MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION

JOB COMPLETION REPORT
RESEARCH PROJECT SEGMENT

State of Montana

Project No. F-33-R-2 Name: Flathead Lake Fishery Study

Job No. I Title: Flathead Lake Investigation of the Fish Population and its Chemical and Physical Characteristics

Period: July 1, 1967 to June 30, 1968

Abstract:

The year around seasonal sampling program was initiated at the 22 stations around the lake. The program was designed specifically to sample the fish population but included concurrent sampling of: plankton, bottom organisms, water quality measurements, and water temperature profiles.

Kokanee concentrations were absent from the northern half of the lake until May, when they progressively moved northward and out into most areas of the lake. The salmon utilized a deeper layer of water as the surface temperatures progressively warmed to a maximum of 73° F. The deepest layer of salmon was found between 45 and 60 feet below the surface and occurred in September.

A wide area distribution was noted for the lake whitefish and Dolly Varden. At least one specimen of each species was taken in every net that was set on the bottom and fished overnight.

Pygmy whitefish were recorded for the first time from Flathead Lake. They were collected in all major areas of the lake. All specimens were taken in mesh sizes of 5/8 and 1-1/2 inch mesh (stretched measure).

Lake trout were found in three main areas and were represented only by large fish. No juveniles have been collected.

No rough fish, such as northern squawfish, peamouth, longnose sucker, largescale sucker, or redside shiner were collected in waters deeper than 90 feet.

Thermal stratification was evident in the lake during the summer; however, no inverse stratification was noted during the winter period. The open area of the lake remained free of ice cover during the entire winter. The waters remained, throughout the winter, in a

homothermic condition. The homothermous condition remained as the waters progressively cooled.

Recommendations:

Sampling this year provided a base for detecting seasonal trends of the physical and biological characteristics. The findings to date suggest that the objectives of this study can be reached. It is recommended the study be continued.

Objectives:

The objective of this study is the development of techniques for determining the relative abundance of the various species of fish in the lake, their seasonal geographic and depth distribution, and to measure year to year trends and fluctuation in species populations.

Techniques used:

A year around sampling program was designed primarily to define the seasonal and depth distribution of the fish in Flathead Lake. Twenty-two stations were selected on the basis of ecological characteristics and are assumed to be representative of the total 126,000 surface acres (Figure 1). Nine stations are in shallow water less than 50 feet deep, 11 are in medium water depth ranging from 50 to 150 feet, and two stations are deep, pelagic waters over 150 feet in depth.

Fish sampling by standard gill net sets was scheduled to be repeated four times a year in each of the selected areas. The sample periods were defined as: Spring transition (May-June-July), Summer stagnation (August-September-October), Winter transition (November-December-January), and Winter stagnation (February-March-April). It was necessary to shift the sample months because the climatic seasonal conditions and, in turn, lake conditions did not fit the breakdown into calendar months.

A standard set for this study consisted of four nets joined together, a total of 600 feet of netting: a 100 feet by 8 feet net containing a 50-foot section of 5/8-inch mesh (all mesh sizes in this report are stretched measure) and another with a 1-1/4 inch mesh, a 250 feet by 8 feet net and a 250 feet by 24 feet net. The 250 feet long nets have 50-foot sections of 1-1/2, 2, 2-1/2, 3, and 4 inch mesh.

A typical set was on the bottom and was fished overnight for a period of approximately 20 hours. Proper placement and alignment of the net and depth were checked and recorded on sonar tape. A special floating net of monofilament nylon, 250 feet by 25 feet, with the same 50-foot sections of mesh sizes as the standard net, was used to sample the surface and the areas 30 to 60 feet below the surface. A powered gill net reel aided in pulling and storing of the netting materials. Two sets were made per day during the sample periods. The sonar was used to record the general fish distribution in the vicinity (20 to 30 acres) of each of the sample stations.

