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Development and assessment of steelhead in the Willamette River basin

Wade + Buchanan 1983

ANNUAL PROGRESS REPORT

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OREGON

PROJECT TITLE: Development and assessment of steelhead in the Willamette River basin.

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Prepared by M.G. Wade
D.V. Buchanan

Oregon Department of Fish and Wildlife
506 S.W. Mill Street
P.O. Box 3503
Portland, Oregon 97208

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CONTENTS

CONTENTS (continued)

TABLES

FIGURES

SUMMARY

Job 1

Objective

Our objective is to develop steelhead fisheries in new areas of the Willamette basin. In FY 1983 we continued our evaluation of Skamania summer steelhead in the Middle Fork of the Willamette.

Accomplishments in FY 1983

We collected adult summer steelhead at Dexter Dam on the Middle Fork of the Willamette.

Findings in FY 1983

Nineteen fin marked adult summer steelhad were collected at Dexter Dam.

Managment Implications

Smolt releases of Skamania summer steelhead in the Middle Fork Willamette will produce adults.

Job 2

Objective

Our objective is to determine the migration timing and the hatchery:wild ratio of adult Big Creek, Willamette, and Skamania stock steelhead at Willamette Falls. In FY 1983 we continued to collect scale samples from adult steelhead captured at Willamette Falls.

Accomplishments in FY 1983

We captured and determined the origin of 39 Big Creek steelhead and 115 Skamania steelhead at Willamette Falls.

Findings in FY 1983

1. No wild adult Skamania summer steelhead were captured at Willamette Falls.
2. Wild fish composed 25% of the adult Big Creek steelhead captured at Willamette Falls.

Management Implication

Wild production of Skamania summer steelhead is low or nonexistant in the Willamette basin above Willamette Falls.

Job 3

No work was done on this job in FY 1983. We need to determine run timing by stock and hatchery:wild ratios first (see Job 2).

Job 4

Objective

Our objective is to improve the percentage of adult return from hatchery releases of Skamania, Big Creek, and Willamette stocks to at least 2.5% of smolt release. In FY 1983 we continued size at release studies and started a rearing density study with Skamania steelhead.

Accomplishments in FY 1983

1. Groups of 18 to <20 cm fork length, 20 to <22 cm and >22 cm Skamania summer steelhead smolts were released below Foster Dam. Migration timing and relative migration success to Lebanon Dam were determined.
2. Skamania summer steelhead smolts were reared at two densities, marked and released at South Santiam Hatchery. Migration timing and relative migration success to Lebanon Dam were determined.

3. Groups of Skamania summer steelhead smolts were marked AN-LM or LV-RM, and AN-LV or RV-RM and released to evaluate differential mortality caused by these marks.
4. Skamania steelhead adults that returned from the 1980 and 1982 size at release experiments were captured at Foster Dam and the date, fin mark, length, and sex recorded.

Findings

1. Peak migration of fish >22 cm fork length was 1 week earlier than peak migration of fish <22 cm.
2. There were no differences in migration timing or percent captured at Lebanon Dam between fish raised at 6,800 lbs/pond and 5,400 lbs/pond at South Santiam Hatchery.
3. Smolts $\geq$20 cm produced twice as many adults as smolts 18 to <20 cm and 10 times as many adults as smolts <18 cm.
4. Smolts $\geq$20 cm produced 90% 2-salts and 8% 3-salts while smolts <18 cm produced 75% 2-salts and 23% 3-salts.

Management Implications

1. Releasing larger smolts reduces the time hatchery fish remain at the release site and may decrease interactions with wild fish.
2. South Santiam Hatchery can rear up to 6,800 pounds of steelhead per pond without adversely affecting migration of the smolts.
3. Releasing larger Skamania steelhead smolts increases the percentage of adult return.
4. Releasing larger Skamania steelhead smolts skews the age distribution of fish at return towards 2-salts, but increases the number of 3-salts due to higher total survival.

