Transportation Operations and Research on the Snake and Columbia Rivers, 1981

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TABLE OF CONTENTS

INTRODUCTION

In 1981, the National Marine Fisheries Service (NMFS) conducted activities under contract to the U.S. Army Corps of Engineers (CofE) relating to transport operations and research.

The NMFS' role in transportation activities changed significantly in 1981. NMFS no longer oversees daily operations for collection of smolts or their subsequent transport. Beginning in 1981, these activities were supervised by biologists from the CofE, Operations Division, Walla Walla District.

NMFS was in part responsible for the operation of transport activities in that we served as advisors to the CofE on technical matters. During the juvenile migration season, a NMFS biologist was assigned to each of the three collector dams (Lower Granite, Little Goose, and McNary). The trucking phase of the CofE transport operation was monitored by NMFS personnel based on delayed mortalities from samples of juvenile chinook salmon taken from selected loads following transport from the collector dam to Bonneville Dam.

NMFS also served as a contractor to state fisheries agencies (funding provided by the CofE) so their biologists could be on site at collector dams and assume a more active role in transportation operations. Transportation of smolts in 1981 was a coordinated function of CofE; NMFS; and state fisheries agencies from Idaho, Washington, and Oregon. A detailed account of this coordinated effort, numbers of fish transported from each dam, etc. is provided by Basham et al. (1982).

In 1981, research activities by NMFS included: (1) investigations of potential stress areas in collection and transport systems that may affect post-release survival of juvenile chinook salmon; (2) delayed mortality

tests at Bonneville Dam for chinook salmon following transportation from Lower Granite, Little Goose, and McNary Dams; (3) marking fall chinook salmon at McNary Dam for continued transport evaluation; (4) evaluation of a new wet separator at Little Goose Dam; and (5) continued work relating to the recovery of adult salmonids previously tagged as juveniles for transportation evaluation. The latter activity was a major effort--data on tags from over 2,000 adults were recovered from live traps at Bonneville, McNary, or Lower Granite Dams; ocean and sport fisheries; hatcheries; and spawning grounds.

TRANSPORT RESEARCH--JUVENILES

Seawater Challenge Bioassays for Stressed Chinook Salmon

In 1972, blood glucose and urea levels from spring chinook salmon were measured in fish from selected points within the collection, marking, and transport systems at Little Goose Dam (Ebel et al. 1973). From these tests, Ebel reported an increase in stress after marking but no significant difference in stress among groups taken from gatewells and after passage through the bypass and fingerling sorter. An additional increase in stress was noted in fish following truck transport.

Substantial changes have been designed into more recent bypass systems, especially at Lower Granite Dam which did not exist in 1972. Despite many features which enhance the number of fish to be collected and hopefully do not impair juvenile survival, there are still areas of potential stress or injury. This is especially true if there are unseen factors such as under-water debris (lodged in pipes) or malfunctioning traveling screens (in turbine intakes) which could injure many fish in a relatively short time. An example of a more visible area of potential

stress is the higher fish densities in gatewells, raceways, and transport equipment than were typical at Little Goose Dam in 1972.

In 1981, the NMFS began preliminary research at Lower Granite Dam to determine if seawater challenge bioassays were a reliable method for measuring the relative stress levels of chinook salmon smolts at different points within the collection system and following transport by truck to Bonneville Dam. Since collection and transport of fish are relatively rapid processes (24-36 h), we hypothesized that the stresses would be cummulative (i.e., smolts would not have sufficient time in any one area of the system to recover from any previous stress). Therefore, if smolts are challenged to seawater (a severe secondary stress), previous stresses would be evidenced by a mortality which would vary based on the severity of the primary stresses inflicted upon the smolts. Ideally, the test should have sufficient sensitivity to detect relatively small differences in primary stress levels.

The reader is cautioned that when interpreting results of these tests, mortality following the secondary stress challenge does not have any known relationship to long-term survival. The data are useful for determining where primary stresses occur so that action may be taken to reduce collection and transport stresses to smolts and hence provide for maximum long-term survival.

For our study in 1981, five potential areas of stress to chinook salmon smolts were compared against a control group as described below:

1. Control group. These fish were sampled from a C-Slot gatewell in Units 4, 5, or 6. Ideally, the control group should have no exposure to collection stress; however, efforts to capture fish in the Lower Granite Dam forebay which would have satisfied this objective were unsuccessful.

The first area where fish were available for sampling after they enter the collection system were the intake slots. Our rationale for selecting control fish from the C-Slot intakes was that fish in these intake slots are generally less descaled and crowded than are fish in either of the other two intake slots within the same unit. This phenomenon occurs because the C-Slot intake provides the least amount of water to a turbine unit; hence, the water velocities within these intakes are less than in either of the other two intakes.

2. Gatewell group. These fish were sampled from an A-Slot gatewell in Units 4, 5, or 6. Since the A-Slot intake provides the most water (highest veolcity) to a turbine unit, descaling and crowding of fish are generally the highest in these gatewells. Also, within these intakes, fish are more likely to be exposed to undesirable velocity situations which may result in fatigue or swimming impairment.

3. Raceway group. These fish were sampled from the upwell box within the marking facility immediately after removal from the sample raceway. The fish had passed through the gatewell orifices, the bypass channel and pipe, and the fingerling separator. Since these fish were taken from the sample raceway, loading densities were extremely low for all replicates. For this reason, we do not believe any stresses which may be related to high raceway loading densities were represented in these fish.

4. Marked group. These fish were sampled after they had passed through our standard marking procedures used during past transport experiments. These procedures include dipping from the upwell box into the anesthetic trough using a standard dip net, sorting by species, adipose fin clipping, freeze branding, and coded wire tagging. Previous stresses from Groups 2 and 3 would be additive to this group.

5. Trucked group. These fish were sampled after truck transport to Bonneville Dam and challenged to seawater immediately upon arrival. This group did not include any marked fish from Group 4, but did include fish with stresses accumulated in Groups 2 and 3.

6. Delayed challenge trucked group. These fish were sampled from lots of fish matched to Group 5 which were taken for delayed mortality samples. This group of fish was allowed a 24-h stress recovery period in fresh water prior to challenge in seawater.

Methods

To ensure maximum test sensitivity prior to testing, we determined the highest seawater concentration which allowed 90% survival of control fish. This was accomplished by exposure of groups of 15 control fish each to seawater concentrations of 15, 20, 25, and 30 ppt for 48 h. Survival in all of these tests exceeded 90%; therefore, we chose 30 ppt as the seawater concentration for the first test replicate. Thereafter, survival of control fish during the previous replicate was to be used as the indicator for the appropriate seawater concentration in the following replicate. If control fish survival was less than 90% during the previous replicate, control fish would again be challenged to the aforementioned concentrations before replication continued. In this manner, we determined that 30 ppt was the appropriate seawater concentration for all test replicates during the entire study period.

Chinook salmon smolts, the target species, were collected from each area and challenged to seawater the same day to provide reasonable assurance that subpopulation mixtures were equal among all treatment groups. Sampling procedures and techniques by groups were as follows:

Groups 1 and 2. Chinook salmon smolts were sampled from gatewells with a standard gatewell dip basket (Swan et al. 1979) which was modified

to ensure that the fish were never out of water during the dipping process. The fish were removed from the dip basket with a hand dip net fitted with a watertight bag (sanctuary dip net) and transferred to a live car for transport to the test chamber. All groups of fish were sampled and transferred using equipment which provided water to water transfers.

Groups 3 and 4. Chinook salmon smolts were diverted from the sample raceway to the marking facility upwell tank. Group 3 fish were dipped from the upwell tank utilizing the sanctuary dip net and transferred directly to the test chamber. Group 4 fish were dipped form the upwell tank with a standard meshed dip net and passed through the marking line process. After marking, the group was allowed to recover from the effects of anesthesia for 1 to 1-1/2 h before transfer to the test chamber.

Groups 5 and 6. Chinook salmon smolts were loaded into a transport truck using standard loading procedures. An attempt was made to load at a density of 0.5 lb/gal of water. Typically, only enough fish were available to meet this requirement in one or two of the three available compartments. When two compartments were used, both compartments were loaded at a density of 0.5 lb/gal of water.

Upon arrival at Bonneville Dam, trucked fish were released into an inspection pond. Fish destined for seawater challenge and delayed mortality tests were dipped from the pond utilizing a sanctuary dip net and transferred to a live car for transport to the test chamber. To provide adequate fish numbers for the matching seawater challenge and delayed mortality tests, approximately 300 fish were sampled from each load.

The test chambers at both Lower Granite and Bonneville Dams were Living Stream Model 700L recirculating seawater holding systems.1/

1/ Reference to trade names does not imply endorsement by the National Marine Fisheries Service.

These systems, which were subdivided into the appropriate number of test pens, were equipped with filters for biowaste removal and refrigeration units for temperature control.

For each test group of approximately 20 chinook salmon smolts each, seven replicates were bioassayed for 5 days beginning on 20 April 1981 and ending on 6 June 1981. At each dam, fish were placed into fresh water in a bioassay chamber. To provide the desired seawater concentration, a commercial seawater product (Marine Environment) was weighed, mixed into a slurry, and added to the bioassay chamber which was subsequently covered to eliminate possible external interferences. Mortalities were removed at 24-h intervals within the 5-day replication period. All mortalities were examined and abnormalities such as injury, descaling, or obvious disease symptoms were recorded. In test Groups 1-4, these data were also recorded for survivors at the end of the test period. Upon completion of a test replicate, all live fish were released.

Results

After the first replicate, it became evident that our traditional marking procedures resulted in a severe stress to smolts. We, therefore, added a series of tests to isolate where in the anesthesia-marking process stress occurred. Our preliminary assessment, based on few tests, suggests that the fabric dip net and anesthesia accounts for nearly all handling and marking stress. It is possible, however, that fright experienced by smolts released from the net into a shallow anesthetic trough in a well-illuminated environment may be the underlying cause of stress.

In general, there was only a slight increase in stress from the control gatewell through raceway holding (Table 1). The increase was not

Table 1.--Relative stress of juvenile chinook salmon from selected areas of the collection system at Lower Granite Dam and in the truck transport system. Stress levels are indicated by percent mortality when fish were challenged to a secondary stress in 30 ppt seawater.

Date	Replicate no.	Relative stress--percent mortality--by area (test group)					
		Control (1)	Gatewell (2)	Raceway (3)	Post marking (4)	Post transport (5)	24 h post transport (6)
20 April	1	3.0	0.0	6.8	50.0	65.0	35.0
25 April	2	5.7	8.0	23.5	45.0	17.0	9.0
1 May	3	8.3	3.6	15.4	45.0	100.0	14.3
15 May	4	10.0	16.6	8.7	31.8	55.0	8.0
20 May	5	21.0	3.6	0.0	18.2	100.0	68.0
1 June	6	0.0	5.9	8.6	0.0	100.0	65.0
6 June	7	5.3	10.3	3.4	19.0	57.9	22.5
Average for group (weighted)		7.0	6.0	10.8	32.1	71.4	30.9

substantial; however, stress from high load densities in raceways was not measured. Experimental fish from the sample raceway were generally not as densely crowded as from regular raceways, except when the raceway crowding device was used to transfer fish from the raceway to the working facility.