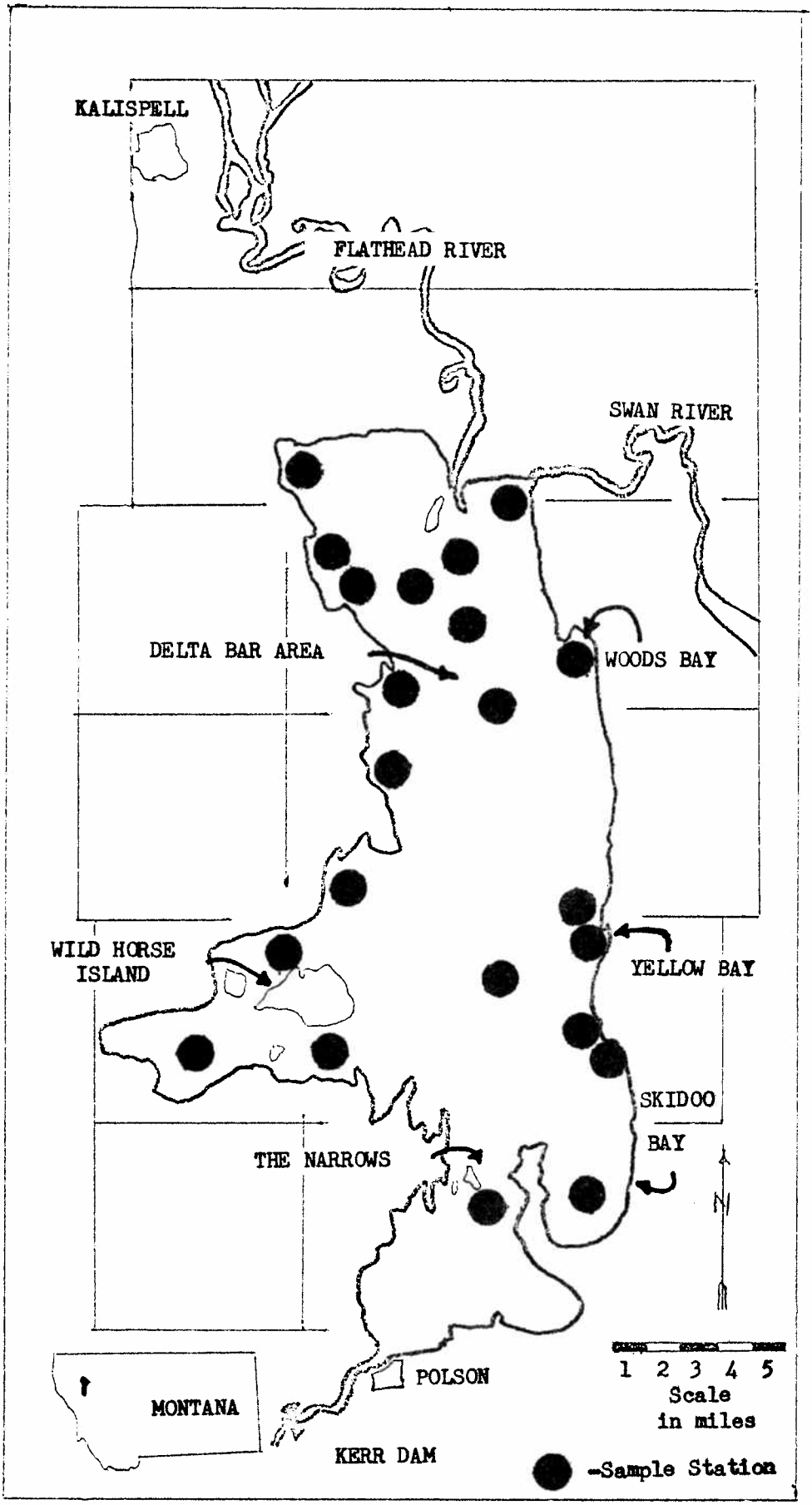

Figure 1. Location of sample stations on Flathead Lake.

Water temperature profiles, basic water chemical analyses, and collections of plankton and bottom organisms were conducted concurrently with the fish sampling at all stations. A resistance thermometer coupled to a depth sensor (Bathythermonitor) was used to record water temperature profiles. Water depths were recorded for each one degree Fahrenheit change in water temperature. A plankton tow net, 45 cm. in diameter, was used to obtain plankton near the surface. A flow meter mounted in the mouth of the net measured the water velocity through the net. Water volumes for each two minute tow were calculated.

Microplankton from samples of 1,000 ml of water collected near the surface and at the 50-foot level were concentrated with a Foerst centrifuge. The plankton samples were preserved for quantitative measurement. Bottom organisms were collected after washing and screening three square feet of bottom material picked from the bottom with a Peterson dredge.

Water quality measurements, based on "Standard Methods for the Examination of Water and Sewage" were made for the following characteristics: total alkalinity, dissolved oxygen, pH and standard conductance. Analyses were made on samples collected from the surface and 50-foot levels. Seechi disc readings were also made during the water sampling.

All fish collected were measured to the nearest one-thenth of an inch total length, weighed to the nearest one-hundredth of a pound and a scale sample extracted and stored in individual envelopes. A cursory examination was made into the abdominal cavity for sex determination and gonadal development. Notes were made on stomach contents and visible parasites. Numerous specimens were preserved for future reference.

Findings:

GENERAL

The recording sonar (Ross Fine Line Model 200-A) proved a valuable tool for precise bottom measurements and recording the depth and general distribution of fish. It was also useful in evaluating the placement and alignment of net sets.

The proper alingment of a net 24 feet deep, set on the bottom in 78 feet of water, is shown in Figure 2(A). The three horizontal marks shown were made by passing directly over and along the net. These marks represent the 3/16 inch polypropylene lines that connect the three 8-foot net panels. The lead core line is not distinguishable in this recording. The marks on the right edge of Figure 2(A) are of the same net, but were made on a course passing over the net at right angles. The float line and some fish can be distinguished above the net. The irregular marks just below the surface are caused by water turbulence.