Job 5

Objective

Our objective is to develop stocks of summer and winter steelhead for use in the Willamette system. In FY 1983 we continued our study of two brood sources for use in the McKenzie River and our study of *Ceratomyxa shasta* resistance of Siletz X Skamania and Umpqua X Skamania stock crosses.

Accomplishments in FY 1983

1. We started a logbook program with steelhead anglers on the McKenzie River to recover information about fin marked steelhead.
2. We helped with a creel survey on the McKenzie River to document catch of steelhead and recover fin mark information.
3. Summer steelhead were trapped at Leaburg Dam on the McKenzie River and examined for marks.
4. Skamania x Umpqua, Skamania x Siletz, and Skamania summer steelhead were exposed to *C. shasta* for a second time.

Findings in FY 83

1. Skamania steelhead reexposed to *C. shasta* continued to be resistant to ceratomyxosis while 20-30 percent of the Skamania x Umpqua and Skamania x Siletz steelhead which had survived one exposure to *C. shasta* died from ceratomyxosis when reexposed 8 months later.

Management Implications

Crosses of Skamania summer steelhead with Siletz or Umpqua summer steelhead are not resistant enough to *C. shasta* for use in the Willamette Basin.

BACKGROUND

The goal of this study is to assess and improve fishery benefits derived from steelhead stocks in the Willamette River basin. Defined fishery benefits include: (1) Produce adult returns of summer and winter steelhead so that run sizes and recreation days as suggested in the 1979 Willamette Basin Fish Management Plan and by the 1981 Willamette Basin Fisheries Coordination Group are satisfied. The objectives for run size above Willamette Falls are 10,000 introduced Big Creek winter steelhead, 14,000 native Willamette winter steelhead and 15,000 introduced summer steelhead. (2) Maintain or increase the number of naturally produced "wild" adult steelhead in the upper Willamette. The term "wild" includes naturally produced fish from Skamania, Big Creek, and Willamette stocks. (3) Improve the survival of hatchery produced summer and winter steelhead smolts released above Willamette Falls to an adult return of at least 2.5% of smolt release.

This report presents the findings of the second year of a proposed five year study. Previous findings can be found in Buchanan and Wade (1982). The Willamette River basin above Willamette Falls with key locations discussed in this report is shown in Fig. 1. The objectives have been summarized in our proposal according to the following five jobs. The purpose of this report is to summarize our activities and accomplishments for each job from July 1, 1982 to June 30, 1983.

