MONTANA DEPARTMENT OF FISH AND GAME
FISHERIES DIVISION

JOB PROGRESS REPORT

State Montana Title Age and growth analysis of fishes of

Project No. F-33-R-7 Flathead Lake - Kokanee

Job No. I-b

Period Covered July 1, 1972 through June 30, 1973

ABSTRACT

Age and growth characteristics were established by analyzing measurements from 430 scale collected from Flathead Lake during the 1972 growing season. An insignificant degree of overlap in the size range between age groups allowed separation on size alone. A body-scale regression analysis showed a strong degree of linearity. Growth increments were calculated by fitting scale measurements into the emperical formula derived from the body-scale analysis. Growth differences were noted between fish of the same age but maturing differently. Four year old (IV annuli) kokanee dominated the mature fish present in the 1972 sampling. Variability of the age at maturity between years and sexes was noted.

BACKGROUND

Flathead Lake in northwest Montana is the state's largest and one of the most important fishing lakes. The large lake contains 20 fish species. Knowledge of their habits and the relationship between them, is essential for managing 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 and the development of a new experimental purse seine have provided adequate numbers and size selection fish for scale samples for age and growth analysis.

OBJECTIVES

The objective of this job is to read, interpret, analyze and report on the seven-year accumulation of scale samples collected during the systematic and seasonal sampling of fish on Flathead Lake. Additional and often specific 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, kokanee, lake whitefish, cutthroat trout, Dolly Varden, lake trout and pygmy whitefish.

PROCEDURES

Scale samples for the age and growth analysis were obtained from fish collected during the 1972 growing season, June 6 through August 4, 1972. Most scales from fish 200 mm T.L. and longer were obtained through sportsmen creel checks with samples from smaller fish primarily taken from fish collected in the purse seine.

Fish were measured to the nearest millimeter to total length (T.L.) 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 hydraulic press with head plates regulated at 200° F. Impressions of scales were enlarged 67 diameters with the aid of a Bausch and Lomb microbeam projector. Measurements of the anterior radii made along a ventral 20° radial line, (Clutter and Whitesel, 1956, Mosher, 1969, Narver, 1968) and rounded to the nearest even millimeter were used to develop the body-scale relationship. Average fish lengths were used.

FINDINGS

A total of 430 kokanee scale samples collected from Flathead Lake during the 1972 growing season, June 6 through August 4, 1972, were analyzed for age and growth characteristics. A length frequency histogram of the age groups present was prepared (Figure 1). The percentages of each age group were as follows: Age I+ - 19.1; Age II+ - 23.3; Age III+ - 24.9; Age IV+ - 32.9; Age V+ - 0.2. Age group V+ (5 year old fish) was represented by one fish and was not included in the frequency histogram; no fish of age group 0+ were taken during the collections.

The average total length of ages I+ through V+, respectively, at time of capture were as follows: 134 mm (5.3 inches); 204 mm (8.0 inches); 267 mm (10.5 inches); 309 mm (12.2 inches); 336 mm (13.2 inches).

The degree of overlap in total length between adjacent age groups was insignificant (Figure 1) during the 1972 season, and this allowed the separation of groups by size alone. This was not the case during the age analysis of the 1971 kokanee data (Hanzel, 1973) when considerable overlap in total length was noted between age groups II+ through IV+ The degree of overlap between age groups is apparently affected by the annual growth and should be checked before the length frequency method is used.

Growth rate of the kokanee was determined by first establishing the relationship between the body length and the anterior scale radius (enlarged 67X). A value of 0.9813, the coefficient of variation "r", developed on 430 scales suggests a strong degree of linearity between the body-scale measurements.

A regression equation was calculated from body-scale measurements: $\underline{\text{Body Length (T.L.)} = 2.3467 \text{ Anterior Scale Radius} + 49.1414}$

Mean body lengths for each scale radius were plotted as shown in Figure 2.

