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Transportation Operations on the Snake and Columbia Rivers, 1980

by
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Larry R. Basham, Bruce H. Monk,
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INTRODUCTION

During 1980, the National Marine Fisheries Service (NMFS) under contract to the U.S. Army Corps of Engineers (CofE) continued to plan, prepare, and carry out most of the activities relevant to collection and transportation operations (popularly known as "Operation Fish Run") on the Snake and Columbia Rivers. The major objective of these operations was to provide protection to a maximum number of juvenile salmonids by transporting them in trucks or barges from Lower Granite, Little Goose, and McNary Dams to safe release sites in the Columbia River below Bonneville Dam.

This report describes and summarizes these operations for 1980 by providing numbers of salmonids transported by species, numbers tagged, overall fish condition, environmental effects, facility and equipment operations, and related problems.

MASS TRANSPORT OF SMOLTS

For the second consecutive year, cool weather prevailed during the late winter and early spring causing delay in the outmigration of fingerlings from all river systems. For example, at Rapid River Hatchery, the major seaward migration of spring chinook salmon, which normally occurs from early to mid-March, was delayed nearly 3 weeks by the abnormally cold water. However, near the end of March when water temperatures finally reached the level required to trigger the migration, the fingerlings were apparently well smolted and moved downstream with a minimum of delay and mortality.

The downstream migration of fingerlings from the Snake River was assisted by an adequate spring freshet. At Lower Granite Dam the daily average river flow (Figure 1) remained above 80,000 cfs from 22 April until 27 June. This combination of well smolted fingerlings and adequate river flows resulted in favorable migration conditions to Lower Granite Dam. These conditions coupled with the excellent spawning escapement in 1978, produced the largest population of chinook salmon smolts to arrive at Lower Granite Dam in the last decade (Table 1).

The operational procedures designed to maximize truck and barge usage among the three collector dams were the same as previously described by Smith et al. (1980). Chinook salmon arrived at Lower Granite Dam in sufficient numbers to begin truck transport operations on 3 April; at Little Goose Dam, the first fish were hauled by truck on 7 April. All fingerlings were hauled by truck until 21 April, when barging operations began. The final barge load of smolts departed Lower Granite Dam on 29 May. Trucks were used to haul the remaining smolts until transport operations were terminated on 7 July.

Again in 1980, less than 100% of the combined smolt collection potential was achieved at the two collector dams on the Snake River. The major reasons were as follows: (1) at Lower Granite Dam, important research conducted by NMFS required operating Intake 4A without a traveling screen until 14 May (Park et al. 1981); (2) an inspection hatch located in the water upwell of the fingerling collection facility at Lower Granite Dam came off sometime during the collection season and allowed passage of an undetermined number of smolts back to the river; (3) after the collection

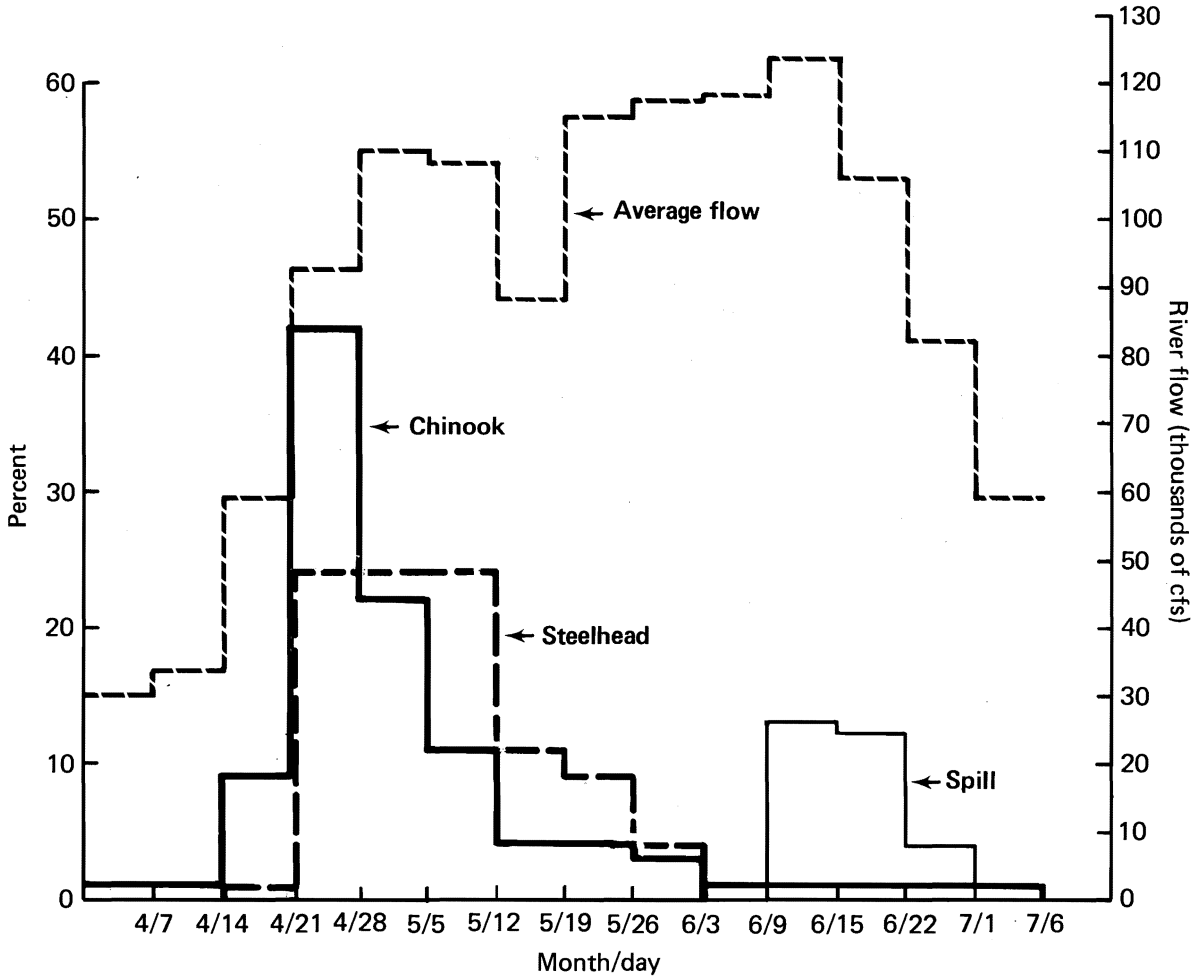

Figure 1.--The timing of chinook salmon and steelhead migrations at Lower Granite Dam compared to average river flows and spill at the dam, 1980.

Table 1.--Number of chinook salmon and steelhead smolts arriving at the upper dam and the number and percent of the total Snake River outmigration transported below Bonneville Dam 1971-1980 (includes experimental fish marked for transport evaluation).

	Chinook smolts			Steelhead smolts		
Year	No. at upper dam (1,000)	No. hauled (1,000)	Percent hauled	No. at upper dam (1,000)	No. hauled (1,000)	Percent hauled
Transport from Little Goose Dam						
1971[a]	4,000	109	3	5,500	154	3
1972	5,000	360	7	2,500	227	9
1973	5,000	247	5	5,500	176	3
1974	3,500	0	0	5,000	0	0
Transport from Lower Granite and Little Goose Dams combined						
1975	4,000	414	10	3,200	549	17
1976	5,000	751	15	3,200	435	14
1977	2,000	1,365	68	1,400	895	64
1978	3,180	1,623	51	2,120	1,355	64
1979	4,270	2,109	49	2,550	1,712	67
1980[b]	5,600	3,254	58	3,600	2,860	79

[a] Data for years 1971-79 from Smith et al. (1980).

[b] Number of smolts estimated at upper dam from Sims et al. (1981).

season, NMFS discovered that the new type traveling screens presently in use at Lower Granite and Little Goose Dams have a structural problem that may have adversely affected their guidance capabilities; and (4) the traveling screens at Little Goose Dam did not operate in an acceptable manner for the entire migration period. These problems are addressed in greater detail later in this report.

Sims et al. (1981) estimated that 5,600,000 chinook salmon and 3,600,000 steelhead arrived at Lower Granite Dam in 1980; we transported 58% of the available chinook salmon and 79% of the available steelhead from the two Snake River dams (Table 1). In spite of the aforementioned collection deficiencies, these figures reflect a 9 and 12% increase, respectively, in the collection efficiencies for these species over the previous year. (See Appendix Tables B1 to B7 for daily transport totals for each species at Lower Granite and Little Goose Dams. These tables also indicate disposition of all fish collected or counted, but not transported to Bonneville Dam.)

At McNary Dam, six guiding devices (three submersible traveling screens and three bar screens) were operated in 1980 as in 1979. These devices, however, were operated in a different gatewell combination, which may have increased the collection potential somewhat. (In 1980, devices were operated in Gatewell Slots A and B of three units; whereas in 1979, devices were operated in Slots A, B, and C of two units.)

In 1980, 7,861,337 salmonids were transported from the three collector dams to safe release sites below Bonneville Dam (Table 2). This is a 55% increase over the total transported during 1979. The two fish transport barges hauled about 62% of the total, with the remainder hauled by truck.

Table 2.--Number of juvenile chinook, coho, and sockeye salmon and steelhead transported from Lower Granite, Little Goose, and McNary Dams and released below Bonneville Dam, 1980.

	Chinook	Coho	Sockeye	Steelhead	Total
Lower Granite Dam					
Truck	316,250	37	1,076	195,774	513,137
Barge	1,700,809	101	2,925	1,617,914	3,321,749
Subtotal	2,017,059	138	4,001	1,813,688	3,834,886[a]
Little Goose Dam					
Truck	792,924	----	1,851	621,985	1,416,760
Barge	444,195	----	1,068	423,883	869,146
Subtotal	1,237,119	----	2,919	1,045,868	2,285,906
McNary Dam					
Truck	972,620	15,377	21,456	82,846	1,092,299
Barge	474,199	17,976	28,931	127,140	648,246
Subtotal	1,446,819[b]	33,353	50,387	209,986	1,740,545
Grand total transported	4,700,997	33,491	57,307	3,069,542	7,861,337[c]

[a] This total adjusted for a significant counter error.

[b] This total includes 651,678 fall chinook salmon.

[c] This total includes those fish marked and transported for experimental purposes.

TRANSPORT OPERATIONS - LOWER GRANITE DAM

Collection, Transportation, and Marking

Prior to the collection season, the CofE cleared the upper areas of the trash racks of accumulated debris by sliding a large, steel H-beam down the trash racks and pushing most of the debris to the bottom of the reservoir. The clearing operation appeared to have benefited the collection and condition of chinook salmon. The collection efficiency for this species increased from 31% in 1979 to 36% in 1980. [Efficiencies are based on population estimates from Sims et al. (1981).] Condition of chinook salmon was the best we have measured (see section on fish condition).

Collection efficiency would probably have been even higher in 1980 except for two events: (1) a traveling screen was not operated in Intake Gateslot 4A until 14 May and (2) an inspection hatch was dislodged in the upwell. The traveling screen was not operated because of a research program being conducted to evaluate areas of potential stress and their relation to survival of chinook salmon (Park et al. 1981). The dislodged inspection hatch resulted in an opening approximately 2 x 3 feet in the cement sill just upstream from the large inclined screen portion of the fingerling sorter system and provided an escape route for migrants back to the river. (We recommend that the CofE improve the method of attachment for this hatch prior to the 1981 collection season.)

Since initiation of mass transport at Lower Granite Dam, we have been perplexed because collection efficiency for chinook salmon has been much lower than the collection efficiency for steelhead. Prior testing of the newly designed traveling screens did not indicate such a difference would

occur. Shortly after the 1980 season ended, however, NMFS personnel discovered that the new traveling screens were not built according to criteria provided by NMFS and had been operating incorrectly since their installation. The upper framework was constructed so the entrance to the gatewell was restricted. Indications were that resultant hydraulic conditions may have impeded the collection of chinook salmon; whereas, the capability to collect/divert steelhead was unchanged. Recommendations to rectify the problem have been made to the CofE. It was also determined that the new traveling screens installed at McNary Dam and those presently under construction for operation at McNary Dam were not affected by this design problem.

Collection and transportation operations began at Lower Granite Dam on 3 April, but the numbers of chinook salmon fingerlings collected remained low and relatively stable until 18 April when the count increased rapidly to peaks on 22 and 24 April (Figure 1). The first and largest peak of steelhead occurred on 26 April. This development provided: (1) extremely large numbers of smolts in a relatively short period of time thereby allowing the first opportunity to examine the maximum holding capacity of the Lower Granite Dam facility and (2) by far the largest number (245,000) of salmonids available for transport on a daily basis since mass transportation operations began. Totals of 2,017,059 chinook salmon and 1,813,688 steelhead were transported from Lower Granite Dam in 1980. (Incidental numbers of coho and sockeye salmon were also transported.) Of these totals, 40,719 chinook salmon and 32,559 steelhead transported by barge were marked to provide a means to index the success of the mass transport operations based on adult returns in future years. A group of

21,876 chinook salmon and 19,273 steelhead were released in the Little Goose Dam tailrace to serve as a control for the transport groups. These fish along with others released in the forebay of Lower Granite Dam were used for population/mortality estimates in related studies conducted by Sims et al. (1981). In addition, the special study conducted by NMFS to determine possible areas of stress to chinook salmon in the bypass system required marking 119,020 chinook salmon.

All marked groups except the index group (Sims et al. 1981) received adipose fin clips, distinctive freeze brands, and coded wire tags. The index group received a freeze brand only. Table 3 and Appendix Tables B8 to B14 contain summaries of all marked release groups. (Appendix Table B15 contains a list of wire tag codes.)

All fish that were marked for the barge, control, and index groups were obtained from a random sample of the total population arriving at the facility in any given 24-h period. The sample was obtained by diverting fish from all of the separator outlet pipes to a specific sample raceway at different times during this period. The majority of the sample was taken when fish counts were highest (evenings). Within the logistical constraints of the facililty, the sample size and numbers marked were determined by the magnitude of the fish migration. That is, progressively larger samples were taken as total fish numbers increased and progressively smaller samples were taken as total fish numbers decreased.

