June 2001

FISH PASSAGE CENTER

2000 Annual Report

DOE/BP-15377-3

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views of this report are the author's and do not necessarily represent the views of BPA.

This document should be cited as follows:

DeHart, Michele - Fish Passage Center, 2002, Fish Passage Center 2001 Annual Report,
Report to Bonneville Power Administration, Contract No. 1999FG15377, Project No. 199403300,
263 electronic pages (BPA Report DOE/BP-15377-3)

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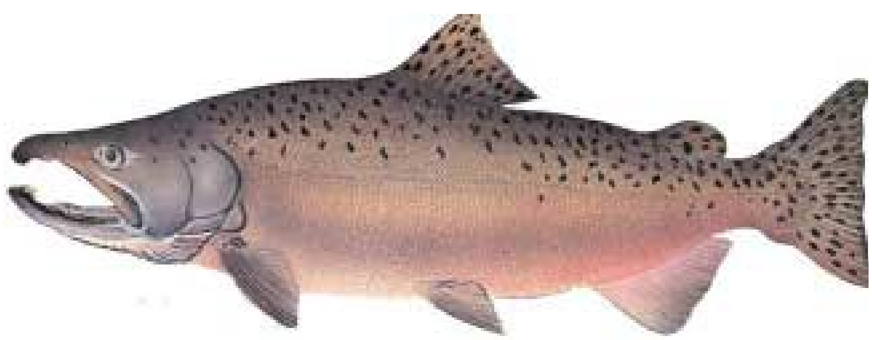
FISH PASSAGE CENTER

2000 ANNUAL REPORT

Fish Passage Center
of the
Columbia Basin Fish & Wildlife Authority



June, 2001

FISH PASSAGE CENTER

ANNUAL REPORT

2000

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.

PROJECT NO. 1994-033-00

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June, 2001

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Acknowledgments

We thank all the individuals, agencies, and organizations who contributed to the successful completion of the 2000 program.

We extend thanks to the hatchery release coordinators, managers, and staffs of all basin facilities for providing timely information on hatchery releases. We are indebted to the managers and staffs of Wells, Winthrop, Leavenworth, Priest Rapids, Rapid River, McCall, Dworshak, and Lookinglass hatcheries, all of whom supplied fish and logistical assistance for the marking program. We extend a special thanks to those who PIT tagged fish for the Smolt Monitoring Program (SMP). Fish marking was carried out by U.S. Fish and Wildlife Service (USFWS), Idaho Department of Fish and Game (IDFG), Oregon Department of Fish and Wildlife (ODFW), Nez Perce Tribe (NPT), and Washington Department of Fish and Wildlife (WDFW).

We appreciate the efforts of the field crews at each of the monitoring sites. Sampling and reporting were carried out by WDFW at Rock Island, 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 Chelan County 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 staff: Michele DeHart, Tom Berggren, Margaret Filardo, Larry Basham, Dusica Jevremovic, Henry Franzoni, Sergei Rasskazov, Jerry McCann, Deidre Wood, Chris McCarty and Dona Watson.

The project was funded by Bonneville Power Administration (BPA), under the northwest Power Planning Council Fish and Wildlife Program, Section 303 (d) (1), BPA Project #94-033.

Executive Summary

The year 2000 hydrosystem operations illustrated two main points: 1) that the NMFS Biological Opinion on the operations of the Federal Columbia River Power System (FCRPS) fish migration measures could not be met in a slightly below average water year, and; 2) the impacts and relationships of energy deregulation and volatile wholesale energy prices on the ability of the FCRPS to provide the Biological Opinion fish migration measures. In 2000, a slightly below average water year, the flow targets were not met and, when energy "emergencies" were declared, salmon protection measures were reduced.

The 2000 migration year was a below average runoff volume year with an actual run off volume of 61.1 MAF or 96% of average. This year illustrated the ability of the hydro system to meet the migration protection measures established by the NMFS Biological Opinion. The winter operation of storage reservoirs was based upon inaccurate runoff volume forecasts which predicted a January-July runoff volume forecast at The Dalles of 102 to 105% of average, from January through June. Reservoir flood control drafts during the winter months occurred according to these forecasts. This caused an over-draft of reservoirs that resulted in less volume of water available for fish flow augmentation in the spring and the summer. The season Biological Opinion flow targets for spring and summer migrants at Lower Granite and McNary dams were not met.

Several power emergencies were declared by BPA in the summer of 2000. The first in June was caused by loss of resources (WNP2 went off-line). The second and third emergencies were declared in August as a result of power emergencies in California and in the Northwest. The unanticipated effects of energy deregulation, power market volatility and rising wholesale electricity prices, and Californian energy deregulation reduced the ability of the FCRPS to implement fish protection measures.

A Spill Plan Agreement was implemented in the FCRPS. Under this plan, spill hours were increased at Lower Monumental Dam. Spill volume at The Dalles was reduced and daytime spill tests were conducted at John Day and Bonneville Dams. Although provided for fish, most spill that occurred in 2000 was either in excess of project hydraulic capacity or excess generation. This effectively reduced the actual cost of the spill program.

For the most part, spill in 2000 was managed to the waiver limits for total dissolved gas levels and the NMFS action criteria for dissolved gas signs were not exceeded.

Hatchery spring chinook returns comprised an estimated 81.4% of the total spring chinook adult return to Lower Granite Dam.

Smolt travel time and survival were similar to past years for most Smolt Monitoring Program groups. The notable exceptions were Snake River hatchery steelhead groups and mid-Columbia hatchery sub-yearling groups from Wells and Ringold hatcheries, which had significantly lower survivals than previous years. Yearling chinook travel time showed variation from past years, reflecting the atypical flow shape in 2000 which had high flows in April, declining through May.

I. 2000 WATER SUPPLY

A. Precipitation-Water Supply Forecasts

Fall period: Precipitation (Table 1) was not uniformly distributed all over the region. The Upper Columbia watershed experienced well above average precipitation in November resulting in above average runoff in the sub-basin (151% of average at The Dalles). At the same time, the Snake River basin received below average precipitation of 62% and 70% respectively for the October-November period, resulting in below average runoffs.

Precipitation in January was average and above average for most of the basin but, due to unprecedented dry soil conditions, resulted in below average runoff volumes of 84% of average at Lower Granite and 92% of average at The Dalles. Snowpack was less than normal due to warm temperatures resulting in seasonal runoff volume forecasts below average for the Snake River basin and close to or slightly above average for the rest of the basin (Table 2). Above average February temperatures and generally above average precipitation caused above average runoff for most of the Columbia River area above Grand Coulee and in the Upper Snake. Other areas had February runoff ranging from 70% to 85% of average. Resulting runoff at Lower Granite was 97% of average and at The Dalles was 102% of average. Snow conditions for most of the basin remained unchanged and seasonal runoff volumes didn't change significantly. March precipitation was below normal across the Snake basin and above average at the upper Columbia, resulting in runoff at Lower Granite at 93% of average and The Dalles at 100% of average. Seasonal runoff volume forecasts didn't change significantly in comparison with the previous month.

April precipitation conditions were below normal to normal in most of the basin except the area above Grand Coulee. Because of the higher than normal temperatures and initiation of the snowmelt, stream flow for April was above average for most of the Columbia Basin, resulting in 128% of average runoff at The Dalles. Areas in the middle to upper Snake experienced below normal runoff, with total runoff at Lower Granite of 117% of normal. Seasonal runoff volume forecasts slightly improved at the Upper Columbia subbasins, but generally dropped for Snake River tributaries by 3%-5%. May precipitation was slightly below average and snowmelt was less then expected, due to below average temperatures and overestimated snowpack forecasts, resulting in only 84% of average runoff at Lower Granite and 89% of average runoff at The

Dalles. A reduced snowpack and slightly below average May precipitation caused a drop of 1%-4% in May forecast volumes at the major subbasins, resulting in decreased base flows and refill volumes of the reservoirs. June precipitation was below average and with reduced snowpack meltoff resulted in very low monthly runoff volumes of 59% of average for Lower Granite and 76% of average for The Dalles. Seasonal runoff volume forecasts experienced a slight increase of 1% at Libby and 3% at Hungry Horse, despite average precipitation conditions in the previous month, and the same or slightly lower (1-3%) values than previous month for the rest of the basin.

July precipitation was well below normal across the most of the basin, resulting in 55% of average runoff at Lower Granite and 92% of average runoff at The Dalles. Runoff Volumes decreased significantly at all major sites during this month due to overestimated snowpack. The July Runoff volume forecast at Libby decreased by 21% compared to the May Final Runoff volume forecast. The Northwest River Forecast Center concluded that in addition to overestimated snowpack, forecasters underestimated the surface flow losses due to subsurface saturation in May and June. Decreases in runoff volume forecasts for the other major sites were between 2% and 5%. The actual runoff volumes for the major sites for the January-July period were lower than the April Final Runoff Volume forecasts of 7%-8%, resulting in overdrafted reservoirs for flood control and failure to refill reservoirs later in the spring season.

Very low August precipitation across the basin resulted in below average runoff volumes in the entire basin, with 73% of average at Lower Granite and 84% of average at The Dalles. Temperatures were above normal across Idaho and northwestern Montana. September precipitation was above normal only at central Idaho, southern British Columbia and southeast Washington, resulting in below normal runoff volumes of 89% at Lower Granite and 92% at The Dalles.

TABLE 1. Monthly Cumulative Precipitation Presented as Percent of Normal at: The Dalles, Ice Harbor at the Snake River and the Columbia above Grand Coulee.

Month	Columbia above The Dalles	Snake River above Ice Harbor	Columbia above Grand Coulee
	% of average 1961-1990	% of average of 1961-1990	% of average of 1961-1990
October	100	62	129
November	114	70	148
December	93	93	90
January	103	119	100
February	113	143	97
March	103	86	111
April	89	79	116
May	101	93	93
June	66	43	76
July	74	45	77
August	35	38	36
September	122	113	116

TABLE 2. Forecasted Volumes for 2000.

Forecast Month	Libby (Apr-Sep)		Hungry Horse (Apr-Sep)		Grand Coulee (Jan-Jul)		Brownlee (Apr-Jul)		Dworshak (Apr-Jul)	
	MAF	%avg	MAF	%avg	MAF	%avg	MAF	%avg	MAF	%avg
January	7.23	107	2.02	92	66.6	105	3.59	62	2.8	104
February	7.25	107	2.04	93	66.1	104	3.67	63	2.8	104
March	7.1	105	2.1	96	65	103	4.06	70	2.8	104
April	7.29	108	2.09	96	65.8	104	3.93	68	2.67	99
May	7.08	105	2.08	95	65.8	104	4.08	70	2.56	95
June	7.18	106	2.13	98	64.8	102	3.86	67	2.56	95
July	5.72	84	2.08	95	61.5	97	4.12	71	2.64	98
Actual	5.84	86	1.94	89	61.1	96	4.37	75	2.67	99

Forecast Month	Columbia above The Dalles (Jan-Jul)		Snake River above Lower Granite (Jan-Jul)	
	MAF	%avg	MAF	%avg
January	105	99	25.7	86
February	106	100	26.9	90
March	105	99	27.6	93
April	105	99	26.7	90
May	105	99	26.4	89
June	102	96	25.7	86
July	97.9	92	24.9	84
Actual	98.01	92	24.66	83

Comparison of the historic data for three reference sites in the Columbia Basin is given in Table 3.

TABLE 3. January - July Actual Runoff Volumes for 1992-2000.

Year	Columbia above Grand Coulee		Columbia above The Dalles		Snake River above Lower Granite	
	MAF	% of avg	MAF	% of avg	MAF	% of avg
1992	46.5	74	70.4	66	14.1	47
1993	49.1	78	88.0	83	26.7	90
1994	50.9	80	75.0	71	15.9	53
1995	59.0	93	104.0	98	29.4	99
1996	78.9	135	139.3	132	42.4	143
1997	88.2	137	159.0	150	49.5	166
1998	59.0	93	104.5	98	31.3	105
1999	71.3	115	124.1	117	36.1	121
2000	61.1	96	98.0	92	24.7	83

B. Operational Guidelines 2000

- The implementation of fish protection measures occurred under the auspices of the federal agencies records of decision and the NMFS Biological Opinions for 1995, 1998 and 1999.
- The hydrosystem operational management in 1999/2000 for fish passage was conducted through the Technical Management Team, TMT, an inter-agency team comprised of representatives of Federal Operating Agencies (COE, BOR, BPA) and State and Federal Fish and Wildlife Agencies (NMFS, USFWS, ODFW, WDFW, IDFG) and the State of Montana.

Guidance for implementation of fish protection requirements for fish passage were based on the National Marine Fisheries Service (NMFS) 1995 Federal Columbia River Power System (FCRPS) Biological Opinion and NMFS 1998 Supplemental Steelhead Biological Opinion and 1999 Supplemental Biological Opinion for the lower Columbia, including the 1995 RPA, the 1995 and 1998 incidental take statements. The addition of lower Columbia chum salmon to ESA listed Snake River spring/summer/fall chinook and sockeye, and mid-Columbia steelhead resulted in required protection flows for the lower Snake and mid/lower Columbia Rivers during the entire year.

1. Fall/Winter Operation: 1999-2000

Columbia River

- Fish protection requirements were in place for Vernita Bar fall chinook spawning and Bonneville chum and fall chinook spawning.
- During the winter period reservoirs were operated primarily for power production, resulting in end of March actual elevations lower than required flood control elevations.

The flow requirement for Vernita Bar, below Priest Rapids Dam was established during October at a minimum daily average of 65 kcfs, in accordance with the terms of the Vernita Bar settlement agreement. Although there was a request to maintain stable flows for chum and fall chinook incubation and spawning at the Ives/Pierce and Hamilton islands below Bonneville dam during the October-April period; flows below Bonneville were shaped primarily for power generation demands. Fishery flow requirements were met and exceeded due to power generation demands for most of the spawning and incubation period, except during the period of November 1-7 when the daily average flows were in the range of 125.1 kcfs-133.03 kcfs, instead of required instantaneous minimum flows of 140 kcfs due to temporarily decreased power generation demand. Meeting the flow target during this period was possible with either additional drafting of Grand Coulee, Hungry Horse or the higher Non Treaty Storage releases. However, December monthly average flows of 206.1 kcfs, due to increased power generation demand, were higher than the requested 160 kcfs for chum spawning below Bonneville Dam.

Upper Columbia reservoirs were at higher elevations at the beginning of the fall season of 1999 than usual due to a wet summer of 1999 and TMT decision to maintain summer target flows of 200 kcfs at McNary as a maximum cap in summer flows. However, very low Snake River Basin fall precipitation and shaping flows for the power market demands negatively affected flows below Bonneville. Upper Columbia reservoirs were shaping flows for power purposes primarily during the October-December period (Table 4):

Libby reservoir decreased its rate of drafting from 12 kcfs to 8 kcfs during November 1-7, when Bonneville flows were below the required minimum. However, the reservoir was drafted to an elevation of 2408.1 ft (Table 4) at the end of December, due to higher demand for power generation, which is 2.9 ft lower than the required end of year elevation of 2411 ft for flood control.

Libby was drafted to flood control elevation on January, and then it was drafted 2.8 ft above required flood control elevation in February in order to improve chances for meeting the April 15 flood control evacuation point with 75% confidence. The reservoir was on minimum outflow of 4 kcfs beginning on March 14.

Hungry Horse was slightly drafted from elevation 3542.34 ft to elevation 3542.26 ft during the period of October 1-November 2. Refill continued by the end of November at elevation of 3544.34 ft. The reservoir was drafted to an elevation of 3536.78 ft by the end of December for power generation purposes.

Hungry Horse was drafted according to Integrated Rule Curves defined by the State of Montana during January and February, resulting in actual end of month elevations lower than required by COE flood control requirements. The end of January elevation was 19.7 ft lower than the required elevation for flood control and the end of February elevation was 16.4 ft lower than the required elevation for flood control. The end of March actual elevation was 10 ft lower than the elevation required by IRC and 14.4 ft lower than the COE required flood control elevation. This operation resulted in 284.4 kaf less water in the reservoirs for the April flows.

Grand Coulee was refilled to 1287.85 ft on November 16 and then drafted to 1272.1 ft at the end of December for power generation purposes. Fishery requirements as a part of Northwest Power Planning Council's Fish and Wildlife Program for resident fish was to maintain a minimum elevation of 1283 ft through November 15 to facilitate kokanee broodstock collection efforts in Lake Roosevelt and to ensure access to tributary spawning streams by naturally-spawning adult kokanee. The reservoir was insufficiently drafted only a foot from 1287.65 ft to 1286.55 ft, during the November 1-7 period of low Bonneville spawning flows.

Grand Coulee was operated for power generation purposes and drafted to the lowest elevation of 1258.4 ft on February 16. The reservoir was 26.7 ft below flood control required elevation at the end of January, 27.4 ft below required flood control elevation at the end of February and 8.85 ft below required flood control elevation at the end of March. The Action Agencies failed to meet the Fishery Agencies request for Grand Coulee outflows to be shaped to provide protection below Bonneville, with a tailwater elevation of 15.7 ft due to shaping flows for power generation demand. Winter operations resulted in 625 KAF less water in the reservoir than required flood control, at the end of March, due to power generation operations.

Snake River

- The Snake Basin reservoirs were operated for irrigation and fishery requirements during the October-December period.

Dworshak reservoir had minimum outflow of 1.5 kcfs throughout the entire period, refilling to 19.06 ft for the October-December period. Dworshak was drafted for flood control during January and February. As the Grand Coulee and Hungry Horse reservoirs were overdrafted in February, providing more than required flood control space in the system, the COE decided to draft Dworshak to only 1522.2 ft instead of 1512.2 ft as required by flood control. This operation preserved 128 kaf for the April migration in the lower Snake.

Brownlee was drafted to its minimum fall elevation of 2027.4 ft on October 17, when IPCo commenced refill through the end of the year with a constant discharge of 9.5 kcfs for spawning and incubation of fall chinook below Hells Canyon Dam. The reservoir was refilled to an elevation of 2073.1 feet on December 31.

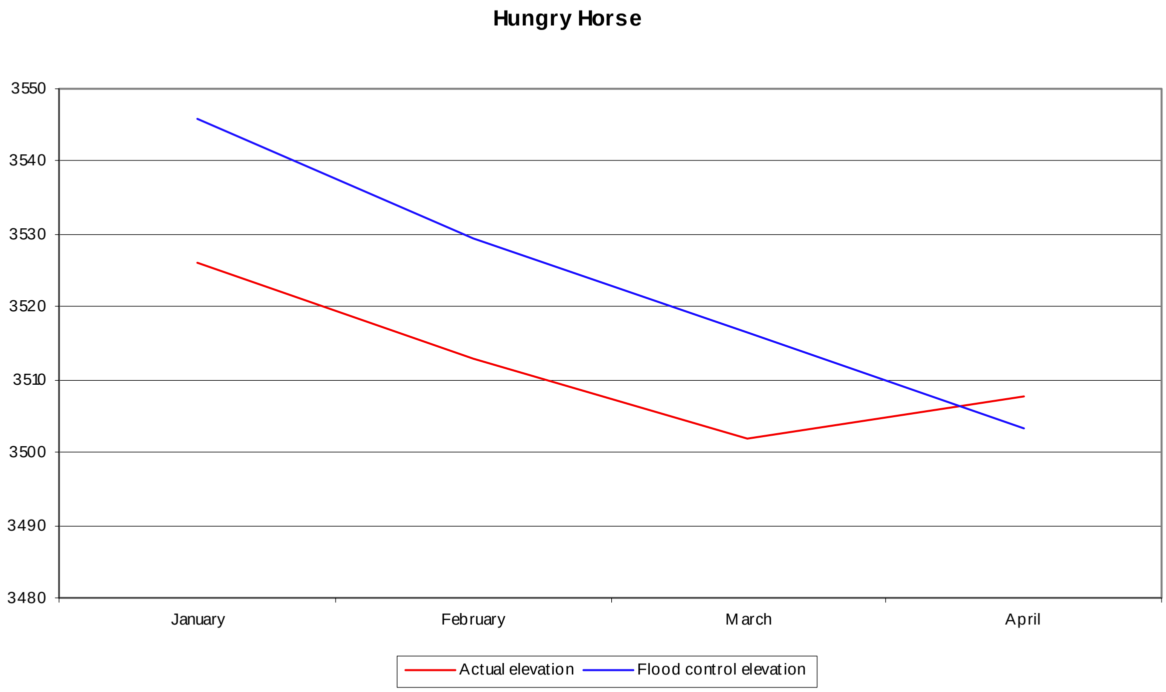
Brownlee was refilled to 2075.2 ft on January 3, and then initiated flood control operations. The lowest elevation of 2053.7 ft was achieved on February 12. Flows were shaped for power generation purposes during the January-March period, with an end of January elevation of 13.64 ft below the required flood control elevation. The end of February elevation was 3.25 ft higher than required flood control elevation due to a sufficient level of system flood control space at that time. The end of March actual elevation was 2.6 ft lower than the COE required flood control elevation, or 30 kaf less in the reservoir for April flows.

The **Upper Snake** reservoirs continued to be drafted for irrigation demands through the middle of October, at which time they continued with passing inflow and initiating refill operations, as the BOR strategy is to avoid any risk in providing irrigation water because precipitation during the fall ranged only 1% to 60% of average. At the end of October, Jackson Lake was at 74.3% of capacity, Palisades was at 75.3% of capacity and American Falls was at 44.6% of capacity. Refill operations resulted in the following volumes at the end of December: Jackson Lake was at 74.7% of full capacity, Palisades was at 81.1% of full capacity and American Falls was at 70.1% of full capacity. The Upper Snake reservoirs continued with refill and passing inflow operations. Jackson Lake and Palisades, with average and slightly above average inflows, were passing inflow or slightly drafted to 77.6% of full capacity and 82.4% of full capacity respectively at the end of March. American Falls was refilled from 70.1% to 98.5% of full capacity in the end of December to end of March period. IPCo conservative strategy resulted in maximized refill of the system by the end of March for the average water year conditions.

TABLE 4. End of December 2000 Reservoir Elevations.

PROJECTS	Actual elevation on October 1 [ft]	Actual Elevation on December 31 [ft]
Libby	2448.55	2408.1
Hungry Horse	3544.43	3536.78
Grand Coulee	1285.95	1272.1
Brownlee	2038.3	2073.1
Dworshak	1518.81	1537.86

Winter operations were characterized with reservoir drafting for power generation and flood control requirements. Actual and flood control required elevations for the January-April period are shown in Figure 1.



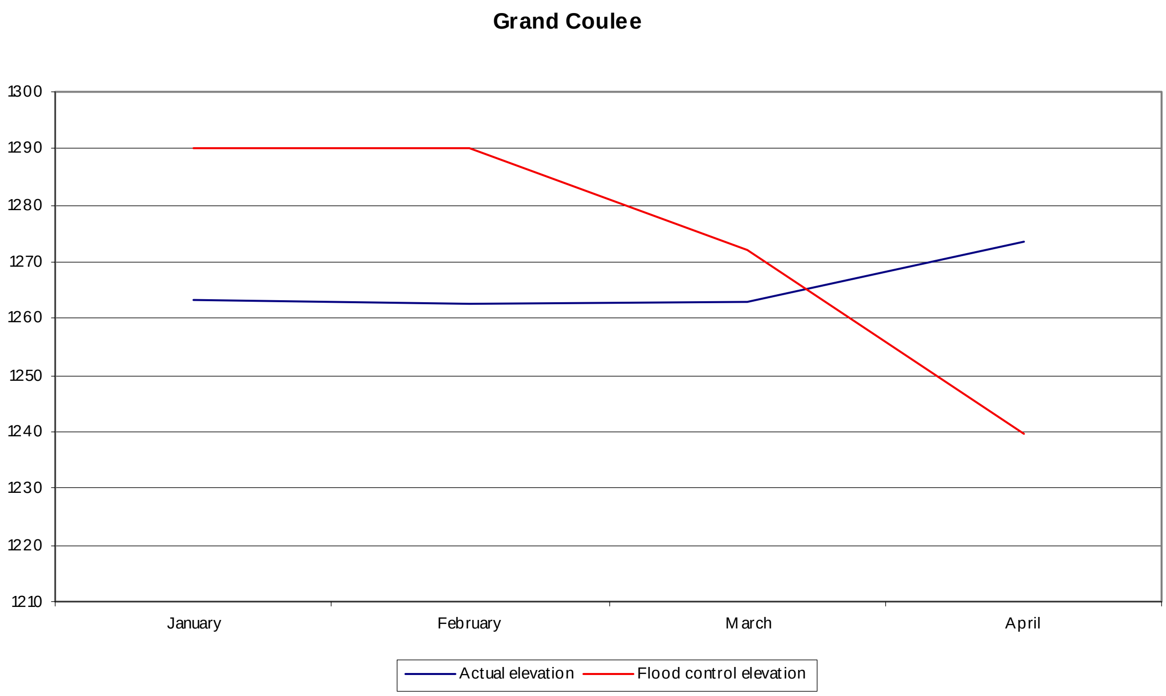


FIGURE 1. Required flood control elevations and observed elevations at major reservoirs in the basin.

Figure 1 continued

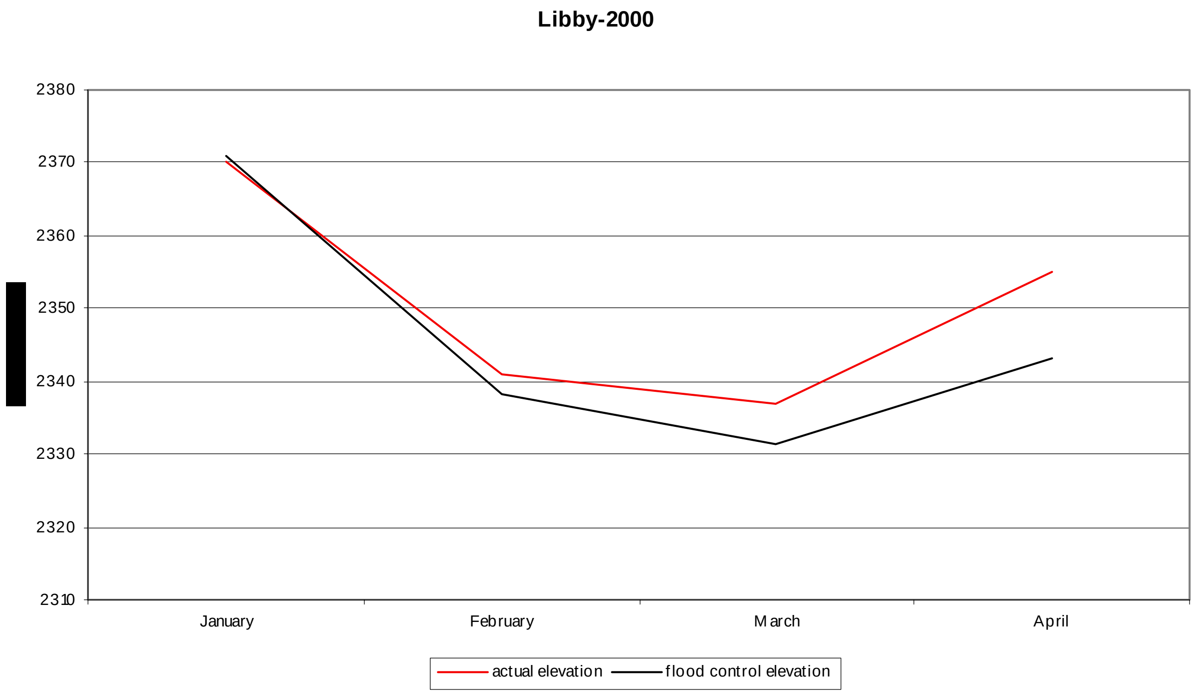
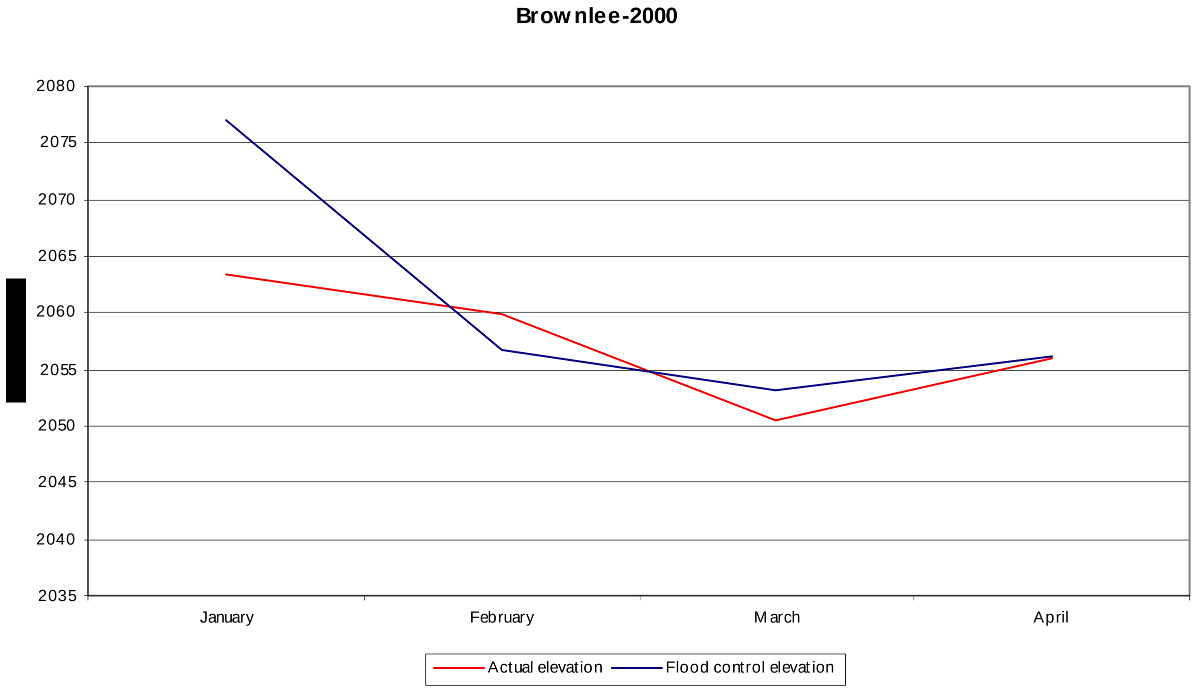


FIGURE 1. Required flood control elevations and observed elevations at major reservoirs in the basin.

Figure 1 continued



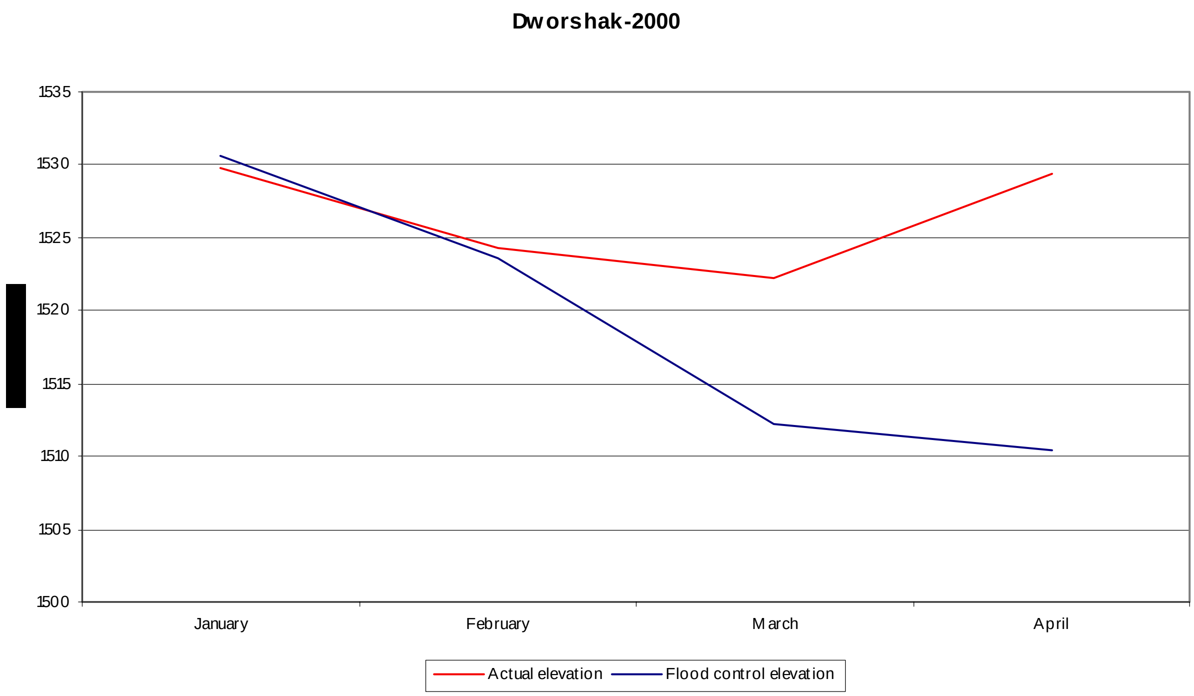


FIGURE 1. Required flood control elevations and observed elevations at major reservoirs in the basin.

Runoff volume forecasts during January through March for the major projects did not change or decreased slightly, therefore the required end of month flood control elevations didn't change significantly from month to month. The Salmon Managers requested in the third week of March, refilling reservoirs beyond the April 10 Biological Opinion target reservoir elevation in order to maximize available water for spring migration. This request was based upon below normal March precipitation for the Snake basin, resulting in increased probability that the April Final runoff volumes would decrease. This occurred in previous years, resulting in inaccurate runoff volume forecasting, which in case of the average water year may have serious consequences on spring migration flows. The request was not implemented by federal regulators. Instead, reservoirs were operated to meet load, resulting in actual flows below Bonneville for chum protection, being higher than requested, and actual end of March elevations lower than required for flood control protection (see Table 5). This action resulted in lower spring migration flows for juvenile salmon. The reservoirs were operated as follows:

TABLE 5. End of March Required Flood Control Elevations and Actual Elevations at Reservoirs.

Projects	Required Flood Control Elevation on March 31 [ft]	Actual Elevation on March 31 [ft]	Min/Max Pool Elevation [ft]	Max. 2000 Winter Draft and Date (period of 1/1-3/31)
Libby	2331.3	2337.01	2287.0/2459.0	2336.65 ft on 3/23
Hungry Horse	3516.5	3502.03	3336.0/3560.0	3502.03 ft on 3/31
Grand Coulee	1272.0	1263.1	1208.0/1290.0	1258.4 ft on 2/16
Brownlee	2053.1	2050.5	1976.0/2077.0	2050.5 ft on 3/31
Dworshak	1498.3	1522.2	1445.0/1600.0	1515.57 ft on 3/18

2. Spring Operations: 2000

The Steelhead 1998 Biological Opinion specified that Libby, Hungry Horse, and Grand Coulee should be at their flood control elevations on April 10, when the migration season begins in the mid-Columbia reach. The Snake River reservoirs are required by the 1995 Biological Opinion to be at their flood control elevations by April 20 for the beginning of the migration season in the lower Snake River. Reservoirs are required to be at their flood control elevations on the marked dates to increase probability of meeting the spring BiOp flow targets at Priest Rapids, Lower Granite, and McNary; and to meet the probability of refill by June 30, as summarized in Table 6.

TABLE 6. Spring Flood Control Elevations at Reservoirs.

PROJECT	COE Required Flood Control Elevation on April 30 [ft]	Actual Elevation on April 30 [ft]	Opinion Required Elevation on April 10*/20** [ft]	Actual Elevation on April 10*/20** [ft]	Maximum Draft Achieved During Spring Season [ft] (4/1-6/30)
Libby	2343.1	2355.06	Na	2339.34*	2337.1 ft on 4/1
Hungry Horse	3503.2	3507.66	3511.5*	3502.64*	3502.12 ft on 4/3
Grand Coulee	1239.6	1243.4	1260.9*	1257.6*	1233.9 ft on 5/19
Brownlee	2056.2	2055.93	2053.2**	2058.66**	2337.1 ft on 4/1
Dworshak	1510.4	1529.32	1515.1**	1525.34**	1518.85 ft on 4/13

*The April 10 elevation determined by linear interpolation between March and April flood control elevations based on March Final Runoff Volume forecast

**The April 20 elevation determined by linear interpolation between end of March and April flood control elevations based on March Final Runoff volume Forecast

***The April 10 approximately calculated BiOp required elevation based on March FCE and April Final end of April FCE

Spring reservoir operations were based on overestimated Runoff Volume Forecasts which failed to materialize later in the year. This resulted in the failure of Federal operators to refill some of the major reservoirs to the required April 10 BiOp elevation, because of deep winter drafts for power generation. The winter reservoir drafts, delayed snowmelt and below average precipitation resulted in low Spring flows in the system. This in turn resulted in failure to meet the 95 BiOp required end of June elevation. Individual reservoirs were operated as follows.

Libby was on minimum flow of 4 kcfs beginning March 14, in an attempt to meet the requirements of salmon BiOp and sturgeon BiOp. A sturgeon pulse operation was initiated on June 7 with a gradual increase in outflows to 25 kcfs during June 13 through June 28 period. The outflows gradually decreased to 8 kcfs on July 3 to meet the minimum required flows for bull trout below the dam. The reservoir was operated during the January-June period based on the April-September runoff volume forecasts which were in the range of 105%-108% of average.

The **Hungry Horse** deep winter drafts for power generation resulted in a failure of the Action Agencies to refill the reservoir to the BiOp required April 10 elevation. The actual elevation was 8.9 ft lower than the BiOp required elevation which reduced the amount of water available for spring flow augmentation by 173.5 kaf. The end of April reservoir elevation was 4.5 ft higher than the required flood control elevation, due to increased inflows in the last week of April.

The Action Agencies decided to avoid spill and operate the project to its maximum hydraulic capacity of 8 kcfs, which also contributed to the higher end of April elevation.

The project was refilled to an elevation of 3558.35 ft by June 30, which is 1.65 ft below the BiOp required elevation of 3560 ft. This resulted in a 43 kaf reduction of flow augmentation for summer migrants.

Grand Coulee was operated for flood control in April. Fishery agencies warned the Action Agencies about the high probability of runoff volume forecasting failure and the consequence of drafting reservoirs too deeply for flood control in winter, warning that it might result in low flows in the spring. The final April Runoff Volume forecast for Grand Coulee was 104% of average and the Final July Runoff Volume Forecast was 97% of average, resulting in lower than projected May and June flows in the system. Due to high temperatures, initiation of snowmelt and local high precipitation in the area, the inflows increased to 134% of average in April. However, the Fishery Agencies request for refill beyond the required April 10 BiOp elevation was not met due to a deep draft in March and power generation requirements in early April. The actual April 10 elevation was 3.3 ft lower than the BiOp required elevation, resulting in 224.3 KAF less water in the reservoir for Spring migrants. The Action Agencies met the requirements of the Fishery Agencies and shifted the end of April flood control draft to the first week of May in order to avoid SSARR projected steep decreases in the mid-Columbia flows. The actual end of April elevation was 3.8 ft higher than required, and the May 7 actual elevation was 2.3 ft above required flood control, resulting in shifting 229.6 kaf of flow augmentation from April into the first week of May and 138.2 kaf from the first week of May into the second week of May. Decreased flows in the mid-Columbia during the peak of the migration prompted the decision of the Action Agencies and the Fishery Agencies to augment flows by drafting Grand Coulee through May 19 to elevation 1233.9 ft, which is 5.7 ft below flood control level. Subsequently the action agencies prioritized refill over meeting the fishery agencies requested flow at McNary for May 20 through June 11. The reservoir was refilled to 1262.1 ft. Fishery agencies prioritized higher flows at McNary over refill of winter overdrafted Grand Coulee, requested minimum flows of 170 kcfs. However, NMFS supported meeting the minimum achievable flow target of 170 kcfs at McNary further supported storing additional water beyond the required minimum in Grand Coulee for the week of June 12-18, resulting in refill to 1274.55 ft instead of the Fisheries requested 1268 ft. The reservoir continued refill to elevation 1279 ft by the end of June, effectively reducing spring migration flow because 866.3 kaf less water for the spring migration, which was shifted to summer.

Brownlee reservoir was operated for flood control operations in April, resulting in spill at Hells Canyon Dam during April 14-27. The Fishery Agencies' request for higher outflows during the last week of April and first week of May to improve flows below Lower Granite was denied. IPCo and the Action Agencies chose instead to avoid spill at Hells Canyon Dam and Oxbow Dam. In addition, a minimum flow of 11 kcfs below Hells Canyon Dam for the Nez Perce Hatchery during May. IPCo operated the reservoir to secure refill of the reservoir to 2069 ft for recreational purposes for the Memorial Day weekend. An additional agreement between BPA and IPCo for the period of May 10 through 15 provided increased flows due to a higher rate of Brownlee draft. However, limiting hydraulic capacity of Oxbow Dam precluded utilization of available 110 KAF. Only 61.28 kaf was drafted in that period and returned through May 15 as an additional volume over inflow. The reservoir was refilled to 2075.99 ft on June 13. It was drafted to 2072.05 ft or 54.6 kaf through June 30 to improve rapidly decreasing flows at Lower Granite.

Dworshak reservoir was operated for flood control in April but outflow was limited by the Idaho State Total Dissolved Gas Standards and limited hydraulic capacity of the project, so the reservoir was 18.9 ft above the end of April flood control elevation. May refill was slower as a result of flow augmentation at Lower Granite during the first week of May. Refill in June, due to increased inflows, was shaped to improve flows at Lower Granite in the first half of the month. The reservoir was refilled to 1598.6 ft on June 30.

The **Upper Snake** reservoirs were operated for refill and irrigation in April. The system was refilled to 90% of its capacity by the end of the April. Refill to 95% of capacity occurred in May due to cold weather and decreased irrigation demands. Flow for salmon augmentation was initiated on June 22 with a gradual increase at Milner to 1.5 kcfs on June 24.

TABLE 7. Reservoir Elevations at June 30.

PROJECT	Normal Full Pool Elevation [ft]	Pool Elevation on June 30 [ft]	Highest Pool Elevation and Date
Libby	2459	2418.12	2436.2 ft on 8/19
Hungry Horse	3560	3558.35	3558.35 ft on 6/30
Grand Coulee	1290	1279.0	1286 ft on 7/16
Brownlee	2077	2072.06	2075.99 ft on 6/13
Dworshak	1600	1598.62	1598.76 ft on 6/29

3. Summer Operations: 2000

Summer operations were determined in large part by the failure of the Runoff Volume to materialize as predicted. The most extreme case occurred at Libby, where actual flows were 20% lower than the June Final Runoff Volume Forecast. Consequently, actual summer flows were lower than projected earlier in the spring. Upper Columbia reservoirs with the exception of Hungry Horse were not refilled during the spring and failed to deliver summer augmentation flows. Reservoirs were operated as follows.

Libby reservoir continued to be operated for bull trout flow requirements of 8 kcfs during July. The Runoff Volume Forecast failure to materialize in July, resulted in a 22% decrease of estimated runoff volume for the January through July period. Earlier winter drafting was based on the earlier forecast. The reservoir was not refilled and it was at 2434.49 ft by the end of July, which is 1081.2 kaf less water in the reservoir than is required by the BiOp. The reservoir continued to be operated at 8 kcfs for bull trout resulting in elevation of 2434.89 ft at the end of August, which is 4.11 ft below the BiOp required elevation.

Hungry Horse was operated for flow augmentation during July 2-August 31 to an end of August elevation of 3539.8 ft.

Grand Coulee was refilled to 1286 ft by July 16. The flows were shaped for power generation primarily and then for flow augmentation during the July and August periods. The reservoir was drafted to 1284.1 ft through July 31 for flow augmentation. Although the Fishery Agencies requested drafting to 1283 ft through August 6 to support higher flows at McNary, the reservoir was refilled to 1285.5 ft in order to maintain availability for power drafts. The reservoir was drafted to 1284 ft on August 13 instead of the Fishery Agencies requested draft to elevation of 1282 ft. Furthermore, the reservoir was drafted to 1281.6 ft instead of the Fishery Agencies requested draft to 1281 ft through August 20. The end of August elevation was 1280.4 ft. The reservoir was drafted to its lowest point of 1279.8 ft on September 6, and then refilled to its highest elevation of 1286.5 ft on September 24, with an end of September elevation of 1285.5 ft. The reservoir elevation was kept between 1280 ft and 1283 ft during September for the operation of kokanee artificial production facilities.

Brownlee was operated for flow augmentation from July 5 through July 28 as requested by the Fishery Agencies. The reservoir was drafted from an elevation of 2071.02 ft to 2042.53 ft for delivery of 237 kaf as the part of the IPCo BiOp obligation and shaped 75 kaf from the Payette system. The Fishery Agencies requested a further draft in August to improve low flows at Lower Granite, without jeopardizing the provision of the flows for fall chinook spawning below Bonneville. The reservoir was managed for power generation demands and refilled to an elevation of 2047.2 ft by August 31 from an elevation of 2042.8 ft on August 1. The reservoir continued to be operated for power generation purposes in the September through mid-October period, at variable outflows.

Dworshak initiated drafting for flow augmentation on July 1 at a rate of 6.6 kcfs as requested by fishery agencies. Outflow was gradually increased to 13.3 kcfs through July 11, limited to a 110% of Total Dissolved Gas standard (as mandated by the State of Idaho) in the tailrace of the dam. The outflows gradually decreased from August 22 to August 31, when the reservoir reached the BiOp prescribed elevation of 1520 ft. The reservoir was drafted to 1518.93 ft on September 31. The Fishery Agencies requested deeper drafts to 1500 ft by September 17 to evaluate the effects of cool water releases, but the Action Agencies refused this request in order to avoid any risk in not refilling the reservoir through June 30, 2001.

The **Upper Snake** reservoirs have been drafted for irrigation and for salmon flow augmentation. American Falls was drafted to 18.6% of its capacity at the end of August for irrigation. American Falls provided 180 kaf of augmentation water.

TABLE 8. Reservoir Elevation at August 31.

PROJECT	Opinion Summer Reservoir Draft Limit [ft]	Actual Elevation on August 31 [ft]
Libby	2439	2434.89
Hungry Horse	3540	3539.77
Grand Coulee	1280	1280.4
Brownlee	2059	2047.22
Dworshak	1520	1520.07

USBOR delivered 427 kcf as a part of its BiOp obligation during the July through August period.

Canadian Reservoirs: Columbia River Operations conducted under the Columbia River Treaty and the Non Treaty storage agreement directly impact salmon migration conditions. The operation of Canadian reservoirs under these two agreements can potentially improve or limit migration protection provided for salmon. Canadian reservoirs (Mica, Arrow and Duncan) and the US reservoir (Libby) are operated under a US-Canada Treaty which was established in 1964.

These reservoirs were built under the auspices of the Columbia River Treaty and comprise almost half of the storage of 15.5 MAF in the Columbia River System. An additional 5 MAF of storage behind Mica Dam is not included in the Treaty Operations and is referred to, as "Non Treaty" Storage. The 1995 BiOp, the 1998 Supplemental BiOp and 1999 BiOp do not specify any special operation of these reservoirs for the purposes of anadromous fish migration improvement in water years when the 95% confidence January through July unregulated volume runoff forecast at The Dalles is above 90 MAF. The 2000 runoff volume forecast was above 90 MAF, and no additional storage for flow augmentation measures are included in the BiOp for this runoff volume. However, the 1995 BiOp includes the requirement that BPA negotiate with BC Hydro and the other US Non Treaty Storage agreement signatories to mutually store water in NTS during the spring for subsequent release in July and August for flow enhancement, as long as operational forecasts indicate that water stored in the spring can be released in July and August. This term is reiterated in the supplemental BiOp of 1998 and in practice limits BPA's NTS release rights in the summer only to water it stores in the spring. Although there is potential to improve fish passage conditions by utilizing additional non-treaty storage operations, there is a constraint in the Biological Opinion. The Biological Opinion states that non-power objectives must be addressed in a "revenue-neutral" manner for BPA.

Currently the FCRPS has been operated according to the Detailed Operating Plan for Columbia River Treaty System for August 1, 1999 through 31 July 2000. Under the Detailed Operating Plan, the entities empowered the Columbia River Treaty Operating Committee to prepare and implement changes to the DOP that produce additional mutually beneficial results, related to operation of Treaty Storage for non power uses.

Current operations for non power purposes include meeting Canadian white fish, trout spawning and Arrow recreational level obligations, and meeting US Vernita Bar obligations for the period of January 1, 2000 through July 31, 2000 through the storage and specific obligations related to chum operations to protect chum or fall chinook salmon below Bonneville Dam for the period of October 1999 through April 2000. Following is a summary of the operations of Canadian reservoirs.

- The whitefish operation, which took place from December 20 through January 18, limits the actual outflows below Arrow Dam for whitefish spawning. BPA stored 540 ksfd during this period. Flows were limited to between 50.1 kcfs and 62.9 kcfs being held at 50-51.4 kcfs during December 25-31 and 54.9-55.5 kcfs on January 1-17. Stored water was released in the period of March 3-24, when flows in the Lower Columbia were already higher than required, for protection of chum and chinook redds below Bonneville. Part of that water could be used in a period of low November flows to provide spawning habitat for chum and chinook salmon.

- Flows below Arrow were restricted to 12 kcfs and 51.9 kcfs, between March 29 and June 30 to limit the area of trout spawning below the dam. As it was during previous years, flows were not managed to meet the flow targets at McNary during the spring season. For the entire period, flows varied between 11.9 kcfs and 52 kcfs, lower at the earlier period of the spawning, through the third week of May, in the range of 12 kcfs-20 kcfs. Later in the season, flows were fluctuated, depending on the power generation needs.
- The US Entity NTS releases were implemented primarily to meet power generation needs. During water year 2000 releases were made primarily in October, of 193.9 ksfd; November-releases were 43.5 ksfd, and December releases were 107.3 ksfd, to meet power generation and marketing needs. Monthly average flows below Bonneville exceeded required flows for spawning below Bonneville. At the same time, flows were not shaped to meet spawning needs below Bonneville during November 1-7, when the flows were lower than requested for spawning and incubation. Minor storage, a total of 83.6 ksfd, occurred in the January-March period, to meet power demand. However, major storage occurred in April and May, a total of 225 ksfd, was stored when actual May flows at McNary were lower than the spring flow target. NTS was refilled to 80% of its full capacity through the end of June. It released 192 ksfd in July and 113 ksfd in August from NTS in agreement with BC Hydro, which was more than previously anticipated, 50% of the May-June period. In September, the NTS released 97.5 ksfd for power generation purposes.

4. Flows

Spring and summer migration period flow targets were established in accordance with terms identified by NMFS in the Opinion of 1995 and the 1998 Supplemental Steelhead Biological Opinion. Spring and summer flow objectives at Lower Granite are based on the April Final Runoff volume forecast. Based upon the runoff volume predicted in the April Final Runoff Volume Forecast, a sliding scale of flow targets was developed by a linear interpolation between 85 kcfs and 100 kcfs for the spring flow target and between 50 kcfs and 55 kcfs for the summer flow target. The spring flow objective at McNary was based on the January-July runoff volume forecast for the Dalles and another sliding scale determined by linear interpolation between 220 kcfs and 260 kcfs. The summer BiOp flow target is provisionally determined to be 200 kcfs, based on the best available biological information at that time for reducing mortality for subyearling chinook migrating through the lower Columbia. The Supplemental Biological Opinion of 1998 established a flow objective for the mid-Columbia reach of 135 kcfs. The resulting seasonal flow targets, observed seasonal average flows, and its range are shown in Table 9.

TABLE 9. Flow Targets at Lower Granite, McNary and Priest Rapids.

Location	Period	Flow Target [kcfs]	Observed Seasonal Average Flow [kcfs]	Observed Seasonal Range in Daily Average [kcfs]
Snake River at Lower Granite	April 10-June 20	96.3	85.1	57.3-115.4
Columbia River at Priest Rapids	April 10-June 30	135.0	158.1	89.2-239.9
Columbia River at McNary	April 20-June 30	260.0	243.4	171.4-359.3
Snake River at Lower Granite	June 21-August 31	51.3	39.6	18.1-55.4
Columbia River at McNary	July 1-August 31	200.0	153.6	82.0-212.2

In order to avoid severe drops in flows on weekends, the 1995 Biological Opinion recommended that McNary's daily average flows on weekends not drop below 80% of the preceding week's average weekday outflow. This criteria was not satisfied on July 2 (78% of average), July 16 (73.3% of average), July 23 (74.3% of average), August 20 (57.5% of average), and August 27 (72.8% of average).

The seasonal flow target was met only at Priest Rapids. The fun-off volume forecast at Grand Coulee for the January-July period was near average, making it possible to meet the Priest Rapids target seasonally. Other seasonal flow targets were not met. The actual runoff volumes were below average, 92% of average for the January-July period at The Dalles and 83% of average for the January-July period at Lower Granite. Reservoirs were managed, based on overestimated January-July runoff volume forecasts, which failed to materialize later in the season. In general, runoff volume forecasts decreased 6% to 21% from March through July, resulting in over-drafted reservoirs for flood control and power generation, and lower than projected inflows later in the season.

5. Detailed Project Operations

The following discussion describes specific operations throughout the passage season at major river reference points. These sites are the subject of system operation requests and management points for passage operations and requests. Individual storage reservoir operations that resulted in the flow conditions at run-of-river projects are discussed in detail in Appendix A.

Lower Granite (Figure 2)

Spring/Summer operations: The 1995 Biological Opinion spring flow target at Lower Granite was established at 96.3 kcfs. The actual 2000 seasonal spring (April 10-June 20) flow average was 85.1 kcfs, with wide daily flow variations in the range of 62.3 to 115.4 kcfs. Daily flow variations were mostly due to seasonal fluctuations in inflow and power production demands. The summary of the weekly average flows and ranges is given in the Table 10. Peak flow of 115.4 kcfs for the spring migration occurred on April 23.

TABLE 10. Lower Granite Dam: Spring 2000 Weekly Average Flows.

Seasonal Average (4/10-6/20)=85.1 kcfs		
Week ending	Weekly average [kcfs]	Range [kcfs]
April 16	93.7	78.5-108.8
April 23	104.5	96.1-115.4
April 30	97.7	88.8-109.3
May 7	94.8	88.5-99.3
May 14	77.5	70.8-83.0
May 21	71.1	62.3-79.9
May 28	91.5	87.2-99.1
June 4	80.1	69.0-88.9
June 11	76.8	65.9-85.9
June 18	69.8	57.3-78.2

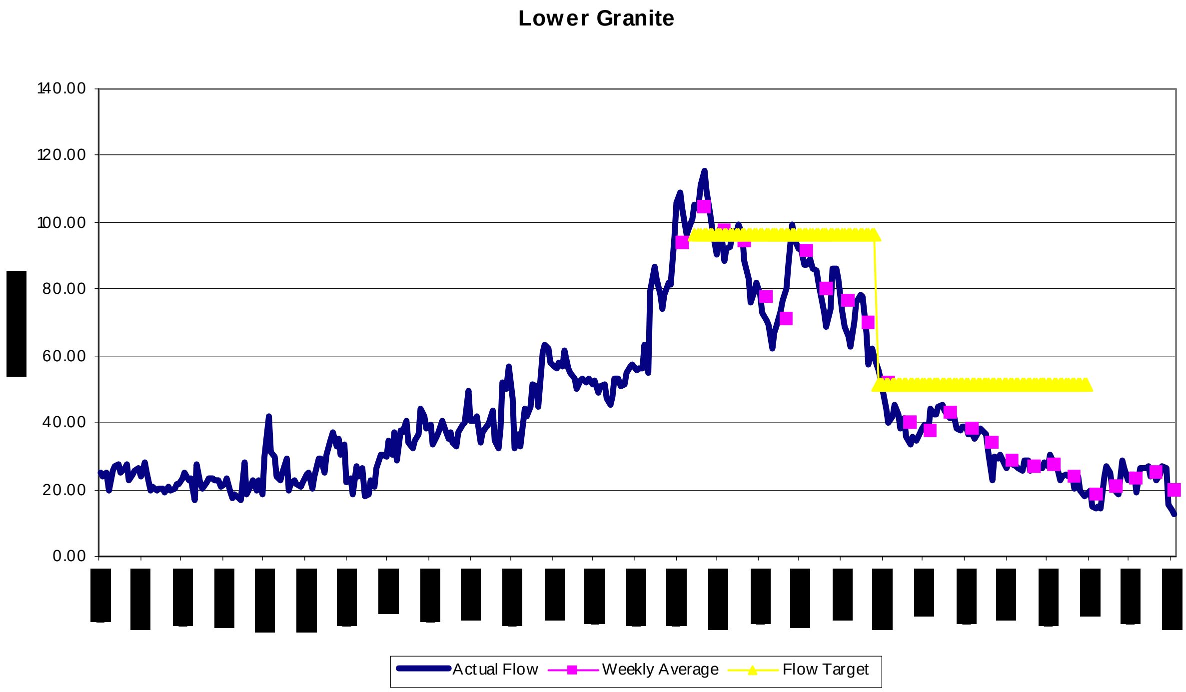


FIGURE 2. Target flows versus actual flows at Lower Granite.

The Fishery Agencies requested flows of 100 kcfs at Lower Granite during the last week of April and first week of May. The request was not met due to limitations in Total Dissolved Gas content in the tailrace of Dworshak and an IPCo decision to avoid spill at Hells Canyon and Oxbow Dams. Flows were improved in a limited manner for the period of May 10-15 due to an agreement between IPCo and Bonneville for an additional draft of 110 kaf. Oxbow dam hydraulic capacity limited full utilization of 110 KAF by May 15. Only 61.28 KAF was drafted during that period. Flows continued to decrease through the third week of May and then increased to a weekly average of 91.5 kcfs during the last week of May because of snowmelt. Flows continued to decrease by the end of June due to delayed snowmelt, refill and precipitation below average.

The summer flow target at Lower Granite was established at 51.3 kcfs. The actual average seasonal flow was 39.6 kcfs. The summer flow target was met on a weekly basis only in the first week of migration. During the rest of the summer migration period, flows were well below the target flow due to well below average precipitation and insufficient augmentation. During the fourth week of migration, the flows increased due to initiation of the augmentation from Dworshak. Flows decreased from 55.4 kcfs on June 21 to 18.1 kcfs on August 30. Flows in September fluctuated between 12.8 kcfs on September 30 and 28.8 kcfs on September 12. A summary of the weekly average flows during the summer season is given in the Table 11.

TABLE 11. Lower Granite Dam: Summer 2000 Weekly Average Flows.

Seasonal Average (6/21-8/31)=39.6 kcfs		
Week Ending	Weekly Average [kcfs]	Range [kcfs]
June 25	52.3	40.2-62.4
July 2	39.9	33.6-45.7
July 9	38.0	34.5-44.0
July 16	43.0	41.0-45.2
July 23	38.3	36.3-41.9
July 30	33.8	22.7-38.0
August 6	28.7	27.4-30.5
August 13	27.2	25.9-28.7
August 20	27.7	26.5-30.3
August 27	23.9	20.6-24.4
September 3	18.5	14.5-23.9
September 10	20.7	14.6-26.8
September 17	23.5	18.3-28.8
September 24	25.4	22.7-27.2
September 30	20.0	12.8-26.7

A comparison of the 1995 through 2000 spring and summer monthly average flows is given in Table 12. It shows that the spring 2000 migration was one with the lowest flows of the entire 1995-2000 period. Summer average monthly flows were also the lowest in this period.

TABLE 12. Lower Granite Dam: Spring/Summer 1995-2000 monthly average flows.

MONTH	FLOW [kcfs]					
	1995	**1996**	**1997**	**1998**	**1999**	**2000**
April Average	61.1	114.5	122.0	65.5	93.9	90.2
May Average	108.9	127.2	169.0	141.01	112.5	84.04
June Average	114.8	144.9	161.3	113.6	133.7	63.4
July Average	60.8	54.4	68.9	61.7	54.7	37.8
August Average	37.2	37.2	46.1	32.9	37.7	25.9
Spring Opinion Flow Target	95.0	100.0	100.0	90.0	100.0	96.3
Actual Spring Average	101.1	138.3	162.5	115.6	117.0	85.1
Summer Opinion Flow Target	52.0	53.5	55.0	50.6	54.0	51.3
Actual Summer Average	55.3	52.7	66.3	53.2	56.01	39.6

Priest Rapids (Figure 3)

Fall/Winter Operations: The Vernita Bar agreement established the main criteria for systems operations in mid Columbia during October 27-November 19. Minimum required daily average flows for adult spawning fall chinook below Priest Rapids were 65 kcfs. Average daily fluctuations in the period of October 27-March 31 were between 52.9 kcfs on October 31 and 182.2 kcfs on December 24. The summary of the monthly averages with daily average range is given in Table 13.

TABLE 13. Priest Rapids Dam: Fall/Winter 1999/2000 Monthly Average Flows

Month	Monthly Average [kcfs]	Range [kcfs]
October	95.2	52.9-125.5
November	117.1	88.1-158.05
December	155.9	119.6-182.2
January	153.6	108.7-175.9
February	125.4	69.9-166.1
March	110.2	64.4-151.8

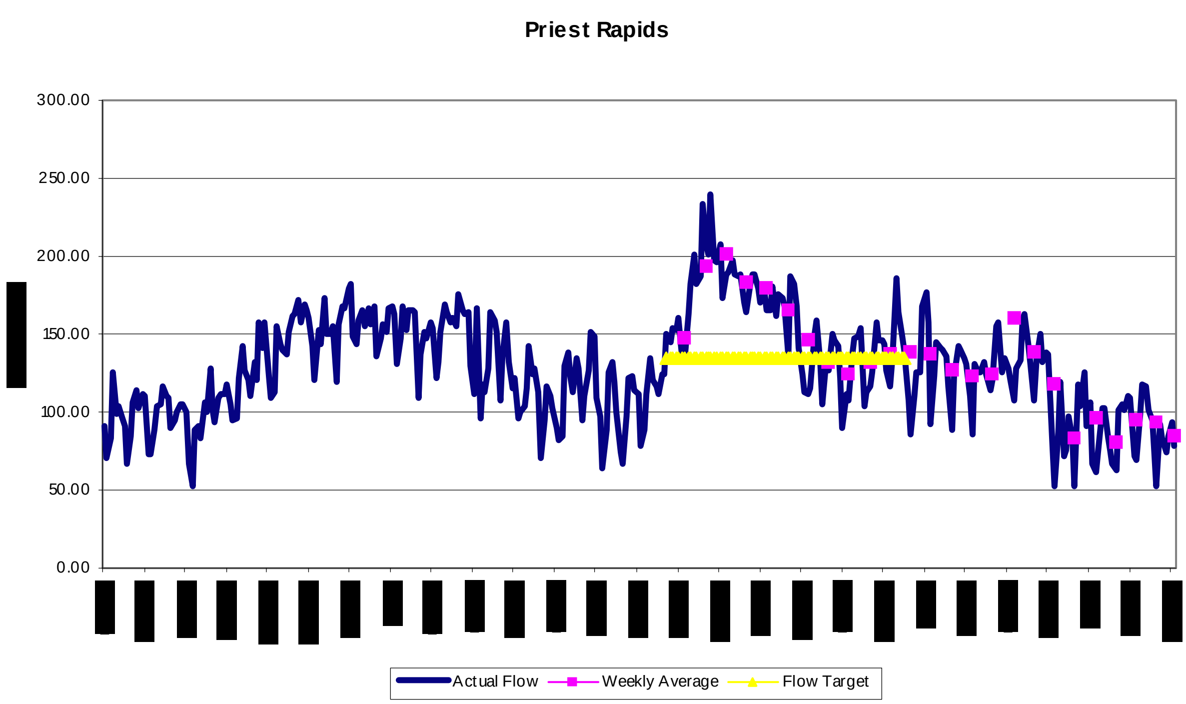


FIGURE 3. Target flows versus actual flows at Priest Rapids.

Spring/Summer Operations: The 1998 Supplemental Biological Opinion established spring flow targets at Priest Rapids of 135 kcfs during the April 10 through June 30 period. The flow target was met on a seasonal basis, with an average of 158.1 kcfs. Weekly averages ranged from 124.2 kcfs during the second week of June to 200.7 kcfs during last week of April. A summary of the spring weekly averages and their ranges is given in the Table 14.

TABLE 14. Priest Rapids Dam: Spring 2000 Weekly Average Flows

Seasonal Average [4/10-6/30]=158.1 kcfs		
Week Ending	**Flow Average [kcfs]**	**Range [kcfs]**
April 16	147.3	134.4-160.5
April 23	193.6	163.4-232.9
April 30	200.7	173.4-239.9
May 7	183.5	164.1-196.9
May 14	179.0	165.6-188.7
May 21	166.01	136.2-181.7
May 28	146.8	111.6-187.6
June 4	131.5	105.5-159.4
June 11	124.2	89.2-150.1
June 18	131.6	104.3-154.3

The fishery agencies requested that Action Agencies avoid large decreases of projected 40 kcfs in flows, at the end of April and first week of May, by modifying flood control at Grand Coulee. Weekly average flows for the week ending April 30 were 200.7 kcfs and for the week ending May 7 were 183.5 kcfs. However, a significant drop in daily average flows of 33 kcfs occurred at Priest Rapids from 239.9 kcfs on April 25 to 196.8 kcfs on April 26. Again flows declined 34.1 kcfs, from 207.5 kcfs on April 28 to 173.4 kcfs on April 29, due to weekend reduction in flows. The fishery agencies also requested minimum flows of 170 kcfs to avoid stranding fish during the peak emergence period of May 6-14 at Vernita Bar. Daily average flows fluctuated between 164.1 kcfs on May 6 to 188.7 kcfs on May 10, and were more than 170 kcfs, beginning May 7. A drop in the daily flows was recorded for the period of May 5-7, from 189 kcfs to 164.1 kcfs. Weekly average flows remained below the flow target during month of June due to refill of Grand Coulee.

Summer weekly averages were in the range of 83.8 kcfs to 138.5 kcfs. A summary of the weekly averages and their ranges is given in the Table 15.

TABLE 15. Priest Rapids Dam: Summer Weekly Average Flows.

Seasonal Average [7/1-8/31]=121.3 kcfs		
Week Ending	**Weekly Average [kcfs]**	**Range [kcfs]**
June 25	137.7	117.0-158.0
July 2	138.5	86.3-185.3
July 9	136.6	92.5-168.1
July 16	127.2	88.7-144.8
July 23	123.7	86.5-141.8
July 30	124.7	120.4-132.2
August 6	132.7	107.8-157.9
August 13	138.2	107.9-163.2
August 20	117.4	52.2-149.4
August 27	83.8	52.3-119.3
September 3	96	61.2-125.6
September 10	80.9	62.2-102.0
September 17	95.2	68.7-109.7
September 24	93.7	52.9-117.5
September 30	84.1	74.1-93.1

The average spring and summer monthly flows in comparison with the same period of 1995 through 2000 are given in Table 16. The monthly average distribution during the spring/ summer season of 2000 is similar to what occurred in the summer of 1998. Spring monthly average flows were the lowest on record.

TABLE 16. Priest Rapids Dam: Spring/Summer Monthly Average Flows in 1995-2000.

Month	Average Flow [kcfs]					
	1995	**1996**	**1997**	**1998**	**1999**	**2000**
April	101.8	194.5	179.8	86.3	145.4	160.03
May	136.5	216.3	279.0	175.5	164.3	166.2
June	154.8	241.3	328.0	175.3	192.3	130.5
July	131.5	189.6	201.6	133.7	185.2	126.95
August	101.5	148.2	151.9	113.2	162.02	115.7

McNary (Figure 4)

Spring/Summer Operations: The 1995 Opinion established a spring flow target of 260 kcfs at McNary Dam based on the the May Final January through July Runoff Volume forecast at The Dalles. The flow target was not met on a seasonal basis, with the seasonal actual average flow of 243.4 kcfs. The peak spring flow was 359.3 kcfs on April 23. The flow target was met on a weekly basis during the April-May 14 period due to drafts for flood control, and initiation of the snowmelt. However, daily average flow was below 260 kcfs on May 10 due to decreasing inflows in the system and on May 12-14 due to weekend reduction in flows.