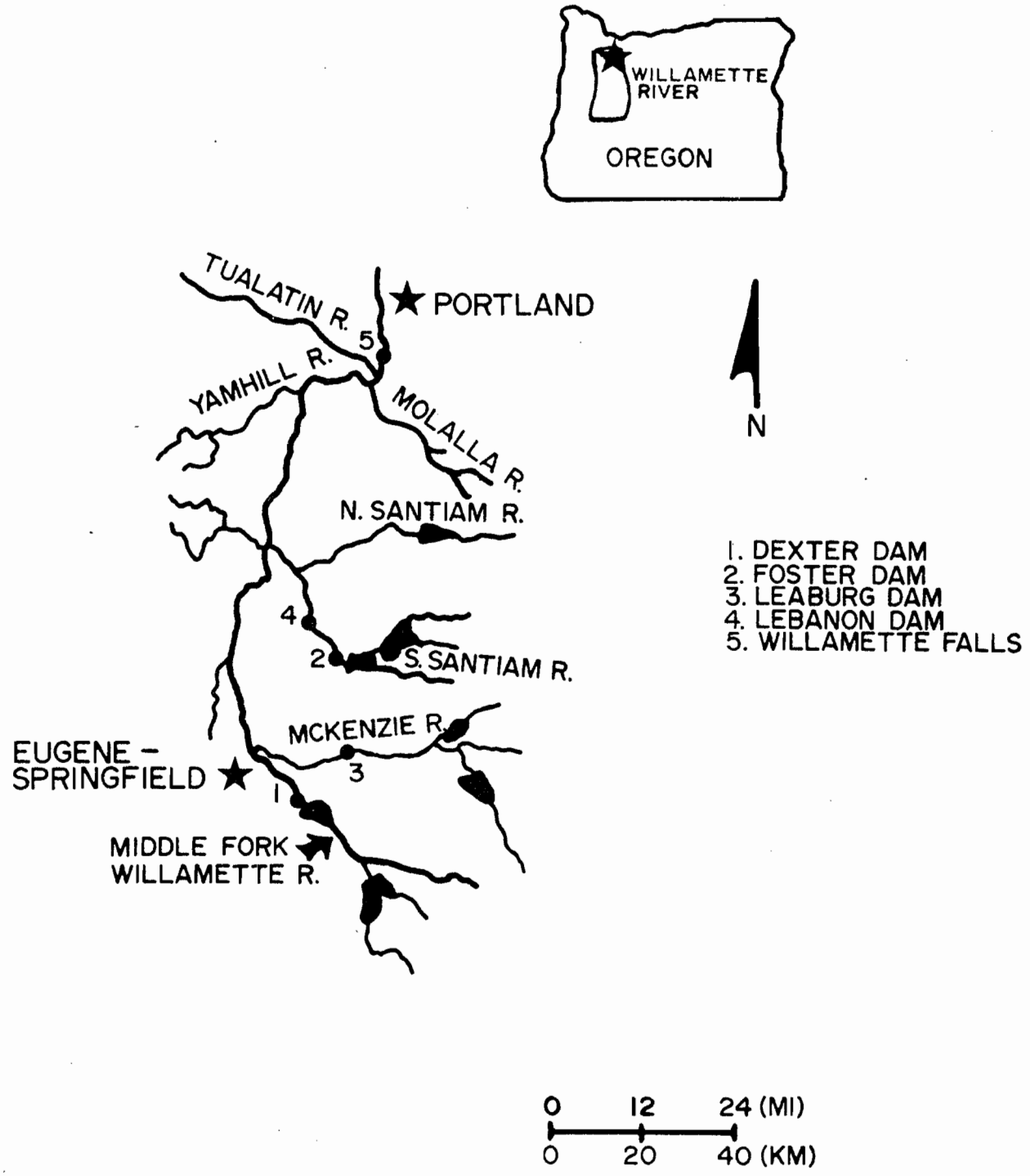

Fig. 1. Willamette River system.

Job 1. Increase Angling Opportunities

INTRODUCTION

Our objective is to develop additional steelhead fisheries in the Willamette Basin. Introductions of Skamania summer steelhead into the Willamette Basin have been quite successful. Releases of Skamania smolts in the Clackamas River above North Fork Dam have produced adult returns of over 5,500 fish and releases of smolts in the South Santiam, North Santiam, and McKenzie rivers have produced adult returns in excess of 15,000 fish over Willamette Falls. Additional tributary streams in the basin have good water quality, and flow and may support additional summer steelhead fisheries. One of these streams is the Middle Fork of the Willamette River below Dexter Dam.

METHODS

Marked Skamania summer steelhead smolts were released into the McKenzie and Middle Fork Willamette rivers in 1981 and 1982 (Buchanan and Wade 1982). Adult returns to the Dexter collection facility and catch estimates from the punchcards will be used to document the development of the fishery.

RESULTS

We collected 17 adult steelhead from the 1981 smolt release and 5 adult steelhead from the 1982 smolt release at Dexter Pond. Catch estimates for the 1983 season from punchcards and logbook information are not available at this time.

DISCUSSION

Only 0.04% of the smolts released in the Middle Fork Willamette in 1981 were collected at Dexter Pond as adults in 1983. Oregon Department of Fish and Wildlife personnel saw an additional 40 steelhead at Dexter Pond that did not enter the trap. We will report the catch estimates from the punchcards when they become available.

