NORTHWEST FISHERIES CENTER
PROCESSED REPORT
NOVEMBER 1975

Snake River Runs of Salmon and Steelhead Trout: Collection and Transportation Experiments at Little Goose Dam, 1971-75

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SNAKE RIVER RUNS OF SALMON AND STEELHEAD TROUT: COLLECTION AND TRANSPORTATION EXPERIMENTS AT LITTLE GOOSE AND LOWER GRANITE DAMS, 1971 - 75

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Report of Research

Financed By

U.S. Army Corps of Engineers

North Pacific Division

and

Northwest Fisheries Center

National Marine Fisheries Service

Coastal Zone and Estuarine Studies Division

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Revised November 1975

INTRODUCTION

The National Marine Fisheries Service (NMFS) has been conducting transportation experiments since 1968 to find ways of reducing downstream losses of Snake River populations of juvenile chinook salmon, Oncorhynchus tshawytscha, and steelhead trout, Salmo gairdneri. Since 1971, we have been concentrating on an experiment where migrating juvenile salmon and steelhead trout are collected at Little Goose Dam and then transported to two locations downstream from Bonneville Dam (Fig. 1). Beginning in 1975, similar experiments are ongoing at Lower Granite Dam. At Little Goose and Lower Granite dams traveling screens are a significant part of the collection system and experiments have been designed to test their effectiveness in guiding fingerlings into the bypass system.

Transportation Summary - Little Goose Dam

The transport experiment was designed to determine effects of transportation on homing and survival of juveniles. The data, summarized in Figures 2 (chinook) and 3 (steelhead) indicate that survival of both chinook and steelhead was increased in most years (71-73) by collection and transportation. The percentage increase in survival varies from year to year depending on river conditions. During years when survival of natural migrants was very low, we had correspondingly low survival of our control release and the percentage benefit from transport was greatest. For example, in 1973, survival estimates indicated an all-time low survival rate for both juvenile chinook and steelhead migrants; transport benefit ratios were the highest (16:1 for chinook - 13:1 for steelhead). (Adult return data through November 10, 1975.) The only exception was the poor return of chinook

Transportation route from Little Goose and Lower Granite Dams to Bonneville tailrace.

