IDAHO
FISH & GAME DEPARTMENT

Fisheries Studies in Connection With

Dworshak (Bruces Eddy) Dam and Reservoir

1964

STATE OF IDAHO

FISH AND GAME DEPARTMENT John R. Woodworth, Director

Fisheries Studies in Connection with Dworshak (Bruces Eddy) Dam and Reservoir

Conducted Under Contract With Corps of Engineers
Contract No. DA 45-164 CIVENG-62-294

Segment No.	Segment Title
1.	Steelhead Downstream Migrant Study - North Fork of the Clearwater River
2.	Movement of Juvenile Steelhead Between Tributary and Main Stem Streams
3.	Non-Game Fish Range and Distribution Study
4.	Adult Steelhead Spawning Study by

Melvin Reingold
Fishery Biologist

August 1964

Segment #1

Steelhead Downstream Migrant Study

North Fork of the Clearwater River

TABLE OF CONTENTS

Page

ABSTRACT AND INTRODUCTION 1

OBJECTIVES.....2

TECHNIQUES USED 2

Floating Barge-Type Scoop Trap.....2

Experimental Cable Trap 4

FINDINGS..... 4

Cable Trap - Spring Run 4

Barge Trap - Fall Run 8

LIST OF TABLES

Table 1. The number of non-game fish captured by the floating scoop trap, 1 1/2 miles upstream from the mouth in the North Fork of the Clearwater River..... 11

LIST OF FIGURES

Page

Figure 1. Bruces Eddy Fisheries project floating scoop trap in position, approximately 1 1/2 miles above the mouth in the North Fork of the Clearwater River. August, 1962. 3

Figure 2 Scoop trap and barge were damaged by flood waters bringing drifting logs downriver. Conventional trapping methods are not feasible during high water on the North Fork of the Clearwater River. November, 1962..... 3

Figures 3, 4, S Photographs of cable trap in various stages of construction Note electric motors and speed reduction gear boxes used to raise and lower scoop trap. August to December, 1962. North Fork of the Clearwater River, Bruces Eddy Fisheries Studies , ... S

Figures 6, 7, 8. Photographs of Bruces Eddy Fisheries project cable trap. Operators climbed down into trap to clean it and check for catches. North Fork of the Clearwater River, Idaho. February, 1964..... 6

Figure 9. Scoop trap in fishing position. Bruces Eddy project cable trap, North Fork of the Clearwater River, 1/4 mile above Ahsahka, Idaho. April, 1964. o 7

Figure 10. Relationship between catch of steelhead migrants and rainfall, total catch of floating scoop trap, Bruces Eddy Fisheries Studies. North Fork of the Clearwater River, Idaho 9

Figure 11 Relationship between catch of immature steelhead from the North Fork of the Clearwater River, Idaho and the time of day 10

Figure 12. Length frequency distribution of juvenile steelhead, Salmo gairdneri g., captured in the floating scoop trap, Bruces Eddy Fisheries studies, August 15 to October 31, 1962, and August 1 to November 9, 1963, North Fork of the Clearwater River, Idaho. 10

Segment #2

Movement of Juvenile Steelhead Between Tributary and Main Stem Streams

TABLE OF CONTENTS

Page

ABSTRACT 12

OBJECTIVES 12

TECHNIQUES USED 12

Definitions 13

Study Streams 13

Trapping Operations 13

FINDINGS 13

Trapping Results 13

Treatment Program and Results - Dix Creek 14

Treatment Program and Results - Robinson Creek 14

Winter Sampling and Results 15

CONCLUSIONS 16

LITERATURE CITED 16

Segment #3

Non-Game Fish Range and Distribution Study

TABLE OF CONTENTS

Page

ABSTRACT 17

RECOMMENDATIONS 17

OBJECTIVES 19

TECHNIQUES USED 19

FINDINGS 19

LIST OF TABLES

Table 1. Names, physical data on sampling date, and stream distances sampled for non-game species, North Fork of the Clearwater drainage. Bruces Eddy Fisheries Studies, Segment #3. August-September, 1963. 21

Table 2. Numbers of species of non-game fish collected or observed in tributaries of the North Fork of the Clearwater River. Bruces Eddy Studies, Segment #3. August-September, 1963. 22

LIST OF FIGURES

Figure 1. North Fork of the Clearwater drainage, showing streams sampled for presence of non-game fish species, and species found. Bruces Eddy Fisheries Studies, Segment #3. August-September, 1963 18

Segment #4

Adult Steelhead Spawning Study

TABLE OF CONTENTS

Page

ABSTRACT.....23

RECOMMENDATIONS 24

OBJECTIVES.....24

TECHNIQUES USED 24

The Study Stream.....24

Weir and Traps 27

Tagging Procedure 27

Redds 29

Records 29

FINDINGS.....29

Timing.....29

I. Arrival 29

II, Departure 29

III. Numbers of Fish 30

Length of Stay 30

I, Total Time.....30

II. Before Spawning 30

III. Length of Time in Stream After Spawning 30

IV. Length of Time on Redd.....31

Redd Construction 31

I, Preliminary Digging 31

II. Spawning Areas.....31

Page

Spawning. 31

I. Females 31

II. Males 32

Other Observations. 33

I. Fish Handling Shock 33

II. Fish Movement 33

Redd Recognition. 33

ACKNOWLEDGEMENTS. 39

LIST OF TABLES

Table 1. Summary of information collected on redds constructed in Little Moose Creek during segment #4 of the Bruces Eddy Fisheries Studies, North Fork of the Clearwater River, March-June, 1964. 36

Table 2. Summary of information collected on redds constructed in Kelly Creek and Moose Creek during segment #4 of the Bruces Eddy Fisheries Studies. Length of discernibility of redds is dependent to a great extent upon water conditions. North Fork of the Clearwater River, Idaho. March-June, 1964 37

Table 3. Summary of information collected on steelhead spawners in Little Moose Creek during segment #4 project. Bruces Eddy Fisheries Studies, North Fork of the Clearwater River, March-June, 1964. 38

LIST OF FIGURES

Page

Figure 1. Weir and traps in Little Moose Creek looking upstream into the entrance of the upstream trap. Downstream trap is on the right. Heavy rocks were used to hold A-frames in place, Bruces Eddy Fisheries Studies, March, 1964. 25

Figure 2. Weir and traps in Little Moose Creek looking downstream into the entrance of the downstream trap, Upstream trap is on the right, Fish were released from traps by raising gates, Bruces Eddy Fisheries Studies, March, 1964. 25

Figure 3. Releasing adult steelhead after tagging. Note tag hanging below fish. Some steelhead suffered handling shock and had to be watched closely for a few hours. There were no losses. Bruces Eddy Fisheries Studies, Little Moose Creek, May, 1964 26

Figure 4. Map of upper North Fork of the Clearwater area showing study area and stream sections flown by helicopter for steelhead and redd couts, Bruces Eddy Fisheries Studies, Segment #4. March-June, 1964. 35

Figure 5. Waterfall approximately one-third mile upstream from weir in Little Moose Creek, upper limits of study area. Flood waters in June,1964 may have opened passable channel on right side. Bruces Eddy Fisheries Studies, May, 1964 28

Figure 6, Tags used to mark steelhead entering Little Moose Creek. Hog rings were closed into back between dorsal and adipose fins. Plastic tended to crack and split in cold water. Bruces Eddy Fisheries Studies, May,1964 28

JOB COMPLETION REPORT

RESEARCH PROJECT SEGMENT

Agency: State of Idaho Fish and Game Department

Bruces Eddy Fisheries Studies

Project Title: Steelhead Downstream Migrant Study - North Fork of the Clearwater River

Project No. 1-000-07 Job No. Segment #1

Period Covered: March 1, 1962 through July 1, 1964

ABSTRACT AND INTRODUCTION

The North Fork of the Clearwater River in North Central Idaho is one of two rivers in the United States that still supports an annual log drive as a major means of delivering marketable timber to downstream mills. Ten to 15 million board feet of logs are pushed into the North Fork each spring during high water. Logs also drift loose from log decks during fall river rises caused by rains.

Because of the drifting logs and accompanying debris it is not feasible to use conventional fish trapping methods to sample fall and spring steelhead smolt migrations.

In early 1962, the Idaho Fish and Game Department, under contract to the Army Corps of Engineers, initiated the design and construction of an experimental trapping system that could operate during high water periods when logs are drifting downriver. The primary purpose of the trap was to sample the spring steelhead smolt migration.

A unique system consisting of a standard inclined screen trap suspended from a cable-supported trolley was designed and constructed. This mechanism. was operated periodically in 1962, 63, and 64. Many electrical and mechanical changes and alterations were made to improve the original equipment.

In the fall of 1963 the device was considered operable and it was put into operation in February, 1964, as soon as ice conditions allowed. The trap was operated Until May 9, 1964,. at which time safe operation became impossible because of extreme flows and excessive numbers of drifting logs and debris. During the period from February 1 to May 9, two steelhead smolts and five non-game fish were collected in the trap.

This sampling device was designed to operate in flows near the average spring peak flow of 18,600 c,f.s. for the 24-year period from 1927 to 1950. Unfortunately, the spring run-off of 1964 proved to be considerably above normal and flows exceeded 25, 000 c,f.s. for most of the months of May and June. River height and velocities in the trapping area prevented operation of the device and

operations ceased on May 9, 1964. The Army Engineers' contract terminated July 1, 1964, and further operation or development of this trapping system has ceased.

A floating barge-type scoop trap was operated during fall low water periods when velocities were too low for effective fishing of the cable trap.

Steelhead smolt catches of this floating trap were low (104 total for 1962 and 1963), but tend to indicate a relationship between rainfall and fall downstream smolt movement.

Large numbers of non-game fish species were also collected by this floating trap,

OBJECTIVES

The objectives of this study were to design, develop, and operate a fish trapping system that could sample the spring steelhead smolt migration in the North Fork of the Clearwater River.

The prime objective was to determine the timing of steelhead smolt migrations, the size of the migrants, and the environmental factors which appear to influence these movements, and to use information collected by this study for pre and post Dworshak Dam evaluation, and to aid in determining fish passage facilities at the damsite,

TECHNIQUES USED

The North Fork of the Clearwater River is confined for its entire length to a relatively narrow canyon, Variation between river levels commonly reach 15 feet, and velocities may increase six times, Because of the variation in flows and velocities, no one location was suitable for trap operation during both the fall and spring seasons, It was necessary to have two trapping sites to sample both fall and spring migrations.

The experimental cable trap was constructed in an area where velocities were suitable for trap operation during the spring run-off (4 to 8 c.f.s,),
A floating barge-type trap was used to sample the fall downstream migration when river levels were low and danger from drifting logs is at a minimum,

Floating Barge-Type Scoop Trap

The floating trap used in the falls of 1962 and 1963 was a 20 by 30 foot steel pontoon barge with a 10 by 20 foot inclined screen trap, Figure 1. It was operated from August IS to November 21, 1962 and August 1, to November 9, 1963.

