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Research related to transportation of juvenile salmonids on the Columbia and Snake Rivers, 1993

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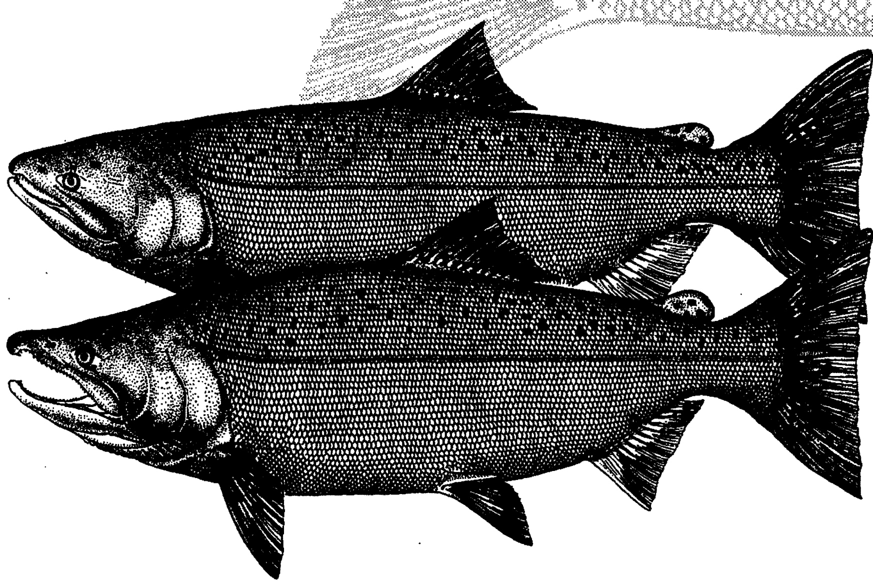

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CONTENTS

EXECUTIVE SUMMARY

In 1993, National Marine Fisheries Service (NMFS) research addressed three areas related to smolt transportation. The first was a continuation of adult recoveries of juveniles marked to evaluate barge transport of smolts from Lower Granite and McNary Dams to a release site below Bonneville Dam; the second was an estuarine release-site study on barged steelhead (*Oncorhynchus mykiss*) smolts; and the third was an evaluation of the new PIT-tag diversion system at Little Goose Dam.

Barge Transportation Studies

Projected low Snake River flows precluded marking of spring/summer chinook salmon (*O. tshawytscha*) and steelhead smolts for the final year of a 3-year reevaluation of transportation from Lower Granite Dam. Releases for a similar 3-year study of marked juvenile fall and spring/summer chinook salmon at McNary Dam were completed in 1988.

In 1993, adult recoveries for these studies continued, and recoveries were completed for a group of spring/summer chinook salmon smolts marked for transport at Lower Granite Dam during the 1990 drought year. This transported group of spring/summer chinook salmon returned at a higher rate than any group we have marked since 1975. Observed and estimated total adult-return rates were 0.37 and 0.90%, respectively. The estimated total adult-return rates for hatchery and wild fish were 0.60 (range 0.30-2.10%) and 2.20% (range 0.50-4.10%), respectively. Groups

of both hatchery and wild smolts marked and transported after mid-May 1990 returned as adults at much higher rates than earlier groups.

Adult recoveries of steelhead smolts, marked as transports and controls and released in 1989, are complete and were also poor. At Lower Granite Dam, the T/C and 95% CI were 2.1 (1.3, 3.5).

At Lower Granite Dam, we continued to observe high abrasion levels from marine mammal teeth and claws on adult spring/summer chinook salmon. Prevalence of abrasions in 1993 was 18.3%, with open wounds occurring on about one-third of the fish with abrasions. We also observed lesions on the head and opercula ("headburns") on 8.3% of the adult spring/summer chinook salmon trapped at the dam this year. This malady is strongly related to periods of extensive hydroelectric system spill.

For the McNary Dam studies, adult returns from transport and control groups of fall chinook salmon juveniles marked in 1987 are complete. The T/C from all areas combined was 3.5, with a 95% CI between 1.7 and 7.1. Adult returns for the 1988 study year are incomplete; however, recoveries from all areas continue to strongly favor the transported groups.

Estuarine Release-Site Study

In 1993, between 13 May and 1 June, we marked 7 release lots of approximately 9,000 steelhead each for the Tongue Point (near the estuary) releases, and 7 lots of 10,000 steelhead each for the Skamania Light (standard release site) releases. Overall post-marking delayed mortality and tag loss were low, averaging 0.2 and 1.4%, respectively.

We also recovered age-1-ocean steelhead returning from the initial smolt marking effort in 1992. These adult returns were 10-15 times lower than expected, with 28 fish returning from the Tongue Point release site and 27 fish returning from the Skamania Light release site.

Little Goose Dam PIT-Tag Diversion System Evaluation

We completed an evaluation of the new PIT-tag diversion system at Little Goose Dam in 1993. As during previous studies at Lower Granite Dam, the efficiency of the system varied proportionally to the hourly facility fish counts. For the "A" flume (small-fish flume), the number of untagged fish diverted per cycle ranged from 0.52 at counts between 4,001 and 6,000 fish per hour to 2.56 at counts between 8,001 and 10,000 fish per hour. For the "B" flume (large-fish flume), untagged fish were diverted from 0.56 at counts between 0 and 2,000 fish per hour, to 2.19 at counts between 6,001 and 8,000 fish per hour. These results were comparable to those obtained during testing of a similar system at Lower Granite Dam in 1991, and they indicate that the system at Little Goose Dam is ready for use in monitoring or research projects.

TRANSPORTATION STUDIES: LOWER GRANITE AND MCNARY DAMS

Introduction

The U.S. Army Corps of Engineers (COE) has conducted the barge transportation program annually since 1981. To continue to monitor its relative success, the National Marine Fisheries Service (NMFS) marked spring/summer chinook salmon (*Oncorhynchus tshawytscha*) smolts at Lower Granite Dam in 1983, 1984, and 1985, and steelhead (*O. mykiss*) smolts in 1984 and 1985. No paired control groups of either species were marked during any of these years. The 1985 smolt-marking operations were conducted by the Fish Passage Center (formerly the Water Budget Center). Therefore, data on these releases were not available for previous NMFS annual reports. Final adult returns for the 1983 and 1984 release groups were reported by Harmon et al. (1989), and final adult returns for the 1985 releases were reported by Matthews et al. (1990).

By 1985, preliminary adult returns from the 1983 and 1984 marking efforts indicated that survival of marked, transported smolts had improved considerably compared to returns of smolts marked during the 1976-80 study years (Park et al. 1986). We believe a combination of factors was responsible for the observed increase in smolt-to-adult survival. These factors included, the following: major improvements in transport and collection facilities, improved fish quality, greatly improved fish handling/marking techniques, and a period of favorable near-ocean rearing conditions (Ware and Thomson 1991).

In 1986, a new 3-year transportation study was initiated on spring/summer chinook salmon and steelhead at Lower Granite Dam and spring/summer and fall chinook salmon at McNary Dam. The primary goal of the study was to reevaluate transportation of smolts around dams, utilizing state-of-the-art collection/transport and handling/marking techniques.

At McNary Dam, we marked transport and control groups of spring/summer and fall chinook salmon for 3 consecutive years (1986-88). No smolt marking has occurred at this dam since 1988. At Lower Granite Dam, we marked transport and control groups of spring/summer chinook salmon and steelhead in 1986. Drought conditions caused low river flows in 1987-1988 and 1990-1993. As a result, no inriver control releases were marked in those years. In 1987, barge transport groups of spring/summer chinook salmon and steelhead were marked for indexing of transportation. In 1990, only spring/summer chinook salmon smolts were marked for that purpose.

While recovery of adults for some of these marking efforts is complete, other adult recovery efforts are ongoing. Completed studies previously reported for Lower Granite Dam include results from both spring/summer chinook salmon and steelhead released in 1986 (Matthews et al. 1992), and spring/summer chinook salmon released in 1987 (Achord et al. 1992) and 1989 (Harmon et al. 1993). For McNary Dam studies, complete returns include those for spring/summer chinook salmon released in 1986 (Matthews et al. 1992), 1987 (Achord et al. 1992), and 1988 (Harmon et al. 1993), and for fall chinook salmon released in 1986 (Harmon et al. 1993). Here we report the results from complete adult returns of fall chinook salmon marked at McNary Dam in 1987 and steelhead and spring/summer chinook salmon marked at Lower Granite Dam in 1989 and 1990, respectively.

To determine the hatchery/wild composition of the Snake River spring/summer chinook salmon population, NMFS and the Oregon Department of Fish and Wildlife (ODFW) began a study in 1991. The study uses a discriminant function scale analysis on smolts and returning adults to distinguish between hatchery and wild fish (Achord et al. 1992, Harmon et al. 1993). In particular, the study was intended to examine the hatchery/wild composition of each marked group of smolts for the transportation study, and to examine the scales of those subsequently returning as adults. Since drought conditions precluded marking of smolts for the 1991, 1992, and 1993 study years, we sampled scales from adults returning from previous marking efforts and from the general population. Results of the 1993 effort are reported in Appendix B.

Methods

General

Smolts at both dams were marked with coded-wire tags (CWT) and freeze brands during the smolt outmigration each year and either transported by barge for release below Bonneville Dam or released as controls below Little Goose or McNary Dams. Smolts were marked according to the procedures described by Matthews et al. (1987).

Recovery of Adults and Data Analysis

Adults were recovered from 3 to 6 years after their release as juveniles, depending upon species and study site. Traps in fish ladders at Lower Granite and Priest Rapids Dams (for McNary Dam releases) were the primary recovery sites for spring/summer chinook salmon and steelhead. Ocean and river commercial fisheries were primary recovery sites for fall chinook salmon marked at McNary Dam. If recoveries were sufficient, trapping efficiencies were estimated for individual release lots by comparing the number of marked trap recoveries to the total number of marked fish returning to the hatcheries and, when available, to tributary sport fisheries and natal spawning areas.

Evaluation of transportation was based upon adult recovery transport/control ratios (T/C) from fish marked as juveniles. A 95% confidence interval (CI) was used to test the null hypothesis: the true transport to control ratio was equal to 1. If the 95% CI did not include a ratio equal to 1, then the null hypothesis was rejected. Beginning at Lower Granite Dam in 1989, the study design was adjusted to measure the precision around an expected T/C of 1.5, with a coefficient of variation of 10% for spring/summer chinook salmon and 7.5% for steelhead.

To normalize the distribution, the ratios were log-transformed prior to CI construction. The endpoints of the CI were then back-transformed to provide a nonsymmetric CI on the original scale. For analysis of total recoveries, the CI was calculated using both theoretical and empirical estimates of variance. The CI employing the empirical variance estimate was preferred.

The 95% CI using transformed data based on theoretical variance was derived by the following term:

$$\ln(T/C) \pm 1.96\sqrt{\frac{1}{n_t}+\frac{1}{n_c}-\frac{1}{N_t}-\frac{1}{N_c}}$$

The 95% CI was then back-transformed to its original scale using the following term:

$$\left(e^{\ln(T/C) - 1.96\sqrt{\frac{1}{n_t}+\frac{1}{n_c}-\frac{1}{N_t}-\frac{1}{N_c}}},\ e^{\ln(T/C) + 1.96\sqrt{\frac{1}{n_t}+\frac{1}{n_c}-\frac{1}{N_t}-\frac{1}{N_c}}} \right)$$

The 95% CI using transformed data based on empirical variance was derived by the following term:

$$\ln(T/C) \pm t_{0.05}{}^{n-1}\ S.E.(\ln(T/C))$$

The 95% CI was then back-transformed to the original scale using the following term:

$$\left(e^{\ln(T/C) - t_{0.05}{}^{n-1}\ S.E.(\ln(T/C))},\ e^{\ln(T/C) + t_{0.05}{}^{n-1}\ S.E.(\ln(T/C))} \right)$$

where,

T/C = overall transport recovery percentage divided by overall control recovery percentage

$S.E.$ = standard deviation of the r replicate ln(T/C)'s divided by $r^{1/2}$

n_t = total of transport recoveries

n_c = total of control recoveries

N_t = total of transport releases

N_c = total of control releases

t = the t probability for a two-sided significance level $\alpha = 0.05$ and n-1 degrees of freedom

1.96 = the normal probability for a two-sided $\alpha = 0.05$

Results and Discussion

Adult Recoveries for Lower Granite Dam Studies

Spring/summer chinook salmon--During spring 1990, we marked a transport index group of barged spring/summer chinook salmon smolts at Lower Granite Dam (Matthews et al. 1992). This group was composed of seven distinctly marked release lots of smolts, with marking beginning on 13 April and ending on 8 June. No inriver controls were marked due to low river flows. Adult returns for this marking effort are now complete. At Lower Granite Dam, we recovered 164 fish or 0.37% of the release (Appendix Tables 1.0 through 1.7 and Table 1). This was the highest observed adult return rate since 1975.

Adult returns from the index group barged in 1990 provided the first opportunity to make independent estimates of adult return rates for transported hatchery and wild spring/summer chinook salmon. Although we were incapable of differentiating between hatchery and wild smolts during marking, we reconstructed

Table 1.--Summary of recovered adult spring/summer chinook salmon marked at Lower Granite Dam in 1990 (recoveries through December 1993). Numbers in parentheses represent fish that were jaw tagged at the dams and subsequently recovered upstream

			Observed adult returns									
Group	Number released	Ocean-age	Ocean fishery	Bonneville Dam	River fishery	Indian fishery	L. Granite Dam N	L. Granite Dam %	Hatcheries	Stream surveys	Total[a] N	Total[a] %
Transport	44,708	1	0	0	0	0	8 (1)	0.02	7	0	14	0.03
		2	1	4 (3)	1	0	71 (14)	0.16	35	0	95	0.21
		3	0	0	1	1	85 (5)	0.19	3	4	89	0.20
		Total	1	4 (3)	2	1	164 (20)	0.37	45	4	198	0.44

[a] Fish captured more than once were only counted once in totals

the overall outmigration timings of both groups using juvenile PIT-tag-detection data. The 1990 outmigration timing of wild fish was based on detections at Lower Granite Dam of fish PIT tagged as parr in Idaho and Oregon during summer 1989 (Matthews et al. 1992). For hatchery fish, the 1990 outmigration timing was based upon PIT-tag detections of fish released from Dworshak, Sawtooth, and McCall Hatcheries. For McCall Hatchery, we used detections of PIT-tagged fish from the 1989 outmigration to reconstruct the 1990 outmigration, because freeze brands (rather than PIT tags) were used at that hatchery in 1990. This appeared reasonable because outmigration timing of McCall Hatchery fish was quite similar for the 2 years (FPC 1991). The outmigration timing of the three hatcheries combined matched quite accurately the passage timing of all freeze-branded-hatchery fish in 1990 (FPC 1991).

To make independent estimates of the total numbers of hatchery and wild fish collected at Lower Granite Dam, we assumed that 15% of the overall smolt population collected was composed of wild fish. We next applied the outmigration timing data to the collection-period totals to estimate the percentages of hatchery and wild fish collected during each marking period. These percentages were then applied to the numbers of smolts marked during each period. On returning adults, hatchery/wild determinations were based on a discriminant function scale analysis by the Oregon Department of Fish and Wildlife (ODFW) (see Appendix B). Finally, to estimate total adult returns, we adjusted for adult trapping efficiency at Lower Granite Dam by multiplying the observed adult returns of each marked group by 2.5 (40% trapping efficiency). The 40% adult trapping-efficiency estimate was based upon recoveries of adults upstream from the dam, and was equal to the proportion of adults that had been previously identified (jaw tagged) in the Lower Granite Dam adult trap. This proportion has remained relatively stable since the early 1980s.

Using this analytical approach, we estimated a total adult-return rate of 0.9% for the overall spring/summer chinook salmon smolt population marked and transported from Lower Granite Dam in spring 1990 (Table 2). The estimated total adult-return rate of hatchery fish was 0.6%, with individual release-lot return rates ranging from 0.3 to 2.1%. For wild fish, the estimated total adult-return rate was 2.2%, with individual release-lot return rates ranging from 0.5 to 4.1%.

An interesting, and we believe very important, trend in these data was the major improvement in adult return rates for smolts transported later in the outmigration. Particularly for hatchery fish, smolts marked and transported after mid-May returned as adults at much higher rates than the earlier groups, which represented the bulk of the smolt outmigration. This is particularly puzzling in light of the consistent annual findings that the incidence and severity of *Renibacterum salmoninarum* infections were higher in later-migrating smolts (Elliott and

Table 2.--Adult returns to Lower Granite Dam of spring/summer chinook salmon smolts marked and transported from the dam in 1990.

Dates marked	Number of smolts marked[a]		Observed adult returns[b] N	Observed adult returns[b] (%)	Total adult return estimates[c] N	Total adult return estimates[c] (%)
13-18 Apr	5,938	hatchery	9	0.15	23	0.40
	1,062	wild	2	0.19	5	0.50
18-21 Apr	6,218	hatchery	7	0.11	18	0.30
	782	wild	2	0.26	5	0.60
21-25 Apr	6,256	hatchery	10	0.16	25	0.40
	744	wild	7	0.94	18	2.40
25 Apr-2 May	6,039	hatchery	12	0.20	30	0.50
	961	wild	2	0.21	5	0.50
2-14 May	6,203	hatchery	12	0.19	30	0.50
	797	wild	9	1.10	23	2.90
14-29 May	4,857	hatchery	34	0.70	85	1.80
	2,143	wild	23	1.10	58	2.70
29 May-8 Jun	1,177	hatchery	10	0.85	25	2.10
	1,531	wild	25	1.63	63	4.10
Totals	36,688	hatchery	94	0.26	235	0.60
	8,020	wild	70	0.87	175	2.20
Grand total	44,708		164	0.37	410	0.90

[a] Numbers of hatchery and wild smolts based upon outmigration timing data from PIT-tagged smolts detected at Lower Granite Dam, and presumes 15% of the overall smolt outmigration were wild fish.

[b] Hatchery and wild adult returns based upon scale analysis.

[c] Estimated adult returns are observed adult returns adjusted (X 2.5) for trapping efficiency at Lower Granite Dam.

Pascho 1993). In addition, ambient river flows varied considerably after mid-May, ranging from the lowest (17-24 May) to the highest (30 May-8 June) spring flow periods at both Lower Granite and Bonneville Dams (FPC 1991).

We strongly suspect that conditions favorable to survival upon ocean entry were responsible for the high adult return rates for both hatchery and wild smolts transported late in the 1990 outmigration season.

The high adult-return rates of hatchery and wild spring/summer chinook salmon smolts marked and transported after mid-May 1990 clearly demonstrated the potential of transportation to quickly recover wild stocks when outside factors are conducive to good survival. Moreover, adult return rates of these magnitudes would eventually provide for a substantial, sustainable harvest. Finally, and most importantly, if smolt transportation were intrinsically harmful to salmonid smolts, it is highly unlikely that adult-return rates as high as these would have occurred.

Marine mammal abrasions--We continued monitoring the prevalence of marine mammal tooth and claw abrasions on adult spring/summer chinook salmon during 1993. Overall, prevalence averaged 18.3%, with open wounds noted on approximately one-third of the fish with abrasions (Table 3). As in past years, the prevalence of abrasions was generally higher during the earliest portion of the run (Matthews et al. 1992, Achord et al. 1992, Harmon et al. 1993). In 1993, average abrasion prevalence was somewhat higher than during the past 2 years and was similar to that of 1990, the first year we reported a high prevalence of the condition. Our concern about the potential negative effects of marine mammals on the depressed runs of wild Snake River spring/summer chinook salmon continues.

"Headburns"--In 1993, we also noted numerous adult spring/summer chinook salmon with a malady not observed for many years--lesions occurring primarily on the top of the head and, to a lesser extent, on the opercula. We termed these lesions "headburns" for their similarity in appearance to third-degree burns. The lesions ranged in size from about 1 cm in diameter to complete cranial envelopment. Some fish had one large lesion while others were typified by one or more smaller lesions. Through bacterial or fungal activity, smaller lesions appeared to be expanding to form or join larger ones.

This condition was first observed on 18 May, a few days after high river flows forced extensive spill at all eight lower Snake and Columbia River dams. From 18 May through 17 August, weekly headburn prevalence increased temporally, with an overall average of 8.3% for the period (Table 4). For adults that were tagged with radio transmitters at John Day Dam, the overall average prevalence of this conditions was 22.3% (Bjornn et al. 1995). Headburn incidence has coincided with periods of extensive, sustained spill, both recently and historically. With low flows and minimal system spill being the norm in recent years, and in the absence of spill prior to mid-May 1993, the

Table 3.--Weekly prevalence (25 April to 17 August) of marine mammal tooth and claw abrasions on adult spring/summer chinook salmon at Lower Granite Dam in 1993.

Date	Sample size		Incidence (%)
25 April - 2 May	156		30.8
3-9 May	465		28.4
10-16 May	652		25.6
17-23 May	199		20.1
24-30 May	275		17.1
31 May - 6 June	417		21.3
7-13 June	209		15.3
14-20 June	314		11.8
21-27 June	443		11.3
28 June - 4 July	340		7.1
5-11 July	164		9.1
12-18 July	72		6.9
19-25 July	38		13.2
26 July - 1 August	27		3.7
2-8 August	11		0.0
9-15 August	7		14.3
16-17 August	1		0.0
Total	3,790	Average	18.3[a]

[a] Open wounds were associated with 31.6% of the abrasions.

Table 4.--Weekly prevalence (18 May to 17 August) of head lesions ("headburns") on adult spring/summer chinook salmon at Lower Granite Dam in 1993.

Date	Sample Size		Incidence (%)
18-23 May	157		5.1
24-30 May	275		8.7
31 May-6 June	417		9.4
7 June-13 June	209		11.5
14-20 June	314		6.7
21-27 June	443		6.5
28 June-4 July	340		6.8
5-11 July	164		7.9
12-18 July	72		16.7
19-25 July	38		13.2
26 July-1 August	27		14.8
2-8 August	11		18.2
9-17 August	8		28.0
Total	2,475	Average	8.3

condition was nonexistent. However, not only did the condition first appear after system spill began in 1993, it was also regularly observed during the early 1970s when excess flow was commonly spilled at many dams (Larry Basham, Fish Passage Center, 2501 S. W. First Ave. Suite 230, Portland OR 97201-4752. Pers. commun., August 1993). Prespawning mortality would undoubtedly be higher for fish suffering from this affliction as well as for those with open, pinniped-related wounds.

Steelhead--Adult recoveries of steelhead smolts marked in 1989 are complete and are much lower than expected (Appendix Tables 2.0 through 3.6 and Table 5). Total adult recoveries to Lower Granite Dam for transport and control groups numbered 163 (0.54% of the release) and 109 (0.26% of the release), respectively, for a T/C and 95% CI of 2.1 (1.3, 3.5). For individual release lots of both transports and inriver controls, return rates declined steadily and rapidly through time, while T/C estimates increased.

Overall, marked adult steelhead in both test groups returned at about one-third the expected rate, as did adult steelhead in general from smolts outmigrating in spring 1989. The same pattern was apparent for adult spring/summer chinook salmon from the 1989 smolt outmigration (Harmon et al. 1993). While river flows in spring 1989 were below average, they were not severely depressed. Since both test groups and the run-at-large of both species were similarly affected, Achord et al. (1992) suggested that poor estuary and/or early-ocean survival of smolts likely

Table 5.--Summary of recovered adult steelhead marked at Lower Granite Dam in 1989 (recoveries through December 1993). Numbers in parentheses represent fish that were jaw tagged at the dam and subsequently recovered upstream.

Groups	Number released	Ocean-age	Observed adult returns: Bonneville Dam	Indian fishery	River fishery	Lower Granite Dam N		Lower Granite Dam %	Hatcheries	Total[a] N	Total[a] %
Transport	30,116	1	0	2	5	33	(8)	0.11	8	40	0.13
		2	0	17	38	129	(44)	0.43	13	153	0.51
		3	0	1	1	1	(1)	0.00	0	2	0.01
		Total	0	20	44	163	(53)	0.54	21	195	0.65
Control	42,259	1	1	2	9	33	(14)	0.08	5	36	0.09
		2	0	5	22	72	(23)	0.17	7	83	0.20
		3	0	1	2	4	(1)	0.01	0	6	0.01
		Total	1	8	33	109	(38)	0.26	12	125	0.30

[a] Fish captured more than once were only counted once in totals.

accounted for the low adult returns of both species from the 1989 smolt outmigration.

Adult Recoveries for McNary Dam Studies

Fall chinook salmon--Adult returns of fall chinook salmon released as juvenile transport and control groups from McNary Dam in 1987 are complete (Appendix Tables 4.0 through 5.7 and Table 6). A total of 374 transports and 101 controls were recovered from all sites. We constructed 95% CIs using empirical standard errors (Table 7). The data showed significant transport benefits and similar T/Cs at all recovery sites except the combined hatcheries, which were predominated by recoveries from Priest Rapids Hatchery. These results are similar to those reported for the 1986 study year (Harmon et al. 1993).

Preliminary adult recoveries of fall chinook salmon released in 1988 total 52 transports (0.09% of the release) and 18 controls (0.03% of the release) (Appendix Tables 6.0 through 7.6 and Table 8). Although these preliminary data indicate a substantial survival benefit for transported fish, the total recoveries remain low. When recoveries of age-5-ocean adults and other late-arriving data are processed, we will provide a complete statistical analysis of the results.

Table 6.--Summary of recovered adult fall chinook salmon marked at McNary Dam in 1987 (recoveries through December 1993). Numbers in parentheses represent fish that were jaw tagged at the dam and subsequently recovered upstream.

Groups	Number released	Ocean-age	Observed adult returns: Ocean fishery	Bonneville Dam	River fishery	Indian fishery	Priest Rapids Dam	Hatcheries	Stream surveys	Total[a] N	Total[a] %
1987 Transport	68,376	1	8	24	1	0	0	6	0	39	0.06
		2	12	0	6	7	0	8	2	35	0.05
		3	65	38 (12)	12	49	0	8	4	164	0.25
		4	46	23 (6)	22	31	1	4	9	130	0.18
		5	3	1 (1)	0	2	0	1	0	6	0.00
		Total	134	86 (19)	41	89	1	27	15	374	0.55
1987 Control	68,291	1	4	8	1	0	0	4	0	17	0.02
		2	2	0	0	1	0	4	0	7	0.01
		3	17	17 (7)	3	14	0	6	0	50	0.07
		4	6	5 (3)	6	5	0	4	4	27	0.04
		5	0	0	0	0	0	0	0	0	0.00
		Total	29	30 (10)	10	20	0	18	4	101	0.15

[a] Fish captured more than once were only counted once in the totals.

Table 7.--Summary of T/Cs and 95% CIs for adult recoveries of fall chinook salmon marked as smolts at McNary Dam in 1987.

Recovery site	T/C	Empirical 95% CI
Ocean fishery	4.6	(2.0, 10.5)
River fishery	4.0	(1.8, 8.7)
Bonneville Dam	2.9	(1.4, 6.1)
Indian fishery	4.4	(1.2, 17.2)
Hatcheries	1.5	(0.6, 3.8)
Spawning ground	3.8	(1.2, 11.3)
Combined	3.5	(1.7, 7.1)

Table 8.--Preliminary summary of recovered adult fall chinook salmon marked at McNary Dam in 1988 (recoveries through December 1993). Numbers in parentheses represent fish that were jaw tagged at the dam and subsequently recovered upstream

Groups	Number released	Ocean-age	Observed adult returns: Ocean fishery	Bonneville Dam	River fishery	Indian fishery	Priest Rapids Dam	Hatcheries	Stream surveys	Total* N	Total* %
1988 Transport	60,013	1	1	0	1	0	0	1	0	3	0.00
		2	5	3 (2)	1	1	0	1	0	9	0.01
		3	9	4	6	5	0	3	1	28	0.04
		4	7	4	4	4	0	0	0	19	0.02
		Total	15	11 (2)	12	10	0	5	1	52*	0.09
1988 Control	60,010	1	0	0	0	0	0	1	0	1	0.00
		2	2	2	1	2	0	0	0	7	0.01
		3	0	1	0	1	0	0	1	3	0.00
		4	4	1	1	0	0	1	0	7	0.01
		Total	6	4	2	3	0	2	1	18*	0.03

* Fish captured more than once were only counted once in totals.

