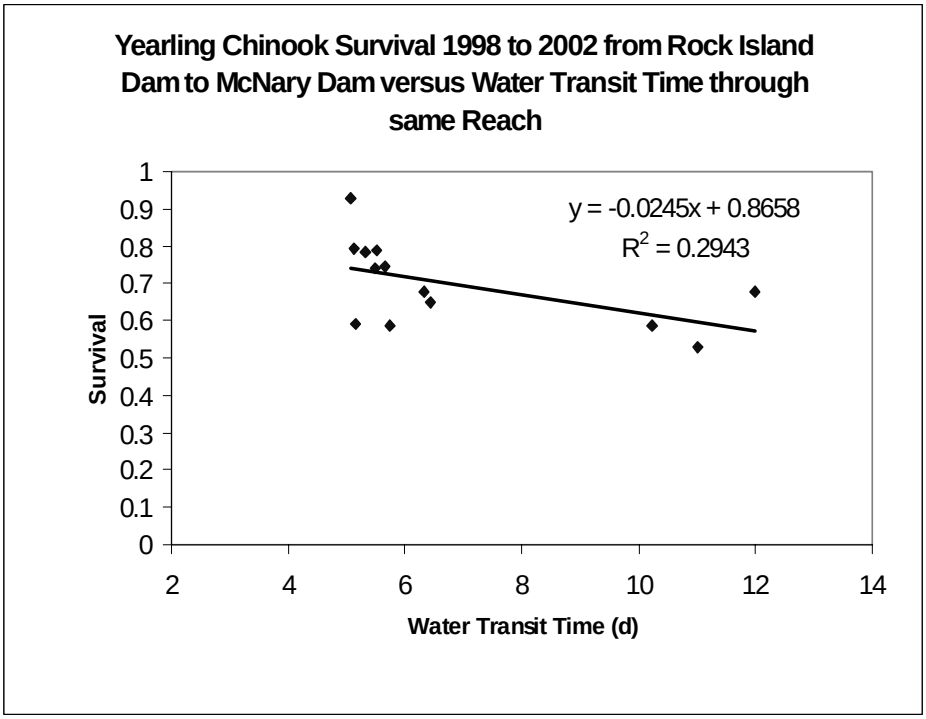

FIGURE 34. Yearling chinook survival versus water transit time.

In the multiple regression analysis for yearling chinook, only WTT was moderately significant in explaining variation in the dependent variable survival (Table 47). In the presence WTT, SPILLPROP did not significantly explain any variation in survival. Since the level of spill at Wanapam and Priest Rapids dams remained fairly constant over the years covered in the analysis, it is not surprising that SPILLPROP did not explain additional variation in survival. For survival prediction purposes, the simple bivariate model of WTT provides the best model for predicting yearling chinook survival from the tailrace of Rock Island Dam to the tailrace of McNary Dam.

TABLE 47. Multiple regression model for predicting survival of yearling chinook salmon in the Mid-Columbia River from the tailrace of Rock Island Dam to the tailrace of McNary Dam.

	Variable	Coefficient	SE	P	MSE	R^2
N = 13	Constant	0.86052	0.08282	0.00000	0.00956	0.23
	WTT	-0.02446	0.54250	0.05543		

Lower Columbia River Reach: McNary Dam to Bonneville Dam

Survival Analysis for steelhead

For combined hatchery and wild steelhead, the water transit time, spill proportion, and water temperature variables each had high correlation with the dependent variable survival (Table 48). Correlation between each pair of predictor variables was also very high, which lead to problems of multicollinearity when trying to include more than one predictor variable in the model. Thus, a model with only one predictor variable was obtained. Since WTT had the highest correlation with steelhead smolt survival, it entered into the bivariate model that explained the most variation in the dependent variable survival (Table 49). A plot of estimated survival of steelhead from the tailrace of Lower Granite Dam to the tailrace of McNary Dam relative to WTT shows a linear relation in Figure 35. Although a multiple regression model was not attainable, one must keep in mind that SPILLPROP still has a direct influence on the resulting magnitude of the survival estimate. This is because, as stated earlier, the survival of smolts that pass through the spill route is typically higher than any other passage route at a dam.

TABLE 48. Correlation matrix for variables related to steelhead.

	SURVIVAL	WTT	SPILLPROP
WTT	-0.959		
SPILLPROP	0.871	-0.969	
TEMP	-0.948	0.985	-0.930

TABLE 49. Bivariate regression model for predicting survival of steelhead salmon in the lower Columbia River from the tailrace of McNary Dam to the tailrace of Bonneville Dam.

	Variable	Coefficient	SE	P	MSE	R^2
N = 4	Constant	0.97747	0.10775	0.0119	0.00518	0.92
	WTT	-0.06481	0.01358	0.0412		

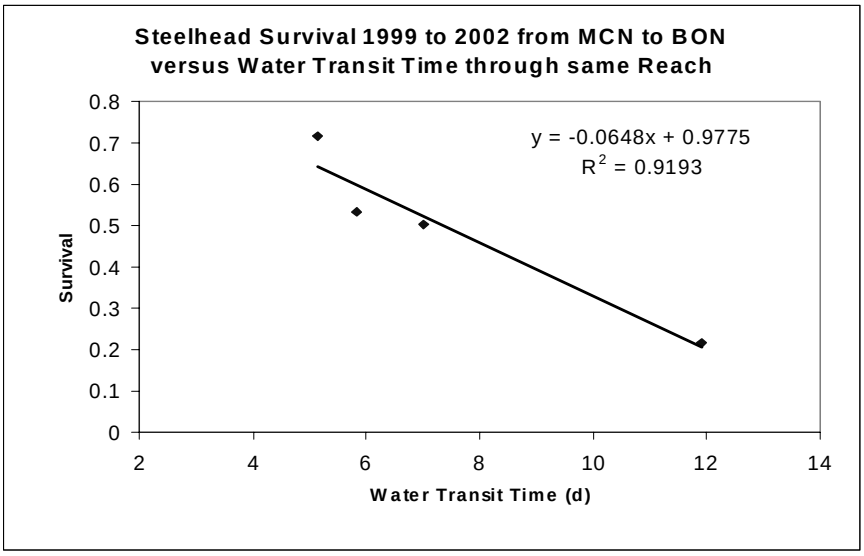

FIGURE 35. Steelhead survival versus water transit time.

Survival for Yearling Chinook

For combined hatchery and wild yearling chinook, both WTT and SPILLPROP variables had high correlation with the dependent variable survival (Table 50), whereas TEMP had only a moderate correlation. Correlation between WTT and SPILLPROP was not high enough to create multicollinearity problems, but it was high enough to both variables from remaining together in a multiple regression model.

TABLE 50. Correlation matrix for variables related to yearling chinook salmon.

	SURVIVAL	WTT	SPILLPROP
WTT	-0.771		
SPILLPROP	0.870	-0.882	
TEMP	-0.433	0.431	-0.341

Since SPILLPROP had the highest correlation with yearling chinook smolt survival, it entered into the bivariate model that explained the most variation in the dependent variable sur-

vival (Table 51). This is not to say that WTT is less important than SPILLPROP with regard to yearling chinook survival. But it does show a major weakness in using regression techniques to pick the most important "causative" factors from the set of factors being considered in the modeling exercise. Although SPILLPROP has a direct influence on the resulting magnitude of the survival estimate, the level of spill in the hydro system operation does not occur independent of the prevailing flows. Thus flows have a direct influence on WTT and so both variables must be considered as key elements affecting the inriver survival of smolts through the hydro system. A bivariate plot of estimated survival of yearling chinook from the tailrace of McNary Dam to the tailrace of Bonneville Dam is shown in Figure 36 relative to WTT and in Figure 37 relative to SPILLPROP.

TABLE 51. Bivariate regression models for predicting survival of yearling chinook salmon in the lower Columbia River from the tailrace of McNary Dam to the tailrace of Bonneville Dam.

	Variable	Coefficient	SE	P	MSE	R^2
N = 11	Constant	0.37096	0.05513	0.00009	0.00272	0.76
	SPILLPROP	0.87267	0.16458	0.00049		

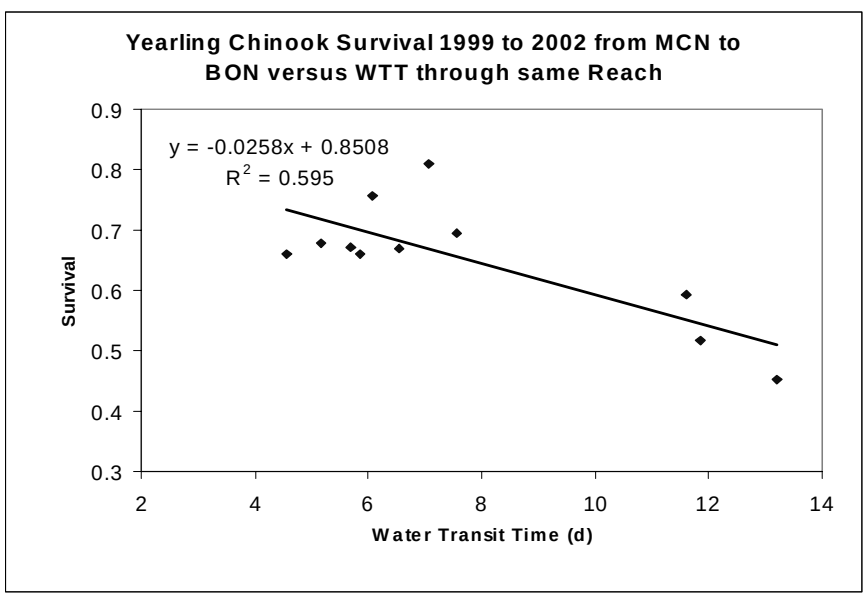

FIGURE 36. Yearling chinook survival versus water transit time.

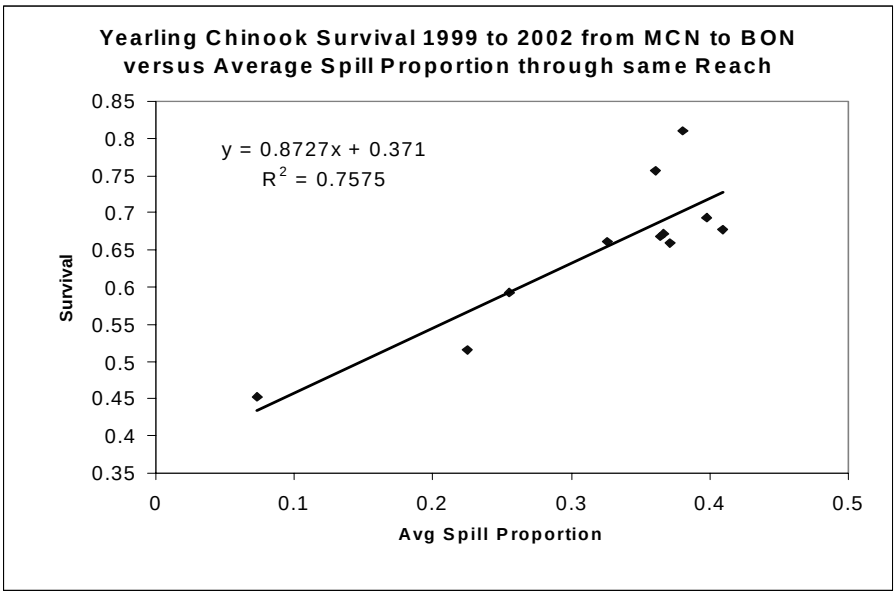

FIGURE 37. Yearling chinook survival versus average spill proportion.

4. Summary and Conclusions

Based on the multi-year analysis we can draw several conclusions. First, it is clear a water travel time/ survival relationship exists for spring migrating chinook and steelhead of Snake River and Mid-Columbia River origin. These results should be considered in view of the fact that it is difficult to define a flow survival relationship because survival is the combined result of many interacting variables and the methodology for estimating survival does not lend itself to identifying each individual environmental or biotic variable. Despite these difficulties the relationships were significant in several analyzed groups. Also, a water travel time and fish travel time relationship exists for spring migrating chinook and steelhead in all reaches.

5. References

Burnham, K. P., D. R. Anderson, G. C. White, C. Brownie, K. H. Pollock. 1987. Design and analysis methods for fish survival experiments based on release-recapture. American Fisheries Society Monograph 5, ISBN 0362-1715, Bethesda, Maryland.

IV. 2002 ADULT FISH PASSAGE

A. Overview

Fish passage facilities at mainstem dams are to be operated within standards and criteria to safely pass adult fish past each dam. These standards are specified in Fish Passage Plans or Habitat Conservation Plans that are required as part of the Biological Opinion set forth by NMFS. Adult fish should have encountered satisfactory migration conditions throughout most of the 2002 passage season.

The adult cycle of a salmon migrating from the Columbia River mouth and up to the spawning areas is not without potential hazards. From the mouth and up to Bonneville Dam, the fish initially must evade marine mammals, then commercial and sport fishers during designated seasons and finally they search and find the passage route past the first large dam. Personnel at the Lower Granite Dam trapping site reported that approximately 20% of the spring and summer adult chinook had evidence of marine mammal attacks, e.g., descaling or scratches or in some cases flesh wounds: personal communication, NMFS, Jan. 2003. When fish have passed Bonneville Dam, they must navigate through a series of dams, navigate through a tribal commercial fishery, normally pass through a series of sports fisheries, and potentially migrate upstream through a wide range of water temperatures. Again at Lower Granite trapping site, about 3.9% of the sampled adult spring and summer chinook were reported with head scrapes and "burns", Personal Communication; NMFS, Jan. 2003. The fall run of salmon species generally must pass through an intensive fish commercial season in addition to warm water temperatures in the Columbia and Snake Rivers.

To assess passage of adult fish at the mainstem dams, the operating agencies are required to fund fish counting programs at the COE and PUD projects. These counting programs normally run from early spring through late fall to encompass most of the fish passage that occurs throughout the year. WDFW contracts to count fish at COE projects while the PUD directly contract with personnel to count adult fish at the Mid-Columbia River projects. Fish counts may be assessed by directly counting fish as they swim through the counting slot or are videotaped through the slot. Daily counts from each dam are reported to the COE and final data are compiled and incorporated in an annual Fish Passage Report by the COE. The fish counts are updated daily on the FPC Web

site during the fish passage season.

The FPC reports on adult fish passage and passage conditions at the dams throughout the adult fish migration. The FPC Weekly Report incorporates adult fish counts for that season and compares that total to the previous year as well as the 10-year average through the same block of time. An annual report titled Adult Fishway Inspections at the mainstream Snake and Columbia River Dams summarizes inspections made at the COE and PUD projects. This fishway inspection program has been on-going since 1984 and fishway inspections are completed to assure that adult fishways are maintained at acceptable criteria levels throughout the fish passage season. State and Federal fish agencies complete the fish facilities inspections on a monthly basis. Fishway equipment such as fish turbines, fish pumps, or other water supply equipment operated satisfactorily throughout most of the fish passage season. Flows during the spring and early summer of 2002 were near normal levels after the drought-like low flows experienced in 2001. Cooler water temperatures and higher flow levels likely resulted in the arrival of adult spring chinook at the lower project about one to two weeks later in 2002 than the previous season. Higher water temperatures were still an issue during the later summer and early fall seasons in the Columbia and Snake rivers.

B. Adult Fish Counts

In 2002, numbers of adult salmon returning to the Columbia River were well above average levels for most species of salmon counted at Bonneville Dam and upriver dams. About 871,000 adult chinook salmon, 88,000 coho salmon, 50,000 sockeye salmon and 481,000 steelhead were counted at Bonneville Dam in 2002. The adult chinook returns were similar to the previous year (871,000 versus 868,000) reported in 2001 and the summer and fall chinook runs were at record-high levels in 2002. Counts of coho salmon and sockeye salmon were less than 50% of the preceding year, and were likely affected by the drought and low flow conditions that occurred during the juvenile portion of their downstream migration. Steelhead counts were reduced from the record returns of 2001, but were 183% of the 10-year average and second highest counts at Bonneville Dam. Adult returns to mainstem dams are summarized for the various species and runs of salmon for year 2002.

1. Spring Chinook Salmon

In 2002, the counted total of adult spring chinook salmon returning to Bonneville Dam was 268,813, more than double the 10-year average and ranked as the second highest count at Bonneville Dam since 1938. The 2002 return of spring chinook included a sports fishery downstream of Bonneville Dam, only the second since the 1970s. This year's adult run was comprised of a mixture of three, four and five year old fish that spend one to three years of their life cycle in the ocean. About 86% of the 2001 adult spring chinook run was comprised of 4-year old chinook based on sampling results completed at the Bonneville Dam adult trapping facility by Columbia River Inter-Tribal Fish Commission (CRITFC). About 13% of the sample was 5-year old fish with the remaining 1.5% being jack salmon (3-yr old) fish. The Bonneville count of 6,477 spring chinook (jack) salmon was less than half the 2001 return; however, it was about 115% of the 10-year average. The Technical Advisory Committee is projecting the upriver run (Bonneville Dam and above) to exceed 145,000 in 2003. Figure 38 illustrates the increase in numbers of adult spring chinook that began in 2000 and continued through 2002, after record low numbers of less than 40,000 fish in 1998 and 1999.

Approximately 67.4% of the fish passing Bonneville were counted at The Dalles Dam this year. The Wind, Klickitat, Little and Big White Salmon, and Hood rivers all support spring chinook via hatchery programs, or programs to establish "natural" runs in these basins. A limited commercial Tribal fishery on adult spring chinook was again allowed as well as a sport fishery in the tributaries this season.

About 47% of the spring chinook counted at The Dalles Dam entered the Snake River. This percentage was about 10% reduced from the 2001 returns when a much higher percentage entered the Snake River basin. The fish count at Lower Granite Dam was 75,025, greater than double the 10-year average. Estimated hatchery chinook at Lower Granite Dam comprised a minimum of 69.7% of the run [note that this percentage is based only on the absence of the adipose fin]. The unclipped fish are considered to be "wild" or "natural" fish. In some cases a poorly clipped fin or missed clipping of a fin can lead to the mis-identification of a hatchery fish as a wild fish. The spring chinook count in the Snake River was at the all-time low of about 1,500 as recent as 1995, but the past two years has increased both hatchery and wild/natural returns to this Region. The number of "jack" spring chinook salmon that returned to the Snake River reduced to

near 2,000, about 2/3 the 2001 return, but still exceeded the 10-year average.

The spring chinook count at Priest Rapids Dam was 34,083 with 24,000 arriving at Rock Island Dam. The 2002 count was about 67.6% and 242% of the respective 2001 and 10-year average adult spring chinook count at Priest Rapids. The Yakama River had an adult return of near 13,300 for the 2002 migration. Most spring chinook returning to the Mid-Columbia River are hatchery reared fish. The returns to the Yakama River basin was split about 52% to 48% Hatchery/Wild. In the Mid-Columbia not all hatchery spring chinook are fin clipped to signify being of hatchery origin and no hatchery/wild adult return estimates were made from the fish counts. Numbers of "wild" chinook in the tributaries located above Rock Island Dam are still at extremely low levels.

Spring chinook "jack" salmon count at Rock Island Dam was 827, about 50% of the 2001 "jack" return and 1.7 times greater than the 10-year average. Expected return of adult salmon to the upper Columbia River in 2003 should be close to 13,200 based on TAC estimates.

2. Summer Chinook

The summer chinook count at Bonneville Dam was 127,436, about 1.7 and 4.8 times greater than the respective 2001 and 10-year average. This year's return of summer chinook salmon was the largest return to the Columbia River basin since the 1950s and resulted in a limited commercial and sports fishery in 2002. The summer chinook count at McNary Dam reduced to 109,937, about 86.3% of the Bonneville Dam count (Note: No juvenile summer chinook from hatchery programs are released in tributaries below McNary Dam; hence no spawning of summer chinook occurs between Bonneville and McNary dams).

About 26,600 adult summer chinook were counted at Ice Harbor Dam with nearly 22,200 passing Lower Granite Dam in 2002. Based on fish counts at Ice Harbor Dam that are recorded from 1962 to present, the 2002 return of adult summer chinook was within the range of summer chinook returning in the 1962-72 era which ranged from about 15,000 to 30,000 per year. The summer chinook count at Lower Granite was about 1.6 times and 4.4 times greater than the respective 2001 and 10-year average. Snake River summer chinook are mainly destined for the South Fork of the Salmon River and its tributaries and the Pahsimeroi River. This year's count of summer chinook "jacks" was 1,953 at Lower Granite Dam, about 50% of the 2001 total, but 1.8

times greater than the 10-year average at the project. The 2003 forecast by TAC is estimated to be 19,300 adult summer chinook for the Snake River.

The Mid-Columbia count of adult summer chinook at Priest Rapids Dam was 96,326, and this total was about 1.8 and 5.2 times greater than the respective 2001 and 10-year average. The passage of summer chinook at Rock Island Dam was 86,825 with 73,104 recorded at Rocky Reach Dam. Summer chinook destined for the Wenatchee River basin comprised about 16% of the Summer Run with the remaining 84% passing upstream of Rocky Reach Dam. Summer chinook can be either trapped at Wells Dam or volitionally enter Wells Hatchery for their hatchery program. The return of "jack" summer chinook was less than 50% of the 2001 returns at the PUD projects and would suggest that the 2-ocean component of the summer run could be reduced; however, the overall run to this Reach should remain fairly strong as TAC is projecting about 68,000 upriver summer chinook will return to the Mid-Columbia.

3. Fall Chinook

The number of adult fall chinook counted at Bonneville Dam was 474,738 with an additional 40,210 jack chinook salmon also counted. The 2002 adult count surpassed the 2001 total and was 2.3 times greater than the 10-year average. In fact, this total surpassed all previous counts of fall chinook at Bonneville Dam back to 1938. The number of adult fall chinook (Bright component) that arrived at McNary Dam was near 141,700 (Figure 39), and exceeded the year 2001, and the 10-year average. Most fall chinook passing McNary Dam are "wild" origin and are destined for the Hanford Reach to spawn. Numbers counted at Rock Island and upstream dams continue to show increases over the past few years as noted when compared to the 10-year average. The Yakima River also supports a Run of upriver bright fall chinook.

Tule fall chinook estimated from the fish counts at Bonneville Dam totaled near 164,000 with 70,959 adult chinook arriving at Spring Creek National Fish Hatchery, located in the Bonneville Dam pool (Figure 40). This component of the fall chinook run was record high and bolstered the overall record fall chinook count at Bonneville Dam. Most tule fall chinook spawn in the Bonneville pool and do not make the lengthy migration journeys of the upriver bright stocks.

The Snake River component of the fall chinook run has been increasing during the past few years as a result of the hatchery and supplementation efforts in the Snake and Clearwater River basins. Greater than 15,000 adult fall chinook were counted past the two lower projects with about 12,400 counted above Lower Granite Dam. These adult returns are about triple the 10-year average at these Snake River projects. The jack chinook count was well below the 2000 and 2001 counts, but was twice the 10-year average.

4. Sockeye Salmon

The number of sockeye salmon returning to Bonneville Dam was less than half the previous year's count with 49,610 counted for the season. Columbia River sockeye are primarily destined for the upper Mid-Columbia River with approximately 28% destined for Lake Osoyoos and 72% destined for Lake Wenatchee in 2002. This ratio of fish returning to each basin was opposite to the previous year, when about 70% were bound for the Osoyoos and 30% for the Wenatchee River basin. This year's return was nearly equal the 10-year average at Rock Island and lower river projects.

Sockeye salmon recovery efforts in the upper Salmon basin continued with captive brood stock, habitat and other enhancement efforts in Red Fish, Alturas, and Pettit Lakes. In 2002, 52 adult sockeye were counted at Lower Granite Dam.

5. Coho Salmon

The combined return of adult and jack count of coho salmon in 2002 was about 95,000, approximately 1/3 the 2002 return, and 1.7 times greater than the 10-year average at Bonneville Dam. Additional juvenile coho have been released into river basins above the Bonneville Pool and future years should result in more fish traveling upstream to spawn. The majority of coho passing Bonneville Dam still "home" into rivers and hatcheries located in the Bonneville pool. About 7,700 adult coho were counted at John Day Dam with most destined for the Umatilla River and the Yakama River. Based on fish counts at Rock Island and Rocky Reach dams, about 1,000 adult/jack coho may have returned to the Wenatchee River with a small number passing Wells project and likely ending in the Methow River. About 200 coho entered the Snake River basin

and are part of on-going efforts to establish coho again in this basin.

6. Steelhead

The count of steelhead at Bonneville Dam totaled 474,036 and exceeded all counts recorded at Bonneville Dam since 1938, except the 2001 total. The count at The Dalles Dam was 387,920, John Day reported 390,300, and McNary Dam at 286,805. Many adult steelhead returning to the Bonneville pool tributaries are Skamania stock fish, either summer or winter run with the Hood River receiving winter and summer run stocks from Oak Springs Hatchery. The Deschutes River in The Dalles pool has a large return of summer run steelhead, both hatchery and wild. The John Day River remains a "Wild" stream with no hatchery releases in that river basin.

The main contributor of steelhead in the Columbia River basin is the Snake River. In 2002, the turnoff into the Snake River was about 210,000 or 71% of the total counted at McNary Dam. The Snake River steelhead count was about double the 10-year average. Adult returns of steelhead to the Snake River are comprised mainly of hatchery-reared fish and support a sport fishery while the "wild" steelhead remain depressed and are listed as "Threatened" under the ESA. Numbers of "wild" steelhead (non-clipped status only) increased to about 55,000 average per project in the Snake River in 2002.

The Mid-Columbia count of steelhead at Priest Rapids Dam was 15,898, about 54% and 156% of the respective 2001 and 10-year average. Of the 15,000 above Rock Island Dam, about 11,800 steelhead were counted at Rocky Reach with 8,900 above Wells Dam. Wild steelhead and Wells stock hatchery steelhead in the upper Mid-Columbia River remain depressed and are listed as "Threatened" under the ESA.

TABLE 52. Adult Salmonid Totals.

Cumulative Adult Passage at Mainstem Dams

	Spring Chinook						Summer Chinook						Fall Chinook					
	2002		2001		10-Yr Avg.		2002		2001		10-Yr Avg.		2002		2001		10-Yr Avg.	
DAM	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack
BON	268,813	6,477	391,367	14,172	104,143	5,654	127,436	7,952	76,156	14,723	26,786	4,828	474,738	40,210	400,410	74,503	202,529	34,700
TDA	181,176	3,870	303,912	9,953	68,558	3,895	113,069	5,743	71,462	10,926	22,478	3,504	245,928	33,369	181,316	51,765	112,396	23,768
JDA	139,887	2,403	264,177	6,208	58,196	3,052	105,354	5,615	64,186	10,049	20,885	3,005	164,920	29,550	124,747	41,620	85,476	18,919
MCN	129,357	3,872	258,689	6,683	54,462	2,970	109,937	6,810	67,914	9,600	21,443	2,927	141,682	25,432	110,517	36,381	72,116	17,551
IHR	85,207	1,826	171,173	3,026	32,988	1,807	26,607	2,437	15,270	2,397	5,356	857	15,248	6,079	13,516	10,170	4,920	3,392
LMN	76,304	1,537	180,787	1,784	32,792	1,811	23,743	1,687	19,287	1,612	5,597	792	15,193	6,185	13,297	8,512	4,059	3,016
LGS	77,232	1,815	174,823	2,990	31,528	1,921	20,854	2,254	15,929	2,803	5,147	995	12,905	4,264	10,550	7,275	2,850	2,071
LWG	75,025	2,132	171,958	3,135	30,329	1,865	22,159	1,953	13,735	3,804	5,072	1,094	12,351	5,727	8,915	8,834	2,406	2,097
PRD	34,083	196	50,379	987	14,082	343	96,326	1,455	53,170	3,207	18,552	1,069	26,819	2,628	24,288	6,559	16,228	2,784
RIS	24,017	827	39,785	1,761	10,698	482	86,825	3,216	48,844	13,086	16,314	3,301	14,524	1,090	13,357	6,294	6,011	2,191
RRH	9,999	161	15,895	543	3,286	112	73,104	2,807	39,174	5,548	9,829	1,369	11,372	1,313	9,072	3,956	4,042	1,418
WEL	7,585	41	9,989	892	1,774	153	62,595	412	33,244	4,882	6,695	1,137	5,883	210	6,928	2,672	1,838	631

	Coho						Sockeye			Steelhead			
	2002		2001		10-Yr Avg.				10-Yr			10-Yr	Wild
DAM	Adult	Jack	Adult	Jack	Adult	Jack	2002	2001	Avg.	2002	2001	Avg.	2002
BON	88,180	6,823	259,756	6,780	52,730	4,094	49,610	114,934	50,283	481,036	633,464	263,055	143,032
TDA	9,765	3,021	62,378	2,179	12,929	1,317	40,554	102,562	40,061	387,920	503,327	192,346	116,565
JDA	7,669	1,603	48,870	2,311	10,408	1,110	41,915	107,869	43,271	390,300	483,409	184,676	112,755
MCN	2,144	1,048	22,918	1,812	5,180	498	39,177	97,188	39,888	286,805	398,784	146,220	81,439
IHR	199	32	1,286	74	216	11	61	38	13	202,173	255,720	111,466	51,308
LMN	138	11	798	159	123	12	45	32	21	212,625	252,907	102,474	55,708
LGS	109	24	490	50	71	0	38	72	24	203,494	232,669	91,918	53,484
LWG	248	149	968	119	184	3	52	36	23	218,716	262,568	100,931	57,289
PRD	1,143	412	10,144	1,045	1,016	73	47,883	111,320	48,768	15,898	29,675	10,169	***
RIS	1,751	0	10,465	0	1,188	0	44,319	104,847	43,423	15,286	28,602	9,165	10,353
RRH	481	0	1,628	0	188	0	12,372	66,222	27,194	11,842	22,027	6,598	7,025
WEL	130	0	609	7	63	0	10,586	74,490	27,057	8,925	18,483	5,095	5,517

Non-clipped steelhead are counted as wild. In 2000 and 2001 about 9 to 11% of the hatchery steelhead released into the Snake and Mid-Columbia River were unclipped.

**PRD is not reporting Wild Steelhead numbers.

These numbers were collected from the COE's Running Sums text files, except where otherwise noted.

Wild steelhead numbers are included in the total.

Historic counts (pre-1996) were obtained from CRITFC and compiled by the FPC.

Historic counts 1997 to present were obtained from the Corps of Engineers.

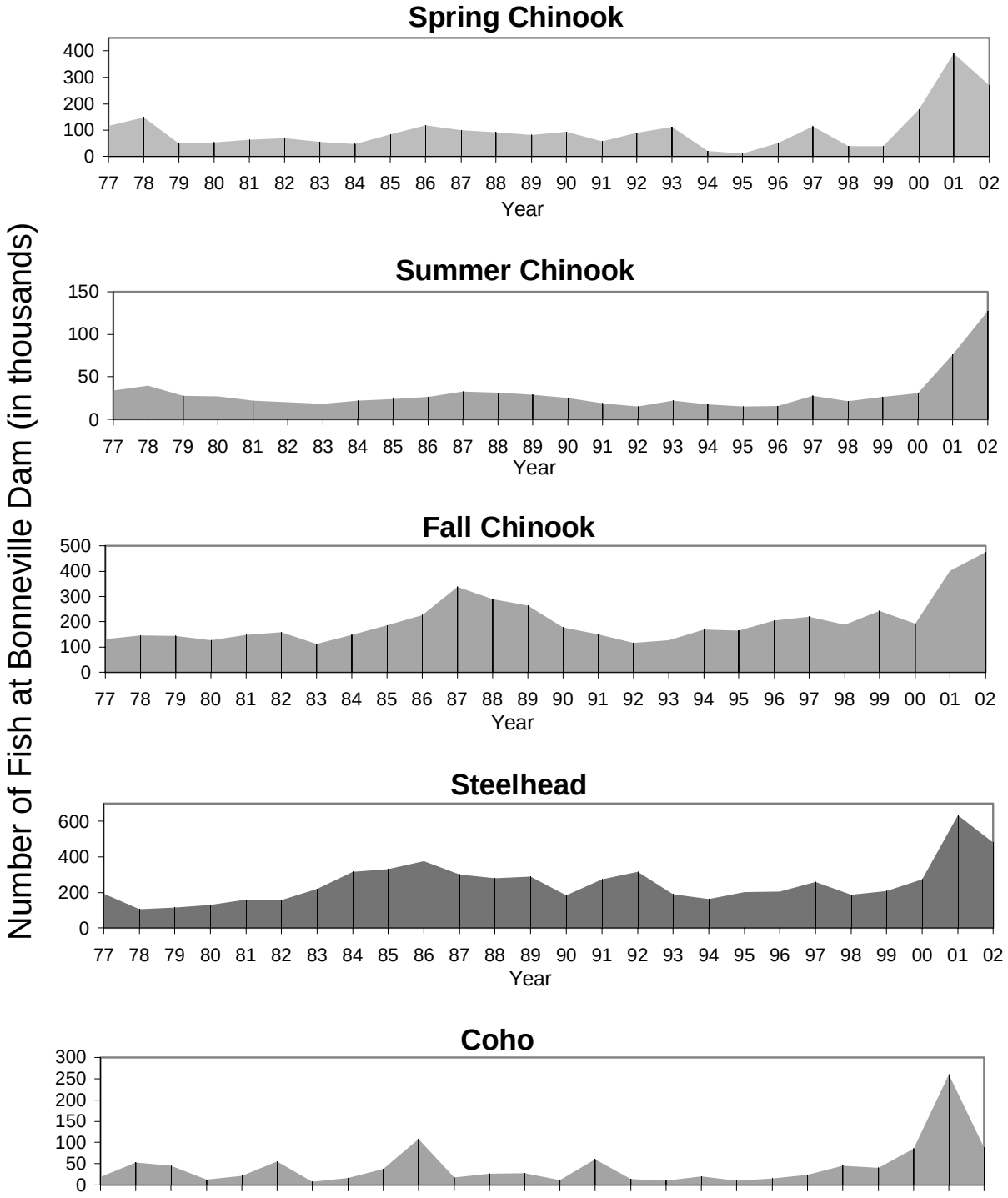

FIGURE 38. Adult Counts at Bonneville Dam, through 2002.

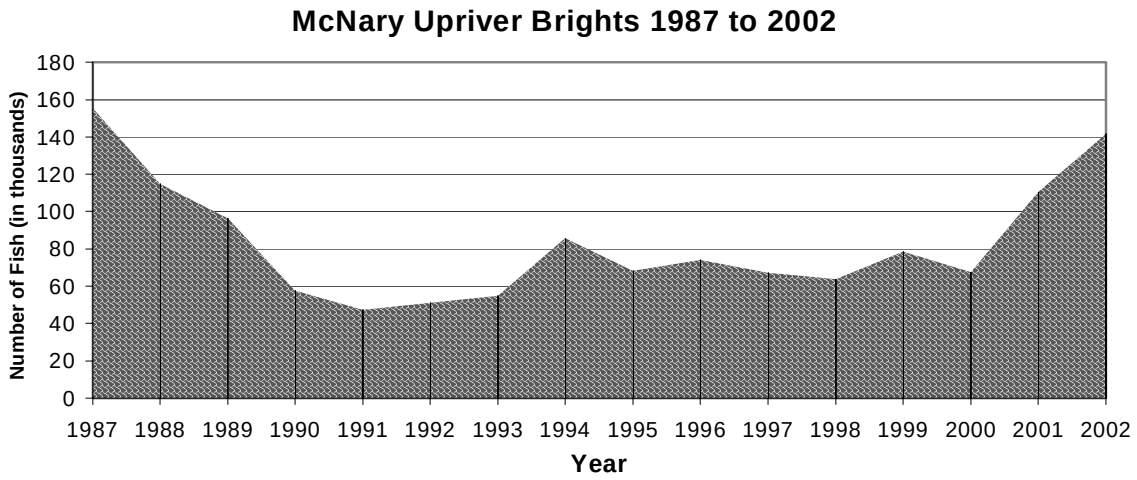

FIGURE 39. Upriver bright Fall Chinook passage at McNary Dam, 1986 to 2002.

Upriver bright Fall Chinook passage at McNary Dam, 1987 to 2002.

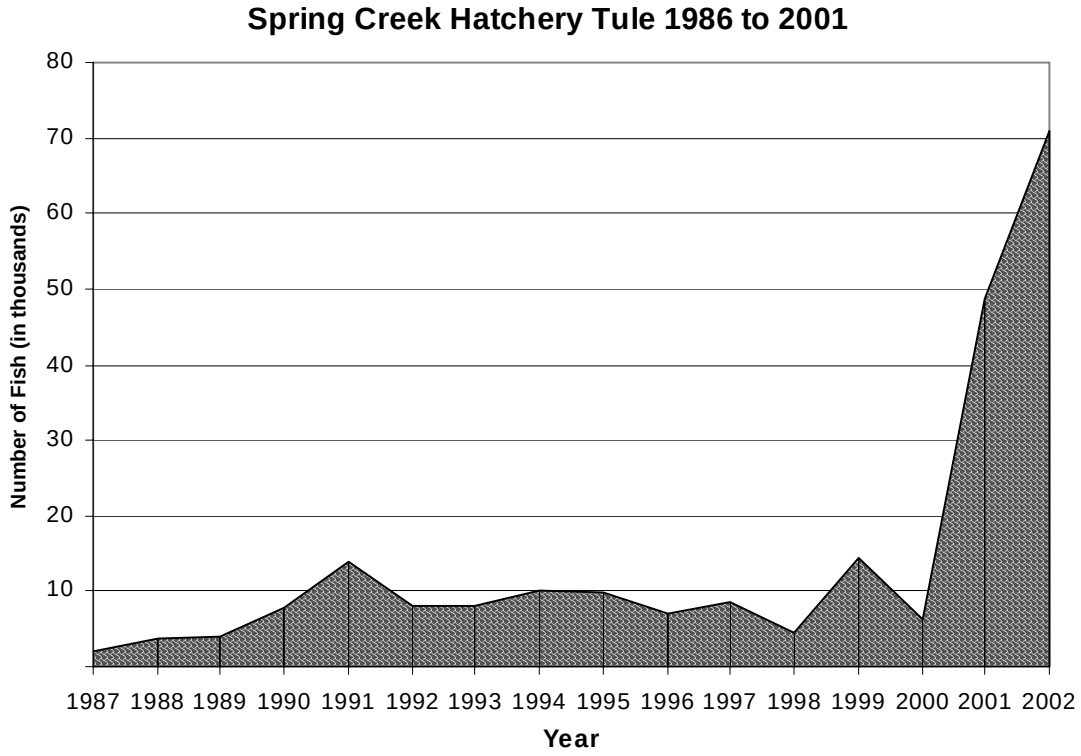

FIGURE 40. Tule Fall Chinook returns to Spring Creek Hatchery, 1986 to 2002.

Tule Fall Chinook returns to Spring Creek Hatchery, 1986 to 2002.

V. 2002 COLUMBIA RIVER BASIN HATCHERY RELEASES

A. Overview

The Fish Passage Center maintains a hatchery database of anadromous salmon species released from State, Federal, and Tribal hatcheries for archived numbers, from 1979 to the present year, 2002. This season the database was upgraded to also facilitate its use for Artificial Production Review and Evaluation (APRE) and Hatchery Genetic Management Plan (HGMP) purposes. Explanation of the new fields/columns can be found in the FPC hatchery meta data section located on the FPC website www.fpc.org. The hatchery data are assimilated and entered into the database in the following manner. The Fish Passage Center receives preliminary hatchery release schedules (annually) prior to the juvenile fish migration and these release schedules are then updated throughout the year until the release numbers are "finalized" by the State, Federal, and Tribal fish agencies. Proposed hatchery releases are generally updated on a weekly basis during the spring and summer season to assure that the Salmon Managers will have accurate information relating to the migration of juvenile fish from Columbia River hatcheries upstream of Bonneville Dam. Hatchery fish released below Bonneville Dam will be updated throughout the season, but normally after the fish are released from the hatchery facilities.

The FPC hatchery release schedules do not include eggs that might be placed in egg boxes or planted in the gravel of Columbia River streams. Fry plants (not fall chinook fry) are included in the release schedules and are normally listed as migrating the following year. Also, fish that fall in the category of "non anadromous" by the fish managers are not included in the FPC hatchery release schedule (an example would be subyearling summer chinook released in Lake Chelan; these fish normally do not migrate from the lake).

In 2002, about 87 million juvenile salmon were released from Federal, State, Tribal or private hatcheries into the Columbia River Basin above Bonneville Dam. Table 53 gives hatchery release totals by river zone; Snake River, Mid-Columbia, and Lower Columbia. The 2002 hatchery release totals were increased nearly 123% from the previous season, when only 71 million were released in the Columbia River basin above Bonneville Dam.

TABLE 53. Summary of Hatchery Releases by Species and Release Area for 2002.

Species	Snake River	Mid-Columbia	Lower Columbia	Total
Spring Chinook	10,066,687	3,915,963	5,748,143	19,870,793
Summer Chinook	1,676,957	3,520,683	0	5,197,640
Fall Chinook "Brights"	3,665,801	10,913,482	7,183,850	26,343,158
Fall Chinook "Tules"	0	0	19,159,308	19,159,308
Coho	1,089,672	1,911,684	6,069,844	9,070,791
Sockeye	184,507	308,042	0	492,549
Steelhead	9,509,463	1,312,693	620,529	11,442,685
TOTAL	26,333,087	21,882,547	38,781,265	86,996,899

The 2002 Hatchery Release Schedule (Appendix H) lists the agency, hatchery, release numbers along with other pertinent data such as mark groups, number per pound, date of release, release site, and river zone. The Year 2002 Release Schedule can be accessed at the FPC Website Home Page under Hatchery Data, and then Query Current and Historic Hatchery Database (1979-2002). Table 54 through Table 56 list the hatchery release totals from 1979 through 2002 for the Snake, Mid-Columbia, and Lower Columbia rivers.

The main factors affecting change in the 2002 hatchery release numbers included:

- The numbers of hatchery spring chinook released in 2002 increased by nearly 8.0 million.
- The tule fall chinook released from Spring Creek National Fish Hatchery totaled 19.2 million, about 4.0 million above normal production for the facility, and about 8.5 million greater than the total released in 2001.
- Coho and steelhead production were similar to previous years relative to release totals.
- Sockeye production was increased slightly from the preceding year, while the combined numbers of hatchery summer chinook in the Snake and Mid-Columbia rivers were slightly decreased from the 2001 total.

B. Lower Columbia River

In the FPC database, the Lower Columbia River is designated as the Reach from above Bonneville Dam to McNary Dam. This Reach accounted for approximately 44.5% of the fish released above Bonneville Dam in 2002, with a grand total of 38.8 million liberated from the different hatcheries. Overall, 68% or 26.3 million of the 38 million hatchery fish released in this River Zone were yearling or subyearling upriver bright fall or subyearling "tule" chinook stocks (Table 54).

About 19.2 million tule fall chinook were released from Spring Creek National Fish Hatchery; this total includes unfed fry released in December 2001 from the hatchery. The Tule fall chinook are present mainly in the Bonneville pool (from Spring Creek Hatchery) and tributaries that flow into the pool. About 7.2 million bright fall chinook were released in the Klickitat, Little White Salmon, and Umatilla rivers, a slight increase from the previous year. Yearling releases continue to comprise a small portion of the total release; most are subyearling fall chinook released during the late spring and early summer time-frame. This year's total of 26.3 million fall chinook fell within the normal range of release totals listed in the FPC database since 1979.

The total number of yearling and subyearling spring chinook released from Lower Columbia River hatcheries was 5.75 million, about equal to the previous three-year release totals. (Table 54). The 2002 spring chinook production in this Reach exceeded release of spring chinook in the Mid-Columbia Reach; however, it was less than 60% of the Snake River release totals. Subyearling spring chinook (598,000) were released in the upper Klickitat River in May 2002 and in the Big White Salmon River in August 2001. Yearling spring chinook (about 5.1 million) were released in the Wind, Klickitat, Little White Salmon, Hood, Umatilla, and Deschutes rivers from the late March to May time frame.

The number of coho salmon released in the lower Columbia Reach during 2002 was about 6.1 million, and was the lowest total released in this Reach since 1986. This total was approximately 500,000 to one million below normal levels. Hatchery reared coho (both Type-S and Type-N) were released in the Klickitat, Little White Salmon, and Umatilla rivers. Hatcheries located below Bonneville Dam continue to supply a large portion of the coho planted in the Klickitat and Umatilla rivers.

Both summer and winter race steelhead are released in this Reach, with 15-Mile Creek (just below The Dalles Dam) being the upper boundary for the winter-run steelhead. The number of steelhead (summer and winter races) released in 2002 was 620,529, and falls within the range recorded in this Reach since 1991 (583k to 689k). Since 1980, steelhead releases have averaged about 630 thousand per year. Winter steelhead releases totaled about 81,000 for the year, similar to the previous three years. Winter steelhead were released in the Hood and Big White Salmon rivers. About 539,000 summer steelhead were stocked in the Klickitat, Hood, Deschutes, and Umatilla rivers. The John Day River remains a "wild" stream with no steelhead or chinook released in that River basin. No hatchery steelhead have been released in the Wind River since 1998. Hatcheries located below Bonneville Dam, Skamania (WDFW), and Oak Springs (ODFW) supplied winter run steelhead and some summer run steelhead released in this Reach.

TABLE 54. Lower Columbia Hatchery releases, 1979-2002.

Year	Spring Chinook	Summer Chinook	Fall Chinook	Steelhead	Coho	Sockeye	Totals
1979	3,491,500	110,500	40,975,000	456,500	3,288,000	0	48,321,500
1980	5,806,000	0	31,896,000	819,000	5,495,500	0	44,016,500
1981	6,066,500	0	35,936,500	609,500	4,391,500	0	47,004,000
1982	4,692,500	0	28,093,500	746,000	4,412,500	0	37,944,500
1983	6,003,500	0	34,141,500	631,000	4,912,500	0	45,688,500
1984	6,529,645	0	24,256,048	777,125	4,984,334	0	36,547,152
1985	6,344,905	0	20,804,201	744,290	2,162,846	0	30,056,242
1986	7,234,772	0	19,245,721	588,905	6,736,127	64,384	33,869,909
1987	6,099,130	0	18,149,291	404,000	9,292,000	0	34,002,428
1988	7,628,500	0	20,147,500	447,000	8,690,000	0	36,913,000
1989	8,891,430	0	24,805,762	555,526	8,451,762	0	42,709,616
1990	11,977,052	0	19,347,320	513,171	8,579,511	0	40,417,054
1991	9,046,069	0	27,266,266	583,156	8,467,969	0	45,363,460
1992	8,503,011	0	33,013,100	671,066	6,405,391	0	48,592,568
1993	7,435,146	0	30,927,448	689,196	8,954,465	0	48,006,255
1994	8,204,213	0	27,950,458	652,320	6,299,002	0	43,105,993
1995	6,939,030	0	24,858,274	587,171	6,712,604	0	39,097,079
1996	4,766,136	0	26,442,513	676,167	8,021,423	0	39,906,239
1997	4,093,528	0	23,233,638	688,909	6,763,470	0	34,779,545
1998	8,191,856	0	31,805,034	681,591	7,254,648	0	47,933,129
1999	5,488,404	0	19,322,806	621,079	7,186,404	0	32,618,693
2000	5,320,322	0	28,615,317	635,308	8,021,720	0	42,592,667
2001	5,853,807	0	17,405,628	603,293	6,762,367	0	30,625,095
2002	5,748,143	0	26,343,158	620,529	6,069,435	0	38,781,265

C. Mid-Columbia River

The Mid-Columbia Reach or Zone encompasses the area from above McNary Dam to Chief Joseph Dam. In 2002, approximately 22.1 million juvenile salmonids were released, about 1 million fewer than the previous year and similar to the 1998 and 2000 totals (Table 55). Hatchery releases of juvenile chinook, sockeye, coho, and steelhead in this Reach have been relatively stable since 1994 and numbers of juvenile salmon released are expected to increase only slightly in the next few years. The release of juvenile hatchery summer chinook and coho salmon remained in the upper range of release totals during the past two seasons.

Production releases of juvenile fall chinook (up-river bright stock) totaled 10.9 million, about 1 million less than numbers reported during the past 5 years where totals ranged between 11.9 and 12.4 million released per year. Subyearling fall chinook were released from Priest Rapids Hatchery (6.8 million) with the remainder released in the Yakima River basin and in the main Columbia River from Ringold Hatchery. No yearling fall chinook were released in this Reach in 2002. Hatchery fall chinook comprised about 49.5% of the total fish released in this Zone.

About 3.5 million summer chinook salmon were released from hatcheries, acclimation ponds or into Mid-Columbia streams and tributaries located above Rock Island Dam. Most summer chinook are reared in the hatcheries until yearling age (about 18 months) and released during the spring. The subyearling releases (about 1.1 million) were released in June/July and normally migrated through the Mid and Lower Columbia rivers in June, July and August. Summer chinook were released in the Wenatchee, Similkameen, and Methow rivers, and the mainstem Columbia River from Wells and Turtle Rock hatcheries. From 1979 through 1994, releases averaged about 2.1-million summer chinook per year. From 1995 to present, releases have increased and now range between 2.8 and 4.3 million per year.

Mid-Columbia hatcheries released about 3.9 million yearling spring chinook this year, an increase of about 650,000 from 2001 and almost equal to the 2000 release total. Most hatcheries were beginning to reach closer to their production levels in 2002. As mentioned in a previous report, production of spring chinook at Ringold State Hatchery was terminated in 2001. All returning adult fish to Ringold Hatchery were transported for release into the S. Fork Walla Walla River or other designated sites again this season. Yearling spring chinook were released in the Methow, Entiat, and Wenatchee rivers and tributaries with approximately ½ million released from

acclimation facilities in the Yakima River basin (Easton Pond, Jack Creek and Clark Flat). Hatchery releases of spring chinook averaged about 4.8 million from 1980 to 2000. Release totals have been reduced since 1993 with only two of the nine years up to the 4.8 million average. Hatchery spring chinook releases should increase slightly over the next few years, but may not maintain the higher levels of previous years.

Coho salmon production released from acclimation ponds and hatcheries was about 1.9 million (about equal to 2001) for the Mid-Columbia Reach with 730,000 released in the Yakima River Basin and 1.0 million and 0.2 million released in the Wenatchee and Methow rivers, respectively. All coho released in this Reach were transferred from hatcheries below Bonneville Dam or from Willard Hatchery (Bonneville Pool) to acclimation pond(s) or hatchery and held until liberated from the rearing pond or raceway. All coho released in the Mid-Columbia are part of the Yakama Tribal Program to reestablish coho runs in the Yakima, Methow, and Wenatchee river basins.

For the Mid-Columbia Reach, 308,042 yearling sockeye salmon were released for the 2002 Migration Season. About 190,000 yearling sockeye from the net pens located in Lake Wenatchee and 118,000 sockeye from the Okanogan River basins were released from August to November 2001 with the majority of these fish expected to migrate from the lakes in spring of 2002. The Wenatchee sockeye were 100% ad clipped with Coded Wire Tags (CWTs) while the Osoyoos stock sockeye were 100% LV clipped with no CWTs. Hatchery production of both stocks was increased for the 2002 migration. The Osoyoos Program was terminated after this release of sockeye (fall, 2001).

Since 1992, hatchery production of juvenile steelhead has averaged about 1.4 million per year in this Reach with 2002 releases at 1.3 million. About 271,000 juvenile steelhead were released in the Walla Walla River basin with the remainder in the Okanogan, Methow, Entiat, and Wenatchee rivers and tributaries as well as the mainstem release from Ringold Hatchery. As noted in previous years, hatchery steelhead (Wells stock) are listed as Threatened under the ESA. Hatchery steelhead have not been released in the Yakima River for many years. Hatchery steelhead production has been very stable in this Reach throughout the past 20 years.

TABLE 55. Mid-Columbia Hatchery releases, 1979-2002.

Year	Spring Chinook	Summer Chinook	Fall Chinook	Steelhead	Coho	Sockeye	Totals
1979	3,509,000	2,501,000	826,500	592,500	640,000	0	8,069,000
1980	4,788,000	2,638,000	3,327,500	873,000	1,206,500	0	12,833,000
1981	5,161,000	2,271,500	5,115,500	985,000	1,089,500	0	14,622,500
1982	5,186,500	3,010,500	6,297,500	1,263,500	482,500	0	16,240,500
1983	4,369,000	1,609,000	10,276,500	1,471,500	536,000	0	18,262,000
1984	6,492,744	1,240,865	15,548,324	1,587,329	517,100	0	25,386,362
1985	4,796,554	1,630,322	10,789,141	1,345,923	389,005	64,031	19,016,813
1986	4,651,848	1,992,057	10,402,956	1,504,450	556,017	64,926	19,259,428
1987	4,585,223	1,413,000	8,606,441	1,748,868	911,500	25,000	17,308,132
1988	6,034,795	2,144,500	9,769,500	2,167,000	1,329,500	47,500	21,492,795
1989	4,565,017	2,597,099	7,571,364	1,810,287	1,084,753	107,299	17,735,819
1990	8,800,002	1,912,708	9,339,478	1,822,491	1,118,138	91,999	23,084,816
1991	6,455,727	2,258,293	7,195,765	1,913,905	1,126,683	616,038	19,566,411
1992	5,250,389	2,551,616	7,216,100	1,382,511	1,246,195	112,205	17,759,016
1993	4,305,286	1,800,199	8,862,582	1,368,682	1,167,694	354,595	17,859,038
1994	3,803,697	2,097,319	14,162,311	1,440,117	857,783	428,200	22,789,427
1995	5,076,896	2,760,748	14,399,490	1,414,719	666,862	40,963	24,359,678
1996	3,243,054	3,889,547	12,422,257	1,411,096	1,680,209	150,000	22,796,163
1997	1,328,576	3,403,136	12,407,097	1,420,394	1,124,821	339,158	20,023,182
1998	3,328,869	3,537,781	11,924,206	1,472,296	1,739,476	365,784	22,368,412
1999	4,956,745	2,977,364	11,870,800	1,726,741	1,486,500	210,591	23,228,741
2000	3,939,920	2,853,950	12,293,934	1,396,898	1,662,994	142,901	22,290,597
2001	3,258,547	4,324,169	11,976,344	1,291,813	2,151,318	241,216	23,243,407
2002	3,915,963	3,520,683	10,913,482	1,312,693	1,911,684	308,042	21,882,547

D. Snake River

The total release of salmon species in the Snake River basin was 26,333,087 for the 2002 migration season, about 9.2 million more than the preceding year (Table 56). Basically, the increase in production of spring chinook released in this Zone during the fall of 2001 and spring 2002 resulted in an additional 7.4 million spring chinook released from IDFG, ODFW, USFWS, and WDFW hatcheries. Spring and summer chinook salmon continue to rebuild after the low production in 1996 and 1997.

The 2002 production release of hatchery spring chinook in the Snake River basin totaled about 10.2 million, the highest total on the FPC database since 1990. Yearling spring chinook were released in the Snake (Hells Canyon area) Clearwater, Grande Ronde, Salmon, Tucannon,

and Imnaha River basins from hatcheries or acclimation ponds during the spring season. Most spring/summer chinook were adipose or ventral fin clipped; however, not all hatchery fish were marked in 2002. A portion of the hatchery production of spring chinook from IDFG, ODFW and WDFW hatcheries remain classified as "listed" under the ESA. Captive brood stock releases of juvenile salmon are now occurring at some of these hatcheries. Some of the low cycles of juvenile spring chinook production will continue to be filled in and more stable hatchery production can be maintained in future years.

About 1.68 million juvenile summer chinook were released from McCall and Pahsimeroi hatcheries in 2002, and this year's release total will rank 2nd highest since 1990. The summer chinook did not have the precipitous decline that was noted in the spring chinook production and hatchery production should begin leveling off at these summer chinook facilities. A portion of the hatchery summer chinook from McCall Hatchery is listed as Threatened under the ESA. Yearling-age summer chinook from McCall Hatchery are annually trucked to and released at Knox Bridge located on the South Fork Salmon River. Supplemental releases of summer chinook were also completed from the Stolle Meadow Pond and where possible to Johnson Creek during the past few years.

Hatchery production releases of Snake River fall chinook were up to 3.7 million, the 2nd highest total recorded in the FPC database. The trend has definitely been heading in a positive direction since 1998. About 912,000 yearling chinook were released from Lyons Ferry Hatchery and acclimation facilities at Pittsburg Landing and CPT Johns Landing on the Snake River and Big Canyon Creek on the Clearwater River. Subyearling fall chinook were released from CPT Johns Landing, Big Canyon Creek and Pittsburg Landing acclimation facilities. Yearling releases were completed in April with the subyearling chinook released in late May and June. A portion of the subyearling chinook released from the acclimation sites was unmarked. Distinguishing "Hatchery from Wild" chinook was not possible as juvenile migrants, and will continue to be difficult to ascertain when these fish return as adults in future years. IDFG began a hatchery program that will require release of subyearling fall chinook in the Hells Canyon area from 2002 and future years.

Production releases of yearling sockeye into Red Fish, Alturas, and Pettit lakes and Red Fish Lake Creek totaled 184,507, about twice the 2001 release total. Releases occurred during the fall (2001) and a small number in spring 2002. All sockeye were 100% marked with adipose fin clips and a small number of the fish were PIT tagged. Efforts continue to allow adult sockeye to

establish a natural spawning base in the Lake system to complement the hatchery-reared fish released as juvenile migrants each year.

More than one million yearling coho salmon were released into the Clearwater River basin in 2002. This year's release total was the record high total since hatchery production fish were released in 1998. The reintroduction of coho into the Snake River Basin will continue through upcoming years. Most production releases have been unmarked, i.e., released without fin clips. Adult coho salmon are now returning to these natal upstream sites and spawning.

Juvenile hatchery steelhead released in the Snake River basin totaled 9.5 million in 2002. From 1981 to present, steelhead production has ranged between 8.1 to 12.1 million with the 2002 release groups residing within this range. About 36% of the anadromous salmonids released from Snake River basin hatcheries were steelhead. B-Run steelhead were released in the Clearwater River basin as well as selected areas in the Salmon River Basin. A-Run steelhead were released in the Salmon, Grande Ronde, Imnaha, Snake River (below Hells Canyon) and Tucannon River basins, and other tributaries of or from Lyons Ferry Hatchery on the Snake River. Most steelhead are released during the spring, late March through late-May and migrate through the River in April and May with the later fish migrating in June.

TABLE 56. Snake River Hatchery Releases, 1979-2002.

Year	Spring Chinook	Summer Chinook	Fall Chinook	Steelhead	Coho	Sockeye	Totals
1979	5,641,235	236,500	0	4,064,000	0	0	9,941,735
1980	6,113,500	0	0	6,328,000	0	0	12,441,500
1981	5,767,807	249,500	0	8,602,500	0	0	14,619,807
1982	3,068,233	264,000	0	8,687,500	209,500	0	12,229,233
1983	5,393,623	198,500	79,000	8,921,500	0	0	14,592,623
1984	7,076,708	356,673	427,191	10,802,035	0	0	18,662,607
1985	8,084,943	781,405	1,317,921	9,419,904	0	210,000	19,814,173
1986	6,314,421	982,443	2,271,520	8,085,953	0	0	17,671,075
1987	10,743,364	1,217,000	1,060,500	8,242,200	0	0	21,601,064
1988	11,230,300	1,777,500	4,981,000	11,726,776	0	0	29,715,576
1989	10,446,274	1,991,300	2,153,882	9,146,283	0	0	23,737,739
1990	13,306,749	2,882,400	3,480,110	11,149,502	0	0	30,818,761
1991	8,908,172	936,100	224,660	12,068,104	0	0	22,137,036
1992	8,178,071	1,507,400	689,601	9,510,474	0	0	19,885,546
1993	4,046,446	982,300	966,793	10,302,377	0	0	16,297,916
1994	6,752,805	1,190,673	603,661	9,600,381	0	0	18,147,520
1995	8,557,388	2,095,143	374,882	10,109,372	0	30,973	21,167,758
1996	1,541,127	676,894	630,612	10,461,986	0	157,095	13,467,714
1997	477,929	360,603	1,137,678	9,959,153	0	1,926	11,937,289
1998	3,176,804	577,618	842,007	9,209,992	695,716	263,307	14,765,444
1999	9,310,024	1,574,369	1,834,739	9,840,622	788,358	151,899	23,500,011
2000	5,968,537	1,172,717	3,234,767	9,775,735	797,474	40,419	20,989,649
2001	2,801,460	1,343,943	2,536,218	9,796,039	597,192	86,017	17,160,869
2002	10,206,687	1,676,957	3,665,801	9,509,463	1,089,672	184,507	26,333,087

APPENDIX A

Memorandums

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MEMORANDUM

TO: Michele DeHart

FROM: David A. Benner

DATE: September 16, 2002

RE: **Updated Version: Spring/Summer Reservoir Operations**

Water year 2002 was approximately normal in terms of runoff volume (97% of normal above The Dalles, January-July). However, in spite of near normal runoff volumes, relatively low spring and summer flows occurred on both a weekly and seasonal basis. The Biological Opinion flow objectives were met only periodically during the spring and summer flow objective periods.

Spring Flows

Based upon the April 2002 final water supply forecasts, flow objectives were 97 kcfs at Lower Granite between 4/3/02 and 6/20/02, 246 kcfs at McNary between 4/10/02 and 6/30/02, and 135 kcfs at Priest Rapids from 4/10/02 and 6/30/02. Table 1 displays average weekly flows at Lower Granite, McNary, and Priest Rapids over the spring BiOp period. Several points are important to note concerning Table 1 and the 2002 Spring BiOp flow objectives.

- Nine of eleven weeklong periods contained flows at Lower Granite below the 2002 Spring BiOp Flow Objective.
- The average seasonal (4-3 to 6-20) flow at Lower Granite was 83.4 Kcfs, 13.6 Kcfs below the 97 Kcfs objective.

- Five of twelve weeklong periods contained flows less than the Spring BiOp Flow Objective at McNary.
- The average seasonal (4-10 to 6-30) flow at McNary was 269.3 Kcfs, 23.3 Kcfs above the 246 Spring BiOp flow objective.
- Only one of 12 week long periods at Priest Rapids contained flows less than the Spring BiOp Objective of 135 Kcfs.

From Table 1, it is clear that both Lower Granite and McNary struggled to achieve BiOp flow objectives between April 24th and May 21st of 2002. Between 4/24/02 and 5/21/02, Lower Granite and McNary weekly average flows were between 0.7 and 41.2 Kcfs below the BiOp flow objectives. During this low flow period, TMT meetings focused on liberating extra water from storage reservoirs to supplement river flows; however, operators were reluctant and delayed decision making until the freshet had started. This low flow period occurred at an important phase for spring migrants.

Table 1. 2002 weekly average flows at Lower Granite, McNary, and Priest Rapids in comparison to the Spring Biological Opinion Flow Objectives. Weeklong periods that did not meet the BiOp Objectives are italicized and bolded.

Week WY 2002	***Lower Granite*** Weekly Average Flow (Flow Obj. = 97 Kcfs)	***McNary*** Weekly Average Flow (Flow Obj. = 246 Kcfs)	***Priest Rapids*** Weekly Average Flow (Flow Obj. = 135 Kcfs)
4-3 to 4-9	***64.4***	N/A	N/A
4-10 to 4-16	***89.6***	***214.0***	***123.6***
4-17 to 4-23	***80.8***	286.0	196.4
4-24 to 4-30	***60.9***	***223.5***	154.9
5-1 to 5-7	***73.4***	***223.0***	149.8
5-8 to 5-14	***60.8***	***204.8***	144.8
5-15 to 5-21	***79.5***	***221.6***	138.6
5-22 to 5-28	***96.3***	260.8	160.1
5-29 to 6-4	128.0	318.4	188.3
6-5 to 6-11	98.3	347.5	243.4
6-12 to 6-18	**82.6**	298.7	213.6
6-19 to 6-25	N/A	325.9	230.2
6-26 to 6-30	N/A	322.7	239.9
Seasonal Total	***83.4***	**269.3**	**180.6**

Spring Reservoir Operation

Reservoirs were generally over drafted in the winter/early spring months. Figures 1 through 5 display operations at each of five major storage reservoirs within the Columbia Hydrosystem: Grand Coulee, Dworshak, Brownlee, Hungry Horse, and Libby. At all locations, with the exceptions of Dworshak and Libby, reservoirs were drafted significantly below their winter/spring flood control elevations, requiring them to refill to attempt to meet the April 10th Biological Opinion target. If the reservoirs had been operated to the winter/spring Flood Control Elevations (FCE), rather than drafted below the FCE, they would have had to draft or slightly refill to their respective April 10th targets. As observed previously, over drafting reservoirs in the winter/early spring make it increasingly difficult to meet the April 10th BiOp elevations and results in lower early season flows.

The 2000 NMFS Biological Opinion, 9.6.1.2.1. Action 14 (Page 9-55), directly states:

> " The Flow-management program uses three strategies:
>
> •Limit the winter/spring drawdown of storage reservoirs to *increase* spring flows and the probability of reservoir refill.
>
> … Before the 1995 Biological Opinion, FCRPS storage reservoirs routinely drafted well below these levels (flood control) to maximize hydropower generation during the fall and winter. Meeting the spring flow objectives occasionally requires reservoir drafting, but the *spring flow objectives are primarily met by limiting winter drafting and refill rates*. This operation allows for a more natural spring hydrograph by passing spring runoff through storage reservoirs."

According to the BiOp, the over drafting of reservoirs in the winter/spring directly influences the likelihood of meeting April 10th target, possibly limiting the ability to meet the flow objectives. Therefore, extreme over drafting in the winter/early spring contradicts the intent of the Biological Opinion.

GRAND COULEE

Figure 1 displays operations at Grand Coulee, the largest of the storage reservoirs within the Columbia Hydrosystem (5,185,500 acre-feet of active storage), over the first one-half of 2002. Grand Coulee was drafted heavily over the winter months of 2002, when the demand for electricity was high. During the winter months, Grand Coulee was drafted over 30 feet below its flood control elevations (Figure 1). By the middle portion of March, Grand Coulee had dropped nearly

thirty feet to 1255.0 feet AMSL, and subsequently had to refill to meet the April 10th Biological Opinion target. After meeting the BiOp target, Grand Coulee immediately began drafting water to meet flood control targets.

In 2002, the Bureau of Reclamation (BOR) was reluctant to draft Grand Coulee below 1240 feet AMSL, despite the fact that river flows were well below the Biological Opinion objectives. In general, reservoirs met their end of April flood control targets and there was reluctance to draft further; however, earlier in the winter/spring operators had routinely drafted *well* below the flood control elevations. In 2002, the spring freshet was delayed (due to temperature) and the river was dependent on the storage reservoirs to release water to meet the BiOp flow objectives.

From the operation of Grand Coulee over 2002, several issues are important for discussion. First off, according to 9.6.1.2.1 Action 14 (Page 9-55) of the NMFS 2000 Biological Opinion:

> The Action Agencies shall operate FCRPS dams and reservoirs with the intent of meeting the flow objectives on both a *seasonal* and *weekly* average basis for the benefit of migrating juvenile salmon.

Currently, the Columbia is operated to meet flow objectives on a seasonal basis, but not a weekly basis. If flow objectives are provided on a seasonal basis, operators may delay augmentation until the freshet begins resulting in weeks that have flows well below flow objectives.

Furthermore, the BiOp states that the reservoirs should limit draft in the winter/spring. Grand Coulee drafted *significantly b*elow its flood control targets during the winter/spring before April 10th. On the other hand, the BOR would not draft to provide BiOp flow objectives.

Additionally, BOR stated that they could not draft below 1240 feet AMSL during the low flow period before the onset of the freshet. It should be pointed out that Grand Coulee has regularly drafted below 1240 feet AMSL over the same period in past years for flood control and power production purposes.

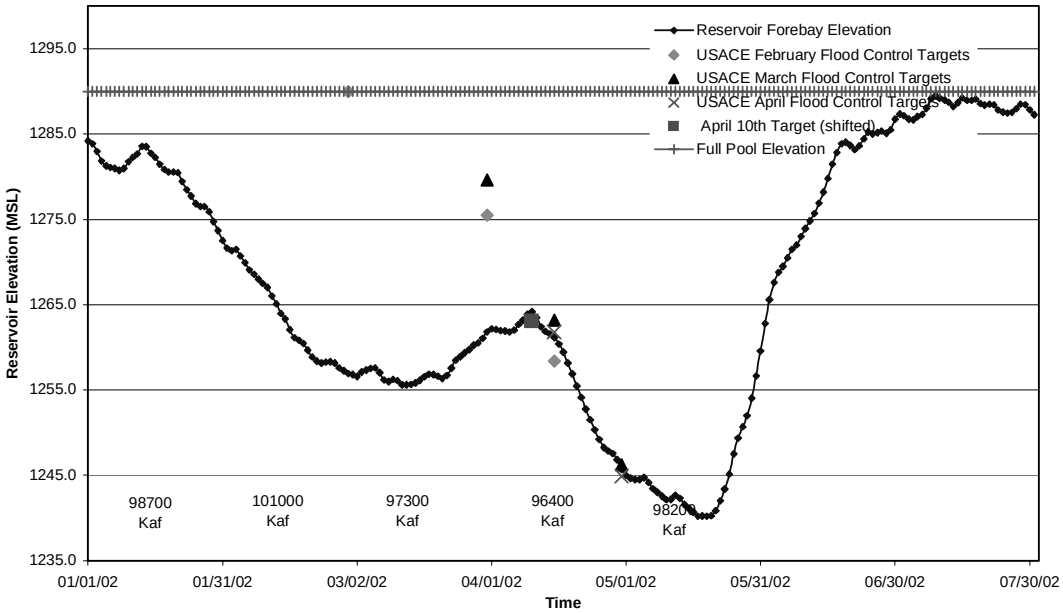

Figure 1. Reservoir operations at Grand Coulee over the first one-half of 2002. Final January-July Water Supply Forecasts at The Dalles for each month are along the bottom of the graph.

DWORSHAK

Figure 2 displays the operation of the Dworshak reservoir (useable storage = 2,015,000 acre-feet) over the first one-half of 2002. For most of the year, Dworshak was operated above the FCE, as a result of a shift that traded some flood control space with Grand Coulee. During the spring of 2002, Dworshak was used to supplement flows during the low flow period before the onset of the freshet. At the time, COE was concerned that releasing water to supplement flows would negatively impact the probability of refill by June 30th. However, calculations performed by COE demonstrated that a significant volume of water was available for flow augmentation with Dworshak still having a 70% chance of refill. TMT calls were confused with various water supply forecasts during the decision making process. A standard water supply forecast (i.e., 70% probability) and method would eliminate some of the confusion. As it turned out, Dworshak was less than one foot from full by June 20, 2002 (Figure 2).

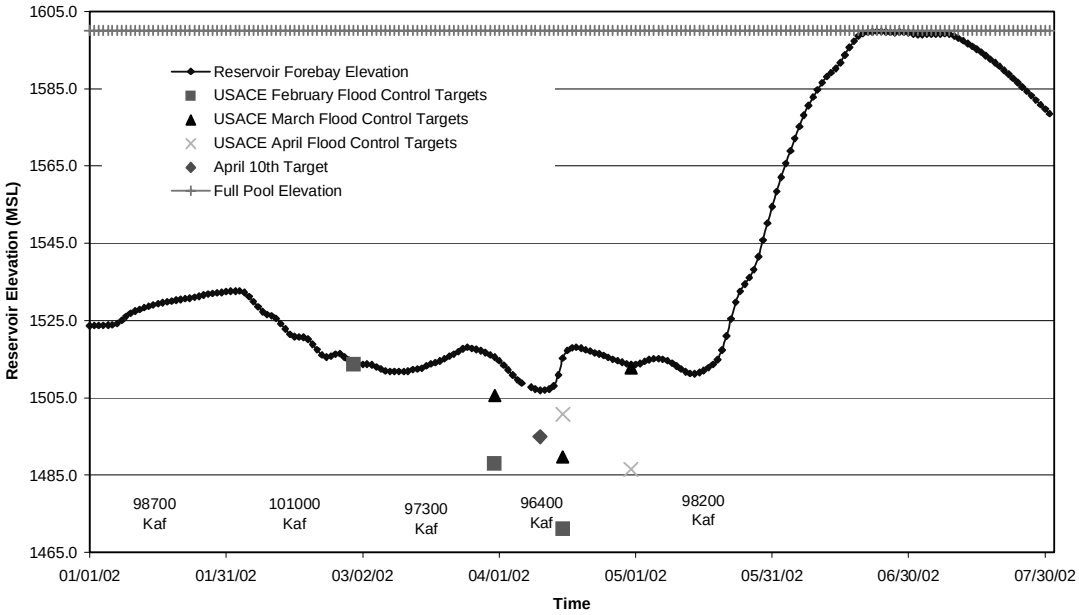

Figure 2. Reservoir operations at Dworshak over the first one-half of 2002. Final January-July Water Supply Forecasts at The Dalles for each month are along the bottom of the graph.

BROWNLEE

Figure 3 displays the operation of the Brownlee reservoir from the start of 2002. Brownlee was drafted nearly ten feet below February and March flood control elevations. Brownlee began refilling around the beginning of April and essentially was within one foot of full by mid/late May. As mentioned earlier, the low flow period along the Columbia River that occurred before the onset of the spring freshet took place predominantly between 4-24-02 and 5-21-02. During this period, System Operation Requests (SORs) were submitted (2002-03 and 2002-04) that requested Brownlee reduce its rate of refill and pass inflow at a time when water was needed to meet BiOp Flow Objectives in the hydrosystem. In a letter addressed to the Technical Management Team (TMT), IPC requested that TMT reject the SOR. Coincidentally, Brownlee began releasing more water at approximately the same time as the beginning of the spring freshet. Brownlee remained within one and half feet of full from 4/29/02 to 7/3/02.

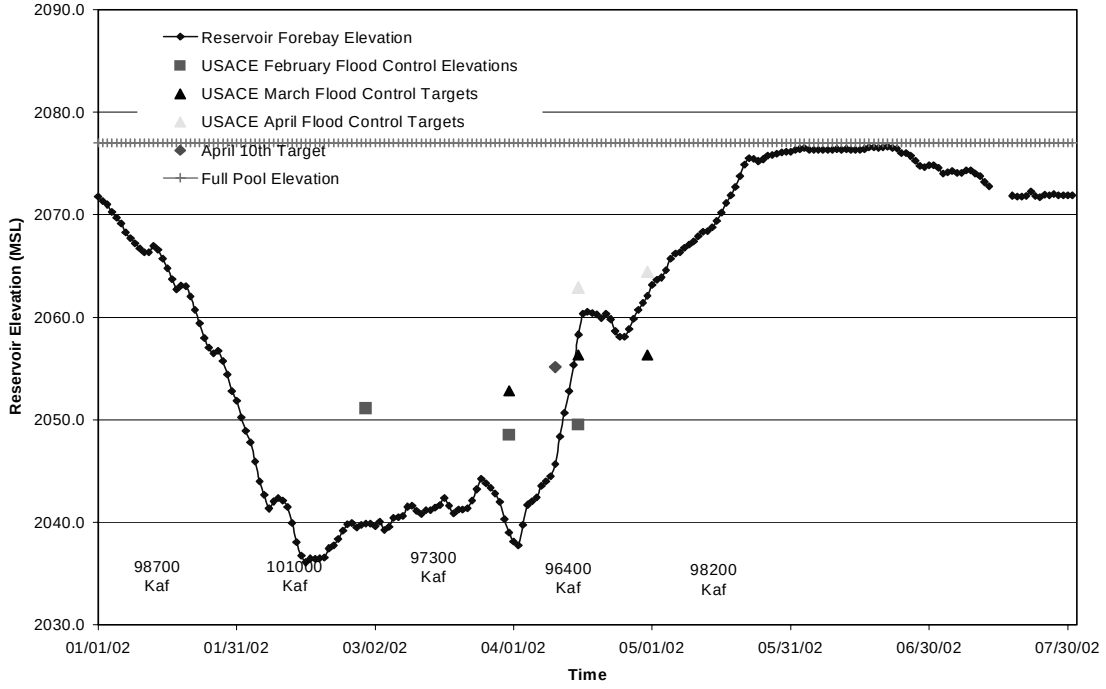

Figure 3. Reservoir operations at Brownlee over the first one-half of 2002. Final January-July Water Supply Forecasts at The Dalles for each month are along the bottom of the graph.

Actions by the operators of the Brownlee reservoir did not fulfill the flow management objectives outlined in the Biological Opinion (see 9.6.1.2.1 Action 14, page 9-55). Brownlee was removing water from the system during the BiOp flow period, when the objectives were not being met. If Brownlee had passed inflows, flows would have been closer to meeting the BiOp objectives. Instead, Brownlee was either refilling or full during the entire spring migration period.

HUNGRY HORSE

Figure 4 displays operations at the Hungry Horse storage reservoir (active storage = 3,161,000 acre-feet) over the first one-half of 2002. Hungry Horse was drafted heavily over the winter months of 2002, when the demand for electricity was high. During this period, Hungry Horse was drafted more than 25 feet below its flood control elevations (Figure 4). By April 10th, the Hungry Horse Reservoir was at an elevation of approximately 3509 feet AMSL, over 20 feet below its Biological Opinion Target. The over draft of the Hungry Horse reservoir contradicted the intent of the Biological Opinion (it should be pointed out that the over draft of Hungry Horse may have been partially needed to meet the Columbia Falls Minimum flows).

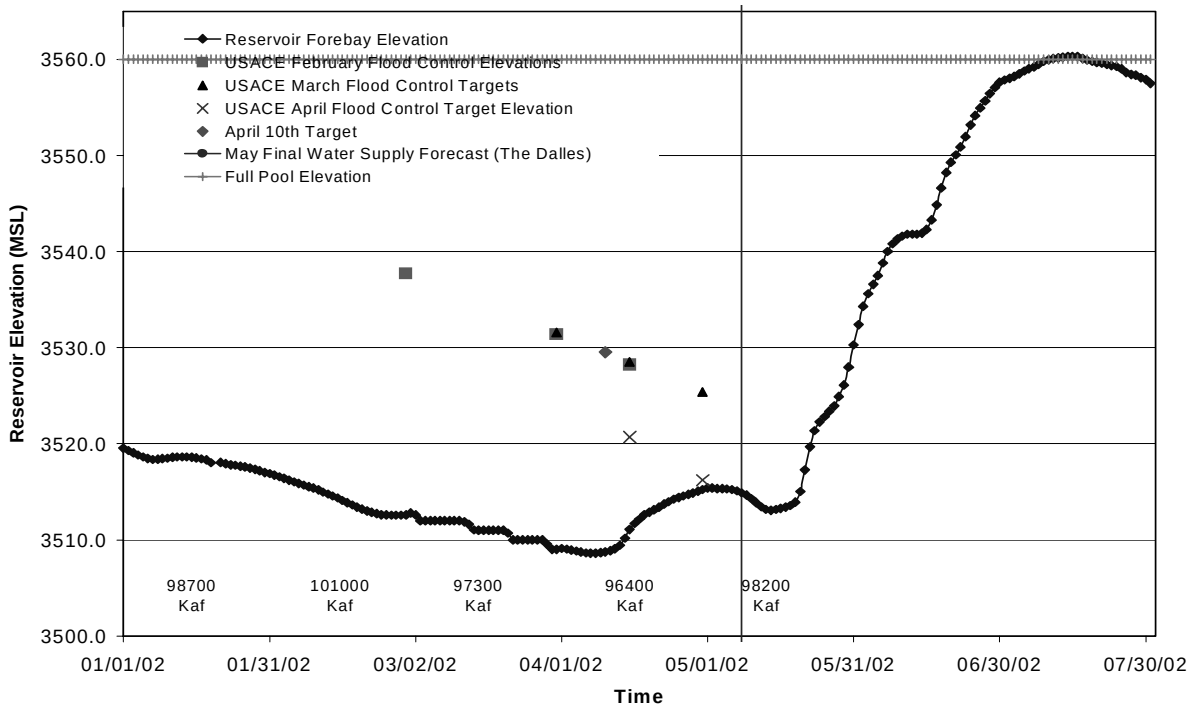

Figure 4. Reservoir operations at Hungry Horse over the first one-half of 2002. Final January-July Water Supply Forecasts at The Dalles for each month are along the bottom of the graph.

LIBBY

Figure 5 displays operations at the Libby storage reservoir (useable storage = 4,979,500 acre-feet) over the first one-half of 2002. Libby was drafted in accordance with its flood control elevations over the winter months of 2002. At the Technical Management Team (TMT) meeting held on 2-27-02, the USACE presented February 2002 QADJ modeling results that predicted the probability of several reservoirs refilling by June 30th, as suggested in the BiOp. The results showed Libby to have a 7% chance of refilling by June 30th of 2002. Later into the spring, at the March 27, 2002 TMT Meeting the COE released documents that again indicated, "…it is unlikely Libby will refill by the end of July…" Early spring flows in the Columbia River would have benefited largely from flow augmentation releases from Libby. Instead, Libby was operated conservatively. In response to Libby refill outlooks, Jim Litchfield, representing the State of Montana, stated at the 3-27-02 TMT Meeting "I would suggest that we keep a very close eye on the Libby operation, and do everything we can to get Libby as full as possible." The Libby reservoir was with in less than three feet of full by June 30th, 2002 and would have easily filled if extremely high inflows over the last portion of June did not force the COE to leave flood space in the reservoir. During the high flow event, the COE were involuntarily forced to spill water at Libby, leading to relatively high levels of TDG. In retrospect, if Libby water were used to supplement flows in the early spring of 2002, extra room in the reservoir would have been available for flood control purposes.

This would have led to higher overall spring flows and less (if any) involuntary spill in the late spring/early summer.

From Figure 5, it is apparent that the Water Supply Forecast (WSF) above Libby increased dramatically, as flood control elevations dropped approximately 15 feet between the March 31st and April 15th, 2002. If an April 10th Biological Opinion target were interpolated between the mentioned flood control elevations, it would have been approximately 2359.9 feet. On the 10th of April, 2002 the Libby reservoir was at an elevation of 2370.7 feet, approximately 11 feet above the April 10th BiOp target. If the COE would have operated Libby to its April flood control targets, more water would have been available for fish and water would have likely not been involuntarily spilled during the high flow period.

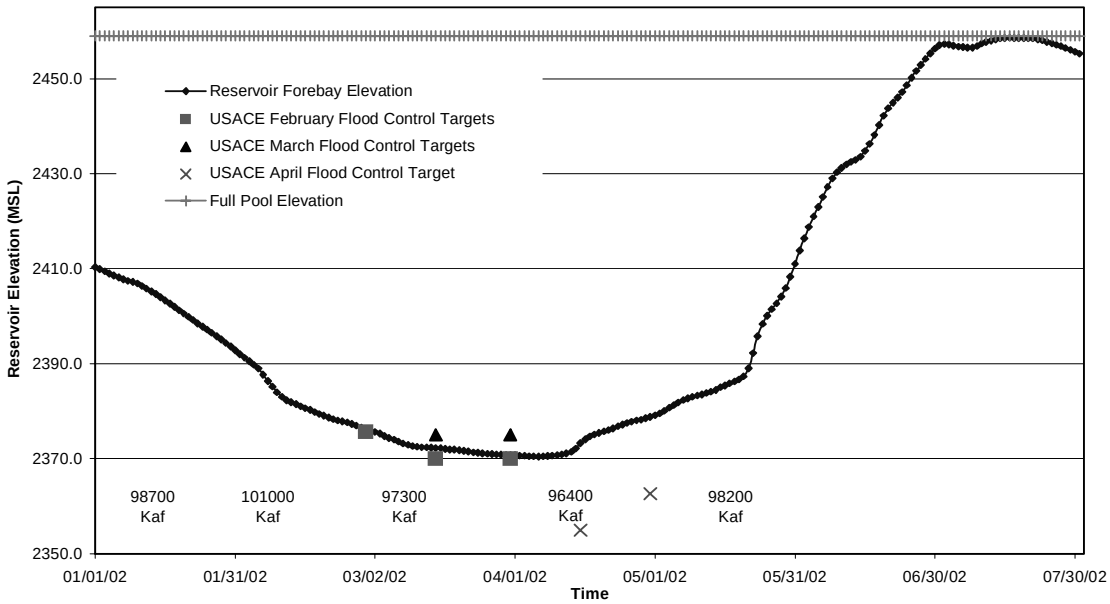

Figure 5. Reservoir operations at Libby over the first one-half of 2002. Final January-July Water Supply Forecasts at The Dalles for each month are along the bottom of the graph.

CONCLUSIONS

Over the winter/spring of 2002 reservoirs were generally drafted below their FCE, limiting the likelihood of achieving their April 10th BiOp elevation and of meeting spring flow objectives. Furthermore, during the period of time before the runoff began, operators were reluctant to release water needed for flow augmentation, directly contradicting 9.6.1.2.1 Action 14 of the BiOp (page 9-55) calling for objectives to be met on both a seasonal and ***weekly*** basis.

The Bureau of Reclamation (BOR) intensely drafted the Grand Coulee and Hungry Horse reservoirs in the winter/early spring of 2002; however, did manage to meet the April 10th target at Grand Coulee by capturing early season flows and limiting downstream flows. Additionally, the BOR did not operate the mentioned reservoirs with the intent of meeting the flow objectives on both a *seasonal* and *weekly* average basis for the benefit of migrating juvenile salmon. BOR essentially refused to draft Grand Coulee below 1240 feet AMSL. The reasons for this limitation remain unclear given the operation of this reservoir below 1240 feet in past years for flood control and power production purposes.

The Idaho Power Company also drafted the Brownlee reservoir intensely over the winter/early spring of 2002; however, also met the April 10th elevation target. Additionally, operators at Brownlee were actively refilling at a time when Columbia and Snake River flows were below the BiOp objectives. Between 4-24-02 and 5-21-02, water was desperately needed in the Columbia River; at this time, Brownlee was predominantly refilling. In situations such as 2002 were the spring freshet is delayed, reservoirs should not be refilling during times when the BiOp objectives are not being met. More so, this should be reinforced when a reservoir is within ten feet of full with extremely minimal chances of *not* filling.

Despite the fact that the Action Agencies were worried about the probability of refill, all projects either refilled or were very close to full by the 30th of June (Figures 1-4).

Summer Flows

The BiOp summer flow objective season began at Lower Granite on 6-21-02 and at McNary on 7-1-02. Both the BiOp summer flow objective seasons at Lower Granite and McNary ended on the 31st of August. The summer objectives were 51 Kcfs at Lower Granite and 200 Kcfs at McNary. Table 2 displays the weekly average flows at each of the mentioned projects.

Table 2. 2002 weekly average flows at Lower Granite and McNary in comparison to the Summer Biological Opinion Flow Objectives. Weeklong periods that did not meet the BiOp Objectives are italicized and bolded.