Two trap operators fished the trap for eight-hour periods, every other eight hours around the clock, except for periods of high water when the barge was moved out of operation because of danger from drifting logs,

The trap was raised and checked once each hour and water temperatures and velocities were recorded. Any fish in the trap were identified and measured and the time and date of capture recorded.

Figure 1. Bruces Eddy Fisheries project floating scoop trap in position, approximately 1 1/2 miles above the mouth in the North Fork of the Clearwater River. August, 1962.

Figure 2. Scoop trap and barge were damaged by flood waters bringing drifting logs downriver. Conventional trapping methods are not feasible during high water on the North Fork of the Clearwater River. November, 1962.

On November 22, 1962, an unseasonal flood brought large numbers of logs downriver and the floating trap was heavily damaged, Figure 2. The trap catch records for November 1 to 21 were lost at that time; however, the number of fish captured was small, and none of them were steelhead smolts.

Experimental Cable Trap

The experimental cable trap consisted basically of an inclined screen trap, 10 by 20 feet, suspended by cables from motor-driven drums. The entire unit, including an operators cage, could travel laterally back and forth across the river on two 7/8 inch cables. The trap could be lowered into fishing position by the motor-driven drums, and raised in a few seconds when threatened by drifting logs, Figures 3-9.

The method of moving and holding the unit over the river was with a third cable looped once over a 49-inch Gypsey-type traction sheave, Two other arrangements were tried for transverse movement before the traction sheave and proved unsatisfactory because of cable sag and incline. These were a sprocket and #50 roller chain, and a double winch arrangement.

It is beyond the scope and purpose of this report to provide all engineering and technical data on this mechanism. Measurements, gear ratios, motor sizes, etc. can be obtained from the Idaho Fish and Game Department for those desiring this information.

A major problem encountered with this device was trap movement in the water. The trap, suspended by a cable to each corner, was not stable in the water and currents caused movement both vertically and horizontally. Increase in velocities caused greater movement. It was estimated that at seven feet per second velocity the trap was in proper fishing position approximately 30 percent of the time. This could be a major reason why the trap failed to collect many fish inasmuch as the inclined screen trap was otherwise basically the same as that used on barge traps.

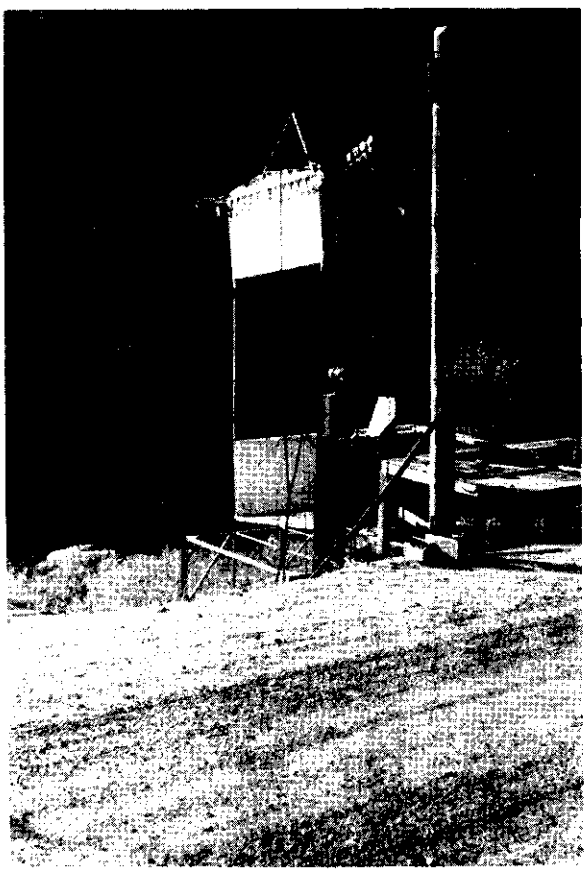
The cables from the drums to the trap passed over a pulley arrangement and some problems of cable breakage were encountered until more flexible airplane control cable was employed.

At velocities of eight feet per second, a dynometer on the left upstream corner of the trap indicated a maximum pull of 1,500 pounds when pulling the trap from the water. These forces varied depending on how much debris was in the trap. Safety links on each corner of the trap were designed to break before unsafe strain was placed on the main overhead cables.

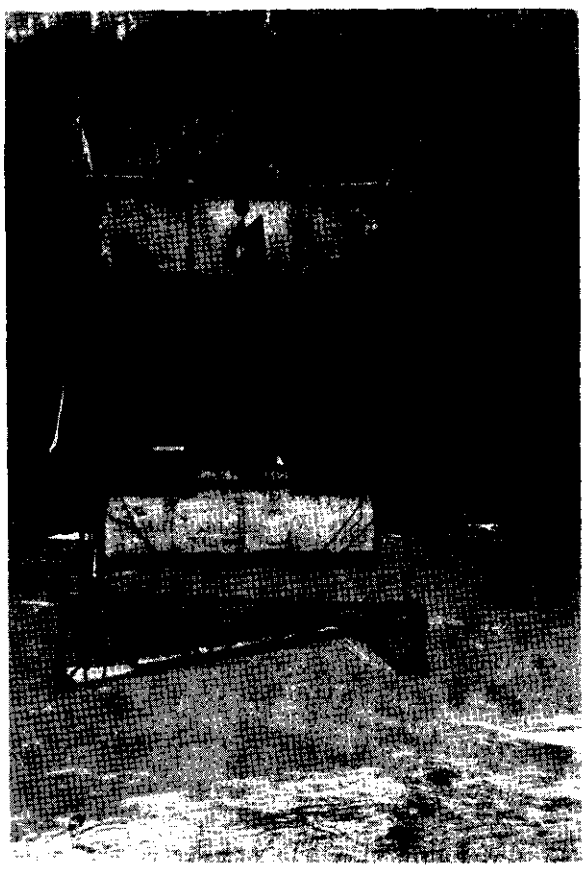
FINDINGS

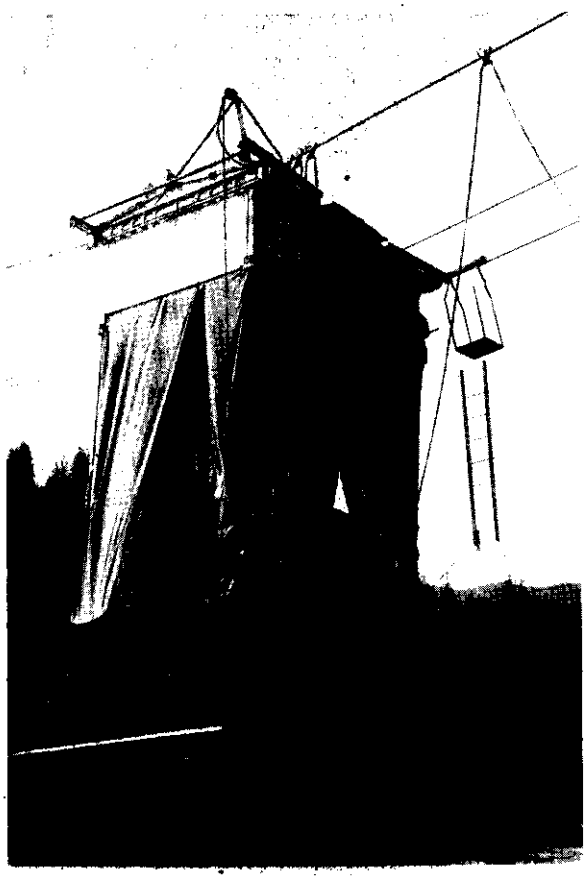
Cable Trap - Spring Run

As a fish trapping device, the cable trap, in the stage of development reached when the project was terminated, did not fulfill its purpose. Two steel-head smolts and five small non-game fish were collected from February 1, to May 9, 1964 Downstream migrant sampling facilities, operating on other tributaries of the Clearwater River on unrelated projects, collected large numbers of down-stream migrating steelhead smolts during the tame time periods (unpublished data of Columbia River Development Program, Idaho Fish and Game Department),



Figures 3, 4, 5. Photographs of cable trap in various stages of construction. Note electric motors and speed reduction gear boxes used to raise and lower scoop trap. August to December, 1962. North Fork of the Clearwater River, Bruces-Eddy Fisheries Studies.





Figures 6, 7, 8. Photographs of Bruces Eddy Fisheries project cable trap. Operators climbed down into trap to clean it and check for catches. North Fork of the Clearwater River, Idaho. February, 1964.

Figure 9. Scoop trap in fishing position. Bruces Eddy project cable trap, North Fork of the Clearwater River, 1/4 mile above Ahsahka, Idaho. April, 1964.

Due to an unusually large spring runoff, the trap was inoperable through May and June and further adjustments and changes could not be effected.

In retrospect, it is believed that while this particular facility did not operate successfully, the basic idea and design has merit under sampling conditions such as found in the North Fork of the Clearwater River.

Barge Trap - Fall Run

The floating barge trap was operated from August 15 to November 21, 1962, and from August 1 to November 9, 1963. Seventy-seven steelhead smolts were collected in 1962 and 27 in 1963. Although the numbers taken are small, the catches coincided closely with rainfall which brought increased flows and turbid- ities, and decreased river temperatures, (Figure 10).

Smolt catches occurred at all hours of the day, although there is a slight increase in numbers caught during the early daylight hours, from 9;00 A.M. to 2:00 P.M., (Figure 11.

The barge was fished until November 21, 1962 and November 9, 1963. No smolts were captured during November, 1962. Termination of the barge trapping operations in November of both years was caused by high river flow conditions and drifting logs and debris.

Large numbers of non-game fish species were collected in the barge trap, (Table 1). Redside shiners, Richardsonius balteatus, were most numerous. Nine-thousand-twenty-five shiners were collected in 1962 and 1963. Sixty=five percent were captured during the dusk hours, from 5;00 PR to 10:00 P.M. These shiners were collected primarily during the late summer months, August and September.

The barge also collected 30 sculpin, 9 dace, 69 squawfish, 11 chisel= mouth, and 505 suckers. There were also a few smallmouth bass and Dolly Varden trout caught in the trap.

Steelhead juveniles captured in the barge trap ranged from 55 to 240 millimeters fork-length, (Figure 12).