An improperly aligned bottom net set in 72-feet of water is shown in Figure 2(B). A portion of this 8-foot net can be seen (from left to right) collapsed and hanging diagonally about 10 feet off the

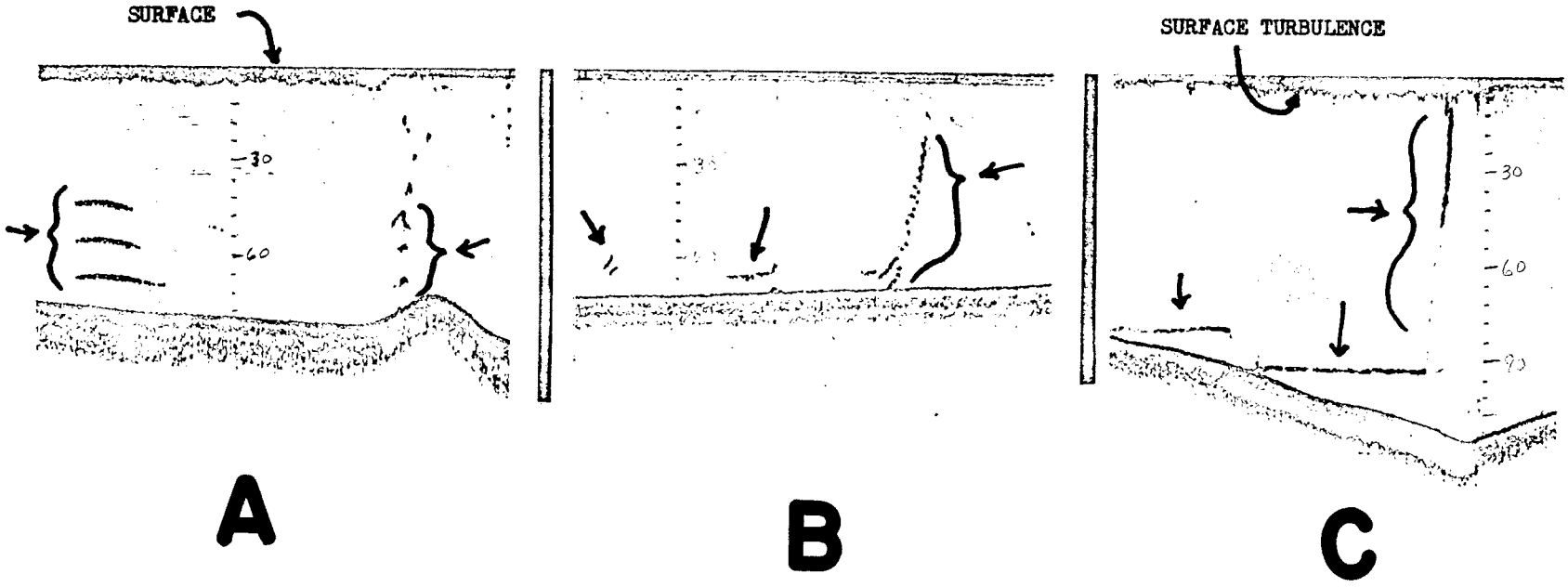

Figure 2. Sonar records that show its use with sampling equipment. (A) Correct placement of a net in 80 feet of water; a parallel and perpendicular run over the net shown by arrows. (B) Improper set of net (shown by arrows) in 76 feet of water. (C) Placement of a Kemmerer water bottle (shown by arrows) at a sample depth of 93 feet.

bottom; also shown is a portion correctly set and fishing the bottom; and a portion having too much bouyancy at one end causing the net to raise to within 24 feet of the surface. From the surface, this net appeared to be set correctly, but the sonar indicated it was not. A Kemmerer water bottle can be seen in Figure 2(C) being lowered to the desired depth of 93 feet, and then raised to the surface.

A fair degree of accuracy can be attained in the recognition of fish species and their approximate size by comparing catch data and sonar records. Such records of fish concentrations were recorded in Flathead Lake and are shown in Figures 3, 4, 5, and 6. Big fish tend to give a larger and darker mark, often causing an inverted "V", as shown in Figure 6. Here netting showed a predominance of eight to ten pound Dolly Varden or lake trout and 1-pound lake whitefish near the bottom. Some kokanee were taken above 42 feet.

Only one station was sampled south of the area known as "The Narrows". This station was located in the narrow channel that carries the majority of water that passes through the lake to the outlet at Kerr Dam. Some temperatures, water chemistry, plankton and bottom fauna data were collected south of this station but are not included in this report.

The coordinating phase of the project was continued by keeping in contact with the personnel in charge of various studies on the lake. Several meetings were attended during the year to discuss mutual findings and progress of the present studies. Plankton and water samples have been collected, preserved and presented to students at the Unitersity of Montana's Biological Station located at Yellow Bay. The report containing the analysis of these samples is not completed.

SAMPLING RESULTS

Fish sampling was accomplished by gill netting during three seasons chosen to fit the conditions of the lake. The seasons sampled were: February-March, June-July-August, and November-December.

The first sampling series consisted of test netting only, with the results used to determine the netting material necessary to sample this lake. The major ecological areas were sampled; however, these sets were located primarily in the northern half of the lake. The results of this series was limited because of the experimental use of various types and kinds of nets. Nets were fished at depths ranging from 120 feet to the surface and varied in length from 100 to 1,450 feet. The net material ranged in depth from 6 to 40 feet. Mesh sizes varied from 5/8 inch to 6 inches.