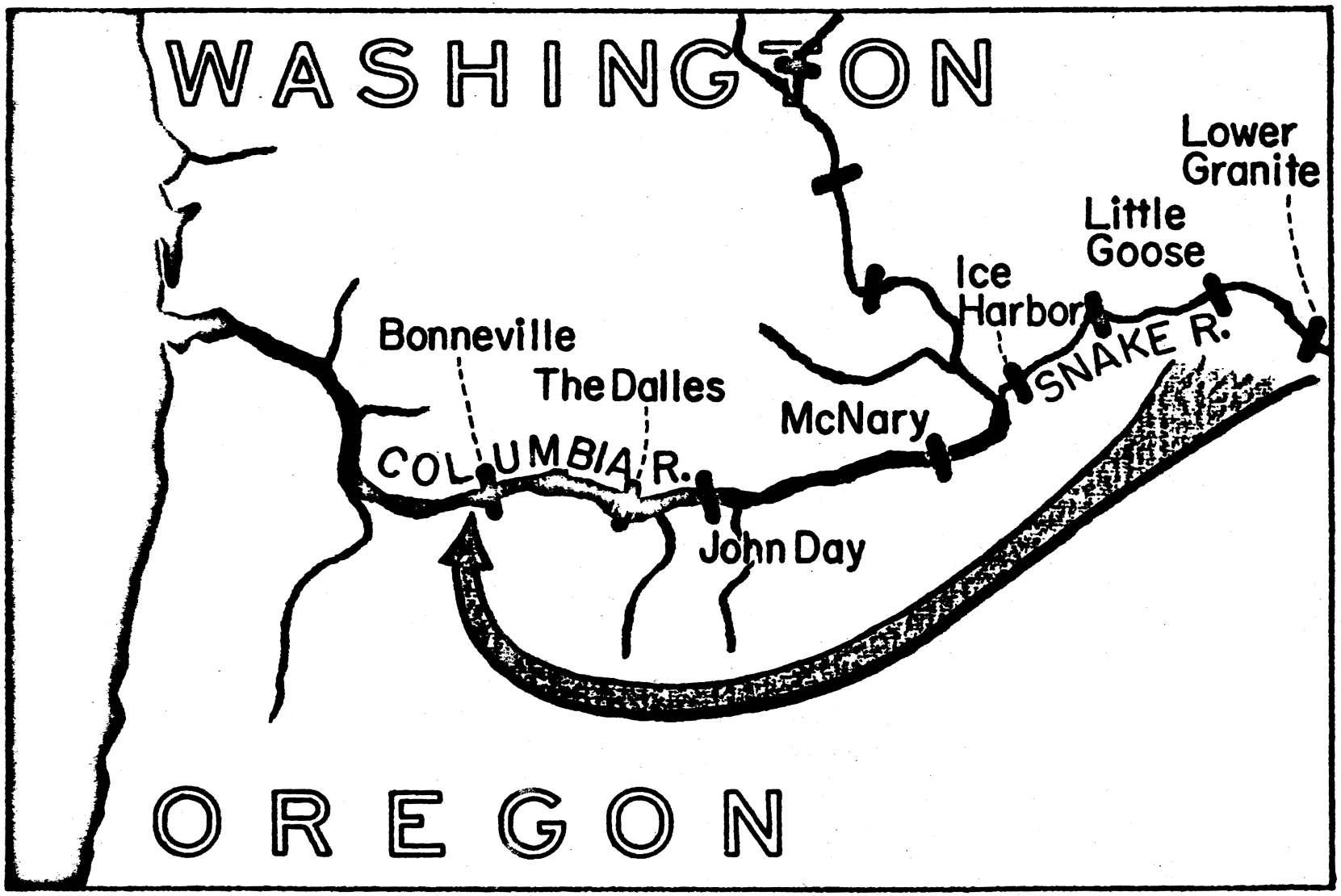

Figure 1

COMPARISONS OF ADULT RETURNS FROM CONTROL AND TRANSPORTED RELEASES OF JUVENILE CHINOOK SALMON FROM LITTLE GOOSE DAM

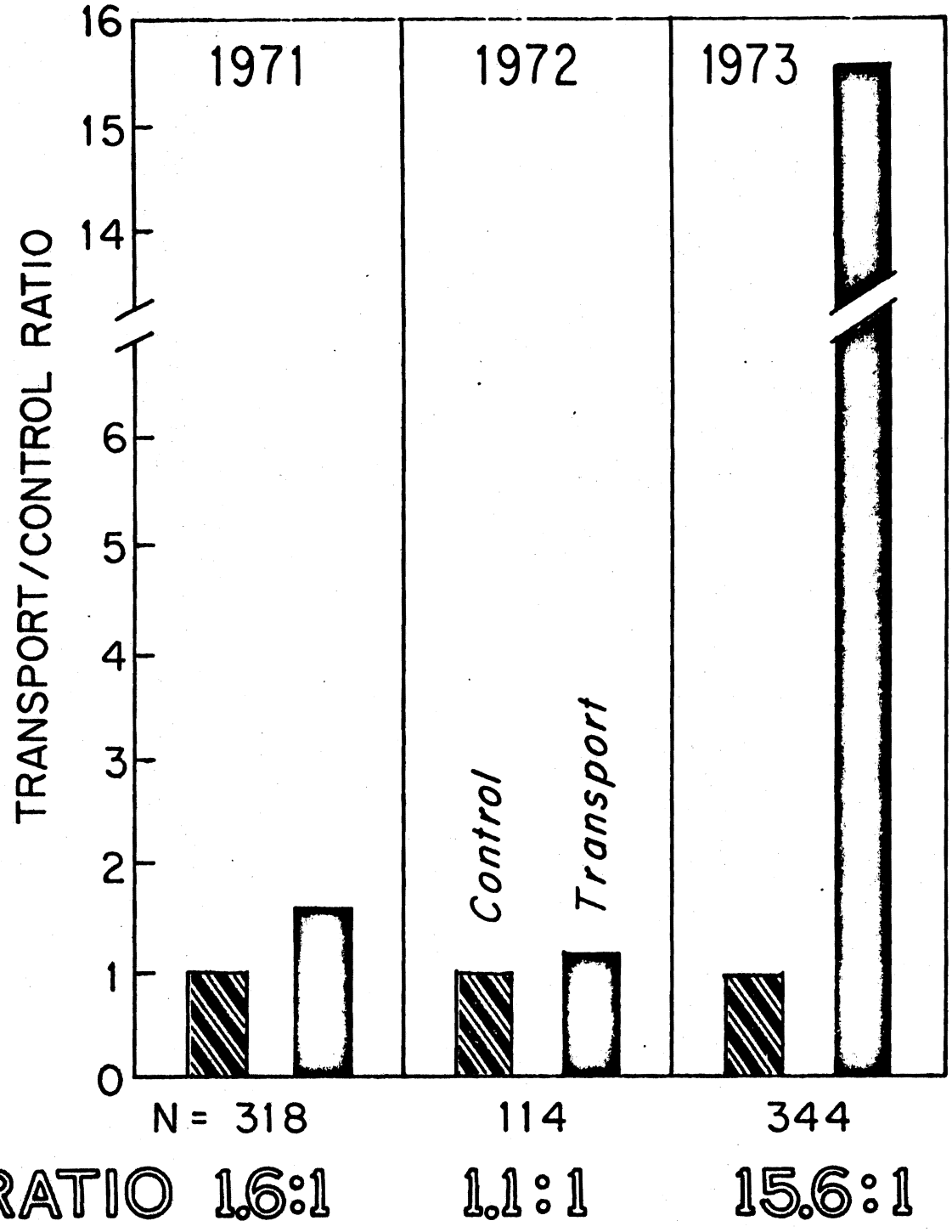

Figure 2

COMPARISONS OF ADULT RETURNS FROM CONTROL AND TRANSPORTED RELEASES OF JUVENILE STEELHEAD FROM LITTLE GOOSE DAM

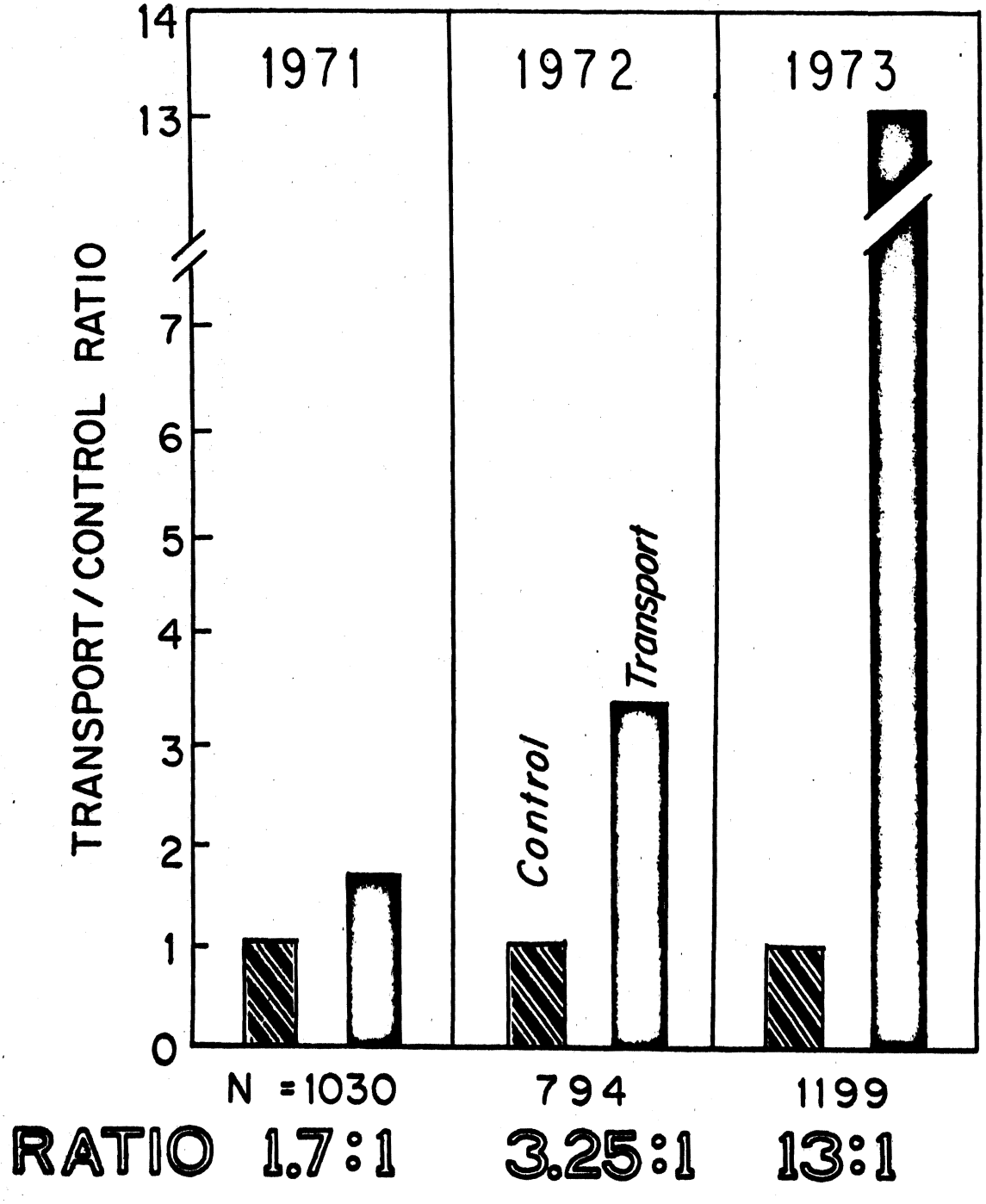

Figure 3

transported in 1972. Adult returns of chinook to Rapid River hatchery from the 1972 release were also unusually low. Since kidney disease may have been a complicating factor contributing to their poor return, then disease among our transported fish could have offset a potential benefit of transportation.

Analysis of the test-to-control ratios provides the best insight as to the benefit possible from the transportation system, but total percentage return obtained from the groups transported must also be examined to accurately assess the effectiveness of the system as it now operates. If both test