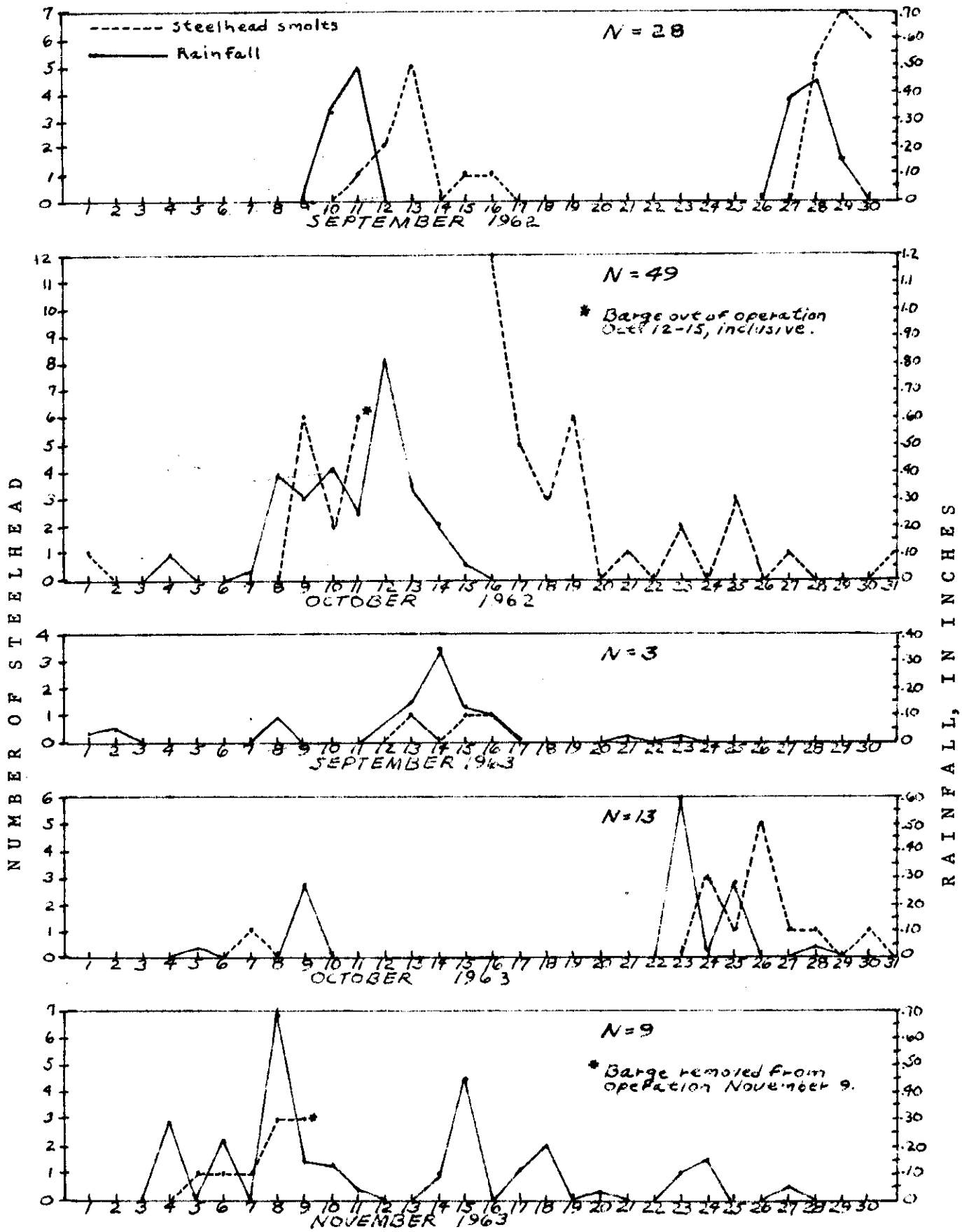


Figure 10. Relationship between catch of steelhead migrants and rainfall, total catch of floating scoop trap, Bruces Eddy Fisheries Studies. North Fork of the Clearwater River, Idaho

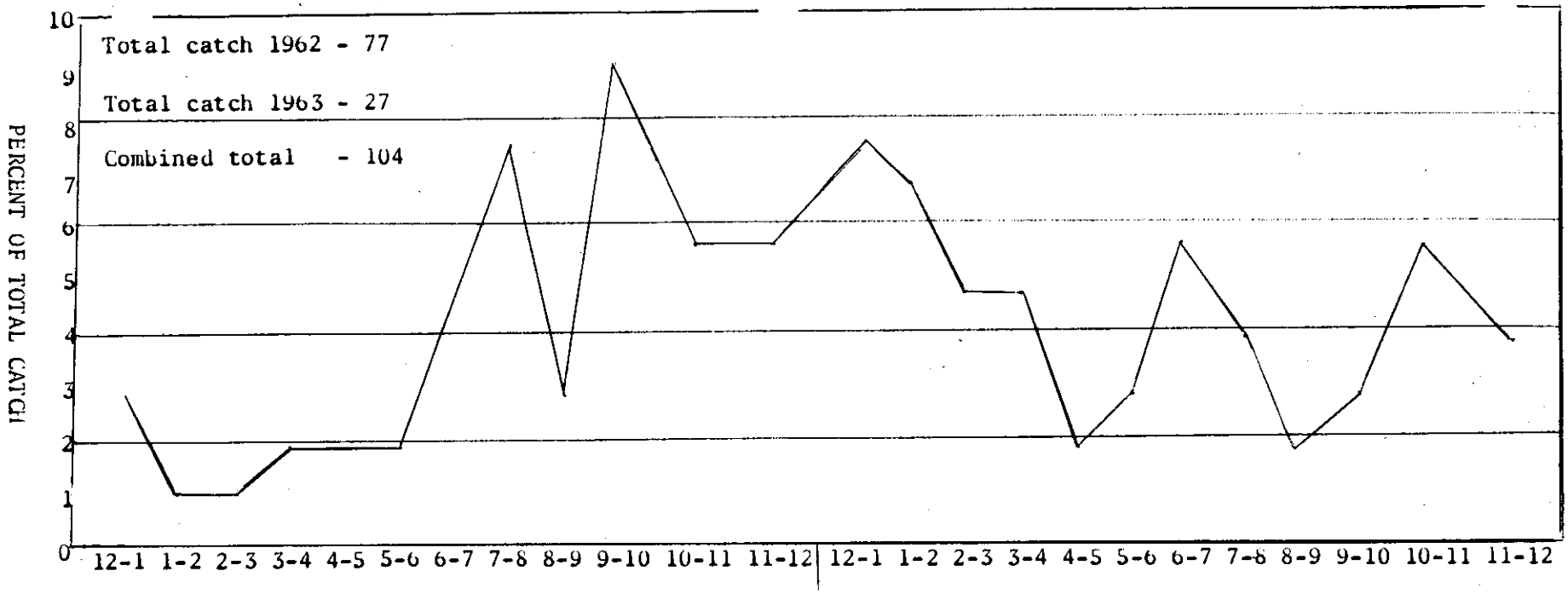


Figure 11. Relationship between catch of immature steelhead from the North Fork of the Clearwater River, Idaho, and the time of day.

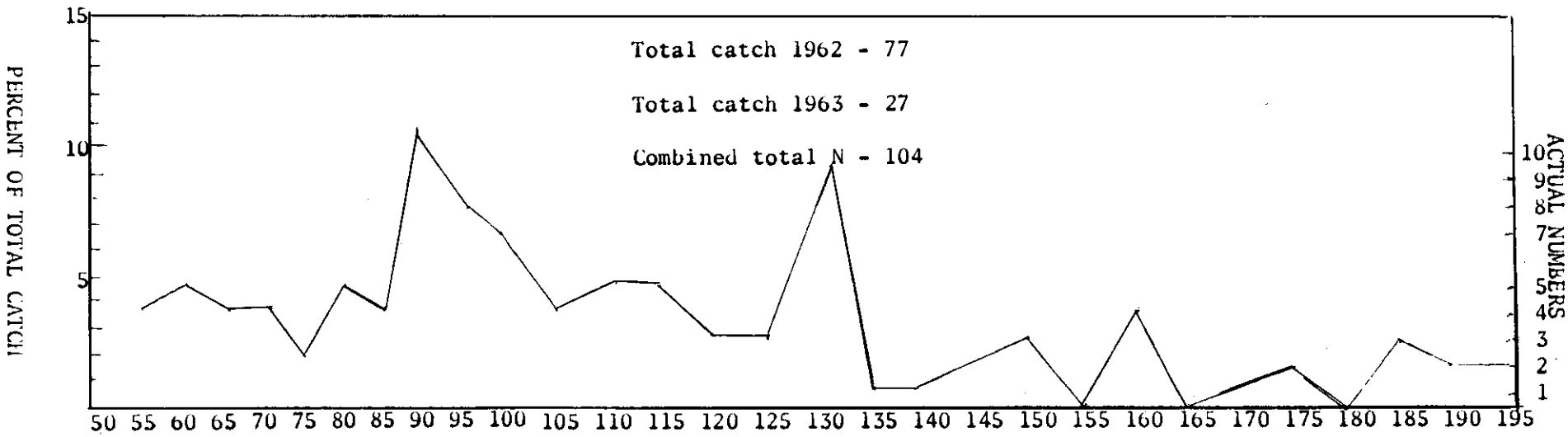


Figure 12. Length frequency distribution of juvenile steelhead, Salmo gairdneri g., captured in the floating scoop trap, Bruces Eddy Fisheries Studies, August 15 to October 31, 1962, and August 1 to November 9, 1963. North Fork of the Clearwater River, Idaho.

Table 1. The number of non-game and game fish captured by the floating, scoop trap, 1 1/2 mile upstream from the mouth of the North Fork of the Clearwater River.

Time Period	Species Collected									
	Rainbow	Shiners	Whitefish	Suckers	S.uawfith	Doll V.	Chiselmouth	Dace	Sculpin	Bass
1962										
August 15-31	0	739	13	3	8	1	1	4	4	0
September 1-30	28	294	4	7	6	3	1	2	2	0
October 1-12, 16-31	49	71	38	13	10	2	6	0	1	3
1963										
August 1-31	2	3369*	21	22	13	0	2	1	10	7
September 1-30	3	3972	7	192*	23	7	0	2	5	14
October 1-31	13	580	2	203	9	5	1	0	8	7
November 1-9	9	0	0	65	0	0	0	0	0	0
Totals	104	9025	85	505	69	18	11	9	30	31

* The three -eighths inch mesh used in the trap basket in 1962 was replaced with one-quarter inch mesh in 1963. This increased catches of small shiners and suckers.

JOB COMPLETION REPORT

RESEARCH PROJECT SEGMENT

Agency: State of Idaho Fish and Game Department

Bruces Eddy Fisheries Studies

Project Title: Movement of Juvenile Steelhead Between Tributary and Main Stem Streams

Project No. 1-000-07 Job No. Segment #2

Period Covered: August 15, 1962 through September 30, 1963

ABSTRACT

Results of a study conducted on the North Fork of the Clearwater River, Idaho, indicates that there is a movement of juvenile steelhead trout between the main river and its feeder streams during fall, spring, and summer.

