

MONTANA DEPARTMENT OF FISH AND GAME
FISHERIES DIVISION

JOB PROGRESS REPORT

State Montana Title Flathead Lake Fisheries Studies
Project No. F-33-R-6 Title Age and growth analysis of fishes of
Job No. I-b Flathead Lake - Kokanee
Period Covered July 1, 1971 through June 30, 1972

ABSTRACT

Age assessments were made on a total of 412 kokanee collected from four major kokanee fishing areas during the summer of 1971.

The segment of the kokanee population that is being harvested by anglers is represented by 6.6, 58.2 and 35.2 percent of the age groups II+, III+ and IV+ annuli, respectively.

Age composition of two kokanee schools within a large bay were found to differ. One area (South Big Arm) contained a group of fish that was nearly equal in numbers of four and five year old fish while the other area (North Big Arm) had a predominance of four year old fish. All fishing areas showed a strong dependance on four year old fish for the bulk of their fishery.

Nearly all five year old fish were found to be mature while 82 percent of the four year old males and 71.4 percent of the four year old females were considered mature. The number of mature three year old fish was small. Eighty and one-half percent of the female kokanee and 84.5 of the male kokanee caught by anglers were mature fish.

Food analysis was made on 151 stomachs from kokanee caught by anglers from June 15 through September 22, 1971. The stomachs were primarily from four and five year old fish. Three large sized genera: Daphnia, Epischura and Leptodora, made up the bulk of the food for kokanee during this summer period. Changes in the diet during seven sample periods are illustrated.

BACKGROUND

Flathead Lake in northwest Montana is the state's largest and one of the most important fishing lakes. The fishery depends almost entirely on natural reproduction and recruitment from the lake and tributary system. This drainage system lies the headwater area of the Columbia River, in an area that is rapidly changing due to the development of its natural resources; water, timber and recreation.

This large lake contains 20 fish species. The knowledge of their habits and the relationship that exists between them, is essential to manage the fisheries resource. Determination of the age of fish is important because it is basic to assessing intra- and inter-specific relationships. Age determination, in conjunction with length and weight, relate to productivity.

Age and growth studies have been limited on this lake because of its large size and great depth and the difficulty of obtaining adequate scale samples. The recent fish sampling program, 1967 - 1970, systematically and seasonally sampled fish in the entire lake and provided the necessary scale collections for determination of basic age and growth of the major game fish species.

Age and growth analysis of the pygmy whitefish was completed and reported by Hanzel, 1972. The information will be published in Volume 71, No. 2 of the Fishery Bulletin as part of "The pygmy whitefish, Prosopium coulteri, in Western Montana," by G. F. Weisel, D. A. Hanzel and R. L. Newell.

OBJECTIVES

The objective of this job is to read, interpret, analyze and report on the six-year accumulation of scale samples collected during the systematic and seasonal sampling of fish on Flathead Lake. Additional sampling will provide growth information for present conditions on the lake. The initial work will include the analysis of the age and growth of the major game fish species, lake whitefish, kokanee cutthroat trout, Dolly Varden, lake trout and the pygmy whitefish.

PROCEDURES

Scale collections were taken from all kokanee gathered from gill nets and from fishermen creel checks. Kokanee caught in the nets were taken in the 1 1/2 and 2 inches stretch mesh measure sections. They ranged in size from 176 mm to 334 mm (6.9 to 13.2 inches) in total length. The fish caught by the fishermen fell within the same size range as the fish taken in the nets. The term fishermen used here shall refer to anglers either trolling or still fishing as opposed to snagging.

Fish were measured to the nearest millimeter in total length and weighed to the nearest gram. A scale sample was extracted from the fish in an area above the lateral line and just posterior to the dorsal fin. The scales were generally extracted from the fourth row of scales above the lateral line and stored in individual envelopes for each fish. Plastic impressions were made from the scales in a hydraulic press with head plates regulated at 200° F. Impressions of scales were enlarged 67 diameters. Measurements of the anterior radii were made along a 20° ventral radial line, Clutter and Whitesel, 1956, Mosher, 1969, Narver, 1970.

The stomach contents of salmon was extracted and preserved in plastic vials for future identification. The percentage composition of the various food items in individual stomachs was estimated from two 1 mm samples extracted from a well-mixed sample. Examinations were made with the aid of a 15X power binocular microscope.

FINDINGS

Scale samples of kokanee for age and growth analysis were collected through the gill netting program and from creel checks. These two methods generally provided samples from fish that ranged in size from 229 mm to 353 mm (9.0 to 13.9 inches). Less than ten fish smaller than 230 mm (9.0 inches) were taken by these two methods.