The average catch per net, January through April, was 12.3 fish. Percent of total catch by species was as follows: lake whitefish 53.1, northern squawfish 20.4, Dolly Varden 13.3, pygmy whitefish 8.8, and longnose sucker 4.4.

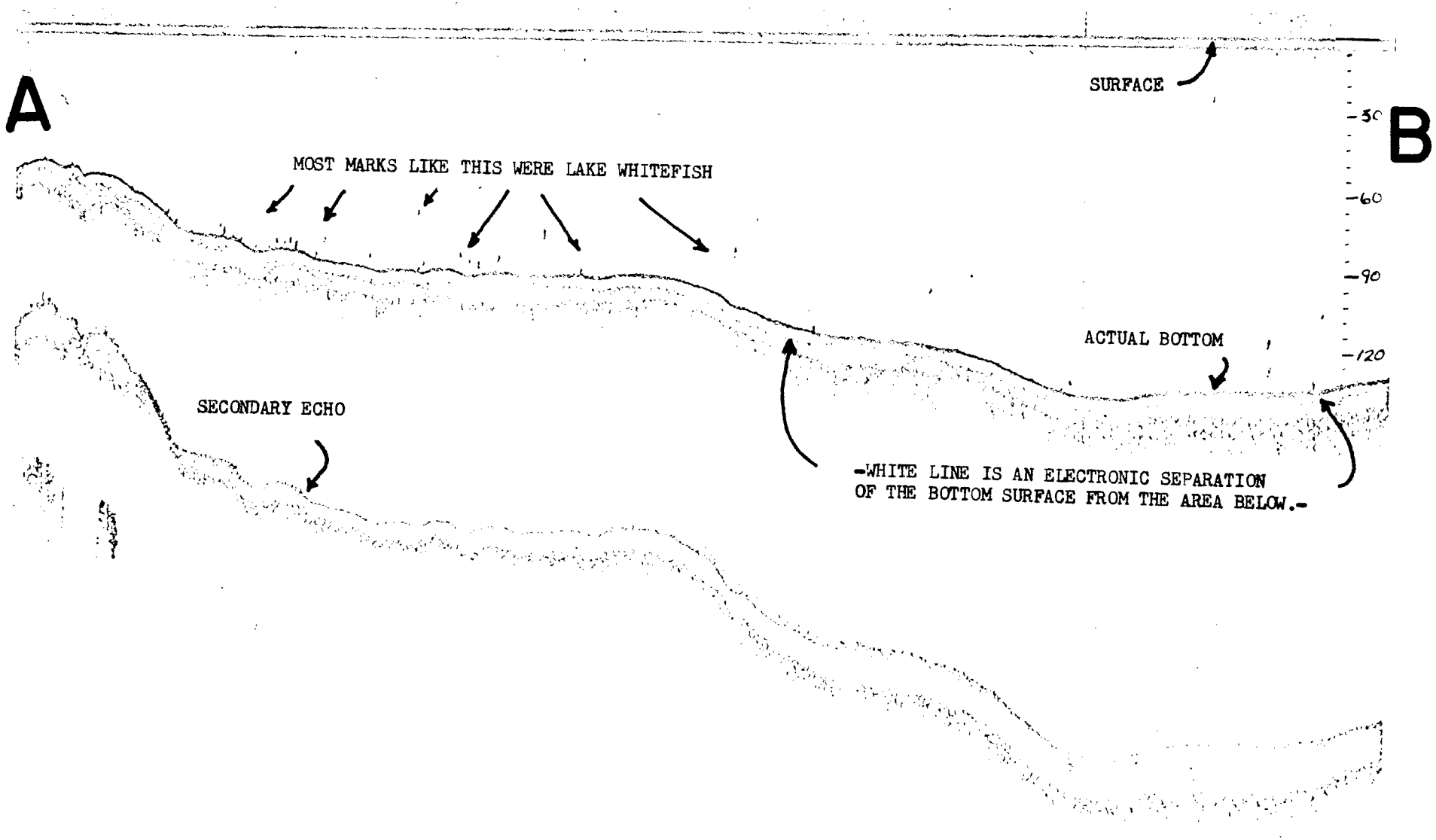

Figure 3. A sonar record illustrating a concentration of lake whitefish in 90 feet of water. Points A to B covers approximately 1-1/2 miles. April 5, 1967