Previous investigation on the North Fork of the Clearwater disclosed a substantial fall movement of steelhead progeny out of the tributaries into the main river (Keating, 1958). However, in the following spring young steelhead of several age groups are found in large numbers in these same tributaries.

This investigation substantiated this fall movement, which appears to be related to climatic conditions, and determined that varying numbers of steelhead progeny remain in the streams throughout the winter, and that there is a large movement of juvenile steelhead back into these tributaries in the spring and summer months.

OBJECTIVES

The objectives of this study were to determine if and when movement of juvenile steelhead trout, Salmon gairdneri gairdneri, between the North Fork of the Clearwater River and its feeder streams occurred.

The information collected is to be used, along with other segments of the Bruces Eddy Fisheries Studies, to present a clearer understanding of juvenile steelhead movements for pre and post Dworshak Dam evaluation, and to aid in determining fish passage facilities at the damsite.

TECHNIQUES USED

Two tributaries of the North Fork of the Clearwater were treated with rotenone after trap catches indicated that the fall migration out of these streams had passed. This was done to determine if a population of steelhead still remained in these streams,

Both tributaries were treated again the following summer to determine if juvenile steelhead other than the current year class had entered the stream. A follow-up treatment of one of the streams 61 days later was undertaken to determine if steelhead had moved back into the stream during the summer following treatment,

Other tributaries of both the North Fork and main Clearwater Rivers were sampled with electrofishing gear to determine the relative abundance of immature steelhead in these streams throughout the winter months.

Definitions

The definitions of the terms "mature" and "immature" are based on the condition of the gonads. Those fish in which the gonads were completely undeveloped and were threadlike in appearance were termed immature fish, Those fish in which the gonads were easily recognizable either as white milt sacs or eggs of any size were termed mature fish.

All the streams sampled support runs of adult steelhead and because of the lack of mature resident rainbow, the author believes that the great majority of the immature rainbow collected during this study are steelhead progeny.

Less than five percent of the fish collected were over two years of age thus substantiating the belief that most of the rainbow-steelhead juveniles collected were steelhead progeny.

Study Streams

The two main streams used in the study were Dix Creek, approximately 8 1/2 river miles from the mouth of the North Fork, and Robinson Creek, approximately 40 river miles from the mouth.

Streams sampled with electrofishing gear during the winter months include Benton Creek and Orogrande Creek on the North Fork, and Big Canyon, Cottonwood, and Six-Mile Creek on the main Clearwater River.

Trapping Operations

On August IS, 1962, a downstream migrant trap was placed at the mouth of Dix Creek. A local resident was hired to tend this trap, make a daily count of all rainbows in the trap, and take scale samples.

No trap was installed in Robinson Creek due to the remoteness of that stream. It was felt that fish movement in Dix Creek could be used as a criterion for the timing of movement. in other tributaries, and the timing of the treatment program on Robinson Creek was determined on this basis,

FINDINGS

Trapping Results

The downstream migrant trap was operated in Dix Creek from August 15 to October 17, 1962 at which time high water rendered the trap inoperable. A logging operation was due to start in the immediate area October 19, so the trap was removed from the stream.

Previous investigations of tributaries of the North Fork of the Clearwater River have shown that the period of greatest downstream movement of juvenile steelhead in the fall occurred from September 10 to October 3, and that these movements coincided with inclement weather conditions and accompanying variations in stream flows and temperatures (Keating, 1958).

Ninety-five rainbow trout were captured in the Dix Creek trap. All movement occurred after September 24. Movement into the trap appeared to be related to the occurrence of rainfall which brought increased stream flow, lower water temperatures, and increased water turbidity.

Average size of the rainbow taken from the trap was 92 millimeters fork- length, with a range from 31 to 100 millimeters. Seventy-five percent of the fish sampled were in age group 0 and 25 percent in age group I (zero and one annulus).

Some very small rainbow trout were observed passing through the three-eigths-inch mesh of the trap.

Treatment Program and Results Dix Creek

Dix Creek was treated with five percent emulsifiable rotenone on October 31, 1962. This treatment apparently resulted in a complete kill of fish in the stream.

A waterfall one mile from the mouth of Dix Creek stops all upstream migration beyond that point. A 200-yard sample collected immediately downstream from the fall disclosed 22 immature and one mature rainbow. Size range of the immature fish was from 52 to 152 millimeters fork-length. Fifty percent of the fish were in age group 0 and 50 percent in age group I.

Dix Creek was retreated July 16, 1963. Two general size classes of fish were present-the fish that were hatched that spring, ranging from 33 to 58 milli-meters in length, and the fish that had entered the stream from the North Fork since the fall treatment which ranged from 95 to 174 millimeters.

The sample collected on July 16, 1963 over the same 200-yard area sampled the previous October contained 25 young-of-the-year fingerlings and 17 immature rainbow trout that had entered the stream since the last treatment. Forty-four rainbow were also collected in the lower stretches of the stream (newly-entered fish) to aid in age determination.

Scale age determination based on scales from all 61 reentered rainbow trout showed three percent in age group 0, 91 percent age group I, and six percent age group II,

There was one mature fish collected below the falls in the first fall treatment and none in the spring treatment. Fingerling trout from the spring hatch were found throughout the stream below the falls.

Treatment Program and Results Robinson Creek

Treatment of Robinson Creek was initiated on October 24, 1962. The south and north forks of the stream are blocked to upstream migration at the mouths and contain only stunted cutthroat trout. These forks were not treated.

In the main stem of Robinson Creek the total number of fish collected in a 650-yard sample area was 41 rainbow trout and two cutthroat trout. Thirty-nine

of the rainbow were immature. Size range was from 52 to 176 millimeters. Fifty-four percent of the fish were in age group O, and 46 percent in age group I.

The two mature trout were males 118 and 157 millimeters, both age group II.

On July 23, 1963, the main stem of Robinson Creek was treated once more. A collection from the mouth of the stream 400 yards upstream disclosed 20 rainbow 98 to 174 millimeters. These trout which had entered the stream had not reached as far upstream at the time of this treatment as they had been found in the fall treatment. Young of the year fingerling rainbow were numerous in the sample area and were found approximately one-quarter mile farther upstream than the fish that had newly entered.

Analysis of scales from the rainbow showed 59 percent were in age group I, 39 percent in age group II and two percent in age group III.

Robinson Creek was retreated on September 24, (61 days later). Immature rainbow were once again present. Twenty-eight rainbow from 44 to 200 millimeters were collected over the same 400-yard area. Thirty-four percent of the fish were in age group 1,55 percent in age group II, and 11 percent in age group III. One mature female 199 millimeters was also found,

Winter Sampling and Results

Five streams were sampled for the presence of over-wintering juvenile steelhead trout.

On January 22 and 23, 1963, sampling operations were initiated on Cotton-wood and Big Canyon Creeks, tributaries of the main Clearwater River, An AC electric shocker was used after breaking surface ice on the streams.

In Big Canyon Creek 25 immature rainbow were found in a 200-yard section. Size range was from 78 to 219 millimeters. Eleven percent of the fish were in age group 0, 52 percent age group II, and 26 percent age group III.

In Cottonwood Creek two holes were shocked totaling approximately 25 yards of stream. Forty-four immature rainbow were collected. Size range was from 65 to 195 millimeters. Fifty-six percent of the fish were in age group 0, 28 percent age group I, and 16 percent age group II.

Orogrande Creek, a tributary of the North Fork of the Clearwater, was sampled on February 12 and 13, 1963. Explosives and an AC electric shocker were used on approximately 500 yards of stream. Only three juvenile steelhead were collected---65, 85, and 103 millimeters—all age group 0.

Extensive scouring of Orogrande Creek by ice occurred one week previous. in some places moving over the road 15 feet above the stream bed, This could possibly have had some bearing on the scarcity of fish.

Creel census work the following summer showed a large population of small rainbow steelhead trout in Orogrande Creek, which apparently entered that spring.

On March 6, 1963, Benton Creek on the North Fork was sampled. Sampling proved extremely difficult and only seven immature rainbow were collected in one small area. The fish ranged in size from 45 to 70 millimeters, all in age group 0.

Six-Mile Creek, a tributary of the main Clearwater River, was sampled with the shocker on March 10, 1963, Twenty-five immature rainbow trout from 60 to 110 millimeters in length were collected from a 100-foot section.
Eighty-three percent of the fish were in age group 0, and 17 percent in age group I.

Also collected in Six-Mile Creek were three mature rainbow--one female (170 millimeters, age group III) and two males (95 and 112 millimeters, age group I).

CONCLUSIONS

It has been established from this and previous investigations that there is a fall migration out of the tributary streams into the main river, apparently largely influenced by rainfall and consequent stream changes.

It appears that a large but varying percentage of the steelhead progeny also remain in the tributary streams all winter. The size of this remaining population may possibly be dependent upon winter conditions in the stream, (e.g. Orogrande Creek).

Also, there appears to be movements of juvenile rainbow-steelhead trout back into these streams in the spring and summer months, apparently continuing into the early fall. The exact cause of these movements is a subject for future investigation.

LITERATURE CITED

Keating, James F_a, Jr.

Clearwater River Fisheries Investigation, II. Trout Migration Studies. Final Report, Federal Aid to Fisheries Project F-15-R. Idaho Department of Fish and Game, Boise, Idaho. Mimeo.

JOB COMPLETION REPORT

RESEARCH PROJECT SEGMENT

Agency: State of Idaho Fish and Game Department

Bruces Eddy Fisheries Study

Project Title: Non-Game Fish Range and Distribution Study

Project No. 1-000-07 Job No. Segment #3

Period Covered: August 1, 1963 through September 30, 1963

ABSTRACT

In the summer of 1963, 20 tributaries of the North Fork of the Clearwater River, from 18 to 150 river miles above the mouths were sampled to determine range and distribution of non game fish species. One tributary of the main Clearwater River was also sampled.

Beyond Elk Creek, at river mile 18 (Figure 1), longnose dace and fresh-water sculpins were the only nongame fish species collected or observed in the sampled tributaries.

Sculpin were common to practically all streams sampled, including Short Creek, approximately 150 river miles from the mouth of the North Fork of the Clearwater. Longnose dace were found as far upstream as Fourth of July Creek, about 115 river miles from the mouth of the North Fork.

Elk Creek and Six-Mile Creek, a tributary of the main Clearwater River, were the only two sampled streams containing non game fish species other than sculpin and dace.