ESTUARINE RELEASE-SITE STUDY

Introduction

There is a growing body of evidence suggesting that survival of juvenile salmonids can be enhanced by releasing them into upper areas of estuaries rather than farther upstream in freshwater areas. In Scandanavian countries, releases of hatchery-reared Atlantic salmon (*Salmo salar*) smolts directly into estuarine waters have resulted in increased survival compared to similar releases in fresh water (Gunnerod et al. 1988). Macdonald et al. (1988) and Levings et al. (1989) speculated that increased survival of salmonid juveniles released into estuarine areas was related to decreased predation and stress, increased food availability, and ease of osmoregulation in the estuary. In a 5-year study, Solazzi et al. (1991) released hatchery-reared coho salmon (*O. kisutch*) immediately below Bonneville Dam (control), at Tongue Point (upper intrusion of salt water in the estuary), and at several locations farther into the Columbia River plume. They reported a survival rate 1.6 times higher for fish released at Tongue Point than for the control group.

After release at the site immediately below Bonneville Dam, smolts transported from the Snake River must migrate approximately 150 km through the lower Columbia River before arriving at the estuary. Although the river is free-flowing in this reach, the area is known to harbor large numbers of predators, primarily northern squawfish (*Ptychocheilus oregonensis*) and various avian species. The studies mentioned above suggest that mortality from predation alone may be of sufficient magnitude to warrant the additional transport distance.

In spring 1992, we began a study to determine if steelhead smolts, transported by barge and released in the upper estuary at Tongue Point, will return as adults to Lower Granite Dam in significantly greater numbers than those transported by barge and released at the traditional site near Skamania Light just downstream from Bonneville Dam. Spring/summer chinook salmon were not included in the present study, because excessively large numbers of marked smolts are required to detect small differences in survival for this species. Depending upon the results of the study for steelhead, spring/summer chinook salmon may be tested in the future.

In 1993, we marked steelhead smolts for the second year of the 3-year study and recovered age-1-ocean adult steelhead from the 1992 study year. Results of these efforts are reported here.

Methods

All sampling and marking was conducted using a new fish-handling system that we designed and installed adjacent to the upstream (new) raceways at Lower Granite Dam. The system included a preanesthesia handling method (Matthews et al. 1986). With the new facilities, the large numbers of smolts required for transportation research were sorted and marked without impacting other sampling and fish-handling activities at the collection facility.

Much of the basic marking methodology was the same as previously described (Matthews et al. 1987, Harmon et al. 1993). Fish used in the study were systematically sampled from the population passing through the fish and debris separator at the juvenile fish collection and handling facility. Two of the upstream raceways were used to collect and hold sampled fish prior to marking. Sufficient numbers of smolts were marked to test a T/C of 1.1 with a 5.0% coefficient of variation. For this study, the Tongue Point (upper estuary) releases were considered test groups and Skamania Light (below Bonneville Dam) releases were considered control groups.

Between 13 May and 1 June, we marked 7 release lots of approximately 19,000 steelhead each with CWTs, freeze brands, and left ventral fin clips, for a total of 131,964 marked fish (Appendix Table 10.0). Lots consisted of approximately 10,000 steelhead smolts each for release at Skamania Light and 9,000 steelhead smolts each for release in the upper estuary near Tongue Point.

Fish for each release lot were marked and transferred into a raceway the first day, and loaded onto a barge the next day. For the Tongue Point releases, additional fish were loaded onto the 2000-series barges so that hauling densities approached those on the barge used for the Skamania Light releases. Periodic samples of marked smolts were held for 24 hours to measure post-marking delayed mortality and tag loss.

Both of the older, 2000-series barges plus an additional tugboat were required for this study. Each 2000-series barge was used in tandem with a larger barge for the trip from Lower Granite Dam to Bonneville Dam. Once at Bonneville Dam, the additional tugboat moved the 2000-series barge with the test group the remaining distance downstream to the Tongue Point release site. The tug then returned the empty 2000-series barge to Bonneville Dam for reattachment to a larger barge returning to Lower Granite Dam.

The 2000-series barges were used only for the Tongue Point releases because their compartments cannot be emptied independently. The Skamania Light releases were transported in and released from barges used during normal transport operations. The marking was scheduled so that 2000-series barges were at opposite ends of the transport cycle at any given time.

Adults will be recovered in each of 3 years following the juvenile releases with Lower Granite Dam as the primary evaluation point. Statistical analysis of the results will be the same as previously described for the other transportation studies.

Results and Discussion

Smolt Marking

Smolt marking was delayed until mid-May, because all barges were engaged in the transport of large numbers of smolts collected prior to that time. In addition, release of the Tongue Point group marked on 1 June was made approximately 1 mile upstream from Longview, Washington (RM 67) due to an oil spill from a freighter in the designated release area.

Post-marking delayed mortality and tag loss were low, averaging 0.2% and 1.4%, respectively (Appendix Table 11.0). The delayed mortality value was one of the lowest we have measured for handled/marked steelhead smolts. The new, temporary handling/marking system at Lower Granite Dam continued to perform exceptionally well, allowing us to safely handle and mark large numbers of smolts.

Adult Recoveries

Preliminary adult returns of steelhead smolts marked for the release-site study in 1992 have been exceptionally poor (Appendix Tables 8.0 through 9.5 and Table 9). So far, only 28 fish from the Tongue Point releases (0.05% of the release) and 27 fish from the Skamania Light releases (0.04% of the release) have been recovered at Lower Granite Dam. These return rates were 10-15 times lower than expected. Moreover, overall adult returns from the 1992 smolt outmigrations of both steelhead and spring/summer chinook salmon were also severely depressed.

Table 9.--Preliminary summary of recovered adult steelhead marked at Lower Granite Dam in 1992 and transported to either Tongue Point or below Bonneville Dam (recoveries through December 1993). Numbers in parentheses represent fish that were jaw-tagged at the dams and subsequently recovered upstream.

Release group	Number released	Ocean-age	Observed adult returns: River fishery	Indian fishery	L. Granite Dam N		L. Granite Dam %	Hatcheries	Total[a] N	Total[a] %
Tongue Point	55,366	1	4	2	28	(4)	0.05	0	34	0.06
Bonneville	60,577	1	2	1	27	(2)	0.04	0	30	0.05

[a] Fish captured more than once were counted only once in totals.

While the low river flows and warmer-than-normal water temperatures extant during spring 1992 may have contributed to the abysmal adult returns in 1993, we believe, as posited earlier by Achord et al. (1992), that periodic, exceptionally unfavorable estuary and/or early-ocean conditions continued as the primary causative factors.

If smolt loss due to unfavorable spring and early summer river conditions within the hydropower corridor was the major limiting factor, then returns from the 1990 smolt outmigration should have been nearly as depressed as those from the 1992 smolt outmigration. However, they were not. In fact, the 1990 smolt outmigration produced the highest overall adult return of spring/summer chinook salmon since the 1985 smolt outmigration, and the highest adult return of marked/transported fish since 1975.

To complete the release-site study, we need to mark steelhead smolts from at least one additional outmigration. Assuming this marking can be accomplished in spring 1994 with no delays or other complications, complete adult returns for the 3-year study would be available in spring 1998. Unfortunately, the extremely depressed age-1-ocean adult steelhead returns reported above have already compromised results from the initial study.

LITTLE GOOSE DAM PIT-TAG DIVERSION SYSTEM EVALUATION

Introduction

In spring 1992, a PIT-tag diversion system was installed at Little Goose Dam. The system was modeled after one at Lower Granite Dam, and incorporated design and operational modifications developed at that dam during evaluations from 1989 through 1991 (Matthews et al. 1990, 1992; Achord et al. 1992). Testing of the Little Goose Dam system was to begin in spring 1992, but technical difficulties forced a delay until spring 1993.

Figure 1 shows the layout of the PIT-tag diversion system within the juvenile fish collection and transportation facility at Little Goose Dam. It is important to note that, unlike the fish and debris separator at Lower Granite Dam, the separator at Little Goose Dam was designed to sort fish by size. Once sorted, fish exit the separator via small- and large-fish flumes (flumes A and B, respectively), and are thus kept separate throughout further handling, sorting, holding for transportation, and/or bypass to the river. It is this difference that necessitated individual evaluations of each flume.

The principal feature of the PIT-tag diversion system is a sliding gate (slide gate) in the bottom of each flume exiting the fish and debris separator. The slide gates open to divert PIT-tagged fish from the general population passing through flumes to the collection raceways, river, or barge.

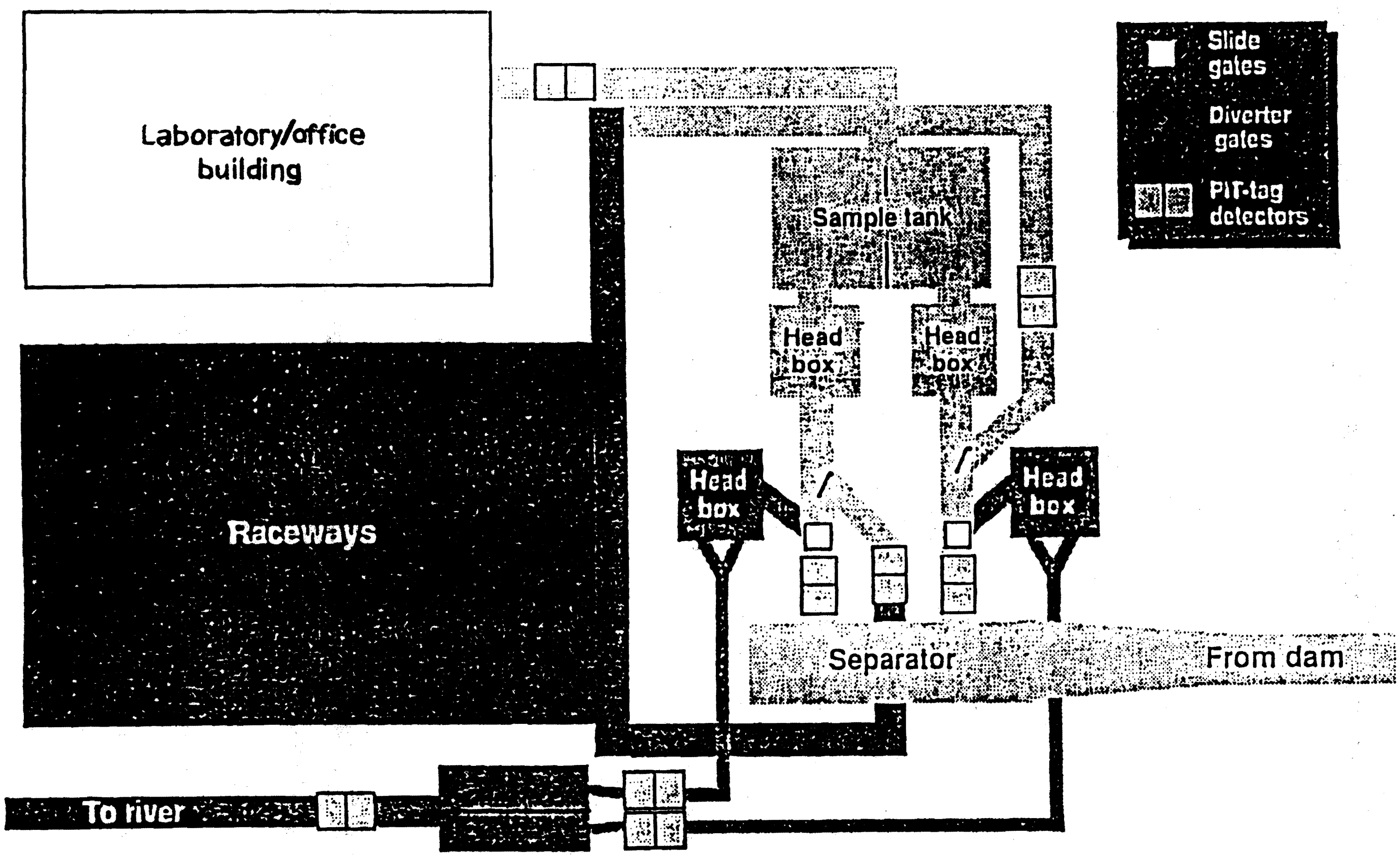

Figure 1.--Schematic of the PIT-tag diversion system within the smolt collection facility at Little Goose Dam.

The primary objectives of the 1993 tests were to evaluate the reliability and efficiency of the system and to determine if modifications were needed to retain high efficiency while maintaining minimal levels of slide-gate-induced injury and/or mortality.

Methods

As at Lower Granite Dam, the efficiency of the Little Goose Dam PIT-tag diversion system was defined as the ratio of untagged fish diverted per slide-gate diversion cycle. Since this ratio is a function of cycle time and rate of fish movement past the system, an expected value for this ratio can be estimated. Also, since there is a mechanical separation of fish passing through the separator, a different estimate was made for each flume. The formulas used to estimate the expected values were:

$$\text{Expected Value flume "A"} = \sum_{i=1}^{n} \frac{H_i(T_{ai})}{3600n}$$

$$\text{Expected Value flume "B"} = \sum_{i=1}^{n} \frac{H_i(T_{bi})}{3600n}$$

where:

- n = the number of tests in each grouping
- i = 1,...,n
- H_i = the expanded hourly facility count for test i
- T_{ai} = the cycle time for flume "A"
- T_{bi} = the cycle time for flume "B"

These formulas assume a linear relationship between the facility count and the expected value. As the facility count increases, the expected values increase proportionally (Achord et al. 1992).

The efficiency of the PIT-tag diversion system was determined by conducting hourly tests during the 1993 smolt outmigration. The tests were timed to correspond with daily peaks of outmigrating smolts passing through the fish and debris separator. However, since the hourly fish counts and the number of PIT-tag cycles were not known in advance, peak passage periods were estimated by examining facility counts from the previous day.

Prior to testing, we observed that a large volume of water entered the PIT-tag collection tank at a high velocity. Therefore, to allow dissipation of the water and limit any injury or descaling that might result from fish being impinged or rolled into the collection net, we designed a distinctive system for collecting the diverted fish at this dam. We built frame-supported net-pens that spanned the length and depth of the collection tanks and were held in place by a series of removable brackets. The system performed well.

Fish from each hourly test were kept separate by removing the brackets and using a push bar to crowd and collect the fish at the downstream end of the net pens. Several of the brackets were then reinstalled and the next hourly test begun. The collected fish were removed using a sanctuary dip-net and anesthetized. They were then scanned for PIT tags, identified by species, counted, and observed for injury and descaling. All PIT-tagged fish were weighed and measured (fork length). Finally, all fish were allowed to recover in a section of the collection tank prior to release into the flumes leading back to the river.

Results and Discussion

During the testing season, 148 successful tests were performed on both the "A" and "B" flumes. Several tests were aborted due to electrical and/or procedural problems. Testing was to begin in mid-April, but, due to low fish numbers, daily testing was delayed until late April. The highest hourly facility counts tested were 8,400 and 8,200 for the "A" and "B" flumes, respectively. For the "A" flume, the number of untagged fish diverted per slide-gate cycle ranged from 0.52 at counts between 4,001 and 6,000 fish per hour, to 2.56 when counts were between 8,001 and 10,000 fish per hour (Table 10). For the "B" flume, the number of untagged fish diverted per cycle ranged from 0.56 at counts from 0 to 2,000 fish per hour, to 2.19 at counts from 6,001 to 8,000 fish per hour.

The overall injury/descaling rates of 9.2% for spring/summer chinook salmon smolts and 9.0% for steelhead smolts were higher than those measured in the collection facility's daily sample and higher than those observed in 1991 at Lower Granite Dam during the final year of slide-gate testing. The higher rates at Little Goose Dam were likely due to fish handling necessitated by the

Table 10.--Summary of the PIT-tag diversion system test results at Little Goose Dam in 1993.

Hourly fish counts	Number of tests	Untagged fish per cycle	Standard error	Expected value
		Flume "A"		
0-2,000	129	0.54	0.15	0.21
2,001-4,000	15	1.06	0.22	0.74
4,001-6,000	2	0.52	0.50	1.16
6,001-8,000	1	2.48	0.00	2.22
8,001-10,000	1	2.56	0.00	2.33
Totals and averages	148	0.70	0.13	0.30
		Flume "B"		
0-2,000	114	0.56	0.08	0.23
2,001-4,000	25	1.49	0.22	0.75
4,001-6,000	6	1.52	0.33	1.32
6,001-8,000	2	2.19	4.00	1.78
8,001-10,000	1	1.75	0.00	2.28
Totals and averages	148	0.93	0.10	0.43

slide-gate study. However, no direct slide-gate-induced injuries were observed. Also, although we did observe some dead fish passing through the system, we could find no evidence that the mortalities were attributable to the slide gate.

Few electronic, mechanical, or procedural problems were encountered during testing. Of those that occurred, all but two were corrected prior to the end of testing. These were the malfunctioning electronic counters on the outlet lines of the slide-gate headboxes and the low hourly sample rate taken by the facility. The low sample rate affected our ability to acquire highly accurate hourly counts. The Corps of Engineers biologist was notified of these problems.

Overall, the results of the PIT-tag diversion system tests indicated that the system operated well and at a high level of efficiency. Test results were comparable to those obtained during testing of a similar system at Lower Granite Dam in 1991. The Little Goose Dam system is ready for use in research or monitoring programs. It is easy to operate and fine-tune, and will be an important component of future research projects.

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BLUE SH. BEF. AP. A

Appendix A

Data Tables

Appendix Table 1.0.--Summary of all recoveries of adult spring chinook salmon transported as juveniles from Lower Granite Dam to below Bonneville Dam in 1990.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9006A 9006B 9006C 9006D 9006E 9006F 9006G

1990 L.GRANITE TRANS BARGE BELOW BONNEVILLE

SPRING CHINOOK

Brands Used: RAL 1 RAL 4 RAL 2 RAV 1 RAV 2 RAV 3 RAV 4
Wire Codes Used: 232429 232430 232431 232432 232433 232434 232435

NUMBER RELEASED: 44708

RECOVERY AREA		1990	1991	1992	1993	1994	TOTAL	% RETURN
			YEAR OF RETURN					
RIVER SYSTEM TRAPS								
BONNEVILLE TRAP		0	0	4	0	0	4	0.009
LOWER GRANITE TRAP		0	8	71	85	0	164	0.367
OCEAN FISHERIES								
WASHINGTON		0	0	1	0	0	1	0.002
RIVER SPORT								
SNAKE R.		0	0	1	0	0	1	0.002
OTHER RIVERS		0	0	0	1	0	1	0.002
RIVER COMMERCIAL		0	0	0	0	0	0	0.000
INDIAN FISHERIES								
INDIAN GENERAL		0	0	0	1	0	1	0.002
HATCHERIES								
PAHSIMEROI H.		0	0	1	0	0	1	0.002
RAPID RIVER H.		0	0	4	0	0	4	0.009
HELLS CANYON (OXBOW) H.		0	0	3	0	0	3	0.007
LOOKINGGLASS H.		0	0	1	0	0	1	0.002
SAWTOOTH H. AND TRAP		0	0	1	0	0	1	0.002
SOUTH FORK SALMON TRAP		0	7	21	3	0	31	0.069
IMNAHA RIVER TRAP		0	0	4	0	0	4	0.009
STREAM SURVEY		0	0	0	4	0	4	0.009
OTHER		0	0	0	1	0	1	0.002
TOTALS		0	15	112	95	0	222	0.497
PERCENT OF RECOVERY	%	0.0	6.8	50.5	42.8	0.0		

Appendix Table 1.1.--Recoveries of adult spring chinook salmon transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam from 13 to 18 April 1990.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9006A

1990 L.GRANITE TRANS BARGE BELOW BONNEVILLE

SPRING CHINOOK

Brands Used: RAL 1
Wire Codes Used: 232429

NUMBER RELEASED: 7000

RECOVERY AREA		YEAR OF RETURN 1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS								
LOWER GRANITE TRAP		0	0	9	2	0	11	0.157
OCEAN FISHERIES		0	0	0	0	0	0	0.000
RIVER SPORT		0	0	0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0	0	0.000
HATCHERIES								
RAPID RIVER H.		0	0	1	0	0	1	0.014
HELLS CANYON (OXBOW) H.		0	0	1	0	0	1	0.014
STREAM SURVEY		0	0	0	0	0	0	0.000
TOTALS		0	0	11	2	0	13	0.186
PERCENT OF RECOVERY	%	0.0	0.0	84.6	15.4	0.0		

Appendix Table 1.2.--Recoveries of adult spring chinook salmon transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam from 17 to 21 April 1990.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9006B

1990 L.GRANITE TRANS BARGE BELOW BONNEVILLE

SPRING CHINOOK

Brands Used: RAL 4
Wire Codes Used: 232430

NUMBER RELEASED: 7000

RECOVERY AREA		1990	YEAR OF RETURN 1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS								
BONNEVILLE TRAP		0	0	1	0	0	1	0.014
LOWER GRANITE TRAP		0	0	6	3	0	9	0.129
OCEAN FISHERIES		0	0	0	0	0	0	0.000
RIVER SPORT								
SNAKE R.		0	0	1	0	0	1	0.014
RIVER COMMERCIAL		0	0	0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0	0	0.000
HATCHERIES								
RAPID RIVER H.		0	0	2	0	0	2	0.029
LOOKINGGLASS H.		0	0	1	0	0	1	0.014
IMNAHA RIVER TRAP		0	0	1	0	0	1	0.014
STREAM SURVEY		0	0	0	0	0	0	0.000
TOTALS		0	0	12	3	0	15	0.214
PERCENT OF RECOVERY	%	0.0	0.0	80.0	20.0	0.0		

Appendix Table 1.3.--Recoveries of adult spring chinook salmon transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam from 21 to 25 April 1990.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9006C

1990 L.GRANITE TRANS BARGE BELOW BONNEVILLE

SPRING CHINOOK

Brands Used: RAL 2
Wire Codes Used: 232431

NUMBER RELEASED: 7000

RECOVERY AREA		YEAR OF RETURN 1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS								
LOWER GRANITE TRAP		0	4	8	5	0	17	0.243
OCEAN FISHERIES		0	0	0	0	0	0	0.000
RIVER SPORT								
OTHER RIVERS		0	0	0	1	0	1	0.014
RIVER COMMERCIAL		0	0	0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0	0	0.000
HATCHERIES								
SOUTH FORK SALMON TRAP		0	1	0	0	0	1	0.014
IMNAHA RIVER TRAP		0	0	1	0	0	1	0.014
STREAM SURVEY		0	0	0	0	0	0	0.000
TOTALS		0	5	9	6	0	20	0.286
PERCENT OF RECOVERY	%	0.0	25.0	45.0	30.0	0.0		

Appendix Table 1.4.--Recoveries of adult spring chinook salmon transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam from 25 April to 2 May 1990.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9006D

1990 L.GRANITE TRANS BARGE BELOW BONNEVILLE
SPRING CHINOOK

Brands Used: RAV 1
Wire Codes Used: 232432

NUMBER RELEASED: 7000

RECOVERY AREA		YEAR OF RETURN 1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS								
BONNEVILLE TRAP		0	0	1	0	0	1	0.014
LOWER GRANITE TRAP		0	0	10	4	0	14	0.200
OCEAN FISHERIES		0	0	0	0	0	0	0.000
RIVER SPORT		0	0	0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0	0	0.000
INDIAN FISHERIES								
INDIAN GENERAL		0	0	0	1	0	1	0.014
HATCHERIES								
RAPID RIVER H.		0	0	1	0	0	1	0.014
HELLS CANYON (OXBOW) H.		0	0	1	0	0	1	0.014
SOUTH FORK SALMON TRAP		0	0	2	0	0	2	0.029
STREAM SURVEY		0	0	0	0	0	0	0.000
TOTALS		0	0	15	5	0	20	0.286
PERCENT OF RECOVERY	%	0.0	0.0	75.0	25.0	0.0		

Appendix Table 1.5.--Recoveries of adult spring chinook salmon transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam from 2 to 14 May 1990.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9006E

1990 L.GRANITE TRANS BARGE BELOW BONNEVILLE

SPRING CHINOOK

Brands Used: RAY 2
Wire Codes Used: 232433

NUMBER RELEASED: 7000

RECOVERY AREA		YEAR OF RETURN 1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS								
BONNEVILLE TRAP		0	0	2	0	0	2	0.029
LOWER GRANITE TRAP		0	1	10	10	0	21	0.300
OCEAN FISHERIES		0	0	0	0	0	0	0.000
RIVER SPORT		0	0	0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0	0	0.000
HATCHERIES								
PAHSIMEROI H.		0	0	1	0	0	1	0.014
SOUTH FORK SALMON TRAP		0	0	4	1	0	5	0.071
IMNAHA RIVER TRAP		0	0	2	0	0	2	0.029
STREAM SURVEY		0	0	0	1	0	1	0.014
TOTALS		0	1	19	12	0	32	0.457
PERCENT OF RECOVERY	%	0.0	3.1	59.4	37.5	0.0		

Appendix Table 1.6.--Recoveries of adult spring chinook salmon transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam from 14 to 29 May 1990.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9005F

1990 L.GRANITE TRANS BARGE BELOW BONNEVILLE
SPRING CHINOOK

Brands Used: RAY 3
Wire Codes Used: 232434

NUMBER RELEASED: 7000

RECOVERY AREA		YEAR OF RETURN 1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS								
LOWER GRANITE TRAP		0	3	19	35	0	57	0.814
OCEAN FISHERIES		0	0	0	0	0	0	0.000
RIVER SPORT		0	0	0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0	0	0.000
HATCHERIES								
HELLS CANYON (OXBOW) H.		0	0	1	0	0	1	0.014
SAWTOOTH H. AND TRAP		0	0	1	0	0	1	0.014
SOUTH FORK SALMON TRAP		0	6	13	2	0	21	0.300
STREAM SURVEY		0	0	0	1	0	1	0.014
OTHER		0	0	0	1	0	1	0.014
TOTALS		0	9	34	39	0	82	1.171
PERCENT OF RECOVERY	%	0.0	11.0	41.5	47.6	0.0		

Appendix Table 1.7.--Recoveries of adult spring chinook salmon transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam from 29 May to 8 June 1990.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9006G

1990 L.GRANITE TRANS BARGE BELOW BONNEVILLE

SPRING CHINOOK

Brands Used: RAV 4
Wire Codes Used: 232435

NUMBER RELEASED: 2708

RECOVERY AREA		YEAR OF RETURN 1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS								
LOWER GRANITE TRAP		0	0	9	26	0	35	1.292
OCEAN FISHERIES								
WASHINGTON		0	0	1	0	0	1	0.037
RIVER SPORT		0	0	0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0	0	0.000
HATCHERIES								
SOUTH FORK SALMON TRAP		0	0	2	0	0	2	0.074
STREAM SURVEY		0	0	0	2	0	2	0.074
TOTALS		0	0	12	28	0	40	1.477
PERCENT OF RECOVERY	%	0.0	0.0	30.0	70.0	0.0		

Appendix Table 2.0.--Summary of all recoveries of adult steelhead released as juveniles below Little Goose Dam in 1989.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8909A 8909B 8909C 8909D 8909E 8909F

1989 L.GRANITE TRANS CONTROL BELOW L.GOOSE

STEELHEAD

Brands Used: LA3 1 LA3 2 LA3 3 LA3 4 LA2 1 LA2 2
Wire Codes Used: 232343 232345 232346 232347 232353 232355

