MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

OBSERVATIONS ON THE LIFE HISTORY AND MOVEMENT OF CUTTHROAT TROUT (SALMO CLARKI) IN FLATHEAD RIVER DRAINAGE, MONTANA

COMPLETION REPORT FOR JOB III, PROJECT NO. F-7-R-10

A FEDERAL AID TO FISH RESTORATION PROJECT

(Prepared as a thesis in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management at Montana State College)

by

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Project No. F-33-R-6 Title: Flathead Lake Fisheries Studies
Job No. II-a Title: Seasonal measurement of basic water chemistry, plankton production and certain physical characteristics of Flathead Lake.

The major zooplankton organisms and their relative seasonal abundance in the surface waters of Flathead Lake are described for 1967-71. Diaptomus ashlandi and Cyclops bicupsidatus are the two dominant planters in the surface waters of the lake. Large cladocera and copepodes do not appear in the surface waters until the summer and fall months.

A series of plankton was collected each fall and spring at eight stations to define the seasonal and depth variations in the plankton community. Sampling was done with the cooperation of the University of Montana, Yellow Bay Biological Station. Collections were made with a Clarke-Bumpus sampler at selected depths ranging from the surface to 250 feet. Water samples were taken concurrently and at the same depths as plankton and analyzed for the basic water chemical characteristics. Analysis of the plankton samples and the description of the various species and their seasonal distribution in the lake has been started but is not complete.

Project No. F-34-R-6 Title: Reservoir Investigations
Job No. I-a Title: Noxon Rapids - Cabinet Gorge Reservoirs Study

Temperature and oxygen profiles were collected from two stations in each reservoir during the summer of 1971. Trapping of Prospect Creek, tributary of Noxon Rapids, in the fall of 1971 caught no brown trout entering this creek for spawning. Burbot (Lota lota) were planted in Noxon Rapids in 1971 and kokanee (Oncorhynchus nerka) in 1971 and 1972. Sampling to determine success of these plantings was cancelled.

Project No. F-34-R-6 Title: Reservoir Investigations
Job No. II-a Title: Hungry Horse Reservoir Study

Twenty-four overnight gill net sets were made at four netting stations in May 1972. These data combined with similar netting to be done in October 1972 will complete the 1972 biennial sampling of the reservoir's fish population. Efforts were made to collect fish from the South Fork Flathead River above the reservoir but gear failure aborted this mission. Location of some of the spawning areas used by Dolly Varden (Salvelinus malma) in the South Fork Flathead River drainage within the Bob Marshall Wilderness area are given.

Project No. F-34-R-6 Title: Reservoir Investigations
Job No. III-a Title: Life History Studies of Westslope Cutthroat Trout

A fish trap was operated on Hungry Horse Creek from May 25 through July 27, 1971. An estimated 703 adult westslope cutthroat trout (Salmo clarki subsp.)entered the creek for spawning. The 1971 spawning run included 131 repeat spawners that had spawned in Hungry Horse Creek in 1968, 1969 or 1970. Downstream escapement of spent fish was 256 including 52 repeat spawners. The downstream trap also caught 1,951 juvenile cutthroat trout as they moved toward Hungry Horse Reservoir.

Sex ratio of the adult fish was 1.0 males to 6.2 females. Several females caught in the downstream trap were examined internally and found to contain eggs starting to be reabsorbed. Concern is expressed that insufficient adult males may be present. Sex ratio of cutthroat trout gill netted in the reservoir in 1970 was determined to be 1.0:1.8 males to females while sex ration of 103 outmigrant juveniles caught in 1971 was determined to be 1.0:1.9.

Project No. F-33-R-6 Title: Flathead Lake Fisheries Studies
Job No. I-b Title: Age and growth analysis of fishes of Flathead Lake - Kokanee

Age assessments were made on a total of 412 kokanee collected from four major kokanee fishing areas during the summer of 1971.

The segment of the kokanee population that is being harvested by anglers is represented by 6.6, 58.2 and 35.2 percent of the age groups II+, III+ and IV+ annuli, respectively.

Age composition of two kokanee schools within a large bay were found to differ. One area (South Big Arm) contained a group of fish that was nearly equal in numbers of four and five year old fish while the other area (North Big Arm) had a predominance of four year old fish. All fishing areas showed a strong dependance on four year old fish for the bulk of their fishery.

Nearly all five year old fish were found to be mature while 82 percent of the four year old males and 71.4 percent of the four year old females were considered mature. The number of mature three year old fish was small. Eighty and one-half percent of the female kokanee and 84.5 of the male kokanee caught by anglers were mature fish.

Food analysis was made on 151 stomachs from kokanee caught by anglers from June 15 through September 22, 1971. The stomachs were primarily from four and five year old fish. Three large sized genera: Daphnia, Epischura and Leptodora, made up the bulk of the food for kokanee during this summer period. Changes in the diet during seven sample periods are illustrated.

Project No. F-33-R-6 Title: Flathead Lake Fisheries Studies
Job No. I-c Title: Develop Techniques for sampling Juveniles and Determine Trends in Flathead Lake Kokanee Populations

An experimental purse seine 560 feet long was designed to collect juvenile kokanee in Flathead Lake. It was not completed before the concentrations of salmon had dispersed from their wintering areas where they occupy water depths of less than 30 feet. The seine was test fished for configuration and workmanship and found to be satisfactory. The net was stowed on a 12 ft. x 20 ft. barge and was laid and pursed with power aboard the "Dolly Varden."

Fluorescent fish marking was found to be an acceptable method for identifying previously captured salmon for checking movement and distribution patterns in Flathead Lake. This mark was tested on fish ranging from 40 to 80 mm total length (T. L.) (1.5 to 3.2 inches) retained under hatchery conditions. After four months, the mark was recognizable from 70 to 100 percent of the individuals if the fish were marked on both sides.

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION

JOB COMPLETION REPORT
RESEARCH PROJECT SEGMENT

State of Montana

Project No. F-34-R-2 Name: Reservoir Investigations
Title: Hungry Horse Reservoir

Job No. 2

Period Covered July 1, 1967 - June 30, 1968

ABSTRACT:

Detailed information of work completed through April 30, 1968 is included and only general information on work done in May and June, 1968. Sampling reservoir fish populations and movement of spawning westslope cutthroat trout (Salmo clarki subsp.) both upstream and downstream requires work overlapping two fiscal years. These data will be presented in F-34-R-3 completion report. Data are presented on cutthroat trout spawning in Hungry Horse Creek for years 1963 through 1968.

High water in the spring of 1967 severely damaged the experimental fish trap in Hungry Horse Creek. Repair work done in late 1967 included replacement of 40 feet of the 48-foot long velocity barrier, replacement of 52 feet of bank between the velocity barrier and controlled flow channel headgate, enlargement of the headgate to 9 feet wide from 4 feet, and installation of gabion aprons below the headgate and velocity barrier.

Trapping of adult cutthroat trout moving upstream started May 21, 1968 and continued through June 25, 1968. Downstream trap started operating June 26, 1968 and continued through July 19, 1968. The downstream trap was operated again July 29-31 and August 20-21, 1968. An estimated 1,160 adult cutthroat trout entered Hungry Horse Creek for spawning in 1968. Of these, 900 were taken by the upstream trap. Male cutthroat trout averaged 14.7 inches total length and females 14.5 inches total length. Sex ratio was 1 male to 3.7 females. It was calculated that the average female contained 983 eggs. Downstream trapping was carried out during only part of the time spent adults and juvenile fish were leaving the creek. Catch included 241 spent adults and 2,110 juveniles. Juvenile fish averaged 5.8 inches total length and ranged from 2.2 to 9.2 inches total length.

Information on angler's harvest was collected from the reservoir and its tributary streams during spawning periods of cutthroat trout and mountain whitefish (Prosopium williamsoni). It was concluded that the small harvest of spawning fish was not detrimental to the population of these two species.

RECOMMENDATIONS:

A detailed study of the life history of mountain whitefish and west-slope cutthroat trout should be made. Information crucial to intensive management is lacking and must be acquired soon. It is recommended that a more complete study be made of these two species in the Hungry Horse Reservoir-Hungry Horse Creek complex.

Specific information about adult spawners should be collected with emphasis on their homing instincts, distribution in drainage, spawning success, quality of spawning habitat, mortality rates, and continuation of data collected in prior years' work. Information about the life of juvenile fish in the creek should be collected with emphasis on their distribution in the creek, mortality rates, growth, age, time and numbers of migrants to the reservoir. Studies should be made of the distribution, food habits, and mortality rates of juveniles in the reservoir.

OBJECTIVES:

The objectives of this job were as follows:

1. Repair and operation of the experimental fish trap on Hungry Horse Creek.

2. Collection of information about the trends of the reservoir's fish population.

3. Survey of reservoir tributaries.

4. Evaluation and construction of fish passage facilities at barrier culverts where needed.

FINDINGS:

Reservoir Population Trends: Forty overnight gill net sets were made at five netting stations distributed throughout the length of the reservoir in May, 1968. Netting sites and number of sets were similar to past years' work. This series of sets combined with a similar series made in October, 1968 comprise a year's sampling and these data will be presented in F-34-R-3 report and compared to previous years' information.

Net catches from May sampling totalled 1,259 fish of which 278 were suckers (Catostomus spp.), 355 northern squawfish (Ptychocheilus oregonensis), 405 mountain whitefish, 178 Dolly Varden (Salvelinus malma) and 43 cutthroat trout. Average catch per net was much higher than anticipated and was probably influenced by the reduction of volume with the 50-foot drawdown at time of netting.

Stream Survey - Bunker Creek: Bunker Creek drainage forms part of the boundary of the Bob Marshall Wilderness Area, and until 1967 was not accessible by road. U.S. Forest Service is building a road into the drainage and will start harvesting 31.7 million board feet of timber in the first sale. Fishery survey work has been done in Bunker Creek for two years and findings are:

1. Bunker Creek provides excellent spawning for reservoir fish from its mouth to a falls about one-half mile upstream from Gorge Creek. This is a distance of about 6 miles.

2. Bunker Creek above the falls and Gorge Creek contains excellent populations of fluvial 1/ westslope cutthroat trout.

3. Dolly Varden are the most important users of the section of Bunker Creek drainage accessible to reservoir fish.

4. Some westslope cutthroat trout and mountain whitefish also spawn in the accessible portion.

Stream Survey - Wheeler Creek: Wheeler Creek flows directly into the reservoir about 30 miles upstream from Hungry Horse Dam. A high falls is located about 5 miles upstream from its mouth and blocks all fish upstream passage. A few fluvial westslope cutthroat trout of small size are found above this fall. Below the falls excellent spawning areas are heavily used by westslope cutthroat trout, Dolly Varden, and mountain whitefish.

Evaluation of Fish Passage Structures: No fish passage facilities were built during this report period. Rock hard points were constructed to reduce streambed erosion below culverts on South Fork Logan, Murray, Hungry Horse, and Margaret Creeks. Evaluation of fish passage showed that spawning cutthroat were able to pass through all structures following construction although some runs were delayed several days by peak high water.

Monies spent in repair work were hold-over funds from a cooperative Montana Fish and Game Department-U.S. Forest Service fish passage project started in 1963.

Creel Census: Creel census data were obtained on June 16, June 22-23, and June 29-30, the first three weekends of stream fishing. The season opening occurred during the westslope cutthroat trout spawning. Creel census data were also gathered during the hunting season, October 22 through November 19, 1967, which coincided with mountain whitefish spawning. Census stations were located on the two roads by which anglers leave the reservoir. Information collected included number of anglers, hours fished, place fished, catch by species, sex and gonad condition of spawning fish.

Harvest information for these census periods is listed in table 1 and is given separately for anglers fishing the reservoir and the tributary streams.

1/ Fluvial refers to fish spending their entire life-span in a stream whereas adfluvial means fish that leave the reservoir to spawn in a stream. Salmonid species referred to in this report are adfluvial fish unless otherwise specified.

Table 1. Creel cnesus summary for Hungry Horse Reservoir area, June 16, 22, 23, 29, 30 and October 22 through November 19, 1967

Dates	Location	Number anglers	CPMH*	C/A**	Numbers caught	
					Whitefish	Cutthroat
June 16, 22, 23, 29, 30	Streams	689	0.35	1.1	3	790
	Reservoir	110	0.29	1.0		114
October 22-November 19	Streams	171	2.92	8.8	1,493	5
	Reservoir	38	0.62	2.7		103

*Catch per man hour of effort
**Catch per angler trip

Of the 790 cutthroat taken from streams in June, 740 were adfluvial spawners and the remaining 50 either fluvial fish or adfluvial juveniles. Harvest of adfluvial spawners included 496 female fish and 244 male fish. A total of 241 ripe females were caught, the remaining females were either spent or partially spent fish. Angler harvest of spawning cutthroat from Hungry Horse Creek totaled 123 fish of which 33 were males and 90 were females. Mountain whitefish taken from streams in the fall are all ripe fish with few exceptions. They are generally caught while concentrated in large pools before reaching the spawning areas.

Hungry Horse Creek Experimental Trap: The trap on Hungry Horse Creek was damaged beyond use by flood water in May, 1967. Repair of the trap was completed in November, 1967. Primary damage done to the structure included a washout of about 50 feet of bank between the control flow channel and the main channel, collapse of one velocity barrier abutment, and sagging of the velocity barrier spillway structure. Repair work included replacement of 40 feet of the 48-foot long velocity barrier and one abutment. The washed out bank between the velocity barrier channel and the control flow channel was replaced by using gabions 1 meter by 1 meter by 3 meters long stacked two gabions wide and two gabions high. A new headgate structure was built to regulate flows in a control flow channel when a 4 foot wide channel was replaced by one 9 foot wide. Aprons built of gabions 1/3 meter by 1 meter by 2 meters were added below the control flow headgate and the velocity barrier. One large log jam, numerous stumps and single logs were bulldozed out of the stream for a distance of 300 yards above the trap. An access road was built into the trap site and a vehicle barrier was installed across the road to limit its use to work vehicles only.

Trapping commenced May 21, 1968 when adult cutthroat trout were first observed around the trap site and continued through June 25, 1968. During this time 900 adults were captured, sexed, fin-clipped, measured, scale samples were taken from 400 fish, and 15 females killed for egg counts. The remaining fish were released upstream.

Male cutthroat averaged 14.7 inches total length and ranged from 9.2 to 16.5 inches. Female cutthroat averaged 14.5 inches total length and ranged from 11.2 to 16.2 inches. Sex ratio of the 900 fish trapped was 1.0 male to 3.7 females. The average female cutthroat was calculated to contain 983 eggs.

The downstream trap was placed into operation June 26, 1968 and fished continuously through July 19, then from July 29 through July 31 and August 20 and 21, 1968. This trap captured 241 spawned out fish moving out of the drainage into the reservoir. Catch included 71 males of which 56 were fin-clipped and 170 females of which 131 were fin-clipped. The remainder were not marked. The daily catch of adult cutthroat trout for the period June 26 through July 19 averaged 10.4, for July 29 through July 31 it averaged 0.67, and was zero for August 20 and 21.

The upstream trap system was not fish proof as indicated by unmarked fish taken in the downstream trap. Project personnel observed a few large male and female cutthroat swimming over the velocity barrier spillway. This spillway had a 33% grade and water velocities were maintained at about 9 feet per second. Spillway drop has been modified and increased to 42 percent in hopes velocities can be maintained at about 11 feet per second. It is possible that trapping operations did not start soon enough to capture the early part of the run. More likely the trap leads within the control flow channel developed leaks that were not corrected until some fish had escaped upstream.

Catch of juvenile cutthroat trout moving downstream totaled 2,110 fish during the 29 days of downstream trapping. Average daily catch for the period of June 26 through July 19 was 89.0 fish, for July 29 through July 31 averaged 20.3 fish, and for August 20 and 21 averaged 4.5 fish. Juvenile cutthroat trout averaged 5.8 inches total length and ranged from 2.2 inches to 9.2 inches.

Resume of 1963-1968 Trap Operations: Spawning runs of westslope cutthroat trout have been trapped entering Hungry Horse Creek drainage since 1963. Traps were operated in tributaries in 1963, 1964, and 1967 and in main-stem Hungry Horse Creek in 1965, 1966, and 1968.

Cutthroat population estimates were made each year from mark and recovery information except for 1964 and 1967. Sex ratios, average sizes and ranges of size by sex were obtained each year. Age and rate of growth from scale analysis were calculated for each year except 1963. These data are presented in tables 2, 3, and 4.

Table 2. Population estimates, sex ratios, average size and size ranges in inches of spawning westslope cutthroat trout, Hungry Horse Creek, 1963-1968

Parameter	1963	1964	1965	1966	1967	1968
Estimated size of run	1500	----	1200	1200	----	1160
Sex ratio (♂:♀)	1:1.8	1:3.1	1:3.2	1:3.3	1:3.3	1:3.7
Average length (♂)	16.0	15.4	14.5	14.6	14.5	14.7
Range (♂)	11.5-18.6	12.5-16.6	10.5-16.8	9.9-17.0	12.8-15.5	9.2-16.5
Average length (♀)	15.3	14.8	14.4	14.7	14.3	14.5
Range (♀)	12.0-17.0	12.9-16.9	12.5-16.4	11.5-18.4	12.0-15.0	11.2-16.2

The data in table 2 show that estimated size of run declined from 1963 to 1965 but has remained stable since 1965. Average size of both male and female fish declined from 1963 through 1965 but has remained stable since 1965. Size ranges of both sexes have remained about the same except for the year of 1967 when the large trout caught were not as large as in other years.

Age composition of the spawning runs for the years 1964 through 1967 yielded some information as to the possible cause for the narrower size range of fish taken in 1967. The age-class composition of the 1964 through 1967 spawning runs are given in table 3 and are divided into X_2 and X_3 migration classes. Class X_2 contains fish 3, 4, 5, 6, and 7 years old that were reared in the stream two years prior to migrating to the reservoir. Class X_3 contains fish 4, 5, 6, and 7 years old that were reared in the stream three years before moving into the reservoir. A few X_1 fish were found in the 1966 and 1967 runs but they are not included in the table. Cutthroat trout 16 inches total length or longer taken from Hungry Horse Creek generally have poor or regenerate scales and interpretation is extremely difficult. As a result, fish 7 years old or older were likely present in the 1964 and 1965 collections but could not be determined by scale analysis. Fish older than 6 years did not occur in the 1967 spawning run.

Table 3. Age composition of cutthroat trout spawning in Hungry Horse Creek, 1964, 1965, 1966, 1967

Year	Migration class	Percent of total run	Age composition of migration class				
			3_2	4_2	5_2	6_2	7_2
1964	X_2	79.1	2.3	40.2	51.7	5.8	?
1965	X_2	77.6	5.1	64.4	20.3	10.2	?
1966	X_2	66.4	2.6	59.7	29.9	6.5	1.3
1967	X_2	75.8	---	38.0	60.0	2.0	----
				4_3	5_3	6_3	7_3
1964	X_3	20.9		4.3	52.2	43.5	?
1965	X_3	22.4		11.8	52.9	35.3	?
1966	X_3	32.8		2.6	65.8	23.7	7.9
1967	X_3	22.7		6.7	73.3	20.0	---

The percent of the population made up of X_2 and X_3 fish has not varied much except in 1966 when the numbers of X_3 increased and X_2 decreased about 11 percent. No explanation for this change in structure can be given. The 1964 run of X_2's appears to be fairly even in its distribution between 4 and 5 year old fish; the 1965 and 1966 runs were dominated by 4 year old fish, and the 1967 run by 5 year old fish. No fish of age-class 3_2 were present in the 1967 run although they appeared in small numbers in previous years. Spawning cutthroat only 3 years old are generally precocious males. Fish of age 3_2 in 1967 would represent the 1964 year class; 1964 being the year of the record Flathead River flood. The fact that this year-class failed to appear in the run may have been the result of this flood. A decline in numbers of fish 6_2 years of age and absence of fish 7_2 years of age was also noted in 1967.