RECOMMENDATIONS

To obtain more complete information in any further range and distribution studies, it is recommended that the North Fork of the Clearwater itself also be sampled. Suckers and squawfish have been observed in the North Fork far above Elk Creek, but none were collected in any other tributaries sampled during this study. Possible sampling methods could include the use of explosives in selected areas, heavy-duty shocking apparatus, or gill nets in pool areas. Skin diving equipment might also be effectively applied here.

Further insight into nongame fish distribution might also be gained by tributary sampling at times of the year other than low water summer conditions.

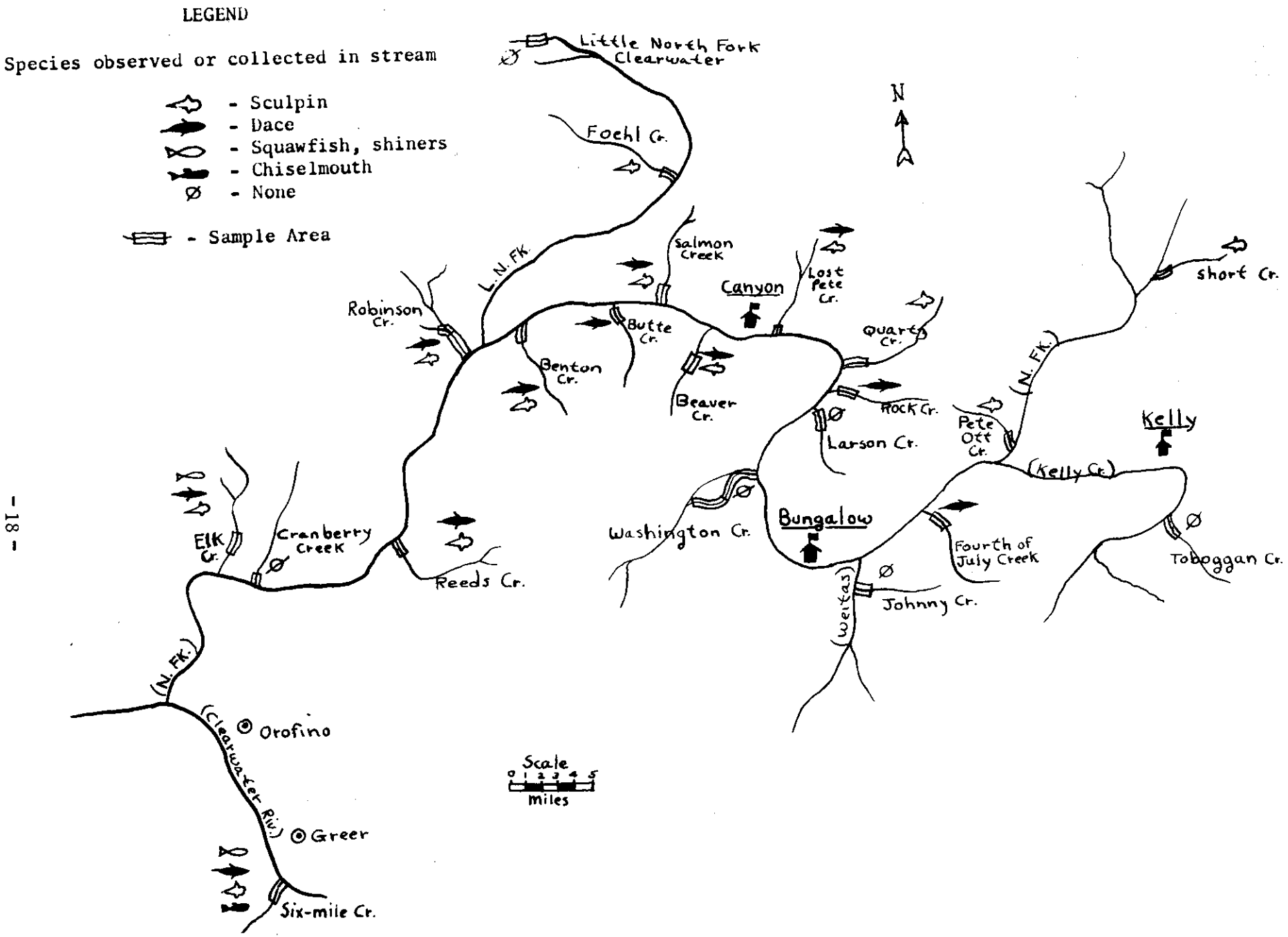


Figure 1. North Fork of the Clearwater drainage, showing streams sampled for presence of non-game fish species, and species found. Bruces Eddy Fisheries Studies, Segment #3, August-September, 1963.

OBJECTIVES

The primary objective of this study was to determine the feasibility of conducting a program of this sort to determine present range and abundance of non-game fish species for use in post Dworshak Dam construction evaluation.

Secondary objectives were to develop efficient sampling techniques and to determine time and effort involved in a sampling program of this type.

TECHNIQUES USED

The topography of the country and physical characteristics of streams in the North Fork of the Clearwater drainage necessitate light portable sampling equipment and materials. Many streams in the drainage are accessible by trail only.

To sample these tributaries, five percent emulsifiable rotenone was used over short areas. Potassium permangenate oxidizing agent was introduced at the terminus of the sampled area to counteract rotenone toxicity, Most streams were sampled near their confluence with the North Fork to take advantage of the dissipating effect of the river.

On most streams a 6 x 15 foot, one-quarter inch mesh minnow seine was stretched across the lower end of the sample area. In swift turbulent streams this greatly helped in the recovery of stunned and dead fish,

Physical data on the streams was recorded at the time of sampling and appears in tabular form in Table 1.

FINDINGS

Above Elk Creek, at river mile 18, the only species collected in North Fork tributaries were Rhinichthys cataractae, the longnose dace, and unidentified freshwater sculpins, Cottus al).

In Elk Creek, three other non **game** species were present* Richardsonius balteatus, the redside shiner, Ptychocheilus oregonensis, the northern squawfish, and Rhinichthys osculus, the speckle ace, 0 t e 4 dace collected in Elk Creek (Table 2), 30 were R. osculus, and 14 were the species IL cataraetae. Smallmouth bass were also present in Elk Creek.

In Six-Mile Creek all the above species were found plus Acrocheilus alutaceum9, the chiselmouth. Of the four dace collected in Six-Mile CCreek, three were the speckled dace, R. osculus, and one was the longnose dace, R. catatactae,

In all the streams sampled, small rainbow trout, presumably juvenile steelhead, were present. These trout varied in abundance in the sample area from approximately 500 in Toboggan Creek to two in the sample area in the Little North Fork. A general estimate for the over-all sampled areas, however, would be from five to eight rainbow for every non-game fish species

Cutthroat and Dolly Varden trout occurred in small numbers, primarily in the uppermost tributaries.

It required 30 man-days to sample all 21 streams. The streams were chosen for sampling on two requisites, size of the stream and location in the drainage. For maximum efficiency a two-man team is better than a single-man; however, using the minnow seine, it is possible for one man to operate fairly effectively,

Table 1. Names, physical data on sampling date, and stream distance for non-game species, North Fork of the Clearwater drainage.

Stream name	Date	Stream flow	Temp. F	Water conditions	Yards sampled	Yards from mouth	Remarks
Six-mile	8/2	5cfs	59	low mossy	100	0	Tributary of main Clearwater.
Elk	8/21	40	68	low clear	35	800	Lowermost tributary sampled, approx. 18 river miles.
Cranberry	9/10	2 1/2	58	low mossy	25	0	Too small to support many fish. Heavily silted.
Reeds	8/22	40	57	low clear	75	0	
Robinson	9/24	15	--	low clear	400	0	
L. N. Fk.	8/28	25	49	low clear	100	-	Sampled under bridge on road to Roundtop Ranger Station.
Foehl	8/27	40	53	low clear	100	0	Tributary of Little North Fork of the Clearwater.
Benton	9/25	12	--	low clear	50	0	Sample area includes wooden culvert.
Butte	9/25	8	--	low clear	35	0	
Salmon	8/9	7	61	low clear	50	0	
Beaver	8/8	60	62	low clear	35	500	
Lost Pete	8/8	6	60	low clear	50	0	Falls look like upstream block. Mouth sampled.
Quartz	7/31	35	54	low clear	200	0	
Rock	8/13	20	62	low clear	50	50	
Larsons	7/30	10	61	low clear	50	25	
Washington	7/30	45	58	low clear	400	0	Sampled side channel around lower falls.
Johnny	8/13	15	68	low clear	50	0	Tributary of Weitas Creek. (Weitas 76°F. this date).
4th July	8/15	80	65	low clear	100	25	
Toboggan	8/1	30	51	low clear	200	0	
Pete Ott	8/14	10	64	low clear	50	0	
Short	8/14	12	57	low clear	100	0	Uppermost tributary sampled, approx. 150 river miles.

Table 2. Numbers of species of non-game fish collected or observed in tributaries of the North Fork of the Clearwater River.

Stream name	Species collected					Species observed only
	Sculpin	Dace	Shiners	Squawfish	Chiselmouth	
Six-mile*	1	4	11	3	10	
Elk	13	44	17	5		
Cranberry			none			none
Reeds	5	38				
Robinson		14				
L. N. Fk.			none			none
Foehl			none			2 sculpin
Benton	23	1				
Butte		10				
Salmon	1	38				
Beaver	2	5				
Lost Pete	12	9				
Quartz			none			1 sculpin
Rock		27				
Larsons			none			none
Washington			none			none
Johnny			none			none
4th July		9				
Toboggan			none			none
Pete Ott	2					
Short	2					

* Tributary of the main Clearwater River.

JOB COMPLETION REPORT

RESEARCH PROJECT SEGMENT

Agency: State of Idaho Fish and Game Department

Bruces Eddy Fisheries Studies

Project Title: Adult Steelhead Spawning Study

Project No. 1-000-07 Job No. Segment #4

Period Covered: March 1, 1964 through July 1, 1964

ABSTRACT

In the spring of 1964, the Idaho Fish and Game Department, under contract to the Army Corps of Engineers, conducted a study of spawning steelhead on Little Moose Creek, in the upper North Fork of the Clearwater drainage.

A weir and traps were placed in the stream and adult steelhead entering Little Moose Creek were captured, tagged, released, and closely observed while in the study area.

Observations were made on timing, movement, spawning, redd discernability, competition, and general activity.

Steelhead were later than usual in entering the study area due to the winter conditions that prevailed until late spring. Fish were in the study stream from April 20 through the first week in June, and averaged 15.8 days in the stream.

Length of time in the stream before spawning ranged from one to 22 days, and after spawning from zero to six days.

Length of time spent on the redd averaged 1.6 days and no fish stayed on any redd more than three days.

Water conditions mainly determined how long a redd was discernible. High turbid water caused redds to disappear in a few days.