A total of 412 scale samples were collected from four major kokanee fishing areas during the summer of 1971. Age assessments were made without the calculation of any growth rates, since the smaller kokanee were not represented in the collections.

The four sample areas are the same as those described by Hanzel (1973). He illustrated area differences in these kokanee populations by plotting length frequency distributions. The four sample areas represent three popular fishing areas (Lakeside, Big Arm and Bigfork) and one unusual fishing area (Polson).

The Lakeside area is located in the northwest end of the lake, the Big Arm area along the southwest shore, the Bigfork area in the northeast end and the Polson area in the extreme southern portion. The three popular areas are fished regularly by fishermen but salmon are only caught rarely in the Polson area. A large school of kokanee apparently entered Polson Bay and were found by fishermen on June 1st, kokanee remained in the vicinity of the city dock until June 21st, then disappeared. This was the first record of salmon taken in the Polson area during the spring or summer months.

Size Range

Analysis of the kokanee samples revealed three age groups were represented in the fishermen's harvest. They were II+, III+ and IV+ annuli fish or fish that were three, four and five years old, respectively. The size range of three age groups are presented in Table 1.

Considerable overlap existed within the size range of each age group so that length frequency modes would not separate the age classes. Four extremely small-sized (III+) males in the Polson sample extended the minimum size range of four year old fish. All other samples of four year old kokanee had a minimum size of 262 mm (10.3 inches).

Age Assessment

Age classification was made on a total of 412 kokanee. The percent fish found within each age group II+, III+ and IV+ annuli fish, sexes combined, was 6.6, 53.2 and 35.2 percent, respectively. A breakdown of the age composition by area and date and the percentage of each age group by sexes is presented in Table 2.

Table 1. The range of total length measurements, by age group, of kokanee caught by fishermen in Flathead Lake, June - August, 1971.

Age Group	mm	inches
II+ annuli	189-298	7.5-11.7
III+ annuli	176-338	6.9-13.3
IV+ annuli	285-353	11.2-13.9

Two collections of scales samples were available from the Bigfork area; one in June, the other in August. Changes in age composition in the Bigfork area between June and August sampling suggests a change in the population by either fish moving into or leaving the area. Sport fishing in this area resulted in good success during the month of June but dropped off to almost nothing during the first two weeks in July. From mid-July through August, fishing success again increased to about the same level as was reached in June. Sonar records of fish distribution in the area during early July showed relatively few fish compared to records made in June and August. During the period of low fishing success (early July) kokanee were for the first time this summer being caught by fishermen in the lower areas of the Flathead River and were assumed to be the same group of fish that disappeared from the Bigfork area.

The two collections of scales taken within Big Arm Bay on the same day illustrated changes in age composition of two large kokanee schools, one in southern and one in the northern area. The southern school was comprised of nearly equal percentages of four and five year old fish compared to the 70 percent dominance of four year old fish in the northern school.

All fishing areas showed a strong representation of the four year old (III+ annuli) fish. The three year old (II+ annuli) fish, were seen most in the early June fishery.

The age composition of the male and female kokanee from the four sample areas (Table 2) did show variations between areas but the dominant age group for both males and females for any one area or sampling data remained the same.

Age of Maturity

Maturation determined by gonadal development for 337 kokanee is presented (Table 3). Nearly all five year old (IV+ annuli) kokanee were found

Table 2. Age group composition, percent of the total number of fish, of male and female kokanee caught by fishermen from four distinct areas of Flathead Lake, June -- August, 1971.

Area (Date)	Total fish	Age Group Composition by Percent							
		Sexes Combined				Males			
		II+	III+	IV+	Number of annuli IV+	II+	III+	IV+	Number of annuli II+ III+ IV+
Polson 6/71	41	12.2	63.4	24.4		11.1	72.2	16.7	9.1 59.1 31.8
Bigfork 6/71	104	12.5	51.9	35.6		12.7	51.9	35.4	12.0 52.0 36.0
8/71	77	1.3	48.1	50.6		1.7	50.0	48.3	-- 42.1 57.9
Lakeside 7/71	109	5.7	74.3	20.0		5.3	73.7	21.0	6.3 75.0 18.7
Big Arm South 7/71	46	2.2	41.3	56.3		3.4	41.4	55.2	-- 41.2 58.8
North 7/71	35	2.9	65.7	31.4		4.8	61.9	33.3	-- 71.4 28.3
Total or Average	412	6.6	58.2	35.2		7.1	54.5	38.4	5.3 55.8 38.9

to be mature and would spawn that fall. Only one five year old male, taken in the south Big Arm school, showed no signs of maturing in his fifth year and possibly would have reached maturity in his sixth year. The proportion of four year old kokanee that were considered mature was 82.0 percent for the males (range 76.9 to 85.4 percent) and 71.4 percent (range 50.0 to 100 percent) for the females. Three year old mature fish were present but their numbers were small. Their presence, however, did indicate that kokanee do mature from three through six years old, (II+ through V+ annuli).