The most noticeable decline in range of sizes of the spawning cutthroat trout occurred in the 1967 spawning run and was probably due to decreased numbers of older cutthroat trout. Declining numbers of older fish might be related to drawdown of Hungry Horse Reservoir. Prior to 1965 drawdown averaged about 60 feet and from 1965 through 1967 about 90 feet.

Growth rates of spawning cutthroat from Hungry Horse Creek have also shown small changes. Data for fish collected in years 1964 through 1967 are listed by year-class in table 4. Growth rates were calculated assuming straight line relationship between fish body length and scale length.

Table 4. Growth rates for spawning cutthroat by year-class, Hungry Horse Creek spawning runs of 1964 through 1967

Year class	Migration class	Length in inches at annulus I	II	III	IV	V	VI	VII
1958	X_2	2.6(5)*	4.4(5)	9.6(5)	12.3(5)	14.5(5)	15.9(5)	
1959	X_2	2.7(52)	4.9(52)	9.5(52)	12.4(52)	14.5(52)	15.8(7)	17.0(1)
1960	X_2	2.6(52)	4.9(52)	10.2(52)	13.1(52)	14.8(52)	16.2(5)	
1961	X_2	2.5(64)	4.8(64)	10.0(64)	12.9(62)	14.8(24)	14.7(1)	
1962	X_2	2.7(79)	5.0(79)	10.3(79)	13.1(76)	14.3(30)		
1963	X_2	2.6(21)	5.0(21)	10.5(21)	13.2(19)			
1958	X_3	2.1(10)	3.9(10)	6.5(10)	11.0(10)	13.5(10)	15.1(10)	
1959	X_3	2.4(21)	4.2(21)	6.7(21)	11.3(21)	14.0(21)	15.1(9)	16.1(3)
1960	X_3	2.2(19)	3.9(19)	6.2(19)	10.9(19)	13.7(18)	15.3(9)	
1961	X_3	2.2(28)	4.0(28)	6.3(28)	11.3(28)	13.8(26)	14.3(1)	
1962	X_3	2.3(12)	4.1(12)	6.4(12)	11.5(12)	13.8(11)		
1963	X_3	2.3(1)	3.7(1)	5.3(1)	12.4(1)			

*Numbers in parenthesis are size of samples.

The data given in table 4 indicate that growth rate (inches) of X_2 fish during their third and fourth years of life is increasing slightly. These two years represent the first years these fish spend in the reservoir environment. The factors creating better growth rates in face of increasing yearly drawdown are not fully understood. Unpublished data concerning changes in the reservoir's fish population structure indicate that declining sucker populations may be the key.

Review of X_3 growth data reveal no apparent trends, but rather a degree of stability. The lack of knowledge about possible cutthroat trout sub-population structure in the reservoir may masked reasons why no change has occurred in X_3 growth rates while changes are apparent in X_2 rates. X_2

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Approved by George D. Holton

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Waters referred to:

08-3580
08-0980
08-7720
08-8860

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

State Montana

Project No. F-34-R-3 Name Reservoir Investigations

Job No. 2 Title Hungry Horse Reservoir

Period Covered July 1, 1968 through June 30, 1969

Abstract

This report covers work in two fiscal years. Work completed includes spring and fall gill net surveys of the fish population of Hungry Horse Reservoir, observations of spawning westslope cutthroat trout (Salmo clarki subsp.) movement through road culverts, and operation of the Hungry Horse Creek experimental trap to enumerate cutthroat trout moving into and out of this drainage.

Operation of the upstream portion of the trap commenced May 21, 1968 and ended June 25, 1968. The spawning population of cutthroat trout entering the creek was estimated at 1,160 fish of which 900 were taken by the trap. Male cutthroat trout averaged 14.7 inches and females 14.5 inches total length. Sex ratio was 1 male to 3.7 females.

Downstream trapping was carried out only part of the time fish were moving out of the drainage. Total catch was 241 spent adults and 2,110 juvenile cutthroat trout.

Gill net surveys of Hungry Horse Reservoir were conducted May 5 - 10 and October 27 - November 1, 1968. Spring sampling consisted of 40 overnight gill net sets distributed about equally between five stations throughout the length of the reservoir. Fall netting was similar to the spring netting except that only 38 overnight net sets were made. The 1968 netting data are compared with similar efforts made in 1959, 1961 and 1966.

Background

Hungry Horse Reservoir is a hydroelectric impoundment on the South Fork Flathead River near the town of Hungry Horse, Montana. When full this impoundment has a surface area of 22,500 acres. The amount of annual fluctuation is determined by water needed for power production and space for flood control storage. Maximum drawdown since dam completion in 1952 was 119 feet in 1967.

Fishery research and management work have been carried out on the reservoir and its tributaries since 1958 as follows: 1) collection of trend information about the fish populations inhabiting the reservoir proper; 2) cooperative program with the U.S. Forest Service to remove natural or man-made fish barriers on streams tributary to the reservoir; and 3) development, construction and operation of a fish trap to capture adult and juvenile cutthroat trout moving into or out of Hungry Horse Creek.

A resume of operation of the Hungry Horse Creek trap for the years 1963 through 1967 is given by Huston[1/].

Objectives

The objectives of this job were: 1) obtain trend information about the fish population of the reservoir by gill net sampling; 2) further evaluate gabion fishways at barrier culverts; 3) determine some population parameters on the spawning run of cutthroat trout entering Hungry Horse Creek; and 4) determine feasibility of a downstream trap in Hungry Horse Creek.

Procedures

Trapping of adult cutthroat trout entering the Hungry Horse Creek drainage has been done since 1963. In some years tributaries have been trapped, and in other years a trap on the main-stem has been used. Development and construction of the main-stem trap has progressed to the point that this structure should be able to withstand the high spring flows of this drainage. This velocity barrier trap was fished throughout the time adult fish were entering the drainage, May 21 through June 25, 1968. A Wolf type downstream trap was operated continuously from June 26 through July 19, 1968 then from July 29 through July 31 and on August 20 and 21, 1968.

Adult fish entering the upstream trap were sexed, measured (total length), and had scale samples taken from some fish. Each fish was fin-clipped by removal of the adipose fin and then released above the trap. Egg counts were made of fifteen female cutthroat. Spent adult fish taken in the downstream trap were counted and released below the trap. Juvenile fish taken in the downstream trap were counted, a sample was measured and scale samples taken from 370 fish.

Trends of the reservoir fish populations were determined by sampling with gill nets. A netting series in Hungry Horse consists of sampling during the spring, usually mid-May, and again in the fall, usually late October or early November. Five stations have been used for all sampling and were distributed along the length of the reservoir (Figure 1).

1/ Huston, Joe E. 1969. Reservoir Investigations. Job completion report, Federal Aid to Fish Restoration Project F-34-R-2, Job No. 2, Montana Fish and Game Department, 8 pp. mimeo.

The catch was measured and recorded separately for all nets. Cutthroat trout and Dolly Varden (Salvelinus malma) from each net were measured and weighed individually and scale samples taken. Individual fish of other species from about one-half of the nets, were weighed and measured separately. Catches from remaining nets were counted and recorded.

Movements of cutthroat trout were measured by visual observation and by hook and line angling to test the effectiveness of gabion fishways at barrier culverts.

Findings

Fish Population Trends in Hungry Horse Reservoir

Data collected from the 1968 sampling will be presented in tabular form along with data collected in 1958, 1961 and 1966. The average catch per net for the sampling done in these four years is presented in Table 1.

Table 1. Average catch in numbers per net by species for Hungry Horse Reservoir; spring and fall of 1958, 1961, 1966 and 1968

Year	Cutthroat trout	Dolly Varden	Mountain Whitefish	Largescale suckers	Longnose suckers	Northern squawfish	Totals Per Net
1958 (33)*	1.1	7.1	10.3	3.9	12.1	3.1	37.6
1961 (73)	0.7	4.4	11.0	2.8	6.0	1.8	26.7
1966 (58)	1.5	2.2	11.9	1.3	0.3	7.6	24.8
1968 (78)	1.0	3.9	9.1	2.3	1.7	5.5	23.5

* Number in parentheses is number of net sets.

The author believes very little reliance is to be placed on the above data as a clear picture of the trends of the Hungry Horse Reservoir fish population. The most serious drawback to analysis of these data is comparing year-to-year information obtained from netting the reservoir at different stages of drawdown. All of the spring netting has been done at different levels of drawdown. The 1958 and 1961 netting was done while the reservoir level was down about 10 feet. During the 1966 netting water levels were down 35 feet while in 1968 levels were down about 49 feet. The fall gill net series has been done each year while the reservoir was within 5 feet of full pool; therefore these data should be much more reliable than either the spring data or spring-fall data combined. Table 2 gives the average catch per net for the fall netting in Hungry Horse Reservoir for the years of 1958, 1961, 1966 and 1968.

Table 2. Average catch in numbers per net by species, fall netting series for Hungry Horse Reservoir; 1958, 1961, 1966 and 1968

Year	Cutthroat trout	Dolly Varden	Mountain whitefish	Largescale suckers	Longnose suckers	Northern squawfish	Totals Per Net
1958 (15)*	1.1	6.9	14.6	1.8	2.9	3.5	30.8
1961 (41)	0.8	4.6	15.3	1.2	0.8	2.1	24.8
1966 (31)	0.8	2.2	11.7	1.8	0.3	11.8	28.6
1968 (38)	1.0	3.4	8.0	1.2	0.0	2.0	15.6

* Figure in parentheses is number of net sets.

The data in Table 2 indicate that the total number caught for the years 1958, 1961, and 1966 were relatively uniform but in 1968 total numbers caught were much less. Table 1 shows a notable reduction in the catch from 1958 to 1961 with a more stable catch in 1961, 1966 and 1968. If the total catch data shown in Table 2 are more representative of the lake's population trends then there may be some correlation between numbers of fish caught and reservoir operation. For the period of 1954 through 1959 average annual drawdown was 75 feet and for 1960 through 1964 it was 53 feet. For the period of 1965 through 1968 average annual drawdown had increased to 89 feet including the all-time maximum draft of 119 feet in 1967. If the data given in Table 1 are more representative of the population trends, then the declining catch from 1958 to 1961 may not be correlated with reservoir drawdown.

It is assumed that the fall catches are more representative of population trends. The data concerning cutthroat trout given in Table 2 show a catch of 1.1 fish per net in 1958, a drop to 0.8 fish per net in 1961 and 1966, and a rise to 1.0 fish per net in 1968. Average total length of cutthroat caught varied between sampling periods; in 1958 it was 11.7 inches, in 1961 14.3 inches, in 1966 12.3 inches and 11.6 inches in 1968. The average catch and average size indicated that cutthroat trout were becoming less numerous and larger in 1961 than in 1958, and that inadequate annual recruitment to the reservoir's population might be responsible.

Department and U.S. Forest Service undertook a joint effort to remove barriers on several potential cutthroat trout spawning streams that were blocked to spawning fish by road culverts and log jams (see evaluation of fish passage structures section). During the years of 1962 through 1965, 12 streams containing about 60 miles of spawning area were opened. Spawning cutthroat trout were observed to enter 11 of the 12 streams the first spring following installation of passage facilities. It does appear that opening of the 12 streams to use by spawning cutthroat trout has had an effect upon the numbers of cutthroat trout found in Hungry Horse Reservoir (see Table 2). The increased catch of cutthroat in 1968 may not be solely related to increased stream spawning area.

Dolly Varden have also shown a variable catch rate decreasing from 6.9 fish per net in 1958 to 2.2 fish in 1966, then increasing to 3.4 fish per net in 1968 (Table 2). The average total length of Dolly Varden caught in 1958 was 15.3 inches, 10.9 inches in 1966 and increased to 11.5 inches in 1968. Changes in both average size and average catch per net of Dolly Varden is thought to be related to the age-structure of the population. The 1958 and 1961 combined catch totaled 294 Dolly Varden of which 108 (37%) were 6 years old or older. The combined catch of 1966 and 1968 totaled 236 fish of which only 12 (5%) were 6 years old or older. It is expected that the catch in the 1970 and 1972 sampling will again contain large numbers of large, older fish. It would appear that the Dolly Varden inhabiting the reservoir are still in the process of attaining stabilized age-structure 16 years after the reservoir was completed.

The catch of mountain whitefish (Prosopium williamsoni) appears to have been stable for the 1958 and 1961 sampling but shows a decline through 1968 (Table 2). The increasingly smaller catch in the 1966 and 1968 sampling compared to the stable catch of 1958 and 1961 may indicate the effects of increased reservoir drawdown starting in 1965. The average length of this species of fish has shown little change throughout the four years sampled. The total average length in 1958 was 11.4 inches. In 1961 and 1966 the average total length was 12.2 inches and it dropped to 12.1 inches in 1968.

The number of largescale suckers (Catostomus macrocheilus) caught each year has shown little change. Average total length has also not varied much from year-to-year; it was 12.2 inches in 1958 and 1966 and 11.5 inches in 1961 and 1968. Catch of longnose suckers (Catostomus catostomus) has shown a steady decline since 1958 and this decline in numbers is correlated with a steady increase in average size. The average catch per net of longnose suckers in 1958 was 2.9 fish averaging 9.0 inches total length. The average catch in 1966 was 0.3 fish averaging 10.8 inches total length. No longnose suckers were caught in fall but the fish caught in spring 1968 averaged 11.5 inches total length.

Largescale suckers appear to be more adapted to living in a fluctuating reservoir environment than the longnose sucker. Largescale suckers have remained abundant in Noxon Rapids and Cabinet Gorge Reservoirs while longnose suckers have largely disappeared2/. The longnose sucker was abundant in Canyon Ferry Reservoir immediately following impoundment, but declined dramatically after several years of impoundment3/.

2/ Huston, Joe E. 1965. Investigation of two Clark Fork River hydroelectrical impoundments. Proc. Mont. Acad. Sci., 25:20-40, 1965.

3/ Heaton, John R. 1961. Canyon Ferry Investigation and Management. Completion report, Federal Aid to Fish Restoration Project F-9-R-9, Job 2A, Montana Fish and Game Department, 19 pp. mimeo.

Numbers of squawfish (Ptychocheilus oregonensis) caught each year except in 1966 have also been similar: 3.5 fish in 1958, 2.1 in 1961 and 2.0 in 1968 (Table 2). Average lengths were 10.5 inches in 1958 and 1961 and 10.8 inches in 1968. Average size of this fish in 1966 was 9.4 inches when average net catch was 11.8 fish. It would appear that large numbers of small squawfish entered the catch in 1966 but they did not survive to enter the 1968 catch.

Evaluation of Fish Passage Structures

From 1962 through 1965 the Montana Fish and Game Department and U.S. Forest Service eliminated barriers on 12 streams tributary to Hungry Horse Reservoir that had been blocked to spawning cutthroat trout by log jams or improperly placed road culverts. The log jams were removed from the stream and step-down dams were built below the culverts to eliminate the falls at the lower lip. Elimination of the out-fall on the culverts allowed the spawning fish easy access to the pipe and better opportunity to swim upstream in spite of the high water velocities inside the culvert.

The streams opened to spawning cutthroat trout, type of barriers removed and stream miles made available for spawning fish are listed in Table 3. The location of these streams is shown in Figure 1.

Table 3. Streams tributary to Hungry Horse Reservoir where barriers to spawning fish were eliminated

Stream	Year repaired	Type of barrier		Miles of stream opened
		Log-Jam	Culvert	
Quintonkon	1962	X		11
Wounded Buck	1962		X	8
Lost Johnny	1962		X	1
Doris	1962	X	X	7
Margaret	1964		X	3
Lost Mare	1964		X	2
Riverside	1964		X	6
Murray	1964-65		X	4
Harris	1963		X	4
N. Fork Logan	1964		X	6
S. Fork Logan	1964-65		X	4
Hoke	1965		X	3

The repair of the barrier limiting access by spawning fish was done during the late fall and early winter months. Observations to evaluate the success or failure of the work was done the next spring during the time spawning cutthroat

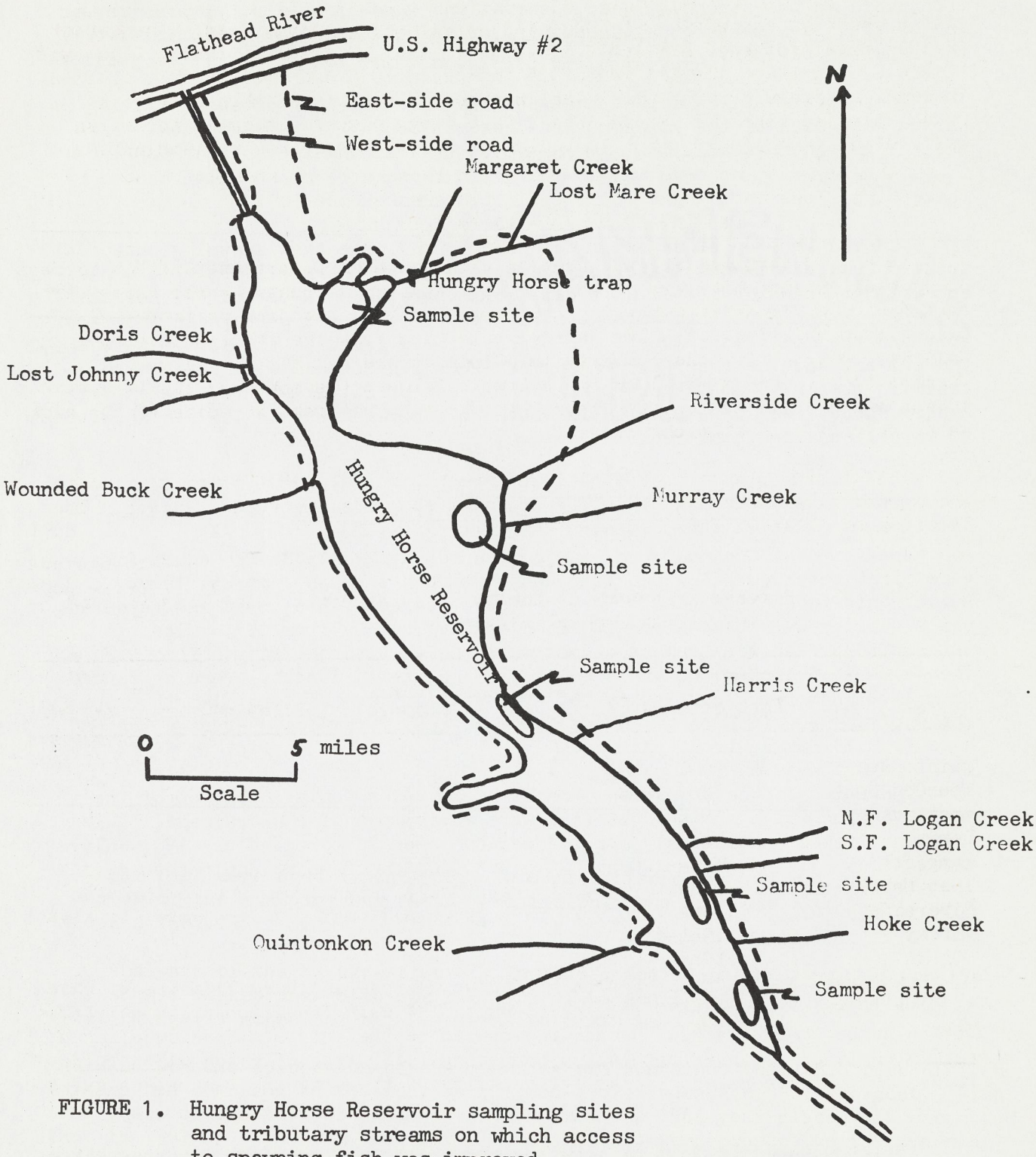

FIGURE 1. Hungry Horse Reservoir sampling sites and tributary streams on which access to spawning fish was improved.

trout were in the stream. These observations were limited to visual sighting of fish passing through the culvert or to hook and line sampling above the repaired barrier.

