MONTANA STATE DEPARTMENT OF FISH AND GAME
FEDERAL AID IN FISH RESTORATION SECTION

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Project No. F-7-R-3 Work Plan No. III Job No. III-A

Title of Job: Natural Reproduction of Kokanee in Flathead Lake and Tributaries

Abstract:

Kokanee were found to spawn successfully along the shores of Flathead Lake. Thirty-one separate areas were found to be utilized during the course of the study. Many of the tributary streams were used for spawning purposes. Kokanee were found to spawn in one stream 52 river miles from Flathead Lake. Stream spawning was highly successful. Shore spawning was not successful along shores where no seepage water was present and the beds were exposed to the elements. In areas where seepage water was present the eggs developed and hatched. During the course of the study the fluctuation of the lake level has changed due to the construction of Hungry Horse Dam. This new drawdown pattern may result in a higher percentage hatch of kokanee spawn, since the water level of Flathead Lake will fluctuate less during and after the spawning period.

Objectives:

Reproduction is an essential and key phase in the survival of any living organism. Flathead Lake is lowered considerably in the winter months by a hydroelectric plant, thus exposing many of the spawning beds. The purpose of this study is to establish the extent of kokanee spawning in Flathead Lake and its tributaries together with the degree of successful spawning.

Techniques Used:

During the spawning season, areas of concentration of kokanee were noted and marked on a map. An airplane was used in December and was extremely useful in locating spawning areas in isolated part of the lake shore. Tributary streams were observed to determine how far upstream kokanee had migrated to spawn. Spawning beds were examined at the time of hatching of the eggs.

Findings:

Flathead Lake is the largest natural lake in Montana having an area of 120,320 acres and a shoreline of 127 miles. The chief tributaries are the Flathead and Swan Rivers. The deepest part of the lake is 339 feet in the vicinity of Yellow Bay.

The lake freezes over about once in five years. In the past three years only the sheltered bays were covered with ice. The ice is usually on the bays from December to April.

A dam was constructed (Kerr Dam) at outlet of Flathead Lake in 1938 and as a result the flood waters were stored during the spring and summer and then used in the winter for the generation of electricity. This type of water manipulation left many spawning beds along the shore of the lake exposed to the elements (Figure 1). Since the construction of Hungry Horse Dam on one of the tributaries, the fluctuation of the water level of the lake has changed considerably. The water level in the past two seasons has been about five feet lower during the spawning season than formerly.

Bad weather prevented an aerial survey of all the lake shore, however, anglers were observed snagging kokanee in many areas. An aerial survey was made on December 10 of the tributary streams and the heaviest concentrations of kokanee were found in Whitefish River and MacDonald Creek.

On March 22, kokanee eggs and sac fry were collected from spawning areas in the Whitefish River and Spring Creek. Not many "bad" eggs were found in these two areas. The following day kokanee eggs and sac fry were collected from MacDonald Creek, tributary to the Middle Fork of Flathead River and Dr. Richard's Bay on the east shore of Flathead Lake. The eggs and fry collected from Dr. Richard's Bay were about one foot above the lake level in a seepage area. On March 24 eggs and fry were collected from Table Bay on the west shore of Flathead Lake. All of the fry found in this area were dead and so were many of the eggs. Of the five redds observed only one contained live eyed eggs. All of the redds were above the surface of the lake (from 6" to 2ft.), and no seepage water was present.

A count was made of eggs of 10 unspawned kokanee collected in Somers Bay of Flathead Lake on November 24. The number of eggs per fish averaged 843 with a range from 631 to 1,216. The length of the 10 fish averaged 13.3 inches total length.

Lengths were taken of 974 kokanee taken from 3 areas of the lake and two tributary streams. The average lengths and the range in size are given in Table 1.

From November 12 to 17, 6,233 males and 6,419 females were taken in seine hauls at the various bays giving a sex ratio of 1 male to 1.03 females. In MacDonald Creek, 2,468 males and 1,961 females were captured in a trap from November 15 to 30, giving a male to female ratio of 1:0.79.

Analysis and Recommendations:

Job Completion Reports (F-7-R-1, Job No. III-A and F-7-R-2, Job No. III-A) have been made during the past two years, and this report is intended as a job completion report 1953 as well as a final report for this job. Most of the phases of this job have been satisfactorily completed.

