MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION
JOB PROGRESS REPORT

STATE: Montana PROJECT TITLE: Lake Fisheries Inventory

PROJECT NO. F-33-R-21 JOB TITLE: Measure annual trends in the recruitment and migration of kokanee populations and identify major factors affecting trends.

JOB NO. I-b

PERIOD COVERED: July 1, 1986 to June 30, 1987

ABSTRACT

A weighted average of 25.01 fish/surface acre (sa) was calculated from acoustic fish data collected from 11 established transects covering 96.6 kilometers during August and September. This density represents 20.90 fish/sa of "small" salmon ranging from 203 to 305 mm and 4.11 fish/sa of "large" fish ranging from 305 to 430 mm. Expansion of these densities would project the fall lake salmon population to be 2.25 million fish with 0.4 million adult sized fish.

Four-year old salmon predominated in both river and lake areas, comprising 90 percent of the total. The average length of the mature lake and river males was 400 mm and 389 mm, respectively. The 1986 average size of mature salmon in Flathead Lake was 8 mm larger than the 1985 measurement and represented the largest size salmon in 35 years of record.

Summer angling success of 0.2 fish/hr for salmon was considered below the "normal" catch rate of approximately 1.0 fish/hr. The winter salmon fishery in Skidoo Bay was closed to fishing from March through April, 1987 to conserve numbers of 1987 spawners.

The replacement boat for the "Dolly Varden" was delivered during May, 1987. Initial work involved installation of new acoustic sounder and outfitting the boat for mid-water trawling.

BACKGROUND

Flathead Lake in northwest Montana is the state's largest (126,000 surface acres - maximum depth of 386 feet) and one of the most important fishing lakes (Hanzel, 1986a). The lake is part of a large interdependent lake-river system that contains populations of migrating salmonids. This system offers the public a national renowned lake and stream fishery along with many other types of water-based recreation amidst a setting of beautiful mountains. The fishery depends almost entirely on natural reproduction and recruitment from the lake and tributary system. The 130 miles of shoreline offers protected bays along the west shore with the east shore characterized

by steep precipitous slopes that drop into a 300-foot trough which parallels this shore. The southern half of the lake lies within the boundary of the Confederated Salish and Kootenai Indian Tribal Reservation. Kerr Dam, a 204-foot private hydropower facility, located a short distance downstream from the natural lake outlet at its southern end isolates the lake from the lower part of the watershed. This facility through agreement regulates the year-around lake level within a prescribed maximum drawdown of 10 feet.

Kokanee have provided a popular summer troll fishery in the lake since their establishment in 1933 and presently support the second highest fishing pressure of any lake in Montana. It is estimated that between 130,000 and 170,000 angler days of fishing pressure are expended annually on the lake resulting in a harvest ranging from 300,000 to 540,000 salmon.

The Department has used hydroacoustic techniques since 1979 to measure annual trends in the salmon population and used yearly measurements of age and growth on the year classes of salmon in the lake to assess population changes of the fish.

Since 1978, the Department has coordinated and cooperated with environmental studies (Graham et al. 1980) of the fisheries of the upper Flathead River system and the lake proper. These studies were designed to investigate the life histories of the fishes of the system and evaluate the impacts of hydro develop-ment upon the recruitment and migration of Flathead Lake salmon.

OBJECTIVES

It shall be the primary objectives of the job to establish relative abundance of the six major fish species with the present segment emphasizing kokanee and to identify the environmental factors affecting population changes.

PROCEDURES

Population density estimates of kokanee 203 mm and larger were made in the fall using the hydro acoustical technique and transects described by Hanzel (1984). This method has been used annually to establish population indices since 1979. Acoustical transects are measured during August and early September during the dark hours, a time when salmon show the most uniform distributional pattern.

Acoustical fish data, measured over 96.6 kilometers were collected and recorded on magnetic tape while traveling at 3.1 m/second. The acoustical data represent information from all major fall salmon habitats (Hanzel 1984). Fish numbers were enumerated using the "direct count" method by playing back acoustic signals on a delayed-sweep oscilloscope. Size of fish (small 203-305 mm and large 305-430 mm) were separated by signal strength differences.

Densities were calculated from number of fish targets by 3.67 m intervals, from depths between 7.3 and 43.9 m below the surface.