Week WY 2002	***Lower Granite*** Weekly Average Flow (Flow Obj. = 51 Kcfs)	***McNary*** Weekly Average Flow (Flow Obj. = 200 Kcfs)
6-21 to 6-27	86.0	Na
6-28 to 7-4	68.5	Na
7-5 to 7-11	***41.4***	238.0
7-12 to 7-18	***38.7***	245.1
7-19 to 7-25	***31.6***	212.4
7-26 to 8-1	***28.3***	***166.3***
8-2 to 8-8	***26.9***	***156.3***
9-9 to 8-15	***30.2***	***155.7***
8-16 to 8-22	***30.6***	***141.9***
8-23 to 8-29	***29.7***	***138.9***
Seasonal Total	***41.2***	**190.9**

From Table 2, it is clear that both Lower Granite and McNary struggled to achieve BiOp flow objectives over the last five weeks of the summer flow objective period. At Lower granite, river flows were below the 51 Kcfs objective for 8 of the 10 weeks encompassing the summer BiOp flow period. On a seasonal basis, neither Lower Granite nor McNary met their summer BiOp flow objectives.

Summer Reservoir Operations

GRAND COULEE

The Grand Coulee reservoir began the summer (7-1-02) at approximately 1286 feet and began drafting near the end of the third week in July. Grand Coulee continued to draft to 1280.1 feet on 8-22-02, then essentially held steady until the BOR agreed to draft Grand Coulee from approximately 1280.0 feet to 1279.5 feet by the 30th of August, liberating 35 Kaf of water in a few days to offset water lost in the Libby/Canadian swap.

Some confusion was identified concerning the August 31st draft limit at Grand Coulee as outlined in the NMFS 2000 Biological Opinion. The BiOp reads:

> *Based upon the July final April-to-August runoff volume forecast at The Dalles Dam, the Action Agencies shall limit the reservoir draft to the following end-of August elevations: 1280 feet in years when the forecast for The Dalles equals or exceeds 92 Maf and 1278 feet in years when the forecast is less than 92 Maf.*

According to the NOAA River Forecast Center (RFC), a July Final Water Supply Forecast does not exist from year. Traditionally, according to the RFC, the last forecast for the year is the July Early-Bird. Yet, the Biological Opinion calls for the summer draft limit at Grand Coulee to be determined by the July ***Final*** Water Supply Forecast. At any rate, the August 31st, 2002 draft limit at Grand Coulee was set at 1280 feet. This elevation was based upon the July Early-Bird Water Supply Forecast of 94.5 Maf at The Dalles (April-August) issued by the RFC.

BROWNLEE

On June 25, 2002, SOR 2002-5 asked the Idaho Power Company (IPC) to pre-draft USBR summer flow augmentation water out of Brownlee during July. In a letter addressed the COE (July 9, 2002), in response to SOR 2002-5, the IPC stated:

> *The SOR recommends that the Company operate the Hells Canyon Complex (HCC) to facilitate the delivery of U.S. Bureau of Reclamation (USBR) water released from the Upper Snake River basin, as well as provide additional water from the HCC during July and August to assist in meeting the "summer flow objective of 51 Kcfs at Lower Granite Reservoir." This is not only an inappropriate recommendation, but one that implies that the Company bears some responsibility for meeting those flow objectives and assisting with the migration of juvenile salmonids through the lower Snake River federal projects. The Company does not.*

During the second week of August, Brownlee began to draft water for power production purposes at a rate of more than a few feet of water per week; by 8-30-02 Brownlee was at an elevation of 2055.8 feet.

HUNGRY HORSE

According to the 2000 Biological Opinion, the Hungry Horse reservoir can draft to elevation 3540 feet by August 31st for summer flow augmentation. By midnight of August 31st 2002, Hungry Horse drafted to an elevation of 3544.9 feet, nearly five feet above the BiOp draft limit of 3540 feet. The remaining five feet of water in Hungry Horse will be released during the month of September. According to the reservoir storage table for the Hungry Horse Reservoir, 2793.6 Kaf of useable storage is available at a reservoir elevation of 3544.9 feet; at an elevation of 3540 feet,

2680 Kaf of useable storage is available. Therefore, the volume of water that will be held back at the Hungry Horse reservoir for September flows is ***113.6 Kaf***, this volume of water could have been used during the summer BiOp flow objective period.

DWORSHAK

According to the 2000 Biological Opinion, the Dworshak reservoir can draft to elevation 1520 feet by August 31st for summer flow augmentation. By August 31st 2002, Dworshak drafted to an elevation of 1534.0 feet, 14 feet above the BiOp draft limit. The remaining 14 feet of water in Dworshak will be released during the month of September. According to the reservoir storage table for the Dworshak Reservoir, 973.0 Kaf of useable storage is available at a reservoir elevation of 1534.0 feet; at an elevation of 1520 feet, 786 Kaf of useable storage is available. Therefore, the volume of water that will be held back at the Dworshak reservoir for September flows is ***187 Kaf***, this volume of water could have been used during the summer BiOp flow Objective period.

LIBBY

At the July 7th, 2002 TMT Meeting an operation was outlined that included drafting Libby between elevations 2442.2 and 2442.3 feet by August 31st, 2002. The BiOp draft limit at Libby is 2439 feet by August 31st; therefore, more than three feet of water was projected to remain in the reservoir after August 31st. According to the operation, an amount of water equivalent to the difference in storage between elevation 2442.2-2442.3 and 2439 feet (**140 Kaf**) was to be released from Canadian Storage. This operation was in response to SOR #2002-MT-1 drafted by the State of Montana.

Discussions at the August 28, 2002 TMT Meeting were focused upon the Libby/Canadian swap. At this meeting, it was learned that the Canadian projects would be releasing zero of the 140 Kaf that was originally agreed upon. BPA did point out that outflows were increased from 58 to 64 Kcfs from the Arrow reservoir as a result of a required provisional draft because of reduced inflows between the August 22nd and August 8th TSR (Treaty Storage Regulation). The mentioned increases at Arrow resulted in approximately 80 Kaf of additional water at the Canada/US border. However, this water would have been released regardless of the Libby/Canadian swap agreement; therefore, the provisional draft water should not count toward the Libby/Canada swap volume. In light of the Canadian operations, TMT agreed to continue operations at Libby as outlined in the agreement, however, asked the Action Agencies if any water was available to offset the Libby/Canadian swap deficit. The BOR agreed to draft Grand Coulee from approximately 1280.0 feet to 1279.5 feet by the 30th of August, liberating 35 Kaf of water over a two-day period. All in all, the Libby/Canadian swap will result in a loss of ***105 Kaf*** of summertime water

CANADIAN/UNITED STATES NON-TREATY STORAGE

According to BPA personnel, an annual letter agreement between the United States and Canada exists that allows Canadian projects to store water in the spring for release in the summer. In the spring of 2002, 340 Ksfd (673 Kaf) was stored for the US and 340 Ksfd (673 Kaf) was stored by BC Hydro. According to the agreement, all of the US water and one-half of the BC Hydro water must be released in July and August of 2002. The 2002 total release volume between the US and BC Hydro water is 510 Ksfd (1010 Kaf) in July and August. According to a recent conversation with BPA personnel, all of the non-treaty storage water was released from Canada by the 31st of August 2002.

SNAKE RIVER

According to notes recorded at the July 10th, 2002 TMT meeting, the BOR will release approximately 238 Kaf of water for summer flow augmentation by the end of August. The NMFS Biological Opinion and the NWPPC Fish and Wildlife program call for the BOR to provide up to 427 Kaf of volume from Upper Snake River Reservoirs for summer flow augmentation. Therefore, during the summer months of 2002, ***189 Kaf*** less water will be released from Upper Snake Reservoirs.

CONCLUSION

During the 2002 summer BiOp flow objective period, significant volumes of water have either not been released or held back for September releases. In total, **734.6 Kaf** (113.6 +187 + 140+ 105 + 189) less water was released during the 2002 summer flow objective period, a combined result of operations at Hungry Horse, Dworshak, Libby, and the Upper Snake Reservoirs. If the water either not released or held back along the Snake River were distributed evenly over the summer BiOp period at Lower Granite, flows would have increased continually by approximately 2600 cfs. If the water either not released or held back along both the Snake and Columbia River rivers were distributed evenly over the summer BiOp period at McNary, flows would have increased continually by approximately 6000 cfs.

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MEMORANDUM

TO: Rod Sando, CBFWA

FROM: Michele DeHart

DATE: August 7, 2002

RE: Prediction of adult returns based upon Spring Chinook Jack Counts and Steelhead adult counts at dams.

In response to your questions regarding spring chinook jack counts and steelhead returns in 2002, **I recommend caution**. There are a lot of details to account for when considering the dam counts. This is particularly true if you are attempting to relate adult returns to a specific out migration year. Many of the recent declarations of success based upon dam counts might be misleading to policy makers and the public. Recent history has shown us the danger of predictions, as those recently reported by the article in the Oregonian. The same types of predictions based upon dam counts have been presented in past years and turned out to be erroneous.

- There is nothing in the adult return data, or the PIT tag data that weakens the NMFS scientific basis for migration flows or spill for fish passage for in-river migrants. The success of the mass transportation of smolts in 2001 will not be determined until all of the adult return data is analyzed.
- To date the steelhead return data reflects out migrants primarily from 2000 and 1999.

Spring Chinook returns

The attached memorandum from Michael Schiewe, NMFS to Usha Varanasi, NMFS was circulated in August of 1997. The memorandum, like the June 24, 2002 memorandum from Michael Schiewe to Brian Brown, NMFS, predicts returns from transportation, based upon returns of two-ocean fish. The prediction is based upon an assumption of proportion of age com-

position in the return from the 1995 out-migration year. The memorandum also based, upon partial tag returns predicts that there is no effect of bypass passage. Several fishery management agencies raised their concerns with the NMFS memorandum at subsequent meetings. Concerns were documented in writing and provided to NMFS. A few examples are attached.

Once the complete adult return data was analyzed it became apparent that the assumptions and conclusions in the NMFS memorandum and their early conclusions were inaccurate. Management actions or decisions on the basis of the August 1, 1997 memorandum would have been wrong.

Steelhead dam counts

Statements have been circulated regarding the steelhead dam counts relative to the ten-year average. Some individuals are observing the steelhead dam counts as evidence that the 2001 out migration conditions did not impact adult returns. The FPC recommendation is that the actual impact of the 2001 out-migration conditions will not be understood until all of the adult return data is complete. The following points explain the basis of our cautious recommendation.

- The steelhead adult dam counts that have occurred prior to June 1, 2002 are comprised of individuals that out-migrated as juveniles in 1999 and 2000. These fish hold over in various parts of the river and continue their upstream migration in the spring of 2002. The steelhead count at Lower Granite Dam on May 30, 2002 was 12,424. The steelhead count at Lower Granite on August 2, 2002 is 17,764. Thus far 70% of the adult return of steelhead to Lower Granite Dam to date, is comprised of fish that out migrated in 2000 and 1999.
- Adult steelhead that returned as adults after June 1, 2002 will mainly be comprised of juvenile fish that migrated to the ocean in 2000 and 2001. (with a small proportion from 1999).
- Sampling takes place at Bonneville Dam to determine the age composition of returning adults, as well as hatchery/wild origin and length.
- Most steelhead returning to the Columbia basin are1 ocean fish, and are referred to as the A-run. Steelhead originating from the Snake River include larger proportions of 2-ocean fish. B-run fish in particular, which return to Dworshak Hatchery, and the Clearwater River and Middle Fork and South Fork Salmon River in Idaho are referred to as B-run and are comprised of large proportions (up to 85%) of 2- ocean fish. About half the Snake River wild steelhead are 2-ocean fish.
- This means that the steelhead return in 2002 is only giving us a portion of the information about the 2001 out migration. Much of the 2002 adult return is coming from the better out-migration conditions that occurred prior to 2001 when Biological Opinion flow and spill measures were implemented to a greater degree. The proportion of fish in the 2002 adult return that returned from the 2001 out-migration can only be determined by length/scale analysis and PIT tag returns.

In summary, while there is regional hope that good ocean conditions and maximum transportation of smolts in 2001 averted a disaster, it is too soon in the process to declare victory. Historical information suggests the need to proceed with caution.

August 22, 1997

Mr. Mike Field
Northwest Power Planning Council
Third Floor
450 W State
Boise ID 83720

Dear Mike:

Here are copies of the Commission position and the memo from Schiewe to Stelle on the 1995 pit tag data. As I said, I think it unprofessional to start talking about the conclusions of a scientific study before the data are all in and the analysis is complete. When people do that they are playing politics, not doing science.

I do not refute the 1997 data that are in, which say the survival benefit of fish collected, marked and transported is 2:1 over fish collected, marked and returned to the river for the adults which have returned. I disagree with the speculation about what will occur when the 1998 adults return. Mike Schiewe says they expect survival to be 1.8% for wild fish. For that to occur, 88% of the wild fish in the "class of 95" would have to be 3-ocean (i. e., return in 1998 rather than 1997). We have rarely seen that high a proportion of 3-ocean wild fish. I have asked staff to get the data on historic age composition of wild fish for the September 15 meeting.

However, even if we buy the NMFS prediction (which I don't), the survival rate of 1.8% is below what the NMFS/NPPC science group says is needed for recovery, which is 2% to 6%. Put that in the context that we did everything that was politically and/or biologically possible for the "class of 95," and that we had an extremely good water year and a productive ocean environment, and you reach my logical conclusion: you can't get to recovery via transportation. Since 1975, only on one occasion is there documentation of transported fish surviving at over 2%. Most of the data set is far below this minimum requirement.

Before I leave for my new job, I'd like to make my other misgivings with NMFS approach to transportation research a matter of record. The margin note in the last paragraph of Schiewe's memo is a major point of contention. My staff claims that the initial data on the returns of adults that were not detected at any of the dams, i.e. those which either went through turbines, over spillways, or got to the ocean by divine intervention, survived at the same rate as detected fish, not at a lower rate. We need to get that one straightened out. My long-standing concern is accurately described by Schiewe in the first part of the paragraph. If the trip through the collection/bypass system compromises long-term survival, the transport benefit ratios are only relevant in terms of collected fish, and cannot be used to represent what is happening to all the fish. That would help explain the answer to the main question, which is "If transportation is working so well, where the heck are the adults?"

Mr. Mike Field
August 22, 1997
Page 2

I don't claim to be the guy with all the answers. I just have spent a long time looking at the fate of Snake River fish over time, and have come to the obvious conclusion they are going extinct in spite of transportation "benefits." I will leave you policy makers and a host of very competent scientists to continue the debates, and move on to other species of wildlife. But I think eventually you will conclude that the only way to have recovered Snake River chinook was to have allowed them to migrate to the ocean on a normal schedule without handling them. Good luck.

Sincerely,

Steven M. Huffaker, Chief
Bureau of Fisheries

c: Michael Schiewe, NMFS

e:/huffaker/esa/end

FYI ECB
GM
DAC
SWK
BB
CP

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administratio
NATIONAL MARINE FISHERIES SERVICE
Northwest Fisheries Science Center
Coastal Zone & Estuarine Studies Divi
2725 Montlake Boulevard East
Seattle, Washington 98112-2097

August 1, 1997

MEMORANDUM FOR: F/NW - William Stelle

THRU: F/NWC - Usha Varanasi

FROM: F/NWC1 - Michael H. Schiewe

SUBJECT: Preliminary Results--1995 Smolt Transportation Study

In spring 1995, Coastal Zone and Estuarine Studies Division staff PIT tagged nearly a quarter-million spring/summer chinook salmon smolts to test transportation vs. inriver migration from Lower Granite Dam. The 2-ocean-age adult fish from this study have returned this spring and summer, with 3-ocean-age fish due back in spring/summer 1998.

The 2-ocean-age adult returns are virtually complete to Lower Granite Dam. As of 21 July 1997, we recovered 702 fish (604 hatchery and 98 wild). On average, twice as many adult fish returned from juveniles transported to below Bonneville Dam compared to those released into the tailrace of Lower Granite Dam (T/I = 2.0). We do not expect the transport-to-inriver return ratio to change appreciably when returns of 3-ocean-age fish are complete next summer. Further, based on previous return patterns, we expect that the total return of 3-ocean-age fish will be roughly equivalent to the total return of 2-ocean-age fish; however, the proportion of hatchery and wild fish in the 3-ocean-age component will be the reverse of those in the 2-ocean-age component.

To date, the adult return rates of transported hatchery and wild fish to Lower Granite Dam are approximately 0.44 and 0.25%, respectively. When adult returns are complete next summer, we anticipate the total return rates of transported hatchery and wild fish will be approximately 0.51 and 1.80%, respectively. The adult return rate for wild fish is a conservative estimate because roughly 15-20% of the hatchery smolts were either not fin-clipped or were poorly fin-clipped, and thus were indistinguishable from wild fish when PIT tagged at the dam. Furthermore, to adjust these current return rates so that they are comparable to estimates made prior to Snake River hydropower system development, the return rates will require adjustment for losses of adult fish between Ice Harbor and Lower Granite Dams and for harvest in lower river fisheries. This will increase estimated return rates of transported wild fish to about 2.3%,

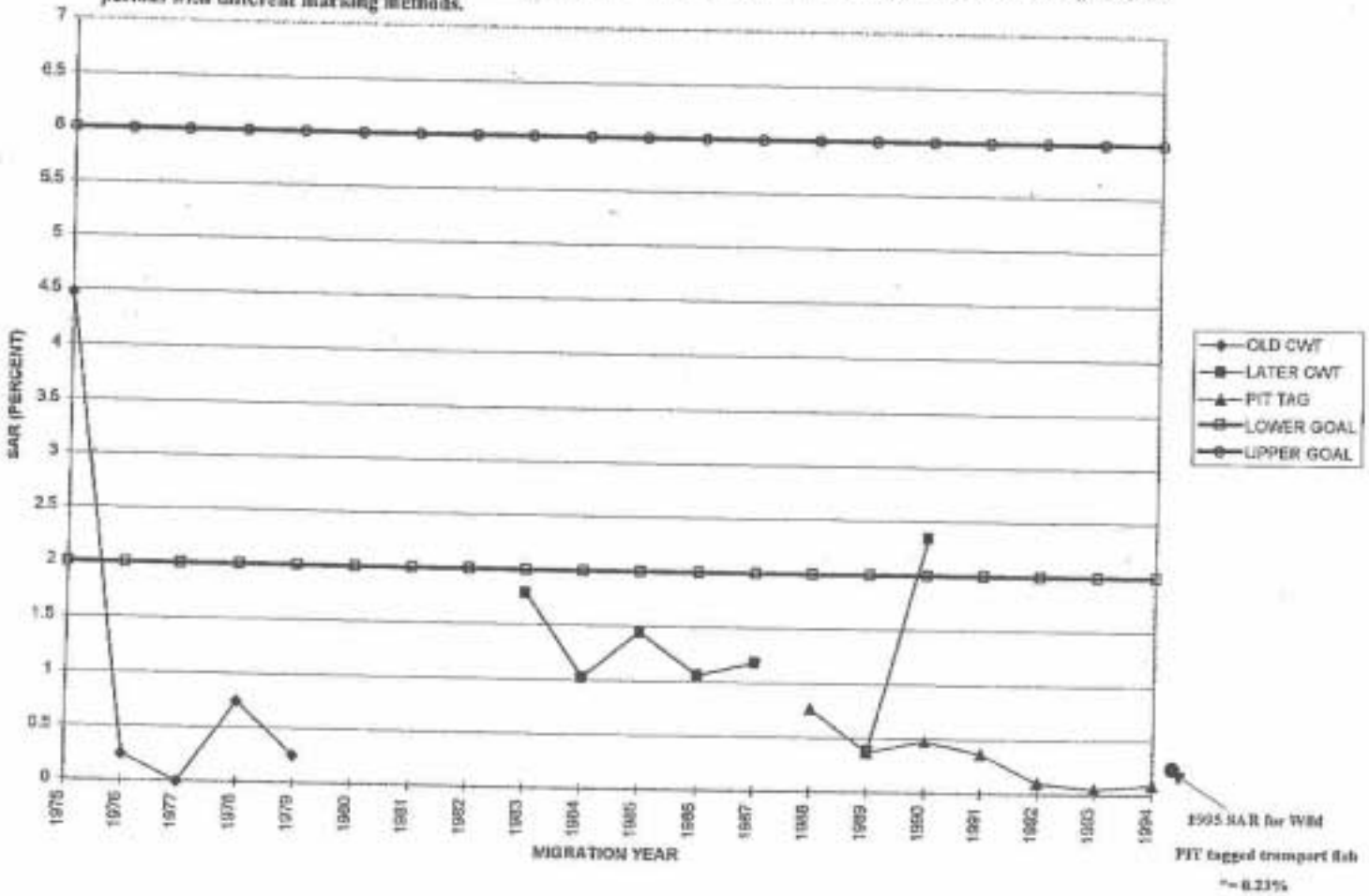
which is consistent with return rates observed prior to full Snake River hydropower development. (These were actually 3.7 & 6.1% (see Raymond '88)) Even [illegible] happens a rare

In recent years, several questions have been raised regarding the NMFS experimental approach to evaluating transportation effects. Concern exists that handling and tagging fish as smolts at dams compromises their survival to adulthood; hence, the fish that we release inriver are not representative of unhandled fish passing the dam and are therefore not appropriate controls for the transportation experiments. It has also been suggested that, during the smolt migration, passage through one or more smolt bypass systems at dams is more detrimental than passage through turbines and/or spillways. To examine these concerns, we compared the adult returns of fish arriving at Lower Granite Dam that were PIT tagged as parr at hatcheries vs. hatchery fish that were collected as smolts at the dam, PIT tagged, and released to continue their migration. For the 1995 smolt outmigration, there is virtually no difference in the adult return rates between these two groups of fish. Furthermore, return rates were lower for fish never detected passing through a smolt bypass system than for those detected passing through one or more of them. Thus, concerns about the transportation study design and smolt bypass systems appear unfounded. Op[illegible] of RB[illegible] find[illegible] on Sa[illegible] Grea[illegible]

If you have any questions regarding this information, please contact Dr. John Williams or myself.

cc: F/NWO - Donna Darm, Brian Brown, Chris Toole
F/NCW1 - John Williams, Gene Matthews, Jerry Harmon

Figure 1. Smolt to Adult (SAR) values for transported fish observed as part of the transport research during different periods with different marking methods.



IDAHO FISH & GAME
600 South Walnut / Box 25
Boise, Idaho 83707-0025

August 22, 1997

Philip E. Batt / Governor
Stephen P. Mealey / Director

The Honorable Philip E. Batt
Governor of Idaho
Statehouse Mail
Boise ID 83720

Dear Governor:

Yesterday you asked me to find out how the current report of new studies documenting the relative success of barging smolts vs leaving them in the river relates to the Commission's position that transportation/flow augmentation is not a viable long-term solution. Preliminary PIT tag data on adults returning from the 1995 outmigration indicate a 2:1 advantage for barged fish. Regrettably, even with this advantage, survival of barged fish is still far below that necessary to turn the corner toward recovery. Copies of a memorandum describing that data and a memorandum from the Fisheries Bureau to Mike Field on this subject are enclosed for your information.

The data I showed you (Figure 1) is the long-term track record of survival for Idaho spring/summer chinook salmon. In order to affect recovery, the scientists working under NMFS and NPPC direction say smolt-to-adult survival must reach at least 2%. Although barged, fish may have survived better than in-river fish for the "class of '95" outmigrants, the smolt-to-adult survival of these barged fish will still be less than 2%. The 1995 year class had the benefit of an excellent water year and very productive ocean conditions. Their survival rate is the very best we can hope for with the current hydropower system operations in place.

The Commission has tracked the scientific debates over salmon recovery for over two decades. During the early years the Commission supported transportation as an experimental, interim recovery tool. Since that time the runs have continued to decline despite the best anyone could do with water budgets and improvements to collection and transportation of smolts. The Commission believes the verdict is in: barging and the flow augmentation it takes to make barging work have failed to reverse the declines. There is no scientific basis to conclude that improvements to barging and flow augmentation will work, and this approach increases the risk that Idaho water will be seen as a major component in the long-term solution.

The Commission believes the biological evidence is sufficient, and the fish cannot afford another iteration of scientific debate. If a long-term solution is to be gained, the focus must shift to address the social and economic issues associated with recovery options. The Commission's position clearly states the need for social and economic factors to be considered in recovery decisions, and the need for societal involvement in and acceptance of final solutions. Until a long-term solution is developed and implemented, the Department will continue to support an interim spread-the-risk policy that strikes a logical balance between in-river and transported smolts. This balance is determined annually based on snow pack and projected river conditions.

I appreciate the opportunity to clarify the Commission's position on the 1999 decision point for anadromous fish recovery. I believe its position is very consistent with the steelhead listing comments submitted by the State of Idaho last January, and gives strong consideration to the broad interests of the State. I would be happy to meet personally with you to address any additional comments or questions you might have. We look forward to continuing our active partnership with your office, our congressional representatives and the NPPC as we collectively work toward salmon and steelhead recovery.

Sincerely,

Stephen P. Mealey
Director

Enclosure

** TOTAL PAGE.08 **

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MEMORANDUM

TO: Michele DeHart

FROM: David A. Benner

DATE: August 7, 2002

RE: Cumulative Impacts to Summer Columbia River Flows as a result of Operations at Dworshak, Hungry Horse, and the Upper Snake Reservoirs. Libby and Canadian Non-Treaty Storage Operational Plans.

At your request, I have evaluated the cumulative impacts to summer Columbia River flows as a result of current operations at Dworshak, Hungry Horse, and the Upper Snake Reservoirs. Operations at the mentioned reservoirs are as follows:

Hungry Horse

According to the 2000 Biological Opinion, the Hungry Horse reservoir can draft to elevation 3540 feet by August 31st for summer flow augmentation. The latest SSARR (8-6-02) issued by the COE has Hungry Horse drafting to an elevation of 3545 feet by August 31st 2002, five feet above the BiOp draft limit of 3540 feet. The remaining five feet of water in Hungry Horse will be released during the month of September. According to the reservoir storage table for the Hungry Horse Reservoir, 2796 Kaf of useable storage is available at a reservoir elevation of 3545 feet; at an elevation of 3540 feet, 2680 Kaf of useable storage is available. Therefore, the volume of

water that is planned to be held back at the Hungry Horse reservoir for September flows is ***116 Kaf***, this volume of water could have been used during the summer BiOp flow Objective period.

Dworshak

According to the 2000 Biological Opinion, the Dworshak reservoir can draft to elevation 1520 feet by August 31st for summer flow augmentation. The latest SSARR (8-6-02) issued by the COE has Dworshak drafting to an elevation of 1530 feet by August 31st 2002, ten feet above the BiOp draft limit. The remaining ten feet of water in Dworshak will be released during the month of September. According to the reservoir storage table for the Dworshak Reservoir, 919 Kaf of useable storage is available at a reservoir elevation of 1530 feet; at an elevation of 1520 feet, 786 Kaf of useable storage is available. Therefore, the volume of water that is planned to be held back at the Dworshak reservoir for September flows is ***133 Kaf***, this volume of water could have been used during the summer BiOp flow Objective period.

Upper Snake River

According to notes recorded at the July 10th, 2002 TMT meeting, the BOR will release approximately 238 Kaf of water for summer flow augmentation by the end of August. The NMFS Biological Opinion and the NWPPC Fish and Wildlife program call for the BOR to provide up to 427 Kaf of volume from Upper Snake River Reservoirs for summer flow augmentation. Therefore, during the summer months of 2002, ***189 Kaf*** less water will be released from Upper Snake Reservoirs.

Conclusion

During the 2002 summer BiOp flow objective period, significant volumes of water have either not been released or held back for September releases. In total, **438 Kaf** (116 + 133 +189) less water will be released during the 2002 summer flow objective period, a combined result of operations at Hungry Horse, Dworshak, and the Upper Snake Reservoirs. If this water were distributed evenly over the remaining portion of August (8th to the 31st, 23 days), Columbia River flows would increase continuously by 9.6 Kcfs. From the last 8-6-02 SSARR, flows at McNary are projected to range between 171 and 145 Kcfs. The 2002 Biological Opinion Flow Objective is 200 Kcfs at McNary; therefore, a 9.6 Kcfs increase in flows would be beneficial.

Libby and Canadian/United States Non-Treaty Storage operational plans are also worth noting when discussing 2002 summer river flows as alternative operations discussed earlier in the year could have reduced summer migration flows.

Libby

At the July 7th, 2002 TMT Meeting a tentative operation was outlined that includes drafting Libby to elevation 2444 feet by August 31st, 2002. The BiOp draft limit at Libby is 2439 feet by August 31st; therefore, five feet of water is projected to remain in the reservoir after August 31st. According to the tentative operation, an amount of water equivalent to the difference in storage between elevation 2444 and 2439 feet (218 Kaf) will be released from Canadian Storage. This operation is in response to SOR #2002-MT-1 drafted by the State of Montana. As currently outlined, the operational plan at Libby should not limit summer Columbia River flows.

Canadian/United States Non-Treaty Storage

According to BPA personnel, an annual letter agreement between the United States and Canada exists that allows Canadian projects to store water in the spring for release in the summer. In the spring of 2002, 340 Ksfd (673 Kaf) was stored for the for the US and 340 Ksfd (673 Kaf) was stored by BC Hydro. According to the agreement, all of the US water and one-half of the BC Hydro water must be released in July and August of 2002. The 2002 total release volume between the US and BC Hydro water is 510 Ksfd (1010 Kaf) in July and August. To date (August 8, 2002), 241.5 Ksfd (478 Kaf) of the non-treaty storage water has been released. Therefore, 268.5 Ksfd (532 Kaf) of non-treaty summer flow augmentation water still exists in Canadian projects. To get all of the water out, approximately 12.2 Kcfs of non-treaty storage water will need to be released from August 9th to the 31st of 2002. According to BPA personnel, all of the non-treaty storage water should be out of Canada by the 31st of August 2002.

The last two described operations both involve water coming out of Canada. To ensure that water from the non-treaty releases and water from the Libby swap are not confused, it may be of some value for fisheries managers to ask for a weekly water volume accounting summary.

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MEMORANDUM

TO: Rod Sando

Executive Director, CBFWA

FROM: Michele DeHart

DATE: July 30, 2002

RE: 2002 Spring Chinook Jack Return

In response to your request the FPC staff reviewed the spring chinook jack return for 2002 and the attached article, which appeared in The Oregonian newspaper on July 30, 2002. The article appears to be, in part, based upon a June 24, 2002 memorandum from Michael Schiewe, NMFS, to Brian Brown, NMFS, (attached). The NMFS memorandum is simply an observation of the final jack counts in 2002 compared with previous years and the magnitude of the hatchery release. The article in the Oregonian seems to expand and stretch the actual information in the NMFS memorandum. The information in the NMFS memorandum is presented without qualification or context, which in turn leads to the expansion and sweeping conclusions in the Oregonian article.

Because in-river migration conditions were so deadly in 2001, the region was forced to implement a singular passage strategy of complete reliance on transportation of smolts. Reliance on a singular passage strategy amplifies the risk of one strategy and the impact of uncontrollable variables such as ocean conditions. The data is clear regarding the impact of low flows and no spill, in 2001, on juvenile survival of chinook and steelhead that migrated in river. The NMFS memorandum clearly states the effect of low flow and minimal spill conditions, specifically that the out migration conditions and resulting juvenile survivals were the poorest that have occurred in the last decade. The spring chinook jack return is near the ten-year average. **The actual results**

of implemented passage strategies in 2001 cannot be determined until all of the adult return data from transported and in-river migrating fish in 2001 is analyzed. Our specific comments and observations follow.

"Early Indicators Banish Gloomy Forecasts For Salmon" – The Oregonian - July 30,2002

- The initial context of the Oregonian article (attached) is difficult to understand, since it does not identify the "gloomy forecasts" either specifically or by source. It however infers that a forecast of the adult return was generated before the 2002 jack count was available. We are unaware of any early forecasts of adult returns that were made prior to the jack counts. In general predictions of adult returns are based partially on jack counts. We reviewed presentations and data summaries that were prepared; none included a prediction of adult returns. However, the in-stream migration data was reported and the point was emphasized that the 2001 out migration was relying on transportation and good ocean and estuary conditions because in-river conditions were the worst in recent history.
- The "gloomy" information that was available prior to the jack counts, was not a prediction of adult returns. It was the actual calculated survival of in-river migrating salmon and steelhead. The NMFS memorandum clearly states, and there is no disagreement, that the in-river migrants in 2001 had the lowest survival of any recent years. The memo also states that nearly 100% of the live fish that arrived below Bonneville Dam were transported as smolts. This statement only applies to smolts outmigrating above Lower Granite. Mid-Columbia yearling chinook and steelhead had 35% and 30% respectively, of smolts arriving at McNary Dam forebay, transported. There was no transportation of smolts arriving in the Columbia River below McNary Dam. All of these fish had to migrate in-river. This means that the adult returns from the 2001 migration will be the result of the single passage strategy of transportation and the effects of good ocean conditions.

In river migration in 2001

- As the result of low flows and minimal spill, in river survival for steelhead and chinook out migrants was the lowest observed since 1992. The estimated steelhead survival from Lower Granite tailrace to Bonneville tailrace was 4% in 2001 as compared to 39% in 2000. The estimated chinook survival through the same reach was 30% as compared to 49% in previous years.
- Passage timing and travel time was affected. Travel times were twice as long as those observed historically for chinook and steelhead juveniles. Passage indices of yearling chinook and steelhead (figure 1, attached) at Lower Granite Dam peaked during two periods of increased natural flow from rain. Flow averaged 60 kcfs during the middle 80% of the spring migrants at lower Granite with peak flows occurring between 80 and 90 kcfs.
- The passage conditions in 2001 affected the maximization of transportation strategy. The hatchery population arriving at Lower Granite Dam, the first transport site, was at least 10 percentage points lower than any of the past three years. The estimated population of

wild steelhead and chinook and hatchery steelhead arriving at Lower Granite Dam in 2001 were also lower than the previous three years. (FPC, Annual Report 2001)

Spring/Summer chinook jack returns in 2002 – Are they surprising?

- The dam counts of jacks are based upon size criteria. Fish passing a counting window that are less than specific length are recorded as "jacks". The term "jack" refers to age, a fish that has spent one year in the ocean. Age data for a returning population is determined by scale sampling and analysis, which determines the age of a fish. Past, scale age data collected since the mid-1980s, indicates that each year, some proportion of the "jack" count each year is actually fish that have spent two years in the ocean. For this reason run reconstructions are based in part upon scale analysis age data and not simply jack counts. The result of the 2001 out migration will not be accurately determined until all of the data is analyzed.
- The spring/summer jack returns in 2002 are near the ten-year average for the 1991-2001 period. This is a considerable decrease from the returns of the last two years.
- Jack returns are a reasonable predictor of adult returns of both hatchery and wild Snake River chinook (r^2=0.6 to 0.8)
- In general Snake River hatchery populations have a higher proportion of jacks returning in the population than wild stocks. Summer chinook tend to have a higher proportion of the population returning as jacks when compared to spring chinook.
- The jack return to Lower Granite in 2002 is not surprising. When the range of SAR estimates for transported hatchery chinook from the CSS study is applied to the number of hatchery chinook transported in 2001, the returning hatchery chinook population estimate is in the range of 23,795 and 60,003. The average proportion of jacks in the returning hatchery population averages 11%. Applying this average to the estimated return, results in an estimated spring/summer chinook jack return to Lower Granite ranging from 2,617 to 6,600. The 2002 jack return is within that range and so the jack counts in 2002 are not unexpectedly high or low, which is an early indicator that transportation may have been only as effective as indicated by past data.
- The mid-Columbia spring chinook jack return in 2002 related to the number of chinook transported at McNary Dam is illustrated in figure 2. Jack returns increased through the past three years without transportation of spring chinook at McNary Dam and decreased with the implementation of spring chinook transportation at McNary Dam. However, Jack returns or total adult returns, as explained in the NMFS memorandum are not considered an evaluation of transportation of smolts.

Transportation of Smolts

- The total adult returns from 2001 will determine the results of the maximization of transportation strategy that NMFS was forced to implement in 2001 as a result of the low water year and the BPA financial crisis precipitated by California energy deregulation.
- All of the historic available data indicates that, when compared to the lethal passage conditions existing in-river in 2001, more adults should return from transportation. In their memorandum, NMFS states that the vast majority of returns seen to date or which will

be seen are from transported fish. This is a safe assumption since the in-river conditions were documented to be lethal. The question remains, as to what the smolt-to-adult return rates (SARs) will be on transported wild and hatchery fish from the 2001 out-migration and whether or not those will reach levels required to recover listed stocks.

- The assessment of the success of the 2001 out migration and the passage strategies that were implemented will depend on the smolt-to-adult return rates achieved that year for hatchery and wild stocks, and whether levels needed to recover listed stocks were achieved by maximizing transportation.
- Although not mentioned in the NMFS memorandum, adult returns from transportation in 2001 will also reflect the condition of the smolts at the time of collection and transport. Physiological studies have shown that smolt condition can be reduced by stresses at the dams and in transportation as well as by a reduction in energy (lipid) reserve when migration is delayed. Visual observations Lower Granite Dam from the smolt monitoring program in 2001 indicated that smolt condition during the spring migration was above average.
- 130 PIT tagged chinook jacks returned to Lower Granite Dam. Two of those PIT tags were from wild fish. One wild chinook (jack) was transported, the other wild chinook (jack) migrated in-river.
- The 2002 jack returns of PIT tagged fish were comprised primarily of CSS hatchery mark groups. The SARs of CSS jack returns in 2002 were compared with previous years for each mark group. The CSS groups that historically have a high proportion of production retuning as jacks, Imnaha and McCall had lower SARs on jacks in 2002 than the previous four years. Those CSS mark groups with a lower proportion of jacks comprising the adult return, Dworshak and Rapid River, had SARs within the range observed in the past four years.

Conclusions

- The 2001 juvenile migration year clearly showed the effects of flow and spill on downstream juvenile migrants. The low in-river survivals resulting from the low flow and spill provide additional support and basis for the NMFS Biological Opinion flow and spill measures.
- It is too early to determine the combined effect of the 2001 out migration conditions, ocean conditions and transportation on listed and unlisted stocks of salmon and steelhead. Review of past data shows that the highest smolt to adult return rates for both in-river migrants and transported migrants occurs from out-migration years with higher flow and spill levels.
- The spring jack returns are within the expected range given the recent smolt-to-adult return rates for transported chinook generated through the CSS study.
- The complete result of the passage strategy implemented in 2001 will not be determined until all of the adult return data is available.
- Spawner to recruit ratios for wild stocks will be a key factor in determining the results of the passage strategies and ocean conditions which occurred in 2001.
- The statements regarding recovery in the Oregonian article are out of context. In order to determine if the passage strategy implemented in 2001 will accomplish recovery goals,

the smolt-to-adult return rates on hatchery and wild stocks of steelhead and chinook will have to be calculated when all of the adult return tag data is analyzed. Key to this analysis will be the response of wild chinook and steelhead to transportation.

- Because the in-river migration conditions were lethal, and the ocean conditions were good, 2001 may represent the best possible results that can be expected from transportation of smolts.
- At this point, the 2001 implemented passage strategy, maximization of transportation of smolts, as it relates to recovery of listed stocks cannot be determined.

Early indicators banish gloomy forecasts for salmon

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News

Early indicators banish gloomy forecasts for salmon
07/30/02
JONATHAN BRINCKMAN
The drought and the energy crisis last summer sent power prices soaring and raised fears that Columbia River salmon and steelhead would be decimated. But it wasn't a catastrophe for fish after all.

Many conservationists and biologists predicted dire consequences for salmon runs after the federal government gave electricity generation priority over fish protection last year. Yet counts of yearling male salmon that return early to spawn -- they are called jacks -- indicate that spring and summer chinook numbers next year will be well above the average throughout the 1990s.

"Things aren't as bad as the gloom and doom that everybody said," said John Williams, a National Marine Fisheries Service biologist. "People were overly pessimistic."

It appears a combination of factors is responsible: aggressive barging of juvenile fish from hatcheries to the ocean, reducing mortality in migrations that occurred while dammed water was withheld for power generation; and cold upwellings in the ocean, carrying with them rich nutrient loads. No one is sure, however, which played the more critical role. The results are clear, however: Most of the young salmon that migrated down the Columbia River last year and survived will return as adults in 2003, after spending two years in the ocean. A small fraction of those fish, the jacks, return a year early. Their number provides a reliable indicator of the next year's adult run, biologists say.

About 14,000 spring and summer chinook jacks had been counted by Wednesday at Bonneville Dam. That's 4,600 more than the annual average for that date since 1990. State fish biologists predict that 250,000 to 300,000 spring and summer chinook will pass Bonneville Dam in 2003.
Not counting this year and last year -- which saw much larger than average runs of spring and summer chinook -- 300,000 fish would be the largest spring/summer run since 1972.

The preliminary 2003 forecast for fall chinook, which arrive after spring and summer chinook, has not been completed.

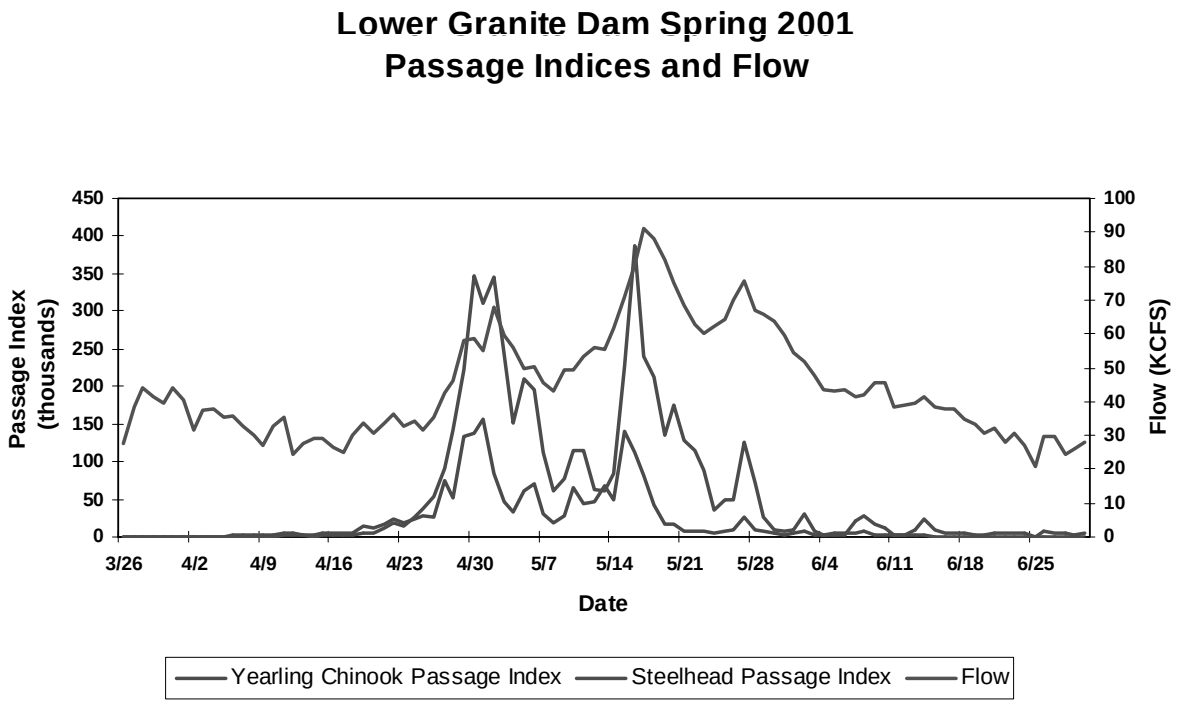
Emergency measures
Last year, many biologists were pessimistic about the outlook for 2003 runs. The Bonneville Power Administration, which markets electricity generated at federal dams in the Columbia Basin, declared a power emergency in early 2001 because the drought had reduced river flows at the same time wholesale electricity prices soared to record levels. Declaring an emergency allowed the federal government to sharply reduce the amount of water it sends through spillways, an action normally

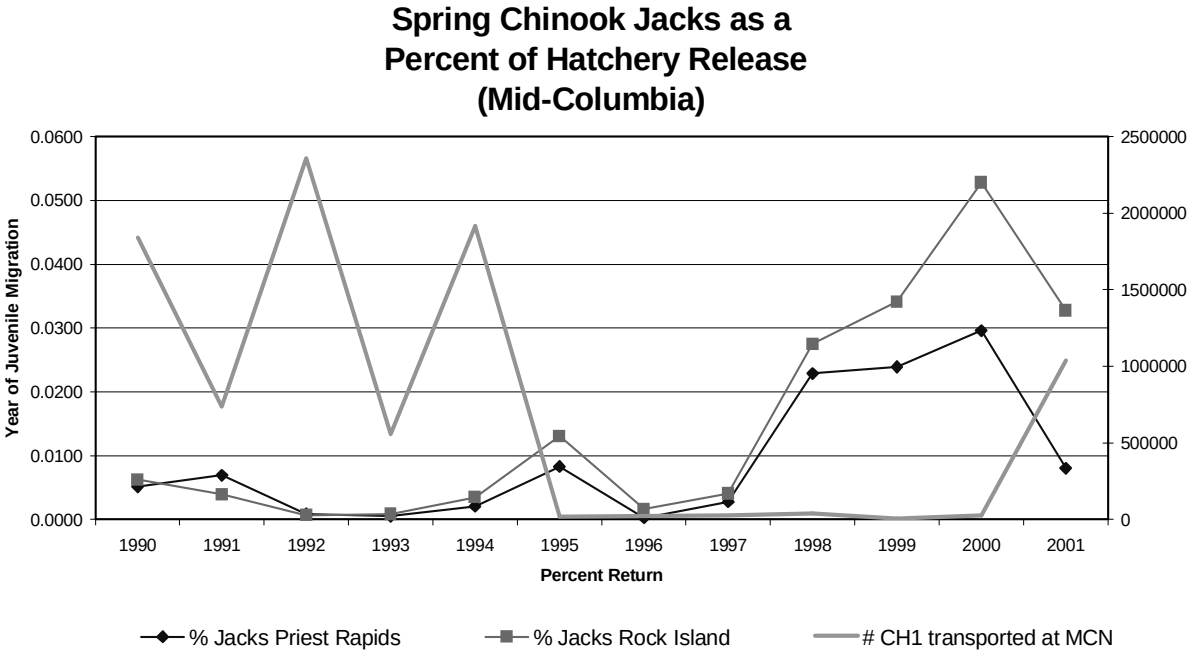
required by the federal Endangered Species Act to give young salmon a way to get past dams without going through electricity-generating turbines. The turbines' spinning blades kill or injure some of the young fish and can disorient the survivors, making them more vulnerable to predatory fish downriver from the dams.

BPA officials said they had no choice but to reduce the spill in order to meet regional demand for electricity. They said they spilled as much water as they could -- about 20 percent of what normally is required -- to help salmon as much as possible. In addition, about 90 percent of the young salmon and steelhead migrating down the Snake River were collected, loaded into trucks and barges, and transported around the dams to the ocean, which reduced the impact of the smaller spill, they said. But BPA officials also didn't anticipate that so many jacks would turn up this year. "The jack counts are very positive and much better than expected," said Greg Delwiche, the BPA's vice president of generation supply. "This should be good news for anyone interested in salmon recovery." The high jack counts show that transporting as many juvenile fish as possible is a good strategy during drought years, because it gets young fish out of the slow, warm and potentially lethal river, said officials at the BPA and the National Marine Fisheries Service, the federal agency in charge of salmon recovery. Ocean more nurturing But something else is also going on: Ocean conditions appear to be very favorable to salmon. Upwelling is bringing nutrients from deep water, providing food for the marine life that salmon feed upon in the ocean. Fish that safely reached the ocean appear to have survived at a high rate, biologists said. "Our ability to collect fish and transport them on barges seems to have worked," said Bill Muir, a research biologist with the fisheries service. "And then ocean conditions saved us."

But some conservationists and sport fishing advocates are still critical of the way the federal government operated dams last year. Pat Ford, executive director of Save Our Wild Salmon, said it's not enough to beat the average of the past 10 years. Returns in the 1990s, he said, were low enough to put many salmon runs on the road to extinction. Liz Hamilton, executive director of the Northwest Sportfishing Industry Association, said the number of salmon returning next year would have been much smaller if ocean conditions weren't so good. "Right now the ocean conditions are like the stock market was in the '90s -- anything can succeed," Hamilton said. "But the fishing community is not satisfied, because we know things could have been a lot better."

You can reach Jonathan Brinckman at 503-221-8190 or by e-mail at jbrinckman@news.oregonian.com. Latest News | The Oregonian Links & Archives User Agreement | Privacy Policy | Help/Feedback | Advertise With Us © 2002 OregonLive.com. All Rights Reserved.


Lower Granite Dam Spring 2001
Passage Indices and Flow
Passage Index (thousands)
Flow (KCFS)
Date
3/26
4/2
4/9
4/16
4/23
4/30
5/7
5/14
5/21
5/28
6/4
6/11
6/18
6/25
Yearling Chinook Passage Index
Steelhead Passage Index
Flow


Spring Chinook Jacks as a
Percent of Hatchery Release
(Mid-Columbia)
Year of Juvenile Migration
Percent Return
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
% Jacks Priest Rapids
% Jacks Rock Island
# CH1 transported at MCN

CSS PIT tagged hatchery yearling spring/summer chinook in migration years 1997 to 2001

Migration Year	Hatchery=> Category=>	DWOR T0	DWOR C0	RAPH T0	RAPH C0	IMNH T0	IMNH C0	MCCA T0	MCCA C0
1997	SAR jacks	0.00%	0.03%	0.00%	0.00%	0.56%	0.14%	0.12%	0.07%
1997	SAR adults	0.82%	0.43%	0.79%	0.45%	1.16%	0.86%	1.51%	1.09%
1997	T0/C0 jacks		N.A.		N.A.		4.13		1.57
1997	T0/C0 adults		1.91		1.73		1.36		1.38
1997	% jacks	0.0%	7.1%	0.0%	0.0%	32.4%	13.6%	7.1%	6.3%
1998	SAR jacks	0.13%	0.21%	0.09%	0.19%	0.71%	0.42%	0.58%	0.49%
1998	SAR adults	0.88%	1.32%	1.99%	1.23%	0.86%	0.57%	2.68%	1.38%
1998	T0/C0 jacks		0.61		0.46		1.71		1.18
1998	T0/C0 adults		0.67		1.63		1.50		1.95
1998	% jacks	12.6%	13.7%	4.1%	13.1%	45.3%	42.1%	17.8%	26.4%
1999	SAR jacks	0.041%	0.048%	0.13%	0.13%	0.91%	0.42%	0.49%	0.42%
1999	SAR adults	1.18%	1.19%	3.03%	2.33%	2.55%	1.43%	3.55%	2.40%
1999	T0/C0 jacks		0.85		1.05		2.17		1.17
1999	T0/C0 adults		0.99		1.30		1.79		1.48
1999	% jacks	3.3%	3.8%	4.2%	5.1%	26.2%	22.6%	12.2%	14.9%
2000	SAR jacks	0.011%	0.007%	0.019%	0.025%	1.20%	0.97%	0.62%	0.38%
2000	SAR adults*	0.49%	0.49%	1.35%	0.74%	2.49%	1.85%	2.94%	1.42%
2000	T0/C0 jacks		1.51		0.75		1.24		1.66
2000	T0/C0 adults*		1.01		1.82		1.35		2.06
2000	% jacks	2.2%	1.5%	1.4%	3.2%	32.5%	34.4%	17.5%	20.9%
2001	SAR jacks	0.06%	0.00%	0.11%	0.00%	0.36%	0.00%	0.32%	0.17%
2001	T0/C0 jacks		N.A.		N.A.		N.A.		1.87

Note: adults* include 2-ocean fish only
Note: 2001 SARs for jacks are preliminary values

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National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Northwest Fisheries Science Center
Fish Ecology Division
2725 Montlake Boulevard East
Seattle, Washington 98112-2097

June 24, 2002

MEMORANDUM FOR: F/NWR5 - Brian Brown

FROM: F/NWC3 - Michael H. Schiewe

SUBJECT: Preliminary jack returns from Snake River spring-summer chinook salmon juveniles that migrated during the 2001 low-flow conditions

Because of very low flow, compounded by lack of spill at Snake River dams, the 2001 smolt migration conditions were considered some of the poorest in the last few decades. Our estimate of survival for Snake River spring-summer chinook salmon smolts migrating downstream from Lower Granite Dam to the Bonneville Dam tailrace was approximately 26%. This was a fifth lower than the estimated 33% average survival for hydropower system migrants during the 1993 and 1994 outmigrations, prior to the implementation of BiOp spill, and approximately one-half of the estimated 50% average survival for hydropower system migrants during the 1995 through 2000 outmigrations.

Earlier this year we presented to the Northwest Power Planning Council and the Implementation Team estimates of survival for the 2001 outmigration. At that time, we stated that despite the poor migration conditions, the strength of the subsequent adult return would likely hinge mostly on conditions downstream from Bonneville Dam and in the ocean, because as seen in Figure 1, nearly 100% of the live fish below Bonneville Dam in 2001 arrived via transportation. We also pointed out that the percentage of live fish below Bonneville Dam that arrived via transportation in 2001 was not particularly unusual compared to previous years. Finally, we stated in our presentations that although most adult returns would come from transported fish, the size of subsequent adult runs was not an evaluation of transportation, nor did we intend to use these returns to advocate for or against transportation as a means to mitigate for Snake River dams. We merely noted that the vast majority of returns we have seen, or will see, are from transported fish.

Although not a perfect predictor, the return of 1-ocean fish (jacks) from an outmigration provides an indication of the expected subsequent adult return. Figure 2 provides Snake River chinook salmon jack return rates to Ice Harbor Dam through 23 June of this year compared to jack return rates through the

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same date in previous years. The jack return rate is computed as total hatchery and wild returns divided by the total number of spring-summer chinook salmon smolts released at Snake River basin hatcheries the previous year. Based on these data, we expect that the complete adult return rate from the 2001 outmigration will likely fall in the range of those from the last few years.

The adult escapement of spring-summer chinook salmon to the Snake River in 2001 was the largest on record. This year's return will have the second largest escapement. These returns resulted primarily from large hatchery releases (10.9M in 1999 and 7.1M in 2000) coinciding with good survival in the ocean. While jack return rates this year are similar to those of recent years, we expect considerably fewer adult fish will return in 2003, as the hatchery release in 2001 was only 4.1M fish.

If you have any questions concerning these results, please call John Williams at (206) 860-3277.

cc: F/NWR - Lohn
F/NWC - Varanasi
F/NWR5 - Ruff
F/NWC3 - Ferguson
F/NWC3 - Matthews
F/NWC3 - Muir
F/NWC3 - Smith
F/NWC3 - Williams
F/NWC3 - Zabel

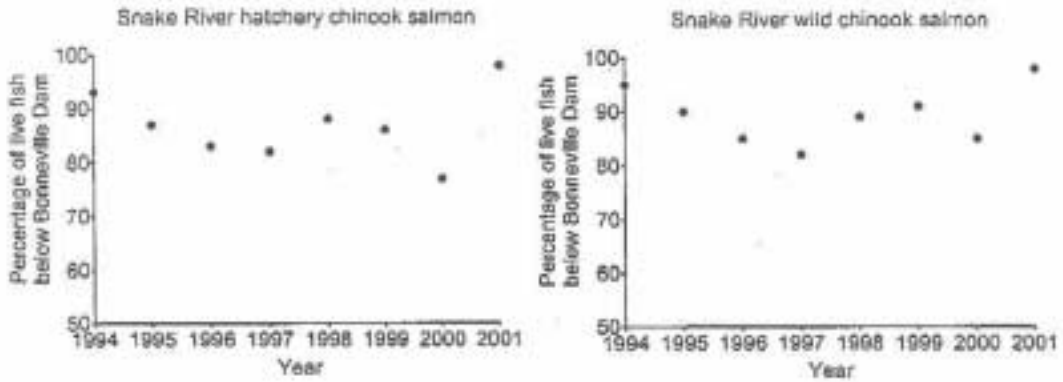

Figure 1. Percentage of live juvenile spring-summer chinook salmon smolts from the Snake River that arrived below Bonneville Dam via transportation. Assumed 98% of transported fish were alive at release. Applied annual system survival estimates to the percentage of the population that was not transported.

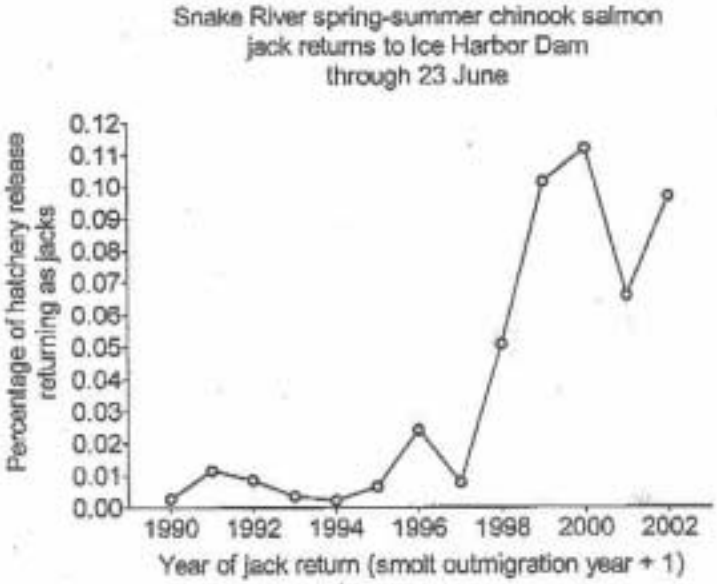

Figure 2. Annual percent return of jack spring-summer chinook salmon to Ice Harbor Dam through 23 June, based on the total number of spring-summer chinook salmon smolts released at Snake River Basin hatcheries (as reported in Fish Passage Center Annual Report) the previous migration year.

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MEMORANDUM

TO: Michele DeHart

FROM: David A. Benner

DATE: June 24, 2002

RE: **Spring Reservoir Operations**

During water year 2002, a year of approximately normal runoff volume, reservoir operators within the Columbia Hydrosystem were reluctant to provide supplemental water for BiOp spring flow objectives during the central portion of the spring anadromous fish migration. Relatively low flows in the river were a combined result of a delayed spring freshet and depleted storage reservoirs. In retrospect, it is very likely that flow objectives would/could have been met, had storage reservoirs operated differently entering the spring period. This document focuses on analyzing spring reservoir operations and further provides suggestion in regards to how operations may be altered as to reduce the future possibility of *not* achieving BiOp flow objectives on a weekly basis in years when runoff is normal.

Based upon the April 2002 final water supply forecasts, flow objectives were 97 kcfs at Lower Granite between 4/3/02 and 6/20/02, 246 kcfs at McNary between 4/10/02 and 6/30/02, and 135 kcfs at Priest Rapids from 4/10/02 and 6/30/02. Table 1 displays average weekly flows at Lower Granite, McNary, and Priest Rapids over eight weeklong periods. From Table 1, it is clear that both Lower Granite and McNary struggled to achieve BiOp flow objectives between May 26th and April 16th of 2002. Between 4/26/02 and 5/16/02, Lower Granite and McNary weekly aver-

age flows were between 20.6 and 46.3 Kcfs below the BiOp flow objectives. During this low flow period, TMT meetings focused on liberating extra water from storage reservoirs to supplement river flows; however, operators were reluctant and delayed decision making until the freshet had started. This low flow period occurred at an important phase for spring migrants.

Table 1. 2002 weekly average flows at Lower Granite, McNary, and Priest Rapids in comparison to the Spring Biological Opinion Flow Objectives.

Week WY 2002	***Lower Granite*** Weekly Average Flow (Flow Obj. = 97 Kcfs)	***McNary*** Weekly Average Flow (Flow Obj. = 246 Kcfs)	***Priest Rapids*** Weekly Average Flow (Flow Obj. = 135 Kcfs)
4-19 to 4-25	72.7	268.4	185.6
4-26 to 5-2	61.3	213.2	147.4
5-3 to 5-9	72.8	226.4	150.5
5-10 to 5-16	61.0	199.7	141.0
5-17 to 5-23	91.0	239.9	144.4
5-24 to 5-30	99.6	267.6	165.1
5-31 to 6-6-	126.2	341.4	210.8
6-7 to 6-13	87.7	326.8	234.4

Reservoirs were generally over drafted in the early spring months. Figures 1 through 4 display operations at each of four major storage reservoirs within the Columbia Hydrosystem: Grand Coulee, Dworshak, Brownlee, and Hungry Horse. At all locations, with the exception of Dworshak, reservoirs were drafted significantly below their winter/spring flood control elevations, requiring them to refill to attempt to meet the April 10th Biological Opinion target. If the reservoirs were operated in accordance with the winter/spring flood control targets then reservoirs would typically either need to be drafted or only slightly refilled to reach their respective April 10th targets.

The NMFS Biological Opinion directly states:

> " The Flow-management program uses three strategies:
>
> • Limit the winter/spring drawdown of storage reservoirs to *increase* spring flows and the probability of reservoir refill.
>
> … Before the 1995 Biological Opinion, FCRPS storage reservoirs routinely drafted well below these levels (flood control) to maximize hydropower generation during the fall and winter. Meeting the spring flow objectives occasionally requires reservoir drafting, but

> the *spring flow objectives are primarily met by limiting winter drafting and refill rates*. This operation allows for a more natural spring hydrograph by passing spring runoff through storage reservoirs."

According to the BiOp, the over drafting of reservoirs in the winter/spring directly influences the likelihood of meeting the flow objectives before the freshet. Therefore, over drafting directly contradicts the intent of the Biological Opinion. From the above BiOp statement, it is clear that reservoir drafting has occurred for years and the negative impacts in terms of spring flows are known. Yet, operators continue to overdraft with little consequence.

Figure 1 displays operations at Grand Coulee, the largest of the storage reservoirs with in the Columbia Hydrosystem (5,185,500 acre-feet of active storage), over the first one-half of 2002. Grand Coulee was drafted heavily over the winter months of 2002, when the demand for electricity was high. During the winter months, Grand Coulee was drafted over 30 feet below its flood control elevations (Figure 1). By the middle portion of March, Grand Coulee had dropped nearly thirty feet to 1255.0 feet AMSL, and subsequently had to refill to meet the April 10th Biological Opinion target. After meeting the BiOp target, Grand Coulee immediately began drafting water to meet flood control targets.

In 2002, the Bureau of Reclamation (BOR) was very reluctant to draft Grand Coulee below 1240 feet AMSL, despite the fact that river flows were well below the Biological Opinion objectives. Reservoirs generally met their end of April flood control targets and were reluctant to draft further; however, earlier in the winter/spring operators had routinely drafted *well* below the flood control elevations. In 2002, the spring freshet was delayed and the river was relying on the storage reservoirs to release water to meet the BiOp flow objectives. Between 4-26-02 and 5-16-02, the operators at Grand Coulee did liberate some additional water to supplement flows in the Columbia River (approximately five feet of reservoir space from 1245 to 1240 feet AMSL).

From the operation of Grand Coulee over 2002, several issues are important for discussion. First off, according to Action 14 of the NMFS 2000 Biological Opinion:

> The Action Agencies shall operate FCRPS dams and reservoirs with the intent of meeting the flow objectives on both a *seasonal* and *weekly* average basis for the benefit of migrating juvenile salmon.

Currently, the Columbia is operated to meet flow objectives on a seasonal basis, but not a weekly basis. If flow objectives are analyzed on a seasonal basis, a scenario exists where operators may run the river on low water until the freshet begins. It seems sensible to reinforce to the Action Agencies the importance of meeting the BiOp flow objectives on a weekly basis, possibly creating consequences for not meeting weekly flow targets during years of normal water. As was the case in 2002, operators should not have the right to refuse to liberate water beyond a certain elevation, against the wishes of nearly every other agency. Priorities may need to be reevaluated.

Furthermore, the BiOp states that the reservoirs should limit draft in the winter/spring. Grand Coulee drafted *significantly b*elow its flood control targets during the winter/spring. On the other hand, Grand Coulee was reluctant to draft below flood control during the middle of spring when the water was needed to fulfill BiOp flow objectives.

At Grand Coulee, BOR stated that they could not draft below 1240 feet AMSL during the low flow period before the onset of the freshet. If a spring draft limit actually exists then this should be accounted for before the onset of the BiOp flow period. Reservoirs should have enough water to supplement flows in the event that the freshet is delayed. It should be pointed out that Grand Coulee has regularly drafted below 1240 feet AMSL over the same period in past years. The following displays the draft elevations below 1240 feet AMSL at Grand Coulee over the last six years:

1996: Grand Coulee drafted to **1227** feet AMSL in mid-May
1997: Grand Coulee drafted to **1208** feet AMSL in early-May
1999: Grand Coulee drafted to **1214** feet AMSL in early/late-May
2000: Grand Coulee drafted to **1233** feet AMSL in mid/late-May
2001: Grand Coulee drafted to **1217** feet AMSL in late-April

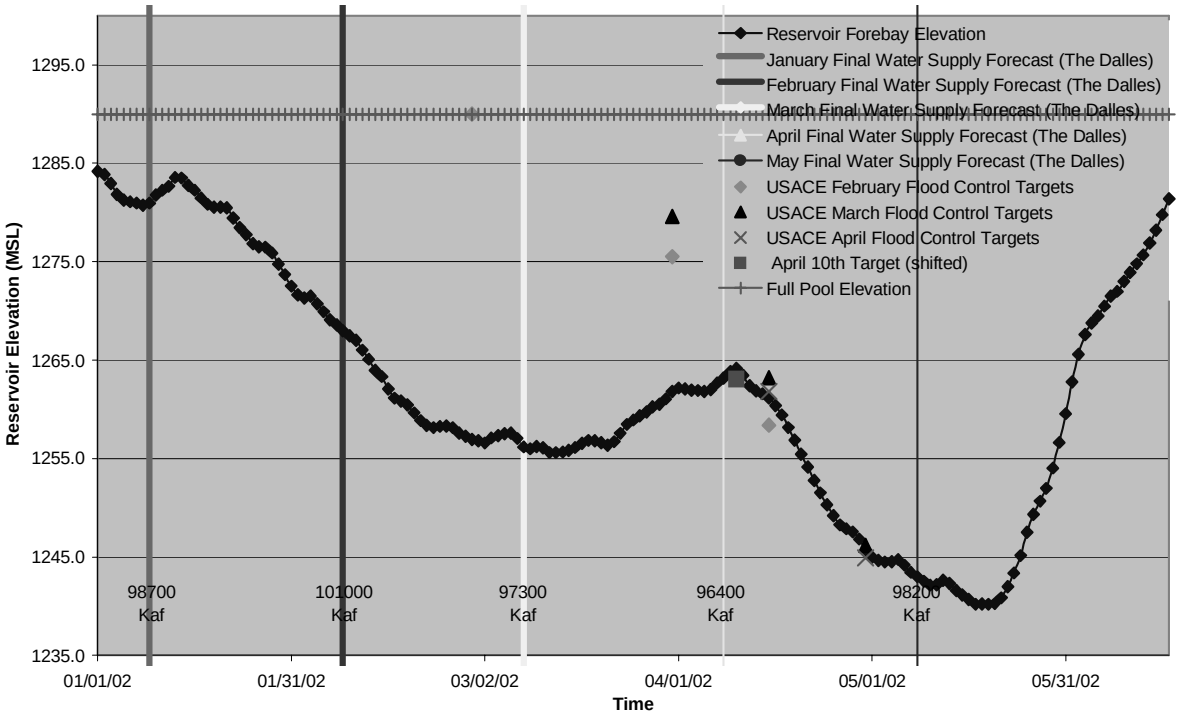

Figure 1. Reservoir operations at Grand Coulee over the first one-half of 2002.

Figure 2 displays the operation of the Dworshak reservoir (useable storage = 2,015,000 acre-feet) over the first one-half of 2002. For most of the year, Dworshak was operated above the USACE determined flood control elevations, as a result of a shift that traded some flood control space with Grand Coulee. During the spring of 2002, Dworshak was able to use reservoir water to supplement flows during the low flow period before the onset of the freshet. At the time, USACE was concerned that releasing water to supplement flows would negatively impact the probability of refill by June 30th at Dworshak. However, calculations performed by USACE demonstrated that a significant volume of water was available for flow augmentation with Dworshak still having a 70% chance of refilling. TMT calls were confused with various water supply forecasts during the decision making process. It is recommended that a standard water supply forecast (i.e., 70% probability) and method be agreed upon before a decision period arises. All calculations of refill and augmentation volumes should use the same standard forecast, methods, etc. As it turns out, Dworshak is only feet away from refilling with nearly two weeks before the June 30th refill date (Figure 2).

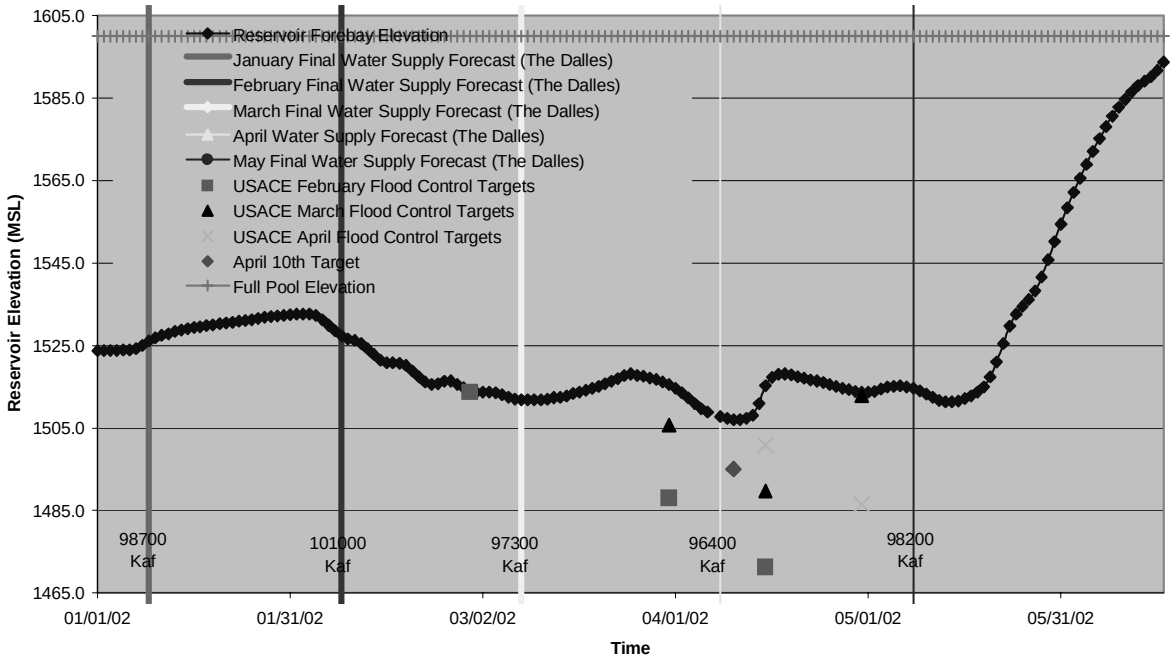

Figure 2. Reservoir operations at Dworshak over the first one-half of 2002.

Figure 3 displays the operation of the Brownlee reservoir over the start of 2002. Brownlee was drafted nearly ten feet below February and March flood control elevations. Brownlee began refilling around the beginning of April and essentially was within one foot of full by mid/late May. As mentioned earlier, the low flow period along the Columbia River that occurred before the onset of the spring freshet took place predominantly between 4-26-02 and 5-16-02. During

this period, System Operation Requests (SORs) were drafted (2002-03 and 2002-04) which included requesting that Brownlee reduce the rate of refill and pass inflow at a time when water was desperately needed further down in the Columbia Hydrosystem. Operators at Brownlee ignored these requests until the reservoir was within a few feet of full. Coincidentally, Brownlee began releasing more water at approximately the same time as the beginning of the spring freshet. Presently, Brownlee has been within one foot of full for over three weeks. In situations such as 2002 were the spring freshet is delayed, reservoirs should not be refilling during times when the BiOp objectives are not being met. More so, this should be reinforced when a reservoir is within ten feet of full with extremely minimal chances of not filling.

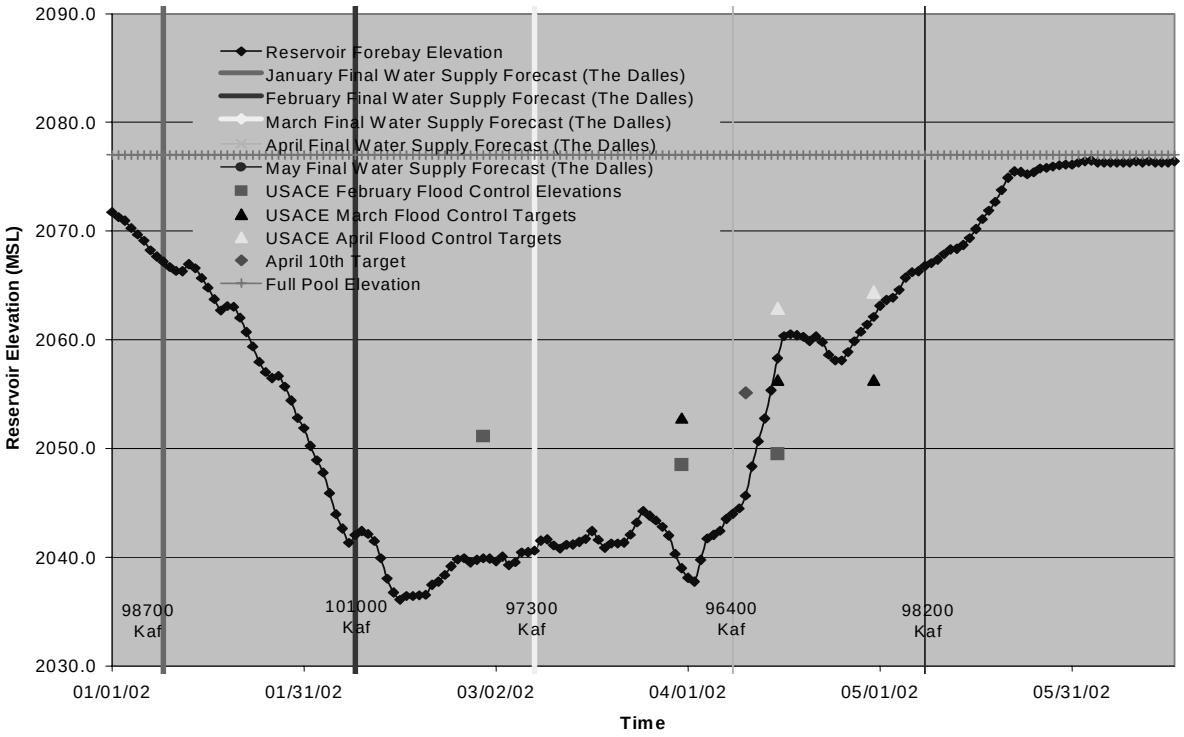

Figure 3. Reservoir operations at Brownlee over the first one-half of 2002.

Actions by the operators of the Brownlee reservoir did not fulfill the flow management objectives outlined in the Biological Opinion (see Action 14, page 3). Brownlee was taking water out of the system during the BiOp flow period when the objectives were not being met. If Brownlee had passed inflows, flows would have been closer to meeting the BiOp objectives. Instead, Brownlee refilled and presently remains nearly full and passing inflows.

Additionally, the BiOp states that the reservoirs should limit draft in the winter/spring. Brownlee drafted *significantly b*elow its flood control targets during the winter/spring (Figure 3). Accord-

ing to the BiOp, the over drafting of reservoirs in the winter/spring directly influences the likelihood of meeting the flow objectives before the freshet. Therefore, the over drafting of Brownlee directly contradicts the intent of the Biological Opinion.

Figure 4 displays operations at the Hungry Horse storage reservoir (active storage = 3,161,000 acre-feet) over the first one-half of 2002. Hungry Horse was drafted heavily over the winter months of 2002, when the demand for electricity was high. During this period, Hungry Horse was drafted more than 25 feet below its flood control elevations (Figure 4). By April 10th, the Hungry horse reservoir was at an elevation of approximately 3509 feet AMSL, over 20 feet below its Biological Opinion Target. Again, the over draft of the Hungry Horse reservoir contradicted the intent of the Biological Opinion.

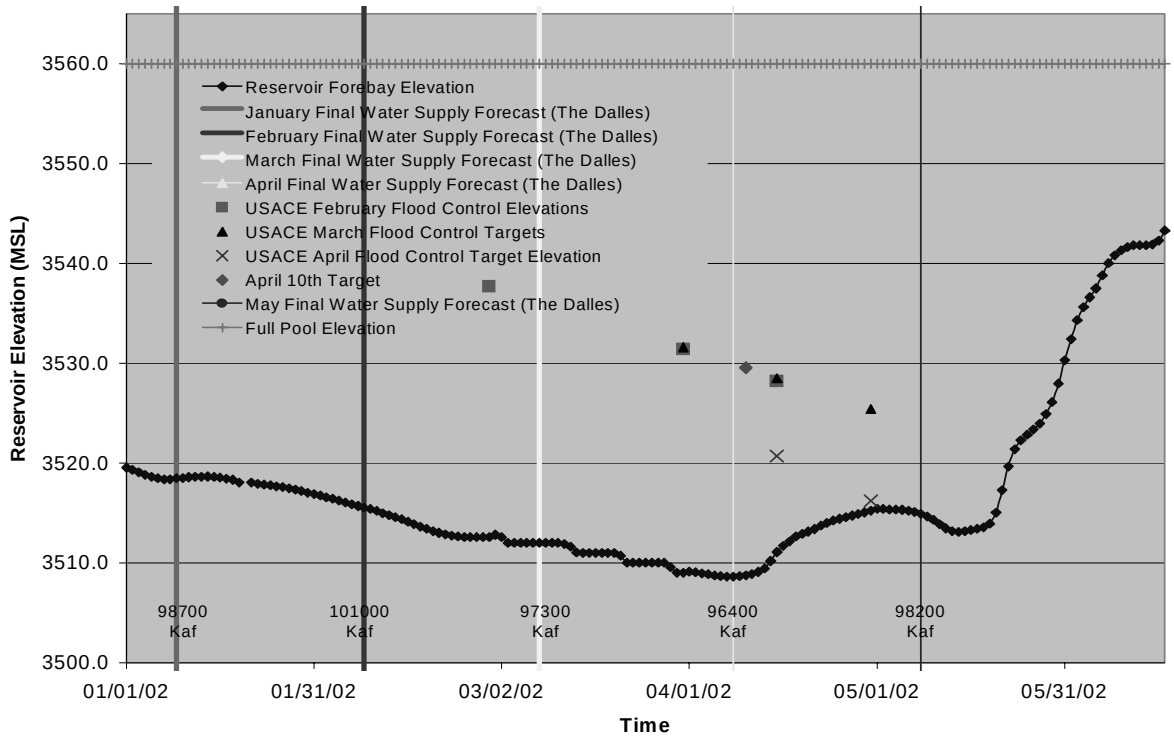

Figure 4. Reservoir operations at Hungry Horse over the first one-half of 2002.

Over the winter/spring of 2002, operators struggled to adhere to the Biological Opinion. In particular, reservoirs were over drafted in the winter/early spring, limiting the likelihood of meeting spring flow objectives. Furthermore, during the low flow period, operators were reluctant to release water need for flow augmentation, directly contradicting Action 14 of the BiOp (page 3).

The Bureau of Reclamation (BOR) over drafted the Grand Coulee and Hungry Horse reservoirs in the winter/early spring of 2002. Additionally, BOR did not operate the mentioned reservoirs with the intent of meeting the flow objectives on both a *seasonal* and *weekly* average basis for the ben-

efit of migrating juvenile salmon. BOR essentially refused to draft Grand Coulee below 1240 feet AMSL, yet had drafted well below the mentioned point in five of the last six years.

The Idaho Power Company also over drafted the Brownlee reservoir over the winter/early spring of 2002. Additionally, operators at Brownlee were actively refilling at a time of Columbia River flows below the BiOp objectives. Between 4-26-02 and 5-16-02, water was desperately needed in the Columbia River; at this time, Brownlee was with in 10 feet of full and continuing to refill.

Generally, the first one-half of 2002 represented a normal year in terms of runoff volumes. Yet, early reservoir operations severely limited the ability of the Columbia River Hydrosystem to supply additional water during a time of low flows and delayed freshet. In future years, winter reservoir operations should be analyzed to a larger degree, to ensure that spring flows have a reasonable chance of maintaining, on a weekly basis, the BiOp flow objectives.

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MEMORANDUM

TO: Jim Ruff, NMFS
Bill Tweit, WDFW
Sharon Kiefer, IDFG
Howard Schaller, USFWS
Rob Lothrop, CRITFC
Tony Nigro, ODFW
FPAC

FROM: Michele DeHart

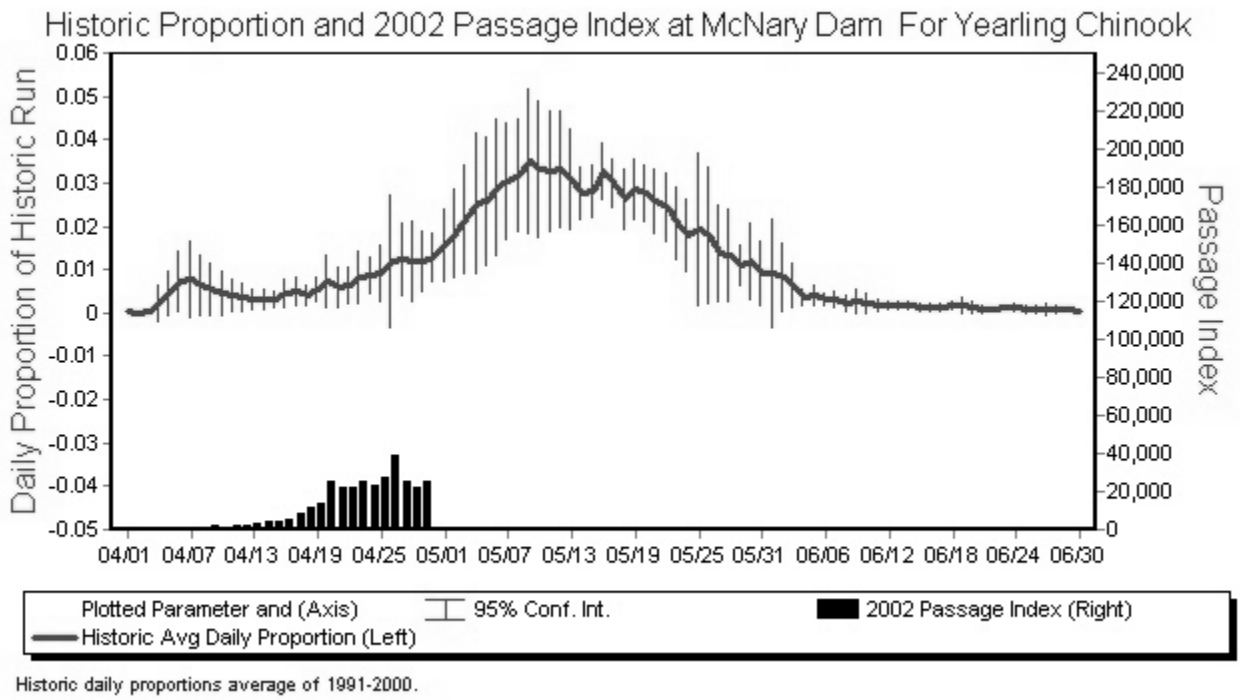
DATE: May 1, 2002

RE: Juvenile Fish Passage Status Report

An emergency Technical Management Team meeting was held to discuss a US Bureau of Reclamation proposal regarding the operation of Grand Coulee Dam and Reservoir. The USBR is proposing to limit Grand Coulee draft to elevation 1240 and then to begin refill. The USBR proposal will result in flows at McNary Dam, which are much lower than the NMFS fish migration flow target. The FPC staff reviewed and summarized the fish passage data for consideration in this discussion. The following discussion of historic versus present fish passage emphasizes the following points:

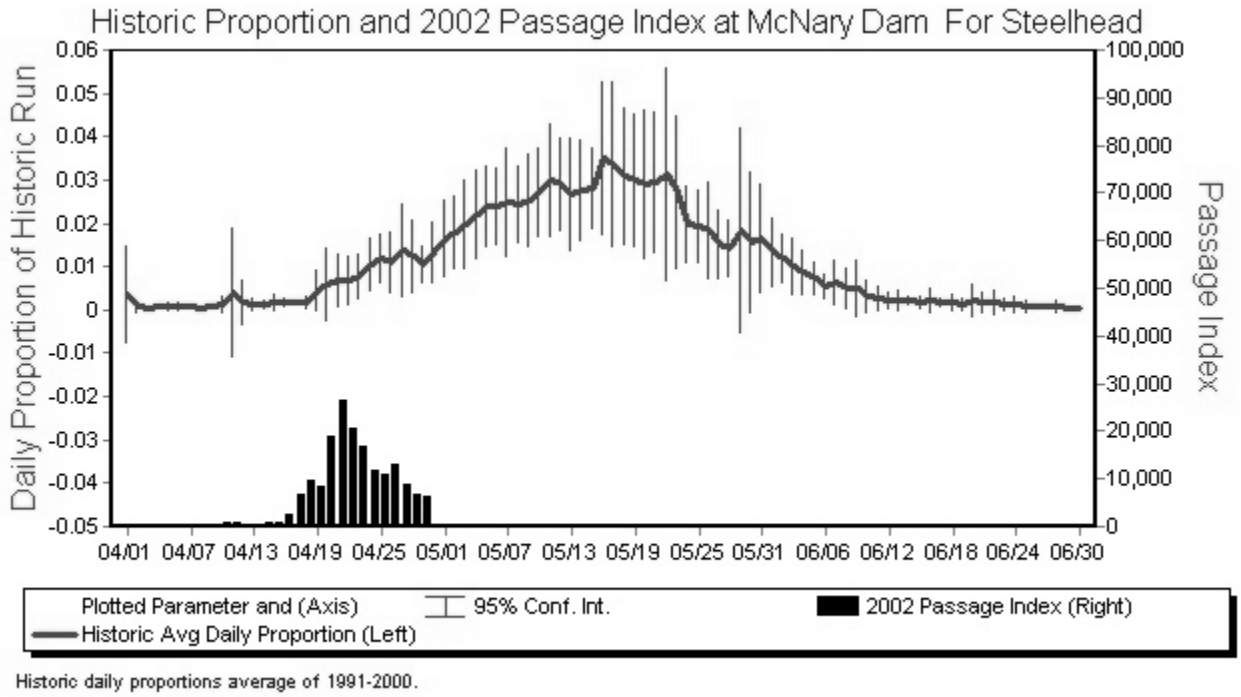
- The historic timing curve shows a rapid increase in rate of passage beginning May 1 and continuing increase the first ten days of May.
- Presently the passage of Chinook is not increasing and the passage rate of steelhead is declining.