Job 2. Adult Timing and Hatchery:Wild Ratios

INTRODUCTION

Our objective is to develop accurate estimates of hatchery and wild production of Big Creek, Skamania, and native Willamette steelhead above Willamette Falls. This information is needed to protect spawning and rearing areas of wild fish and to assess the percentage of adults returning from hatchery releases. Accurate counts of steelhead that return to the river system have been made since 1971, but separation of stocks and hatchery:wild ratios have been only a guess (Buchanan and Wade 1982).

METHODS

Adult steelhead were captured at Willamette Falls using a shunt and a Denile steeppass in the upper section of the cul-de-sac leg of the adult fishway. This capture method allowed uninterrupted passage of fish through the other three entrances of the fishway. Each captured fish was measured and was examined for fin marks, dorsal fin stubbing, color, and spawning condition. A scale sample was taken and a numbered Floy anchor tag was inserted. Big Creek and Skamania stock fish were classified hatchery or wild origin based on subjective scale analysis. Fish that had migrated at age 1+ smolts were classified as hatchery and fish that had migrated as age 2+ and 3+ smolts were classified as wild.

RESULTS

Table 1. Origin of Big Creek and Skamania stock steelhead captured at Willamette Falls in 1982 and 1983.

Run year	Stock	Number captured	Percentage wild origin	Percentage hatchery origin
1982-83	Big Creek	39	26	74
1982	Skamania	44	2	98
1983	Skamania	115	0	100

DISCUSSION

We will determine migration timing of Big Creek stock steelhead at Willamette Falls in 1983-84 when marked adults from 1982 smolt releases return.

Job 4. Improve Hatchery Returns

INTRODUCTION

Our objective is to improve the survival of steelhead smolts released from the hatcheries to at least 2.5% adult reuturn. This would produce a run of 12,500 summer steelhead above Willamette Falls with the present number of smolts released. In FY 1983 we released the third of the scheduled 3 brood years of marked size groups of Skamania steelhead smolts. We also included experiments to determine the effects of two rearing densities, and compare mortality caused by fin clips.

METHODS

Smolt Migration

Skamania summer steelhead were reared in two ponds at the South Santiam Hatchery. One pond contained 24,246 fish that weighed 5,416 pounds prior to release (low density) and the other pond contained 31,650 fish that weighed 6,814 pounds prior to release (high density). Flow into each pond was 1,220 L/minute.

Smolts were separated into three size groups, 18 to <20 cm, 20 to <22 cm, and >22 cm and fin marked three weeks before release. Details of each release group are listed in Table 2.

Relative percentage of freshwater migration, migration timing, and growth were measured at Lebanon Dam (26 kilometer below Foster Dam) from April 12 to June 1 (Buchanan and Wade 1982). Fish caught were counted by species, examined for marks, measured to the nearest 0.1 cm fork length, and released.

We believe that the capture rate of smolts at Lebanon Dam varies over time which biases estimates of the relative number of migrants in each group if the migration timing of those groups is not the same (Buchanan et al. 1983). We therefore made comparisons only between groups whose migration timing were the same and had equivalent marks. A X^2 contingency table was used to compare the number of smolts captured and not captured at the P=0.05 level.

Adult Returns

Adult summer steelhead from the 1980 and 1982 releases of <18 cm, 18 to <20 cm, and >20 cm smolt groups returned to Foster Dam as adults in 1983. These fish were captured at the Foster Dam trap and the date of capture, fin mark, length, and sex were recorded.

RESULTS

Smolt Migration

The results of the 1983 smolt migration are reported in Tables 2 and 3 and Figure 2.

Adult Studies

The results of the adult returns from the 1980 and 1982 smolt releases are reported in Tables 4 to 6.