The retirement of the research boat, the "Dolly Varden", during July, 1985, required the collection of acoustical data with a portable acoustic system aboard a 24-foot jet powered boat. A new sounder was purchased and was used to collect the 1986 acoustic data. The sounder (BioSonic Model 105) emits 420 KHZ signals from a 15 degree beam transducer. The use of the jet boat did not allow opportunities for mid-water trawling, thus there was no concurrent verification of fish size to acoustic signal strength. Fish sizes were established by using the last verified trawl data collected during the fall of 1984. Fish target numbers, by size from all transects, are stored in the regional computer system. Calculations of the weighted average of salmon numbers were accomplished with the aid of the computer program described by Hanzel (1984). The program averages fish densities along each transect and then accumulates a weighted average of all transects for the entire lake.

Density information will be presented in fish/surface acre, however, the following equations allow for conversion of data to other density measurements:

Fish/100 m^2	=	Fish/surface acre ÷ 400.5
Fish/hectare	=	Fish/100 m^2 x 100
Fish/hectare	=	Fish/surface acre x 2.4691

Creel checks were made in the popular kokanee areas (Hanzel 1983) during the summer (July-August) and in Skidoo Bay during the winter (January-February) to obtain scale and otolith collections that were used to establish the 1986 growth analyses. Sampling of mature kokanee for collection of otoliths was accomplished by gill nets, beach seines, and electrofishing equipment. Sampling sites included six lakeshore and three river spawning areas:

Lake areas	River areas[1]
Bigfork Bay	House of Mystery (45/72)
Crescent Bay	McDonald Lake (Outlet) (63/108)
Blue Bay	McDonald Creek (60/97)
Gravel Bay	
Pine Glen	
Thurston's	

[1]Numbers in parentheses indicate (miles/kilometers) that the site is upstream from the mouth of the river.

All age measurements from the scale and otolith collections are stored in the regional computer system and were analyzed using the programs developed by Hanzel (1984).

FINDINGS

Population Density Estimate

Eleven acoustical transects were used to establish the 1986 population estimate. These transects have been used since initiating the annual population trend estimate in 1979. Acoustical data were collected on three nights between August 26 and 28 and on September 24. An average of 25.01 fish/surface acre was calculated from the eleven transects. This density represents 20.90 fish/sa of "small" salmon and 4.11 fish/sa of "large" salmon. Kokanee distribution, during the fall acoustic survey, occupies approximately 90,000 surface acres (72 percent of the total lake area). Expansion of the density figures would set the 1986 lake salmon populations at 1,881,000 small fish and 369,900 large fish for a combined total of 2,250,900 salmon.

During this survey period, fish concentrations found in the south half of the lake (transects 7-11) and in the extreme northern areas (transects 1-2) were higher than those found in the mid lake areas (Table 1). Higher concentrations of fish have persisted in the southern areas of the lake since 1983, whereas, prior to this time northern concentrations were either similar to or higher than densities in the southern areas. The highest concentration of small fish (60.43 fish/sa) occurred along the 1986 Transect No.1. This area is located in along the northwest area of the lake and represented 9.3 percent of the total transect survey time. This density was 4.4 times the 8-year average density for small fish of 13.60 fish/sa.

Table 1. Density (fish/surface acre) estimates of small and large sized kokanee by transect and weighted average for Flathead Lake, 1986.

Transect No.	Small Fish Fish/sa	Large Fish Fish/sa	Total Fish Fish/sa
1	60.43	9.41	69.43
2	26.54	3.71	30.25
3	7.76	2.15	9.91
4	8.00	0.83	8.83
5	9.23	1.67	10.39
6	8.57	1.75	10.32
7	17.08	2.59	19.67
8	32.36	6.94	39.30
9	22.08	6.99	29.07
10	23.02	7.16	30.18
11	17.34	7.80	25.14
Weighted Avg.	20.90	4.10	25.00

It should be noted at this time that the 1986 acoustic estimates were made without the vertification of fish sizes with by trawling. The unusually high numbers of small fish in the northern transects then might suggest that more than one age class of fish is included in this figure.

The 1986 density of large fish targets decreased in abundance by 1.45 fish/sa compared to the 1985 data and also dropped of 1.22 fish/sa less than the 8-year average of 5.32 fish/sa. The only lower large fish density occurred in 1983 when 1.58 fish/sa was recorded.