Stress during transport was substantial; bioassay mortalities ranged from 17.0 to 100% (71.4% average) in our replicated tests. As indicated in Table 1, stress of truck transported fish was almost seven times that of fish sampled from the raceway (10.8 vs 71.4%). It is difficult to perceive that confinement in trucks for approximately 8 h is totally responsible for this increased stress. As indicated previously, raceway stress measurements were taken in the sample raceway, whereas, trucked fish were generally taken from higher density raceways. If density was a factor, the raceway measurements would have been artifically low. The real difference between the raceway and truck measurements was probably less than measured. Two other factors not addressed in this experiment may also account for some of the observed stress on transported fish. These are: (1) loading techniques (fish pass over a dewatering area between raceways and final delivery to the truck) and (2) release techniques (at Bonneville Dam samples were taken after fish were released from a dark truck environment to an open illuminated inspection pond).

The delayed challenge test demonstrated that if severely stressed fish were allowed to recover at rest for 24 h, stress was reduced by more than one-half.

The relationship between descaling rates and survival in the seawater bioassays is indicated in Table 2. The high percentage (78.6%) of all

Table 2.--The percent of all test fish that were descaled, the percent of all test mortalities that were descaled, and the percent of all descaled test fish that died by test group.

Test group	Percent of all test fish descaled	Percent of all test mortalities descaled	Percent of all descaled test fish that died
1 (Control)	2.5	27.3	75.0
2 (Gatewell)	4.2	33.3	57.1
3 (Raceway)	6.2	42.9	75.0
4 (Post marking)	13.0	36.2	89.5
5 (Post transport)	Not available	37.0	Not available
6 (24 h post transport)	Not available	40.4	Not available
Weighted averages	6.3	37.3	78.6

descaled test fish that died demonstrates the adverse impact that descaling may have on survival in full-strength seawater. Further, the percent of all test mortalities that were descaled is fairly consistent among the test groups suggesting that the descaling itself can be responsible for mortalities regardless of added stresses. These data further illustrate the necessity to continue efforts designed to reduce descaling in all collection, bypass, and transport systems.

These results indicate that the present transport-collection systems at Lower Granite Dam impart a significant stress on chinook salmon. The effects of stress, however, can be significantly reduced by providing a recovery period of 24 h or more after release. Research scheduled for 1982 is aimed at further defining major causes of stress in the system and developing methods to reduce stress. Planned efforts include: (1) defining impact of crowded raceways, (2) improving loading and release operations, and (3) defining the recovery period needed after release. Measurements will be made on fish collected and transported from McNary Dam as well as Lower Granite Dam.

Delayed Mortality Tests at Bonneville Dam

Objectives of the delayed mortality tests at Bonneville Dam in 1981 were to: (1) provide corroborative data for delayed mortality from the same truck loads of spring chinook salmon that were challenged to seawater and (2) provide general monitoring of the quality of fish released after truck transport from the three collection dams.

Samples for delayed mortality tests were taken following release of fish into the inspection pond in the same manner as described in the previous section. Approximately 200 to 300 spring chinook salmon from each of 23 truck releases were transferred in live cars to holding tanks with

pass-through water supplies for 5 days of mortality observations. All fish were examined for descaling. Fish surviving the holding period were released into the Columbia River. Tests were begun on 7 April and concluded on 17 June.

There were a number of important inferences and conclusions based on the results of the tests shown in Table 3: (1) the delayed mortality was low--7.7, 11.0, and 8.2% for Lower Granite, Little Goose, and McNary Dams, respectively; (2) the descaling rate in populations tested was high--16.7 to 21.8%; (3) descaled fish were more prone to die--most of the mortalities ($\approx$ 75%) came from descaled fish; and (4) problems continue to exist in the collection system at Little Goose Dam--mortality and descaling were highest at this collection site.

From these results and the results from seawater challenge tests, it appears that descaling has an extremely negative impact on the ability of juvenile spring chinook salmon to survive. Survival was impaired on descaled fish whether they were subjected to a secondary stress (seawater) or whether they rested in a sanctuary environment. Minimizing injury (descaling) in collection and transport systems, therefore, is clearly mandated to assure maximum survival of smolts released below Bonneville Dam.

Installation and Evaluation of a Wet Separator Device for Smolts

Each collector dam is equipped with a fish bypass system (Matthews et al. 1977; Smith and Farr 1975). These systems move fish from the gatewells to a series of raceways where they are held until transported. Before entering the raceways each fish must pass through a "dry" separator (above water), into a collection hopper, and through a counting tunnel.

Table 3.--Delayed mortality of spring chinook salmon following transportation by truck from Lower Granite, Little Goose, and McNary Dams measured at Bonneville Dam (5-days holding).

Item	Lower Granite	Little Goose	McNary
Number of tests	11	5	8
Number of fish held	2450	1140	1695
5-day mortality percent (number)	7.7 (188)	11.0 (125)	8.2 (139)
Percent of population descaled	16.7	21.8	18.9
Percent of mortality descaled	72.9	72.0	77.6
Percent of descaled fish that died	33.6	36.3	33.8
Percent of nondescaled fish that died	2.5	3.9	2.3

The function of the separator is to grade fish for counting purposes by size and to some degree by species (salmon are generally smaller than steelhead). Also, considerable quantities of debris are separated from fish and water passing to the raceways. Each separator has one large collection hopper divided into two compartments. A series of parallel, sloping, plastic coated pipes cover the hopper. These pipes are situated above the water level of the compartments and the gap between pipes varies in size over the two compartments. Fish are separated by falling through the gaps between the pipes--the larger fish are restricted to falling into the compartment covered by pipes with the larger gap size. A fine water spray is directed onto the separator pipes from above to aid the fish's movement during separation.

Although these separators are very effective in sorting small and large salmonids (up to 90% separation), concern has arisen as to the additional stress placed on fish because they are out of the water and may hang up while being separated. Smolting salmonids are continually subjected to potential stress situations, both natural and man-made, during their seaward migration. Measures should be taken to alleviate as many of these problems as possible, especially considering the large number of fish being transported.

Preliminary Model Studies

In 1980, NMFS personnel conducted a series of preliminary tests at Lower Granite Dam with a new type separator system in an effort to minimize stress by keeping fish in water. This was accomplished by placing the separator pipes below the water level in the compartment (hence the name "wet" separator).

Two observed characteristics of smolting salmonids were used in the development of the "wet" separator. First, the attraction these fish exhibit toward a flow and second, their tendency to dive or sound as an avoidance movement.

Three variables were considered during the tests: (1) submerged spray bars, on or off; (2) overhead lighting, on or off; and (3) varying the gap between the separator pipes in the two compartments. To determine the appropriate gap, head widths were measured for samples of spring chinook salmon and steelhead. It was determined that the head width of juvenile spring chinook salmon and steelhead could be estimated to be approximately one tenth of the fork length (160 mm fork length = 16 mm head width).

The following combination of variables provided the best results: (1) submerged spray bars, on; (2) overhead lighting, on; and (3) a 1/2-inch gap between the separator pipes for the first compartment and a 1/1-4-inch gap for those in the second compartment. This configuration gave a separation of 90% (241/269) of the spring chinook salmon into the first compartment and 87% (364/418) of the steelhead into the second compartment.

Prototype Installation and Evaluation at Little Goose Dam.

Little Goose Dam was selected as the site for the prototype tests for two primary reasons. First, it is the second collection site on the Snake River for transportation purposes and as such does not normally collect as many fish as either Lower Granite or McNary Dams. Secondly, the water supply in the fingerling bypass system is entirely gravity flow with about a 90-foot head and a pinch valve in the pipe to minimize surging. A stable water supply is necessary for the "wet" separator to operate effectively.

The basic separator, illustrated in Figures 1 and 2, consisted of two fish compartments, each 6 feet long x 10 feet wide x 3 feet deep. An 18-inch and a 12-inch diameter pipe with a maximum head of 2 feet supplied auxiliary water to the two compartments and the spray bars. Air operated gate valves on each pipe were used to regulate these flows. Water for both compartments entered the upstream end of the first compartment. Two sections of perforated plate acted as baffles to provide smooth flows within the compartments. One section divided the two compartments. The other section ran the length of the compartments and was positioned between the water supply and the fish collection sections. Each compartment had three 4-inch diameter outlets with counting tunnels.

The spray bars consisted of 2-inch diameter plastic pipe with 3/16-inch diameter holes placed at 4-inch intervals. These bars extended the length of the fish hopper and were set at 6-inch spaces across the width of the compartments. The separator pipes were two sets of 1-inch diameter metal tubing covered with a thin plastic coating for smoothness. Initially the gap setting was 5/8 inch in the first compartment and 1-1/4 inches in the second. Spacers were used to maintain gap integrity. The slope of each section of separator pipes was adjusted by raising or lowering the downstream end.

A fish distribution system was installed in conjunction with the "wet" separator. This system involved a pair of aluminum channels with slide gates. These allowed operators to divert the fish from the compartments into selected raceways. A series of five raceways were available for collection at Little Goose Dam. Two raceways were normally used for small

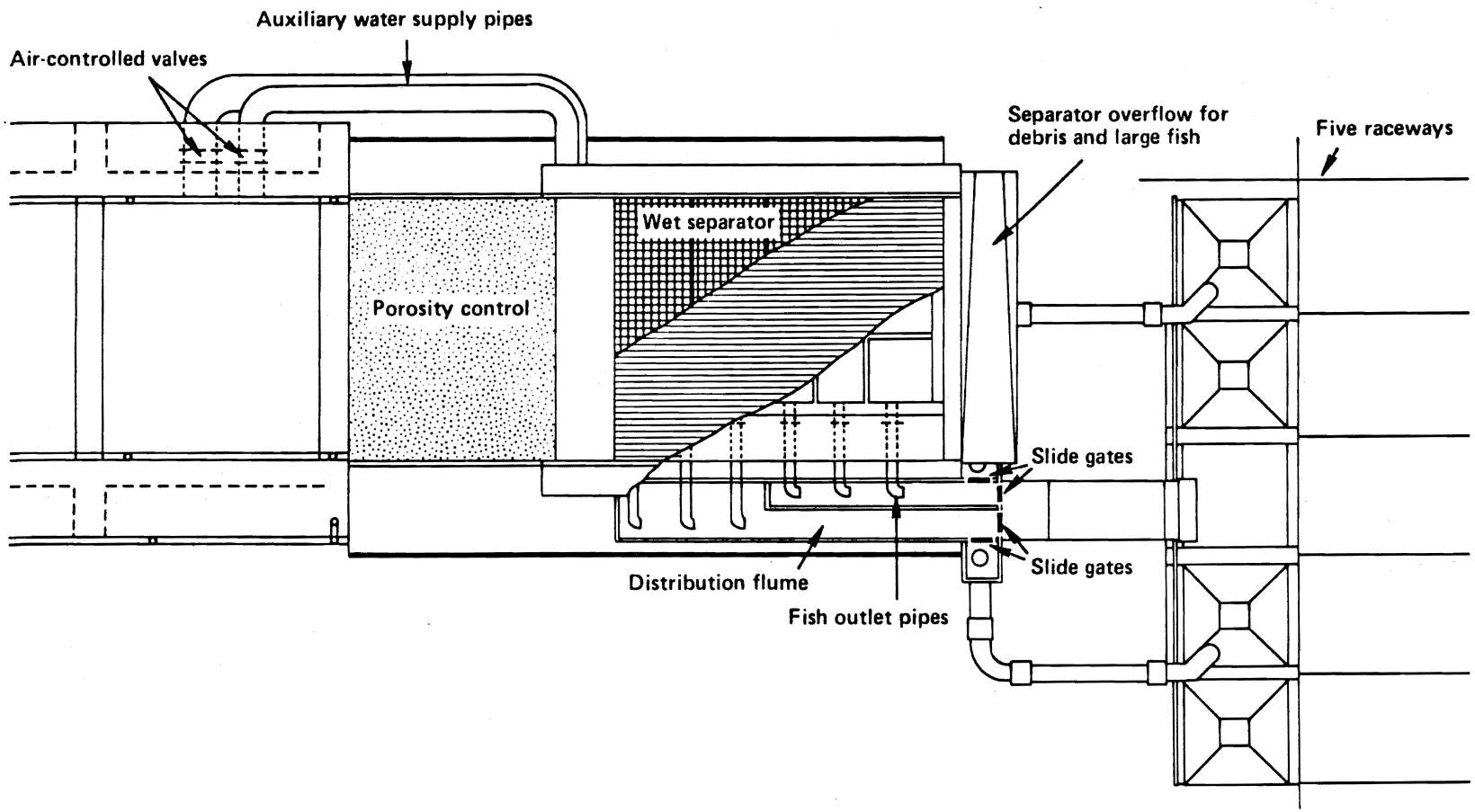

Figure 1.--Top view prototype "wet" separator, Little Goose Dam, 1981.