In the following plot we see that the largest numbers of yearling chinook smolts pass McNary Dam during the month of May. The historic average timing curve shows a rapid increase in rate of passage (steeper increasing slope) beginning May 1 and lasting the first 10 days of May. Coinciding with this increasing passage has been the general pattern of increasing flows during May. The past nine days in April of 2002 have seen a fairly flat passage of yearling chinook at McNary Dam. During this time flows have been decreasing from 300 kcfs to around 200 kcfs. This drop in flow appears to have suppressed the normal increase in yearling chinook smolt passage that should typically occur at this time. If flows continue to be below average for early May, then the normal increasing passage of yearling chinook during May will also most likely be delayed. PIT tagged wild chinook from the Yakima and Walla Walla River basins have been detected at McNary Dam since April 4. PIT tagged wild chinook from the Snake River basin have been mostly (97%) detected at McNary Dam since April 20 (see attached table).



In the following plot we see that the largest numbers of steelhead smolts also pass McNary Dam during the month of May. The historic average timing curve shows a rapid increase in rate of passage (steeper increasing slope) beginning May 1 and lasting the first 10 days of May. Coinciding with this increasing passage has been the general pattern of increasing flows during May. Coinciding with this increaseing passage has been the general pattern of increasing flows during May. But unlike the flat passage of yearling chinook during the past nine days in April 2002, we see a decreasing passage of steelhead. During this time flows have been decreasing from 300 kcfs to around 200 kcfs. This drop in flow appears to have done more than just suppress the normal

increase in steelhead smolt passage, it appears to have cause passage of steelhead to drop. This is a sign that flows currently are too low to adequately move steelhead through the hydro system. If flows continue to be below average for early May, then the normal increasing passage of steelhead during May could be delayed enough to cause reduced in-river survival in 2002. PIT tagged wild steelhead from the Yakima River and Snake River basins have been the most consistent groups detected at McNary Dam since mid-April (see attached table).



In addition detection of PIT tagged steelhead and Chinook juveniles at McNary Dam show that wild and hatchery Chinook and steelhead originating throughout the Snake River Basin and the Yakima River basin are passing the project. Yakima River stocks are maintaining a strong presence at McNary Dam.

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MEMORANDUM

TO: Michele DeHart

FROM: David A. Benner

DATE: May 1, 2002

RE: **May 2002 Flows for Lower Snake and Lower Columbia Rivers**

In response to our discussion on April 30, 2002, I have researched potential additional water supplies at several projects in anticipation of decreased flows within the Columbia and Snake Rivers before the onset of the spring freshet. Several possible sources of water were located:

1. Grand Coulee

Flows are projected to drastically decrease at Grand Coulee, directly influencing the spring flow targets at Priest Rapids and McNary. Essentially, Grand Coulee contains water available to supplement flows in the lower Columbia River. According to calculations, it appears that a total volume of 600 Kaf of water would be involved if Grand Coulee were to pass inflows and draft approximately 30 Kcfs of water for ten days. Assuming the current (4-30-02) elevation to be 1245 feet AMSL (useable storage = 1978 Kaf), a 600 Kaf draft would lower the reservoir to approximately 1235 feet AMSL (useable storage = 1378 Kaf). According to the latest flow projections, McNary flows may decrease as low as 136 to 178 Kcfs between May 7th and May 15th, 2002. A 30 Kcfs increase from Grand Coulee would drastically assist flows at McNary.

However, some issues have arisen concerning the pumping of water into Banks Lake if Grand Coulee were to decline below 1240 feet AMSL. The full pool elevation at Banks Lake is 1570

feet AMSL and current irrigation outflows are approximately 7000 cfs. Also, it is known that the BOR is authorized to operate Banks Lake five feet below the full pool elevation. As of 4-29-02, the elevation of Banks Lake was 1267.9 feet AMSL, leaving 2.9 feet of water available before reaching the level five feet below full pool. Additionally, according to personnel at the Grand Coulee Power Office, one-foot of reservoir water is equivalent to 24,000 acre-feet of water, therefore with 2.9 feet of available water, a volume of 69,600 acre-feet is currently available for irrigational uses if inputs from Grand Coulee were to stop. At a current rate of output of 7,000 cfs, the 2.9 feet of available water would last approximately five days. It should be pointed out that that the pumps at Grand Coulee will continue to be operable for inputs to Banks Lake below an elevation of 1240 feet AMSL, therefore, the five day supply of water would act essentially as a water supply "cushion. It may also be advisable, if possible, to limit irrigational uses from Banks Lake over the anticipated low flow period.

At any rate, the 600 Kaf of water used now from Grand Coulee could be made up in a period of less than a week during the spring freshet and still meet flow objectives at Priest Rapids and Grand Coulee.

2. Dworshak

Dworshak is currently releasing approximately 15 Kcfs of water, 10.5 Kcfs through the powerhouse and about 4.5 Kcfs of spill water. Based upon the daily Dissolved Gas Reports on the USACE website, Total Dissolved gas levels are not being exceeded below Dworshak, and therefore additional room exists to spill larger volumes of water at Dworshak. Currently, Dworshak just ended the month of April well *above* its flood control target, and the April Mid-month water supply forecast has runoff volumes at Dworshak from April to July being 121% of normal. It may be possible to initiate the spill of an additional 5 Kcfs of water at Dworshak, monitor TDG levels, and re-adjust spill accordingly. Any additional flows at Dworshak would assist flow objectives at Lower Granite and also McNary.

3. **Brownlee**

The Brownlee reservoir ended April at 2062.1 feet AMSL; its end of April flood control target was 2064.4 feet AMSL. Over the past several days, Brownlee has been refilling. The Brownlee reservoir would decrease approximately 1 foot per day if the reservoir were to pass inflows and draft 5 Kcfs of water during the project low flow period. It should be pointed out that the April Mid-month water supply forecast predicted only 61% of the average runoff at Brownlee. However, it is anticipated that the relatively minor volume of water potentially used from Brownlee could be made up in a short period after the onset of the spring freshet. At any rate, water released from Brownlee would provide further assistance to flow targets at McNary.

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MEMORANDUM

TO: FPAC
CSS Oversight Committee

FROM: Michele DeHart

DATE: April 24, 2002

RE: Planned operations at Lower Monumental Dam starting May 1, 2002

The FPC staff has reviewed the most recent decision by NMFS regarding the operations at Lower Monumental Dam. NMFS advised FPAC that planned research was a key consideration in the decision to change operation from full flow bypass to every other day transportation on May 1. The CSS Oversight Committee had reviewed the options provided by NMFS for Lower Monumental operations and had recommended that Lower Monumental continue in a full flow bypass operation through the entire spring migration to facilitate the analysis of CSS data. NMFS instead indicated that they would pursue the full transportation option to facilitate their transportation research. In discussions of this option the agencies and tribes maintained that this would not be a useful test of transportation because the in-river group would not be experiencing BIOP passage conditions. Subsequently, NMFS has proposed a fifth option, which is based upon every-other-day transportation.

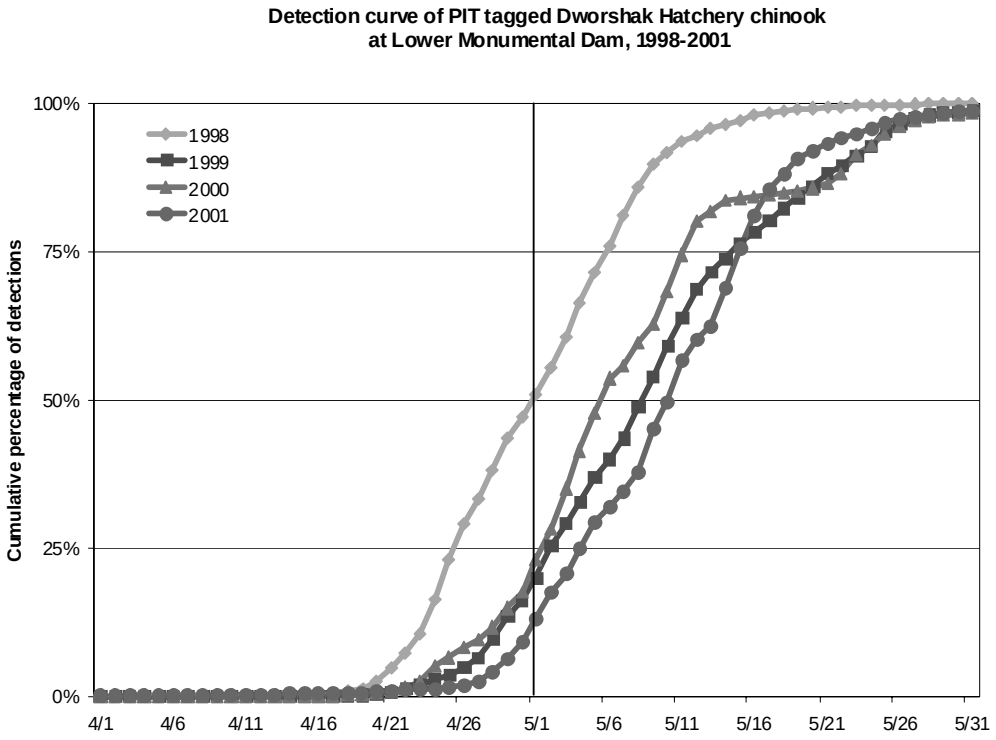
The most recent plan of NFMS to operate Lower Monumental Dam with alternating days of transportation and full bypass passage does not improve the problems the change in operations on May 1 presents for the CSS analysis, in fact it will only exacerbate the impacts already imposed on the conduct and analysis of the CSS. This is because the present April operation has resulted in virtually all PIT tagged CSS hatchery and wild chinook passing Lower Monumental Dam in April to pass without the possibility of detection. Changing operations on May 1 means that a varying portion of each mark group will be detected over the season. This limits possible

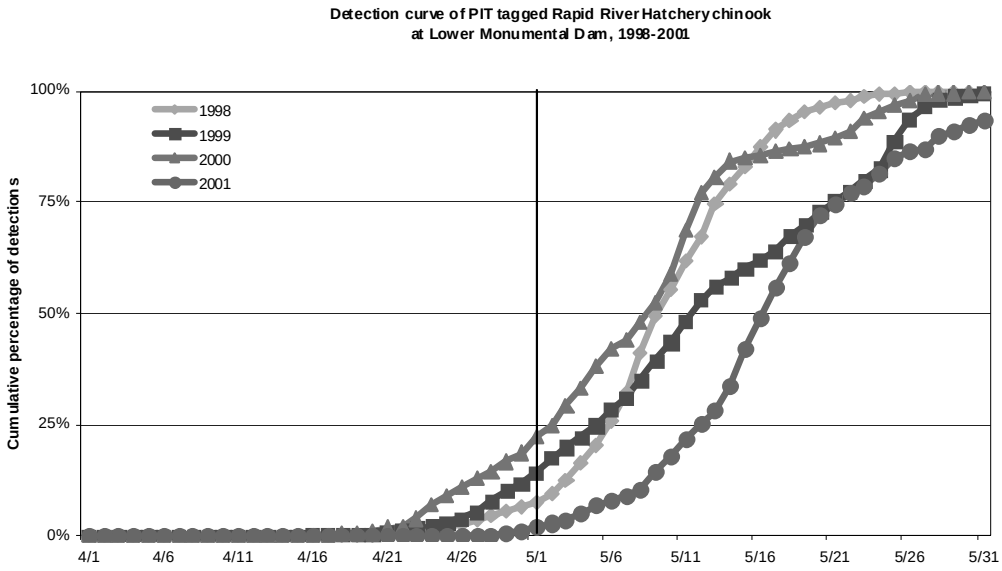
analysis at Lower Monumental Dam in 2002. The most straightforward approach will be to simply consider Lower Monumental Dam as a non-existent PIT tag detection site for the entire springtime migration season.

Continuing the full bypass mode would be the most consistent operation at Lower Monumental Dam. Survival estimates would be generated directly for the longer reach between Little Goose Dam tailrace and McNary Dam tailrace, without the ability to partition this overall survival between that above and below Lower Monumental Dam tailrace components. How the fish pass Lower Monumental Dam for the entire springtime season would be consistent, either through the turbines or through the bypass channel (following primary dewatering only), and possibly some limited periods of above hydraulic capacity spill. This consistent springtime operation at Lower Monumental Dam would be the preferred for the CSS. At least then the conditions over which the smolts pass Lower Monumental Dam would be more controlled.

With the new NMFS plan of operating Lower Monumental Dam with alternating days of transportation and full bypass passage, or even if went to transportation every day starting in May, the CSS PIT tagged fish would still need to be returned to the river on the transportation days. Since this operation would not allow the estimating of the survival and collection efficiency parameters at Lower Monumental Dam, it would not be possible to remove CSS PIT tagged smolts for transportation without biasing the survival estimation in the longer reach from Little Goose Dam tailrace to McNary Dam tailrace for these CSS smolts, because the need is to account for survival up to the point where the actual removal of PIT tagged smolts for transportation takes place. As for trying to maintain more similar conditions over which the smolts pass Lower Monumental Dam starting in May to what occurred in April, one could view the new alternating day operations as potentially closer to that of full bypass operation in that 50% of the time there would be full bypass operation. However, the alternating day operations will not help in your ability to estimate survival and collection efficiency parameters at Lower Monumental Dam after May 1.

To conclude, the FPC staff still recommends a constant operation at Lower Monumental through the spring migration season, which means maintaining full flow bypass at Lower Monumental. But as for the CSS, there will not be any attempt to route PIT tagged smolts to transport at Lower Monumental Dam, because of the problems described above regarding parameter estimation and because of the fact that nearly one-third or more of the hatchery chinook passage distribution will have already passed Lower Monumental Dam by the time this new operation would be implemented. Since only first-time detected PIT tagged CSS smolts (no prior detection at Lower Granite or Little Goose dams) are candidate fish for transportation at Lower Monumental Dam, the operation as being planned would likely result in fewer than desired numbers of smolts to evaluate transportation from Lower Monumental Dam versus transportation at an upstream dam or versus remaining in-river and undetected below Lower Monumental Dam (CSS Category C_0). Therefore, the CSS PIT tagged smolts will only be transported at Lower Granite and Little Goose dams for the 2002. The NMFS plan to generate a transportation SAR, by switching project operations on May 1, may introduce weaknesses into the analysis that significantly reduce the application and utility of the results.


Detection curve of PIT tagged Dworshak Hatchery chinook
at Lower Monumental Dam, 1998-2001
Cumulative percentage of detections
100%
75%
50%
25%
0%
1998
1999
2000
2001
4/1
4/6
4/11
4/16
4/21
4/26
5/1
5/6
5/11
5/16
5/21
5/26
5/31


Detection curve of PIT tagged Rapid River Hatchery chinook
at Lower Monumental Dam, 1998-2001
Cumulative percentage of detections
100%
75%
50%
25%
0%
1998
1999
2000
2001
4/1
4/6
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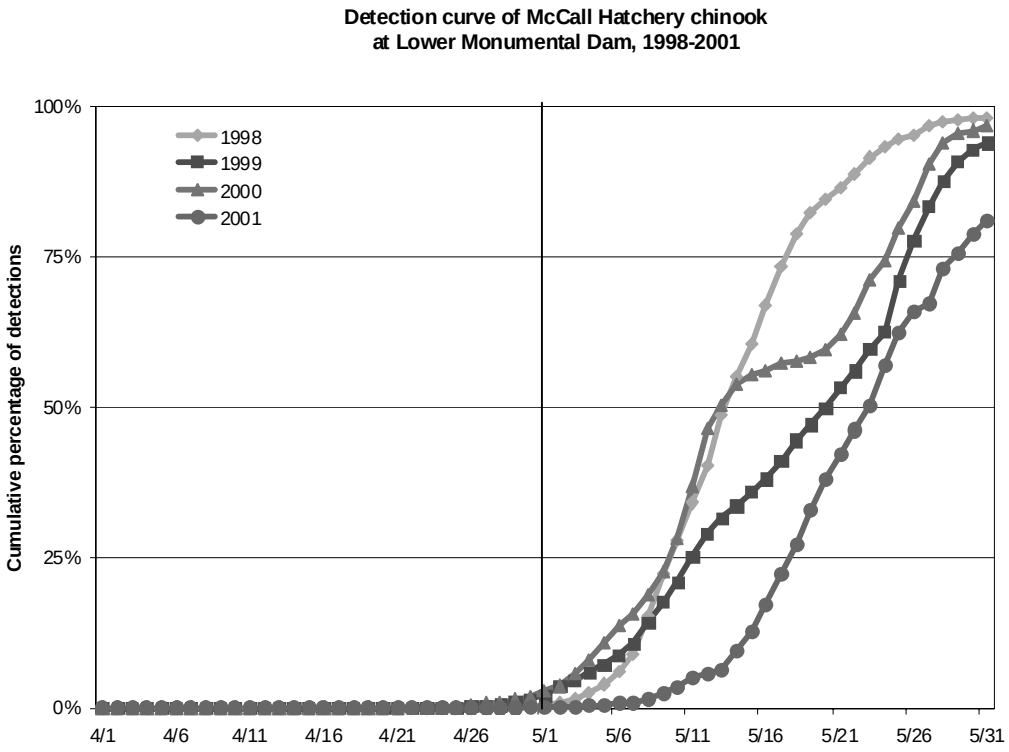
5/16
5/21
5/26
5/31


Detection curve of McCall Hatchery chinook
at Lower Monumental Dam, 1998-2001
Cumulative percentage of detections
100%
75%
50%
25%
0%
1998
1999
2000
2001
4/1
4/6
4/11
4/16
4/21
4/26
5/1
5/6
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5/16
5/21
5/26
5/31

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MEMORANDUM

TO: Brian Brown, NMFS
Jim Ruff, NMFS
Paul Wagner, NMFS
FPAC

FROM: Michele DeHart
FPC Manager

DATE: April 22, 2002

RE: NMFS Decision Regarding Lower Monumental Dam

On April 1, 2002 the Fish Passage Center Staff provided a memo to FPAC detailing a preferred alternative for Lower Monumental and Little Goose dam operation in 2002 (Attachment A). This alternative was intended to address the termination of spill at Lower Monumental Dam throughout the 2002 migration. The alternative operations were originally discussed at FPAC on March 19th and March 26th. On March 26th the FPC agreed to look at the alternatives in more detail and to provide additional information for discussion on April 2nd, prior to the discussion at TMT on April 3, 2002. However, on April 2nd the NMFS advised that an alternative had already been agreed to by the federal agencies. This alternative was significantly less than the alternative slated for further discussion at FPAC.

A request was made by the State of Oregon to provide in writing the technical justification upon which the federal agreement was based. While NMFS did not send an actual response articulating the specific reasoning used for rejecting Option 2, they provided general documentation from which the agencies were left to ascertain the NMFS logic. This information provided by NMFS in response to the request is contained in Attachment B. After reviewing the information provided by NMFS we do not agree with the decision regarding operation of Lower Monumental

Dam that was made for 2002 for the following reasons:

1. NMFS apparently used SIMPAS modeling to assess that the difference in juvenile survival due to terminating spill at Lower Monumental Dam would be on the order of a 1% decrease. This small decrease leads one to believe that significant changes to the system are not necessary to offset the LMN operation. We do not agree with NMFS use of SIMPAS in terms of generating point estimate information. We have objected to this application of the output from SIMPAS in other analyses (see FPC comments on impacts of terminating spill in 2001). SIMPAS is best used in evaluating relative benefits of changes. The fact that SIMPAS showed a decrease in survival is reason enough to look at significant changes to the proposed operation.

2. NMFS provided a memo from Mike Schiewe that suggests that migration from Lower Granite early in April does not show a positive benefit from transportation. We agree with this assessment since it is consistent with what we have reported for the CSS study. However, we do not agree with the implication that past May 1 there is a positive benefit from transportation from Lower Monumental Dam, as there appears to be for Lower Granite Dam. NMFS does not appear to agree with the assessment that the transport benefit ratios are equivocal from Lower Monumental Dam.

   In a recent study "Estimation of Smolt-to-Adult return percentages for Snake River Basin Anadromous Salmonids, 1990-1997", (Sanford and Smith, 2002) it was shown that fish transported from Lower Granite and Little Goose dams generally had higher SARs than fish transported from Lower Monumental or McNary dams. Giorgi et al, 2002 concluded "the rationale for transporting smolts from Lower Monumental and McNary dams is less clear. The benefits of transporting Snake River hatchery fish from those dams are equivocal." These reviews of the data suggest that transportation does not provide a substantial benefit from this project. Additionally, much of the concern regarding bypassing fish at this project was a function of the outfall conditions from the bypass pipe. Full flow bypass addresses many of the concerns by limiting stress on fish due to dewatering and by increasing outflow velocities to improve bypass exit conditions.

3. The existence of delayed differential mortality (D) necessitates the implementation of alternate strategies, such as "spreading the risk". Spill is integral to the recovery of Snake River listed species in providing a passage route with the lowest associated mortality, as well as maintaining an in-river population of migrating salmonids to spread the risk. The Comparative Survival Study results provide empirical evidence for delayed hydrosystem mortality for both hatchery and wild Snake River spring/summer chinook (Comparative Survival Study Final Report, February 2002).

   The relative proportion of fish that would be transported for the option recommended for implementation by NMFS results in near 80% of the juvenile migrants being transported from the Snake River this year. Consequently, the goal of spreading the risk is not achieved by going to full flow bypass only during the month of April.

4. The fourth reason that NMFS has used to justify beginning transport from the project beginning May 1 is their need to collect fish from LMN for a study that is being conducted at Ice Harbor Dam. We do not agree that a research need should dictate the operation of a project over the provision of better fishery migration conditions. We believe that NMFS could have made alternate arrangements for the collection of fish, such as collecting fish at Little Goose Dam.

NMFS has also expressed a desire to collect TBR information from Lower Monumental Dam this year in order to address whether transport from this project is equivocal. They state that conduct of the study this year will likely yield results that will settle the concern at this project. However, it is unlikely whether one year of information is sufficient to address the concerns for this project and, again, the conduct of a research study should not preclude the implementation of the better management action for fish.

In addition, full flow bypass at Lower Monumental dam for the entire spring period could be more informative than initiating transport at this project beginning May 1. There are several years of completed transportation studies for Lower Monumental Dam and there are several planned years of study for the future. In most years the smolt to adult return rates for the transported fish have been lower than the rates for the unseen in-river group (Sandford and Smith, 2002 in press). NMFS has expressed interest in conducting their transport study at Lower Monumental in 2002 since larger numbers of juveniles will be transported from Lower Monumental this year, which will yield a more precise estimate for the transported group. However, the unseen in-river group will be severely altered by the transportation configuration that NMFS will implement on May 1. Consequently, the 2002 proposed operation would not yield any data that will refine the ability to determine the effectiveness of transportation as a management strategy at Lower Monumental. On the other hand, if the system remains in full flow bypass throughout the season it may result in useful information regarding full flow bypass as a future passage option at Lower Monumental Dam. Furthermore, the continuation of full flow bypass for the entire spring migration provides a consistent operation that is preferable for complete analysis of fish tagged as part of the CSS study.

So in conclusion, given that based on the information collected to-date spread-the-risk is the best management strategy and that transportation is equivocal from this project, the in-river strategy, with full flow bypass at Lower Monumental Dam represents the best fishery recommendation for the 2002 migration. It remains unclear why Option 2 was not chosen as the best management strategy for fish. The NMFS decision to reject Option 2 failed to consider that full flow bypass might have potential as the future preferred operational choice at Lower Monumental Dam. We recommend that NMFS reconsider the May to June 20 operation proposed for Lower Monumental Dam.

ATTACHMENT A

FISH PASSAGE CENTER

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MEMORANDUM

TO: FPAC

FROM: Fish Passage Center Staff

DATE: April 1, 2002

RE: Snake River Operations for 2002

The US Army Corps of Engineers has contracted to conduct repairs in the stilling basin below Lower Monumental Dam that preclude the provision of spill at this project for the entire 2002 migration season. Under normal Biological Opinion operations spill at this project would have been implanted 24-hours per day throughout the spring migration. Spill at the Snake River projects is not called for by the Biological Opinion during the summer migration period, in order to maximize transportation from these projects. Several alternative operations have been discussed for implementation this spring to offset the impact of this repair work regarding operations in the Snake River that best address fish passage in this compromised operational scenario. Those alternatives range from terminating spill at Little Goose Dam and implementing full transport at Little Goose and Lower Monumental dams to increasing spill to twenty-four hours at Little Goose Dam and terminating transport at Lower Monumental and implementing full flow bypass at this project. This second option has been proposed for the month of April only, or for the entire spring migration period.

While there is little argument that survival rates in fish transported through the hydrosystem exceeds the survival of fish migrating through the hydrosystem, the existence of delayed differential mortality (D) necessitates the implementation of alternate strategies, such as purposely keeping fish in-river and “spreading the risk”. Spill is integral to the recovery of Snake River listed species in providing a passage route with the lowest associated mortality, as well as main-

taining an in-river population of migrating salmonids to spread the risk. The Comparative Survival Study results provide empirical evidence for delayed hydrosystem mortality for both hatchery and wild Snake River spring/summer chinook (Comparative Survival Study Final Report, February 2002). The following shows the relative proportion of fish that would be transported over the range of options being discussed.

Option 1: Biop spill at only at LGR all season
transport all 3 dams

site	spill prop	sp:ph odds	SPE	P(fish|PH)	P(fge)	P(J)
LGR	0.28	2.5:1 1.8	0.51	0.70	0.35	
LGS	0.00	2:1	1.00	0.72	0.72	
LMN	0.00	2:1	1.00	0.48	0.48	

Estimate of transport proportion — Chinook Yearlings
P = P1 + (1-P1)*P2 + (1-P1)(1-P2)*P3 — **0.91**

If spill was terminated at Little Goose Dam and transport maximized at both Little Goose and Lower Monumental dams the proportion transported would exceed 91%.

Option 2: Biop spill at LGR and 2*biop at LGS only in April
start LMN transport in May

site	spill prop	sp:ph odds	SPE	P(fish|PH)	P(fge)	P(J)
LGR	0.28	2.5:1 1.8	0.51	0.70	0.35	
LGS	0.25	2:1 1.6	0.60	0.72	0.43	
LMN	0.00	2:1	1.00	0.48	0.36	<= 75% run in May

Estimate of transport proportion — Chinook Yearlings
P = P1 + (1-P1)*P2 + (1-P1)(1-P2)*P3 — **0.76**

If 24 hour spill was implemented at Little Goose Dam and transport were suspended from this project for the month of April the proportion transported would be reduced to approximately 76%.

Option 3: Biop spill at LGR and 2*biop at LGS over season
no transport at LMN

site	spill prop	sp:ph odds	SPE	P(fish|PH)	P(fge)	P(J)
LGR	0.28	2.5:1 1.8	0.51	0.70	0.35	
LGS	0.40	2:1 1.4	0.43	0.72	0.31	
LMN	0.00	2:1	1.00	0.48	0.00	

Estimate of transport proportion — Chinook Yearlings
P = P1 + (1-P1)*P2 + (1-P1)(1-P2)*P3 — **0.55**

However, if this same scenario were conducted throughout the spring migration the goal of spreading the risk would be better achieved by going to full flow bypass throughout the season. (Keep in mind that these are not exact numbers but represent the relative change among scenarios. For lack of better information we treated Lower Granite Dam as if were spilling to Biological Opinion levels every day in the season. However, due to the conduct of the RSW tests it is unlikely that the project will operate in this fashion and we have overestimated the effect of spill at Lower Granite Dam. Consequently, the actual proportions transported would likely be higher.)

In a recent study "Estimation of Smolt-to-Adult return percentages for Snake River Basin Anadromous Salmonids, 1990-1997", (Sanford and Smith, 2002) it was shown that fish transported from Lower Granite and Little Goose dams generally had higher SARs than fish transported from Lower Monumental or McNary dams. Giorgi et al, 2002 concluded that "the rationale for transporting smolts from Lower Monumental and McNary dams is less clear. The benefits of transporting Snake River hatchery fish from those dams is equivocal." These reviews of the data suggest that transportation does not provide a substantial benefit from this project. Additionally, much of the concern regarding bypassing fish at this project was a function of the outfall conditions from the bypass pipe. Full flow bypass addresses many of the concerns by limiting stress on fish due to dewatering and by increasing outflow velocities to improve bypass exit conditions.

It is our recommendation to pursue Option 3 as described above. Given that spread-the-risk is the best management strategy at this point and that transportation is equivocal from this project, the in-river strategy with full flow bypass at Lower Monumental Dam represents the best fishery recommendation.

The proposed options were discussed with the CSS Oversight Committee. The Oversight Committee agreed that the operations in 2002 would be anomalous, and would not produce results that furthered our understanding of the survival of in-river versus transported fish in preferred in-river conditions. They agreed that the best migration conditions for Snake River salmon in 2002 would likely be provided under Option 3.

It is important that the in-river conditions through the remainder of the hydrosystem be maintained in order to provide good in-river conditions. This means that full Biological opinion spill should be implemented at McNary Dam. At John Day Dam implementation of Biological Opinion spill during nighttime hours and daytime spill is recommended.

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April 10, 2002

Ms. Liz Hamilton, Executive Director
Northwest Sportfishing Industry Association
PO Box 4
Oregon City, OR 97045

Dear Liz,

Thank you for your inquiry regarding spill implementation in 2002. From our review of the 2002 Spill Operations document provided to you by Bonneville Power Administration we understand that it is the intent of the Action Agencies to provide spill as described by the Biological Opinion (BIOP) except for special circumstances due to research and in-water repair work. We explain the proposed operation by project:

Lower Granite – Biological Opinion spill only occurs during the spring migration (transportation of fish is maximized from the transport projects during the summer). Spill will be provided at the Biological Opinion level, except during the testing of the removable spillway weir (RSW). The RSW will be tested between April 15th and May 31st. During this time period spill will alternate between BIOP levels and two other test conditions. The test conditions have two different spill levels (5 and 16 Kcfs) and it is anticipated that the RSW will be passing a significant number of fish over the spillway. So during the 45-day test period spill will be less than the BIOP on two out of three days, but it is possible that more fish will go over the spillway with the RSW than under BIOP spill levels.

Little Goose - Spill will be provided through the spring (up to the gas cap) as described in the BIOP.

Lower Monumental – No spill will occur because of repairs that are being made to the stilling basin below the project. Normally BIOP spill levels of 40 Kcfs for 24-hours per day would have occurred during the spring.

The federal parties have negotiated an agreement to address the impact of terminating spill at Lower Monumental for the stilling basin work this year. Under the agreement, Little Goose Dam will spill 24-hours per day up to the gas cap (instead of the 12 hour period called for by the BIOP) from the initiation of spill on April 5 until May 1, 2002. During this time period Lower Monumental Dam will operate in primary bypass mode and fish will not be transported from this project.

Ice Harbor - Spill will be provided through the spring and summer (up to the gas cap) as described in the BIOP. The research being conducted does not require a modification of the BIOP spill levels.

McNary - Spill will be provided through the spring (up to the gas cap) as described in the BIOP.

John Day Dam - Spill will be provided at the Biological Opinion level during the spring and summer, except during the study period (4/18-5/31 and 6/8-7/20). Under the BIOP, John Day dam spills 60% of water during nighttime hours. Under the study design daytime spill is being tested and the nighttime 60% is redistributed to 30% for the 24-hour period. The study design calls for alternating days of BIOP spill and the 30% for 24 hours.

The Dalles Dam - Spill will be provided through the spring and summer (up to the gas cap) as described in the BIOP.

Bonneville Dam – The Biological Opinion calls for spill at 75Kcfs during the day and 125 Kcfs during the night. Bonneville will be conducting a study this year throughout the season that calls for BIOP spill alternating with the test condition of 125 Kcfs for 24 hours, which exceeds the BIOP levels.

In summary, the BIOP measures are being implemented except when studies are being conducted and necessary repairs are being made. This means that less spill will be provided in the Snake River and slightly more spill (because of the daytime spill test at Bonneville Dam) will be provided in the lower River. We hope this addresses your question. Please fell free to contact us if you need any further explanation.

Sincerely,

Michele DeHart

Michele DeHart
Fish Passage Manager

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MEMORANDUM

TO: Michele DeHart
FROM: Tom Berggren
DATE: April 1, 2002

RE: Migration timing of PIT tagged smolts at John Day Dam

Attached are John Day Dam yearling chinook and steelhead smolt migration timing plots developed using PIT tagged fish released in four key drainages – Umatilla River, John Day River, Snake River basin and Mid-Columbia River basin. Each cumulative proportion curve for a basin is a simple summation of PIT tagged smolts from different releases within the respective basin. PIT tagged smolts from large releases at dams for special studies are not included since they do not reflect the timing of the run-at-large. Migration timing plots are available for migration years 1998 to 2001 for yearling chinook and steelhead from the Umatilla, Snake, and Mid-Columbia River basins. For smolts from the John Day River basin, only two past years are available for yearling chinook and one past year for steelhead. Migration timing of PIT tagged smolts from migration year 2002 will be compared to this series of plots.

Currently, as of 06:00 April 1, 2002, the PIT tag detections at John Day Dam have consisted of all but one chinook and steelhead that over-wintered from last year's migration season. PIT tag detections include three hatchery steelhead and one wild steelhead from the Snake River basin that held over, as well as one hatchery steelhead from the Umatilla river basin (captured and tagged at Three Mile Falls Dam facility on March 12, 2002, well before any steelhead releases for the 2002 migration year). There were also three hatchery summer chinook from the Mid-Columbia River basin, and three wild and nine hatchery fall chinook from the Snake River basin that held-over from last year. There has been one yearling fall chinook PIT tagged released for migration year 2002 that has been detected. It was released in the Umatilla River basin, although the PIT tag record does not show a release date yet – it was either from the Thornhollow acclimation pond release in early March or the direct stream release in mid-March.

I will continue to monitor the PIT tagged smolt detections at John Day Dam relative the planned April 10 date of spill initiation at John Day Dam in 2002.

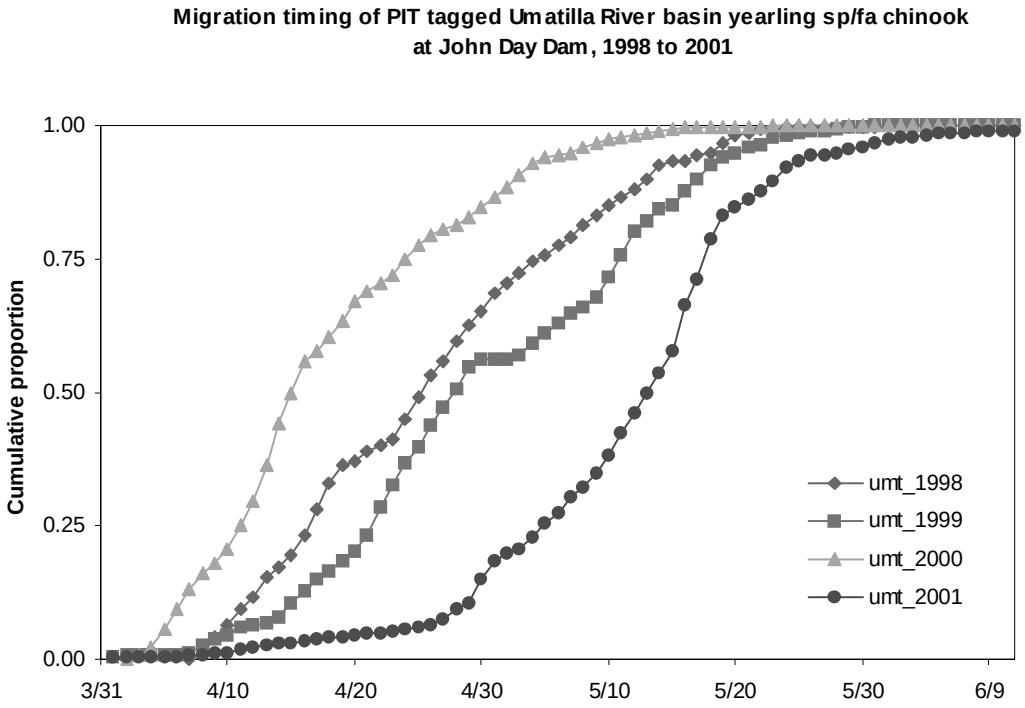


FIGURE 1. UMATILLA RIVER YEARLING CHINOOK AT JOHN DAY DAM.

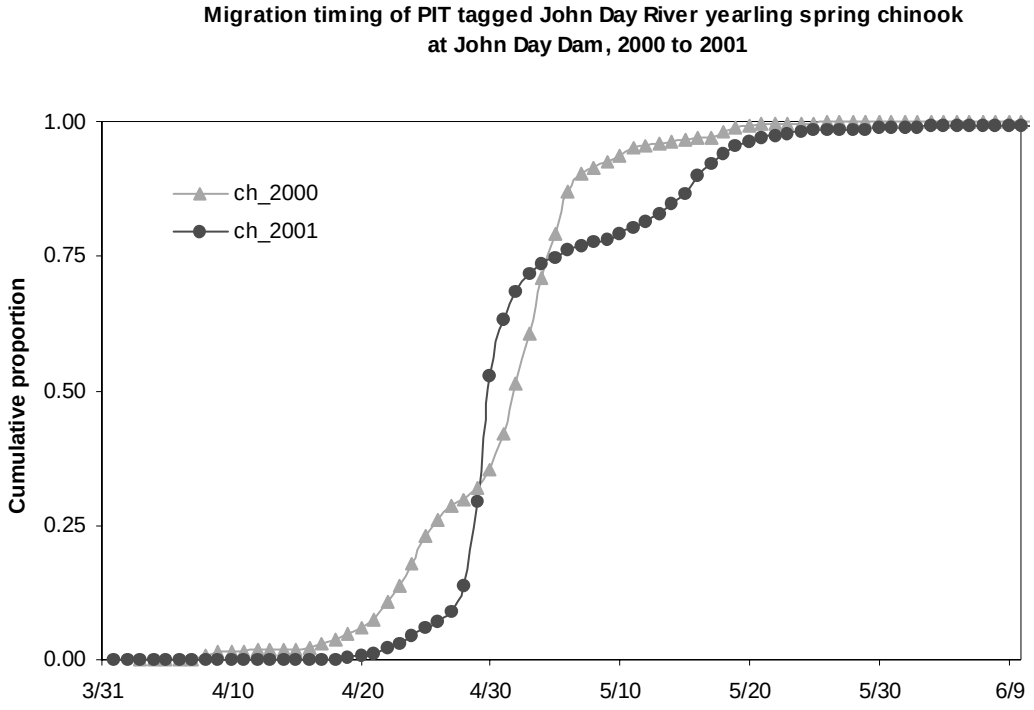


FIGURE 2. JOHN DAY RIVER YEARLING CHINOOK AT JOHN DAY DAM.

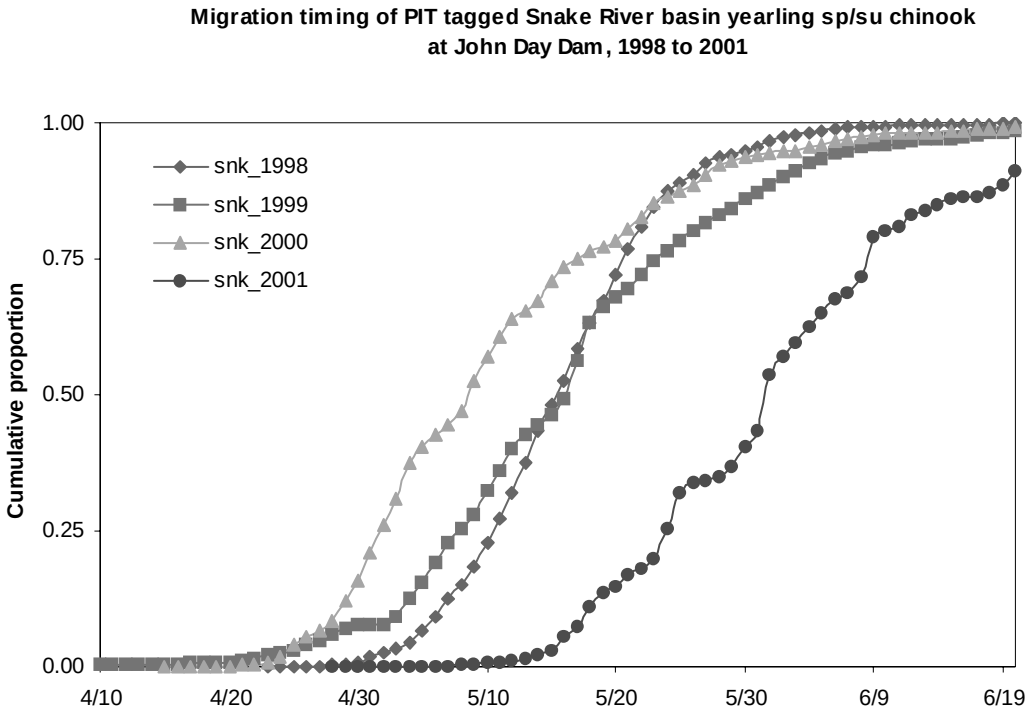


FIGURE 3. SNAKE RIVER BASIN YEARLING CHINOOK AT JOHN DAY DAM.

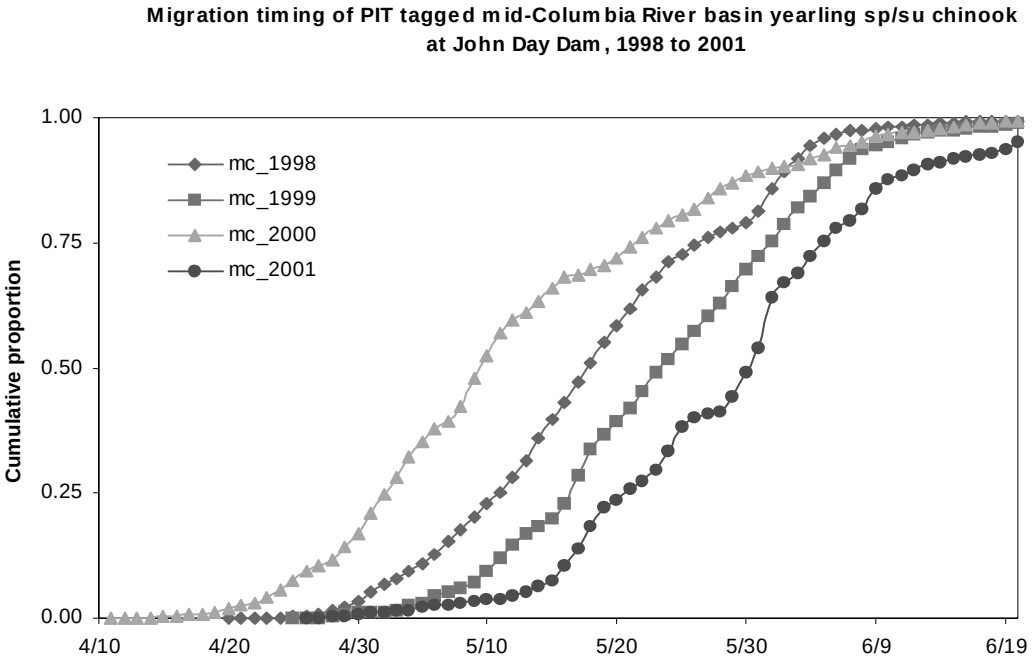


FIGURE 4. MID-COLUMBIA BASIN YEARLING CHINOOK AT JOHN DAY DAM.

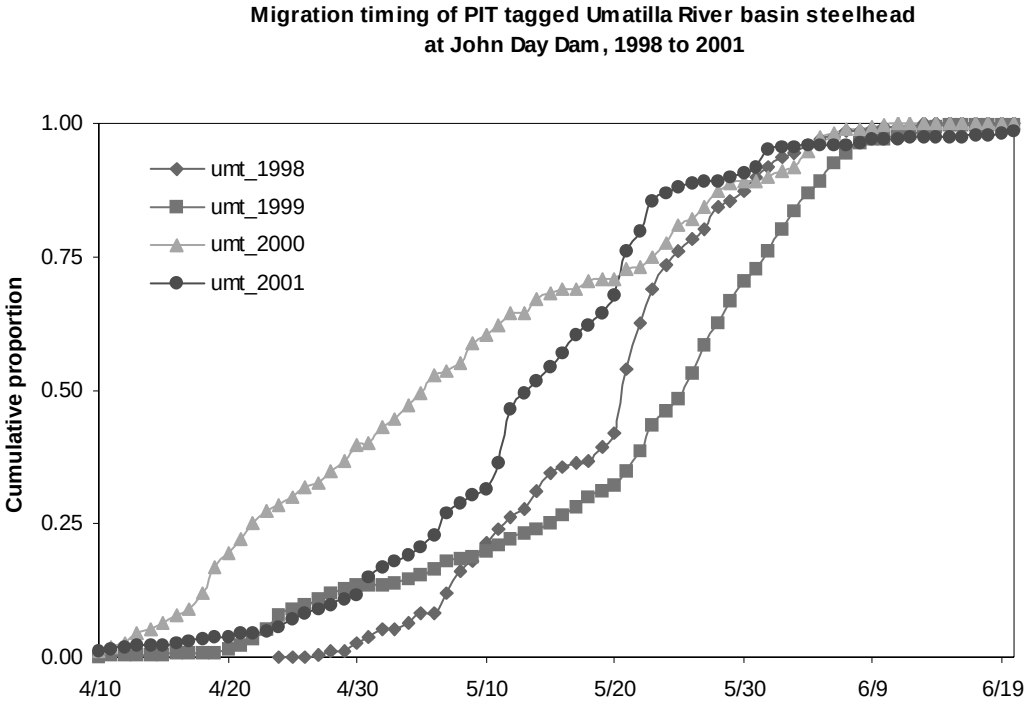


FIGURE 5. UMATILLA RIVER STEELHEAD AT JOHN DAY DAM.

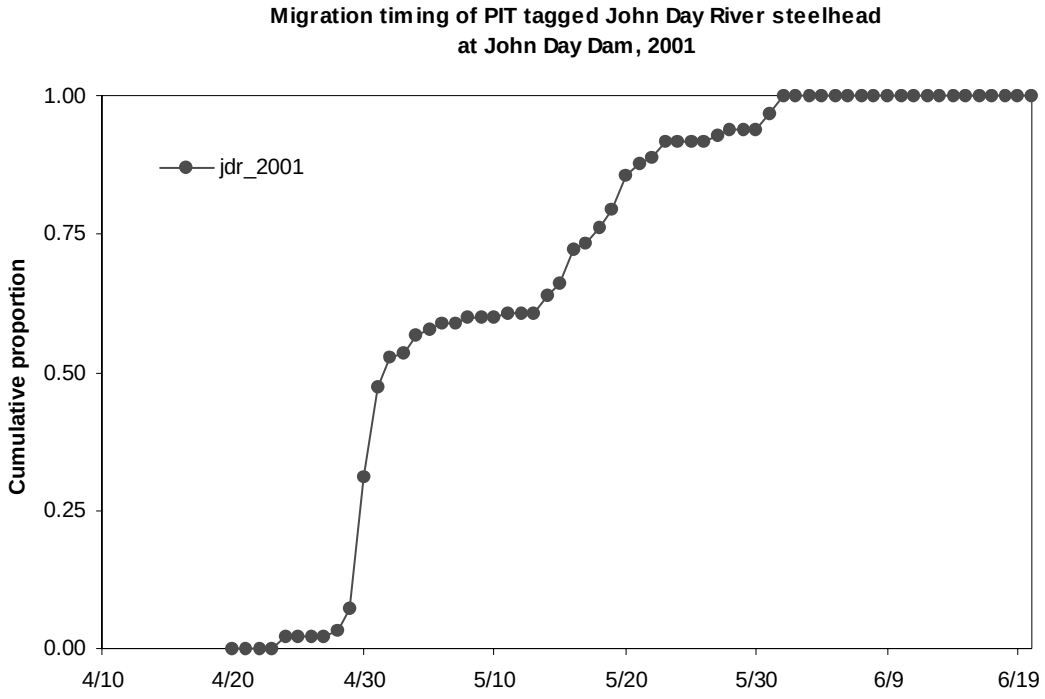


FIGURE 6. JOHN DAY RIVER STEELHEAD AT JOHN DAY DAM.

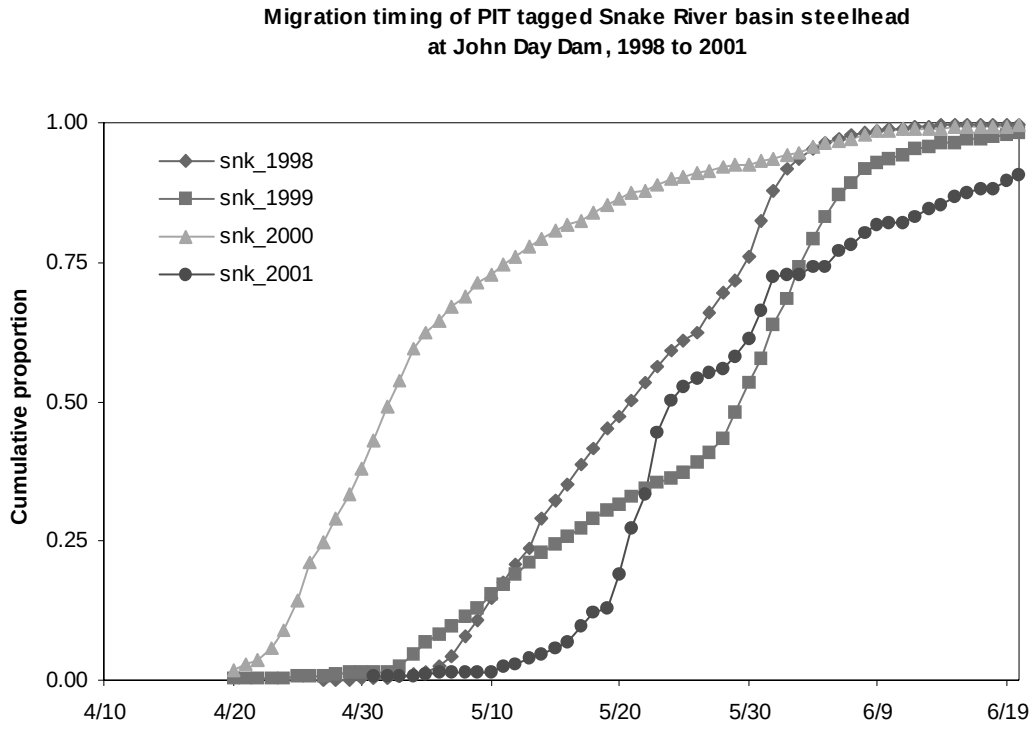


FIGURE 7. SNAKE RIVER BASIN STEELHEAD AT JOHN DAY DAM.

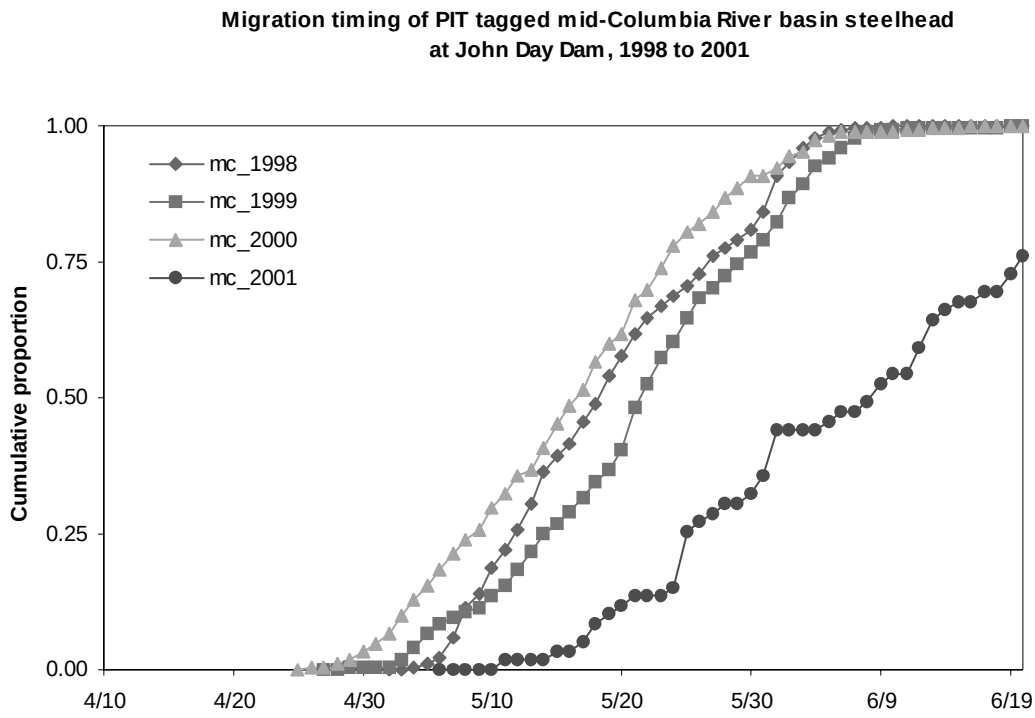


FIGURE 8. MID-COLUMBIA BASIN STEELHEAD AT JOHN DAY DAM.

APPENDIX B

Total Dissolved Gas Saturation Plots

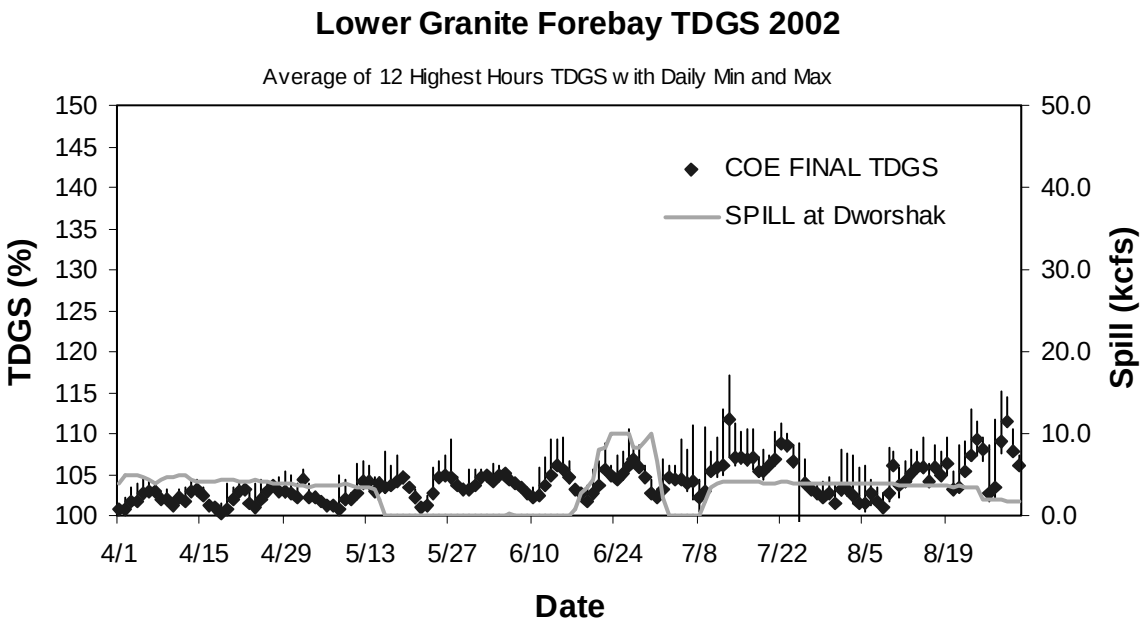


FIGURE B-1. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Lower Granite Forebay.

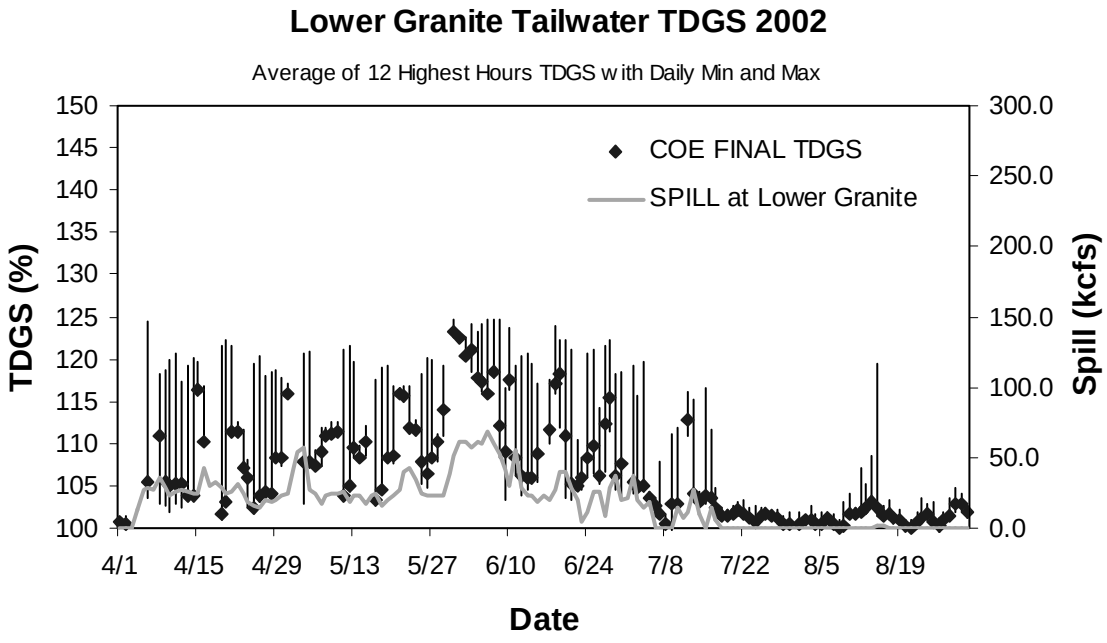


FIGURE B-2. Comparison of the daily average of the 12 highest hourly TDGS readings as report by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Lower Granite Tailwater.

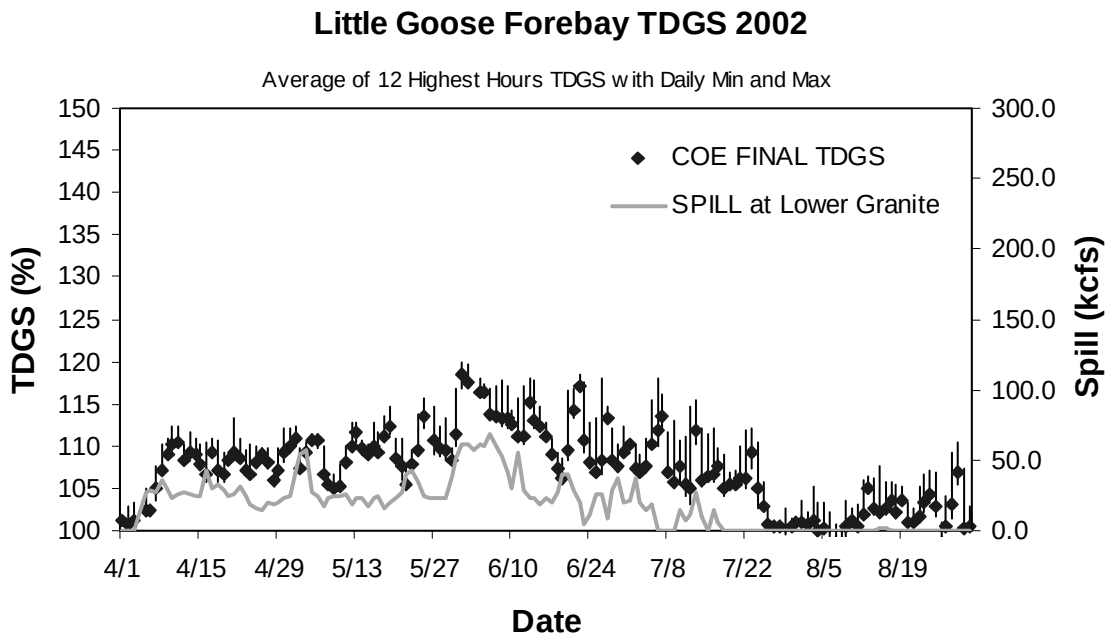


FIGURE B-3. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Little Goose Forebay.

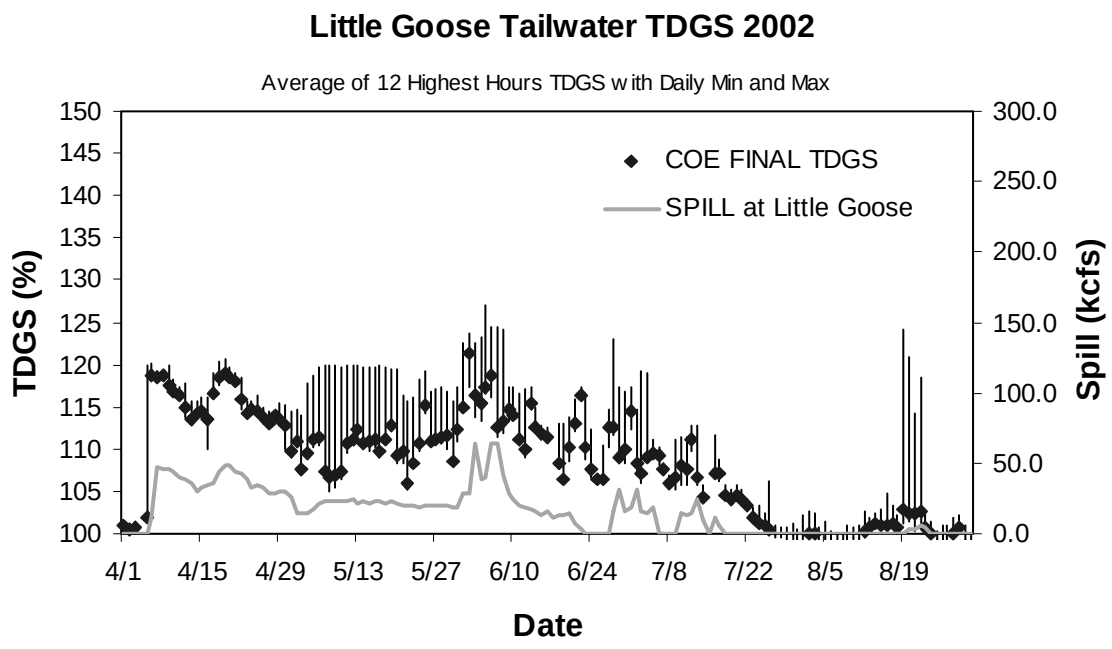


FIGURE B-4. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Little Goose Tailwater.

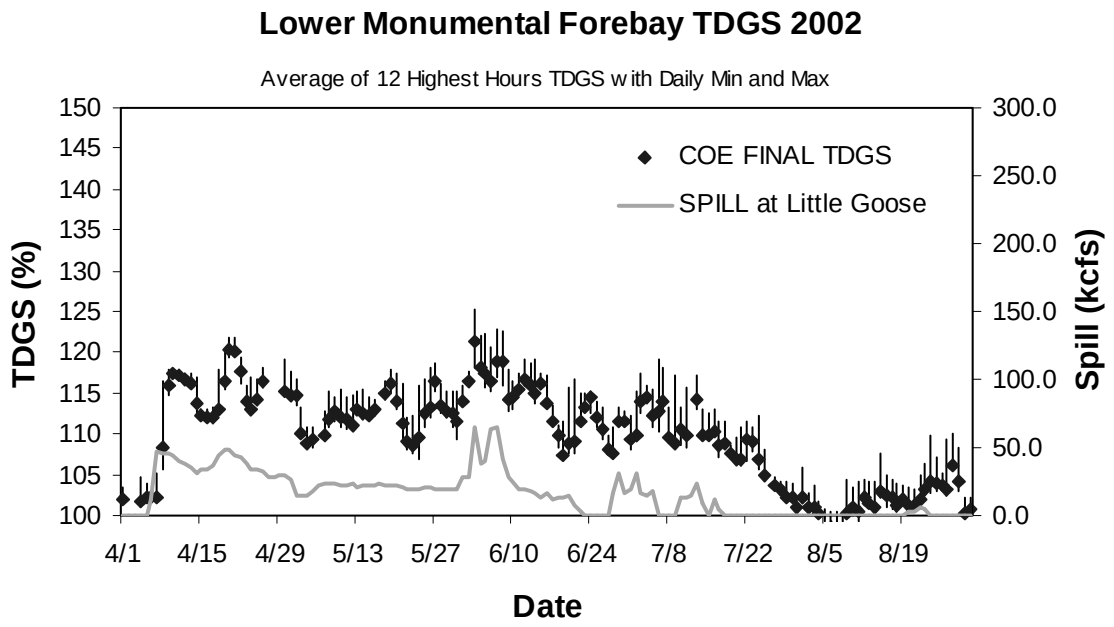


FIGURE B-5. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Lower Monumental Forebay.

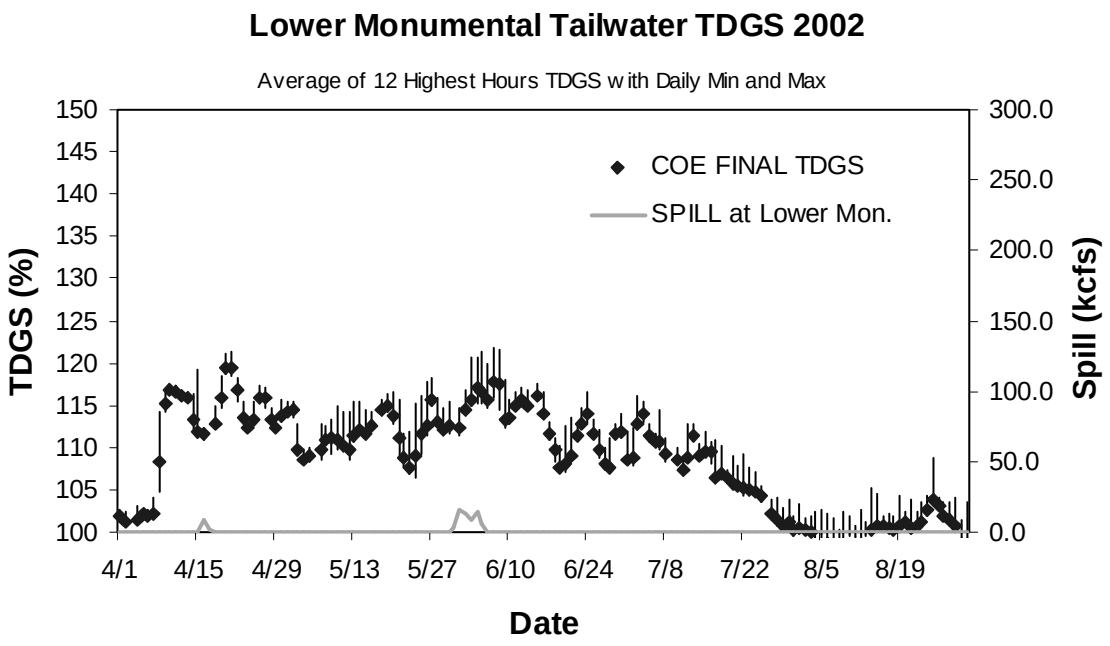


FIGURE B-6. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Lower Monumental Tailwater.

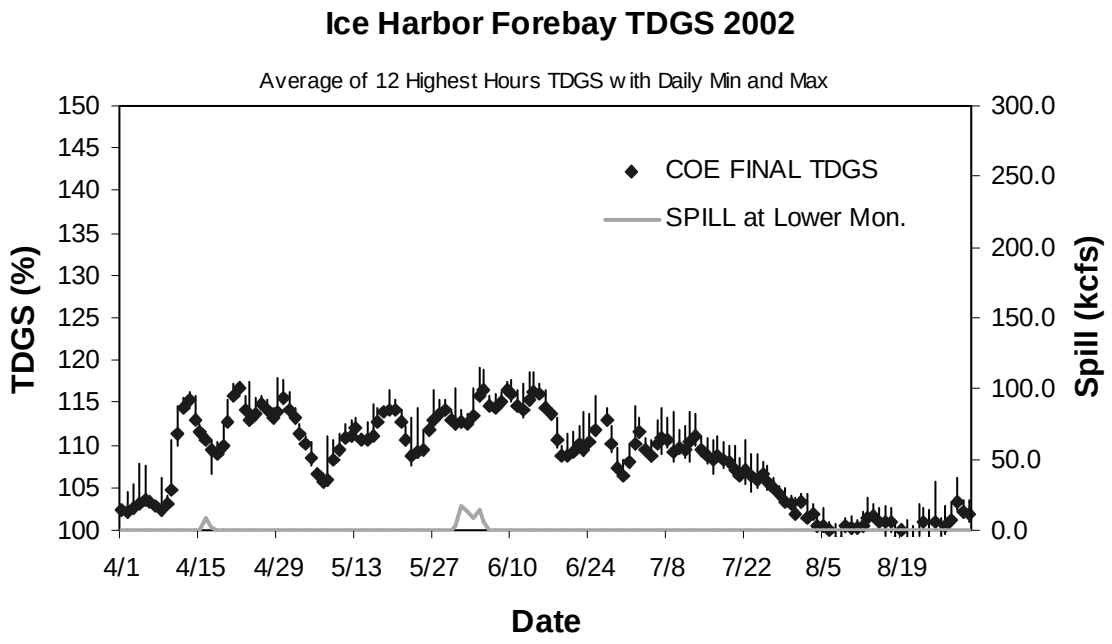


FIGURE B-7. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Ice Harbor Forebay.

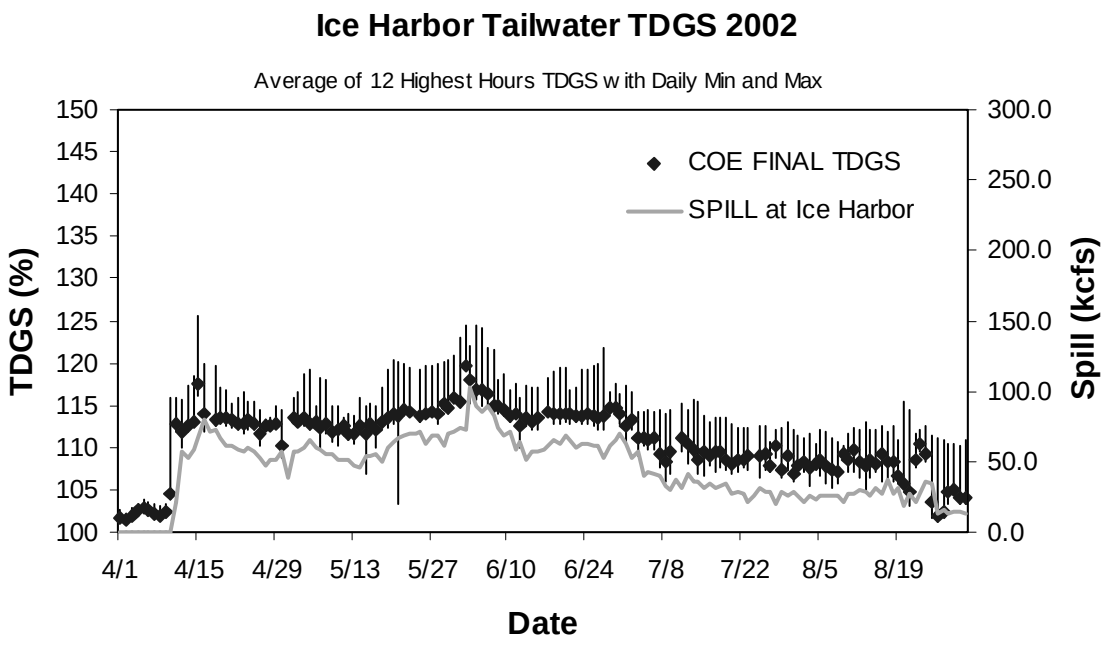


FIGURE B-8. Comparison of the daily average of the 12 highest hourly TDGS readings as report by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Ice Harbor Tailwater.

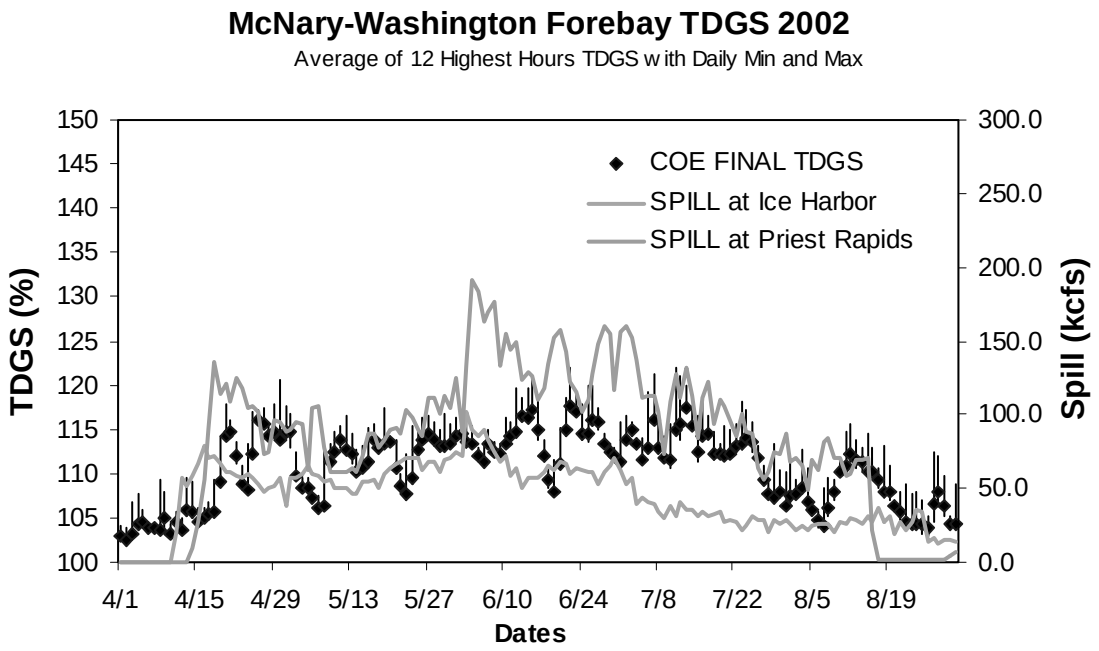


FIGURE B-9. Comparison of the daily average of the 12 highest hourly TDGS readings as report by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at McNary-Washington Forebay.

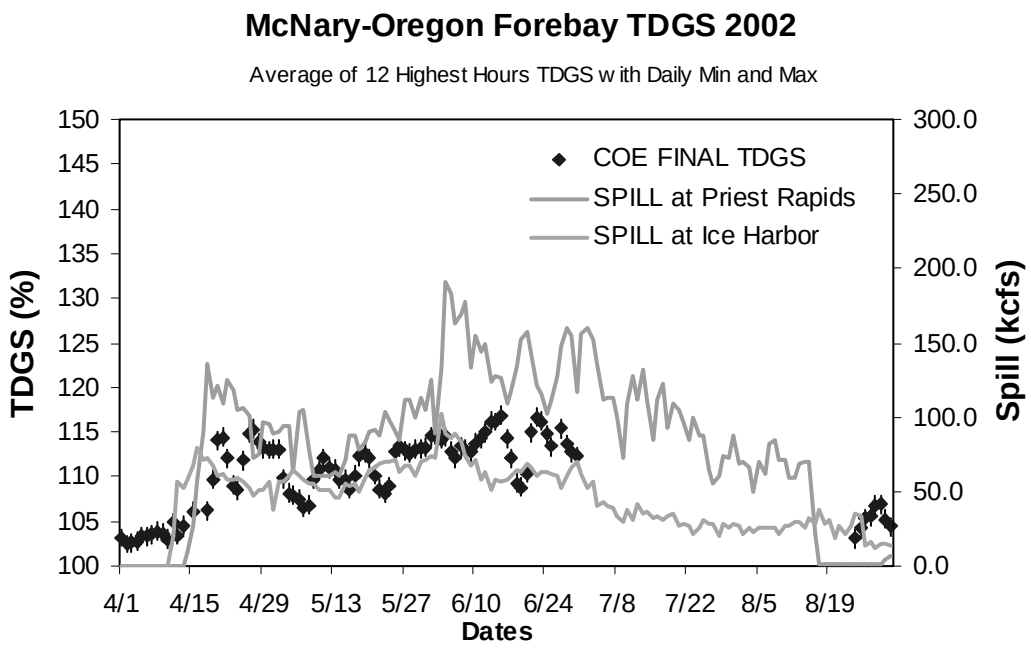


FIGURE B-10. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at McNary-Oregon Forebay.

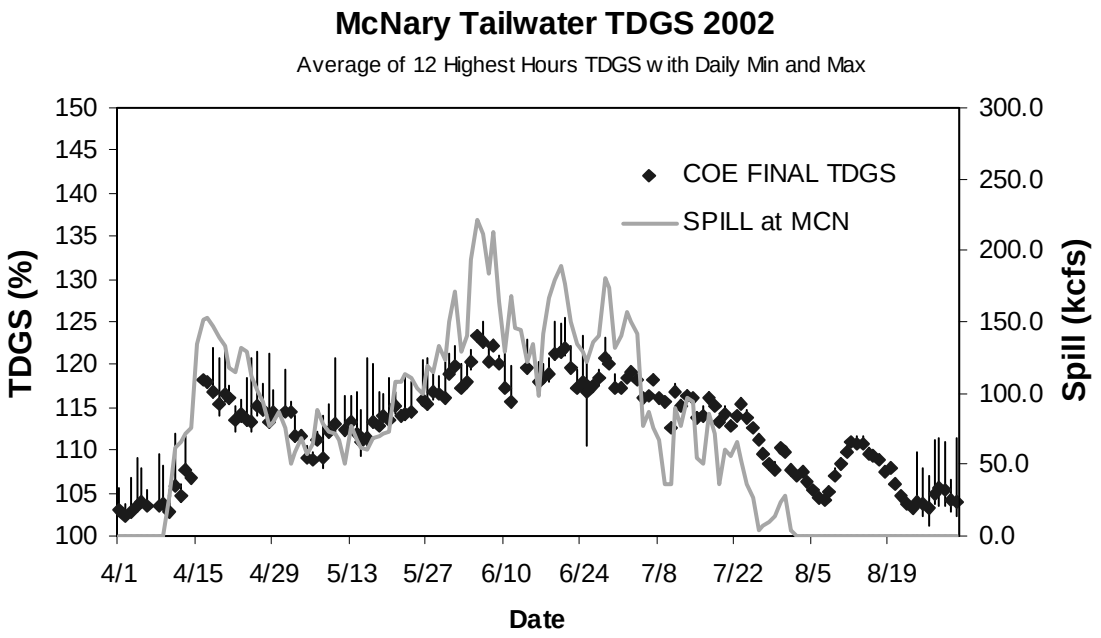


FIGURE B-11. Comparison of the daily average of the 12 highest hourly TDGS reading as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at McNary Tailwater.

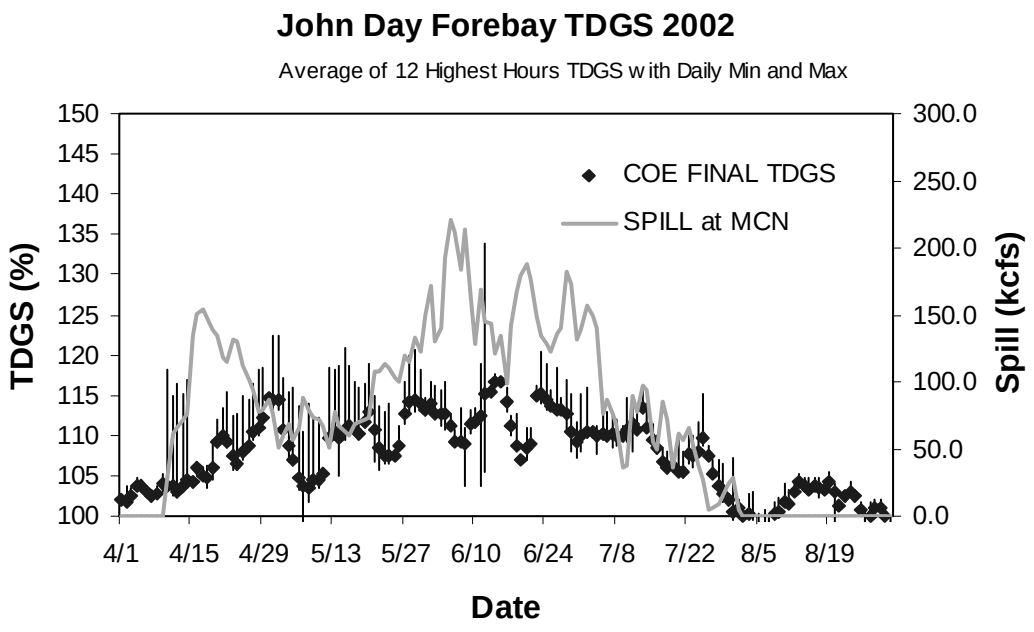


FIGURE B-12. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at John Day Forebay.

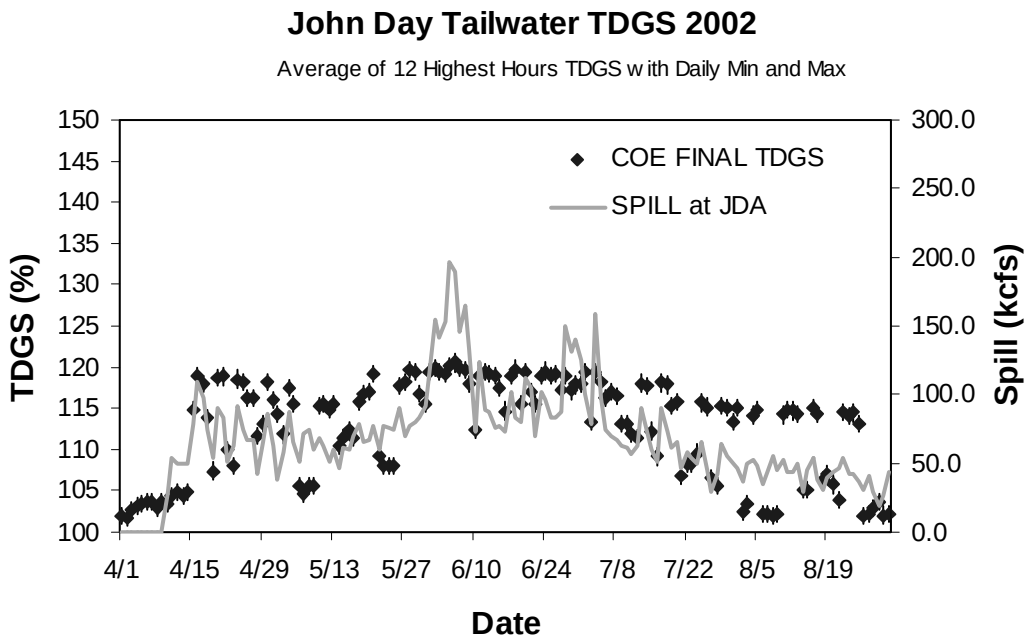


FIGURE B-13. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at John Day Tailwater.

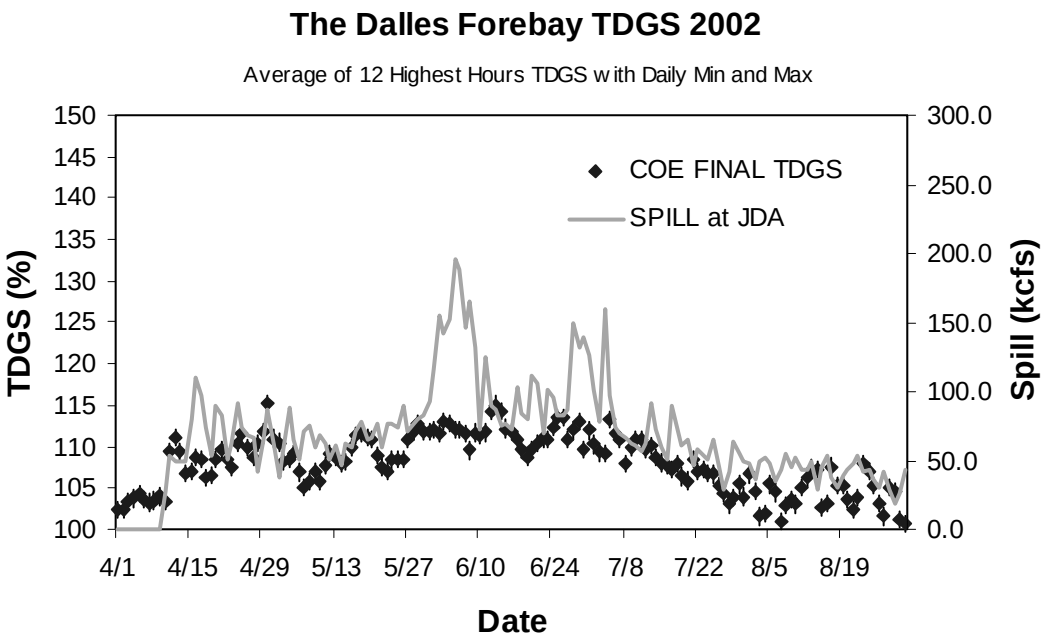


FIGURE B-14. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at The Dalles Forebay.

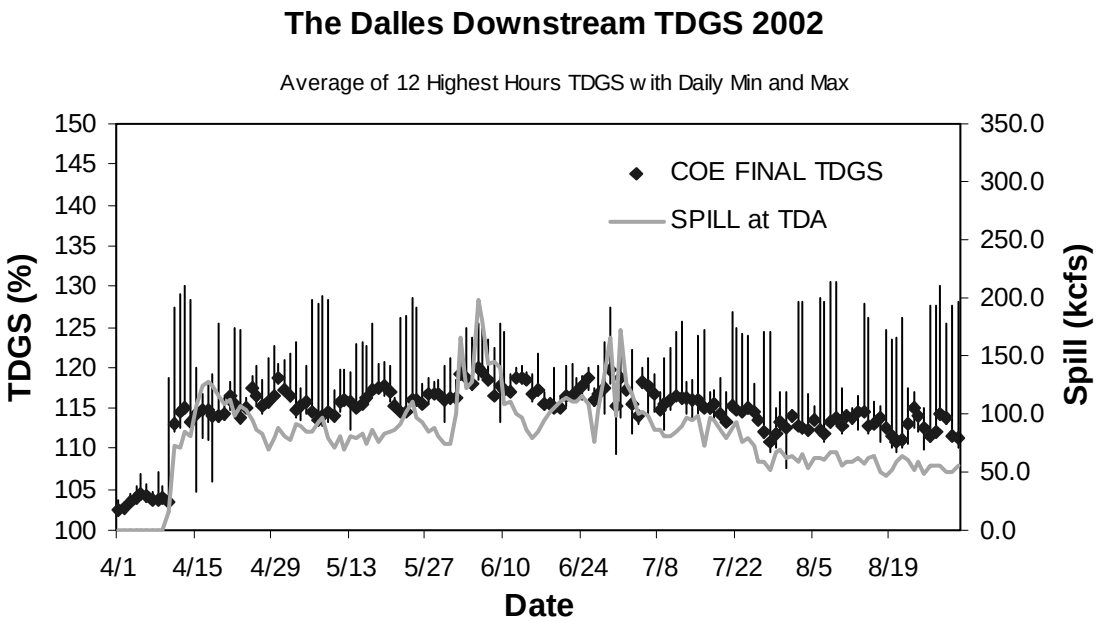


FIGURE B-15. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at The Dalles (downstream).

