FISHERIES DIVISION
MONTANA FISH AND GAME DEPARTMENT
PROGRESS REPORT
HUNGRY HORSE RESERVOIR RESEARCH AND MANAGEMENT; PROJECT 29-E-2

INVESTIGATIONS OF THE HUNGRY HORSE RESERVOIR FISHERY, JULY 1960-JUNE 1962

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December 1962

Hungry Horse Reservoir is an artificial lake created by the impoundment of the South Fork of the Flathead River. The reservoir was completed in 1952. The dam is located five miles upstream of the confluence of the South Fork and the main Flathead River, near the town of Hungry Horse, Montana. It is 564 feet high and creates a lake 34 miles long, capable of storing 3,500,000 acre feet of water, covering 22,500 surface acres when full. Maximum depth of this lake is about 500 feet. Water uses include electrical power production and maintenance of water levels in downstream hydroelectrical power impoundments.

Prior to the completion of this reservoir in 1952, the South Fork of the Flathead River provided for good cutthroat trout (Salmo clarki), Dolly Varden (Salvelinus malma), and kokanee (Oncorhynchus nerka) spawning runs from Flathead Lake. The dam structure has eliminated these runs from Flathead Lake the use of the South Fork drainage above the dam. Also, prior to impoundment, the portion of the South Fork which was inundated provided a good stream fishery for mountain whitefish (Prosopium williamsoni), cutthroat trout, and Dolly Varden.

Management efforts for this reservoir have been limited. Grayling (Thymallus arcticus) have been planted periodically since 1953. From 1953 to 1956, 5,728,000 grayling fry were planted. From 1957 to 1960, 362,310 grayling fry were planted. The latter plants were made only when the Montana hatchery system had excess grayling available. Fishing regulations have been used to protect spawning runs of cutthroat trout and to insure that the Dolly Varden were not harvested before reaching sexual maturity.

Investigations of Lake: Investigation of the fishery of Hungry Horse Reservoir has been conducted on the following items:

1. Fish population sampling
2. Angler success
3. Age and growth of various fish species
4. Length of Dolly Varden at sexual maturity
5. Survey of tributary streams to determine use by spawning cutthroat trout

POPULATION SAMPLING

The fish population of Hungry Horse Reservoir was sampled by gill netting in June and October, 1958, June and September, 1959, July 1960, and in May, July, and November, 1961. The report, A Preliminary Fishery Survey of Hungry Horse Reservoir, by John J. Gaffney covers the data collected in 1958. Certain data from Gaffney's report will be integrated into this report.

The fish population of this reservoir was sampled using nylon or monofilament, graduated gill nets. These nets were 125 feet long, 6 feet deep, and had five 25-foot long sections with mesh sizes of 3/4", 1", 1-1/4", 1-1/2" and 2" bar measure. The nets were set overnight in water from 6 feet to 120 feet deep. Almost all of the nets were set perpendicular to the shoreline, with one end within ten feet of the shoreline. All of the net sets were bottom sets.

Four sampling stations were used during the netting of 1958 through 1960. Four and five sampling sites were used in 1961. These stations are shown in Figure 1. The drawdown of the lake during the spring netting of 1961 made the Devils Corkscrew station the same as the Inlet Station. The Canyon Creek station was not sampled in October, 1958 because of bad roads. Only a small number of sets were made in 1959 and all these were at one station. The number of sets made at each station, by date, is given in Table 1.

Table 1. Number of overnight gill net sets by station, Hungry Horse Reservoir, 1958-1961

Date	Emery Cr.	Riverside Cr.	Canyon Cr.	Devils Corkscrew	Inlet
June, 1958	8	6	5	-	5
October, 1958	5	5	-	-	5
June, 1959	-	4	-	-	-
September, 1959	-	-	-	-	2
July, 1960	5	4	6	-	-
May, 1961	8	9	8	6	-
July, 1961	8	7	7	6	3
November, 1961	8	8	8	8	9

The non-uniformity in the number of net sets at each sampling and in the time of year precludes any sound comparison of year-to-year data. However, some indices of population trends, movements, and relative abundance may be obtained from an analysis of the data. The analysis will include information on the following fish: cutthroat trout, Dolly Varden, mountain whitefish; suckers, both longnose (Catastomus catastomus) and large scale (C. macrocheilus); and squawfish (Ptychocheilus oregonsis). One kokanee was taken in the 1959 netting; no furhter mention of this species will be made.

The numbers of fish taken per overnight net set, by sampling time, and station is given in Table 2.

The data given in Table 2 shows a marked decline in the average catch per net-night of all species combined at all stations except the Inlet. The Devil's Corkscrew station was first sampled in 1961 so no comparisons between years can be made.