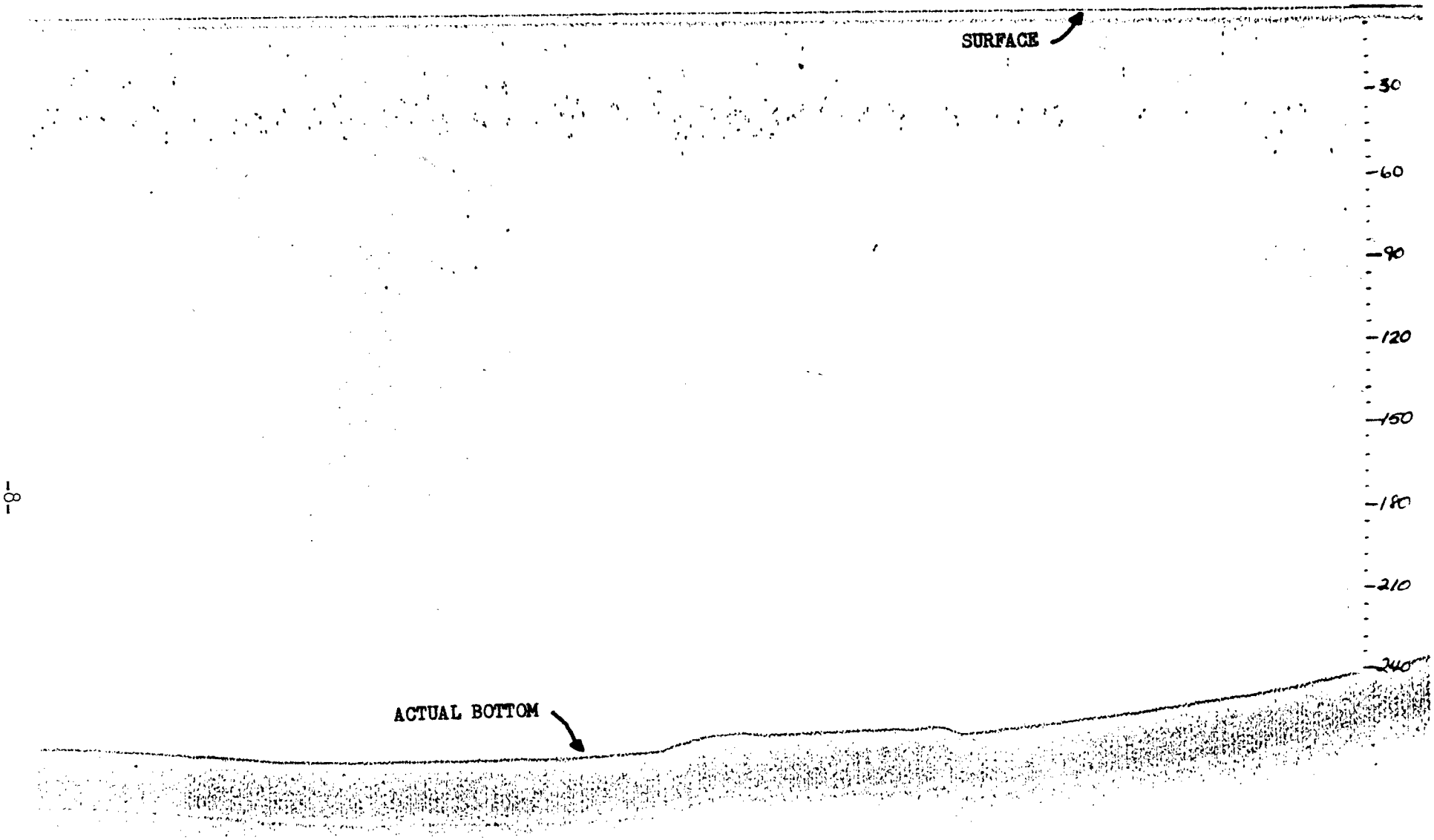

Figure 4. A 2-mile run in the deep pelagic area illustrating the layer of kokanee between 24 and 48 feet of water. Maximum bottom depth is 270 feet. July 7, 1967.