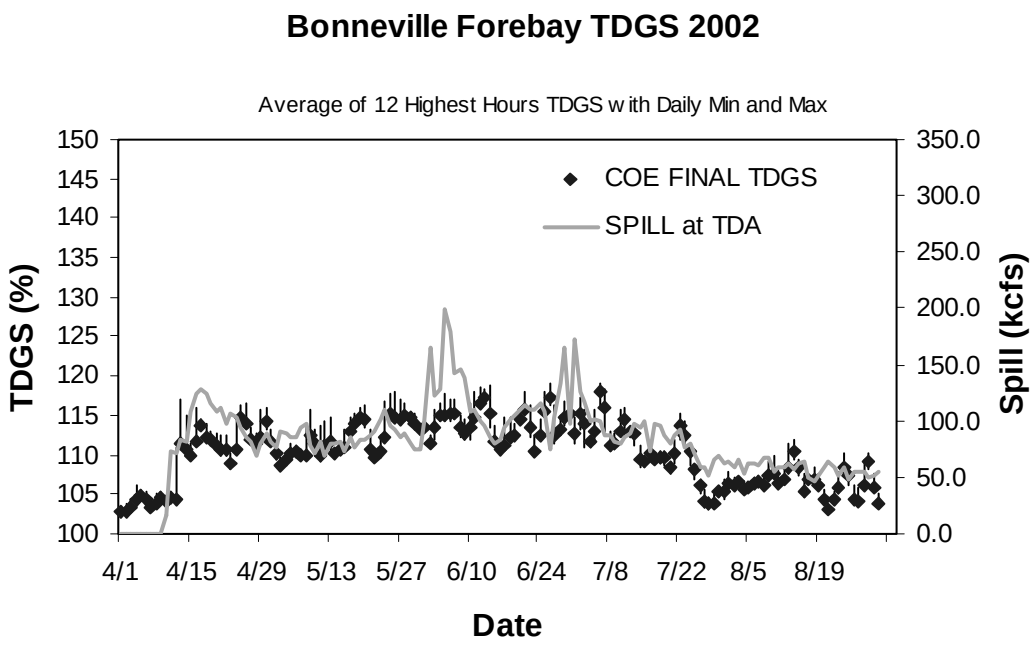


FIGURE B-16. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Bonneville Forebay.

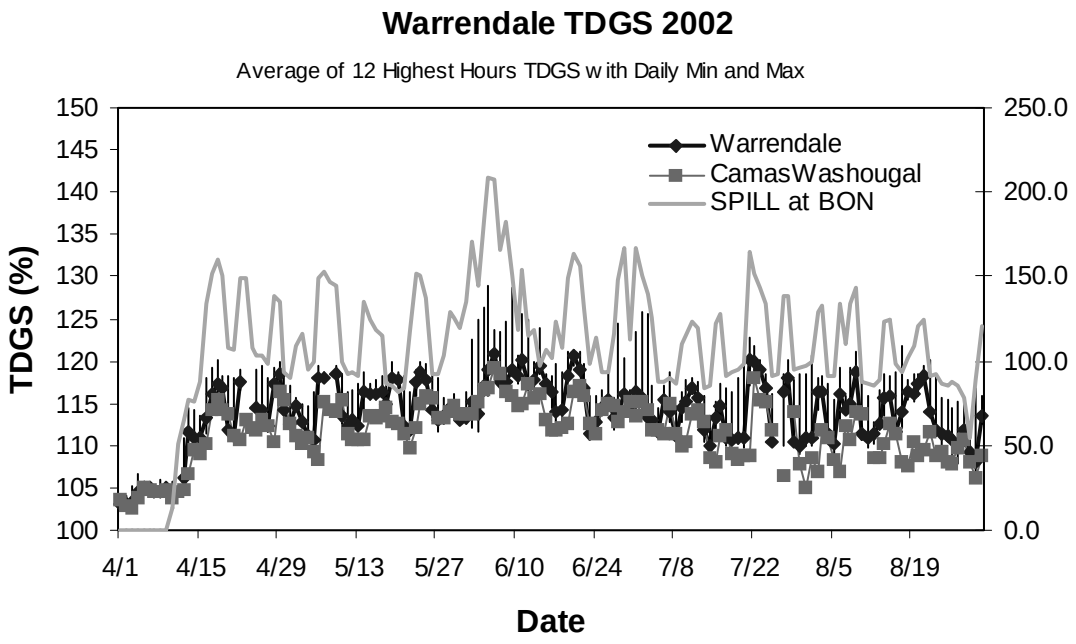


FIGURE B-17. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Warrendale.

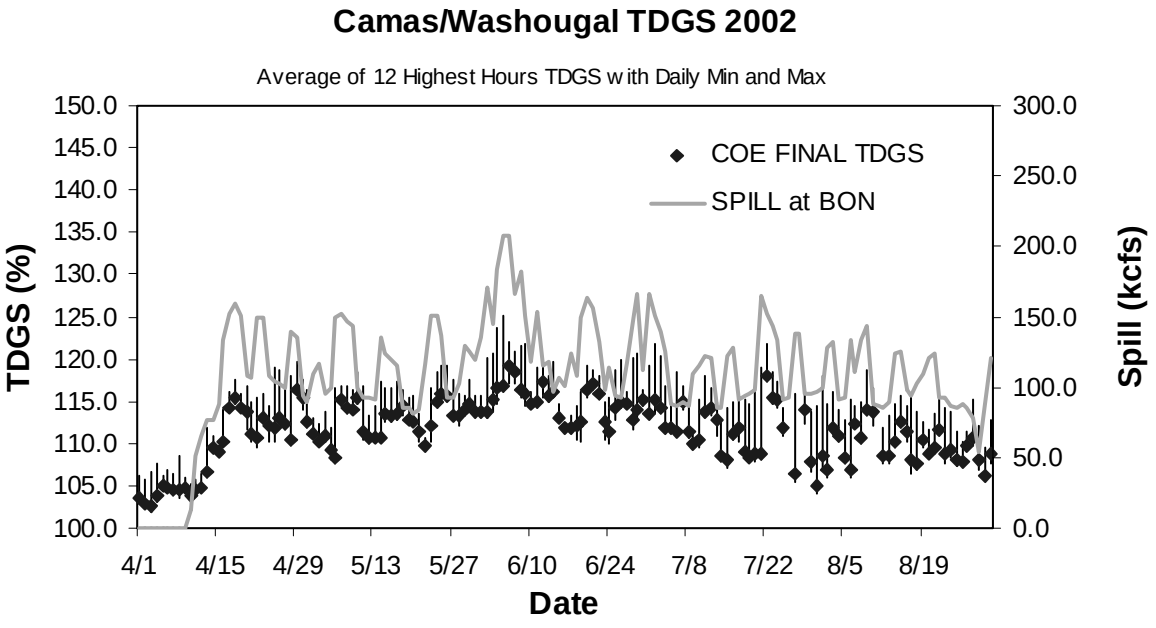


FIGURE B-18. Comparison of the daily average of the 12highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Camas/Washougal.

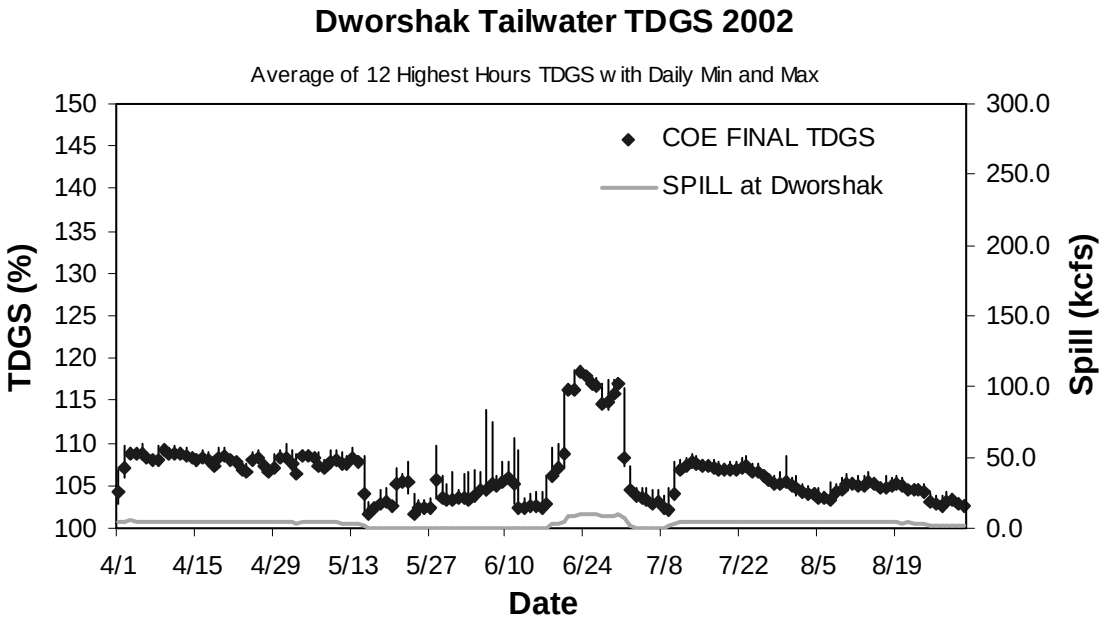


FIGURE B-19. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Dworshak Tailwater.

APPENDIX C

Gas Bubble Trauma and

Total Dissolved Gas Saturation

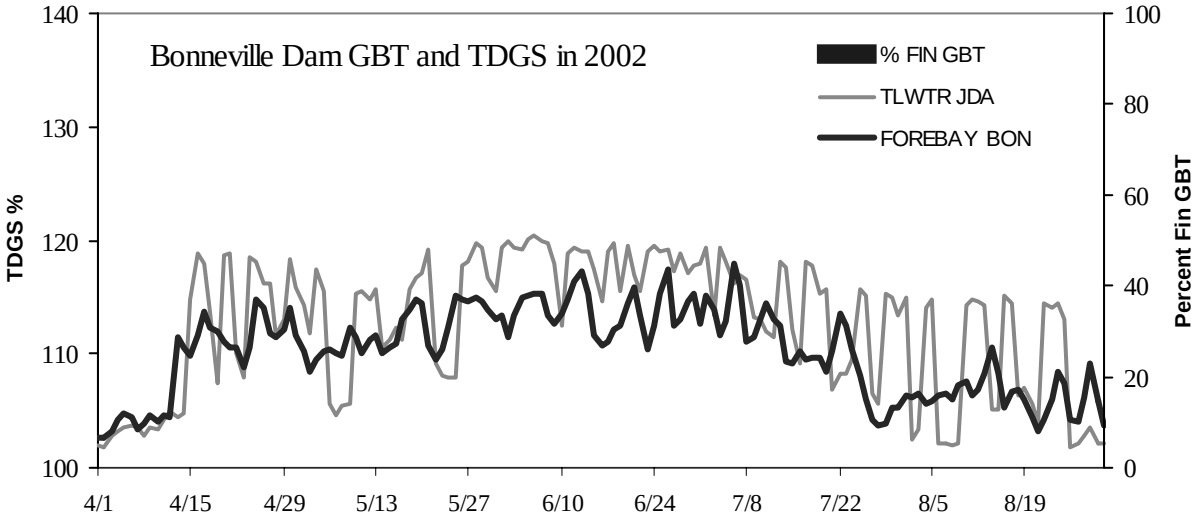


FIGURE B-1. Percent of fish examined at Bonneville Dam showing signs of GBT with associated dissolved gas saturation levels in the Bonneville Dam forebay and the John Day Dam tailwater.

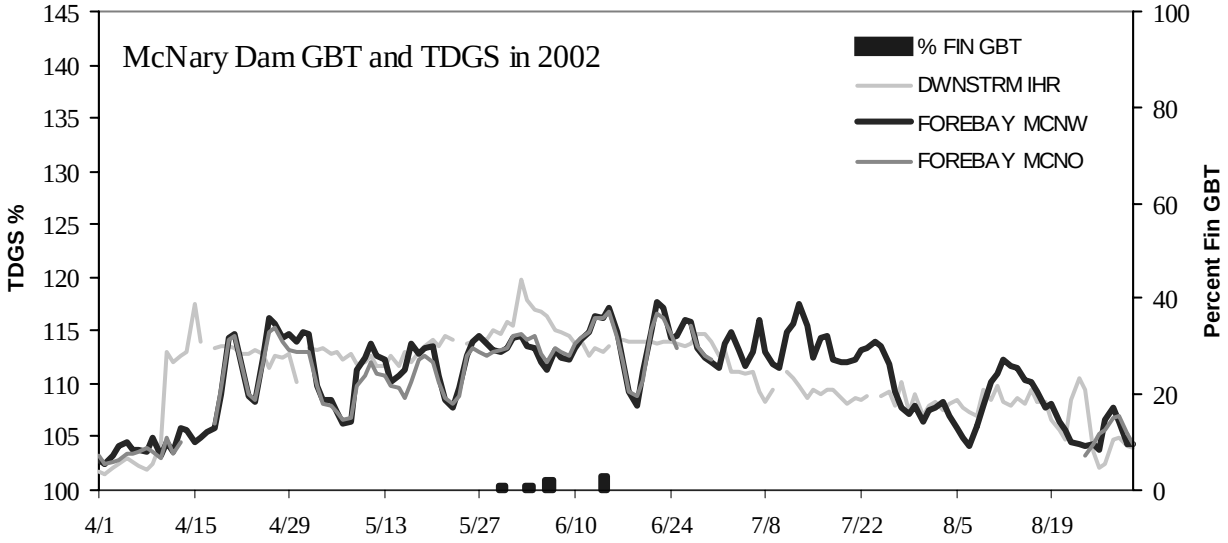


FIGURE B-2. Percent of fish examined at McNary Dam showing signs of GBT with associated dissolved gas saturation levels in the McNary Dam forebay (Oregon and Washington sides) and the Ice Harbor Dam tailwater.

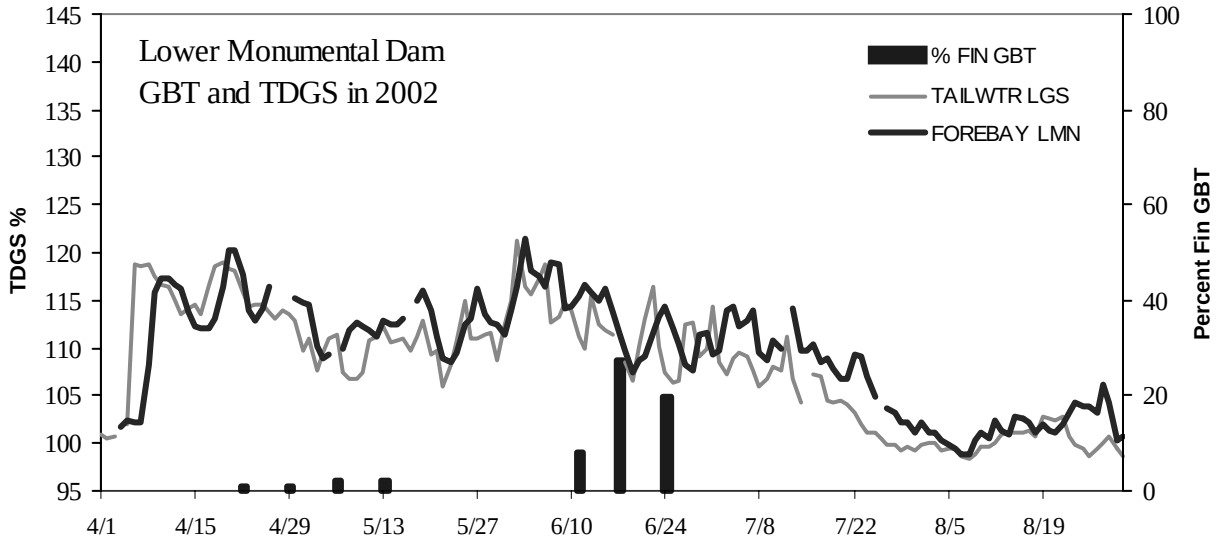


FIGURE B-3. Percent of fish examined at Lower Monumental Dam showing signs of GBT with associated dissolved gas saturation levels in the Lower Monumental Dam forebay and the Little Goose Dam tailwater.

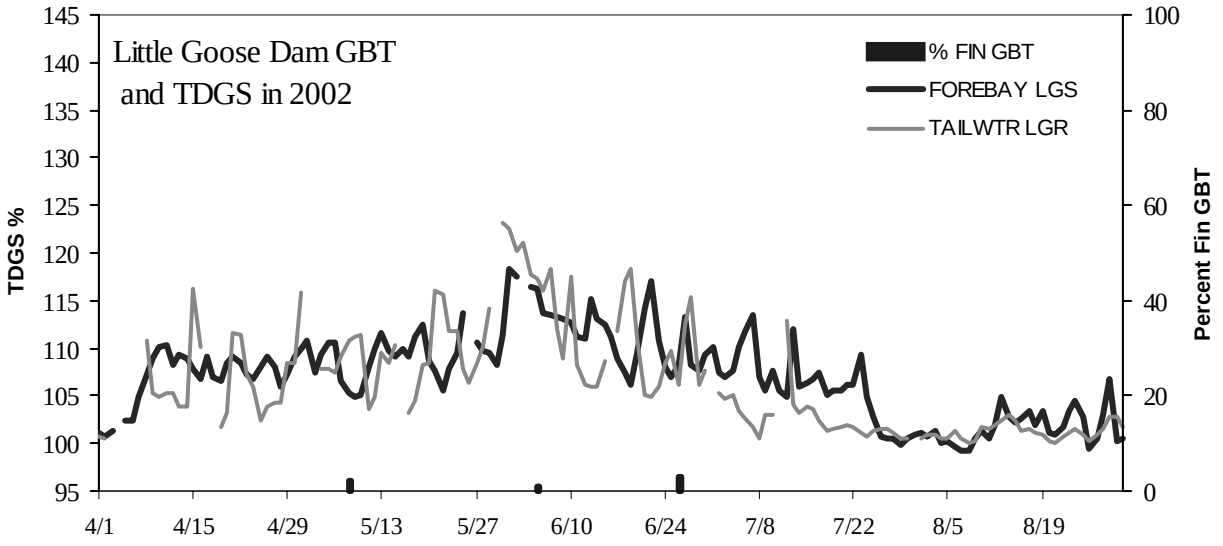


FIGURE B-4. Percent of fish examined at Little Goose Dam showing signs of GBT with associated dissolved gas saturation levels in the Little Goose Dam forebay and the Lower Granite Dam tailwater.

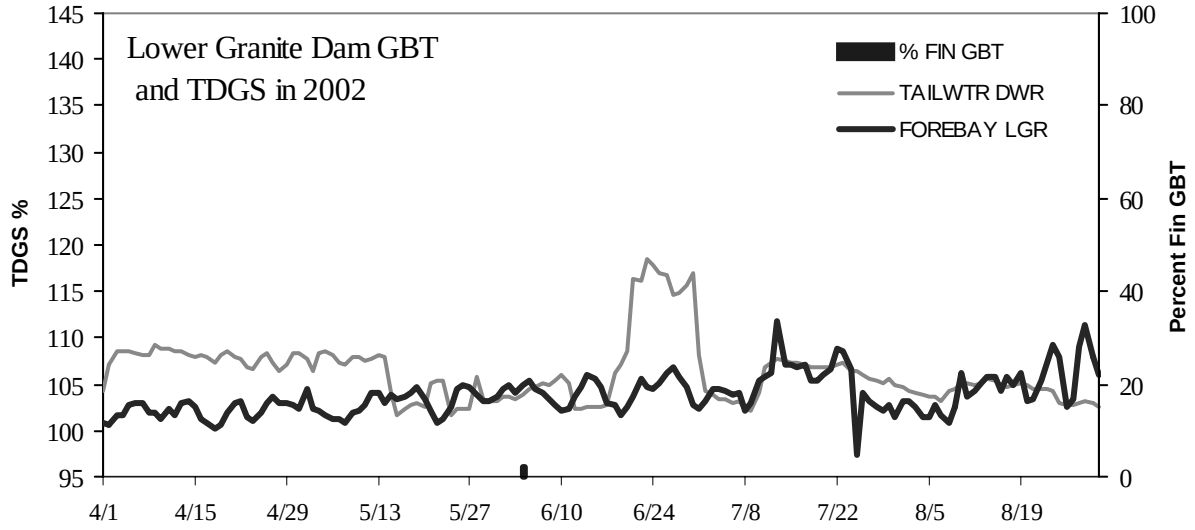


FIGURE B-5. Percent of fish examined at Lower Granite Dam showing signs of GBT with associated dissolved gas saturation levels in the Lower Granite Dam forebay and the Dworshak Dam tailwater.

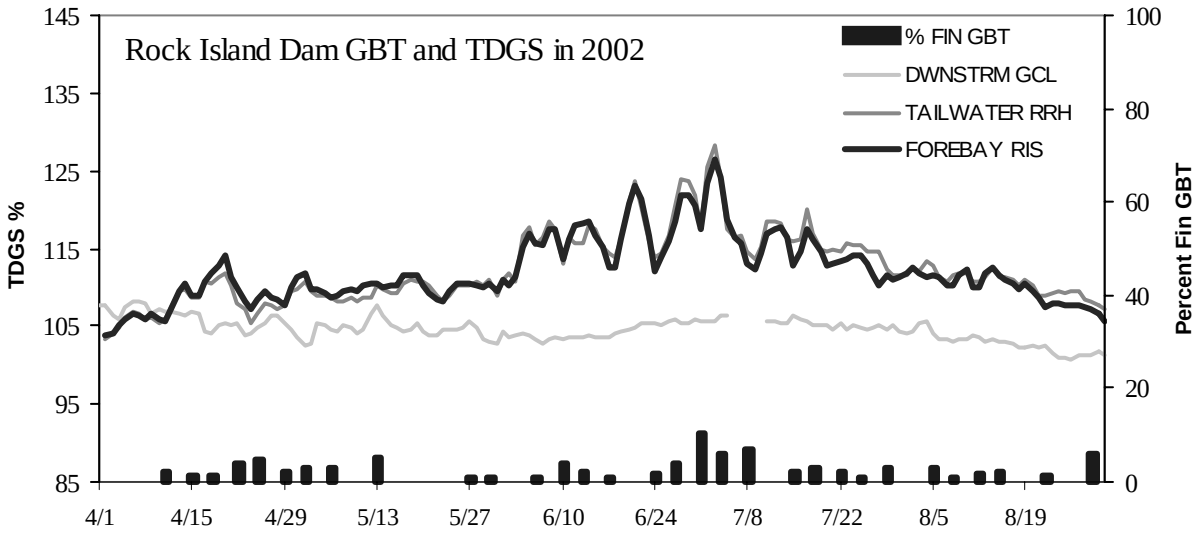


FIGURE B-6. Percent of fish examined at Rock Island Dam showing signs of GBT with associated dissolved gas saturation levels in the Rock Island and Rocky Reach Dam forebays and the Grand Coulee Dam tailwater.

APPENDIX D

Migration Timing Plots

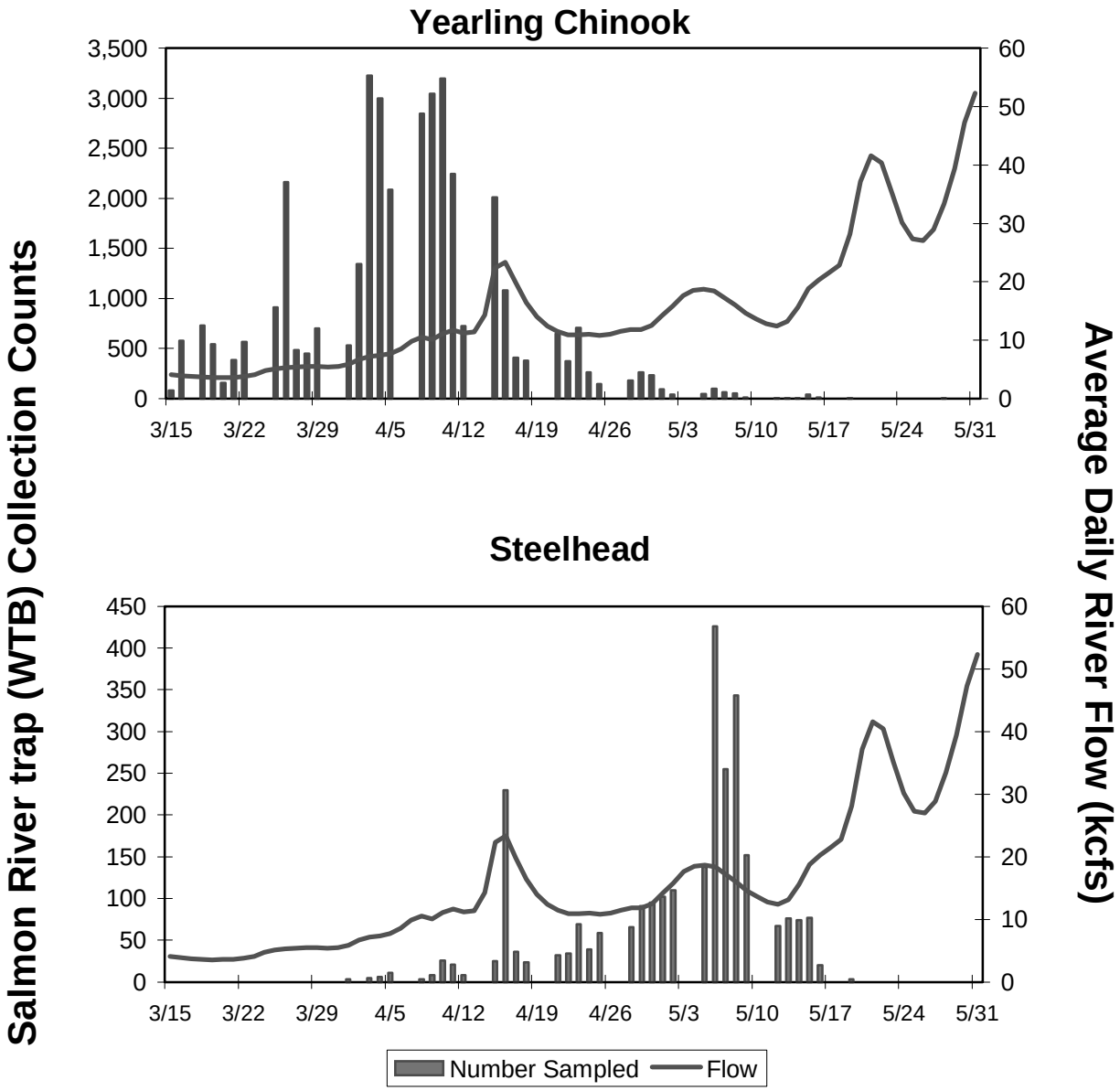


FIGURE D-1. Smolt migration timing at Salmon River Trap (WTB) with associated flow, 2002.

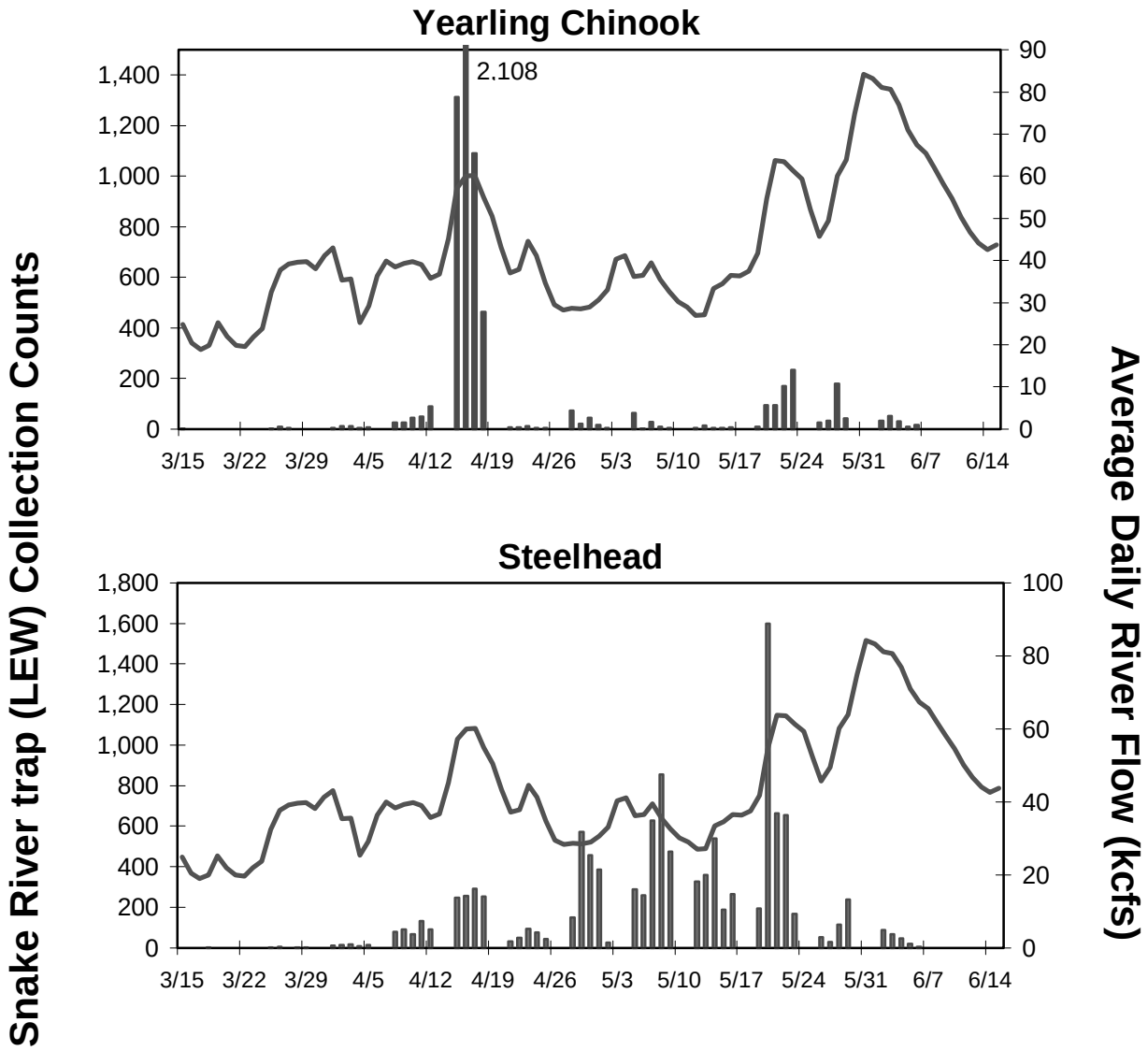


FIGURE D-2. Smolt migration timing at Snake River Trap (LEW) and associated flow, 2002.

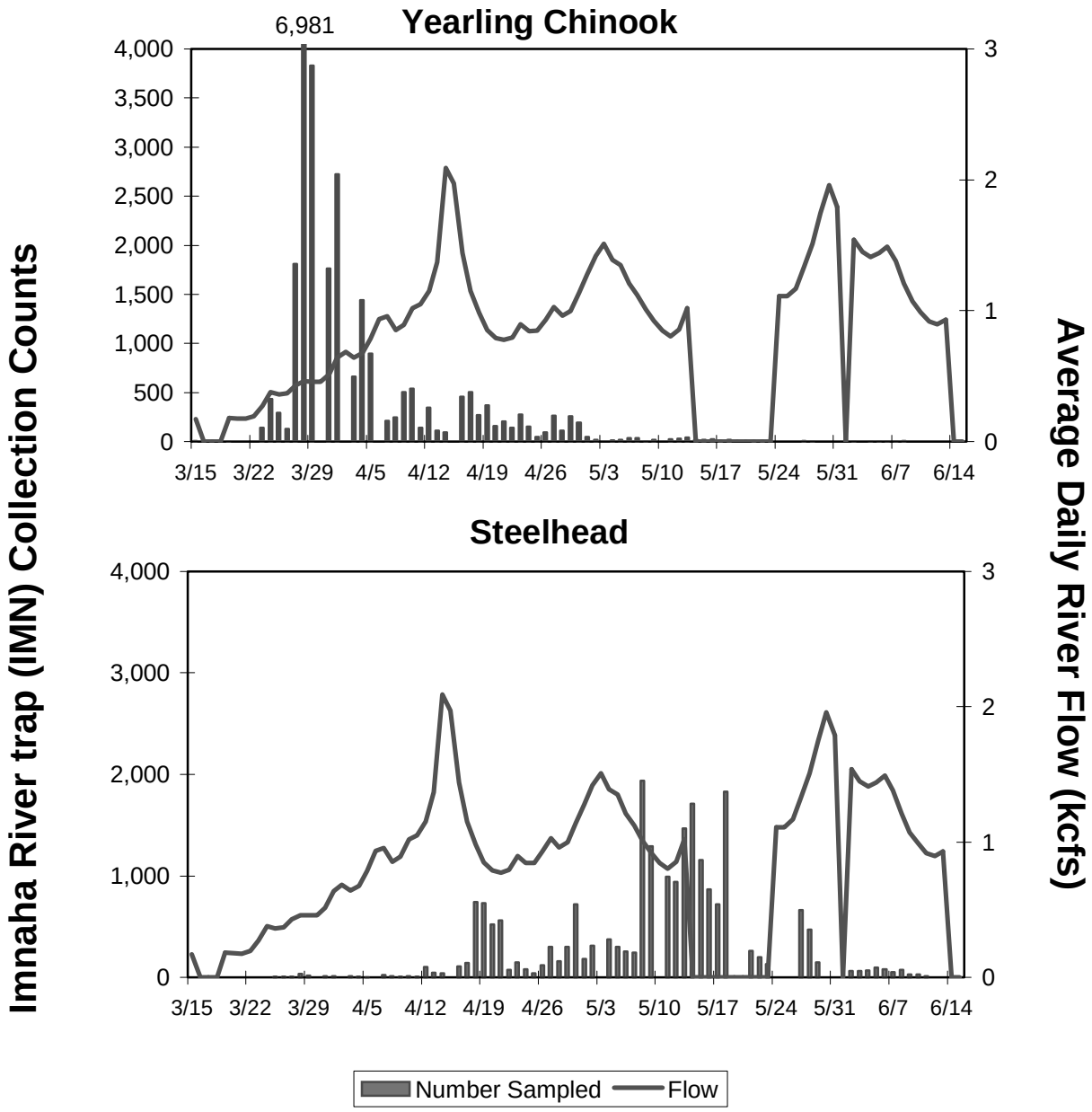


FIGURE D-3. Smolt migration timing at Imnaha River Trap with associated flows, 2002.

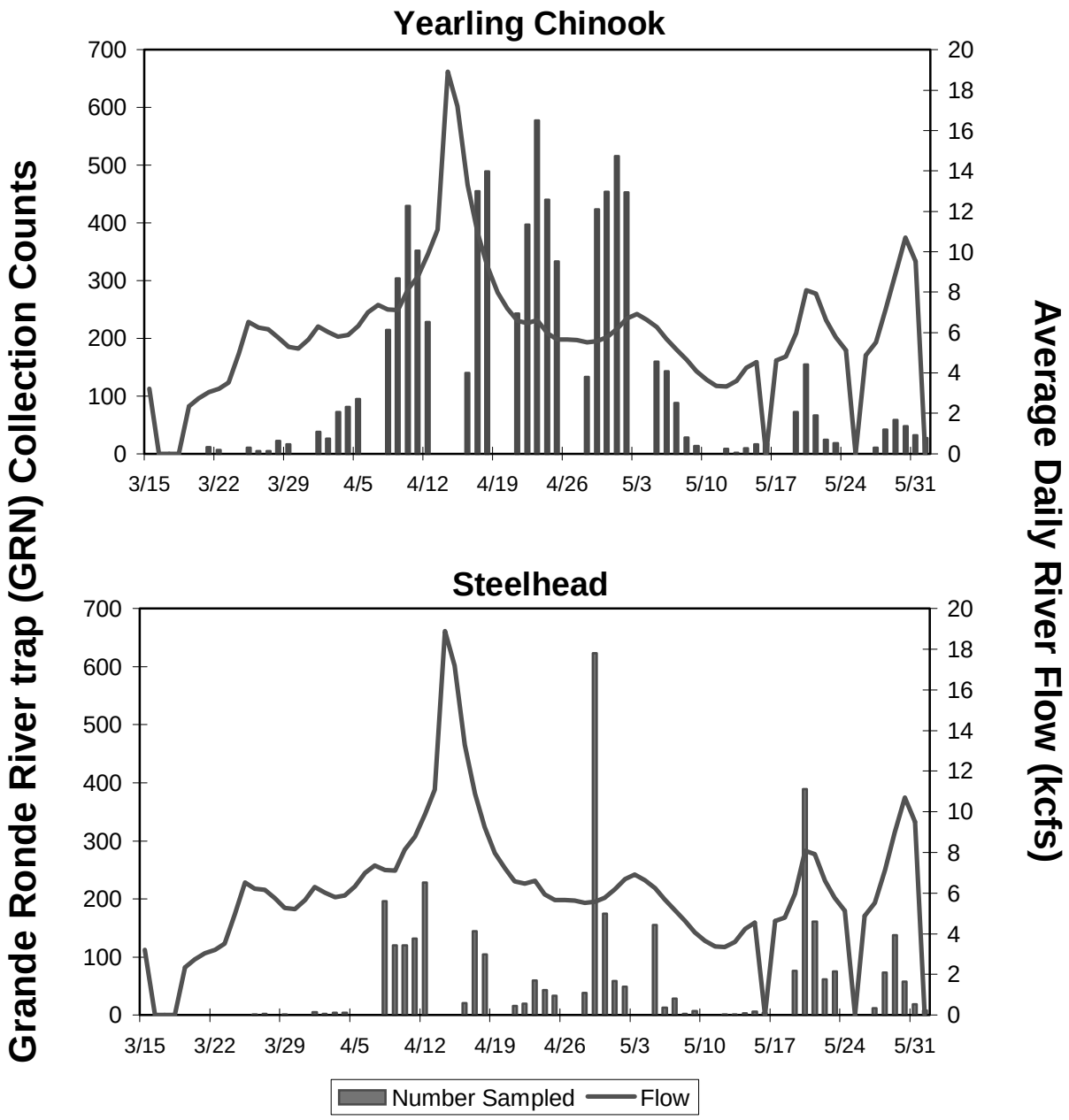


FIGURE D-4. Smolt migration timing at Grande Ronde River Trap with associated flows, 2002.

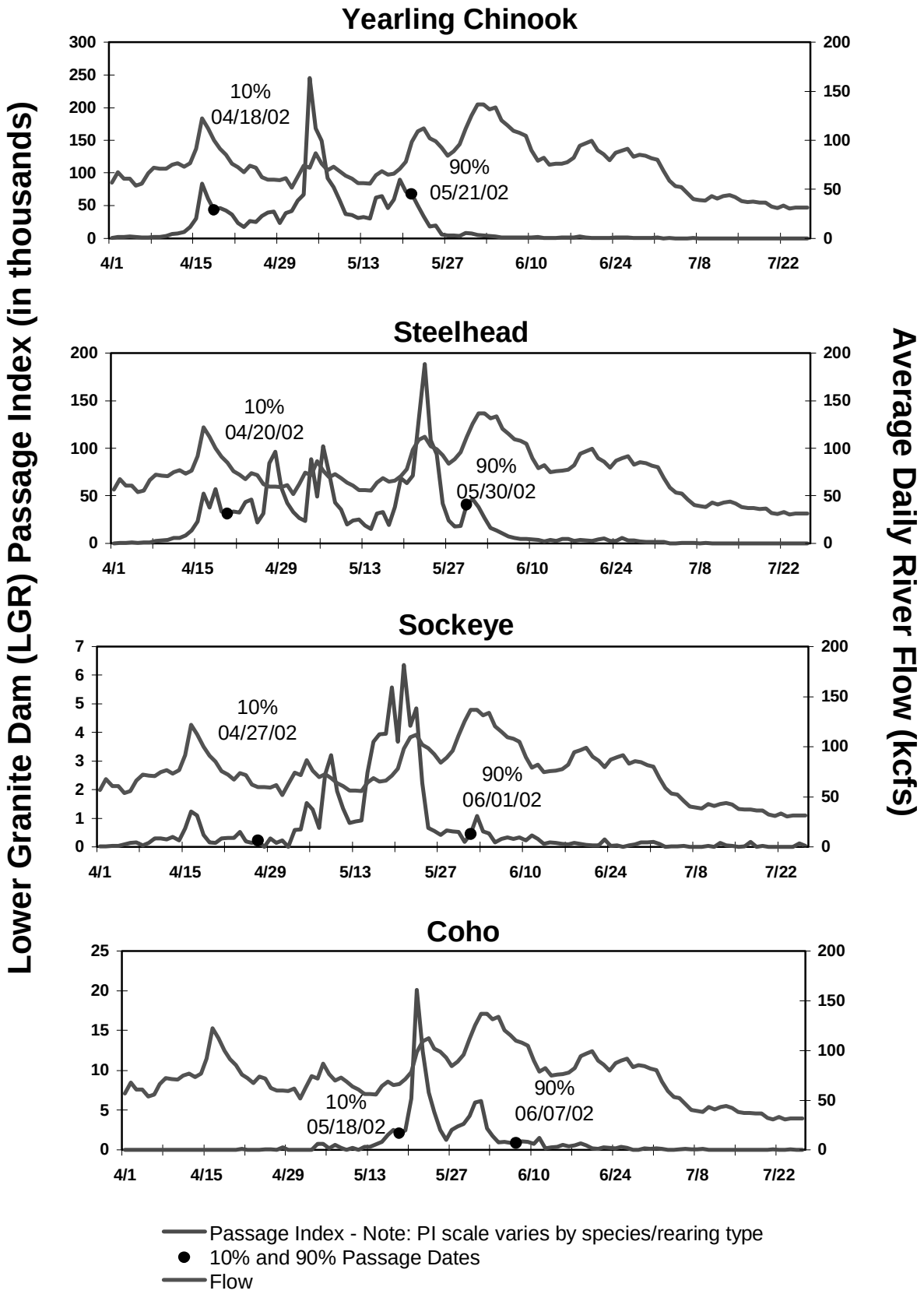


FIGURE D-5. Smolt migration timing at Lower Granite Dam with associated flow, 2002.

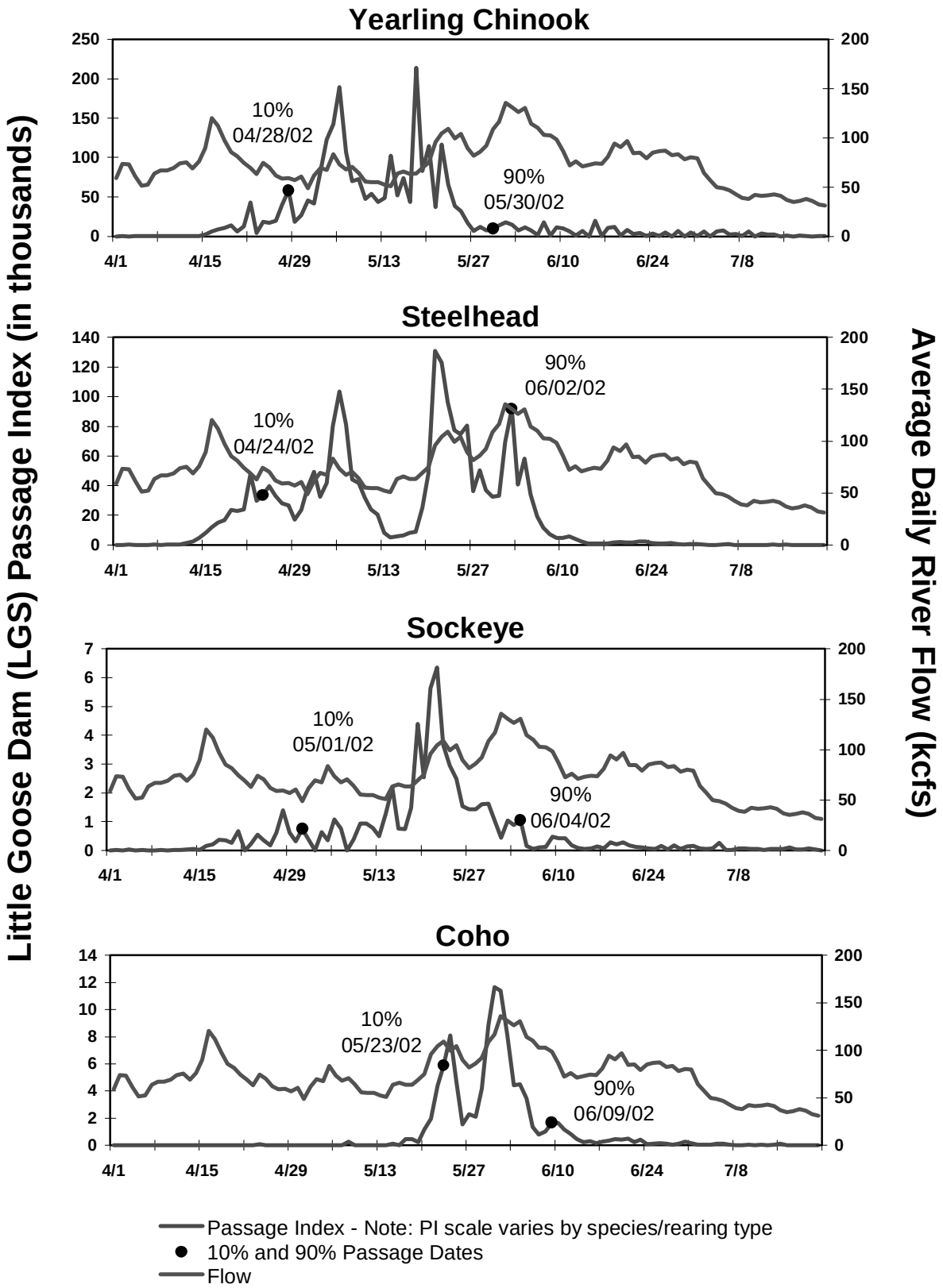


FIGURE D-6. Smolt migration timing at Little Goose Dam with associated flows, 2002.

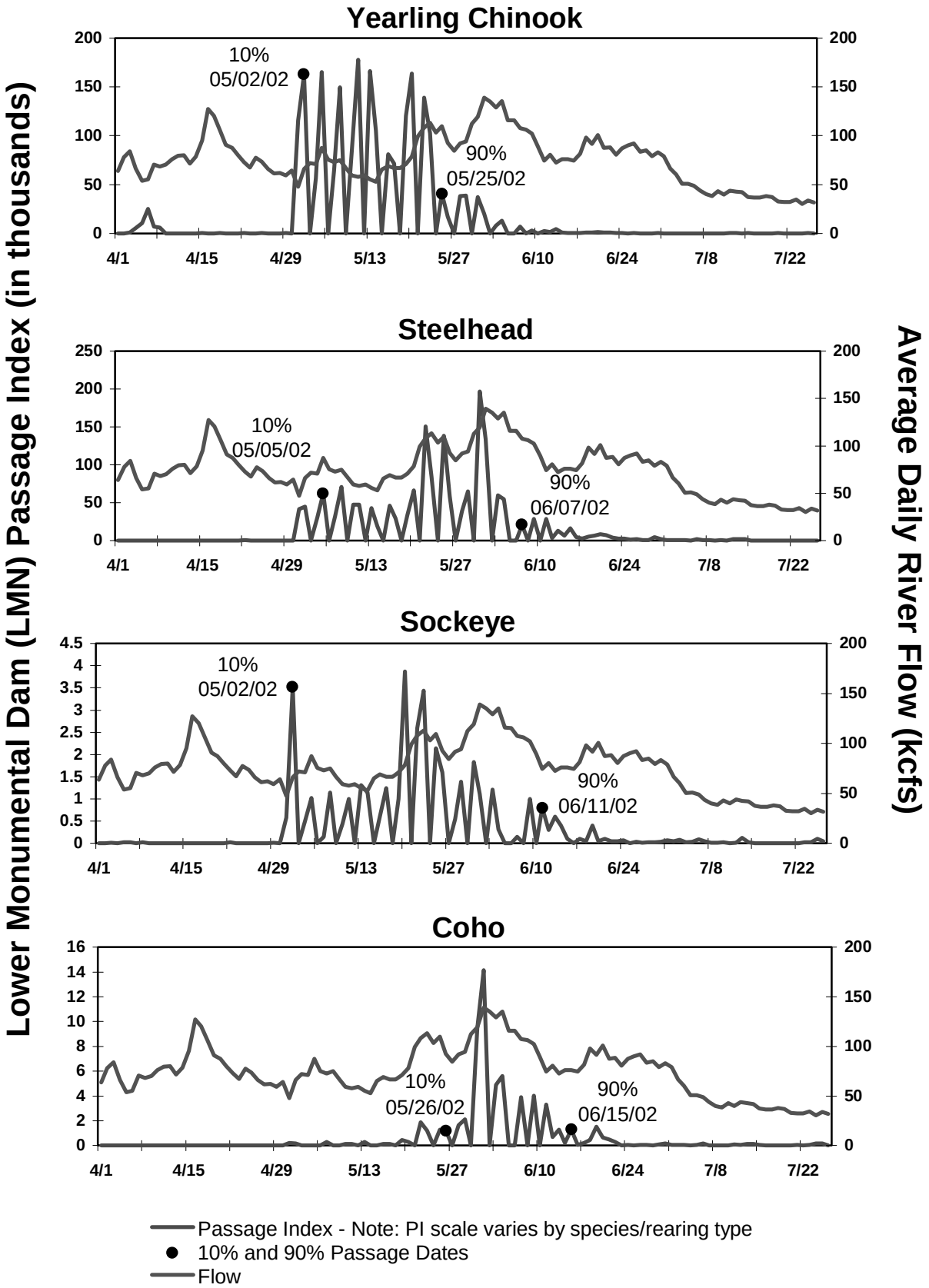


FIGURE D-7. Smolt Migration timing at Lower Monumental Dam with associated flow, 2002.

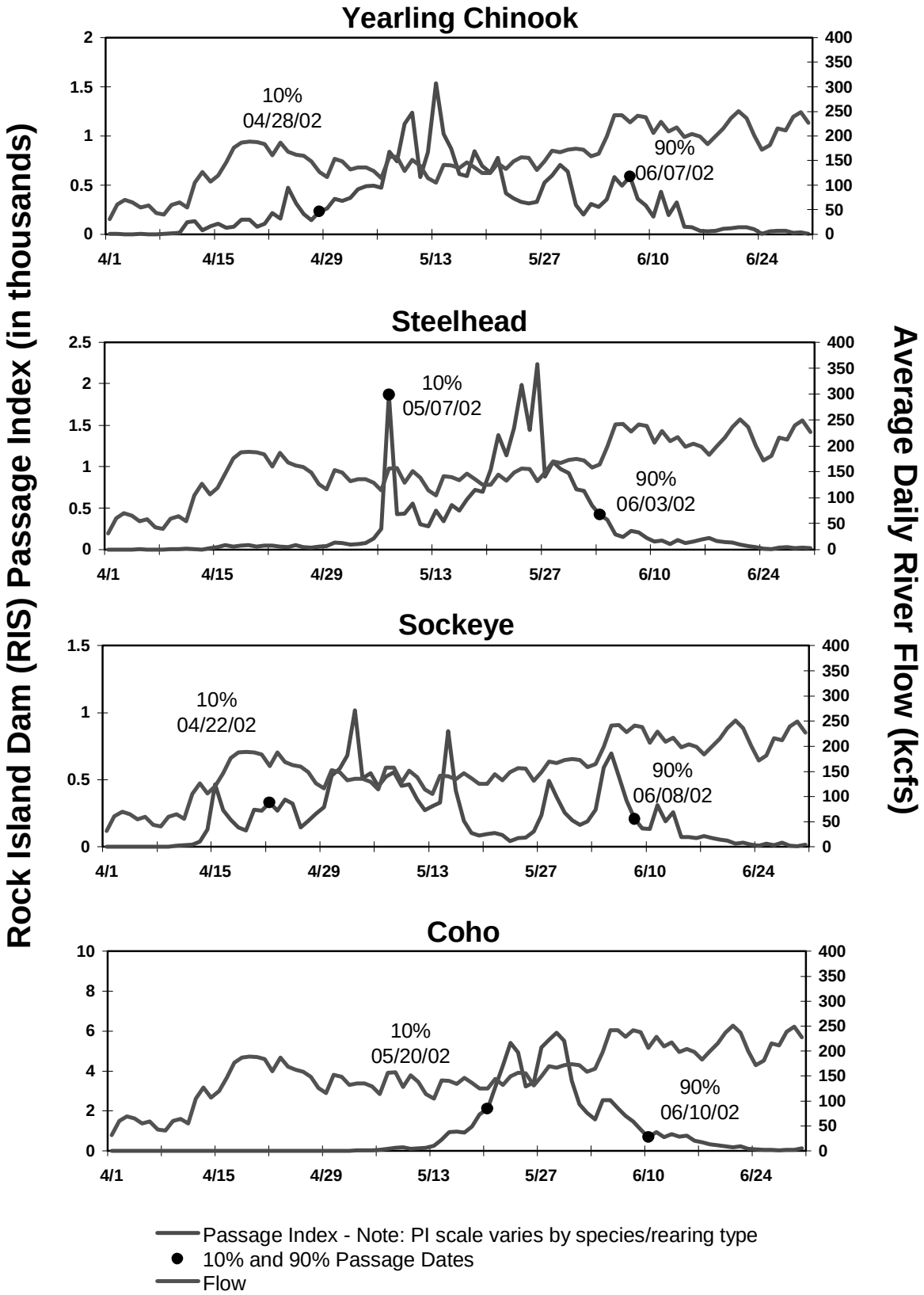


FIGURE D-8. Smolt migration timing at Rock Island Dam with associated flow, 2002.

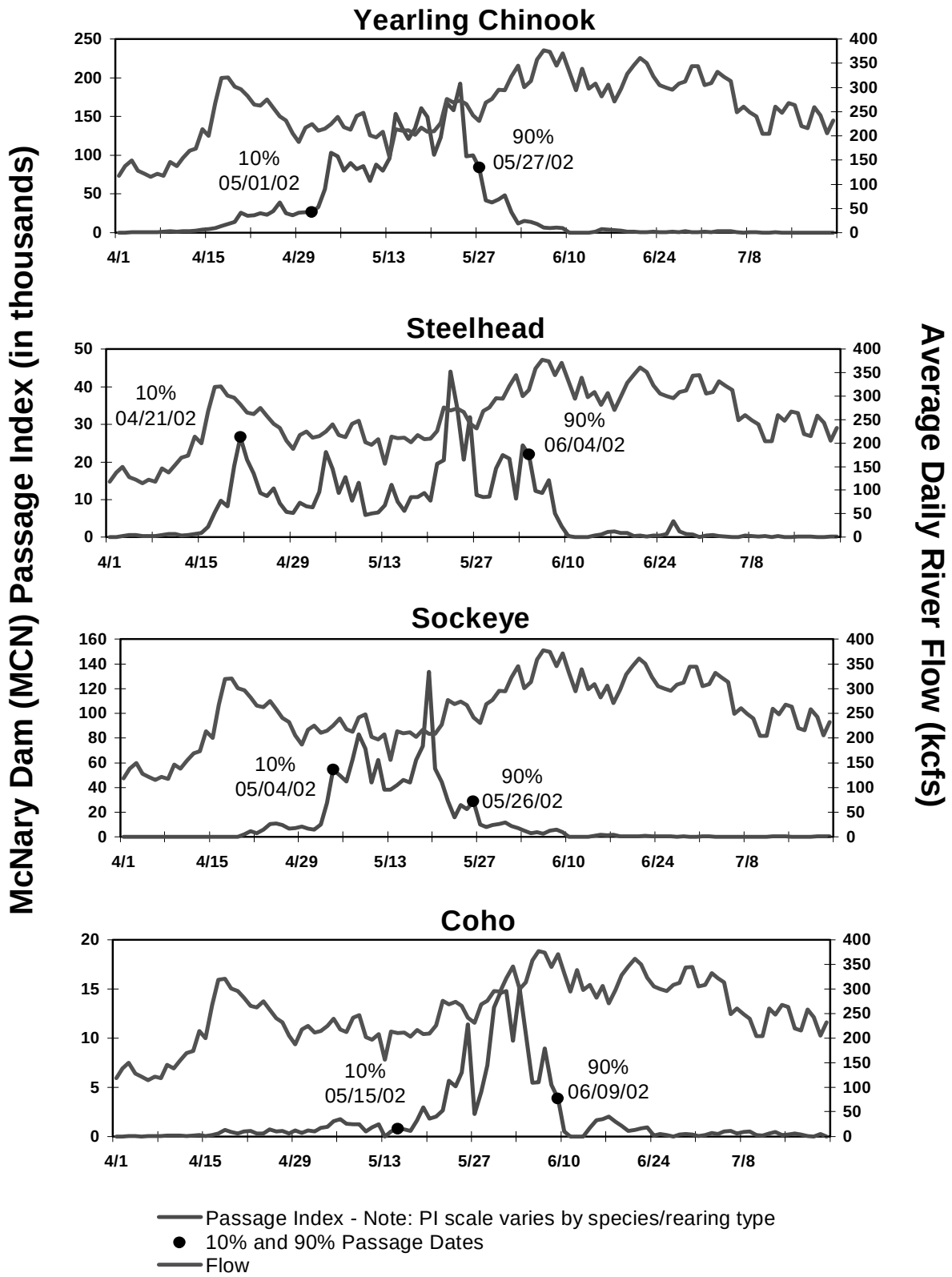


FIGURE D-9. Smolt migration timing at McNary Dam with associated flow, 2002.

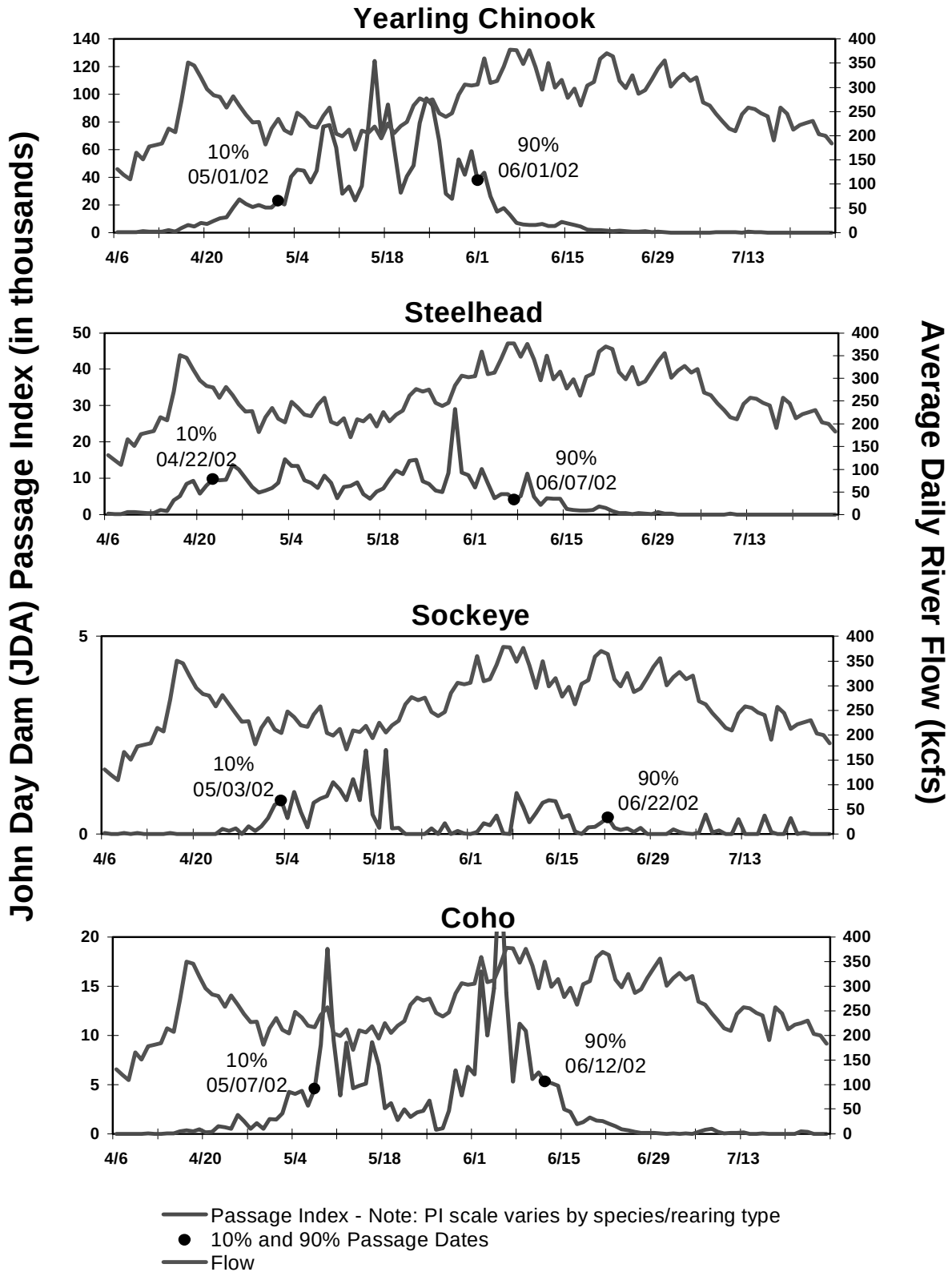


FIGURE D-10. Smolt migration timing at John Day Dam with associated flow, 2002.

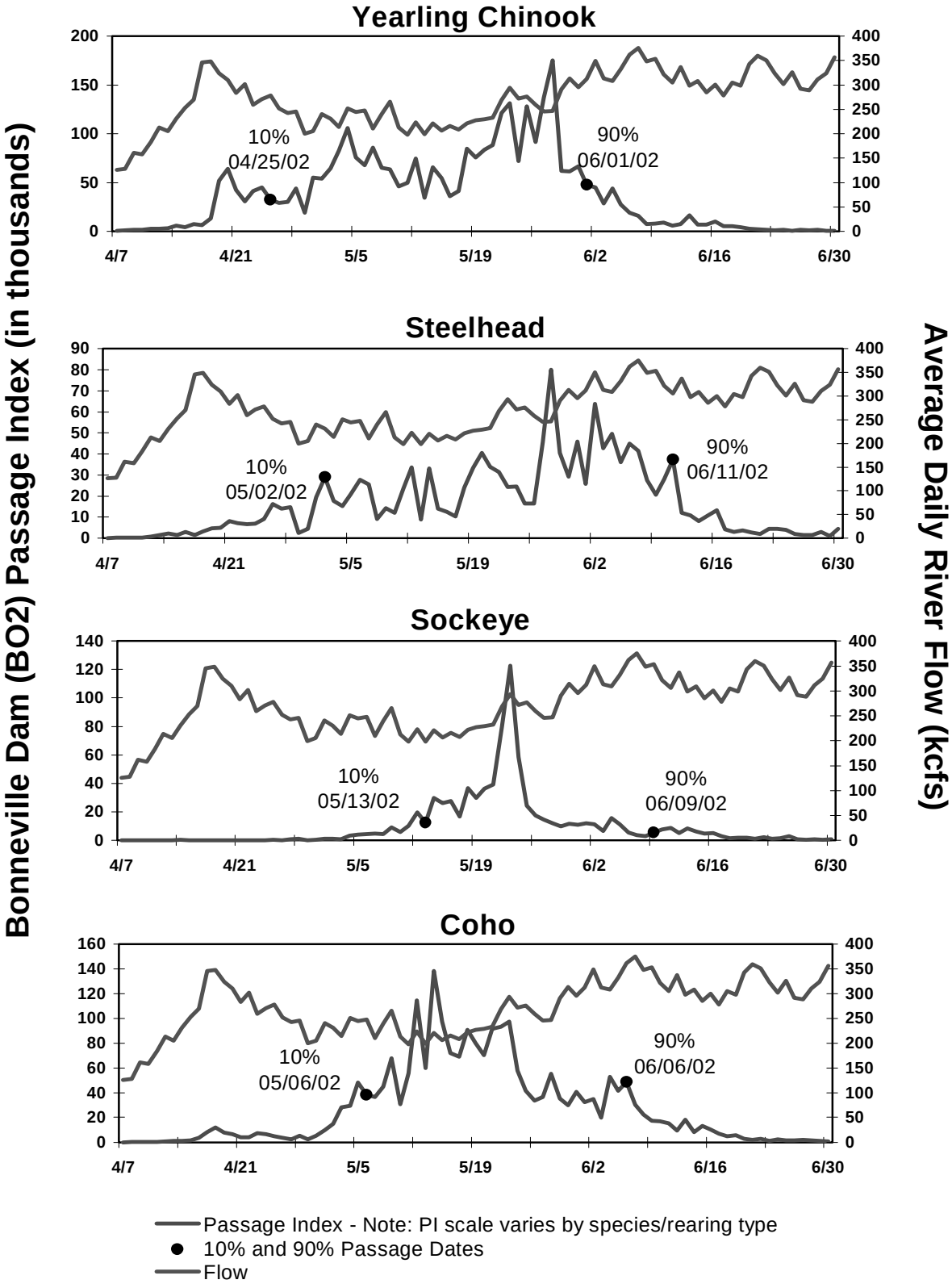


FIGURE D-11. Smolt migration timing at Bonneville Powerhouse II (BO2) with associated flow, 2002.

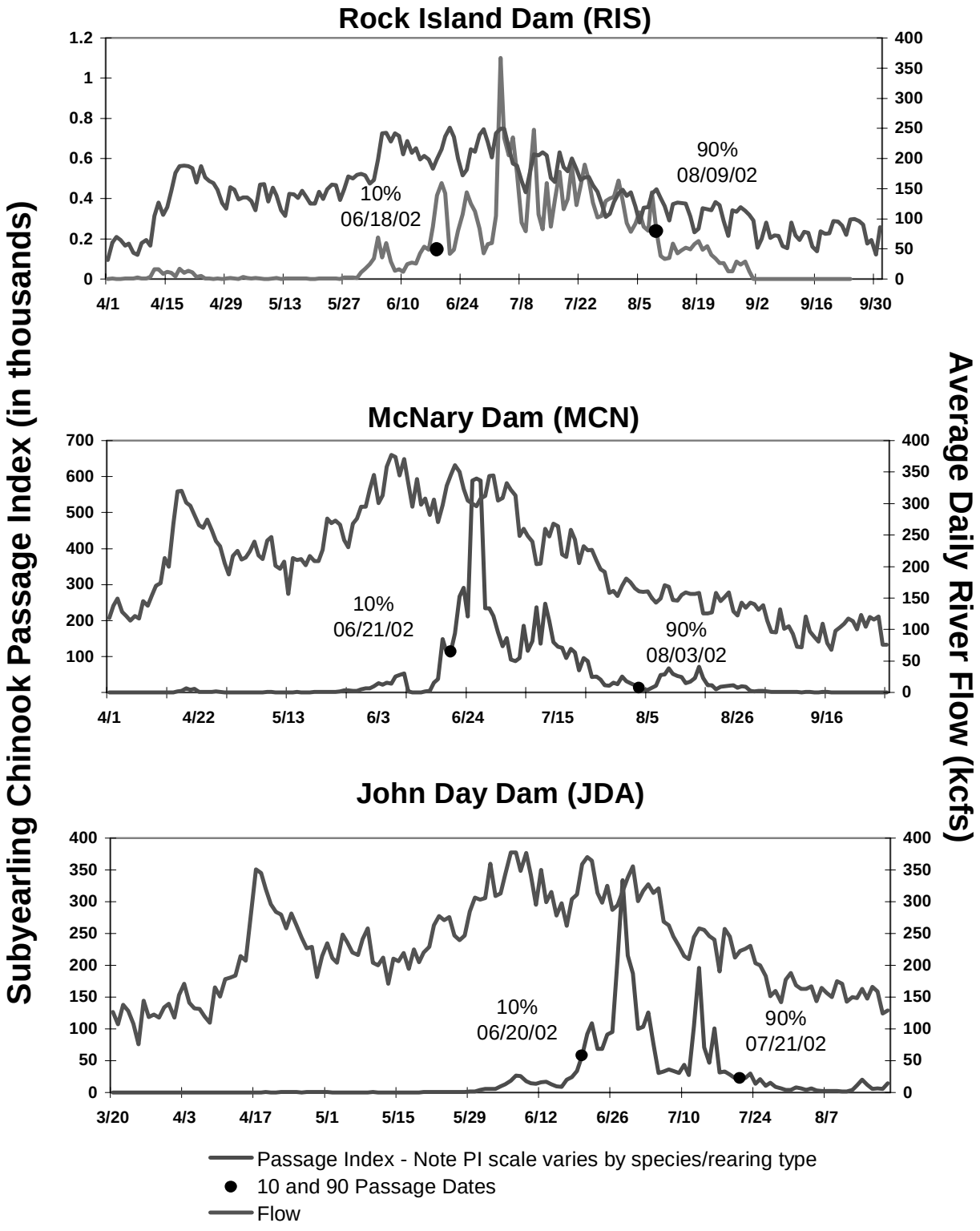


FIGURE D-12. Subyearling chinook smolt migration timing at Snake River sites with associated flow, 2002.

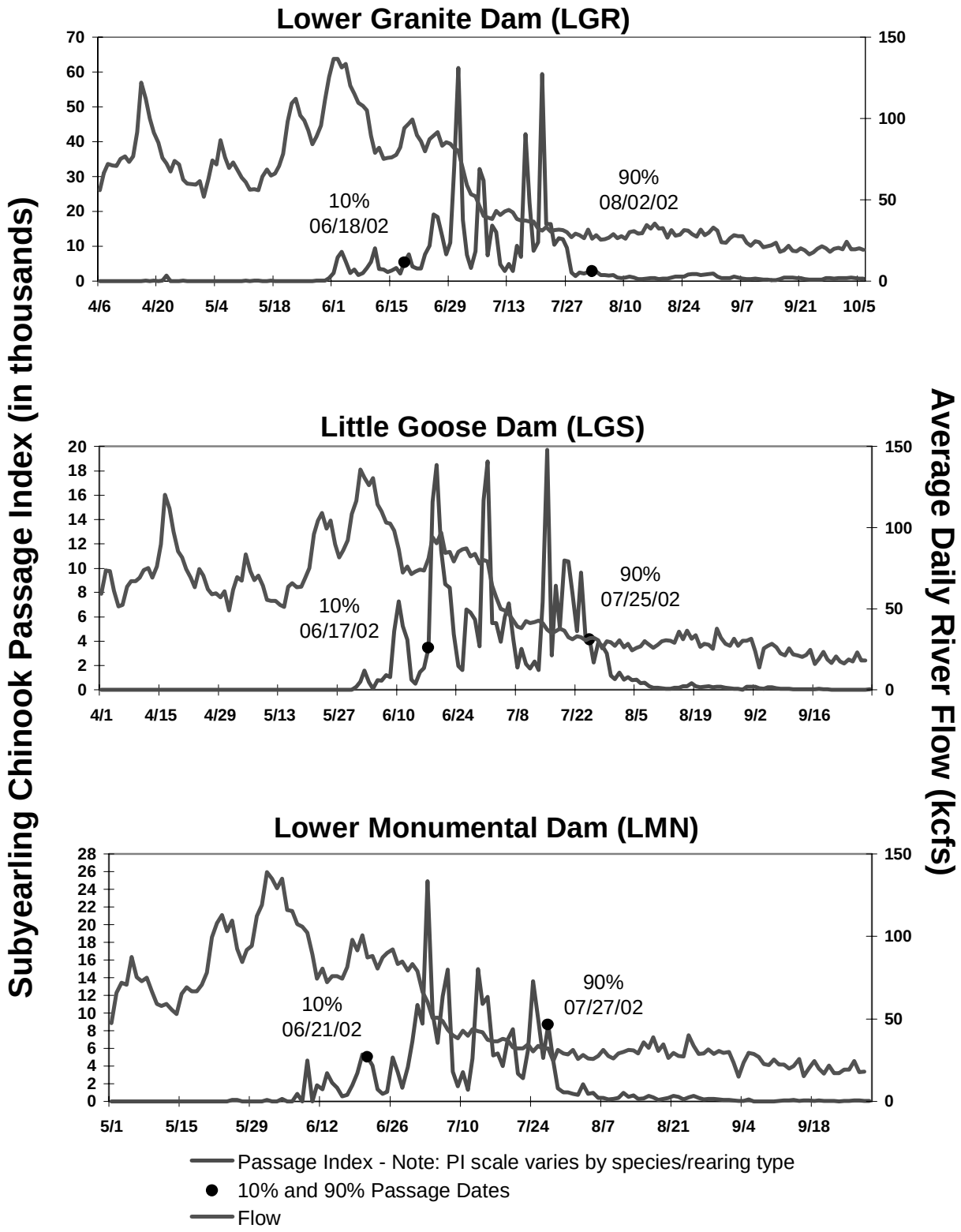
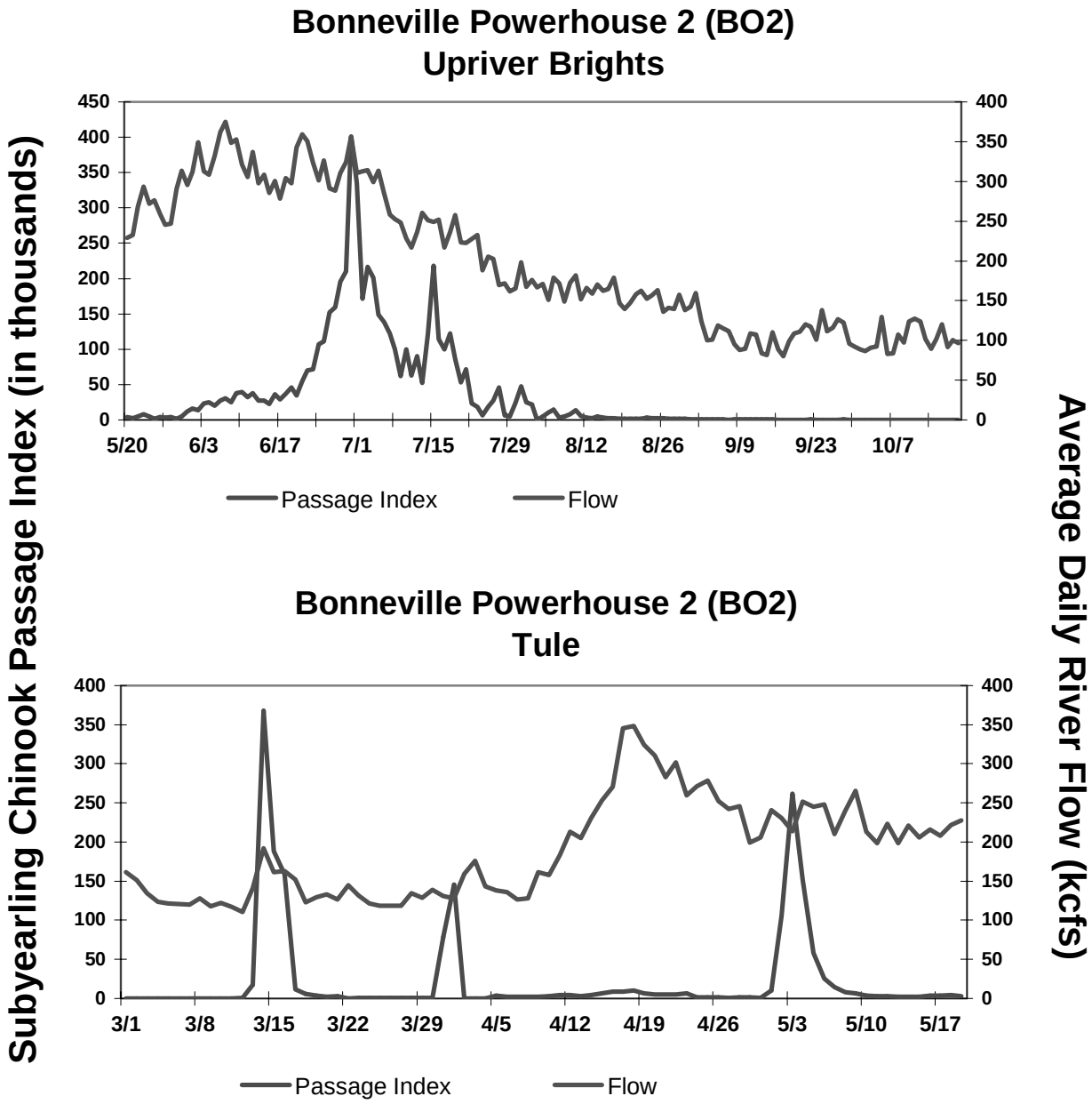


FIGURE D-13. Subyearling chinook smolt migration timing at Snake River sites with associated flow, 2002.



Spring Creek Hatchery Chinook (Tule) released on:

Date	Number Released
02/11/02	848,986
03/11/02	7,791,715
03/29/02	3,995,694
04/30/02	3,481,511

FIGURE D-14. Subyearling chinook smolt migration timing at Columbia River sites with associated flow, 2002.

APPENDIX E

Travel Time Tables

DISTANCES OVER WHICH TRAVEL TIME IS MEASURED:

Snake River Basin Hatcheries		**Distance to Lower Granite Dam**	
Drainage	**Hatchery/Release Site**	**Kilometers**	**Miles**
S.F. Salmon River	McCall H/Knox Bridge	457	284
Salmon River	Rapid River H	283	176
Salmon River	Imnaha A P	209	130
Grand Ronde River		238	148
Clearwater River	Dworshak H	116	72

Snake River Basin Traps		**Distance to Lower Granite Dam**	
Drainage	**Trap Location**	**Kilometers**	**Miles**
Salmon River	km 103	233	145
Imnaha River	km 7	142	88
Grande Ronde River	km 5	103	64
Snake River	km 225	52	32

Mid-Columbia River Basin		**Distance to McNary Dam**	
Drainage	**Hatchery**	**Kilometers**	**Miles**
Methow River	Winthrop H	454	282
Wenatchee River	Leavenworth H	330	205
Mainstem Columbia River	Wells H	360	224
Mainstem Columbia River	Priest Rapids H	169	105
Mainstem Columbia River	Ringold H	97	60

Key Index Reaches	**Reach Distance**	
Reach Location	**Kilometers**	**Miles**
Lower Granite Dam to McNary Dam	225	140
Rock Island Dam to McNary Dam	260	161
McNary Dam to Bonneville Dam	236	147

Distance Source: Kilometers of sites obtained from 1998 PIT Tag Specification Document, [editor] Carter Stein, Pacific States Marine Fisheries Commission, March 17, 1998. Miles computed using conversion 0.621 miles per kilometer.

Computation of average flow and average temperature: Flow and temperature data are averaged over the period of days equal to the estimated median travel time commencing on the date of

release (or date of passage at upstream dam for the Snake River and lower Columbia River index reaches). The flows and temperatures are indexed at Lower Granite Dam for the release to Lower Granite Dam travel time data. They are indexed at Ice Harbor Dam for the Lower Granite Dam to McNary Dam index reach and at The Dalles Dam for McNary Dam to Bonneville Dam index reach. For the release to McNary Dam travel time data of mid-Columbia River basin released fish, the flows and temperatures are indexed at Priest Rapids Dam.

TABLE E-1. 2002 travel time of PIT- tagged wild chinook released from the Salmon River trap to Lower Granite Dam.

Salmon Trap	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
3/28	16.7	18.6	25.9	16.7	25.9	8	72.5	49.6
3/29	13.2	20.4	27.9	15.2	26.2	10	75.2	49.4
3/30	13.9	17.8	30.6	15.5	27.8	10	74.8	49.5
3/31	9.5	16.2	34.4	14.7	25.9	17	74.3	49.6
4/1	10	14.6	44	13.9	15.2	21	75.4	49.6
4/2	10.4	16.2	57.7	14.9	22.7	25	78.2	49.4
4/3	8.8	13.8	48.4	11	24.5	17	78.5	49.3
4/4	9.2	16.8	55.1	12.9	23.8	41	80.1	48.7
4/5	6	12.9	56.5	11.4	17.3	63	82.5	48.9
4/6	6.2	12.5	48.3	10.9	17.7	99	84.6	48.5
4/7	7.1	12.4	50.5	10.9	17.4	56	86	48.6
4/8	6.6	18	46.2	13.1	20.2	70	80.5	48.2
4/9	6.3	11.6	44	9.4	16	86	86.3	48.4
4/10	4.6	13.7	49.2	10.4	16.8	104	84.3	48.1
4/11	4.4	18.5	66.7	12.7	23.2	77	77.2	49.2
4/12	5.9	17.5	40.7	11.5	22.5	32	77.2	49.3
4/13	4.1	14.4	45.5	12	20.5	54	81.4	48.5
4/14	3.3	15	36.2	8.9	21.8	29	79.1	49.1
4/15	4.3	21.9	46.8	14.6	33.1	39	75.7	50.3
4/16	4.1	14.4	35.7	9.4	18.2	31	73.6	49.2
4/17	4.2	18.3	42.6	17.2	22.7	47	71.8	50.1
4/18	6.6	27.7	37.1	15.6	33.7	17	67.8	51
4/19	15.2	30.6	35.2	16.5	33.9	10	68.4	51.5
4/20	13.8	19.8	31.8	13.8	31.8	8	67.8	50.9
4/21	14.6	28.9	32.8	14.6	32.8	7	67.6	51.8
4/22	11.5	27	32.3	15	29.9	16	66.3	52
4/23	10.7	26	31.2	17.1	29.1	9	66.3	52.2
4/24	9.5	20.8	30.4	12.6	28.4	16	65.2	52

TABLE E-2. 2002 travel time of PIT-tagged hatchery chinook released from the Salmon River trap to Lower Granite Dam.

Salmon River Trap	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
3/14	27	35.2	65.1	31.9	44.2	29	59.3	48.4
3/15	24.9	41.5	49.5	24.9	49.5	7	62	48.2
3/16	20.1	38.6	63.2	31.5	48.5	46	62.8	48.2
3/18	26.8	39.2	50.8	28.6	46.7	16	64.5	48.3
3/19	26.9	36	55	28.9	46.5	16	65.6	48.4
3/20	24.2	43.7	59.9	36.3	45.5	23	65.8	49.3
3/21	20.1	30	46.4	25.8	39.2	18	67.1	48.8
3/22	17.7	33.6	50.8	23.7	44.7	22	68.6	48.6
3/25	21.6	39.1	42.1	28.5	40.2	18	70.2	49.6
3/26	15.5	29.4	48.6	22.4	39.6	18	73.3	48.8
3/27	15.3	28.8	54.2	19.6	39.4	23	73.6	48.9
3/28	18.1	22.3	39.3	18.7	30	12	75.1	49.3
3/29	11.2	17.9	36.5	15.2	23.7	18	73	49.6
3/30	16.9	16.9	16.9	-	-	1	73.4	49.6
4/1	13.8	29	44.5	14.5	33.1	14	73.3	49.4
4/2	12.1	31.9	40.2	22.8	33.7	28	73.5	49.8
4/3	11.4	32.3	44.4	30.6	33	25	74	49.8
4/4	11.2	29.7	38.3	23.1	30.7	21	74.3	49.6
4/5	10.4	26.2	31.1	15.3	29.4	18	74.7	49.1
4/8	8.4	26.3	36.7	16.7	33.4	19	76.2	49.6
4/9	7.3	26.8	41.9	25.2	31.4	43	76.1	49.8
4/10	10.2	27.6	41.2	24.7	34.6	21	75.9	50.1
4/11	6.8	24.6	41.4	23.5	31.2	16	76.4	50
4/12	15.7	27	39.5	22.6	31.6	20	75.5	50.3
4/15	18.5	29.6	35.6	22.1	33.1	24	72.1	50.7
4/16	5.2	33.5	44.6	19.5	34.8	18	71.2	51.2
4/17	6.5	29.7	35.5	25.6	32.4	29	68.8	51
4/18	14.5	30.4	36.1	25.1	31.4	30	67.8	51.3
4/19	15.6	25.2	31.2	18.4	30.3	10	66.9	50.9
4/22	7.5	14.2	27.7	12.6	20.2	21	67.2	51.3
4/23	7	17	27.7	12.5	21.4	26	67.1	51.6
4/24	6	12.6	25.7	11.4	14.2	26	67.2	52.2
4/25	5.1	14	25.3	11.7	20.5	28	66.7	52.4
4/26	7.9	12	21.6	8.8	19.5	14	67.3	52.8
4/29	5.3	13.4	21.1	9.3	16.6	28	66.6	52.4
4/30	7.3	14.4	19.3	9	17.2	15	66.1	52.3
5/1	4.7	16.6	20.8	13.6	17.4	22	67.2	52.7
5/2	7.7	14.8	19.9	13.4	16.9	17	67.3	52.6
5/3	10.6	16.4	17.5	-	-	5	67.8	52.7
5/4	11.4	14	16.1	-	-	6	66.8	52.6
5/5	7.9	12.3	16.5	9	15.1	17	64.9	52.4
5/6	11.2	13.3	16.1	-	-	4	65.5	52.6
5/7	9.7	12.7	15.5	10.8	15.3	11	67.6	52.6
5/8	10.1	12.2	14.5	11.5	13.5	9	67.1	52.6
5/9	9	10.6	19.3	9	19.3	7	67	52.8

TABLE E-3. 2002 travel time of PIT-tagged wild steelhead released from the Salmon River trap to Lower Granite Dam.

Salmon Trap	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/16	2.9	4.4	32.2	3.7	7.5	23	92.9	48
4/17	3.5	5.4	31.1	4.3	8.5	23	81.9	47.3

TABLE E-4. 2002 travel time of PIT-tagged hatchery steelhead released from the Salmon River trap to Lower Granite Dam.

Salmon Trap	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/13	3.3	4	6.4	3.4	4.9	10	100.5	49.4
4/14	2.9	3	6.3	2.9	6.3	7	106.4	49.5
4/15	3.1	3.9	15.7	3.1	15.7	7	102.1	48.6
4/16	2.8	3.9	17.6	3.1	7.4	12	92.9	48
4/17	2.8	5.2	33.4	4.2	7.5	44	81.9	47.3
4/18	4.5	9.9	28.9	4.5	28.9	7	70.8	48.5
4/22	5.5	6.3	16.6	-	-	5	64.9	49.3
4/23	3.9	6	7.6	-	-	5	64.1	50.3
4/24	3.9	4.6	6	-	-	4	62.4	51
4/25	3.9	16.4	26.7	-	-	4	65.8	52.3
4/26	8.2	11.9	15.6	-	-	2	67.3	52.8
4/27	8.6	8.6	8.6	-	-	1	67.3	53
4/28	5.8	8.4	22.9	-	-	6	68.2	53
4/29	4.9	7	22.7	-	-	5	69.3	53
4/30	3.4	5.6	19.3	5.5	8.6	10	70.4	53
5/1	2.7	4.8	11.2	4.5	8.1	18	73.5	53
5/2	3.5	4.2	8.8	3.7	4.7	22	75.7	53
5/3	2.6	3.3	6.9	2.8	5.7	11	76.1	53
5/4	2.8	4.5	13.2	-	-	6	72.9	52.2
5/5	3.3	5.6	21.7	3.9	13	16	66.9	51.9
5/6	3.6	4.3	17.7	3.7	16.4	9	67.1	51.6
5/7	3.7	5.9	16.2	5.1	7.9	18	62.1	51.7
5/8	4	8	24.5	4.2	14.4	10	62.1	52
5/9	4.5	9	22.9	4.8	15.2	10	62.8	52.7
5/10	5	10.7	14.5	-	-	6	70.8	52.9
5/13	3.6	5.6	12.1	3.6	12.1	7	67	53.4
5/14	3.5	5.4	16.8	4.6	7.8	18	68.9	53.7
5/15	3.6	4.3	14.5	3.7	5.7	15	69.8	54
5/16	3.5	5.2	12.2	3.8	8.3	17	81.3	54

TABLE E-5. 2002 travel time of PIT-tagged wild chinook released from the Snake River trap to Lower Granite Dam.

