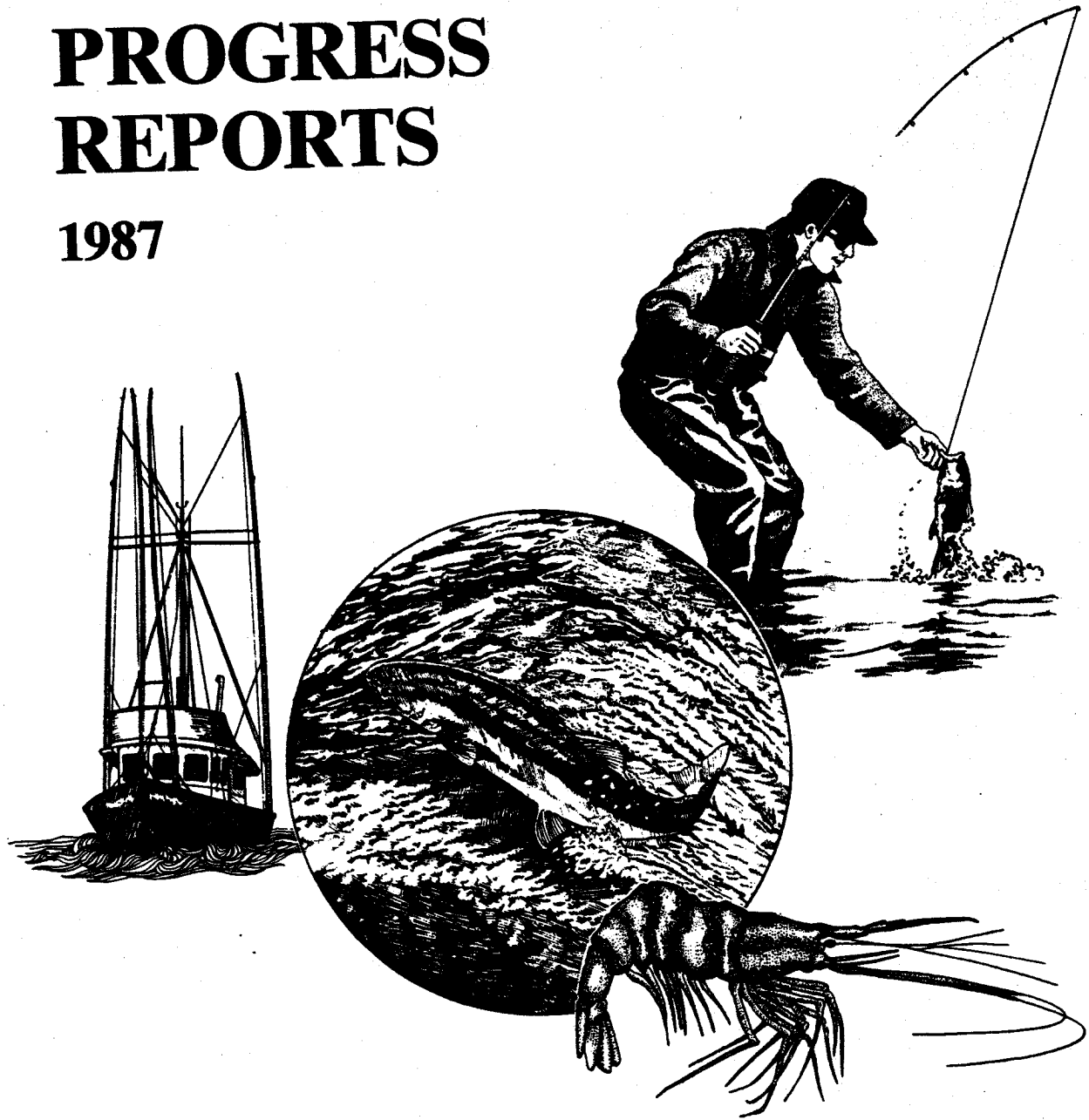


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PROGRESS REPORTS

1987



FISH DIVISION
Oregon Department of Fish and Wildlife

Willamette River Salmon Studies

ANNUAL PROGRESS REPORT
FISH RESEARCH PROJECT
OREGON

PROJECT TITLE: Willamette River Salmon Studies
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Job 2.12 Willamette Salmon Enhancement
Job 3.11 Fall Salmon Evaluation
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SUMMARY

Job 2.12--Willamette Salmon Enhancement

Objectives for FY 1987

Objectives for all spring chinook salmon *Oncorhynchus tshawytscha* studies were to (1) collect and tabulate freshwater recovery data from finmarked and Ad+CWT adults returning in 1987, (2) analyze data collected, and (3) mark smolts to integrate hatchery evaluation capabilities into the Interception Treaty Ad+CWT programs at all major hatcheries that produce Willamette spring chinook salmon.