Of six successfully spawning marked female steelhead in Little Moose Creek, one built two redds and five built one redd each. Of four successfully spawning marked male steelhead, two spawned three times each, one spawned twice, and one spawned once. Competition between males was constantly observable.

A helicopter count of fish and redds was conducted in Kelly and Cayuse Creeks. Counts were compared to data available from the U.S. Bureau of Commercial Fisheries on a similar count in 1959. Steelhead and redd counts were considerably lower in 1964.

RECOMMENDATIONS

It is recommended that helicopter counts of steelhead and redds be continued each year in this area and other parts of the drainage to gather trend information for pre and post Dworshak Dam evaluation.

Redd discernability observations could also be conducted in more accessible areas to aid in determining frequency of aerial counts and evaluating their accuracy.

OBJECTIVES

The over=-all objective of this study was to collect information on adult steelhead spawning behavior to aid in formulating a trend gathering program to evaluate the effects on the North Fork steelhead population of Dworshak Dam, now under the first stages of construction at the mouth of the North Fork of the Clearwater River.

Primary information desired was the time of arrival of adult steelhead in specific areas, the length of time the fish remain in the area before, during, and after spawning, time on the spawning sites, and the length of time redds are recognizable after construction.

Other information to be gathered was length of spawning time, competition between male steelhead, movement of steelhead within the study area, activity at various times and water conditions, and any other biological information that might be collected during the study.

TECHNIQUES USED

A stream was selected in the upper North Fork of the Clearwater River drainage that supports a small annual spawning population of steelhead. A weir with upstream and downstream trapping facilities was constructed in this stream before the arrival of the spring spawning run of adult steelhead (Figures 1 and 2).

As each steelhead entered the upstream trap it was netted, measured, observed for sex, tagged and released (Figure 3). Each fish was marked with a different colored easily-observable tag.

An observer checked the stream and recorded the location and actions of each individual fish at least twice each day. When. a fish entered the downstream trap its time of departure from the study stream was noted and the fish was released.

Redds were marked and observed for the length of time they were discernible as a steelhead nest.

The Study Stream

Little Moose Creek, near the old Kelly Creek Ranger Station on the upper North Fork of the Clearwater River drainage, was selected as the study stream. This stream lies approximately 125 river miles upstream from the mouth of the North Fork (Figure 4).

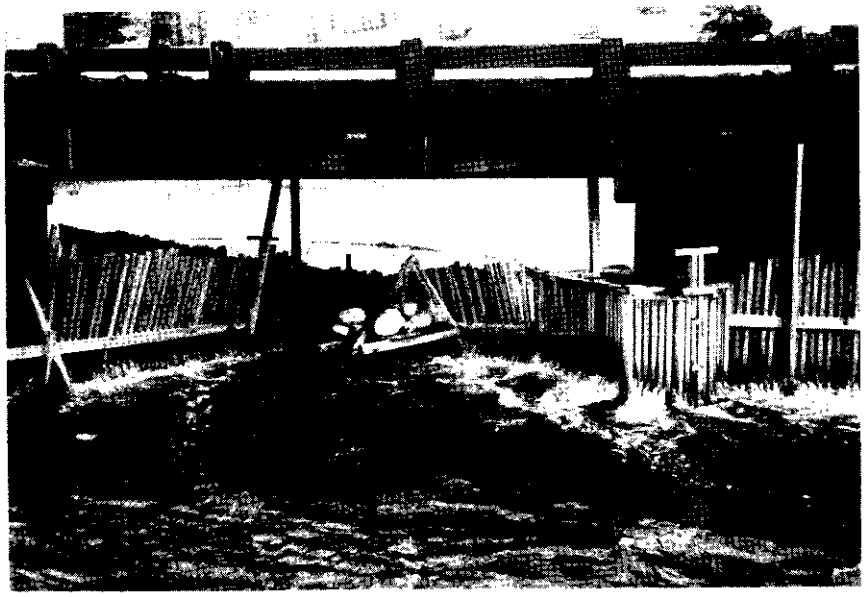


Figure 1. Weir and traps in Little Moose Creek looking upstream into the entrance of the upstream trap. Downstream trap is on the right. Heavy rocks were used to hold A-frames in place. Bruces Eddy Fisheries Studies, March, 1964.

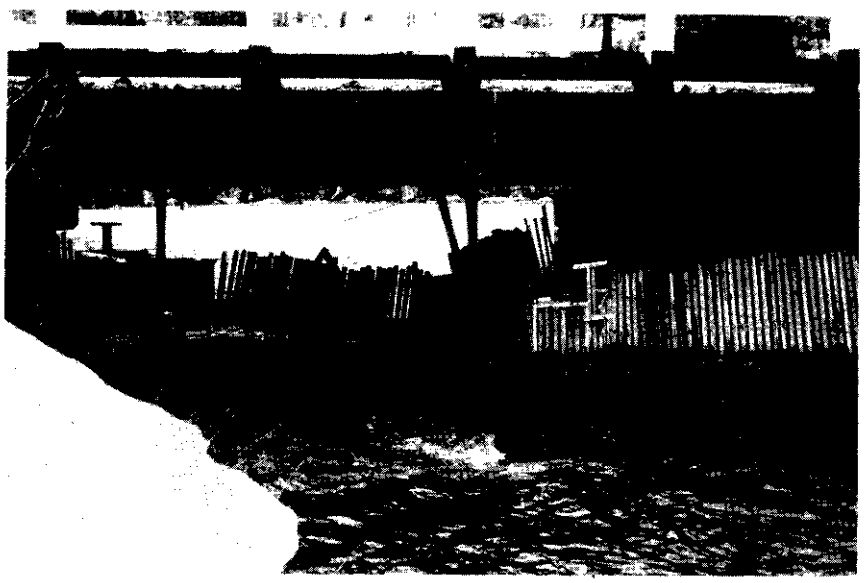


Figure 2. Weir and traps in Little Moose Creek looking downstream into the entrance of the downstream trap. Upstream trap is on the right. Fish were released from traps by raising gates. Bruces Eddy Fisheries Studies, March, 1964.

Figure 3. Releasing adult steelhead after tagging. Note tag hanging below fish. Some steelhead suffered handling shock and had to be watched closely for a few hours. There were no losses. Bruces Eddy Fisheries Studies, Little Moose Creek, May, 1964.

Little Moose Creek flows approximately 150 to 200 cubic feet per second during its average spring run-off. It is a clear running mountain stream and steelhead can usually be observed during the high water period in the spring. Approximately one-third of a mile from its mouth an upstream migration block to most steelhead is created by a waterfall (Figure 5). Only one steelhead was observed successfully jumping these falls. In 196[7] there were 26 steelhead observed spawning in the stream below the falls.

The area from the weir to the waterfall was marked off in sections, nine in all, to facilitate observations on fish movements. These sections averaged approximately 50 yards long and boundaries were log jams, pools, and other natural features.

In most years this stream is not accessible by wheeled vehicle until the first part of May, when snow plows open the road. Food, equipment, and materials were stored at the site in the fall of 1963. A helicopter was used to enter the area on March 9, 1964.

A private mining claim cabin situated at the mouth of the stream was used as headquarters during the study period.

Weir and Traps

A prefabricated weir stored at the study site in the fall of 1963 was placed in the stream March 1215. This weir consisted of an upstream trap, a downstream trap, and guiding weir sections constructed of lumber. The vertical slats were made of 2" x 2" white pine boards five feet in length. The traps were four feet in height (Figures 2,3).

Snow depths in the Clearwater drainage reached record levels in the winter of 1963-64. An exceptionally late and above normal spring run-off caused flooding throughout the entire area. Little Moose Creek was no exception and on May 15, the weir was washed out by extreme flows.

When the weir was completed on March 15, a water gauge on the upstream trap showed 11 inches of water height. On May 15, the water exceeded the four-foot level and washed out under the weir and collapsed the structure, The stream was flowing approximately 300 cubic feet per second at the time

Fifteen fish were tagged and released prior to the loss of the weir on May 15, and information collected on this number of fish, which later appeared to be a majority of the spawning run into Little Moose Creek, as considered to be indicative of the entire run Into this stream.

Tagging Procedure

Each steelhead was marked with a different colored tag made up of plastic flagging tape on a size 00 hog ring (Figure 5). Seven colors were available red, yellow, blue, orange, green, black, and white. Combinations of different colored flagging provided the additional number of marks needed to identify each fish.

The plastic flagging did not prove to be a good tagging material. The plastic became stiff in the cold water and it tended to crack and split from the action of current and fish. Only the knot and a small amount of flagging remained on a few of the fish near the end of the study,

Figure 5. Waterfall approximately one-third mile upstream from weir in Little Moose Creek, upper limits of study area. Flood waters in June 1964 may have opened passable channel on right side. Bruces Eddy Fisheries Studies, May, 1964.

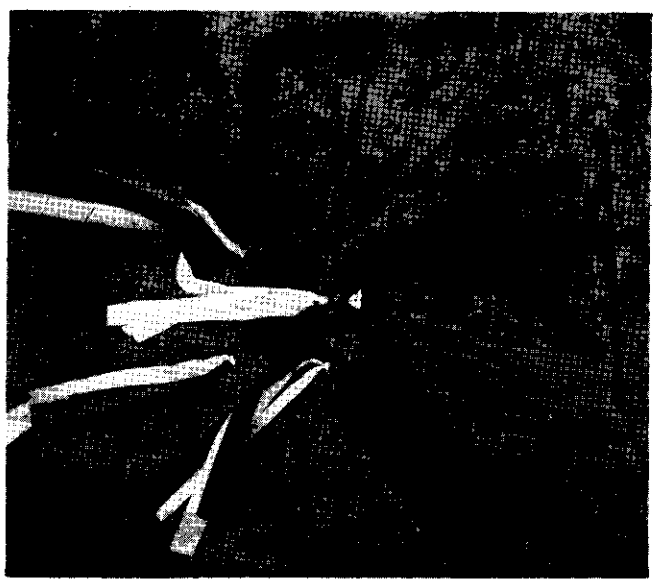


Figure 6. Tags used to mark steelhead entering Little Moose Creek. Hog rings were closed into back between dorsal and adipose fin. Plastic tended to crack and split in cold water. Bruces Eddy Fisheries Studies, May, 1964.

Most colors were highly visible in the water. The black and blue were harder to see, but worked well in combination with other colors. White was sometimes difficult to spot in fast water.

Redds

When a redd was constructed it was marked with a fluorescent oranges painted rock one foot above the upstream edge. Directly opposite, on the shore, a piece of orange flagging was hung„ with the redd number and date of construction on the flagging. Each redd was checked at least once a day in Little Moose Creek, and as often as possible in Moose and Kelly Creeks, generally every other day.

Records

Information on steelhead and redds was recorded on specially-designed forms. The location and activities of the steelhead were normally checked twice each day, in the morning and afternoon. Fifteen steelhead and 25 redds were marked and checked during the study.