These observations showed that spawning cutthroat trout successfully passed into each of the streams listed except South Fork Logan Creek. Fish passage was good at all flow stages except peak spring flows. Peak spring flows usually last no more than two days in these streams so delay caused by these high flows is thought to be of little consequence.

Observations on other modified culverts indicate that spawning cutthroat trout should easily negotiate the South Fork Logan Creek culvert. It would appear that spawning cutthroat trout from Hungry Horse Reservoir either do not enter South Fork Logan Creek or that there is a barrier between the reservoir and the modified culvert. No barriers were found in the stream between the culvert and the reservoir in summer 1964. The stream will be checked again in summer 1970. Hatchery reared progeny of cutthroat trout taken from Hungry Horse Creek were planted in South Fork Logan Creek in 1968 in an attempt to establish a spawning run.

Hungry Horse Creek Experimental Trap - Adult Fish

Operation of the upstream trap commenced May 21, 1968 when adult fish were first observed below the trap and continued through June 25, 1968. During this period 900 adults were captured, sexed, fin-clipped and measured. Scale samples were taken from 400 fish and egg counts from 15 females. A total of 885 fish were released upstream. Male cutthroat ranged from 9.2 inches to 16.5 inches and averaged 14.7 inches total length. Females ranged from 11.2 inches to 16.2 inches and averaged 14.5 inches total length. Sex ratio of the 900 fish captured was 1.0 male to 3.7 females. Average was 983 eggs from 15 female trout examined.

Operation of the downstream trap was limited to only a portion of the season during which spent adult fish were moving out of the drainage. This trap was fished continuously for the periods June 26 through July 19, July 29 through July 31 and August 20 and 21, 1968. Catch of spent adult fish moving downstream totaled 241 cutthroat. Average daily catch from June 26 through July 19 was 10.4 fish, from July 29 through July 31 was 0.7 fish, and for August 20 and 21 it was 0.

The catch of 241 spent adults moving downstream included 71 males of which 56 were fin-clipped and 170 females of which 131 were fin-clipped. Application of the number marked versus number recaptured to the Peterson Index yields an estimated total spawning population numbering 1,160 fish of which 913 were females and 247 were males. Total egg capacity of the spawning run was calculated to be 897,000 eggs.

Age-structure of the 1968 spawning run was determined from interpretation of scales collected from 279 fish. The data are presented in Table 4 and

compared to averages compiled for spawning runs of 1964 through 1967. The age-structure data are divided into X_1, X_2 and X_3 migration classes. Classes $X_{1,2,3}$ include fish that were one, two or three years old before they left a rearing stream and moved downstream into the reservoir.

Table 4. Age composition of cutthroat trout spawning in 1968 compared to average age composition for years 1964, 1965, 1966 and 1967 in Hungry Horse Creek

Year	Migration class	Percent of total run	3_1	4_1	5_1	6_1	7_1
1968	X_1	2.2	16.7%	83.3%			
Average of 1964 - 1967	X_1	0.6	100.0%				
			3_2	4_2	5_2	6_2	7_2
1968	X_2	69.5	4.6%	18.6%	69.6%	7.2%	0.0%
Average of 1964 - 1967	X_2	75.3	2.5%	50.5%	40.4%	6.1%	0.5%
				4_3	5_3	6_3	7_3
1968	X_3	28.3		8.9%	57.0%	31.6%	2.5%
Average of 1964 - 1967	X_3	24.1		6.6%	61.9%	27.6%	3.9%

Six fish were aged X_1 in 1968. This migration class was not identified as a member of the spawning run until 1966 and only one fish was aged X_1 for both 1966 and 1967.

Analysis of the X_2 age-structure in 1968 compared to the averaged for 1964-1967 show a marked change in contribution of 4_2 and 5_2 age fish although no great change is noted for the X_2 migration class as a whole.

In 1968 the X_2 portion of the spawning run contained only 18.6 percent fish 4 years old compared to the four year (1964-1967) average of 50.5 percent. Fish four years of age in 1968 would have been from the 1964 year class. It was noted that in 1967 no fish from the 1964 year class (3_2) were present in the spawning run although an average 2.5 percent of the X_2 migration class was made up of 3_2 age fish in 1964 - 1967. These data indicate the 1964 X_2 year class was weak.

There were preliminary indications that the 1964 X_3 year class was of normal or above normal strength. Fish 4_3, which hatched in 1964, would spawn the first time in 1968. The 1964 year class of fish contributed 8.9 percent of the run of X_3's in 1968. The average contribution of age 4_3 fish was 6.6 percent from 1964 to 1967 and has varied from 2.6 percent in 1966 to 11.8 percent in 1965. Further determination of the strength of the 1964 year class of X_3 will be done in 1969 and 1970.

Growth rates of the cutthroat trout spawning in Hungry Horse Creek have shown little change since 1964. Data for fish collected in 1968 are compared to data from fish collected in 1964 - 1967 by age class and presented in Table 5.

Table 5. Growth rates of spawning cutthroat trout by age-class, Hungry Horse Creek, 1964 - 1967 and 1968

Year	Migration class	Total length in inches at annulus						
		I	II	III	IV	V	VI	VII
1968	X_1	3.5(6)*	9.2(6)	11.8(6)	14.5(5)			
Average of 1964 - 1967	X_1	3.1(2)	8.2(2)	11.8(2)				
1968	X_2	2.7(193)	4.9(193)	10.1(193)	12.8(189)	14.5(148)	15.8(19)	
Average of 1964 - 1967	X_2	2.6(273)	4.9(273)	10.0(273)	12.9(266)	14.5(163)	15.9(20)	17.0(1)
1968	X_3	2.4(79)	4.1(79)	6.2(79)	11.2(79)	13.5(72)	14.8(27)	16.0(2)
Average of 1964 - 1967	X_3	2.2(91)	4.0(91)	6.9(91)	11.2(91)	13.6(86)	15.1(29)	16.1(3)

*Number in parentheses is size of sample.

Hungry Horse Creek Experimental Trap - Juvenile Fish

The downstream trap was fished for juvenile fish a total of 29 days between June 26 and August 21, 1968. During this period 2,110 juvenile cutthroat trout were captured. They averaged 5.8 inches total length and ranged from 2.2 inches to 9.2 inches. For the period June 26 through July 4 the average daily catch was 51.0 fish averaging 6.0 inches total length. The average daily catch was 103 fish per day for the period July 5 through July 15 down to 5.5 inches for the remainder of the period. Fish were captured at the rate of 20.0 per day and averaged 4.3 inches total length from July 29 through July 31. The catch was 4.0 fish per day averaging 4.0 inches total length for August 20 and 21.

Scales for age and growth analysis were taken from 370 juvenile cutthroat trout. Since these fish were taken as they moved downstream, presumably into Hungry Horse Reservoir, the age and growth were analyzed according to the age of out-migration. These data are presented in Table 6. The growth of the juvenile out-migrant fish is very similar to that found for adults spawning in Hungry Horse Creek (Table 5).

Table 6. Growth of juvenile cutthroat trout captured in 1968 from Hungry Horse Creek during out-migration

Out-migration age	Total length in inches at annulus		
	I	II	III
1	2.9 (71)*		
2	2.6 (231)	4.9 (231)	
3	2.3 (46)	4.2 (46)	6.3 (46)

* Number in parentheses is size of sample.

Recommendations

Gill net sampling of Hungry Horse Reservoir should be done once every two years to determine trends of the fish population. Spring and fall net series should be done in a manner comparible with previous years' work. Operation of the Hungry Horse Creek experimental upstream-downstream trap should be continued. A study should be inaugurated to determine the life history of the westslope cutthroat trout spawning and rearing in this stream. Utilization of this trap during the mountain whitefish spawning run would also yield information on the spawning of this species.

The Hungry Horse Reservoir job of Reservoir Investigations should be divided into two jobs; 1) life history studies of westslope cutthroat trout and mountain whitefish in Hungry Horse Creek, and 2) management efforts in Hungry Horse Reservoir and its tributary streams.

Prepared by Joe E. Huston
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Date April 30, 1970

Waters referred to:

1-08886005	1-08432010
1-08358001	1-08586001
1-08566001	1-08498001
1-08792001	1-08326001
1-08436001	1-08426001
1-08230001	1-08348010
1-08450001	

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

State Montana Title Reservoir Investigations

Project No. F-34-R-4 Title Life Cycle Studies of Westslope Cutthroat

Job No. III-a Trout and Mountain Whitefish

Period Covered July 1, 1969 through June 30, 1970

ABSTRACT

An upstream-downstream fish trap was operated on Hungry Horse Creek from May 15 through August 18, 1969. It was estimated that 1,034 adult westslope cutthroat trout, (Salmo clarki subsp.) passed upstream through the trap of which 219 were repeat spawners marked in the 1968 run. The sex ratio was 1: 3.9 males to females in the total upstream run. Total spent adults returning downstream numbered 523 cutthroat trout and had a sex ratio of 1: 5.2 males to females. The repeat spawners surviving their second year through the trap numbered 107 trout with a sex ratio of 1: 8.7 on their downstream run.

Total mortality accounted for 511 of the 1,034 fish entering the creek for spawning. An estimated 95 of the 511 fish were caught by anglers above the trap. Prior to the start of the 1970 spawning run, anglers caught 45 of the 523 cutthroat trout.

Adult cutthroat were tagged with anchor tags as they passed through the upstream trap. Tag loss in spent spawners recaptured in the downstream trap was 23 percent. Tagging also appeared to have caused high drop-back of fish downstream through the velocity barrier resulting in many fish having to re-enter the upstream trap two or three times.

The downstream trap caught 2,680 juvenile cutthroat trout as they moved downstream toward the reservoir. An estimated 41 percent were one-year-old, 55 percent two-year-old, and 4 percent three-year-old fish.

Mountain whitefish (Prosopium williamsoni) were enumerated passing through the trap to spawn in the fall of 1969. Total catch was 146 males averaging 11.9 inches and 40 females averaging 12.6 inches total length (sex ratio 3.6: 1). The major portion of the whitefish run spawn below the trap.

BACKGROUND

This research project segment has evolved after several years of development of a workable combination upstream-downstream fish trap in Hungry Horse Creek.

Annual flow flucuations range from 5 cfs to about 600 cfs. The upstream trap, consisting of a velocity barrier with a bypass channel, evolved from the inadequacies of both a trash-rack trap and a barrier falls bypass channel structure. The upstream trap now in use and a downstream Wolf trap were installed and tested during spring and summer 1968.

The upstream trap can be fished at almost all flows in Hungry Horse Creek. It is calculated to withstand maximum flows of about 900 cfs, the exception being when whole trees or large stumps move downstream into the structure. The downstream trap can be fished at flows up to about 200 cfs unless large amounts of debris are in the water.

OBJECTIVES

Data on cutthroat trout spawning in Hungry Horse Creek have been collected yearly since 1963. Numbers, age structure of the spawning run and growth rates have been calculated. Little information is available on other aspects of the life cycle of westslope cutthroat trout. The long-term objective of this project segment is to delineate characteristics of the spawning and rearing phases of the species in Hungry Horse Creek and collect some information on movement patterns while in Hungry Horse Reservoir.

Operations of the upstream and downstream trap were designed to collect information on the following points in 1969:

1) Number of adult spawners, their age, growth, sex, fecundity

2) Mortality rates of adult spawners and causes of mortality

3) Number of emigrant juvenile fish leaving the drainage

4) Age, size, growth of juvenile fish

5) Relation between movement, stream temperature and time periods for both adult and juvenile fish.

6) Mortality rates and movement patterns of marked fish moving out of the drainage.

PROCEDURES

The upstream trap was operated continuously from May 15 through June 26, 1969. Adult fish entering the trap were sexed, measured and examined for an adipose fin-clip denoting those that had spawned in Hungry Horse Creek in 1968. All fish caught were sexed and tagged with numbered anchor tags inserted into the body immediately posterior to and below the dorsal fin. Scale samples for age and growth determinations were taken from all fish handled. Fifteen female cutthroat trout were killed and ovarian eggs counted.

The upstream trap was operated again from October 20 through November 22, 1969 to sample mountain whitefish spawning above the trap. Fish caught were sexed, measured and released above the trap.

The downstream trap was finished from June 11 through August 18, 1969 except for July 1, 2 and 3. Flows in excess of 200 cfs damaged the trap requiring it be removed for repairs. When spent adult fish appeared in the downstream trap, it was apparent that the anchor tags were being lost by many fish. Fish that had lost their tags were retagged and the adipose fin was removed. Spent adults captured for the first time were sexed, measured and marked by removal of the adipose fin and insertion of the numbered anchor tag. Scale samples were taken from adults captured for the first time. In summary every fish released from the downstream trap was marked two ways, by an adipose fin-clip and by a numbered anchor tag.

Scale samples were taken from 1,100 fish from the downstream trap. All fish were measured and assigned by their length to an age-class or an overlap zone between age-classes. Fish calculated to belong to age classes I, II and III and the overlap between ages I and II and III were marked with separate fin-clips or insertion of colored anchor tags. The lengths assigned to each age-class or overlap class were derived from data on juvenile fish measured and aged from the 1968 downstream trap operation.

Operation of the trap in June and most of July required at least daily screen cleaning and release of fish downstream. Operation in the latter part of July and August required screen cleaning and release of fish once every second or third day.

A staff gauge to measure flows in Hungry Horse Creek was installed in April, 1969. Limited accuracy was obtainable in reading this gauge during high flows due to bounce on the gauge face. A stilling well was built by project personnel in October 1969 to house a U.S. Geological Survey's continuous recorder planned for installation in April 1970.

A 30-day thermograph borrowed from the Washington Water Power Company was used to measure water temperatures during May 1969 and replaced when a new Foxoforo 30-day thermograph was obtained. Unfortunately the new instrument was not in working order and measurements were not obtainable.

FINDINGS

Cutthroat Trout - Adults

The first spawning westslope cutthroat trout were captured May 17, 1969. The upstream trap was operated until June 26, 1969 but the last adult capture was June 20, 1969. A total of 139 male and 730 female cutthroat (sex ratio 1: 5.2) were captured. A total of 854 fish were released above the trap. Spent adults were first taken in the downstream trap June 11 and the last fish was captured July 25, 1969. During this time 72 males and 426 females (1: 5.9) were captured of which 47 and 378 (1: 8.0) were recaptures, respectively.

Estimated number of cutthroat trout entering Hungry Horse Creek for spawning totalled 1,034 fish of which 212 were males and 822 were females (1: 3.9). The females averaged 14.5 inches total length and ranged from 12.4 to 16.2 inches. Males averaged 14.5 inches total length and ranged from 9.5 to 17.3 inches. The fifteen females sacrificed for egg counts averaged 14.6 inches total length and contained an average of 1,086 eggs. Total egg potential of the spawning run was calculated to be 892,500 eggs.

Downstream trap was thought to be 100 percent efficient for spent adult fish except for the three days, July 1-3, when high water damaged the incline screens requiring the trap to be removed for repairs. It was estimated that not more than 25 fish moved downstream during these three days. The estimated total downstream return of spent adult fish was 523 of which 84 were males and 439 were females (1: 5.2). Repeat spawners in 1969 numbered 11 males and 96 females (1: 8.7) which had survived from the 219 marked in 1968 spawning run.

Survival rates for fish spawning in Hungry Horse Creek in 1968 and in 1969 are presented in Table 1. Since the downstream trap was not operated all the time fish were moving downstream in 1968, survival rates from the 1969 data are applied to the 1968 run to obtain 1968 escapement estimates. Total survival for the 1969 run was 39.6 percent for males and 53.4 percent for females.

Table 1. Survival rates of westslope cutthroat trout spawning in Hungry Horse Creek, 1968 and 1969

	1968 Spawning Run		1969 Spawning Run	
	Female	Male	Female	Male
Number of fish in run	913	247	634*	181*
Downstream escapement	487	98	343*	73*
Percent survival	(53.4%)	(39.6%)	(54.1%)	(40.3%)
Number of 1968 fish returning to spawn in 1969	-	-	188	31
Percent survival	-	-	(38.6%)	(31.6%)
Downstream escapement	-	-	96	11
Percent survival	-	-	(51.1%)	(35.5%)

* Does not include the 1968 repeat spawners.

Reliability of the survival rate between the 1968 and 1969 spawning is questionable. It is possible that westslope cutthroat trout may have a tendency to spawn every other year or may not demonstrate strong homing to the natal stream. Operation of the trap in 1970 disclosed that 6 males and 51 females from the 1968 run returned to spawn in 1970 but not in 1969. Survival rates between spawning in 1968 and 1969 are likely nearer 50 percent for females and 40 percent for males than the values given in Table 1. The data in Table 1 show that females survive from period to period at a greater rate than males.

Estimated angler harvest of trout in Hungry Horse Creek before recapture in the downstream trap was 95 fish with a sex ratio 1: 3.0, male to females. Anglers returned tags from 45 trout that had been caught below the trap or from the reservoir prior to the start of the 1970 spawning run. Sex ratio of these fish was 1: 2.2. Sex ratio of the spawning run was 1: 3.9. It would appear that the male cutthroat trout are somewhat more susceptible to hook and line capture than female trout. It is doubtful that this is the prime reason why the male cutthroat trout death rate is greater for the female.

Age structure and growth rates of the 1968 spawning run were determined from interpretation of scales taken from 592 fish. The data are presented in Table 2 and divided into X_1, X_2, X_3 and X_4 migration classes. These classes are for fish that were one, two, three and four years old before they left the rearing stream and moved downstream into the reservoir as juveniles.

