Ket ID 86174

MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS
FISHERIES DIVISION

JOB PROGRESS REPORT

State: Montana

Project No. F-33-R-20 Title: Lake Fisheries Inventory

Job. No. I-b Title: Measure annual trends in the recruitment and migration of kokanee populations and identify major factors affecting trends.

Period Covered: July 1, 1985 to June 30, 1986

ABSTRACT

A weighted average of 15.77 fish/surface acre (38.94 fish/hectare) was calculated from acoustic fish data collected from 11 established transects covering 60 miles (96.6 kilometers) during September. This density represents 10.22 fish/sa (25.23 fish/ha) of "small" salmon ranging from 8 to 12 inches (203 to 305 mm) and 5.55 fish/sa (13.71 fish/ha) of "large" fish ranging from 12 to 17 inches (305 to 430 mm).

The 1985 density figure was one of the lowest values measured since the indices were started in 1979 and closely resembles the 1981 estimate. Densities in southern areas of the lake were nearly twice those of the northern areas.

Average size of 3-, 4-, and 5-year old salmon was 9.4 inches (238 mm), 12.5 inches (317 mm), and 13.7 inches (348 mm) respectively. Actual growth increments during the four-month growing period (spring to fall) ranged between 0.9 and 1.3 inches (23 and 32 mm).

Four-year old salmon predominated in both river and lake areas, comprising more than 95 percent of the total. The average length of the mature river and lake males was 14.5 inches (369 mm) and 15.1 inches (383 mm), respectively. The 1985 average size of mature salmon in Flathead Lake was 0.3 inches (8 mm) larger than the 1984 measurement.

Abnormally cold weather during November caused the lake to cool rapidly and completely freeze over by January 2, 1986. The lake remained frozen for 79 days. This is the earliest "freeze" date on record and represents the first occurrence of ice-cover during consecutive years.

BACKGROUND

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 establish 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 development 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 10 inches (254 mm) and larger were made in the fall using the hydro-acoustical technique described by Hanzel (1984). This method has been used annually to establish population indices since 1979. Acoustical transects are made in early September during the dark hours, a time when salmon show the most uniform distributional pattern.

Acoustical fish data, measuring over 60 miles (96.6 kilometers) were collected and recorded on magnetic tape while traveling at 6.9 miles/hour (3.1 m/second). The acoustical data represents 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 8-12 inches (203-350 mm) and large 12-17 (305-430) inches] were separated by signal strength differences. Densities were calculated from number of fish targets by 12 foot (3.67 m) intervals, from depths between 24 and 144 feet (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 the portable system aboard a 24-foot jet powered boat. The use of this boat did not allow opportunities for mid-water trawling, thus there was no concurrent verification of acoustic signal strength to fish size. 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 average fish densities along each transect and then accumulates a weighted average of all transect for the entire lake.

Creel checks were made in the popular kokanee areas (Hanzel 1983) during the summer (July-August) and in Skidoo Bay during the winter (December-March) to obtain scale and otolith collections that were used to establish the 1985 growth analyses. Sampling of mature spawning kokanee for collection of otoliths was accomplished by gill nets, beach seines, and electrofishing equipment. Sampling sites included seven lakeshore and four river spawning areas:

Lake areas	River areas	River Miles	(Kilometers)
Bigfork Bay	Brenneman Slough	22	(35)
Hatchery Bay	House of Mystery	45	(72)
Crescent Bay	Mouth of S.F.Flathead	50	(80)
Blue Bay	McDonald Creek	60	(97)
Gravel Bay			
Pine Glen			
Thurston's			

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, totaling 60 miles (96.6 kilometers), were used to establish the 1985 population estimate. These transects have been used since initiating the annual population trend estimate in 1979. Acoustical data were collected on four nights between September 3 and 17. An average of 15.77 fish/surface acre (38.94 fish/hectare) was calculated from the eleven transects. This density collectively represents 10.22 fish/sa (25.23 fish/ha) of "small" salmon and 5.55 fish/sa (13.71 fish/ha) of "large" salmon. During this survey period, fish concentrations found in the south half of the lake (transects 6-11) were higher than those found in the northern areas of the lake (Table 1). This trend was followed by both the numbers of small and large fish targets. This same pattern has persisted in the lake since 1983, whereas, prior to this time northern concentrations were either similar to or higher than densities in the southern areas.

Table 1. Density estimates of small and large sized kokanee by transect and weighted average for Flathead Lake, 1985.

Trans No.	Small Fish Fish/sa	Large Fish Fish/sa	Total Fish Fish/sa
1	12.29	5.21	17.50
2	9.62	2.38	12.00
3	9.89	2.80	12.69
4	8.00	1.99	9.99
5	10.07	2.75	12.82
6	10.26	5.50	15.76
7	3.45	4.46	7.91
8	10.78	9.54	20.32
9	14.93	14.31	29.24
10	13.87	10.33	24.20
11	11.15	12.76	23.91
Weighted Avg.	10.22	5.55	15.77

The following equations allow for conversion of density data into familiar surface area units:

Fish/hectare = Fish/100 m x 100
Fish/surface acre = Fish/100 m x 400.5
Fish/hectare = Fish/surface acre x 2.4691

The 1985 total fish density estimate was one of the lowest measured since acoustic population trends were established in 1979 (Figure 1). The 1985 estimate was 2.28 fish/sa less than the 7-year average of 18.05 fish/sa and closely resembled the 1981 estimate. Both years represent the lowest numbers of fish during the period of record. The 7-year average of small and large fish targets is 12.55 and 5.39 fish/sa respectively.

