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. II Title Evaluation of Kokanee Spawning and Population Density in Flathead Lake and Tributaries

Period: July 1, 1962 to June 30, 1963

Abstract:

Kokanee introduced into Flathead River drainage in 1916 have since spread over the drainage through natural extension of their range and planting of fry from State fish hatcheries. They have created an important sport fishery. This report reviews information gained on them in studies over the years.

Kokanee still use the same spawning areas in the drainage that were observed in 1950; however, there are indications of a shift to more spawning in the river system and less in Flathead Lake. Measurements of spawning kokanee for over 10 years show ups and downs in average total lengths of individual fish. In Flathead Lake the size has varied from 16.0 inches in 1938 to 11.4 inches in 1957. Similar trends in size are noted from other lakes in the drainage which have isolated kokanee populations. Kokanee sizes differ from water to water. In 1961 they averaged 14.2 inches in Lake Mary Ronan and 11.3 inches in Swan Lake. Water quality and the reproduction success are probably the main factors causing these differences.

Movements of kokanee from the lake to search for spawning areas start as early as July, but do not reach a peak until early October. There appears to be a second peak in late October. The latter is the largest and concentrates in lower river spawning areas. The most distant spawning area found is 60 miles above Flathead Lake. During late October kokanee can be observed using areas from this point to Flathead Lake.

Ageing by examining otoliths has been initiated, but difficulty with preservatives causing opaqueness of the bones has resulted in questionable analysis. It has been determined, however, that the mature spawning salmon are in their fourth or fifth year of life.

Fry movements from the spawning gravels start approximately 19 weeks after fertilization. The fry do not leave the areas until all the yolk sac is absorbed and travel primarily during the evening hours. Movements from hatching areas are spread throughout late March and April. This movement usually precedes the heavy spring run-off in this river system.

Recommendations:

It is recommended that continued yearly measurements be made on the spawning salmon in the Flathead River drainage to provide a population trend index to future kokanee management. Although the investigations indicated unlimited salmon spawning areas along the Flathead River, the unknown effects of proposed industrial development along this river could greatly reduce the salmon reproduction. A continuing effort should be made to answer the following problems:

1. To establish the areas of utilization by the young (one, two and three year old) salmon in Flathead Lake.

2. To determine the effects of water releases from Hungry Horse Reservoir on the salmon in relationship to water quality and temperature.

3. To determine the results of planting swim-up fry (salmon) in areas of Flathead Lake that historically sustained populations of salmon.

Objectives:

The purpose of this project is to evaluate present conditions affecting the kokanee in Flathead Drainage and to compare present conditions to those found in earlier investigations that have been described in Job Completion Reports F-7-R-1, -2, and -3.

Techniques Used:

Sampling of kokanee was primarily made during the spawning runs, when large numbers of fish were congregated both in Flathead River and Flathead Lake. Otoliths and length and weight measurements were taken from samples of the population. Samples of eggs were collected during the annual egg taking operations of the department spawning crew. The spawning crew employed a 250 foot beach seine to capture concentrations of spawning salmon. Additional samples, particularly during the summer months, were made in cooperation with River Basin personnel, Bureau of Sport Fisheries and Wildlife,who were engaged in a year around creel census program on Flathead Lake. Locations for egg survival tests were selected during the fall spawning concentration of kokanee.

Collection of eyed eggs in the gravel was accomplished by digging in gravel areas and collecting the eggs on a screen. Fry were collected from only one area. This was approximately 25 miles above the lake. Here a fry trap was constructed across the outlet of a slough and was operated twice daily for a two-week period.

Findings:

The introduction of kokanee salmon into the Flathead River drainage was made in 1916; since that time they have spread throughout the drainage. The extension of this range has been both by natural fish movements and by planting fry. At present kokanee occupy an important role as a game fish in Northwestern Montana. The abundance and availability of spawning fish has provided

a source of eggs for introductions into waters throughout Montana, into many other states and Canadian Provinces.