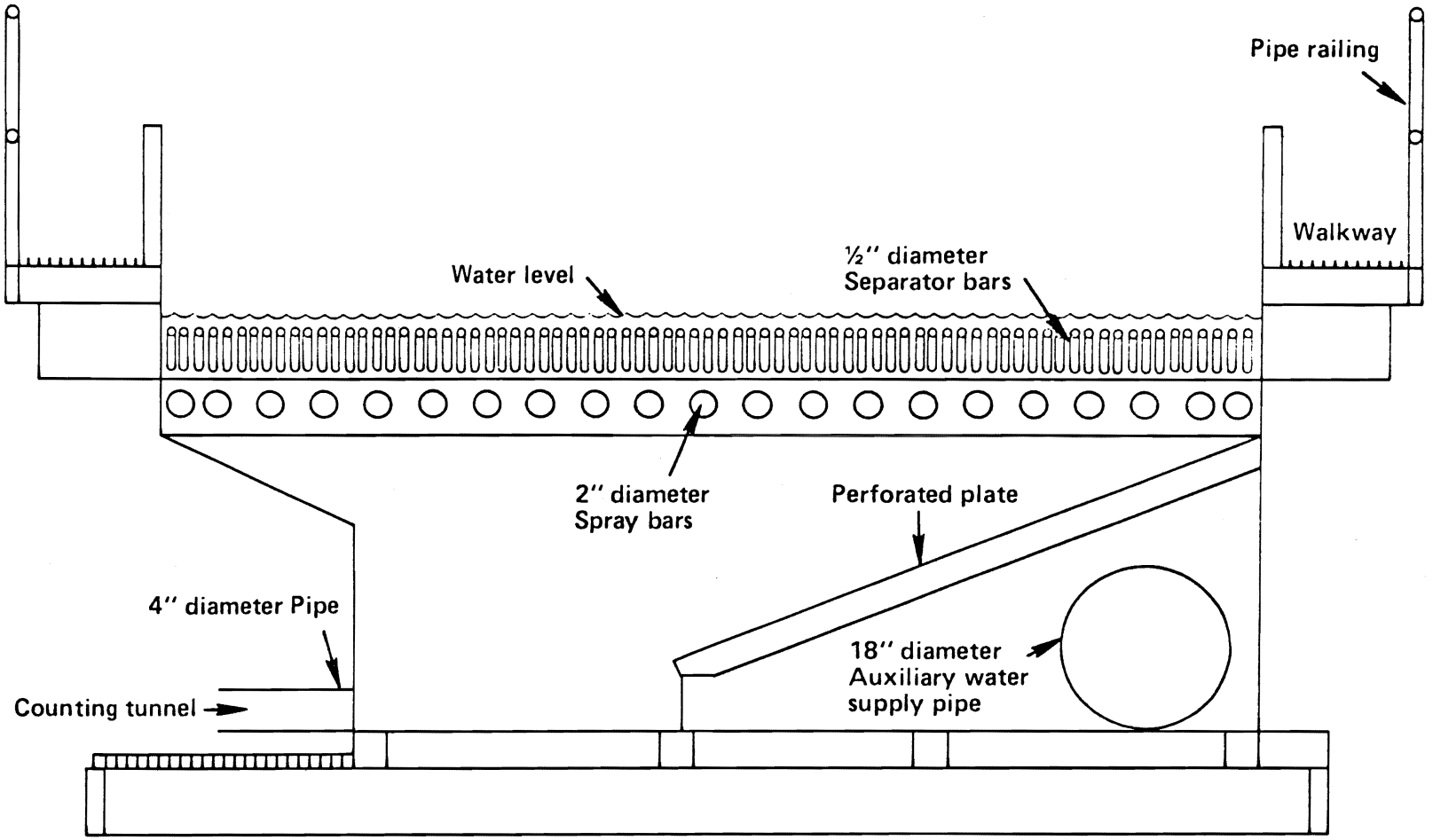

Figure 2.--End view prototype "wet" separator, Little Goose Dam, 1981.

fish and two for large fish. The center raceway was used as a daily sample raceway and collected fish from both compartments. CofE biologists took samples of approximately 50 fish on an hourly basis for each 24-h period. At the end of the collection period, the fish were identified and a species count made. These data gave a percentage breakdown for the individual species on a daily basis. Hourly recordings were also made for each counting tunnel to determine the number of fish collected during each 24-h period.

Evaluation of the separator was based on the percentage of the total chinook salmon collected each day that passed through the first compartment. The 24-h chinook salmon total was calculated from the percentage of chinook salmon in the sample raceway, times the total fish (all species) counted through the separator each day. The number and percentage of chinook salmon passing through the first compartment was calculated by subtracting numbers estimated in the second compartment from the total 24-h chinook salmon collection. Fish exiting the second compartment were diverted into a pen placed in the sample raceway. Samples, 10-minutes at 1-hour intervals, were taken during the hours of peak movement of the fingerlings. These sample totals were expanded to provide daily estimates of passage (all species) through the second compartment.

Field testing of the prototype device was limited because the smooth flows required to carry fish and surface water to the device seldom existed. Continuing problems with water control lasted throughout the season. When the pinch valve was operated in the 42 inch-diameter bypass pipe, flows were smooth, however, hydraulic conditions in the pipe (probably near the pinch value) killed or injured some fish. Injured fish

would not respond to flows created within the separator which were designed to cause a response resulting in separation.

Debris was also a major problem. Flows within each compartment tended to pull some debris toward the outlets, and at times these became completely plugged.

Another problem existed at the overflow at the downstream end of the separator; large steelhead smolts commonly passed over the separator and were never collected. Increased bar spacing from 1-1/4 inches to 1-1/2 inches should alleviate this problem.

In spite of these problems, tests to define separation of chinook salmon were attempted (Table 4). In three of eight tests, 80% or more of the chinook salmon were correctly separated into the first hopper. Although a significant number of steelhead entered the first hopper in all tests, these were restricted to small fish capable of passing through the 5/8-inch bar gap. (Steelhead entry was restricted further after 19 May when the gap was reduced to 1/2 inch.)

Because of small steelhead, achievement of more than 80% separation of chinook salmon and steelhead is unlikely. Separation by species, though, is probably not as critical as separation by size. It is important, in our estimation, to keep large steelhead separated from the smaller steelhead and chinook salmon in raceways and transport systems.

Smolt Marking-McNary Dam

In 1981, fall chinook salmon were the only smolts marked during the summer migration at McNary Dam. Collection and marking procedures were the same as reported by Park et al. (1981). Marking occurred over a 3-week period in July (Table 5). Brand orientation was changed every 5 to 7 days

Table 4.--Chinook salmon separation with prototype "wet" separator at Little Goose Dam, 1981.

Date	Total chinook collected, 24 h	Total chinook, second hopper	Total chinook, first hopper	Chinook separation(%)
2 May 81	25,444	5,772	19,672	77.3
4 May 81	15,086	5,174	9,912	65.7
11 May 81	3,527	1,266	2,261	64.1
11 May 81	1,389	555	834	60.0
12 May 81	1,168	201	967	82.8
18 May 81	1,954	649	1,305	66.8
19 May 81[a/]	2,471	485	1,987	80.4
20 May 81[a/]	3,321	642	2,679	80.7

[a/] Gap size in first hopper reduced from 5/8 to 1/2".

Table 5.--Summary of brands and wire codes used to identify juvenile fall chinook salmon that were marked by McNary Dam and released as controls below McNary or transported to below Bonneville Dam, 1981.

Marking period	Brand, position, and orientation	Wire tag code	Number
Control			
9-14 July	LA - 1M 1	03-17-32	10,115
15-18 July	LA - 1M 3	03-17-32	10,143
20-23 July	LA - 1M 2	03-17-32	10,012
27-31 July	LA - 1M 4	03-17-32	12,310
		Subtotal	42,580
Transport			
9-14 July	RA - 1+ 1	03-17-33	10,096
15-18 July	RA - 1+ 3	03-17-33	10,142
20-23 July	RA - 1+ 2	03-17-33	10,018
27-31 July	RA - 1+ 4	03-17-33	12,668
		Subtotal	42,924

to provide stratified identification during periods of changing flows, changing stocks of fish, or other factors which might influence survival of controls released in the McNary Dam tailrace. This treatment of the controls was required for summer flow studies being conducted in John Day Reservoir by other NMFS investigations. Marked groups of transported (truck) fish were similarly stratified to provide useful comparisons of transported fish vs nontransported fish for various segments of the migration in 1981.

ADULT RETURNS TO THE COLUMBIA AND SNAKE RIVERS

Tagged adult salmonids from previous juvenile tagging experiments were recovered at dams by operating tag detection equipment in fishways at Bonneville, McNary, and Lower Granite Dams. These facilities were operated from March through November in 1981. Other tagged adults were recovered in 1981 at hatcheries, in Columbia and Snake Rivers sport fisheries, from ocean and Columbia River commercial fisheries, and from spawning grounds.

Only returns to river site collectors in 1981 are presented in this report. Most of the recovery data from hatcheries and the various fisheries in 1981 were previously analyzed and reported by Park et al. (1981). These data, covering returns through June 1981, were valuable to the analyses at that time and were the prime reasons for delaying the completion of the 1980 research report to the CofE. The few returns since June did not alter any of the evaluation previously reported and therefore will not be discussed in the 1981 research report. The reader can, however, obtain information on all 1981 recoveries from hatcheries, the fishery, as well as other recovery areas by referring to appendix tables attached to this report.