NUMBER RELEASED: 42259

RECOVERY AREA	1989	YEAR OF RETURN 1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS								
BONNEVILLE TRAP	0	1	0	0	0	0	1	0.002
LOWER GRANITE TRAP	0	33	72	4	0	0	109	0.258
OCEAN FISHERIES	0	0	0	0	0	0	0	0.000
RIVER SPORT								
COLUMBIA R. BELOW SNAKE R.	0	0	1	0	0	0	1	0.002
COLUMBIA R. ABOVE SNAKE R.	0	0	0	1	0	0	1	0.002
SNAKE R.	0	8	7	0	0	0	15	0.035
CLEARWATER R.	0	1	13	1	0	0	15	0.035
OTHER RIVERS	0	0	1	0	0	0	1	0.002
RIVER COMMERCIAL	0	0	0	0	0	0	0	0.000
INDIAN FISHERIES								
FALL INDIAN NET	0	2	5	1	0	0	8	0.019
HATCHERIES								
DWORSHAK H.	0	1	3	0	0	0	4	0.009
PAHSIMEROI H.	0	1	0	0	0	0	1	0.002
RAPID RIVER H.	0	0	1	0	0	0	1	0.002
HELLS CANYON (OXBOW) H.	0	1	2	0	0	0	3	0.007
WALLOWA H.	0	2	1	0	0	0	3	0.007
STREAM SURVEY	0	0	0	0	0	0	0	0.000
OTHER	0	0	1	0	0	0	1	0.002
TOTALS	0	50	107	7	0	0	164	0.388
PERCENT OF RECOVERY %	0.0	30.5	65.2	4.3	0.0	0.0		

Appendix Table 2.1.--Recoveries of adult steelhead released as juveniles below Little Goose Dam from 21 April to 2 May 1989.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8909A

1989 L.GRANITE TRANS CONTROL BELOW L.GOOSE

STEELHEAD

Brands Used: LA3 1
Wire Codes Used: 232343

NUMBER RELEASED: 7003

RECOVERY AREA		YEAR OF RETURN							
		1989	1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
LOWER GRANITE TRAP		0	16	27	3	0	0	46	0.657
OCEAN FISHERIES		0	0	0	0	0	0	0	0.000
RIVER SPORT									
SNAKE R.		0	5	2	0	0	0	7	0.100
CLEARWATER R.		0	0	1	1	0	0	2	0.029
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES									
FALL INDIAN NET		0	1	2	0	0	0	3	0.043
HATCHERIES									
WALLOWA H.		0	1	0	0	0	0	1	0.014
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	23	32	4	0	0	59	0.842
PERCENT OF RECOVERY	%	0.0	39.0	54.2	6.8	0.0	0.0		

Appendix Table 2.2.--Recoveries of adult steelhead released as juveniles below Little Goose Dam from 4 to 6 May 1989.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8909B

1989 L.GRANITE TRANS CONTROL BELOW L.GOOSE
STEELHEAD

Brands Used: LA3 2
Wire Codes Used: 232345

NUMBER RELEASED: 7049

RECOVERY AREA		1989	YEAR OF RETURN 1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
LOWER GRANITE TRAP		0	10	21	0	0	0	31	0.440
OCEAN FISHERIES		0	0	0	0	0	0	0	0.000
RIVER SPORT									
SNAKE R.		0	2	4	0	0	0	6	0.085
CLEARWATER R.		0	1	3	0	0	0	4	0.057
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES									
FALL INDIAN NET		0	0	1	1	0	0	2	0.028
HATCHERIES									
DWORSHAK H.		0	1	1	0	0	0	2	0.028
PAHSIMEROI H.		0	1	0	0	0	0	1	0.014
RAPID RIVER H.		0	0	1	0	0	0	1	0.014
HELLS CANYON (OXBOW) H.		0	0	1	0	0	0	1	0.014
STREAM SURVEY		0	0	0	0	0	0	0	0.000
OTHER		0	0	1	0	0	0	1	0.014
TOTALS		0	15	33	1	0	0	49	0.695
PERCENT OF RECOVERY	%	0.0	30.6	67.3	2.0	0.0	0.0		

Appendix Table 2.3.--Recoveries of adult steelhead released as juveniles below Little Goose Dam from 9 to 11 May 1989.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8909C

1989 L.GRANITE TRANS CONTROL BELOW L.GOOSE

STEELHEAD

Brands Used: LA3 3
Wire Codes Used: 232346

NUMBER RELEASED: 7088

RECOVERY AREA		1989	YEAR OF RETURN 1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	1	0	0	0	0	1	0.014
LOWER GRANITE TRAP		0	4	11	1	0	0	16	0.226
OCEAN FISHERIES		0	0	0	0	0	0	0	0.000
RIVER SPORT									
COLUMBIA R. BELOW SNAKE R.		0	0	1	0	0	0	1	0.014
SNAKE R.		0	0	1	0	0	0	1	0.014
CLEARWATER R.		0	0	8	0	0	0	8	0.113
OTHER RIVERS		0	0	1	0	0	0	1	0.014
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES									
FALL INDIAN NET		0	1	1	0	0	0	2	0.028
HATCHERIES									
DWORSHAK H.		0	0	2	0	0	0	2	0.028
HELLS CANYON (OXBOW) H.		0	1	1	0	0	0	2	0.028
WALLOWA H.		0	1	1	0	0	0	2	0.028
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	8	27	1	0	0	36	0.508
PERCENT OF RECOVERY	%	0.0	22.2	75.0	2.8	0.0	0.0		

Appendix Table 2.4.--Recoveries of adult steelhead released as juveniles below Little Goose Dam from 13 to 16 May 1989.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8909D

1989 L.GRANITE TRANS CONTROL BELOW L.GOOSE

STEELHEAD

Brands Used: LA3 4
Wire Codes Used: 232347

NUMBER RELEASED: 7000

RECOVERY AREA		YEAR OF RETURN 1989	1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
LOWER GRANITE TRAP		0	2	9	0	0	0	11	0.157
OCEAN FISHERIES		0	0	0	0	0	0	0	0.000
RIVER SPORT									
SNAKE R.		0	1	0	0	0	0	1	0.014
CLEARWATER R.		0	0	1	0	0	0	1	0.014
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES									
FALL INDIAN NET		0	0	1	0	0	0	1	0.014
HATCHERIES		0	0	0	0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	3	11	0	0	0	14	0.200
PERCENT OF RECOVERY	%	0.0	21.4	78.6	0.0	0.0	0.0		

Appendix Table 2.5.--Recoveries of adult steelhead released as juveniles below Little Goose Dam from 18 to 20 May 1989.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8909E

1989 L.GRANITE TRANS CONTROL BELOW L.GOOSE

STEELHEAD

Brands Used: LA2 1
Wire Codes Used: 232353

NUMBER RELEASED: 7005

RECOVERY AREA		YEAR OF RETURN						
	1989	1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS								
LOWER GRANITE TRAP	0	1	3	0	0	0	4	0.057
OCEAN FISHERIES	0	0	0	0	0	0	0	0.000
RIVER SPORT								
COLUMBIA R. ABOVE SNAKE R.	0	0	0	1	0	0	1	0.014
RIVER COMMERCIAL	0	0	0	0	0	0	0	0.000
INDIAN FISHERIES	0	0	0	0	0	0	0	0.000
HATCHERIES	0	0	0	0	0	0	0	0.000
STREAM SURVEY	0	0	0	0	0	0	0	0.000
TOTALS	0	1	3	1	0	0	5	0.071
PERCENT OF RECOVERY %	0.0	20.0	60.0	20.0	0.0	0.0		

Appendix Table 2.6.--Recoveries of adult steelhead released as juveniles below Little Goose Dam from 22 to 24 May 1989.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8909F

1989 L.GRANITE TRANS CONTROL BELOW L.GOOSE

STEELHEAD

Brands Used: LA2 2
Wire Codes Used: 232355

NUMBER RELEASED: 7114

RECOVERY AREA		YEAR OF RETURN 1989	1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
LOWER GRANITE TRAP		0	0	1	0	0	0	1	0.014
OCEAN FISHERIES		0	0	0	0	0	0	0	0.000
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0	0	0	0.000
HATCHERIES		0	0	0	0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	0	1	0	0	0	1	0.014
PERCENT OF RECOVERY	%	0.0	0.0	100.0	0.0	0.0	0.0		

Appendix Table 3.0.--Summary of all recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam in 1989.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8910A 8910B 8910C 8910D 8910E 8910F

1989 L.GRANITE TRANS BARGE BELOW BONNEVILLE

STEELHEAD

Brands Used: RASU1 RASU2 RASU3 RASU4 RAF 1 RAF 2
Wire Codes Used: 232020 232021 232024 232026 232027 232028

NUMBER RELEASED: 30116

RECOVERY AREA		YEAR OF RETURN 1989	1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
LOWER GRANITE TRAP		0	33	129	1	0	0	163	0.541
OCEAN FISHERIES		0	0	0	0	0	0	0	0.000
RIVER SPORT									
COLUMBIA R. BELOW SNAKE R.		0	0	3	0	0	0	3	0.010
SNAKE R.		0	4	22	0	0	0	26	0.086
CLEARWATER R.		0	1	12	1	0	0	14	0.046
OTHER RIVERS		0	0	1	0	0	0	1	0.003
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES									
FALL INDIAN NET		0	2	14	1	0	0	17	0.056
WINTER INDIAN NET		0	0	1	0	0	0	1	0.003
CLEARWATER INDIAN		0	0	2	0	0	0	2	0.007
HATCHERIES									
DWORSHAK H.		0	0	10	0	0	0	10	0.033
PAHSIMEROI H.		0	1	1	0	0	0	2	0.007
HELLS CANYON (OXBOW) H.		0	2	0	0	0	0	2	0.007
DESCHUTES R. HATCHERIES		0	1	0	0	0	0	1	0.003
WALLOWA H.		0	2	2	0	0	0	4	0.013
BIG SHEEP CR. TRAP		0	1	0	0	0	0	1	0.003
BIG CANYON TRAP		0	1	0	0	0	0	1	0.003
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	48	197	3	0	0	248	0.823
PERCENT OF RECOVERY	%	0.0	19.4	79.4	1.2	0.0	0.0		

Appendix Table 3.1.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam from 25 April to 3 May 1989.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8910A

1989 L.GRANITE TRANS BARGE BELOW BONNEVILLE
STEELHEAD

Brands Used: RASU1
Wire Codes Used: 232020

NUMBER RELEASED: 5000

RECOVERY AREA	YEAR OF RETURN 1989	1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS								
LOWER GRANITE TRAP	0	16	36	0	0	0	52	1.040
OCEAN FISHERIES	0	0	0	0	0	0	0	0.000
RIVER SPORT								
COLUMBIA R. BELOW SNAKE R.	0	0	1	0	0	0	1	0.020
SNAKE R.	0	3	4	0	0	0	7	0.140
CLEARWATER R.	0	0	1	0	0	0	1	0.020
RIVER COMMERCIAL	0	0	0	0	0	0	0	0.000
INDIAN FISHERIES								
FALL INDIAN NET	0	0	3	0	0	0	3	0.060
WINTER INDIAN NET	0	0	1	0	0	0	1	0.020
HATCHERIES								
DWORSHAK H.	0	0	1	0	0	0	1	0.020
STREAM SURVEY	0	0	0	0	0	0	0	0.000
TOTALS	0	19	47	0	0	0	66	1.320
PERCENT OF RECOVERY %	0.0	28.8	71.2	0.0	0.0	0.0		

Appendix Table 3.2.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam from 3 to 5 May 1989.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8910B

1989 L.GRANITE TRANS BARGE BELOW BONNEVILLE

STEELHEAD

Brands Used: RASU2
Wire Codes Used: 232021

NUMBER RELEASED: 5020

RECOVERY AREA		1989	YEAR OF RETURN 1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
LOWER GRANITE TRAP		0	5	37	0	0	0	42	0.837
OCEAN FISHERIES		0	0	0	0	0	0	0	0.000
RIVER SPORT									
SNAKE R.		0	0	7	0	0	0	7	0.139
CLEARWATER R.		0	0	7	0	0	0	7	0.139
OTHER RIVERS		0	0	1	0	0	0	1	0.020
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES									
FALL INDIAN NET		0	1	6	1	0	0	8	0.159
CLEARWATER INDIAN		0	0	1	0	0	0	1	0.020
HATCHERIES									
DWORSHAK H.		0	0	2	0	0	0	2	0.040
HELLS CANYON (OXBOW) H.		0	1	0	0	0	0	1	0.020
BIG SHEEP CR. TRAP		0	1	0	0	0	0	1	0.020
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	8	61	1	0	0	70	1.394
PERCENT OF RECOVERY	%	0.0	11.4	87.1	1.4	0.0	0.0		

Appendix Table 3.3.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam from 8 to 10 May 1989.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8910C

1989 L.GRANITE TRANS BARGE BELOW BONNEVILLE

STEELHEAD

Brands Used: RASU3
Wire Codes Used: 232024

NUMBER RELEASED: 5034

RECOVERY AREA		1989	YEAR OF RETURN 1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
LOWER GRANITE TRAP		0	5	31	0	0	0	36	0.715
OCEAN FISHERIES		0	0	0	0	0	0	0	0.000
RIVER SPORT									
COLUMBIA R. BELOW SNAKE R.		0	0	1	0	0	0	1	0.020
SNAKE R.		0	1	3	0	0	0	4	0.079
CLEARWATER R.		0	1	3	0	0	0	4	0.079
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES									
FALL INDIAN NET		0	1	4	0	0	0	5	0.099
CLEARWATER INDIAN		0	0	1	0	0	0	1	0.020
HATCHERIES									
DWORSHAK H.		0	0	5	0	0	0	5	0.099
PAHSIMEROI H.		0	1	1	0	0	0	2	0.040
HELLS CANYON (OXBOW) H.		0	1	0	0	0	0	1	0.020
WALLOWA H.		0	0	1	0	0	0	1	0.020
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	10	50	0	0	0	60	1.192
PERCENT OF RECOVERY	%	0.0	16.7	83.3	0.0	0.0	0.0		

Appendix Table 3.4.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam from 12 to 15 May 1989.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8910D

1989 L.GRANITE TRANS BARGE BELOW BONNEVILLE
STEELHEAD

Brands Used: RAS04
Wire Codes Used: 232026

NUMBER RELEASED: 5024

RECOVERY AREA		YEAR OF RETURN 1989	1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
LOWER GRANITE TRAP		0	4	13	0	0	0	17	0.338
OCEAN FISHERIES		0	0	0	0	0	0	0	0.000
RIVER SPORT									
SNAKE R.		0	0	4	0	0	0	4	0.080
CLEARWATER R.		0	0	1	0	0	0	1	0.020
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES									
FALL INDIAN NET		0	0	1	0	0	0	1	0.020
HATCHERIES									
DWORSHAK H.		0	0	2	0	0	0	2	0.040
DESCHUTES R. HATCHERIES		0	1	0	0	0	0	1	0.020
WALLOWA H.		0	1	1	0	0	0	2	0.040
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	6	22	0	0	0	28	0.557
PERCENT OF RECOVERY	%	0.0	21.4	78.6	0.0	0.0	0.0		

Appendix Table 3.5.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam from 17 to 19 May 1989.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8910E

1989 L.GRANITE TRANS BARGE BELOW BONNEVILLE

STEELHEAD

Brands Used: RAF 1
Wire Codes Used: 232027

NUMBER RELEASED: 5014

RECOVERY AREA		YEAR OF RETURN							
	1989	1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
LOWER GRANITE TRAP	0	3	9	0	0	0	12	0.239
OCEAN FISHERIES	0	0	0	0	0	0	0	0.000
RIVER SPORT								
COLUMBIA R. BELOW SNAKE R.	0	0	1	0	0	0	1	0.020
SNAKE R.	0	0	4	0	0	0	4	0.080
RIVER COMMERCIAL	0	0	0	0	0	0	0	0.000
INDIAN FISHERIES	0	0	0	0	0	0	0	0.000
HATCHERIES								
WALLOWA H.	0	1	0	0	0	0	1	0.020
BIG CANYON TRAP	0	1	0	0	0	0	1	0.020
STREAM SURVEY	0	0	0	0	0	0	0	0.000
TOTALS	0	5	14	0	0	0	19	0.379
PERCENT OF RECOVERY %	0.0	26.3	73.7	0.0	0.0	0.0		

Appendix Table 3.6.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam from 23 to 25 May 1989.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8910F

1989 L.GRANITE TRANS BARGE BELOW BONNEVILLE

STEELHEAD

Brands Used: RAF 2
Wire Codes Used: 232028

NUMBER RELEASED: 5024

RECOVERY AREA		YEAR OF RETURN 1989	1990	1991	1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
LOWER GRANITE TRAP		0	0	3	1	0	0	4	0.080
OCEAN FISHERIES		0	0	0	0	0	0	0	0.000
RIVER SPORT									
CLEARWATER R.		0	0	0	1	0	0	1	0.020
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0	0	0	0.000
HATCHERIES		0	0	0	0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	0	3	2	0	0	5	0.100
PERCENT OF RECOVERY	%	0.0	0.0	60.0	40.0	0.0	0.0		

Appendix Table 4.0.--Summary of all recoveries of adult fall chinook salmon released as juveniles below McNary Dam in 1987.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8708A 8708B 8708C 8708D 8708E 8708F 8708G

1987 MCNARY TRANS CONTROL BELOW MCNARY

FALL CHINOOK

Brands Used: LA1X1 LA1X3 LA2C1 LA2C3 LA2J1 LA2J3 LA1J1
Wire Codes Used: 232002 232003 232004 232005 232006 232007 231957

NUMBER RELEASED: 68291

RECOVERY AREA		YEAR OF RETURN						
	1987	1988	1989	1990	1991	1992	TOTAL	% RETURN
RIVER SYSTEM TRAPS								
BONNEVILLE TRAP	0	8	0	17	5	0	30	0.044
OCEAN FISHERIES								
ALASKA	0	0	1	8	3	0	12	0.018
BRITISH COLUMBIA	0	1	1	8	2	0	12	0.018
WASHINGTON	0	1	0	1	0	0	2	0.003
OREGON	0	2	0	0	0	0	2	0.003
OTHER	0	0	0	0	1	0	1	0.001
RIVER SPORT								
COLUMBIA R. BELOW SNAKE R.	0	1	0	0	0	0	1	0.001
COLUMBIA R. ABOVE SNAKE R.	0	0	0	1	0	0	1	0.001
RIVER COMMERCIAL								
COMMERCIAL NET	0	0	0	2	6	0	8	0.012
INDIAN FISHERIES								
INDIAN GENERAL	0	0	0	3	0	0	3	0.004
FALL INDIAN NET	0	0	1	11	5	0	17	0.025
HATCHERIES								
LYONS FERRY H.	0	0	0	1	0	0	1	0.001
WELLS H.	0	0	0	0	1	0	1	0.001
PRIEST RAPIDS H.	0	4	4	5	3	0	16	0.023
STREAM SURVEY								
GENERAL	0	0	0	0	4	0	4	0.006
TOTALS	0	17	7	57	30	0	111	0.163
PERCENT OF RECOVERY %	0.0	15.3	6.3	51.4	27.0	0.0		

Appendix Table 4.1.--Recoveries of adult fall chinook salmon released as juveniles below McNary Dam from 18 to 23 June 1987.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8708A

1987 MCNARY TRANS CONTROL BELOW MCNARY

FALL CHINOOK

Brands Used: LAIX1
Wire Codes Used: 232002

NUMBER RELEASED: 10000

RECOVERY AREA		1987	1988	1989	1990	1991	1992	TOTAL	% RETURN
			YEAR OF RETURN						
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	0	0	2	0	0	2	0.020
OCEAN FISHERIES									
ALASKA		0	0	0	1	0	0	1	0.010
BRITISH COLUMBIA		0	0	1	0	1	0	2	0.020
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES									
FALL INDIAN NET		0	0	0	1	0	0	1	0.010
HATCHERIES									
PRIEST RAPIDS H.		0	0	1	2	1	0	4	0.040
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	0	2	6	2	0	10	0.100
PERCENT OF RECOVERY	%	0.0	0.0	20.0	60.0	20.0	0.0		

Appendix Table 4.2.--Recoveries of adult fall chinook salmon released as juveniles below McNary Dam from 23 to 25 June 1987.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8708B

1987 MCNARY TRANS CONTROL BELOW MCNARY

FALL CHINOOK

Brands Used: LAIX3
Wire Codes Used: 232003

NUMBER RELEASED: 9146

RECOVERY AREA		1987	YEAR OF RETURN 1988	1989	1990	1991	1992	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	0	0	2	1	0	3	0.033
OCEAN FISHERIES									
BRITISH COLUMBIA		0	0	0	1	0	0	1	0.011
WASHINGTON		0	1	0	0	0	0	1	0.011
OTHER		0	0	0	0	1	0	1	0.011
RIVER SPORT									
COLUMBIA R. ABOVE SNAKE R.		0	0	0	1	0	0	1	0.011
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES									
INDIAN GENERAL		0	0	0	1	0	0	1	0.011
FALL INDIAN NET		0	0	0	2	0	0	2	0.022
HATCHERIES									
PRIEST RAPIDS H.		0	2	2	0	0	0	4	0.044
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	3	2	7	2	0	14	0.153
PERCENT OF RECOVERY	%	0.0	21.4	14.3	50.0	14.3	0.0		

Appendix Table 4.3.--Recoveries of adult fall chinook salmon released as juveniles below McNary Dam from 25 June to 1 July 1987.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8708C

1987 MCNARY TRANS CONTROL BELOW MCNARY

FALL CHINOOK

Brands Used: LA2C1
Wire Codes Used: 232004

NUMBER RELEASED: 9753

RECOVERY AREA		1987	1988	1989	1990	1991	1992	TOTAL	% RETURN
			YEAR OF RETURN						
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	0	0	1	0	0	1	0.010
OCEAN FISHERIES									
ALASKA		0	0	0	1	1	0	2	0.021
BRITISH COLUMBIA		0	0	0	1	0	0	1	0.010
WASHINGTON		0	0	0	1	0	0	1	0.010
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES									
INDIAN GENERAL		0	0	0	1	0	0	1	0.010
HATCHERIES									
PRIEST RAPIDS H.		0	0	1	0	0	0	1	0.010
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	0	1	5	1	0	7	0.072
PERCENT OF RECOVERY	%	0.0	0.0	14.3	71.4	14.3	0.0		

Appendix Table 4.4.--Recoveries of adult fall chinook salmon released as juveniles below McNary Dam from 1 to 8 July 1987.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8708D

1987 MCNARY TRANS CONTROL BELOW MCNARY

FALL CHINOOK

Brands Used: LA2C3
Wire Codes Used: 232005

NUMBER RELEASED: 10000

RECOVERY AREA	1987	YEAR OF RETURN 1988	1989	1990	1991	1992	TOTAL	% RETURN
RIVER SYSTEM TRAPS								
BONNEVILLE TRAP	0	2	0	3	0	0	5	0.050
OCEAN FISHERIES								
ALASKA	0	0	0	1	1	0	2	0.020
BRITISH COLUMBIA	0	1	0	2	0	0	3	0.030
OREGON	0	1	0	0	0	0	1	0.010
RIVER SPORT								
COLUMBIA R. BELOW SNAKE R.	0	1	0	0	0	0	1	0.010
RIVER COMMERCIAL								
COMMERCIAL NET	0	0	0	1	3	0	4	0.040
INDIAN FISHERIES								
INDIAN GENERAL	0	0	0	1	0	0	1	0.010
FALL INDIAN NET	0	0	1	3	1	0	5	0.050
HATCHERIES	0	0	0	0	0	0	0	0.000
STREAM SURVEY	0	0	0	0	0	0	0	0.000
TOTALS	0	5	1	11	5	0	22	0.220
PERCENT OF RECOVERY %	0.0	22.7	4.5	50.0	22.7	0.0		

Appendix Table 4.5.--Recoveries of adult fall chinook salmon released as juveniles below McNary Dam from 8 to 14 July 1987.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8708E

1987 MCNARY TRANS CONTROL BELOW MCNARY

FALL CHINOOK

Brands Used: LA2J1
Wire Codes Used: 232006

NUMBER RELEASED: 10000

RECOVERY AREA		1987	1988	1989	1990	1991	1992	TOTAL	% RETURN
			YEAR OF RETURN						
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	1	0	4	2	0	7	0.070
OCEAN FISHERIES									
ALASKA		0	0	1	2	0	0	3	0.030
BRITISH COLUMBIA		0	0	0	1	0	0	1	0.010
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL									
COMMERCIAL NET		0	0	0	0	2	0	2	0.020
INDIAN FISHERIES									
FALL INDIAN NET		0	0	0	2	1	0	3	0.030
HATCHERIES									
PRIEST RAPIDS H.		0	0	0	1	1	0	2	0.020
STREAM SURVEY									
GENERAL		0	0	0	0	1	0	1	0.010
TOTALS		0	1	1	10	7	0	19	0.190
PERCENT OF RECOVERY	%	0.0	5.3	5.3	52.6	36.8	0.0		

Appendix Table 4.6.--Recoveries of adult fall chinook salmon released as juveniles below McNary Dam from 15 to 30 July 1987.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8708F

1987 MCNARY TRANS CONTROL BELOW MCNARY

FALL CHINOOK

Brands Used: LA2J3
Wire Codes Used: 232007

NUMBER RELEASED: 9392

RECOVERY AREA		1987	YEAR OF RETURN 1988	1989	1990	1991	1992	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	0	0	3	1	0	4	0.043
OCEAN FISHERIES									
ALASKA		0	0	0	1	1	0	2	0.021
BRITISH COLUMBIA		0	0	0	2	1	0	3	0.032
OREGON		0	1	0	0	0	0	1	0.011
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES									
FALL INDIAN NET		0	0	0	3	1	0	4	0.043
HATCHERIES									
WELLS H.		0	0	0	0	1	0	1	0.011
PRIEST RAPIDS H.		0	0	0	1	0	0	1	0.011
STREAM SURVEY									
GENERAL		0	0	0	0	1	0	1	0.011
TOTALS		0	1	0	10	6	0	17	0.181
PERCENT OF RECOVERY	%	0.0	5.9	0.0	58.8	35.3	0.0		

Appendix Table 4.7.--Recoveries of adult fall chinook salmon released as juveniles below McNary Dam from 30 July to 13 August 1987.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 87086

1987 MCNARY TRANS CONTROL BELOW MCNARY

FALL CHINOOK

Brands Used: LAIJ1
Wire Codes Used: 231957

NUMBER RELEASED: 10000

RECOVERY AREA		1987	YEAR OF RETURN 1988	1989	1990	1991	1992	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	5	0	2	1	0	8	0.080
OCEAN FISHERIES									
ALASKA		0	0	0	2	0	0	2	0.020
BRITISH COLUMBIA		0	0	0	1	0	0	1	0.010
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL									
COMMERCIAL NET		0	0	0	1	1	0	2	0.020
INDIAN FISHERIES									
FALL INDIAN NET		0	0	0	0	2	0	2	0.020
HATCHERIES									
LYONS FERRY H.		0	0	0	1	0	0	1	0.010
PRIEST RAPIDS H.		0	2	0	1	1	0	4	0.040
STREAM SURVEY									
GENERAL		0	0	0	0	2	0	2	0.020
TOTALS		0	7	0	8	7	0	22	0.220
PERCENT OF RECOVERY	%	0.0	31.8	0.0	36.4	31.8	0.0		

Appendix Table 5.0.--Summary of all recoveries of adult fall chinook salmon transported as juveniles by barge from McNary Dam to below Bonneville Dam in 1987.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8709A 8709B 8709C 8709D 8709E 8709F 8709G

1987 MCNARY TRANS TEST/BARGE BELOW BONNEVILLE

FALL CHINOOK

Brands Used: RA141 RA143 RAIR1 RAIR3 RAIS1 RAIS3 RAIK1
Wire Codes Used: 231959 231960 231961 231962 231963 232001 232016

NUMBER RELEASED: 68376

RECOVERY AREA	1987	YEAR OF RETURN 1988	1989	1990	1991	1992	TOTAL	% RETURN
RIVER SYSTEM TRAPS								
BONNEVILLE TRAP	0	24	0	38	23	1	86	0.126
PRIEST RAPIDS TRAP	0	0	0	0	1	0	1	0.001
OCEAN FISHERIES								
ALASKA	0	1	3	27	22	2	55	0.080
BRITISH COLUMBIA	0	2	7	36	23	1	69	0.101
WASHINGTON	0	4	1	1	1	0	7	0.010
OREGON	0	1	1	1	0	0	3	0.004
RIVER SPORT								
COLUMBIA R. BELOW SNAKE R.	0	0	0	0	1	0	1	0.001
COLUMBIA R. ABOVE SNAKE R.	0	0	0	2	4	0	6	0.009
WENATCHEE R.	0	1	1	0	0	0	2	0.003
RIVER COMMERCIAL								
COMMERCIAL NET	0	0	5	10	17	0	32	0.047
INDIAN FISHERIES								
INDIAN GENERAL	0	0	0	3	0	1	4	0.006
FALL INDIAN NET	0	0	7	46	31	1	85	0.124
HATCHERIES								
LYONS FERRY H.	0	0	1	0	0	0	1	0.001
WELLS H.	0	0	1	0	1	0	2	0.003
PRIEST RAPIDS H.	0	6	6	7	3	1	23	0.034
SPRING CREEK H.	0	0	0	1	0	0	1	0.001
STREAM SURVEY								
GENERAL	0	0	2	4	9	0	15	0.022
OTHER	0	0	0	1	1	0	2	0.003
TOTALS	0	39	35	177	137	7	395	0.578
PERCENT OF RECOVERY %	0.0	9.9	8.9	44.8	34.7	1.8		