For the third straight year the kokanee were found to spawn along the shore of Flathead Lake and in several of the tributaries. The only area where little success was observed was at Lookout Bay. No seepage water was present in the latter area and most of the eggs and fry found above the water level were dead. On March 22, 1954, an attempt was made to determine the degree of successful "eyeing up" of the kokanee eggs. Less than 5 percent of the eggs collected were "bad" eggs. In all three streams examined, it was difficult to find "bad" eggs.

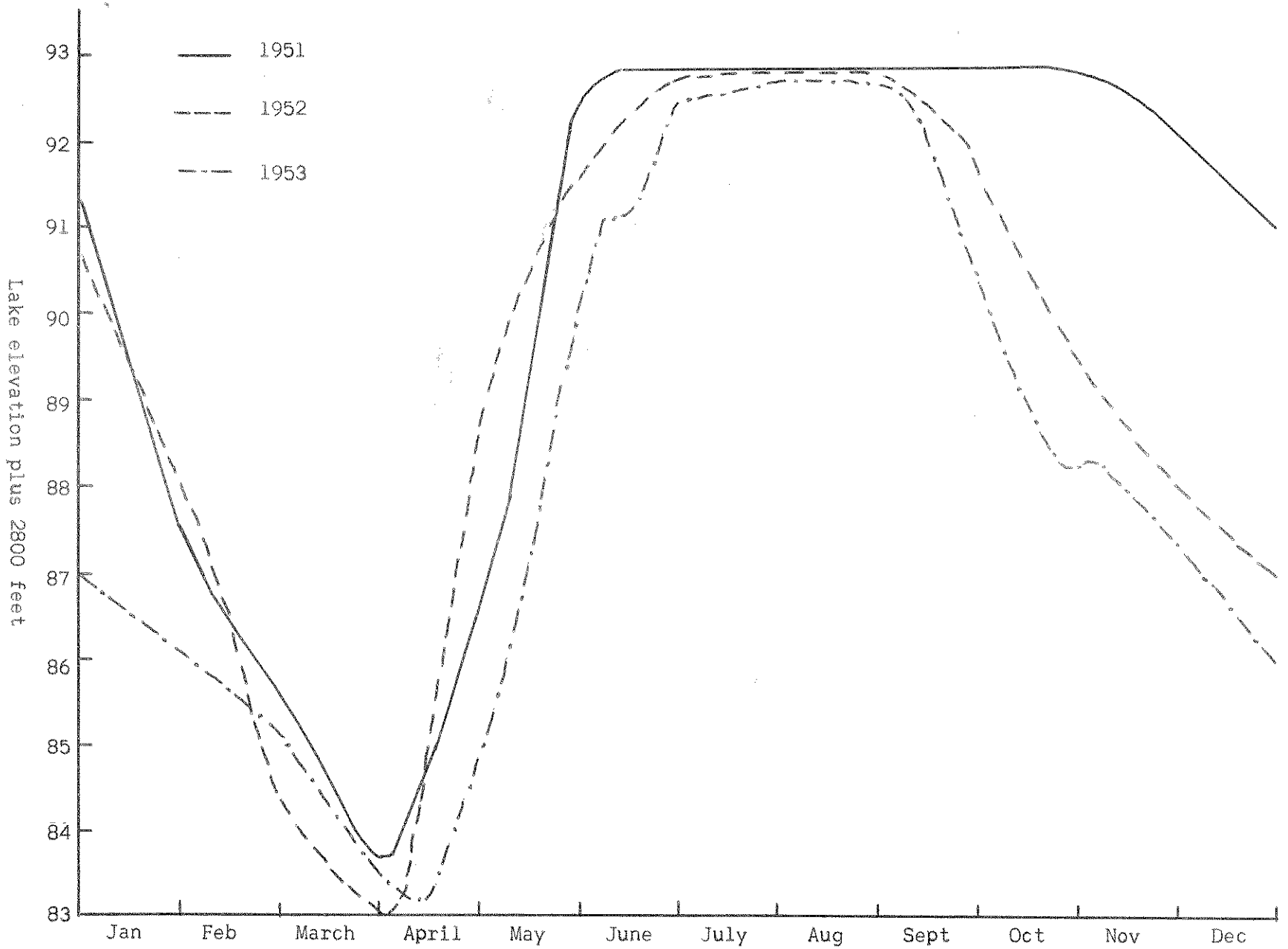

Figure 1. Water level fluctuations of Flathead Lake as recorded at Kerr Dam for the years 1951, 1952 and 1953

TABLE I

The average length and range in size of Kokanee taken from Flathead Lake, and tributaries during November and December 1953.