Adult Returns from Smolts Transported from the Snake River in 1978-80

Chinook Salmon

Returns from the 1978 experiment are complete (Table 6). One additional return from Little Goose Dam and 15 additional returns (all transported fish) from Lower Granite Dam releases were obtained from adult sampling in 1981. The added returns slightly increased the transport benefit ratio, but the overall percentage return was disappointingly low compared to steelhead (0.116 vs 1.137%--Table 6).

There were only 14 returns from the 1979 release--insufficient for any meaningful analysis. No jacks returned from the 1980 releases.

The poor returns of chinook salmon in recent years reflect poor survival probably resulting from a conbination of poor ocean survival and stresses in the collection-transportation system. As indicated previously in this report, research is currently addressing the stress problem.

Steelhead

Tagged adult steelhead in the 1981 run were intercepted at the Lower Granite Dam trapping facility. The facility was operational from 1 June through 30 November 1981, except for a 2-week period in August. The facility was temporarily deactivated because water temperature was elevated (24°-25°C) and severely retarded the migration of adult salmonids. Approximately 200 adults passed the dam during the nontrapping period.

Adults recovered during the summer-fall period were primarily those from Lower Granite Dam smolt releases in 1979-80. The small number of adults returning from transport and control releases from Little Goose and Lower Granite Dams in 1978 did not materially change analyses for those test groups previously reported by Park et al. (1981).

Table 6.--Transport to control benefit ratios for spring chinook salmon and steelhead transported from Little Goose Dam and from Lower Granite Dam to below Bonneville Dam in 1978. (Data are based upon adults returning to Lower Granite Dam.)

Species	Year	Test condition	Observed return no. (%)	Benefit ratio	Appendix table ref. no.[c]
		LITTLE GOOSE DAM			
Spring chinook	1978	Control (tailrace)	5 (0.013)	--	A-1
	1978	Truck (fresh water)	4 (0.008)	0.62:1	A-2
	1979	Truck (salt water)	1 (0.002)	0.15:1	A-3
Steelhead	1978	Control (tailrace)	67 (0.220)	--	A-4
	1978	Truck (fresh water)	367 (1.022)	4.65:1	A-5
	1978	Truck (salt water)	329 (1.022)	4.65:1	A-6
		LOWER GRANITE DAM			
Spring chinook	1978	Control[a]	5 (0.013)	--	A-1
	1978	Barge	66 (0.116)	8.92:1	A-7
	1978	Truck (fresh water)	32 (0.072)	5.54:1	A-8
	1978	Truck (fw 24 h hold)	5 (0.012)	0.92:1	A-9
	1978	Truck (sw 24 h hold)	5 (0.012)	0.92:1	A-10
	1979	Control[b]	3 (0.011)	--	A-11
	1979	Barge	11 (0.040)	3.64:1	A-12
	1980	Control[a]	0 (0.000)	--	A-13
	1980	Truck	0 (0.000)	0	A-14
	1980	Barge	0 (0.000)	0	A-15
Steelhead	1978	Control[a]	67 (0.220)	--	A-1
	1978	Barge	498 (1.137)	5.17:1	A-16
	1978	Truck (fresh water)	511 (1.066)	4.85:1	A-17
	1979	Control[b]	99 (0.470)	--	A-18
	1979	Barge	251 (0.823)	1.75:1	A-19
	1980	Control[a]	8 (0.041)	--	A-20
	1980	Barge	33 (0.101)	2.46:1	A-21

[a] Control group was released in the tailrace at Little Goose Dam.

[b] Control group was released in the tailrace at Lower Granite Dam.

[c] Contains return data through 1981 to all recovery areas including fishery and hatcheries by year of return.

The benefit realized by barge transport in 1979 appears to be a 75% increase in the number of returning adults when compared to nontransported fish (Table 6). However, this figure is biased. In 1979, the control releases were made in the forebay of Lower Granite Dam. With an overall collection in the Snake River that year of 67%, most of the marked control releases were actually transported around the dams. In 1980, the control releases were made below Little Goose Dam. The 140% benefit realized by barge transport in 1980 more accurately portrays benefits realized from transporting steelhead.

Overall comparisons of percent return and transport benefits to steelhead for 1978-80 are shown in Table 6. The indicated rate of return for the 1979 releases is lower than the 1978 releases. Detection problems in the fall of 1980 coupled with a nonrepresentative control release in 1979 has made it difficult to evaluate benefits of transportation based on marked fish returns in 1979. However, an analysis by Park et al. (1981) based on unmarked returns indicate that returns from 1979 were excellent.

The total number of 1-ocean age adults (1980 outmigration) in the run was low at Lower Granite Dam in 1981. We estimated that only 12,000 to 13,000 fish had passed the dam as of 30 November. Sampling of the sport fishery indicated a lower than expected abundance of Salmon River stocks which are normally 1-ocean age fish and more than the expected abundance of 1-ocean age fish in the Clearwater River (these are B-group fish that seldom return at 1-ocean age). Because the Clearwater River run is a dominant 2-ocean age run and the preliminary returns to Dworshak Hatchery (22 February 1982) and to the Clearwater River sport fishery indicate a relative abundance of 1-ocean age fish, a dramatic upturn in numbers of

2-ocean age fish may be expected in that river system in the fall of 1982[2/].

The differences in abundance (Clearwater River vs Salmon River stocks) may be the result of differences in survival as smolts in 1980 as a result of the Mount St. Helens volcanic eruption. Most of the Clearwater River (Dworshak Hatchery) stocks were transported below Bonneville Dam before the eruption. Smolts from the Salmon River (Pahsimeroi Hatchery) arrived about 2 weeks later and were subjected to the poorer environmental conditions in the lower Columbia River after the eruption.

Overall, the Snake River steelhead run in 1981 was smaller than expected. About 36,000 fish were counted at Lower Granite Dam. NMFS biologists were expecting a run of about 55,000 steelhead, mostly from the 1979 outmigration. It appears that this expectation was justified, based upon a very high count at Bonneville Dam--about 150,000 fish. However, a significant loss of steelhead in the John Day Reservoir, as explained below, may account for the smaller than expected run at Lower Granite Dam.

In the fall of 1981, a severe and unaccounted for loss of steelhead and fall chinook salmon occurred in the John Day Reservoir. Based upon comparative dam counts at John Day and McNary Dams, losses were 35,000 and 9,400 for steelhead and chinook salmon, respectively. Rate of loss for these two fish runs, based on run size, was comparable. Although the above figures represent total count discrepancies, a reasonable expected loss or discrepancy between the two dams would be no more than 15,000 steelhead considering the magnitude of the run. The excessive loss then becomes at

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2/ Personal communication, Steve Pettit, Idaho Department of Fish and Game, Lewiston, Idaho.

least 20,000 fish--about the difference between the actual and expected Lower Granite steelhead counts in 1981.

The losses occurring in September and October were real and not due to straying or other factors due to transportation (losses of nontransported fall chinook salmon and transported steelhead were comparable). In addition, most of the losses were probably steelhead returning to the Snake River since most mid-Columbia stocks migrate earlier in the year.

Adult Returns from Smolts Transported in 1978-80 from McNary Dam

As in previous years, combined adult collections at Bonneville, McNary, and Lower Granite Dams were used for transportation evaluation of McNary Dam transportation experiments. Adult return data collected at McNary Dam alone does not provide sufficient data because the northshore trapping facility does not sample a sufficient proportion of the total population passing the dam. For example, in the case of steelhead, only 16.5 and 9.4% of the steelhead passing McNary Dam used the north shore fishway in 1980 and 1981, respectively.

Chinook Salmon

The few returns of adults to river collector sites in 1981 did not materially change the analysis previously reported by Park et al. (1981). Total recoveries by year of juvenile releases for both spring and fall chinook salmon are shown in Table 7. Generally, fall chinook salmon showed a positive benefit from transportation, but the numbers of spring chinook salmon adult returns were too small to make any meaningful comparisons. The poor returns of spring chinook salmon, as with those at Lower Granite Dam, may be the result of poor ocean survival, poor quality of smolts released from hatcheries (over 80% of the spring chinook salmon collected

Table 7.--Transport to control benefit ratios for fall chinook salmon and steelhead transported from McNary Dam in 1978-80 to below Bonneville Dam. (Data are based upon conbined returns to Bonneville, McNary, and Lower Granite Dams.)

Species	Year	Test condition	Observed return no. (%)	Benefit ratio	Appendix Table ref. no.[a/]
Spring chinook	1978	Control (tailrace)	7 (0.022)	--	B-1
	1978	Truck	20 (0.063)	2.86:1	B-2
	1979	Control (tailrace)	13 (0.042)	--	B-3
	1979	Truck	12 (0.028)	0.66:1	B-4
	1979	Barge	10 (0.025)	0.59:1	B-5
	1980	Control (tailrace)	1 (0.002)	--	B-6
	1980	Truck	4 (0.010)	5.0:1	B-7
	1980	Barge	2 (0.005)	2.5:1	B-8
Coho	1978	Control (tailrace)	9 (0.041)		B-9
	1978	Truck	24 (0.109)		B-10
Fall chinook	1978	Control (tailrace)	13 (0.034)	--	B-11
	1978	Truck	113 (0.280)	8.24:1	B-12
	1979	Control (tailrace)	5 (0.004)	--	B-13
	1979	Truck	73 (0.055)	13.75:1	B-14
	1980	Control (tailrace)	7 (0.008)	--	B-15
	1980	Truck	30 (0.070)	4.63:1	B-16
Steelhead	1978	Control (tailrace)	75 (0.481)	--	B-17
	1978	Truck	308 (1.508)	3.14:1	B-18
	1979	Control (tailrace)	39 (0.454)	--	B-19
	1979	Truck	138 (0.897)	1.98:1	B-20
	1979	Barge	210 (1.155)	2.54:1	B-21
	1980	Control (tailrace)	15 (0.070)	--	B-22
	1980	Truck	29 (0.130)	1.86:1	B-23
	1980	Barge	42 (0.138)	1.97:1	B-24

[a/] Contains return data through 1981 to all recovery areas including fishery and hatcheries, by year of return.

at McNary Dam are of hatchery origin), or stress incurred in the collection-transport system. Both clinical and seawater challenge tests will be conducted in 1982 to isolate areas of stress in the system at McNary Dam.

Steelhead

Recovery of adults at the three dam collector sites from smolt releases in 1978-80, indicates that transportation of steelhead from McNary Dam is continuing to show excellent benefits (Table 7), although the observed percent return of the transported fish in 1979 was less than observed for 1978. The observed return, however, was lower than the actual return. Park et al. (1981) previously reported an excellent contribution of transported fish in the Methow River sport fishery from those transported in 1979. Possible explanations for the lower number of observed returns from 1979 include: (1) lower number of 1979 returns at Lower Granite Dam because of detection problems in 1981 and fewer Snake River fish transported from McNary Dam in 1979 than in 1978 and (2) a lower number of 1979 returns at McNary Dam because fewer fish used the North Ladder in 1981 when the 1979 run was returning than in 1980 when the 1978 run was returning.

The low number of adults (and subsequent low rate of return) recovered from 1980 releases has likely been the result of low survival of all groups. Most of the juveniles marked and released from McNary Dam in 1980 were also subjected to the poor environmental conditions in the lower Columbia River following the eruption of Mount St. Helens.