and control groups are excessively stressed during the diversion, collection, marking, and transport operation, then percentage return will be abnormally low even though test-to-control ratios are favorable. We therefore have been comparing percentage return of the transport groups with percentage returns achieved at Dworshak and Rapid River Hatcheries and with estimated percentage return of steelhead and chinook to Little Goose Dam.

Percentage returns from releases of steelhead at Dworshak were 0.25% in 1971 and 0.20% in 1972. Preliminary returns of 1-ocean returns from the 1973 release indicates a survival of only 0.01%. Corresponding percentage returns of steelhead from those transported from Little Goose Dam in 1971, 72, and 73 (Table 1) were 1.7, 1.8, and 2.5%. Estimated percentage return from a mixture of wild and hatchery populations of juvenile steelhead passing Little Goose Dam in 1971, 72, and 73 were 0.8, 0.4, and 0.2%, respectively. An obvious substantial increase in survival of steelhead is indicated by either test/control type analysis or percentage return comparisons.

Table 1. Returns to Little Goose Dam of steelhead from control and transport releases of smolts, 1971-73.

Release site and year (experimental group)	Number released	Number adults recaptured	Adult return in % of juvenile released		(DW)3/	Transport benefit (year)
			Obsv ret	Est ret		
Little Goose (control) (1971)	33,243	199	0.599	1.03	(0.25)	
Bonneville (transport) (1971)	80,906	831	1.027	1.74	(0.25)	(1971) 1.71:1
Little Goose (control) (1972)	32,488	132	0.406	0.564	(0.20)	
Bonneville (transport) (1972)	50,157	662	1.320	1.83	(0.20)	(1972) 3.25:1
Little Goose (control) (1973)	42,461	59 1/	0.138 2/	0.190	(0.01)	
Bonneville (transport) (1973)	63,452	1140 1/	1.80 2/	2.48	(0.01)	(1973) 13.0:1

1/ Returns through November 10, 1975.

2/ Only partial returns of 2-ocean fish are in at this time.

3/ Percentage return of adults observed at Dworshak Hatchery, Idaho.