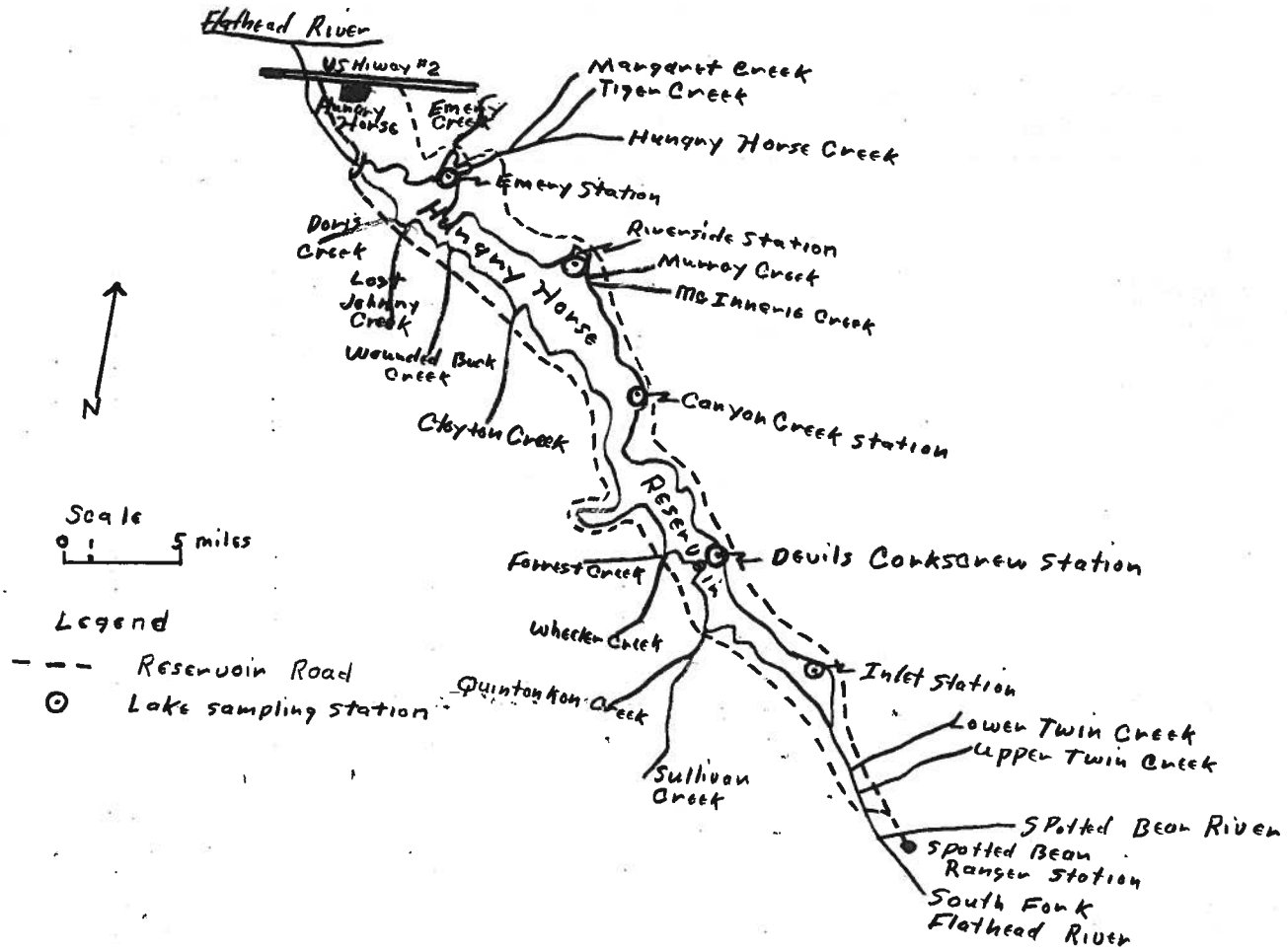

Figure 1. Map of Hungry Horse Reservoir

Table 2. Average catch per net night, 1958-1961, Hungry Horse Reservoir

Sampling Time	No. Net Sets	Dolly Varden	Cut-throat	White-fish	Suckers	Squaw-fish	Total
Station 1 - Emery Creek							
June, 1958	8	7.0	1.2	6.7	29.5	5.4	49.8
October, 1958	5	7.4	0.4	19.6	7.2	8.2	42.8
July, 1960	5	4.4	0.2	5.0	43.8	8.2	61.6
May, 1961	8	3.5	0.5	5.9	18.0	1.6	29.5
July, 1961	8	1.1	0.1	3.9	15.0	12.7	32.8
November, 1961	8	5.0	0.3	10.1	2.0	5.0	22.4
Station 2 - Riverside Creek							
June, 1958	6	8.3	0.3	7.7	30.7	0.3	47.3
October, 1958	4	5.8	1.2	12.4	5.8	1.2	26.4
June, 1959	4	7.0	1.0	7.5	22.5	9.5	47.5
July, 1960	4	7.5	0.3	7.5	24.0	4.2	43.5
May, 1961	9	3.2	0.6	5.6	8.7	0.6	18.7
July, 1961	7	0.6	0.3	4.1	10.6	9.6	25.2
November, 1961	8	2.9	0.8	6.9	1.5	0.6	12.7
Station 3 - Canyon Creek							
June, 1958	5	5.6	0.4	9.4	30.4	1.0	46.8
July, 1960	6	7.8	0.3	4.7	43.8	3.0	59.6
May, 1961	8	5.2	0.6	4.1	24.6	2.1	36.6
July, 1961	7	0.0	0.1	1.1	8.7	6.0	15.9
November, 1961	8	3.0	0.3	7.4	2.1	1.6	14.4
Station 4 - Devils Corkscrew							
May, 1961	6	4.8	0.5	8.1	23.3	2.0	38.7
July, 1961	6	0.3	0.0	1.3	7.7	8.0	17.3
November, 1961	8	4.6	1.3	13.1	1.6	3.3	23.9
Station 5 - Inlet							
June, 1958	5	10.2	1.6	4.2	24.4	0.4	30.8
October, 1958	5	7.4	5.8	11.8	1.6	1.0	27.6
September, 1959	2	7.5	5.0	13.5	4.5	2.5	33.0
July, 1961	3	0.7	0.7	2.0	14.0	14.0	31.4
November, 1961	9	7.6	1.4	36.4	2.6	0.8	47.8

This decline in total catch is most noticeable in the numbers of suckers taken from year to year. The average catch per net-night of suckers has declined at all stations from year to year. The squawfish population appears to be increasing throughout the entire reservoir. The netting indicates these fish, at present, are most numerous in the lower part of the reservoir and least numerous near the Inlet.