As indicated earlier, this report has been confined to recoveries from the river site collectors only in 1981. Data from hatcheries and commercial and sport fisheries which are expected by mid-1982 should

provide a basis for a more detailed discussion on both the Snake River and McNary Dam release groups in subsequent reports. Appendices A and B contain the new computer printout of all returns through 1981 from the 1978-80 releases from the Snake River and McNary Dam. Additional details on 1978-80 releases not covered in this report, e.g., hatcheries and fisheries, are contained in these appendices.

SUMMARY

1. NMFS research personnel acted as advisors to the CofE for transport operations in 1981. For the first time, NMFS did not provide direct oversight for daily collection and transportation of smolts.

2. At Lower Granite Dam, seawater (30 ppt) challenge bioassays were used to measure relative stress of juvenile spring chinook salmon sampled from various points within the collection and truck transport system. The most severe stress occurred in samples of fish taken following transport to Bonneville Dam. Confinement in the transport tank could account for most of the stress; however, high raceway density, loading techniques, and release procedures for our tests could have contributed a part of the observed stress.

3. Descaled fish in bioassays were severely stressed (78.6% died when challenged), indicating efforts should be continued to reduce descaling of fish at all points in the collection system.

4. Delayed mortality (5 days) for spring chinook salmon was monitored at Bonneville Dam following transport by truck from Lower Granite, Little Goose, and McNary Dams. Delayed mortality was surprisingly low--7.7, 11.0, and 8.2%, respectively. The importance of descaling was again revealed--about 33% of descaled fish died, whereas, only 2.3 to 3.9% of nondescaled fish died.

5. A new "wet" separator for smolts was installed at Little Goose Dam. High separation (80%) of chinook salmon from steelhead was achieved in three of eight tests. Separation by size, rather than by species is probably more important in avoiding stress and predation when large numbers of fish are held in crowded conditions (as in raceways).

6. At McNary Dam, 85,504 juvenile fall chinook salmon were marked for continued truck transport tests (test and control group). Marking was done between 9 and 31 July 1981.

7. Returns of transported and nontransported spring chinook salmon continue to be low, probably due to low ocean survival. On the other hand, transport benefit and adult return rate for steelhead continues to be excellent.

8. An unaccounted loss of about 20,000 adult steelhead occurred in John Day Reservoir in the fall of 1981. Losses do not appear to be related to transportation (e.g., impairment of homing) but to some other factor.

LITERATURE CITED

Basham, L. R., M. R. Delarm, J. B. Athearn, and S. W. Pettit.

1982. Fish transportation oversight team annual report - FY 1981. Transportation operations on the Snake and Columbia Rivers. NOAA technical memorandum, NMFS, F/NWR2. 58 p.

Ebel, W. J., H. L. Raymond, C. W. Long, W. M. Marquette, R. F. Krcma, and D. L. Park.

1973. Evaluation of fish protective facilities at Little Goose Dam and review of other studies relating to protection of juvenile salmonids in the Columbia and Snake Rivers, 1972. NOAA, NMFS, Northwest and Alaska Fisheries Center, Seattle, WA. 55 p. Processed.

Matthews, G. M., G. A. Swan, and J. R. Smith.

1977. Improved bypass and collection system for protection of juvenile salmon and steelhead trout at Lower Granite Dam. Mar. Fish. Rev. MFR 1256, Vol. 39 (2): 10-14.

Park, D. L., J. R. Harmon, B. H. Monk, T. E. Ruehle, T. W. Newcomb, L. R. Basham, and T. A. Flagg.

1981. Transportation research on the Columbia and Snake Rivers, 1980. NOAA, NMFS, Northwest and Alaska Fisheries Center, Seattle, Washington. 45 p. with appendix. Processed.

Smith, J. R., G. M. Matthews, L. R. Basham, B. H. Monk, and S. Achord.

1981. Transportation operations on the Snake and Columbia River-1980. NOAA, NMFS, Northwest Fisheries Center, Seattle, Washington. Report to U.S. Army Corps of Engineers, Contract No. DACW68-78-C-0051.

Smith, J. R., and W. E. Farr.

1975. Bypass and collection system for protection of juvenile salmon and steelhead trout at Little Goose Dam. Mar. Fish. Rev. 37 (2): 31-35.

Swan, George A., R. F. Krcma, and W. E. Farr.

1979. Dipbasket for collecting juvenile salmon and trout in gatewells at hydroelectric dams. Jan 1979. Prog. Fish Cult. 41(1):48-49.

APPENDIX A

The computerized format presented in the following tables was only recently developed. For this reason, the data should be considered preliminary. The NMFS is currently working on other computer programs which will provide more detailed analysis for returns to specific sampling areas such as ocean fisheries and hatcheries.

This appendix contains summaries of all adult recovery data from releases of smolts from 1978-80 used to derive text Table 6.

By necessity, the table headings which include year of release, dam of origin, transport route, treatment, and species are simplified. If questions arise, the user is urged to consult previous published reports which provide more detailed information on any given release group by the year in which the study/release was undertaken.

Appendix Table A-1. 1978 LITTLE GOOSE CONTROLS - TAILRACE

SPRING/SUMMER CHINOOK

MARKS USED	LAPI1 YWBRBR	LAPI2 ORGNRD	LAPI3	LAPI4	ORPK	NUMBER RELEASED	36441

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	0	0	0	0	0.000
MCNARY TRAP	0	0	0	0	0	0.000
LOWER GRANITE TRAP	0	0	5	0	5	0.013
OCEAN SPORT	0	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0	0	0.000
RIVER SPORT	0	0	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0	0	0.000
INDIAN FISHERY	0	0	0	0	0	0.000
DWORSHAK	0	0	1	0	1	0.002
RAPID RIVER	0	0	2	1	3	0.008
MCCALL	0	0	1	1	2	0.005
TOTALS	0	0	9	2	11	0.030
PERCENT OF RECOVERY	0.0	0.0	81.8	18.1	100.0	

Appendix Table A-2. 1978 LITTLE GOOSE TRUCK

SPRING/SUMMER CHINOOK

MARKS USED RAJ 1 RAJ 3 RDOR RD NUMBER RELEASED 49391

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	0	0	0	0	0.000
MCNARY TRAP	0	0	0	0	0	0.000
LOWER GRANITE TRAP	0	1	2	1	4	0.008
OCEAN SPORT	0	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0	0	0.000
RIVER SPORT	0	0	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0	0	0.000
INDIAN FISHERY	0	0	0	0	0	0.000
RAPID RIVER	0	0	2	0	2	0.004
MCCALL	0	0	0	1	1	0.002
TOTALS	0	1	4	2	7	0.014
PERCENT OF RECOVERY	0.0	14.2	57.1	28.5	100.0	

Appendix Table A-3. 1978 LITTLE GOOSE TRUCK - 10PPT SALT

SPRING/SUMMER CHINOOK

MARKS USED RAJ 2 RAJ 4 RDLG ORGNYW NUMBER RELEASED 47661

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	0	0	0	0	0.000
MCNARY TRAP	0	0	0	0	0	0.000
LOWER GRANITE TRAP	0	0	0	1	1	0.002
OCEAN SPORT	0	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0	0	0.000
RIVER SPORT	0	0	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0	0	0.000
INDIAN FISHERY	0	0	0	0	0	0.000
RAPID RIVER	0	0	0	1	1	0.002
TOTALS	0	0	0	2	2	0.004
PERCENT OF RECOVERY	0.0	0.0	0.0	100.0	100.0	

Appendix Table A-4. 1978 LITTLE GOOSE CONTROLS - TAILRACE STEELHEAD

MARKS USED	LAPI1 YWBRBR	LAPI2 ORGNRD	LAPI3	LAPI4	ORPK	NUMBER RELEASED	30364

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	2	3	1	6	0.019
MCNARY TRAP	0	3	2	0	5	0.016
LOWER GRANITE TRAP	0	46	18	3	67	0.220
OCEAN SPORT	0	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0	0	0.000
RIVER SPORT	0	3	8	2	13	0.042
RIVER COMMERCIAL	0	0	0	0	0	0.000
INDIAN FISHERY	0	0	3	0	3	0.009
DWORSHAK	0	0	0	1	1	0.003
PAHSIMEROI	0	0	3	0	3	0.009
KOOSKIA	0	0	0	2	2	0.006
TOTALS	0	54	37	9	100	0.329
PERCENT OF RECOVERY	0.0	54.0	37.0	9.0	100.0	

Appendix Table A-5 **1978 LITTLE GOOSE TRUCK**

STEELHEAD

MARKS USED RAJ 1 RAJ 3 RDOR RD NUMBER RELEASED 35875

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	10	14	1	25	0.069
MCNARY TRAP	0	17	5	0	22	0.061
LOWER GRANITE TRAP	0	199	151	17	367	1.022
PRIEST RAPIDS TRAP	0	1	0	0	1	0.002
OCEAN SPORT	0	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0	0	0.000
RIVER SPORT	0	14	20	8	42	0.117
RIVER COMMERCIAL	0	0	1	1	2	0.005
INDIAN FISHERY	0	12	10	2	24	0.066
DWORSHAK	0	0	2	13	15	0.041
PAHSIMEROI	0	0	13	2	15	0.041
RAPID RIVER	0	1	0	0	1	0.002
HELLS CANYON (OXBOW)	0	0	1	0	1	0.002
KOOSKIA	0	0	0	6	6	0.016
TOTALS	0	254	217	50	521	1.452
PERCENT OF RECOVERY	0.0	48.7	41.6	9.5	100.0	

Appendix Table A-6. 1978 LITTLE GOOSE TRUCK - 10PPT SALT

STEELHEAD

MARKS USED RAJ 2 RAJ 4 RDLG ORGNYW NUMBER RELEASED 32170

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	10	5	1	16	0.049
MCNARY TRAP	0	4	9	0	13	0.040
LOWER GRANITE TRAP	0	184	130	15	329	1.022
OCEAN SPORT	0	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	2	0	2	0.006
RIVER SPORT	0	9	28	15	52	0.161
RIVER COMMERCIAL	0	0	0	0	0	0.000
INDIAN FISHERY	0	6	10	2	18	0.055
DWORSHAK	0	0	3	14	17	0.052
PAHSIMEROI	0	0	12	2	14	0.043
HAYDEN CREEK	0	0	0	2	2	0.006
KOOSKIA	0	0	0	3	3	0.009
CHELAN	0	0	1	0	1	0.003
TOTALS	0	213	200	54	467	1.451
PERCENT OF RECOVERY	0.0	45.6	42.8	11.5	100.0	

Appendix Table A-7. 1978 LOWER GRANITE BARGE

SPRING/SUMMER CHINOOK

MARKS USED RAW 3 RAW 4 RDRD RDRDOR NUMBER RELEASED 56546

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	0	0	0	0	0.000
MCNARY TRAP	0	0	0	0	0	0.000
LOWER GRANITE TRAP	0	6	50	10	66	0.116
OCEAN SPORT	0	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0	0	0.000
RIVER SPORT	0	0	3	0	3	0.005
RIVER COMMERCIAL	0	0	0	1	1	0.001
INDIAN FISHERY	0	0	0	1	1	0.001
RAPID RIVER	0	3	5	0	8	0.014
MCCALL	0	0	1	2	3	0.005
KOOSKIA	0	0	1	0	1	0.001
TOTALS	0	9	60	14	83	0.146
PERCENT OF RECOVERY	0.0	10.8	72.2	16.8	100.0	