Snake Trap	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/13	1.9	6.1	16.9	3.1	16.5	13	96.9	48.9
4/14	1.8	3.8	13.7	2	6.5	13	103.4	49.2
4/15	2.5	6.6	19.8	3.5	10	33	90.7	48
4/16	2.2	8	29	6.4	9.4	50	83.3	47.6
4/17	3.1	8.1	17.3	4.4	10.6	15	77.8	47.4
4/18	3.3	7.8	17.1	6.2	8.6	48	73.3	47.4
4/19	5.3	10.3	29.8	5.9	23.2	12	68.1	49
4/20	5	12.1	16.7	-	-	4	65.6	49.9
4/29	5.1	5.3	7.3	-	-	4	68.1	53.2
5/1	3.6	5.1	6.6	-	-	4	73.5	53
5/2	3.5	3.5	3.5	-	-	1	75.7	53
5/6	5.2	5.6	6.1	-	-	2	64	51.7
5/8	6.4	6.4	6.4	-	-	1	60.8	51.6
5/14	3	3	3	-	-	1	66	53.5
5/19	2.6	2.6	2.6	-	-	1	99.5	52.8
5/21	1.9	3	8.5	2.7	5.3	14	105.6	51
5/22	2.5	7.8	10.4	6.2	10	16	101.2	50.7
5/23	3.5	6.1	17	4.7	8.3	17	96.2	50.5

TABLE E-6. 2002 travel time of PIT-tagged hatchery chinook released from the Snake River trap to Lower Granite Dam.

Snake Trap	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/10	5.5	9.9	35.6	5.5	35.6	7	89	48.5
4/11	3.5	4.9	22.5	-	-	5	92	49.3
4/12	3.8	7.2	21.1	4.3	16.8	10	94	48.9
4/13	2.6	10.7	34.6	6.7	20.5	23	86.6	48.1
4/14	2.1	3.6	30.5	3	8.5	21	103.4	49.2
4/15	2.2	11.5	21.3	8.1	18.5	28	81	48.3
4/16	3.1	18.1	33.5	14.5	19.4	23	73.7	49.9
4/17	2.5	12.6	26.4	9.1	17.8	26	70.9	49.2
4/18	3.4	11.5	18.9	7.4	16.4	21	68.6	49.2
4/21	3.9	15	15.8	-	-	6	67.6	51
4/22	5.8	5.8	5.8	-	-	1	64.9	49.3
4/24	3.4	3.4	3.4	-	-	1	63.4	49.7
4/27	5.7	5.7	5.7	-	-	1	63	53.2
4/28	6.5	9	9.5	-	-	3	68.7	53
4/29	3.7	4.9	5.4	-	-	4	68.1	53.2
4/30	3.5	4.7	8.8	-	-	4	70.5	53.2
5/1	3.4	5.5	15.6	4.5	7.6	13	73.4	53
5/2	3.7	4	4.2	-	-	2	75.7	53
5/3	4.3	4.3	4.3	-	-	1	75.4	53
5/4	5.5	7.1	10.5	-	-	5	69.3	52
5/5	5.4	5.4	5.4	-	-	1	68.6	51.8
5/6	2.5	8.8	12.4	2.5	12.4	8	63.7	51.8

TABLE E-7. 2002 travel time of PIT-tagged wild steelhead released from the Snake River trap to Lower Granite Dam.

Snake Trap	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/11	2.1	3	4.8	2.2	3.5	12	79.5	49
4/12	2.3	2.5	3.4	2.3	2.6	13	90.8	49.5
4/13	1.6	1.8	2.5	1.7	2.4	9	96.7	49.7
4/14	1.4	1.8	3.1	1.7	2	26	108.6	50
4/15	1.4	2.1	7.7	1.7	2.3	29	111.4	49.3
4/16	1.6	2.4	6.2	1.8	2.8	21	101.1	48.7
4/17	1.8	2.4	8.9	2.2	3.1	34	92.1	47.7
4/18	1.8	3.2	9.3	2.7	3.5	38	81.1	47.2
4/19	2.7	3.4	10.8	2.7	10.8	8	75.1	47
4/20	1.9	2.9	4.5	2.5	3.4	9	72.3	47
4/21	2.3	2.8	5.9	2.6	3.7	10	71.3	47
4/22	12	12	12	-	-	1	66.4	51.1
4/23	2.5	2.5	2.5	-	-	1	67	47.7
4/24	2.4	3.3	4.1	2.4	4.1	7	63.4	49.7
4/26	3.5	3.5	3.5	-	-	2	58.4	53
4/27	2.4	2.6	2.9	2.5	2.8	10	58.1	53
4/28	3.4	3.4	3.4	-	-	1	58.8	53
4/29	33.3	33.3	33.3	-	-	1	82.2	52.4
4/30	2.6	2.6	2.9	-	-	3	65.1	53.3
5/2	1.8	2.5	4.2	1.9	3	14	77.2	53.2
5/3	2.5	2.5	2.5	-	-	1	76.1	53
5/4	1.9	2.3	8.8	2.3	5.3	12	77.4	52.7
5/5	1.8	2.2	8.3	-	-	5	72.9	52.7
5/6	1.9	2.4	3.5	1.9	3.5	8	70.4	52
5/7	2.3	2.8	7.9	2.4	3.8	18	66.5	51.5
5/8	2.2	2.5	5.4	2.4	3.2	23	62.4	51.2
5/9	1.6	3	4.7	2.8	3.7	21	59.3	51.5
5/10	2.5	4.2	11.5	3.2	7.4	9	58.7	51.8
5/11	3	3.7	4.1	-	-	4	60.2	52
5/12	2.4	2.6	3.9	2.4	3	9	61.2	52
5/13	2	2.4	6.8	-	-	3	62.8	52
5/14	1.5	2	2.7	-	-	6	65.9	53
5/15	1.6	2.6	3.9	2.3	2.7	26	67.6	54.2
5/16	2.5	3	3.6	2.7	3.5	9	70.1	54.5
5/17	2.2	2.6	2.9	-	-	2	78.4	54
5/18	1.5	2.4	3	1.8	2.6	9	82.5	53.7
5/19	1.5	1.7	2.7	1.6	2	16	95.3	53
5/20	1.5	1.7	2.5	1.6	2.2	17	106.6	52.7
5/21	1.2	1.6	3.6	1.5	1.7	73	107.8	51.7
5/22	1.4	1.8	10.4	1.6	2.6	34	104.3	50.3
5/23	1.6	2.1	7	1.9	2.4	37	97.8	50

TABLE E-8. 2002 travel time of PIT-tagged hatchery steelhead released from the Snake River trap to Lower Granite Dam.

Snake Trap	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/7	2.8	3.6	10.3	2.9	5	12	73.1	48.2
4/8	2.3	3.1	8.4	2.5	3.2	16	73.4	48.2
4/9	2.4	3.4	19.6	3	3.8	16	73.9	48.2
4/10	2.3	3.1	15.3	2.8	3.8	20	75.4	48.5
4/11	1.8	3	4.8	2.4	3.2	33	79.5	49
4/12	1.9	2.3	2.9	2.1	2.6	34	80.4	49.3
4/13	1.4	2	5.1	1.9	2.2	57	96.7	49.7
4/14	1.1	1.9	20.3	1.7	2.1	63	108.6	50
4/15	1.2	1.9	14.9	1.8	2.2	70	111.4	49.3
4/16	1.2	1.8	12.8	1.8	2	50	101.1	48.7
4/17	1.8	2.2	12.1	2	2.7	39	92.1	47.7
4/18	1.8	2.7	31.3	2.2	3	66	81.1	47.2
4/21	1.6	2.4	24.5	2.4	2.7	52	71.2	47
4/22	1.7	2.7	4.3	2	3.5	9	68.9	47.5
4/23	2.4	2.8	4.5	2.4	4.5	7	67	47.7
4/24	2.4	2.8	8.4	2.7	3.4	21	63.4	49.7
4/25	1.9	3.2	11.7	2.6	4.2	16	60.3	51.7
4/26	1.6	2.4	6.5	1.6	6.5	7	59.6	53
4/27	1.8	2.7	10.4	2.6	2.9	56	58.1	53
4/28	2.6	2.8	3.1	-	-	3	58.8	53
4/29	2.6	2.7	18.9	-	-	6	62.5	53
4/30	1.6	2.6	3.6	-	-	2	65.1	53.3
5/1	4	4	4	-	-	1	74.3	53.2
5/2	1.5	1.7	3.4	1.6	2.5	11	77.6	53.3
5/3	1.6	1.9	2.6	-	-	5	78.2	53.3
5/4	1.4	1.8	6.1	1.4	2.3	20	77.4	52.7
5/5	1.6	1.9	10	1.6	9.4	11	72.9	52.7
5/6	1.6	2.7	10	2.1	3	20	68.7	51.8
5/7	2.4	2.7	7.3	2.4	3.2	11	66.5	51.5
5/8	2.1	2.8	5.6	2.2	4	9	62.4	51.2
5/9	2.1	2.8	5.9	2.1	5.9	8	59.3	51.5
5/10	3.4	3.4	3.4	-	-	1	57.3	51.8
5/12	2.4	2.8	9.5	2.8	2.9	43	61.2	52
5/13	1.8	2.2	5.4	1.8	2.9	14	62.8	52
5/14	1.9	2	2	-	-	2	65.9	53
5/15	1.7	2.4	7.6	1.9	3.5	14	66.6	54
5/16	2.8	3.1	3.4	2.9	3.3	9	70.1	54.5
5/17	2.2	2.6	2.7	-	-	6	78.4	54
5/19	1.5	1.8	6	1.7	2.4	32	95.3	53
5/20	1.5	1.8	4.5	1.7	1.8	38	106.6	52.7
5/21	1.2	1.5	5.3	1.4	1.6	32	107.8	51.7
5/22	1.3	1.7	4.1	1.6	1.9	34	104.3	50.3

TABLE E-8. 2002 travel time of PIT-tagged hatchery steelhead released from the Snake River trap to Lower Granite Dam.
(continued)

Snake Trap	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
5/23	1.5	2	11.5	1.8	2.4	43	97.8	50
5/24	1.6	2.4	12.7	2	2.5	30	91.8	50.3
5/26	1.7	2	4	1.7	4	8	89.5	51
5/27	1.4	1.8	2.6	1.6	2.6	14	98.7	51
5/28	1.5	1.6	2.5	1.5	2.5	7	110.9	51
5/29	1.3	1.5	2.7	1.4	1.6	23	124.5	54
5/30	1.2	1.5	2.2	1.4	1.6	19	132.9	54
5/31	1.9	2	2.4	-	-	4	134.9	54
6/1	1.3	1.4	2.2	1.3	1.6	12	134.1	54
6/2	1.2	1.5	2.4	1.4	1.7	21	128.5	53.7
6/3	1.1	1.4	4.9	1.2	2	13	127	53.5

TABLE E-9. 2002 travel time of PIT-tagged wild chinook released from the Imnaha River trap to Lower Granite Dam.

Imnaha Trap	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
3/25	9.5	21.8	39.6	19.4	29	26	69.9	49.5
3/26	7.4	20.7	38.3	16.4	28.4	21	71	49.6
3/27	6	19.2	39.1	16.2	32	15	69.8	49.6
3/28	11.1	18.7	39.2	11.1	39.2	7	72.5	49.6
3/29	11.8	24.4	31.5	-	-	5	75.2	49
3/31	15.4	18	33.2	-	-	5	76.6	49.4
4/1	9.3	14	34.3	10.9	23.7	9	73	49.6
4/3	9.4	13.2	33.1	9.4	33.1	7	77	49.4
4/4	7	29.1	31.4	8.5	31.4	13	73.9	49.5
4/7	5.7	10	26.6	5.7	26.6	7	85.6	48.8
4/8	7.7	9.3	26.8	8.4	25.9	9	86.9	48.9
4/9	4.6	8.8	41	6.5	13.8	31	88.9	48.8
4/10	4.7	8.8	43	4.9	33.4	9	90.3	48.7
4/12	4.6	6.9	36.8	5.2	18.1	10	94	48.9
4/13	4.2	4.2	4.2	-	-	1	100.5	49.4
4/17	4.8	13.2	20.2	6.1	19	10	70.9	49.2
4/18	5	17.9	31.9	16	20.5	20	70.2	50.4
4/19	4.1	15.4	48	14.9	16.4	28	68.5	50.2
4/20	13.2	15	29.8	14	17	13	67.9	50.6
4/21	10.1	16.1	38.1	14	25.2	23	67.9	51.1
4/22	10.8	13.9	17.4	-	-	6	67.2	51.3
4/23	10.3	12.4	22.8	10.3	14.4	9	67.1	51.6
4/24	9.1	11.3	35.8	10.1	13.7	20	66.5	52.1
4/25	9.4	10.5	17.5	10	15	14	66.3	52.6
4/26	7.4	10.4	19.8	7.9	14	11	66.7	53
4/27	6.9	10.3	19.3	7.9	13.7	12	67.8	53
4/28	6.2	8.2	23.2	7	10.9	20	68.2	53
4/29	6	7.9	11	6	11	7	69.7	53
4/30	6.5	10.3	29.3	7.8	13.6	24	69	52.4
5/1	2.9	8.8	20.7	6.3	11.8	29	70.7	52.3
5/2	17.3	17.3	17.3	-	-	1	68.1	52.7
5/3	10.8	10.8	10.8	-	-	1	66.9	52.2
5/5	7.6	10.1	12.6	-	-	2	64.8	51.9
5/7	8	11.8	13.8	-	-	4	65.2	52.6
5/8	8.3	10	24.7	-	-	4	63.3	52.5
5/10	6.2	8.9	10.8	-	-	5	64.2	52.9
5/12	6.6	7.2	8.1	-	-	3	65.7	53.2
5/13	5.4	6.4	11.8	5.4	11.8	8	67	53.4
5/14	4.9	5.2	6.5	-	-	6	68.9	53.7

TABLE E-10. 2002 travel time of PIT-tagged hatchery chinook released from the Imnaha River trap to Lower Granite Dam.

Imnaha Trap	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
3/4	40.1	62.4	78	46.8	68.9	17	57	48.5
3/9	51.4	51.4	51.4	-	-	1	58.5	48.2
3/11	39.4	55.6	71.5	41.1	64.6	10	61.2	48.9
3/23	9.8	29	50.1	18.7	37	16	70	48.9
3/24	35.9	38.4	41	-	-	2	69.2	49.3
3/25	7.1	21.8	38.3	8.6	31.5	11	69.9	49.5
3/26	5.4	21.2	39.1	10.3	37.5	11	71	49.6
3/27	5.8	27.3	40	18.3	39.9	14	74	49
3/28	18.4	28.4	38.4	-	-	2	74.1	48.8
3/29	15.8	31.6	49.3	-	-	6	72.1	49.4
3/31	11.6	21	44.1	14.6	34.7	16	76.7	49.1
4/1	13.5	21.4	35.1	-	-	4	77.2	49
4/3	19.9	32.6	45.1	-	-	6	73.9	49.9
4/4	9.1	24.9	41	11.1	31.3	15	75.3	49
4/7	5.8	22.7	35.4	15.8	28.2	16	76.4	49
4/8	7.6	26.4	41.1	17.9	29	18	76.2	49.6
4/9	8.3	25.4	35	24.1	26.1	15	76.4	49.6
4/10	8	26.2	34.8	23.2	33.4	12	76.3	49.9
4/12	4	28.2	38.8	21.1	36.2	16	75	50.3
4/14	15.6	22.8	35.1	19.7	33.6	10	76.3	50.3
4/17	7.7	26.7	33.1	19.7	29	53	69	50.7
4/18	16.2	26	31.3	16.2	31.3	7	67.8	50.8
4/19	17.7	24.2	30.1	-	-	6	67	50.9
4/20	14.2	14.2	14.2	-	-	1	67.4	50.5
4/21	28.9	28.9	28.9	-	-	1	67.6	51.8
4/22	10.1	16.2	29.2	14.4	24.3	21	67.7	51.4
4/24	9.2	19.4	25.5	14.3	22.9	34	65.1	51.9
4/25	8.2	13.3	23.8	10	19.3	15	66.9	52.5
4/27	6.4	19.9	22.9	-	-	3	65.3	52.6
4/28	5.2	12.7	23.1	8.9	18.8	31	66.9	52.5
4/29	6.6	15.8	20.6	7.6	17.4	11	66	52.3
4/30	5.1	14	21.1	8.8	17.3	23	66.1	52.3
5/1	9.9	15.5	19.1	9.9	19.1	7	67	52.6

TABLE E-11. 2002 travel of PIT-tagged wild steelhead released from the Imnaha River trap to Lower Granite Dam.

Imnaha Trap	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/17	3.9	9	30.8	3.9	30.8	8	76	47.4
4/18	3.6	9.9	34.8	5.6	17.3	19	70.8	48.5
4/19	4.1	9	29.1	5.4	15.9	15	68.7	48.6
4/20	3.4	16	33.1	3.4	33.1	7	68	50.7
4/21	3.9	13.6	30.4	3.9	30.4	8	67.4	50.9
4/22	9.8	12.2	26.1	-	-	4	66.4	51.1
4/23	4.1	14.1	29.2	4.1	28.8	9	67.6	51.8
4/24	6	12.5	27.8	6	27.8	8	67.2	52.2
4/25	8.9	13.8	23.9	-	-	4	66.7	52.4
4/26	5.6	8.1	10.6	-	-	5	65.3	53.1
4/27	6.1	7.5	24.5	-	-	4	67.1	53.1
4/28	4.5	6.5	9.3	5.8	8.2	12	68	53.1
4/29	4.8	5.4	12.5	4.8	12.5	8	68.1	53.2
4/30	3.5	4.5	17.4	4.2	5	34	70.5	53.2
5/1	2.7	5	22.4	4.6	5.7	58	73.5	53
5/2	2.7	4.3	8.6	3.6	5.5	9	75.7	53
5/3	2.8	4.9	19.5	4.4	8.4	26	74.3	52.7
5/5	5.6	8.4	35	6.4	13.9	16	64.5	51.9
5/6	4.2	5.4	12.4	4.5	10.7	15	65.3	51.7
5/7	3.7	7.6	24.5	5.5	8.6	23	63	51.8
5/8	4.1	7.6	14.4	5.8	9.6	20	62.1	52
5/9	4.4	7.9	21.7	4.5	13	14	61.9	52.4
5/10	4.7	6.1	14.3	5	8.2	20	61	52.3
5/12	3.6	4.7	17.9	4.4	5.6	37	62.7	53
5/13	2.8	4.5	37.4	4.4	5.3	70	65.1	53.5
5/14	2.8	4.4	7.2	4.2	4.6	80	67	53.8
5/15	3.1	4.8	16.7	4.7	4.9	178	74.5	53.8
5/16	3	4.7	8.5	4	5.6	20	81.3	54
5/17	3	4	9	3.1	4.6	19	84.6	53.8
5/18	2.9	3.7	4.8	3.4	4	18	93.8	53.2
5/22	2.7	7.4	9.2	6.6	8	24	98.2	50.7
5/23	3.5	6.8	10.5	5	7.6	12	99.9	50.5
5/24	3.6	5.6	8.2	5.4	6.6	19	99.6	50.6
5/28	2.1	3.2	7.5	2.7	3.4	35	117.3	52.5
5/29	2.2	2.8	9.6	2.5	3.1	16	127.6	54
6/3	3.6	4.9	7.7	-	-	4	115.3	54.2
6/4	2.5	4.8	21.8	3.4	17	13	107.9	54.3
6/5	2.5	3.1	8.7	2.5	8.7	8	109.4	54.5
6/6	2.3	5.8	20	2.6	10.9	13	92.6	53.7
6/7	2.4	4.8	7.7	3.5	6	10	89.7	53.7
6/8	3.5	6.1	10.2	3.7	7.8	11	83.2	53.7
6/9	3.4	7.6	14.7	4.8	13.2	10	81.3	54.9
6/10	5.7	5.9	6.1	-	-	2	78.3	54.6
6/11	5.8	6	6.2	-	-	2	80.5	55.3

TABLE E-12. 2002 travel time of PIT-tagged hatchery steelhead released from the Rock Island Dam to McNary Dam.

Imnaha Trap	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/12	2.3	6.3	50.2	5.1	16	25	95.2	49.1
4/13	2.8	4.9	36.6	3.3	9.6	15	98.9	49.2
4/14	2.1	3.5	5.7	2.8	4.7	9	103.4	49.2
4/17	2.7	8.9	32.5	5.1	18.8	17	76	47.4
4/18	3.8	9.5	61.1	4.5	29.7	14	70.8	48.5
4/19	2.5	5.1	39.9	4.4	10	41	74.4	47
4/20	3	13.6	30.9	-	-	5	67.4	50.5
4/21	3.7	5.3	38.9	4.1	13.3	13	67.9	47.4
4/22	3.9	14.2	37.9	13.2	24.2	48	67.2	51.3
4/28	5.1	7.7	23.6	6.4	12.9	17	68.2	53
4/29	3.8	7	9.1	3.8	9.1	7	69.3	53
4/30	3.5	5.5	16.1	3.7	14.5	9	70.4	53
5/2	3.5	5.1	17.6	3.5	14	13	75.2	53
5/3	7.3	7.3	7.3	-	-	1	71.3	52.2
5/5	2.9	11	17.5	3.9	15	16	64.8	52.2
5/6	2.6	13.1	19.2	8.5	14.8	17	65.5	52.6
5/9	6.2	11.5	16.7	8.9	14.1	11	70.3	52.8
5/12	2.9	8.5	23.6	6.2	9.8	9	73.3	53.2
5/13	5	6.7	8	-	-	5	70.9	53.4
5/17	2.9	4.8	6.2	3.8	5.6	15	89.2	53.5
5/18	2.8	4	12.7	2.9	8.9	11	93.8	53.2
5/22	2.9	7.9	29.9	7.2	8.7	40	101.2	50.7
5/23	3.4	7.2	35	6.7	8	33	99.9	50.5
5/24	2.5	4.6	7	3.3	5.8	10	95.2	50.6
5/28	1.7	2.8	22.5	2.5	4.4	22	117.3	52.5
5/29	2.5	2.9	27.6	2.6	9.7	17	127.6	54

TABLE E-13. 2002 travel time of PIT-tagged wild chinook released from the Grand Ronde River trap to Lower Granite Dam.

Grande Ronde	Travel Time			Confidence Limits			River Zone	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
1/1	153.7	153.7	153.7	-	-	1	51.7	49.8
1/9	90.3	99	119.6	90.3	119.6	7	39.6	47.8
1/28	95.7	97.9	102.8	-	-	3	47.3	48.6
3/1	46.2	49.8	53.4	-	-	2	52	47.7
3/4	43.6	56	76.5	-	-	4	55.6	48
3/6	37.9	37.9	37.9	-	-	1	47.5	47.6
3/7	46.6	75.4	86.5	-	-	5	61.1	49.5
3/8	36.6	36.6	36.6	-	-	1	49.8	47.8
3/10	29.2	30	30.7	-	-	2	46.8	47.8
3/11	53.5	71.4	81.8	-	-	4	63.1	49.8
3/12	75	75	75	-	-	1	65.9	49.9
3/13	38.6	48.2	53.5	-	-	4	60.8	48.6
3/14	32.4	53.9	101.8	-	-	6	62.7	49.2
3/15	27.6	51.3	73.4	-	-	3	62.8	49.1
3/16	29.9	40.8	40.8	-	-	3	62.7	48.3
3/17	29.3	40.9	48.3	-	-	3	63.3	48.4
3/18	29.4	32.6	64.9	-	-	6	63.9	48.5
3/19	15	45.4	72.5	15	72.5	8	65	49.2
3/20	7.4	48.4	74.7	-	-	4	66.6	49.6
3/21	18.5	30	43.4	-	-	3	67.1	48.8
3/22	27.5	32.3	58.4	-	-	3	68.7	48.7
3/23	23	44.8	67.4	32	58.9	12	69.2	49.8
3/24	9.3	37.7	69.5	22.5	55.1	18	69.2	49.3
3/25	9.4	22.2	68.9	21.3	28.6	51	69.9	49.5
3/26	7.4	38.2	66.3	26.8	45.4	45	70.8	49.6
3/27	5.9	19.4	67.4	18.7	23.3	44	69.8	49.6
3/28	9.8	21.1	64.4	17.9	37.7	29	74.6	49.4
3/29	11.8	26.2	72.1	19.2	38.1	27	75	48.8
3/30	13.9	20.4	52.1	16.6	43.5	16	76	49.3
3/31	9.5	24.1	63.6	16.8	34.4	36	76	48.8
4/1	7.4	15.2	84	14.6	28.6	81	75.4	49.6
4/2	6.8	17.1	71.7	15.1	25.3	55	78.6	49.3
4/3	5.8	19.9	66.3	13.6	23.8	71	78.3	48.7
4/4	4.9	21.2	78.2	13.9	29.4	96	78	48.5
4/5	3.9	18.2	92.7	13	29.4	113	80.5	48.4
4/6	4.2	16.7	78.4	12	19.1	133	81.8	48.2
4/7	5.7	16.6	103.9	11.9	22.5	90	82.1	48.2
4/8	5.6	19.4	82.8	14.7	25.9	116	79.4	48.5
4/9	4.6	14	80.1	10.9	16.7	188	84.2	48.2
4/10	4.5	19.5	75.4	15.8	24.4	165	77.1	49.2
4/11	2.9	14.2	85.7	11	20.7	155	83.5	48.2
4/12	4	17.5	79.7	11.6	22	79	77.2	49.3
4/13	1.9	15.2	65.6	12.9	20.5	88	80.1	48.8
4/14	1.8	21.8	89.7	15.7	31.6	80	76.5	50.2
4/15	2.5	11.4	46.8	9.9	18.9	74	82.8	47.9
4/16	2.2	9.7	50.5	8.2	13.3	90	79.3	47.7
4/17	3.1	18.3	80.1	16.9	22.7	94	71.8	50.1

TABLE E-13. 2002 travel time of PIT-tagged wild chinook released from the Grand Ronde River trap to Lower Granite Dam.
(continued)

Grande Ronde	Travel Time			Confidence Limits			River Zone	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/18	3.3	15.3	73	9.8	16.5	108	68.8	49.9
4/19	4.1	19.8	71.6	15.8	26.8	78	68.9	50.7
4/20	5	29.6	74.2	17	42.1	51	67.8	51.7
4/21	6.3	27.1	70.7	16.1	31.3	50	66.1	51.7
4/22	10.8	28.4	69.8	19.2	33.5	40	67.4	52
4/23	9.9	16.6	74.9	12.4	25.1	64	67.1	51.6
4/24	9.1	23.7	67.7	13.7	28.1	54	65.5	52.3
4/25	9.4	13.6	52	10.7	25.7	25	66.7	52.4
4/26	7.4	14	58.7	10.4	41.3	21	66.6	52.5
4/27	6.9	14	55.2	10.1	28.9	28	66.4	52.5
4/28	6.2	10.6	57.5	8	19.4	32	68.2	52.6
4/29	5.1	11	69.1	7.4	31.5	35	68.4	52.5
4/30	5.5	13.8	61.5	10.7	19.6	54	66.1	52.3
5/1	2.9	11.8	65.4	7.5	16.2	69	67.3	52.2
5/2	3.5	20.4	59.5	17.3	29.8	42	73.6	52.7
5/3	2.7	17.2	56.2	11.9	27.7	43	69.4	52.7
5/4	7.5	17.1	69.2	15.6	21.7	33	71.5	52.7
5/5	7.6	18.7	54.6	13.9	26.8	21	75.7	52.3
5/6	5.2	16.6	49.8	12.8	25.2	21	74.4	52.4
5/7	5.3	20.8	53.4	12.7	38.7	23	78.6	52
5/8	6.4	24.6	53.6	12.1	39.5	32	88.4	52.2
5/9	5.4	23.2	70.7	15.9	33.8	42	87.4	52.2
5/10	6.2	28.6	65.5	10.8	43.5	24	95.2	52.8
5/11	8.1	25.2	56.2	13.7	38.3	20	95.2	52.6
5/12	6.6	27.6	50	9.4	38.4	18	97.6	52.9
5/13	5.3	16.9	50.7	6.9	38.3	30	88.2	52.2
5/14	3	38.7	63.1	27.7	41.4	51	95.3	54
5/15	4.4	35.5	67.7	16.3	44.2	38	96.8	53.9
5/16	4.2	34.1	71.9	15.3	41.4	41	97.8	53.8
5/17	2.7	18.3	55.9	11.5	37.7	25	104.9	52.5
5/18	3.5	9.5	43.4	4.4	25.3	17	93.7	51.7
5/19	2.5	24.9	46.9	11.3	32.2	15	103.6	52.8
5/20	2	11.4	35.4	4.2	29	17	104.6	51.5
5/21	1.9	35.8	68.9	32.4	39.5	98	98.7	54.7
5/22	2.5	27.5	65.5	10.4	33.1	53	101.2	53.8
5/23	3.5	26.4	58.9	18.7	37.1	75	100.9	53.7
5/24	6.7	24.9	45.8	17.5	29.3	28	100.8	53.8
5/25	3.5	23.7	49.6	11.9	30.2	16	100.9	54
5/26	18.8	29.4	51.3	-	-	5	98.7	55
5/27	7.3	25.3	34.3	16.8	34	13	100.8	54.7
5/28	5	38.3	59.9	32.7	44.6	62	91.7	57.3
5/29	3.5	37.7	61.4	32.8	39.9	94	90.2	57.7
5/30	2.5	27.5	60.8	18.5	31.4	46	98	56

TABLE E-13. 2002 travel time of PIT-tagged wild chinook released from the Grand Ronde River trap to Lower Granite Dam.
(continued)

Grande Ronde	Travel Time			Confidence Limits			River Zone	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
5/31	2.7	29	46.4	24.9	30.1	40	96.1	56.4
6/1	8.1	20.7	28.8	16.1	24.6	19	97.4	55.3
6/2	3.8	22	27.9	15.8	25.8	26	94.9	55.6
6/3	5.6	21.2	32.2	15.8	26.8	13	93.2	55.6
6/4	3.5	33.6	52.9	31.2	35.9	132	80.6	58.5
6/5	8.1	30.4	54.4	25.3	33.9	43	83.3	58.1
6/6	4.6	24.1	50	20.7	29.8	49	87.5	57.3
6/7	7	27.4	45.7	22.5	31.1	38	82.6	58.2
6/8	11.4	17.3	29.4	15.9	18.6	21	86.5	56.3
6/9	7.3	14.8	26.3	13.5	16.8	28	85	56.2
6/10	10	19.5	32.4	14.3	25	15	84.6	57.8
6/11	6.5	29.7	48.5	25.3	34.9	127	71.6	60.1
6/12	6.1	23.9	44.8	18.6	32	61	77.4	59.5
6/13	9.5	16.7	45	11.9	31.2	21	85.6	58.7
6/14	7.5	16.2	32.2	10	20.9	17	86.2	59
6/15	8.3	15.6	22.9	11.4	21	16	85.7	59.4
6/16	7.4	13.2	22.8	8.8	20	14	87.9	59.1
6/17	6.4	9.9	12.5	-	-	5	89.3	58.5
6/18	4.4	17.6	41.4	13.3	27.9	43	76.5	60.7
6/19	5.9	15.2	35.7	10.7	16.8	28	79.4	60.5
6/20	9.4	18.6	32.5	11	29.2	14	68.9	61.4
6/21	14.6	16.1	28.2	-	-	5	71	61.4
6/22	16.5	22	27.4	-	-	2	61.3	63
6/23	6.8	11.9	12.2	-	-	3	74	61.5
6/24	11.5	11.5	11.5	-	-	1	70.4	62
6/25	8.2	25	32.1	9.8	28	10	52.5	64.7
6/26	8.8	20	28	-	-	4	54.1	64.3
6/27	8.5	11.4	19.7	-	-	3	60.7	63
6/28	7.1	9.2	17.7	-	-	3	60.5	63.1
6/29	17.5	17.5	17.5	-	-	1	48.4	65
6/30	15.6	16.5	19.5	-	-	3	46.6	65.1

TABLE E-14. 2002 travel time of PIT-tagged hatchery chinook released from the Grande Ronde River trap to Lower Granite Dam.

Grande Ronde	Travel Time			Confidence Limits			River Zone	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
1/28	67.1	93.2	114.4	83.7	99.1	14	45.8	48.1
2/19	57.2	57.2	57.2	-	-	1	46.8	47.8
3/4	40.1	63.2	78	51.3	68.9	18	57.2	48.6
3/6	34.3	46.8	59.3	-	-	2	55.7	47.7
3/8	35.1	56.5	58.9	35.1	58.9	8	58.9	48.5
3/9	51.4	51.4	51.4	-	-	1	58.5	48.2
3/11	39.4	55.6	71.5	41.1	64.6	10	61.2	48.9
3/14	27	35.2	65.1	31.9	44.1	31	59.3	48.4
3/15	24.9	41.5	49.5	24.9	49.5	7	62	48.2
3/16	20.1	38.6	63.2	31.5	48.5	46	62.8	48.2
3/18	14.1	47.4	89.2	47.4	47.4	27745	64.7	49.1
3/19	26.9	36	55	28.9	46.5	16	65.6	48.4
3/20	24.2	63.1	107.7	62.9	63.6	585	68.1	50.4
3/21	8.2	45.2	66	44.9	45.4	2559	67.2	49.5
3/22	17.7	34.7	50.8	24	44.7	24	68.4	48.6
3/23	9.8	29	50.1	18.7	37	16	70	48.9
3/24	9.5	31.1	41	-	-	5	71.3	48.8
3/25	7.1	51.3	82.5	51	51.4	6787	69.4	50.2
3/26	5.4	27.3	48.6	21.2	34.9	29	73.4	49
3/27	3.5	38.2	75.6	38.1	38.3	3941	71.7	49.8
3/28	3.4	37.5	77.6	37.2	38.1	2609	72.1	49.9
3/29	11.2	19.7	49.3	15.8	30.1	24	75.2	49.4
3/30	16.9	16.9	16.9	-	-	1	73.4	49.6
3/31	11.6	21	44.1	14.6	34.7	16	76.7	49.1
4/1	4.9	43.8	82.9	43.6	44.3	3900	71.3	50.3
4/2	6.2	43.2	82.5	42.5	43.9	1101	71.3	50.3
4/3	10	32.2	45.1	26.7	33	32	74	49.8
4/4	9.1	29	50.7	22.7	30	40	73.9	49.5
4/5	4.7	28.4	64.6	21	29.2	101	74.6	49.4
4/6	2.9	8.1	29.3	-	-	4	74.8	48.4
4/7	5	20.4	35.4	12.1	28	21	79.1	48.4
4/8	4.2	27.2	41.9	26.3	29.3	77	76.2	49.7
4/9	3.9	26.5	76.5	25.6	27.7	117	76.1	49.8
4/10	2.8	10.9	86.4	9.1	13.3	914	87.6	48.4
4/11	2.5	10	66.3	8.9	12.4	745	88.8	48.5
4/12	2.6	12.9	79.1	11.1	13.9	568	84	48.2
4/13	2.6	20.4	70.2	10.7	23.4	31	76.3	49.7
4/14	2.1	8.5	35.1	3.6	20.7	31	89.1	48.1
4/15	1.1	12.9	55.1	12.2	13.7	1279	79.5	48.7
4/16	3.1	14.3	98.9	13.8	15.2	693	73.6	49.2
4/17	2.5	12.3	58	11.2	12.7	691	72.3	48.8
4/18	3.4	25.2	36.1	21.4	27.9	140	68	50.8
4/19	14.6	28.1	41.4	24.1	29.2	39	66.9	51.3
4/20	14.2	45.4	71.6	-	-	3	82.2	51.8
4/21	3.9	19.1	33.5	15.6	26	60	67.4	51.1
4/22	5.8	15	29.2	13.6	20.2	43	67.6	51.4
4/23	7	17.5	56.5	13.8	21.5	33	66.5	51.6

TABLE E-14. 2002 travel time of PIT-tagged hatchery chinook released from the Grande Ronde River trap to Lower Granite Dam.
(continued)

Grande Ronde	Travel Time			Confidence Limits			River Zone	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/24	3.4	16.5	64.8	13.1	20.2	65	66.1	51.9
4/25	5.1	13.6	25.3	11.7	19.2	43	66.7	52.4
4/26	7.9	12.8	58.8	9.5	21	16	67	52.7
4/27	5.7	13.2	22.9	-	-	4	67.1	52.5
4/28	5.2	12.7	50.5	9	18.4	35	66.9	52.5
4/29	3.7	13.3	21.1	9.1	16.5	43	66.6	52.4
4/30	3.5	13.9	53.4	9	16.9	44	66.1	52.3
5/1	3.4	13.9	20.8	8.3	16.5	42	67.2	52.2
5/2	3.7	14.3	19.9	12	16.4	23	67.4	52.4
5/3	4.3	16.4	17.6	4.3	17.6	7	67.8	52.7
5/4	5.5	11.5	16.3	7.1	15.7	13	66.5	52.2
5/5	5.4	12.3	16.5	9.3	13.6	21	64.9	52.4
5/6	2.5	12	52	7.9	14.5	19	64.5	52.5
5/7	6.7	12.7	48.5	11.7	15.5	15	67.6	52.6
5/8	6.3	11.4	14.5	7.8	12.5	16	64.6	52.6
5/9	7.9	10.2	45.5	8.6	19.3	12	64.2	52.7
5/10	7.3	9.7	10	-	-	3	67.3	52.9
5/11	8.7	9.8	46.9	8.7	46.9	8	71.7	53.1
5/13	5.7	6.6	8.5	-	-	3	70.9	53.4
5/14	3.6	5.9	39.6	4.2	35	10	73	53.6
5/15	5.6	24.7	43.7	-	-	2	102.1	53
5/16	5.2	5.4	58.4	5.2	58.4	7	81.3	54
5/17	3	31.4	41.9	4.7	40.4	9	98.8	53.5
5/18	3.9	22.3	26.3	-	-	3	106.7	52.9
5/19	2.4	2.4	2.4	-	-	1	95.3	53
5/21	2	27.6	47.8	25.6	28	179	101.6	53.6
5/22	3.1	4.6	6.9	3.1	6.9	7	96.4	50.7
5/23	3	5.5	17.4	4.6	6.7	20	96.2	50.5
5/24	2.8	37.2	65.1	36.8	37.5	943	96.3	55.8
5/25	3.3	21.8	33.5	16.7	24.5	18	101.4	53.7
5/26	7.7	22.7	29.6	-	-	3	101.3	54.2
5/27	2.3	40.5	63.6	40.1	42.1	570	89.1	57.5
5/28	3.2	38.4	59.5	37.2	39.3	193	91.7	57.3
5/29	2.2	43.8	62	41.3	46.7	1968	83.7	58.7
5/30	7.9	40.4	60.5	39.3	45.2	694	86	58.2
5/31	10.9	38.8	59.4	37.4	44.2	272	85.1	58.2
6/3	2.6	42.7	56.9	40.4	42.8	1195	74.5	59.9
6/4	2.9	41.2	55.7	36.9	41.8	1340	74	59.8
6/5	3.3	41.4	54.9	41.1	41.8	1134	72	60.2
6/6	4.4	40.6	53.9	40.1	41.1	1474	70.2	60.5
6/7	4.3	39.6	52.9	39.1	40	1284	69.2	60.7
6/9	13.6	13.6	13.6	-	-	1	84.7	56.1
6/10	3.6	38.8	49.9	37.3	39.5	1047	65.1	61.5

TABLE E-14. 2002 travel time of PIT-tagged hatchery chinook released from the Grande Ronde River trap to Lower Granite Dam.
(continued)

Grande Ronde	Travel Time			Confidence Limits			River Zone	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
6/11	4.3	36.8	48.7	36	38.2	1025	65.6	61.5
6/12	3.3	37.4	47.6	36.4	37.6	809	64.3	61.9
6/13	2.9	36.6	46.9	36.3	36.7	1047	63.1	62.3
6/14	4.2	35.8	46.1	35.7	35.9	470	62.8	62.6
6/15	7.2	7.2	7.2	-	-	1	88.2	57.8
6/18	3.6	31.9	41.9	31.8	32	1008	60.4	63.2
6/25	3.5	25.1	31.5	24.5	28	28	52.5	64.7
6/27	7.1	12.1	17.2	-	-	2	59.4	63.1
6/29	16.9	16.9	16.9	-	-	1	49.1	64.8
6/30	13.5	13.5	13.5	-	-	1	48.5	64.5
7/2	12.9	18.7	24.4	14	24.2	11	41.1	66

TABLE E-15. 2002 travel time of PIT-tagged wild steelhead released from the Grande Ronde River trap to Lower Granite Dam.

Grande Ronde	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/5	6.2	20.5	55.4	11	36.4	21	78.3	48.3
4/6	4.3	14	56.4	7	46.8	10	84	48.4
4/7	5.3	13	45.7	8.7	28.8	16	85.2	48.5
4/8	3.5	8.8	33.7	6.5	26.2	10	86.9	48.9
4/9	2.8	5.6	44.2	4.3	37.7	12	83.7	48.9
4/10	3.4	7.6	52.1	6.4	13.9	33	90.9	48.9
4/11	2.1	4.6	32.1	3.3	4.8	39	92	49.3
4/12	2.3	3.6	50.5	2.8	5.3	48	95.1	49.6
4/13	1.6	4.1	48.3	3	10.8	33	100.5	49.4
4/14	1.4	3	41	2.2	5.9	54	106.4	49.5
4/15	1.4	2.3	63.4	2.1	3.7	42	111.4	49.3
4/16	1.6	4.1	47	3.3	7.5	59	92.9	48
4/17	1.8	4.3	46.4	3.6	5.4	77	84.9	47.4
4/18	1.8	4.4	42.6	3.6	5.3	73	78.3	47.2
4/19	2.7	7.8	41	5.5	10.8	40	69.8	48
4/20	1.9	11.8	62.9	3.4	28.3	29	65.6	49.9
4/21	2.3	8.2	64.4	3.3	14.8	26	65.3	49.5
4/22	6.3	13.6	28.8	9.8	28.6	10	67.2	51.3
4/23	2.5	21	38.9	5.9	28.3	23	65.5	51.7
4/24	2.4	10.2	39	5.9	27.5	29	65.6	52
4/25	6.2	10.2	64.8	8.1	23.9	20	66	52.7
4/26	3.5	9.8	37.7	7.5	12.2	23	66.7	53
4/27	2.4	6.3	34.1	2.8	8.2	29	63	53.2
4/28	3.4	7.5	31.4	6.5	9.1	35	68.2	53
4/29	4.6	6.7	33.3	5.6	9.6	25	69.3	53
4/30	2.6	5.6	22.9	4.5	6.3	64	70.4	53
5/1	2.7	5.9	29.3	5.2	7.2	99	73.4	53
5/2	1.8	5.7	33.8	4.3	7	63	74.3	52.7
5/3	2.4	7.1	58.7	5.5	9.1	61	71.3	52.2
5/4	1.9	6.8	20.4	2.3	9.8	24	69.3	52
5/5	1.8	8.4	35	7.1	9.9	44	64.5	51.9
5/6	1.9	4.7	17.5	3.5	6.4	30	65.3	51.7
5/7	2.3	6	42.8	4.7	7.6	56	62.1	51.7
5/8	2.2	5.6	22.4	3.9	7.6	56	60.8	51.6
5/9	1.6	5.3	21.7	4.4	6.3	49	59.5	51.7
5/10	2.5	6.8	45.8	5.2	8.2	44	61.6	52.6
5/11	3	6.9	10.9	3.8	8.2	12	62.9	53.1
5/12	2.4	4.7	17.9	4.1	5.9	55	62.7	53
5/13	2	5.2	37.4	4.5	5.5	93	65.1	53.5
5/14	1.5	4.6	35.7	4.5	5.1	136	68.9	53.7
5/15	1.6	4.8	17.2	4.5	4.9	226	74.5	53.8
5/16	2.5	5	8.8	3.7	5.6	42	81.3	54
5/17	2.2	4.6	33.7	4	5.6	39	89.2	53.5
5/18	1.5	3.7	11.2	3.4	3.9	37	93.8	53.2
5/19	1.5	2	13.2	1.7	3.3	25	95.3	53
5/20	1.5	2.3	15.8	1.8	5.2	42	106.6	52.7

TABLE E-15. 2002 travel time of PIT-tagged wild steelhead released from the Grande Ronde River trap to Lower Granite Dam.
(continued)

Grande Ronde	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
5/21	1.2	1.7	8.3	1.7	1.8	108	107.8	51.7
5/22	1.4	3	34.6	2.6	5.5	72	101.4	50.5
5/23	1.6	2.8	29.7	2.5	5.4	80	94.3	50.2
5/24	2.5	5.5	31.5	3.9	6.5	32	99.6	50.6
5/25	3.4	5.3	12.9	3.4	12.9	7	99.7	51
5/26	5.9	6.2	6.4	-	-	2	111.3	52.2
5/27	4.2	5	5.8	-	-	2	115.8	52.5
5/28	1.5	3.1	23.7	2.7	3.3	42	117.3	52.5
5/29	1.5	2.7	9.6	2.3	3	31	127.6	54
5/30	1.3	1.6	6.7	1.5	2.2	18	132.9	54
5/31	1.5	2.2	10.3	1.6	3.3	12	134.9	54
6/1	1.3	1.5	1.7	-	-	2	133.9	53.7
6/2	1.5	1.7	2.9	-	-	5	128.5	53.7
6/3	1.4	3.6	7.7	1.4	6.2	9	117.3	54
6/4	1.2	4.6	21.8	2.5	6.8	18	107.9	54.3
6/5	1.2	3.4	8.7	2.7	4.8	12	109.4	54.5
6/6	2.3	5.8	20	2.7	10.9	15	92.6	53.7
6/7	1.6	4.8	7.7	3.5	6	12	89.7	53.7
6/8	3.5	6.1	10.2	3.7	7.8	11	83.2	53.7
6/9	3.4	7.6	14.7	4.8	13.2	10	81.3	54.9

TABLE E-16. 2002 travel time of PIT-tagged hatchery steelhead released from the Grande Ronde River trap to Lower Granite Dam.

Grande Ronde	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/2	3.2	41.4	94.9	33.3	50.9	62	71.6	50.2
4/3	3.7	19.6	65.4	16.7	31.5	44	78.3	48.7
4/4	4	48.5	84.9	32.7	49.5	49	74.4	50.8
4/5	3.2	3.7	30.3	-	-	5	67.2	48.8
4/6	3.1	6.2	17.3	-	-	4	72.2	48.1
4/7	2.8	3.7	10.3	2.9	5.8	13	73.1	48.2
4/8	2.3	4.4	60.5	3.8	6.7	64	73.3	48.4
4/9	2.4	8.4	62.6	6.5	10.9	93	88.7	48.9
4/10	2.3	24.7	79.9	19.8	26.3	227	76.6	49.8
4/11	1.8	4	77.2	3.5	4.8	138	88	49.2
4/12	1.9	2.9	50.2	2.6	3.6	102	90.8	49.5
4/13	1.4	3	40.9	2.4	3.7	103	100.6	49.8
4/14	1.1	2.1	20.3	1.9	2.2	79	108.6	50
4/15	1.2	8.5	43.4	7.7	9.8	261	87.2	47.8
4/16	1.2	5.4	38.4	3.1	7.6	115	89.4	47.8
4/17	1.8	11.1	68.3	6.8	17.5	186	73.2	48.5
4/18	1.8	8.8	61.1	7.5	10.5	256	71.9	48
4/19	2.3	16	41.4	10.8	17.6	145	69	50.4
4/20	3	17.9	38.5	9.7	28.5	13	68.3	50.9
4/21	1.6	2.8	38.9	2.5	3.9	70	71.3	47
4/22	1.7	12.3	42.8	8.5	13.4	443	66.4	51.1
4/23	2.4	4.6	44.4	4.5	4.8	263	64.5	49.8
4/24	2.4	11.5	47.4	10.7	14.5	93	66.7	52.1
4/25	1.9	17.9	59.6	11.6	22.6	203	64.7	52.2
4/26	1.6	26.9	59	25.7	27.5	119	71.5	52.7
4/27	1.8	2.7	26	2.6	2.9	58	58.1	53
4/28	2.6	8.4	23.6	7.5	8.9	31	68.2	53
4/29	2.6	6.6	22.7	3.8	8.2	18	69.3	53
4/30	1.6	5.6	31.5	4.8	6.5	48	70.4	53
5/1	2.6	8.6	32.2	4.8	11.9	64	70.7	52.3
5/2	1.5	22	88.9	20.4	23.8	277	75.9	52.4
5/3	1.6	18	45.7	15.5	18.9	70	71.5	52.7
5/4	1.4	2.3	18.1	1.7	3.6	30	77.4	52.7
5/5	1.6	6.6	21.7	4.9	9.5	56	65.6	51.9
5/6	1.6	15.6	43.4	14.5	16.3	237	72.8	52.6
5/7	2.4	5.8	17.4	4.6	7	42	62.1	51.7
5/8	2.1	14.5	51.7	13.8	15.4	124	74.8	52.4
5/9	2.1	13.6	58	13.2	14.5	138	75.2	52.5
5/10	3.4	12.4	25.1	11.7	14.1	84	74	52.8
5/11	7.3	10.4	19.5	8.4	13.4	19	71.7	53.1
5/12	2.4	2.9	23.6	2.8	3.1	52	61.2	52
5/13	1.8	5.9	12.1	5.3	6.8	47	67	53.4
5/14	1.9	6.6	20.9	5.5	9.5	41	77.6	53.5
5/15	1.7	8	46.3	7.4	8.3	146	85.6	53.1

TABLE E-16. 2002 travel time of PIT-tagged hatchery steelhead released from the Grande Ronde River trap to Lower Granite Dam.
(continued)

Grande Ronde	Travel Time			Confidence Limits			Lower Granite Dam	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
5/16	2.8	5.7	21.3	4.8	7	51	85.7	53.7
5/17	2.2	6.3	17.6	5.3	7.9	56	91	53
5/18	2.8	4.2	12.7	3	8.8	14	93.8	53.2
5/19	1.5	2.4	14.8	1.8	3.4	45	95.3	53
5/20	1.5	1.9	16.1	1.8	2.4	73	106.6	52.7
5/21	1.2	2	12.6	1.6	2.2	126	107.8	51.7
5/22	1.3	2.8	29.9	2.4	3.6	124	101.4	50.5
5/23	1.5	4.9	35	2.7	6.6	109	93.6	50.5
5/24	1.6	5.2	14.2	3.7	6.3	94	95.2	50.6
5/25	5.4	6.2	13.1	5.4	8.7	10	105	51.6
5/26	1.7	7.3	10.9	4.9	7.8	36	113.8	52.5
5/27	1.4	2.2	9.6	1.6	2.6	18	98.7	51
5/28	1.5	2.5	22.5	2.4	3.4	35	117.3	52.5
5/29	1.3	1.8	27.6	1.6	2.6	50	124.5	54
5/30	1.2	1.6	6.7	1.5	1.6	45	132.9	54
5/31	1.4	2	4.9	1.7	2.4	14	134.9	54
6/1	1.3	1.4	14.8	1.4	2.1	15	134.1	54
6/2	1.2	1.5	2.4	1.4	1.7	22	128.5	53.7
6/3	1.1	1.4	5.2	1.2	2.9	14	127	53.5

TABLE E-17. 2002 travel time of PIT-tagged yearling chinook released from the Rock Island Dam to McNary Dam.

Rock Island	Travel Time			Confidence Limits			River Zone	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/18	5.2	8	10.1	-	-	2	187	NULL
4/19	12.7	14	15.7	-	-	4	166	NULL
4/20	11.1	14	15.2	-	-	3	164	NULL
4/21	9.4	13	26.9	9.4	26.9	8	161	NULL
4/22	11.9	15	37.8	12.5	22.7	13	158	NULL
4/23	10.4	19	32	13.3	26.2	20	151	9.2
4/24	9.7	20	33.4	15.3	22.9	34	150	9.4
4/25	7.3	13	34.2	10.7	15.4	44	151	NULL
4/26	6.6	13	37.2	9.4	19	20	149	9.1
4/27	7.4	12	17.8	8.4	15.3	11	148	9.1
4/28	6.7	11	23.5	9.1	16.5	17	150	9.1
4/29	4.9	14	32.8	11	17.7	25	150	9.3
4/30	9	13	28.7	10.9	16	29	150	9.3
5/1	9.4	11	24.3	9.7	12.2	14	146	9.2
5/2	8	10	19.9	9.3	13	21	146	9.2
5/3	7.4	12	24.5	10.7	13.9	44	146	9.4
5/4	6.7	11	20.4	9	17.3	14	145	9.4
5/5	5.9	12	26.5	10	12.7	59	144	9.7
5/6	7	10	20.9	9.2	12	35	148	9.5
5/7	5.6	9	25.9	8.1	11	37	146	9.5
5/8	5.8	11	50.1	9.9	12.8	43	141	9.9
5/9	5.9	11	25.1	9.4	13.3	49	141	10
5/10	6.2	11	35.4	9.5	13.4	38	141	10.2
5/11	7	10	16.7	8.9	11.5	40	139	10.3
5/12	5.9	10	41.8	8.7	11.9	24	140	10.4
5/13	4.9	9	21.4	8.3	9.9	42	142	10.6
5/14	6.4	10	22.7	8	11.9	27	144	10.8
5/15	6.4	9	17.6	8.3	9.9	26	144	10.9
5/16	8	12	15.4	9.4	13.3	12	151	11.1
5/17	6.2	9	29.4	7.6	10.3	15	146	11.1
5/19	7.1	10	29.6	9.3	13.8	22	156	11.3
5/20	5.6	9	26.9	7.2	10.6	21	158	11.4
5/21	6.9	9	30	7.4	11	13	162	11.4
5/23	6.1	9	22.8	7.5	12.6	12	169	11.6
5/24	8.4	10	11.8	-	-	2	170	11.8
5/26	5.9	6	7.2	-	-	3	174	11.8
5/27	6.5	7	9.6	-	-	3	178	12
5/28	4.6	6	7.5	-	-	2	178	12
5/29	5.5	8	20.8	-	-	5	202	12.2
5/30	8.9	9	9.7	-	-	2	218	12.2

TABLE E-18. 2002 travel time of PIT-tagged subyearling chinook released from Rock Island Dam to McNary Dam.

Rock Island	Travel Time			Confidence Limits			River Zone	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
6/25	5	15	25.7	11.4	19.8	12	223	15.2
6/26	8.1	15	18.8	9.4	17.9	10	226	15.3
6/27	6.2	16	21	8.4	17.8	10	224	15.4
6/28	8.9	11	20	9	16	9	225	15.2
6/29	7.1	12	20.3	9.8	15	10	220	15.3
6/30	6.1	14	29.9	7	21.6	14	217	15.5
7/1	7.9	10	11.8	-	-	5	219	15.3
7/2	5	9.1	39.4	6.3	12.2	18	215	15.4
7/3	5.8	10.2	42	8.1	13.2	29	209.7	15.5
7/4	5.7	13.1	29.4	10.4	16.8	27	203.2	15.9
7/5	5.4	13	35.3	11.1	17.2	27	198.4	16.1
7/6	7.9	11.9	36.6	10.3	13.9	52	198.3	16.2
7/7	5.8	11.8	33.1	9.7	13.6	39	198.4	16.4
7/10	4.7	10.2	36.9	8.8	14.7	36	203.2	16.8
7/11	6	10.7	29.4	9.7	12	57	199.5	17
7/12	5.7	10	34.8	8.8	14.5	37	196.2	17
7/13	7.9	12	28.1	9.9	18.6	20	189.7	17.4
7/14	5.4	10.9	28.5	8.4	13.7	60	186.8	17.5
7/15	5.1	12	33.9	9.2	16.7	31	174.7	17.7
7/16	4.2	13.4	33	8.7	21.7	27	170.1	17.8
7/17	6.4	12.3	27.4	10.1	16.2	44	167.2	17.9
7/18	5.2	19.6	33.2	12.2	22.5	37	150	18.1
7/19	4.4	13.7	30	10.8	20.4	35	157.5	18.1
7/20	7.5	17.6	34.4	11.2	19.8	34	146	18.1
7/21	5.5	19.2	101	11.1	21	43	143.6	18.2
7/22	5	17	33.6	14	18.8	48	141.4	18.3
7/23	6.1	15.7	32	11.3	18	48	140.4	18.3
7/24	5.1	16.7	139.1	15.5	17.4	61	136.9	18.4
7/25	6.1	15.8	28.8	13.5	18.3	46	135.4	18.4
7/26	7.6	14.6	27.5	13.3	16.4	24	133.6	18.5
7/27	4.4	18.9	74.8	16	20.3	33	130.7	18.5
7/28	6.6	17.7	106	13.7	19.7	31	132	18.5
7/29	5.7	13.4	30.6	11.7	18.9	29	135.2	18.6
7/30	8	14.2	22.2	11.5	16.8	26	131.9	18.6
7/31	7.7	13.2	119.5	10.6	15.9	44	131.3	18.5
8/1	6.4	11.8	88.8	10.5	14.2	46	128.9	NULL
8/2	7.4	12	122	9.2	14.5	33	128.4	NULL
8/3	6.1	11.8	113	9.3	13.5	38	126.8	NULL
8/4	6.5	11.6	99.3	9.7	12.7	36	125.6	NULL
8/5	6.5	12.3	123	11.8	14.6	49	124.2	NULL

TABLE E-18. 2002 travel time of PIT-tagged subyearling chinook released from Rock Island Dam to McNary Dam.
(continued)

Rock Island	Travel Time			Confidence Limits			River Zone	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
8/6	5.7	10.1	17.2	9.2	11	31	127.8	NULL
8/7	4.7	11	70.8	8.8	13.7	20	121.3	NULL
8/8	6.8	10.7	19.5	7.8	15.6	10	118.9	NULL
8/9	6	12.1	81	10.3	17.8	21	116	NULL
8/10	7.4	12.8	21.1	11	17.9	14	116.7	NULL
8/11	5.1	8.2	19.1	7.3	12.1	12	111.3	NULL
8/12	6.1	11.2	27.6	8.4	18.2	14	116	NULL
8/13	7.8	11.3	97.2	7.8	97.2	8	115.9	NULL
8/14	7	9.1	12.7	8.3	10.9	11	115.2	NULL
8/15	6.1	11.3	55.2	6.9	18.2	10	109.5	NULL
8/16	7.1	8	10.1	-	-	5	111.4	NULL
8/17	8.1	8.1	8.1	-	-	1	107.9	NULL
8/18	7.2	7.2	7.2	-	-	1	111.6	NULL

TABLE E-19. 2002 travel time of PIT-tagged steelhead released from Rock Island Dam to McNary Dam.

Rock Island	Travel Time			Confidence Limits			River Zone	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/19	8	20	31.9	-	-	2	161	9.1
4/20	8.7	10.5	12.3	-	-	2	167	NULL
4/21	7.5	11	11.3	-	-	3	163	NULL
4/23	5.5	13.4	26.9	-	-	4	154	NULL
4/24	7.4	7.7	8	-	-	2	153	NULL
4/25	6.2	7.7	9.3	6.2	9.3	8	151	NULL
4/26	5.7	6.4	12.2	-	-	3	147	NULL
4/27	5.8	6.6	7.5	-	-	5	147	NULL
4/28	5.4	6.1	9.6	5.4	9.6	7	151	NULL
4/29	5.2	6.5	8.7	5.2	8.7	8	151	NULL
4/30	5.9	6.3	13.4	5.9	13.4	8	150	NULL
5/1	6	6.8	10.8	-	-	6	150	NULL
5/2	5.9	7	9.7	5.9	9.7	7	150	9.1
5/3	5.9	9.1	18.4	5.9	18.4	7	146	9.2
5/4	5.7	6.8	8.9	-	-	5	148	9.2
5/5	5.9	6.5	15.8	6	8.9	15	144	9.2
5/6	5.5	7.2	10.8	5.9	9.8	11	152	9.3
5/7	4.8	6.8	17.4	5.5	9.7	18	148	9.4
5/8	4.9	6.9	12	6.6	8	18	143	9.4
5/9	5.5	7.6	11.6	6	8.4	19	142	9.7
5/10	6	9.1	24.2	7.2	11.3	23	139	10
5/11	6.3	10	19.5	8.2	13.4	22	139	10.3
5/12	4.6	7.7	13.2	6.2	8.6	19	139	10.3
5/13	5.3	7.8	11.6	6.7	8.6	24	142	10.5
5/14	4.4	8.3	20.9	6.5	10.9	26	140	10.7
5/15	4.5	7.4	18.6	6.5	8.8	31	139	10.8
5/16	5.1	7.2	21.3	6.7	7.8	16	144	10.9
5/17	6.4	8.1	15.2	7.8	14	13	147	11.1
5/19	6	12	14.8	-	-	5	159	11.4
5/20	4.9	9.3	16.1	8.2	10.6	25	158	11.4
5/21	6.3	6.8	12.6	6.3	9.3	10	159	11.4
5/23	4.2	6.8	12.8	6.3	7.6	31	166	11.5
5/24	3.9	8.1	14.2	6.7	9.3	26	169	11.7
5/25	5.4	6.2	13.1	5.4	8.7	10	167	11.6
5/26	4.6	5.1	8.6	-	-	6	170	11.7
5/27	4.2	5.8	9.6	-	-	6	174	11.9
5/28	5.4	5.8	7.6	-	-	4	178	12
5/29	4.3	4.7	6.8	-	-	5	177	12
5/30	4.9	5.4	6.7	-	-	5	193	12.2

TABLE E-20. 2002 travel time of PIT-tagged sockeye released from Rock Island Dam to McNary Dam.

Rock Island	Travel Time			Confidence Limits			River Zone	
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/18	7.2	7.3	16	-	-	3	190	NULL
4/20	6.5	13	13.8	-	-	3	165	NULL
4/22	6.9	11.4	19.9	9.7	11.9	12	161	NULL
4/23	9.6	9.8	13.6	-	-	4	157	NULL
4/24	8.5	9.9	23.3	9.3	11.7	16	153	NULL
4/25	6.3	10.8	24.1	7.9	14.7	13	149	NULL
4/26	6.8	6.8	6.8	-	-	1	148	NULL
4/27	10.3	11.4	12.5	-	-	2	148	NULL
4/28	4.6	7.5	14	6.4	11.3	12	148	NULL
4/29	5.3	7.7	9.2	-	-	6	154	NULL
4/30	5.9	6.9	11.6	6.2	8.3	19	153	NULL
5/1	5	6.2	11.5	5.7	7.7	14	150	NULL
5/2	5.4	7	14	6.2	8.2	26	150	9.1
5/3	5.4	7.4	26	7	7.6	55	151	9.1
5/4	5.7	6.3	10.7	5.7	10.7	7	151	9.1
5/5	4.8	6.2	10.3	5.6	7.9	22	147	9.2
5/6	5	6.8	10.2	6	7.9	16	152	9.3
5/7	4.6	6.2	8.7	5.6	6.8	20	149	9.3
5/8	5.3	6.8	11.1	5.9	8.9	12	143	9.4
5/9	5.8	6.9	8	6	7.2	9	142	9.5
5/10	6.4	8.3	9.4	6.7	9	9	140	9.9
5/11	5.6	6.6	16.5	5.8	9.6	10	138	9.9
5/12	5	6.1	37.1	5	37.1	7	139	10
5/13	4.7	5.3	9.2	4.7	9.2	8	142	10.1
5/14	3.7	5.1	7	3.7	7	7	137	10.4
5/15	5.1	6	9.6	5.6	7.3	19	139	10.7
5/16	5.8	6.6	9.3	5.8	9.3	7	144	10.9
5/17	6.8	7.5	8.4	-	-	3	147	11.1
5/18	5.3	7	8.1	-	-	4	147	11.2
5/19	5.5	5.5	5.5	-	-	2	150	11.2
5/20	9.9	9.9	9.9	-	-	1	160	11.4
5/23	5.2	5.2	5.2	-	-	1	163	11.4
5/27	4.2	5.8	9.3	4.2	9.3	8	174	11.9
5/28	4.8	5.5	8.2	-	-	3	178	12
5/29	4.3	7.4	21.9	-	-	3	197	12.2
5/30	5.1	11.4	17.7	-	-	2	219	12.2
5/31	5.1	6.6	8	-	-	2	216	12.3
6/2	7	7	7	-	-	1	230	12.3

TABLE E-21. 2002 travel time of PIT-tagged yearling chinook released in the Snake River Basin from between Lower Granite Dam and McNary Dam (grouped by observation date at Lower Granite Dam).

Lower Granite	Travel Time			Confidence Limits		Ice Harbor Dam		
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
04/01	23.3	35.5	48.3	-	-	5	77.8	46.9
04/02	14.7	31.8	44.7	22.7	40.9	12	77.9	46.8
04/03	16.1	31.2	52	16.7	36.2	11	77.7	46.9
04/04	17.7	18.8	36.8	-	-	3	83.1	46.3
04/05	18.3	29.6	31.3	-	-	6	78.8	47.3
04/06	15.9	30.3	32.7	-	-	4	79.5	47.6
04/07	30.8	35	39.1	-	-	2	77.4	48.3
04/08	23.6	28.6	32.1	-	-	5	80.2	48
04/09	15	24.8	39.9	21.2	28.2	20	80.9	47.9
04/10	8.1	23.1	38.1	20.6	25.8	26	80.8	47.9
04/11	11.3	25.9	39.7	16.6	29.2	17	80.8	48.3
04/12	9.5	22.2	34	20.2	24.6	36	81.1	48.1
04/13	9.2	19.8	32.8	16.7	20.9	82	81	48.2
04/14	9.2	20	38.6	19.2	20.9	163	81.4	48.4
04/15	7.7	19.3	43.4	19	19.9	435	80.4	48.4
04/16	7.6	19.4	43.3	18.8	20.1	374	77.9	48.5
04/17	6.1	19.2	36.2	18.7	19.9	266	75.6	48.6
04/18	9.5	19.5	40.9	19	20.1	252	73.9	48.8
04/19	11.4	19.6	36.8	19.3	20.1	312	72.4	48.9
04/20	11.9	18.3	35.1	17.9	19.1	130	72.1	48.8
04/21	9.1	17.7	37.3	17	18.4	168	71	49
04/22	8.8	16.1	30	15.7	16.7	62	71.3	48.9
04/23	8.9	15	30.9	14.3	15.8	156	71.4	49
04/24	7.8	14.3	34.8	13.4	15.3	121	70.8	49.1
04/25	8.1	14	38.7	13.3	15	258	69.7	49.3
04/26	8.4	13	40.5	12.5	14.3	187	69.7	49.4
04/27	7.9	12.8	30	12	13.4	211	69.5	49.5
04/28	7.3	12	23.5	10.6	13.4	78	69.9	49.6
04/29	7.3	13.3	25.7	12.4	13.9	137	69.1	50
04/30	6.9	11.7	27	11.1	12.7	109	69.2	50.2
05/01	6.8	12	22.8	11.1	12.9	85	69.7	50.5
05/02	7.3	12	29.3	11.3	13	91	69.7	50.8
05/03	7	11.5	31	11.2	11.8	488	69.3	51
05/04	7.1	11.9	32.4	11.7	12	1531	69.2	51.2
05/05	7.2	11.7	40.3	11.6	11.8	1200	67.6	51.3
05/06	7.5	12.3	29.1	11.9	12.5	787	67.1	51.5
05/07	7.4	13	28.5	12.4	13.3	440	69.8	51.6
05/08	8.2	12.7	27.6	12.5	13	303	72.3	51.9
05/09	7.5	12.4	26.2	12	12.7	185	72.3	52
05/10	7.1	12	19.7	11.5	12.4	84	76.3	52.2
05/11	8.2	10.9	21.8	10.5	11.2	162	77.6	52.2
05/12	7.4	10.4	19.7	10.1	10.7	87	79.1	52.4
05/13	7.1	9	17	8.7	9.4	126	81.2	52.4
05/14	6.9	8.9	20.6	8.7	9.3	178	86.3	52.4
05/15	6	8.3	19.5	8.2	8.7	290	88.1	52.3

TABLE E-21. 2002 travel time of PIT-tagged yearling chinook released in the Snake River Basin from between Lower Granite Dam and McNary Dam (grouped by observation date at Lower Granite Dam). (continued)

Lower Granite	Travel Time			Confidence Limits		Ice Harbor Dam		
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
05/16	6	9.1	18	8.7	9.4	111	92.5	52.4
05/17	5.3	8.6	18.1	8.5	9	182	94.2	52.6
05/18	5.2	8	17.3	7.8	8.1	249	97.2	52.7
05/19	5.8	7.3	15.8	7	7.6	177	100.3	52.8
05/20	4.9	9	17.1	8.6	9.4	233	102.7	53.1
05/21	5.2	9.6	14.7	8.9	9.8	75	107.5	53.2
05/22	6.5	9	15.4	8.3	9.6	50	107.2	53.2
05/23	5.8	10.1	17.4	8.2	11.4	17	111.7	53.3
05/24	7.2	9.2	12.3	7.5	9.8	16	112.3	53.4
05/25	7	8.9	13.2	7.6	12	11	114.8	53.6

TABLE E-22. 2002 travel time of PIT-tagged steelhead released in the Snake River basin between Lower Granite and McNary Dam (grouped by observation date at Lower Granite Dam).

Lower Granite	Travel Time			Confidence Limits		Ice Harbor Dam		
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
04/13	6.3	11.5	24.6	6.3	24.6	7	90.6	47.8
04/14	6.9	9	30.9	7.9	18.5	17	95.1	48
04/15	5.5	14.2	23.9	10.5	17.6	35	83.6	48
04/16	6.4	13.3	31.2	9.2	15.1	34	80.3	48
04/17	6.7	11.6	39.1	9.8	16.9	34	77.1	48
04/18	8.4	15.2	46.2	13.9	20.9	20	72.5	48.3
04/19	6.6	13	33.1	10.9	15.8	23	71	48.2
04/20	9.2	12.6	43.3	11.5	14	20	69.8	48.4
04/21	7.7	12.4	22.6	9.2	13.5	15	69	48.4
04/22	8.4	11.3	18.1	9.4	14.6	17	68.4	48.5
04/23	8.3	12.8	42.9	12	18.8	18	71	48.8
04/24	9.8	14.5	29.1	13.5	19	13	70.2	49.2
04/25	9.1	11.6	25.5	9.1	25.5	7	70.2	49.1
04/26	7.4	11.3	38.9	10.4	12.8	33	70.4	49.2
04/27	7.3	10.7	36.6	9.9	11.6	28	71	49.2
04/28	7.1	13.5	32	10.6	15.7	23	68.5	49.9
04/29	8	19	34.3	8.6	33.8	10	68.7	50.7
04/30	11	13.8	25.1	11.3	18.2	11	68.3	50.5
05/01	7	12	21.6	-	-	4	69.7	50.5
05/02	7.9	9.6	15.1	-	-	6	70.9	50.5
05/03	7.8	17.8	22.7	-	-	4	74	51.4
05/04	8	15.1	31	10.3	18.6	26	70	51.3
05/05	7.4	15.9	28.1	12.1	24.2	18	73.2	51.5
05/06	8.4	15.2	29.2	11.5	17.7	29	72.8	51.6
05/07	8.3	12.3	18.4	9.4	16.1	10	67.4	51.6
05/08	8.5	13	17.3	-	-	6	72.3	51.9
05/09	10.6	14	16.9	10.9	16.7	9	77.2	52.1
05/10	9.7	12.8	23.2	9.9	21.3	10	78.4	52.1
05/11	9.9	11.1	14.2	10.4	13.8	11	77.6	52.2
05/12	10	11.2	20.3	10	20.3	8	81.3	52.3
05/13	8.7	12.4	21.4	-	-	6	86.2	52.5
05/14	8.1	8.2	14	-	-	3	84.1	52.4
05/15	7.2	9	22.3	7.5	18.5	10	90.4	52.3
05/16	6.1	8.3	9.8	6.9	9.7	11	92.7	52.2
05/17	6.3	7.9	16.9	6.7	8.6	11	94.9	52.4
05/18	5.9	7.2	15.8	7.1	7.9	28	98.3	52.5
05/19	5.7	10.1	15.3	6.8	13.8	27	100.7	53
05/20	6	8.6	26.1	6.9	13.5	16	102.7	53.1
05/21	4.9	9.6	25.4	7.4	11.7	27	107.5	53.2
05/22	5.6	10.1	22.7	9	11.3	47	109.9	53.2
05/23	7.1	10.5	23.5	9.5	11.1	30	113.8	53.3

TABLE E-22. 2002 travel time of PIT-tagged steelhead released in the Snake River basin between Lower Granite and McNary Dam (grouped by observation date at Lower Granite Dam).
(continued)

Lower Granite	Travel Time			Confidence Limits		Ice Harbor Dam		
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
05/24	6.8	9.7	14	8.7	10.7	12	114.5	53.5
05/25	8.1	9.1	20	8.6	11.2	13	114.8	53.6
05/26	7.1	8.3	10.4	7.2	10.2	9	117.5	53.6
05/27	6.2	7.6	10.2	-	-	5	120.7	53.6
05/28	5.3	6.7	10.5	-	-	6	123.8	53.5
05/29	7.8	7.8	7.8	-	-	1	124.5	53.6
05/30	4	6.1	8.8	4.5	8.5	11	128.3	53.6
05/31	5.3	6.5	42.4	5.6	8.9	14	124.8	53.9

TABLE E-23. 2002 travel time of PIT-tagged subyearling chinook released in the Snake River basin between Lower Granite and McNary Dam (grouped by observation date at Lower Granite Dam).

Lower Granite	Travel Time			Confidence Limits		Ice Harbor Dam		
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
06/22	7.5	15.2	24.9	7.9	24	9	72.6	60.4
06/23	7.7	20.3	37	8.2	36.5	11	64	61.1
06/24	7.4	16.2	32.7	12.2	22.2	16	65.6	60.9
06/25	9	18.5	38.4	10.5	20	16	60	61.5
06/26	11.2	14.5	22.3	11.2	22.3	7	61	61.1
06/27	6.7	14.2	34.2	9.5	28.1	13	59.4	61.2
06/28	8.3	13.4	18.4	-	-	2	57.7	61.3
06/29	7.2	14.5	41.6	11.5	19.6	19	53.5	61.9
06/30	6.9	16.3	48.7	12.1	18.4	67	49.8	62.6
07/01	9.9	18.4	39.6	14.4	20.2	20	46.5	63.4
07/02	15.3	16.7	19.2	-	-	3	45.2	63.6
07/03	12.4	26.8	33.3	-	-	4	39.9	65.6
07/04	11.1	12.5	44.6	11.6	22.5	10	44.4	63.4
07/05	9.8	14	153.4	11.3	16.6	45	42.9	64.1
07/06	8.7	13.5	59.6	12	16.2	61	41.9	64.5
07/07	8.5	15	27.7	11.9	26.2	11	40.6	65.1
07/08	8.1	11.5	21	9.3	18	17	41.3	64.8
07/09	6.4	15	35.4	10.1	18.3	18	39.7	65.8
07/10	12.2	21.9	29.1	-	-	6	36.6	67.2
07/11	7.9	10	16.2	-	-	5	40.2	65.9
07/12	10.3	15.4	22.9	-	-	3	37.2	66.9

TABLE E-24. 2002 travel time of PIT-tagged yearling chinook released in any basin above McNary Dam between McNary Dam and Bonneville Dam (grouped by observation date at McNary Dam).

McNary Dam	Travel Time			Confidence Limits			The Dalles Dam	
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
04/11	26.7	37	42.6	26.7	42.6	8	230	53
04/12	22.1	34.7	45.4	29.2	40.1	25	233	53
04/13	9.4	32.8	44.4	25.1	35.4	39	234	53.1
04/14	8.1	33	44	27.5	35.8	39	235	53.4
04/15	20.3	28.4	35.1	24.5	33.5	15	240	53
04/16	4.7	29.9	66.4	24.5	36.2	49	235	53.5
04/17	8.2	19.4	65.4	9.4	56.4	13	244	52.4
04/18	6.2	12	43.7	8.5	21	22	249	51.9
04/19	5.2	13.1	41.8	10.5	15.2	33	237	52.5
04/20	5.4	12.3	33.2	9.9	14.4	27	233	52.8
04/21	5.7	10.9	21.6	9.7	12.4	30	230	53
04/22	5.9	12	23.3	10.2	13.5	32	227	53.5
04/23	5.1	10.6	29.4	10	12	39	225	53.7
04/24	6.4	9.7	15.4	8.7	10.3	39	221	54
04/25	5.9	9	60.6	8.6	9.9	77	217	54.2
04/26	4.7	8.5	19.6	8.2	9.4	48	215	54.4
04/27	5.7	8.2	29.5	7.6	9.2	49	215	54.4
04/28	5.5	7.6	15.4	7.1	8.3	50	213	54.1
04/29	5.1	7.3	12.1	7	7.7	49	219	54.1
04/30	4.9	7.1	13.6	6.6	8	73	222	54.4
05/01	4.8	6.9	13.5	6.7	7.2	85	225	53.8
05/02	4.6	6.4	13.6	6.2	6.6	185	227	53.7
05/03	4.4	6.7	14.8	6.3	6.9	219	224	54.1
05/04	4	6.4	25.7	6.3	6.5	376	220	54.1
05/05	4.3	6.3	19.4	6.2	6.4	448	217	54.4
05/06	4.1	6.3	18.1	6.2	6.5	438	212	54.7
05/07	4.2	6.3	20.9	6.2	6.3	492	210	55.6
05/08	4.3	5.7	23.3	5.6	5.9	541	205	55.7
05/09	4.1	6.1	24.1	5.9	6.3	279	200	56.7
05/10	4.2	5.8	65.5	5.6	5.9	395	196	56.9
05/11	4.3	6.2	15.5	6	6.3	497	202	57
05/12	3.6	5.6	15.7	5.5	5.7	614	201	56.1
05/13	4	5.4	14.2	5.4	5.5	952	205	56
05/14	3.6	5.4	17.1	5.3	5.4	928	207	55.3
05/15	3.9	5.2	14.9	5.1	5.2	791	210	55.7
05/16	3.7	5	23.2	5	5.1	108	218	55.8
05/17	3.6	4.7	18	4.7	4.8	144	232	55.5
05/18	3.5	4.6	15	4.5	4.6	752	238	56
05/19	3.2	4.7	12.6	4.6	4.8	483	250	57.3
05/20	3.1	4.4	19.9	4.3	4.4	669	258	58.2
05/21	3.1	4.8	25.8	4.7	4.8	109	258	58.3
05/22	3.3	4.5	19.6	4.4	4.5	109	254	58.5
05/23	3.2	4.6	31.1	4.5	4.6	122	254	59.7
05/24	3.3	5.2	12.5	5.1	5.3	565	261	59.2
05/25	3.6	4.9	11.4	4.8	4.9	771	263	59.2

TABLE E-24. 2002 travel time of PIT-tagged yearling chinook released in any basin above McNary Dam between McNary Dam and Bonneville Dam (grouped by observation date at McNary Dam).
(continued)

McNary Dam	Travel Time			Confidence Limits			The Dalles Dam	
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
05/26	3.2	4.5	27.8	4.4	4.5	641	273	60
05/27	3.3	4.3	12.6	4.2	4.4	214	280	60.2
05/28	3.1	4.2	24.1	4.1	4.3	225	302	61.2
05/29	2.9	4.2	10.7	4	4.3	162	310	60.2
05/30	2.7	4	10.1	3.9	4	226	310	61.5
05/31	2.8	3.6	18.1	3.5	3.8	164	319	61
06/01	3	4	7.2	3.7	4.1	68	334	60.4
06/02	2.8	3.6	6.7	3.5	3.8	46	340	59.6
06/03	2.9	3.6	10.1	3.4	3.8	65	345	60.6
06/04	2.7	3.5	5.7	3.3	3.7	40	357	60.2
06/05	2.7	3.4	6.6	3.1	3.7	40	362	60.5
06/06	2.6	3.8	9.1	3.5	3.9	59	339	60
06/07	2.9	3.8	6.4	3.5	3.9	42	332	59.6
06/08	3.3	4.3	35	4	4.5	46	323	58.8
06/09	3.6	4.2	7.8	3.6	5.5	13	310	58.6

TABLE E-25. 2002 travel time of PIT-tagged steelhead released in any basin above McNary Dam between McNary Dam and Bonneville Dam (grouped by observation date at McNary Dam).

McNary Dam	Travel Time			Confidence Limits			The Dalles Dam	
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
04/09	6.3	13.2	41.3	8.9	25	21	247	48.7
04/10	6.4	15.8	38.9	7.5	31.1	14	252	49.7
04/11	10.3	16.8	23.2	-	-	2	251	50.4
04/12	11.2	23.8	36.5	-	-	2	243	51.6
04/13	11.4	11.4	11.4	-	-	1	274	49.8
04/15	4.4	35.2	72.9	-	-	4	234	53.5
04/16	3.5	3.9	4.9	-	-	3	311	49.4
04/17	4.2	4.2	4.2	-	-	1	301	49.6
04/18	4	5.7	23.7	4	23.7	7	277	50.4
04/19	4.4	5.2	7.8	4.9	5.9	16	270	50.7
04/20	4.4	5.3	6.3	4.4	6.3	7	262	51.2
04/21	4.4	5.1	12.9	4.6	10.7	11	252	51.4
04/22	4.4	4.6	9.6	-	-	4	244	52.2
04/23	6.9	9.4	20	8	11.6	19	222	53.6
04/24	6	7.6	19.7	6.7	8.7	29	218	53.9
04/25	5.2	6	16.8	5.6	6.9	22	215	54
04/26	5	5.7	10.8	5.6	6.2	26	209	54.3
04/27	4.6	6.6	13.9	5.9	7.5	17	215	54.4
04/28	5.3	6.7	12.4	6.2	7.4	41	213	54.5
04/29	4.8	7	20.3	6	7.5	41	219	54.1
04/30	5	6.3	22.1	5.8	10.1	22	220	54.1
05/01	4.6	6.6	9.9	5.2	9	16	225	53.8
05/02	4.3	6.9	11	5.7	8.4	24	225	54
05/03	4.7	6.6	9	5.6	7.1	42	224	54.1
05/04	4	6.1	17.9	5.6	6.9	39	220	54.1
05/05	4.4	5.5	12.7	5.2	5.7	54	217	54.4
05/06	4.2	5.4	15.7	5	5.7	48	218	54.3
05/07	4	6.2	33.5	5.6	6.9	31	210	55.6
05/08	5	6	17.7	5.5	7	27	205	55.7
05/09	4.7	5.4	10.5	5.2	6.6	12	198	56.7
05/10	5	7.4	11.6	5.9	10.3	14	200	56.9
05/11	5.1	6.8	8.4	5.4	7.8	17	202	56.2
05/12	5.4	6.8	8.9	5.9	7.5	18	203	55.8
05/13	4.2	5.8	15.5	5.4	6.3	35	207	55.6
05/14	4.4	5.3	6.8	4.8	5.6	29	207	55.3
05/15	4.5	5.9	17.9	5	6.7	17	217	56
05/16	4	5.6	9.8	4.9	7.1	20	226	55.7
05/17	4.3	5.6	13	5.2	8.2	20	236	56.1
05/18	4	5.5	8.3	4.8	6.8	19	243	56.4
05/19	4	5.8	11.5	4.3	8.4	12	249	57.6
05/20	3.7	6.6	13.3	5	7.3	23	250	58.5

TABLE E-25. 2002 travel time of PIT-tagged steelhead released in any basin above McNary Dam between McNary Dam and Bonneville Dam (grouped by observation date at McNary Dam).
(continued)

McNary Dam	Travel Time			Confidence Limits			The Dalles Dam	
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
05/21	3.9	5.5	16.1	5	6	41	254	58.4
05/22	3.3	4.8	13.4	4.6	5	54	254	58.5
05/23	3.7	4.7	17.9	4.6	4.9	70	254	59.7
05/24	4	5.6	16.6	5.1	6.2	37	265	59.2
05/25	3.9	5.4	16.1	4.8	6	56	263	59.2
05/26	3.9	5.1	34.3	4.7	6.2	38	273	60
05/27	4	5.5	9.7	4.9	6.4	27	294	60.3
05/28	3	4.8	9.5	4.3	5.3	24	304	60.6
05/29	3.2	5	6.8	4.1	5.5	16	309	60.6
05/30	3.2	4.2	11.8	4.1	4.8	30	310	61.5
05/31	3.2	4.2	5.7	3.8	4.3	17	319	61
06/01	2.9	4.2	6	3.7	4.4	23	334	60.4
06/02	3	3.7	9	3.5	4.1	29	340	59.6
06/03	2.8	3.8	10.6	3.5	4	39	345	60.6
06/04	3.3	3.7	6.1	3.3	4.4	11	357	60.2
06/05	2.6	4.2	5.7	3.5	5.5	14	356	60.2
06/06	2.9	3.7	4.7	3.5	4	23	339	60
06/07	3	3.8	7.6	3.7	4.3	25	332	59.6
06/08	3.5	4	5.1	3.6	4.8	9	323	58.8

TABLE E-26. 2002 travel time of PIT-tagged subyearling chinook released in any basin above McNary Dam between McNary Dam and Bonneville Dam (grouped by observation date at McNary Dam).

