IV. 1990 SMOLT MONITORING PROGRAM

The objective of the Smolt Monitoring Program (SMP) is to provide information to the Fish Passage Center on the status of the smolt migration for in-season management of the Water Budget and Spill Agreement. Information is also provided for post-season analyses of the migration in order to meet the requirements of the NPPC Fish and Wildlife Program. This information includes data from key monitoring sites on daily indices of smolt passage, annual indices of relative passage magnitude, smolt condition, and smolt migration timing. Additional information is provided on smolt travel time to many of these sites. This section of the report presents this information for monitoring sites on the Snake and Clearwater rivers and at Lower Granite, Rock Island, McNary, John Day and Bonneville dams. More detailed coverage of the smolt condition data derived from the physiological monitoring will be reported by USFWS researchers in a separate document.

A. PASSAGE INDICES

1. Methods.

Information on the status of the smolt outmigration is provided to the Fish Passage Center for in-season Water Budget and spill management needs through the use of daily indices of smolt abundance (passage indices) at monitoring sites in the Columbia River basin. These passage indices are computed using data from the sampling of the smolt migration passing the monitoring sites listed in Table 8. The daily passage indices at the traps on the Snake and Clearwater rivers equal the daily fish collection for each species. The daily passage indices for each species at hydroelectric sites are computed by dividing the daily fish collection estimate by the proportion of flow passing through the sampled unit or powerhouse. This adjustment compensates for different daily project operations (*e.g.*, spill and unit loading) assuming fish pass through spill and powerhouse units in numbers proportional to the flow through these passage routes. The passage index is not further divided by any estimate of fish guidance efficiency (FGE), since past FGE estimates have been so variable, both across days within years, and across years of study. For this and other reasons, the passage index is not an estimate of absolute daily passage, but does provide a relative measure of how each species' run is progressing over the migration season. Changes in the magnitude of the passage index for a species cannot be considered in isolation from other influential factors such as hatchery releases, smolt condition, flow patterns, and project operations.

Summing the daily passage indices for a particular species over the migration season produces an annual passage index for that site. Since FGE differs by site and species, the annual passage indices should not be directly compared among sites or among species at a site within a given year. However, annual passage indices can be compared to previous years for a particular species and site, provided

Table 8. Smolt monitoring sites for 1990.

SITE	METHOD	DATA GATHERED	DATES OF OPERATION
SNAKE RIVER			
Snake River Trap*	Dipper Trap	PIT tags,brands,species	3/9 - 6/19
Clearwater R. Trap	Scoop Trap	PIT tags,brands,species	3/13 - 6/1
Lower Granite*	Bypass Collection	PIT tags,brands,species	3/26 - 7/26
Little Goose	Bypass Collection	PIT tags,species	4/12 - 7/21
Lower Monumental	Gatewell Dip	Brands,species	3/25 - 8/1
MID-COLUMBIA			
Rock Island*	Bypass Trap(PH2)	Brands,species	3/31 - 8/31
LOWER COLUMBIA			
McNary*	Bypass Collection	PIT tags,brands,species	4/1 - 9/14
John Day*	Airlift Pump	Brands,species	3/26 - 10/31
The Dalles	Gatewell Dip/ Airlift Pump	Brands,species	4/9 - 8/31
Bonneville (PH1)*	Bypass Trap	Brands,species	3/12 - 11/30
Bonneville (PH2)	Bypass Collection	Brands,species	3/12 - 11/30

• Key monitoring sites covered in remainder of this section of report.

they are not considered in isolation of other information. In making comparisons to historical data, the following factors are considered: (1) stability of historic FGE estimates (either fairly constant or following a similar pattern of temporal change within each year); (2) potential FGE improvement due to structural modifications (*e.g.*, raised bulkhead gates at Lower Granite Dam); (3) the magnitude of the annual hatchery releases above a particular monitoring site, by considering a passage index to hatchery release ratio; (4) potential contribution of wild stocks; (5) the magnitude of the transportation program, such as full transportation or a partial bypass mode of operation; and (6) flow conditions. Comparisons of the 1990 annual passage indices are made to the average of the historical values for available years since 1984. An annual passage index/hatchery release ratio is also computed for Lower Granite, Rock Island and McNary dams.