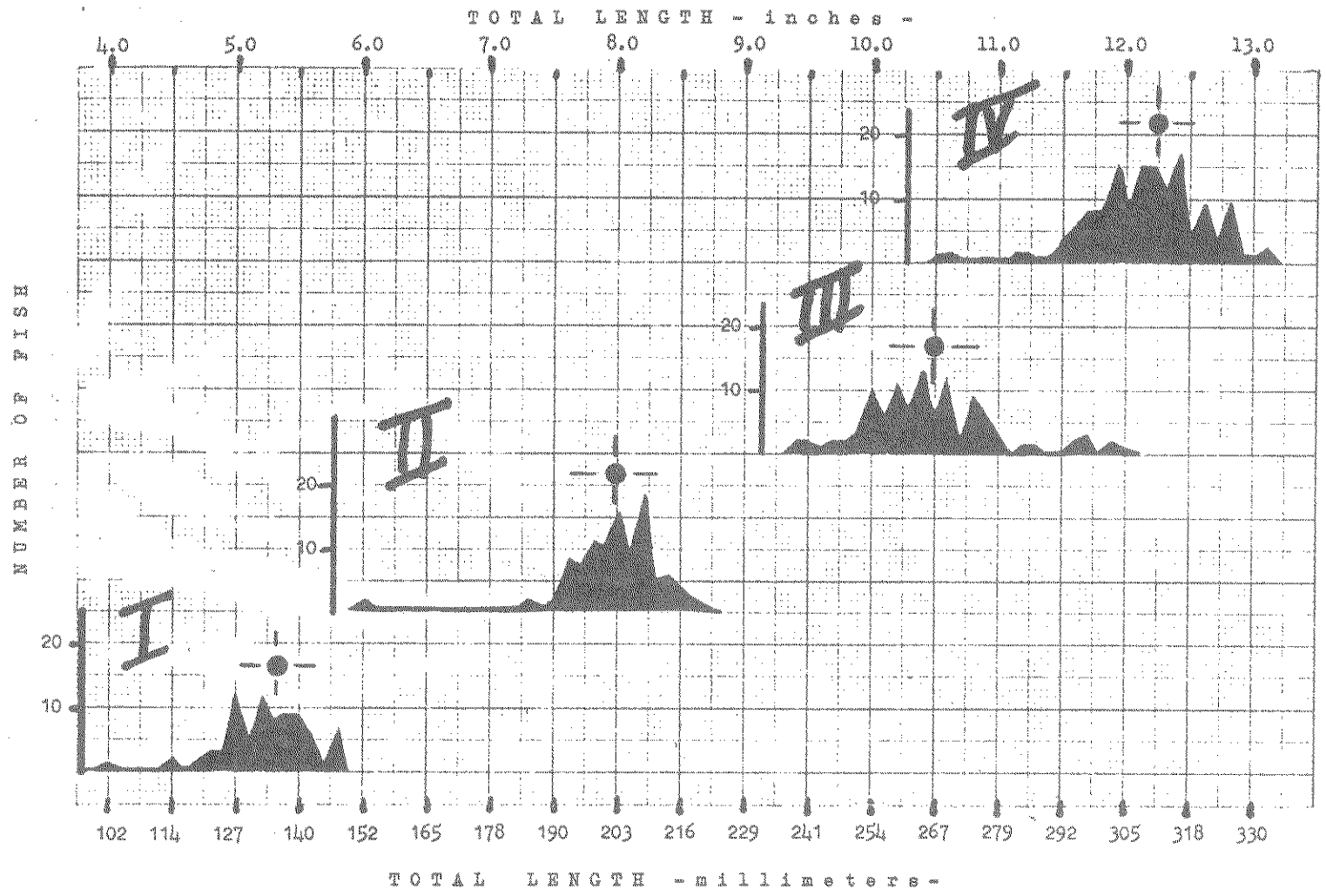

Figure 1. Length frequency histograms showing the age groups represented by 430 kokanee and the average length, point indicated, for each age group taken in Flathead Lake, June 6 through August 4, 1972.