Table 2. Age composition by percent, of cutthroat trout spawning in Hungry Horse Creek, 1969

Migration Class	Percent of Total Run		Age-Class Composition				
X_1	5.1	Age/Yrs. in Trib.	3_1	4_1	5_1	6_1	7_1
			10.0%	63.3%	26.7%	0.0%	0.0%
X_2	77.9	Age/Yrs. in Trib.	3_2	4_2	5_2	6_2	7_2
			3.3%	34.9%	54.9%	6.9%	0.0%
X_3	16.9	Age/Yrs. in Trib.		4_3	5_3	6_3	7_3
				2.0%	67.0%	30.0%	1.0%
X_4	0.1	Age/Yrs. in Trib.			5_4	6_4	7_4
					100%	0.0%	0.0%
Total	100%						

Data given in Table 2 show several changes when compared to data for the years 1964-68, by Huston [1]. The strength of the X_1 migration class has increased each year since 1967. This class contributed less than one percent of the run in 1967, two percent in 1968 and five percent in 1969.

[1] Huston, Joe E. 1970. Reservoir Investigations. Job Progress Report, Federal Aid to Fish Restoration Project, F-34-R-3, Job 2. Montana Fish and Game Department. 11pp mimeo.

The run of X_2 migration class has shown little change since 1964, averaging about 75 percent of the total run. Major shifts have occurred however; in age-class strengths of the X_2 class. Prior to 1968 age-class 4_2 was the most numerous, but in both 1968 and 1969 fish of age-class 5_2 have been the most numerous. In 1969 age-class 5_2 was weaker than in 1968 being 55 percent and 70 percent, respectively. The 1969 age-class 4_2 was stronger than in 1968 with 35 percent and 19 percent, respectively.

The percentage the X_3 migration class made in the 1969 run was smaller than any past year. These fish comprised 17 percent of the 1969 run compared to an average of about 25 percent in previous years. Age distribution within this migration class has been similar in all years.

An age structure comparison of the spawning run shows some differences between the sexes as presented in Table 3. Very few females mature and spawn at three years of age while three-year-old mature males are numerous.

Table 3. Percent of total run for cutthroat trout spawning in Hungry Horse Creek by age and sex, 1969

Age	3	4	5	6	7
Males	19.2	23.1	43.6	12.8	1.3
Females	0.6	32.0	57.3	10.1	0.0

Five year old males and females were most abundant but distribution around this age was more diverse for male fish than for female fish.

Growth rates of cutthroat spawning in Hungry Horse Creek in 1969 are presented in Table 4 by migration class and sex.

Table 4. Growth rates of spawning cutthroat trout by sex and migration class, Hungry Horse Creek, 1969

Migration Class	Sex	Total length in inches at annulus I	II	III	IV	V	VI	VII
X_1	Male	3.3(4)*	7.8(4)	11.2(4)	14.3(3)	15.7(1)		
	Female	3.3(26)	8.7(26)	12.2(26)	14.2(24)	15.2(7)		
X_2	Male	2.8(67)	5.1(67)	10.4(67)	13.1(53)	15.0(39)	15.9(8)	
	Female	2.7(394)	4.9(394)	10.8(394)	13.1(393)	14.5(246)	15.5(24)	
X_3	Male	2.5(7)	4.7(7)	7.3(7)	11.4(6)	13.8(4)	15.2(2)	16.5(1)
	Female	2.2(93)	4.0(93)	6.2(93)	11.6(93)	13.9(93)	14.8(28)	
X_4	Male	2.0(1)	3.8(1)	6.0(1)	8.2(1)	14.1(1)		

* Number in parentheses is size of sample

Fecundity counts were made on the ovaries of 15 female cutthroat trout captured as they passed through the upstream trap. A length-frequency distribution study was made of the total catch during the first five days of the 1969 fish trapping. Data were seriated by one-half inch intervals and the percentage that each length group contributed determined. The sample of females was distributed around the expected size of the average female in the run. Fifteen fish were randomly selected by half-inch groups, killed, ovaries removed and eggs from each ovary were counted manually. The results of these counts are given in Table 5.

Table 5. Size of female cutthroat trout and number of eggs contained in ovaries

Size of Fish	Number of Eggs	Size of Fish	Number of Eggs
13.7 inches	902	14.7 inches	897
13.9 "	1,001	14.8 "	1,076
14.1 "	1,172	14.8 "	1,440
14.2 "	1,033	14.9 "	1,484
14.5 "	810	15.0 "	841
14.5 "	1,428	15.2 "	1,109
14.5 "	1,185	15.4 "	1,051
14.6 "	858	Average 14.6 "	Average 1,086

It was determined that an average length trout contained an average of 1,086 eggs. In 1968 the average female contained 983 eggs. The estimated total egg capacity of the 1969 run was 892,500 eggs compared to 897,000 eggs in 1968 [2/].

Effect of Tagging

Each adult cutthroat trout was tagged by insertion of an anchor tag posterior to and immediately below the dorsal fin. Tags were numbered for individual identification and were International Orange color coded for easy visual observation. The fish were anesthetized with tricaine methanosulfonate (MS-222) before the tag was inserted. The fish were held in a live box for at least thirty minutes or until fully recovered from the effects of the anesthesia before they were released above the trap. Release point was about 100 feet upstream in a quiet pool.

In previous years the fish had been anesthetized with MS-222 or urethane to facilitate data collection and marked by fin-removal. Fish dropping back downstream and re-entering the upstream trap had never been a problem previously, although a few did. The drop-back of fish tagged with the anchor tag was a serious problem in 1969. A total of 306 fish dropped back and re-entered the upstream trap one, two or three times. Table 6 shows the number of fish re-entering the trap and the time lapsed between initial entry and final entry.

[2/] Op. sit.

Table 6. Drop-back through the trap, re-entry and time lapse, Hungry Horse Creek, 1969

	Number of re-enteries into upstream trap		
	One time	Two times	Three times
Number of fish	224	68	14
Average time before final re-entry	11 days	16 days	16 days
Range of time	1-22 days	9-26 days	3-24 days

Male cutthroat trout entering Hungry Horse Creek were ripe enough to start spawning immediately. Female cutthroat trout were green when first caught and appeared to require several days before being able to spawn. The ratio of males to females dropping back and re-entering the trap was 1: 4.5 compared to the ratio of 1: 5.2 in the total trap catch. The ratios indicate that the males suffered as much or more drop-back than the females suggesting that drop-back was not related to the ripeness of the individual female fish. It is probable that insertion of the anchor tag caused enough traumatic injury to the fish causing drop-back downstream. One tagged fish dropped back downstream and into the reservoir where it was caught by an angler. Two fish were observed near the mouth of another stream entering Hungry Horse Reservoir several miles away from Hungry Horse Creek.

The delay of the fish reaching the spawning areas in the Hungry Horse Creek drainage may have more serious ramifications than drop-back out of Hungry Horse Creek. Observations in past years indicated that little spawning took place immediately upstream from the trap for a distance of about 3/4 mile. Evidence of spawning, redds and fish observed, were abundant in this area in 1969 indicating that many fish did not reach their "normal" spawning area further upstream.

The anchor tags were inserted to provide identification of individual fish. It was readily apparent that the spawning cutthroat trout did not retain the anchor tag. Twenty-three percent of the spent spawners captured in the downstream trap had lost their tags. Many of the fish still retaining tags showed evidence of severe ulceration around the point of entry. Operation of experimental trap in 1970 showed that very few of the downstream adults escaping in 1969 retained their tags. Trout that had been tagged could easily be identified by tagging scars. Tagged fish caught in 1970 numbered 172 but only 17 fish still retained the tags, the remainder were identified by tag scars.

Cutthroat trout, Juveniles

Juvenile cutthroat trout were first captured June 13, 1969, two days after the downstream trap was installed. About 3 fish per day were being captured when the trap was dismantled August 18, 1969.

Operation of the trap resulted in the capture of 2,680 juvenile cutthroat trout as they moved downstream toward the reservoir. Scale samples from 1,100 of these fish were taken for age and growth analysis. All fish were measured and assigned to an age-class or age-class overlap by length and marked. The anticipated age-length relationships and the actual age-length relationships are presented in Table 7.

Table 7. Anticipated and actual age-length relationship for juvenile cutthroat trout moving down Hungry Horse Creek, 1969

Time period	Length of fish in inches for age-class or overlap				
	I	I-II	II	II-III	III
June 13-June 23					
Anticipated	2.0-4.2	4.3-4.7	4.7-5.7	5.8-7.0	7.1
Actual	2.5-4.1	4.2-4.8	4.9-6.5	6.6-7.4	7.5
June 24-July 6					
Anticipated	2.0-4.3	4.4-4.9	5.0-6.2	6.3-7.1	7.2
Actual	2.2-4.3	4.4-4.8	4.9-6.7	6.8-7.1	7.2
July 6-July 21					
Anticipated	2.0-4.7	4.8-5.4	5.5-6.5	6.6-7.2	7.3
Actual	2.3-4.7	4.8-5.4	5.5-6.6	6.7-7.5	7.6
July 22-August 18					
Anticipated	2.0-5.0	5.1-5.5	5.6-6.6	6.7-7.3	7.4
Actual	2.2-5.1	5.2-5.6	5.7-7.3	None	7.6+

Each fish was marked or tagged according to the age-class or age-class overlap to which it was assigned. Marks used included the removal of the right pectoral fin for age-class I, anal fin age-class I-II, a green plastic jaw tag for age-class II, removal of the right pelvic fin for age-class II-III and a blue jaw tag for age-class III. Subsequent return of these marked fish to a spawning stream should give some insight into homing tendencies and age-class mortality rates. Many of these fish should spawn for the first time in the spring of 1971.

It was known that the downstream trap was not 100 percent efficient when operated and that juvenile fish move downstream in months other than those fished. No estimate of total downstream escapement of juvenile cutthroat trout from the Hungry Horse Creek drainage can be obtained from the 1969 catch data. Short term trap operation in April and October, 1970 caught small numbers of fish. It is thought that the peak out-migration does occur in June and July and that some fish move downstream throughout the entire year. The number of juvenile fish caught, measured, marked and released by age-class and time-period are shown in Table 8. The number of fish in each age-class was estimated from catch by time periods and from scale analysis. Age-growth data are presented later in Tables 9 and 10.

Table 8. Number of juvenile cutthroat trout by age captured in the downstream trap, Hungry Horse Creek, June 13 through August 18, 1969

Time period	Number of fish in age-class I	II	III	Total	Average per day
June 13-June 23	129	374	39	542	49.3
June 24-July 6	132	333	33	498	45.3
July 7-July 21	639	666	36	1,341	89.4
July 22-August 18	195	99	5	299	10.7
TOTAL	1,095	1,472	113	2,680	41.2

The data in Table 8 indicate that the peak migration occurs in the middle of July. Daily catch for July 8 through July 13 averaged 131.5 fish and was more than 100 fish each day. Daily catch exceeded 100 fish only one other day, June 19, for the rest of the days fished.

It appears that the age II and III fish move downstream in greatest numbers in early June and July. The movement of the older fish was further substantiated by the short-term trap operation in April 1970 when almost all the fish caught were two or three year old fish. Short term trap operation in October 1970 caught few two-year old fish. The greatest movement of one-year old fish seems to occur in July, August or later. Trap operation in October 1970 yielded mostly one-year old fish.

Most of the juvenile fish and spent adult spawners were caught between the hours of midnight and 6 A.M. contrasted to afternoon upstream movement of adults moving into the drainage. Spent adult and juvenile fish could be seen congregating above the downstream trap in quiet waters during daylight hours and a rough estimate of downstream catch could be made from the number of fish observed.

A review of the age-growth data collected in 1968 indicated that the age of about 65 percent of the downstream fish could have been correctly predicted from lengths. Scales from 701 juvenile cutthroat trout collected in 1969 were analyzed to determine growth rates, ages and accuracy of assigning fish to age-groups by lengths. Accuracy of assigning fish to age groups by lengths is shown in Table 9. Data show that of 196 fish assigned to age-class I, 194 were one-year old fish; of the 217 assigned to age-class II, 215 were two-year old; and of the 33 assigned to age-class III, 27 were three-year old fish. Fish assigned to overlap age-classes numbered 255 of which 42 were I, 202 were II and 11 were III year old fish. The data show that fish assigned to a specfic age-class very likely were that age and that fish assigned to an overlap likely were age-class II fish.

Table 9. Numbers of juvenile cutthroat trout assigned in the field to various age-classes or overlap classes compared with numbers in same classes determined by scale reading for different collection periods, Hungry Horse Creek, 1969

Age by length	I		I-II		II		II-III		III	
Age by scale analysis	I	II	I	II	II	III	II	III	II	III
June 13-June 23	36	1	6	7	60	1	66	3	5	12
June 24-July 6	8	0	2	15	45	0	14	2	0	7
July 7-July 21	84	1	20	43	86	0	38	6	1	8
July 22-August 18	66	0	14	15	24	1	4	0	-	-
Total Numbers	194	2	42	80	215	2	122	11	6	27

Growth rates of 701 juvenile cutthroat trout captured in the downstream trap were calculated from scale analysis. These data are presented in Table 10 by age-class.

Table 10. Growth of juvenile cutthroat trout collected during out-migration, Hungry Horse, 1969

Out-migration age	Total Length in inches at Annulus		
	I	II	III
1+	3.1 (236)		
2+	2.9 (425)	4.9 (425)	
3+	2.6((40)*	4.6 (40)	6.6 (40)

* Number in parentheses is size of sample.

Mountain Whitefish, adults

The upstream trap was operated from October 20 through November 22, 1969 to enumerate mountain whitefish spawning above the trap-site. During the years of 1962 through 1968 observations indicated that this creek supported a good number of spawning whitefish. Several hundred were estimated to have spawned in the creek above the trap. The major part of the run was thought to spawn in the stream below the trap. The total catch included 146 males and 40 female whitefish (sex ratio 3.6: 1). The males averaged 11.9 inches and the females 12.6 inches total length. The fish were enumerated, measured and released upstream.

Hungry Horse Reservoir was drawn down about 41 feet at this time, forming several hundred yards of creek that is normally inundated at the start of the whitefish spawning run. Observations indicate that many mountain whitefish were spawning in this area. It is assumed that the drawdown resulted in forming more stream channel below the trap and reduced considerably the number of fish that "normally" would have spawned above the trap in 1969.

RECOMMENDATIONS

Recommendations are for the continuation of this job. It is recommended that the upstream and downstream trap be operated in 1970 but only during the time adult fish are in the drainage. Use of the anchor tag to mark either adult or juvenile cutthroat trout should be discontinued.

Investigations should be made to determine whether the downstream trap can be fished during the period of March through December. Methods would have to be found to alleviate ice-formation on the screens during freezing weather and to eliminate flow ice from entering the trap.

Trapping of the mountain whitefish spawning run should not be attempted unless Hungry Horse Reservoir is at or near full pool during the spawning run.

Prepared by Joe E. Huston

Date June 7, 1971

Waters referred to:

1-08358001
1-08886005

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION

JOB PROGRESS REPORT
RESEARCH PROJECT

State Montana

Project No. F-34-R-5 Name Reservoir Investigations

Job No. III-a Title Life History Studies of Westslope Cutthroat Trout and Mountain Whitefish

Period covered July 1, 1970 through June 30, 1971

ABSTRACT

An upstream-downstream fish trap was operated on Hungry Horse Creek from May 20 through August 6, 1970. An estimated 1,003 adult westslope cutthroat trout (Salmo clarki subsp.), with a sex ratio of 1.0 males to 5.6 females, passed upstream through the trap to spawn. There were 239 repeat spawners from the 1968 and 1969 spawning run. Spent fish passed downstream through the trap numbered 442, of which 134 were repeat spawners from 1968 and 1969. The downstream trap also caught 2,024 juvenile cutthroat trout as they moved downstream toward Hungry Horse Reservoir.

Age structure of the adult spawners included 6 percent which had migrated to the reservoir as one-year-old fish, 74 percent as two-year-old, 19 percent as three-year-old, and 1 percent as four-year-old fish. An estimated 35 percent of the juvenile migrants were one-year old, 54 percent two-year old, and 11 percent three-year-old fish.

BACKGROUND

The Hungry Horse Creek fish trap has been successfully operated each year since 1968. Three preceding years were spent developing a trap system capable of being operated at a wide range of flows. The upstream trap is operable at flows up to about 600 cfs while the downstream trap can be run at flows up to about 150 cfs.

The westslope cutthroat trout is listed as an endangered species by the Bureau of Sport Fisheries and Wildlife. Flathead River drainage, including Hungry Horse Reservoir and the South Fork, is one of the last strongholds of this fish. The long-term objective of this project segment has been to delineate characteristics of the spawning and rearing phases of this cutthroat trout while in the stream environment and to collect some information on movement patterns while in the reservoir environment.

OBJECTIVES

The objectives of this job were (1) correlate fish movement into and out of Hungry Horse Creek with stream temperatures and volumes, (2) determine numbers of adult fish spawning in Hungry Horse Creek, (3) determine numbers of juvenile fish leaving the creek during peak periods of emigration, and (4) locate principle spawning areas within the drainage.

PROCEDURES

The upstream trap was operated continuously from May 20 through June 26, 1970. Adult fish entering the trap were measured (total length), sexed and examined for fin clips, anchor tags, or anchor tag scars. Scale samples for age and growth determinations were taken from a representative sample of fish. Fifteen female trout were killed and ovarian eggs counted. Adult fish were marked by removal of the right pectoral fin and released upstream.

The downstream trap was placed into operation June 22 and maintained through August 6, 1970. Spent adult fish caught were measured, sexed and examined for fin clips, anchor tags, or anchor tag scars. Fish with an adipose clip, anchor tag or scar combined with a right pectoral clip were released downstream, while those with no pectoral mark were clipped before release. Fish without identifying marks or with the right pectoral clip were tagged with a numbered plastic jaw tag and released downstream.

Juvenile trout caught by the downstream trap were measured and assigned to an age-class by their length. Scales from 275 fish were collected for age and growth determinations. Fish in each age-class (age-class I, II, III) were marked by removal of a single fin and released below the trap. The age class assigned each length group was derived from data collected in 1968 and 1969[1/].

FINDINGS

Cutthroat trout - Adults

The upstream trap was operated from May 20 through June 26, 1970. The first fish was a male captured May 25th and the last fish was a female caught June 24th. A total of 125 males and 689 females were captured by the upstream trap. The estimated total spawning population was calculated from the ratio of unmarked to marked adult fish caught in the downstream trap. The estimated number of adult cutthroat trout passing through the trap totalled 1,003 fish, of which 153 were males and 850 females. The sex ratio was 1.0 males to 5.6 females. Spent adults captured in the downstream trap numbered 442 fish. There were 55 males, 47 of which were marked, and 387 females of which 317 were marked.

The average male fish was 14.1 inches total length and ranged from 8.9 to 16.5 inches. Females averaged 14.2 inches and ranged from 11.6 inches to 16.3 inches total length. The 15 females sacrificed for egg counts averaged 14.1 inches and contained 1,007 eggs. Total egg capacity of the spawning run was calculated to be 856,000 eggs.

1/ Huston, Joe E. 1971. Reservoir Investigations, Job Progress Report, Federal Aid to Fish Restoration Project F-34-R, Job III-a, Montana Fish and Game Department, 12 pp. mimeo.

Age structure and growth rates of the 1970 spawning run were determined from interpretation of scales taken from 190 fish. Data are presented in Table 1 and divided into X_1, X_2, X_3, and X_4 migration classes. The classes are for fish that were one, two, three or four years old when they left the rearing stream and moved downstream into Hungry Horse Reservoir.