In order to prevent further decrease in flows, fishery agencies requested flows of 220 kcfs for the week ending June 4. Action Agencies decided to prioritize refill of Grand Coulee over meeting the flow target, with weekly actual averages of 217.9 kcfs. The Fishery Agencies also prioritized higher flows for the week ending June 18 over refill of Grand Coulee. The Action Agencies implemented a request on a half-half basis: splitting the volume of available water beyond minimum requested flows of 170 kcfs on refill and the immediate augmentation resulting in weekly average flows of 210.9 kcfs. Flows continued to decrease throughout the rest of the season due to the refill of the previously emptied reservoirs for flood control and decrease in the actual runoff volumes. The summary of the weekly average flows for the spring season is given in the Table 17.

TABLE 17. McNary Dam: Spring 2000 Weekly Average Flows

Seasonal Average [4/20-6/30]=243.4 kcfs		
Week Ending	**Weekly Average [kcfs]**	**Range [kcfs]**
April 16	246.7	213.1-280.2
April 23	305.9	260.2-359.3
April 30	301.2	268.9-327.0
May 7	282.6	257.2-297.0
May 14	260.2	228.8-277.8
May 21	244.8	231.6-256.5
May 28	246.8	208.9-281.5
June 4	217.9	195.8-250.8
June 11	211.6	182.3-232.2
June 18	210.9	190.1-238.1
June 25	197.6	171.4-227.2

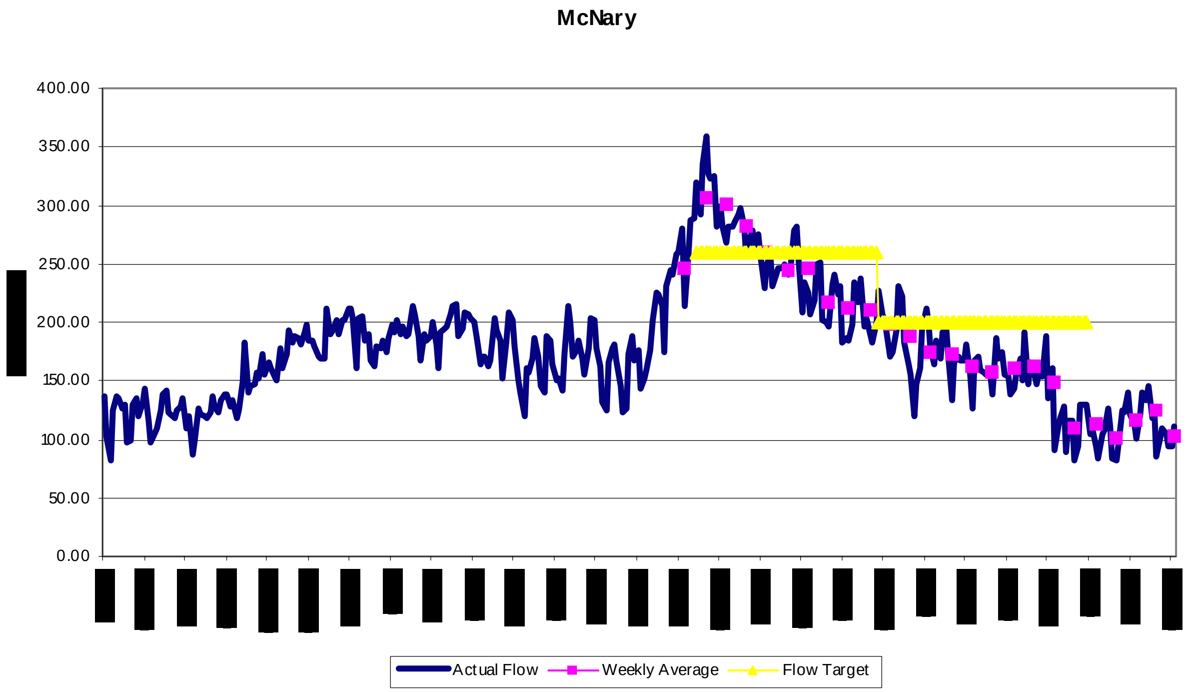


FIGURE 4. Target flows versus actual flows at McNary.

The summer flow target was not met either on a weekly or on a seasonal basis. Peaking flows higher than 200 kcfs, were, 212.2 kcfs on July 7 and 200.4 kcfs on July 8 due to initiation of flow augmentation from the reservoirs. Weekly average flows were in the range of 108.7 kcfs to 188.8 kcfs.

Power Emergencies

Several power emergencies were declared by BPA in the summer of 2000. The first BPA system emergency was declared on June 26. At 8:30 am on June 26, the Columbia generating station (WNP2, 1150 average MWs) tripped off-line. BPA could not meet its firm load and reduced spill for fish passage at Columbia and Snake river dams.

Later in the summer, on August 1, BPA responded to a stage 3 power emergency declaration in California. On August 3, in response to an executive order, BPA modified operations to provide power to California utilities. BPA's major action was to curtail fish protection measures in order to respond to the California power emergency. There was no power emergency at the time in the Northwest region.

On August 21, 2000 BPA declared a Northwest Power emergency. Once again fish protection measures, spill and flow were curtailed.

The unanticipated effect of energy deregulation, power market volatility and rising wholesale electricity prices and California generation and demand proved to have significant adverse impacts on the implementation of fish protection measures.

In order to improve flows at the beginning of the summer, Fishery Agencies requested higher flows on the first week of August, with a more intensive draft of Grand Coulee to an elevation of 1283 ft. However, the request was never implemented, due to shaping flows for power generation production with Coulee drafted only to 1285.5 ft and resulting in 14.5 kcfs lower flows. Flows during August continued to be shaped for power generation. Fishery agencies requested further drafting of Coulee to an elevation of 1282 ft by August 13 to improve summer flows. Instead, Coulee was operated for power generation and drafted only to an elevation of 1284 ft with 11 kcfs lower flows. The summary of the weekly average flows is given in the Table 18.

TABLE 18. McNary Dam: Summer 2000 Weekly Average Flows.

Seasonal Average [7/1-8/31]=153.6 kcfs		
Week Ending	**Weekly Average [kcfs]**	**Range [kcfs]**
July 2	188.8	156.2-231.5
July 9	173.6	178.3-212.2
July 16	172.5	132.5-193.1
July 23	162.6	126.9-181.1
July 30	157.4	138.1-170.3
August 6	160.1	139.0-186.2
August 13	162.5	147.2-191.0
August 20	147.9	90.2-187.2
August 27	108.7	82.0-128.6
September 3	113.2	93.9-130.4
September 10	100.1	82.9-111.6
September 17	117.0	101.3-139.7
September 24	124.2	86.1-145.4
September 30	102.6	94.2-110.8

A summary of the monthly average flows for the spring/summer season is given in Table 19. Comparison with previous years monthly average flows shows that 2000 was the year with the lowest flows during the period of 1995-2000.

TABLE 19. McNary Dam: Spring/Summer 1995-2000 Monthly Average Flows.

	FLOW [kcfs]					
	1995	**1996**	**1997**	**1998**	**1999**	**2000**
April Average	169.0	311.9	313.0	154.9	245.7	254.9
May Average	251.1	338.7	449.0	320.4	281.0	255.4
June Average	277.6	379.2	482.2	292.0	330.97	206.4
July Average	191.2	245.9	274.6	197.2	247.9	166.7
August Average	138.2	183.0	198.3	142.2	208.5	140.4
Spring Opinion Flow Target	249.0	260.0	260.0	228.0	260.0	260.0
Actual Spring Average	253.0	357.1	454.8	287.8	303.6	243.4
Summer Opinion Flow Target	200.0	200.0	200.0	200.0	200.0	200.0
Actual Summer Average	164.7	214.5	237.0	169.7	228.2	153.6

Bonneville (Table 5)

Flows below Bonneville were shaped primarily for power generation during the October-March period. Requests for protection of spawning grounds of chum and fall chinook salmon below Bonneville Dam were developed.

The Fishery Agencies requested a minimum instantaneous discharge of 125 kcfs for fall chinook and chum staging, and initiation of spawning at the Ives/Pierce Islands area below Bonneville Dam for the period of October 15 through October 31 of 1999. Resulting actual flows were 131.04 kcfs, with fluctuations in the range of 124.3 kcfs to 148.2 kcfs. The flow request was increased to 140 kcfs during November 1 through November 14. Resulting average flow was 134.9 kcfs with fluctuations in the range of 125.1 kcfs to 145.07 kcfs. Fishery flow requirements were not met during the period of November 1-7 when the daily average flows were in the range of 125.1 kcfs to 133.03 kcfs, instead of the required minimum of 140 kcfs, due to a temporary decrease in power generation demand. Requested flow was further increased to 150 kcfs during November 15-30. The resulting average flow was 173.2 kcfs, with fluctuations in the range of 147.01 kcfs to 223.74 kcfs. Flow requested for the December 1-31 period was 160 kcfs. The resulting average flow was 206.1 kcfs, with fluctuations in the range of 174.8 kcfs to 239.7 kcfs.

Some of the highest chum redds were exposed during February 20-24. The Fisheries Agencies requested full protection of redds, defining the protection criteria as the tailwater elevation minimum of 2.5ft at gauge #2 at Ives Island. The requirement was met for the rest of incubation period.

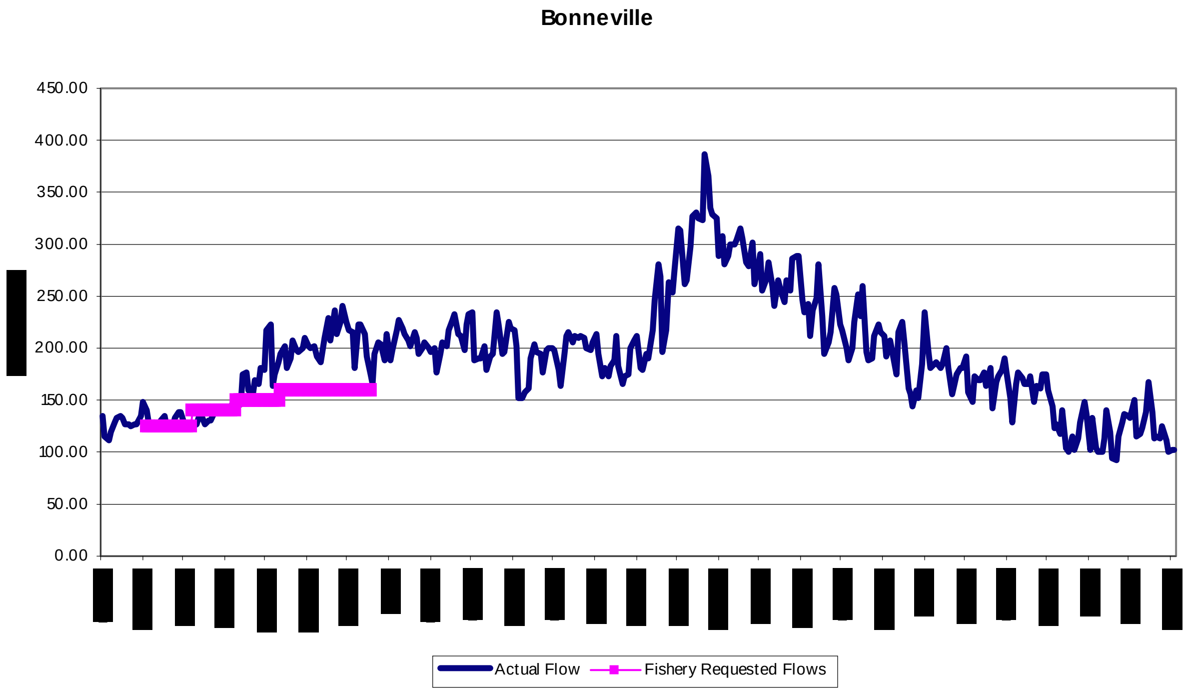


FIGURE 5. Target flows versus actual flows at Bonneville.

C. Conclusions:

- Water Year 2000 was below normal water year, with observed Runoff Volume Forecast of 82% of average at Lower Granite and 92% of average at The Dalles. However, runoff volume forecasts were overestimated during the January-March period resulting in overdrafted reservoirs for flood control and failure to refill them. The runoff volume forecasts decreased in the range of 1%-22% from April to July. The highest decrease of 22% was recorded at Libby and 7% at Grand Coulee. Failures in forecasting were due to overestimated snowpack and unadjusted subsurface portion of the total flow. These forecasts, and resulting hydro operations, adversely affected Spring and Summer migration conditions.
- Winter operations drafted for power generation during January through March period, resulting in end of March elevations lower than required for flood control. This operation resulted in 943.5 kaf less water in the reservoirs, than would have occurred for flood control operations.

- Spring reservoir operations were managed for flood control based on overestimated Runoff Volume Forecasts. The Action Agencies failed to refill some of the major reservoirs, to required April 10 BiOp elevations, due to previous deep winter drafts for power generation. Hungry Horse was 8.9 ft below April 10 BiOp required elevation, Grand Coulee was 3.3 ft lower than April 10 BiOp required elevation, resulting in total 397.8 kaf of water less in the system at the beginning of the migration. Some of the major reservoirs did not refill to full pool elevation by June 30 as a result of inaccurate runoff volume forecasts and winter operations. Grand Coulee was 11 ft below full pool elevation and Libby was 40.8 ft below full pool elevation. Brownlee was refilled on June 13 to 2075.99 ft, but due to rapidly decreasing flows at Lower Granite, it was drafted to 2072.05 ft by the end of June. At the beginning of the summer migration season, the storage reservoirs were 996 kaf short of volumes contemplated in the BIOP for the beginning of the summer migration.
- A flood control shift was implemented two times during spring: 1) at the end of March, when Dworshak was 10 ft higher than the elevation required by flood control, due to previously overdrafted Hungry Horse and Grand Coulee for power generation. This operation preserved 128 kaf for spring migration in lower Snake. 2) at the end of April, when Grand Coulee was at 3.8 ft higher elevation than required by flood control, resulting in shifted 229.6 kaf from April to May 7, when elevation was 2.3 ft above flood control requirement. This operation resulted in shifted 138.2 kaf into second week of May for improving mid Columbia flows.
- The energy deregulation actions that began in 1992 and subsequent energy deregulation in California resulted in adverse impacts on migration conditions for listed and unlisted stocks of Snake and Columbia River salmon. A volatile power market, high wholesale power prices, and generation outages resulted in the declaration of Northwest and California power emergencies. Fish protection measures established by the NMFS Biological Opinion were curtailed in response to these emergency declarations.
- During the December through March period, Arrow Dam was operated to meet whitefish spawning limitations and for power generation demands. Flows were not managed to provide flows for ESA listed chum spawning below Bonneville.

Conclusions:

- During the March 29 through June period, Arrow Dam was operated to limit trout spawning below the dam and for power generation demands. Flows were not managed to improve required flows at McNary for spring chinook migration.
- Non Treaty Storage releases were managed during the entire year, primarily to meet power generation needs. They were not shaped to benefit flows for chum salmon spawning in the fall or spring and summer chinook migrations.
- Upper Snake reservoirs were been operated primarily for refill during the fall/winter period due to average water year conditions and BOR's conservative strategy to secure refill for the spring/summer irrigation season.
- The spring flow target of 96.3 kcfs at Lower Granite Dam was not met. The observed seasonal average flow was 85.1 kcfs. Fishery Agencies's requests for improvement of flows were not implemented because of the State of Idaho limitations of dissolved gas waiver, and the limited hydraulic capacity of Oxbow Dam and Hells Canyon Dam.
- The summer flow target of 51.3 kcfs at Lower Granite Dam was not met. The observed seasonal average flow was 39.6 kcfs.
- The spring flow target of 135 kcfs at Priest Rapids was met and exceeded on a seasonal basis. The observed seasonal average was 158.1 kcfs. However, weekly averages fluctuated between 124.2 kcfs in second week of June to 200.7 kcfs in last week of April. Significant daily flow decreases occurred due to weekend reductions in flows. Runoff volume forecast errors at Grand Coulee and refill prioritization resulted in lower flows at Priest Rapids than requested by fishery agencies.
- The spring flow target of 260 kcfs at McNary was not met. The decision of Action Agencies to prioritize refill of Grand Coulee resulted in reduced flow, the actual flow was 243.4 kcfs.
- Flow below Bonneville was shaped primarily for power generation during the fall/winter period. The flow target for chum spawning was met and exceeded during the October through March period, except during November 1-7. Meeting the flow target during this period would have been possible with either addition drafting of Grand Coulee, Libby, Hungry Horse or higher Non-Treaty storage releases.

II. 2000 Spill Management

A. Spill

1. Overview

In March of 1995, an ESA Section 7 Biological Opinion (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.

In May of 1998, the NMFS issued a Supplemental Biological Opinion (Supplemental Opinion) to the Biological Opinion signed on March 2, 1995. The Supplemental Biological Opinion was developed 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 calls for additional spill to the gas caps on a system-wide basis to provide further benefits to steelhead, while also increasing the survival of Snake River spring/summer and fall chinook and sockeye. To the extent that the fish passage efficiency (FPE) at some projects will exceed 80%, this additional spill supplements 1995 RPA Measure 2 for an interim period pending decisions regarding biologically based performance standards for project passage.

The Supplemental Opinion also modified the planning dates for the initiation and duration of the spill program. The planning dates start spill earlier in both the Snake and lower Columbia rivers, with the actual initiation of the spill program dependent on the presence of juvenile migrants based on in-season fish monitoring information.

The National Marine Fisheries Service again modified spill on April 13, 2000. At this time NMFS released their Spill Plan Agreement for the Federal Columbia River Power System for immediate implementation. This was a negotiated agreement among the federal parties which was to be included in the 2000 Biological Opinion. The Spill Plan Agreement modifies spill at Lower Monumental, The Dalles, John Day and Bonneville dams. 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 significantly from 64% of instantaneous flow to only 40% of instantaneous flow. Spill at John Day and Bonneville dams remained unchanged from the 1998 Supplemental Biop, but the Spill Plan Agreement 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 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 2000 water year was characterized at the April 1 forecast to be 90% of average (1961-1990) runoff volume above Lower Granite Dam, and 99% of average above The Dalles Dam for the January to July time period. This below average runoff volume trend continued through the spring with the final July runoff volume forecast calling for 92% of average runoff volume above The Dalles and 84% of average above Lower Granite. The flows during the 2000 migration season were considerably less than those observed during recent past years, and the dissolved gas levels observed in 2000 reflect these lower flows. The average monthly flows that occurred at Lower Granite and McNary Dams are contained in Table 20.

TABLE 20. Average monthly flows at Lower Granite and McNary dams in 2000.

	Average Monthly Flow (kcfs)	
Month	Lower Granite	McNary
April	90.2	254.9
May	84.1	255.4
June	68.4	206.4
July	37.8	166.7
August	25.9	140.4

The flows that occurred during 2000 rarely exceeded the hydraulic capacity of the projects during the spring migration period. The hydraulic capacity of a project is defined as the amount of water that can be passed through a powerhouse of a project. Any water above the hydraulic capacity must pass over the spillway of a project. Most of the excess hydraulic capacity occurred at McNary Dam.

3. Total Dissolved Gas Waivers

In 2000, as in previous years, the NMFS requested that the Oregon Department of Environmental Quality (DEQ), the Washington Department of Ecology (DOE), The Idaho Department of Health and Welfare and the Nez Perce Tribe, 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 2000 season by the Oregon and Washington state water quality agencies. The waiver suggested by the State of Idaho and the Nez Perce Tribe was conditioned on the acceptance of a summer plan for Idaho reservoir operations that were not acceptable to NMFS. They were requested to separate the spring from the summer waiver. However, that request was not met and no spill waiver was provided by the State of Idaho for the 2000 fish migration. Total dissolved gas levels were limited to the 110% level. The effect of withholding the gas waiver was a limitation on the way in which Dworshak Reservoir was operated for flow augmentation.

The Oregon DEQ granted a waiver request from the USFWS for the March 9 through 19 spill period associated with the Spring Creek Hatchery fall chinook release, as did the Washington Department of Ecology. Consequently, the provision of spill was allowed up to the 120% total dissolved gas criteria.

4. Spill Implementation

The water conditions during 2000 were below average in terms of volume runoff. In general, spill was managed to meet the TDGS waivers. Therefore, spill during the spring passage season could be 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 waiver from Idaho or the Nez Perce Tribe. Spill began early in April and for the most part ended on June 20 at Lower Granite, Little Goose and Lower Monumental dams, while continuing through August at Ice Harbor Dam.

Dworshak

No spill (Figure 6) 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. However, spill levels were limited so as not to exceed the 110% waiver. Spill occurred again during flow augmentation for the summer period. The 110% TDGS level limited spill again during the summer augmentation period.

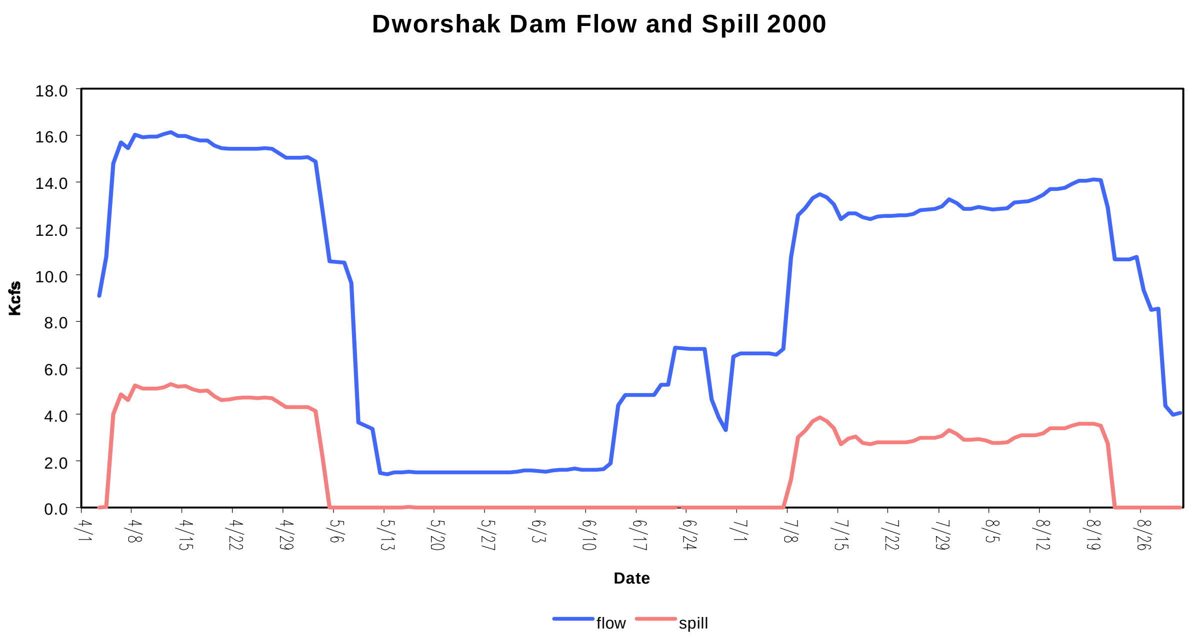


FIGURE 6. Project flow and spill at Dworshak Dam, 2000.

Lower Granite Dam

A request was made by the fishery agencies to initiate spill on April 7, 2000 based on increasing numbers of juvenile migrants passing Lower Granite Dam. In the 1998 Supplemental Biological Opinion NMFS set a spill equal to the gas cap at a level of 45 Kcfs for 12 hours (1800 to 0600 hours). Spill was implemented at this level until the surface bypass collector research began on April 10, 2000. Spill was provided as 20% of instantaneous flow on a 24-hour basis during the study (Figure 7). This limitation on spill precluded achieving the 80% FPE throughout most of the spring migration. There is no spill requirement for summer spill at this project, as transportation is maximized for subyearling migrants.

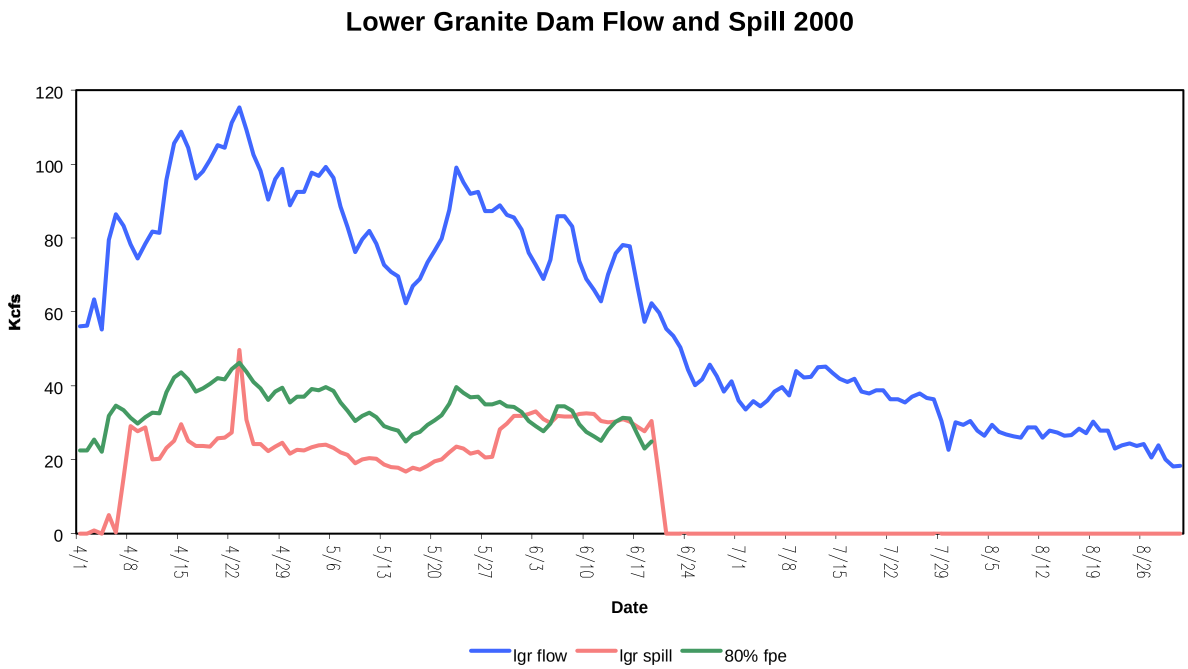


FIGURE 7. 2000 Lower Granite Dam flow and spill compared to that identified in the 1995 Biological Opinion as necessary to achieve the 80% fish passage efficiency standards.

Little Goose Dam

The 1998 Supplemental Biological Opinion sets spill at this project to 60 Kcfs for a 12-hour period. Spill began on April 10, 2000 according to the modified implementation of spill presented by BPA. At this project the 80% FPE was only met a few days in April (Figure 8), and again during late May and late June. There is no Biological Opinion spill requirement for this project during the summer. A request was made by the state and tribal fishery agencies and the USFWS to increase spill levels to 24-hours per day. This request was referred to NMFS' Implementation Team for discussion on May 4. The request was denied by NMFS.

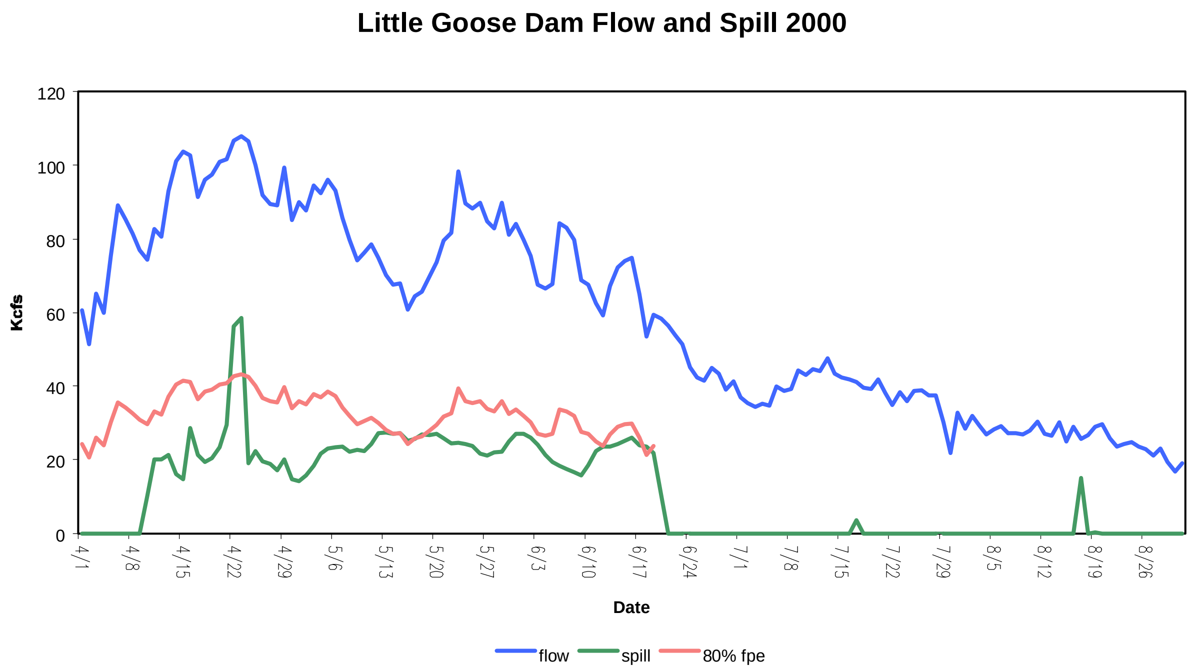


FIGURE 8. 2000 Little Goose Dam flow and spill compared to that identified in the 1995 Biological Opinion as necessary to achieve the 80% fish passage efficiency standards.

Lower Monumental Dam

Spill was initiated on April 4, 2000 at levels described in the 1998 Supplemental Biological Opinion. This request for spill earlier than the planning date contained in the Biop was based on the observed fish numbers passing Lower Monumental and Ice Harbor dams. These fish were primarily from Lyons Ferry Hatchery releases on site and in the Tucannon. Subsequent to this date NMFS released the Spill Plan Agreement for immediate implementation. The Spill Plan Agreement calls for 24-hour spill to the gas cap at this project. This spill level was implemented on April 14, 2000. Under 24-hour spill this project came much closer to achieving the 80% FPE than it had in previous years' (Figure 9). As with the other Snake River transportation sites, there is no requirement for summer spill according to the Biological Opinion.

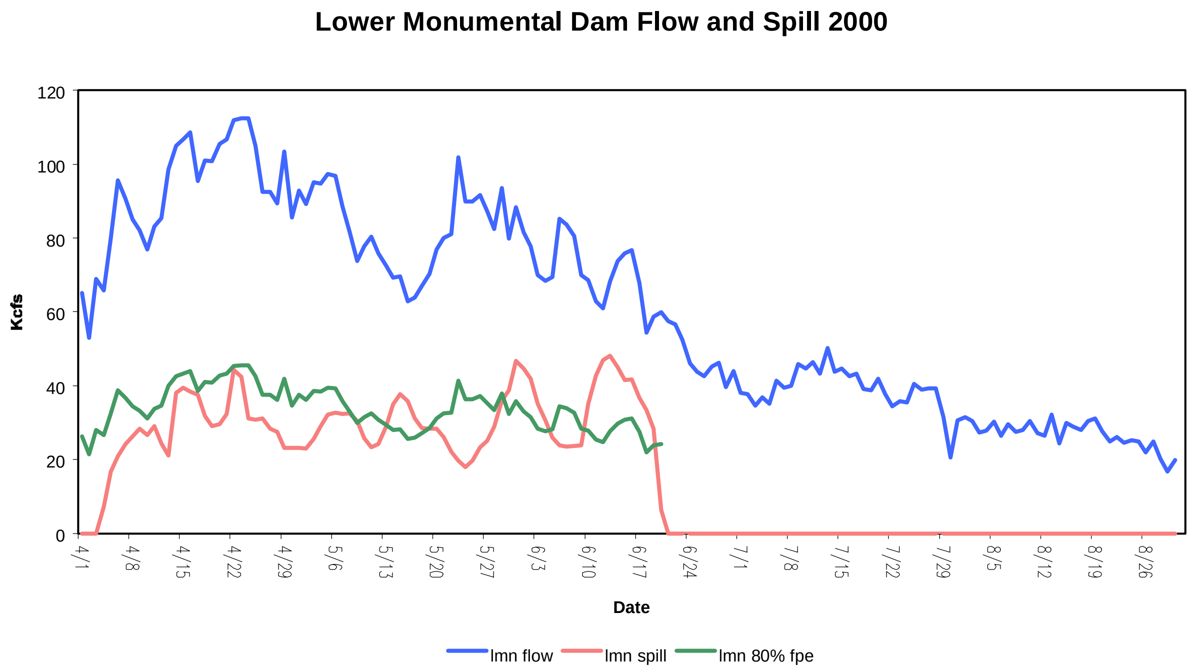


FIGURE 9. 2000 Lower Monumental Dam flow and spill compared to that identified in the 1995 Biological Opinion as necessary to achieve the 80% fish passage efficiency standards.

Ice Harbor Dam

The Supplemental Opinion specifies an instantaneous spill level of 75 Kcfs. As discussed above, spill began on April 4, 2000 because of observed fish passage. The 80% FPE was exceeded through most of the spring and summer migration (Figure 10), primarily due to involuntary spill. Spill was limited to less than what was possible under the spill cap based on the forebay total dissolved gas readings at McNary Dam.

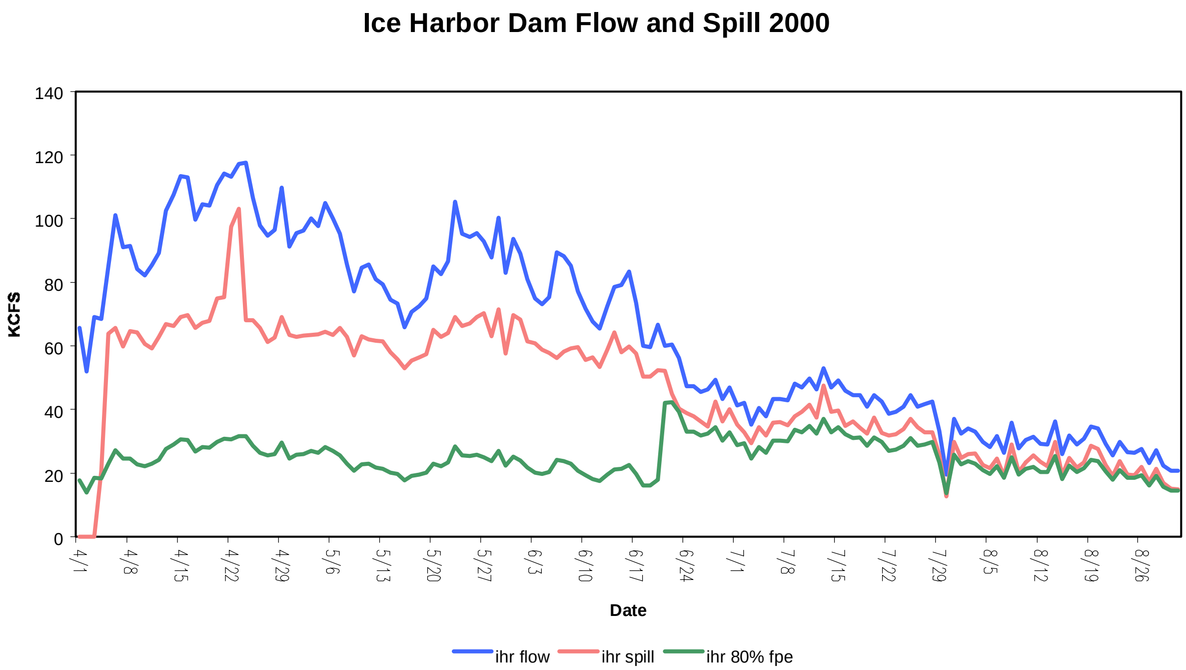


FIGURE 10. 2000 Ice Harbor Dam flow and spill compared to that identified in the 1995 Biological Opinion as necessary to achieve the 80% fish passage efficiency standards.

Lower Columbia River

The 2000 water year was below average in the lower Columbia River. Peak flow exceeded 350 Kcfs in late April, which was earlier than usual. Spill was a product of Biological Opinion planned spill and over generation spill. The fishery agencies and tribes submitted a System Operational Request for spill to begin earlier than the planning date in the Lower River based on fish movement. Spill continued through the spring and summer in the lower Columbia.

McNary Dam

Spill for fish passage was requested to begin on April 11, but was delayed until April 13 because of BPA scheduling issues. 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 11). The Supplemental Opinion specifies that spill will occur at an instantaneous rate of 150 Kcfs from 1800 to 0600 hours daily. The Spill Plan Agreement did not modify the 1998 Supplemental Opinion. 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 flows, spill continued through the summer.

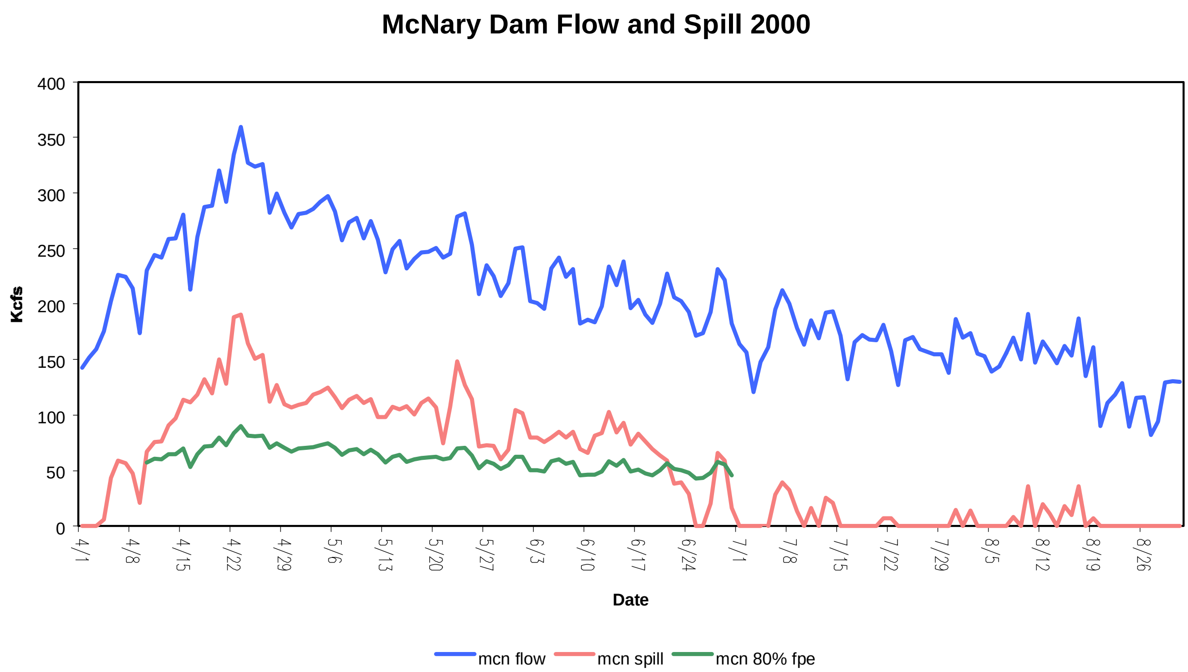


FIGURE 11. 2000 McNary Dam flow and spill compared to that identified in the 1995 Biological Opinion as necessary to achieve the 80% fish passage efficiency standards.

John Day Dam

The Supplemental Opinion specifies a level of spill up to the gas cap (approximately 180 Kcfs) for a period from one hour before sunrise to one hour after sunset. The Spill Plan Agreement calls for the conduct of a daytime spill test at this project. Spill was to vary between 0 and 30% of instantaneous flow in three-day blocks. This study was to be coordinated with the daytime spill study at Bonneville Dam such that spill was only occurring at one of the two projects during any given day.

Because of dissolved gas limitations spill almost never achieved the 80% FPE (Figure 12) except on days when daytime spill occurred.

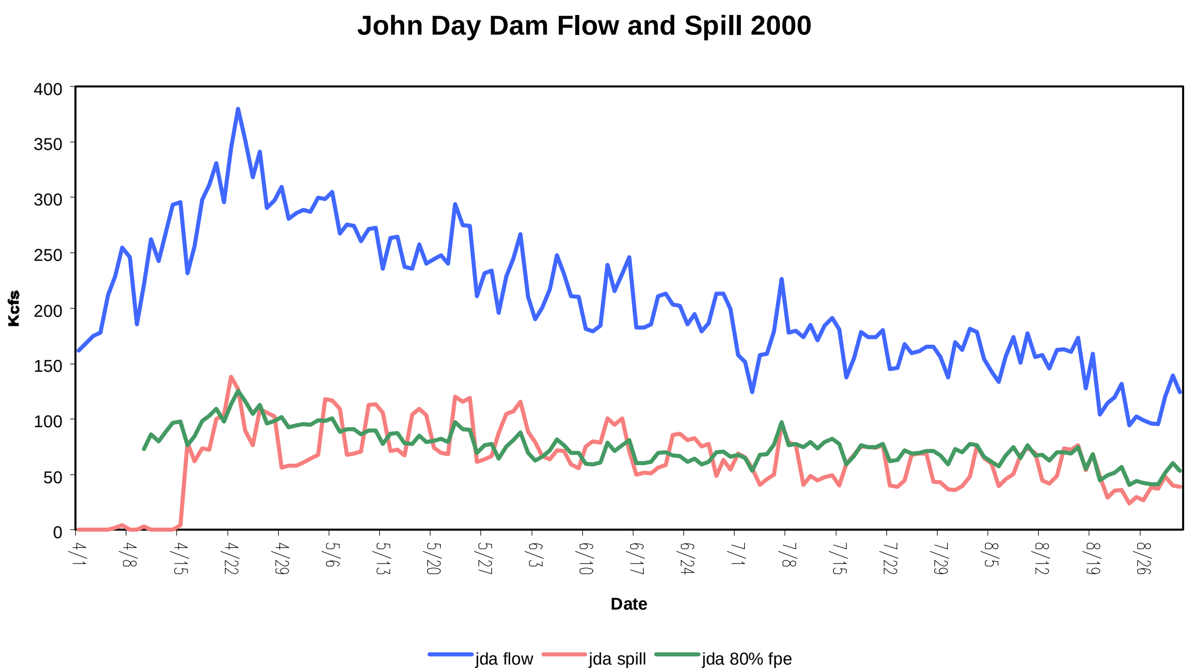


FIGURE 12. 2000 John Day Dam flow and spill compared to that identified in the 1995 Biological Opinion as necessary to achieve the 80% fish passage efficiency standards.

The Dalles Dam

Spill at The Dalles Dam was reduced to 40% of instantaneous flow. As seen in the graph (Figure 13) spill never came close to the 80% FPE.

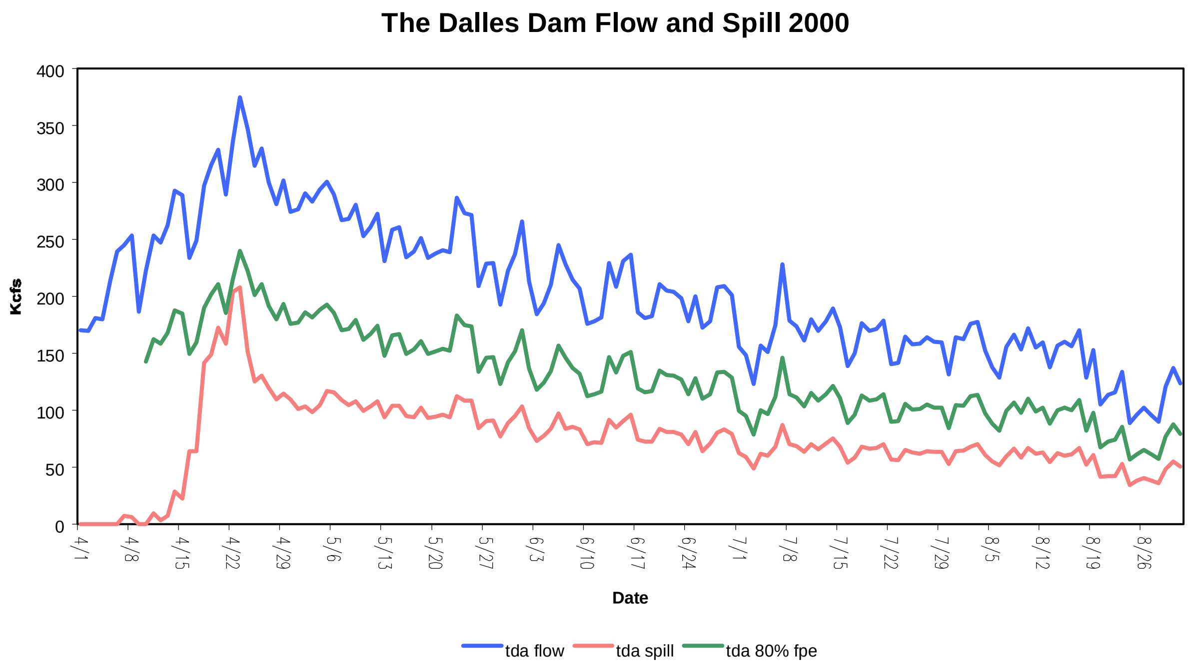


FIGURE 13. 2000 The Dalles Dam flow and spill compared to that identified in the 1995 Biological Opinion as necessary to achieve the 80% fish passage efficiency standards.

Bonneville Dam

The Supplemental Opinion made no changes to the levels of spill specified for Bonneville Dam in the 1995 Biological Opinion. At Bonneville Dam the spill is limited to prevent adult fall-back. Spill is not to exceed 75 Kcfs during daytime hours and can be up 100% of flow, limited to the gas cap, during nighttime hours. Under these conditions the 80% FPE is not achievable. During the 2000 migration season the 80% FPE was not achieved (Figure 14).

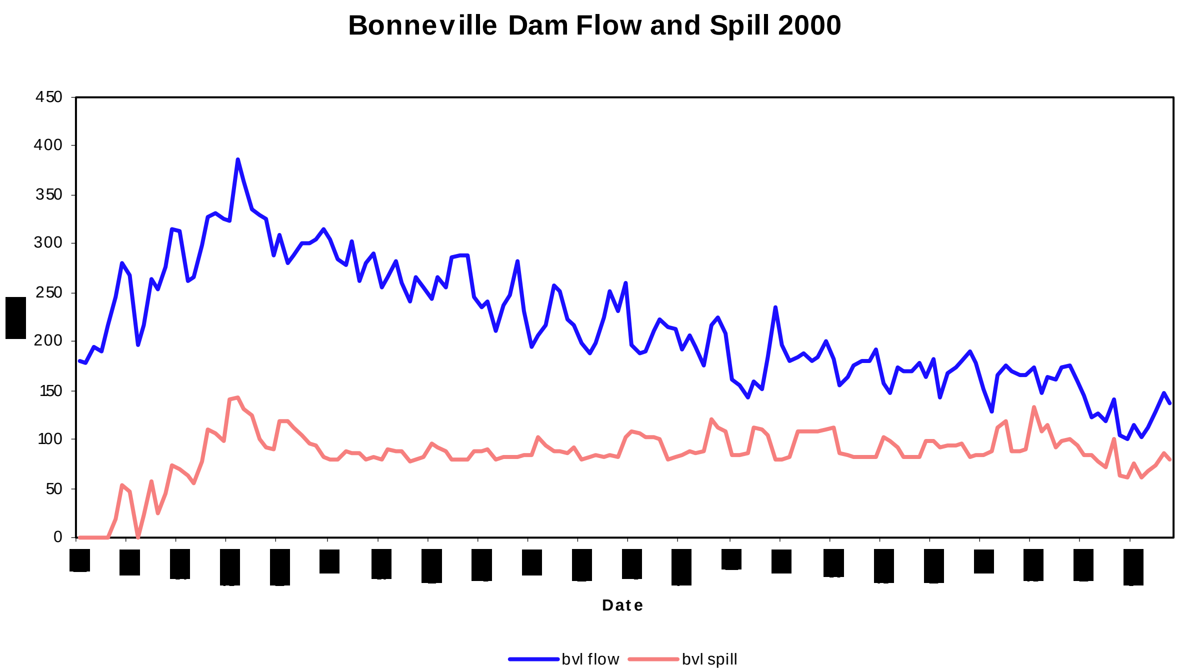


FIGURE 14. 2000 Bonneville Dam flow nd spill and the estimated FPE achieved.

B. Voluntary and Involuntary Spill

In any given year, the federal operators and regulators are directed to spill according to the Biological Opinion. Dependent on the water year a certain amount of Opinion spill is involuntary spill. In 2000, the BPA and the COE collected data to allow for the distinction of voluntary and involuntary spill.

As can be seen the graph (Figure 15), spill during 2000 was in large part involuntary. In other words, spill in excess of hydraulic capacity or generation capacity comprised a significant amount of the spill in the spring. In the Snake River, over 60% of the spill that occurred during the spring period was involuntary. Ice Harbor Dam is the only Lower Snake project that has a summer spill program. As summer progressed and flows decreased, an increasing proportion of the spill could be deemed voluntary. Only this volume of spill can be legitimately considered fish spill as called for by the Biological Opinion. In the lower Columbia, mostly all spill at McNary dam was involuntary due to the river flows and the limited hydraulic capacity of this project. At

John Day Dam, most all spring spill and a great proportion of the summer spill was voluntary. At The Dalles and Bonneville dams, involuntary spill decreased as the season progressed. It is important to recognize that whenever voluntary spill occurred in the system, the projects where spill occurred, complied with the State waivers for TDGS. Exceedences of the criteria occurred during periods of involuntary spill, which were not as great as observed in past years due to the shape of the runoff.

The data collected in 2000, an above average water year, again illustrates that the violations of the established criteria for the total dissolved gas criteria that occurred were due to flows in excess of turbine capacity and available power market. The most significant gains made toward decreasing the levels of TDGS were made at Ice Harbor and John Day dams with the installation of gas abatement structures. The majority of the spill that occurred during the migration period was not specifically provided for fish, but was primarily involuntary.

In the Snake River, a small amount of spring spill and some summer spill was voluntary and can be considered fish spill as called for by the Biological Opinion. In the lower Columbia, all spill at McNary Dam was involuntary. At John Day and Bonneville dams, 80 to 90% of spill was involuntary, while at The Dalles Dam almost 70% was involuntary. However, it is important to note that whenever voluntary spill occurred in the system, the projects where spill occurred, complied with the State waivers for TDGS. Exceedences of the criteria occurred during periods of involuntary spill.

Figure 15 summarizes the total amount of spill at each project from April through August. The graph again illustrates that, given the 2000 water year; less than half the spill that occurred can actually be attributed to the Biological Opinion Spill Program.

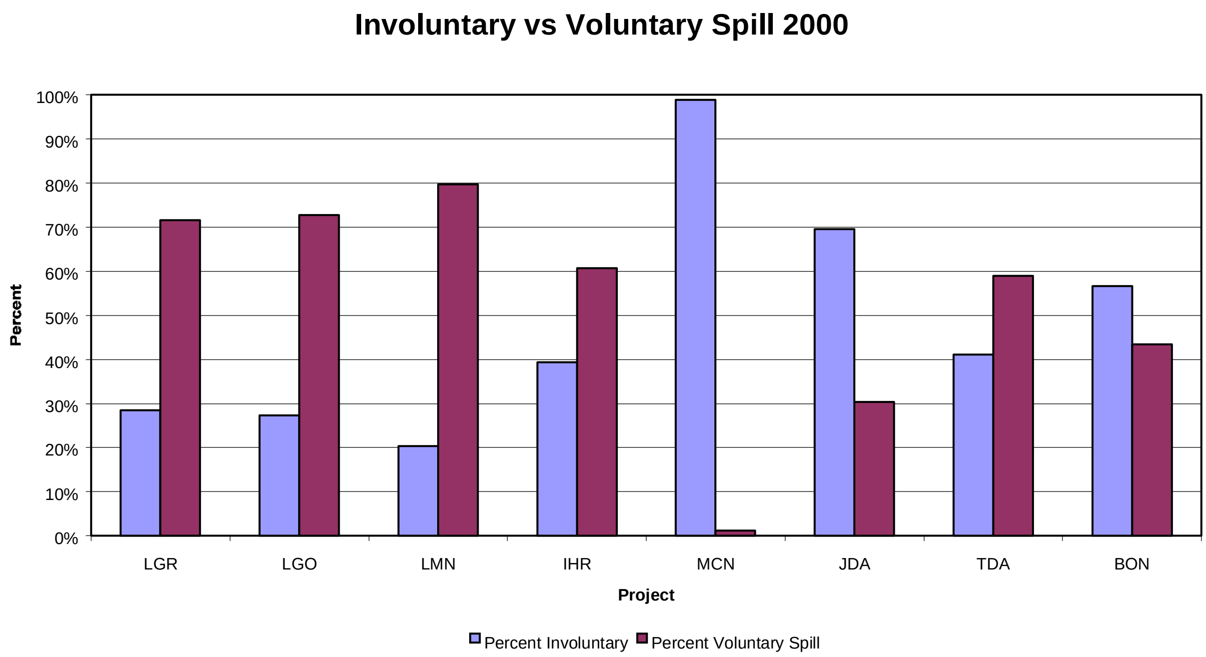


FIGURE 15. Comparison of involuntary and voluntary spill at lower Snake and Columbia dams.

C. Summary and Conclusions

- The provision of spill for fish released from the Spring Creek Hatchery continued to be contentious because they 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.
- The majority of spill during the season was involuntary and resulted from flows in excess of power needs.
- The daily number of spill hours was increased at Lower Monumental Dam, while spill volume was decreased at The Dalles Dam, according to the Spill Plan Agreement
- A daytime spill test occurred at John Day Dam and a test of increasing spill volume was partly implemented at Bonneville Dam.
- Summer spill was managed for provision of the Biological Opinion spill for fish passage, within the constraints of the State waivers for TDGS.

D. Gas Bubble Trauma Monitoring and Data Reporting

1. Overview

Monitoring of juvenile salmonids in 2000 for 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 Ice Harbor Dam, 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, where spill continued 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. Sampling at Ice Harbor Dam was conducted twice a week in conjunction with the smolt sampling at the facility. 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. Further, if high TDGS levels were encountered, the number of sampling days per week would have been increased. However, total dissolved gas saturation (TDGS) levels only exceeded the NMFS waiver levels of 115% in forebays and 120% in tailraces for a short period of time during the spring spill season, and sampling frequency was never increased as a result.

The goal was to sample 100 fish of each of the dominant species during each day of sampling at each site. Examinations of fish were done using a variable magnification (6x to 40x) dissecting scope. The lateral line, both 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 left side lateral line was examined for the presence of bubbles. A similar ranking system to that used for the fins was used to assign a rank to the percent lateral line occluded. Based on the average number of lateral line scales in chinook and steelhead, the length spanned by 7 lateral line scales was equivalent to approximately 5% of the total length of the lateral line. The scale approximation was used as a guide to estimate percent occlusion. Then a rank was assigned based upon this approximation. It was assumed that few fish would have greater than 5% lateral line occlusion. 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.

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 were collected from the bypass trap that was sampled every 30 minutes from 4 pm to midnight. 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 21,391 juvenile salmonids were examined for GBT between April and August (Table 21). A total of 96 or 0.4% showed some signs of GBT in fins, eyes or lateral lines (Table 22). Fin signs were found in 91 or 0.4% of the fish sampled at all sites. The fin signs, by highest rank in each fish with signs, were as follows: 75, or 0.4%**,** were rank 1; 15 or 0.1% were rank 2; and 1 fish or 0.0% was rank 3 or greater. The prevalence of GBT signs at Rock Island Dam was higher than any other Columbia River site during the 2000 monitoring 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 21. 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 2000 as part of the GBT Monitoring Program.

Species	**Site**							
	BON	MCN	IHR	LMN	LGS	LGR	RIS	Total
Chinook Subyearlings	2,170	2,488	0	0	0	0	1,326	5,984
Chinook Yearlings	1,779	1,667	483	869	669	763	1,306	7,536
Steelhead	1,763	1,735	450	920	811	1,131	1,061	7,871
Total	5,712	5,890	933	1,789	1,480	1,894	3,693	21,391

TABLE 22. Number of juvenile salmonids found with any signs of GBT at dams on the Lower Snake River and on the Columbia River from April to August 2000 as part of the GBT Monitoring Program

	Site							
Species	BON	MCN	IHR	LMN	LGS	LGR	RIS	Total
Chinook Subyearlings	0	1	0	0	0	0	22	23
Chinook Yearlings	0	0	0	1	9	0	40	50
Steelhead	1	1	2	6	6	1	6	23
Total	1	2	2	7	15	1	68	96

The percent of fish with signs of GBT in 2000, 0.4% was the lowest since monitoring began in 1995. At Lower Columbia River and Snake River sites (i.e. excluding Rock Island) a total of 17,698 fish were examined with 28 (0.2%) exhibiting signs of GBT, compared to 1.4% in 1999, 1.6% in 1998, 4.3% in 1997, 4.2% in 1996 and 1.3% in 1995.

A total of 23 (0.1%) fish from the Lower Snake and Lower Columbia rivers showed fin signs. The fin signs found in 2000 were a considerable reduction in prevalence compared to other years; 0.3% in 1999, 1.0% in 1998, 3.2% in 1997 and 3.3% in 1996. No severe fin GBT was found in Lower Snake and Lower Columbia sampling. This is similar to 1995 when no severe fin GBT was found and to 1999 when only 1 fish (0.001%) showed severe signs. 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.

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 never exceeded in 2000** (based on dates when at least 30 fish of the species exhibiting signs were sampled). When Rock Island Dam is removed from the calculations, there were no exceedences of the NMFS action criteria in 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 1995 to 2000 reflected changes in TDGS conditions in the river from year to year. In 1995 no fish had severe fin GBT and 1995 had the lowest number of days with high TDGS (Table 22). Also 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 22 and Table 23). While 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 23. 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.

	2000		1999		1998		1997		1996		1995	
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
Lower Granite	0	0	0	0	0	0	0	0	0	0	0	0
Little Goose	0	0	5	0	8	3	23	8	29	6	0	0
Lower Monumental	0	0	7	2	14	8	61	31	64	33	0	0
Ice Harbor	1	0	5	1	14	4	52	19	41	11	0	0
McNary (Oregon)	0	0	3	0	0	0	46	0	30	4	3	0
John Day	0	0	0	0	7	0	47	15	33	11	0	0
Bonneville	0	0	0	0	3	0	65	27	45	6	0	0
Total	1	0	20	3	46	16	294	100	242	60	3	0

TABLE 24. 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	2000	1999	1998	1997	1996	1995
Lower Granite	0	0	0	0	0	0
Little Goose	0	0	0	1	1	0
Lower Monumental	0	0	0	7	9	0
Ice Harbor	0	0	0	3	2	0
McNary	0	0	0	2	1	0
John Day	0	0	0	1	4	0
Bonneville	0	0	0	11	4	0
Total	0	0	0	25	21	0

[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%.

E. Total Dissolved Gas Saturation

The 2000 TDGS levels were much lower system-wide than in other recent years. Colder than normal temperatures in April, and early May resulted in a very gradual snow-melt which translated into lower flows and less spill than initially forecast by COE. As a result, TDGS levels were relatively low, with values above the waiver limits for only a short two-week period in mid-May when projects spilled excess powerhouse capacity volume.

Dworshak

Total dissolved gas levels never went above the 110% this migration season. Although there was some spill in April in order to achieve flood control elevations at Dworshak, it did not result in TDGS levels above 110% (the federal water quality standard). By May 4 spill ended and TDGS levels remained below 110% until mid-July as refill commenced to meet June 30 refill targets. Spill began again for summer flow augmentation beginning on July 1, with low spill levels TDGS levels again neared the 110% standard but total discharge was restricted to insure TDGS levels did not exceed the standard.

Lower Granite Dam

Forebay readings at this project are typically low because of its location. Values measured at the forebay monitor never exceeded 112% during the entire season. Tailwater TDGS levels rose to 111% TDGS in early April as average hourly nighttime spill of 28 to 30 kcfs for BiOp began. The TDGS level fluctuated between 106% and 114% until May 27 when it dropped to 105% and then fell to nearly 100% by June 20 when spill for BiOp ended. The peak spill level for 1999 was 49 kcfs on April 23 and resulted in TDGS of 114% in the tailwater on that date but quickly receded below 110% the next day.

Little Goose Dam

Total dissolved gas saturation remained near or below 112% (i.e. within 2%) through much of the spring spill season, when spill at Lower Granite was nearly 30 kcfs. During the spring, forebay TDGS at Little Goose never rose above the 115% waiver. Spill for fish at Little Goose began on April 2 and averaged 25 kcfs (nighttime hourly average) with a two day spike of nearly 60 kcfs on April 22 and 23. The tailwater TDGS at Little Goose did not exceed 120% at any time during the entire season. As lower spill levels were maintained at the project, TDGS levels at Little Goose tailwater fell to less than 110% on April 26. Saturation values remained well below the waiver limit throughout the year.

Lower Monumental Dam

Forebay gas levels were in excess of the water quality waiver limit (115%) shortly after spill for fish management began in early April, causing spill at Little Goose to be reduced from nighttime average hourly value of 50 kcfs to 30 kcfs on April 24. Based on a comparison of the Little Goose tailwater TDGS to Lower Monumental forebay, it appeared that little or no dissipation of gas was occurring between dams. For example, when the tailwater TDGS at Little Goose was reading between 107 and 108% (average of 12 highest hours) from May 2 to May 10, the forebay at Lower Monumental went from 109% to 111% from May 2 to May 10. TDGS values at the tailwater monitor at Lower Monumental measured nearly 120% for only three days in early April, and from then through the end of the spill season remained closer to 115%.

Ice Harbor Dam

Spill for fish began April 3 at Ice Harbor. Total dissolved gas measurements in the tailwater were at or above 115%; tailwater remained below 115% despite peak average spill of 100 kcfs on April 22 and April 23.

McNary Dam

Total dissolved gas levels rose steadily in early April as excess hydraulic capacity spill increased. Gas levels peaked near 125% on April 22 when spill reached 190 kcfs, the highest level seen at the site during the season. Spill decreased to around 120 kcfs and stayed near that level until the end of May, with gas levels remaining just below the gas cap at or near to 118%. Even though spill decreased by June to nearly 80 kcfs, gas levels remained above 115% until June 19, when gas levels decreased as spill decreased.

John Day Dam

The BiOp calls for daily average spill to be 35% of flow during night hours at this project during spill season. During the 2000 season, day time spill levels were being manipulated between 0% and 30% of total discharge as part of a study. Gas levels varied between 115% and 120% throughout the spill season.

The Dalles Dam

Total dissolved gas measurements remained at or below the 120% standard in the tailwater of this project for the entire season. Tailwater TDGS levels remained relatively stable at 120% throughout the season, with a 24 hour 30% spill regime throughout the season.

Bonneville Dam

Total dissolved gas measurements in the forebay were variable, but remained well below the 115% cap throughout the season. Tailwater measurements at Warrendale and Skamania also stayed at or below the tailwater waiver limit (120%) for the entire season with only a few dates having reached 121%.

Rock Island Dam

Forebay TDGS readings were highly erratic until April 28 when values leveled off to near 110%.

Spill of 40kcfs, 24 hours a day, commenced on April 20 at Rock Island according to FERC guidelines. Consequently, TDGS rose in the tailwater to 118% on April 21; up from 107% on April 18. The TDGS levels remained close to 118% when spill was maintained at 40 kcfs.

F. Dissolved Gas and Gas Bubble Trauma Summary and Conclusions

There appears to be a good correlation between the levels of TDGS and the prevalence of signs of GBT found in the biological monitoring program. A comparison among dams and years when TDGS levels were above 120% in the forebays of various dams, may be useful in characterizing the general conditions in which the juvenile fish migrated. Based on that comparison, it is apparent that in 1999 TDGS levels were higher than in 1995 but did not approach the high levels nor the duration experienced in 1996 and 1997. In ranking the years in terms of high gas levels 1997 had the highest, 1996 was second, followed by 1998, 1999 and finally 1995 with the lowest levels of TDGS.

A similar ranking of years in terms of a comparison of severe GBT signs (in fins) and number of days the NMFS criteria were exceeded results in the same ranking: 1997 showed the greatest number of exceedences, followed by 1996, while none were found in 1995, 1998, or 1999. For the record, the number of fish exhibiting severe fin GBT was higher in 1999 (1 fish) than in 1995 when no fish had severe fin signs. The comparison of incidence of severe signs to high TDGS shows that high incidences of GBT only occur during periods when the gas levels are well above the water quality waiver. Indeed in 1999, as in 1998 and 1995, there were no dates when the NMFS biological criteria were exceeded when sample sizes were greater than 30 fish per target species. The low incidence of signs in the biological monitoring in 1999, 1998, and 1995 reflect the relatively low gas saturation levels seen in those years.

While research related to characterizing GBT signs in relation to exposure to high TDGS has often found contradictory and confusing results when trying to relate the progression of signs to level of exposure, the GBT monitoring program has shown that the incidence of signs in migrating juvenile salmonids follows the levels of TDGS in the river quite closely. Laboratory experiments at USGS-BRD in Cook, Washington found high incidences (60% to 80%) of fin GBT in fish exposed to relatively low gas levels for long periods (110% TDG for 22 days). The levels of fin signs found in the “chronic exposure scenario” was indistinguishable from levels of signs found in fish exposed to “acute” high levels (130% TDG for 4 h to 8 h). By comparison the biological monitoring program found the incidence of fin signs rarely approached 10% when TDGS levels at dam forebays were below 115%. Indeed, only at Rock Island Dam did the incidence of fin GBT ever approach the levels of incidence found in the laboratory. At that site there are some serious questions about the effects of collection and holding of the fish that may influence the relative incidence of signs. At all other sites the incidence of GBT never exceeded 40% when the sample sizes were large enough to have reasonable confidence that the incidence sampled at the dam was representative of the migrating population (i.e near the 100 fish target sample size). At TDGS levels of 120% or higher the incidence of fin signs in laboratory experiments exceeded 80%, while the biological monitoring found percent fin signs only approached 10% to 15% when TDGS levels in the forebays of the dams reached 125%. The laboratory exposures are indeed, as the researchers describe them, “a worst case scenario”.

While the difference between laboratory results and monitoring results has led some to conclude that fish were dying or that signs were disappearing before the fish could be examined for GBT, researchers sampling fish in reservoir, have found the levels of signs in the reservoir are similar to those in the biological monitoring program. According to research by NMFS, the monitoring program found a higher incidence of signs than those in fish captured by the researchers sampling fish in the forebay of the same dam. Other research by NMFS has shown that the incidence of signs in the fish passing through the bypass prior to examination for GBT does not change significantly. Therefore, we conclude that GBT monitoring does accurately depict the incidence of signs in fish passing the dams and may in some cases slightly over estimate the incidence. However, over-estimation of the incidence of signs would only serve to protect the population since NMFS action criteria are set so that steps are taken when the incidence exceeds 15%. Thus slight overestimation would prove protective of the migrating fish. Realistically, the times the NMFS criteria have been exceeded occurred during periods of uncontrolled spill and TDGS levels have been well above the 120% tailwater and 115% forebay limits set by water quality agencies. At such times little can be done to reduce TDGS levels.

Based on the results of the monitoring it appears that fish behavior combined with short duration of exposure in tailwaters due to high water velocity may diminish the effective exposure of the fish. Indeed the very moderate levels of signs found in the biological monitoring data suggest that the intermittent exposure fish experience greatly reduces the incidence of signs relative to those observed in laboratory conditions. Because the migrating population does not manifest nearly the level of signs that are seen in long term exposures in the laboratory it seems reasonable to conclude that exposure is both less severe and more importantly much less lethal than laboratory experiments suggest. Further, because the correlation between TDGS levels and incidence of signs is more consistent in monitoring data than in laboratory experiments it's more likely that if mortality due to exposure to high TDGS were quantifiable its rate would vary with the incidence of signs found in the monitoring program.

III. 2000 SMOLT MONITORING

A. Smolt Monitoring Sites and 2000 Schedules.

Information on the status of the Columbia Basin salmonid smolt migration is collected each year to aid the Fishery Agencies and Tribes in making fish passage management decisions to enhance juvenile fish passage as they migrate from natal streams through the hydro system to the ocean. The Smolt Monitoring Program collects data on relative fish abundance at dams, fish migration timing at traps and dams, fish travel time between monitoring sites, and fish survival from traps and dams to downstream monitoring sites. Some of this data are generated for each species from the run-at-large and some of this data is generated from specially marked groups of fish. All of this data is collected for the purpose of in-season management of flows and spills and the post-season evaluation of the effect of that year's management actions on migrating salmonids.