Appendix Table 5.1.--Recoveries of adult fall chinook salmon transported as juveniles by barge from McNary Dam to below Bonneville Dam from 18 to 23 June 1987.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8709A

1987 MCNARY TRANS TEST/BARGE BELOW BONNEVILLE

FALL CHINOOK

Brands Used: RA141
Wire Codes Used: 231959

NUMBER RELEASED: 10003

RECOVERY AREA		1987	YEAR OF RETURN 1988	1989	1990	1991	1992	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	1	0	6	0	0	7	0.070
OCEAN FISHERIES									
ALASKA		0	0	1	3	2	1	7	0.070
BRITISH COLUMBIA		0	1	2	10	3	0	16	0.160
WASHINGTON		0	1	0	0	0	0	1	0.010
RIVER SPORT									
COLUMBIA R. ABOVE SNAKE R.		0	0	0	2	0	0	2	0.020
WENATCHEE R.		0	1	1	0	0	0	2	0.020
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES									
FALL INDIAN NET		0	0	3	9	2	0	14	0.140
HATCHERIES									
PRIEST RAPIDS H.		0	1	2	2	1	1	7	0.070
STREAM SURVEY									
GENERAL		0	0	0	1	2	0	3	0.030
TOTALS		0	5	9	33	10	2	59	0.590
PERCENT OF RECOVERY	%	0.0	8.5	15.3	55.9	16.9	3.4		

Appendix Table 5.2.--Recoveries of adult fall chinook salmon transported as juveniles by barge from McNary Dam to below Bonneville Dam from 23 to 25 June 1987.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8709B

1987 MCNARY TRANS TEST/BARGE BELOW BONNEVILLE

FALL CHINOOK

Brands Used: RA143
Wire Codes Used: 231960

NUMBER RELEASED: 9146

RECOVERY AREA		1987	YEAR OF RETURN 1988	1989	1990	1991	1992	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	0	0	3	3	0	6	0.066
OCEAN FISHERIES									
ALASKA		0	0	0	3	1	0	4	0.044
BRITISH COLUMBIA		0	0	1	2	1	0	4	0.044
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL									
COMMERCIAL NET		0	0	1	0	0	0	1	0.011
INDIAN FISHERIES									
FALL INDIAN NET		0	0	0	1	1	0	2	0.022
HATCHERIES									
LYONS FERRY H.		0	0	1	0	0	0	1	0.011
STREAM SURVEY		0	0	0	0	0	0	0	0.000
OTHER		0	0	0	1	0	0	1	0.011
TOTALS		0	0	3	10	6	0	19	0.208
PERCENT OF RECOVERY	%	0.0	0.0	15.8	52.6	31.6	0.0		

Appendix Table 5.3.--Recoveries of adult fall chinook salmon transported as juveniles by barge from McNary Dam to below Bonneville Dam from 25 June to 1 July 1987.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8709C

1987 MCNARY TRANS TEST/BARGE BELOW BONNEVILLE
FALL CHINOOK

Brands Used: RAIR1
Wire Codes Used: 231961

NUMBER RELEASED: 9834

RECOVERY AREA	1987	YEAR OF RETURN 1988	1989	1990	1991	1992	TOTAL	% RETURN
RIVER SYSTEM TRAPS								
BONNEVILLE TRAP	0	1	0	3	4	0	8	0.081
OCEAN FISHERIES								
ALASKA	0	0	1	3	1	0	5	0.051
BRITISH COLUMBIA	0	0	1	2	3	0	6	0.061
WASHINGTON	0	0	0	0	1	0	1	0.010
RIVER SPORT								
COLUMBIA R. ABOVE SNAKE R.	0	0	0	0	1	0	1	0.010
RIVER COMMERCIAL								
COMMERCIAL NET	0	0	2	1	2	0	5	0.051
INDIAN FISHERIES								
INDIAN GENERAL	0	0	0	1	0	0	1	0.010
FALL INDIAN NET	0	0	0	2	3	0	5	0.051
HATCHERIES								
PRIEST RAPIDS H.	0	0	2	0	0	0	2	0.020
STREAM SURVEY	0	0	0	0	0	0	0	0.000
TOTALS	0	1	6	12	15	0	34	0.346
PERCENT OF RECOVERY %	0.0	2.9	17.6	35.3	44.1	0.0		

Appendix Table 5.4.--Recoveries of adult fall chinook salmon transported as juveniles by barge from McNary Dam to below Bonneville Dam from 1 to 8 July 1987.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8709D

1987 MCNARY TRANS TEST/BARGE BELOW BONNEVILLE

FALL CHINOOK

Brands Used: RAIR3
Wire Codes Used: 231962

NUMBER RELEASED: 10001

RECOVERY AREA	1987	YEAR OF RETURN 1988	1989	1990	1991	1992	TOTAL	% RETURN
RIVER SYSTEM TRAPS								
BONNEVILLE TRAP	0	2	0	1	2	0	5	0.050
OCEAN FISHERIES								
ALASKA	0	0	0	1	2	0	3	0.030
BRITISH COLUMBIA	0	0	0	2	3	0	5	0.050
OREGON	0	0	0	1	0	0	1	0.010
RIVER SPORT								
COLUMBIA R. ABOVE SNAKE R.	0	0	0	0	3	0	3	0.030
RIVER COMMERCIAL								
COMMERCIAL NET	0	0	0	1	3	0	4	0.040
INDIAN FISHERIES								
FALL INDIAN NET	0	0	1	3	1	0	5	0.050
HATCHERIES								
PRIEST RAPIDS H.	0	1	2	2	0	0	5	0.050
STREAM SURVEY	0	0	0	0	0	0	0	0.000
TOTALS	0	3	3	11	14	0	31	0.310
PERCENT OF RECOVERY %	0.0	9.7	9.7	35.5	45.2	0.0		

Appendix Table 5.5.--Recoveries of adult fall chinook salmon transported as juveniles by barge from McNary Dam to below Bonneville Dam from 8 to 14 July 1987.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8709E

1987 MCNARY TRANS TEST/BARGE BELOW BONNEVILLE

FALL CHINOOK

Brands Used: RAIS1
Wire Codes Used: 231963

NUMBER RELEASED: 10000

RECOVERY AREA		YEAR OF RETURN 1987	1988	1989	1990	1991	1992	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	4	0	6	1	0	11	0.110
OCEAN FISHERIES									
ALASKA		0	0	0	4	0	0	4	0.040
BRITISH COLUMBIA		0	1	0	2	3	0	6	0.060
OREGON		0	0	1	0	0	0	1	0.010
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL									
COMMERCIAL NET		0	0	0	1	4	0	5	0.050
INDIAN FISHERIES									
FALL INDIAN NET		0	0	0	4	2	0	6	0.060
HATCHERIES									
PRIEST RAPIDS H.		0	0	0	1	0	0	1	0.010
STREAM SURVEY									
GENERAL		0	0	0	0	2	0	2	0.020
TOTALS		0	5	1	18	12	0	36	0.360
PERCENT OF RECOVERY	%	0.0	13.9	2.8	50.0	33.3	0.0		

Appendix Table 5.6.--Recoveries of adult fall chinook salmon transported as juveniles by barge from McNary Dam to below Bonneville Dam from 15 to 30 July 1987.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8709F

1987 MCNARY TRANS TEST/BARGE BELOW BONNEVILLE
FALL CHINOOK

Brands Used: RAIS3
Wire Codes Used: 232001

NUMBER RELEASED: 9392

RECOVERY AREA		1987	1988	1989	1990	1991	1992	TOTAL	% RETURN
			YEAR OF RETURN						
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	5	0	10	6	0	21	0.224
OCEAN FISHERIES									
ALASKA		0	1	1	6	4	0	12	0.128
BRITISH COLUMBIA		0	0	1	7	2	0	10	0.106
WASHINGTON		0	0	1	0	0	0	1	0.011
OREGON		0	1	0	0	0	0	1	0.011
RIVER SPORT									
COLUMBIA R. BELOW SNAKE R.		0	0	0	0	1	0	1	0.011
RIVER COMMERCIAL									
COMMERCIAL NET		0	0	1	1	2	0	4	0.043
INDIAN FISHERIES									
INDIAN GENERAL		0	0	0	1	0	0	1	0.011
FALL INDIAN NET		0	0	1	7	12	1	21	0.224
HATCHERIES									
PRIEST RAPIDS H.		0	1	0	0	0	0	1	0.011
STREAM SURVEY									
GENERAL		0	0	1	1	3	0	5	0.053
OTHER		0	0	0	0	1	0	1	0.011
TOTALS		0	8	6	33	31	1	79	0.841
PERCENT OF RECOVERY	%	0.0	10.1	7.6	41.8	39.2	1.3		

Appendix Table 5.7.--Recoveries of adult fall chinook salmon transported as juveniles by barge from McNary Dam to below Bonneville Dam from 30 July to 14 August 1987.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8709G

1987 MCNARY TRANS TEST/BARGE BELOW BONNEVILLE
FALL CHINOOK

Brands Used: RAIK1
Wire Codes Used: 232016

NUMBER RELEASED: 10000

RECOVERY AREA		1987	1988	1989	1990	1991	1992	TOTAL	% RETURN
			YEAR OF RETURN						
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	11	0	9	7	1	28	0.280
PRIEST RAPIDS TRAP		0	0	0	0	1	0	1	0.010
OCEAN FISHERIES									
ALASKA		0	0	0	7	12	1	20	0.200
BRITISH COLUMBIA		0	0	2	11	8	1	22	0.220
WASHINGTON		0	3	0	1	0	0	4	0.040
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL									
COMMERCIAL NET		0	0	1	6	6	0	13	0.130
INDIAN FISHERIES									
INDIAN GENERAL		0	0	0	1	0	1	2	0.020
FALL INDIAN NET		0	0	2	20	10	0	32	0.320
HATCHERIES									
WELLS H.		0	0	1	0	1	0	2	0.020
PRIEST RAPIDS H.		0	3	0	2	2	0	7	0.070
SPRING CREEK H.		0	0	0	1	0	0	1	0.010
STREAM SURVEY									
GENERAL		0	0	1	2	2	0	5	0.050
TOTALS		0	17	7	60	49	4	137	1.370
PERCENT OF RECOVERY	%	0.0	12.4	5.1	43.8	35.8	2.9		

Appendix Table 6.0.--Summary of all recoveries of adult fall chinook salmon released as juveniles below McNary Dam in 1988.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8804A 8804B 8804C 8804D 8804E 8804F 8804G

1988 MCNARY TRANS CONTROL BELOW MCNARY

FALL CHINOOK

Brands Used: LAIT1 LAIT2 LAIT3 LAIT4 LA2X1 LA2X3 LAIC1
Wire Codes Used: 232246 232247 232248 232249 232250 232048 232049

NUMBER RELEASED: 60010

RECOVERY AREA		1988	1989 (YEAR OF RETURN)	1990	1991	1992	1993	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	0	2	1	1	0	4	0.007
OCEAN FISHERIES									
ALASKA		0	0	0	0	3	0	3	0.005
BRITISH COLUMBIA		0	0	1	0	1	0	2	0.003
OREGON		0	0	1	0	0	0	1	0.002
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL									
COMMERCIAL NET		0	0	1	0	0	0	1	0.002
COL. R. TEST FSHRY (ORE)		0	0	0	0	1	0	1	0.002
INDIAN FISHERIES									
FALL INDIAN NET		0	0	2	1	0	0	3	0.005
HATCHERIES									
PRIEST RAPIDS H.		0	1	0	0	1	0	2	0.003
STREAM SURVEY									
GENERAL		0	0	0	1	0	0	1	0.002
TOTALS		0	1	7	3	7	0	18	0.030
PERCENT OF RECOVERY	%	0.0	5.6	38.9	16.7	38.9	0.0		

Appendix Table 6.1.--Recoveries of adult fall chinook salmon released as juveniles below McNary Dam from 13 to 21 June 1988.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8804A

1988 MCNARY TRANS CONTROL BELOW MCNARY

FALL CHINOOK

Brands Used: LAIT1
Wire Codes Used: 232246

NUMBER RELEASED: 10002

RECOVERY AREA		YEAR OF RETURN 1988	1989	1990	1991	1992	1993	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	0	1	1	0	0	2	0.020
OCEAN FISHERIES									
ALASKA		0	0	0	0	2	0	2	0.020
OREGON		0	0	1	0	0	0	1	0.010
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES									
FALL INDIAN NET		0	0	1	0	0	0	1	0.010
HATCHERIES		0	0	0	0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	0	3	1	2	0	6	0.060
PERCENT OF RECOVERY	%	0.0	0.0	50.0	16.7	33.3	0.0		

Appendix Table 6.2.--Recoveries of adult fall chinook salmon released as juveniles below McNary Dam from 23 to 26 June 1988.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8804C

1988 MCNARY TRANS CONTROL BELOW MCNARY

FALL CHINOOK

Brands Used: LAIT3
Wire Codes Used: 232248

NUMBER RELEASED: 10002

RECOVERY AREA		YEAR OF RETURN 1988	1989	1990	1991	1992	1993	TOTAL	% RETURN
RIVER SYSTEM TRAPS BONNEVILLE TRAP		0	0	1	0	1	0	2	0.020
OCEAN FISHERIES		0	0	0	0	0	0	0	0.000
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES FALL INDIAN NET		0	0	1	0	0	0	1	0.010
HATCHERIES PRIEST RAPIDS H.		0	1	0	0	1	0	2	0.020
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	1	2	0	2	0	5	0.050
PERCENT OF RECOVERY	%	0.0	20.0	40.0	0.0	40.0	0.0		

Appendix Table 6.3.--Recoveries of adult fall chinook salmon released as juveniles below McNary Dam from 27 June to 1 July 1988.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8804D

1988 MCNARY TRANS CONTROL BELOW MCNARY

FALL CHINOOK

Brands Used: LAIT4
Wire Codes Used: 232249

NUMBER RELEASED: 10002

RECOVERY AREA		YEAR OF RETURN 1988	1989	1990	1991	1992	1993	TOTAL	% RETURN
RIVER SYSTEM TRAPS		0	0	0	0	0	0	0	0.000
OCEAN FISHERIES BRITISH COLUMBIA		0	0	1	0	0	0	1	0.010
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0	0	0	0.000
HATCHERIES		0	0	0	0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	0	1	0	0	0	1	0.010
PERCENT OF RECOVERY	%	0.0	0.0	100.0	0.0	0.0	0.0		

Appendix Table 6.4.--Recoveries of adult fall chinook salmon released as juveniles below McNary Dam from 5 to 13 July 1988.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8804E

1988 MCNARY TRANS CONTROL BELOW MCNARY

FALL CHINOOK

Brands Used: LA2X1
Wire Codes Used: 232250

NUMBER RELEASED: 10002

RECOVERY AREA		YEAR OF RETURN 1988	1989	1990	1991	1992	1993	TOTAL	% RETURN
RIVER SYSTEM TRAPS		0	0	0	0	0	0	0	0.000
OCEAN FISHERIES BRITISH COLUMBIA		0	0	0	0	1	0	1	0.010
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES FALL INDIAN NET		0	0	0	1	0	0	1	0.010
HATCHERIES		0	0	0	0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	0	0	1	1	0	2	0.020
PERCENT OF RECOVERY	%	0.0	0.0	0.0	50.0	50.0	0.0		

Appendix Table 6.5.--Recoveries of adult fall chinook salmon released as juveniles below McNary Dam from 13 to 14 July 1988.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8804F

1988 MCNARY TRANS CONTROL BELOW MCNARY

FALL CHINOOK

Brands Used: LA2X3
Wire Codes Used: 232048

NUMBER RELEASED: 5008

RECOVERY AREA		1988	YEAR OF RETURN 1989	1990	1991	1992	1993	TOTAL	% RETURN
RIVER SYSTEM TRAPS		0	0	0	0	0	0	0	0.000
OCEAN FISHERIES ALASKA		0	0	0	0	1	0	1	0.020
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL COMMERCIAL NET		0	0	1	0	0	0	1	0.020
INDIAN FISHERIES		0	0	0	0	0	0	0	0.000
HATCHERIES		0	0	0	0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	0	1	0	1	0	2	0.040
PERCENT OF RECOVERY	%	0.0	0.0	50.0	0.0	50.0	0.0		

Appendix Table 6.6.--Recoveries of adult fall chinook salmon released as juveniles below McNary Dam from 18 to 21 July 1988.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8804G

1988 MCNARY TRANS CONTROL BELOW MCNARY

FALL CHINOOK

Brands Used: LAIC1
Wire Codes Used: 232049

NUMBER RELEASED: 4992

RECOVERY AREA		1988	1989	1990	1991	1992	1993	TOTAL	% RETURN
			YEAR OF RETURN						
RIVER SYSTEM TRAPS		0	0	0	0	0	0	0	0.000
OCEAN FISHERIES		0	0	0	0	0	0	0	0.000
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL									
COL. R. TEST FSHRY (ORE)		0	0	0	0	1	0	1	0.020
INDIAN FISHERIES		0	0	0	0	0	0	0	0.000
HATCHERIES		0	0	0	0	0	0	0	0.000
STREAM SURVEY									
GENERAL		0	0	0	1	0	0	1	0.020
TOTALS		0	0	0	1	1	0	2	0.040
PERCENT OF RECOVERY	%	0.0	0.0	0.0	50.0	50.0	0.0		

Appendix Table 7.0.--Summary of all recoveries of adult fall chinook salmon transported as juveniles by barge from McNary Dam to below Bonneville Dam in 1988.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8803A 8803B 8803C 8803D 8803E 8803F

1988 MCNARY TRANS BARGE BELOW BONNEVILLE

FALL CHINOOK

Brands Used: RAIU1 RAIU2 RAIU3 RAIU4 RAID1 RAID3
Wire Codes Used: 232260 232261 232301 232302 232303 232304

NUMBER RELEASED: 60013

RECOVERY AREA	1988	YEAR OF RETURN 1989	1990	1991	1992	1993	TOTAL	% RETURN
RIVER SYSTEM TRAPS								
BONNEVILLE TRAP	0	0	3	4	4	0	11	0.018
OCEAN FISHERIES								
ALASKA	0	0	3	5	3	0	11	0.018
BRITISH COLOMBIA	0	1	1	4	4	0	10	0.017
WASHINGTON	0	0	1	0	0	0	1	0.002
RIVER SPORT								
COLUMBIA R. BELOW SNAKE R.	0	0	1	1	1	0	3	0.005
COLUMBIA R. ABOVE SNAKE R.	0	0	0	1	1	0	2	0.003
RIVER COMMERCIAL								
COMMERCIAL NET	0	1	0	4	2	0	7	0.012
INDIAN FISHERIES								
INDIAN GENERAL	0	0	1	0	0	0	1	0.002
FALL INDIAN NET	0	0	0	5	4	0	9	0.015
HATCHERIES								
PRIEST RAPIDS H.	0	1	1	3	0	0	5	0.008
STREAM SURVEY								
GENERAL	0	0	0	1	0	0	1	0.002
TOTALS	0	3	11	28	19	0	61	0.102
PERCENT OF RECOVERY %	0.0	4.9	18.0	45.9	31.1	0.0		

Appendix Table 7.1.--Recoveries of adult fall chinook salmon transported as juveniles by barge from McNary Dam to below Bonneville Dam from 13 to 21 June 1988.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8803A

1988 MCNARY TRANS BARGE BELOW BONNEVILLE

FALL CHINOOK

Brands Used: RAIU1
Wire Codes Used: 232260

NUMBER RELEASED: 10002

RECOVERY AREA		YEAR OF RETURN 1988	1989	1990	1991	1992	1993	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	0	2	0	1	0	3	0.030
OCEAN FISHERIES		0	0	0	0	0	0	0	0.000
RIVER SPORT									
COLUMBIA R. BELOW SNAKE R.		0	0	1	0	1	0	2	0.020
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0	0	0	0.000
HATCHERIES									
PRIEST RAPIDS H.		0	0	0	1	0	0	1	0.010
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	0	3	1	2	0	6	0.060
PERCENT OF RECOVERY	%	0.0	0.0	50.0	16.7	33.3	0.0		

Appendix Table 7.2.--Recoveries of adult fall chinook salmon transported as juveniles by barge from McNary Dam to below Bonneville Dam from 21 to 23 June 1988.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8803B

1988 MCNARY TRANS BARGE BELOW BONNEVILLE

FALL CHINOOK

Brands Used: RAIU2
Wire Codes Used: 232261

NUMBER RELEASED: 10003

RECOVERY AREA		YEAR OF RETURN 1988	1989	1990	1991	1992	1993	TOTAL	% RETURN
RIVER SYSTEM TRAPS		0	0	0	0	0	0	0	0.000
OCEAN FISHERIES									
ALASKA		0	0	1	1	0	0	2	0.020
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0	0	0	0.000
HATCHERIES									
PRIEST RAPIDS H.		0	0	1	0	0	0	1	0.010
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	0	2	1	0	0	3	0.030
PERCENT OF RECOVERY	%	0.0	0.0	66.7	33.3	0.0	0.0		

Appendix Table 7.3.--Recoveries of adult fall chinook salmon transported as juveniles by barge from McNary Dam to below Bonneville Dam from 23 to 26 June 1988.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8803C

1988 MCNARY TRANS BARGE BELOW BONNEVILLE

FALL CHINOOK

Brands Used: RAIU3
Wire Codes Used: 232301

NUMBER RELEASED: 10002

RECOVERY AREA		YEAR OF RETURN 1988	1989	1990	1991	1992	1993	TOTAL	% RETURN
RIVER SYSTEM TRAPS BONNEVILLE TRAP		0	0	1	2	1	0	4	0.040
OCEAN FISHERIES		0	0	0	0	0	0	0	0.000
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0	0	0	0.000
INDIAN FISHERIES INDIAN GENERAL		0	0	1	0	0	0	1	0.010
HATCHERIES PRIEST RAPIDS H.		0	1	0	0	0	0	1	0.010
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	1	2	2	1	0	6	0.060
PERCENT OF RECOVERY	%	0.0	16.7	33.3	33.3	16.7	0.0		

Appendix Table 7.4.--Recoveries of adult fall chinook salmon transported as juveniles by barge from McNary Dam to below Bonneville Dam from 27 June to 1 July 1988.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8803D

1988 MCNARY TRANS BARGE BELOW BONNEVILLE

FALL CHINOOK

Brands Used: RAIU4
Wire Codes Used: 232302

NUMBER RELEASED: 10002

RECOVERY AREA		YEAR OF RETURN 1988	1989	1990	1991	1992	1993	TOTAL	% RETURN
RIVER SYSTEM TRAPS		0	0	0	0	0	0	0	0.000
OCEAN FISHERIES									
ALASKA		0	0	0	0	1	0	1	0.010
BRITISH COLUMBIA		0	0	0	0	1	0	1	0.010
RIVER SPORT		0	0	0	0	0	0	0	0.000
RIVER COMMERCIAL									
COMMERCIAL NET		0	0	0	1	0	0	1	0.010
INDIAN FISHERIES									
FALL INDIAN NET		0	0	0	3	0	0	3	0.030
HATCHERIES									
PRIEST RAPIDS H.		0	0	0	2	0	0	2	0.020
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	0	0	6	2	0	8	0.080
PERCENT OF RECOVERY	%	0.0	0.0	0.0	75.0	25.0	0.0		

Appendix Table 7.5.--Recoveries of adult fall chinook salmon transported as juveniles by barge from McNary Dam to below Bonneville Dam from 5 to 13 July 1988.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8803E

1988 MCNARY TRANS BARGE BELOW BONNEVILLE

FALL CHINOOK

Brands Used: RAID1
Wire Codes Used: 232303

NUMBER RELEASED: 10002

RECOVERY AREA		1988	YEAR OF RETURN 1989	1990	1991	1992	1993	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	0	0	2	0	0	2	0.020
OCEAN FISHERIES									
ALASKA		0	0	0	2	1	0	3	0.030
BRITISH COLUMBIA		0	0	1	2	2	0	5	0.050
WASHINGTON		0	0	1	0	0	0	1	0.010
RIVER SPORT									
COLUMBIA R. ABOVE SNAKE R.		0	0	0	0	1	0	1	0.010
RIVER COMMERCIAL									
COMMERCIAL NET		0	0	0	3	1	0	4	0.040
INDIAN FISHERIES									
FALL INDIAN NET		0	0	0	0	1	0	1	0.010
HATCHERIES		0	0	0	0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0	0	0	0.000
TOTALS		0	0	2	9	6	0	17	0.170
PERCENT OF RECOVERY	%	0.0	0.0	11.8	52.9	35.3	0.0		

Appendix Table 7.6.--Recoveries of adult fall chinook salmon transported as juveniles by barge from McNary Dam to below Bonneville Dam from 13 to 21 July 1988.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 8803F

1988 MCNARY TRANS BARGE BELOW BONNEVILLE
FALL CHINOOK

Brands Used: RAID3
Wire Codes Used: 232304

NUMBER RELEASED: 10002

RECOVERY AREA		YEAR OF RETURN 1988	1989	1990	1991	1992	1993	TOTAL	% RETURN
RIVER SYSTEM TRAPS									
BONNEVILLE TRAP		0	0	0	0	2	0	2	0.020
OCEAN FISHERIES									
ALASKA		0	0	2	2	1	0	5	0.050
BRITISH COLUMBIA		0	1	0	2	1	0	4	0.040
RIVER SPORT									
COLUMBIA R. BELOW SNAKE R.		0	0	0	1	0	0	1	0.010
COLUMBIA R. ABOVE SNAKE R.		0	0	0	1	0	0	1	0.010
RIVER COMMERCIAL									
COMMERCIAL NET		0	1	0	0	1	0	2	0.020
INDIAN FISHERIES									
FALL INDIAN NET		0	0	0	2	3	0	5	0.050
HATCHERIES		0	0	0	0	0	0	0	0.000
STREAM SURVEY									
GENERAL		0	0	0	1	0	0	1	0.010
TOTALS		0	2	2	9	8	0	21	0.210
PERCENT OF RECOVERY	%	0.0	9.5	9.5	42.9	38.1	0.0		

Appendix Table 8.0.--Summary of all recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to Tongue Point in 1992.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9207A 9207B 9207C 9207D 9207E 9207F

1992 L.GRANITE LGR RELEASE SITE TONGUE POINT

STEELHEAD

Brands Used: RAL 1 RASU1 RASU2 RASU3 RASU4 RAZ 1
Wire Codes Used: 232445 232447 232448 232449 232450 232444

NUMBER RELEASED: 55366

RECOVERY AREA		YEAR OF RETURN 1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS						
LOWER GRANITE TRAP		0	28	0	28	0.051
OCEAN FISHERIES		0	0	0	0	0.000
RIVER SPORT						
SNAKE R.		0	2	0	2	0.004
CLEARWATER R.		0	2	0	2	0.004
RIVER COMMERCIAL		0	0	0	0	0.000
INDIAN FISHERIES						
FALL INDIAN NET		0	2	0	2	0.004
HATCHERIES		0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0.000
TOTALS		0	34	0	34	0.061
PERCENT OF RECOVERY	%	0.0	100.0	0.0		

Appendix Table 8.1.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to Tongue Point on 4 May 1992.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9207A

1992 L.GRANITE LGR RELEASE SITE TONGUE POINT

STEELHEAD

Brands Used: RAL 1
Wire Codes Used: 232445

NUMBER RELEASED: 9199

RECOVERY AREA		1992	YEAR OF RETURN 1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS						
LOWER GRANITE TRAP		0	11	0	11	0.120
OCEAN FISHERIES		0	0	0	0	0.000
RIVER SPORT						
SNAKE R.		0	2	0	2	0.022
RIVER COMMERCIAL		0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0.000
HATCHERIES		0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0.000
TOTALS		0	13	0	13	0.141
PERCENT OF RECOVERY	%	0.0	100.0	0.0		