Appendix Table A-8. 1978 LOWER GRANITE TRUCK

SPRING/SUMMER CHINOOK

MARKS USED RAW 1 RAW 2 RDGN RDBL NUMBER RELEASED 43855

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	0	0	0	0	0.000
MCNARY TRAP	0	0	0	0	0	0.000
LOWER GRANITE TRAP	0	4	24	4	32	0.072
OCEAN SPORT	0	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0	0	0.000
RIVER SPORT	0	0	0	2	2	0.004
RIVER COMMERCIAL	0	0	2	0	2	0.004
INDIAN FISHERY	0	0	0	0	0	0.000
DWORSHAK	0	0	2	0	2	0.004
RAPID RIVER	0	2	2	0	4	0.009
MCCALL	0	0	0	1	1	0.002
DESCHUTES R. HATCHERIES	0	2	0	0	2	0.004
STREAM SURVEY	0	0	1	0	1	0.002
TOTALS	0	8	31	7	46	0.104
PERCENT OF RECOVERY	0.0	17.3	67.3	15.2	100.0	

Appendix Table A-9. 1978 LOWER GRANITE TRUCK - 24HR HOLD
SPRING/SUMMER CHINOOK

MARKS USED RAIS1 ORBL NUMBER RELEASED 38685

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	0	0	0	0	0.000
MCNARY TRAP	0	0	0	0	0	0.000
LOWER GRANITE TRAP	0	2	3	0	5	0.012
OCEAN SPORT	0	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0	0	0.000
RIVER SPORT	0	0	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0	0	0.000
INDIAN FISHERY	0	0	0	0	0	0.000
RAPID RIVER	0	2	3	0	5	0.012
DESCHUTES R. HATCHERIES	0	0	1	0	1	0.002
TOTALS	0	4	7	0	11	0.028
PERCENT OF RECOVERY	0.0	36.3	63.6	0.0	100.0	

Appendix Table A-10. 1978 LOWER GRANITE TRUCK - 2HR SALT
SPRING/SUMMER CHINOOK

MARKS USED RAIS2 ORDR NUMBER RELEASED 40841

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	0	0	0	0	0.000
MCNARY TRAP	0	0	0	0	0	0.000
LOWER GRANITE TRAP	0	1	4	0	5	0.012
OCEAN SPORT	0	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0	0	0.000
RIVER SPORT	0	0	2	0	2	0.004
RIVER COMMERCIAL	0	0	0	0	0	0.000
INDIAN FISHERY	0	0	0	0	0	0.000
MCCALL	0	0	0	1	1	0.002
KOOSKIA	0	0	1	0	1	0.002
TOTALS	0	1	7	1	9	0.022
PERCENT OF RECOVERY	0.0	11.1	77.7	11.1	100.0	

Appendix Table A-11. 1979 LOWER GRANITE -CONTROL -TAILRACE SPRING/SUMMER CHINOOK

MARKS USED LAK 3 LAK 4 YWLB NUMBER RELEASED 25532

RECOVERY AREA	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	0	1	1	0.003
MCNARY TRAP	0	0	0	0	0.000
LOWER GRANITE TRAP	0	0	3	3	0.011
OCEAN SPORT	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0	0.000
RIVER SPORT	0	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0	0.000
INDIAN FISHERY	0	0	0	0	0.000
TOTALS	0	0	4	4	0.015
PERCENT OF RECOVERY	0.0	0.0	100.0	100.0	

Appendix Table A-12. 1979 LOWER GRANITE - BARGE SPRING/SUMMER CHINOOK

MARKS USED RAF 1 RAF 2 RDYWOR NUMBER RELEASED 27336

RECOVERY AREA	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	1	0	0	1	0.003
MCNARY TRAP	0	0	1	1	0.003
LOWER GRANITE TRAP	0	4	7	11	0.040
OCEAN SPORT	0	0	0	0	0.000
OCEAN COMMERCIAL	1	0	0	1	0.003
RIVER SPORT	0	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0	0.000
INDIAN FISHERY	0	0	1	1	0.003
RAPID RIVER	0	1	7	8	0.029
MCCALL	0	1	1	2	0.007
DESCHUTES R. HATCHERIES	0	1	0	1	0.003
TOTALS	2	7	17	26	0.095
PERCENT OF RECOVERY	7.6	26.9	65.3	100.0	

Appendix Table A-13. 1980 LITTLE GOOSE - TAILRACE CONTROL

SPRING/SUMMER CHINOOK

MARKS USED LAP 1 LAP 2 LAP 3 ER NUMBER RELEASED 21876

RECOVERY AREA	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	1	1	0.004
MCNARY TRAP	0	0	0	0.000
LOWER GRANITE TRAP	0	0	0	0.000
OCEAN SPORT	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0.000
RIVER SPORT	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	0	0	0.000
TOTALS	0	1	1	0.004
PERCENT OF RECOVERY	0.0	100.0	100.0	

Appendix Table A-14. 1980 LOWER GRANITE - TRUCK - TRAD. MANR SPRING/SUMMER CHINOOK

MARKS USED RA3T1 RA3T3 RA2T1 PRTB NUMBER RELEASED 32772

RECOVERY AREA	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	0	0	0.000
MCNARY TRAP	0	0	0	0.000
LOWER GRANITE TRAP	0	0	0	0.000
OCEAN SPORT	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0.000
RIVER SPORT	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	0	0	0.000
TOTALS	0	0	0	0.000
PERCENT OF RECOVERY	0.0	0.0	0.0	

Appendix Table A-15. 1980 LOWER GRANITE - BARGE
SPRING/SUMMER CHINOOK

MARKS USED RAW 1 RAW 2 HOPR DYPR NUMBER RELEASED 40719

RECOVERY AREA	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	0	0	0.000
MCNARY TRAP	0	0	0	0.000
LOWER GRANITE TRAP	0	0	0	0.000
OCEAN SPORT	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0.000
RIVER SPORT	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	0	0	0.000
TOTALS	0	0	0	0.000
PERCENT OF RECOVERY	0.0	0.0	0.0	

Appendix Table A-16. 1978 LOWER GRANITE BARGE

STEELHEAD

MARKS USED RAW 3 RAW 4 RDRD RDRDOR NUMBER RELEASED 43770

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	15	8	3	26	0.059
MCNARY TRAP	0	15	12	0	27	0.061
LOWER GRANITE TRAP	0	249	221	28	498	1.137
OCEAN SPORT	0	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0	0	0.000
RIVER SPORT	0	24	30	13	67	0.153
RIVER COMMERCIAL	0	1	1	0	2	0.004
INDIAN FISHERY	0	12	19	14	45	0.102
DWORSHAK	0	0	3	41	44	0.100
PAHSIMEROI	0	0	30	7	37	0.084
RAPID RIVER	0	2	0	0	2	0.004
HAYDEN CREEK	0	0	0	1	1	0.002
HELLS CANYON (OXBOW)	0	0	6	1	7	0.015
KOOSKIA	0	0	1	12	13	0.029
TOTALS	0	318	331	120	769	1.756
PERCENT OF RECOVERY	0.0	41.3	43.0	15.6	100.0	

Appendix Table A-17. 1978 LOWER GRANITE TRUCK

STEELHEAD

MARKS USED RAW 1 RAW 2 RDGN RDBL NUMBER RELEASED 47899

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	20	8	1	29	0.060
MCNARY TRAP	0	26	9	0	35	0.073
LOWER GRANITE TRAP	0	285	185	41	511	1.066
PRIEST RAPIDS TRAP	0	1	0	0	1	0.002
OCEAN SPORT	0	0	0	0	0	0.000
OCEAN COMMERCIAL	0	1	0	0	1	0.002
RIVER SPORT	0	37	43	13	93	0.194
RIVER COMMERCIAL	0	1	0	1	2	0.004
INDIAN FISHERY	0	15	14	3	32	0.066
DWORSHAK	0	0	3	40	43	0.089
PAHSIMEROI	0	1	45	8	54	0.112
HAYDEN CREEK	0	0	0	2	2	0.004
HELLS CANYON (OXBOW)	0	0	4	4	8	0.016
KOOSKIA	0	5	2	3	10	0.020
BIG CREEK	0	1	0	0	1	0.002
TOTALS	0	393	313	116	822	1.716
PERCENT OF RECOVERY	0.0	47.8	38.0	14.1	100.0	

Appendix Table A-18. 1979 LOWER GRANITE -CONTROL -TAILRACE STEELHEAD

MARKS USED LAK 3 LAK 4 YWLB NUMBER RELEASED 21050

RECOVERY AREA	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	1	10	11	0.052
MCNARY TRAP	0	0	1	1	0.004
LOWER GRANITE TRAP	0	17	82	99	0.470
OCEAN SPORT	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0	0.000
RIVER SPORT	0	4	3	7	0.033
RIVER COMMERCIAL	0	0	0	0	0.000
INDIAN FISHERY	0	0	0	0	0.000
RAPID RIVER	0	1	0	1	0.004
TOTALS	0	23	96	119	0.565
PERCENT OF RECOVERY	0.0	19.3	80.6	100.0	

Appendix Table A-19. 1979 LOWER GRANITE – BARGE STEELHEAD

MARKS USED RAF 1 RAF 2 RDYWOR NUMBER RELEASED 30495

RECOVERY AREA	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	1	35	36	0.118
MCNARY TRAP	0	2	2	4	0.013
LOWER GRANITE TRAP	0	49	202	251	0.823
OCEAN SPORT	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0	0.000
RIVER SPORT	1	21	22	44	0.144
RIVER COMMERCIAL	0	0	2	2	0.006
INDIAN FISHERY	0	5	30	35	0.114
DWORSHAK	0	0	2	2	0.006
PAHSIMEROI	0	0	16	16	0.052
TOTALS	1	78	311	390	1.278
PERCENT OF RECOVERY	0.2	20.0	79.7	100.0	

Appendix Table A-20. 1980 LITTLE GOOSE - TAILRACE CONTROL

STEELHEAD

MARKS USED LAP 1 LAP 2 LAP 3 ER NUMBER RELEASED 19273

RECOVERY AREA	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	0	0	0.000
MCNARY TRAP	0	0	0	0.000
LOWER GRANITE TRAP	0	8	8	0.041
OCEAN SPORT	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0.000
RIVER SPORT	0	1	1	0.005
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	0	0	0.000
TOTALS	0	9	9	0.046
PERCENT OF RECOVERY	0.0	100.0	100.0	

Appendix Table A-21. 1980 LOWER GRANITE – BARGE STEELHEAD

MARKS USED RAW 1 RAW 2 HOPR DYPR NUMBER RELEASED 32559

RECOVERY AREA	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	20	20	0.061
MCNARY TRAP	0	0	0	0.000
LOWER GRANITE TRAP	0	33	33	0.101
OCEAN SPORT	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0.000
RIVER SPORT	0	2	2	0.006
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	0	0	0.000
TOTALS	0	55	55	0.168
PERCENT OF RECOVERY	0.0	100.0	100.0	

APPENDIX B

The computerized format presented in the following tables was only recently developed. For this reason, the data should be considered preliminary. The NMFS is currently working on other computer programs which will provide more detailed analysis for returns to specific sampling areas such as ocean fisheries and hatcheries.

