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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

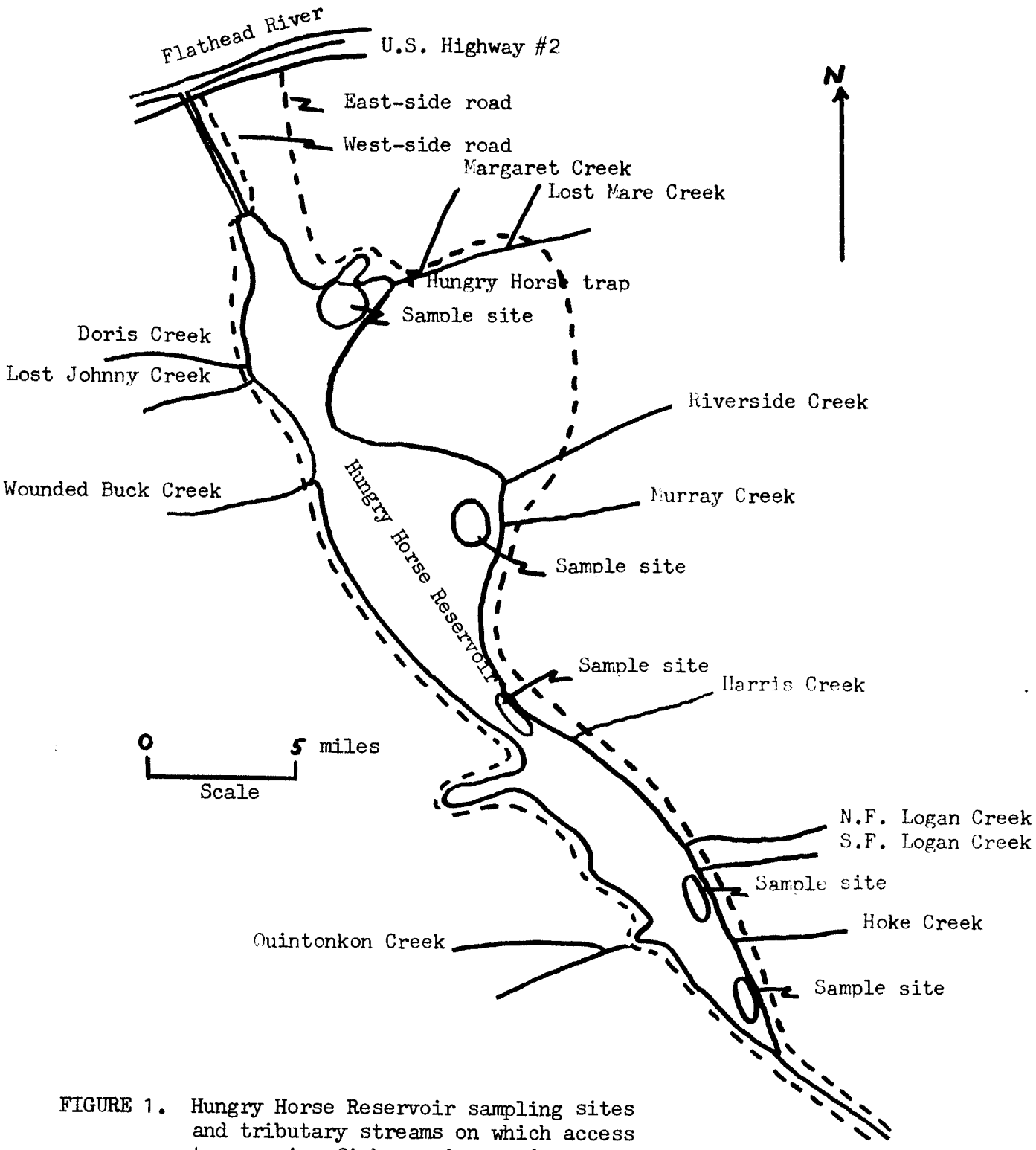

FIGURE 1. Hungry Horse Reservoir sampling sites and tributary streams on which access to spawning fish was improved.

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.

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Waters referred to: 1-08886005, 1-08358001, 1-08566001, 1-08792001, 1-08436001, 1-08230001, 1-08450001, 1-08432010, 1-08586001, 1-08498001, 1-08326001, 1-08426001, 1-08348010