Table 2. Recaptures at Lebanon Dam of Skamania summer steelhead smolts fin marked by size group in spring 1983.

Release group	Fin mark	Number released	Number captured at Lebanon dam	Percentage of release captured at Lebanon Dam
Low Density				
18 to <20 cm	AN-RV	4,365	102	2.3
20 to <22 cm	AN-LV	5,786	100	1.7
20 to <22 cm	RV-RM	5,611	89	1.6
≥22 cm	RV-LM	6,505	110	1.7
High Density				
18 to <29 cm	AN-RM	5,726	139	2.4
20 to <22 cm	AN-LM	7,721	131	1.7
20 to <22 cm	LV-RM	7,445	132	1.8
≥22 cm	LV-LM	9,203	151	1.6

Table 3. Results of mark comparison, rearing density, and size at release studies with Skamania Summer steelhead released at Foster and captured at Lebanon Dam in spring 1983.

Test	Comparison	Difference
Mark Comparison	AN-LV vs. RV-RM	Not significant
	AN-LM vs. LV-RM	Not significant
Rearing Density	20 to <22 cm, high density vs. low density	Not significant
	≥22 cm, high density vs. low density	Not significant
Size at release	Low density, 18 to <20 cm vs. 20 to <22 cm	[a]
	Low density, 20 to <20 cm vs. ≥22 cm	[a]
	High density, 18 to <20 cm vs. 20 to <22 cm	[a]
	High density, 20 to <22 cm vs. ≥22 cm	[a]