This information is obtained from eleven monitoring sites in the Columbia River basin (sites and dates of operation are presented in Table 25). These monitoring sites include four traps in tributaries above Lower Granite Dam, three dams on the lower Snake River, one dam in the mid-Columbia River reach, and three dams on the lower Columbia River. During periods of monitoring, the daily collection information from each of these sites is transmitted to the Fish Passage Center (FPC), where it is stored and compiled into data summaries for distribution to interested parties in the region. This data is posted daily on the Fish Passage Center's web page at www.fpc.org. Fish were marked for the 2000 outmigration with either PIT (passage integrated transponder) tags implanted in the fishes' gut cavity, color elastomer (plastic) tags, or freeze brands. SMP crews look for the elastomer and freeze brands in the samples at the sites and transmitted this data daily to the FPC, while the PIT tags are generally electronically detected without the need for fish handling and sent directly to the Pacific States Marine Fisheries Commission's PTAGIS data system.

Appendix E Table E-1 lists the days when non-standard samples or no samples were obtained during the monitoring period due to conditions such as high flow and debris levels, equipment failures, scheduled dewatering for maintenance, transportation changes, and fish disease concerns. On those days a biased or "null" collection count will occur.

TABLE 25. Smolt monitoring sites and schedules for 2000.

Site	Sampling method	Dates of Operation	Primary fish data*
Salmon River trap (km103)	Scoop trap	16:00 3/12 – 09:00 5/22	C, FQ, PIT
Imnaha River trap (km6.8)	Screw trap(s) (1-2 traps)	14:00 2/25 – 06:30 6/15	C, FQ, PIT
Grande Ronde River trap (km 5)	Scoop trap	18:00 3/12 – 09:00 6/2	C, FQ, PIT
Snake River trap (km 225)	Dipper trap	15:00 3/12 – 09:00 6/16	C, FQ, PIT
Snake River dams: Lower Granite Dam (km 173)	Timed subsample from bypass	07:00 3/25 – 07:00 10/31	C, FQ, GBT(1)
Little Goose Dam (km 113)	Timed subsample from bypass	07:00 4/1 – 07:00 10/31	C, FQ, GBT(1)
Lower Monumental Dam (km 67)	Timed subsample from bypass	07:00 4/1 – 07:00 10/31	C, FQ, GBT(1)
Columbia River dams: Rock Island Dam (km 730)	Census of fish in volitional bypass at Powerhouse 2	09:00 3/31 – 09:00 8/31	C, FQ, PIT, GBT(2)
McNary Dam (km 470)	Timed subsample from bypass	07:00 3/31 – 07:00 11/30	C, FQ, GBT(2)
John Day Dam (km 347)	Timed subsample from bypass	07:00 4/3 – 07:00 9/18	C, FQ
Bonneville Dam (km 234)	PH 2: Timed sub-sample from bypass PH 1: trap sample	07:00 3/7 – 07:00 10/31 4/2-9/2 (3-d/w)	C, FQ FQ, GBT(2)

* C = fish counts recorded
FQ = fish quality including descaling and injury data obtained
PIT = PIT tagging and release from site
GBT(k) = gas bubble trauma measurements taken "k" days per week

This chapter and associated appendices present data from the 2000 Smolt Monitoring Program on the (1) collection counts at each monitoring site (plus relative magnitude [termed passage index] at dams), (2) migration timing at key sites, (3) travel time between selected sites, and (4) estimates of survival between selected sites. Greater details of the sampling at the traps and dams may be found in the individual reports prepared by the respective monitoring organizations. Washington Department of Fish and Wildlife (WDFW) reports on sampling at Lower Granite, Lower Monumental, Rock Island, and McNary dams. Oregon Department of Fish and Wildlife (ODFW) reports on sampling at Little Goose Dam and the Grande Ronde River trap.

Idaho Department of Fish and Game (IDFG) reports on sampling at the traps on the Salmon and Snake rivers. Nez Perce Tribe (NPT) reports on the sampling at the Imnaha River trap. Pacific States Marine Fisheries Commission (PSMFC) reports on the sampling at John Day and Bonneville dams.

B. Collection Counts and Relative Abundance.

In the March through October weekly reports prepared by the Fish Passage Center, a daily passage index is presented for each species and rearing type available in the run-at-large. As long as these daily passage indices remain highly correlated with daily population abundance existing at a given monitoring site, the fishery managers may use the daily passage indices to effectively determine significant shifts in passage at that monitoring site. The actual value of fish guidance efficiency of the screens or effectiveness of spill is not required, only the existence of seasonal stability of these factors is required. The daily passage indices account 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. For these reasons, when the Smolt Monitoring Program began in 1984, the use of daily passage indices was chosen over attempts to estimate daily absolute population sizes. 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 26). Since 1998, sampling at John Day Dam has been with a timed sample from the entire powerhouse bypass system instead of only one gatewell slot as occurred in prior years. Beginning in 2000, index sampling at Bonneville Dam has moved to a timed sample at the new Powerhouse II bypass system from the old timed trap samples from Powerhouse I ‘s bypass system as occurred in prior years. Sampling at Powerhouse I in 2000 was limited to three days per week for fish condition and gas bubble trauma observations.

At monitoring sites where a sample timer is used to systematically divert a fixed proportion of fish into a sample tank for processing, the resulting sample number is divided by the sample rate to arrive at the estimated collection number. Post-season, the daily passage indices are summed for the season at a given site to provide an annual passage index for each species and rearing type available. This annual passage index reflects the strength of the particular run for the given year. The passage index is not applicable to the trap sites; therefore, only collection counts are reported at the four traps.

TABLE 26. Formulas to compute passage indices (collection/flow expansion factor) at dams.

Sampling Site	Years	Collection	Flow expansion factor
Rock Island Dam (PH 2)	1985-2000	Catch / 1	PH2/(PH1+PH2+SP)
Lower Granite Dam Little Goose Dam Lower Monumental Dam McNary Dam	1984-2000 1984-2000 1993-2000 1984-2000	Catch / sample rate	PH/(PH+SP)
John Day Dam (bypass) John Day Dam Unit 3	1998-2000 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	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).

Table 27 presents the cumulative counts of salmonids at the four traps above Lower Granite Dam over the scheduled dates of operation in 2000. These traps operated primarily on a 5 days per week schedule (Sunday afternoon through Friday morning). Sampling on the Imnaha River involved the use of two traps during much of the season to increase the number of fish for PIT tagging purposes. These counts simply reflect how many fish were handled at these traps for timing, fish condition, and PIT tagging purposes. We do not have measures of trap efficiencies for any expansion to run size. Data are shown in 2000 aggregated across a mixture of wild and hatchery fish to the level of species. This is due to increased numbers of hatchery fish being released without a fin clip in areas of the basins where previously management required the clipping of fins of hatchery fish (chinook with a BWT and steelhead with no marking). In addition, there is evidence that upwards of 10% of unclipped chinook leaving the Salmon River had visual fin erosion typical of hatchery fish. The effect of not clipping fins on hatchery and wild chinook has substantially decreased the ability of SMP crews to use fin clips to adequately separate hatchery and wild stocks of yearling chinook and steelhead anymore. Table 28 and Table 29 show the percent in over-count bias that could occur if unclipped yearling chinook and steelhead, respectively, were counted as wild stocks.

TABLE 27. Sampled number of composite wild/hatchery chinook, steelhead, coho and sockeye at the four traps used in the Smolt Monitoring Program in 2000.

Species	No. of Fish Sampled	Species	No. of Fish Sampled
Salmon River Trap (aboveWhitebird)		**Snake River Trap (at Lewiston)**	
Chinook 1's	25,538	Chinook 1's (thru 5/19)	6,031
Steelhead	2,625	Steelhead	10,142
Sockeye	8	Sockeye	132
		Coho	159
		W Chinook 0's	689
		Mix of unclipped H Chinook 0's and H/W Chinook 1's from 5/22 – 6/16	2,111
Imnaha River Trap		**Grande Ronde River Trap**	
Chinook 1's	25,637	Chinook 1's	4,038
Steelhead	27,540	Steelhead	6,256

TABLE 28. Investigation of bias in wild chinook numbers if all unclipped chinook counted as wild stock at the Salmon and Snake River traps in 2000.

Site	Total unclipped	Unclipped with blank wire tag (BWT)	Unclipped without BWT but with fin erosion of hatchery fish	Remaining number of wild fish	Wild stock over-count if all unclipped fish included
Salmon River trap	4,454	780	311	3,363	32.4%
Snake River trap 3/13 – 5/19 data	1,917	100	65	1,752	9.4%

TABLE 29. Investigation of bias in wild steelhead numbers if all unclipped steelhead counted as wild stocks at the Salmon and Snake River traps and Lower Granite Dam in 2000.

Site	Total unclipped	Unclipped but with fin erosion of hatchery fish	Remaining number of wild fish	Wild stock over-count if all unclipped fish included
Salmon River trap	470	134	336	39.9%
Snake River trap	1,695	330	1,365	24.2%
Lower Granite Dam[1]	757,493	306,123	451,370	67.8%

[1]Lower Granite Dam's timed sample of unclipped steelhead was examined for fin erosion and sample counts expanded to facility collection estimates; additional steelhead collected off the separator for GBT evaluations were not checked for fin erosion.

The 2000 cumulative number of fish sampled at each dam, along with expanded collection and passage index levels for the season, are presented in Table 30 for Snake River dams, along with a comparison to the average of the 1998 and 1999 annual passage indices. Lower Granite Dam's annual 2000 passage indices showed large increases over the past 2-yr average for both subyearling and yearling chinook as the result of increased hatchery production, while that of hatchery sockeye was only about one-tenth of the past 2-yr average. The wild/kokanee index appears to contain a large proportion of kokanee again this year since 25% of the wild/kokanee cumulative index occurred prior to mid-May. Little Goose and Lower Monumental Dams' annual 2000 passage indices were lower than the past 2-yr average for all species except chinook subyearlings. This trend for springtime migrants was due in part to higher than usual collections at Little Goose and Lower Monumental dams in 1999 resulting from more fish staying in-river below Lower Granite Dam that year because of its lower than usual collection efficiencies. In 2000, IDFG's natural supplementation program again used a blank wire tag inserted in the fishes' snout as the only method to distinguish these fish. Of the total yearling chinook collected at Lower Granite Dam in 2000, approximately 1.1% was from this natural supplementation program.

TABLE 30. Sample, collection, and passage indices of Salmonids at Snake River dams in 2000 and comparison with the past 2-year average (1998/1999) annual passage indices.

Dam	Species	Rear Type	2000			1998/99 Average Index
			Sample	Collected	Passage Index	
Lower Granite	Chinook Age 0	All	70,056	682,351	747,929	200,136
	Chinook Age 1	All*	27,055	2,450,180	3,290,463	2,751,432
	Chinook Age 1	Supplement	-----	27,502	-----	-----
	Coho	All	2,318	122,107	166,041	171,837
	Steelhead	All	53,401	5,039,624	6,782,370	6,076,607
	Sockeye/kokanee	Wild	488	4,184	5,400	6,670
	Sockeye	Hatchery	68	2,688	3,591	41,257
Little Goose	Chinook Age 0	All	48,316	331,585	357,060	133,058
	Chinook Age 1	All	19,627	1,357,206	1,876,659	2,912,092
	Coho	All	2,211	41,735	54,969	118,495
	Steelhead	All	17,886	1,055,762	1,415,791	3,124,955
	Sockeye/kokanee	All	425	3,720	4,893	27,158
Lower Monumental	Chinook Age 0	All	77,665	189,094	235,017	80,886
	Chinook Age 1	All	55,317	608,628	899,360	1,508,754
	Coho	All	4,079	19,173	30,203	56,815
	Steelhead	All	76,760	766,307	1,159,533	1,915,827
	Sockeye/kokanee	All	483	4,341	6,605	19,445

* All chinook include both clipped and unclipped BWT fish (supplementation fish); while the supplement line shows number of supplementation fish alone.

The 2000 cumulative number of fish sampled at each dam, along with expanded collection and passage index levels for the season, are presented in Table 31 for Columbia River dams, along with a comparison to the average of the 1998 and 1999 annual passage indices. Rock Island Dam's annual 2000 passage indices, compared to the average of the past two years, were somewhat lower for yearling and subyearling chinook and steelhead, and somewhat higher for coho. But for wild and hatchery sockeye, the annual 2000 passage index at Rock Island was only about one-tenth of the past 2-yr average. This same reduction in level of sockeye passage in 2000 was evident at McNary and John Day dams also. The annual 2000 passage indices for yearling and subyearling chinook, coho, and steelhead saw only moderate changes from the past 2-yr average at McNary Dam, while at John Day Dam the annual 2000 passage indices for these species was only half of the past 2-yr average. This is the first year of reporting Bonneville Dam's annual passage indices based on monitoring at the Second Powerhouse.

The the exceptionally low sockeye run from the Mid-Columbia River basin in 2000 may be the result of a low adult return in 1998, elevated water temperatures encountered by these returning adults, and later flooding which scoured sockeye redds. In 1998, numbers of returning adult sockeye salmon to the Mid-Columbia River were about 20-25% of the 10-year average count at Rock Island and Rocky Reach dams. The reduced number of spawning adult sockeye, based on adult counts, and environmental factors after the sockeye had spawned, specifically, flooding and scouring of the redds in the Lake Wenatchee tributaries resulted in the reduced numbers of juvenile migrants in year 2000. In addition, the 1998 Okanogan River basin sockeye salmon encountered elevated water temperatures in the Okanogan River, during their spawning migration which likely impacted survival of adult spawners as well as reduced egg viability. Both the Wenatchee and Okanogan River basins were affected by harsh environmental conditions that resulted in reduced survival of juvenile sockeye salmon migrating to the ocean in 2000.

TABLE 31. Sample, collection, and passage indices of Salmonids at Columbia River dams in 2000 and comparison with the past 2-year average (1998/1999) annual passage indices.

Dam	Species	Rear Type	2000			1998/99 Average Index
			Sample	Collected	Passage Index	
Rock Island	Chinook Age 0	All	9,948	9,948	13,687	22,772
	Chinook Age 1	All	17,164	17,164	25,292	32,640
	Coho	All	33,775	33,775	49,548	43,998
	Steelhead	All	15,882	15,882	23,590	30,561
	Sockeye	Wild	1,488	1,488	2,242	17,776
	Sockeye	Hatchery	130	130	186	2,141
McNary	Chinook Age 0	All	175,769	9,250,320	10,661,118	9,457,626
	Chinook Age 1	All	30,379	1,164,638	1,988,412	2,716,414
	Coho	All	3,418	169,061	260,186	261,681
	Steelhead	All	13,945	365,807	616,339	790,345
	Sockeye	All	2,477	95,959	140,394	1,204,691
John Day	Chinook Age 0	All	197,340	1,132,204	1,681,001	3,058,329
	Chinook Age 1	All	124,788	579,810	827,712	1,667,676
	Coho	All	57,716	172,742	263,801	557,963
	Steelhead	All	82,891	370,637	522,227	1,157,035
	Sockeye	All	17,012	41,126	60,021	548,859
Bonneville Power House #1	Chinook Age 0	All	19,683	1,130,109	3,814,968	n.a
	Chinook Age 1	All	17,337	809,700	2,539,352	n.a
	Coho	All	11,596	619,676	1,977,605	n.a
	Steelhead	All	5,047	211,706	657,552	n.a
	Sockeye	All	407	19,717	65,490	n.a

To distinguish the hatchery yearling fall chinook released from Lyons Ferry Hatchery both on-site and out-planted into the three acclimation ponds above Lower Granite Dam, a colored elastomer (plastic) tag was inserted into the fleshy tissue above an eye. At the traps and dams where these fish may be present, the crews checked all hatchery chinook for the presence or absence of an elastomer tag, and all fish with an elastomer were entered into the mark recapture database. An estimate of the daily yearling spring/summer chinook passage indices at the Snake River trap and at each downstream dam was obtained by subtracting the daily hatchery yearling fall chinook passage indices from the daily total yearling chinook passage indices. The proportion of hatchery yearling fall chinook in the cumulative total yearling chinook passage indices ranged between 1.3 and 19.2% in 2000 depending on site, with the highest percentage occurring at Lower Monumental Dam due to its close proximity to Lyons Ferry Hatchery (Table 32).

TABLE 32. Cumulative 2000 passage indices for Snake River basin yearling hatchery fall chinook (distinguished by presence of colored elastomer tag) compared to overall yearling spring/summer chinook and total yearling chinook by rearing type.

Site	Total Yearling Chinook	Hatchery Yearling Fall Chinook[1]	Total Yearling Spring/Summer Chinook	Yearling Fall Chinook %
Snake R trap (collection thru 5/19)	6,031	394	5,637	6.5%
Lower Granite Dam	3,290,463	128,731	3,161,732	3.9%
Lower Monumental	899,360	172,278	727,082	19.2%
McNary Dam	1,988,412	120,752	1,867,660	6.1%
John Day Dam	827,712	108,937	718,775	13.2%
Bonneville Dam	2,539,352	32,046	2,507,306	1.3%

[1] elastomer colors and positions were Left eye Blue color for Captain John Rapids acclimation pond (Snake River); Left eye Green color for Big Canyon Creek acclimation pond (Clearwater River); Right eye Green color for Pittsburg Landing acclimation pond (Snake River); and Left eye Red color for Lyons Ferry Hatchery on-site release (Snake River).cc

The only hatchery subyearling chinook within the Snake River drainage that were adipose clipped were the Lyons Ferry Hatchery fish released on-site. Therefore, at Lower Monumental Dam any subyearling chinook with an adipose clip was known to have originated at Lyons Ferry Hatchery. The cumulative passage index of Lyons Ferry Hatchery subyearling chinook at Lower Monumental Dam was 11,231 fish, which equates to 4.8% of all subyearling chinook (hatchery and wild combined) collected at Lower Monumental Dam in 2000.

Chinook fry ($\leq$ 65 mm) represented a small percentage of the annual subyearling chinook passage index in 2000, except at Rock Island Dam (Table 33), which is a trend similar to last year. Most dams had less than 0.6% fry in the total subyearling chinook passage indices. Rock Island Dam had over 20% of its cumulative passage index for subyearling chinook consisting of chinook fry.

TABLE 33. Subyearling chinook fry passage indices and percentages for 2000.

Site	Fry (≤ 65 mm) chinook passage index	Total subyearling chinook passage index	Percent chinook fry
Lower Granite Dam	4,143	747,929	0.55%
Rock Island Dam	2,921	13,687	21.35%
McNary Dam	24,083	10,661,118	0.23%
John Day Dam	9,075	1,681,001	0.54%
Bonneville Dam	50,498	819,421*	6.16%

* Excludes subyearling chinook counted as Spring Creek Hatchery tule fall chinook.
Note: sample count with negligible fry at Little Goose (one fish) and Lower Monumental (12 fish) dams.

Freeze brands were applied to groups of hatchery steelhead from the Lyons Ferry Hatchery complex that were released on-site from the hatchery, released in the Tucannon River, and volitionally released from Cottonwood acclimation pond on the Grande Ronde River and Dayton acclimation pond on the Touchet River (Walla Walla River basin). The crews at the sampling sites looked for freeze branded steelhead and, when observed, recorded a fork length. The hatchery is interested in the size distribution of their fish at downstream monitoring sites. Table 34 presents the average fork length of these marked steelhead at key sites in the basin. On average, the Lyons Ferry Hatchery steelhead released from Cottonwood acclimation pond tended to be smaller than their cohorts released at the other sites.

TABLE 34. Average length of freeze branded hatchery steelhead sampled (number in parenthesis) at selected traps and dams in 2000.

Site	Cottonwood RA-2-2	Tucannon RA-IC-1	Lyons Ferry Hatchery		Touchet LA-2-2
			LA-IC-1	LA-IC-3	
Grande Ronde River trap	203.7 (354)	n.a.	n.a.	n.a.	n.a.
Lower Granite Dam	206.1 (174)	n.a.	n.a.	n.a.	n.a.
Lower Monumental	208.3 (196)	226.3 (273)	233.8 (208)	232.6 (175)	n.a.
McNary Dam	215.5 (15)	232.1 (48)	234.7 (34)	235.3 (31)	240.2 (85)
John Day Dam	215.8 (18)	225.8 (70)	228.3 (29)	224.8 (25)	235.9 (138)

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 each dam, key cumulative percentiles of 10%, 50%, and 90% are reported for each species. This passage timing data is also plotted for the run-at-large in Appendix F.

In the Snake River, the middle 80% passage period of springtime migrants in 2000 at Lower Granite Dam was similar to last year, except for the extended duration of sockeye passage in 2000 (Table 35). The last 10% of the sockeye run appeared to migrate pass Lower Granite Dam in September, following two months of virtually no presence there. The 2000 middle 80% passage period for subyearling chinook was similar to that of 1999.

In the Mid-Columbia River, the most striking differences in middle 80% passage timing at Rock Island Dam occurred during the early part of the migration for subyearling chinook and during the latter part of the migration for sockeye (Table 35). The higher than usual number of subyearling fry collected at Rock Island Dam during early April caused the date of 10% passage to occur very early this year. Excluding chinook fry, the subyearling chinook migration in 2000 was similar to last year. The reason for the very extended migration period for sockeye in 2000 may be due in part to the low summertime flows of 2000.

By the time the mixture of Snake and Mid-Columbia River fish were passing McNary Dam, the migration timing in 2000 was similar to the middle 80% passage period in 1999 for all salmonids except sockeye (Table 35). The 2000 passage distribution of sockeye at McNary Dam extended well into the fall months, resulting in a date of 10% passage as late as September 9, over three months later than in 1999 and most other recent years. At Bonneville Dam the middle 80% passage period of all salmonids is again more in line with 1999. The date of 90% passage at Bonneville Dam is June 7, three months earlier than occurred at McNary Dam in 2000. This large shift in the date of 90% passage of sockeye from McNary Dam to Bonneville Dam may be due in part to the resumption of transportation from McNary Dam in the summer and the potential of late in-river migrating sockeye having low survival in the lower Columbia River during the summer months.

TABLE 35. Migration timing of salmonids at Lower Granite, Rock Island, McNary, and John Day dams in 2000 compared to 1999.

Dam	Species	Rear Type	2000			1999		
			10%	50%	90%	10%	50%	90%
Lower Granite	Chinook Age 0	All	6/14	7/3	8/20	6/9	7/3	8/16
	Chinook Age 1	All	4/21	5/4	5/15	4/22	5/6	5/23
	Coho	All	5/12	5/25	6/4	5/20	5/27	6/7
	Steelhead	All	4/19	5/8	5/24	4/24	5/8	5/27
	Sockeye and kokanee	All	4/15	5/24	6/28 – 8/27 [1]	4/23	5/28	6/7
Rock Island	Chinook Age 0	All	4/19	7/15	8/10	6/10	7/15	8/14
	Chinook Age 1	All	5/3	5/14	5/31	4/24	5/7	5/28
	Coho	All	5/20	5/27	6/7	5/14	5/26	6/11
	Steelhead	All	5/5	5/18	5/28	5/3	5/26	6/15
	Sockeye	All	4/21	5/13	7/13	4/28	5/6	5/25
McNary	Chinook Age 0	All	6/21	6/30	7/30	6/14	6/30	8/4
	Chinook Age 1	All	4/28	5/15	6/2	4/18	5/13	5/27
	Coho	All	5/27	6/7	6/22	5/21	5/30	6/14
	Steelhead	All	4/12	5/10	6/6	4/22	5/21	6/1
	Sockeye	All	5/9	5/30	9/9	5/6	5/13	5/28
Bonneville PH 2 in 2000 PH 1 in 1999	Chinook Age 0	All	6/6	6/22	7/19	6/11	6/30	7/25
	Chinook Age 1	All	4/23	5/17	6/1	4/21	5/9	5/30
	Coho	All	5/6	5/22	6/3	4/28	5/23	6/7
	Steelhead	All	4/27	5/17	6/2	4/25	5/18	6/4
	Sockeye	All	5/5	5/25	6/7	5/10	5/17	6/1

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

D. Travel Time.

The PIT tag provides a unique alpha-numeric code for individual fish that allows the 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 interval 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.

Weighted average travel times for weekly and longer duration blocks are computed from the daily median travel times from Appendix E. The duration of the blocks for PIT tag releases from the four Snake River basin traps and from Rock Island Dam are set to coincide with the temporal blocking used in survival estimation from these index reach and McNary Dam to Bonneville Dam index reach are set to one-week intervals beginning each Sunday. Associated with each weighted average travel time is a weighted average flow (plus temperature for the two index reaches). The weighting used in all cases is the number of fish being averaged.

1. Release to Lower Granite Dam Reach

Travel time of smolts from release to Lower Granite Dam was computed for smolts PIT tagged and released from four hatcheries in 2000. Median travel time for yearling chinook released from Dworshak, Imnaha, McCall, and Rapid River hatcheries ranged from 27 to nearly

50 days (Table 36). Dworshak Hatchery steelhead had a median travel time of only 3.5 days compared to 27.3 days for their chinook counterparts.

TABLE 36. Median travel time from release to Lower Granite Dam for Snake River basin hatchery yearling chinook and steelhead in 2000.

Hatchery	Species	Number	Median Travel Time
Dworshak H	Chinook	13,774	27.3
Imnaha AP	Chinook	5,600	42.8*
McCall H	Chinook	12,066	34.1
Rapid River H	Chinook	14,789	49.0
Dworshak H	Steelhead	1,974	3.5

*Rapid River Hatchery and Imnaha Acclimation Pond had volitional releases of 39 days and 27 days, respectively. The median travel time is relative to first day of volitional release period, so actual population median travel time would be less than the value report. The Rapid River Hatchery volitional release was monitored with detectors on the hatchery pond outfall, and results from that monitored release will be presented in the final annual report document.

2. Traps to Lower Granite Dam

Weekly average travel time for yearling chinook from the traps on the lower Salmon, Grande Ronde, and Imnaha rivers, and mainstem Snake River at Lewiston, showed lengthy travel times from all locations until mid-April. From mid-April to late May, the shortest yearling chinook travel times were observed. At the Imnaha River trap where adequate numbers of wild chinook were available for tagging through mid-June, weekly average travel times again began to lengthen as flows decreased (Table 37).

Weekly average travel time for steelhead from the traps on the lower Salmon, Grande Ronde, and Imnaha rivers, and mainstem Snake River at Lewiston, also showed the shortest travel times from all locations between mid-April and late May (Table 37). Steelhead migrated much faster than yearling chinook in 2000, with corresponding travel times from each site being nearly half the number of days for steelhead as yearling chinook.

TABLE 37. Weekly weighted average travel time and Lower Granite Dam flow for steelhead released from traps on Salmon, Imnaha, Grande Ronde, and mainstem Snake rivers in 2000.

	*** Wild Steelhead ***			*** Hatchery Steelhead ***		
Rel_date	**TT days**	**Number**	**Flow**	**TT days**	**Number**	**Flow**
			SALMON RIVER TRAP			
4/10-4/14				13.0	29	101.5
4/17-4/21	3.6	43	106.3	4.5	161	107.4
4/24-4/28	5.0	34	96.0	5.5	351	94.0
5/1-5/5	3.6	27	93.9	4.5	306	94.4
5/8-5/12	5.3	13	74.1	7.1	122	73.4
5/15-5/19	4.1	20	72.6	5.5	234	76.2
			SNAKE RIVER TRAP			
4/3-4/7	4.4	12	80.6	3.4	21	79.3
4/10-4/14	2.4	45	96.6	2.4	95	96.6
4/17-4/21	2.0	82	102.3	1.8	280	105.4
4/24-4/28	2.2	185	97.2	2.2	328	98.2
5/1-5/5	2.0	132	96.0	2.0	385	95.8
5/8-5/12	2.6	57	77.2	2.5	358	79.0
5/15-5/19	2.4	33	75.2	2.8	368	73.7
5/22-5/26	2.1	43	93.2	2.3	282	93.1
			GRANDE RONDE RIVER TRAP			
4/3-4/7	6.2	67	80.6			
4/10-4/14	3.6	94	100.0	3.8	290	98.8
4/17-4/21	3.0	99	104.2	4.2	303	105.7
4/24-4/28	2.9	96	97.6	3.2	324	98.1
5/1-5/5	2.6	100	96.2	2.5	132	96.9
5/8-5/12	3.6	89	75.8	3.7	238	75.4
5/15-5/19				3.5	64	80.3
5/22-5/26				2.7	182	93.2
			IMNAHA RIVER TRAP			
4/3-4/9	6.8	52	82.6			
4/10-4/16	6.1	91	102.3	20.9	196	99.8
4/17-4/23	4.7	159	106.9	7.9	382	103.9
4/24-4/30	5.4	260	94.8	13.9	489	93.8
5/1-5/7	4.0	630	94.3	4.9	610	93.8
5/8-5/14	5.2	264	75.2	7.1	550	74.0
5/15-5/21	4.4	473	74.8	4.9	520	70.9
5/22-5/28	3.5	190	92.2	2.8	441	93.5
5/29-6/4	5.5	16	77.4			

3. Lower Granite Dam to McNary Dam Index Reach

Weekly average travel time of smolts between Lower Granite and McNary dams was estimated using a composite of smolts from multiple sources aggregated to the level of species, blocked by week of passage at Lower Granite Dam. Weekly average travel time for yearling chinook and steelhead are presented in Table 38 for 2000 along with years 1998 and 1999 for comparison. The typical springtime pattern for flows is to increase between early April and late May and both years 1998 and 1999 followed that pattern, but year 2000 did not. Flows changed over a much narrower range in 2000 compared to the other two years and in the opposite direction over time, so that flows decreased through May. The resulting travel time estimated for steelhead between Lower Granite Dam and McNary Dam was a shorter number of days at the higher flows in each year. The regression of smolt travel time and flow (Chart A) for the composite of these three years was significant ($P<0.01$, $R2 = 0.72$, $\ln TT = 1.444 + 89.879/FLOW$). The resulting travel time estimated for yearling chinook between Lower Granite Dam and McNary Dam was a shorter number of days at the higher flows in 1998 and 1999, but not in 2000. The narrower flow range in 2000 and the fact that the higher flows for 2000 were in April rather than in May could explain some of this difference. The regression of smolt travel time and flow (Chart B) for the composite of these three years was significant ($P<0.01$, $R2 = 0.38$, $\ln TT = 1.648 + 75.683/FLOW$). In the plot, we see 2000 data grouped around a narrower flow range compared to the other two years. The plot also shows the prediction curve generated in the past with PIT tag data from 1991 to 1997 ($P<0.01$, $R2 = 0.35$, $\ln TT = 2.087 + 35.662/FLOW$). The two curves follow the same trend, with a higher slope of the recent 3-year curve.

TABLE 38. Weighted average travel time Lower Granite Dam to McNary Dam for yearling chinook and steelhead with flow and temperature at Ice Harbor Dam.

Date at LGR	TT days	Number	Flow	Temp	TT days	Number	Flow	Temp
	YEARLING CHINOOK				STEELHEAD			
4/16-4/22	12.0	189	104.8	51.8	8.8	184	107.2	51.6
4/23-4/29	11.6	499	97.6	52.5	8.5	360	99.1	52.4
4/30-5/6	11.1	715	87.4	53.3	9.3	314	90.0	53.2
5/7-5/13	9.9	1187	77.5	54.0	9.7	263	77.2	53.9
5/14-5/20	10.9	880	86.0	55.7	10.5	162	84.8	55.5
5/21-5/27	10.9	557	89.1	57.3	12.6	202	87.5	57.2
5/28-6/3	7.9	443	82.6	57.1	12.7	242	80.1	57.2
6/4-6/10	8.8	107	76.0	57.7	15.2	156	72.3	58.7
6/11-6/16					22.0	38	53.0	61.7

Travel Time.

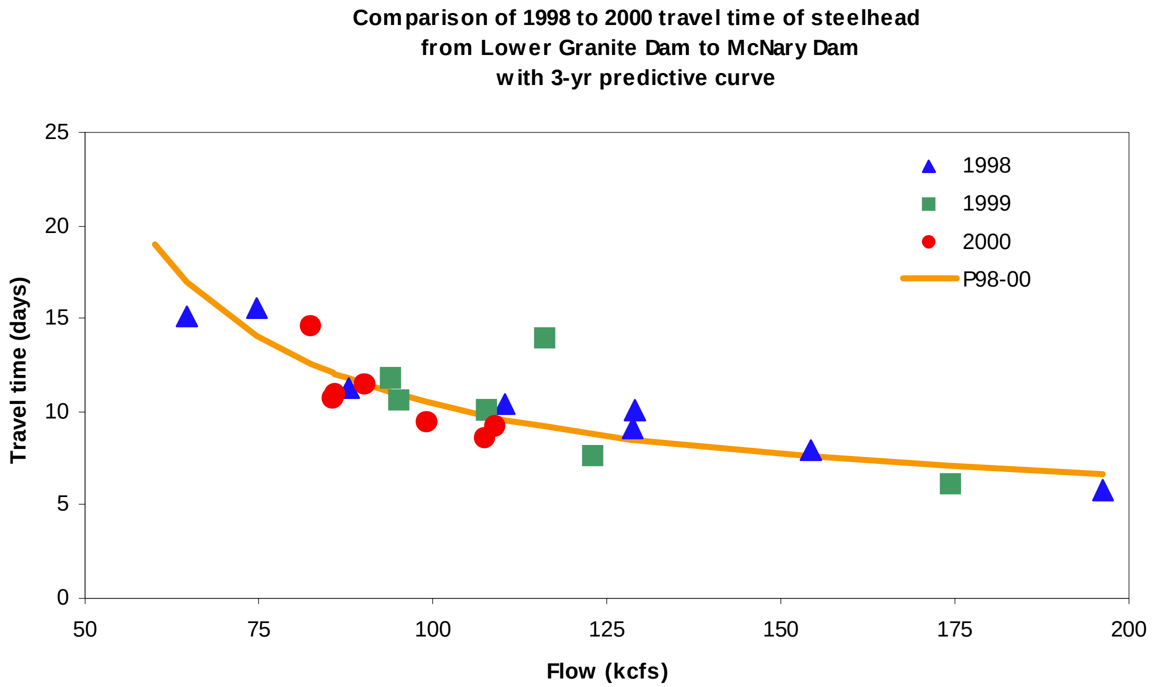


CHART A. Comparison of 1998 to 2000 travel time of steelhead from Lower Granite Dam to McNary Dam with 3-yr predictive curve.

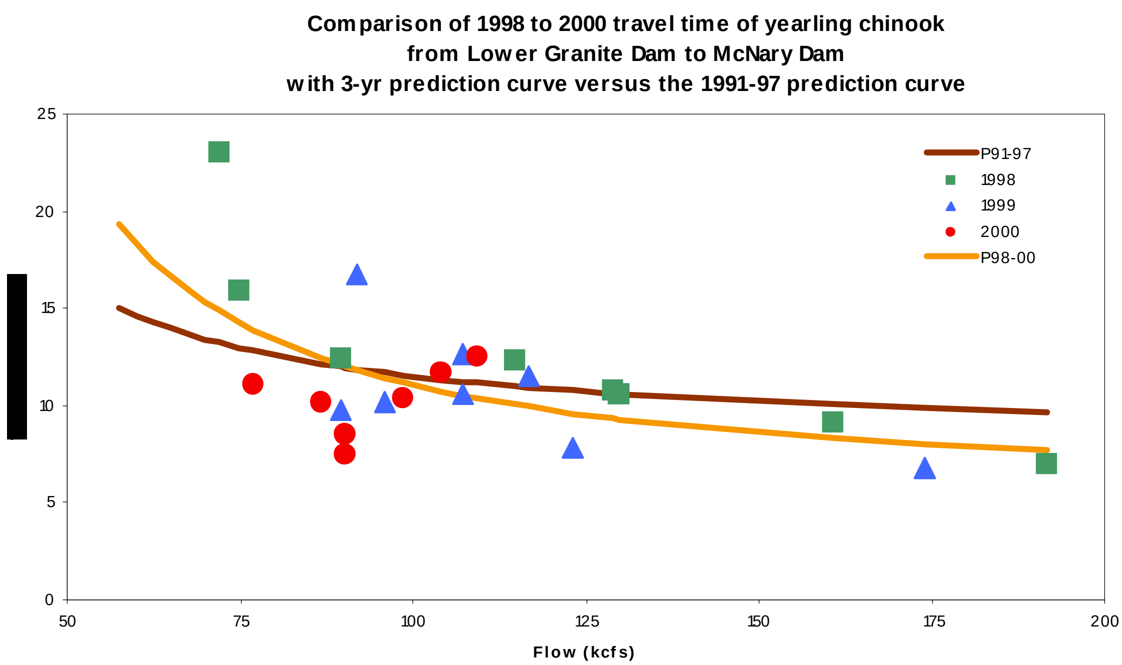


CHART B. Comparison of 1998 to 2000 travel time of yearling chinook from Lower Granite Dam to McNary Dam with 3-yr prediction curve versus the 1991-97 prediction curve.

4. McNary Dam to Bonneville Dam Index Reach

Weekly average travel time of smolts between McNary and Bonneville dams was estimated using a composite of smolts from multiple sources (Snake and Mid-Columbia drainages) aggregated to the level of species. Weekly average travel time for yearling chinook and steelhead are presented in Table 39 for year 2000 along with years 1998 and 1999 for comparison. The typical springtime pattern for flows is to increase between early April and late May and both years 1998 and 1999 followed that pattern, but year 2000 did not. Flows changed in the opposite direction in 2000 compared to the other two years. The resulting travel time estimated for steelhead between McNary Dam and Bonneville Dam was a shorter number of days at the higher flows in each year. The regression of smolt travel time and flow (Figure C) for the composite of these three years was significant ($P<0.01$, $R2 = 0.37$, $lnTT = 1.243 + 134.907/FLOW$). The resulting travel time estimated for yearling chinook between McNary Dam and Bonneville Dam was a shorter number of days at the higher flows in 1998 and 1999, but not in 2000. The fact that the higher flows for 2000 were in April rather than in May could explain some of this difference. The regression of smolt travel time and flow (Figure D) for the composite of these three years was significant ($a=0.05$ level) but with more scatter around the curve than occurred for steelhead ($P-0.04$, $R2 = 0.18$, $lnTT = 1.379 + 108.834/FLOW$). Much of this noise around the curve was due to the 2000 data.

TABLE 39. Yearling chinook and steelhead weekly average travel time from Lower Granite Dam to McNary Dam, 1998 to 2000, with flow [1] indexed at Ice Harbor Dam.

YEARLING CHINOOK							
		Year 1998		Year 1999		Year 2000	
Blk	Date Range	Travel time (d)	Flow (kcfs)	Travel time (d)	Flow (kcfs)	Travel time (d)	Flow (kcfs)
1	4/2 – 4/9	23.0	71.9	16.8	91.9		
2	4/10 – 4/17	15.9	74.7	12.7	107.3	12.5	109.2
3	4/18 – 4/24	12.4	89.5	11.5	116.8	11.7	104.2
4	4/25 – 5/1	12.3	114.7	10.6	107.2	10.4	98.7
5	5/2 – 5/8	10.8	128.9	10.2	96.1	10.2	86.8
6	5/9 – 5/15	10.6	129.7	9.8	89.5	11.1	76.9
7	5/16 – 5/22	9.2	160.8	7.8	123.0	8.5	90.2
8	5/23 – 5/30	7.0	191.7	6.8	174.0	7.5	90.3

STEELHEAD							
		Year 1998		Year 1999		Year 2000	
Blk	Date range	Travel time (d)	Flow (kcfs)	Travel time (d)	Flow (kcfs)	Travel time (d)	Flow (kcfs)
1	4/2 – 4/9	15.1	64.7				
2	4/10 – 4/17	15.6	74.7			9.2	108.9
3	4/18 – 4/24	11.3	88.0	14.0	116.0	8.6	107.5
4	4/25 – 5/1	10.4	110.4	10.1	107.8	9.4	99.1
5	5/2 – 5/8	10.1	128.9	10.6	95.2	10.7	85.6
6	5/9 – 5/15	9.1	128.8	11.8	94.0	14.6	82.4
7	5/16 – 5/22	7.9	154.3	7.6	123.0	11.5	90.3
8	5/23 – 5/30	5.8	196.3	6.1	174.4	10.9	86.0

1 Flow indexed at Ice Harbor Dam - average for period beginning middle date of block and extending for number of days equal to travel time estimate for block.

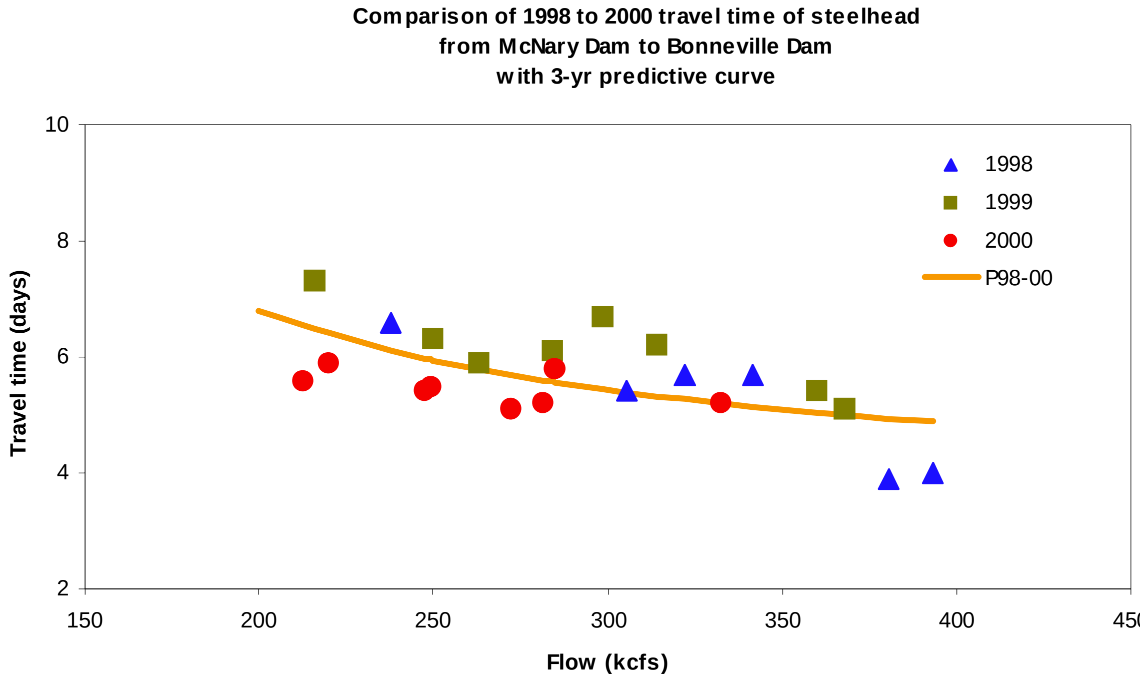


CHART C. Comparison of 1998 to 2000 travel time of steelhead from McNary Dam to Bonneville Dam with 3-yr predictive curve.

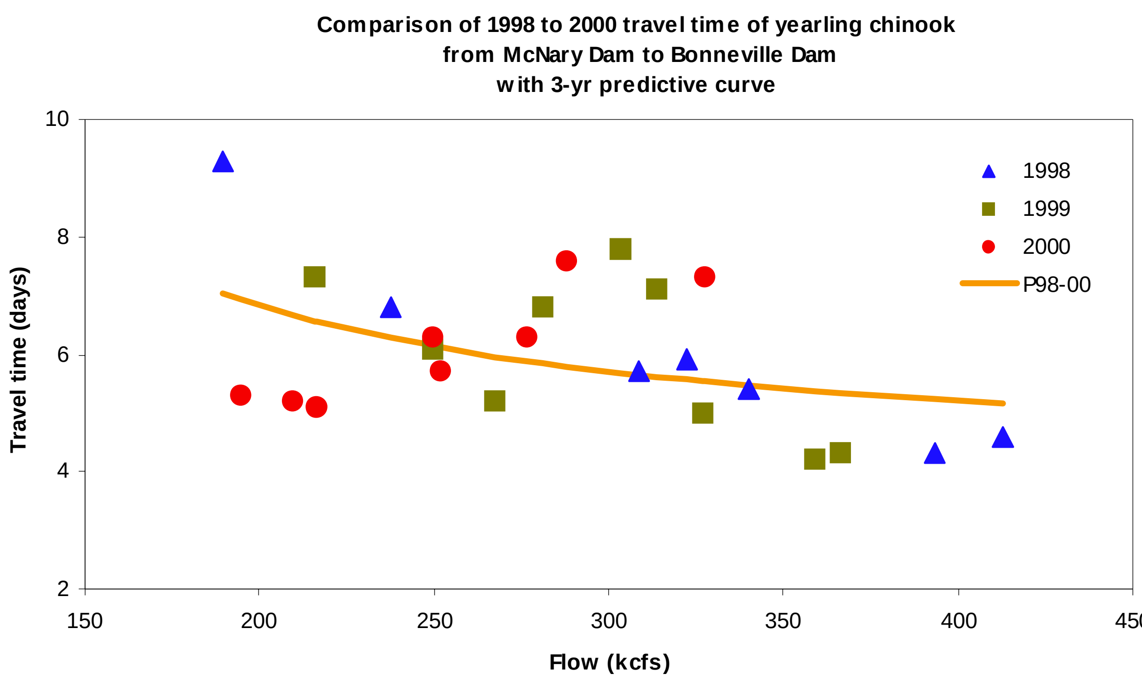


CHART D. Comparison of 1998 to 2000 travel time of yearling chinook from McNary Dam to Bonneville Dam with 3-yr predictive curve.

5. Mid-Columbia River Basin Smolts to McNary Dam Reach

Travel time of Mid-Columbia River basin smolts from release to McNary Dam was computed using smolts PIT tagged at hatcheries and Rock Island Dam. The median travel time of yearling chinook from Winthrop and Leavenworth hatcheries was 30 and 36 days, respectively (Table 40). The median travel time of subyearling chinook of Mid-Columbia River basin origin for hatchery fall chinook from Priest Rapids and Ringold hatcheries was 9.8 to 12.3 days and that of Wells Hatchery summer chinook was 35 days. The longer migration distance to McNary Dam for Wells Hatchery smolts contributes to this longer median travel time.

TABLE 40. Yearling chinook and steelhead weekly average travel time from McNary Dam to Bonneville Dam, 1998 to 2000, with flow[1] indexed at The Dalles Dam.

YEARLING CHINOOK							
		Year 1998		Year 1999		Year 2000	
Blk	Date Range	Travel time (d)	Flow (kcfs)	Travel time (d)	Flow (kcfs)	Travel time (d)	Flow (kcfs)
1	4/11 – 4/17			7.3	215.8		
2	4/18 – 4/24	9.3	189.4	7.8	303.2	7.3	327.6
3	4/25 – 5/1	6.8	237.7	7.1	313.9	7.6	287.9
4	5/2 – 5/8	5.4	339.9	6.8	280.9	6.3	276.5
5	5/9 – 5/15	5.9	322.2	6.1	249.9	6.3	249.5
6	5/16 – 5/22	5.7	308.4	5.2	267.1	5.7	251.7
7	5/23 – 5/29	4.6	412.5	4.2	359.1	5.1	216.5
8	5/30 – 6/5	4.3	393.5	4.3	366.3	5.2	209.5
9	6/6 – 6/12			5	326.9	5.3	194.4
STEELHEAD							
		Year 1998		Year 1999		Year 2000	
Blk	Date range	Travel time (d)	Flow (kcfs)	Travel time (d)	Flow (kcfs)	Travel time (d)	Flow (kcfs)
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
3	4/25 – 5/1	6.6	237.7	6.2	314.0	5.8	284.7
4	5/2 – 5/8	5.7	341.8	6.1	284.4	5.2	281.2
5	5/9 – 5/15	5.7	322.2	6.3	249.9	5.5	249.5
6	5/16 – 5/22	5.4	305.6	5.9	263.2	5.4	247.5
7	5/23 – 5/29	3.9	380.5	5.4	360.2	5.9	220.0
8	5/30 – 6/5	4.0	393.5	5.1	367.8	5.6	212.7

1 Flow indexed at The Dalles Dam - average for period beginning middle date of block and extending for number of days equal to travel time estimate for block.

For smolts PIT tagged and released from Rock Island Dam, the weighted average travel time to McNary Dam for steelhead was nearly half of that observed for yearling chinook and sockeye (Table 41). Weighted average travel time for subyearling chinook was about 20 days for fish tagged and released from the dam between mid-June and late July. Tagged subyearling chinook released between July 27 and August 19 showed weighted average travel times closer to 12 days, similar to what was observed for yearling chinook released in May.

TABLE 41. Median travel time for PIT tagged chinook, steelhead, and sockeye released from Rock Island Dam to McNary Dam in 2000.

Release date range	TT days	Number	Flow
	YEARLING CHINOOK		
4/21-5/4	17.3	186	181.2
5/5-5/14	13.1	184	171.5
5/16-6/2	12.1	193	140.4
	STEELHEAD		
4/21-5/9	5.9	143	184.2
5/10-5/16	6.2	60	170.6
5/17-6/2	7.6	66	149.5
	SOCKEYE		
4/21-5/9	13.3	38	188.4
5/10-5/31	13.5	19	150.5
	SUBYEARLING CHINOOK		
6/19-7/5	21.5	239	131.7
7/6-7/18	20.1	272	127.4
7/19-7/26	19.9	251	129.9
7/27-8/3	11.9	235	134.5
8/4-8/19	12.8	202	121.5

E. Estimates of Survival:

Survival is estimated from release to first detection site, and between series of dams, by the Jolly-Seber 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. For a specified group of fish, this methodology provides a group estimate of survival through a series of reservoirs and dams, as well as a group estimate of collection efficiency at the dams. For the group of PIT tagged fish of interest, this method uses the subsequent detection information on the known number of fish re-released at a particular dam to estimate the number of fish that passed that particular dam alive but undetected. By adding the number of fish detected at the dam and the estimated number of fish alive but undetected passing the dam, we have an estimate of the total number of fish from the group of interest at that particular site. Dividing that estimated total by the estimated total of an upstream dam, we arrived at the survival estimate from the tailrace of the upstream dam to the tailrace of the downstream dam. If one divides by the release number, then an estimate of survival from release to the tailrace of the downstream dam of interest is obtained.

In 2000, a total of 67 groups of wild and hatchery chinook and steelhead were created for survival estimation from the daily releases of PIT tagged fish from the four traps above Lower Granite Dam. The weekly tagging goal for survival estimation was set at 600 fish, but this number of fish per week was not always possible. Therefore, a release period of up to 15 consecutive days was used in some instances to try to activate the target release size. The detailed survival tables for these groups are presented in Appendix F, Table 1 and summarized in the text below. The format of the data in this appendix is identical to that found in prior FPC Annual Reports, showing survival from release site to Lower Monumental Dam tailrace and for the three shorter reaches that make up this longer reach. The extended multi-dam reach survival estimate is the product of three shorter reach estimates. The associated variance for the extended reach estimate is computed using Meyer's (1975) formulas for propagation of error in products of non-independent estimates. For each release location, species, rearing type of fish (hatchery or wild), and release period, we obtain an extended reach survival estimate with associated 95% confidence interval.

Reach survival from Rock Island Dam to McNary Dam was estimated for a total of 13 groups of yearling and subyearling chinook, steelhead, and sockeye (all mixtures of hatchery and wild fish) released from Rock Island Dam. The same weekly tagging goal of 600 fish per group was sought. However, due to fewer downstream recovery sites for Mid-Columbia River released fish and the low collection efficiency at McNary Dam during the spring season, it was necessary to have release sizes in excess of 600 fish to obtain survival estimates with reasonable precision. This required blocks between 7 and 17 days. The estimated survival to McNary Dam tailrace for groups released from Rock Island Dam are presented in Appendix F, Table 3 and summarized in the text below.

Survival estimates were also obtained for hatchery yearling chinook and steelhead from four hatcheries in the Snake River drainage and for hatchery yearling and subyearling chinook from five hatcheries in the Mid-Columbia River drainage. Data for the Snake River hatcheries show survival estimates from release site to Lower Monumental Dam tailrace (product of three reach survival estimates) and from release site to John Day Dam tailrace (product of five reach survival estimates). Data from the Mid-Columbia River hatcheries show survival estimates from release site to McNary Dam only. Data for the reaches in the Snake and Mid-Columbia River basins are presented in Appendix F, Table 2 and Table 3, respectively, and are summarized in the text below.

For each species and rearing type, a seasonal average was obtained for releases from the four traps and Rock Island Dam whenever the survival estimates of the groups released over time did not significantly differ. To determine 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.

The 2000 seasonal estimate of survival for PIT tagged wild and hatchery chinook from the four traps to Lower Monumental Dam tailrace averaged between 54% and 92%, with 4 of 7 cases in the 76%-78% range (Table 42).

TABLE 42. Yearling chinook annual reach survival estimates from release location at trap to Lower Monumental Dam tailrace, 2000 compared to 1998 - 1999.

Tag Site	Species	Rearing type	Year	Date Range	No. blocks averaged	Survival	Lower Limit	Upper Limit
Salmon River trap								
	Chinook	Wild	1998	3/23-5/1	3	0.777	0.697	0.857
			1999	3/18-4/30	5	0.809	0.775	0.844
			2000	3/27-4/21	4	0.763	0.690	0.835
Salmon River trap								
	Chinook	Hatchery	1998	4/6-5/1	3	0.679	0.618	0.740
			1999	3/18-5/21	8	0.694	0.660	0.729
			2000	3/13-5/5	8	0.690	0.602	0.777
Snake River trap								
	Chinook	Wild	1998	3/25-5/8	2	0.767	0.669	0.865
			1999	3/22-5/25	5	0.861	0.832	0.891
			2000	4/10-4/28	3	0.916	0.779	1.052
Snake River trap								
	Chinook	Hatchery	1998	4/13-5/8	4	0.797	0.729	0.865
			1999	4/5-5/25	5	0.884	0.842	0.926
			2000	4/10-5/5	4	0.770	0.672	0.868
Imnaha River trap								
	Chinook	Wild	1998	3/16-4/23	6	0.751	0.707	0.795
			1999	3/28-5/14	5	0.806	0.775	0.837
			2000	3/13-4/23	4	0.757	0.699	0.815
Imnaha River trap								
	Chinook	Hatchery	1998*	4/8-4/9	1	0.583	0.512	0.655
			1998*	4/13-4/14	1	0.738	0.624	0.853
			1999	4/4-4/16	2	0.610	0.554	0.665
			2000	3/20-4/16	4	0.535	0.445	0.626
Grande Ronde River trap								
	Chinook	Wild	1998	3/24-5/8	2	0.699	0.600	0.798
			1999	4/12-4/30	1	0.825	0.756	0.894
			2000	4/3-5/5	5	0.775	0.650	0.900
Grande Ronde River trap								
	Chinook	Hatchery	1998	4/8-4/9	1	0.776	0.619	0.934
			1999*	3/17-3/26	1	0.580	0.523	0.637
			1999*	3/29-4/9	1	0.706	0.634	0.779
			2000	4/24-5/5	1	(>1 unreliable estimate)		

*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.

The 2000 seasonal estimate of survival for PIT tagged hatchery steelhead from the four traps to Lower Monumental Dam tailrace averaged between 51% and 69%, with 3 of 4 traps having survival estimates below 60% (Table 43). Season survival estimates for wild steelhead tended to be higher, ranging between 61% and 74% (Table 43).

TABLE 43. Steelhead annual reach survival estimates from release location at trap to Lower Monumental Dam tailrace, 2000 compared to 1998 - 1999.

Tag Site	Species	Rearing type	Year	Date Range	No. blocks averaged	Survival	Lower Limit	Upper Limit
Salmon River trap								
	Steelhead	Hatchery	1998	4/20-5/1	2	0.814	0.723	0.905
			1999	4/14-5/21	4	0.692	0.651	0.733
			2000	4/17-5/19	4	0.514	0.398	0.629
Snake River trap								
	Steelhead	Wild	1999	4/19-5/25	2	0.816	0.739	0.893
			2000	4/17-5/5	3	0.743	0.622	0.865
Snake River trap								
	Steelhead	Hatchery	1998	4/6-5/23	7	0.728	0.683	0.773
			1999*	4/19-4/30	2	0.874	0.817	0.930
			1999*	5/3-5/25	2	0.717	0.676	0.758
			2000	4/17-5/26	4	0.692	0.580	0.803
Imnaha River trap								
	Steelhead	Wild	1999	5/10-5/20	2	0.784	0.733	0.835
			2000	4/17-5/21	5	0.611	0.508	0.714
Imnaha River trap								
	Steelhead	Hatchery	1998	4/27-5/22	4	0.635	0.589	0.681
			1999	4/11-6/24	5	0.711	0.680	0.742
			2000	4/17-5/21	5	0.551	0.463	0.639
Grande Ronde River trap								
	Steelhead	Wild	1999	4/19-5/25	2	0.806	0.747	0.866
			2000	4/5-4/28	4	0.729	0.614	0.843
Grande Ronde River trap								
	Steelhead	Hatchery	1998	4/24-5/15	4	0.632	0.586	0.678
			1999	4/19-5/25	3	0.720	0.678	0.761
			2000	4/10-5/12	4	0.561	0.489	0.633

*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.

Note: 1998 wild steelhead survival estimates are not included in the comparisons because of potential biases in the estimation that year (see pastes 67-68 of 1998 FPC Annual Report).

The 2000 estimates of survival for PIT tagged hatchery chinook from the hatchery release site to the tailrace of John Day Dam was 51.3% for Dworshak Hatchery fish, 52.2% for Rapid

River Hatchery fish, 42.5% for Imnaha Hatchery fish, and unknown for McCall Hatchery fish (Table 44). No reliable estimate of survival from hatchery release site to John Day Dam tailrace was available for McCall Hatchery chinook because estimated survival in each reach below Lower Monumental Dam was in excess of 100% with wide confidence intervals. However, survival of McCall Hatchery chinook to Lower Monumental Dam tailrace was 51.6%, below the range of that reach's survival estimate for Rapid River Hatchery chinook (69.0%) (Figure 2), Imnaha Acclimation Pond chinook (57.1%), and Dworshak Hatchery chinook (68.4%). Table 44 shows the survival of hatchery chinook and one group of steelhead to John Day Dam.

TABLE 44. Reach survival estimates for hatchery yearling chinook and Dworshak steelhead to John Day Dam tailrace (JDA), 2000 compared to 1998 - 1999.

Tag Site	Species	Rearing Type	Year	Date Range	Release Number	Survival	Lower Limit	Upper Limit
McCall SFH								
	Chinook	Hatchery	1998	3/30	47460	0.384	0.340	0.429
			1999	4/6-4/7	47802	0.543	0.490	0.595
			2000	4/3-4/5	47709	n.a.	n.a.	n.a.
Rapid River SFH								
	Chinook	Hatchery	1998	V: 3/16-4/21	48357	0.459	0.404	0.513
			1999	V: 3/18-4/26	47802	0.564	0.522	0.607
			2000	V: 3/17-4/25	47748	0.522	0.401	0.642
Imnaha Acclimation Pond								
	Chinook	Hatchery	1998	4/6	19169	0.440	0.378	0.503
			1999	V: 3/16-4/16	22662	0.484	0.432	0.535
			2000	V: 3/22-4/18	20819	0.425	0.296	0.554
Dworshak NFH								
	Chinook	Hatchery	1998	3/25-3/26	47704	0.484	0.425	0.544
			1999	4/7-4/8	47840	0.554	0.522	0.587
			2000	3/23; 4/5-4/6	47745	0.513	0.420	0.607
Dworshak NFH								
	Steelhead	Hatchery	1998	4/27-4/30	1500	0.500	0.347	0.652
			1999	4/26-4/30	3715	0.481	0.408	0.554
			2000	5/3-5/5	4208	0.408	0.101	0.714

V denotes volitional release periods at Rapid River Hatchery and Imnaha Acclimation Pond.

The 2000 survival for PIT tagged hatchery yearling chinook released from Leavenworth and Winthrop hatcheries was estimated at 59% and 48%, respectively, to McNary Dam tailrace

(Table 45). The Leavenworth Hatchery fish passed four dams and was similar to the past two years, while the Winthrop Hatchery fish passed six dams and was lower (though not statistically different) than the past two years. Subyearling chinook released from Wells Hatchery (passing five dams) had estimated survival of 21% to the tailrace of McNary Dam, which was lower than the past two years (the drop was statistically significant compared to 1999) (Table 45). Subyearling chinook released from Priest Rapids and Ringold hatcheries also had lower survival estimates to McNary Dam tailrace in 2000 compared to 1999 (the drop was statistically significant for the Ringold Hatchery release). The lower flows in 2000 during the subyearling chinook migration may have contributed to the lower seasonal average survival.

TABLE 45. Survival estimates for Mid-Columbia River basin yearling and subyearling chinook from release site to McNary Dam (MCN) tailrace, 2000 compared to 1998-1999.

Tag Site	Species	Rearing type	Year	Release Date Range	Survival	Lower Limit	Upper Limit
Winthrop NFH							
	Chinook	Hatchery	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
Leavenworth NFH							
	Chinook	Hatchery	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
Wells SFH							
	Chinook	Hatchery	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
Priest Rapids SFH							
	Chinook	Hatchery	1999	6/14-6/23	0.757	0.679	0.836
			2000	6/15-6/27	0.666	0.577	0.755
Ringold SFH							
	Chinook	Hatchery	1999	6/16	0.835	0.740	0.929
			2000	6/17-6/19	0.540	0.475	0.604

The 2000 seasonal average survival estimates for fish PIT tagged and released from Rock Island Dam 83% for yearling chinook, 66% for steelhead, 63% for sockeye, and 60% for subyearling chinook (all species are a combination of hatchery and wild fish). Although these seasonal survival estimates were similar to the 1998 and 1999 estimates, the precision in the 2000 estimates for the spring migrants was much lower (i.e., wider confidence intervals). The trend toward lower survival estimates in 2000 observed for specific releases of hatchery chinook fish (both yearling and subyearling chinook) was not observed with the PIT tagged yearling and subyearling chinook released from Rock Island Dam (Table 46). The latter fish are a run-of-river mixture of wild and hatchery stocks, and this mixture may obscure the hatchery specific changes noted previously between years.

TABLE 46. Annual reach survival estimates from release at Rock Island Dam (RIS) to McNary Dam (MCN) tailrace, 2000 compared to 1998 - 1999.

Tag Site	Species	Rearing type	Year	Date Range	No. blocks averaged	Survival	Lower Limit	Upper Limit
Rock Island Dam								
	Chinook	Combined	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
Rock Island Dam								
	Steelhead	Combined	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
Rock Island Dam								
	Sockeye	Combined	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
Rock Island Dam								
	Chinook	Combined	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

*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. Summary and Conclusions.

- Passage indices and migration timing of yearling chinook, subyearling chinook, steelhead, and coho in 2000 were not much different than expected compared to last year after accounting for increases in chinook production in 2000 and differences in collection efficiency (estimated from PIT tag data) at Snake River sites between years.

- Passage indices and migration timing of wild and hatchery sockeye in 2000 were radically different from past years. Passage indices were about one-fifth last years level at Lower Granite and Little Goose dams, and only about one-ninth last years level at Rock Island, McNary, and John Day dams. The exceptionally low sockeye run from the Mid-Columbia River basin in 2000 may be trace back to a low adult return in 1998, elevated water temperatures encountered by these returning adults, and later flood scoured sockeye redds. The sockeye migration timing was extended two to three months later than usual apparently due in part to the low summertime flows in 2000.

- Steelhead smolts collected, PIT tagged, and released from tributary traps (lower Salmon, Imnaha, and Grande Ronde rivers) migrated about twice as fast as yearling chinook smolts to Lower Granite Dam in 2000.

- PIT tagged steelhead smolts in 2000 had estimated travel times between Lower Granite and McNary dams, and between McNary and Bonneville dams, that followed the typical flow-travel time relation (decreasing travel time with increasing flow). The yearling chinook travel times reflected flow shaping with higher flows occurring in April and declining through May. Flow-travel time regressions using a composite of the most recent three years of data (1998, 1999, and 2000) indicate that the travel times followed the expected flow/travel time relationship with variation in chinook travel times due to flow shaping.

- Seasonal survival estimates for yearling chinook and steelhead from the four traps (lower Salmon, Imnaha, Grande Ronde, and mainstem Snake River at Lewiston) to Lower Monumental Dam tailrace similar to previous years. Yearling wild and hatchery chinook and wild steelhead seasonal survival estimates were above 60% for all but Imnaha River hatchery chinook, and within the range observed in 1998 and 1999. Hatchery steelhead seasonal survival estimates in 2000 were below 60% for releases from three of the four traps, and significantly lower than the 1999 seasonal estimates.

- Hatchery chinook released from Rapid River, Dworshak (plus a release of steelhead) and Imnaha hatcheries in 2000 had survival estimates to John Day Dam tailrace that were not significantly different from the survival estimates for 1998 and 1999.
- Yearling and subyearling chinook, steelhead, and sockeye smolts collected, PIT tagged, and released from Rock Island Dam had seasonal survival estimates to the tailrace of McNary Dam that remained fairly similar across the three years 1998 to 2000.
- PIT tagged hatchery subyearling chinook released from Wells and Ringold hatcheries had significantly lower survival estimates to McNary Dam tailrace in 2000 compared to 1999, while those from Priest Rapids Hatchery did not. Likewise, PIT tagged hatchery yearling chinook from Leavenworth and Winthrop hatcheries did not have significantly lower survival estimates to McNary Dam in 2000 compared to 1998 and 1999.
- Year 2000 had flows that were below NMFS biological opinion levels, and impacts of these lower flows in terms of longer travel times and lower survival estimates appeared the greatest on hatchery steelhead in the Snake River and hatchery subyearling chinook in the Mid-Columbia River.

IV. Adult Fish Passage

A. Overview

Annually, adult salmon (all races and species) along with other species such as lamprey, shad and resident fishes are counted as they migrate upstream past mainstream Columbia and Snake River dams. These fish are either videotaped as they pass through the counting slots or are directly counted by personnel. Fish counting seasons normally run from March/April through October/November. The U. S. Army Corps of Engineers (COE) contracts with the Washington Department of Fish and Wildlife (WDFW) to count fish at COE projects while the Public Utility Districts (PUD) contract personnel to count adult fish at their dams. 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. In addition, fish counts are daily updated on Web sites including the FPC Web site.

The Fish Passage Center 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. The inspections are completed to assure that fishways are maintained at acceptable criteria levels throughout the fish passage season. State and Federal fish agencies complete the fish facilities inspections.

Some general conditions occurring during the 2000 adult fish passage season that might have affected fish passage at the mainstream dams are listed.

- Water temperatures warmed to the lower 70°F during the summer and late fall in 2000 and caused some delay in the steelhead passage this season.

- Adult fish continue to fallback at some projects. Fish were also examined for head burns and rated according to established protocol from early April through late July at Bonneville and Lower Granite dams. Signs of head burn on adult salmon were minimal for the season with about 1% of the sampled fish affected at Bonneville Dam. This percentage increased at the

Lower Granite trapping site to 3% (information supplied by CRITFC at Bonneville Dam and by NMFS at Lower Granite Dam).

- Adult passage conditions at mainstem projects were satisfactory, with no major problems noted that impeded upstream migrants in 2000.

B. Adult Fish Counts

1. Spring Chinook Salmon

In 2000, numbers of adult spring chinook salmon returning to Bonneville Dam and upstream sites rebounded from record low levels noted during most of the 1990s to a near record high at Bonneville Dam of 178,600. This year's adult run was comprised of a mixture of 3-year, 4-year, and 5-year old fish that spend one to three years of their life cycle in the ocean. This total was comprised mainly of 4-year old Chinook, about 83% based on adult sampling results completed at the Bonneville Dam adult trapping facility by CRITFC. However, the Bonneville count of 21,259 spring chinook (jack) salmon was the highest total on record and accounted for about 11% of the spring Chinook run during 2000. Figure 16 illustrates the decline of adult spring chinook during the 1994, 95, and 96 seasons; the large increase in adult returns noted in 1997, and then the drop to less than 40,000 fish in 1998 and 1999, and the rebound to nearly record levels in 2000.