Juvenile fish were in the northern areas of the lake during November and information on densities will be fully analyzed when acoustic data can be again verified with mid-water trawling catches.

1986 Age and Growth Analysis

Annual growth analyses of kokanee scale and otolith collections from Flathead Lake have been made since 1972 and provided a basis to compare growth and age composition as the population changes. Summer growth by age-class and sex are measured from scales while age at maturity, size and age-class composition at specific spawning areas are estimated from the otolith bones.

Scale Interpretations

A total of 63 scale samples from adult kokanee were collected and will be used to establish the 1986 salmon growth.
Samples of juvenile salmon were collected with gill nets and in a fixed frame trawl in conjunction with the BPA contract fisheries study on the lake. The age and growth analysis is not presented in this report but will be included with the combined scale data from both adult and juvenile salmon in the 1986 BPA contract report (Effect of Operation of Kerr and Hungry Horse Dams on the Reproductive Success of Kokanee in the Flathead System).

Otolith Interpretations

Age compositions of mature salmon were determined from 202 otolith bones collected on 9 major spawning sites. These sites represented 3 river and 6 lakeshore spawning areas. Four-year old salmon predominated in both the river and lakeshore areas and represented 92.3 and 85.5 percent of the total, respectively. Other ages and their relative contribution are 2.8 and 9.3 percent of the total for ages 3 and 5 year old salmon. The 1986 predominance of four-year old fish was slightly less than their predominance in 1985 of 95.0 percent and is the third year that the predominance of an age group was so strong in both the river and lake spawning areas. The trend in predominance has shifted from a 50-50 predominance of 4- and 5-year old fish to the predominance by 4-year old salmon. Impacts of success or failure from the recruitment of a strong predominant spawning age group would be far more dramatic than would result from a multi-age spawning group.

Size at Spawning

Previously the combined average length of all ages of male and/or female salmon was used to indicate the annual size of a specific spawning year. However, this figure reflects relative strength of several year classes; a better size indicator would be represented by the average size of the dominant age group and for Flathead Lake that would be the 4-year old salmon.

The average size of four-year old males in the lake was 400 mm while river males averaged 389 mm, representing the largest fish since 1970. Average lengths of four year-old females was also the largest on record with 384 mm and 365 mm for lake and river fish, respectively. The size range of all ages of 1986 spawners varied from 320-457 mm. Since measurements of spawning females salmon proportionately represents less variability in average length caused by dimorphic body changes their measurements will be use to compare size changes between years. Past female length data has shown a progressive increase in size of Flathead salmon (Figure 1.). Size of spawners decreased only four times during the past 16 years; in 1973, 1976, 1983 and 1984. The past length data also shows how consistant the size differs between the lake and river spawners and how each reflect the same general change in size.

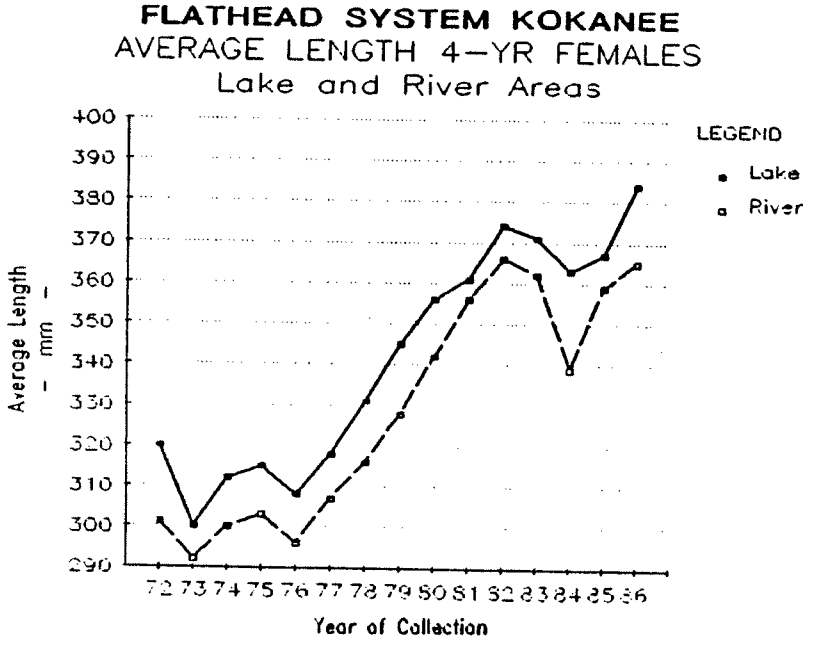

Figure 1. Average lengths (mm) of 4-yr old female kokanee from Flathead Lake and River spawning areas, 1972-1986.