Investigations in the Flathead Drainage are directed toward a better understanding of this fish and its management. Reports from 1952 through 1954 studies[1] describe the locations of spawning areas in Flathead Lake and tributaries. Since 1955 fall measurements of numbers and/or sizes of spawning fish have been made to establish a basis for observing population trends. Length measurements (total length- inches and tenths) on kokanee from Flathead Lake (Figure 1.) have been accumulated by department personnel since 1947. Length data was also collected from 1938 through 1951 by personnel at Yellow Bay Biological Station on Flathead Lake. (Brunson, Castle and Pirtle, 1952). Graphically, the size of the salmon has had ups and downs, ranging from 16.0 inches in 1938 to 11.4 inches in 1957. Since 1957 the average size has increased or remained the same, except for a one-half inch drop in 1962.

Numerous additional kokanee throughout the drainage have been measured. For each area sampled average lengths were taken from 100 to over 500 fish. A summary of all measurements is presented in Table 1. The river samples were either from the main Flathead River or from tributary streams. The lakes sampled included: Flathead Lake (three areas), Swan Lake, Ashley Lake and Lake Mary Ronan. Kokanee populations in all the areas except Lake Mary Ronan depend on natural reproduction.

Analysis of variance was used to determine if the size of salmon from three areas in Flathead Lake[2] was statistically different. The analysis was confined to the years 1950, '52, '53, and '54. There was a significant difference between the average lengths for 1954 when compared to any of the other years. There was no difference between any of the other years, 1950, 1952, 1953.

Measurements of spawning salmon in Lake Mary Ronan were also made from 1957 to 1963 (Figure 2). This lake is located about 10 miles west of Flathead Lake and has 2,000 surface acres. Salmon were introduced in 1946, and since 1954, 300,000 fry have been planted annually. The success of salmon reproduction is questionable in this lake. Other fish present in the lake are rainbow trout, largemouth bass, pumpkinseed and redside shiner. Generally the average size of salmon from this lake is larger than those collected from Flathead Lake. The initial introduction of salmon into Lake Mary Ronan was made from eggs taken from Flathead Lake. The average size of kokanee in Lake Mary Ronan also has had its ups and downs and fluctuated four inches since the measurements have been made.

A new system was devised in 1963 to record total length measurements. This system is an adaptation of one used in mid-west states to measure warm-water

[1]Completion Reports, Montana, F-7-R-1, Job IVB; F-7-R-2, Job IIIA; F-7-R-3, Job IIIB and IVB; F-7-R-4, Job IIA.

[2]Leik, Tom. 1960. Flathead Lake - Kokanee Salmon, Analysis of Variance. Unpublished Report, 7 pp.