After a sample was obtained for a 24-h period, it was transferred into the fish marking building for processing, sorting, and marking; descaling rates, previous marks, fish weights, and species composition were recorded. Later, this information was extrapolated to the entire population represented by the sample. Previously marked, descaled, injured, or

Table 3.--Summary of marked and unmarked chinook salmon and steelhead at Lower Granite Dam by release sites, 1980. (Includes controls that were marked but not actually transported.)

Release Sites	Marked		Unmarked	
	Chinook	Steelhead	Chinook	Steelhead
Trucked				
Bonneville Dam	119,020	--	197,230	195,774
Barged				
Bonneville Dam	40,719	32,559	1,660,090	1,585,355
Lower Granite forebay[a]				
Clarkston, WA (Index)	29,131	16,634	--	--
Little Goose tailrace				
Texas Rapids (Control)	21,876	19,273	--	--
Totals	210,746	68,466	1,857,320	1,781,129

[a] This group was marked by freeze brand only. All other groups were branded, adipose clipped, and wire tagged.

fungused fish were sent directly to a truck or barge. Other fish in the sample judged to be in good condition were diverted to the marking stations for adipose fin removal, freeze branding, and injection of the magnetic coded wire tag into the fish's snout. The freeze brand and wire tag identify a specific group; whereas, the adipose fin clips simply indicate the presence of a wire tag in the fish's snout. After completion of the marking process, the fish were sent through an electronic detector head that automatically rejected any untagged fish, thereby ensuring that only properly tagged fish were included in each group. To inhibit fungal growth, properly tagged fish entered a 20-foot section of PVC pipe containing a recirculating, temperature-controlled solution (1:20,000) of malachite green. At the end of this pipe, the fish passed over a screen device that eliminated the malachite solution. They then passed into a pipe containing running fresh water that carried them to a truck or barge.

Fish Condition, Descaling, and Delayed Mortality

As in past years, descaling rates (percentage of a population considered descaled) measured at the fish marking facility were used to index the general condition of transported fish. A fish was considered to be descaled if 10% of its scales were missing. The average daily descaling rate for chinook salmon was 4.0% (range 1 to 11%)--the lowest ever recorded for this species (Appendix Table B16). The rate of descaling for steelhead measured 8.2% (range 1 to 24%)--the highest rate ever recorded for this species (Appendix Table B17). We believe the very low descaling rate measured for chinook salmon resulted from a combination of factors including: excellent traveling screen condition and operation, relatively debris-free trash racks, and environmental conditions which produced a rapid downstream migration of fingerlings.

The high rate of descaling for steelhead, especially among hatchery fish, probably occurred before the fish arrived at Lower Granite Dam, since the chinook salmon collected were in excellent condition (our past experience at the dam indicates that chinook salmon descale much easier than steelhead). The descaling apparently did not impact steelhead survival to Lower Granite Dam--Sims et al. (1981) report a high survival of steelhead from Dworshak and Pahsimeroi Hatcheries to Lower Granite Dam.

Descaling and injury of fingerlings in gatewells where traveling screens were operating were monitored throughout the season (Table 4). Traveling screen operation and condition were satisfactory in 1980 based on the low combined average descaling rate of 2.2% for chinook salmon. However, again in 1980, the average descaling rate for chinook salmon was slightly higher in Units 1 and 2. This probably resulted from this year's cleaning technique being inadequate for removing the very large quantity of debris accumulated over a number of years at these particular units.

The condition of both species as determined by mortality rates and visual observation was excellent in 1980. In particular, the outstanding condition of steelhead smolts originating from the Dworshak National Fish Hatchery (NFH) was unprecedented and very encouraging. Fin erosion was limited almost entirely to the periphery of the dorsal fin and the incidence of fungal infection, so common on these fish in previous years, was practically nil. In addition, personnel from Dworshak NFH measured nine blood chemistry parameters comparing their fish with wild steelhead at the Lower Granite Dam facility. The tests indicated that the levels of the parameters measured were very similar for both groups of steelhead.[1/]

[1/]Personal communication, Terry Bradley, Dworshak NFH.

Table 4.--Average percent descaling for naturally migrating chinook salmon and steelhead collected from turbine intake gatewells at Lower Granite Dam, 1980.

	Descaling - chinook salmon																	
Unit	1			2			3			4			5			6		
Gatewell	A	B	C	A	B	C	A	B	C	A[a/]	B	C	A	B	C[b/]	A	B	C
		(%)			(%)			(%)			(%)			(%)			(%)	
Average by gatewell	2.0	3.3	2.0	3.5	4.5	5.0	1.1	2.8	1.3	--	1.5	2.1	0.0	2.3	--	1.3	1.5	1.3
Average by turbine unit		2.4			4.2			1.7			1.8			1.2			1.4	

Combined average for entire season 2.2%

	Descaling - steelhead																	
Unit	1			2			3			4			5			6		
Gatewell	A	B	C	A	B	C	A	B	C	A[a/]	B	C	A	B	C[b/]	A	B	C
		(%)			(%)			(%)			(%)			(%)			(%)	
Average by gatewell	6.7	5.5	6.6	9.3	5.4	10.3	6.5	5.2	6.3	7.7	6.7	7.3	6.2	5.0	--	4.2	6.7	4.5
Average by turbine unit		6.3			8.3			6.0			7.2			5.9			5.2	

Combined average for entire season 7.6%

a/ A traveling screen was not operated in this turbine intake gatewell until 14 May 1980.

b/ Traveling screen storage prevented sampling of this gatewell.

A special delayed mortality study to measure the survival of chinook salmon fingerlings transported from Lower Granite Dam was conducted by NMFS research personnel in 1980. Several groups of fingerlings from barge and truck releases were held in tanks at Bonneville Dam for 2-day and 14-day intervals. Similar control groups were also held in tanks at Lower Granite Dam. The average percent survival for these groups is presented in Table 5. The average 2-day survival rates of 99.0, 98.1, and 97.8% for the barge, truck, and control groups, respectively, represent the highest average survival of chinook salmon that we have ever measured in studies of this type. The high average for the trucked group is especially encouraging and probably reflects both good fish condition and improved post transport sampling techniques. After 14 days, survival of transported fish declined to about 80% and control fish to 90%. This suggests that the bypass-collection system and transportation each imparted about the same stress and subsequent mortality. It should be emphasized that even with this mortality, survival of 80% is still significantly higher than the survival of nontransported fish [33% survival to John Day Dam in 1980 (Sims et al. 1981)]. A more detailed discussion of the stress study is presented in Park et al. (1981).

In summation, we expect the excellent physical condition of both chinook salmon and steelhead will have a very positive influence on the survival of fish transported from Lower Granite Dam in 1980. (Note, however, the Mount St. Helens eruption on 18 May 1980 may be a complicating factor influencing survival. By 15 May 80, 85% of <u>all</u> chinook salmon and 75% of <u>all</u> steelhead had been transferred from Snake River dams. Although most Snake River fish should have been below the mouth of the Cowlitz River

Table 5.--Average percent survival, after 2 and 14 days, of samples of chinook salmon collected at Lower Granite Dam and transported to Bonneville Dam by truck or barge. Survivals of control groups held at Lower Granite Dam are also shown.

Group	Number held	Average survival (%)	
		2-day	14-day
Barge[a/]	571	99.0	80.8
Truck[a/]	766	98.1	79.4
Control[b/]	458	97.8	89.7

a/ Groups held in tanks at Bonneville Dam after transport.

b/ Groups held in tanks at Lower Granite Dam prior to transport.

where tremendous quantities of silt emptied into the Columbia River, it is speculative to say if the effects were beneficial or detrimental to smolts.)

Facility Modifications and Effects

Makeup Water Sluice Gate

At the request of NMFS, the CofE installed an additional 42-inch diameter makeup water sluice gate in the downstream end of the bypass gallery to improve water regulation in the entire fish bypass system. As anticipated, operation of the bypass system with the new sluice gate eliminated the problems we had experienced in past years with water control. However, operation of the system in this manner introduced a minor, unforeseen problem discovered during the peak of the steelhead outmigration. During periods of heavy fingerling (especially steelhead) movement, large numbers of fish tended to build up in the calm area at the upstream end of the bypass channel. To alleviate this buildup problem, we recommend shutting off the new sluice gate and running the old makeup water gate for 15 to 20 minutes each day that daily fish counts exceed 50,000 and 15 to 20 minutes every third day regardless of fish count.

After the new makeup water gate was installed, a design problem was discovered which prevented the gate from opening more than about half way. Since there was not enough time to correct this problem before the 1980 collection season, we agreed to operate under this constraint with the proviso that the forebay level at Lower Granite Dam be held at or above 735 feet. Although no problems were encountered using this operating procedure, we recommend the flaw be corrected prior to the 1981 collection season so that the system can be operated as designed.

Fish Separator

Prior to the 1980 collection season, NMFS removed and modified the fish separator at Lower Granite Dam. The modifications included: (1) drilling a row of holes along every other separator bar to provide more water along the separation area; (2) installing metal wiers along the inner edges of the hopper pans to provide a water cushion for fish falling through the separator bars over these pans; and (3) increasing the number of egress pipes and associated counter tunnels from 4 to 6. The objectives of these modifications were to reduce stress and injury to fingerlings during the separation process and to provide more accurate fish counts. We believe the first two modifications were successful in reducing stress and injury to the fingerlings; however, they also introduced certain hydraulic conditions within the collection hoppers which caused a disproportionate number of fingerlings to egress through Counter Tunnel Number 4. This resulted in substantial errors in total count. These errors were as high as 43% during periods of heavy fish movement. To adjust for these errors, a series of tests were made in which fish were passed through the electronic counters and then manually counted to establish a calibration curve for the electronic counters. A detailed explanation of this procedure and adjusted counter data are provided in Appendix A. All of the totals for Lower Granite Dam contained in this report were adjusted using this procedure. A modified separator designed to alleviate this problem in future years is being constructed and will be installed by NMFS prior to the 1981 collection and transportation season.

Constrictor Rings

During the early part of the 1980 collection season when fish numbers were still low, we suddenly began to observe unusually high mortalities of

up to 7% for chinook salmon at the collection facility. By releasing fish at different locations within the collection and bypass system, we determined the mortality was originating in the bypass pipe between the collection gallery inside the dam and the fish separator. In 1975, NMFS installed three constrictor rings in the lower end of the bypass pipe to improve the water regulation problems mentioned previously. A subsequent inspection of the bypass pipe revealed that the two upstream rings had moved down the pipe and were lodged against and slightly offset from the downstream ring. In this position, the rings provided little, if any, benefit for water regulation and probably introduced hydraulic sheer planes and abrupt edges into the path of the fingerlings. Therefore, we removed the rings from the bypass pipe. As expected, the mortality rate for chinook salmon decreased immediately to less than 1%.

Because the new makeup water gate provides excellent water control in the entire system, we recommend that these rings not be replaced in the bypass pipe at Lower Granite Dam. Also, similar constrictor rings installed in the bypass pipe at Little Goose Dam where water control problems still exist should be checked annually prior to the collection season.

System Capacities

In 1980, the nearly simultaneous and relatively concentrated peaks of chinook salmon and steelhead provided the first evidence of the fish holding capacity of the raceway holding area at Lower Granite Dam. At one point almost 50,000 lb of fingerlings were contained in the holding raceways; about three times the poundage that had been held at this facility previously.

The most important consideration when holding fish in a flow through system is the amount of water flow required to provide adequate oxygen levels to maintain a certain poundage of fish. In other words, loading rates are determined by the gallons per minute (gpm) of water flow through a system (consideration must also be given to water velocity, as will be discussed later). The fisheries literature contains many entries that pertain to loading rates for salmonid parr under different hatchery conditions. However, information of this type for salmonid smolts in a nonhatchery type of environment is wanting.

Using the available literature pertaining to hatchery parr and some intuitive reasoning, we determined in past years that loading rates for smolts in the barges and raceways should not exceed 10 lb of fish per gpm of water flow. This year, we experienced situations that approached these calculated loading rates for both barges and raceways at Lower Granite Dam.

Normally raceway capacity in pounds will be dependent upon: (1) quantity of fish (weight), (2) species composition, (3) inflow to the raceway, (4) condition of fish present, (5) volume of water in the raceway, and (6) velocity of water passing through the screen at the downstream end of each raceway. In practical operations we have control over variables 3 and 6 above. Inflow can be controlled by a gate valve at the head of each raceway, and the velocity through the screen can be controlled to the extent that it can be cleaned, maintaining a maximum open area of the screen. Although all variables mentioned must be considered, our observations this year lead us to believe that in practical operations, the holding capacity of the raceways is limited by water velocity through the

retaining screens at the end of the raceways and not by the inflow capacity. When water flow volume exceeds 1,200 gpm, the small, weaker swimming chinook salmon fingerlings begin to impinge on the retaining screens. Even small increases in water volume above this level caused large accumulations of fingerlings on the screen and subsequent mortalities in relatively short periods of time. As the buildup of fish and debris on the screens increased, the open area of the screen is further reduced resulting in a greater head loss and increased velocity on the gross area of the screen which causes faster buildups of fingerlings over the remaining open areas of the screens. If the screens are not kept clean, large numbers of chinook salmon mortalities will occur on the screens, and if the screens are allowed to become completely plugged, the raceways will overflow. Using the maximum criterion of 10 lb of fish per gpm of water flow, the maximum capacity for each raceway is 12,000 lb (10 lb x 1,200 gpm).