Table 1. Age structure and growth rates of cutthroat trout spawning in Hungry Horse Creek, 1970

Migration class	percent of sample	Length in inches at annulus I	II	III	IV	V	VI	VII
X_1	6.3	3.5 (12)*	8.6 (12)	12.0 (12)	14.1 (6)	15.0 (2)		
X_2	73.7	2.5 (140)	4.7 (140)	9.9 (140)	12.8 (136)	14.4 (55)	15.2 (6)	
X_3	18.9	2.3 (36)	4.2 (36)	6.5 (36)	11.2 (36)	13.4 (29)	14.8 (13)	15.4 (1)
X_4	1.1	2.0 (2)	4.0 (2)	6.7 (2)	8.8 (2)	13.0 (2)	14.8 (2)	

*Number in parentheses is size of sample

Fecundity counts were made on the ovaries of fifteen female cutthroat trout. Length-frequency distribution was calculated continuously for female fish as they entered the trap. Selection for egg counts was done so that the average length of those selected would closely approximate the average of all females. The fish were killed, ovaries removed and eggs counted manually. Results of these counts and of similar samplings done in 1968 and 1969 are presented in Table 2.

Table 2. Average length and number of eggs per female cutthroat trout and estimated egg potential, 1968, 1969, and 1970

Year	Average length run	sample	Average number eggs-sample	Total of females	Spawning egg estimate
1968	14.5"	14.4"	986	913	897,000
1969	14.5	14.6	1,086	822	892,500
1970	14.2	14.1	1,007	850	856,000

Spent spawners leaving Hungry Horse Creek each year since 1968 have been marked so that spawning years can be separated. It has been suspected the westslope cutthroat trout exhibit some degree of alternate year spawning. The 1970 spawning run included 57 fish that spawned in Hungry Horse Creek in 1968 but not in 1969, evidence of alternate year spawning. The run included 182 that spawned in 1969 and 764 that spawned for the first time in 1970.

Creel checks of anglers fishing reservoir tributary streams in 1970 indicated very little straying by spawning fish occurred. One adult fish marked in Hungry Horse Creek in 1969 was caught from Emery Creek. Both streams enter Hungry Horse Reservoir within one-half mile of each other and Emery Creek was a tributary of Hungry Horse Creek prior to filling of the reservoir.

Cutthroat trout - Juveniles

The downstream trap was installed and operated continuously from June 22 through August 6, 1970. Creek discharge in excess of 150 cfs during the first five days of trap operation precluded trapping the entire creek. About 75 percent of the creek was passed through the trap and the remainder through the bypass channel. An upstream trap in the bypass channel stopped the spent adults but not the smaller juvenile fish.

Total catch during the 46 days of downstream operation was 2,024 juvenile cutthroat trout. Average daily catch was 44 and 53 fish per day for 1970 and 1969, respectively. The greatest number of fish taken any one day was 105 in 1970 compared to 213 fish in 1969. Peak emigration of juvenile fish was made between July 1 and July 20 for the years 1968, 1969 and 1970. Number of days with catches of 100 or more fish were 10 days in 1968, 6 in 1969 and 1 in 1970.

Scales from 175 juvenile trout were collected for age and growth analysis, Table 3. Compared to similar collections in 1968 and 1969, the 1970 data show little change.

Table 3. Age and growth of juvenile cutthroat trout collected during out-migration, Hungry Horse Creek, 1970

	Length in inches at annulus			Estimated numbers
Out-migration age	I	II	III	by age-class
1+	2.9(92)*			709
2+	2.7(111)	4.8		1,103
3+	2.5(9)	4.4	6.5	218

*Number in parentheses is size of sample

Fish Movement Patterns

Movement of adult fish from the reservoir into the creek has been observed to occur at night. Generally, the fish will not move further upstream than the first suitable resting pool where they remain until the next afternoon. Upstream movement of the spawning fish appears to be correlated with daily stream temperatures. Visual observations, hook and line sampling, electrofishing and trap operations have all indicated that movement occurs only in the afternoon hours when daily water temperatures are at their highest. There does not appear to be any correlation between daily or seasonal flow patterns and fish movement.

The temperature, volume of flow, and number of fish caught at the trap for June 10, 11 and 12, 1970 are given in Table 4 and illustrate the effects of temperature upon number of fish moving into the trap. Visual observations of the resting areas immediately below the trap indicated about equal numbers of fish available for trap entry each day.

Table 4. Stream temperatures, flows and number of spawning cutthroat trout taken June 10, 11 and 12, 1970, Hungry Horse Creek

Date	Number of fish	Time	Temperature	Volume
		12 Noon	40°F.	184 cfs
		2 p.m.	41	187
June 10	22	4 p.m.	42	181
		6 p.m.	41	176
		8 p.m.	41	171
		12 Noon	41	149
		2 p.m.	43	146
June 11	130	4 p.m.	44	142
		6 p.m.	45	140
		8 p.m.	43	144
		12 Noon	41	130
		2 p.m.	42	129
June 12	29	4 p.m.	42	130
		6 p.m.	42	130
		8 p.m.	41	124

Sampling has also indicated a daily movement pattern related to distance. Fish entering the stream at night and resting near the mouth will swim upstream to immediately below the trap the following afternoon. The second afternoon fish move through the trap and on upstream into either Margaret Creek or into an area near the junction of Tiger Creek and Hungry Horse Creek. The third days' travel will put the fish into the main spawning areas of Margaret Creek, Tiger Creek or Hungry Horse Creek. These resting areas are shown in Figure 1. Distances covered each of the three days is about one mile.

Upstream movement of adult fish within a specific area around the trap has shown little variation from year to year. Prior to trap construction it was noted that fish moved in a definite pattern. Adult fish followed the south bank for a distance of about 100 feet above and below the trap (Figure 1). The creek was deepest and swiftest along this bank. Three large pools, 100 feet to 400 feet below the trap, served as resting pools while one resting pool was formed by the junction of Margaret Creek and Hungry Horse Creek about 200 feet above the trap.

The upstream trap was constructed so that the main trap box was positioned near the south bank. The concrete trap apron was built so that the heaviest flows are directed along the south bank below the structure. The bypass channel outlet re-enters the creek channel from the north at the upstream end of the nearest resting pool. Observations since trap construction indicate that fish entering the main trap box do so from near the south bank while fish entering the bypass channel do so from the resting pool Very few fish are observed to follow the north bank upstream from the mouth of the bypass channel onto the trap apron.

Downstream movement of spent adult fish also follows a definite pattern related to time and space. Observations have indicated that spent fish travel about the same distance each day and use the same resting areas they used when they moved upstream. The primary difference is that downstream movement occurs in late afternoon and at night before midnight.

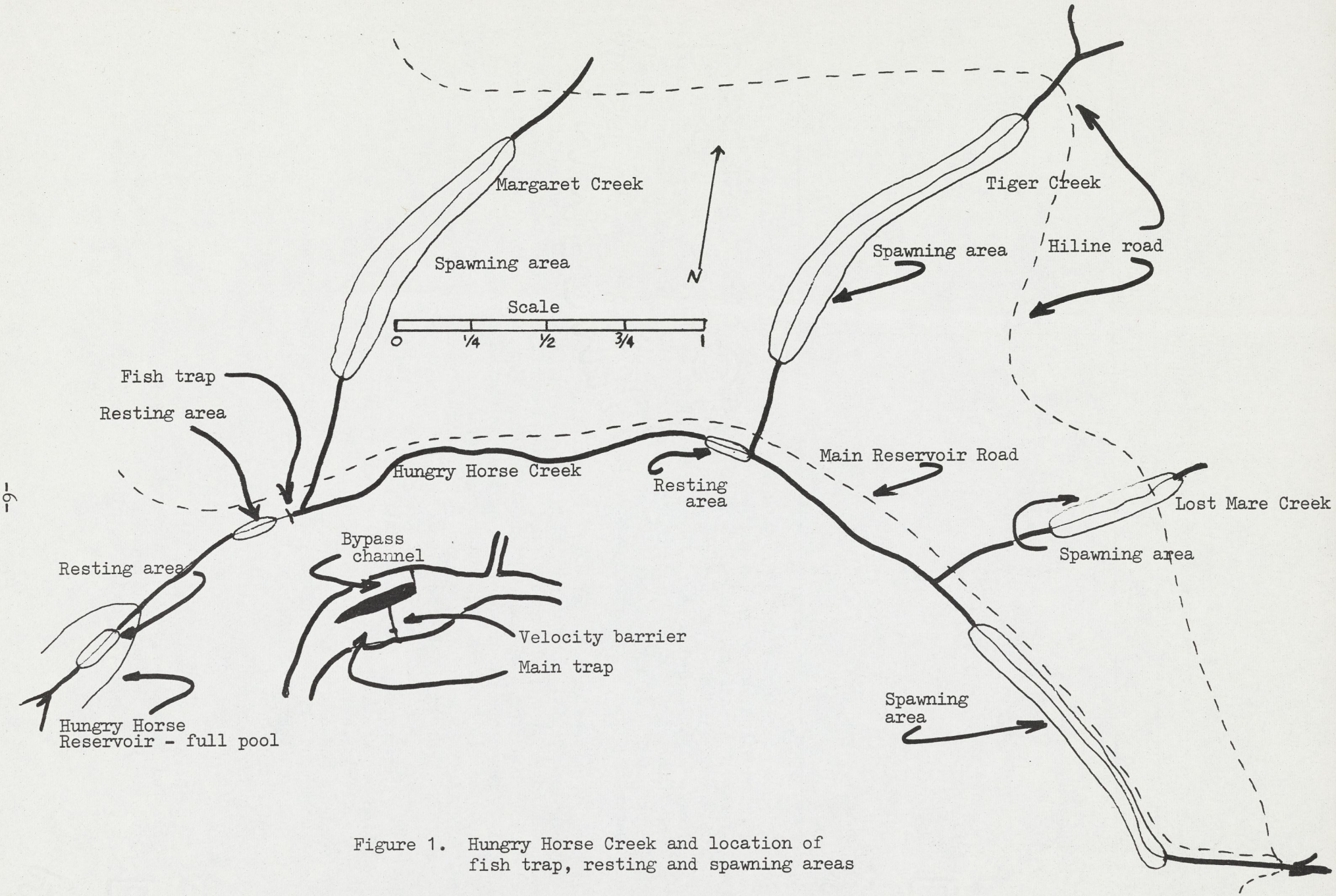


Figure 1. Hungry Horse Creek and location of fish trap, resting and spawning areas

Juvenile cutthroat trout moving downstream also travel at night. The greatest number of these fish are trapped between midnight and dawn.

Spawning Areas

Limits of heaviest used spawning areas within the Hungry Horse Creek drainage are shown in Figure 1. These areas have been confirmed by repeated sampling with hook and line, electrofishing and by visual observations over a period of 6 years. Cutthroat trout are daylight spawners and with some stealth can be observed. Redd building by fish has been observed to occur most frequently in the afternoon and may be related to daily temperature patterns.

Areas used for spawning within the drainage have changed little since 1964 with the exception of 1969. In 1969, the spawning run started about two weeks later than usual and marking of the fish with an anchor tag caused another delay. Spawning activities for 1969 were numerous immediately upstream from the trap and extended to the junction of Tiger and Hungry Horse Creeks. In other years spawning activity in this area of the stream has been very limited with most spawning occurring further upstream.

RECOMMENDATIONS

It is recommended that the upstream and downstream trap be operated in 1971 only during the time adult fish are in the drainage. It is planned that operation of this trap will terminate in late 1972. Plans should be formulated so that the trap can be removed with the least disturbance to the creek and can be reinstalled with minimum effort. Replacement of the wooden bypass channel headgate with a concrete structure is needed.

Prepared by Joe E. Huston

Date March 20, 1972

Waters referred to:

1-08356001
1-08886005
1-08726010
1-08450001
1-08432010

MONTANA DEPARTMENT OF FISH AND GAME
FISHERIES DIVISION

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

State Montana Title Reservoir Investigations

Project No. F-34-R-6 Title Life History Studies of Westslope Cutthroat

Job No. III-a trout

Period Covered July 1, 1971 through June 30, 1972

ABSTRACT

A fish trap was operated on Hungry Horse Creek from May 25 through July 27, 1971. An estimated 703 adult westslope cutthroat trout (Salmo clarki subsp.) entered the creek for spawning. The 1971 spawning run included 131 repeat spawners that had spawned in Hungry Horse Creek in 1968, 1969 or 1970. Downstream escapement of spent fish was 256 including 52 repeat spawners. The downstream trap also caught 1,951 juvenile cutthroat trout as they moved toward Hungry Horse Reservoir.

Sex ratio of the adult fish was 1.0 males to 6.2 females. Several females caught in the downstream trap were examined internally and found to contain eggs starting to be reabsorbed. Concern is expressed that insufficient adult males may be present. Sex ratio of cutthroat trout gill netted in the reservoir in 1970 was determined to be 1.0:1.8 males to females while sex ratio of 103 outmigrant juveniles caught in 1971 was determined to be 1.0:1.9.

The wooden inlet structure regulating flows into the bypass channel was replaced with a concrete structure.

BACKGROUND

An upstream-downstream fish trap has been operated in Hungry Horse Creek annually since 1968. Numbers of westslope cutthroat trout spawning in Hungry Horse Creek and numbers of outmigrant juvenile fish leaving the creek during the period of peak outmigration have been determined yearly. The long term objectives of this project have been to delineate some of the spawning and rearing characteristics of the westslope cutthroat, their movement patterns in the reservoir environment and the reservoir population of cutthroat trout.

OBJECTIVES

The objectives of this job were to: (1) determine numbers of adult cutthroat spawning in Hungry Horse Creek, (2) determine downstream escapement of spent adult fish, (3) determine downstream escapement of juvenile cutthroat trout during period of greatest movement, (4) correlate upstream and downstream cutthroat movement with stream volumes and temperatures and (5) replace the wooden bypass channel headgate with a concrete structure and perform other needed maintenance.

PROCEDURES

The upstream fish trap was operated continuously from May 25 through June 26, 1971. Adult fish captured were measured in total length, sexed, had scale samples taken (some fish), were examined for identifying marks and released upstream. Spent fish released from the trap in 1968, 1969 and 1970 were each given a fin-clip or tag singular to that year. Captured repeat spawners bearing a tag would, in addition, be given a fin-clip signifying the year. As an example a fish re-entering the trap to spawn in 1971 could have a fin-clip from 1968, plus a jaw-tag and fin-clip from 1969 plus another fin-clip from 1970.

Juvenile fish released from the downstream trap in 1969 and 1970 were marked by fin removal or jaw-tags. The jaw tags were color coded or numbered so that they were different from tags used in spent adult fish. Fin-clips were selected so that chance of mixing between the juveniles and spent adults would be minimized. Noting of marks and tags on fish in 1971 enabled project personnel to determine fish that were first-time spawners in Hungry Horse Creek, spawners marked as smolts returning to the natal stream to spawn or repeat spawners.

In 1971, adult fish entering the upstream trap were marked by removal of the right posterior tip of the pre-maxillary bone.

The downstream trap was placed into operation and fished continuously from June 18 through July 27, 1971. Spent adult fish caught were measured, sexed and examined for identifying marks. If a fish carried a combination of marks which included the pre-maxillary clip, it was released downstream. Fish with only the pre-maxillary clip were tagged with a numbered jaw-tag and released. All adult trout were given a pre-maxillary clip either passing upstream or downstream and a numbered jaw tag passing downstream.

Juvenile trout caught in the downstream trap were enumerated and released downstream. A large sample were measured for total length. A total of 104 were killed and sex determinations made.

Stream temperatures through the period of trapping were collected using a 31-day continuous recording thermograph. Stream volumes during the same period were obtained from a U.S. Geological Survey continuous flow recorder. These data will not be included in this report but are on file at Regional Headquarters, Montana Department of Fish and Game, Kalispell, Montana.

FINDINGS

The upstream trap was fished from May 25 through June 26, 1971 and the first ripe adult cutthroat trout was captured May 26th. A total of 81 males and 562 females (determined by external characteristics) were captured by the upstream trap and the estimated total run was calculated to have been 97 males and 606 females. The estimated total spawning population was calculated from the ratio of unmarked to marked (pre-maxillary clip) fish caught in the downstream trap. Spent fish caught in the downstream trap totaled 256. There were 30 males of which two were unmarked and 226 females of which 16 were unmarked.

Male fish averaged 13.8 inches total length and ranged from 9.0 to 16.2 inches. Females averaged 14.1 inches and ranged from 12.4 to 16.1 inches total length. Average size of the females and range of size of females and males conformed closely to data collected in 1970. Average size of the males measured in 1971 was 0.3 inches smaller than that found in 1970.1/ It was noted that in 1971 most of the males were either less than 13.0 inches or larger than 15.0 inches. Most of the female fish were closely arrayed around the average size.

Sex ratio of the 1971 spawning run was calculated to be 1.0 males to 6.2 females. Several female fish were caught in the downstream trap in mid- and late July that had not spawned or that appeared to be only partially spent. Internal examination confirmed that they had not completed spawning and that eggs were being reabsorbed.

The percent of females in the cutthroat sex ratio of Hungry Horse Creek has been increased yearly. The sex ratio in 1963 was 1.0 : 1.8 males to females, compared to the 1971 ratio of 1.0 : 6.2. No logical explanation can be given for this change. Gill netting in the reservoir in 1970 yielded a ratio of 1.0 : 1.8 for both immature and mature fish. Sexing of 104 outmigrant juveniles caught by the Hungry Horse Creek downstream trap in 1971 resulted in a sex ratio of 1.0 : 1.9 males to females. Size of juveniles examined ranged from 3 to 7 inches total length.

Data collected in 1970 indicate that cutthroat trout spawning in Hungry Horse Creek exibited some alternate year spawning. This was further substantiated in 1971. The 1970 spawning run included 57 fish that spawned in 1968 and 1970 in Hungry Horse Creek while the 1971 spawning run included 57 fish that spawned in 1969 and 1971 in Hungry Horse Creek.2/

Little evidence has been collected to indicate that fish marked in Hungry Horse Creek spawn in other reservoir tributary streams except Emery Creek. Creel census data collected during the opening two or three week-ends of angling included some fish caught at Emery Creek which has been marked at Hungry Horse Creek. Both creeks drain into the same reservoir bay and Emery Creek was a tributary of Hungry Horse Creek prior to impoundment of Hungry Horse Reservoir in 1952.

1/ Huston, Joe E. 1971. Life cycle studies of westslope cutthroat trout and mountain whitefish. Job Prog. Report, Federal Aid to Fish Restoration Project F-34-R-5, Montana Department of Fish and Game, Job II-a, 7pp. mimeo.

2/ Ibid.

The total spawning run was estimated at 1,003 fish in 1970 and 703 fish in 1971. Data on spawning populations prior to 1970 indicate a gradual decline in numbers of spawners but no year so dramatic as from 1970 to 1971. The 1971 spawning data indicate that poor survival of cutthroat while in the reservoir may be a major cause of their decline.

An analysis of repeat spawning the following year by "new" fish spawning the first time in either 1969 or 1970 showed marked changes. A "new" fish is one that is spawning in Hungry Horse Creek for the first time. The estimated downstream escapement of "new" fish from the 1969 spawning run totaled 298 fish of which 182 returned to spawn in 1970. The return was 61 percent. A total of 308 "new" fish escaped following spawning in 1970 but only 38 of these fish returned to spawn in 1971. Return of these fish was only 12 percent; a decided reduction.