Appendix Table 8.2.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to Tongue Point on 10 May 1992

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9207B

1992 L.GRANITE LGR RELEASE SITE TONGUE POINT

STEELHEAD

Brands Used: RASU1
Wire Codes Used: 232447

NUMBER RELEASED: 9418

RECOVERY AREA		YEAR OF RETURN 1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS						
LOWER GRANITE TRAP		0	4	0	4	0.042
OCEAN FISHERIES		0	0	0	0	0.000
RIVER SPORT		0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0.000
HATCHERIES		0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0.000
TOTALS		0	4	0	4	0.042
PERCENT OF RECOVERY	%	0.0	100.0	0.0		

Appendix Table 8.3.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to Tongue Point on 12 May 1992.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9207C

1992 L.GRANITE LGR RELEASE SITE TONGUE POINT

STEELHEAD

Brands Used: RASU2
Wire Codes Used: 232448

NUMBER RELEASED: 9137

RECOVERY AREA		YEAR OF RETURN 1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS LOWER GRANITE TRAP		0	2	0	2	0.022
OCEAN FISHERIES		0	0	0	0	0.000
RIVER SPORT		0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0.000
HATCHERIES		0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0.000
TOTALS		0	2	0	2	0.022
PERCENT OF RECOVERY	%	0.0	100.0	0.0		

Appendix Table 8.4.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to Tongue Point on 16 May 1992.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9207D

1992 L.GRANITE LGR RELEASE SITE TONGUE POINT

STEELHEAD

Brands Used: RAS03
Wire Codes Used: 232449

NUMBER RELEASED: 9118

RECOVERY AREA		YEAR OF RETURN 1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS						
LOWER GRANITE TRAP		0	4	0	4	0.044
OCEAN FISHERIES		0	0	0	0	0.000
RIVER SPORT		0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0.000
INDIAN FISHERIES						
FALL INDIAN NET		0	2	0	2	0.022
HATCHERIES		0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0.000
TOTALS		0	6	0	6	0.066
PERCENT OF RECOVERY	%	0.0	100.0	0.0		

Appendix Table 8.5.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to Tongue Point on 18 May 1992.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9207E

1992 L.GRANITE LGR RELEASE SITE TONGUE POINT

STEELHEAD

Brands Used: RAS04
Wire Codes Used: 232450

NUMBER RELEASED: 9220

RECOVERY AREA		YEAR OF RETURN 1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS						
LOWER GRANITE TRAP		0	5	0	5	0.054
OCEAN FISHERIES		0	0	0	0	0.000
RIVER SPORT						
CLEARWATER R.		0	1	0	1	0.011
RIVER COMMERCIAL		0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0.000
HATCHERIES		0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0.000
TOTALS		0	6	0	6	0.065
PERCENT OF RECOVERY	%	0.0	100.0	0.0		

Appendix Table 8.6.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to Tongue Point on 22 May 1992.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9207F

1992 L.GRANITE LGR RELEASE SITE TONGUE POINT

STEELHEAD

Brands Used: RAZ 1
Wire Codes Used: 232444

NUMBER RELEASED: 9274

RECOVERY AREA		1992	YEAR OF RETURN 1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS						
LOWER GRANITE TRAP		0	2	0	2	0.022
OCEAN FISHERIES		0	0	0	0	0.000
RIVER SPORT						
CLEARWATER R.		0	1	0	1	0.011
RIVER COMMERCIAL		0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0.000
HATCHERIES		0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0.000
TOTALS		0	3	0	3	0.032
PERCENT OF RECOVERY	%	0.0	100.0	0.0		

Appendix Table 9.0.--Summary of all recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam in 1992.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9208A 9208B 9208C 9208D 9208E 9208F

1992 L.GRANITE LGR RELEASE SITE BELOW BONNEVILLE
STEELHEAD

Brands Used: LAF 1 LAF 3 LAF 4 LAV 1 LAV 2 LAV 3
Wire Codes Used: 232419 232417 232418 232420 232421 232422

NUMBER RELEASED: 60577

RECOVERY AREA		1992	YEAR OF RETURN 1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS						
LOWER GRANITE TRAP		0	27	0	27	0.045
OCEAN FISHERIES		0	0	0	0	0.000
RIVER SPORT						
SNAKE R.		0	2	0	2	0.003
RIVER COMMERCIAL		0	0	0	0	0.000
INDIAN FISHERIES						
FALL INDIAN NET		0	1	0	1	0.002
HATCHERIES		0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0.000
TOTALS		0	30	0	30	0.050
PERCENT OF RECOVERY	%	0.0	100.0	0.0		

Appendix Table 9.1.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam on 4 May 1992.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9208A

1992 L.GRANITE LGR RELEASE SITE BELOW BONNEVILLE

STEELHEAD

Brands Used: LAF 1
Wire Codes Used: 232419

NUMBER RELEASED: 9740

RECOVERY AREA		YEAR OF RETURN 1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS						
LOWER GRANITE TRAP		0	12	0	12	0.123
OCEAN FISHERIES		0	0	0	0	0.000
RIVER SPORT						
SNAKE R.		0	2	0	2	0.021
RIVER COMMERCIAL		0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0.000
HATCHERIES		0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0.000
TOTALS		0	14	0	14	0.144
PERCENT OF RECOVERY	%	0.0	100.0	0.0		

Appendix Table 9.2.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam on 10 May 1992.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9208B

1992 L.GRANITE LGR RELEASE SITE BELOW BONNEVILLE
STEELHEAD

Brands Used: LAF 3
Wire Codes Used: 232417

NUMBER RELEASED: 10285

RECOVERY AREA		YEAR OF RETURN 1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS						
LOWER GRANITE TRAP		0	10	0	10	0.097
OCEAN FISHERIES		0	0	0	0	0.000
RIVER SPORT		0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0.000
HATCHERIES		0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0.000
TOTALS		0	10	0	10	0.097
PERCENT OF RECOVERY	%	0.0	100.0	0.0		

Appendix Table 9.3.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam on 12 May 1992.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9208C

1992 L.GRANITE LGR RELEASE SITE BELOW BONNEVILLE

STEELHEAD

Brands Used: LAF 4
Wire Codes Used: 232418

NUMBER RELEASED: 10149

RECOVERY AREA		1992	YEAR OF RETURN 1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS LOWER GRANITE TRAP		0	2	0	2	0.020
OCEAN FISHERIES		0	0	0	0	0.000
RIVER SPORT		0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0.000
INDIAN FISHERIES FALL INDIAN NET		0	1	0	1	0.010
HATCHERIES		0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0.000
TOTALS		0	3	0	3	0.030
PERCENT OF RECOVERY	%	0.0	100.0	0.0		

Appendix Table 9.4.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam on 18 May 1992.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9208E

1992 L.GRANITE LGR RELEASE SITE BELOW BONNEVILLE

STEELHEAD

Brands Used: LAY 2
Wire Codes Used: 232421

NUMBER RELEASED: 10112

RECOVERY AREA		YEAR OF RETURN 1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS						
LOWER GRANITE TRAP		0	2	0	2	0.020
OCEAN FISHERIES		0	0	0	0	0.000
RIVER SPORT		0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0.000
HATCHERIES		0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0.000
TOTALS		0	2	0	2	0.020
PERCENT OF RECOVERY	%	0.0	100.0	0.0		

Appendix Table 9.5.--Recoveries of adult steelhead transported as juveniles by barge from Lower Granite Dam to below Bonneville Dam on 22 May 1992.

Master File Date : 4 February 1994
RELEASE GROUPS INCLUDED: 9208F

1992 L.GRANITE LGR RELEASE SITE BELOW BONNEVILLE
STEELHEAD

Brands Used: LAV 3
Wire Codes Used: 232422

NUMBER RELEASED: 10218

RECOVERY AREA		YEAR OF RETURN 1992	1993	1994	TOTAL	% RETURN
RIVER SYSTEM TRAPS						
LOWER GRANITE TRAP		0	1	0	1	0.010
OCEAN FISHERIES		0	0	0	0	0.000
RIVER SPORT		0	0	0	0	0.000
RIVER COMMERCIAL		0	0	0	0	0.000
INDIAN FISHERIES		0	0	0	0	0.000
HATCHERIES		0	0	0	0	0.000
STREAM SURVEY		0	0	0	0	0.000
TOTALS		0	1	0	1	0.010
PERCENT OF RECOVERY	%	0.0	100.0	0.0		

Appendix Table 10.0.--Summary of steelhead smolts marked at Lower Granite Dam in 1993 for Tongue Point release site study.

Replicate number	Release site	Marking period	Release date	Brand position,[a] symbol, and orientation.[b]	Wire-tag code	Number barged		
						Hatchery	Wild	Total
1	Tongue Pt.	13 May	16 May	RAPI1	23-29-60	7,988	1,044	9,032
	Bonneville	13 May	16 May	LA3-1	23-30-05	9,067	942	10,009
2	Tongue Pt.	15 May	18 May	RAPI2	23-29-61	7,527	1,547	9,074
	Bonneville	15 May	18 May	LA3-2	23-30-06	9,074	1,012	10,086
3	Tongue Pt.	19 May	23 May	RAPI3	23-29-62	7,877	1,226	9,103
	Bonneville	19 May	22 May	LA3-3	23-30-11	8,829	1,056	9,885
4	Tongue Pt.	21 May	25 May	RAPI4	23-29-63	7,701	1,321	9,022
	Bonneville	21 May	24 May	LA3-4	23-30-12	9,609	439	10,048
5	Tongue Pt.	26 May	29 May	RAP-1	23-30-01	7,937	1,144	9,081
	Bonneville	26 May	29 May	LA2-1	23-30-13	9,310	787	10,097
6	Tongue Pt.	28 May	1 Jun	RAP-2	23-30-02	8,131	980	9,111
	Bonneville	28 May	31 May	LA2-2	23-30-14	9,124	1,089	10,213
7	Tongue Pt.[c]	1 Jun	4 Jun	RAP-3	23-30-03	7,647	749	8,396
	Bonneville	1 Jun	4 Jun	LA2-3	23-30-15	7,905	902	8,807
					Total	117,726	14,238	131,964

[a] RA and LA (position) indicate right and left anterior sides of fish, respectively.
[b] Orientation refers to rotation of brand around its center point.
[c] Released 1 mile above Longview (RM 67) because of an oil spill.

Appendix Table 11.0.--Mortality and tag loss of tagged steelhead that were held 24 hours at Lower Granite Dam in 1993.

Date	Wire-tag code	Number held	Mortality	Lost tags
13 May	23-30-05	57	1	0
13 May	23-29-60	51	0	0
19 May	23-30-11	51	0	0
19 May	23-29-62	50	0	1
21 May	23-30-12	49	0	1
21 May	23-29-63	48	0	1
26 May	23-30-13	53	0	0
26 May	23-30-01	60	0	1
28 May	23-30-14	17	0	3
28 May	23-30-02	21	0	0
1 June	23-30-15	48	0	1
1 June	23-30-03	50	0	0
	Totals	555	1	8
	% Mortality and tag loss		0.2	1.4

Appendix Table 12.--Physical parameters of hourly tests of the "A" flume PIT-tag diversion system at Little Goose Dam, 1993.

Date	Time	Slide-gate cycle time	Expanded hourly count	Percent steelhead
04/27/93	8:00:00	1.000	1020.0	14.7
04/27/93	9:00:00	1.000	420.0	14.7
04/27/93	10:00:00	1.000	100.0	14.7
04/27/93	11:00:00	1.000	300.0	14.7
04/27/93	12:00:00	1.000	240.0	14.7
04/28/93	10:00:00	0.500	100.0	17.1
04/28/93	11:00:00	0.500	360.4	17.1
04/28/93	12:00:00	0.500	510.5	17.1
04/29/93	8:00:00	0.800	778.4	13.1
04/29/93	9:00:00	0.800	718.6	13.1
04/29/93	10:00:00	0.800	419.2	13.1
04/29/93	11:00:00	0.800	179.6	13.1
04/29/93	12:00:00	0.800	1437.1	13.1
04/30/93	17:00:00	0.800	479.0	15.6
04/30/93	18:00:00	0.800	778.4	15.6
04/30/93	19:00:00	0.800	359.3	15.6
04/30/93	20:00:00	0.800	359.3	15.6
04/30/93	21:00:00	0.800	359.3	15.6
05/01/93	7:00:00	0.800	843.4	10.4
05/01/93	8:00:00	0.800	2048.2	10.4
05/01/93	9:00:00	0.800	1084.3	10.4
05/01/93	10:00:00	0.800	1566.3	10.4
05/01/93	11:00:00	0.800	963.9	10.4
05/01/93	12:00:00	0.800	481.9	10.4
05/01/93	13:00:00	0.800	722.9	10.4
05/01/93	14:00:00	0.800	1686.7	10.4
05/02/93	6:00:00	0.800	1084.3	10.0
05/02/93	7:00:00	0.800	241.0	10.0
05/02/93	8:00:00	0.800	1686.7	10.0
05/02/93[a]	12:00:00	0.800	15.0	10.0
05/02/93	13:00:00	0.800	1084.3	10.0
05/03/93	7:00:00	0.800	298.5	11.5
05/03/93	8:00:00	0.800	149.3	11.5
05/03/93	9:00:00	0.800	298.5	11.5
05/03/93	10:00:00	0.800	1343.3	11.5
05/03/93	11:00:00	0.800	746.3	11.5
05/03/93	12:00:00	0.800	2388.1	11.5
05/03/93	13:00:00	0.800	597.0	11.5
05/03/93	14:00:00	0.800	1194.0	11.5
05/04/93	7:00:00	0.800	447.8	9.2
05/04/93	12:00:00	0.800	447.8	9.2
05/04/93	13:00:00	0.800	1343.3	9.2

Appendix Table 12.--(continued)

Date	Time	Slide-gate cycle time	Expanded hourly count	Percent steelhead
05/05/93	17:00:00	0.800	410.0	8.2
05/05/93	18:00:00	0.800	320.0	8.2
05/05/93	19:00:00	0.800	1370.0	8.2
05/05/93	20:00:00	0.800	3000.0	8.2
05/05/93	21:00:00	0.800	3870.0	8.2
05/06/93	7:00:00	0.800	1343.3	8.2
05/06/93	8:00:00	0.800	746.3	8.2
05/06/93	9:00:00	0.800	4179.1	8.2
05/06/93	10:00:00	0.800	895.5	8.2
05/06/93	11:00:00	0.800	3880.6	8.2
05/06/93	12:00:00	0.800	1194.0	8.2
05/06/93	13:00:00	0.800	1641.8	8.2
05/06/93	14:00:00	0.800	746.3	8.2
05/07/93[a]	7:00:00	0.800	3.0	17.7
05/07/93	8:00:00	0.800	480.0	17.7
05/07/93	9:00:00	0.800	2686.6	17.7
05/07/93	10:00:00	0.800	2537.3	17.7
05/07/93	11:00:00	0.800	2238.8	17.7
05/07/93	12:00:00	0.800	2686.6	17.7
05/07/93	13:00:00	0.800	746.3	17.7
05/07/93	14:00:00	0.800	298.5	17.7
05/08/93	7:00:00	0.800	895.5	31.5
05/08/93	8:00:00	0.800	2238.8	31.5
05/08/93	9:00:00	0.800	895.5	31.5
05/08/93	10:00:00	0.800	1343.3	31.5
05/08/93	11:00:00	0.800	2388.1	31.5
05/08/93	12:00:00	0.800	746.3	31.5
05/08/93	13:00:00	0.800	2388.1	31.5
05/08/93	14:00:00	0.800	1791.0	31.5
05/09/93	18:00:00	0.800	1200.0	27.1
05/09/93	19:00:00	0.800	2800.0	27.1
05/09/93	20:00:00	0.800	8400.0	27.1
05/09/93	21:00:00	0.800	8000.0	27.1
05/10/93	7:00:00	0.800	1000.0	28.3
05/10/93	8:00:00	0.800	1600.0	28.3
05/10/93[a]	9:00:00	0.800	8.8	28.3
05/10/93	10:00:00	0.800	2200.0	28.3
05/10/93	11:00:00	0.800	1200.0	28.3
05/10/93	12:00:00	0.800	1600.0	28.3
05/10/93	13:00:00	0.800	1800.0	28.3
05/10/93	14:00:00	0.800	800.0	28.3
05/12/93	13:00:00	0.800	746.3	28.2
05/12/93[a]	14:00:00	0.800	0.0	28.2
05/12/93	15:00:00	0.800	2835.8	28.2

Appendix Table 12.--(continued)

Date	Time	Slide-gate cycle time	Expanded hourly count	Percent steelhead
05/12/93	16:00:00	0.800	895.5	28.2
05/12/93	17:00:00	0.800	4179.1	28.2
05/12/93	18:00:00	0.800	385.0	28.2
05/12/93	19:00:00	0.800	870.0	28.2
05/12/93	20:00:00	0.800	1355.0	28.2
05/13/93	13:00:00	0.800	1343.3	27.3
05/13/93	14:00:00	0.800	597.0	27.3
05/13/93	15:00:00	0.800	447.0	27.3
05/13/93	16:00:00	0.800	1641.8	27.3
05/13/93	17:00:00	0.800	597.0	27.3
05/13/93	18:00:00	0.800	597.0	27.3
05/13/93	19:00:00	0.800	1194.0	27.3
05/13/93	20:00:00	0.800	1194.0	27.3
05/14/93	7:00:00	0.800	746.3	19.1
05/14/93	8:00:00	0.800	895.5	19.1
05/14/93	9:00:00	0.800	1343.3	19.1
05/14/93	10:00:00	0.800	1044.8	19.1
05/14/93	11:00:00	0.800	447.8	19.1
05/15/93	13:00:00	0.800	895.5	28.0
05/15/93[a]	14:00:00	0.800	0.0	28.0
05/15/93	15:00:00	0.800	447.8	28.0
05/15/93	16:00:00	0.800	1194.0	28.0
05/15/93	17:00:00	0.800	447.8	28.0
05/15/93	18:00:00	0.800	149.3	28.0
05/15/93	19:00:00	0.800	895.5	28.0
05/15/93	20:00:00	0.800	1044.8	28.0
05/16/93	7:00:00	0.800	846.2	37.1
05/16/93	8:00:00	0.800	538.5	37.1
05/16/93	9:00:00	0.800	692.3	37.1
05/16/93	10:00:00	0.800	692.3	37.1
05/17/93	16:00:00	0.800	538.5	48.5
05/17/93[a]	17:00:00	0.800	0.0	48.5
05/17/93	18:00:00	0.800	307.7	48.5
05/17/93	19:00:00	0.800	846.2	48.5
05/17/93	20:00:00	0.800	1615.4	48.5
05/17/93	21:00:00	0.800	1692.3	48.5
05/19/93	12:00:00	0.800	615.4	33.6
05/19/93	13:00:00	0.800	923.1	33.6
05/19/93	14:00:00	0.800	769.2	33.6
05/19/93	15:00:00	0.800	692.3	33.6
05/19/93	16:00:00	0.800	1230.8	33.6
05/19/93	17:00:00	0.800	538.5	33.6
05/19/93	18:00:00	0.800	230.8	33.6
05/19/93	19:00:00	0.800	615.4	33.6

Appendix Table 12.--(continued)

Date	Time	Slide-gate cycle time	Expanded hourly count	Percent steelhead
05/19/93	20:00:00	0.800	1076.9	33.6
05/19/93	21:00:00	0.800	1000.0	33.6
05/20/93	12:00:00	0.800	538.5	50.9
05/20/93	13:00:00	0.800	846.2	50.9
05/20/93	14:00:00	0.800	461.5	50.9
05/20/93	15:00:00	0.800	307.7	50.9
05/20/93	16:00:00	0.800	846.2	50.9
05/20/93	17:00:00	0.800	846.2	50.9
05/20/93	18:00:00	0.800	307.7	50.9
05/20/93	19:00:00	0.800	538.5	50.9
05/21/93	12:00:00	0.800	230.8	48.6
05/21/93	13:00:00	0.800	76.9	48.6
05/21/93	14:00:00	0.800	76.9	48.6
05/21/93	15:00:00	0.800	615.4	48.6
05/21/93	16:00:00	0.800	230.8	48.6
05/21/93	17:00:00	0.800	461.5	48.6
05/21/93	18:00:00	0.800	307.7	48.6
05/21/93	19:00:00	0.800	538.5	48.6
05/21/93	20:00:00	0.800	538.5	48.6
05/22/93	13:00:00	0.800	200.0	47.2
05/22/93	14:00:00	0.800	200.0	47.2
05/22/93	15:00:00	0.800	350.0	47.2
05/22/93	16:00:00	0.800	150.0	47.2
05/22/93	17:00:00	0.800	150.0	47.2

[a] Test results were not included in the analysis because the facility count indicated fewer fish passed through the system than were diverted.

Appendix Table 13.--Numbers of PIT-tagged and untagged fish diverted per hourly test of the flume "A" PIT-tag diversion system at Little Goose Dam, 1993.

Date	Time	Tagged chinook	Tagged steelhead	Total tagged	Untagged chinook	Untagged steelhead	Total untagged	No. cycles	Untagged per cycle
04/27/93	8:00:00	2	0	2	1	1	2	5	0.40
04/27/93	9:00:00	6	0	6	1	1	2	4	0.50
04/27/93	10:00:00	2	0	2	0	0	0	2	0.00
04/27/93	11:00:00	2	0	2	1	0	1	6	0.17
04/27/93	12:00:00	4	0	4	2	0	2	4	0.50
04/28/93	10:00:00	1	1	2	0	0	0	4	0.00
04/28/93	11:00:00	7	0	7	2	1	3	12	0.25
04/28/93	12:00:00	11	1	12	2	0	2	7	0.29
04/29/93	8:00:00	6	2	8	1	0	1	8	0.13
04/29/93	9:00:00	8	1	9	3	1	4	17	0.24
04/29/93	10:00:00	10	0	10	3	0	3	8	0.38
04/29/93	11:00:00	8	0	8	2	1	3	11	0.27
04/29/93	12:00:00	38	2	40	18	0	18	34	0.53
04/30/93	17:00:00	10	0	10	0	1	1	12	0.08
04/30/93	18:00:00	8	0	8	2	0	2	9	0.22
04/30/93	19:00:00	2	0	2	0	0	0	5	0.00
04/30/93	20:00:00	0	0	0	0	0	0	7	0.00
04/30/93	21:00:00	5	1	6	4	2	6	6	1.00
05/01/93	7:00:00	6	0	6	4	0	4	8	0.50
05/01/93	8:00:00	19	0	19	5	1	6	22	0.27
05/01/93	9:00:00	15	2	17	3	0	3	15	0.20
05/01/93	10:00:00	24	0	24	5	0	5	23	0.22
05/01/93	11:00:00	7	2	9	1	1	2	17	0.12
05/01/93	12:00:00	24	0	24	1	1	2	27	0.07
05/01/93	13:00:00	27	0	27	10	0	10	26	0.38
05/01/93	14:00:00	43	0	43	14	4	18	36	0.50
05/02/93	6:00:00	58	1	59	45	4	49	28	1.75
05/02/93	7:00:00	25	6	31	25	8	33	66	0.50
05/02/93	8:00:00	64	2	66	25	18	43	61	0.70
05/02/93	12:00:00[a]	20	1	21	9	4	13	24	0.54
05/02/93	13:00:00	26	2	28	21	5	26	60	0.43
05/03/93	7:00:00	27	1	28	11	1	12	36	0.33
05/03/93	8:00:00	27	4	31	8	1	9	35	0.26
05/03/93	9:00:00	22	0	22	8	0	8	26	0.31
05/03/93	10:00:00	11	1	12	2	1	3	20	0.15
05/03/93	11:00:00	25	0	25	7	0	7	28	0.25
05/03/93	12:00:00	60	1	61	50	2	52	91	0.57
05/03/93	13:00:00	48	4	52	28	9	37	28	1.32
05/03/93	14:00:00	61	2	63	33	3	36	29	1.24
05/04/93	7:00:00	49	0	49	20	0	20	42	0.48
05/04/93	12:00:00	11	2	13	2	1	3	25	0.12
05/04/93	13:00:00	52	0	52	20	10	30	45	0.67
05/05/93	17:00:00	10	1	11	15	1	16	19	0.84
05/05/93	18:00:00	16	0	16	8	1	9	9	1.00
05/05/93	19:00:00	21	3	24	17	0	17	23	0.74
05/05/93	20:00:00	34	5	39	60	6	66	42	1.57
05/05/93	21:00:00	45	6	51	94	9	103	54	1.91
05/06/93	7:00:00	21	3	24	9	1	10	27	0.37
05/06/93	8:00:00	14	0	14	8	0	8	18	0.44
05/06/93	9:00:00	14	4	18	4	3	7	20	0.35
05/06/93	10:00:00	11	1	12	2	1	3	10	0.30
05/06/93	11:00:00	14	1	15	7	1	8	20	0.40
05/06/93	12:00:00	11	3	14	5	2	7	15	0.47
05/06/93	13:00:00	20	1	21	3	0	3	22	0.14
05/06/93	14:00:00	26	1	27	11	1	12	12	1.00
05/07/93	7:00:00[a]	5	0	5	6	0	6	6	1.00
05/07/93	8:00:00	7	0	7	7	0	7	13	0.54
05/07/93	9:00:00	20	1	21	8	4	12	16	0.75
05/07/93	10:00:00	17	5	22	7	0	7	23	0.30
05/07/93	11:00:00	10	2	12	0	0	0	12	0.00
05/07/93	12:00:00	13	4	17	4	0	4	13	0.31
05/07/93	13:00:00	3	0	3	1	0	1	5	0.20
05/07/93	14:00:00	12	1	13	5	0	5	10	0.50
05/08/93	7:00:00	8	4	12	9	4	13	18	0.72
05/08/93	8:00:00	2	9	11	9	2	11	16	0.69
05/08/93	9:00:00	17	4	21	8	5	13	21	0.62
05/08/93	10:00:00	13	7	20	1	1	2	20	0.10
05/08/93	11:00:00	19	7	26	17	3	20	24	0.83
05/08/93	12:00:00	16	9	25	22	10	32	22	1.45

Appendix Table 13.--(continued)