The following examples of capacity or near capacity situations were observed at Lower Granite Dam in 1980: (1) A raceway contained 105,000 fish--90% chinook salmon and 10% steelhead--with a combined average weight of 15/lb. We calculated total weight to be 7,000 lb. There were approximately 1,200 gpm of inflow to the raceway, and no impingement of fish was observed on the retaining screen. (2) In the second example, 80,000 fish were present--50% chinook salmon and 50% steelhead--with an average weight of 8/lb. Thus we were holding 10,000 lb of fish. The inflow was 1,400 gpm, and we observed that chinook salmon (weaker and possibly more highly smolted fish) were impinging on the retaining screen. We reduced the inflow to 1,200 gpm and impingement ceased.

These cases are not intended to show that maximum capacity was attained in the raceways. They do, however, indicate the interaction among the variables. They also point out that future managers of holding facilities must be alert because even relatively minor changes of capacity variables will have significant effects on the well being of fish.

Overall, a good rule of thumb for managers planning barging schedules is that, collectively, the Lower Granite Dam facility raceways are capable of holding a little more than one barge load of fish. This rule will vary somewhat depending upon the species composition at any given time. That is, the facility is capable of holding more pounds of steelhead than chinook salmon, whereas, the barge is limited to the same poundage of both species because inflow to the barge tanks is limited by pumping capacity.

In the near future, the substantially increased smolt production level planned for the Snake River system together with the probability that simultaneous peaks of both species will occur, make it inevitable that the holding capacity of the present facility will be exceeded. We recommend three additional concrete raceways be installed just upstream from the fish separator. To provide maximum protection for fish, design specifications for these raceways should be closely coordinated with individuals experienced in the interactions between systems of this type and smolted salmonids.

TRANSPORT OPERATIONS - LITTLE GOOSE DAM

Collection and Transportation

A new fingerling bypass system was completed and water tested prior to the 1980 fish transportation season. Traveling screens were installed and in operation by 1 April. The screen installation was just in time as 800 chinook salmon were counted in the first 4 days of operation. A comparison

of fish counts at Lower Granite Dam with those at Little Goose Dam over the season indicates that smolts generally take 2 days to travel from the upper dam to Little Goose Dam.

Collection at Little Goose Dam exceeded 1.2 million chinook salmon and 1.0 million steelhead--most of which were transported by truck or barge (Table 2). Appendix Tables B5 to B7 provide a detailed daily accounting of numbers counted, numbers transported, and mortalities observed in collection.

Daily mortality of juvenile chinook salmon was excessive through most of April, reaching a peak on 27 April; whereas, mortality to steelhead was low. The problem was finally traced to the operation of the makeup water gate which provides a stabilizing flow to the fingerling bypass pipe. The gate itself did not cause mortality, but velocities were created by its use which we believe caused mortality within the bypass pipe. To temporarily rectify the problem, the gate was operated at no more than 20% open, thereby greatly reducing mortality to chinook salmon. The CofE is planning to install a pinch valve in the bypass pipe prior to 1 April 1981. This will reduce the water velocity and allow greater flexibility in the operation of the makeup water gate.

Fish Condition, Descaling, and Traveling Screen Operations

Salmonids were dipped from the gatewell slots to determine descaling rates for those fish diverted from turbine intakes to gatewells. The combined average descaling for chinook salmon and steelhead was 8.0% (Table 6 and Appendix Tables B18 and B19). The descaling rates at Little Goose Dam were higher than at Lower Granite Dam for chinook salmon (8.0 vs 2.2%) and for steelhead (8.0 vs 7.6%).

Table 6.--Average percent descaling for naturally migrating juvenile chinook salmon and steelhead collected from turbine intake gatewells at Little Goose Dam, 1980

	Descaling - chinook salmon												
Unit	1			2			3			4			5
Gatewell	A	B	C	A	B	C	A	B	C	A	B	C	B
		(%)			(%)			(%)			(%)		(%)
Average by gatewell	7.9	8.3	8.1	9.6	11.6	5.9	6.9	8.0	9.6	6.7	6.6	6.3	6.9
Average by turbine unit		8.1			9.4			8.2			6.6		6.9

Combined average for entire season 8.0%

	Descaling - steelhead												
Unit	1			2			3			4			5
Gatewell	A	B	C	A	B	C	A	B	C	A	B	C	B
		(%)			(%)			(%)			(%)		(%)
Average by gatewell	8.7	7.4	9.7	7.2	7.5	7.7	7.9	7.3	7.4	7.0	7.6	9.0	6.4
Average by turbine unit		8.6			7.4			7.5			7.8		6.4

Combined average for entire season 8.0%

We anticipated that descaling rates for salmonids dipped from gatewells would provide an indicator to determine if the traveling screens were functioning properly. We now believe this technique is no longer useful because passage of fish through the 12-inch diameter gatewell orifices was very efficient, and at times we had trouble collecting a valid sample for descaling measurements.

Chinook salmon and steelhead were also sampled from the raceways to ascertain their condition after passing through the bypass system. Descaling of chinook salmon ranged from 5.5 to 20.6% with an overall average of 11.0%; whereas, steelhead ranged from 2.1 to 16.4% with an overall average of 8.6%. It is likely that malfunctioning traveling screens and the existing fingerling sorter (discussed next) coupled with the problem mentioned earlier (i.e., the makeup water gate) contributed the major part of the descaling to chinook salmon at Little Goose Dam. Because of these problems, there was no effective way to ascertain whether the new bypass system improved fish condition.

Trash and debris accumulation at the fingerling sorter was severe at times, and it took constant vigilance to keep the system operating properly. The dry sorter used at all collector dams in 1980 probably caused some stress, and, when coupled with the presence of debris, may also cause descaling. In a step to improve fingerling sorters, NMFS will install and test a new "wet" separation concept at Little Goose Dam in 1981.

The traveling screens were inspected by the NMFS and were in good condition prior to the start of operation. However, at the end of the season, their condition was unsatisfactory. It is likely that most of the 12 screens were not operating when the fish collection period ended. Several factors contributed to the poor condition of the screens and these

have been discussed with operations staff. The most important of these is the lack of an adequate means of detecting a malfunction.

Since there is a need to monitor all screens more closely during the operating season, we urge the CofE to expedite the development of an automated inspection system (perhaps utilizing underwater TV). Screens could then be visually checked for proper operation without the costly time delays inherent in withdrawing units to deck level. Hopefully, the formation of the Fish Transport Oversight Team and an agreed upon inspection schedule should resolve many of these problems.

Construction of New Fingerling Facilities

A new bypass system for juvenile salmonids was in operation this year at Little Goose Dam. The previous bypass system described by Smith and Farr (1975) was altered substantially. The diversion system now consists of a 665-foot long rectangular concrete flume, 6 feet wide by 7 feet high, that extends the full length of the powerhouse. There are two lighted 12-inch diameter orifices that empty into the bypass flume from each gatewell slot.

A 42-inch diameter makeup-water gate valve was installed perpendicular to the bypass flume at its downstream end. Flows from the flume combine with makeup water and flow into a "hopper" prior to entry into the bypass pipe. The makeup gate can be automatically set to supplement flows from the orifices (flume) to attain a constant flow through the bypass pipe.

The bypass pipe is 600 feet long, manufactured of steel at its beginning and of spun concrete for that portion that is underground. The pipe's diameter is 39 inches at the beginning, extending to 42 inches in the underground portion. There are three constrictor rings at the lower end of the pipe (spread about 25 yards apart) that retard the water velocity

through the pipe. The overall water velocity in the bypass pipe was approximately 25 fps with a maximum water volume of 225 cfs when functioning as designed. The upwell and sorter at the terminal end of the pipe is similar to the one used at Lower Granite Dam (Matthews et al. 1977).

A barge loading facility was also constructed prior to the 1980 transportation season. This installation made it possible for a tug with barge to moor adjacent to the fish collection raceways. Fish were moved through a flexible hose directly from the raceways into the waiting barge.

TRANSPORT OPERATIONS - McNARY DAM

At McNary Dam, 1980 marked the third year of collection and transportation. Virtually the same collection capability prevailed as in 1979. Vertical barrier screens were in all gatewell slots and three traveling screens and three bar screens were used in Turbine Units 4, 5, and 6 (two in each unit).

A total of 2.1 million salmonids were collected. Details for daily collection, marking, mortality, and disposition of all fish handled at McNary Dam are addressed in Park et al. (1981).

BARGE OPERATIONS

Marine Leasing of Vancouver, Washington was under contract with the CofE for barging operations between 20 April and 31 May 1980. Their two tugs (PATRICIA and JOHN ACKERMAN) in conjunction with the CofE barges, transported 4.8 million juvenile salmonids from two Snake River dams (Little Goose and Lower Granite) and McNary Dam on the Columbia River (Appendix Table B20). These juveniles were released below Bonneville Dam at River Mile 147 where water depth was 60 to 70 feet.

Numbers of fish barged from the three dams, water quality (temperature and dissolved O_2), and transport mortalities were monitored during each barge trip (Appendix Table B20). From these data, it was apparent that under all load densities, life support conditions were adequate. With 513,000 fish in the barge, transport mortality for chinook salmon was about average (0.26%), and steelhead mortality was negligible.

Although numbers of salmonids barged surpassed that of all previous years, we did encounter the following problems:

1. The diesel engines that drive the water pumps had sticky valves, overheating problems, and two complete breakdowns (promptly repaired by the CofE).

2. Mooring was difficult at the fish collection facilities at Little Goose Dam, and on 16 May 1980 minor damage was inflicted to the loading hose.

3. Tailrace elevations at Little Goose Dam were high during the barge loading operations. The high tailrace resulted in loss of head, which inturn hampered gravity flow loading. At times, raceway water level and barge elevations were very close to equal. To solve this problem either tailrace levels should be held lower during anticipated loading times or the raceways should be elevated.

4. In 1979, there were two NMFS personnel--a diesel maintenance mechanic and a fishery biologist--on each barge, responsible for monitoring life support systems to the three fish holding compartments while barges were in transit. These two employees alternated work schedules (4 h on and 4 h off) to alleviate long continuous shifts of up to 36 h. This season we operated with only a NMFS supplied fishery biologist on the barge. Without

two employees, the operation entailed long hours and presented a safety hazard to NMFS personnel. There were also short periods of time when no surveilance of fish and fish life support systems occurred.

5. The smaller tug (JOHN ACKERMAN) had problems maintaining our transport schedule. This fact, coupled with an abundance of fish collected at all dams, caused an unnecessary release of a load of fish just downstream from The Dalles Dam. Tugs should have adequate power to maintain transport schedules. In our judgement, no fish loads should be released prior to the targeted release site at Bonneville Dam unless fish life on board is in immediate jeopardy.

SUMMARY

1. In 1980, the largest population of chinook salmon in the past decade arrived at Lower Granite Dam and were available for transport. We transported 6,120,792 salmonids from the two collector dams on the Snake River. We estimated that 58% of the chinook salmon and 79% of steelhead that arrived at Lower Granite and Little Goose Dams were transported. In addition, 1,740,545 salmonids were transported from McNary Dam, bringing the total transported in 1980 to 7,861,337. This number represents a 55% increase over the total transported during 1979. At Lower Granite Dam a total of 279,212 salmonids were marked for various release groups.

2. In 1980, overall fish condition was excellent at Lower Granite Dam. Descaling rates measured at the fish marking facility were 4.0% for chinook salmon and 8.2% for steelhead. The good condition of steelhead from Dworshak NFH was especially encouraging.

3. In 1980, the concentrated and nearly simultaneous peaks of both species at Lower Granite Dam provided important information relative to

systems capacities and loading rates. Except in emergencies, loading rates should not exceed 10 lb of fish per gpm of water flow in all flow through systems. Impingement of chinook salmon on raceway retaining screens may occur when inflow exceeds 1,200 gpm in heavily loaded raceways.

4. Prior to 1980, a barge loading system was installed at Little Goose Dam. This installation made it possible for a tug with barge to moor adjacent to the fish collection raceways and receive fish, gravity fed, through a flexible hose. A total of 868,078 salmonids were successfully loaded and transported.

5. Traveling screen operation at Little Goose Dam was unsatisfactory in 1980. The combined average descaling for fish from the gatewell slots was 8.0% for chinook salmon and 8.0% for steelhead. These descaling rates surpassed Lower Granite Dam's rates by 5.8% for chinook salmon and 0.4% for steelhead.

RECOMMENDATIONS

1. Improve the method of attachment of the inspection hatch located in the upwell at Lower Granite Dam.

2. Whenever juvenile fish counts exceed 50,000 per day at Lower Granite Dam, operate the bypass system once a day for 15 to 20 minutes using the old makeup water gate in lieu of the new gate. The same procedure should be followed at least every third day regardless of fish count.

3. Correct the design problem that inhibits full use of the new makeup water gate at Lower Granite Dam.

4. Except during emergency situations, do not exceed a loading rate of 10 lb per gpm in all flow through systems.

5. At Lower Granite Dam, install three additional concrete raceways just upstream from the fingerling separator.

6. Improve traveling screen operations at Little Goose Dam.

7. Contract for tugboats with adequate power to permit a coordinated schedule for barging smolts from these dams.

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APPENDIX A

CALIBRATION OF ELECTRIC FISH COUNTERS

To calibrate the electronic fish counters a series of 2-h tests were made in which the numbers of fish counted electronically were compared with actual manual counts of the same fish. These data were used to calculate a linear calibration curve for the electronic fish counters (Figure A1). This calibration curve was applied to the daily electronic counts to obtain a corrected daily count of fish at the dam (Table A1). In these calculations, the daily fish counts were appropriately translated to be compatible with the 2-h sample interval used to construct the calibration curve.

Table A1.--Corrected daily fish counts at Lower Granite Dam, 1980.