Location	Sex	Number	Average Length	Range	Standard Deviation
Tributaries					
Whitefish River	Males	100	12.9	11.7 to 14.1	.5
	Females	100	12.2	11.4 to 13.4	.4
McDonald Creek	Males	100	12.9	11.2 to 14.3	.5
	Females	74	12.4	11.2 to 13.4	.4
Flathead Lake Dr. Richards Bay	Males	100	13.5	12.2 to 14.5	.5
	Females	100	13.1	11.9 to 14.3	.4
Rollins Bay	Males	100	13.6	12.2 to 14.7	.5
	Females	100	13.1	12.0 to 14.4	.5
Somers Hatchery Bay	Males	100	13.4	11.8 to 15.3	.6
	Females	100	12.8	11.8 to 14.3	.5

There was little difference between the average length of the fish collected from the east shore and that of the west shore of the lake. However, there is a difference between the average length of the fish collected in the lake from those collected in the tributary streams.

Over the past three years, kokanee were observed spawning in many areas of Flathead Lake (Figure 2). Before the construction of Hungry Horse Dam there was approximately six to eight feet fluctuation of the water level after kokanee had spawned until the eggs were hatched. This lowering of the water was thought by many to kill all eggs laid by these fish. However, no thought was given to depth of kokanee redds as it was assumed that all redds were exposed to the elements before the fry could get into the lake. During the course of the study it was found that eggs laid in seepage areas hatched out and there was a great possibility for the fry to enter the lake. Since Hungry Horse Dam has been in operation the fluctuation of Flathead Lake for the past two seasons, and it is presumed that this will be it in the future, is such that there was about four to five feet of lowering of the lake level from time of kokanee spawning to the time the fry were ready to enter the lake. This change in water fluctuation may increase the number of kokanee fry recruited to the lake. Little information was gathered on the depth that the kokanee spawn and it is recommended that this be studied in the next three years.

When this study was undertaken, it was thought by many that the only kokanee spawning was along the shores of Flathead Lake. During the course of the study it was found that kokanee traveled great distances to spawn in tributaries (Figure 3). In comparing the success of spawning along the lake shore to that in the tributaries, more dead eggs were found along the lake shore. Many eggs were lost along the lake shore due to lowering of the water and wave action. It was not unusual to find windrows of dead eggs washed upon the shore of Crescent Bay in November and December. Most of the streams were used extensively except where barriers were present. Barriers in Stillwater River, Swan River and the South Fork River prevent more of these particular streams from being used. The recruitment of kokanee from the tributaries to the lake must be enormous.

It has been the policy to plant many kokanee fry in Flathead Lake each year. The number planted for the years 1946 through 1952 are presented in Table II. The total number of fry planted each year is impressive, however; when the number of kokanee fry planted per acre is examined, the large numbers lose their impressiveness. It is opportune at this time to quote R. E. Foerster (1954) on the study of artificial and natural propagation of sockeye salmon on Cultus Lake, B. C. from 1925 to 1934.

"By 1934, the following percentages of efficiency had been obtained.

Natural propagation	1.13,	1.05,	3.16 or an average of 1.78
Fry liberation	3.93,	2.38,	1.71 or an average of 2.67
Egg planting	0.95,	3.55,	or an average of 2.25

"So little difference between the methods had been demonstrated that it was concluded that 'in an area, such as Cultus Lake, where a natural run of sockeye occurs with a reasonable expectancy of successful spawning, artificial propagation, for purposes of continuing the run to that area, is unnecessary and, if producing any additional results over natural spawning, these would not appear to be in any way commensurate with the cost.'