Date	Time	Tagged chinook	Tagged steelhead	Total tagged	Untagged chinook	Untagged steelhead	Total untagged	No. cycles	Untagged per cycle
05/08/93	13:00:00	16	10	26	37	25	62	26	2.38
05/08/93	14:00:00	18	8	26	31	14	45	20	2.25
05/09/93	18:00:00	8	1	9	16	0	16	6	2.67
05/09/93	19:00:00	9	12	21	35	20	55	27	2.04
05/09/93	20:00:00	23	15	38	78	22	100	39	2.56
05/09/93	21:00:00	29	9	38	61	11	72	29	2.48
05/10/93	7:00:00	0	0	0	0	0	0	7	0.00
05/10/93	8:00:00	17	2	19	17	29	46	17	2.71
05/10/93	9:00:00[a]	1	3	4	12	6	18	3	6.00
05/10/93	10:00:00	5	1	6	14	1	15	7	2.14
05/10/93	11:00:00	6	6	12	6	2	8	12	0.67
05/10/93	12:00:00	7	4	11	2	1	3	13	0.23
05/10/93	13:00:00	7	3	10	3	0	3	6	0.50
05/10/93	14:00:00	7	3	10	3	2	5	7	0.71
05/12/93	13:00:00	6	3	9	3	0	3	10	0.30
05/12/93	14:00:00[a]	1	4	5	2	0	2	6	0.33
05/12/93	15:00:00	4	0	4	1	0	1	5	0.20
05/12/93	16:00:00	7	2	9	0	0	0	10	0.00
05/12/93	17:00:00	8	6	14	5	5	10	13	0.77
05/12/93	18:00:00	1	1	2	0	0	0	6	0.00
05/12/93	19:00:00	3	0	3	0	1	1	9	0.11
05/12/93	20:00:00	8	3	11	4	2	6	24	0.25
05/13/93	13:00:00	3	1	4	1	2	3	4	0.75
05/13/93	14:00:00	4	0	4	0	0	0	2	0.00
05/13/93	15:00:00	4	0	4	4	1	5	5	1.00
05/13/93	16:00:00	7	1	8	4	4	8	7	1.14
05/13/93	17:00:00	5	2	7	1	1	2	7	0.29
05/13/93	18:00:00	5	1	6	1	0	1	8	0.13
05/13/93	19:00:00	2	1	3	0	1	1	3	0.33
05/13/93	20:00:00	2	3	5	1	0	1	7	0.14
05/14/93	7:00:00	6	1	7	1	2	3	5	0.60
05/14/93	8:00:00	6	3	9	0	0	0	10	0.00
05/14/93	9:00:00	3	3	6	3	2	5	6	0.83
05/14/93	10:00:00	2	2	4	2	0	2	5	0.40
05/14/93	11:00:00	1	3	4	1	1	2	4	0.50
05/15/93	13:00:00	9	2	11	2	3	5	9	0.56
05/15/93	14:00:00[a]	6	1	7	0	0	0	8	0.00
05/15/93	15:00:00	13	0	13	1	1	2	14	0.14
05/15/93	16:00:00	11	2	13	3	0	3	12	0.25
05/15/93	17:00:00	5	0	5	0	0	0	5	0.00
05/15/93	18:00:00	6	0	6	0	1	1	6	0.17
05/15/93	19:00:00	4	0	4	0	0	0	5	0.00
05/15/93	20:00:00	2	5	7	0	3	3	6	0.50
05/16/93	7:00:00	6	4	10	4	4	8	12	0.67
05/16/93	8:00:00	15	0	15	1	0	1	17	0.06
05/16/93	9:00:00	9	1	10	2	2	4	8	0.50
05/16/93	10:00:00	4	1	5	2	0	2	7	0.29
05/17/93	16:00:00	1	1	2	1	1	2	2	1.00
05/17/93	17:00:00[a]	3	0	3	1	0	1	3	0.33
05/17/93	18:00:00	3	0	3	0	0	0	4	0.00
05/17/93	19:00:00	2	0	2	0	0	0	2	0.00
05/17/93	20:00:00	1	2	3	0	1	1	4	0.25
05/17/93	21:00:00	4	4	8	3	2	5	8	0.63
05/19/93	12:00:00	17	0	17	17	1	18	1	18.00
05/19/93	13:00:00	5	1	6	13	0	13	5	2.60
05/19/93	14:00:00	7	2	9	2	1	3	9	0.33
05/19/93	15:00:00	6	1	7	0	1	1	6	0.17
05/19/93	16:00:00	3	1	4	0	0	0	4	0.00
05/19/93	17:00:00	2	1	3	0	1	1	4	0.25
05/19/93	18:00:00	2	2	4	0	2	2	5	0.40
05/19/93	19:00:00	2	0	2	0	0	0	3	0.00
05/19/93	20:00:00	0	7	7	13	7	20	8	2.50
05/19/93	21:00:00	1	1	2	1	0	1	2	0.50
05/20/93	12:00:00	2	0	2	1	1	2	2	1.00
05/20/93	13:00:00	3	2	5	0	1	1	5	0.20
05/20/93	14:00:00	5	0	5	0	3	3	6	0.50
05/20/93	15:00:00	5	0	5	0	1	1	5	0.20
05/20/93	16:00:00	4	0	4	0	0	0	5	0.00
05/20/93	17:00:00	4	2	6	0	1	1	5	0.20
05/20/93	18:00:00	1	1	2	1	0	1	2	0.50

Appendix Table 13.--(continued)

Date	Time	Tagged chinook	Tagged steelhead	Total tagged	Untagged chinook	Untagged steelhead	Total untagged	No. cycles	Untagged per cycle
05/20/93	19:00:00	3	1	4	0	1	1	5	0.20
05/21/93	12:00:00	1	0	1	0	0	0	0	0.00
05/21/93	13:00:00	1	0	1	0	0	0	1	0.00
05/21/93	14:00:00	2	0	2	0	0	0	3	0.00
05/21/93	15:00:00	1	1	2	0	0	0	3	0.00
05/21/93	16:00:00	0	1	1	0	0	0	1	0.00
05/21/93	17:00:00	1	0	1	0	0	0	1	0.00
05/21/93	18:00:00	3	1	4	0	1	1	4	0.00
05/21/93	19:00:00	2	1	3	0	0	0	3	0.00
05/21/93	20:00:00	1	1	2	0	0	0	1	0.00
05/22/93	13:00:00	2	1	3	0	0	0	3	0.00
05/22/93	14:00:00	4	1	5	0	0	0	5	0.00
05/22/93	15:00:00	3	0	3	0	0	0	2	0.00
05/22/93	16:00:00	1	0	1	0	0	0	1	0.00
05/22/93	17:00:00	3	0	3	0	0	0	4	0.00
Totals		1742	290	2032	1171	334	1504	2110	
Averages		11.31	1.88	13.19	7.60	2.17	9.71	13.70	0.71

[a] Test results were not included in the analysis because the facility count indicated fewer fish passed through the system than were diverted.

Appendix Table 14.--Injury and descaling data for hourly tests of the "A" flume PIT-tag diversion system at Little Goose Dam, 1993.

		Chinook		Steelhead				
Date	Time	Not inj/des	inj/des	Not inj/des	inj/des	Total inj/des	Total fish	% inj/des
04/27/93	8:00:00	3	0	1	0	0	4	0.00
04/27/93	9:00:00	6	1	1	0	1	8	12.50
04/27/93	10:00:00	2	0	0	0	0	2	0.00
04/27/93	11:00:00	3	0	0	0	0	3	0.00
04/27/93	12:00:00	6	0	0	0	0	6	0.00
04/28/93	10:00:00	1	0	1	0	0	2	0.00
04/28/93	11:00:00	8	1	1	0	1	10	10.00
04/28/93	12:00:00	12	1	1	1	2	15	13.33
04/29/93	8:00:00	7	0	2	0	0	9	0.00
04/29/93	9:00:00	10	1	1	1	2	13	15.38
04/29/93	10:00:00	11	2	0	0	2	13	15.38
04/29/93	11:00:00	10	0	1	0	0	11	0.00
04/29/93	12:00:00	53	3	2	0	3	58	5.17
04/30/93	17:00:00	10	0	1	0	0	11	0.00
04/30/93	18:00:00	10	0	0	0	0	10	0.00
04/30/93	19:00:00	2	0	0	0	0	2	0.00
04/30/93	20:00:00	0	0	0	0	0	0	0.00
04/30/93	21:00:00	9	0	3	0	0	12	0.00
05/01/93	7:00:00	10	0	0	0	0	10	0.00
05/01/93	8:00:00	24	0	1	0	0	25	0.00
05/01/93	9:00:00	17	1	2	0	1	20	5.00
05/01/93	10:00:00	26	3	0	0	3	29	10.34
05/01/93	11:00:00	7	1	3	0	1	11	9.09
05/01/93	12:00:00	24	1	1	0	1	26	3.85
05/01/93	13:00:00	32	5	0	0	5	37	13.51
05/01/93	14:00:00	47	10	4	0	10	61	16.39
05/02/93	6:00:00	97	6	5	0	6	108	5.56
05/02/93	7:00:00	49	1	12	2	3	64	4.69
05/02/93	8:00:00	85	4	20	0	4	109	3.67
05/02/93	12:00:00[a]	26	3	4	1	4	34	11.76
05/02/93	13:00:00	41	6	6	1	7	54	12.96
05/03/93	7:00:00	36	2	2	0	2	40	5.00
05/03/93	8:00:00	31	4	5	0	4	40	10.00
05/03/93	9:00:00	28	2	0	0	2	30	6.67
05/03/93	10:00:00	12	1	1	1	2	15	13.33
05/03/93	11:00:00	27	5	0	1	6	33	18.18
05/03/93	12:00:00	108	2	1	2	4	113	3.54
05/03/93	13:00:00	68	8	11	2	10	89	11.24
05/03/93	14:00:00	81	13	5	0	13	99	13.13
05/04/93	7:00:00	59	10	0	0	10	69	14.50
05/04/93	12:00:00	13	0	3	0	0	16	0.00
05/04/93	13:00:00	67	5	9	1	6	82	7.31
05/05/93	17:00:00	21	4	1	1	5	27	18.52
05/05/93	18:00:00	20	4	1	0	4	25	16.00
05/05/93	19:00:00	34	4	3	0	4	41	9.76
05/05/93	20:00:00	83	11	10	1	12	105	11.43
05/05/93	21:00:00	120	19	15	0	19	154	12.34
05/06/93	7:00:00	29	1	4	0	1	34	2.94
05/06/93	8:00:00	21	1	0	0	1	22	4.55
05/06/93	9:00:00	17	1	5	2	3	25	12.00

Appendix Table 14.--(continued)

Date	Time	Chinook Not inj/des	Chinook inj/des	Steelhead Not inj/des	Steelhead inj/des	Total inj/des	Total fish	% inj/des
05/06/93	10:00:00	12	1	2	0	1	15	6.67
05/06/93	11:00:00	20	1	2	0	1	23	4.35
05/06/93	12:00:00	13	3	4	1	4	21	19.05
05/06/93	13:00:00	22	1	1	0	1	24	4.17
05/06/93	14:00:00	36	1	2	0	1	39	2.56
05/07/93	7:00:00[a]	9	2	0	0	2	11	18.18
05/07/93	8:00:00	13	1	0	0	1	14	7.14
05/07/93	9:00:00	23	5	5	0	5	33	15.15
05/07/93	10:00:00	24	0	5	0	0	29	0.00
05/07/93	11:00:00	10	0	2	0	0	12	0.00
05/07/93	12:00:00	14	3	4	0	3	21	14.29
05/07/93	13:00:00	4	0	0	0	0	4	0.00
05/07/93	14:00:00	16	1	1	0	1	18	5.56
05/08/93	7:00:00	15	2	6	2	4	25	16.00
05/08/93	8:00:00	10	1	9	2	3	22	13.64
05/08/93	9:00:00	23	2	8	1	3	34	8.82
05/08/93	10:00:00	14	0	8	0	0	22	0.00
05/08/93	11:00:00	34	2	8	2	4	46	8.70
05/08/93	12:00:00	33	5	19	0	5	57	8.77
05/08/93	13:00:00	50	3	32	3	6	88	6.82
05/08/93	14:00:00	44	5	21	1	6	71	8.45
05/09/93	18:00:00	23	1	1	0	1	25	4.00
05/09/93	19:00:00	37	7	31	1	8	76	10.53
05/09/93	20:00:00	100	1	36	1	2	138	1.45
05/09/93	21:00:00	79	11	19	1	12	110	10.91
05/10/93	7:00:00	7	1	0	0	1	8	12.50
05/10/93	8:00:00	29	5	28	3	8	65	12.31
05/10/93	9:00:00[a]	13	0	9	0	0	22	0.00
05/10/93	10:00:00	18	1	2	0	1	21	4.76
05/10/93	11:00:00	12	0	8	0	0	20	0.00
05/10/93	12:00:00	9	0	5	0	0	14	0.00
05/10/93	13:00:00	10	0	3	0	0	13	0.00
05/10/93	14:00:00	10	0	4	1	1	15	6.67
05/12/93	13:00:00	9	0	3	0	0	12	0.00
05/12/93	14:00:00[a]	3	0	3	1	1	7	14.29
05/12/93	15:00:00	3	2	0	0	2	5	40.00
05/12/93	16:00:00	6	1	2	0	1	9	11.11
05/12/93	17:00:00	13	0	11	0	0	24	0.00
05/12/93	18:00:00	1	0	1	0	0	2	0.00
05/12/93	19:00:00	3	0	1	0	0	4	0.00
05/12/93	20:00:00	11	1	4	1	2	17	11.76
05/13/93	13:00:00	3	1	3	0	1	7	14.29
05/13/93	14:00:00	4	0	0	0	0	4	0.00
05/13/93	15:00:00	8	0	0	1	1	9	11.11
05/13/93	16:00:00	11	0	4	1	1	16	6.25
05/13/93	17:00:00	6	0	3	0	0	9	0.00
05/13/93	18:00:00	6	0	1	0	0	7	0.00
05/13/93	19:00:00	2	0	2	0	0	4	0.00
05/13/93	20:00:00	3	0	3	0	0	6	0.00
05/14/93	7:00:00	6	1	3	0	1	10	10.00
05/14/93	8:00:00	5	1	2	1	2	9	22.22

Appendix Table 14.--(continued)

Date	Time	Chinook Not inj/des	Chinook inj/des	Steelhead Not inj/des	Steelhead inj/des	Total inj/des	Total fish	% inj/des
05/14/93	9:00:00	3	3	5	0	3	11	27.27
05/14/93	10:00:00	4	0	1	1	1	6	16.67
05/14/93	11:00:00	2	0	4	0	0	6	0.00
05/15/93	13:00:00	11	0	5	0	0	16	0.00
05/15/93	14:00:00[a]	5	1	1	0	1	7	14.29
05/15/93	15:00:00	14	0	1	0	0	15	0.00
05/15/93	16:00:00	14	0	2	0	0	16	0.00
05/15/93	17:00:00	4	1	0	0	1	5	20.00
05/15/93	18:00:00	4	2	1	0	2	7	28.57
05/15/93	19:00:00	4	0	0	0	0	4	0.00
05/15/93	20:00:00	1	1	7	1	2	10	20.00
05/16/93	7:00:00	8	2	7	1	3	18	16.67
05/16/93	8:00:00	15	1	0	0	1	16	6.25
05/16/93	9:00:00	8	3	3	0	3	14	21.43
05/16/93	10:00:00	6	0	0	1	1	7	14.30
05/17/93	16:00:00	2	0	2	0	0	4	0.00
05/17/93	17:00:00[a]	4	0	0	0	0	4	0.00
05/17/93	18:00:00	3	0	0	0	0	3	0.00
05/17/93	19:00:00	2	0	0	0	0	2	0.00
05/17/93	20:00:00	1	0	3	0	0	4	0.00
05/17/93	21:00:00	5	2	5	1	3	13	23.08
05/19/93	12:00:00	33	1	1	0	1	35	2.86
05/19/93	13:00:00	18	0	1	0	0	19	0.00
05/19/93	14:00:00	9	0	3	0	0	12	0.00
05/19/93	15:00:00	5	1	2	0	1	8	12.50
05/19/93	16:00:00	3	0	1	0	0	4	0.00
05/19/93	17:00:00	2	0	2	0	0	4	0.00
05/19/93	18:00:00	1	1	4	0	1	6	16.67
05/19/93	19:00:00	2	0	0	0	0	2	0.00
05/19/93	20:00:00	13	0	14	0	0	27	0.00
05/19/93	21:00:00	2	0	1	0	0	3	0.00
05/20/93	12:00:00	3	0	0	1	1	4	25.00
05/20/93	13:00:00	3	0	2	1	1	6	16.67
05/20/93	14:00:00	5	0	3	0	0	8	0.00
05/20/93	15:00:00	5	0	1	0	0	6	0.00
05/20/93	16:00:00	4	0	0	0	0	4	0.00
05/20/93	17:00:00	4	0	3	0	0	7	0.00
05/20/93	18:00:00	2	0	1	0	0	3	0.00
05/20/93	19:00:00	3	0	2	0	0	5	0.00
05/21/93	12:00:00	1	0	0	0	0	1	0.00
05/21/93	13:00:00	1	0	0	0	0	1	0.00
05/21/93	14:00:00	2	0	0	0	0	2	0.00
05/21/93	15:00:00	1	0	1	0	0	2	0.00
05/21/93	16:00:00	0	0	1	0	0	1	0.00
05/21/93	17:00:00	1	0	0	0	0	1	0.00
05/21/93	18:00:00	3	0	2	0	0	5	0.00
05/21/93	19:00:00	1	1	1	0	1	3	33.33
05/21/93	20:00:00	1	0	1	0	0	2	0.00
05/22/93	13:00:00	2	0	1	0	0	3	0.00
05/22/93	14:00:00	4	0	0	1	1	5	20.00
05/22/93	15:00:00	3	0	0	0	0	3	0.00

Appendix Table 14.--(continued)

Date	Time	Chinook Not inj/des	Chinook inj/des	Steelhead Not inj/des	Steelhead inj/des	Total inj/des	Total fish	% inj/des
05/22/93	16:00:00	1	0	0	0	0	1	0.00
05/22/93	17:00:00	3	0	0	0	0	3	0.00
Totals or averages		2673	240	575	49	289	3537	8.17

[a] Test results were not included in the analysis because the facility count indicated fewer fish passed through the system than were diverted.

Appendix Table 15.--Physical parameters of hourly tests of the "B" flume PIT -tag diversion system at Little Goose Dam, 1993.

Date	Time	Slide-gate cycle time	Expanded hourly count	Percent steelhead
04/27/93	8:00:00	1.000	360.4	72.8
04/27/93	9:00:00	1.000	450.5	72.8
04/27/93	10:00:00	1.000	240.2	72.8
04/27/93	11:00:00	1.000	450.5	72.8
04/27/93	12:00:00	1.000	660.7	72.8
04/28/93	10:00:00	0.500	240.2	70.0
04/28/93	11:00:00	0.500	690.7	70.0
04/28/93	12:00:00	0.500	690.7	70.0
04/29/93	8:00:00	0.800	38.0	70.0
04/29/93	9:00:00	0.800	1018.0	70.0
04/29/93	10:00:00	0.800	658.7	70.0
04/29/93	11:00:00	0.800	419.2	70.0
04/29/93	12:00:00	0.800	898.2	70.0
04/30/93	17:00:00	0.800	359.3	68.4
04/30/93	18:00:00	0.800	359.3	68.4
04/30/93	19:00:00	0.800	1197.6	68.4
04/30/93	20:00:00	0.800	1018.0	68.4
04/30/93	21:00:00	0.800	359.3	68.4
05/01/93	7:00:00	0.800	1325.3	64.6
05/01/93	8:00:00	0.800	602.4	64.6
05/01/93	9:00:00	0.800	1325.3	64.6
05/01/93	10:00:00	0.800	481.9	64.6
05/01/93	11:00:00	0.800	2168.7	64.6
05/01/93	12:00:00	0.800	602.4	64.6
05/01/93	13:00:00	0.800	1445.8	64.6
05/01/93	14:00:00	0.800	963.9	64.6
05/02/93	6:00:00	0.800	843.4	79.0
05/02/93	7:00:00	0.800	2168.7	79.0
05/02/93	8:00:00	0.800	1686.7	79.0
05/03/93	7:00:00	0.800	746.3	67.1
05/03/93	8:00:00	0.800	2388.1	67.1
05/03/93	9:00:00	0.800	1343.3	67.1
05/03/93	10:00:00	0.800	895.5	67.1
05/03/93	11:00:00	0.800	1194.0	67.1
05/03/93	12:00:00	0.800	1641.8	67.1
05/03/93	13:00:00	0.800	895.5	67.1
05/03/93	14:00:00	0.800	746.3	67.1
05/04/93	7:00:00	0.800	1940.3	64.2
05/04/93	12:00:00	0.800	298.5	64.2
05/04/93	13:00:00	0.800	1044.8	64.2
05/05/93	17:00:00	0.800	895.5	69.0
05/05/93[a]	18:00:00	0.800	0.0	69.0

Appendix Table 15.--(continued)

Date	Time	Slide-gate cycle time	Expanded hourly count	Percent steelhead
05/05/93	19:00:00	0.800	1343.3	69.0
05/05/93	20:00:00	0.800	5074.6	69.0
05/05/93	21:00:00	0.800	5223.9	69.0
05/06/93	7:00:00	0.800	1791.0	69.0
05/06/93	8:00:00	0.800	2238.8	69.0
05/06/93	9:00:00	0.800	4925.4	69.0
05/06/93	10:00:00	0.800	2238.8	69.0
05/06/93	11:00:00	0.800	3283.6	69.0
05/06/93	12:00:00	0.800	1343.3	69.0
05/06/93	13:00:00	0.800	1194.0	69.0
05/06/93	14:00:00	0.800	597.0	69.0
05/07/93	7:00:00	0.800	895.5	74.2
05/07/93[a]	8:00:00	0.800	0.0	74.2
05/07/93	9:00:00	0.800	1194.0	74.2
05/07/93	10:00:00	0.800	1044.8	74.2
05/07/93	11:00:00	0.800	447.8	74.2
05/07/93	12:00:00	0.800	2388.1	74.2
05/07/93	13:00:00	0.800	1194.0	74.2
05/07/93	14:00:00	0.800	746.3	74.2
05/08/93	7:00:00	0.800	1641.8	88.4
05/08/93	8:00:00	0.800	1343.3	88.4
05/08/93	9:00:00	0.800	6417.9	88.4
05/08/93	10:00:00	0.800	1492.5	88.4
05/08/93	11:00:00	0.800	3582.1	88.4
05/08/93	12:00:00	0.800	4477.6	88.4
05/08/93	13:00:00	0.800	2985.1	88.4
05/08/93	14:00:00	0.800	1492.5	88.4
05/09/93	18:00:00	0.800	3000.0	89.6
05/09/93	19:00:00	0.800	3200.0	89.6
05/09/93	20:00:00	0.800	8200.0	89.6
05/09/93	21:00:00	0.800	3600.0	89.6
05/10/93	7:00:00	0.800	6400.0	80.5
05/10/93[a]	8:00:00	0.800	5.0	80.5
05/10/93	9:00:00	0.800	3400.0	80.5
05/10/93	10:00:00	0.800	2000.0	80.5
05/10/93	11:00:00	0.800	1600.0	80.5
05/10/93	12:00:00	0.800	1000.0	80.5
05/10/93	13:00:00	0.800	1600.0	80.5
05/10/93	14:00:00	0.800	600.0	80.5
05/12/93	13:00:00	0.800	1492.5	87.0
05/12/93	14:00:00	0.800	895.5	87.0
05/12/93	15:00:00	0.800	1343.3	87.0
05/12/93	16:00:00	0.800	1343.3	87.0
05/12/93	17:00:00	0.800	2388.1	87.0

Appendix Table 15.--(continued)

Date	Time	Slide-gate cycle time	Expanded hourly count	Percent steelhead
05/12/93	18:00:00	0.800	447.8	87.0
05/12/93	19:00:00	0.800	2238.8	87.0
05/12/93	20:00:00	0.800	1940.3	87.0
05/13/93	13:00:00	0.800	3134.3	85.0
05/13/93	14:00:00	0.800	1044.8	85.0
05/13/93	15:00:00	0.800	1641.8	85.0
05/13/93	16:00:00	0.800	597.0	85.0
05/13/93	17:00:00	0.800	1194.0	85.0
05/13/93	18:00:00	0.800	895.5	85.0
05/13/93	19:00:00	0.800	1641.8	85.0
05/13/93	20:00:00	0.800	2089.6	85.0
05/14/93	7:00:00	0.800	746.3	84.1
05/14/93	8:00:00	0.800	2089.6	84.1
05/14/93	9:00:00	0.800	1194.0	84.1
05/14/93	10:00:00	0.800	3432.8	84.1
05/14/93	11:00:00	0.800	597.0	84.1
05/15/93	13:00:00	0.800	1940.3	81.2
05/15/93	14:00:00	0.800	447.8	81.2
05/15/93	15:00:00	0.800	597.0	81.2
05/15/93	16:00:00	0.800	597.0	81.2
05/15/93	17:00:00	0.800	1343.3	81.2
05/15/93	18:00:00	0.800	746.3	81.2
05/15/93	19:00:00	0.800	1492.5	81.2
05/15/93	20:00:00	0.800	1343.3	81.2
05/16/93	7:00:00	0.800	4461.5	92.6
05/16/93	8:00:00	0.800	1461.5	92.6
05/16/93	9:00:00	0.800	2538.5	92.6
05/16/93	10:00:00	0.800	2461.5	92.6
05/17/93	16:00:00	0.800	1000.5	90.0
05/17/93	17:00:00	0.800	923.1	90.0
05/17/93	18:00:00	0.800	1153.8	90.0
05/17/93	19:00:00	0.800	1538.5	90.0
05/17/93	20:00:00	0.800	4307.7	90.0
05/17/93	21:00:00	0.800	1692.3	90.0
05/19/93	12:00:00	0.800	1538.5	84.7
05/19/93	13:00:00	0.800	1230.8	84.7
05/19/93	14:00:00	0.800	3153.8	84.7
05/19/93	15:00:00	0.800	2000.0	84.7
05/19/93	16:00:00	0.800	1923.1	84.7
05/19/93	17:00:00	0.800	2076.9	84.7
05/19/93	18:00:00	0.800	846.2	84.7
05/19/93	19:00:00	0.800	1538.5	84.7
05/19/93	20:00:00	0.800	2692.3	84.7
05/19/93	21:00:00	0.800	2153.8	84.7

Appendix Table 15.--(continued)

Date	Time	Slide-gate cycle time	Expanded hourly count	Percent steelhead
05/20/93	12:00:00	0.800	384.6	88.9
05/20/93	13:00:00	0.800	1153.8	88.9
05/20/93	14:00:00	0.800	1230.8	88.9
05/20/93	15:00:00	0.800	461.5	88.9
05/20/93	16:00:00	0.800	538.5	88.9
05/20/93	17:00:00	0.800	923.1	88.9
05/20/93	18:00:00	0.800	384.6	88.9
05/20/93	19:00:00	0.800	846.2	88.9
05/21/93	12:00:00	0.800	384.6	91.4
05/21/93[a]	13:00:00	0.800	0.0	91.4
05/21/93	14:00:00	0.800	538.5	91.4
05/21/93	15:00:00	0.800	692.3	91.4
05/21/93	16:00:00	0.800	307.7	91.4
05/21/93	17:00:00	0.800	384.6	91.4
05/21/93	18:00:00	0.800	384.6	91.4
05/21/93	19:00:00	0.800	1076.9	91.4
05/21/93	20:00:00	0.800	1307.7	91.4
05/22/93	13:00:00	0.800	600.0	90.5
05/22/93	14:00:00	0.800	1650.0	90.5
05/22/93	15:00:00	0.800	1050.0	90.5
05/22/93	16:00:00	0.800	650.0	90.5
05/22/93	17:00:00	0.800	550.0	90.5

[a] Test results were not included in the analysis because facility count indicated fewer fish passed through the system than were diverted.