Date	Number of fish	
	Electronic count	Corrected count[a]
4/21	63058	69690
4/22	105215	131745
4/23	127549	164621
4/24	142977	187331
4/25	200486	271984
4/26	166752	222328
4/27	156493	207226
4/28	142978	187332
4/29	172978	231492
4/30	132969	172599
5/1	94430	115870
5/2	78579	92537
5/3	69144	78649
5/4	83303	99491
5/5	97774	120792
5/6	104720	131017
5/7	89765	109003
5/8	105394	132009
5/9	86129	103651
5/10	73604	85214
5/11	50535	51256
5/12	50549	51277
5/13	54634	57290
5/14	40999	37219
5/15	32062	24064
5/16	33020	25474
5/17	30313	21490
5/18	43387	40734
5/19	21344	8287
5/20	25824	14882
5/21	29714	20608
5/22	24113	12363
5/23	29689	20571
5/24	26677	16137
5/25	28075	18195
5/26	40505	36492
5/27	40556	36567
5/28	46536	45370
TOTALS	2,942,829	3,452,857

a/ See Figure A1.

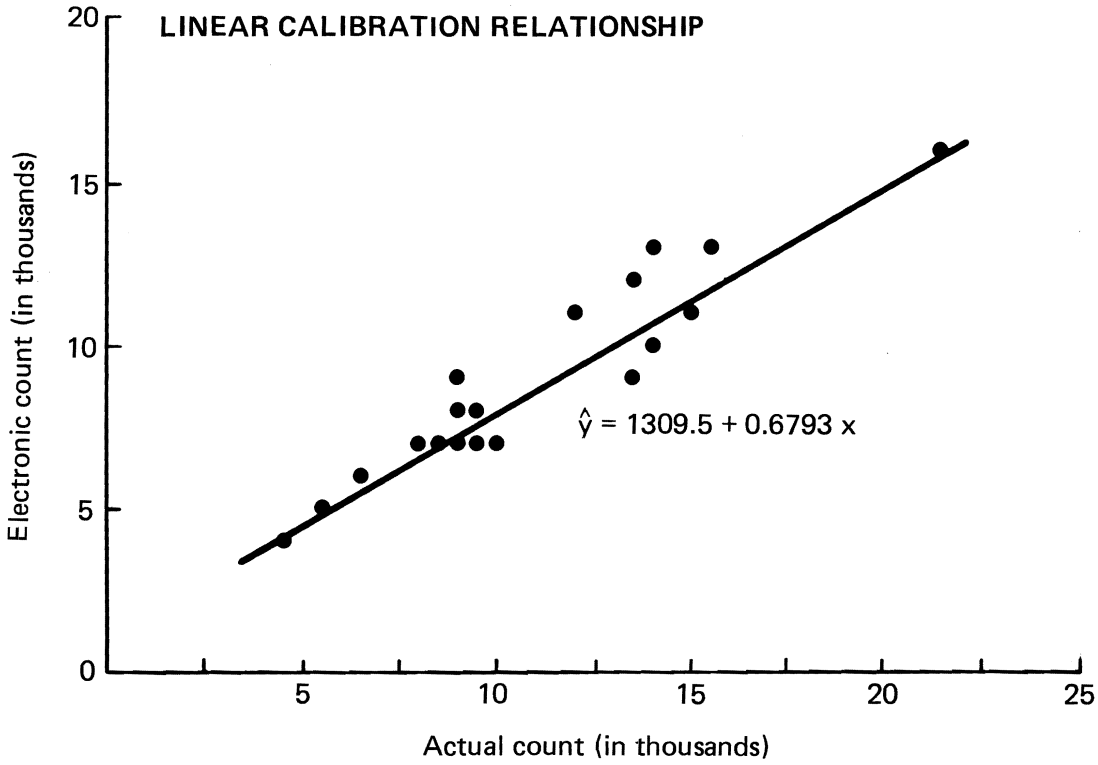

Figure A1.--Linear calibration relationship between the count obtained by the electronic counters and the actual number of fish passing through the system.

APPENDIX B

APPENDIX B

Table B1.--Numbers of juvenile chinook salmon counted, trucked, barged, and released as controls and mortality in collection by date at Lower Granite Dam, 1980.

Table B2.--Numbers of juvenile steelhead counted, trucked, barged, and released as controls and mortality in collection by date at Lower Granited Dam, 1980.

Table B3.--Numbers of juvenile sockeye salmon counted, trucked, and barged and mortality in collection by date at Lower Granite Dam, 1980.

Table B4.--Numbers of juvenile coho salmon counted, trucked, and barged and mortality in collection by date at Lower Granite Dam, 1980.

Table B5.--Numbers of juvenile chinook salmon counted, trucked, barged, observed as collection mortalities, and returned to Snake River by date at Little Goose Dam, 1980.

Table B6.--Numbers of juvenile steelhead counted, trucked, barged, observed as collection mortalities, and returned to Snake River by date at Little Goose Dam, 1980.

Table B7.--Numbers of juvenile sockeye salmon counted, trucked, and barged and mortality in collection by date at Little Goose Dam, 1980.

Table B8.--Date, brand position and orientation, and numbers of juvenile chinook salmon and steelhead marked and released in the Lower Granite Dam forebay at Clarkston, WA, 1980.

Table B9.--Date, wire tag code, brand position and orientation, and numbers of juvenile chinook salmon and steelhead marked and transported by barge from Lower Granite Dam to below Bonneville Dam, 1980.

Table B10.--Date, wire tag code, brand position and orientation, and numbers of juvenile chinook salmon and steelhead collected and marked at Lower Granite Dam and released as controls in the Little Goose Dam tailrace, 1980.

Table B11.--Date, wire tag code, brand position and orientation, and numbers of juvenile chinook salmon marked and transported by truck (Test #3) from Lower Granite Dam to below Bonneville Dam, 1980. (NOTE: Although this test was not conducted under mass transportation operations contract, the numbers were included in transport totals during 1980.)

Table B12.--Date, wire tag code, brand position and orientation, and numbers of juvenile chinook salmon marked and transported by truck (traditional manner) from Lower Granite Dam to below Bonneville Dam, 1980. (NOTE: Although this test was not conducted under mass transportation operations contract, the numbers were included in transport totals during 1980.)

Table B13.--Date, wire tag code, brand position and orientation, and numbers of juvenile chinook salmon marked and transported by truck (Test #1) from Lower Granite Dam to below Bonneville Dam, 1980. (NOTE: Although this test was not conducted under mass transportation operations contract, the numbers were included in transport totals during 1980.)

Table B14.--Date, wire tag code, brand position and orientation, and numbers of juvenile chinook salmon marked and transported by truck (Test #2) from Lower Granite Dam to below Bonneville Dam, 1980. (NOTE: Although this test was not conducted under mass transportation operations contract, the numbers were included in transport totals during 1980.)

Table B15.--List of codes used with rare-earth metals magnetic wire tags.

Table B16.--Percent descaling of juvenile chinook salmon by date, unit number, and gatewell slot designation or fish marking facility at Lower Granite Dam, 1980.

Table B17.--Percent descaling of juvenile steelhead by date, unit number, and gatewell designation or fish marking facility at Lower Granite Dam, 1980.

Table B18.--Percent descaling of juvenile chinook salmon by date, unit number, and gatewell slot designation or fish marking facility at Little Goose Dam, 1980.

Table B19.--Percent descaling of juvenile steelhead by date, unit number, and gatewell slot designation or fish marking facility at Little Goose Dam, 1980.

Table B20.--Number of salmonid transported from Lower Granite, Little Goose, and McNary Dams; oxygen levels; water temperature; and transport mortalities, 1980.

Appendix Table B1.--Numbers of juvenile chinook salmon counted, trucked, barged, and released as controls and mortality in collection by date at Lower Granite Dam, 1980.

Date	Number counted	Trucked to Bonneville		Barged to Bonneville		Daily totals transported	Controls	Mortality in collection
		marked	unmarked	marked	unmarked			
4-3	3,574	--	3,530	--	--	3,530	--	44
4-4	2,108	--	--	--	--	--	--	45
4-5	1,662	--	3,770	--	--	3,770	--	39
4-6	1,558	--	--	--	--	--	--	41
4-7	1,558	--	--	--	--	--	--	41
4-8	4,293	1,958	5,451	--	--	7,409	--	61
4-9	2,008	1,044	129	--	--	1,173	835	61
4-10	2,278	719	317	--	--	1,036	1,242	70
4-11	1,741	1,331	410	--	--	1,741	--	56
4-12	1,923	1,670	253	--	--	1,923	--	71
4-13	1,239	--	--	--	--	--	--	58
4-14	1,239	--	1,175	--	--	1,175	1,200	59
4-15	2,257	1,949	308	--	--	2,257	--	57
4-16	1,732	--	1,671	--	--	1,671	--	61
4-17	4,293	--	--	--	--	--	--	--
4-18	11,709	3,417	16,340	--	--	19,757	2,405	900
4-19	26,609	7,900	15,833	--	--	23,733	--	753
4-20	19,021	9,256	23	3,877	226	13,382	--	416
4-21	41,072	5,232	6,695	--	44,157	56,084	3,006	288
4-22	80,885	14,919	1,341	3,643	7,906	27,809	--	1,044
4-23	115,067	11,205	4,291	--	164,832	180,328	4,042	1,042
4-24	144,934	11,611	5,268	3,530	21,836	42,245	3,838	638
4-25	124,152	10,473	5,242	--	229,269	244,984	--	2,262
4-26	143,000	6,595	7,324	--	--	13,919	2,038	837
4-27	109,415	--	--	--	--	--	--	600
4-28	107,829	7,998	2,514	--	277,863	288,375	3,959	511
4-29	110,218	--	--	5,179	168,473	173,652	2,264	2,604
4-30	110,506	7,340	3,259	--	--	10,599	--	529
5-1	88,151	--	--	2,933	183,834	186,767	3,084	1,109
5-2	70,615	--	--	1,913	12,281	14,194	3,044	50
5-3	36,690	--	--	2,598	78,909	81,507	138	305
5-4	31,192	--	--	--	--	--	--	--
5-5	46,624	4,729	2,877	--	75,770	83,376	--	580
5-6	42,344	--	--	1,547	6,437	7,984	2,259	402
5-7	40,040	4,148	3,020	--	65,124	72,292	1,743	200
5-8	31,199	--	--	1,376	3,961	5,337	1,126	65
5-9	47,764	2,785	3,020	--	66,212	72,029	1,376	500

Appendix Table B1.--Continued.

Date	Numbers counted	Trucked to Bonneville		Barged to Bonneville		Daily totals transported	Controls	Mortality in collection
		marked	unmarked	marked	unmarked			
5-10	27,208	--	--	824	3,368	4,192	922	60
5-11	34,224	--	--	--	52,176	52,176	--	490
5-12	23,442	2,741	1,270	--	--	4,011	762	62
5-13	11,591	--	--	--	31,124	31,124	--	53
5-14	13,284	--	--	1,147	1,205	2,352	932	42
5-15	15,774	--	--	1,159	24,145	25,304	819	72
5-16	14,852	--	--	1,421	1,201	2,622	897	32
5-17	12,279	--	--	1,527	21,857	23,384	1,152	42
5-18	9,056	--	--	--	--	--	--	--
5-19	13,211	--	--	--	--	--	--	--
5-20	6,617	--	--	--	24,325	24,325	--	120
5-21	7,234	--	12,357	--	--	12,357	--	102
5-22	9,501	--	--	2,226	14,826	17,052	--	51
5-23	8,731	--	--	--	1,046	1,046	2,680	103
5-24	10,803	--	--	966	16,985	17,951	356	106
5-25	9,039	--	--	--	--	--	--	66
5-26	9,005	--	--	--	--	--	--	66
5-27	13,761	--	--	1,749	3,031	4,780	1,109	66
5-28	21,303	--	--	1,835	53,478	55,313	1,303	62
5-29	19,618	--	--	1,269	4,233	5,502	474	75
5-30	4,371	--	4,220	--	--	4,220	880	43
5-31	2,980	--	60	--	--	60	547	22
6-1	1,587	--	--	--	--	--	--	--
6-2	1,939	--	5,018	--	--	5,018	566	45
6-3	2,424	--	--	--	--	--	--	--
6-4	2,065	--	4,338	--	--	4,338	--	107
6-5	2,292	--	--	--	--	--	--	--
6-6	2,489	--	4,853	--	--	4,853	--	78
6-7	3,130	--	--	--	--	--	--	--
6-8	2,633	--	6,151	--	--	6,151	--	52
6-9	2,928	--	--	--	--	--	--	35
6-10	2,794	--	5,348	--	--	5,348	--	35
6-11	2,747	--	--	--	--	--	--	--
6-12	2,111	--	4,940	--	--	4,940	--	104
6-13	3,208	--	--	--	--	--	--	--
6-14	2,625	--	5,082	--	--	5,082	--	125
6-15	4,552	--	--	--	--	--	--	--
6-16	3,983	--	8,867	--	--	8,867	--	129

Appendix Table B1.--Continued.

Date	Number counted	Trucked to Bonneville		Barged to Bonneville		Daily totals transported	Controls	Mortality in collection
		marked	unmarked	marked	unmarked			
6-17	2,845	--	--	--	--	--	--	--
6-18	2,626	--	5,430	--	--	5,430	--	44
6-19	1,809	--	--	--	--	--	--	--
6-20	1,206	--	--	--	--	--	--	--
6-21	1,005	--	3,992	--	--	3,992	566	33
6-22	2,008	--	--	--	--	--	--	--
6-23	1,888	--	4,605	--	--	4,605	--	40
6-24	2,463	--	--	--	--	--	--	--
6-25	2,210	--	4,621	--	--	4,621	--	52
6-26	1,599	--	--	--	--	--	--	--
6-27	900	--	2,488	--	--	2,488	--	11
6-28	1,326	--	--	--	--	--	--	--
6-29	1,194	--	--	--	--	--	--	--
6-30	1,658	--	--	--	--	--	--	--
7-1	1,525	--	--	--	--	--	--	--
7-2	929	--	6,624	--	--	6,624	--	30
7-3	2,457	--	--	--	--	--	--	--
7-4	2,532	--	--	--	--	--	--	--
7-5	3,366	--	--	--	--	--	--	--
7-6	4,319	--	--	--	--	--	--	--
7-7	2,219	--	12,893	--	--	12,893	--	2,000
TOTALS	1,995,964	316,250		1,700,809		2,017,059	50,998	21,044

Appendix Table B2.--Numbers of juvenile steelhead counted, trucked, barged, and released as controls and mortality in collection by date at Lower Granite Dam, 1980.