Of the Bonneville count (178,302), approximately 57.7% or 102,953 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 fishery on adult spring chinook was again allowed that permitted a sport fishery in the tributaries and a Tribal ceremonial fishery in this Reach.

About 37.1% of the spring chinook counted at The Dalles Dam chose the Snake River. This percentage was greater than 1999 returns, but well below the 1997 and 1998 percentages. About 88.5% of the fish entering the Snake River were counted past Lower Granite Dam (33,822). Estimated **hatchery** chinook at Lower Granite Dam comprised a minimum of 81.4% of the run [note that this percentage is based only on the absence of the adipose fin]. The remainder [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 (Ice Harbor Dam) was about 7.1 times greater than the 1999 count and 2.5 times greater than the 10-year average.

The number of “jack” spring chinook salmon that returned to the Snake River was nearly 10,000, about 13 times greater than the 10-year average. These “jacks” were from the 1997 brood year and migrated in 1999. This increase in the jack count is reason for further optimism; the pre-season forecast made by the Technical Advisory Committee (TAC) is projecting a return of 206,700 Snake River fish to the Columbia River in 2001. This total includes an estimated 39,300 wild “threatened” spring chinook to the Snake River Basin in 2001.

The spring chinook count at Priest Rapids Dam was 19,143 with 14,400 fish arriving at Rock Island Dam. The 2000 count was about 4.5 times and 2.1 times greater than the respective 1999 and 10-year average adult spring chinook count at both projects. Most spring chinook returning to the Mid-Columbia River are hatchery reared fish; with the exception of the Yakama River. However, 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 Priest Rapids Dam was 1085, about 1.2 times greater than the 1999 “jack” returns and 5.6 times greater than the 10-year average. Expected return of adult salmon to the upper Columbia River should rebound to about 38,100 in year 2001 based on TAC estimates.

2. Summer Chinook

The summer chinook count at Bonneville Dam was 30,616, about 1.2 and 1.5 times greater than the respective 1999 and 10-year average. The summer chinook count at The Dalles Dam dropped to 25,147, about 82% of the Bonneville Dam count (Note: This percentage reduction was about equal to the 1999 conversion rate between Bonneville and The Dalles dams).

The Snake River count at Ice Harbor Dam was 4,241 adult summer chinook or 17% of The Dalles count. The Lower Granite Dam count was 3,933, about 93% of the Ice Harbor count. The summer chinook count at Lower Granite was about 120% of the 1999 and 93% of the 10-year average. Snake River summer chinook are mainly destined for the South Fork of the Salmon River and its tributaries. This year’s count of summer chinook “jacks” also rebounded to nearly 3,700 to Lower Granite Dam. This total was double the 1999 and 7.5 times greater than the 10-

year average at the project. The 2000 forecast by TAC was estimated for 6,100 adult summer Chinook for the Snake River.

The Mid-Columbia count of adult summer chinook was 22,306, a total about 1.1 and 1.6 times greater than the respective 1999 and 10-year average. The passage of summer chinook at Rock Island Dam was 18,717 with 13,422 recorded at Rocky Reach Dam. Summer chinook destined for the Wenatchee River basin comprised about 28% of the Run, with the remaining 72% passing upstream of Rocky Reach Dam. Summer chinook can be either trapped at Wells Dam or volitionally enter Wells Hatchery for their hatchery program. One interesting point is that “jack” summer chinook counted at Priest Rapids Dam was about 22% the jack count at Rock Island Dam and 63% of the Rocky Reach count. Overall, this suggests that fish counts were highly variable, enumerating “jack chinook” for the summer chinook in the Mid-Columbia in 2000 (similar to what occurred in 1999).

3. Fall Chinook

The number of fall chinook counted at Bonneville Dam was 192,815, with an additional 55,382 jack chinook also counted. The 2000 adult count was less than the 1999 count but greater than the 10-year average, while the jack count was 2.4 and 1.9 times greater than the respective 1998 and 10-year average. The number of adult fall chinook (bright component) that arrived at McNary Dam was reduced to 66,378 (Figure 17), however, this total still exceeded the 10-year average. Most fall chinook passing McNary Dam are of “wild” origin and generally destined for the Hanford Reach to spawn. Numbers counted above Priest Rapids Dam have shown a steady increase during the past few years and compared to the 10-year average. Tule fall chinook estimated from the fish counts at Bonneville Dam totaled 21,852, with 6,287 adult chinook arriving at Spring Creek National Fish Hatchery, located in the Bonneville Dam pool (Figure 18). The number of Tule jack chinook rebounded from an almost record low of 261 in 1999 to 5,060, an almost record high returning to Spring Creek NFH.

The turn-off into the Snake River of 6,509 adult fall chinook was nearly equal to the 1999 total; however, the 9,729 jack salmon that returned was 2.8 and 5.5 times greater than the 1999 and 10-year average. Passage of adult fall chinook at Lower Granite Dam exceeded the 1999 number and was nearly 3 times greater than the 10-year average.

4. Sockeye Salmon

The number of sockeye salmon returning to Bonneville Dam was 93,398 for the season. The bulk of sockeye in the Columbia River are destined for the Mid-Columbia River, with approximately 75% destined for Lake Osoyoos and 25% destined for Lake Wenatchee in 2000. This year's return showed a large gain as the counts were nearly double the 10-year average.

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 2000, about 300 adult sockeye were counted at Lower Granite Dam and more than 200 returning to Red Fish Lake trapping sites.

5. Coho Salmon

The combined return of adult and jack counts of coho salmon was about 97,000, double the 1999 return, and greater than triple the 10-year average at Bonneville Dam. The year 2000 count of coho was again fairly strong, due in part to release of more juvenile fish into river basins above Bonneville Dam. The majority of coho passing Bonneville Dam still "home" into rivers and hatcheries located in the Bonneville pool. About 20,400 **adult** coho were counted at John Day Dam with most normally destined for either the Umatilla River or the Yakama River. About 10,000 adult coho passed McNary Dam with most expected to enter the Yakama River. Numbers of coho that returned to Wenatchee River as well as the Snake River basin exceeded expectations and are part of on-going efforts to establish coho again in the upper basins.

6. Steelhead

The count of steelhead at Bonneville Dam totaled 275,273 and exceeded both the 1999 and 10-year average. The count at The Dalles Dam was 205,241 while John Day reported 215,393. This is the 3rd consecutive year that the John Day steelhead counts were greater than The Dalles Dam. These numbers indicate some discrepancy in steelhead counts in the lower river. The COE and WDFW are assessing this problem. The number of steelhead counted at McNary Dam was 129,696, about 150% and 108% of the respective 1999 and 10-year average.

The count at Ice Harbor Dam was 115,394; Lower Granite reported 111,751. The Snake River steelhead count at Lower Granite Dam was about 150% and 141% of the respective 1999 and 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. Approximately 20,000 "wild" steelhead were counted past Lower Granite in 2000.

The Mid-Columbia count of steelhead at Priest Rapids Dam was about 11,000, 132% of the respective 1998 and 10-year average. About 10,500 steelhead were counted at Rock Island, with 6,336 above Wells Dam. Returns of "wild" steelhead and Wells and Wenatchee stock hatchery steelhead in the upper Mid-Columbia River remain depressed and have been listed as "Threatened" under the ESA.

TABLE 47. 2000 Adult Year to Date Totals

2000 Cumulative Adult Passage at Mainstem Dams

	Spring Chinook						Summer Chinook						Fall Chinook					
	2000		1999		10-Yr Avg.		2000		1999		10-Yr Avg.		2000		1999		10-Yr Avg.	
DAM	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack
BON	178,302	21,259	38,669	8,691	62,347	2,737	30,616	13,554	26,169	4,022	20,522	2,637	192,815	55,382	242,143	23,482	176,016	29,813
TDA	102,953	14,796	17,563	6,180	36,497	1,828	25,147	10,433	21,730	3,207	16,441	1,905	124,967	37,918	131,786	19,025	98,712	20,906
JDA	86,502	12,133	15,409	5,089	29,402	1,505	23,069	8,146	22,210	2,504	15,458	1,691	102,907	36,261	106,052	12,018	75,685	15,476
MCN	64,647	10,839	9,260	3,972	28,536	1,577	20,776	7,098	19,275	2,343	16,138	1,747	66,378	20,001	78,356	8,740	64,834	16,944
IHR	38,234	9,129	5,351	2,657	15,091	720	4,241	3,182	3,900	1,311	4,465	461	6,509	9,729	6,532	3,489	3,759	1,776
LMN	35,634	10,389	3,924	2,726	14,041	753	4,678	3,288	3,372	1,344	4,195	468	5,353	9,666	5,508	3,397	2,575	1,439
LGS	34,468	10,152	3,445	2,690	**	**	4,160	3,776	3,273	1,583	**	**	3,586	6,820	4,196	2,048	**	**
LWG	33,822	10,318	3,296	2,507	12,180	669	3,933	3,736	3,260	1,584	4,222	494	3,602	7,112	3,384	1,863	1,295	608
PRD	19,143	1,085	4,139	761	9,052	194	22,306	2,503	20,896	517	14,069	596	37,053	5,037	29,537	1,191	11,041	2,074
RIS	14,850	1,558	3,309	915	6,567	218	20,218	12,056	18,588	1,548	11,793	977	9,432	3,004	7,590	847	4,352	1,717
RRH	5,336	392	1,389	233	1,501	54	14,633	4,198	10,536	1,140	5,185	476	5,770	1,364	5,492	4,090	2,921	1,081
WEL	2,130	451	141	199	752	53	6,447	3,706	7,335	541	3,247	354	2,211	1,196	1,925	631	1,075	321

	Coho						Sockeye			Steelhead			
	2000		1999		10-Yr Avg.				10-Yr			10-Yr	Wild
DAM	Adult	Jack	Adult	Jack	Adult	Jack	2000	1999	Avg.	2000	1999	Avg.	2000
BON	85,734	11,393	40,684	4,468	25,452	4,153	93,398	17,875	42,103	275,273	206,488	218,051	76,220
TDA	24,966	4,513	13,393	1,648	5,324	1,018	73,383	13,715	32,883	205,241	156,874	154,501	53,711
JDA	20,434	3,396	11,901	1,331	4,322	880	88,229	14,809	34,267	215,393	165,314	141,175	56,585
MCN	9,965	994	4,736	199	2,071	419	58,271	11,794	35,747	129,696	84,088	119,820	30,118
IHR	937	198	120	6	26	1	214	8	9	115,394	80,267	91,841	23,002
LMN	582	171	81	7	11	1	289	15	8	110,114	72,817	80,170	20,663
LGS	309	6	85	4	**	**	299	16	**	100,394	65,471	**	16,063
LWG	884	35	241	19	33	2	282	14	7	111,751	74,440	79,231	20,216
PRD	197	21	52	4	16	1	89,878	16,360	40,492	10,995	8,276	8,358	***
RIS	2,020	NA	12	0	35	0	76,512	18,371	35,978	10,515	6,361	7,140	4,424
RRH	550	NA	1	0	19	0	57,428	14,111	18,554	8,268	4,815	7,941	2,474
WEL	0	0	199	21	29	3	59,944	12,228	17,217	6,336	3,557	3,859	1,810

RIS and RRH does not distinguish between Coho adults and jacks.
These numbers were collected from the COE's Running Sums text files.
Wild steelhead numbers are included in the total.
**Adult count records at Little Goose Dam have been maintained since 1991, visual counts were not conducted at Little Goose Dam between 1982 and 1990.
***PRD is not reporting Wild Steelhead numbers.
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.

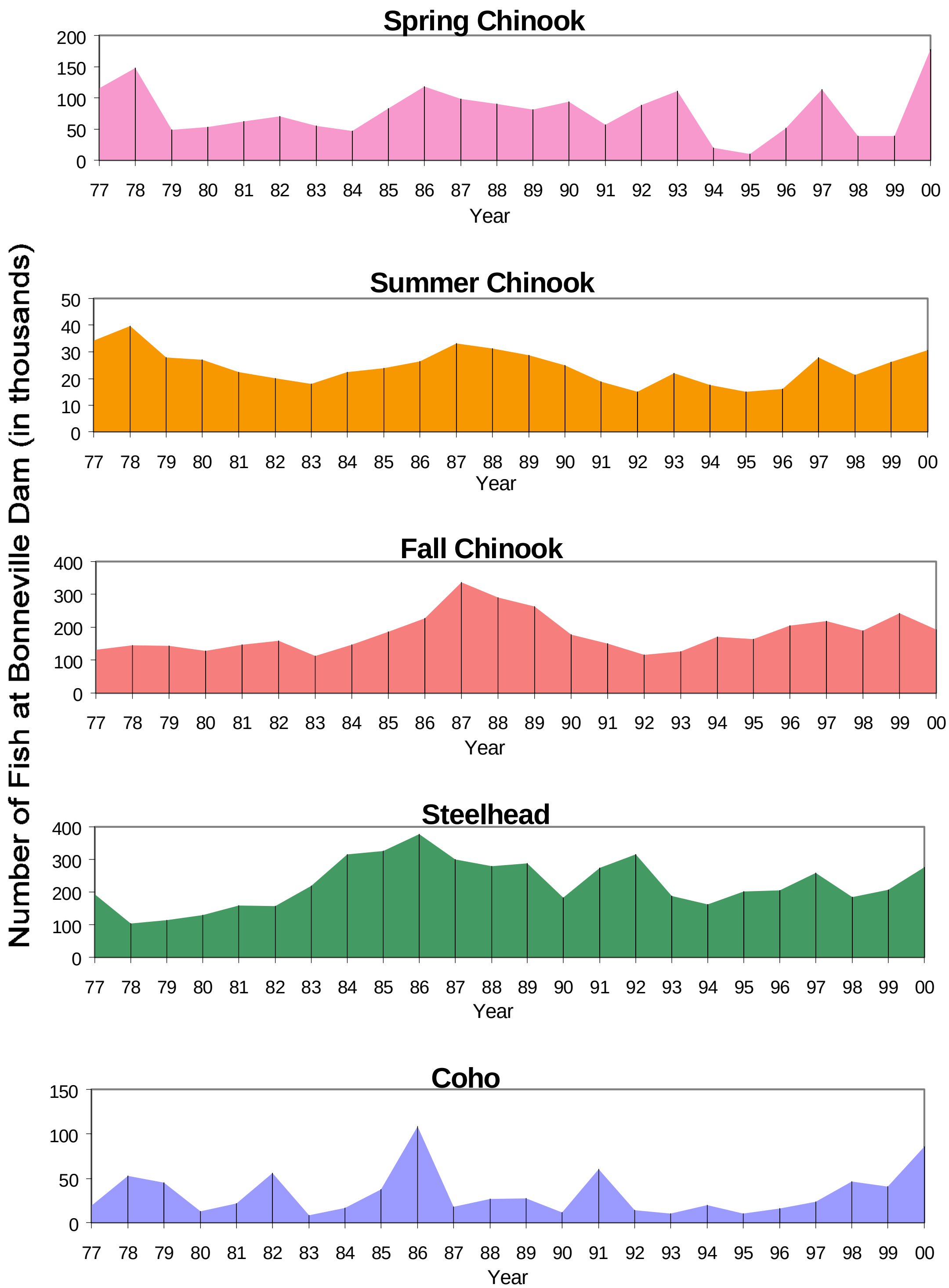


FIGURE 16. Adult Counts at Bonneville Dam, through 2000.

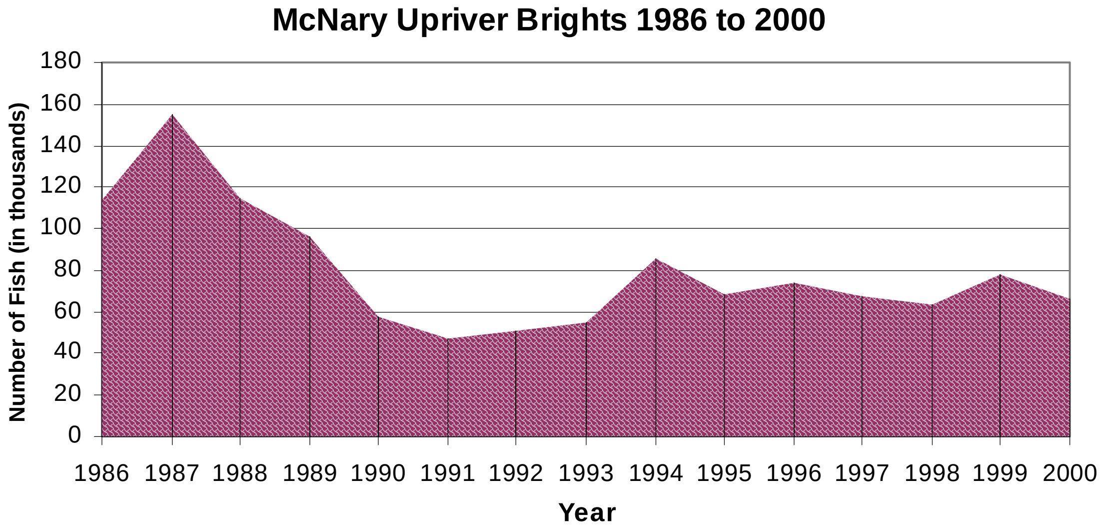


FIGURE 17. Upriver bright Fall Chinook passage at McNary Dam, 1986 to 2000.

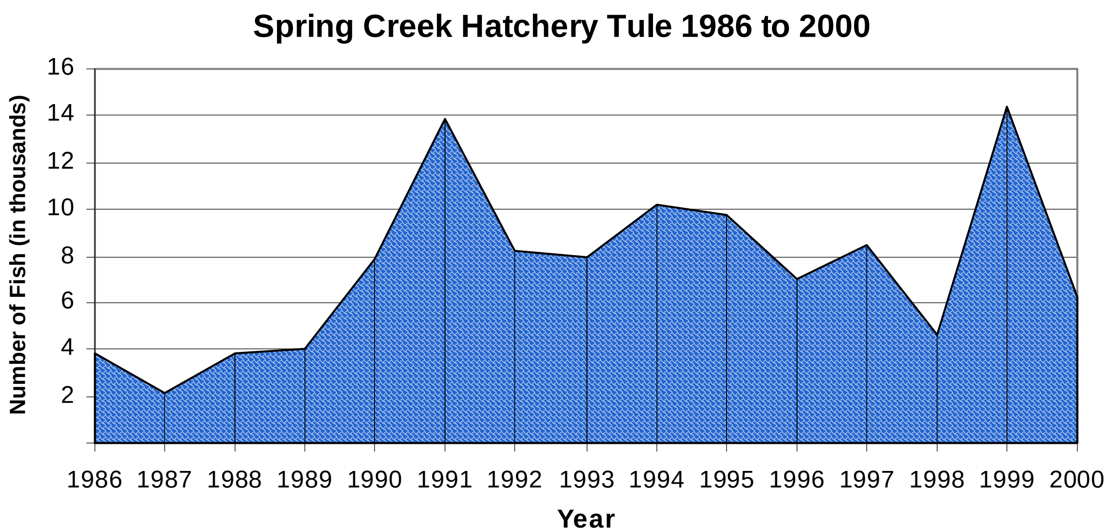


FIGURE 18. Tule Fall Chinook returns to Spring Creek Hatchery, 1986 to 2000.

V. Columbia River Basin Hatchery Releases

A. General Overview

The Fish Passage Center maintains a hatchery database of anadromous salmon species released from State, Federal, and Tribal hatcheries for archived numbers (back to 1979) as well as for the present year (2000). Annually, the Fish Passage Center receives preliminary hatchery release schedules that are updated through 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.

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 but will usually be listed as migrating the following year. The fry release totals are not normally calculated in the annual total for that year. Also, fish that were determined to be 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 2000, about 83 million juvenile salmon were released from Federal, State, Tribal or private hatcheries into the Columbia River Basin **above Bonneville Dam**. Table 48 gives hatchery release totals by River zone, **Snake River, Mid-Columbia, and Lower Columbia**. The 2000 hatchery release totals were increased about 4.5% from the previous season.

TABLE 48. Summary of Hatchery Releases by Species and Release Area for 2000.

Species	Snake River	Mid-Columbia	Lower Columbia	Total
Spring Chinook	5,970,088	3,939,920	5,259,480	15,169,488
Summer Chinook	1,172,717	2,853,950	0	4,026,667
Fall Chinook “Brights”	3,232,953	12,362,833	9,477,866	25,073,652
Fall Chinook “Tules”	0	0	16,065,945	16,065,945
Coho	797,474	1,564,468	8,383,500	10,745,442
Sockeye	40,419	142,901	0	362,490
Steelhead	9,775,828	1,396,898	635,460	11,808,186
TOTAL	20,989,479	22,260,970	39,822,251	83,072,700

The 2000 Hatchery Release Schedule (Appendix H) lists the agency, hatchery, and release numbers, along with other pertinent data such as mark groups, number per pound, date of release, release site, and river zone. The Year 2000 Release Schedule can be accessed at the FPC Website under Hatchery. Table 48 through Table 51 list the hatchery release totals from 1979 through 2000 for the Snake, Mid-Columbia, and Lower Columbia rivers. The main factors affecting the 2000 hatchery release numbers were: Hatchery spring chinook released in 2000, decreased by 4.6 million.

Fall Chinook, mainly “Tules”, released from Spring Creek National Fish Hatchery, increased by 6.2 million in the Lower Columbia Zone, with the Snake River increased by about 1.4 million bright fall chinook.

The distribution of Coho from Hatcheries located below Bonneville Dam to those hatcheries and acclimation ponds in Mid-Columbia and Snake River Reaches in recent years have increased.

B. Lower Columbia River

The Lower Columbia River is designated as the Reach from above Bonneville Dam to McNary Dam. This Reach accounted for approximately 48% of the fish released above Bonneville Dam in 2000. The release total increased to more normal levels this year with 39.8 million fish released from hatcheries or acclimation ponds. Nearly 64% or 25.5 million were yearling or subyearling Tule or Bright fall chinook stocks (Table 49).

About 16.1 million Tule fall chinook were released from Spring Creek National Fish Hatchery, about 4 million more than in 1999. The Bonneville pool remains the only area that Tule fall chinook are present above Bonneville Dam. About 9.5 million up-river Bright fall chinook were released in the Klickitat, Little White Salmon, and Umatilla rivers. The Bright fall chinook numbers increased from the 1999 total; overall, releases of Bright fall chinook remain fairly stable with previous years' releases. 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.

The total number of yearling and subyearling spring chinook released this year from Lower Columbia River hatcheries was 5.26 million, about equal the 1999 release total. (Table 49). The 2000 spring chinook production was well below hatchery release levels reported from 1990-95. Lower Columbia hatcheries released fewer spring chinook than the Snake River but more than the Mid-Columbia Reach (similar to 1999). Subyearling spring chinook (130,000) were released in the upper Klickitat River in May. Yearling spring chinook (about 5.3 million) were released in the Wind, Klickitat, Little White Salmon, Hood, Umatilla, and Deschutes rivers in late March to May.

The number of coho salmon released in spring of 2000 in the lower Columbia Reach was about 8.4 million, an increase from the 1999 and previous 5 years, which ranged between 6.4 and 8.0 million fish. Hatchery reared coho were released in the Klickitat, Little White Salmon, and Umatilla rivers. Hatcheries located below Bonneville Dam supply a large portion of the coho planted in the Klickitat and Umatilla rivers. Both Type-S and Type-N coho have been planted above Bonneville Dam in recent years.

Juvenile steelhead released in this Reach are comprised of both summer and winter races, with 15-Mile Creek being the upper boundary for the Winter race of steelhead. The number of steelhead (summer and winter races) released in 2000 was about 635,000, and falls within the range recorded in this Reach since 1991 (583k to 689k). Since 1980, steelhead releases have averaged 633.4k. Winter steelhead production was 79,700 for 2000, which is similar to that in 1999. Winter steelhead were released in Hood River and Big White Salmon River. About 556,800 summer steelhead were stocked in the Klickitat, Big White Salmon, 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 49. Lower Columbia Hatchery Releases, 1979-2000.

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		48,321,500
1980	5,806,000		31,097,000	819,000	5,495,500		43,217,500
1981	6,066,500		36,735,500	609,500	4,391,500		47,803,000
1982	4,692,500		28,093,500	746,000	4,412,500		37,944,500
1983	6,003,500		34,141,500	631,000	4,912,500		45,688,500
1984	6,529,645		24,256,048	777,125	4,984,334		36,547,152
1985	6,344,905		20,804,201	744,290	2,162,846		30,056,242
1986	7,234,772		19,245,721	588,905	6,736,127	64,384	33,869,909
1987	6,099,130		18,149,291	404,000	9,292,000		34,002,428
1988	7,628,500		20,147,500	447,000	8,690,000		36,913,000
1989	8,891,430		24,805,762	555,526	8,451,762		42,709,616
1990	11,977,052		19,347,320	513,171	8,579,511		40,417,054
1991	9,046,069		27,266,266	583,156	8,467,969		45,363,460
1992	8,406,011		29,615,546	651,066	6,405,391		45,078,014
1993	7,435,146		30,927,448	689,196	8,954,465		48,006,255
1994	8,204,213		27,950,458	652,320	6,299,002		43,105,993
1995	6,939,030		24,858,274	587,171	6,712,604		39,097,079
1996	4,387,575		26,442,513	676,167	8,021,423		39,527,678
1997	4,093,528		23,233,638	688,909	6,763,470		34,779,545
1998	8,191,856		31,805,034	681,591	7,254,648		47,933,129
1999	5,488,404		19,322,806	621,079	7,186,404		32,618,693
2000	5,259,480		25,543,811	635,460	8,383,500		39,822,251

C. Mid-Columbia River

The Mid-Columbia Reach or Zone encompasses the area from above McNary Dam to Chief Joseph Dam. In 2000, approximately 22.3 million juvenile salmonids were released, about 1 million fewer than the previous year and similar to the 1998 total (Table 50). Approximately 1.0 fewer juvenile spring chinook were released in this Reach this year.

Production releases of juvenile fall chinook (up-river Bright stock) totaled 12.4 million, similar to the past 4 years where totals ranged between 11.9 and 12.4 million released per year. Subyearling fall chinook were released from Priest Rapids Hatchery, (6.9 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 1999 and 2000. Hatchery fall chinook comprised about 55.5% of the total fish released in this Zone.

About 2.9 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 were held in the hatcheries until yearling age (1.8 million) and released during the spring season. The subyearling releases (about 1.1 million) were released in June and migrated through the Mid and Lower Columbia River in June, July, and August. Summer chinook were released in the Wenatchee River, Similkameen River, Methow River, the mainstem Columbia River below Wells Dam from Wells Hatchery, and another mainstem release about 3 miles above Rocky Reach Dam from Turtle Rock Hatchery. Since 1980, releases averaged about 2.4 million summer chinook per year. From 1995 to present, releases have ranged between 2.8 to 3.9 million per year.

Mid-Columbia hatcheries released about 3.9 million yearling spring Chinook in year 2000. Spring chinook were released in the Methow, Entiat, and Wenatchee rivers and tributaries, with spring chinook released directly from Ringold Hatchery into the small stream exiting from the hatchery. About 470k hatchery spring chinook were volitionally released from acclimation facilities in the Yakama River basin (Easton Pond, Jack Creek and Clark Flat). Hatchery releases of spring Chinook averaged about 4.8 million from 1980 through 2000. Release totals have been reduced since 1993, with only 2 of the 8 years up to the 4.8 million average. Expectations are that hatchery spring Chinook releases will increase closer to the average over the next few years.

Coho salmon production released from acclimation ponds and hatcheries was about 1.6 million for the Mid-Columbia Reach with 875,000 released in the Yakima River Basin and another 0.5 and 0.2 million released in the Wenatchee and Methow rivers, respectively. As in 1999, all coho released in this Reach are transferred from hatcheries below Bonneville Dam or from Willard Hatchery (Bonneville Pool) to acclimation pond(s) or hatchery and held for a specified time frame until liberated from the pond. The release of yearling coho in the Mid-Columbia Reach has ranged between 1.1 to 1.7 million since 1996. All coho releases were part of the Yakama Tribal Program to reestablish coho in the Yakama, Methow and Wenatchee river basins.

For the Mid-Columbia Reach, 142,901 yearling sockeye salmon were released for the 2000 Migration Year. About 121,000 yearling sockeye from the net pens located in Lake Wenatchee and 21,000 sockeye from Lake Osoyoos were released October 1999 and would migrate from the lakes in spring of 2000. The Wenatchee sockeye were 100% ad clipped with no CWTs while the Osoyoos stock sockeye were 100% LV clipped with no CWTs. Hatchery production of both stocks was reduced for the 2000 migration, but should increase over the next few years as numbers of adult fish begin increasing.

Since 1992, hatchery production of juvenile steelhead has averaged about 1.4 million per year in this Reach, with 2000 releases at 1.4 million. About 290,000 juvenile steelhead were released in the Walla Walla River basin with the remainder in the Okanogan, Methow, Entiat, and Wenatchee rivers and tributaries. A mainstem release from Ringold Hatchery remains as an ongoing program. As noted in previous years, hatchery steelhead (Wells stock) are on the Threatened List under the ESA. Hatchery steelhead have not been released in the Yakama River for several years. The hatchery steelhead production totals have been very stable over the past 20 years in this Reach.

TABLE 50. Mid-Columbia Hatchery Releases, 1979-2000.

Year	Spring Chinook	Summer Chinook	Fall Chinook	Steelhead	Coho	Sockeye	Totals
1979	3,509,000	2,501,000	826,500	592,500	640,000		8,069,000
1980	4,788,000	2,638,000	3,327,500	873,000	1,206,500		12,833,000
1981	5,161,000	2,271,500	5,115,500	985,000	1,089,500		14,622,500
1982	5,186,500	3,010,500	6,297,500	1,263,500	482,500		16,240,500
1983	4,369,000	1,609,000	10,276,500	1,471,500	536,000		18,262,000
1984	6,492,744	1,240,865	15,548,324	1,587,329	517,100		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	107,052	17,753,863
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	12,362,833	1,396,898	1,564,468	142,901	22,260,970

D. Snake River

The total release of all species of salmon in the Snake River basin was 21.0 million for the 2000 migration season, about 2.5 million less than the preceding year. Basically, hatchery releases of spring and summer Chinook decreased while fall Chinook production increased this season. The year 2000 production from hatcheries and acclimation facilities ranked 7th highest on the FPC database since 1980 (Table 51).

The 2000 production release of hatchery spring chinook in the Snake River basin totaled almost 6.0 million, still about 50% of the highest record 13.3 million released for the 1990 migration season. The 2000 spring Chinook production was well above the record low numbers in the FPC database in 1993, and 1996-98. Yearling spring chinook were again released into the Clearwater, Grande Ronde, Salmon, Tucannon, and Imnaha River basins from hatcheries, acclimation ponds, or direct stream releases during the fall (primarily Clearwater River) and the spring season for the majority of the fish. As noted in the 1999 Report and continued in 2000, not all spring/summer Chinook were adipose or Ventral clipped but were marked only with CWTs. This practice will continue to cause some problems in determining whether the fish are “Wild” or “Hatchery” at sampling sites, counting facilities, or other locations in the fish’s journey. This same practice was also used on supplementation groups of summer chinook released in the South Fork Salmon River.

About 1.17 million juvenile summer chinook were released from McCall and Pahsimeroi hatcheries. The 2000 release was reduced from 1999, but was well above the low production totals experienced from 1996 to 1998. A portion of the hatchery summer chinook from McCall Hatchery is listed as Threatened under the ESA as Snake River summer chinook are classified as spring/summer Chinook. Production releases of summer Chinook are normally reared to yearling age and released during the spring of the migration year. Yearling summer Chinook from McCall Hatchery are annually trucked to the South Fork Salmon River and released at the Knox Bridge Site. Supplemental releases of summer Chinook have been from the Stolle Meadow Pond during the past 2-3 years.

Hatchery production of Snake River fall chinook almost doubled the 1999 total with 3.2 million released in 2000. About 856,000 yearling chinook were released from Lyons Ferry Hatchery and acclimation facilities at Pittsburg Landing and CPT Johns on the Snake River and Big

Canyon Creek on the Clearwater River. Subyearling fall chinook were released directly from Lyons Ferry Hatchery (200k) with 2.1 million chinook released from CPT Johns, Big Canyon and Pittsburg Landing acclimation facilities. Yearling releases were completed in April, with the subyearling chinook released in late May and June. Unmarked subyearling chinook were again released from the acclimation sites. 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.

Production releases of yearling sockeye into Red Fish, Alturas, and Pettit lakes and Red Fish Lake Creek totaled 40,419. Releases occurred during the fall of 1999 and spring of 2000. All sockeye were 100% marked with adipose fin clips, with a small number of the fish PIT tagged. The 2000 migrants were less than 30% of the 1999 groups. 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.

About 797,000 yearling coho salmon were released in the Clearwater River basin in 2000. This year’s release total was equal to the 1999 release and will be an on-going program to reintroduce coho to the Snake River Basin. Most of the production releases have been unmarked, i.e., released with no clipped fins. Adult coho salmon are now returning to these natal upstream sites and spawning.

Production of hatchery steelhead in the Snake River basin remains at nearly 10 million per year with 9.8 million released in 2000. From 1981 to present, steelhead production has ranged between 8.1 to 12.1 million with the 2000 migration group residing within this range. About 46.4% of the anadromous salmonids released from Snake River basin hatcheries were steelhead. B-Run steelhead were released in the Clearwater system and selected areas in the Salmon River Basin, and A-Run steelhead in the Salmon, Grande Ronde, Imnaha, and Tucannon River Basins, and other tributaries of 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 stragglers in June.

TABLE 51. Snake River Hatchery Releases, 1979-2000.

Year	Spring Chinook	Summer Chinook	Fall Chinook	Steelhead	Coho	Sockeye	Totals
1979	5,641,500	236,500		4,064,000			9,942,000
1980	6,113,500			6,328,000			12,441,500
1981	4,778,000	249,500		8,602,500			13,630,000
1982	3,027,500	264,000		8,687,500	209,500		12,188,500
1983	5,393,500	198,500	79,000	8,921,500			14,592,500
1984	7,076,708	356,673	427,191	10,802,035			18,662,607
1985	8,084,943	781,405	1,317,921	9,419,904		210,000	19,814,173
1986	6,314,421	982,443	2,271,520	8,085,953			17,671,075
1987	10,743,364	1,217,000	1,060,500	8,242,200			21,601,064
1988	11,230,000	1,777,500	4,981,000	11,726,776			29,715,276
1989	10,446,274	1,991,300	2,153,882	9,146,283			23,737,739
1990	13,306,749	2,882,400	3,480,110	11,149,502			30,818,761
1991	8,908,172	936,100	224,660	12,068,104			22,137,036
1992	8,006,203	1,507,400	689,601	9,510,474			19,713,678
1993	4,046,446	982,300	966,793	10,302,377			16,297,916
1994	6,752,820	1,190,673	603,661	9,600,381			18,147,535
1995	8,175,250	2,095,143	374,882	10,109,372		30,973	20,785,620
1996	1,541,127	676,894	630,612	10,461,986		157,095	13,467,714
1997	478,096	360,603	1,137,678	9,959,153		1,926	11,937,456
1998	3,176,804	577,618	842,007	9,209,992	695,716	263,307	14,765,444
1999	9,309,857	1,574,369	1,834,739	9,840,622	788,358	151,899	23,499,844
2000	5,970,088	1,172,717	3,232,953	9,775,828	797,474	40,419	20,989,479

APPENDIX A

Individual Reservoir Operations

A. Canadian Reservoir Operations

Coordination of the Pacific Northwest and BC Hydro systems began 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 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 augment or reduce 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 parties and the Canadian party that during the storage period of May 1 through the end of June, 2000; water may be stored into Mica active storage space by BPA and/or BCH consistent with the Non Treaty Storage Agreement. Stored water will be released during the return period of July-August 2000. The intent is to release all of the water stored by BPA and one half of the water stored by BCH during the July/August period. However, water releases will not occur such that they cause spill at Mica or Revelstoke, or create flooding downstream of Arrow Dam.

Treaty Storage Operations: The Treaty requires Canada to operate at least 8.45 MAF of storage for flood control in Canada and the US downstream power benefits from Canadian Treaty storage are to be shared equally between the two countries. Each year the US 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 US 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 US salmon flow augmentation and Vernita Bar needs, in return for meeting Canadian trout and white fish spawning and for blowing dust on reservoir shorelines.

The coordinated system was operated for proportional draft in October 1999 at Proportional Draft Point of 2, in second part of August at Proportional Draft Point of 2.3 and in September at Proportional Draft Point of 2.3 due to lower than average inflows. For the rest of the 2000 Water Year, the system was operated upon Energy Content Curve.

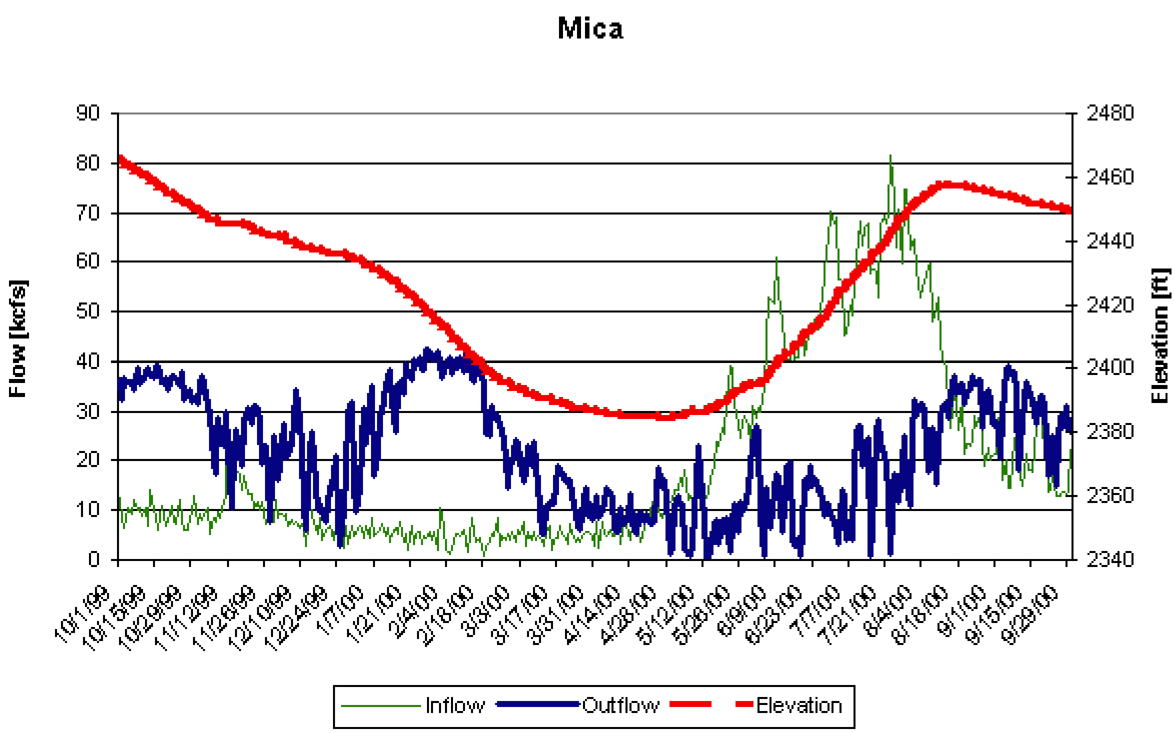


FIGURE A-1. 2000 Mica Operations

Mica was operated for power production and flood control as a part of the coordinated system during the entire year. The Reservoir has been drafted for power generation to elevation of 2434.25 ft. by the end of December. During the January through April period the reservoir was drafted for flood control and power generation to elevation of 2386.9 ft. at the end of March and to elevation of 2385.1 ft. by the end of April.

The April through September Runoff Volume Forecasts decreased from 109% of average in January to 101% of average in March and to 103% of average in April, resulting in overdrafted reservoirs during the in January through April period. The lowest elevation of 2384.51 ft. was reached on April 27.

The reservoir initiated refill in May, but due to decreasing runoff volume forecasts from 104% of average in May to 93% of average in July, failed to refill to full pool elevation by the end of July. The reservoir was refilled to 2451.32 ft. on July 31 and to 2455.2 ft. by the end of August, 19.8 ft. lower than full pool elevation. The average outflow in August was 30.7 kcfs.

Due to low inflows in the system and energy power production demand, the reservoir was drafted to 2449.3 ft. by the end of September.

1. Mica Non Treaty Operations

A Summary of the Non Treaty Storage balances at the end of month for BPA for the entire 2000 Water Year is given in Table A-1.

TABLE A-1. End of Month Non-Treaty Storage Balances (Volume capacity of the storage is 1.1 MAF)

Months	BPA Account [ksfd]
September '99	152.8
October '99	346.7
November '99	390.2
December '99	497.5
January '00	505.6
February '00	528.1
March '00	581.1
April '00	756.1
May '00	906.1
June '00	906.6
July '00	805.5
August '00	692.5
September '00	595

Balances at the end of month showed that most storage of water was during October (193.9 ksfd), December (107.6 ksfd), April (175 ksfd), and May (150 ksfd). The dynamics of releases showed that the primary factor in flow shaping was power generation demand. Releases were inadequate to provide adequate flow below Bonneville during the critical chum and chinook spawning period of November 1-7. Under the terms of agreement with BC Hydro, BPA stored 322.5 KAF of water into Non Treaty Storage during spring with the obligation to release 50% of stored water during the summer. However, BPA released 214.1 KAF, which is more than 50% of the volume of stored water in spring due to favorable market demands in July and August. As such, Non Treaty releases were not sufficient to meet the flow target on a weekly basis during the summer at McNary.

Average monthly outflows were in the range of 9 kcfs to 35.8 kcfs. Average daily flows below Mica Dam in August were in the range of 17.8 kcfs-37.3 kcfs, what is lower than maximum hydraulic capacity of 41.6 kcfs.

TABLE A-2. Mica Dam: Average Monthly Outflows

Month	Monthly Average Flow at Mica [kcfs]
October '99	35.8
November '99	25.0
December '99	17.8
January '00	33.7
February '00	33.3
March '00	14.5
April '00	9.7
May '00	9.0
June '00	12.1
July '00	15.3
August '00	30.7
September '00	29.0

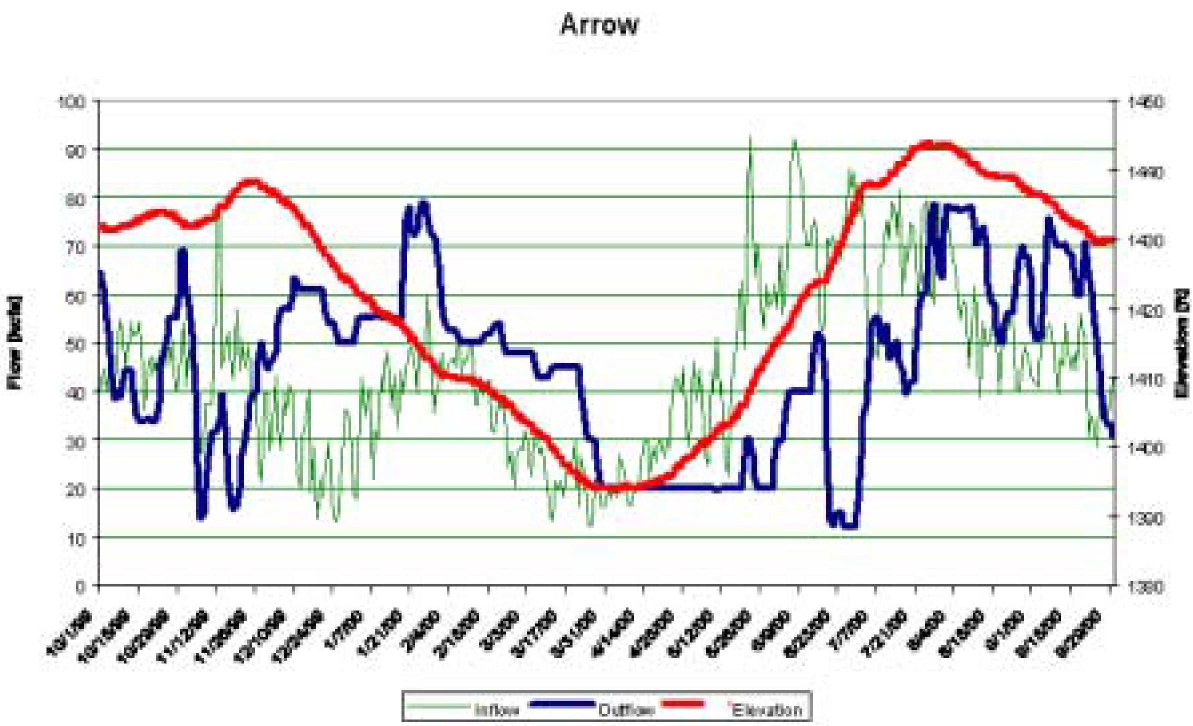


FIGURE A-2. 2000 Arrow Operations

Arrow reservoir was operated primarily for system flood control, system power generation and non-power uses. The reservoir does not have power generating facilities on the site. The major non-power requirement during the October through March period was the Vernita Bar agreement, which refers to a minimum stream flow objective for the Columbia River below Priest Rapids dam that is established each year to protect natural spawners during October through early May. This year it was determined that the minimum required flow was 65 kcfs for Vernita Bar. The reservoir began the water year at elevation of 1431.9 ft. on October 1. It reached its highest elevation of 1433.8 ft. on October 21 during the October through March period. The canadian whitefish water operation commenced in September 1999, with the release of 315 ksfd of provisional draft above Treaty outflows. Provisional draft of 75 ksfd continued in the last week of October, and 30 ksfd from November 1-5. However, the drafted volume in the first week of November was not sufficient to maintain requested spawning flows below Bonneville Dam on November 7. Actual flows in November fluctuated between 14 kcfs and 57.7 kcfs, and were shaped primarily for power generation (see Table 3). At the end of the year, on December 31, the reservoir was drafted to 1423.29 ft. Stormy weather and increased water supply resulted in provisional draft return from November 15 through December 3. Beginning January 1, BC Hydro requested that Arrow outflows be selectively reduced below Treaty requests to keep river levels at acceptable and maintainable levels during whitefish spawning downstream from Keenleyside. The Treaty requests were reduced holding back a total of 363 ksfd in Whitefish Treaty storage and Local Whitefish storage. This volume was released during March 3-24, for power generation. A total of 604 ksfd was stored during the January through April period for fish flow augmentation. During the January through April period, flood control operations resulted in drafting of the reservoir to lowest elevation of 1393.82 ft. on April 4. The end of April elevation was 1398.4 ft.

During April through June, Arrow was operated under the terms of agreement on "Non Power Use of Canadian Treaty Storage" between the entities for protection of trout reds. The agreement specifies discharge from Arrow designed to avoid de-watering rainbow trout reds. The flows are maintained at a low level to avoid trout spawning at higher stream floor elevations. With a minimum discharge of 20 kcfs, Arrow level rose to 1398.4 ft. by the end of April. Its annual refill cycle began in May and it was refilled to 1443.89 ft. through July 25.

Outflows in May fluctuated between 26 kcfs and 43 kcfs, and in June between 11.9 kcfs and 52 kcfs. Outflows were not coordinated to help meet McNary flow targets. Since June 20, through the end of June, outflows were reduced to range of 11.9 kcfs-17.3 kcfs due to backwater effect of Kootenai Lake which increases water level in the spawning grounds. In September, the reservoir was drafted 200 ksfd below Treaty level due to increased energy demand. The reservoir elevation on September 30 was 1430 ft.

TABLE A-3. Arrow Dam: Actual Monthly Average Flows

Months	Monthly Average Flows and Daily Range [kcfs]
October '99	46.0 (33.8-68.9)
November '99	33.3 (14.0-57.7)
December '99	55.7 (45.9-63.5)
January '00	63.5 (55.1-79.2)
February '00	51.1 (47.9-57.5)
March '00	39.9 (20.0-47.9)
April '00	20.1 (20.0-20.4)
May '00	31.0 (26.0-43.0)
June '00	40.6 (11.9-52.0)
July '00	52.6 (26.7-78.5)
August '00	67.5 (50.0-78.2)
September '00	58.2 (31.0-75.8)

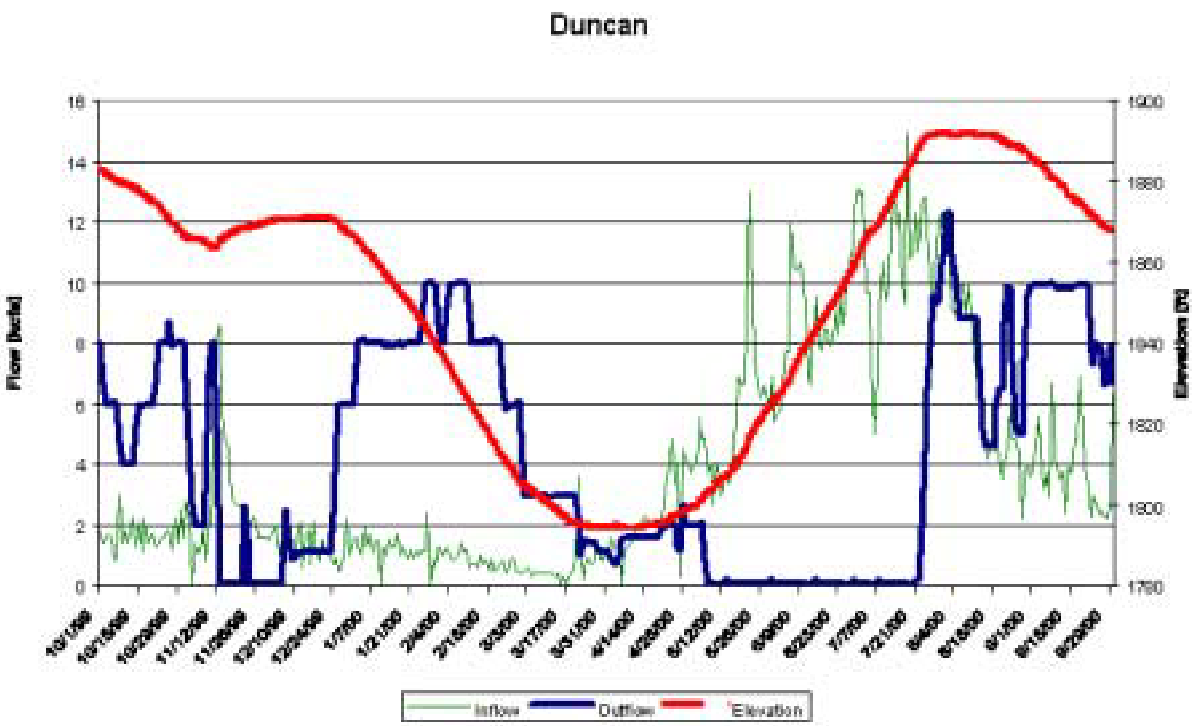


FIGURE A-3. 2000 Duncan Operations

Duncan Dam and Lake are on the Duncan River, a tributary to Kootenay Lake in south-eastern British Columbia. The reservoir is operated for downstream power generation and flood control, maintaining the International Joint Commission required elevations at Kootenai Lake during the year. A summary of the actual end of month elevations and actual monthly average flows is given in Table A-4.

TABLE A-4. Duncan Dam: Actual Monthly Average Flows and End of Month Elevations

Months	End of Month Elevations [ft]	Monthly Average Flows and Daily Range [kcfs]
October '99	1867.06	6.4 (4.0-8.7)
November '99	1869.88	2.0 (0.1-8.0)
December '99	1866.79	2.1 (0.1-6.0)
January '00	1838.42	8.3 (7.3-10.0)
February '00	1806.13	8.1 (5.8-10.0)
March '00	1794.36	2.4 (1.1-4.1)
April '00	1799.02	1.6 (0.7-2.0)
May '00	1825.75	0.4 (0.1-2.0)
June '00	1861.37	0.1 (0.0-0.2)
July '00	1892.07	2.4 (0.0-10.9)
August '00	1886.52	7.9 (4.6-12.3)
September '00	1867.95	9.2 (6.7-10.0)

A. Upper and Mid Columbia Basin

1. Hungry Horse-Figure A-4:

The reservoir was operated to provide minimum flows of 3.5 kcfs for kokanee spawning at Columbia Falls for the entire year. The reservoir was at 3544.43 ft. on October 1, 1999 due to the Federal Agencies imposed cap on McNary summer 1999 flows. Summer flows during 1999 could have been higher if the reservoir had been drafted to the BIOP elevation of 3540 by August 31, 1999. During the fall period of October through December 1999, the reservoir was operated to shape flows for power generation. The end of December elevation was 3536.78 ft. (see Table A-5). Monthly inflows were 96%, 123% and 91% of average respectively. Daily outflows were fluctuating between 0.4 kcfs (in November, when the reservoir was refilled) and 8.7 kcfs (In October, when the reservoir was drafted for power generation). The reservoir was drafted for power generation, in spite of lower than average monthly inflows in the range of 79% (October) to 89% (November). The reservoir was operated according to Integrated Rule Curves (IRC) in

January and February, resulting in elevation of 3526.18 ft. and 3513.06 ft. respectively. The end of March elevation was 3502.12 ft., what was 14.4 ft. lower than COE required flood control elevation, and 10 ft. lower than IRC required elevation. January through March daily outflows were in the range of 2.29 kcfs-6.4 kcfs. The refill of the reservoir was initiated in April, and due to increased local precipitation and inflows, the reservoir was refilled to a 4.5 ft. higher elevation than required by flood control. The lowest elevation was 3502.12 ft. on April 3. The reservoir was refilled to 3558.33 ft. by the end of June, with inflows of 105% of average in May and 78% of average in June. Summer salmon augmentation commenced in July and due to below average inflows in July-August period of 48% and 59% of average, resulted in daily average outflows in the range of 2.1-6.4 kcfs. Inflows in September continued to be below average with outflows in the range of 1.5 kcfs-2.4 kcfs. The reservoir was drafted to elevation of 3535.9 ft. by the end of September.

TABLE A-5. Hungry Horse: Actual Monthly Average Flows and End of Month Elevations

Months	Monthly Average Inflow [kcfs] and % of 1961-1990 Average Flow	Monthly Average Outflow and Daily Range [kcfs]	End of Month Elevation [ft]
October '99	1.04 (96%)	6.4 (4.0-8.7)	3542.34
November '99	1.73 (123%)	1.0 (0.4-2.9)	3544.34
December '99	1.11 (91%)	3.8 (2.0-6.5)	3536.78
January '00	0.86 (79%)	4.42 (2.3-5.6)	3526.18
February '00	0.96 (87%)	5.4 (3.2-6.4)	3513.06
March '00	1.15 (80%)	4.5 (2.4-6.4)	3502.12
April '00	5.92 (129%)	5.1 (2.3-8.1)	3507.42
May '00	12.9 (105%)	2.0 (0.5-8.0)	3538.35
June '00	10.2 (78%)	2.7 (0.5-5.6)	3558.33
July '00	1.87 (48%)	5.8 (5.2-6.4)	3550.16
August '00	0.68 (59%)	4.5 (2.1-5.9)	3539.08
September '00	0.49 (46%)	1.9 (1.5-2.4)	3535.91

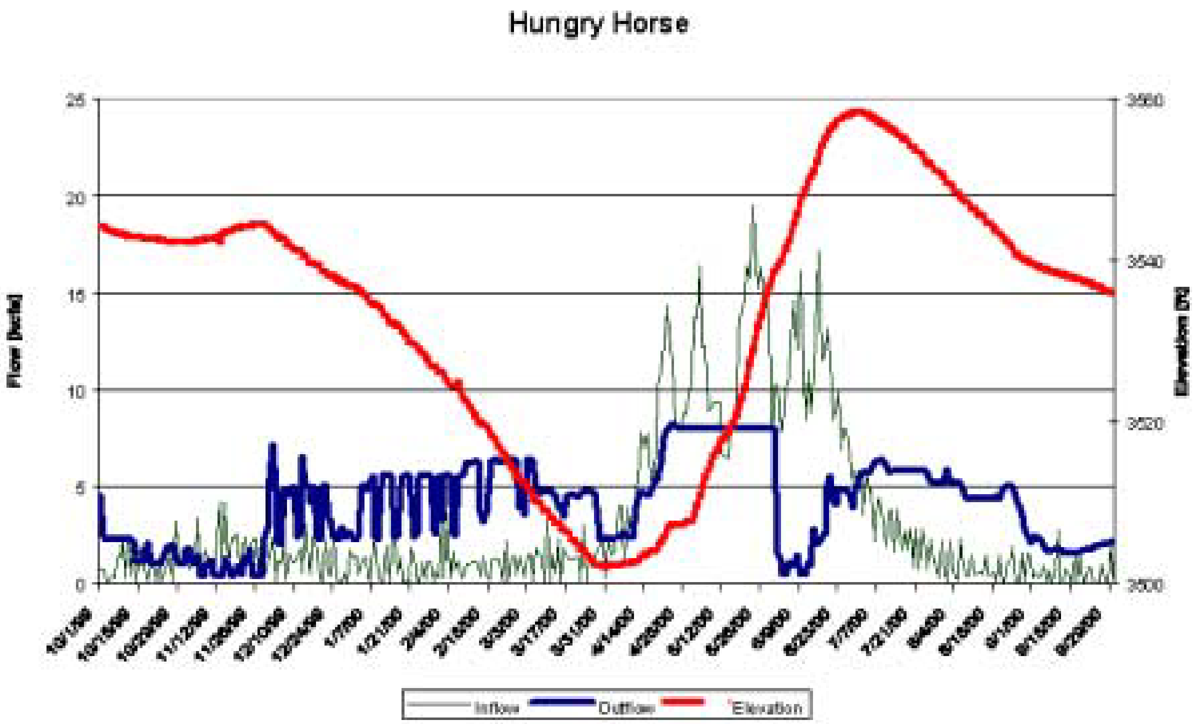


FIGURE A-4. 2000 Hungry Horse Operations

2. Libby-Figure A-5:

Libby was operated for power generation during the October through December period, with an end of December elevation of 2408.1 ft., which is 2.9 ft. lower than the elevation prescribed for flood control operations at the end of the year. The reservoir was drafted for flood control to lowest elevation of 2336.65 ft. on March 25. Monthly inflows during the January through April period was higher than average, in the range of 110% to 164% of average. Contrary to the spring months, inflows during the rest of the water year were far below average. Refill was initiated on March 14 with minimum outflows of 4 kcfs. Failure of the runoff volume forecast to materialize resulted in lower than average inflows and failure to refill to full pool elevation by the end of July. The highest elevation of 2436.33 ft. was reached at August 14.

The reservoir was operated for sturgeon flow peaking during June, with gradually increased flows to 25 kcfs. For the rest of the summer period the reservoir was operated for bull trout requirements of 8 kcfs to elevation of 2432.3 ft. on September 30.

TABLE A-6. Libby: Actual Monthly Average Flows

Months	Monthly Average Inflow and % of 1961-1990 Average Flow [kcfs]	Monthly Average Outflow and Daily Range [kcfs]	End of Month Elevation [ft]
October '99	5.11 (92%)	11.8 (10.0-12.0)	2439.78
November '99	12.4 (255%)	15.2 (8.0-25.0)	2435.83
December '99	6.1 (165%)	23.6 (15.0-26.5)	2408.10
January '00	5.4 (164%)	24.1 (18.0-26.0)	2370.13
February '00	4.4 (132%)	16.7 (9.2-20.9)	2341.13
March '00	4.0 (110%)	5.5 (4.0-8.5)	2337.01
April '00	11.5 (137%)	4.0	2355.06
May '00	22.9 (84%)	4.0	2397.07
June '00	29.8 (75%)	17.4 (4.0-25.0)	2418.12
July '00	18.8 (91%)	8.1 (8.0-10.3)	2434.49
August '00	8.3 (85%)	8.0	2434.89
September '00	5.7 (86%)	7.5 (6.0-8.0)	2432.31

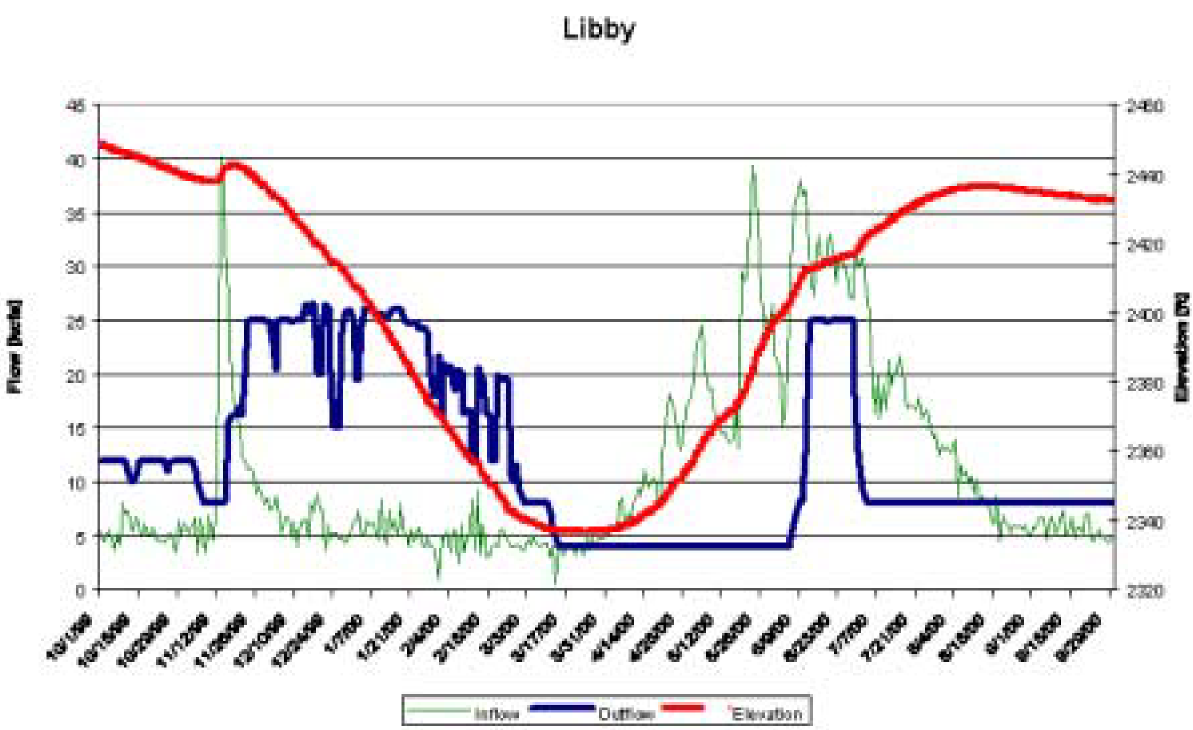


FIGURE A-5. 2000 Libby Operations

3. Grand Coulee-Figure A-6:

The reservoir was drafted to 1283.4 ft. on October 25, and then refilled to 1287.85 ft. on November 16 (Table A-7). The lowest elevation of 1258.4 ft. was reached on February 16. Inflows were widely fluctuating between 92% of average (October) to 182% of average (November) during fall/winter months. The reservoir was further drafted for flood control to the lowest elevation of the season of 1233.9 ft. on May 19. The erroneous of runoff volume forecast resulted in lower than average spring inflows and failure to refill by the end of June, after reservoirs were drafted during the winter according to the erroneous forecast. The elevation at the end of June was 1279 ft. The reservoir was refilled only to 1286 ft. on July 16 and drafted to 1280.4 ft. through the end of August with inflows of 88% of average. The reservoir was refilled to elevation of 1285.5 ft. by the end of September, which was 2.5 ft. higher than required elevation of 1280 ft.-1283 ft. for kokanee spawning.

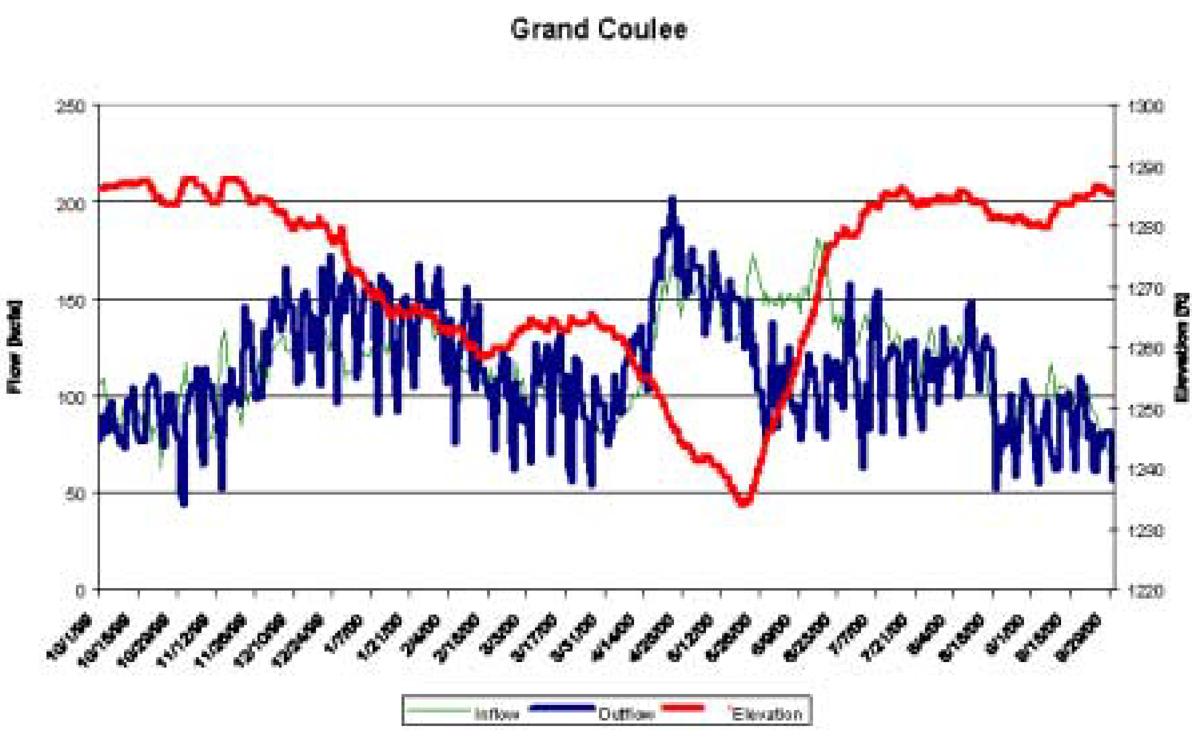


FIGURE A-6. 2000 Grand Coulee Operations

TABLE A-7. Grand Coulee: Actual Monthly Average Flows

Months	Monthly Average Inflow and % of 1961-1990 Average Flow [kcfs]	Monthly Average Outflow and Daily Range [kcfs]	End of Month Elevation [ft]
October '99	44.5 (92%)	85.7 (44.1-110.6)	
November '99	88.1 (182%)	102.6 (72.3-145.9)	1284.25
December '99	53.2 (126%)	141.7 (96.0-166.1)	1272.1
January '00	41.7 (101%)	140.4 (91.3-166.2)	1263.3
February '00	44.5 (99%)	111.7 (62.2-144.3)	1262.6
March '00	60.1 (102%)	97.6 (65.2-127.1)	1263.15
April '00	156 (134%)	138.8 (74.9-186.6)	1243.35
May '00	241.2 (92%)	138.3 (79.0-176.3)	1247.3
June '00	269.4 (82%)	106.0 (77.1-157.8)	1279.0
July '00	197.8 (103%)	111.0 (62.7-147.7)	1284.05
August '00	91.8 (88%)	104.7 (51.4-149.1)	1280.35
September '00	58.5 (111%)	80.5 (56.8-109.5)	1285.45

B. Snake River Basin

1. Dworshak- Figure A-7:

Dworshak was refilled during the October through December period at minimum outflow rate of 1.5 kcfs to elevation of 1537.86 ft. (see Table A-8). With average and above average inflows, in the range of 97% to 135% in the October through December period, the reservoir was refilled to 1537.86 ft. by the end of December and 1538.9 ft. on January 9. Drafting for flood control in January and February resulted in elevation 1524.27 ft. at the end of February. Shifting flood control to overdrafted Grand Coulee at the end of March resulted in 1522.2 ft., a 10 ft. higher elevation than required for flood control. High inflows of 16.5 kcfs (144% of average), limited hydraulic capacity of the project and total dissolved gas limit resulted in an end of April elevation of 1529.26 ft., which was 18.9 ft. above the required flood control elevation. During the spring, 185 KAF was delivered during first part of May for spring augmentation. The reservoir was refilled to 1598.62 ft. by June 30, with inflows in the range of 94% and 78% of average respectively. Summer flow augmentation was delivered by August 30, and the reservoir was drafted to 1520.07 ft. with outflows not exceeding 110% of the Total Dissolved Gas Limit in the tailrace of the dam. Inflows were only 62% and 64% of average during the July through August period. The end of September elevation was 1518.9 ft. with minimum outflow.