Appendix Table 16.--Numbers of tagged and untagged fish diverted per hourly test of the "B" flume PIT-tag diversion system at Little Goose Dam 1993

Date	Time	Tagged chinook	Tagged steelhead	Total tagged	Untagged chinook	Untagged steelhead	Total untagged	No. cycles	Untagged per cycle
04/27/93	8:00:00	1	1	2	0	0	0	1	0.00
04/27/93	9:00:00	2	1	3	0	0	0	3	0.00
04/27/93	10:00:00	4	2	6	0	0	0	7	0.00
04/27/93	11:00:00	2	1	3	0	3	3	6	0.50
04/27/93	12:00:00	1	2	3	0	3	3	3	1.00
04/28/93	10:00:00	1	3	4	0	0	0	7	0.00
04/28/93	11:00:00	4	3	7	0	4	4	11	0.36
04/28/93	12:00:00	6	4	10	0	3	3	7	0.43
04/29/93	8:00:00	3	2	5	0	0	0	5	0.00
04/29/93	9:00:00	1	0	1	0	0	0	5	0.00
04/29/93	10:00:00	2	1	3	0	0	0	4	0.00
04/29/93	11:00:00	0	2	2	0	1	1	2	0.50
04/29/93	12:00:00	4	0	4	1	16	17	4	4.25
04/30/93	17:00:00	0	0	0	0	0	0	0	0.00
04/30/93	18:00:00	0	1	1	0	1	1	2	0.50
04/30/93	19:00:00	0	2	2	0	2	2	2	1.00
04/30/93	20:00:00	0	2	2	0	1	1	2	0.50
04/30/93	21:00:00	3	2	5	1	3	4	3	1.33
05/01/93	7:00:00	14	0	14	5	0	5	10	0.50
05/01/93	8:00:00	1	3	4	0	0	0	4	0.00
05/01/93	9:00:00	5	2	7	0	0	0	7	0.00
05/01/93	10:00:00	4	2	6	0	2	2	5	0.40
05/01/93	11:00:00	3	1	4	0	1	1	2	0.50
05/01/93	12:00:00	2	2	4	1	1	2	4	0.50
05/01/93	13:00:00	0	0	0	0	0	0	0	0.00
05/01/93	14:00:00	2	0	2	0	0	0	1	0.00
05/02/93	6:00:00	3	2	5	0	3	3	5	0.60
05/02/93	7:00:00	3	2	5	0	0	0	2	0.00
05/02/93	8:00:00	5	2	7	1	0	1	5	0.20
05/03/93	7:00:00	15	5	20	1	4	5	20	0.25
05/03/93	8:00:00	16	5	21	6	2	8	17	0.47
05/03/93	9:00:00	17	2	19	2	4	6	13	0.46
05/03/93	10:00:00	9	4	13	0	6	6	17	0.35
05/03/93	11:00:00	12	13	25	3	20	23	28	0.82
05/03/93	12:00:00	9	9	18	2	22	24	22	1.10
05/03/93	13:00:00	15	10	25	3	12	15	21	0.71
05/03/93	14:00:00	12	2	14	2	14	16	2	8.00
05/04/93	7:00:00	9	6	15	7	6	13	16	0.81
05/04/93	12:00:00	7	6	13	0	1	1	15	0.07
05/04/93	13:00:00	11	2	13	0	13	13	14	0.92
05/05/93	17:00:00	2	11	13	0	12	12	19	0.63
05/05/93	18:00:00[a]	3	5	8	1	2	3	13	0.23
05/05/93	19:00:00	7	11	18	3	12	15	20	0.75
05/05/93	20:00:00	11	20	31	7	28	35	35	1.00
05/05/93	21:00:00	19	17	36	22	56	78	40	1.63
05/06/93	2:00:00	2	13	15	2	4	6	16	0.38
05/06/93	7:00:00	6	7	13	5	12	17	15	1.13
05/06/93	9:00:00	4	10	14	1	5	6	14	0.48
05/06/93	10:00:00	1	7	8	2	2	4	8	0.50
05/06/93	11:00:00	5	8	13	1	8	9	14	0.64
05/06/93	12:00:00	1	6	7	1	2	3	7	0.43
05/06/93	13:00:00	5	9	14	0	3	3	13	0.23
05/06/93	14:00:00	8	10	18	2	1	3	15	0.20
05/07/93	7:00:00	2	3	5	0	7	7	5	1.40
05/07/93	8:00:00[a]	3	6	9	1	2	3	8	0.38
05/07/93	9:00:00	1	2	3	0	2	2	4	0.50
05/07/93	10:00:00	2	6	8	1	0	1	4	0.25
05/07/93	11:00:00	3	7	10	2	4	6	12	0.50
05/07/93	12:00:00	3	16	19	1	5	6	15	0.40
05/07/93	13:00:00	1	5	6	0	3	3	6	0.50
05/07/93	14:00:00	3	5	8	1	4	5	7	0.71
05/08/93	7:00:00	0	13	13	0	4	4	15	0.27
05/08/93	8:00:00	2	17	19	5	14	19	22	0.86
05/08/93	9:00:00	4	14	18	2	16	18	14	1.29
05/08/93	10:00:00	1	16	17	2	5	7	18	0.39
05/08/93	11:00:00	1	18	19	0	17	17	26	0.65
05/08/93	12:00:00	5	28	33	5	47	52	25	2.08
05/08/93	13:00:00	7	27	34	7	116	123	35	3.51
05/08/93	14:00:00	3	28	31	2	24	26	32	0.81

Appendix Table 16. --(continued)

Date	Time	Tagged chinook	Tagged steelhead	Total tagged	Untagged chinook	Untagged steelhead	Total untagged	No. cycles	Untagged per cycle
05/09/93	18:00:00	0	7	7	0	3	3	7	0.43
05/09/93	19:00:00	5	25	30	9	87	96	34	2.82
05/09/93	20:00:00	1	22	23	6	43	49	28	1.75
05/09/93	21:00:00	6	18	24	6	37	43	22	1.95
05/10/93	7:00:00	2	2	4	14	3	17	2	8.50
05/10/93	8:00:00[a]	0	5	5	1	7	8	4	2.00
05/10/93	9:00:00	1	10	11	0	28	28	11	2.55
05/10/93	10:00:00	1	7	8	0	2	2	8	0.25
05/10/93	11:00:00	0	6	6	0	0	0	6	0.00
05/10/93	12:00:00	0	11	11	0	4	4	12	0.33
05/10/93	13:00:00	0	8	8	1	14	15	8	1.88
05/10/93	14:00:00	0	7	7	1	2	3	7	0.43
05/12/93	13:00:00	0	6	6	0	2	2	6	0.33
05/12/93	14:00:00	1	2	3	0	4	4	6	0.67
05/12/93	15:00:00	0	4	4	0	1	1	4	0.25
05/12/93	16:00:00	0	4	4	1	4	5	5	1.00
05/12/93	17:00:00	1	12	13	0	12	12	12	1.00
05/12/93	18:00:00	1	1	2	1	1	2	3	0.67
05/12/93	19:00:00	2	10	12	0	6	6	13	0.46
05/12/93	20:00:00	5	14	19	2	10	12	17	0.71
05/13/93	13:00:00	1	4	5	0	2	2	4	0.50
05/13/93	14:00:00	0	5	5	0	2	2	5	0.40
05/13/93	15:00:00	0	6	6	1	2	3	6	0.50
05/13/93	16:00:00	0	4	4	1	2	3	5	0.60
05/13/93	17:00:00	1	2	3	0	1	1	4	0.25
05/13/93	18:00:00	2	4	6	0	0	0	6	0.00
05/13/93	19:00:00	1	11	12	1	6	7	12	0.58
05/13/93	20:00:00	4	20	24	9	20	29	24	1.21
05/14/93	7:00:00	5	6	11	2	7	9	12	0.75
05/14/93	8:00:00	1	7	8	1	2	3	7	0.43
05/14/93	9:00:00	2	7	9	0	4	4	8	0.50
05/14/93	10:00:00	2	8	10	1	7	8	10	0.80
05/14/93	11:00:00	0	4	4	2	1	3	5	0.60
05/15/93	13:00:00	4	10	14	1	6	7	15	0.47
05/15/93	14:00:00	3	7	10	1	2	3	8	0.38
05/15/93	15:00:00	8	2	10	2	1	3	12	0.25
05/15/93	16:00:00	5	1	6	0	0	0	4	0.00
05/15/93	17:00:00	3	6	9	2	2	4	9	0.44
05/15/93	18:00:00	4	3	7	0	1	1	9	0.11
05/15/93	19:00:00	4	9	13	1	0	1	14	0.07
05/15/93	20:00:00	6	10	16	1	9	10	16	0.63
05/16/93	7:00:00	3	9	12	2	20	22	12	1.83
05/16/93	8:00:00	8	7	15	0	17	17	14	1.21
05/16/93	9:00:00	3	5	8	1	4	5	10	0.50
05/16/93	10:00:00	3	9	12	0	5	5	11	0.45
05/17/93	16:00:00	3	3	6	2	1	3	5	0.60
05/17/93	17:00:00	1	5	6	2	3	5	7	0.71
05/17/93	18:00:00	0	5	5	0	2	2	5	0.40
05/17/93	19:00:00	2	6	8	0	2	2	6	0.33
05/17/93	20:00:00	4	11	15	3	21	24	17	1.41
05/17/93	21:00:00	2	5	7	0	7	7	9	0.78
05/19/93	12:00:00	3	1	4	0	0	0	3	0.00
05/19/93	13:00:00	3	3	6	0	4	4	5	0.80
05/19/93	14:00:00	2	4	6	0	14	14	7	2.00
05/19/93	15:00:00	1	9	10	1	4	5	8	0.63
05/19/93	16:00:00	1	3	4	0	3	3	4	0.75
05/19/93	17:00:00	1	1	2	1	2	3	3	1.00
05/19/93	18:00:00	2	4	6	0	2	2	6	0.33
05/19/93	19:00:00	1	4	5	0	7	7	7	1.00
05/19/93	20:00:00	7	13	20	10	50	60	19	3.16
05/19/93	21:00:00	4	10	14	4	5	9	15	0.60
05/20/93	12:00:00	0	0	0	0	0	0	0	0.00
05/20/93	13:00:00	4	3	7	1	2	3	7	0.43
05/20/93	14:00:00	2	4	6	0	5	5	9	0.56
05/20/93	15:00:00	3	2	5	0	2	2	6	0.33
05/20/93	16:00:00	2	2	4	0	1	1	2	0.50
05/20/93	17:00:00	1	2	3	0	0	0	4	0.00
05/20/93	18:00:00	1	1	2	0	0	0	4	0.00
05/20/93	19:00:00	5	2	7	1	0	1	5	0.20
05/21/93	12:00:00	1	2	3	1	2	3	3	1.00

Appendix Table 16. --(continued)

Date	Time	Tagged chinook	Tagged steelhead	Total tagged	Untagged chinook	Untagged steelhead	Total untagged	No. cycles	Untagged per cycle
05/21/93	13:00:00[a]	0	2	2	1	2	3	2	1.50
05/21/93	14:00:00	0	2	2	0	2	2	4	0.50
05/21/93	15:00:00	3	1	4	0	0	0	3	0.00
05/21/93	16:00:00	2	1	3	0	4	4	3	1.33
05/21/93	17:00:00	2	0	2	0	0	0	4	0.00
05/21/93	18:00:00	2	1	3	0	0	0	2	0.00
05/21/93	19:00:00	0	1	1	0	0	0	2	0.00
05/21/93	20:00:00	1	4	5	0	4	4	3	1.33
05/22/93	13:00:00	2	3	5	0	2	2	5	0.40
05/22/93	14:00:00	2	0	2	0	0	0	1	0.00
05/22/93	15:00:00	2	0	2	0	0	0	2	0.00
05/22/93	16:00:00	0	1	1	0	0	0	1	0.00
05/22/93	17:00:00	0	1	1	0	0	0	1	0.00
Totals		494	923	1417	209	1111	1378	1437	
Averages		3.25	6.07	9.32	1.38	7.31	8.68	9.45	0.96

[a] Test results were not included in the analysis because facility count indicated fewer fish passed through the system than were diverted.

Appendix Table 17.--Injury and descaling data from the hourly tests of the "B" flume PIT-tag diversion system at Little Goose Dam, 1993.

		Chinook		Steelhead				
Date	Time	Not inj/des	inj/des	Not inj/des	inj/des	Total inj/des	Total fish	% inj/des
04/27/93	8:00:00	1	0	1	0	0	2	0.00
04/27/93	9:00:00	2	0	1	0	0	3	0.00
04/27/93	10:00:00	4	0	2	0	0	6	0.00
04/27/93	11:00:00	2	0	4	0	0	6	0.00
04/27/93	12:00:00	1	0	5	0	0	6	0.00
04/28/93	10:00:00	1	0	3	0	0	4	0.00
04/28/93	11:00:00	4	0	7	0	0	11	0.00
04/28/93	12:00:00	6	0	6	1	1	13	7.69
04/29/93	8:00:00	3	0	2	0	0	5	0.00
04/29/93	9:00:00	1	0	0	0	0	1	0.00
04/29/93	10:00:00	2	0	1	0	0	3	0.00
04/29/93	11:00:00	0	0	3	0	0	3	0.00
04/29/93	12:00:00	5	0	16	0	0	21	0.00
04/30/93	17:00:00	0	0	0	0	0	0	0.00
04/30/93	18:00:00	0	0	2	0	0	2	0.00
04/30/93	19:00:00	0	0	4	0	0	4	0.00
04/30/93	20:00:00	0	0	3	0	0	3	0.00
04/30/93	21:00:00	4	0	5	0	0	9	0.00
05/01/93	7:00:00	18	1	0	0	1	19	5.26
05/01/93	8:00:00	1	0	3	0	0	4	0.00
05/01/93	9:00:00	5	0	2	0	0	7	0.00
05/01/93	10:00:00	4	0	4	0	0	8	0.00
05/01/93	11:00:00	2	1	2	0	1	5	20.00
05/01/93	12:00:00	3	0	3	0	0	6	0.00
05/01/93	13:00:00	0	0	0	0	0	0	0.00
05/01/93	14:00:00	1	1	0	0	1	2	50.00
05/02/93	6:00:00	2	1	4	1	2	8	25.00
05/02/93	7:00:00	2	1	1	1	2	5	40.00
05/02/93	8:00:00	5	1	1	1	2	8	25.00
05/03/93	7:00:00	13	3	9	0	3	25	12.00
05/03/93	8:00:00	17	5	7	0	5	29	17.24
05/03/93	9:00:00	17	2	5	1	3	25	12.00
05/03/93	10:00:00	9	0	10	0	0	19	0.00
05/03/93	11:00:00	15	0	32	1	1	48	2.08
05/03/93	12:00:00	11	0	30	1	1	42	2.38
05/03/93	13:00:00	16	2	21	1	3	40	7.50
05/03/93	14:00:00	13	1	16	0	1	30	3.33
05/04/93	7:00:00	15	1	12	0	1	28	3.57
05/04/93	12:00:00	6	1	7	0	1	14	7.14
05/04/93	13:00:00	10	1	15	0	1	26	3.85
05/05/93	17:00:00	2	0	20	3	3	25	12.00
05/05/93	18:00:00[a]	4	0	6	1	1	11	9.09
05/05/93	19:00:00	8	2	21	2	4	33	12.12
05/05/93	20:00:00	11	7	43	5	12	66	18.18
05/05/93	21:00:00	23	18	65	8	26	114	22.81
05/06/93	7:00:00	11	0	18	1	1	30	3.33
05/06/93	8:00:00	4	0	17	0	0	21	0.00
05/06/93	9:00:00	4	1	14	1	2	20	10.00
05/06/93	10:00:00	2	1	8	1	2	12	16.67

Appendix Table 17.--(continued)

Date	Time	Chinook Not inj/des	Chinook inj/des	Steelhead Not inj/Des	Steelhead inj/des	Total inj/des	Total fish	% inj/des
05/06/93	11:00:00	5	1	14	2	3	22	13.64
05/06/93	12:00:00	2	0	7	1	1	10	10.00
05/06/93	13:00:00	4	1	12	0	1	17	5.88
05/06/93	14:00:00	9	1	11	0	1	21	4.76
05/07/93	7:00:00	2	0	9	1	1	12	3.97
05/07/93	8:00:00[a]	4	0	8	0	0	12	0.00
05/07/93	9:00:00	1	0	4	0	0	5	0.00
05/07/93	10:00:00	3	0	6	0	0	9	0.00
05/07/93	11:00:00	5	0	10	1	1	16	6.25
05/07/93	12:00:00	3	1	20	1	2	25	8.00
05/07/93	13:00:00	1	0	7	1	1	9	11.11
05/07/93	14:00:00	4	0	9	0	0	13	0.00
05/08/93	7:00:00	0	0	15	2	2	17	11.76
05/08/93	8:00:00	5	2	28	3	5	38	13.16
05/08/93	9:00:00	6	0	27	3	3	36	8.33
05/08/93	10:00:00	3	0	16	5	5	24	20.83
05/08/93	11:00:00	1	0	31	4	4	36	11.11
05/08/93	12:00:00	10	0	67	8	8	85	9.41
05/08/93	13:00:00	12	2	143	0	2	157	1.27
05/08/93	14:00:00	4	1	47	5	6	57	10.53
05/09/93	18:00:00	0	0	10	0	0	10	0.00
05/09/93	19:00:00	11	3	101	11	14	126	11.11
05/09/93	20:00:00	4	3	62	3	6	72	8.33
05/09/93	21:00:00	9	3	54	1	4	67	5.97
05/10/93	7:00:00	16	0	5	0	0	21	0.00
05/10/93	8:00:00[a]	1	0	12	0	0	13	0.00
05/10/93	9:00:00	1	0	37	1	1	39	2.56
05/10/93	10:00:00	1	0	8	1	1	10	10.00
05/10/93	11:00:00	0	0	6	0	0	6	0.00
05/10/93	12:00:00	0	0	15	0	0	15	0.00
05/10/93	13:00:00	1	0	19	3	3	23	13.04
05/10/93	14:00:00	0	1	9	0	1	10	10.00
05/12/93	13:00:00	0	0	8	0	0	8	0.00
05/12/93	14:00:00	1	0	6	0	0	7	0.00
05/12/93	15:00:00	0	0	4	1	1	5	20.00
05/12/93	16:00:00	1	0	8	0	0	9	0.00
05/12/93	17:00:00	1	0	14	10	10	25	40.00
05/12/93	18:00:00	2	0	2	0	0	4	0.00
05/12/93	19:00:00	2	0	15	1	1	18	5.56
05/12/93	20:00:00	6	1	19	5	6	31	19.35
05/13/93	13:00:00	1	0	6	0	0	7	0.00
05/13/93	14:00:00	0	0	7	0	0	7	0.00
05/13/93	15:00:00	1	0	6	2	2	9	22.22
05/13/93	16:00:00	1	0	6	0	0	7	0.00
05/13/93	17:00:00	1	0	2	1	1	4	25.00
05/13/93	18:00:00	2	0	4	0	0	6	0.00
05/13/93	19:00:00	2	0	15	2	2	19	10.53
05/13/93	20:00:00	11	2	40	0	2	53	3.77
05/14/93	7:00:00	6	1	11	2	3	20	15.00
05/14/93	8:00:00	2	0	9	0	0	11	0.00
05/14/93	9:00:00	2	0	11	0	0	13	0.00

Appendix Table 17.--(continued)

Date	Time	Chinook Not inj/des	Chinook inj/des	Steelhead Not inj/des	Steelhead inj/des	Total inj/des	Total fish	% inj/des
05/14/93	10:00:00	3	0	11	4	4	18	22.22
05/14/93	11:00:00	2	0	4	1	1	7	14.29
05/15/93	13:00:00	5	0	14	2	2	21	9.52
05/15/93	14:00:00	4	0	8	1	1	13	7.69
05/15/93	15:00:00	9	1	3	0	1	13	7.69
05/15/93	16:00:00	5	0	1	0	0	6	0.00
05/15/93	17:00:00	5	0	6	2	2	13	15.38
05/15/93	18:00:00	4	0	4	0	0	8	0.00
05/15/93	19:00:00	5	0	9	0	0	14	0.00
05/15/93	20:00:00	6	1	16	3	9	26	34.62
05/16/93	7:00:00	5	0	26	3	3	34	8.82
05/16/93	8:00:00	8	0	20	4	4	32	27.57
05/16/93	9:00:00	3	1	9	0	1	13	7.69
05/16/93	10:00:00	3	0	12	2	2	17	11.76
05/17/93	16:00:00	5	0	4	0	0	9	0.00
05/17/93	17:00:00	2	1	8	0	1	11	9.09
05/17/93	18:00:00	0	0	6	1	1	7	14.29
05/17/93	19:00:00	1	1	7	1	2	10	20.00
05/17/93	20:00:00	6	1	27	5	6	39	15.38
05/17/93	21:00:00	2	0	11	1	1	14	7.14
05/19/93	12:00:00	3	0	1	0	0	4	0.00
05/19/93	13:00:00	3	0	3	4	4	10	40.00
05/19/93	14:00:00	2	0	13	5	5	20	25.00
05/19/93	15:00:00	2	0	10	3	3	15	20.00
05/19/93	16:00:00	1	0	4	2	2	7	28.57
05/19/93	17:00:00	2	0	3	0	0	5	0.00
05/19/93	18:00:00	2	0	6	0	0	8	0.00
05/19/93	19:00:00	1	0	9	2	2	12	16.67
05/19/93	20:00:00	15	2	51	12	14	80	17.50
05/19/93	21:00:00	5	3	14	1	4	23	17.39
05/20/93	12:00:00	0	0	0	0	0	0	0.00
05/20/93	13:00:00	5	0	2	3	2	10	20.00
05/20/93	14:00:00	2	0	6	3	3	11	27.27
05/20/93	15:00:00	3	0	4	0	0	7	0.00
05/20/93	16:00:00	2	0	3	0	0	5	0.00
05/20/93	17:00:00	1	0	2	0	0	3	0.00
05/20/93	18:00:00	0	1	1	0	1	2	50.00
05/20/93	19:00:00	6	0	2	0	0	8	0.00
05/21/93	12:00:00	2	0	4	0	0	6	0.00
05/21/93	13:00:00[a]	1	0	3	1	1	5	20.00
05/21/93	14:00:00	0	0	4	0	0	4	0.00
05/21/93	15:00:00	3	0	0	1	1	4	25.00
05/21/93	16:00:00	2	0	3	2	2	7	28.57
05/21/93	17:00:00	2	0	0	0	0	2	0.00
05/21/93	18:00:00	1	1	1	0	1	3	33.33
05/21/93	19:00:00	0	0	1	0	0	1	0.00
05/21/93	20:00:00	0	1	3	5	6	9	66.67
05/22/93	13:00:00	2	0	2	3	3	7	42.86
05/22/93	14:00:00	2	0	0	0	0	2	0.00
05/22/93	15:00:00	2	0	0	0	0	2	0.00
05/22/93	16:00:00	0	0	0	1	1	1	100.00

Appendix Table 17.--(continued)

Date	Time	Chinook Not inj/des	Chinook inj/des	Steelhead Not inj/des	Steelhead inj/des	Total inj/des	Total fish	% inj/des
05/22/93	17:00:00	0	0	1	0	0	1	0.00
Totals or average		610	93	1845	189	282	2737	10.30

[a] Test results were not included in the analysis because facility count indicated fewer fish passed through the system than were diverted.

BLUE SH. BEF. AP. B

Appendix B

Scale Analysis Report

ANNUAL PROGRESS REPORT

FISH RESEARCH PROJECT
OREGON

PROJECT TITLE: Life History Studies of Spring and Summer Chinook Salmon and Steelhead from the Snake River Using Scale Analysis

CONTRACT NUMBER: 40ABNF201411

CONTRACT PERIOD: April 1 to September 30, 1993.

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CONTENTS

SUMMARY

Objectives for FY 1993

1. Determine the hatchery:wild ratios of spring and summer chinook salmon from scales of juveniles and adults sampled at Lower Granite Dam.

2. Determine the effects of transport on age at maturity, growth, migration timing, and other life history characteristics from scales of adult spring and summer chinook salmon and steelhead at Lower Granite Dam.

Accomplishments in FY 1993

We read the scales from 790 juvenile chinook salmon, 645 adult spring chinook salmon, and 307 adult summer chinook salmon from the run-at-large and classified their rearing origin as hatchery or wild. We examined scales from 164 spring and summer chinook salmon marked for the transportation study and tested for differences in life history and growth characteristics between transport and control groups.

Findings in FY 1993

We estimated that 22.7% ($\pm$7.1%) of the outmigration of juvenile spring and summer chinook salmon was wild, while 18.4% ($\pm$5.2%) of the spring chinook salmon and 51.1% ($\pm$7.3%) of the summer chinook salmon returning to Lower Granite Dam were wild fish. We found no differences in life history, migration timing, or growth between transported and control groups of chinook salmon. Immediately after ocean entrance, steelhead from the control group displayed significantly better growth than did fish that were transported, however, growth rates between the two groups quickly became similar.

INTRODUCTION

Since 1975, run sizes of spring and summer chinook salmon in the Snake River have decreased to historical lows with completion of Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams. The Columbia Basin Fish and Wildlife Authority and U.S. Army Corps of Engineers have implemented a large-scale transportation program in an effort to eliminate mortality of juvenile salmonids caused by dam passage. Although decisions have been made to implement transport at near maximum levels, definitive data on survival benefits of transporting spring chinook salmon are lacking (Matthews et al. 1990). Transportation benefits for spring chinook salmon have been difficult to evaluate because of inadequate adult returns and unexplained variability in existing return data. This variation may be caused by unknown proportions of hatchery and wild fish in the experimental transport and control samples.

In 1988, the National Marine Fisheries Service (NMFS) began a pilot study to evaluate the feasibility of using PIT-tagged wild spring chinook salmon to determine transportation benefits to wild fish. However, the 10% recovery rate for marked fish at Lower Granite Dam (LGD) makes this method difficult in a large study because of the large number of wild fish that need to be tagged and the high cost of PIT tags.

Discriminant analysis of fish scale patterns is an accepted method of identifying hatchery or wild origins of salmon. Between 1978 and 1987, the Oregon Department of Fish and Wildlife (ODFW) used discriminant analysis to correctly classify 85-95% of hatchery and wild coho salmon caught in ocean fisheries off Oregon (Borgerson 1988). Fryer and Schwartzberg (1990) used discriminant analysis to correctly classify 84-91% of hatchery and wild spring chinook salmon from the Deschutes, Wenatchee, Grande Ronde, and Imnaha rivers. Discriminant analysis will be used as an alternative method to estimate the wild and hatchery composition of the run-at-large and the experimental transport and control groups for the NMFS transportation study.

Benefits of transport have been evaluated in terms of smolt-to-adult survival. Transport may have effects on the life history dynamics of the populations that need to be understood to evaluate fully the benefits of transport programs. It is reasonable to expect that fish that are transported 320 miles from LGD to below Bonneville Dam in 1-3 days and control fish that migrate volitionally the same distance in 20-60 days may differ in migration timing, growth, and age at maturity. Park (1985) found that steelhead transported from Little Goose and Lower Granite dams returned to hatcheries later than non-transported fish.

In 1991, we began analyzing scales on returning adults (Borgerson 1991). In 1992, we analyzed scales from outmigrating juveniles as well as adults (Borgerson 1992). This report includes results from the analysis of scales from both juveniles and adults sampled in 1993 and the comparison of life history characteristics of adult chinook salmon belonging to transport and control groups for the NMFS transportation study. Also in this report is a table on the age compositions of the adult run-at-large for 1991-93. Age composition data for fish used in the transportation study have been reported, but we did not include data for the run-at-large in previous reports.

METHODS

Scale Preparation and Reading

Scale collection involved three agencies and two tribes. Personnel from NMFS collected the mixed-stock groups of chinook salmon and steelhead from LGD. Personnel from Idaho Department of Fish and Game, ODFW, and the Nez Perce and Umatilla tribes collected the known origin scales used to develop the discriminant functions. We provided diagrams showing location of the key scale area (Nicholas and Van Dyke 1982) and sample procedures so all collections were sampled by the same methods.

Mixed-stock spring and summer chinook salmon from LGD were collected proportionally throughout the run-at-large. We selected sample sizes for all groups so that the analyses would yield 95% confidence intervals that were ±25% of the point estimates (Worlund and Fredin 1962). Because the percentage of wild fish in the sample affects the size of the confidence interval, we started our study by assuming that wild fish would comprise 5-10% of the juvenile population and 20% of the adult population. Based on these criteria, we set the sample size requirements at 1,750 per group of juveniles and 550 per group of adults. All adult spring and summer chinook salmon and summer steelhead marked for the transportation study were sampled for scales.

We mounted the scales from LGD on gummed cards and made acetate impressions. Scales collected at other locations were mounted and pressed by the collecting agency. All collectors provided location, length, date, presence or absence of mark, and sex data for each sample.

We used an Apple IIc microcomputer, Altec digitizing board, and Scale Reader Program software (Mullen 1984) to measure and record scale measurements. The scale image was enlarged to 88x magnification using a microfiche reader. Measurements were made along a radius 20^{0} to the anterior-posterior axis on the ventral side of the scale. We made two groups of measurements; one group consisted of intensive measurements in the freshwater zone on all chinook salmon scales used for the hatchery or wild discriminant analysis (Figure 1). A second set of measurements was made on the portion of the scale that represented juvenile migration and early ocean residence of all chinook salmon and summer steelhead that were marked for the transportation study (Figure 2). After reading the scales, measurement data were transferred from the Apple IIc computer to an IBM-compatible computer for computation of additional variables (Table 1) and final analysis.

Hatchery or Wild Classification of Chinook Salmon

We used discriminant analysis to classify spring and summer chinook salmon by hatchery or wild origin. For discriminant analysis to provide meaningful results, the training populations of known origin samples used to develop the function must be representative of the groups within the unknown sample. We used scale samples from various streams based on the estimated contribution of fish from that stream to the overall population. For example, the wild spring chinook salmon training population was weighted so that 1/4 of the samples were from Oregon tributaries and 3/4 were from Idaho tributaries. The training populations representing hatchery fish were composed of scale samples in proportion to the release numbers from each hatchery and the approximate survival of the hatchery group. **APPENDIX A** contains a list of specific locations where scales used in training populations were collected.