Accomplishments in FY 1987

We tabulated recoveries of Ad+CWT-marked adults sampled in fisheries in the Columbia and Willamette rivers and collected at Willamette Basin hatcheries. We tagged a total of approximately 405,000 smolts for release from Clackamas, Marion Forks, South Santiam, McKenzie, and Oakridge-Dexter hatcheries. We conducted analysis of variance on the results of the 1977-1980 broods of size-identified smolts released from Oakridge-Dexter hatcheries.

Findings in FY 1987

The best surviving treatment (adults produced per 100 smolts released) was the medium-sized smolts released in the spring. We could not identify specific smolt-release treatments that contributed a higher proportion of the surviving adults to target fisheries in the Columbia or Willamette rivers.

The most economical smolt-release strategies (adults produced per 1,000 pounds of smolts released) were associated with release of small- or medium-sized smolts in the spring.

Recommendations

We should (1) continue the current production transition toward releasing more smolts of smaller average size in the spring from all Willamette River hatcheries that produce healthy juveniles; (2) investigate methods of retarding smolt growth without resorting to restrictive feeding schedules; and (3) improve methods of producing healthy juveniles at disease-prone hatcheries.

Job 1.21--Leaburg Screen Evaluation

Objectives for FY 1987

The objective of the evaluation of Leaburg Canal fish screen was to determine the most effective facility operations to safely divert migrating fish from Leaburg Canal to the river below Leaburg Dam.

Accomplishments in FY 1987

We monitored fish condition and mortality associated with operation of Eugene Water and Electric Board's fish-protection screen in Leaburg Canal. We conducted ten controlled tests with smolt-sized spring chinook salmon and five tests with smolt-sized steelhead *Salmo gairdneri*. We periodically sampled condition and mortality of all species of fish naturally migrating down Leaburg Canal from October 1986 to October 1987.

We developed a method of dyeing salmon fry in the hatchery and used this technique to conduct tests of fry mortality on the canal screens.

Findings in FY 1987

Controlled tests with smolt-sized salmonids indicated only low levels of injury and mortality associated with diversion out of Leaburg Canal. Periodic observations of physical condition of naturally-migrating fish indicated generally low levels of injury and mortality.

Fry-sized salmonids less than 60 mm fork length continue to become fixed on the screens in the canal. Loss of fry was substantially reduced when the screen backflush system was operated continuously. Fry loss was lowest on the left-bank segment of screen panels, apparently associated with lower through-screen flows in this segment.

Recommendations

The screen-backflush system should be operated continuously during times of substantial fry migration, generally mid-January to July. We should evaluate proposed facility modifications designed to level through-screen flows rates.

Job 3.11--Fall Salmon Evaluation

Objectives for FY 1987

1. Estimate the relative abundance of pond-reared and wild fall chinook salmon in the run that passed over Willamette Falls in 1987.
2. Count chinook redds throughout the major spawning areas of the Willamette basin.
3. Compile and summarize release data (fish size, total number released, and Ad+CWT component) for juveniles from the fall chinook salmon rearing program at Stayton Pond.

Accomplishments in FY 1987

We accomplished all three objectives for fall salmon studies in FY 1987.

Findings in FY 1987

Fish raised at Stayton Pond composed 68% of the 8,949 fall chinook salmon that migrated upstream past Willamette Falls in 1987. In April and May 1987 we released about 5.8 million juvenile fall chinook salmon from Stayton Pond. About 3.5% of the fish released were marked Ad+CWT.

Surveys of the spawning areas used by fall chinook salmon in the Willamette basin in 1987 produced mean counts of 3.87 redds/km in the Clackamas River, 4.71 redds/km in Miller and Shelton ditches, and 4.22 redds/km in the mainstem Willamette and larger tributaries above Willamette Falls.

Recommendations

We should investigate the potential for developing a run of "bright" fall chinook salmon in the Willamette basin (fall chinook Objective 2, revised Willamette Basin Fish Management Plan).

INTRODUCTION

The purpose, scope, and goals of the past Willamette Salmon Studies projects have been documented in progress reports (Hansen and Williams 1979; Smith et al. 1981, 1982, 1983, and 1985). Objectives and methods for evaluation of Leaburg screen appear in the project proposal (Smith 1983).

Job 2.12--Willamette Salmon Enhancement

SMOLT TAGGING

In 1987 we tagged approximately 405,000 spring chinook salmon of the 1986 brood at five ODFW hatcheries in the Willamette Basin (Table 1).