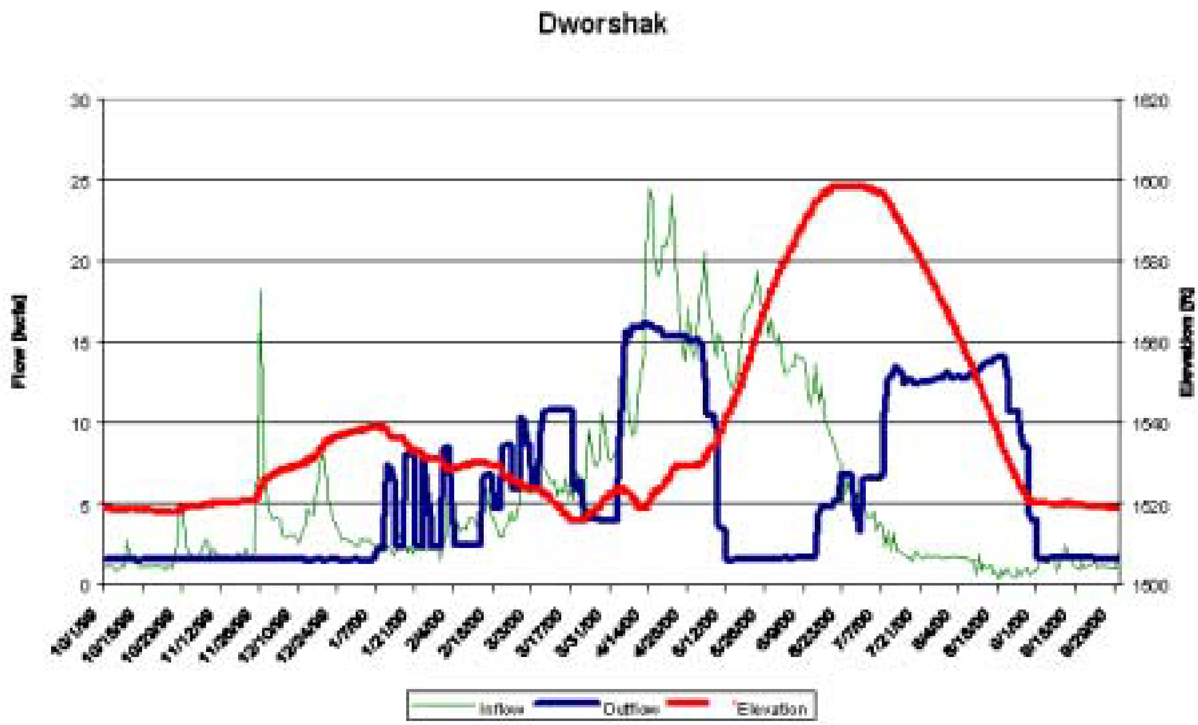


FIGURE A-7. 2000 Dworshak Operations

TABLE A-8. Dworshak: Actual Monthly Average Flows

Months	Monthly Average Inflow and % of Average 1961-1990 Flow [kcfs]	Monthly Average Outflow and Daily Range [kcfs]	End of Month Elevation [ft]
October '99	1.6 (97%)	1.5	1519.18
November '99	3.2 (135%)	1.5	1526.86
December '99	3.9 (123%)	1.5	1537.86
January '00	2.3 (69%)	4.1 (1.5-8.5)	1529.73
February '00	4.2 (95%)	5.5 (2.4-10.4)	1524.27
March '00	6.9 (110%)	7.3 (4.0-10.8)	1522.2
April '00	16.5 (1.44%)	14.4 (3.9-16.2)	1529.26
May '00	15.9 (94%)	4.5 (1.5-15.1)	1577.26
June '00	10.1 (78%)	3.8 (1.5-6.8)	1598.62
July '00	2.4 (62%)	11.3 (6.6-13.5)	1566.4
August '00	1.1 (64%)	11.7 (4.0-14.1)	1520.07
September '00	1.3 (111%)	1.6 (1.5-1.7)	1518.93

2. Brownlee-Figure A-8:

The reservoir was drafted to its lowest elevation of 2027.24 ft. by October 17. IPCo reservoir draft is designed to allow IPCo to maintain flows at a minimum to limit fall chinook spawning in the Hells Canyon Reach. IPCo operates at a maximum flow of 9.5 kcfs through the end of December. The inflows were close to average during fall and the reservoir refilled to 2075.2 ft. on January 3 with the flow limitation. The reservoir was operated for power generation purposes during the January through March period with end of months elevations fluctuating 13.6 ft. below the required flood control elevation at the end of January, to 3.25 ft. above the flood control elevation at the end of February and 2.6 ft. below the flood control elevation at the end of March (see Table A-9). The highest daily inflows of 31.2 kcfs and 34.5 kcfs were recorded on February 24 and April 15, respectively. While inflow in April was close to average, inflows in May and June were far below average, of 66% and 55% of average respectively. The reservoir was refilled to 2075.99 ft. on June 13, and drafted to 2072.05 ft. on June 30 to improve rapidly decreasing flows at Lower Granite. The reservoir was further drafted to 2042.53 ft. on July 28 for salmon summer flow augmentation. For the rest of the summer through the end of September the flows were shaped for power generation purposes, with end of September elevation of 2039.65 ft. The lowest elevation of 2036.46 ft. was achieved on September 25.

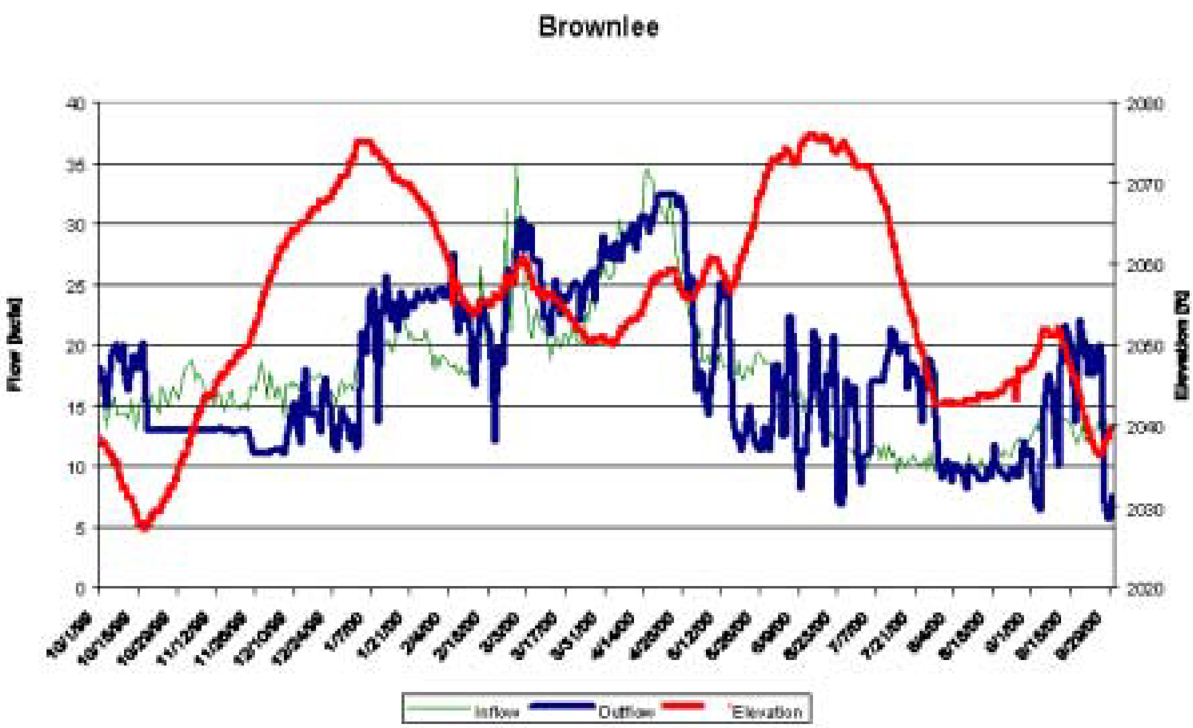


FIGURE A-8. 2000 Brownlee Operations

TABLE A-9. Brownlee: Actual Monthly Average Flows

Months	Monthly Average Inflow and % of Average 1961-1990 Flow [kcfs]	Monthly Average Outflow and Daily Range [kcfs]	End of Month Elevation [ft]
October '99	15.2 (95%)	15.8 (13.0-20.2)	2036.3
November '99	16.3 (98%)	12.6 (11.0-13.0)	2057.1
December '99	16.6 (93%)	13.5 (11.1-17.3)	2073.1
January '00	20.0 (103%)	22.2 (11.54-24.5)	2063.36
February '00	21.04 (98%)	22.5 (18.2-30.4)	2059.95
March '00	22.1 (86%)	25.3 (20.9-30.3)	2050.51
April '00	29.2 (99%)	29.8 (24.4-32.4)	2055.93
May '00	19.0 (66%)	16.5 (11.4-25.6)	2072.9
June '00	14.0 (55%)	14.9 (6.8-21.2)	2072.06
July '00	10.4 (84%)	16.3 (8.6-21.3)	2042.6
August '00	10.5 (96%)	9.8 (8.1-12.0)	2047.22
September '00	13.6 (100%)	15.0 (5.7-22.1)	2039.65

Upper Snake Reservoirs:

The Upper Snake basin contributes to augmentation flows as the part of Bureau of Reclamation obligation for summer augmentation for the lower Snake. The system has been developed for flood control protection of the area, irrigation and power generation. The largest three reservoirs in the system are: Jackson Lake, Palisades and American Falls.

Runoff Volume Forecasts were in the range of 60%-69% for Weiser and 78%-85% for Heise. The March Runoff Volume Forecasts increased significantly due to high precipitation in the basin during January-February period. A summary of the Final Runoff Volume Forecasts at Weiser, upstream from Milner and Heise, upstream from American Falls is given in the Table A-10:

TABLE A-10. Monthly Final Runoff Volume Forecast at Weiser and Heise

Months	Volume [MAF] and % of (1961-1990) Average at Weiser	Volume [MAF] and % of (1961-1990) Average at Heise
January	3.3 (60%)	2.7 (78%)
February	3.4 (62%)	2.7 (78%)
March	3.77 (69%)	2.94 (85%)
April	3.62 (66%)	2.94 (85%)
May	3.69 (68%)	2.83 (82%)
June	3.49 (64%)	2.91 (84%)
July	3.67 (67%)	2.85 (83%)

Precipitation was fluctuating between 159% and 129% in January and February to 25% in October 1999 and 49% in July 2000. The summary of the monthly cumulative precipitation in % of average for the Upper Snake is given in Table A-11.

TABLE A-11. Cumulative Monthly Precipitation in% of Average

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
% of (1961-1990) Avg	25	54	98	159	129	90	76	100	61	49	81	66

Jackson Lake and Palisades Reservoirs:

Both reservoirs are operated as a multipurpose unit for local flood control, irrigation, recreation and power production. Active Storage includes 847 KAF in Jackson Lake and 1200 KAF in Palisades reservoir, for a combined total of 2047 KAF.

A summary of the end of month changes in the reservoir storage is given in the Table A-12.

TABLE A-12. Monthly Jackson and Palisades Reservoir Storage Status

Month	Volume in KAF at Jackson Lake and % of Total Volume	Volume in KAF at Palisades and % of Total Volume
October	629.173 (74.3)	903.757 (75.3%)
November	628.445 (74.2%)	939.768 (78.3%)
December	632.295 (74.7%)	972.865 (81.1%)
January	645.031 (76.2%)	1012.164 (84.3%)
February	653.485 (77.2%)	1047.093 (87.3%)
March	657.364 (77.6%)	988.833 (82.4%)
April	843.939 (99.6%)	1123.783 (93.6%)
May	843.429 (99.6%)	1111.822 (92.7%)
June	789.243 (93.2%)	726.533 (60.5%)
July	711.738 (84.03%)	423.792 (35.3%)
August	713.705 (84.3%)	433.608 (36.1%)
September	646.475 (76.3%)	253.873 (21.2%)

The reservoirs were operated for flood control during October-March period. Refill took place in April, for irrigation purposes to 99.6% of average and 93.6% of average at Jackson Lake and Palisades. Irrigation demands were not significant in May, resulting in reservoirs at 99.6% and 92.7% of average at the end of month, due to average precipitation and moderate temperatures. For the rest of the season, the system was drafted to 76.3% and 21.2% of average at Jackson Lake and Palisades for irrigation.

Discharge from the Palisades reservoir is measured at the Snake River near the Irwin, Idaho gage. A summary of the monthly average flows at Irwin is given in Table A-13.

TABLE A-13. Monthly Average Flow and its Range at Irwin Gage

Month	Monthly Average Flow and it's Range in kcfs
October	3.8 (3.0-5.4)
November	2.4 (2.2-2.8)
December	2.2 (1.9-2.3)
January	2.1 (2.0-2.3)
February	2.0 (1.9-2.0)
March	3.6 (2.0-4.3)
April	6.7 (4.3-7.8)
May	11.2 (7.7-15.3)
June	13.5 (11.8-15.3)
July	12.0 (9.7-14.1)
August	9.3 (8.9-10.0)
September	6.9 (5.1-8.8)

American Falls Reservoir:

The project is operated for irrigation, power and flood control. The major irrigation diversion below American falls is at Minidoka. The active capacity of the reservoir is 1.68 MAF. The reservoir was a major source of salmon augmentation water. A summary of the end of month's changes in the reservoir storage is given in the Table A-14.

TABLE A-14. Monthly American Falls Reservoir Storage Status

Month	Volume in KAF and % of total volume
October	745.849 (44.6)
November	982.302 (58.7%)
December	1172.546 (70.1%)
January	1159.798 (69.3%)
February	1414.568 (84.6%)
March	1647.606 (98.5%)
April	1672.022 (99.9%)
May	1575.047 (94.2%)
June	761.722 (45.5%)
July	299.755 (17.9%)
August	310.977 (18.6%)
September	127.389 (7.6%)

The reservoir was refilling during entire October-March period. The major releases occurred in the June through September period for irrigation. There were no any additional releases for salmon flow augmentation beyond the BiOp prescribed volume from Upper Snake.

The resulting discharges from the entire Upper Snake system are measured at the Milner gauge. A summary of the monthly average Milner flows is given in the Table A-15.

TABLE A-15. Monthly Average Flows at Milner, Idaho.

Months	Monthly Average Flow and it's Daily Range in kcfs
October	2.07 (1.2-5.3)
November	3.8 (2.6-5.3)
December	4.6 (3.8-7.9)
January	7.01 (5.8-7.8)
February	2.8 (1.2-5.5)
March	3.1 (1.9-5.7)
April	4.7 (0.3-6.5)
May	0.5 (0.3-1.6)
June	0.6 (0.3-1.6)
July	1.5 (1.6-1.5)
August	1.5 (1.5-1.7)
September	0.8 (0.2-1.3)

APPENDIX B

Total Dissolved Gas Saturation Plots

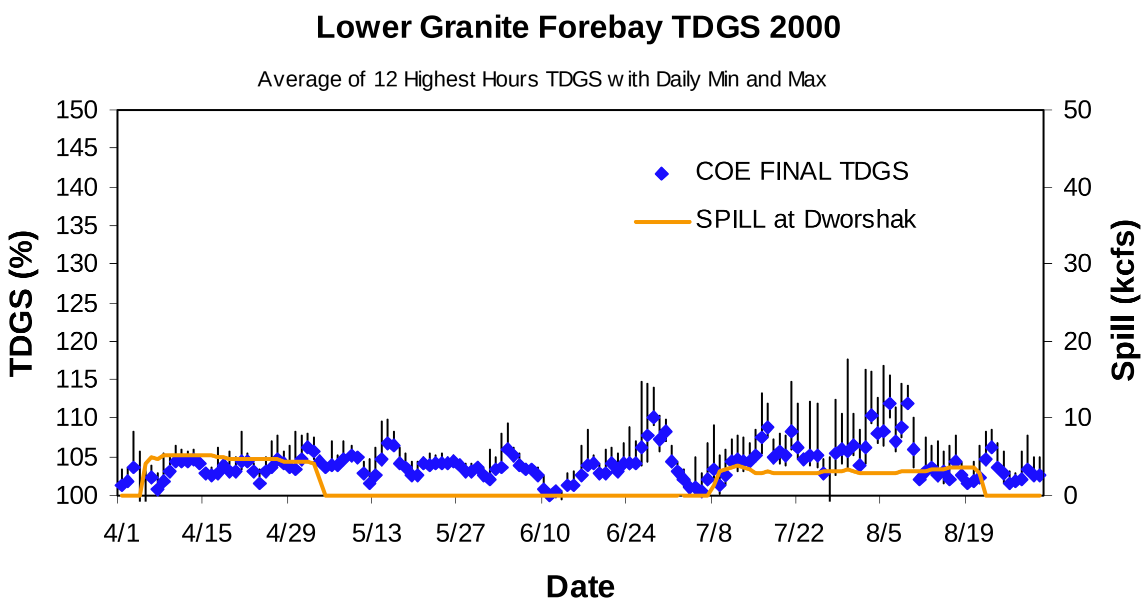


FIGURE B-1. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Lower Granite Forebay.

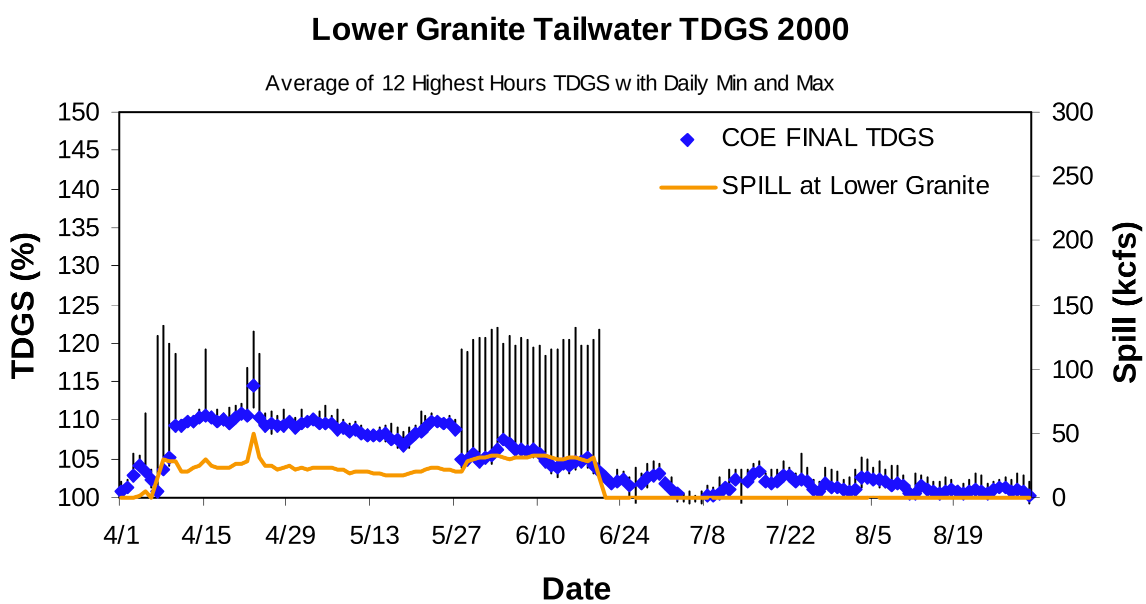


FIGURE B-2. Comparison of the daily average of the 12 highest hourly TDGS readings as report by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Lower Granite Tailwater.

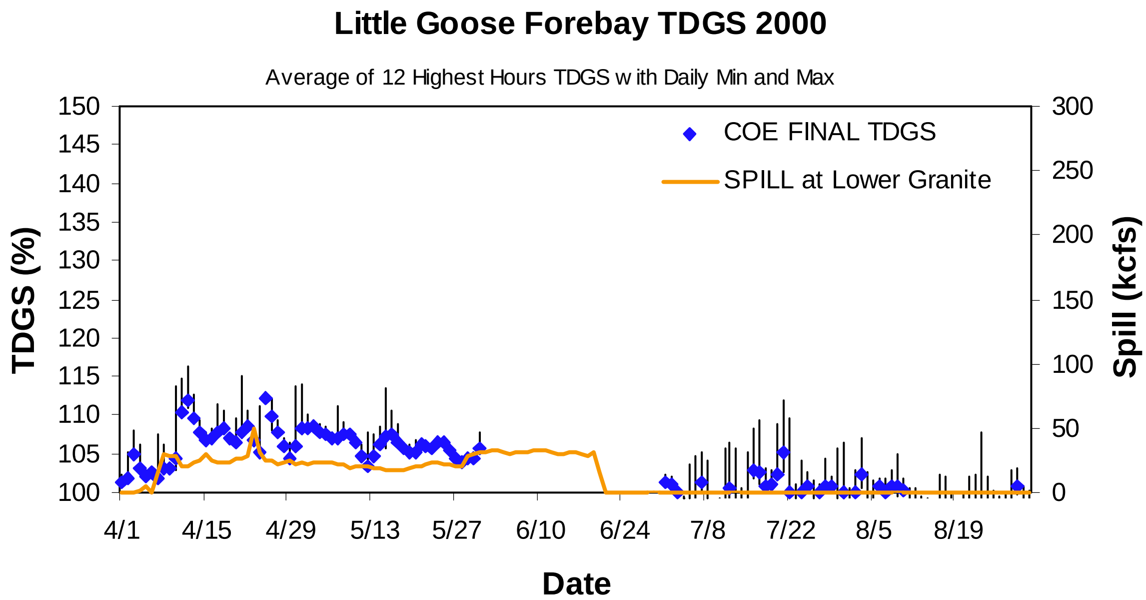


FIGURE B-3. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Little Goose Forebay.

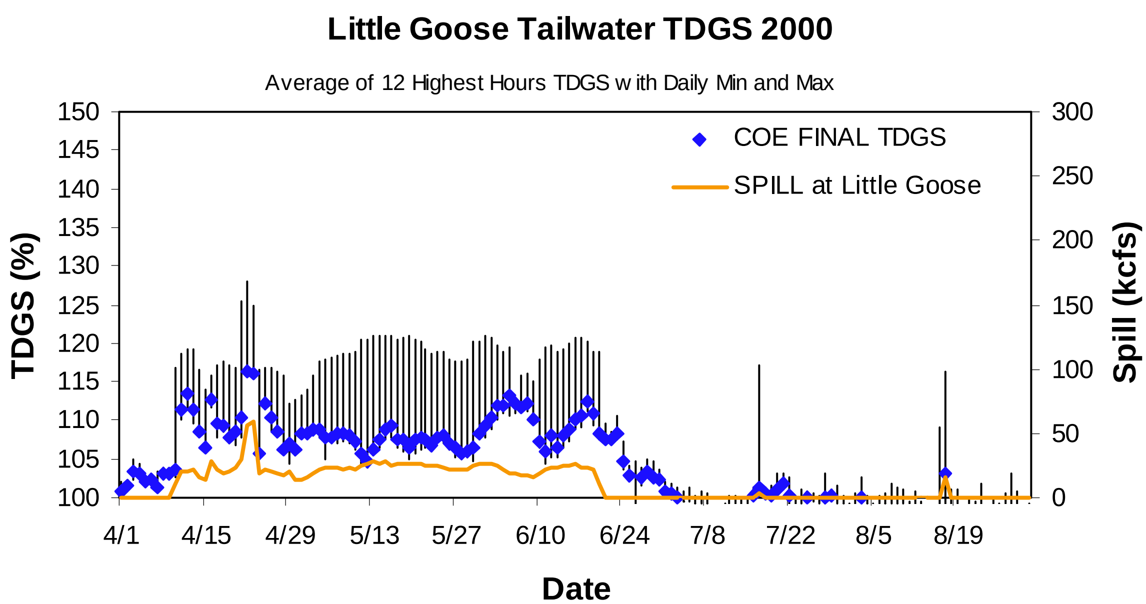


FIGURE B-4. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Little Goose Tailwater.

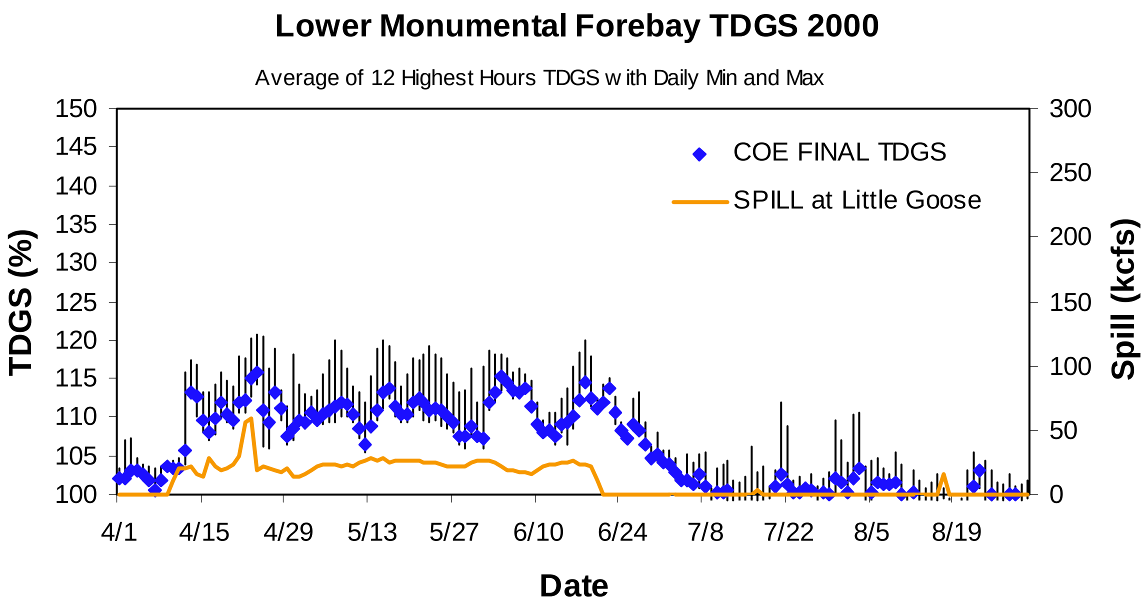


FIGURE B-5. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Lower Monumental Forebay.

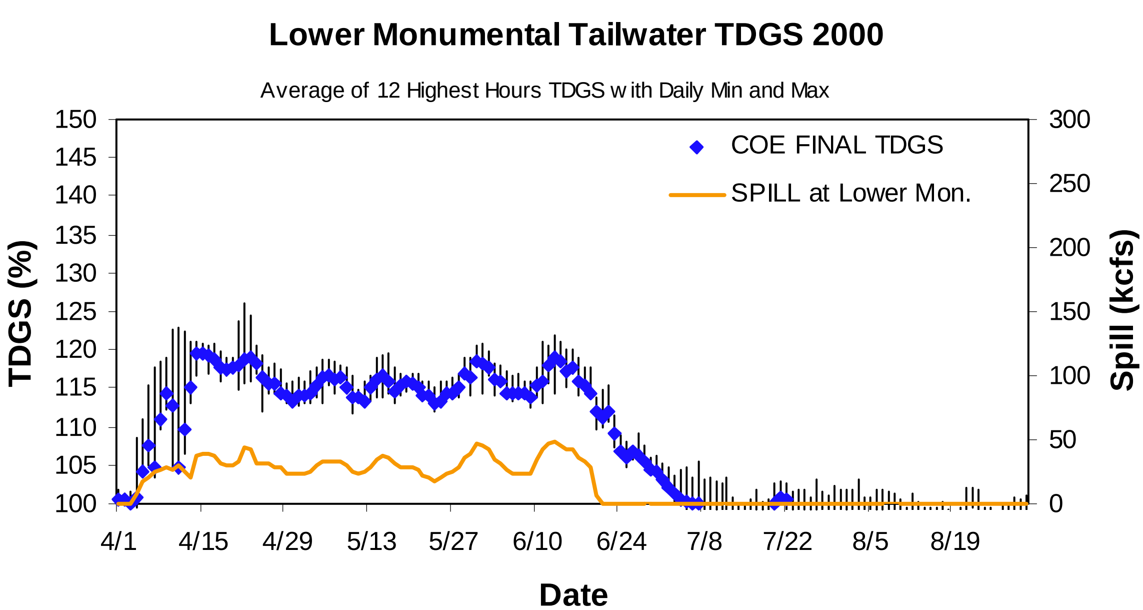


FIGURE B-6. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Lower Monumental Tailwater.

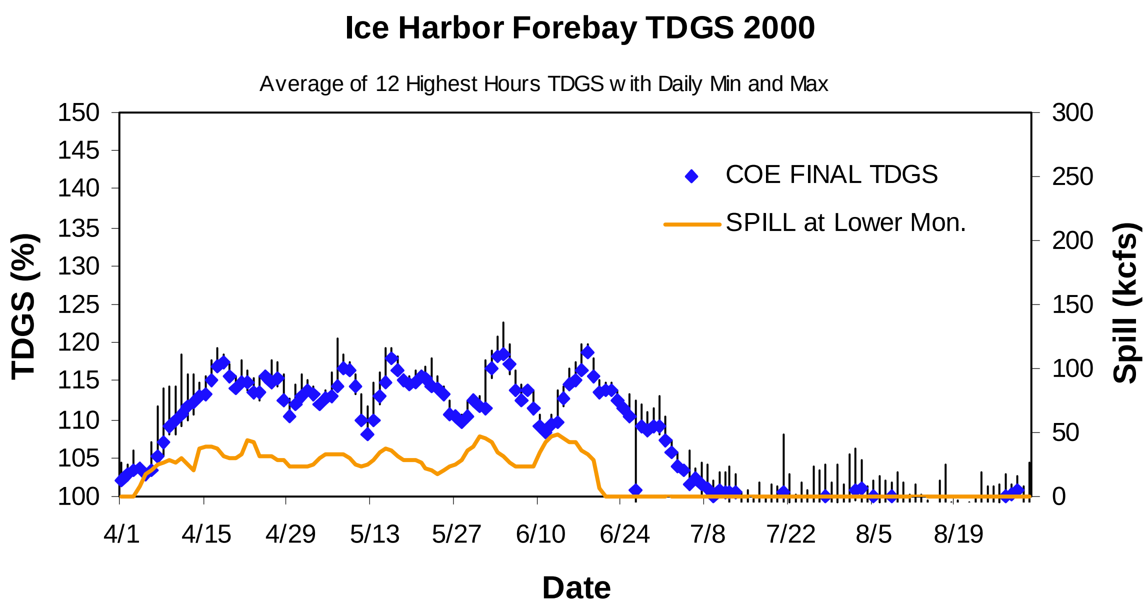


FIGURE B-7. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Ice Harbor Forebay

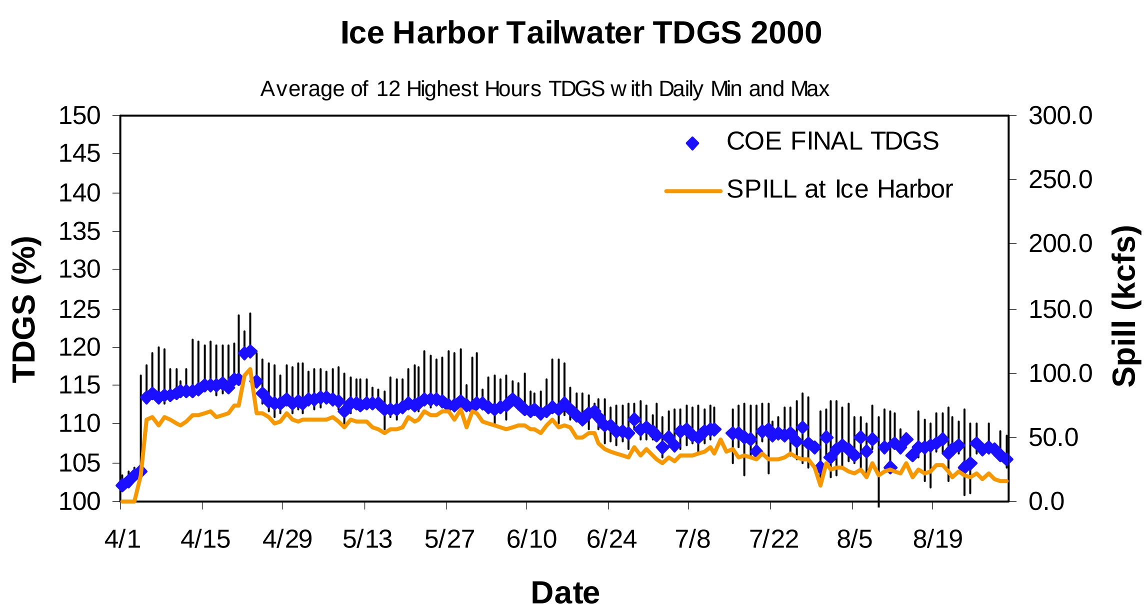


FIGURE B-8. Comparison of the daily average of the 12 highest hourly TDGS readings as report by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Ice Harbor Tailwater

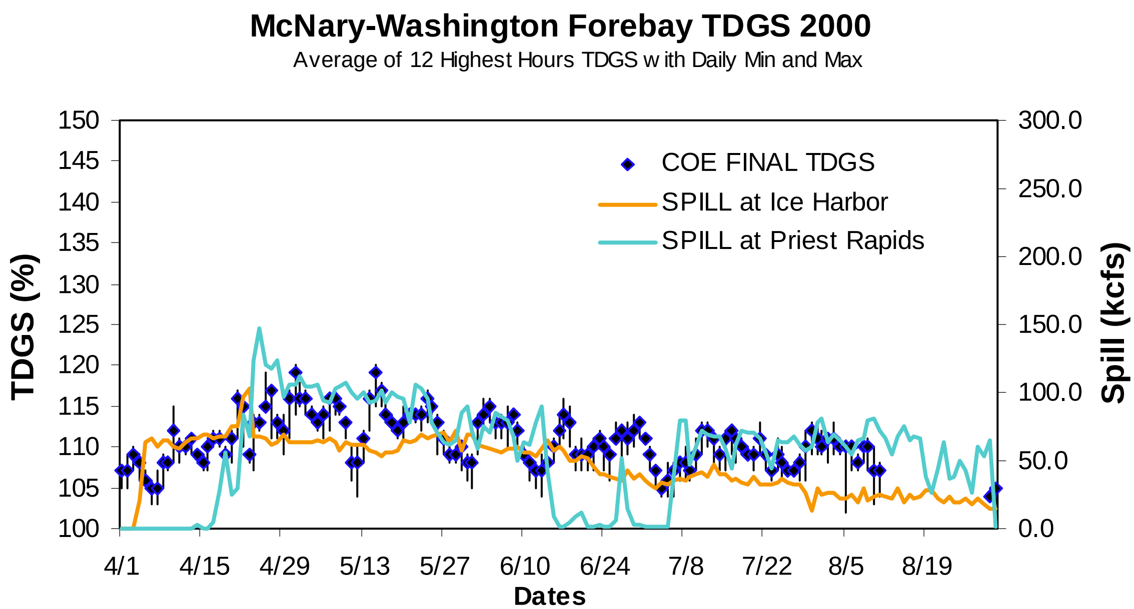


FIGURE B-9. Comparison of the daily average of the 12 highest hourly TDGS readings as report by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at McNary-Washington Forebay.

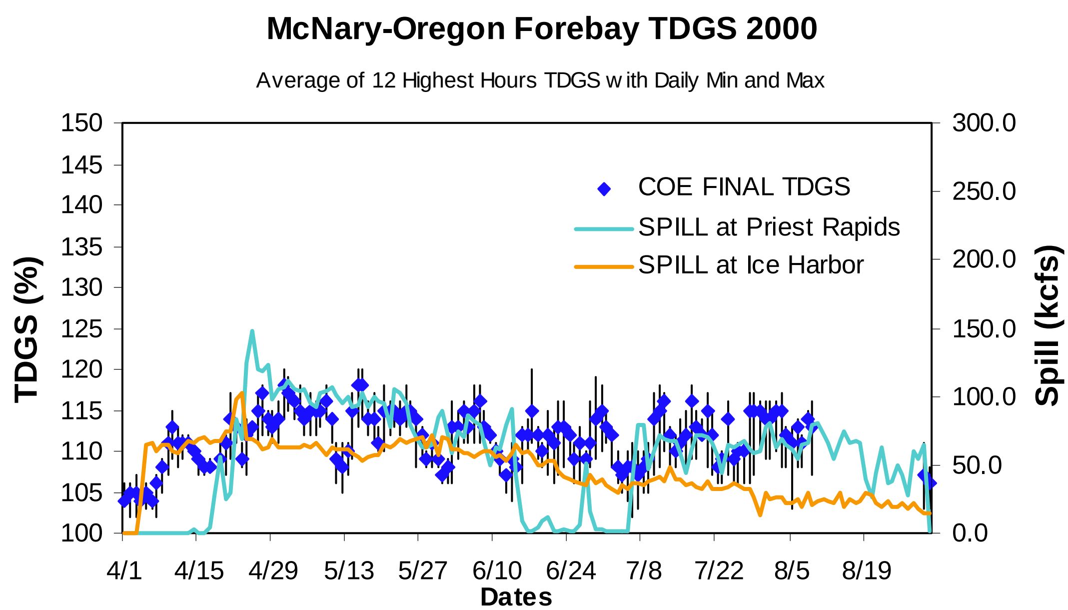


FIGURE B-10. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at McNary-Oregon Forebay.

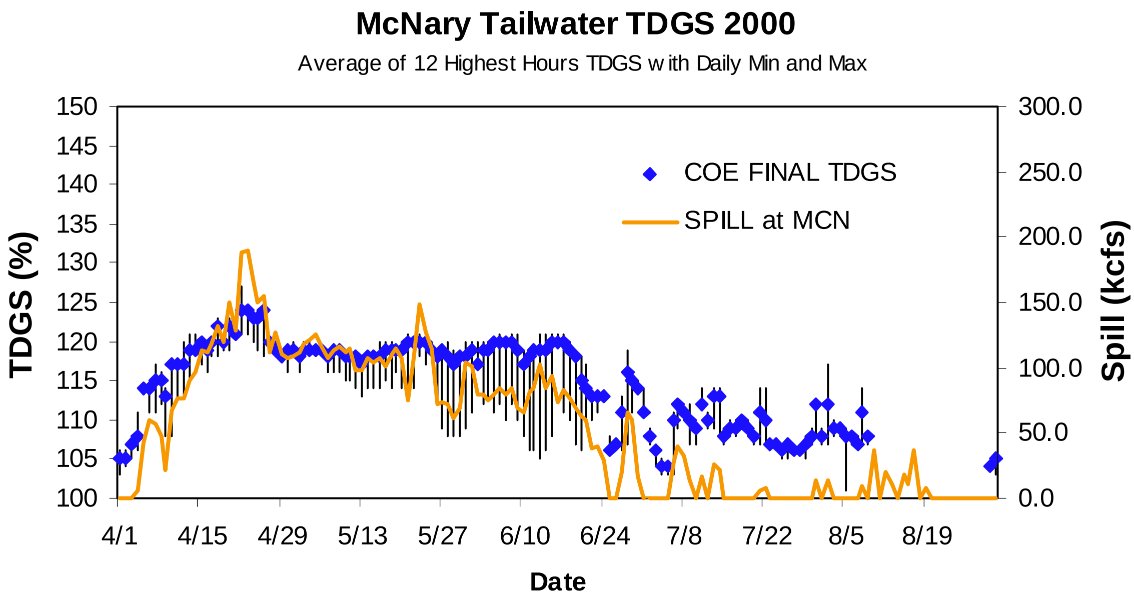


FIGURE B-11. Comparison of the daily average of the 12 highest hourly TDGS reading as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at McNary Tailwater.

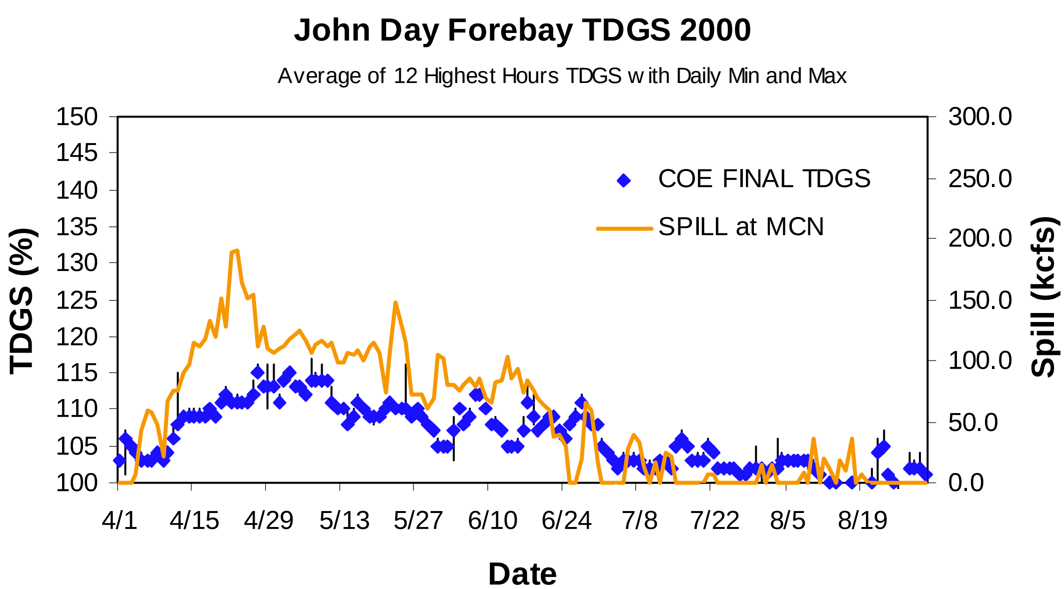


FIGURE B-12. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at John Day Forebay.

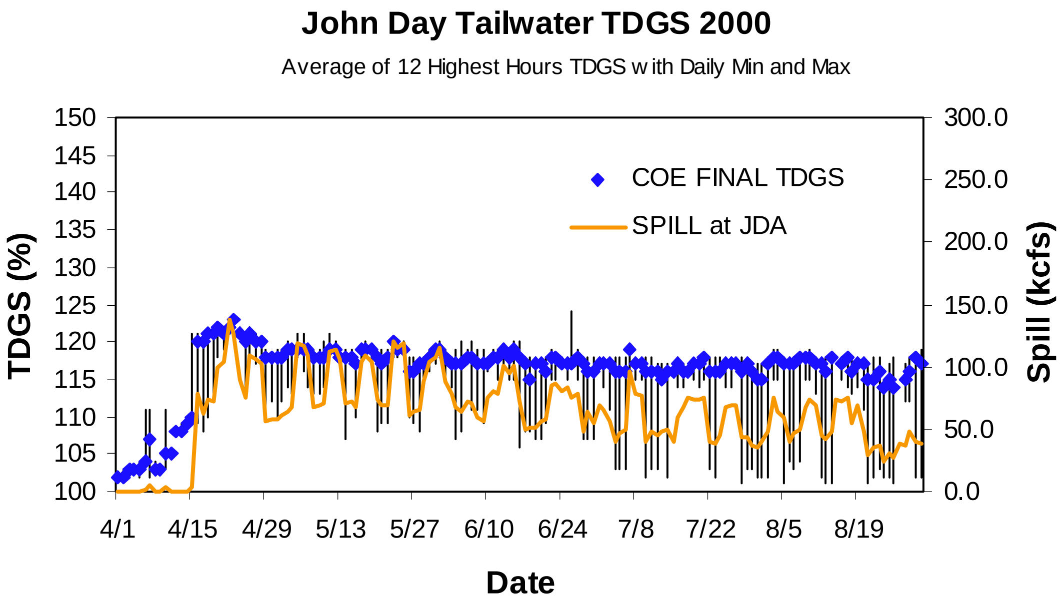


FIGURE B-13. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at John Day Tailwater.

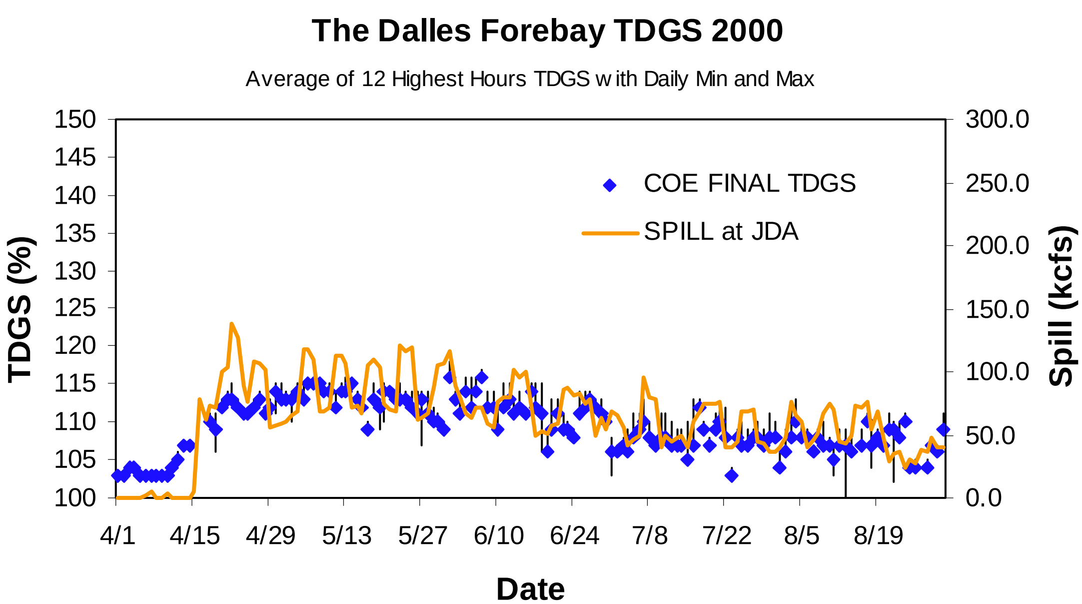


FIGURE B-14. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at The Dalles Forebay.

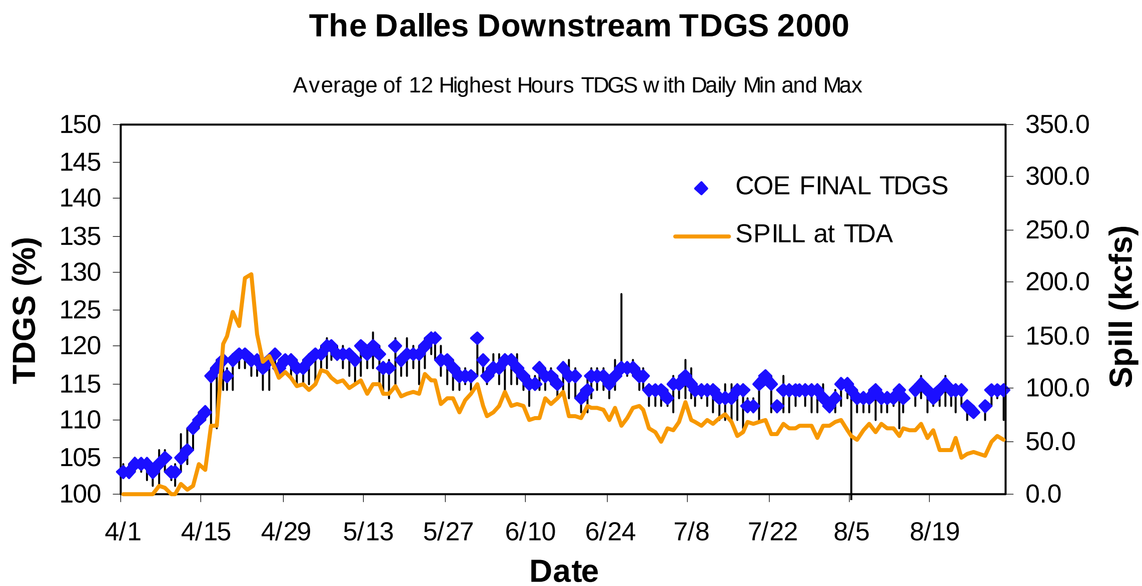


FIGURE B-15. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at The Dalles (downstream).

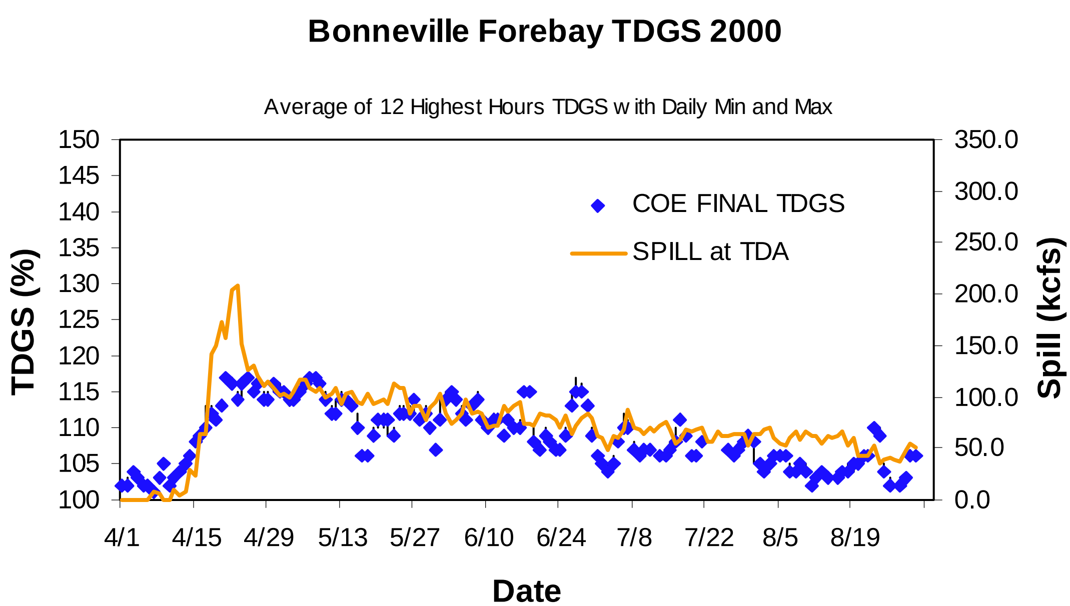


FIGURE B-16. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Bonneville Forebay.

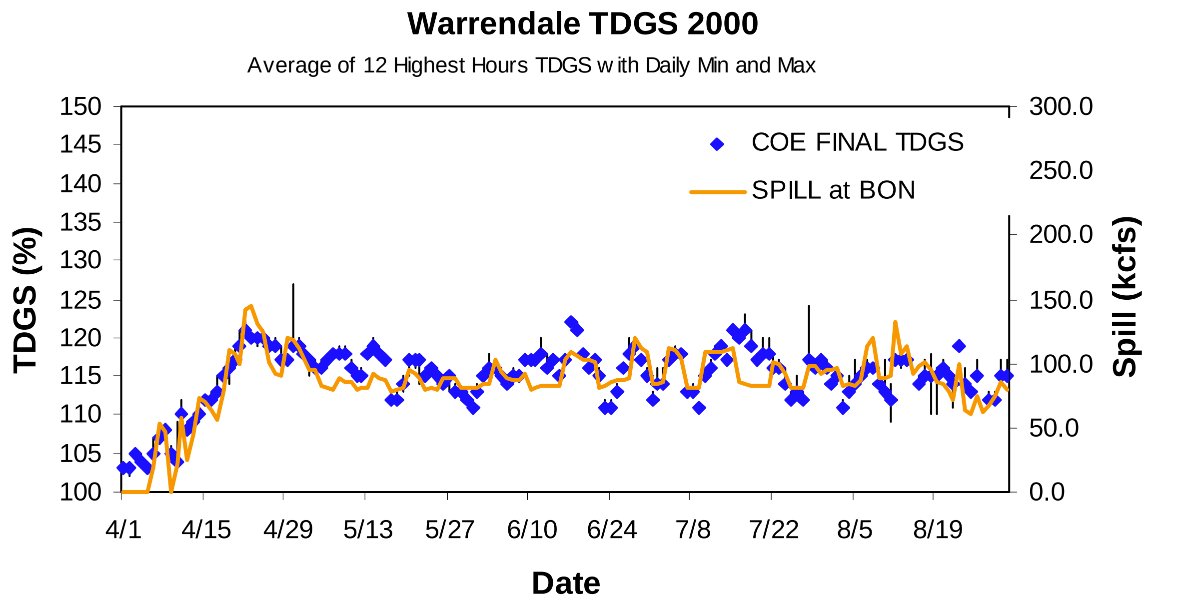


FIGURE B-17. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Warrendale.

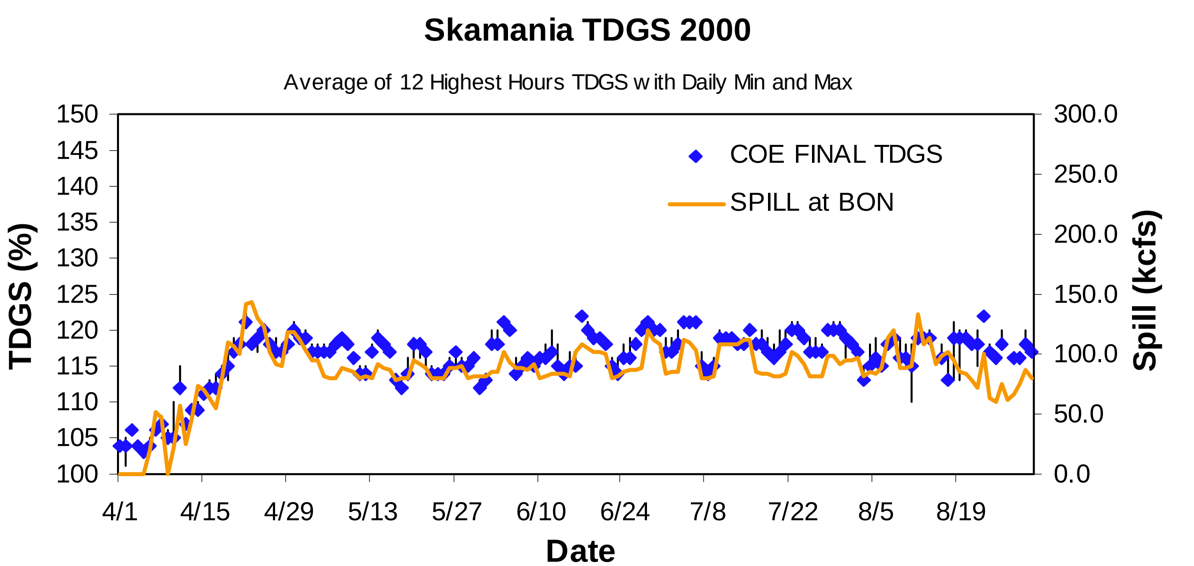


FIGURE B-18. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Skamania.

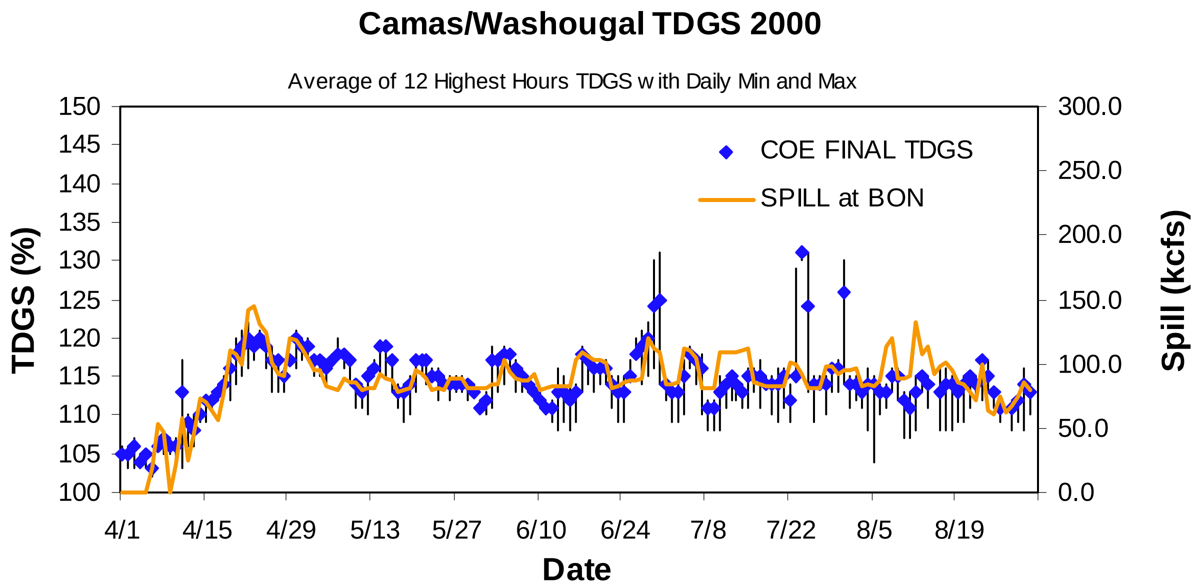


FIGURE B-19. Comparison of the daily average of the 12highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Camas/Washougal.

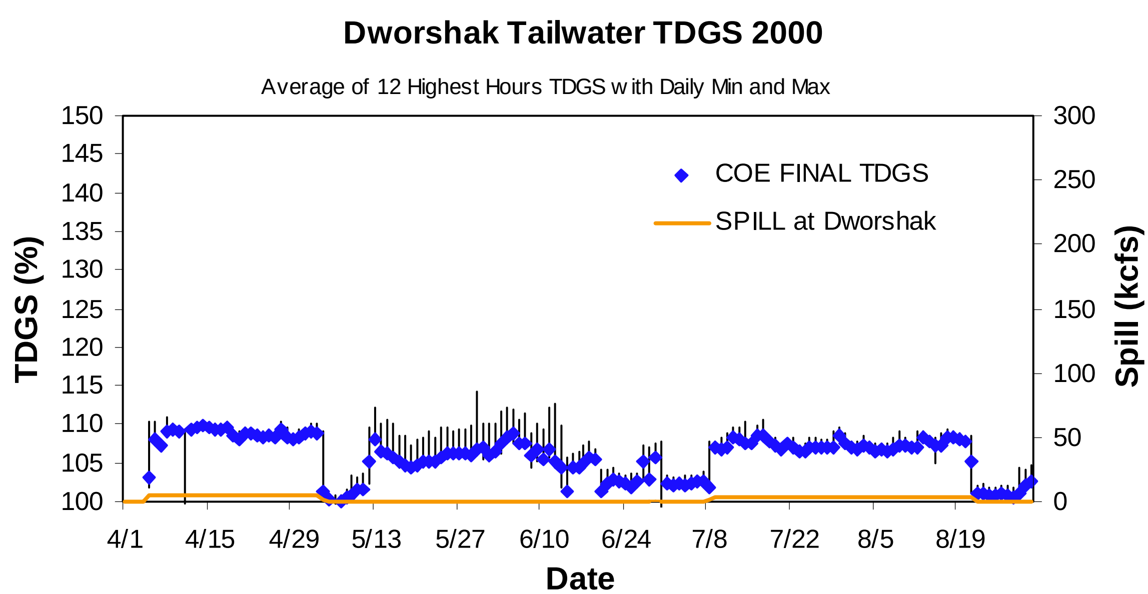


FIGURE B-20. Comparison of the daily average of the 12 highest hourly TDGS readings as reported by FPC from CROHMS data (FPC TDGS) and as computed from COE final database (COE TDGS) at Dworshak Tailwater.

APPENDIX C

Gas Bubble Trauma and

Total Dissolved Gas Saturation

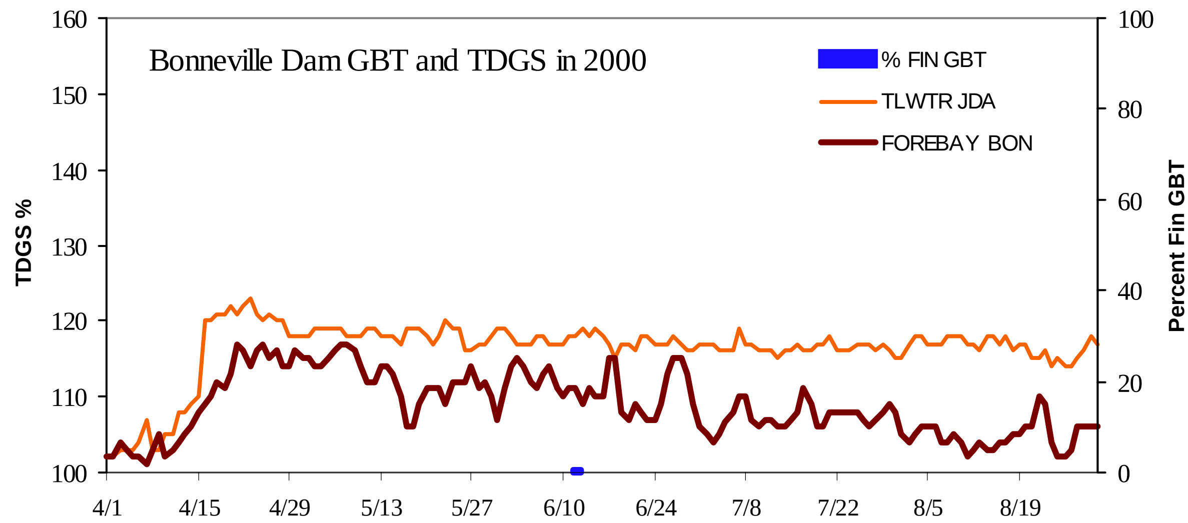


FIGURE C-1. Percent of fish examined at Bonneville Dam showing signs of GBT with associated dissolved gas saturation levels in the Bonneville Dam forebay and the John Day Dam tailwater.

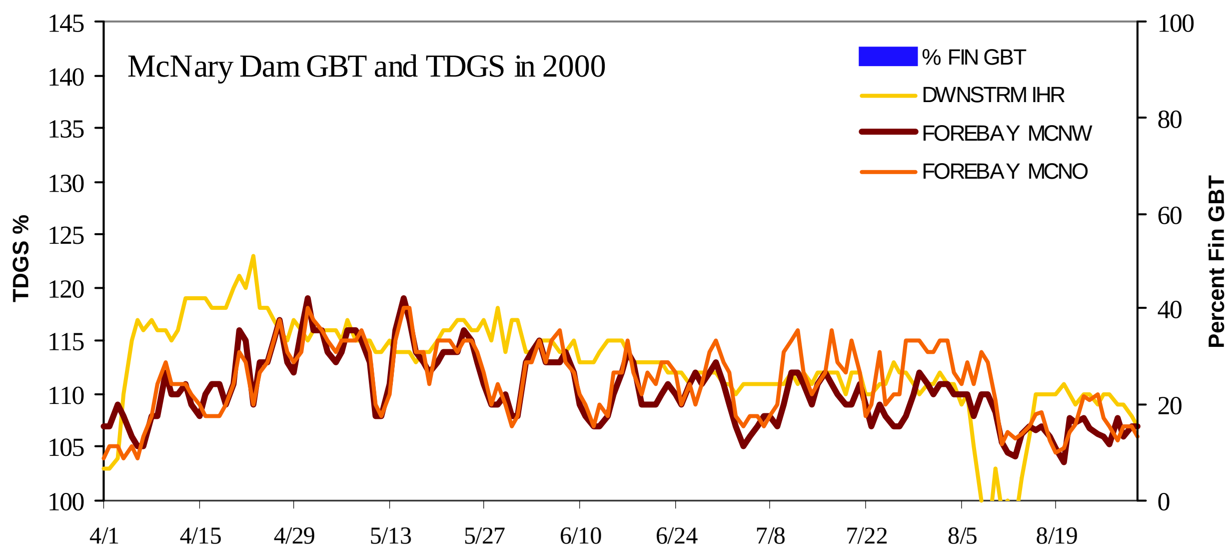


FIGURE C-2. Percent of fish examined at McNary Dam showing signs of GBT with associated dissolved gas saturation levels in the McNary Dam forebay (Oregon and Washington sides) and the Ice Harbor Dam tailwater

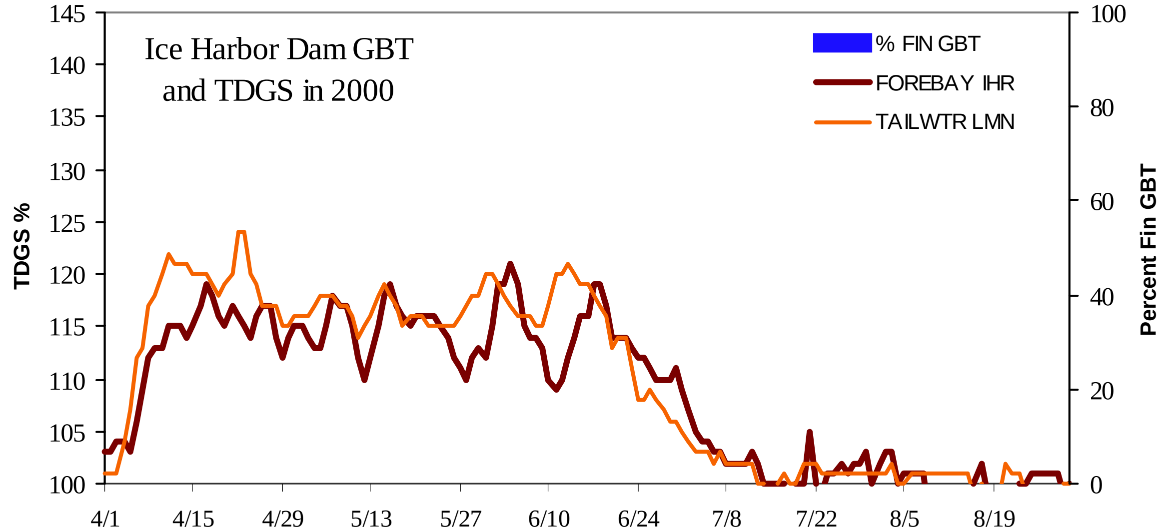


FIGURE C-3. Percent of fish examined at Ice Harbor Dam showing signs of GBT with associated dissolved gas saturation levels in the Ice Harbor Dam forebay and the Lower Monumental Dam tailwater.

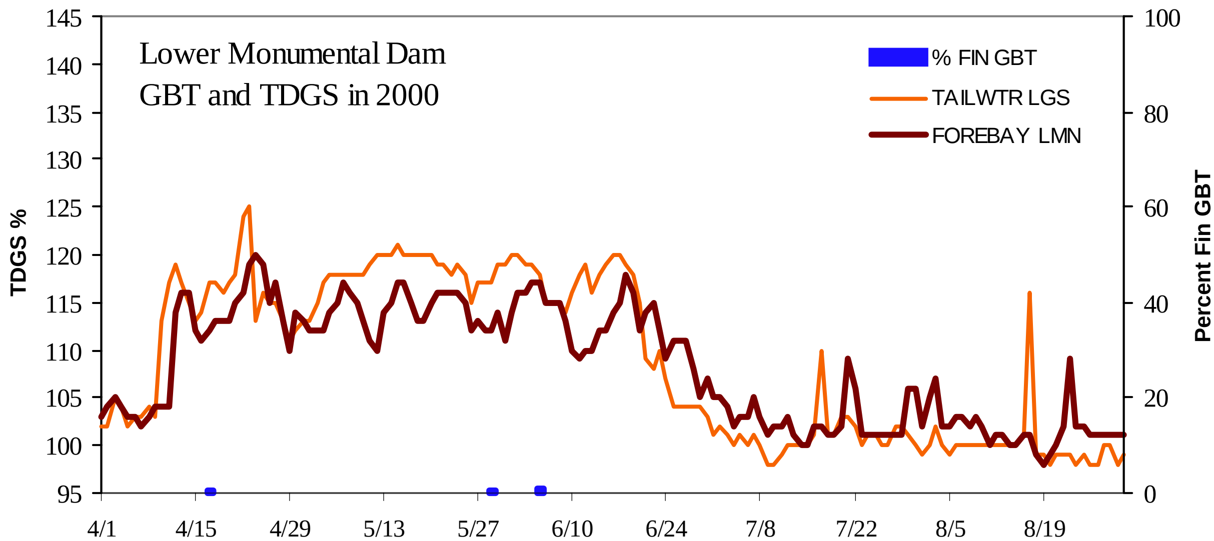


FIGURE C-4. Percent of fish examined at Lower Monumental Dam showing signs of GBT with associated dissolved gas saturation levels in the Lower Monumental Dam forebay and the Little Goose Dam tailwater.