Ideally, the samples making up the training populations would be from the same brood years as the samples in the unknown groups. Since field personnel were unable to collect sufficient known samples from any one year, we used as many known samples from the current brood years as were available and augmented the training populations with fish from previous brood years that were reared most similarly to current production strategies. With each new year of analysis, we add current year scales to the training populations and remove scales that are from the oldest brood years.

We developed three linear discriminant functions using BMDP Statistical Software 88 Release (Dixon et al. 1988). One function classified combined spring and summer chinook salmon juveniles. A second function classified adult spring chinook salmon, while the third was developed for adult summer chinook salmon. All three functions classified the fish according to hatchery

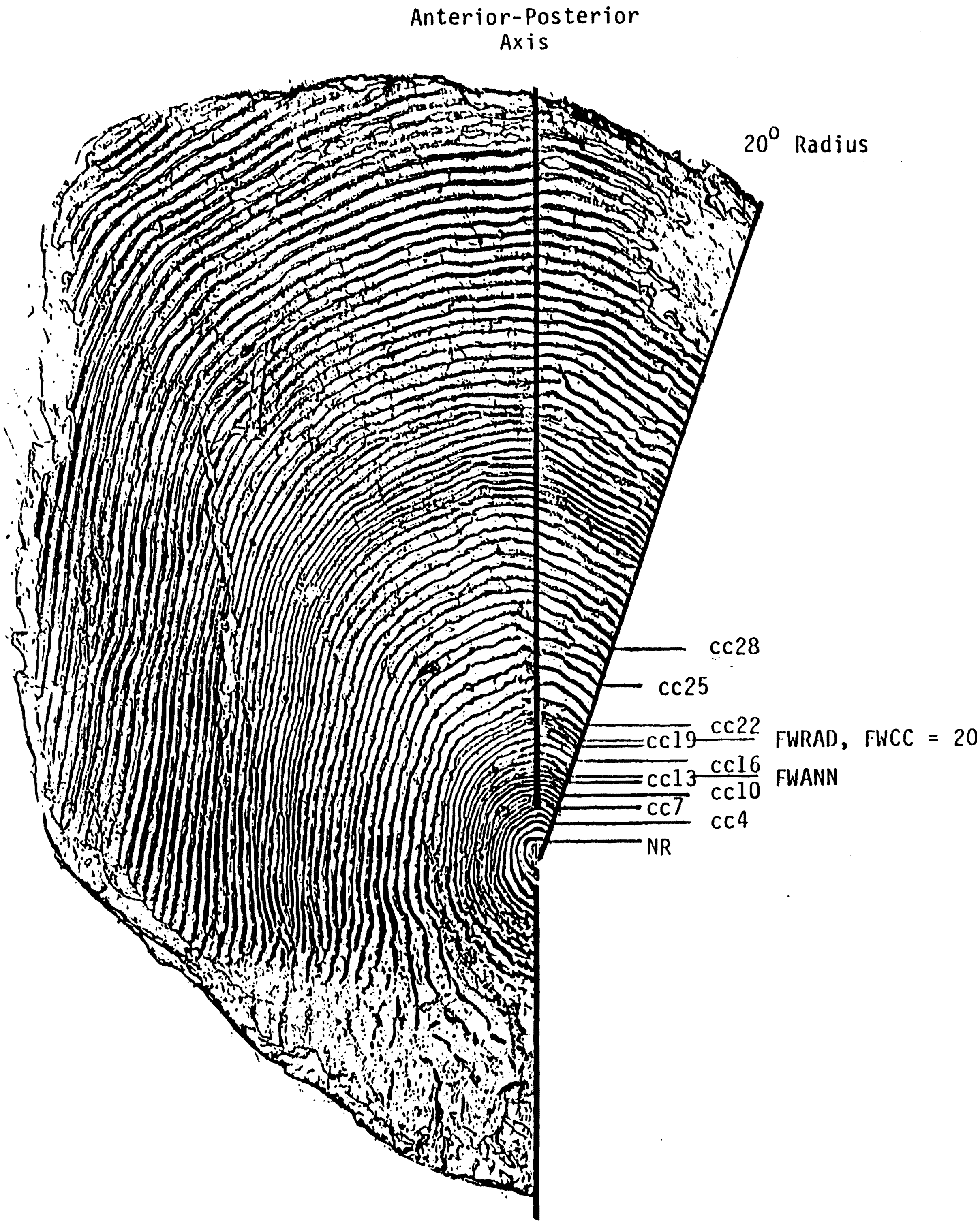

Figure 1. Measurements of scale growth used to discriminate between hatchery and wild chinook salmon. The scale is from a wild spring chinook salmon sampled in Capehorn Creek, tributary to North Fork of the Salmon River. Measurement labels are defined in Table 1.

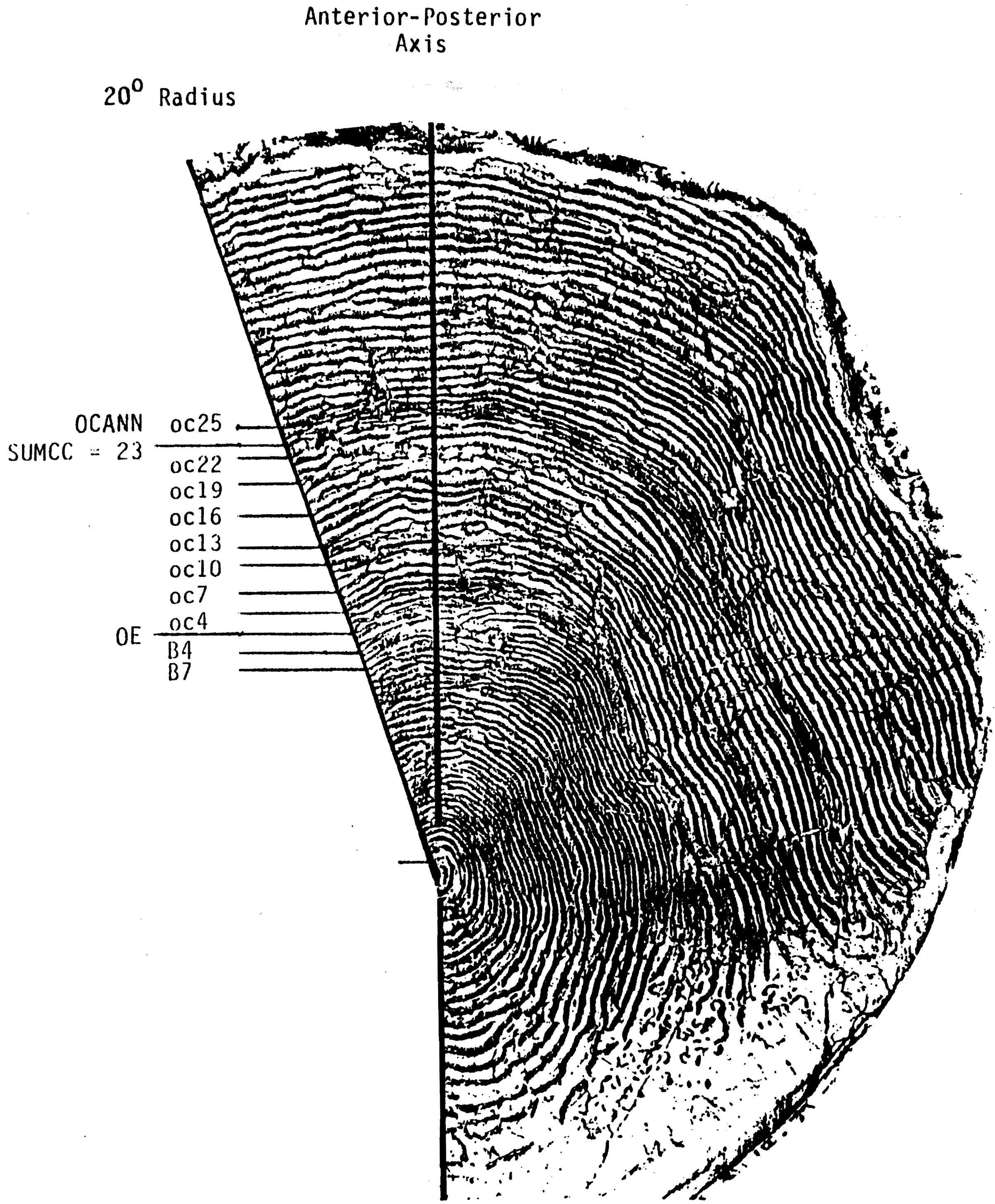

Figure 2. Measurements of scale growth that occurred during juvenile migration and early ocean residence. The scale is from a hatchery reared summer steelhead marked as part of the control group for the transport study. Measurement labels are defined in Table 1.

Table 1. Definition of scale variables read or calculated.

Variable	Definition
Read:	
FWCC	Number of circuli in the freshwater zone.
NR	Radial measurement of the nucleus, also considered Circulus 1.
FWANN	Radial measurement to the winter annulus of the freshwater zone.
FWRAD, OE	Radial measurement to the last circulus in the freshwater zone.
CC4-CC28	Radial measurements in 3 circuli increments between the fourth and 28th circuli of the freshwater zone.
SUMCC	Number of circuli between OE and the first annulus formed in the ocean.
OCANN	Radial measurement to the first annulus formed in the ocean.
OC4-OC25	Radial measurements in 3 circuli increments between the fourth and 25th circuli of the ocean zone.
B4	Radial measurement to the fourth circulus counted back into the freshwater zone from OE, inclusive.
B7	Radial measurement to the seventh circulus counted back into the freshwater zone from OE, inclusive.
Calculated:	
BW1	Width of first band of 3 circuli, CC4-NR.
BW2	Width of second band of 3 circuli, CC7 - CC4.
BW123	Bandwidths 1, 2, and 3, CC10 - NR.
BW56	Bandwidths 5 and 6, CC19 - CC13.
FWANN2	FWANN - NR.
FWAVSP	Average circuli spacing in the freshwater zone, (FWRAD-NR)/(FWCC-1).
R1D6	Ratio of bandwidths 1 and 6, (CC4-NR)/(CC19-CC16).
JM1	OE - B4.
JM2	B4 - B7.
OR1	OC4 - OE.
OR2	OC7 - OC4.
OR3	OC10 - OC7.
OR4	OC13 - OC10.
OR5	OC16 - OC13.
OR6	OC19 - OC16.
OR7	OC22 - OC19.
OR8	OC25 - OC22.
OET	OCANN-OE.

or wild origin. Variables were added to or removed from the function in a step-wise method based on their F values. The juvenile chinook salmon function contained four variables (FWANN2, FWAVSP, CC13, and BW1), the adult spring chinook salmon function contained five variables (FWANN2, FWAVSP, CC13, CC22, and CC25), and the summer chinook salmon function contained five variables (FWANN2, R12D67, BW1, CC13, and FWAVSP). For all functions, the variable FWANN2, representing fish size at the end of the winter in fresh water, was the first variable selected and was the most powerful for discriminating between hatchery and wild fish.

Ideally, we would have tested the classification ability of our functions with additional sets of known origin samples, but that was not possible. Instead, we estimated correct classification using the cross validation method (Table 2). In 1991, we estimated the correct classification of our spring chinook salmon function using the jackknife method, provided by BMDP Statistical Software (Efron 1982), as well as the cross-validation and bootstrap methods (Efron and Tibshirani 1991) and found that cross validation provided the most conservative results.

After the run-at-large samples were classified, we corrected the results for misclassification and calculated confidence intervals using the methods of Worlund and Fredin (1962). Fish that had been marked for the transportation study were also classified. We noted the percentage of wild fish within the marked transport and control groups, but we did not correct the estimate or calculate confidence intervals for these small subsamples.

Table 2. Two-way classification matrixes for the known hatchery and wild groups of spring and summer chinook salmon used to develop discriminant function in 1993.

	Stock		
	Wild	Hatchery	Composite
Juvenile spring and summer chinook salmon			
% Correct classification	88.0	96.7	90.6
Sample size	216	92	308
Adult spring chinook salmon			
% Correct classification	86.8	87.8	87.3
Sample size	151	164	315
Adult summer chinook salmon			
% Correct classification	90.4	92.4	91.3
Sample size	125	105	230

Age Composition, Ocean Growth Rate, and Migration Timing

We determined the total age of each fish by counting winter annuli. The total age was calculated by adding one to the count of annuli to account for the first winter spent in the gravel as an egg or pre-emergent fry. Brood year was determined by subtracting total age from the return year. Age compositions of fish returning in one year were calculated as simple percentages of the fish of each age within our sample. The age composition of fish in a brood year were determined by weighting the fish of each age by the run size the year they returned. We used a contingency table to compare the age compositions.

We used two-way analysis of variance on scale measurements representing ocean entrance timing and growth during juvenile migration and early ocean residence to test for significant differences ($P \leq 0.05$) between hatchery and wild fish that were transported or used as controls in the transportation study. Chinook salmon were included in either the hatchery or wild group based on the results of the discriminant analysis. For this analysis, spring and summer run fish were pooled together. Steelhead were identified as hatchery fish by having clipped fins. All steelhead released from hatcheries in the Snake River system are fin clipped; steelhead with no clipped fins were assumed to be wild. Chinook salmon and summer steelhead were identified as belonging to experimental transport and control groups by various freeze brands (Matthews et al. 1991). For this analysis we used all fish that were branded in 1989, including those that were analyzed in previous years (Borgerson 1992).

To represent growth that occurred during early ocean residence, we used measurements of five-circuli bands beyond the ocean entrance check. To represent growth that occurred in the Snake and Columbia rivers during migration, we measured two bands of three circuli that immediately preceded the ocean entrance check (Figure 2). Depending on how quickly a fish migrated, these river bands may include growth from freshwater residence as well as migration.

We used the distance between the first winter annulus formed in the ocean and the ocean entrance check to index the time of ocean entrance. We assumed that the winter annulus was formed at the same time of the year for all fish so if the distance between the ocean entrance check and the annulus was large, the fish had entered the ocean "early." A small distance would indicate "late" ocean entrance.

RESULTS AND DISCUSSION

Wild or Hatchery Classification of Chinook Salmon

Results from our hatchery or wild discriminant analysis are in Table 3. Scales from juveniles were analyzed for the first time in 1992, while scales from adults were analyzed in 1991 and 1992. In 1991 we found 20.1% and 54.6% wild fish in the spring and summer runs of adult chinook salmon, respectively. In contrast to the 1991 runs, we found that wild fish made up 11.3% and 35.8% of the spring and summer runs of returning adults in 1992, respectively, while 11.6% of the outmigrating juveniles were wild. The 1993 results are very similar to the 1991 results.

Table 3. Percentage of wild fish in the spring and summer chinook salmon populations (run-at-large) sampled at LGD, estimated by discriminant analysis of scale patterns.

Group	Estimate (± half-width of the 95% confidence interval)
Juvenile spring and summer chinook salmon (Brood year 1991)	22.7% (± 7.1%)
Adult spring chinook salmon (Brood years 1988-90)	18.4% (± 5.2%)
Adult summer chinook salmon (Brood years 1988-90)	51.1% (± 7.3%)

With the 1993 sampling, we completed returns of the fish branded in 1989 and 1990 for the NMFS transportation study. We assume we will not recover any age 6 fish branded in 1990. Over the 3 years of scale analysis, we recovered 48 branded fish in 1991, 91 branded fish in 1992, and 75 branded fish in 1993. In 1992 we reported receiving only 16 scale samples from branded fish, however, we received an additional 75 samples collected in 1992 after our report was printed. The percentage of wild fish by return year is given in Table 4. Within one return year are fish that were branded in several different years. Return year data are comparable to the percent wild reported for the run-at-large and include fish from several different brood years. Run-at-large data are divided into spring and summer runs while data from branded fish are pooled. To compare branded groups to the run at large, we weighted the data from the spring and summer runs by the counts of fish over LGD (personal communication on 7 December 1993 with Jerrel Harmon, National Marine Fisheries Service, Pomeroy, Washington) and calculated that the combined run contained 33.8%, 18.9%, and 23.5% wild fish in 1991, 1992, and 1993, respectively. The 3-year weighted average of contribution by wild fish was 23.7%. The combined run-at-large contained both barged and naturally migrating fish.

Pooling all branded fish recovered in 1991 and 1992 results in 3 fish branded in 1988 at McNary Dam, 64 fish branded in 1989 for transport and control groups at LGD, and 147 fish branded in 1990 for the barge transport index at LGD. The percentage of wild fish in each group is given in Table 5. The number of fish classified as wild for each individual brand applied at LGD is given in **APPENDIX B**. Branded fish are not separated into spring and summer runs in either table. Discounting the group branded in 1988 at McNary Dam for poor sample size, our data show a higher percentage of wild fish in the barged groups. Since the 1990 barge index group has no control, it can be compared to only the run-at-large, which was composed of fish that were both transported and allowed to migrate naturally.

Table 4. Percentage of wild fish in groups of fish branded and coded wire tagged for the transportation study and recovered at Lower Granite Dam in 1991, 1992, and 1993. Data for the combined spring and summer run-at-large are included for comparison.

Return year	Barged	Control	Barged and control groups combined		Run-at-large	
			% wild	No.	% wild	No.
1991	52.9	28.6	45.8	48	33.8	756
1992	23.2	22.2	23.1	91	18.9	785
1993	55.6	--	53.3	75	23.5	952

Table 5. Percentage of wild fish in groups of fish branded and coded wire tagged for the transportation study in 1988, 1989, and 1990, sampled at Lower Granite Dam.

Dam where marked	Brand year	Group	Percent wild	N
McNary	1988	Control	100	1
McNary	1988	Barge experiment	50.0	2
Lower Granite	1989	Control	22.7	22
Lower Granite	1989	Barge experiment	38.1	42
Lower Granite	1990	Barge index	40.8	147

Age Composition of the Run-at-Large, 1991-1993

Managers and researchers have used historical, average age compositions in their plans and analyses because year-specific data were not available. Table 6 contains the age compositions of the hatchery and wild components of the spring and summer run of chinook salmon for the return years 1991-93. Within each return year, wild fish (spring and summer runs combined) had significantly different age compositions from hatchery fish ($P \leq 0.05$). The age compositions of all fish combined differed significantly among the three years of our sample ($P \leq 0.05$). These data should not become the "new" average age composition because they were influenced by the strong 1988 brood and may not represent other years. The 1988 brood contributed to between-year differences by producing high percentages of age 3 fish in 1991, age 4 fish in 1992, and age 5 fish in 1993.

Within the return years of 1991-1993, we have nearly complete data for the brood year 1988 (Table 6). Only age 6 fish are missing and they will probably account for less than 0.5% of the total fish. The age composition of wild fish was significantly different ($P \leq 0.05$) from the age composition of hatchery fish from the 1988 brood, and we found significant differences in the age compositions between spring and summer runs for both wild and hatchery stocks.

Table 6. Percent age composition of adult spring and summer chinook salmon sampled from the run-at-large at Lower Granite Dam in 1991, 1992, and 1993. Also included is the age composition for the 1988 brood, which migrated in 1990 and returned 1991-1993.

Total age	Spring chinook salmon		Summer chinook salmon		All fish	Total scales read
	Wild	Hatchery	Wild	Hatchery		
Return year 1991:						
3	11.8	18.4	16.8	33.0	19.2	145
4	37.8	48.8	36.5	38.4	43.3	327
5	50.4	32.8	46.7	28.6	37.5	283
	100	100	100	100	100	755
Return year 1992:						
3	0	1.7	3.1	4.1	2.3	20
4	84.3	80.6	59.1	72.9	75.9	653
5	15.7	17.4	37.8	22.5	21.5	185
6	0	0.3	0	0.5	0.2	2
	100	100	100	100	100	860
Return year 1993:						
3	0	0.8	1.1	2.6	1.0	10
4	23.7	35.7	21.3	23.7	29.2	300
5	76.3	63.5	77.0	73.7	69.7	716
6	0	0	0.6	0	0.1	1
	100	100	100	100	100	1,027
Brood year 1988:						
3	3.4	4.6	11.7	10.3	6.2	145
4	31.2	51.5	42.2	50.1	47.7	653
5	65.4	43.8	46.1	39.6	46.1	716
	100	100	100	100	100	1,514

Differences in Age Composition, Ocean Growth Rate, and Migration Timing Between Hatchery and Wild Fish Belonging to Experimental Transport and Control Groups

We found no significant differences between the age compositions of transport and control groups of chinook salmon ($X^2 = 0.207$, $P = 0.902$) or summer steelhead ($X^2 = 5.845$, $P = 0.558$). Age compositions for fish used in transportation studies at LGD are given in Table 7. For chinook salmon, 3-year-old fish were recovered one year before scale sampling began so the number given in Table 7 for age 3 is taken from Appendix Tables 2.0 and 3.0 by Matthews et al. (1991).

We found no differences ($P > 0.05$) in any scale parameter between groups of barged and control chinook salmon. Also, there were no differences in scale variables representing early ocean growth and migration timing between hatchery and wild chinook salmon. Means of variables analyzed are in Tables 8 and 9.

We found significant differences in three variables between groups of barged and control steelhead (Table 10). The variable OR1 represents growth occurring immediately after ocean entrance and soon after migration or transport. The other two significant variables, OR4 and OR5, occur later in time, probably near the middle of the summer. The two variables, OR2 and OR3, which represent growth during the time between OR1 and OR4, were not significant and cast some doubt as to how transporting could truly influence OR4 and OR5 when it did not influence these two variables. We found significant differences in most variables between hatchery and wild fish. Our data suggest that wild steelhead entered the ocean earlier than hatchery fish and once in the ocean grew better than hatchery fish.

PLANS FOR 1994

We will analyze scales from the run-at-large of juvenile and adult spring and summer chinook salmon for hatchery or wild origin.

Table 7. Age composition of spring and summer chinook salmon and summer steelhead marked for the transportation study in 1989 and recovered through 1993 at Lower Granite Dam.

Total age	Life history[a] (Freshwater/Ocean)	Transport		Control	
		Number	Percent	Number	Percent
Spring and summer chinook salmon					
3	1/1	3	6.7	2	7.7
4	1/2	24	53.3	15	57.7
5	1/3	18	40.0	9	34.6
Summer steelhead					
3	1/1	25	17.1	21	23.9
4	2/1	5	3.4	5	5.7
5	3/1	2	1.4	2	2.3
4	1/2	91	62.3	50	56.8
5	2/2	20	13.7	7	8.0
6	3/2	2	1.4	1	1.1
5	1/3	1	0.7	1	1.1
6	2/3	0	--	1	1.1

[a] *Number of freshwater annuli/number of ocean annuli.*

Table 8. Group means for scale variables representing growth during juvenile migration (JM) and early ocean residence (OR), and ocean entrance timing (OET) for adult spring and summer chinook salmon from the transportation study branded at Lower Granite Dam in 1989 and sampled at Lower Granite Dam through 1993.

Variable name	Means			
	Wild		Hatchery	
	Transport	Control	Transport	Control
JM1	60.2	53.0	58.0	54.1
JM2	59.4	60.6	54.5	48.7
OR1	85.0	85.4	98.6	97.9
OR2	111.4	92.4	114.6	111.8
OR3	108.4	98.6	108.3	105.8
OR4	105.1	101.8	97.5	106.1
OR5	109.1	113.0	104.3	110.9
OR6	110.9	98.3	106.4	110.9
OET	768.1	615.2	680.7	706.3
Sample size	16	5	26	17

Table 9. Group means for scale variables representing growth during juvenile migration (JM) and early ocean residence (OR), and ocean entrance timing (OET) for adult spring and summer chinook salmon in the barge index group from the transportation study branded at Lower Granite Dam in 1990 and recovered at Lower Granite Dam through 1993.

Variable name	Means: Wild	Means: Hatchery
JM1	64.9	55.2
JM2	63.4	54.0
OR1	97.3	102.5
OR2	99.5	106.3
OR3	88.4	93.0
OR4	92.5	95.6
OR5	96.6	107.3
OR6	107.4	104.1
OET	487.0	588.8
Sample size	60	87

Table 10. Two-way analysis of variance and group means for scale variables representing growth during juvenile migration (JM) and early ocean residence (OR), and ocean entrance timing (OET) for adult summer steelhead from the transportation study sampled at Lower Granite Dam in 1991.

Variable name	Means: Wild Transport	Means: Wild Control	Means: Hatchery Transport	Means: Hatchery Control	Significant differences ($P < .05$): Type	Origin	Type x origin interaction
JM1	58.4	62.6	63.0	61.8	-	-	-
JM2	53.8	58.7	65.0	61.5	-	X	-
OR1	83.0	93.3	80.4	87.9	X	-	-
OR2	100.1	97.8	90.1	94.4	-	X	-
OR3	104.7	109.5	90.2	94.2	-	X	-
OR4	100.7	110.3	90.9	98.9	X	X	-
OR5	101.1	111.1	98.4	101.1	X	X	-
OR6	108.3	118.2	103.7	99.1	-	X	X
OR7	112.6	110.7	98.1	90.8	-	X	-
OR8	113.7	113.3	94.9	73.5	-	X	-
OET	747.3	746.1	553.9	515.3	-	X	-
Sample size	28	16	117	72			

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APPENDIX A

Stock composition of training populations used to develop discriminant functions for classifying spring and summer chinook salmon of unknown origin.

Training population location	Number	Percent
Juvenile Spring and Summer Chinook Salmon		
Hatchery:		
Dworshak	11	12.0
McCall	11	12.0
Rapid River	64	69.5
Kooskia	6	6.5
	92	100.0
Wild:		
Clearwater	4	1.9
Grande Ronde	46	21.3
Imnaha	15	6.9
Middle Fork Salmon	89	41.2
Salmon	21	9.7
South Fork Salmon	41	19.0
	216	100.0
Adult Spring Chinook Salmon		
Hatchery:		
Clearwater	17	10.5
Rapid River	48	29.6
Kooskia	15	9.3
Sawtooth	38	23.4
Dworshak	29	17.9
Lookingglass	15	9.3
	162	100.0
Wild:		
Middle Fork Salmon	82	54.3
Clearwater	4	2.7
Salmon	21	13.9
Grande Ronde	44	29.1
	151	100.0

APPENDIX A. Continued.

Training population location	Number	Percent
Adult Summer Chinook Salmon		
Hatchery:		
McCall	49	46.7
Pahsimeroi	37	35.2
Lookingglass	19	18.1
	105	100.0
Wild:		
South Fork Salmon	85	66.7
Imnaha	40	33.3
	125	100.0

APPENDIX B

Hatchery or wild classification based on scale analysis of spring and summer chinook salmon marked for the transportation study at Lower Granite Dam in 1989 and recovered at the same dam in 1991, 1992, and 1993.

Mark		Classification		
Brand	CWT code	Number hatchery	Number wild	Total
		1989 Control		
LA2-1	232256	2	0	2
LA2-2	232258	0	0	0
LA2-3	232349	2	0	2
LA2-4	232350	7	1	8
LART-1	232351	1	1	2
LART-2	232352	0	0	0
LART-3	232411	1	0	1
LART-4	232412	0	0	0
LA3-1	232413	1	2	3
LA3-2	232414	1	1	2
LA3-3	232415	0	0	0
LA3-4	232415	1	0	1
Total		16	5	21
		1989 Barge Experiment		
RAF-1	232252	2	0	2
RAF-2	232259	5	3	8
RAF-3	232262	4	0	4
RAF-4	232309	3	8	11
RA9-1	232310	2	1	3
RA9-2	232311	3	1	4
RA9-3	232312	2	1	3
RA9-4	232313	0	2	2
RASU-1	232340	1	1	2
RASU-2	232354	1	0	1
RASU-3	232251	1	0	1
RASU-4	232251	1	0	1
RASU-?	?	1	0	1
Total		26	17	43

APPENDIX B. Continued.

Mark		Classification		
Brand	CWT code	Number hatchery	Number wild	Total
		1990 Barge Index		
RAL-1	232429	9	2	11
RAL-4	232430	7	1	8
RAL-2	232431	10	7	17
RAV-1	232432	12	1	13
RAV-2	232433	10	8	18
RAV-3	232434	29	20	49
RAV-4	232435	8	21	29
RA?	?	2	0	2
Total		87	60	147