2. Results and Discussion.

The 1990 cumulative passage indices for Lower Granite, Rock Island, McNary, John Day, and Bonneville (powerhouse 1) dams are presented in Table 9. Associated estimated confidence intervals are presented in Appendix D. Several observations should be made before considering each site in detail. First, the size of the total hatchery releases above Lower Granite, Rock Island, and McNary dams were near, or above, the average for the previous five or six years. Therefore, annual passage indices at these three sites should be similar to the historic mean, unless: (1) survival or collection efficiency dropped; (2) the contribution of hatchery to wild fish changed; or (3) in the case of McNary Dam, fewer Snake River fish arrived due to a higher recovery at Snake River transportation facilities. Second, even though annual passage indices are not directly comparable among sites due

Table 9. 1990 and historical annual passage indices for juvenile salmonids at key monitoring sites.

SITE	SPECIES	1990 PASSAGE INDEX (X1000)	1990 HATCHERY RELEASE (X1000)	1990 RATIO	HISTORICAL MEAN PASSAGE INDEX (X1000)	HISTORICAL MEAN HATCHERY RELEASE (X1000)	HISTORICAL MEAN RATIO
LOWER GRANITE	YRLG CHINOOK	3,199.6	12,488	0.26	2,106.5	9,394	0.22
	STEELHEAD	6,139.9	10,154	0.60	3,518.1	7,646	0.46
	SOCKEYE	16.6	0	—	7.8	0	—
ROCK ISLAND DAM	YRLG CHINOOK	20.9	4,632	0.005	29.5	4,897	0.006
	SUBYR CHINOOK	54.7	2,589	0.021	40.9	1,959	0.021
	STEELHEAD	18.1	1,216	0.015	39.3	1,033	0.038
	COHO	15.6	473	0.033	37.7	392	0.096
	SOCKEYE	4.3	0	—	31.6	0	—
MCNARY DAM	YRLG CHINOOK	2,432.7	18,572	0.13	2,946.6	14,998	0.20
	SUBYR CHINOOK	8,507.9	14,267	0.60	6,267.2	13,750	0.46
	STEELHEAD	660.4	12,175	0.05	972.3	9,581	0.10
	COHO	231.0	1,118	0.21	172.0	792	0.22
	SOCKEYE	294.3	0	—	692.5	0	—
JOHN DAY DAM	YRLG CHINOOK	362.0	—	—	820.3	—	—
	SUBYR CHINOOK	513.7	—	—	1,213.7	—	—
	STEELHEAD	133.8	—	—	361.2	—	—
	COHO	84.3	—	—	83.8	—	—
	SOCKEYE	23.6	—	—	157.8	—	—
BONNEVILLE PH#1	YRLG CHINOOK	332.8	—	—	400.7	—	—
	SUBYR CHINOOK	1,219.8	—	—	1,240.5	—	—
	"BRIGHTS"	929.1			347.6		
	STEELHEAD	127.9	—	—	155.0	—	—
	COHO	677.1	—	—	545.4	—	—
	SOCKEYE	81.4	—	—	108.1	—	—

- Historical mean passage indices and hatchery releases are based on data for 6 years (1984-89) at Lower Granite and McNary dams, 5 years (1985-89) at Rock Island and John Day dams, and 2 years (1988-89) at Bonneville Dam.
- Outages of Unit 5 at John Day Dam during the periods April 16-19, May 30-June 10, June 21-23, and August 13-16 make the computed 1990 annual passage indices an underestimate. Historical mean annual passage indices are based on sampling in Unit 3, which typically collects a higher proportion of fish passing John Day Dam than Unit 5.
- An unplanned barge release of approximately 600,000 yearling chinook and steelhead above John Day Dam on May 30 resulted in an excess of about 75,000 steelhead and 5,000 yearling chinook in the Bonneville Dam passage index for June 2 and 3. The estimated extra barged fish were subtracted from the June 2-3 passage indices at Bonneville Dam before computation of the 1990 annual passage index.
- "Brights" at Bonneville Dam refers to subyearling chinook arriving after June 1; this excludes most "tule" fall chinook originating from Spring Creek Hatchery.