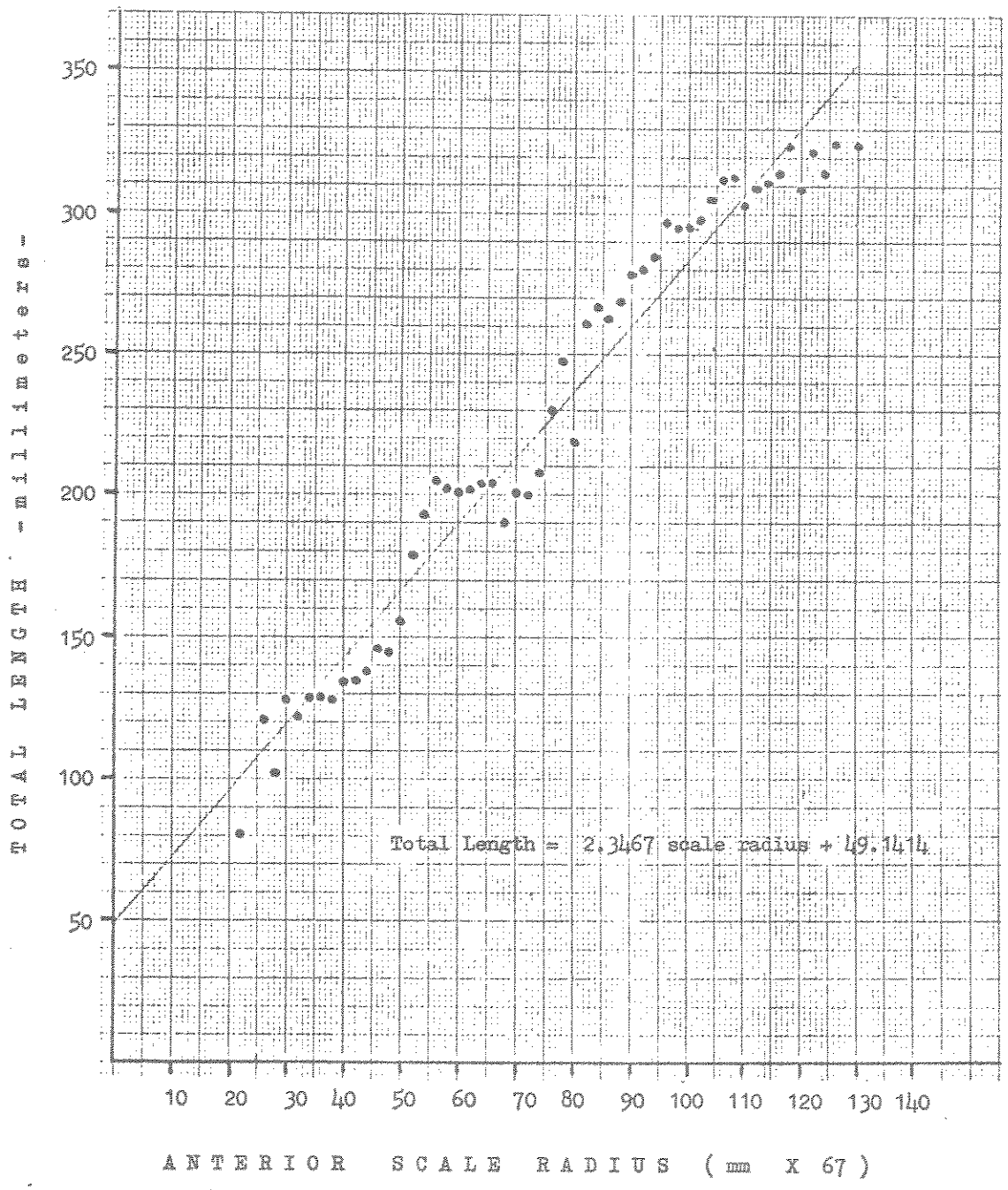

Figure 2. Body length-scale radius relation of kokanee from Flathead Lake. Solid line is the calculated equation; dots represent mean body lengths for given scale radii, 1972.

Growth increments were calculated by age group, sex and state of maturity (Table 1). State of maturity was established by examining gonadal tissues and determining whether the fish would or would not spawn during the 1972 season. Analysis by these catagories allows comparison of growth for different periods for any specific age and also provides data on fish the same age that would mature at different rates.

The age groups of mature and non-mature fish, for ages 2 years and older, showed different growth patterns. Non-maturing fish of the same age were generally 20 mm smaller than those that would spawn that season. Since combined increments of growth for each sex were similar (Table 1), average increments of growth (sexes combined and mature and immature combined) for ages I+ through V+ were 106; 91; 67; 27 and 15 mm, respectively. The annual growth increment of the Flathead Lake kokanee showed a progressive decrease with increased age.