The great variation in numbers of suckers taken within a year is thought to be a product of temperatures during netting, and spawning activities. Suckers were most numerous during the late spring and summer sampling times. It is thought that the warmer lake temperatures and spawning activities during this time may have increased the catch of this fish over that of other sampling times. The greatest numbers of squawfish were taken during the July samplings. The lake temperature should be near its maximum at this time and this may affect the take of squawfish. Squawfish have been reported to spawn when temperatures are in the 60°F. Surface temperatures of Hungry Horse Reservoir in July have averaged between 65-70 degrees fahrenheit.

The numbers of whitefish taken from year to year appear to have remained somewhat stable. The netting data shows much variation between sampling times of a given year. It is thought that this variation is a result of spawning activity. Whitefish spawn in late fall; October and November. The catch of these fish at Emery Creek, Devils Corkscrew, and the Inlet stations have shown marked increases during the late netting as compared to the spring or summer netting. During the November netting of 1961, the gonads of many whitefish were examined. This examination showed that over sixty percent of the total catch of whitefish at any station were either green, ripe, or spent fish.

The greatest variation between average net catches of whitefish within a given year occurred at the Inlet station in 1961. The average net catch in July, 1961 was 2.0 fish, and in November, 1961 was 36.4 fish. Almost all of the whitefish taken at this station in November were green, ripe, or spent fish. These data indicate that a large number of whitefish may use the South Fork of the Flathead for spawning purposes.

The netting data given in Table 2 may not be indicative of the true population of cutthroat trout present in Hungry Horse Reservoir. Limited observations during creel census and during the 1961 netting indicate that the Hungry Horse cutthroat may be a much more pelagic fish than previously suspected. The method used for fishing gill nets during this study may have precluded the sampling of the true cutthroat population. In any case, since very little change of netting methods have occurred since 1958, the cutthroat population data does show a decline in abundance. This species is least numerous near the outlet of the lake, and most numerous near the inlet of the lake.

It is not known what effects the spawning habits of the cutthroat have upon the netting data. Hungry Horse cutthroat are thought to begin spawning in late April and continue through to early June. The netting data show variations in catch during the year. Catches during the spring and fall sampling were similar but the catch decreased in the summer netting. Very few immature cutthroat have been taken in the nets during any sampling time. The decreased catch of cutthroat in the summer netting period is probably from fish movement from shoreline areas to open water.

Cutthroat use of tributary streams other than the South Fork for spawning is thought to be limited. Spawning in some of these tributary streams will be discussed later in this report. Netting of creek mouths at the netting sites during the spring sampling period have shown that cutthroat are no more numerous than in areas away from creek mouths. The inlet station has never been sampled before June, and therefore the netting data from this station probably does not show whether or not concentrations of cutthroat occur in the spring.

The catch data also indicate that Dolly Varden have decreased in abundance. Numbers of these fish appear to be about equal for all parts of the lake. Within-year variations of catch of this species of fish are thought to be the result of spawning activity.

Dolly Varden are known to migrate into lake tributary streams for spawning. Jeppson (1960) reports that Dolly Varden congregate around stream mouths in early summer and leave the lake in late summer. Return to the lake of the spawning fish occurs in late fall or early winter. The 1961 net-catch data show that Hungry Horse Dolly Varden follow about the same time schedule. Very few Dolly Varden were taken in the July netting of 1961, while greater numbers were taken in the May and November netting periods. Examination of gonads of Dolly Varden taken in the November, 1961 netting showed that immature, mature, freshly spent, and old spent fish were taken in the same netting area. No ripe fish were taken.

These gonad examinations along with the netting data show that during 1961 the Dolly Varden entered the tributary streams sometime after late May. The fish started returning to the lake about the 1st of October and were still returning the first week of November. Use of tributary streams other than the South Fork for spawning is thought to be light.

In general, the netting data indicate that the fish population of Hungry Horse Reservoir is decreasing in numbers. Table 3 gives a comparison of average catch-per-net-night for the years of 1958 and 1961. The sampling of these years is thought to represent the best measure of the lake's fish population. To make the data more comparable only the spring and fall sampling information for both years has been included.

The average catch-per-net-night in numbers of fish and in total weight has decreased since 1958 for Dolly Varden, cutthroat, suckers and squawfish. The total weight decrease is not so marked as the decrease in numbers for the former three since the average weight per fish has increased since 1958. The catch of squawfish has decreased both in numbers and in average weight of the individual fish. The average catch of whitefish has increased both in numbers and in average weight of each fish.

The percentage of total catch for game and non-game fish has shown some change between 1958 and 1961. The average catch of game fish has declined slightly while the weight of this catch has increased. The number of non-game fish per net has shown a marked decline; while the total weight a less marked decrease.

These data showing no great change in species composition, but a great change in the total catch of all species is the result of several factors. The author's estimate of the two most important are listed below.

Table 3. Average catch-per-net-night and weight of the average individual fish, Hungry Horse Reservoir, spring and fall sampling, 1958 and 1961.

Species		1958 Aver/Net	1958 % of Total	1958 Aver. Lbs.	1961 Aver/Net	1961 % Total	1961 Aver. Lbs.
Dolly Varden	No.	7.31	17.8		4.46	16.5	
	lbs.	10.35	46.0	1.40	9.19	44.9	2.06
Cutthroat	No.	1.51	3.6		0.69	2.5	
	lbs	0.85	3.8	0.56	0.72	3.5	1.04
Whitefish	No.	9.92	23.9		11.21	41.4	
	lbs.	4.33	19.2	0.44	6.39	31.3	0.57
Suckers	No.	20.03	48.3		8.89	32.8	
	lbs.	5.98	26.6	0.29	3.56	17.4	0.40
Squawfish	No.	2.67	6.4		1.83	6.8	
	lbs.	0.99	4.4	0.37	0.57	2.9	0.31
All game fish	No.	18.81	45.3		16.36	60.4	
	lbs.	15.53	69.0		16.30	79.7	
All non-game	No.	22.70	54.7		10.72	39.6	
	lbs.	6.97	31.0		4.13	20.3	
Total	No.	41.57			27.08		
	lbs.	22.50			20.43		

1. The factor limiting the abundance of the Hungry Horse Reservoir game fish is thought to be reproduction and recruitment to the population. The increased size of the average individual game fish from 1958 to 1961 indicates that the recruitment of young fish is low.