Date	Number counted	Trucked to Bonneville		Barged to Bonneville		Daily totals transported	Controls	Mortality in collection
		marked	unmarked	marked	unmarked			
4-3	80	--	80	--	--	80	--	--
4-4	37	--	--	--	--	--	--	--
4-5	21	--	58	--	--	58	--	--
4-6	16	--	--	--	--	--	--	--
4-7	16	--	--	--	--	--	--	--
4-8	63	--	95	--	--	95	--	--
4-9	21	--	21	--	--	21	--	3
4-10	33	--	33	--	--	33	--	--
4-11	29	--	29	--	--	29	--	--
4-12	49	--	49	--	--	49	--	--
4-13	44	--	--	--	--	--	--	--
4-14	45	--	88	--	--	88	1	--
4-15	75	--	75	--	--	75	--	--
4-16	44	--	44	--	--	44	--	1
4-17	119	--	--	--	--	--	--	--
4-18	325	--	584	--	--	584	42	3
4-19	865	--	627	--	--	627	--	--
4-20	1,131	--	542	82	179	803	--	6
4-21	2,603	--	1,003	--	2,818	3,821	36	11
4-22	4,163	--	2,177	36	267	2,480	--	11
4-23	19,152	--	3,709	--	18,290	21,999	254	11
4-24	24,056	--	4,374	426	3,864	8,664	297	57
4-25	54,451	--	8,102	--	68,852	76,954	--	76
4-26	111,080	--	11,971	--	--	11,971	887	31
4-27	93,581	--	--	--	--	--	--	25
4-28	89,037	--	6,885	--	235,795	242,680	2,471	32
4-29	59,610	--	--	1,514	107,022	108,536	815	23
4-30	98,169	--	6,202	--	--	6,202	--	20
5-1	67,869	--	--	2,232	145,493	147,725	1,552	28
5-2	42,915	--	--	837	8,194	9,031	1,449	5
5-3	50,667	--	--	2,284	77,801	80,085	668	25
5-4	45,448	--	--	--	--	--	--	--
5-5	67,401	--	10,639	--	103,839	114,478	--	40
5-6	71,182	--	--	1,668	12,742	14,410	2,826	70
5-7	93,381	--	8,498	--	135,701	144,199	2,201	100
5-8	70,760	--	--	3,387	9,793	13,180	1,523	10
5-9	88,245	--	15,283	--	129,300	144,583	925	40

Appendix Table B2.--Continued.

Date	Number counted	Trucked to Bonneville		Barged to Bonneville		totals transported	Controls	Mortality in collection
		marked	unmarked	marked	unmarked			
5-10	70,661	--	--	2,088	9,533	11,621	1,666	5
5-11	50,488	--	--	--	98,386	98,386	--	135
5-12	43,062	--	10,293	--	--	10,293	830	25
5-13	43,232	--	--	--	71,801	71,801	--	61
5-14	46,554	--	--	2,633	6,157	8,790	2,729	38
5-15	27,955	--	--	976	56,558	57,534	1,622	37
5-16	19,584	--	--	1,098	2,172	3,270	1,382	31
5-17	22,799	--	--	1,600	35,490	37,090	1,527	20
5-18	22,882	--	--	--	--	--	--	--
5-19	33,380	--	--	--	--	--	--	--
5-20	16,721	--	--	--	61,646	61,646	--	110
5-21	19,910	--	18,361	--	--	18,361	--	153
5-22	21,794	--	--	4,247	35,120	39,367	--	105
5-23	17,918	--	--	--	3,349	3,349	4,336	162
5-24	21,283	--	--	1,201	34,460	35,661	605	133
5-25	20,457	--	--	--	--	--	--	101
5-26	20,380	--	--	--	--	--	--	101
5-27	31,141	--	--	3,557	8,791	12,348	977	103
5-28	22,585	--	--	1,627	94,710	96,337	639	127
5-29	30,183	--	--	1,066	7,232	8,298	962	62
5-30	5,945	--	6,308	--	--	6,308	658	51
5-31	6,304	--	271	--	--	271	1,014	27
6-1	3,597	--	--	--	--	--	--	--
6-2	4,394	--	11,597	--	--	11,597	1,013	63
6-3	4,230	--	--	--	--	--	--	--
6-4	3,604	--	7,598	--	--	7,598	--	142
6-5	4,461	--	--	--	--	--	--	--
6-6	4,845	--	9,469	--	--	9,469	--	132
6-7	3,080	--	--	--	--	--	--	--
6-8	2,591	--	6,480	--	--	6,480	--	85
6-9	3,142	--	--	--	--	--	--	--
6-10	2,998	--	5,700	--	--	5,700	--	92
6-11	3,328	--	--	--	--	--	--	--
6-12	2,557	--	5,992	--	--	5,992	--	113
6-13	3,701	--	--	--	--	--	--	--
6-14	3,028	--	5,884	--	--	5,884	--	130
6-15	3,424	--	--	--	--	--	--	--
6-16	2,996	--	6,627	--	--	6,627	--	138

Appendix Table B2.--Continued.

Date	Number counted	Trucked to Bonneville		Barged to Bonneville		Daily totals transported	Controls	Mortality in collection
		marked	unmarked	marked	unmarked			
6-17	2,850	--	--	--	--	--	--	--
6-18	2,631	--	5,429	--	--	5,429	--	70
6-19	1,886	--	--	--	--	--	--	--
6-20	1,258	--	--	--	--	--	--	--
6-21	1,049	--	4,120	--	--	4,120	--	89
6-22	1,492	--	--	--	--	--	--	--
6-23	1,403	--	3,589	--	--	3,589	--	61
6-24	1,712	--	--	--	--	--	--	--
6-25	1,537	--	3,184	--	--	3,184	--	65
6-26	929	--	--	--	--	--	--	--
6-27	523	--	1,437	--	--	1,437	--	22
6-28	308	--	--	--	--	--	--	--
6-29	277	--	--	--	--	--	--	--
6-30	385	--	--	--	--	--	--	--
7-1	354	--	--	--	--	--	--	--
7-2	217	--	1,531	--	--	1,531	--	20
7-3	128	--	--	--	--	--	--	--
7-4	132	--	--	--	--	--	--	--
7-5	175	--	--	--	--	--	--	--
7-6	225	--	--	--	--	--	--	--
7-7	116	--	736	--	--	736	--	70
TOTALS	1,847,564	195,774		1,617,914		1,813,688	35,907	3,507

Appendix Table B3.--Numbers of juvenile sockeye salmon counted, trucked, and barged and mortality in collection by date at Lower Granite Dam, 1980.

Date	Number counted	Trucked to Bonneville	Barged to Bonneville	Daily totals transported	Mortality in collection
4-3	7	7	--	7	--
4-4	7	--	--	--	--
4-5	2	9	--	9	--
4-6	4	--	--	--	--
4-7	3	--	--	--	--
4-8	20	27	--	27	--
4-9	--	--	--	--	--
4-10	--	--	--	--	--
4-11	3	3	--	3	--
4-12	--	--	--	--	--
4-13	--	--	--	--	--
4-14	1	1	--	1	--
4-15	1	1	--	1	--
4-16	2	2	--	2	--
4-17	5	--	--	--	--
4-18	12	21	--	21	--
4-19	20	15	1	16	--
4-20	1	--	--	--	--
4-21	--	--	--	--	--
4-22	71	4	--	4	--
4-23	--	--	72	72	--
4-24	1	1	--	1	--
4-25	1	--	1	1	--
4-26	--	--	--	--	--
4-27	4	--	--	--	--
4-28	1	1	--	1	--
4-29	--	--	--	--	--
4-30	96	2	--	2	--
5-1	1	--	97	97	--
5-2	--	--	--	--	--
5-3	--	--	--	--	--
5-4	--	4	--	4	--
5-5	2	2	--	2	--
5-6	1	--	1	1	--
5-7	1	1	--	1	--
5-8	1	--	1	1	--
5-9	4	4	--	4	--
5-10	4	--	4	4	--
5-11	--	--	--	--	--
5-12	4	4	--	4	--
5-13	114	--	114	114	--
5-14	--	--	--	--	--
5-15	98	--	98	98	--
5-16	104	--	24	24	--
5-17	106	--	185	185	--
5-18	3	--	--	--	--
5-19	6	--	--	--	--
5-20	152	--	161	161	--
5-21	140	138	--	138	--
5-22	107	--	109	109	--
5-23	133	--	133	133	--
5-24	275	--	275	275	--

Appendix Table B3.--Continued.

Date	Number counted	Trucked to Bonneville	Barged to Bonneville	Daily totals transported	Mortality in collection
5-25	238	--	--	--	--
5-26	238	--	--	--	--
5-27	362	--	151	151	1
5-28	309	--	995	995	--
5-29	503	--	503	503	--
5-30	47	47	--	47	--
5-31	28	6	--	6	--
6-1	37	--	--	--	--
6-2	45	82	--	82	--
6-3	60	--	--	--	--
6-4	50	110	--	110	--
6-5	75	--	--	--	--
6-6	82	165	--	165	--
6-7	37	--	--	--	--
6-8	29	66	--	66	--
6-9	31	--	--	--	--
6-10	30	61	--	61	--
6-11	30	--	--	--	--
6-12	23	53	--	53	--
6-13	21	--	--	--	--
6-14	17	38	--	38	--
6-15	24	--	--	--	--
6-16	26	50	--	50	4
6-17	17	--	--	--	--
6-18	11	28	--	28	--
6-19	16	--	--	--	--
6-20	12	--	--	--	--
6-21	--	28	--	28	--
6-22	9	--	--	--	--
6-23	10	19	--	19	--
6-24	8	--	--	--	--
6-25	7	15	--	15	--
6-26	17	--	--	--	--
6-27	16	33	--	33	1
6-28	--	--	--	--	--
6-29	--	--	--	--	--
6-30	--	--	--	--	--
7-1	--	--	--	--	--
7-2	26	26	--	26	--
7-3	--	--	--	--	--
7-4	--	--	--	--	--
7-5	--	--	--	--	--
7-6	--	--	--	--	--
7-7	2	2	--	2	--
TOTALS	4,111	1,076	2,925	4,001	6

Appendix Table B4.--Numbers of juvenile coho salmon counted, trucked, and barged and mortality in collection by date at Lower Granite Dam, 1980.

Date	Number counted	Trucked to Bonneville	Barged to Bonneville	Daily totals transported	Mortality in collection
4-3	--	--	--	--	--
4-4	--	--	--	--	--
4-5	--	--	--	--	--
4-6	--	--	--	--	--
4-7	--	--	--	--	--
4-8	--	--	--	--	--
4-9	--	--	--	--	--
4-10	--	--	--	--	--
4-11	--	--	--	--	--
4-12	--	--	--	--	--
4-13	--	--	--	--	--
4-14	--	--	--	--	--
4-15	--	--	--	--	--
4-16	--	--	--	--	--
4-17	--	--	--	--	--
4-18	--	--	--	--	--
4-19	--	--	--	--	--
4-20	--	--	--	--	--
4-21	1	1	--	1	--
4-22	2	2	--	2	--
4-23	--	--	--	--	--
4-24	--	--	--	--	--
4-25	--	--	--	--	--
4-26	--	--	--	--	--
4-27	--	--	--	--	--
4-28	--	--	--	--	--
4-29	--	--	--	--	--
4-30	28	1	--	1	--
5-1	--	--	26	26	--
5-2	--	--	--	--	--
5-3	--	--	--	--	--
5-4	--	--	--	--	--
5-5	--	--	--	--	--
5-6	--	--	--	--	--
5-7	--	--	--	--	--
5-8	--	--	--	--	--
5-9	--	--	--	--	--
5-10	--	--	--	--	--
5-11	--	--	--	--	--
5-12	--	--	--	--	--
5-13	--	--	--	--	--
5-14	--	--	--	--	--
5-15	--	--	--	--	--
5-16	--	--	--	--	--
5-17	--	--	--	--	--
5-18	1	--	--	--	--
5-19	1	--	--	--	--
5-20	72	--	75	75	--
5-21	--	--	--	--	--
5-22	--	--	--	--	--
5-23	--	--	--	--	--
5-24	--	--	--	--	--
5-25	--	--	--	--	--

Appendix Table B4.--Continued.

Date	Number counted	Trucked to Bonneville	Barged to Bonneville	Daily totals transported	in collection
5-26	--	--	--	--	--
5-27	--	--	--	--	--
5-28	--	--	--	--	--
5-29	--	--	--	--	--
5-30	--	--	--	--	--
5-31	--	--	--	--	--
6-1	--	--	--	--	--
6-2	--	--	--	--	--
6-3	--	--	--	--	--
6-4	--	--	--	--	--
6-5	14	--	--	--	--
6-6	15	29	--	29	--
6-7	--	--	--	--	--
6-8	--	--	--	--	--
6-9	--	--	--	--	--
6-10	--	--	--	--	--
6-11	--	--	--	--	--
6-12	--	--	--	--	--
6-13	--	--	--	--	--
6-14	--	--	--	--	--
6-15	--	--	--	--	--
6-16	--	--	--	--	--
6-17	--	--	--	--	--
6-18	--	--	--	--	--
6-19	--	--	--	--	--
6-20	--	--	--	--	--
6-21	--	--	--	--	--
6-22	--	--	--	--	--
6-23	--	--	--	--	--
6-24	--	--	--	--	--
6-25	3	3	--	3	--
6-26	--	--	--	--	--
6-27	1	1	--	1	--
6-28	--	--	--	--	--
6-29	--	--	--	--	--
6-30	--	--	--	--	--
7-1	--	--	--	--	--
7-2	--	--	--	--	--
7-3	--	--	--	--	--
7-4	--	--	--	--	--
7-5	--	--	--	--	--
7-6	--	--	--	--	--
7-7	--	--	--	--	--
TOTALS	138	37	101	138	0

Appendix Table B5.--Numbers of juvenile chinook salmon counted, trucked, barged, observed as collection mortalities, and returned to Snake River by date at Little Goose Dam, 1980.