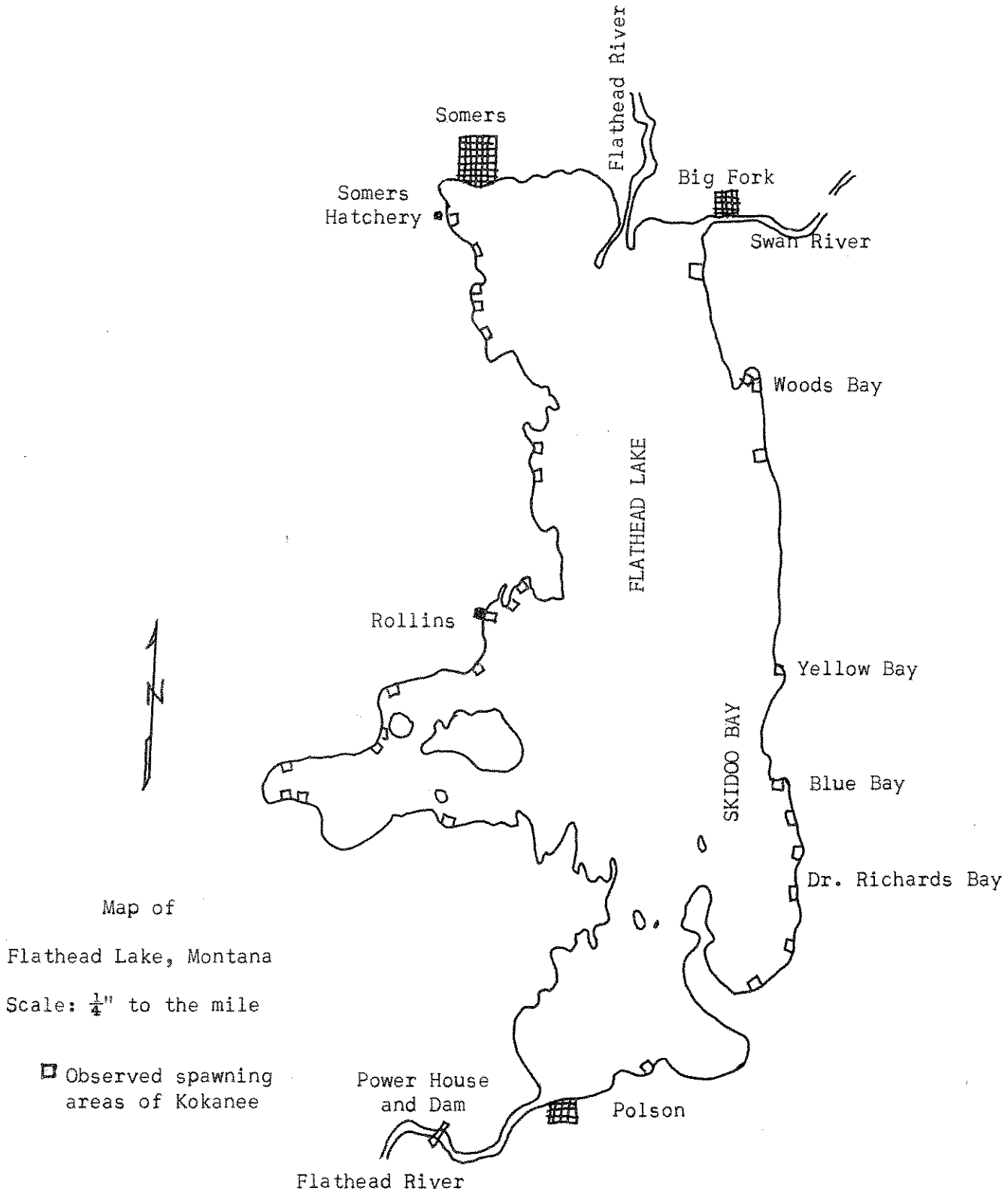

Figure 2. Shore areas used by spawning kokanee in 1951, 1952 and 1953.

TABLE II

KOKANEE PLANTED IN FLATHEAD LAKE

Year	Total Kokanee Fry	No. Per Acre
1946	1,460,700	12
1947	2,268,800	19
1948	2,271,710	19
1949	2,470,968	21
1950	2,275,399	19
1951	2,093,000	17
1952	1,743,258	14

"Additional information was presented to show that (a) the average annual egg collections at all hatcheries (77.3 million) probably represented about three percent of the egg capacity of the spawning runs, and (b)that heavy mortality occurs shortly after the fry are released into the lake. Among marked sockeye released from rearing ponds into the lake, mortality amounted to 67 percent after seven months' lake residence and to 78 percent after nine months' lake residence.

"As a result of the conclusions that were reached by the Biological Board of Canada from these findings, and presented to the Department of Fisheries, all Pacific salmon hatcheries in Canada were closed in 1935. Subsequent study of the populations of sockeye returning to areas where hatcheries had previously operated has not shown any adverse effect from the cessation of hatchery operation."