The potential for alternate year spawning was considered as a possible reason for the low return of the 1970 "new" fish in 1971. Preliminary analysis of the 1972 spawning run data indicated that only about 56 "new" fish from the 1970 downstream escapement spawned in Hungry Horse Creek in 1972 as alternate year spawners.

The 1970 spawning run included 239 fish (24 percent) which were repeat spawners and 764 (76 percent) which were "new" fish. The 1971 spawning run included 131 (19 percent) repeat spawners and 572 (81 percent) "new" fish. These data suggest no great change in make-up of the spawning run between "new" and repeat spawners. They do suggest a general decline affecting both groups of fish.

The most numerous age-groups as determined by scale reading in the spawning runs has been four year-old fish which migrated out of the natal stream at two years of age. The most numerous age-group of juvenile fish moving downstream out of Hungry Horse Creek into Hungry Horse Reservoir has been two year-old fish. The majority of fish entering Hungry Horse Creek for first-time spawning in 1970 should have been from the juvenile outmigration of 1968 while "new" fish entering for spawning in 1971 should have been from the juvenile outmigration in 1969.

Capture of juvenile cutthroat during the peak of outmigration in 1968 was about 2,200 fish. The number caught during the same period in 1969 was about 2,300 fish. These data would indicate similar downstream escapement between the years which with similar reservoir survival should have resulted in similar numbers of "new" fish entering the spawning run. However, as discussed above, the 1971 spawning run was markedly less than the 1970 run.

Operation of Hungry Horse Reservoir for flood control and production of electrical power has changed. Prior to 1965 average annual drawdown was about 60 feet. For the years of 1965 through 1971, average annual drawdown has increased to about 100 feet. Drawdown in these later years has also occurred at different times of the year than before 1965. Early years' drawdown usually did not start until November or December and filling was accomplished by late June. Time of drawdown since 1965 has varied from August to October and filling has not been completed until early or mid-July.

The downstream trap was placed into operation June 18 and fished through July 27, 1971. A total of 256 spent, partially spent and unspawned fish were captured and released downstream. Of these fish 226 were females and 30 were males.

Spawning survival (For period from passing through trap going upstream until return to trap) for males was 31 percent compared to 37 percent for females. The downstream trap also captured 1,951 juvenile cutthroat trout as they moved downstream toward the reservoir.

In September 1971, the wooden headgate structure controlling flows into the bypass channel was replaced with a concrete headgate. The new structure is ten feet wide divided into two equal bays. The old structure was eight feet wide divided into two equal bays. The new structure is aligned with the stream so that additional bays can be added if needed. The new structure was also designed to draw water away from the main velocity barrier (which includes the fish trap) and insure fish passage after the velocity barrier is removed in fall 1972. Soundness of the design will be determined in spring 1973.

RECOMMENDATIONS

The Hungry Horse Creek fish trap should be operated to enumerate the upstream movement of adults into the creek for spawning and the downstream escapement of juveniles into Hungry Horse Reservoir in 1972. It is planned that this structure will be removed in early fall 1972 and the downstream trap will be operated up to the time of removal.

Work should be started on a final job report covering all activities on this project since 1963. It is expected that write-up of this report will entail work in fiscal years 1973 and 1974.

Hungry Horse Creek has considerable volume and velocity in the area of the trap site. Trap removal will be done in the best manner possible leading to the least environmental disturbance. It was noted in an Environmental Impact Statement that some creek bottom disturbances were unavoidable. Work in the area may by needed in future years to stabilize channel characteristics.

Prepared by Joe E. Huston

Date April 30, 1973

Waters referred to:

1-08358001
1-08886005

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

JOB COMPLETION REPORT
RESEARCH PROJECT SEGMENT

State of Montana

Project No. F-7-R-13 Name: Northwest Montana Fishery Study

Job No. III Title: Survey of Cutthroat Trout and Dolly Varden In The Flathead River and Tributaries Above Flathead Lake

Period: July 1, 1963 to June 30, 1964

Abstract:

The tagging of cutthroat trout and Dolly Varden was discontinued until techniques are developed to collect the older and mature fish in Flathead Lake. Major emphasis was placed in the establishment of water quality monitoring stations along the Flathead River.

Water samples were collected twice a month at three stations on the Flathead River and at the U.S.G.S. guage station on the South Fork of the Flathead River below Hungry Horse Dam. This water quality data illustrates the difference between water discharged from the bottom of a 500-foot high peaking power dam (without multigated outlet) and water in a free flowing river. These data will also be a basis for determining basic water quality for future industrial development along this river.

Data were collected on: water temperatures, dissolved oxygen concentration, pH, total alkalinity and specific conductance.

Discharges (taken at 285 and 325 feet) from the reservoir held water temperatures immediately below the dam near 39° F. throughout the year. The other water criteria measured, below the dam, showed a tempered effect compared to the free flowing water stations.

Twenty-five cutthroat trout and 10 Dolly Varden, tagged during 1961-1963 were recaptured. Time from tagging to recapturing varied from 2 - 24 months for the cutthroat and from 8 - 33 months for the Dolly Varden.

The longest movement recorded was for a cutthroat trout which traveled 102 miles downstream. It was tagged on the North Fork River near the Canadian border and was recaptured in Flathead Lake.

All Dolly Varden recaptures were from fish tagged in Flathead Lake. One return showed an upstream movement of 99 miles in 13 months. This fish was recaptured 44 miles up the Middle Fork of the Flathead River. All other returns were recaptured in Flathead Lake. Tagging results to date show that the Dolly Varden travel the entire shoreline of Flathead Lake, from the Narrows at the north end of the lake to the mouth of the Flathead River at the north end.

RECOMMENDATIONS:

It is recommended that intensive cutthroat trout and Dolly Varden tagging be discontinued until techniques are developed to collect the older and mature fish in Flathead Lake. Efforts should be made to recover tagged fish that move downstream in to Flathead Lake.

Emphasis should be shifted from the tagging phase of the fish movement study to monitoring water quality in the river system. Water quality information will aid in understanding fish movements.

TECHNIQUES USED:

The tagging of cutthroat trout and Dolly Varden was an incidental part of the project. Major emphasis was placed on the establishment of water quality stations. Standard water quality techniques were used to determine: 1. dissolved oxygen concentration; 2. total alkalinity; 3. standard conductance; 4. pH; 5. daily max-min water temperatures. Water discharges were determined at two stations from U.S.G.S. water guaging records. Samples were collected at two week intervals. The time of day data was collected from any one station never varied over one hour throughout the entire project period.

OBJECTIVES:

The Flathead River and tributary streams above Flathead Lake have provided an important fishery on cutthroat trout and Dolly Varden. Very little is known about the extent of fish recruitment from the upper tributaries to the larger river system and from the river system to the lake below. The objectives of this investigation are to determine distances involved in cutthroat trout and Dolly Varden spawning migration in this drainage, the timing of the migration, and the extent to which some of the major tributaries of the North and Middle Fork Rivers are used for spawning. A secondary objective is to obtain information on other fish species - particularly information that will aid in understanding fish production in these waters and the recruitment of the native fishes in the Flathead River system.

FINDINGS:

WATER QUALITY. Since the completion of Hungry Horse Dam in 1951, the annual upstream spawning migration of cutthroat trout and Dolly Varden from Flathead Lake has been confined to the North Fork and Middle Fork of the Flathead River and their tributaries. The peaking power demand at Hungry Horse Dam create violent fluctuations of water discharges into the Flathead River. Information is needed to further understand the effects of these rapid changes in water flows on fish, water temperatures and chemistry below Hungry Horse Dam and on the lower river and lake system.

In connection with this phase of the study, efforts are being made to establish water quality criteria for the Flathead River. Future industrial development in the valley will pose a threat to the water quality of the Flathead River. The construction of a ground wood fiber mill has been proposed at a site one mile south of Columbia Falls on Flathead River. Effluents from this plant could alter the physical and chemical characteristics of the water and affect aquatic life below the mill site. In cooperation with the State Board of Health and the U.S.G.S., water quality data have been collected above and below the proposed mill sire. This will be useful

in establishing water standards for the Flathead Valley.

This report will summarize data collected by Fish and Game personnel from January 1963 through December 1964. Water quality data have been collected at two week intervals from four stations in the Flathead River drainage above Flathead Lake. These stations are currently in operation, they are described as follows: (1) The Blankenship Bridge site on the Flathead River just below the confluence of the North and Middle Forks; (2) The U.S.G.S. guaging station on the South Fork a mile below Hungry Horse Reservoir; (3) The U.S.G.S. guaging station on the Flathead River at Columbia Falls and (4) The Old Holt Bridge on the Flathead River approximately three miles above Flathead Lake. Water samples were collected at each station to determine the dissolved oxygen concentration, total alkalinity, pH, and standard conductance. Water samples were collected in numerical sequence at each station at approximately the same time of day (within one hour) throughout the entire year.

During the June 1964 flood the thermograph installation at the Blankenship station was lost when the bridge washed away. This thermograph has not been replaced. Water samples were not collected two times (mid June - early July) because of inaccessibility to the station caused by the high water. Water information from Columbia Falls is incomplete due to the continual malfunction of the thermograph. Also, the accuracy of the readings obtained is questionable. Therefore the thermograph information from this station will not be referred to in this report. Water flow measurements at the Hungry Horse and Columbia Falls guaging stations were obtained from the U.S.G.S. records.

Water Temperatures. The daily maximum-minimum water temperatures recorded at the Blankenship Bridge, Hungry Horse and Holt Bridge stations are graphically shown in Appendix A and B. During the months of December, January and February 1963 water temperatures averaged about 32 degrees at the Blankenship Bridge station. Average temperatures at the Holt Bridge station for this period were 2 to 3 degrees warmer. About mid-February temperatures began to climb slowly reading an average of 40 degrees by late March and early April. By mid-August, temperatures reached their peak, 68 degrees at Holt Bridge and 63 degrees at the Blankenship Bridge station. From this point temperatures declined progressively, reading 40 degrees by early November. A greater range of daily temperature fluctuation was exhibited at the Blankenship Bridge station than at the Holt Bridge station.

Although data for 1964 is incomplete, temperature trends are believed to be similar. However, cool weather and late spring run-off kept water temperatures at an average of 2 to 3 degrees cooler during the summer months. A maximum temperature of 61 degrees was recorded in mid-August at the Holt Bridge.

Water temperatures at the Hungry Horse station are directly affected by water releases from Hungry Horse Dam. Water releases from the dam during the winter months tend to have a warming affect on water temperatures below; whereas summer water releases cool river water temperatures. Water releases for power are drawn from the reservoir at 285 and 325 feet below maximum pool elevation and year round temperatures are 39 degrees. In 1963 the maximum-minimum water temperatures over a 7½ month period (late October through May) showed a variation of only 4 degrees. With the exception of the months of November, March and brief periods in February, the continuous moderate to heavy water discharge from Hungry Horse Reservoir had a tempering effect on the river temperature.

Fluctuating water temperatures at Hungry Horse station in June and from late July through October were directly influenced by water releases from Hungry Horse Reservoir during peak power period of the day. Through this period, water temperatures varied from 1 to 18 degrees over a 24 hour period. The average maximum daily temperature fluctuation of 14.23 degrees occurred during the month of September. An example of water flows versus temperature over a two day period in September 1963 is shown in Figure 1.

Basically, the same general water flow-temperature pattern was evident during 1964 with possibly two exceptions. The heavy spring run-off increased water temperatures during the month of June, and water releases in the fall of the year began about a month earlier in mid-October and decreasing water temperatures to around 40 degrees.

At the crest of the June 9 flood, the maximum estimated flow was 140,000 cfs at the Columbia Falls station. Tremendous amounts of debris and silt were carried down the North Fork, Middle Fork and upper South Fork drainages. For the first time since the construction of Hungry Horse Dam water releases below the dam were running turbid. Turbid water releases from Hungry Horse Dam were evident for months later after the North and Middle Fork Rivers cleared. Flood waters carried tons of silt into Flathead Lake creating turbid conditions throughout the summer and fall.

The far reaching effects of the flood on aquatic life in the river and lake regions have not been determined. However, the heavy silt load carried into the lake could reduce the plankton and other aquatic life. The tributary streams, heavily scoured by the flood, may have had heavy losses of resident stream cutthroat.

Water Chemistry (1963-1964)

(pH) Over the two year period, the pH value ranged between 7.3 and 8.1 at the four stations. Readings at the Hungry Horse station generally averaged 0.2 to 0.3 below the other stations.

(Dissolved Oxygen). Dissolved oxygen readings at the four stations ranged from 9.1 to 14.2 during the two year sampling period. Dissolved oxygen concentration reached a peak in the late winter when cooler waters absorbed more free oxygen from the air. Oxygen readings recorded at the South Fork station were generally lower than at Flathead River stations. The samples taken from the Blankenship station were constantly highest in dissolved oxygen concentration.

(Alkalinity). Total alkalinity (0.00 ppm phenolphthalein) readings averaged between 80 and 85 ppm at the stations on the Flathead River. South Fork River (below dam) readings averaged somewhat less; about 70 ppm (range 55-75). Readings at the Flathead River stations ranged between 54 and 96 ppm. Total alkalinity values showed a general decline during the early summer months (April - mid-August).

(Standard Conductance). All water conductance readings were standardized to 77° F. Readings during September through mid-December could not be made due to power failure in the resistance meter. Conductance readings at the four stations ranged from 133 to 227. South Fork River (below dam) readings averaged 153 (range 135-179) whereas at the Blankenship Bridge station (control) they averaged 185. The readings at the other two stations

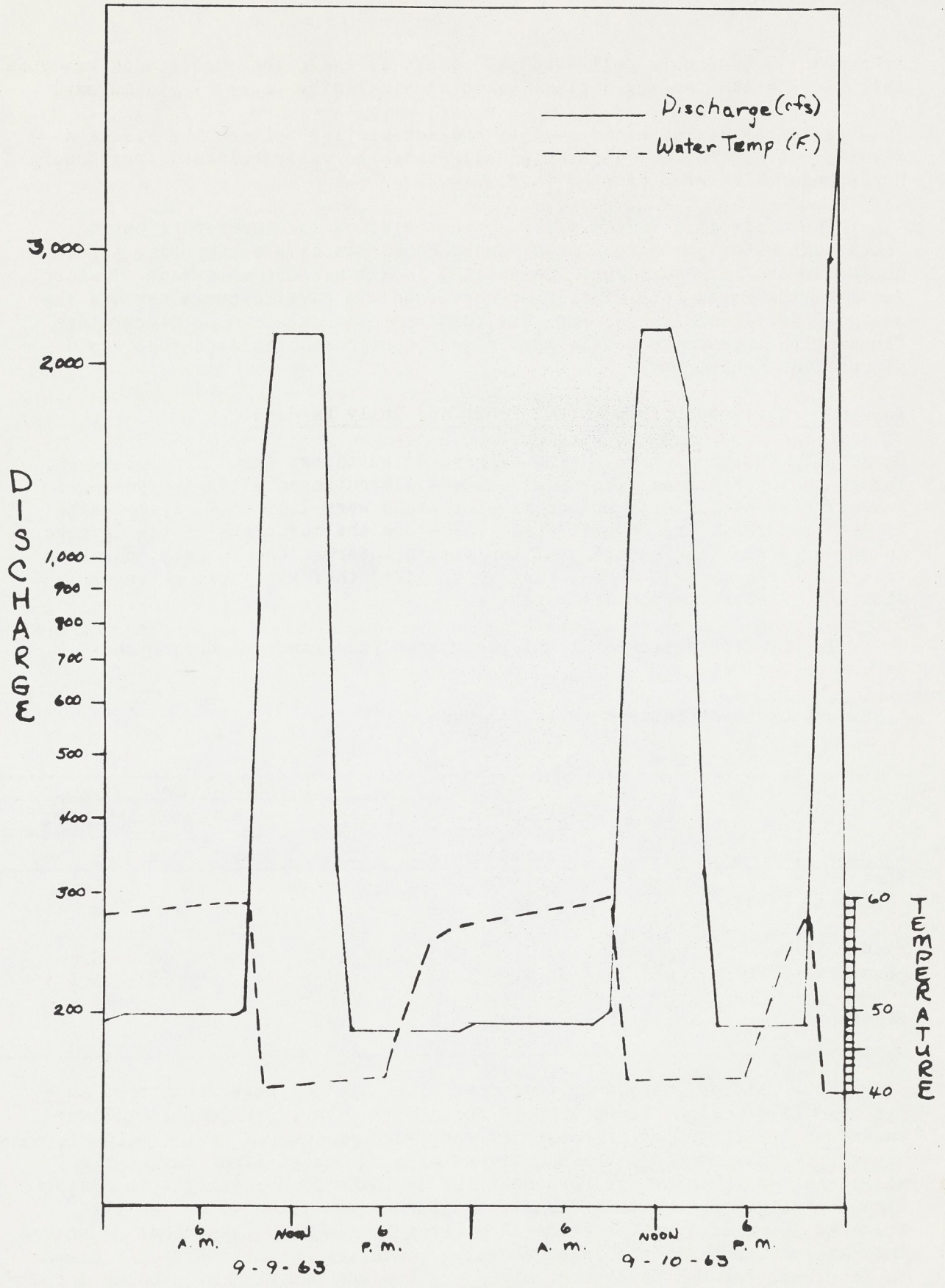


Figure 1. Hourly discharge (cfs) and water temperature (F.) on September 9th and 10th, 1963 recorded at U.S.G.S.guaging station below Hungry Horse Dam.

averaged 180 (Columbia Falls) and 178 (Holt Bridge). The conductance readings followed the same spring decline as total alkalinity (April - mid-August).

A comparison of water quality characteristics between the Flathead River (control station) at Blankenship Bridge to water released from Hungry Horse Reservoir are presented in Figure 2.

The monitoring of the water characteristics for the report period shows that water discharges from Hungry Horse Dam have a tempering effect on the lower Flathead River. Generally, in all measurements made of water quality, the South Fork discharges were found to have lower values and the seasonal variation (range) was less than the other stations. Temperature fluctuation appears to be the most significant characteristic that would affect fish habitation.

Tagging - Movements of Cutthroat Trout and Dolly Varden:

Wild cutthroat trout. The tagging of cutthroat trout and Dolly Varden in the Flathead River drainage was discontinued after two years of intensive work. Efforts on the tagging phase were limited to advertising for tag returns. The objective was to define the movements of the larger and older fish. The majority of tag return information, to date, has been from fish less than 10 inches (age group III+) that have been recaught within a 12 month period after tagging.

Twenty-five cutthroat trout recaptures were recorded during the report period.

A summary of these returns is as follows:

Tagging Area	No. of returns	Time tagging to recapture	MOVEMENTS				
			No. Up	Range (Miles)	No. Down	Range (Miles)	None Time Lapse (Mo.)
North Fork, Flathead River	10	2-24 mos.	1	23	8	2-102	1-(11)
Middle Fork, Flathead River	7	8-23 mos.	3	2-12	3	68-86	1-(23)
Flathead River	8	4-16 mos.	2	10-27	5	12-75	1-(10)

Four returns, tagged in the upper river system, were recaptured in Flathead Lake. Eight recaptures (5 North Fork River; 3 Middle Fork River), tagged in the two major tributary streams, were recaptured in the main Flathead River. The maximum downstream movement of a cutthroat trout has been 102 miles (tagged in the North Fork near the Canadian border, caught in Flathead Lake). Another interesting downstream journey was taken by a fish that traveled 35 miles down the Flathead River into Flathead Lake, then journeyed the maximum length of the lake, 28 miles, down the Flathead River, 3 miles to Kerr Dam, through this power structure and was caught ½ mile below the dam, for a total of 67 miles.