to differences in FGE, trends in magnitude between 1990 and historic levels for individual species should be similar in direction at successive downstream sites (provided that recruitment between sites is low or accounted for). Third, monitoring at John Day Dam was in Unit 5 in 1990 as opposed to Unit 3 in previous years. The 1990 annual passage index at John Day Dam for each species was expected to be lower than in prior years, since passage levels tend to decrease at units farther from the Oregon shore at this project. Fourth, annual passage indices at Rock Island Dam are always substantially lower than at other monitoring sites because the bypass collection system there relies on volitional entry into gatewells of an unscreened powerhouse.

The 1990 cumulative passage indices at Lower Granite Dam were 3,199,600 chinook, 6,139,900

steelhead, and 16,600 sockeye/kokanee. Since there was no spill this year, these passage indices equalled the collection numbers. The annual passage index to hatchery release ratio was slightly higher than the prior 6-year average for chinook and substantially higher for steelhead (Table 9). However, the 1990 steelhead passage index/hatchery ratio was not greater than last year's ratio. Without the higher natural flows after May 25, this year's steelhead collection at Lower Granite Dam would have been dismal. About 35% of the total steelhead collection for the season occurred subsequent to May 25 as a result of the higher flows. The annual passage index for wild steelhead in 1990 was 28% higher than in 1989 (Table 10). Overall, there was 88.6% hatchery steelhead and 11.4% wild steelhead in the collection at Lower Granite Dam in 1990, which was close to last year's composition (Table 10). The passage index for sockeye was higher than the 6-year average, surpassing the 15,800 estimate for 1984. It is not clear how many of these fish are anadromous sockeye as opposed to kokanee (resident sockeye) from places like Dworshak reservoir. Apparently, kokanee are passing Dworshak Dam through the turbines and over the spillway, based on research being conducted by IDFG.

The 1990 cumulative passage indices at Rock Island Dam were 20,900 yearling chinook, 54,700 subyearling chinook (including accelerated growth spring chinook from Leavenworth Hatchery), 18,100 steelhead, 15,600 coho, and 4,300 sockeye (Table 9). Given the 1990 hatchery releases, the cumulative passage indices for yearling and subyearling chinook this year were within the range of expectation (similar annual passage index/hatchery release ratio to the prior 5-year average ratio). However, the steelhead and coho cumulative passage indices were about 60% lower than expected given the size of the 1990 hatchery releases. In a FPC letter dated June 12 to NPPC Member Ted Bottiger, it was noted that freeze-branded steelhead from the Wells Hatchery releases into the Methow and Similkameen rivers were recovered at Rock Island and McNary dams in proportions lower than in prior years. It is likely that fewer Wells Hatchery steelhead outplants were surviving to Rock Island and McNary dams this year. Reduced survival may have occurred with wild steelhead also, as the composition of wild to hatchery steelhead at Rock Island Dam did not change much from last year (Table 10). However, the severity of the drop in the 1990 steelhead cumulative passage index compared to the historic levels, the fact that both hatchery and wild steelhead appeared affected, and the similar and simultaneous drop in the coho cumulative passage index, implies that collection efficiency of steelhead and coho may have also been substantially lower in 1990. However, nothing unusual was noted about the flow and spill conditions this year that might impact collection efficiency. Possibly, both reduced survival and collection efficiency were responsible for the low 1990 annual indices for steelhead and coho. These factors, plus a decreasing run of Osoyoos stock sockeye each year since 1986, may have contributed to the 86% drop in the cumulative sockeye passage index

Table 10. Hatchery and wild steelhead passage indices for 1990 compared to 1989 at key monitoring sites.