Definition of Smolt-Production Criteria

We conducted analyses of variance on recoveries of adults from the 1977-1980 broods of smolts released from Oakridge-Dexter hatchery complex. Results of these analyses indicated:

1. We saw a wide variation in rate of survival among the smolt groups tested. We identified smolt sizes and season of release that produced significantly ($P \leq 0.05$) more adults per 100 smolts released (Table 2).
2. We could not identify specific smolt treatments that contributed disproportionately more of the surviving adults to target locations or fisheries (return to freshwater, lower Columbia sport and commercial fisheries, or lower Willamette sport fisheries).

Table 1. Spring chinook salmon smolts of the 1986 brood tagged at Willamette River hatcheries in 1987 for tests of offshore interception and for improvements in production.

Hatchery	Smolts tagged	Release schedule		Tagging Purpose
		Stream	Dates	
Clackamas	60,000	Clackamas	Oct 1987	Interception evaluation, monitor relative survival of fall and spring smolt releases
	30,000	Clackamas	Mar 1988	
	<u>90,000</u>			
Marion Forks	30,000	North Santiam	Mar 1988	Interception evaluation, evaluate relative value of outsystem release of smolts produced at Marion Forks
	30,000	South Santiam	Mar 1988	
	<u>60,000</u>			
South Santiam	25,000	South Santiam	Nov 1987	Interception evaluation, monitor survival of smolts produced under improved hatchery practices at South Santiam Hatchery
McKenzie	30,000	McKenzie	Nov 1987	Interception evaluation, verify survival rates of smolts fed antibiotics at McKenzie Hatchery
	30,000	McKenzie	Mar 1988	
	<u>60,000</u>			
Oakridge/Dexter	30,000	Willamette	Sep 1987	Interception evaluation, evaluate effects of month of smolt release
	30,000	Willamette	Oct 1987	
	30,000	Willamette	Nov 1987	
	20,000	Willamette	Feb 1988	
	20,000	Willamette	Mar 1988	
	20,000	Willamette	Apr 1988	
20,000	Willamette	May 1988		
	<u>170,000</u>			
GRAND TOTAL	405,000			

Table 2. Results of analyses of variance on relative survival of smolt-release groups, Oakridge-Dexter study, 1977-1980 broods.

Release time	Fall	Fall	Falla	Fall	Falla	Spring	Spring	Spring	Spring
Treatment ^b	Small	Medium	Large	graded	graded	graded	Small	Large	Medium
Rearing location	Oakridge	Oakridge	Oakridge	Oakridge	Dexter	Oakridge	Dexter	Oakridge	Dexter
Mean % survival	0.274	0.559	0.925	1.044	1.479	1.892	2.018	2.053	2.549
Statistically similar	_____								
($P < 0.05$)	_____								
Groups underlined	_____								

^a Currently used as a production goal for smolt release.

^b Smolt size designation refers to body length category at time of grading in the fall: ungraded, small = > 120 mm, medium = 120-150 mm, large = < 150 mm.

3. Relative cost of production varied. These results suggest the most economical production modes entail releasing small and medium-size smolts from Dexter in the spring (Table 3).

Table 3. Results of analysis of variance performed on production costs, Oakridge-Dexter study, 1977-1980 broods.

Release time	Falla	Fall	Falla	Fall	Spring	Fall	Spring	Spring ^a	Spring
Treatment ^b	Large	Small	graded	Medium	Large	graded	graded	Medium	Small
Rearing location	Oakridge	Oakridge	Dexter	Oakridge	Oakridge	Oakridge	Oakridge	Dexter	Dexter
Adults per 1,000 lbs smolts	68.15	75.09	88.78	89.77	93.00	113.08	160.09	216.73	262.78
Mean production cost per surviving adult ^c	\$33.46	\$30.36	\$25.68	\$25.40	\$24.52	\$20.16	\$14.24	\$10.52	\$8.68
Statistically similar ($P < 0.05$) Groups under- lined									

^a Currently used as a production goal for smolt release.

^b Smolt size designation refers to body length category at time of grading in the fall: ungraded, small = > 120 mm, medium = 120-150 mm, large = < 150 mm.

^c Based on production costs of \$2.28 per pound of smolts released in 1985-86.

Methods

Methods employed are generally described in Smith et al. (1986). Fry tests in 1987 were aided by release of artificially-dyed test fish that could be separated by color from the naturally-migrating fry that appeared simultaneously on the screens.