Percentage returns of chinook to Rapid River Hatchery from juvenile releases in 1971, 72, and 73 were 0.59, 0.12, and 0.15 respectively (Table 2). The corresponding percentage returns from juvenile chinook transported from Little Goose Dam were 0.76, 0.11, and 0.28 (1- and 2-ocean returns only for 1973). Estimated percentage returns of mixture of wild and hatchery populations of juvenile chinook passing Little Goose Dam in 1971 and 72 were 1.3, .6, and .4%. While some benefit can be shown when percentage return data from transported groups are compared with only the Rapid River Hatchery returns for 1971 and 1973, no benefit is shown when transport returns are compared with estimated percentage returns of mixed wild and hatchery stocks passing Little Goose Dam.

Research - Lower Granite Dam

Research at Lower Granite in 1975 was largely exploratory. The fingerling bypass and collection system became operational in mid-April when Unit 1 went into power production. The second unit went into service in mid-May -- after the peak of the smolt outmigration. Fingerling salmon and steelhead were collected and marked to evaluate the transport concept from Lower Granite. Approximately 44,000 chinook and 50,000 steelhead were marked and released near Clarkston, Washington (Controls) and 68,000 chinook and 60,000 steelhead were marked and transported to the tailrace area at Bonneville Dam (Test).

Traveling screens were tested at Lower Granite utilizing three screens which had previously been in service at Little Goose Dam. Lower Granite is unique among the dams constructed on the Columbia and Snake Rivers in that an additional slot has been placed upstream from the bulkhead slot (which had been traditionally used for traveling screens) for the sole purpose of

Table 2. Returns to Little Goose Dam of spring and summer chinook from control and transport releases of smolts, 1971-73.

Release site and year (experimental group)	Number released	Number adults recaptured	Adult return in % of uveniles released			Transport benefit (year)
			Obsv ret	Est ret	(RR)[2/]	
Little Goose (control) (1971)	20,674	52	0.252	0.37	(0.59)	
Bonneville (transport) (1971)	65,889	266	0.404	0.768	(0.59)	(1971) 1.6:1
Little Goose (control) (1972)	32,836	25	0.076	0.106	(0.12)	
Bonneville (transport) (1972)	106,405	114	0.084	0.111	(0.12)	(1972) 1.1:1
Little Goose (control) (1973)	88,170	13[1/]	0.015	0.018	(0.15)	
Bonneville (transport) (1973)	141,364	344[1/]	0.234	0.284	(0.15)	(1973) 15.6:1

1/ Incomplete data based on 1- and 2-ocean fish only.

2/ Percentage return of adults observed at Rapid River Hatchery, Idaho.

accommodating traveling screens. When a single traveling screen was tested in the fish screen slot, however, a high rate of descaling was measured (in excess of 20%) and further testing there was abandoned. Testing now underway at Lower Granite should shed some light on specific hydraulic problems we are encountering in the fish screen slot. Further testing was accomplished in the bulkhead slot where descaling of 4-9% on chinook salmon was measured depending upon the slot tested (A, B or C) and the type of screen and perforated plate combination used (Fig. 4). We are encouraged that descaling and subsequent injury to migrating fingerlings can be controlled by the use of perforated plate backing on traveling screens. Progress is being made in lowering descaling rate of juveniles and we believe that by prudent use of lights, proper screen placement and screen mesh that a high level of guidance can be achieved without serious descaling.

We believe the collection system as a whole at Lower Granite is greatly improved over the one presently in use at Little Goose. We are concerned, however, that delayed mortality among chinook salmon transported from Lower Granite to Bonneville was about 12% -- essentially the same as we reported for chinook transported from Little Goose. Stresses from the collection system, transport, handling and possibly disease all could be contributing to the delayed mortality.

This spring, NMFS began testing moderately saline water (5 ppt) as a means of reducing stress and subsequent mortality due to stress in holding and transport systems. Results from a limited test program (3 replicates) indicated delayed mortality of chinook salmon can be reduced from 12% (fish hauled in fresh water) to about 1% for those fingerlings hauled in 5 ppt salt water (Fig. 5).