McNary Dam	Travel Time			Confidence Limits			The Dalles Dam	
Passage Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
06/19	3.5	4.6	8.1	-	-	5	328.8	57.5
06/20	3.4	4	10.1	3.4	10.1	7	327.3	57.8
06/21	3.2	4.8	5.3	-	-	3	306.3	58.8
06/22	3	5.5	21.1	3.6	6.3	11	302.1	59.3
06/23	3.6	4.8	5.4	4.2	5.1	14	300.4	59.2
06/24	3.4	5	9.4	4.7	5.2	48	310.9	58.8
06/25	3.6	4.8	16.1	4.6	5	66	305.8	58.7
06/26	3.2	4.6	8.4	4.4	4.7	106	311.9	58.7
06/27	3.3	4.7	13.2	4.5	5.3	55	318.2	58.7
06/28	3.5	4.8	21.8	4.6	5	49	318.2	58.8
06/29	2.8	4.9	12.5	4.6	5.1	52	315.5	59.5
06/30	3.3	5.1	18.4	4.7	5.3	129	299.8	60.3
07/01	2.7	4.9	14	4.7	5.1	135	294.4	61.2
07/02	3.7	5.1	17.3	5	5.5	150	280.7	61.7
07/03	3.3	5.6	15.4	5.2	6.3	148	258.2	62.1
07/04	3.8	6.2	16.4	5.7	6.6	155	244.4	62.3
07/05	4.1	6.1	14.1	6	6.4	172	233.2	63
07/06	4.3	5.8	11.8	5.6	6.1	298	231.9	62.7
07/07	4	6.2	49.6	6	6.3	305	230.2	62.1
07/08	3.4	5.4	9.7	5.4	5.5	412	229.4	62
07/09	3.6	5.2	11.2	5.1	5.3	526	231.3	61.3
07/10	3.5	4.8	10.8	4.8	4.9	427	236.5	62.2
07/11	3.3	4.7	8.2	4.6	4.8	324	233.3	61.5
07/12	3.4	5.2	17.7	5.1	5.3	238	236.1	60.3
07/13	3.6	4.8	7.5	4.7	5	147	234.4	60.2
07/14	4	5.1	10.3	4.9	5.3	59	229.3	62
07/15	3.6	4.9	6.9	4.5	5.2	67	225.1	63.7
07/16	3.7	4.4	8.8	4.3	4.6	56	221.3	62.8
07/17	3.6	3.8	4.6	3.7	4.5	9	228.2	64.4
07/18	3.6	4.5	7.6	3.6	7.6	8	219.4	66.8
07/19	3.7	5.8	7.7	-	-	6	208.3	68.9
07/20	4.6	5.5	6.7	5.1	5.8	13	198.8	69
07/21	4.5	5.6	5.8	5.3	5.6	13	190.6	69.3

APPENDIX F

Reach Survival Tables

Description of Reach Survival Tables:

Table F-1 presents 2002 survival estimates for yearling chinook and steelhead released from traps on the lower Salmon (103 km above mouth at Twin Bridges), lower Imnaha (6.8 km above mouth), lower Grande Ronde (5 km above mouth), and mainstem Snake (225 km above mouth at Lewiston) rivers through a series of three reservoirs and dams to the tailrace of Lower Monumental Dam. The Seber (1965) and Jolly (1965) methodology and computer program Mark (Burnham *et al.* 1987) were used to obtain point estimates of survival for the series of reaches, along with corresponding standard errors of the estimates and the correlation between estimates from adjacent reaches. The three reaches were: trap location to Lower Granite Dam tailrace (denoted **lgr**); Lower Granite Dam tailrace to Little Goose Dam tailrace (denoted **lgs**); and Little Goose Dam tailrace to Lower Monumental Dam tailrace (denoted **lmn**). The product of these three reach estimates produced the entire 3-dam reach survival estimate from the trap's location to Lower Monumental Dam tailrace (denoted **surv_reach**). The associated standard errors (denoted **se_lgr**, **se_lgs**, and **se_lmn** for the respective reach estimates) and covariances derived from the correlation estimates (denoted **corr_lgrlgs** and **corr_lgslmn**) went into computing the variance for the overall reach estimate (denoted **var_reach**) using Meyer's (1975) formulas for propagation of error (*i.e.*, variance of the product of three random variables whose error may be correlated). Normally distributed 95% confidence intervals were computed for the overall reach survival point estimates, and are denoted **ul_reach** for the upper limit and **ll_reach** for the lower limit. Plots of the reach survival estimates with associated 95% confidence intervals are presented in Figures F – 1 through F – 4 for releases from the Salmon, Snake, Imnaha, and Grande Ronde rivers, respectively.

Table F-2 presents 2002 survival estimates for yearling chinook and steelhead from selected hatcheries in the Snake River basin through a series of reservoirs and dams. The first table provides survival estimates and confidence intervals through the 3-dam reach as described in the preceding paragraph. The second table extends the entire reach estimate further downstream to encompass the Lower Monumental Dam tailrace to McNary Dam tailrace reach (denoted **mcn**), and McNary Dam tailrace to John Day Dam tailrace reach (denoted **jda**). The product of the five reach estimates produced the entire 5-reach survival estimate from trap's release location to the tailrace of John Day Dam (again denoted **surv_reach**). Along with the additional standard errors (**se_mcn**, and **se_jda**) and correlations (**corr_lmnmcn**, and

corr_mcnjda), the variance for the entire 5-reach survival estimate was computed using Meyer's (1975) formulas.

Table F-3 presents 2002 survival estimates for yearling and subyearling chinook, steelhead, and sockeye from several release sites in the Mid-Columbia River basin through one reach consisting of multiple reservoirs and dams. Winthrop Hatchery yearling chinook passed 6 dams, Wells Hatchery subyearling chinook passed five dams, Leavenworth Hatchery yearling chinook passed four dams, Rock Island Dam releases passed three dams, and Priest Rapids Hatchery and Ringold Hatchery passed one dam. The tables present survival estimates (denoted **mcn**) and confidence intervals from release site to tailrace of McNary Dam.

Sources:

Burnham, K.P., D.R. Anderson, G.C. White, C. Bronwnie, and K.H. Pollock, 1987, *Design and analysis methods for fish survival experiments based on release-recapture*, American Fisheries Society Monograph 5, 437 pp.

Jolly, G.M., 1965, Explicit estimates from capture-recapture data with both death and immigration – stochastic model, *Biometrika*, 52: 225-247.

Meyer, S.L., 1975, *Data analysis for scientists and engineers*, John Wiley and sons, N.Y., 513 pp.

Seber, G.A.F., 1965, A note on the multiple-recapture census, *Biometrika*, 52: 249-259.

TABLE F- 1. 2002 survival estimates for trap released fish to Lower Granite Dam tailrace (lgr), between subsequent dams (lgs and lmn), and within the entire reach (surv-reach).

Site	Snake Trap							
species/ reartype	Hatchery Chinook	Wild Chinook	Hatchery Steelhead					
dates	4/12 to 4/18	4/12 to 4/18	4/12 to 4/18	4/21 to 4/27	4/28 to 5/04	5/05 to 5/10	5/12 to 5/20	5/29 to 6/06
lgr	1.0025	1.0204	0.9189	0.9413	0.8987	0.9669	0.8798	0.9348
se_lgr	0.0468	0.0503	0.0283	0.0602	0.1338	0.1188	0.0474	0.0816
lgs	0.9131	0.8439	0.9458	0.8868	0.8613	0.8257	0.8731	1.0007
se_lgs	0.0567	0.0527	0.0588	0.0979	0.1638	0.1278	0.0613	0.1318
lmn	0.9764	1.0299	1.0690	0.7829	0.9425	0.7728	0.9282	1.0097
se_lmn	0.0604	0.0527	0.1246	0.1053	0.1658	0.0947	0.0739	0.2142
corr_lgrlgs	-0.7556	-0.8817	-0.4506	-0.5687	-0.7772	-0.7909	-0.7407	-0.6563
corr_lgslmn	-0.4018	-0.2556	-0.4059	-0.5379	-0.4136	-0.4522	-0.3368	-0.3508
N	777	890	866	613	593	635	799	606
ul_reach	0.9794	0.9623	1.1182	0.7839	0.9192	0.7169	0.8099	1.2921
ll_reach	0.8080	0.8114	0.7399	0.5231	0.5399	0.5170	0.6161	0.5969
surv_reach	0.8937	0.8868	0.9291	0.6535	0.7296	0.6170	0.7130	0.9445
var_reach	0.0019	0.0015	0.0093	0.0044	0.0094	0.0026	0.0024	0.0315

Site	Salmon River Trap					
species/reartype	Wild Yearling Chinook					
dates	3/30 to 4/5	4/6 to 4/7	4/8 to 4/9	4/10 to 4/11	4/12 to 4/15	4/16-4/22
lgr	0.8708	0.8477	0.8713	0.8042	0.8827	0.8083
se_lgr	0.0414	0.0426	0.0523	0.0342	0.0408	0.0365
lgs	0.9328	0.9319	0.8555	1.0026	0.8787	1.0204
se_lgs	0.0622	0.0624	0.0668	0.0575	0.0500	0.0617
lmn	1.0415	1.0020	1.0226	0.9502	1.1204	0.9836
se_lmn	0.0771	0.0679	0.0755	0.0567	0.0657	0.0692
corr_lgrlgs	-0.7608	-0.7688	-0.8148	-0.7274	-0.8267	-0.7012
corr_lgslmn	-0.3658	-0.3835	-0.3260	-0.4428	-0.2194	-0.4371
N	866	785	812	959	734	753
ul_reach	0.9475	0.8759	0.8537	0.8346	0.9622	0.8997
ll_reach	0.7443	0.7074	0.6707	0.6976	0.7757	0.7228
surv_reach	0.8459	0.7916	0.7622	0.7661	0.8690	0.8113
var_reach	0.0027	0.0018	0.0022	0.0012	0.0023	0.0020

TABLE F- 1. 2002 survival estimates for trap released fish to Lower Granite Dam tailrace (lgr), between subsequent dams (lgs and lmn), and within the entire reach (surv-reach).
(Continued)

Site	Salmon River Trap							
species/reartype	Hatchery Yearling Chinook							
dates	3/14-3/16	3/18-3/22	3/25-3/29	3/30 to 4/5	4/8 to 4/12	4/15 to 4/19	4/22 to 4/26	4/29 to 5/7
lgr	0.7290	0.6908	0.7908	0.7705	0.8516	0.8026	0.9020	0.8133
se_lgr	0.0448	0.0406	0.0497	0.0429	0.0539	0.0409	0.0554	0.0406
lgs	0.9387	1.0467	0.9662	0.9411	0.9469	1.0597	0.8726	0.9742
se_lgs	0.0705	0.0849	0.0801	0.0698	0.0829	0.0779	0.0731	0.0640
lmn	1.0696	0.8724	0.9080	0.9693	0.9432	0.8962	1.0763	0.9977
se_lmn	0.0835	0.0792	0.0728	0.0740	0.0799	0.0766	0.0960	0.0755
corr_lgrlgs	-0.6862	-0.5711	-0.6792	-0.6313	-0.6769	-0.5883	-0.7028	-0.6639
corr_lgslmn	-0.3953	-0.5372	-0.4913	-0.4874	-0.5119	-0.5265	-0.4165	-0.4205
N	600	601	598	601	604	601	604	701
ul_reach	0.8287	0.7175	0.7758	0.7866	0.8518	0.8600	0.9679	0.8885
ll_reach	0.6353	0.5441	0.6116	0.6190	0.6693	0.6643	0.7263	0.6924
surv_reach	0.7320	0.6308	0.6937	0.7028	0.7605	0.7622	0.8471	0.7904
var_reach	0.0024	0.0020	0.0018	0.0018	0.0022	0.0025	0.0038	0.0025

Site	Salmon River Trap			
species/reartype	Hatchery Steelhead			
dates	4/13-4/26	4/27-5/4	5/5-5/10	5/13-5/19
lgr	0.8733	0.8990	0.8058	0.7847
se_lgr	0.0809	0.1185	0.0867	0.0674
lgs	0.7841	0.9399	0.8129	0.9159
se_lgs	0.1089	0.2025	0.1099	0.1087
lmn	0.7625	0.5513	0.8656	0.9314
se_lmn	0.1245	0.1124	0.1164	0.1620
corr_lgrlgs	-0.6458	-0.6084	-0.7702	-0.6400
corr_lgslmn	-0.4639	-0.6603	-0.3622	-0.3428
N	504	612	599	294
ul_reach	0.6551	0.5691	0.6905	0.8747
ll_reach	0.3891	0.3626	0.4435	0.4639
surv_reach	0.5221	0.4659	0.5670	0.6693
var_reach	0.0046	0.0028	0.0040	0.0110

TABLE F- 1. 2002 survival estimates for trap released fish to Lower Granite Dam tailrace (lgr), between subsequent dams (lgs and lmn), and within the entire reach (surv-reach).
(continued)

Site	Imnaha River Trap							
species/reartype	Hatchery Yearling Chinook					Wild Yearling Chinook		
dates	3/23-3/31	4/3-4/10	4/12-4/21	4/22-4/29		3/25-4/7	4/8-4/21	4/22-4/29
lgr	0.7345	0.7803	0.7323	0.8680		0.9670	0.9525	0.8167
se_lgr	0.0496	0.0485	0.0471	0.0562		0.0549	0.0434	0.0386
lgs	1.0248	1.0055	0.8955	0.7953		0.7856	0.8850	0.9680
se_lgs	0.0891	0.0814	0.0694	0.0637		0.0537	0.0525	0.0600
lmn	0.9281	0.9338	1.0325	1.0249		1.0390	0.9962	0.9754
se_lmn	0.0821	0.0821	0.0857	0.0784		0.0566	0.0624	0.0686
corr_lgrlgs	-0.6938	-0.6653	-0.7181	-0.7660		-0.8238	-0.7457	-0.6397
corr_lgslmn	-0.4580	-0.4516	-0.3333	-0.3133		-0.2491	-0.3497	-0.4375
N	686	534	620	608		556	688	611
ul_reach	0.7929	0.8345	0.7762	0.8023		0.8684	0.9282	0.8601
ll_reach	0.6042	0.6308	0.5778	0.6127		0.7102	0.7513	0.6823
surv_reach	0.6986	0.7327	0.6770	0.7075		0.7893	0.8397	0.7712
var_reach	0.0023	0.0027	0.0026	0.0023		0.0016	0.0020	0.0021

Site	Imnaha River Trap									
species/reartype	Hatchery Steelhead				Wild Steelhead					
dates	4/12-4/22	4/29-5/12	5/17-5/29		4/17-4/29	4/30-5/3	5/5-5/12	5/13-5/14	5/15	05/16-5/29
lgr	0.8210	0.9207	0.7991		0.8987	0.8243	0.7584	0.8298	0.8065	0.8727
se_lgr	0.0387	0.0871	0.0437		0.0615	0.0587	0.0442	0.0419	0.0379	0.0405
lgs	1.0377	0.8143	0.9727		0.7799	0.8788	0.9705	0.8961	0.8695	0.8935
se_lgs	0.0855	0.1012	0.0792		0.0667	0.1162	0.0800	0.0603	0.0533	0.0524
lmn	0.9192	1.0637	0.8817		1.1266	0.8619	0.9722	0.9558	0.9005	0.9423
se_lmn	0.0987	0.1411	0.1129		0.0984	0.1151	0.1017	0.0772	0.0888	0.0734
corr_lgrlgs	-0.4990	-0.7516	-0.5860		-0.7739	-0.5050	-0.6339	-0.6648	-0.6529	-0.7263
corr_lgslmn	-0.5545	-0.3740	-0.3802		-0.3012	-0.7079	-0.4296	-0.3806	-0.2666	-0.2816
N	738	604	630		615	635	888	702	714	779
ul_reach	0.9102	0.9687	0.8376		0.9101	0.7182	0.8381	0.8087	0.7470	0.8380
ll_reach	0.6561	0.6263	0.5330		0.6690	0.5305	0.5930	0.6128	0.5159	0.6316
surv_reach	0.7831	0.7975	0.6853		0.7896	0.6243	0.7155	0.7107	0.6315	0.7348
var_reach	0.0042	0.0076	0.0060		0.0038	0.0023	0.0039	0.0025	0.0035	0.0028

TABLE F- 2. 2002 survival estimates for Snake River basin fish from release site to John Day Dam tailrace (jda).

Hatchery & species	McCall Chinook	Dworshak Chinook	Rapid R Chinook	Imnaha R Chinook	Catherine Ck Chinook
lgr	0.5970	0.8284	0.7545	0.6693	0.4044
se_lgr	0.0114	0.0162	0.0133	0.0157	0.0086
lgs	0.9606	0.9150	0.9502	0.9478	0.9527
se_lgs	0.0255	0.0241	0.0237	0.0297	0.0294
lmn	0.9879	0.9776	0.9817	0.9506	1.0038
se_lmn	0.0241	0.0201	0.0223	0.0261	0.0337
mcn	0.8363	0.8048	0.8320	0.8533	0.8037
se_mcn	0.0273	0.0163	0.0222	0.0284	0.0406
jda	1.0514	0.9500	0.9724	0.8172	0.9404
se_jda	0.0844	0.0457	0.0646	0.0575	0.0995
corr_lgrlgs	-0.7471	-0.8036	-1.7427	-0.7847	-0.6666
corr_lgslmn	-0.4795	-0.4853	-0.7796	-0.4490	-0.4836
corr_lmnmcn	-0.2867	-0.3045	-0.3533	-0.3145	-0.3130
corr_mcnjda	-0.3117	-0.2758	-0.2513	-0.3367	-0.3715
N	54737	54725	54905	20920	20848
c-hat	3.0100	2.0200	3.5500	1.7400	1.2600
surv_reach	0.4981	0.5665	0.5694	0.4205	0.2923
se_reach	0.0376	0.0258	0.0303	0.0275	0.0283
Ul_reach	0.5718	0.6171	0.6289	0.4743	0.3478
Ll_reach	0.4244	0.5160	0.5099	0.3666	0.2369

TABLE F- 3. 2002 survival estimates for Mid-Columbia River basin fish from release site to McNary Dam tailrace (mcn).

Site	Leavenworth Hatchery			Winthrop Hatchery	
species/reartype	Chinook 1's[a]	Chinook 1's[b]	Coho	Chinook 1's[a]	Chinook 1's[b]
Dates	**04/22/02**	**04/24/02**	**04/25/02**	**4/15/02**	**4/15/02**
rel to mcn	0.5181	0.5633	0.6349	0.4824	0.5084
se	0.0065	0.0044	0.0425	0.0191	0.0219
N	50023	258142	8000	7494	18187
ll_reach	0.5053	0.5546	0.5484	0.4450	0.4654
ul_reach	0.5309	0.5719	0.7135	0.5197	0.5514

aLRB coordinator ID (CSS study releases)

bDMM coordinator ID (NMFS transportation study releases)

TABLE F- 3. 2002 survival estimates for Mid-Columbia River basin fish from release site to McNary Dam tailrace (mcn).
(continued)

Site	**Wells Hatchery**	**Priest Rapids H**	**Ringold Hatchery**
species/reartype	**Chinook 0's**	**Chinook 0's**	**Chinook 0's**
Dates	**6/17**	**6/11-6/19**	**6/18-6/19**
rel to mcn	0.4488	0.6968	0.7047
se	0.0275	0.0357	0.0327
N	5992	2997	2995
ll_reach	0.3949	0.6269	0.6407
ul_reach	0.5028	0.7667	0.7688

Site	**Rock Island Dam**				
species/reartype	**Chinook 0's**	**Chinook 0's**	**Chinook 0's**	**Chinook 0's**	**Chinook 0's**
dates	**7/1 to 7/7**	**7/10 to 7/16**	**7/17 to 7/23**	**7/24 to 7/30**	**7/31 to 8/5**
mcn	0.7083	0.6821	0.6410	0.5678	0.4902
se_mcn	0.0778	0.0709	0.0497	0.0493	0.0429
N	744	876	792	721	767
ll_reach	0.5559	0.5430	0.5436	0.4711	0.4062
ul_reach	0.8607	0.8211	0.7384	0.6644	0.5742

Site	**Rock Island Dam**		
species/reartype	**Sockeye**		
dates	**4/25-5/3**	**5/4-5/10**	**5/11-5/24**
mcn	0.6564	0.5487	0.383603
se	0.0952	0.0925	0.064919
N	613	608	473
ul_reach	0.4699	0.3675	0.2564
ll_reach	0.8429	0.7299	0.5108

APPENDIX G

Multi-Year Analysis Survival Estimates

Multi-year Analysis Survival Estimates

TABLE G1. Rock Island Dam to McNary Dam Reach Survival Estimates and Related Parameters used in Multi-Year Analysis.

Species	Migration Year	Release Dates	Fish in Release	Survival	ul 95% CI	ll 95% CI	Avg Spill Proportion	Water Transit Time	Avg Reach Temperate (?C)
ST	1998	4/21-5/4	1552	0.586	0.699	0.474	0.42	6.0	12.5
ST	1998	5/5-5/18	1624	0.600	0.720	0.480	0.42	5.1	11.2
ST	1998	5/19-6/1	792	0.455	0.578	0.331	0.47	4.7	12.8
ST	1999	4/21-5/04	1213	0.670	0.777	0.563	0.48	5.3	9.2
ST	1999	5/05-5/18	2517	0.607	0.684	0.530	0.46	5.6	10.6
ST	1999	5/19-6/01	854	0.681	0.846	0.515	0.49	5.1	12.4
ST	2000	4/21-5/4	563	0.913	1.279	0.548	0.46	5.0	11.1
ST	2000	5/5-5/18	2286	0.657	0.849	0.465	0.45	5.5	12.9
ST	2000	5/19-6/01	1079	0.405	0.650	0.161	0.43	6.6	13.3
ST	2001	4/21-5/4	528	0.247	0.307	0.186	0.34	11.3	11.2
ST	2001	5/5-5/18	1172	0.230	0.295	0.165	0.36	11.8	13.0
ST	2001	5/19-6/01	1908	0.178	0.255	0.101	0.36	10.2	14.4
ST	2002	4/21-5/4	300	0.764	1.001	0.527	0.40	6.4	10.0
ST	2002	5/5-5/18	2015	0.676	0.803	0.549	0.39	6.3	10.9
ST	2002	5/19-6/01	1467	0.625	0.810	0.441	0.48	5.1	12.3
CH1	1998	4/21-5/4	1470	0.589	0.703	0.475	0.43	5.7	12.5
CH1	1998	5/5-5/18	1326	0.926	1.238	0.615	0.42	5.1	11.2
CH1	1999	4/21-5/04	1707	0.741	0.819	0.662	0.47	5.5	9.5
CH1	1999	5/05-5/18	1093	0.744	0.869	0.619	0.46	5.6	10.6
CH1	1999	5/19-6/01	965	0.794	1.060	0.527	0.49	5.1	12.4
CH1	2000	4/21-5/4	1391	0.783	1.001	0.566	0.46	5.3	12.6
CH1	2000	5/5-5/18	1672	0.790	0.987	0.592	0.45	5.5	12.9
CH1	2001	4/21-5/4	761	0.527	0.582	0.471	0.36	11.0	12.0
CH1	2001	5/5-5/18	466	0.677	0.780	0.574	0.36	12.0	13.0
CH1	2001	5/19-6/01	463	0.588	0.725	0.451	0.36	10.2	14.4
CH1	2002	4/21-5/4	1228	0.649	0.740	0.557	0.38	6.4	10.0
CH1	2002	5/5-5/18	1946	0.678	0.755	0.601	0.39	6.3	10.9
CH1	2002	5/19-6/01	584	0.591	0.755	0.427	0.48	5.2	12.3

TABLE G2. Lower Granite to McNary Dam Reach Survival Estimates and Related Parameters used in Multi-Year Analysis.

Species	Migration Year	Release Dates	Fish in Release	Survival	ul 95% CI	ll 95% CI	Avg Spill Proportion	Water Transit Time	Avg Reach Temperate (?C)
ST	1998	4/17-4/23	403	0.616	0.821	0.411	0.39	9.8	11.8
ST	1998	4/24-4/30	3055	0.752	0.848	0.656	0.38	8.3	12.4
ST	1998	5/1-5/7	4479	0.682	0.757	0.607	0.37	7.2	12.8
ST	1998	5/8-5/14	1969	0.688	0.797	0.578	0.36	7.4	12.4
ST	1998	5/15-5/21	997	0.754	1.021	0.487	0.44	6.1	12.9
ST	1998	5/22-5/28	762	0.627	0.759	0.495	0.51	5.2	12.5
ST	1999	4/17-4/23	1144	0.746	0.859	0.634	0.35	7.8	10.3
ST	1999	4/24-4/30	1287	0.721	0.802	0.640	0.36	8.4	10.3
ST	1999	5/1-5/7	1351	0.705	0.798	0.613	0.39	9.4	10.4
ST	1999	5/8-5/14	653	0.632	0.750	0.514	0.40	9.8	11.5
ST	1999	5/15-5/21	958	0.744	0.867	0.621	0.38	7.6	12.6
ST	1999	5/22-5/28	2162	0.837	0.945	0.729	0.42	5.8	13.1
ST	2000	4/17-4/23	2791	0.715	0.792	0.639	0.43	8.4	10.7
ST	2000	4/24-4/30	2447	0.595	0.684	0.505	0.39	9.2	11.3
ST	2000	5/1-5/7	6297	0.549	0.652	0.447	0.46	10.5	11.8
ST	2000	5/8-5/14	3427	0.559	0.792	0.325	0.45	10.7	13.5
ST	2001	4/24-4/30	6035	0.159	0.173	0.144	0.00	16.2	12.3
ST	2001	5/1-5/7	9229	0.177	0.192	0.161	0.00	14.5	12.4
ST	2001	5/8-5/14	4533	0.187	0.214	0.159	0.01	13.1	13.4
ST	2001	5/15-5/21	8217	0.143	0.169	0.117	0.01	14.2	13.7
ST	2001	5/22-5/28	2211	0.079	0.134	0.025	0.00	18.2	15.5
ST	2002	4/24-4/30	1112	0.461	0.542	0.380	0.36	12.3	10.3
ST	2002	5/1-5/7	1055	0.466	0.577	0.355	0.37	13.4	11.1
ST	2002	5/8-5/14	629	0.390	0.536	0.244	0.36	10.6	11.5
ST	2002	5/15-5/21	1485	0.516	0.642	0.390	0.33	9.2	12.1
ST	2002	5/22-5/28	1711	0.724	1.028	0.421	0.36	7.4	12.6
ST	1996	4/24-4/30	2877	0.793	0.985	0.602	0.33	8.4	10.7
ST	1996	5/1-5/7	3403	0.792	1.006	0.579	0.36	9.1	10.8
ST	1996	5/15-5/21	2570	0.659	0.897	0.421	0.48	5.8	10.8
ST	1997	4/17-4/23	2042	0.902	1.237	0.567	0.47	5.4	9.5
ST	1997	4/24-4/30	1523	0.611	0.812	0.410	0.47	5.6	10.0
ST	1997	5/1-5/7	3069	0.804	1.081	0.527	0.42	5.9	11.1
CH1H	1998	4/1-4/7	898	0.806	0.972	0.640	0.41	11.4	10.9
CH1H	1998	4/8-4/14	7820	0.737	0.780	0.695	0.40	11.3	11.0
CH1H	1998	4/15-4/21	17411	0.744	0.778	0.710	0.38	10.4	11.5
CH1H	1998	4/22-4/28	23226	0.807	0.846	0.769	0.38	8.1	12.5
CH1H	1998	4/29-5/5	18381	0.793	0.843	0.743	0.37	7.2	12.9
CH1H	1998	5/6-5/12	12124	0.805	0.852	0.758	0.36	7.4	12.4
CH1H	1998	5/13-5/19	2480	0.863	1.065	0.661	0.43	6.3	12.9

TABLE G2. Lower Granite to McNary Dam Reach Survival Estimates and Related Parameters used in Multi-Year Analysis.
(continued)

Species	Migration Year	Release Dates	Fish in Release	Survival	ul 95% CI	ll 95% CI	Avg Spill Proportion	Water Transit Time	Avg Reach Temperate (?C)
CH1H	1999	4/1-4/7	320	0.830	0.996	0.664	0.39	11.0	8.6
CH1H	1999	4/8-4/14	305	0.754	0.915	0.593	0.37	8.8	9.6
CH1H	1999	4/15-4/21	3208	0.720	0.777	0.664	0.35	7.8	10.2
CH1H	1999	4/22-4/28	19166	0.806	0.828	0.784	0.36	8.4	10.4
CH1H	1999	4/29-5/5	25330	0.815	0.834	0.795	0.39	9.3	10.4
CH1H	1999	5/6-5/12	13407	0.799	0.832	0.765	0.41	10.1	11.2
CH1H	1999	5/13-5/19	6972	0.796	0.855	0.737	0.38	8.3	12.2
CH1H	1999	5/20-5/26	4177	0.716	0.817	0.615	0.40	6.1	13.2
CH1H	2000	4/15-4/21	794	0.936	1.169	0.704	0.42	8.7	10.9
CH1H	2000	4/22-4/28	2872	0.764	0.864	0.663	0.39	9.2	11.4
CH1H	2000	4/29-5/5	7629	0.717	0.792	0.643	0.44	10.1	11.7
CH1H	2000	5/6-5/12	6655	0.749	0.854	0.644	0.52	11.7	12.4
CH1H	2000	5/20-5/26	1481	0.729	0.953	0.504	0.41	10.0	14.3
CH1H	2001	4/8-4/14	667	0.573	0.633	0.512	0.00	18.4	11.5
CH1H	2001	4/15-4/21	2467	0.605	0.635	0.576	0.00	18.0	11.6
CH1H	2001	4/22-4/28	11963	0.593	0.606	0.579	0.00	16.5	12.3
CH1H	2001	4/29-5/5	21537	0.578	0.590	0.567	0.01	14.1	12.7
CH1H	2001	5/6-5/12	7006	0.552	0.576	0.529	0.01	13.4	13.5

TABLE G3. McNary Dam to Bonneville Dam Reach Survival Estimates and Related Parameters used in Multi-Year Analysis.

Species	Migration Year	Release Dates	Fish in Release	Survival	ul 95% CI	ll 95% CI	Avg Spill Proportion	Water Transit Time	Avg Reach Temperate (?C)
ST	1999	5/11 to 6/8	22219	0.717	0.832	0.560	0.37	5.1	13.5
ST	2000	5/11 to 6/8	7455	0.505	0.664	0.345	0.37	7.0	14.5
ST	2001	5/11 to 6/8	5271	0.217	0.279	0.155	0.24	11.9	16.0
ST	2002	5/11 to 6/8	5732	0.519	0.701	0.337	0.39	5.8	13.7
CH1	1999	4/25-5/8	22795	0.672	0.789	0.556	0.37	5.7	10.8
CH1	1999	5/9-5/22	33148	0.756	0.856	0.657	0.36	6.1	12.3
CH1	1999	5/23-6/5	13804	0.660	0.845	0.475	0.37	4.6	14.3
CH1	2000	4/25-5/8	12794	0.661	0.829	0.493	0.33	5.9	11.8
CH1	2000	5/9-5/22	19374	0.669	0.810	0.528	0.36	6.5	14.0
CH1	2001	4/25-5/8	8587	0.452	0.588	0.316	0.07	13.2	13.2
CH1	2001	5/9-5/22	52602	0.516	0.573	0.459	0.23	11.8	15.3
CH1	2001	5/23-6/5	66279	0.593	0.657	0.530	0.26	11.6	16.4
CH1	2002	4/25-5/8	18715	0.694	0.640	0.392	0.40	7.6	10.6
CH1	2002	5/9-5/22	67635	0.819	0.903	0.717	0.38	7.1	12.6
CH1	2002	5/23-6/5	26973	0.671	0.808	0.547	0.41	5.2	14.3

APPENDIX H

Hatchery Release Schedule

Hatchery Releases above Bonneville Dam - 2002 Migration Year

Fish Passage Center Data System

Colville Tribe

Cassimer Bar Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
SO	UN	10/19/01	10/25/01	117,868	21.0	Osoyoos Lake	Okanogan River	2000	100% LV clip.
Cassimer Bar Hatchery Total				**117,868**					

Leavenworth Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH1	SP	03/20/02	03/21/02	47,955	29.0	Omak Creek	Okanogan River	2000	100% LV clip only.
Leavenworth Hatchery Total				**47,955**					

Winthrop Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH0	SP	03/01/01	03/06/01	100,149	455.0	Okanogan River	Okanogan River	2000	100% LV clip; Rel = Omak Cr (RM 18).
Spring Subyearling Chinook Total				100,149					
CH1	SP	03/18/02	04/18/02	250,000	25.5	Okanogan River	Okanogan River	2000	100% ad clip; Rel = Ellis Ford APd; 1.5 N of Tonasket.
Spring Yearling Chinook Total				250,000					
Winthrop Hatchery Total				**350,149**					
Colville Tribe Total				**515,972**					

Idaho Dept. of Fish and Wildlife

Bonneville Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
SO	UN	05/07/02	05/07/02	38,672	16.5	Redfish Lake Creek	Salmon River (ID)	2000	100% ad+CWT; 1k PIT tag.
Bonneville Hatchery Total				**38,672**					

Clearwater Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH0	SP	07/24/01	07/24/01	30,945	62.5	Lochsa River	Clearwater River M F	2000	Rel - Squaw & Pete King Cr; 100% CWT; no ad clip; 1.7k PITs.
CH0	SP	07/25/01	07/25/01	298,742	29.4	White Sands Creek	Lochsa River	2000	Supplem rel; 100% LV clip; 700 PITs.
Spring Subyearling Chinook Total				329,687					
CH1	SP	09/18/01	09/28/01	155,887	19.5	Crooked R Acclim Pond	S Fk Clearwater River	2000	Supplemental Rel; 100% LV clip; .5k PIT tag.
CH1	SP	04/10/02	04/12/02	726,489	15.3	Crooked R Acclim Pond	S Fk Clearwater River	2000	100% ad clip; .3k PIT tag.
CH1	SP	04/09/02	04/10/02	206,473	19.5	N Fk Clearwater River	Clearwater River M F	2000	100% ad clip.
CH1	SP	04/10/02	04/10/02	57,461	15.0	Papoose Creek	Lochsa River	2000	100% CWT; no clips; .75k PIT tag; ISS group.
CH1	SP	09/24/01	10/01/01	559,630	29.3	Powell Acclim Pond	Lochsa River	2000	100% ad clip; 700 PITs.
CH1	SP	04/10/02	04/10/02	349,890	15.3	Powell Acclim Pond	Lochsa River	2000	100% ad clip; .3k PIT tag.
CH1	SP	09/18/01	09/28/01	84,238	27.4	Red River Acclim Pond	S Fk Clearwater River	2000	Supplemental Rel; 100% RV clip; 500 PITs.
CH1	SP	04/10/02	04/12/02	350,318	15.3	Red River Acclim Pond	S Fk Clearwater River	2000	100% ad clip; .3k PIT tag.
Spring Yearling Chinook Total				2,490,386					
ST	SU	04/19/02	04/19/02	40,499	6.2	Clear Creek	Clearwater River M F	2001	100% ad clip.
ST	SU	04/18/02	04/26/02	136,027	7.6	Crooked R Acclim Pond	S Fk Clearwater River	2001	11k ad clip only; 101.5k no clip; 22.5k ad+CWT; 20k CWT only; .3k PIT tag.
ST	SU	04/19/02	04/22/02	138,769	7.4	Redhouse (SFk ClearH20 R)	S Fk Clearwater River	2001	100% ad clip; 60k adLV+CWT; .3k PIT tag.
ST	SU	04/17/02	04/25/02	181,316	6.7	Red River Acclim Pond	S Fk Clearwater River	2001	30k ad clip; .3k PIT tag; 150k no clip/no mark.
Summer Steelhead Total				496,611					
Clearwater Hatchery Total				**3,316,684**					

Magic Valley Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST	SU	04/29/02	05/01/02	217,371	4.1	East Fk Salmon River	Salmon River (ID)	2001	100% ad clip; Rel = lower River.
ST	SU	05/01/02	05/01/02	3,800	4.4	East Fk Salmon River	Salmon River (ID)	2001	No clips; natural rel group.
ST	SU	04/10/02	04/12/02	179,558	3.9	Hammer Creek	Salmon River (ID)	2001	100% ad clip; .3k PIT tag.
ST	SU	04/18/02	04/19/02	84,608	4.2	Lemhi River	Salmon River (ID)	2001	100% ad clip; rel = Lemhi Hole; Sec. 17.
ST	SU	05/03/02	05/07/02	115,223	3.8	Lemhi River	Salmon River (ID)	2001	100% ad clip; 33k adLV+CWT; .3k PIT tag.
ST	SU	05/03/02	05/07/02	143,363	3.9	Lemhi River	Salmon River (ID)	2001	No ad clip; .3k PIT.
ST	SU	04/08/02	04/09/02	104,750	4.3	Little Salmon River	Salmon River (ID)	2001	Rel = Stinky Springs; 100% ad clip; .3k PIT tag.
ST	SU	04/12/02	04/12/02	54,000	4.5	Little Salmon River	Salmon River (ID)	2001	Rel = Stinky Springs; 100% ad clip.
ST	SU	04/15/02	04/15/02	43,000	4.3	Salmon River (ID)	Salmon River (ID)	2001	100% ad clip; rel = Lewis & Clark; Section 16.
ST	SU	04/15/02	04/15/02	44,770	4.5	Salmon River (ID)	Salmon River (ID)	2001	100% ad clip; rel = Wagonhammer; Section 16.
ST	SU	04/19/02	04/19/02	40,265	4.0	Salmon River (ID)	Salmon River (ID)	2001	100% ad clip; .3k PIT tag; rel = Red Rock; Section 16.
ST	SU	04/22/02	04/23/02	120,390	4.0	Salmon River (ID)	Salmon River (ID)	2001	100% ad clip; .3k PIT tag; rel = McNabb & Tunnel Rock; Sec. 18.
ST	SU	04/22/02	04/24/02	119,020	4.3	Salmon River (ID)	Salmon River (ID)	2001	100% ad clip; 33k adLV+CWT; rel = Challis & Cottonwood; Sec 18.
ST	SU	04/12/02	04/18/02	145,700	4.3	Shoup Br (Salmon R)	Salmon River (ID)	2001	100% ad clip; .3k PIT; 90k rel = Colston & Eye Hole in Sec. 17.
ST	SU	04/08/02	04/08/02	94,440	4.8	Squaw Cr Acclim Pond	Salmon River (ID)	2001	100% ad clip; 1.8k PIT tag.
ST	SU	04/24/02	05/01/02	289,534	4.1	Squaw Creek	Salmon River (ID)	2001	100% ad clip; 63k CWT; 32k LV+CWT clip; .3k PIT tag.
ST	SU	05/02/02	05/02/02	99,738	3.9	Yankee Fk (Salmon R)	Salmon River (ID)	2001	100% ad clip; .3k PIT tag.
Magic Valley Hatchery Total				**1,899,530**					

McCall Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH1	SU	03/25/02	03/28/02	1,022,550	23.0	Knox Bridge	Salmon River (ID)	2000	100% ad clip; 345k CWT; 55k PIT.
CH1	SU	03/25/02	03/25/02	41,700	23.0	Knox Bridge	Salmon River (ID)	2000	100% RV clip; .6k PIT.
CH1	SU	08/22/01	11/30/01	46,975	66.5	Stolle Meadows Acclim Pond	Salmon River (ID)	2000	100% CWT; no fin clips; .6k PIT.
McCall Hatchery Total				**1,111,225**					

Niagara Springs Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST	SU	03/25/02	04/05/02	526,168	4.4	Hells Canyon Dam	Snake River	2001	100% ad clip; 33.5k adLV+CWT 10-15-72; 10-69-70; .3k PIT tag.
ST	SU	04/06/02	05/09/02	474,272	4.1	Little Salmon River	Salmon River (ID)	2001	100% ad clip; .3k PIT tag.
ST	SU	04/14/02	05/04/02	836,713	3.9	Pahsimeroi Hatchery	Pahsimeroi River	2001	100% ad clip; 35k adLV+CWT 10-14-72; 10-70-70; .3k PIT tag.
Niagara Springs Hatchery Total				**1,837,153**					

Oxbow-Idaho Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH0	FA	05/21/02	05/21/02	161,271	42.0	Hells Canyon Dam	Snake River	2001	100% ad clip; 100 PITs.
Oxbow-Idaho Hatchery Total				**161,271**					

Pahsimeroi Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH1	SU	04/15/02	04/22/02	418,417	10.9	Pahsimeroi Hatchery	Pahsimeroi River	2000	100% ad clip; .5k PIT.
CH1	SU	04/15/02	04/22/02	89,923	10.7	Pahsimeroi Hatchery	Pahsimeroi River	2000	100% CWT; no ad clip; .5k PIT; Supplem group.
Pahsimeroi Hatchery Total				**508,340**					

Rapid River Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH1	SP	03/14/02	03/14/02	300,018	18.6	Hazard Creek/Little Salmon R	Little Salmon River	2000	100% ad clip.
CH1	SP	03/11/02	03/13/02	500,195	22.7	Hells Canyon Dam	Snake River	2000	100% ad clip.
CH1	SP	03/12/02	04/22/02	2,669,476	19.8	Rapid River Hatchery	Little Salmon River	2000	100% ad clip; 354k CWT; 184k PIT.
Rapid River Hatchery Total				**3,469,689**					

Sawtooth Hatchery

	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
	CH1	SP	04/09/02	04/23/02	385,671	15.6	Sawtooth Hatchery	Salmon River (ID)	2000	265k ad+CWT; (120k CWT only; no ad clip - Supplem rel) 2k PIT.
Spring Chinook Yearling Total					385,671					
	SO	UN	07/01/01	07/31/01	6,123	72.4	Alturas Lake	Salmon River (ID)	2000	50% adLV at 31.3/lb; 50%adRV at 113.5/lb.
	SO	UN	10/09/01	10/09/01	5,990	32.4	Alturas Lake	Salmon River (ID)	2000	100% ad clip.
	SO	UN	07/27/01	07/31/01	6,057	72.4	Pettit Lake	Salmon River (ID)	2000	100% adLV clip.
	SO	UN	10/09/01	10/09/01	5,990	32.3	Pettit Lake	Salmon River (ID)	2000	100% ad clip.
	SO	UN	10/09/01	10/10/01	83,003	20.8	Redfish Lake	Salmon River (ID)	2000	40k rel from net pens; 100% ad clip.
	SO	UN	05/07/02	05/07/02	38,672	16.5	Redfish Lake Creek	Salmon River (ID)	2001	100% ad+CWT; 1k PIT.
Sockeye Total					145,835					
Sawtooth Hatchery Total					**531,506**					
Idaho Dept. of Fish and Wildlife Total					**12,874,070**					

Nez Perce Tribe

Clearwater Hatchery

	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
	CH0	SP	07/17/01	07/17/01	103,811	69.3	Selway River	Clearwater River M F	2000	Rel - Upper Selway; 100% ad clip.
Spring Subyearling Chinook Total					103,811					
	CH1	SP	04/05/02	04/05/02	101,690	17.5	Lochsa River	Clearwater River M F	2000	73k CWT 61-26-21; 28k BWT; no fin clips; Rel = Boulder Cr.
	CH1	SP	10/01/01	10/01/02	104,720	51.3	Lochsa River	Clearwater River M F	2000	Rel - Boulder Cr; 100% ad clip.
	CH1	SP	04/03/02	04/09/02	149,185	16.1	Lolo Creek	Clearwater River M F	2000	100% CWT 61-26-24; no clips; 1k PIT.
	CH1	SP	10/11/01	10/11/01	89,490	52.5	Meadow Creek - SELW	Selway River	2000	2.2k PIT & ad clip.
	CH1	SP	04/16/02	04/26/02	296,841	15.2	Meadow Creek - SELW	Selway River	2000	100% CWT 61-26-23; no clips; 1k PIT.
	CH1	SP	04/03/02	04/09/02	114,994	16.5	Newsome Creek	S Fk Clearwater River	2000	100% CWT 61-26-25; no clips; 1k PIT; 40k rel = Mill Cr - CWT.
Spring Yearling Chinook Total					856,920					
	CO	UN	04/30/02	04/30/02	25,000	200.0	Potlatch River	Clearwater River M F	2001	Rel = Mission Cr; unmarked fry; Reared Potlatch Pd.
Coho Total					25,000					
	ST	SU	04/09/02	04/30/02	18,000	10.0	Lolo Creek	Clearwater River M F	2001	No fin clips.
	ST	SU	04/22/02	04/26/02	60,460	10.0	Meadow Creek - CLES	S Fk Clearwater River	2001	34k rel = Mill Cr also; unmarked/no clip groups.
Summer Steelhead Total					78,460					
Clearwater Hatchery Total					**1,064,191**					

Dworshak Hatchery

	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
	CO	UN	05/14/02	05/14/02	236,692	15.0	Kooskia Hatchery	Clearwater River M F	2000	No fin clips; 50k CWT 61-26-20; 1k PIT tag.
Dworshak Hatchery Total					**236,692**					

Eagle Creek Hatchery

	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
	CO	UN	04/10/02	04/19/02	277,980	15.0	Potlatch River	Clearwater River M F	2000	Unmarked.
Eagle Creek Hatchery Total					**277,980**					

Hagerman Hatchery

	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
	ST	SU	04/30/02	05/10/02	94,232	4.4	American River	S Fk Clearwater River	2001	No fin clips.
	ST	SU	04/12/02	04/12/02	42,620	4.1	Hazard Creek/Little Salmon R	Little Salmon River	2001	No fin clips.
	ST	SU	04/01/02	04/15/02	175,504	4.2	Little Salmon River	Salmon River (ID)	2001	No fin clips; .3k PIT tag; rel = Hwy 94 Bridge.
	ST	SU	05/10/02	05/15/02	85,722	4.1	Newsome Creek	S Fk Clearwater River	2001	No fin clips.
	ST	SU	05/02/02	05/06/02	139,445	4.4	Yankee Fk (Salmon R)	Salmon River (ID)	2001	1.6k fin clipped; remainder no fin clips; .3k PIT tag.
Hagerman Hatchery Total					**537,523**					

Lookingglass Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH1	SP	04/01/02	04/14/02	77,551	16.9	Lostine Accim Pond	Wallowa River	2000	100% ad+CWT 9-34-19; 21..23; 25;26; 28; 29; 8k PIT tag.
CH1	SP	04/01/02	04/14/02	31,464	15.8	Lostine Accim Pond	Wallowa River	2000	100% ad+CWT 7-58-52+Rt Rd Elast tag; 8K PIT tag; Endemic Stock.
Lookingglass Hatchery Total				**109,015**					

Lyons Ferry Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH0	FA	05/27/02	05/28/02	495,215	80.0	Big Canyon (Clearwater R)	Clearwater River M F	2001	2.5k PIT; 200k CWT only 61-26-39.
CH0	FA	06/18/02	06/19/02	505,674	80.0	Big Canyon (Clearwater R)	Clearwater River M F	2001	2.5k PIT.
CH0	FA	05/28/02	05/28/02	498,927	80.0	Cpt John Acclim Pond	Snake River	2001	200k CWT only 61-1-6; 2.5k PIT.
CH0	FA	06/20/02	06/20/02	498,948	80.0	Cpt John Acclim Pond	Snake River	2001	182k CWT only 61-21-5; 2.5k PIT.
CH0	FA	05/27/02	05/28/02	399,315	80.0	Pittsburg Landing Acclim Pond	Snake River	2001	200k CWT only 61-25-1; 2.5k PIT.
Fall Subyearling Chinook Total				2,398,079					
CH1	FA	04/10/02	04/12/02	159,472	12.9	Big Canyon (Clearwater R)	Clearwater River M F	2000	100% ad+Elast+CWT 63-6-77; 25; 7.5k PIT.
CH1	FA	04/16/02	04/16/02	160,155	16.6	Cpt John Acclim Pond	Snake River	2000	100% ad+Elast+CWT 63-1-83; 2.5k PIT.
CH1	FA	04/15/02	04/17/02	159,731	13.4	Pittsburg Landing Acclim Pond	Snake River	2000	100% ad+Elast+CWT 63-6-78; 7.5k PIT.
Fall Chinook Yearling Total				479,358					
Lyons Ferry Hatchery Total				**2,877,437**					

McCall Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH1	SU	03/18/02	03/19/02	57,392	23.0	Johnson Cr Idaho	South Fork Salmon River	2000	100% CWT+VIE (Left Yellow); 10k PIT; No clips.
McCall Hatchery Total				**57,392**					

Willard Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	UN	03/11/02	03/11/02	275,000	15.0	Lapwai Creek	Clearwater River M F	2000	215k no clips; 60k ad+CWT 61-26-36; 37; 1k PIT tag.
CO	UN	03/13/02	03/13/02	275,000	15.0	Potlatch River	Clearwater River M F	2000	60k ad+CWT 61-26-18; 19; 215 k no clip; 1k PIT tag.
Willard Hatchery Total				**550,000**					

Nez Perce Tribe Total **5,710,230**

Oregon Dept. of Fish and Wildlife

Irrigon Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST	SU	04/11/02	04/12/02	168,704	4.3	Big Canyon Acclim.Pd (Grande Ronde)	Grande Ronde River	2001	100% ad clip; 25k adLV+CWT 9-34-7.
ST	SU	05/08/02	05/09/02	102,581	3.9	Big Canyon Acclim.Pd (Grande Ronde)	Grande Ronde River	2001	100% ad clip; 50k adLV+CWT 9-34-8; 9.
ST	SU	09/06/00	09/06/00	93,680	103.0	Big Sheep Creek	Imnaha River	2000	Dir str. - excess sthd; 100% ad clip; mig yr & Surv to smolt unk.
ST	SU	04/16/02	04/17/02	101,594	5.2	Big Sheep Creek	Imnaha River	2001	50k unmarked?; 50k adLV+CWT 9-1-25.
ST	SU	05/02/02	05/02/02	1,007	5.2	Deer Creek	Grande Ronde River	2001	Sthd x Rbow Cross; 100% ad +PIT tag.
ST	SU	04/11/02	04/11/02	121,336	4.4	L Sheep Acclim Pond	Imnaha River	2001	53k ad only; 25k adLV+CWT 9-34-2.
ST	SU	05/08/02	05/08/02	74,239	4.5	L Sheep Acclim Pond	Imnaha River	2001	100% ad clip; 25k adLV+CWT 9-34-3.
Irrigon Hatchery Total				**663,141**					

Lookingglass Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH1	SP	03/21/02	04/17/02	303,737	14.1	Imnaha Acclim Pond	Imnaha River	2000	100% ad+CWT 9-34-13..17; 43; 7-58-51; 21k PIT.
CH1	SP	09/24/01	09/24/01	51,864	24.5	Lookingglass Hatchery	Grande Ronde River	2000	100% ad clip; ~50% ad+CWT 9-34-34; 37; rel for Umat. Tribe.
Lookingglass Hatchery Total				**355,601**					

Oak Springs Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST	SU	04/17/02	04/18/02	58,911	6.0	Hood River	Hood River	2001	100% ad clip.
Oak Springs Hatchery Total				**58,911**					

Round Butte Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH1	SP	04/15/02	04/18/02	306,460	9.9	Bel. Pelton Dam	Deschutes River	2000	100% ad+CWT 9-33-16...19 from Cells 1-3; 6.
Spring Yearling Chinook Total				306,460					
ST	SU	04/01/02	04/02/02	159,622	4.7	Bel. Pelton Dam	Deschutes River	2001	100% adRV clip.
Summer Steelhead Total				159,622					
Round Butte Hatchery Total				**466,082**					

Umatilla Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST	SU	04/29/02	05/18/02	2,649	4.2	Umatilla River	Umatilla River	2001	100% ad clip; 822 adLV+CWT 9-34-12 & PIT tagged.
Umatilla Hatchery Total				**2,649**					

Wallowa Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST	SU	04/04/02	04/05/02	354,332	4.5	Wallowa Acclim Pond	Wallowa River	2001	97.8% ad clip; 25k adLV+CWT 9-34-4
ST	SU	05/01/02	05/02/02	206,301	4.0	Wallowa Acclim Pond	Wallowa River	2001	97.5% ad clip; 50k adLV+CWT 9-34-5; 6.
Wallowa Hatchery Total				**560,633**					

Oregon Dept. of Fish and Wildlife Total **2,107,017**

U.S. Fish and Wildlife Service

Carson Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH1	SP	04/16/02	04/17/02	1,449,361	15.6	Carson Hatchery	Wind River	2000	100% ad clip; 100k ad+CWT; 15k PIT tag.
Carson Hatchery Total				**1,449,361**					

Dworshak Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH1	SP	03/27/02	03/28/02	1,000,561	20.1	Dworshak Hatchery	Clearwater River M F	2000	100% ad clip; 130k CWT; 55k PIT.
CH1	SP	04/04/02	04/04/02	498,532	26.8	Kooskia Hatchery	Clearwater River M F	2000	100% ad clip; 69k CWT; .7k PIT.
Spring Chinook Yearling Total				1,499,093					
ST	SU	04/22/02	04/24/02	1,365,823	5.4	Dworshak Hatchery	Clearwater River M F	2001	1.254 mil. ad clip; 105k BWT/non clip; 140k adLV+CWT; 40k adLV+CWT+FB; 4.2k PITtag.
ST	SU	04/15/02	04/19/02	585,699	5.5	Redhouse (SFk ClearH20 R)	S Fk Clearwater River	2001	100% ad clip; 20k adLV+CWT; 1.2k PIT tag.
Summer Steelhead Total				1,951,522					
Dworshak Hatchery Total				**3,450,615**					

Entiat Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH1	SP	04/07/02	04/08/02	533,720	17.0	Entiat Hatchery	Entiat River	2000	100% ad clip; 200k CWT; 60k PIT tag; 50k @ 32/lb.
Entiat Hatchery Total				**533,720**					

	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
Hagerman Hatchery										
	ST	SU	04/25/02	04/29/02	781,706	4.3	Sawtooth Hatchery	Salmon River (ID)	2001	100% ad clip; 40k adLV+CWT; .6k PIT tag.
Hagerman Hatchery Total					**781,706**					
Kooskia Hatchery										
	CH1	SP	04/04/02	04/04/02	51,329	24.3	Clear Creek	Clearwater River M F	2000	100% LV clip: Supplem Rel group; 1k PIT.
Spring Yearling Chinook Total					51,329					
	ST	SU	04/15/02	04/19/02	264,031	5.5	Kooskia Hatchery	Clearwater River M F	2001	100% ad clip; 20k adLV+CWT; .6k PIT tag.
Summer Steelhead Total					264,031					
Kooskia Hatchery Total					**315,360**					
Little White Salmon Hatchery										
	CH0	FA	06/20/02	06/20/02	2,074,295	82.2	Little White Salmon Hatchery	Little White Salmon River	2001	200k ad+CWT 5-1-3-1-6.
Fall Subyearling Chinook Total					2,074,295					
	CH1	SP	04/18/02	04/18/02	1,037,382	15.8	Little White Salmon Hatchery	Little White Salmon River	2000	100% ad clip; 76k CWT 5-44-70.
Spring Yearling Chinook Total					1,037,382					
Little White Salmon Hatchery Total					**3,111,677**					
Leavenworth Hatchery										
	CH1	SP	04/22/02	04/22/02	1,554,362	22.4	Leavenworth Hatchery	Wenatchee River	2000	100% ad clip; 550k CWT 5-44-15; 36...40; 5-43-7; 320k PIT tag.
Leavenworth Hatchery Total					**1,554,362**					
Spring Creek National Fish Hatchery										
	CH0	FA	12/11/01	12/12/01	3,041,402	1175.0	Spring Creek Hatchery	L Col R (D/s McN Dam)	2001	Unfed Fry; 100% thermal otolith mark.
	CH0	FA	03/11/02	03/11/02	7,791,715	116.1	Spring Creek Hatchery	L Col R (D/s McN Dam)	2001	150k ad+CWT.
	CH0	FA	03/29/02	03/29/02	3,995,694	99.8	Spring Creek Hatchery	L Col R (D/s McN Dam)	2001	150k ad+CWT.
	CH0	FA	04/30/02	04/30/02	3,481,511	49.0	Spring Creek Hatchery	L Col R (D/s McN Dam)	2001	150k ad+CWT; early rel.
	CH0	FA	02/11/02	03/01/02	848,986	350.0	Spring Creek Hatchery	L Col R (D/s McN Dam)	2001	Unmarked Rel.
Fall Subyearling Chinook Total					19,159,308					
	CH0	SP	08/17/01	08/24/01	373,970	18.0	White Salmon River	White Salmon River	2000	Transf from Winthrop H; 100% ad clip; % PIT tag.
Spring Subyearling Chinook Total					373,970					
	CH1	SP	01/07/02	01/08/02	170,600	15.0	White Salmon River	White Salmon River	2000	100% ad clip; CWT 5-1-3-7-4; 2k PIT tag; early rel - flood.
Spring Yearling Chinook Total					170,600					
Spring Creek National Fish Hatchery Total					**19,703,878**					
Warm Springs National Fish Hatchery										
	CH1	SP	10/01/01	11/14/01	57,975	22.0	Warm Springs Hatchery	Deschutes River	2000	100% ad+CWT5-49-28..30; 5-44-10..12; 5-45-15; 10k adLV+CWT 5-5-74..76.
	CH1	SP	03/26/02	04/24/02	560,847	20.1	Warm Springs Hatchery	Deschutes River	2000	100% ad+CWT 5-44-9..12; 5-45-15; 5-49-28..30; 55k LV clip; 4k PIT.
Warm Springs National Fish Hatchery Total					**618,822**					
Willard Hatchery										
	CO	UN	04/18/02	04/19/02	969,412	17.6	Little White Salmon River	Little White Salmon River	2000	100% ad clip; 118k ad+CWT 5-43-8; 5-42-63; 5-44-43.
Willard Hatchery Total					**969,412**					

	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
Winthrop National Fish Hatchery										
	CH1	SP	04/15/02	04/15/02	201,604	17.6	Winthrop Hatchery	Methow River	2000	100% CWT 5-46-17..26; 5-44-41; 27.5k PIT tag; no fin clip.
Spring Yearling Chinook Total					201,604					
	ST	SU	04/15/02	04/30/02	150,488	5.8	Winthrop Hatchery	Methow River	2001	100% ad clip.
Summer Steelhead Total					150,488					
Winthrop National Fish Hatchery Total					**352,092**					
U.S. Fish and Wildlife Service Total					**32,841,005**					

Umatilla Tribe

	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
Bonneville Hatchery										
	CH1	FA	03/01/02	03/07/02	259,607	9.0	Thornhollow Acclim Pond	Umatilla River	2000	25k ad+CWT 9-33-46; 235k BWT; some PIT tagged.
	CH1	FA	04/04/02	04/11/02	260,957	8.7	Thornhollow Acclim Pond	Umatilla River	2000	25k ad+CWT 9-33-47; 235k BWT; some PIT tagged.
Bonneville Hatchery Total					**520,564**					
Cascade Hatchery										
	CO	UN	03/07/02	03/29/02	977,177	15.0	Pendelton Acclim Pond	Umatilla River	2000	750k ad clip; %CWT 9-30-10; 16; 9-33-27.
	CO	UN	04/17/02	04/17/02	644,680	14.2	Pendelton Acclim Pond	Umatilla River	2000	100% ad clip; % CWT 9-30-17.
Cascade Hatchery					**1,621,857**					
Lookingglass Hatchery										
	CH1	SP	04/01/02	04/15/02	180,343	18.6	Catherine Cr Acclim Pond	Grande Ronde River	2000	100% ad+CWT 9-34-20; 29...37; 21k PIT Tag.
	CH1	SP	10/02/01	10/02/01	76,941	24.0	Grande Ronde Acclim Pond	Grande Ronde River	2000	% CWT 9-34-24; 42; 44; Rel sites in upper GRonde.
	CH1	SP	04/01/02	04/15/02	151,444	17.9	Grande Ronde Acclim Pond	Grande Ronde River	2000	100% ad+CWT 9-34-16; 39..42; 44; 9-26-11; 7-1-49; PIT tag groups; 50k died - 3/3/02.
Lookingglass Hatchery					**408,728**					
Umatilla Hatchery										
	CH0	FA	05/17/02	05/23/02	307,194	40.7	Thornhollow Acclim Pond	Umatilla River	2001	100% ad+CWT 9-35-1; 3; some PIT tagged.
	CH0	FA	05/23/02	05/23/02	312,897	39.0	Umatilla River	Umatilla River	2001	Dir. Str Rel at RM 48; 100% ad+CWT 9-33-4; 35-2.
Fall Subyearling Chinook Total					620,091					
	CH1	SP	02/02/02	02/07/02	148,048	13.7	Imeques Acclim Pond	Umatilla River	2000	100% ad clip; 19.7k adLV+CWT 09-26-57...59; .9k PIT.
	CH1	SP	03/01/02	03/08/02	363,932	12.6	Imeques Acclim Pond	Umatilla River	2000	100% ad clip; 80k adLV+CWT 9-33-58...63; 9-34-1.
Spring Yearling Chinook Total					511,980					
	ST	SU	04/02/02	04/09/02	54,917	5.1	Bonifer Acclim Pond	Umatilla River	2001	20k adLV+CWT 9-34-10; 34k ad only.
	ST	SU	04/29/02	04/30/02	47,521	4.5	Minthorn Acclimation Pond	Umatilla River	2001	20k adLV+CWT 9-34-12; 28k ad only; some PIT tag.
	ST	SU	04/30/02	04/30/02	54,366	4.2	Pendelton Acclim Pond	Umatilla River	2001	20k adLV+CWT 9-34-11; 34k ad only; some PIT tagged.
Summer Steelhead Total					156,804					
Umatilla Hatchery Total					**1,288,875**					
Willard Hatchery										
	CH1	SP	04/04/02	04/11/02	220,725	14.9	Imeques Acclim Pond	Umatilla River	2000	100% ad clip; 24k adLV+CWT 5-46-61.
	CH1	SP	03/08/02	03/14/02	143,516	17.0	Imeques Acclim Pond	Umatilla River	2000	100% ad clip; 25k ad+CWT 5-46-62.
Willard Hatchery					**364,241**					
Umatilla Tribe Total					**4,204,265**					

Warm Springs Tribe

Blackberry Acclim. Pond

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH1	SP	04/05/02	04/25/02	33,948	14.5	Blackberry Acclim Pond	Hood River	2000	100% adLM+CWT 9-33-20;21; from Pelton Ldr cell 4 & 5.
Blackberry Acclim. Pond Total				**33,948**					

Jones Creek Acclim. Pond

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH1	SP	04/05/02	04/13/02	14,090	14.7	Jones Creek Acclim Pond	Hood River	2000	100% adLM+CWT 9-33-20; Emerg rel - high H2O.
Jones Creek Acclim. Pond Total				**14,090**					

Oak Springs Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST	WI	04/12/02	04/29/02	30,832	5.7	E Fk Irrig Dist Sand Trap	Hood River	2001	100% adLV+CWT 9-33-51.
ST	WI	04/12/02	04/29/02	31,234	5.8	Parkdale Acclim Pond	Hood River	2001	100% adLV+CWT 9-33-50.
Winter Steelhead Total				62,066					
ST	SU	04/10/02	05/01/02	39,862	4.7	Blackberry Acclim Pond	Hood River	2001	100% LMaxil Clip.
Summer Steelhead Total				39,862					
Oak Springs Hatchery Total				**101,928**					

Parkdale Acclim. Pond

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH1	SP	07/23/01	07/23/01	8,000	90.0	Parkdale Acclim Pond	Hood River	2000	100% adRV+CWT; Pilot Study Group.
Parkdale Acclim. Pond Total				**8,000**					

Round Butte Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH1	SP	04/05/02	04/05/02	30,991	13.2	Parkdale Acclim Pond	Hood River	2000	100% adRV+CWT 9-33-22.
Round Butte Hatchery Total				**30,991**					

Warm Springs Tribe Total **188,957**

Washington Dept. of Fish and Wildlife

East Bank Hatchery

Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH0	SU	07/02/02	07/02/02	214,059	34.0	Turtle Rock Hatchery	Mid-Columbia River	2001	100% ad+CWT 63-8-94.
CH0	SU	07/02/02	07/02/02	481,584	23.0	Turtle Rock Hatchery	Mid-Columbia River	2001	100% ad+CWT 63-8-94; Accel Growth.
Summer Subyearling Chinook Total				695,643					
CH1	SU	04/14/02	04/28/02	138,863	6.0	Bel. Rocky Reach Dam	Mid-Columbia River	2000	50% rel - R Isld; Surv. Study; 100% ad+CWT 63-2-74; 100k PIT.
CH1	SU	04/30/02	05/01/02	336,762	8.3	Carlton Acclim Pond	Methow River	2000	100% ad+CWT 63-9-97.
CH1	SU	05/06/02	05/06/02	804,501	10.0	Dryden Acclim Pond	Wenatchee River	2000	100% ad+CWT 63-12-71; 72.
CH1	SU	04/08/02	04/08/02	532,453	22.3	Similkameen Acclim Pd	Okanogan River	2000	100% ad+CWT 63-9-96; Early rel pond - Medical.
CH1	SU	04/15/02	04/15/02	165,935	6.0	Turtle Rock Hatchery	Mid-Columbia River	2000	100% ad+CWT 63-7-81.
CH1	SU	04/16/02	04/16/02	124,995	10.8	Wenatchee River	Wenatchee River	2000	Dir. Rel - near Leavenworth; 100% ad+CWT 63-12-71; 72.
Summer Chinook Yearling Total				2,103,509					
CH1	SP	04/22/02	04/29/02	47,104	9.7	Chiwawa Hatchery	Wenatchee River	2000	100% ad+CWT 63-7-91.
Spring Yearling Chinook Total				47,104					
SO	UN	08/27/01	08/27/01	92,055	20.3	Lake Wenatchee	Wenatchee River	2000	100% ad+CWT 63-8-82.
SO	UN	09/27/01	09/27/01	98,119	12.4	Lake Wenatchee	Wenatchee River	2000	100% ad+CWT 63-8-78.
Sockeye Total				190,174					
ST	SU	04/29/02	05/15/02	120,055	3.9	Chiwawa Hatchery	Wenatchee River	2001	no fin clips; HXH Cross; 100% Elast Mark.
ST	SU	04/29/02	05/03/02	75,276	4.5	Nason Creek	Wenatchee River	2001	No fin clips; HXW Cross; 100% Elast Mark.
ST	SU	04/29/02	05/15/02	92,487	3.9	Chiwawa Hatchery	Wenatchee River	2001	No fin clips; HXW Cross; 100% Elast Mark.
ST	SU	04/29/02	05/03/02	48,115	4.5	Nason Creek	Wenatchee River	2001	No fin clips; WxW Cross; 100% Elast Mark.
Summer Steelhead Total				335,933					
East Bank Hatchery Total				**3,372,363**					

Klickitat Hatchery

	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
	CH0	FA	06/03/02	07/16/02	3,968,900	66.0	Klickitat Hatchery	Klickitat River	2001	3-rel grps; 6/3; 7/1--5 - 7/15-17; 233k ad+CWT 63-09-87; 63-13-95.
Fall Subyearling Chinook Total					3,968,900					
	CH1	SP	03/08/02	03/12/02	605,000	7.7	Klickitat Hatchery	Klickitat River	2000	278k ad clip; 91k ad+CWT 63-06-95; 96.
Spring Yearling Chinook Total					605,000					
	CO	NO	05/02/02	05/09/02	1,025,000	16.0	Klickitat Hatchery	Klickitat River	2000	100% ad clip; 45k ad+CWT 63-5-88.
Coho Total					1,025,000					
Klickitat Hatchery Total					**5,598,900**					

Lyons Ferry Hatchery

	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
	CH0	FA	06/24/02	06/24/02	194,582	52.0	Lyons Ferry Hatchery	Snake River	2001	100% ad+CWT 63-8-90; 1.5k PIT.
Fall Subyearling Chinook Total					194,582					
	CH0	SP	05/06/02	05/06/02	20,592	165.0	Tucannon River	Tucannon River	2001	Captive Brood Rel - 100% ad+CWT 63-14-30.
	CH0	SP	05/06/02	05/06/02	21,043	123.4	Tucannon River	Tucannon River	2001	Supplementation Rel - 100% ad+CWT 63-14-29.
Spring Subyearling Chinook Total					41,635					
	CH1	FA	04/01/02	04/11/02	432,511	9.3	Lyons Ferry Hatchery	Snake River	2000	100% marked ad+Elast+CWT 63-12-73; 1k PIT.
Fall Yearling Chinook Total					432,511					
	ST	SU	04/01/02	04/30/02	182,722	5.3	Cottonwood Acclim Pond	Grande Ronde River	2001	100% ad clip; 40k adLV+CWT 63-11-78+FB.
	ST	SU	04/01/02	04/30/02	125,391	4.1	Dayton Acclim Pond	Touchet River	2001	100% ad clip; 20k adLV+CWT 63-12-79+FB.
	ST	SU	05/02/02	05/02/02	45,501	6.0	Dayton Acclim Pond	Touchet River	2001	100% CWT 63-11-77+Elast; rel = up. Touchet R; WxW cross.
	ST	SU	04/16/02	04/30/02	62,612	4.2	Lyons Ferry Hatchery	Snake River	2001	100% ad clip; 20k adLV+CWT 63-12-70+FB.
	ST	SU	04/02/02	04/05/02	58,616	5.5	Tucannon Hatchery	Tucannon River	2001	WxW Cross; 100% CWT 63-9-70+Elast Mark.
	ST	SU	04/16/02	04/25/02	135,203	4.3	Tucannon River	Tucannon River	2001	100% ad clip; 21k adLV +CWT 63-12-78+FB.
	ST	SU	04/16/02	04/18/02	99,859	4.0	Walla Walla River	Walla Walla River	2001	100% ad clip; 19k adLV+CWT 63-12-69.
Summer Steelhead Total					709,904					
Lyons Ferry Hatchery Total					**1,378,632**					

Methow Hatchery

	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
	CH1	SP	04/16/02	04/19/02	266,392	15.7	Chewuch Acclim Pond	Methow River	2000	100% ad+CWT 63-7-76; 66.5k rel = Methow H.
	CH1	SP	04/15/02	04/23/02	80,392	15.5	Twisp Acclim Pond	Methow River	2000	100% ad+CWT 63-1-82; 1k Captive Br 63-9-94.
Methow Hatchery Total					**346,784**					

Priest Rapids Hatchery

	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
	CH0	FA	06/11/02	06/20/02	6,779,035	45.2	Priest Rapids Hatchery	Mid-Columbia River	2001	5 Rel - 6/11; 6/13; 6/15; 6/17; 6/19; 200k ad+CWT 63-13-82; 3k PIT tag.
Priest Rapids Hatchery Total					**6,779,035**					

Ringold Springs Hatchery

	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
	CH0	FA	06/17/02	06/24/02	2,283,020	50.4	Ringold Springs Hatchery	Mid-Columbia River	2001	432k ad+CWT 63-8-92;85; 86; 3k PIT tag.
Fall Subyearling Chinook Total					2,283,020					
	ST	SU	04/10/02	04/17/02	164,556	4.3	Ringold Springs Hatchery	Mid-Columbia River	2001	100% adRV clip.
Summer Steelhead Total					164,556					
Ringold Hatchery Total					**2,447,576**					

Skamania Hatchery	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
	ST	SU	05/02/02	05/09/02	99,941	5.0	Klickitat River	Klickitat River	2001	100% ad clip; Rel = RM12-27; Icehouse;Twin Bridges; Leidle.
Summer Steelhead Total					99,941					
	ST	WI	05/01/02	05/01/02	20,174	4.9	White Salmon River	White Salmon River	2001	100% ad clip; Rel = near USFWS pds.
	ST	WI	04/29/02	04/29/02	20,500	4.8	Salmon Creek (WA)	Columbia River	2001	100% ad clip.
Winter Steelhead Total					40,674					
Skamania Hatchery Total					**140,615**					

Tucannon Hatchery	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
	CH1	SP	04/01/02	04/23/02	102,099	15.5	Curl Lake	Tucannon River	2000	100% CWT 63-8-87+Elast Mark.
	CH1	SP	03/15/02	04/23/02	3,055	8.9	Curl Lake	Tucannon River	2000	100% CWT 63-63-63; 1st Captive Brood Rel. Group.
Tucannon Hatchery Total					**105,154**					

Washougal Hatchery	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
	CO	NO	03/27/02	04/04/02	2,453,166	19.4	Klickitat River	Klickitat River	2000	Rel = RM 20; 57k ad+CWT 63-11-65
Washougal Hatchery Total					**2,453,166**					

Wells Hatchery	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
	CH0	SU	06/17/02	06/18/02	376,027	20.0	Wells Hatchery	Mid-Columbia River	2001	100% ad+CWT 63-14-23.
Summer Subyearling Chinook Total					376,027					
	CH1	SU	04/15/02	04/30/02	345,504	9.6	Wells Hatchery	Mid-Columbia River	2000	100% ad+CWT 63-9-95.
Summer Yearling Chinook Total					345,504					
	ST	SU	05/01/02	05/23/02	85,615	6.0	Chewuch Acclim Pond	Methow River	2001	100% Elast tag; No fin clips; HxW Cross.
	ST	SU	04/29/02	05/23/02	94,020	6.0	Methow River	Methow River	2001	100% Elast tag; No fin clips; HxW Cross.
	ST	SU	04/29/02	05/23/02	126,855	5.3	Okanogan River	Okanogan River	2001	100% ad clip; Rel = Similkameen; Omak & Salmon R.
	ST	SU	05/01/02	05/23/02	84,475	6.0	Twisp River	Methow River	2001	100% Elast tag; no fin clip; HxW Cross.
Summer Steelhead Total					390,965					
Wells Hatchery Total					**1,112,496**					
Washington Dept. of Fish and Wildlife Total					**23,734,721**					

Yakama Tribe

Cle Elum Hatchery	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
	CH1	SP	03/15/02	05/24/02	285,954	21.9	Clark Flat Acclim Pond	Yakama River	2000	100% ad+CWT 63-13-64; 65; -9-80; 81; -5-82; 83+ Elast tag; 13.4k PIT tag.
	CH1	SP	03/15/02	05/24/02	263,061	23.6	Easton Pond	Yakama River	2000	100% ad+CWT 63-12-98; 99; -9-78; 79; -9-74; -11-76+ Elast tag; 13.4k PIT tag.
	CH1	SP	03/15/02	05/24/02	285,270	22.5	Jack Creek Acclim Pond	Yakama River	2000	100% ad+CWT 63-12-96; 97; -13-60; 63; -9-72; 73 + Elast tag; 13.4k PITtag.
Cle Elum Hatchery Total					**834,285**					

Easton Pond Hatchery	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
	CO	UN	05/06/02	05/25/02	307,947	17.5	Easton Pond	Yakama River	2000	100k rel on 5/6; 208k rel on 5/25; 100% CWT; 5k PIT tag.
Easton Pond Hatchery Total					**307,947**					

	Species	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
Klickitat Hatchery										
	CH0	SP	05/05/02	05/13/02	223,298	51.4	Upper Klickitat River	Klickitat River	2001	Unmarked rel group.
Klickitat Hatchery Total					**223,298**					
Leavenworth Hatchery										
	CO	UN	04/24/02	04/24/02	765,924	16.9	Icicle Creek	Wenatchee River	2000	100% CWT; 17k PIT tag; No fin clip.
	CO	UN	04/21/02	05/01/02	230,157	16.0	Nason Creek	Wenatchee River	2000	rel = Butcher Cr Pd-Beaver & Early Pd; 100% CWT; 8k PIT tag; No fin clip.
Leavenworth Hatchery Total					**996,081**					
Lost Creek Hatchery										
	CO	UN	05/06/02	05/25/02	185,200	16.8	Lost Creek Acclim Pond	Yakama River	2000	50% rel on 5/6 & 5/25; 100% CWT; 5k PIT tag.
Lost Creek Hatchery Total					**185,200**					
Prosser Hatchery										
	CH0	FA	04/16/02	05/17/02	143,079	74.7	Prosser Acclim Pond	Yakama River	2001	100% RV clip (Apr rel); 100% LV clip (May rel); 5k PIT tag.
	CH0	FA	05/13/02	05/13/02	1,704,348	65.0	Prosser Acclim Pond	Yakama River	2001	Transf from L White Salmon H.
	CH0	FA	04/15/02	04/15/02	4,000	65.0	Prosser Acclim Pond	Yakama River	2001	Unmarked rel into Marion Drain; 1k PIT tag.
Fall Subyearling Chinook Total					1,851,427					
	CO	UN	03/28/02	03/28/02	42,321	17.0	Yakama River	Yakama River	2000	Rel - near Prosser WA
Coho Total					42,321					
Prosser Hatchery					**1,893,748**					
Stiles Pond										
	CO	UN	05/06/02	05/25/02	194,082	14.6	Naches River	Yakama River	2000	Rel = 50% on 5/6 & 5/25 in Stiles Pd; 100% CWT; 5k PIT tag.
Stiles Pond Total					**194,082**					
Winthrop National Fish Hatchery										
	CO	UN	04/19/02	04/30/02	186,053	18.5	Winthrop Hatchery	Methow River	2000	17k CWT 5-45-27; 62k ad clip; 54k ad+CWT 9-33-26; 28; 52k CWT only 5-43-32.
Wintrhop National Fish Hatchery Total					**186,053**					
Yakama Tribe					**4,820,694**					
Above Bonneville Dam Total					**86,996,931**					

APPENDIX I

Transportation Proportion Tables

Transportation Proportion in 2002

Proportion of Lower Granite Dam forebay population destined to be transported in 2002.

Model to estimate proportion:

In the transportation proportion estimation procedure, the population of N smolts in Lower Granite Dam forebay is partitioned into X1 fish destined to be transported and X2 fish destined to migrate in-river. The proportion of fish in the transportation category is Pt =X1/N and the proportion of fish in the in-river category is (1-Pt)=X2/N. Below is the derivation of model for springtime migrants with three transportation dams – the procedure for summertime migrants is similar with the addition of a fourth transportation dam (McNary Dam).

The number of fish, x2, estimated to remain in-river below last transportation site for springtime migrants:

$$x2 = (((N*s1-t1)*s2-t2)*s3-t3) = N*s1*s2*s3 – t1*s2*s3 – t2*s3 –t3$$

where s1=survival from origin in Lower Granite Dam forebay to Lower Granite Dam tailrace
s2=survival from Lower Granite Dam tailrace to Little Goose Dam tailrace
s3=survival from Little Goose Dam tailrace to Lower Monumental Dam tailrace
t1=fish removed at Lower Granite Dam for transportation
t2=fish removed at Little Goose Dam for transportation
t3=fish removed at Lower Monumental Dam for transportation

To index x2 back to the starting population in Lower Granite Dam, X2, requires dividing by the survival estimate s1*s2*s3 from Lower Granite Dam forebay to Lower Monumental Dam tailrace.

$$X = x2/(s1*s2*s3) = N - t1/s1 - t2/(s1*s2) - t3/(s1*s2*s3)$$

The number of fish in the starting population destined to be transported then becomes

$$X1 = N-X2 = t1/s1 + t2/(s1*s2) + t3/(s1*s2*s3)$$

The proportion of fish in the starting population destined to be transported is

$$Pt = X1/N = t1/(N*s1) + t2/(N*(s1*s2)) + t3/(N*(s1*s2*s3))$$

The number of fish surviving to the tailrace of each dam is given by the following series of equations:

Lower Granite	N1 = N*s1
Little Goose	N2 = (N1-t1)*s2 = N1*(1-t1/N1)*s2
Lower Monumental	N3 = (N2-t2)*s3 = N2*(1-t2/N2)*s3 = N1*(1-t1/N1)*s2*(1-t2/N2)*s3

Substituting these equalities into the equation for Pt gives

$$Pt = t1/N1 + (1-t1/N1)*t2/N2 + (1-t1/N1)*(1-t2/N2)*t3/N3$$

Letting P1=t1/N1, P2=t2/N2, and P3=t3/N3 the equation for proportion of transport fish in Lower Granite Dam forebay destined for transportation becomes:

$$Pt = P1 +(1-P1)*P2 + (1-P1)*(1-P2)*P3$$

With McNary Dam transportation added the equation becomes:

$$Pt = P1 +(1-P1)*P2 + (1-P1)*(1-P2)*P3 + (1-P1)*(1-P2)*(1-P3)*P4$$

where P(J) = transport number / population number
= (transport proportion * collection) / (collection / collection efficiency)
= transport proportion * collection efficiency

The site-specific transport proportions P(J) are based on data from the run-at-large at each dam. These P1, P2, P3, and P4 proportions are computed using facility collection, transport, and population estimates for Lower Granite (J=1), Little Goose (J=2), Lower Monumental (J=3), and McNary (J=4) dams, respectively, and are presented in Tables I-1 through I-3 for yearling chinook, steelhead , and subyearling chinook, respectively. In 2002 there was no spring time transportation at McNary Dam. However, transportation did occur in the summer time, beginning June 26, small numbers of subyearling chinook were barged, with full scale barging operations begun July 16. The estimate of proportion of Snake River subyearling chinook "destined for transport" are presented both with and without McNary Dam considered in the model. This allows direct comparison with past years when only three transportation sites are used during the springtime, and a comparison of the amount of transportation added by McNary Dam for subyearling chinook originating above Lower Granite Dam in 2002. For subyearling chinook originating in the Mid-Columbia River basin, the transportation proportion is simply estimated by P4 above, and is presented in Table I-3.

The 2002 collection efficiency is estimated using the CSJ mark-recapture model on PIT tagged yearling chinook and steelhead released from the Salmon, Snake and Imnaha River traps in 2002. The 2002 collection efficiency for subyearling chinook was based on estimated FGE's derived from the 2000 release of PIT tagged subyearling chinook at Snake River basin fall chinook acclimation ponds.

TABLE I- 1. Yearling chinook model input data for 2002.

Site	Facility Collection	Estimated Population	Spill Proportion	Estimated Collection Efficiency	Collection Transport Proportion	P(J)
LGR (J=1)	1,537,299	6,900,000	0.375	0.22	0.973	0.216
LGS (J=2)	1,907,387	5,900,000	0.330	0.33	0.999	0.325
LMN (J=3)	2,214,728	5,300,000	0.003	0.41	0.967	0.401

TABLE I- 2. Steelhead model input data for 2002.

Site	Facility Collection	Estimated Population	Spill Proportion	Estimated Collection Efficiency	Collection Transport Proportion	P(J)
LGR (J=1)	1,698,933	7,100,000	0.347	0.24	0.960	0.230
LGS (J=2)	1,562,847	5,400,000	0.313	0.29	0.999	0.291
LMN (J=3)	1,754,304	4,200,000	0.022	0.42	0.977	0.409

The estimated percent of smolts arriving Lower Granite Dam forebay that were destined for transportation in 2001, including McNary Dam transportation, was approximately 68% for both yearling chinook and steelhead, and 93% for subyearling chinook (Table I-4). For smolts originating in the Mid-Columbia River basin, the estimated percent of smolts arriving McNary Dam forebay that were transported was approximately 24% for subyearling chinook.

TABLE I- 3. Subyearling chinook model input data for 2002.

Site	Facility Collection	Estimated Population	Spill Proportion	Estimated Collection Efficiency	Collection Transport Proportion	P(J)
LGR (j=1)	632,284	1,100,000	0.161	0.60	0.987	0.592
LGS (j=2)	292,124	500,000	0.130	0.60	0.996	0.598
LMN (j=3)	306,159	600,000	0.000	0.48	0.896	0.430
MCN (j=4)	5,414,497	8,700,000	0.306	0.62	0.386	0.239

TABLE I- 4. Estimated proportion destined for transportation in 2002.

Species- age group	Transport Proportion		
	Origin Snake R Basin above Lower Granite Dam		Origin Mid-Columbia R Basin
	Without McNary Dam transport	With McNary Dam transport	With McNary Dam transport
Yearling Chinook	0.683	N/A	N/A
Steelhead	0.677	N/A	N/A
Subyearling Chinook	N/A	0.929	0.239

Model without McNary Dam: Pt = P1 +(1-P1)*P2 + (1-P1)*(1-P2)*P3
Model with McNary Dam: Pt = P1 +(1-P1)*P2 + (1-P1)*(1-P2)*P3 + (1-P1)*(1-P2)*(1-P3)*P4
Model for Mid-Columbia R Basin fish: Pt = P4

The proportion of smolts transported in 2002 was much lower than in 2001 and fairly close to the number transported in three years prior to 2001.

TABLE I- 5. Comparison of the 2002 estimate of the proportion of Snake River Basin smolt population in Lower Granite Dam forebay that are "destined for transportation" and the corresponding estimates from 1998 to 2001. For yearling chinook and steelhead, the 2001 results exclude transport at McNary Dam to mimic conditions in the prior three years.

Species- age group	Transport Proportion[1]				
	2002	2001	2000	1999	1998
Yearling Chinook	0.683	0.980	0.71	0.777 (W) 0.862 (H)	0.66-0.81 (W) 0.69-0.77 (H)
Steelhead	0.677	0.986	0.81	0.825	0.69-0.83 (W) 0.72-0.85 (H)
Subyearling Chinook	0.929	0.962	0.93	0.870	0.91(W)

[1] In years 1999-2002, estimates of collection efficiency based on PIT tag data was used to generate a single annual estimate of proportion transported, while in 1998 assumed levels of high and low FGE and high and low spill effectiveness were used to generate a range for that year's estimate of proportion transported.

APPENDIX J

2002 System Operational Requests (SOR)

2002 System Operational Requests Summary

SORs are drafted and presented to the U.S. Army Corps of Engineers (COE) and Bonneville Power Administration (BPA) by the Salmon Managers. The Salmon Managers are state, federal and tribal entities with legally recognized mandates and jurisdictions to manage salmon resources in the Columbia River Basin. SORs are submitted in response to river, or project-specific operations and are intended to provide both juvenile and adult salmon with the most conducive migration conditions and survival opportunities possible.

The Fish Passage Center also posts System Operational Requests from Columbia River Inter-Tribal Fish Commission. Contact Kyle Martin at CRITFC.

SOR #	Date	Subject	Response of Action Agencies
#2002-8	10/30/02	Tailwater elevation at Bonneville Dam to protect natural spawning of chum and fall chinook salmon at the Ives/Pierce Island Complex and the I-205 seeps.	Partially Implemented
#2002-11 (CRITFC)	09/18/02	Operation of the Lower Columbia Pools for the Autumn 2002 Treaty Fishery	
#2002-10 (CRITFC)	09/12/02	Operation of the Lower Columbia Pools for the Autumn 2002 Treaty Fishery	
#2002-9 (CRITFC)	08/15/02	Operation of the Lower Columbia Pools for the Autumn 2002 Treaty Fishery	
#2002-7	08/13/02	August – September operation for Dworshak reservoir. Provide greater than minimum discharge from Dworshak to maintain the present thermal regime and try to achieve the water quality temperature standard in Lower Granite Reservoir into mid-September and monitor the adult passage response to this operation.	Implemented
#2002-6	07/18/02	Hungry Horse and Grand Coulee Summer Operations	Not Implemented
#2002-5	06/25/02	Brownlee Operations for Fall Chinook Migration	Not Implemented
#2002-8 (CRITFC)	06/26/02	Dworshak Summer Operations Plan	Not Implemented

#2002-4	05/21/02	Biological Opinion Flow Objective at Lower Granite Dam from May 22, 2002 through May 28, 2002 and Biological Opinion Flow Objective at McNary Dam from May 22 through June 2.	Partially Implemented
#2002-C7 (CRITFC)	05/15/02	Operation of the Lower Columbia Pools for the Spring 2002 Treaty Fishery	
#2002-3	05/14/02	Implement the NMFS Biological Opinion	Not Implemented
#2002-2	05/14/02	Implementation of the NMFS Biological Opinion and adherence to established procedures.	Implemented
#2002-C6 (CRITFC)	05/08/02	Operation of the Lower Columbia Pools for the Spring 2002 Treaty Fishery	Partially Implemented
#2002-C5 (CRITFC)	05/02/02	May 2002 Flows for Hanford Reach, Lower Snake and Lower Columbia	Partially Implemented
#2002-C4 (CRITFC)	04/30/02	Operation of the Lower Columbia Pools for the Spring 2002 Treaty Fishery	Partially Implemented
#2002-C3 (CRITFC)	04/23/02	Operation of the Lower Columbia Pools for the Spring 2002 Treaty Fishery	Partially Implemented
#2002-C2 (CRITFC)	04/12/02	Operation of the Lower Columbia Pools for the Spring 2002 Treaty Fishery	Partially Implemented
#2002-C1 (CRITFC)	04/02/02	Operation of the Lower Columbia Pools for the Spring 2002 Treaty Fishery	Partially Implemented
#2002-1	03/05/02	Spill and Flow at Bonneville Dam for the Spring Creek Hatchery Release	Alternate Implementation

The following pages include the SOR's summarized above. You may also go to our web-site for more information regarding SOR's at www.fpc.org.