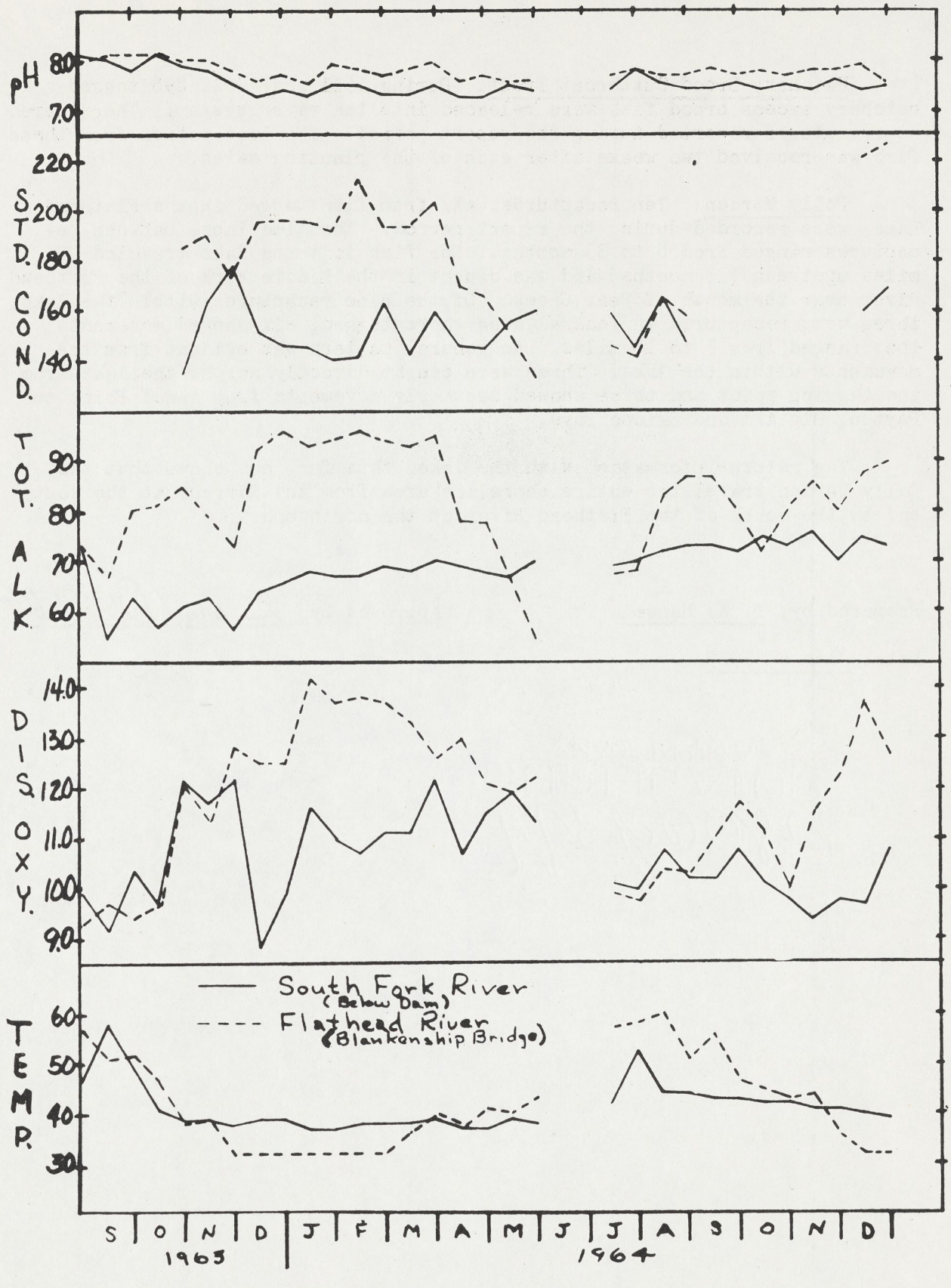


Figure 2. Comparison of water characteristics during 1963-1964 of Flathead River (Blankenship Bridge) to water releases from Hungry Horse Reservoir.

Hatchery Brood Cutthroat Trout: During 1961 and 1962, 898 tagged hatchery excess brood fish were released into the river system. There were no recaptures reported during the report period. The last return from these fish was received two weeks after each of the planting dates.

Dolly Varden: Ten recaptures, all from fish tagged in the Flathead Lake, were recorded during the report period. The time lapse between recaptures ranged from 8 to 33 months. One fish left the lake traveled 99 miles upstream (13 months) and was caught in the Middle Fork of the Flathead River near the mouth of Bear Creek. Of the nine recaptures within the lake, three were recaptured in general area where tagged, six showed movements that ranged from 3 to 18 miles. No general pattern was evident from the movements within the lake. Three were caught directly across the lake from the tagging point and three showed southerly movements from Angel Point to Dayton, Big Arm and Skidoo Bays.

Tag return information with the lake, thus far, has shown that the Dolly Varden travel the entire shoreline area from the Narrows at the south end to the mouth of the Flathead River at the north end.

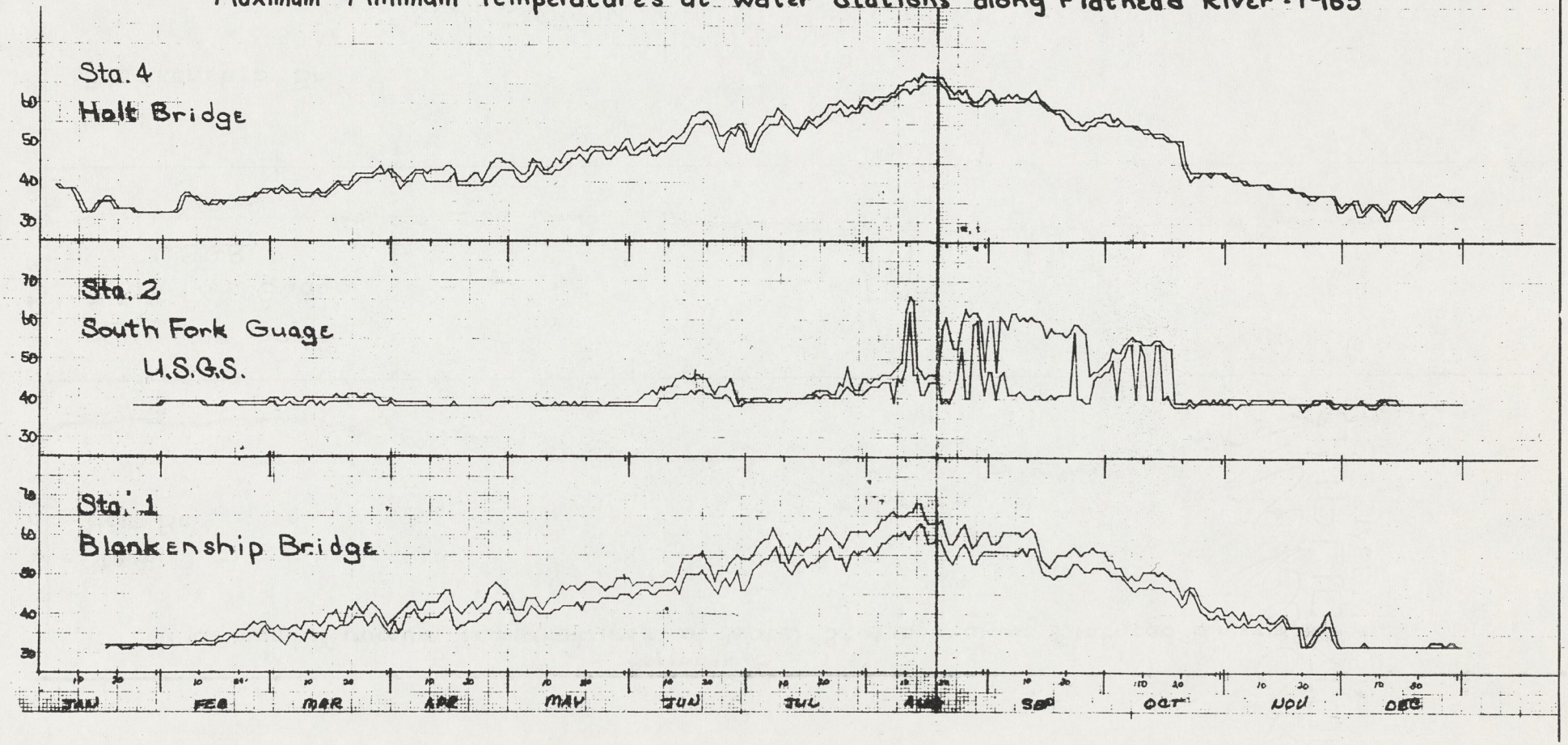
Prepared by: D. A. Hanzel

Approved by: George D. Holton

Date: June 9, 1965

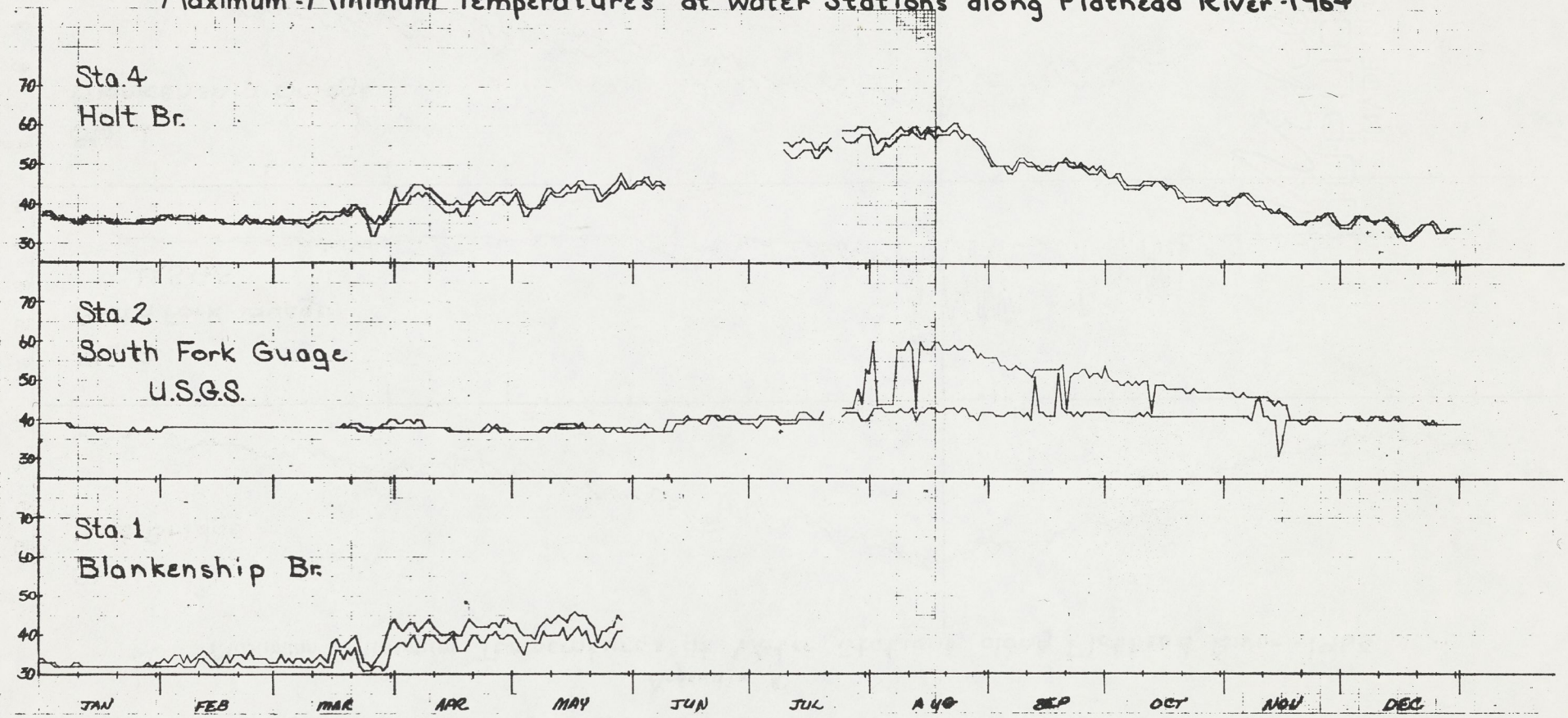
Appendix A'

Maximum - Minimum Temperatures at Water Stations along Flathead River - 1963



Appendix B

Maximum - Minimum Temperatures at Water Stations along Flathead River - 1964



MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

JOB COMPLETION REPORT
RESEARCH PROJECT SEGMENT

State of Montana

Project No. F-7-R-12 Name Northwest Montana Fishery Study

Job No. III Title Survey of Cutthroat and Dolly Varden Trout in Flathead River and Tributaries Above Flathead Lake

Period Covered: July 1, 1962 - June 30, 1963

Abstract: A crew of four men was employed to capture, tag and release Dolly Varden and cutthroat trout in the 171 miles of the Flathead River Drainage above Flathead Lake. Catch rate for tagged fish was 1.6 fish per hour per man (including float time). The average size of the cutthroat trout tagged averaged 9.0 inches, with a range from 7 to 16.5 inches. A total of 1,676 wild cutthroat trout and 297 Dolly Varden were tagged and released in the river system in 1961 and 1962.

Recapture information was received on 183 (10.9 percent) wild cutthroat trout, and 33 (11.1 percent) Dolly Varden. Planting tagged brood cutthroat trout in the Middle Fork of Flathead River yielded a 21.1% (103 of 487 fish tagged) return to anglers. Eighty percent of these fish were caught within three days after being planted. No fish were caught after two weeks.

Movement patterns were indicated, however, another summer's field work is necessary before the complete movements of the cutthroat trout in the Flathead River Drainage can be determined. Another summer's work would provide additional information on recaptures of tagged fish. Also information pertaining to water discharges and temperatures could be correlated to the movement patterns established.

Recommendations: It is recommended that the movement phase of the cutthroat trout and Dolly Varden in the Flathead River system be continued. This would result in more recaptures and facilitate correlation of water discharges and temperatures with fish movements.

Techniques Used: The collection of cutthroat trout in the Flathead River system above Flathead Lake has been a problem in the investigations of this species. Since 1950, conventional methods of capturing fish failed to achieve the desired number of cutthroat trout; the sampling procedure used in 1961 and 1962 provided more cutthroat than collected by other means. In these years four men floated, angled and tagged fish in the 171 miles of river system above Flathead Lake. Fish were tagged in the major tributaries as well as the main North and Middle Fork Rivers. Pack animals furnished the transportation in the areas inaccessible by vehicles.

All cutthroat trout and Dolly Varden collected that were over 7 inches (total length) were tagged with a plastic band around the mandible. Tricaine methanesulphonate (MS_{222}) was used as an anesthetic. The tagging information was recorded on a master tagging form and on individual (5" x 8") punch cards. Locations were designated by river section; tagging sections were approximately 2 miles long. Flathead Lake was divided into 12 tagging areas.

Findings:

Fish collection and tagging: The float crew made 33 individual trips on the rivers during the months of July, August and September 1962. These trips covered a sampling and tagging area of 171 river miles. Fourteen trips were made on the North Fork of the Flathead River, eight trips on the Middle Fork and eleven trips on the main Flathead River. Trip time ranged from 2 to 10 hours. The crew caught an average of 2.05 fish per hour per man (including float time) and tagged 1.61 fish per hour per man. A total of 1,329 cutthroat trout and Dolly Varden were caught, of which 78.5 percent were taggable (over 7 inches total length). The 1961 catch was 2.8 fish per hour per man and 1.8 tagged fish per hour. Fifty four percent of the trout collected were taggable size. Although angling technique was aimed toward cutthroat and Dolly Varden, other species were collected and released. These included mountain whitefish, kokanee, brook and rainbow trout.

The average size of cutthroat trout collected in the rivers were as follows:

	North Fork	Middle Fork	Flathead River
1961	8.4"	9.6"	8.8"
1962	8.5"	9.7"	9.8"

The average size of all cutthroat tagged in 1962 was 9.0 inches (same as in 1961) with a range from 7.0 to 16.5 inches.

In addition to the wild fishes tagged in the Flathead River system, in 1962, 487 hatchery brood west slope c utthroat trout were tagged and released at three locations on the Middle Fork of the Flathead River. The fish were four and five year old brood fish which ranged in size from 12 to 14 inches.

Total tagged fish in the river and lake system (including those tagged by sportsmen) are as follows:

	Year	Ct.	DV	Others[1]	Total
North Fork	1961	411	18	0	429
	1962	595	6	5	606
Middle Fork	1961	239	3	1	243
	1962	157(487)[2]	12	2	171 (487)
Flathead River	1961	94(216)	12	2	108 (216)
	1962	148	17	45	210
Flathead Lake	1961	20(195)	183	8	211 (195)
	1962	5	45	1	51
Swan River	1961	5	1	12	18
	1962	2	0	4	6
	1961	769	217	23	1,009 (411)
	1962	907	80	57	1,044 (487)
Grand Total		1,676	297	80	2,053 (898)
					2,951

[1] Rainbow, rainbow x cutthroat hybrids, brook trout and lake trout

[2] Figures in parentheses are cutthroat trout brood fish from the Libby Station, which were tagged and released

Returns:

Wild Cutthroat Trout: Tag return information depended on voluntary fisherman returns, catch data from the float crew, and creel checks made by wardens and personnel of the Fish and Wildlife Service operating on Flathead Lake. Newspaper articles and posters advertized and explained the tagging program to local sportsmen. In order to present a complete picture of fish movement in the river system, all tag returns received since the start of the tagging program in 1957, (Completion Reports, Job III F-7-R-10 and 11) are included in the present report.

One hundred and eighty three recaptures (10.9 percent of 1,676 tagged wild cutthroat trout in the Flathead River drainage) have been recorded. The breakdown of the tag recaptures are as follows:

	Available Tags	Tag Returns	Percent Return	Movement: Down Stream	Movement: Up Stream	Movement: Same Area
North Fork	1,006	94	9.4	62	11	21
Middle Fork	396	59	14.9	25	7	27
Flathead River	242	26	10.7	15	7	4
Flathead Lake	25	2	8.0	(Recaptured in lake)		
Swan River*	7	2	28.6	1	0	1
	1,676	183	10.9	103	25	53

*At the Swan River diversion dam

Seventy-six (73.7 percent) of the recaptured fish that showed downstream movement had traveled over 10 miles, whereas five (20.0 percent) of 25 upstream movements were over 10 miles. The up and downstream movements were as follows:

	Movements in Miles			
	Up 10	11-30	31-50	50-96
Downstream Movement	26	28	22	26
Upstream Movement	20	4	0	1

The time lapse between recaptures has ranged between 1 day and 25 months. After 25 months some fish were recaptured in the area where they were tagged and still other fish show movements of 40 miles downstream in less than one week. A breakdown of the recaptures as to length of time after tagging is as follows.