Information on weather, water and air temperatures, and water conditions were also recorded daily.

FINDINGS

Timing

I, Arrival

The first steelhead were observed on April 19, when five fish were spotted from the Kelly Creek Bridge and one fish was seen entering Moose Creek.

The first steelhead entered the study stream April 20. In 1964, the bulk of the run of spawners into Little Moose Creek occurred between April 30 and May 20.

The spawning run in Kelly Creek drainage was somewhat later than in previous years, Snowfall and ice conditions in this area were much heavier and stayed later than normal. The ice did not leave Kelly Creek until April 2. Water temperatures in Little Moose Creek exceeded 36°F, only once before April 14.

Observations over several years by Forest Service personnel living at Kelly Creek Ranger Station and Department fieldmen indicate that steelhead were usually to be seen from the Kelly Creek ridge early in March and by April 15 many spawning steelhead were usually to be seen on the gravel bars below the bridge.

A helicopter count of steelhead and redds in Kelly Creek was made by the U.S„ Bureau of Commerical Fisheries on April 14, 1959. On that date, 41 fish and 43 redds were counted from Kelly Forks to Cayuse Creek, a distance of 14 miles. The first steelhead of the 1964 run sighted by personnel assigned to this study was observed on April 19, 1964.

II, Departure

Observations through the years indicate that most steelhead have completed spawning and have left the Kelly area by the second week in June,. This held

III. Numbers of Fish

A total of 15 fish were marked and put over the weir in Little Moose Creek, and one fish with a large dorsal scar was seen entering and leaving but was not captured or marked. An estimated eight to ten steelhead entered the study stream after the weir was washed out.

Numbers of fish observed in Kelly Creek were low compared to data from 1959. On May 9, 1959, a helicopter survey made by the U.S. Bureau of Commercial Fisheries showed 96 redds and 28 fish from the mouth of Cayuse Creek to the Kelly Creek Bridge, a distance of four miles0. As a comparison, a helicopter survey by Idaho Fish and Game personnel on May 8, 1964, over the same area showed 15 redds and 11 fish.

A U. S. Bureau of Commercial Fisheries count on May 11, 1959 in Cayuse Creek showed 179 redds and 80 fish. A helicopter count by Idaho Fish and Game personnel over this same area on May 8, 1964 showed 39 redds and **six** fish.

The 1958-59 fish-year count of steelhead over the Lewiston Dam was 33,216. The 1963=64 fish-year count was 21,561. The difference of 11,655 fewer fish likely accounted for some of the difference in spawning ground counts. The time of arrival of steelhead at the spawning ground was delayed by the heavy winter conditions that prevailed until very late in the spring of 1964. Some of the difference may be due to the later arrival of the fish on the spawning grounds in 1964.

Length of Stay

I. Total Time

The times of arrival and departure in the study area of 14 steelhead were noted and recorded. Length of time in the stream ranged from four to 28 days and averaged 15.8 days.

Twelve of the marked fish arrived in a six-day period, May 7 to May 12. This movement corresponded with a warming trend which caused water temperatures to rise and the stream flow to increase from melting snow.

One tagged steelhead could not be accounted *for* after it was released from the weir, One fish .was found dead one week after it entered Little Moose Creek,

II. Before Spawning

Length of time in the stream before spawning varied from one to 22 days. The second fish to enter the stream, on April 30, was one of the last to spawn on May 22. One of the last females tagged at the weir on May 11 was one of the first to spawn on May 14. Within limits there appeared to be no relationship between time of arrival and spawning time.

III. Length of Time in Stream After Spawning

The length of time spent in the study ,stream after spawning ranged film zero to six days, and averaged 3.0 days. This was from the time the fish left the redd until it left the stream. It does not take into account the time spent on the redd itself. In cases where fish spawned more than once this time was from the departure of the last redd constructed.

IV. Length of Time on Redd

There were 14 redds marked in Little Moose Creek, five in Moose Creek, and six in Kelly Creek. The length of time spent on the redd by the spawning fish was checked on 19 of these marked redds. The time ranged from one to three days and averaged 1.6 days. There were only four pairs that remained on the redd for the third day.

The actual spawning took place intermittently over the length of time spent on the redd and the fish-left the redd soon after spawning was completed. In most cases both male and female fish departed from the redd at the same time; but in a few instances, the male fish remained on the redd a few hours longer than the female.

During the spawning time both fish would move on and off the redd, often moving to other parts of the stream and chasing each other about. These paired fish always returned to the same redd.

Several night checks were made and fish were found on the redds at night. No actual digging or spawning was observed at night, however, as the artificial light and approach of the observer seemed to disturb the steelhead and caused them to leave the redd. Fish were often on the redd in the evening and gone for good the next morning.

Redd Construction

I, Preliminary Digging

Several female fish were observed doing some preliminary digging in different areas before constructing the main redd and actually spawning.

This action consisted of digging in the gravel with the caudal fin two or three times and then deserting the area. In most cases they were not accompanied by a male at the time. These areas were not dug enough to appear as redds and a person not observing the action would not recognize the area as a steelhead nest.

None of the male fish were observed doing any digging at any time.

II, Spawning Areas

Various areas in the streams were chosen by the fish in which to construct redds. Some redds were constructed on large open gravel bars, some were built in small pockets of gravel behind rocks or near logs, and some on the edge of white water. Some of the redds constructed would be extremely difficult to discern if they were not observed being built.

Spawning

I. Females

Nine female steelhead were tagged and released into Little Moose Creek. Of this number, one disappeared, one was found dead, and one was not observed spawning although was barren of eggs when released from the downstream trap. This female was gravid when it entered the stream.

The six remaining females all spawned successfully and one female constructed two redds. These two redds were built two days apart in different sections of the stream and this female was accompanied by a different male at each redd.

The actual time of spawning appeared to be dependent upon the female. The arrival of a male steelhead did not appear to trigger the actual spawning as some males were generally in the vicinity of most females.

Three of the females were in the stream from 16 to 22 days before spawning during which time they were near almost every male steelhead at one time or another.

II. Males

Seven male steelhead were observed in Little Moose Creek. Only four of these were observed in the act of spawning with a female. Two of the males. spawned three times each, one of them spawned twice, each time with a different female, and one male spawned once,

The two males that spawned three times each were the two largest males, 39 and 35 inches in length and approximately 20 and 17 pounds in weight, respectively. The male that spawned twice was a scarred fish that entered after the weir was washed out and not tagged or measured but estimated at 15 to 18 pounds. That male that spawned once was 34 1/2 inches long and weighed approximately 16 pounds,

The three males that were not observed. in the spawning act with females were 28, 29, and 36 inches in length, The 36-inch male was a thin fish that weighed approximately 15 pounds and was not observed attempting to spawn and departed the area only eight days after entering the stream, The smaller males attempted to spawn with various females but were unsuccessful as they were constantly chased away by the larger fish,

In Little Moose Creek, a yellow and black tagged male spawned with two females simultaneously. Redd numbers two and three were located one behind the other about 10 feet apart. This male moved from one redd to the other spawning with each female in turn during a two-day period, A smaller male, also attempting to spawn with the females, was chased off continually by the yellow and black tagged fish. The yellow and black tagged male also spawned again 11 days later, in another part of the stream, and fought off the large scarred-fin male from that redd.

A large 39-inch, 20-pound male in the stream for 28 days also spawned three times—May 9, May 14, and May 22. This male also chased other male steelhead away from the redds,

Competition between males was also oberved in Kelly Creek, In one instance a large male chased off a smaller male that was spawning with a female and moved onto the redd.

The larger males unquestionably dominated the spawning during the time when observations were made.

Other Observations

I, Fish Handling Shock

In several cases fish that were netted, measured, tagged, and handled went into a state of shock. In two cases the fish would possibly have died if not revived by hand. This was accomplished by holding the fish level in the water and gently rocking it until it could hold itself upright. Most of the fish drifted immediately into the downstream trap upon being released. These fish could often be touched without causing them to swim away, These fish were left in the down-stream trap and upon recovery in an hour or two would swim out of the trap and continue upsteam.

II, Fish Movement

The location of each steelhead was noted at least twice each day in an attempt to determine movement in the spawning stream, There was much variation in the pattern of movement. Some steelhead proceeded immediately upstream to the falls, the upper limit of travel, and some never left the first section of the stream.

There did arise a general pattern of behavior. The movement of steelhead up and down the stream increased prior to spawning. Generally one to two days before spawning occurred, the fish would move through several sections of the stream. In three cases individual steelhead moved from one extreme of the stream to the other.

Prior to this increase in activity, movement was restricted and most of the fish stayed within one or two sections of the stream, This did not hold for all the steelhead observed, but was a general pattern on the majority of observations,

During periods of high turbid water, activity was at a minimum. Although the steelhead were hard to observe during these periods, they were often found in sheltered areas near the bank or in quiet eddies,

Movement of fish into the stream occurred after water temperatures began to increase above 36°F. during the day,

Redd Recognition

Twenty-five redds were marked and observed for the length of time they were discernible as a steelhead redd. Of this number, one was obliterated by large debris moving downstream and one was obliterated by spawning fish.

The length of time the redds were discernible varied somewhat according to the composition of the area in which they were constructed, Redds dug in small gravel pockets tended to fade and level sooner than large redds dug on open gravel bars,

The greatest factors causing the redds to disappear were turbidity and velocity of flow. Most of the redds were constructed during low water prior to the spring run-off. After a several-day flow of high turbid water, marked redds became indistinguishable from the surrounding bottom.

Turbidity appeared to be the greatest factor in obliterating the redds by darkening the churned gravel to match the surrounding area. A former dredge mining operation on Moose Creek created conditions that caused that stream to turn very turbid each warm afternoon. Redds in this stream disappeared faster than redds in Kelly Creek or Little Moose Creek, Increased velocity during the rise in water flow tended to level out the redd mounds.

Of the 23 closely-observed redds, recognition time ranged from five to 21 days. Most all of the redds were discernible until several days of high turbid water obliterated them. Some of the smaller redds in Little Moose Creek disappeared quickly even during low water flows. Those built in small gravel pockets were no longer recognizable as redds in a matter of five days to a week even though waters were relatively free from silt.

In Moose Creek, redds 100, 101, 102, and 103 were all discernible on May 12. From May 12 to 16, the flows in Moose Creek were extremely high and turbid. On May 16 none of the redds could be discerned from the surrounding gravel.

In Kelly Creek, all six marked redds were discernible until a nine-day period of high, turbid water obliterated all of them. Much them same pattern followed in the study stream, Little Moose Creek,

Redd discernibility was judged on color difference primarily. Mound height was also considered, but was not as significant,

In summary of redd recognition, it appeared that water conditions were the main factors. If water conditions were low and clear, the redds would have remained discernible for longer periods of time.