SYSTEM OPERATIONAL REQUEST: #2002-1

[2] ***The following State and Federal Salmon Managers have participated in the preparation and support this SOR: Oregon Department of Fish & Wildlife, U.S. Fish & Wildlife Service, Columbia River Inter-tribal Fish Commission, Washington Department of Fish and Wildlife and The National Marine Fisheries Service.***

TO:	**BG Fastabend**	**COE-NWD**
	William Branch	**COE-Water Management**
	Cindy Henriksen	**COE-RCC**
	Witt Anderson	**COE-P**
	Col. Randall J. Butler	**COE-Portland District**
	LTC Wagenaar	**COE-Walla Walla District**
	J. William McDonald	**USBR-Boise Regional Director**
	Steven Wright	**BPA-Administrator**
	Greg Delwiche	**BPA-PG-5**

Raymond R Boyce

FROM: **Ron Boyce, Chairperson, Salmon Managers**

DATE: **March 5, 2002**

SUBJECT: **Spill and Flow at Bonneville Dam for the Spring Creek Hatchery Release**

SPECIFICATIONS: The Salmon Managers are requesting the following fishery operations at the Bonneville Project following the March 11 Spring Creek Hatchery tule fall chinook release:

1. No operation of unscreened units at Bonneville Powerhouse I or II and follow the tur bine operating priority in the Fish Passage Plan;
2. Operate Powerhouse II as first priority. Fully load PH II before operating PH I;
3. Operate PH II ice and trash sluiceway;
4. Operate turbine units within 1% of peak efficiency;
5. Operate juvenile and adult facilities according to criteria;
6. Provide an instantaneous flow of 170 Kcfs. Based on modeling by the USFWS, we estimate that a flow of 170 Kcfs is sufficient to allow approximately 100 Kcfs of spill 24 hours a day, while maintaining a maximum level of 105 % TDG (factored for depth compensation) at the Ives Island gage 3 and the highest elevation chum salmon redd on the Oregon shore.
7. Provide an initial spill level of 80 Kcfs, increasing to 100 Kcfs or more dependent on real-time TDG monitoring. Because of our desire to be conservative and provide maximum protection to the ESA listed chum salmon, we request that spill initially be pro-

vided at a level of 80 Kcfs. Spill is to be increased based on real-time TDG measurements collected by the USFWS. The USFWS will notify the project operator beginning the evening of March 11, 2002 if spill levels can be increased while not exceeding 105% TDG factored for depth compensation at the highest elevation chum redd. (At no time is spill to exceed 120% total dissolved gas measured at the Warrendale monitor as allowed under the dissolved gas waiver request to be considered by the Oregon Environmental Quality Commission on March 8.)

8. These operations are to begin at 2000 hours on March 11, 2002. If after five days of flow augmentation and spill operations it has been estimated that at least 85% of the release has passed Bonneville Dam, the operations may be terminated. If less than 85% of the release has passed Bonneville Dam after five days of operations, continue flow augmentation and spill for up to ten days or until an estimated 85% of the release has passed Bonneville Dam.
9. We recognize that based on the past few months' reservoir operations, reservoirs are presently near, or in some cases below, flood control rule curves. We request that the Action Agencies use the remaining flexibility in the system to accomplish this SOR without jeopardizing the April 10th rule curve elevations called for by the Biological Opinion.

JUSTIFICATION:

Spring Creek Hatchery is scheduled to release 7.8 million tule fall chinook on the morning of March 11, 2002. An additional release of this stock will occur during the spring migration season. The overall importance of this stock to ocean and Columbia River commercial, sport and tribal fisheries has been previously documented and recently reported in the Oregon Department of Environmental Quality request for a total dissolved gas waiver. The Spring Creek Hatchery fall chinook are an important buffer to ESA listed stocks present in ocean and Columbia River mixed stock fisheries.

The current performance of the Bonneville Project is significantly below fish passage standards. Therefore, spill is necessary to begin to achieve fish passage standards. Spill at Bonneville is also the safest route available for downstream migrating juvenile salmonids. Few adult migrants will be present during the time period associated with this spill. Furthermore, recent studies of radio tagged adult chinook salmon have shown that spill up to the dissolved gas limit has little potential to increase fall-back. These studies have also shown that some of the adult fish that fall back initially migrate well past Bonneville Dam before turning around and falling back past the project. These fish, which may fall back, need a safe passage route. Spill is presently the safest route for an adult fish to fall back past Bonneville Dam. By prioritizing PH II we expect to minimize usage of the Bradford Island adult ladder, which contributes the highest percentage of fall-back.

In order to protect the most sensitive developmental stages of juvenile fall chinook and chum salmon that are incubating downstream from Bonneville Dam in the Ives/Pierce Islands area and along the Oregon shore across from the Ives/Pierce areas, the total dissolved gas supersaturation levels over the redds should not exceed 105%. At the same time, the fishery agencies

and tribes wish to provide adequate spill protection for the Spring Creek Hatchery release. To ensure the protection of incubating juvenile fall chinook and chum salmon, while providing some protection for the Spring Creek Hatchery release, spill should be provided at approximately 100 Kcfs. We estimate the a spill of approximately 100 Kcfs will produce a total dissolved gas supersaturation level at, or below, the 105% TDG for the highest observed chum redd below Bonneville Dam. The flow from PH II is preferred because it provides a buffer between the more highly saturated spillway flow and the Ives/Pierce Islands area on the Washington shore, where most of the chum redds are located.

The distribution of chum redds this year is markedly different from past years. As a result, the level of uncertainty in predicting TDG at these new sites is greater and is the reason for adaptively managing spill above the 80 Kcfs level. Spill should be provided above 100 Kcfs if in-season monitoring confirms that TDG of 105% over the redds will not be exceeded. If this SOR cannot be implemented as requested, please provide a written response to the Fish Passage Advisory Committee documenting the rationale for the actions taken.

SYSTEM OPERATIONAL REQUEST: #2002-2

[2] *The following State and Federal Salmon Managers have participated in the preparation and support this SOR: Oregon Department of Fish & Wildlife, U.S. Fish & Wildlife Service, Columbia River Inter-tribal Fish Commission, Washington Department of Fish and Wildlife, Idaho Department of Fish and Game and The National Marine Fisheries Service.*

TO:	**BG Fastabend**	**COE-NWD**
	William Branch	**COE-Water Management**
	Cindy Henriksen	**COE-RCC**
	Witt Anderson	**COE-P**
	Col. Randall J. Butler	**COE-Portland District**
	LTC Wagenaar	**COE-Walla Walla District**
	J. William McDonald	**USBR-Boise Regional Director**
	Steven Wright	**BPA-Administrator**
	Greg Delwiche	**BPA-PG-5**

Raymond R. Boyce

FROM: **Ron Boyce, Chairperson, Salmon Managers**

DATE: **May 14, 2002**

SUBJECT: Implementation of the NMFS Biological Opinion and adherence to established procedures.

SPECIFICATIONS:

- § Implement the NMFS 2000 Biological Opinion spill levels.
- § Follow the existing protocol to be used during a NW or SW Reliability Event.

JUSTIFICATION:

There is broad regional agreement among state, federal and tribal fish and wildlife management agencies that spill is the safest and most effective mitigation means to pass fish around hydroelectric projects on the Snake and Columbia rivers. A significant volume of spill passage studies provides the basis for this agreement.

Thus far in the 2002 spring migration period, migration flows have been far below the NMFS

flow objectives. Analysis at John Day Dam in 2001 has shown that spill is effective in increasing juvenile fish survival even under low flow conditions. Meeting the NMFS Biological Opinion spill for fish passage levels is important under any flow conditions.

An emergency action list is part of existing TMT procedures. The intent of the list is to provide operators with a sequence of actions to take in the event that operators experience a Northwest or a Southwest system reliability event. This sequence includes curtailing the implementation of Biological Opinion measures. The interruption of fish protection measures are well below other steps to be taken and should not be utilized as the first response mechanism.
On May 13 at 2000 hours, spill for fish passage was reduced below the NMFS Biological Opinion levels for one hour at John Day Dam to meet load due to a daily draft limitation at Grand Coulee Reservoir. These kinds of fluctuations in the system are not true emergencies and the interruption of Biological Opinion measures, particularly under the present environmental conditions, is not consistent with procedures in place.

SYSTEM OPERATIONAL REQUEST: #2002-3

[2] *The following State and Federal Salmon Managers have participated in the preparation and support this SOR: Oregon Department of Fish & Wildlife, U.S. Fish & Wildlife Service, Columbia River Inter-tribal Fish Commission, Washington Department of Fish and Wildlife, Idaho Department of Fish and Game and The National Marine Fisheries Service.*

TO:	**BG Fastabend**	**COE-NWD**
	William Branch	**COE-Water Management**
	Cindy Henriksen	**COE-RCC**
	Witt Anderson	**COE-P**
	Col. Randall J. Butler	**COE-Portland District**
	LTC Wagenaar	**COE-Walla Walla District**
	J. William McDonald	**USBR-Boise Regional Director**
	Steven Wright	**BPA-Administrator**
	Greg Delwiche	**BPA-PG-5**

Raymond R Boyce

FROM: **Ron Boyce, Chairperson, Salmon Managers**

DATE: **May 14, 2002**

SUBJECT: Implementation of the NMFS Biological Opinion

SPECIFICATIONS: Provide at least the minimum juvenile fish migration flows specified in the NMFS 2000 Biological Opinion at McNary and Lower Granite Dams, utilizing Grand Coulee, Dworshak and Brownlee operations.

§ Meet Biological Opinion flow objectives through drafting of Grand Coulee Reservoir and utilizing the options of reshaping outflows from other storage reservoirs to provide higher flows at Lower Granite Dam and McNary Dams.

JUSTIFICATION:
The re-shaping of outflows and drafting of reservoirs is needed to meet Biological Opinion flow objectives. Presently, flows are below the NMFS Biological Opinion flow objectives and objectives have not been met for most of the spring migration period in the Snake and Columbia rivers. Several discussions have occurred relative to the need to improve migration conditions. However, to-date reservoir operators have declined to reshape runoff volumes to provide migration flows for juvenile steelhead and chinook salmon. Migration flow conditions have resulted

in lower flows in the Mid Columbia and Snake Rivers at this time of the year than in the last five years, except for the extremely low flows of 2001 (Figures 1 and 2). The chinook and steelhead migration is underway and has demonstrated delayed timing and passage distributions. Spring migrating juvenile chinook and steelhead experienced the poorest migration conditions in recent history in 2001, which resulted in the lowest in-river juvenile survivals in recent record. Because juvenile salmon outmigrants from a particular year return in several year classes, two subsequent years of poor outmigration conditions will seriously impact adult returns for several years.

An abundance of smolt monitoring travel time data exists. There is regional agreement that there is a flow/travel time relation for spring migrating steelhead and chinook salmon. Smolt monitoring data for 2002 shows that the low flows which have occurred in the Snake River are delaying the arrival of yearling chinook and steelhead at Lower Granite Dam and together with lower river flows have lengthened the travel time of smolts from Lower Granite Dam to the mouth of the Columbia River. Based on the historic cumulative passage timing plot, the number of yearling chinook and steelhead appears to be less than half of what is expected, through May 12. Historically, the current proportion of the run of yearling chinook would have occurred 15 days ago, and that of steelhead 10 days ago. Smolts have been currently migrating at flows averaging 67 kcfs since the historic 10% passage dates at Lower Granite Dam when Biological Opinion flows should have been 97 kcfs. At present flows the additional travel time expected based on the flow-travel time relation presented in the FPC 2001 annual report, is on average, approximately 5 days for yearling chinook and 6 days for steelhead. Together the delayed arrival into the hydro system and longer travel time of in-river migrating smolts through the hydro system will cause these in-river migrating smolts to reach the mouth of the Columbia River about 20 days later for yearling chinook and 16 days later for steelhead than their average ocean entry period (Figures 3 and 4).

In addition smolt-monitoring personnel at the Lewiston trap have reported a decrease in spring migrant steelhead condition. Past data has shown that steelhead are particularly sensitive to flow conditions and may residualize if migration is delayed.

The attached Memorandum (Attachment 1) of discussions held on May 7, illustrate that a more flexible approach to the operation of Grand Coulee project is possible, with a draft below elevation 1240 feet, which would increase flows at McNary Dam while protecting cultural resources of the Spokane and Colville Tribes. This operation is consistent with anticipated operations in the NMFS Biological Opinion, which states “meeting the spring flow objectives occasionally requires reservoir drafting.”

Options exist for managing outflows and drafting reservoirs to increase flows at Lower Granite Dam. Review of the information available for the Dworshak project (Attachment 2) indicates

that flexibility exists to improve the migration conditions in the Snake River for most of May. Project inflows and run off volume information indicates that Dworshak could operate at a flow level of at least 10 Kcfs through most of May, and then reduce outflow in June to minimum while still meeting refill requirements of the Biological Opinion. (CRITFC and the Nez Perce Tribe support the operation of Dworshak in this manner if a high degree of certainty of refill by June 30th can be maintained.)

The Brownlee reservoir is currently (5-13-02, midnight) only 8.6 feet from its full pool elevation. Brownlee outflows over the past week have averaged several Kcfs below inflows: therefore, if Brownlee were to simply pass inflows or provide a moderate draft, several Kcfs of water could be added to Lower Snake and Columbia River flows.

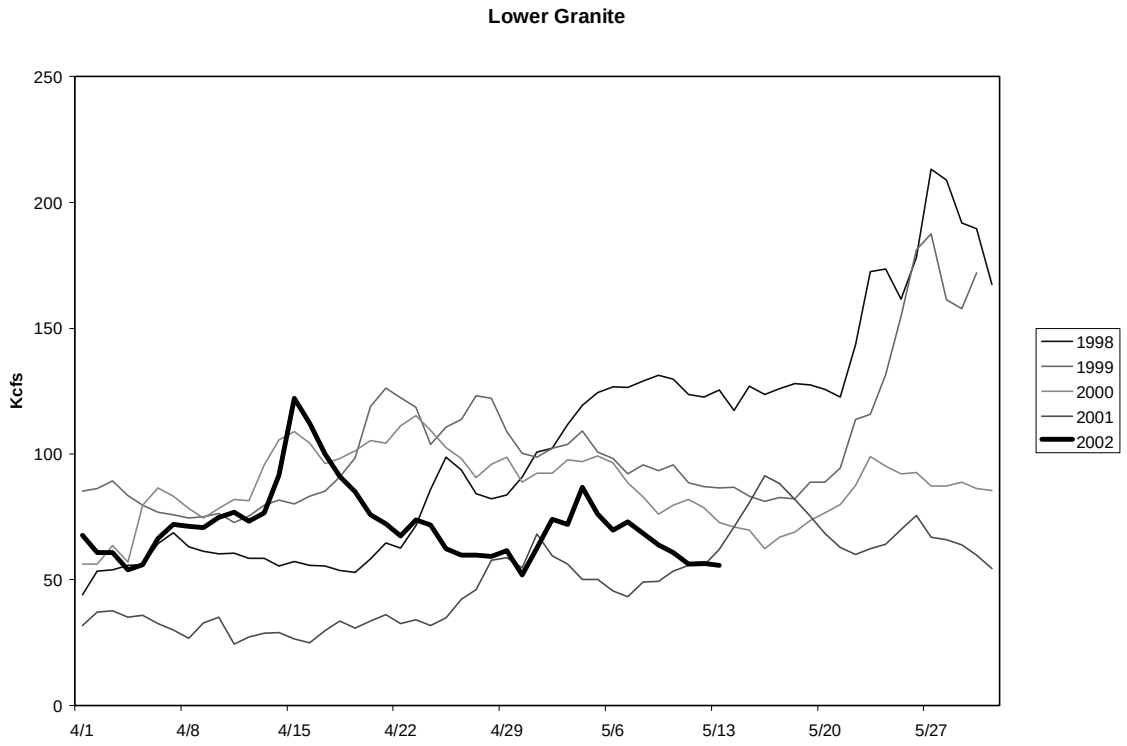


Figure 1. Lower Granite Flows over the last five years.

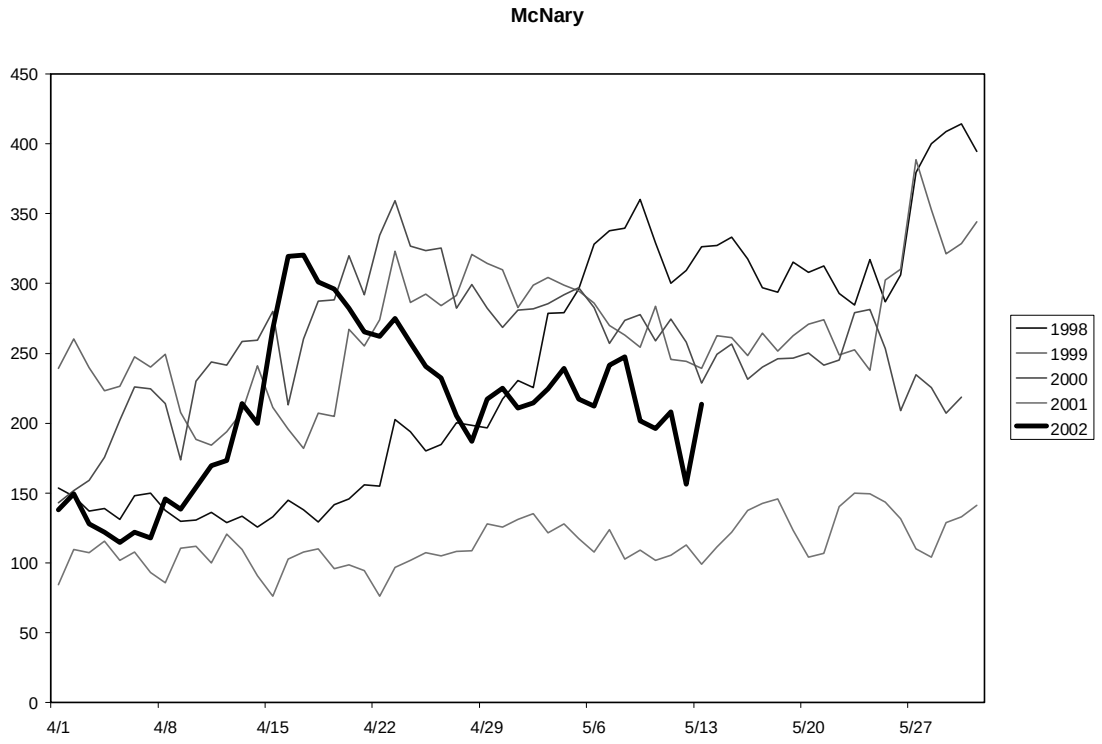
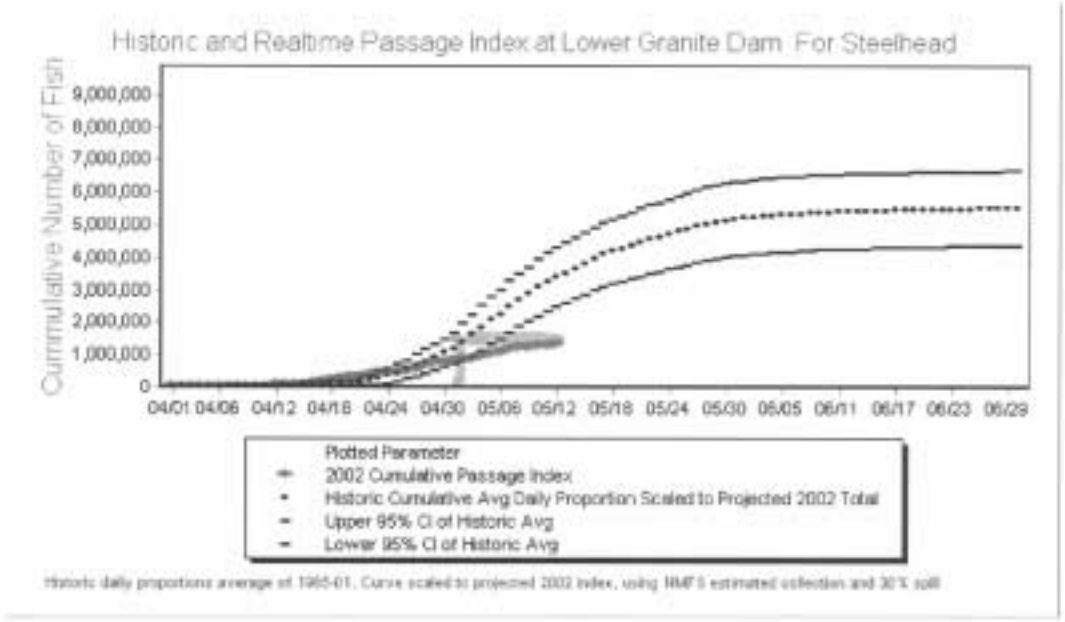


Figure 2. McNary Flows over the last five years.



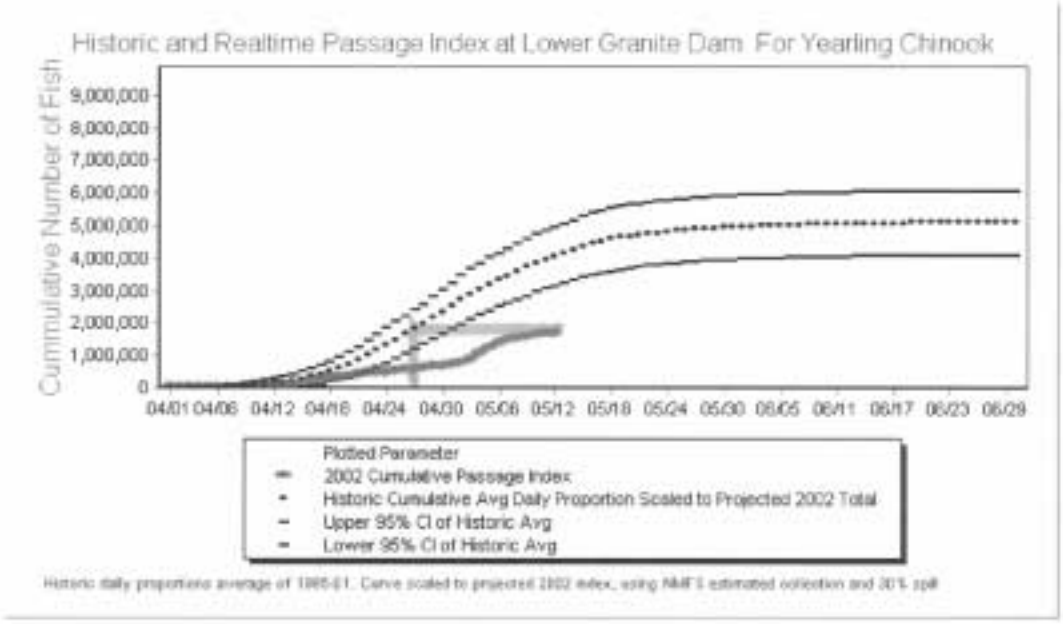


Figure 3. Projected migration delay for Snake River chinook and steelhead.

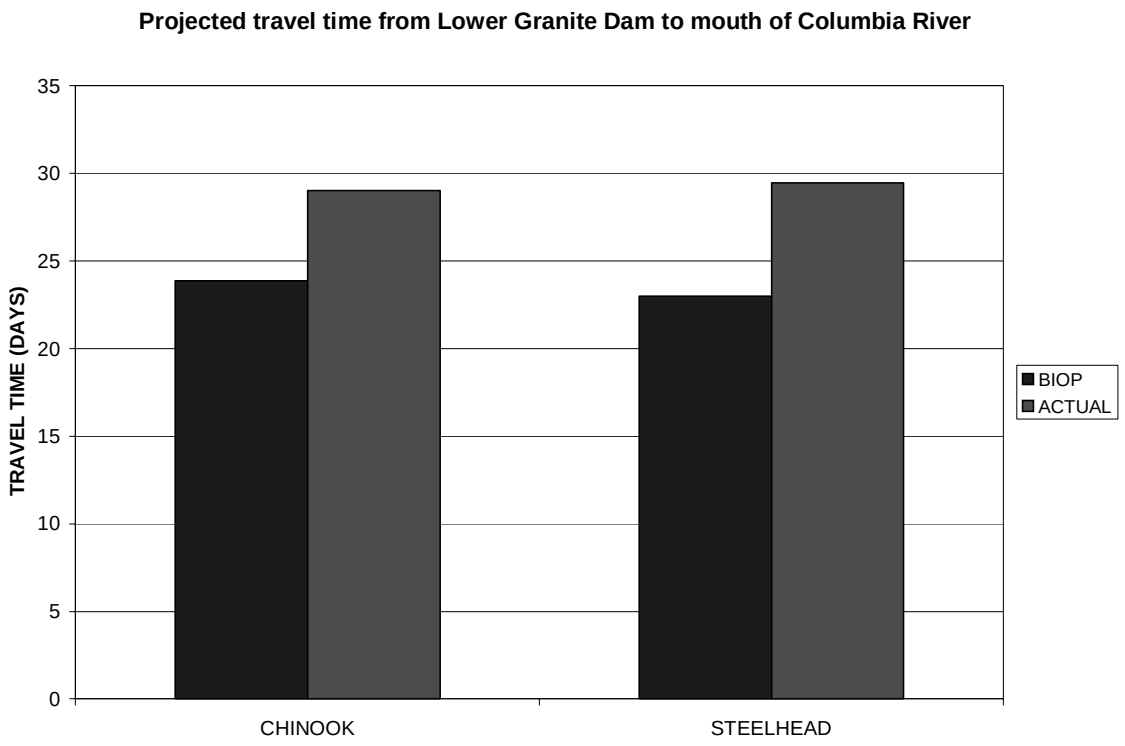


Figure 4. Increase in salmonid travel time at lower flows.

FISH PASSAGE CENTER

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MEMORANDUM

TO: Jim Fodrea, USBR

FROM: Fish Passage Advisory Committee

DATE: May 10, 2002

RE: Operations of Grand Coulee Reservoir

On May 7, 2002 a joint FPAC and CBFWA Members Management group meeting was held to discuss the current and proposed operations of Grand Coulee project, reservoir elevations and operations. An attendance list is attached.

The group discussed potential solutions to the 1240-foot draft limitation being maintained by the USBR. Because of the cooler than normal weather causing a delay in runoff, the migration flows at McNary Dam have been much lower than the NMFS 2000 Biological Opinion flow target. The USBR has taken and maintained the position that the reservoir should not be drawn down below elevation 1240 feet, even though the runoff volume forecast is large enough to project refill by June 30 with a high degree of certainty. Concern has been heightened since the reservoir actually filled slightly over the past week, while flows at McNary were far below the flow target (see attached memo to FPAC).

Tribal cultural resources representatives from the Colville and Spokane tribes addressed the issue of protection and survey of tribal burial and cultural sites. The tribal representatives explained that they had contracts with the USBR to implement archeological and security surveys of the sites exposed as the reservoir is drafted. The contract that is in place at the present time is limited to surveys that would take place as the reservoir is drafted to elevation 1240 feet. Tribal representatives explained that contract modifications would be required to cover additional costs, of surveys and security patrols if the reservoir is drafted below elevation 1240 feet.

After discussion the state, federal and tribal representatives present agreed to support additional USBR funding through contract modifications to continue to conduct additional archeological surveys and security patrols. The group agreed that the additional funding should be provided to allow the reservoir to draft to elevation 1240 feet through this week and then to elevation 1235 to support fish migration flows at Priest Rapids and McNary dams, although the group recognized that this would likely not provide the flow target flows. The purpose of this operation is to improve migration flows through the mid-Columbia Reach and at McNary Dam by reshaping the timing of flows through the spring migration. The proposed shaping operation would also reduce the likelihood of a high flow event in the Columbia River later in May or early June that could result in high forced spill conditions and exceedence of the state water quality gas variances throughout the river.

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MEMORANDUM

TO: Michele DeHart/Margaret Filardo

FROM: David A. Benner

DATE: May 14, 2002

RE: Dworshak Flow Augmentation

The USACE has provided a volume forecast for the Dworshak reservoir, updated on May 13th, 2002, available on the TMT web page (see attachment). According to this forecast, three April-June water supply forecast scenarios are possible, each with varying degrees of confidence (30, 50, and 70). According to this plot, a water supply of 2965 Kaf has a 70% confidence of occurring; this is the "worst case" scenario that USACE provides on their plot. From USACE calculations, 267 Kaf of water would be available to augment flows (assuming the WSF was 2965 Kaf) from May 13th to June 30th. The 267 Kaf of available water assumes that the entire period would contain a minimum outflow of 1.5 Kcfs and Dworshak would fill. Based on this flow augmentation volume, the following operations scenario has been developed:

Minimum outflows = 2 kcfs from May 13th to June 30th
All extra available water used in last 14 days of May

To bring minimum outflows to 2 Kcfs, the following volume of water would be needed:

Need an additional 0.5 kcfs (above the 1.5 Kcfs) to reach 2.0 Kcfs
May 14th to June 30th = 48 days

0.5 Kcfs = 500 cfs = 43200000 cfd * 48 days = 47603 acre-feet = 47.6 Kaf

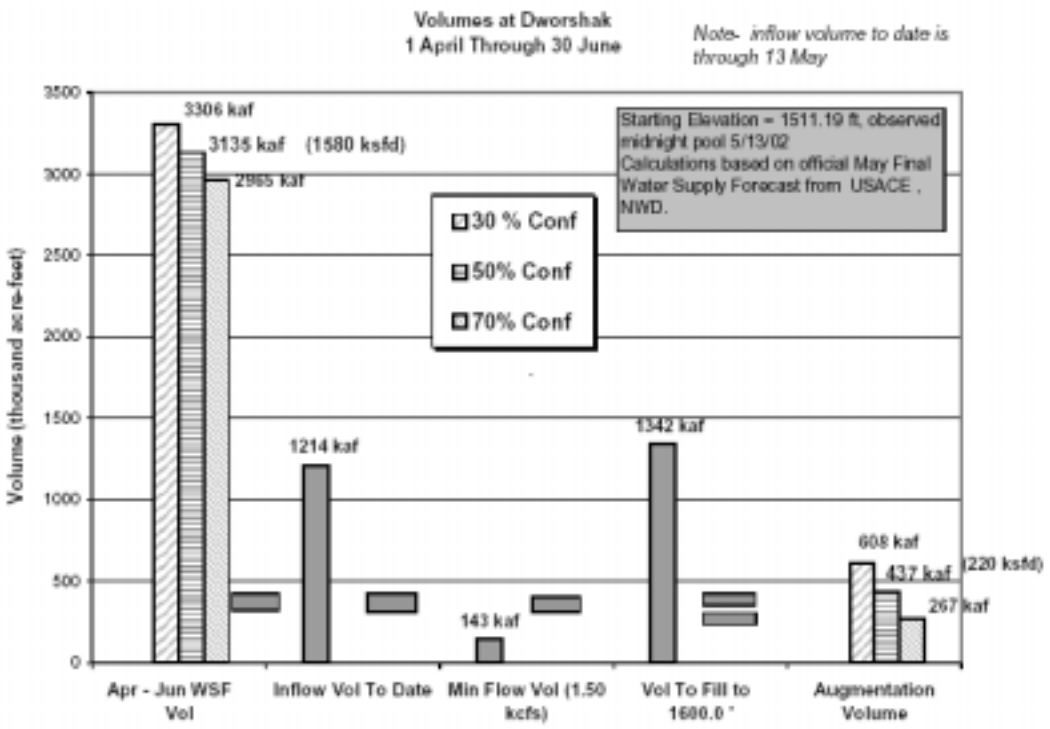
267 Kaf (augmentation volume) – 47.6 Kaf (volume to bring outflows to 2.0 Kcfs) =

= 219.4 Kaf
(Available for last two weeks in May)

219.4 Kaf / 14 days =
= 15.67 Kaf/d = 15671 acre-feet/day = 682647429 cfd =

7901 cfs =
7.9 Kcfs

Therefore, if the above scenario were implemented, a continuous outflow of 9.9 Kcfs (7.9 Kcfs + minimum outflow of 2.0 Kcfs) would be available at Dworshak for the last two weeks in May. It should be pointed out that this is the worst-case water supply scenario that USACE presented in their volume forecast plot. If the best-case scenario were used, 20.2 Kcfs of additional water, beyond the minimum flow of 2.0 Kcfs, would be available in the last two weeks of May.


Volumes at Dworshak
1 April Through 30 June
Note- inflow volume to date is through 13 May
Starting Elevation = 1511.19 ft, observed midnight pool 5/13/02
Calculations based on official May Final Water Supply Forecast from USACE , NWD.
30 % Conf
50% Conf
70% Conf
3306 kaf
3135 kaf (1580 ksfd)
2965 kaf
1214 kaf
143 kaf
1342 kaf
608 kaf
437 kaf (220 ksfd)
267 kaf
Volume (thousand acre-feet)
3500
3000
2500
2000
1500
1000
500
0
Apr - Jun WSF Vol
Inflow Vol To Date
Min Flow Vol (1.50 kcfs)
Vol To Fill to 1600.0 '
Augmentation Volume

SYSTEM OPERATIONAL REQUEST: #2002-4

[2] ***The following State, Tribal and Federal Salmon Managers have participated in the preparation and support this SOR: U.S. Fish & Wildlife Service, National Marine Fisheries Service, Oregon Department of Fish & Wildlife, Idaho Department of Fish and Game, Columbia River Inter Tribal Fish Commission, Nez Perce Tribe and the Washington Department of Fish and Wildlife.***

TO:	**BG. Fastabend**	**COE-NWD**
	William Branch	**COE-Water Management**
	Cindy Henriksen	**COE-RCC**
	Witt Anderson	**COE-P**
	Col. Randall J. Butler	**COE-Portland District**
	LTC Wagenaar	**COE-Walla Walla District**
	J. William McDonald	**USBR-Boise Regional Director**
	Steven Wright	**BPA-Administrator**
	Greg Delwiche	**BPA-PG-5**

Raymond R. Boyce

FROM: **Ron Boyce, Chairperson, Salmon Managers**

DATE: **May 21, 2002**

SUBJECT: Biological Opinion Flow Objective at Lower Granite Dam from May 22, 2002 through May 28, 2002 and Biological Opinion Flow Objective at McNary Dam from May 22 through June 2.

SPECIFICATIONS:

Beginning Immediately:

- Adjust Dworshak outflows in accordance with flows recorded at Lower Granite Dam above the 97 Kcfs Biological Opinion flow objective.

Begin passing inflows at the Brownlee Reservoir to meet the Biological Opinion flow objective of 97 Kcfs at Lower Granite Dam.[1]

- Meet the Biological Opinion flow objective of 246 Kcfs at McNary Dam. This operation includes the potential drafting of Grand Coulee to 1237 feet and the incorporates the US Bureau of Reclamation agreement on May 15th to not fill Grand Coulee above 1240 feet if the flow objective of 246 Kcfs at McNary Dam is not being met.

1. IDFG would not object to Idaho power Company's voluntary participation.

Natural flows have increased over the last several days at the Lower Granite Dam and are predicted to remain relatively high for a brief period of time. Last week, in response to SOR 2002-3, TMT decided to limit Dworshak outflows to a 10 Kcfs minimum, as opposed to dropping outflows to the 1.5 Kcfs minimum. Due to predicted increasing flows above the Lower Granite Dam, we are requesting that the refill of the Dworshak reservoir be managed to maintain the NMFS Biological Opinion flow objective of 97 kcfs at Lower Granite. This proposal is designed to both take advantage of the runoff to refill the Dworshak reservoir and improve migration conditions for salmon and steelhead. The following operation is suggested:

> When flows at Lower Granite exceed the 97 Kcfs flow target, adjust outflow at Dworshak in accordance with the level at which the flow target is exceeded at Lower Granite, down to the minimum flow of 1.5 Kcfs. For example, if flows at Lower Granite exceed the 97 Kcfs flow target by 6.0 Kcfs, outflows at Dworshak could be lowered to 4.0 Kcfs. Conversely, if flows at Lower Granite Dam are below 97 Kcfs the outflow at Dworshak would be increased to meet the 97 Kcfs Biological Opinion flow target up to a maximum outflow of 10 Kcfs at Dworshak.

Flows at McNary continue to be very low. Last week, TMT agreed (5-15-02) to draft Grand Coulee down to 1237 feet AMSL to meet a 220 Kcfs minimum flow at McNary with the goal of meeting the Biological Opinion flow objective of 246 Kcfs. Since this time, average daily flows have not met the 220 Kcfs minimum at any time (average over the period from 5-15-02 to 5-19-02 was 209.6 Kcfs). The operation discussed at last week's TMT meeting was to draft Grand Coulee to a minimum of 1237 feet AMSL to provide a minimum average daily flow of 220 Kcfs[2] at McNary, and not fill above 1240 feet at Grand Coulee if the 246 Kcfs is not being met.

While flows in the lower Snake and Columbia rivers remain low, the Brownlee Reservoir continues to refill. As of midnight on 5-20-02, Brownlee was at an elevation of 2073.8 feet AMSL, 3.2 feet from full. It is proposed that Brownlee immediately stop refilling and begin passing inflow.

JUSTIFICATION:

The NMFS Biological Opinion flow targets have not been met for the entire spring migration period in the Snake and Columbia Rivers. Throughout the spring period, reservoir operators have provided minimal reshaping of runoff volumes, which has not been successful in achieving Biological Opinion migration flows for juvenile steelhead and chinook salmon.

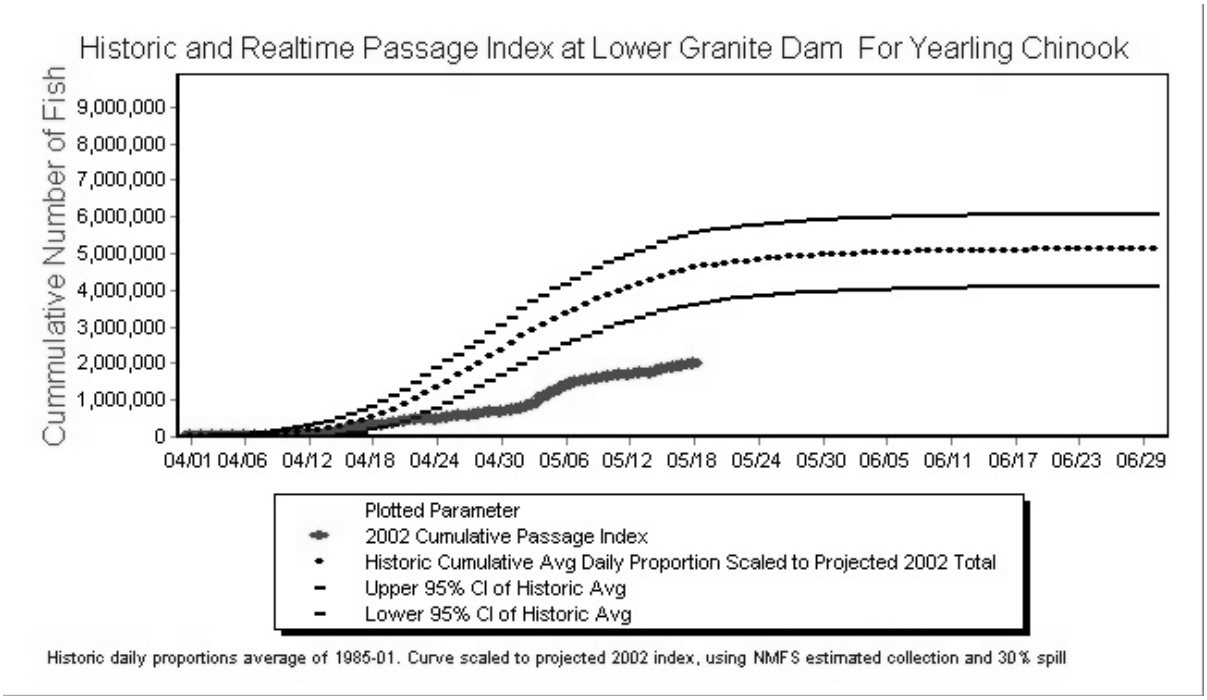
The attached cumulative passage plots of the Lower Granite and McNary dams illustrate the current passage pattern and distribution. From inspection of these plots, the influence of low river flows on delay, passage distribution, and passage magnitude is clear.

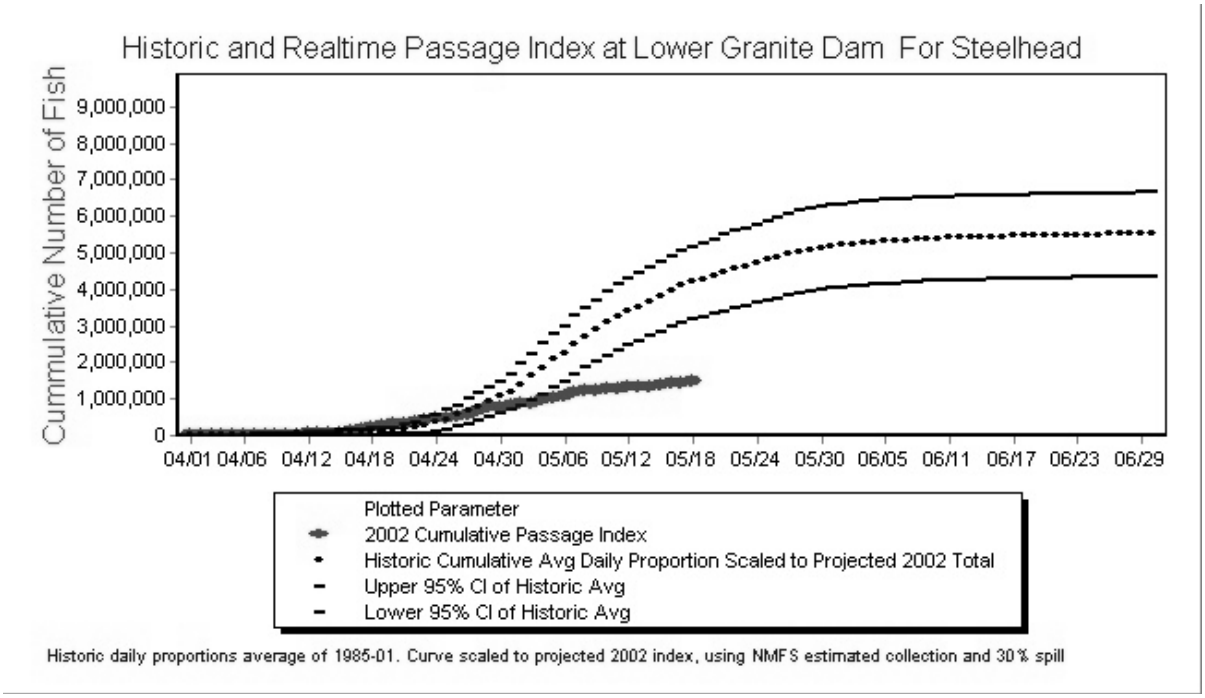
Yearling chinook and steelhead smolt passage indices at Lower Granite Dam have oscil-

---

2. It should be noted that the 220 Kcfs minimum flow objective at McNary is well below the BiOp objective of 246 Kcfs.

lated over the last 15 days in response to changes in river flows. Between May 4 to 8, daily average flows were 75 Kcfs, dropping to 59 Kcfs during the next five days, and rising again to 67 kcfs during May 14 to 18. During these same 5-day intervals, yearling chinook passage indices have averaged 137,000 fish, dropping to 37,000 fish, and rising to 52,000 fish. In the two days of May 18 and 19, yearling chinook passage indices have risen above 70,000 fish, so greater numbers of yearling chinook are passing Lower Granite Dam again. A similar trend has been recognized with steelhead. Between May 4 to 8, steelhead passage indices averaged 66,000 fish, dropping to 24,000 fish during the next five days, and rising slightly to 28,000 fish during the 5-day interval ending May 18. In the two days of May 19 and 20, steelhead passage indices have risen again to levels above 60,000 fish. Increased passage indices have also been seen at Little Goose Dam during the past few days. Little Goose Dam saw a large passage day on May 18 with 211,000 yearling chinook smolts and on May 20 with 130,000 steelhead smolts. Overall, there appear to be large numbers of Snake River basin yearling chinook and steelhead still in the river between Lower Granite and McNary Dam at this time and increases in flow would be beneficial to move these fish out of the Snake River and into the lower Columbia River before the end of the month.




Historic and Realtime Passage Index at Lower Granite Dam For Steelhead
Cummulative Number of Fish
9,000,000
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
04/01 04/06 04/12 04/18 04/24 04/30 05/06 05/12 05/18 05/24 05/30 06/05 06/11 06/17 06/23 06/29
Plotted Parameter
2002 Cumulative Passage Index
Historic Cumulative Avg Daily Proportion Scaled to Projected 2002 Total
Upper 95% CI of Historic Avg
Lower 95% CI of Historic Avg
Historic daily proportions average of 1985-01. Curve scaled to projected 2002 index, using NMFS estimated collection and 30% spill

SYSTEM OPERATIONAL REQUEST: #2002-5

- *The following State, Tribal and Federal Salmon Managers have participated in the preparation and support this SOR: U.S. Fish & Wildlife Service, National Marine Fisheries Service, Oregon Department of Fish & Wildlife, Columbia River Inter Tribal Fish Commission, Nez Perce Tribe and the Washington Department of Fish and Wildlife. ***

TO:	**Jan B. Packwood, CEO,**	**Idaho Power Company**
	J. Ric Gale,	**VP Regulatory Affairs, IPC.**
	Ann Miles	**FERC, Hydro relicensing**
	BG. Fastabend	**COE-NWD**
	William Branch	**COE-Water Management**
	Cindy Henriksen	**COE-RCC**
	Witt Anderson	**COE-P**
	Col. Randall J. Butler	**COE-Portland District**
	LTC Wagenaar	**COE-Walla Walla District**
	J. William McDonald	**USBR-Boise Regional Director**
	Steven Wright	**BPA-Administrator**
	Greg Delwiche	**BPA-PG-5**

Raymond R. Boyce

FROM: **Ron Boyce, Chairperson, Salmon Managers**

DATE: **June 25, 2002**

SUBJECT: **Brownlee Operations for Fall Chinook Migration**[3]

SPECIFICATIONS:

- Draft Brownlee reservoir to shape USBR water which will not pass through Brownlee until after July 31 to assist in meeting the July/early August flow objective at Lower Granite Reservoir. This draft will likely be between 150 and 215 kaf (elevation 2066' to 2061' from full pool) by July 31. This volume of pass through and draft should total between 300 and 427 kaf of USBR water from the Upper Snake River basin..
- Draft an additional 137 KAF of water volume by August 10, to assist in meeting the summer flow objective of 51 kcfs at Lower Granite, pursuant to the current Northwest Power Planning Council Fish and Wildlife Program draft from Brownlee Reservoir.

3. This recommendation is limited to 2002. It should not be construed as fulfilling the Idaho Power Company's obligations under the Endangered Species Act.

- Draft the remainder of the Northwest Power Planning Council required volume from Brownlee reservoir, 100 KAF during the rest of August to assist in meeting the summer flow objective of 51 kcfs at Lower Granite Reservoir.
- It would be most beneficial for salmon to begin refill at Brownlee after August 31.
- Flow augmentation should be provided in a manner to avoid adverse impacts to water quality and other fish and wildlife resources.
- USBR should take all reasonable effort to deliver water held as powerhead for Anderson Ranch, Palisades, and Minidoka to minimize the deficit between the 427 KAF and actual deliveries.

** The Idaho Department of Fish and Game has reviewed the proposed operation and the technical rationale and support data for the proposal. IDFG agrees that the data and analysis clearly show the benefit of flow and temperature on fall chinook survival. IDFG agrees that the proposed operation will benefit juvenile fall Chinook survival.

JUSTIFICATION:

The importance of flows and water temperature for summer migrating chinook salmon has been well documented. Analysis based upon multiple regression models, indicate that downstream migration rates for Snake River fall chinook salmon would decrease from 0.1 to 0.2 km/day if summer flow augmentation was not implemented. This translates to the average fish taking from 1 to 5 days longer to pass Lower Granite Dam without the aid of summer flow augmentation.

Additional analysis indicated that summer flow augmentation increased survival of fall chinook salmon smolts by up to 24 percent. In recent analysis[4] to determine the factors affecting survival of wild Snake River fall chinook salmon the predictor variables flow and water temperature were not correlated and both variables entered into a multiple regression model fit to describe survival. Flow and temperature explained 92.3% of the observed variability in survival. Based on this regression model survival was predicted to change by approximately 3% with each change of 3.5 kcfs (100 $m^{3/s}$) in flow when temperature was held constant. The change in survival was approximately 7% for each 1o C. increase or decrease in temperature when flow was held constant. Connor concluded that flow and temperature influence survival simultaneously.

Recent passage timing of juvenile fall chinook migrants, with the present configuration of reservoir storage and run-of-river hydroelectric projects and irrigation withdrawals is provided in the attached plots. The attached memorandums describe recent juvenile fall chinook timing in the Snake and Lower Columbia Rivers. These recent passage data support the requested utilization of migration flow augmentation from the Hells Canyon Complex.

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4. Connor, W. P. 2001. Juvenile life history, downstream migration rate, and survival of wild Snake River fall chinook salmon. PH.D. Dissertation. University of Idaho, Moscow, Idaho.

The USBR volume is presented as a range not less than 300 kaf for 2002. The 300 kaf volume does not meet the requirements of the NWPPC fish and wildlife program and does not meet Biological Opinion flow objectives. With IPC shaping, the 300 kaf will provide flow through early August. The attached plot of wild fall Chinook passage shows that significant passage of wild fall Chinook occurs in the Snake River in August and into September. Volume in addition to 300 KAF is needed from Upper Snake River reservoirs to provide passage flow mitigation for August juvenile migrants. NMFS' Biological Opinion and the NWPPC Fish and Wildlife program call for the USBR to provide up to 427 kaf of volume from Upper Snake River reservoirs. The volumes and flow targets were not achieved in 2001. The fisheries managers seek to avoid the effect of sequential years of not providing mitigation measures and potentially serious adverse affecting migrating fall chinook. We urge the USBR to make best efforts to provide the full volume of 427 KAF.

SYSTEM OPERATIONAL REQUEST: #2002-6

- The following State and Federal Salmon Managers have participated in the preparation and support this SOR: U.S. Fish & Wildlife Service, Oregon Department of Fish & Wildlife, Idaho Department of Fish and Game, and the Columbia River Inter Tribal Fish Commission

TO:	**BG. Fastabend**	**COE-NWD**
	William Branch	**COE-Water Management**
	Cathy Hlebechuk	**COE-RCC**
	Witt Anderson	**COE-P**
	Col. Randall J. Butler	**COE-Portland District**
	LTC Wagenaar	**COE-Walla Walla District**
	J. William McDonald	**USBR-Boise Regional Director**
	Steven Wright	**BPA-Administrator**
	Greg Delwiche	**BPA-PG-5**

FROM: **Ron Boyce, Chairperson, Salmon Managers**

DATE: **July 18, 2002**

SUBJECT: **Hungry Horse and Grand Coulee Summer Operations**

SPECIFICATIONS: The Salmon Managers are requesting the following operations be implemented at the Grand Coulee and Hungry Horse projects during August and September of 2002 to aid in the migration of summer anadromous fish and, to benefit bull trout and other resident species in the Flathead River.

1. Release water from Hungry Horse at a rate of 5 Kcfs. Transitional flows from August into September should be relatively smooth and reflect a receding hydrograph.
2. Pre-draft a volume of water from the Grand Coulee Reservoir in August that is equivalent, but not to exceed 150 Kaf, to the volume of water from Hungry Horse Reservoir that will not be discharged by the end of August (of the 20 feet designated from Hungry Horse that is reserved for summer flow augmentation under the NMFS 2000 Biological Opinion).
3. During the beginning of August draft this water as necessary to meet the Biological Opinion flow objectives at McNary. Drafting should begin when flows begin to drop below 200 Kcfs at McNary.
4. Refill the Grand Coulee reservoir in September with the volume of water from Hungry Horse that is equivalent to the volume pre-drafted from Grand Coulee in August.

5. If this SOR is not implementable, draft full Biological Opinion volume from Hungry Horse by August 31.
6. In addition, as per the 2000 NMFS Biological Opinion, reduce the volume of water pumped into Bank's Lake from Grand Coulee (Lake Roosevelt) by 130 KAF (volume of water in normal operating range). Draft this volume of water directly from Grand Coulee to augment flows during the summer migration period, extending the time during which the flow objectives at McNary Dam are met.

JUSTIFICATION:

The 2000 NMFS Biological Opinion (page 9-63) states that:

> "The Action Agencies shall limit the reservoir draft to elevation 3,540 feet by August 31 for salmon flow augmentation. BOR shall coordinate drafts for salmon with NMFS, USFWS, the Action Agencies, and other entities through the in-season management process. As a guideline for salmon flow augmentation releases during July and August, Hungry Horse may be operated in a manner that reduces impacts to other listed species while also releasing water to meet salmon flow objectives. Reduction in a second flow peak operation may be achieved by discharging water earlier, or at a more constant rate, to provide the full volume available for salmon."

This operation is consistent with the Biological Opinion. Pre-drafting Grand Coulee will allow releases from Hungry Horse to be constant, while at the same time utilizing the water from Hungry Horse reserved for salmon flow augmentation during fall chinook summer migration.

SYSTEM OPERATIONAL REQUEST: #2002-07

- The following State, Federal, and Tribal Salmon Managers have participated in the preparation and support this SOR: U.S. Fish & Wildlife Service, National Marine Fisheries Service, Idaho Department of Fish and Game, Columbia River Inter Tribal Fish Commission, Nez Perce Tribe, and the Washington Department of Fish and Wildlife.

TO:	**BG. Fastabend**	**COE-NWD**
	William Branch	**COE-Water Management**
	Cathy Hlebechuk	**COE-RCC**
	Witt Anderson	**COE-P**
	Col. Randall J. Butler	**COE-Portland District**
	LTCKertis, Jr.	**COE-Walla Walla District**
	J. William McDonald	**USBR-Boise Regional Director**
	Steven Wright	**BPA-Administrator**
	Greg Delwiche	**BPA-PG-5**

FROM: **Greg Haller, Nez Perce Tribe and Steve Pettit, IDFG, for Salmon Managers**

DATE: **August 13, 2002**

SUBJECT: August – September operation for Dworshak reservoir. Provide greater than minimum discharge from Dworshak to maintain the present thermal regime and try to achieve the water quality temperature standard in Lower Granite Reservoir into mid-September and monitor the adult passage response to this operation.

SPECIFICATIONS:

Operate Dworshak Dam to provide the following outflows for the period August 15 through September 14, 2002.

- Continue to provide the current discharge rate of 13.8 kcfs through August 24.
- Provide 12 kcfs outflow August 25 through August 31.
- Provide 10 kcfs outflow September 1 through September 10.
- At the end of the test period, begin to ramp project discharge down at the standard project ramp rate (no greater than 1 foot per hour at the Peck gauge) until the minimum outflow of approximately 1.4 kcfs is achieved.
- Water temperature during this operation will be maintained at approximately 48^0F.
- If the provision of the 200 KAF for the test appears to require a draft below elevation 1517, FAPC and TMT will reconvene to reconsider the operation.

JUSTIFICATION:

RPA action 34 of National Marine Fisheries Service's 2000 Biological Opinion on the Federal Columbia River Power System directs the Action Agencies to: "Evaluate potential benefits to adult Snake River steelhead and fall chinook salmon passage by drafting Dworshak Reservoir to elevation 1,500 feet in September. An evaluation of the temperature effects and adult migration behavior should accompany a draft of Dworshak reservoir substantially below elevation 1,520 feet."

The summer of 2002 provides a unique opportunity to accomplish the intent of this action without drafting the reservoir to elevation 1500 feet. The runoff volume and runoff shape of the North Fork Clearwater basin's snowpack was such that this action has a reasonable probability of being accomplished without drafting the reservoir below the Biological Opinion stated August draft limit. Extensive thermal data will be collected in the lower Snake project reservoirs and an adult monitoring effort will be in place to document this year's adult behavior given the thermal condition of the reservoirs. The adult monitoring effort will consist of:

- The thermal history of approximately 20 steelhead and 6 fall chinook salmon tagged with data storage tags (DST) which migrated from Bonneville Dam through the lower Snake River. It is anticipated 6 of these fish will migrate during August, and the balance will migrate during September.
- The passage timing of 100 - 200 radio tagged steelhead which migrate from Bonneville Dam past Lower Granite Dam.
- The behavioral response to thermal conditions in the Lower Granite pool of approximately 50 fall chinook and 70 steelhead radio tagged with depth sensitive (MAP) tags at Lower Granite Dam. It is anticipated 10 fall chinook / 40 steelhead will be tagged and tracked in August, and 40 fall chinook / 30 steelhead will be tagged and tracked in September.
- Passage timing of all salmon and steelhead adults this year will be available for comparison to past and future years.

While the focus of the monitoring effort will be on adult fish, it is the position of the Nez Perce Tribe, CRITFC, and the state of Idaho that late migrating juveniles will also benefit from water releases extending into September.

SYSTEM OPERATIONAL REQUEST: #2002-08

The following State, Federal, and Tribal Salmon Managers have participated in the preparation and support this SOR: U.S. Fish & Wildlife Service, National Marine Fisheries Service, Idaho Department of Fish and Game, Columbia River Inter Tribal Fish Commission and the Oregon Department of Fish and Wildlife.

TO:	**B. G. Fastabend**	**COE-NWD**
	William Branch	**COE-Water Management**
	Cathy Hlebechuk	**COE-RCC**
	Witt Anderson	**COE-P**
	Col. Richard Hobernicht	**COE-Portland District**
	LTC Kertis, Jr.	**COE-Walla Walla District**
	J. William McDonald	**USBR-Boise Regional Director**
	Steven Wright	**BPA-Administrator**
	Greg Delwiche	**BPA-PG-5**

FROM: **David A. Wills, Chairperson, Salmon Managers**

DATE: **October 30, 2002**

SUBJECT: Tailwater elevation at Bonneville Dam to protect natural spawning of chum and fall chinook salmon at the Ives/Pierce Island Complex and the I-205 seeps.

SPECIFICATIONS: As required by the 2000 NMFS Biological Opinion, beginning November 1 and continuing until further notice, provide a minimum instantaneous tailrace elevation of 11.5 feet at Bonneville Dam. On average it is anticipated that daily average flows will not exceed 125 Kcfs.

JUSTIFICATION: The Ives/Pierce Islands Complex below Bonneville Dam represents a limited natural spawning area for ESA listed Columbia River (CR) chum and Lower Columbia River chinook. The NMFS 2000 Biological Opinion (BiOp) recognizes that access to spawning habitat in the Ives/Pierce area is primarily a function of the water surface elevation. More so, the BiOp recognizes that managing water levels to a tail water gage height rather than a flow level may be preferable. Current (October 30th, 2002) SSARR modeling indicates that at least 125 Kcfs of water will be available at Bonneville starting early November 2002, providing ample water to maintain the 11.5-foot tailwater gage height.

Over the last ten days the flow below Bonneville has varied between 77 and 121 Kcfs, with tailwater elevations fluctuating between 7 and 11 feet. These variable flows and tailwater elevations are not adequate to provide spawning area for chum salmon at the Ives/Pierce Islands

Complex and the I-205 seeps, or to provide access to both Hardy and Hamilton creeks. The provision of a minimum 11.5-foot tailwater elevation at Bonneville Dam will provide access to a limited area of mainstem spawning habitat for chum salmon and allow unrestricted access to Hardy and Hamilton creeks. Historic data (**Figure 1**) suggests that chum salmon will begin staging and spawning in the area around the first of November. In addition, LRB fall chinook are already present in the vicinity of the Ives/Pierce Island Complex, and based on data collected 1998-99 (**Figure 2**) have already begun to spawn in significant numbers with peak counts expected in early November. Increasing tailwater elevation will allow chinook access to some preferred shallow-water habitat in the island area.

The provision of flow to facilitate spawning in the shallow water habitat and tributaries will benefit the chum population by: 1) allowing access to habitat, 2) providing stable spawning conditions, 3) extending the timeframe over which spawning occurs, and 4) protecting life history diversity of early spawning fish. This risk adverse approach recognizes that adequate chum flows can be provided without significant impacts on other fish and power operations. Based on research collected to date, the island areas and tributaries provide suitable spawning habitat for chum. Unlike chinook, chum cannot spawn in the high velocity large cobble substrate of the mainstem. The delay of providing spawning flows poses an unnecessary risk to this population that number less than 1% of their historic abundance. The opportunity for enhancing natural spawning areas and production in the mainstem Columbia system is extremely limited and should be given high priority for protection and enhancement.

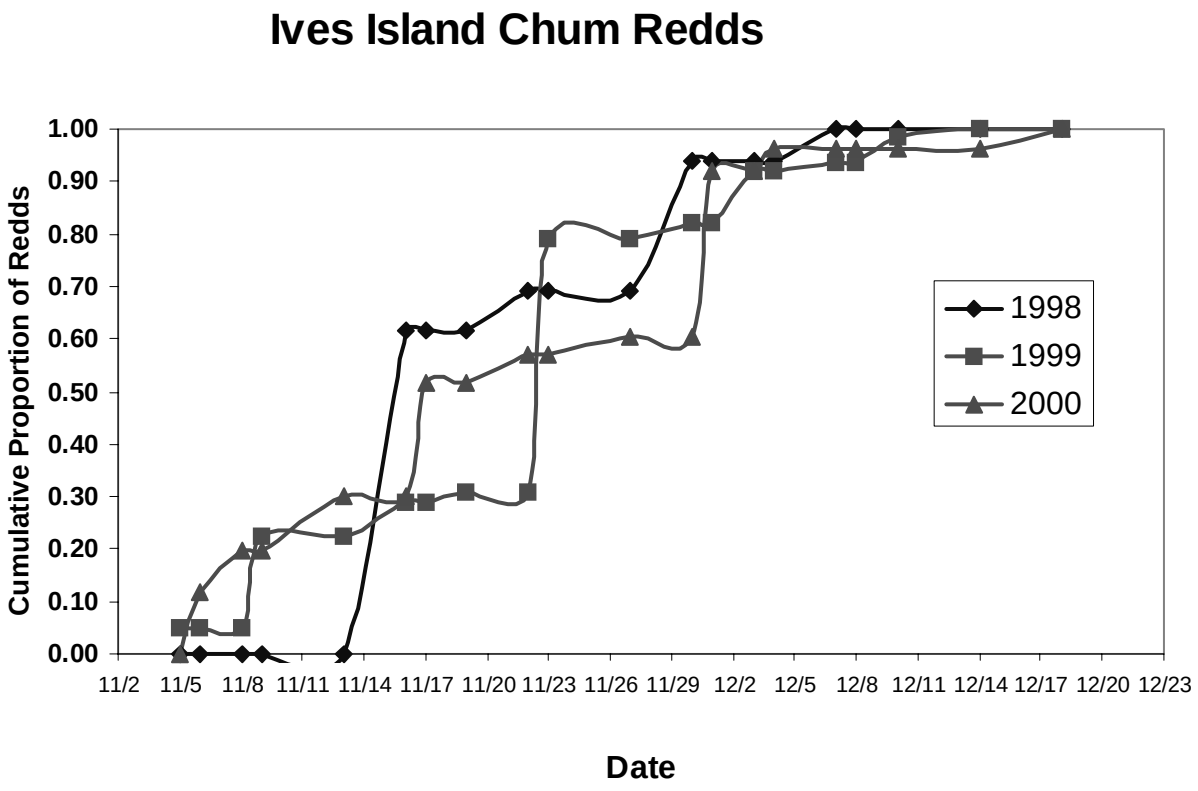

Figure 1. Chum redd counts.

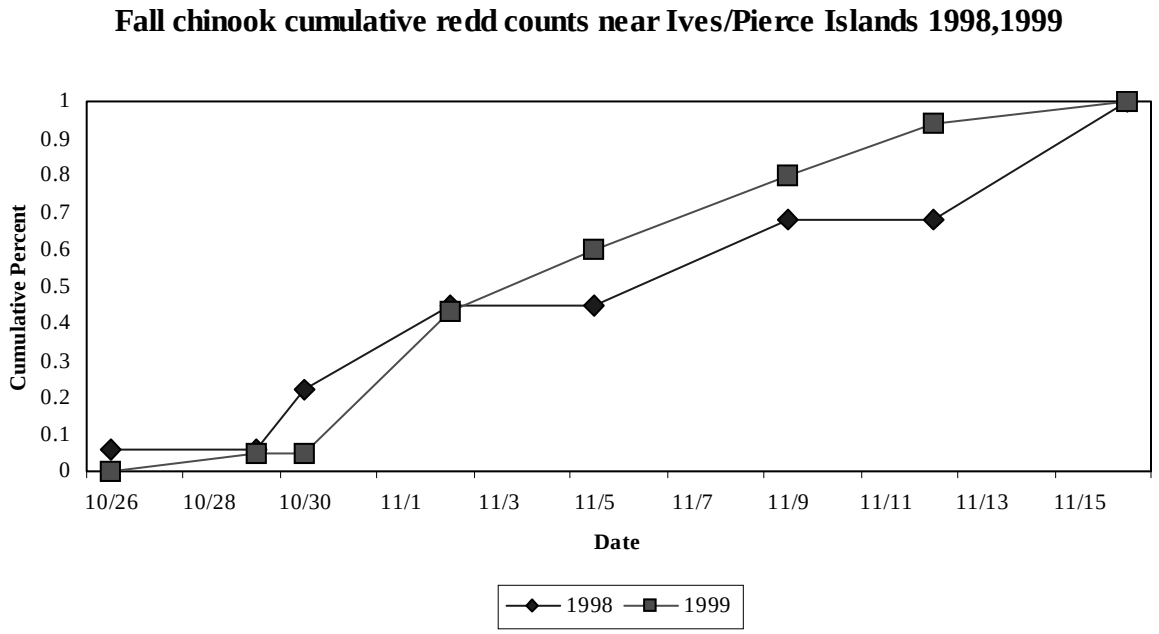

Figure 2. Fall chinook redd counts.

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
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SYSTEM OPERATIONAL REQUEST: 2002 C-1

TO:	Brigadier General Fastabend	COE-NWD
	Steven Wright	BPA Administrator
	J. William McDonald	USBR-- Pacific Northwest Regional Director
	William Branch	COE-NWD-NP-Water Management
	C. Henriksen, R. Turner	COE-NWD-NP-WM-RCC
	Witt Anderson	COE-NWD-CM-F (Pacific Salmon Coord. Office)
	Col. Randall Butler	COE-Portland District
	G.Delwiche, T.Lamb, R.MacKay	BPA-PG-5 and BPA-PGPO

FROM: Don Sampson, Executive Director

DATE: April 2nd, 2002

SUBJECT: **Operation of the Lower Columbia Pools for the Spring 2002 Treaty Fishery**

The Columbia River Inter-Tribal Fish Commission, on behalf of its member tribes the Nez Perce Tribe, the Yakama Nation, the Confederated Tribes of the Umatilla Reservation, and the Confederated Tribes of the Warm Springs Reservation, requests the following reservoir operations in Zone 6 (Bonneville to McNary dams) during the 2002 spring ceremonial Treaty fishery. Implement the following hydro-system operations during the ceremonial and subsistence Treaty fishery times as established by the tribes.

SPECIFICATIONS:

Implement the following pool operations as follows:

April 2nd, 2002, 6 am, Tuesday, through 6 pm, April 13th, 2002, Saturday

- **Bonneville Pool. Operate the pool within 1.0 foot from full pool (msl elevation 77 – 76)**
- **The Dalles (Celilo) Pool. Operate the pool within 1.0 foot (msl elevation 159.5 - 158.5)**
- **John Day Pool. Operate the pool within 1.0 foot (msl elevation 264.5 - 263.5)**

Additional pool operations may be requested for the ceremonial, subsistence, and commercial fishery established through the Columbia River Compact starting in mid-April. Specific requests for pool operations during these fisheries will be sent to the federal operators at that time.

JUSTIFICATION:

The 2002 spring Treaty fishing season is of high importance to CRITFC member tribes. The anticipated escapement of over 333,000 adult spring chinook will create harvest opportunitiesthat tribal fishers realized only one other time in the last 25 years, and many fishers will be exercising their treaty rights by participating in this harvest. Many cultural and religiousceremonies and practices will occur with the harvest of these salmon.

During a meeting at CRITFC's Law Enforcement Division in Hood River on September 2, 1999, tribal fishers explained the impacts of unstable pools and pools below full to the Treaty fishery to Colonel Mogren and Lt. Colonel Harshbarger. The tribal fishers explained that a pool fluctuation of 1.0 foot or more disrupts tribal fishery operations. Specific problems include: (1) increased local currents that sweep debris into fishing nets, (2) rapid 1-2 hour drops in water-level will lead to entanglement of nets, (3) boat access problems, and (4) nets torn from their anchors. Nets and gear are costly to replace.

The fishers also stressed to Corps officials that much of the tribal fishers' income and food is generated during the brief treaty fishing season, so that any delays or disruptions to their fishing operations caused by the excessive pool fluctuations in Zone 6 negatively impact tribal incomes, food resources and cultural practices.

Implementing this request will insure that the Federal operating agencies meet their federal trust responsibilities to the Columbia Basin treaty tribes. If this SOR cannot be accommodated, CRITFC's member tribes request a detailed written response from the federal operators with justification by April 5th, 2002.

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
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www.critfc.org

SYSTEM OPERATIONAL REQUEST: 2002 C-2

TO:	Brigadier General Fastabend	COE-NWD
	Steven Wright	BPA Administrator
	J. William McDonald	USBR-- Pacific Northwest Regional Director
	William Branch	COE-NWD-NP-Water Management
	C. Henriksen, R. Turner	COE-NWD-NP-WM-RCC
	Witt Anderson	COE-NWD-CM-F (Pacific Salmon Coord. Office)
	Col. Randall Butler	COE-Portland District
	G. Delwiche, T. Lamb, R. MacKay	BPA-PG-5 and BPA-PGPO

FROM: Don Sampson, *Executive Director*

DATE: April 12th, 2002

SUBJECT: **Operation of the Lower Columbia Pools for the Spring 2002 Treaty Fishery**

The Columbia River Inter-Tribal Fish Commission, on behalf of its member tribes the Nez Perce Tribe, the Yakama Nation, the Confederated Tribes of the Umatilla Reservation, and the Confederated Tribes of the Warm Springs Reservation, requests the following reservoir operations in Zone 6 (Bonneville to McNary dams) during the 2002 spring ceremonial Treaty fishery. Implement the following hydro-system operations during the ceremonial and subsistence Treaty fishery times as established by the tribes.

SPECIFICATIONS:

Implement the following pool operations as follows:

April 15th, 2002, 6 am, Monday, through 6 pm, April 20th, 2002, Saturday

- **Bonneville Pool. Operate the pool within 1.0 foot from full pool (msl elevation 77 – 76)**

- **The Dalles (Celilo) Pool. Operate the pool within 1.0 foot (msl elevation 159.5 - 158.5)**

- **John Day Pool. Operate the pool within 1.0 foot (msl elevation 264.5 - 263.5)**

Additional pool operations may be requested for the ceremonial, subsistence, and commercial fishery established through the Columbia River Compact later in April. Specific requests for pool operations during these fisheries will be sent to the federal operators at that time.

JUSTIFICATION:

The 2002 spring Treaty fishing season is of high importance to CRITFC member tribes. The anticipated escapement of over 333,000 adult spring chinook will create harvest opportunities that tribal fishers realized only one other time in the last 25 years, and many fishers will be exercising their treaty rights by participating in this harvest. Many cultural and religious ceremonies and practices will occur with the harvest of these salmon.

During a meeting at CRITFC's Law Enforcement Division in Hood River on September 2, 1999, tribal fishers explained the impacts of unstable pools and pools below full to the Treaty fishery to Colonel Mogren and Lt. Colonel Harshbarger. The tribal fishers explained that a pool fluctuation of 1.0 foot or more disrupts tribal fishery operations. Specific problems include: (1) increased local currents that sweep debris into fishing nets, (2) rapid 1-2 hour drops in water level will lead to entanglement of nets, (3) boat access problems, and (4) nets torn from their anchors. Nets and gear are costly to replace.

The fishers also stressed to Corps officials that much of the tribal fishers' income and food is generated during the brief treaty fishing season, so that any delays or disruptions to their fishing operations caused by the excessive pool fluctuations in Zone 6 negatively impact tribal incomes, food resources and cultural practices.

Implementing this request will insure that the Federal operating agencies meet their federal trust responsibilities to the Columbia Basin treaty tribes. If this SOR cannot be accommodated, CRITFC's member tribes request a detailed written response from the federal operators with justification by April 19th, 2002.

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
729 N.E. Oregon, Suite 200, Portland, Oregon 97232 Telephone (503) 238-0667
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www.critfc.org

SYSTEM OPERATIONAL REQUEST: 2002 C-3

TO:	Brigadier General Fastabend	COE-NWD
	Steven Wright	BPA Administrator
	J. William McDonald	USBR-- Pacific Northwest Regional Director
	William Branch	COE-NWD-NP-Water Management
	Cindy Henriksen, Rudd Turner	COE-NWD-NP-WM-RCC
	Witt Anderson	COE-NWD-CM-F (Pacific Salmon Coord. Office)
	Col. Randall Butler	COE-Portland District
	G. Delwiche, T. Lamb, S. Bettin	BPA-PG-5 and BPA-PGPO

FROM: Don Sampson, *Executive Director*

DATE: April 23rd, 2002

SUBJECT: **Operation of the Lower Columbia Pools for the Spring 2002 Treaty Fishery**

The Columbia River Inter-Tribal Fish Commission, on behalf of its member tribes the Nez Perce Tribe, the Yakama Nation, the Confederated Tribes of the Umatilla Reservation, and the Confederated Tribes of the Warm Springs Reservation, requests the following reservoir operations in Zone 6 (Bonneville to McNary dams) during the 2002 spring Treaty fishery. Implement the following hydro-system operations during the ceremonial and subsistence, plus commercial, Treaty fishery times as established by the tribes.

SPECIFICATIONS:

Implement the following pool operations as follows:

April 25th, 2002, 6 am, Thursday, through 6 pm, April 27th, 2002, Saturday

- **Bonneville Pool. Operate the pool within 1.0 foot from full pool (msl elevation 77 – 76)**
- **The Dalles (Celilo) Pool. Operate the pool within 1.0 foot (msl elevation 159.5 - 158.5)**
- **John Day Pool. Operate the pool within 1.0 foot (msl elevation 264.5 - 263.5)**

Additional pool operations may be requested for the ceremonial, subsistence, and commercial fishery established through the Columbia River Compact for early May. Specific requests for pool operations during these fisheries will be sent to the federal operators at that time.

JUSTIFICATION:

The 2002 spring Treaty fishing season is of high importance to CRITFC member tribes. The anticipated escapement of ~250,000 adult spring chinook will create harvest opportunities that tribal fishers realized only one other time in the last 25 years, and many fishers will be exercising their treaty rights by participating in this harvest. Many cultural and religious ceremonies and practices will occur with the harvest of these salmon.

During a meeting at CRITFC's Law Enforcement Division in Hood River on September 2, 1999, tribal fishers explained the impacts of unstable pools and pools below full to the Treaty fishery to Colonel Mogren and Lt. Colonel Harshbarger. The tribal fishers explained that a pool fluctuation of 1.0 foot or more disrupts tribal fishery operations. Specific problems include: (1) increased local currents that sweep debris into fishing nets, (2) rapid 1-2 hour drops in water level will lead to entanglement of nets, (3) boat access problems, and (4) nets torn from their anchors. Nets and gear are costly to replace.

The fishers also stressed to Corps officials that much of the tribal fishers' income and food is generated during the brief treaty fishing season, so that any delays or disruptions to their fishing operations caused by the excessive pool fluctuations in Zone 6 negatively impact tribal incomes, food resources and cultural practices.

Implementing this request will insure that the Federal operating agencies meet their federal trust responsibilities to the Columbia Basin treaty tribes. If this SOR cannot be accommodated, CRITFC's member tribes request a detailed written response from the federal operators with justification by April 26th, 2002.

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
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SYSTEM OPERATIONAL REQUEST: 2002 C-4

TO:	Brigadier General Fastabend	COE-NWD
	Steven Wright	BPA Administrator
	J. William McDonald	USBR-- Pacific Northwest Regional Director
	William Branch	COE-NWD-NP-Water Management
	Cindy Henriksen, Rudd Turner	COE-NWD-NP-WM-RCC
	Witt Anderson	COE-NWD-CM-F (Pacific Salmon Coord. Office)
	Col. Randall Butler	COE-Portland District
	G. Delwiche, T. Lamb, S. Bettin	BPA-PG-5 and BPA-PGPO
	Stan Speaks, K. Hatch	BIA, Portland Area Office

FROM: Don Sampson, *Executive Director*

DATE: April 30, 2002

SUBJECT: **Operation of the Lower Columbia Pools for the Spring 2002 Treaty Fishery**

The Columbia River Inter-Tribal Fish Commission, on behalf of its member tribes the Nez Perce Tribe, the Yakama Nation, the Confederated Tribes of the Umatilla Reservation, and the Confederated Tribes of the Warm Springs Reservation, requests the following reservoir operations in Zone 6 (Bonneville to McNary dams) during the 2002 spring Treaty fishery. Implement the following hydrosystem operations during the ceremonial and subsistence, and commercial, Treaty fishery times as established by the tribes and the Columbia River Compact.

SPECIFICATIONS: Implement the following pool operations as a hard system constraint as follows:

May 2nd, 2002, 6 am, Thursday, through 6 pm, May 4th, 2002, Saturday

- **Bonneville Pool. Operate the pool within 1.0 foot from full pool (msl elevation 77 – 76)**
- **The Dalles (Celilo) Pool. Operate the pool within 1.0 foot (msl elevation 159.5 - 158.5)**
- **John Day Pool. Operate the pool within 1.0 foot (msl elevation 264.5 - 263.5)**

- **Maintain flows through all of the Zone 6 pools at a near constant rate (no more than plus or minus 10 kcfs from the beginning of the fishery to the end of the fishery)**

Additional pool operations may be requested for the ceremonial, subsistence, and commercial fishery established through the Columbia River Compact for early May. Specific requests for pool operations during these fisheries will be sent to the federal operators at that time.

JUSTIFICATION:

The 2002 spring Treaty fishing season is of critical importance to CRITFC's member tribes. The anticipated escapement of an estimated 293,000 adult spring chinook will create harvest opportunities that tribal fishers realized only one other time in the last 25 years, and many fishers will be exercising their treaty rights by participating in this harvest. Many cultural and religious ceremonies and practices will occur with the harvest of these salmon.

During a meeting at CRITFC's Law Enforcement Division in Hood River on September 2, 1999, tribal fishers explained the impacts of unstable pools and pools below full to the Treaty fishery to Colonel Mogren and Lt. Colonel Harshbarger. The tribal fishers explained that a pool fluctuation of 1.0 foot or more disrupts tribal fishery operations. Specific problems include: (1) increased local currents that sweep debris into fishing nets, (2) rapid 1-2 hour drops in water level will lead to entanglement of nets, (3) boat access problems, and (4) nets torn from their anchors. Nets and gear are costly to replace.

As was just noted during the April 25-29, 2002 treaty fishery, it is also critical to maintain near constant flow conditions during the fishery, because changes in pool flows, even with stable pool conditions, causes 1) nets to sag and drift shorewards and 2) disruption to shoreline eddy conditions and velocities important to successful harvest. The loss of fishing opportunity during the extremely limited treaty fishery cannot be replaced.

Much of the tribal fishers' income and food is generated during the brief treaty fishing season, thus, any delays or disruptions to their fishing operations caused by the excessive pool fluctuations in Zone 6 negatively impacts tribal incomes, food resources and cultural practices.

Implementing this request will insure that the Federal operating agencies meet their federal trust responsibilities to the Columbia Basin treaty tribes. If this SOR cannot be accommodated, CRITFC's member tribes request a detailed written response from the federal operators with justification by May 1, 2002, before the fishery begins on May 2.

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
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SYSTEM OPERATIONAL REQUEST: 2002 C-5

TO:	Brigadier General Fastabend	COE-NWD
	Steven Wright	BPA Administrator
	J. William McDonald	USBR-- Pacific Northwest Regional Director
	William Branch	COE-NWD-NP-Water Management
	Cindy Henriksen, Rudd Turner	COE-NWD-NP-WM-RCC
	Witt Anderson	COE-NWD-CM-F (Pacific Salmon Coord. Office)
	Col. Randall Butler	COE-Portland District
	G. Delwiche, T. Lamb, S. Bettin	BPA-PG-5 and BPA-PGPO

FROM: Don Sampson, Executive Director

DATE: May 2nd, 2002

SUBJECT: May 2002 Flows for Hanford Reach, Lower Snake, and Lower Columbia

The Columbia River Inter-Tribal Fish Commission, on behalf of its member tribes the Nez Perce Tribe, the Yakama Nation, the Confederated Tribes of the Umatilla Reservation, and the Confederated Tribesof the Warm Springs Reservation, requests the following hydrosystem operations.

SPECIFICATIONS:
Assume initial pool elevations relative to Sunday, April 21, 2002. Operate appropriate reservoirs to meet BiOp flow targets at McNary Dam (260 kcfs) and Priest Rapids (135 Kcfs) as well as meeting the criteria for Hanford Reach flows. Any flow reduction should be accompanied by an appropriate fluctuation rate to reduce stranding in the Hanford Reach as well as reducing the risk of slope failure due to rapid flow fluctuations. At the current flow rates of ~130 Kcfs at Priest Rapids that would be a band of no more than 10 kcfs change in 24 hours, which would equate to a change of no more than approximately 1.2 feet.

Current SSARR runs show a dramatic reduction in flows at McNary from 220 kcfs on May 5 to a low of 136 kcfs on May 12 and last through May 15, which would have negative impacts on juvenile outmigrants, adult salmon migrants, water quality, Hanford Reach stranding, and the Zone 6 tribal treaty fisheries, which is currently in progress. Refer to attachments for calculations on potential operations to mitigate for the predicated low flows.

JUSTIFICATION:

The requested operation will generate steady to increasing flows, mimicking a normative, natural peaking hydrograph in the lower Columbia as compared to the proposed federal operations (see figure below). Current forecasted flow projections suggest a sharp drop in early May. This dramatic drop would have negative impacts to adult salmon migrants, water quality, juvenile migrants, and the Zone 6 tribal treaty fisheries.

About 80% of all the adult spring chinook salmon and steelhead kelts for the 2002 migration will be in the mainstem Columbia during the requested operations. The Columbia Basin Fish and Wildlife Authority has noted that adults are attracted to fast flowing water and that high flows favor upstream migration (CBFWA 1991). Migration delays to adult fish from reduced flows can contribute to reproductive failure (CBFWA 1991). Low flows also increase the frequency that adult fishways are operated out of criteria.

(figure would not transfer from pdf to framemaker)

Further it is our understanding that Banks Lake can be operated up to 5 feet below full. Current elevation is ~2.1 feet below full. Thus, Reclamation's current pumping into Banks Lake could be reduced to help increase flows below Grand Coulee. Current elevation of Grand Coulee is 1244. We propose using additional storage by drawing down Grand Coulee to ~msl 1238 to meet the flow targets in the lower river at Priest Rapids and McNary Dam or until natural flows increase to meet the BiOp flow targets. The current SSARR shows a freshet occurring mid to late May and continuing into June. We would propose to use a portion of this water to back fill any additional storage we use now to meet BiOp flow targets. Considering the time of year with respects to cooler temperatures and lack of people for recreation, it would appear that this would be the best time of year to have lower pool elevations if meeting downstream flow targets requires additional drafting of Lake Roosevelt.

Current vs. Historic Fish Data:

The following discussion of historic versus present fish passage emphasizes the following points:

- The historic timing curve shows a rapid increase in rate of passage beginning May 1 and continuing increase the first ten days of May.
- Presently the passage of chinook is not increasing and the passage rate of steelhead is declining.

In the following plot we see that the largest numbers of yearling chinook smolts pass McNary Dam during the month of May. The historic average timing curve shows a rapid increase in rate of passage (steeper increasing slope) beginning May 1 and lasting the first 10 days of May. Coincid-

ing with this increasing passage has been the general pattern of increasing flows during May. The past nine days in April of 2002 have seen a fairly flat passage of yearling chinook at McNary Dam. During this time flows have been decreasing from 300 kcfs to around ~200 kcfs. This drop in flow appears to have suppressed the normal increase in yearling chinook smolt passage that should typically occur at this time. If flows continue to be below average for early May, then the normal increasing passage of yearling chinook during May will also most likely be delayed. PIT tagged wild chinook from the Yakima and Walla Walla River basins have been detected at McNary Dam since April 4. PIT tagged wild chinook from the Snake River basin have been mostly (97%) detected at McNary Dam since April 20 (see attached table).

(table wouldn't translate from pdf to framemaker)

In the following plot we see that the largest numbers of steelhead smolts also pass McNary Dam during the month of May. The historic average timing curve shows a rapid increase in rate of passage (steeper increasing slope) beginning May 1 and lasting the first 10 days of May. Coinciding with this increasing passage has been the general pattern of increasing flows during May. But unlike the flat passage of yearling chinook during the past nine days in April 2002, we see a decreasing passage of steelhead. During this time flows have been decreasing from 300 kcfs to around 200 kcfs. This drop in flow appears to have done more than just suppress the normal increase in steelhead smolt passage; it appears to have caused passage of steelhead to drop. This is a sign that flows currently are too low to adequately move steelhead through the hydro system. If flows continue to be below average for early May, then the normal increasing passage of steelhead during May could be delayed enough to cause reduced in-river survival in 2002. PIT tagged wild steelhead from the Yakima River and Snake River basins have been the most consistent groups detected at McNary Dam since mid-April (see attached table).

(table would not translate from pdf to framemaker)

In addition detection of PIT tagged steelhead and Chinook juveniles at McNary Dam show that wild and hatchery Chinook and steelhead originating throughout the Snake River Basin and the Yakima River basin are passing the project. Yakima River stocks are maintaining a strong presence at McNary Dam.