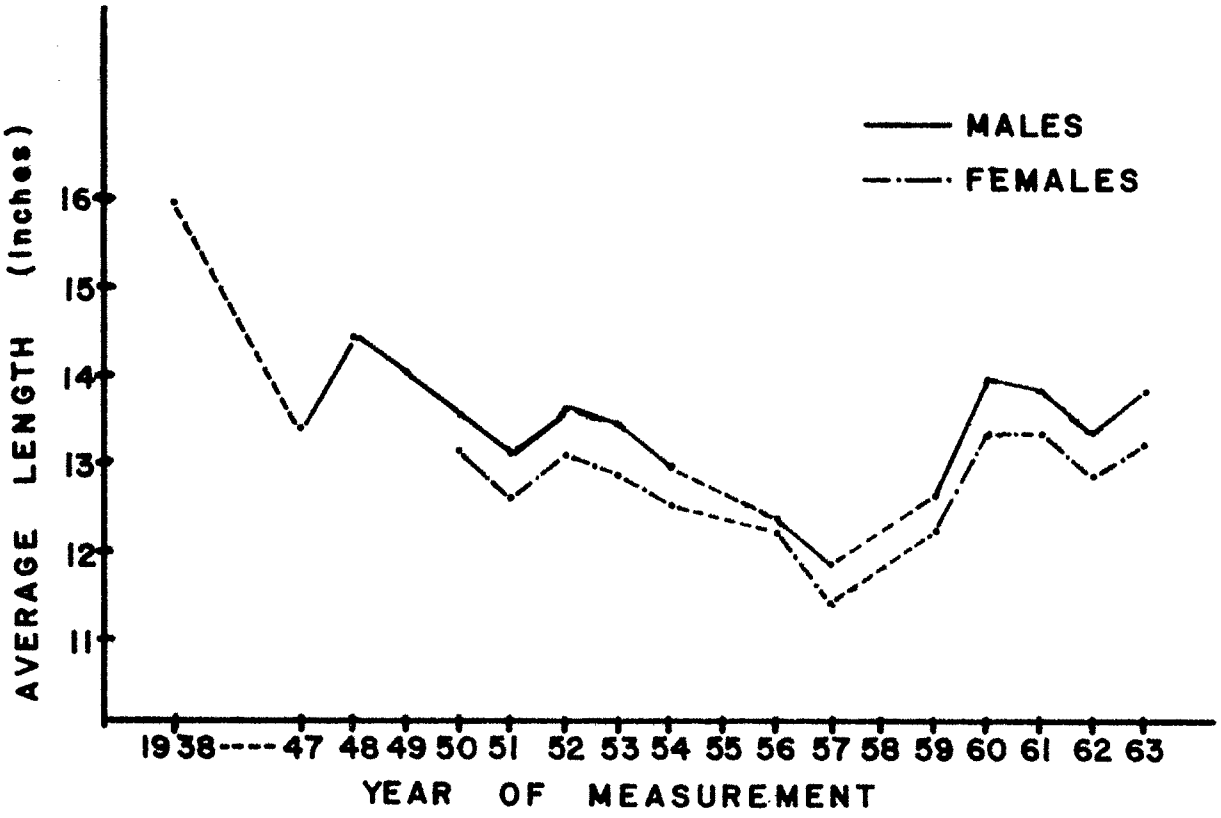


Figure 1. The average length of kokanee salmon (male and female) 1938, through 1963 from Flathead Lake.

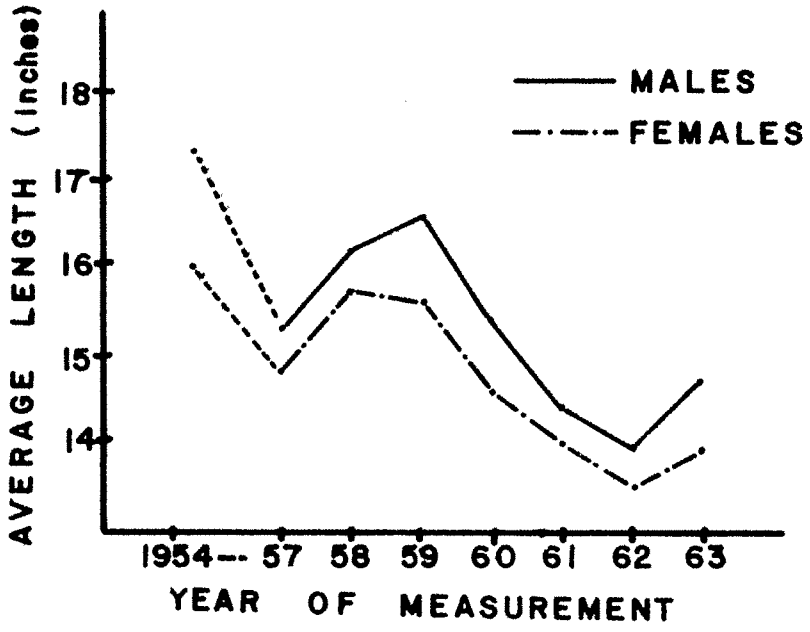


Figure 2. The average length of kokanee salmon (male and female) 1954, through 1963 from Lake Mary Ronan.

Table 1. The average lengths of kokanee salmon from numerous areas within the Flathead River Drainage

Location / Sex	Years of Measurement													
	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Flathead Lake														
Male	13.5	13.1	13.7	13.4	12.9	12.3	11.8			12.6	13.9	13.8	13.3	13.8
Female	13.1	12.8	13.1	12.8	12.5	12.2	11.4			12.2	13.3	13.3	12.8	13.2
Flathead River														
Male												13.6	13.1	13.3
Female												12.9	12.8	12.6
Whitefish River														
Male		12.4	13.3	12.9										
Female		12.0	12.7	12.2										
McDonald Creek														
Male				12.9								12.5		13.3
Female				12.4								12.0		12.8
Lake Mary Ronan														
Male					17.3		15.3	16.2	16.6	15.4	14.4	13.8		14.7
Female					16.0		14.8	15.7	15.6	14.6	14.0	13.4		13.8
Swan Lake														
Male												11.8	12.1	12.0
Female												10.9	11.6	11.5
Ashley Lake														
Male												11.5		
Female												11.1		

fish. It employed a wooden measuring frame that held a 3-inch by 5-inch plastic card. Total lengths were recorded by a punch from a compass needle tapped on the end of a 3/8 inch dowel. The plastic card could be set at any measured length along the frame. This system is considerably faster than conventional measuring methods and can be done by one man. Over 100 measurements for both sexes can be recorded on a card. The sexes are kept separate by a line dividing the plastic (Figure 3). This method is particularly applicable to fish populations that have a limited size range. The data can be interpreted, in the office, by placing the card on a selected graph paper.