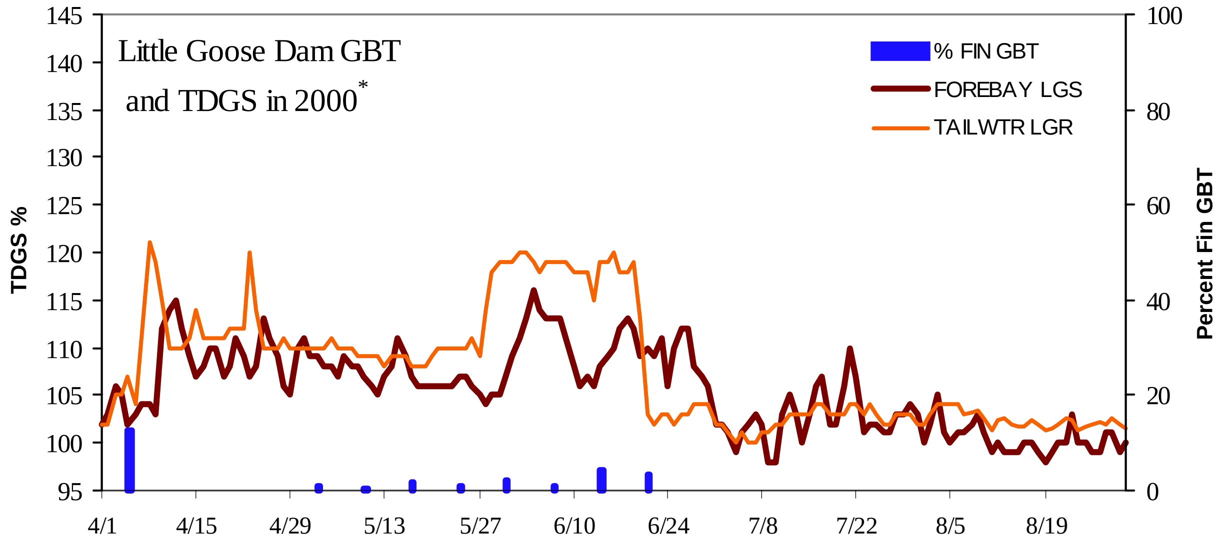


FIGURE C-5. Percent of fish examined at Little Goose Dam showing signs of GBT with associated dissolved gas saturation levels in the Little Goose Dam forebay and the Lower Granite Dam tailwater.

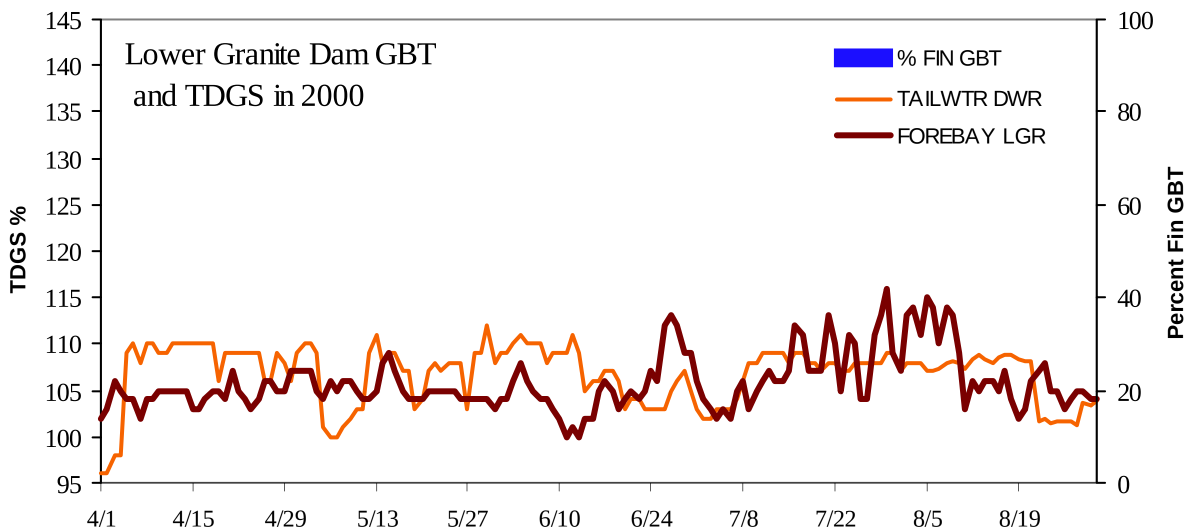


FIGURE C-6. Percent of fish examined at Lower Granite Dam showing signs of GBT with associated dissolved gas saturation levels in the Lower Granite Dam forebay and the Dworshak Dam tailwater.

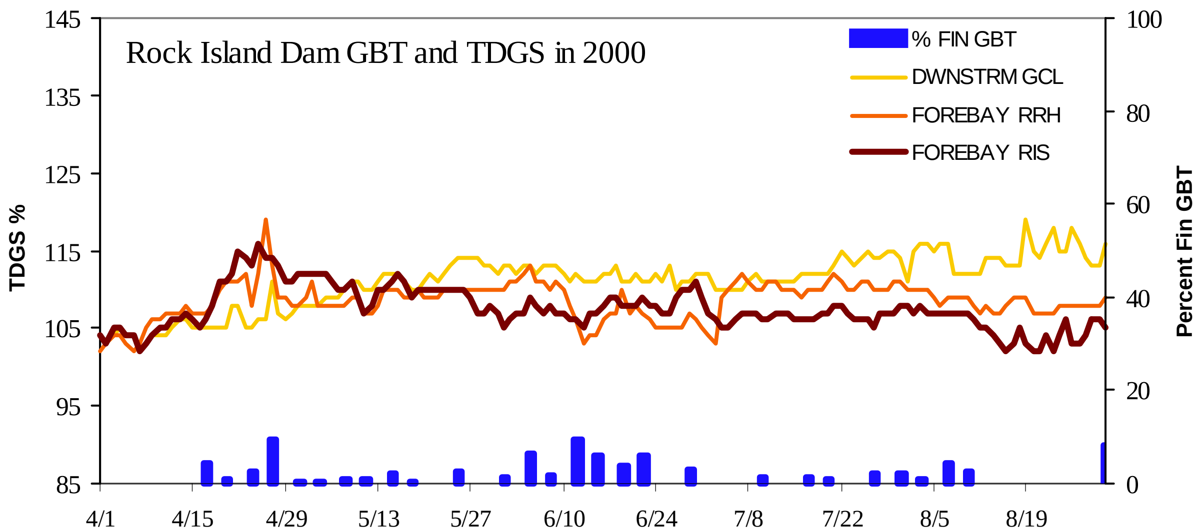


FIGURE C-7. Percent of fish examined at Rock Island Dam showing signs of GBT with associated dissolved gas saturation levels in the Rock Island and Rocky Reach Dam forebays and the Grand Coulee Dam tailwater.

APPENDIX D

Migration Timing Plots

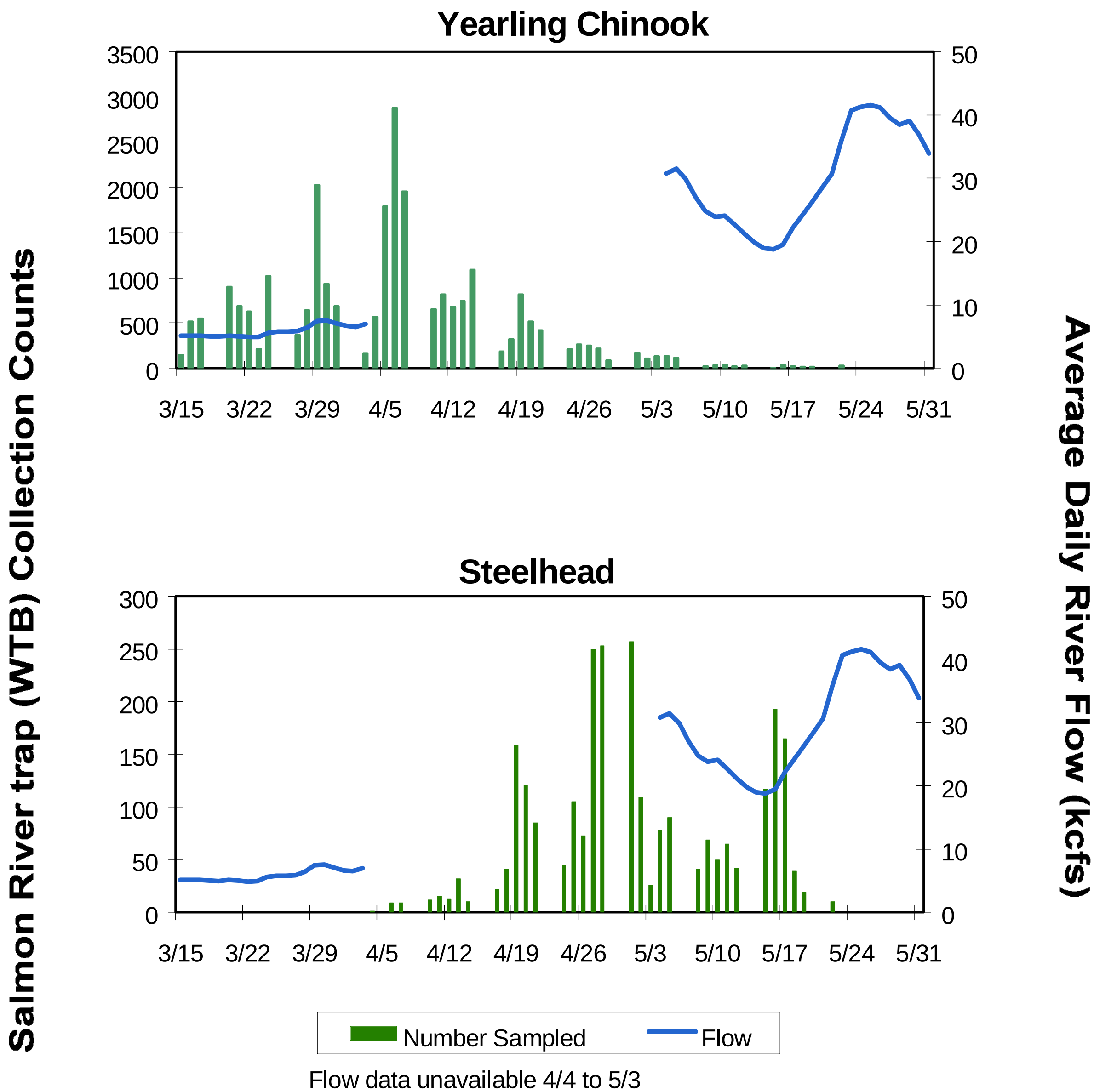


FIGURE D-1. Smolt migration timing at Salmon River Trap (WTB) with associated flow, 2000.

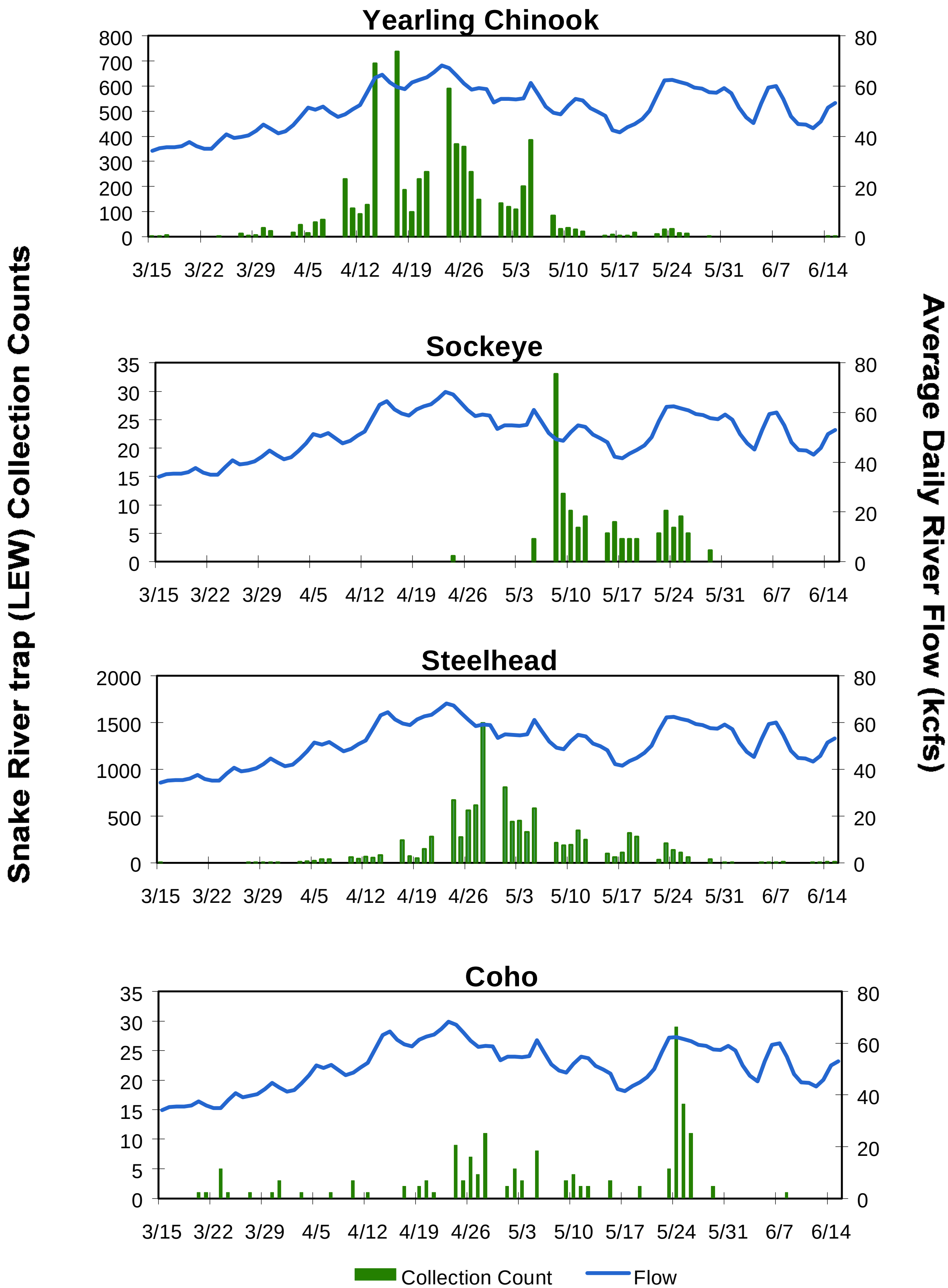


FIGURE D-2. Smolt migration timing at Snake River trap (LEW) and associated flow, 2000.

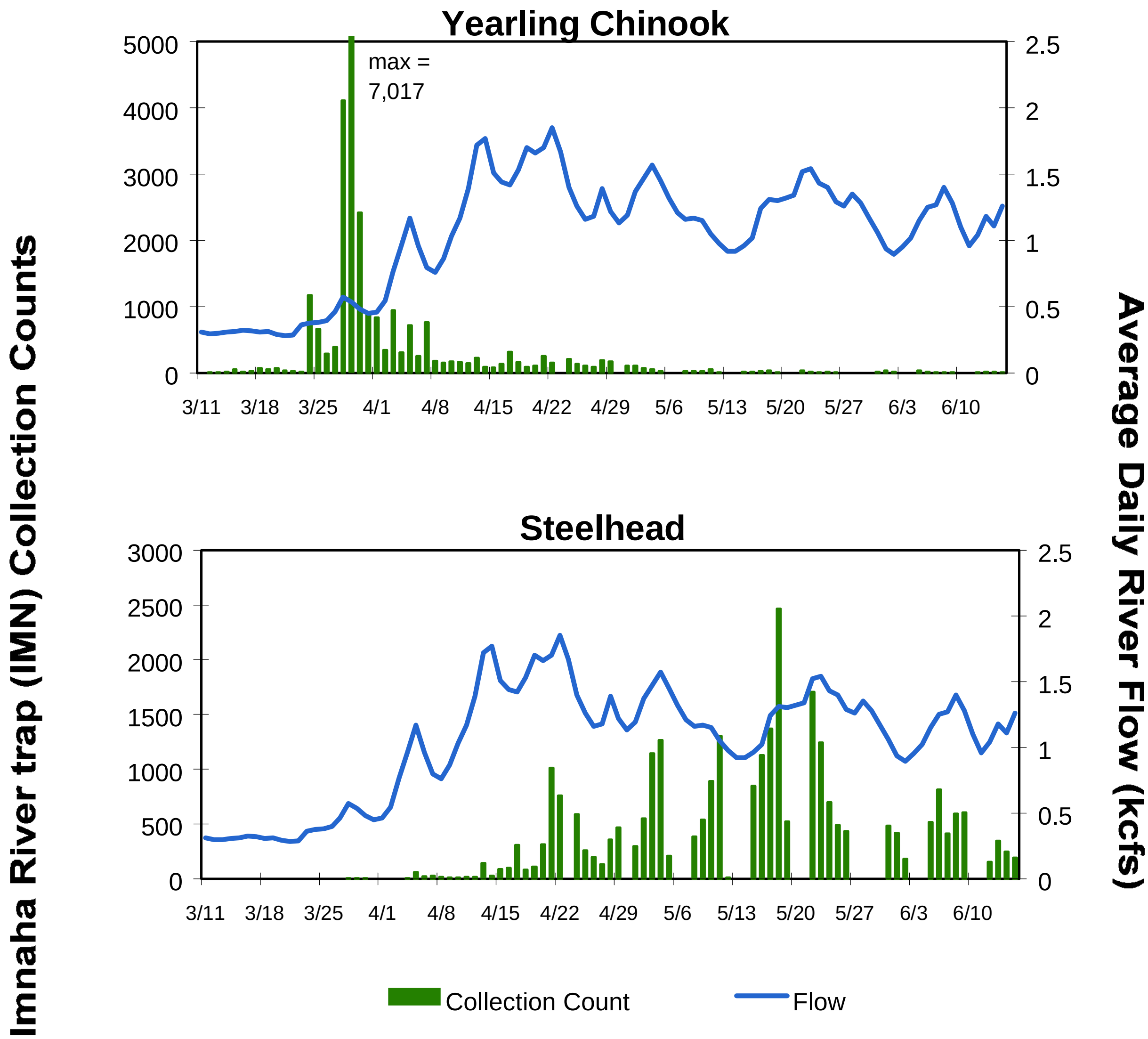


FIGURE D-3. Smolt migration timing at Imnaha River trap with associated flows, 2000.

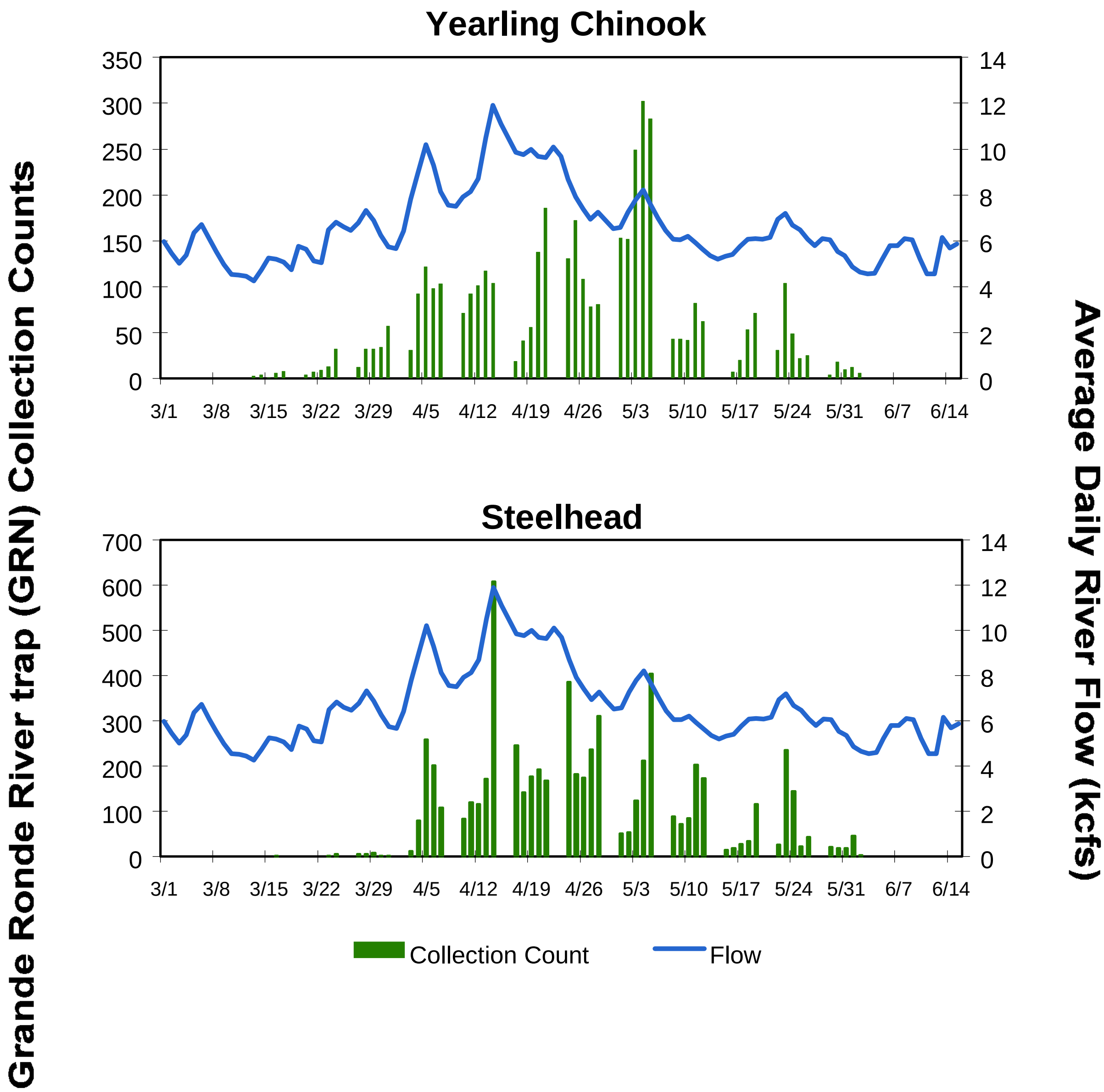


FIGURE D-4. Smolt migration timing at Grande Ronde River Trap with associated flows, 2000.

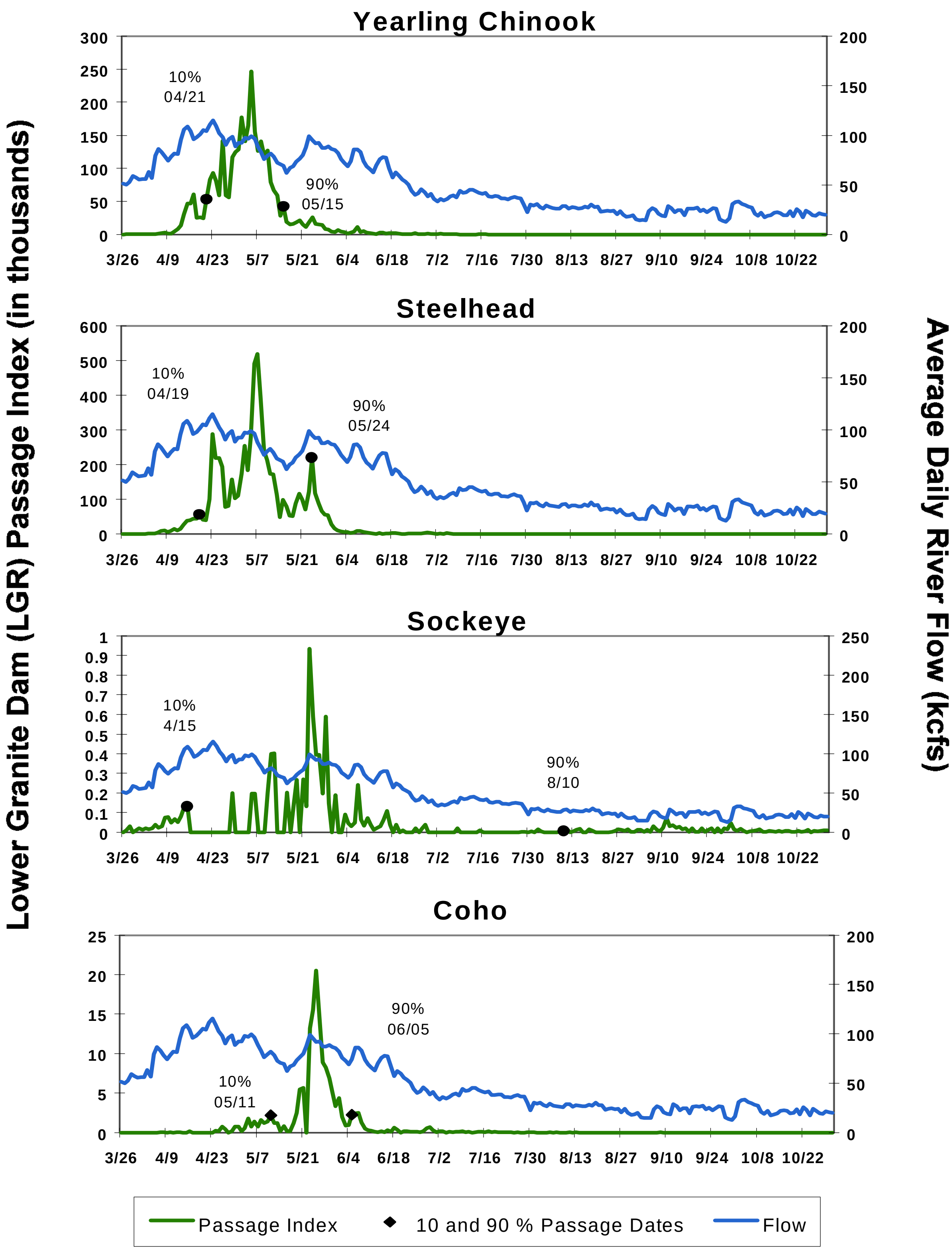


FIGURE D-5. Smolt migration timing at Lower Granite Dam with associated flow, 2000.

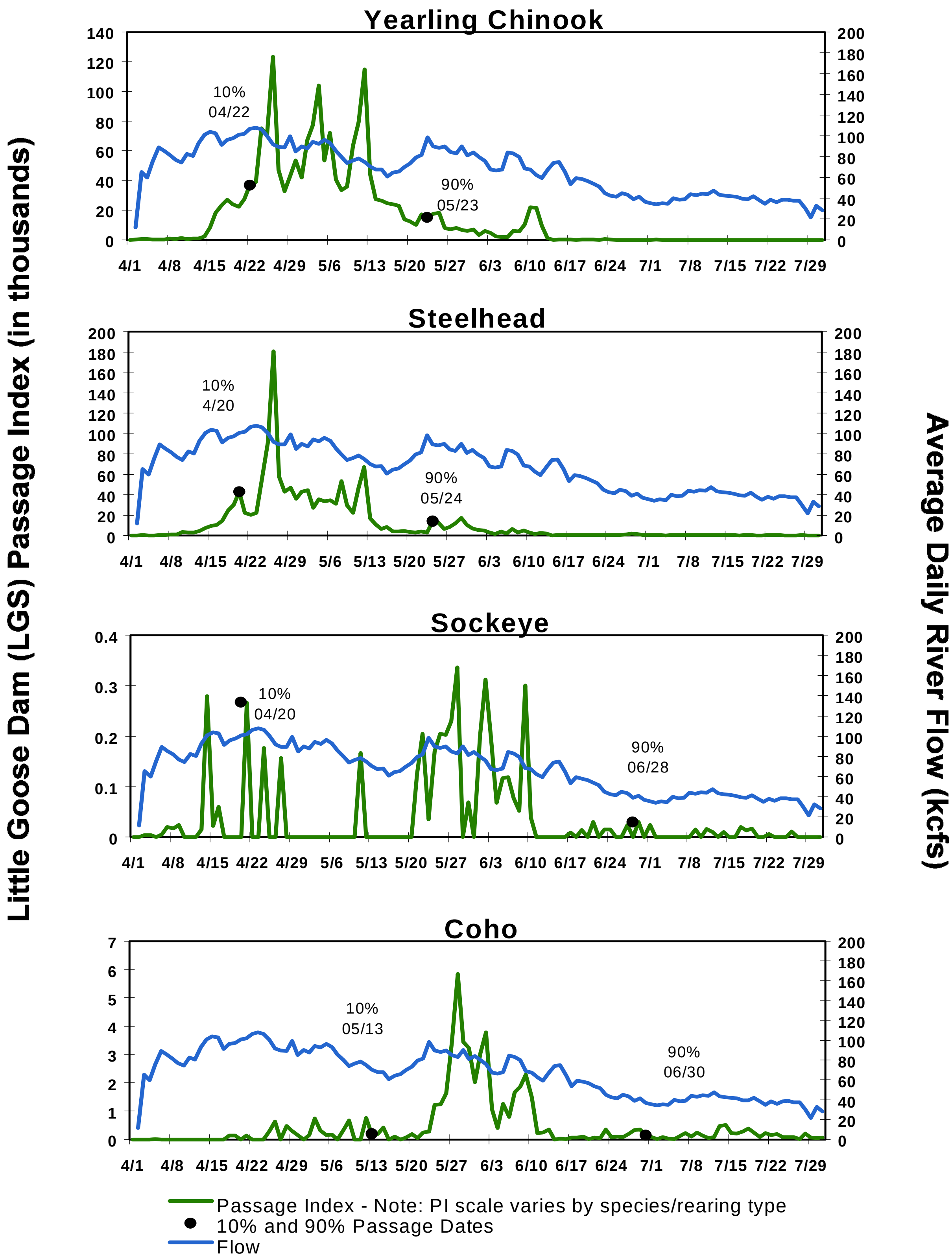


FIGURE D-6. Smolt migration timing at Little Goose Dam with associated flows, 2000.

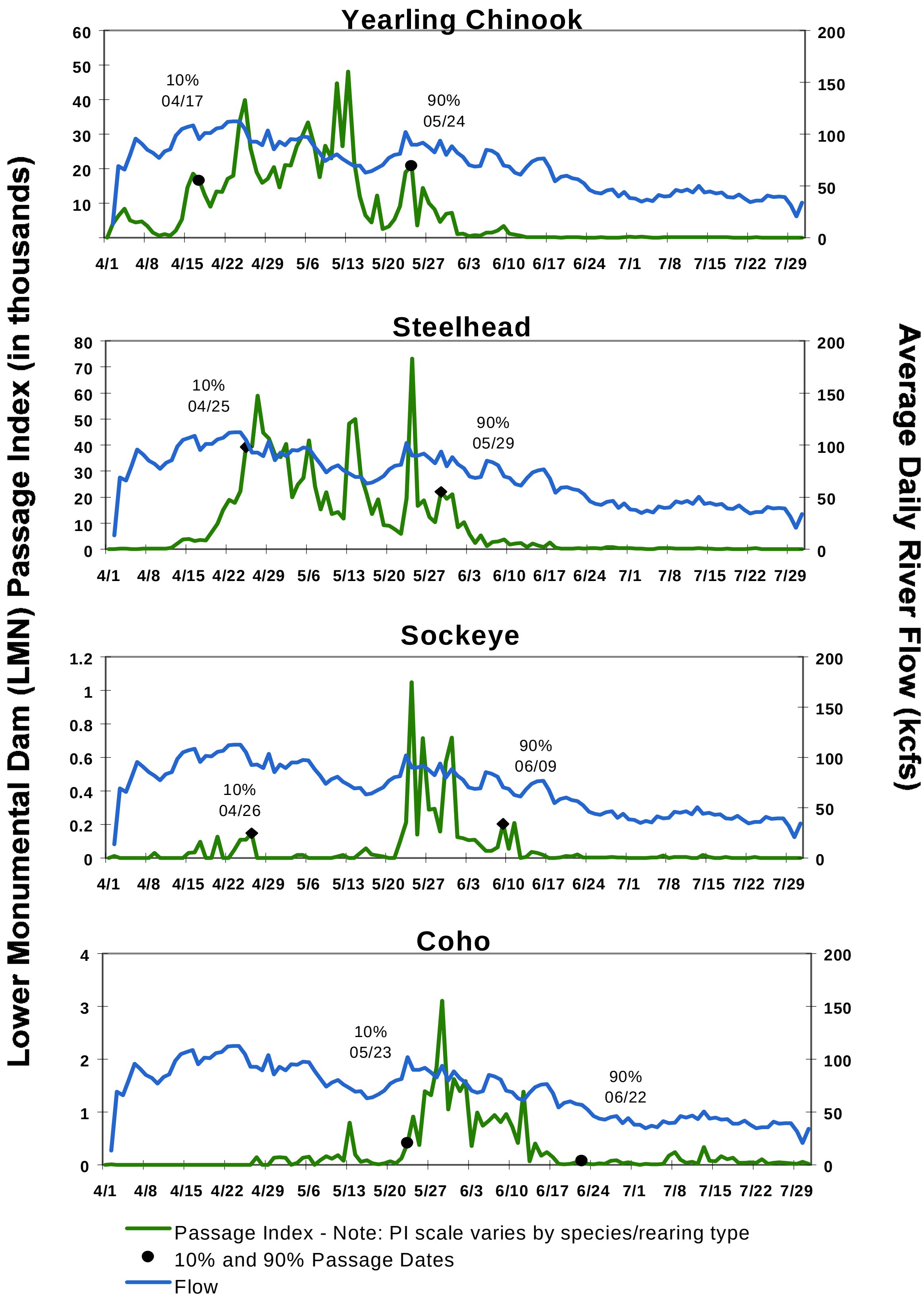


FIGURE D-7. Smolt Migration timing at Lower Monumental Dam with associated flow, 2000.

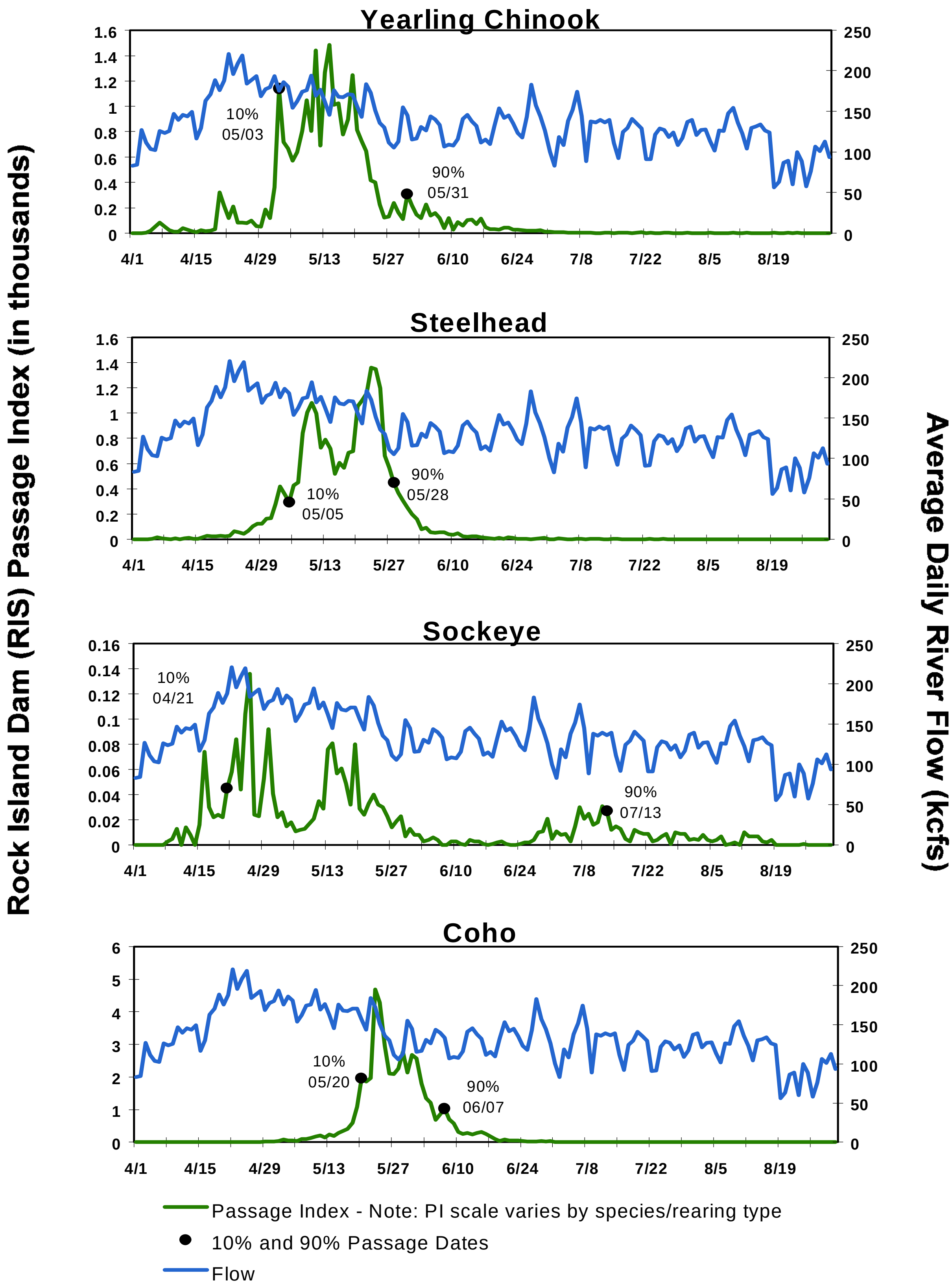


FIGURE D-8. Smolt migration timing at Rock Island Dam with associated flow, 2000.

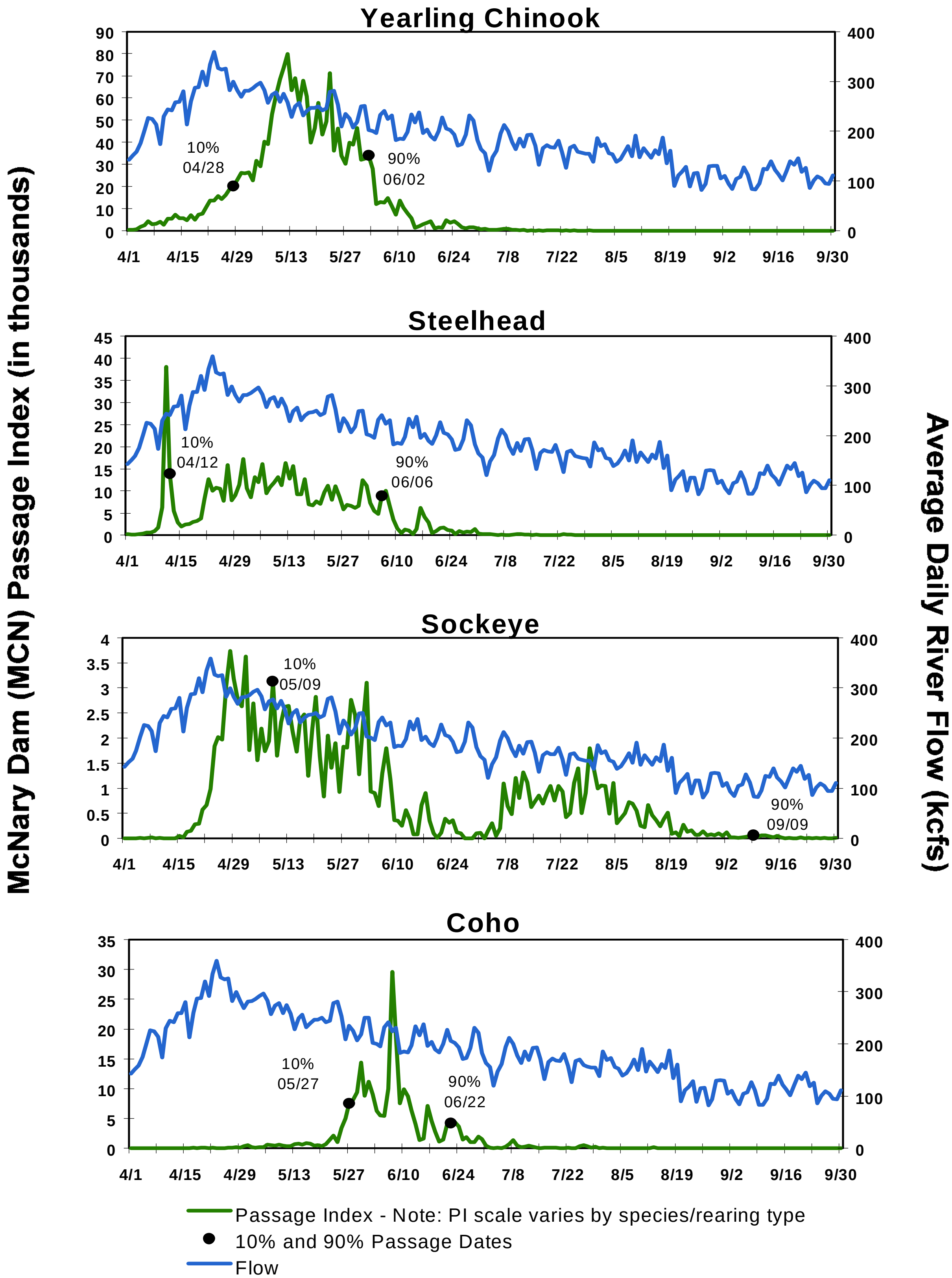


FIGURE D-9. Smolt migration timing at McNary Dam with associated flow, 2000.

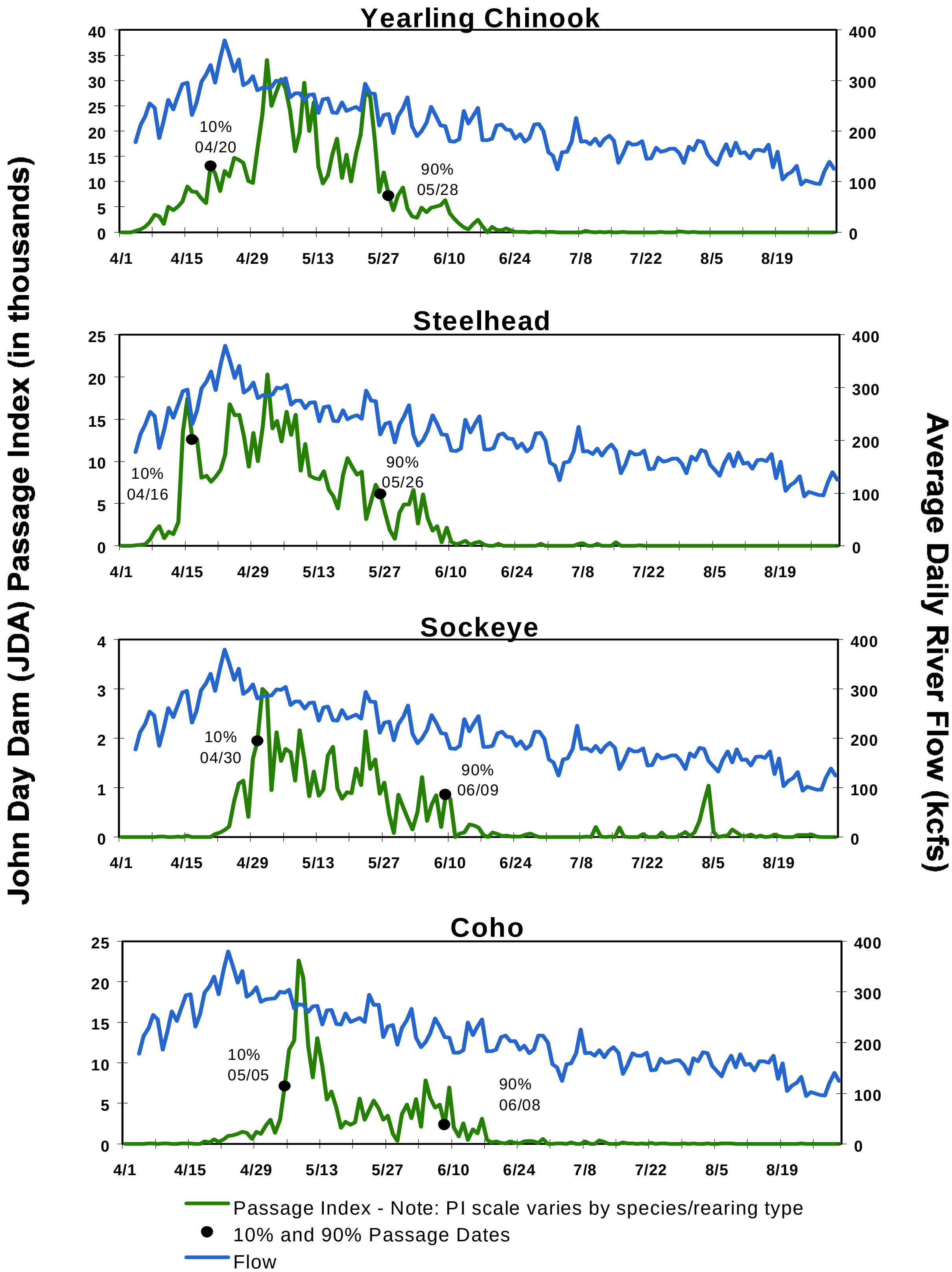


FIGURE D-10. Smolt migration timing at John Day Dam with associated flow, 2000.

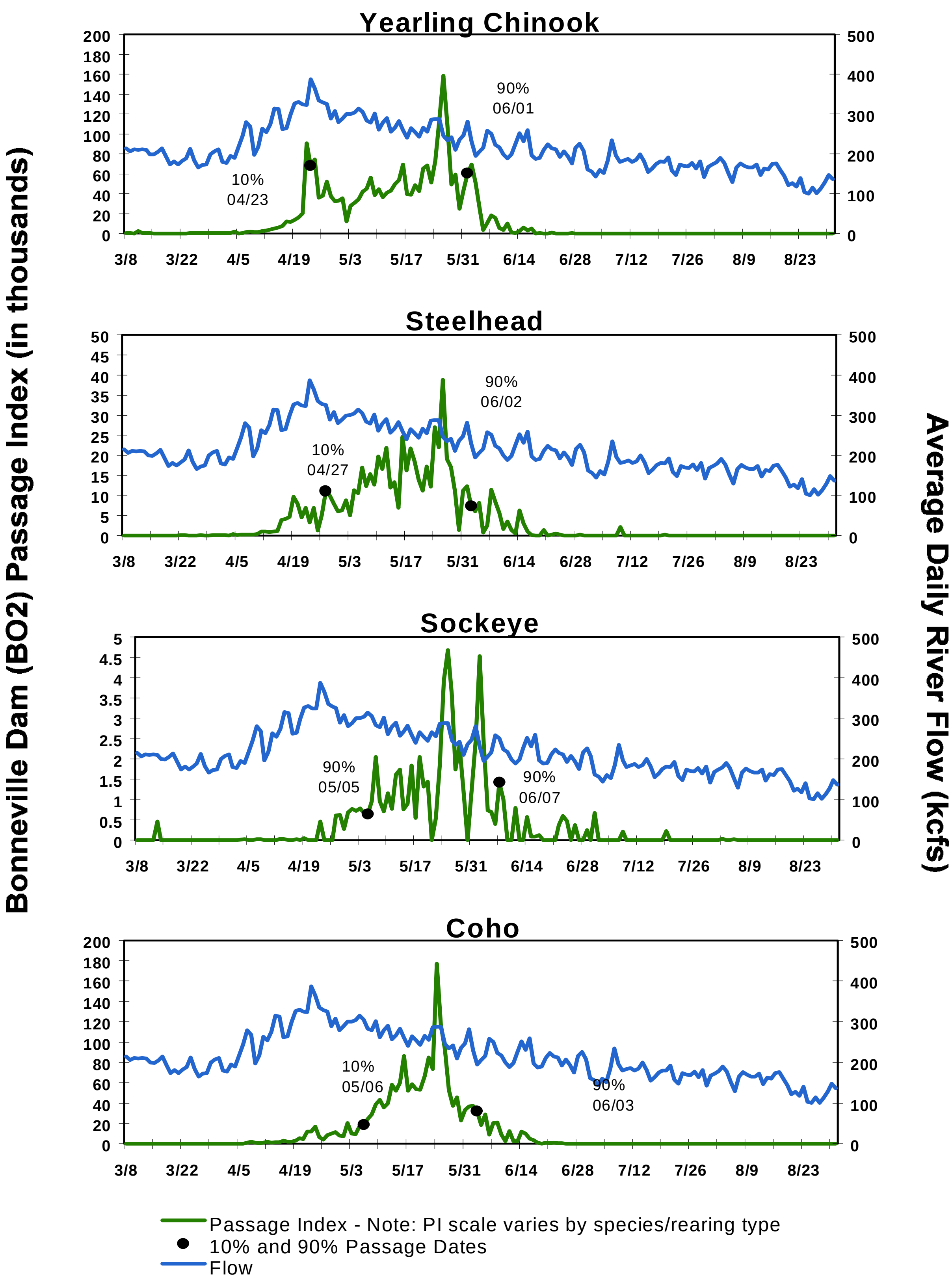


FIGURE D-11. Smolt migration timing at Bonneville Powerhouse II (BO2) with associated flow, 2000

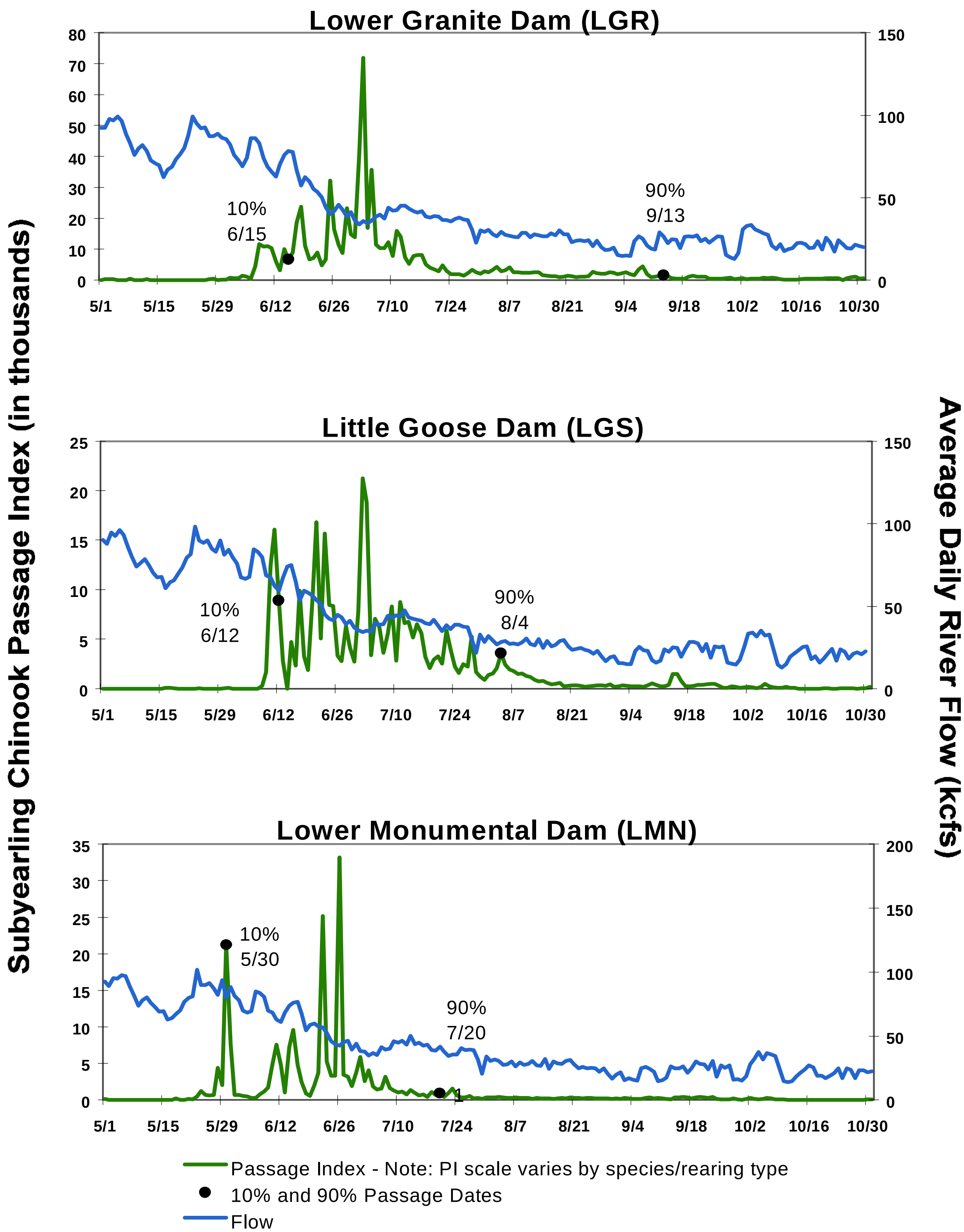


FIGURE D-12. Subyearling chinook smolt migration timing at Snake River sites with associated flow, 2000.

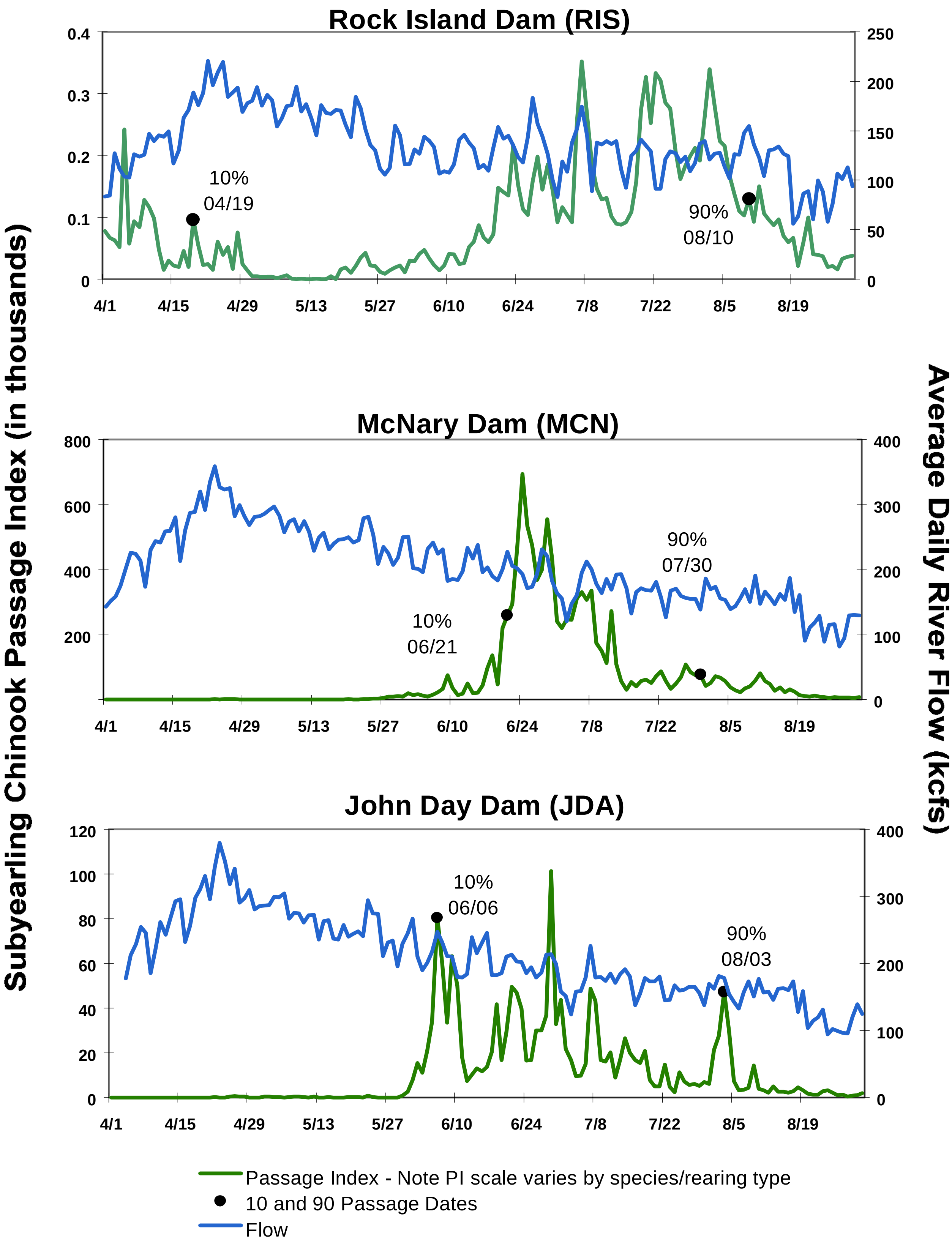
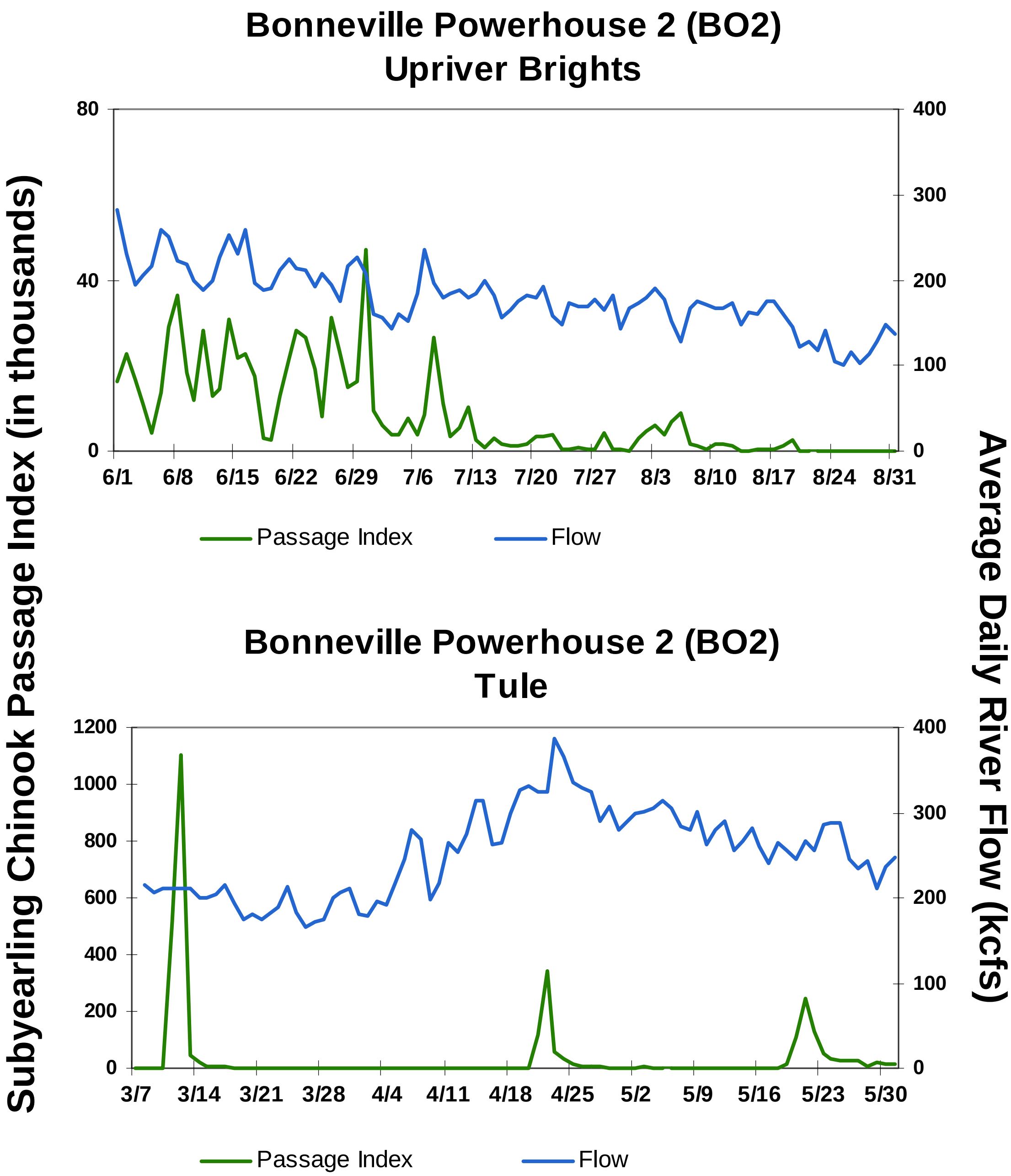


FIGURE D-13. Subyearling chinook smolt migration timing at Snake River sites with associated flow, 2000.



Spring Creek Hatchery Chinook (Tule) released on:

Date	Number Released
03/09/00	8,177,725
04/20/00	4,309,676
05/18/00	3,578,544

FIGURE D-14. Subyearling chinook smolt migration timing at Columbia River sites with associated flow, 2000.

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. 2000 travel time of PIT tagged hatchery chinook and steelhead released from various locations in the Snake River basin to Lower Granite Dam.

	Travel Time			Confidence Limits		Lower Granite		
Release Date	**Min**	**Med**	**Max**	**Lower**	**Upper**	**Number**	**Flow**	**Temp**
Chinook								
Rapid River Hatchery								
3/17 - 4/25 *	19.7	49	75.9	48.9	49	14,789	79.2	49.7
McCall Hatchery								
4/3 - 4/5	11.3	34.1	114	34	34.2	12,066	94.2	51.6
Dworshak Hatchery								
3/23, 4/5 - 4/6	3.9	27.3	86.8	27.2	27.3	13,774	74.8	48.8
Imnaha Hatchery								
3/22 - 4/18**	15.7	42.8	66.3	42.5	43.1	5,600	82.1	50
Steelhead								
Dworshak Hatchery	1.6	3.5	66.6	3.5	3.5	1,974	95.2	53.2
5/3 - 5/5								

* Rapid River Hatchery had 39-day volitional release period -- travel time estimates were computed from starting day of volitional release period for draft report. Final estimates will use data from new PIT tag monitors at hatchery pond exit.
** Imnaha Acclimation Pond had a 27-day volitional release period -- travel time estimates were computed from starting day of volitional release period.

TABLE E-2. 2000 travel time of PIT tagged hatchery chinook released from various locations in the mid-Columbia River basin to McNary Dam.

	Travel Time			Confidence Limits		Priest Rapids		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
Chinook								
Winthrop Hatchery Yearling								
4/10	11.8	30.2	80.6	29.3	31	720	181.8	NULL
Leavenworth HatcheryYearling								
4/18	11.9	36.1	79.2	34.6	36.9	987	184.7	NULL
Wells Hatchery Subyearling								
6/19	12.4	35.3	67	32.5	36.5	606	132.7	NULL
Priest Rapids Hatchery Subyearling								
6/15	5.1	12.1	49.9	11.5	13.1	420	136.5	NULL
6/19	4.4	13.4	37.4	12.3	14.2	376	138.1	NULL
6/27	4.3	11.5	43	11.2	13.1	363	137.6	NULL
Ringold Hatchery Subyearlings								
6/17 to 6/19	0.2	9.8	56.7	9.2	10.2	1090	140.3	NULL

TABLE E-3. 2000 travel time of PIT tagged wild chinook released from the Salmon River trap to Lower Granite

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
3/27	17.6	18.7	25.7	17.6	25.7	7	73.1	48.8
3/28	13.9	17.2	23.7	15.5	17.5	15	72.4	48.7
3/29	14.6	16.5	55.6	15.4	23.4	12	75.5	49
3/30	12	15.5	46.3	14.6	26.3	13	76.4	49
3/31	8.7	14.8	26.7	8.7	26.7	8	77.6	49.2
4/3	8.9	11.6	28.7	11.1	13.5	26	82.6	49.5
4/4	8.6	10.8	49.1	10.5	11.6	63	84.2	49.6
4/5	7.8	10.5	32.6	10.1	15.8	53	88.2	49.8
4/6	7.2	15.6	43.1	14.7	17.5	39	93.8	50.7
4/7	6.9	13.4	31.7	9.6	21	20	92.3	50.4
4/10	5.5	15.9	40.5	11	20.6	35	99.9	51.4
4/11	4.6	11.7	44.5	10.8	14.3	47	100.7	51.2
4/12	4.8	10.8	42.8	9.7	13.5	40	102.3	51.3
4/13	6.1	13.5	41.7	11.4	20.4	33	103.1	51.7
4/14	6.3	11.4	25.7	7.5	14.8	17	105.2	51.8
4/17	5.6	11	39.4	8.4	12.5	29	102.3	52.2
4/18	5.8	10.1	14.8	7.4	10.9	25	102.9	52.4
4/19	6.3	9.6	14.5	7.2	11.4	9	103	52.5
4/20	4.3	10.4	19.9	5.9	13.6	11	101.8	52.5
4/21	4.7	8.6	35.3	6.9	12.7	21	101.5	52.5
4/24	4.9	8.8	30.7	7.2	10.4	24	96.7	52.4
4/25	5.6	10.6	16.6	9.2	14.6	10	95.8	52.6
4/26	5.5	15	30.5	7.9	18.9	16	91	52.8
4/27	7.1	11.2	27.7	8.7	17.5	12	93.4	52.7
4/28	7.6	7.8	9.7	-	-	3	95.4	52.7
5/1	5.8	7.5	13.6	5.9	13.5	11	91.4	53
5/2	6.4	6.8	18.4	-	-	4	91.3	53.1
5/3	4.7	8.7	10.9	-	-	5	87.8	53.3
5/4	6.6	8.5	18.8	6.6	18.8	8	85.3	53.2
5/5	7.3	10	19.8	7.3	19.8	8	81.5	53.1
5/8	10.8	14	16.6	-	-	3	75.2	53.9
5/9	8.9	15.2	15.5	-	-	6	77.5	54.4
5/10	13.6	16.4	17.7	-	-	4	79.3	54.6
5/11	14.6	15.2	15.7	-	-	2	79.3	54.7
5/12	6.8	12.1	16.2	-	-	6	77	54.6
5/16	5.8	8.4	9.4	-	-	4	78.9	55.3
5/22	4.5	5.1	5.7	-	-	5	92.3	56.8

TABLE E-4. 2000 travel time of PIT tagged hatchery chinook released from the Salmon River trap to Lower Granite Dam.