[a] *Timing differences (see Fig. 2).*

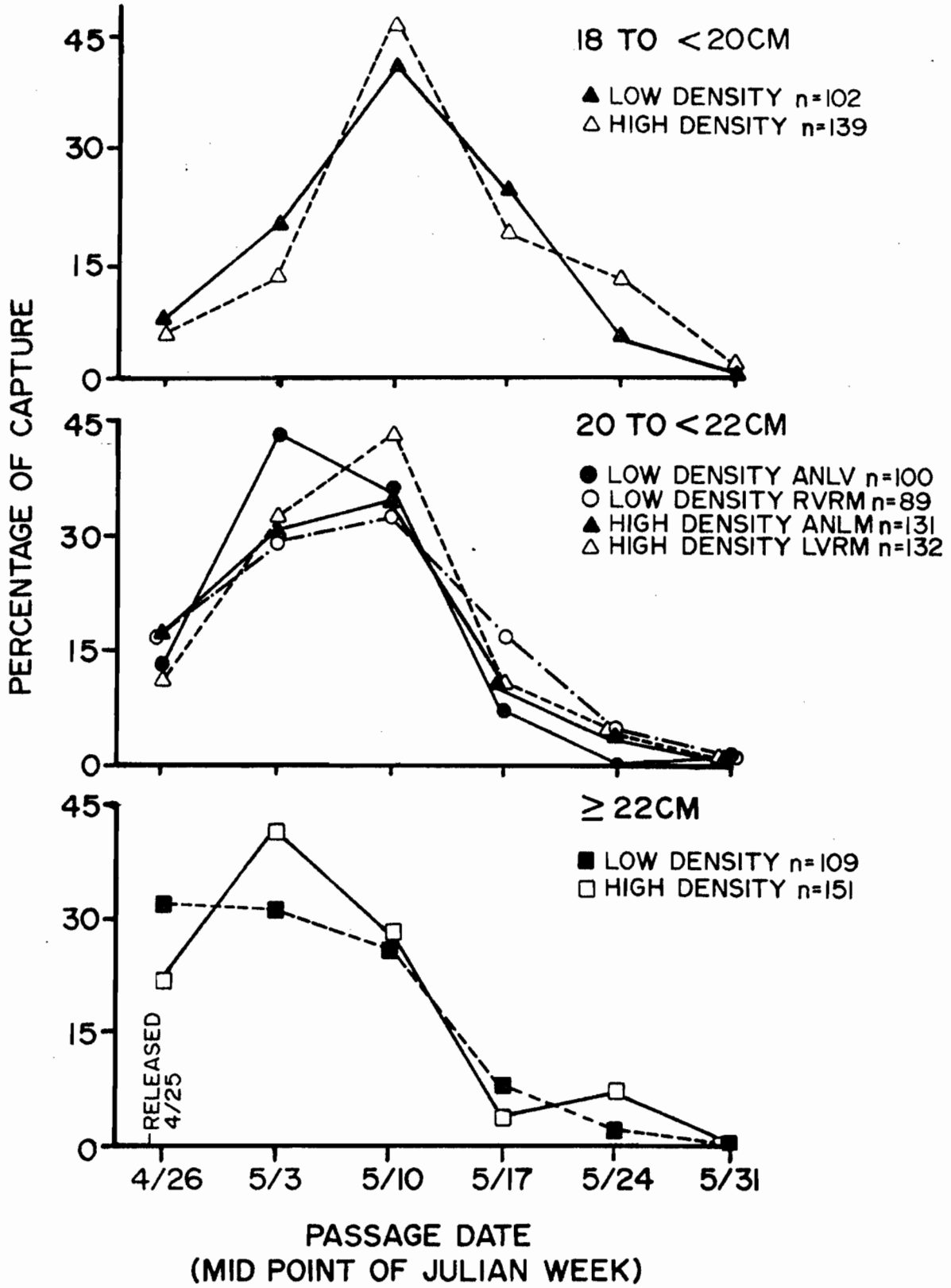

Fig. 2. Migration timing of three size groups of Skamania summer steelhead smolts past Lebanon Dam in spring 1983.

Table 4. Recaptures of Skamania summer steelhead released as smolts at Foster in spring 1980.

Size at release	Number of smolts released	Number of smolts captured near Lebanon Dam in 1980	Percentage of release captured near Lebanon Dam	Number of adults captured at Foster Dam in 1981	Number of adults captured at Foster Dam in 1982	Number of adults captured at Foster Dam in 1983	Percentage of release captured at Foster Dam
<18 cm	25,328	134	0.5	1	55	17	0.3
18 to <20 cm	37,947	295	0.8	3	476	77	1.5
≥20 cm	27,271	207	0.9	17	737	73	3.0

Table 5. Ocean age at return of adult Skamania summer steelhead captured at Foster Dam from three sizes of smolts released in 1980.

Size at release (cm)	Percent 1-salt	Percent 2-salt	Percent 3-salt
<18	1.4	75.3	23.3
18 to <20	0.5	85.6	13.9
≥20	2.1	89.1	8.8

Table 6. Numbers of 1-salt, 2-salt, and 3-salt adults returning to Foster Dam per 10,000 smolts of <18 cm, 18 to <20 cm and ≥20 cm size groups released at the South Santiam Hatchery in 1980.

Size at release (cm)	Adult age			Total
	1-salt	2-salts	3-salts	
<18	<1	22	7	29
18 to <20	1	127	19	147
≥20	6	272	25	303

Table 7. Recaptures of Skamania summer steelhead released as smolts at Foster in spring 1982 and captured at Willamette Falls in spring 1982.

Size at release, (cm)	Fin mark	Number of smolts released	Number of smolts captured at Willamette Falls	Percentage of release captured at Willamette Falls	Number of adults captured at Foster Dam in 1983 [a]	Percentage of release captured at Foster Dam
<18	LV	4,858	87	1.8	0	0.0
18 to <20	RM	18,106	706	3.9	21	0.1
≥20	RV	18,577	660	3.6	41	0.2
≥20	LM	19,766	867	4.4	41	0.2

[a] *Incomplete returns through November 11. One-salt usually comprise les than 5% of the run.*