Date	Number counted	Trucked to Bonneville	Barged to Bonneville	Daily totals transported	Returned to river	Mortality in collection
4-1-4	800	--	--	--	800	--
4-7-9	1,878	1,800	--	1,800	---	78
4-9-11	6,010	3,792	--	3,792	---	246
4-12-14	4,864	5,974	--	5,974	252	150
4-15	3,023	--	--	--	---	--
4-16	3,572	4,725	--	4,725	---	200
4-17	2,650	--	--	--	---	100
4-18	2,578	5,866	--	5,866	---	165
4-19	6,392	--	--	--	---	500
4-20	16,500	--	--	--	---	500
4-21	16,651	26,325	--	26,325	---	560
4-22	30,364	20,380	--	20,380	---	1,004
4-23	34,221	--	37,559	37,559	---	1,247
4-24	56,089	33,090	--	33,090	---	1,370
4-25	65,523	--	64,060	64,060	---	2,412
4-26	62,915	65,687	--	65,687	---	2,842
4-27	47,467	41,489	--	41,489	---	2,989
4-28	44,479	30,408	--	30,408	---	4,650
4-29	68,752	27,691	36,903	64,594	---	5,000
4-30	64,531	49,626	--	49,626	---	3,000
5-1	62,309	51,579	57,379	108,958	---	3,019
5-2	65,461	28,572	--	28,572	200	1,839
5-3	56,147	46,757	31,950	78,707	---	2,780
5-4	56,208	45,027	--	45,027	---	1,382
5-5	35,420	58,061	--	58,061	---	1,876
5-6	32,160	23,801	--	23,801	---	672
5-7	35,316	10,798	28,463	39,261	---	519
5-8	33,918	18,309	--	18,309	---	298
5-9	29,333	13,860	30,746	44,606	---	357
5-10	24,332	6,854	--	6,854	---	185
5-11	20,714	7,957	34,407	42,364	---	595
5-12	17,192	13,142	--	13,142	---	169
5-13	10,627	--	17,992	17,992	---	117
5-14	12,465	5,304	--	5,304	---	99
5-15	12,832	--	16,808	16,808	---	66
5-16	9,224	7,514	--	7,514	---	296
5-17	11,533	--	18,697	18,697	---	421
5-18	13,223	--	--	--	---	76
5-19	10,816	--	--	--	---	218
5-20	4,474	--	--	--	---	56
5-21	8,079	30,776	--	30,776	---	196
5-22	8,331	--	12,355	12,355	---	94
5-23	10,689	--	--	--	---	25
5-24	9,812	--	20,766	20,766	---	272
5-25	8,755	--	--	--	---	52
5-26	7,576	--	--	--	---	142
5-27	7,605	--	--	--	---	164

Appendix Table B5.--Continued.

Date	Number counted	Trucked to Bonneville	Barged to Bonneville	Daily totals transported	Returned to river	Mortality in collection
5-28	6,730	--	--	--	---	196
5-29	8,472	--	36,110	36,110	---	388
5-30	8,790	10,456	--	10,456	---	144
5-31	3,877	5,777	--	5,777	---	141
6-1	2,405	--	--	--	---	8
6-2	1,723	3,372	--	3,372	---	32
6-3	3,168	--	--	--	---	20
6-4	3,152	7,746	--	7,746	---	34
6-5	2,058	--	--	--	---	9
6-6	2,342	--	--	--	---	6
6-7	2,941	6,609	--	6,609	---	8
6-8	2,395	--	--	--	---	9
6-9	2,006	1,980	--	1,980	---	9
6-10	3,340	--	--	--	---	12
6-11	4,949	--	--	--	---	43
6-12	4,880	--	--	--	---	104
6-13	2,738	12,636	--	12,636	---	180
6-14	3,910	--	--	--	---	50
6-15	3,661	7,150	--	7,150	---	100
6-16	4,544	--	--	--	---	36
6-17	4,019	8,320	--	8,320	---	76
6-18	3,845	--	--	--	---	44
6-19	4,042	8,034	--	8,034	---	80
6-20	2,499	--	--	--	---	40
6-21	2,145	--	--	--	---	24
6-22	1,729	6,872	--	6,872	---	14
6-23	2,012	--	--	--	---	8
6-24	3,751	4,572	--	4,572	---	27
6-25	3,016	--	--	--	---	25
6-26	2,399	--	--	--	---	20
6-27	2,122	9,347	--	9,347	---	27
6-28	1,152	--	--	--	---	12
6-29	1,846	--	--	--	---	20
6-30	861	3,922	--	3,922	---	5
7-1	3,740	--	--	--	---	7
7-2	1,920	--	--	--	---	10
7-3	2,689	--	--	--	---	8
7-4	2,032	10,967	--	10,967	---	5
TOTALS	1,277,710	792,924	444,195	1,237,119	1,252	44,979

Appendix Table B6.--Numbers of juvenile steelhead counted, trucked, barged, observed as collection mortalities, and returned to Snake River by date at Little Goose Dam, 1980.

Date	Number counted	Trucked to Bonneville	Barged to Bonneville	Daily totals transported	Returned to river	Mortality in collection
4-1-4	200	--	--	--	200	--
4-7-9	200	195	--	195	---	5
4-10-11	316	213	--	213	---	--
4-12-14	326	326	--	326	---	--
4-15	159	--	--	--	---	--
4-16	169	234	--	234	---	--
4-17	38	--	--	--	---	--
4-18	37	37	--	37	---	--
4-19	91	--	--	--	---	5
4-20	945	--	--	--	---	5
4-21	953	1,478	--	1,478	---	--
4-22	1,739	1,364	--	1,264	---	1
4-23	1,133	--	1,274	1,274	---	10
4-24	2,459	1,486	--	1,486	---	25
4-25	3,449	--	3,439	3,439	---	60
4-26	11,016	11,912	--	11,912	---	87
4-27	29,341	27,346	--	27,346	---	147
4-28	53,926	42,403	--	42,403	---	100
4-29	83,355	33,573	44,740	78,313	---	300
4-30	78,872	60,653	--	60,653	---	330
5-1	33,551	29,182	30,897	60,079	---	217
5-2	36,982	16,977	--	16,977	800	204
5-3	31,720	27,780	18,050	45,830	---	206
5-4	31,754	26,119	--	26,119	---	100
5-5	24,513	41,342	--	41,342	---	137
5-6	26,958	20,152	--	20,152	---	78
5-7	35,427	10,799	28,573	39,372	---	104
5-8	33,901	18,538	--	18,538	---	52
5-9	34,560	16,140	35,804	51,944	---	50
5-10	36,497	10,505	--	10,505	---	53
5-11	31,660	12,524	52,194	64,718	---	309
5-12	39,982	31,011	--	31,011	---	47
5-13	25,058	--	41,918	41,918	---	81
5-14	28,874	12,271	--	12,271	---	40
5-15	28,854	--	37,981	37,981	---	81
5-16	20,888	17,698	--	17,698	---	98
5-17	10,978	--	18,774	18,774	---	101
5-18	12,206	--	--	--	---	28
5-19	9,984	--	--	--	---	48
5-20	19,441	--	--	--	---	45
5-21	15,690	48,765	--	48,765	---	224
5-22	16,070	--	23,707	23,707	---	167
5-23	20,232	--	--	--	---	18
5-24	15,823	--	33,324	33,324	---	219
5-25	13,651	--	--	--	---	33
5-26	10,465	--	--	--	---	145
5-27	10,704	--	--	--	---	206
5-28	9,711	--	--	--	---	424
5-29	15,230	--	53,208	53,208	---	553
5-30	15,830	18,900	--	18,900	---	241
5-31	5,428	8,192	--	8,192	---	94

Appendix Table B6.--Continued.

Date	Number counted	Trucked to Bonneville	Barged to Bonneville	Daily totals transported	Returned to river	Mortality in collection
6-1	3,368	--	--	--	---	7
6-2	3,768	7,472	--	7,472	---	50
6-3	6,903	--	--	--	---	25
6-4	4,818	11,541	--	11,541	---	27
6-5	3,018	--	--	--	---	7
6-6	3,434	--	--	--	---	9
6-7	3,241	9,730	--	9,730	---	20
6-8	2,638	--	--	--	---	25
6-9	2,210	2,155	--	2,155	---	10
6-10	1,927	--	--	--	---	30
6-11	2,856	--	--	--	---	34
6-12	1,720	--	--	--	---	53
6-13	1,966	9,075	--	9,075	---	126
6-14	2,809	--	--	--	---	60
6-15	2,630	5,115	--	5,115	---	68
6-16	3,264	--	--	--	---	32
6-17	2,887	5,951	--	5,951	---	67
6-18	2,694	--	--	--	---	37
6-19	2,832	5,605	--	5,605	---	75
6-20	1,751	--	--	--	---	31
6-21	1,503	--	--	--	---	20
6-22	977	4,795	--	4,795	---	30
6-23	1,137	--	--	--	---	14
6-24	1,021	1,486	--	1,486	---	22
6-25	821	--	--	--	---	10
6-26	1,673	--	--	--	---	21
6-27	1,450	4,174	--	4,174	---	13
6-28	788	--	--	--	---	31
6-29	1,261	--	--	--	---	40
6-30	589	2,702	--	2,702	---	6
7-1	1,383	--	--	--	---	8
7-2	710	--	--	--	---	5
7-3	994	--	--	--	---	3
7-4	752	4,069	--	4,069	---	1
TOTALS	1,047,139	621,985	423,883	1,045,868	1,000	6,495

Appendix Table B7.--Numbers of juvenile sockeye salmon counted, trucked, and barged and mortality in collection by date at Little Goose Dam, 1980.

Date	Number counted	Trucked to Bonneville	Barged to Bonneville	Daily totals transported	Mortality in collection
4-16	27	---	---	---	---
4-17	8	---	---	---	---
4-18	8	---	---	---	---
4-19	20	---	---	---	---
4-20	52	---	---	---	---
4-21	53	---	---	---	---
4-22	96	70	---	70	---
4-23	35	40	---	40	---
4-24	3	---	---	---	---
5-16	2	5	---	5	---
5-17	---	---	2	2	---
5-20	3	---	---	---	---
5-21	2	5	---	5	---
5-22	47	---	54	54	---
5-23	71	---	---	---	---
5-24	175	---	378	378	---
5-25	158	---	---	---	---
5-26	127	---	---	---	---
5-27	129	---	---	---	---
5-28	110	---	---	---	---
5-29	164	---	634	634	1
5-30	176	212	---	212	---
5-31	214	329	---	329	---
6-1	136	---	---	---	---
6-2	92	186	---	186	---
6-3	175	---	---	---	---
6-4	124	311	---	311	---
6-5	83	---	---	---	---
6-6	94	---	---	---	---
6-7	50	268	---	268	---
6-8	41	---	---	---	---
6-9	35	34	---	34	1
6-10	86	---	---	---	---
6-11	127	---	---	---	---
6-12	94	---	---	---	---
6-22	17	324	---	324	---
6-23	20	---	---	---	---
6-24	---	20	---	20	---
6-26	29	---	---	---	---
6-27	2	47	---	47	---
TOTALS	2,885	1,851	1,068	2,919	2

Appendix Table B8.--Date, brand position and orientation, and numbers of juvenile chinook salmon and steelhead marked and released in the Lower Granite Dam forebay at Clarkston, WA, 1980.

Date	Position[a] and brand	Brand orientation[b]	Chinook salmon	Steelhead
4-9	LA-IS	1	835	---
4-10	"	"	1,242	---
4-14	"	"	1,200	1
4-18	"	"	2,405	42
	Subtotal		5,682	43
4-21	LA-IS	2	3,006	36
4-24	"	"	3,838	297
4-26	"	"	2,038	887
4-29	"	"	2,264	815
5-2	"	"	2,568	718
5-3	"	"	138	668
5-6	"	"	1,186	1,731
	Subtotal		15,038	5,152
5-9	LA-IS	3	1,376	925
5-12	"	"	762	830
5-16	"	"	897	1,382
	Subtotal		3,035	3,137
5-23	LA-IS	4	2,680	4,336
5-27	"	"	1,109	977
5-29	"	"	474	962
5-31	"	"	547	1,014
6-2	"	"	566	1,013
	Subtotal		5,376	8,302
	TOTAL		29,131	16,634

a/ Indicates brand position - left anterior.

b/ Orientation 1 means symbol in normal readable position (IS).
Orientation 2 means symbol is rotated 90° clockwise (SI).
Orientation 3 means symbol is rotated 180° clockwise (SI).
Orientation 4 means symbol is rotated 270° clockwise (IS).

Appendix Table B9.--Date, wire tag code, brand position and orientation, and numbers of juvenile chinook salmon and steelhead marked and transported by barge from Lower Granite Dam to below Bonneville Dam, 1980.

Date	Wire tag[a] code	Position[b] and brand	Brand[c] orientation	Chinook salmon	Steelhead
4-20	HO-PR	RA-W	1	3,877	82
4-22	"	"	"	3,643	36
4-24	"	"	"	3,530	426
4-29	"	"	"	5,179	1,514
5-1	"	"	2	2,933	2,232
5-2	"	"	"	1,913	837
5-3	"	"	"	2,598	2,284
5-6	"	"	"	1,547	1,668
5-8	"	"	"	1,376	3,387
5-10	"	"	"	824	2,088
	Subtotal			27,420	14,554
5-14	DY-PR	RA-W	2	1,147	2,633
5-15	"	"	"	1,159	976
5-16	"	"	"	1,421	1,098
5-17	"	"	"	1,527	1,600
5-22	"	"	"	2,226	4,247
5-24	"	"	"	966	1,201
5-27	"	"	"	1,749	3,557
5-28	"	"	"	1,835	1,627
5-29	"	"	"	1,269	1,066
	Subtotal			13,299	18,005
	TOTALS			40,719	32,559

a/ Indicates rare earth coded wire tags. See Appendix Table B15 for symbol interpretation.

b/ Indicates brand position - right anterior.

c/ Orientation 1 means symbol in normal readable position (W). Orientation 2 means symbol is rotated 90° clockwise (M).