The 1985 number of large fish targets decreased 0.61 (11 percent) fish/sa while small fish targets dropped 0.20 (2.0 percent) fish/sa from the 1984 estimate. These decreases were disproportionate to the numbers of small to large fish. The proportion of small to large fish, during the 7 years of record was nearly 70 and 30 percent, respectively. The major exception to this norm composition was experienced in 1983, when small fish targets represented 91.4 percent of the total. This exception could possibly be masked by the inability to distinguish the small and large fish targets by target strength alone.

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

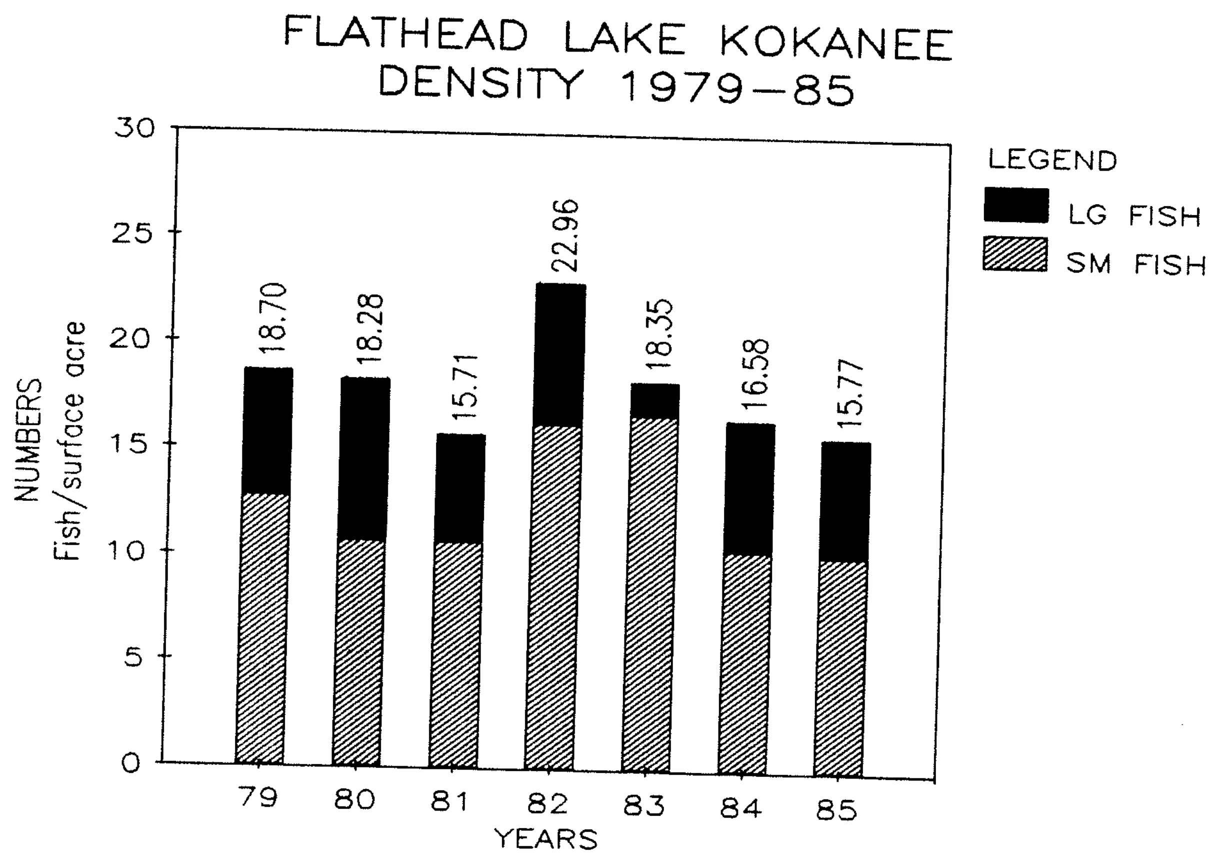

Figure 1. Annual fall density estimate of kokanee for large and small fish targets for Flathead Lake, 1979 through 1985. Numbers above bars are total densities of fish/surface acre.

1985 Age Analysis

Annual growth analyses of kokanee scale and otolith collections from Flathead Lake have been made since 1972 and provide a basis to compare growth 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 191 scales were used to establish the 1985 growth analysis. This analysis included 80 samples taken during the spring (February-April) and 111 samples taken during the summer (July-August). Four-year old (age III+) salmon was the predominant age group found in the creels of the anglers, representing 82.4 percent of the total. The remainder was represented by 15.8 percent three-year olds and 1.8 percent five-year olds. Yearling and two-year old salmon were not found in the creel and none were collected since no boat was available to operate the mid-water trawl.