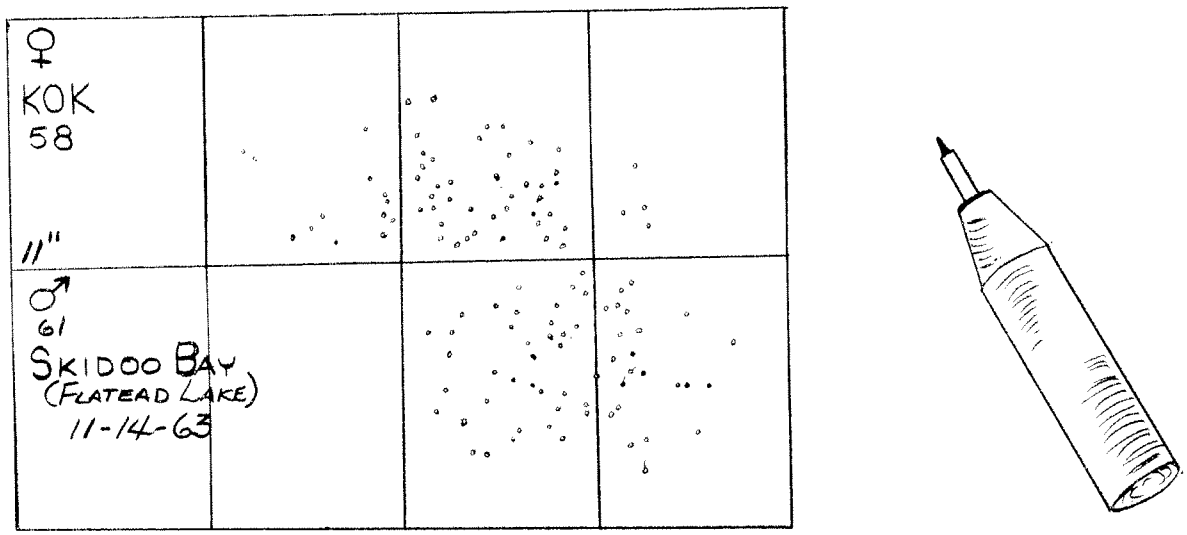


Figure 3. Plastic card and punch used in recording kokanee measurements (T.L.)

Movements and Spawning Areas

Salmon in Flathead Lake start ascending the main stem river as early as July. However, few fish migrate this early and anglers seldom catch these early migrants. One specimen was taken on July 13, 1962 just above the junction of the North and Middle Fork Rivers. By late September, salmon concentrations move into the lower river The typical spawning appearance (hook jaw, etc.) is just becoming evident. The eggs are still intact in the ovary. By mid-October this group reach McDonald Creek, a tributary of the Middle Fork of the Flathead River (60 miles above Flathead Lake - Figure 4). By this time the eggs are ripe. Prior to 1957 spawn takers at a trap operated on McDonald Creek started to take eggs on the 15th of October. At this time female salmon in Flathead Lake are still green. A similar starting date (October 20) has remained fairly constant for spawn taking at Lake Mary Ronan. By late October and early November fish in the southern areas of Flathead Lake are ready to spawn. This stage progressively becomes apparent in the northern areas by mid-November. A second run or concentration of fish appears in the river during early November. This run disperses all along the river sloughs and backwaters, and into the lower tributaries (Stillwater and Whitefish Rivers). During this time aerial flights have been made and large concentrations of salmon were observed spawning in the river areas from the vicinity of Kalispell to McDonald Creek (Figure 4.).

The latest spawning area along the Flathead River is located in a slough area 25 miles above the lake. In this area (Brenneman Slough) there are springs that gather and join a small spring creek that flows about 2 miles before spilling into the main river. Measurements from this area have indicated that the average salmon is ½ to 1 inch smaller than salmon taken from the river or lake the same year.