2. Reservoirs are generally considered to be more productive during the early years of impoundment than at any other time of the reservoir's life. Hungry Horse Reservoir may have reached its greatest level of productivity around 1958, and is now in the process of adjusting the numbers of fish to a lower productivity level and decreased carrying capacity.

Other less important factors may be:

1. Sucker and whitefish populations are heavily infested with an intestinal tapeworm.

2. Since water stored in Hungry Horse Reservoir is used for power generation fluctuation of the water level occur. The yearly fluctuation has been in excess of 70 feet. How greatly this has affected fish and fish-food production is not known.

3. Gaffney (1959) reported that Hungry Horse Reservoir may form a thermocline. Air temperatures of 1960 and 1961 averaged warmer than in 1958, resulting of warmer lake temperatures. Thermostratification may have occurred in 1960-1961 and not in previous years.

SURVEY OF TRIBUTARY STREAMS

Very little information has been collected concerning the spawning habits of the Flathead River drainage cutthroat trout and Dolly Varden. Since this type of information is desirable for any management program, efforts were initiated in 1961 to collect information concerning the spawning of Hungry Horse cutthroat and Dolly Varden. Aspects of this problem dealt with first were the use of Hungry Horse tributary streams by cutthroat and Dolly Varden for spawning.

About forty-four streams flow directly into Hungry Horse Reservoir. These streams vary in size from the South Fork of the Flathead River with a low flow of about 2000 cfs to streams with intermittent flow patterns. Of these forty-four streams, over half were judged to be unsuitable for cutthroat and Dolly Varden spawning by their flow characteristics, gradient and volume of flow, or presence of natural or man-made barriers to upstream movement.

Six of the remaining streams judged "suitable for spawning" were surveyed in both 1961 and 1962. These streams are: Sullivan Creek, Quintonkon Creek, a tributary of Sullivan Creek, Upper and Lower Twin Creek, Hungry Horse Creek, and Emery Creek. Wounded Buck Creek, which has a culvert blocking fish passage was surveyed at the request of the Forest Service. Figure 1 gives the location of these streams.

Information to be collected and methods used are listed below:

1. Resident fish populations of streams

2. Presence of spawning fish from Hungry Horse Reservoir.

Population sampling in the reservoir has indicated that mature cutthroat are usually 12 inches or longer in total length. Fisheries work in other Flathead River tributaries indicate that stream populations of cutthroat rarely reach a maximum size of 12 inches. If this size differential was found to hold for Hungry Horse Reservoir fish and its tributary populations, the presence of large (12" or greater) cutthroat in the tributaries would indicate that they were lake fish and had moved into the stream for spawning purposes. Each of the six streams were to be surveyed twice, one in late summer or fall of 1961 and again in the spring of 1962. Fish population surveys were done by hook and line, by visual observations, by using cresol, and by electrofishing. Other factors such as presence of barriers, extent of suitable spawning sites and abundance, and flow patterns were noted.

3. Downstream movement of young cutthroat into Hungry Horse Reservoir.

There is some question as to when the offspring of lake cutthroat move out of spawning streams into the lake. It is not known whether this movement occurs when the fish are fry or fingerlings or when they are yearling or two-year olds. Time of year when this downstream movement occurs is also not known.

Downstream migrant fry traps were placed in the streams at or near the mouth of five of the six streams. The trap placed in the sixth stream, Sullivan Creek, was about one mile upstream from the mouth. Quintonkon Creek enters Sullivan Creek near the placement of the Sullivan Creek trap. The traps were placed into operation July 15, 1961 and removed September 15, 1961. Research by Johnson (1961) indicated that cutthroat fry and/or fingerling cutthroat start their downward movement

in late July and August.

Each of the traps were checked and cleaned of debris two to three times weekly. Samll fish caught by the traps were enumerated by species (if possible) and preserved in formalin.

The findings of the stream survey program are given by stream below.

Hungry Horse Creek--This stream flows into Hungry Horse Reservoir about 6 miles upstream from the dam on the east side. This stream was first sampled in the fall of 1961. It was determined that this stream contained no fish in the lower 1½ mile, but that small cutthroat were very numerous in the upper reaches of the creek. The largest cutthroat taken was less than seven inches in total length. Hungry Horse Creek has a low flow of about 15-20 cfs and spawning sites are numerous and in excellent condition. No barriers to fish movement exist in the main stream, but a partial barrier due to a culvert is present on one tributary stream, Margaret Creek.

Sampling done in Hungry Horse Creek and two tributaries, Margaret and Tiger Creek, in late May and June, 1962, indicated that the drainage was heavily used by the reservoir cutthroat for spawning. Five 400-foot sections were electrofished; 1 in Margaret Creek, 1 in Tiger Creek, and three in Hungry Horse Creek. An average of one pair of spawning cutthroat were found every 200 feet of stream worked. The hole below the culvert barrier on Margaret Creek was electrofished once also. Thirty-five lake cutthroat were taken. It was also determined that the larger spawning cutthroat could negotiate the culvert and continue upstream.