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
3/13	23.5	35.3	49.2	33.5	39.1	35	65.8	47.9
3/14	27.4	36.4	47.5	33.7	39	37	68	48.1
3/15	22.8	37	47.2	31.4	38.1	22	70.3	48.3
3/16	26.7	35.6	40.5	29.5	37.4	18	70.9	48.4
3/17	27.4	36.8	50.1	29.2	44.1	20	73.6	48.7
3/20	24.8	39	47.7	34.5	43.4	29	78.6	49.4
3/21	22.2	31.6	49.1	26.5	39.4	32	75.2	48.9
3/22	21.8	34.7	52	33.4	37.3	38	79.4	49.5
3/23	20.5	38.5	49.7	28.7	39.6	33	82	49.9
3/24	20.3	32.6	41.5	29.4	36	28	81.3	49.7
3/27	16.3	31.5	46.7	29.4	35.6	38	84.7	50.2
3/28	16.3	32.5	44.1	28.6	35.7	37	86.2	50.3
3/29	16.4	33.7	44.5	29.7	35.7	48	87.5	50.5
3/30	15.7	35.4	43.6	33.5	36.6	40	88.9	50.7
3/31	16.7	32.7	50.6	30	36.1	46	89.5	50.8
4/3	10.8	22.4	41.6	18.5	29.7	24	92.3	50.6
4/4	9.9	24.8	45.7	24.2	27.9	54	93.9	51
4/5	10.7	27.8	40	26.6	29.7	42	95	51.3
4/6	10.1	27.2	43.5	23.5	28.4	47	95.6	51.4
4/7	9.7	26.5	40.2	22	28.8	31	96	51.6
4/10	5.6	21.7	50.7	20.8	26.6	37	98.1	51.6
4/11	7.5	23.5	40.6	19.8	26.7	39	98.9	51.9
4/12	9.8	22	40.1	20.5	23.7	55	99.6	51.9
4/13	9	18.5	41.9	17.4	21.1	51	100.7	51.8
4/14	11.6	22.8	31.8	16.6	25.8	24	99.9	52.2
4/17	5.9	17.3	35.5	14.5	18.6	36	99.7	52.3
4/18	5.2	16	24.7	13.5	16.7	42	99.9	52.5
4/19	5.2	12.8	21.9	10.5	15.6	51	100.4	52.4
4/20	5.6	14.8	22.8	12.8	17.8	32	99.9	52.7
4/21	5.7	14.6	31.8	12.8	15.7	51	99.4	52.7
4/24	6.6	14.4	31.9	12.7	15.8	44	95.4	52.7
4/25	7.1	14.9	29.5	13.7	17.6	44	92.3	52.7
4/26	7.7	14.2	26.9	12.5	16.6	40	91.6	52.7
4/27	7.8	13.2	26.7	12.4	15.1	34	91.2	52.7
4/28	6.8	12.6	25.5	9.6	16.3	16	90.6	52.9
5/1	5.6	9.5	22.5	7.9	11.4	36	89.5	53.1
5/2	4.3	10.7	24.5	8.4	16.7	29	86.9	53.2
5/3	4.5	10.7	23.5	8.9	11.7	41	85.1	53.2
5/4	3.5	15	25.6	11.7	16.6	45	79.1	53.4
5/5	6.5	15.9	22.3	7.8	20.8	10	77.9	53.6
5/8	13.5	16	18.6	-	-	2	77.8	54.3
5/9	8.5	14.4	17.6	8.5	17.6	8	76.3	54.2
5/10	5.5	14.5	15.6	-	-	4	78.5	54.6
5/11	8.8	12.6	13.7	-	-	4	77.4	54.6
5/12	9.8	9.8	9.8	-	-	1	73.4	54.2
5/16	4.7	6.5	12.5	4.7	12.5	7	76.8	55.1

TABLE E-5. 2000 travel time of PIT tagged wild steelhead released from the Salmon River trap to Lower Granite Dam.

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/17	3.4	3.5	7.8	-	-	5	101	51.6
4/18	3.4	3.9	6.4	3.6	6.4	9	104	52.2
4/19	2.9	3.5	7.5	3.4	3.8	18	107.5	52.8
4/20	2.5	3.4	9.7	-	-	4	109	53
4/21	2.5	3.5	4.9	2.5	4.9	7	108.5	53
4/24	3.3	4.8	20.5	-	-	4	99.2	52.3
4/25	3.4	3.7	13.5	3.5	4.7	13	97.2	52.2
4/26	3.5	8.6	23.5	-	-	6	95.1	52.5
4/27	4.4	4.8	5.5	-	-	5	93.1	52
4/28	3.7	4.7	5.6	-	-	6	94.3	52.3
5/1	2.9	3.7	4.7	-	-	5	95.7	53
5/2	2.8	3.6	4.5	-	-	6	96.5	53.2
5/3	3.5	3.7	7.4	-	-	3	95.7	53.4
5/4	2.6	3.5	5	2.7	3.8	9	92.8	53.2
5/5	3.6	3.6	16.8	-	-	4	88.7	53
5/8	3.7	4.5	4.7	-	-	3	78.7	53.2
5/9	5.5	5.9	7.1	-	-	4	75.6	53.1
5/11	4.6	4.8	4.9	-	-	2	72.7	53.3
5/12	3.8	5.5	11.8	-	-	4	70	53.4
5/15	3.8	4.2	6.1	-	-	4	68.2	53.8
5/16	3.6	4.6	5.9	-	-	5	71.3	54.5
5/17	3.5	3.8	5.6	3.5	5.6	8	73.1	54.6
5/18	2.8	3.6	4.5	-	-	2	77.3	55.2
5/19	4.4	4.4	4.4	-	-	1	83.3	55.8

TABLE E-6. 2000 travel time of PIT tagged hatchery steelhead released from the Salmon River trap to Lower Granite Dam.

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/6	12.6	16.5	32.7	-	-	5	95	50.8
4/7	28.8	28.8	28.8	-	-	1	96.1	51.7
4/10	4.4	9.6	12.5	-	-	5	96.1	50.6
4/11	4.2	19.8	27.7	4.2	27.7	7	99.3	51.6
4/12	3.4	11.4	26.6	-	-	5	102.3	51.3
4/13	2.6	11.4	38	4.6	20.4	11	104.6	51.6
4/14	8.6	8.6	8.6	-	-	1	105	51.6
4/17	4	6.5	9.2	4.5	7.6	9	105.1	52.1
4/18	2.5	4.4	36.7	3.6	6.5	20	104	52.2
4/19	3.3	4.6	30.8	3.8	5.3	51	107.8	52.8
4/20	2.4	4.5	24.9	3.5	4.7	47	108	53
4/21	2.5	3.8	19.6	3.2	4.7	34	108.5	53
4/24	3	9.4	27	4.4	13.8	19	96.7	52.4
4/25	3.4	8.9	28.5	5.8	11.2	39	95.4	52.5
4/26	2.8	5.7	22.8	4.9	8.8	34	93.9	52
4/27	2.8	4.7	26.1	4.6	5.3	149	93.1	52
4/28	2.8	4.8	32.8	4.7	5.7	110	94.3	52.3
5/1	2.7	4.5	22.8	4.4	4.7	147	95.8	53
5/2	2.5	4.3	22.8	3.6	4.9	71	96.5	53.2
5/3	2.6	3.6	21.6	2.8	17	10	95.7	53.4
5/4	2.4	3.8	20.2	3.5	4.8	41	92.8	53.2
5/5	2.5	5.8	32.8	4.7	9.6	37	86.4	53.1
5/8	2.9	7.9	15.7	4.2	12.3	22	75	53.2
5/9	2.7	5.7	18.8	5.5	9.7	33	75.6	53.1
5/10	2.6	7.4	14.3	4.7	8.7	23	72.8	53.4
5/11	4.5	7.4	17.5	6	9.8	22	71.5	53.5
5/12	4.8	7.7	16.8	6.1	10.6	22	71.1	53.6
5/15	4.7	5.7	9.8	5	8.7	11	71.1	54.3
5/16	2.8	5.4	12.9	4.7	6.1	95	71.3	54.5
5/17	2.6	5.5	20.2	4.9	5.6	90	78.9	55.3
5/18	3.5	5.6	9.5	5.5	5.8	28	82.9	55.7
5/19	2.9	4.8	6	3.6	5.6	10	85.3	56

TABLE E-7. 2000 travel time of PIT tagged wild chinook released from the Snake River trap to Lower Granite Dam.

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/4	9.4	10.2	12.6	9.4	12.6	7	82	49.5
4/5	13.6	13.6	13.6	-	-	1	90.2	50
4/6	4.8	8	9.7	4.8	9.7	8	85.1	49.9
4/7	5.6	7.1	23.5	5.9	17.8	9	84.9	49.9
4/10	3.6	5.2	12.5	4.7	8.5	32	92	50.3
4/11	3.7	7.5	17.4	5.4	9.5	23	97	50.4
4/12	3.4	8.5	13.6	4.4	9.9	15	100.1	51
4/13	2.9	4.3	12.3	2.9	12.3	8	102.1	50.4
4/14	2.4	5.8	15	4.4	6.6	30	102.8	51
4/17	3.7	5.4	15.5	5.1	6.1	59	102.7	51.8
4/18	3.7	5.2	11.5	3.8	7	10	105.9	52.3
4/19	3.4	4.6	15.4	3.6	7.6	14	107.8	52.8
4/20	2.5	4.5	9.4	3.8	5.7	27	108	53
4/21	2.4	5.4	13.5	4.3	7.7	19	106.8	52.8
4/24	2.4	5.4	11.4	4.7	5.6	61	99.2	52.3
4/25	3.4	5	16.7	4.4	5.7	28	95.8	52.2
4/26	2.4	5.6	13.4	4.5	7.1	27	93.9	52
4/27	3.5	4.9	8.4	4.5	6.7	17	93.1	52
4/28	2.8	5.4	8.9	2.8	8.9	8	94.3	52.3
5/1	3.2	3.5	18.7	3.2	6.7	10	95.7	53
5/2	2.7	4.5	8.4	3.3	7.7	11	95.2	53.2
5/3	2.5	4.5	27.6	3.4	5.5	11	93.6	53.3
5/4	3.4	4.2	5.9	-	-	6	92.8	53.2
5/5	2.6	4.6	6.5	3.8	5.5	24	87.2	53
5/8	2.7	4.7	6.5	3	6.5	9	78.7	53.2
5/9	3.6	6	8.5	-	-	2	75.6	53.1
5/10	2.5	4.1	5.8	-	-	4	76.7	53.2
5/11	4.6	5.6	6.5	-	-	2	71.8	53.4
5/12	4.9	6.5	12.6	-	-	3	70.4	53.5

TABLE E-8. 2000 travel time of PIT tagged hatchery chinook released from the Snake River trap to Lower Granite

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/4	8.4	9.5	13.5	-	-	6	82	49.5
4/5	6.5	9.4	12.3	-	-	2	84.5	49.7
4/6	7.5	8.5	25.4	7.6	14.5	9	87.4	50
4/7	4.9	8	14.4	7	8.4	12	87.5	50
4/10	4.3	11.9	28.5	9.2	17.7	33	97.9	51
4/11	3.5	6.6	16.7	4.4	12.4	9	96.5	50.2
4/12	2.6	8	16.4	4.6	12.5	14	99.6	50.8
4/13	2.5	8.6	24.6	6.6	10.6	31	103.1	51.3
4/14	1.8	7.7	26.6	6.9	8.5	118	103.9	51.4
4/17	3.2	7.8	35.3	6.1	9.1	80	104.8	52.2
4/18	1.8	6.6	17.8	5.7	8	49	105.9	52.5
4/19	2.6	7.1	16.7	5.4	12.1	26	105.9	52.8
4/20	1.7	6.4	31.5	5.5	8.5	56	106.6	52.9
4/21	2.4	6.3	17.7	4.5	7.7	46	104.5	52.7
4/24	2.5	7.6	16.7	6.7	8.7	85	96.5	52.2
4/25	3.4	7.4	14.7	6.5	8.5	35	94.9	52.1
4/26	3.3	6.6	15.7	5.6	7.7	45	94.3	52.2
4/27	2.5	5.8	12	5.1	7.2	36	93.8	52.3
4/28	3.6	6.1	16.5	4.8	7.8	31	94.7	52.6
5/1	1.7	5	10.6	4.5	6.6	40	95.8	53
5/2	2.6	5.5	9.5	4.1	5.6	35	93.4	53.1
5/3	2.5	4.6	7.7	4	5.6	33	93.6	53.3
5/4	1.7	4.6	17	3.9	4.9	72	90	53.2
5/5	2.6	5	14.7	4.3	5.7	55	87.2	53
5/8	3.6	6.6	14.2	4.4	10.4	17	76.6	53.1
5/9	2.5	5	8.8	-	-	5	76.6	53.2
5/10	4.4	5	10.6	-	-	6	75.6	53.2
5/11	3.5	3.6	3.8	-	-	5	74.7	53.2

TABLE E-9. 2000 travel time of PIT tagged wild steelhead released from the Snake River trap to Lower Granite Dam.

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/4	2.4	3	10.3	-	-	3	76.5	48.8
4/5	3.4	3.4	3.4	-	-	1	81.9	49
4/6	1.8	3.8	13.5	-	-	5	80.2	49.5
4/7	2.1	7	7.2	-	-	3	84.9	49.9
4/10	2.6	2.7	3.7	2.6	3.7	8	84.3	50
4/11	2.3	3.4	7.9	2.4	3.8	11	91.1	50.2
4/12	2.3	2.4	29.4	-	-	6	94.2	50.3
4/13	1.6	1.8	2	1.6	2	7	103.4	50.7
4/14	1.4	1.7	2.5	1.6	2.1	13	106.3	50.7
4/17	1.6	2.3	3.6	2.3	2.5	35	98.5	50.7
4/18	1.5	1.7	3.5	1.6	2.5	11	101.5	51.7
4/19	1.5	1.7	7	1.5	2.5	11	103.6	52.7
4/20	1.5	1.7	2.4	1.6	2	21	106.9	53
4/21	1.5	1.7	2.4	-	-	4	110.3	53
4/24	1.5	1.8	5.3	1.7	2.4	50	103.4	52.7
4/25	1.6	2.8	16.5	2.4	3.3	21	96.8	52.2
4/26	1.7	2.4	4	2.3	2.5	33	94.9	52
4/27	1.5	2	4.4	1.6	2.5	36	95	52
4/28	1.5	2.5	9.1	2.3	2.6	45	94	52
5/1	1.5	1.7	4.4	1.6	2.2	29	94.2	52.7
5/2	1.7	2.6	3.5	1.8	2.7	13	96.6	53.2
5/3	1.6	2	3.3	1.7	2.4	24	97.9	53.7
5/4	1.4	1.8	3.5	1.6	2.3	31	97.5	53.3
5/5	1.4	2.3	3.4	1.9	2.4	35	94.7	53
5/8	1.5	2.4	3.8	2.2	2.9	12	79.6	53
5/9	1.8	2.6	3.8	1.8	3.8	8	79.1	53.2
5/10	1.6	1.9	4.4	1.7	2.4	9	80.1	53.3
5/11	1.6	3	4.7	2.5	3.5	16	76	53.2
5/12	2.5	2.6	4.3	2.5	3.6	12	72.9	53
5/15	2.7	2.7	2.7	-	-	1	67	53.8
5/16	3.6	3.8	4.1	-	-	2	69.6	54
5/17	1.7	2.6	5.4	1.7	5.4	7	71.4	54
5/18	1.5	1.8	5.1	1.5	5.1	8	72.9	54
5/19	1.6	2.5	3.8	1.8	2.9	15	79.4	55.5
5/22	1.6	1.7	1.7	-	-	4	93.9	57
5/23	1.5	2	4.5	1.6	2.2	15	95.4	57
5/24	1.6	2.3	3.4	2.1	2.6	12	93.2	57
5/25	1.7	2.4	3.8	1.7	3.8	8	90.6	56.5
5/26	1.8	2.2	2.5	-	-	4	89	56

TABLE E-10. 2000 Travel time of PIT tagged hatchery steelhead released from the Snake River trap to Lower Granite Dam.

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/4	2.8	2.8	3	-	-	4	76.5	48.8
4/5	2.3	2.3	2.3	-	-	1	83.1	49
4/6	2.2	3	3.4	-	-	6	80.6	49.3
4/7	2.7	4	7.4	2.9	6.1	10	79.3	49.5
4/10	2.4	3.2	4.5	2.6	3.8	18	84.3	50
4/11	1.9	2.6	4.9	2.4	3.4	17	91.1	50.2
4/12	1.5	2.5	8	2.1	2.7	25	97.9	50.5
4/13	1.4	1.7	2.6	1.6	2.1	19	103.4	50.7
4/14	1.5	1.8	2.8	1.6	1.9	16	106.3	50.7
4/17	1.5	2.3	20.6	2.1	2.5	73	98.5	50.7
4/18	1.4	1.8	5.9	1.7	2.4	21	101.5	51.7
4/19	1.5	1.8	2.9	1.6	2.5	16	103.6	52.7
4/20	1.5	1.8	8.6	1.7	1.8	66	106.9	53
4/21	1.3	1.5	3.8	1.5	1.6	104	110.3	53
4/24	1.3	1.8	23.1	1.7	1.8	111	103.4	52.7
4/25	1.7	2.8	14.7	2.7	2.9	61	96.8	52.2
4/26	1.7	2.6	5.3	2.5	2.7	54	95.8	52
4/27	1.5	1.8	5.8	1.7	2.4	53	95	52
4/28	1.5	2.6	14.5	1.9	2.7	49	94	52
5/1	1.4	1.9	22	1.7	2.4	135	94.2	52.7
5/2	1.8	2.7	7.9	2.5	2.8	60	96.6	53.2
5/3	1.3	1.9	5.2	1.8	2.4	66	97.9	53.7
5/4	1.4	1.7	4.5	1.7	1.8	63	97.5	53.3
5/5	1.4	1.7	3.6	1.7	1.8	61	94.7	53
5/8	1.6	2.5	7.4	2.5	2.6	119	80.2	53.2
5/9	1.6	2.5	11	2.1	2.7	86	79.1	53.2
5/10	1.4	2	11.9	1.8	2.6	95	80.1	53.3
5/11	1.6	3.2	4.7	2.5	3.7	29	76	53.2
5/12	2.5	2.9	13	2.7	3.6	29	72.9	53
5/15	1.9	3.5	8.8	2.9	3.8	42	68.2	53.8
5/16	1.7	3.3	9.5	2.8	4.9	31	67.9	54
5/17	1.6	2.7	9.6	2.6	3	56	71.4	54
5/18	1.4	2.6	9.7	2.2	2.7	177	74.7	54.8
5/19	1.5	2.7	10.2	2.2	2.9	62	79.4	55.5
5/22	1.5	1.8	4	1.7	2	15	93.9	57
5/23	1.4	2	5.8	1.8	2.2	116	95.4	57
5/24	1.6	2.4	6.7	2.2	2.6	71	93.2	57
5/25	1.7	2.6	7.7	2.3	2.7	55	89.7	56.3
5/26	1.7	2.5	3.8	2.4	2.6	25	88.9	56
5/29	1.6	2.3	4	-	-	5	86.9	56

TABLE E-11. 2000 travel time of PIT tagged wild chinook released from the Imnaha River trap to Lower Granite Dam.

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
3/1	35.8	43.2	44.3	-	-	5	59.8	46.7
3/2	31	41.3	50.3	-	-	3	59	46.7
3/3	41.1	41.4	41.7	-	-	2	59.8	46.9
3/4	32.3	35.9	41	-	-	4	57.2	46.6
3/5	38.3	38.3	38.3	-	-	1	59.1	46.9
3/6	36.1	38.1	45	-	-	3	60	47.1
3/7	28.2	38.4	56.4	34.9	48	9	61.2	47.3
3/8	34.4	39.2	39.2	-	-	3	63.5	47.5
3/9	33.3	33.8	34.3	-	-	2	59.1	47.2
3/10	31.2	34.2	35.5	-	-	4	60.3	47.3
3/11	32.1	33	34	-	-	2	60.5	47.4
3/12	33.1	33.1	33.1	-	-	1	62	47.6
3/13	30.3	31.2	32.1	-	-	2	61	47.5
3/14	22.7	31.4	38.3	-	-	5	62.7	47.6
3/15	22.7	30.9	46.3	28.2	41.1	14	64.5	47.7
3/16	29.1	29.1	29.1	-	-	1	63.5	47.6
3/17	26.2	27.9	30.7	-	-	6	63.9	47.7
3/18	22.8	27.4	43	25.2	33.2	17	64.2	47.7
3/19	18.6	28.6	33.2	25.2	32.2	10	68.6	48.1
3/20	23.3	25.1	36.3	24.1	32.8	17	65.5	47.9
3/21	22.1	25	38	22.2	33.4	10	67.7	48.1
3/22	15.6	23.6	29	20.6	27.7	10	68.5	48.2
3/25	12.5	19.9	30.9	19.1	21.2	28	69.4	48.4
3/26	8	19	33	18.1	20.9	23	70.2	48.5
3/27	11.9	17	33	15.1	18.7	15	69.3	48.5
3/28	5.7	17.4	35	16.9	19.1	100	72.4	48.7
3/29	8.2	17.2	36.2	16.6	19.2	172	75.5	49
3/31	8.1	16.9	33.5	15.3	21.2	27	80.1	49.3
4/1	11.2	13.6	35.7	12.3	21.1	17	79.1	49.3
4/2	10.8	12.6	32.4	-	-	5	80.7	49.4
4/3	8	12.6	29.1	11.5	15.1	35	84.2	49.5
4/4	6	16.4	30	11.2	17.3	38	89.2	50.1
4/5	7.3	15.8	32.9	12.9	19	52	91.9	50.4
4/6	7.3	14.1	24.9	8.6	24.6	9	92	50.4
4/7	6.2	16.4	31.2	14.2	19.3	40	95.5	50.9
4/8	5.9	18.4	36.3	11.5	22.4	27	97.4	51.3
4/9	7.3	15.9	23.2	9.7	21.2	13	98.5	51.4
4/10	6.2	13.8	28.8	10.7	19.7	18	99.8	51.3

TABLE E-11. 2000 travel time of PIT tagged wild chinook released from the Imnaha River trap to Lower Granite Dam.

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/11	4.4	14.2	28.2	10	19.1	19	101.4	51.5
4/12	2.9	11.1	27.6	8.3	14.2	21	102.3	51.3
4/13	8.9	12.4	18.2	-	-	4	104.5	51.7
4/14	10.4	10.4	10.4	-	-	1	105.4	51.7
4/15	8.7	12.5	17.9	8.7	17.9	7	102.9	51.9
4/16	6.7	15	23.7	13.3	16.7	40	100.8	52
4/17	7.5	14.8	21	11.6	16.5	22	100	52.1
4/19	6.6	10.4	20.6	-	-	6	103	52.5
4/20	8	8	8	-	-	1	103.6	52.7
4/21	5.2	10.2	17.4	8.2	12.4	12	100.7	52.5
4/22	5.9	9.8	28.4	9	12.1	18	99.6	52.4
4/24	6.1	10.6	26.6	9	14.3	14	96.9	52.6
4/25	6.3	9.2	13.8	7.5	10.7	15	95.4	52.5
4/26	4.4	8.5	24.1	7.4	10	23	95.1	52.5
4/27	6.2	7.1	26.8	6.3	10.1	15	94.2	52.5
4/29	4.5	8.2	21	7.1	11.1	38	94.6	52.8
5/1	5.3	7.7	12.1	6.1	9.3	14	91.4	53
5/2	4.2	6.4	22.1	5.9	8.1	20	93.4	53.1
5/3	4	8.1	16.3	4.7	15.2	13	88.8	53.3
5/4	6.1	7	15.5	6.1	15.5	8	87.7	53.2
5/5	13.1	13.2	14.4	-	-	4	78.2	53.3
5/8	10.3	13.1	14.4	-	-	4	74.3	53.7
5/9	7	9.4	16.2	-	-	6	72.8	53.4
5/10	7.5	9.6	11.7	-	-	2	72.9	53.5
5/11	6.4	11.7	16.2	6.9	14.4	10	76	54.4
5/16	5.2	7.1	10.1	-	-	3	76.8	55.1
5/17	5.6	6.4	7.1	-	-	4	78.9	55.3
5/18	4.1	7.7	18.8	-	-	6	85	55.9
5/22	3.8	6.2	9.7	-	-	5	91.5	56.7
5/23	3.3	4.1	7.4	-	-	5	93.2	56.8
5/25	6.3	6.6	8.8	-	-	3	87.7	56.1
5/26	6.4	6.4	6.4	-	-	1	87.1	56
5/31	7.5	8	8.5	-	-	2	79.4	57.3
6/1	13	20	22.4	-	-	3	71.6	58.2
6/5	15.7	22.5	29.4	-	-	2	63.4	60
6/6	11.4	18	20.3	-	-	3	67.2	59.4
6/12	9.6	15.8	50.2	-	-	6	57.9	60.1
6/13	11.4	16.3	20.9	-	-	5	56.5	60.5
6/14	8.6	12.8	25.4	-	-	6	57.8	60.1
6/15	7.8	11.2	14.6	-	-	2	57.3	60

TABLE E-12. 2000 travel of PIT tagged hatchery chinook released from the Imnaha River trap to Lower Granite Dam.

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
3/25	15.3	31.2	44.4	30.1	33.4	131	81.7	49.7
3/28	10.1	32.6	42.2	30.2	34.2	74	86.2	50.3
3/29	13.4	33.2	37.5	30.1	34.2	40	87.4	50.5
3/31	29	29	29	-	-	2	89.1	50.6
4/3	11.6	28.7	44.4	26.4	30.6	85	92.6	51
4/4	11.3	27.8	37.7	21.9	31.8	25	93.6	51.1
4/5	6.3	27.8	37.7	25.7	29.1	58	95	51.3
4/6	14	27.6	28.5	-	-	4	95.6	51.5
4/8	17.9	17.9	17.9	-	-	1	97.4	51.3
4/11	13.7	23.7	30.6	21.3	27.3	30	98.9	51.9
4/12	9	24.2	33.4	19.6	27.3	28	99.5	52
4/13	6	22	29.1	16.1	26.2	18	100.4	52
4/14	8.9	22.4	31.2	20.9	25.2	30	100.4	52.2
4/15	8.3	20	34.9	18	25.2	20	100.4	52.2
4/16	12.1	21.1	32.2	18.2	24.2	26	99.2	52.3
4/20	8.1	19.6	32.1	17.6	22	34	96.3	52.8
4/21	4.2	19.2	32.6	16.4	24	36	95.9	52.8
4/22	4	16	28.2	13.6	21.3	35	97.5	52.7

TABLE E-13. 2000 travel of PIT tagged wild steelhead released from the Imnaha River trap to Lower Granite Dam.

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/5	3	6.4	20.3	4.4	9.1	24	80.3	49.3
4/6	4.4	5.2	28.5	4.4	28.5	7	80.5	49.6
4/7	3.4	11	26.4	7	25.2	10	90.5	50
4/8	4.3	5.4	23.6	4.3	23.6	8	81.7	49.8
4/9	4	4	5.3	-	-	3	82.3	50
4/10	4.7	5.1	5.5	-	-	2	92	50.3
4/11	2.9	4.8	29	3	25.2	9	96.3	50.3
4/12	2.6	9.2	21.9	-	-	6	100.1	51
4/13	2.6	4.4	26	3.3	8.9	10	102.1	50.4
4/14	3.4	6.4	19.4	3.4	19.4	8	102.8	51
4/15	2.5	5.9	34.9	4.8	7.9	20	102.6	51.3
4/16	4.3	6.5	39.5	5.9	7.4	36	104.5	51.8
4/17	3.7	5.6	18.8	4.8	6.6	32	104.5	52
4/19	2.8	4.8	18.6	4.1	6.8	24	107.8	52.8
4/20	2.6	4.1	11.5	3.6	4.7	29	109.1	53
4/21	2.2	4	33.1	3.5	4.6	43	108.5	53
4/22	2.3	5.3	18.8	4.1	8.8	31	104.5	52.7
4/24	3.6	7.7	29.9	6.7	8.4	51	96.5	52.2
4/25	3.4	5.6	11.6	4.4	6.3	30	95.3	52.1
4/26	2.7	4.6	6.5	3.6	5.3	23	94.1	52
4/27	2.6	4.4	18.7	3.8	4.8	33	93.3	52
4/29	2.8	4.9	21	4.6	5.5	123	94.5	52.7
5/1	2.8	3.8	9.5	3.7	4	67	95.7	53
5/2	2.3	3.8	35.9	3.5	4.1	176	96.5	53.2
5/3	2.4	3.8	15.5	3.7	4.4	210	95.7	53.4
5/4	2	4.8	21.3	4	5.7	148	90	53.2
5/5	2.6	3.9	19.9	3.6	5.8	29	88.7	53
5/8	3.6	4.7	18.4	4.6	6.5	43	78.7	53.2
5/9	3.1	5.6	13.8	4.7	5.7	64	75.6	53.1
5/10	2.6	4.9	20.9	4.7	5.4	71	75.6	53.2
5/11	3.6	5.3	16	4.9	6.5	86	72.7	53.3
5/15	3	4.5	16.3	4.2	4.8	65	69.6	53.8
5/16	2.6	4.3	25.7	3.9	4.7	124	69.6	54
5/17	2.7	3.9	31.5	3.8	4.3	107	73.1	54.6
5/18	2.7	4.7	11.3	4.5	4.8	145	80.9	55.5
5/19	3.1	4.4	7.6	3.9	4.8	32	83.3	55.8
5/22	1.8	3	30.1	2.8	3.1	79	93.5	57
5/23	2.7	3.6	9.4	3.4	4.7	43	93.2	56.8
5/24	2.7	4.1	7.7	3.7	4.6	33	90.8	56.5
5/25	2.9	3.7	14.6	3.5	4.1	26	89.6	56.2
5/26	3	3.7	5.1	3.2	4.1	9	88.4	56
5/31	3.3	5.8	7.8	4.7	7.4	9	77.9	56.3
6/1	3.9	5.1	26.5	3.9	26.5	7	76.7	56.3

TABLE E-14. 2000 travel of PIT tagged hatchery steelhead released from the Imnaha River trap to Lower Granite Dam.

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/13	5.2	15.3	43.7	6.7	23.5	12	102.7	51.8
4/14	4.6	21.3	85.3	5.9	35.4	19	100.6	52.1
4/15	2.2	21	50.4	19.8	23.9	55	100.2	52.2
4/16	5.1	21.4	99.5	19.6	28.9	110	99.2	52.3
4/17	4.8	6.8	42.6	4.9	18.9	12	105.1	52.1
4/19	2.6	15.1	47.8	7	16.8	30	100	52.6
4/20	2.6	6.2	51.5	5	8.3	153	106.6	52.9
4/21	1.8	8.9	68.2	6.7	11.6	160	101.5	52.5
4/22	2.3	3.8	38.9	3	14.1	27	107.3	52.8
4/24	2.9	16.7	72.4	14.1	18.6	275	92.7	52.8
4/25	3.4	11.5	60.6	10.5	13.8	102	95.2	52.6
4/26	2.6	9.6	80.8	7.8	10.5	76	95.2	52.5
4/27	2.7	7.9	26.5	5.5	10.9	36	94.7	52.6
5/1	3.2	4.6	38.2	4	4.9	70	95.8	53
5/2	2.3	4.4	27.6	4.3	4.7	123	96.5	53.2
5/3	2.2	4.9	28.2	4.6	5.8	339	93.6	53.3
5/4	2	6.2	26.8	5.1	9.8	78	88.5	53.1
5/8	2.8	7.1	23.2	6.8	7.9	151	76.6	53.1
5/9	2.7	6.2	45	6	7	140	75.6	53.1
5/11	3	7.5	48.2	7	8	259	71.7	53.6
5/15	2.8	5.1	23.1	4.9	5.5	266	69.6	53.8
5/16	2.9	5	13.1	4.7	5.3	129	71.3	54.5
5/17	2.6	4.3	24.5	4	4.8	125	73.1	54.6
5/22	1.6	2.8	43.2	2.7	2.8	441	93.5	57

TABLE E-15. 2000 travel of PIT tagged wild chinook release from the Grande Ronde River to Lower Granite Dam.

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
3/27	15.4	18.1	33	-	-	4	71.2	48.7
3/28	7.6	16.7	24.5	13.7	22.7	10	72.4	48.7
3/29	13.5	15.8	24.2	14.5	23.5	10	73.5	48.9
3/30	12.5	15.2	17.4	12.5	17.4	8	74.4	48.9
3/31	13.4	15.7	32.7	13.7	22.3	19	79.2	49.2
4/3	7	10.5	11.9	7.4	11.7	11	80.4	49.4
4/4	6.1	11.1	20	9.7	17.4	20	84.2	49.6
4/5	7.4	9.7	19	8.4	14	17	86.7	49.8
4/6	7	9.5	18.2	7.1	16.8	10	89	50
4/10	4.7	12.1	17.3	-	-	5	97.9	51
4/11	4.1	9.1	22.4	5.6	10.6	19	97.8	50.7
4/12	3.6	9.4	18.4	5.7	11.4	20	100.1	51
4/13	2.6	8.4	18.7	7.7	12.3	24	102.2	51.1
4/14	23.2	23.2	23.2	-	-	1	99.9	52.2
4/18	4.5	6.4	25.6	-	-	6	106.4	52.4
4/19	4.4	5.8	9.7	5.1	8.6	15	107	52.9
4/20	3.4	8.1	19.3	5.8	9.4	30	103.6	52.7
4/21	3.8	7.7	16.4	6.6	9.5	20	102.9	52.6
4/24	4.6	8.4	14.4	6.6	10.5	15	96.5	52.2
4/25	3.4	6.6	13.6	5.5	7.7	26	94.9	52.1
4/26	3.4	6.6	15.1	5	9.4	22	94.3	52.2
4/27	3.7	5.6	10.5	4.5	7.7	14	93.8	52.3
5/1	2.5	4.6	7.7	3.4	5.1	20	95.8	53
5/2	2.6	4.1	6.5	3.5	5.2	23	96.5	53.2
5/3	2.6	4.6	11.4	3.9	5.6	36	93.6	53.3
5/4	5.4	5.4	5.4	-	-	1	90	53.2
5/8	4	5.2	6.5	-	-	2	78.7	53.2
5/9	4.5	5.1	7.8	-	-	3	76.6	53.2
5/10	4.5	5.4	5.8	-	-	3	75.6	53.2
5/11	4.6	7.2	14	4.6	14	8	71.5	53.5
5/12	4.7	6.6	12.7	-	-	6	70.4	53.5
5/22	2.7	3.6	4.4	-	-	2	93.3	57
5/23	3.2	4.5	5.7	3.7	5.2	19	92.2	56.6
5/24	2.6	3.7	4.6	-	-	6	90.8	56.5
5/25	6	6	6	-	-	1	88.5	56.2
5/26	3.7	4.8	5.3	-	-	4	87.9	56
5/29	4.2	4.2	4.2	-	-	1	83.8	55.8
5/30	3.3	3.3	3.7	-	-	3	82.5	55.8
5/31	8.5	24.2	40	-	-	2	69.5	58.6
6/1	20.6	20.8	21	-	-	2	70.8	58.3

TABLE E-16. 2000 travel of PIT tagged hatchery chinook release from the Grande Ronde River to Lower Granite Dam.

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/4	13.6	24.5	34.8	-	-	4	93.9	51
4/5	7.7	27.9	30.4	9.3	30.3	9	95	51.3
4/6	14.3	26.6	33.3	18.2	31.9	14	95.6	51.4
4/7	5.6	27.8	32.6	18.8	31.5	12	96.1	51.6
4/10	15.3	26.4	33.4	24.4	30.4	14	98	51.9
4/11	5.7	23.4	30.4	13.3	27.9	13	98.9	51.8
4/12	9.6	21.6	45.8	18.6	25.4	20	99.6	51.9
4/13	9.5	19.9	22.5	-	-	6	100.6	51.9
4/14	6.4	18.4	25.6	6.4	25.6	7	101	51.9
4/17	4.7	23.6	24.5	-	-	3	96	52.6
4/18	7.6	13	16.6	-	-	4	100.8	52.3
4/19	5.4	10.8	21.4	-	-	6	101.8	52.5
4/20	5.5	14.4	31.7	12.5	26.2	13	100	52.7
4/21	4.4	19.1	31.4	14.6	24.7	24	95.9	52.8
4/24	5.6	14.6	26.4	13.9	16	26	94.2	52.7
4/25	4.5	15.3	26.4	11.4	19.2	29	92.3	52.7
4/26	4.5	12.4	22.4	8.7	16.6	17	93.7	52.6
4/27	11.4	11.4	11.4	-	-	1	93.4	52.7
5/1	3.4	7.4	21.5	6.4	9.4	37	93.3	53
5/2	3.4	6.4	18.8	5.6	8.4	31	93.4	53.1
5/3	2.4	6.5	22.6	5.6	7.4	61	89.7	53.2
5/4	3.5	8	19.5	7.4	9.7	77	86.7	53.2
5/5	2.7	7.7	22.6	6.9	9.6	51	84	53.1
5/8	3.4	7.9	14.5	5.2	10.7	10	75	53.2
5/9	5	6.7	11.6	5	11.6	8	74	53.2
5/10	6	7.6	10.9	-	-	6	72.4	53.4
5/11	4.3	7.8	10.3	6	8.7	18	71.7	53.6
5/12	3.7	7.3	12.5	5.7	8.4	15	70.4	53.5
5/18	2.4	3.6	6.5	2.6	6.4	10	77.3	55.2
5/19	2.6	5.5	7.4	3.6	6.6	9	86.3	56.1

TABLE E-17. 2000 travel time of PIT tagged wild steelhead release from the Grande Ronde River to Lower Granite Dam.

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/5	2.5	6.1	17.5	4.8	6.6	57	80.3	49.3
4/6	4.8	6.6	13.5	4.8	8.3	10	82.5	49.7
4/10	3.4	5.4	30.5	-	-	5	92	50.3
4/11	2.5	4.3	45.3	2.9	5.4	14	94.7	50.4
4/12	2.5	2.8	14.3	2.6	4.4	22	97.9	50.5
4/13	1.7	2.8	5.8	2.6	3.7	26	103.6	50.5
4/14	2.5	4.4	18.5	2.9	5.4	27	102.6	50.4
4/17	2.3	3.4	5.4	2.8	4.3	22	100.2	51.2
4/18	1.7	2.7	10.3	2.6	3.4	27	102.2	52
4/19	2.4	3.1	23.2	2.6	3.5	29	105.5	52.8
4/20	2.4	2.8	11.6	2.4	3.4	21	109	53
4/24	2.1	2.8	29.6	2.6	3.7	40	100.1	52.5
4/25	2.6	3.4	6.4	3.1	3.6	25	96.8	52.2
4/26	2.4	2.7	6.6	2.5	3.6	21	95.8	52
4/27	2.4	2.7	10.1	2.4	10.1	8	93.5	52
4/28	2.4	2.8	3.1	-	-	2	94	52
5/1	2.1	2.7	3.7	2.5	3	13	94.8	53
5/2	2.3	2.6	3.4	2.3	2.7	10	96.6	53.2
5/3	1.8	2.6	19.6	2.5	2.7	40	97.5	53.5
5/4	1.7	2.5	4.8	2.4	2.6	36	95.2	53.2
5/5	2.2	2.2	2.2	-	-	1	94.7	53
5/8	2.4	3.1	5.7	2.6	3.7	13	80.2	53.2
5/9	2.3	3	15.2	2.5	8.9	11	79.1	53.2
5/10	2.2	2.7	4.1	2.5	3.6	11	78.2	53.2
5/11	2.5	3.7	12.7	3.5	4.5	41	74.7	53.2
5/12	2.5	5.1	8.5	2.8	7	13	70.2	53.3

TABLE E-18. 2000 travel time of PIT tagged hatchery steelhead from the Grande Ronde River to Lower Granite Dam.

	Travel Time			Confidence Limits		Lower Granite		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/10	2.6	3.9	19.7	3.2	4.5	37	88.6	50.2
4/11	2.2	3.7	41.5	3.4	4.5	51	94.7	50.4
4/12	2.2	3.1	22.8	2.7	3.4	43	97.9	50.5
4/13	1.6	2.9	20.8	2.6	3.4	35	103.6	50.5
4/14	1.9	4.4	53.2	3.6	5.4	124	102.6	50.4
4/17	2.4	6.4	114.9	4.6	11.1	105	104.5	52
4/18	1.8	2.9	39.7	2.6	4	51	102.2	52
4/19	2	3	38.7	2.7	3.8	66	105.5	52.8
4/20	2.1	3.6	33.7	2.6	8.7	48	109.1	53
4/21	1.4	2.8	20.4	2.4	5.8	33	110.1	53
4/24	1.6	3.1	26.8	2.9	3.5	162	100.1	52.5
4/25	2.6	3.7	34.2	3.5	3.9	75	97.2	52.2
4/26	2.4	2.8	21.5	2.7	3.6	58	95.8	52
4/27	2.4	3.4	14.8	2.6	4.3	29	93.5	52
5/1	1.6	2.7	13.6	2.5	3.4	15	94.8	53
5/2	2.1	2.7	4.9	2.5	4.4	11	96.6	53.2
5/3	1.7	2.6	12.2	2.4	2.7	31	97.5	53.5
5/4	1.5	2.3	7.7	1.7	2.4	71	97.5	53.3
5/5	1.8	3.2	4.5	-	-	4	91.8	53
5/8	2.4	2.8	19.5	2.6	3.7	36	80.2	53.2
5/9	2.4	3	17.4	2.8	3.6	32	79.1	53.2
5/10	1.6	3.4	16.3	2.8	4.8	28	78.2	53.2
5/11	2.5	3.9	27.7	3.6	4.1	81	74.7	53.2
5/12	2.5	4.6	17.1	3.8	5.7	61	70.2	53.3
5/15	2.7	3.2	3.6	-	-	4	67	53.8
5/16	2.6	3.2	7	-	-	4	67.9	54
5/17	2.6	5	7.5	-	-	2	75.6	55
5/18	2.6	3	4.3	-	-	6	74.7	54.8
5/19	2.5	3.6	5.6	3.2	3.8	48	83.3	55.8
5/22	1.6	1.9	3.2	-	-	6	93.9	57
5/23	1.6	2.6	5.6	2.4	2.7	100	94.7	57
5/24	1.8	2.8	5	2.6	3.6	59	91.7	56.7
5/25	2.7	3.1	3.4	-	-	6	89.7	56.3
5/26	2.4	2.7	4.8	2.4	4.5	11	88.9	56
5/29	3.8	3.8	3.8	-	-	1	83.8	55.8
5/31	2.3	3.3	3.9	-	-	3	79.1	55.5
6/1	3.1	15.6	28.2	-	-	2	74.6	58.2

TABLE E-19. 2000 travel time of PIT tagged yearling chinook released from Rock Island Dam to McNary Dam

	Travel Time			Confidence Limits		Priest Rapids		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/21	9.2	24.9	46.2	21.3	30.5	18	189.1	NULL
4/22	12.4	26.2	42.3	-	-	4	187.7	NULL
4/23	15.9	27.1	42.3	21.5	40.5	11	184.8	NULL
4/24	9	19.9	39.4	9	39.4	8	187.7	NULL
4/25	7.6	15.5	22.1	-	-	5	189.9	NULL
4/26	7.7	13	17.1	-	-	5	187.1	NULL
4/27	11.2	15	69.9	11.2	69.9	7	185.1	NULL
4/28	9.1	17.1	19.7	-	-	3	181.8	NULL
4/29	11.3	16.2	21.2	-	-	2	180.3	NULL
4/30	11.6	22.4	29.5	13.2	28.6	12	177.2	NULL
5/1	7.5	10.8	23.4	8.1	17.5	9	183	NULL
5/2	5.2	14.4	54	11.2	17.9	31	179.7	NULL
5/3	5	12.9	78.7	10.7	19.4	48	178.4	NULL
5/4	6.1	19	50.7	15.2	25	23	174.7	NULL
5/5	7.3	15.6	48.3	12.1	18.5	20	172.8	NULL
5/7	5.9	13.4	48.5	10.5	15.7	28	174.5	NULL
5/8	7.3	13.5	30.4	9.2	15.4	23	173.5	NULL
5/9	6.2	13.1	26.4	11.7	15.9	21	172.8	NULL
5/10	6.6	14.3	32.8	9.8	19.8	20	172.1	NULL
5/11	7.7	12.1	43.6	8.8	17.9	20	171.1	NULL
5/12	6.1	11.3	47.9	8.9	16.3	19	170.4	NULL
5/13	5	13.4	21.6	8.3	18.9	13	164.8	NULL
5/14	6.1	10.8	39.1	8.9	13.7	20	167.2	NULL
5/16	6	12.9	36.3	8.8	15.6	20	152.8	NULL
5/17	8.2	12.6	45.6	10.1	19.1	14	150.6	NULL
5/18	6.8	10	18.5	8.4	10.7	15	152.8	NULL
5/19	5.6	9.9	34.9	9.3	11.7	28	147.3	NULL
5/21	5.6	11.9	17.8	5.6	17.8	7	140.4	NULL
5/22	5.8	10.6	31.8	8	15.5	12	140.7	NULL
5/23	5.7	11.6	19.3	8.7	15.8	17	135.4	NULL
5/24	8.3	12.9	35.2	8.8	29.1	9	133.8	NULL
5/25	8	11.7	42.5	8.8	23.6	17	131.2	NULL
5/26	6.7	10.6	43.9	-	-	5	130.4	NULL
5/27	8.8	10.4	41.1	9.4	31.7	9	130.9	NULL
5/28	7.1	10.8	39.5	8.3	31	9	132.7	NULL
5/29	5.7	9.2	17.7	7.4	16.1	9	135.8	NULL
5/30	7.3	17.2	37.3	7.3	37.3	8	131.4	NULL
5/31	6	23.8	31.1	-	-	5	131.7	NULL
6/1	9.4	15.6	27.6	-	-	5	127.6	NULL
6/2	18.6	23	25.1	-	-	4	130	NULL

TABLE E-20. 2000 travel time of PIT tagged subyearling chinook released from Rock Island Dam to McNary Dam.

	Travel Time			Confidence Limits		Priest Rapids		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
6/19	7.1	9.7	23.8	-	-	6	145.4	NULL
6/20	6	10.5	16.7	-	-	6	143.5	NULL
6/21	6.9	16	35.7	6.9	35.7	8	138.6	NULL
6/22	6.7	12.4	26	6.7	26	8	133.8	NULL
6/23	8.5	19.7	36.8	8.5	36.8	7	136.3	NULL
6/24	7.7	13.8	47.3	9.3	25.8	10	138.5	NULL
6/25	6.7	16.9	36.1	12	33.6	11	136.2	NULL
6/26	11	14.5	51.9	12.1	33.7	14	137.1	NULL
6/27	7.4	17.7	37.9	7.4	37.9	8	136.3	NULL
6/28	9.7	25.1	38.8	16.5	29.6	25	129.2	NULL
6/29	8	22.4	33.7	9.5	28.8	16	130.4	NULL
6/30	9.1	22	41.4	18	26.9	33	128.7	NULL
7/1	8.7	26.8	42	17.4	28.1	25	126.6	NULL
7/2	9.2	25.5	37.8	18.5	28.7	17	127.3	NULL
7/3	13	27.4	34.6	24.8	29.7	18	128	NULL
7/4	6	23.4	34	15	27.5	15	129.8	NULL
7/5	13.3	26.8	88.1	19.5	28.5	12	130.8	NULL
7/6	5.8	21.4	36	19.8	23.5	42	130.2	NULL
7/7	7.2	20.1	32.7	18.3	21.4	63	128.4	NULL
7/8	12.9	19.7	32.2	18	23	31	125.9	NULL
7/9	9.6	20.4	33.3	18.9	23.3	21	123.9	NULL
7/10	13	21.8	32	18	24	24	127.9	NULL
7/11	13.9	17.8	37.8	14.9	30.5	11	125.6	NULL
7/12	8.9	19.8	40.3	14.4	28.2	16	127.4	NULL
7/13	10.9	15.6	22.2	-	-	5	123.5	NULL
7/14	10.9	20.9	27.9	10.9	27.9	8	126.5	NULL
7/15	10.7	21.7	30.1	13	27	9	125	NULL
7/16	10.4	17.4	30	12.9	20.3	15	125.9	NULL
7/17	11.7	18.6	26	13.8	24.1	13	128	NULL
7/18	6.8	20.9	29.8	10.8	24.9	14	127.5	NULL
7/19	7.7	18.5	40.8	12.6	23.9	24	126.5	NULL
7/20	6.7	21	38.7	12.9	22.6	31	129.4	NULL
7/21	6	19.8	38.9	17.1	21.3	40	129.2	NULL
7/22	6	21	53.6	19	22	38	129.9	NULL
7/23	6.6	21.8	40.3	12.2	26.6	31	130	NULL
7/24	6.9	20.2	95.8	16	26	28	131.9	NULL
7/25	6.9	19.8	56	16.9	22.8	43	132	NULL
7/26	6.8	13.3	55.9	8.9	26.4	16	129	NULL
7/27	5.6	13.2	36.1	6.7	18	15	131.4	NULL
7/28	6.6	17.1	34	12.1	24.1	24	132.7	NULL
7/29	5	16	37.3	11.1	21.1	25	133.2	NULL
7/30	6.9	10.9	40.5	9.8	17.1	27	136	NULL
7/31	6.9	11.2	42.9	8.8	14	28	138	NULL

TABLE E-20. 2000 travel time of PIT tagged subyearling chinook released from Rock Island Dam to McNary Dam.

	Travel Time			Confidence Limits		Priest Rapids		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
8/1	5.7	11	29.1	9.1	16.8	32	136.1	NULL
8/2	4.9	9.3	51	8	12.7	50	134.3	NULL
8/3	5.4	10.4	55.5	7.9	14.4	34	132.5	NULL
8/4	4.8	11.5	94.8	8.1	13.9	33	133.8	NULL
8/5	4.4	11	32.8	9.1	13	35	134.2	NULL
8/6	7.2	10.1	32.8	8.7	19	17	135.5	NULL
8/7	8.9	13	89.7	10	18.2	12	127.8	NULL
8/8	8	13.6	88.5	9.1	24.3	10	124.5	NULL
8/9	6.7	11.7	23.3	8.3	17.8	13	124.3	NULL
8/10	6.3	11.4	23.8	8.1	13.6	16	121.4	NULL
8/11	6.1	8.1	23.2	6.8	11.1	11	128.2	NULL
8/12	6.9	13.1	85.1	10.9	18.9	9	108	NULL
8/13	8	16.4	84.2	-	-	6	102.3	NULL
8/14	8.2	14.8	69.2	8.2	69.2	7	101.9	NULL
8/15	8.2	23.1	66.3	8.2	66.3	7	96.2	NULL
8/16	8.8	12.8	71.1	10.8	37.3	13	96.2	NULL
8/17	9.5	22.6	78.1	-	-	5	90.4	NULL
8/18	16.4	19.1	55.8	-	-	3	90.2	NULL
8/19	14.9	21.3	79	-	-	5	86	NULL

TABLE E-21. 2000 travel time of PIT tagged steelhead released from Rock Island Dam to McNary Dam.

	Travel Time			Confidence Limits		Priest Rapids		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/21	5.7	5.8	6	-	-	2	208.8	NULL
4/22	4.4	4.8	5.2	-	-	2	212.5	NULL
4/23	4	5.9	7.9	-	-	5	203.2	NULL
4/24	3.9	5.5	9.1	3.9	9.1	7	200.7	NULL
4/25	6.3	7.9	10.3	-	-	3	197.5	NULL
4/26	5.9	5.9	5.9	-	-	1	192.8	NULL
4/27	5.3	5.6	6	-	-	2	191.5	NULL
4/28	5.1	7	10.4	-	-	5	190	NULL
4/29	6	6.6	6.9	-	-	4	185.3	NULL
4/30	4.8	6	10.5	-	-	5	187	NULL
5/1	4.9	6.6	7.7	-	-	4	183.5	NULL
5/2	4.7	5.8	6.9	-	-	4	182.6	NULL
5/3	4.2	5.6	11.1	5.3	7.5	17	181.4	NULL
5/4	4.3	6.4	7.4	4.3	7.4	7	181.5	NULL
5/5	7.1	8.1	9.4	-	-	5	179	NULL
5/6	5	6.9	11.2	5.4	7.9	11	177.7	NULL
5/7	5	6	8.9	5.5	6.6	12	178.8	NULL
5/8	3.9	5.4	9.3	4.9	6.3	31	181.3	NULL
5/9	3.2	4.8	6.7	4.3	5.7	16	178.3	NULL
5/10	4.4	4.8	11.2	4.5	5.4	10	174.5	NULL
5/11	4.1	4.8	9.4	4.5	7	13	173.2	NULL
5/12	4.8	6.9	14.7	5.8	11.7	9	171.2	NULL
5/13	4.7	7.6	11.7	4.7	11.7	8	167.1	NULL
5/14	6.5	9	11.3	-	-	6	169.7	NULL
5/15	4.6	6.4	8.7	4.6	8.7	8	166	NULL
5/16	4.6	5.6	7.6	-	-	6	169.1	NULL
5/17	4.2	5.4	6.6	4.2	6.6	7	167.1	NULL
5/18	4.4	6.7	7	-	-	5	166.6	NULL
5/19	5.2	6.3	13.8	5.6	10.2	11	165.2	NULL
5/20	4.6	6.8	13.6	4.7	8.7	11	152.6	NULL
5/21	9.8	11.4	13	-	-	2	143.3	NULL
5/22	6.2	10.2	11.3	6.2	11.3	7	143.9	NULL
5/23	5.5	7.3	14.8	5.6	8.2	9	138.2	NULL
5/24	5.7	6.8	8.6	-	-	4	135.4	NULL
5/25	7.5	12.4	13.5	-	-	4	131.2	NULL
5/28	6	8.4	10.7	-	-	2	131.3	NULL
6/1	9.6	9.9	10.1	-	-	3	124	NULL
6/2	5.8	5.8	5.8	-	-	1	132.1	NULL

TABLE E-22. 2000 travel time of PIT tagged sockeye released from Rock Island Dam to McNary Dam.

	Travel Time			Confidence Limits		Priest Rapids		
Release Date	Min	Med	Max	Lower	Upper	Number	Flow	Temp
4/21	5.7	5.7	5.7	-	-	1	208.8	NULL
4/22	10.2	30.7	47.6	-	-	3	184.8	NULL
4/23	5.1	7.8	36.5	5.1	36.5	7	200.1	NULL
4/24	7.3	7.8	8.3	-	-	2	199	NULL
4/25	7.3	12.5	41	8.1	24.3	9	190.8	NULL
4/26	7.3	18.6	44.2	-	-	5	183.3	NULL
4/29	38.9	38.9	38.9	-	-	1	161.2	NULL
4/30	6.6	7	47.3	-	-	3	184.2	NULL
5/1	9.5	18	26.5	-	-	2	178.7	NULL
5/2	5.5	5.5	5.5	-	-	1	182.6	NULL
5/5	7.9	7.9	7.9	-	-	1	179	NULL
5/6	5.6	5.6	5.6	-	-	1	178	NULL
5/7	9.6	9.6	9.6	-	-	1	175	NULL
5/8	6.2	6.2	6.2	-	-	1	179	NULL
5/13	7.2	22.9	38.6	-	-	2	150.1	NULL
5/14	10	24.2	38.3	-	-	2	148.5	NULL
5/15	6.9	11.9	16.9	-	-	2	159.8	NULL
5/16	10.8	10.8	10.8	-	-	1	159.3	NULL
5/17	6.8	6.8	14.6	-	-	3	169.2	NULL
5/18	5.2	5.2	5.2	-	-	1	170.6	NULL
5/19	12.9	13.4	13.8	-	-	2	147.2	NULL
5/20	15.7	15.7	15.7	-	-	1	141.3	NULL
5/21	10.4	10.4	10.4	-	-	1	144.5	NULL
5/24	9.8	9.8	9.8	-	-	1	131.9	NULL
5/25	22.3	22.3	22.3	-	-	1	129.1	NULL
5/27	8.7	8.7	8.7	-	-	1	129.4	NULL
5/29	7.5	7.5	7.5	-	-	1	135.1	NULL

TABLE E-23. 2000 travel time of PIT tagged yearling chinook released in the Snake River basin in the reach 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
04/11	9.1	11.2	22.5	9.9	22.3	11	104.8	50.8
04/12	8.1	10.8	19.6	9.6	12.3	14	107.4	51
04/13	7.5	11.5	24.3	10.3	13	36	109.5	51.2
04/14	8.4	12.2	29.1	11.5	13	122	109.2	51.3
04/15	7.5	12.7	39.4	12.1	13.4	113	107.3	51.4
04/16	7.7	12.8	84.9	12.4	13.7	108	107.1	51.5
04/17	6.4	13.4	42.9	11.8	15.4	72	105.5	51.6
04/18	7.8	12.5	23.6	11.6	14.1	46	105.2	51.6
04/19	7.9	13	24	10.4	14.8	32	104.6	51.8
04/20	5.9	11.2	22.9	10.4	12.2	74	105.4	51.8
04/21	6.1	10.7	26.7	9.7	12.4	113	104.2	51.9
04/22	6.7	11.8	21.8	11.2	12.1	164	102.6	52.2
04/23	6.6	12.2	25.8	11.7	12.7	78	101.9	52.3
04/24	7.3	11.8	22.6	11.3	12.5	91	100.6	52.4
04/25	8	11.8	26.4	11.2	12.5	138	98.9	52.5
04/26	7.8	11.4	24.4	10.8	11.8	100	98.3	52.5
04/27	7	11.4	19.1	11.1	11.8	59	97.3	52.6
04/28	7	10.5	26.2	10.1	10.9	153	95.8	52.7
04/29	6.6	9.8	30	9.6	10.4	145	95.7	52.7
04/30	6.5	9.7	26.7	9.3	10.1	147	93.5	52.8
05/01	6.1	9.6	17.5	9.4	10.1	198	92.9	53
05/02	6.3	9.6	18.2	9.1	9.9	190	91.6	53.2
05/03	5.5	9.4	35.3	9.2	9.7	201	91.2	53.2
05/04	6	10.4	22.8	10.1	10.7	325	87.8	53.4
05/05	6.8	10.7	25.2	10.4	10.8	203	83.9	53.5
05/06	6.2	10.5	25.2	10.1	10.8	153	81.1	53.6
05/07	7.3	10.6	18.3	10.1	11.2	115	78.8	53.7
05/08	7.2	10.7	22.5	10.5	11.2	149	77.1	53.8
05/09	7.4	10.8	23.7	10.5	11.3	178	77	53.8
05/10	8.1	11.4	22.3	10.7	12.1	91	77.5	54
05/11	7.8	11	27.8	10.6	11.2	96	77.7	54.2
05/12	8	11.2	22.9	10.4	11.8	88	79.3	54.4
05/13	8	11.1	18.3	9.7	13.1	45	80.5	54.6
05/14	7.1	10.8	16.5	10.2	12.3	48	81.7	54.8
05/15	6.2	12.2	16.8	10.1	14.6	23	84.2	55.4
05/16	7.5	11.2	16.6	9.8	12.9	23	85.1	55.5
05/17	6.9	9.6	14.7	7.9	10.7	23	86.8	55.6
05/18	5.5	9.1	56.9	8.5	9.8	30	88.5	55.8
05/19	5.1	8.4	17.5	7.9	8.8	62	90.2	56
05/20	6	8.3	12.3	7.5	8.8	34	91.7	56.4
05/21	5.4	8	11.4	6.9	8.6	43	93.4	56.9
05/22	4.5	7.4	11.5	7.1	7.9	65	94.7	57.1
05/23	5.1	7.3	13	6.9	7.9	45	94.2	57.4

TABLE E-23. 2000 travel time of PIT tagged yearling chinook released in the Snake River basin in the reach 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
05/24	5	6.5	14.7	6.2	7.1	72	92.8	57.5
05/25	5	7	13	6.7	7.3	68	92	57.6
05/26	5.8	7.3	12.2	6.6	8.3	39	90.3	57.6
05/27	5.6	8.1	10.6	7.3	8.5	43	86.1	57.4
05/28	5.6	8.5	11.9	7.7	9.2	35	84.7	57.3
05/29	6.3	9	12	8.4	9.7	35	84.7	57.2
05/30	6.8	8.3	33.9	7.5	9.2	23	83	57.1
05/31	6.4	9.7	13.2	7.1	11.7	11	81.6	57
06/01	7.1	10	14.2	7.2	12.9	9	79.3	57

TABLE E-24. 2000 travel time of PIT tagged steelhead released in the Snake River basin in the reach 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
04/09	6.6	10.3	26.1	9	13.4	15	98.7	50.2
04/10	6.9	10.6	14.1	8.2	12.3	13	102.2	50.5
04/11	7.6	8.2	11.6	-	-	5	102.2	50.7
04/12	6.6	8.4	11.7	-	-	5	104.9	50.9
04/13	6.1	10.6	19.1	6.9	15.9	14	109.8	51.2
04/14	6.1	9.6	18.8	7.1	13.6	22	110.4	51.2
04/15	5.8	8.8	17.7	7.8	9.8	36	110.7	51.2
04/16	6.2	8.2	24.6	7.5	10.5	37	110.4	51.2
04/17	6.5	9.1	15.6	8	10.2	36	108.5	51.4
04/18	5.6	8.7	16.9	7.2	10.9	34	108	51.5
04/19	4.8	8	27	6.4	10.5	32	108.4	51.6
04/20	5	8.2	20.3	7.2	9.2	44	107.6	51.7
04/21	4.9	7.9	17.6	6.5	8.6	45	107.5	51.8
04/22	4	7.7	28.8	7.4	8.4	110	104.9	51.9
04/23	5.9	10.1	19.8	8	11.3	63	102.1	52.2
04/24	5.6	9.5	34.5	9.2	10.7	69	100.3	52.3
04/25	6.8	9.2	14.5	8.8	9.8	54	98.6	52.3
04/26	6.3	9.4	23.1	8.3	11.9	40	98.4	52.4
04/27	6.4	11.5	14.5	8.7	12.6	32	95.7	52.6
04/28	5.8	8.6	19.4	7.6	10.9	39	98.7	52.6
04/29	5.9	9.4	48.1	8.4	11.4	46	97.6	52.7
04/30	5.7	9	17.1	7.8	11	25	94.4	52.8
05/01	5.9	9.2	17.9	8.4	9.6	52	93.7	52.9
05/02	5.9	9	30.4	8.1	11	52	92.7	53.1
05/03	5.8	9.2	33.1	8.1	10.8	54	91.2	53.2
05/04	5.7	10.4	33.6	7.9	12.7	38	87.8	53.4
05/05	6	10.1	32.9	9.4	11.3	88	85.6	53.5
05/06	6.5	11	41.7	10.3	13.4	107	81.1	53.6
05/07	6.6	12.1	40.2	10	14.4	80	78.5	53.7
05/08	6.9	13.2	38.8	9.9	17.2	40	78	53.9
05/09	6.9	12.2	29	10	15.4	44	77.5	53.9
05/10	8.3	13.8	27.3	11.8	17.5	28	81.1	54.4
05/11	9.1	17.1	35.1	12.2	21	29	83.5	55.2
05/12	7.9	15.9	43	11	17.9	29	83.4	55.3
05/13	8.4	15	42.9	10.6	19.2	14	83.5	55.4
05/14	7.8	14.1	33	13.2	17.8	25	83.8	55.5
05/15	7.8	15.3	23.5	11.9	16	23	85.3	55.9
05/16	10	12.7	31.1	11.2	19.6	20	86.4	55.9
05/17	7.7	15	19.7	11.5	18.6	13	88	56.2
05/18	7.5	11.4	27.5	9	17.4	18	89.4	56.2
05/19	6.8	13.1	33.1	11	17.5	33	90.4	56.6
05/20	7	11.4	18.2	9.9	12.7	35	91.8	56.8
05/21	5.4	10.7	24	8.6	14.2	39	92.1	57
05/22	5.7	8.9	32	7.7	10.2	33	93.4	57.2

TABLE E-24. 2000 travel time of PIT tagged steelhead released in the Snake River basin in the reach 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
05/23	5.4	9.3	23.3	8.2	13.3	28	93.6	57.3
05/24	7.2	11.6	22	9.8	13.3	41	87.3	57.3
05/25	5.7	11.8	23.1	9.7	13	35	86.9	57.4
05/26	5.2	11.1	20.8	9.1	12.2	24	86.3	57.4
05/27	7.9	10.8	29.2	9.3	19.2	18	85.7	57.3
05/28	8.1	9.2	10.1	-	-	6	84.7	57.3
05/29	6	10.2	20.8	8.3	17.6	14	84.8	57.2
05/30	6.9	10.2	17.2	-	-	6	82.7	57.1

TABLE E-25. 2000 travel time of PIT tagged yearling chinook release in any basin above McNary Dam in the reach 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
04/20	5.9	7.4	11	5.9	11	7	327.8	52.1
04/21	3.9	6.4	16	5.7	7.2	26	327.6	52
04/22	4.3	6.5	11.8	6	7.3	27	323.4	51.6
04/23	4.9	7.4	15.3	6.9	8.2	50	315.7	51.5
04/24	5.7	8	13.3	7.6	8.8	61	301.9	51.4
04/25	5.2	8.5	16.8	7.9	9.3	69	294.7	51.7
04/26	5.4	8.4	23.4	7.9	8.8	97	292.5	51.7
04/27	5.1	8	28.4	7.7	8.3	138	289.3	51.7
04/28	5	7.5	33.4	7.4	7.7	178	288.1	51.7
04/29	4.8	7.6	16.1	7.1	7.8	164	286.5	52
04/30	4.8	7	20	6.8	7.5	174	284.5	52.2
05/01	3.8	7	25.6	6.6	7.4	151	283.7	52.6
05/02	4.5	6.7	18.8	6.4	6.8	119	284.3	53.1
05/03	4.5	6.6	22.4	6.1	6.9	112	279.6	53.4
05/04	4.8	6.6	20.3	6.4	6.9	170	276.8	53.5
05/05	4.1	6.8	16.1	6.4	7.1	170	274.1	53.6
05/06	4.5	6.4	13.3	6.1	6.7	200	270.3	53.9
05/07	4	6	18.8	5.9	6.3	243	261.9	54.3
05/08	4.1	6	16.4	5.9	6.2	330	260.7	54.4
05/09	4.2	5.9	14.5	5.7	6	305	259.7	54.4
05/10	4.1	5.9	15.8	5.7	6.1	310	253.1	54.7
05/11	3.9	6.8	14.9	6.7	7	253	251.2	54.5
05/12	4.7	6.5	13.1	6.4	6.7	258	247.8	54.5
05/13	3.7	6.3	15.1	6	6.5	246	244.3	54.6
05/14	4.1	6.2	17.2	6	6.5	220	245.2	54.4
05/15	4.3	6.4	13.2	6.1	6.6	228	242.6	54.7
05/16	4.6	6.6	24.5	6.3	6.8	232	245.3	55.4
05/17	4.4	6.2	14.6	6	6.6	180	246.9	55.3
05/18	4.2	6	14.2	5.9	6.2	238	251.7	55.7
05/19	4.4	5.8	13.1	5.7	5.9	248	254.6	56.1
05/20	3.8	5.1	12.8	5	5.2	193	258	56.5
05/21	3.3	4.9	11.5	4.8	5	204	253.3	57
05/22	3.4	5.2	10.3	4.9	5.4	166	251.3	56.8
05/23	3	5.4	10.2	4.9	5.8	101	249.8	56.8

TABLE E-25. 2000 travel time of PIT tagged yearling chinook release in any basin above McNary Dam in the reach 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
05/24	3.9	5.5	9.2	5	6	75	232.5	57.3
05/25	4.6	6	10	5.6	6.3	76	227.4	57.7
05/26	3.7	5.2	10	5.1	5.5	102	220	57.8
05/27	3.9	4.9	10.5	4.8	5	195	229.4	58
05/28	3.6	4.6	16.8	4.5	4.8	131	226.9	58.5
05/29	3.6	4.7	9.6	4.4	5	75	219.4	59
05/30	3.8	5	8.8	4.7	6.2	41	219.6	59.3
05/31	4.1	5.7	13.9	5.2	6.3	29	221.6	59.6
06/01	3.9	5.3	8.5	5.1	5.7	63	218.9	59.7
06/02	3.9	4.9	7.6	4.5	5.2	33	212.7	59.8
06/03	4.2	5.2	7.8	4.8	5.4	18	212.9	60.2
06/04	4.1	4.7	6.8	4.5	6.1	15	216.7	59.8
06/05	4.1	5.3	5.8	4.7	5.8	17	213.6	59.7
06/06	4.2	5	9.2	4.6	6.1	26	208.1	59.5
06/07	4.2	5.6	7.9	4.7	6.4	15	202.1	59.6
06/08	4.6	5.5	8	5.1	5.9	15	199.3	59.7
06/09	4.5	5.4	20.6	5.1	5.9	23	196.8	59.5
06/10	4.2	5.8	8	5.2	6.6	12	205.9	60.1
06/11	4.1	4.8	6	4.6	5.4	12	210.9	60.3

TABLE E-26. 2000 travel time of PIT tagged steelhead released in any basin above McNary Dam in the reach 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
04/14	4.5	5.3	10	4.5	10	7	279.6	50.5
04/15	4.3	5.2	12.3	4.6	6.8	12	285.6	51.3
04/16	4.3	5.5	6.9	4.8	5.9	11	292.9	51.7
04/17	3.7	4.6	13.7	4.1	6.4	15	302.8	52
04/18	4	5.1	6.9	4	6	11	323.7	52
04/19	3.8	5.1	12.5	4.4	5.8	21	332.1	52.2
04/20	3.4	5.4	15	4.5	6	24	332.1	52.2
04/21	3.7	5.5	9.2	4.2	6.7	19	327.6	52
04/22	3.6	5.2	14	4.6	5.9	38	333.9	52
04/23	4	5	18.3	4.7	5.5	68	324.8	51.8
04/24	3.8	5.2	13.3	4.9	5.6	83	312.6	51.5
04/25	3.8	5.7	14.3	5.3	6.2	73	297	51.1
04/26	3.8	5.6	12.5	5.4	6.2	106	293.5	51.3
04/27	4.1	6.1	21.2	5.6	6.5	127	286.9	51.4
04/28	4	6.1	11.7	5.8	6.5	95	286	51.6
04/29	3.9	5.7	17.8	5.3	5.9	135	288.9	51.7
04/30	3.9	5.6	21.7	5.4	6	102	287.1	52
05/01	3.8	5.4	28.5	5.2	5.8	97	289.2	52.2
05/02	3.2	5.2	14.9	4.9	5.5	63	287.6	52.8
05/03	3.4	5.1	8.8	4.9	5.5	89	283.8	53
05/04	3.7	5.3	11.6	5	5.6	109	283.3	53.2
05/05	3.6	5.2	12.3	5	5.4	133	276.5	53.5
05/06	3.9	5.4	18	5.2	5.5	115	269.9	53.8
05/07	3.7	5.2	10	4.9	5.5	90	267	54.2
05/08	3.8	5.1	12.1	4.9	5.4	111	261	54.3
05/09	3.9	5.6	15.1	5.1	5.9	96	259.7	54.4
05/10	3.9	5.6	15.7	5.3	5.8	80	253.1	54.7
05/11	3.9	5.2	10.2	5	5.5	102	253.1	54.7
05/12	4.2	5.6	13.9	5.3	6	123	249.8	54.6
05/13	4	5.5	22.6	5.3	5.9	107	244.3	54.6
05/14	3.8	5.6	14.4	5.1	5.9	85	245.2	54.4
05/15	3.9	5.2	12.8	4.8	5.9	40	242.9	54.3
05/16	4	5.6	16.2	5.1	6.8	39	239.4	55.1
05/17	4.3	6.3	20.3	5.4	8.3	29	246.9	55.3
05/18	4.2	5.4	15.5	4.9	6.2	28	248.1	55.5
05/19	4.4	5.4	9.9	4.9	6.3	25	251.7	56
05/20	3.9	4.9	10.9	4.6	5.7	24	258	56.5
05/21	3.6	4.8	17.2	4.5	5.2	39	253.3	57
05/22	4	5	5.9	4.1	5.7	12	251.3	56.8
05/23	4.3	5.9	9.8	4.7	8.7	14	241.6	57
05/24	4.5	6.7	10.5	6	7.6	20	233.1	57.6

TABLE E-26. 2000 travel time of PIT tagged steelhead released in any basin above McNary Dam in the reach 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
05/25	4.1	6.9	12.1	5.1	9.1	17	232.2	57.9
05/26	4.2	5	7.2	4.9	6.7	13	220	57.8
05/27	4.4	5.1	12.2	4.6	5.7	22	229.4	58
05/28	4.5	5.6	8.3	5.1	7.4	10	220.8	58.7
05/29	4.5	5.4	8.6	4.5	7.4	10	219.4	59
05/30	5	6	10.1	5.1	7.7	11	218.3	59.4
05/31	4.9	5.8	7	5.4	6.3	20	221.6	59.6
06/01	4.8	5.3	8.2	5	5.9	11	218.9	59.7
06/02	4.1	5.2	6.7	4.8	6.1	12	212.7	59.8

APPENDIX F

Reach Survival Tables

Description of Reach Survival Tables:

Table G-1 presents 2000 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 RELEASE (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 H – 1 through H – 4 for releases from the Salmon, Snake, Imnaha, and Grande Ronde rivers, respectively.