	1990				1989			
SITE	WILD STEELHEAD P.I.	WILD STEELHEAD PERCENT	HATCHERY STEELHEAD P.I.	HATCHERY STEELHEAD PERCENT	WILD STEELHEAD P.I.	WILD STEELHEAD PERCENT	HATCHERY STEELHEAD P.I.	HATCHERY STEELHEAD PERCENT
LOWER GRANITE	698.2	11.4	5,441.6	88.6	545.0	10.4	4,695.9	89.6
ROCK ISLAND DAM	3.7	20.6	14.3	79.4	6.8	17.7	31.6	82.3
MCNARY DAM	166.0	25.1	494.5	74.9	210.5	20.9	796.4	79.1
JOHN DAY DAM	68.4	51.2	65.3	48.8	122.5	43.5	159.2	56.5
BONNEVILLE PH#1	61.7	48.3	66.1	51.7	99.6	48.3	106.4	51.7

- P.I. is annual passage index in thousands.
- Outages of Unit 5 at John Day Dam during the periods April 16-19 and May 30 - June 10 make computed percentiles gross approximations only. It is likely that the hatchery percentage for 1990 would be higher if uninterrupted sampling had occurred.
- An unplanned barge release of juvenile salmonids above John Day Dam on May 30 resulted in excess of approximately 75,000 steelhead in the Bonneville Dam passage index. Therefore, an estimated 8,000 wild and 67,000 hatchery steelhead (barge fish) were excluded from the June 2 and 3 passage indices before computation of cumulative annual passage index and hatchery/wild percentages.

from the average of the previous five years.

The 1990 cumulative passage indices for yearling chinook and steelhead at McNary Dam were 2,432,700 yearling chinook and 660,400 steelhead (Table 9). The annual passage index/hatchery release ratio for yearling chinook and steelhead was lower than the 6-year average. Several factors may have contributed to the reduction in this ratio for yearling chinook and steelhead this year. The reduced Snake River flows during mid-May may have decreased the survival of smolts migrating to McNary Dam. Also, increased collections at transportation sites in the Snake River could have decreased the proportion of Snake River smolts arriving at McNary Dam. Fewer mid-Columbia yearling chinook and steelhead may have arrived at McNary Dam. For example, the recovery proportions of marked spring chinook from Leavenworth, Entiat and Winthrop hatcheries were 20 to 33% lower than last year, and the brand recovery proportions of Wells Hatchery steelhead released in the Similkameen and Methow rivers were 13% and 30% lower than in 1989, respectively. Also, about 10% of the yearling chinook and 20% of the steelhead cumulative passage indices for 1990 occurred on days when over 20% of the flow at McNary Dam was spilled, which may have passed mid-Columbia origin fish at a higher rate than accounted for in the passage index. The reduction in recovery proportion was more severe for hatchery steelhead than wild steelhead at McNary Dam. The 1990 hatchery steelhead passage index was 38% lower than in 1989, while the wild steelhead passage index was 21% lower (Table 10).

The 1990 cumulative passage indices for the remaining species at McNary Dam were 231,000

coho, 294,300 sockeye, and 8,507,900 subyearling chinook (Table 9). The 1990 cumulative passage index for coho did not differ from expectations at McNary Dam, based on the magnitude of the hatchery releases above that site. Almost 60% of these hatchery coho were planted in the Yakima River system, and the remaining 40% were released above Rock Island Dam. The speculation that a lower collection efficiency occurred at Rock Island Dam in 1990 was supported by the fact that the 1990 annual coho passage index/hatchery release ratio at McNary Dam did not decrease. The sockeye annual passage index at McNary Dam continued to decrease in 1990 relative to historical levels. The low recovery of sockeye at McNary Dam and at the other monitoring sites confirmed that the sockeye outmigration for 1990 was depressed. The run of Osoyoos stock sockeye was nearly non-existent this year. On the brighter side, the 1990 annual passage index for subyearling chinook was the highest recorded at McNary Dam since the SMP began in 1984. River flow increased to over 300 kcfs by the start of June and remained above 260 kcfs for all but two days in June, and above 200 kcfs for all but one day in the first half of July. These higher flows moved large numbers of subyearling chinook past McNary Dam this year.