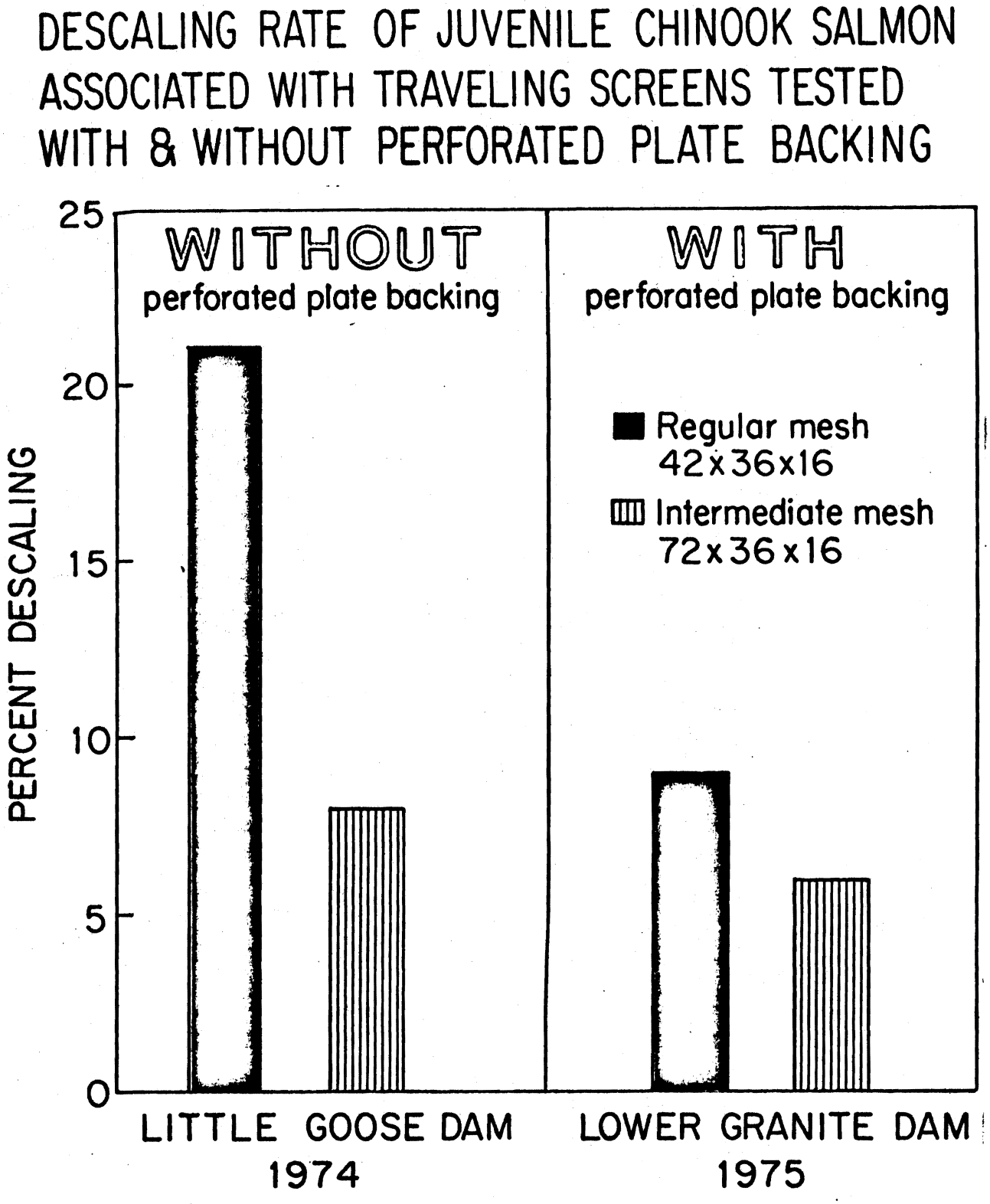
DESCALING RATE OF JUVENILE CHINOOK SALMON ASSOCIATED WITH TRAVELING SCREENS TESTED WITH & WITHOUT PERFORATED PLATE BACKING
PERCENT DESCALING
25
20
15
10
5
0
WITHOUT
perforated plate backing
WITH
perforated plate backing
Regular mesh
42x36x16
Intermediate mesh
72x36x16
LITTLE GOOSE DAM
1974
LOWER GRANITE DAM
1975