Angling Census

A total of 149 lake anglers, fishing in popular kokanee areas, were interviewed on 7 days during July-August to establish the annual angling

success and to collect age and growth information. These anglers represented 73 parties that fished a total of 347.8 hours and caught 63 fish for a catch rate of 0.18 fish/hour. Salmon represented 69.8 percent of the fish caught. Other fish caught included lake trout, cutthroat trout, lake whitefish and bull trout in decreasing order of catch. The highest success rate of 0.20 fish/hr occurred during early July; thereafter the rate continue to deteriorate to a low of 0.02 fish/hour. The average length of summer caught kokanee was 356 mm and ranged in size from 281 to 420 mm.

The winter fishery for salmon in the SW Bay (Skidoo Bay) was monitored through the cooperative BPA contract study on the lake prior to the salmon fishing closure on the lake on March 1, 1987. This closure was implimented to conserve the numbers of salmon since acoustic estimates showed large fish numbers to be lower than 1985. The winter salmon averaged 307 mm in length and 253g. Males were slightly larger (7 mm) than the females caught in Skidoo Bay.

The 1986 Flathead Lake adult kokanee population would be classified "low" or "below average" when comparing angling success of the past. The 1985 salmon population was classified as near "normal" when 0.8 fish/hour were reported by Hanzel (1986a and 1986b). During "normal" years summer salmon angling success averages about 1.0 fish/hour. The slight decline of the 1986 fall acoustic densities of large fish targets did not reflect the "low" 1986 lake kokanee population, suggesting the need for an earlier population indicator prior to the time that the early river-run salmon leave the lake. However, the higher estimates of small fish targets suggests a recovery to "normal" or "above normal" for the 1987 and/or 1988 adult kokanee numbers.

Boat Replacement

The requisition and purchase order for a replacement boat for the "Dolly Varden" were prepared June, 1985 with the boat being projected to be available by the late fall of 1986. Problems with establishment of performance bonding and final bid acceptance delayed the delivery of the boat until May,1987. Initial work of installation of present fish sampling equipment and new sounder, then the calibration of new and old methods was accomplished. The replacement ship is an all-aluminum hull 26 feet in length and is driven by 350 HP gas power I/O unit. The boat is equipped with a swing-down mast and boom assembly which allows for easy trailering. The original hydraulic powered winch on the "Dolly Varden" was installed on the deck for retrieving the trawl or towing lines.

RECOMMENDATIONS

The age and length of spawners, creel composition, growth analysis and acoustic density estimates collectively provide an index of Flathead Lake kokanee. These parameters were monitored from 1972 to 1983 to establish a baseline from which changes can be determined. Each parameter described specific conditions about the kokanee and assisted in interpreting population changes.

Present trends in the kokanee populations are unstable as they respond to improved river spawning conditons resulting from stabilized flows in the Flathead River. A continuation of the monitoring of salmon population parameters in the lake would aid in interpreting and evaluating the salmon status during the recovery period. Continued monitoring would also aid in evaluating salmon density and/or growth responses to impacts resulting from fluctuating lake levels upon lakeshore spawning areas or possibly to the rapidly increasing numbers of Mysis shrimp in the lake.

It is recommended to continue to monitor the following kokanee population parameters:

1. Age composition of lake and river spawners
2. Lake creel age compositions
3. Fall acoustic density estimates
4. Annual growth

It is recommended to continue monitoring of indices until the collective salmon studies in the basin arrive at a kokanee management plan to supply numbers that will maintain a fish that averages 356 mm in length and produces a summer angling success rate of 1.0 salmon/hour.

It is further recommended to develop acoustic techniques to measure densities of spring juvenile salmon and early-run river salmon while still in the lake. These data combined with the fall estimates will provide a total salmon population indicator and allow for determining lake mortality by year class.

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Date: August 26, 1987

Waters referred to : Flathead Lake 07-6400-01
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