Appendix Table B10.--Date, wire tag code, brand position and orientation, and numbers of juvenile chinook salmon and steelhead collected and marked at Lower Granite Dam and released as controls in the Little Goose Dam tailrace, 1980.

Date	Wire tag[a/] code	Position[b/] and brand	Brand orientation	Chinook salmon	Steelhead
4-24	ER	LA-P	1	4,042	254
4-28	""	"	"	3,959	2,471
5-1	""	"	"	3,084	1,552
5-2	""	"	"	476	731
5-6	""	"	2	1,073	1,095
5-7	""	"	"	1,743	2,201
5-8	""	"	"	1,126	1,523
5-10	""	"	"	922	1,666
5-14	""	"	"	932	2,729
5-15	""	"	"	819	1,622
5-17	""	"	3	1,152	1,527
5-24	""	"	"	356	605
5-28	""	"	"	1,303	639
5-30	""	"	"	880	658
	TOTAL			21,876	19,273

a/ Indicates rare-earth coded wire tags. See Appendix Table B15 for symbol interpretations.

b/ Indicates brand position - left anterior.

c/ Orientation 1 means the symbol in normal readable position (P).
Orientation 2 means the symbol is rotated 90° clockwise (ᑫ).
Orientation 3 means the symbol is rotated 180° clockwise (d).

Appendix Table B11.--Date, wire tag code, brand position and orientation, and numbers of juvenile chinook salmon marked and transported by truck (Test #3) from Lower Granite Dam to below Bonneville Dam, 1980. (NOTE: Although this test was not conducted under mass transportation operations contract, the numbers were included in transport totals during 1980.)

Date	Wire tag[a/] code	Position[b/] and brand	Brand[c/] orientation	Chinook salmon
4-9	LA-PR	RA-2J	1	349
4-11	" "	"	"	176
4-15	" "	"	"	146
4-19	" "	"	"	3,475
4-20	" "	"	"	4,218
4-22	" "	"	"	4,099
4-23	" "	"	3	2,719
4-24	" "	"	"	4,026
4-25	" "	"	"	1,603
4-26	" "	"	"	1,971
4-28	" "	"	"	2,277
4-30	" "	"	"	1,253
5-5	" "	RA-3J	1	996
5-7	" "	"	"	2,348
5-9	" "	"	"	1,054
5-12	" "	"	"	322
	TOTAL			31,032

a/ Indicates rare-earth coded wire tags. See Appendix Table B15 for symbol interpretations.

b/ Indicates brand position - right anterior.

c/ Orientation 1 means the symbol in normal readable position (2J). Orientation 3 means the symbol is rotated 180° clockwise (ſZ).

Appendix Table B12.--Date, wire tag code, brand position and orientation, and numbers of juvenile chinook salmon marked and transported by truck (traditional manner) from Lower Granite Dam to below Bonneville Dam, 1980. (NOTE: Although this test was not conducted under mass transportation operations contract, the numbers were included in transport totals during 1980.)

Date	Wire tag[a/] code	Position[b/] and brand	Brand[c/] orientation	Chinook salmon
4-8	PR-TB	RA-3T	1	1,279
4-9	" "	"	"	488
4-10	" "	"	"	364
4-11	" "	"	"	989
4-12	" "	"	"	1,193
4-15	" "	"	"	1,352
4-18	" "	"	"	1,165
4-21	" "	"	"	2,006
4-22	" "	"	"	4,547
4-23	" "	"	3	2,333
4-25	" "	"	"	5,806
4-26	" "	"	"	2,031
4-28	" "	"	"	2,080
4-30	" "	"	"	2,894
5-5	" "	RA-2T	1	2,671
5-12	" "	"	"	1,574
	TOTAL			32,772

a/ Indicates rare-earth coded wire tags. See Appendix Table B15 for symbol interpretation.

b/ Indicates brand position - right anterior.

c/ Orientation 1 means the symbol in normal readable position (3T). Orientation 3 means the symbol is rotated 180° clockwise (3T).

Appendix Table B13.--Date, wire tag code, brand position and orientation, and numbers of juvenile chinook salmon marked and transported by truck (Test #1) from Lower Granite Dam to below Bonneville Dam, 1980. (NOTE: Although this test was not conducted under mass transportation operations contract, the numbers were included in transport totals during 1980.)

Date	Wire tag[a/] code	Position[b/] and brand	Brand[c/] orientation	Chinook salmon
4-8	CE-TB	RA-2C	1	482
4-9	" "	"	"	207
4-10	" "	"	"	227
4-11	" "	"	"	166
4-12	" "	"	"	191
4-15	" "	"	"	451
4-18	" "	"	"	1,203
4-19	" "	"	"	1,281
4-20	" "	"	"	1,455
4-21	" "	"	"	3,226
4-22	" "	"	"	2,558
4-23	" "	"	3	3,003
4-24	" "	"	"	3,918
4-25	" "	"	"	1,234
4-26	" "	"	"	1,248
4-28	" "	"	"	1,123
4-30	" "	"	"	1,270
5-5	" "	RA-3C	1	306
5-7	" "	"	"	716
5-9	" "	"	"	650
5-12	" "	"	"	427
	TOTAL			25,342

a/ Indicates rare-earth coded wire tags. See Appendix Table B15 for symbol interpretations.

b/ Indicates brand position - right anterior.

c/ Orientation 1 means the symbol in normal readable position (2C). Orientation 3 means the symbol is rotated 180° clockwise (2C).

Appendix Table B14.--Date, wire tag code, brand position and orientation, and numbers of juvenile chinook salmon marked and transported by truck (Test #2) from Lower Granite Dam to below Bonneville Dam, 1980. (NOTE: Although this test was not conducted under mass transportation operations contract, the numbers were included in transport totals during 1980.)

Date	Wire tag[a/] code	Position[b/] and brand	Brand[c/] orientation	Chinook salmon
4-8	ND	RA-3L	1	197
4-10	""	"	"	128
4-12	""	"	"	286
4-18	""	"	"	1,049
4-19	""	"	"	3,144
4-20	""	"	"	3,583
4-22	""	"	"	3,715
4-23	""	"	3	3,150
4-24	""	"	"	3,667
4-25	""	"	"	1,830
4-26	""	"	"	1,345
4-28	""	"	"	2,518
4=30	""	"	"	1,923
5-5	""	RA-2L	1	756
5-7	""	"	"	1,084
509	""	"	"	1,081
5-12	""	"	"	418
	TOTAL			29,874

a/ Indicates rare-earth coded wire tags. See Appendix Table B15 for symbol interpretation.

b/ Indicates brand position - right anterior.

c/ Orientation 1 means the symbol in normal readable position (3L). Orientation 3 means the symbol is rotated 180°clockwise (TE).

Appendix Table B15.--List of codes used with rare-earth metals magnetic wire tags.

Rare-earth elements, Lanthanide subgroup	Atomic number	Code
Lanthanum	57	LA
Cerium	58	CE
Praeseodymium	59	PR
Neodymium	60	ND
Promethium	61	PM
Samarium	62	SM
Europium	63	EU
Gadolinium	64	GD
Terbium	65	TB
Dysprosium	66	DY
Holmium	67	HO
Erbium	68	ER
Thulium	69	TM
Ytterbium	70	YB
Lutetium	71	LU

Appendix Table B16.--Percent descaling of juvenile chinook salmon by date, unit number, and gatewell slot designation or fish marking facility at Lower Granite Dam, 1980.

Date	Unit 1			Unit 2			Unit 3			Unit 4			Unit 5			Unit 6			Fish marking facility
	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A[a]	Slot B	Slot C	Slot A	Slot B	Slot C[b]	Slot A	Slot B	Slot C	
4-14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.5
4-15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0
4-18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.0
4-19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.0
4-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0
4-21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.0
4-22	--	--	--	--	--	--	--	--	--	--	--	--	0.0	5.0	--	3.0	0.0	--	6.0
4-23	4.0	5.0	2.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0	5.0
4-24	--	--	--	4.0	6.0	7.0	--	--	--	--	--	3.0	--	--	--	--	--	--	8.0
4-25	--	--	--	--	--	--	0.0	3.0	5.0	--	--	--	0.0	--	--	--	--	--	8.0
4-26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11.0
4-28	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0	--	1.0	3.0	2.0	6.0
4-29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0
4-30	*	2.0	4.0	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.0
5-1	--	--	--	--	3.0	3.0	1.0	5.0	--	--	--	--	--	--	--	--	--	--	9.0
5-2	--	--	--	--	--	--	--	--	0.0	--	3.0	1.1	*	--	--	--	--	--	7.0
5-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0
5-5	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0	--	0.0	*	0.0	3.0
5-6	0.0	3.0	1.0	6.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.0
5-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.0
5-8	--	--	--	--	*	5.0	*	1.0	--	*	--	--	--	--	--	--	--	--	3.0
5-9	--	--	--	--	--	--	--	--	0.0	--	0.0	--	0.0	--	--	--	--	--	8.0
5-10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0

a/ A traveling screen was not operated in this gatewell until 14 May 1980.

b/ Traveling screen storage prevented sampling of this gatewell.

* Indicates number of fish in sample is too small for accurate estimate - less than 50.

Appendix Table B16.--Continued.

Date	Unit 1			Unit 2			Unit 3			Unit 4			Unit 5			Unit 6			Fish marking facility
	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A[a]	Slot B	Slot C	Slot A	Slot B	Slot C[b]	Slot A	Slot B	Slot C	
5-12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0
5-13	*	*	1.0	3.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0
5-14	--	--	--	--	*	*	2.3	*	--	--	--	--	--	--	--	--	--	--	9.0
5-15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0
5-16	--	--	--	--	--	--	--	--	*	*	*	*	--	--	--	--	--	--	1.0
5-17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0
5-19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0
5-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.0
5-22	--	--	--	--	--	--	--	--	--	--	--	--	*	*	--	*	--	--	1.0
5-23	*	*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	*	*	2.0
5-24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.0
5-27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0
5-28	--	--	--	--	--	--	--	2.0	0.0	*	*	--	--	--	--	--	--	--	0.0
5-29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0
5-30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0
5-31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	*
6-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	*
6-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0
6-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0
6-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0
6-10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.0
6-12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.0
6-14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0

a/ A traveling screen was not operated in this gatewell until 14 May 1980.

b/ Traveling screen storage prevented sampling of this gatewell.

* Indicates number of fish in sample is too small for accurate estimate - less than 50.

Appendix Table B16.--Continued.

Date	Unit 1			Unit 2			Unit 3			Unit 4			Unit 5			Unit 6			Fish marking facility
	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A[a]	Slot B	Slot C	Slot A	Slot B	Slot C[b]	Slot A	Slot B	Slot C	
6-16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.7
6-18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.0
6-21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0
6-23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0
6-25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.0
6-27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.0
7-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.7
7-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.0

a/ A traveling screen was not operated in this gatewell until 14 May 1980.

b/ Traveling screen storage prevented sampling of this gatewell.

* Indicates number of fish in sample is too small for accurate estimate - less than 50.

Appendix Table B17.--Percent descaling of juvenile steelhead by date, unit number, and gatewell designation or fish marking facility at Lower Granite Dam, 1980.

Date	Unit 1			Unit 2			Unit 3			Unit 4			Unit 5			Unit 6			Fish marking facility
	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A[a]	Slot B	Slot C	Slot A	Slot B	Slot C[b]	Slot A	Slot B	Slot C	
4-24	--	--	--	11.0	4.0	8.0	--	--	--	--	--	5.0	--	--	--	--	--	--	*
4-25	--	--	--	--	--	--	4.0	6.0	4.0	--	--	--	1.0	--	--	--	--	--	*
4-28	--	--	--	--	--	--	--	--	--	--	--	--	--	6.0	--	4.5	5.0	8.0	6.0
4-29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.0
4-30	5.0	8.0	5.0	7.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0
5-1	--	--	--	--	4.0	11.0	10.0	11.0	--	--	--	--	--	--	--	--	--	--	9.0
5-2	--	--	--	--	--	--	--	--	10.5	--	11.0	10.0	12.0	--	--	--	--	--	8.0
5-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0
5-5	--	--	--	--	--	--	--	--	--	--	--	--	8.0	--	--	5.0	7.0	--	6.0
5-6	7.0	3.0	10.0	7.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.0
5-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.0
5-8	--	--	--	--	5.5	8.2	6.0	2.0	--	7.0	--	--	--	--	--	--	--	--	4.8
5-9	--	--	--	--	--	--	--	--	5.0	--	3.0	--	6.0	--	--	--	--	--	4.7
5-10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.0
5-12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.3
5-13	6.9	6.0	4.9	12.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.0
5-14	--	--	--	--	8.0	14.0	6.0	3.0	--	--	--	--	--	--	--	--	--	--	9.0
5-15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0
5-16	--	--	--	--	--	--	--	--	11.0	11.0	6.8	7.0	--	--	--	--	--	--	7.0
5-17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.0
5-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.0
5-22	--	--	--	--	--	--	--	--	--	--	--	--	4.0	4.0	--	3.0	--	--	8.0

a/ A traveling screen was not operated in this gatewell until 14 May 1980.

b/ Traveling screen storage prevented sampling of this gatewell.

* Indicates number of fish in sample is too small for accurate estimate - less than 50.

Appendix Table B17.--Continued.