The fry trap placed in the mouth of Hungry Horse Creek during the summer and fall of 1961 caught no cutthroat. Several sucker or squawfish fry were taken.

Emery Creek--Emery Creek enters Hungry Horse Reservoir from the east side about five miles upstream from the dam. This creek has low flows of about 15-20 cfs. Spawning areas are abundant and in good to excellent condition. Several log-jams are present in the creek, but are not fish-proof as yet. It has been recommended to the Forest Service that some of these jams might bear removal in the near future.

Summer sampling by hook and line showed that cutthroat were present throughout the first six miles of Emery Creek, but were more abundant in the upper portion of the six mile stretch. Cutthroat were all less than seven inches in length. Sampling in the spring of 1962 was done by electrofishing two 400-foot long sections. This sampling was done near the end of the cutthroat spawning season and several spent or nearly spent lake cutthroat were taken. An average of one pair of spawning fish per 300 feet of stream was collected.

A fry trap placed near the mouth of Emery Creek in 1961 caught no fish of any species.

Upper and Lower Twin Creek--These two streams enter into the South Fork of the Flathead River about three miles upstream of the confluence of the South Fork with Hungry Horse Reservoir. Low flows for both streams are about 15-20 cfs. Spawning areas are scarce and generally of a poor quality. Low falls are present in both streams and may act as partial barriers to upstream movement of fish.

These two streams were surveyed by hook and line in 1961, but were not re-surveyed in 1962. The 1961 sampling showed that both streams contained fair numbers of small cutthroat throughout the areas sampled. About one mile of stream extending upstream from the mouth was fished.

Fry traps placed near the mouths of these two creeks caught not fish of any species.

Quintonkon Creek--Quintonkon Creek enters into Sullivan Creek about two miles upstream from the confluence of Sullivan Creek with the reservoir. This stream has low flows of about 20-25 cfs. It contains numerous, good quality spawning sites throughout the eleven miles of stream examined, but a fish-proof log-jam existed 1/4 mile upstream from the mouth. Cutthroat seven inches or less were numerous, both above and below this barrier. Lake cutthroat spawned in the area below the barrier in the spring of 1962.

It was recommended to the Forest Service that the log-jam barrier be removed sometime in 1962. At the time of this writing (August 1962) the barrier had been removed. This should open up about ten miles of spawning area to the use of the lake cutthroat.

The fry trap placed into the mouth of Quintonkon Creek caught eleven 1-to 2-inch cutthroat.

Sullivan Creek--Sullivan Creek enters into Hungry Horse Reservoir from the west about 40 miles upstream from the dam. This stream has low flows of about 40-50 cfs and contains numerous, good quality spawning sites throughout the eleven miles of stream examined. No barriers to fish movement exist in the area surveyed, although most of the tributaries to Sullivan Creek are blocked by log-jams.

The stream was first sampled in 1961 by hook and line in the middle and both ends of the eleven mile section. Sampling was conducted in the same general areas in 1962 using hook and line and electrofishing. The 1961 survey showed that small cutthroat were present throughout, but that they were most numerous at the upper-most sampling site. The 1962 sampling was done well after the peak of the spawning run. The numbers of spawning fish taken by angling, by both project personnel and sportsmen, and by electrofishing suggest that this stream may be the most important spawning area surveyed.

A fry trap placed in Sullivan Creek two miles up from the mouth caught six fingerling cutthroat.

Wounded Buck Creek--A stream survey was conducted on this stream at the request of the Hungry Horse District Ranger. A fish-proof culvert barrier exists near the mouth of this stream. The Forest Service is taking steps to correct this situation.

Wounded Buck Creek enters the reservoir from the west about nine miles upstream from the dam. Low stream flows are in the magnitude of 40 cfs. The lower three miles of the stream was sampled by hook and line in 1961. This survey showed that the lower 1½ mile was devoid of fish life, but the upper mile contained an abundant population of cutthroat. The largest cutthroat taken was 10 inches in length. The lower 1 mile of stream contains numerous log-jams that, at present, are not fish-proof, but could easily become so.

Wounded Buck Bay was observed using underwater lights during the 1962 cutthroat spawning season. These observations showed that several hundred spawning cutthroat were milling about the mouth of the creek. Observations on the downstream side of the culvert barrier showed that cutthroat were attempting to negotiate the culvert, but with no success.

Several other Hungry Horse Reservoir tributaries were sampled during the spring of 1962 for the presence or absence of spawning cutthroat trout. These streams are listed below:

Doris Creek--Doris Creek enters the reservoir from the west about four miles upstream from the dam and has a low flow of about 25 cfs. This stream was blocked to upstream fish movement by numerous log-jams. The Forest Service, in 1961 and 1962 removed these barriers. It was observed that lake cutthroat were using this stream for spawning in 1962.

Lost Johnny Creek--Lost Johnny enters into the reservoir from the west about five miles upstream from the dam and has a low flow of about 30 cfs. This stream was blocked to spawning fish by a culvert which created high water velocities and by falls created by this culvert. The Forest Service, in the spring of 1962, took steps to alleviate this barrier by raising the water level on the downstream side of the culvert to eliminate the falls. Electrofishing down below the culvert showed that many cutthroat were attempting to enter this stream for spawning. It is thought that the larger cutthroat were able to move through the culvert following the raising of the water level. Additional work is planned by the Forest Service to further insure fish passage.

Clayton Creek--Clayton Creek, with low flows of 15 cfs, enters the reservoir from the west about 17 miles upstream from the dam. Lake cutthroat were observed by a Hungry Horse District Ranger to enter into this stream. Natural falls limit the area of this stream for spawning purposes to less than one-half mile.