Figure 4

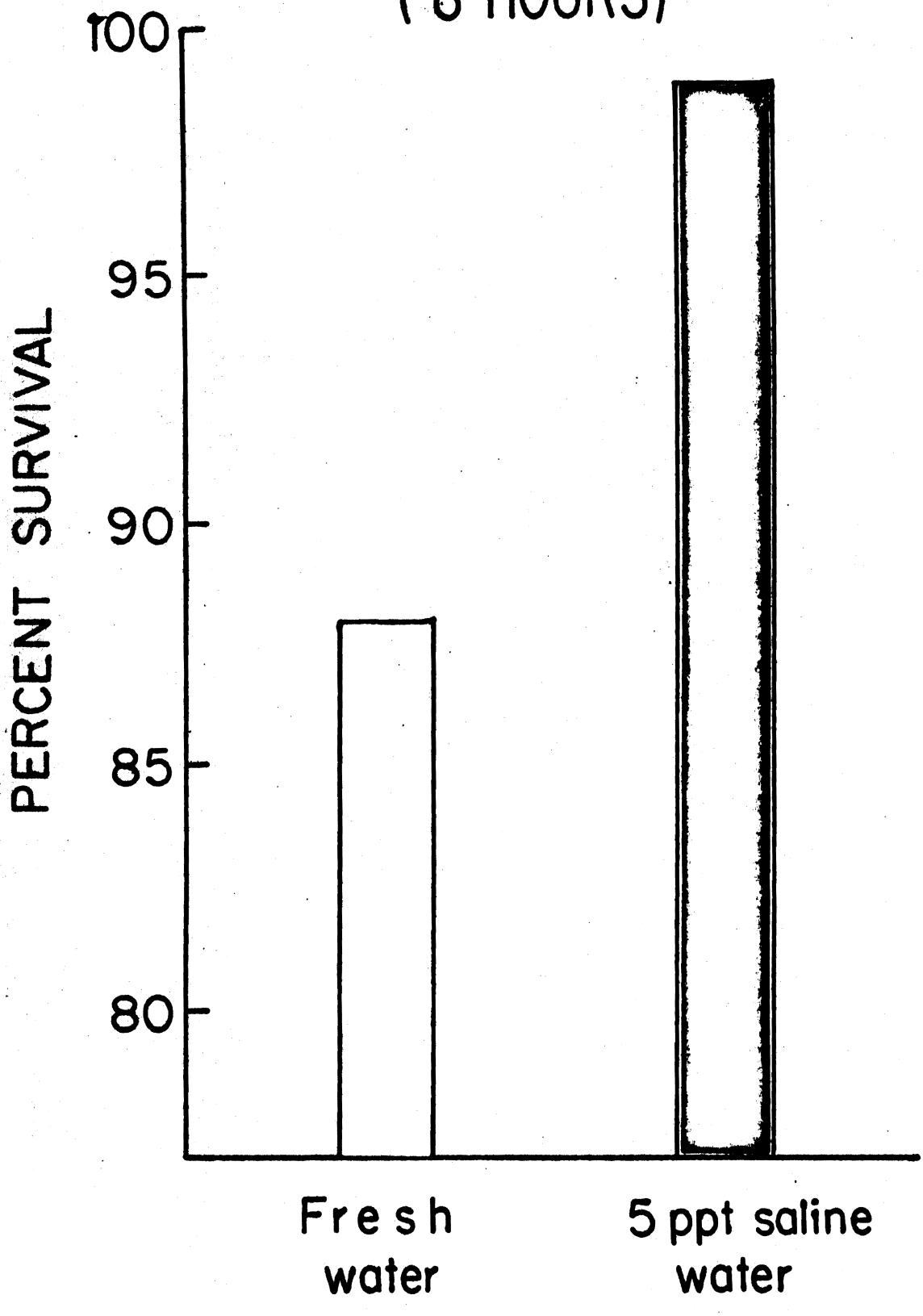
SURVIVAL OF CHINOOK SALMON SMOLTS
TRANSPORTED IN FRESH & SALT WATER
(8 HOURS)
PERCENT SURVIVAL
100
95
90
85
80
Fresh water
5 ppt saline water

Figure 5

Mass Transportation

Low survival of naturally migrating smolts in 1972-73 prompted a decision by Northwest fisheries agencies during the winter of 1974 to mass transport steelhead trout from Little Goose Dam in the spring of 1975.