RESULTS AND DISCUSSION

In 10 controlled tests with chinook salmon smolts conducted from October 1986 to September 1987, net injury rate was 2.8% and net mortality was 1.8%. Five controlled tests with steelhead smolts conducted between February and June 1987 indicated a net injury rate of 1.1% and net mortality of 1.4%.

Observations of physical condition of "river run" fish sampled from November 1986 through September 1987 produced results similar to those during the 1986 sampling. Most species of bypassed fish exhibited low levels of physical injury and mortality (Table 4), although largescale suckers

Catostomus macrocheilus and mountain whitefish *Prosopium williamsoni* again sustained high levels of injury. Larger rainbow trout suffered about 9% injury and 6% direct mortality. Spring chinook salmon smolts appeared to have migrated through the outlet structures at Blue River Reservoir with relatively little injury in 1987; in 1986 we saw 18% injury and a low level of mortality associated with migrants from this impoundment.

Table 4. Observed conditions of fish sampled during "river run" testing at Leaburg Dam, November 1986-September 1987.

Species	Size or origin	Number sampled	Percent injury	Percent direct mortality
Spring chinook salmon	Wild smolts	1,804	1.8	0.1
	Hatchery smolts	9,805	4.3	0.2
	Reservoir smolts	250	4.8	0
Summer steelhead	Wild smolts	834	1.6	0.1
	Hatchery smolts	5	0	0
Rainbow trout	Wild ≤ 150 mm	235	2.1	0
	Wild > 150 mm	104	8.7	5.8
	Hatchery	120	1.7	0
Cutthroat trout	≤ 150 mm	48	0	0
	> 150 mm	16	6.3	0
Largescale sucker	Adults	414	54.6	3.1
Mountain whitefish	Miscellaneous sizes	13	46.2	0

Evaluation of mortality of fry-sized fish that become fixed on the stationary screen panels illustrated that:

1. Fewer spring chinook salmon fry died when the screen backflush system was operated continuously. Three tests conducted with the backflush system turned off resulted in a mean mortality of 83.2%. Three comparable tests conducted with the backflush pumps turned on yielded a mean mortality of 54.4%.
2. Smaller fry sustained higher losses than larger fry (Figure 1). When fry grew to mean lengths of about 60 mm fork length, mortality ceased. In 1987, fry averaging 35 mm began migrating in mid-January. A mean length of 60 mm was reached in mid-July.
3. Fry loss was related to location of approach to the screen system. Net mortality of dye-marked fry released above the left bank segment was 15.8%, significantly ($P < 0.05$) lower than the mean net losses observed in the middle and right bank segments (60.4% and 72.3%, respectively). Flow velocity through the left bank screen panels was also lower, according to flow meter measurements. Facility modifications are being designed to even the flow across the width of the screen.