Date	Unit 1			Unit 2			Unit 3			Unit 4			Unit 5			Unit 6			Fish marking facility
	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A[a]	Slot B	Slot C	Slot A	Slot B	Slot C[b]	Slot A	Slot B	Slot C	
5-23	8.0	5.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.0	1.0	12.0
5-24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.0
5-27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.0
5-28	--	--	--	--	--	--	--	4.0	1.0	5.0	6.0	--	--	--	--	--	--	--	11.0
5-29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9.0
5-30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.0
5-31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.7
6-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.0
6-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.0
6-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.0
6-8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15.0
6-10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24.0
6-12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16.0
6-14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.0
6-16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.0
6-18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15.0
6-21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18.0
6-23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9.0
6-25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.0
6-27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.6
7-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.9
7-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.9

a/ A traveling screen was not operated in this gatewell until 14 May 1980.

b/ Traveling screen storage prevented sampling of this gatewell.

* Indicates number of fish in sample is too small for accurate estimate - less than 50.

Appendix Table B18.--Percent descaling of juvenile chinook salmon by date, unit number, and gatewell slot designation or fish marking facility at Little Goose Dam, 1980.

Date	Unit 1			Unit 2			Unit 3			Unit 4			Unit 5[a]	Unit 6[a]	Fish marking facility
	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	slot B		
4-16	1.3	6.3	1.0	--	--	--	--	--	--	--	--	--	--	--	9.5
4-18	9.3	2.0	8.3	12.1	--	--	--	--	--	--	--	--	--	--	12.0
4-21	--	--	--	--	15.9	4.7	5.3	16.2	9.3	--	--	--	--	--	13.0
4-23	4.8	7.7	13.6	6.2	--	--	--	--	--	--	--	--	--	--	17.6
4-24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.7
4-25	*	8.2	--	--	--	--	--	--	--	--	--	--	--	--	--
4-26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20.6
4-27	14.3	12.6	--	6.8	9.4	--	--	--	--	--	--	--	--	--	15.0
4-28	--	--	--	--	--	6.5	7.7	12.1	14.8	8.0	--	--	--	--	12.6
4-29	--	--	--	--	--	--	--	--	--	--	7.1	6.9	6.2	--	--
4-30	9.3	10.8	5.5	--	--	--	--	--	--	--	--	--	--	--	--
5-1	--	--	--	9.5	6.3	6.5	10.0	5.5	--	--	--	--	--	--	--
5-2	--	--	7.6	--	--	--	--	--	10.0	9.0	10.8	4.8	--	--	10.5
5-3	7.2	7.4	--	--	--	--	--	--	--	--	--	--	4.5	--	--
5-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.3
5-5	--	--	--	8.5	--	12.0	10.2	7.0	7.9	--	--	--	--	--	--
5-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.1
5-7	*	11.0	--	--	--	--	--	--	--	9.6	6.7	--	--	--	9.5
5-8	--	--	5.7	8.7	--	--	--	4.7	8.2	--	--	--	13.5	--	5.7
5-9	--	--	--	--	8.1	--	5.6	--	--	--	--	--	--	--	--
5-10	*	--	--	--	--	9.1	--	--	--	11.4	4.5	4.8	--	--	8.6
5-11	--	*	7.4	*	10.0	--	--	--	--	--	--	--	--	--	--
5-12	--	--	--	--	--	--	*	5.6	5.0	3.2	5.3	--	--	--	5.5

a/ Intake Slots 5A & C and all of Unit 6 were not sampled due to small numbers of fish present during the entire season.

* Indicates number of fish in sample is too small for accurate estimate - less than 50.

Appendix Table B18.--Continued.

Date	Unit 1			Unit 2			Unit 3			Unit 4			Unit 5[a/]	Unit 6[a/]	Fish marking facility
	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	slot B		
5-13	*	*	7.8	*	--	--	--	--	--	--	--	11.4	--	--	6.2
5-14	--	--	--	--	*	1.4	*	*	--	--	--	--	--	--	6.9
5-15	--	--	--	--	--	--	--	--	4.7	8.1	4.7	*	*	--	9.5
5-16	9.1	*	6.0	*	--	--	--	--	--	--	--	--	--	--	9.5
5-17	--	--	--	--	10.1	*	8.6	6.0	--	--	--	--	--	--	4.9
5-20	*	*	*	--	--	--	--	--	--	*	7.0	0.0	--	--	13.1
5-21	--	--	--	*	8.7	*	--	--	--	--	--	--	4.0	--	7.2
5-22	--	--	--	--	--	--	4.7	*	8.3	6.6	--	--	--	--	--
5-23	*	*	--	--	--	--	--	--	--	--	7.4	11.6	6.8	--	5.5
5-24	--	--	--	*	17.0	*	7.0	9.3	*	--	--	--	--	--	5.6
5-26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9.5
5-27	--	--	9.0	--	--	--	--	--	--	3.5	4.2	--	3.9	--	--
5-28	*	*	--	15.6	11.6	1.0	--	--	--	--	--	--	--	--	12.3
5-29	--	--	--	--	--	--	0.0	10.9	11.4	1.3	6.5	--	--	--	8.2
5-30	--	--	--	--	--	--	--	--	--	--	--	4.3	9.5	--	9.3
5-31	*	*	23.6	*	--	--	--	--	--	--	--	--	--	--	7.0
6-2	--	--	--	--	18.9	*	9.8	2.3	--	--	--	--	--	--	6.7
6-3	--	--	--	--	--	--	--	--	16.7	6.7	8.9	*	--	--	12.3
6-4	*	*	1.8	*	--	--	--	--	--	--	--	--	--	--	7.4
6-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9.7
6-13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.1
6-16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.6
6-19	7	8	12	7	10	7	10	10	10	10	11	7	7	--	6.7

a/ Intake Slots 5A & C and all of Unit 6 were not sampled due to small numbers of fish present during the entire season.

* Indicates number of fish in sample is too small for accurate estimate - less than 50.

Appendix Table B18.--Continued.

Date	Unit 1			Unit 2			Unit 3			Unit 4			Unit 5[a/]	Unit 6[a/]	Fish marking facility
	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	slot B		
6-23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.2
6-25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.0
6-27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14.0
6-30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11.4
7-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.0

Average percent descaled: 11.0%

a/ Intake Slots 5A & C and all of Unit 6 were not sampled due to small numbers of fish during the entire season.

* Indicates number of fish in sample is too small for accurate estimate - less than 50.

Appendix Table B19.--Percent descaling of juvenile steelhead by date, unit number, and gatewell slot designation or fish marking facility at Little Goose Dam, 1980.

Date	Unit 1			Unit 2			Unit 3			Unit 4			Unit 5[a/]	Unit 6[a/]	Fish marking facility
	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	slot B		
4-16	*	*	*	*	--	--	--	--	--	--	--	--	--	--	--
4-18	*	*	*	*	--	--	--	--	--	--	--	--	--	--	--
4-21	--	--	--	--	*	*	*	*	*	--	--	--	--	--	--
4-23	*	*	*	3.8	--	--	--	--	--	--	--	--	--	--	--
4-25	6.1	*	--	--	--	--	--	--	--	--	--	--	--	--	--
4-26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.1
4-27	10.4	7.7	--	2.8	4.9	--	--	--	--	--	--	--	--	--	6.9
4-28	--	--	--	--	--	4.8	2.9	6.3	7.5	5.6	--	--	--	--	6.9
4-29	--	--	--	--	--	--	--	--	--	--	3.6	2.8	3.7	--	--
4-30	8.9	6.8	7.2	--	--	--	--	--	--	--	--	--	--	--	--
5-1	--	--	--	8.5	6.7	5.1	11.5	6.3	--	--	--	--	--	--	--
5-2	--	--	7.9	--	--	--	--	--	3.5	7.7	4.6	5.8	--	--	14.0
5-3	10.0	5.6	--	--	--	--	--	--	--	--	--	--	5.6	--	--
5-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9.6
5-5	--	--	--	5.0	--	8.1	7.0	9.8	5.0	--	--	--	--	--	--
5-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.6
5-7	2.9	4.0	--	--	--	--	--	--	--	8.2	3.7	--	--	--	8.7
5-8	--	--	10.2	5.1	--	--	--	6.0	7.4	--	--	--	7.0	--	8.5
5-9	--	--	--	--	2.4	--	3.8	--	--	--	--	--	--	--	--
5-10	6.1	--	--	--	--	7.9	--	--	--	7.5	5.2	5.8	--	--	3.4
5-11	--	7.2	8.6	12.8	7.4	--	--	--	--	--	--	--	--	--	--
5-12	--	--	--	--	--	--	8.7	3.4	8.4	9.4	4.6	--	--	--	10.1
5-13	8.2	10.5	12.4	7.5	--	--	--	--	--	--	--	7.7	--	--	9.5
5-14	--	--	--	--	7.9	6.2	8.4	9.3	--	--	--	--	--	--	6.2

a/ Intake Slots 5A & C and all of Unit 6 were not sampled due to small numbers of fish present during the entire season.

* Indicates number of fish in sample is too small for accurate estimate - less than 50.

Appendix B19.--Continued.

Date	Unit 1			Unit 2			Unit 3			Unit 4			Unit 5[a/]	Unit 6[a/]	Fish marking facility
	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	Slot A	Slot B	Slot C	slot B		
5-15	--	--	--	--	--	--	--	--	7.1	3.9	6.3	6.6	2.2	--	7.9
5-16	12.8	7.5	9.2	8.6	--	--	--	--	--	--	--	--	--	--	3.9
5-17	--	--	--	--	11.0	5.5	7.1	8.4	--	--	--	--	--	--	7.9
5-20	9.6	5.9	7.0	--	--	--	--	--	--	3.6	7.3	7.2	--	--	9.3
5-21	--	--	--	--	--	--	--	8.2	7.5	11.9	--	--	--	--	9.9
5-23	10.5	10.3	--	--	--	--	--	--	--	--	12.1	9.6	11.2	--	9.5
5-24	--	--	--	7.8	9.7	11.5	7.1	7.1	8.3	--	--	--	--	--	12.0
5-26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.2
5-27	--	--	18.6	--	--	--	--	--	--	8.9	7.9	6.8	8.9	--	--
5-28	11.7	8.0	--	11.4	9.1	12.5	--	--	--	--	--	--	--	--	16.4
5-29	--	--	--	--	--	--	8.7	11.4	7.4	5.6	12.0	--	--	--	8.2
5-30	--	--	--	--	--	--	--	--	--	--	--	*	--	--	9.2
5-31	4.5	*	7.7	*	--	--	--	--	--	--	--	--	--	--	9.1
6-2	--	--	--	--	8.8	*	13.6	4.0	--	--	--	--	--	--	9.7
6-3	--	--	--	--	--	--	--	--	11.8	5.0	16.0	28.5	--	--	9.9
6-4	11.3	8.2	8.6	5.4	--	--	--	--	--	--	--	--	--	--	7.5
6-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.7
6-13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.5
6-16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.2
6-19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11.1
6-23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.3
6-25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.0
6-27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11.0
6-30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.1
7-2	13	11	10	11	9	8	10	11	10	11	11	9	--	--	5.5

a/ Intake Slots 5A & C and all of Unit 6 were not sampled due to small numbers of fish present during the entire season.

* Indicates number of fish in sample is too small for accurate estimate - less than 50.

Appendix Table 20.--Number of salmonid transported from Lower Granite, Little Goose, and McNary Dams; oxygen levels; water temperature; and transport mortalities, 1980.

Trip No.	Date	Number transported				Oxygen (P.P.M.)[a]			Temperature	Transport mortalities			
		Lower Granite Dam	Little Goose Dam	McNary Dam	Totals	Stern	Center	Bow	(°C)	Chinook %	Steelhead %	Coho %	Sockeye %
1	4(21-22)	63,191	--	12,775	75,966	9.9	10.8	11.2	10.5	0.09	--	--	---
2	4(23-24)	212,778	38,833	--	251,611	10.3	10/8	10.5	10.9	0.18	0.005	--	---
3	4(25-26)	298,121	67,499	13,715	379,335	9.2	9.5	9.0	10.9	0.51	0.003	--	---
4	4(27-28)	513,658	--	--	513,658	8.0	8.4	8.5	11.5	0.26	0.001	--	---
5	4(29-30)	282,188	81,643	12,375	376,206	9.0	8.4	8.1	11.2	0.94	0.004	--	---
6	5(1-2)	357,717	88,276	26,355	472,348	8.8	8.7	9.3	11.7	0.53	0.005	--	0.001
7	5(3-4)	161,592	50,000	64,240	275,832	9.1	8.3	8.9	12.8	0.31	0.002	0.001	---
8	5(5-6)	202,003	--	--	202,003	9.5	9.3	9.3	12.1	0.07	0.003	--	---
9	5(7-8)	219,342	57,036	61,490	337,868	8.6	8.5	8.2	12.7	0.57	0.02	--	0.001
10	5(9-10)	211,325	66,550	95,067	372,942	8.2	8.2	8.9	12.1	0.11	0.01	0.0002	0.0005
11	5(11-12)	150,562	86,601	52,978	290,141	8.6	8.7	8.6	12.6	0.16	0.01	--	0.001
12	5(13-14)	114,067	59,910	26,817	200,794	9.4	9.5	9.5	12.0	0.08	0.01	--	0.0009
13	5(15-16)	88,730	54,789	20,283	163,802	9.3	10.1	9.0	12.5	0.15	0.02	--	---
14	5(17-18)	60,474	37,471	56,231	154,176	9.3	9.1	9.7	12.7	0.04	0.03	--	0.002
15	5(20-21)	85,971	--	36,125	122,096	9.0	10.0	--	13.3	0.08	0.05	0.003	0.002
16	5(22-23)	60,814	36,062	64,557	161,433	9.8	10.2	10.1	13.1	0.05	0.008	0.001	0.003
17	5(24-25)	53,612	54,090	55,208	162,910	8.7	9.2	9.3	12.6	0.06	0.07	--	0.003
18	5(28-29)	182,578	89,318	34,437	306,333	9.4	9.3	9.3	11.3	0.11	0.17	0.02	0.004
19	5(30)	---	--	15,593	15,593	--	--	--	--	--	--	--	---
TOTALS		3,318,723	868,078	648,246	4,835,047								

a/ Average oxygen taken in the three separate fish compartments.