It is doubtful that the planting of kokanee is contributing a measurable amount to the fishery of Flathead Lake. There is another matter for consideration, however. The Fish and Game Department depends upon Flathead Lake for obtaining its kokanee spawn for liberation in other lakes in the State. Certain areas of the lake are well suited for seining, which method is used for collecting the fish to be spawned. These areas have been planted annually with the idea that the kokanee have a sufficiently strong homing instinct that they will return to the point of the lake where liberated. There is the belief that the spawn-taking operations make natural reproduction in these areas of negligable importance, and that the perpetuity of the runs for spawn-taking is dependent upon those fish planted. To test this, kokanee fry are being liberated at the east lake shore spawn-taking locations one year and at the west shore locations the next year. Thus, every other year no fish are planted at the spawn-taking locations. If the abundance of kokanee at these spawn-taking locations is dependent upon hatchery planting, this will be evident if fish are not present when seine hauls are made four years after the plantings were discontinued.

It was reported that the size of kokanee have decreased considerably over the past 18 years. During the course of this study no decrease in size of fish was noted (Table III). The average length of the fish in 1952 was larger than either 1951 or 1953. This phase of the study should be carried over a long period of time to determine any changes in size of the kokanee.

Flathead Lake is open to fishing the entire year for all species of fish. The daily limit on kokanee is 35 fish from October 1 to December 15 at which time they may be snagged on their spawning grounds. During the remainder

of the year the limit is 15 fish. Kokanee are certainly more available to capture during the spawning period when snagging is allowed. The reasoning should not be, however, as it is, that since they are more available the limit should be higher than during periods of the year when they may be taken only by conventional angling methods. If regulation is needed on the season to keep the kokanee population at a high level, the higher take should be allowed during the angling season when the fish are in a prime condition, when they are less available to the angler, and when more sportsman-like methods of catch are used and not during the spawning period when the flesh is in poor condition, when they are heavily concentrated, and when snagging is allowed. Of course, sportsmen reason that since the kokanee is going to die anyway, he might as well be caught. To this reasoning should be added the thought that it matters not at all whether a fish is caught during the summer or during the spawning season; it is dead in either case and will not spawn. The great majority of the fish caught by snaggers have not spawned.

Thus, it is evident that the present regulations as to limit are not set wisely. It is recommended that either the limit on kokanee be set at 35 fish throughout the year, or that the limit be restricted during the winter snagging season if further restriction is needed.

TABLE III

Average length of kokanee by sexes collected during the spawning seasons in Somers Hatchery Bay on Flathead Lake and Whitefish River for the years 1951, 1952 and 1953

		Sex	Number	Range	Standard Deviation
		Males			
Somers	1951	13.1	100	11.8 to 14.1	.5
	1952	13.7	100	12.6 to 14.4	.4
	1953	13.4	100	11.8 to 15.3	.6
		Females			
	1951	12.6	100	11.5 to 13.9	.5
	1952	13.1	100	12.4 to 13.7	.3
	1953	12.8	100	11.8 to 14.3	.5
Whitefish River		Males			
	1951	12.4	100	11.5 to 13.4	.5
	1952	13.3	100	12.2 to 13.9	.4
	1953	12.9	100	11.7 to 14.1	.5
		Females			
	1951	12.0	100	11.2 to 13.5	.5
	1952	12.7	100	11.7 to 13.8	.4
	1953	12.2	100	11.4 to 13.4	.4