Size ranges and average size (total length of fish at capture) of the three year classes represented were as follows:

Age Class	Range	Average Length
3	200-269 mm	9.4 in. - 238 mm
4	260-369 mm	12.6 in. - 320 mm
5	330-369 mm	13.6 in. - 345 mm

Since little overlap occurred between the size ranges of the age classes 3 and 4, size alone could identify age class 3 fish. Although the average size of the age 5 salmon was larger by 1.0 inch (25 mm) than age 4 fish, both ranges overlapped completely, and size could not be used to distinguish these age classes.

A comparison of average length of fish collected during the spring (January-March) and fall (July-August) of the 3 year classes did provide seasonal growth estimates. The seasonal growths were: 0.9 inches (23 mm) (18.25 percent); 1.3 inches (32 mm) (64 percent); and 0.9 inches (24 mm) (75 percent) for age class 3, 4, and 5, respectively. Spring samples showed the annulus to be forming with no new growth. Back calculated lengths were derived using the Monastyrsky technique, a logarithmic scale radius-body length relationship. This same technique was used by Hanzel (1984) in comparing growth of salmon from the lake from 1972-1983. A slope of 0.86373, developed from a sample of 4,836 scales representing six age groups, was used. A summary of this age analysis is presented in Table 2. These data did not include age calculations by sex since growth exhibited by the male and female salmon from the lake were similar (Hanzel 1984).

Table 2. Average total length at capture (mm), number of circuli to first annulus and average calculated length at annulus by age of kokanee in Flathead Lake, 1985. Figures in parentheses express annual incremental growth.

1985 Growth Summary

Age	No.	Average Length	Number of circuli to 1st annulus	Length at Annulus I	II	III	IV
3	35	238	19	106	232		
					(126)		
4	153	317	17	104	251	301	
					(147)	(50)	
5	3	348	16	104	228	298	330
					(124)	(70)	(32)
Total or Avg.	191		17	105	247	301	330
					(142)	(54)	(29)

Otolith Interpretations

Age compositions of mature salmon were determined from 561 otolith bones collected on 12 major spawning sites. These sites represented 4 river and 8 lakeshore spawning areas. Four-year old salmon predominated in both the river and lakeshore areas and represented 95.6 and 95.2 percent of the total respectively. Other ages and their relative contribution was 0.2 and 4.5 percent of the total for ages 3 and 5, respectively. The 1985 predominance of four-year old fish was stronger than their predominance in 1984 of 80 percent and is the first year that the dominance of any age group was so strong in both the river and lake spawning areas. Impacts of a strong dominant spawning age group on the lake population would be far more dramatic than would result from a multi-age spawning group, be that of either success or failure of their recruitment.

The average size of mature four-year old males in the lake was 15.1 inches (383 mm) while river males averaged 14.5 inches (369 mm). Average lengths of females from the lake followed the norm described by Hanzel (1984): "females lengths can be estimated by subtracting 0.6 inches (15 mm) from the length of males". The 1985 four-year old lake females averaged 14.4 inches (367 mm) while river females averaged 14.1 inches (359 mm).

The average size of the 1985 four-year males was 0.3 inches (8 mm) larger than the 1984 males and was 0.2 inches (4 mm) smaller than the 1982 and 1983 four-year olds.

Consecutive Ice-Cover Period

Extreme cold weather during December cooled lake temperatures abnormally early and the lake completely froze over on January 2, 1986. This is the earliest "freeze-up" date on record. The mid portion of the lake remained ice-covered until March 21, 1986, a period of 79 days, and was the first occurrence of complete ice-cover during consecutive years.

Boat Replacement and Lake Census

The requisition and purchase order for a replacement boat for the "Dolly Varden" were prepared with the boat being made available by the late fall of 1986. Initial work will be the installation of present fish sampling equipment and new sounder, then the calibration of new and old methods will be accomplished. The replacement boat will be 26 feet long, be constructed of aluminum, and be driven by I/O power unit. The boat will be able to be towed by a trailer.

The creel census data on kokanee and annual summer harvest information is included in the progress report for Job No. I-a, F-32-R-20.

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 increases in reproduction 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 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 control numbers that will maintain the kokanee fishery and other recreational aspects of the Flathead River Basin.

It is further recommended to develop acoustic techniques to measure densities of early-run river salmon while still in the lake.

LITERATURE CITED

Hanzel, D. A. 1984. Measure annual trends in recruitment and migration of kokanee populations and identify major factors affecting trends. Comp. Report. Montana Department of Fish and Game. F-33-R-18, Job I-b. 43p.

Graham, P. J., D. Read, S. Leathe, J. Miller and K. Pratt 1980. Flathead River Basin Fisheries Study. Montana Department of Fish, Wildlife and Parks. 168p.

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Waters referred to : Flathead Lake 07-6400-01
Flathead River 07-1560-01