The percent of male and female kokanee that would have matured in year of capture was 80.5 to 84.5, respectively. Composition of mature fish by age class for each sex is presented in Table 4.

Food Habits

Knowledge of the food habits of the kokanee in any body of water is basic to accurate assessment of age and growth characteristics.

It is generally accepted that kokanee feed primarily on zooplankton through most of their lives. Ricker (1937) described the rate of food consumption for young sockeye as; low in May (0.3 mg) increased rapidly during the summer (31.1 mg in August), decreased in autumn and winter (21.6 mg in November to 6.1 mg in January). Stross (1954) found in Lake Pend O'reille that in May the larger sized kokanee eat four times (4X) the amount eaten during the earlier spring months, and that volumes during July through September increased to 20X the early spring levels. He also found that the size of the fish was not as important in the amount of food intake as was the abundance of natural food and corresponding water temperatures.

Ricker (1957) reported that young salmon generally feed most actively during the period from July through September which corresponded to the season of most rapid growth. Narver, 1970, described the two most active summer feeding periods of young sockeye as being at dawn and dusk with a latter period being the longer of the two. He noted that as the waters cooled in the fall the feeding period were shorter and the fish fed with less intensity than during the summer months. Brett, 1971, in his satiation and appetite studies, found the sockeye salmon independent of size, active feed for a period of 43 minutes ($\pm$ 8 min.) before they became full and stopped eating.

Food habits of the kokanee of Flathead Lake were made from 151 stomachs taken from fish caught by fishermen from June 15 through September 22, 1971. The kokanee then ranged in size from 260 to 350 mm T.L. (10.2 to 13.8 inches).

Three genera, two Cladocera and one Copepode, made up the bulk of the kokanee food for this summer period. They were Daphnia, Epischura and Leptodora, in decreasing order of occurrence. The estimated percent of the total stomach content and the percent of occurrence for seven periods are shown in Figure 1. The three species of Daphnia, D. thorata, D. longiremis and D. rosea comprised more than 60 percent of total content volume for all stomachs that were taken during June and July. Daphnia thorata was by far the dominant species. The major item consumed by the kokanee during August was Epischura

Table 3. The percentage of the total number of male and female kokanee considered mature and caught within each age group by fishermen in four distinct areas of Flathead Lake, June-August, 1971.

Area (Date)	Percent Mature by Age Group					
	Males			Females		
	Number of annuli			Number of annuli		
	II+	III+	IV+	II+	III+	IV+
Polson 6/71	100	77	100	50	54	100
Bigfork 6/71	10	85	100	33	77	100
8/71	100	83	100	--	100	100
Lakeside 7/71	0	85	100	0	75	100
Big Arm South 7/71	0	75	94	--	86	100
North 7/71	0	77	100	--	50	100
Collective Average	25	82	99	33	71	100

Table 4. The percent of mature male and female kokanee represented in the fishermen's creels from Flathead Lake, June - August, 1971

Total fish	Sex	Percent mature fish by age class			
		Number of annuli			Ages Combined
		II+	III+	IV+	
113	Female	2.1	49.5	48.4	80.5
224	Male	2.1	52.9	45.0	84.4

which gradually shifted to a mixed dominance of Epischura and Leptodora in the bulk of the stomachs. Late September stomachs showed Epischura to be decreasing with Daphnia and Leptodora making the bulk of the diet. Other identifiable organisms, found in the stomachs in decreasing order of occurrence, were Tendipedidae (midge larva), Scaphloberis, Cyclops, Diaptomus, Sida, lake whitefish eggs, snail eggs, Notonectidae (back swimmers) and Bosmina. Figure 1 lists the percent of occurrence of these minor food constituents. Size selection apparently persist during the feeding periods of the kokanee for the larger size organisms did provide the bulk of the diet of the salmon. The salmon continually utilized the large organisms while the dominant and most abundant zooplankters in the surface plankton population were Diaptomus and Cyclops, Hanzel, 1973. Stross, 1953, found the kokanee in Lake Pend Oreille to utilize extensively Cyclops and Diaptomus during the spring season. During June their diet shifted to primarily Bosmina and Daphnia and in July to Daphnia, Epischura and Leptodora. The major food items for kokanee in Idaho were Daphnia, Bosmina, Cyclops and Diaptomus during the sampling year while in Flathead Lake the major items were Daphnia, Epischura and Leptodora in the summer.