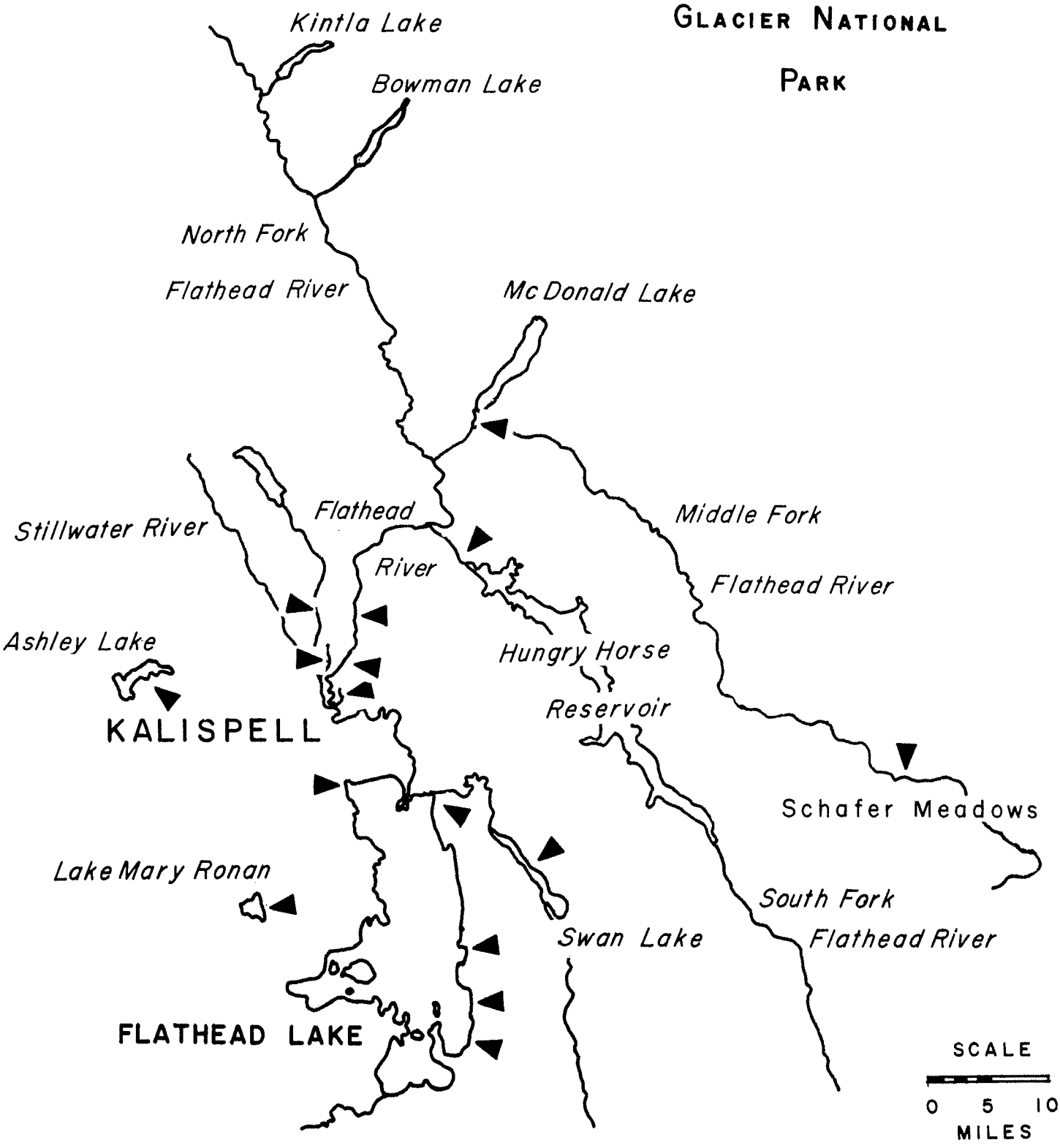


Figure 4. The Flathead River Drainage, showing kokanee sampling and spawning areas.

Ashley Lake is the site of the latest spawning in the entire drainage. Here the spawning starts in late November and continues to mid-December. Often the fish can be observed spawning under the ice.