The 1990 cumulative passage indices at John Day Dam were 362,000 yearling chinook, 513,700 subyearling chinook, 133,800 steelhead, 84,300 coho and 23,600 sockeye (Table 9). These passage indices were less than half of the average of the previous five years for all species but coho. However, the use of a 5-year average for coho is inappropriate, since large hatchery releases of coho in the Umatilla River began only three years before 1990. When the 1990 annual passage index for coho was compared to the average of the previous three years, a 33% decrease was detected. The primary reason for the lower collections of all species in 1990 was that Unit 5 was monitored instead of Unit 3. Typically, greater numbers of smolts pass through the units closer to the shoreline, such as Unit 3. In addition, Unit 5 was out of service four times during the season for a total of 19 days. The longest outage of 11 days was due to the fire in the powerhouse late in May. Flows increased dramatically during this outage, which undoubtedly pushed large numbers of late spring migrant and early summer migrants past John Day Dam, as occurred at other monitoring sites. The steelhead annual passage index consisted of 51.2% wild and 48.8% hatchery stocks (Table 10), but had sampling continued during late May into early June, higher percentages of hatchery steelhead would have been collected. Because of these sampling problems, the 1990 cumulative passage indices at John Day Dam have limited utility.

The 1990 cumulative passage indices at Bonneville Dam powerhouse 1 were 332,500 yearling chinook, 1,217,500 subyearling chinook, 127,800 steelhead, 677,100 coho and 81,400 sockeye (Table 9). Approximately 595,000 smolts were released above John Day Dam on May 30 from a transportation barge. An estimate of 5,000 yearling chinook and 75,000 steelhead from this barge

release were subtracted from the passage indices of June 2 and 3 before the annual passage indices listed above for yearling chinook and steelhead were computed. The 75,000 steelhead estimate was further divided into 67,000 hatchery and 8,000 wild fish, based on the 11% wild to 89% hatchery steelhead composition determined at Lower Granite Dam, where most of the fish originated. Although the resulting steelhead cumulative passage index at Bonneville Dam consisted of 48.3% wild and 51.7% hatchery stocks, identical to last year's composition, the index was 38% lower in 1990 than in 1989 for these stocks (Table 10). The relation between the 1990 cumulative passage indices and historical means for each species were similar at Bonneville Dam to that observed at McNary Dam, indicating a consistency in the data for the lower Columbia River reach. Most noteworthy this year was the 167% increase over the previous 2-year average for the cumulative passage index of subyearling chinook passing Bonneville Dam after June 1. These fish were almost exclusively upriver bright stocks (hatchery and wild). The high flows in June and the first half of July moved large numbers of subyearling chinook of both upriver origin and Bonneville pool origin past Bonneville Dam this year.

3. Conclusions.

Cumulative passage indices of spring migrants were higher at Lower Granite Dam and lower at Rock Island, McNary, and Bonneville dams compared to the historical average. Reduced survival from lower flows during mid-May in the Snake River, increased transportation of steelhead from in the Snake River, and lower contribution of mid-Columbia River yearling chinook, steelhead and sockeye may have contributed to the reduced cumulative passage indices of these spring migrants in the lower Columbia River in 1990. High flows throughout June and early July in the lower Columbia River contributed to the highest cumulative passage indices for summer migrants being recorded at McNary and Bonneville dams since monitoring began at these sites. The 1990 summer migration documented the benefits to smolt survival of increased flow levels.