By necessity, the table headings which include year of release, dam of origin, transport route, treatment, and species are simplified. If questions arise, the user is urged to consult previous published reports which provide more detailed information on any given release group by the year in which the study/release was undertaken.

This appendix contains summaries of all adult recovery data from releases of smolts from 1978-80 used to derive text Table 7.

Appendix Table B1. 1978 MCNARY CONTROLS - TAILRACE

SPRING/SUMMER CHINOOK

MARKS USED	LAH 1 RDORRD	LAH 2 LAIF1	LAS 1 LAIF3	LAS 2 PUGNBL	RDYWRD YWXYGN	NUMBER RELEASED	31376

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	0	0	1	1	0.003
MCNARY TRAP	0	0	0	1	1	0.003
LOWER GRANITE TRAP	0	2	2	1	5	0.015
OCEAN SPORT	0	0	1	0	1	0.003
OCEAN COMMERCIAL	0	0	0	0	0	0.000
RIVER SPORT	0	0	1	0	1	0.003
RIVER COMMERCIAL	0	1	0	0	1	0.003
INDIAN FISHERY	0	0	0	2	2	0.006
DWORSHAK	0	0	1	0	1	0.003
RAPID RIVER	0	0	1	0	1	0.003
RINGOLD	0	1	0	0	1	0.003
LEAVENWORTH	0	0	0	2	2	0.006
TOTALS	0	4	6	7	17	0.054
PERCENT OF RECOVERY	0.0	23.5	35.2	41.1	100.0	

Appendix Table B2. 1978 MCNARY - TRUCK

SPRING/SUMMER CHINOOK

MARKS USED	RAV 1 RAIC1	RAV 2 RAIC3	GM ORGNLG	GMWH LG	RDYWYW	NUMBER RELEASED	31956

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	0	1	2	3	0.009
MCNARY TRAP	0	0	1	2	3	0.009
LOWER GRANITE TRAP	0	3	10	1	14	0.043
OCEAN SPORT	2	3	0	0	5	0.015
OCEAN COMMERCIAL	0	1	1	0	2	0.006
RIVER SPORT	0	1	0	0	1	0.003
RIVER COMMERCIAL	0	1	2	1	4	0.012
INDIAN FISHERY	0	0	1	1	2	0.006
RAPID RIVER	0	1	4	0	5	0.015
HAYDEN CREEK	0	0	2	0	2	0.006
RINGOLD	0	1	0	0	1	0.003
LEAVENWORTH	0	0	0	2	2	0.006
TOTALS	2	11	22	9	44	0.137
PERCENT OF RECOVERY	4.5	25.0	50.0	20.4	100.0	

Appendix Table B3. 1979 MCNARY - CONTROL - TAILRACE

SPRING/SUMMER CHINOOK

MARKS USED	LA5 1 LAIM2 RDYWPK	LA5 2 LAIM3 LBYWLB	LA5 3 LAIM4 RDLBPK	LA5 4 PR	LAIM1 RDLGYW	NUMBER RELEASED	31229

RECOVERY AREA	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	6	0	3	9	0.028
MCNARY TRAP	0	0	1	1	0.003
LOWER GRANITE TRAP	0	1	2	3	0.009
OCEAN SPORT	0	8	3	11	0.035
OCEAN COMMERCIAL	0	3	4	7	0.022
RIVER SPORT	0	0	0	0	0.000
RIVER COMMERCIAL	1	0	3	4	0.012
INDIAN FISHERY	0	0	10	10	0.032
RAPID RIVER	0	0	1	1	0.003
STREAM SURVEY	0	0	1	1	0.003
TOTALS	7	12	28	47	0.150
PERCENT OF RECOVERY	14.8	25.5	59.5	100.0	

Appendix Table B4. 1979 MCNARY – TRUCK

SPRING/SUMMER CHINOOK

MARKS USED	RA3 1 RAI+2 RDPKLB	RA3 2 RAI+3 RDPKOR	RA3 3 RAI+4 LBYWLG	RA3 4 SM RDLBYW	RAI+1 RDLGPK	NUMBER RELEASED	42748

RECOVERY AREA	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	5	0	2	7	0.016
MCNARY TRAP	0	0	3	3	0.007
LOWER GRANITE TRAP	0	1	1	2	0.004
OCEAN SPORT	0	12	3	15	0.035
OCEAN COMMERCIAL	1	17	6	24	0.056
RIVER SPORT	0	3	1	4	0.009
RIVER COMMERCIAL	0	0	2	2	0.004
INDIAN FISHERY	0	0	7	7	0.016
RAPID RIVER	0	1	0	1	0.002
TOTALS	6	34	25	65	0.152
PERCENT OF RECOVERY	9.2	52.3	38.4	100.0	

Appendix Table B5. 1979 MCNARY – BARGE

SPRING/SUMMER CHINOOK

MARKS USED	RAR 1 RDPKYW	RAR 2 RDYWPK	RAR 3	RAR 4	RDYWLG	NUMBER RELEASED	40126

RECOVERY AREA	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	4	1	0	5	0.012
MCNARY TRAP	0	0	0	0	0.000
LOWER GRANITE TRAP	0	3	2	5	0.012
OCEAN SPORT	0	9	0	9	0.022
OCEAN COMMERCIAL	0	4	3	7	0.017
RIVER SPORT	0	0	4	4	0.009
RIVER COMMERCIAL	1	0	1	2	0.004
INDIAN FISHERY	0	0	1	1	0.002
RINGOLD	1	0	0	1	0.002
STREAM SURVEY	0	0	2	2	0.004
TOTALS	6	17	13	36	0.089
PERCENT OF RECOVERY	16.6	47.2	36.1	100.0	

Appendix Table B6. 1980 MCNARY - TAILRACE CONTROL

SPRING/SUMMER CHINOOK

MARKS USED	LAH 1 CEND	LAH 2 CE	LAIF1 CEDY	LAIF3	ERLA	NUMBER RELEASED	46585

RECOVERY AREA	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	1	1	0.002
MCNARY TRAP	0	0	0	0.000
LOWER GRANITE TRAP	0	0	0	0.000
OCEAN SPORT	0	3	3	0.006
OCEAN COMMERCIAL	0	0	0	0.000
RIVER SPORT	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	0	0	0.000
TOTALS	0	4	4	0.008
PERCENT OF RECOVERY	0.0	100.0	100.0	

Appendix Table B7. 1980 MCNARY – TRUCK

SPRING/SUMMER CHINOOK

MARKS USED	RAV 1 DY	RAV 2 LA	RAIC1 HO	RAIC3	NDSM	NUMBER RELEASED	40938

RECOVERY AREA	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	3	3	0.007
MCNARY TRAP	1	0	1	0.002
LOWER GRANITE TRAP	0	0	0	0.000
OCEAN SPORT	0	4	4	0.009
OCEAN COMMERCIAL	0	3	3	0.007
RIVER SPORT	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	1	1	0.002
TOTALS	1	11	12	0.029
PERCENT OF RECOVERY	8.3	91.6	100.0	

Appendix Table B8. 1980 MCNARY - BARGE

SPRING/SUMMER CHINOOK

MARKS USED RA2 1 RA2 2 ERPR LAT8 NUMBER RELEASED 44023

RECOVERY AREA	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	0	0	0.000
MCNARY TRAP	2	0	2	0.004
LOWER GRANITE TRAP	0	0	0	0.000
OCEAN SPORT	0	3	3	0.006
OCEAN COMMERCIAL	0	0	0	0.000
RIVER SPORT	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	0	0	0.000
TOTALS	2	3	5	0.011
PERCENT OF RECOVERY	40.0	60.0	100.0	

Appendix Table B9. 1978 MCNARY CONTROLS - TAILRACE

COHO

MARKS USED	LAH 1 RDORRD	LAH 2 LAIF1	LAS 1 LAIF3	LAS 2 PUGNBL	RDYWRD YWXYGN	NUMBER RELEASED	21767

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	6	0	0	0	6	0.027
MCNARY TRAP	0	3	0	0	3	0.013
LOWER GRANITE TRAP	0	0	0	0	0	0.000
OCEAN SPORT	3	19	0	0	22	0.101
OCEAN COMMERCIAL	2	44	0	0	46	0.211
RIVER SPORT	0	1	0	0	1	0.004
RIVER COMMERCIAL	1	13	0	1	15	0.068
INDIAN FISHERY	0	0	0	0	0	0.000
TOTALS	12	80	0	1	93	0.427
PERCENT OF RECOVERY	12.9	86.0	0.0	1.0	100.0	

Appendix Table B10. 1978 MCNARY – TRUCK

COHO

MARKS USED	RAV 1 RAIC1	RAV 2 RAIC3	GM ORGNLG	GMWH LG	RDYWYW	NUMBER RELEASED	22065

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	8	3	0	0	11	0.049
MCNARY TRAP	0	11	0	0	11	0.049
LOWER GRANITE TRAP	0	2	0	0	2	0.009
OCEAN SPORT	18	50	0	0	68	0.308
OCEAN COMMERCIAL	8	70	0	0	78	0.353
RIVER SPORT	0	0	0	0	0	0.000
RIVER COMMERCIAL	3	25	0	0	28	0.126
INDIAN FISHERY	0	3	0	0	3	0.013
CASCADE	0	1	0	0	1	0.004
TOTALS	37	165	0	0	202	0.915
PERCENT OF RECOVERY	18.3	81.6	0.0	0.0	100.0	

Appendix Table B11. 1978 MCNARY CONTROLS - TAILRACE

FALL CHINOOK

MARKS USED	LAH 1 RDORRD	LAH 2 LAIF1	LAS 1 LAIF3	LAS 2 PUGNBL	RDYWRD YWXYGN	NUMBER RELEASED	38137

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	4	1	0	5	0.013
MCNARY TRAP	0	7	1	0	8	0.020
LOWER GRANITE TRAP	0	0	0	0	0	0.000
OCEAN SPORT	0	0	1	1	2	0.005
OCEAN COMMERCIAL	0	2	3	0	5	0.013
RIVER SPORT	0	1	0	2	3	0.007
RIVER COMMERCIAL	0	0	3	0	3	0.007
INDIAN FISHERY	0	2	1	1	4	0.010
WELLS	0	1	0	0	1	0.002
TOTALS	0	17	10	4	31	0.081
PERCENT OF RECOVERY	0.0	54.8	32.2	12.9	100.0	

Appendix Table B12. 1978 MCNARY – TRUCK

FALL CHINOOK

MARKS USED	RAV 1 RAIC1	RAV 2 RAIC3	GM ORGNLG	GMWH LG	RDYWYW	NUMBER RELEASED	40361

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	21	2	2	25	0.061
MCNARY TRAP	0	58	15	11	84	0.208
LOWER GRANITE TRAP	0	4	0	0	4	0.009
OCEAN SPORT	0	0	2	0	2	0.004
OCEAN COMMERCIAL	0	10	13	2	25	0.061
RIVER SPORT	0	3	0	1	4	0.009
RIVER COMMERCIAL	0	6	8	3	17	0.042
INDIAN FISHERY	0	3	3	20	26	0.064
DWORSHAK	0	0	1	0	1	0.002
TUCANNON	0	0	1	1	2	0.004
WELLS	0	4	0	0	4	0.009
STREAM SURVEY	0	0	0	2	2	0.004
TOTALS	0	109	45	42	196	0.485
PERCENT OF RECOVERY	0.0	55.6	22.9	21.4	100.0	