Age at maturity was determined for 275 kokanee (Table 2). The percentage of mature ages II+ and older fish was 65.6 percent for males and 64.2 percent for females. The sex ratio of males to females during 1972 was 1.0 male to 0.6 females. The 1971 sex ratio was 1.0 to 0.5 (Hanzel, 1973).

Four-year-old salmon (IV annuli) comprised the largest portion of all mature age groups. This age group represented 74.3 percent of the males and 65.7 percent of the females. This dominance of 4-year-old fish was a shift from the near equal representation of 3- and 4-year-old mature salmon during the previous season, 1971. The variability in the age of maturity of salmon within a body of water is further illustrated when the percentages of mature fish in each age group and sex are compared, Table 2.

The youngest age group of mature fish was represented by 2-year-old males and 3-year-old females. Two-year-old mature females have been reported, (Hanzel, 1973) but none were taken during the present season. A 5-year-old male was the oldest mature fish.

RECOMMENDATIONS

It is recommended that the assessments of the growth characteristics from kokanee scale collections be continued another year. Additional time is needed to measure annual growth variations and to establish area differences. This information is basic to the assessment of mortality rates, abundance, distribution and habitat requirements.

LITERATURE CITED

Clutter, R. I. and L. E. Whitesel. 1956. Collections and interpretation of sockeye salmon scales. Int. Pac. Salmon Fish Com. Bulletin IX. 159 pp.

Hanzel, Delano A. 1973. Age and growth analysis of fishes of Flathead Lake - Kokanee. Progress Report, Montana Department of Fish and Game, F-33-R-6, Job I-b, Multilith.

Table 1. Average calculated total length (millimeters) and average length at capture of kokanee that will spawn (+) and will not spawn (-) in 1972 Flathead Lake, June 6 - August 4, 1972

Group	Sex	No. of Fish	Average length at capture -mm-	Average length at capture -inches-	Calculated length at annulus formation 1	2	3	4	5
I+	♂-	-	-	-	-	-	-	-	-
	♀-	2	126	5.0	109	-	-	-	-
	Unk	80	134	5.3	109	-	-	-	-
II+	♂-	14	207	8.1	108	193	-	-	-
	♂+	14	207	8.1	107	185	-	-	-
	♀-	23	203	8.0	109	190	-	-	-
	♀+	-	-	-	-	-	-	-	-
	Unk	49	203	8.0	110	196	-	-	-
III+	♂-	37	265	10.4	106	193	256	-	-
	♂+	13	287	11.3	111	213	270	-	-
	♀-	16	259	10.2	107	192	254	-	-
	♀+	24	269	10.6	110	201	259	-	-
	Unk	17	258	10.1	105	186	240	-	-
IV+	♂-	6	292	11.5	99	188	247	277	-
	♂+	81	312	12.3	101	202	272	297	-
	♀-	-	-	-	-	-	-	-	-
	♀+	46	304	12.0	101	200	269	289	-
V+	♂+	1	337	13.2	96	195	249	288	306
Average Increment	♂				109	80	71	36	10
	♀				109	81	67	32	
	Unk				109	87	44	56	
Average Length	♂	166			104	198	266	292	306
	♀	111			106	197	264	289	
	Unk	153			109	194	251	295	
Total		430	Weighed average of body length at annulus formation		106	197	264	291	306

Table 2. The percentage of the total number of male and female kokanee considered mature and the proportion of mature fish represented by each age group, Flathead Lake, June - August, 1972

Age Group	Males		Females		Combined	
	% Mature	% of Total	% Mature	% of Total	% Mature	% of Total
II+	50.0	12.8	--	--	27.5	7.8
III+	26.0	11.9	60.0	34.3	41.1	20.7
IV+	93.1	74.3	100.0	65.7	95.5	71.0
V+	100.0	0.9	--	--	100.0	0.5

Mosher, Kenneth H. 1969. Identification of Pacific salmon and steelhead trout by scale characteristics. U.S. Dept. Int. USFS&Wl. Bur. of Comm. Fish Dir. 317.

Narver, David W. 1968. Identification of adult sockeye salmon groups in the Chignik River system by lacustrine scale measurement, time of entry, and time and location of spawning. Univ. of Washington. Pub. in Fisheries, Vol. III. 115 - 148 pp.

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Waters referred to:

Flathead Lake 7-6400-03