	Number of tagged fish recaptured		
	Caught the same year of tagging	Caught one year after tagging	Caught two years after tagging
North Fork	65	26	3
Middle Fork	41	16	2
Flathead River, Lake and Swan	20	10	0
	126	52	5

Total - 183

Hatchery Brood Cutthroat Trout:

Brood fish (excess) were separated and held in the Libby Rearing Station until all spawning activities were completed. A total of 489 fish were tagged and retained in the hatchery ponds for one week to observe delayed mortalities. Two fish died of undetermined causes during this waiting period. All the fish planted were males and three to four years old. They were transplanted into waters of the Middle Fork of the Flathead River on August 17th. The three areas of liberation (West Glacier, Nyack Flat and Walton Ranger Station) are all areas of fishermen concentration and are accessible by road. One hundred and three (21.1 percent) were taken by anglers. Eighty percent of the recaptures were caught within three days after liberation. No fish were reported recaptured after two weeks. Little movement either up or down stream was indicated from the recaptures - 83 percent were caught within 2 miles of the release points. Although the fish planted in the Middle Fork River were liberated close to Glacier National Park, where there are concentrations of non-resident fishermen, 59 percent of the recaptures were caught by Montana residents. A summary of the release

and recovery of hatchery brood fish in 1961 and 1962 is as follows:

	Total Released	Tags Recaptured	Percent Return	Mortality Observed*
1961	411	13	3.0	5
1962	487	103	20.5	3

*Mortalities observed after planting

Dolly Varden:

Although the emphasis of the tagging project was placed on the cutthroat trout, Dolly Varden were tagged when collected on the float trips. Also a special effort was made to capture and tag Dolly Varden during their spring concentrations in the lake. Eighty Dolly Varden were tagged during this report period and 25 were recaptured. Summarization of the Dolly Varden tagged and recaptured in the Flathead Drainage is as follows:

	Total Tagged	Recaptured
1961-2	217	8
1962-3	80	25
	297	33

Although Dolly Varden were tagged in both the river and lake, all recaptures were fish that were tagged in the lake. Two tagging projects were conducted on the Flathead River system prior to 1961. In 1953 and 1954 [1], a two-way weir was placed on the North Fork of the Flathead River at Trail Creek (105 miles above Flathead Lake); in 1957 [2], a two-way weir was placed at Bear Creek on the Middle Fork of the Flathead River (99 miles above Flathead Lake). A summary of these studies was as follows:

	Total Tagged	Total Returns	Percent Return
1953-54	198	29	14.7
1957	213	14	6.6
	411	43	

In all studies to date, movements have been recorded on 76 Dolly Varden. This is a 10.7 percent return of the fish tagged. In 1962-63,

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[1] Block, Daniel G. 1955. Trout migration and spawning studies on the North Drainage of the Flathead River. Unpublished thesis, University of Montana.

[2] Johnson, Howard E. 1957. Survey of cutthroat trout fishery in the Flathead River and tributaries above Flathead Lake. Job Completion Report Fed. Aid in Fish Restoration Project Montana F-7-R-7, Job IV: pp multilithed.

9 of 33 returns left Flathead Lake and were recaptured upstream (maximum movement 120 miles). In 1952-54, 15 of 29 returns were caught in Flathead Lake (maximum downstream movement of 122 miles); in 1957, 4 of 14 returns were recaught at the lake (maximum downstream movement 110 miles).

Prepared by Delano A. Hanzel Approved by George D. Holton

Date October 15, 1963

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-7-R-11 Name Northwest Montana Fishery Study

Job No. III Title Survey of Cutthroat and Dolly Varden Trout in Flathead River and Tributaries Above Flathead Lake.

Period Covered: May 1, 1961 - June 30, 1962

Abstract: A crew of four men was employed to capture, tag and release Dolly Varden and cutthroat trout in the 171 miles of the Flathead River Drainage above Flathead Lake. Catch rate for tagged fish was 1.8 fish per hour per man (including float time). The average size of the cutthroat trout tagged averaged 9.0 inches, with a range from 7 to 17 inches. A total of 1,175 cutthroat and 216 Dolly Varden have been tagged and released in the river system.

Recapture information was received on 62 (8.5 percent) wild cutthroat trout. Recapture information was also received on 13 hatchery brood cutthroat trout and 8 Dolly Varden trout. Seventy-five percent of the recapture information was returned by interested fishermen through letters, by phone or personal contact.

Movement patterns were indicated; however, another summer's project is necessary before the complete movements of the cutthroat trout in the Flathead River Drainage can be formulated.

Objectives: The objectives of this investigation are to determine the extent, time and distance which the cutthroat and Dolly Varden trout travel in the Flathead lake and river system, and to develop management measures so that a future fishery can be assured in this area. Incidental objectives would be to obtain additional life history data and information on other species present. This would aid in assessing fish production in these waters and the recruitment of native fishes of the Flathead River system.

Techniques Used: The collection of cutthroat trout in the Flathead River system above Flathead Lake has been a problem to the investigations of this species. Since 1950, studies have employed methods which range from fish weirs to electro-fishing with a 1,000 volt A.C. generator. Positive results were not obtained. High water, moving debris and low conductivity of the water were the main deterring factors. Pirate traps ($\frac{1}{2}$ & $\frac{1}{4}$ inch mesh) have been fished without success for taggable species in the lake where angler catch has shown the presence of cutthroat trout and Dolly Varden.

Since other methods had not given desired results, a crew of four men was organized in 1961 and again in 1962 to float, angle, and tag fish in the 171 miles of river system (76 miles-Middle Fork, 53 miles-North Fork, and 42 miles-Flathead River) above Flathead Lake. Fish were also tagged in the major tributaries on the North and Middle Fork Rivers. Pack animals furnished the transportation in the areas inaccessible by vehicles. In addition to the float crew, series of gill nets were fished (July-August, 1961; April-May, 1962) in

the northern area of Flathead Lake. Depths of net sets ranged from 6 to 170 feet. The crews tagged all cutthroat trout and Dolly Varden collected that were over seven inches (total length) with plastic band around the mandible. Tricaine methanesulphonate (MS_{222}) was used as an anesthetic. The tagging information was recorded on a master tagging form and on individual (5" x 8") punch cards. Tagging designations were taken from the sectionized rivers (approximately 2 miles per section). Flathead Lake was divided into 12 tagging areas.

Findings:

Fish collection and tagging: The float crew made 37 individual trips on the river during the months of July, August and September. These trips covered a sampling and tagging area of 171 river miles. Fifteen trips were made on the North Fork of the Flathead River, eleven trips each on the Middle Fork and the main Flathead River. Trip time ranged from 2 to 10 hours. The crew caught an average of 2.8 fish per hour per man (including float time) and tagged 1.8 fish per hour per man. The crew collected 1,045 fish, of which 54% were taggable (over seven inches total length). Although angling procedure was aimed toward cutthroat and Dolly Varden, other species were collected and released. This included mountain whitefish, grayling, brook and rainbow trout.

The average size of cutthroat trout collected in the rivers are as follows:

North Fork	Middle Fork	Flathead River
8.4"	9.6"	8.8"

The grand average size of all cutthroat tagged was 9.0 inches with a range from 7-17 inches.

Spring sampling during April and May in the main Flathead River and Flathead Lake employed gill net sets, pirate trap operation and angling. Angling in the lake was incidental to tending the nets and was in the vicinity of the sets, but was found to be the most effective method of collecting and tagging cutthroat and Dolly Varden trout. Gill nets were fished for 238 hours, the pirate trap operated for 590 hours and total angler time was 282 hours. Taggable fish for each method were as follows:

	*DV	CT	Rb	Lt	Total
Gill nets	23	4	1	0	28
Pirate trap	9	0	0	0	9
Angling	142	24	6	2	174

*DV-Dolly Varden, CT-Cutthroat, Rb-rainbow, Lt-Lake trout

In addition to the tagging of wild fishes in the Flathead River system, 411 hatchery brood west slope cutthroat trout were tagged and released (216 in Flathead River and 195 in Flathead Lake). The fish were four and five year old brood fish which ranged in size from 12 to 14 inches.

Total tagged fish in the river and lake system (including those tagged by sportsmen) are as follows:

	Ct	DV	*Others	Total
Middle Fork	239	3	1	243
North Fork	411	18	0	429
Flathead River	310	12	2	324
Flathead Lake	215	183	8	406
Total	1,175	216	11	1,402

*Rainbow, rainbow X cutthroat hybrids, brook trout, lake trout

Returns

Wild cutthroat trout: Tag return information was dependent on voluntary fishermen returns, catch data from the float crew, and creel checks made by wardens and personnel of the Fish and Wildlife Service operating on Flathead Lake. Newspaper articles and posters advertized and explained the tagging program to local sportsmen. In order to present a complete picture of fish movements in the river system, 12 returns described by Johnson, 1961* were included.

Sixty-three recaptures (8.5 percent) of 744 tagged wild cutthroat trout in the Flathead River drainage have been recorded. Three-fourths of the recaptures were returned by interested fishermen, through letters, by phone or personal contact.

In the North Fork of the Flathead River, 28 returns were received from the 411 available tagged fish or 6.8 percent return. Thirteen of the returns were retaken in the same general area, from 0 to 3 miles up or down from the point of tagging. The time lapse between tagging and recapture ranged from 1 day to 25 months. Six were retaken between 1 and 4 days, the remaining between 1 and 25 months. The cutthroat retaken after 25 months was captured both times in Hay Creek and both times was assumed to be spawning, based on its size (15.5 inches when tagged). This particular stream was checked periodically during the spring and summer seasons the following year and no fish of spawning size was either collected or observed.

Two recaptures showed upstream movements. One fish moved from the North Fork River to a lake on a tributary stream (11 miles up river and 6 miles up the tributary to the lake) in a period of 12 months. The other fish traveled 10 miles upstream in $9\frac{1}{2}$ months.

Downstream movements were recorded on thirteen cutthroat trout in the North Fork River.

*Johnson, Howard, 1961. Observations on the life history and movement of cutthroat trout (Salmo clarki) in Flathead River drainage, Montana. Comp. Report Job III, Project F-7-R-10. pp 17-18.

Their movement and time were as follows:

Miles	No. of Fish	Movement in Miles/Time between Captures
4 - 10	4	4/12days, 6/10mo., 9/½mo., 10/11mo.
11 - 20	5	12/½mo., 12/7days, 14/1mo.,17/9mo.,19/1½mo.
21 - 50	3	29/½mo., 40/6 days, 40/10mo.
51 - 70	1	54/17 days

Four of the above fish (movements of 19-54 miles) moved from the North Fork River into the Flathead River; two fish moved downstream (10 & 17 miles) from a tributary stream into the North Fork River. Individual movements of the fish are plotted on Figure 1.

In the Middle Fork of the Flathead River, 28 returns were received from the 239 available tagged cutthroat trout. This is a 11.7 percent return. Sixteen of the returns were recaptured in the same general area, from 0 - 1/4 mile up or down from the tagging point. Ten of these fish were recaught from 1 - 5 days after being tagged; the remainder were taken after a time lapse from 19 days to 11 months. Fish showing no movements between tagging and recapture were represented by both river and tributary tagged fish.

One fish showed an upstream movement of 6 miles in 5 days.

Downstream movements were shown by 10 recaptures in the Middle Fork River. Their movements and time were as follows:

Miles	No. of Fish	Movement in Miles/Time between Captures
2 - 10	2	2/24 days, 6/5 days
11 - 20	2	12/9 mo., 18/13½ mo.
21 - 50	5	25/1mo., 39/5days, 40/11½mo.,44/1½mo.,47/1½mo.
51 - 70	2	66/1½mo., 67/1 mo.

Three of the above fish (movements of 39, 66, and 67 miles downstream) moved from the Middle Fork River into the Flathead River; one fish moved 18 miles downstream from a tributary stream into the Middle Fork River.

In the Flathead River, 6 returns were received from the 94 available tagged fish. This is a 6.4 percent return. Two of the returns were captured in the same general area (½ mile up or down from the tagging point) after a time lapse of one and nine months.

One fish showed upstream movement of 3 miles in 1 month's time.

Downstream movements were shown by 3 recaptures in the Flathead River. Their movements and time were as follows:

Miles	No. of Fish	Movement in Miles/Time between Captures
0 - 10	1	10/18 days
11 - 20	0	
21 - 50	1	40/8 mo.
51 - 70	1	55/12 mo.

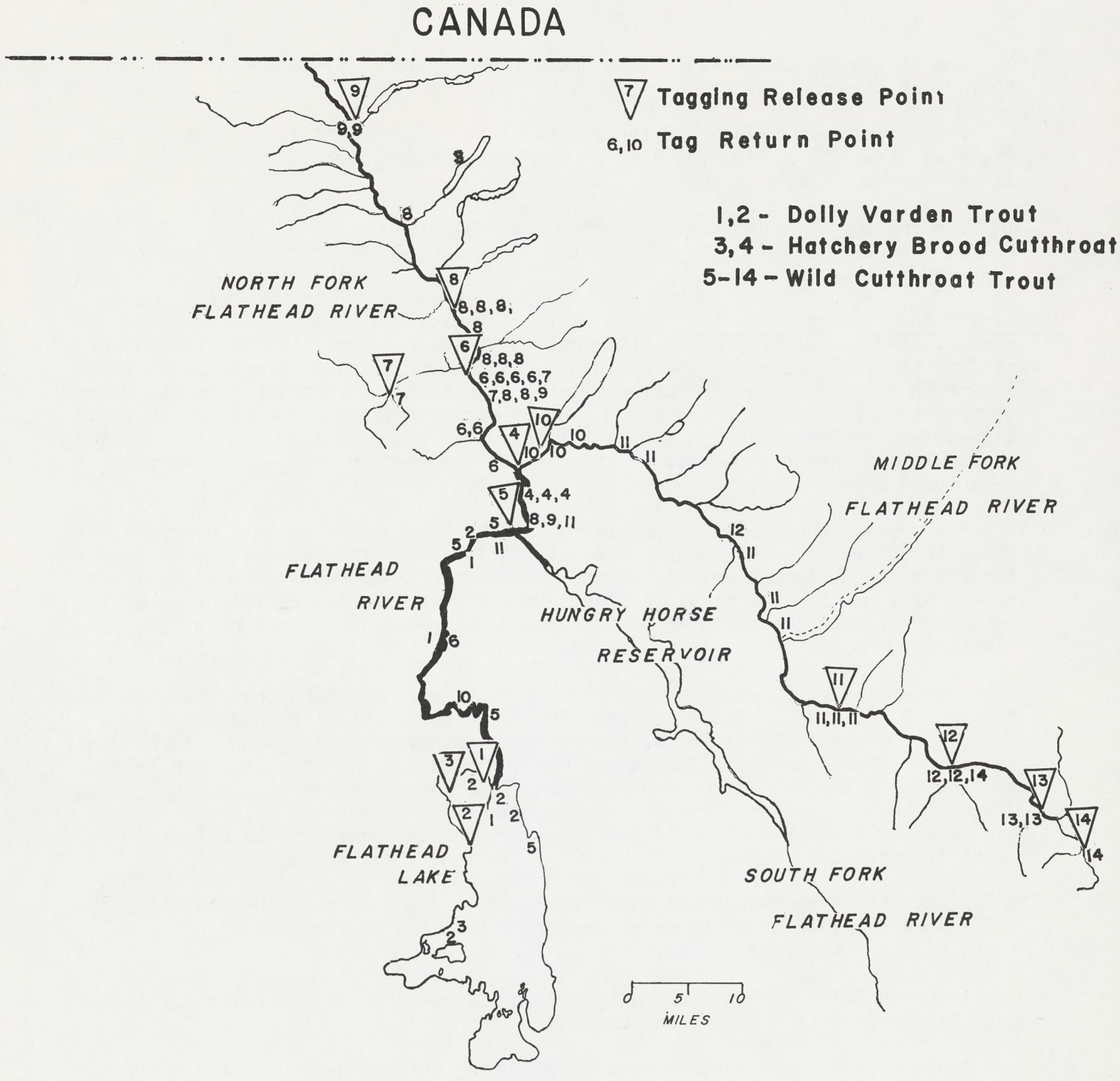

Figure 1. Graphical movements of cutthroat and Dolly Varden trout in the Flathead River system and Flathead Lake.

One of the above fish (55 miles downstream) traveled from the mouth of the South Fork River to the Woods Bay area in Flathead Lake (Figure 1).

One recapture was recorded from 20 available tagged cutthroat trout in Flathead Lake. This fish traveled in the lake 2 miles north of the tagging point in one month.

One tagged cutthroat trout was found dead after 46 days, 35 miles below the release point. This fish moved from the North Fork River downstream into the Flathead River.

Hatchery Brood Cutthroat Trout: These particular brood fish were all males and were planted immediately after being culled at the hatchery. It was the intent of this early plant in June to avoid the skinned and scuffed up appearance which occurs in spawning males in hatchery troughs. At this particular time the waters of the river were still being influenced by spring rains and run-off which could have affected the survival and catch of the river planted fish. Thirteen of the available 411 tagged fish were recaptured for 3 percent return. Five of these were found dead.

Seven tags from the 216 fish planted in the Flathead River were returned. Three of the returns were found dead. Two of the dead fish were found 10 days later 2 miles below the release point, the other 8 miles downstream after a period of 1 month. The remaining four returns were reported by fishermen and were all taken in the vicinity of 1/4 mile downstream within four days after planting.

Six returns were reported from the 195 fish released in Hatchery Bay, Flathead Lake. Two of these returns were found dead. Both of these fish were found in the general vicinity of the planting point. One was found 7 days later, the other after 2 months. The latter was quite unique, in that only the lower mandible with the tag intact was recovered from the bottom of the bay by a SCUBA diver. Three of the four returns by fishermen were caught the following day in the planting area, the other 12 months later 20 miles south of the release point (Figure 1.).

Dolly Varden: Eight recaptures of Dolly Varden were reported from the available 216 tagged fish. Four of these returns were from the 32 fish tagged prior to the spring tagging (April, May, June 1962).

Although Dolly Varden were collected and tagged in both the river and lake, only lake tagged fish have been recaught.

Seven of the eight returns were taken during the months of May and early June, the other fish was caught in early September.

Movement within the lake were recorded on five fish; their movements were as follows:

Time between Recaptures	(Miles) Distance-Direction/Movement
2 days	8E/West shore to east shore
3 days	12S/West shore
6 months	3E/North shore to river mouth
10½ months	5NE/West shore to north shore
12 months	5 NE/West shore to river mouth

Lake to river movements were recorded on three fish; their movements were as follows:

Time between Recaptures	Distances Upstream
19 days	50 miles
1½ months	46 miles
2½ months	30 miles

No dead tagged Dolly Varden have been reported.

Recommendations:

It is recommended that the movement phase of the cutthroat trout and Dolly Varden in the Flathead River system be continued. Through the recent tagging efforts, general locations and productive fishing times were established. With this information next year's project will permit greater emphasis on fish tagging. Another summer's activities is required before the final formulation of fish movements and new management procedures can be applied in the Flathead River system.

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Approved by George D Holton

Date October 1, 1962