Table G-2 presents 2000 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 G-3 presents 2000 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 5 dams, Leavenworth Hatchery yearling chinook passed 4 dams, Rock Island Dam releases passed 3 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. 2000 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 River trap			
species/reartype	Hatchery Chinook			
dates	4/10-4/14	4/17-4/21	4/24-4/28	5/1-5/5
lgr	0.95487	0.99307	0.94327	0.97694
se_lgr	0.03328	0.03357	0.04396	0.04836
lgs	1.03597	0.86097	0.99156	0.90583
se_lgs	0.06205	0.04976	0.10175	0.09457
lmn	0.85525	0.86082	0.79424	0.85379
se_lmn	0.08181	0.09469	0.13540	0.17054
corr_lgrlgs	-0.54823	-0.58073	-0.43616	-0.46780
corr_lgslmn	-0.44092	-0.30857	-0.48436	-0.39893
N	588	574	572	570
ul_reach	0.98085	0.88304	0.95207	1.01953
ll_reach	0.71121	0.58896	0.53365	0.49158
surv_reach	0.84603	0.73600	0.74286	0.75556
var_reach	0.00473	0.00563	0.01139	0.01814

site	Salmon River trap					
species/reartype	Hatchery Chinook					
dates	3/13-3/17	3/20-3/24	3/27-3/31	4/3-4/7	4/10-4/14	4/17-4/21
lgr	0.65667	0.75678	0.80340	0.82338	1.09643	0.94959
se_lgr	0.03561	0.04098	0.03897	0.04180	0.04717	0.04796
lgs	0.91238	0.87122	0.82883	0.86115	1.05035	0.94838
se_lgs	0.06252	0.06811	0.06559	0.07329	0.10937	0.09361
lmn	0.90694	0.87200	0.84398	0.93110	0.77470	1.03021
se_lmn	0.08846	0.10299	0.11153	0.13834	0.15397	0.21845
corr_lgrlgs	-0.55822	-0.56932	-0.51081	-0.51807	-0.46306	-0.49797
corr_lgslmn	-0.36087	-0.37394	-0.37891	-0.37129	-0.43541	-0.34369
N	600	597	599	585	436	584
ul_reach	0.63968	0.69454	0.69339	0.83395	1.19516	1.28180
ll_reach	0.44707	0.45531	0.43059	0.48645	0.58918	0.57374
surv_reach	0.54337	0.57492	0.56199	0.66020	0.89217	0.92777
var_reach	0.00241	0.00372	0.00449	0.00786	0.02390	0.03263

TABLE F-1. 2000 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			Grande Ronde River trap
species/reartype	Hatchery Chinook			Hatchery Chinook
dates	4/24-4/28	5/1-5/5		4/28-5/5
lgr	0.77380	0.98715		1.14755
se_lgr	0.04636	0.08460		0.05139
lgs	0.92472	0.85075		0.76120
se_lgs	0.10839	0.15285		0.07439
lmn	0.89204	0.85557		[1.29577]
se_lmn	0.19354	0.26683		[0.26612]
corr_lgrlgs	-0.44042	-0.48219		-0.50784
corr_lgslmn	-0.40952	-0.43836		-0.34418
N	548	497		646
ul_reach	0.88021	1.09881		n.a.
ll_reach	0.39640	0.33824		n.a.
surv_reach	0.63831	0.71852		n.a.
var_reach	0.01523	0.03765		n.a.

site	Imnaha River trap				
species	Hatchery Chinook				
dates	3/20-3/26	3/37-4/2	4/3-4/9	4/10-4/16	4/17-4/23
lgr	0.65200	0.68239	0.78896	0.79865	0.83244
se_lgr	0.03905	0.04757	0.04601	0.05464	0.07024
lgs	0.84915	0.81290	0.86491	0.89048	0.98265
se_lgs	0.06474	0.08053	0.08174	0.11705	0.18980
lmn	0.96201	0.73281	1.01567	0.71433	[1.24231]
se_lmn	0.11572	0.09935	0.21560	0.15262	[0.57223]
corr_lgrlgs	-0.59064	-0.56151	-0.53982	-0.46500	-0.39938
corr_lgslmn	-0.29159	-0.38646	-0.28239	-0.45761	-0.34761
N	595	451	593	474	304
ul_reach	0.65222	0.50381	0.96513	0.69038	n.a.
ll_reach	0.41300	0.30919	0.42101	0.32566	n.a.
surv_reach	0.53261	0.40650	0.69307	0.50802	n.a.
var_reach	0.00372	0.00246	0.01927	0.00866	n.a.

TABLE F-1. 2000 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	Snake River trap		
species	Wild Chinook		
dates	4/10-4/14	4/17-4/21	4/24-4/28
lgr	0.94369	1.04565	0.95774
se_lgr	0.03476	0.04836	0.04777
lgs	1.03923	0.85571	1.07099
se_lgs	0.05490	0.05393	0.09771
lmn	0.84143	0.93297	1.06049
se_lmn	0.06709	0.08561	0.20130
corr_lgrlgs	-0.61466	-0.77121	-0.53711
corr_lgslmn	-0.41212	-0.23981	-0.34718
N	371	422	427
ul_reach	0.93538	0.97423	1.45662
ll_reach	0.71502	0.69536	0.71892
surv_reach	0.82520	0.83479	1.08777
var_reach	0.00316	0.00506	0.03541

site	Salmon River trap			
species	Wild Chinook			
dates	3/27-3/31	4/3-4/7	4/10-4/14	4/17-4/21
lgr	0.87440	0.96053	1.10939	0.94045
se_lgr	0.05772	0.03345	0.04010	0.06647
lgs	0.91676	0.88496	0.94853	0.79377
se_lgs	0.07513	0.04350	0.05835	0.08720
lmn	0.85567	0.90070	0.88040	0.90031
se_lmn	0.10011	0.05579	0.07890	0.14643
corr_lgrlgs	-0.68094	-0.67344	-0.69467	-0.61746
corr_lgslmn	-0.26800	-0.34317	-0.39167	-0.34948
N	207	585	455	264
ul_reach	0.83475	0.84877	1.06370	0.86496
ll_reach	0.53709	0.68247	0.78918	0.47921
surv_reach	0.68592	0.76562	0.92644	0.67208
var_reach	0.00577	0.00180	0.00490	0.00968

TABLE F-1. 2000 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	Grande Ronde River trap				
species	Wild Chinook				
dates	4/3-4/7	4/10-4/14	4/17-4/21	4/24-4/28	5/1-5/5
lgr	1.03268	0.99111	1.01663	0.75519	0.95522
se_lgr	0.07290	0.06513	0.08099	0.05167	0.07291
lgs	0.81185	0.82923	0.77261	1.06394	0.89377
se_lgs	0.07396	0.07559	0.09022	0.14411	0.12700
lmn	1.13883	0.85911	0.97368	0.97181	0.78174
se_lmn	0.14223	0.10517	0.22512	0.26304	0.18076
corr_lgrlgs	-0.79950	-0.71704	-0.70484	-0.33026	-0.52387
corr_lgslmn	-0.18328	-0.27127	-0.20531	-0.43317	-0.42219
N	200	201	200	200	201
ul_reach	1.17954	0.86366	1.09740	1.15070	0.93027
ll_reach	0.73001	0.54846	0.43216	0.41096	0.40456
surv_reach	0.95478	0.70606	0.76478	0.78083	0.66742
var_reach	0.01315	0.00647	0.02880	0.03561	0.01799

site	Imnaha River trap				
species/reartype	Wild Chinook				
dates	3/13-3/26	3/27-4/2	4/3-4/9	4/10-4/23	4/24-4/30
lgr	0.83999	0.90818	0.85992	0.86174	0.81796
se_lgr	0.03305	0.02565	0.02722	0.04049	0.04956
lgs	0.94558	0.92659	0.96882	0.86573	1.07194
se_lgs	0.04485	0.03490	0.04245	0.06561	0.12535
lmn	0.97317	0.93049	0.95090	0.91091	[1.32300]
se_lmn	0.07398	0.04952	0.07090	0.11637	[0.40684]
corr_lgrlgs	-0.65531	-0.67879	-0.54123	-0.51971	-0.41710
corr_lgslmn	-0.25851	-0.31340	-0.34471	-0.36277	-0.30989
N	581	1235	631	437	306
ul_reach	0.88291	0.85738	0.89896	0.83459	n.a.
ll_reach	0.66302	0.70865	0.68544	0.52455	n.a.
surv_reach	0.77297	0.78301	0.79220	0.67957	n.a.
var_reach	0.00315	0.00144	0.00297	0.00626	n.a.

TABLE F-1. 2000 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	**Snake River trap**			
species/reartype	**Hatchery Steelhead**			
dates	4/17-4/21	4/24-4/28	5/1-5/12	5/15-5/26
lgr	0.95803	0.94716	0.87170	0.90058
se_lgr	0.02537	0.02683	0.02412	0.03332
lgs	0.94626	0.86563	0.63444	0.71074
se_lgs	0.04924	0.04864	0.04929	0.10908
lmn	0.88225	0.80239	1.14906	1.05335
se_lmn	0.06347	0.08194	0.16738	0.34524
corr_lgrlgs	-0.45289	-0.45020	-0.30262	-0.22724
corr_lgslmn	-0.53030	-0.38128	-0.43093	-0.43725
N	551	598	1220	1039
ul_reach	0.89075	0.77730	0.79771	1.06125
ll_reach	0.70884	0.53845	0.47324	0.28719
surv_reach	0.79979	0.65788	0.63548	0.67422
var_reach	0.00215	0.00371	0.00685	0.03899

site	**Grande Ronde River trap**			
species/reartype	**Hatchery Steelhead**			
dates	4/10-4/14	4/17-4/21	4/24-4/28	5/1-5/12
lgr	0.89503	0.94833	0.91651	0.95777
se_lgr	0.02870	0.03485	0.03376	0.05245
lgs	0.84212	0.75393	0.72542	0.60094
se_lgs	0.04449	0.05186	0.05373	0.11834
lmn	0.89758	0.83106	0.81143	0.75249
se_lmn	0.07257	0.07830	0.12277	0.22684
corr_lgrlgs	-0.50322	-0.50643	-0.44831	-0.27174
corr_lgslmn	-0.37521	-0.44384	-0.32230	-0.58425
N	624	601	601	598
ul_reach	0.77438	0.68912	0.68926	0.63653
ll_reach	0.57867	0.49925	0.38971	0.22969
surv_reach	0.67653	0.59419	0.53948	0.43311
var_reach	0.00249	0.00235	0.00584	0.01077

TABLE F-1. 2000 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 Steelhead					
dates	4/17-4/23	4/24-4/30	5/1-5/7	5/8-5/14	5/15-5/21	5/22-5/28
lgr	0.67119	0.83731	0.83926	0.88738	0.81111	0.92760
se_lgr	0.02508	0.03223	0.02780	0.03526	0.03070	0.04009
lgs	0.80408	0.73390	0.88084	0.97133	1.01368	0.71176
se_lgs	0.05758	0.08522	0.11860	0.16860	0.16380	0.10625
lmn	0.96929	0.92868	0.84959	0.68854	0.53306	[1.60710]
se_lmn	0.13097	0.21941	0.19368	0.17462	0.12298	[0.77533]
corr_lgrlgs	-0.32996	-0.28552	-0.20587	-0.21231	-0.19774	-0.27539
corr_lgslmn	-0.40391	-0.43071	-0.55769	-0.65622	-0.67312	-0.27967
N	932	895	1044	1007	963	729
ul_reach	0.64951	0.80688	0.85876	0.81210	0.58244	n.a.
ll_reach	0.39671	0.33446	0.39737	0.37486	0.29413	n.a.
surv_reach	0.52311	0.57067	0.62806	0.59348	0.43828	n.a.
var_reach	0.00416	0.01452	0.01385	0.01244	0.00541	n.a.

site	Snake River trap			Salmon River trap
species/reartype	Wild Steelhead			Wild Steelhead
dates	4/17-4/21	4/24-4/28	5/1-5/5	
lgr	0.90140	1.03310	1.00454	Insufficient numbers to estimate survival for weekly blocks – same problem as in 1999
se_lgr	0.04653	0.04035	0.06896	
lgs	0.99693	0.78542	0.81836	
se_lgs	0.08745	0.05173	0.14496	
lmn	0.87246	1.01117	0.76115	
se_lmn	0.11599	0.13317	0.19601	
corr_lgrlgs	-0.47456	-0.63463	-0.39529	
corr_lgslmn	-0.48011	-0.23126	-0.56682	
N	203	373	252	
ul_reach	0.95609	1.02345	0.87428	
ll_reach	0.61196	0.61750	0.37715	
surv_reach	0.78402	0.82048	0.62572	
var_reach	0.00771	0.01072	0.01608	

TABLE F-1. 2000 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	Grande Ronde River trap				
species/reartype	Wild Steelhead				
dates	4/5-4/7	4/10-4/14	4/17-4/21	4/24-4/28	5/1-5/12
lgr	0.91410	0.94507	0.88667	0.88218	0.91064
se_lgr	0.05503	0.04361	0.03999	0.04131	0.06950
lgs	0.99283	0.86015	0.97183	1.04143	0.68547
se_lgs	0.09199	0.05982	0.07616	0.09617	0.13793
lmn	0.66817	0.98958	0.83344	0.85455	[1.20405]
se_lmn	0.08084	0.12102	0.11301	0.21581	[0.51206]
corr_lgrlgs	-0.57215	-0.58221	-0.40623	-0.35880	-0.36435
corr_lgslmn	-0.48798	-0.24892	-0.43339	-0.31839	-0.39599
N	201	200	200	200	400
ul_reach	0.72239	0.99066	0.88755	1.15101	n.a.
ll_reach	0.49041	0.61821	0.54879	0.41919	n.a.
surv_reach	0.60640	0.80443	0.71817	0.78510	n.a.
var_reach	0.00350	0.00903	0.00747	0.03485	n.a.

site	Imnaha River trap					
species/reartype	Wild Steelhead					
dates	4/17-4/23	4/24-4/30	5/1-5/7	5/8-5/14	515-5/21	5/22-5/28
lgr	0.74821	0.86689	0.87541	0.73432	0.89733	0.80825
se_lgr	0.03299	0.02842	0.02651	0.04488	0.03919	0.06078
lgs	0.84385	0.81753	0.73610	0.95098	0.73037	0.58335
se_lgs	0.04766	0.05120	0.05465	0.22711	0.07918	0.10010
lmn	0.86250	0.97756	0.84009	1.04684	0.83408	[1.45136]
se_lmn	0.06698	0.13404	0.10351	0.39534	0.15557	[0.77255]
corr_lgrlgs	-0.44365	-0.36076	-0.35563	-0.21935	-0.38213	-0.40224
corr_lgslmn	-0.33361	-0.30538	-0.48171	-0.59507	-0.47603	-0.24651
N	394	447	1179	621	1022	428
ul_reach	0.62743	0.87022	0.65362	1.16003	0.71799	n.a.
ll_reach	0.46169	0.51539	0.42906	0.30203	0.37529	n.a.
surv_reach	0.54456	0.69281	0.54134	0.73103	0.54664	n.a.
var_reach	0.00179	0.00819	0.00328	0.04791	0.00764	n.a.

TABLE F-2. 2000 Survival estimates for Snake River basin hatchery fish to Lower Granite Dam tailrace (lgr), between subsequent dams, and within the entire reach (surv_reach) for reaches extending from hatchery release site to Lower Monumental Dam Tailrace and from hatchery release site to John Day Dam tailrace.

Hatchery	**McCall H Chinook**	**Rapid River H Chinook**	**Imnaha AP Chinook**	**Dworshak H Chinook**	**Dworshak H Steelhead**
Lgr	0.67609	0.74755	0.69235	0.84119	0.79389
se_lgr	0.00907	0.00716	0.01114	0.00914	0.01550
Lgs	0.84287	0.82235	0.80516	0.78375	0.81471
se_lgs	0.02726	0.01716	0.02594	0.01567	0.04684
Lmn	0.90516	1.12203	1.02508	1.03814	0.71918
se_lmn	0.05277	0.06171	0.08336	0.04450	0.05698
Mcn	1.03963	0.83723	0.86494	0.83346	0.91892
se_mcn	0.06768	0.05541	0.08885	0.04449	0.16684
Jda	[1.44163]	0.90375	0.85983	0.89997	0.95345
se_jda	[0.33149]	0.11044	0.14112	0.08683	0.40014
corr_lgrlgs	-0.53537	-0.60012	-0.62835	-0.69757	-0.28975
corr_lgslmn	-0.45843	-0.29608	-0.29159	-0.28896	-0.64085
corr_lmnmcn	-0.66801	-0.78940	-0.76261	-0.78081	-0.22823
corr_mcnjda	-0.10102	-0.14476	-0.19366	-0.14189	-0.38775
N	47709	47748	20819	47745	4208
REACH SURVIVAL					
Hatchery release site to Lower Monumental Dam tailrace					
surv_reach	0.51581	0.68977	0.57143	0.68443	0.46516
var_reach	0.00065	0.00125	0.00187	0.00073	0.00075
ul_reach	0.56566	0.75913	0.65622	0.73736	0.51890
ll_reach	0.46596	0.62040	0.48665	0.63150	0.41141
Hatchery release site to John Day Dam tailrace					
surv_reach	n.a.	0.52191	0.42498	0.51338	0.40755
var_reach	n.a.	0.00377	0.00433	0.00229	0.02440
ul_reach	n.a.	0.64233	0.55388	0.60713	0.71371
ll_reach	n.a.	0.40149	0.29607	0.41963	0.10138

No reliable estimate of survival from hatchery release site to John Day Dam tailrace is available for McCall Hatchery chinook because estimated survival in each reach below Lower Monumental Dam was in excess of 1.0 with wide confidence intervals.

TABLE F-3. 2000 survival estimates for Mid-Columbia River basin fish to McNary Dam tailrace (mcn).

site	**Leavenworth Hatchery**	**Winthrop Hatchery**	**Wells Hatchery**	**Priest Rapids Hatchery**	**Ringold Hatchery**
species	**Chinook 1's**	**Chinook 1's**	**Chinook 0's**	**Chinook 0's**	**Chinook 0's**
dates	4/18	4/10	6/19	6/15-6/19-6/27	6/17-6/19
mcn	0.59325	0.48262	0.21038	0.66590	0.53986
se_mcn	0.03755	0.03243	0.02188	0.04555	0.03285
N	7401	7490	5997	2961	3090
ul_reach	0.66684	0.54618	0.25326	0.75518	0.60424
ll_reach	0.51966	0.41905	0.16750	0.57662	0.47547

site	**Rock Island Dam**					
species	**Yearling Chinook**				**Sockeye**	
dates	4/21-5/4	5/5-5/14	5/16-6/2		4/21-5/5	5/10-5/24
mcn	0.78419	0.77786	0.93572		0.65882	0.60900
se_mcn	0.11114	0.10956	0.18692		0.25188	0.38514
N	1389	1301	1297		340	289
ul_reach	1.00202	0.99260	1.30208		1.15251	1.36387
ll_reach	0.56635	0.56313	0.56937		0.16514	-0.14588

site	**Rock Island Dam**		
species	**Steelhead**		
dates	4/21-5/9	5/10-5/16	5/17-6/2
mcn	0.74460	0.69611	0.54959
se_mcn	0.09968	0.17430	0.17431
N	1275	1336	1336
ul_reach	0.93998	1.03773	0.89123
ll_reach	0.54922	0.35449	0.20795

site	**Rock Island Dam**				
species	**Subyearling Chinook**				
dates	6/19-7/5	7/6-7/18	7/19-7/26	7/27-8/3	8/4-8/19
mcn	0.64177	0.77410	0.52274	0.60513	0.43523
se_mcn	0.10236	0.11598	0.06693	0.09496	0.06540
N	690	861	861	792	869
ul_reach	0.84240	1.00142	0.65393	0.79125	0.56340
ll_reach	0.44115	0.54678	0.39155	0.41901	0.30705

APPENDIX G

Transportation Proportion Tables

Proportion of Lower Granite Dam forebay population destined to be transported

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.

$$X2 = x2/(s1*s2*s3) = N - t1/s1 - t2/(s1*s2) - t3/(s1*s2*s3)$$

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:

$$Pt = P1 +(1-P1)*P2 + (1-P1)*(1-P2)*P3$$

The P1, P2, and P3 proportions are computed using facility collection, transport, and population estimates for Lower Granite, Little Goose, and Lower Monumental dams, respectively. For sites J=1 to 3, the individual proportions P(J) are computed with

P(J) = transport number / population number
= (transport proportion * collection) / (collection / collection efficiency)
= transport proportion * collection efficiency

Model results:

The respective P(J)'s for each dam are shown in Tables 1 through 3 for yearling chinook, steelhead , and subyearling chinook, respectively. The transport proportion is based on data from the run-at-large at each dam. The collection efficiency is estimated using the Seber-Jolly mark-recapture model on PIT tagged yearling chinook and steelhead released from the SMP's four Snake River basin traps and PIT tagged subyearling chinook released from the three Snake River basin fall chinook acclimation ponds in 2000. The estimated percent of smolts arriving Lower Granite Dam forebay that were destined for transportation in 2000 was 71% for yearling chinook, 81% for steelhead, and 93% for subyearling chinook.

TABLE G-1. Yearling chinook model input data for 2000.

Site	Facility Collection	Estimated Population	Spill Proportion	Estimated Collection Efficiency	Collection Transport Proportion	P(J)
LGR (j=1)	2,450,180	6,400,000	25.5%	0.38	0.951	0.361
LGS (j=2)	1,357,206	3,300,000	27.7%	0.41	0.997	0.409
LMN (j=3)	608,625	2,400,000	32.3%	0.25	0.956	0.239

TABLE G-2. Steelhead model input data for 2000.

Site	Facility Collection	Estimated Population	Spill Proportion	Estimated Collection Efficiency	Collection Transport Proportion	P(J)
LGR (j=1)	5,039,620	8,500,000	25.7%	0.59	0.955	0.563
LGS (j=2)	1,055,759	3,000,000	25.4%	0.35	0.999	0.350
LMN (j=3)	766,300	2,300,000	33.9%	0.34	0.996	0.339

TABLE G-3. Subyearling chinook model input data for 2000.

Site	Facility Collection	Estimated Population	Spill Proportion	Estimated Collection Efficiency	Collection Transport Proportion	P(J)
LGR (j=1)	681,803	1,200,000	8.8%	0.55	0.995	0.547
LGS (j=2)	331,428	600,000	7.1%	0.56	1	0.560
LMN (j=3)	188,875	500,000	19.5%	0.39	0.889	0.347
MCN (j=4)	9,250,320	19,300,000	13.2%	0.48	0.917	0.440

TABLE G-4. Estimated proportion destined for transportation in 2000.

Species- age group	Transport Proportion
Yearling Chinook	0.71
Steelhead	0.81
Subyearling Chinook	0.93

Model for yearling chinook and steelhead: Pt = P1 +(1-P1)*P2 + (1-P1)*(1-P2)*P3

Model for subyearling chinook: Pt = P1 +(1-P1)*P2 + (1-P1)*(1-P2)*P3 + (1-P1)*(1-P2)*(1-P3)*P4

APPENDIX H

Hatchery Release Schedule

HATCHERY RELEASES ABOVE BONNEVILLE DAM - 2000 MIGRATION YEAR
FISH PASSAGE CENTER DATA SYSTEM

Colville Tribe

Cassimer Bar Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
SO	1	UN	10/15/99	11/15/99	21,557	56.0	Osoyoos Lake	Okanogan River	1998	2nd season - yearling migrants; 100% LV clip.
Cassimer Bar Total					**21,557**					
Colville Tribe Total					**21,557**					

Idaho Department of Fish and Game

Clearwater Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	4/19/00	4/20/00	183,857	4.9	Clear Cr	Clearwater Rvr M F	1999	100% ad clip; 43k adLV+CWT 10-54-19; 300 PIT tag.
ST		SU	4/20/00	4/21/00	311,416	5.4	Redhouse (SFk ClearH20 R)	Clearwater Rvr M F	1999	100% ad clip; 63k adLV+CWT 10-54-8, 26; 300 PIT tag.
CH	1	SP	3/6/00	3/10/00	463,068	15.1	Rapid R	Little Salmon River	1998	Parentage from Rapid River; Reared - Clearwater H; 100% ad clip.
CH	1	SP	4/10/00	4/13/00	396,010	19.6	Crooked R Acclim Pd	S Fk Clearwater River	1998	100% ad clip; 21.5k ad+CWT 10-46-41, 42; 300 PIT tag.
CH	1	SP	4/10/00	4/14/00	159,051	18.0	Red River Acclim Pd	S Fk Clearwater River	1998	100% ad clip; 23k ad+CWT 10-46-39, 40
CH	1	SP	9/27/99	9/27/99	74,981	27.0	Red River Acclim Pd	S Fk Clearwater River	1998	100% RV clip; ISS group.
CH	1	SP	9/28/99	9/28/99	89,299	27.0	Crooked R Acclim Pd	S Fk Clearwater River	1998	100% LV clip; ISS group.
Clearwater Total					**1,677,682**					

Eagle Hatchery										
Species	**Age**	**Race**	**RelStart**	**RelEnd**	**NumRel**	**Size**	**ReleaseSite**	**RiverName**	**Brood**	**Comments**
SO	1	UN	5/9/00	5/9/00	148	1.8	Redfish Lake Cr	Salmon River	1998	100% ad clip & PIT tag.
Eagle Total					**148**					

Magic Valley Hatchery										
Species	**Age**	**Race**	**RelStart**	**RelEnd**	**NumRel**	**Size**	**ReleaseSite**	**RiverName**	**Brood**	**Comments**
ST		SU	4/10/00	4/11/00	106,135	4.4	Squaw Cr Acclim Pd	Salmon River	1999	100% ad clip.
ST		SU	4/20/00	6/5/00	245,502	4.3	Squaw Cr Acclim Pd	Salmon River	1999	100% ad clip; 60k adLV+CWT 10-54-13, 10-46-47; 600 PIT tag; Rel in lower section of Pd.
ST		SU	4/27/00	5/2/00	239,981	4.4	E Fk Salmon R	Salmon River	1999	100% ad clip; Rel in lower section of E. Fk.
ST		SU	4/11/00	4/27/00	300,523	4.1	Little Salmon R	Salmon River	1999	100% ad clip; 63k adLV+CWT 10-36-5; Rel at Stinky Springs.
ST		SU	4/11/00	4/12/00	115,423	4.3	Little Salmon R	Salmon River	1999	100% ad clip; Rel at Stinky Springs.
ST		SU	4/12/00	4/21/00	200,077	4.0	Lemhi R	Salmon River	1999	100% ad clip; 62k adLV+CWT; 300 PIT tag; 62,670 rel at Red Rock.
ST		SU	4/17/00	4/17/00	61,732	4.1	N Fk Salmon R	Salmon River	1999	100% ad clip; Rel site was Lewis & Clark.
ST		SU	4/17/00	4/17/00	41,091	4.1	Salmon R Idaho	Salmon River	1999	100% ad clip; Rel in Section 16 at Wagonhammer.
ST		SU	4/14/00	4/18/00	126,040	4.1	Shoup Br (Salmon R)	Salmon River	1999	Rel 20k each at Eye Hole, Kilpatrick & Colston Corner; 100% ad clip; 60k adLV+CWT 10-46-48, 10-54-14.
ST		SU	4/13/00	4/24/00	342,164	4.3	McNabb/Salmon R	Salmon River	1999	100% ad clip; 61.5k adLV+CWT 10-48-29, 10-54-15; 300 PIT tag; Rel at Tunnel Rk
Magic Valley Total					**1,778,668**					

McCall Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SU	4/3/00	4/6/00	845,244	23.3	S Fk Salmon R	Salmon River	1998	100% ad clip; 325k ad+CWT 10-55-6...10; 48k PIT tag; Rel at Knox Bridge.
CH	1	SU	4/3/00	4/6/00	194,686	23.3	S Fk Salmon R	Salmon River	1998	Rel at Knox Br; 100% RV clip; 600 PIT tag; ISS Group.
McCall Total					**1,039,930**					

Niagara Springs Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	3/27/00	4/9/00	601,907	4.1	Hells Canyon Dam	Snake River	1999	100% ad clip; 62k adLV+CWT 10-54-24, 25; 300 PIT tag.
ST		SU	4/14/00	5/4/00	830,315	4.3	Pahsimeroi H	Pahsimeroi River	1999	100% ad clip; 64k adLV+CWT 10-55-11, 12, 10-46-49, 50; 300 PIT tag
ST		SU	5/5/00	5/8/00	181,317	4.1	Hammer Cr	Salmon River	1999	100% ad clip; 61k adLV+CWT 10-55-28..30; 300 PIT tag.
ST		SU	4/10/00	4/13/00	190,996	4.8	Little Salmon R	Salmon River	1999	100% ad clip; 63.5k adLV+CWT 10-55-13...15; 300 PIT tag.
Niagara Springs Total					**1,804,535**					

Pahsimeroi Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SU	4/13/00	4/17/00	53,837	10.9	Pahsimeroi H	Pahsimeroi River	1998	100% ad clip; 500 PIT tag; ISS Group.
Pahsimeroi Total					**53,837**					

Powell Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	4/10/00	4/13/00	293,522	10.9	Powell Acclim Pd	Lochsa River	1998	100% ad+CWT 10-54-7, 9...12, 18; 300 PIT tag.
Powell Total					**293,522**					

Rapid River Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	3/15/00	4/25/00	2,462,354	19.2	Rapid River H	Little Salmon River	1998	100% ad clip; 330k ad+CWT10-55-1..5; 48k PIT tag.
Rapid River Total					**2,462,354**					

Sawtooth Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	4/12/00	4/19/00	123,425	16.5	Sawtooth H	Salmon River	1998	No fin clip; 100% CWT 10-54-20...23, 28, 29; 1k PIT tag; ISS "Natures Study".
ST		SU	4/26/00	4/26/00	606,925	4.2	Sawtooth H	Salmon River	1999	100% ad clip; 120k adLV+CWT 10-55-19..24; 900 PIT tag; Transf from HNFH; Feed/diet study.
SO	1	UN	10/13/99	10/13/99	23,886	43.2	Redfish Lake	Salmon River	1998	100% ad clip; 1.5k PIT tag; Captive Brood Production Fish.
SO	1	UN	5/23/00	5/23/00	12,955	43.2	Alturas Lake	Salmon River	1998	100% ad clip; 1.5k PIT tag; Captive Brood Production fish.
SO	1	UN	10/13/99	10/13/99	3,430	43.2	Pettit Lake	Salmon River	1998	100% ad clip; 2k PIT tag; Captive Brood Production Fish.
Sawtooth Total					**770,621**					
IDFG Total					**9,881,297**					

Nez Perce Tribe

Clearwater Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	4/27/00	5/4/00	139,662	4.8	Red River Acclim Pd	S Fk Clearwater River	1999	No fin clip; Supplemental Group.
ST		SU	4/27/00	5/4/00	100,331	4.6	Crooked R Acclim Pd	S Fk Clearwater River	1999	Supplemental Group - No ad clip.
Clearwater Total					**239,993**					

Kooskia Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	5/10/00	5/10/00	270,000	16.0	Kooskia H	Clearwater Rvr M F	1998	60k CWT only; 220k unmarked.
Kooskia Total					**270,000**					

Lookingglass Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	4/18/00	4/18/00	34,986	21.0	Lostine Accim Pd	Wallowa River	1998	100% ad+CWT 9 -28-31, 32, 34..36, 41; 23% PIT tag; Captive Brood (F1 gen.).
CH	1	SP	4/1/00	4/18/00	37,980	22.5	Catherine Cr Acclim Pd	Grande Ronde River	1998	Rel - new Acclim Pd, F1 gen of Captive Brood; 100% ad+CWT 9-28-33, 37, 39
CH	1	SP	3/14/00	3/14/00	1,508	19.5	Grande Ronde Acclim Pd	Grande Ronde River	1998	Captive Brood (F1 generation); 100% ad+CWT 9-28-40.
Lookingglass Total					**74,474**					

Lyons Ferry Hatchery										
Species	**Age**	**Race**	**RelStart**	**RelEnd**	**NumRel**	**Size**	**ReleaseSite**	**RiverName**	**Brood**	**Comments**
CH	1	FA	4/11/00	4/13/00	134,709	12.0	Pittsburg Landing	Snake River	1998	100% ad+CWT 63-12-12; 100% VI right green; 8k PIT tag.
CH	1	FA	4/11/00	4/13/00	131,306	12.0	Big Canyon (Clearwater R)	Clearwater Rvr M F	1998	100%ad+CWT 63-10-12; 100% VI left green; 8k PIT tag.
CH	1	FA	4/8/00	4/12/00	131,324	12.0	Cpt John Acclim Pd	Snake River	1998	100% ad+CWT 63-10-13; 100% VI left blue; 2k PIT tag.
CH	0	FA	5/24/00	5/26/00	398,747	50.0	Pittsburg Landing	Snake River	1999	1k PIT tag.
CH	0	FA	5/30/00	6/1/00	497,790	48.0	Big Canyon (Clearwater R)	Clearwater Rvr M F	1999	200k CWT only; 1k PIT tag.
CH	0	FA	6/21/00	6/26/00	395,000	42.0	Big Canyon (Clearwater R)	Clearwater Rvr M F	1999	Unmarked; 30k rel from 6/21 to 6/25; remainder out on 6/26.
CH	0	FA	5/20/00	5/31/00	491,033	55.0	Cpt John Acclim Pd	Snake River	1999	Volit Rel; 200k CWT; 1k PIT tag.
CH	0	FA	6/15/00	6/23/00	401,814	40.0	Cpt John Acclim Pd	Snake River	1999	Volit rel with 2/3 out of pd by 6/23; 200k CWT 63-1-69.
Lyons Ferry Total					**2,581,723**					

Magic Valley Hatchery										
Species	**Age**	**Race**	**RelStart**	**RelEnd**	**NumRel**	**Size**	**ReleaseSite**	**RiverName**	**Brood**	**Comments**
ST		SU	5/4/00	5/9/00	100,078	4.3	Newsome Cr	S Fk Clearwater River	1999	No fin clips; 300 PIT tag; Supplementation rel.
ST		SU	5/5/00	5/9/00	96,187	4.3	American R	S Fk Clearwater River	1999	No fin clips; 300 PIT tag; Supplementation Group.
ST		SU	5/2/00	5/2/00	19,556	4.3	Mill Cr Bridge	S Fk Clearwater River	1999	No fin clip; Supplementation Group.
ST		SU	5/10/00	5/10/00	30,480	4.0	Red R	S Fk Clearwater River	1999	No fin clip; Supplementation Group.
ST		SU	5/2/00	5/2/00	19,557	4.3	Meadow Cr	S Fk Clearwater River	1999	No fin clip; Supplementation Group.
Magic Valley Total					**265,858**					

McCall Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SU	3/27/00	3/30/00	78,950	28.6	Johnson Cr Idaho	South Fork Salmon River	1998	100% CWT 61-17-1 & Rt Red Elast Tag; no ad clip; 8k PITs; Dir stream Rel.
CO	1	UN	3/15/00	3/15/00	263,793	19.1	Lapwai Cr	Clearwater Rvr M F	1998	30k ad+CWT; 30k CWT only; __k PIT tag; 200k non marked.
CO	1	UN	3/17/00	3/17/00	263,681	19.3	Potlatch R	Clearwater Rvr M F	1998	30k ad+CWT; 30k CWT only; __k PIT tag; 200k unmarked.
McCall Total					**606,424**					
Nez Perce Total					**4,038,472**					

National Marine Fisheries Service

Dworshak Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	4/4/00	4/6/00	1,600	6.8	Bel. Lower Gran Dam	Snake River	1999	Research fish rel at LGR, LGS and LWN dams - 100% PIT tagged.
ST		SU	4/7/00	4/12/00	1,200	6.8	Bel. McNary Dam	L Col R (D/s McN Dam)	1999	Research fish rel at McN, Jday, & Bonnev dams; 100% ad + PIT tag.
Dworshak Total					**2,800**					
NMFS Total					**2,800**					

Oregon Department of Fish and Wildlife

Big Canyon Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	4/12/00	4/13/00	178,655	4.1	Deer Cr	Grande Ronde River	1999	Acclim 1 month; 100% ad clip; 50k adLV+CWT 9-29-34, 35
ST		SU	5/10/00	5/11/00	135,048	4.0	Deer Cr	Grande Ronde River	1999	100% ad clip; 25k adLV+CWT 9-29-36, 37
ST		SU	5/11/00	5/25/00	65,250	4.2	Big Canyon H	Grande Ronde River	1999	100% ad clip; 25k
Big Canyon Total					**378,953**					

Imnaha Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	3/22/00	4/18/00	179,797	19.1	Imnaha Acclim Pd	Imnaha River	1998	100% ad+CWT 9-28-21..23..25, 27, 28, 30; 108k at 25/lb; 72k at 15/lb; 21k PIT tag.
ST		SU	5/3/00	5/3/00	860	5.2	Deer Cr	Grande Ronde River	1999	100% PIT tag; Sthd x RB Cross; Total Sthd + RB = 2497.
ST		SU	4/18/00	4/20/00	100,007	5.2	Big Sheep Cr	Imnaha River	1999	Direct stream rel; 100% ad clip.
Imnaha Total					**280,664**					

Li Sheep Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	4/12/00	4/12/00	161,582	4.5	L Sheep Acclim Pd	Imnaha River	1999	Acclim 1 month; 100% ad clip; 50k adLV+CWT 9-29-27, 28.
ST		SU	5/10/00	5/10/00	66,624	3.9	L Sheep Acclim Pd	Imnaha River	1999	Acclim ~1 month; 100% ad clip; 25k adLV+CWT 9-29-29.
Li Sheep Total					**228,206**					

Lookingglass Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	3/10/00	3/10/00	1,550	20.0	Grande Ronde Acclim Pd	Grande Ronde River	1998	Rel in new Acclim Pd; 100% ad+CWT.
CH	1	SP	6/24/99	6/24/99	57,290	127.3	Lookingglass H	Grande Ronde River	1998	100% ad+CWT 9-28-19; Subyearling rel of last group of Rapid R stock.
Lookingglass Total					**58,840**					

Oak Springs Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	4/12/00	4/14/00	51,878	6.0	Hood R	Hood River	1999	Direct Stream Rel; 100% ad clip.
ST		SU	4/24/00	4/24/00	4,762	5.3	Hood R	Hood River	1999	100% LM or RM clip.
Oak Springs Total					**56,640**					

Round Butte Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	4/10/00	4/13/00	162,005	3.8	Bel. Pelton Dam	Deschutes River	1999	100% adLM clip.
CH	1	SP	4/17/00	4/20/00	269,559	7.8	Bel. Pelton Dam	Deschutes River	1998	Rel from Pelton Ldr, Cells 1, 2, 3, 6; 100% ad+CWT 9-28-51...54.
CH	1	SP	5/9/00	5/9/00	28,501	7.8	Bel. Pelton Dam	Deschutes River	1998	Forced from ladder on 5/9; 100% ad+CWT 9-28-51...54.
Round Butte Total					**460,065**					

Umatilla Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	11/29/99	11/29/99	9,878	43.9	Umatilla R	Umatilla River	1999	non-marked release; grade outs
Umatilla Total					**9,878**					

Wallowa Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	4/5/00	4/6/00	363,515	4.0	Wallowa Acclim Pd	Grande Ronde River	1999	100% ad clip; 50k adLV+CWT 9-29-30, 31
ST		SU	5/3/00	5/4/00	212,691	3.9	Wallowa Acclim Pd	Wallowa River	1999	100% ad clip; 50k adLV+CWT 9-29-32, 33
ST		SU	5/4/00	5/18/00	108,750	4.2	Wallowa Acclim Pd	Wallowa River	1999	100% ad clip; 25k adLV+CWT
Wallowa Total					**684,956**					
ODFW Total					**2,158,202**					

Umatilla Tribe

Bonifer Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	4/3/00	4/11/00	49,343	6.4	Bonifer Acclim Pd	Umatilla River	1999	100% ad clip; 20k adLV+CWT 7-9-47; .3k PIT tag.
Bonifer Total					**49,343**					

Cascade Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	3/8/00	3/15/00	249,792	16.8	Pendelton Acclim Pd	Umatilla River	1998	New A Pd (RM 56); 25k ad+CWT 9-27-18, 9-29-15.
CO	1	UN	4/21/00	4/28/00	798,210	15.2	Pendelton Acclim Pd	Umatilla River	1998	New acclim pd at RM 56; 25k ad+CWT 9-27-19.
Cascade Total					**1,048,002**					

Lower Herman C Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	3/8/00	3/15/00	512,288	16.8	Pendelton Acclim Pd	Umatilla River	1998	New acclim pd at RM 56; 25k ad+CWT 9-27-17.
Lower Herman C Total					**512,288**					

Imeques Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	3/6/00	3/9/00	531,267	13.0	Imeques Acclim Pd	Umatilla River	1998	Fish transf. from Umat H (360k) [140k ad+CWT 7-60-38..41, 45, 49..51; L White Salmon H = 175k [19.3k ad+CWT 5-36-45] 2.4k PIT tag.
CH	1	SP	4/6/00	4/12/00	284,917	12.3	Imeques Acclim Pd	Umatilla River	1998	Transf from Carson & L. White Salm H; Acclim 1 mo; 40k ad+CWT 5-36-47, 5-46-55; .6k PIT tag.
Imeques Total					**816,184**					

Minthorn Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	4/24/00	4/28/00	52,736	4.7	Minthorn Acclim Pd	Umatilla River	1999	100% ad clip; 22k ad+CWT 9-23-61; 1.4k PIT tag.
ST		SU	3/30/00	4/4/00	51,659	4.8	Minthorn Acclim Pd	Umatilla River	1999	100% ad clip; 21k ad+CWT 7-5-35; .3k PIT tag.
Minthorn Total					**104,395**					

Thornhollow Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	FA	3/6/00	3/9/00	235,246	10.9	Thornhollow Acclim Pd	Umatilla River	1998	27k ad+CWT 9-29-25; .3K PIT tag; Remainder BWT.
CH	1	FA	4/6/00	4/13/00	234,510	10.1	Thornhollow Acclim Pd	Umatilla River	1998	28k ad+CWT 9-29-26; Remainder 100% BWT; .3k PIT tag.
CH	0	FA	5/23/00	5/23/00	975,871	49.2	Thornhollow Acclim Pd	Umatilla River	1999	Rel at RM 73.5; 194k ad+CWT9-30-35..37; Rem 100% BWT; 1.8k PIT tag..
Thornhollow Total					**1,445,627**					

Umatilla Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	0	FA	5/24/00	5/24/00	2,044,647	48.3	Pendelton Acclim Pd	Umatilla River	1999	369k ad+CWT 09-30-2..4;32...34; Remainder BWT; 3.6k PIT tag.
Umatilla Total					**2,044,647**					
Umatilla Tribe Total					**6,020,486**					

US Fish and Wildlife Service

Carson Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	4/20/00	4/20/00	1,430,022	15.6	Carson H	Wind River	1998	15k PIT tag; 75k ad+CWT 5-38-54, 5-42-43, 5-15-60.
Carson Total					**1,430,022**					

Dworshak Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	3/22/00	4/6/00	1,017,873	24.0	Dworshak H	Clearwater Rvr M F	1998	100% ad clip; 140k ad+CWT; 48k PIT tag; 65k rel 3/22 - p.m, remainder rel on 4/5 & 4/6.
ST		SU	4/17/00	4/20/00	622,567	6.0	Redhouse (SFk ClearH20 R)	S Fk Clearwater River	1999	100% ad clip.
ST		SU	5/3/00	5/5/00	1,308,647	5.7	Dworshak H	Clearwater Rvr M F	1999	1.2 million ad clip; 100k BWT (no ad clip); 1.5k PIT Tag; 40k adLV+CWT+FB.
ST		SU	4/18/00	4/20/00	211,693	5.9	Clear Cr	Clearwater Rvr M F	1999	100% ad clip.
Dworshak Total					**3,160,780**					

Eagle Creek Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	4/24/00	4/27/00	1,357,126	14.1	Little White Salmon H	Little White Salmon River	1998	100% ad clip; rel for Tribe.
Eagle Creek Total					**1,357,126**					

Entiat Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	4/4/00	4/4/00	359,667	12.0	Entiat H	Entiat River	1998	110k ad+CWT 5-39-23, 26, 27, 5-48-39.
Ential Total					**359,667**					

Hagerman Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	4/22/00	4/25/00	120,144	4.1	Sawtooth H	Salmon River	1999	100% adLV+CWT 10-55-16..18, 25..27; Late/early egg exper; dir str rel at Sawtooth Weir.
ST		SU	4/3/00	4/7/00	154,428	4.5	Little Salmon R	Salmon River	1999	18k no ad clip (L. Hazard Cr); 136k rel at Stinky Spr w/ad clip.
ST		SU	4/26/00	5/8/00	259,908	4.1	Little Salmon R	Salmon River	1999	Supplemental [178k with No fin clip]; 300 PIT tag; Remainder ad clip.
ST		SU	4/28/00	4/28/00	32,751	4.1	Hazard Cr/Little Salmon R	Little Salmon River	1999	No fin clip; 300 PIT tag; Supplementation Group.
Hagerman Total					**567,231**					

Kooskia Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	4/6/00	4/6/00	365,150	20.0	Kooskia H	Clearwater Rvr M F	1998	100% ad clip; 100k ad+CWT 5-29-61, 5-32-16.
CH	1	SP	4/7/00	4/7/00	84,304	24.0	Clear Cr	Clearwater Rvr M F	1998	100% RV clip; Supplemental Group.
Kooskia Total					**449,454**					

Leavenworth Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	4/18/00	4/18/00	1,680,904	18.2	Leavenworth H	Wenatchee River	1998	7.5k PIT tag; 200k ad+CWT 5-42-45, 46, 57..59.
Leavenworth Total					**1,680,904**					

L White Salmon Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	4/20/00	4/20/00	1,115,384	14.8	Little White Salmon H	Little White Salmon River	1998	75k ad+CWT 5-15-57..59.
CO	1	UN	4/20/00	4/20/00	547,938	17.2	Little White Salmon H	Little White Salmon River	1998	100k ad+CWT 63-9-10.
CH	0	FA	6/22/00	6/22/00	1,970,592	65.9	Little White Salmon H	Little White Salmon River	1999	200k ad+CWT 0501021005.
L White Salmon Total					**3,633,914**					

Spring Creek Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	0	FA	3/9/00	3/9/00	8,177,725	121.9	Spring Creek H	Columbia River	1999	150k ad+CWT 5-44-20, 21
CH	0	FA	4/20/00	4/20/00	4,309,676	67.7	Spring Creek H	Columbia River	1999	150k ad+CWT 5-44-22, 23
CH	0	FA	5/18/00	5/18/00	3,578,544	38.7	Spring Creek H	Columbia River	1999	150k ad+CWT 5-44-18, 19
CH	0	FA	12/16/99	12/16/99	3,116,006	1194.0	Spring Creek H	L Col R (D/s McN Dam)	1999	Unfed Fry Release.
Spring Creek Total					**19,181,951**					

Willard Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	4/20/00	4/20/00	998,146	15.3	Willard H	Little White Salmon River	1998	100% ad clip; 100k ad+CWT 5-49-26, 27
Willard Total					**998,146**					

Winthrop Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	4/10/00	4/10/00	377,696	14.0	Winthrop H	Methow River	1998	7.5k PIT tag; 100% ad+CWT 5-36-32, 5-44-6, 5-48-40, 41, 5-49-31, 49
ST		SU	4/12/00	5/22/00	105,510	5.5	Winthrop H	Methow River	1999	100% ad clip; Volitional Rel.
CO	1	UN	4/30/00	5/15/00	199,763	17.1	Winthrop H	Methow River	1998	26k ad+CWT 9-27-21; 8k PIT Tag; Rel for Yak. Tribe.
Winthrop Total					**682,969**					

Warm Springs Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	3/22/00	4/19/00	679,042	14.2	Warm Springs H	Deschutes River	1998	100% adCWT or adLV+CWT 5-51-15..19, 21..24
CH	1	SP	10/7/99	11/17/99	91,377	17.0	Warm Springs H	Deschutes River	1998	Volit fall rel; 100%ad+CWT; 2/3 adLV+CWT 5-51-15..19, 21..24
Warm Springs Total					**770,419**					
USFWS					**34,991,917**					

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Chiwawa Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	4/10/00	4/10/00	75,906	11.5	Chiwawa H	Wenatchee River	1998	100% ad+CWT 63-11-2.
ST		SU	4/26/00	5/15/00	25,600	6.0	Chiwawa H	Wenatchee River	1999	100% Rt Red VIE; CWT 63-11-20.
ST		SU	4/26/00	5/15/00	43,400	5.0	Chiwawa H	Wenatchee River	1999	100% Rt Green VIE + CWT 63-09-40; H x W cross.
ST		SU	4/17/00	4/24/00	30,600	5.0	Chiwawa H	Wenatchee River	1999	100% Rt Orange VIE + CWT 63-11-23; W x W cross.
Chiwawa Total					**175,506**					

Dryden Pond Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SU	5/1/00	5/1/00	649,612	8.5	Dryden Acclim Pd	Wenatchee River	1998	100% ad+CWT 63-11-51.
Dryden Pond Total					**649,612**					

East Bank Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	4/26/00	5/8/00	45,153	6.3	Chiwawa H	Wenatchee River	1999	100% left green VIE = CWT 63-9-14; H x W cross.
ST		SU	4/26/00	5/8/00	30,710	6.3	Chiwawa H	Wenatchee River	1999	100% Left orange VIE + CWT 63-11-45; W x W cross.
SO	1	UN	10/29/99	10/29/99	121,344	26.7	Lake Wenatchee	Wenatchee River	1998	100% ad clip.
ST	0	SU	4/26/00	5/8/00	23,241	6.3	Chiwawa H	Wenatchee River	1999	100% ad clip; rel with marked study fish.
East Bank Total					**220,448**					

Klickitat Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	3/1/00	3/31/00	562,000	6.5	Klickitat H	Klickitat River	1998	100k ad+CWT 63-10-22, 23. 230k rel on 3/1-5; 332k rel on 3/20-24.
CH	0	SP	1/19/01	1/19/01	130,000	63.6	Upper Klickitat R	Klickitat River	1999	Rel for YIN; 100% ad+CWT 63-1-84.
CO	1	NO	4/19/00	5/15/00	1,420,000	16.5	Klickitat H	Klickitat River	1998	100% ad clip; 90k ad+CWT 63-11-9, 10
CH	0	FA	5/15/00	5/22/00	1,517,000	65.1	Klickitat H	Klickitat River	1999	1.3 mil BWT; 200k ad+CWT 9-30-31 for straying study.
CH	0	FA	6/12/00	7/10/00	2,455,500	58.0	Klickitat H	Klickitat River	1999	100% ad+BWT or CWT; 1.5 million rel wk of 6/12; 1.0 mil rel wk of 7/5.
CH	0	SP	8/9/00	8/17/00	60,842	37.4	Klickitat H	Klickitat River	1999	Subyearling Rel.
Klickitat Total					**6,145,342**					

Lyons Ferry Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	3/31/00	4/30/00	274,146	5.5	Cottonwood Acclim Pd	Grande Ronde River	1999	194K ad only, 80K adLV+CWT 63-13-9+FB.
ST		SU	4/17/00	4/27/00	59,879	4.2	Lyons Ferry H	Snake River	1999	100% ad clip; 20k adLV+CWT 63-13-7.
ST		SU	3/25/00	4/30/00	124,654	3.6	Dayton Acclim Pd	Touchet River	1999	100% ad clip; 40K adLV+CWT 63-13-8 + FB.
ST		SU	4/17/00	4/30/00	145,768	4.3	Tucannon R	Tucannon River	1999	100% ad clip, 40K adLV+CWT 63-13-5, 6; Rel at Marengo & Enrich Rd.
ST		SU	4/17/00	4/26/00	165,500	4.1	Walla Walla R	Walla Walla River	1999	100% ad clip
CH	1	FA	3/21/00	4/14/00	456,401	9.4	Lyons Ferry H	Snake River	1998	100% ad+CWT 63-12-13; 100% VIE Left Red.
CH	0	FA	5/26/00	5/26/00	196,643	45.5	Lyons Ferry H	Snake River	1999	100% ad+CWT 63-1-67.
Lyons Ferry Total					**1,422,991**					

Methow Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	4/19/00	4/19/00	217,171	18.4	Chewuch R	Methow River	1998	100% ad+CWT 63-10-24.
CH	1	SP	4/19/00	4/19/00	218,499	16.0	Methow H	Methow River	1998	100% ad+CWT 63-10-24.
CH	1	SP	4/19/00	4/19/00	15,470	15.0	Twisp R	Methow River	1998	100% ad+CWT 63-10-41; rel from Twisp Acclim pd.
Methow Total					**451,140**					

Priest Rapids Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	0	FA	6/14/00	6/27/00	6,856,000	50.0	Priest Rapids H	Mid-Columbia River	1999	6/14 unmkd rel of 1.7 mil; 6/16, 18, 20, 26, 27 rel dates w/1.3 mil each; 200k ad+CWT 63-13-33; 5-13-12; 3k PIT tagged.
Priest Rapids Total					**6,856,000**					

Ringold Springs Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	1/5/00	1/14/00	391,816	15.0	Ringold Springs H	Mid-Columbia River	1998	100% ad+CWT 63-12-10; Early rel due to Botulism in pd.
CH	0	FA	6/18/00	6/19/00	3,436,897	47.0	Ringold Springs H	Mid-Columbia River	1999	213k ad+CWT.
ST		SU	4/3/00	4/7/00	181,000	5.2	Ringold Springs H	Mid-Columbia River	1999	100% adRV clip.
Ringold Springs Total					**4,009,713**					

Skamania Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		SU	5/2/00	5/9/00	118,454	5.5	Klickitat R	Klickitat River	1999	100% ad clip; Rel sites between Rm 10-30.
ST		WI	5/1/00	5/1/00	16,500	5.2	White Salmon R	White Salmon River	1999	Unmarked rel at RM 4; net pen reared in NWestern L.
ST		SU	5/8/00	5/8/00	19,848	5.1	Little White Salmon R	Little White Salmon River	1999	100% ad clip; Rel in Drano Lake.
Skamania Total					**154,802**					

Tucannon Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	3/20/00	4/26/00	127,939	12.4	Curl Lake	Tucannon River	1998	100% ad+CWT 63-12-11.
Tucannon Total					**127,939**					

Turtle Rock Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SU	4/19/00	4/22/00	167,382	9.8	Turtle Rock H	Mid-Columbia River	1998	100% ad+CWT 63-10-32.
CH	0	SU	7/5/00	7/5/00	369,026	46.0	Turtle Rock H	Mid-Columbia River	1999	100% ad+CWT 63 01-76.
CH	0	SU	7/5/00	7/5/00	347,946	24.0	Turtle Rock H	Mid-Columbia River	1999	Accelerated growth; 100% ad+CWT 63-1-77.
Turtle Rock Total					**884,354**					

Washougal Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	SO	3/4/00	3/27/00	1,616,494	17.4	Klickitat R	Klickitat River	1998	100% ad clip w/portion CWT; Rel at RMs 18 - 30.
CO	1	NO	3/4/00	3/27/00	521,726	17.4	Klickitat R	Klickitat River	1998	Portion ad+CWT; Rel Rm 18-30.
Washougal Total					**2,138,220**					

COOP Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	0	SU	5/26/00	5/26/00	85	70.0	Okanogan R	Okanogan River	1999	Rel by Brewster SD; Unmarked.
CH	0	SU	4/27/00	4/27/00	196	80.0	Similkameen Acclim Pd	Okanogan River	1999	Unmarked rel; Rel by Oroville Elem. School in Similk R.
COOP Total					**281**					

Wells Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SU	4/18/00	5/12/00	457,770	7.0	Wells H	Mid-Columbia River	1998	100%ad+CWT 63-10-61.
ST		SU	4/11/00	4/18/00	139,900	7.0	Methow R	Methow River	1999	No fin clips; 100% FB (LA "F") rel in upper Methow R.
ST		SU	5/1/00	5/3/00	68,580	6.2	Similkameen Acclim Pd	Okanogan River	1999	100% ad clip.
ST		SU	5/5/00	5/26/00	76,070	6.2	Okanogan R	Okanogan River	1999	100% ad clip; 19.4k rel - Omak Cr; 10.4k rel - Salmon Cr.
ST		SU	5/1/00	5/24/00	62,000	6.2	Bel. Wells Dam	Mid-Columbia River	1999	DPUD Surv Study; 1/2 rel below Wells Dam; 1/2 rel in Col R near Pateros, WA; 100% ad + PIT Tag.

CH	1	SU	5/2/00	5/2/00	205,269	8.8	Carlton Acclim Pd	Methow River	1998	100% ad+CWT.
CH	1	SU	4/13/00	4/26/00	293,064	9.0	Similkameen Acclim Pd	Okanogan River	1998	100% ad+CWT 63-11-48.
CH	0	SU	6/19/00	6/19/00	363,600	18.5	Wells H	Mid-Columbia River	1999	100% ad+CWT 63-2-87; 6k PIT tag.
ST		SU	4/25/00	5/23/00	136,680	6.3	Twisp R	Methow River	1999	No fin clip, 100% BWT; H x H = L cheek tag; H x W = R cheek tag.
ST		SU	4/25/00	5/23/00	138,300	6.2	Chewuch R	Methow River	1999	No fin clip; 100% BWT; H x H = L cheek tag; H x W = R cheek tag.
Wells Total					**1,941,233**					
WDFW Total					**25,177,581**					

Warm Springs Tribe

Blackberry Pond Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	5/9/00	5/10/00	5,835	7.5	Columbia R Above Bonn	Columbia River	1998	Rel near mouth of Hood R; Non migrators from Ac Pd; 100% adLM+CWT 9-28-55, 56
ST		SU	5/9/00	5/9/00	4,738	6.2	Columbia R Above Bonn	Columbia River	1999	Non migr from Ac Pd rel near mouth of Hood R; 100% adLM or adRM clip.
Blackberry Pond Total					**10,573**					

Jones Cr Pond Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	5/8/00	5/8/00	4,822	7.0	Columbia R Above Bonn	Columbia River	1998	Non migrators rel near mouth of Hood R; 100% adLM+CWT 9-28-55, 56
Jones Cr Pond Total					**4,822**					

Oak Springs Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
ST		WI	4/17/00	5/1/00	29,546	7.6	E Fk Irrig Dist Sand Trap	Hood River	1999	13.8k rel on 4/17; 15.7k rel on 5/1; 100% adlV+CWT 9-29-23, 24
ST		WI	4/17/00	5/1/00	30,857	7.5	Parkdale Acclim Pd	Hood River	1999	15.3k rel on 4/17; 15.6k rel on 5/1; 100% adLV+CWT 9-29-23, 24
ST		SU	4/13/00	4/27/00	29,152	5.8	Blackberry Acclim Pd	Hood River	1999	15.6k rel on 4/13; 13.6k rel on 4/27; 100% marked, 10k LM clip; 20k RM clip.
ST		WI	5/16/00	5/16/00	1,590	10.3	Columbia R Above Bonn	Columbia River	1999	Non migrators from East Fk Sand Ponds [See 00142].
Oak Springs Total					**91,145**					

Parkdale Pond Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	3/20/00	3/20/00	4,126	14.9	Parkdale Acclim Pd	Hood River	1998	Pilot Study; 100% adLV+CWT 9-17-4, 7-11-23, 24
CH	1	SP	5/15/00	5/15/00	91	5.7	Columbia R Above Bonn	Columbia River	1998	Non migrators from Parkdale Pd; 100% adRV+CWT 9-28-57, 17-4, 11-23, 24
ST		WI	5/19/00	5/19/00	1,162	11.3	Columbia R Above Bonn	Columbia River	1999	Non Migrators from Parkdale Pd; Rel below mouth of Hood R; 100% adLV+CWT 9-29-23, 24
Parkdale Pond Total					**5,379**					

Round Butte Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	4/10/00	4/25/00	30,429	6.1	Parkdale Acclim Pd	Hood River	1998	15.3k rel on 4/10; 15.2k rel on 4/25; 100% adRV+CWT 9-28-57.
CH	1	SP	4/10/00	4/24/00	58,499	7.0	Blackberry Acclim Pd	Hood River	1998	30.3k rel on 4/10; 28.2k rel on 4/24; 100% adLM+CWT 9-28-56.
CH	1	SP	4/10/00	4/24/00	33,609	7.3	Jones Creek Acclim Pd	Hood River	1998	17.4k rel on 4/10; 16.2k rel on 4/24; 100% adLM+CWT 9-28-55, 56
Round Butte Total					**122,537**					
Warm Springs Tribe Total					**234,456**					

Yakima Tribe

Clark Flat Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	3/15/00	6/2/00	229,176	18.5	Clark Flat Acclim Pd	Yakama River	1998	Wild Parentage; 100% ad+CWT; 10% PIT tag.
Clark Flat Total					**229,176**					

Cle Elum Slough Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	5/7/00	5/10/00	123,783	16.0	Cle Elum R	Yakama River	1998	100% CWT 5-44-51; 2.5k PIT tag.
CO	1	UN	5/25/00	5/31/00	123,740	14.0	Cle Elem Slough	Yakama River	1998	Rel from Upper Pds; 100% CWT 5-44-52; 2.5k PIT tag.
Cle Elum Slough Total					**247,523**					

Easton Pond Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	3/15/00	6/2/00	236,113	18.9	Easton Pd	Yakama River	1998	Wild Parentage; 100% ad+CWT; 10% PIT tag.
CO	1	UN	5/7/00	5/10/00	123,329	14.0	Easton Pd	Yakama River	1998	100% CWT 5-44-49; 2.5k PIT tag.
CO	1	UN	5/25/00	5/31/00	123,824	12.0	Easton Pd	Yakama River	1998	100% CWT 5-44-50; 2.5k PIT tag.
Easton Pond Total					**483,266**					

Jack Creek Pond Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	1	SP	3/31/00	6/2/00	137,502	20.2	Jack Creek Acclim Pd	Yakama River	1998	Wild Parentage; 100% ad+CWT; 10% PIT tag.
Jack Creek Pond Total					**137,502**					

Leavenworth Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	4/8/00	4/8/00	489,705	18.7	Icicle Cr	Wenatchee River	1998	Rel from Acclim Pds near Leav H; unmarked.
Leavenworth Total					**489,705**					

Lost Creek Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	5/7/00	5/10/00	121,982	16.7	Lost Creek Acclim Pd	Yakama River	1998	100% CWT 5-44-61; 2.5k PIT tag.
CO	1	UN	5/25/00	5/31/00	113,620	14.0	Lost Creek Acclim Pd	Yakama River	1998	100% CWT 5-44-62; 2.5k PIT tag.
Lost Creek Total					**235,602**					

Prosser Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CH	0	FA	5/25/00	5/25/00	1,695,037	67.0	Prosser Acclim Pd	Yakama River	1999	Transfer from LWNFH.
CH	0	FA	4/10/00	4/20/00	148,000	55.0	Prosser Acclim Pd	Yakama River	1999	100% RP clip; 2k PIT tag; accel growth grp; 16k unmk rel 4/10 - Marion Drain.
CH	0	FA	5/25/00	5/25/00	158,000	55.0	Prosser Acclim Pd	Yakama River	1999	100% LP clip; 2k PIT tag.
Prosser Total					**2,001,037**					

Stiles Pond Hatchery

Species	Age	Race	RelStart	RelEnd	NumRel	Size	ReleaseSite	RiverName	Brood	Comments
CO	1	UN	5/7/00	5/10/00	123,921	18.4	Naches R	Yakama River	1998	100% CWT 5-44-63; 2.5k PIT tag.
CO	1	UN	5/25/00	5/31/00	119,327	15.1	Naches R	Yakama River	1998	100% CWT 5-45-4; 2.5k PIT tag.
Stiles Pond Total					**243,248**					
Yakima Tribe Total					**4,067,059**					
ABOVE BONNEVILLE TOTAL					**86,593,827**					