It is well to note that in the areas where the spawning season is later, the average size of the salmon is progressively smaller. It is also important to note that as the salmon ascend the main river system (Figure 4) and approach the junction of the North and Middle Forks of the Flathead River, they turn up the Middle Fork and continue upstream for five miles to the mouth of McDonald Creek. No large concentrations of salmon have been observed above the mouth of the North Fork River or above the mouth of McDonald Creek on the Middle Fork River. Salmon do occur, however, in both drainages. In the North Fork there are two lakes, Kintla and Bowman Lakes, that sustain populations of salmon. Both lakes have outlets that enter the North Fork River. In the Middle Fork, except for Lake McDonald, there are no lakes containing kokanee, but several specimens were collected on September 20, 1963 as far up this river as Schafer Meadows (60 miles above the mouth of McDonald Creek and 125 miles above Flathead Lake). It was not ascertained whether these fish were migrants or residents. Salmon also ascend the South Fork of the Flathead River, approximately 6 miles, to the base of Hungry Horse Dam. Here large concentrations can be observed on their spawning run.

Age Determination

Age determinations were first initiated in 1954, when 50 pairs (25 males and 25 females) of otolith bones were collected from spawning salmon and sent to Region I office of the Fish and Wildlife Service, Portland, Oregon, for analysis. These specimens were preserved in Bowins solution. The examination showed that the majority of the otoliths were either partially dissolved or were rendered unreadable because of opaque surfaces. Age analysis was questionable. In 1961 195 pairs of otoliths were collected from spawning salmon. These specimens were preserved in a 3 percent solution of trisodium phosphate (Clemens, 1950) and stored in vials. The collection was sent to the Montana State Fisheries Laboratory for analysis. Examination showed the otoliths to be opaque, again resulting in questionable analysis. The analysis of these two collections were as follows:

1954	Size range	Year of life III	IV	V
25 males	12.0" - 13.7"	0	0	25
25 females	11.7" - 14.2"	0	4	21
50		0	4	46

42 percent of the sample were partially dissolved; results questionable

1961	Size range	Year of life III	IV	V
99 males	10.6" - 15.3"	16	80	3
96 females	10.3" - 14.6"	18	77	1
195		34	157	4

36 percent of the sample considered questionable because of opaqueness

Due to the difficulty in the attempts to analyze the age of the kokanee a study was designed, with the cooperation of Bureau of Sport Fisheries and Wildlife personnel, to collect scale samples from salmon during the summer months; to collect both scale samples and otoliths from salmon that enter the river during the early migration; and to collect otoliths from spawning concentrations of salmon. It was felt that with these materials age determinations could be made and verified. The analysis of this study is not complete at the time of writing this report.

Egg survival and fry collections

During the spring of 1962, 15 areas were sampled for eggs to determine successful spawning sites. Six areas were sampled in Flathead Lake, four in the Flathead River, and one each in the Whitefish River, a spring creek, the South Fork of the Flathead River and McDonald Creek. Sample areas had been located during the actual spawning season. Redds in backwaters or slough areas remained recognizable five months after egg deposition. Redds in the river and along the lake were obscured by current or wave action. Discharge releases from Hungry Horse Reservoir resulted in spawning areas that were sometimes out of water and other times flooded to five feet. Along the lake, the shallow spawning areas are subjected to a 10 foot fluctuation. This occurs from mid-November (spawning time-maximum pool elevation) to mid-April (hatching time-minimum pool elevation).

In two of the sample areas of Flathead Lake (Skidoo and Gravel Bays), no eggs were found; although large concentrations of salmon had been observed over gravel areas during spawning season. In all other sample areas successful egg deposition and fry development were observed. Areas found to have successful spawning were as follows:

Flathead Lake
- Yellow Bay
- Blue Bay
- Bigfork Bay

Whitefish River
- (Lower 4 miles)

Stillwater River
- Spring Creek

Flathead River
- Highway #2 Bridge
- Brenneman's Slough
- Helena Flats
- Buck's Bar

South Fork Flathead River
- Below Hungry Horse Reservoir

Middle Fork Flathead River
- McDonald Creek

The places sampled are only a portion of the available spawning areas in this river system. There are indications since the completion of Hungry Horse Reservoir in 1951 that there has been a shift in salmon spawning areas - - more salmon now use the river system for spawning and less salmon use spring areas of the lake.