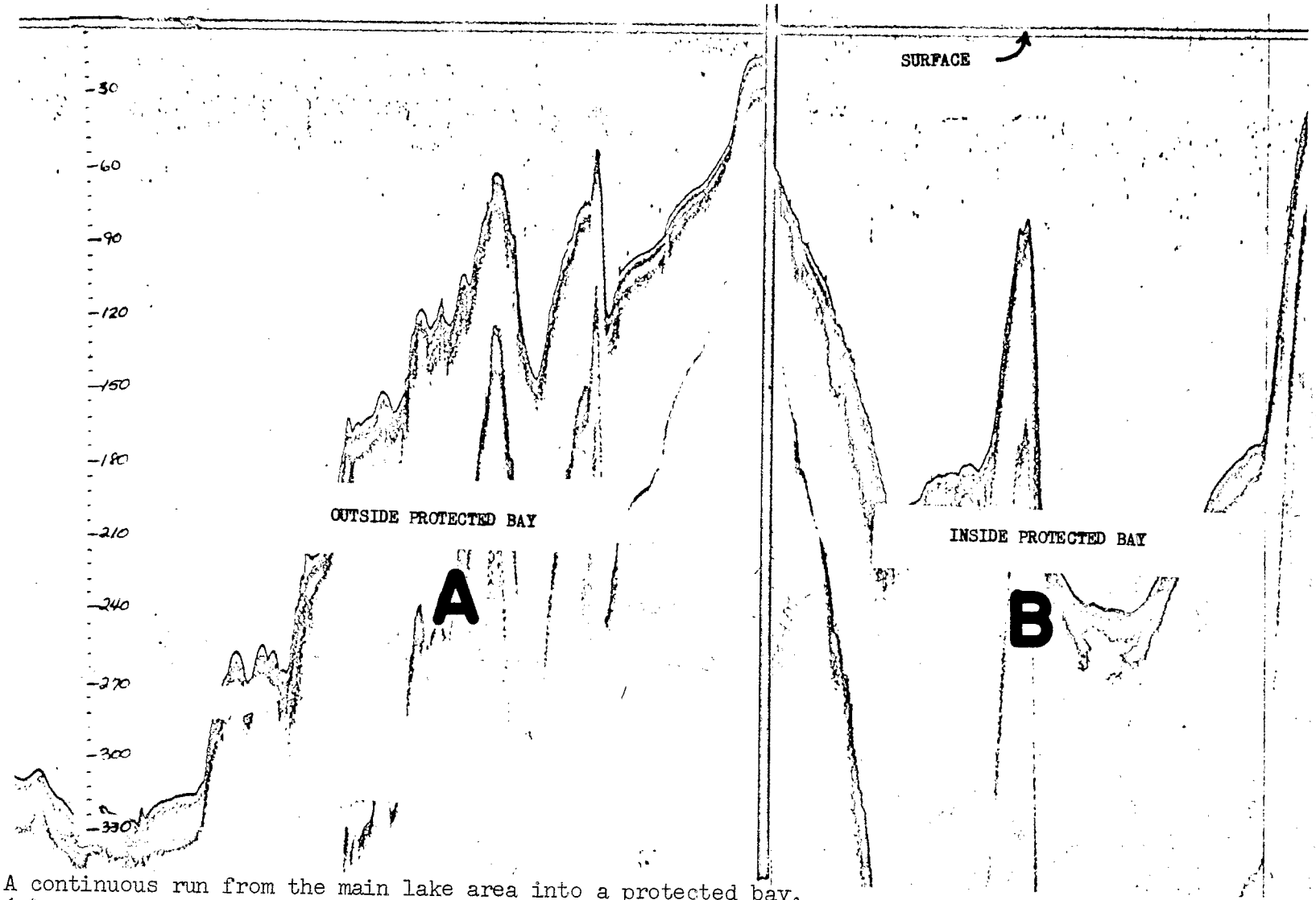

Figure 5. A continuous run from the main lake area into a protected bay. (A) A 1/2-mile run outside the bay area. (B) A 1/2-mile run inside of a protected bay. NOTE: the kokanee outside the bay are found between 24 and 48 feet; inside they lie between 30 and 84 feet. August 2, 1967.