Wheeler Creek--Wheeler Creek enters the lake from the west about 35 miles upstream from the dam and its low flow is about 30 cfs. Lake cutthroat were caught by project personnel in this stream. The stream contains very excellent spawning facilities and its use by lake fish should be great.

Forrest Creek--Forrest Creek is a small stream (5 cfs) entering from the west about 35 miles upstream from the dam. Lake cutthroat were caught from this stream. Observations indicate that gravel areas suitable for spawning are scarce and of poor quality, and use for spawning should not be large.

Murray Creek--Murray Creek enters into Hungry Horse from the east side about 19 miles upstream from the dam. The creek is small (5 cfs) and a culvert barrier is present which limits the upper areas to the larger spawning cutthroat. For the size of stream, Murray Creek supports a large spawning population.

McInnerie Creek--This stream enters the reservoir about $\frac{1}{2}$-mile upstream from Murray Creek. No spawning cutthroat were observed in this stream. It is suspected that a natural barrier is present below the area surveyed.

Harris, Felix, Logan Creek--All of these streams enter the reservoir from the east. Cutthroat enter each of these streams for spawning, but are blocked by fish-

proof culvert barriers.

Water temperatures taken in Murray Creek during the spring of 1962 indicated that the lake cutthroat enter the tributary streams when these streams warm to 41°F. Temperatures in Murray Creek varied between 37 and 40 degrees during April and the first week of May. Lake cutthroat were first observed in Murray Creek May 6th when the temperature had risen to 41 degrees.

A time-lag was observed between spawning in east-side and west-side streams. Cutthroat started entering east-side streams in large numbers toward the last of May, but were delayed two weeks in west-side streams. Almost all of the cutthroat had spawned in the east-side streams by July 1, but fish were still entering west-side streams at this date. Spawning was completed in west-side streams about the end of July.

Lengths were taken on all spawning cutthroat collected. No size differences were noted between any stream or between east and west-side streams. The size of the mature, spawning cutthroat ranged from 12 to 18 inches with the majority of fish being from 14 to 16 inches.

Data collected from the fry trap operation indicates that there may be some downstream drift of young cutthroat, but that no great numbers enter into the reservoir as fry or fingerling size fish. This may indicate that population recruitment to Hungry Horse Reservoir comes from fish larger than fingerling trout.

Observations on all small cutthroat taken from all streams at any sampling time showed two outstanding characteristics. These characteristics are:

1. Six to eight inch cutthroat taken from the same area fell into two different color patterns. Group A was characterized by a light, silvery background with few dark spots, and generally a light pink, red, or orange cutthroat "slash". Group B was characterized by deep black spots on a darker background. These fish often carried prominent parr marks and were often pink colored around the belly. The cutthroat "slash" was usually a dark orange, pink, or red.

2. Group A fish were almost always immature while Group B fish were almost always mature fish.

These differences between group A and B lead the author to believe that group A fish are cutthroat with parentage from Hungry Horse Reservoir and will return to the reservoir. Group B fish are believed to be cutthroat resident to the stream.

The stream surveys indicated that Dolly Varden spawn in few of the streams that flow directly into the Reservoir. In this study they were found to spawn in only Quintonkon Creek and Sullivan Creek. It is thought that most of the Dolly Varden spawn somewhere in the South Fork drainage above the reservoir. Suckers, (both coarse-scale and longnose) were observed spawning in almost all of the streams surveyed. Suckers entered the streams for spawning near the tail end of the cutthroat run.

The stream survey, although very limited in scope, gives a good indication

of the important cutthroat spawning areas and of some of the problems involved. Further studies are planned on the following streams; Doris Creek, Lost Johnny, Wounded Buck, Wheeler Creek, Sullivan Creek, Quintonkon Creek, Emery Creek, Hungry Horse Creek, and Murray Creek. These studies will be aimed at determining time of spawning, size of spawning runs, time of return of young fish to the lake, and effectiveness of passing fish through repaired culvert barriers and log-jams.

Addition streams, both directly tributary to the lake and tributary to the South Fork will be surveyed to determine the presence or absence of spawning lake cutthroat.

ANGLER SUCCESS

Some creel census information has been collected yearly from Hungry Horse Reservoir since 1956. The census information for the years of 1956 through 1960 was from Montana game wardens reports and fishermen logs. The information collected in 1961 was gathered by project personnel, and by big-game checking station operators. The census information to date is presented in Table 4.

The census information for 1956-1960 is for the summer fishing season only. The census information for 1961 has been divided into two periods of time; June 1 through September 30, and October 1 through November 30. The reasons behind these divisions are apparent in Table 4 and will be discussed later in this report.

Table 4. Creel census, Hungry Horse Reservoir, 1956-1961

Year	Number of fishermen	Catch per man hour	Cut-throat	Dolly Varden	White-fish	Grayling	Kokanee
1956	48	1.23	85	82	3	1	-
1957	56	0.78	120	11	6	-	-
1958	154	0.46	223	20	15	1	-
1959	40	0.47	86	3	-	3	-
1960	120	0.34	101	20	-	-	7
1961 (all)	292	0.86	208	9	540	1	8
Summer 1961	192	0.24	135	3	-	1	8
Winter 1961	100	2.28	73	6	540	-	-

The catch data information given in Table 4 show that summer fishing success has declined in Hungry Horse Reservoir since 1956. This trend is similar to the pattern found in many reservoirs; i.e., outstanding fishing immediately after

impoundment followed by a leveling off in success.

Seasonal variations in fish movement caused by spawning migrations have affected the fishing success in this lake to a very noticable degree. The 1961 creel information shows that to adequately present a clear picture of the fishing success the fishing season should be divided into three distinct units: from June 1 to September 30, from October 1 to November 30, and from December 1 through May 30.