DISCUSSION

Although there was no difference in survival to Willamette Falls in 1980 between Skamania summer steelhead smolts 18 to <20 cm and smolts ≥20 cm in fork length, adult return data indicate that size does affect survival somewhere after passage at the falls (Buchanan and Wade 1982). Fish ≥20 cm (4.3 fish/pound) returned at twice the rate of the fish 18 to <20 cm (5.8 fish/pound). From this data it would appear that releasing fish at 4.3 fish/pound would be a cost effective method of improving survival to adult. However, our test groups were produced by grading so that the length frequency of the ≥20 cm group was truncated at 20 cm compared to the length frequency of a production group weighing 4.3 fish/pound, which would have a normal distribution. In addition the fish ≥20 cm were the fastest growing fish of our test group. We do not know the relationship between the growth rate of smolts and survival to adult. We need to investigate size of steelhead smolts at release with test groups produced by programming the feed so that there would be fast and slow growing fish in each group. This would more accurately simulate groups of production smolts at release.

Job 5. Develop New Steelhead Stocks

INTRODUCTION

In an effort to increase the number of steelhead returning to the Willamette system, we have investigated improving currently cultured stocks. Our approaches were to use a local brood source (McKenzie broodstock experiment) and to study introducing characteristics into the stock which we feel are important to survival in the Willamette system (*Ceratomyxa shasta* studies).

METHODS

McKenzie Broodstock

Marked groups of Skamania smolts from McKenzie broodstock and South Santiam broodstock were released in the McKenzie River in 1981 and 1982. A creel survey, a logbook program with selected steelhead anglers and guides, and adult steelhead trapping at Leaburg Dam were used to recover fin marks in 1983. Evaluation of brood sources will be based fin mark recoveries in 1983 and 1984.

C. shasta Studies

Groups of reciprocal crosses of Umpqua x Skamania and Siletz x Skamania along with control groups of Umpqua, Siletz, and Skamania stock fish from the 1981 brood year were reared at the Corvallis Research Lab. These fish were exposed to *C. shasta* in the Willamette River in September and October 1981 (Buchanan and Wade 1982). After exposure, the fish were held in pathogen-free wellwater at 12°C and fed Oregon Moist Pellet with 3% oxytetracycline added to prevent bacterial infection.

Fish that survived the first *C. shasta* challenge were reexposed to C. shasta for 16 days beginning May 24, 1982. Dead fish were collected daily for 123 days after reexposure. Fish were considered infected by *C. shasta* if a smear of intestinal fluid examined microscopically (400x) contained spores.

RESULTS

McKenzie Broodstock

The logbooks have not been returned by anglers as the 1983 steelhead season on the McKenzie River is not completed. Results from the creel survey are also unavailable. Only 23 fish, of which 5 were fin marked, have been trapped from the McKenzie River through September 14, 1983.

C. shasta Studies

Results are listed in Table 8.

Table 8. The effects of *Ceratomyxa shasta* on reciprocal crosses of summer steelhead when re-exposed to Willamette River water near Corvallis from May 24 to June 19, 1982.

Stock crosses (male x female)	Number of fish exposed	Number of dead fish	Number of dead fish infected with *C. shasta*	Percentage of fish dead and infected with *C. shasta*
Skamania x Skamania	72	2	1	1
Umpqua x Skamania	21	8	6	29
Skamania x Umpqua	54	11	11	20
Siletz x Skamania	40	16	13	32
Skamania x Siletz	25	6	5	20

DISCUSSION

McKenzie Broodstock

We have not recovered enough marks yet to determine whether or not collecting broodstock from the McKenzie River improves the percentage of adult return. We will continue to collect adult steelhead and recover fin marks at Leaburg Dam in 1984 and we will report the results of the logbook program and creel survey when they become available.

C. shasta studies

We plan to spawn the hybrid fish that have survived two *C. shasta* challenges and test the F_2 generation for susceptibility of *C. shasta*.

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Post Office Box 3503
Portland, Oregon 97208