Appendix Table B13. 1979 MCNARY - CONTROL - TAILRACE

FALL CHINOOK

MARKS USED	LA5 1 LAIM2 RDYWPK	LA5 2 LAIM3 LBYWLB	LA5 3 LAIM4 RDLBPK	LA5 4 PR	LAIM1 RDLGYW	NUMBER RELEASED	112718

RECOVERY AREA	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	3	0	3	0.002
MCNARY TRAP	0	2	0	2	0.001
LOWER GRANITE TRAP	0	0	0	0	0.000
OCEAN SPORT	0	0	0	0	0.000
OCEAN COMMERCIAL	0	1	0	1	0.000
RIVER SPORT	0	0	0	0	0.000
RIVER COMMERCIAL	0	0	1	1	0.000
INDIAN FISHERY	0	0	2	2	0.001
TOTALS	0	6	3	9	0.007
PERCENT OF RECOVERY	0.0	66.6	33.3	100.0	

Appendix Table B14. 1979 MCNARY - TRUCK

FALL CHINOOK

MARKS USED	RA3 1 RAI+2 RDPKLB	RA3 2 RAI+3 RDPKOR	RA3 3 RAI+4 LBYWLG	RA3 4 SM RDLBYW	RAI+1 RDLGPK	NUMBER RELEASED	132919

RECOVERY AREA	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	26	8	34	0.025
MCNARY TRAP	0	34	5	39	0.029
LOWER GRANITE TRAP	0	0	0	0	0.000
OCEAN SPORT	0	0	1	1	0.000
OCEAN COMMERCIAL	0	10	1	11	0.008
RIVER SPORT	0	3	0	3	0.002
RIVER COMMERCIAL	0	2	0	2	0.001
INDIAN FISHERY	0	1	9	10	0.007
DWORSHAK	0	0	1	1	0.000
STREAM SURVEY	0	0	1	1	0.000
TOTALS	0	76	26	102	0.076
PERCENT OF RECOVERY	0.0	74.5	25.4	100.0	

Appendix Table B15. 1980 MCNARY - TAILRACE CONTROL

FALL CHINOOK

MARKS USED	LAH 1 CEND	LAH 2 CE	LAIF1 CEDY	LAIF3	ERLA	NUMBER RELEASED	84587

RECOVERY AREA	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	4	4	0.004
MCNARY TRAP	1	1	2	0.002
LOWER GRANITE TRAP	0	1	1	0.001
OCEAN SPORT	0	1	1	0.001
OCEAN COMMERCIAL	0	0	0	0.000
RIVER SPORT	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	1	1	0.001
TUCANNON	0	2	2	0.002
TOTALS	1	10	11	0.013
PERCENT OF RECOVERY	9.0	90.9	100.0	

Appendix Table B16. 1980 MCNARY – TRUCK

FALL CHINOOK

MARKS USED	RAV 1 DY	RAV 2 LA	RAIC1 HO	RAIC3	NDSM	NUMBER RELEASED	80213

RECOVERY AREA	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	18	18	0.022
MCNARY TRAP	0	12	12	0.014
LOWER GRANITE TRAP	0	0	0	0.000
OCEAN SPORT	0	1	1	0.001
OCEAN COMMERCIAL	0	0	0	0.000
RIVER SPORT	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	4	4	0.004
TOTALS	0	35	35	0.043
PERCENT OF RECOVERY	0.0	100.0	100.0	

Appendix Table B17. 1978 MCNARY CONTROLS - TAILRACE

STEELHEAD

MARKS USED	LAH 1 RDORRD	LAH 2 LAIF1	LAS 1 LAIF3	LAS 2 PUGNBL	RDYWRD YWXYGN	NUMBER RELEASED	15585

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	5	7	2	14	0.089
MCNARY TRAP	0	8	9	1	18	0.115
LOWER GRANITE TRAP	0	22	20	1	43	0.275
PRIEST RAPIDS TRAP	0	6	4	0	10	0.064
OCEAN SPORT	0	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0	0	0.000
RIVER SPORT	0	5	9	2	16	0.102
RIVER COMMERCIAL	0	0	0	0	0	0.000
INDIAN FISHERY	0	2	2	0	4	0.025
DWORSHAK	0	0	0	2	2	0.012
PAHSIMEROI	0	0	1	0	1	0.006
KOOSKIA	0	0	0	1	1	0.006
CHELAN	0	0	3	0	3	0.019
RINGOLD	0	0	1	0	1	0.006
TOTALS	0	48	56	9	113	0.725
PERCENT OF RECOVERY	0.0	42.4	49.5	7.9	100.0	

Appendix Table B18. 1978 MCNARY - TRUCK

STEELHEAD

MARKS USED	RAV 1 RAIC1	RAV 2 RAIC3	GM ORGNLG	GMWH LG	RDYWYW	NUMBER RELEASED	20416

RECOVERY AREA	1978	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	17	28	9	54	0.264
MCNARY TRAP	0	20	44	4	68	0.333
LOWER GRANITE TRAP	0	106	68	12	186	0.911
PRIEST RAPIDS TRAP	0	21	7	0	28	0.137
OCEAN SPORT	0	0	0	0	0	0.000
OCEAN COMMERCIAL	0	1	0	0	1	0.004
RIVER SPORT	0	28	45	13	86	0.421
RIVER COMMERCIAL	0	0	0	0	0	0.000
INDIAN FISHERY	0	1	7	3	11	0.053
DWORSHAK	0	0	0	10	10	0.048
PAHSIMEROI	0	0	4	2	6	0.029
RAPID RIVER	0	0	1	0	1	0.004
HELLS CANYON (OXBOW)	0	0	0	1	1	0.004
KOOSKIA	0	0	0	1	1	0.004
CHELAN	0	0	2	0	2	0.009
WELLS	0	0	3	0	3	0.014
RINGOLD	0	0	1	0	1	0.004
LEAVENWORTH	0	0	0	1	1	0.004
TOTALS	0	194	210	56	460	2.253
PERCENT OF RECOVERY	0.0	42.1	45.6	12.1	100.0	

Appendix Table B19. 1979 MCNARY - CONTROL - TAILRACE

STEELHEAD

MARKS USED	LA5 1 LAIM2 RDYWPK	LA5 2 LAIM3 LBYWLB	LA5 3 LAIM4 RDLBPK	LA5 4 PR	LAIM1 RDLGYW	NUMBER RELEASED	8595

RECOVERY AREA	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	3	14	17	0.197
MCNARY TRAP	0	4	4	8	0.093
LOWER GRANITE TRAP	0	6	8	14	0.162
PRIEST RAPIDS TRAP	0	4	0	4	0.046
OCEAN SPORT	0	0	0	0	0.000
OCEAN COMMERCIAL	0	1	0	1	0.011
RIVER SPORT	0	6	8	14	0.162
RIVER COMMERCIAL	0	0	0	0	0.000
INDIAN FISHERY	0	1	0	1	0.011
TOTALS	0	25	34	59	0.686
PERCENT OF RECOVERY	0.0	42.3	57.6	100.0	

Appendix Table B20. 1979 MCNARY - TRUCK

STEELHEAD

MARKS USED	RA3 1 RAI+2 RDPKLB	RA3 2 RAI+3 RDPKOR	RA3 3 RAI+4 LBYWLG	RA3 4 SM RDLBYW	RAI+1 RDLGPK	NUMBER RELEASED	15379

RECOVERY AREA	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	12	34	46	0.299
MCNARY TRAP	0	11	26	37	0.240
LOWER GRANITE TRAP	0	19	36	55	0.357
PRIEST RAPIDS TRAP	0	19	0	19	0.123
OCEAN SPORT	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0	0.000
RIVER SPORT	0	24	32	56	0.364
RIVER COMMERCIAL	0	0	0	0	0.000
INDIAN FISHERY	0	5	15	20	0.130
PAHSIMEROI	0	0	4	4	0.026
LEAVENWORTH	0	0	1	1	0.006
TOTALS	0	90	148	238	1.547
PERCENT OF RECOVERY	0.0	37.8	62.1	100.0	

Appendix Table B21. 1979 MCNARY - BARGE

STEELHEAD

MARKS USED RAR 1 RDPKYW RAR 2 RDYWPK RAR 3 RAR 4 RDYWLG NUMBER RELEASED 18182

RECOVERY AREA	1979	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	24	49	73	0.401
MCNARY TRAP	0	15	42	57	0.313
LOWER GRANITE TRAP	0	27	56	83	0.456
PRIEST RAPIDS TRAP	0	34	8	42	0.230
OCEAN SPORT	0	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0	0.000
RIVER SPORT	0	37	50	87	0.478
RIVER COMMERCIAL	0	0	0	0	0.000
INDIAN FISHERY	0	4	14	24	0.131
PAHSIMEROI	0	0	3	3	0.016
CHELAN	0	0	0	1	0.005
WELLS	0	0	2	7	0.038
WINTHROP	0	0	1	1	0.005
	0	0	0	19	0.104
TOTALS	0	141	225	397	2.183
PERCENT OF RECOVERY	0.0	35.5	56.6	100.0	

Appendix Table B22. 1980 MCNARY - TAILRACE CONTROL

STEELHEAD

MARKS USED	LAH 1 CEND	LAH 2 CE	LAIF1 CEDY	LAIF3	ERLA	NUMBER RELEASED	21291

RECOVERY AREA	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	8	8	0.037
MCNARY TRAP	0	0	0	0.000
LOWER GRANITE TRAP	0	7	7	0.032
OCEAN SPORT	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0.000
RIVER SPORT	0	3	3	0.014
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	0	0	0.000
TOTALS	0	18	18	0.084
PERCENT OF RECOVERY	0.0	100.0	100.0	

Appendix Table B23. 1980 MCNARY – TRUCK

STEELHEAD

MARKS USED	RAV 1 DY	RAV 2 LA	RAIC1 HO	RAIC3	NDSM	NUMBER RELEASED	22362

RECOVERY AREA	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	17	17	0.076
MCNARY TRAP	0	2	2	0.008
LOWER GRANITE TRAP	0	10	10	0.044
OCEAN SPORT	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0.000
RIVER SPORT	0	0	0	0.000
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	0	0	0.000
TOTALS	0	29	29	0.129
PERCENT OF RECOVERY	0.0	100.0	100.0	

Appendix Table B24. 1980 MCNARY – BARGE

STEELHEAD

MARKS USED RA2 1 RA2 2 ERPR LATB NUMBER RELEASED 30382

RECOVERY AREA	1980	1981	TOTALS	PERCENT RETURN
BONNEVILLE TRAP	0	23	23	0.075
MCNARY TRAP	0	1	1	0.003
LOWER GRANITE TRAP	0	18	18	0.059
OCEAN SPORT	0	0	0	0.000
OCEAN COMMERCIAL	0	0	0	0.000
RIVER SPORT	0	2	2	0.006
RIVER COMMERCIAL	0	0	0	0.000
INDIAN FISHERY	0	1	1	0.003
TOTALS	0	45	45	0.148
PERCENT OF RECOVERY	0.0	100.0	100.0	