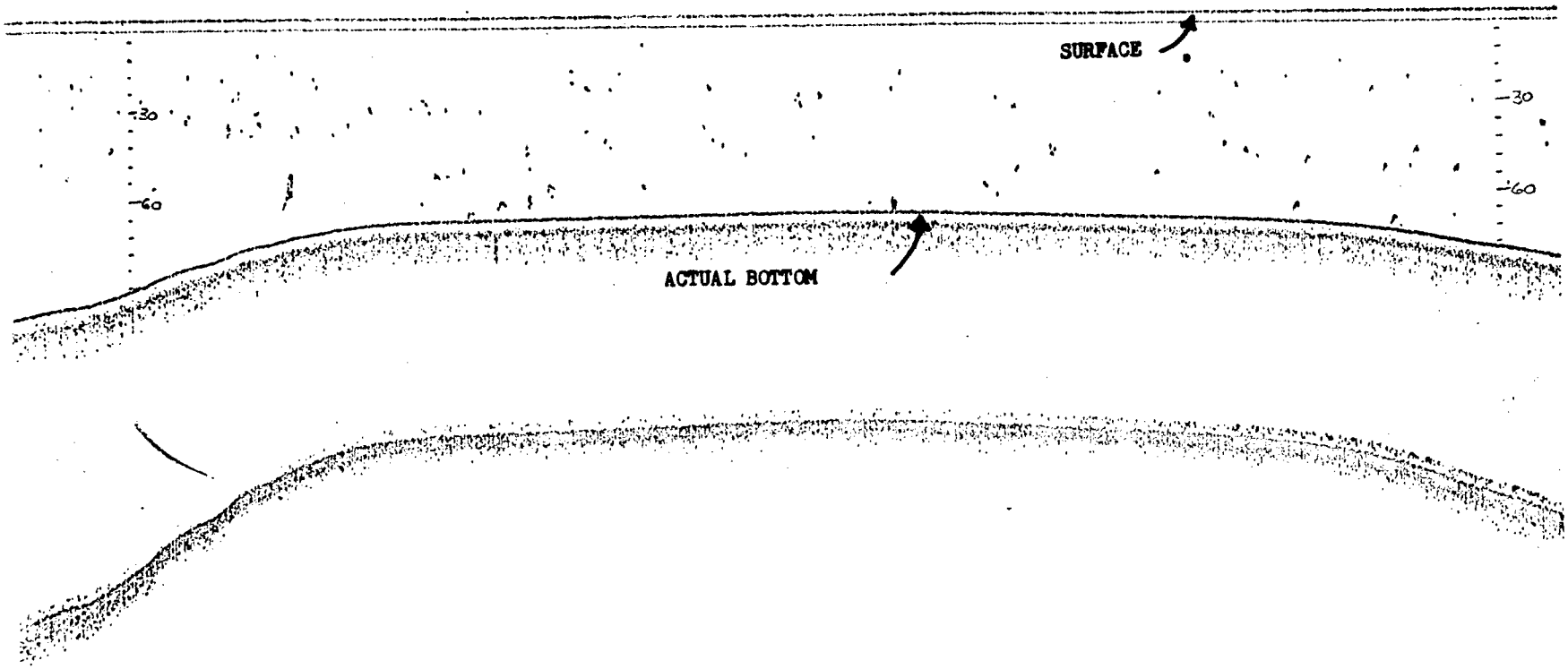

Figure 6. A 2-mile run on a bar area in the northern portion of the lake off the mouth of the Flathead River. This is a popular fishing area for kokanee which were found in a layer between 24 and 42 feet. Dolly Varden and lake trout can be seen near the bottom of the bar. Water depth on the bar is 72 feet. September 28, 1967

The second sampling series started in June and ended in August with ten stations sampled. The stations in this series were considered representative of the major environments of the lake. Net sets were constant during this series. The basic net used was 650 feet long and contained the following sections: 200 feet by 6 feet with 100-foot of 5-inch and 100-foot of 6-inch mesh; 100 feet by 8 feet with 50-foot sections of 5/8 and 1-1/4 inch mesh; 250 feet by 8 feet with 50-foot sections of 1-1/2, 2, 2-1/2, 3, and 4-inch mesh; 100 feet by 24 feet deep with 25-foot sections of 1, 2, 3, and 4-inch mesh. Three suspended sets were made between 30 and 60 feet from the surface to specifically collect samples of kokanee.

The average catch per net, June through August, was 21.4 fish. Percent of total catch by species was as follows: lake whitefish 31.3, kokanee 18.7, Dolly Varden 17.8, pygmy whitefish 13.1, squawfish 8.4, longnose sucker 3.7, lake trout 2.8. Peamouth, largescale sucker, yellow perch and mountain whitefish represented 3.2 percent, collectively. The first records of pygmy whitefish in Flathead Lake were taken in the nets and verified by Dr. C. J. D. Brown.1/ These fish were collected in most of the areas sampled. They ranged in size from 3.5 to 7.5 inches. All specimens were taken in the fry net (5/8 and 1-1/4-inch mesh). The depths at which they were taken ranged from 6 to 120 feet, but rarely more than 5 fish were taken per 100 feet of net.

There were no fish taken in the total of 3,000 feet of 5 and 6-inch mesh fished during this season. These nets were always attached to the other sample nets that were catching fish. All kokanee of the maturing size, 8 to 11 inches, were collected in the 2-inch mesh sections of the nets.

Depth preference by species was illustrated by the catch of the 24-foot deep net. The bottom 8 feet of the net collected 95 percent of the lake whitefish, 90 percent of the Dolly Varden and 80 percent for squawfish whereas 80 percent of the kokanee were taken in the top 8 feet. Occasionally squawfish and Dolly Varden were taken in the middle and top sections.

The third sampling series was conducted during November and December. This included the sampling of six stations with the standard net described in techniques used. The design of this net was based on techniques developed during earlier netting periods. Sampling had to be terminated early because of icing conditions that hampered the use of the 35-foot research boat. Areas sampled were in the northern half of the lake and included most of the deep, pelagic stations. Fish sampling was continued during the winter period by using a 14-foot boat. The use of the 24-foot net had to be discontinued because the nets were being pulled by hand. The results of this netting will be presented in the next segment of this project, F-33-R-3.

1/ Professor of Fisheries, Montana State University, Bozeman, Montana.

The catch of the standard nets, November and December, averaged 50.0 fish per net. The catch by species was: lake whitefish 62 percent, Dolly Varden 13.9 percent, kokanee 11.9 percent, squawfish 7.6 percent, pygmy whitefish 3.6 percent, and 1.0 percent for longnose sucker and peamouth, collectively.

The three netting series, indicate a wide range in both seasonal and area distribution for the Dolly Varden and lake whitefish. All bottom net-sets contained at least one specimen of these species. The lake trout distribution was limited to three areas of the lake, 1) on the delta bar off the Flathead River, 2) in the vicinity of Wild Horse Island in the southern area of the lake, 3) in Skidoo Bay. No juvenile lake trout have been taken in the nets, or by fishermen.

Discussion:

A summary of the seasonal limnological conditions in the lake was prepared from: netting results, interpretation of sonar recordings, analysis of water samples, and comparisons of water temperature profile data.

Winter (October 1966-March 1967)

Prior to this sample period, surface water temperatures reached the maximum summer temperatures of 70° F. on September 7, 1966. Also, kokanee concentrations were found to frequent the depths between 24 and 45 feet during September. December temperatures were characterized by being homothermous at 40° F. The lake waters remained homothermous but progressively cooled during the next three months. Water temperatures for these months were as follows: January 39°, February 37°, and March 35° F.