The first strata would measure the fishing success during periods of warm weather, when the cutthroat trout are least concentrated and tending toward open water, and when the Dolly Varden are leaving the lake for spawning. The second strata, October 1 to November 30, would measure the fishing success when the cutthroat trout appear to be more numerous in in-shore areas, when the Dolly Varden are returning to the lake following spawning, and when the whitefish are congregated around streams mouths and are in streams for spawning. The winter census of 1961 showed that large numbers of whitefish were caught in November. Most of these fish were caught in the lake within a short distance of a stream mouth or up in a tributary stream. The third census strata, December 1 through May 30, would measure angler success when neither the whitefish or Dolly Varden are engaged in spawning activities, when Hungry Horse tributary streams and the lake within 100 yards of a stream mouth are closed to fishing, and when the cutthroat trout are moving from the lake into the tributary streams for spawning.

Although fishing success during the summertime is poor, the quality of fish caught is excellent. Regulations require that all of the Dolly Varden kept by fishermen be at least 18 inches in total length. The average of the three Dolly Varden checked in the summer of 1961 was about 21 inches long. The average length of the Dolly Varden taken during the winter census was about 23 inches long. Whitefish taken in 1961 averaged about 13 inches in length. Cutthroat taken during 1961 ranged from 7 to 17 inches in total length with the average about 14 inches.

Fishing success varied with the type of gear used, particularly in the summer months. Fishermen trolling "hardware" or "cowbells" deep (over 50 feet) did much better than fishermen trolling shallow with the same gear. Fly fishermen fishing stream mouths early and late in the day were more effective than those who trolled shallow. Bank fishermen using bait were least successful of any type of fishermen.

AGE-GROWTH OF GAME FISH

Scale samples for age and growth analysis were collected from Dolly Varden, cutthroat, and whitefish in 1958 and 1961. These data are given in Table 5 below.

Table 5. Age and growth rates of Dolly Varden, cutthroat, and whitefish, Hungry Horse Reservoir, collections of 1958 and 1961

		LENGTH IN INCHES AT ANNULUS							
Species	YR.	I	II	III	IV	V	VI	VII	VIII
Dolly Varden	1958	2.6(152)*	5.4(152)	8.7(138)	12.7(98)	17.1(40)	20.6(19)	23.3(1)	
	1961	2.8(2.4)	5.5(2.4)	8.7(194)	13.0(133)	17.5(91)	23.3(31)	27.6(5)	
White-fish	1958	3.3(103)	7.0(99)	9.3(77)	10.8(48)	11.3(14)	12.5(3)	14.6(2)	14.6(2)
	1961	3.4(119)	7.3(114)	10.0(94)	11.8(61)	12.7(27)	13.7(5)		
Cut-throat	1958	2.8(70)	5.8(66)	9.5(45)	12.2(23)	13.7(6)			
	1961	2.4(51)	4.6(51)	8.0(43)	12.3(37)	14.5(29)	15.2(16)		

*Sample size in parentheses.

These data show that Dolly Varden and cutthroat growth is slow for the first three years of life, but thereafter it increases markedly. Whitefish growth is good for the first three years of life and slows down thereafter. In general it appears that the growth rate of age group IV and older fish has increased since 1958. This may be a factor associated with the decreased average net catch experienced between 1958 and 1961.

Further analysis of the cutthroat growth data pointed out that the fish could be placed into two groups according to growth rates and that the difference in growth rate came to light at the third year of life. Table 6 gives the two different growth rates, fast and slow, for fish three years old or more from both the 1958 and 1961 collections. Seperation into the two groups was done by judgement.

Table 6. Average length, range and yearly increment of fast and slow growing cutthroat from Hungry Horse Reservoir, 1958 and 1961

		Average length and range in inches at each annulus					
Year	Group	I	II	III	IV	V	VI
1958	Slow	2.4(23)*	4.8(23)	7.9(23)	11.6(14)	13.3(5)	
		1.5-3.5	3.0-8.0	5.1-9.8	9.3-13.7	11.9-14.5	
		2.4	2.4	3.1	3.7	1.7	
1958	Fast	2.8(22)	5.9(22)	11.2(22)	13.1(9)	15.5(1)	
		1.4-3.7	3.7-9.5	10.3-12.4	12.6-14.1		
		2.8	3.1	5.3	1.9	2.4	
1961	Slow	2.1(34)	4.1(34)	7.0(34)	11.8(30)	14.3(26)	15.2(7)
		1.2-3.0	3.0-6.1	5.1-9.9	9.8-13.4	12.6-15.6	13.7-16.0
		2.1	2.0	2.9	4.8	2.5	0.9
1961	Fast	12.8(9)	5.6(9)	11.7(9)	14.4(7)	15.9(3)	
		2.3-3.7	4.4-6.7	10.8-12.2	13.9-15.7	15.4-16.2	
		2.8	2.8	6.1	2.7	1.5	

*Sample size in parentheses.

The difference between the growth patterns of the slow growing and fast growing cutthroat is most noticeable at the third annulus. Slow growing fish had average lengths of 7.9 inches (1958) and 7.0 inches (1961) while the fast growers had average lengths of 11.2 inches (1958) and 11.7 inches (1961) at the third annulus. Also, there is no overlap between the length ranges of the slow and fast groups at the third annulus. Considerable overlap exists between the two groups for the first two annulus.

These apparently different growth patterns will be studied. It has been suggested that the two growth patterns may be explained by one or more of the following theories concerning the origins and life habits of the Hungry Horse cutthroat.

1. Hungry Horse Reservoir possibly contains populations of fish from

Flathead Lake, from the South Fork of the Flathead, and from tributary streams draining into South Fork before inundation. It may be that the lake-inhabiting cutthroat have different habits than a stream cutthroat.