In 1975, we mass transported from Little Goose approximately 500,000 steelhead trout and 350,000 chinook salmon which were collected incidental to the steelhead smolts. The transport was an emergency effort involving many fisheries agencies. The effort was limited, however, in that no provision for evaluation was made (i.e., no smolt marking) and only six traveling screens were used to divert smolts into the collection system.

Recent adult return data for steelhead transported in 1972-73 clearly justifies the decision to mass transport. The data indicates that returns of all adults from the above releases (marked and unmarked) accounts for a total return of 6,000 fish in the fall runs of 1974-75 (Table 3). Transport benefits are even more dramatic when considering the returns from the 1973 outmigration separately. About 3.5% (177,000) of the steelhead smolts were transported in 1973. Raymond[1/] reports that there were approximately 11,000 adult steelhead returning in 1974-75 runs from the smolt outmigration in 1973. The transport contribution for steelhead hauled in 1973 was 4,375 or about 40% of total returns. If no transportation had taken place, only 6,600 adults would have returned from that outmigration. Unfortunately, we returned 695,000 steelhead smolts to the river at Little Goose Dam; our return data indicates that had these been transported along with experimental fish, the total adult return from 1973 would have been about 29,000 rather than the actual 11,000.

1/ Raymond, Howard L. Snake River runs of salmon and steelhead trout: trends in abundance of adults and downstream survival of juveniles. Northwest Fish. Centr., Natl. Mar. Fish. Serv., NOAA, Seattle, Wash. Processed Report, November, 1974. 6 p.

Table 3. Contribution of adult steelhead to the Snake River runs 1974-75 from smolts transported marked and unmarked (mass transported) in 1972-73.

	Trans Marked	Trans Unmarked	Obs Ret[1/]	Est Ret[2/]	Est Total Contribution[3/]
1972	50,157	176,500	0.520[4/]	0.72	1621
1973	63,452	113,413	1.80	2.48	4375
					5996

1/ Observed return is the percentage return of adults from marked fish released at Bonneville.

2/ The observed return note is expanded by a factor of 1.38 which indicates a trapping efficiency of 72%.

3/ Total contribution is calculated by adding the number of marked and unmarked fish and multiplying by the estimated return.

4/ The percent observed return is only that portion of the release that returned in 1974 (2-ocean fish).

Future Plans and Recommendations

We are continuing to look for ways to improve the survival of transported chinook salmon. We will do this by (1) expanding our test program of hauling fingerlings in salt water; (2) testing existing and new designs of traveling screens to maximize guidance and minimize descaling; (3) test hauling by aerial tanker to minimize transport stress; (4) test benefits of transporting fish to the estuary (in conjunction with item 3).

Present plans call for six traveling screens to be used at Little Goose. Mass transport would continue there and future evaluation of returns would be obtained by marking juveniles in 1976. We recommend that chinook salmon be mass transported in 1976. Once smolts have passed through the rigors of the collection system, it is a negative process to turn them back to the river only to encounter further losses at lower dams. The improved outlook for reducing delayed mortality by using salt and a new fish lift for loading trucks (thereby eliminating the fish pump) should greatly improve survival of all fish.

Research activities at Lower Granite Dam will include traveling screen testing, fingerling transportation, and evaluation of returning adults. Seven screens will be available for testing including the new prototype designed by the Corps of Engineers. Objective will be to obtain sufficient design criteria for incorporation on remaining screens to be installed prior to the spring of 1977. Marking and transportation of fingerlings would be undertaken to test various methods of hauling, (fresh vs salt water, trucks vs air, Bonneville Dam vs estuary) in relation to homing and survival. Fingerlings collected in excess of those needed for marking, should be transported below Bonneville Dam to enhance their survival.