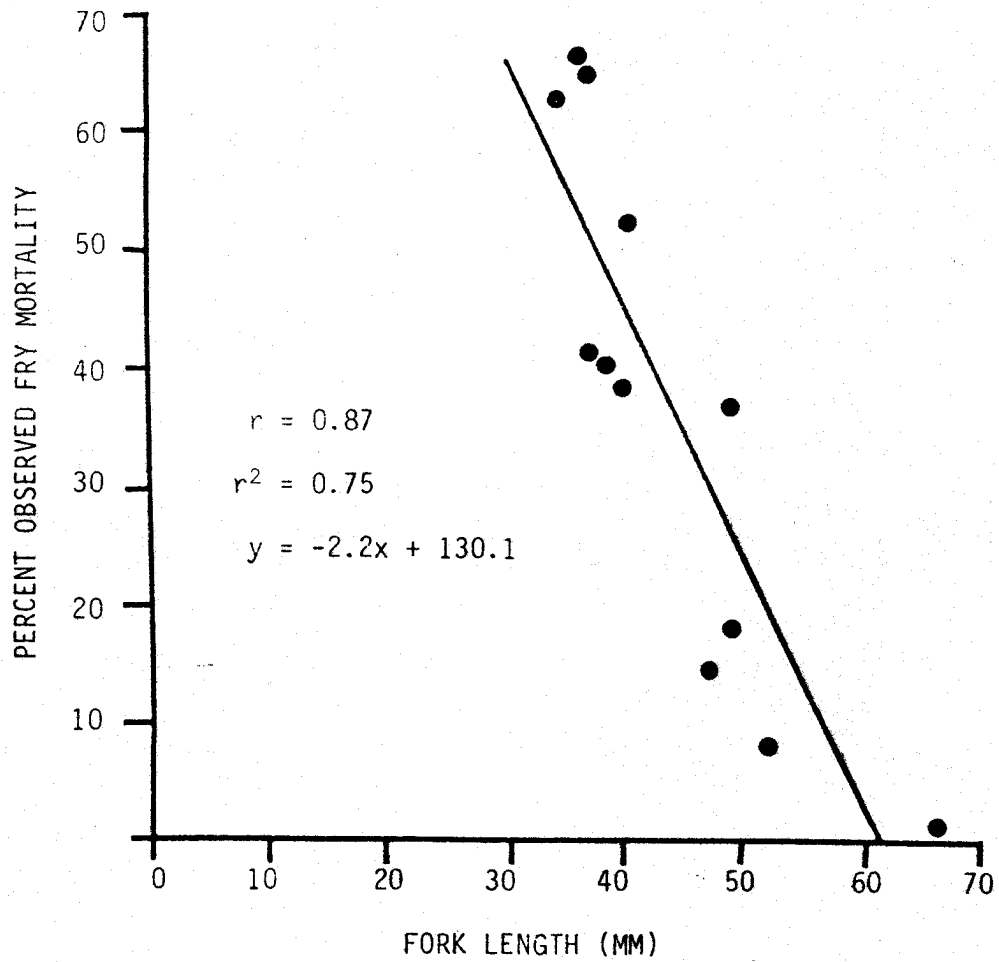


Figure 1. Relationship of fish length and mortality of spring chinook salmon fry at the Leaburg screen, 1986-1987.

JOB 3.11--FALL SALMON EVALUATION

We estimated that about 5.8 million juvenile fall chinook salmon were released from Stayton Pond into the Willamette River system in late April and early May 1987. This total included 198,690 fish marked Ad+CWT (Table 5).

We calculated that wild-reared fall chinook salmon composed 32% of the upper Willamette run in 1987 (Table 6). In the 7 run-years from 1981 through 1987, wild-reared salmon composed an estimated average of 29% of the fall chinook salmon runs.

Surveys of fall chinook salmon spawning areas in fall of 1987 indicated 3.87 redds/km in the Clackamas River, 4.71 redds/km in Miller and Shelton ditches, and 4.22 redds/km in the rest of the Basin surveyed (Table 7).

Table 5. Summary of juvenile fall chinook salmon released from Stayton Pond, 1978-85 brood years.

Brood year	Date of release	Mean size (g/fish)	Number released	Percentage marked Ad+CWT
1978	05/07-29/79	6.8	4,691,601	6.3
1979	02/28-06/21/80	5.2	6,348,695	4.5
1980	04/28-06/15/81	6.1	5,902,559	4.3
1981	04/03-05/21/82	5.2	6,750,813	4.0
1982	04/25-05/19/83	5.8	6,912,074	2.4
1983	05/08-05/31/84	7.8	5,170,607	2.9
1984 ^a	05/14-05/31/85	8.6	4,534,194	4.0
1985	04/29-05/13/86	6.7	4,993,546	3.7
1986	04/28-05/07/87	7.5	5,768,935	3.5

^a Approximately two-thirds of these fish were transported to Bonneville Hatchery on the Columbia River for release.

Table 6. Estimated origin of the fall chinook salmon run that passed Willamette Falls, 1981-86 run years.

Run year	Counts at viewing window ^a	Pond reared		Wild reared	
		Number	%	Number	%
1981	17,775	9,020	51	8,625	49
1982	26,883	19,759	73	7,308	27
1983	13,733	11,152	84	2,180	16
1984	21,144	15,607	72	5,841	27
1985	30,203	20,459	67	9,810	32
1986	14,847	12,673	84	2,359	16
1987	8,949	6,138	68	2,875	32

^a Some of these were spring chinook salmon and marked stray fall chinook salmon, and we removed some additional fish from the fishway for sampling and spawning purposes.

Table 7. Results of fall chinook salmon spawning surveys in the Willamette Basin, 1982-87.

Year	Clackamas River (aerial surveys)		Miller-Shelton Ditch (boat surveys)		Willamette River and other tributaries (aerial surveys)	
	Stream km surveyed	Mean redds/km	Stream km surveyed	Mean redds/km	Stream km surveyed	Mean redds/km
1982	38.0	9.76	33.3	5.50	475.7	13.20
1983	38.0	5.82	33.3	5.20	489.1	5.79
1984	38.0	2.24	33.3	11.32	42.6 ^a	1.49
1985	38.0	1.66	33.3	30.03	42.6 ^a	1.06
1986	38.0	4.16	33.3	10.99	479.6	4.52
1987	38.0	3.87	33.3	4.71	385.5	4.22

^a Only the Molalla River surveyed.

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