2. Analysis of other Flathead River drainage cutthroat data seem to indicate that the Flathead Lake cutthroat spends the first two to three years in the tributary streams before returning to the lake proper. It is also thought that these early years are spent in 2nd, 3rd, and 4th grade tributaries to Flathead Lake. If the Hungry Horse cutthroat is derived from Flathead Lake stock similar reproduction and movement patterns should exist.

If they follow this pattern, fish spawned in streams directly tributary to Hungry Horse may enter the lake (where better growth conditions exist) at an earlier date than the fish spawned in streams tributary to the South Fork above the reservoir.

SIZE AT SEXUAL MATURITY--DOLLY VARDENS

The data presented elsewhere in this report show that Hungry Horse Reservoir contains an excellent population of Dolly Varden trout. Creel-census information indicates that very few of these fish are harvested by the angler. Current fishing regulations set a minimum length limit of 18 inches for Dolly Varden taken from Hungry Horse Reservoir. This regulation was designed to insure that the Dolly Varden attained sexual maturity before entering into the creel.

During the November 1961 netting, gonad examinations of Dolly Varden were made to help determine at what size these fish enter into the spawning population. The result of this study is presented in Table 7.

Table 7. Relationship of length and sexual maturity of Dolly Vardens, Hungry Horse Reservoir

Length in Inches	MALES			FEMALES		
	Immature	Mature	Spent*	Immature	Mature	Spent*
8.0-9.9	9	-	-	15	-	-
10.0-11.9	11	1	-	13	3	-
12.0-13.9	3	4	-	5	9	-
14.0-15.9	5	3	-	3	13	-
16.0-17.9	5	2	-	1	3	-
18.0-19.9	-	7	1	-	5	-
20.0-21.9	-	6	4	-	5	1
22.0-23.9	-	3	-	-	9	1
24.0-25.9	-	2	4	-	4	-
26.0-27.9	-	1	5	-	2	3
28.0-34.0	-	-	5	-	3	6
TOTALS	33	29	19	37	56	11

*See text for explanation

These data show that Dolly Varden, both males and females, mature by the time they reach eighteen inches in total length. Some females and males are mature at

10-12 inches total length. Ten of the 29 mature males and 28 of the 56 mature females were less than 18 inches.

Close examination of the gonads and size of eggs in the small fish indicated that two or more years may pass between the time that the fish starts forming eggs and the time that it first spawns. Since it was possible to distinguish many of the fish that had spawned before the netting, these fish were recorded as spent fish. It should be noted that the smallest spent male was in the 18 to 20-inch class, while the smallest spent female was in the 20 to 22-inch class. These two datum support the thought that more than one year exists between the time of reaching sexual maturity and the time of the first spawning.

RECOMMENDATIONS

The Flathead River drainage above Kerr Dam is one of the last strongholds of the Dolly Varden and cutthroat trout in the continental United States. The encroachment of civilization in this area is steadily decreasing the range and abundance of the cutthroat. Very little life history information has been obtained on cutthroat and Dolly Varden. Without this information, management of these two species of fish is a guessing proposition. The limited information available indicate the habits of lake-dwelling cutthroat and Dolly Varden may be markedly different from stream fish. Information needed most at this time concerns reproduction of the lake populations and mortality rates.

Recommendations are listed below for the continuation of the study of the fishing of Hungry Horse Reservoir:

1. Population sampling (netting) of all species present in the lake should continue similar to the program followed in 1961, but only once every third year. During a sampling year netting of the five stations should occur three times: once in late April, once in late June, and again in late October. Data collected from the fish taken should include lengths and weights, scale samples for age and growth analysis from both the game and non-game fish and gonad condition.

2. Measurements of oxygen levels and temperature structure in the reservoir should be made. It is thought that Hungry Horse Reservoir may stratify thermally during the summer months. If this occurs, measurements of intensity and effects of the stratification should be made.

3. Observations on the life histories of the suckers, squawfish, and whitefish should be recorded.

4. Fisherman harvest information should be collected. With the combination of low fishing pressure and a large body of water, creel census will have to be conducted on a catch-as catch-can basis.

5. Studies should be made to collect information concerning the reproduction of the Dolly Varden and cutthroat. These studies should cover the following items:

A. Age and size at maturity
B. Fecundity

C. Times of spawning migrations from the lake and time of return to lake
D. Determination of spawning tributaries and areas
E. Habits of newly hatched fish while in stream habitat
F. Size of spawning runs, and estimate of population recruitment.

6. Habits of the cutthroat and Dolly Varden in the lake habitat should be investigated. The following items should be studied:

A. Areas inhabited and depth distribution of fish during various seasons of the year
B. Food habits

7. The best methods of angler harvest should be determined. The harvest of both the cutthroat and particularly the Dolly Varden has been judged to be small. Public dissemination of angler information might increase the harvest of these fish. Special types of fishing, such as night fishing, should also be investigated.

Two recommendations are made for the management of the Hungry Horse Reservoir fishery. These recommendations are:

1. It is recommended that streams tributary to Hungry Horse Reservoir including the South Fork of the Flathead to the mouth of Spotted Bear River and the Spotted Bear River drainage be closed to fishing from the end of the current fishing season through June 30 each year.

This recommendation is thought to be essential to provide protection to the spawning cutthroat trout. The peak of the 1962 spawning run occured simultaniously with the opening of stream fishing. It is conceded that the 1962 spawning season was later than normal because of abnormally cold weather. How often this occurs is not known, but neither can it be predicted. To insure year-to-year protection for the cutthroat spawning runs, the opening of these Hungry Horse tributaries should be delayed from the current opening in the middle of June to the first day of July.

2. It is recommended that all possible speed be taken to open up tributary streams that are now blocked to spawning fish.

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