Prepared by:

Melvin Reingold
Fishery Biologist

Approved by:

John R. Woodworth
Director

James C. Simpson
Chief, Fisheries Mgmt. Div.

Ed C. Bjorn
Fisheries Research Supervisor

LEGEND

1. A count of steelhead and redds was taken by helicopter from this point to the mouth of Cayuse Creek on May 8, 1964. 39 redds - 6 fish

2. A count of steelhead and redds was taken by helicopter from the mouth of Cayuse to the Kelly Creek bridge on May 8, 1964. 15 redds - 11 fish

3. The location of the study stream used in this project.

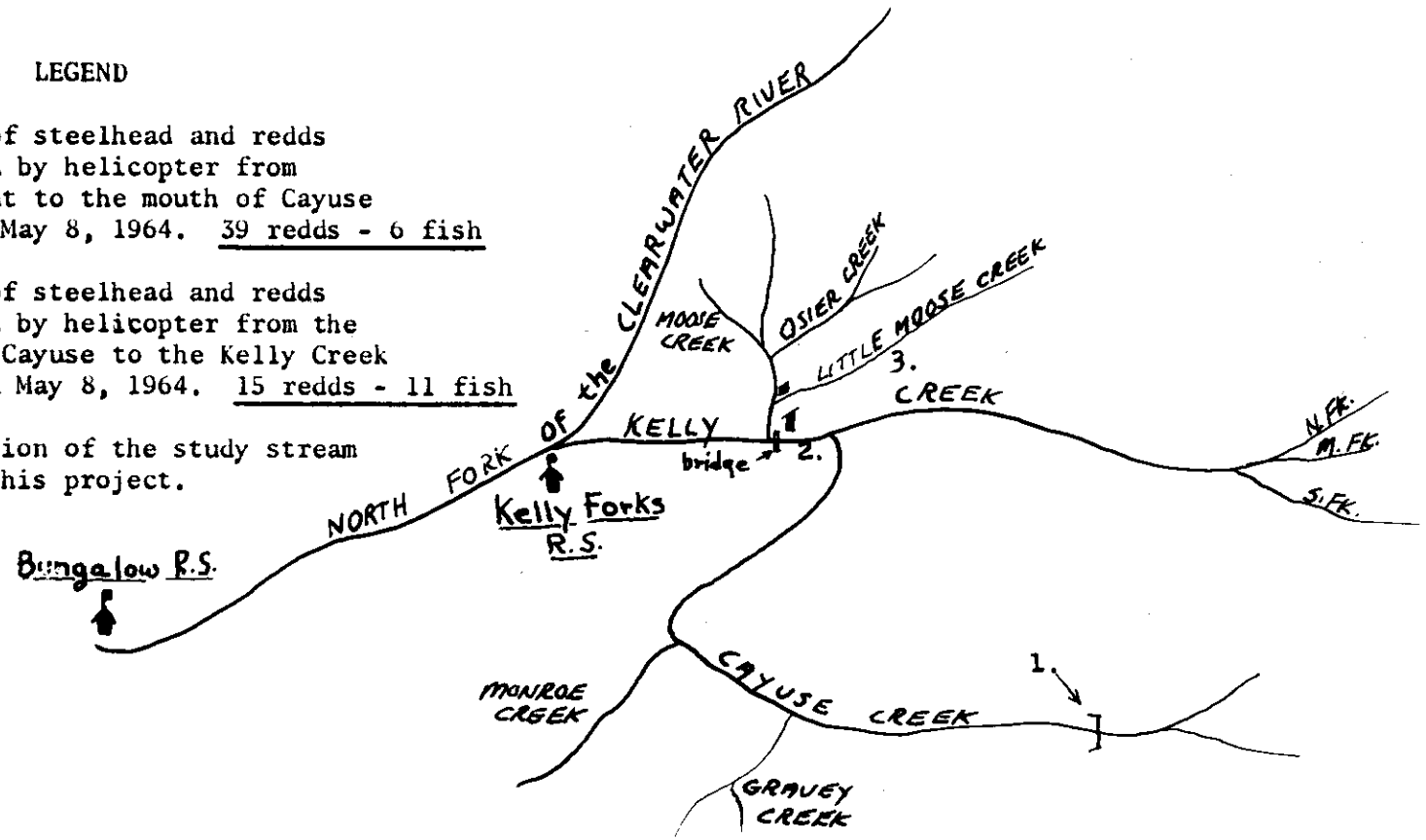


Figure 4. Map of upper North Fork of the Clearwater area showing study area and stream sections flown by helicopter for steelhead and redd counts. Bruces Eddy Fisheries Studies, Segment #4. March - June, 1964.

Table 1. Summary of information collected on redds constructed in Little Moose Creek during Segment #4 of the Bruces Eddy Fisheries Studies. North Fork of the Clearwater River, March - June, 1964.

LITTLE MOOSE CREEK

Redd No.	Built	Gone	Total	Days Fish on Redd	Description of Redd and Remarks
1	5/10	5/18	8	1	Hard to discern. Built in swift rocky-sandy area. Small redd approx. 2 1/2 feet diameter. Sand eventually obscured redd.
2	5/14	5/26	12	2	Redd #2 easily discernible when built. High turbid water from 5/16 to 5/22 caused redd to fade greatly.
3	5/14	5/26	12	1	Redd #3 built directly behind redd #2 on same day.
4	5/14	5/19	5	2	In small pocket of gravel between white water at tail end of turbulent run. Very difficult to see. Small redd: 18" dia.
5	5/17	5/22	5	3	Difficult to discern. Color difference slight. On swift deep gravel bar. Aprox. 3 feet dia.
6	5/22	6/1*	10	3	On bar in eddy area between swift currents, very hard to see.
7	5/24	6/1	8	2	In fast water in front of floating log. Small redd, approx. 18".
8	5/24	6/4	11	1	Very small redd, approx. 15" dia., but easily discernible.
9	5/25	6/1	7	1	Hard to discern, white water, small amount of gravel, large rocks, sandy area. Just behind redd #6.
10	5/25	6/10	16	1	Very large redd, approx. 6 feet long by 4 feet wide. In fast shallow water, good gravel area.
11	5/26	-	-	1	Redd #11 was obliterated on 6/1 by steelhead building redd #14.
12	5/27	6/6	10	1	Next to sunken log. Small gravel in shallow fast water. Sand washed into redd during high water. Area dry in summer.
13	5/27	6/7	11	-	Fish never observed on this redd, found morning of 5/27. Large easily seen redd. Fast water over gravel bar.
14	6/1	6/10	9	1	Built over redd #11, dug deep into gravel next to bank in fairly fast water. This area normally dry in early summer. 3-3 1/2 feet diameter.

* Little Moose Creek ran extremely high and turbid from May 30 to June 5. This caused many of the redds to to fade out and become unrecognizable.

Table 2. Summary of information collected on redds constructed in Kelly Creek and Moose Creek during Segment #4 of the Bruces Eddy Fisheries Studies. Length of discernibility of redds is dependent to a great extent upon water conditions. North Fork of the Clearwater River, Idaho. March - June, 1964.

KELLY CREEK

Redd No.	Built	Gone	Total	Days Fish on Redd	Description of Redd and Remarks
200	5/3	5/24	21	3	All the redds marked in Kelly Creek were on the gravel bar just downstream from the bridge. All the redds were large and easy to observe. From May 16 to May 24 Kelly Creek ran very high and turbid and the redds could not be seen during this period. On May 24 when the creek cleared none of the marked redds could be discerned from the surrounding bottom.
201	5/3	5/24	21	-	
202	5/3	5/24	21	1	
203	5/4	5/24	20	-	
204	5/6	5/24	18	2	
205	5/9	5/24	15	-	

MOOSE CREEK

Redd No.	Built	Gone	Total	Days Fish on Redd	Description of Redd and Remarks
100	4/26	5/15	20	-	All the redds in Moose Creek were discernible to some extent until high turbid water from May 9 to 16 obliterated them.
101	5/5	5/15	10	3	
102	5/8	5/15	7	2	Redd #104 was destroyed by drifting trees the day after it was built, on May 16. The water commenced raising again on the 16 in all the streams in the area, including Kelly and Little Moose Creek.
103	5/8	5/15	7	2	
104	5/15	-	-	-	

Table 3. Summary of information collected on steelhead spawners in Little Moose Creek during Segment #4 project, Bruces Eddy Fisheries Studies, North Fork of the Clearwater River, March - June, 1964.

Steelhead	Sex	Arrival	Departure	Days spent in stream: Before spawning	On redd	After spawning	Total	Spawning date(s)	Redd No.
1	F	4/20	5/12	Was not observed spawning in stream			22	-	-
2	F	4/30	5/27	22	3	3	28	5/22-23	6
3	M	5/1	5/25	9 - 16 - 22	2,3,2	3	27	5/9-10, 5/16-18 5/22-23	1,4,6
4	M	5/7	5/20	Left stream without successfully spawning			14	-	-
5	M	5/8	5/15	Left stream without successfully spawning			8	-	-
6	F	5/8	5/14	1	1	-	7	5/9	1
7	F	5/8	5/31	16 - 18	2,1	4	23	5/24, 5/28	7, 11
8	F	5/9	----	Found dead May 16. Did not spawn			-	-	-
9	F	5/9	5/17	6	2	0	8	5/14-15	8
10	F	5/9	5/27	16	1	1	18	5/26	9
11	M	5/10	5/29	15	1	3	19	5/25	10
12	F	5/10	----	Disappeared May 14, and was not seen again			-	-	-
13	F	5/11	5/15	3	1	0	4	5/14	3
14	M	5/11	6/2	3* - 16	1,2,1	6	23	5/14, 5/26	3,2,11
15	M	5/12	5/15	Left stream without successfully spawning			4	-	-
16	M	5/17	6/2	8 - 10	-	5	16	5/25, 5/27	9,12

* Steelhead number 14 spawned with two females on the same dates, May 14 and 15.

Note Redds numbers 5, 8, 13, and 14 were constructed by unmarked steelhead that entered the stream after the weir was washed out on May 15. Some of the tagged steelhead spawned with untagged partners.

ACKNOWLEDGEMENTS

Several people contributed their time and effort to the Bruces Eddy project. Special appreciation is expressed to Fishery Biologist James F. Keating, who contributed to this project in a supervisory capacity and as an untiring source of direction.

Appreciation is also expressed to Conservation Officers Joe Bross and Frank Keough, and to Bob Irving, Regional Conservation Officer, Lewiston, Idaho.

Personnel of the U. S. Forest Service were most helpful in supplying facilities and equipment during this project.

Mr. Hugo Marconi of Clarkston, Washington, loaned the use of his back country cabin for part of the study.