Chemical stratification during this season was not indicated. The pH readings ranged between 7.4 and 8.2. Readings above 8.0 were taken during the October sampling. Readings less than 7.7 units were taken from December through March. The percent of saturation of dissolved oxygen ranged from 88 to 112 percent, and averaged 97.0 percent. One fourth of the oxygen readings had saturation levels over 100 percent. Standard conductance readings varied throughout the season from 157 to 164 micromhos/cm. Total methyl-orange alkalinities averaged 88.5 ppm and showed a progressive seasonal increase from 84 to 96 ppm. There was no indicate of phenophthalein alkalinity.

Summer (July-September 1967)

The distribution of kokanee during early July was spread over the entire southern two-thirds of the lake. These salmon were concentrated in a layer of water between 24 and 40 feet below the surface (Figure 4). A number of large lake trout, large Dolly Varden and lake whitefish were found to have moved onto the delta bar, in water depths from 60 to 90 feet, off the mouth of the Flathead River and remained there through September (Figure 6). Kokanee were found directly above this same bar area but were noticeably absent on

either side. The rough fish (squawfish, longnose sucker, peamouth and redside shiner) were starting to concentrate in littoral areas; none were found in waters deeper than 90 feet. Water temperatures were starting to stratify, with the upper limits of the thermocline forming at 28 feet. Surface temperatures reached 68° F. while waters within the thermocline ranged between 48 and 63° F.

Surface water temperatures during August rose from 68 to 73° with the thermocline becoming well established over most of the lake. As the surface temperatures warmed the upper limit of the thermocline dropped to 38 feet or 10 feet deeper than July. The over-all depths from top to bottom of the thermocline remained the same, 15 feet. Kokanee became more concentrated during this period and could be found at depths between 36 to 48 feet. This layer of kokanee showed a similar drop in depth as did the limits of the thermocline. This layer was 12 feet deeper than the level found in July. Heavier concentrations of salmon were located over shallow bars and in waters near the shoreline drop-offs. A number of mature sized (20-25 inches) Dolly Varden taken in August showed no signs of gonadal development.

In September surface temperatures started to cool, dropping to 68° F. from the summer's high of 73°. The thermocline continued to sink another 10 feet this month. The salmon concentration level again dropped and was found between 42 and 60 feet. The first run of mature kokanee entered the lower portions of the Flathead River. Two other large concentrations of kokanee were located off the mouths of the Swan and Flathead Rivers.

The pH values remained relatively constant during the summer period with a range from 7.9 to 8.1. Subsurface measurements were less than those at the surface, but there was never more than 0.2 of a unit separating the two measurements.

Little change was noted during the summer readings in percent of dissolved oxygen saturation. The surface and subsurface samples averaged 102 and 90 percent, respectively. Standard conductance readings ranged from 111 to 207 micromhos/cm. with the low in July and high in September. The total alkalinity (methyl-orange) during the summer averaged 91.0 ppm. This was a slight rise from the winter average of 88.5.

Spring turbidities decreased rapidly as the run-off decreased and surface samples averaged 5 JTU (Jackson Turbidity Units) by mid-July. Subsurface turbidities in July were higher than surface readings indicating the effects of currents in the lake.

The subsurface turbidities extended into the lake beyond the point where river currents could be detected visually. Seechi disc readings ranged from 2 feet in July to 34 feet in September.

Winter (November-December)

Water temperatures reached a homothermous condition prior to the sample period. The lake water cooled slowly during the period from 45 to 42° F. but remained homothermous. A definite drop in pH units was noted during the season. The winter range was 7.5 to 7.6 compared to the summer range of 7.9 to 8.1. Data from the three sample periods indicate pH values in the lake will range between 7.3 and 7.7 from November through May, then rise and maintain a level between 7.9 and 8.3 from June through October.

During the winter period dissolved oxygen concentrations remained constant with an average of 85 percent of saturation. Standard conductance readings dropped during the season from 193 to 166 micromhoms/cm. Total alkalinity also dropped from 92 to 82 ppm.

The last spawning salmon were found in early December in the lower parts of the Flathead River and in the spawning areas of the northern half of the lake. The largest concentrations of mature kokanee (including spawned-out fish) continued to congregate near the mouths of the Swan and Flathead Rivers. Most gravel and spring areas along the shoreline attracted some spawning kokanee during the three month spawning period (mid-September through mid-December). Heavily used shoreline areas were primarily in Woods, Yellow and Skidoo Bays. Spring areas south of The Narrows seldom attract spawning salmon; however, some kokanee did utilize the spring areas near the Polson golf course. This was the first record in ten years of spawning kokanee in this area. The wide spread spawning activities of the salmon attracted numerous predacious Dolly Varden and lake trout. Examinations of the stomachs of the Dolly Varden and lake trout showed them to be feeding exclusively on the dying salmon.

Very few fish were sampled or appeared on the sonar recorder in the open areas of the lake during this winter season. Several schools of lake whitefish and squawfish appeared in the vicinity of the mouths of the Flathead and Swan Rivers in November and remained there through the season.

Prepared by: Delano A. Hanzel

Approved by: George D. Holton

Date: April 20, 1969

Water referred to:

7-6400