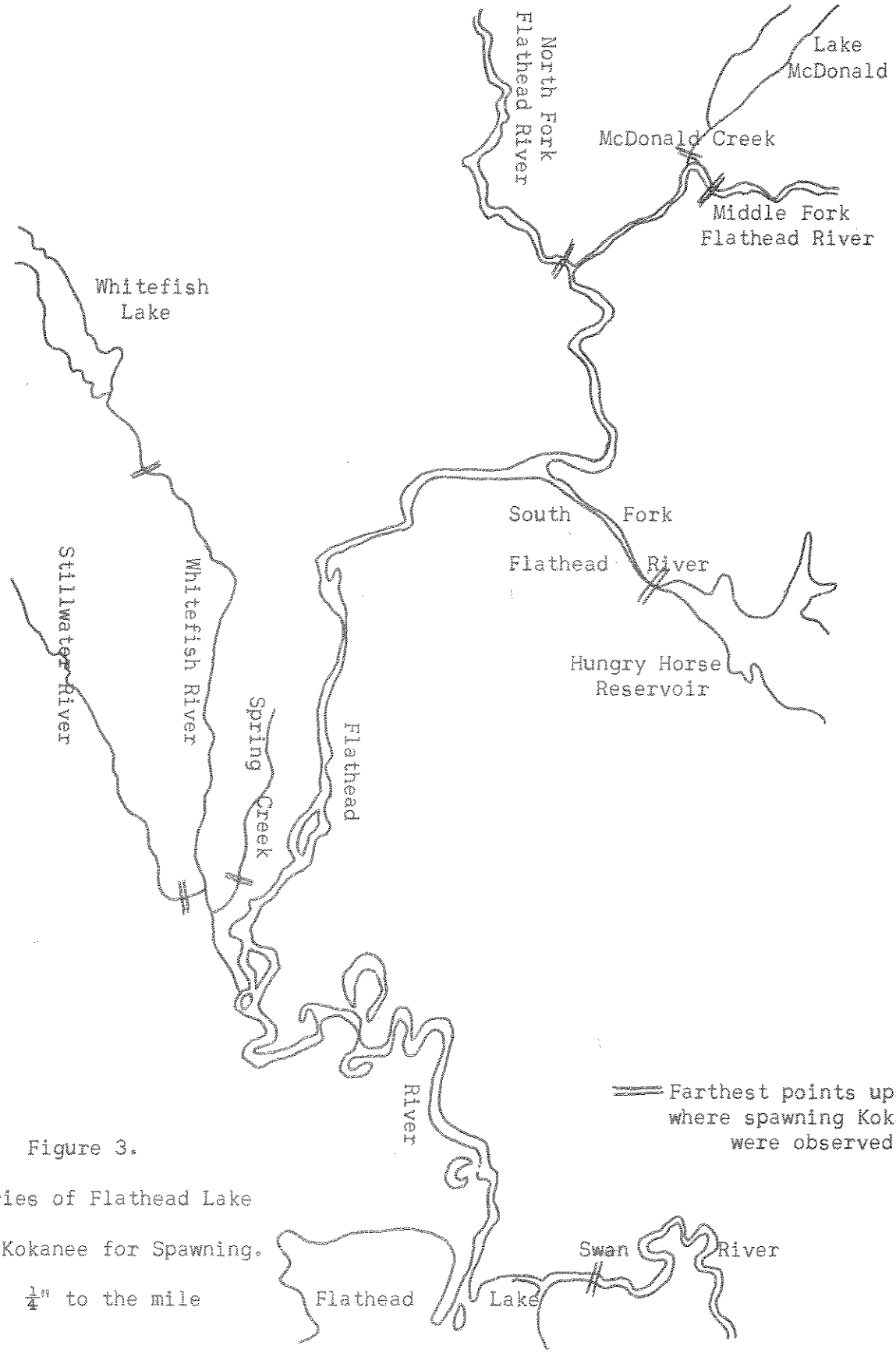

Figure 3.

Tributaries of Flathead Lake

Used by Kokanee for Spawning.

Scale: $\frac{1}{4}$" to the mile

Since it was not determined at what depths the kokanee spawns in Flathead Lake, it is recommended that this phase of the study be continued.

Summary:

Kokanee were found to spawn successfully along the shores of Flathead Lake. Thirty-one separate areas were utilized during the course of the study. Many of the tributary streams were used for spawning, one stream being 52 river miles from the lake. Stream spawning was highly successful. Since the start of the study the water fluctuation of Flathead Lake has changed due to construction of the Hungry Horse Dam.

The new operating plan for the lake will be such that there will be less fluctuation of the water level after the kokanee eggs are laid than formerly. It was found in one tributary stream that less than 5 percent of the eggs were "bad" and the remainder were "eyed". Along the lake shore some redds were found with all eggs dead; however, in seepage areas, the success was compared to that of the streams. No redds were examined in the lake that were below the water level.

Data and Reports:

The original data and reports are with the project leader at Kalispell, Montana.

Literature Cited:

Foerster, R. E.
1954. A study of the relative merits of natural and artificial propagation of sockeye salmon in British Columbia. Prog. Fish-Cult. 16 (2) pp. 92-93.

Prepared by Frank A. Stefanich Approved by _____

Date April 28, 1954