RECOMMENDATIONS

It is recommended that the assessments of growth from kokanee scale collections and the further analysis of scale collections from Dolly Varden and cutthroat trout and other major game species be continued. This information is basic to the assessment of mortality rates, abundance, distribution and habitat requirements.

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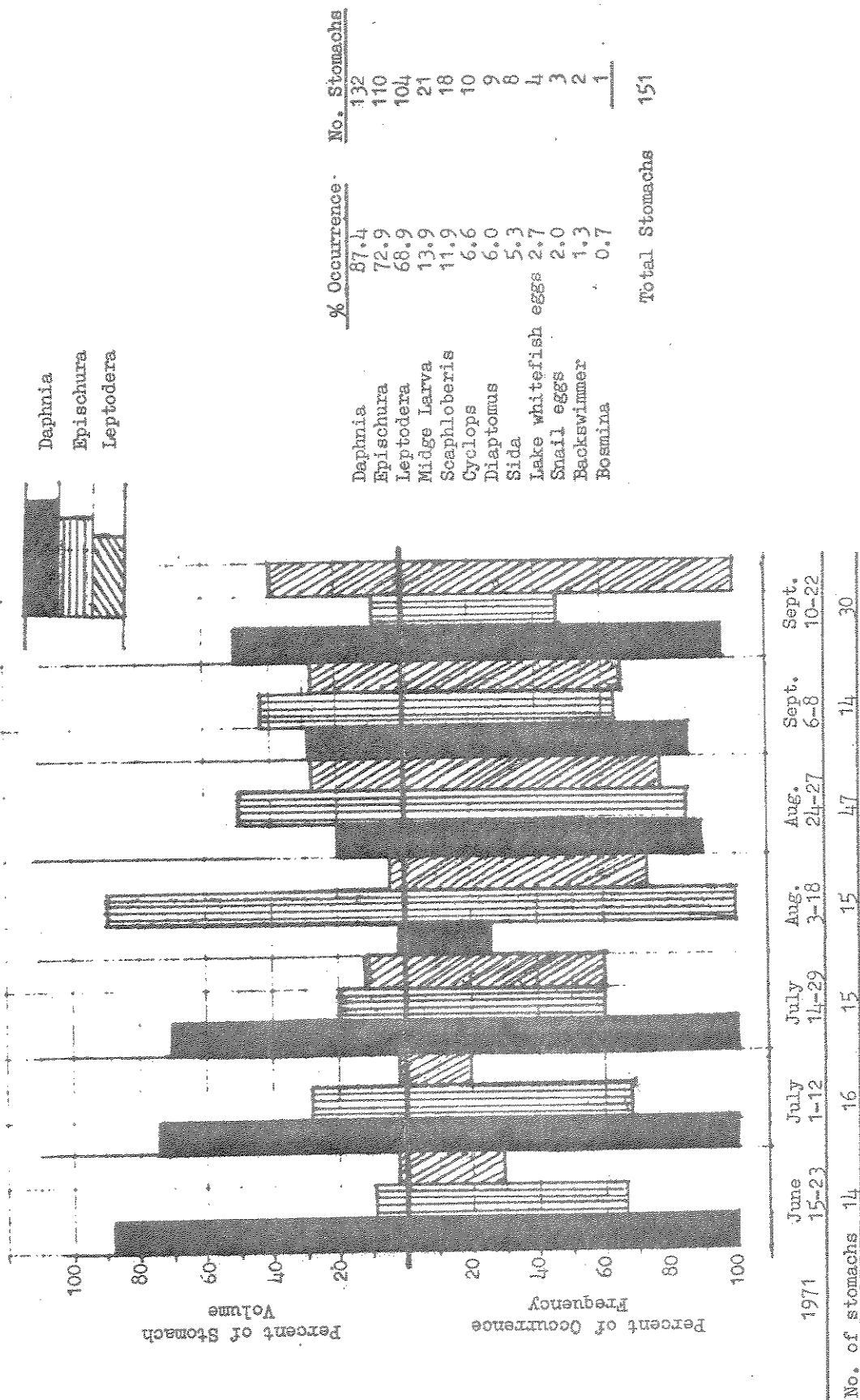


Figure 1. The percent of stomach volume and the frequency of occurrence of the three major items found to be eaten by kokanee in Flathead Lake during the summer of 1971, and a list of all items identified and their percent of occurrence.

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Prepared by Delano A. Hanzel

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