If this SOR can not be meet we request a written explanations from the federal operators.

Attachements:

1. Grand Coulee

Flows are projected to drastically decrease at Grand Coulee, directly influencing the spring flow targets at Priest Rapids and McNary. Essentially, Grand Coulee contains water available to supplement flows in the lower Columbia River. According to calculations, it appears that a total volume of 600 Kaf of water would be involved if Grand Coulee were to pass inflows and draft

approximately 30 Kcfs of water for ten days. Assuming the current (4-30-02) elevation to be 1245 feet AMSL (useable storage = 1978 Kaf), a 600 Kaf draft would lower the reservoir to approximately 1235 feet AMSL (useable storage = 1378 Kaf). According to the latest flow projections, McNary flows may decrease as low as 136 to 178 Kcfs between May 7th and May 15th, 2002. A 30 Kcfs increase from Grand Coulee would drastically assist flows at McNary.

However, some issues have arisen concerning the pumping of water into Banks Lake if Grand Coulee were to decline below 1240 feet AMSL. The full pool elevation at Banks Lake is 1570 feet AMSL and current irrigation outflows are approximately 7000 cfs. Also, it is known that the BOR is authorized to operate Banks Lake five feet below the full pool elevation. As of 4-29-02, the elevation of Banks Lake was 1267.9 feet AMSL, leaving 2.9 feet of water available before reaching the level five feet below full pool. Additionally, according to personnel at the Grand Coulee Power Office, one-foot of reservoir water is equivalent to 24,000 acre-feet of water, therefore with 2.9 feet of available water, a volume of 69,600 acre-feet is currently available for irrigational uses if inputs from Grand Coulee were to stop. At a current rate of output of 7,000 cfs, the 2.9 feet of available water would last approximately five days. It should be pointed out that that the pumps at Grand Coulee will continue to be operable for inputs to Banks Lake below an elevation of 1240 feet AMSL, therefore, the five day supply of water would act essentially as a water supply “cushion. It may also be advisable, if possible, to limit irrigational uses from Banks Lake over the anticipated low flow period.

At any rate, the 600 Kaf of water used now from Grand Coulee could be made up in a period of less than a week during the spring freshet and still meet flow objectives at Priest Rapids and Grand Coulee.

2. Brownlee

The Brownlee reservoir ended April at 2062.1 feet AMSL; its end of April flood control target was 2064.4 feet AMSL. Over the past several days, Brownlee has been refilling. The Brownlee reservoir would decrease approximately 1 foot per day if the reservoir were to pass inflows and draft 5 Kcfs of water during the project low flow period. It should be pointed out that the April Mid-month water supply forecast predicted only 61% of the average runoff at Brownlee. However, it is anticipated that the relatively minor volume of water potentially used from Brownlee could be made up in a short period after the onset of the spring freshet. At any rate, water released from Brownlee would provide further assistance to flow targets at McNary.

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
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SYSTEM OPERATIONAL REQUEST: 2002 C-6

TO:	Brigadier General Fastabend	COE-NWD
	Steven Wright	BPA Administrator
	J. William McDonald	USBR-- Pacific Northwest Regional Director
	William Branch	COE-NWD-NP-Water Management
	Cindy Henriksen, Rudd Turner	COE-NWD-NP-WM-RCC
	Witt Anderson	COE-NWD-CM-F (Pacific Salmon Coord. Office)
	Col. Randall Butler	COE-Portland District
	G. Delwiche, T. Lamb, S. Bettin	BPA-PG-5 and BPA-PGPO
	Stan Speaks, K. Hatch	BIA, Portland Area Office

FROM: Don Sampson, *Executive Director*

DATE: May 8th, 2002

SUBJECT: **Operation of the Lower Columbia Pools for the Spring 2002 Treaty Fishery**

The Columbia River Inter-Tribal Fish Commission, on behalf of its member tribes the Nez Perce Tribe, the Yakama Nation, the Confederated Tribes of the Umatilla Reservation, and the Confederated Tribes of the Warm Springs Reservation, requests the following reservoir operations in Zone 6 (Bonneville to McNary dams) during the 2002 spring Treaty fishery. Implement the following hydro-system operations during the ceremonial and subsistence, and commercial, Treaty fishery times as established by the tribes and the Columbia River Compact.

SPECIFICATIONS: Implement the following operations as a hard system constraint as follows:

May 10th, 2002, 6 am, Friday, through 6 pm, May 11th, 2002, Saturday

Bonneville Pool: Operate the pool within 1.0 foot from full pool (msl elevation 77 – 76)

The Dalles (Celilo) Pool: Operate the pool within 1.0 foot (msl elevation 159.5 - 158.5)

John Day Pool: Operate the pool within 1.0 foot (msl elevation 264.5 - 263.5)

Maintain flows through all of the Zone 6 pools at a near constant rate (no more than plus or minus 10 kcfs from the beginning of the fishery to the end of the fishery)

JUSTIFICATION:

The 2002 spring Treaty fishing season is of critical importance to CRITFC's member tribes. The anticipated escapement of an estimated 309,000 adult spring chinook will create harvest opportunities that tribal fishers realized only one other time in the last 25 years, and many fishers will be exercising their treaty rights by participating in this harvest. Many cultural and religious ceremonies and practices will occur with the harvest of these salmon.

During a meeting at CRITFC's Law Enforcement Division in Hood River on September 2, 1999, tribal fishers explained the impacts of unstable pools and pools below full to the Treaty fishery to Colonel Mogren and Lt. Colonel Harshbarger. The tribal fishers explained that a pool fluctuation of 1.0 foot or more disrupts tribal fishery operations. Specific problems include: (1) increased local currents that sweep debris into fishing nets, (2) rapid 1-2 hour drops in water level will lead to entanglement of nets, (3) boat access problems, and (4) nets torn from their anchors. Nets and gear are costly to replace.

As was noted during the April 25-29, 2002 treaty fishery, it is also critical to maintain near constant flow conditions during the fishery, because changes in pool flows, even with stable pool conditions, causes 1) nets to sag and drift towards shore and 2) disruption to shoreline eddy conditions and velocities important to successful harvest. The loss of fishing opportunity during the extremely limited treaty fishery cannot be replaced. Much of the tribal fishers' income and food is generated during the brief treaty fishing season, thus, any delays or disruptions to their fishing operations caused by the excessive pool fluctuations in Zone 6 negatively impacts tribal incomes, food resources, and cultural practices.

Implementing this request will insure that the Federal operating agencies meet their federal trust responsibilities to the Columbia Basin treaty tribes. If this SOR cannot be accommodated, CRITFC's member tribes request a detailed written response from the federal operators, with justification, by Friday May 10th, 2002.

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
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SYSTEM OPERATIONAL REQUEST: 2002 C-7

TO:	Brigadier General Fastabend	COE-NWD
	Steven Wright	BPA Administrator
	J. William McDonald	USBR-- Pacific Northwest Regional Director
	William Branch	COE-NWD-NP-Water Management
	Cindy Henriksen, Rudd Turner	COE-NWD-NP-WM-RCC
	Witt Anderson	COE-NWD-CM-F (Pacific Salmon Coord. Office)
	Col. Randall Butler	COE-Portland District
	G. Delwiche, T. Lamb, S. Bettin	BPA-PG-5 and BPA-PGPO
	Stan Speaks, Keith Hatch	BIA, Portland Area Office

FROM: Don Sampson, *Executive Director*

DATE: May 15th, 2002

SUBJECT: **Operation of the Lower Columbia Pools for the Spring 2002 Treaty Fishery**

The Columbia River Inter-Tribal Fish Commission, on behalf of its member tribes the Nez Perce Tribe, the Yakama Nation, the Confederated Tribes of the Umatilla Reservation, and the Confederated Tribes of the Warm Springs Reservation, requests the following reservoir operations in Zone 6 (Bonneville to McNary dams) during the 2002 spring Treaty fishery. Implement the following hydro-system operations during the ceremonial and subsistence, and commercial, Treaty fishery times as established by the tribes and the Columbia River Compact.

SPECIFICATIONS: Implement the following operations as a hard system constraint as follows:

May 17th, 2002, 6 am, Friday, through 6 pm, May 18th, 2002, Saturday

Bonneville Pool: Operate the pool within 1.0 foot from full pool (msl elevation 77 – 76)

The Dalles (Celilo) Pool: Operate the pool within 1.0 foot (msl elevation 159.5 - 158.5)

John Day Pool: Operate the pool within 1.0 foot (msl elevation 264.5 - 263.5)

Maintain flows through all of the Zone 6 pools at a near constant rate (no more than plus or minus 10 kcfs from the beginning of the fishery to the end of the fishery)

JUSTIFICATION:

The 2002 spring Treaty fishing season is of critical importance to CRITFC's member tribes. The anticipated escapement of an estimated 303,000 adult spring chinook will create harvest opportunities that tribal fishers realized only one other time in the last 25 years, and many fishers will be exercising their treaty rights by participating in this harvest. Many cultural and religious ceremonies and practices will occur with the harvest of these salmon.

During a meeting at CRITFC's Law Enforcement Division in Hood River on September 2, 1999, tribal fishers explained the impacts of unstable pools and pools below full to the Treaty fishery to Colonel Mogren and Lt. Colonel Harshbarger. The tribal fishers explained that a pool fluctuation of 1.0 foot or more disrupts tribal fishery operations. Specific problems include: (1) increased local currents that sweep debris into fishing nets, (2) rapid 1-2 hour drops in water level will lead to entanglement of nets, (3) boat access problems, and (4) nets torn from their anchors. Nets and gear are costly to replace.

As was noted during the April 25-29, 2002 treaty fishery, it is also critical to maintain near constant flow conditions during the fishery, because changes in pool flows, even with stable pool conditions, causes 1) nets to sag and drift towards shore and 2) disruption to shoreline eddy conditions and velocities important to successful harvest. The loss of fishing opportunity during the extremely limited treaty fishery cannot be replaced. Much of the tribal fishers' income and food is generated during the brief treaty fishing season, thus, any delays or disruptions to their fishing operations caused by the excessive pool fluctuations in Zone 6 negatively impacts tribal incomes, food resources, and cultural practices.

Implementing this request will insure that the Federal operating agencies meet their federal trust responsibilities to the Columbia Basin treaty tribes. If this SOR cannot be accommodated, CRITFC's member tribes request a detailed written response from the federal operators, with justification, by Friday May 17th, 2002.

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
729 N.E. Oregon, Suite 200, Portland, Oregon 97232 Telephone (503) 238-0667
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www.critfc.org

SYSTEM OPERATIONAL REQUEST: 2002 C-8

TO:	Brigadier General Fastabend	COE-NWD
	Steven Wright	BPA Administrator
	J. William McDonald	USBR-- Pacific Northwest Regional Director
	William Branch	COE-NWD-NP-Water Management
	Cindy Henriksen, Rudd Turner	COE-NWD-NP-WM-RCC
	Witt Anderson	COE-NWD-CM-F (Pacific Salmon Coord. Office)
	Col. Randall Butler	COE-Portland District
	G. Delwiche, T. Lamb, S. Bettin	BPA-PG-5 and BPA-PGPO
	Stan Speaks, Keith Hatch	BIA, Portland Area Office

FROM: Don Sampson, *Executive Director*

DATE: June 26th, 2002

SUBJECT: **Dworshak Summer Operations Plan**

The Columbia River Inter-Tribal Fish Commission, on behalf of its member tribes the Nez Perce Tribe, the Yakama Nation, the Confederated Tribes of the Umatilla Reservation, and the Confederated Tribes of the Warm Springs Reservation, as well as the State of Idaho, requests the following reservoir operations during summer 2002. This Plan also complies with the State of Idaho Dworshak Operations Plan (see attached), which was approved by the Idaho legislature. The Washington Department of Fish & Wildlife has also stated their support of this SOR.

SPECIFICATIONS: Implement the following operational guidelines, refer to (Figures 1 and 2). If river conditions degrade dramatically or flow varies significantly from the predicted model similations during the period of the specified operation (1-9), in season management options will be discussed. We request that data being collected by the Corps monitoring program outlined by RPA measure 143 be made available for the weekly TMT meetings or discuss an alternative reporting schedule.

1. Keep Dworshak full, 1600 feet, through July 14th, 2002. Pass inflow and use 47 degF water.
2. Ramp up flows to 6,000 cfs by mid-day July 15th, 2002, and hold through July 21st, 2002.

3. Ramp up flows to 9,000 cfs by mid-day July 22nd, 2002, and hold through July 28th, 2002.
4. Ramp up flows to 13,000 cfs by mid-day July 29th, 2002, and hold through August 4th, 2002.
5. Ramp up to 14,000 cfs by mid-day August 5th, 2002, and hold through September 1st, 2002.
6. From September 2nd through 8th, 2002, reduce flows to 10,000 cfs.
7. From September 9th through 15th, 2002, reduce flows to 7,000 cfs.
8. From September 16th through 22nd, 2002, reduce flows to 2,500 cfs.
9. From September 23rd through 29th, 2002, reduce flows to near minimum 1,400 cfs.

JUSTIFICATION:

Idaho, Nez Perce Tribe, and CRITFC desire to meet water quality standards in the Clearwater River that afford balanced protection of sub-yearling salmonids and returning adults; maintain Dworshak elevation at or above 1520 ft; optimize the rearing of listed Clearwater River fall Chinook; and minimize impacts at the Dworshak National Fish Hatchery. The SOR is consistent with the Nez Perce Tribe-Idaho Plan for Total Dissolved Gas Short-Term Activity Exemption.

Water Temperature

Model results from EPA- Seattle imply that a SOR using a natural peaking flow regime would keep Lower Granite water temperatures at 20 degC or less by late summer, which would greatly benefit returning adults (Refer to Dr. Dale McCullough's work on the benefits of cooler water on returning salmon adults during late summer: http://www.critfc.org/tech/EPAreport.htm). This SOR does keep water temperatures at or below 20 degC in Lower Granite for most of August and September (Figure 3). Current water temperatures are ~2 degC less than initial model starting conditions, so the modeled temperatures in late July may be too high and not materialize. Scenario #4 in the EPA model best represents the operations outlined in this SOR, however current flows from Dworshak are quite different than what is modeled. Staff views the model results are best used to depict heating trends rather than absolute magnitudes or water temperature values.

Weather Considerations

The latest two-week climate forecast suggests near normal temperatures, and below normal precipitation, for the Snake Basin. This pattern indicates that water temperatures, currently below normal, will stay below the temperature standard through July, and gradually warm to near normal temperatures by late July, with Dworshak operated as per this SOR. As "El Nino" strengthens later on this summer (http://www.noaanews.noaa.gov/stories/s922.htm), the chances increase for above normal air temperatures by late summer.

Fishery Concerns

The Nez Perce Tribe and State of Idaho strongly believe that Dworshak should not be drafted below 1537 ft elevation before September 1st in order to reserve water for a 200 KaF draft in September. Washington Department of Fish & Wildlife supports a more flexible ending elevation target for Dworshak reservoir in August to provide the September flows. This draft would benefit sub-yearling and adult fall chinook and steelhead migration.

Sub-yearling fall Chinook do not typically outmigrate from the Clearwater until an average size of 85 mm is reached. Sampling conducted on June 10th, 2002 on the Clearwater by the Nez Perce Tribal staff indicates fish were 40+ mm. At an average growth rate of 1mm per day, these fish are not expected to reach smolt size (actively migrating) until late July. Cold-water conditions from protracted runoff may slow grow rates and delay outmigration. Passage data indicates that 40 % of listed sub-yearling Clearwater fall Chinook migrate past Lower Granite Dam in September and October. Implementation of this SOR is needed to accommodate these fish.

Implementing this request will insure that the Federal operating agencies meet their federal trust responsibilities to the Columbia Basin treaty tribes. If this SOR cannot be accommodated, CRITFC requests a detailed written response from the federal operators, with justification, by Friday June 28th, 2002.

N.F. Clearwater at Dworshak (DWR)

20-Jun-02	Outflow	SSARR Inflow (6-19-02)		DWR Pool
WY 2002	(CRITFC)		Storage	Elevation
SUMMER	(kcfs)	(kcfs)	Change	(feet)
PLAN			(KaF)	end-of-week
NPT-ID Plan				
				Forecast:
Jun 24-30				1600.0
Jul 1-7	9.1	9.1	0	1600.0
Jul 8-14	5.2	5.2	0	1600.0
Jul 15-21	6.0	3.3	-37	1598.0
Jul 22-28	9.0	2.3	-94	1593.0
Jul 29-Aug 4	13.0	1.8	-156	1584.0
Aug 5-11	14.0	1.6	-172	1573.5
Aug 12-18	14.0	1.5	-174	1562.5
Aug 19-25	14.0	1.4	-175	1550.5
Aug 26-Sp1	14.0	1.3	-176	1538.0

Sep 2-8	10.0	1.1	-124	1529.0
Sep 9-15	7.0	0.7	-87	1522.5
Sep 16-22	2.5	0.7	-25	1521.0
Sp 23-Sp29	1.4	0.6	-11	1520.0
Total (KaF):	1,655	425	-1230	

CRITFC Hydro Program **June 2002 Water Supply Forecast**

Figure 1. Summary of proposed Dworshak operations.

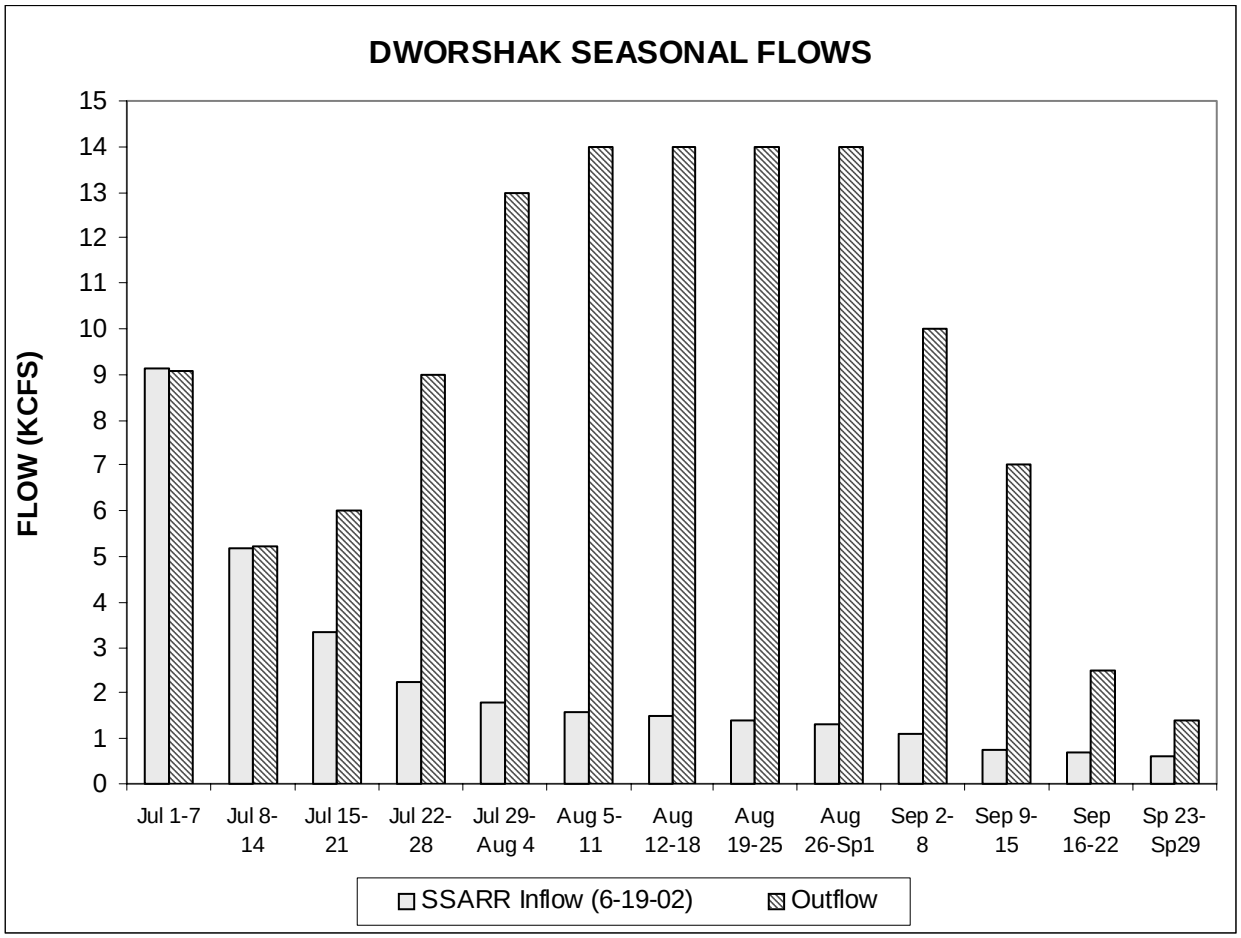

Figure 2. Summary hydrograph of proposed ID-NPT-CRITFC operation.

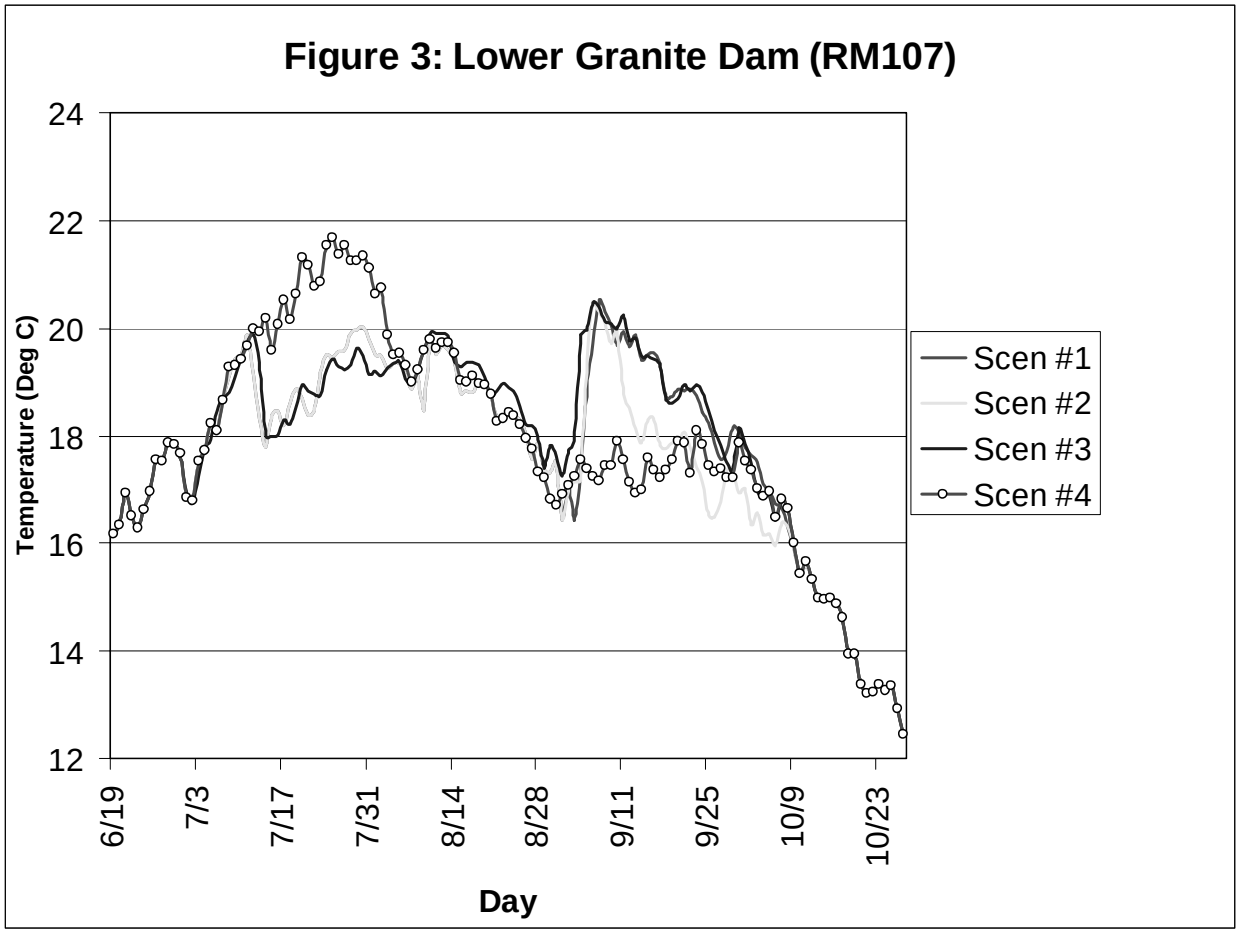

Figure 3. Summary of EPA modeling results. Scenario #4 is the proposed ID-NPT-CRITFC Plan. Daily water temperatures assume WY 2000 conditions (near normal). Daily tributary flows assume WY 1985 conditions (similar percent and volume to WY 2002). Daily meteorology assumes WY 1989 (moderately dry summer with near normal temperatures).

DWORSHAK OPERATION PLAN

Prepared by: Idaho Department of Water Resources
Water Planning Bureau

Prepared for: Idaho Water Resource Board

Joseph L. Jordan, Chairman
Jerry R. Rigby, Vice-Chairman
J. David Erickson, Secretary
Robert Graham
L. Claude Storer
Terry T. Uhling
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Adopted December 21, 2000

Acknowledgements

The Idaho Water Resource Board would like to acknowledge the Dworshak Operation Plan Committee and key contributors for their efforts in formulation of the Dworshak Operation Plan.

I. Dworshak Operation Plan Committee

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Rep. Charles D. Cuddy, Idaho State Legislature
Alex Irby, Orofino Chamber of Commerce
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TABLE

Table 1. Summarization of days by year with total dissolved gas exceeding Idaho state water quality standard and the percentage of gas bubble trauma observed for selected fish species. .... Table 1. Summarization of days by year with total dissolved gas exceeding Idaho state water quality standard and the percentage of gas bubble trauma observed for selected fish species (Cochnauer, 1999).

Introduction

The Idaho Water Resource Board (Board) adopted the Comprehensive State Water Plan – North Fork Clearwater River Basin in January 1996. The plan contains a series of policies formulated by the Board, in consultation with local citizens and public officials, to provide direction to the Corps of Engineers (CoE) and other federal agencies regarding the operation of the Dworshak Project (dam and reservoir). The sixth policy in the Plan calls for a committee consisting of state and local representatives, to develop a management plan, in consultation with the CoE, for the Dworshak Project that fully addresses the other five policies, listed below:

(1) The Dworshak Project will be operated as a multiple use project in full consideration of the current authorizations of flood control, navigation (log transport), recreation, power production and fish and wildlife conservation.

(2) Summer reservoir levels will be managed to optimize the seasonal beneficial uses of recreation and log transportation.

(3) Dworshak Project outflows, other than during the summer months, will be configured to benefit the Clearwater River population of B-run steelhead.

(4) Dworshak Pool will be managed to support reservoir and upper basin fish and wildlife, and to provide a high-quality source of water to the Ahsahka fish hatcheries.

(5) Water released from the Dworshak Project will be in compliance with state water quality standards.

Consistent with this policy, the Dworshak Operation Plan is formulated as an amendment to the North Fork Clearwater River Basin plan.

Plan Objective

The objective of the Dworshak Operation Plan is to implement procedures that optimize the use of Dworshak water for all beneficial uses, including flood control, power production, recreation, commercial
navigation, fish (both anadromous and resident populations), wildlife, and water quality. The operation plan recognizes the management policies set forth in the North Fork Clearwater Plan.

Current Operations

Commencing in 1992, spring and summer flow releases from the Dworshak Project were modified to improve out migration conditions for juvenile anadromous fish. Populations of concern are chinook salmon, sockeye salmon, and steelhead originating from Idaho, Oregon and Washington tributaries, as well as the mainstem Snake River. Dworshak releases subsequently contributed to flow objectives for the lower Snake River set out in the 1995 Columbia River Power System Biological Opinion, and in the 1998 supplement to that document. The flow objectives as measured at Lower Granite Dam are:

85,000 – 100,000 cfs from April 1 to June 20.
50,000 – 55,000 cfs from June 21 to August 31.

Within this framework, spring augmentation usually commences around April 10 with Dworshak releases approaching 20,000 cfs. Duration of spring augmentation is normally around 30 days. Releases are then reduced in an attempt to fill the Dworshak pool by June 30. Summer releases typically approach 20,000 cfs by mid-July and often remain high until the end of August. Reservoir elevations begin to decline from the full pool elevation in early July, and continue to recede to elevation 1520 feet. Summer augmentation provides 1.2 million acre-feet of Dworshak storage in addition to reservoir inflows. During six of the nine flow augmentation years, the reservoir pool was lowered to elevation 1,520 feet by August 31. During the remaining three years, the reservoir was lowered to elevation 1,520 feet no later than September 12.

Impacts of Project Operations

Resident Fishery

Dworshak Reservoir Productivity

The majority of the North Fork Clearwater River drainage is comprised of nutrient- poor granites of the Idaho batholith. Dworshak Reservoir, like most new reservoirs, experienced a few years of higher productivity. Since 1977 the reservoir has gradually become less productive and is now classified as oligotrophic (Reiman and Meyers, 1992). Most of the nutrient budget is probably comprised of recycled phosphorus and nitrogen and inputs from tributary streams and shoreline areas (Bennett, 1997). The current low-nutrient condition of the reservoir does not support rapid fish growth.

Fisheries Mitigation

The CoE has the legal responsibility to mitigate the effects of lost fishing opportunity created by Dworshak Reservoir. Originally that mitigation was defined as 100,000 pounds of hatchery-reared fish. Since 1972 that level of stocking has only been met three times. The average stocking level for those 25 years has been 38,500 lbs. In the past 10 years the stocking level has averaged less than 15,000 lbs. (IDFG stocking records).

When Dworshak Reservoir was new, productivity was relatively high, fish food was relatively abundant and rainbow trout dominated the sport fishery. These rainbow trout were stocked as part of a federal fisheries mitigation requirement. Small-mouth bass and kokanee salmon were introduced to the reservoir a few years later. Originally, small-mouth bass performed very well on the abundant forage of red side shiners. In fact, Dworshak Reservoir produced an Idaho state record small-mouth bass in 1982. However, success and consistency of the two fisheries are limited and widely variable, largely due to the operational effects of Dworshak, and the lack of nutrients. Kokanee populations fluctuate wildly from year to year, mostly controlled by mortality (entrainment) caused by winter releases from Dworshak. Small-mouth bass in Dworshak Reservoir exhibit the slowest growth rate of any population in the region, due primarily to a lack of forage. Water level fluctuations have eliminated successful spawning of redside shiners, the preferred forage of small-mouths in Dworshak. The small-mouth fishery currently produces only limited harvest to Dworshak anglers.

Trout stocking has shown mixed results over the history of Dworshak Reservoir. In years of low kokanee abundance, stocked trout provide the bulk of consumptive fishing opportunity in the reservoir. Hatchery trout also dominate the creel of shoreline anglers at Dworshak.

Fisheries Enhancement

The Idaho Department of Fish and Game (IDFG), CoE, U.S. Fish and Wildlife Service, and Nez Perce Tribe are attempting to work together to provide a reasonable and responsible fisheries program for Dworshak Reservoir. This program recognizes the importance of optimizing the kokanee fishery, enhancing the bass fishery, stocking trout, and managing native species, primarily bull trout and westslope cutthroat. Reservoir operation and integration of access, recreation, and anadromous fish all play important roles in the Dworshak resident fisheries program.

Historically, fry, fingerling, sub-catchable, and catchable size rainbow trout have been stocked. Rainbow trout stocking has associated risks to native populations and benefits to localized fishery opportunities. Most risks associated with stocking hatchery rainbow trout concern genetics of native cutthroat trout. Hatchery rainbow trout that leave Dworshak Reservoir and ascend tributaries could spawn with native cutthroat and contaminate the genetics of these native fishes. Earlier reservoir research indicates that size at stocking and stocking location are factors in rainbow trout movement (Ball and Pettit, 1974). Stocking catchable size fish downstream of the Dent Bridge may minimize hatchery fish movement into Dworshak tributaries (Maiolie et al., 1992). Stocking catchable size trout at major access points enhances harvest opportunity. Furthermore, development of sterilized rainbow trout to be stocked in Dworshak Reservoir was recently accomplished.

Total angler use averaged approximately 88,000 hours annually from 1972 through 1980. During these years rainbow trout dominated the fishery. Catch rates averaged less than one fish per hour. Following introduction in the 1970's, kokanee salmon became more prevalent in the reservoir and by the 1980's had replaced rainbow trout as the dominant fishery (Horton, 1981). Plentiful populations and liberal bag limits provided annual harvests of up to 200,000 kokanee per year from Dworshak. Harvest of kokanee was 206,000 in 1988 and fell to 98,000 in 1990. Creel surveys indicate the kokanee decline advanced further in 1991 (Maiolie et al., 1992).

The Dworshak kokanee population has not been stable from year to year, and has exhibited exceedingly low annual survival rates, much lower than other kokanee populations in the same geographical region. In some years over 80 percent of yearling kokanee have "died" before entering the fishery the following year, and may have resulted in up to a 60 percent reduction in fishing effort (Maiolie and Elam, 1994).

Research has shown a strong relationship between the quantity of water discharged through the dam on an annual basis and kokanee survival. Recent analysis suggests that dam discharge can be a more important factor in driving the population than the number of spawning fish (Fredricks, 1995). Years with high snow pack forced flood control rule curve evacuations that flushed kokanee from the reservoir because kokanee tend to congregate in the lower six reaches of the reservoir during winter and early spring. Powerhouse operation of up to 10,000 cfs generally flushed yearling fish. Spill during winter and early spring flushed all age classes (Maiolie et al., 1992).

Changes in dam operation associated with summer drafting of Dworshak Reservoir coupled with relatively low flow years have significantly increased kokanee survival and density in Dworshak Reservoir. Although removal of up to 80 feet of water from the reservoir is not popular with people that recreate on Dworshak Reservoir during the summer, it has reduced the loss of kokanee out of the reservoir. Bennett (1997) found a higher correlation between kokanee entrainment and mean daily discharge during January – March than during July – September. When water is released during the summer kokanee are more active and are not congregated near the dam. Lower numbers of kokanee are lost through the dam under this scenario. In fact, annual kokanee survival during years of summer drafting has been as much as 10 times higher than in years of winter drafting. Unfortunately, this has generally resulted in over abundant kokanee populations, small fish and a decline in angler satisfaction.

Bull Trout

Dworshak Reservoir is in a key watershed for bull trout, currently listed under the Endangered Species Act as threatened, and may provide important over-wintering habitat. Kokanee is a primary food source of bull trout, and both species may congregate near the lower end of the reservoir in the winter. Late winter or early spring spills from the Dworshak Project have been linked to major losses of kokanee through entrainment, and may cause similar losses of bull trout.

Late summer drawdown of the Dworshak pool may also result in negative impacts to North Fork Clearwater bull trout population. Dewatered shorelines can decrease reservoir productivity. Low pool elevations can create both physical and thermal barriers, which may interfere with fall kokanee and bull trout spawning migration.

Anadromous Fishery

Dworshak Dam eliminated access of anadromous fish to all but the lower 1.9 miles of the North Fork Clearwater River. Dworshak hatchery was constructed to mitigate the loss of steelhead caused by the elimination of this production area. Dworshak Hatchery brood stock was developed from wild adult steelhead from the North Fork Clearwater River population. A second hatchery became operational in 1991, primarily to produce B-run steelhead and spring chinook salmon for the Clearwater Basin. Returning adult hatchery steelhead were intended to perpetuate this genetically unique population and provide sport fishing and tribal harvest.

Water released from Dworshak Reservoir during April and May is primarily used to augment flows in the lower Snake River when necessary to meet the NMFS flow target of 85,000 – 100,000 cfs at Lower Granite Dam. In mid-summer, 1.2 million acre-feet (80 feet of pool elevation) from Dworshak Reservoir is used to help meet the NMFS 50,000 – 55,000 cfs flow target at Lower Granite Dam. Summer flow augmentation is for the benefit of juvenile fall chinook salmon. Mid-summer releases from Dworshak Reservoir also cool water temperatures in the

lower Snake River. Both increased flow and cooler water temperatures are reported by NMFS to be beneficial for fall chinook salmon juveniles. NMFS uses reservoir elevation 1520 (80 feet down) at Dworshak Reservoir as a target regardless of lower Snake River conditions, fish presence or abundance (Columbia R. dart; Ed Shriever personal communication).

Historically, juvenile fall chinook would have left the lower Snake River by mid-July. Changes to the ecosystem caused by hydro-power development have shifted migration timing of juvenile fish from May-June to July. Providing artificially cold water condi-tions in the lower Snake River in the sum-mer may further complicate the ecosystem and delay the out-migration of these fish. Some recent evidence indicates that cold-water releases from Dworshak in August and September may be beneficial to immigrating adult fall chinook and steelhead (Karr et al., 1998). Fall chinook and steelhead upstream migration into the Snake River system begins in mid-August and continues through October 31. Declining water temperature in the lower Snake River result in lower residence time, and may increase adult survival. Releases from Dworshak in November and/or December likely benefit the steelhead sport fishery in the lower Clearwater River.

The Nez Perce Tribe is currently bringing new hatchery facilities near Lenore into production. This facility will produce juvenile fall chinook salmon to supplement the Clearwater stocks. Late summer flow augmentation in the lower Clearwater River would likely enhance out-migration of these fish.

Wildlife

Winter operation of the Dworshak Project may impact wildlife through related icing patterns. Deer and elk have been observed falling through the ice during attempted cross-reservoir migrations. Winter management to retard ice build-up, or to enhance early formation of safe ice cover may have a substantially positive impact on winter deer and elk survival.

Recreation

Recreation Facilities

Approximately 80 minicamp locations provide 125 sites for camping and day use. Two fee campgrounds have been developed. The CoE operates Dent Acres and Idaho Department of Parks and Recreation (IDPR) operates Dworshak State Park and Big Eddy Marina. There are seven improved boat launch facilities. Four facilities allow boats to be launched with up to a 90-foot pool reduction, and three allow boats to be launched with up to a 110-foot pool reduction. CoE visitor surveys at Dworshak Reservoir indicate that the overwhelming reason people come to the reservoir is to fish.

Mid-summer water level reductions have negatively impacted visitor use at Dworshak Reservoir. Visitor days at CoE docks and camps averaged 131,425 from 1984-91 (Jaymi Osborne, CoE, per-

sonal commun-ication, data provided). Visitor days at the same locations averaged 98,399 from 1992-94, a 25 percent reduction. Visitor days at Dworshak State Park averaged 36,960 during 1990 and 91. Use was at or above this average in 1992 and 93, but fell to 65 percent of average in 1994 (Mike McElhatton, Idaho Department of Parks and Recreation, personal communication, data provided). Regression analysis of visitor use and water level indicates that, except for June, from May to August the majority of the variation in user visits can be explained by reservoir elevation. Further analysis of use and water level indicates that minicamp use is virtually abandoned when drawdown exceeds 30 feet. Operation plan committee members also observed that boater use was substantially reduced when drawdown exceeded 30 feet.

Economics

Using the direct cost method, the fishery in Dworshak reservoir in the late 80's is valued at approximately $620,000 annually (1985 dollars, Sorg et. al.). Multiplied by three for an estimated economic ripple effect, the reservoir fishery generates approximately $1.8 million annually (1985 dollars). Applying visitation trends to the fishery indicates a 20-25 percent reduction in participation due to reduced pool elevations in the summer months. However, the economic value of the steelhead sport fishery in the Clearwater River has been estimated at 10-14 million dollars annually. A four- percent increase in the economic value of the steelhead fishery may compensate for a 20 percent decline in the value of the reservoir fishery.

Commercial Navigation

Between 1988 and 1991, 81 million board feet of timber were transported from four dump sites on the Dworshak pool to takeout facilities located near Dworshak Dam (Fig. 1; BPA *et al.*, 1995a). Approximately 90 percent of this activity occurred in the months of June, July, and August. Logs have not been transported via the reservoir since 1991 due to early drafting for flow augmentation and resulting declines in reservoir elevations. The log dumpsites cannot be used when the reservoir elevation drops below 1570 ft. The added annual cost of truck transportation when the reservoir

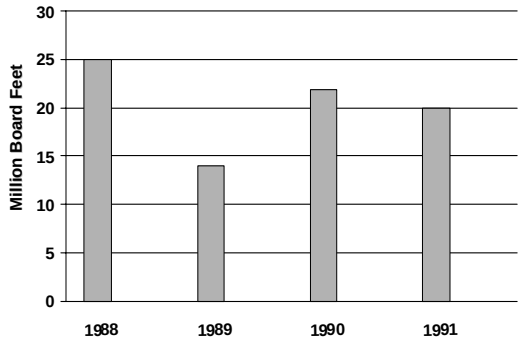

Figure 1. Log Transportation on the Dworshak Pool.

cannot be used has been estimated as high as $470,000 when harvest is near the more distant dump sites.

Power Production

The average annual power production for the Dworshak Project between 1974 and 1991 was 1,769,000 megawatt hours (Fig. 2, CoE Power Production Records). At the Bonneville Power Administration preferred customer rate of 24 mils/kilowatt hour, the average annual power value was $42.5 million. The average annual production between 1992 and 1998 was 1,418,000 megawatt hours, resulting in an average annual value of $34.0 million. This represents a 20 percent reduction in power revenues under flow augmentation During the pre flow augmentation period (1974-1991) one of the peak power production periods was November through January, which helped offset regional winter demands (Fig. 3). During the flow augmentation period, 1992-1998, peak production coincided with spring and summer augmentation releases. Power production during the winter months has been reduced substantially.

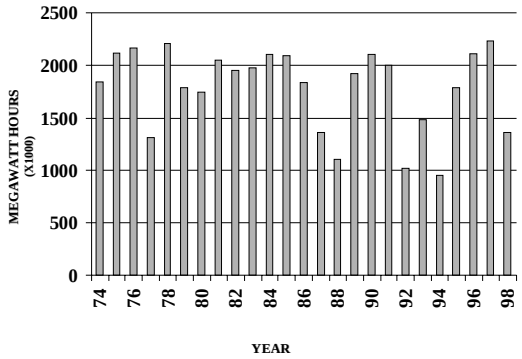

Figure 2. Annual Power Production for the Dworshak Project, 1974-1998.

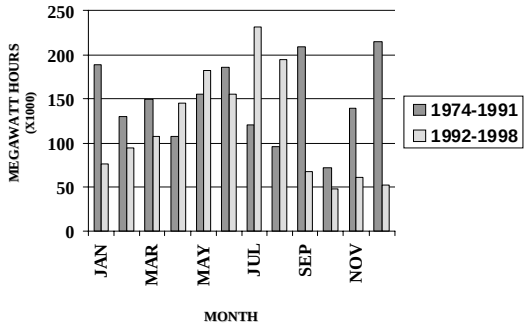

Figure 3. Average Monthly Power Production for the Dworshak Project, 1974-1998.

Flood Control

The primary objective of Columbia River system flood control operations is to reduce peak flows on the lower Columbia River (BPA *et al.*, 1995b). This area includes parts of Portland, Oregon and an additional 120 river miles protected by 42 diking districts. Under traditional operations, the Dworshak pool was maintained at or near full until after September 1. Between September 1 and January 1, the pool was gradually drafted to pool elevations of 1550 to 1560 feet (this provided approximately 700,000 acre-feet of space). Drafting continued into early April resulting in low pool elevations approaching 1450 feet (1,970,000 acre-feet available storage). Spring runoff resulted in reservoir refill, and full pool, elevation 1600 feet, was typically attained around June 10th. The reservoir pool elevation was usually maintained at 1600 feet through September 1.

With the advent of flow augmentation in 1992, some of the flood control space could be transferred from Dworshak to the Grand Coulee project. In theory, this would leave more water in the Dworshak pool to support
spring flow augmentation while increasing the likelihood of full pool in late spring or early summer.

Water Quality

In 1998, the Idaho Division of Environmental Quality (IDEQ) issued a draft list of 19 stream segments in the Upper North Fork Clearwater (Hydrologic Unit Code 17060307), which are purportedly water quality limited due to excess sediment pollution. In addition, Osier Creek is also listed as water quality limited due to water temperature exceedances and flow/habitat alterations. A total daily maximum load (TMDL) analyses for the Upper North Fork Clearwater is scheduled for completion by December 31, 2000.

Water quality issues in the lower North Fork Clearwater River (Hydrologic Unit Code 17060308) and the mainstem Clearwater River (Hydrologic Unit Code 17060306) include both water temperature and total dissolved gas supersaturation. Specifically, IDEQ and IDFG are concerned about thermal shock and gas saturation created when 20,000 cfs of 8 deg C water is released from the dam during the summer low flow period. Releasing cold water from Dworshak Reservoir for the purpose of flow augmentation and water temperature control in Lower Granite Reservoir during the summer can have an adverse effect on the growth and the productivity of both resident and anadromous fish in the lower Clearwater River. A TMDL for the lower North Fork Clearwater River is due in the year 2002 and a TMDL for the mainstem Clearwater River is due in the year 2003.

Short Term Activity Exemption

Since April 1995, the National Marine Fisheries Service (NMFS) has sent annual requests to both the IDEQ and to the Nez Perce Tribe seeking approval for a short-term activity exemption to exceed the total dissolved gas standard of 110 percent supersaturation in the North Fork Clearwa-

ter and the mainstem Clearwater Rivers below Dworshak Dam. The basis for this request is to provide water from Dworshak Reservoir to augment flows in the lower Snake River for the purpose of improving migration conditions for juvenile chinook, steelhead, and sockeye salmon originating from Idaho, Oregon, and Washington tributaries as well as the mainstem Snake River. Dissolved gas monitoring information from the CoE indicates that the 110 percent standard is exceeded in the river below Dworshak Dam at approximately 4,000 to 5,000 cfs spillway flow, or 14,000 to 15,000 cfs total flow.

The Idaho Administrative Procedures Act (IDAPA 16, Title 01, Chapter 02, Section 080.02) provides that the Idaho Department of Health and Welfare or the Board of Health and Welfare may conditionally authorize short-term activities that may result in a violation of state water quality standards (rules). The Idaho Water Quality Standards provide state that no activity can be authorized unless:

- The activity is essential to the protection or promotion of public interest;
- No permanent or long-term injury of beneficial uses is likely as a result of the activity. The designated beneficial uses listed for the North Fork Clearwater and the Clearwater Rivers in the Idaho Water Quality Standards are:

- Cold Water Biota
- Salmonid Spawning
- Primary Contact Recreation
- Secondary Contact Recreation
- Special Resource Water

Gas Bubble Trauma Monitoring

Beginning in 1995, NMFS requested a variance from the total dissolved gas standard to allow flow augmentation spills that could result in total dissolved gas levels up to 120 percent saturation. A requirement imposed by IDEQ with the activity exemption was a monitoring program for fish populations in the affected waters to determine extent of gas bubble trauma (GBT) associated with elevated dissolved gas saturation levels. Over the course of the past five years (1995 through 1999), over 30,000 individual fish were examined for gas bubble trauma (Table 1; Cochnauer, 1999). The incidence of GBT was never greater than 1.0 percent of all fish examined in a given year. Over 95 percent of all GBT incidences were observed in the two monitoring areas closest to Dworshak Dam. Wild rainbow trout showed the highest incidence of GBT in 1996 and 1997. The highest incidence of GBT for both an individual species and all species collectively occurred in 1997 when the greatest number of days exceeding the 110 percent and 120 percent total dissolved gas saturation occurred. Seventy-three percent of the fish exhibiting GBT were at the lowest trauma level. Fifty-three percent of GBT was observed during the summer flow augmentation interval.

Table 1. Summarization of days by year with total dissolved gas exceeding Idaho state water quality standard and the percentage of gas bubble trauma observed for selected fish species (Cochnauer, 1999).

	1995	1996	1997	1998	1999
Days TDG exceeding 110%	33	41	55	47	41
Days TDG exceeding 120%	10	17	20	0	0
Number of individual fish examined	4,752	5,773	8,557	5,474	5,935
Number of fish species with GBT	5	2	7	1	2
% GBT for all species	0.2	0.2	0.8	<0.1	<0.1
%GBT for wild rainbow trout	0.0	2.0	7.5	0.0	0.4
%GBT for mountain whitefish	1.0	0.1	0.7	0.0	0.0
%GBT for largescale sucker	0.1*	0.2*	1.3	0.0	<0.1

*May include some bridgelip suckers

Ongoing Activities

Total Dissolved Gas Activity Exemption

In March 2000, the IDEQ and the Nez Perce Tribe worked together in a collaborative manner to prepare a joint response to the NMFS annual request for a short-term activity exemption (Appendix A). This approach provides for the State of Idaho and the Nez Perce Tribe to have a collective regional voice with the Federal Caucus.

The 2000 Activity Exemption also varies from past exemptions in that conditions are attached that pertain to summer water storage and release from the Dworshak Project. These conditions specify that the Dworshak Project will be at full pool by June 30th, that full pool will be maintained through July 31 and that 200,000 acre-feet of the flow augmentation water will be preserved for augmentation needs after August 31. The purpose of these conditions is to shape releases from Dworshak to better meet anadromous and resident fish needs, as well the other traditional beneficial uses of the Project.

Following issuance of the waiver on March 31, 2000, NMFS notified the Tribe and the State that the conditions of exemption were unacceptable. Spring releases from Dworshak were made at levels that were not supposed to exceed the 110 percent standard. Subsequent review of hourly recordings indicated that the CoE may have been in violation of the standard. Summer releases from Dworshak are also being shaped to not exceed the 110-percent saturation standard.
If flow augmentation is successful in 2000 without exceeding the total dissolved gas standard, annual activity exemptions may no longer be required on a regular basis. It is anticipated that any future requests for exemptions will be linked to the integrated rule curve currently being developed for the Dworshak Project (see page 18), and supported by flow, temperature, total dissolved gas, and fish passage monitoring and modeling.

Technical Basis for Flow Augmentation (temperature modeling)

Prior to formulation of the Dworshak Operation Plan, efforts to model water temperature have focussed on the Snake River from Lower Granite Reservoir to its confluence with the Columbia River. Water quality and flow parameters for the Snake and Clearwater Rivers above Lower Granite Reservoir are input as boundary conditions. Mixing processes at the confluence of the two rivers and the effect of cold water releases from Dworshak had not been modeled.

Dr. Steven Wright of the University of Michigan, working through the University of Idaho, provided hydrologic analysis and preliminary temperature modeling in support of the Dworshak Operation Plan. Dr. Wright's hydrologic analysis focused on the mixing processes at the confluence of the Snake and Clearwater Rivers. Subsequent modeling simulated the impact of cold

water
releases from Dworshak on Snake River
temperatures below the Clearwater confluence.

The hydrologic analysis of mixing processes at the confluence of the Snake and Clearwater Rivers relied heavily on thermal imagery developed for the Idaho Department of Environmental Quality (Wright, 2000a). In a thermal scan of the Snake and Clearwater confluence during 1999 summer flow augmentation, the colder Clearwater River water is shown diving under the warmer Snake River water. Warm surface water temperatures indicate that very little mixing occurs below the confluence. Water released from the bottom of pool at Lower Granite Dam is substantially cooler than water surface in the forebay. The cooler Clearwater River water flows along the bottom of the reservoir and out the intakes at Lower Granite. The warmer water occupies the upper portions of the water column and remains relatively stagnant. The degree of vertical stratification is reduced as water moves through the remaining lower Snake reservoirs. The difference between forebay surface and the bottom-of-pool temperature is about one degree at Ice Harbor Dam.

A numerical model developed by Dr. Wright used historical data for mainstem Clearwater and Snake River discharges and temperature along with two different scenarios for Dworshak releases (Wright, 2000b). Simulations were performed for the summer release seasons (6/1 to 8/31) for four years; 1994 (dry), 1995 (average), 1996 (wet), and 1997 (very wet). The numerical model was one-dimensional and predicted Snake River temperatures are based on an assumption of complete mixing with Clearwater River water.

Under the NMFS Scenario (Scenario A), release begins on July 1 with a reservoir discharge of 14,500 cfs. This is the maximum discharge from Dworshak that remains at or below the state total dissolved gas saturation standard of 110 percent. Discharge then remains at 14,500 cfs until the full 1.2 million acre-feet of flow augmentation water are released (Fig. 4-7). The end of release date varies from August 16 (dry) to August 25 (very wet). The general effect of Dworshak augmentation under Scenario A is a reduction of temperature following the July 1 flow increase. Water temperature down-reservoir of the Snake confluence remains below 20 deg C (considered to be the upper limit of tolerance for migrating salmonids) until the 1.2 million acre-feet have been released (usually between 8/15 and 8/25). After augmentation, reservoir outflow is generally reduced to equal inflow. Mid to late August reductions are followed by Lower Granite temperatures exceeding 20 deg C. often into mid-September.

Under the Idaho Scenario (Scenario B), Dworshak remains at full pool from July 1 through July 31, then 1 million acre-feet are released from storage, along with natural inflow by August 31 (Fig. 8-11). This leaves 200,000 acre-feet of storage for late summer or early fall augmentation. In Scenario B the temperature reduction occurs later in summer, and remains in effect through August 31. The temperature reduction may be somewhat more pronounced due to a higher flow release from Dworshak, and the temperature reduction effect may be greater during

dry years, such as 1994. Lower Granite water temperature may exceed 20 deg C in September, but this can be controlled through the use of the 200,000 acre-feet held in reserve, and by slight reductions in August release discharges from Dworshak.

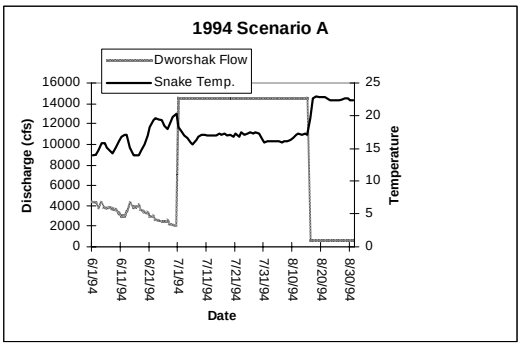

Figure 4. Scenario A, 1994.

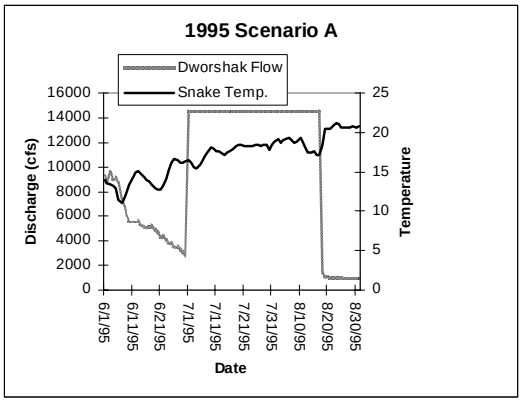

Figure 5. Scenario A, 1995

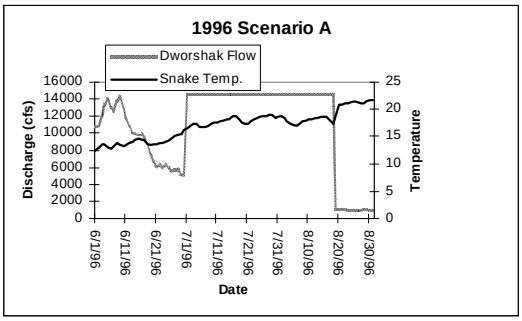

Figure 6. Scenario A, 1996.

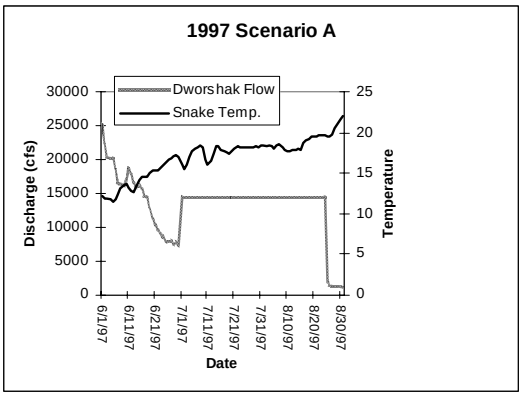

Figure 7. Scenario A, 1997.

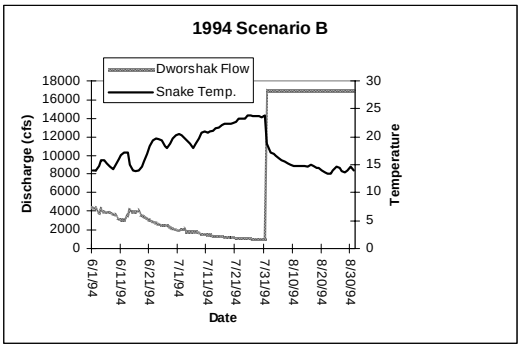

Figure 8. Scenario B, 1994.

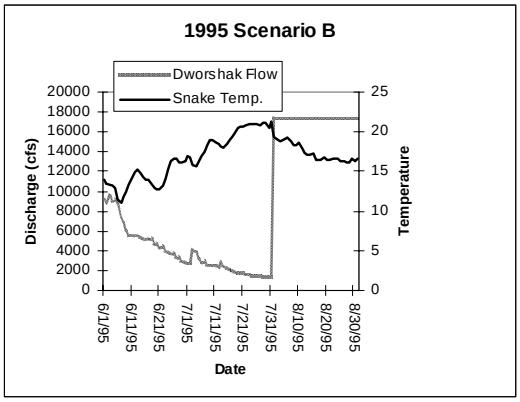

Figure 9. Scenario B, 1995

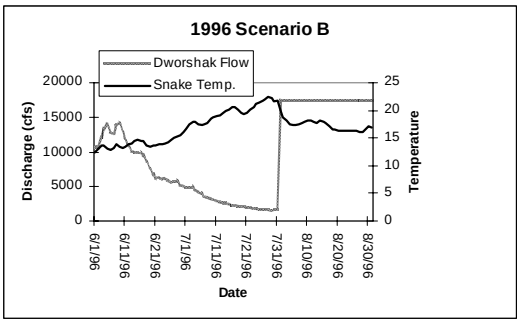

Figure 10. Scenario B, 1996

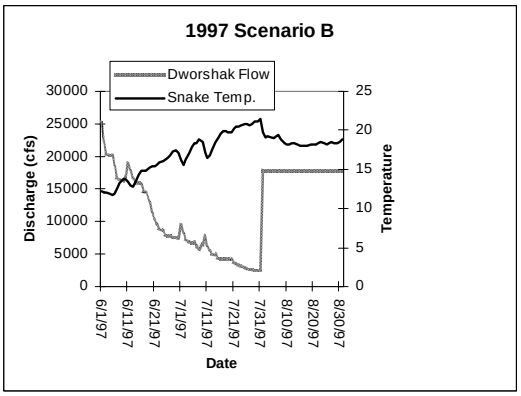

Figure 11. Scenario B, 1997.

Dr. Wright also provided an analysis of conditions that would be expected to result in thermal stratification in Lower Granite. Based on the depth and water velocity for a 14,500 cfs Clearwater flow at the confluence, Dr. Wright estimated that with a temperature difference of 6 deg C or greater between the Snake River and Clearwater temperatures, thermal stratification would develop in the Lower Granite pool.

The modeling support provided by Dr. Wright illustrates the importance of obtaining expertise in this area, and utilizing modeling capabilities to optimize the beneficial uses of Idaho's water. To this end, the Department of Water Resources, in partnership with the IDEQ and the University of Idaho, is obtaining the capability to model water quality. Initially this effort will focus on TMDL development and flow augmentation in the Snake River below Hells Canyon Dam and the Clearwater below the Dworshak Project.

Integrated Rule Curve

The Dworshak Operation Plan Committee learned of the Nez Perce Tribe's integrated rule curve

(IRC) development through a presentation at the Committee's June 16, 1999 meeting. The beneficial uses of significance to the Tribe are similar to the authorizations specified by the Dworshak Management Policies in the North Fork Clearwater Plan. This led to discussions of the benefits of state and tribal collaboration in the IRC modeling process. A verbal commitment to work together in developing a model that considered beneficial uses of importance to both Idaho and the Tribe was reached in October 1999. The Idaho Department of Fish and Game is currently cooperating with the Nez Perce Department of Fisheries in this effort.

The Tribe's Department of Fisheries is currently in the process of developing an IRC model for the Dworshak Project that optimizes project storage and outflows to meet multiple beneficial uses. The tribal fisheries agency received funding through the Northwest Power Planning Council to initiate the development of an IRC model for the Dworshak project in 1995. Extensive efforts to collect dissolved oxygen, temperature, photometry, and productivity data for the Dworshak pool were recently completed. Additional information regarding recreation, power production,
commercial navigation, flood control, resident and anadromous fish, and wildlife has also been pulled together.

The Nez Perce Tribe recently entered into a subcontract with Washington State University to apply the Montana Biological Rule Curve modeling template (Marotz *et al., 1996)* to the Dworshak Project. Model development is scheduled for completion in early 2001.

Multi-Species Framework

The Columbia Multi-Species Framework Project is an ongoing effort by state, federal, and tribal resource managers to address fish and wildlife planning in the Columbia River Basin. The Framework provides a structure for regional planning, stressing ecological objectives, and strategies supported by a long-term science-based vision. The Multi-Species aspect reflects the emphasis on breaking down the usual demarcations between terrestrial and aquatic management and between management of anadromous versus resident fish.

The main application of the Framework Project will be the development of the fish and wildlife program for the Northwest Power Planning Council. The Council plans to structure the goals and actions of their next program, which directs the expenditure of $127 million annually around the Framework. The Framework analysis will also be the basis for future watershed-level planning. This will be aimed at development of specific sub-basin plans to provide sub-basin objectives and guide annual prioritization and selection of actions. In the Clearwater River Basin, watershed level planning is being accomplished and co-coordinated by the Idaho Soil Conservation Commission and the Nez Perce Tribe through a Clearwater Focus Program.

The Clearwater Focus Program

The Northwest Power Planning Council (NPPC), under the Northwest Power Act of 1980, developed a program to protect and enhance Columbia River Basin fish and wildlife, including threatened or endangered species. This program promotes protecting and improving anadromous and resident fish habitat and water quality. To facilitate this concept, the NPPC proposed in 1995 that Idaho, Montana, Oregon, and Washington each identify at least one basin in which to apply and implement the approach used in the Pacific Northwest Model Watershed Project. This process emphasizes local involvement in developing strategies to manage fish and wildlife. In June 1995, the NPPC recommended that a focus project be implemented in the Clearwater River subbasin.

The Clearwater Focus Program is co-coordinated by the Idaho Soil Conservation Commission and the Nez Perce Tribe. Input and assistance are provided by a policy advisory committee with representation from the Idaho Association of Soil Conservation Districts, the Idaho Department of Environmental Quality, the Idaho Department of Fish and Game, the Idaho Department of Lands, the Clearwater National Forest, the Potlatch Corporation, the Idaho County Commission, and the Nez Perce Tribe. To date, the Clearwater Focus Program has provided leadership, continuity, and a framework for water quality and fisheries habitat improvements in the Clearwater River subbasin. The project has been instrumental in developing an inventory of watershed projects and technical data sources, and in implementing a comprehensive watershed assessment process. The ultimate goal of the Clearwater Focus Program is to develop a plan that identifies critical habitat protection and improvement needs, sets basin-wide priorities, and establishes funding strategies for plan implementation. The Dworshak Operation Plan is expected to be a key component of the integrated Clearwater Focus Project Plan.

National Recreation Lakes Pilot Program

In September 2000, the CoE, Walla Walla District nominated Dworshak Dam and Reservoir for inclusion in the National Recreation Lakes Pilot Program. Through this program, a commission appointed by the President will prepare reports for selected federally managed manmade lakes and reservoirs that:

- Review the extent to which components identified in specific authorizations have been accomplished.
- Evaluate the feasibility of enhancing recreation opportunities at federally managed lakes and reservoirs.
- Consider legislative changes that would enhance recreation opportunities.
- Make recommendations on alternatives for enhanced recreation opportunities.

Dworshak Dam and Reservoir were not selected for inclusion in the program during the current federal fiscal year.

Recommendations

Consistent with the Dworshak management policies and the objective of this plan, the Board makes the following recommendations:

1. The Board recommends that the CoE incorporate the integrated rule curve developed for the for Dworshak Project by Nez Perce Tribe in collaboration with the Water Resource Board and the State of Idaho into the Dworshak Master Plan.

1. The Board recommends continued collaborative issuance of annual short-term activity exemptions for total dissolved gas that contain operating conditions consistent with the integrated rule curve for the Dworshak Project.

1. The Board recommends and supports continued water quality modeling, including temperature, by the State of Idaho to determine the quantity and timing of discharges from Dworshak to optimize anadromous fish migration through the lower Snake River, while providing favorable conditions for resident species of concern. Resident species of concern include bull trout and cutthroat trout. Future modeling efforts must include biological parameters to directly link fish migration data with water quality parameters.

1. The Board recommends continued support by the Northwest Power Planning Council of the Clearwater Focus Program to perform an ecological assessment and to formulate a plan for the Clearwater River subbasin. The assessment process will identify critical habitat, and the planning process will define implementation actions and strategies.

1. The Board recommends that the CoE review the Dworshak mitigation-stocking program with the Idaho Department of Fish and Game on an annual basis. The Board further recommends that this program be utilized to optimize the resident sport fishery in Dworshak Reservoir.

1. The Board recommends that the CoE study the following enhancements to the Dworshak Project through their master plan process:

- A strobe light or equivalent system at the Dworshak outlet works to eliminate or reduce resident fish escapement from the reservoir.
- Improved swimming and boating facilities that provide continued use of the reservoir under less than full conditions.
- Processes, such as tributary fertilization, to enhance the resident sport fishery.
- Funding mechanisms for the maintenance of Dent Bridge.
- Enhancements to log transportation facilities that would provide for dumping and transport under drawdown conditions.

- Processes that may improve reservoir shoreline vegetation.
- Project landscaping enhancements.

Feasibility analysis of these enhancements must focus on the overall benefit to the region and the nearby community of Orofino. The Board recommends that enhancements determined to have substantial positive benefits be implemented on a timely basis.

1. The Board recommends that the CoE resubmit the nomination of Dworshak Dam and Reservoir for inclusion in the National Recreation Lakes Pilot Program prior to 2002 federal fiscal year.

1. The Board recommends that the Dworshak Project be operated in a manner that is consistent with Idaho Code and the Comprehensive State Water Plan.

Action

Pursuant to Policy 4B of the Comprehensive State Water Plan, Part A (the statewide water policy plan), the Board will meet annually with the CoE to discuss spring and summer flow release strategies for the Dworshak Project.

Implementation

The Board requests the support of the Idaho congressional delegation in ensuring that the Dworshak Operation Plan is incorporated into the Dworshak Master Plan currently being prepared by the CoE. The Board will then seek full implementation of the Master Plan.

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Wright, Steven J. 2000a. Written communication to Mr. William S. Whelan, dated March 20, 2000.

Wright, Steven J. 2000b. Written communication to Mr. Bill Graham, dated June 2, 2000.

Appendix A: Letter and Attachment Regarding Short Term Activity Exemption of Total Dissolved Gas Supersaturation Standard

March 31, 2000

William Stelle, Jr., Regional Director
United States Department of Commerce
National Marine Fisheries Service
525 NE Oregon Street
Portland, Oregon 97232-2737

Brigadier General Carl A. Strock
Commander, North Pacific Division
United States Army Corps of Engineers
P.O. Box 2870
Portland, Oregon 97208-2870

Re: Short Term Activity Exemption of Total Dissolved Gas Supersaturation Standard

Dear Gentlemen:

This letter is a joint response from the Nez Perce Tribe and the State of Idaho to a request on February 17, 2000 by the National Marine Fisheries Service (NMFS) for a short term activity exemption to allow exceedance of the water quality standard of 110% total dissolved gas (TDG) supersaturation in the North Fork of the Clearwater River below Dworshak Dam and the Clearwater River below the North Fork between April 3 and August 31, 2000. The stated reason for the NMFS request for exceedance of the TDG standard is to supplement flows in the lower Snake River to achieve flow objectives as set forth in the 1995 Federal Columbia River Power System Biological Opinion and the 1998 supplement to that document.

The Nez Perce Tribe and the State of Idaho, in consultation with various state and federal agencies, have reviewed the information provided by the referenced request for a short term activity exemption. The Nez Perce Tribe and the State of Idaho grant a short term activity exemption to allow exceedance of the TDG standard up to 120% for 12 of the highest hourly measurements

during 24 hour spill, as measured at the U.S. Army Corps of Engineers Dworshak fish hatchery monitoring station, for the lower North Fork Clearwater and the mainstem Clearwater Rivers during the period April 3 through August 31, 2000. This short term activity exemption is granted by the Nez Perce Tribe and the State of Idaho under the conditions set forth in Attachment A.
This joint response to your request for a short term activity exemption represents a collaborative effort between the Nez Perce Tribe and the State of Idaho and is designed to address the needs of migrating and resident fish and to optimize water management in the Snake and Clearwater River Basins. We look forward to working with you and other federal, tribal and state agencies to successfully implement this short term activity exemption process.

Sincerely,

Samuel N. Penney
Chairman
Nez Perce Tribe

C. Stephen Allred
Administrator
Idaho Division of Environmental Quality

cc: James Yost
Karl Dreher
Rod Sando
Chuck Clarke
Mike Field

CONDITIONS OF THE SHORT TERM ACTIVITY EXEMPTION
TO THE STATE AND TRIBAL
TOTAL DISSOLVED GAS STANDARD
31 March 2000

The Nez Perce Tribe (Tribe) and the State of Idaho (State) are jointly issuing a short term activity exemption, through their authorities, to the total dissolved gas standard of 110 percent of saturation. The short term activity exemption allows the standard to be exceeded up to 120 percent within the North Fork Clearwater River, Dworshak Project to mouth, and the main Clearwater River, North Fork confluence to mouth. The conditions of the short term activity exemption are set forth in this document.

Conditions of Short term activity exemption

1. The Dworshak Project will be at full pool (elevation 1600 ft) by June 30th.

2. The Dworshak Pool will be maintained at elevation 1600 ft through July 31st.

3. On August 31st, the Dworshak pool will be at or above elevation 1537 ft. This will provide 200,000 AF to meet late summer/fall augmentation needs.

1. All releases from Dworshak for the purposes of anadromous fish migration and water temperature control must first be approved by the State and the Tribe upon a finding that the release is supported by scientifically defensible water quality and fish migration studies and data.

- Supporting studies and/or data must show that Dworshak releases will achieve their stated purpose(s).
    - Releases from Dworshak will not interfere with the rearing and migration of Clearwater River fall chinook smolts.
    - Specific flow augmentation releases will be authorized jointly in writing by the designated representatives of the Tribe and the State within this framework, after demonstration that there is scientifically defensible support for the release.

Releases will be approved only with the written concurrence of both parties.

1. The US Army Corps of Engineers will maintain the dissolved gas and temperature monitoring network, including monitoring stations at Dworshak, Peck and Lewiston. These stations will be operated and maintained on a continuous basis during the period of the short term activity exemption, except that the Dworshak station will be operated and maintained year-around.

Exceptions

Exceptions to these conditions may be granted under unusual circumstances (e.g. drought, specific fish passage needs, flood management requirements, etc.) if supported by scientifically defensible data and/or studies.

- The request for an exception will be made in writing to the Tribe and the State, and may result in a meeting with designated state and tribal representatives in Lewiston.
- Scientific data supporting the need for an exception will be attached to the request.
- A joint decision regarding the request for exception will be issued in writing by the designated state and tribal representatives.
- System operations requests for use of Dworshak water for flow augmentation and temperature control will not be presented to the NMFS Adaptive Management Process (TMT, IT) until after the request for exception is approved and issued by the designated state and tribal representatives.

Exceptions will be approved only with written concurrence of both parties.

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
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SYSTEM OPERATIONAL REQUEST: 2002 C-9

TO:	Brigadier General Fastabend	COE-NWD
	Steven Wright	BPA Administrator
	J. William McDonald	USBR-- Pacific Northwest Regional Director
	William Branch	COE-NWD-NP-Water Management
	Rudd Turner (acting Chief)	COE-NWD-NP-WM-RCC
	Witt Anderson	COE-NWD-CM-F (Pacific Salmon Coord. Office)
	LTC Edward Kertis, Jr.	COE-Walla Walla District
	Col. Richard Hobernicht	COE-Portland District
	Greg Delwiche, Scott Bettin	BPA-PG-5 and BPA-PGPO
	Stan Speaks, Keith Hatch	BIA, Portland Area Office

FROM: Don Sampson, *Executive Director*

DATE: August 15th, 2002

SUBJECT: **Operation of the Lower Columbia Pools for the Autumn 2002 Treaty Fishery**

The Columbia River Inter-Tribal Fish Commission, on behalf of its member tribes the Nez Perce Tribe, the Yakama Nation, the Confederated Tribes of the Umatilla Reservation, and the Confederated Tribes of the Warm Springs Reservation, requests the following reservoir operations in Zone 6 (Bonneville to McNary dams) during the 2002 autumn Treaty fishery. Implement the following hydro-system operations during the ceremonial and subsistence, and commercial, Treaty fishery times as established by the tribes and the Columbia River Compact.

SPECIFICATIONS: Implement the following operations as a hard system constraint as follows:

August 28th, 2002, 6 am, Wednesday, through 6 pm, August 31st, 2002, Saturday
September 4th, 2002, 6 am, Wednesday, through 6 pm, September 7th, 2002, Saturday
September 11th, 2002, 6 am, Wednesday, through 6 pm, September 14th, 2002, Saturday

Bonneville Pool: Operate the pool within 1.0 foot from full pool (msl elevation 77 – 76)
The Dalles (Celilo) Pool: Operate the pool within 1.0 foot (msl elevation 159.5 - 158.5)
John Day Pool: Operate the pool within 1.0 foot (msl elevation 264.5 - 263.5)

Maintain flows through all of the Zone 6 pools at a near constant rate. Fluctuate no more than plus or minus 10 kcfs from the beginning of the fishery to the end of the fishery.

JUSTIFICATION:

The 2002 autumn Treaty fishing season is of critical importance to CRITFC's member tribes. The anticipated escapement of an estimated 429,000 adult fall chinook will create harvest opportunities that tribal fishers realized only twice in the last 25 years, and many fishers will be exercising their treaty rights by participating in this harvest. Many cultural and religious ceremonies and practices will occur with the harvest of these salmon.

During a meeting at CRITFC's Law Enforcement Division in Hood River on September 2, 1999, tribal fishers explained the impacts of unstable pools and pools below full to the Treaty fishery to Colonel Mogren and Lt. Colonel Harshbarger. The tribal fishers explained that a pool fluctuation of 1.0 foot or more disrupts tribal fishery operations. Specific problems include: (1) increased local currents that sweep debris into fishing nets, (2) rapid 1-2 hour drops in water level will lead to entanglement of nets, (3) boat access problems, and (4) nets torn from their anchors. Nets and gear are costly to replace. Any delays or disruptions to tribal fishing operations caused by the excessive pool fluctuations in Zone 6 negatively impacts tribal incomes, food resources and cultural practices.

It is also critical to maintain near constant flow conditions during the fishery, because changes in pool flows, even with stable pool conditions, causes 1) nets to sag and drift towards shore and 2) disruption to shoreline eddy conditions and velocities important to successful harvest. The loss of fishing opportunity during the extremely limited treaty fishery cannot be replaced. Much of the tribal fishers' income and food is generated during the brief treaty fishing season, thus, any delays or disruptions to their fishing operations caused by the excessive pool fluctuations in Zone 6 negatively impacts tribal incomes, food resources, and cultural practices.

Implementing this request will insure that the Federal operating agencies meet their federal trust responsibilities to the Columbia Basin treaty tribes. If this SOR cannot be accommodated, CRITFC's member tribes request a detailed written response from the federal operators, with justification, by Friday August 23rd, 2002.

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SYSTEM OPERATIONAL REQUEST: 2002 C-10

TO:	Brigadier General Fastabend	COE-NWD
	Steven Wright	BPA Administrator
	J. William McDonald	USBR-- Pacific Northwest Regional Director
	William Branch	COE-NWD-NP-Water Management
	Rudd Turner (acting Chief)	COE-NWD-NP-WM-RCC
	Witt Anderson	COE-NWD-CM-F (Pacific Salmon Coord. Office)
	LTC Edward Kertis, Jr.	COE-Walla Walla District
	Col. Richard Hobernicht	COE-Portland District
	Greg Delwiche, Scott Bettin	BPA-PG-5 and BPA-PGPO
	Stan Speaks, Keith Hatch	BIA, Portland Area Office

FROM: Don Sampson, *Executive Director*

DATE: September 12th, 2002

SUBJECT: **Operation of the Lower Columbia Pools for the Autumn 2002 Treaty Fishery**

The Columbia River Inter-Tribal Fish Commission, on behalf of its member tribes the Nez Perce Tribe, the Yakama Nation, the Confederated Tribes of the Umatilla Reservation, and the Confederated Tribes of the Warm Springs Reservation, requests the following reservoir operations in Zone 6 (Bonneville to McNary dams) during the 2002 autumn Treaty fishery. Implement the following hydro-system operations during the ceremonial and subsistence, and commercial, Treaty fishery times as established by the tribes and the Columbia River Compact.

SPECIFICATIONS: Implement the following operations as a hard system constraint as follows:

September 16th, 2002, 6 am, Monday, through 6 pm, September 20th, 2002, Friday

Bonneville Pool: Operate the pool within 1.0 foot from full pool (msl elevation 77 – 76)
The Dalles (Celilo) Pool: Operate the pool within 1.0 foot (msl elevation 159.5 - 158.5)

John Day Pool: Operate the pool within 1.0 foot (msl elevation 264.5 - 263.5)

Maintain flows through all of the Zone 6 pools at a near constant rate. Fluctuate no more than plus or minus 10 kcfs from the beginning of the fishery to the end of the fishery.

Another week of the fishery may occur, with Compact agreement. The Corps will be notified.

JUSTIFICATION:

The 2002 autumn Treaty fishing season is of critical importance to CRITFC's member tribes. The anticipated escapement of an estimated 429,000 adult fall chinook will create harvest opportunities that tribal fishers realized only twice in the last 25 years, and many fishers will be exercising their treaty rights by participating in this harvest. Many cultural and religious ceremonies and practices will occur with the harvest of these salmon.

During a meeting at CRITFC's Law Enforcement Division in Hood River on September 2, 1999, tribal fishers explained the impacts of unstable pools and pools below full to the Treaty fishery to Colonel Mogren and Lt. Colonel Harshbarger. The tribal fishers explained that a pool fluctuation of 1.0 foot or more disrupts tribal fishery operations. Specific problems include: (1) increased local currents that sweep debris into fishing nets, (2) rapid 1-2 hour drops in water level will lead to entanglement of nets, (3) boat access problems, and (4) nets torn from their anchors. Nets and gear are costly to replace. Any delays or disruptions to tribal fishing operations caused by the excessive pool fluctuations in Zone 6 negatively impacts tribal incomes, food resources and cultural practices.

It is also critical to maintain near constant flow conditions during the fishery, because changes in pool flows, even with stable pool conditions, causes 1) nets to sag and drift towards shore and 2) disruption to shoreline eddy conditions and velocities important to successful harvest. The loss of fishing opportunity during the extremely limited treaty fishery cannot be replaced. Much of the tribal fishers' income and food is generated during the brief treaty fishing season, thus, any delays or disruptions to their fishing operations caused by the excessive pool fluctuations in Zone 6 negatively impacts tribal incomes, food resources, and cultural practices.

Implementing this request will insure that the Federal operating agencies meet their federal trust responsibilities to the Columbia Basin treaty tribes. If this SOR cannot be accommodated, CRITFC's member tribes request a detailed written response from the federal operators, with justification, by Friday September 20th, 2002.

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
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SYSTEM OPERATIONAL REQUEST: 2002 C-11

TO:	Brigadier General Fastabend	COE-NWD
	Steven Wright	BPA Administrator
	J. William McDonald	USBR-- Pacific Northwest Regional Director
	William Branch	COE-NWD-NP-Water Management
	Rudd Turner (acting Chief)	COE-NWD-NP-WM-RCC
	Witt Anderson	COE-NWD-CM-F (Pacific Salmon Coord. Office)
	LTC Edward Kertis, Jr.	COE-Walla Walla District
	Col. Richard Hobernicht	COE-Portland District
	Greg Delwiche, Scott Bettin	BPA-PG-5 and BPA-PGPO
	Stan Speaks, Keith Hatch	BIA, Portland Area Office

FROM: Don Sampson, *Executive Director*

DATE: September 18th, 2002

SUBJECT: **Operation of the Lower Columbia Pools for the Autumn 2002 Treaty Fishery**

The Columbia River Inter-Tribal Fish Commission, on behalf of its member tribes the Nez Perce Tribe, the Yakama Nation, the Confederated Tribes of the Umatilla Reservation, and the Confederated Tribes of the Warm Springs Reservation, requests the following reservoir operations in Zone 6 (Bonneville to McNary dams) during the 2002 autumn Treaty fishery. Implement the following hydro-system operations during the ceremonial and subsistence, and commercial, Treaty fishery times as established by the tribes and the Columbia River Compact.

SPECIFICATIONS: Implement the following operations as a hard system constraint as follows:

September 25th, 2002, 6 am, Wednesday, through 6 pm, September 28th, 2002, Saturday

Bonneville Pool: Operate the pool within 1.0 foot from full pool (msl elevation 77 – 76)
The Dalles (Celilo) Pool: Operate the pool within 1.0 foot (msl elevation 159.5 - 158.5)

John Day Pool: Operate the pool within 1.0 foot (msl elevation 264.5 - 263.5)

Maintain flows through all of the Zone 6 pools at a near constant rate. Fluctuate no more than plus or minus 10 kcfs from the beginning of the fishery to the end of the fishery.

JUSTIFICATION:

The 2002 autumn Treaty fishing season is of critical importance to CRITFC's member tribes. The anticipated escapement of ~475,000 adult fall Chinook, a 10% increase from prior forecasts, will create harvest opportunities that tribal fishers realized only twice in the last 25 years, and many fishers will be exercising their treaty rights by participating in this harvest. Many cultural and religious ceremonies and practices will occur with the harvest of these salmon.

During a meeting at CRITFC's Law Enforcement Division in Hood River on September 2, 1999, tribal fishers explained the impacts of unstable pools and pools below full to the Treaty fishery to Colonel Mogren and Lt. Colonel Harshbarger. The tribal fishers explained that a pool fluctuation of 1.0 foot or more disrupts tribal fishery operations. Specific problems include: (1) increased local currents that sweep debris into fishing nets, (2) rapid 1-2 hour drops in water level will lead to entanglement of nets, (3) boat access problems, and (4) nets torn from their anchors. Nets and gear are costly to replace. Any delays or disruptions to tribal fishing operations caused by the excessive pool fluctuations in Zone 6 negatively impacts tribal incomes, food resources and cultural practices.

It is also critical to maintain near constant flow conditions during the fishery, because changes in pool flows, even with stable pool conditions, causes 1) nets to sag and drift towards shore and 2) disruption to shoreline eddy conditions and velocities important to successful harvest. The loss of fishing opportunity during the extremely limited treaty fishery cannot be replaced. Much of the tribal fishers' income and food is generated during the brief treaty fishing season, thus, any delays or disruptions to their fishing operations caused by the excessive pool fluctuations in Zone 6 negatively impacts tribal incomes, food resources, and cultural practices.

Implementing this request will insure that the Federal operating agencies meet their federal trust responsibilities to the Columbia Basin treaty tribes. If this SOR cannot be accommodated, CRITFC's member tribes request a detailed written response from the federal operators, with justification, by Friday September 27th, 2002.

APPENDIX K

A c r o n y m s

List of Acronyms used in Fish Passage Center Annual Report

APRE	Artificial Production Review and Evaluation
BC Hydro	British Columbia hydro
BOR	Bureau of Reclamation
BPA	Bonneville Power Administration
CJS	Cormack, Jolly, Seber
COE	United States Army Corps of Engineers
CRITFC	Columbia River Inter-tribal Fish Commission
CWT	Coded wire tag
DEQ	Oregon Department of Environmental Quality
DOE	Washington Department of Ecology
ESA	Endangered Species Act
FCE	Flood control elevation
FPC	Fish Passage Center
FPE	Fish passage efficiency
GBT	Gas bubble trauma
HCC	Hells Canyon Complex
HGMP	Hatchery genetic management plan
IDFG	Idaho Department of Fish and Game
IPC	Idaho Power Company
NMFS	National Marine Fisheries Service now National Oceanographic and Atmospheric Administration Fisheries
NPT	Nez Perce Tribe
NTS	Non-treaty storage
NWPPC	Northwest Power Planning Council
NWRFC	Northwest River Forecast Center
ODFW	Oregon Department of Fish and Wildlife
Opinion	NOAA Fisheries 2000 Biological Opinion
PIT	Passive Integrated Tag
PSMFC	Pacific States Marine Fisheries Commission
RPA	Reasonable and prudent alternative

RSW	Removable spillway weir
SMP	Smolt Monitoring Program
SOR	System Operational Request
SPILLPROP	Spill proportion variable
TDG	Total dissolved gas
TDGS	Total dissolved gas supersaturation
TEMP	Temperature variable
TMT	Technical Management Team
TREATY	Columbia River Treaty
TSR	Treaty storage regulation
USFWS	United States Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
WSF	Water Supply Forecast
WTT	Water particle transit time
WY	Water year

APPENDIX L

Response to Comments on the FPC 2002 Annual Report

FISH PASSAGE CENTER

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http://www.fpc.org e-mail us at *fpcstaff@fpc.org*

MEMORANDUM

TO: Chris Ross

FROM: Michele DeHart

DATE: May 19, 2003

RE: Response to comments on the FPC 2002 Annual Report

Q: *Tables 33-36 Need to state what the lower and upper limits are – 90% C.I., 95% C.I., Std. Deviation, Std. Error.*

Response: Tables 33-36 limits are 95% confidence intervals. While the methods section does refer to the type of limit these are, we will make these changes to tables to make it more easily apparent to readers.

Q: *Add a table for MCN to BON reach survivals in the body of the text. The 2001 report at least has a bar graph of MCN-BON (fig. 43). Table is better.*

Response: We have included a table that provides weighted mean reach survivals for the LGR to MCN, MCN to BON and RIS to MCN reaches.

Q: *Survivals in 2002 report are different than survivals in 2001 report (compare Fig. 43 in 2001 to Table G3 in 2002 report).*

Response: These differences are due to the use of different types of estimates. In 2001 report shows unweighted average of 2 temporal blocks mimicking before and after spill time periods at

John Day Dam. While the 2002 An Report shows 3 two-week blocks. The difference is likely due to different blocking (thus time periods covered by the blocks) used for the different estimates.

Q: *Yearly averages for CH would be helpful (see multiple groups within years in Table G3).*

Response: We have included a table that provides passage index weighted mean reach survivals for the LGR to MCN, MCN to BON and RIS to MCN reaches for all years of the multi-year analysis 1998 to 2002. Those tables are in Appendix G, tables G4 through G9.