A fry trap was placed in Brenneman Slough to determine when the fry leave the gravel and start their movement toward the lake. The particular location was selected because there was very little current flowing through the spawning area and fish movements would be directed by the fish rather than by water flow. Egg samples were collected from the gravel to determine the hatching date. On February 19, 1962 eyed eggs and sac fry were found 4 inches below the gravel. On March 13th, the trap was placed across the entire creek 1/4 mile below the spawning area. On March 15th five fry entered the trap. The first mass movement was found on March 19th, when 218 fry were collected. For the next three days 124 to 195 fry per day left the spring area and were only collected during the evening hours (dusk to sunrise). During the daylight hours very few fry (from 0 to 6 per day) were collected in the trap. The fry ceased descending the creek on the evening of March 22nd and the trap was pulled on the evening of March 23rd.

There were probably many such movements of fry down this spring creek resulting from the spawning which occurred for over a month. The fry that were collected in the downstream trap had absorbed the entire egg sac. Comparisons of the development rate of these fry to fry hatched at the Somers Fish Hatchery showed these fish to be approximately 19 weeks old. Water in both the hatchery and slough is from springs that ranged from 40° to 47° F.

Prepared by Delano A. Hanzel Approved by George D Holton

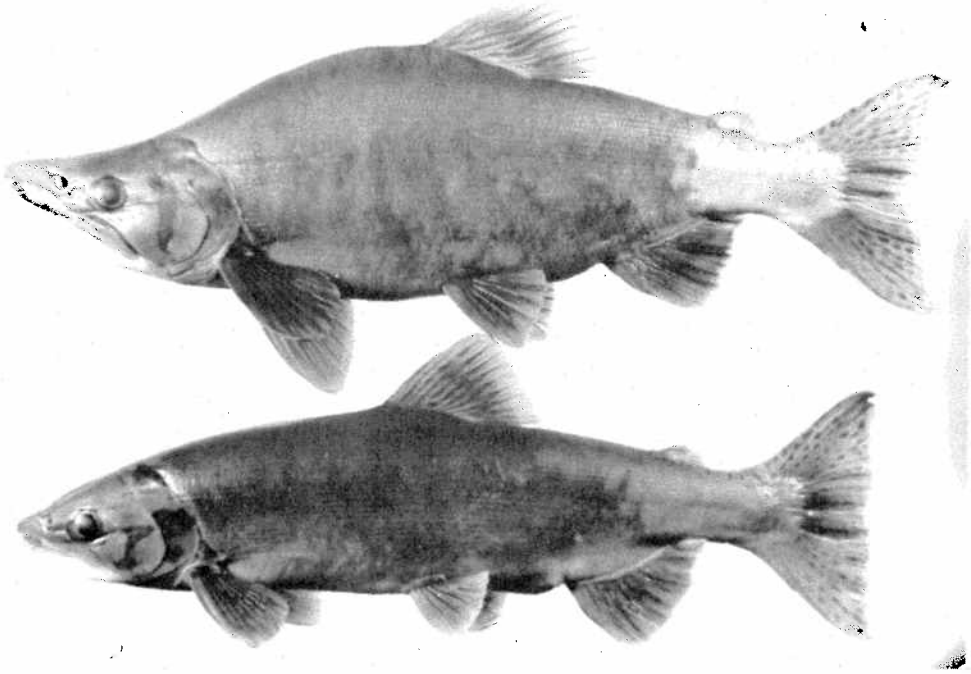
Date October 1, 1964

Literature Cited

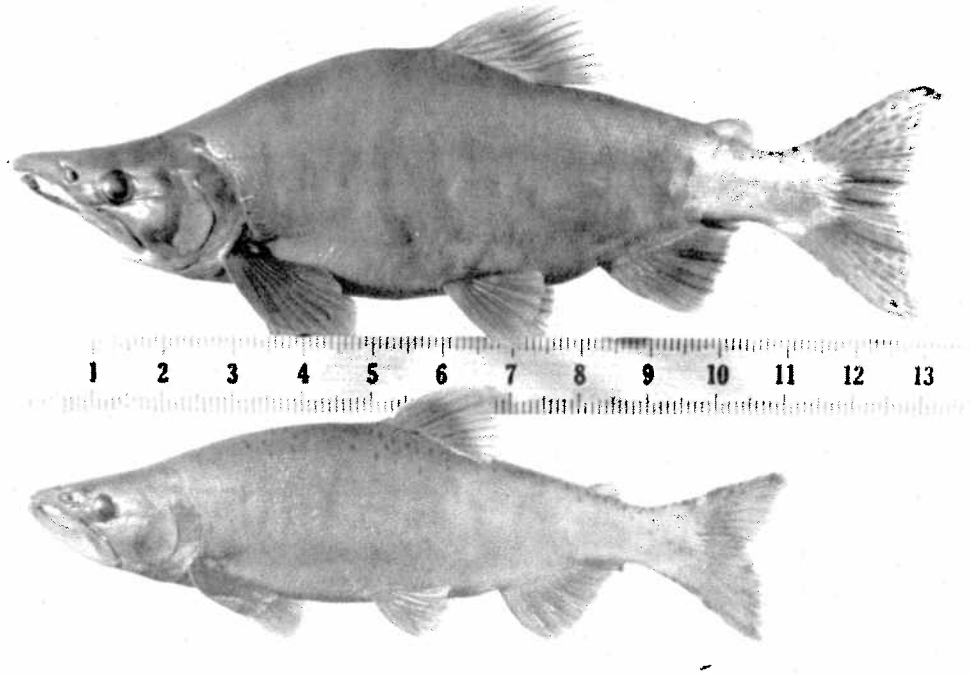
Brunson, Castle and Pirtle. 1952. Studies of Sockeye Salmon (Onchrohychus nerka) from Flathead Lake, Montana. Proc. Mont. Acad. Sci., 12:35-43.

Clemens, H.P. 1950. The Growth of the Burbot, (Lota lota maculosa), in Lake Erie. Trans. Amer. Fish. Soc., 80: 163-173.

PHOTO APPENDIX

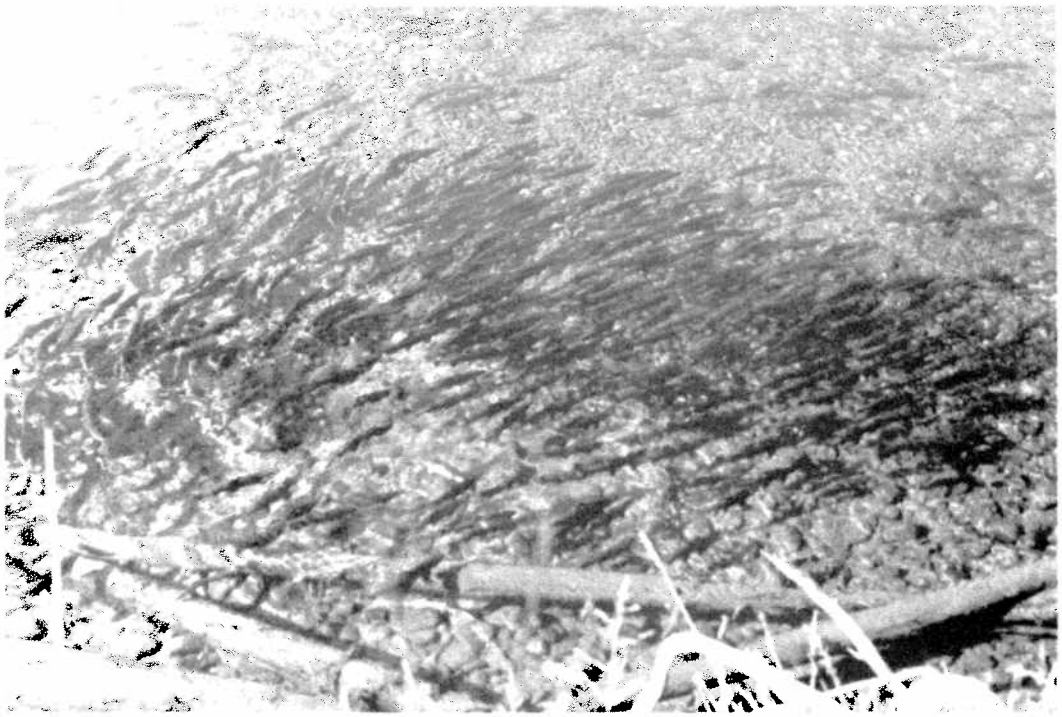


1. Male and female kokanee salmon from Flathead Lake, showing body conformation during spawning period.



2. Comparison of male kokanee; top Flathead Lake, bottom Swan Lake.

3. Spawning kokanee in spring area of Brenneman Slough.



4. Spawning concentrations of salmon in McDonald Creek.